Appendix A

Final Initial Study/Mitigated Negative Declaration for BART Hayward Maintenance Complex Project

For Consideration by the BART Board on May 26, 2011

FINAL INITIAL STUDY/MITIGATED NEGATIVE DECLARATION

Hayward Maintenance Complex Project

SCH# 2010122013

San Francisco Bay Area Rapid Transit District

May 2011

FINAL INITIAL STUDY/MITIGATED NEGATIVE DECLARATION

Hayward Maintenance Complex Project

San Francisco Bay Area Rapid Transit District

SCH# 2010122013

Prepared for
San Francisco Bay Area Rapid Transit District
300 Lakeside Drive, 16th Floor
Oakland, CA 94612

Prepared by
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May 2011

INITIAL STUDY/MITIGATED NEGATIVE DECLARATION

Date of Publication of Draft Initial Study/Mitigated Negative Declaration: December 3, 2010

Project Title: Hayward Maintenance Complex Project
Lead Agency: San Francisco Bay Area Rapid Transit District
Agency Contact Person: Ellen Smith **Telephone:** (510) 287-4758

Project Location: City of Hayward and Union City, Alameda County; west of one existing Union Pacific Railroad (UPRR) rail line (Oakland Subdivision) and east of a second (Niles Subdivision), south of Industrial Parkway (in Hayward) extending south of Whipple Road to about D Street (in Union City).

Project Description: The San Francisco Bay Area Rapid Transit District (BART) operates and maintains 104 miles of track in revenue service and 43 stations, serving an average of 360,000 passenger trips every weekday in the counties of San Francisco, Alameda, Contra Costa, and San Mateo. The Hayward Yard is one of four BART maintenance facilities serving the BART system. Over the next 30 years, BART will require additional vehicles to meet future demand associated with regional population growth, system expansions for the Warm Springs and Silicon Valley/San Jose Extension projects, and additional riders from the Oakland Airport Connector, and eBART projects. Accordingly, BART requires expanded maintenance and storage facilities to serve the expanded fleet. The proposed Hayward Maintenance Complex project (proposed project) would consist of acquisition and improvement to three properties on the west side of the existing Hayward Yard and the construction of additional storage tracks for a maximum of 250 vehicles on undeveloped BART property on the east side of the Hayward Yard. The project site is zoned for industrial uses and the proposed activities would be consistent with this zoning designation.

This Project Could Not Have A Significant Effect on the Environment: This finding is based upon the criteria of the Guidelines of the State Secretary for Resources, Sections 15064 (Determining Significant Effect), 15065 (Mandatory Findings of Significance), and 15070 (Decision to Prepare a Negative Declaration), and the reasons documented in the Environmental Evaluation (Initial Study) for the project, which is attached. Mitigation measures are included in this project to avoid potentially significant effects. They are identified in the attached Initial Study and summarized below.

Copies of the Initial Study/Mitigated Negative Declaration: Copies of the document can be obtained by calling the agency contact person at the following number and leaving information on how you may be contacted: (510) 287-4758. A copy of the document will be mailed to you. Copies of the Initial Study/Mitigated Negative Declaration can also be reviewed on the BART website at www.bart.gov/hmc. In addition, copies of the Initial Study/Mitigated Negative Declaration are available at the main libraries in Hayward and Union City. The locations of those libraries are:

Hayward Main Library
835 C Street
Hayward, CA 94541

Union City Library
34007 Alvarado-Niles Road
Union City, California 94587

Copies of the Initial Study/Mitigated Negative Declaration and background documents are available for review at the offices of the San Francisco Bay Area Rapid Transit District: 300 Lakeside Drive, 16th Floor, Oakland, CA 94612.

Public Meeting: BART held two public meetings to receive public comments on the Draft Initial Study/Mitigated Negative Declaration. The meetings were held at the following locations:

December 15, 2010
6:30 pm to 8:00 pm
New Haven Adult School
600 G Street
Union City, CA 94587

January 20, 2011
6:30 pm to 8:00 pm
Fairway Park Baptist Church
425 Gresel Street
Haywad, CA 94544

Comments on the Draft Initial Study/Mitigated Negative Declaration: The public review period for the Draft IS/MND began on December 3, 2010 and ended February 11, 2011. During this time frame, the document was reviewed by various State, regional, and local agencies, as well as by interested organizations and individuals. Written comments were received from 6 public agencies (State, regional, and local) and 2 individuals. Comments were also received orally from members of the public during the December 15, 2010 and January 20, 2011 public hearings. In general, the comments received in writing and at the public hearings were related to visual quality, light and glare, construction-related and operational noise, land use designations, hydrology and water quality, biological resources, air quality, greenhouse gas emissions, and traffic.

Changes to the Draft IS/MND: In response to comments received in writing and at the public hearing, several changes were made to the Draft IS/MND. These changes can be found in Appendix C of this document and are also incorporated into the text of this Final IS/MND. In addition, staff-initiated changes have been made to the IS/MND and are included in Appendix D of this document. Changes to the IS/MND are contained in the following sections: Project Description, Aesthetics, Biological Resources, Land Use, Hazards and Hazardous Materials, Hydrology and Water Quality, and Noise and Vibration.

The following mitigation measures are being incorporated into the Hayward Maintenance Complex Project:

VQ-1 *Replacement of Trees that Screen Views of Industrial Buildings.* If construction activities south of Whipple Road require removal of the existing trees near the industrial buildings west of the BART mainline, BART shall plant replacement trees at a 1:1 ratio in the area of removal, after construction activities are complete.

AQ-1 *Construction Phasing to Reduce Air Emissions.* For construction of the storage tracks in Phase 2, BART shall ensure that all work involving clearing, grubbing, grading, and fill transport associated with work on the project site north of Whipple Road not be conducted concurrently with construction work south of Whipple Road to assure that the BAAQMD NOx construction equipment emission threshold would not be exceeded.

AQ-2 *Dust Control during Construction.* BART shall ensure implementation of the following mitigation measures during project construction, in accordance with Bay Area Air Quality Management District (BAAQMD) standard mitigation requirements:

- All exposed surfaces (e.g., parking areas, staging areas, soil piles, graded areas, and unpaved access roads) shall be watered two times per day, or as necessary to control dust.
- All haul trucks transporting soil, sand, or other loose material off-site shall be covered.
- All visible mud or dirt track-out onto adjacent public roads shall be removed using wet power vacuum street sweepers at least once per day. The use of dry power sweeping is prohibited.
- All vehicle speeds on unpaved roads shall be limited to 15 mph.
- All roadways, driveways, and sidewalks to be paved shall be completed as soon as practical.
- Building pads shall be laid as soon as practical after grading unless seeding or soil binders are used.
- Idling times shall be minimized either by shutting equipment off when not in use or reducing the maximum idling time to 5 minutes (as required by the California airborne toxics control measure Title 13, Section 2485 of California Code of Regulations [CCR]). Clear signage stating the regulations shall be provided for construction workers at all access points.
- All construction equipment shall be maintained and properly tuned in accordance with manufacturer's specifications. All equipment shall be checked by a certified mechanic and determined to be running in proper condition prior to operation.
- Post a publicly visible sign with the telephone number and person to contact at the Lead Agency regarding dust complaints. This person shall respond and take corrective action within 48 hours. The Air District's phone number shall also be visible to ensure compliance with applicable regulations.

BIO-1 *Wetland Avoidance and Protection.* BART shall ensure that the wetlands adjacent to the east side expansion area of the project site are not affected during construction by installing orange exclusionary fence to alert construction crews that the areas are to be avoided during construction, and through compliance with applicable statewide NPDES general permits.

In addition, BART shall ensure that post installation conditions shall not cause significant changes to the pre-project hydrology, water quality, or water quantity in any wetland or other water of the U.S. that is affected by the project. This shall be accomplished through implementation of Mitigation Measures HYD-1 and HYD-2 from the Hydrology section, *Stormwater Drainage System Design*, and through compliance with applicable statewide NPDES general permits.

BIO-2 *Restrictions on Tree or Shrub Removal to Avoid Nesting Birds.* Tree or shrub removal or pruning shall be avoided from March 1 through September 15, the bird nesting period, to the extent feasible. If no tree or shrub removal or pruning is proposed during the nesting period, no surveys or further mitigation measures are required.

BIO-3 *Pre-construction Nesting Bird Survey and Measures to Reduce Harm to Nesting Birds.* If tree and shrub removal is unavoidable during the nesting season, BART shall hire a qualified biologist to conduct a survey for nesting raptors and other birds covered by the MBTA. BART shall have a qualified biologist conduct nest surveys no more than 30 days prior to any demolition/construction or ground-disturbing activities that are within 500 feet of potential nest trees or suitable nesting habitat (i.e., trees, tule, cattails, grassland). A pre-construction survey report shall be submitted to CDFG that includes, at a minimum: (1) a description of the methodology including dates of field visits, the names of survey personnel with resumes, and a list of references cited and persons contacted; and (2) a map showing the location(s) of any bird nests observed on the project site. If no active nests of MBTA-covered species are identified, then no further mitigation is required.

If active nests of protected bird species are identified in the focused nest surveys, BART will consult with the appropriate regulatory agencies to identify project-level mitigation requirements, based on the agencies' standards and policies as then in effect. Mitigation may include the following, based on current agency standards and policies:

a) BART, in consultation with CDFG, would delay construction in the vicinity of active nest sites during the breeding season (March 1 through September 15) while the nest is occupied with adults and/or young. A qualified biologist would monitor any occupied nest to determine when the nest is no longer used. If the construction cannot be delayed, avoidance measures would include the establishment of a non-disturbance buffer zone around the nest site. The size of the buffer zone would be determined in consultation with the CDFG, but will be a minimum of 100 feet. The buffer zone would be delineated with highly visible temporary construction fencing.

b) No intensive disturbance (e.g., heavy equipment operation associated with construction, or use of cranes) or other project-related activities that could cause nest abandonment or forced fledging would be initiated within the established buffer zone of an active nest between March 1 and September 15.

c) If construction activities are unavoidable within the buffer zone, BART would retain a qualified biologist to monitor the nest site to determine if construction activities are disturbing the adult or young birds. If abandonment occurs, the biologist would consult with CDFG or USFWS (who monitor compliance with the MBTA) for the appropriate salvage measures (e.g., remove abandoned nestlings to an agency approved wildlife care group). BART would be required to fund the full costs of the salvage measures.

d) If fully protected species are found to be nesting near the construction area, their nests would be completely avoided until the birds fledge. Avoidance would include the establishment of a non-disturbance buffer zone of 250 feet, or as determined in consultation with the CDFG.

BIO-4 *Tree Survey and Replacement of Protected Trees to be Removed.* Prior to construction, BART shall retain a certified arborist to survey trees in the project area, including potential access roads and staging areas, to identify and evaluate trees that shall be removed. A report shall be prepared and submitted to BART to document the trees that are to be removed. Mitigation shall be required for impacts to trees designated as "protected trees" in the cities of Hayward or Union City. Replacement trees will be a native tree species. Each removed tree meeting the above classifications will be replaced at a 1:1 ratio. Trees will be planted in locations suitable for the replacement species. Selection of the replacement sites and installation of replacement plantings will be supervised by a qualified botanist. Trees will be replaced as soon as practical after construction is completed. A qualified botanist will monitor newly planted trees at least once a year for 5 years. Each year during that period, any trees that do not survive will be replaced. Any trees planted as remediation for failed plantings will be planted as stipulated here for original plantings, and will be monitored for a period of 5 years following installation.

CR-1 *Avoidance of Discovered Cultural Resources and Measures to Reduce Harm.* If evidence of an archaeological site or other suspected historic resource is encountered during construction, including darkened soil representing past human activity ("midden") that could conceal material remains (e.g., worked stone, faunal bone, hearths, or storage pit), all ground-disturbing activity within 100 feet of the find shall be halted and BART notified. BART will hire an archaeologist meeting the Secretary of the Interior's Standards for Professional Archaeologist to assess the find. Impacts to any significant resources may be mitigated through avoidance, data recovery, or other methods determined adequate by the qualified archaeologist and that are consistent with the Secretary of the Interior's Standards for Archeological Documentation. Any mitigation plan developed by the qualified archaeologist shall be approved by BART prior to implementation. Project-related ground-disturbing activities shall not be continued in the vicinity of any discovered resource until the significance of the resource is resolved and mitigation action (if any) is completed.

CR-2 *Avoidance of Discovered Human Remains and Measures to Reduce Harm.* If human remains, including disarticulated or cremated remains, are discovered during any phase of construction, all ground-disturbing activities in the vicinity and any nearby area reasonably suspected to overlie adjacent human remains shall be immediately halted. BART and the Alameda County Coroner shall be notified immediately, according to Section 5097.98 of the State Public Resources Code and Section 7050.05 of California's Health and Safety Code. If the remains are determined by the county coroner to be Native American, it is the responsibility of the county coroner to inform the Native American Heritage Commission (NAHC) within 24 hours. The guidelines of the NAHC should be adhered to in the treatment and disposition of the remains. BART shall retain a qualified archaeologist who meets the Secretary of the Interior's Standards for Professional Archaeologist and with Native American burial experience to conduct a field investigation of the specific site and consult with the person identified as the Most Likely Descendent, if any, identified by the NAHC. BART shall approve any mitigation recommended by the qualified archaeologist prior to implementation, taking account of the provisions of State law as set forth in the California Environmental Quality Act (CEQA) Guidelines Section 15064.5(e) and Public Resources Code Section 5097.98. Approved mitigation must be implemented before resumption of ground-disturbing activities in the vicinity of where the remains were discovered.

GHG-1 *Construction-Related Greenhouse Gas Best Management Practices.* BART shall ensure implementation of the following mitigation measures during project construction, in accordance with Bay Area Air Quality Management District (BAAQMD) standard mitigation recommendations which suggest:

- Use alternative-fueled (e.g., biodiesel, electric) construction vehicles/equipment for at least 15 percent of the fleet;
- Use local building materials (within 100 miles) of at least 10 percent; and
- Recycle or reuse at least 50 percent of construction waste or demolition materials.

HAZ-1 *File Review and a Phase I ESA Prior to Construction.* Prior to construction, BART shall conduct an environmental site assessment (ESA) to further analyze potential hazardous materials and waste sites around the project site. BART shall ensure that additional research, including a file review with the Alameda County Department of Environmental Health and the RWQCB and a Phase I ESA for the west side expansion area, is performed. If the file review reveals no potential impact from environmental contamination, no further action to remedy soil or groundwater contamination would be necessary.

HAZ-2 *Further Soil and Groundwater Investigations Prior to any Construction Activities.* If the file review under Mitigation Measure HAZ-1 above reveals potential environmental contamination along or beneath the proposed project's footprint or other facilities, BART shall evaluate the sites to determine the level of investigation appropriate to evaluate the possible presence of hazardous chemicals in soil and groundwater. In the event soil and/or groundwater testing is deemed appropriate, BART shall ensure that a Phase II soil and groundwater investigation is conducted in the affected areas, including field sampling and laboratory analysis, to evaluate conditions where excavation and grading will take place. The Phase II investigation shall be completed prior to any construction or excavation work, and a schedule shall be developed in the pre-design phase of the project to ensure that a sufficient amount of time is allotted prior to site development to identify and implement actions to investigate the presence of hazardous substances in soil and groundwater, and to identify design and contingency measures in the event that the results of the investigation indicate the need for further testing, site controls, or remediation.

The number, location of field samples, and constituents tested would depend on the size of the impacted site, site activities, and possible transport or migration routes. Field samples may include soil, soil gas, or groundwater, depending on the nature of the contaminants suspected to be present. The sampling plan shall specify that all soil and groundwater chemical analyses shall be performed by a California-certified laboratory, using standard EPA and California chemical testing methods. The investigation results shall, if necessary, lead to preparation of a:

- Remedial Action Plan for soil and groundwater treatment and disposal;
- Health and Safety Risk Assessment; and
- Soil management plan with criteria for impacted soils, in consultation with DTSC and RWQCB.

If necessary, a Remedial Action Plan shall be prepared to identify options for remediation of the contaminated site. If the proposed remedial approach does not involve complete source removal, a Health and Safety Risk Assessment shall be completed. Work in impacted areas will be conducted in accordance with applicable Cal OSHA requirements.

HAZ-3 *Remediation of Contaminated Sites Prior to Construction.* If hazardous materials are identified in soil and groundwater at levels that present a risk to the public, to construction workers, or to the environment, based on the investigations described in Mitigation Measure HAZ-2 above, BART shall ensure that remediation is conducted at contaminated sites pursuant to applicable laws and regulations.

A Remedial Action Plan may be developed if warranted to address potential air and health impacts from soil excavation activities, potential transportation impacts from the removal of remedial activities, and potential risks of public upset should there be an accident at excavation sites. During excavation activities, construction workers or the public may be exposed to contaminants in the soil through ingestion, dermal contact, inhalation of fugitive dust, and inhalation of volatile emissions. The Site-Specific Health and Safety Plan will include measures to mitigate these potential impacts, such as cordoning off excavation sites to prevent public access, water misting to control dust during removal activities, perimeter air monitoring for dust along the site boundaries both upwind and immediately downwind of site excavation and stockpiling activities, and air monitoring of volatile organic compounds (VOC). All exposed contaminated materials shall be covered at the end of each day. Excavation work shall be performed in compliance with all OSHA rules and regulations.

HAZ-4 *Discovered Environmental Contamination During Construction.* In the event that soil, groundwater or other environmental medium with suspected contamination is encountered unexpectedly during construction activities after implementation of Mitigation Measure HAZ-3, BART's contractor shall cease work in the vicinity of the suspect material, the area shall be secured as necessary, and contractor shall take all appropriate measures to protect human health and the environment. Appropriate measures shall include notification of the applicable regulatory agency(ies) as necessary, to identify the nature and extent of contamination. Work shall not resume in the area(s) affected until the measures have been implemented under the oversight of the corresponding regulatory agency(ies), as appropriate.

HYD-1 *Stormwater Drainage System Design.* Prior to final design of each phase of the proposed project, BART shall have a licensed professional engineer registered in California prepare a detailed Hydrology and Hydraulics Report that identifies flow contributing areas (catchments), flow pathways, off-site discharge locations, receiving storm drain systems, and proposed on-site flow conveyance structures and conveyance capacities.

The Hydrology and Hydraulics Report shall identify the off-site peak flow rates and flow volumes for the 100-year storm event at all proposed off-site discharge locations, retained existing on-site flow conveyance structures, and proposed on-site flow conveyance structures for both existing conditions and proposed project conditions. The detailed Hydrology and Hydraulics Report calculations shall be prepared in accordance with Alameda County Flood Control District Hydrology and Hydraulics Manual (June 2003, or later version, as applicable).

Off-site Runoff. Based on the detailed Hydrology and Hydraulics Report, BART shall design on-site detention (or retention) facilities sufficient to detain increases in 100-year runoff peak flow rates and retain increases in 100-year flow volumes at all off-site discharge locations compared to existing conditions.

BART shall submit a preliminary design, along with the Hydrology and Hydraulics Report, to the Alameda Flood Control District and City of Hayward Public Works Department for review. BART shall incorporate Alameda Flood Control District recommendations into the project design, where applicable, prior to the beginning of construction activities.

On-site Runoff. BART shall design on-site drainage in accordance with one of the following, or a combination of the following:

- BART shall design sufficient on-site detention (or retention) to detain increase in flow rates in excess of the conveyance capacity of existing downstream structures; or
- BART shall upgrade existing on-site conveyance structures to provide sufficient conveyance capacity. All proposed on-site conveyance structures shall be designed with adequate capacity to convey the 100-year storm event.

NO-1 *Construction of Sound Walls.* BART shall incorporate sound walls at the BART right-of-way line or other locations that mitigate the noise impacts indicated in Table 13 and Table 14 of this IS/MND. Implementation of sound walls will provide approximately 10 dBA reduction in overall noise levels. Concrete block masonry, poured-in-place, or pre-cast concrete walls would be acceptable as construction materials provided they have a minimum surface density of 4 lbs/ft2. The specific location of sound walls will be addressed in final design. Sound walls will be constructed in phases as necessary to reduce noise as components of the project are constructed.

NO-2 *Installation of Building Sound Insulation Features.* For those receptors where the outdoor wayside noise from the train operations at ground level can be mitigated to achieve the FTA criteria, but the sound walls provided by Mitigation Measure NO-1 are not sufficient to mitigate noise levels at upper stories, BART will measure operational noise levels on a case-by-case basis following project implementation. Where the existing building construction does not provide interior noise levels of Ldn 45 dBA or lower, BART will quantitatively evaluate individual structures and implement a formal program of building sound insulation improvement as necessary to meet this criterion.

NO-3 *Construction Noise Best Management Practices.* BART shall incorporate the following practices into the construction documents to be implemented by the project contractor. Such practices include, but are not limited to, the following measures:

- Where feasible, BART shall require that the contractor complies with a Performance Standard of 80 dBA 8-hour Leq during the daytime (7 a.m. to 10 p.m.) and 75 dBA 8-hour Leq during the nighttime (10 p.m. to 7 a.m.) at the property line of the sensitive receptor.

- Prior to construction, BART shall ensure that a Noise Control and Monitoring Report is prepared. The report shall include expected construction noise levels, noise control measures, and explain how the contractor intends to monitor and document construction noise and complaints.

- Locate noisy equipment as far as possible from noise sensitive receptors. In addition, the use of temporary barriers should be employed around the equipment.

- Where construction noise impacts have been identified, use temporary noise barriers along the working area and/or project right-of-way. Barriers/curtains must achieve a Sound Transmission Class (STC) of 30 or greater in accordance with ASTM Test Method E90 and be constructed from material having a surface density of at least 4 pounds/square foot, to ensure adequate transmission loss.

- When nighttime or 24-hour construction will be required, coordinate with residents to ensure that the affected residents are fully informed about the upcoming construction. Residents will be given the option of sleeping in hotel rooms at BART expense for the duration of the nighttime construction in areas where construction is expected to exceed the FTA criterion. Residents that work nights and sleep days in locations where construction noise is expected to exceed the FTA criterion will be given the same option.

- Require ambient sensitive (“smart”) backup alarms, SAE Class D, or limit to SAE Class C (97 dB) for vehicles over 2.5 cubic yards haulage capacity, or Cal-OSHA/DOSH-approved methods that avoid backup alarm noise for vehicles under 2.5 cubic yards haulage capacity.

- Fit silencers to combustion engines. Ensure that equipment has effective, quality mufflers installed, in good working condition.

- Switch off engines or reduce to idle when not in use.

- Lubricate and maintain equipment regularly.

- Route construction-related truck traffic along roadways that result in the least disturbance to sensitive receptors.

NO-4 *Vibration Reducing Technology*. BART shall incorporate vibration mitigation measures such as tire-derived aggregate (TDA) or floating slab track (FST) under the track, or other technology that may be developed to attain the FTA groundborne vibration operational criterion of 72 VdB. The general location of the mitigation measures under the track is presented in Table 22. However, the actual extent of the mitigation control would be determined during final design.

NO-5 *Construction Vibration Best Management Practices*. Where potential construction vibration impacts have been identified, the contractor shall be required to select equipment and methods that would reduce potential annoyance to nearby residents. Such practices include, but are not limited to, the following measures:

- Comply with a Performance Standard of 0.3 in/sec PPV at any building at any time.
- Minimize vibration annoyance by maintaining vibration levels at 80 VdB or less at any building at any time.
- Prior to construction, BART shall prepare a Vibration Control and Monitoring Report, in which the contractor indicates what vibration levels they expect to generate, vibration control measures they intend to implement, and how they intend to monitor and document construction vibration and complaints.
- Avoid the use of impact pile drivers, and use instead sonic or vibratory impact drivers. It is also encouraged that “quiet” or “silent” piling technologies be used, if feasible.
- When nighttime or 24-hour construction is necessary, coordinate with residents to ensure that the affected residents are fully informed about the upcoming construction. Residents will be given the option of sleeping in hotel rooms at BART expense for the duration of the nighttime construction in areas where construction is expected to exceed the FTA criterion. Residents that work nights and sleep days in locations where construction vibration is expected to exceed the FTA criterion will be given the same option.
- Monitor vibration during construction to ensure compliance with the criterion for building damage for buildings within 40 feet from construction activities. Conduct a pre-construction crack survey at these structures.
- Plan routes for hauling material out of the project site that would cause the least impact (annoyance).
- Restrict high amplitude vibration methods such as vibratory pile driving and soil compaction using large truck-mounted compactors to areas beyond 50 feet and 20 feet, respectively, of residential structures or wood-framed buildings. Otherwise, temporary accommodations away from construction shall be coordinated between BART and the residents.

TR-1 *Construction Phasing and Traffic Management Plan.* BART will ensure that a Construction Phasing and Traffic Management Plan is developed and implemented by the contractor. The plan shall define how traffic operations, including construction equipment and worker traffic, are managed and maintained during each phase of construction. The plan shall be developed in consultation with the cities of Union City and Hayward, BART, and Union City Transit Bus Lines. To the maximum practical extent, the plan shall include the following measures:

a) Specify predetermined haul routes from staging areas to construction sites and disposal areas by agreement with the cities of Union City and Hayward prior to construction. The routes shall follow streets and highways that provide the safest route and avoid congested intersections to the extent feasible.

b) Identify construction activities that, due to concerns regarding traffic safety or congestion, must take place during off-peak hours.

c) Identify a telephone number that the public can call for information on construction scheduling, phasing, and duration, as well as for complaints. Such information shall also be posted on BART's website.

TR-2 *Reconfiguration of Southbound Approach of the West Side Expansion Area Driveway*. BART will reconfigure the approach to Whipple Road for the west side expansion area driveway by narrowing the mouth of the intersection and channeling southbound traffic to approach Whipple Road at a more perpendicular angle. In addition, shrubbery/vegetation that impedes vehicle line of sight to the east will be removed.

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FIGURES

TABLES

APPENDICES

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I. BACKGROUND

1. **Project Title:** Hayward Maintenance Complex Project

2. **Lead Agency Name and Address:** San Francisco Bay Area Rapid Transit (BART) District
300 Lakeside Drive, 16th Floor
Oakland, CA 94612

3. **Contact Person and Phone Number:** Ellen Smith
(510) 287-4758

4. **Project Location:** Between two existing Union Pacific Railroad (UPRR) rail lines, and south of Industrial Parkway in Hayward and extending south of Whipple Road to about D Street in Union City.

5. **General Plan Designation:** *Industrial Corridor* in City of Hayward; *Residential* in Union City

6. **Zoning:** *I* (Industrial) in City of Hayward; *RM 2500* (Multi-Family Residential) in Union City

7. **Description of Project:** See Section V, Project Description.

8. **Surrounding Land Uses and Setting**: See Section V, Project Description.

9. **Other Public Agencies Whose Approval is Required**: See Section V, Project Description.

II. ENVIRONMENTAL FACTORS POTENTIALLY AFFECTED

Project impacts on each of the environmental factors listed below are evaluated in this Initial Study. None of the environmental factors listed below would result in any significant effects that cannot be mitigated to less-than-significant levels through project-specific mitigation measures identified in this Initial Study.

☒ Aesthetics
☒ Biological Resources
☒ Greenhouse Gas Emissions
☐ Land Use/Planning
☐ Population/Housing
☒ Transportation/Traffic
☐ Agriculture and Forestry Resources
☒ Cultural Resources
☒ Hazards & Hazardous Materials
☐ Mineral Resources
☐ Public Services
☐ Utilities/Services Systems
☒ Air Quality
☐ Geology/Soils
☒ Hydrology/Water Quality
☒ Noise and Vibration
☐ Recreation
☐ Mandatory Findings of Significance

III. DETERMINATION

On the basis of this initial evaluation:

☐ I find that the proposed project COULD NOT have a significant effect on the environment, and a NEGATIVE DECLARATION will be prepared.

☒ I find that although the proposed project could have a significant effect on the environment, there will not be a significant effect in this case because revisions in the project have been made by or agreed to by the applicant. A MITIGATED NEGATIVE DECLARATION will be prepared.

☐ I find that the proposed project MAY have a significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required.

☐ I find that the proposed project MAY have a "potentially significant impact" or "potentially significant unless mitigated" impact on the environment, but at least one effect 1) has been adequately analyzed in an earlier document pursuant to applicable legal standards, and 2) has been addressed by mitigation measures based on the earlier analysis as described on attached sheets. An ENVIRONMENTAL IMPACT REPORT is required, but it must analyze only the effects that remain to be addressed.

☐ I find that although the proposed project could have a significant effect on the environment, because all potentially significant effects (a) have been analyzed adequately in an earlier EIR or NEGATIVE DECLARATION pursuant to applicable standards, and (b) have been avoided or mitigated pursuant to that earlier EIR OR NEGATIVE DECLARATION, including revisions or mitigation measures that are imposed upon the proposed project, nothing further is required.

Signature

May 10, 2011
Date

Ellen M. Smith
Printed Name

BART
For

IV. BART SYSTEM/PURPOSE AND NEED

The San Francisco Bay Area Rapid Transit (BART) has been in operation since 1972 and currently operates in four Bay Area counties. It operates and maintains 104 miles of revenue track and 43 stations serving an average of 360,000 passenger trips every weekday in the counties of San Francisco, Alameda, Contra Costa, and San Mateo. The most recent extensions to the BART system are to Dublin/Pleasanton in eastern Alameda County, Pittsburg/Bay Point in east Contra Costa County, and San Francisco International Airport in San Mateo County, with a terminus in Millbrae. BART is currently building the first phase of the 5.4-mile Warm Springs Extension south from the Fremont Station in southern Alameda County. Other recently approved projects include extensions to Oakland International Airport (Oakland Airport Connector), eastern Contra Costa County (eBART), and Silicon Valley (Berryessa Extension). BART has also selected a preferred alignment alternative for a potential future system expansion to Livermore, but has yet to approve an extension project. The existing BART system is illustrated in Figure 1.

BART is currently in the process of replacing its existing fleet. Over the next 30 years, BART will require additional vehicles to meet future demand associated with regional population growth, service expansions for the Warm Springs and Silicon Valley/San Jose extension projects, and additional riders from the Oakland Airport Connector, and eBART projects.

BART's current fleet of 669 revenue vehicles can all be stored within the four existing yards associated with the four vehicle maintenance shops. As the fleet expands to meet future needs, additional maintenance and storage will be necessary, both to accommodate the expected number of cars and to minimize non-revenue train movements[1] to initiate and end daily service.

Maintenance will also need to be expanded to ensure future reliability and performance. BART has instituted a Strategic Maintenance Program (SMP) that will provide scheduled maintenance and overhauls for the vehicle fleet. Acquisition of three properties (with four warehouses) adjacent to Hayward Yard would create an efficient complex that could provide the necessary maintenance and also allow a consolidation of existing BART services.

Undeveloped land at BART's existing Hayward Maintenance Yard provides an economical means to expand vehicle storage on a suitable piece of vacant land, which BART already owns on the east side of the Hayward Yard. The proposed facility and components are described below in the project description.

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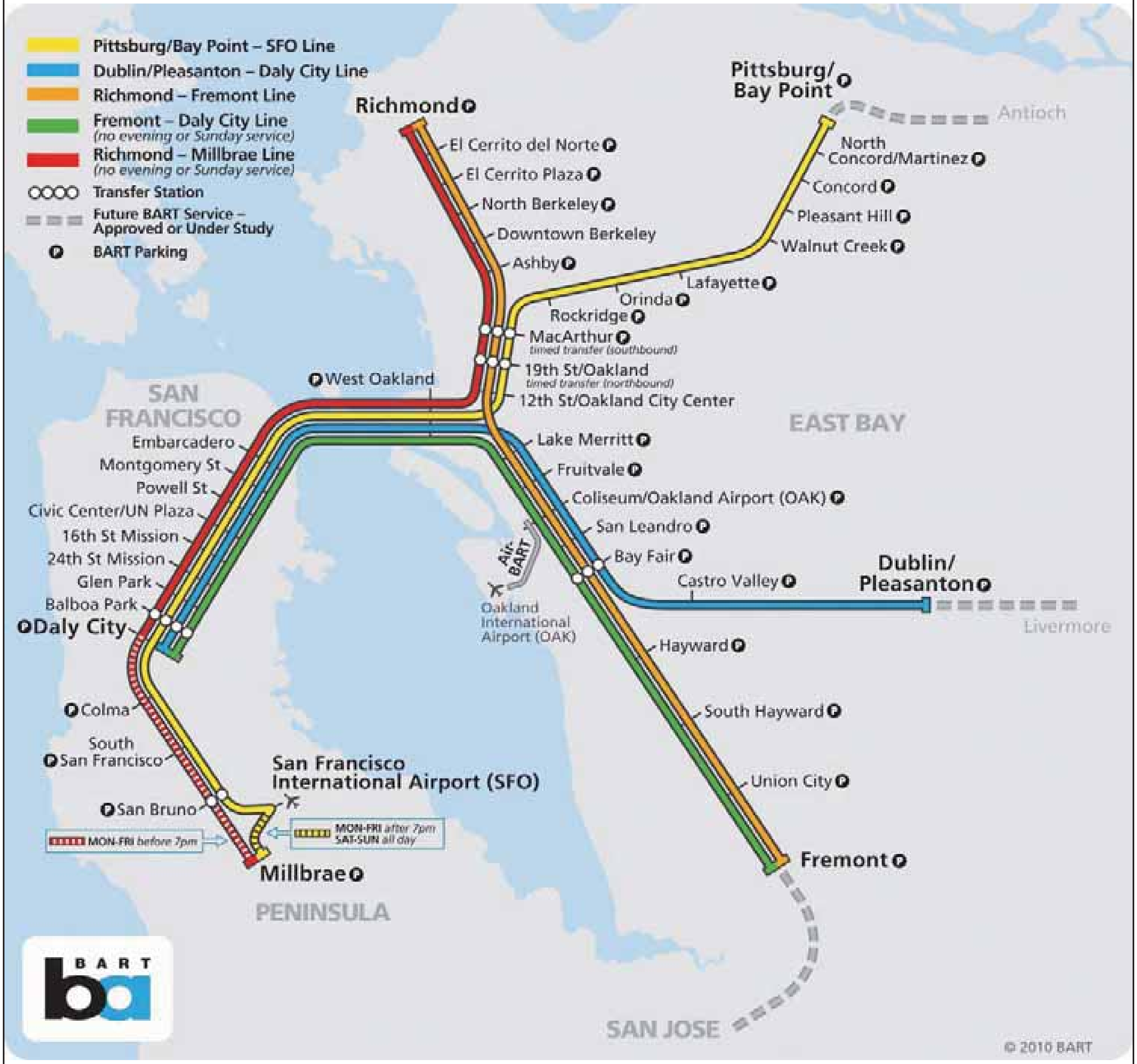
[1] Train movements without passengers that do not yield revenue are called non-revenue train movements.



NORTH
NOT TO SCALE

Source: BART, 2009.

FIGURE **1**

BART System Map

100016453

Hayward Maintenance Complex Project IS/MND

V. PROJECT DESCRIPTION

PROJECT BACKGROUND

BART currently has a fleet of 669 vehicles and expects that the total fleet requirement will be 1,000 vehicles in 2030. In order to maintain and store the new BART vehicles, BART requires expanded maintenance and storage facilities. The proposed project would provide expanded capacity for maintenance and warehouse activities for the future BART fleet on three properties to be acquired on the west side of the existing BART property and additional storage capacity within the existing BART property to the east.

PROJECT OBJECTIVES

The objectives for the proposed project are to:

- Provide facilities for a revenue vehicle Strategic Maintenance Program (SMP) Overhaul Program.
- Provide capacity for vehicle maintenance and component repair for an expanding fleet.
- Provide a central materials warehouse.
- Provide Maintenance and Engineering (M&E) yard, shops, and storage for non-revenue maintenance equipment.
- Provide enhanced facilities for the Vehicle Inspection area.
- Provide additional storage tracks for up to 250 additional BART cars.
- Provide increased flexibility for BART operations.

EXISTING CONDITIONS

The Hayward Yard is one of four rail vehicle maintenance facilities serving the BART system (Hayward, Concord, Richmond, and Daly City) with train storage, train washing, and general maintenance facilities for the BART fleet. In addition, Hayward Yard has a parts warehouse and can provide accident and component repair, which is not available at the other BART maintenance yards.

The 88-acre Hayward Yard, including currently undeveloped BART-owned property on the east side which is being proposed for expansion, is located in the City of Hayward just north of Whipple Avenue and south of Industrial Parkway (Figure 2 and Figure 3). Tracks at the south end of the Hayward Yard extend into Union City. The yard has a long and narrow configuration and is oriented north-south along both sides of the BART mainline tracks. The yard currently has train storage tracks and maintenance facilities to the west of the BART mainline tracks and maintenance-of-way[2] materials

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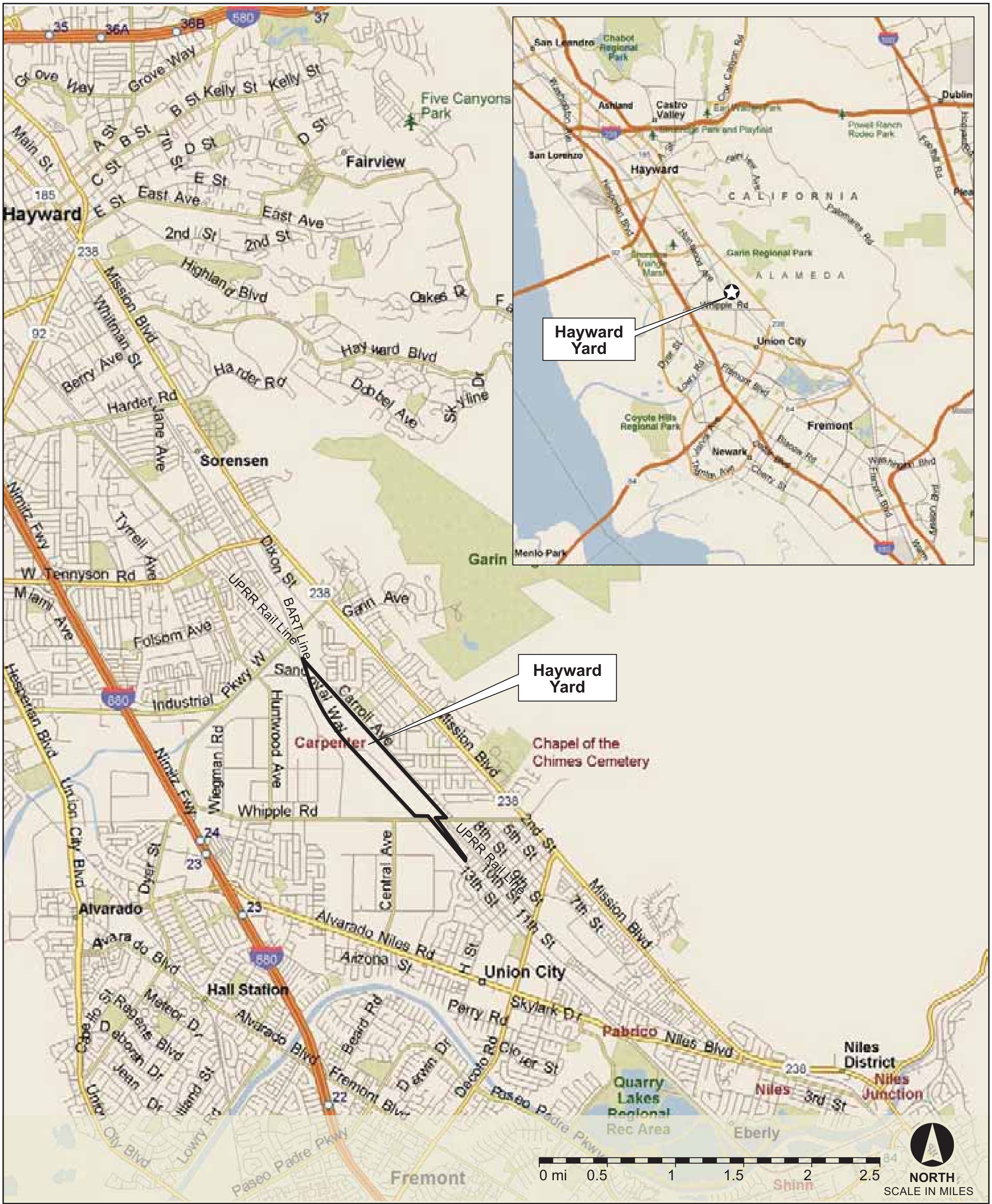
[2] Maintenance-of-way refers to the material, equipment, and operations necessary to maintain the track and right-of-way.



Source: Microsoft Streets and Trips, 2009.

FIGURE **2**

Project Location

Source: Environmental Data Resources, Inc., 2009; Google Earth, 2009; PBS&J, 2010.

PBS&J

FIGURE 3
Project Site and Context

100016453

storage to the east of the mainline tracks. Motor vehicles access the main shop and the yard west of the mainline tracks from Sandoval Way, and access the yard east of the mainline from Whipple Avenue.

The Hayward Yard is bordered on the west by industrial and warehouse development and a Union Pacific Railroad (UPRR) line (Oakland subdivision). A second UPRR line borders the yard to the east (Niles subdivision).[3] In the project vicinity, industrial uses are generally located west of the UPRR corridor and residential uses are located east of the UPRR corridor. Surrounding uses include industrial businesses and warehouses to the west, residential development to the east, and a golf driving range to the north. There are existing sound walls approximately 7 to 9 feet high along the east side of the BART corridor south of Whipple Road. There is a 7-foot tall existing chain link security fence around the BART property. The security fence also includes a wire around the top of the fence. The area proposed for expansion to the west of the Hayward Yard includes four partially occupied warehouse and light industrial buildings. The 6-acre portion of the expansion area on the southern end near Whipple Road is undeveloped.

The Hayward Yard operates 24 hours per day, 365 days per year. BART activities are cyclical and the number of employees at the Hayward Yard increases or decreases depending on various BART operations and maintenance activities occurring over the course of a day. There are approximately 280 BART employees at the Hayward Yard, distributed over 24 hours and a number of shifts. BART operates trains in the project area seven days a week with 204 daytime trains and 52 nighttime trains. Two proposed BART extension projects, the Warm Springs Project and the Silicon Valley Rapid Transit Project, are expected to increase train traffic in the project area by 59 trains daily.

Rail car storage capacity at the Hayward Yard is 218 cars, all on the yard's west side. Presently, 205 cars can be stored as complete trains of commonly scheduled lengths (twelve 10-car trains, one 8-car train, twelve 6-car trains, and one 5-car train). The remaining spaces accommodate single cars. At this time, approximately 105 cars are regularly stored overnight, and 41 cars are regularly stored midday.

Utilization of storage space has varied over the years, depending on operations and other storage locations around the BART District. (Before 2008, when the Hayward Shop was used for running repairs, 121 cars were regularly stored in the yard.) Currently, all of BART's other yards are full, so the Hayward Yard provides the only additional storage capacity in the system. This capacity is essential in cases of facility maintenance and unexpected circumstances. BART's Fleet Management Plan calls for 174 cars to be stored as complete trains on the yard's west side in 2030, leaving space for 44 single cars.

The Hayward Yard also contains the BART test track, where cars with mechanical problems are tested before being returned to service, and where new cars are delivered and tested before entering service. The test track is 2.25 miles long and extends beyond the Hayward Yard approximately 3,730 feet (0.71 miles) to the north and 1,750 feet (0.33 mile) to south. Testing hours are 8 a.m. to 4 p.m. Test track

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[3] There are two sets of Union Pacific tracks that run north-south in the project vicinity. One set is immediately adjacent to the Hayward Yard on the east and the second set is approximately 1,100 feet to the west of the first.

hours could be longer during periods of new fleet acceptance. New cars can be delivered to the yard by either rail or flatbed semi-trailer.

PROPOSED PROJECT CHARACTERISTICS

The proposed project primarily would consist of acquisition and improvement to three properties on the west side of the existing Hayward Yard and the construction of a maximum 250-car storage area on undeveloped BART property on the east side of the Hayward Yard. Figure 4 shows the proposed site plan; there would be new facilities and yard modifications to the west of the existing yard and mainline tracks under the proposed Phase 1 expansion. Figure 5 shows the proposed site plan for the east side of the existing yard and mainline tracks under the proposed Phase 2 expansion. The various elements of the Hayward Maintenance Complex (HMC) are described below.

Proposed Phase 1 Expansion

BART would acquire three properties containing four warehouses adjacent to the west side of the existing Hayward Yard. The properties collectively total approximately 28 acres. BART would reconfigure the properties for use as an integrated maintenance complex that would include a new vehicle level overhaul shop, component repair shop, central warehouse, and maintenance and engineering shop and storage area. The properties currently have motor vehicle access from Whipple Road. A new motor vehicle connection would allow vehicle access between the new properties and Sandoval Way, the existing yard roadway. Rail car access would be added along the east side of the properties to connect them to the existing Hayward Yard. Maintenance operations and storage would move from the east side yard to the west side with the establishment of the proposed maintenance and engineering shop and storage area.

Overhaul Shop

The Overhaul Shop would be located at the site of one of the existing warehouses, an 86,400-square-foot concrete slab-on-grade structure constructed of wood columns and concrete tilt-up walls. The orientation of the existing building does not allow the introduction of rail tracks and its construction would make it difficult to retrofit as a vehicle level overhaul shop; therefore, the existing building would be demolished, and a new facility would be constructed with a different orientation. The Overhaul Shop would remove trucks[4] and other components from the rail cars for overhaul and transfer them to and from the adjacent Component Repair Shop. The new building would have a footprint approximately 210 feet by 212 feet with a height of approximately 30 feet. The building would be double-ended, with a 70-foot by 210-foot concrete apron on the east side and an open 200-foot by 100-foot transfer table on the west end. The building would have the following features:

- 12 rail car repair spots
- 100-foot-long rail vehicle transfer table at the north end
- 12 rail car hoists with two 10-ton cranes overhead

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[4] “Truck” refers to the wheel assembly that supports and propels the car body on the rails. There is a truck under each end of the rail car. Each truck is composed of four wheels, two axles, two motors, and two gearboxes.

- 5-ton crane over truck storage track
- Offices, bathroom, and break rooms (second floor)
- Associated equipment to support operations in the shop: communications, traction power, closed-circuit TV, public address system, yard control systems
- Truck transfer track to/from the adjacent Component Repair Shop
- 75 auto parking spaces along the north and west perimeter of the shop

Site work and trackwork would be included for nine turnouts and spurs between the new Overhaul Shop and the existing Hayward Yard tracks. Some excavation work would be necessary to provide acceptable grades to meet track elevations at the existing yard.

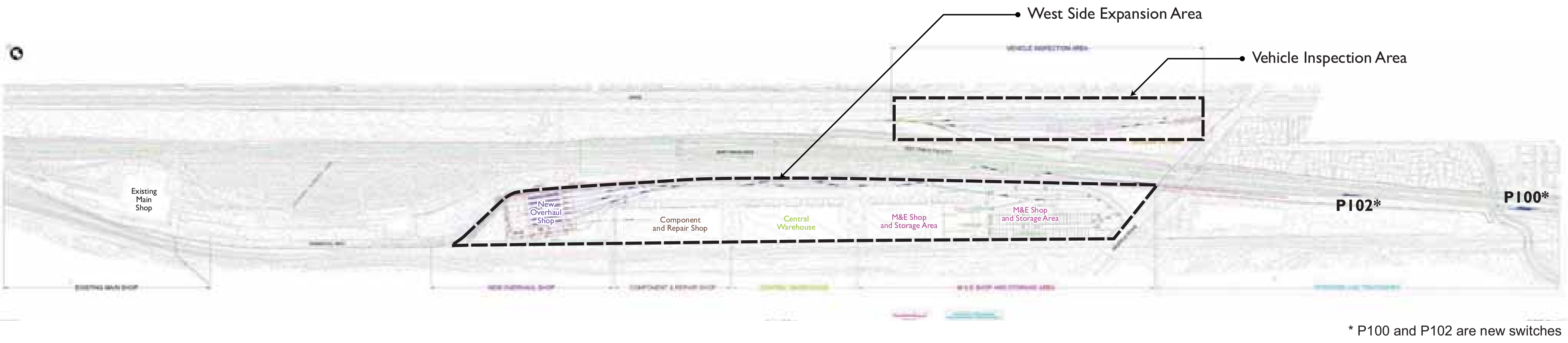
Component Repair Shop

The Component Repair Shop would be located in one of the existing buildings, a 120,000-square-foot structure constructed of concrete slab-on-grade, wood columns and laminated beams, plywood panel roof, and concrete tilt-up exterior walls. Truck loading docks are located along the structure's east side.

The structure would serve as the Component Repair Shop, with three major areas: the truck shop, electronic repair shop, and electro-mechanical repair shop. Renovations would be made within the existing building footprint, and building modifications would be minimized. The existing roof, columns, and walls would be used without major modifications to the degree possible. The existing floor area would be demolished leaving columns and footings in place and would be replaced with new concrete, equipment footings, embedded rail, pits, etc. The roof would be raised approximately 10 feet to accommodate a new 10-ton overhead crane. The structure would be upgraded to new seismic code requirements. New bathrooms and break rooms would be added to accommodate the workforce.

The Component Repair Shop would contain the following facilities:

- Truck Shop
  - one 10-ton crane, three 2-ton jib cranes
  - tracks and turntables arranged as a truck production line
- Truck Component Areas (wheel, motor, gearbox, axle build)
  - new wheel press and relocated old wheel press from existing back shop
  - four 2-ton jib and overhead cranes
- Electro-Mechanical Repair Area (heating, ventilation, and air conditioning (HVAC); hydraulics; power; etc.)
- Small Component Repair Area
- Electronics Repair Shop – electrostatic discharge (ESD)/Clean Environment

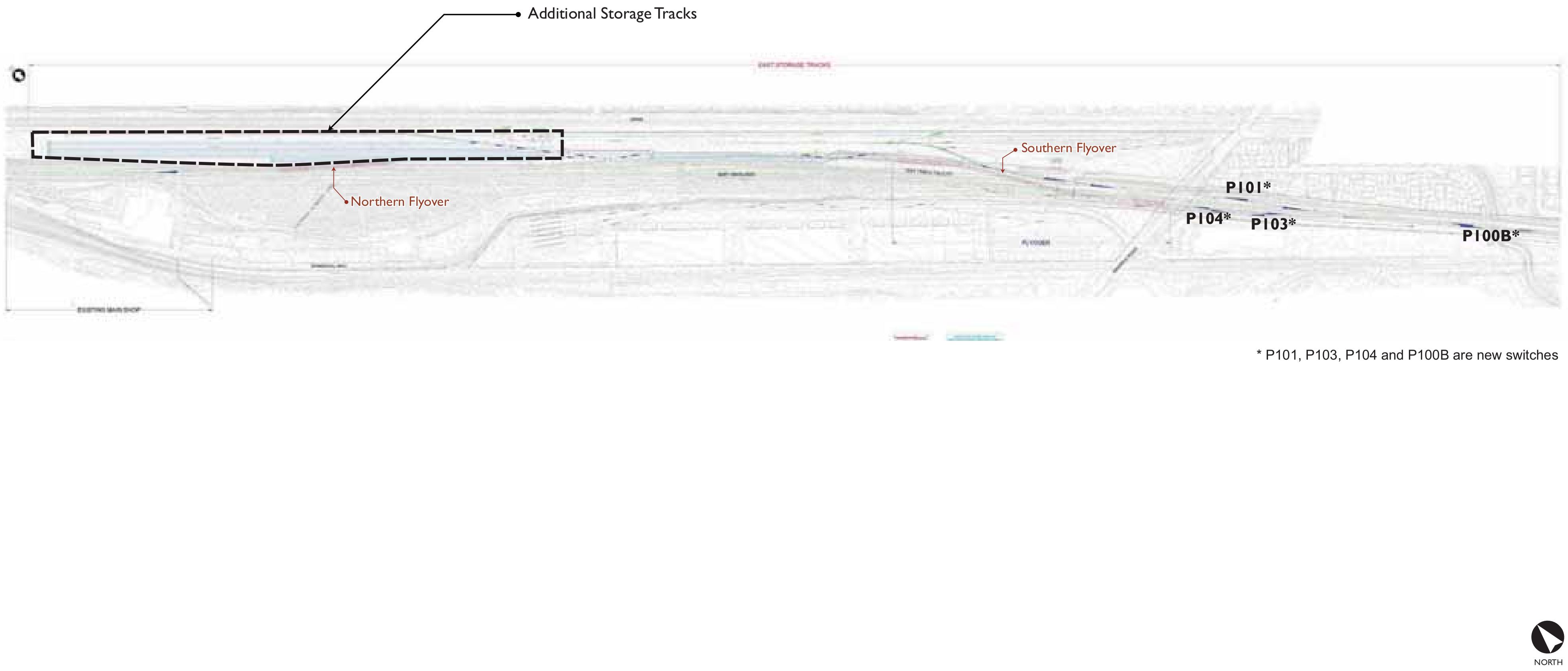


* P100 and P102 are new switches

Source: BART, 2009.

FIGURE **4**

West Side Expansion Area Site Plan



* P101, P103, P104 and P100B are new switches

Source: BART, 2009.

FIGURE 5

East Side Expansion Site Plan

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Central Warehouse

The Central Warehouse would be located in one of the existing buildings, a 120,000-square-foot structure constructed of concrete slab-on-grade, wood columns, and laminated beams, plywood panel roof and concrete tilt-up exterior walls. Truck loading docks are located along the structure's east side.

This structure would become the parts and logistics center for an on-demand warehousing center. The building interior would be retrofitted with standard pallet racks and small parts carousel and kitting area. Existing fire protection and lighting would be modified to accommodate rack layout. The proposed project would also include seismic upgrade to the structures. The adjacent asphalt area would include stub tracks for loading material into BART non-revenue material transfer vehicles.

M&E Non-Revenue Vehicle and Storage Area

The non-revenue vehicle and storage area would be located at the site of one of the existing buildings, a 120,000-square-foot structure constructed of concrete slab-on-grade, wood columns and laminated beams, plywood panel roof and concrete tilt-up exterior walls. Truck loading docks are located along the structure's east side.

BART Maintenance and Engineering (M&E) is responsible for all BART facilities and systems other than the rail fleet. This shop would become the primary maintenance headquarters for the southern portion of the BART system. Structural improvements would be made within the existing building footprint, and the vacant 6-acre area to the south would be improved to provide outdoor storage. The entire existing floor area would be demolished, leaving columns and footings in place, and replaced with new concrete, equipment footings, embedded rail, pits, etc. Modifications would be minimized; existing columns and walls would be used without major modifications where possible. The roof would be raised approximately 10 feet to accommodate a new 10-ton overhead crane. The structure would be upgraded to new seismic code requirements.

The building's existing facilities would be modified to accommodate the following features:

- Vehicle fueling and wash areas
- Power supply, mechanical, and grounding systems for the Hi-Rail Vehicle Shop,
- Non-Revenue Vehicle Shop, and M&E Support Shops
- Mechanical and power supply facilities overhaul
- Storm drainage at all vehicle entrances and roof
- Sewer drainage for restrooms
- Locker and break rooms
- Industrial waste drainage for floor and pit drains
- Potable water system to all restrooms, locker, and break rooms

- Sprinkler and wet standpipe fire protection system
- Exhaust ventilation to extract hot air and fumes from the shops
- Compressed air system
- Motorized coiling doors at all vehicle and service equipment entrances
- Emergency bus to supply power to critical loads such as fire alarm and other fire/life/safety system
- Communication systems and traction power auxiliary power
- 48-volt DC power supply system for communication circuits
- 10-ton overhead crane in the Hi-Rail Vehicle Shop

The undeveloped area south of the building would be paved for a 6-acre outdoor storage and staging area, with individual stalls for various materials, including approximately 12 assorted types of Hi-Rail and rubber-tire vehicle equipment.

Sound Walls

Along the east side of the BART corridor south of Whipple Road, BART would install three of the four sound walls (SW01, SW02, and SW03) recommended to mitigate operational noise to the adjacent residential uses prior to the start of track construction, in order to reduce impacts from construction noise. The recommended fourth sound wall (SW04) is not required for noise mitigation until Phase 2. See Section 12, Noise and Vibration, and Figure 13 and Figure 14 of this document for more detail regarding the proposed new sound walls.

Programmed Station Stop

A station platform along the main line would be provided for use by HMC workers commuting by BART with regularly scheduled stops.

Cart and Pedestrian Bridge

A pedestrian bridge would be constructed over the mainline tracks so employees could reach the test track and the east side of the yard. The bridge would be capable of holding a golf cart and would be constructed over the west yard storage tracks, mainline, and test track. The bridge would be approximately 200 feet long and a have minimum width of 6 feet. It would be approximately 16 feet above the tracks. Ramps at either end of the bridge would be provided for carts to access the bridge. Cart access would expedite moving employees and supplies from the west side to the east side of the yard.

Vehicle Inspection Area

The existing Vehicle Inspection Area is a single-bay shed structure with unloading ramps located on the east side of the existing yard near the Whipple Road gate. The existing shed would be upgraded and expanded to hold four cars to accelerate the inspection process. The expanded shed structure would be approximately 200 feet long, 60 feet wide, and less than 30 feet high with concrete aprons on either end.

HMC Access Tracks (West and South of BART Yard Tracks)

One No. 10 track turnout[5] and 11 No. 8 turnouts would be installed to the east side of the maintenance complex north of Whipple Road to connect it to the existing yard tracks. Two No. 10 crossovers would be constructed to connect the HMC access tracks to the BART main line tracks south of Whipple Road.

To provide the correct grade, a retaining wall with associated excavation would be required along the west side of the tracks from approximately 400 feet north of Whipple Road to a point approximately 650 feet south of Whipple Road (see the construction scenario below). A combination of pipes, culverts, and open drainages would replace a portion of an existing open culvert/ditch along portions of the drainage between the BART mainline tracks and the west side expansion area**.**

Proposed Phase 2 Expansion

There is a 20-acre undeveloped portion of the yard in its northeast quadrant, east of the mainline and north of the maintenance-of-way storage yard. A new storage area is proposed on approximately 13 acres of this undeveloped area, which consists of a level, grassy field, with a smattering of small trees and bushes. The site is bounded by the existing UPRR rail line on the east, the BART mainline and test track to the west, and BART's existing materials storage yard to the south. In addition to the new expansion area to the east of the existing yard, a portion of the approximately 12 acres of the existing BART storage yard (which is already paved) would be reconfigured with connecting tracks.

East Side Train Storage Area

The proposed east side storage project would provide storage for a maximum of 250 vehicles and connecting trackwork. Almost all the new facilities and yard modifications would occur east of the existing yard and mainline tracks. Two new crossovers would be installed on the BART tracks south of Whipple Avenue (in the City of Union City) to provide access from the existing BART tracks via the test track to the new storage area.

Although primarily for train storage, the expansion area has been designed to allow train operations on the west side of the yard (such as train dispatch) to move to the expansion area at some time in the future; maintenance activities would remain within the existing yard to the west of the project site.

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[5] Turnouts are switches that transfer rail vehicles from one track to another and are categorized by degree of turn provided. For example, a No. 20 turnout moves the track 1 foot over for every 20 feet forward. A No. 10 turnout moves the track 1 foot over for every 10 feet forward. Both No. 10 and No. 8 turnouts are considered low speed turnouts.

The following components are included in construction of the East Side Storage Tracks:

- Site grading.
- Underground utilities – Power, water, sanitary sewer, and communications would be extended from the existing connections to the expansion area.
- Traction power, train control, and communications systems – Embedded electrical conduit for traction power would be provided for power and communications circuits.
- Contact rails – Third rail to provide power to tracks and to power the vehicles would be installed.
- Traction power substation – A traction power substation would be constructed at the south end of the storage tracks area to provide power to the storage tracks.
- Storage and transfer tracks – Storage for a maximum of 250 BART cars would be provided.
- Turnouts and crossovers – A combination of turnouts and crossovers as indicated in Figure 5 would be installed. Some are north of Whipple Road, and four are south of Whipple Road.
- Drainage – A combination of pipes and open drainage would replace an existing open culvert/ditch along portions of the drainage to the west of the east side storage area. No construction activities or permanent alteration of the drainage to the east of the east side storage area would be expected.
- Lighting – Light poles would be added to the storage area. Light poles would be 15 to 18 feet high with shielded lamps. The new lights would not include motion detectors.
- Access road – A new 20-foot-wide, two-lane, paved road would extend north from Whipple Road to the expansion area and along the east perimeter of the expansion area to its northern boundary. It would be located on BART property between the existing maintenance-of-way material storage area and the UPRR property. Approximately 6,500 feet long, it would provide both BART access and fire and emergency access to the proposed east side expansion area.
- Cleaning supplies facility – A single-story building approximately 20 feet by 40 feet for car interior cleaning supplies would be located at the south end of the expansion area. Drains from the mop sinks would be connected to the yard’s industrial waste system. An employee restroom (with separate outside access) would be attached.
- Perimeter fence – An 8-foot-high chain link security fence would be provided along the new perimeter of the expansion area.

There would be an increased level of train movement activity in the Hayward Yard related to the proposed car storage area, as eventually 60 trains could be dispatched from the east side storage tracks in the morning and returned at the end of the operating day. However, train movements in the storage area would be at low speed (30 mph or less). As noted above, current maintenance operations and storage would move from the east side yard to the west side with the establishment of the proposed M&E maintenance and storage area under Phase 1.

Flyovers

The new east side storage tracks would be connected to the mainline tracks via turnouts that use the test track as a route to the proposed train storage area. To reduce the potential disruption to test track activity and mainline traffic due to trains moving in and out of the east side storage area, two flyovers are proposed. The southern flyover would provide access from the storage area to the southbound mainline, and the northern flyover would provide direct access from the east side storage area to the northbound mainline. The two flyovers would be constructed independently of each other. Each would provide a separate and independent function for train movements in the yard.

Southern Flyover. The southern flyover would be located at the south end of the yard to provide access from the east storage area to the southbound mainline over the test track and two mainline tracks. It would also provide access to the existing west side transfer tracks and shops. The southern flyover is important for efficient yard operations and is much more likely to be built first of the two flyovers. The southern flyover would have an elevation of approximately 28 feet above grade, measured from grade to the top of a train on the flyover. Tailtracks would extend to a point approximately 1,250 feet south of Whipple Road. (Visual simulations of the southern flyover are provided below under Aesthetics.)

Northern Flyover. The northern flyover would be located toward the north end of the yard and would provide access from the east storage yard to the northbound mainline over the test track. The northern flyover would be similar in size and scale to the southern flyover.

Employees

Development of the HMC project, under Phase 1 and Phase 2, would increase employment at the Hayward Yard. Table 1 illustrates anticipated employment at each of the HMC components. Total employment is estimated to be approximately 350, with peak occupancy estimated to be approximately 165 workers. Peak occupancy would be from 8 a.m. to 4 p.m. Some of the HMC employees may be current BART employees who would be relocated to Hayward Yard as BART functions are consolidated at Hayward (Central Warehouse for example); others would be new employees as BART develops new programs, such as the SMP and vehicle level overhaul shop. For the purpose of this analysis, BART estimates that 135 of the 350 employees would be existing employees, and 215 employees would be new employees to the site.

Construction Scenarios

Construction of the HMC project would be done in two distinct phases. Construction of the west side of the HMC project plus the enhanced vehicle inspection area (east side) would be conducted as Phase 1 and construction of the remaining facilities on the east side would be completed in Phase 2. Therefore, Phase 1 would include the Vehicle Level Overhaul Shop, Component Repair Shop, Central Warehouse, M&E Vehicle and Storage Area, Vehicle Inspection Area, and connecting tracks for the new activities on the west side of the yard; Phase 2 would include the east side storage tracks, flyovers, and connecting tracks for the east side of the yard.

Table 1
HMC Employees

	Total Employees	Existing Hayward Yard Employees[a]	Peak Occupancy
New Overhaul Shop	50	0	25
Component Repair Shop	150	80	75
Central Warehouse	30	30	20
M&E	100	15[b]	40
East side storage tracks	20	10	10
Total	**350**	**135**	**170**

Source: BART, August 2010.

Notes:

a. Existing Hayward Yard employees that would be relocated to the new facilities under the proposed project.

b. There would be 15 employees relocated from the Hayward Yard to the M&E facility. The remaining 85 employees would be relocated from other BART facilities outside of Hayward.

The proposed project would require two different approaches to construction. The areas north of Whipple Road provide sufficient area and access to allow traditional construction methods. Construction north of Whipple Road would also occur mostly during the daytime hours; however, there would be some activities at the staging areas during the nighttime hours. A 50-foot buffer of no construction activities would be established along the eastern property line to maintain construction activities below the nighttime noise criteria. Construction of the crossovers and switches south of Whipple Road must take place in a narrow corridor adjacent to an active BART line. The constrained access creates additional challenges not present in the construction areas north of Whipple Road. Potential construction scenarios for both areas are discussed below. Final details of project construction will be determined by BART during final design.

Construction Schedule. The project schedule is contingent on funding. Each component of the HMC could be constructed independently of the others, although full use of the Vehicle Level Overhaul Shop, Component Repair Shop, and M&E Shop would require construction of HMC access tracks west and south of the existing yard tracks. Phase 1 and Phase 2 of the HMC project could be separated by many years.

Phase 1 Construction

Overhaul Shop. The existing 86,400-square-foot warehouse would be demolished, and a new Overhaul Shop would be constructed in its place. Demolition of the structure would take approximately 2 months. Demolition would require a combination of bulldozers, loaders, and trucks. Though some of the removed material would be recycled, that would not take place on site. An estimated 500 truckloads (1,000 truck trips) would be required to remove the debris. Construction of the new 44,520-square-foot Overhaul Shop would use standard construction. The new structure would be a post and beam structure with a concrete slab on-grade foundation. The walls could be tilt-up concrete or metal clad. Delivery of building materials and concrete is expected to generate up to 500 trucks loads (1,000 truck trips) over the 1 year duration of the Vehicle Level Overhaul Shop construction.[6]

The other three existing warehouse structures that are proposed for Component Repair, Central Warehouse, and M&E use would be seismically upgraded and retrofit for BART use. The existing roof, columns, and walls would be used to the degree possible. Therefore, the level of construction activity would be greatly reduced compared to the construction of a new structure.

In addition to retrofitting the structure proposed for M&E use, approximately 75 percent of the 6-acre undeveloped area to the south of the structure would be graded and paved for outdoor storage. Although relatively flat, the outdoor storage area would be grubbed, [7] and approximately 3,800 cubic yards would be off-hauled. Assuming a truck size of 10 cubic yards, approximately 380 truckloads (760 truck trips) would be generated. Once grubbed, site grading would be minimal.

Vehicle Inspection Area. The existing vehicle inspection area would be enlarged from one bay to four bays. The new structure would be approximately 200 feet long by 60 feet wide with concrete aprons on either end. The site is level and minimal site preparation would be necessary. The structure likely would be standard post and beam construction with metal walls. Approximately 250 truck trips would be necessary to deliver materials.

Phase 1 of the HMC would include use of typical construction equipment including trucks, water trucks, bulldozers, truck-mounted cranes, loaders, lubrication/fueling service trucks, transit-mix concrete trucks, concrete pumps, and diesel-driven generators and compressed air units for construction power, equipment, and tools.

Construction access to the HMC area north of Whipple Road, including truck access, would be primarily from Whipple Road, which connects Interstate 880 to the west and State Route 238 to the east. Areas of the existing BART storage yard on the east side and existing parking lots and proposed M&E outdoor storage area on the west side could be used as staging areas. Construction is contingent on funding, but if funding becomes available, Phase 1 could be completed in approximately 36 months.

Construction South of Whipple Road. Phase 1 construction activities south of Whipple Road include additional connecting track, track crossovers, and switches. Construction must take place in a narrow corridor adjacent to and within an active BART line.

Sound Walls. In order to reduce impacts from construction noise along the east side of the BART corridor south of Whipple Road, BART would install the sound walls (SW01, SW02, and SW03), which are required to mitigate operational noise to the adjacent residential uses prior to the start of track construction. See Section 12, Noise and Vibration, for more detail regarding the proposed new sound walls.

Retaining Wall. To provide a rail connection to the west side of the HMC, new connecting track would need to be provided parallel to and west of the mainline tracks, and a retaining wall would be

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[6] Each truck load of material requires two truck trips: one trip in and one trip out.

[7] Grubbing is the process of removing vegetation and organic material from the surface of a construction area.

required along the west side of the new track. The retaining wall would extend approximately 400 feet north and 650 feet south of Whipple Road. Approximately 5,000 cubic yards of cut would be required, which could be placed on the M&E outdoor storage area to prevent any need to export the cut material.

Additional Track and Switches. Installing the mainline crossovers would include removing the existing track at the new crossover location, including ballast, ties, rails, third rail, and approximately 1.0 to 1.5 feet of dirt below the sub-ballast.[8] This would be accomplished by using an excavator and a front-end loader. The material removed (ballast, dirt, etc.) would be hauled away by truck. Approximately 100 truck trips (assuming 5 cubic yard capacity) are estimated to haul away removed material and bring in new material. A drum roller and various vibratory plates would be used to compact material. Ballast would be compacted using a ballast tamper. Cranes operating from the west side of the tracks would be used to install switches and rails. Work outside of the mainline could be conducted during normal work hours, typically between 7 a.m. and 7 p.m., without affecting mainline BART operations. However, in order to reduce impacts on BART operations, work on the proposed mainline crossovers would be conducted by working 24 hours a day over weekends. Preparations for construction before and after the installation period could be conducted during a standard work day (between 7 a.m. and 7 p.m.).

Construction along the mainline track would most likely include construction of sound walls along the east side of the BART property. Depending on the type of sound wall construction, concrete transit-mix trucks and mortar and grouting pumps may be used.

Access. Primary access to the track area south of Whipple Road would be from the yard area north of Whipple Road; access is possible both east and west of the mainline tracks, including using the test track. The M&E storage area north of Whipple Road could be used as a staging area with equipment shuttling back and forth between the staging area and the work area south of Whipple Road. If necessary, alternative access could be provided via three other locations. Construction also may require some combination of these access points:

- The most likely option would be through the existing parking lot of an industrial property adjacent to BART tracks on the west. Construction at this location could require removal of trees along the fence line.
- Dry Creek service road, which is on the north side of Dry Creek, leads to a gate adjacent to the BART test track. Equipment could then reach the work areas by moving north along the test track.
- F Street, which crosses under the BART tracks approximately 0.7 miles south of Whipple Road, provides direct street access to the BART right-of-way along the west side of the mainline tracks.

Nearby Construction Efforts. Union City is planning the seismic upgrade of the Whipple Road bridge over the BART tracks. The upgrade is in the final stages of design and permitting. Because construction will occur within the BART right-of-way, BART is cooperating with the City of Union City on its

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[8] Ballast and sub-ballast refer to the crushed angular rocks that are packed below, between, and around rail ties. The use of ballast facilitates drainage as well as bearing the weight of the trains.

construction activities. Construction of this project is anticipated to occur in early 2011 and to last for approximately 6 months.

Phase 2 Construction

Storage Tracks. The construction activities associated with the HMC north of Whipple Road would include a variety of activities: site grading, drainage improvements, underground utilities, buried duct banks (for traction power, train control, lighting, and communications), an access road, area lighting, storage and transfer tracks (including the contact rails for power), connecting turnouts and crossovers, and various signals and systems components on the track structure. Two small, one-story buildings, a traction power substation and cleaning supply room would also be constructed.

The expansion site would need to be cleared, grubbed, and graded to a fairly flat gradient to satisfy the storage track requirements. BART plans to limit the number of truck trips to and from the site during construction to the extent feasible by balancing the amount of cut and fill onsite to the degree possible. Currently, additional embankment material is expected to be necessary. Therefore, truck traffic associated with the project would be substantial.

At a minimum, the 13-acre undeveloped portion of the site would be cleared and grubbed to the depth of one-half foot, and the material would be exported. This would generate approximately 700 truckloads of material or 1,400 truck trips. A preliminary worst-case estimate indicates that 40,000 cubic yards of fill would be imported. Assuming an average truck capacity of 15 cubic yards per truck and accounting for additional 15 percent soil compaction onsite, approximately 3,100 truckloads (6,200 truck trips) of fill would be required. A total of approximately 7,600 truck trips would be necessary for this phase of construction. Assuming that grub and fill operations take place over a 3-month period (72 working days) between the hours of 7 a.m. to 7 p.m., the project would generate approximately 105 truck trips (53 truck loads) per day. In addition, one and one-half feet of ballast and sub-ballast would be imported, although this material as well as railroad ties could be delivered by rail car on existing rail lines. (BART has a spur connection to the UPRR line to the east.) Rails also could be brought in by railroad.

The work in the area may also include some minor structures such as retaining walls and a cart overpass. Concrete transit trucks would be coming and going to perform this work, but the number and frequency would depend both on the type of structures developed in final design and the schedule on which the contractor advanced the construction process.

Typical construction equipment would include dump trucks, self-propelled earth-scrapers, water trucks, bulldozers, grade-alls, truck-mounted cranes, loaders, excavators, rollers, lubrication/fueling service trucks, transit-mix concrete trucks, concrete pumps, and diesel-driven generators and compressed air units for construction power, equipment, and tools.

Construction access to the east side expansion area, including truck access, would be from the existing BART gate on Whipple Road, just east of the BART tracks. The only approach would be along Whipple Road. Areas of the existing BART storage yard or portions of the expansion area itself could be used as staging areas. Construction of the storage track area would last approximately 15 months.

Construction South of Whipple Road. Major construction activities associated with the proposed project south of Whipple Road are related to track modifications, including test track crossovers and switches. Work on the test track could be conducted from the test track itself. The BART yard north of Whipple Road could be used as a staging area with equipment shuttling back and forth between the staging area and the work area south of Whipple along the BART test track. Trucks, excavators, and other equipment could be provided on high-railers that can run on the BART tracks or from flatbed BART cars. Installing the crossover would include removing the existing test track at the new construction area including ballast, ties, rails, third rail, and approximately 1.0 to 1.5 feet of dirt below the sub-ballast. This would be accomplished by using an excavator, a front-end loader, and high-railer trucks (5 cubic-yard capacity). The material removed (ballast, dirt, etc.) would be hauled away by using high-rail trucks. A minimum of 100 truck trips are estimated to haul away removed material and bring in new material. A drum roller and various vibratory plates would be used to compact material. Ballast would be compacted using a ballast tamper. Cranes and/or hoisting from the flatcar would be used to install switches and rails.

Work outside the mainline could be conducted during normal work hours, typically between 7 a.m. and 7 p.m., without affecting mainline BART operations. In order to reduce impacts on BART operations, work on the proposed mainline crossovers would be conducted by working 24 hours a day over weekends, if feasible. Preparations for construction before and after the installation period could be conducted during a standard work day (between 7 a.m. and 7 p.m.).

Construction along the test track would most likely include construction of sound walls near the test track. Depending on the type of sound wall construction, concrete transit-mix trucks and mortar and grouting pumps may be used.

Access. Installing the crossovers to the mainline tracks could not be conducted from the test tracks and would be more complex. Although most of the equipment and material could be supplied to the mainline crossover locations via the test track and stored at locations between test track and the mainline, equipment may be too large to fit under the Whipple Road bridge and would need another point of access. As noted for the west side construction described above, three possible access points to the mainline work areas south of Whipple Road include the industrial property along the west side of the mainline tracks just south of Whipple Road, the service road adjacent to Dry Creek, or F Street to the south. Construction also may require some combination of these three points.

Flyovers. Construction of the flyover would involve cast-in-place concrete columns[9] to support the elevated pre-cast guideway over the test track and mainline tracks. Pile driving may be required for the footings of the flyover columns. Construction would require trucks to remove excavated soil and to deliver forms, reinforcing steel, transit-mix concrete, and other materials. Approximately 150 truck loads (300 truck trips) would be necessary to remove the small amount of excavated material and bring in the materials, such as reinforcing bar and concrete, necessary to construct the flyovers. The 300 truck trips would be distributed over the approximately 6 months required to construct the flyovers.

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[9] Cast-in-place concrete is transported in an unhardened state, commonly referred to as ready-mix cement. The concrete is then poured into wooden “forms” and allowed to cure on site.

Although truck activity would be greater during certain periods, truck trips would average approximately two per day.

Additional equipment required for the aerial guideway construction could include drilling rigs, pile drivers, trucks to remove excavated soil, specialized truck trailers to deliver pre-cast concrete beams, cranes, trucks to deliver forms, reinforcing steel, pre-cast concrete post tensioning jacks, and related equipment.

REQUIRED PERMITS AND APPROVALS

The proposed project is subject to the California Environmental Quality Act (CEQA), and BART is the lead agency for the project. As such, BART must oversee environmental review of the project under CEQA prior to approving the project. In addition, if federal funding is to be obtained, the Federal Transit Administration (FTA) must make a determination whether the proposed project is exempt from the requirements of the National Environmental Policy Act (NEPA), or whether NEPA review is required.

The proposed project is also subject to National Pollutant Discharge Elimination System (NPDES) stormwater control requirements pursuant to the Federal Clean Water Act. The project must obtain coverage under the State Water Resources Control Board's NPDES General Permits for Industrial and Construction Stormwater Discharges and approval of its Stormwater Pollution Prevention Plan by the San Francisco Bay Regional Water Quality Control Board (RWQCB). If waters of the State are identified on the project site, and if the proposed project would impact these water features, Waste Discharge Requirements (WDR) from the RWQCB would be required.

VI. ENVIRONMENTAL CHECKLIST

INTRODUCTION

The following Checklist contains the environmental checklist form from Appendix G of the CEQA Guidelines. The checklist form is used to identify the impacts of the proposed project. A discussion follows each environmental issue in the checklist to explain the rationale for determining whether there are significant impacts. Included in each discussion are project-specific mitigation measures, where appropriate, to reduce potentially significant impacts to less than significant. In addition, the analysis discussions provided below distinguish between Phase 1 and Phase 2 components of the proposed project as appropriate.

For this checklist, the following designations are used:

- **Potentially Significant Impact:** An impact that could be significant, and for which mitigation must be identified. If potentially significant impacts are identified for which mitigation is not possible, an EIR must be prepared.
- **Less than Significant With Mitigation Incorporated:** An impact that requires mitigation to reduce the impact to a less-than-significant level.

- **Less-Than-Significant Impact:** Any impact that would not be considered significant under CEQA based on established significance thresholds.
- **No Impact:** The project would not have an impact.

1. AESTHETICS

Would the project:	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less-Than-Significant Impact	No Impact
a. Have a substantial adverse effect on a scenic vista?	☐	☐	☐	■
b. Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings along a scenic highway?	☐	☐	☐	■
c. Substantially degrade the existing visual character or quality of the site and its surroundings?	☐	■	☐	☐
d. Create a new source of substantial light or glare that would adversely affect daytime or nighttime views in the area?	☐	☐	■	☐

Background

The Hayward Yard is within an urbanized area and is currently developed with the existing maintenance yard, which includes storage tracks, maintenance buildings, and the BART mainline tracks, and is either paved or covered in a compacted gravel surface. The project site includes expansion on both the east side and west side of the existing Hayward Yard. The west side expansion consists of three properties covering approximately 28 acres. The east side expansion consists of an undeveloped, but highly disturbed approximately 13-acre area, characterized by flat topography, ruderal (weedy) vegetation, and a variety of fruit-bearing trees. Industrial uses, warehouses, residences (in structures of one to two stories), and UPRR tracks characterize the project area.

Discussion

a, b. **No Impact.** There are no identified scenic vistas, resources, or scenic highways in the project area.[10,11] The project site is currently within an urbanized and built-up area along the existing UPRR rail line and is surrounded by industrial uses to the west and the UPRR rail line and residences to the east. Immediate views in the project area are limited because of the flat terrain and the number of mature trees, industrial and residential buildings, and sound walls surrounding the site. Available views from the project site are largely close-up and reflect the urban and industrial character of the surroundings, which do not include scenic resources, such

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[10] California Department of Transportation, Officially Designated Scenic Highways, Alameda County, http://www.dot.ca.gov/hq/LandArch/scenic_highways/index.htm, accessed October 29, 2009.

[11] City of Hayward, *City of Hayward General Plan*, adopted March 12, 2002, amended June 27, 2006. Chapter 6: Community Facilities and Amenities, p. 6-18.

as significant landforms, rock outcroppings, historic resources, or architecturally or visually distinctive buildings. Some long-range views of hills beyond the residences to the east are available from within the project site; however, there are no scenic vistas in the project vicinity. There are no highways or freeways adjacent to the project area, only local roadways. No roadways adjacent to the project area or in the vicinity are designated scenic routes or state scenic highways. Therefore, the proposed project would have no impact on scenic vistas or scenic resources.

c. **Less than Significant with Mitigation Incorporated.** The west side expansion area contains four industrial buildings, and an undeveloped parcel containing ruderal (weedy) vegetation and surrounded by ornamental trees and shrubs. The east side expansion area also contains ruderal vegetation and a variety of fruit-bearing trees, which are likely associated with a former orchard at the proposed storage track portion of the site. The project area is characterized by flat topography and urbanized land surrounding the existing Hayward Yard and along the UPRR tracks. Surrounding uses include the UPRR tracks and industrial businesses to the west, residential uses to the east, and a golf driving range to the north. Views from the Hayward Yard toward the San Francisco Bay are blocked by the existing industrial buildings and mature trees in the west side expansion area.

Single-family residential neighborhoods are located east of the project site on the opposite side of the UPRR rail line (see Figure 3). The Fairway Park neighborhood in the City of Hayward is east of the project site, north of Whipple Road. Residences front onto Carroll Avenue to the east with backyards and fencing that abut the UPRR to the west. Many of these one- and two-story residences that abut the UPRR rail line are screened from the project site by backyard fencing. Since the area is generally flat, these structures on the west side of Carroll Avenue block views of the project site from residents to the east. Union City extends north of Whipple Road east of the UPRR tracks and includes single-family homes on Edna Court, Fay Court, Ithaca Street, Kathy Court, Marge Court, and Wendy Court.

The City of Union City Decoto neighborhood is south of Whipple Road in the area proposed for track modifications. The portion of the neighborhood between the BART mainline and the eastern UPRR tracks consists of two-story single-family residences. Whipple Road borders this neighborhood to the north, Railroad Avenue and the UPRR rail line to the east, and the south end of the project trackwork borders this neighborhood to the west. A sound wall separates the residential structures from the BART tracks.

Operations. Permanent changes in the appearance of the project site and vicinity would result from redevelopment of the existing industrial buildings in the west side expansion under Phase 1 of the project. The project would demolish one of the industrial buildings and redevelop the site with a new building in a modified configuration. The project would also raise the roof of two of the existing industrial buildings by approximately 10 feet. All other buildings would be retrofitted without major modifications to the existing roof, columns, or walls to the degree possible. Permanent changes would also result from construction of an outdoor storage area in the undeveloped parcel in the west side expansion area. Existing views of the area around the project site include industrial buildings to the west, and the existing Hayward Yard to the east. These views would not be adversely affected by the proposed building modifications and development of the undeveloped parcel at the west side expansion area.

Phase 1 of the project would also include improvements to the existing vehicle inspection area on the east side of the existing yard near the Whipple Road gate. Permanent changes in the appearance of the project site would result from expansion of the existing shed from a single-bay structure to a four-bay structure and the addition of unloading ramps. The height of the improved shed structure would be similar in scale to the existing shed. Views of the vehicle inspection area would be consistent with those of the existing uses at the Hayward Yard. The improvements within the vehicle inspection would not alter the visual appearance of the area substantially since the site already contains rail lines and maintenance structures. The existing views are not considered high quality in that they generally include the existing Hayward Yard and the industrial and warehouse buildings to the west. These views would not be adversely affected by the proposed improvements at the vehicle inspection area.

Permanent changes under Phase 2 would result from changes for the storage track area in the east side expansion area. The currently undeveloped 13-acre expansion area would be converted from ruderal vegetation and fruit-bearing trees to transportation-related uses, similar to the existing yard to the west. The east side expansion would include a new internal access road, storage tracks, a car cleaner facility for car interiors, restrooms, and a traction power substation. Generally, the buildings would be pre-engineered steel with concrete or masonry panels. Building heights would be no taller than one story. The mass and heights of these buildings would be smaller in scale than the existing maintenance yard buildings within the project area. The storage tracks would be generally the same elevation as the houses to the east, although as the grade declines gradually toward the north and the wetland area, the storage track area would be filled to maintain a steady gradient for the tracks, which would raise them somewhat in relationship to the residences to the east. Views of the maintenance yard expansion area would be similar to those of the existing uses at the Hayward Yard, and the structures and features of the new expansion area would be visually compatible and similar to the existing yard facilities. The addition of tracks would not alter the visual appearance of the area substantially since the site already contains rail lines and maintenance structures. In addition, the existing views are not considered high quality in that they generally include the existing Hayward Yard and the industrial and warehouse buildings to the west.

Mitigation Measure NO-1 of this document would require the construction of sound walls along the east side of the BART mainline tracks south of Whipple Road to mitigate potential noise impacts. In each area where noise impacts are predicted, BART would install a new sound wall between the BART tracks and the existing sound wall along the properties east of the BART tracks. While the precise design of the wall has not been delineated, the tops of the new sound walls would be between one and four feet higher than the existing wall to the east, and would be constructed approximately 5 feet west of the existing sound wall to allow for maintenance access.

Under Phase 1, two sound walls would be constructed (see Figures 13 and 14 in Section 12, Noise and Vibration). The first sound wall (SW01) would be near the residents at 11th Street and Boyle Street, and the top of the wall would be approximately 4 feet higher than the existing 9-foot sound wall. This increase in height would not result in a substantial change in the visual character of the area, since the visual character and views are already defined in part by existing sound walls. In addition, the proposed sound wall would not result in visual encroachment on the residents since they are currently separated from the existing sound wall by a roadway and the new sound wall would be constructed farther from the residents than the existing sound walls.

The second sound wall to be constructed under Phase 1 (SW02) would be for residents near Alicante Terrace and Carrara Terrace. The top of this wall would be approximately one to two feet higher than the existing 7-foot sound wall and, consequently, would not result in a substantial change in the visual character of the area. The existing sound walls in this area are very close to the residents (in some areas, only a few feet separate the sound walls from the homes). Construction of a new sound wall to protect residents from noise impacts could create a feeling of visual encroachment for these residents. However, because the new sound wall would be built west of the existing walls (and thereby allowing some physical separation, or distance, from the residences) and the height of the new wall be no more than two feet higher than the existing wall, the visual encroachment impacts would be considered to be less than significant.

Two additional sound walls are proposed under Phase 2, one north and one south of SW02. Similar to Phase 1, the sound walls under Phase 2 would also be approximately one to two feet higher than the existing 7-foot sound wall and would result in less-than-significant impacts similar to those described above for Phase 1. Therefore, the proposed project's impact on the visual character of the area would be less than significant.

Flyovers. Phase 2 of the project would include two flyovers. Three visual simulations of the southern flyover were prepared from vantage points depicted in Figure 6. These viewpoints are from the nearby visually sensitive residential areas that could be most affected by the new structures. Figure 7 presents the views looking northwest from Whipple Road. Figure 8 and Figure 9 depict views from a residential neighborhood along Carroll Avenue looking southwest and south, respectively. As seen in Figure 8 and Figure 9, the southern flyover would be visible from the east and north and would alter the visual appearance of the area.

Although the flyovers at the north and south ends of the project site would be 28 feet in height, they would not degrade the existing visual character or quality of the site and its surroundings. As seen in Figure 7, the southern flyover would be at approximately the same elevation as the Whipple Road overpass, and would not become a visually significant element because the existing elevation of the BART mainline tracks is below that of the residential areas to the east. The design of the southern flyover would be similar to the design of the northern flyover. Thus, visual simulations of the southern flyover would be representative of the height and mass of the northern flyover. The maximum height of the northern flyover would be the same as the southern flyover and would also be visible from the south. The northern flyover would be

Source: Environmental Data Resources, Inc., 2009; Google Earth, 2009; PBS&J, 2010.

FIGURE **6**

Viewpoint Locations

Existing Conditions

Proposed Conditions

FIGURE **7**

Viewpoint 1 - Southern Flyover from Whipple Road looking Northwest

Source**:** PGH Wong, 2010.

Existing Conditions

Proposed Conditions

Source: PGH Wong, 2010.

FIGURE **8**

Viewpoint 2 - Southern Flyover near Carroll Avenue looking Southwest

Source: PGH Wong, 2010.

FIGURE 9
Viewpoint 3 - Southern Flyover near Carroll Avenue looking South

visible from the east and north, similar to the southern flyover as shown in Figure 8 andFigure 9, and would alter the visual appearance of the area. However, existing views of the project site including both flyover locations are not considered high quality because they generally include the existing Hayward Yard and the industrial and warehouse buildings to the west. Vegetation and topography also limit visibility of the project site from off-site locations. Both flyovers would be consistent with the visual appearance of the existing infrastructure and industrial-like operations of the Hayward Yard and would not noticeably detract from the area's existing visual character, which is not considered to be highly sensitive from a visual perspective (i.e., there are no scenic views, resources, or visual attributes that distinguish the area). Therefore, the impact of the northern and southern flyovers on the visual character of the area would be less than significant.

Construction. Temporary construction activities associated with the proposed project would involve the use of heavy equipment. Construction activities would be easily visible from public roadways, along the active BART line, from trains traveling along the UPRR rail line, and from the backyards of nearby residences. Views of the project construction activities would be temporary. Due to the short-term, temporary nature of construction activities, potential visual effects associated with project construction are considered less than significant.

Construction of the proposed crossover switches south of Whipple Road could require the removal of trees to the west of the BART mainline to provide track access. These trees currently screen views from residents east of the BART mainline toward the existing industrial buildings to the west. The removal of these trees could alter views from the residential area and increase the visibility of the industrial uses to the west; this would be a potentially significant impact of the project.

MITIGATION MEASURE. Mitigation Measure VQ-1 below would reduce potential impacts associated with removal of trees south of Whipple Road during construction to less than significant.

VQ-1 *Replacement of Trees that Screen Views of Industrial Buildings.* If construction activities south of Whipple Road require removal of the existing trees near the industrial buildings west of the BART mainline, BART shall plant replacement trees at a 1:1 ratio in the area of removal, after construction activities are complete.

d. **Less than Significant.** The project area is currently developed with industrial buildings in the west side expansion area, and the existing maintenance yard. The maintenance yard includes storage tracks, maintenance buildings, and the BART mainline tracks. Existing nightlight and glare on the project site are minimal and result primarily from trains along the BART tracks that pass through the site and by trains along the UPRR rail line. Construction of the two flyovers would result in nightlight and glare similar to that contributed by existing BART tracks and passing trains. Existing nightlight and glare in the surrounding area is substantial and is primarily cast by security lighting for the maintenance yard and industrial buildings. Light sources beyond the site include roadway light fixtures along the Whipple Road overpass and vehicle headlights, and other outdoor lighting from nearby industrial and residential uses.

New exterior light associated with the proposed project would be provided on 15- to 18-foot-high poles, which would be shorter than those at the existing Hayward Yard. Shielding to direct the light downward would be provided. Motion detectors would not be used. Existing views in the project vicinity are limited, so that introduction of new lighting from the proposed project would not significantly detract from existing views or be noticeably different than under existing conditions from the current lighting system at the Hayward Yard and west side expansion area. Existing exterior lights are in and around the Hayward Yard on 40-foot-high poles. Thus, the addition of new lighting similar to the existing lighting would not create a significant new source of light and glare. Accordingly, development of the proposed project would have a less-than-significant light and glare impact.

2. AGRICULTURE AND FORESTRY RESOURCES

Would the project:	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less-Than-Significant Impact	No Impact
a. Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?	☐	☐	☐	■
b. Conflict with existing zoning for agricultural use or conflict with a Williamson Act contract?	☐	☐	☐	■
c. Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code section 12220(g)), timberland (as defined by Public Resources Code section 4526), or timberland zoned Timberland Production (as defined by Government Code section 51104(g))?	☐	☐	☐	■
d. Result in the loss of forest land or conversion of forest land to non-forest use?	☐	☐	☐	■
e. Involve other changes in the existing environment that, due to their location or nature, could result in conversion of Farmland to non-agricultural use?	☐	☐	☐	■

Discussion

a-e. **No Impact.** Based on a review of maps and aerial photographs of the project area and site visits by PBS&J, both the west side and east side expansions are not on or in the vicinity of farmland, agriculturally active land, or forestry land. According to the State Department of Conservation Farmland Mapping and Monitoring Program map,[12] the project site, including the west side and east side expansion areas, is designated as Urban/Built-Up land. The project site

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[12] California Department of Conservation, Farmland Mapping and Monitoring Program, 2008 data. ftp://ftp.consrv.ca.gov/pub/dlrp/FMMP/pdf/2008/ala08.pdf, accessed August 10, 2010.

and the area south of Whipple Road where track modifications are proposed are designated in the Hayward and Union City General Plans, respectively, as industrial and are zoned for industrial uses, which do not provide for agricultural-related or forestry-related activities.[13] The project site is not on land that is currently under a Williamson Act contract.[14] Therefore, the proposed project, including both Phase 1 and 2, would have no impact on agricultural or forestry resources.

3. AIR QUALITY

Would the project:	**Potentially Significant Impact**	**Less Than Significant With Mitigation Incorporated**	**Less-Than-Significant Impact**	**No Impact**
a. Conflict with or obstruct implementation of the applicable air quality plan?	☐	■	☐	☐
b. Violate any air quality standard or contribute substantially to an existing or projected air quality violation?	☐	■	☐	☐
c. Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is a non- attainment area for an applicable federal or state ambient air quality standard (including releasing emissions that exceed quantitative thresholds for ozone precursors)?	☐	■	☐	☐
d. Expose sensitive receptors to substantial pollutant concentrations?	☐	■	☐	☐
e. Create objectionable odors affecting a substantial number of people?	☐	☐	■	☐

Background

The proposed project is within the jurisdiction of the Bay Area Air Quality Management District (BAAQMD), a state agency charged with implementing state and federal air quality standards in the San Francisco Bay Area. The BAAQMD adopted the Bay Area 1991 Clean Air Plan to implement the requirements of the California Clean Air Act of 1988, and has since then, updated and adopted the 2000 Clean Air Plan.

With the assistance of BAAQMD, the California Air Resources Board (CARB) compiles inventories and projections of emissions of major pollutants. Air quality conditions are reported in the San Francisco Bay Area for both "criteria air pollutants" and "toxic air contaminants." Criteria air pollutants refer to a group of pollutants for which regulatory agencies have adopted ambient air quality standards and pollution reduction plans. Criteria air pollutants include ozone, carbon monoxide (CO),

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[13] Pursuant to California Government Code Section 53090, as a rapid transit district, BART is exempt from local land use policies, plans, and zoning ordinances. BART nevertheless provides information concerning local zoning for informational purposes.

[14] California Department of Conservation, Williamson Act Program, ftp://ftp.consrv.ca.gov/pub/dlrp/wa/Map%20 and%20PDF/Alameda/AlamedaWA_08_09.pdf, accessed October 14, 2009.

nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter (PM_{10} and $PM_{2.5}$), and lead. Reactive organic gases (ROG) and nitrogen oxides (NO_x) are regulated pollutants, because they are precursors to ozone formation. Two subsets of particulate matter are regulated as inhalable particulate matter less than ten microns in diameter (PM_{10}) and particulate matter less than 2.5 microns in diameter ($PM_{2.5}$). Toxic air contaminants (TACs) is a general term for a diverse group of air pollutants that can adversely affect human health, but have not had ambient air quality standards established for them. They are not fundamentally different from the pollutants discussed above, but lack ambient air quality standards for a variety of reasons (e.g., insufficient data on toxicity, association with particular workplace exposures rather than general environmental exposure, etc.). The health effects of TACs can result from either acute (severe exposure and rapid absorption) or chronic (prolonged or repeated exposures over many days, months or years) exposure; many types of cancer are associated with chronic TAC exposures.

The United States Environmental Protection Agency (USEPA) has designated the San Francisco Bay Area Air Basin (SFBAAB), which includes the project site, as nonattainment for the federal 8-hour ozone standard and the 24-hour $PM_{2.5}$ standard, meaning that the Bay Area does not meet the air quality standards for these air pollutants. The USEPA has designated the SFBAAB as unclassified for PM_{10}, and as in attainment of the federal CO, NO_X, and SO_X standards. The State has designated the SFBAAB as serious nonattainment of the State ozone standard and nonattainment of the State PM_{10} and $PM_{2.5}$ standards. The SFBAAB has also been designated as being in attainment of the State CO, NO_X, and SO_X standards. These designations are based on the latest amendments to the state and federal ambient air quality standards.

BAAQMD has adopted a number of air quality plans, and rules and regulations as needed to achieve the federal and State air quality standards and meet other air quality obligations. On November 16, 2005, BAAQMD adopted its Particulate Matter Implementation Schedule, pursuant to California Senate Bill 656, to implement further feasible measures to control emissions of particulate matter. On January 4, 2006, BAAQMD adopted the 2005 Ozone Strategy to identify further steps needed to continue reducing the public's exposure to unhealthy levels of ozone. On September 15, 2010, BAAQMD adopted its 2010 Clean Air Plan (2010 CAP). According to BAAQMD, the 2010 CAP is intended to:

- Update the Bay Area 2005 Ozone Strategy in accordance with the requirements of the California Clean Air Act to implement "all feasible measures" to reduce ozone;
- Provide a control strategy to reduce ozone, particulate matter (PM), air toxics, and greenhouse gases in a single, integrated plan;
- Review progress in improving air quality in recent years; and
- Establish emission control measures to be adopted or implemented in the 2010-2012 timeframe.

The methodologies and thresholds of significance included in the BAAQMD's *CEQA Guidelines* are intended to assist local jurisdictions and agencies in the evaluation of air quality impacts under CEQA. The BAAQMD recently revised its *CEQA Guidelines* with new thresholds of significance for both construction and operational emissions of criteria air pollutants and ozone precursors, as shown in Table 2 below.

Table 2
BAAQMD CEQA Air Pollutant Thresholds of Significance

Air Pollutant	Construction Phase (lbs/day)	Operational Phase Average Daily (lbs)/Maximum Annual (tons)
ROG	54	54/10
NOx	54	54/10
PM_{10}	82*	82/15
$PM_{2.5}$	54*	54/10

Source: BAAQMD CEQA Guidelines, 2010.
Notes:
* Construction equipment exhaust only.

Land uses such as schools, hospitals, and convalescent homes are considered to be sensitive receptors to poor air quality because the very young, the old, and the infirm are more susceptible to respiratory infections and other air quality-related health problems than the general public. Residential uses are also considered sensitive because people in residential areas are often at home, and therefore exposed to pollutants, for extended periods of time. Recreational areas are considered moderately sensitive to poor air quality because vigorous exercise associated with recreation places a high demand on the human respiratory function. The project site is zoned for mixed industrial; however, to the north, northeast, and east of the project site, there are single-family residential neighborhoods and four schools within one-quarter mile, Bidwell, Hillview Crest, Treeview, and Our Lady of the Rosary.

Discussion

a-d. **Less than Significant with Mitigation Incorporated.** The following discussion addresses the increase in air emissions associated with the proposed project (both Phases 1 and 2) and the potential to affect sensitive receptors. Emissions during operations and construction are different and thus are presented separately.

Operational Emissions. Operation of the Hayward Yard occurs 24 hours a day. When trains assigned to this maintenance yard are not in use on the BART system, they are stored at the facility. The proposed project would increase the maintenance activities at the site under Phase 1, and would increase the yard's onsite train storage capacity and the interior cleaning activities on the trains stored there during Phase 2. Current operations at the Hayward Yard do not involve the use of equipment that emits substantial amounts of air pollutants (e.g., portable diesel powered equipment like generators, power washers, etc.); all the equipment used for train maintenance work is electrically powered. Although washing and other maintenance activities would increase with project implementation, the yard's reliance on electrically powered equipment for this maintenance work would continue. Thus, there would be no increase in air pollutant emissions from onsite use of portable powered equipment. Also, since the BART trains are electrically powered, the increased activity of trains moving into, out of or within the yard would not generate additional air pollutant emissions locally.

The work force assigned to the Hayward Maintenance Complex would be approximately 350 daily employees. However, a portion of these employees (135 employees) would be BART employees who currently work at the existing Hayward Yard. Therefore, the net increase in employment at the Hayward site would be 215 employees. The project would also include a programmed station stop at the site to allow employees to ride BART to the site. An estimated 20 percent of employees at the Hayward Yard would use BART with this programmed stop. As discussed in Section 16, Transportation/Traffic, under existing conditions, the BART Hayward Yard and the existing industrial uses in the west side expansion area generate approximately 1,436 daily trips. With implementation of the proposed project, trips to the project site associated with the existing Hayward Yard and proposed Hayward Maintenance Complex would be approximately 1,122 daily trips (a net decrease of 314 daily trips from existing conditions). Therefore, with implementation of the project, there would be a decrease in air pollutant emissions from worker motor vehicles. Therefore, the proposed project would not have significant operational air pollutant emissions.

Since project operational emissions are expected to decrease compared to existing baseline conditions, project operations would not have a significant impact on air quality, either individually or cumulatively. In addition, because the project would not generate significant air emissions, the project would also not conflict with or obstruct implementation of the air quality plans designed to bring the region into attainment.

Construction Emissions. The proposed project would generate short-term air emissions associated with construction activities. Construction of Phase 1 is scheduled to last approximately 36 months. Construction would require the use of standard heavy construction equipment, including bulldozers, loaders, and trucks for demolition and construction or retrofit of the industrial buildings on the west side. Demolition of the warehouse at the Overhaul Shop site would require removal of debris with an estimated 500 truckloads. New material for construction of the Overhaul Shop is estimated to generate up to 500 truckloads over the 1-year construction duration. Also, during the initial construction stages, the undeveloped parcel on site would be cleared, grubbed, and graded to accommodate the proposed outdoor storage area. This would require the export of about 3,800 cubic yards, for an average of 53 truck-loads a day over a 3-month period. The construction equipment and the trucks used to haul the fill during Phase 1 would emit ROG, NO_X, $PM_{10,}$ and $PM_{2.5}$.

The project's construction-related air pollutant emissions were estimated using the URBEMIS model initialized with construction activity and phasing data provided by BART. Construction emissions of ROG, NO_X, PM_{10}, and $PM_{2.5}$ for Phase 1 and Phase 2 are shown in Table 3 below. ROG, PM_{10}, and $PM_{2.5}$ for each activity area are well below the BAAQMD significance thresholds; however, there is the potential for exceedance of the NO_X threshold depending on the phasing of construction activities. For Phase 1, even if the clearing, grubbing, and grading were to occur simultaneously with the building construction, NO_X emissions would not exceed the BAAQMD's threshold of 54 pounds per day. Therefore, Phase 1 would not have the potential to exceed any BAAQMD threshold. However, there would be a potential for an exceedance of the NO_X threshold if the clearing, grubbing, grading, and fill transport activities planned for Phase 2 are conducted simultaneously with other project construction activities. Without precautionary restrictions on construction phasing, the air quality impact from construction emissions of NO_X would be potentially significant.

Table 3
Air Pollutant Emissions from Project Construction Activities (lbs/day)

Construction Phase/Activity	ROG	NOx	PM_{10}	$PM_{2.5}$
Phase 1: West Side Expansion				
Clearing, Grubbing, Grading, and Fill Transport	3.0	25.5	1.3	1.2
Building Construction	4.5	26.0	1.5	1.4
Phase 2: East Side Expansion				
Clearing, Grubbing, Grading, and Fill Transport	4.6	50.4	2.2	2.0
Underground Infrastructure and Above-ground Facilities	5.6	36.3	1.9	1.8
Switches and Crossovers	3.0	25.1	1.3	1.2

Source: PBS&J, 2010.

PM_{10} and $PM_{2.5}$ would also be generated from soil-disturbing activities. These dust emissions could impact sensitive residential receptors to the north, northeast, and east of the project site by increasing local ambient PM_{10} concentrations there. For construction-phase impacts, the BAAQMD recommends that impact significance be determined based on a commitment to implement effective dust control measures. Thus, with such controls, fugitive dust emitted during project construction phases would not have a potentially significant impact.

MITIGATION MEASURES. BART shall implement the following recommended measures to reduce air pollutant emissions during project construction.

AQ-1 *Construction Phasing to Reduce Air Emissions.* For construction of the storage tracks in Phase 2, BART shall ensure that all work involving clearing, grubbing, grading, and fill transport associated with work on the project site north of Whipple Road not be conducted concurrently with construction work south of Whipple Road to assure that the BAAQMD NO_x construction equipment emission threshold would not be exceeded.

AQ-2 *Dust Control during Construction.* BART shall ensure implementation of the following mitigation measures during project construction, in accordance with Bay Area Air Quality Management District (BAAQMD) standard mitigation requirements:

- All exposed surfaces (e.g., parking areas, staging areas, soil piles, graded areas, and unpaved access roads) shall be watered two times per day, or as necessary to control dust.
- All haul trucks transporting soil, sand, or other loose material off-site shall be covered.

- All visible mud or dirt track-out onto adjacent public roads shall be removed using wet power vacuum street sweepers at least once per day. The use of dry power sweeping is prohibited.
- All vehicle speeds on unpaved roads shall be limited to 15 mph.
- All roadways, driveways, and sidewalks to be paved shall be completed as soon as practical.
- Building pads shall be laid as soon as practical after grading unless seeding or soil binders are used.
- Idling times shall be minimized either by shutting equipment off when not in use or reducing the maximum idling time to 5 minutes (as required by the California airborne toxics control measure Title 13, Section 2485 of California Code of Regulations [CCR]). Clear signage stating the regulations shall be provided for construction workers at all access points.
- All construction equipment shall be maintained and properly tuned in accordance with manufacturer’s specifications. All equipment shall be checked by a certified mechanic and determined to be running in proper condition prior to operation.
- Post a publicly visible sign with the telephone number and person to contact at the Lead Agency regarding dust complaints. This person shall respond and take corrective action within 48 hours. The Air District’s phone number shall also be visible to ensure compliance with applicable regulations.

e. **Less than Significant.** BART trains operating on the project site are electrically run and therefore do not emit odorous exhaust; the only odors from the site would be an occasional exposure to diesel exhaust from trucks accessing the site from public roadways and occasional odors from use of cleaning agents, solvents, and chemicals associated with cleaning and maintenance. The operation of equipment and cleaning of the vehicles can generate localized odors that are typically only noticeable by workers near these sources. Residents and businesses in close proximity to the construction areas may also experience occasional odors from diesel equipment exhaust during construction. This effect would be intermittent, would be contingent on prevailing wind conditions, and occur only during construction activities. Because the generation of odors would be periodic, and because these emissions would not affect a substantial number of people, the impact is considered less than significant during both operations and construction.

4. BIOLOGICAL RESOURCES

Would the project:	**Potentially Significant Impact**	**Less Than Significant With Mitigation Incorporated**	**Less-Than-Significant Impact**	**No Impact**
a. Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?	☐	☐	☐	■
b. Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?	☐	☐	☐	■
c. Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marshes, vernal pools, coastal wetlands, etc.), or wetlands that are waters of the State through direct removal, filling hydrological interruption, or other means?	☐	■	☐	☐
d. Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?	☐	■	☐	☐
e. Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?	☐	■	☐	☐
f. Conflict with the provisions of an adopted habitat conservation plan, natural community conservation plan, or other approved local, regional, or state habitat conservation plan?	☐	☐	☐	■

Background

Field Reconnaissance. A PBS&J biologist visited the project site and vicinity on September 24, 2009 (east side expansion area) and August 4, 2010 (west side expansion area). The purpose of the visits was to determine if any wetlands or potential habitat for special-status plant or wildlife species occur on the site that could pose constraints on the proposed expansion of the BART Hayward Yard. Prior to the site visit, queries of the California Department of Fish and Game's (CDFG) Natural Diversity Database (CNDDB) and the U.S. Fish and Wildlife Service's (USFWS) Online Threatened and Endangered Species Database[15] were conducted to identify those special-status species that have

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[15] U.S. Fish and Wildlife Service. Online Threatened and Endangered Species Database http://sacramento.fws.gov/es/spp_lists/auto_list_form.cfm, accessed October 30, 2009.

potential to occur in the project vicinity. The results of these queries are included in Appendix A of this document. The survey of the site consisted of walking the perimeter of the site, followed by walking representative transects through the site's interior, while recording plant and wildlife species, vegetation communities, and potential wetlands.

The majority of the site is in the City of Hayward with a portion (south of Whipple Road) in Union City, and is surrounded primarily by residential and industrial land uses. The majority of the approximately 28-acre west expansion area consists of existing active warehouses and adjacent parking lots, with a small area of disked ruderal grassland at the south end. Most of this undeveloped, but highly disturbed portion of the west expansion area occurs on the west side of the driveway leading to the warehouses, but a small triangular portion of undeveloped disked ruderal grassland occurs on the east side of the driveway adjacent to the existing BART right-of-way.

The majority of the east side expansion area consists of the existing BART storage/maintenance yard, and is either paved or covered in a compacted gravel surface. The project site consists of an undeveloped, but highly disturbed area characterized as non-native annual grassland with patches of native and non-native woody vegetation. The grassland areas are mostly flat, and are disked on an annual basis, but the patches of woody vegetation are left largely undisturbed. A large depression occurs at the north end of the site, where two patches of willows (*Salix* sp.) are present. The east side project site occurs between BART tracks to the west and UPRR tracks to the east.

Plant species observed during the September 24, 2009 field survey of the east side expansion area included coyote brush (*Baccharis pilularis*), fennel (*Foeniculum vulgare*), coast live oak (*Quercus agrifolia*), almond (*Prunus dulcis*), peach (*Prunus persica*), wild oats (*Avena fatua*), wild radish (*Raphanus sativa*), willow, toyon (*Heteromeles arbutifolia*), wild mustard (*Brassica* spp.), California poppy (*Eschscholzia californica*), and yellow star thistle (*Centaurea solstitialis*). Wildlife species observed included pigeon (*Columba livia*), mourning dove (*Zenaida macroura*), scrub jay (*Aphelocoma coerulescens*), house sparrow (*Passer domesticus*), mule deer (*Odocoileus hemionus*), and western fence lizard (*Sceloporus occidentalis*).

Two potential wetlands were observed adjacent to the east side expansion area. The first is a short segment of the narrow channel that follows the western edge of the site. While the majority of this channel contains no wetland vegetation or other wetland characteristics and no surface water was present, one portion near the northern end contains cattails (*Typha latifolia*). This area covers approximately 0.01 acre. The second potential wetland is the large depression north of the proposed storage track area. This depression is approximately 1.2 acres. BART's original plans for the expansion area encompassed this large depression. Following the field observations by the PBS&J biologist, BART modified its site plan to exclude this potential wetland from the project site. Additionally, the project design was modified to avoid direct disturbance to the drainage channel along the western edge of the site.

As stated above, the majority of the west side expansion area consists of warehouses and adjacent parking lots. The only vegetation in this portion of the area consists of ornamental landscaping in the planting beds near the warehouse buildings, and include mock orange (*Pittosporum tobira*), oleander (*Nerium oleander*), and English ivy (*Hedera helix*). In addition to the planting beds, a row of coast redwoods (*Sequoia sempervirens*) occurs along the eastern boundary of the west side expansion area, between the existing BART yard, and the warehouses. The southern, undeveloped portion of the west side expansion area appeared to have been mowed and disked at some point within the previous months, but enough portions of the existing plant species were present that they could be identified. Plant species observed during the August 4, 2010 survey of the west side expansion area included coyote brush, fennel, wild oats, prickly oxtongue (*Picris echioides*), prickly lettuce (*Lactuca serriola*), wild radish, salsify (*Tragopogon porrifolius*), California poppy (*Eschscholzia californica*), Bermuda grass (*Cynodon dactylon*), cheeseweed (*Malva parviflora*), and field bindweed (*Convolvulus arvensis*).

Special-Status Species. The potential occurrence of special-status plant and animal species within the project area and surrounding region has been determined through a review of the CNDDB, the USFWS online species list database, and the reconnaissance field surveys by PBS&J.

For the purposes of this section, special-status species include:

- species listed, proposed, or candidate species for listing as Threatened or Endangered by the USFWS pursuant to the Federal Endangered Species Act (FESA) of 1973, as amended;
- species listed as Rare, Threatened, or Endangered by the CDFG pursuant to the California Endangered Species Act (CESA) of 1984, as amended;
- species designated as Fully Protected under Sections 3511 (birds), 4700 (mammals), and 5050 (reptiles and amphibians) of the California Fish and Game Code;
- species designated by the CDFG as California Species of Special Concern;
- plant species listed as Category 1B and 2 by the California Native Plant Society (CNPS); and
- species not currently protected by statute or regulation, but considered rare, threatened, or endangered under CEQA Guidelines Section 15380.

Species identified through the above means, along with their status and likelihood of occurrence in the project area, are listed in Table 4. This list represents those species identified in the review of the CNDDB and USFWS queries having the highest likelihood to occur in the project area (i.e., within the known range, and/or with potential habitat present). Species identified by these sources as potentially occurring in the region, but for which there is no suitable habitat and the project area is outside the known range of the species, are not addressed further. Additionally, species identified in the CDFG and USFWS queries that do not meet the status criteria described above are not addressed in this document. Finally, since no aquatic habitat is present in the project area, no special-status fish species known to occur in the region are addressed in this document.

Table 4
Special Status Species Potentially Occurring in the Project Vicinity

Common Name	Scientific Name	Status[1] Fed/CA/Other	Habitat and Seasonal Distribution in California	Likelihood of Occurrence Within the Project Vicinity[2]
Fragrant fritillary	*Fritillaria liliacea*	none/none/1B.2	Cismontane woodland, coastal prairie, coastal scrub, and valley and foothill grassland habitats often in association with serpentine soils. 3 – 410 m. Blooms February – April.	**Not Likely.** Long-term disking of the project area renders habitat unsuitable.
Diablo helianthella	*Helianthella castanea*	none/none/1B.2	Found in broad-leafed upland forest, chaparral, cismontane woodland, coastal scrub, riparian woodland, and valley and foothill grassland habitats. 60 – 1300 m. Blooms March – June.	**Not Likely.** Long-term disking of the project area renders habitat unsuitable.
Santa Cruz tarplant	*Holocarpha macradenia*	FT/SE/1B.1	Found in coastal prairie, valley and foothill grasslands at elevation ranging from 10-220 m. Blooms from June – Oct.	**Not Likely.** Long-term disking of the project area renders habitat unsuitable.
Most beautiful jewel-flower	*Streptanthus albidus ssp. Peramoenus*	none/none/1B.2	Chaparral, cismontane woodland, valley and foothill grasslands, often on serpentine soils. 110 – 1000 meters. Blooms April – June.	**Not Likely.** Long-term disking of the project area renders habitat unsuitable.
Monarch butterfly	*Danaus plexippus*	Wintering sites protected by CDFG	Eucalyptus groves used as winter roost sites.	**Not Likely.** No suitable habitat in the project area.
California red-legged frog	*Rana aurora draytonii*	FT/CSC/none	Slow-flowing portions of perennial streams, ephemeral streams, and hillside seeps that maintain pool environments (including ponds) or saturated soils throughout the summer months	**Not Likely.** No suitable habitat in the project area.
Alameda whipsnake [=striped racer]	*Masticophis lateralis euryxanthus*	FT/ST/none	Scrub and chaparral habitats in Alameda and Contra Costa counties but may occur in any inner Coast Range plant communities, including grasslands, open woodlands, rocky slopes, and along open streams and arroyos near scrub and chaparral.	**Not Likely.** No suitable habitat in the project area. Project area highly disturbed, and isolated from known occurrences by urban development.
Northern harrier	*Circus cyaneus*	none/CSC/MBTA	Grasslands and open habitats; typically nests on the ground in dense vegetation.	**Moderate.** Could forage in the project area, but no nesting habitat is present due to disking.
White-tailed kite	*Elanus leucurus*	none/CFP/MBTA	Preferred habitat is marshes and waste fields in the Central Valley and coastal plains of California.	**Moderate.** Could forage in the project area, but no nesting habitat is present.
Pallid bat	*Antrozous pallidus*	none/CSC/none	Found in deserts, grasslands, shrublands, woodlands and forests. Roosts in rock crevices, buildings, and bridges in arid regions.	**Moderate.** Could forage in the project area, but no roosting habitat is present.

Table 4
Special Status Species Potentially Occurring in the Project Vicinity

Source: California Department of Fish and Game's Natural Diversity Database (CNDDB), September 7, 2010. United States Fish and Wildlife Service online threatened and endangered species database (http://sacramento.fws.gov/es/spp_lists/auto_list_form.cfm), September 7, 2010

Notes:

Federal

FE	Federally listed as Endangered
FT	Federally listed as Threatened
MBTA	Protected under the Migratory Bird Treaty Act
BCC	USFWS Bird of Conservation Concern

State

SE	State listed as Endangered
ST	State listed as Threatened
SR	State Recovered
CR	California rare
CSC	California Department of Fish and Game designated "Species of Special Concern"

CNPS

1A	Presumed extinct
1B	California Native Plant Society (CNPS) Ranking. Defined as plants that are rare, threatened, or endangered in California and elsewhere.
2	California Native Plant Society (CNPS) Ranking. Defined as plants that are rare, threatened, or endangered in California, but more common elsewhere.
3	Needs more review

CNPS Threat Code Extension

1	Species seriously endangered in California
2	Species fairly endangered in California
3	Species not very endangered in California

2-Likelihood of Occurrence: CDFG Natural Diversity Database (CNDDB) California Natural Diversity Database, 2007.
Likelihood of occurrence evaluations:

- A rating of "known" indicates that the species has been observed on the site.
- A rating of "high" indicates that the species has not been observed, but sufficient information is available to indicate suitable habitat and conditions are present on-site and the species is expected to occur on-site.
- A rating of "moderate" indicates that it is not known if the species is present, but suitable habitat exists on-site.
- A rating of "low" indicates that species was not found during biological surveys conducted to date on the site and may not be expected given the species' known regional distribution or the quality of habitats located on the site.
- A rating of "not likely" indicates that the taxa would not be expected to occur on the project site because the site does not include the known range or does not support suitable habitat.

Regulatory Framework. Applicable state and federal regulations governing biological resources are described below.

Federal Endangered Species Act. The USFWS and the National Marine Fisheries Service (NMFS) implement the Federal Endangered Species Act (FESA; 16 USC 153 et seq.). Projects that would result in take of any federally-listed threatened or endangered species are required to obtain authorization from the USFWS and the NMFS through either Section 7 (interagency consultation) or Section 10(a) (incidental take permit) of FESA, depending on whether the federal government is involved in permitting or funding the project. The authorization process is used to determine if a project would jeopardize the continued existence of a listed species and the mitigation measures required to avoid jeopardizing the species.

Federal Clean Water Act, Section 404. The objective of the Clean Water Act (CWA) is to restore and maintain the chemical, physical, and biological integrity of the nation's waters. Section 301 prohibits the discharge of any pollutant into the nation's waters without a permit, and Section 402 establishes the permit program. Under Section 404 of the CWA, the U.S. Army Corps of Engineers (Corps) has the authority to regulate activities that discharge fill or dredge material into wetlands or other waters of the U.S. The Corps implements the federal policy embodied in Executive Order 11990, which is intended to result in no-net-loss of wetland values or acres.

Federal Clean Water Act, Section 401 and Porter-Cologne Water Quality Control Act. The State Water Resources Control Board (SWRCB) has authority over federally jurisdictional wetlands through Section 401 of the CWA, which requires that an applicant for a Section 404 permit (to discharge dredged or fill material into waters of the United States) obtain certification from the appropriate state agency stating that the fill is consistent with the State's water quality standards. In California, the authority to certify permits is delegated by the SWRCB to the nine regional boards. The San Francisco Bay Regional Water Quality Control Board (SFBRWQCB) is the appointed authority for Section 401 compliance in the project area. A request for certification is submitted to the regional board at the same time that an application is filed with the Corps. Because no Corps permit is valid under the CWA unless "certified" by the state, these boards may effectively veto or add conditions to any Corps permit. In addition, the SWRCB and SFBRWQCB have authority over wetlands that are not federally jurisdictional under the Porter-Cologne Water Quality Control Act, which requires a permit for discharges to "waters of the State."

Migratory Bird Treaty Act (MBTA). The MBTA regulates or prohibits the taking, killing, possession of, or harm of migratory bird species listed in Title 50 Code of Federal Regulations (CFR) Section 10.13. It implements an international treaty for the conservation and management of bird species that migrate through more than one country and is enforced in the United States by the USFWS. Hunting of specific migratory game birds is permitted under the regulations listed in Title 50 CFR 20.

California Endangered Species Act. The CDFG derives its authority from the Fish and Game Code of California, which implements the California Endangered Species Act 1985 (CESA; Fish and Game Code Section 2050 et seq.). CESA prohibits the "take" of listed threatened or endangered species. Take under CESA is restricted to the direct killing of a listed species and does not prohibit indirect harm by way of habitat modification.

Fish and Game Code - Sections 3503, 3503.5, and 3513. Fish and Game Code Section 3503 states that it is unlawful to take, possess, or needlessly destroy the nests or eggs of any bird, except as otherwise provided by this code or any regulation made pursuant thereto. Fish and Game Code Section 3503.5 protects all birds-of-prey (raptors) and their eggs and nests. Section 3513 states that it is unlawful to take or possess any migratory nongame bird as designated in the MBTA. These regulations could require that elements of the proposed project (particularly vegetation removal or construction near nest trees) be reduced or eliminated during critical phases of the nesting cycle unless surveys by a qualified biologist demonstrate that nests, eggs, or nesting birds will not be disturbed, subject to approval by CDFG and/or USFWS.

Fish and Game Code - Sections 3511, 4700, 5050, and 5515. Sections 3511 (birds), 4700 (mammals), 5050 (reptiles and amphibians), and 5515 (fish) of the California Fish and Game Code designate certain species as "fully protected." Fully protected species, or parts thereof, may not be taken or possessed at any time, and no provision of the California Fish and Game Code or any other law may be construed to authorize the issuance of permits of licenses to take any fully protected species. No such permits or licenses heretofore issued may have any force or effect for any such purpose, except that the California Fish and Game Commission may authorize the collecting of such species for necessary scientific research. Legally imported and fully protected species or parts thereof may be possessed under a permit issued by CDFG.

Tree Protection Regulations. California Government Code Section 53090 exempts rapid transit districts such as BART from complying with local land use plans, policies, and zoning ordinances. Nevertheless, this section identifies local policies and standards for the cities of Hayward and Union City governing protection of trees for informational purposes.

City of Hayward Municipal Code, Article 15, Tree Preservation. Article 15 of the City of Hayward's Municipal Code states that: "No person shall remove, destroy, perform cutting of branches over one inch in diameter, or disfigure or cause to be removed or destroyed or disfigured any Protected Tree without having first obtained a permit to do so... All Protected Trees shall require a permit for removal, relocation, cutting or reshaping. All removed or disfigured trees shall also require replacement with like-size, like-kind trees or an equal value tree or trees as determined by the City's Landscape Architect…The replacement trees shall be located on site wherever possible…"

The City's ordinance defines Protected Trees as:

1) Trees having a minimum trunk diameter of eight inches measured 54 inches above the ground. When measuring a multi-trunk tree, the diameters of the largest three trunks shall be added together.
2) Street trees or other required trees such as those required as a condition of approval, Use Permit, or other Zoning requirement, regardless of size.
3) All memorial trees dedicated by an entity recognized by the City, and all specimen trees that define a neighborhood or community.
4) Trees of the following species that have reached a minimum of four inches diameter trunk size:
    a) Big Leaf Maple (*Acer macrophylla*)
    b) California Buckeye (*Aesculus californica*)
    c) Madrone (*Arbutus menziesii*)
    d) Western Dogwood (*Cornus nuttallii*)
    e) California Sycamore (*Platanus racemosa*)
    f) Coast Live Oak (*Quercus agrifolia*)
    g) Canyon Live Oak (*Quercus chrysolepis*)
    h) Blue Oak (*Quercus douglasii*)
    i) Oregon White Oak (*Quercus garryana*)
    j) California Black Oak (*Quercus kelloggii*)

    k) Valley Oak (*Quercus lobata*)
    l) Interior Live Oak (*Quercus wislizenii*)
    m) California Bay (*Umbellularia californica*)

5) A tree or trees of any size planted as a replacement for a Protected Tree. Trees located on a developed single-family residential lot that cannot be further subdivided are exempt unless they have been required or protected as a condition of approval.

<u>City of Union City Tree Ordinance.</u> The City of Union City's tree ordinance (Ordinance #318-89) is intended to provide a comprehensive plan for the design and installation of public trees and to limit the removal of significant trees. Title 12, Chapter 12.16.170 Tree conservation, states that: "The preservation of trees is necessary for the health and welfare of the citizens of the City in order to preserve the scenic beauty, prevent erosion of topsoil, protect against flood hazards and risk of landslides, counteract the pollutants in the air, maintain the climatic balance and decrease wind velocities, contributing greatly to the value of land in the City." This chapter also a states that: "It is unlawful for any person to trim or remove a tree covered by this section without a permit…a condition on which a permit is granted that one or more replacement trees of a species and a size designed by the Public Works Director…"

The City's ordinance defines protected trees as:

a) All trees which have a thirty-five-inch or greater circumference of a trunk, or in the case of multi-trunk trees, a total of seventy inches or more of the circumference of all trunks, where such trees are located on residential property;

b) All trees which have a twelve-inch or greater circumference of any trunk, when removal relates to any transaction for which zoning approval or subdivision approval is required;

c) Any tree that existed at the time of a zoning approval or subdivision approval and was a specific subject of such approval or otherwise covered by paragraph (b) of this subdivision;

d) Any tree that was required to be planted by the terms of a zoning approval or a subdivision approval;

e) All trees which have a twelve-inch or greater circumference of any trunk and are located on a vacant lot or undeveloped property;

f) All trees which have a twelve-inch or greater circumference of any trunk and are located on commercial, office or industrial developed property.

Discussion

a. **No Impact.** Although portions of the project site are undeveloped, they are subject to regular disturbance due to annual disking. As such, the project site does not contain habitat for any of the special-status species known from the region. The portion of the proposed project south of the Whipple Road, where trackwork would be modified, is used extensively for train operations and likewise does not contain habitat. Additionally, both areas are isolated from areas where these and other special-status species are known to occur by rail lines and residential and industrial development. Therefore, it is highly unlikely that any of the special-status species known from the region would occur at the project site, and there would be no impact on these resources from the proposed project under both Phases 1 and 2.

b. **No Impact.** The project site and the trackwork area south of Whipple Road do not contain any riparian habitat or other sensitive natural community identified in local or regional plans, policies, or regulations, or by the CDFG or USFWS. Since none of these resources are present where the proposed project would alter the existing setting under both Phases 1 (west side expansion area) and 2 (east side expansion area), implementation of the proposed project would not result in the loss of any riparian habitat or other sensitive natural communities. Therefore, there would be no impact on these resources.

c. **Less than Significant with Mitigation Incorporated.** No potential waters of the U.S. or waters of the State occur in the west side expansion area, so no impacts on waters of the U.S. or the State would occur as a part of Phase 1 of the project. However, an open ditch is adjacent to the Phase 1 expansion area and would be affected by the proposed project. While this drainage is not federally jurisdictional, if this drainage is identified as a water of the State, an individual WDR or waiver of a WDR from the RWQCB would be required for activity within or alteration of the drainage feature.

Two potential wetlands occur adjacent to the east side expansion area. The first occurs along a narrow, artificial drainage channel that follows the western edge of the site adjacent to the eastern edge of the BART tracks. The majority of this channel contains no wetland vegetation or other wetland characteristics. However, one segment of this potential wetland, covering approximately 0.01 acre, contains wetland vegetation, although no surface water was present. The second potential wetland is the approximately 1.2-acre depression north of the project site. No other federally jurisdictional wetlands or "waters of the State" occur in the project area.

Under current project designs of Phase 2, the drainage channel east of the east side storage area and the approximately 1.2–acre wetland north of the project site would be avoided. However, the project could disturb these wetlands during construction or change the hydrology, water quality, or water quantity in those wetlands after the project's completion, thus resulting in an indirect effect. The loss of wetlands or other waters of the U.S. is a potentially significant impact. Additionally, portions of the drainage channel west of the east side storage area would be piped or otherwise altered. If this drainage is identified as a water of the State, an individual WDR or waiver of a WDR from the RWQCB would be required for activity within or alteration of the drainage feature.

MITIGATION MEASURE. Implementation of the following measure would reduce this impact to a less-than-significant level.

BIO-1 *Wetland Avoidance and Protection.* BART shall ensure that the wetlands adjacent to the east side expansion area of the project site are not affected during construction by installing orange exclusionary fence to alert construction crews that the areas are to be avoided during construction, and through compliance with applicable statewide NPDES general permits.

In addition, BART shall ensure that post installation conditions shall not cause significant changes to the pre-project hydrology, water quality, or water quantity in any wetland or other water of the U.S. that is affected by the project. This shall be accomplished through implementation of Mitigation Measures HYD-1 and HYD-2 from the Hydrology section, *Stormwater Drainage System Design*, and through compliance with applicable statewide NPDES general permits.

d. **Less than Significant with Mitigation Incorporated.** Trees and shrubs found within both the east side and west side expansion areas could provide nesting habitat for a wide variety of native birds. Nesting birds, including raptors, are protected by the California Department of Fish and Game Code 3503, which reads, "It is unlawful to take, possess, or needlessly destroy the nest or eggs of any bird, except as otherwise provided by this code or any regulation made pursuant thereto." Passerines and non-passerine land birds are further protected under the MBTA. As such, the CDFG typically recommends pre-construction surveys for potentially suitable nesting habitat that will be directly (actual removal of trees/vegetation) or indirectly (noise disturbance) impacted by construction-related activities. Implementation of the proposed project (both Phases 1 and 2) would require tree and shrub removal in preparation for project construction and at the potential access point at the industrial property along the west side of the mainline tracks just south of Whipple Road. Tree and shrub removal during the nesting season (March 1 to September 15) could result in the loss of active bird nests. The loss of active nests due to tree and shrub removal is a potentially significant impact.

MITIGATION MEASURES. Mitigation Measures BIO-2 and BIO-3 below, to be implemented by BART, would reduce the proposed project's impact on nesting migratory birds to a less-than-significant level.

BIO-2 *Restrictions on Tree or Shrub Removal to Avoid Nesting Birds*. Tree or shrub removal or pruning shall be avoided from March 1 through September 15, the bird nesting period, to the extent feasible. If no tree or shrub removal or pruning is proposed during the nesting period, no surveys or further mitigation measures are required.

BIO-3 *Pre-construction Nesting Bird Survey and Measures to Reduce Harm to Nesting Birds*. If tree and shrub removal is unavoidable during the nesting season, BART shall hire a qualified biologist to conduct a survey for nesting raptors and other birds covered by the MBTA. BART shall have a qualified biologist conduct nest surveys no more than 30 days prior to any demolition/construction or ground-disturbing activities that are within 500 feet of potential nest trees or suitable nesting habitat (i.e., trees, tule, cattails, grassland). A pre-construction survey report shall be submitted to CDFG that includes, at a minimum: (1) a description of the methodology including dates of field visits, the names of survey personnel with resumes, and a list of references cited and persons contacted; and (2) a map showing the location(s) of any bird nests observed on the project site. If no active nests of MBTA-covered species are identified, then no further mitigation is required.

If active nests of protected bird species are identified in the focused nest surveys, BART will consult with the appropriate regulatory agencies to identify project-level mitigation requirements, based on the agencies' standards and policies as then in effect. Mitigation may include the following, based on current agency standards and policies:

e) BART, in consultation with CDFG, would delay construction in the vicinity of active nest sites during the breeding season (March 1 through September 15) while the nest is occupied with adults and/or young. A qualified biologist would monitor any occupied nest to determine when the nest is no longer used. If the construction cannot be delayed, avoidance measures would include the establishment of a non-disturbance buffer zone around the nest site. The size of the buffer zone would be determined in consultation with the CDFG, but will be a minimum of 100 feet. The buffer zone would be delineated with highly visible temporary construction fencing.

f) No intensive disturbance (e.g., heavy equipment operation associated with construction, or use of cranes) or other project-related activities that could cause nest abandonment or forced fledging would be initiated within the established buffer zone of an active nest between March 1 and September 15.

g) If construction activities are unavoidable within the buffer zone, BART would retain a qualified biologist to monitor the nest site to determine if construction activities are disturbing the adult or young birds. If abandonment occurs, the biologist would consult with CDFG or USFWS (who monitor compliance with the MBTA) for the appropriate salvage measures (e.g., remove abandoned nestlings to an agency approved wildlife care group). BART would be required to fund the full costs of the salvage measures.

h) If fully protected species are found to be nesting near the construction area, their nests would be completely avoided until the birds fledge. Avoidance would include the establishment of a non-disturbance buffer zone of 250 feet, or as determined in consultation with the CDFG.

e. **Less than Significant with Mitigation Incorporated.** As stated previously, pursuant to California Government Code Section 53090, as a rapid transit district, BART is exempt from local land use policies, plans, and zoning ordinances. BART nevertheless provides information concerning local regulations for informational purposes. The City of Hayward's Tree Preservation Ordinance (Municipal Code, Article 15) prohibits the removal of any trees meeting the criteria of protected tree as outlined under the regulatory setting above. Trees present in the east side expansion area consist of non-native ornamental trees, volunteer orchard trees (e.g., almonds, peaches, olives), and a few small coast live oaks. None of these trees are greater than 8 inches diameter at 54 inches above the ground, or are designated as street trees, memorial trees, or replacement trees. The coast live oak is a species listed in Section 10-15.11–4f. However, these individuals are seedling trees that have not yet reached 4 inches in diameter. None of these trees meet the criteria of Protected Tree under the City of Hayward's Tree Preservation Ordinance; therefore, there would be no impact as a result of the proposed project.

Trees in the west side expansion area also include ornamental species in the planting beds adjacent to the existing warehouses, and a row of coast redwoods east of the warehouses (approximately 100 trees), adjacent to the existing BART yard. These coast redwoods range between 6 and 12 inches in diameter at 54 inches above ground, and would be considered protected trees under the City of Hayward's Tree Preservation Ordinance. Some of these trees would be removed when the connecting tracks for the west side are built.

Tree removal could also be required at the potential access point from the industrial property along the west side of the mainline tracks just south of Whipple Road in Union City. Construction access points would not be determined until construction plans are final. Therefore, the number and type of trees that would be removed is not known at this time. Although BART is not legally required to comply with local ordinances, BART considers this impact potentially significant.

MITIGATION MEASURES. Mitigation Measure BIO-4 below, to be implemented by BART, would reduce the proposed project's impact resulting from tree removal to a less-than-significant level.

BIO-4 *Tree Survey and Replacement of Protected Trees to be Removed.* Prior to construction, BART shall retain a certified arborist to survey trees in the project area, including potential access roads and staging areas, to identify and evaluate trees that shall be removed. A report shall be prepared and submitted to BART to document the trees that are to be removed. Mitigation shall be required for impacts to trees designated as "protected trees" in the cities of Hayward or Union City. Replacement trees will be a native tree species. Each removed tree meeting the above classifications will be replaced at a 1:1 ratio. Trees will be planted in locations suitable for the replacement species. Selection of the replacement sites and installation of replacement plantings will be supervised by a qualified botanist. Trees will be replaced as soon as practical after construction is completed. A qualified botanist will monitor newly planted trees at least once a year for 5 years. Each year during that period, any trees that do not survive will be replaced. Any trees planted as remediation for failed plantings will be planted as stipulated here for original plantings, and will be monitored for a period of 5 years following installation.

f. **No Impact**. The project area is not located within the boundaries of any adopted Habitat Conservation Plan (HCP) or Natural Community Conservation Plan (NCCP). The nearest adopted HCPs are the San Francisco Alameda Watershed Habitat Conservation Plan and the East Contra Costa County Habitat Conservation Plan. However, as stated above, the project area is not located within the boundaries of either of these plans. Since the proposed project (including both Phase 1 and 2) is not within the boundaries of any adopted HCP or NCCP, there would be no conflicts with such plans. Therefore, there would be no impact on any adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan.

5. CULTURAL RESOURCES

Would the project:	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less-Than-Significant Impact	No Impact
a. Cause a substantial adverse change in the significance of a historical resource as defined in Section 15064.5?	☐	☐	☐	■
b. Cause a substantial adverse change in the significance of an archaeological resource pursuant to Section 15064.5?	☐	■	☐	☐
c. Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?	☐	☐	☐	■
d. Disturb any human remains, including those interred outside of formal cemeteries?	☐	■	☐	☐

Background

The following analysis was prepared using background information obtained from *Cultural Resources Survey Report for the BART Hayward Maintenance Complex, Hayward, Alameda County, California*.[16]

The San Francisco Bay Area was the most densely populated region in California prior to European contact. The project area is located on the traditional territory of the Ohlone/Costanoan Native American tribe. The San Francisco Bay Area has a long and complex history of Native American habitation that dates to at least 10,000 years ago. From approximately 10,000 to 2,500 years ago, archaeological studies indicate that prehistoric groups employed a generalized mobile forager pattern. Populations are thought to be sparse and highly mobile, and groups moved to new resource catchment areas as old ones became depleted. Movement was seasonal to exploit resources as they became available. Winters were spent in base camps along the coast; during the summer, groups moved to the interior valleys and hills.[17]

Between 2,500 and 1,750 years ago, there were drastic changes in ornamental items and ceremonial systems throughout California. Several new artifact types also entered the archaeological record in the San Francisco Bay Area. Groups are thought to have been semi-sedentary or sedentary.

The next 800 years was a time of dramatic changes in mortuary practices and ornaments. Mobility patterns do not appear to have varied from the preceding period. The beginning of the Upper Middle Period also saw the abandonment of over half the known archaeological sites occupied during previous

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[16] PBS&J. *Cultural Resources Survey Report for the BART Hayward Maintenance Complex*. Hayward, Alameda County, California, August, 2010.

[17] Moratto, M.J., *California Archaeology*. Stanford University Press, Stanford, California. 2004 reprint.

intervals. Many researchers have interpreted this as indicative of a drop in population level. There is a large increase in the amount of sea-otter bone in sites that were still occupied during this period, which may signal an intensification of resource extraction practices. Acorn remained an important resource. The frequency of seeds recovered from midden deposits also increase at some sites.

Between 950-450 years ago, there is an increase in cultural complexity. Populations became more sedentary and many open coastal residential sites were abandoned. There continued to be a heavy reliance on marine resources, but they were exploited from specialized processing and camp sites.

Artifacts that appear during this period include the flanged pipe, banjo effigy ornaments, and bow and arrow technology. The banjo effigy ornaments may be the precursor to the ethnographically documented Kuksu cult, a widespread ceremonial system practiced by various language groups around the San Francisco Bay Area. An important technological breakthrough during this period was the adoption of the bow and arrow.

The region also has a rich history of Spanish, Mexican, and American exploration, settlement, and development. Alameda County takes its name from Alameda Creek. *Alameda* is a Spanish word meaning "place where the poplar trees grow" but can be used to reference any tree-shaded area. In the fall of 1769, Gaspar de Portolá sent out an expedition led by José Francisco de Ortega to find an overland route up to the eastern shore of the newly discovered San Francisco Bay to Point Reyes. In early November 1769, the party crossed Alameda Creek into what would become Alameda County. A second expedition, this one led by Pedro Fages, crossed into the future Alameda County on April 1, 1772, again attempting to find a land route to Point Reyes; this endeavor was successful. No further record of Spanish exploration of Alameda is on record until 1795 when Sergeant Pedro Amador visited southern Alameda County in search of a suitable location to found Mission San Jose.

The modern city of Hayward is located on one of two divisions of Rancho San Lorenzo. The division containing Hayward (and Castro Valley) was awarded to Guillermo Castro in 1841 by Governor Juan B. Alvarado. Castro sold a large tract of land to William Hayward who built a general store and lodging house at present day A and Main Streets. This was located near the intersection of the main roads from Oakland to San Jose and Castro to Livermore Valleys. A settlement grew around these establishments and was initially called Haywards and then later shortened to Hayward.

The area around the settlement had rich soil and plentiful water to support farming and ranching industries. Several farms and ranches were established in the area, most ranging in size from 100 to 500 acres, though a few encompassed 1,000 acres or more.

Railroad development helped urban and agricultural growth in the region. A local rail line was established in 1865 with service between Hayward and Alameda, where trains connected with ferries to San Francisco. The line was bought by the Central Pacific Railroad and by 1869 transcontinental trains began running through Hayward. In 1878 a second railroad began service along the bayshore with a station at Eden Point.

Hayward was incorporated in 1876. At that time, the town plat extended east from the vicinity of present-day Mission Boulevard to Fourth Street; A Street marked Hayward's northern boundary; E

Street and Jackson Street the southern boundary. These boundaries would remain relatively unchanged for the next 30 to 40 years. The 1920s were prosperous for Hayward as the population increased to 5,000 and the city grid was again expanded. By the time the United States entered World War II in 1941, the city's population had grown to 7,000, but was still an agricultural town.

Hayward's population doubled in less than a decade from 1941 to 1950. Housing tracts were built at the periphery of the city limits, which now extended to Tennyson Road to the south and to the Southern Pacific railroad tracks to the west.[18]

John M. Horner purchased 110 acres from Agustin Alviso in 1850, platting a townsite, which he called Union City. Horner named the place after his river steamer, called the *Union*, made in Union City, New Jersey, which he used to haul agricultural produce to San Francisco. Henry C. Smith bought another 465 acres in December 1850 from Alviso and Tomas Pacheco adjacent to Union City, selling lots and founding a town called New Haven. A third town, called Alvarado, was established in 1852 on another 750 acres bought from Alviso, which were adjacent to the first two towns. In March 1853, Alameda County was carved out of parts of Contra Costa and Santa Clara Counties, and New Haven was designated as the first county seat and Alvarado the judicial seat. New Haven, however, soon thereafter seems to have taken the name of Alvarado. Alvarado did not long remain the county seat, as it was moved to San Leandro in 1855. In 1958 there was an amalgamation of Alvarado and the town of Decoto, located a few miles to the east, with the new incorporation taking the old name of Union City.

The early success of Union City and Alvarado in the mid-1850s was due both to their location as a shipping place (Alameda Creek was still navigable to that point) and to the fact that farmers were rapidly settling the Alameda plain to the east. Accompanying flour and sugar mills were erected and the town undoubtedly became both a produce shipping and supply point for a good part of the county. Another extremely important industry that kept the town prosperous was its solar salt industry. The solar salt industry in the area began in 1862, when John Quigley, one of the pioneering salt producers in Alameda County, began operations at Alvarado or Union City.

The Quigley works operated until the 1890s. There was apparently no production at the Quigley works from 1899 to 1907, when the facility was sold to the West Shore Salt Company. This company was disincorporated in 1911 and its plant taken over by the San Francisco Salt Refinery, an affiliate of the Stauffer Chemical Company. Stauffer was in turn taken over by Leslie Salt Company in 1942. Cargill Corporation later acquired the Leslie Salt Company in 1978. The salt industry was a main employer for residents of the old towns of Union City and Alvarado.

After many years of limited development, the environs of old Union City have been urbanizing rapidly in recent years. Many new subdivisions have filled the space formerly occupied by farming.

Discussion

a. **No Impact.** Research performed by the Northwestern Information Center (NWIC) of the California Historical Information System did not indicate the presence of known historical resources recorded within the project site or within a ½-mile radius of the project site and the

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[18] City of Hayward, *City of Hayward General Plan 2002*, amended 2006.

trackwork area south of Whipple Road. Historic maps and aerials of the project site do not indicate historic-era structures within the project Area of Potential Effect (APE) and the pedestrian survey conducted for the project did not encounter any historic-era resources. The APE includes the west side and east side portions of the proposed project.

b. **Less than Significant with Mitigation Incorporated.** The NWIC records search did not identify any prehistoric cultural resources within a ½-mile radius of the project site and the Native American Heritage Commission (NAHC) sacred lands data base has no recorded Native American cultural resources in the project vicinity. A pedestrian archaeological survey conducted for the project on September 24, 2009 and on August 4, 2010 did not identify any prehistoric cultural resources. Sites in the area are often located near natural drainages or consist of mounds; neither landform type is present in the project APE.

It is unlikely that prehistoric cultural resources are located within the project site. The region, however, has a long and rich record of prehistoric use. The absence of surface indicators does not preclude the possibility of buried prehistoric archaeological deposits. If any prehistoric resources are located subsurface within the project area, project-related ground-disturbing activities could potentially cause a significant impact to those resources.

MITIGATION MEASURE. The impacts to any discovered resources would be reduced to a less-than-significant level with implementation of Mitigation Measure CR-1. Mitigation Measure CR-1 ensures that any discovered resources are examined by qualified professionals and appropriate action is taken.

CR-1 *Avoidance of Discovered Cultural Resources and Measures to Reduce Harm.* If evidence of an archaeological site or other suspected historic resource is encountered during construction, including darkened soil representing past human activity ("midden") that could conceal material remains (e.g., worked stone, faunal bone, hearths, or storage pit), all ground-disturbing activity within 100 feet of the find shall be halted and BART notified. BART will hire an archaeologist meeting the Secretary of the Interior's Standards for Professional Archaeologist to assess the find. Impacts to any significant resources may be mitigated through avoidance, data recovery, or other methods determined adequate by the qualified archaeologist and that are consistent with the Secretary of the Interior's Standards for Archeological Documentation. Any mitigation plan developed by the qualified archaeologist shall be approved by BART prior to implementation. Project-related ground-disturbing activities shall not be continued in the vicinity of any discovered resource until the significance of the resource is resolved and mitigation action (if any) is completed.

c. **No Impact.** Paleontological resources are non-renewable fossilized evidence of previous animal and plant life found in the geologic record. This evidence contains the remains or traces of the past life that has existed during the 600 million year geological history of the San

Francisco Bay region. A review of the geologic map of the San Francisco Bay Region[19] indicates the region is underlain by Holocene alluvium in the northern portion of the project area and Pleistocene alluvium in the southern end of the project area. Both formations have a low potential to contain significant paleontological resources. Accordingly, the proposed project (Phases 1 and 2) would not be expected to affect significant paleontological resources.

d. **Less than Significant with Mitigation Incorporated.** The NWIC records search did not identify any prehistoric cultural resources within a ½-mile radius of the project site (and the trackwork area south of Whipple Road) and the NAHC sacred lands database has no record of cemeteries or other sacred lands in the project vicinity. The pedestrian survey did not identify any evidence of prehistoric activity within the project area.

Nonetheless, during certain intervals in prehistory, Native American groups placed burials distant from residential areas. These types of sites have only been encountered in the last 25 years with modern development spreading to increasingly remote areas. It is unlikely that human remains are present within the project APE, but the absence of surface indicators does not preclude the possibility of buried human remains being present. It is therefore possible that project-related ground-disturbing activities (in both the west side and east side portions of the project) could disturb or destroy any human remains that are present within the project area, causing a significant impact.

MITIGATION MEASURE. The impacts due to the discovery of human remains would be reduced to a less-than-significant level with implementation of Mitigation Measure CR-2. Mitigation Measure CR-2 ensures that the NAHC be notified, that potential human remains are examined by qualified professionals, and that appropriate action is taken.

CR-2 *Avoidance of Discovered Human Remains and Measures to Reduce Harm.* If human remains, including disarticulated or cremated remains, are discovered during any phase of construction, all ground-disturbing activities in the vicinity and any nearby area reasonably suspected to overlie adjacent human remains shall be immediately halted. BART and the Alameda County Coroner shall be notified immediately, according to Section 5097.98 of the State Public Resources Code and Section 7050.05 of California's Health and Safety Code. If the remains are determined by the county coroner to be Native American, it is the responsibility of the county coroner to inform the Native American Heritage Commission (NAHC) within 24 hours. The guidelines of the NAHC should be adhered to in the treatment and disposition of the remains. BART shall retain a qualified archaeologist who meets the Secretary of the Interior's Standards for Professional Archaeologist and with Native American burial experience to conduct a field investigation of the specific site and consult with the person identified as the Most Likely Descendent, if any, identified by the NAHC. BART shall approve any mitigation recommended by the qualified archaeologist prior to implementation, taking account of the provisions of State law as set forth in the California Environmental Quality Act

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[19] R.W. Graymer, B.C. Moring, G.J. Saucedo, C.M. Wentworth, E.E. Brabb, and K.L. Knudsen, *Geologic Map of the San Francisco Bay Region*. 2006.

(CEQA) Guidelines Section 15064.5(e) and Public Resources Code Section 5097.98. Approved mitigation must be implemented before resumption of ground-disturbing activities in the vicinity of where the remains were discovered.

6. GEOLOGY AND SOILS

Would the project:	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less-Than-Significant Impact	No Impact
a. Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:				
i. Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.	☐	☐	☐	■
ii. Strong seismic groundshaking?	☐	☐	■	☐
iii. Seismic-related ground failure, including liquefaction?	☐	☐	■	☐
iv. Landslides?	☐	☐	☐	■
b. Result in substantial soil erosion or the loss of topsoil?	☐	☐	■	☐
c. Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?	☐	☐	■	☐
d. Be located on expansive soil, as defined in Table 18-1-B of the California Building Code (1998), creating substantial risks to life or property?	☐	☐	■	☐
e. Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water?	☐	☐	☐	■

Discussion

a.(i) **No Impact.** The project site is not within an Alquist-Priolo Earthquake Fault Zone.[20] The closest active fault is the southern segment of the Hayward Fault, approximately 3,000 feet (0.57 mile) east of the project site. Consequently, the proposed buildings and facilities

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[20] California Department of Conservation, California Geological Survey, Alquist-Priolo Earthquake Fault Zones, Table 4, Cities and Counties Affected by Alquist-Priolo Earthquake Fault Zones as of May 1, 1999, updated from the 1997 edition of Special Publication 42 (Fault Rupture Hazard Zones in California, by Earl W. Hart and William A. Bryant), http://www.conservation.ca.gov/cgs/rghm/ap/Pages/affected.aspx,

included under the west side and east side expansion areas are not expected to expose people or structures to adverse effects caused by the rupture of a known fault. There would be no impact associated with fault rupture.

a.(ii) **Less than Significant.** Studies by the United States Geological Survey (USGS) indicate that there is a 62 percent probability of a major, damaging earthquake occurring in the Bay Area between 2002 and 2031. Although there are numerous regional faults, including the San Andreas fault, that could cause such an earthquake that could affect the project site, USGS considers the most hazardous fault system in the Bay Area to be the Hayward-Rogers Creek fault.[21] The southern Hayward fault ruptured in a magnitude (M) 6.8 earthquake in 1868 and caused extensive damage to man-made structures in downtown Hayward, and there is a 27 percent likelihood of a magnitude 6.7 or greater earthquake on the southern segment of the Hayward fault in the next 30 years. Under the Association of Bay Area Government's (ABAG's) planning scenario, such an event could result in Modified Mercalli Intensity (MMI) shaking ranging from VIII (very strong) to X (very violent).[22] MMI VIII is characterized by damage to engineered structures, and MMI X is characterized by serious damage and destruction.

Although there is a potential for strong seismic groundshaking (and possible ground failure – see Item a.(iii) below) to occur at the site, the risk of excessive permanent damage would be reduced because the new buildings and facilities proposed under the Phase 1 and Phase 2 expansion would comply with seismic safety standards per BART Facilities Standards. The general design policy of BART Facilities Standards Structural Criteria for Seismic Design incorporates the relevant seismic safety provisions of the California Building Code (CBC) and the California Department of Transportation Bridge Design Specifications (CBDS) along with other professional industry standards. BART Design Criteria requires that all operating facilities be designed to withstand the effects of the Maximum Credible Earthquake without significant degradation of structural integrity.

Consequently, the proposed project is not expected to expose people or structures to risks associated with strong groundshaking that could not be mitigated through standard engineering design. The impact would be less than significant.

a.(iii) **Less than Significant.** The project site is in an active seismic region with potential for strong groundshaking that could cause liquefaction. According to California Geological Survey (CGS) mapping under the Seismic Hazards Zone mapping program (Newark Quadrangle, July 2003),[23] there is a small area in the northernmost part of the project site that requires special study for liquefaction hazard. Under the Seismic Hazards Mapping Act, appropriate site-

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[21] Working Group on California Earthquake Probabilities, *Earthquake Probabilities in the San Francisco Bay Region: 2002 to 2031*, United States Geological Survey Open File Report 03-214, 2003, Chapter 1, page 1, Chapter 7, page 4.

[22] Association of Bay Area Governments (ABAG), ABAG Earthquake Protection Program, ABAG Earthquake Shaking Scenario: south Hayward earthquake – magnitude 6.7. Available at http://quake.abag.ca.gov. Accessed November 2, 2009.

[23] California Geological Survey, *Seismic Hazard Zone Report of the Newark 7.5-Minute Quadrangle*, Alameda County, California, CGS Seismic Hazard Zone Report 090.

specific geologic or geotechnical investigations must be performed, and measures to reduce potential damage have been incorporated into project design. Compliance with this requirement would be demonstrated through implementation of the general design policy of BART Facilities Standards Structural Criteria for Seismic Design.

In locations susceptible to liquefaction, the primary hazards are seismic induced settlement and temporary increase in lateral earth pressures on below-grade structures. Methods used on recent BART projects include in-situ treatment/densification with vibro-replacement stone columns; load transfer to underlying bearing layers, which are non-liquefiable with soil/cement columns; and the overexcavation method via removal and replacement with compacted engineered fill. Methods considered to eliminate or minimize the effects of seismic liquefaction include, but are not limited to, in-situ densification with stone columns, dynamic compaction, vibro-compaction, surcharging, and/or compaction grouting. The exact methodologies to be used will be determined during final engineering. These design requirements would reduce the potential exposure of people to hazard from seismic risk associated with liquefaction.

Lateral spreading involves the lateral displacement of surficial blocks of sediment (e.g., alluvium) as a result of liquefaction in a subsurface layer. The surficial mass moves toward an unconfined area, such as a descending slope, and can occur on slope gradients as gentle as one degree.[24] Given the potential for liquefaction in at least a portion of the site, lateral spreading is a potential hazard that would require site-specific evaluation and mitigation if any deep excavations are constructed.

Prior to final design of the project, a site-specific geotechnical study would be prepared to identify site-specific liquefaction and lateral spreading hazard mitigation, which would be implemented pursuant to the BART Facilities Standards. Consequently, the new buildings and facilities proposed under the west side and east side expansion are not expected to expose people or structures to seismic-related ground failure associated with liquefaction or lateral spreading. The impact would be less than significant.

a.(iv) **No Impact.** The project site is located in a flat area, and is not identified by the CGS as a seismically induced landslide hazard zone requiring special study.[25] Consequently, the proposed project (both west side and east side expansion) would not expose people or structures to landslides, and there would be no impact associated with landslide risk.

b. **Less than Significant.** Construction activity anticipated for the project components would temporarily cause soil disturbance that could be subject to wind or water erosion. Section 1.08 – Erosion and Sediment Control – of the BART Facilities Standards Standard Specifications (Section 01-57-00, Temporary Controls) identifies specific methods that would be used to

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[24] Youd, T., et. al., “Mapping liquefaction induced ground failure potential”, in Proceedings of American Society of Civil Engineers, Journal of the Geotechnical Engineering Division, 1978; Tinsley, J., et.al., Evaluating Liquefaction Potential. In *Evaluating Earthquake Hazards in the Los Angeles Region—an Earth Science Perspective*, USGS Professional Paper 1360, 1985, p. 263-315.

[25] California Geological Survey, *Seismic Hazard Zone Report of the Newark 7.5-Minute Quadrangle*, Alameda County, California, CGS Seismic Hazard Zone Report 090.

prevent erosion of excavated areas, embankments, stockpiled earth materials, and other erodible construction areas. To minimize erosion potential and to protect construction workers from potential hazards associated with excavations, BART Facilities Standards Standard Specifications require excavations to be shored (Section 31-50-00, Excavation Support and Protection). In accordance with BART Facilities Standards Standard Specifications (Section 31-00-00, Earthwork), any salvaged topsoil from stripped and excavated areas would be stockpiled on the site at appropriate locations and protected to prevent contamination by other materials. Stockpiled topsoil would be placed in areas to be landscaped. With implementation of these specifications, there would be no substantial soil erosion or loss of topsoil, and impacts of the proposed project under Phases 1 and 2 would be less than significant.

c. **Less than Significant.** See Item a.(iii), above, regarding lateral spreading and liquefaction. The project site is underlain by Quaternary alluvium (Qal), soils, and artificial fill. Sandy portions of the subsurface materials (alluvium, fill) could be subject to compression, causing settlement. Settlement occurs in areas prone to different rates of ground surface sinking and densification (differential compaction), and are underlain by sediments that differ laterally in composition or degree of existing compaction. Differential settlement can damage structures and other subsurface features. Strong groundshaking can also cause soil settlement by vibrating sediment particles into more tightly compacted configurations, thereby reducing pore space. Unconsolidated, loosely packed alluvial deposits and sand are especially susceptible to this phenomenon. Poorly compacted artificial fills may experience seismically induced settlement. BART Facilities Standards Facility Design – Guidelines and associated Criteria require that loads resulting from estimated amounts of differential settlement must be accounted for in project design.

When weak soils are re-engineered specifically for stability prior to use, these potential effects can be reduced or eliminated. An acceptable degree of soil stability could be achieved for expansive or compressible soils through routine soil treatment programs (replacement, grouting, compaction, drainage control, etc.). Properly designing buildings and roads can offset the limited ability of the soil to support a load. All buildings and roads would be constructed in accordance to the BART Facilities Standards, which would ensure that impacts associated with on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse are less than significant. Project impacts related to unstable soils under both the west side and east side expansion would be less than significant.

d. **Less than Significant.** Soils at the project site (Rincon clay loam, 0-2% slopes; Clear Lake clay, 0-2% slopes, drained) have a high shrink-swell potential.[26] Expansive soils could potentially damage foundations, pavements, and other rigid structures installed as part of the project. BART Facilities Standards would require that proposed structures be designed to account for potential soil expansion. Standard engineering practices will be implemented where necessary to minimize the potential for damage from expansive soils. The specific practices used will be selected during the final design stages of the project, but may involve the

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[26] U.S. Department of Agriculture, Soil Conservation Service, Soil Survey of Alameda County, California, Western Part, 1981, pp.10, 23.

treatment of expansive soils with lime to reduce expansion potential, the installation of structures that can withstand pressures generated by expansive soils, and/or the replacement of expansive soils with non-expansive fill material. Because of the practices and standards set forth in the BART Facility Standards, impacts from the proposed project would be less than significant.

e. **No Impact.** The proposed project would not involve the use of septic systems. There would thus be no impact associated with septic systems.

7. GREENHOUSE GAS EMISSIONS

Would the project:	**Significant or Potentially Significant Impact**	**Less Than Significant With Mitigation Incorporated**	**Less-Than-Significant Impact**	**No Impact**
a. Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?	☐	■	☐	☐
b. Conflict with any applicable plan, policy, or regulation of an agency adopted for the purpose of reducing the emissions of greenhouse gases?	☐	☐	■	☐

Background

The Earth's climate is changing because human activities, primarily the combustion of fossil fuels, are altering the chemical composition of the atmosphere through the buildup of greenhouse gases (GHGs). GHGs allow the sun's radiation to penetrate the atmosphere and warm the Earth's surface, but do not let the infrared radiation emitted from the Earth to escape back into space. As a result, global temperatures are predicted to increase over the next century. In particular, if climate change remains unabated, Earth’s surface temperatures are expected to increase anywhere from 1.4 to 5.8 degrees Fahrenheit by the end of the century. Not only would higher temperatures directly affect the health of individuals through greater risk of dehydration, heat stroke, and respiratory distress, higher temperatures may increase ozone formation, thereby worsening air quality. Rising temperatures could also reduce the snow pack, which would increase the risk of water shortages. Higher temperatures along with reduced water supplies could reduce the quantity and quality of agricultural products. In addition, there could be an increase in wildfires and a shift in distribution of natural vegetation throughout the State. Global warming could also increase sea levels and coastal storms resulting in greater risk of flooding.

Emissions of carbon dioxide (CO_2) are the leading cause of global warming, with emissions of other substances such as methane, nitrous oxide, and hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride also contributing. The magnitude of impact on global warming differs among the GHGs. However, CO_2 has the greatest impact on global warming because of the relatively large quantities of CO_2 emitted into the atmosphere. For example, the Bay Area Air Quality Management District (BAAQMD) estimates that in 2007 CO_2 made up about 91 percent of the total Bay Area emissions of the six gases listed above. Global CO_2 concentrations, which ranged from 265 parts per million (ppm) to 280 ppm over the last 10,000 years, began rising in the last 200 years to current levels of 365 ppm, a 30 percent increase.

In the Bay Area, GHG emissions result mainly from combustion of fossil fuels such as gasoline, diesel, and natural gas used in mobile sources and energy-generation-related activities. BAAQMD estimated that transportation, industrial/commercia1, and power plants generated 41 percent, 34 percent, and 15 percent, respectively, of the total GHG emissions in the Bay Area. Seventeen percent of these emissions originate in Alameda County.

Federal and State legislation, regulations, and guidance documents regarding GHG emissions continue to evolve, but no specific emission standards have yet been established other than emission standards for certain new motor vehicles, beginning in 2011.

In California, on June 1, 2005, Governor Schwarzenegger signed Executive Order S-3-05 establishing the following GHG emission reduction targets for California:

- By 2010, reduce GHG emissions to 2000 emission levels
- By 2020, reduce GHG emissions to 1990 emission levels
- By 2050, reduce GHG emissions to 80 percent below 1990 levels

Assembly Bill 32 (AB 32), the California Global Warming Solutions Act of 2006, codified the state's goal to reduce statewide GHG emissions to 1990 levels by the year 2020. This reduction will be accomplished through a statewide cap on GHG emissions beginning in 2012, with yearly reductions in the level of the cap until the 1990 emissions level is reached in 2020. AB 32 directs the California Air Resources Board (CARB) to establish a mandatory reporting system to track and monitor global warming emissions levels, and to develop appropriate regulations to achieve the final cap level of emissions by 2020. CARB estimates that California GHG emissions must be reduced by about 173 million metric tons of carbon dioxide equivalent (CO_2e) to meet the cap for 2020.

AB 32 also required that CARB adopt a Scoping Plan by January 1, 2009, indicating how GHG emissions reductions will be achieved via regulations, voluntary actions, monetary and nonmonetary incentives, market mechanisms, and other actions. CARB adopted the final Scoping Plan in November 2008. Among the various measures included to achieve the targeted GHG emission reductions by 2020, the Scoping Plan identifies reductions of approximately 2 million metric tons of CO_2e from local and regional government actions, including regional transportation planning to establish preferred land use and transportation scenarios.

The State has not identified significance thresholds for GHG emissions from projects. However, on June 2, 2010, BAAQMD adopted an updated CEQA guidance document entitled California Environmental Quality Act Air Quality Guidelines (BAAQMD CEQA Guidelines), which includes thresholds of significance for GHG emissions. The BAAQMD CEQA Guidelines specify that projects other than permitted stationary sources will be considered to have significant operational GHG emissions impacts if (i) a locally-adopted Qualified Greenhouse Gas Reduction Strategy exists, and the project does not comply with it; or (ii) project operation will emit more than 1,100 metric tons of CO_2e per year or more than 4.6 metric tons of CO_2e per Service Population (residents + employees) per year. The guidelines also provide that "If a proposed project involves the removal of existing emission sources, BAAQMD recommends subtracting the existing emissions levels from the emissions levels estimated for the new proposed land use." However, BAAQMD did not adopt a numeric GHG significance threshold for construction activities.

The BAAQMD CEQA Guidelines include screening criteria, which "provide lead agencies and project applicants with a conservative indication of whether the proposed project could result in potentially significant air quality impacts. If all of the screening criteria are met by a proposed project, then the lead agency or applicant would not need to perform a detailed air quality assessment of their project's air pollutant emissions."[27] The BAAQMD CEQA Guidelines do not identify any screening criterion for transportation maintenance facilities; however, there are criteria for similar land uses. For the purposes of this analysis, the proposed project is reviewed relative to the screening criterion of 121,000 square feet for general light industry.

Discussion

a. Less Than Significant With Mitigation Incorporated. The warehouse and shop activities planned for the proposed project would take place in three existing buildings totaling approximately 360,000 square feet, and one new building of approximately 44,500 square feet on the site of an existing building that will be demolished. These activities would replace existing warehouse and light industry activities in space totaling approximately 446,400 square feet, of which 314,400 square feet is currently occupied. Since the proposed project would increase the space used for maintenance (light industrial) activities by about 90,100 square feet (total project floor area of 404,500 square feet less existing occupied floor area of 314,400 square feet), the proposed project is below the BAAQMD GHG screening criterion of 121,000 square feet, and therefore would not have significant operational GHG-related impacts.

In addition, construction of the proposed project would generate short-term GHG emissions. These emissions are estimated to be 786 tons CO_2/year (in the year of maximum construction activity) using the URBEMIS model, based on construction activity and phasing information provided by BART. The BAAQMD CEQA Guidelines do not include quantitative significance criteria for construction-related GHG emissions. However, BAAQMD encourages lead agencies to quantify and disclose GHG emissions from construction activities. To mitigate construction-related GHG emissions, BAAQMD suggests the implementation of best management practices (BMPs). With implementation of these BMPs, project construction would not be considered to have a significant GHG-related impact.

MITIGATION MEASURES. BART shall implement the following recommended measures to reduce GHG emissions during project construction.

GHG-1 *Construction-Related Greenhouse Gas Best Management Practices.* BART shall ensure implementation of the following mitigation measures during project construction, in accordance with Bay Area Air Quality Management District (BAAQMD) standard mitigation recommendations which suggest:

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[27] BAAQMD CEQA Guidelines, p. 3-1.

- Use alternative-fueled (e.g., biodiesel, electric) construction vehicles/equipment for at least 15 percent of the fleet;
- Use local building materials (within 100 miles) of at least 10 percent; and
- Recycle or reuse at least 50 percent of construction waste or demolition materials.

b. **Less Than Significant.** As described under Item a above, the HMC project would not exceed the screening criterion for light industrial uses nor would it result in adverse effects related to construction. Accordingly, the proposed project would have a less-than-significant effect on efforts to comply with regional and state GHG emission reduction plans, policies, or regulations.

8. HAZARDS AND HAZARDOUS MATERIALS

Would the project:	**Significant or Potentially Significant Impact**	**Less Than Significant With Mitigation Incorporated**	**Less-Than-Significant Impact**	**No Impact**
a. Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?	☐	☐	■	☐
b. Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?	☐	■	☐	☐
c. Emit hazardous emissions or involve handling hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?	☐	☐	■	☐
d. Be located on a site that is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?	☐	■	☐	☐
e. Be located within an airport land use plan area or, where such a plan has not been adopted, be within two miles of a public airport or public use airport, and result in a safety hazard for people residing or working in the project area?	☐	☐	☐	■
f. Be located within the vicinity of a private airstrip and result in a safety hazard for people residing or working in the project area?	☐	☐	☐	■

Would the project:	Significant or Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less-Than-Significant Impact	No Impact
g. Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?	☐	☐	■	☐
h. Expose people or structures to a significant risk of loss, injury, or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?	☐	☐	☐	■

Discussion

a. **Less than Significant.** Day-to-day operations at the HMC would range from integrated maintenance activities to cleaning car interiors and equipment. Specifically, the west side expansion area would include similar operations to the existing Hayward Yard, but at a larger capacity. Operations at the west side expansion area would include train and track maintenance, overhaul activities, storage, and cleaning.

Currently, the main Hayward Yard stores chemicals associated with day-to-day maintenance and train-washing and cleaning operations, including hydraulic/motor oil; solvents; lubricant grease; chemicals such as sodium hydroxide, sulfuric acid, trichlorofluoromethane, chlorodifluoromethane, among others; train batteries; oxygen and compressed nitrogen; and paints and varnishes.[28] Because the types of activities at the west side expansion area would be similar to current operations at the existing Hayward Yard, it is expected that the same chemicals listed above would be used and stored at the proposed vehicle level overhaul shop, repair shop, central warehouse, and maintenance and engineering shop and storage area.

Operations on the east side expansion area would be limited to car storage and car interior cleaning. Therefore, it is anticipated that operations at the east side expansion would include storage of cleaning compounds and solvents used to wash interiors and equipment.

Construction and site preparation for the proposed project would involve the use of heavy equipment and vehicles containing fuel, oil, and grease, as well as materials such as concrete, asphalt, paints, and solvents. Fluids such as oil or grease could leak from construction vehicles or be inadvertently released in the event of an accident, potentially releasing petroleum compounds laden with metals and other pollutants.

All activities associated with the proposed project could result in accidental spills of hazardous materials during operations and/or construction activities. These accidental spills could adversely affect the health and safety of individuals working at the facility and individuals at adjacent land uses. In the event of a release or accidental spill, BART would adhere to and comply with the existing Health and Safely Plan for the Hayward Yard. The plan was prepared

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[28] San Francisco Bay Area Rapid Transit District, Hazardous Materials Business Plan Chemical Inventory Sheet. Hayward Yard. March 2000.

in compliance with California Health and Safety Code, Section 25503.5, and includes an inventory statement, a site map showing the location of hazardous materials, an emergency response and contingency plan, an employee training plan, and general facility information.

In addition, BART would follow the Spill Prevention and Emergency Response Plan for the existing Hayward Yard.[29] The plan identifies emergency procedures in the event of a hazardous materials spill, and ways to contain any potential contamination. Specifically, the plan calls for protecting all storm drain and sewer inlets in and near the release site using plugs or spill booms; isolating the spill by placing booms or absorbent material around the edges of the spill to prevent further spread; stopping the source of the release by plugging the leak; placing the leaking container on or in secondary containment, or transferring the material to a new container; absorbing the released material using spill booms or diatomaceous earth; and containing the spill clean-up waste in appropriate containers for disposal.

By adhering to the existing Health and Safety Plan and Spill Prevention and Emergency Response Plan for the existing Hayward Yard, future accidental spills or releases from day-to-day operations at the expanded HMC would be contained, recycled, and disposed of properly, in compliance with federal, State, and local regulations. Therefore, procedures at the expansion areas would be the same as the procedures that BART already follows at the existing Hayward Yard, and such procedures would reduce potential hazards with routine use of hazardous materials to less than significant.

Additionally, operations associated with the proposed project would not involve the routine transport of hazardous materials. Disposal of chemicals and any hazardous materials used in the day-to-day operations would adhere to hazardous materials handling and disposal regulations set forth under the Resource Conservation and Recovery Act (RCRA), the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and the California Hazardous Waste Control Law. Overall, the proposed project is not expected to create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials. Accordingly, this impact would be less than significant.

b, d. Less than Significant with Mitigation Incorporated. A search of regulatory agency databases listing hazardous material sites within a half mile of the project site was requested from Environmental Data Resources, Inc. (EDR) for this analysis. The EDR report indicates three sites designated pursuant to Government Code Section 65962.5, also referred to as the Cortese List. The project site (including the existing Hayward Yard and the proposed west side expansion area) is not on the Cortese List. The Cortese database identifies public drinking water wells with detectable levels of contamination, hazardous substance sites selected for remedial action, sites with known toxic material identified through the abandoned site assessment program, sites with Underground Storage Tanks (USTs) having a reportable release, and all solid waste disposal facilities from which there is known migration. Of the three sites listed in Table 5 below (see Figure 10), two of the cases are closed.

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[29] San Francisco Bay Area Rapid Transit District, Spill Prevention and Emergency Response Plan for Hayward Shop. February 15, 2005.

One site, Univar USA, Inc., is listed as an open case under the Cortese database. As described by the San Francisco Bay Regional Water Control Board,[30] the site occupies approximately five acres in the South Hayward Industrial Park. Two-thirds of the site is paved with concrete or covered with office and storage buildings. The southern one-third is not paved and includes the former underground storage tank area. In 1989, ChemCentral discovered soil and groundwater pollution due to leakage and spillage of chemicals stored in USTs. ChemCentral reported soil and groundwater contamination from VOCs, including trichloroethene, tetrachloroethene, cis-1,2 dichloroethene, 1,1,1-trichloroethane, 1,1-dichloroethene, benzene, toluene, ethyl benzene, xylenes, acetone, and methyl ethyl ketone. In the 1990s, all USTs were removed. Subsequent investigations have concluded that VOC impacts to soil are confined to on-site areas, primarily near the former tank area, whereas VOCs in groundwater have migrated offsite. ChemCentral began site cleanup in 1999. Univar upgraded its vapor extraction system in May 2009. On- and off-site groundwater and soil vapor monitoring program will continue until final cleanup standards are met.

Table 5
Hazardous Materials Sites Listed under Cortese Database with Potential to Affect the Project Area

Map ID - Figure 10	Site Name	Address	Approximate Distance from Project Site	Summary of Environmental Conditions
1	Univar USA, Inc. Facility (formerly ChemCentral Corporation)	31702 Hayman Street, Hayward	Approximately 1/8 to ¼ mile south/ southwest	The site is listed as having soil and groundwater pollution due to leakage and/or spillage of chemicals stored in underground storage tanks (USTs). Volatile organic compounds (VOCs) are reported as the main pollutant. Case is currently open.
2	Clementina Limited	31823 Hayman Street, Hayward	Approximately ¼ to ½ mile; south/ southwest	Case is closed.
3	ABC Services Plumbing	31845 Hayman Street, Hayward	Approximately ¼ to ½ mile; south/ southwest	Case is closed.

Source: Environmental Data Resources, Inc., December 2009.

Operations of the proposed project would not entail potential exposure to contaminated materials. However, construction of the proposed project would involve excavation and site grading to accommodate the various project buildings and facilities. As described in the above paragraph, VOC contaminated soils are confined to on-site areas of the Univar property, and as such, no soil contamination from the Univar property is expected to be encountered during HMC construction activities. As depicted in Figure 10, the known subsurface contaminated groundwater plume lies adjacent to the western boundary of the project area, and extends

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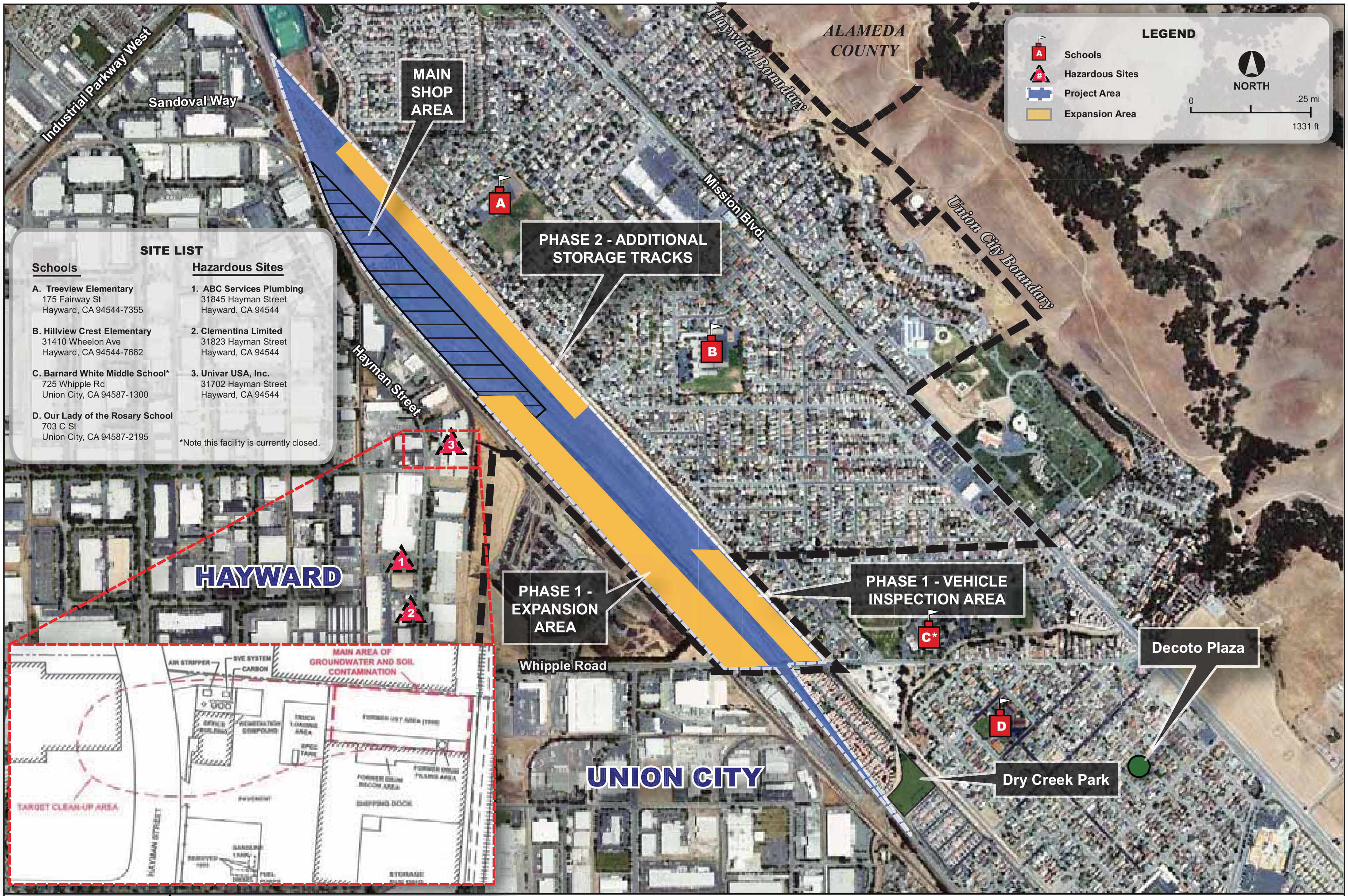
[30] State Regional Water Quality Control Board, San Francisco Bay Region. Soil and Groundwater Cleanup Activities. At Former Univar USA, Inc. Facility (Formerly ChemCentral Corporation). 31702 Hayman Street, Hayward. September 2009.



SITE LIST

Schools

A. **Treeview Elementary**
175 Fairway St
Hayward, CA 94544-7355

B. **Hillview Crest Elementary**
31410 Wheelon Ave
Hayward, CA 94544-7662

C. **Barnard White Middle School***
725 Whipple Rd
Union City, CA 94587-1300

D. **Our Lady of the Rosary School**
703 C St
Union City, CA 94587-2195

Hazardous Sites

1. **ABC Services Plumbing**
31845 Hayman Street
Hayward, CA 94544

2. **Clementina Limited**
31823 Hayman Street
Hayward, CA 94544

3. **Univar USA, Inc.**
31702 Hayman Street
Hayward, CA 94544

*Note this facility is currently closed.

Source: Environmental Data Resources, Inc., 2009; Google Earth, 2009; PBS&J, 2010.

FIGURE **10**

Schools and Hazardous Sites within 1/4 Mile of Hayward Yard

west/northwest, following groundwater trends. The known groundwater contamination plume on the neighboring Univar site is therefore moving away from, rather than toward, the proposed project site. Nevertheless, the potential of encountering unknown contaminated material (both groundwater and soil) still exists, given the proximity to the known groundwater contamination.

The west side expansion area is not listed on the Cortese List; however, the area is currently used for warehouse and light industrial uses. These uses may presently or previously have included the storage and/or use of chemicals associated with these activities. Given the history of warehouse and light industrial land uses at the site, it is possible that unreported releases of hazardous materials may have occurred. Based on these findings, there may be a potential to encounter contaminated soils at the project site during excavation. If found, contamination could potentially pose a health risk to construction workers at the project site, and may require special soil management and disposal procedures to ensure that contaminated soil and/or groundwater are managed in accordance with applicable laws and regulations. Exposing workers and employees during construction to any contaminated materials would be a potentially significant impact.

MITIGATION MEASURE. The following measures would reduce the significant accidental release of hazardous materials impacts during construction to less than significant. (LTS).

HAZ-1 *File Review and a Phase I ESA Prior to Construction.* Prior to construction, BART shall conduct an environmental site assessment (ESA) to further analyze potential hazardous materials and waste sites around the project site. BART shall ensure that additional research, including a file review with the Alameda County Department of Environmental Health and the RWQCB and a Phase I ESA for the west side expansion area, is performed. If the file review reveals no potential impact from environmental contamination, no further action to remedy soil or groundwater contamination would be necessary.

HAZ-2 *Further Soil and Groundwater Investigations Prior to any Construction Activities.* If the file review under Mitigation Measure HAZ-1 above reveals potential environmental contamination along or beneath the proposed project's footprint or other facilities, BART shall evaluate the sites to determine the level of investigation appropriate to evaluate the possible presence of hazardous chemicals in soil and groundwater. In the event soil and/or groundwater testing is deemed appropriate, BART shall ensure that a Phase II soil and groundwater investigation is conducted in the affected areas, including field sampling and laboratory analysis, to evaluate conditions where excavation and grading will take place. The Phase II investigation shall be completed prior to any construction or excavation work, and a schedule shall be developed in the pre-design phase of the project to ensure that a sufficient amount of time is allotted prior to site development to identify and implement actions to investigate the presence of hazardous substances in soil and groundwater, and to identify design and contingency measures in the event that the results of the investigation indicate the need for further testing, site controls, or remediation.

The number, location of field samples, and constituents tested would depend on the size of the impacted site, site activities, and possible transport or migration routes. Field samples may include soil, soil gas, or groundwater, depending on the nature of the contaminants suspected to be present. The sampling plan shall specify that all soil and groundwater chemical analyses shall be performed by a California-certified laboratory, using standard EPA and California chemical testing methods. The investigation results shall, if necessary, lead to preparation of a:

- Remedial Action Plan for soil and groundwater treatment and disposal;
- Health and Safety Risk Assessment; and
- Soil management plan with criteria for impacted soils, in consultation with DTSC and RWQCB.

If necessary, a Remedial Action Plan shall be prepared to identify options for remediation of the contaminated site. If the proposed remedial approach does not involve complete source removal, a Health and Safety Risk Assessment shall be completed. Work in impacted areas will be conducted in accordance with applicable Cal OSHA requirements.

HAZ-3 *Remediation of Contaminated Sites Prior to Construction.* If hazardous materials are identified in soil and groundwater at levels that present a risk to the public, to construction workers, or to the environment, based on the investigations described in Mitigation Measure HAZ-2 above, BART shall ensure that remediation is conducted at contaminated sites pursuant to applicable laws and regulations.

A Remedial Action Plan may be developed if warranted to address potential air and health impacts from soil excavation activities, potential transportation impacts from the removal of remedial activities, and potential risks of public upset should there be an accident at excavation sites. During excavation activities, construction workers or the public may be exposed to contaminants in the soil through ingestion, dermal contact, inhalation of fugitive dust, and inhalation of volatile emissions. The Site-Specific Health and Safety Plan will include measures to mitigate these potential impacts, such as cordoning off excavation sites to prevent public access, water misting to control dust during removal activities, perimeter air monitoring for dust along the site boundaries both upwind and immediately downwind of site excavation and stockpiling activities, and air monitoring of volatile organic compounds (VOC). All exposed contaminated materials shall be covered at the end of each day. Excavation work shall be performed in compliance with all OSHA rules and regulations.

HAZ-4 *Discovered Environmental Contamination During Construction.* In the event that soil, groundwater or other environmental medium with suspected contamination is encountered unexpectedly during construction activities after implementation of

Mitigation Measure HAZ-3, BART's contractor shall cease work in the vicinity of the suspect material, the area shall be secured as necessary, and contractor shall take all appropriate measures to protect human health and the environment. Appropriate measures shall include notification of the applicable regulatory agency(ies) as necessary, to identify the nature and extent of contamination. Work shall not resume in the area(s) affected until the measures have been implemented under the oversight of the corresponding regulatory agency(ies), as appropriate.

c. **Less than Significant**. The project site would be located within ¼ mile of four schools. The schools are Hillview Crest Elementary School (approximately ¼ miles east), Barnard-White Middle School (approximately 1,000 feet east),[31] Treeview Elementary School – Bidwell Campus (approximately 1,000 feet east), and Our Lady of the Rosary School (approximately 1,200 feet east/southeast). Day-to-day operations, such as train maintenance and repair, train washing, equipment cleaning, or other maintenance activities may result in accidental spills and release of hazardous materials related to cleaning compounds.

The west side expansion area would include uses such as train repair overhaul and other maintenance activities. The east side expansion area would be used for storage of BART cars. These activities have the potential to incrementally increase use of hazardous materials. Compliance with the existing Health and Safety Plan for the Hayward Yard would adequately reduce potential releases (that could result in the unlikely event of a spill) from the project site. The current Health and Safety Plan for the Hayward Yard was prepared in compliance with California Health and Safety Code, Section 25503.5, and includes an inventory statement, a site map showing the location of hazardous materials, an emergency response and contingency plan, an employee training plan, and general facility information. As such, hazardous material impacts to schools located within ¼ of a mile of the project site would be less than significant.

e, f. **No Impact.** The project site is not in the vicinity of a public or private airport or within an airport land use plan. Hayward Executive Airport is the closest airport, approximately five miles northwest of the project site. No other private airstrips are in the vicinity of the proposed project. Therefore, airport and aircraft operations would not pose a safety hazard for people working on the project site.

g. **Less than Significant.** The proposed west side expansion would occupy three properties containing four warehouses adjacent to the west side of the existing Hayward Yard. The proposed east side expansion would take place within an undeveloped property owned by BART northeast of the existing Hayward Yard operations, between the active BART line and the UPRR tracks. The trackwork area south of Whipple Road is in an area already developed with tracks and would not interfere with local streets and emergency access routes.

The west side expansion area would have access to fire and emergency vehicles via an existing driveway from Whipple Road into the project site. The west side and east side expansion areas

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[31] At the time of preparation of this document, the Barnard-White Middle School was closed. It was unknown whether this school would be reopened in the future.

would also connect to the existing Hayward Yard through interior access roads. Access to the Hayward Yard is currently through Sandoval Way. Therefore, with the proposed interior connections, fire and emergency vehicles would have access to the existing Hayward Yard and the west side expansion from both Whipple Road and Sandoval Way. Emergency access to the east side expansion area would be from Whipple Road. The existing exterior streets that would be used to access the project site are built to City of Hayward or Union City standards, and the new interior access road would be constructed to appropriate standards, thereby ensuring that emergency vehicles can readily and easily access the project buildings and activities. Therefore, the proposed project would not impair the implementation of, or interfere with, an adopted emergency response plan or emergency evacuation plan, and impacts to emergency response would be less than significant

h. **No Impact.** The project site is in an urbanized area within the City of Hayward and the City of Union City and is not adjacent to wildlands. As such, the proposed project (both the west side and east side expansion areas) would not be subject to wildland fire risks.

9. HYDROLOGY AND WATER QUALITY

Would the project:	**Potentially Significant Impact**	**Less Than Significant With Mitigation Incorporated**	**Less-Than-Significant Impact**	**No Impact**
a. Violate any water quality standards or waste discharge requirements?	☐	☐	■	☐
b. Substantially deplete groundwater supplies or interfere substantially with groundwater recharge, resulting in a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level that would not support existing land uses or planned uses for which permits have been granted)?	☐	☐	■	☐
c. Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner that would result in substantial erosion or siltation onsite or offsite?	☐	☐	■	☐
d. Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner that would result in flooding onsite or offsite?	☐	■	☐	☐
e. Create or contribute runoff water that would exceed the capacity of existing or planned stormwater drainage Systems or provide substantial additional sources of polluted runoff?	☐	☐	■	☐

Would the project:	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less-Than-Significant Impact	No Impact
f. Otherwise substantially degrade water quality?	☐	☐	☐	■
g. Place housing within a 100-year flood hazard area, as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?	☐	☐	☐	■
h. Place structures within a 100-year flood hazard area that would impede or redirect flood flows?	☐	☐	☐	■
i. Expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of a levee or dam?	☐	■	☐	☐
j. Contribute to inundation by seiche, tsunami, or mudflow?	☐	☐	■	☐

Discussion

a, c, e. Less than Significant. The following discussion addresses potential water quality impacts related to HMC operational stormwater runoff and construction-related activities.

The majority of the project site is within the historic Ward Creek watershed and the track extension southeast of Whipple Road is within the Dry Creek watershed. The majority of project site runoff flows northwest to on-site retention areas, an engineered channel system at Industrial Boulevard (Alameda Flood Control and Water Conservation District [AFCWCD] Line D channel) that comprises the historic Ward Creek drainage system, or to a 1.2-acre wetland (refer to Section 4, Biological Resources) north of the proposed train storage area. A small portion of the southwest area of the west site, north of Whipple Road, may flow to an underground storm drain in Whipple Road, which also discharges to the AFCWCD Line D channel. The Line D channel flows southwestwardly and discharges to the Old Alameda Creek channel at a location about 800 feet west of I-880. The Old Alameda Creek channel discharges to the Lower San Francisco Bay. The project site track area extending southeast of Whipple Road drains to the Dry Creek watershed, which crosses the track area about 250 feet west of the southeast boundary (refer to Figure 11, Figure 11 Regional Hydrology). Dry Creek flows primarily southward and discharges to the Alameda Flood Control Channel, which outlets to the Lower San Francisco Bay.

The relevant water quality standards are listed in the Basin Plan.[32] The applicable waste discharge requirements for the Hayward Yard are contained in the National Pollutant Discharge

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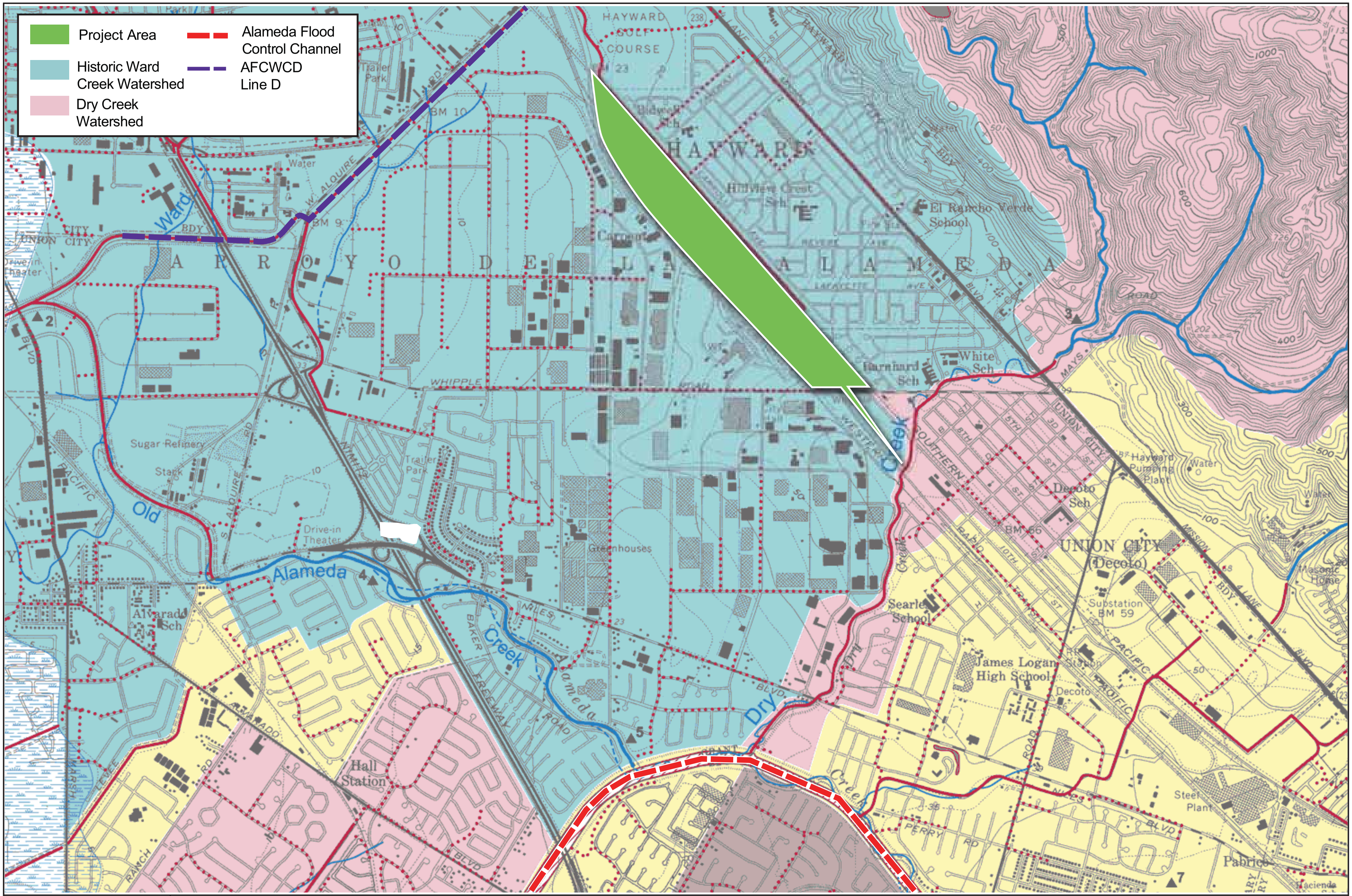
[32] California Regional Water Quality Control Board, San Francisco Bay Region. 2007. *Water quality standards in the San Francisco Bay Basin (Region 2) Water Quality Control Plan (Basin Plan)*. Incorporating all amendments approved by the Office of Administrative Law as of January 18, 2007.



Source: Creek & Watershed Map of Fremont & Vicinity, 1999.

PBS&J®

FIGURE 11
Regional Hydrology

Elimination System (NPDES) General Permit for Discharges of Storm Water Associated with Industrial Activities Excluding Construction Activities (SWRCB Order No. 97-03-DWQ, NPDES No. CAS000001 [Industrial General Permit]) and the NPDES General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities (SWRCB Order No. 2009-0009-DWQ, NPDES No. CAS000002 [Construction General Permit]), adopted September 2, 2009. In addition, the SWRCB adopted a Municipal Regional Permit (MRP) in October 2009 that consolidates individual municipal stormwater permits (from 77 permittees) into one regional Bay Area permit to ensure a consistent level of implementation and reporting of stormwater runoff control and management. Additionally, individual Waste Discharge Requirements (WDR) may be applicable for activity within or alteration of on-site ditches if they are identified as waters of the State.

Alameda Creek beneficial uses listed in the Basin Plan include agriculture supply, groundwater recharge, warm and cold freshwater habitat, fish migration and spawning, wildlife habitat, and water contact and non-contact water recreation. Lower San Francisco Bay beneficial uses listed in the Basin Plan include industrial service supply, commercial fishing, shellfish harvesting, estuarine habitat, fish migration, wildlife habitat, water contact and non-contact water recreation, and navigation. The Lower San Francisco Bay is also listed as potentially supporting fish spawning. There are no designated beneficial uses listed in the Basin Plan for the historic Ward Creek (AFCWCD Line D), Dry Creek, or the Alameda Flood Control Channel. As such, the applicable water quality standards are those for Alameda Creek and the Lower San Francisco Bay.

The Lower San Francisco Bay is listed as impaired (2006 Clean Water Act section 303(d)) by a number of pollutants from non-point sources[33] including mercury, polychlorinated biphenyls (PCBs), dioxin-like PCBs, and pesticides (dieldrin, chlordane, and dichlorodiphenyl trichloroethane [DDT]). Both the Lower San Francisco Bay and Alameda Creek are also proposed by the San Francisco Bay Regional Water Quality Control Board (RWQCB) for listing as impaired by trash, but the State Water Resources Control Board (SWRCB) and US EPA have not yet approved these listings.

Operations. Operation of the proposed project during Phase 1 and 2 would consist mainly of vehicle level overhaul, train storage, materials storage, and train maintenance. As proposed, the project would include additional storage track for up to a maximum of 250 cars as well as renovation of existing buildings for car maintenance, a new materials storage area, associated infrastructure, and tracks to accommodate transfer of cars between facilities. Grading and installation of facilities and features would alter the local drainage patterns and increase stormwater runoff by up to 3.49 cubic feet per second (cfs) for the 10-year storm event during Phase 1.[34] This increased runoff to creeks and channel could cause or contribute to stream bed

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[33] "Non-point sources" refer to those pollutants that are generated over a diffuse area, such as urban stormwater runoff.

[34] Calculated using the Hydrology and Hydraulics Manual, Alameda County Flood Control District, June 2003 Modified Rational Method.

or bank erosion and degradation of creek habitat. The additional impervious surfaces associated with the Phase 1 materials storage area (about 1.96 acres) could also collect pollutants from atmospheric deposition or operational activities. Pollutants on impervious surfaces are more susceptible to transport in stormwater runoff. The proposed project would also result in the storage and use of cleaning compounds, corrosives, metals, adhesives, and solvents used to wash interiors and equipment. Release of these types of substances could enter the stormwater sewer system or local drainages in the event of a spill or leaking container. Unless properly managed, such releases could result in adverse human health or environmental effects. See Item 8a, above, for a discussion of handling hazardous materials during project operations.

The proposed project would comply with all substantiative requirements of the MRP and implement operational controls to protect water quality. The MRP, as adopted, aims at implementing controls to reduce pollutants in stormwater runoff to the maximum extent practicable through implementation of Low Impact Development (LID)[35] stormwater quality best management practices (BMPs) and prohibition of non-stormwater discharges to manage pollutant contributions to prevent violation of water quality standards. The Alameda Countywide Clean Water Program (ACCWP) is responsible for the overall coordination and implementation of the MRP through its Storm Water Management Plan (SWMP). The MRP requires that all Regulated Projects, such as the proposed project, must implement onsite source control and site design measures that at a minimum shall include the following LID practices (Provision C.3.c):

- Minimization of stormwater pollutants of concern in urban runoff through measures that may include plumbing of the following discharges to the sanitary sewer, subject to the local sanitary sewer agency’s authority and standards:
  - Discharges from indoor floor mat/equipment/hood filter wash racks or covered outdoor wash racks for restaurants;
  - Dumpster drips from covered trash, food waste and compactor enclosures;
  - Discharges from covered outdoor wash areas for vehicles, equipment, and accessories;
  - Swimming pool water, if discharge to onsite vegetated areas is not a feasible option; and
  - Fire sprinkler test water, if discharge to onsite vegetated areas is not a feasible option;
- Properly designed covers, drains, and storage precautions for outdoor material storage areas, loading docks, repair/maintenance bays, and fueling areas;
- Properly designed trash storage areas;

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[35] The goal of LID is to reduce runoff and mimic a site’s predevelopment hydrology by minimizing disturbed areas and impervious cover and then infiltrating, storing, detaining, evapotranspiring, and/or biotreating stormwater runoff close to its source. LID employs principles such as preserving and recreating natural landscape features and minimizing imperviousness to create functional and appealing site drainage that treats stormwater as a resource, rather than a waste product. Practices used to adhere to these LID principles include measures such as rain barrels and cisterns, green roofs, permeable pavement, preserving undeveloped open space, and biotreatment through rain gardens, bioretention units, bioswales, and planter/tree boxes.

- Landscaping that minimizes irrigation and runoff, promotes surface infiltration, minimizes the use of pesticides and fertilizers, and incorporates other appropriate sustainable landscaping practices and programs such as Bay-Friendly Landscaping;
- Efficient irrigation systems;
- Storm drain system stenciling or signage;
- Require each Regulated Project to implement at least the following design strategies onsite:
  - Limit disturbance of natural water bodies and drainage systems; minimize compaction of highly permeable soils; protect slopes and channels; and minimize impacts from stormwater and urban runoff on the biological integrity of natural drainage systems and water bodies;
  - Conserve natural areas, including existing trees, other vegetation, and soils;
  - Minimize impervious surfaces;
  - Minimize disturbances to natural drainages; and
  - Minimize stormwater runoff by implementing one or more of the following site design measures:
    - Direct roof runoff into cisterns or rain barrels for reuse.
    - Direct roof runoff onto vegetated areas.
    - Direct runoff from sidewalks, walkways, and/or patios onto vegetated areas.
    - Direct runoff from driveways and/or uncovered parking lots onto vegetated areas.
    - Construct sidewalks, walkways, and/or patios with permeable surfaces.
    - Construct driveways, bike lanes, and/or uncovered parking lots with permeable surfaces.
- Require each Regulated Project to treat 100% of the amount of runoff identified in Provision C.3.d for the Regulated Project's drainage area with LID treatment measures onsite or with LID treatment measures at a joint stormwater treatment facility.
  - LID treatment measures are harvesting and re-use, infiltration, evapotranspiration, or biotreatment.
  - A properly engineered and maintained biotreatment system may be considered only if it is infeasible to implement harvesting and re-use, infiltration, or evapotranspiration at a project site.
  - Infeasibility to implement harvesting and re-use, infiltration, or evapotranspiration at a project site may result from conditions including the following:
    - Locations where seasonal high groundwater would be within 10 feet of the base of the LID treatment measure.
    - Locations within 100 feet of a groundwater well used for drinking water.
    - Development sites where pollutant mobilization in the soil or groundwater is a documented concern.
    - Locations with potential geotechnical hazards.

- Smart growth and infill or redevelopment sites where the density and/or nature of the project would create significant difficulty for compliance with the onsite volume retention requirement.
- Locations with tight clay soils that significantly limit the infiltration of stormwater.

The MRP also requires that stormwater quality treatment BMPs are numerically sized in accordance with specific flow rate or volume treatment requirements, depending upon the type of BMP; hydrograph modification[36] controls where increases in runoff could cause or contribute to bed and bank erosion in susceptible receiving waters; and implementation of total maximum daily load (TMDL) requirements. Applicable TMDLs would include the San Francisco Bay mercury TMDL, the San Francisco Bay PCB TMDL, and the Urban Creeks Pesticide Toxicity TMDL. Compliance with the MRP would reduce the potential for pollutants in stormwater runoff to reach receiving waters.

In accordance with the Construction General Permit, disturbed areas would be stabilized following construction, which would minimize the potential for erosion and sediment transport. The project site is not located in an area where hydrograph modification controls could be required because it does not drain to a channel(s) susceptible to bed or bank erosion. Compliance with these requirements and would ensure that potential off-site erosion and siltation would not be substantial.

If any altered drainage features are identified as waters of the State, a Report of Waste Discharge would have to be submitted to the RWQCB. The RWQCB would issue an individual WDR that would specify conditions and BMPs to ensure protection of water quality and hydrology within these drainages. The RWQCB may also issue a waiver of a WDR if the RWQCB determines that the proposed activities and alterations would not substantially affect water quality and hydrology.

Because the proposed project is a vehicle maintenance facility, BART would also be required to obtain coverage under the statewide Industrial General Permit. Industrial facility operators must comply with all of the conditions of the Industrial General Permit, including preparation of an operational Stormwater Pollution Prevention Plan (SWPPP) emphasizing BMPs. The SWPPP has two major objectives: (1) to help identify the sources of pollution that affect the quality of industrial storm water discharges and authorized non-storm water discharges, and (2) to describe and ensure the implementation of BMPs to reduce or prevent pollutants in industrial storm water discharges and authorized non-storm water discharges. One of the major elements of the SWPPP is the elimination of unauthorized non-storm water discharges to the facility's storm drain system. Noncompliance constitutes a violation of the CWA and Porter-Cologne Act, and is grounds for (a) enforcement action; (b) Industrial General Permit termination,

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[36] 'Hydrograph modification' refers to an alteration in the storm event flow regime of a watercourse such as increases in peak flow rates, longer duration of storm flow, and higher storm flow volume. If runoff to the watercourse increases, or the timing of runoff changes, this could cause a change in the watercourse storm event flow. Hydrograph modification controls are controls designed to maintain the flow regime for small storm events.

revocation and reissuance, or modification; or (c) denial of an Industrial General Permit renewal application.

This Industrial General Permit has been prepared by SWRCB and RWQCB to be protective of water quality standards. BART Facility Standards require compliance with all applicable federal, state, and local laws, order, and regulations concerning the prevention, control, and abatement of water pollution (BART Facility Standards Section 01 57 00 1.08.A.4.). As such, the proposed project would not violate waste discharge requirements or water quality standards and operational impacts on erosion and siltation and polluted runoff would be less than significant.

Construction. Construction of the proposed project under both Phases 1 and 2 would include site improvements such as clearing and grubbing, excavations, installation of ballast and tracks, pavement removal, grading, and paving. Construction would also include installing power, signal and communication systems, renovation of existing buildings to support operations, building demolition and construction, cleaning facilities, sound wall improvements, lighting, and security fencing. All construction would result in earthmoving activities that would alter drainage patterns and expose soil, which could increase the potential of erosion and sediment transport to existing stormwater drainage systems, including creeks and channels. Construction and site preparation for the proposed project would involve the use of heavy equipment and vehicles containing fuel, oil, and grease, as well as materials such as concrete, asphalt, paints, and solvents. Fluids such as oil or grease could leak from construction vehicles or be inadvertently released in the event of an accident, potentially releasing petroleum compounds laden with metals and other pollutants. No deep excavations are planned for construction of the proposed project; therefore, substantial dewatering is not expected.

The SWRCB permits all regulated construction activities under the statewide Construction General Permit. Every construction project that disturbs one or more acres of land surface or that are part of a common plan of development or sale that disturbs more than one acre of land surface would require coverage under this Construction General Permit. To obtain coverage under this Construction General Permit, the landowner or other applicable entity must file Permit Registration Documents prior to the commencement of construction activity, which include a Notice of Intent, construction SWPPP, and other documents required by the RWQCB or SWRCB, and mail the appropriate permit fee to the SWRCB. Because the proposed project would cumulatively disturb more than one acre, construction of the proposed project would be subject to the Construction General Permit requirements, which include specific minimum BMPs. The Construction General Permit mandates specific minimum BMPs during construction, depending on the project's sediment risk level, to protect water quality during construction activities. Specific minimum BMPs required for all projects, including the proposed project, are:

- Specific good site management (i.e., "housekeeping") measures for construction materials that could potentially be a threat to water quality if discharged
- Specific good housekeeping measures for waste management, including a spill response and implementation element

- Specific good housekeeping for vehicle storage and maintenance
- Specific good housekeeping for landscape materials
- Specific good housekeeping measures on the construction site to control the air deposition of site materials and from site operations
- Non-stormwater management BMPs (e.g., measures to control all non-stormwater discharges during construction)
- Erosion control measures
- Sediment controls
- Run-on and runoff controls
- Monitoring and reporting requirements including development and implementation of a written site-specific Construction Site Monitoring Program (CSMP) in accordance with the requirements of the Construction General Permit.

The Construction General Permit has been developed to be protective of water quality during construction activities. The RWQCB enforces compliance with the Construction General Permit through site inspections and fines. Implementation of the required specific BMPs would minimize the potential for pollutants in stormwater runoff and pollutant transport to Old Alameda Creek and the Lower San Francisco Bay during construction activities. Construction General Permit required erosion, sediment, and run-on and runoff controls would also minimize the potential for on- and off-site erosion and sediment transport.

Furthermore, BART Facility Standards Section 01 57 00 (Temporary Controls, 1.08 - Erosion and Sediment Control, 1.09 - Dust Control, and 1.10 - Mud Control)) and Section 31 00 00 (Earthwork, 1.11 - Site Conditions and 3.03 - Earthwork General Requirements) includes requirements for erosion and sediment controls from construction operations, including an Erosion and Sediment Control Plan, and Section 01 57 00 (Temporary Controls, 1.07 – Pollution Abatement) requires BMPs to minimize pollution potential. Where natural drainage ways are intercepted by construction activities, BART Facility Standards require that such drainage ways shall be protected so that runoff from the site or water from construction activities is not allowed to enter the natural drainage way (Section 01 57 00 Temporary Controls, 1.08.C.-Prevention of Erosion). Section 01 71 13 (Mobilization, 1.09 – Demobilization) and Section 31 11 00 (Clearing and Grubbing, 1.06 - Jobsite Conditions) require restoration of the construction area after completion of construction activities. BART Facility Standards Section 32 84 00 (Planting Irrigation) and Section 32 90 00 (Planting) ensure adequate establishment of permanent vegetative cover to protect surfaces from erosion. Compliance with these requirements would ensure that the proposed project would not violate WDRs or water quality standards and construction impacts on erosion and siltation and polluted runoff would be less than significant.

b. **Less than Significant.** The Santa Clara Valley East Bay Plain, which is a subbasin of the Santa Clara Groundwater Basin, underlies the project area. The East Bay Plain Subbasin is a northwest trending alluvial plain bounded on the north by San Pablo Bay, on the east by the contact with Franciscan Basement rock, and on the south by the Niles Cone Groundwater Basin. The East Bay Plain Basin extends beneath San Francisco Bay to the west.[37]

The project site is located in the San Lorenzo Sub-Area of the San Francisco Basin of the East Bay Plain.[38] The San Lorenzo Sub-Area is primarily filled with alluvial fans.[39] It has been proposed that a clay layer forms an extensive east-west aquitard[40] across this basin. [41] However, the project site is not likely located over the aquitard and, therefore, groundwater recharge from infiltration is possible. Sources of groundwater recharge in the San Lorenzo Sub-Area have been identified as rainfall infiltration, stream seepage, pipe leakage, agriculture return water, and subsurface inflow, with rainfall infiltration comprising about 18.3 percent (3,700 acre-feet per year) of recharge in the 114 square miles of the Alameda County portion of the East Bay Plain. [42]

The City of Hayward historically operated a wellfield near Hesperian and Industrial Boulevards, over one mile west of the project site. This wellfield was phased out of service starting in 1962, when Hetch Hetchy water became available. Groundwater is not a substantial water supply for the City of Hayward; the City of Hayward depends on the San Francisco Public Utilities Commission's Hetch Hetchy aqueduct for its municipal water supply. However, since a major earthquake could disrupt this supply for periods of days, Hayward has installed an emergency water supply well system. In the event of an earthquake, the wells are expected to be in use for no more than 7 days. Hayward overlies the San Lorenzo Cone, which contains an upper and a lower aquifer. The emergency water supply well screens are generally perforated across several intervals in the Lower Hayward Aquifer, between 350 and 550 feet below grade. Wells near or within the former wellfield are used for the emergency water supply.[43]

No permanent groundwater wells would be developed as part of the proposed project. As reported in the EDR, Inc. documents (see Section 8, Hazards and Hazardous Materials), groundwater can be found at approximately 36 feet below the surface in the area of the proposed project.[44] The maximum groundwater levels at Industrial Boulevard, just north of the project site, have been measured at about 25 feet below the lowest elevation of the project

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[37] California Department of Water Resources. *Santa Clara Valley Groundwater Basin, East Bay Plain Subbasin. Bulleting 118*. February 2004.

[38] California Regional Water Quality Control Board San Francisco Bay Region, Groundwater Committee. *East Bay Plain Groundwater Beneficial Use Groundwater Evaluation Report*, Alameda and Contra Costa Counties, CA. Prepared June 1999. p. 32

[39] Ibid. p. 40

[40] An "aquitard" is a restrictive layer that impedes the free flow of water across the aquifer and creates confined or semi-confined aquifer conditions.

[41] California Regional Water Quality Control Board San Francisco Bay Region, Groundwater Committee. *East Bay Plain Groundwater Beneficial Use Groundwater Evaluation Report*, Alameda and Contra Costa Counties, CA. Prepared June 1999. p. 40

[42] Ibid. p. 41

[43] Ibid. p. 70-71

[44] Environmental Data Resources, Inc. BART Hayward Railyard Extension. Inquire Number: 2616157.2s. October 15, 2009.

site.[45] No deep excavations are planned for the proposed project that would extend to more than 20 feet below ground surface and most excavations would not exceed 2 feet in depth. Construction ground disturbance activities would entail grading and paving; installing power, signal and communication systems; renovation of existing buildings to support operations; building demolition and construction; installation of cleaning facilities; sound wall improvements; lighting; and security fencing, none of which would require deep excavations. As such, construction activities are not expected to encounter groundwater and groundwater dewatering would not occur during construction or operation. Overall, the proposed project would have no direct effect on the local groundwater table and no effect on lowering of groundwater supplies.

The proposed project would increase impervious surfaces by about 1.96 acres, which could impede groundwater recharge from rainfall percolation and affect the emergency water supply. However, as mentioned above, rainfall percolation accounts for only 18.3 percent of the recharge in the Alameda County portion of the East Bay Plain, which encompasses 114 square miles. At best, only about 25 percent of this area would be able to contribute to groundwater recharge from rainfall percolation (land surface portion). An additional 1.96 acres of impervious surfaces from the proposed project would reduce potential recharge area by about 0.01 percent and indirect effects on groundwater levels and water supplies would not be substantial.

Pollutants in stormwater runoff from the project site could contribute pollutants to groundwater resources, affect groundwater quality, and therefore groundwater supplies as polluted runoff percolates through pervious surfaces to groundwater. However, as noted above, the depth to shallow groundwater is more than 20 feet below the ground surface. Additionally, the construction SWPPP-required BMPs, industrial SWPPP BMPs, and MRP would regulate the pollutants in runoff. Furthermore, the MRP requires that use of any infiltration BMPs to treat stormwater runoff would not degrade groundwater quality. BART Facility Standards also require BMPs to minimize pollution potential (Section 01 57 00 Temporary Controls, 1.07 – Pollution Abatement) and prevent stormwater run-on into excavated pits and trenches (31 23 19 Dewatering, 1.08 – Site Conditions; 31 00 00 Earthwork, 3.06 – Excavation). Compliance with these requirements would ensure that potential indirect effects on groundwater recharge and groundwater quality would have a less-than-significant impact on local groundwater levels and groundwater supplies.

d. **Less than Significant with Mitigation Incorporated.** The proposed project during Phase 1 and 2 would result in a net increase in impervious surface at the Hayward Yard, which would change existing runoff characteristics on the project site. The increase in impervious surfaces (i.e., access road, cleaning facility, etc.) would increase the flow and volume of stormwater during a storm event. This could result in on- or off-site increases in the rate and amount of

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[45] California Department of Water Resources. n.d. Groundwater Level Data for Well 03S02W35R001M, October 1958 through May 1997. Available at: http://www.water.ca.gov/waterdatalibrary/groundwater/hydrographs/report_html.cfm?wellNumber=03S02W35R001M. Accessed September 7, 2010.

stormwater entering local drainages and the stormwater system that could result in on- or off-site flooding by exceeding the existing stormwater drainage system capacity.

The majority of project site off-site discharges are to the AFCWCD Line D, Sandoval Way where it crosses under the existing BART tracks, and the wetland area north of the project site. Drainage pipes and ditches would also be added along the northeastern perimeter of the expansion area.

If runoff to the wetland area increases, potential effects would not be substantial and may be beneficial. However, increased runoff to either Sandoval Way, the AFCWCD Line D channel, or under the UPPR track embankment could have substantial effects on off-site flooding. The 100-year event flows are not contained in the AFCWCD Line D and the downstream Old Alameda Creek; levees are over-topped and substantial flooding occurs during a 100-year flood event.[46] Sandoval Way crosses the project site beneath the railroad tracks through a localized topographic depression. Runoff from the project site could contribute to localized flooding of Sandoval Way, which generally flows from southeast to northwest towards the Sandoval Way crossing. The channel and area east of the UPPR tracks (AFCWCD Line N) is subject to flooding during a 500-year flood event and ties into the constrained AFCWCD Line D. Increased project site runoff to offsite areas could have a potentially significant effect on off-site flooding and exceed the capacity of the existing storm drain system. The proposed project could increase runoff to these systems by up to 5.20 cfs for the 100-year storm event. Because these systems are already constrained, an increase in 100-year runoff could have a substantial effect on off-site flooding. Figure 11 depicts surface water drainage within the project area.

On-site flooding could also occur with implementation of the proposed project. However, on-site flooding would occur in the depressed area between tracks. Flooding between tracks would not contribute to a substantial effect except where drainage is routed through culverts and pipes beneath project site facilities. If new or existing culverts are not adequate to convey the additional 100-year flows, flows could back up and on-site flooding would be potentially significant.

MITIGATION MEASURE. Implementation of the following measures would require BART to retain or detain the increase in runoff from the 100-year storm event onsite and to adequately size new culverts and pipes to convey 100-year storm flows. This mitigation measure would reduce this impact to a less-than-significant level.

HYD-1 *Stormwater Drainage System Design*. Prior to final design of each phase of the proposed project, BART shall have a licensed professional engineer registered in California prepare a detailed Hydrology and Hydraulics Report that identifies flow contributing areas (catchments), flow pathways, off-site discharge locations, receiving storm drain systems, and proposed on-site flow conveyance structures and conveyance capacities.

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[46] Federal Emergency Management Agency. 2009. *FIRM Flood Insurance Rate Map, Alameda County, California and Incorporated Areas*. Panels 427, 431, and 432 of 725; Community Numbers 060001, 065033, and 060014; Map Numbers 06001C0427G, 06001C0431G, and 06001C0432G effective date August 3, 2009

The Hydrology and Hydraulics Report shall identify the off-site peak flow rates and flow volumes for the 100-year storm event at all proposed off-site discharge locations, retained existing on-site flow conveyance structures, and proposed on-site flow conveyance structures for both existing conditions and proposed project conditions. The detailed Hydrology and Hydraulics Report calculations shall be prepared in accordance with Alameda County Flood Control District Hydrology and Hydraulics Manual (June 2003, or later version, as applicable).

Off-site Runoff. Based on the detailed Hydrology and Hydraulics Report, BART shall design on-site detention (or retention) facilities sufficient to detain increases in 100-year runoff peak flow rates and retain increases in 100-year flow volumes at all off-site discharge locations compared to existing conditions.

BART shall submit a preliminary design, along with the Hydrology and Hydraulics Report, to the Alameda Flood Control District and City of Hayward Public Works Department for review. BART shall incorporate Alameda Flood Control District recommendations into the project design, where applicable, prior to the beginning of construction activities.

On-site Runoff. BART shall design on-site drainage in accordance with one of the following, or a combination of the following:

- BART shall design sufficient on-site detention (or retention) to detain increase in flow rates in excess of the conveyance capacity of existing downstream structures; or
- BART shall upgrade existing on-site conveyance structures to provide sufficient conveyance capacity. All proposed on-site conveyance structures shall be designed with adequate capacity to convey the 100-year storm event.

f. **No Impact.** As discussed under Item 9a, b, c, and e above**,** the proposed project would not otherwise substantially degrade water quality.

g, h. **No Impact.** The proposed project is not located within a 100-year flood hazard area.[47] Although the proposed project would cross Dry Creek and add soundwalls adjacent to the Dry Creek 100-year floodplain, the proposed project would not encroach upon the floodplain. Existing tracks are elevated above the floodplain and track modifications near Dry Creek would only involve installation of rail turnouts. As such, there would be no 100-year floodplain impacts.

i. **Less than Significant Impact with Mitigation.** The project site is not located in an area subject to dam failure inundation; therefore, there would be no dam failure inundation

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[47] Federal Emergency Management Agency. *FIRM Flood Insurance Rate Map, Alameda County, California and Incorporated Areas*. Panels 427, 431, and 432 of 725; Community Numbers 060001, 065033, and 060014; Map Numbers 06001C0427G, 06001C0431G, and 06001C0432G. August 3, 2009

impacts.[48] The project site is not located within an area protected by levees. [49] However, drainage from the project site is routed to the AFCWCD Line D and Old Alameda Creek channels, both of which are partially leveed to protect adjacent areas from 100-year flooding. In many areas, the levees are provisionally accredited or do not contain the entire 100-year flood event. As such, increases in 100-year flow to these channels could contribute to or exacerbate a levee failure resulting in more off-site flooding. This is a potentially significant impact.

MITIGATION MEASURE. Implementation of Mitigation Measure HYD-1 would ensure that no increase in flood flows over existing conditions would occur with implementation of the proposed project. Potential off-site flooding impacts would thus be reduced to less-than-significant levels.

j. **Less than Significant Impact.** The project area is located approximately five miles inland from the eastern boundary of the San Francisco Bay. It is not located in an area subject to tsunamis,[50] nor is the project site down gradient of any large enclosed or semi-enclosed water bodies that could be subject to seiche effects.[51] As such, the proposed project would not be affected by a tsunami or a seiche. Additionally, the project site is not located near areas with steep slopes that would create mudflows; the project site is located over 900 feet down gradient of the nearest steep slopes and there is residential development between the project site and nearest steep slopes.[52] Although locally steep slopes exist on the project site to support tracks, these berms are engineered fill material and gravel ballast and are not subject to mudflows. Therefore, the potential for inundation by mudflows is low and the impact related to these hazards would be less than significant.

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[48] City of Hayward. *City of Hayward General Plan,* Safety Element Update, Appendix L Geologic and Seismic Hazards Maps: Plate 6 Tsunami and Dam Failure Inundation Hazards Map, p. L-4. General Plan adopted by City Council March 22, 2002 as amended through June 22, 2010 (Resolution 10-106).

[49] Federal Emergency Management Agency. *FIRM Flood Insurance Rate Map, Alameda County, California and Incorporated Areas.* Panels 427, 431, and 432 of 725; Community Numbers 060001, 065033, and 060014; Map Numbers 06001C0427G, 06001C0431G, and 06001C0432G. August 3, 2009

[50] City of Hayward. *City of Hayward General Plan,* Safety Element Update, Appendix L Geologic and Seismic Hazards Maps: Plate 6 Tsunami and Dam Failure Inundation Hazards Map, p. L-4. General Plan adopted by City Council March 22, 2002 as amended through June 22, 2010 (Resolution 10-106).

[51] While the San Francisco Bay could also be subject to seiches, the effect would not be as great as a tsunami.

[52] USGS. *Topographic Map, Union City, California* 1:24,000 scale. Updated July 1, 1998.

10. LAND USE AND PLANNING

Would the project:	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less-Than-Significant Impact	No Impact
a. Physically divide an established community?	☐	☐	☐	■
b. Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to, a general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?	☐	☐	☐	■
c. Conflict with any applicable habitat conservation plan or natural community conservation plan?	☐	☐	☐	■
d. Result in land use/operational conflicts between existing and proposed on-site or off-site land uses?	☐	☐	■	☐

Discussion

a. **No Impact.** Existing land uses in the project vicinity are industrial, parks and recreation, and low density residential. The west side expansion area is currently developed with industrial uses, and most of the east side expansion area is currently undeveloped. Both expansion areas are adjacent to UPRR rail lines and the BART Hayward Yard. Commercial and industrial properties border the project site to the south and west, industrial and open space to the north, and residential to the east. Redevelopment of the west side expansion area buildings and construction of storage tracks would not introduce a new physical barrier that would divide a neighborhood or business community with established physical connectivity and social/business interactions, since the project area is already divided by the BART mainline tracks, yard, and UPRR tracks. Therefore, the proposed project under both Phase 1 and 2 would have no impact in terms of physically dividing an established community.

b. **No Impact.** Even though this section describes the proposed project's consistency with local policies, California Government Code Section 53090 exempts rapid transit districts like BART from complying with local land use plans, policies, and zoning ordinances. Information from the local policy documents is presented here for informational purposes.

The City of Hayward General Plan designates the project site including both the west side and east side expansion areas as an Industrial Corridor, which allows planned business and industrial parks along with supporting office and commercial uses.[53] The project site is also zoned as Industrial by the City of Hayward. The proposed project's maintenance and vehicle storage areas would be consistent with the land use plan designations and zoning. Therefore, there would be no impact to applicable adopted plans.

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[53] City of Hayward, *City of Hayward General Plan*, Amended 2006, Appendix C: General Plan Land Use Map, pg. C-3. http://gis.hayward-ca.gov/pdf-maps/COH_General_Plan.pdf

The Union City General Plan designates the portion of the project area south of Whipple Road as Residential (R10–17). The trackwork area south of Whipple Road is also zoned Residential by the City of Union City. However, the portion of the project area that the City identifies as "residential" is, in fact, limited to the existing BART trackway, where modifications to the tracks are required to allow BART trains to switch from the mainline to the maintenance area. Typically, local jurisdictions utilize land use designations and/or zoning districts that allow for public utilities, railroad rights-of-way, flood control channels, and other types of infrastructure. In this case, neither the Union City General Plan nor Zoning Ordinance provide land use designations or districts for these uses. Instead, infrastructure uses throughout the Union City have been given whatever General Plan designation and zoning the adjacent land uses happen to have. This practice results in the anomalous designation and zoning of the existing BART mainline tracks and UPRR rail line right-of-way for "residential use." However, the existing land use for BART tracks is, in fact, not residential and the proposed project would not involve any use within Union City that is outside the existing use. Moreover, as noted above, BART is in any event exempt by State law from municipal General Plans and zoning ordinances. Accordingly, this inconsistency with Union City's General Plan and zoning ordinance is not considered to constitute a significant land use impact.

c. **No Impact.** The project site and vicinity are not included in either a habitat conservation plan or natural community conservation plan. Because such plans do not exist in the project area, there would be no impact.

d. **Less than Significant.** The project site and the trackwork area south of Whipple Road area are surrounded by a variety of uses, including commercial, industrial, and residential. Typical industrial uses include processing and manufacturing operations, warehouses, research laboratories, and wholesale establishments. The proposed project under both Phase 1 and 2 would be compatible with these uses and the proposed new storage tracks on the east side would not introduce new uses that would conflict with the operations of these uses. Activities associated with the project site include the storage, cleaning, and maintenance of BART vehicles and facilities. Activities associated with the trackwork area south of Whipple Road would be the same as currently exist. Impacts that are associated with land use character are addressed in other parts of this checklist: see Section 1, Aesthetics; Section 3, Air Quality; Section 12, Noise and Vibration; and Section 16, Transportation/Traffic. As noted in Section 12, Noise and Vibration, and above under Checklist Item b., there would be additional noise and vibration from the trackwork south of Whipple Road; however, with mitigation measures proposed in Section 12, impacts would be reduced to less than significant. Based on the discussion under these sections, along with the discussion here in this section, the project including Phases 1 and 2 would not be expected to cause land use/operational conflicts and thus would result in a less-than-significant land use impact.

11. MINERAL RESOURCES

Would the project:	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less-Than-Significant Impact	No Impact
a. Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?	☐	☐	☐	■
b. Result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan?	☐	☐	☐	■

Discussion

a, b. **No Impact.** The state requires local jurisdictions to protect areas with economically significant mineral resources from incompatible development. The California Division of Mines and Geology (under the authority of the Surface Mining and Reclamation Act of 1975) has classified aggregate mineral zones throughout the state. The only designated "sector" of regional significance in Hayward and Union City is La Vista Quarry, located in the unincorporated area east of Mission Boulevard and Tennyson Road.[54] This quarry is located approximately 1.14 miles from the project site. In addition, the California Division of Mines and Geology has classified the project site as Mineral Resource Zone (MRZ) 1. MRZ-1 is defined as "an area where adequate information indicated that no significant mineral deposits are present or where it is judged that little likelihood exists for their presence."[55] Therefore, no significant aggregate or mineral resources are located in either city, and therefore the proposed project would have no impact related to mineral resources.

12. NOISE AND VIBRATION

Would the project:	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less-Than-Significant Impact	No Impact
a. Expose persons to or generate noise levels in excess of standards established in a local general plan or noise ordinance?	☐	■	☐	☐
b. Expose persons to or generate excessive groundborne vibration or groundborne noise levels?	☐	■	☐	☐
c. Result in a substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?	☐	■	☐	☐

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[54] City of Hayward, *City of Hayward General Plan*, Amended June 2006, page 7-5.

[55] California Department of Conservation, Division of Mines and Geology, *Mineral Land Classification Map*, Newark Quadrangle.

Would the project:	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less-Than-Significant Impact	No Impact
d. Result in a substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?	☐	■	☐	☐
e. Be located within an airport land use plan area, or, where such a plan has not been adopted, within two miles of a public airport or public use airport and expose people residing or working in the project area to excessive noise levels?	☐	☐	☐	■
f. Be located in the vicinity of a private airstrip and expose people residing or working in the project area to excessive noise levels?	☐	☐	☐	■

Background

Noise Characteristics and Metrics. The principal source of noise in the study area is vehicular traffic from automobiles, buses, and trucks, and from BART train passbys and the nearby freight/Amtrak track. Noise has the potential to interrupt ongoing activities and result in community annoyance, especially in residential areas. Most noticeably, annoyance occurs when noise interferes significantly with activities such as sleeping, talking, and listening to the television, radio, or music. Transportation noise has been ranked among the most significant causes of community dissatisfaction.[56]

Sound is mechanical energy transmitted by pressure waves in a compressible medium such as air. Noise is typically considered to be unwanted sound. Humans are affected by three basic parameters of noise: amplitude, frequency, and time patterns. The amplitude, or loudness, of a sound depends on the fluctuations associated with a particular sound wave. Amplitude is expressed in terms of decibels (dB), with human hearing ranging from 20 dB to 120 dB. Typically, a change in sound level of 10 dB is perceived as doubling (or halving) the loudness.

The frequency, or tone or pitch, of a sound is described in terms of cycles per second or Hertz (Hz). The range of human hearing is between 20 Hz to 20,000 Hz with frequencies below 250 Hz and above 10,000 Hz being harder to hear. To account for this variation, three categories, or weighted curves, are used to represent how humans respond to normal, very loud, and extremely loud sounds (A-, B- and C-weighted curves, respectively). Typically, environmental noise falls into the "normal" category so the A-weighted curve is most widely accepted as the proper unit of measurement to represent the human response to environmental noise. A-weighted decibel sound levels are denoted as dBA.

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[56] Federal Transportation Authority (FTA). *Transit Noise and Vibration Impact Assessment*, FTA-VA-90-1003-06, May 2006.

The fluctuation of noise levels with respect to time variations is the third parameter. Environmental noise is typically a conglomeration of distant noise sources which result in a low-level background noise from which no individual noise source is prevalent or identifiable. The background noise remains relatively constant from moment to moment; however, it may vary from hour to hour as changes in human activity patterns occur. Loud, relatively brief noise from identifiable sources such as aircraft flyovers, screeching of brakes, and other short-term events, will cause the noise level to fluctuate distinctively from moment to moment.

Because of these fluctuations over time, it is common practice to combine all this information into a single value. To determine cumulative noise levels for residential land uses, the L_{dn} or Day-Night Sound Level is used. The L_{dn} is an A-weighted 24-hour L_{eq} which is adjusted by a 10 dB increase for all noise which occurs during the nighttime hours from 10:00 p.m. to 7:00 a.m. when sensitivity to noise is heightened.[57]

Vibration Characteristics and Metrics. Groundborne vibration is an oscillatory motion that can be described in terms of the displacement, velocity, or acceleration of the motion. When evaluating human response, groundborne vibration is usually expressed in terms of decibels.[58] To avoid confusion with sound decibels, the abbreviation VdB is used for vibration decibels.

The perception level for humans is approximately 65 VdB, with the typical background vibration velocity in residential areas of 50 VdB. The range of vibration velocity that is of interest is between approximately 50 VdB and 100 VdB. Although perceptible at 65 VdB, typically vibration is not considered significant until it exceeds 70 VdB. Under ideal conditions, rapid transit systems typically generate vibration levels of 70 VdB or more near their tracks. However, wheel flats, uneven or rough track, and geologic conditions can increase vibration levels by up to 10 VdB; therefore, the upper range for rapid transit vibration is around 80 VdB; for commuter rail, 85 VdB.

Activities such as construction, including blasting and pile-driving, buses on rough roads, and trains can result in groundborne vibration. Annoyance from vibration can occur when the vibration is only marginally perceptible, and is well below the damage threshold for normal buildings. Although there has been relatively little research into human and building response to groundborne vibration from construction, there is substantial experience with vibration from rail systems. In general, the collective experience indicates that:

- Groundborne vibration from rail systems almost never results in building damage, even minor cosmetic damage. The primary consideration, therefore, is whether vibration will be intrusive to building occupants or will interfere with sensitive interior activities or machinery.
- The threshold for human perception is approximately 65 VdB. Vibration levels in the range of 70 to 75 VdB are often noticeable but acceptable. Above 80 VdB, vibration levels are often considered unacceptable.

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[57] The L_{eq} is an average or constant sound level over a given period that would have the same sound energy as the time-varying A-weighted sound over the same period. The period is typically taken over 1 hour and represented as Leq(h).

[58] All vibration decibels in this report use a decibel reference of 1 micro-inch/second (μin/sec), where one μin/sec = 10^{-6} in/sec.

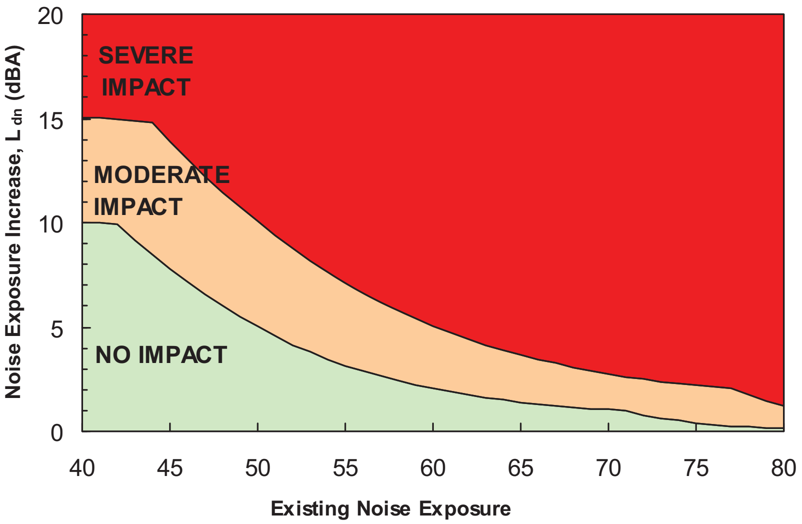
- There is a relationship between the number of daily events and the degree of annoyance caused by groundborne vibration. Transit operations are classified as having frequent events (>70 trains/day), occasional events (30-70 trains/day), or infrequent events (<30 trains/day).[59] Those systems with more events have more stringent (lower) impact thresholds. BART is considered a system with frequent events.

Noise and Vibration Criteria. BART has adopted the FTA thresholds for noise and vibration impacts as part of the BART Facilities Standards.

Noise. There are no FTA criteria for construction noise impacts and no limits on construction noise. However, the FTA guidance suggests that noise impacts will occur in residential areas if construction noise causes daytime 8-hour L_{eq} to exceed 80 dBA or the nighttime 8-hr L_{eq} to exceed 70 dBA.[60]

For operational noise, the delineation of noise impacts represented graphically in Figure 12 from the FTA Guidance Manual and numerically in Table 6 applies to all rail projects, including rail rapid transit, light rail transit, commuter rail, and automated guideway transit, as well as fixed facilities such as storage, maintenance yards, passenger stations and terminals, parking facilities, and substations. As seen in Table 6 and Figure 12, noise impacts are based on a comparison of existing outdoor noise levels and future outdoor noise levels from the proposed project. Furthermore, the criteria for noise impacts allow for a project to generate more noise in areas with lower existing noise levels, before triggering an adverse human response.

Figure 12 FTA Noise Impact Criteria for Transit Projects



Source: FTA, *Transit Noise and Vibration Impact Assessment*, FTA-VA-90-1003-06, May 2006, pp. 3-6.

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[59] FTA. *Transit Noise and Vibration Impact Assessment*, FTA-VA-90-1003-06, May 2006.

[60] FTA. *Transit Noise and Vibration Impact Assessment*, FTA-VA-90-1003-06, May 2006.

Table 6
Noise Levels Defining Impact for Transit Projects

Existing Noise Exposure[1] L_{eq}(h) or L_{dn} (dBA)	Project Noise Impact Exposure, L_{eq}(h) or L_{dn} (dBA)[1]					
	Category 1 or 2 sites[2]			Category 3 Sites[2]		
	No Impact	Moderate Impact	Severe Impact	No Impact	Moderate Impact	Severe Impact
59	< 58	58-63	> 63	< 63	63-68	> 68
60	< 58	58-63	> 63	< 63	63-68	> 68
61	< 59	59-64	> 64	< 64	64-69	> 69
62	< 59	59-64	> 64	< 64	64-69	> 69
63	< 60	60-65	> 65	< 65	65-70	> 70
64	< 61	61-65	> 65	< 66	66-70	> 70
65	< 61	61-66	> 66	<66	66-71	> 71
66	< 62	62-67	> 67	< 67	67-72	> 72
67	< 63	63-67	> 67	< 68	68-72	> 72
68	< 63	63-68	> 68	< 68	68-73	> 73

Source: FTA, *Transit Noise and Vibration Impact Assessment*, FTA-VA-90-1003-06, May 2006, pp. 3-4.

1. L_{dn} is used for land use where nighttime sensitivity is a factor; L_{eq} during the hour of maximum transit noise exposure is used for land use involving only daytime activities.
2. Category 1 sites where quiet is essential, such as outdoor amphitheaters; Category 2 sites include residences and buildings where people normally sleep such as homes, hospitals, and hotels; Category 3 sites include schools, libraries, and churches where quiet in outdoor spaces in important.

The FTA defines three levels of noise impact: no impact, moderate, and severe. In accordance with the FTA Guidance Manual, noise mitigation must be investigated for moderate and severe impacts. The Manual also states that for severe impacts "… there is a presumption by the FTA that mitigation will be incorporated in the project unless there are truly extenuating circumstances which prevent it." The FTA allows more discretion for mitigation of moderate impacts, based on consideration of factors that include cost, number of sensitive receptors affected, community views, the amount that the predicted levels exceed the impact threshold, and the sensitivity of the affected receptors. The FTA noise impact criteria are given in tabular format in Table 7 with the thresholds rounded off to the nearest decibel.

Table 7
Noise Impact Criteria: Effect on Cumulative Noise Exposure

L_{dn} or L_{eq} in dBA (rounded to the nearest whole decibel)			
Existing Noise Exposure	Allowable Project Noise Exposure	Allowable Combined Total Noise Exposure	Allowable Noise Exposure Increase
45	51	52	7
50	53	55	5
55	55	58	3
60	57	62	2
65	60	66	1
70	64	71	1
75	65	75	0

Source: FTA, *Transit Noise and Vibration Impact Assessment*, FTA-VA-90-1003-06, May 2006, pp. 3-7.

Vibration. The FTA vibration impact criteria are based on the maximum indoor vibration level as a train passes. There are no impact criteria for outdoor spaces such as parks. Table 8 shows the FTA General Assessment criteria for groundborne vibration from rail transit systems. With greater than 70 trains per day (estimated over 300 cumulative for the project), the threshold for residential buildings (Category 2) is 72 VdB.

The FTA vibration thresholds do not specifically account for existing vibration. Although arterial roadways in the study area have substantial volumes of vehicular traffic including trucks and buses, rubber-tired vehicles rarely generate perceptible ground vibration unless there are irregularities in the roadway surface, such as potholes or wide expansion joints. As such, it is expected that there are few if any locations along the project site where traffic-generated groundborne vibration is perceptible.

Table 8
FTA Impact Thresholds for Groundborne Vibration

	Groundborne Vibration (VdB re 1 micro inch/sec)		
Land Use Category[1]	**Frequent Events**[2]	**Occasional Events**[3]	**Infrequent Events**[4]
Category 1. Buildings where vibration would interfere with interior operations.	65 VdB	65 VdB	65 VdB
Category 2. Residences and buildings where people normally sleep.	72 VdB	75 VdB	80 VdB
Category 3. Institutional land uses with primarily daytime use.	75 VdB	78 VdB	83 VdB

Source: FTA, *Transit Noise and Vibration Impact Assessment*, FTA-VA-90-1003-06, May 2006, pp. 8-3.

Notes:

1. Note that the FTA land use categories for vibration impacts are different than the land use categories for noise impacts. The primary difference applicable to this project is that noise Category 3 includes outdoor land uses, such as parks, and vibration Category 3 applies exclusively to indoor land uses. This is because vibration is an issue only for building occupants. Train vibration is rarely intrusive to observers who are outdoors.
2. Frequent events are defined as more than 70 vibration events per day.
3. Occasional events are defined as between 30 and 70 events per day.
4. Infrequent events are defined as less than 30 events per day.

For the evaluation of construction vibration impacts, BART follows criteria developed by the FTA. These criteria are reported in Table 9.

Table 9
Vibration Damage Impact Criteria during Construction

Land Use	**Acceptable Vibration Levels (VdB)**	**Acceptable Peak Particle Velocity (in/sec)**
Reinforced-concrete, steel or timber (no plaster)	102	0.5
Engineered concrete and masonry (no plaster)	98	0.3
Non-Engineered timber and masonry buildings	94	0.2
Buildings extremely susceptible to vibration damage	90	0.12

Source: FTA, *Transit Noise and Vibration Impact Assessment, Final Report*, May 2006.

Discussion

a, c, d. Less than Significant with Mitigation Incorporated. Increases in ambient noise levels are anticipated during construction and post-construction of the HMC project.

BART operates trains in the project area seven days a week with 204 daytime trains and 52 nighttime trains. Two proposed BART extension projects, the Warm Springs Project and the Silicon Valley Rapid Transit Project, are expected to increase train traffic in the project area by 59 trains daily. The noise analysis is based on these future train volumes. The impact assessment is based on a comparison of the increased levels (L_{dn}) associated with BART operations and the FTA impact thresholds.

Noise from BART operations as part of the proposed project includes BART train movements on proposed tracks and crossovers, and a power substation proposed at the south end of the project site (east side) to provide power to the storage tracks. The reference sound exposure level (SEL) specified in the FTA guidance manual is 118 dBA for 20 train movements during peak hour activities. The east side expansion project proposes adding 40 train movements per day and 20 movements during night hours to the existing train movements at the Hayward Yard. The unshielded noise levels from the traction power substation were projected to nearby residences. The reference SEL used in the calculation for the traction power substation was 99 dBA at 50 feet, based on FTA guidelines.[61]

Operational Noise from Train Movements South of Whipple Road. Table 9 and Table 10 show the projected cumulative noise levels from train operations and the proposed project under Phase 1 and Phase 2, respectively. Projected noise levels in the tables include the effect of BART train operations on the mainline (future schedule), and BART operations on the new crossovers (including future test track operations). The discussion below is based on the *Noise and Vibration Technical Report* by Wilson, Ihrig & Associates, Inc.[62]

Phase 1. There would be a potential for moderate impacts on three single-family residences located on 11th Street due to the proximity to crossover P100 in the track modification area south of Whipple Road (see Figure 13). There would also be a potential for moderate impacts to 14 single-family residences located on Alicante Terrace and Carrara Terrace due to the proximity to crossover P102. Potential noise increases at Alicante Terrace and Carrara Terrace would be between 2.0 to 2.7 dBA L_{dn} above ambient conditions (see Table 10). This would constitute a significant impact.

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[61] BART specifications for their substations follow the National Electrical Manufacturers Association (NEMA) rating. The maximum NEMA ratings, which are specified in terms of the average sound level, are 60 dBA for a self-cooled ventilated system, 59 dBA for a self-cooled sealed system, and 67 dBA for a ventilated forced-air cooled system. These sound levels are quieter than those specified in the FTA guidance. Therefore, following the FTA procedure results in a more conservative analysis for the project.

[62] Wilson, Ihrig & Associates, Inc. *BART-Hayward Maintenance Complex Noise and Vibration Technical Report*, November 22, 2010.

Phase 1

Phase 2

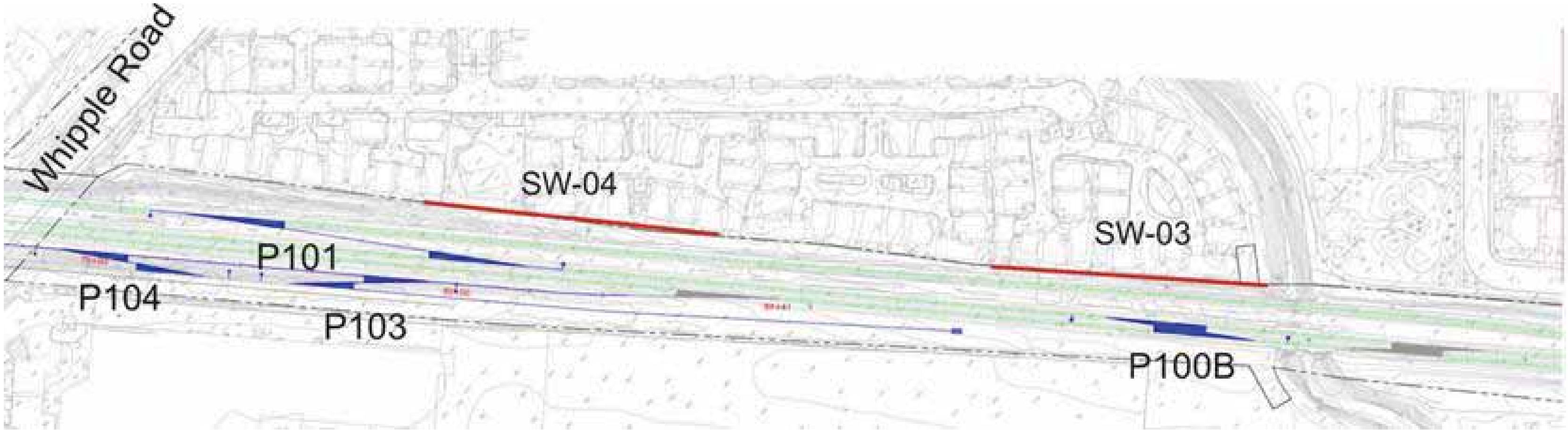


FIGURE 13
Location and Minimum Recommended Extent of Sound Wall for Phase 1 and Phase 2

Source: WIA, 2010.

Table 10
Noise Impacts from Phase 1 South of Whipple Road

Location	Distance[1] (ft)	Ambient Level (L_{dn}/L_{eq})[2]	FTA Criteria[3] M / S	Projected L_{dn}/L_{eq} (dBA)[2,4]	Increase (dBA)	Projected L_{dn} (dBA) After Mitigation[5]	Impact Before Mitigation /Impact After Mitigation (Number of Buildings with Impact)
11th Street between Stone Street and Boyle Street	135 xo	60	2.0/5.0	62	2.0	---	Less than Significant
11th Street and Boyle Street	140 xo	60	2.0/5.0	63	2.7	62	Potentially Significant (3)/Less than Significant
Dry Creek Park	120 xo	60	4.6/9.0	63	2.8	---	Less than Significant
La Brea Terrace	75	62	1.7/4.4	64	1.6	---	Less than Significant
Alicante Terrace	75 xo	62	1.7/4.4	65	2.7	64	Potentially Significant (7)/Less than Significant
Carrara Terrace	80 xo	62	1.7/4.4	64	2.0	63	Potentially Significant (7)/Less than Significant
Messina Terrace	85	62	1.7/4.4	63	0.5	---	Less than Significant
La Bonita Terrace	90	63	1.6/4.1	63	0.0	---	Less than Significant

Source: Wilson, Ihrig & Associates, Inc., 2010.

Notes:

1. Distance from residential land use to centerline of nearest track. If the track involves a crossover switch, the distance is measured to the crossover which is designated as "xo."
2. L_{dn} is the metric for FTA Category 2 sensitive receptors. L_{eq} is the metric for FTA Category 3 sensitive receptors.
3. Threshold increase in decibels for (M)oderate and (S)evere impacts.
4. Projected noise includes noise levels from future BART trains on mainline, crossover, and test track.
5. As shown in Table 13 of this document.

Phase 2. There would be a potential for severe impacts on nine single-family residences located on La Brea Terrace due to the noise increase associated with the BART trains from crossover P100B and the distance from the crossover to the residences. Additionally, there would be a potential for moderate impacts to six single-family homes located on Carrara Avenue due to crossover P101 that would connect to the northbound mainline with the test track. Potential noise increases to residences on La Brea Terrace and Carrara Avenue would be between 2.5 to 4.7 dBA L_{dn} above ambient conditions (see Table 11). This would constitute a significant impact.

Additional homes on Messina Terrace and La Bonita Terrace are sufficiently near the crossover to be impacted; however, noise levels from the operation of crossover 101 would be less than significant because of the existing sound wall. Therefore, no noise impact is anticipated to Messina Terrace and La Bonita Terrace residences.

Table 11
Noise Impacts from Phase 2 South of Whipple Road

Location	Distance[1] (ft)	Ambient Level (L_{dn}/L_{eq})[2]	FTA Criteria[3] M / S	Projected L_{dn}/L_{eq} (dBA)[2,4]	Increase (dBA)	Projected L_{dn} (dBA) After Mitigation[5]	Impact Before Mitigation /Impact After Mitigation (Number of Buildings with Impact)
11th Street between Stone Street and Boyle Street	135 xo	60	2.0/5.0	61	1.4	---	Less than Significant
11th Street and Boyle Street	140 xo	60	2.0/5.0	62	1.7	---	Less than Significant
Dry Creek Park	120 xo	60	4.6/9.0	62	1.8	---	Less than Significant
La Brea Terrace	75 xo	62	1.7/4.4	67	4.7	64	Potentially Significant (9)/ Less than Significant
Alicante Terrace	75 xo	62	1.7/4.4	64	1.5	---	Less than Significant
Carrara Terrace	80 xo	62	1.7/4.4	65	2.5	63	Potentially Significant (6)/ Less than Significant
Messina Terrace	85 xo	62	1.7/4.4	63	1.4	---	Less than Significant
La Bonita Terrace	90 xo	63	1.6/4.1	63	0.4	---	Less than Significant

Source: Wilson, Ihrig & Associates, Inc., 2010.

Notes:

1. Distance from residential land use to centerline of nearest track. If the track involves a crossover switch, the distance is measured to the crossover which is designated as "xo."
2. L_{dn} is the metric for FTA Category 2 sensitive receptors. L_{eq} is the metric for FTA Category 3 sensitive receptors.
3. Threshold increase in decibels for (M)oderate and (S)evere impacts.
4. Projected noise includes noise levels from future BART trains on mainline, crossover, and test track.
5. As shown in Table 14 of this document.

North of Whipple Road, the project would slightly increase the cumulative noise levels at nearby single-family residences due to trains on the aerial flyover. However, the increase would be below the threshold for moderate impacts. As a result, BART operations on the aerial guideway would be less than significant.

Operational Noise from Facilities North of Whipple Road (Train Storage, West Side Expansion, Traction Power Substation, and enhanced Vehicle Inspection Area) under Phase 1 and Phase 2. The assessment of cumulative noise impact resulting from the proposed project is presented in Table 12. Noise levels for this analysis account for train movements at lower speed during storage, noise from the power substation, operations on the aerial structures for the dispatch flyover, operations at the west side expansion area, and operations at the enhanced Vehicle Inspection Area. Due to BART operations on the proposed storage tracks and other tracks associated with it, there would be a slight increase in noise levels for nearby residences, between 0.1 and 1.1 dBA over the existing ambient noise. Because the increase would not exceed the threshold of significance for these residences, the impact would be less than significant.

Table 12
Noise Impacts from Train Storage, West Side Expansion, and Traction Power Substation for Phase 1 and Phase 2 North of Whipple Road

Location	Distance[1] (ft)	Ambient Level (L_{dn})	FTA Criteria[2] M / S	Projected[3] L_{dn} (dBA)	Increase (dBA)	Impact (Number of Buildings with Impact)
Ithaca Avenue between Whipple Road and Troy Place	630 – 2,900	70	1.0/2.8	70	0.1	Less than Significant
Carroll Avenue between Troy Place and Gresel Street	320 – 1,400	69	1.1/2.9	69	0.3	Less than Significant
Carroll Avenue between Gresel Street and Becker Place	170 – 1,100	67	1.2/3.1	68	1.1	Less than Significant
Carroll Avenue between Becker Place and Fairway Street	200 – 1,400	67	1.2/3.1	68	1.0	Less than Significant
Carroll Avenue north of Fairway Street	370 – 2,500	67	1.2/3.1	67	0.2	Less than Significant

Source: Wilson, Ihrig & Associates., Inc., 2010.

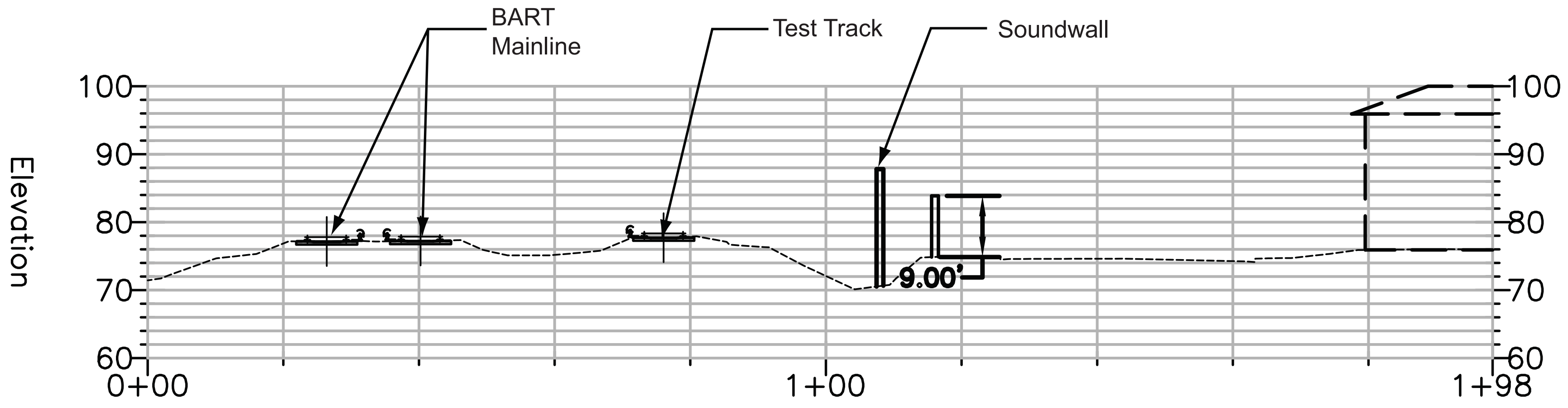
Notes:

1. Range of typical distance from residential land use to nearest track.
2. Threshold increase in decibels for (M)oderate and (S)evere impacts.
3. Projected noise includes noise levels from future BART trains on mainline, crossover, and test track.

MITIGATION MEASURES. The two primary factors that reduce levels of environmental sounds are increasing the distance between the sound source and the receiver and/or having intervening obstacles such as walls, buildings, or terrain features block the direct path between the sound source and the receiver. Mitigation Measure NO-1 recommends the construction of sound walls to mitigate noise for ground-level receptors. Figure 13 illustrates the probable location of sound walls according to the preliminary noise analysis. Figure 14 illustrates the conceptual cross-section for sound walls under Phase 1. Sound walls under Phase 2 would be similar to the sound walls presented for Sound Wall 2 (SW02) under Phase 1. Final height and location of sound walls would be determined during final design.

Mitigation Measure NO-2 recommends additional mitigation measures to reduce interior noise levels for the upper stories of the residential homes, if that proves necessary. The interior noise levels for residents south of Whipple Road with two or more stories that are facing the BART right-of-way would potentially remain exposed to noise levels higher than 45 dBA L_{dn} even with the recommended sound walls in Tables 13 and 14. These residences should be considered for building noise insulation as additional mitigation. To achieve an interior noise level equivalent to 45 dBA L_{dn} or less, the window(s) must provide a sound transmission class (STC) greater than 27. Based on field observations, the current construction elements of the residential structures south of Whipple Road may provide an STC rating greater than 27. Therefore, future train operations from the proposed project may comply with the indoor 45 dBA L_{dn} and additional sound insulation may not be necessary. Since it is not possible to verify

SW01 Profile



SW02 Profile

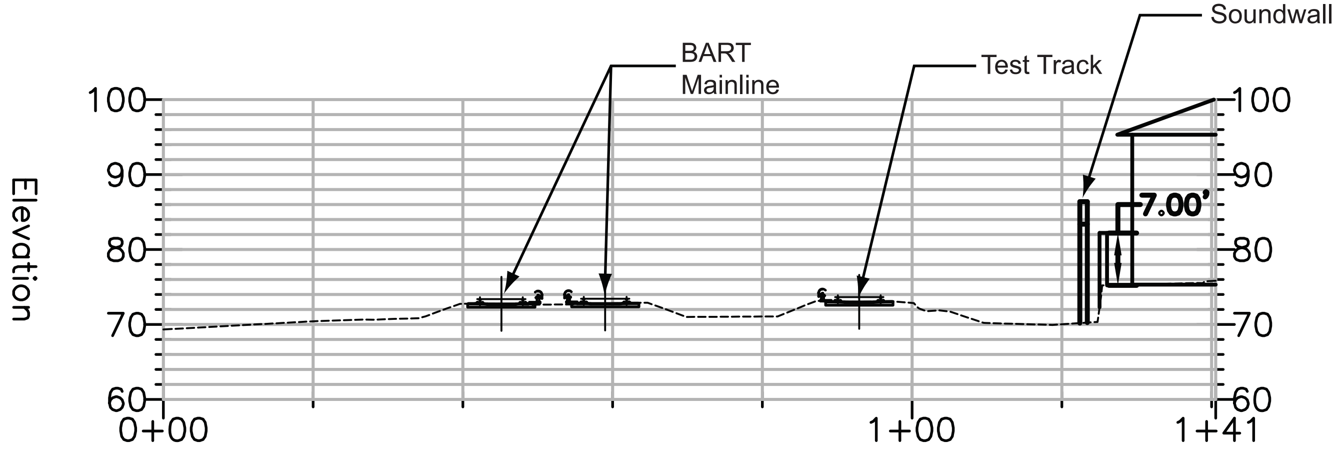


FIGURE **14**

Conceptual Cross-Sections for Proposed Sound Walls under Phase 1

Source: BART, 2010.

this condition at the present time, BART would evaluate compliance with the proposed indoor criteria once the proposed project has been implemented. The following mitigation measures would reduce operational noise impacts from train movements to less than significant.

NO-1 *Construction of Sound Walls.* BART shall incorporate sound walls at the BART right-of-way line or other locations that mitigate the noise impacts indicated in Table 13 and Table 14 of this IS/MND. Implementation of sound walls will provide approximately 10 dBA reduction in overall noise levels. Concrete block masonry, poured-in-place, or pre-cast concrete walls would be acceptable as construction materials provided they have a minimum surface density of 4 lbs/ft^2. The specific location of sound walls will be addressed in final design. Sound walls will be constructed in phases as necessary to reduce noise as components of the project are constructed.

NO-2 *Installation of Building Sound Insulation Features.* For those receptors where the outdoor wayside noise from the train operations at ground level can be mitigated to achieve the FTA criteria, but the sound walls provided by Mitigation Measure NO-1 are not sufficient to mitigate noise levels at upper stories, BART will measure operational noise levels on a case-by-case basis following project implementation. Where the existing building construction does not provide interior noise levels of Ldn 45 dBA or lower, BART will quantitatively evaluate individual structures and implement a formal program of building sound insulation improvement as necessary to meet this criterion.

Construction Noise. Construction would temporarily increase noise levels at the adjacent land uses. Noise impacts resulting from construction activities depend on the various pieces of construction equipment, timing, duration of activities, and distance between noise sources and receptors. Highest noise levels typically occur during excavation, grading, and pile driving activities, with lower noise levels during building construction and paving. It is estimated that noise levels during project construction with the use of heavy equipment would typically range between 61 to 85 dBA, depending on the distance of the construction activity to the noise sensitive receptor. As noted in the Project Description, in order to reduce impacts from construction noise, BART would install three of the four sound walls (SW01, SW02, and SW03) recommended to mitigate operational noise to the adjacent residential uses prior to the start of track construction. The recommended fourth sound wall (SW04) is not required for noise mitigation until Phase 2, and is not included in the construction analysis. Table 15 and Table 16 show the projected range of noise levels expected from the use of heavy equipment during construction and track installation for the project during Phase 1 and Phase 2, respectively. The tables present the range of noise levels expected for each group of receptors. Results of the analysis show that residential receptors located within 75 feet of heavy equipment during daytime construction would be exposed to a potentially significant noise impact. This distance would be extended to 190 feet (unobstructed) if construction activities are conducted during nighttime.

Table 13
Sound Wall Mitigation – Phase 1

	SW #	SW[1] Height (ft)	SW length (ft)	FTA Criteria[2] M/S	Projected[3] L_{dn} (dBA)	Increase (dBA)	Residual Impact after Mitigation
11th Street between Stone Street and Boyle Street	---	---	---	2.0 /5.0	---	---	---
11th Street and Boyle Street	SW01	10	320	2.0 /5.0	62	1.7	Less than Significant
Dry Creek Park	---	---	---	4.6/9.0	---	---	---
La Brea Terrace	---	---	---	1.7/4.4	---	---	---
Alicante Terrace	SW02	10	320	1.7/4.4	64	1.7	Less than Significant
Carrara Terrace	SW02	13	340	1.7/4.4	63	1.3	Less than Significant
Messina Terrace	---	---	---	1.7/4.4	---	---	---
La Bonita Terrace	---	---	---	1.6/4.1	---	---	---

Source: Wilson, Ihrig & Associates, Inc., 2010.

Notes:

1. Approximate height from BART top-of-rail.
2. Threshold increase in decibels for (M)oderate and (S)evere impacts.
3. Projected noise includes noise levels from future BART trains on mainline, crossover, and test track.

Table 14
Sound Wall Mitigation – Phase 2

	SW #	SW[1] Height (ft)	SW length (ft)	FTA Criteria[2] M/S	Projected[3] L_{dn} (dBA)	Increase (dBA)	Residual Impact after Mitigation
11th Street between Stone Street and Boyle Street	---	---	---	2.0 / 5.0	---	---	---
11th Street and Boyle Street	---	---	---	2.0 / 5.0	---	---	---
Dry Creek Park	---	---	---	4.6/9.0	---	---	---
La Brea Terrace	SW03	9	380	1.7/4.4	64	1.4	Less than Significant
Alicante Terrace	---	---	---	1.7/4.4	---	---	---
Carrara Terrace	SW04	14	410	1.7/4.4	63	1.3	Less than Significant
Messina Terrace	---	---	---	1.7/4.4	---	---	---
La Bonita Terrace	---	---	---	1.6/4.1	---	---	---

Source: Wilson, Ihrig & Associates, Inc., 2010.

Notes:

1. Approximate height from BART top-of-rail.
2. Threshold increase in decibels for (M)oderate and (S)evere impacts.
3. Projected noise includes noise levels from future BART trains on mainline, crossover, and test track.

Table 15
Projected Construction Noise Impacts – Phase 1

	Distance to Construction (ft)		Criteria		Projected Noise Levels from Heavy Equipment Construction and Track Installation Without Noise Control, L_{eq} (dBA)[1]									
					Heavy Equipment					Track Installation				
							Impact Type					Impact Type		
Location	Nearest	Farthest	Day	Night	Nearest	Farthest	Day	Night	# Impacts	Nearest	Farthest	Day	Night	# Impacts
11th Street between D Street and Stone Street	500	500	80	70	62	62	LTS	LTS	0	66	66	LTS	LTS	0
11th Street between Stone Street and Boyle Street	400	400	80	70	64	64	LTS	LTS	0	68	68	LTS	LTS	0
11th Street and Boyle Street	150	300	80	70	64	64	LTS	LTS	0	62	56	LTS	LTS	0
La Brea Terrace	170	550	80	70	63	53	LTS	LTS	0	61	50	LTS	LTS	0
Alicante Terrace	85	550	80	70	69	53	LTS	LTS	0	67	50	LTS	LTS	0
Carrara Terrace	85	500	80	70	69	54	LTS	LTS	0	67	51	LTS	LTS	0
Messina Terrace	120	250	80	70	67	61	LTS	LTS	0	65	59	LTS	LTS	0
La Bonita Terrace	150	350	80	70	65	58	LTS	LTS	0	63	56	LTS	LTS	0
Ithaca Street between Whipple Road and Carroll Avenue	540	650	80	70	61	59	LTS	LTS[2]	0	66	64	LTS	LTS[2]	0
Carroll Avenue between Troy Place and Gresel Street	540	650	80	70	61	59	LTS	LTS[2]	0	66	64	LTS	LTS[2]	0
Carroll Avenue between Gresel Street and Becker Place	540	650	80	70	61	59	LTS	LTS[2]	0	66	64	LTS	LTS[2]	0
Carroll Avenue between Becker Place and Fairway Street	660	660	80	70	59	59	LTS	LTS[2]	0	64	64	LTS	LTS[2]	0
Carroll Avenue north of Fairway Street	660	660	80	70	59	59	LTS	LTS[2]	0	64	64	LTS	LTS[2]	0

Source: Wilson, Ihrig & Associates, Inc., 2010.

Notes:

Day: from 7 am to 10 pm.

Night: from 10 pm to 7 am.

Impacts = # of residences affected

PS: Potentially Significant Impact

LTS: Less than Significant Impact

1. Includes the effects of existing sound walls and new project sound walls SW01, SW02, and SW03 implemented at the start of construction. See Figure 13 for location of sound walls.
2. Includes a 50-foot buffer of no construction activities north of Whipple Road along the eastern property line to maintain construction activities below the nighttime noise criteria.

Table 16
Projected Construction Noise Impacts - Phase 2

Location	Distance to Construction (ft)		Criteria		Projected Noise Levels from Heavy Equipment Construction and Track Installation Without Noise Control, L_{eq} (dBA)[1]													
					Heavy Equipment									Track Installation				
							Impact Type					Impact Type				Impact Type		
	Nearest	Farthest	Day	Night	Nearest	Farthest	Day	Night	# Impacts	Distance to Pile Driving	Level	Day	Night	Nearest	Farthest	Day	Night	# Impacts
11th Street between D Street and Stone Street	500	500	80	70	62	62	LTS	LTS	0	2600	55	LTS	N/A[4]	66	66	LTS	LTS	0
11th Street between Stone Street and Boyle Street	320	320	80	70	66	66	LTS	LTS	0	2400	55	LTS	N/A[4]	70	70	LTS	LTS	0
11th Street and Boyle Street	350	500	80	70	57	54	LTS	LTS	0	2200	56	LTS	N/A[4]	54	51	LTS	LTS	0
La Brea Terrace	75	250	80	70	70	60	LTS	LTS	0	1500	59	LTS	N/A[4]	68	57	LTS	LTS	0
Alicante Terrace	180	300	80	70	63	58	LTS	LTS	0	1300	61	LTS	N/A[4]	60	56	LTS	LTS	0
Carrara Terrace	80	300	80	70	70	58	LTS	LTS	0	1000	63	LTS	N/A[4]	67	56	LTS	LTS	0
Messina Terrace	60	300	80	70	73	59	LTS	PS	7	600	67	LTS	N/A[4]	71	57	LTS	PS	7
La Bonita Terrace	60	250	80	70	73	61	LTS	PS	8	400	71	LTS	N/A[4]	71	59	LTS	PS	8
Ithaca Street between Whipple Road and Carroll Avenue	150	400	80	70	72	64	LTS	N/A[3]	0	400	71	LTS	N/A[3,4]	77	68	LTS	N/A[2]	0
Carroll Avenue between Troy Place and Gresel Street	150	350	80	70	72	65	LTS	N/A[3]	0	400	71	LTS	N/A[3,4]	77	69	LTS	N/A[2]	0
Carroll Avenue between Gresel Street and Becker Place	200	300	80	70	70	66	LTS	N/A[3]	0	300	73	LTS	N/A[3,4]	74	71	LTS	N/A[2]	0
Carroll Avenue between Becker Place and Fairway Street	150	400	80	70	72	64	LTS	N/A[3]	0	350	72	LTS	N/A[3,4]	77	68	LTS	N/A[2]	0
Carroll Avenue north of Fairway Street	150	350	80	70	72	65	LTS	N/A[3]	0	1400	60	LTS	N/A[3,4]	77	69	LTS	N/A[2]	0

Table 16
Projected Construction Noise Impacts - Phase 2

Source: Wilson, Ihrig & Associates, Inc., 2010.

Notes:

Day: from 7 am to 10 pm.

Night: from 10 pm to 7 am.

Impacts = # of residences affected

PS: Potentially Significant Impact

LTS: Less than Significant Impact

N/A: Not Applicable. Since track installation would not affect the mainline and would be conducted during the daytime, no nighttime noise impacts have been evaluated.

1. Includes the effect of existing sound walls and new project sound walls SW01, SW02, and SW03 implemented at the start of construction. See Figure 13 for location of sound walls.
2. Since track installation activities in this area would not affect the mainline and would thus be conducted during the daytime, no nighttime noise impact has been evaluated.
3. No nighttime work would be conducted north of Whipple Road.
4. No pile driving would be conducted at night for the flyover construction.

During Phase 1, the typical noise levels from heavy equipment would range from 53 to 72 dBA at the location of sensitive receptors. As presented in Table 15, with the existing and proposed sound walls at Innovation Homes,[63] residences would experience less-than-significant construction noise impacts. Additionally, residences along 11th Street would experience less-than-significant noise impacts during construction of Phase 1.

During Phase 2, the use of heavy equipment during construction would also generate potentially significant impacts in the Innovation Homes development, specifically along Messina Terrace and La Bonita Terrace.

The use of ballast tamping and ballast regulators (for track installation) would result in less-than-significant noise impacts during Phase 1 at all residences. During Phase 2, activities involving track installation would be carried out at night and temporary impacts would occur for residences within 75 feet. An estimated 15 single-family homes at the Innovation Homes development could be significantly impacted by nighttime construction.

Construction of the flyovers would take place during Phase 2 and could include the use of sonic or vibratory pile drivers, which in general produce lower noise levels than an impact pile driver. However, vibratory pile drivers can generate high levels of noise if not shielded properly. The noise levels presented in Table 16 include the noise from pile driving for the aerial structures.

Pile driving is expected to exceed the FTA noise criterion for residential receptors within 140 feet of operation during daytime hours. If pile driving is scheduled at night (between the hours of 10:00 p.m. to 7:00 a.m.) the area of impact could be extended up to 420 feet from the alignment right-of-way. However, since no nighttime work would be conducted north of Whipple Road for Phase 2, based on the alignment for the flyovers, which are approximately 300 feet or more from the residential homes, the impact would beless than significant.

Staging areas are proposed on the expansion area and on the existing storage area south and west of the project site. Noise from the staging areas would potentially cause a significant impact for homes within 70 feet of the staging area's property line during daytime hours and 200 feet during nighttime. Some of the residential homes that are located along Ithaca Street (specifically on Margo Court, Edna Court, Wendy Court, Fay Court, and Kathy Court) are located approximately 150 feet from the southeast staging area. To ensure that those homes do not experience significant nighttime noise impacts, a buffer zone of approximately 50 feet will be maintained where no noise-generating activity would be permitted during nighttime construction. The buffer zone would extend along the property line within the BART property and would be sufficiently wide to ensure that a minimum of 200 feet is maintained between the staging area and the nearby homes. With implementation of the buffer zone, construction noise impacts from the staging areas would be less than significant.

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[63] Innovation Homes is the single-family community in Union City east of the BART racks, south of Whipple Road and north of Dry Creek.

Trucks would be required to transport equipment and supplies. The California Vehicle Code limits vehicle noise emission levels of new highway trucks built after 1987 to 80 dBA at a distance of 50 feet from the centerline of travel under any condition of operation, including acceleration and deceleration, in any gear. Older, noisier trucks may still be in use, but it is reasonable to assume that contractor's trucks meet current regulations for new trucks.

Generally, trucks would access the project site from Whipple Road east of the BART mainline tracks, which is approximately 150 feet from residences along Ithaca Street. Noise levels at residences could reach up to 63 dBA resulting in a less-than-significant impact. For the purpose of this assessment, about 20 trucks per hour (1 minute each) were assumed. It was also assumed that trucks would idle for no more than 5 minutes consistent with Mitigation Measure AQ-2 for mitigation of construction air quality impacts.

For construction activities occurring south of Whipple Road or for equipment too large to go under the Whipple Road Bridge, access is being considered at three locations. Assuming five to six trucks per day accessing the site, the residences north of Dry Creek would experience noise levels of approximately 57 dBA or lower, which is not a significant impact. If the F Street access option is selected, a temporary access road may need to be constructed along the west side of the BART mainline. The nearest sensitive receptors would be 50 feet or more from this road, resulting in a noise level below 50 dBA and, therefore, no impact would occur.

Audible backup alarms on moving equipment may generate neighborhood complaints because the sound of the alarm is tonal, since it is meant to be heard and to attract attention. Backup alarms for haul trucks must be audible above the surrounding ambient noise level at a distance of up to 200 feet.[64] Many alarms are preconfigured to be higher than a worst-case construction/industrial operating environment by 10 to 15 dBA. Since the construction noise environment at 50 feet behind any piece of moving machinery may be as high as 70 to 90 dBA, backup alarms are typically designed to emit a sound as loud as 85 to 115 dBA. This would be a potentially significant impact of the project.

MITIGATION MEASURE. Mitigation Measure NO-3 below would reduce construction noise to less than significant.

NO-3 *Construction Noise Best Management Practices.* BART shall incorporate the following practices into the construction documents to be implemented by the project contractor. Such practices include, but are not limited to, the following measures:

- Where feasible, BART shall require that the contractor complies with a Performance Standard of 80 dBA 8-hour L_{eq} during the daytime (7 a.m. to 10 p.m.) and 75 dBA 8-hour L_{eq} during the nighttime (10 p.m. to 7 a.m.) at the property line of the sensitive receptor.
- Prior to construction, BART shall ensure that a Noise Control and Monitoring Report is prepared. The report shall include expected construction noise

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[64] California Occupational Safety and Health Administration, Title 8, Section 1592(a)

levels, noise control measures, and explain how the contractor intends to monitor and document construction noise and complaints.

- Locate noisy equipment as far as possible from noise sensitive receptors. In addition, the use of temporary barriers should be employed around the equipment.
- Where construction noise impacts have been identified, use temporary noise barriers along the working area and/or project right-of-way. Barriers/curtains must achieve a Sound Transmission Class (STC) of 30 or greater in accordance with ASTM Test Method E90 and be constructed from material having a surface density of at least 4 pounds/square foot, to ensure adequate transmission loss.
- When nighttime or 24-hour construction will be required, coordinate with residents to ensure that the affected residents are fully informed about the upcoming construction. Residents will be given the option of sleeping in hotel rooms at BART expense for the duration of the nighttime construction in areas where construction is expected to exceed the FTA criterion. Residents that work nights and sleep days in locations where construction noise is expected to exceed the FTA criterion will be given the same option.
- Require ambient sensitive ("smart") backup alarms, SAE Class D, or limit to SAE Class C (97 dB) for vehicles over 2.5 cubic yards haulage capacity, or Cal-OSHA/DOSH-approved methods that avoid backup alarm noise for vehicles under 2.5 cubic yards haulage capacity.
- Fit silencers to combustion engines. Ensure that equipment has effective, quality mufflers installed, in good working condition.
- Switch off engines or reduce to idle when not in use.
- Lubricate and maintain equipment regularly.
- Route construction-related truck traffic along roadways that result in the least disturbance to sensitive receptors.

b. **Less than Significant with Mitigation Incorporated.** As with the noise assessment, vibration from operational activities are evaluated first, followed by construction activities. The impact assessment is based on the overall vibration levels associated with BART operations projected to sensitive receptors. When vibration levels exceed 72 VdB, the FTA threshold for frequent events, a vibration impact is identified. The discussion below is based on the *Noise and Vibration Technical Report* by Wilson, Ihrig & Associates, Inc.[65]

Operational Vibration. The vibration analysis for all components of Phases 1 and 2 indicates that the highest levels of vibration would occur near the proposed crossovers south of Whipple

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[65] Wilson, Ihrig & Associates, Inc., *BART-Hayward Maintenance Complex Noise and Vibration Technical Report*, November 22, 2010.

Road. Vibration impacts from these crossovers are presented in Table 17 and Table 18 below for residential uses. Recreational uses such as Dry Creek Park are not considered vibration-sensitive receptors, since these are not areas where people would sleep. Impacts from all other proposed project components would be less than presented in Table 17 and Table 18.

Phase 1. As presented in Table 17, there would be less-than-significant vibration impacts from train operations on the proposed single crossover P100 along 11th Street. Vibration sensitive receptors would be located far enough away that the vibration levels would be below the 72 VdB criterion. Therefore, no vibration mitigation measures would be needed. However, in the vicinity of the crossover P102, vibration levels associated with trains crossing the crossover would be 6 to 7 VdB in excess of the FTA criterion, resulting in potentially significant vibration impacts at six residences on Alicante Terrace and four residences on Carrara Terrace.

Table 17
Vibration Impacts from Train Movements – Phase 1

Location	Distance to Crossover (ft)	FTA Criterion	GBV from Crossover	Impact	Number of Buildings with Impact
11th Street between Stone Street and Boyle Street	200	72	62	LTS	0
11th Street and Boyle Street	150	72	68	LTS	0
La Brea Terrace	170	72	65	LTS	0
Alicante Terrace	85	72	79	PS	6
Carrara Terrace	90	72	78	PS	4
Messina Terrace	---	72	---	LTS	0
La Bonita Terrace	---	72	---	LTS	0

Source: Wilson, Ihrig & Associates, Inc., 2010.

Notes:

GBV: Groundborne Vibration

LTS = Less-than-Significant (No Impact as defined by FTA).

PS = Potentially Significant (Moderate or Severe Impact as defined by FTA).

Phase 2. As presented in Table 18, vibration levels associated with trains crossing the crossover would be 8 to 12 VdB in excess of the FTA criterion, resulting in potentially significant vibration impacts at eight single-family homes at La Bonita Terrace and seven at Carrara Terrace. Mitigation measures are recommended to reduce these impacts to less than significant. In addition, vibration impacts are expected at receptors located within 130 feet from turnout P100B. The overall vibration criterion would be exceeded by up to 4 VdB at nine single-family residences on La Brea Terrace. Vibration mitigation measures for crossover P100B would be required to reduce the level of impact to less than significant.

Table 18
Vibration Impacts from Train Movements – Phase 2

Location	Distance to Crossover (ft)	FTA Criterion	GBV from Crossover	Impact	Number of Buildings with Impact
11th Street between Stone Street and Boyle Street	---	72	---	LTS	0
11th Street and Boyle Street	---	72	---	LTS	0
La Brea Terrace	100	72	76	PS	9
Alicante Terrace	220	72	59	LTS	0
Carrara Terrace	80	72	80	PS	7
Messina Terrace	120	70	70	LTS	0
La Bonita Terrace	60	72	84	PS	8

Source: Wilson, Ihrig & Associates, Inc., 2010.

Notes:

GBV: Groundborne Vibration

LTS = Less-than-Significant (No Impact as defined by FTA).

PS = Potentially Significant (Moderate or Severe Impact as defined by FTA).

Vibration levels from BART train operation on crossovers P103 and 104 would be below the FTA criterion and, thus, no vibration mitigation measures would be necessary. Lower vibration levels from these crossovers are due to the distance to and from residences, and the slower train operational speed on the dispatch track.

With respect to future activities from BART trains within the existing Hayward Yard and the additional storage tracks on the east side of the Hayward Yard, train movements are expected to occur at a lower speed, and the vibration levels adjusted for these reduced speeds would be below the FTA criterion. Therefore, vibration impacts for activities proposed at the east storage yard would be less than significant.

Construction Vibration. Construction activities can result in varying degrees of ground vibration, depending on the equipment and methods employed. Operation of construction equipment causes ground vibrations that spread through the ground and diminish in strength with distance.

Table 19 shows the equipment assumed for this analysis. Vibration reference levels are presented in terms of the peak-particle velocity (PPV) and their approximate vibration level (i.e., in VdB), at a reference distance of 25 feet. The table only shows the equipment expected to have the greatest impacts.

Two types of potential construction-induced vibration effects were evaluated: annoyance and building damage. The criterion used in assessing annoyance is contained in the FTA guidance manual and presented earlier in Table 8 and Table 9. The criteria relating to potential cosmetic damage (i.e., cracking) due to building vibration is 0.3 in/sec PPV based on the FTA guidelines.

Table 19
Typical Construction Equipment Vibration Levels

Equipment	PPV at 25 feet (in/sec)	Approximate Vibration Velocity Level at 25 feet, VdB
Pile Driver (sonic)	0.730	105
Vibratory Roller	0.200	94
Hoe Ram	0.089	87
Large Bulldozer	0.090	87
Caisson Drilling	0.089	87
Jack Hammer	0.035	79

Source: FTA Transit and Vibration Impact Assessment, May 2006; Wilson, Ihrig & Associates, Inc., 2010.

Table 20 and Table 21 show the expected vibration levels from construction activities using heavy equipment during Phase 1 and Phase 2, respectively. Annoyance from construction activities would likely occur at 41 sensitive receptors in the vicinity of the project that are located within 100 feet of any heavy equipment. Specifically, vibration annoyance would be expected during installation of crossover P100 and P102 at 26 residences on La Brea Terrace, Alicante Terrace, and Carrara Terrace during Phase 1. During Phase 2, vibration annoyance would be expected to occur during installation of crossovers P100B, P101, P103, and P104 at 32 residences on Carrara Terrace, Messina Terrace, and La Bonita Terrace.

The use of heavy equipment during construction would generate peak velocity levels that would be well below the threshold of cosmetic damage. Consequently, construction of the project would result in no vibration impact from equipment or activities that would potentially cause building damage.

Table 20
Projected Construction Vibration Impacts from Heavy Equipment – Phase 1

		Vibration Criteria		Projected Maximum Vibration during Heavy Equipment Construction				
				Bldg Damage			Annoyance	
Location	Distance (feet)	Building Damage (in/sec)	Annoyance VdB, re: 1 micro-in/sec	PPV (in/sec)	Impact Type	# of Imp.	Vibration Level, VdB	Exceed Criterion
11th Street between D Street and Stone Street	500	0.3	80	< 0.01	LTS	0	58	No
11th Street between Stone Street and Boyle Street	400	0.3	80	< 0.01	LTS	0	61	No
11th Street and Boyle Street	150	0.3	80	< 0.01	LTS	0	74	No
La Brea Terrace	170 – 550	0.3	80	< 0.03	LTS	0	57 – 72	Yes
Alicante Terrace	85 – 550	0.3	80	< 0.03	LTS	0	57 – 81	Yes
Carrara Terrace	85 – 500	0.3	80	< 0.03	LTS	0	58 – 81	Yes
Messina Terrace	120 – 250	0.3	80	< 0.02	LTS	0	67 – 77	No
La Bonita Terrace	150 – 350	0.3	80	< 0.01	LTS	0	63 – 74	No
Ithaca Street between Whipple Road and Carroll Avenue	540 – 660	0.3	80	< 0.01	LTS	0	55 – 57	No
Carroll Avenue between Troy Place and Gresel Street	540 – 660	0.3	80	< 0.01	LTS	0	56 – 57	No
Carroll Avenue between Gresel Street and Becker Place	540 – 660	0.3	80	< 0.01	LTS	0	55 – 57	No
Carroll Avenue between Becker Place and Fairway Street	660	0.3	80	< 0.01	LTS	0	54	No
Carroll Avenue north of Fairway Street	660	0.3	80	< 0.01	LTS	0	45	No

Source: Wilson, Ihrig & Associates, Inc., 2010.

LTS = Less than Significant (No Impact as defined by FTA).

Table 21
Projected Construction Vibration Impacts from Heavy Equipment – Phase 2

		Vibration Criteria		Projected Maximum Vibration during Heavy Equipment Construction				
				Bldg Damage			Annoyance	
Location	Distance (feet)	Building Damage (in/sec)	Annoyance VdB, re: 1 micro-in/sec	PPV (in/sec)	Impact Type	# of Imp.	Vibration Level, VdB	Exceed Criterion
11th Street between D Street and Stone Street	500	0.3	80	< 0.02	LTS	0	58	No
11th Street between Stone Street and Boyle Street	320	0.3	80	< 0.02	LTS	0	64	No
11th Street and Boyle Street	350 – 500	0.3	80	< 0.02	LTS	0	58 – 63	No
La Brea Terrace	75 – 250	0.3	80	< 0.04	LTS	0	65 – 83	Yes
Alicante Terrace	180 – 300	0.3	80	< 0.01	LTS	0	65 – 71	No
Carrara Terrace	80 – 300	0.3	80	< 0.03	LTS	0	65 – 82	Yes
Messina Terrace	60 – 300	0.3	80	0.01 – 0.05	LTS	0	67 – 86	Yes
La Bonita Terrace	60 – 250	0.3	80	0.01 - 0.05	LTS	0	67 – 86	Yes
Ithaca Street between Whipple Road and Carroll Avenue	150 – 400	0.3	80	< 0.01	LTS	0	61 – 74	No
Carroll Avenue between Troy Place and Gresel Street	150 – 350	0.3	80	< 0.01	LTS	0	63 – 74	No
Carroll Avenue between Gresel Street and Becker Place	200 – 300	0.3	80	< 0.01	LTS	0	65 – 70	No
Carroll Avenue between Becker Place and Fairway Street	150 – 400	0.3	80	< 0.01	LTS	0	61 – 74	No
Carroll Avenue north of Fairway Street	150 – 350	0.3	80	< 0.01	LTS	0	63 – 74	No

Source: Wilson, Ihrig & Associates, Inc., 2010.

LTS = Less than Significant (No Impact as defined by FTA).

MITIGATION MEASURES. The following measures would reduce the vibration effects of the proposed project to less than significant.

NO-4 *Vibration Reducing Technology*. BART shall incorporate vibration mitigation measures such as tire-derived aggregate (TDA) or floating slab track (FST) under the track, or other technology that may be developed to attain the FTA groundborne vibration operational criterion of 72 VdB. The general location of the mitigation measures under the track is presented in Table 22. However, the actual extent of the mitigation control would be determined during final design.

Table 22
Vibration Mitigation

Crossover #	Mitigation Required for Phase 1	Mitigation Required for Phase 2
P100B	No	Yes[1]
P100	No	No
P101	No	Yes [1]
P102	Yes[1]	No
P103	No	No
P104	No	No

Source: WIA 2010

Notes:

1. Mitigation extent will be determined during final design.

NO-5 *Construction Vibration Best Management Practices*. Where potential construction vibration impacts have been identified, the contractor shall be required to select equipment and methods that would reduce potential annoyance to nearby residents. Such practices include, but are not limited to, the following measures:

- Comply with a Performance Standard of 0.3 in/sec PPV at any building at any time.
- Minimize vibration annoyance by maintaining vibration levels at 80 VdB or less at any building at any time.
- Prior to construction, BART shall prepare a Vibration Control and Monitoring Report, in which the contractor indicates what vibration levels they expect to generate, vibration control measures they intend to implement, and how they intend to monitor and document construction vibration and complaints.
- Avoid the use of impact pile drivers, and use instead sonic or vibratory impact drivers. It is also encouraged that "quiet" or "silent" piling technologies be used, if feasible.
- When nighttime or 24-hour construction is necessary, coordinate with residents to ensure that the affected residents are fully informed about the upcoming

construction. Residents will be given the option of sleeping in hotel rooms at BART expense for the duration of the nighttime construction in areas where construction is expected to exceed the FTA criterion. Residents that work nights and sleep days in locations where construction vibration is expected to exceed the FTA criterion will be given the same option.

- Monitor vibration during construction to ensure compliance with the criterion for building damage for buildings within 40 feet from construction activities. Conduct a pre-construction crack survey at these structures.
- Plan routes for hauling material out of the project site that would cause the least impact (annoyance).
- Restrict high amplitude vibration methods such as vibratory pile driving and soil compaction using large truck-mounted compactors to areas beyond 50 feet and 20 feet, respectively, of residential structures or wood-framed buildings. Otherwise, temporary accommodations away from construction shall be coordinated between BART and the residents.

e, f. **No Impact.** The project area is not located within two miles of a public airport, private airstrip, or airport land use plan. Thus, there would be no impact from air traffic noise.

13. POPULATION AND HOUSING

Would the project:	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less-Than-Significant Impact	No Impact
a. Induce substantial population growth in an area, either directly (e.g., by proposing new homes and businesses) or indirectly (e.g., through extension of roads or other infrastructure)?	☐	☐	☐	■
b. Displace a substantial number of existing housing units, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	■
c. Displace a substantial number of people, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	■

Discussion

a. **No Impact.** The proposed project under both Phase 1 and 2 would not include the construction of residential units, and thus would not directly induce population growth. The proposed project would expand the existing BART storage yard so that additional maintenance and storage track facilities could accommodate more BART vehicles. Phase 1 and 2 of the proposed project would require 350 employees for operation (see Table 1 above). It is estimated that of those, 135 employees would be existing employees at the Hayward Yard that would be relocated to the new west side expansion area, and 215 employees would be new employees to the site. Approximately 85 of the new employees at the Hayward Yard would be existing BART employees from other BART maintenance yards that would be relocated to the site. According to ABAG 2009 Projections, the cities of Hayward and Union City project an increase of 1,190 and 1,940 employees, respectively, between the years 2010 and 2015.[66] The increase in employment in the area of 215 new employees anticipated under the proposed project represent approximately 7 percent of the anticipated employment growth in the area. This projected increase in employment at the maintenance complex would not create a substantial direct or indirect demand for housing in the project vicinity or region. This negligible increase in employment would be accommodated by the existing housing supply in the project vicinity or within the region. Therefore, the proposed project would not directly or indirectly induce population growth.

b, c. **No Impact.** The west side expansion area would redevelop an existing industrial site with maintenance and warehouse uses. The proposed train storage yard would include additional train tracks on a site that is undeveloped. The project would not remove any existing housing units and therefore would not displace existing housing units or people. As a result, the proposed project would have no impact on displacing housing or people.

14. PUBLIC SERVICES

Would the project:	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less-Than-Significant Impact	No Impact
Result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities or a need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times, or other performance objectives for any of the following public services:				
a. Fire protection?	☐	☐	■	☐
b. Police protection?	☐	☐	■	☐
c. Schools?	☐	☐	☐	■
d. Parks?	☐	☐	☐	■
e. Other public facilities?	☐	☐	☐	■

Discussion

a. **Less Than Significant.** The project site and trackwork area south of Whipple Road is served by the Hayward and Union City fire departments for fire protection and emergency medical services. Hayward Fire Department Station 3 at 31982 Medinah Street is the closest fire station to the Hayward portion of the site and would provide first response emergency services. Union City Fire Department Station 1 at 33555 Central Avenue is the closest fire station to the Union City portion of the site. In 2008 there was a fire in the Hayward Yard. The fire

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[66] ABAG, Projections and Priorities, 2009.

occurred during a period when there were multiple construction projects in the yard. There was an electric short in the high voltage power system that burned cables and damaged the yard's traction power and communication systems. As a result, BART has strengthened its construction safety procedures and project coordination. Although the proposed project would increase the footprint of the Hayward Yard, it would also provide an upgrade to some of BART's electrical systems. Therefore, the impact to fire protection from expansion of the Hayward Yard would be less than significant.

b. **Less Than Significant.** Common police-related offenses that may occur in connection with the proposed project are vandalism and criminal trespass. BART has its own police department to investigate crimes and provide law enforcement on BART properties, such as the Hayward Yard. Local police departments respond to calls in surrounding areas and occasionally support BART Police by responding to calls on BART property. The local police departments that would be affected by the proposed project are the Hayward Police Department and the Union City Police Department. Historically, local police forces have seen a relatively low increase in demand for police services with regard to BART projects.[67] Therefore, the proposed project would have a less-than-significant impact on the local police departments.

c-e. **No Impact.** As described above under Section 13, Population and Housing, the proposed project would not substantially increase the number of residents, since the project would not include residential units. There may be an indirect growth in residents associated with the 215 new jobs at the site; however, only a portion of those employees would live in the surrounding area. Because the demand for schools, park services, and other public facilities is driven by population, the proposed project would not substantially increase demand for those services. As a result, the proposed project would result in no impact to these services.

15. RECREATION

Would the project:	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less-Than-Significant Impact	No Impact
a. Increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?	☐	☐	☐	■
b. Include recreational facilities or require the construction or expansion of recreational facilities that might have an adverse physical effect on the environment?	☐	☐	☐	■

Discussion

a, b. **No Impact.** Because the proposed project would not substantially increase population directly or indirectly, the proposed project would not generate a substantial demand for recreational

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[67] San Francisco Bay Area Rapid Transit District, *BART to Livermore Extension Draft Program EIR*, November 2009, page 3.13-14.

facilities. Thus, the proposed project would not affect use of existing facilities, nor would it require the construction or expansion of existing recreational facilities. Therefore, the proposed project would have no impact on recreational facilities.

16. TRANSPORTATION/TRAFFIC

Would the project:	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less-Than-Significant Impact	No Impact
a. Conflict with an applicable plan, ordinance or policy establishing measures of effectiveness for the performance of the circulation system, taking into account all modes of transportation including mass transit and non-motorized travel and relevant components of the circulation system, including but not limited to intersection, streets, highway and freeways, pedestrian and bicycle paths and mass transit?	☐	■	☐	☐
b. Conflict with an applicable congestion management program, including, but not limited to level of service standards and travel demand measures, or standards established by the county congestion management agency for designated roads or highways?	☐	☐	■	☐
c. Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks?	☐	☐	☐	■
d. Substantially increase hazards because of a design feature (e.g., sharp curves or dangerous intersections or incompatible uses (e.g., farm equipment)?	☐	■	☐	☐
e. Result in inadequate emergency access?	☐	☐	☐	■
f. Conflict with adopted policies, plans or programs regarding public transit, bicycle, or pedestrian facilities, or otherwise decrease the performance or safety of such facilities?	☐	☐	☐	■

Background

Major highways in the vicinity of Hayward and Union City include Interstate 880, approximately 1.5 miles west of the project site, and State Route 238, approximately one-half mile to the east. Within the project area, Industrial Parkway to the north and Whipple Road to the south are the major arterial roadways. In December 2009, Industrial Parkway had a daily traffic volume of approximately 28,500 vehicles in the vicinity of the proposed project. In August 2007, Whipple Road had a daily traffic volume of approximately 39,600 vehicles in the vicinity of the proposed project.

The 116-acre project site (includes the 88-acre existing Hayward Yard and 28-acre west side expansion) is in the City of Hayward just north of Whipple Avenue and south of Industrial Parkway. The existing project site includes four industrial buildings totaling 446,400 square feet of industrial uses. Of this total, approximately 132,000 square feet (or 30 percent) is vacant as of October 2010.[68] These buildings house industrial uses including a mix of service and warehouse facility activities. The City of Hayward designates this area as "Industrial Corridor".[69]

Existing vehicle access to the Hayward Yard is from two access roads. Vehicle access to the main shop and the yard west of the mainline tracks is from Sandoval Way just south of Industrial Parkway. Access to the yard east of the mainline is from a BART access road, north of Whipple Avenue. The west side expansion area is currently fenced off from the Hayward Yard and there is no vehicular or pedestrian access between the two. Vehicular access to the west side expansion area is through a private driveway, north of Whipple Avenue and west of the BART mainline.

Based on 24-hour passenger vehicle and truck counts collected on a typical weekday (Thursday, October 7, 2010), there were 710 daily vehicle trips accessing the warehouses in the west side expansion area. During the AM peak hour (8:00 a.m. to 9:00 a.m.), there were 62 vehicles utilizing the west side expansion area driveway (44 entering and 18 exiting) north of Whipple Road. During the PM peak hour (4:00 p.m. to 5:00 p.m.), there were 51 vehicles utilizing the west side expansion area driveway (7 entering and 44 exiting). The peak vehicle activity occurred during the midday between 11:00 a.m. and 12:00 p.m. with 66 vehicles entering/exiting the warehouse area. Based on the total number of vehicles counted during the 24-hour period, approximately 52 percent were passenger vehicles, 16 were delivery/mail trucks, and the remaining 32 percent were trucks with two or more axles and six or more tires.

At the Sandoval Way entrance, there were 726 daily vehicle trips accessing the main shop and the yard west of the mainline tracks. During the AM peak hour (8:00 a.m. to 9:00 a.m.), 22 vehicles were counted at the Sandoval Way entrance (17 entering and 5 exiting). During the PM peak hour (4:00 p.m. to 5:00 p.m.), 66 vehicles were counted at this location (12 entering and 54 exiting). The peak vehicle activity at this location occurred during the afternoon between 3:00 p.m. and 4:00 p.m. with 84 vehicles entering/exiting the driveway. Based on the total number of vehicles counted during the 24-hour period, approximately 62 percent of all vehicles were passenger vehicles, 24 percent were delivery/mail trucks, and the remaining 14 percent were trucks with two or more axles and six or more tires.

Discussion

a. **Less than Significant with Mitigation.** The proposed project's land use activities would consist of activities similar to those at the existing Hayward Yard. As such, a daily vehicle trip generation rate for the existing uses was calculated using the total number of existing BART employees employed at the site and the 24-hour vehicle counts. This trip generation rate was then used to determine the future vehicles trips that would be generated by the proposed project. Proposed project employee information was provided by BART (see Table 1 in the

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[68] Based on information provided by real estate brokers Colliers International, Oakland.

[69] City of Hayward, *City of Hayward General Plan*, Appendix C: Land Use Map.

Project Description).[70] The percentage of vehicle trips generated during the AM and PM peak hours were also based on the existing vehicle counts.

As part of the proposed project, a new BART programmed station stop at the Hayward Yard would be provided for Hayward Yard employees. BART proposes that stops at this location coincide with employee shifts. Based on information from BART, there would be five stops in the morning and five stops in the evening and about 20 percent of the BART Yard employees would be expected to use the programmed station stop. Table 23 below presents the weekday daily and peak hour vehicle trip generation under the proposed project.

Table 23
Vehicle Trip Generation

	Number of Employees[1]	Daily Vehicle Trip Rate	Daily Vehicle-Trips	AM Peak Hour - % of Daily	AM Peak Hour Trips[2]	PM Peak Hour - % of Daily	PM Peak Hour Trips[2]
Existing Facilities[3]							
BART Hayward Yard	280	2.6/employee	726	6.6%	48	3.3%	24
Warehouse Facilities	--	--	710	6.5%	46	5.2%	37
Total	--	--	*1,436*	--	*94*	--	*61*
Proposed Project							
BART Hayward Yard	280	2.6/employee	726	6.6%	48	3.3%	24
BART Hayward Maintenance Complex	215	2.6/employee	559	6.6%	37	3.3%	18
20% Reduction w/ new BART Programmed Station Stop[4]	--	--	-163	6.6%	-11	3.3%	-5
Total	*495*	--	*1,122*	--	*74*	--	*37*
Net Change in Vehicle Trips[5]			**-314**		**-20**		**-24**

Source: PBS&J, 2010.

Notes:

1. The number of employees at existing and future BART facilities was supplied by BART; employee information for existing warehouse facilities is not available.
2. Based on existing count data, 73% of vehicles enter and 27% exit during the AM peak hour and 16% of vehicles enter and 84% exit during the PM peak hour.
3. 24-hour traffic counts conducted in October 2010 at existing facilities were used to establish the employee vehicle trip rate and the AM and PM peak hour vehicle trip factors.
4. This reduction was only applied to auto trips because trucks do not transport employees for home-to-work or work-to-home trips.
5. Net change in vehicle trips comparing the proposed project to vehicle trips for existing uses.

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[70] The project description indicates the proposed project would have 350 total employees, of which 135 employees would be relocated from the existing Hayward Yard to the new facilities. Therefore, for transportation analysis purposes, a total of 215 future new employees was used in the trip generation assessment.

As shown in Table 23, the proposed project would result in a decrease in daily, AM, and PM peak hour traffic volumes, compared to existing trips. The proposed project would provide a vehicular connection within the project site to connect the existing Hayward Yard to the west side expansion area. This internal connection would result in a redistribution of the trips accessing the site. In order to understand circulation patterns and potential circulation impacts from the proposed project, a vehicle trip distribution analysis was conducted based on current BART employee residential data.

Based on the residential zip code information for existing BART employees at the Hayward facility, approximately 27 percent of employees reside south of the project site and would be expected to access the project site via Whipple Road. Approximately 73 percent of employees reside north of the project site and would be expected to access the project site via Sandoval Way. Figure 15 illustrates the project trip distribution to/from the project site.

By applying the employee trip distribution to the proposed project vehicle trips, approximately 54 vehicles (39 enter/15 exit) would access the site via Sandoval Way in the AM peak hour, which represents an increase of approximately 44 percent over existing conditions. During the PM peak hour, approximately 28 vehicles (4 enter/24 exit) would access the site via Sandoval Way, which represents a decrease of approximately 47 percent over existing conditions. These vehicles would travel through the nearby intersections of Huntwood Avenue/Sandoval Way and Industrial Parkway/Huntwood Avenue, which currently operate at LOS F and D, respectively, during the AM peak hour, and LOS D and F, respectively, during the PM peak hour.[71] When added to and subtracted from the corresponding movements at these intersections, the additional trips or decrease in trips generated by the proposed project would not cause an intersection to operate at LOS F or cause an increase in delay per vehicle of four seconds or more at an intersection already operating at LOS F.[72] As such, the proposed project would have a less-than-significant impact on traffic operations at the two intersections that would be affected by increased vehicle trips accessing the project site via Sandoval Way.

Approximately 20 vehicles (15 enter/5 exit) would access the site via Whipple Road during the AM peak hour, and 10 vehicles (2 enter/8 exit) would access the site via Whipple Road during the PM peak hour. With the proposed onsite connection of the Hayward Yard with the west side expansion area and the employee trip distribution favoring the Sandoval Way entrance, the number of vehicle trips accessing the site via Whipple Road would be less than under existing conditions; therefore, traffic impacts at this location would be less than significant.

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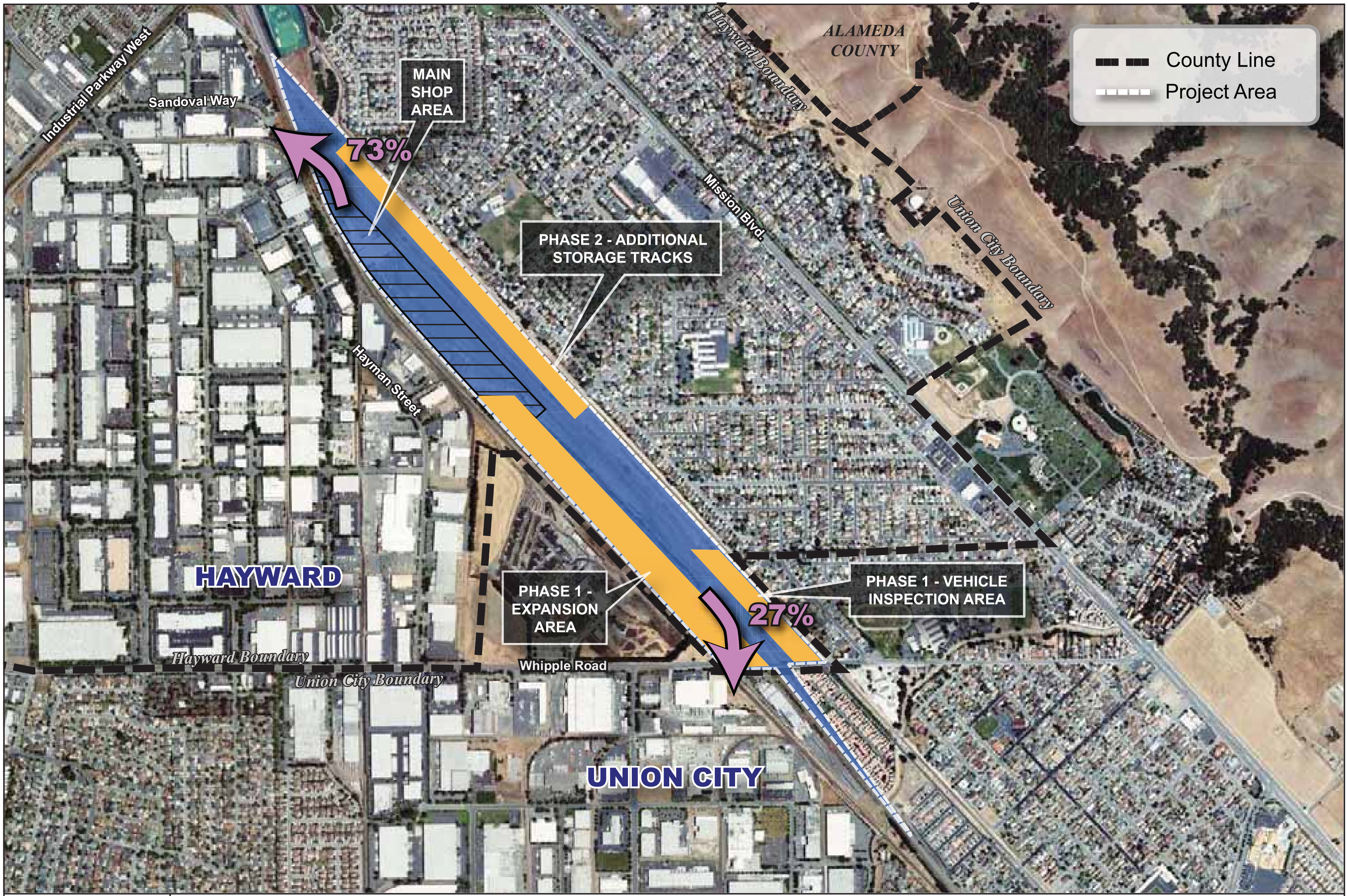
[71] City of Hayward, *RSTP 2009 Grant – Synchro analysis* (see Appendix B).

[72] Based on the City of Hayward's significance standards, an impact would occur if a project causes an intersection to operate at LOS F or causes an increase in delay per vehicle of four seconds or more at an intersection already operating at LOS F.



Source: PBS&J, 2010.

FIGURE 15

Project Trip Distribution

Construction. As described in the Project Description, most construction activities would take place on the project site in two phases. Phase 1 is anticipated to be completed in approximately 36 months and includes the Vehicle Level Overhaul Shop, Component Repair Shop, Central Warehouse, M&E Vehicle and Storage Area, Vehicle Inspection Area, and connecting tracks for new activities on the west side of the yard. Phase 2 is anticipated to be completed in approximately 21 months and includes the east side storage tracks, flyovers, and connecting tracks for the east side of the yard.

Phase 1 construction activities would generate approximately 3,110 construction truck trips to support demolition of existing structures, delivery of building materials and concrete, and retrofitting of three existing warehouse structures. Primary access would be from Whipple Road connecting to/from Interstate 880 to the west and State Route 238 to the east. South of Whipple Road, a minimum of 100 truck trips are estimated for the construction of the mainline crossovers. Primary access to this site would be from the yard area north of Whipple Road (both east and west of the mainline tracks including the test track). The M&E storage area north of Whipple Road could be used as a staging area with equipment shuttling back and forth between the staging area and the work area south of Whipple Road. If necessary, alternative access could be provided via three other locations: the industrial property along the west side of the mainline tracks just south of Whipple Road; the Dry Creek service road on the north side of Dry Creek that leads to a gate adjacent to the BART test track; or from F Street which crosses under the BART tracks approximately 0.7 miles south of Whipple Road (provides direct street access to the BART right-of-way along the west side of the mainline tracks).

Phase 2 construction activities would generate approximately 7,600 construction truck trips (estimated 105 daily truck trips) to support construction of storage tracks over a peak three-month construction period. Primary access would be from Whipple Road connecting to/from Interstate 880 to the west and State Route 238 to the east. For construction activities south of Whipple Road, a minimum of 100 truck trips are estimated to haul away removed material and bring in new material for the construction of test track crossovers and switches. Although most of the equipment and material could be supplied to the mainline crossover locations via the test track and stored at locations between the test track and the mainline, equipment may be too large to fit under the Whipple Road bridge and would need another point of access. Similar to Phase 1, alternative access could be provided via three other locations: industrial property along the west side of the mainline tracks just south of Whipple Road, the service road adjacent to Dry Creek, or from F Street to the south.

Other construction impacts would result from the movement of construction equipment and construction workers' vehicles on and off the project site. Traffic construction effects around the project site and the track work area south of Whipple Road would be a temporary situation, but it would be a daily occurrence during certain portions of the construction period. It is likely that construction equipment would be transported to the site and be stored on site. Since equipment would primarily remain on site, it would be unlikely to interfere with traffic.

Whipple Road currently handles approximately 23,900 vehicles per day between Amaral Street and Railroad Avenue. Between Railroad Avenue and Mission Boulevard, the average daily vehicle trips drops to approximately 10,300. While the precise traffic volumes on Whipple Road at the project site driveway is unknown, it is expected to be closer to the 10,300 documented for the segment between Railroad Avenue and Mission Boulevard because much of the traffic exits from/enters onto Whipple Road at Central Avenue, which is west of the project site driveway.[73] Assuming approximately 100 to 105 daily truck trips are temporarily generated under each phase and a passenger car equivalent (PCE) rate of 2.0,[74] there would be a minimum of 200 to 210 vehicle trips during peak construction activity. The existing warehouse facilities generate approximately 710 daily vehicle trips with up to 32 percent (about 225 truck trips) being 2-axle trucks with 6 tires or larger and travel on Whipple Road to the project site. Therefore, the proposed project's construction-related truck traffic is likely to be less than the existing warehouse truck activity. However, the daily scheduling of truck trips is unknown at this time. Whether the peak construction activity would occur during the AM and PM peak hours or be continuous throughout the course of the day can affect existing roadway facilities. Since project-specific daily construction truck activity is undetermined at this time, construction-related traffic impacts could be potentially significant.

MITIGATION MEASURE. The following measure would reduce construction-related traffic impacts to less than significant.

TR-1 *Construction Phasing and Traffic Management Plan.* BART will ensure that a Construction Phasing and Traffic Management Plan is developed and implemented by the contractor. The plan shall define how traffic operations, including construction equipment and worker traffic, are managed and maintained during each phase of construction. The plan shall be developed in consultation with the cities of Union City and Hayward, BART, and Union City Transit Bus Lines. To the maximum practical extent, the plan shall include the following measures:

a) Specify predetermined haul routes from staging areas to construction sites and disposal areas by agreement with the cities of Union City and Hayward prior to construction. The routes shall follow streets and highways that provide the safest route and avoid congested intersections to the extent feasible.

b) Identify construction activities that, due to concerns regarding traffic safety or congestion, must take place during off-peak hours.

c) Identify a telephone number that the public can call for information on construction scheduling, phasing, and duration, as well as for complaints. Such information shall also be posted on BART's website.

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[73] City of Union City, 2008 traffic counts.

[74] Assumes 2.0 passenger vehicles are equivalent to one truck trip.

b. **Less than Significant.** A traffic analysis was performed to quantify the proposed project's net change in traffic volumes and the potential traffic impacts on the regional roadways or highways under the Alameda County Congestion Management Agency (ACCMA).

As stated previously, the proposed project would result in a reduction in the number of vehicle trips traveling to and from the project site. This includes a reduction in existing vehicles traveling on major highways and regional roadways within the study area. Therefore, operation-related traffic impacts to regional roadways or highways under ACCMA would be less than significant.

Potential construction impacts are temporary and would not significantly affect regional roadways or highways for more than the proposed 36-month construction period of Phase 1 or the 21-month construction period of Phase 2. Therefore construction-related traffic impacts to regional roadways or highways under ACCMA would be less than significant.

c. **No Impact.** The nearest airport (Hayward Executive Airport) is located approximately six miles from the project site. The proposed project would include low-rise structures approximately one-story high that would not interfere with air traffic patterns. As a result, there would be no impact on air safety.

d. **Less than Significant with Mitigation.** To determine if any significant queuing could occur from the existing driveway at the west side expansion area onto Whipple Road and affect the crossing at the existing UPRR track (approximately 150 feet west of the driveway), queuing and safety observations were conducted at the intersection of the west side expansion area driveway and Whipple Road.

Based on observations, the westbound spillback at the intersection occurs as a result of vehicles queuing from Central Avenue during the AM peak hour (the first intersection to the west from the west side expansion area driveway). Southbound left-turning vehicles and eastbound left-turning vehicles at the intersection must wait until a driver allows them to enter the traffic stream along Whipple Road due to the lack of any adequate gaps in the through east/west traffic flow. Eastbound spillback at the intersection also occurs as a result of the Railroad Avenue/at-grade train crossing (UPRR/Amtrak)/Ithaca Street intersection (east of the west side expansion area driveway) during the AM peak hour. One train was observed during the AM peak hour and was the primary cause of the observed spillback queuing. No trains were observed at the nearby (150 feet to the west) at-grade crossing during the AM peak hour and there was a low volume (approximately 18 vehicles) of eastbound vehicles/trucks turning left in to the west side expansion area driveway. No queues were observed that extended to the at-grade railroad crossing at any time during the AM peak hour.

In terms of sight distance safety hazards, there is an existing safety issue for southbound vehicles turning right from the west side expansion area driveway to go westbound onto Whipple Road. The wide configuration of the roadway allows drivers turning right on Whipple Road to approach Whipple Road at an angle where they are looking back over their left shoulder rather than having a more direct view of traffic approaching from the left. The situation is exacerbated by the presence of tall shrubbery growing over the fence that borders the eastern side of the driveway, which may obscure oncoming traffic.The sight distance safety hazards could be mitigated by narrowing the mouth of the intersection so that vehicles approach Whipple Road at a more perpendicular angle and by removing some of the existing vegetation/shrubbery at the intersection that screens view of oncoming traffic from the east.

The existing UPRR crossing to the west of the west side expansion area driveway is inadequately striped, the crossing arms may need to be relocated further away from the crossing, and signage/lane markings should be upgraded. Improvements at this crossing location should be made by UPRR and the California Public Utility Commission (CPUC). The Capitol Corridor has prepared a Program Environmental Assessment (EA) and a related grant application with the Federal Railroad Administration in the railroad corridors adjacent to the project site. The new EA is consistent with the Union City Intermodal Final Environmental Impact Report and Dumbarton Rail Project plans which have proposed some significant service changes to the UPRR rail corridor along the west side of the HMC project site. Improvements related to the Whipple Road grade crossing are included and evaluated as part of the EA.

Since the proposed project may need reconfiguration at the intersection of Whipple Road to mitigate sight distance safety hazards, project design impacts could be potentially significant.

MITIGATION MEASURE. The following measure would reduce sight distance safety impacts to less than significant.

TR-2 *Reconfiguration of Southbound Approach of the West Side Expansion Area Driveway*. BART will reconfigure the approach to Whipple Road for the west side expansion area driveway by narrowing the mouth of the intersection and channeling southbound traffic to approach Whipple Road at a more perpendicular angle. In addition, shrubbery/vegetation that impedes vehicle line of sight to the east will be removed.

e. **No Impact.** The proposed project would use existing driveways for access to the site through Sandoval Way and from Whipple Road into the west side expansion area. These driveways currently provide fire and emergency access to the existing structures and would continue to meet all applicable regulations and requirements for fire and emergency access under future conditions. The proposed project would also include a new access road for the east side storage tracks that would extend north from Whipple Road to the expansion area and along the east perimeter of the expansion area to its northern boundary. The 20-foot-wide, two-lane, paved road would provide both BART access and fire and emergency access to the proposed east side expansion area. The design of this access road would meet all applicable regulations and requirements for such an access. The proposed project would result in no impacts to emergency access to the site.

f. **No Impact.** Both the City of Hayward and the City of Union City include policies in their general plans that are supportive of non-motorized (pedestrian and bicycle) and public transportation. Specific policies include planning methods that promote transportation alternatives to automobiles and place high density and commercial development near intermodal transit facilities, to provide for mass public transit systems such as buses and trains, and to provide safe bicycle access and facilities. Although the specific policies are not relevant to the proposed project, the project would enhance BART's maintenance capabilities, which would support public transportation in the cities of Hayward and Union City and throughout the BART District. The proposed project would not conflict with any bus service, bicycle paths, or pedestrian paths in the area. For these reasons, there would be no impact to alternative transportation modes.

17. UTILITIES AND SERVICE SYSTEMS

Would the project:	**Significant or Potentially Significant Impact**	**Less Than Significant With Mitigation Incorporated**	**Less-Than-Significant Impact**	**No Impact**
a. Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?	☐	☐	■	☐
b. Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	☐	☐	■	☐
c. Require or result in the construction of new stormwater drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	☐	☐	■	☐
d. Have sufficient water supplies available to serve the project from existing entitlements and resources, or would new or expanded entitlements be needed?	☐	☐	■	☐
e. Result in a determination by the wastewater treatment provider that serves or may serve the project that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments?	☐	☐	■	☐
f. Be served by a landfill with sufficient permitted capacity to accommodate the project's solid waste disposal needs?	☐	☐	■	☐
g. Comply with federal, state, and local statutes and regulations related to solid waste?	☐	☐	■	☐

Discussion

a. **Less than Significant.** Wastewater collection and treatment for the existing Hayward Yard is provided by the City of Hayward. The City's wastewater treatment plant treats dry weather flow of 11.9 million gallons per day (mgd) and has a capacity of 16.5 mgd. For the west side expansion area, wastewater collection and treatment is provided by the Union Sanitary District, which serves the cities of Fremont, Newark, and Union City. Wastewater treatment for the Union Sanitary District is provided by the Alvarado Wastewater Treatment Plant. The Alvarado Wastewater Treatment plant has a permitted capacity of 30 mgd, and in 2009 had an average dry weather flow of 24.49 mgd.[75] The City of Hayward and Union Sanitary District are part of the East Bay Dischargers Authority (EBDA), which is a Joint Powers Agency consisting of five local agencies. The effluent from both the City of Hayward wastewater treatment plant and the Alvarado Wastewater Treatment Plant are pumped to the EBDA's "super sewer" for final disposal in the deeper waters of the San Francisco Bay west of San Leandro. The combined effluent meets all the requirements of the EBDA's NPDES permit.

BART provides industrial waste drainage at certain locations around the existing Hayward Yard, where certain activities require it, such as train washing and the blow down pit. These industrial waste drainage units are not directly connected to the sanitary sewer system. In some cases (like the train wash facility), after the wash water has gone through on-site treatment (and most recycled), some of it may be released to the sanitary sewer system. Proposed uses in the Hayward Maintenance Complex that require industrial waste drainage would have on-site pre-treatment or collection. The four warehouses to be acquired have existing sanitary sewer hookups, which would continue to be employed by BART. The project would result in a slight increase in the demand for wastewater treatment associated with routine maintenance activities and to support the on-site staff (see Item b, below, regarding increased water usage), but would not exceed the wastewater treatment requirements of the San Francisco RWQCB. As described above, the wastewater treatment plants that service the project site have existing system capacity to accommodate future growth within the service areas. Therefore, any increase in the demand for wastewater treatment associated with the project would be within the available capacity.

Please refer to Items 9a and 9f under the Hydrology and Water Quality section of this checklist for a discussion of issues related to waste discharge requirements. BART would adhere to the Municipal Regional Stormwater NPDES Permit (MRP), adopted in October 2009 ([MRP], Order No. R2-2009-0074), statewide NPDES General Permit for Discharges of Storm Water Associated with Industrial Activities Excluding Construction Activities (SWRCB Order No. 97-03-DWQ, NPDES No. CAS000001 [Industrial General Permit]), and the statewide NPDES General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities (Order No. 2009-0009-DWQ, NPDES No. CAS000002 [Construction General Permit]), adopted September 2, 2009. All of these permits set forth water quality parameters and requirements that protect water quality.

Furthermore, BART Facility Standards Section 01 57 00 (Temporary Controls, 1.08 - Erosion and Sediment Control, 1.09 - Dust Control, and 1.10 - Mud Control)) and Section 31 00 00 (Earthwork, 1.11 - Site Conditions and 3.03 - Earthwork General Requirements) includes requirements for erosion and sediment controls from construction operations, including an Erosion and Sediment Control Plan, and Section 01 57 00 (Temporary Controls, 1.07 – Pollution Abatement) requires BMPs to minimize pollution potential. Where natural drainage ways are intercepted by construction activities, BART Facility Standards require that such drainage ways shall be protected so that runoff from the site or water from construction activities is not allowed to enter the natural drainage way (Section 01 57 00 Temporary

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[75] Union Sanitary District, http://www.unionsanitary.com/mission.htm, accessed October 14, 2010.

Controls, 1.08.C.-Prevention of Erosion). Section 01 71 13 (Mobilization, 1.09 – Demobilization) and Section 31 11 00 (Clearing and Grubbing, 1.06 - Jobsite Conditions) require restoration of the construction area after completion of construction activities. BART Facility Standards Section 32 84 00 (Planting Irrigation) and Section 32 90 00 (Planting) ensures adequate establishment of permanent vegetative cover to protect surfaces from erosion. As such, the proposed project would not exceed wastewater treatment requirements of the San Francisco RWQCB, and potential wastewater impacts would be less than significant.

b, d, e. **Less than Significant.** The existing BART Hayward Yard consumes water for the routine maintenance activities and to support the on-site staff. For train cleaning, BART typically uses approximately 80 gallons of water per BART car per day twice a week. BART Facility Standards require that approximately 60 percent of the water be recycled. Given the proposed addition of a maximum of 250 vehicles, it is conservatively estimated that approximately 20,000 gallons of water per day twice a week would be required for exterior car washing, assuming no recycling (or 2,080,000 gallons per year). Train washing water usage would be reduced to 8,000 gallons twice per week or 832,000 gallons per year with the implementation of the 60 percent water recycling requirement. This is equivalent to the amount of water consumed by approximately two average households in California.[76] For this reason, water demand from the proposed project would be a less-than-significant impact.

Water usage in the four-building maintenance complex would be limited to showers, lavatory faucets, water closets, break room faucets, washdown, irrigation, and miscellaneous applications. It is estimated that the total additional water demand would be 10,142 gallons per day and the total average sanitary sewer load would be 8,621 gallons per day. It is important to note that these are conservative estimates given that the four buildings sited for the proposed maintenance complex are currently in use for industrial purposes and therefore have an existing water demand and wastewater discharge requirements associated with those uses. The City of Hayward has a water delivery capacity of 32 million gallons per day and an average demand of approximately 18.5 million gallons per day. The City operates its own Water Pollution Control Facility with a rated capacity of 16.5 million gallons per day and the average dry weather flow is between 13 and 14 million gallons per day.[77] There is ample capacity at the City's water supply and wastewater facilities to absorb the additional water demand and sanitary waste generated by the proposed project using existing infrastructure.

c. **Less than Significant.** BART would adhere to the Municipal Regional Stormwater NPDES Permit (MRP), adopted in October 2009 ([MRP], Order No. R2-2009-0074), statewide NPDES General Permit for Discharges of Storm Water Associated with Industrial Activities Excluding Construction Activities (SWRCB Order No. 97-03-DWQ, NPDES No. CAS000001 [Industrial General Permit]), and the statewide NPDES General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities (Order No. 2009-

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[76] The average household in California consumes between one half acre foot (approximately 163,000 gallons) and one acre-foot of water a year (approximately 326,000 gallons).

[77] City of Hayward, *City of Hayward General Plan,* Public Utilities and Services, March 12, 2002, *http://www.hayward-ca.gov/about/generalplan/Chapter08-Public_Utilities_and_Services.pdf,* accessed August 16, 2010.

0009-DWQ, NPDES No. CAS000002 [Construction General Permit]), adopted September 2, 2009. In order to meet the NPDES requirements, the proposed project would require the construction of new onsite stormwater drainage facilities. However, the construction of these facilities would be completed as part of the proposed project and would be subject to the same BART Facilities Standards and mitigation measures presented in this document as other construction activities under the proposed project (see Item 9a, c, and e of this checklist). Therefore, the construction of these facilities would not cause significant environmental effects.

f, g. **Less than Significant.** Solid waste collected at the project site would be sent to the Davis Street Transfer Station in San Leandro. From there, it is transferred to the Vasco Road Sanitary Landfill in Livermore. This landfill has available capacity (currently at 70.1 percent of capacity) and is not expected to close until 2019.[78] For this reason, the proposed project would have a less-than-significant impact on solid waste generation, and the expansion of existing or construction of new solid waste facilities would not be necessary.

18. MANDATORY FINDINGS OF SIGNIFICANCE

Would the project:	Significant or Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less-Than-Significant Impact	No Impact
a. Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal, or eliminate important examples of the major periods of California history or prehistory?	☐	■	☐	☐
b. Does the project have impacts that are individually limited but cumulatively considerable? (“Cumulatively considerable” means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects.)	☐	☐	■	☐
c. Does the project have environmental effects that will cause substantial adverse effects on human beings, either directly or indirectly?	☐	■	☐	☐

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[78] California Integrated Waste Management Board, *Active Landfills Profile for Vasco Road Sanitary Landfill (01-AA-0010)*, http://www.ciwmb.ca.gov/Profiles/Facility/Landfill/LFProfile1.asp?COID=1&FACID=01-AA-0010, accessed October 14, 2010.

Discussion

a. **Less than Significant with Mitigation Incorporated.** As described in Section 4, Biological Resources, the project site does not provide habitat for any fish or wildlife species, nor does it support special-status plant types. However, there are nearby water features (an engineered channel and a low-lying area north of the project site) that include wetland attributes. Mitigation has been proposed to reduce potential impacts to these areas to less than significant. Section 5, Cultural Resources, describes the cultural resources that may be present on the project site. The project site may contain subsurface historical resources or unique archaeological resources. Mitigation has been proposed that would reduce potential impacts to these cultural resources to a less-than-significant level.

b. **Less than Significant.** The proposed project is surrounded by existing developed areas. The Whipple Road bridge, adjacent to the project site, is planned for retrofit by Union City. As noted in the project description, construction activities would be within the BART right-of-way, and BART is cooperating with Union City on the construction activities. However, the schedule for construction of the bridge retrofit project is anticipated to begin in 2011 and to last for approximately 6 months,[79] and would be expected to be completed prior to the start of construction for the proposed project. Therefore, there would be no cumulative impacts associated with construction of the Whipple Road bridge and the proposed project.

Also, there are proposed changes to the rail service along the adjacent UPRR rail corridors along the east and west sides of the project site. Recent environmental documents for projects in the area, including the Capital Corridor Program Environmental Assessment, the Union City Intermodal Final Environmental Impact Report, and the Dumbarton Rail Project plans have indicated significant service changes to the UPRR rail corridor along the west side of the project site. Review of these plans indicate that changes are proposed for the existing Whipple Road grade crossing (e.g., new gates, roadway median). As described in Section 16, Transportation/Traffic, the proposed project would not result in conflicts at the UPRR grade crossing from traffic accessing the site. In addition, improvements planned for the rail crossing would enhance the existing safety measures for vehicles crossing the UPRR tracks.

Other than the projects listed above, which would not generate new traffic or other population-driven impacts, there are no known foreseeable developments in the project vicinity, the impacts of which could cumulate with those of the proposed project. Moreover, the level of activity at the project site is expected to generate minimal traffic and no employment-related impacts. As a result, the project would result in less than cumulatively considerable impacts for these environmental topics. Because there is no foreseeable development, cumulative impacts are not anticipated. The proposed expansion of the Hayward Yard would incrementally increase the use of hazardous materials, contribute to stormwater runoff, remove vegetation, and potentially disturb cultural resources. However, existing regulations and permits governing these hazards and resources would apply to development in the area and

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[79] Personal communication with Michael Renk, Union City Public Works Department, November 3, 2010.

would reduce the contribution from each to less than cumulatively considerable, and thus cumulative impacts would be less than significant.

c. **Less than Significant with Mitigation Incorporated.** The proposed project's potential to impact human beings is addressed in various topics included in the checklist. As identified in Section 8, Hazards and Hazardous Materials, the project site is located next to an area that contains contaminated soil and could be disturbed during construction activities. Mitigation has been proposed to ensure that human beings are not adversely affected. In addition, impacts to human beings due to changes in Air Quality (Section 3) or the Noise environment (Section 12) would be less than significant with the recommended mitigation measures.

Appendix B

Addendum to Final Initial Study/Mitigated Negative Declaration for the Hayward Maintenance Complex Project - Component Repair Shop - Building 3 Replacement

San Francisco Bay Area Rapid Transit District

Addendum to Final Initial Study/Mitigated Negative Declaration for the Hayward Maintenance Complex Project

COMPONENT REPAIR SHOP—BUILDING 3 REPLACEMENT

March 27, 2013

Addendum to Final Initial Study/Mitigated Negative Declaration for the Hayward Maintenance Complex Project:

COMPONENT REPAIR SHOP—BUILDING 3 REPLACEMENT

Introduction and Purpose

In the original Hayward Maintenance Complex (HMC) plan, an existing warehouse (Building 3) would be renovated and become the Component Repair Shop. The project design has evolved, and the current plan is to demolish Building 3 and replace it with a new structure to house the Component Repair Shop. The purpose of this Addendum is to examine if the demolition of Building 3 and construction of a new structure would require additional environmental analysis beyond that provided in the HMC Initial Study/Mitigated Negative Declaration (IS/MND). Based on the following evaluation, no additional environmental review is required.

Original HMC Plan

There are four existing warehouses on the west side of the Hayward Yard. (See Figure A.) The northernmost warehouse (Building 4) will to be demolished and replaced by a new overhaul shop. The northernmost of the three retained warehouses (Building 3) was to be renovated to become the Component Repair Shop. The Final IS/MND (page 10, Final IS/MND) described the renovation to the structure as follows:

> The Component Repair Shop would be located in one of the existing buildings, a 120,000-square-foot structure constructed of concrete slab-on-grade, wood columns and laminated beams, plywood panel roof, and concrete tilt-up exterior walls. Truck loading docks are located along the structure's east side.
>
> The structure would serve as the Component Repair Shop, with three major areas: the truck shop, electronic repair shop, and electro-mechanical repair shop. Renovations would be made within the existing building footprint, and building modifications would be minimized. The existing roof, columns, and walls would be used without major modifications to the degree possible. The existing floor area would be demolished leaving columns and footings in place and would be replaced with new concrete, equipment footings, embedded rail, pits, etc. The roof would be raised approximately 10 feet to accommodate a new 10-ton overhead crane. The structure would be upgraded to new seismic code requirements. New bathrooms and break rooms would be added to accommodate the workforce.

Revised Component Repair Shop Plan

As the detailed analysis of the HMC Project progressed, the advantages of retaining the existing Building 3 structure decreased. The current structure is a tilt-up building designed for warehousing. Although BART could have renovated the structure to bring it to current seismic standards, the repair functions in the Component Repair Shop are essential to the BART system, and as such, the structure must meet life-safety requirements to allow it to function following a catastrophic event. BART has determined that a new structure constructed to higher seismic standards would better meet long-term service goals.

Therefore, the HMC Project has been modified to demolish Building 3 and replace it with a new structure to house the Component Repair Shop.

The new structure would have the same approximate horizontal dimensions (600 feet long, 200 feet wide) as the existing structure and a 125,530 square-foot footprint. Compared to the existing footprint, this is a 4.6 percent increase in square footage. Interior space will be expanded to 157,930 square feet with the addition of 32,400 square feet on a mezzanine floor for offices and the Electronic Repair Shop, representing a 32 percent increase in available office space compared with the existing building footprint.

The new structure would be shifted 20 feet to the south of its current location. The increased distance will provide additional width to accommodate the north-south roadway and an easement for a relocated water line as well as other utilities between the new Vehicle Repair Shop and the Component Repair Shop. The roadway was described in the IS/MND and would connect the existing driveway serving the west side of the HMC project to Sandoval Way and the Hayward Main Shop area. This southward shift would reduce the distance between the Component Repair Shop and adjacent structure on the south, Building 2, from 100 feet to 80 feet. The new building would be a structural steel frame building clad with metal panels. The new structure would be higher than the 26-foot-tall existing structure. The new building roof line would vary in height, with three different roof levels of 30 feet, 38 feet and 45 feet. (See Elevations, Figure B.) The Component Repair equipment and operations within the building would be the same as originally proposed. The number of employees in the Component Repair Shop would stay the same as originally proposed in the IS/MND (75 during peak occupancy, 150 total).

Demolition of the existing building and construction of the new Component Repair Shop building would be similar to those described for the Overhaul Shop in the IS/MND (pp. 20-21). An estimated 500 truck trips over and above those described in the IS/MND would be required to remove the demolition debris and deliver new construction material. Approximately one-half of those additional truck trips (250) would take place over a 2-month demolition period and the remainder would deliver material over the 11-month construction period to follow.[1]

Previous Environmental Review

An Initial Study/Mitigated Negative Declaration (IS/MND) was conducted for the HMC Project, which was adopted by the BART Board on May 26, 2011. The Board approved the HMC Project on the same date. The FTA approved a Categorical Exclusion for the HMC Project on September 21, 2011. The IS/MND examined the full range of potential environmental impacts and provided mitigation measures where potentially significant impacts were identified.

Purpose of Addendum

Section 15164 of the CEQA Guidelines allows a Lead Agency to prepare an Addendum to a previously adopted Negative Declaration if some changes or additions are necessary, as long as none of the conditions described in Section 15162 requiring the preparation of a subsequent EIR or Negative Declaration have occurred. In brief, Section 15162 states that when an EIR has been certified or Negative Declaration adopted, no subsequent EIR or Negative Declaration needs to be prepared for the project

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[1] Galip Sukaya, P.E., Project Engineer, personal communication, January 22, 2013.

unless the Lead Agency determines, on the basis of substantial evidence in the light of the whole record, that there are substantial changes proposed in the project which require major revisions of the previous EIR or Negative Declaration, substantial changes occur with respect to the circumstances under which the project is undertaken, or there is new information of substantial importance regarding new significant effects, more severe effects, or the feasibility or effectiveness of mitigation measures.

Environmental Assessment

The following analysis provides a review of the topics in the IS/MND to examine if any of the conditions requiring subsequent environmental review would be triggered by the proposed demolition and reconstruction of Building 3. Based on this analysis, no subsequent environmental review is necessary.

Aesthetics: The new structure would be the same basic footprint and horizontal dimensions as the existing structure, and the building would be shifted 20 feet to the south. The original HMC plan called for raising the roof of the building by from 25 feet to approximately 35 feet. The revised plan would construct a new building with three different roof levels, but with a maximum height of 45 feet. The new building would be a steel frame building with metal panels for walls, similar to the construction of the Hayward Main Shop. As noted in the Aesthetics section of the IS/MND, the west side of the HMC Project is surrounded by industrial uses. The BART mainline tracks are to the east, the Union Pacific Railroad is to the west, and there are other industrial buildings to both the north and south. There are no immediate views of the area from locations open to the public. Given the relatively minor increase in size and height of the new structure compared to the existing building and other existing structures, its 20-foot shift to the south, and the site's lack of visual access, there would be no change to the determination in IS/MND that there is a less than significant visual impact.

Agriculture and Forestry Resources: No agriculture or forestry resources are present.

Air Quality: Demolition of the structure would create additional dust. The IS/MND includes Mitigation Measure AQ-2 (Dust Control During Construction) that requires contractors to implement standard Bay Area Air Quality Management District (BAAQMD) measures to control construction dust, which would also apply to the demolition of Building 3.

Biological Resources: The area around Building 3 is developed and paved. The only biological resources affected would be a small number of ornamental trees and shrubs at the corners of Building 3. These would be removed as part of the demolition of Building 3. Mitigation Measures BIO-2 (Restrictions on Tree or Shrub Removal to Avoid Nesting Birds), BIO-3 (Pre-construction Nesting Bird Survey and Measures to Reduce Harm to Nesting Birds), and BIO-4 (Tree Survey and Replacement of Protected Trees to the Removed) as identified in the IS/MND would apply to the demolition and construction of a new Component Repair Shop, just as they applied to other elements of the HMC project.

Cultural Resources: No cultural resources were identified in the HMC Project area. However, the IS/MND included two mitigation measures (CR-1 and CR-2) to ensure that there would be no significant impacts to unknown subsurface resources or human remains.

Geology and Soils: The IS/MND identified potential geologic and soil hazards related to strong seismic ground shaking, liquefaction, lateral spreading, settlement, expansive soils, and erosion of excavated areas. In each case, implementation of the BART Facilities Standards as identified in the IS/MND would ensure that the project, including the demolition and reconstruction of Building 3, would be designed and constructed in a manner that the potential hazards would be reduced to a less-than-significant level.

Greenhouse Gas Emissions (GHG): BART calculated the HMC GHG emissions by comparing the net difference between the GHG emissions of the HMC Project minus the emissions generated by the existing warehouse uses to the BAAQMD GHG threshold.[2] (The GHG analysis is provided in Appendix A.) The analysis demonstrated that the revised Component Repair Shop, and the HMC Project as a whole, would not exceed the BAAQMD GHG operational significance threshold of 1,100 metric tons per year. In addition, a second comparison was conducted using project-specific data (specifically the lower net vehicle trip generation rate) and the resulting emissions again were compared with the BAAQMD GHG threshold. The second case also showed that the project GHG emissions would not exceed the BAAQMD threshold for GHG gases. Therefore the revised plan for the Component Repair Shop is still consistent with the GHG determinations made in the IS/MND that the project would not have a significant GHG-related impact.

There would be short-term construction emissions related to the demolition. Mitigation Measure GHG-1 (Construction-Related Greenhouse Gas Best Management Practices) was adopted as part of the project and would apply to demolition of Building 3, as well as the rest of the project.

Hazards and Hazardous Materials: No new materials or processes would be involved in a newly constructed Component Repair Shop that would not have been used in the same activities in a reconstructed Building 3, which was analyzed in the IS/MND. Based on the 1985 and later construction dates for warehouse buildings, it is unlikely that lead-based paint or asbestos are present.
A Phase I Environmental Site Assessment was completed for the properties containing the four existing warehouses in May 2012.[3] The properties are listed on various environmental databases for soil and ground water contamination: Cortese, Leaking Underground Storage Tanks (LUST) and Spills, Leaks, Investigations and Cleanups (SLIC). The contamination is related to a former metal fabricating facility on the site that operated from the 1970s until 1985 and a metal fastener fabricating plant that operated from 1985 to 1992. According to the LUST listing, in 2003, the site received case closure for a gasoline release. After the metal and metal fastener fabricating facilities vacated the site, four underground storage tanks and a septic tank were removed, and contaminated soil removal and groundwater treatment were

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[2] On March 5, 2012, an Alameda County Superior Court judge held that the CEQA significance thresholds adopted by BAAQMD in 2011, including its threshold for GHG emissions, constitute a "project" subject to CEQA review. *California Building Industry Association v. Bay Area Air Quality Management District*, Alameda County Superior Court Case No. RG10548693. The court did not determine whether the thresholds were valid on the merits, but issued a writ of mandate ordering BAAQMD to set aside the thresholds and cease dissemination of them until it had complied with CEQA. BAAQMD has appealed the court's decision and the appeal is currently pending. Meanwhile, lead agencies must identify their own GHG significance thresholds impacts based on substantial evidence in the record, as provided in CEQA Guidelines sections 15064.4 and 15064.7. Notwithstanding that the BAAQMD CEQA thresholds have been set aside, BART has determined that the extensive studies and analysis conducted by BAAQMD while developing its GHG significance criteria constitute substantial evidence supporting their use by BART. See BAAQMD California Environmental Quality Act Air Quality Guidelines (2011), Appendix D, Threshold of Significance Justification. Accordingly, pursuant to CEQA Guidelines section 15064.7, BART is exercising its discretion to utilize the BAAQMD GHG thresholds for purposes of this Addendum.

[3] Environmental Resources Management, Phase I Environmental Site Assessment, Hayward Yard-Bowman Place Properties; 1001-1085 Whipple Road, May 2012.

conducted under the supervision of the Regional Water Quality Control Board (RWQCB). The RWQCB granted closure for the site in 2007. However, access to all portions of the site and personnel knowledgeable about past and current tenant operations were not available at the time of the Phase I investigation. There are also several contaminated properties nearby, including a U.S. Pipe facility to the west-southwest of the warehouses listed in the SLIC and other databases indicating environmental impairment. Therefore, there are remaining unknowns regarding past and current site operations and potential migration of contaminants from adjacent properties.

A Phase II Environmental Site Investigation was conducted, and a draft report was released in September 2012.[4] Borings were made around and between the warehouses, and soil and groundwater samples were taken and analyzed. The results of that investigation did not indicate the obvious presence of significant releases of hazardous substances at the site, although low levels of volatile organic compounds are present in soil vapor, including detections of ethylbenzene above regulatory screening levels that may be attributed to off-site sources or former on-site activities. Detections above screening levels of arsenic in soil and vanadium in groundwater appear to be related to natural background concentrations. However, it is possible that higher concentrations of regulated hazardous substances are present at the site in areas that were not sampled, including possible shallow and deep groundwater contamination. The IS/MND contains mitigation measures in the event hazardous substances are found to be present. Mitigation Measure HAZ-3 (Remediation of Contaminated Sites Prior to Construction) and HAZ-4 (Discovered Environmental Contamination During Construction) would be implemented if necessary. These mitigation measures apply to the demolition and construction of a new Component Repair Shop just as they applied to the original plan to reconstruct Building 3.

Hydrology and Water Quality: The project area is developed and paved. The demolition and reconstruction of the structure would not create any additional impermeable surface and would not change drainage patterns.

Land Use and Planning: Existing land uses in the project area have not changed and the Component Repair Shop would have the same intended uses that were discussed in the IS/MND.

Mineral Resources: There are no mineral resources in the project area.

Noise and Vibration: Operational and construction impacts for noise and vibration were evaluated in the IS/MND. The noise and vibration analysis for HMC operations included activities in the west side expansion area, which includes Building 3. The reconstructed Building 3 would house the same Component Repair Shop activities analyzed in the original analysis, which determined that there would be no significant noise or vibration impacts from HMC operations in the west side expansion area.

The IS/MND also analyzed construction noise and vibration. Construction noise impacts are directly related to the type of equipment being employed and the distance to sensitive receptors. Equipment used in the demolition, such as bulldozers, loaders and hoe rams, would be similar to what would be employed for the demolition of Building 4, which was included in the construction noise analysis. Building 3 is located along the west side of the HMC project. Adjacent land uses west of Building 3 are industrial and

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[4] Environmental Resources Management, Final Phase II Environmental Site Investigation, 1001-1085 Whipple Road, December 2012.

include railroad tracks and construction and storage yards. The closest sensitive receptors are residents in homes along the east side of the yard. These residents are separated from Building 3 by the width of the Hayward Yard and are approximately 675 feet from Building 3. This is the same distance as other elements of the west side expansion that were examined in the IS/MND. No significant construction noise impacts were identified for the west side construction, including the demolition and reconstruction of Building 4; therefore no significant noise impacts are anticipated from the demolition and reconstruction of Building 3.

Construction vibration dissipates quickly as distance from the construction increase. No significant construction vibration impacts were identified for the west side expansion area; therefore no significant vibration impacts are anticipated for the demolition and reconstruction of Building 3.

Population and Housing: Operational employment would be the same as with the original HMC Project. Construction employment could be slightly higher than the originally anticipated due to the additional work for demolition and reconstruction of Building 3, but these would be temporary employees and would not have an effect on local population growth or housing stock.

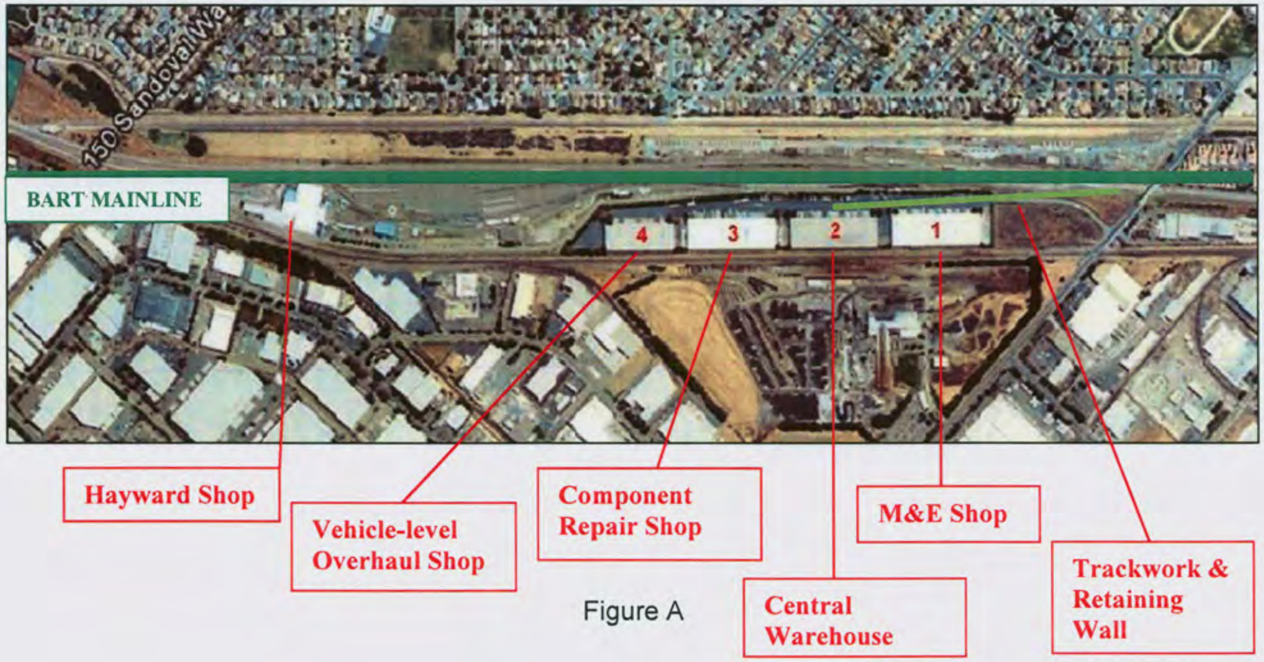
Public Services: No significant public service impacts were identified with the HMC Project and the demolition of Building 3 would not affect the need for police, fire, schools, parks or other public facilities.

Recreation: No recreation impacts were identified with the HMC Project. Construction employment could be slightly higher than originally anticipated due to the additional work for demolition and reconstruction of Building 3, but these would be temporary employees and would not have an effect on local recreation needs.

Transportation/Traffic: As described in the IS/MND, construction activities would take place in two Phases. Phase 1 would take place over approximately 36 months and would include construction of the west side expansion area: Vehicle Overhaul Shop, Component Repair Shop, Central Warehouse, and M&E Vehicle and Storage Area. The IS/MND analysis calculated that approximately 3,110 truck trips would take place during Phase 1 to support demolition of existing structures, delivery of building materials and concrete, and retrofitting the three warehouses that would remain as part to the HMC Project. Demolition of Building 3 is estimated to generate an additional 500 truck trips that would increase truck activity for Phase 1 construction to 3,610 truck trips. Most of these truck trips would enter and exit the west side expansion area via the project access on Whipple Road. Approximately one-half of the additional truck trips (250 truck trips) would take place during the 2-month demolition period for Building 3, with the remainder taking place over the expected 11-month construction of the replacement building. Assuming that the 250 truck trips during demolition would be distributed over 2 months (40 working days), truck activity during demolition would add approximately six additional truck trips per day. Although truck activity during Building 3 construction would be approximately the same as during demolition, it would be spread out over a much longer period and therefore would have a smaller effect on traffic. As noted on page 125 of the IS/MND, approximately 100 to 105 daily truck trips would be generated during project construction. Adding the additional six trucks daily from the demolition would increase the truck traffic to approximately 110 daily truck trips. Applying the passenger car equivalent (PCE) rate of 2.0, there would be a minimum of 200 to approximately 220 vehicle trips during demolition of Building 3. This would be less than the approximately 710 daily vehicle trips (with up to 32 percent truck trips) that were recorded with the project site in warehouse use. The IS/MND contains Mitigation Measure TR-1 (Construction Phasing and Traffic Management Plan) that requires the contractor develop and implement a plan that defines how traffic operations are managed and maintained during each phase of construction. The plan will include predetermined haul routes and will identify activities, such as truck activities, that must take place during off-peak hours. Considering the level of additional truck activity (six trucks per day) and the existing requirement for a construction phasing and traffic management plan, the additional truck activity related to the Building 3 demolition would not create any new or more severe significant impacts not anticipated in the IS/MND.

Utilities and Service Systems: No significant impacts to utilities and service systems were identified in the IS/MND for the HMC Project. The demolition and reconstruction of Building 3 would not change the uses within the Component Repair Shop and would not change the less-than-significant impact on utilities and systems.

Mandatory Findings of Significance: The IS/MND did not identify any potentially significant impacts triggering mandatory findings of significance. The demolition and reconstruction of Building 3 would not affect that conclusion or result in any mandatory findings of significance.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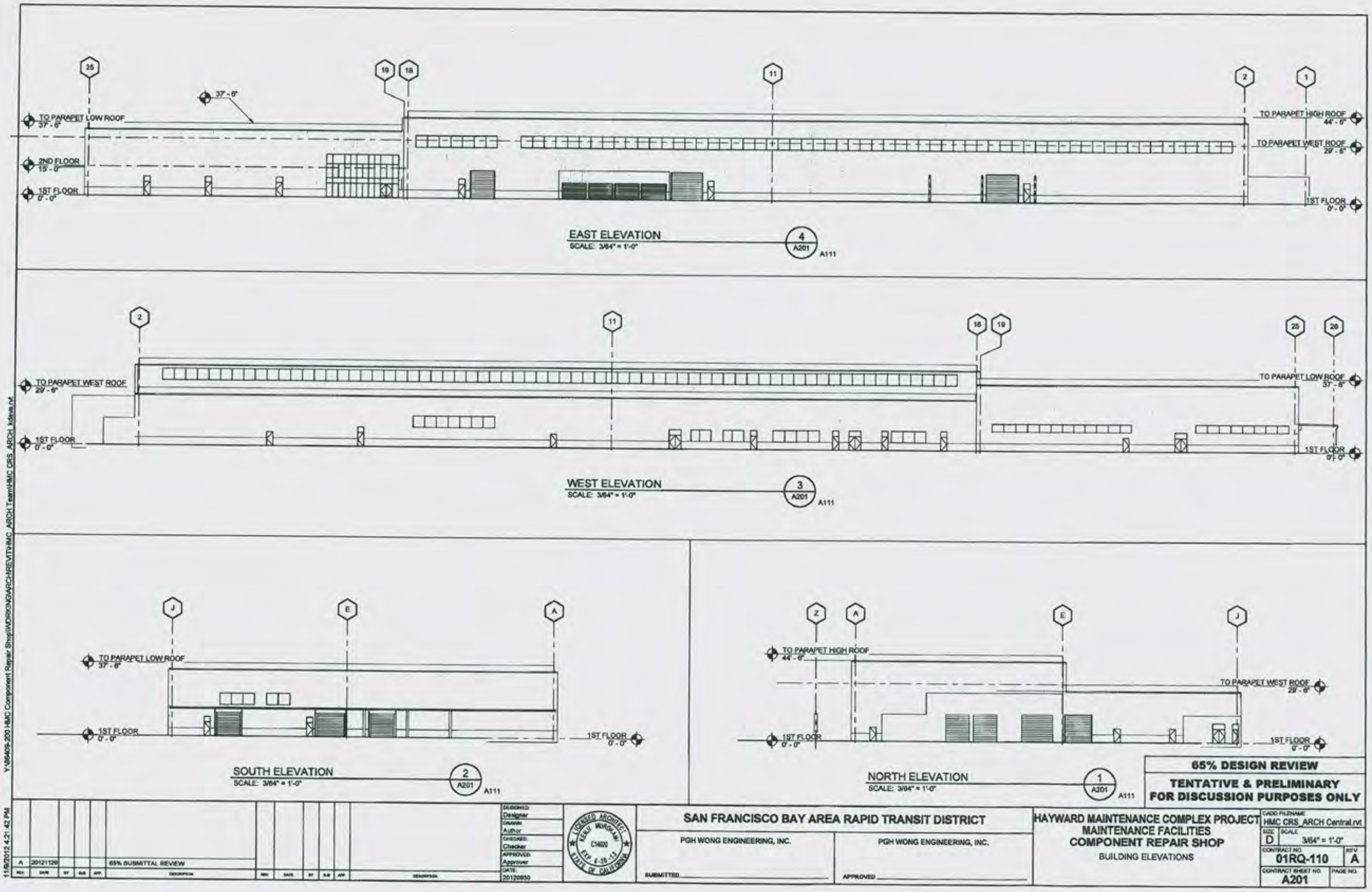
Hayward Shop
Vehicle-level Overhaul Shop
Component Repair Shop
Central Warehouse
M&E Shop
Trackwork & Retaining Wall

Figure A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MAINTENANCE FACILITIES
COMPONENT REPAIR SHOP
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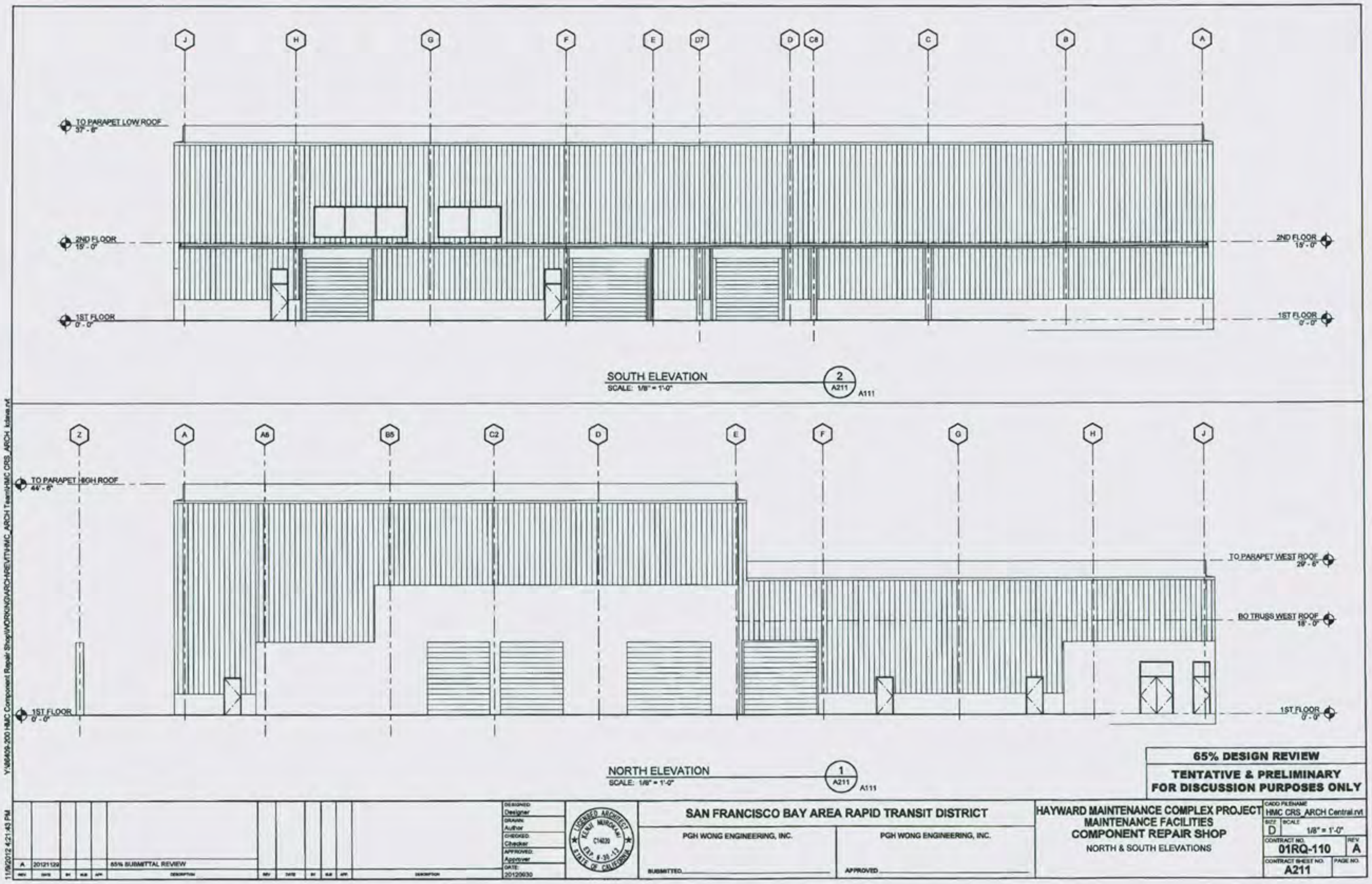
Figure B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SAN FRANCISCO BAY AREA RAPID TRANSIT DISTRICT
PGH WONG ENGINEERING, INC.
PGH WONG ENGINEERING, INC.
SUBMITTED
APPROVED
HAYWARD MAINTENANCE COMPLEX PROJECT
MAINTENANCE FACILITIES
COMPONENT REPAIR SHOP
NORTH & SOUTH ELEVATIONS
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Figure B

APPENDIX A

Supplementary Greenhouse Gas Analysis

Memorandum

To: Don Dean, BART

From: Geoff Hornek, Environmental Air Quality Consultant

Date: December 12, 2012

Re: Calculation of BART Hayward Maintenance Complex (HMC) Greenhouse Gas (GHG) Emissions and Comparison with the Bay Area Air Quality Management District (BAAQMD) California Environmental Quality Act (CEQA) Significance Threshold

In May 2011, BART issued a Final Initial Study/Mitigated Negative Declaration (IS/MND) for its proposed Hayward Maintenance Complex (HMC) project. At that time, the HMC project included the renovation of an existing 120,000-square-foot warehouse (Building 3) to become the Component Repair Shop. But since then BART has decided to alter the Project Description to demolish the old warehouse and build a new structure to house the Component Repair Shop, adding approximately 5,530 square feet (a 4.6 percent increase) to the footprint and an additional 32,400 square feet of interior space (on a mezzanine floor) for a total of 157,930 square feet compared to the plan analyzed in the IS/MND.

With this addition, the HMC project will exceed the Bay Area Air Quality Management District's (BAAQMD's) 121,000-square-foot (net new) operational greenhouse gas (GHG) screening threshold for "General Light Industrial" developments (the land use category in the BAAQMD screening methodology assumed to best-fit the HMC project).[1]

The BAAQMD GHG screening threshold was set based on GHG emissions expected from specific land use categories, as defined and determined by the URBEMIS emission model (with the BAAQMD's BGM add-on spreadsheet for quantifying non-transportation source GHG emissions) using model-defined default assumptions for GHG emissions from motor vehicle trips, energy/water use, solid waste generation, etc. For projects in each land use category exceeding the size specifications of the screening thresholds, GHG emissions would exceed 1,100 metric tons per year

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[1] On March 5, 2012, an Alameda County Superior Court judge held that the CEQA significance thresholds adopted by BAAQMD in 2011, including its threshold for GHG emissions, constitute a "project" subject to CEQA review. *California Building Industry Association v. Bay Area Air Quality Management District*, Alameda County Superior Court Case No. RG10548693. The court did not determine whether the thresholds were valid on the merits, but issued a writ of mandate ordering BAAQMD to set aside the thresholds and cease dissemination of them until it had complied with CEQA. BAAQMD has appealed the court's decision and the appeal is currently pending. Meanwhile, lead agencies must identify their own GHG significance thresholds impacts based on substantial evidence in the record, as provided in CEQA Guidelines sections 15064.4 and 15064.7. Notwithstanding that the BAAQMD CEQA thresholds have been set aside, BART has determined that the extensive studies and analysis conducted by BAAQMD while developing its GHG significance criteria constitute substantial evidence supporting their use by BART. See BAAQMD California Environmental Quality Act Air Quality Guidelines (2011), Appendix D, Threshold of Significance Justification. Accordingly, pursuant to CEQA Guidelines section 15064.7, BART is exercising its discretion to utilize the BAAQMD GHG thresholds for purposes of this Addendum.

(MT/year), which is the BAAQMD's GHG operational emissions CEQA significance threshold. Since the HMC project exceeds the BAAQMD square-footage screening threshold, the next-level CEQA analysis is called for, which would use the URBEMIS/BGM model to estimate the net project GHG emissions with model default assumptions about GHG emission rates from motor vehicles and other important GHG sources (i.e., electricity and water use, solid waste generation, etc.).

Accordingly, GHG emissions were estimated for the proposed project (i.e., the Component Repair Shop, which was assumed to best-fit the URBERMIS "General Light Industrial" land use category) and the existing warehouse it would replace (using the "Warehouse" land use category in URBEMIS). Such emissions for the project and existing land uses using URBEMIS default assumptions are shown in the table below, along with the net emissions for each GHG source category and for the total. The BAAQMD CEQA threshold, which would apply only to net project emissions, is not exceeded in this case, which assumes that the project would be in accord with all default GHG emission rate assumptions in URBEMIS.

However, there is one instance where URBEMIS default assumptions could be replaced with more accurate project-specific data to more accurately estimate net project emissions. URBEMIS assumes that a "General Light Industrial" use would generate 6.97 daily motor vehicle trips per 1000 square feet of floor area, and that a "Warehouse" use would generate 4.96 daily motor vehicle trips per 1000 square feet of floor area. Using these rates, URBEMIS would estimate that project development would produce a net increase of 622 daily motor vehicle trips. But the traffic study done for the HMC project estimates a net reduction of 314 daily motor vehicle trips (because maintenance facility space generates fewer motor vehicle trips than the same amount of warehouse space and because of a further 20% reduction in worker trips due to BART's commitment to provide a peak-hour BART stop at the HMC complex for HMC employees). This removal of motor vehicle trips will reduce the overall total net facility GHG emissions as shown in the last column of the table below. Not only will the total net GHG emissions not exceed the BAAQMD threshold, but there will be a net project benefit to global GHG emissions because of the project-induced reduction in motor vehicle trips.

BART Hayward Maintenance Complex – Greenhouse Gas Emissions Estimates and Comparisons (CO2e - Metric Tons/Year)

GHG Source Category	**Proposed Project** (General Light Industry) *Using All URBEMIS Default Rates*	**Existing Use to be Removed** (Warehouse) *Using All URBEMIS Default Rates*	**Net Project GHG Emissions** *Using All URBEMIS Default Rates*	**Net Project GHG Emissions** *With Project-Specific Motor Vehicle Trip Rate*
Transportation	1418.0	697.3	720.8	-404.4
Area Source	0.2	0.2	0.0	0.0
Electricity	445.5	353.9	91.6	91.6
Natural Gas	36.3	28.9	7.5	7.5
Water & Waste Water	5.0	4.0	1.0	1.0
Solid Waste	111.5	209.7	-98.1	-98.1
Agriculture	0.0	0.0	0.0	0.0
Off-Road Equipment	0.0	0.0	0.0	0.0
Refrigerants	0.0	0.0	0.0	0.0
Sequestration	N/A	N/A	N/A	N/A
Purchase of Offsets	N/A	N/A	N/A	N/A
Total	2016.7	1293.9	722.8	-402.4
BAAQMD Significance Threshold (for Net Project)			**1100**	**1100**
Project Exceeds Threshold?			**No**	**No**

Source: URBEMIS emission model with the BAAQMD's Bay Area Greenhouse Gas Model (BGM) add-on spreadsheet for quantifying non-transportation source GHG emissions; estimates generated December 2012.

Appendix C

Second Addendum to the Final Initial Study/Mitigated Negative Declaration for BART Hayward Maintenance Complex Project

San Francisco Bay Area Rapid Transit District

Second Addendum to the Final Initial Study/Mitigated Negative Declaration

BART Hayward Maintenance Complex Project

August 2016

TABLE OF CONTENTS

Attachments

TABLES

FIGURES

1. Introduction and Purpose

Over the next 30 years, the San Francisco Bay Area Rapid Transit District (BART) will require additional vehicles to meet future demand associated with regional population growth and system expansions. Accordingly, BART requires expanded maintenance and storage facilities to serve this expanded fleet. In response to this requirement, BART is currently constructing the Hayward Maintenance Complex (HMC) project at the existing Hayward Yard. The HMC Project consists of acquisition and improvement to three properties containing four warehouses on the west side of the existing Hayward Yard and the construction of additional storage tracks on undeveloped BART property on the east side of the Hayward Yard. The project location is depicted on Figure 1.

As part of preliminary design, BART is proposing modifications to the previously-approved HMC. This Addendum describes the proposed modifications and provides an examination of whether these modifications would require additional environmental analysis beyond that provided in the HMC Initial Study/Mitigated Negative Declaration (IS/MND) adopted by the BART Board of Directors (Board) on May 26, 2011. Based on the following evaluation, no additional environmental review is required.

2. Previous Environmental Reviews for the Hayward Maintenance Complex

An IS/MND was prepared for the HMC Project pursuant to the California Environmental Quality Act (CEQA). The IS/MND examined a full range of potential environmental impacts and proposed mitigation measures where potentially significant impacts were identified. The IS/MND was adopted, and the HMC Project was approved by the BART Board of Directors (Board) on May 26, 2011. Because the project included federal funding, the Federal Transit Administration (FTA) reviewed the project pursuant to the National Environmental Policy Act (NEPA) and approved a Categorical Exclusion for the project on September 21, 2011.

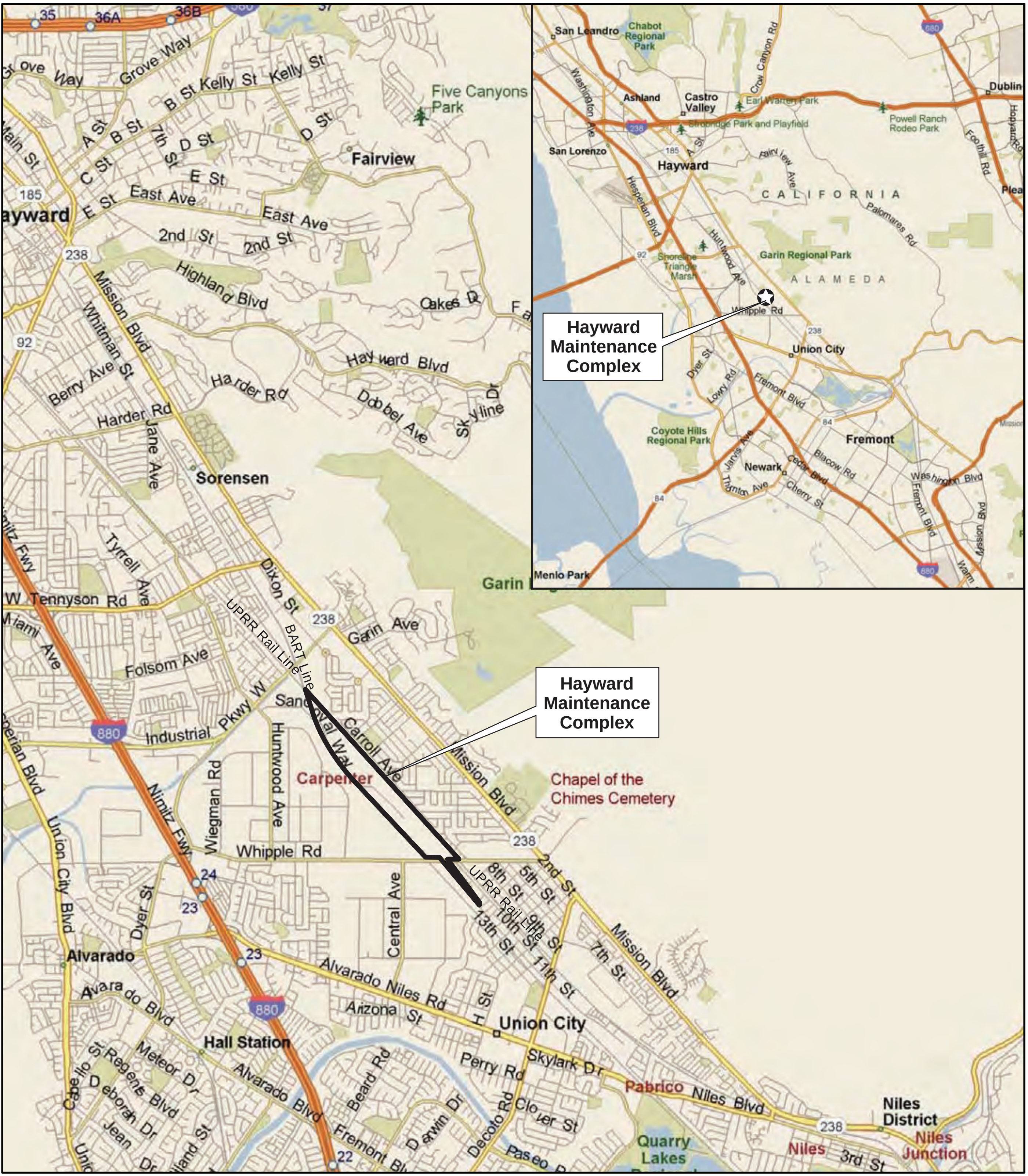
In March 2013, an Addendum to the 2011 IS/MND was prepared in response to proposed modifications to the approved project. In the original HMC plan, an existing warehouse (Building 3) would be renovated and become the Component Repair Shop. The project design was revised to demolish Building 3 and replace it with a new structure to house the Component Repair Shop.

3. Purpose of Addendum

In accordance with Section 15164 of the CEQA Guidelines, BART may prepare an Addendum to the 2011 IS/MND if some changes or additions to the previously approved HMC Project are necessary, as long as none of the conditions described in Section 15162 requiring the preparation of a subsequent EIR or Negative Declaration have occurred.

In brief, Section 15162 states that when an EIR has been certified or Negative Declaration adopted, no subsequent EIR or Negative Declaration needs to be prepared for the project unless the Lead Agency determines, on the basis of substantial evidence in the light of the whole record, that there are:

- Substantial changes proposed in the project which require major revisions of the previous EIR or Negative Declaration,
- Substantial changes occur with respect to the circumstances under which the project is undertaken, or
- There is new information of substantial importance regarding new significant effects, more severe effects, or the feasibility or effectiveness of mitigation measures.



Source: Microsoft Streets and Trips, 2009, PBS&J, 2011.

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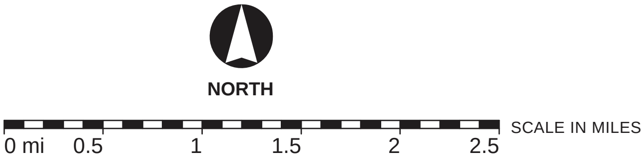


PROJECT LOCATION

Hayward Maintenance Complex
60270000 BART
August 2016 Hayward, California

AECOM

FIGURE 1

4. Determination

This Addendum revisits the analysis conducted in the 2011 IS/MND and 2013 Addendum and evaluates the proposed modifications to the previously-approved HMC. The proposed modifications were evaluated for all categories of impact. As described below, the analysis did not identify any substantial changes to the affected environment and did not identify any new or substantially more severe impacts not already identified in the previous environmental documents. All mitigation measures included in those documents and the MMRP will continue to apply to the proposed modifications. Based on the evaluation presented in this Addendum, there is no substantial evidence in the light of the whole record that the conditions outlined in Section 15162 of the CEQA Guidelines requiring a subsequent IS/MND are met. Therefore, an IS/MND Addendum is appropriate.

5. Proposed Modifications

The HMC Project consists of acquisition and improvement to three properties containing four warehouses on the west side of the existing Hayward Yard and the construction of expanded maintenance and storage facilities. Implementation of the HMC will occur over two phases.

Phase 1 includes a new Vehicle Overhaul and Heavy Repairs Shop (VOHRS), Component Repair Shop, Central Warehouse, and Maintenance and Engineering (M&E) Shop and storage area. A new motor vehicle connection will allow vehicle access between the new properties and Sandoval Way, the existing yard roadway. Rail car access would be added along the east side of the properties to connect them to the existing Hayward Yard. Maintenance operations and storage would move from the east side yard to the west side with the establishment of the proposed M&E Shop and storage area.

Phase 2 will include a new storage area on approximately 13 acres of an undeveloped 20-acre portion of the northeast quadrant of the Hayward Yard. The site is bounded by the existing UPRR rail line on the east, the BART mainline and test track to the west, and BART's existing materials storage yard to the south. In addition to the new expansion area to the east of the existing yard, a portion of the approximately 12 acres of the existing BART storage yard (which is already paved) will be reconfigured with connecting tracks.

The proposed modifications to the HMC Project evaluated in this Addendum include the following elements:

- A self-contained paint booth would be added in the VOHRS.
- Rather than retrofitting existing on-site structures, the existing structures would be demolished and new buildings for the M&E Shop and Central Warehouse will be constructed.
- A new spur track running from the already-planned M&E non-revenue tracks in front of the New M&E Shop and Central Warehouse would be constructed.
- A new fuel island adjacent to the M&E non-revenue tracks with 8,000 gallons of gasoline and 8,000 gallons of diesel would be constructed.
- The “BP” bypass track, proposed for just north of Whipple Road, would be relocated northward by about 1,000 feet. The bypass will be longer than the previously-planned bypass and would cross Sandoval Road at grade.
- The existing revenue vehicle turntable within the existing Hayward Yard would be relocated by about 100 feet to the north to avoid interference with already planned new tracks in the area. The existing yard trackage would be modified to accommodate the new turntable location.

- All new buildings would include provisions for future rooftop solar panels.
- A canopy structure between the CRS and the Central Warehouse would be constructed.
- Proposed Soundwall SW-3 would be relocated revised.
- Protective fencing would be installed south of Whipple Road between the mainline track and the Hayward Test Track.

The locations of these modifications within the HMC are depicted on Figures 2, 3, and 4.

6. Environmental Analysis

The following analysis provides a review of the topics in the previous environmental documents to examine if any of the conditions requiring subsequent environmental review (as defined in Section 15162 of the CEQA Guidelines) would be triggered by the proposed modifications to the HMC Project. Based on this analysis, no subsequent environmental review is necessary.

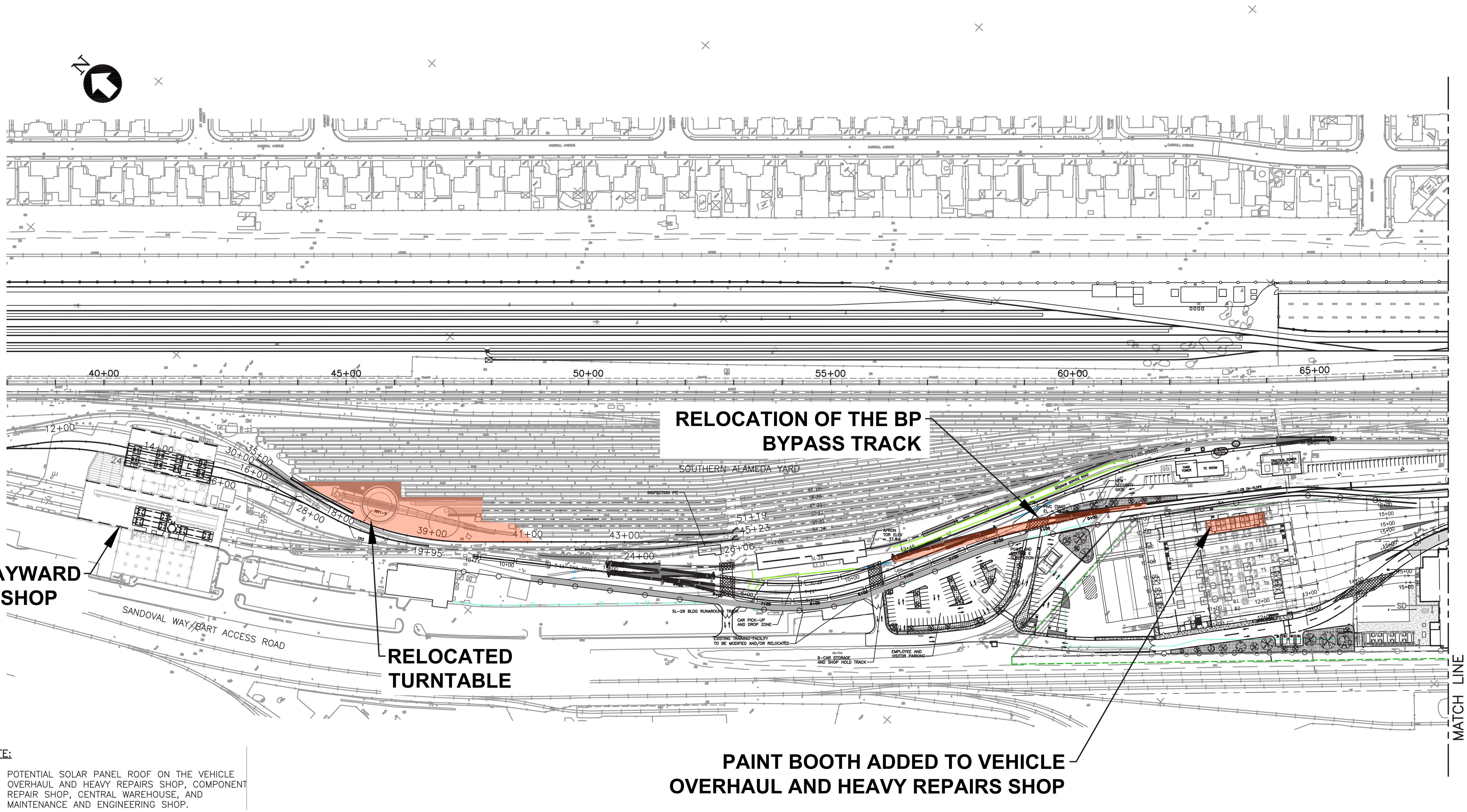
6.1. Aesthetics

The 2011 IS/MND determined that the HMC Project would have no impact on scenic vistas or scenic resources because no scenic vistas or scenic resources are present in the project area. The 2011 IS/MND also determined that the HMC Project would have a less-than-significant impact related to creation of substantial light or glare. However, the 2011 IS/MND determined that the HMC Project could degrade the existing visual character of the project area due to the removal of existing trees required by the construction of the proposed crossover switches south of Whipple Road. Implementation of Mitigation Measure VQ-1 would reduce these potential impacts to a less-than-significant level.

As described in the Aesthetics section of the 2011 IS/MND, the west side of the HMC Project is surrounded by industrial uses. The BART mainline tracks are to the east, the Union Pacific Railroad is to the west, and there are other industrial buildings to the south. The only visual sensitive visual receptors in the project area are residential neighborhoods to the east of the project, and they are beyond the mainline tracks. The proposed modifications would include components that are consistent in terms of massing, scale, lighting, and level of activity with the existing industrial use of the maintenance yard and therefore not create new impacts to the neighborhoods. Overall, there are no immediate views of the project site from vantage points open to the public.

All of the proposed modifications would be constructed within the boundary of the original project footprint that was evaluated in the 2011 IS/MND. While slightly taller (35 feet tall proposed versus 28 feet tall existing) the proposed new buildings for the M&E Shop and the Central Warehouse would be in the same footprint and of similar size in terms of scale and massing as the existing buildings to be demolished. Therefore, these new buildings would not introduce new visual elements in the project area that could adversely affect views or the visual quality of the project site or the larger project area.

The potential future installation of rooftop solar (photovoltaic) panels would not result in new visual impacts given the industrial nature of the project site. Solar panels are generally non-reflective passive elements that do not generate any light or glare. The panels absorb light by design and generally produce less glare than standard window glass. In addition silicon-based panels are coated with anti-reflective materials and are constructed with a rough surface to diffuse reflection and minimize glare. The panels would be installed on the roofs of the buildings at a low angle. Therefore, they would not result in a substantial perceived increase in the heights of the buildings and no new adverse visual effects would result.



NOTE:

1. POTENTIAL SOLAR PANEL ROOF ON THE VEHICLE OVERHAUL AND HEAVY REPAIRS SHOP, COMPONENT REPAIR SHOP, CENTRAL WAREHOUSE, AND MAINTENANCE AND ENGINEERING SHOP.

100' 0' 100' 200'

GRAPHIC SCALE

FOR REVIEW ONLY
NOT FOR CONSTRUCTION

PROPOSED MODIFICATIONS 1 OF 3

Hayward Maintenance Complex
60270000 BART
August 2016 Hayward, California

AECOM

FIGURE 2

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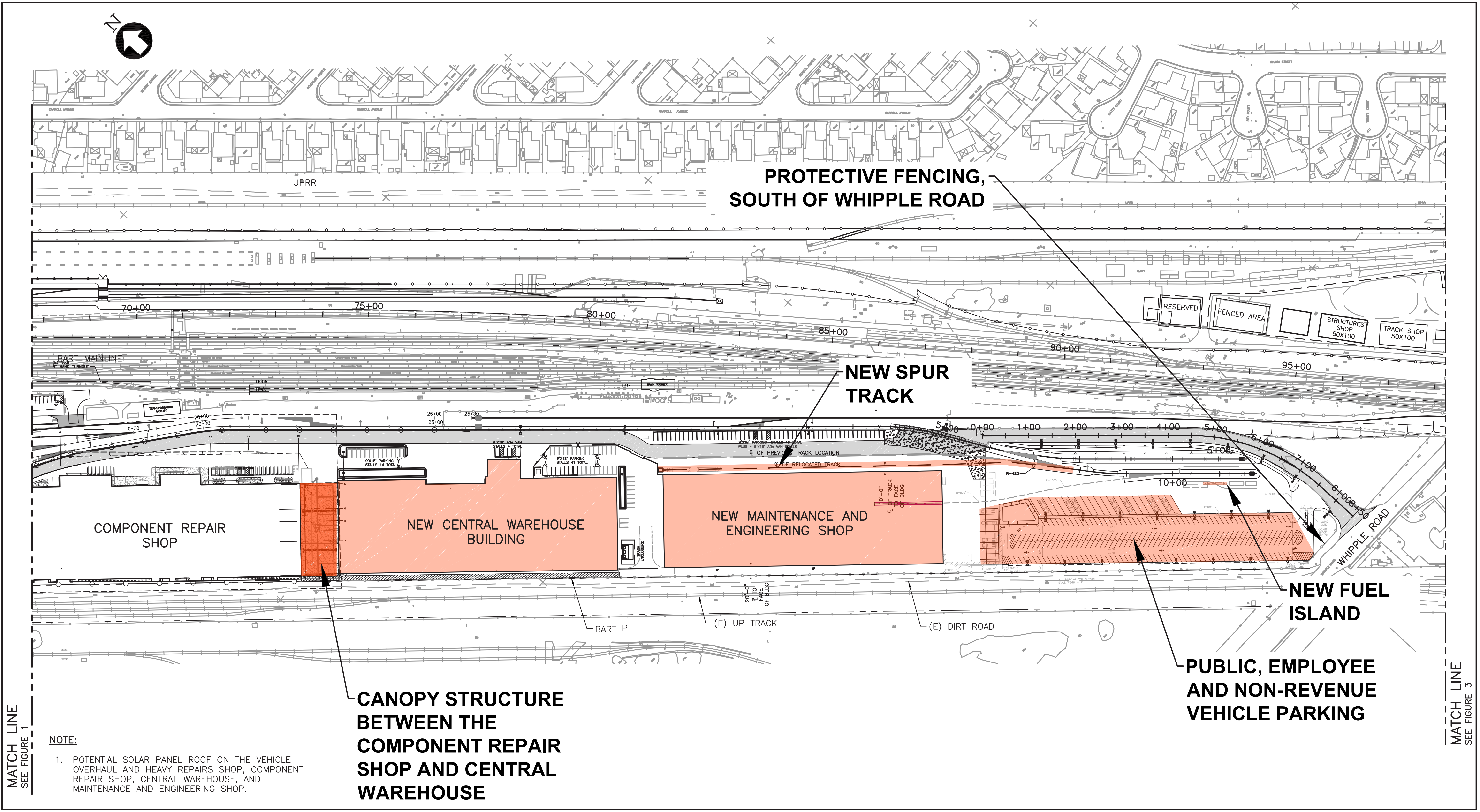

NOTE:

1. POTENTIAL SOLAR PANEL ROOF ON THE VEHICLE OVERHAUL AND HEAVY REPAIRS SHOP, COMPONENT REPAIR SHOP, CENTRAL WAREHOUSE, AND MAINTENANCE AND ENGINEERING SHOP.

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100' 0' 100' 200'

GRAPHIC SCALE

FOR REVIEW ONLY
NOT FOR CONSTRUCTION

PROPOSED MODIFICATIONS 2 OF 3

Hayward Maintenance Complex
60270000 BART
August 2016 Hayward, California

AECOM

FIGURE 3

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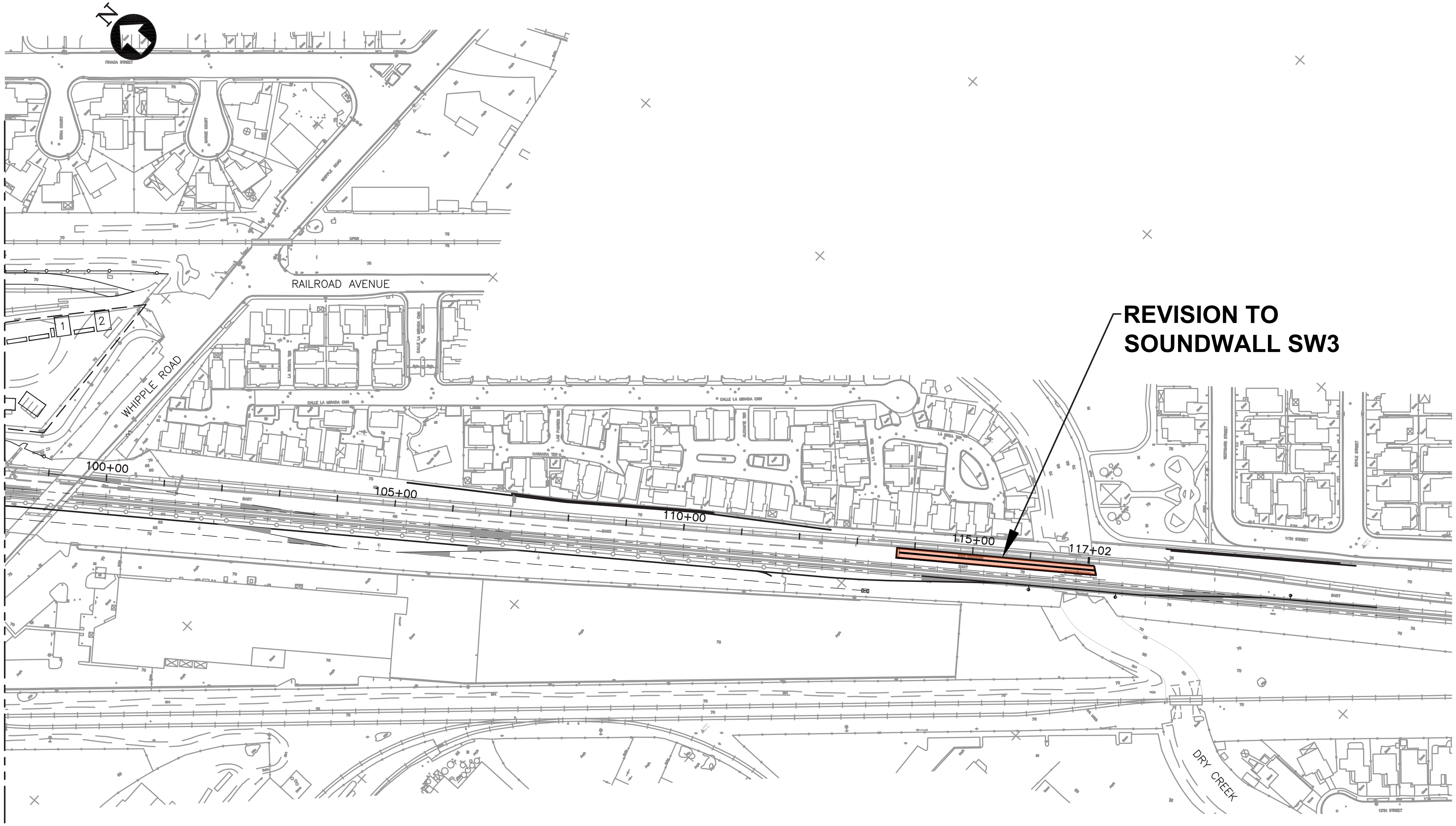

MATCH LINE
SEE FIGURE 2

NOTE:

1. POTENTIAL SOLAR PANEL ROOF ON THE VEHICLE OVERHAUL AND HEAVY REPAIRS SHOP, COMPONENT REPAIR SHOP, CENTRAL WAREHOUSE, AND MAINTENANCE AND ENGINEERING SHOP.

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GRAPHIC SCALE

FOR REVIEW ONLY
NOT FOR CONSTRUCTION

PROPOSED MODIFICATIONS 3 OF 3

Hayward Maintenance Complex
60270000 BART
August 2016 Hayward, California

AECOM

FIGURE 4

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A canopy would be constructed between the Component Repair Shop and the new Central Warehouse. This canopy would introduce a new visual element between the buildings; however, it would be located centrally within the maintenance yard and not visible to the visually sensitive receptors to the north. The relocated turntable, paint booth, and spur track would also be located centrally within the maintenance yard with no visual access from the visually sensitive receptors. These receptors are to the north and separated from this site by much of the yard, storage, and tracks. Because of the limited visibility, views and the visual quality and character of the HMC would not be altered, and these particular proposed modifications would have a less-than-significant impact.

The proposed revisions to soundwall SW3 and the BP bypass track would not result in a substantial change in the location and extent of these project elements from those that were evaluated in the 2011 IS/MND and subsequently approved. The protective fencing to be installed south of Whipple Road and the modifications to the parking lot both would not substantially alter the visual setting and are not incongruous visually with an industrial site. Therefore, these particular revisions would not represent substantial new visual elements to the project site and would not alter the analysis in the 2011 IS/MND.

Given the site's lack of visual access and the location, scale, and height of the proposed modifications, there would be no change to the previous CEQA determination that there would be less-than-significant visual impacts.

6.2. Agriculture and Forestry Resources

The 2011 IS/MND determined that the HMC Project would not be located on or in the vicinity of farmland, agriculturally active land, or forestry land and no impact to these resources would result. The proposed modifications to the project do not include changes to the project location or substantial changes to the footprint of proposed project features. Therefore, the proposed modifications to the approved project would not result in impacts to agriculture and forestry resources and would not alter the no impact CEQA determinations from the 2011 IS/MND.

6.3. Air Quality

The 2011 IS/MND determined that project operational air emissions would be less than significant. The proposed changes to the approved project would increase daily vehicle traffic and would include two improvements that could result in additional VOC emissions: a paint booth and a fuel island with gasoline/diesel fuel dispensing. Project mobile, energy, and area source emissions under the proposed changes were estimated and would be well below BAAQMD significance thresholds (see Attachment A). The paint booth and fuel island stationary sources would be subject to the Bay Area Air Quality Management District (BAAQMD) rules and regulations and permitting requirements. BAAQMD is responsible for issuing permits for the construction and operation of stationary sources in order to reduce air pollution, protect public health, and to attain and maintain the national and California ambient air quality standards in the San Francisco Bay Area Air Basin (SFBAAB). Newly modified or constructed stationary sources, such as the proposed paint booth and fuel island, would be subject to BAAQMD permitting requirements. If emissions exceed Best Available Control Technology (BACT) trigger levels, BACT evaluations for the source must be performed to determine if emissions control equipment or administrative requirements must be implemented to attain the lowest achievable emission rate. Because the net increase in the project's long-term operational land use emissions would be substantially below significance thresholds, and stationary sources would comply with the BAAQMD permitting requirements, the proposed project would not be anticipated to increase operational emissions to significant levels or conflict with applicable air quality plans.

The 2011 IS/MND determined that project construction emissions would be less than significant with mitigation measures AQ-1 and AQ-2 incorporated. These measures include phasing construction to reduce air emissions and implementation of BAAQMD dust control measures. The proposed modifications would involve relocation of some project features, addition of a new spur track, and construction of new buildings for the M&E Shop and Central Warehouse, which are construction activities that were not addressed in the 2011 IS/MND. Construction emissions from the modified project were modeled and were below the BAAQMD significance thresholds. Mitigation measures AQ-1 and AQ-2 would also apply to the construction activities for the proposed changes. Therefore, these changes would not result in additional significant impacts.

6.4. Biological Resources

The 2011 IS/MND determined that the HMC Project would result in less-than-significant impacts to biological resources with the implementation of mitigation measures BIO-1, BIO-2, BIO-3, and BIO-4.

The proposed modifications would be located within the original project footprint, and all potential impacts on biological resources within the footprint were assessed in the 2011 IS/MND. The proposed modifications would not create new or more severe biological impacts not already identified in the 2011 IS/MND. Mitigation measures BIO-1 through BIO-4 would also apply to the proposed modifications and reduce potential impacts to less-than-significant levels.

The relocation of the BP bypass track may result in impacts on an open ditch on site. The section of the ditch that would be impacted by construction lacks riparian or wetland vegetation, special-status species habitat, and an ordinary high water mark, and it does not flow into other waters of the United States or water of the state. Thus, the open ditch is not expected to be under federal or state jurisdiction. Other sections of the ditch that would be potentially jurisdictional will not be impacted by the project. Furthermore, the 2011 IS/MND stated that the ditch would be impacted by construction activities as a part of the original project description, so these potential impacts have already been assessed. Because the ditch is not expected to be under federal or state jurisdiction, and because the ditch was already assessed in the 2011 IS/MND, the relocation of the BP bypass track would not result in new impacts on waters of the United States or waters of the state.

Existing trees could also be affected by the relocation of the BP bypass track, but these impacts were also already assessed in the 2011 IS/MND. Impacts as a result of tree removal will be reduced to a less-than-significant level through implementation of mitigation measure BIO-4, which requires an arborist to identify trees to be removed, replacement of any “protected trees,” and monitoring of any planted trees.

Impacts on trees can also result in impacts on nesting habitat for avian species. These impacts were assessed in the 2011 IS/MND, and implementation of mitigation measures BIO-2 and BIO-3 would reduce these impacts to a less-than-significant level by requiring tree removal outside of the nesting bird season, if feasible, and requiring nesting bird surveys if tree removal occurs during the nesting bird season. Therefore, the proposed relocation of the BP bypass track would not create new or more severe biological impacts not already identified and mitigated for in the 2011 IS/MND.

The location of Soundwall SW-3 is proposed to be modified, and it would now be adjacent to Dry Creek, which is under the jurisdiction of the United States Army Corps of Engineers, California Department of Fish and Game, and the Regional Water Quality Control Board. However, the wall would not cross over the creek and would not extend past the top of bank. No activities would take place within the stream’s bed or bank. In addition, appropriate Best Management Practices would be implemented during construction to maintain compliance with the State Water Resources Control Board’s Construction General Permit to prevent any potential for runoff to Dry Creek. Thus, modifications to Soundwall SW-3 would not create new or more severe biological impacts not already identified in the 2011 IS/MND.

Based on the above discussion and implementation of mitigation measures BIO-1 through BIO-4, the proposed modifications would not change the CEQA determination related to biological resources from that described in the2011 IS/MND.

6.5. Cultural Resources

The 2011 IS/MND determined that the HMC Project would have less-than-significant impacts on cultural resources. According to the *Cultural Resources Survey Report for the Hayward Yard – East Expansion Project* (PBS&J, 2009) prepared for the 2011 IS/MND, the literature and records search did not identify any previously recorded cultural resources within the HMC Project's Area of Potential Effects (APE) or within a 1/4-mile radius of the APE. The pedestrian survey likewise did not identify any cultural resources or historic-age buildings or structures within the APE.

The proposed modifications to the approved HMC Project are located within the APE that was delineated and evaluated for historical resources. Because there no significant historical resources known to occur within the project's APE, no impacts would occur to cultural resources as a result of the proposed modifications.

To protect against inadvertent impacts to previously-unknown cultural resources during implementation of the HMC Project, mitigation measures were adopted that address discovery of previously unknown cultural resources during construction activities: mitigation measures CR-1 and CR-2. These measures would be applicable to the proposed modifications, and would reduce potential impacts to resources identified during construction to less than significant. Therefore, the proposed modifications would not change the CEQA determination from the less-than-significant level with mitigation measures reported in the2011 IS/MND.

6.6. Geology and Soils

The 2011 IS/MND determined that there would be no impacts related to rupture of a known fault or landslides, because the HMC Project site is not located within an Alquist-Priolo Fault Zone or a landslide hazard zone. The proposed modifications would be constructed within the same project site evaluated in the 2011 IS/MND; therefore, the proposed modifications would create no additional impacts related to fault rupture or landslides.

The HMC Project was determined to have less-than-significant impacts related to strong-seismic groundshaking and seismic-related ground failure, because structures would be constructed in compliance with BART Facilities Standards Structural Criteria for Seismic Design. The proposed modifications would also comply with BART Facilities Standards, which require all buildings to be able to withstand the effects of strong seismic groundshaking, seismic-induced liquefaction, and lateral spreading. In addition, the proposed modifications would be designed in accordance with the site-specific geotechnical study prepared for the approved HMC Project to identify site-specific liquefaction and lateral spreading hazard mitigation. Therefore, impacts related to groundshaking and ground failure would continue to be less than significant under the proposed modifications.

The 2011 IS/MND determined that because project construction would comply with BART Facilities Standards Standard Specifications, there would be less-than-significant impacts associated with erosion, loss of topsoil, or construction on unstable soils. Construction of the proposed modifications would also comply with BART Facilities Standards Standard Specifications adopted to avoid and minimize hazards associated with geologic conditions. Therefore, the proposed modifications would also result in less-than-significant impacts on soils.

Similar to the HMC Project, the proposed modifications would not involve the use of septic systems. Therefore, similar to the previous CEQA determination, there would be no impact associated with septic systems.

6.7. Greenhouse Gas Emissions (GHG)

The 2011 IS/MND determined that project operational GHG emissions would be less than significant. The proposed modifications would increase operational GHG emissions because of the addition of a new M&E Shop and Central Warehouse. Project operational GHG emissions from the net increase in developed floor area and vehicle trips were calculated, and were below the BAAQMD significance thresholds. Therefore, the changes would not result in additional significant GHG impacts. The addition of the paint booth and fuel dispensing facility under the proposed modification would be subject to a different permitted stationary source GHG threshold than land use developments. These sources are not substantial contributors to GHG emissions; rather they are largely potential emission sources of VOC and TAC, and would therefore have a less-than-significant GHG impact. The modifications also include provisions for future solar panels on new buildings, which would result in a net decrease in GHG emissions from the proposed changes.

The 2011 IS/MND determined that project construction-related GHG emissions would be less than significant after implementation of GHG best management practices (BMPs) (mitigation measure GHG-1). Construction of the proposed modifications would also implement these BMPs. Therefore, the conclusions of the 2011 IS/MND would not change, and the modified proposed project would have a less-than-significant GHG impact with implementation of the previously adopted mitigation.

6.8. Hazards and Hazardous Materials

The 2011 IS/MND determined that there would be less-than-significant impacts associated with hazards and hazardous materials with implementation of mitigation measures HAZ-1, HAZ-2, HAZ-3, and HAZ-4.

Current operations at the maintenance yard include use of chemicals including fuel, solvents, lubricants, and paint products. With implementation of the existing Spill Prevention and Emergency Response Plan and Health and Safety Plan, as identified in the 2011 IS/MND, hazards to the public or the environment due to accidental spills and releases associated with the approved HMC Project and the proposed modifications would minimize potential hazards to less than significant. I would add that the additional underground storage tanks to be installed on site will be permitted in compliance with the RWQCB UST requirements

In accordance with mitigation measure HAZ-1 in the 2011 IS/MND, a Phase I Environmental Site Assessment (ESA) was prepared and identified the potential hazards associated with the project site. The properties are listed on various environmental databases for soil and ground water contamination: Cortese, Leaking Underground Storage Tanks (LUST) and Spills, Leaks, Investigations and Cleanups (SLIC). The contamination is related to a former metal fabricating facility on the site that operated from the 1970s until 1985 and a metal fastener fabricating plant that operated from 1985 to 1992. According to the LUST listing, in 2003, the site received case closure for a gasoline release. After the metal and metal fastener fabricating facilities vacated the site, four underground storage tanks and a septic tank were removed, and contaminated soil removal and groundwater treatment were conducted under the supervision of the Regional Water Quality Control Board (RWQCB). The RWQCB granted closure for the site in 2007. However, access to all portions of the site and personnel knowledgeable about past and current tenant operations were not available at the time of the Phase I investigation. There are also several contaminated properties nearby, including a U.S. Pipe facility to the west-southwest of the warehouses listed in the SLIC and other databases indicating environmental impairment. Therefore, there are remaining unknowns regarding past and current site operations and potential migration of contaminants from adjacent properties.

As a result of the ESA and accordance with mitigation measure HAZ-2, a Phase II ESA was conducted for the construction of the Component Repair Shop. The results of that investigation did not indicate the obvious presence of significant releases of hazardous substances at the site, although low levels of volatile organic compounds are present in soil vapor, including detections of ethylbenzene above regulatory screening levels that may be attributed to off-site sources or former on-site activities. Detections above screening levels of arsenic in soil and vanadium in groundwater appear to be related to natural background concentrations. Results from the Phase II ESA indicated that implementation of mitigation measure HAZ-3, which requires remediation of contaminated sites pursuant to applicable state and federal laws and regulations, would reduce potential impacts in the vicinity of the Component Repair Shop (including the proposed modifications) to a less-than-significant level.

The 2011 IS/MND also included mitigation measure HAZ-4 to be implemented if previously unrecorded hazardous wastes were discovered prior to and during project construction, as well as measures directed towards the safe handling of any hazardous materials that might be used during construction. This mitigation measure, as well as compliance with the hazardous materials state and local regulations described in the 2011 IS/MND would also be required for the proposed modifications. With implementation of these measures, the proposed modifications would not result in a change in the previous CEQA determination of less-than-significant hazardous materials impact with implementation of mitigation measures.

6.9. Hydrology and Water Quality

The 2011 IS/MND determined that impacts to hydrology and water quality would be mitigated to a less-than-significant level due to compliance with applicable water quality standards, the implementation of BMPs, and mitigation measure HYD-1.

The proposed modifications would be constructed within areas of the HMC that are currently developed and are covered with impervious surfaces. The drainage patterns and impacts to water quality resulting from the proposed modifications would therefore not result in new significant impacts. In addition, the proposed modifications would be subject to the applicable water quality standards, BMPs, and mitigation measure HYD-1 described in the 2011 IS/MND. Therefore, the CEQA determination in the 2011 IS/MND would not be altered as a result of the proposed modifications, and the proposed project would have a less-than-significant impact with respect to hydrology and water quality.

6.10. Land Use and Planning

The 2011 IS/MND determined that the HMC Project would have no impacts related to physical division of a community, conflicts with applicable land use plans, or conflicts with applicable habitat conservation plans. The 2011 IS/MND also determined the HMC Project would result in less-than-significant impact related to conflicts with existing on- or off-site land uses based on the industrial nature of the proposed project.

The proposed modifications would not introduce new non-industrial land uses to the project or surrounding areas. The project would continue to be located in an area surrounded by industrial, open space, and commercial land uses to the north, west, and south; and separated from the residences located to the east by BART tracks. Therefore, the impacts of the proposed modifications would continue to be consistent with the analysis presented in the 2011 IS/MND, and there would be no additional impacts related to land use and planning.

6.11. Mineral Resources

The 2011 IS/MND determined that the HMC Project would have no impacts to mineral resources. The project site is located in an area classified as MRZ-1. This is defined as an "area where adequate information indicated that no significant mineral deposits are present or where it is judged that little likelihood exists for their presence."[1]

The proposed modifications would be within the boundary of the original project footprint and, therefore, would continue to be classified as MRZ-1 and more than 1 mile away from the nearest "sector" of regional mineral significance, the La Vista Quarry. As a result, the proposed modifications would not contribute additional impacts to known mineral resources or mineral resource recovery sites and there would be no change to the CEQA determination in the 2011 IS/MND.

6.12. Noise and Vibration

The 2011 IS/MND determined that the HMC Project would result in less-than-significant impacts related to noise and vibration with implementation of mitigation measures NO-1, NO-2, NO-3, NO-4, and NO-5. As discussed below, the proposed modifications would not result in a change in this CEQA determination.

6.12.1. Construction Noise and Vibration

Construction activities for the proposed modifications would temporarily increase noise levels near the HMC that could expose sensitive receptors to elevated noise levels. Such noise increases would result from both on-site construction activities and construction-related vehicle traffic (off-site). As described in the 2011 IS/MND, construction would result in additional 360 daily vehicle trips on the local roadway network as workers commute and equipment and materials are transported.

Typically, when traffic volumes double on a roadway segment compared to existing conditions, the resultant noise increase is approximately 3 dB. The proposed modifications are estimated to result in an additional 40 construction vehicles per hour. The peak-hour volumes on roadway segments in the project vicinity are well above 40 trips under existing no project conditions. Therefore, construction-related increases in traffic noise levels along the roadways in the project vicinity would not exceed 3 dB under the proposed modifications.

The proposed modifications would also involve operation of construction equipment that may include but would not be limited to graders, backhoes, skip loaders, water trucks, drilling, concrete saw, and other equipment used for grading, excavation, hauling and other activities; these same pieces of equipment were evaluated in the 2011 IS/MND. Noise levels associated with construction activities are based on the quantity, type, and usage factors for each type of equipment. Although noise ranges are generally similar for all construction phases, the highest noise levels typically occur during excavation, grading, and pile driving activities, with lower noise levels during building construction and paving. The noisiest equipment types at construction sites typically range from 88 dB to 90 dB L_{max} at 50 feet (FTA 2006). Average noise levels at construction sites typically range from approximately 65 to 89 dB L_{eq} at 50 feet, depending on the activities performed (FTA 2006).

As described in the 2011 IS/MND, the closest sensitive receptors are located approximately 100 feet from the nearest proposed Phase 1 construction activities south of Whipple Road. However, none of the proposed modifications would be located in closer proximity to any sensitive receptors than what was evaluated in the 2011 IS/MND. Therefore, the proposed modifications would not exceed the levels

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[1] California Department of Conservation, Division of Mines and Geology, *Mineral Land Classification Map*, Newark Quadrangle.

reported in the 2011 IS/MND. Mitigation measure NO-3, which calls for inclusion of construction noise BMPs, would also apply to the proposed modifications. With implementation of this mitigation measure, construction-equipment noise impacts would continue to be less than significant, and construction of the proposed modifications would not change the CEQA determination in the 2011 IS/MND.

As described in the 2011 IS/MND, construction–related vibration would result from the use of heavy earth-moving equipment for area clearing, excavation, and grading. These activities would produce a vibration level of approximately 87 VdB (0.089 in/sec PPV) at a distance of 25 feet (which is the reference vibration level for operation of a large bulldozer [FTA 2006; Caltrans 2004]). Assuming a standard reduction of 9 VdB per doubling of distance (FTA 2006), the estimated maximum vibration levels generated by the project-related construction equipment would be 69 VdB (0.011 in/sec PPV) at the nearest off-site sensitive uses to the project site (100 feet). The construction-related vibration levels at these receptors would be well below the 80 VdB significance threshold for human annoyance (FTA 2006), and also below the significance threshold of 0.2 in/sec PPV (FTA 2006) for building structures. In addition, mitigation measure NO-5 in the 2011 IS/MND, which calls for the implementation of construction BMPs, would apply to the proposed modifications. With implementation of this mitigation measure, construction vibration impacts would continue to be less than significant and the proposed modifications would not change the CEQA determination in the 2011 IS/MND.

6.12.2. Operational Noise and Vibration

Rail and roadway noise and vibration impacts associated with the HMC Project were evaluated in the 2011 IS/MND. The proposed modifications would not involve major changes in number of trains per day and night or in roadway traffic volume, or in types and usage of operational equipment within the HMC.

The existing ambient noise condition is assumed to be same as that measured under the 2011 IS/MND, since no new noise sources or changes to existing noise are known to have been introduced into the project area. As noted above, the proposed modifications involve minor track improvements, relocations of already approved components of the HMC Project, or new facilities that have either no or little exterior noise. In addition, mitigation measures NO-1, NO-2, and NO-3 in the 2011 IS/MND, which will reduce construction and operational noise impacts of the approved HMC Project, would apply to the proposed modifications. Therefore, the exterior noise levels at the closest noise-sensitive residential uses, about 100 feet from the project site, would not be expected to increase due to the proposed modifications, and would not alter the CEQA determination in the 2011 IS/MND.

The vibration analysis in the 2011 IS/MND evaluated the impacts of train operations near the sensitive areas. The proposed modifications do not include major rail track changes near sensitive receptors, but a spur track and a BP bypass track on which train movements would occur at low speeds. The vibration levels based on these reduced speeds would be below the FTA criterion for annoyance. These less-than-significant vibration impacts would be further reduced with implementation of mitigation measure NO-4, which requires vibration reducing technology, in the 2011 IS/MND, which would apply to the proposed modifications. Therefore, vibration impacts associated with the proposed modifications would continue to be less than significant, and the proposed modifications would not change the CEQA determination in the 2011 IS/MND.

6.13. Population and Housing

The 2011 IS/MND determined that the HMC Project would have no impacts to population and housing, because it would not include construction of new residential units, induce a substantial number of new employees for operation, nor displace any housing or people.

Under the proposed modifications, the number of new employees to the site would increase from 215 under the approved HMC Project to 560. This projected increase in employment would not create a substantial demand for housing in the project vicinity, and would continue to be able to be accommodated by existing housing supply. Therefore, the proposed modifications would not induce substantial population growth beyond that identified for the HMC Project. Because the proposed modifications would occur within the boundary of the original project footprint, they would also not result in the removal of existing housing or displace housing units or people. Therefore, the proposed modifications would not result in a substantial new impact not previously evaluated in the 2011 IS/MND.

6.14. Public Services

The 2011 IS/MND determined that the HMC Project would result in less-than-significant impacts to fire and police protection. In addition, 2011 IS/MND determined that the HMC Project would have no impact to schools, parks, and other public facilities, because it would not introduce new uses that generate a demand for these public services.

Similarly, the proposed modifications would not result in an increase the number of residences, businesses, or other facilities that would require public services. In addition, as described above under Population and Housing, the proposed modifications would not induce substantial population growth in the area. As such, there would be no increased demand for fire, police, school, or park services as a result of the proposed modifications. Therefore, the proposed modifications would not result in new significant impacts nor would they change the CEQA determination in the 2011 IS/MND.

6.15. Recreation

The 2011 IS/MND determined that the HMC Project would not induce population growth, and therefore would not impact existing recreational facilities or require the construction or expansion of recreational facilities. As described above for Population and Housing, the proposed modifications would also not substantially induce population growth directly or indirectly. Therefore, the proposed modifications would not change the 2011 CEQA determination, and there would be no impacts to recreation.

6.16. Transportation/Traffic

The 2011 IS/MND determined that the HMC Project would have less-than-significant impacts related to transportation and traffic with implementation of mitigation measures TR-1 and TR-2. As described in the 2011 IS/MND, construction of the HMC Project would occur over two phases, Phase 1 and Phase 2.

The majority of the proposed modifications would occur during Phase 1. Construction activities associated with the demolition and replacement of the M&E Shop and the Central Warehouse are the major construction activities associated with the proposed modifications. In addition, the proposed modifications would result in an increase in the number of employees at the M&E Shop. The remaining components of the proposed modifications would not result in a substantial increase in construction trips or trips associated with new employees. As discussed below, the proposed modifications would not result in a change in the CEQA determination for transportation and traffic in the 2011 IS/MND.

6.16.1. Construction Traffic

Phase 1 of the HMC Project would include alterations to the Vehicle Overhaul Shop, the Component Repair Shop, the Central Warehouse, and the M&E Shop. Construction of Phase 1 would occur over a 36-month period. The 2011 IS/MND calculated that the Phase 1 construction activities would generate approximately 3,110 construction truck trips. The 2013 Addendum estimated an additional 500 truck trips, increasing the truck activity for Phase 1 construction to 3,610 truck trips.

The proposed modifications to demolish and replace the existing M&E Shop and Central Warehouse (rather than retrofitting the structures as previously approved) would result in construction activities similar to those described in the 2011 IS/MND for the Overhaul Shop. Table 1 outlines the estimated truckloads required for the demolition and construction of the new buildings.

Table 1: Truckload Generation for the Proposed Modifications to the Approved HMC Project

	Existing Square Footage	Proposed Square Footage	Demolition Truckloads[1]	Construction Truckloads[2]
M&E Shop	120,000	120,000	700	1,450
Central Warehouse	120,000	155,000	700	1,800
Total	**240,000**	**275,000**	**1,400**	**3,250**

Notes:
1. Assumes 500 truckloads for each 86,000 square feet demolished.
2. Assumes 500 truckloads for each 43,000 square feet constructed.
Source: AECOM, 2016

The two-month demolition of the existing M&E Shop and Central Warehouse would result in an additional 1,400 truckloads (2,800 truck trips)[2] during Phase 1. Assuming that the 2,800 truck trips are evenly distributed across the 40 working days of the demolition phase would result in an increase of approximately 70 daily trips. Therefore, a total of approximately 180 truck trips per day is estimated, including the previously approved demolition activities: 100 to 105 daily truck trips identified in the 2011 IS/MND, and the additional six trips identified in the 2013 Addendum. Applying the passenger car equivalent rate (PCE) rate of 2.0, there would be approximately 360 vehicle trips per day during the demolition phase.

During the 11-month construction phase, 3,250 truckloads (6,500 truck trips) would be added to the current Phase 1 construction scenario. Assuming that the 6,500 truck trips are evenly distributed across the 220 working days of the 11-month construction phase, this would result in an increase of approximately 30 daily trips. Therefore, construction of the M&E Shop and Central Warehouse would result in a total of approximately 140 truck trips per day, including the previously approved construction activities: 100 to 105 daily truck trips identified in the 2011 IS/MND, and the additional six trips identified in the 2013 Addendum. Applying the passenger car equivalent rate (PCE) rate of 2.0, there would be approximately 280 vehicle trips per day during the construction phase.

During the demolition and construction of the two buildings, existing operations in these two buildings would cease and the buildings vacated prior to demolition. The existing warehouse facilities generate approximately 710 daily vehicle trips with up to 32 percent (about 225 truck trips) being 2-axle trucks with six tires or larger, which exceeds the estimated construction vehicle trips from the proposed modifications. As a result, the trips during the demolition and construction phases at M&E Shop and the Central Warehouse would be less than under existing conditions.

Mitigation measure TR-1 requires that the contractor develop and implement a plan to define traffic operations to minimize the effect of the construction efforts by specifying predetermined haul routes and identifying construction activities that, due to concerns regarding traffic safety or congestion, must take place during off-peak hours. This mitigation measure would also apply to the proposed modifications. Because the trips during construction of the proposed modifications would be less than existing

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[2] Each truckload is equivalent to two truck trips: one trip to enter the site and one trip to exit the site.

conditions and mitigation measure TR-1 would be implemented, the demolition and reconstruction of the M&E Shop and Central Warehouse would not result in new or more severe impacts compared to those described in the 2011 IS/MND.

6.16.2. Operational Traffic

After construction, the project modifications would result in a total of 695 employees at the HMC, of which 135 employees would be relocated from the existing Hayward Yard to the new facilities. These changes are summarized in Table 2. As a result, of the proposed modifications would result in a net increase of 560 new employees. Table 3 presents the weekday daily and peak hour vehicle trip generation for the HMC with the proposed modifications. All assumptions regarding the number of peak hour, entering, and exiting trips are consistent with the percentages determined by the traffic counts taken for the 2011 IS/MND.

Table 2: HMC Employees with Proposed Modifications

	Total Employees (2011 IS/MND)	**Total Employees (2016 Addendum)**
New Overhaul Shop	50	50
Component Repair Shop	150	150
Central Warehouse	30	42
M&E Shop	100	433
East side storage tracks	20	20
Subtotal	**350**	**695**
Employees Relocated		-135
Total New Employees		**560**

Source: BART 2016

By applying the employee trip distribution to HMC and proposed modifications vehicle trips, it is estimated 92 vehicles (67 enter/25 exit) would access the site via Sandoval Way in the AM peak hour. During the PM peak hour, approximately 46 vehicles would access the site via Sandoval Way (7 enter/39 exiting), as shown in Table 4.

Based on 24-hour passenger vehicle and truck counts collected for the 2011 IS/MND, during the AM peak hour (8:00 AM to 9:00 AM) 22 vehicles were counted at the Sandoval Way entrance (17 entering and 5 exiting). During the PM peak hour (4:00 PM to 5:00 PM), 66 vehicles were counted at this location (12 entering and 54 exiting). Projected volumes during the PM peak hour (46 vehicles) would not exceed the existing conditions (66 vehicles); therefore, there would be no impact during the PM peak hour.

As described 2011 IS/MND, vehicles accessing the site via Sandoval Way would travel through the nearby intersections of Huntwood Avenue/Sandoval Way and Industrial Parkway/Huntwood Avenue, which currently operate at a LOS F and D, respectively, during the AM peak hour. In the 2011 IS/MND, the projected 54 vehicles (39 entering/15 exiting) associated with the approved HMC Project would increase delay over existing conditions by 1.6 seconds at the Huntwood Avenue/Sandoval Way intersection.

Table 3: Vehicle Trip Generation

	Number of Employees[1]	Daily Vehicle Trip Rate	Daily Vehicle-Trips	AM Peak Hour - % of Daily	AM Peak Hour Trips[2]	PM Peak Hour - % of Daily	PM Peak Hour Trips[2]
Existing Facilities[3]							
BART Hayward Yard	280	2.6/ employee	726	6.6%	48	3.3%	24
Warehouse Facilities	--	--	710	6.5%	46	5.2%	37
Total	--	--	*1,436*	--	*94*	--	*61*
With Proposed Modifications							
BART Hayward Yard	280	2.6/ employee	726	6.6%	48	3.3%	24
BART HMC[4]	560	2.6/ employee	1,456	6.6%	96	3.3%	48
20% Reduction w/ new BART Programmed Station Stop[5]	--	--	-273	6.6%	-18	3.3%	-9
Total	*840*	--	*1,909*	--	*126*	--	*63*
Net Change in Vehicle Trips[6]			**473**		**32**		**2**

Notes:

1. The number of employees at existing and future BART facilities was supplied by BART; employee information for existing warehouse facilities is not available.
2. Based on existing count data, 73% of vehicles enter and 27% exit during the AM peak hour and 16% of vehicles enter and 84% exit during the PM peak hour.
3. 24-hour traffic counts conducted in October 2010 at existing facilities were used to establish the employee vehicle trip rate and the AM and PM peak hour vehicle trip factors.
4. Some of the HMC employees may be current BART employees who would be relocated to Hayward Yard as BART functions are consolidated. For this analysis, Warehouse Facilities employees are included in the HMC employee numbers.
5. This reduction was only applied to auto trips because trucks do not transport employees for home-to-work or work-to-home trips.
6. Net change in vehicle trips for the existing uses plus proposed modifications compared to vehicle trips for existing uses.

Sources: PBS&J, 2010; AECOM, 2016

This delay of 1.6 seconds for an increase of 32 vehicles equates to a delay of 0.05 second per vehicle. Applying this average delay per vehicle to the estimated increase of 70 vehicles under the proposed modifications would cause a delay of 3.5 seconds over existing conditions. The estimated 3.5-second delay would not exceed the 4-second delay threshold used by the City of Hayward to identify a significant impact at this intersection.[3] The proposed modifications would increase the level of delay at this intersection, but it would not result in a substantial new impact not previously identified in the 2011 IS/MND.

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[3] Based on the City of Hayward's significance standards, an impact would occur if a project causes an intersection to operate at a LOS F or causes and increase in delay per vehicle of four seconds or more at an intersection already operating at a LOS F.

Table 4: Vehicle Trip Generation for Sandoval Way and Whipple Road

	Sandoval Way	**Sandoval Way: Enter**	**Sandoval Way: Exit**	**Whipple Road**	**Whipple Road: Enter**	**Whipple Road: Exit**
	AM (**PM**)	AM (**PM**)	AM (**PM**)	AM (**PM**)	AM (**PM**)	AM (**PM**)
2010 Existing Counts	22 (**66**)	17 (**12**)	5 (**54**)	62 (**51**)	44 (**7**)	18 (**44**)
2016 Proposed Modifications	92 (**46**)	67 (**7**)	25 (**39**)	34 (**17**)	25 (**3**)	9 (**14**)
Change from 2010	70[1] (**-20**)			-28 (**-34**)		

Note:
1. Projected volumes only exceed the existing count volumes during the AM peak hour at Sandoval Way.

Source: AECOM, 2016

At the Industrial Parkway/Huntwood Avenue intersection, the projected 32 vehicles associated with the approved HMC Project would increase delay over existing conditions by 0.1 second. Applying this delay to the proposed modifications results in an estimated 0.2-second increase in delay; therefore, it is not anticipated that this increase would cause the intersection to operate at a LOS F.[4] Therefore, the proposed modifications would not result in a change in the level of impacts at the two intersections that would be affected by increased vehicle trips accessing the project site via Sandoval Way during the AM peak hour and would not alter the CEQA determination in the 2011 IS/MND.

Approximately 34 vehicles (25 enter/9 exit) would access the site via Whipple Road during the AM peak hour, and 17 vehicles (3 enter/14 exit) during the PM peak hour. Based on 24-hour passenger vehicle and truck counts collected for the 2011 IS/MND, there were 62 vehicles (44 entering/18 exiting) accessing the site via Whipple Road during the AM peak hour and 51 vehicles (7 entering/44 exiting) during the PM peak hour. The number of vehicle trips accessing the site via Whipple Road with the proposed modifications would be less than under existing conditions; therefore, traffic impacts at this location would be less-than-significant and no more severe than those described in the 2011 IS/MND.

6.17. Utilities and Service Systems

The 2011 IS/MND determined that the HMC Project would result in less-than-significant impacts to utilities and service systems.

The proposed modifications would be constructed within the area previously evaluated and would not result in a substantial change in the operation of the HMC. Therefore, the proposed modifications would not result in a change to the demand on utilities or service systems from that described in the 2011 IS/MND. Therefore, the proposed modifications would not create new significant impacts nor would they change the less-than-significant impact on utilities and service systems as determined in the 2011 IS/MND.

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[4] Based on the City of Hayward's significance standards.

Attachment A
CalEEMod Outputs

BART HMC Construction

Alameda County, Annual

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
General Light Industry	490.63	1000sqft	53.00	490,630.00	0

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.2	**Precipitation Freq (Days)**	63
Climate Zone	5			**Operational Year**	2017
Utility Company	Pacific Gas & Electric Company				
CO2 Intensity (lb/MWhr)	641.35	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Project Characteristics - BART HMC construction emissions

Land Use - Lot acreage based on total Phase 1 (28 acre) and Phase 2 (13 acre development and 12 acre existing reconfiguration).

Grading - Import and export based on Phase 1 and Phase 2 totals

Demolition -

Trips and VMT -

Vehicle Trips - Operational emissions not calculated here

Energy Use -

Table Name	Column Name	Default Value	New Value
tblArchitecturalCoating	EF_Nonresidential_Exterior	150.00	250.00
tblArchitecturalCoating	EF_Nonresidential_Interior	100.00	250.00

tblArchitecturalCoating	EF_Residential_Exterior	150.00	250.00
tblArchitecturalCoating	EF_Residential_Interior	100.00	250.00
tblGrading	MaterialExported	0.00	14,800.00
tblGrading	MaterialImported	0.00	46,500.00
tblLandUse	LotAcreage	11.26	53.00
tblProjectCharacteristics	OperationalYear	2014	2017
tblVehicleTrips	ST_TR	1.32	0.00
tblVehicleTrips	SU_TR	0.68	0.00
tblVehicleTrips	WD_TR	6.97	0.00

2.0 Emissions Summary

2.1 Overall Construction

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2017	0.7743	8.3149	6.5378	0.0107	1.1659	0.3662	1.5321	0.4635	0.3385	0.8020	0.0000	962.6257	962.6257	0.1709	0.0000	966.2145
2018	0.5395	4.0148	4.8257	8.9100e-003	0.3115	0.2097	0.5212	0.0843	0.1968	0.2811	0.0000	734.3943	734.3943	0.0879	0.0000	736.2393
2019	0.4813	3.6293	4.5901	8.9000e-003	0.3115	0.1814	0.4929	0.0843	0.1703	0.2546	0.0000	719.7630	719.7630	0.0858	0.0000	721.5649
2020	0.4379	3.2717	4.4214	8.9300e-003	0.3127	0.1582	0.4709	0.0846	0.1486	0.2332	0.0000	704.9903	704.9903	0.0845	0.0000	706.7646
2021	0.4006	2.9052	4.2724	8.8900e-003	0.3115	0.1359	0.4475	0.0843	0.1276	0.2119	0.0000	698.7078	698.7078	0.0829	0.0000	700.4483
2022	5.7734	0.7179	1.0655	2.0300e-003	0.0489	0.0353	0.0842	0.0132	0.0329	0.0460	0.0000	164.0691	164.0691	0.0329	0.0000	164.7601
Total	**8.4070**	**22.8538**	**25.7128**	**0.0483**	**2.4620**	**1.0867**	**3.5487**	**0.8142**	**1.0146**	**1.8288**	**0.0000**	**3,984.5501**	**3,984.5501**	**0.5448**	**0.0000**	**3,995.9917**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2017	0.7742	8.3149	6.5378	0.0107	1.1659	0.3662	1.5321	0.4635	0.3385	0.8020	0.0000	962.6250	962.6250	0.1709	0.0000	966.2138
2018	0.5395	4.0148	4.8257	8.9100e-003	0.3115	0.2097	0.5212	0.0843	0.1968	0.2811	0.0000	734.3939	734.3939	0.0879	0.0000	736.2390
2019	0.4813	3.6293	4.5901	8.9000e-003	0.3115	0.1814	0.4929	0.0843	0.1703	0.2546	0.0000	719.7627	719.7627	0.0858	0.0000	721.5645
2020	0.4379	3.2717	4.4214	8.9300e-003	0.3127	0.1582	0.4709	0.0846	0.1486	0.2332	0.0000	704.9899	704.9899	0.0845	0.0000	706.7642
2021	0.4006	2.9052	4.2724	8.8900e-003	0.3115	0.1359	0.4475	0.0843	0.1276	0.2119	0.0000	698.7074	698.7074	0.0829	0.0000	700.4480
2022	5.7734	0.7179	1.0655	2.0300e-003	0.0489	0.0353	0.0842	0.0132	0.0329	0.0460	0.0000	164.0689	164.0689	0.0329	0.0000	164.7599
Total	**8.4070**	**22.8538**	**25.7128**	**0.0483**	**2.4620**	**1.0867**	**3.5487**	**0.8142**	**1.0146**	**1.8288**	**0.0000**	**3,984.5479**	**3,984.5479**	**0.5448**	**0.0000**	**3,995.9894**

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

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	2.1724	4.0000e-005	4.5900e-003	0.0000		2.0000e-005	2.0000e-005		2.0000e-005	2.0000e-005	0.0000	8.7700e-003	8.7700e-003	2.0000e-005	0.0000	9.2800e-003
Energy	0.0679	0.6176	0.5188	3.7100e-003		0.0469	0.0469		0.0469	0.0469	0.0000	1,852.7270	1,852.7270	0.0663	0.0234	1,861.3629

Mobile	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Waste						0.0000	0.0000		0.0000	0.0000	123.4956	0.0000	123.4956	7.2984	0.0000	276.7617
Water						0.0000	0.0000		0.0000	0.0000	35.9951	178.5970	214.5921	3.7051	0.0890	319.9789
Total	**2.2404**	**0.6177**	**0.5234**	**3.7100e-003**	**0.0000**	**0.0470**	**0.0470**	**0.0000**	**0.0470**	**0.0470**	**159.4907**	**2,031.3328**	**2,190.8235**	**11.0698**	**0.1123**	**2,458.1128**

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	2.1724	4.0000e-005	4.5900e-003	0.0000		2.0000e-005	2.0000e-005		2.0000e-005	2.0000e-005	0.0000	8.7700e-003	8.7700e-003	2.0000e-005	0.0000	9.2800e-003
Energy	0.0679	0.6176	0.5188	3.7100e-003		0.0469	0.0469		0.0469	0.0469	0.0000	1,852.7270	1,852.7270	0.0663	0.0234	1,861.3629
Mobile	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Waste						0.0000	0.0000		0.0000	0.0000	123.4956	0.0000	123.4956	7.2984	0.0000	276.7617
Water						0.0000	0.0000		0.0000	0.0000	35.9951	178.5970	214.5921	3.7044	0.0888	319.9214
Total	**2.2404**	**0.6177**	**0.5234**	**3.7100e-003**	**0.0000**	**0.0470**	**0.0470**	**0.0000**	**0.0470**	**0.0470**	**159.4907**	**2,031.3328**	**2,190.8235**	**11.0691**	**0.1122**	**2,458.0553**

	ROG	**NOx**	**CO**	**SO2**	**Fugitive PM10**	**Exhaust PM10**	**PM10 Total**	**Fugitive PM2.5**	**Exhaust PM2.5**	**PM2.5 Total**	**Bio- CO2**	**NBio-CO2**	**Total CO2**	**CH4**	**N20**	**CO2e**
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.01**	**0.12**	**0.00**

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Demolition	Demolition	1/1/2017	4/7/2017	5	70	
2	Site Preparation	Site Preparation	4/8/2017	6/2/2017	5	40	
3	Grading	Grading	6/3/2017	11/3/2017	5	110	
4	Building Construction	Building Construction	11/4/2017	2/4/2022	5	1110	
5	Paving	Paving	2/5/2022	5/20/2022	5	75	
6	Architectural Coating	Architectural Coating	5/21/2022	9/2/2022	5	75	

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 275

Acres of Paving: 0

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 735,945; Non-Residential Outdoor: 245,315 (Architectural Coating

OffRoad Equipment

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Architectural Coating	Air Compressors	1	6.00	78	0.48
Demolition	Excavators	3	8.00	162	0.38
Demolition	Concrete/Industrial Saws	1	8.00	81	0.73
Grading	Excavators	2	8.00	162	0.38
Building Construction	Cranes	1	7.00	226	0.29
Building Construction	Forklifts	3	8.00	89	0.20
Building Construction	Generator Sets	1	8.00	84	0.74
Paving	Pavers	2	8.00	125	0.42
Paving	Rollers	2	8.00	80	0.38
Demolition	Rubber Tired Dozers	2	8.00	255	0.40
Grading	Rubber Tired Dozers	1	8.00	255	0.40
Building Construction	Tractors/Loaders/Backhoes	3	7.00	97	0.37
Grading	Graders	1	8.00	174	0.41
Grading	Tractors/Loaders/Backhoes	2	8.00	97	0.37

Paving	Paving Equipment	2	8.00	130	0.36
Site Preparation	Tractors/Loaders/Backhoes	4	8.00	97	0.37
Site Preparation	Rubber Tired Dozers	3	8.00	255	0.40
Grading	Scrapers	2	8.00	361	0.48
Building Construction	Welders	1	8.00	46	0.45

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
Demolition	6	15.00	0.00	1,660.00	12.40	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Site Preparation	7	18.00	0.00	0.00	12.40	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Grading	8	20.00	0.00	7,663.00	12.40	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Building Construction	9	206.00	80.00	0.00	12.40	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Paving	6	15.00	0.00	0.00	12.40	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Architectural Coating	1	41.00	0.00	0.00	12.40	7.30	20.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

3.2 Demolition - 2017

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.1796	0.0000	0.1796	0.0272	0.0000	0.0272	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.1417	1.4944	1.1863	1.4000e-003		0.0744	0.0744		0.0693	0.0693	0.0000	128.1638	128.1638	0.0352	0.0000	128.9021
Total	**0.1417**	**1.4944**	**1.1863**	**1.4000e-003**	**0.1796**	**0.0744**	**0.2540**	**0.0272**	**0.0693**	**0.0965**	**0.0000**	**128.1638**	**128.1638**	**0.0352**	**0.0000**	**128.9021**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0177	0.2233	0.1977	6.3000e-004	0.0140	2.8800e-003	0.0169	3.8500e-003	2.6400e-003	6.4900e-003	0.0000	56.2939	56.2939	4.1000e-004	0.0000	56.3025
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	1.7800e-003	2.6600e-003	0.0255	6.0000e-005	4.7700e-003	4.0000e-005	4.8000e-003	1.2700e-003	4.0000e-005	1.3000e-003	0.0000	4.1695	4.1695	2.2000e-004	0.0000	4.1742
Total	**0.0195**	**0.2259**	**0.2232**	**6.9000e-004**	**0.0188**	**2.9200e-003**	**0.0217**	**5.1200e-003**	**2.6800e-003**	**7.7900e-003**	**0.0000**	**60.4634**	**60.4634**	**6.3000e-004**	**0.0000**	**60.4767**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.1796	0.0000	0.1796	0.0272	0.0000	0.0272	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.1417	1.4944	1.1863	1.4000e-003		0.0744	0.0744		0.0693	0.0693	0.0000	128.1636	128.1636	0.0352	0.0000	128.9019
Total	**0.1417**	**1.4944**	**1.1863**	**1.4000e-003**	**0.1796**	**0.0744**	**0.2540**	**0.0272**	**0.0693**	**0.0965**	**0.0000**	**128.1636**	**128.1636**	**0.0352**	**0.0000**	**128.9019**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0177	0.2233	0.1977	6.3000e-004	0.0140	2.8800e-003	0.0169	3.8500e-003	2.6400e-003	6.4900e-003	0.0000	56.2939	56.2939	4.1000e-004	0.0000	56.3025
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	1.7800e-003	2.6600e-003	0.0255	6.0000e-005	4.7700e-003	4.0000e-005	4.8000e-003	1.2700e-003	4.0000e-005	1.3000e-003	0.0000	4.1695	4.1695	2.2000e-004	0.0000	4.1742
Total	**0.0195**	**0.2259**	**0.2232**	**6.9000e-004**	**0.0188**	**2.9200e-003**	**0.0217**	**5.1200e-003**	**2.6800e-003**	**7.7900e-003**	**0.0000**	**60.4634**	**60.4634**	**6.3000e-004**	**0.0000**	**60.4767**

3.3 Site Preparation - 2017

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.3613	0.0000	0.3613	0.1986	0.0000	0.1986	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0968	1.0351	0.7879	7.8000e-004		0.0551	0.0551		0.0507	0.0507	0.0000	72.6308	72.6308	0.0223	0.0000	73.0981
Total	**0.0968**	**1.0351**	**0.7879**	**7.8000e-004**	**0.3613**	**0.0551**	**0.4164**	**0.1986**	**0.0507**	**0.2493**	**0.0000**	**72.6308**	**72.6308**	**0.0223**	**0.0000**	**73.0981**

Unmitigated Construction Off-Site

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

Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	1.2200e-003	1.8200e-003	0.0175	4.0000e-005	3.2700e-003	3.0000e-005	3.2900e-003	8.7000e-004	2.0000e-005	8.9000e-004	0.0000	2.8591	2.8591	1.5000e-004	0.0000	2.8623
Total	**1.2200e-003**	**1.8200e-003**	**0.0175**	**4.0000e-005**	**3.2700e-003**	**3.0000e-005**	**3.2900e-003**	**8.7000e-004**	**2.0000e-005**	**8.9000e-004**	**0.0000**	**2.8591**	**2.8591**	**1.5000e-004**	**0.0000**	**2.8623**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.3613	0.0000	0.3613	0.1986	0.0000	0.1986	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0968	1.0351	0.7879	7.8000e-004		0.0551	0.0551		0.0507	0.0507	0.0000	72.6307	72.6307	0.0223	0.0000	73.0980
Total	**0.0968**	**1.0351**	**0.7879**	**7.8000e-004**	**0.3613**	**0.0551**	**0.4164**	**0.1986**	**0.0507**	**0.2493**	**0.0000**	**72.6307**	**72.6307**	**0.0223**	**0.0000**	**73.0980**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	1.2200e-003	1.8200e-003	0.0175	4.0000e-005	3.2700e-003	3.0000e-005	3.2900e-003	8.7000e-004	2.0000e-005	8.9000e-004	0.0000	2.8591	2.8591	1.5000e-004	0.0000	2.8623
Total	**1.2200e-003**	**1.8200e-003**	**0.0175**	**4.0000e-005**	**3.2700e-003**	**3.0000e-005**	**3.2900e-003**	**8.7000e-004**	**2.0000e-005**	**8.9000e-004**	**0.0000**	**2.8591**	**2.8591**	**1.5000e-004**	**0.0000**	**2.8623**

3.4 Grading - 2017

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.4805	0.0000	0.4805	0.1983	0.0000	0.1983	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.3355	3.8276	2.5743	3.3900e-003		0.1825	0.1825		0.1679	0.1679	0.0000	315.0066	315.0066	0.0965	0.0000	317.0334
Total	**0.3355**	**3.8276**	**2.5743**	**3.3900e-003**	**0.4805**	**0.1825**	**0.6630**	**0.1983**	**0.1679**	**0.3662**	**0.0000**	**315.0066**	**315.0066**	**0.0965**	**0.0000**	**317.0334**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0819	1.0306	0.9128	2.8900e-003	0.0647	0.0133	0.0779	0.0178	0.0122	0.0300	0.0000	259.8675	259.8675	1.8900e-003	0.0000	259.9073
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	3.7300e-003	5.5700e-003	0.0534	1.2000e-004	9.9800e-003	8.0000e-005	0.0101	2.6600e-003	7.0000e-005	2.7300e-003	0.0000	8.7361	8.7361	4.7000e-004	0.0000	8.7459
Total	**0.0856**	**1.0362**	**0.9662**	**3.0100e-003**	**0.0746**	**0.0134**	**0.0880**	**0.0204**	**0.0123**	**0.0327**	**0.0000**	**268.6036**	**268.6036**	**2.3600e-003**	**0.0000**	**268.6532**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.4805	0.0000	0.4805	0.1983	0.0000	0.1983	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.3355	3.8276	2.5743	3.3900e-003		0.1825	0.1825		0.1679	0.1679	0.0000	315.0062	315.0062	0.0965	0.0000	317.0331
Total	**0.3355**	**3.8276**	**2.5743**	**3.3900e-003**	**0.4805**	**0.1825**	**0.6630**	**0.1983**	**0.1679**	**0.3662**	**0.0000**	**315.0062**	**315.0062**	**0.0965**	**0.0000**	**317.0331**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0819	1.0306	0.9128	2.8900e-003	0.0647	0.0133	0.0779	0.0178	0.0122	0.0300	0.0000	259.8675	259.8675	1.8900e-003	0.0000	259.9073
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	3.7300e-003	5.5700e-003	0.0534	1.2000e-004	9.9800e-003	8.0000e-005	0.0101	2.6600e-003	7.0000e-005	2.7300e-003	0.0000	8.7361	8.7361	4.7000e-004	0.0000	8.7459
Total	**0.0856**	**1.0362**	**0.9662**	**3.0100e-003**	**0.0746**	**0.0134**	**0.0880**	**0.0204**	**0.0123**	**0.0327**	**0.0000**	**268.6036**	**268.6036**	**2.3600e-003**	**0.0000**	**268.6532**

3.5 Building Construction - 2017

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0621	0.5281	0.3626	5.4000e-004		0.0356	0.0356		0.0335	0.0335	0.0000	47.8958	47.8958	0.0118	0.0000	48.1434

Total	**0.0621**	**0.5281**	**0.3626**	**5.4000e-004**		**0.0356**	**0.0356**		**0.0335**	**0.0335**	**0.0000**	**47.8958**	**47.8958**	**0.0118**	**0.0000**	**48.1434**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0180	0.1450	0.2198	3.8000e-004	0.0104	2.1100e-003	0.0125	2.9700e-003	1.9400e-003	4.9100e-003	0.0000	34.2822	34.2822	2.7000e-004	0.0000	34.2879
Worker	0.0140	0.0209	0.2000	4.5000e-004	0.0374	3.0000e-004	0.0377	9.9500e-003	2.8000e-004	0.0102	0.0000	32.7205	32.7205	1.7600e-003	0.0000	32.7574
Total	**0.0319**	**0.1658**	**0.4199**	**8.3000e-004**	**0.0478**	**2.4100e-003**	**0.0502**	**0.0129**	**2.2200e-003**	**0.0151**	**0.0000**	**67.0028**	**67.0028**	**2.0300e-003**	**0.0000**	**67.0453**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0621	0.5281	0.3626	5.4000e-004		0.0356	0.0356		0.0335	0.0335	0.0000	47.8958	47.8958	0.0118	0.0000	48.1433
Total	**0.0621**	**0.5281**	**0.3626**	**5.4000e-004**		**0.0356**	**0.0356**		**0.0335**	**0.0335**	**0.0000**	**47.8958**	**47.8958**	**0.0118**	**0.0000**	**48.1433**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0180	0.1450	0.2198	3.8000e-004	0.0104	2.1100e-003	0.0125	2.9700e-003	1.9400e-003	4.9100e-003	0.0000	34.2822	34.2822	2.7000e-004	0.0000	34.2879
Worker	0.0140	0.0209	0.2000	4.5000e-004	0.0374	3.0000e-004	0.0377	9.9500e-003	2.8000e-004	0.0102	0.0000	32.7205	32.7205	1.7600e-003	0.0000	32.7574
Total	**0.0319**	**0.1658**	**0.4199**	**8.3000e-004**	**0.0478**	**2.4100e-003**	**0.0502**	**0.0129**	**2.2200e-003**	**0.0151**	**0.0000**	**67.0028**	**67.0028**	**2.0300e-003**	**0.0000**	**67.0453**

3.5 Building Construction - 2018

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.3483	3.0355	2.2880	3.5000e-003		0.1950	0.1950		0.1833	0.1833	0.0000	308.9844	308.9844	0.0756	0.0000	310.5723
Total	**0.3483**	**3.0355**	**2.2880**	**3.5000e-003**		**0.1950**	**0.1950**		**0.1833**	**0.1833**	**0.0000**	**308.9844**	**308.9844**	**0.0756**	**0.0000**	**310.5723**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e

Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.1105	0.8569	1.3736	2.5000e-003	0.0675	0.0127	0.0802	0.0194	0.0117	0.0311	0.0000	219.8378	219.8378	1.7100e-003	0.0000	219.8738
Worker	0.0808	0.1224	1.1641	2.9100e-003	0.2440	1.9100e-003	0.2459	0.0649	1.7700e-003	0.0667	0.0000	205.5720	205.5720	0.0105	0.0000	205.7932
Total	**0.1913**	**0.9792**	**2.5377**	**5.4100e-003**	**0.3115**	**0.0147**	**0.3262**	**0.0843**	**0.0135**	**0.0978**	**0.0000**	**425.4098**	**425.4098**	**0.0122**	**0.0000**	**425.6670**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.3483	3.0355	2.2880	3.5000e-003		0.1950	0.1950		0.1833	0.1833	0.0000	308.9841	308.9841	0.0756	0.0000	310.5720
Total	**0.3483**	**3.0355**	**2.2880**	**3.5000e-003**		**0.1950**	**0.1950**		**0.1833**	**0.1833**	**0.0000**	**308.9841**	**308.9841**	**0.0756**	**0.0000**	**310.5720**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.1105	0.8569	1.3736	2.5000e-003	0.0675	0.0127	0.0802	0.0194	0.0117	0.0311	0.0000	219.8378	219.8378	1.7100e-003	0.0000	219.8738

Worker	0.0808	0.1224	1.1641	2.9100e-003	0.2440	1.9100e-003	0.2459	0.0649	1.7700e-003	0.0667	0.0000	205.5720	205.5720	0.0105	0.0000	205.7932
Total	**0.1913**	**0.9792**	**2.5377**	**5.4100e-003**	**0.3115**	**0.0147**	**0.3262**	**0.0843**	**0.0135**	**0.0978**	**0.0000**	**425.4098**	**425.4098**	**0.0122**	**0.0000**	**425.6670**

3.5 Building Construction - 2019

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.3069	2.7359	2.2342	3.5000e-003		0.1677	0.1677		0.1577	0.1577	0.0000	305.5302	305.5302	0.0743	0.0000	307.0913
Total	**0.3069**	**2.7359**	**2.2342**	**3.5000e-003**		**0.1677**	**0.1677**		**0.1577**	**0.1577**	**0.0000**	**305.5302**	**305.5302**	**0.0743**	**0.0000**	**307.0913**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.1010	0.7819	1.2995	2.4900e-003	0.0675	0.0118	0.0793	0.0194	0.0109	0.0303	0.0000	216.0406	216.0406	1.6700e-003	0.0000	216.0757
Worker	0.0735	0.1115	1.0564	2.9100e-003	0.2440	1.8700e-003	0.2459	0.0649	1.7300e-003	0.0666	0.0000	198.1922	198.1922	9.7900e-003	0.0000	198.3979
Total	**0.1745**	**0.8933**	**2.3559**	**5.4000e-003**	**0.3115**	**0.0137**	**0.3252**	**0.0843**	**0.0126**	**0.0969**	**0.0000**	**414.2328**	**414.2328**	**0.0115**	**0.0000**	**414.4736**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.3069	2.7359	2.2342	3.5000e-003		0.1677	0.1677		0.1577	0.1577	0.0000	305.5299	305.5299	0.0743	0.0000	307.0909
Total	**0.3069**	**2.7359**	**2.2342**	**3.5000e-003**		**0.1677**	**0.1677**		**0.1577**	**0.1577**	**0.0000**	**305.5299**	**305.5299**	**0.0743**	**0.0000**	**307.0909**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.1010	0.7819	1.2995	2.4900e-003	0.0675	0.0118	0.0793	0.0194	0.0109	0.0303	0.0000	216.0406	216.0406	1.6700e-003	0.0000	216.0757
Worker	0.0735	0.1115	1.0564	2.9100e-003	0.2440	1.8700e-003	0.2459	0.0649	1.7300e-003	0.0666	0.0000	198.1922	198.1922	9.7900e-003	0.0000	198.3979
Total	**0.1745**	**0.8933**	**2.3559**	**5.4000e-003**	**0.3115**	**0.0137**	**0.3252**	**0.0843**	**0.0126**	**0.0969**	**0.0000**	**414.2328**	**414.2328**	**0.0115**	**0.0000**	**414.4736**

3.5 Building Construction - 2020

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e

Category	tons/yr										MT/yr					
Off-Road	0.2766	2.5000	2.2019	3.5100e-003		0.1458	0.1458		0.1371	0.1371	0.0000	302.1514	302.1514	0.0736	0.0000	303.6973
Total	**0.2766**	**2.5000**	**2.2019**	**3.5100e-003**		**0.1458**	**0.1458**		**0.1371**	**0.1371**	**0.0000**	**302.1514**	**302.1514**	**0.0736**	**0.0000**	**303.6973**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0927	0.6686	1.2415	2.5000e-003	0.0678	0.0106	0.0784	0.0195	9.7600e-003	0.0292	0.0000	211.8655	211.8655	1.6300e-003	0.0000	211.8997
Worker	0.0686	0.1031	0.9780	2.9200e-003	0.2449	1.8500e-003	0.2468	0.0652	1.7200e-003	0.0669	0.0000	190.9734	190.9734	9.2500e-003	0.0000	191.1676
Total	**0.1613**	**0.7717**	**2.2195**	**5.4200e-003**	**0.3127**	**0.0125**	**0.3251**	**0.0846**	**0.0115**	**0.0961**	**0.0000**	**402.8389**	**402.8389**	**0.0109**	**0.0000**	**403.0673**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.2766	2.5000	2.2019	3.5100e-003		0.1458	0.1458		0.1371	0.1371	0.0000	302.1510	302.1510	0.0736	0.0000	303.6969
Total	**0.2766**	**2.5000**	**2.2019**	**3.5100e-003**		**0.1458**	**0.1458**		**0.1371**	**0.1371**	**0.0000**	**302.1510**	**302.1510**	**0.0736**	**0.0000**	**303.6969**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0927	0.6686	1.2415	2.5000e-003	0.0678	0.0106	0.0784	0.0195	9.7600e-003	0.0292	0.0000	211.8655	211.8655	1.6300e-003	0.0000	211.8997
Worker	0.0686	0.1031	0.9780	2.9200e-003	0.2449	1.8500e-003	0.2468	0.0652	1.7200e-003	0.0669	0.0000	190.9734	190.9734	9.2500e-003	0.0000	191.1676
Total	**0.1613**	**0.7717**	**2.2195**	**5.4200e-003**	**0.3127**	**0.0125**	**0.3251**	**0.0846**	**0.0115**	**0.0961**	**0.0000**	**402.8389**	**402.8389**	**0.0109**	**0.0000**	**403.0673**

3.5 Building Construction - 2021

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.2471	2.2629	2.1582	3.5000e-003		0.1246	0.1246		0.1172	0.1172	0.0000	301.0339	301.0339	0.0725	0.0000	302.5568
Total	**0.2471**	**2.2629**	**2.1582**	**3.5000e-003**		**0.1246**	**0.1246**		**0.1172**	**0.1172**	**0.0000**	**301.0339**	**301.0339**	**0.0725**	**0.0000**	**302.5568**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0891	0.5468	1.2050	2.4800e-003	0.0675	9.4900e-003	0.0770	0.0194	8.7300e-003	0.0281	0.0000	210.7619	210.7619	1.6200e-003	0.0000	210.7959
Worker	0.0645	0.0956	0.9092	2.9100e-003	0.2440	1.8300e-003	0.2458	0.0649	1.7000e-003	0.0666	0.0000	186.9120	186.9120	8.7400e-003	0.0000	187.0956
Total	**0.1535**	**0.6423**	**2.1142**	**5.3900e-003**	**0.3115**	**0.0113**	**0.3228**	**0.0843**	**0.0104**	**0.0947**	**0.0000**	**397.6739**	**397.6739**	**0.0104**	**0.0000**	**397.8915**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.2471	2.2629	2.1582	3.5000e-003		0.1246	0.1246		0.1172	0.1172	0.0000	301.0335	301.0335	0.0725	0.0000	302.5565
Total	**0.2471**	**2.2629**	**2.1582**	**3.5000e-003**		**0.1246**	**0.1246**		**0.1172**	**0.1172**	**0.0000**	**301.0335**	**301.0335**	**0.0725**	**0.0000**	**302.5565**

Mitigated Construction Off-Site

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

Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0891	0.5468	1.2050	2.4800e-003	0.0675	9.4900e-003	0.0770	0.0194	8.7300e-003	0.0281	0.0000	210.7619	210.7619	1.6200e-003	0.0000	210.7959
Worker	0.0645	0.0956	0.9092	2.9100e-003	0.2440	1.8300e-003	0.2458	0.0649	1.7000e-003	0.0666	0.0000	186.9120	186.9120	8.7400e-003	0.0000	187.0956
Total	**0.1535**	**0.6423**	**2.1142**	**5.3900e-003**	**0.3115**	**0.0113**	**0.3228**	**0.0843**	**0.0104**	**0.0947**	**0.0000**	**397.6739**	**397.6739**	**0.0104**	**0.0000**	**397.8915**

3.5 Building Construction - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0212	0.1942	0.2041	3.4000e-004		0.0101	0.0101		9.4800e-003	9.4800e-003	0.0000	28.8456	28.8456	6.9000e-003	0.0000	28.9906
Total	**0.0212**	**0.1942**	**0.2041**	**3.4000e-004**		**0.0101**	**0.0101**		**9.4800e-003**	**9.4800e-003**	**0.0000**	**28.8456**	**28.8456**	**6.9000e-003**	**0.0000**	**28.9906**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	8.1600e-003	0.0462	0.1100	2.4000e-004	6.4700e-003	9.0000e-004	7.3600e-003	1.8600e-003	8.2000e-004	2.6800e-003	0.0000	20.1694	20.1694	1.6000e-004	0.0000	20.1728
Worker	5.8400e-003	8.5500e-003	0.0814	2.8000e-004	0.0234	1.7000e-004	0.0236	6.2200e-003	1.6000e-004	6.3800e-003	0.0000	17.6113	17.6113	8.0000e-004	0.0000	17.6281

Total	**0.0140**	**0.0548**	**0.1914**	**5.2000e-004**	**0.0298**	**1.0700e-003**	**0.0309**	**8.0800e-003**	**9.8000e-004**	**9.0600e-003**	**0.0000**	**37.7808**	**37.7808**	**9.6000e-004**	**0.0000**	**37.8009**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0212	0.1942	0.2041	3.4000e-004		0.0101	0.0101		9.4800e-003	9.4800e-003	0.0000	28.8456	28.8456	6.9000e-003	0.0000	28.9905
Total	**0.0212**	**0.1942**	**0.2041**	**3.4000e-004**		**0.0101**	**0.0101**		**9.4800e-003**	**9.4800e-003**	**0.0000**	**28.8456**	**28.8456**	**6.9000e-003**	**0.0000**	**28.9905**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	8.1600e-003	0.0462	0.1100	2.4000e-004	6.4700e-003	9.0000e-004	7.3600e-003	1.8600e-003	8.2000e-004	2.6800e-003	0.0000	20.1694	20.1694	1.6000e-004	0.0000	20.1728
Worker	5.8400e-003	8.5500e-003	0.0814	2.8000e-004	0.0234	1.7000e-004	0.0236	6.2200e-003	1.6000e-004	6.3800e-003	0.0000	17.6113	17.6113	8.0000e-004	0.0000	17.6281
Total	**0.0140**	**0.0548**	**0.1914**	**5.2000e-004**	**0.0298**	**1.0700e-003**	**0.0309**	**8.0800e-003**	**9.8000e-004**	**9.0600e-003**	**0.0000**	**37.7808**	**37.7808**	**9.6000e-004**	**0.0000**	**37.8009**

3.6 Paving - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0406	0.4092	0.5356	8.4000e-004		0.0209	0.0209		0.0192	0.0192	0.0000	73.5053	73.5053	0.0238	0.0000	74.0046
Paving	0.0000					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0406**	**0.4092**	**0.5356**	**8.4000e-004**		**0.0209**	**0.0209**		**0.0192**	**0.0192**	**0.0000**	**73.5053**	**73.5053**	**0.0238**	**0.0000**	**74.0046**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	1.2800e-003	1.8700e-003	0.0178	6.0000e-005	5.1100e-003	4.0000e-005	5.1400e-003	1.3600e-003	4.0000e-005	1.3900e-003	0.0000	3.8471	3.8471	1.7000e-004	0.0000	3.8508
Total	**1.2800e-003**	**1.8700e-003**	**0.0178**	**6.0000e-005**	**5.1100e-003**	**4.0000e-005**	**5.1400e-003**	**1.3600e-003**	**4.0000e-005**	**1.3900e-003**	**0.0000**	**3.8471**	**3.8471**	**1.7000e-004**	**0.0000**	**3.8508**

Mitigated Construction On-Site

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

Off-Road	0.0406	0.4092	0.5356	8.4000e-004		0.0209	0.0209		0.0192	0.0192	0.0000	73.5052	73.5052	0.0238	0.0000	74.0045
Paving	0.0000					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0406**	**0.4092**	**0.5356**	**8.4000e-004**		**0.0209**	**0.0209**		**0.0192**	**0.0192**	**0.0000**	**73.5052**	**73.5052**	**0.0238**	**0.0000**	**74.0045**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	1.2800e-003	1.8700e-003	0.0178	6.0000e-005	5.1100e-003	4.0000e-005	5.1400e-003	1.3600e-003	4.0000e-005	1.3900e-003	0.0000	3.8471	3.8471	1.7000e-004	0.0000	3.8508
Total	**1.2800e-003**	**1.8700e-003**	**0.0178**	**6.0000e-005**	**5.1100e-003**	**4.0000e-005**	**5.1400e-003**	**1.3600e-003**	**4.0000e-005**	**1.3900e-003**	**0.0000**	**3.8471**	**3.8471**	**1.7000e-004**	**0.0000**	**3.8508**

3.7 Architectural Coating - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Archit. Coating	5.6852					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	7.6700e-003	0.0528	0.0680	1.1000e-004		3.0600e-003	3.0600e-003		3.0600e-003	3.0600e-003	0.0000	9.5747	9.5747	6.2000e-004	0.0000	9.5878
Total	**5.6929**	**0.0528**	**0.0680**	**1.1000e-004**		**3.0600e-003**	**3.0600e-003**		**3.0600e-003**	**3.0600e-003**	**0.0000**	**9.5747**	**9.5747**	**6.2000e-004**	**0.0000**	**9.5878**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	3.4900e-003	5.1000e-003	0.0486	1.7000e-004	0.0140	1.0000e-004	0.0141	3.7100e-003	1.0000e-004	3.8100e-003	0.0000	10.5155	10.5155	4.8000e-004	0.0000	10.5255
Total	**3.4900e-003**	**5.1000e-003**	**0.0486**	**1.7000e-004**	**0.0140**	**1.0000e-004**	**0.0141**	**3.7100e-003**	**1.0000e-004**	**3.8100e-003**	**0.0000**	**10.5155**	**10.5155**	**4.8000e-004**	**0.0000**	**10.5255**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Archit. Coating	5.6852					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	7.6700e-003	0.0528	0.0680	1.1000e-004		3.0600e-003	3.0600e-003		3.0600e-003	3.0600e-003	0.0000	9.5747	9.5747	6.2000e-004	0.0000	9.5878
Total	**5.6929**	**0.0528**	**0.0680**	**1.1000e-004**		**3.0600e-003**	**3.0600e-003**		**3.0600e-003**	**3.0600e-003**	**0.0000**	**9.5747**	**9.5747**	**6.2000e-004**	**0.0000**	**9.5878**

Mitigated Construction Off-Site

Category	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	3.4900e-003	5.1000e-003	0.0486	1.7000e-004	0.0140	1.0000e-004	0.0141	3.7100e-003	1.0000e-004	3.8100e-003	0.0000	10.5155	10.5155	4.8000e-004	0.0000	10.5255
Total	**3.4900e-003**	**5.1000e-003**	**0.0486**	**1.7000e-004**	**0.0140**	**1.0000e-004**	**0.0141**	**3.7100e-003**	**1.0000e-004**	**3.8100e-003**	**0.0000**	**10.5155**	**10.5155**	**4.8000e-004**	**0.0000**	**10.5255**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

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

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
General Light Industry	0.00	0.00	0.00		
Total	0.00	0.00	0.00		

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
General Light Industry	9.50	7.30	7.30	59.00	28.00	13.00	92	5	3

LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
0.541334	0.061893	0.168156	0.111955	0.031019	0.004607	0.019268	0.049011	0.001782	0.003693	0.005649	0.000207	0.001427

5.0 Energy Detail

4.4 Fleet Mix

Historical Energy Use: N

5.1 Mitigation Measures Energy

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Electricity Mitigated						0.0000	0.0000		0.0000	0.0000	0.0000	1,180.3762	1,180.3762	0.0534	0.0110	1,184.9203
Electricity Unmitigated						0.0000	0.0000		0.0000	0.0000	0.0000	1,180.3762	1,180.3762	0.0534	0.0110	1,184.9203
NaturalGas Mitigated	0.0679	0.6176	0.5188	3.7100e-003		0.0469	0.0469		0.0469	0.0469	0.0000	672.3508	672.3508	0.0129	0.0123	676.4426
NaturalGas Unmitigated	0.0679	0.6176	0.5188	3.7100e-003		0.0469	0.0469		0.0469	0.0469	0.0000	672.3508	672.3508	0.0129	0.0123	676.4426

5.2 Energy by Land Use - NaturalGas

Unmitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e

Land Use	kBTU/yr	tons/yr										MT/yr					
General Light Industry	1.25994e+007	0.0679	0.6176	0.5188	3.7100e-003		0.0469	0.0469		0.0469	0.0469	0.0000	672.3508	672.3508	0.0129	0.0123	676.4426
Total		**0.0679**	**0.6176**	**0.5188**	**3.7100e-003**		**0.0469**	**0.0469**		**0.0469**	**0.0469**	**0.0000**	**672.3508**	**672.3508**	**0.0129**	**0.0123**	**676.4426**

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
General Light Industry	1.25994e+007	0.0679	0.6176	0.5188	3.7100e-003		0.0469	0.0469		0.0469	0.0469	0.0000	672.3508	672.3508	0.0129	0.0123	676.4426
Total		**0.0679**	**0.6176**	**0.5188**	**3.7100e-003**		**0.0469**	**0.0469**		**0.0469**	**0.0469**	**0.0000**	**672.3508**	**672.3508**	**0.0129**	**0.0123**	**676.4426**

5.3 Energy by Land Use - Electricity

Unmitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
General Light Industry	4.05751e+006	1,180.3762	0.0534	0.0110	1,184.9203
Total		**1,180.3762**	**0.0534**	**0.0110**	**1,184.9203**

Mitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
General Light Industry	4.05751e+006	1,180.3762	0.0534	0.0110	1,184.9203
Total		**1,180.3762**	**0.0534**	**0.0110**	**1,184.9203**

6.0 Area Detail

6.1 Mitigation Measures Area

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	2.1724	4.0000e-005	4.5900e-003	0.0000		2.0000e-005	2.0000e-005		2.0000e-005	2.0000e-005	0.0000	8.7700e-003	8.7700e-003	2.0000e-005	0.0000	9.2800e-003
Unmitigated	2.1724	4.0000e-005	4.5900e-003	0.0000		2.0000e-005	2.0000e-005		2.0000e-005	2.0000e-005	0.0000	8.7700e-003	8.7700e-003	2.0000e-005	0.0000	9.2800e-003

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	0.2558					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	1.9162					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	4.4000e-004	4.0000e-005	4.5900e-003	0.0000		2.0000e-005	2.0000e-005		2.0000e-005	2.0000e-005	0.0000	8.7700e-003	8.7700e-003	2.0000e-005	0.0000	9.2800e-003
Total	**2.1724**	**4.0000e-005**	**4.5900e-003**	**0.0000**		**2.0000e-005**	**2.0000e-005**		**2.0000e-005**	**2.0000e-005**	**0.0000**	**8.7700e-003**	**8.7700e-003**	**2.0000e-005**	**0.0000**	**9.2800e-003**

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Consumer Products	1.9162					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	4.4000e-004	4.0000e-005	4.5900e-003	0.0000		2.0000e-005	2.0000e-005		2.0000e-005	2.0000e-005	0.0000	8.7700e-003	8.7700e-003	2.0000e-005	0.0000	9.2800e-003
Architectural Coating	0.2558					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**2.1724**	**4.0000e-005**	**4.5900e-003**	**0.0000**		**2.0000e-005**	**2.0000e-005**		**2.0000e-005**	**2.0000e-005**	**0.0000**	**8.7700e-003**	**8.7700e-003**	**2.0000e-005**	**0.0000**	**9.2800e-003**

7.0 Water Detail

7.1 Mitigation Measures Water

	Total CO2	CH4	N2O	CO2e

Category	MT/yr			
Mitigated	214.5921	3.7044	0.0888	319.9214
Unmitigated	214.5921	3.7051	0.0890	319.9789

7.2 Water by Land Use

Unmitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
General Light Industry	113.458 / 0	214.5921	3.7051	0.0890	319.9789
Total		**214.5921**	**3.7051**	**0.0890**	**319.9789**

Mitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
General Light Industry	113.458 / 0	214.5921	3.7044	0.0888	319.9214
Total		**214.5921**	**3.7044**	**0.0888**	**319.9214**

8.0 Waste Detail

8.1 Mitigation Measures Waste

Category/Year

	Total CO2	CH4	N2O	CO2e
	MT/yr			
Mitigated	123.4956	7.2984	0.0000	276.7617
Unmitigated	123.4956	7.2984	0.0000	276.7617

8.2 Waste by Land Use

Unmitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
General Light Industry	608.38	123.4956	7.2984	0.0000	276.7617
Total		**123.4956**	**7.2984**	**0.0000**	**276.7617**

Mitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
General Light Industry	608.38	123.4956	7.2984	0.0000	276.7617
Total		**123.4956**	**7.2984**	**0.0000**	**276.7617**

9.0 Operational Offroad

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

10.0 Vegetation

BART HMC Operational

Alameda County, Annual

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
General Light Industry	125.63	1000sqft	53.00	125,630.00	0

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.2	**Precipitation Freq (Days)**	63
Climate Zone	5			**Operational Year**	2017
Utility Company	User Defined				
CO2 Intensity (lb/MWhr)	427.27	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.00617

1.3 User Entered Comments & Non-Default Data

Project Characteristics - BART HMC operational land use emissions. GHG intensity factors for PG&E electricity were updated to the latest available emissions data (The Climate Registry 2013).

Land Use - Project size based on net project size (490,630 sq ft of new buildings replacing 365,000 sq ft of existing)

Construction Phase - Construction emissions not calculated here.

Off-road Equipment - Construction emissions not being calculated here.

Vehicle Trips - Based on net trip rate generation of 473 trips/day. Same trip rate assumed for weekdays and weekends.

Energy Use -

Water And Wastewater - Water use assumed same from 2011 ISMND

Table Name	Column Name	Default Value	New Value
tblConstructionPhase	PhaseEndDate	4/7/2017	1/4/2011
tblConstructionPhase	PhaseStartDate	1/1/2017	1/2/2011

tblLandUse	LotAcreage	2.88	53.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	3.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	0.00
tblOffRoadEquipment	UsageHours	8.00	0.00
tblOffRoadEquipment	UsageHours	8.00	0.00
tblOffRoadEquipment	UsageHours	8.00	0.00
tblProjectCharacteristics	CH4IntensityFactor	0	0.029
tblProjectCharacteristics	CO2IntensityFactor	0	427.27
tblProjectCharacteristics	N2OIntensityFactor	0	0.00617
tblProjectCharacteristics	OperationalYear	2014	2017
tblVehicleTrips	ST_TR	1.32	3.77
tblVehicleTrips	SU_TR	0.68	3.77
tblVehicleTrips	WD_TR	6.97	3.77
tblWater	IndoorWaterUseRate	29,051,937.50	3,519,630.00

2.0 Emissions Summary

2.1 Overall Construction

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2011	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2011	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

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

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	0.5563	1.0000e-005	1.1800e-003	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.2400e-003	2.2400e-003	1.0000e-005	0.0000	2.3800e-003
Energy	0.0174	0.1582	0.1328	9.5000e-004		0.0120	0.0120		0.0120	0.0120	0.0000	373.5183	373.5183	0.0170	6.0600e-003	375.7544
Mobile	0.3328	1.0857	3.7937	7.8500e-003	0.5172	0.0143	0.5314	0.1390	0.0131	0.1521	0.0000	613.6565	613.6565	0.0234	0.0000	614.1468
Waste						0.0000	0.0000		0.0000	0.0000	31.6219	0.0000	31.6219	1.8688	0.0000	70.8668
Water						0.0000	0.0000		0.0000	0.0000	1.1166	3.6910	4.8076	0.1149	2.7600e-003	8.0773

Total	**0.9065**	**1.2439**	**3.9277**	**8.8000e-003**	**0.5172**	**0.0263**	**0.5435**	**0.1390**	**0.0252**	**0.1641**	**32.7386**	**990.8680**	**1,023.6065**	**2.0241**	**8.8200e-003**	**1,068.8477**

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	0.5563	1.0000e-005	1.1800e-003	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.2400e-003	2.2400e-003	1.0000e-005	0.0000	2.3800e-003
Energy	0.0174	0.1582	0.1328	9.5000e-004		0.0120	0.0120		0.0120	0.0120	0.0000	373.5183	373.5183	0.0170	6.0600e-003	375.7544
Mobile	0.3328	1.0857	3.7937	7.8500e-003	0.5172	0.0143	0.5314	0.1390	0.0131	0.1521	0.0000	613.6565	613.6565	0.0234	0.0000	614.1468
Waste						0.0000	0.0000		0.0000	0.0000	31.6219	0.0000	31.6219	1.8688	0.0000	70.8668
Water						0.0000	0.0000		0.0000	0.0000	1.1166	3.6910	4.8076	0.1149	2.7600e-003	8.0755
Total	**0.9065**	**1.2439**	**3.9277**	**8.8000e-003**	**0.5172**	**0.0263**	**0.5435**	**0.1390**	**0.0252**	**0.1641**	**32.7386**	**990.8680**	**1,023.6065**	**2.0241**	**8.8200e-003**	**1,068.8459**

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

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Demolition	Demolition	1/2/2011	1/4/2011	5	70	

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 0

Acres of Paving: 0

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

OffRoad Equipment

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Demolition	Concrete/Industrial Saws	0	0.00	81	0.73
Demolition	Excavators	0	0.00	162	0.38
Demolition	Rubber Tired Dozers	0	0.00	255	0.40

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
Demolition	0	0.00	0.00	0.00	12.40	7.30	20.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

3.2 Demolition - 2011

Unmitigated Construction On-Site

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

Unmitigated Construction Off-Site

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

Mitigated Construction On-Site

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

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e

Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	0.3328	1.0857	3.7937	7.8500e-003	0.5172	0.0143	0.5314	0.1390	0.0131	0.1521	0.0000	613.6565	613.6565	0.0234	0.0000	614.1468
Unmitigated	0.3328	1.0857	3.7937	7.8500e-003	0.5172	0.0143	0.5314	0.1390	0.0131	0.1521	0.0000	613.6565	613.6565	0.0234	0.0000	614.1468

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
General Light Industry	473.63	473.63	473.63	1,382,754	1,382,754
Total	473.63	473.63	473.63	1,382,754	1,382,754

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-W	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by

General Light Industry	9.50	7.30	7.30	59.00	28.00	13.00	92	5	3

LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
0.541334	0.061893	0.168156	0.111955	0.031019	0.004607	0.019268	0.049011	0.001782	0.003693	0.005649	0.000207	0.001427

5.0 Energy Detail

4.4 Fleet Mix

Historical Energy Use: N

5.1 Mitigation Measures Energy

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Electricity Mitigated						0.0000	0.0000		0.0000	0.0000	0.0000	201.3571	201.3571	0.0137	2.9100e-003	202.5455
Electricity Unmitigated						0.0000	0.0000		0.0000	0.0000	0.0000	201.3571	201.3571	0.0137	2.9100e-003	202.5455
NaturalGas Mitigated	0.0174	0.1582	0.1328	9.5000e-004		0.0120	0.0120		0.0120	0.0120	0.0000	172.1612	172.1612	3.3000e-003	3.1600e-003	173.2089
NaturalGas Unmitigated	0.0174	0.1582	0.1328	9.5000e-004		0.0120	0.0120		0.0120	0.0120	0.0000	172.1612	172.1612	3.3000e-003	3.1600e-003	173.2089

5.2 Energy by Land Use - NaturalGas

Unmitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					

General Light Industry	3.22618e+006	0.0174	0.1582	0.1328	9.5000e-004		0.0120	0.0120		0.0120	0.0120	0.0000	172.1612	172.1612	3.3000e-003	3.1600e-003	173.2089
Total		**0.0174**	**0.1582**	**0.1328**	**9.5000e-004**		**0.0120**	**0.0120**		**0.0120**	**0.0120**	**0.0000**	**172.1612**	**172.1612**	**3.3000e-003**	**3.1600e-003**	**173.2089**

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
General Light Industry	3.22618e+006	0.0174	0.1582	0.1328	9.5000e-004		0.0120	0.0120		0.0120	0.0120	0.0000	172.1612	172.1612	3.3000e-003	3.1600e-003	173.2089
Total		**0.0174**	**0.1582**	**0.1328**	**9.5000e-004**		**0.0120**	**0.0120**		**0.0120**	**0.0120**	**0.0000**	**172.1612**	**172.1612**	**3.3000e-003**	**3.1600e-003**	**173.2089**

5.3 Energy by Land Use - Electricity

Unmitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
General Light Industry	1.03896e+006	201.3571	0.0137	2.9100e-003	202.5455
Total		**201.3571**	**0.0137**	**2.9100e-003**	**202.5455**

Mitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
General Light Industry	1.03896e+006	201.3571	0.0137	2.9100e-003	202.5455
Total		**201.3571**	**0.0137**	**2.9100e-003**	**202.5455**

6.0 Area Detail

6.1 Mitigation Measures Area

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	0.5563	1.0000e-005	1.1800e-003	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.2400e-003	2.2400e-003	1.0000e-005	0.0000	2.3800e-003
Unmitigated	0.5563	1.0000e-005	1.1800e-003	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.2400e-003	2.2400e-003	1.0000e-005	0.0000	2.3800e-003

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e

SubCategory	tons/yr										MT/yr					
Architectural Coating	0.0655					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	0.4907					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	1.1000e-004	1.0000e-005	1.1800e-003	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.2400e-003	2.2400e-003	1.0000e-005	0.0000	2.3800e-003
Total	**0.5563**	**1.0000e-005**	**1.1800e-003**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**2.2400e-003**	**2.2400e-003**	**1.0000e-005**	**0.0000**	**2.3800e-003**

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Consumer Products	0.4907					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	1.1000e-004	1.0000e-005	1.1800e-003	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.2400e-003	2.2400e-003	1.0000e-005	0.0000	2.3800e-003
Architectural Coating	0.0655					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.5563**	**1.0000e-005**	**1.1800e-003**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**2.2400e-003**	**2.2400e-003**	**1.0000e-005**	**0.0000**	**2.3800e-003**

7.0 Water Detail

7.1 Mitigation Measures Water

	Total CO2	CH4	N2O	CO2e
Category	MT/yr			
Mitigated	4.8076	0.1149	2.7600e-003	8.0755

Unmitigated	4.8076	0.1149	2.7600e-003	8.0773

7.2 Water by Land Use

Unmitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
General Light Industry	3.51963 / 0	4.8076	0.1149	2.7600e-003	8.0773
Total		**4.8076**	**0.1149**	**2.7600e-003**	**8.0773**

Mitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
General Light Industry	3.51963 / 0	4.8076	0.1149	2.7600e-003	8.0755
Total		**4.8076**	**0.1149**	**2.7600e-003**	**8.0755**

8.0 Waste Detail

8.1 Mitigation Measures Waste

Category/Year

	Total CO2	CH4	N2O	CO2e
	MT/yr			
Unmitigated	31.6219	1.8688	0.0000	70.8668
Mitigated	31.6219	1.8688	0.0000	70.8668

8.2 Waste by Land Use

Unmitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
General Light Industry	155.78	31.6219	1.8688	0.0000	70.8668
Total		**31.6219**	**1.8688**	**0.0000**	**70.8668**

Mitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e

Land Use	tons	MT/yr			
General Light Industry	155.78	31.6219	1.8688	0.0000	70.8668
Total		**31.6219**	**1.8688**	**0.0000**	**70.8668**

9.0 Operational Offroad

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

10.0 Vegetation

Appendix D

FTA Categorical Exclusion for the BART Hayward Maintenance Complex Project

Copies to: PO
CS
CM

REC'D SEP 27 2011

U.S. Department
of Transportation
**Federal Transit
Administration**

REGION IX
Arizona, California,
Hawaii, Nevada, Guam
American Samoa,
Northern Mariana Islands

201 Mission Street
Suite 1650
San Francisco, CA 94105-1839
415-744-3133
415-744-2726 (fax)

SEP 21 2011

Ms. Grace Crunican
General Manager
San Francisco Bay Area Rapid Transit District
P.O. Box 12688
Oakland, CA, 94604-2688

Re: Categorical Exclusion (d)(11)
Hayward Maintenance Complex

Grace

Dear Ms. Crunican:

The Federal Transit Administration (FTA) has completed its review of your letter dated August 18, 2011 requesting a National Environmental Policy Act (NEPA) finding for the San Francisco Bay Area Rapid Transit District Hayward Maintenance Complex Project.

Based on the information received we concur in your request for a categorical exclusion under 23 CFR part 771.117 (d) "Construction of rail storage and maintenance facilities in areas used predominantly for industrial or transportation purposes where such construction is not inconsistent with existing zoning and where there is no significant noise impact on the surrounding community."

We agree that this project, which includes a new vehicle overhaul shop, component repair shop, central warehouse, maintenance and engineering shop and storage area, additional railcar access, and enhanced vehicle inspection area; additional storage for railcars, flyovers and connecting trackwork is consistent with these criteria.

This review, which is based on the information submitted, finds that the project: does not induce significant environmental impacts to planned growth or land use for the area; does not have a significant impact on natural, cultural, recreational, historical or other resource; does not involve significant air, noise, or water quality impacts; does not have significant impacts on travel patterns; or does not otherwise, either individually or cumulatively, have any significant environmental impact.

If you have questions about this review please contact Lorraine Lerman at (415) 744-2735.

Sincerely,

Leslie T. Rogers
Regional Administrator

Appendix E

BART Transbay Corridor Core Capacity Traction Power Simulation

June 2017

Traction Power Simulation Report

Transbay Corridor Core Capacity Program

PGH Wong Engineering, Inc

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The Executive Summary presents a synopsis of the objective, findings, and conclusions for Transbay Core Capacity Traction Power study for the Bay Area Rapid Transit District (BART).

Objective

The purpose of this task is to perform a traction power system simulation to support the Transbay Core Capacity Study for the Bay Area Rapid Transit District (BART). The analysis performed under this task will demonstrate the feasibility of the traction power system to support trains operating at design headways of 30 trains per hour through the transbay tube in both directions under Communications Based Train Control System (CBTC). In addition, normal and contingency operations as defined in the BART Facilities Standards will be considered when developing simulation scenarios. The results from the study will demonstrate the following:

- The ability of the traction power system to provide adequate power to support minimum permissible train voltages.
- The loading of the transformer-rectifier units compared to proposed rated capacities.
- The cable loading for positive feeder, negative return, and 34.5kV compared to proposed rated capacities.
- The potential for power savings due to regenerative braking.

Scope of Work

The key elements of the scope of work in this evaluation are as follows:

- Gather and review traction power and vehicle system data.
- Establish the basis of analysis, including selection of scenarios for normal operations, contingency operations, and train bunching.
- Perform a computer simulation of the selected scenarios utilizing a dynamic traction power and train operations simulator.
- Analyze the results for the various simulation cases and provide recommended mitigations.

Simulation Program

The analysis was performed using a proven set of computer simulation software known as the Traction Electrical Power Analysis Simulation (TEPAS) program. The model provides dynamic simulation of the traction power system, train movements, and the train control system. The integrated set of modules consists of a rail transit simulator, a load flow analysis program, and a flexible output module. The load flow program is specifically designed to analyze and evaluate the electrical performance of an electric rail system under a series of specified train requirements. Typical simulation scenarios for train operations and traction power analysis reflect peak hour operations with 30 trains per hour in both directions through the Transbay Tube.

Findings and Conclusions

The results of the analysis performed on the conceptual design indicate that traction power system improvements or additional consideration of design criteria may be required to address low train voltages identified under normal operations, single contingency conditions, and train bunching. A summary of the findings is provided as follows:

- **Substation Capacity.** The substation capacity was found to be adequate for all normal and single contingency operating conditions analyzed.

  The transformer-rectifier units at the traction power system substations were assumed to be extra heavy-duty type in accordance with NEMA Standard RI-9 and are capable of withstanding short-time overloads due to operations with adjacent substations out-of-service.

- **Train Voltages.** The results of the train voltage evaluation are summarized as follows for the various conditions simulated:

  (a) **Normal Operations.** The results from the normal operating condition simulated in Case CC-NORMAL showed a low train voltage operating at 742 Vdc near the Richmond Yard entrance.

  (b) **Contingency Operations.** The contingency operating conditions included removal of a substation from service and simultaneous starts of trains operating at half acceleration, which resulted in four segments not meeting the minimum permissible train voltage criterion. These segments and low voltages are between Civic Center Station and 16th Street Station showing 725 Vdc, Richmond Station showing 687 Vdc, between Pleasant Hill Station and Concord Yard with 671 Vdc, and between MacArthur Station and 19th Street Station with 740 Vdc.

  (c) **Bunching and Train Delays.** The bunching and train delays resulted in the lowest train voltage of 775 Vdc, which occurred due to simultaneous starting of trains occurring in the Downtown San Francisco area, specifically at Civic Center after service was restored.

Train Voltages below 750 Vdc by Condition and Location

Case ID	Normal Operations, Contingency Operations, and Train Bunching	Train Voltage	Location
CC-NORMAL	Normal Operations	742 Vdc	Richmond Yard entrance
CC08-MPS-SS-PL4	Substation MPS 5MW+5MW Dual Unit Out-of-Service	725 Vdc	Between Civic Center Station and 16th Street Station
CC23-RRI-SS-PL4	Substation RRI 4MW Single Unit Out-of-Service	687 Vdc	Richmond Station
CC36-CPH-SS-PL4	Substation CPH 3MW+3MW Dual Unit Out-of-Service	671 Vdc	Between Pleasant Hill and Concord Yard
CC42-KTT-SS-PL4	Substation KTT 4MW+3MW Dual Unit Out-of-Service	740 Vdc	Between MacArthur Station and 19th Street Station

- **Mitigation Measures.** PGH Wong Engineering, Inc. recommends the following mitigation measures to address low voltage conditions with the BART Transbay Core Capacity train service. The recommended improvements are as follows:

  - Two 5MW substation transformer-rectifier units split between Civic Center Station and at Montgomery Station
  - Two 5MW substation at Richmond Gap Breaker Station RYE
  - Two 5MW substation at Pleasant Hill/Concord
  - Two 5MW substation at K-Line (34th Street)

Cable Loading Summaries. The results from the simulation indicate there are 4 locations where rms current of all cable sets exceeded 555A under normal conditions with regeneration and 10%, North Berkeley, El Cerrito Del Norte, Richmond, and Bay Fair. Recommendation for overloaded cables is the installation of additional feeder cables in parallel to increase the ampacity of the cable set.

Regenerative Braking

A regenerative braking analysis was performed for normal operations on the existing substations to identify potential areas for power savings. The results indicate the following:

- Potential for energy savings through regenerative braking was found to be up to 38,619 kWHr for the normal operations.
- The total systemwide demand was found to be 108,696 kWHr.
- The location with the largest energy savings was observed at Balboa Park Substation (MPB) with input energy reduced by 2,263 kWHr.
- The location with the least amount of energy savings was at the outer C Line with several substations showing input energy reduced by less than 100 kWHr.

SECTION 1

INTRODUCTION

1.0 General

This report presents the methodology, basis of analysis and findings of the Transbay Core Capacity Project for BART. The Traction Power Systems (TPS) improvements will form one element of the overall Transbay Core Capacity Project, which will also consider and identify required improvements for stations, track, vehicle fleet, communications, the on-going Train Control Modernization Program (TCMP), and other infrastructure. The simulation will be based on train services plans and associated schedules which will be developed by BART as part the Transbay Core Capacity Project. The study considers train spacing and movements under Communications Based Train Control System (CBTC) as will be implemented under the TCMP.

1.1 Objective

The purpose of this task is to perform a traction power system simulation for the Transbay Core Capacity Project for BART.

The analysis performed under this effort will demonstrate the substation capacities to support trains operating at design headways under normal operations, contingency operations, and train bunching as defined in the BART Facilities Standards with input from BART personnel and consideration of CBTC operation. The results from this study provide an understanding of the traction power system and its ability to provide sufficient power in support of trains operating at the anticipated Transbay Core Capacity build out of 30 trains per hour in both directions through the transbay tube under normal operations, contingency operations, and train bunching. On this basis, the results from the study will demonstrate the following:

- The ability of the traction power system to provide adequate power to support minimum operating train voltages.
- The loading of the transformer-rectifier units compared to their rated capacities.
- The loading of the cables compared to their rated capacities.
- The regenerative braking power savings compared to cases without regenerative braking.

1.2 Scope of Work

The scope of work for the Transbay Core Capacity–Traction Power System Study is summarized as follows:

(a) **Obtain and Review Data.** Based on information received, develop and document the modeling parameters and scenarios from the new BART vehicle parameters, traction power system configuration including the two recent substation upgrades at Oakland West (KOW) and Coliseum (ACO), and BART service schedule and operations including the design 30 trains per hour in both directions through the transbay tube.

(b) **Perform Simulations.** Perform power computer simulations on scenarios identified utilizing a computer program for dynamic simulation of traction power, train operations, and train control systems.

(c) **Traction Power System Analysis.** Analyze the results and mitigations, including train voltage vs. distance, rectifier loading summaries, and cable loading summaries, under normal operations, contingency operations and train bunching.

(d) **Prepare Report.** Prepare report to document the results and findings of the traction power analysis.

SECTION 2

METHODOLOGY

2.0 General

The study is performed through use of an integrated set of computer programs utilized by PGH Wong Engineering, Inc to perform traction power system analyses. The dynamic computer program simulates actual train movement on tracks, taking into account such factors as grade, train control, acceleration, etc. Nearly all aspects of a train operating system are simulated in the TDS OnTrack Software Simulator. The traction power system is then analyzed utilizing the Train Electric Power Analysis System (TEPAS).

2.1 Overview of the Methodology

The methodology used for the traction power system analysis included the following key steps:

1. Gather Information and Review Data
2. Establish the Basis of Analysis
3. Develop the Simulation Models
4. Perform Simulations
5. Traction Power System Analysis
6. Prepare Report

2.1.1 Gather Information and Review Data

The information gathered is based on the preliminary design data provided by BART and established in the Basis of Analysis Report, Revision 0, submitted on January 16, 2003 with updates based on BART Renovation Program and new BART vehicle procurement, specifically upgrades at Coliseum (ACO) and Oakland West (KOW). Key information is presented in Section 4 as part of the System Data.

2.1.2 Establish the Basis of Analysis

The basis of the analysis was established at the beginning of the study to provide the criteria for conducting the traction power analysis. Additional information derived from the BART new vehicle specifications and BART personnel input was incorporated into the following elements:

(a) **Systems Data.** This section included data for: substations, traction power network, vehicles, tracks, train control system and other miscellaneous data. This section also documented criteria for contingency conditions, touch potentials, and minimum train voltage.

(b) **Simulation Scenarios.** The simulation scenarios to be performed in the course of this study were documented.

(c) **Electrical Single Line Diagrams.** The electrical single line diagrams to be used as the basis for modeling the traction power network were documented.

(d) **Vehicle Tractive Effort, Power, and Regenerative Braking Profiles.** The vehicle tractive effort profile as well as the power and regenerative braking profiles for the new BART vehicles were documented and used in the vehicle model.

(e) **Substation Regulation Profiles.** The substation regulation profiles incorporated standard uncontrolled diode rectifiers.

2.1.3 Develop the Simulation Models

Preparation of input data for the simulation models was an important task, since the objective was to obtain an accurate, detailed computer model of the traction power system. The model was tailored to the BART Transbay Core Capacity specific network and operating configurations as defined in the Basis of Analysis.

2.1.3.1 Types of Data. Critical data for the simulation included the following:

(a) **Substation Data.** These data define the transformer, rectifiers, utility service impedances, and substation contingency criteria for the simulation study.

(b) **Traction Power Network Data.** These data define impedances, interconnections, and configuration of the network, including contact and running rails, dc feeder cables, and negative-return cables. The network simulation simultaneously models and solves both the positive and negative sides of the dc feeder network, thus requiring detailed input for both the positive and negative-return network.

(c) **Vehicle Propulsion Data.** Correct modeling of the propulsion control systems is critical to obtaining realistic traction power loading. The data included tractive and braking effort, power and current speed profiles, and auxiliary power requirements for vehicles were updated with the new BART vehicle specifications.

(d) **Track Description Data.** These data include stationing of platform locations.

(e) **Train Control and Operation Data.** Train headways, schedules, and operations were developed based on input from BART. The signalizing or train control system is based on preliminary studies performed as part of the Train Control Modernization Program. The data and schedules were reviewed to develop a peak headway of 2 minutes in each direction of the transbay tube. The schedule was utilized for the simulation scenarios with contingency conditions.

2.1.3.2 Sources of Data. The sources for data used in the simulation are summarized as follows:

(a) **Substation Data.** These data were taken from BART Electrification Plans Book 36 and BART Extension Program Design Criteria Vol. 4 and established in the basis of analysis submitted on January 16, 2003.

(b) **Traction Power Network Data.** Data for the traction power electrical track network was obtained primarily from BART Electrification Plans Book 36 (revised 5/02) provided by BART.

(c) **Vehicle Propulsion Data.** Accurate representation of the vehicle propulsion system is critical to analyzing the traction power system. The propulsion characteristics for the BART vehicle and vehicle specifications were obtained from BART Vehicle Engineering group's new BART Fleet, Bombardier BART D/E Car Propulsion System.

2.1.4 Perform Simulation

Scenarios were simulated for normal operating conditions with all traction power substations in service, various single contingency conditions, and a combination of train bunching conditions.

2.1.5 Traction Power System Analysis

The following results of the simulation scenarios were analyzed to determine the adequacy of the existing traction power system:

(a) **Contact Rail Voltage at Trains.** Low voltage conditions at trains will have an impact on train performance. This critical condition was evaluated for each scenario by comparing train voltage to the minimum permissible voltage. Even if the train voltage is not below the minimum train operating voltage, trains will suffer a loss of performance at low voltages. Also, low train voltage is an indication that power is being dissipated as heat in the tunnel rather than utilized to drive trains, and while such conditions cannot always be economically cured, they are viewed as opportunities for improvement. The TEPAS program provides tabular reports and graphical output for train voltages including:

- Train voltage vs. distance plots
- Summary tables of lowest voltages with corresponding train locations

(b) **Rectifier Substations.** The results of the rectifier substation loading were compared to the proposed rectifier substation ratings for each substation. Transformer and transformer-rectifier unit ratings were compared against the rms current which was computed for each scenario by the TEPAS program. A Rectifier Loading Summary tabulation was produced which includes each rectifier substation’s average, maximum, and rms current, and the average and maximum power. In addition, the summary indicates selected parameters as a percentage of rated capacity. For example, the simulated rms currents are compared against the rms current ratings of the rectifiers to indicate the percent loading of each unit. The rectifier loading summaries are included in Appendix D.

The peak power and current for the rectifiers are shown in the tabular output in Appendix D. These peak values are used to evaluate the adequacy of the substation short-time overload capability in accordance with NEMA Standard RI-9 for extra heavy-duty traction service.

(c) **DC Positive Feeder and Negative-Return Cables.** The simulation was utilized to provide a Cable Loading Summary tabulation indicating the rms values for each dc feeder and negative-return cable as shown in Appendix F. The simulated rms current can be compared to ampacity of cables.

(d) **34.5kV High Voltage AC Distribution Cables.** The simulation was utilized to provide the ac cable loading summary tabulation indicating the rms values for each ac feeder cable on the existing system cable as shown in Appendix F. The simulated rms current can be compared to ampacity of cables which is further discussed in findings

(e) **Regeneration.** This feature, which allows trains to utilize regenerative current from synchronized train starts and train braking, was simulated with identified improvements and evaluated for optimized regeneration influence zones.

2.1.6 Prepare Report

This report was prepared to document the data collected and reviewed, results and findings from the study, and the traction power analysis used to determine the adequacy of the existing traction power system.

SECTION 3

COMPUTER PROGRAM FOR TRACTION POWER ANALYSIS

3.0 General

Traction power system design and analysis for transit systems requires computer simulation of the transit operations and the traction power network. PGH Wong Engineering, Inc. in association with Transportation Decision Systems, Inc. has developed an integrated, state-of-the-art computer program for dynamic simulation of traction power and train control systems. The integrated set of modules consists of OnTrack Train simulator, a load flow analysis program, and a flexible output module. This section of the report provides a description of the simulation program.

3.1 Overview of Simulation Program

TEPAS is a set of integrated computer simulation tools that is specifically designed to analyze and evaluate the electrical performance of an electric rail system under a series of specified train power requirements. By using a detailed train performance simulation, TEPAS can examine power requirements under normal, abnormal and emergency conditions.

TEPAS is suitable for analyzing and evaluating heavy and light rail transit systems and high speed electrified rail systems. It is capable of rapidly evaluating the performance of alternative power distribution system designs when supporting a variety of different train schedules. TEPAS is also useful for identifying limitations and problems in the design of existing power systems under existing or proposed operations.

3.2 Program Modules

The TEPAS program provides for dynamic simulation of traction power and train control systems. The program is an integrated set of modules consisting of the following:

- **TEPAS Analyzer (TA).** This module performs the dc load flow simulation for the electrical network. It provides complete electrical network solutions at half second intervals or greater as trains run on the system.

- **TEPAS Selector (TS).** TS is a data processing module that assists the user in selecting data of interest from the TEPAS Analyzer output.

- **TEPAS Presenter (TP).** TP is the output module that uses a set of Microsoft Windows-based macros and customized user-friendly dialog boxes for preparing tabular and graphical output.

- **TEPAS Launcher.** This is a Microsoft Windows-based interface permitting the operation of the above modules from an integrated user-friendly Windows interface.

3.3 Program Description

3.3.1 Electrical Systems Modeling. TEPAS Analyzer is designed to support power system evaluations for existing and proposed electrical power network designs under various operating scenarios. The TEPAS Analyzer determines the electrical performance of the system, including the voltage at each bus, and the current flow through each link at each instant of time. Both instantaneous and rms values are available for display. Principal inputs to the TEPAS Analyzer are:

- Description of the electrical power system with geographical locations keyed to the track network
- Train power requirements, including efficiency at different speed/load conditions, and auxiliary power requirements
- Input from the BART ICS Simulator describing the tractive effort requirements for each train at its particular location for each time interval

The key features of the electrical model include:

- **Ease of Input.** For instance, all resistance values are input in ohms rather than per unit. A routine check to ensure data validity is made before proceeding with the solution.
- **Matrix Solution.** The resistances and train currents are combined with substation voltage, resistance specifications, and cable layout into a matrix that is analyzed by means of Kirchoff's equations. The unknowns are bus voltages, and the rows of the matrix are the equation coefficients. The matrix is solved by a high speed computational process that takes advantage of the sparse matrix format.
- **Output.** The TEPAS Analyzer writes the results of the analysis for each half-second time interval, or other user defined interval, into a compressed coded file that contains the voltages at each bus and the current through each link of the system. The compressed output file is read by the user-friendly Windows-based TEPAS Presentation (TP) module.

3.3.2 Program Output. The TEPAS Presenter (TP) is the output module that uses customized, user-friendly dialog boxes for preparing tabular and graphical output.

(a) **Tabular Output.** The tabular output summarizes the results by showing current, power, and voltage in all the nodes for a single snapshot, or lists current, power and voltage versus time at each single node for the duration of the analysis. In addition, the tabular output provides:

- Summaries of time-dependent values such as rms and average current for rectifiers and cables

- Summaries of maximum and minimum train voltages

Since the TEPAS Presenter generates Windows compatible files with the requested data, the user has the option of using either the standard summary formats or generating a project specific format.

(b) **Graphical Output.** Graphic output includes plots of train voltage versus distance. Separate plots indicate instantaneous peak power, average power, and energy consumption at selected power substations, and rectifier peak, average, and rms current output. Extensive use of customized dialog boxes, pull-down menus, and scroll boxes assists the user in specifying the output format.

SECTION 4

SYSTEM DATA

4.0 General

This section of the report presents the basis of analysis and systems data to be used in the simulation of Transbay Core Capacity Study. It consists of the following:

- System voltage levels
- Traction power network characteristics
- Vehicle parameters
- Train operation characteristics

4.1 System Voltage Levels

The following data provide the dc system voltage limitations established for the purposes of the simulation study:

Nominal Substation Line Voltage:	1000 Vdc
Minimum Voltage for Train Operations:	750 Vdc
Maximum Voltage during Regeneration:	1150 Vdc

4.2 Traction Power Network Characteristics

The traction power network characteristics define the impedances, interconnections, and configuration of the network including transformers, rectifiers, utility service impedances, contact and running rails, dc feeder cables, and negative-return cables. The network simulation simultaneously models and solves both the positive and negative sides of the dc feeder network, thus requiring detailed input for both the positive and negative return network. Critical data based on the existing traction power system include the following:

(a) **Transformer-Rectifier Unit Ratings.** The transformer-rectifier units have the following ratings:

- **Continuous Rating:**

All Substations:	Various- See Source
Duty Cycle Rating:	NEMA RI-9, Extra Heavy Traction Duty

- **Voltage Characteristics:**
  - No-load Voltage (1% load): 1055 Vdc
  - 100% Load Voltage: 1000 Vdc

(b) **Voltage Regulation.** Voltage regulation for the utility system and transformer rectifier is:

- Transformer/Rectifier Regulation: 6%

(c) **Traction Power Network Data.** The following data was obtained from BART Electrification Plans Book 36 (revised 5/02) provided by BART:

- Nominal Line Voltage: 1000 V dc
- 3rd Rail Characteristics: Standard: 0.00395Ω/1000ft Low Resistance: 0.00230Ω/1000ft
- Return Rail Characteristics: 119 lb./yd. rail, 0.00930Ω/1000ft
- Single Rail Resistance to Ground: Ballasted: 119 lb./yd. rail, 250Ω/1000ft Direct Fixation: 119 lb./yd. rail, 1000Ω/1000ft
- Double/Single Rail Negative Return: ½ M Ω/fastener Double-rail track circuits
- Track Crossbonds locations: Approximately every 2,000ft. or at crossover
- Yard Loads: Concord Yard is simulated as 2 Standby Trains.

The above data and other information from the BART Electrification Plans Book 36 are incorporated into the Electrical Single Line Diagrams in Appendix A. The Electrical Single Line Diagrams will form the primary basis for creating the electrical network simulation model in the traction power system simulator, TEPAS.

4.3 Vehicle Parameters

Modeling of the propulsion control systems is utilized to determine traction power system loading. The characteristics for modeling these cars was obtained through the new vehicle procurement documents and refined in discussions with BART are documented below and also in Appendix B, Vehicle Tractive Effort and Power Profile Plots.

Vehicle Data	*Basis*	*Source*	*Date*
▪ **Car Weight:**	AW2 (Full Car Weight) = 92,555 lbs.	Bombardier BART D/E Car Propulsion System (See Appendix B)	01/14
▪ **Car Length:**	70 ft./car.	BFS	01/15
▪ **Car Type:**	Each car has two trucks and four axles	Bombardier BART D/E Car Propulsion System (See Appendix B)	01/14
▪ **Train Consist:**	10-car trains	BFS	01/15
▪ **Line Voltage for Application of Forced Reduced Performance:**	Range 1: 879-750 V dc Range 2: 749-650 V dc	Bombardier BART D/E Car Propulsion System (See Appendix X)	01/14
▪ **Forced Reduced Performance Due to Reduced Line Voltage**	Range 1: 5 Amp/Volt decrease above 750 V dc Range 2: Constant 100 Amps between 650-749 V dc	Bombardier BART D/E Car Propulsion System (See Appendix B)	01/14
▪ **Minimum Voltage for Train Operations:**	650 V dc	Bombardier BART D/E Car Propulsion System (See Appendix B)	01/14
▪ **Tractive Effort Under Acceleration**	See Figure 4-1 below.	Bombardier BART D/E Car Propulsion System (See Appendix B)	01/14
▪ **Line Current/Power Profile Under Acceleration**	See Figure 4-2 below.	Bombardier BART D/E Car Propulsion System (See Appendix B)	01/14
▪ **Current Limitations**	1500 A	Bombardier BART D/E Car Propulsion System (See Appendix B)	01/14

▪ **Auxiliary Vehicle Power**	35 kW	Bombardier BART D/E Car Propulsion System (See Appendix B)	01/14
▪ **Maximum Acceleration**	3.0 mph/s (Line Voltages Greater than 880 V dc)	Bombardier BART D/E Car Propulsion System (See Appendix B)	01/14
▪ **Maximum Deceleration**	3.0 mph/s (Emergency) 2.0 mph/s (Service) 2.2 mph/s (Station)	Bombardier BART D/E Car Propulsion System (See Appendix B)	01/14
▪ **Maximum Speed**	80 mph	Bombardier BART D/E Car Propulsion System (See Appendix B)	01/14
▪ **Propulsion Motor**	Analysis is based on TM 1302SP Traction Power motor rated max 180 HP, 228 A (RMS fundamental), and 2220 rpm	Bombardier BART D/E Car Propulsion System (See Appendix B)	01/14

4.4 Train Operations Characteristics

OnTrack contains accurate representations of train propulsion, train control and routing, scheduling. These subsystems affect train operations under a wide variety of scheduling alternatives and future scenarios. Proceeding in one second time steps, OnTrack updates each subsystem in view of constraints imposed by other subsystems, and external inputs. Observance of these mutual constraints by OnTrack permits modeling of transit system performance under almost any conceivable scenario.

The module models the track network in terms of segments that connect operationally critical. This input also contains information on track grades and curves, civil speed limits, and other restrictions so that actual train performance can be simulated over each segment. Train performance data include speed-tractive effort curves, braking curves, and physical characteristics, such as length, weight, and response times.

The scenarios were structured to model operation based on the BART Transbay Core Capacity ultimate buildout of 30 trains per hour in both directions in the transbay tube. This is achieved through the implementation of the new CBTC system which utilizes civil speeds instead of fixed block speed codes. In addition, discussions with BART permit the analysis of the following train operating conditions during peak passenger weekday loadings:

- The normal weekday schedule during the morning 2-hour peak period (7:30 AM to 9:30 AM) was utilized under normal operations with no forced simultaneous starts, contingency conditions, and delayed train recovery/bunching scenarios.

- Red line trains operate between Richmond Station (R60) and Millbrae Station (W40). Richmond bound trains will turn back at Richmond Yard beyond R60 and a new train will be dispatched towards W40.

- Yellow line trains operate between Pittsburg/Bay Point Station (C80) and San Francisco International Airport (Y10). Long trains are dispatched from C80 while short trains are dispatched from Concord Yard near Pleasanton Hill Station (C50). At Y10, short trains turn back to Concord Yard while new long trains are dispatched towards C80.

- Orange line trains operate between Richmond Station (R60) and Warm Springs Station (S20); Blue line trains operate between Dublin/Pleasanton Station (L30) and Daly City Station (M90); Green line trains operate between Warm Springs Station (S20) and Daly City Station (M90).

- Red and Yellow lines operate evenly opposed. Blue and Green lines also operate evenly opposed. When the Red, Yellow, Blue, and Green lines enter the Oakland Wye, they are slotted. Once the Blue and Green line trains reach M90, they turn back for return routes.

- All train lines are loaded during peak hours in both directions while return trains are lighter. During peak hours, northbound train meets occur at MacArthur Station only and the CX track (between 12th Street Station and MacArthur) operates in both directions. Green line southbound trains will run only on the C2 track.

Trains are dispatched in both directions from end terminals at headways of 12 minutes with the exception of the Yellow line, which dispatches long trains interspersed with short trains. Thus, Yellow line trains travel between Pleasant Hill Station and Rockridge Station at headways of 6 minutes in both southbound (Pittsburg/Bay Point to San Francisco International Airport) and northbound (San Francisco International Airport to Pittsburg/Bay Point) directions. When all trains approach the Oakland Wye, trains are slotted and routes are given depending on which train is asking for the route. This maintains a 120-second-train-to-train headway through the Transbay Tube, which ultimately achieves the upgraded train service goal of providing 30 trains per hour in each direction.

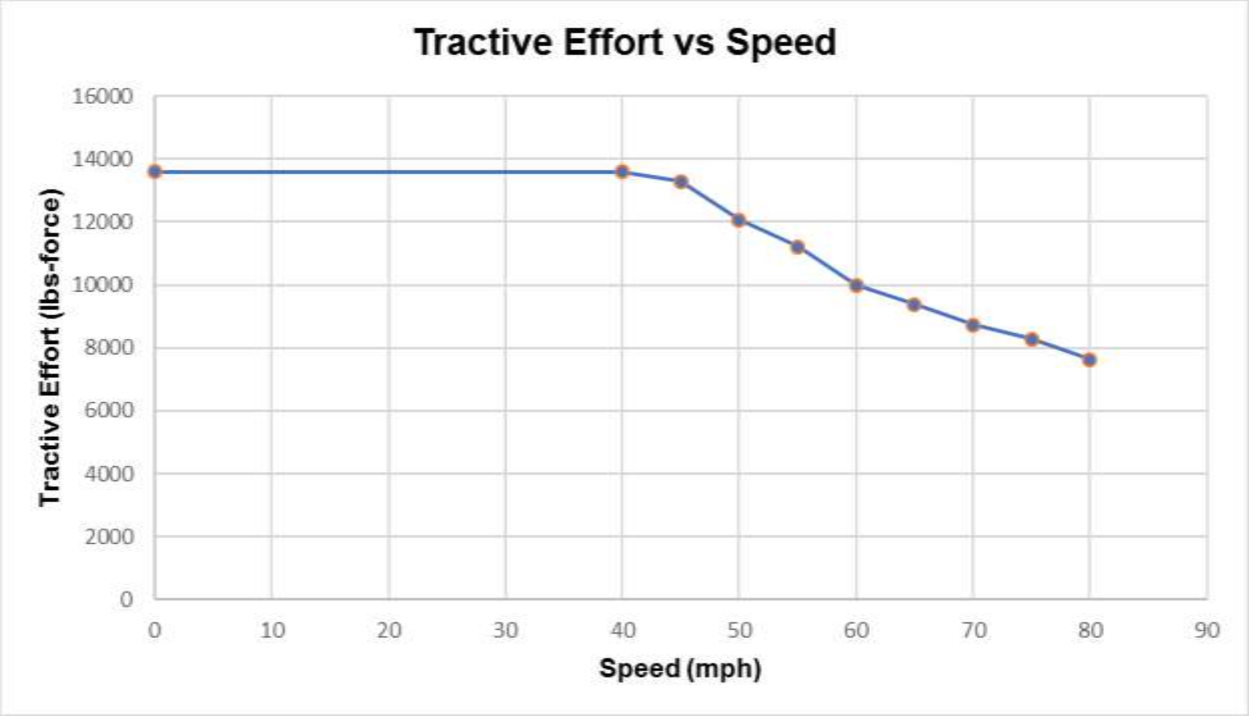


Figure 4-1 – BART Vehicle Tractive Effort vs. Speed Profile (AW2, 1000V)

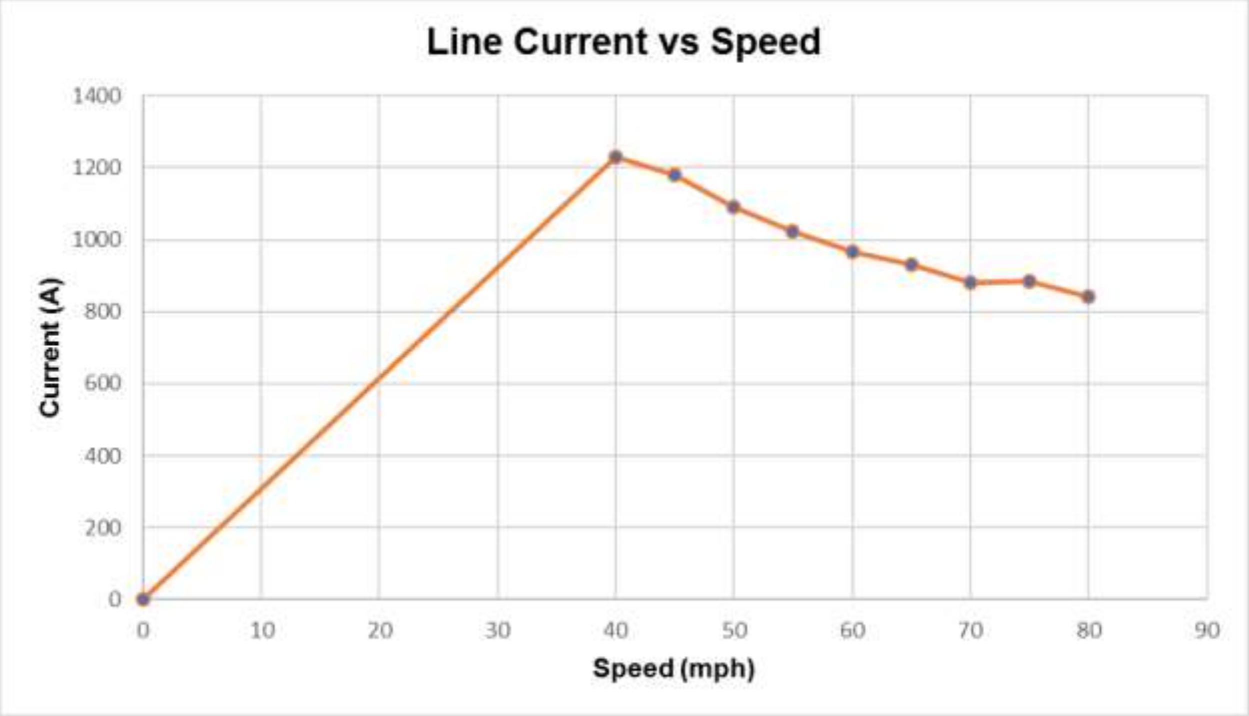


Figure 4-2 BART Vehicle Current vs. Speed Profile (AW2, 1000V)

Below are train schedules for each BART service train line for both Northbound and Southbound directions.

Dublin/Pleasanton - Daly City

Train	L30-2	L20-2	L10-2	A50-2	A40-2	A30-2	A20-2	A10-2	M10-1	M16-1	M20-1	M30-1	M40-1	M50-1	M60-1	M70-1	M80-1	M90-1
B001	5:58:57	6:01:07	6:09:08	6:12:51	6:15:49	6:19:05	6:21:42	6:24:49	6:29:08	6:34:58	6:36:19	6:37:48	6:39:06	6:41:10	6:42:57	6:45:34	6:47:40	6:51:47
B002	6:10:57	6:13:07	6:21:08	6:24:51	6:27:49	6:31:05	6:33:42	6:36:49	6:41:08	6:46:58	6:48:19	6:49:48	6:51:06	6:53:10	6:54:57	6:57:34	6:59:40	7:03:47
B003	6:22:57	6:25:07	6:33:08	6:36:51	6:39:49	6:43:05	6:45:42	6:48:49	6:53:08	6:58:58	7:00:19	7:01:48	7:03:06	7:05:10	7:06:57	7:09:34	7:11:40	7:15:47
B004	6:34:57	6:37:07	6:45:08	6:48:51	6:51:49	6:55:05	6:57:42	7:00:49	7:05:08	7:10:58	7:12:19	7:13:48	7:15:06	7:17:10	7:18:57	7:21:34	7:23:40	7:27:47
B005	6:46:57	6:49:07	6:57:08	7:00:51	7:03:49	7:07:05	7:09:42	7:12:49	7:17:08	7:22:58	7:24:19	7:25:48	7:27:06	7:29:10	7:30:57	7:33:34	7:35:40	7:39:47
B006	6:58:57	7:01:07	7:09:08	7:12:51	7:15:49	7:19:05	7:21:42	7:24:49	7:29:08	7:35:02	7:36:24	7:37:53	7:39:10	7:41:14	7:43:01	7:45:39	7:47:44	7:51:47
B007	7:10:57	7:13:07	7:21:08	7:24:51	7:27:49	7:31:05	7:33:42	7:36:49	7:41:08	7:47:02	7:48:24	7:49:53	7:51:10	7:53:14	7:55:01	7:57:39	7:59:44	8:03:47
B008	7:22:57	7:25:07	7:33:08	7:36:51	7:39:49	7:43:05	7:45:42	7:48:49	7:53:08	7:59:03	8:00:24	8:01:53	8:03:11	8:05:15	8:07:02	8:09:39	8:11:45	8:15:47
B009	7:34:57	7:37:07	7:45:08	7:48:51	7:51:49	7:55:05	7:57:42	8:00:49	8:05:08	8:11:03	8:12:24	8:13:53	8:15:11	8:17:15	8:19:02	8:21:39	8:23:45	8:27:47
B010	7:46:57	7:49:07	7:57:08	8:00:51	8:03:49	8:07:05	8:09:42	8:12:49	8:17:08	8:23:03	8:24:24	8:25:53	8:27:11	8:29:15	8:31:02	8:33:39	8:35:45	8:39:47
B011	7:58:57	8:01:07	8:09:08	8:12:51	8:15:49	8:19:05	8:21:42	8:24:49	8:29:08	8:35:02	8:36:24	8:37:53	8:39:10	8:41:14	8:43:01	8:45:39	8:47:44	8:51:47
B012	8:10:57	8:13:07	8:21:08	8:24:51	8:27:49	8:31:05	8:33:42	8:36:49	8:41:08	8:47:02	8:48:24	8:49:53	8:51:10	8:53:14	8:55:01	8:57:39	8:59:44	9:03:47
B013	8:22:57	8:25:07	8:33:08	8:36:51	8:39:49	8:43:05	8:45:42	8:48:49	8:53:08	8:59:02	9:00:24	9:01:53	9:03:10	9:05:14	9:07:01	9:09:39	9:11:44	9:15:47
B014	8:34:57	8:37:07	8:45:08	8:48:51	8:51:49	8:55:05	8:57:42	9:00:49	9:05:08	9:11:03	9:12:24	9:13:53	9:15:11	9:17:15	9:19:02	9:21:39	9:23:45	9:27:47

Table 4-1 – Blue Line Dublin/Pleasanton to Daly City

Daly City - Dublin/Pleasanton

Train	M90-1	M80-2	M70-2	M60-2	M50-2	M40-2	M30-2	M20-2	M16-2	M10-2	A10-1	A20-1	A30-1	A40-1	A50-1	L10-1	L20-1	L30-1
BR001	5:59:37	6:03:00	6:05:06	6:07:27	6:09:08	6:11:06	6:12:26	6:13:47	6:15:11	6:21:08	6:24:51	6:28:03	6:30:40	6:33:56	6:37:07	6:41:14	6:49:10	6:51:20
BR002	6:11:37	6:15:00	6:17:06	6:19:27	6:21:08	6:23:06	6:24:26	6:25:48	6:27:12	6:33:09	6:36:52	6:40:04	6:42:41	6:45:57	6:49:08	6:53:15	7:01:11	7:03:24
BR003	6:23:37	6:27:00	6:29:06	6:31:27	6:33:08	6:35:06	6:36:26	6:37:48	6:39:12	6:45:09	6:48:52	6:52:04	6:54:41	6:57:57	7:01:08	7:05:15	7:13:11	7:15:24
BR004	6:35:37	6:39:00	6:41:06	6:43:27	6:45:08	6:47:06	6:48:26	6:49:48	6:51:12	6:57:09	7:00:52	7:04:04	7:06:41	7:09:57	7:13:08	7:17:15	7:25:11	7:27:24
BR005	6:47:37	6:51:00	6:53:06	6:55:27	6:57:08	6:59:06	7:00:26	7:01:48	7:03:12	7:09:09	7:12:52	7:16:04	7:18:41	7:21:57	7:25:08	7:29:15	7:37:11	7:39:24
BR006	6:59:37	7:03:00	7:05:06	7:07:27	7:09:08	7:11:06	7:12:26	7:13:48	7:15:12	7:21:09	7:24:52	7:28:04	7:30:41	7:33:57	7:37:08	7:41:15	7:49:11	7:51:24
BR007	7:11:37	7:15:00	7:17:06	7:19:27	7:21:08	7:23:06	7:24:26	7:25:48	7:27:12	7:33:09	7:36:52	7:40:04	7:42:41	7:45:57	7:49:08	7:53:15	8:01:11	8:03:24
BR008	7:23:37	7:27:00	7:29:06	7:31:27	7:33:08	7:35:06	7:36:26	7:37:48	7:39:12	7:45:09	7:48:52	7:52:04	7:54:41	7:57:57	8:01:08	8:05:15	8:13:11	8:15:24
BR009	7:35:37	7:39:00	7:41:06	7:43:27	7:45:08	7:47:06	7:48:26	7:49:48	7:51:12	7:57:09	8:00:52	8:04:04	8:06:41	8:09:57	8:13:08	8:17:15	8:25:11	8:27:24
BR010	7:47:37	7:51:00	7:53:06	7:55:27	7:57:08	7:59:06	8:00:26	8:01:48	8:03:12	8:09:09	8:12:52	8:16:04	8:18:41	8:21:57	8:25:08	8:29:15	8:37:11	8:39:24
BR011	7:59:37	8:03:00	8:05:06	8:07:27	8:09:08	8:11:06	8:12:26	8:13:48	8:15:12	8:21:09	8:24:52	8:28:04	8:30:41	8:33:57	8:37:08	8:41:15	8:49:11	8:51:24
BR012	8:11:37	8:15:00	8:17:06	8:19:27	8:21:08	8:23:06	8:24:26	8:25:48	8:27:12	8:33:09	8:36:52	8:40:04	8:42:41	8:45:57	8:49:08	8:53:15	9:01:11	9:03:24
BR013	8:23:37	8:27:00	8:29:06	8:31:27	8:33:08	8:35:06	8:36:26	8:37:48	8:39:12	8:45:09	8:48:52	8:52:04	8:54:41	8:57:57	9:01:08	9:05:15	9:13:11	9:15:24
BR014	8:35:37	8:39:00	8:41:06	8:43:27	8:45:08	8:47:06	8:48:26	8:49:48	8:51:12	8:57:09	9:00:52	9:04:04	9:06:41	9:09:57	9:13:08	9:17:15	9:25:11	9:27:24

Table 4-2 – Blue Line Daly City to Dublin/Pleasanton

Warm Springs - Daly City

Train	S20-2	A90-2	A80-2	A70-2	A60-2	A50-2	A40-2	A30-2	A20-2	A10-2	M10-1	M16-1	M20-1	M30-1	M40-1	M50-1	M60-1	M70-1	M80-1	M90-1
G001	5:54:40	5:59:12	6:02:38	6:06:33	6:09:49	6:14:17	6:17:29	6:20:51	6:23:28	6:26:41	6:31:00	6:36:50	6:38:11	6:39:40	6:40:58	6:43:02	6:44:49	6:47:26	6:49:32	6:53:15
G002	6:06:40	6:11:12	6:14:38	6:18:33	6:21:49	6:26:17	6:29:29	6:32:51	6:35:28	6:38:41	6:43:00	6:48:50	6:50:11	6:51:40	6:52:58	6:55:02	6:56:49	6:59:26	7:01:32	7:05:15
G003	6:18:40	6:23:12	6:26:38	6:30:33	6:33:49	6:38:17	6:41:29	6:44:51	6:47:28	6:50:41	6:55:00	7:00:50	7:02:11	7:03:40	7:04:58	7:07:02	7:08:49	7:11:26	7:13:32	7:17:15
G004	6:30:40	6:35:12	6:38:38	6:42:33	6:45:49	6:50:17	6:53:29	6:56:51	6:59:28	7:02:41	7:07:00	7:12:50	7:14:11	7:15:40	7:16:58	7:19:02	7:20:49	7:23:26	7:25:32	7:29:15
G005	6:42:40	6:47:12	6:50:38	6:54:33	6:57:49	7:02:17	7:05:29	7:08:51	7:11:28	7:14:41	7:19:00	7:24:50	7:26:11	7:27:40	7:28:58	7:31:02	7:32:49	7:35:26	7:37:32	7:41:15
G006	6:54:40	6:59:12	7:02:38	7:06:33	7:09:49	7:14:17	7:17:29	7:20:51	7:23:28	7:26:41	7:31:00	7:36:50	7:38:11	7:39:40	7:40:58	7:43:02	7:44:49	7:47:26	7:49:32	7:53:15
G007	7:06:40	7:11:12	7:14:38	7:18:33	7:21:49	7:26:17	7:29:29	7:32:51	7:35:28	7:38:41	7:43:00	7:48:50	7:50:11	7:51:40	7:52:58	7:55:02	7:56:49	7:59:26	8:01:32	8:05:15
G008	7:18:40	7:23:12	7:26:38	7:30:33	7:33:49	7:38:17	7:41:29	7:44:51	7:47:28	7:50:41	7:55:00	8:00:50	8:02:11	8:03:40	8:04:58	8:07:02	8:08:49	8:11:26	8:13:32	8:17:15
G009	7:30:40	7:35:12	7:38:38	7:42:33	7:45:49	7:50:17	7:53:29	7:56:51	7:59:28	8:02:41	8:07:00	8:12:50	8:14:11	8:15:40	8:16:58	8:19:02	8:20:49	8:23:26	8:25:32	8:29:15
G010	7:42:40	7:47:12	7:50:38	7:54:33	7:57:49	8:02:17	8:05:29	8:08:51	8:11:28	8:14:41	8:19:00	8:24:50	8:26:11	8:27:40	8:28:58	8:31:02	8:32:49	8:35:26	8:37:32	8:41:15
G011	7:54:40	7:59:12	8:02:38	8:06:33	8:09:49	8:14:17	8:17:29	8:20:51	8:23:28	8:26:41	8:31:00	8:36:50	8:38:11	8:39:40	8:40:58	8:43:02	8:44:49	8:47:26	8:49:32	8:53:15
G022	8:06:40	8:11:12	8:14:38	8:18:33	8:21:49	8:26:17	8:29:29	8:32:51	8:35:28	8:38:41	8:43:00	8:48:50	8:50:11	8:51:40	8:52:58	8:55:02	8:56:49	8:59:26	9:01:32	9:05:15
G023	8:18:40	8:23:12	8:26:38	8:30:33	8:33:49	8:38:17	8:41:29	8:44:51	8:47:28	8:50:41	8:55:00	9:00:50	9:02:11	9:03:40	9:04:58	9:07:02	9:08:49	9:11:26	9:13:32	9:17:15
G014	8:30:40	8:35:12	8:38:38	8:42:33	8:45:49	8:50:17	8:53:29	8:56:51	8:59:28	9:02:41	9:07:00	9:12:50	9:14:11	9:15:40	9:16:58	9:19:02	9:20:49	9:23:26	9:25:32	9:29:15
G015	8:42:40	8:47:12	8:50:38	8:54:33	8:57:49	9:01:09	9:04:08	9:07:24	9:10:00	9:13:08	9:17:27	9:23:16	9:24:37	9:26:06	9:27:24	9:29:28	9:31:15	9:33:52	9:35:58	9:39:45
G016	8:54:40	8:59:12	9:02:38	9:06:33	9:09:49	9:13:09	9:16:08	9:19:24	9:22:00	9:25:08	9:29:27	9:35:16	9:36:37	9:38:06	9:39:24	9:41:28	9:43:15	9:45:52	9:47:58	9:51:45
G017	9:06:40	9:11:12	9:14:38	9:18:33	9:21:49	9:25:09	9:28:08	9:31:24	9:34:00	9:37:08	9:41:27	9:47:16	9:48:38	9:50:07	9:51:24	9:53:28	9:55:15	9:57:53	9:59:58	
G018	9:18:40	9:23:12	9:26:38	9:30:33	9:33:49	9:37:09	9:40:08	9:43:24	9:46:00	9:49:08	9:53:27	9:59:16								
G019	9:30:40	9:35:12	9:38:38	9:42:33	9:45:49	9:49:09	9:52:08	9:55:24	9:58:00											
G020	9:42:40	9:47:12	9:50:38	9:54:33	9:57:49															
G021	9:54:40	9:59:12																		

Table 4-3 – Green Line Warm Springs to Daly City

Daly City - Warm Springs																				
Train	M90-1	M80-2	M70-2	M60-2	M50-2	M40-2	M30-2	M20-2	M16-2	M10-2	A10-1	A20-1	A30-1	A40-1	A50-1	A60-1	A70-1	A80-1	A90-1	S20-1
GR001	6:01:37	6:05:00	6:07:06	6:09:27	6:11:08	6:13:06	6:14:26	6:15:48	6:17:12	6:23:09	6:26:52	6:30:04	6:32:41	6:35:57	6:39:09	6:42:21	6:45:37	6:49:33	6:53:00	6:57:35
GR002	6:13:37	6:17:00	6:19:06	6:21:27	6:23:08	6:25:06	6:26:26	6:27:48	6:29:12	6:35:09	6:38:52	6:42:04	6:44:41	6:47:57	6:51:10	6:54:22	6:57:38	7:01:34	7:05:01	7:09:36
GR003	6:25:37	6:29:00	6:31:06	6:33:27	6:35:08	6:37:06	6:38:26	6:39:48	6:41:12	6:47:09	6:50:52	6:54:04	6:56:41	6:59:57	7:03:10	7:06:22	7:09:38	7:13:34	7:17:01	7:21:36
GR004	6:37:37	6:41:00	6:43:06	6:45:27	6:47:08	6:49:06	6:50:26	6:51:48	6:53:12	6:59:09	7:02:52	7:06:05	7:08:41	7:11:57	7:15:10	7:18:21	7:21:38	7:25:33	7:29:00	7:33:36
GR005	6:49:37	6:53:00	6:55:06	6:57:27	6:59:08	7:01:06	7:02:26	7:03:48	7:05:12	7:11:09	7:14:52	7:18:05	7:20:41	7:23:57	7:27:10	7:30:21	7:33:38	7:37:33	7:41:00	7:45:36
GR006	7:01:37	7:05:00	7:07:06	7:09:27	7:11:08	7:13:06	7:14:26	7:15:48	7:17:12	7:23:09	7:26:52	7:30:05	7:32:41	7:35:57	7:39:10	7:42:21	7:45:38	7:49:33	7:53:00	7:57:36
GR007	7:13:37	7:17:00	7:19:06	7:21:27	7:23:08	7:25:06	7:26:26	7:27:48	7:29:12	7:35:09	7:38:52	7:42:04	7:44:41	7:47:57	7:51:10	7:54:22	7:57:38	8:01:34	8:05:01	8:09:36
GR008	7:25:37	7:29:00	7:31:06	7:33:27	7:35:08	7:37:06	7:38:26	7:39:48	7:41:12	7:47:09	7:50:52	7:54:04	7:56:41	7:59:57	8:03:10	8:06:22	8:09:38	8:13:34	8:17:01	8:21:36
GR009	7:37:37	7:41:00	7:43:06	7:45:27	7:47:08	7:49:06	7:50:26	7:51:48	7:53:12	7:59:09	8:02:52	8:06:04	8:08:41	8:11:57	8:15:10	8:18:22	8:21:38	8:25:34	8:29:01	8:33:36
GR010	7:49:37	7:53:00	7:55:06	7:57:27	7:59:08	8:01:06	8:02:26	8:03:48	8:05:12	8:11:09	8:14:52	8:18:05	8:20:41	8:23:57	8:27:10	8:30:21	8:33:38	8:37:33	8:41:00	8:45:36
GR011	8:01:37	8:05:00	8:07:06	8:09:27	8:11:08	8:13:06	8:14:26	8:15:48	8:17:12	8:23:09	8:26:52	8:30:05	8:32:41	8:35:57	8:39:10	8:42:21	8:45:38	8:49:33	8:53:00	8:57:36
GR022	8:13:37	8:17:00	8:19:06	8:21:27	8:23:08	8:25:06	8:26:26	8:27:48	8:29:12	8:35:09	8:38:52	8:42:05	8:44:41	8:47:57	8:51:10	8:54:21	8:57:38	9:01:33	9:05:00	9:09:35
GR033	8:25:37	8:29:00	8:31:06	8:33:27	8:35:08	8:37:06	8:38:26	8:39:48	8:41:12	8:47:09	8:50:52	8:54:04	8:56:41	8:59:57	9:03:10	9:06:22	9:09:38	9:13:34	9:17:01	9:21:36
GR014	8:37:37	8:41:00	8:43:06	8:45:27	8:47:08	8:49:06	8:50:26	8:51:48	8:53:12	8:59:09	9:02:52	9:06:04	9:08:41	9:11:57	9:15:10	9:18:22	9:21:38	9:25:34	9:29:01	9:33:36
GR015	8:49:37	8:53:00	8:55:06	8:57:27	8:59:08	9:01:06	9:02:26	9:03:47	9:05:11	9:11:08	9:14:51	9:18:04	9:20:40	9:23:56	9:27:05	9:30:17	9:33:33	9:37:29	9:40:56	9:45:31
GR016	9:01:37	9:05:00	9:07:06	9:09:27	9:11:08	9:13:06	9:14:26	9:15:47	9:17:11	9:23:08	9:26:51	9:30:04	9:32:40	9:35:56	9:39:05	9:42:17	9:45:33	9:49:29	9:52:56	9:57:31
GR017	9:13:37	9:17:00	9:19:06	9:21:27	9:23:08	9:25:06	9:26:26	9:27:47	9:29:11	9:35:08	9:38:51	9:42:04	9:44:40	9:47:56	9:51:05	9:54:17	9:57:33			
GR018	9:25:37	9:29:00	9:31:06	9:33:27	9:35:08	9:37:06	9:38:26	9:39:47	9:41:11	9:47:08	9:50:51	9:54:04	9:56:40	9:59:56						
GR019	9:37:37	9:41:00	9:43:06	9:45:27	9:47:08	9:49:06	9:50:26	9:51:47	9:53:11	9:59:08										
GR020	9:49:37	9:53:00	9:55:06	9:57:27	9:59:08															

Table 4-4 – Green Line Daly City to Warm Springs

Richmond - Warm Springs																			
Train	R60-2	R50-2	R40-2	R30-2	R20-2	R10-2	K30-2	K20-2	K10-2	A10-1	A20-1	A30-1	A40-1	A50-1	A60-1	A70-1	A80-1	A90-1	S20-1
O001	6:05:58	6:08:41	6:11:05	6:13:54	6:16:05	6:18:17	6:21:15	6:24:21	6:25:35	6:28:07	6:31:39	6:34:27	6:37:44	6:40:58	6:44:11	6:47:28	6:51:24	6:54:51	6:59:33
O0012	6:17:58	6:20:41	6:23:05	6:25:54	6:28:05	6:30:17	6:33:15	6:36:21	6:37:35	6:40:07	6:43:39	6:46:27	6:49:44	6:52:58	6:56:13	6:59:29	7:03:25	7:06:52	7:11:34
O003	6:29:58	6:32:41	6:35:05	6:37:54	6:40:05	6:42:17	6:45:15	6:48:21	6:49:35	6:52:07	6:55:39	6:58:27	7:01:44	7:04:58	7:08:13	7:11:29	7:15:25	7:18:52	7:23:34
O004	6:41:58	6:44:41	6:47:05	6:49:54	6:52:05	6:54:17	6:57:15	7:00:21	7:01:35	7:04:07	7:07:39	7:10:27	7:13:44	7:16:59	7:20:13	7:23:30	7:27:25	7:30:52	7:35:34
O005	6:53:58	6:56:41	6:59:05	7:01:54	7:04:05	7:06:17	7:09:15	7:12:21	7:13:35	7:16:07	7:19:39	7:22:27	7:25:44	7:28:59	7:32:13	7:35:30	7:39:25	7:42:52	7:47:34
O006	7:05:58	7:08:41	7:11:05	7:13:54	7:16:05	7:18:17	7:21:15	7:24:21	7:25:35	7:28:07	7:31:39	7:34:27	7:37:44	7:40:59	7:44:13	7:47:30	7:51:25	7:54:52	7:59:34
O007	7:17:58	7:20:41	7:23:05	7:25:54	7:28:05	7:30:17	7:33:15	7:36:21	7:37:35	7:40:07	7:43:39	7:46:27	7:49:44	7:52:58	7:56:13	7:59:29	8:03:25	8:06:52	8:11:34
O008	7:29:58	7:32:41	7:35:05	7:37:54	7:40:05	7:42:17	7:45:15	7:48:21	7:49:35	7:52:07	7:55:39	7:58:27	8:01:44	8:04:58	8:08:13	8:11:29	8:15:25	8:18:52	8:23:34
O009	7:41:58	7:44:41	7:47:05	7:49:54	7:52:05	7:54:17	7:57:15	8:00:21	8:01:35	8:04:07	8:07:39	8:10:27	8:13:44	8:16:58	8:20:13	8:23:29	8:27:25	8:30:52	8:35:34
O010	7:53:58	7:56:41	7:59:05	8:01:54	8:04:05	8:06:17	8:09:15	8:12:21	8:13:35	8:16:07	8:19:39	8:22:27	8:25:44	8:28:59	8:32:13	8:35:30	8:39:25	8:42:52	8:47:34
O011	8:05:58	8:08:41	8:11:05	8:13:54	8:16:05	8:18:17	8:21:15	8:24:21	8:25:35	8:28:07	8:31:39	8:34:27	8:37:44	8:40:59	8:44:13	8:47:30	8:51:25	8:54:52	8:59:34
O012	8:17:58	8:20:41	8:23:05	8:25:54	8:28:05	8:30:17	8:33:15	8:36:21	8:37:35	8:40:07	8:43:39	8:46:27	8:49:44	8:52:59	8:56:13	8:59:30	9:03:25	9:06:52	9:11:34
O013	8:29:58	8:32:41	8:35:05	8:37:54	8:40:05	8:42:17	8:45:15	8:48:21	8:49:35	8:52:07	8:55:39	8:58:27	9:01:44	9:04:58	9:08:13	9:11:29	9:15:25	9:18:52	9:23:34
O014	8:41:58	8:44:41	8:47:05	8:49:54	8:52:05	8:54:17	8:57:15	9:00:21	9:01:35	9:04:07	9:07:39	9:10:27	9:13:44	9:16:58	9:20:13	9:23:29	9:27:25	9:30:52	9:35:34
O015	8:53:58	8:56:41	8:59:05	9:01:54	9:04:05	9:06:17	9:09:15	9:12:21	9:13:35	9:16:07	9:19:39	9:22:27	9:25:44	9:28:57	9:32:09	9:35:26	9:39:21	9:42:48	9:47:30
O016	9:05:58	9:08:41	9:11:05	9:13:54	9:16:05	9:18:17	9:21:15	9:24:21	9:25:35	9:28:07	9:31:39	9:34:27	9:37:44	9:40:57	9:44:09	9:47:26	9:51:21	9:54:48	9:59:30

Table 4-5 – Orange Line Richmond to Warm Springs

Warm Springs - Richmond																			
Train	S20-2	A90-2	A80-2	A70-2	A60-2	A50-2	A40-2	A30-2	A20-2	A10-2	K10-1	K20-1	K30-1	R10-1	R20-1	R30-1	R40-1	R50-1	R60-1
OR001	6:00:12	6:05:00	6:08:26	6:12:21	6:15:37	6:18:57	6:21:56	6:25:12	6:27:48	6:30:56	6:33:34	6:34:53	6:38:03	6:40:56	6:43:07	6:45:18	6:48:10	6:50:33	6:53:39
OR002	6:12:12	6:17:00	6:20:26	6:24:21	6:27:37	6:30:57	6:33:56	6:37:12	6:39:48	6:42:56	6:45:34	6:46:53	6:50:03	6:52:56	6:55:07	6:57:18	7:00:10	7:02:33	7:05:39
OR003	6:24:12	6:29:00	6:32:26	6:36:21	6:39:37	6:42:57	6:45:56	6:49:12	6:51:48	6:54:56	6:57:34	6:58:53	7:02:03	7:04:56	7:07:07	7:09:18	7:12:10	7:14:33	7:17:39
OR004	6:36:12	6:41:00	6:44:27	6:48:21	6:51:37	6:54:58	6:57:56	7:01:12	7:03:49	7:06:56	7:09:35	7:10:54	7:14:03	7:16:57	7:19:07	7:21:19	7:24:10	7:26:34	7:29:40
OR005	6:48:12	6:53:00	6:56:26	7:00:21	7:03:37	7:06:57	7:09:56	7:13:12	7:15:48	7:18:56	7:21:34	7:22:53	7:26:03	7:28:56	7:31:07	7:33:18	7:36:10	7:38:33	7:41:39
OR006	7:00:12	7:05:00	7:08:26	7:12:21	7:15:37	7:18:57	7:21:56	7:25:12	7:27:48	7:30:56	7:33:34	7:34:53	7:38:03	7:40:56	7:43:07	7:45:18	7:48:10	7:50:33	7:53:39
OR007	7:12:12	7:17:00	7:20:26	7:24:21	7:27:37	7:30:57	7:33:56	7:37:12	7:39:48	7:42:56	7:45:34	7:46:53	7:50:03	7:52:56	7:55:07	7:57:18	8:00:10	8:02:33	8:05:39
OR008	7:24:12	7:29:00	7:32:26	7:36:21	7:39:37	7:42:57	7:45:56	7:49:12	7:51:48	7:54:56	7:57:34	7:58:53	8:02:03	8:04:56	8:07:07	8:09:18	8:12:10	8:14:33	8:17:39
OR009	7:36:12	7:41:00	7:44:26	7:48:21	7:51:37	7:54:57	7:57:56	8:01:12	8:03:48	8:06:56	8:09:34	8:10:53	8:14:03	8:16:56	8:19:07	8:21:18	8:24:10	8:26:33	8:29:39
OR010	7:48:12	7:53:00	7:56:26	8:00:21	8:03:37	8:06:57	8:09:56	8:13:12	8:15:48	8:18:56	8:21:34	8:22:53	8:26:03	8:28:56	8:31:07	8:33:18	8:36:10	8:38:33	8:41:39
OR011	8:00:12	8:05:00	8:08:26	8:12:21	8:15:37	8:18:57	8:21:56	8:25:12	8:27:48	8:30:56	8:33:34	8:34:53	8:38:03	8:40:56	8:43:07	8:45:18	8:48:10	8:50:33	8:53:39
OR016	8:01:09	8:06:23	8:09:59	8:14:04	8:17:20	8:20:42	8:23:44	8:27:00	8:29:36	8:32:49	8:35:28	8:36:47	8:39:56	8:42:50	8:45:00	8:47:12	8:50:03	8:52:27	8:55:34
OR012	8:12:12	8:17:00	8:20:26	8:24:21	8:27:37	8:30:57	8:33:56	8:37:12	8:39:48	8:42:56	8:45:34	8:46:53	8:50:03	8:52:56	8:55:07	8:57:18	9:00:10	9:02:33	9:05:39
OR013	8:24:12	8:29:00	8:32:26	8:36:21	8:39:37	8:42:57	8:45:56	8:49:12	8:51:48	8:54:56	8:57:34	8:58:53	9:02:03	9:04:56	9:07:07	9:09:18	9:12:10	9:14:33	9:17:39
OR014	8:36:12	8:41:00	8:44:26	8:48:21	8:51:37	8:54:57	8:57:56	9:01:12	9:03:48	9:06:56	9:09:34	9:10:53	9:14:03	9:16:56	9:19:07	9:21:18	9:24:10	9:26:33	9:29:39
OR015	8:48:12	8:53:00	8:56:26	9:00:21	9:03:37	9:06:57	9:09:56	9:13:12	9:15:48	9:18:56	9:21:34	9:22:53	9:26:03	9:28:56	9:31:07	9:33:18	9:36:10	9:38:33	9:41:39

Table 4-6 – Orange Line Warm Springs to Richmond

Richmond - Millbrae

Train	R60-2	R50-2	R40-2	R30-2	R20-2	R10-2	K30-2	K20-2	K10-2	M10-1	M16-1	M20-1	M30-1	M40-1	M50-1	M60-1	M70-1	M80-1	M90-3	W10-1	W20-1	W30-1	W40-3
R001	5:59:42	6:02:41	6:05:05	6:07:54	6:10:05	6:12:17	6:15:15	6:18:21	6:19:34	6:23:35	6:29:24	6:30:46	6:32:15	6:33:32	6:35:36	6:37:23	6:40:01	6:42:06	6:45:37	6:49:24	6:52:04	6:54:59	6:58:51
R002	6:11:42	6:14:41	6:17:05	6:19:54	6:22:05	6:24:17	6:27:15	6:30:21	6:31:34	6:35:35	6:41:24	6:42:46	6:44:15	6:45:32	6:47:36	6:49:23	6:52:01	6:54:06	6:57:37	7:01:24	7:04:04	7:06:59	7:10:51
R003	6:23:42	6:26:41	6:29:05	6:31:54	6:34:05	6:36:17	6:39:15	6:42:21	6:43:34	6:47:35	6:53:24	6:54:46	6:56:15	6:57:32	6:59:36	7:01:23	7:04:01	7:06:06	7:09:37	7:13:24	7:16:04	7:18:59	7:22:51
R004	6:35:42	6:38:41	6:41:05	6:43:54	6:46:05	6:48:17	6:51:15	6:54:21	6:55:34	6:59:35	7:05:24	7:06:46	7:08:15	7:09:32	7:11:36	7:13:23	7:16:01	7:18:06	7:21:37	7:25:24	7:28:04	7:30:59	7:34:51
R005	6:47:42	6:50:41	6:53:05	6:55:54	6:58:05	7:00:17	7:03:15	7:06:21	7:07:34	7:11:35	7:17:24	7:18:46	7:20:15	7:21:32	7:23:36	7:25:23	7:28:01	7:30:06	7:33:37	7:37:24	7:40:04	7:42:59	7:46:51
R006	6:59:42	7:02:41	7:05:05	7:07:54	7:10:05	7:12:17	7:15:15	7:18:21	7:19:34	7:23:35	7:29:24	7:30:46	7:32:15	7:33:32	7:35:36	7:37:23	7:40:01	7:42:06	7:45:37	7:49:24	7:52:04	7:54:59	7:58:51
R007	7:11:42	7:14:41	7:17:05	7:19:54	7:22:05	7:24:17	7:27:15	7:30:21	7:31:34	7:35:35	7:41:24	7:42:46	7:44:15	7:45:32	7:47:36	7:49:23	7:52:01	7:54:06	7:57:37	8:01:24	8:04:04	8:06:59	8:10:51
R008	7:23:42	7:26:41	7:29:05	7:31:54	7:34:05	7:36:17	7:39:15	7:42:21	7:43:34	7:47:35	7:53:24	7:54:46	7:56:15	7:57:32	7:59:36	8:01:23	8:04:01	8:06:06	8:09:37	8:13:24	8:16:04	8:18:59	8:22:51
R009	7:35:42	7:38:41	7:41:05	7:43:54	7:46:05	7:48:17	7:51:15	7:54:21	7:55:34	7:59:35	8:05:24	8:06:46	8:08:15	8:09:32	8:11:36	8:13:23	8:16:01	8:18:06	8:21:37	8:25:24	8:28:04	8:30:59	8:34:51
R010	7:47:42	7:50:41	7:53:05	7:55:54	7:58:05	8:00:17	8:03:15	8:06:21	8:07:34	8:11:35	8:17:24	8:18:46	8:20:15	8:21:32	8:23:36	8:25:23	8:28:01	8:30:06	8:33:37	8:37:24	8:40:04	8:42:59	8:46:51
R011	7:59:42	8:02:41	8:05:05	8:07:54	8:10:05	8:12:17	8:15:15	8:18:21	8:19:34	8:23:35	8:29:24	8:30:46	8:32:15	8:33:32	8:35:36	8:37:23	8:40:01	8:42:06	8:45:37	8:49:24	8:52:04	8:54:59	8:58:51
R012	8:11:42	8:14:41	8:17:05	8:19:54	8:22:05	8:24:17	8:27:15	8:30:21	8:31:34	8:35:35	8:41:24	8:42:46	8:44:15	8:45:32	8:47:36	8:49:23	8:52:01	8:54:06	8:57:37	9:01:24	9:04:04	9:06:59	9:10:51
R013	8:23:42	8:26:41	8:29:05	8:31:54	8:34:05	8:36:17	8:39:15	8:42:21	8:43:34	8:47:35	8:53:24	8:54:46	8:56:15	8:57:32	8:59:36	9:01:23	9:04:01	9:06:06	9:09:37	9:13:24	9:16:04	9:18:59	9:22:51
R014	8:35:42	8:38:41	8:41:05	8:43:54	8:46:05	8:48:17	8:51:15	8:54:21	8:55:34	8:59:35	9:05:24	9:06:46	9:08:15	9:09:32	9:11:36	9:13:23	9:16:01	9:18:06	9:21:37	9:25:24	9:28:04	9:30:59	9:34:51

Table 4-7 – Red Line Richmond to Millbrae

Millbrae - Richmond

Train	W40-2	W30-2	W20-2	W10-2	M90-2	M80-2	M70-2	M60-2	M50-2	M40-2	M30-2	M20-2	M16-2	M10-2	K10-1	K20-1	K30-1	R10-1	R20-1	R30-1	R40-1	R50-1	R60-1
RR000	5:53:14	5:56:55	5:59:50	6:02:29	6:05:25	6:08:59	6:11:05	6:13:26	6:15:07	6:17:05	6:18:25	6:19:47	6:21:11	6:27:08	6:30:37	6:31:56	6:35:05	6:37:59	6:40:09	6:42:21	6:45:12	6:47:36	6:50:37
RR001	6:05:14	6:08:55	6:11:50	6:14:29	6:17:25	6:20:59	6:23:05	6:25:26	6:27:07	6:29:05	6:30:25	6:31:47	6:33:11	6:39:08	6:42:37	6:43:56	6:47:05	6:49:59	6:52:09	6:54:21	6:57:12	6:59:36	7:02:42
RR002	6:17:14	6:20:55	6:23:50	6:26:29	6:29:25	6:32:59	6:35:05	6:37:26	6:39:07	6:41:05	6:42:25	6:43:47	6:45:11	6:51:08	6:54:37	6:55:56	6:59:05	7:01:59	7:04:09	7:06:21	7:09:12	7:11:36	7:14:42
RR003	6:29:14	6:32:55	6:35:50	6:38:29	6:41:25	6:44:59	6:47:05	6:49:26	6:51:07	6:53:05	6:54:25	6:55:47	6:57:11	7:03:08	7:06:37	7:07:56	7:11:05	7:13:59	7:16:09	7:18:21	7:21:12	7:23:36	7:26:42
RR004	6:41:14	6:44:55	6:47:50	6:50:29	6:53:25	6:56:59	6:59:05	7:01:26	7:03:07	7:05:05	7:06:25	7:07:47	7:09:11	7:15:08	7:18:37	7:19:56	7:23:05	7:25:59	7:28:09	7:30:21	7:33:12	7:35:36	7:38:42
RR005	6:53:14	6:56:55	6:59:50	7:02:29	7:05:25	7:08:59	7:11:05	7:13:26	7:15:07	7:17:05	7:18:25	7:19:47	7:21:11	7:27:08	7:30:37	7:31:56	7:35:05	7:37:59	7:40:09	7:42:21	7:45:12	7:47:36	7:50:42
RR006	7:05:14	7:08:55	7:11:50	7:14:29	7:17:25	7:20:59	7:23:05	7:25:26	7:27:07	7:29:05	7:30:25	7:31:47	7:33:11	7:39:08	7:42:37	7:43:56	7:47:05	7:49:59	7:52:09	7:54:21	7:57:12	7:59:36	8:02:42
RR007	7:17:14	7:20:55	7:23:50	7:26:29	7:29:25	7:32:59	7:35:05	7:37:26	7:39:07	7:41:05	7:42:25	7:43:47	7:45:11	7:51:08	7:54:37	7:55:56	7:59:05	8:01:59	8:04:09	8:06:21	8:09:12	8:11:36	8:14:42
RR008	7:29:14	7:32:55	7:35:50	7:38:29	7:41:25	7:44:59	7:47:05	7:49:26	7:51:07	7:53:05	7:54:25	7:55:47	7:57:11	8:03:08	8:06:37	8:07:56	8:11:05	8:13:59	8:16:09	8:18:21	8:21:12	8:23:36	8:26:42
RR009	7:41:14	7:44:55	7:47:50	7:50:29	7:53:25	7:56:59	7:59:05	8:01:26	8:03:07	8:05:05	8:06:25	8:07:47	8:09:11	8:15:08	8:18:37	8:19:56	8:23:05	8:25:59	8:28:09	8:30:21	8:33:12	8:35:36	8:38:42
RR010	7:53:14	7:56:55	7:59:50	8:02:29	8:05:25	8:08:59	8:11:05	8:13:26	8:15:07	8:17:05	8:18:25	8:19:47	8:21:11	8:27:08	8:30:37	8:31:56	8:35:05	8:37:59	8:40:09	8:42:21	8:45:12	8:47:36	8:50:42
RR011	8:05:14	8:08:55	8:11:50	8:14:29	8:17:25	8:20:59	8:23:05	8:25:26	8:27:07	8:29:05	8:30:25	8:31:47	8:33:11	8:39:08	8:42:37	8:43:56	8:47:05	8:49:59	8:52:09	8:54:21	8:57:12	8:59:36	9:02:42
RR012	8:17:14	8:20:55	8:23:50	8:26:29	8:29:25	8:32:59	8:35:05	8:37:26	8:39:07	8:41:05	8:42:25	8:43:47	8:45:11	8:51:08	8:54:37	8:55:56	8:59:05	9:01:59	9:04:09	9:06:21	9:09:12	9:11:36	9:14:42
RR013	8:29:14	8:32:55	8:35:50	8:38:29	8:41:25	8:44:59	8:47:05	8:49:26	8:51:07	8:53:05	8:54:25	8:55:47	8:57:11	9:03:08	9:06:37	9:07:56	9:11:05	9:13:59	9:16:09	9:18:21	9:21:12	9:23:36	9:26:42
RR014	8:41:14	8:44:55	8:47:50	8:50:29	8:53:25	8:56:59	8:59:05	9:01:26	9:03:07	9:05:05	9:06:25	9:07:47	9:09:11	9:15:08	9:18:37	9:19:56	9:23:05	9:25:59	9:28:09	9:30:21	9:33:12	9:35:36	9:38:42

Table 4-8 – Red Line Millbrae to Richmond

Pittsburg/Bay Point - SFO International Airport

Train	C80-2	C70-2	C60-2	C50-2	C40-2	C30-2	C20-2	C10-2	K30-4	K20-2	K10-2	M10-1	M16-1	M20-1	M30-1	M40-1	M50-1	M60-1	M70-1	M80-1	M90-3	W10-1	W20-1	W30-1	Y10-1
Y000	5:42:48	5:48:10	5:51:07	5:55:37	5:57:53	6:01:39	6:05:39	6:10:11	6:12:55	6:16:02	6:17:15	6:21:16	6:27:05	6:28:27	6:29:56	6:31:13	6:33:17	6:35:04	6:37:42	6:39:47	6:43:18	6:47:05	6:49:45	6:52:40	6:56:22
Y001	5:54:48	6:00:10	6:03:07	6:07:37	6:09:53	6:13:39	6:17:39	6:22:11	6:24:55	6:28:02	6:29:15	6:33:16	6:39:05	6:40:27	6:41:56	6:43:13	6:45:17	6:47:04	6:49:42	6:51:47	6:55:18	6:59:05	7:01:45	7:04:40	7:08:23
Y000S				6:01:35	6:03:50	6:07:36	6:11:37	6:16:09	6:18:53	6:22:00	6:23:12	6:27:13	6:33:03	6:34:24	6:35:53	6:37:11	6:39:15	6:41:02	6:43:39	6:45:45	6:49:15	6:53:03	6:55:42	6:58:37	7:02:20
Y002S				6:13:35	6:15:50	6:19:36	6:23:37	6:28:09	6:30:53	6:34:00	6:35:12	6:39:13	6:45:03	6:46:24	6:47:53	6:49:11	6:51:15	6:53:02	6:55:39	6:57:45	7:01:15	7:05:03	7:07:42	7:10:37	7:14:20
Y003	6:06:48	6:12:10	6:15:07	6:19:37	6:21:53	6:25:39	6:29:39	6:34:11	6:36:55	6:40:02	6:41:15	6:45:16	6:51:05	6:52:27	6:53:56	6:55:13	6:57:17	6:59:04	7:01:42	7:03:47	7:07:18	7:11:05	7:13:45	7:16:40	7:20:23
Y004S				6:25:35	6:27:50	6:31:36	6:35:37	6:40:09	6:42:53	6:46:00	6:47:12	6:51:13	6:57:03	6:58:24	6:59:53	7:01:11	7:03:15	7:05:02	7:07:39	7:09:45	7:13:15	7:17:03	7:19:42	7:22:37	7:26:20
Y005	6:18:48	6:24:10	6:27:07	6:31:37	6:33:53	6:37:39	6:41:39	6:46:11	6:48:55	6:52:02	6:53:15	6:57:16	7:03:05	7:04:27	7:05:56	7:07:13	7:09:17	7:11:04	7:13:42	7:15:47	7:19:18	7:23:05	7:25:45	7:28:40	7:32:23
Y006S				6:37:35	6:39:50	6:43:36	6:47:37	6:52:09	6:54:53	6:58:00	6:59:12	7:03:13	7:09:03	7:10:24	7:11:53	7:13:11	7:15:15	7:17:02	7:19:39	7:21:45	7:25:15	7:29:03	7:31:42	7:34:37	7:38:20
Y007	6:30:48	6:36:10	6:39:07	6:43:37	6:45:53	6:49:39	6:53:39	6:58:11	7:00:55	7:04:02	7:05:15	7:09:16	7:15:05	7:16:27	7:17:56	7:19:13	7:21:17	7:23:04	7:25:42	7:27:47	7:31:18	7:35:05	7:37:45	7:40:40	7:44:23
Y008S				6:49:35	6:51:50	6:55:36	6:59:37	7:04:09	7:06:53	7:10:00	7:11:12	7:15:13	7:21:03	7:22:24	7:23:53	7:25:11	7:27:15	7:29:02	7:31:39	7:33:45	7:37:15	7:41:03	7:43:42	7:46:37	7:50:20
Y009	6:42:48	6:48:10	6:51:07	6:55:37	6:57:53	7:01:39	7:05:39	7:10:11	7:12:55	7:16:02	7:17:15	7:21:16	7:27:05	7:28:27	7:29:56	7:31:13	7:33:17	7:35:04	7:37:42	7:39:47	7:43:18	7:47:05	7:49:45	7:52:40	7:56:23
Y010S				7:02:05	7:04:20	7:08:06	7:12:07	7:16:39	7:19:23	7:22:30	7:23:42	7:27:43	7:33:33	7:34:54	7:36:23	7:37:41	7:39:45	7:41:32	7:44:09	7:46:15	7:49:45	7:53:33	7:56:12	7:59:07	8:02:50
Y011	6:54:48	7:00:10	7:03:07	7:07:37	7:09:53	7:13:39	7:17:39	7:22:11	7:24:55	7:28:02	7:29:15	7:33:16	7:39:05	7:40:27	7:41:56	7:43:13	7:45:17	7:47:04	7:49:42	7:51:47	7:55:18	7:59:05	8:01:45	8:04:40	8:08:23
Y012S				7:14:05	7:16:20	7:20:06	7:24:07	7:28:39	7:31:23	7:34:30	7:35:42	7:39:43	7:45:33	7:46:54	7:48:23	7:49:41	7:51:45	7:53:32	7:56:09	7:58:15	8:01:45	8:05:33	8:08:12	8:11:07	8:14:50
Y013	7:06:48	7:12:10	7:15:07	7:19:37	7:21:53	7:25:39	7:29:39	7:34:11	7:36:55	7:40:02	7:41:15	7:45:16	7:51:05	7:52:27	7:53:56	7:55:13	7:57:17	7:59:04	8:01:42	8:03:47	8:07:18	8:11:05	8:13:45	8:16:40	8:20:23
Y014S				7:26:05	7:28:21	7:32:07	7:36:07	7:40:39	7:43:23	7:46:30	7:47:43	7:51:44	7:57:33	7:58:55	8:00:24	8:01:41	8:03:45	8:05:32	8:08:10	8:10:15	8:13:46	8:17:33	8:20:13	8:23:08	8:26:50
Y015	7:18:48	7:24:10	7:27:07	7:31:37	7:33:53	7:37:39	7:41:39	7:46:11	7:48:55	7:52:02	7:53:15	7:57:16	8:03:05	8:04:27	8:05:56	8:07:13	8:09:17	8:11:04	8:13:42	8:15:47	8:19:18	8:23:05	8:25:45	8:28:40	8:32:23
Y016S				7:38:05	7:40:21	7:44:07	7:48:07	7:52:39	7:55:23	7:58:30	7:59:43	8:03:44	8:09:33	8:10:55	8:12:24	8:13:41	8:15:45	8:17:32	8:20:10	8:22:15	8:25:46	8:29:33	8:32:13	8:35:08	8:38:50
Y017	7:30:48	7:36:10	7:39:07	7:43:37	7:45:53	7:49:39	7:53:39	7:58:11	8:00:55	8:04:02	8:05:15	8:09:16	8:15:05	8:16:27	8:17:56	8:19:13	8:21:17	8:23:04	8:25:42	8:27:47	8:31:18	8:35:05	8:37:45	8:40:40	8:44:23
Y018S				7:50:05	7:52:21	7:56:07	8:00:07	8:04:39	8:07:23	8:10:30	8:11:43	8:15:44	8:21:33	8:22:55	8:24:24	8:25:41	8:27:45	8:29:32	8:32:10	8:34:15	8:37:46	8:41:33	8:44:13	8:47:08	8:50:50
Y019	7:42:48	7:48:10	7:51:07	7:55:37	7:57:53	8:01:39	8:05:39	8:10:11	8:12:55	8:16:02	8:17:15	8:21:16	8:27:05	8:28:27	8:29:56	8:31:13	8:33:17	8:35:04	8:37:42	8:39:47	8:43:18	8:47:05	8:49:45	8:52:40	8:56:23
Y020S				8:02:05	8:04:20	8:08:06	8:12:07	8:16:39	8:19:23	8:22:30	8:23:42	8:27:43	8:33:33	8:34:54	8:36:23	8:37:41	8:39:45	8:41:32	8:44:09	8:46:15	8:49:45	8:53:33	8:56:12	8:59:07	9:02:50
Y021	7:54:48	8:00:10	8:03:07	8:07:37	8:09:53	8:13:39	8:17:39	8:22:11	8:24:55	8:28:02	8:29:15	8:33:16	8:39:05	8:40:27	8:41:56	8:43:13	8:45:17	8:47:04	8:49:42	8:51:47	8:55:18	8:59:05	9:01:45	9:04:40	9:08:23
Y022S				8:14:05	8:16:20	8:20:06	8:24:07	8:28:39	8:31:23	8:34:30	8:35:42	8:39:43	8:45:33	8:46:54	8:48:23	8:49:41	8:51:45	8:53:32	8:56:09	8:58:15	9:01:45	9:05:33	9:08:12	9:11:07	9:14:51
Y023	8:06:48	8:12:10	8:15:07	8:19:37	8:21:53	8:25:39	8:29:39	8:34:11	8:36:55	8:40:02	8:41:15	8:45:16	8:51:05	8:52:27	8:53:56	8:55:13	8:57:17	8:59:04	9:01:42	9:03:47	9:07:18	9:11:05	9:13:45	9:16:40	9:20:23
Y024S				8:26:05	8:28:20	8:32:06	8:36:07	8:40:39	8:43:23	8:46:30	8:47:42	8:51:43	8:57:33	8:58:54	9:00:23	9:01:41	9:03:45	9:05:32	9:08:09	9:10:15	9:13:45	9:17:33	9:20:12	9:23:07	9:26:51
Y025	8:18:48	8:24:10	8:27:07	8:31:37	8:33:53	8:37:39	8:41:39	8:46:11	8:48:55	8:52:02	8:53:15	8:57:16	9:03:05	9:04:27	9:05:56	9:07:13	9:09:17	9:11:04	9:13:42	9:15:47	9:19:18	9:23:05	9:25:45	9:28:40	9:32:23
Y026S				8:38:05	8:40:21	8:44:07	8:48:07	8:52:39	8:55:23	8:58:30	8:59:43	9:03:44	9:09:33	9:10:55	9:12:24	9:13:41	9:15:45	9:17:32	9:20:10	9:22:15	9:25:46	9:29:33	9:32:13	9:35:08	9:38:51
Y027	8:30:48	8:36:10	8:39:07	8:43:37	8:45:53	8:49:39	8:53:39	8:58:11	9:00:55	9:04:02	9:05:15	9:09:16	9:15:05	9:16:27	9:17:56	9:19:13	9:21:17	9:23:04	9:25:42	9:27:47	9:31:18	9:35:05	9:37:45	9:40:40	9:44:23
Y028S				8:50:05	8:52:21	8:56:07	9:00:07	9:04:39	9:07:24	9:10:31	9:11:44	9:15:45	9:21:34	9:22:56	9:24:25	9:25:42	9:27:46	9:29:33	9:32:11	9:34:16	9:37:47	9:41:34	9:44:14	9:47:09	9:50:52
Y029	8:42:48	8:48:10	8:51:07	8:55:37	8:57:53	9:01:39	9:05:39	9:10:11	9:12:55	9:16:02	9:17:15	9:21:16	9:27:05	9:28:27	9:29:56	9:31:13	9:33:17	9:35:04	9:37:42	9:39:47	9:43:18	9:47:05	9:49:45	9:52:40	9:56:23
Y030S				9:02:05	9:04:21	9:08:07	9:12:07	9:16:39	9:19:24	9:22:31	9:23:44	9:27:45	9:33:34	9:34:56	9:36:25	9:37:42	9:39:46	9:41:33	9:44:11	9:46:16	9:49:47	9:53:34	9:56:14	9:59:09	
Y031	8:54:48	9:00:10	9:03:07	9:07:37	9:09:53	9:13:39	9:17:39	9:22:11	9:24:55	9:28:02	9:29:15	9:33:16	9:39:05	9:40:27	9:41:56	9:43:13	9:45:17	9:47:04	9:49:42	9:51:47	9:55:18	9:59:05			

Table 4-9 – Yellow Line Pittsburg/Bay Point to SFO International Airport

SFO International Airport - Pittsburg/Bay Point

Train	Y10-2	W30-2	W20-2	W10-2	M90-2	M80-2	M70-2	M60-2	M50-2	M40-2	M30-2	M20-2	M16-2	M10-2	K10-3	K20-3	K30-3	C10-1	C20-1	C30-1	C40-1	C50-1	C60-1	C70-1	C80-1
YR000	5:51:58	5:55:05	5:57:59	6:00:39	6:03:34	6:07:01	6:09:07	6:11:28	6:13:09	6:15:07	6:16:27	6:17:49	6:19:13	6:25:10	6:28:12	6:29:31	6:32:52	6:35:23	6:39:53	6:43:56	6:47:44	6:50:01	6:54:19	6:57:15	7:02:26
YR001	5:57:58	6:01:05	6:03:59	6:06:39	6:09:34	6:13:01	6:15:07	6:17:28	6:19:09	6:21:07	6:22:27	6:23:48	6:25:12	6:31:09	6:34:11	6:35:30	6:38:51	6:41:22	6:45:52	6:49:55	6:53:43	6:56:00	7:00:18	7:03:14	7:08:25
YR002	6:03:58	6:07:05	6:09:59	6:12:39	6:15:34	6:19:01	6:21:07	6:23:28	6:25:09	6:27:07	6:28:27	6:29:49	6:31:13	6:37:10	6:40:12	6:41:31	6:44:52	6:47:23	6:51:53	6:55:56	6:59:44	7:02:01			
YR003	6:09:58	6:13:05	6:15:59	6:18:39	6:21:34	6:25:01	6:27:07	6:29:28	6:31:09	6:33:07	6:34:27	6:35:48	6:37:12	6:43:09	6:46:11	6:47:30	6:50:51	6:53:22	6:57:52	7:01:55	7:05:43	7:08:00	7:12:18	7:15:14	7:20:25
YR004	6:15:58	6:19:05	6:21:59	6:24:39	6:27:34	6:31:01	6:33:07	6:35:28	6:37:09	6:39:07	6:40:27	6:41:49	6:43:13	6:49:10	6:52:12	6:53:31	6:56:52	6:59:23	7:03:53	7:07:56	7:11:44	7:14:01			
YR005	6:21:58	6:25:05	6:27:59	6:30:39	6:33:35	6:37:01	6:39:07	6:41:28	6:43:09	6:45:08	6:46:28	6:47:48	6:49:12	6:55:09	6:58:12	6:59:31	7:02:51	7:05:23	7:09:53	7:13:55	7:17:44	7:20:00	7:24:19	7:27:14	7:32:26
YR006	6:27:58	6:31:05	6:33:59	6:36:39	6:39:34	6:43:01	6:45:07	6:47:28	6:49:09	6:51:07	6:52:27	6:53:49	6:55:13	7:01:10	7:04:12	7:05:31	7:08:52	7:11:23	7:15:53	7:19:56	7:23:44	7:26:01			
YR007	6:33:58	6:37:05	6:39:59	6:42:39	6:45:35	6:49:01	6:51:07	6:53:28	6:55:09	6:57:08	6:58:28	6:59:48	7:01:12	7:07:09	7:10:12	7:11:31	7:14:51	7:17:23	7:21:53	7:25:55	7:29:44	7:32:00	7:36:19	7:39:14	7:44:26
YR008	6:39:58	6:43:05	6:45:59	6:48:39	6:51:34	6:55:01	6:57:07	6:59:28	7:01:09	7:03:07	7:04:27	7:05:49	7:07:13	7:13:10	7:16:12	7:17:31	7:20:52	7:23:23	7:27:53	7:31:56	7:35:44	7:38:01			
YR009	6:45:58	6:49:05	6:51:59	6:54:39	6:57:35	7:01:01	7:03:07	7:05:28	7:07:09	7:09:08	7:10:28	7:11:48	7:13:12	7:19:09	7:22:12	7:23:31	7:26:51	7:29:23	7:33:53	7:37:55	7:41:44	7:44:00	7:48:19	7:51:14	7:56:26
YR010	6:51:58	6:55:05	6:57:59	7:00:39	7:03:34	7:07:01	7:09:07	7:11:28	7:13:09	7:15:07	7:16:27	7:17:49	7:19:13	7:25:10	7:28:12	7:29:31	7:32:52	7:35:23	7:39:53	7:43:56	7:47:44	7:50:01			
YR011	6:57:58	7:01:05	7:03:59	7:06:39	7:09:34	7:13:01	7:15:07	7:17:28	7:19:09	7:21:07	7:22:27	7:23:48	7:25:12	7:31:09	7:34:11	7:35:30	7:38:51	7:41:22	7:45:52	7:49:55	7:53:43	7:56:00	8:00:18	8:03:14	8:08:25
YR012	7:03:58	7:07:05	7:09:59	7:12:39	7:15:34	7:19:01	7:21:07	7:23:28	7:25:09	7:27:07	7:28:27	7:29:49	7:31:13	7:37:10	7:40:12	7:41:31	7:44:52	7:47:23	7:51:53	7:55:56	7:59:44	8:02:01			
YR013	7:09:58	7:13:05	7:15:59	7:18:39	7:21:34	7:25:01	7:27:07	7:29:28	7:31:09	7:33:07	7:34:27	7:35:48	7:37:12	7:43:09	7:46:11	7:47:30	7:50:51	7:53:22	7:57:52	8:01:55	8:05:43	8:08:00	8:12:18	8:15:14	8:20:25
YR014	7:15:58	7:19:05	7:21:59	7:24:39	7:27:34	7:31:01	7:33:07	7:35:28	7:37:09	7:39:07	7:40:27	7:41:49	7:43:13	7:49:10	7:52:12	7:53:31	7:56:52	7:59:23	8:03:53	8:07:56	8:11:44	8:14:01			
YR015	7:21:58	7:25:05	7:27:59	7:30:39	7:33:34	7:37:01	7:39:07	7:41:28	7:43:09	7:45:07	7:46:27	7:47:48	7:49:12	7:55:09	7:58:11	7:59:30	8:02:51	8:05:22	8:09:52	8:13:55	8:17:43	8:20:00	8:24:18	8:27:14	8:32:25
YR016	7:27:58	7:31:05	7:33:59	7:36:39	7:39:34	7:43:01	7:45:07	7:47:28	7:49:09	7:51:07	7:52:27	7:53:49	7:55:13	8:01:10	8:04:12	8:05:31	8:08:52	8:11:23	8:15:53	8:19:56	8:23:44	8:26:01			
YR017	7:33:58	7:37:05	7:39:59	7:42:39	7:45:35	7:49:01	7:51:07	7:53:28	7:55:09	7:57:08	7:58:28	7:59:48	8:01:12	8:07:09	8:10:12	8:11:31	8:14:51	8:17:23	8:21:53	8:25:55	8:29:44	8:32:00	8:36:19	8:39:14	8:44:26
YR018	7:39:58	7:43:05	7:45:59	7:48:39	7:51:34	7:55:01	7:57:07	7:59:28	8:01:09	8:03:07	8:04:27	8:05:49	8:07:13	8:13:10	8:16:12	8:17:31	8:20:52	8:23:23	8:27:53	8:31:56	8:35:44	8:38:01			
YR019	7:45:58	7:49:05	7:51:59	7:54:39	7:57:35	8:01:01	8:03:07	8:05:28	8:07:09	8:09:08	8:10:28	8:11:48	8:13:12	8:19:09	8:22:12	8:23:31	8:26:51	8:29:23	8:33:53	8:37:55	8:41:44	8:44:00	8:48:19	8:51:14	8:56:26
YR020	7:51:58	7:55:05	7:57:59	8:00:39	8:03:34	8:07:01	8:09:07	8:11:28	8:13:09	8:15:07	8:16:27	8:17:49	8:19:13	8:25:10	8:28:12	8:29:31	8:32:52	8:35:23	8:39:53	8:43:56	8:47:44	8:50:01			
YR021	7:57:58	8:01:05	8:03:59	8:06:39	8:09:35	8:13:01	8:15:07	8:17:28	8:19:09	8:21:08	8:22:28	8:23:48	8:25:12	8:31:09	8:34:12	8:35:31	8:38:51	8:41:23	8:45:53	8:49:55	8:53:44	8:56:00	9:00:19	9:03:14	9:08:26
YR022	8:03:58	8:07:05	8:09:59	8:12:39	8:15:34	8:19:01	8:21:07	8:23:28	8:25:09	8:27:07	8:28:27	8:29:49	8:31:13	8:37:10	8:40:12	8:41:31	8:44:52	8:47:23	8:51:53	8:55:56	8:59:44	9:02:01			
YR023	8:09:58	8:13:05	8:15:59	8:18:39	8:21:34	8:25:01	8:27:07	8:29:28	8:31:09	8:33:07	8:34:27	8:35:48	8:37:12	8:43:09	8:46:11	8:47:30	8:50:51	8:53:22	8:57:52	9:01:55	9:05:43	9:08:00	9:12:18	9:15:14	9:20:25
YR024	8:15:58	8:19:05	8:21:59	8:24:39	8:27:34	8:31:01	8:33:07	8:35:28	8:37:09	8:39:07	8:40:27	8:41:49	8:43:13	8:49:10	8:52:12	8:53:31	8:56:52	8:59:23	9:03:53	9:07:56	9:11:44	9:14:01			
YR025	8:21:58	8:25:05	8:27:59	8:30:39	8:33:34	8:37:01	8:39:07	8:41:28	8:43:09	8:45:07	8:46:27	8:47:48	8:49:12	8:55:09	8:58:11	8:59:30	9:02:51	9:05:22	9:09:52	9:13:55	9:17:43	9:20:00	9:24:18	9:27:14	9:32:25
YR026	8:27:58	8:31:05	8:33:59	8:36:39	8:39:34	8:43:01	8:45:07	8:47:28	8:49:09	8:51:07	8:52:27	8:53:49	8:55:13	9:01:10	9:04:12	9:05:31	9:08:52	9:11:23	9:15:53	9:19:56	9:23:44	9:26:01			
YR027	8:33:58	8:37:05	8:39:59	8:42:39	8:45:34	8:49:01	8:51:07	8:53:28	8:55:09	8:57:07	8:58:27	8:59:48	9:01:12	9:07:09	9:10:11	9:11:30	9:14:51	9:17:22	9:21:52	9:25:55	9:29:43	9:32:00	9:36:18	9:39:14	9:44:25
YR028	8:39:58	8:43:05	8:45:59	8:48:39	8:51:34	8:55:01	8:57:07	8:59:28	9:01:09	9:03:07	9:04:27	9:05:48	9:07:12	9:13:09	9:16:11	9:17:30	9:20:51	9:23:22	9:27:52	9:31:55	9:35:43	9:38:00			
YR029	8:45:58	8:49:05	8:51:59	8:54:39	8:57:35	9:01:01	9:03:07	9:05:28	9:07:09	9:09:08	9:10:28	9:11:48	9:13:12	9:19:09	9:22:12	9:23:31	9:26:51	9:29:23	9:33:53	9:37:55	9:41:44	9:44:00	9:48:19	9:51:14	9:56:26
YR030	8:51:58	8:55:05	8:57:59	9:00:39	9:03:34	9:07:01	9:09:07	9:11:28	9:13:09	9:15:07	9:16:27	9:17:48	9:19:12	9:25:09	9:28:11	9:29:30	9:32:51	9:35:22	9:39:52	9:43:55	9:47:43	9:50:00			
YR031	8:57:58	9:01:05	9:03:59	9:06:39	9:09:35	9:13:01	9:15:07	9:17:28	9:19:09	9:21:08	9:22:28	9:23:48	9:25:12	9:31:09	9:34:12	9:35:31	9:38:51	9:41:23	9:45:53	9:49:55	9:53:44	9:56:00			

Table 4-10 – Yellow Line SFO International Airport to Pittsburg/Bay Point

SECTION 5

SELECTION OF SIMULATION SCENARIOS

5.0 General

This section describes the simulation scenarios selected for the traction power simulation study. The simulation scenarios can be grouped into three categories, normal operations and contingency operations, as follows:

(a) **Normal Operating Scenarios.** Normal conditions were simulated with all traction power system equipment in service. Based on evaluation of low voltage areas during normal train circulation, passenger stations were selected for simulation of simultaneous acceleration of two 10-car trains through introducing minor delays to one of the trains at the platform.

(b) **Contingency Operating Scenarios.** Contingency conditions were analyzed as a single substation completely out of service and the non-bridgeable gaps, where applicable, jumpered along the same track. The contingency events were considered in the study as described below:

- Complete Substation – One or Two transformer-rectifier unit out-of-service in a double-ended substation, or single ended substation.
- Schedule permutations were analyzed to account for simultaneous starts of two trains from a passenger station due to minor delay of an inbound or outbound train. The acceleration of trains near the outage substations was reduced to half in accordance with the BART Facilities Standards Design Criteria.

c) **Train Bunching and Delay Scenarios.** Various incident scenarios were selected in collaboration with the BART Team to simulate train bunching and delays in a CBTC operating environment. The bunched trains and resumed operations were considered in the study and are described below:

- Incident at West Oakland Station on M1 track – A 10 car train is held at West Oakland Station for 30 minutes. (8) trains build up evenly spaced on the A2 track between Lake Merritt Station and Fruitvale Station. After 30 minutes, trains will stagger starts in full acceleration in 10 second intervals.
- Incident at Civic Center Station – 10 car trains perform in normal operation with full acceleration at 2 minute headways on the M2 track. (5) 10 car trains are held for 30 minutes each on the M1 track at the following stations: Civic Center Station, Powell Street Station, Montgomery Street Station, Embarcadero Street Station, and West Oakland Station. No trains

will be held within the Transbay Tube. During recovery, trains will stagger starts at half acceleration in 10 second intervals.

- Incident at 19th Street Station – 10 car trains stop and bunch up within 100 feet of each other and are held for 30 minutes.
    - (1) train stopped at Platform 1 at 19th Street Station with (4) trains trailing behind on Track C1, and (1) train on Track M2.
    - (1) train stopped at Platform 2 at 19th Street Station with (8) trains trailing behind on Track C2, and (3) trains on Track C4
    - (1) train stopped at Platform 3 at 19th Street Station with (3) trains trailing behind on Track CX and (3) trains trailing on Track MX

  10 car trains continue to bunch and resume operations as follows:
    - Track C2 and CX extending from 12th Street Station to MacArthur Station
    - Track A2 extending out to Lake Merritt Station
    - Track C2 continues to Rockridge Station
    - Track R2 extending out to Ashby Station

  Trains recover in staggered starts at half acceleration in 10 seconds intervals.

Table 5-1 below depicts all the simulation scenarios:

Table 5-1 - BART Transbay Core Capacity
Traction Power Simulation Scenarios

Case Number	Case ID	Event Type	Event Location	Adjacent Substations (Size in MW)	Train Performance Level	Case Description
Normal Scenario						
1.	CC01-NORMAL	Normal Morning Rush Hour Operations	N/A	N/A	PL-1	Trains operating per upgraded Train Service. Plan. All substations in-service. (60-minute simulation)
Contingency Scenarios						
A-Line - Simultaneous Starts and Substation Out-of-Service Scenarios						
2.	CC12-ALM-SS-PL4	Simultaneous Starts + Schedule Offset + Substation Out-of-Service	Substation ALM (3+3) – MP 0.51 near Lake Merritt Station (A10) – MP 0.57	Substation KWS (4+3) – MP 0.41 Substation KTT (4+3) – MP 1.14 Substation ANA (3+3) – MP 2.05	PL-4 at adjacent platforms	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation ALM (Lake Merritt) out-of-service.
3.	CC12A-ANA-SS-PL4	Simultaneous Starts + Schedule Offset + Substation Out-of-Service	Substation ANA (3+3) – MP 2.05 near Fruitvale Station (A20) – MP 3.32	Substation ALM (3+3) – MP 0.51 Substation AFV (3+3) – MP 3.24	PL-4 at adjacent platforms	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation ANA (Nineteenth) out-of-service.
4.	CC13-AFV-SS-PL4	Simultaneous Starts + Schedule Offset + Substation Out-of-Service	Substation AFV (3+3) – MP 3.24 near Fruitvale Station (A20) – MP 3.32	Substation ANA (3+3) – MP 2.05 Substation ACO (5+5) – MP 5.34	PL-4 at adjacent platforms	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation AFV (Fruitvale) out-of-service.
5.	CC14-ACO-SS-PL4	Simultaneous Starts + Schedule Offset + Substation Out-of-Service	Substation ACO (3+3) – MP 5.34 near Coliseum/Oakland Airport Station (A30) MP 5.34	Substation AFV (3+3) – MP 3.24 Substation ASL (4+3) – MP 8.30	PL-4 at adjacent platforms	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation ACO (Coliseum) out-of-service.
6.	CC15-ASL-SS-PL4	Simultaneous Starts + Schedule Offset + Substation Out-of-Service	Substation ASL (4+3) – MP 8.30 near San Leandro Station (A40) MP 8.38	Substation ACO (5+5) – MP 5.34 Substation ABF (3+4) – MP11.02	PL-4 at adjacent platforms	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation ASL (San Leandro) out-of-service.
7.	CC16-ABF-SS-PL4	Simultaneous Starts + Schedule Offset + Substation Out-of-Service	Substation ABF (3+4) – MP 11.02 near Bay Fair Station (A50) MP 10.94	Substation ASL (4+3) – MP 8.30 Substation AHA (3+4) – MP 13.85	PL-4 at adjacent platforms	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation ABF (Bay Fair) out-of-service.
8.	CC17-AHA-SS-PL4	Simultaneous Starts + Schedule Offset + Substation Out-of-Service	Substation AHA (3+4) – MP 13.85 near Hayward Station (A60) MP 13.80	Substation ABF (3+4) – MP 11.02 Substation ASH (3+3) – MP 16.67	PL-4 at adjacent platforms	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation AHA (Hayward) out-of-service.
9.	CC18-ASH-SS-PL4	Simultaneous Starts + Schedule Offset + Substation Out-of-Service	Substation ASH (3+3) – MP 16.67 near South Hayward Station (A70) – MP 16.75	Substation AHA (3+4) – MP 13.85 Substation AAY (3+3) – MP 18.48	PL-4 at adjacent platforms	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation ASH (South Hayward) out-of-service.
10.	CC19-AAY-SS-PL4	Simultaneous Starts + Schedule Offset + Substation Out-of-Service	Substation AAY (3+3) – MP 18.48 near South Hayward Station (A70) – MP 16.75	Substation ASH (3+3) – MP 16.67 Substation AUC (3+3) – MP 20.42	PL-4 at adjacent platforms	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation AAY (Hayward Yard) out-of-service.
11.	CC20-AUC-SS-PL4	Simultaneous Starts + Schedule Offset + Substation Out-of-Service	Substation AUC (3+3) – MP 20.42 near Union City Station (A80) – MP 20.50	Substation AAY (3+3) – MP 18.48 Substation AFM (3+3) – MP 23.71	PL-4 at adjacent platforms	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation AUC (Union City) out-of-service.
12.	CC21-AFM-SS-PL4	Simultaneous Starts + Schedule Offset + Substation Out-of-Service	Substation AFM (3+3) – MP 23.71 near Fremont Station (A90) – MP 23.86	Substation AUC (3+3) – MP 20.42	PL-4 at adjacent platforms	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation AFM (Fremont) out-of-service.
C-Line - Simultaneous Starts and Nearest Substation Out-of-Service Scenarios						
13.	CC29-CRO-SS-PL4	Simultaneous Starts + Schedule Offset + Substation Out-of-Service	Substation CRO (3) – MP 3.87 near Rockridge Station (C10) – MP 4.15	Substation KMA (4+3) – MP 2.26 Substation CWP (3) – MP 4.60	PL-4	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation CRO (Rockridge) out-of-service.
14.	CC30-CWP-SS-PL4	Simultaneous Starts + Schedule Offset + Substation Out-of-Service	Substation CWP (3) – MP 4.60 near Rockridge Station (C10) – MP 4.15	Substation CRO (3) – MP 3.87 Substation COR (3+3) – MP 8.17	PL-4	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation CWP (West Tunnel Portal) out-of-service.
15.	CC31-COR-SS-PL4	Simultaneous Starts + Schedule Offset + Substation Out-of-Service	Substation COR (3+3) – MP 8.17 near Orinda Station (C20) – MP 8.17	Substation CWP (3) – MP 4.60 Substation CAR (3+3) – MP 10.32	PL-4	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation COR (Orinda) out-of-service.
16.	CC32-CAR-SS-PL4	Simultaneous Starts + Schedule Offset + Substation Out-of-Service	Substation CAR (3+3) – MP 10.32 near Lafayette Station (C30) – MP 11.87	Substation COR (3+3) – MP 8.17 Substation CLA (3+3) – MP 11.87	PL-4	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation CAR (Acalanes Road) out-of-service.

Case Number	Case ID	Event Type	Event Location	Adjacent Substations (Size in MW)	Train Performance Level	Case Description
17.	CC33-CLA-SS-PL4	Simultaneous Starts + Schedule Offset + Substation Out-of-Service	Substation CLA (3+3) – MP 11.87 near Lafayette Station (C30) – MP 11.87	Substation CAR (3+3) – MP 10.32 Substation CCC (2+2) – MP 13.51	PL-4	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation CLA (Lafayette) out-of-service.
18.	CC34-CCC-SS-PL4	Simultaneous Starts + Schedule Offset + Substation Out-of-Service	Substation CCC (2+2) – MP 13.51 near Lafayette Station (C30) – MP 11.87	Substation CLA (3+3) – MP 11.87 Substation CWC (3+3) – MP 15.46	PL-4	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation CCC (Circle Creek) out-of-service.
19.	CC35-CWC-SS-PL4	Simultaneous Starts + Schedule Offset + Substation Out-of-Service	Substation CWC (3+3) – MP 15.46 near Walnut Creek Station (C40) – MP 15.46	Substation CCC (2+2) – MP 13.51 Substation CPH (3+3) – MP 17.16	PL-4	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation CWC (Walnut Creek) out-of-service.
20.	CC36-CPH-SS-PL4	Simultaneous Starts + Schedule Offset + Substation Out-of-Service	Substation CPH (3+3) – MP 17.16 near Pleasant Hill Station (C50) – MP 17.16	Substation CWC (3+3) – MP 15.46 Substation CCY (4+5) – MP 19.90	PL-4	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation CPH (Pleasant Hill) out-of-service.
21.	CC37-CCY-SS-PL4	Simultaneous Starts + Schedule Offset + Substation Out-of-Service	Substation CCY (4+5) – MP 19.90 near Concord Station (C60) – MP 21.11	Substation CPH (3+3) – MP 17.16 Substation CCO (3+5) – MP 21.11	PL-4	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation CCY (Concord Yard) out-of-service.
22.	CC38-CCO-SS-PL4	Simultaneous Starts + Schedule Offset + Substation Out-of-Service	Substation CCO (3+5) – MP 21.11 near Concord Station (C60) – MP 21.11	Substation CCY (4+5) – MP 19.90 Substation CGD (4+4) – MP 22.60	PL-4	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation CCO (Concord) out-of-service.
K-Line - Simultaneous Starts and Nearest Substation Out-of-Service Scenarios						
23.	CC39-KWS-SS-PL4	Simultaneous Start + Nearest Substation Out-of-Service	Substation KWS (4+3) – MP 0.41 near 12th Street Station (K10) – MP 0.35	Substation ALM (5) – MP 0.51 Substation KTT (4+3) – MP 1.14 Substation KOW (5+5) – MP 1.58	PL-4	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation KWS (Washington Street) out-of-service.
24.	CC40-KTT-SS-PL4	Simultaneous Start + Nearest Substation Out-of-Service	Substation KTT (4+3) – MP 1.14 near 19th Street Station (K20) – MP 0.70	Substation KWS (4+3) – MP 0.41 Substation ALM (5) – MP 0.51 Substation KMA (4+3) – MP 2.26	PL-4	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation KTT (Washington Street Switching and Substation) out-of-service.
25.	CC41-KMA-SS-PL4	Simultaneous Start + Nearest Substation Out-of-Service	Substation KMA (4+3) – MP 2.26 near MacArthur Station (K30) – MP 2.22	Substation KTT (4+3) – MP 1.14 Substation CRO (3) – MP 3.87 Substation RAS (5) – MP 4.03	PL-4	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation KMA (MacArthur) out-of-service
26.	CC42-KTT-SS-PL4	Simultaneous Start + Nearest Substation Out-of-Service (CX Reversed Inbound)	Substation KTT (4+3) – MP 1.14 near 19th Street Station (K20) – MP 0.70	Substation KWS (4+3) – MP 0.41 Substation ALM (5) – MP 0.51 Substation KMA (4+3) – MP 2.26	PL-4	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms with CX reversed inbound. Substation KTT (Washington Street Switching and Substation) out-of-service.
27.	CC43-KMA-SS-PL4	Simultaneous Start + Nearest Substation Out-of-Service	Substation KMA (4+3) – MP 2.26 near MacArthur Station (K30) – MP 2.22	Substation KTT (4+3) – MP 1.14 Substation CRO (3) – MP 3.87 Substation RAS (5) – MP 4.03	PL-4	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms with CX reversed inbound. Substation KMA (MacArthur) out-of-service
28.	CC11-KOW-SS-PL4	Simultaneous Start + Nearest Substation Out-of-Service	Substation KOW (4+4) – MP 1.58 near West Oakland Station (M10) – MP 1.48	Substation KWS (4+3) – MP 0.41 Substation KTE (5+5) – MP 3.35	PL-4	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation KOW (Oakland West) out-of-service.
29.	CC10-KTE-SS-PL4	Simultaneous Start + Nearest Substation Out-of-Service	Substation KTE (5+5) – MP 3.35 near West Oakland Station (M10) – MP 1.48	Substation KOW (5+5) – MP 1.58 Substation MTW (5+5) – MP 7.00	PL-4	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation KTE (Bay Tube East) out-of-service.
M-Line - Simultaneous Starts and Nearest Substation Out-of-Service Scenarios						
30.	CC09-MTW-SS-PL4	Simultaneous Start + Nearest Substation Out-of-Service	Substation MTW (5+5) – MP 7.00 near Montgomery Station (M20) – MP 7.69	Substation KTE (5+5) – MP 3.35 Substation MPS (5+5) – MP 8.21	PL-4	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation MTW (Bay Tube West) out-of-service.
31.	CC08-MPS-SS-PL4	Simultaneous Start + Nearest Substation Out-of-Service	Substation MPS (5+5) – MP 8.21 near Montgomery Station (M16) – MP 7.69	Substation MTW (5+5) – MP 7.00 Substation MSS (5+3) – MP 9.71	PL-4	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation MPS (Powell Street) out-of-service.
32.	CC07-MSS-SS-PL4	Simultaneous Start + Nearest Substation Out-of-Service	Substation MSS (5+3) – MP 9.71 near 16th Street Station (M50) MP 9.75	Substation MPS (5+5) – MP 8.21 Substation MTF (5+3) – MP 10.59	PL-4	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation MSS (16th Street) out-of-service.
33.	CC06-MTF-SS-PL4	Simultaneous Start + Nearest Substation Out-of-Service	Substation MTF (5+3) – MP 10.59 near 24th Street Station (M60) MP 10.64	Substation MSS (5+3) – MP 9.71 Substation MGP (4+3) – MP 12.23	PL-4	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation MTF (24th Street) out-of-service.

Case Number	Case ID	Event Type	Event Location	Adjacent Substations (Size in MW)	Train Performance Level	Case Description
34.	CC05-MGP-SS-PL4	Simultaneous Start + Nearest Substation Out-of-Service	Substation MGP (4+3) – MP 12.23 near Glen Park (M70) MP 12.29	Substation MTF (5+3) – MP 10.59 Substation MBP (4+4) – MP 13.51	PL-4	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation MGP (Glen Park) out-of-service.
35.	CC04-MBP-SS-PL4	Simultaneous Start + Nearest Substation Out-of-Service	Substation MBP (4+4) – MP 13.51 near Balboa Park (M80) MP 13.44	Substation MGP (4+3) – MP 12.23 Substation MDC (3+3) – MP 15.02	PL-4	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation MBP (Balboa Park) out-of-service.
36.	CC03-MDC-SS-PL4	Simultaneous Start + Nearest Substation Out-of-Service	Substation MDC (3+3) – MP 15.02 near Daly City Station (M90) MP – 15.23	Substation MBP (4+4) – MP 13.51 Substation MSC (3+3) – MP 16.21	PL-4	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation MDC (Daly City) out-of-service.
37.	CC02-MSC-SS-PL4	Simultaneous Start + Nearest Substation Out-of-Service	Substation MSC (3+3) – MP 16.21 near Daly City Station (M90) MP – 15.23	Substation MDC (3+3) – MP 15.02 Substation MSY (3+3) – MP 16.89	PL-4	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation MSC (School Street) out-of-service.
R-Line - Simultaneous Starts and Nearest Substation Out-of-Service Scenarios						
38.	CC28-RAS-SS-PL4	Simultaneous Start + Nearest Substation Out-of-Service	Substation RAS (5) – MP 4.03 near Ashby Station (R10) – MP 3.95	Substation KMA (4+3) – MP 2.26 Substation RBE (5) – MP 5.03	PL-4	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation RAS (Ashby) out-of-service.
39.	CC27-RBE-SS-PL4	Simultaneous Start + Nearest Substation Out-of-Service	Substation RBE (5) – MP 5.03 near Berkeley Station (R20) – MP 5.16	Substation RAS (5) – MP 4.03 Substation RNB (5) – MP 6.27	PL-4	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation RBE (Berkeley) out-of-service.
40.	CC26-RNB-SS-PL4	Simultaneous Start + Nearest Substation Out-of-Service	Substation RNB (5) – MP 6.27 near North Berkeley Station (R30) – MP 6.21	Substation RBE (5) – MP 5.03 Substation RCP (4+3) – MP 8.51	PL-4	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation RNB (North Berkeley) out-of-service.
41.	CC25-RCP-SS-PL4	Simultaneous Start + Nearest Substation Out-of-Service	Substation RCP (4+3) – MP 8.51 near El Cerrito Plaza Station (R40) – MP 8.41	Substation RNB (5) – MP 6.27 Substation RCN (4+3) – MP 10.17	PL-4	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation RCP (El Cerrito Plaza) out-of-service.
42.	CC24-RCN-SS-PL4	Simultaneous Start + Nearest Substation Out-of-Service	Substation RCN (4+3) – MP 10.17 near El Cerrito del Norte Station (R50) – MP 10.25	Substation RCP (4+3) – MP 8.51 Substation RRI (4) – MP 12.68	PL-4	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation RCN (El Cerrito Del Norte) out-of-service.
43.	CC23-RRI-SS-PL4	Simultaneous Start + Nearest Substation Out-of-Service	Substation RRI (4) – MP 12.68 near Richmond Station (R60) MP – 12.57	Substation RCN (4+3) – MP 10.17 Substation RRY (4) – MP 13.28	PL-4	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation RRI (Richmond) out-of-service.
44.	CC22-RRY-SS-PL4	Simultaneous Start + Nearest Substation Out-of-Service	Substation RRY (4) – MP 13.28 near Richmond Station (R60) MP – 12.57	Substation RRI (4) – MP 12.68	PL-4	Simultaneous start of inbound and outbound trains operating at PL-4 at adjacent station platforms. Substation RRY (Richmond Yard) out-of-service
Bunching / Train Delay Scenarios						
45.	CC60-M10	Incident at West Oakland Station (M10) on M1 track: Hold 10-car trains at A10 for 30 minutes and allow 8 trains (15 TPH) to build up in half acceleration and evenly space trains on A2 track between A10 and A20. After 30 minutes, allow trains to recover with 10 second staggered delay starts in full acceleration. When recovering trains on A2 track depart from A10, they increase to full acceleration.			PL-1	Trains operating per upgraded Train Service. Plan. All substations in-service. (60-minute simulation)
46.	CC61-M40	Incident at Civic Center Station (M40): Perform normal operation of 10-car trains with full acceleration limited to 2 minute headways on M2 track. On M1 track, trains reduce to half acceleration and allow 10-car trains to be held for 30 minutes at each M-Line station at M40, M30, M20, M16, M10 (no trains will be stopped inside TBT). Recover with full acceleration; stagger delayed starts at 10 seconds; and return to 2 minute headways on M1 track.			Various	Trains operating per upgraded Train Service. Plan. All substations in-service. (60-minute simulation)
47.	CC62-K20	Incident at 19th Street Station: Allow trains running in half acceleration to stop and build up within 100 feet of each other and hold for 30 minutes. Allow trains to stack up and stop on track C2 and CX out to K10 and K30, A2 out to A10, C2 out to C10, and R2 out to R10. During recovery, stagger delayed starts of all trains in half acceleration at 10 seconds apart with an extra 10 second delay at station platform stops. Return to 2 minute headways through the TBT.			Various	Trains operating per upgraded Train Service. Plan. All substations in-service. (60-minute simulation)

SECTION 6

FINDINGS AND MITIGATIONS

6.0 General

This section of the report presents the findings of the BART Transbay Core Capacity simulation study. The findings and results are depicted in Table 6-1, which summarizes the adequacy of the traction power configuration evaluated under normal and contingency outage conditions with emphasis on the following:

- Substation Capacity
- Train Voltage
- Cable Loading Summaries

Based on the evaluation of the adequacy of the traction power configuration, a set of improvements identified and simulated with further outcomes to mitigate deficient conditions.

In addition, regenerative braking analysis was performed to identify the potential for energy savings and is presented in Table 6-4.

Table 6-1 - Summary of all Cases

Case	Normal or Contingency Operations	Minimum Voltage; Adjacent Substations In-service	Rectifier-Unit with Highest RMS Current; % of RMS Rating
CC01-Normal	All substations in service - Normal operations	742 Vdc RRI-RRY	47% CRO-1
SUBSTATION OFFLINE OPERATIONS			
CC02-MSC-SS-PL4	MSC Substation Offline - Offsets including Simultaneous Train Start (SS) at Nearby Platform at PL4	761 Vdc MTF-MGP	62% MDC-1
CC03-MDC-SS-PL4	MDC Substation Offline - Offsets including SS Start at Nearby Platform at PL4	761 Vdc MTF-MGP	61% MGP-1
CC04-MBP-SS-PL4	MBP Substation Offline - Offsets including SS Start at Nearby Platform at PL4	770 Vdc RCN-RRI	65% MGP-1
CC05-MGP-SS-PL4	MGP Substation Offline - Offsets including SS Start at Nearby Platform at PL4	770 Vdc RCN-RRI	59% MBP-1
CC06-MTF-SS-PL4	MTF Substation Offline - Offsets including SS Start at Nearby Platform at PL4	770 Vdc RCN-RRI	65% MSS-1
CC07-MSS-SS-PL4	MSS Substation Offline - Offsets including SS Start at Nearby Platform at PL4	770 Vdc RCN-RRI	62% MTF-2
CC08-MPS-SS-PL4	MPS Substation Offline - Offsets including SS Start at Nearby Platform at PL4	**726 Vdc** **MTW-MSS**	62% MSS-2
CC09-MTW-SS-PL4	MTW Substation Offline - Offsets including SS Start at Nearby Platform at PL4	770 Vdc PRCN-RRI	62% MPS-1
CC10-KTE-SS-PL4	KTE Substation Offline - Offsets including SS Start at Nearby Platform at PL4	799 Vdc MPS-MSS	67% CRO-1
CC11-KOW-SS-PL4	KOW Substation Offline - Offsets including SS Start at Nearby Platform at PL4	756 Vdc KWS-KTE	44% CRO-1
CC12-ALM-SS-PL4	ALM Substation Offline - Offsets including SS Start at Nearby Platform at PL4	778 Vdc ASL-ABF	47% CRO-1
CC12A-ANA-SS-PL4	ANA Substation Offline - Offsets including SS Start at Nearby Platform at PL4	759 Vdc ABF-AHA	73% ABF-1
CC13-AFV-SS-PL4	AFV Substation Offline - Offsets including SS Start at Nearby Platform at PL4	759 Vdc ABF-AHA	73% ABF-1
CC14-ACO-SS-PL4	ACO Substation Offline - Offsets including SS Start at Nearby Platform at PL4	758 Vdc ABF-AHA	74% ABF-1
CC15-ASL-SS-PL4	ASL Substation Offline - Offsets including SS Start at Nearby Platform at PL4	757 Vdc ABF-AHA	82% ABF-1
CC16-ABF-SS-PL4	ABF Substation Offline - Offsets including SS Start at Nearby Platform at PL4	773 Vdc ASL-AHA	66% AHA-1
CC17-AHA-SS-PL4	AHA Substation Offline - Offsets including SS Start at Nearby Platform at PL4	768 Vdc ABF-ASH	68% ABF-1
CC18-ASH-SS-PL4	ASH Substation Offline - Offsets including SS Start at Nearby Platform at PL4	755 Vdc ABF-AHA	74% ABF-1

CC19-AAY-SS-PL4	AAY Substation Offline - Offsets including SS Start at Nearby Platform at PL4	758 Vdc ABF-AHA	74% ABF-1
CC20-AUC-SS-PL4	AUC Substation Offline - Offsets including SS Start at Nearby Platform at PL4	773 Vdc AFM-AAY	70% ABF-1
CC21-AFM-SS-PL4	AFM Substation Offline - Offsets including SS Start at Nearby Platform at PL4	767 Vdc ABF-AHA	72% ABF-1
CC22-RRY-SS-PL4	RRY Substation Offline - Offsets including SS Start at Nearby Platform at PL4	789 Vdc RBE-RNB	47% PCRO-1
CC23-RRI-SS-PL4	RRI Substation Offline - Offsets including SS Start at Nearby Platform at PL4	**688 Vdc** **RCN-RRY**	48% RCN-1
CC24-RCN-SS-PL4	RCN Substation Offline - Offsets including SS Start at Nearby Platform at PL4	**681 Vdc** **RCP-RRY**	54% RRI-1
CC25-RCP-SS-PL4	RCP Substation Offline - Offsets including SS Start at Nearby Platform at PL4	775 Vdc RCN-RRI	47% CRO-1
CC26-RNB-SS-PL4	RNB Substation Offline - Offsets including SS Start at Nearby Platform at PL4	777 Vdc RCN-RRI	47% CRO-1
CC27-RBE-SS-PL4	RBE Substation Offline - Offsets including SS Start at Nearby Platform at PL4	777 Vdc RCN-RRI	47% CRO-1
CC28-RAS-SS-PL4	RAS Substation Offline - Offsets including SS Start at Nearby Platform at PL4	751 Vdc KMA-RBE	47% CRO-1
CC29-CRO-SS-PL4	CRO Substation Offline - Offsets including SS Start at Nearby Platform at PL4	751 Vdc KMA-CRO	62% CRO-1
CC30-CWP-SS-PL4	RAS Substation Offline - Offsets including SS Start at Nearby Platform at PL4	801 Vdc KMA-CRO	61% CRO-1
CC31-COR-SS-PL4	CRO Substation Offline - Offsets including SS Start at Nearby Platform at PL4	793 Vdc CWP-CAR	61% CWP-1
CC32-CAR-SS-PL4	CWP Substation Offline - Offsets including SS Start at Nearby Platform at PL4	787 Vdc KMA-CRO	64% CRO-1
CC33-CLA-SS-PL4	COR Substation Offline - Offsets including SS Start at Nearby Platform at PL4	787 Vdc KMA-CRO	60% CWP-1
CC34-CCC-SS-PL4	CAR Substation Offline - Offsets including SS Start at Nearby Platform at PL4	787 Vdc KMA-CRO	58% CRO-1
CC35-CWC-SS-PL4	CLA Substation Offline - Offsets including SS Start at Nearby Platform at PL4	787 Vdc KMA-CRO	58% CRO-1
CC36-CPH-SS-PL4	CCC Substation Offline - Offsets including SS Start at Nearby Platform at PL4	**672 Vdc** **CWC-CCY**	58% CRO-1
CC37-CCY-SS-PL4	CWC Substation Offline - Offsets including SS Start at Nearby Platform at PL4	787 Vdc KMA-CRO	58% CRO-1
CC38-CCO-SS-PL4	CPH Substation Offline - Offsets including SS Start at Nearby Platform at PL4	787 Vdc KMA-CRO	58% CRO-1
CC39-KWS-SS-PL4	KWS Substation Offline - Offsets including SS Start at Nearby Platform at PL4	819 Vdc KTT-KMA	58% CRO-1
CC40-KTT-SS-PL4	KTT Substation Offline - Offsets including SS Start at Nearby Platform at PL4	783 Vdc ALM-KWS-KMA	58% CRO-1

CC41-KMA-SS-PL4	KMA Substation Offline - Offsets including SS Start at Nearby Platform at PL4	765 Vdc CRO-KMA	58% CRO-1
CC42-KTT-SS-PL4	KTT Substation Offline - Offsets including SS Start at Nearby Platform at PL4 (CX Reversed Inbound)	**740 Vdc** **ALM-KWS-KMA**	58% CRO-1
CC43-KMA-SS-PL4	KMA Substation Offline - Offsets including SS Start at Nearby Platform at PL4 (CX Reversed Inbound)	794 Vdc RAS-KTT-CRO	58% CRO-1
MITIGATION OPERATIONS			
CC08-MPS-SS-PL4+MON+CVC	MPS Substation Offline - Offsets including SS Start at Nearby Platform at PL4 with 1-5MW Unit at Civic Center and 1-5MW Unit at Montgomery	770 Vdc RCN-RRI	
CC23-RRI-SS-PL4+RYE	RRI Substation Offline - Offsets including SS Start at Nearby Platform at PL4 with 2-4 MW Substation at Gap Breaker Station RYE	789 Vdc RBE-RNB	
CC24-RCN-SS-PL4+RYE	RCN Substation Offline - Offsets including SS Start at Nearby Platform at PL4 with 2-4 MW Substation at Gap Breaker Station RYE	765 Vdc RCP-RRI	
CC36-CPH-SS-PL4+CDA	CPH Substation Offline - Offsets including SS Start at Nearby Platform at PL4 with 2-4 MW Substation at David St Pleasant Hill	761 Vdc CWC-CDA(CCY)	
BUNCHING/TRAIN DELAY OPERATIONS			
CC60-M10	Incident at West Oakland Station (M10) on M1 track: Hold 10-car trains at A10 for 30 minutes. After 30 minutes, allow trains to recover with 10 second staggered delay starts in full acceleration.	775 Vdc MPS-MSS	48% MGP-2
CC61-M40	Incident at Civic Center Station (M40): Hold for 30 minutes at each M-Line station at M40, M30, M20, M16, M10 (no trains will be stopped inside TBT). Recover with full acceleration; stagger delayed starts at 10 seconds; and return to 2 minute headways on M1 track.	775 Vdc MPS-MSS	48% MGP-2
CC62-K20	Incident at 19th Street Station: Allow trains running in half acceleration to stop and build up within 100 feet of each other and hold for 30 minutes. Allow trains to stack up and stop on track C2 and CX out to K10 and K30, A2 out to A10, C2 out to C10, and R2 out to R10. During recovery, stagger delayed starts of all trains in half acceleration at 10 seconds apart with an extra 10 seconds delay at station platform stops. Return to 2 minute headways through the TBT.	847 Vdc KTT-ALM-KOW	46% CRO-1

6.1 Transformer–Rectifier Unit Capacities

The transformer-rectifier units simulated were found to be adequate for both the normal and the single contingency operations. The maximum % of rated RMS current of 82% was found at substation ABF (case CC15-ASL-SS-PL4). The chart for the RMS current fluctuation is shown in Figure 6-1 below. The loading summaries for each substation in the BART Transbay Core Capacity are provided in detail in Appendix D, Rectifier Loading Summaries. Substations with the highest percentage of rms and peak current loading for each scenario simulated are highlighted within Appendix D.

6.1.1 Analysis of Substation Capacities

In order to determine the adequacy of the existing transformer-rectifier units throughout the BART Transbay Core Capacity, the following analyses were performed under both normal and contingency operations:

- Simulated rms currents were compared against 100% of rated rms currents. Substations requiring improvements would be those with simulated rms current exceeding 100% of rated rms current.

- Simulated peak currents were compared against 450% of the rated continuous current. Substations requiring improvements would be those with simulated peak current exceeding 450% of the rated continuous current.

6.1.2 Rated Capacity

The transformer-rectifier units at the traction power substations are assumed to be extra heavy-duty traction type in accordance with the NEMA Standard RI-9. Consequently, after operating at 100% of rated load amperes until constant full load temperatures have been reached, the transformer-rectifier unit shall be capable of operating at the following overload cycles:

- 150% of rated current for two hours with
- Five cycles of 300% rated current for one minute duration each, equally spaced throughout the 2-hour period, and
- One cycle of 450% rated current for 15 secs at the end of 2 hour period.

For the purpose of this study, the extra heavy-duty load cycle was converted to an equivalent rms current rating for the 2-hour overload period, resulting in 1.603 times the 100% continuous load. The equivalent rms current rating for a 100% continuous current rating of 3,000 amperes was determined as follows:

$$I_{rms} = \sqrt{\frac{1}{n}\sum_{i=1}^{n} I^2(i)}$$

$$I_{rms} = 3kA\sqrt{\frac{1}{7200s}\left(\sum_{1s}^{6885s} 1.5^2 + \sum_{1s}^{300s} 3^2 + \sum_{1s}^{15s} 4.5^2\right)}$$

In the case of a 3 MW transformer-rectifier unit, the base or 100% continuous load is 3,000 amperes at a rectifier terminal 100% load voltage of 1000 Vdc. The percent of continuous rating for current is based on the 3,000 amperes at a rectifier terminal at 100% load. To calculate the extra-heavy duty rms current rating, 3,000 amperes is factored by the equivalent rms current 1.603, equating to obtain 4,809 amperes. The simulated rms current over the simulated period is then compared against the rms rated value of 4,809 amperes to determine the percent of rms rating of the transformer-rectifier units. The highest simulated one second value peak current experienced by a 3 MW rectifier over the simulation period is compared against the 450% current which is 13,500 amperes.

(a) **Normal Operation.** The results from the simulation indicate that the rms and peak currents of all transformer-rectifier units for the core system were within rating during the normal operations in Case CC-Normal as simulated with all substations in service. The highest rms current and the highest peak current are indicated below:

- **Highest RMS Current.** The highest rms current loading occurs at Substation CRO. The single end substation with a 3MW transformer-rectifier unit in service, the substation experienced an rms current load of 2,263 amps, which is 47% of the rms current rating for this substation.

- **Highest Peak Current.** The highest peak current loading occurs at Substation ASH. The Hayward Substation consists of two 3MW transformer-rectifier units in service; the substation experienced a peak current of 8,046 amps per transformer rectifier, which is 306% of the continuous rating for this substation.

(b) **Contingency Operation.** The analysis of contingency operations considered the removal of the complete substation from service. The analysis simulated reduced train performance or half acceleration train starts at the nearby passenger station.

The results from the simulation demonstrated that all transformer-rectifier units operated within rating during contingency operation. The highest rms current was recorded at Substation ABF (Bay Fair) whereas the highest peak current was recorded at Substation CRO (Rockridge). The results are indicated below:

- **Highest RMS Current.** The highest rms current was determined to be at Substation ABF (Bay Fair) when adjacent Substation ASL (San Leandro) was off line as simulated in Case CC15-ASL-SS-PL4. Substation ABF consists of two transformer-rectifier units, 4MW and 3MW. The two units experienced an rms current load of 5,275 amps for the 4MW unit and 3,956 amps for the 3MW unit, which is 82% of their rms current rating. Figure 6-1 depicts the current loading of the substation during the simulation period.

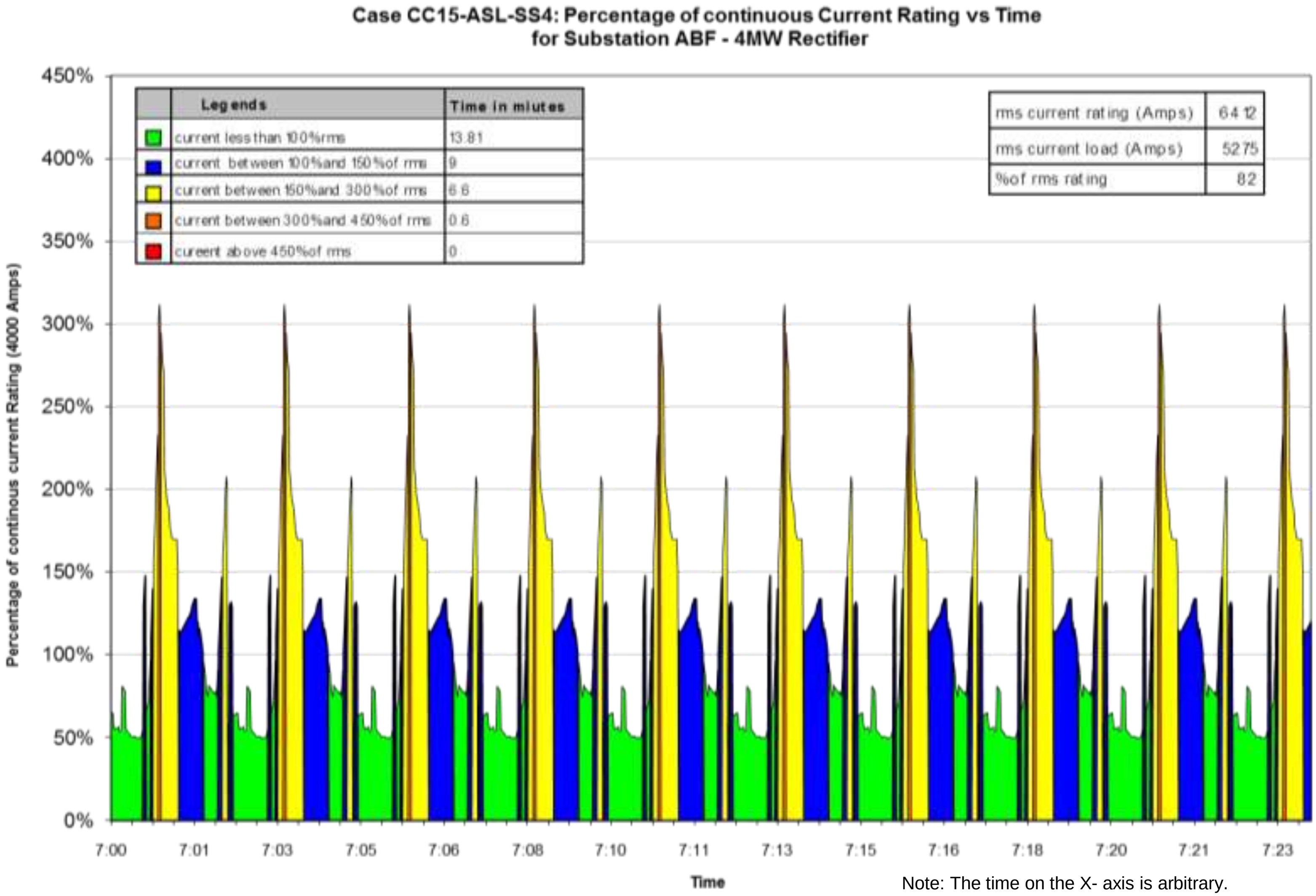
- **Highest Peak Current.** The highest peak current was experienced at Substation CRO (Rockridge) with a peak current of 11,085 amps, which is 370% of its continuous current rating. This substation has only one 3MW transformer-rectifier unit installed.

(c) Train Bunching and Delay Scenarios. The analysis of bunching scenarios considered the incidents affecting train operations. The analysis simulated reduced train performance and staggered starts at the nearby passenger station.

The results from the simulation demonstrated that all transformer-rectifier units operated within rating during resumed train operation. The highest rms current was recorded at Substation MGP (Glen Park) whereas the highest peak current was recorded at Substation RRI (Richmond). The results are indicated below:

- **Highest RMS Current.** The highest rms current was determined to be at Substation MGP (Glen Park) when an incident occurs at Civic Center Station as simulated in Case CC61-M40. Substation MGP consists of two transformer-rectifier units, 4MW and 3MW. The two units experienced an rms current load of 2,791 amps for the 4MW unit and 2,093 amps for the 3MW unit, which is 44% of their rms current rating.

- **Highest Peak Current.** The highest peak current was experienced at Substation RRI (Richmond) with a peak current of 14,289 amps, which is 357% of its continuous current rating. This substation has only one 4MW transformer-rectifier unit installed.



Note: The time on the X- axis is arbitrary.

Figure 6 - 1

6.2 Adequacy of Train Voltages

The adequacy of train voltages was analyzed for each simulation scenario selected. These scenarios focused on realistic train operations as simulated by the OnTrack Train Simulator including simultaneous starts. Substation outages were analyzed, separately for each substation within the core system, the train accelerations at the adjacent to the outage condition were reduced performance or half acceleration (Performance Level 4).

- In order to assess the train voltage situation for each of scenario, the train voltage vs. distance for each train traversing the system was analyzed against the criteria of 750 V dc, and the resulting voltages were plotted. The train voltage plots for every case simulated are included in Appendix E. This analysis demonstrated four locations within the core system that are susceptible to low voltages.

This subsection of the report is organized as follows:

- Section 6.2.1 – Analysis of Train Voltages – Normal Train Operations and All Substations In Service

- Section 6.2.2 – Analysis of Train Voltages – Contingency Operations: Substation Outage.

- Section 6.2.3 - Analysis of Train Voltages – Bunching / Train Delays.

- Section 6.2.4 – Mitigation of Low Train Voltages.

6.2.1 Analysis of Train Voltages - Normal Train Operations and All Substations In Service

Train voltages were analyzed by comparing the train voltage results to the minimum permissible train voltage criteria of 750 Vdc. Locations where train voltages fell below 750 Vdc were specifically identified for traction power system improvements to support the demands of the BART Transbay Core Capacity Service Plan. The traction power simulation scenarios performed under normal demonstrated the following:

(a) **Normal Operation.** The results from the normal operations simulated in Case CC-NORMAL identified a low train voltage condition of 742 Vdc, with all substations in service and train operations at normal peak service, at civil stationing 684+13, near Richmond Yard entrance, between Substations RRI and RRY.

6.2.2 Analysis of Train Voltages - Contingency Operations: Substation Outage

The analysis of single contingency operations included the removal of a substation from service at each location within the study area. During these scenarios, all trains were operating at peak rush hour with half acceleration from the platform adjacent to the outage substation area. The results from the train voltage analysis performed indicated that the minimum permissible train voltage criterion of 750 Vdc was not satisfied at the following four locations:

(a) M-LINE – Powell Street Substation (MPS)

The low voltage condition occurred when Substation MPS (Powell Street), was taken out of service in Case CC08-MPS-SS-PL4. In this scenario, adjacent Substation MSS (16th Street) and Substation MTW (Baytube West) are 14,000 ft. apart with 5 passenger stations in between. The distance and density of passenger stations with traveling trains create a segment with a high load demand along with simultaneous train starts at Civic Center Station and nearby acceleration of trains traveling in the tube and Montgomery. The lowest voltage in this area is 725 Vdc while traveling on outbound track M2 from Civic Station towards 16th Street Station.

(b) R-LINE – Richmond Substation (RRI)

When Substation RRI was taken offline in Case CC23-RRI-SS-PL4, the lowest simulated voltage was found to be 687 Vdc, below the 750 Vdc permissible voltage. In this scenario, adjacent Substation RCN (El Cerrito Del Norte) is supporting the train acceleration at Richmond Station. The low voltage condition similar to the Normal Case and the low voltage is exuberated due to offline substation RRI.

(c) C-LINE – Pleasant Hill (CPH)

The low voltage condition occurred when Substation CPH (Pleasant Hill), was taken out of service in Case CC36-CPH-SS-PL4. In this scenario, adjacent Substation CWC (Walnut Creek) and Substation CCY (Concord Yard) are 23,000 ft. apart with 2 passenger stations and the maintenance yard in between. The distance and density of passenger stations and maintenance facilities create a segment with a high load demand along with simultaneous starting of trains at Pleasant Hill Station and nearby acceleration of trains traveling between Walnut Creek and Concord Stations.

The lowest voltage in this area is 671 Vdc when a C-Line outbound train is accelerating from Pleasant Hill Station towards Concord Station on Track C1.

(d) K-LINE – Downtown Oakland (KTT)

When Substation KTT was placed offline along with the CX track reversed so that two tracks are inbound to Downtown Oakland as simulated in Case CC42-KTT-SS-PL4, the lowest voltage was found to be 740 Vdc. The low voltage condition lasts for four seconds while two trains are traveling from MacArthur to 19th Street. An adjacent train is accelerating in the opposite direction at 12th Street when this condition occurs.

6.2.3 Analysis of Train Voltages – Bunching / Train Delays

In previous cases, normal train operations were maintained to the schedule and abnormal events were not considered. Additional cases were performed to test various “perturbations” with a station platform delays to represent various unplanned events. These train operations resulted in various time or platform hold delays thereby creating train bunching. These cases were selected to evaluate train voltages when the service or trains were released from their holds.

The lowest train voltage occurred due to a simultaneous starting of trains occurring on the M1 and M2 track in the Downtown San Francisco area, specifically at Civic Center. Under the two scenarios, Case CC-60-M10 and CC-61-M40, the scenario coincidentally created a simultaneous train starts after the service was restored. However, the lowest voltage was above the criterion with a voltage 775 Vdc.

6.2.4 Recommended Improvements to Alleviate Low Train Voltages

A set of improvements to the existing traction power network was identified that mitigates all low train voltage conditions with Transbay Core Capacity train operations that were found during normal and contingency condition operations. The recommended improvements are as follows:

- Two 5MW substation transformer-rectifier units split between Civic Center Station and at Montgomery Station
- Two 5MW substation at Richmond Gap Breaker Station RYE
- Two 5MW substation at Pleasant Hill/Concord
- Two 5MW substation at K-Line (34th Street)

(a) **M-LINE Improvements - Downtown San Francisco Powell Street Area.** Due to space constraints within Downtown San Francisco, two single ended 5MW transformer rectifier units, one at Civic Center and the other at Montgomery, alleviate the low train voltage when Powell Street Substation (MPS) is offline. The voltage improved from 725 Vdc to 770 Vdc in the area of low voltage.

(b) **R-LINE Improvements - Richmond Station.** By adding a 2-5MW transformer-rectifier unit at Gap Breaker Station RYE between Richmond Passenger Station and Richmond Yard, the voltage improved from 687 Vdc to 789 Vdc when Richmond Substation (RRI) is offline. The voltage also improves when El Cerrito Del Norte Substation is offline from 681 Vdc to 765 Vdc.

(c) **C-LINE Improvements – Pleasant Hill to Concord Yard.** By adding a 2-5MW transformer-rectifier unit in Concord at David Street, the voltage improved from 671 Vdc to 761 Vdc when simulated Pleasant Hill Substation (CPH) is offline.

(d) **K-LINE Improvements – Oakland.** By adding a 2-5MW transformer-rectifier unit at 34th Street, the voltage improved from 740 Vdc to 776 Vdc when Twenty Third Substation (KTT) is offline and reverse direction is in effect for the CX Track.

6.3 Cable Loading

This subsection provides the findings on the adequacy of the feeder cables under normal and contingency conditions. The analysis consisted of comparing the simulated rms currents against the cable ratings.

6.3.1 DC Feeder Cable Loading

According to IEEE Std 835-1994, IEEE Standard Power Cable Ampacity Table #4, the current carrying capacity of a 750 MCM, 5 kV, triplexed, 3-circuit, copper conductor, at 90°C, 75% load factor, and 60 Rho is 560 A for underground ductbank installation. As established in previous traction power analyses performed by PDI and BART in 1992, the ampacity of the 750 kcmil copper dc feeder cables is assumed to be 555 A for the purposes of this study. The BART Facility Criteria Standard for DC Cables states the following, "For positive feeder cables, cable loading shall be determined from a normal system operation simulation using regenerative braking, with an extra 10% additional load added to allow for contingencies." Total quantity of cables for each dc negative circuit shall be derived using a method similar to that used for the positive cables, but using dynamic braking only.

Cable overload conditions were identified as follows:

- Overload conditions occur for Transbay Core Capacity at the following substations: Bay Fair (ABF), El Cerrito Del Norte (RCN) and North Berkeley (RNB). The positive and return cable sets with the highest rms current ratings for post-regeneration normal and normal+10% are indicated below.

Table 6-2 – Cable Overload Conditions

Substation	Cables	RMS Current	Cable Quantity	RMS Current (A) per Cable	RMS+10% Current (A) Per Cable	% Overload
	POSTIVE FEEDER CABLES					
North Berkeley	PBRNB1_PRNB5	1509	2	754	830	47%
El Cerrito Del Norte	PBRCN1_PRCN3	1996	3	665	732	30%
Richmond	PBRRI1_PRRI4	1628	3	543	597	6%
Bay Fair	PBABF1_PABF3	2269	3	756	832	50%
	RETURN FEEDER CABLES					
San Leandro	NBASL1_NASL2	2745	5	549		-3%

- The highest cable loading overload occurs at Bay Fair (ABF) for the contact rail feed from dc feeder breaker 3 to contact rail A1 with an rms current of 832 A which represents a 50% overload condition. The only mitigation considered for overloaded cables is the installation of additional feeder cables in parallel to increase the ampacity of the cable set.

The rms currents of the feeder cables are indicated for all simulated scenarios (without regeneration) in Appendix F, Feeder Cable Loading Summary, which also shows highlighted peak cable loading for the locations identified in Table 6-2.

6.3.2 Subtransmission System

The 34.5 KV AC Subtransmission System comprises of switching stations and associated ac cables. The 34.5 KV AC Subtransmission System was analyzed for the Transbay Core Capacity Study. The analysis was performed under the normal conditions

Input data used for the analyses of Switching Stations and associated AC Cables are shown in the tables below.

(a) Normal Conditions. The analysis of AC Cables and Switching Stations is discussed below.

- **34.5 KV AC Cables Baseline.** 34.5 KV AC Cables on the BART 34.5 KV Subtransmission System consists of PIPE, EPR, and PILC type cables. PIPE and EPR cables are rated at 95°C while PILC cables are rated at 80°C. These cables are either directly buried or in conduit in air. The cables inside the tunnel walls are assumed to be in conduit in air. The cable ampacity in conduit in air is lower than directly buried cables. To be conservative, all cables are assumed to be in air with a 100% load factor. The cable types and their ratings are indicated in Table 6-3 below.

Table 6-3 - AC Cables Types and Ratings

Cable Designation	Cable Type	Cable Rating
AAY-ASH-L	3/0, PILC, AL	180
AAY-ASH-R	3/0, PILC, AL	180
ACO-AFV-L	250 KCMIL, PIPE, AL	255
AFM-SPP-L	3/0, PILC, AL	180
AFM-SPP-R	3/0, PILC, AL	180
ALM-ANA-R	250 KCMIL, PIPE, AL	255
ASH-AHA-L	3/0, PILC, AL	180
ASL-ACO-L	250 KCMIL, PIPE, AL	255
ASL-ACO-R	250 KCMIL, PIPE, AL	255
AUC-AAY-L	250 KCMIL, PILC, AL	230
AUC-AAY-R	250 KCMIL, PILC, AL	230
AUC-AFM-L	3/0, PILC, AL	180
AUC-AFM-R	3/0, PILC, AL	180
AWA-ABF-R	350 KCMIL, PIPE, AL	310
AWA-ASL-L	350 KCMIL, PIPE, AL	310
AWA-ASL-R	350 KCMIL, PIPE, AL	310
KOW-KTE-L	250 KCMIL, PIPE, AL	255
KOW-KTE-R	250 KCMIL, PIPE, AL	255
KTT-KMA-L	3/0, PILC, AL	180
KWS-ALM-R	250 KCMIL, PIPE, AL	255
KWS-KOW-L	350 KCMIL, PIPE, AL	310
KWS-KOW-R	350 KCMIL, PIPE, AL	310
KWS-KTT-L	250 KCMIL, PILC, CU	297
MGP-MBP-L	250 KCMIL, PIPE, AL	255
MGP-MBP-R	250 KCMIL, PIPE, AL	255
MPS-MTW-L	250 KCMIL, PIPE, AL	255
MPS-MTW-R	250 KCMIL, PIPE, AL	255

MSS-MPS-L	500 KCMIL, PIPE, AL	385
MSS-MPS-R	500 KCMIL, PIPE, AL	385
MTF-MSS-L	750 KCMIL, PIPE, AL	485
MTF-MSS-R	750 KCMIL, PIPE, AL	485
MVS-MGP-L	500 KCMIL, PIPE, AL	385
MVS-MGP-R	500 KCMIL, PIPE, AL	385
MVS-MTF-L	1000 KCMIL, PIPE, AL	565
MVS-MTF-R	1000 KCMIL, PIPE, AL	565
RBE-RAS-L	250 KCMIL, PIPE, AL	255
RCN-RRI-L	3/0, PIPE, AL	200
RCN-RRI-R	3/0, PIPE, AL	200
RCP-RNB-L	250 KCMIL, PIPE, AL	255
RCP-RNB-R	250 KCMIL, PIPE, AL	255
RNB-RBE-L	250 KCMIL, PIPE, AL	255
RNB-RBE-R	250 KCMIL, PIPE, AL	255
RPD-RCN-L	250 KCMIL, PIPE, AL	255
RPD-RCN-R	250 KCMIL, PIPE, AL	255
RPD-RCP-L	350 KCMIL, PIPE, CU	395
RPD-RCP-R	350 KCMIL, PIPE, CU	395
RRI-RRY-L	3/0, PIPE, AL	200
SBR-SWS-R	3/0, PILC, AL	180
SPP-SBR-L	3/0, PILC, AL	180
SPP-SBR-R	3/0, PILC, AL	180

The cable ampacities for PIPE and EPR cables are derived at 90°C from NEC 2008, Tables 310.73 and 310.74. Since the NEC does not provide an ampacity Table for 80°C, the ampacities for PILC cables are assumed to be 90% of their PIPE counterpart.

- **34.5 KV AC Cables Findings.** The rms current for all cables are within their cable ratings using. The highest rms rating was the 250 KCMIL, PIPE, AL segment between Glen Park (MGP) and Balboa Park (MBP) at 117A or 46% of its rms rating. See Appendix F - 34.5 KV Cable Loading Summary for details of the remaining cables.

6.4 Regenerative Braking

Regenerative Braking analysis was performed on normal operations to identify the potential for power savings due to regenerative braking. It should be noted that the results are dependent on the network's receptiveness for the power regenerated by a braking train and is dependent on train schedules and density.

The Regenerative braking analysis was performed on the existing substations. The energy savings of these cases are compared to simulations without regenerative braking. The results indicate the following:

- Potential for energy savings through regenerative braking was found to be up to 38,619 kWHr for the normal operations.
- The total systemwide demand was found to be 108,696 kWHr.

The substation with the largest energy savings was observed at Balboa Park Substation (MPB) with 3 - 3MW transformer rectifier units. The input energy was reduced by 2,263 kWHr. The least amount of energy savings was at the outer C-Line. The energy comparison for each substation can be found in Table 6-4 below.

Table 6-4 Regenerative Braking Data

Substations	Normal Without Regeneration (kWHr)	Normal With Regeneration (kWHr)	Δ Energy (kWHr)
KOW	3842.7	2690.0	1152.6
KTE	3431.3	2267.9	1163.4
MTW	5087.4	3200.1	1887.3
MPS	5391.1	3190.5	2200.6
MSS	4274.8	2952.3	1322.5
MTF	4446.3	3029.0	1417.3
MGP	4800.5	2715.6	2084.8
MBP	4579.4	2316.2	2263.3
MDC	2668.3	1589.8	1078.5
MSC	1650.6	1057.8	592.8
ALM	2026.6	1082.7	943.9
ANA	1576.2	849.1	727.1
AFV	2619.2	1792.4	826.8
ACO	3617.1	2359.1	1258.0
ASL	3836.0	2492.5	1343.5
ABF	3578.7	2266.2	1312.5
AHA	2836.5	1991.4	845.1
ASH	2249.4	1606.6	642.8
AAY	1758.9	1110.4	648.5
AUC	1925.1	1465.6	459.6
AFM	1538.6	1181.9	356.7
KTT	2792.0	1474.0	1318.0
KMA	3089.5	1722.2	1367.4
RAS	1473.2	914.1	559.1

Substations	Normal Without Regeneration (kWHr)	Normal With Regeneration (kWHr)	Δ Energy (kWHr)
RBE	1359.8	864.2	495.7
RNB	1706.2	1125.3	580.9
RCP	2104.1	1324.7	779.5
RCN	1955.0	1421.7	533.3
RRI	1368.1	1104.2	263.9
RRY	286.5	285.1	1.4
CRO	1673.4	1085.4	588.1
CWP	1581.2	1034.4	546.9
COR	3059.2	2087.1	972.0
CAR	1885.0	1116.1	768.9
CLA	2094.1	1549.6	544.4
CCC	1444.7	905.7	539.0
CWC	2318.9	1617.6	701.2
CPH	2361.3	1804.2	557.1
CCY	1878.0	1081.5	796.5
CCO	876.6	575.3	301.3
CGD	588.3	457.8	130.6
CNC	636.6	548.8	87.8
CNS	605.3	525.0	80.2
CER	639.0	471.9	167.1
CPW	603.5	392.3	211.3

SECTION 7

SUMMARY AND CONCLUSIONS

7.0 General

This section of the report presents the summary and conclusions of the Transbay Core Capacity for BART.

7.1 Substation Capacity

In order to determine the adequacy of the transformer-rectifier units at each substation, the simulated rms currents under normal and contingency operations were compared to the rated rms currents of the substations. The substation capacity was found to be adequate for all normal and single contingency operating conditions analyzed. The transformer-rectifier units at the traction power substations are assumed to be the extra heavy-duty type in accordance with NEMA Standard RI-9 and are capable of withstanding short-time overloads due to operations with adjacent substations out-of-service.

The highest rms current loading at a substation under contingency operations was observed in Case CC15-ASL-SS-PL4 where two transformer-rectifier units at substation ASL was out-of-service. The case yielded an rms current of 3,956 amps or 82% of rated rms current for the 3MW unit at Substation ABF. Table 7-1 summarizes the highest rms current loading under the various operating conditions.

Table 7 - 1 - Highest Rms Current Loading

Operating Conditions	Highest Rms Current; Percent of Rating	Substation with Highest Rms Current Load
Normal	2,263 amps; 47%	Substation CRO
Contingency Substation out of Service and half acceleration	3,956 amps, 82%	Substation ABF

7.2 Train Voltages

This section summarizes the findings regarding the adequacy of train voltages under the various normal and contingency scenarios. For the purposes of assessing the adequacy of train voltages, the minimum permissible train was identified as 750Vdc. The findings are summarized by scenario type below and captured in Table 7-2:

(a) **Normal Operations.** The results from the normal operating condition simulated in Case CC-NORMAL showed a low train voltage operating at 742 Vdc at civil stationing 684+13, near Richmond Yard entrance.

(b) **Contingency Operations.** The results from the contingency operating conditions indicated the minimum permissible train voltage criterion not satisfied in four segments along the BART system.

(c) **Bunching/Train Delays.** The results from the train bunching did not result in any low train voltage operating below 750 Vdc.

Table 7 - 2 –Train Voltages below 750 Vdc by Condition and Location

Case ID	Normal and Contingency Operations	Train Voltage	Location
CC-NORMAL	Normal Operations	742 Vdc	Richmond Yard entrance
CC08-MPS-SS-PL4	Substation MPS 5MW+5MW Dual Unit Out-of-Service	725 Vdc	Between Civic Center Station and 16th Street Station
CC23-RRI-SS-PL4	Substation RRI 4MW Single Unit Out-of-Service	687 Vdc	Richmond Station
CC36-CPH-SS-PL4	Substation CPH 3MW+3MW Dual Unit Out-of-Service	671 Vdc	Between Pleasant Hill and Concord Yard
CC42-KTT-SS-PL4	Substation KTT 4MW+3MW Dual Unit Out-of-Service	740 Vdc	Between MacArthur Station and 19th Street Station

7.3 Recommended Improvements to Alleviate Low Train Voltages.

A set of improvements to the existing traction power network was selected based on location proximity, BART personnel recommendations, and space constraints. The identified locations mitigate all low train voltage conditions with Transbay Core Capacity train operations that were found during normal and contingency condition operations. The recommended improvements are as follows:

- Two 5MW substation transformer-rectifier units divided between Civic Center Station and at Montgomery Station
- Two 5MW substation at Richmond Gap Breaker Station RYE
- Two 5MW substation at Pleasant Hill/Concord
- Two 5MW substation at K-Line (34th Street)

7.4 Cable Loading Summaries

a) **Cables Loading.** The results from the simulation indicate there are 4 locations where rms current of all DC feeder cable sets exceeded 555A under normal conditions with regeneration and 10%.

- The highest cable loading overload occurs at Bay Fair (ABF) on the positive feed from dc feeder breaker 3 to track A1 with an rms current of 756 A + 10% which represents a 50% overload condition.

Table 7 - 3 - Highest Rms Current Loading

Substation	Cables	RMS Current (A)	Cable Quantity	RMS Current (A) per Cable	RMS+10% Current (A) Per Cable	% Overload
North Berkeley	PBRNB1_PRNB5	1509	2	754	830	47%
El Cerrito Del Norte	PBRCN1_PRCN3	1996	3	665	732	30%
Richmond	PBRRI1_PRRI4	1628	3	543	597	6%
Bay Fair	PBABF1_PABF3	2269	3	756	832	50%

b) **Mitigation.** Overloaded cables can be mitigated with the installation of additional feeder cables in parallel to increase the ampacity of the cable set.

7.5 Regenerative Braking

The Regenerative braking analysis was performed on the existing substations. The energy savings of these cases are compared to simulations without regenerative braking. The results indicate the following:

- Potential for energy savings through regenerative braking was found to be up to 38,619 kWHr for the normal operations.
- The total systemwide demand was found to be 108,696 kWHr.
- The location with the largest energy savings was observed at Balboa Park Substation (MPB) with input energy reduced by 2,263 kWHr.
- The location with the least amount of energy savings was at the outer C-Line with several substations showing input energy reduced by less than 100 kWHr.

Appendix F

Core Capacity Traction Power Equipment Constructability Review Downtown San Francisco

CORE CAPACITY TRACTION POWER EQUIPMENT CONSTRUCTABILITY REVIEW

DOWNTOWN SAN FRANCISCO

Revision C
May 1, 2017

Prepared by PGH Wong Engineering, Inc.

1. INTRODUCTION AND SCOPE

The Transbay Corridor Core Capacity project will introduce the operation of 28-30 ten-car trains in the peak hour through the Transbay Tube. Through simulation studies and site investigations, the project will recommend potential traction power systems improvements throughout the BART system in order to support traction power demands during the upgraded train service plan. This can be achieved by constructing and installing new dual feed substations. However, due to the limited space available in the downtown San Francisco region, two separate preferred sites are evaluated for installation of single feed substations. Each site is located at an underground passenger station - M20 Montgomery Station and M40 Civic Center Station.

Map of Existing Facilities (Blue) and Proposed New Facilities (Green)

PGH Wong staff performed field site visits and reviewed as-built drawings of the two passenger stations to determine the constructability of building new substations. This constructability review was performed during the preliminary stage when definitive factors such as schedule and unknown project risks were not fully identified at the time. Evaluation of the sites considered the spatial constraints, weight of the equipment, as well as the impact to stakeholders during construction and installation.

2. SCHEDULE AND SEQUENCE

Although a detailed scheduled has not yet been determined, the earliest projected implementation is in the year 2018. The typical duration and sequence of construction work for each new substation site is 2 years as follows:

1. Design and procure TPSS equipment
2. Coordinate utility work (as necessary)
3. Apply for permits, licenses, agreements, and certifications with local jurisdictions (as necessary)
4. Prepare site
5. Provide temporary barriers
6. Relocate or provide protection of other existing equipment
7. Provide civil/structural improvements.
8. Install raceways/conduits through MUNI and BART levels.
9. Modify entry points for TPSS equipment delivery
10. Stage moving equipment
11. Deliver and set TPSS equipment
12. Demobilize and restore facilities
13. Anchor TPSS equipment and install other electrical components
14. Install cables for DC feeder, Negative feeder, and 34.5kV
15. Build permanent fire rated barrier
16. Test and commission

3. TRACTION POWER SUBSTATION EQUIPMENT

Each proposed new substation at the downtown San Francisco stations will consist of several equipment ranging in various size and weight. The equipment can be delivered to the station in individual pieces and anchored at predetermined locations. Below is a table identifying the major equipment with known measurements of weights and dimensions based on recent BART traction power projects.

Typical TPSS Equipment	Quantity	Dimensions (H x W x D in feet)	Weight (pounds over 1000lbs)	Reference (SVBX Project)
AC Switchgear Assembly	3	8’x4’x11’	4200 lbs.	Powell PV38KV Switchgear Specifications dated 2015
Transition Section	1	8’x4’x11’	1000 lbs.	Powell PV38KV Switchgear

				Specifications dated 2015
DC Switchgear Cubicles and Breakers	3	8’x2’x6’	2500 lbs.	Powell DC Switchgear Specifications dated 2015
5MW Diode Rectifier	1	8’x11’x7’	10,000 lbs.	Powell Rectifier Specifications dated 2015
5.5 MVA Rectifier Transformer	1	5’x8’x8’ to 9’x10’x11’	35,000 lbs. to 45,000 lbs.	ABB Inc. dated 2002
Battery System	1	3’x8’x8’	8050 lbs.	Powell PCR Specifications dated 2014
C02/C04 Panel and Monitoring System	1	7’x6’x2’	n/a	Transdyn C02 Panel Layout dated 2012

Table of Major Equipment Sizes and Weight

4. SUBSTATION SITES

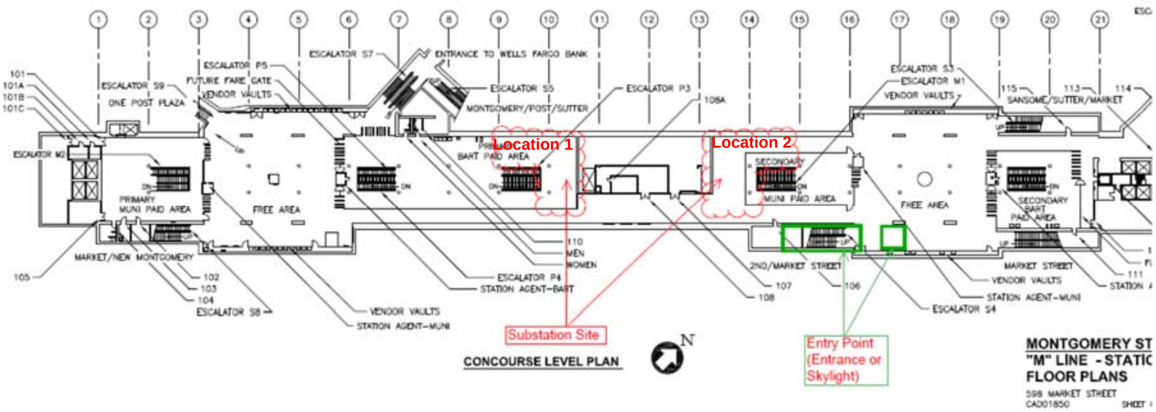
Each substation site contains both similar and unique obstacles during construction and installation of the TPSS equipment as determined by location. Major concerns at both passenger stations are considered as follows:

1. There will be spatial constraints during delivery and setting of equipment into the station. The largest equipment to consider is the 5.5 MVA Rectifier Transformer with dimensions of up to 9’x10’x11’. This will typically require a street level crane setup, work performed during off hours, and traffic mitigations.
2. Overall existing conditions will need structural improvements in order to support TPSS equipment weight. The maximum weight from the 5.5 MVA Rectifier Transformer reaches up to 45,000 lbs. (oil-filled). Along with other equipment, proper placement and distribution of weight should be considered.
3. Routing of raceways/conduits will connect the TPSS equipment at the mezzanine level to the BART track level. Penetration points must be carefully selected while entering the MUNI level and BART level to minimize impacts to the existing structures, embedded features, and operations.
4. A ventilation system with intake and exhaust will be required at the new underground substations. A separate contract will establish the requirements for a vent opening prior to the environmental process, and the results will be included in the environmental document.

Although some facilities were inaccessible and should be visited for confirmation, the following subsections provide findings gathered during as-built reviews and site visits:

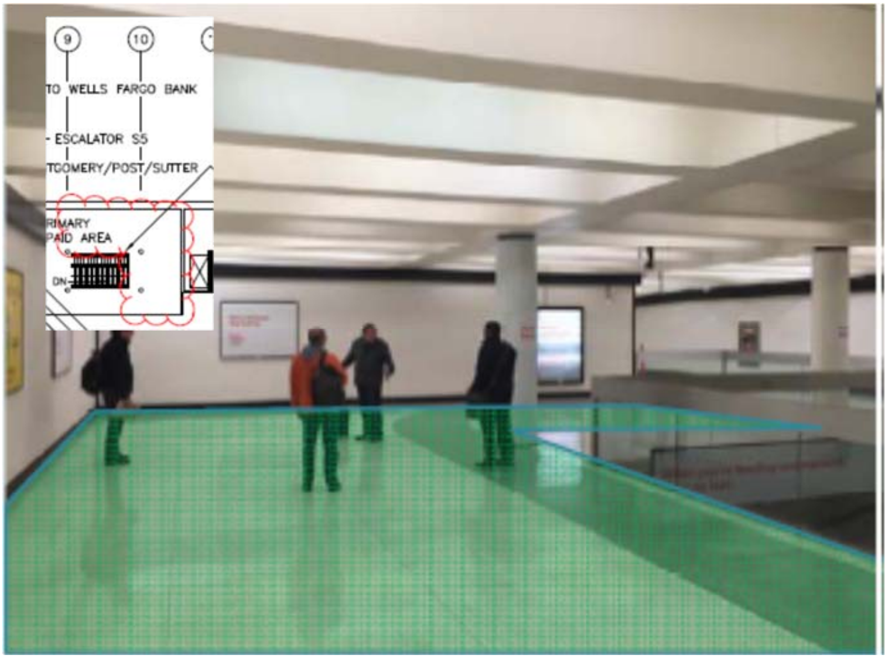
A. M20 - MONTGOMERY STATION

The following floor plan shows the two potential substation sites as well as the entry points for bringing in TPSS equipment at M20 – Montgomery Station.

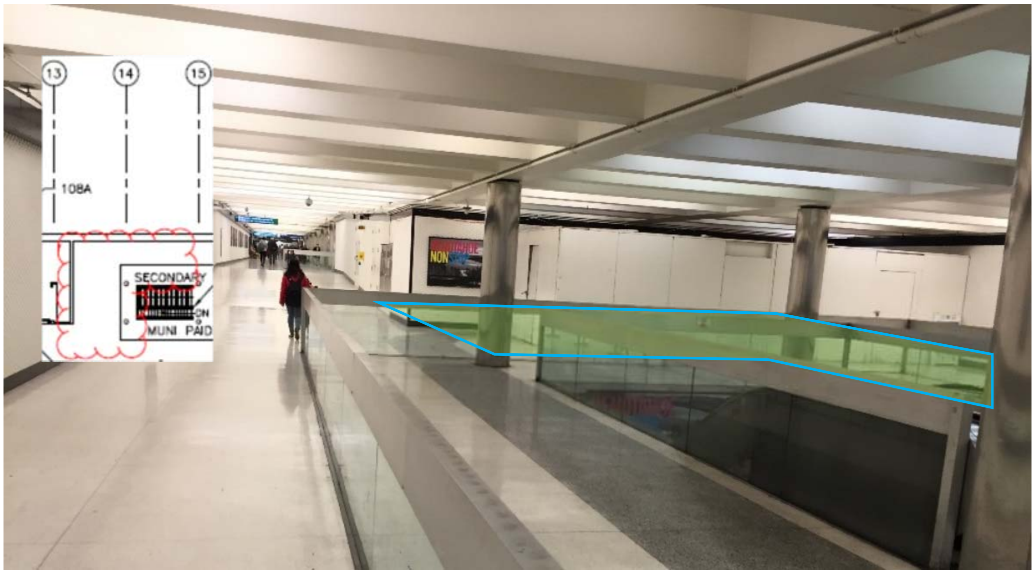


M20 - Montgomery Station Floor Plan with Potential TPSS Site (Red) and Entry Points (Green)

Although both locations reside in an area with minimal foot traffic, the spaces are currently within BART's Paid area or MUNI's Paid area. Redefining the perimeter and paid area barrier will be necessary in the future. Due to the equipment loading, the east location near MUNI's Paid area (Location 2) will require substantial structural improvements in order to support a new substation. The west location near BART's Paid area will require minimal structural improvements (Location 1). However, proper spacing between equipment as well as the stairway should be considered for NEC compliance and structural loading.



M20 - Montgomery Station Substation Location 1



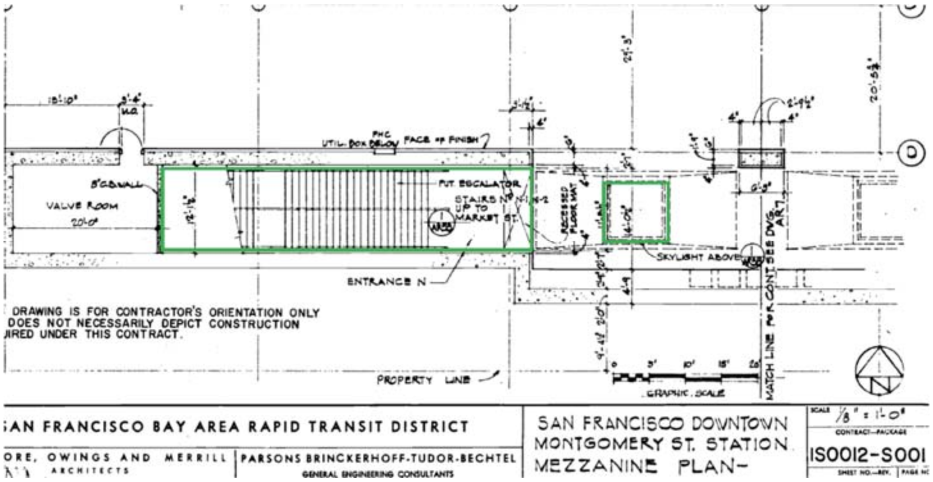
M20 – Montgomery Station Substation Location 2

The minimal ceiling height at the station is 9’-9”, which will allow rolling and placing the rectifier transformer unit at its predetermined location.

M20 – Montgomery Station Measurements

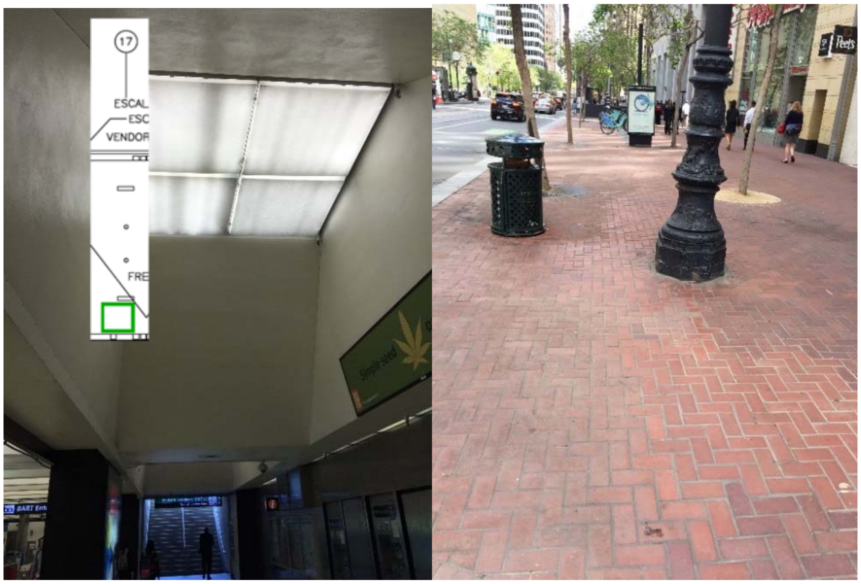
1) STAGING AREAS AND DEMOLITION

There are two alternatives for bringing in TPSS equipment to their final locations: through a skylight or the nearest entrance at 2nd Street and Market Street.



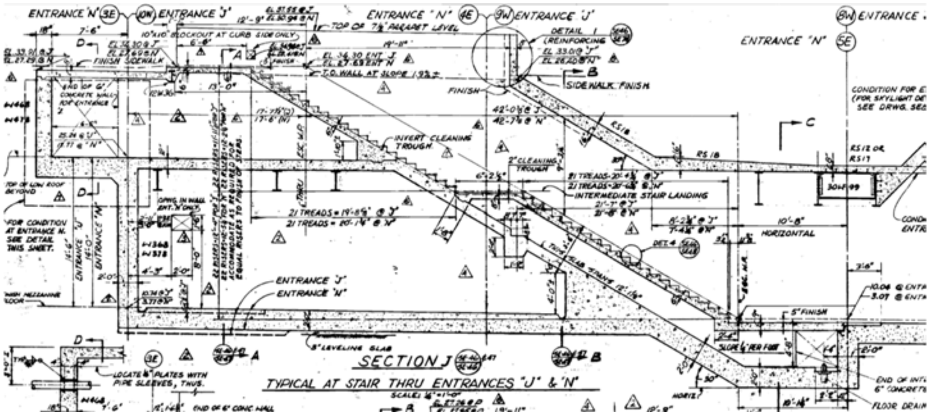
M20 – Montgomery Station As-Built Drawing AR 6-0 dated 1967

M20 – Montgomery Station 2nd Street/Market Street Exit



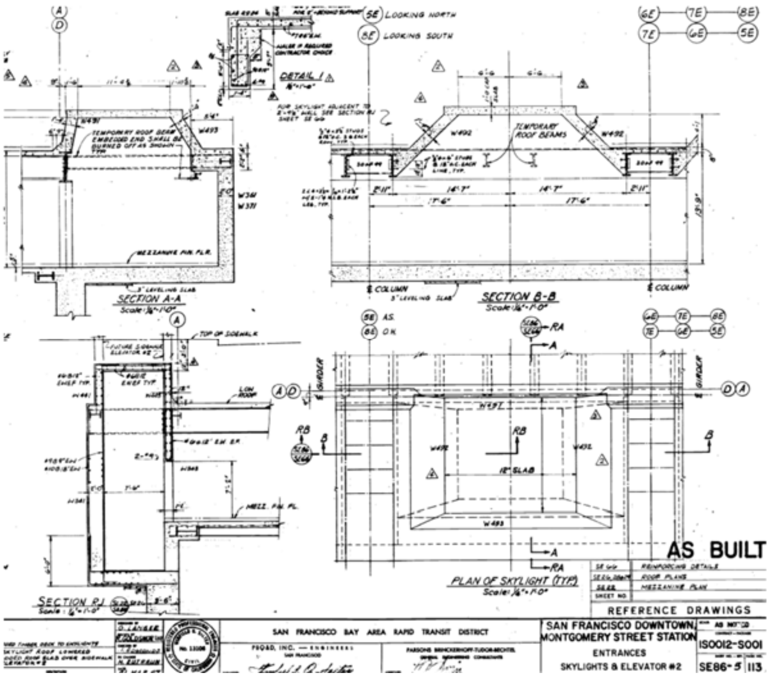
M20 – Montgomery Station Skylight at 2nd Street/Market Street Mezzanine View (Left) and Street View (Right)

According to the As-Built drawing AR 6-0, the entrance “N” at 2nd Street and Market Street is 11’-6” wide. Removal of the escalator and staircase will be necessary for providing an opening to lower the rectifier transformer onto the mezzanine level of Montgomery Station. The following As-Built drawing SE46-7 shows the sectional view of the staircase and escalator with structural crossbeams being a possible obstacle.



M20 – Montgomery Station As-Built Drawing SE46-7 dated 1969

For entry through the skylight, As-Built drawing SE86-5 indicates an opening of about 11.5' x 13' without structural beams. This area can be demolished to provide an opening to lower equipment into the station.



M20 – Montgomery Station As-Built Drawing SE86-5 dated 1969

2) CABLE ROUTING

In order to tie the new substation to the 34.5 kV subtransmission system, provide 1000 V dc feed to the contact rail, and allow negative return, a set of raceway/conduit need to be routed between the substation at the mezzanine level and the BART track level. The conduit should accommodate up to 6-6” conduits and 12-5” conduits, which makes up a cross section of about 20 square feet. In addition, splice boxes and pull boxes will need to be properly positioned to allow 270 degree of bends in conduit routes as well as maximum distance for pulling cables.

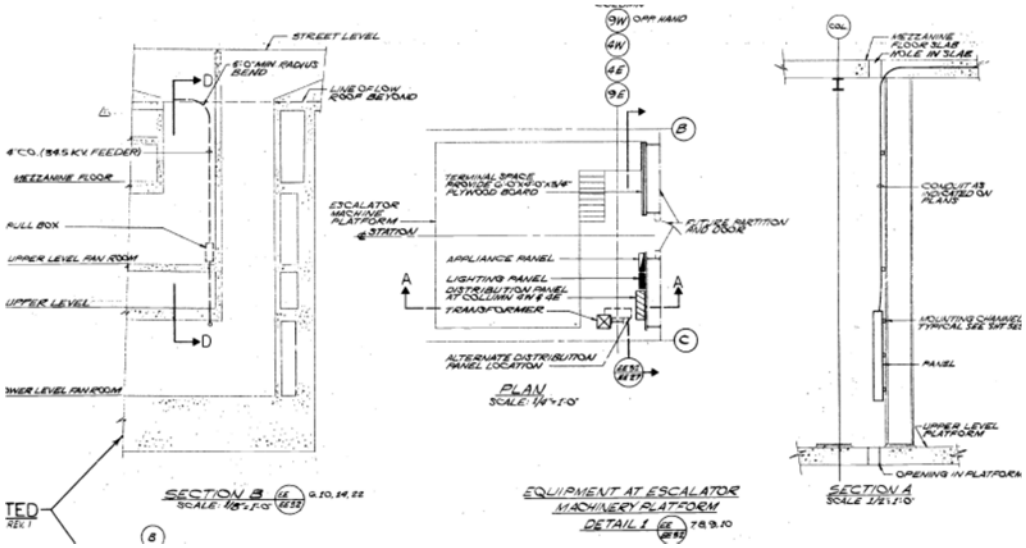
The existing 34.5 kV subtransmission is routed in the MUNI platform area and would require splice boxes in fan room to intercept in place routing for the 34.5 kV cables.

The negative dc conduits and cabling connections would require coordination with the ATC equipment at track level. Impedance bonds would be required at the negative connection.

Exact locations and routing for raceway and conduits have not yet been determined. However, there are potential areas such as niches located near tunnel openings along the MUNI and BART track levels at the end of platforms.

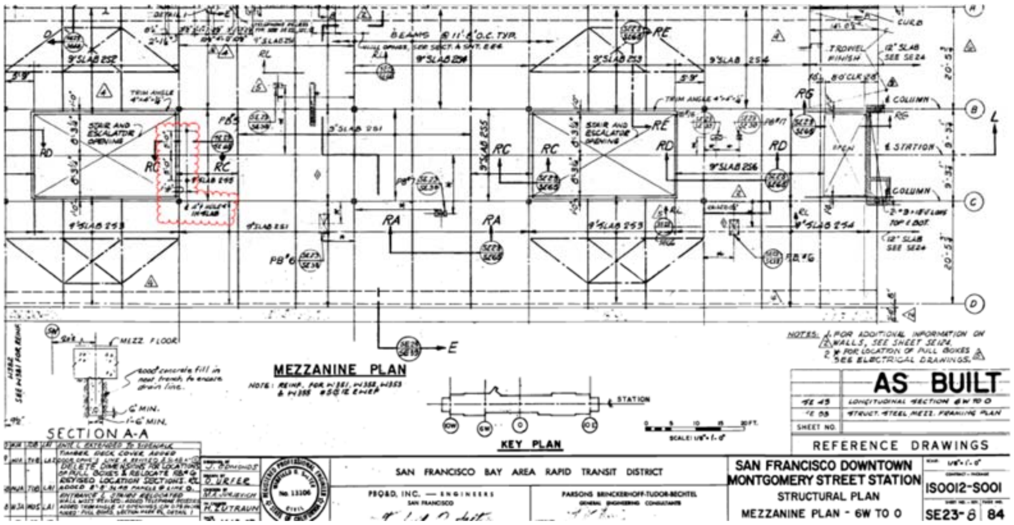
Another possible location would be available by coring through the existing floor slabs while avoiding structural components and routing conduit against the station walls. This would require chipping or coring through existing concrete without disturbing the structural integrity and providing enough space to accommodate necessary conduits. A similar method is presented in M40 – Civic Center Station As-Builts.

While further investigation is necessary, holes in mezzanine slab exist as shown in the M20 – Montgomery Station Electrical Details Part III Drawing EE32-1 with possible routing of the existing 4” conduits for 34.5kV at the column 9W and 4E. These locations may be convenient for both locations 1 and 2.

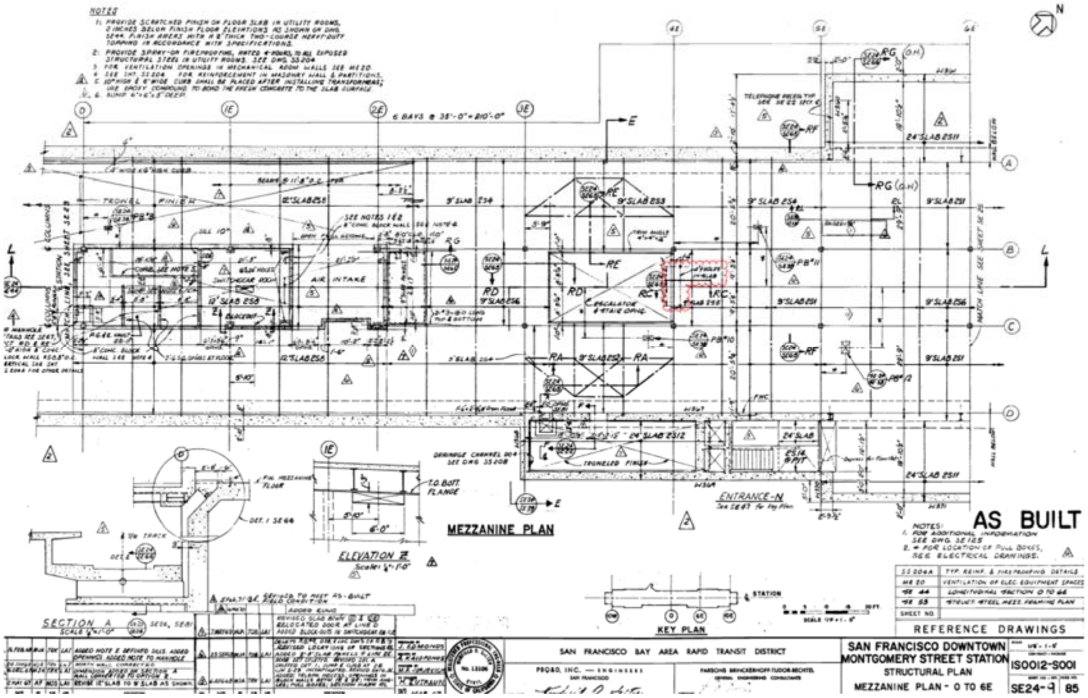


M20 – Montgomery Station Electrical Details III As-Built Drawing EE32-1 dated 1967

Exact locations are identified in the drawings below.



M20 – Montgomery Station Structural Plan As Built Drawing SE23-8 dated 1967



M20 – Montgomery Station Electrical Details III As-Built Drawing SE24-9 dated 1967

Conduits may exit from the substation and route surface mounted or concealed against the mezzanine walls or ceiling before entering through the slab. Once they enter the lower level platform, it may continue along the platform ceiling before coming down to the track level.

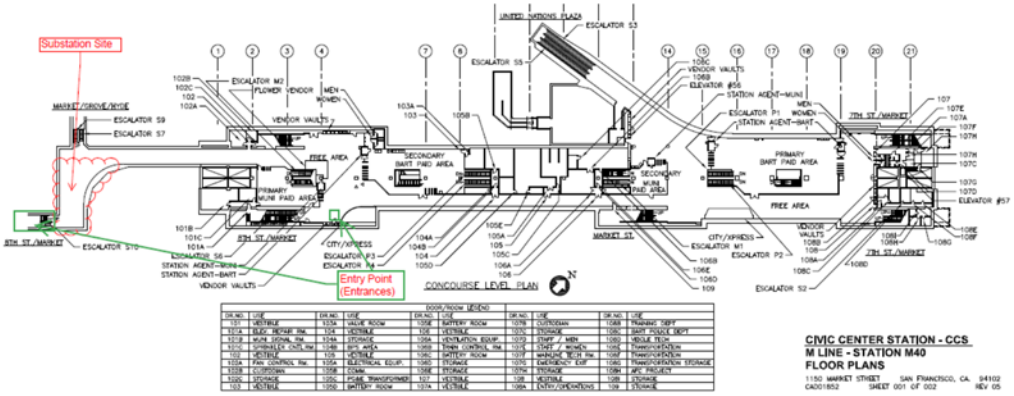
Another route is through the use of existing vent shafts, as long as it does not interfere with the BART line ventilation system. Further investigation and site visits will be necessary to confirm this method. Overall, core drilling through the mezzanine and platform slabs is not an issue as long as careful planning is involved. Ground penetrating radar (GPR) equipment can be used to locate rebar prior to core drilling. Core drilling with a ground detector device should also be used.

3) VENTILATION

For proper ventilation, there will need to be an intake, exhaust, and ducting system integrated into the passenger station in order to accommodate the new substation. BART has indicated that the existing station ventilation system is unavailable. However, an alternative, which will need further investigation, integrates a new ventilation system with sidewalk grates. It is important to consider sourcing only clean air to remove heat and thus not introducing debris into the substation area.

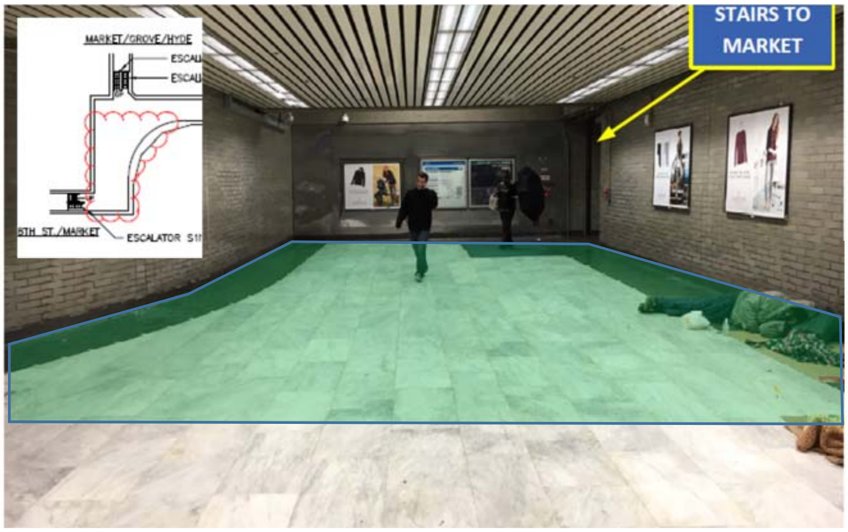
B. M40 - CIVIC CENTER STATION

Only one location has been identified at Civic Center Station. The following floor plan shows the potential substation site as well as the entry points for bringing in TPSS equipment.



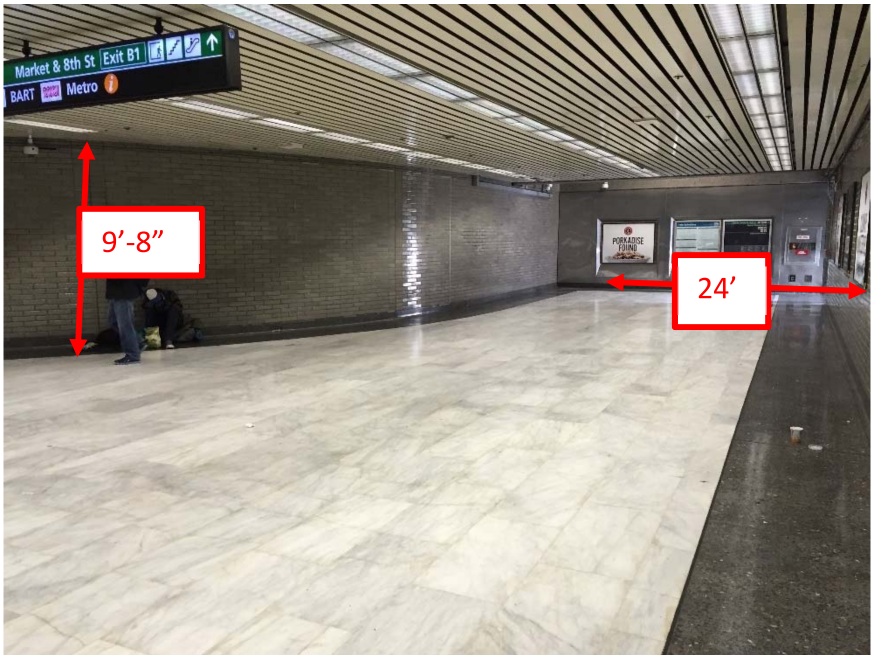
M40 – Civic Center Station Floor Plan with Potential TPSS Site (Red) and Entry Points (Green)

The selected location for the substation site will require closure of both 8th Street and Market Street entrances at the southwest and northwest area of the station.



M40 – Civic Center Station Substation Location

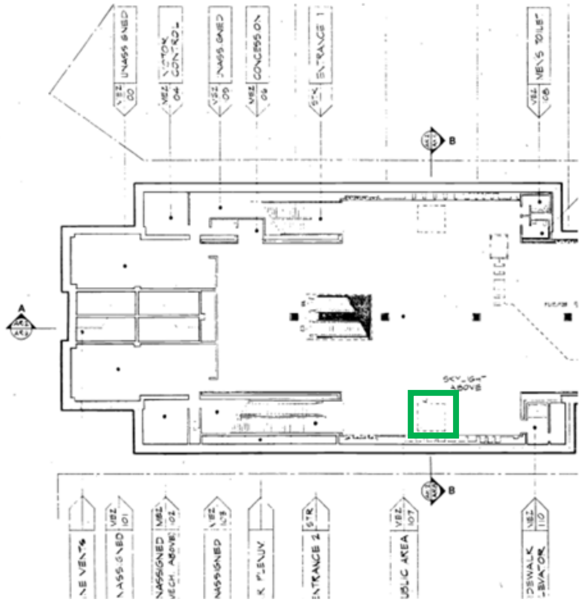
The minimal ceiling height at the station is 9'-8", which will allow placement of the rectifier transformer unit. In addition, the mezzanine floor structure in the area is capable of accommodating the weight of the combined TPSS equipment. No sublevel exists beneath this structure.



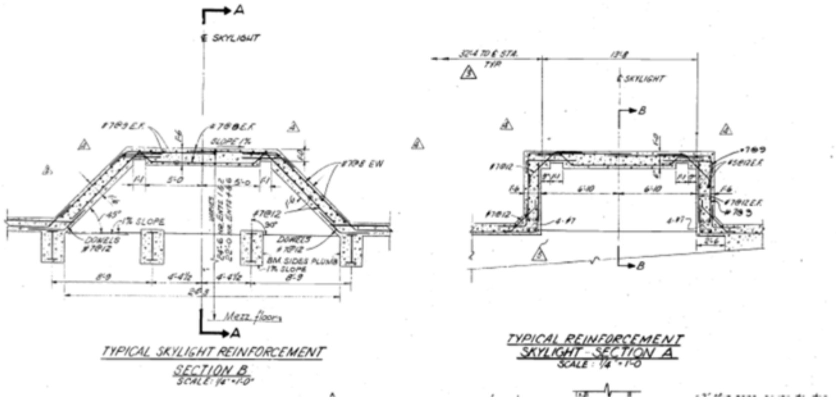
M40 – Civic Center Station Measurements

3) **STAGING AREAS AND DEMOLITION**
There are two alternatives for bringing in TPSS equipment to their final locations: through the skylight or nearest entrance at 8th Street and Market Street. All options would require a crane to lift the equipment at the street level and lower into the mezzanine level.

Use of the skylight at this location would require demolition to allow an opening of up to 13.66'x 24' upon confirmation of structural beams presence as indicated in the As-Built drawing SE657-4.

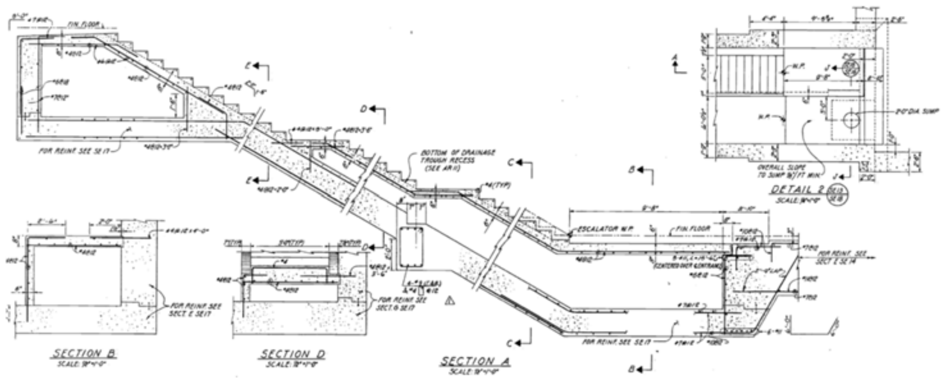


M40 – Civic Center Station Location of Skylight As-Built Drawing AR 2-0 (Green)

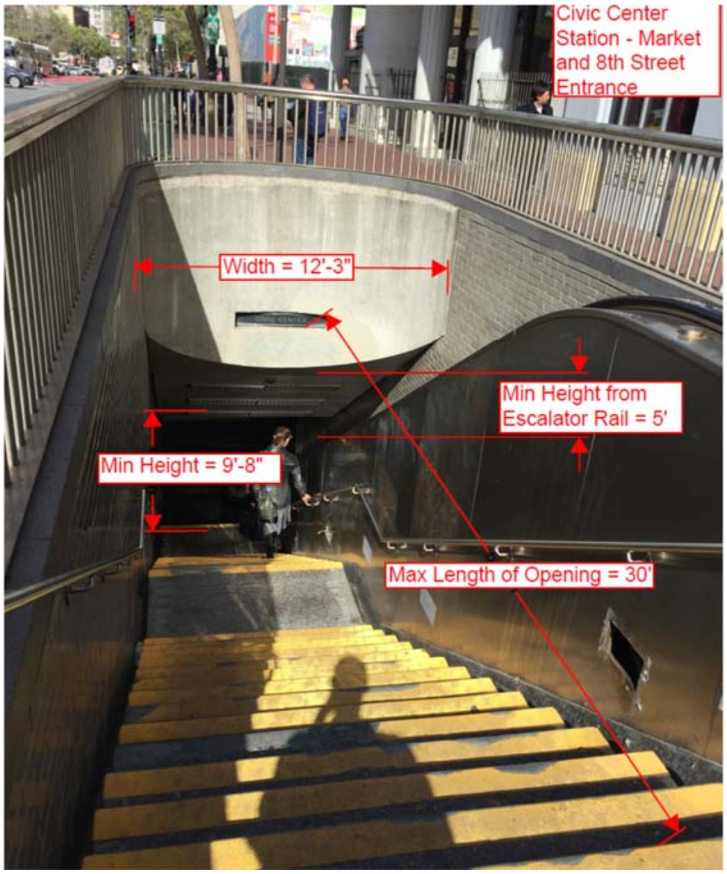


M40 – Civic Center Station Skylight As-Built Drawing SE657-4 dated 1970

Another alternative is to access through the 8th Street and Market Street southwest entrance. Since this entrance will ultimately be closed off due to the installation of the substation, it can be used as an entry point for bringing equipment after demolition, but before restoration. Removal of the escalator and staircase will be necessary during demolition. According to field measurements and As-Built drawing SE18-0, the width of the entrance is 11’ to 12’-3”. Steel reinforcement is present throughout the staircase, but no major structural crossbeams appear. Upon finishing, the entrance will be sealed from public use, but should remain available for maintenance access and emergency egress. A ventilation system may also be integrated as well.



M40 – Civic Center Mezzanine Extension As-Built Drawing SE18-0

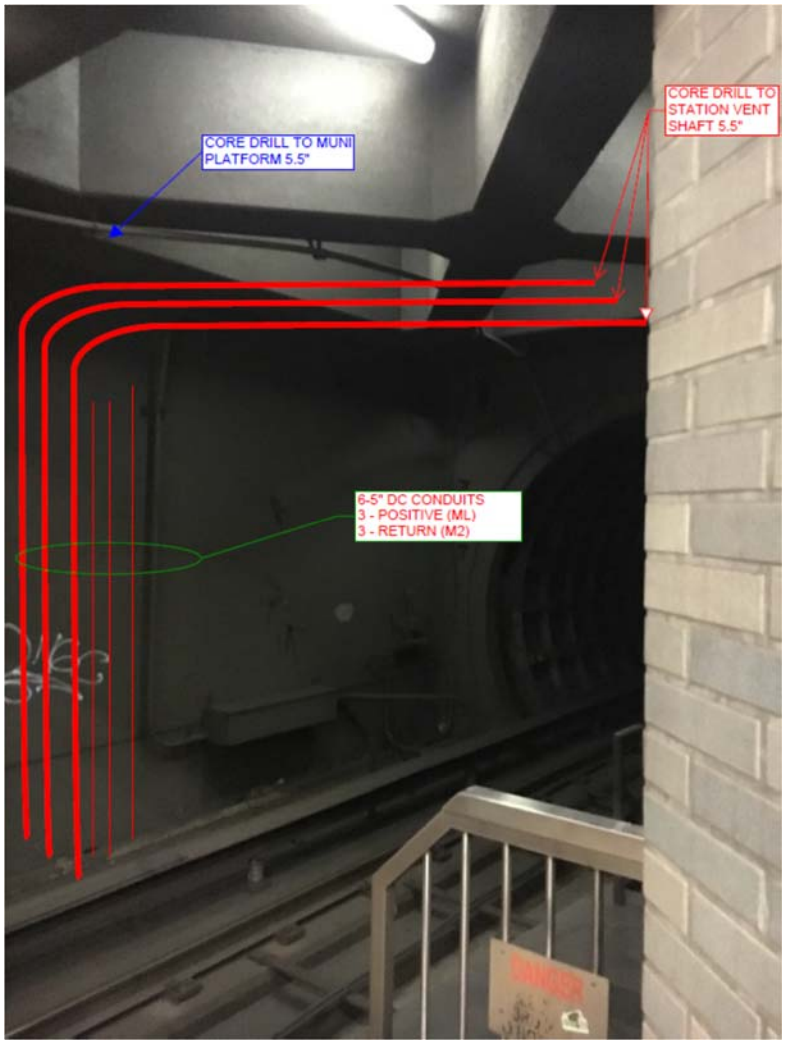


M40 – Civic Center Station 8th St/Market St SW Entrance Measurements

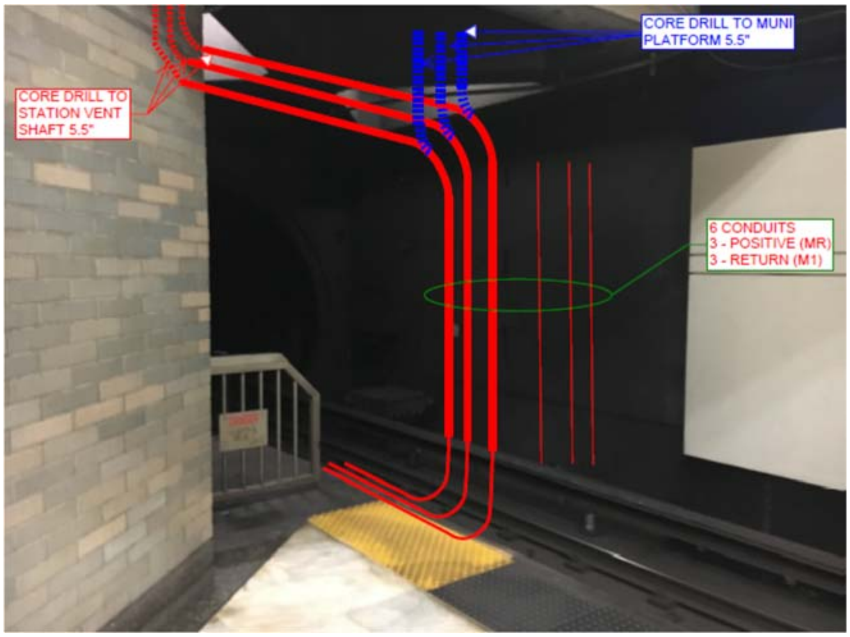
4) CABLE ROUTING

Similar to M20 Montgomery Station, 34.5kV cables and DC feeders need to be routed between the substation at the mezzanine level and the BART track level. The conduits should accommodate up to 6-6” conduits and 12-5” conduits, which makes up a cross section of about 20 square feet. In addition, splice boxes and pull boxes will need to be properly positioned to allow 270 degree of bends in conduit routes as well as maximum distance for pulling cables.

Exact locations and routing for raceway and conduits have not yet been determined. However, there are potential areas identified which can accommodate the necessary space for conduits. This includes niche areas such as those which are located near tunnel openings along the MUNI and BART track levels at the end of platforms.

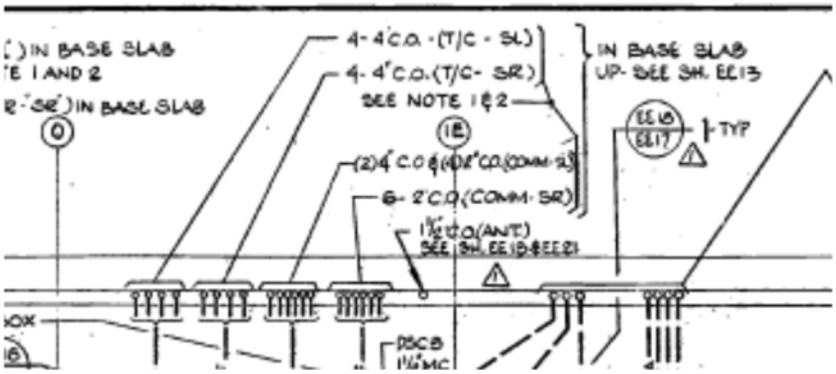


M40 – Civic Center Station BART End of Platform Niche

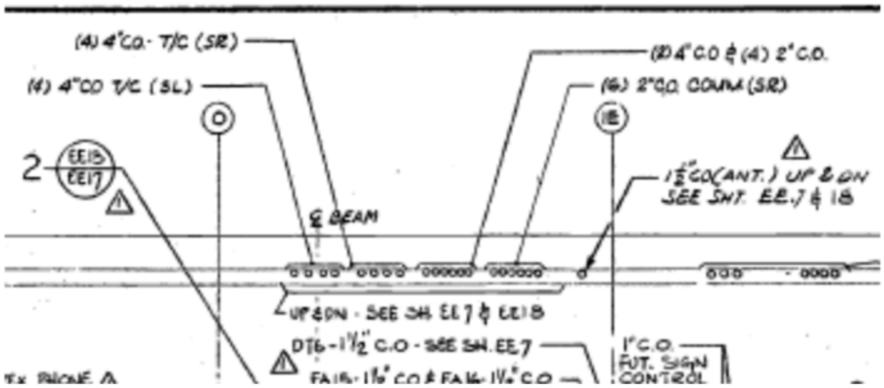


M40 – Civic Center Station BART End of Platform Niche

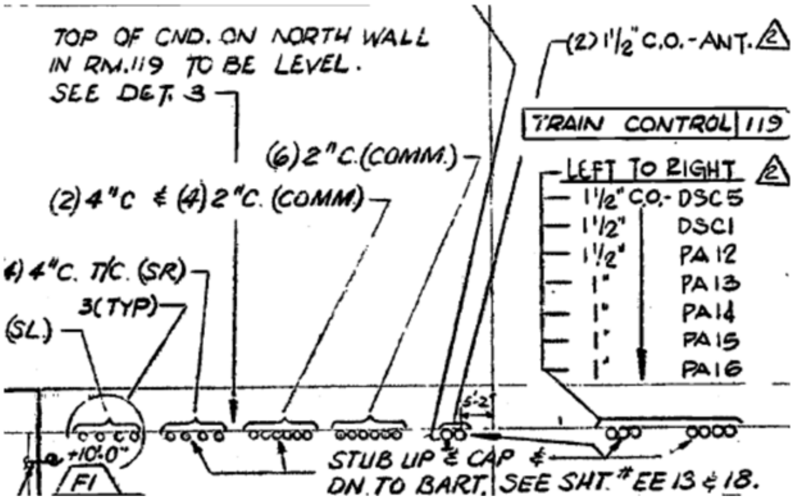
Another possible location would be positioned against the platform walls embedded in concrete. This would require chipping or coring through existing concrete without disturbing the structural integrity and providing enough space to accommodate necessary conduits. A similar method which brings train control conduits from the BART level up to Mezzanine level is shown in the following M40 - Civic Center Station As-Builts EE18-2, EE13-3, and EE7-3 dated 1967. At the Mezzanine level and other levels, conduits can interface into raceways and be supported along the station to its destination by trays or anchors with galvanized rigid steel conduits.



M40 – Civic Center Station BART Level 3W-2E Electrical Plan As-Built Drawing EE 18-2 dated 1967



M40 – Civic Center Station Electrical Plan MUNI Level 3W to 2E As-Built Drawing EE13-3 dated 1967



M40 – Civic Center Station Electrical Plan Mezzanine Level 3W to 2E Drawing EE7-3 dated 1967

4) VENTILATION

For proper ventilation, there will need to be an intake, exhaust, and ducting system integrated into the substation. Both entrances on the northwest and southwest side of 8th Street and Market Street may be closed and replaced with sidewalk vent grates. It will be necessary to locate a source of air that will not introduce unwanted debris from entering the substation equipment. It is also important to consider sourcing only clean air to remove heat and thus not introducing debris into the substation area.

M40 – Civic Center Station Street Level Vent

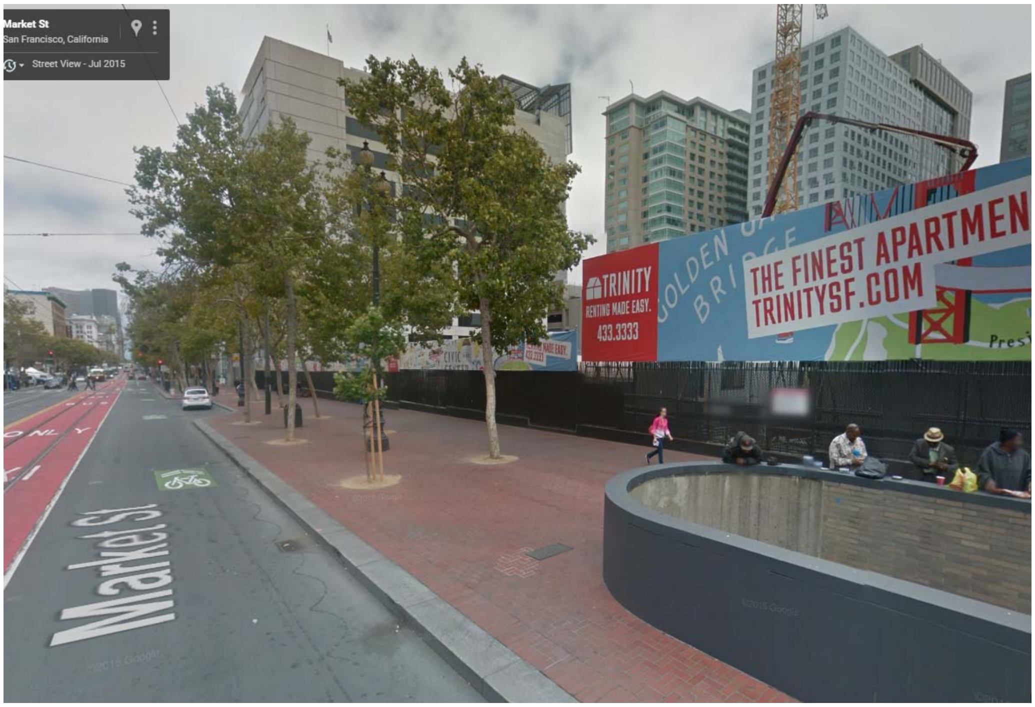
5. IMPACTS AND MITIGATIONS

Construction and delivery of TPSS equipment will impact public areas at the street level and mezzanine level. In order to stage cranes and similar equipment, proper permitting may be required as well as consideration for off hours work. Impact to pedestrians and patrons should also be considered due to the limited sidewalk space at the street level and closure of an entrance.

With staging occurring at M20 – Montgomery Station, the area below for the skylight and station entrance will be impacted at the sidewalk during demolition and at the street for delivery and setting equipment.

M20 – Montgomery Station Staging Area

Staging at M40 – Civic Center Station will occur at 8th Street and Market Street southwest entrance due to closure of the entrance as well as potentially at a skylight near the 8th Street and Market Street northwest entrance.



M40 – Civic Center 8th St/Market St Northwest Entrance Near Skylight Staging Area

M40 – Civic Center 8th St/Market St Southwest Entrance for Closure Staging Area

A. PUBLIC IMPACT

BART is exempt from local permitting requirements. However, BART coordinates all work on city streets and public sidewalks with local jurisdictions for traffic control plans and signage. Work will need to occur during non-peak hours to minimize conflicts with vehicular and pedestrian traffic. BART will conduct outreach activities in conjunction with appropriate city departments.

B. OPERATIONAL IMPACT

During construction and installation, there will be impacts to BART service and MUNI service. Since new raceways and conduits will need to be routed in order to connect the new substation to the existing contact rail system at track level, this work will need to occur during BART and MUNI non-operational hours. Access and work protections from train movement and electrification will need to be implemented.

6. OTHER RISKS

Although not explored in this review, economical and operational risks need to be assessed. Prices of equipment and costs associated with integrating the new substation to the existing BART system may increase. Physical impacts along the trackway, access, and drainage in the tunnels may also impact the project's installation schedule.

Furthermore, due to multiple ongoing or proposed projects occurring at M20 – Montgomery Station and M40 – Civic Center Station, conflicts of schedule and available space may occur. BART has internal processes in place to coordinate track access between projects and to coordinate other work in common locations. See project-level Project Management Plans for details.

Appendix G

Support letter from the San Francisco Planning Department

SAN FRANCISCO
PLANNING DEPARTMENT

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March 20, 2017

Robert Powers, AGM-PD&C
Bay Area Rapid Transit District
300 Lakeside Drive, 21st Floor
Oakland, CA 94612

Dear Mr. Powers:

Thank you for meeting with us on October 6, 2016, and providing an update on BART's Core Capacity Program. We understand that this is a complex program with four major project elements:

- Train Control Modernization;
- 306 Additional Railcars;
- Additional Railcar Storage Facilities; and
- Additional Traction Power Substation Facilities

This program is required in order to allow BART to increase frequencies and provide greater capacity on the BART system through San Francisco. We support BART in moving forward and implementing this program.

We understand that as part of this program, BART needs to install two new traction power substation facilities (TPSS) in San Francisco downtown stations, requiring modifications to the stations and some form of venting to the surface. BART is planning to site these two facilities at Montgomery and at Civic Center, and is proceeding with the CEQA and NEPA processes for these facilities. Obviously, space is limited in the existing downtown stations, and BART has faced challenges in finding suitable locations.

At Montgomery, the TPSS would be located on the concourse level in an area that is currently within the BART paid area. We foresee no complications with this location.

The TPSS at Civic Center would be inside the west end of the station on the concourse level, in an area that is currently used as the westernmost entrance for BART and Muni Metro patrons. BART is proposing to close the two westernmost entrances to the station:

- Portal to Grove Street on the north side of Market Street; and
- Portal to the south side of Market west of 8th Street

To implement this, BART would close off the corridor connecting the main part of the station to these entrances, and then install the substation in this area. Subsequently, there would be no public circulation on the concourse level west of the westernmost SFMTA/Muni faregates. As part of the closures, BART would remove the structures surrounding the current portals. BART would install an escalator at the remaining portal to Hyde Street in front of the Orpheum Theater, and assist San Francisco in making pedestrian improvements to the crossings of both Hyde and 8th Street on the north and south sides of Market Street.

We understand also that BART would install emergency ventilation grates at the sidewalk level at both stations. Current code interpretation indicates that the grates can be constructed flush with the existing sidewalk grade. There would be two grates per station, one for intake and one for exhaust, and current calculations suggest that the size for each would be approximately 4'x6' (24 ft. sq.). At Civic Center, these would be located in place of the existing portals that would be removed. An access hatch for lowering of equipment into the station may also be required at one of the former portal locations. At Montgomery, BART has several options and should work with DPW as the primary contact to locate the proposed vent grates, and any required access hatch.

We understand BART's need to move forward with this project, and support BART's plan as outlined above. As BART proceeds with design work, if any subsequent code interpretation requires a different configuration for the vents, BART must consult with DPW, SFMTA and Planning.

BART should work with DPW Street Use & Mapping to process encroachment permits for the vent grates. We understand that DPW has already calendared this item on the regular quarterly CCSF-BART Coordination meeting, in order to monitor developments as BART moves forward.

Again, we thank you for providing an update on your program, and hope that the project proceeds smoothly.

Sincerely,

John Rahaim
Department of Planning

cc: Mohammed Nuru, DPW
Ed Reiskin, SFMTA

Appendix H

Civic Center Station Egress Analysis and Capacity

NELSON
NYGAARD

MEMORANDUM

To: Tim Chan and Abigail Thorne-Lyman, BART
Kate Howe and Greg Ball, VIA

From: Nelson\Nygaard

Date: July 31, 2015

Subject: Civic Center Station Egress Analysis and Capacity

Total Station Egress Capacity

Nelson\Nygaard has completed a comprehensive egress capacity analysis for Civic Center Station, for projected passenger loads and ridership in 2040. Because ridership forecasts for Civic Center station entries are highest during the PM peak period, egress analysis results are presented for the 2040 PM peak period. Analysis assumptions and capacity calculations are outlined below.

For analysis purposes, egress capacity is generalized across the entire station, rather than assigned to separate portals. This assumes that passengers will utilize the nearest exits or shortest lines where queuing occurs. Therefore, details about exits by fare gate array or station portal are not considered in the capacity analysis. This assumption was applied to egress calculations for the BART-only passenger load with a focus on BART platform to concourse, and the same assumptions are applied to egress calculations for the combined BART-Muni load for BART and Muni platforms to street level.

The follow assumptions inform the calculations for exit time and station exit capacity:

- With crush load train capacities and 2040 PM peak forecasts applied to waiting passengers for both BART and Muni we calculate up to 4,572 passengers must be accommodated.
- We conservatively assume that the first BART passenger and the first Muni passenger will arrive at the concourse exit stairs at the same time. This is determined by the distance and speed of BART passengers traveling up the platform stairs and across the concourse. According to the existing BART egress calculations, we assume 0.92 minutes for the first BART passenger to move from the BART platform to the nearest concourse stair. This path includes travel up the platform stairs, through the faregates, and through the concourse to the concourse stair.
- The California Building Code (CBC) requires that the entire station is cleared in 6 minutes; this leaves 5.08 minutes for the combined BART and Muni passengers to exit the station through the concourse stairs.
- There are 34 stair lanes available for exiting concourse to street (according to VIA's Table 3.9 in the Existing Conditions Tech Memo). CBC code assumes that with queues, stair lane capacity is 35 people per minute per stair lane. With 34 stair lanes, the station provides an exit capacity of 1,190 people per minute from concourse to street.

- The exit capacity for all concourse stair lanes over the 5.08 minutes available to clear the station is calculated as (1,190 people per minute) * (5.08 minutes) = 6,045 people exit capacity. This total is approximately 32 percent higher than the conservative estimate of 4,572 total combined BART and Muni passengers for the 2040 PM scenario.

Calculation assumptions are summarized in the following table:

Element	Constraint	Assumption for Civic Center BART and Muni Passengers	
Total exiting passengers for BART and Muni	2040 PM peak period; CBC passenger load includes exiting passengers for peak and off-peak direction trains, and waiting passengers on platform for two missed headways	Peak direction train arrives with maximum capacity, off-peak direction train arrives with 80% of maximum load, and passengers waiting on platform include entries for 4 minutes during the peak 15 minutes	**4,572 total BART and Muni passengers** exiting at PM Peak period in 2040
Time for first BART passenger to reach concourse stairs	Account for distance and speed from platform to fare gate, and fare gate to concourse stair	Consistent with current BART egress analysis: 0.8 minutes from platform to fare gate, 0.12 minutes from fare gate to concourse stair	**0.92 minutes** for first BART and Muni passengers to converge at concourse stair
Time remaining to clear station	Station must be totally clear in 6 minutes	Concourse to street level clearance begins when first passengers arrive at concourse stairs	**5.08 minutes** remaining for all passengers to exit to street level
Concourse to street stair capacity	35 people per minute per stair lane	34 stair lanes available (excluding two south entrances)	**1,190 people per minute** exit capacity for concourse stairs
		5.08 minutes for passengers to exit through concourse stairs * 1,190 people per minute capacity at Civic Center BART	**6,045 people total exit capacity** for concourse stairs at Civic Center BART

All of the above is consistent with CBC egress guidelines. This is especially conservative because in reality not all passengers will be located on the platform at the start of an evacuation scenario, and many Muni passengers will exit without queuing before the BART passengers exiting the platform arrive at the concourse. Therefore, the question of technical capacity constraints does not apply to the exit closure discussion.

Potential Station Portal Closure Impacts

The typical distribution of passenger exits across station portals does not apply during an emergency egress scenario. However, in considering potential impacts of station portal closures, we are primarily interested in current passenger exit patterns during the AM peak hour, as this is the peak period for station exits.

According to the AM peak passenger counts conducted in February 2015, out of a total of 10,157 AM Peak passenger exits, just under half of exiting passengers used the 7th Street/ UN Plaza exits on the north side of the station, and just over half of exiting passengers used the 8th Street/ Grove Street exits on the south side of the station. Among those exiting through the south portals,

2,815 passengers used the two southernmost portals, or approximately 28 percent of all AM peak passenger exits, and 2,452 passengers used the Orpheum/Trinity portals, or approximately 24 percent of all AM peak passenger exits. If southernmost portals are closed the passengers would likely use the Orpheum/ Trinity exits instead, making these portals the busiest pair in the station for typical weekday AM passenger exits.

Appendix I

Core Capacity Noise and Vibration Technical Memorandum

May 2017

Noise and Vibration Technical Report

Transbay Corridor Core Capacity Program

BART Planning, Development, and Construction

Transbay Corridor Core Capacity Program

Noise and Vibration Technical Report

May 2017

Prepared by:

Transit Modernization Partnership

For:

BART Transbay Corridor Core Capacity Project

BART Agreement No. 6M6068

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Acronyms

ANSI	American National Standards Institute
BART	Bay Area Rapid Transit District
CBTC	Communications-Based Train Control
CNA	Community Noise Analyzer
CWR	continuous welded rail
dBA	decibels, A-weighted
EA	Environmental Assessment
FTA	Federal Transit Administration
HMC	Hayward Maintenance Complex
ISO	International Standards Organization
Ldn	Average day-night sound level
Leq	Equivalent continuous sound level
LT	Long-Term
NEPA	National Environmental Policy Act
MPH	miles-per-hour
NIST	National Institute for Standards and Technology
PPV	peak particle velocity
SEL	Sound Exposure Level
SLM	Sound Level Meter
ST	Short-Term
TMP	Transit Modernization Partnership
US	United States
VdB	Vibration velocity level, in decibels

1.0 INTRODUCTION

This Noise and Vibration Impact study addresses refurbishment and/or construction of new facilities associated with the Bay Area Rapid Transit District (BART) Transbay Corridor Core Capacity Project (Project). This study considered two elements of the Project: Traction Power Substations (TPSS) and Communication Based Train Control (CBTC). Noise and vibration impacts associated with a third element of the Project, the Hayward Maintenance Complex Phase II (HMC), were studied by others and are documented separately. This assessment was conducted in conformance with the Federal Transit Administration (FTA) *Transit Noise and Vibration Impact Assessment* Final Report No. FTA-VA-90-1003-06, May 2006, Office of Planning and Environment, Washington, DC, and guidance provided specifically for the Project by FTA noise specialist staff and BART staff. This report summarizes the noise and vibration aspects of the Project.

2.0 PROJECT DESCRIPTION

The Bay Area Rapid Transit (BART) system currently consists of 112 route miles of heavy rail transit serving 46 stations in San Francisco, in the East Bay, and on the Peninsula. An additional 10 route miles and 2 stations are currently under construction south of Warm Springs, and an additional 10 miles and 2 stations are being built in eastern Contra Costa County. The system operates as five lines designated by different colors - Yellow, Green, Red, Orange and Blue. Four of these lines - all but the Orange Line - merge into a single double-track alignment connecting San Francisco and Oakland, which operates through the Transbay Tube. Figure 1 shows the existing system.

Figure 2-1. BART System

On the main trunk of the BART system, from the Oakland wye through the Transbay Tube to Daly City, BART currently operates a maximum of 23 trains per hour in the peak direction. Train lengths vary, but currently average 8.9 cars per train in the peak. Between Oakland and San Francisco, peak hour trains are crowded and ridership is growing. As the system expands and as the core continues to attract development, further increases in ridership are expected.

BART is proposing a package of strategic investments that will increase capacity between San Francisco and Oakland by more than 30 percent. During peak hour (weekdays from 8 to 9 am and 5:30 to 6:30 pm), the number of trains operating through the tube will be increased from 23 per hour to 30 in each direction, and train lengths will be increased from an average of 8.9 to 10 cars per train. The Transbay Corridor Core Capacity Program will allow BART to operate up to 30 ten-car trains per hour on the existing system and the extension to Berryessa, maximizing throughput in the most heavily used part of the system. The program includes four elements:

1. Expansion of the rail car fleet by 306 new cars;
2. Phase 2 of the Hayward Maintenance Complex (HMC);
3. Communication-based train control (CBTC) system;
4. Five additional traction power substations (TPSS)

2.1 Expansion of the rail car fleet by 306 new cars

Per FTA policy, operation of additional vehicles is not a part of this noise study. However, a brief summary of the improved fleet is provided for information only.

The existing fleet of 669 BART rail cars is at the end of its useful life and is being replaced. BART is starting to receive deliveries on an order of 775 vehicles, including 669 replacement vehicles and 106 vehicles for extensions and capacity expansion[1].

In a second phase of vehicle procurement, BART intends to acquire an additional 306 new rail cars, bringing the total fleet to 1081 vehicles.

Of the 306 additional cars to be acquired in the second phase, 252 are needed for BART to operate 30 ten-car trains per hour on the four lines that operate through the Transbay Tube (Red, Blue, Green and Yellow). The remaining 54 are to increase capacity on the Orange line (which does not operate through the Transbay tube) and to provide additional cars for the ready reserve fleet.

2.2 Hayward Maintenance Center, Phase 2

The current storage capacity across all of BART's yards and tail tracks is 893 vehicles. To accommodate the additional 306 new vehicles, and to maintain functional yards with room to properly marshal trains, BART will construct HMC Phase 2 to provide storage for 25 ten-car trains, or 250 additional rail vehicles. The yard will be constructed with access to the existing yard and electrified such that it may serve as a fully operational vehicle storage facility. The HMC offers the only practical site to expand storage on the BART system to accommodate the additional cars that are part of the Transbay Core Capacity Program. HMC Phase 2 provides for additional storage capacity only. Added maintenance capacity will be provided by the HMC Phase 1 project, which is separately funded and outside the scope of the Transbay Corridor Core Capacity Program.

The HMC Phase 2 project has already been through independent CEQA and NEPA processes, and is not included in the CEQA approval being sought as part of the Statutory Exemption, but is listed in this section so that a complete description of the project is included.

2.3 Train Control Modernization Project (Communications-Based Train Control)

To achieve the shorter headways needed to operate 30 regularly scheduled trains per hour through the Transbay Tube, BART will replace its existing train control system with a new Communications Based Train Control System (CBTC).

The new CBTC system will be based on a moving-block signaling approach throughout the existing system plus the extension now under construction between Warm Springs and Berryessa. The new CBTC system will consist largely of lineside equipment installed within BART's existing right-of-way throughout the entire system. Existing signaling equipment will be overlaid with the most current electronics, software, computer systems, and cabling. New zone controllers, radio antennas, interlocking controllers and wayside radio transponder tags will be installed throughout the trackside alignment, train control rooms and central control facilities. Cars and maintenance vehicles will be outfitted with processor based controllers, transponders, communication equipment and location sensors.

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[1] Bay Area Rapid Transit (BART) *New Train Car Project* http://www.bart.gov/about/projects/cars/why-new-cars [Accessed on August 17th 2016]

Installation activities will include trenching for new cabling, concrete pads for electronic equipment and radio antennas along the trackway as well as new racks, servers, computers, communication equipment and cable trays within the wayside train control rooms and central control facilities. These activities will take place within existing BART right-of-way.

BART has developed an eight-phase implementation program that will begin by testing CBTC equipment on the existing test track adjacent to the HMC. Once the CBTC equipment has been sufficiently proven on test tracks, BART will implement CBTC along the mainline tracks starting from the system's endpoint in Millbrae and expanding north into downtown San Francisco, through the Transbay Tube, and into the East Bay, extending to Richmond, Pittsburg-Bay Point, Dublin/Pleasanton, and to Berryessa.

In order to achieve higher frequency service in the peak hour, CBTC is required along the tracks leading up to and through the Transbay Tube. Once CBTC phases 1 through phase 4 and a portion of phase 5 have been implemented, frequencies can be increased in the Transbay Corridor. The scope of the CBTC project includes installation of lineside equipment within BART's existing right-of-way throughout the entire system.

2.4 Traction Power Substations

BART has conducted traction power simulations to assess the power requirements associated with operating 28-30 regularly-scheduled ten-car trains through the Transbay Tube per hour. The increased train lengths and more frequent peak period trains will require additional traction power during operation. BART has conducted simulations to assess the power requirements associated with operating 30 regularly scheduled ten-car trains through the Transbay Tube per hour. The simulation assumed 30 trains per hour, and included simulations of various delay scenarios that would lead to bunched trains, providing a safety factor or contingency in the analysis. It also assumed the electrical profile of BART's new vehicles as well as the CBTC system necessary to operate trains this frequently. The simulations revealed specific areas along BART's mainline where the traction power requirements exceed the capacity available from BART's existing traction power system (Figure 2-2):

1. Richmond - RYE Gap Breaker Conversion
2. Concord - David Ave and Minert Road
3. Oakland – near I-980 on 34th Street
4. Downtown San Francisco - Civic Center Station
5. Downtown San Francisco - Montgomery Station

Although two of these sites, Richmond and Pleasant Hill, are outside that part of the system where demand exceeds capacity, added power is needed at these points in the system in order for BART to operate the added service through the Transbay Tube at the higher frequencies. Four alternate sites have been identified in case one or more of these five sites proves to be unfeasible.

Figure 2-2: General Location of Additional TPSS Substations

The three locations in the East Bay are all within existing BART or Caltrans right-of-way and are at-grade locations. The two sites in San Francisco are located below grade within existing BART stations, and include two new required emergency vents per station. BART will build these vents to conform to current code, which allows these vents to be built at-grade within the sidewalk right-of-way above the stations. BART is also undertaking a major program to replace and upgrade the existing traction power system. While this program will increase the amount of power available for train operation, it is not considered to be part of the Core Capacity Project.

3.0 NOISE AND VIBRATION

The noise and vibration analysis focused on the CBTC and TPSS elements of the Project, and will be incorporated into the National Environmental Policy Act (NEPA) documentation being prepared for the CBTC, TPSS, and vehicles elements. Separate noise analyses and NEPA documentation have been prepared for the HMC, and HMC is not part of this noise and vibration study scope[2]. Further, as directed by FTA, this noise analysis considers only the noise and vibration that would be generated by the physical changes to the environment that are to be funded by FTA and installed as part of the Project. FTA deemed changes to train lengths and frequencies to be local operational decisions and outside the scope of the federal action[3].

This study assessed the potential for ongoing airborne noise impact on noise-sensitive land use located in proximity to new and refurbished facilities associated with the Project. Because ground-borne vibration impact is not possible from operation of either TPSS or CBTC, vibration from these sources was not further studied. The study includes measurements of existing ambient noise collected by the Transit Modernization Partnership (TMP) staff between June 20th and June 24th, 2016, and the use of available environmental noise data developed by the City of San Francisco.

The Study described herein, including the measurements, modeling, and impact avoidance or possible mitigation was carried out in conformance with FTA and BART policy guidance. In response to BART direction, this report provides noise emission limit criteria that may be used to develop engineering design/purchase specifications and/or include Project features (e.g., noise barrier) that would avoid noise impact from the proposed Project facilities. The impact avoidance criteria is based on the traditional method of comparing environmental noise levels currently experienced in the noise-sensitive environs of the Project facilities to the FTA noise impact criterion levels for the appropriate land use type. The goal of the Project design with respect to noise and vibration is to have no impacts. This is consistent with the Project's overall environmental goal of qualifying for a Categorical Exclusion under the National Environmental Policy Act (NEPA).

An initial analysis of the potential for vibration impact from operations of proposed new Project facilities such as TPSS and the CBTC equipment determined there would be no operations vibration impact. Applicable FTA guidance is that further detailed vibration impact analysis is not appropriate or necessary except for construction phase activity that will be addressed. Thus, going forward, the discussion in this report will focus on the assessment and prevention of long-term noise impact.

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[2] An environmental analysis of HMC was prepared by AECOM and incorporated into environmental documentation required under the California Environmental Quality Act. FTA subsequently relied on this documentation to issue a Categorical Exclusion for HMC pursuant to NEPA. In "Section 5.12. Noise and Vibration" of their study AECOM states:

> "The 2011 IS/MND determined that the HMC Project would result in less-than-significant impacts related to noise and vibration with implementation of mitigation measures NO-1, NO-2, NO-3, NO-4, and NO-5. As discussed below, the proposed modifications would not result in a change in this CEQA determination."

[3] E-mail from Dominique Paukowits, FTA Region 9, August 31, 2015.

3.1 The Impact Assessment Process, Noise Descriptors, and FTA Noise Impact Criteria

The impact evaluation process, basic noise information, and noise impact criteria are discussed in this section. More extensive information is provided in FTA's guidelines manual (FTA 2006). The impact assessment provided in this TM is consistent with the FTA 2006 manual plus specific FTA guidance applicable to this project.

3.1.1 Impact Assessment

In brief, the assessment of noise impact potential and possible mitigation consists of a few well-defined steps:

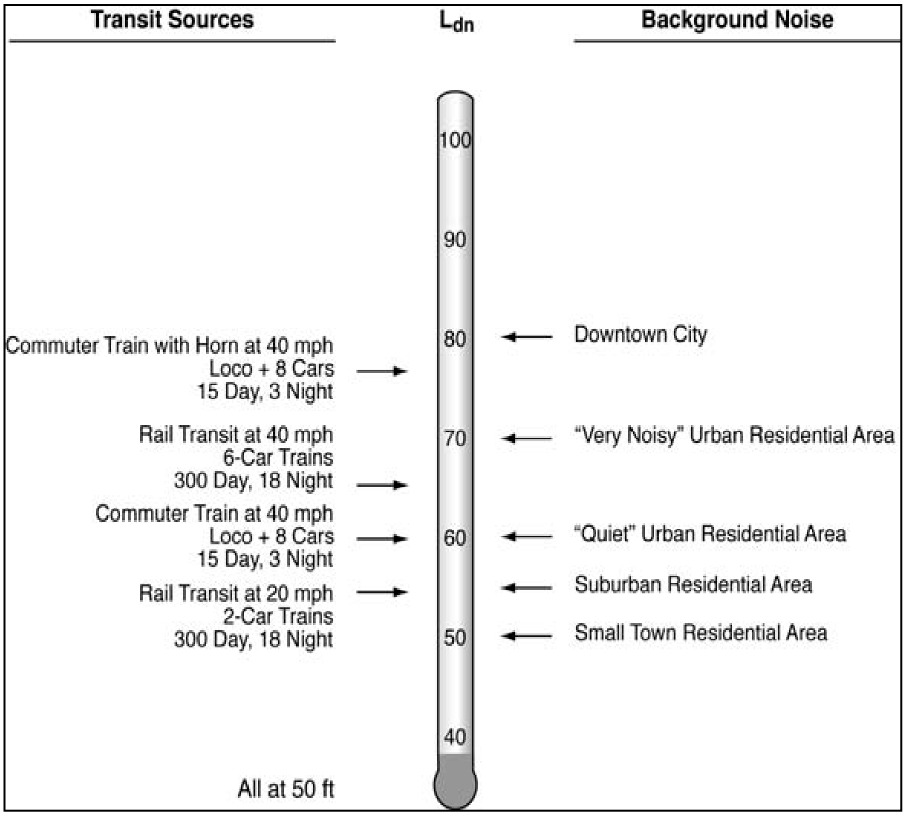
- Identify noise-sensitive land use types that are located in proximity to project-related construction and/or future operations locations. The identified noise-sensitive uses are called receivers or receptors.
- Quantify, by measurement if practicable, the existing noise environment at receptors located near the potential project facilities. Because existing noise level at receivers is a very important parameter in the impact evaluation, accurately describing the existing noise level benefits the project proponent and the potential receptors.
- Calculate the expected project noise levels at the various receivers and compare these expected noise levels to the existing environmental noise level and the FTA impact criteria for the location to determine if impact is likely to occur, **or**
- Evaluate the existing environmental noise level and the FTA impact criteria for each project site with a nearby noise-sensitive use and develop a *specific project noise limit* that would result in No Impact for that site. This option has been requested by BART.
- Determine if action is required satisfy the project noise limit and thus, avoid impacts. As indicated in the Summary section, the action(s) may be to incorporate noise emission criteria into equipment specifications, provide a modified site layout, regulate construction activities, and/or construct noise enclosures or barriers as part of the Project design.

3.1.2 Noise Descriptors

The basic unit of measurement for environmental noise is the decibel (dB), which is a logarithmic measure of sound amplitude that tracks closely with human perception of loudness. To better account for human hearing sensitivity to different frequencies contained in sound or "unwanted sound" called noise, the sound level is quantified in units of "A weighted decibels" (dBA). The "A" scale approximates the average human ear's sensitivity to sounds comprised of many different frequencies. The terms "sound" and "noise" are used interchangeably in this report.

The most commonly used noise metric (also called a "noise descriptor") is the Equivalent Noise Level (Leq), which is the energy average of all the sound that occurs during a measurement period. A descriptor known as Average Day-Night Noise Level (Ldn) is nearly universally used to evaluate environmental noise in areas with noise-sensitive land uses that include sleeping quarters such as permanent and transient residential use. The Ldn is a 24-hour Leq with a 10-dB penalty added to noise occurring from 10 PM in an evening to 7 AM the following morning. The effect of this penalty is that, in the calculation of Ldn, any sound (or noise) event occurring during nighttime hours is equivalent to 10 identical events occurring during daytime hours. This strongly weights Ldn toward nighttime noise, to reflect that people are more easily disturbed and annoyed by noise during nighttime hours when background sounds may be lower and most people are sleeping.

During the field noise measurements, the Ldn values were between 51 and 83 dBA for potentially impacted Category 2 (residential) use not located in San Francisco. The City of San Francisco data show existing Ldn between 74 and 76 dBA for the areas near downtown potential TPSS locations. Figure 3-10 provides typical Ldn values experienced in a range of residential and urban areas across the country. A rural area with no major roads nearby would have a typical Ldn of around 40 dBA; a very noisy urban residential area would average about 70 dBA and just above 80 dBA for the downtown area in a large city.



Source for figure: Transit Noise and Vibration Impact Assessment, (FTA 2006)

Figure 3-1. Typical Ldn Values

The Leq, described previously, can be stated as an energy-average sound level for specified time durations such as 30 minutes, or 1 hour, or other defined period. FTA noise impact criteria apply the hourly Leq for the hour of greatest transit activity during hours of receiver noise sensitivity in order to assess potential impacts at receivers involving primarily daytime use (i.e., where potential sleep disturbance is not an issue). Thus, the Leq is used to consider impacts at locations such as parks, schools, museums, libraries, or churches. As previously stated, a few daytime-only noise-sensitive uses were identified near potential TPSS sites. Most relevant to the Project, the FTA requires use of the Ldn descriptor where there is nearby residential land use.

3.1.3 Noise Impact Criteria

The FTA criteria for assessing noise impacts related to transit projects are provided in their 2006 manual. The criteria are based on typical community reaction to new noise sources or increased noise from existing sources. The criteria considers changes from existing noise conditions using a sliding scale. The higher the level of existing noise, the less room there is for a project to contribute additional noise. Because noise impact may result from a small contribution of project noise where the existing level of ambient noise is high, the potential exists for noise mitigation or impact avoidance to be required of a project even when the project's noise contribution alone is moderate to small.

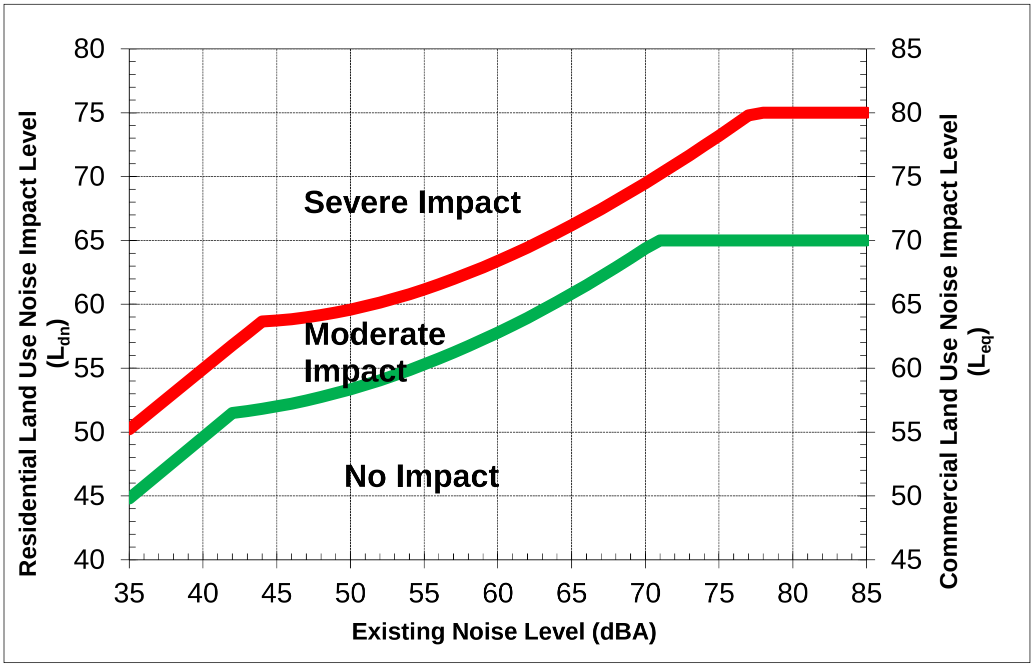
The Ldn noise descriptor and FTA impact criteria for Category 2 land use were used in the impact analyses reported in this report, except for a very few locations where institutional Category 3 land use such as a school were evaluated using Leq. If both Category 2 and 3 use is present near the Project facility the increased sensitivity of the Category 2 use nearly always controls the analysis.

The FTA Noise Impact Criteria places sensitive land uses into the following three categories:

- Category 1: Tracts of land where quiet is an essential element in their intended purpose. This category includes lands set aside for serenity and quiet, and such land uses as outdoor amphitheaters and concert pavilions, as well as national historic landmarks with significant outdoor use. Also included are recording studios and concert halls. *[There are no Category 1 uses within the study area]*
- Category 2: Residences and buildings where people normally sleep. This includes residences, hospitals, and hotels, where nighttime sensitivity is assumed to be of utmost importance. *[This is the most prevalent type of noise-sensitive use potentially affected by the Project]*
- Category 3: Institutional land uses with primarily daytime and evening use. This category includes schools, libraries, theaters, and churches where it is important to avoid interference with activities such as speech, meditation and concentration on reading material. Places for meditation or study associated with cemeteries, monuments, museums, campgrounds and recreational facilities may also be considered to be in this category. Certain historical sites and parks are also included. *[There is potentially affected Category 3 use in the study area]*

The FTA noise impact criteria are almost always applied to exterior locations only. These exterior areas of frequent human use may include back, front, and side yards; patios, decks, pools; common open space and play areas. When there are no such exterior uses associated with a sensitive receiver, the impact criteria are applied near building doors and windows, thus indirectly establishing an interior noise standard.

Figure 3-2, below, shows graphically how “No”, “Moderate”, and “Severe” noise impacts are determined based on the contribution of a project's noise to existing noise. This figure is used by first selecting the value of Existing Noise Level for the desired location on the horizontal axis, then selecting the Impact Noise Level (existing ambient noise + modeled project noise) on the vertical axis. The intersect point will fall within one of the three impact classes. Examples of this process are also presented in Figure 3-2 and Figure 3-3.



Source: Transit Noise and Vibration Impact Assessment, (FTA 2006)

Figure 3-2. FTA Noise Impact Criteria for Transit Projects

The level of impact also affects potential mitigation requirements for a project or noise limits that would avoid noise impact. BART would provide noise mitigation, for noise-sensitive use that would be subject to a Severe Impact. Note that BART has established a good neighbor policy to provide noise mitigation where reasonable for noise-sensitive use that would be subject to a Moderate Impact after consideration of feasibility, creation of adverse visual or other impacts, and other relevant factors. The FTA definitions of impact categories and mitigation policies are provided below.

Severe Impact: Severe noise impacts are considered “significant” as this term is used in NEPA and its implementing regulations. Severe noise impacts represent the most compelling need for mitigation. However before mitigation measures are considered, the project sponsor should first evaluate alternative locations/alignments to determine whether it is feasible to avoid Severe Impacts altogether. If it is not practical to avoid Severe Impacts by changing the location or design of the project, mitigation measures must be considered. Impacts in this range have the greatest adverse impact on the community; thus, there is a presumption that mitigation will be incorporated in the project unless there are truly extenuating circumstances which prevent mitigation.

Moderate Impact: The definition of a moderate impact is that the change in the cumulative noise level is noticeable to most people, but may not be sufficient to cause strong, adverse reactions from the community (FTA 2006). Project noise levels in the Moderate Impact range will also require consideration and adoption of mitigation measures when it is considered reasonable. While impacts in this range are not of the same magnitude as Severe Impacts, there can be circumstances regarding the factors outlined below which make a compelling argument for mitigation. These other factors can include the predicted increase over existing noise levels, the type and number of noise-sensitive land uses affected, existing outdoor/indoor sound insulation, community views, special protection provided by law and the cost-effectiveness of mitigating noise to more acceptable levels. *[Although the Project is statutorily exempt from the California Environmental Quality Act and from local jurisdictions' noise control ordinances, it is BART policy to be a good neighbor where practicable.]*

As an example, Figure 3-3 shows the impact levels for future noise exposure if the existing noise exposure is Ldn or Leq 53 dBA. As shown, for residential land use (Category 2), a Moderate Impact would occur near Ldn 55 dBA and a Severe Impact would occur near Ldn 60 dBA. For institutional land use (Category 3) a Moderate Impact would occur at Leq 60 dBA and a Severe Impact would occur at Leq 65 dBA.

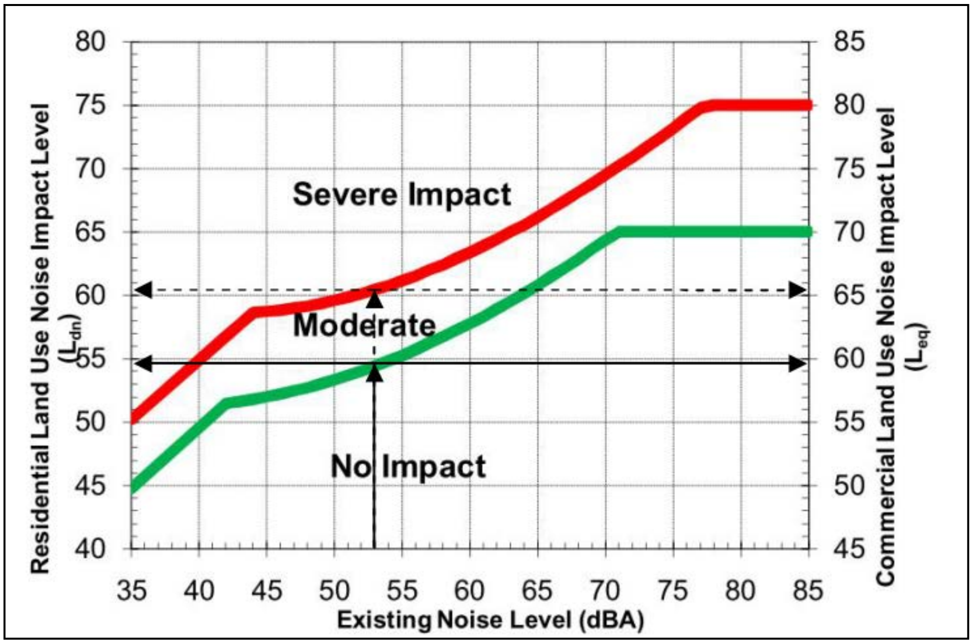


Figure 3-3. Example Impact Level Criteria with Existing Noise Level of 53 dBA.

Figure 3-4 shows the impact levels for future noise exposure if the existing noise exposure is higher at Ldn or Leq 63 dBA. As shown, for residential land use (Category 2), a Moderate Impact would occur above Ldn 60 dBA and a Severe Impact would occur at Ldn 65 dBA.

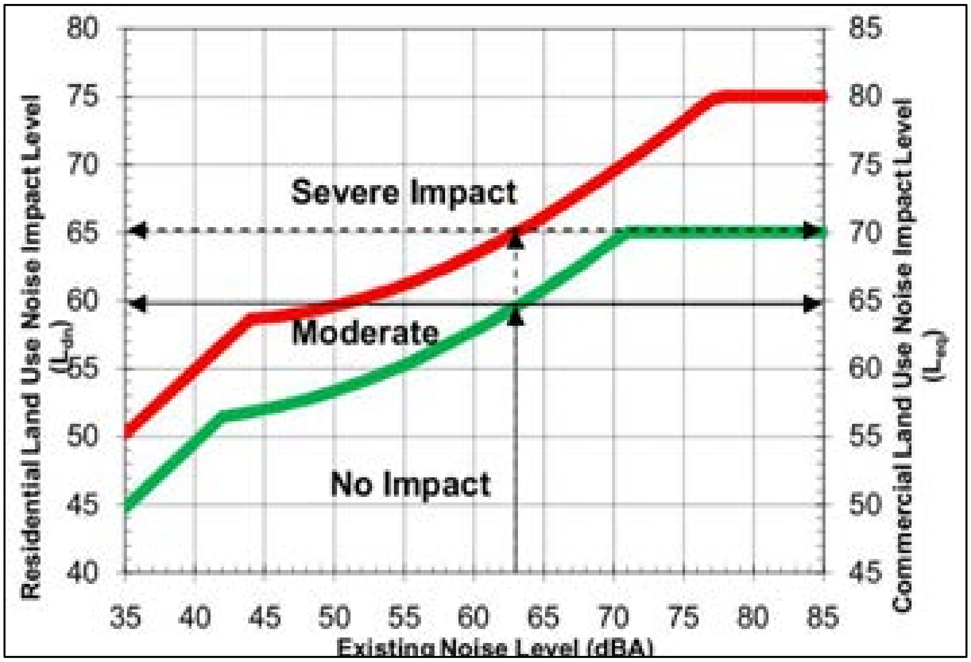


Figure 3-4. Example Impact Level Criteria with Existing Noise Level of 63 dBA

3.2 Affected Environment

3.2.1 Overview

The extent of the affected environment is determined by the nature and location of proposed project activities. For the Project, the potentially affected environment consists of noise-sensitive land use located adjacent to project construction activity and operation of fixed facilities such as TPSS and CBTC. Construction related to the CBTC will be very limited and brief, with expected noise levels typical of routine maintenance activity such as replacing a small utility pole. No perceptible noise is expected from operations (electronic communications) of the CBTC. Thus, the affected environment for this project was determined to be areas of noise-sensitive land use located near proposed new and planned-to-be-upgraded TPSS facilities required for the project. Descriptions of the potential TPSS sites and their environs are provided below.

The candidate sites for new and upgraded TPSS, and the existing noise measurement locations for the TPSS noise impact assessment are shown in Figure 3-5 through Figure 3-13, below. The figures also show the Screening Distances used to assist with the initial evaluation of potential noise impact from BART style TPSS facilities. The screening process was consistent with the guidance found in FTA's guidance manual for assessing potential impacts from a transit project: *Transit Noise and Vibration Impact Assessment Final Report* (FTA-VA-90-1003-06) May 2006. Noise-sensitive use was identified for each potential TPSS site within the Screening Distance, thus measurements of existing ambient noise were conducted, noise impact was evaluated at each site, and noise limit criteria to avoid noise impact were developed.

The new ambient noise measurements were focused on potentially affected noise-sensitive areas located outside of the City of San Francisco. These areas are primarily residential with one school. For the portion of the Project located within the City of San Francisco, the team relied on existing baseline community noise information developed by the City of San Francisco and found in its information database. Potentially affected areas within the City include institutional and residential land use. Retail and commercial use is not generally considered by FTA to be noise-sensitive.

The “buffer” designation in the following figures refers to the Screening Distance for TPSS facilities as discussed above. The terms “Primary (Long-Term)” and “Secondary (Short-Term)” and the methodology relating these terms are discussed in Section 3.3 of this report.

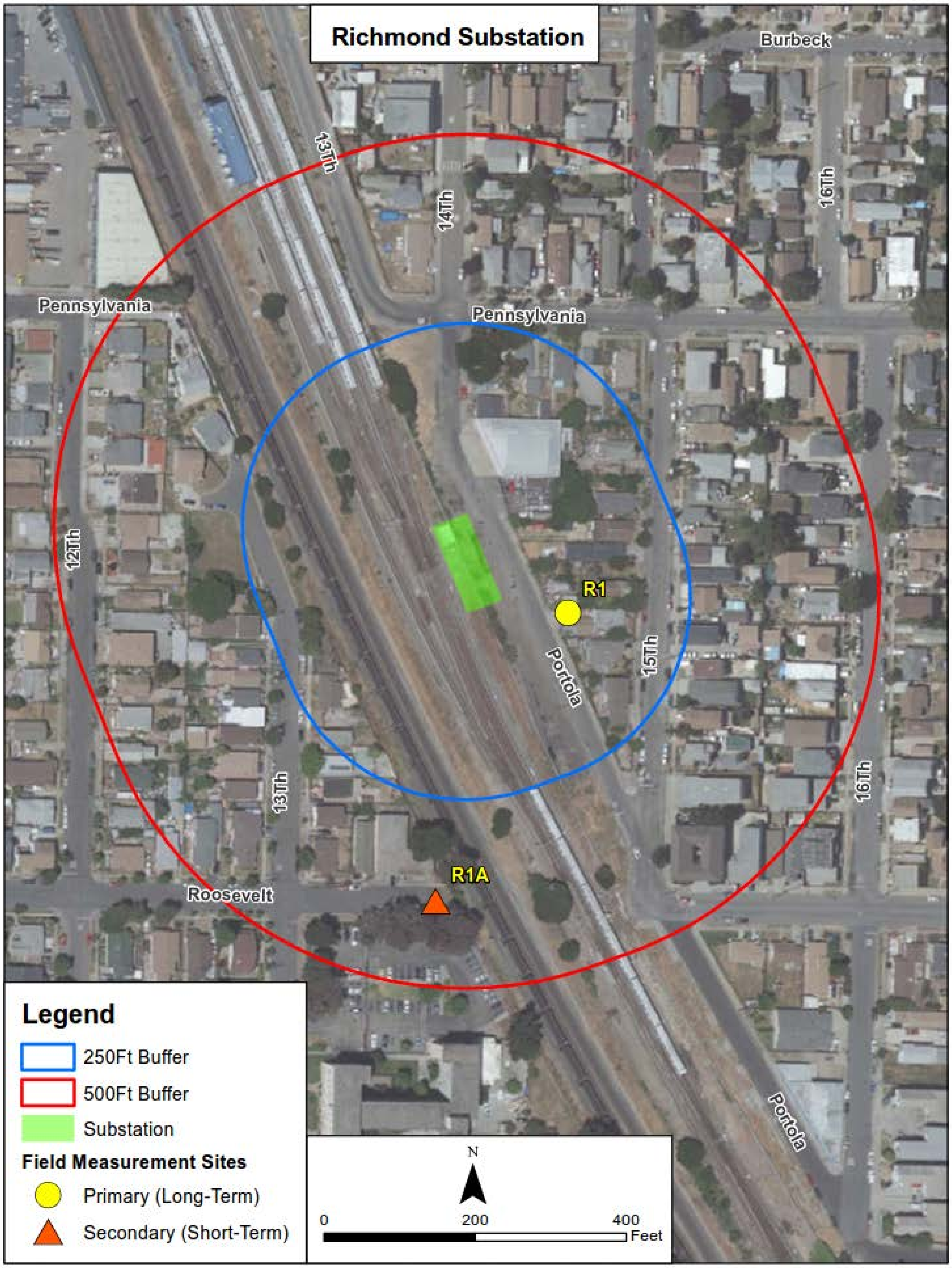


Figure 3-5. Richmond Substation

Figure 3-6. Pleasant Hill [Concord] David/Minert Substation

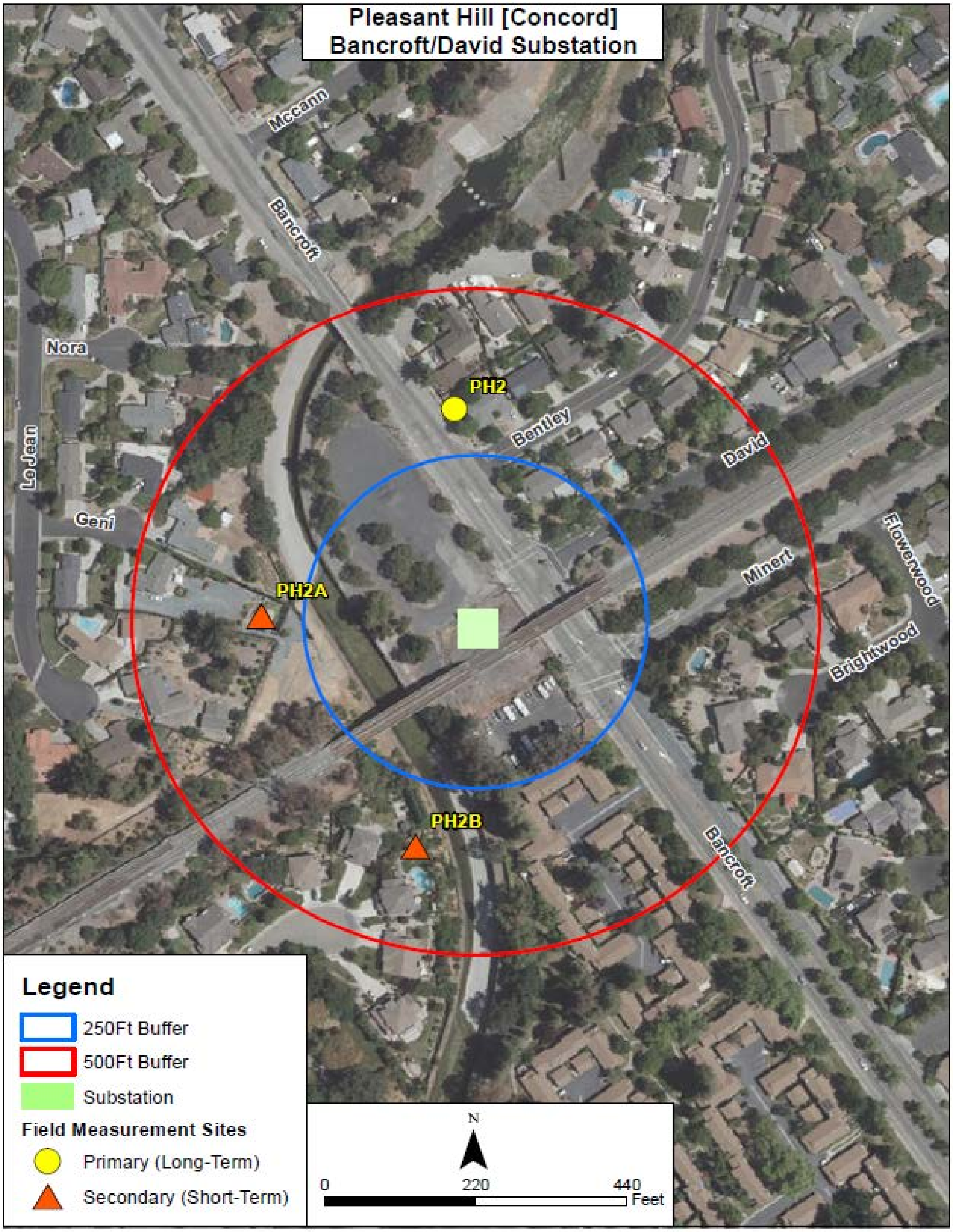


Figure 3-7. Pleasant Hill [Concord] Bancroft/David Substation

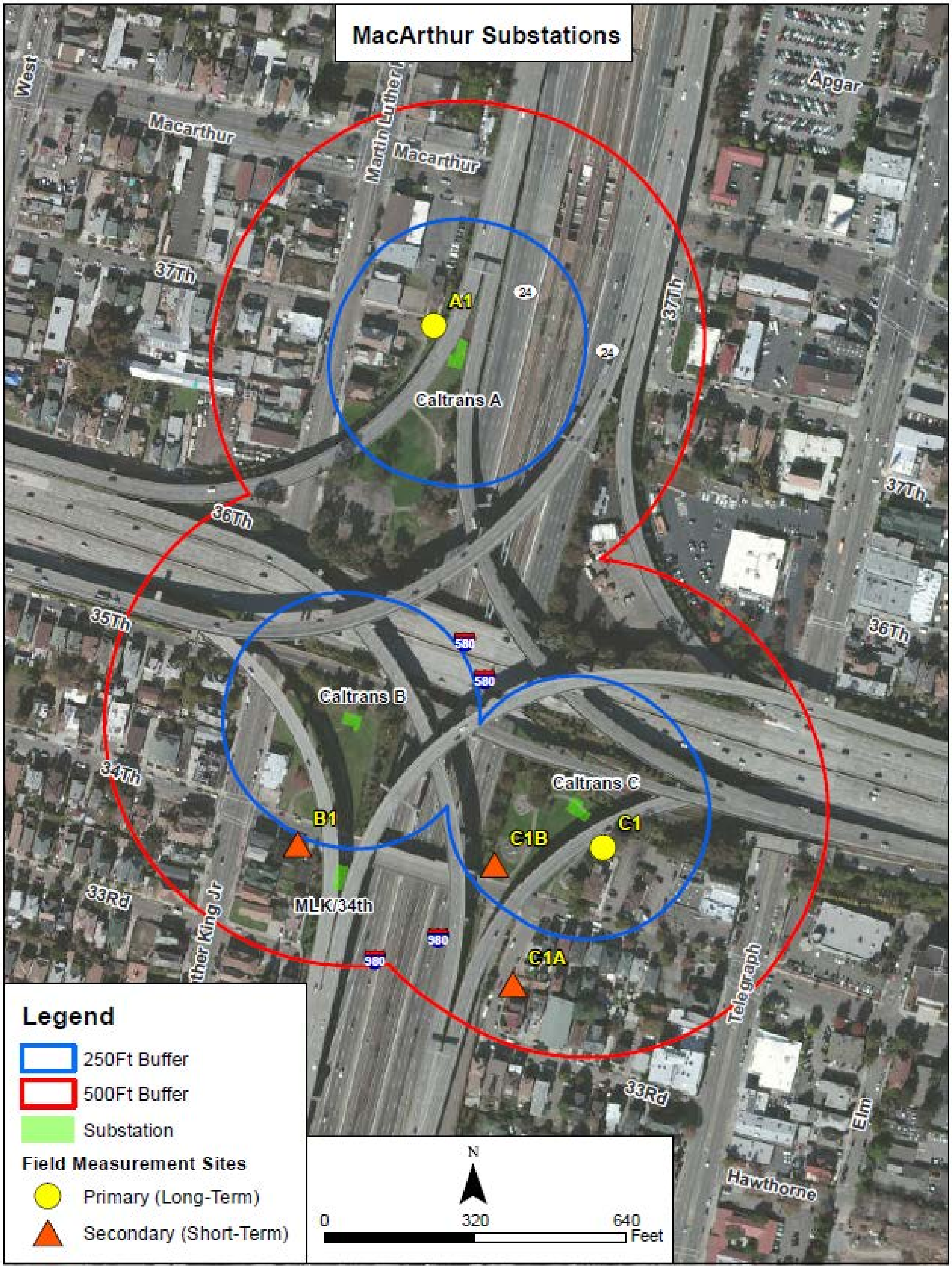


Figure 3-8. MacArthur Substations

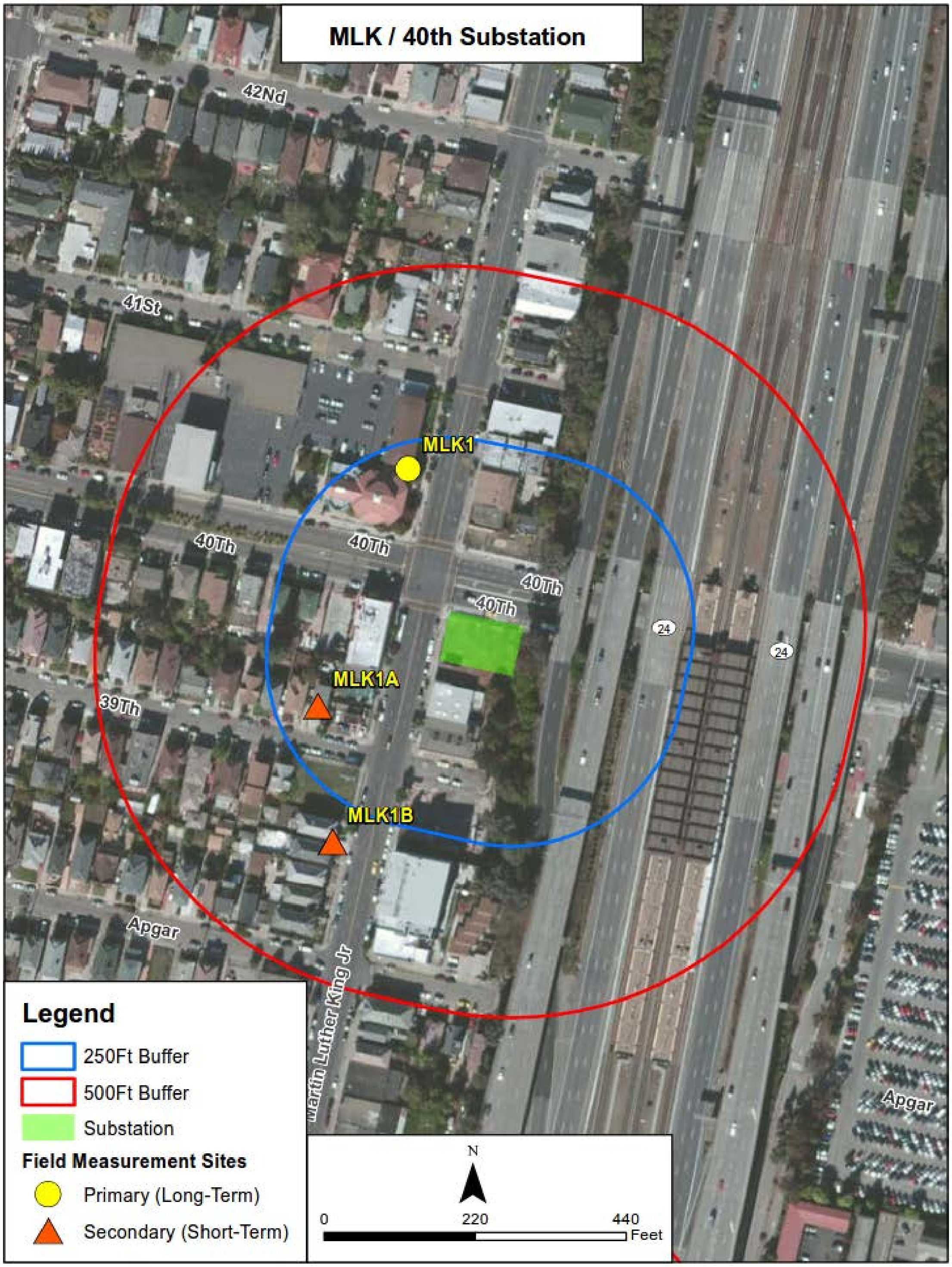


Figure 3-9. MLK/40th Substation

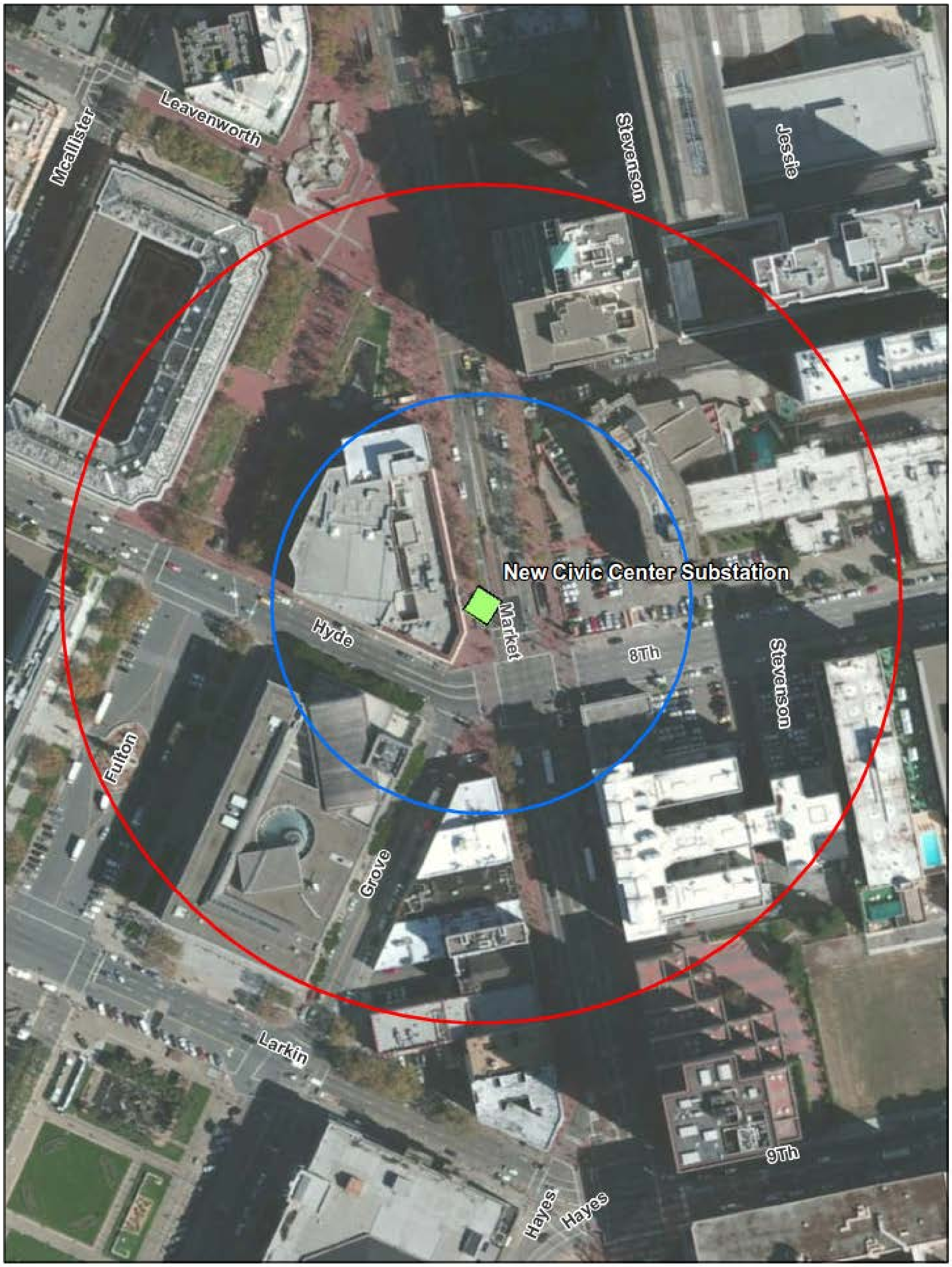


Figure 3-10. Downtown Civic Center Substation

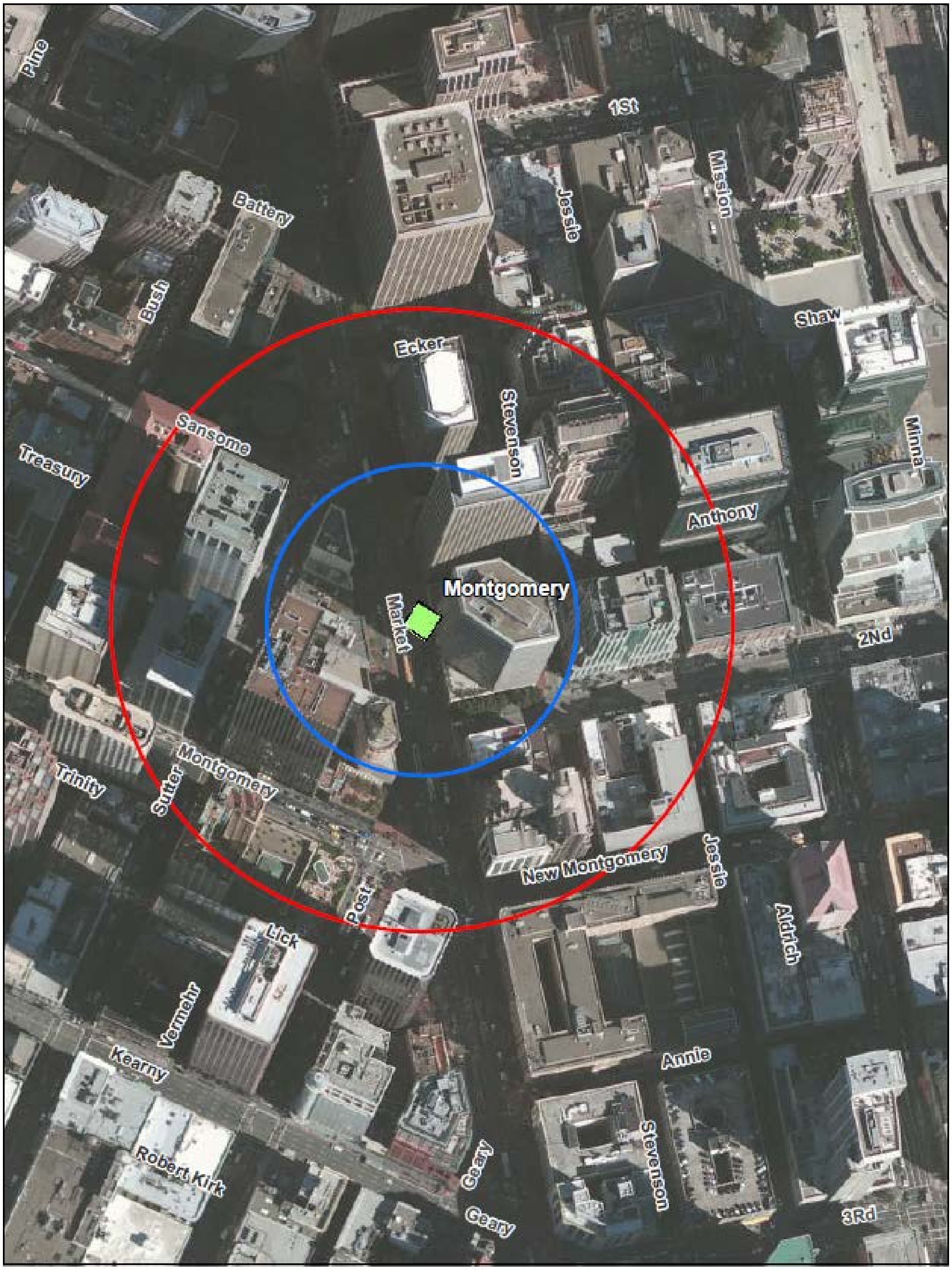


Figure 3-11. Downtown Montgomery Substation

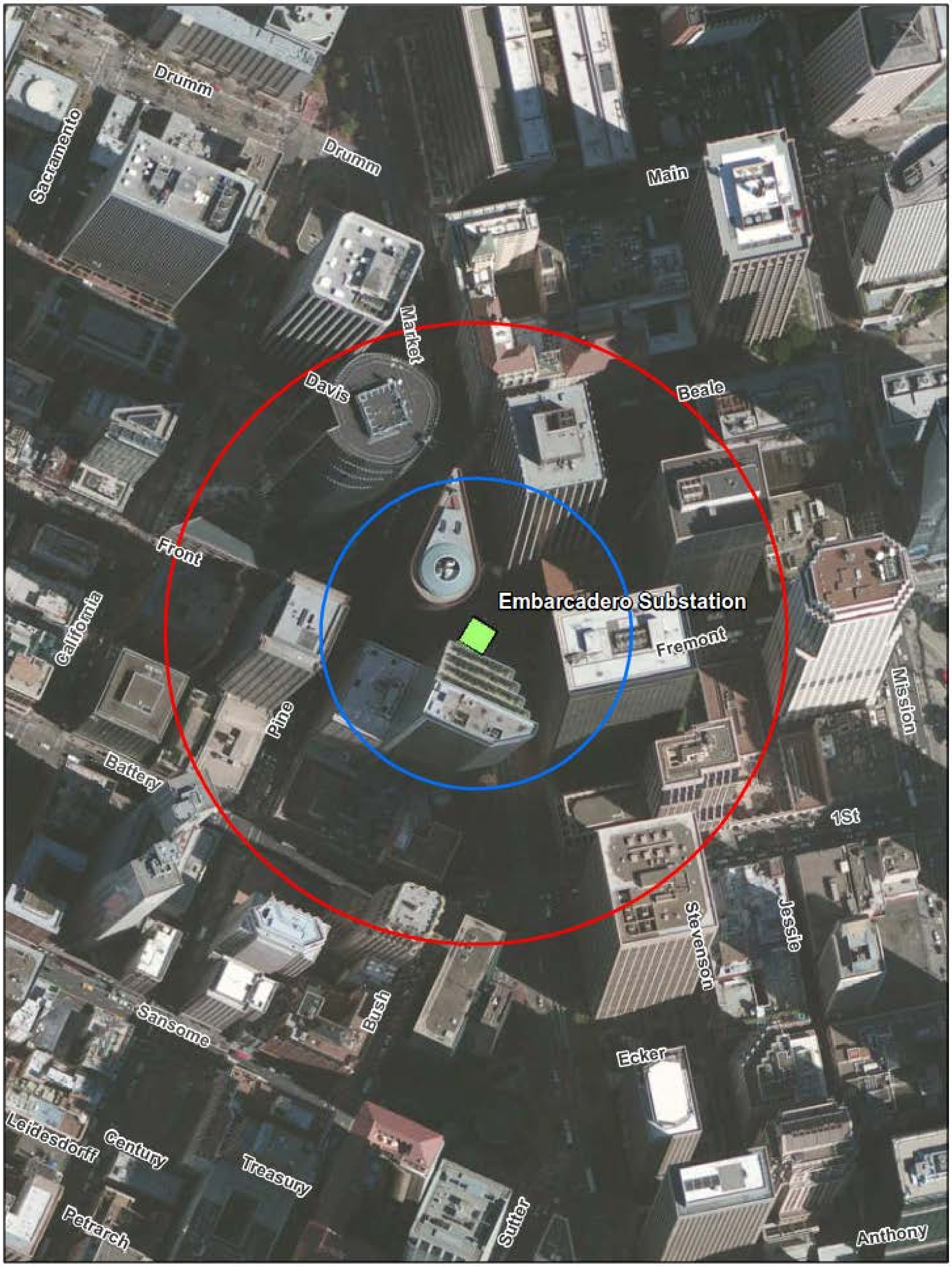


Figure 3-12. Downtown Embarcadero Substation

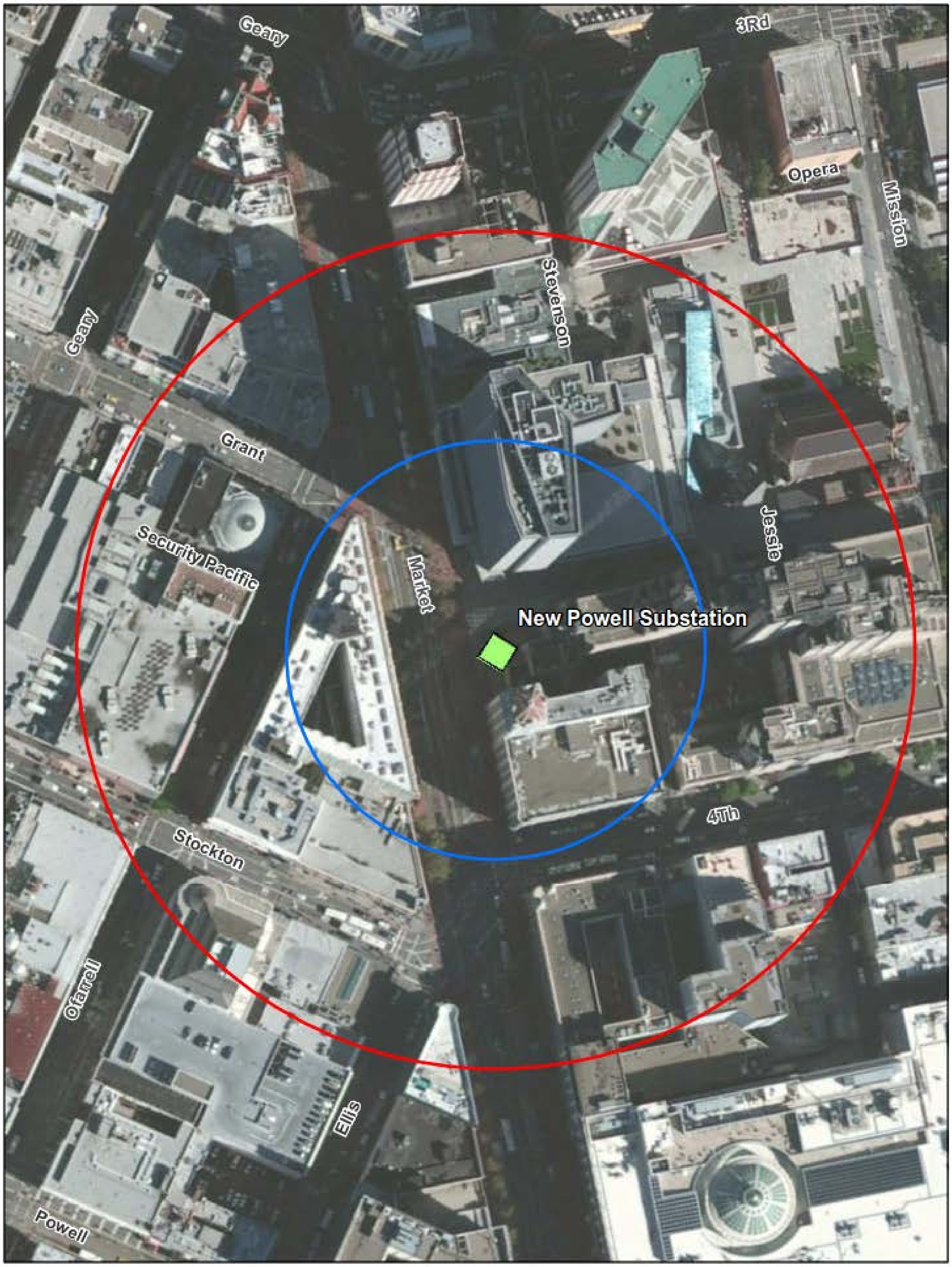


Figure 3-13. Downtown Powell Substation

3.2.1.1 Richmond (Preferred Location)

Noise-sensitive land use includes residences on both sides of the BART and AMTRAK rail lines. The existing noise in the area is predominately from freight and commuter rail use and local street traffic. Field noise measurements were performed in this area to collect existing noise data for the residential areas on both sides of the railroad tracks.

3.2.1.2 Pleasant Hill [Concord] – David Avenue and Minert Road (Preferred Location)

Noise-sensitive land use includes homes on both sides of the BART rail lines plus the Oak Grove Middle School. The existing noise in this area is predominately from local street traffic with some noise contribution from the BART trains. Field noise measurements were performed in this area to collect existing noise data at the school and for the residential area near David Avenue.

3.2.1.3 Pleasant Hill [Concord] – Bancroft Road and David Avenue (Alternate Location)

Noise-sensitive land use includes residential homes in all quadrants from the possible TPSS location. The existing noise in the area is predominately from local street traffic with some noise from the BART trains. Field noise measurements were performed in this area to collect existing noise data in the residential areas.

3.2.1.4 Oakland – Near MacArthur Station (Preferred Location)

Noise-sensitive land use includes residential homes and apartments, Grove Shafter Park, and a dog park near Martin Luther King Junior Way and 37th Street. The existing ambient noise in this area is primarily from the freeways I-580, I-980, and Route 24, and from their related flyover ramps. There is some intermittent noise generated by passing BART trains. Noise measurements were obtained at multiple locations in this area to collect existing noise data because BART is evaluating several possible options for TPSS site placement. A preferred site for this TPSS was subsequently selected (MLK/34th St.) and is under discussion.

3.2.1.5 Oakland – Martin Luther King Junior Way and 40th Street (Alternate Location)

Noise-sensitive land use includes residential homes and apartments, Sacred Heart Church, and Saint Martin de Porres Catholic School. The existing noise levels in this area are primarily generated by traffic using Martin Luther King Junior Way, a four lane road. Measurement locations focused on the church area plus two residential areas with line-of-site to the potential TPSS location.

3.2.1.6 San Francisco

TPSS locations are being considered at four BART stations (Preferred – Montgomery Street and Civic Center Stations, and Alternates – Embarcadero and Powell Street). The entire area is mixed urban with a few noise-sensitive land use types. For example, there are residential apartment buildings near the Civic Center and Powell BART stations, but these buildings do not have windows that open. The Orpheum Theater, the San Francisco Public Library, and City College are within 500 feet of the Civic Center BART station. The existing noise in the area is predominately from local street traffic and intermittent construction activity. Field reconnaissance was conducted, but noise measurements were not performed in this area because existing noise data was available from the City of San Francisco.

3.3 Measurement Methodology and Existing Noise Levels

The FTA guidance manual (FTA 2006) states that performing actual measurements is nearly always the most accurate approach to describing the existing noise environment. For residential land use, the FTA manual, in Section 6.6.2 “Noise Exposure Measurements” states “For residential receivers, full 24-hour measurements are most precise. Such full-duration measurements are preferred over other options, where time and study funds allow.” Although the Ldn is a 24-hour noise descriptor it is not practicable or necessary to conduct a 24-hour measurement at every location of interest. FTA observes that several professionally-recognized approaches are available to describe the existing noise environment. The methodology that was used to measure and determine the existing levels of environmental noise for this Project is discussed below.

In this study, TMP staff used several sound level measuring devices in a "primary-secondary" configuration to directly measure the Ldn at a primary location and calculate the Ldn at a secondary measurement location. Importantly, monitoring of the A-weighted sound level at representative noise-sensitive receptor locations was performed at both LT (long-term, typically 24-hour or longer duration) and ST, (short-term, typically 15-minute duration) locations. In this method, the unattended "primary", a LT (24 hour) logging community noise analyzer (CNA) is installed at selected primary locations and the time-synchronized, attended sound level meter (SLM) is moved from one related secondary location to another. Thus, the calculated Ldn at the secondary location is based on the 24 hour measurement data from the nearest 24-hour primary location.

This “primary-secondary” measurement methodology is consistent with FTA guidance. While time and funds may not allow for a 24 hour measurement at every noise-sensitive receptor, the primary-secondary approach provides the benefit of a 24-hour measurement by using the dual Long-Term/Short-Term location pairing method. FTA, in Section 6.6.3 “Noise Exposure from Partial Measurements” in its guidance manual (FTA 2006), provides that “Often measurements can be made at some of the receivers of interest and then these measurements can be used to estimate noise exposure at nearby receivers.”, and “Measurements at one receiver can be used to represent the noise environment at other sites, but only when proximity to major noise sources is similar among the sites.” To accomplish the description of noise environments from partial measurements, FTA further states “Acoustical professionals are often adept at such computations from partial data and are encouraged here to use their experience and judgment in fully utilizing the measurements in their computations.”

Field reconnaissance of potential TPSS locations was conducted on March 17 (East Bay), March 30 (San Francisco), June 8, (East Bay), and June 23 (San Francisco) in 2016 to observe the nature of nearby land use in more detail than was done initially by reviewing Google Earth™ imagery.

Field noise measurements were conducted between June 20 and June 22, 2016 near the potential TPSS sites. The potential locations of the TPSS and approximate locations of the measurement sites in the study area were previously shown in Figure 3-1 through Figure 3-5.

The six primary locations where CNA where deployed were designated LT-R1, LT-PH1, LT-PH2, LT-C1, LT-A1, and LT-MLK1. Each of the several CNA was temporarily affixed to convenient structures such as a chain link fence and its microphone was equipped with a windscreen. The laboratory calibration of the CNA was field verified using an acoustical calibrator. Each CNA were programmed to measure and store in its internal memory 24 or more hours of continuous noise levels in 15 minute intervals. Thus, during post-processing of the stored data, the Leq for each ¼ hour can be observed for anomalies, any hourly noise level may be obtained, the interval data can be energy averaged to yield the 24 hour Leq, and the Ldn can be calculated. The existing ambient noise at the primary LT locations varied between 64 dBA Ldn and 76 dBA Ldn depending on proximity to local noise sources including trains and road traffic.

Nine locations, designated as ST-R1A, ST-PH1A, ST-PH2A, ST-PH2B, ST-C1A, ST-C1B, ST-B1 ST-MLK1A, and ST-MLK1B were selected for short-term monitoring of ambient noise. One or more ST measurements were conducted at the nine locations.

The measurement instrument used at the secondary ST locations was a Type 1 (Precision) sound level meter (SLM) operated by a noise specialist. This “attended” SLM was tripod-mounted and its microphone was equipped with a windscreen. The laboratory calibration of the SLM was field verified using an acoustical calibrator, also having a NIST-traceable laboratory calibration. At each site, the measurement microphone was positioned to characterize the exposure of the site to the dominant noise sources in the area. For example, the SLM was located with an acoustic view of adjacent roads, rail lines, or other noise source and was positioned to avoid acoustic shielding by landscaping, fences, or other obstructions.

Noise specialists also confirmed several assumptions that are made to reasonably conclude that the primary and secondary locations experience similar exposure to ambient noise. For example, that one of the locations is not shielded from a major distant noise source such as a busy highway while the other location has a direct exposure to that source. Also, when reviewing the data from the primary CNA, a check is made that each of the 15 minute Leq intervals do not deviate significantly from the adjacent intervals.

The 15 minute measurement period of the secondary SLM was time synchronized to match a specific 15 minute (or longer if necessary) interval of existing sound level that was measured by and stored in the paired primary CNA. The "offset" or difference in noise environment between the two locations during the synchronized period was then used to calculate the Ldn at the secondary ST location (again, based on the interval and 24-hour sound level data measured at the primary LT location). Using the decibel offset values, the secondary ST locations’ Ldn values varied from 51 dBA to 83 dBA. No specific noise sources were excluded from the measurements.

The results of the existing ambient noise measurements and calculations are summarized in Table 3-1. The presented information serves as a basis for describing existing environmental noise conditions at all noise-sensitive receptors identified near potential TPSS sites, and for evaluating noise impact as described in Section 3.5.

In addition to Figure 3-5 through Figure 3-13, more detailed information about each measurement site is included in the Field Measurement Data Sheets provided in Appendix A. Photographs of the measurement sites are included in Appendix B.

Table 3-1. Existing Ambient Noise Measurement Results

Site No.	Measurement Location Description	P/S	Measurement		Duration	Outdoor Noise Exposure		
						Ldn (dBA)		Interval Offset Leq or L_{50} (dBA)
			Date	Start Time		Measured	Calculated	
LT-R1	627 15th Street, Richmond (rear yard of residence adjacent to Portola Ave)	P	6/21/16	1017	24+ hrs.	66		
ST-R1A	1317 Roosevelt, Richmond (in front of apartment house at dead end of street)	S	6/21/16	1045 1101	15 min 15 min		61	-5
LT-PH1	2050 Minert Road, Concord(in front of Oak Grove Middle School)	P	6/20/16	1700	24 hrs	64		
ST-PH1A	1767 David Avenue, Concord (on driveway in front of residence)	S	6/20/16	1645	15 min		67	+3
LT-PH2	1211 Bentley Street, Concord (on side fence of residence rear yard facing TPSS site)	P	6/21/16	1300	24 hrs	71		
ST-PH2A	493 Geni Court, Walnut Creek (rear yard of residence near shrine)	S	6/22/16	0915	15 min.		57	-14
ST-PH2B	1160 Briarwood Way, Walnut Creek (rear yard of residence by swimming pool)	S	6/22/16	1030	15 min.		51	-20
LT-C1	546 34th Street. Oakland (rear side yard fence of apartments next to TPSS)	P	6/20/16	1200	24 hrs	75		
ST-C1A	33rd Street, Oakland (mid-block on street between two residences)	S	6/20/16	1430	15 min		80	+5
ST-C1B	Grove Shafter Park, Oakland (34th Street side near play equipment)	S	6/21/16	1511	15 min		80	+5
ST-B1	625 34th Street Oakland, CA (at sidewalk between house and apartment building)	S	6/21/16	1540	15		83	+8
LT-A1	624 37th Street, Oakland (on chain link fence next to apartment building)	P	6/21/16	1645	24 hrs	76		
LT-MLK1	4025 Martin Luther King Way, Oakland (between church building and residence building)	P	6/21/16	1300	24 hrs	69		

Site No.	Measurement Location Description	P/S	Measurement		Duration	Outdoor Noise Exposure		
						Ldn (dBA)		Interval Offset Leq or L$_{50}$ (dBA)
			Date	Start Time		Measured	Calculated	
ST-MLK1A	656 39TH Street, Oakland (on 2nd floor landing of duplex)	S	6/22/16	1530	15 min		68	-1
ST-MLK1B	3869 Martin Luther King Way, Oakland	S	6/22/16	1550	10 Min		69	±0

TMP, 2016.
Notes Source: P/S = Primary or Secondary
LT = Long-Term ST = Short-Term

dBA = decibels, A-weighted
hrs. = hours
min. = minutes

Ldn = Day-Night sound level
Leq = Equivalent sound level
L$_{50}$ = Sound level exceeded 50% of period duration

Table 3-2. Existing Ambient Noise from City of San Francisco Data

Potential TPSS Site	Location	Modeled Noise Exposure - Ldn	Estimated Noise Exposure - Leq[1]
Downtown – Civic Center	Market Street at street level	74	70
Downtown - Montgomery	Market Street at street level	75	71
Downtown - Embarcadero	Market Street at street level	76	72
Downtown - Powell	Market Street at street level	75	71

[1] Estimate of Leq by TMP; not available from SF data.

3.4 Impact Evaluation

3.4.1 Methodology

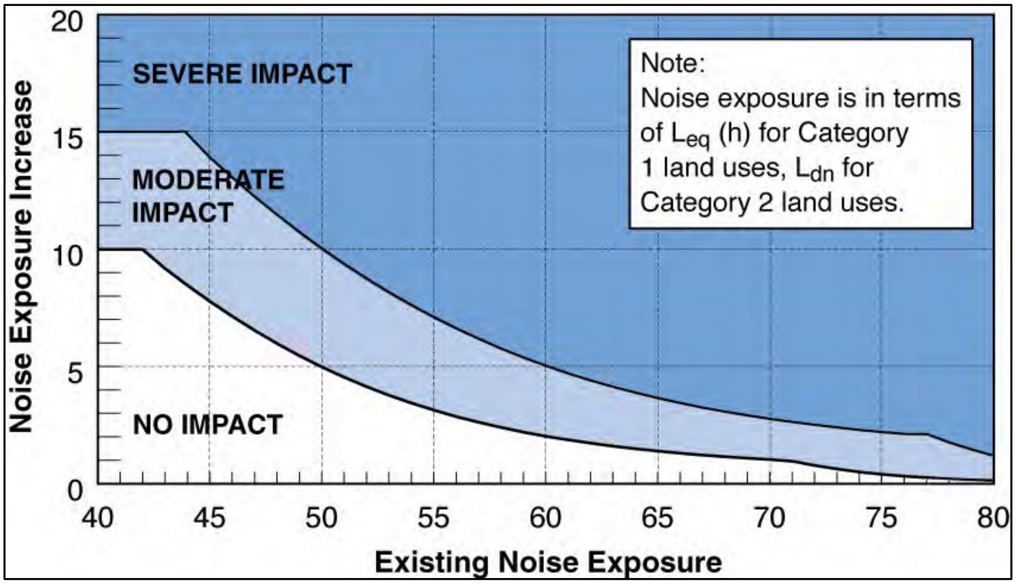
The noise impact assessment methodology is described in this section.

3.4.1.1 Evaluation Criteria

The environmental noise descriptor Ldn is used to characterize noise exposure for residential areas (Category 2). For other noise- sensitive land uses in the Study area (Categories 3), the maximum 1-hour Leq occurring during the facility's operating period would be used if needed.

The potential for noise impact from the project is based on the criteria defined in the FTA guidance manual. The FTA noise impact criteria and its basis were discussed in detail in Section 3.2 of this report. Recall that impacts are based on change in noise exposure due to a project using a sliding scale based on existing pre-project noise level. Although higher contributions of transit noise from a project are allowed in neighborhoods with low levels of existing noise, only small increases in total noise exposure (existing + project) are allowed where existing noise levels are high. As previously noted, it is possible for relatively small noise contributions from a new project to cause a noise impact. Also as discussed previously, the FTA Noise Impact Assessment guidelines group noise-sensitive land uses into three categories. There are no Category 1(extremely sensitive) uses located near any TPSS site. Category 2 (residential) uses are located adjacent to several of the potential TPSS sites. Category 3 (e.g., school) uses are minimal, but one or two are located close enough to TPSS sites to potentially be impacted. Thus, predominately Category 2 use and environmental noise levels in terms of Ldn are of primary concern for noise impacts, with a few Category 3 uses justifying analysis using Leq unless a nearby Category 2 use is present.

The FTA noise impact criteria were previously shown in graphical form in Figure 3-2, Figure 3-3, and Figure 3-4. An alternative way to evaluate the FTA noise impact criteria is to look at the change in cumulative noise exposure that is predicted to result from a project as shown below in Figure 3-14, Increase in Cumulative Noise Levels Allowed by FTA Criteria. This figure shows the noise impact criteria for Category 1 and 2 land uses in terms of the *allowable increase* in the cumulative noise exposure. No Category 1 land uses were identified within the Project study area.



Source: FTA Guidance Manual 2006.

Figure 3-14. Increase in Cumulative Noise Levels Allowed by FTA Criteria

3.4.1.2 Project Noise Modeling

Because the specific equipment and layout for each final TPSS location has not yet been determined it is not possible to accurately predict the TPSS noise emission level and accurately calculate noise impacts as would be the traditional approach to noise impact analysis. BART requested an alternative approach that would allow development of the TPSS component specifications, equipment layout and ancillary features such as a perimeter screen wall that would avoid impacts in the environs of the final TPSS locations. Thus, using the information provided in the FTA guidance manual (FTA 2006), noise level limits in Leq at the site boundary for each potential TPSS site were developed from two well-defined factors:

- The existing noise levels at sensitive receptors, and
- The FTA impact criteria.

The noise limit for each TPSS site will allow for design and construction of the Project's required TPSS facilities without creating noise impacts or requiring further environmental impact analysis. The noise impact criteria and noise limits for no impact are presented in the next sections.

3.4.1.3 FTA Noise Impact Criteria

Table 3-3, below is Table 3-1 from the FTA manual's Chapter 3: Noise Impact Criteria.

Table 3-3. FTA Noise Impact Criteria

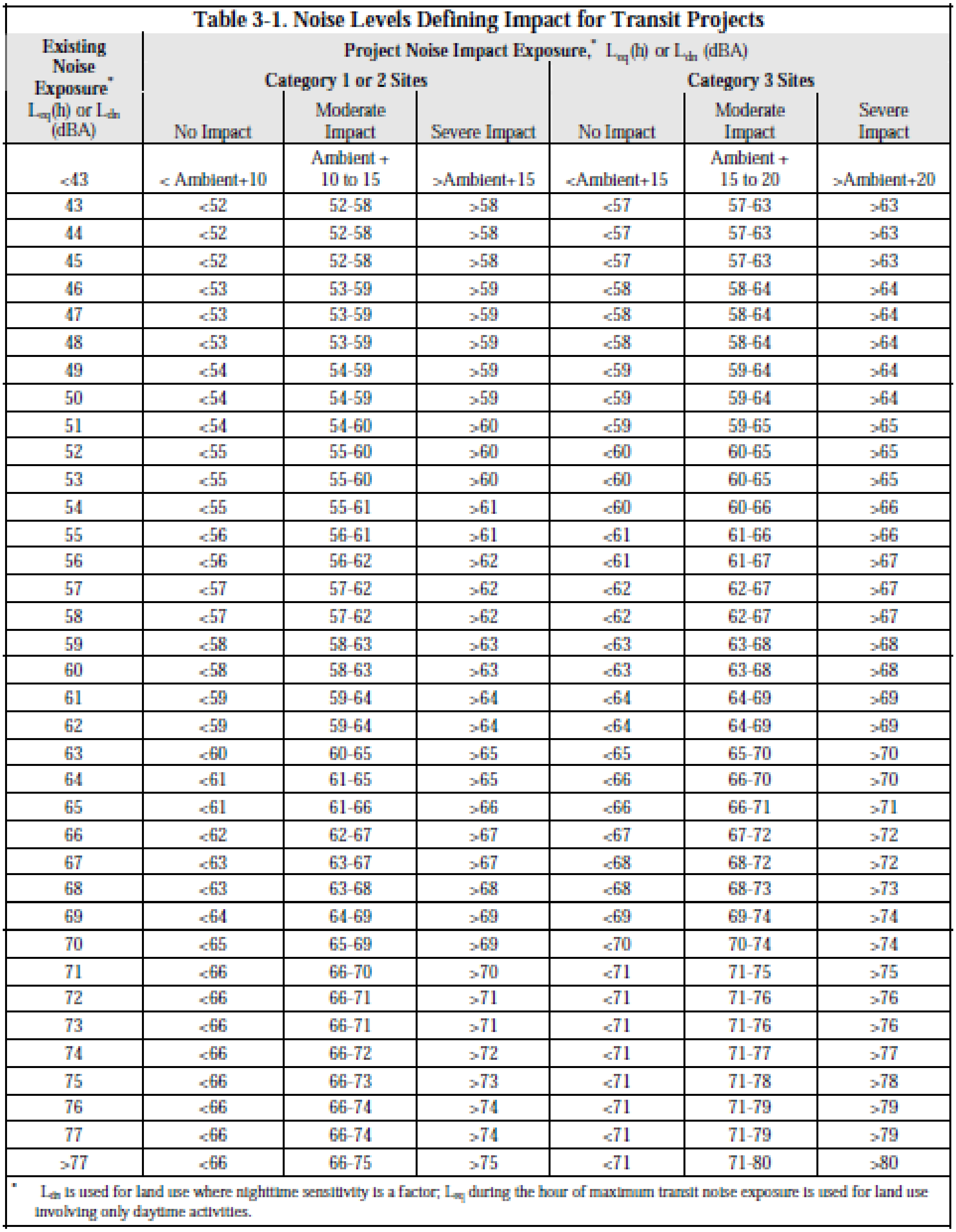


Table 3-1. Noise Levels Defining Impact for Transit Projects

Existing Noise Exposure* L_{eq}(h) or L_{dn} (dBA)	Project Noise Impact Exposure,* L_{eq}(h) or L_{dn} (dBA)					
	Category 1 or 2 Sites			Category 3 Sites		
	No Impact	Moderate Impact	Severe Impact	No Impact	Moderate Impact	Severe Impact
<43	< Ambient+10	Ambient + 10 to 15	>Ambient+15	<Ambient+15	Ambient + 15 to 20	>Ambient+20
43	<52	52-58	>58	<57	57-63	>63
44	<52	52-58	>58	<57	57-63	>63
45	<52	52-58	>58	<57	57-63	>63
46	<53	53-59	>59	<58	58-64	>64
47	<53	53-59	>59	<58	58-64	>64
48	<53	53-59	>59	<58	58-64	>64
49	<54	54-59	>59	<59	59-64	>64
50	<54	54-59	>59	<59	59-64	>64
51	<54	54-60	>60	<59	59-65	>65
52	<55	55-60	>60	<60	60-65	>65
53	<55	55-60	>60	<60	60-65	>65
54	<55	55-61	>61	<60	60-66	>66
55	<56	56-61	>61	<61	61-66	>66
56	<56	56-62	>62	<61	61-67	>67
57	<57	57-62	>62	<62	62-67	>67
58	<57	57-62	>62	<62	62-67	>67
59	<58	58-63	>63	<63	63-68	>68
60	<58	58-63	>63	<63	63-68	>68
61	<59	59-64	>64	<64	64-69	>69
62	<59	59-64	>64	<64	64-69	>69
63	<60	60-65	>65	<65	65-70	>70
64	<61	61-65	>65	<66	66-70	>70
65	<61	61-66	>66	<66	66-71	>71
66	<62	62-67	>67	<67	67-72	>72
67	<63	63-67	>67	<68	68-72	>72
68	<63	63-68	>68	<68	68-73	>73
69	<64	64-69	>69	<69	69-74	>74
70	<65	65-69	>69	<70	70-74	>74
71	<66	66-70	>70	<71	71-75	>75
72	<66	66-71	>71	<71	71-76	>76
73	<66	66-71	>71	<71	71-76	>76
74	<66	66-72	>72	<71	71-77	>77
75	<66	66-73	>73	<71	71-78	>78
76	<66	66-74	>74	<71	71-79	>79
77	<66	66-74	>74	<71	71-79	>79
>77	<66	66-75	>75	<71	71-80	>80

* L_{dn} is used for land use where nighttime sensitivity is a factor; L_{eq} during the hour of maximum transit noise exposure is used for land use involving only daytime activities.

3.4.2 Impact Avoidance Criteria

The noise impact avoidance criterion at the approximate boundary of each TPSS site is provided in Table 3-4 in terms of Leq dBA for the expected continuous 24 hours per day operation. The Leq criterion values have been adjusted to account for use of the Ldn descriptor required by FTA to evaluate noise impact to Category 2 land use. Note that noise from continuous facility operation, with a given Leq value will result in an Ldn value approximately 7 dBA higher at the same point selected for measurement or for modeling. This Ldn "penalty" was accounted for in the development of the noise limit criterion with lower allowable Leq values. The impact avoidance criterion addresses the energy sum of all contributing noise sources at the TPSS facility. This would include noise from transformers, reactors, switch gear, and any other mechanical equipment noise such as from ventilation fans.

The FTA guidance manual provides a brief definition of "pure tone" (Sound of a single frequency) and mentions pure tone evaluation as a tool for mitigation development. However, the FTA guidance manual does not discuss the increased annoyance from noise containing pure tones. If pure tones (as defined in ANSI S12.9/Part 3 – 1993/8 Appendix C) are anticipated in the noise emitted from TPSS sites it is recommended that additional sound attenuation of the pure tone frequencies be considered in the design of the TPSS facility. Additional noise attenuation of pure tones is not included in the noise level limits presented in Table 3-4, below.

Table 3-4. Impact Avoidance Criteria for TPSS Sites

TPSS Site	Distance to Nearest Sensitive Receptor (ft)[1]	Sensitive Use Type	Impact Level Based on Existing Sound Level at Most Critical Receptor (dBA)	Impact Avoidance Limit at TPSS Boundary for Most Critical Receptor (dBA, Leq)[3]
Richmond	100	Category 2	62 Ldn/55 Leq	55 + 5 = <60
Pleasant Hill [Concord] 1	110	Category 2	63 Ldn/56 Leq	56 + 4 = <60
Pleasant Hill [Concord] 2	215	Category 2	54 Ldn/47 Leq	47 + 13 = <60
MacArthur (MLK/34th)	85	Category 2	66 Ldn/59 Leq	59 + 4 = <63
MLK/40th	155	Category 2	63 Ldn/56 Leq	56 + 10 = <66
Downtown Civic Center	10[2]	Category 2 and Category 3	66 Ldn/59 Leq	59 + 4 = <63
Downtown Montgomery	10[2]	Category 2 and Category 3	66 Ldn/59 Leq	59 + 4 = <63
Downtown Embarcadero	10[2]	Category 2 and Category 3	66 Ldn/59 Leq	59 + 4 = <63
Downtown Powell	10[2]	Category 2 and Category 3	66 Ldn/59 Leq	59 + 4 = <63

Notes: 1. Distance is from TPSS nearest site boundary to nearest critical receptor. 2. Distance from ventilation system intake or discharge grill near street level with receptor at approximately ≥15 feet from grill. 3. Inclusive of all noise produced at TPSS facility. Source: TMP, 2016.

3.4.2.1 Impact Summary

With TPSS acoustic noise emission performance consistent with the limit criterion levels presented in Table 3-3, above, the operational TPSS noise on a continuous basis will avoid noise impact at any identified noise-sensitive land use in the vicinity of TPSS facilities. Impact Avoidance Limits are identified based on surrounding transit sensitive land uses and will be followed during design of the TPSS. Final design of TPSS sites will follow best practices in noise mitigation guidelines along with any applicable modeling and/or monitoring during operations.

3.4.2.2 Highly Sensitive Use, Parkland and Historic Property

No Category 1 use was identified within the Project study area. No other highly-sensitive special uses (e.g., recording studio, amphitheater) were noted within the Project study area.

The residential uses that abut the Grove Shafter Community Park in Oakland are more noise-sensitive than the park itself. Thus, the recommended TPSS noise limits for residential use would preclude noise impact on the park and no constructive use impairment would occur.

The current Downtown – Civic Center TPSS site is within an historical district. TPSS noise emission from the ventilation grills will be attenuated to satisfy the no noise impact criterion level for the Civic Center site.

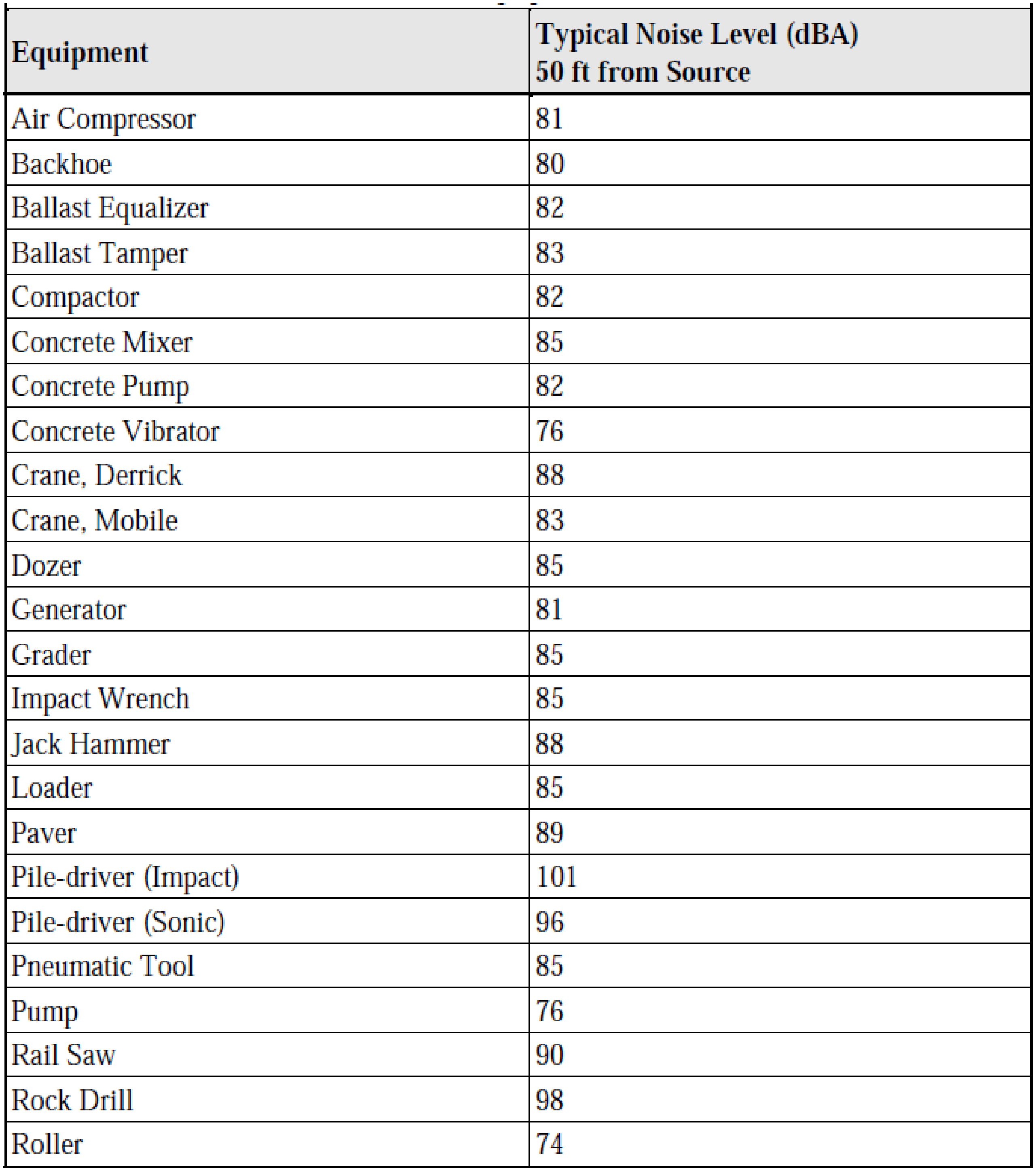
3.4.2.3 Operations Vibration Impacts

The operation of a TPSS or CBTC will not generate detectible ground vibration at any sensitive use and thus, cannot create vibration impacts. No vibration avoidance or mitigation measures are necessary or recommended.

3.4.2.4 Temporary Construction Impacts

Installation of the CBTC equipment requires minor construction activity similar to routine maintenance of the BART right-of-way and would not create substantial noise or impacts. The types of construction equipment used to refurbish or newly construct TPSS facilities contains a typical mix of internal combustion engine powered heavy vehicles as listed in Table 3-3, below from the FTA guidance manual (FTA 2006) plus smaller light duty vehicles. Several of these types of construction equipment were observed by the field staff in nearly all of the areas where the existing noise was measured and at several locations along Market Street in downtown San Francisco.

Table 3-5. Construction Equipment Noise Emission Levels (from FTA 2006)



Equipment	**Typical Noise Level (dBA) 50 ft from Source**
Air Compressor	81
Backhoe	80
Ballast Equalizer	82
Ballast Tamper	83
Compactor	82
Concrete Mixer	85
Concrete Pump	82
Concrete Vibrator	76
Crane, Derrick	88
Crane, Mobile	83
Dozer	85
Generator	81
Grader	85
Impact Wrench	85
Jack Hammer	88
Loader	85
Paver	89
Pile-driver (Impact)	101
Pile-driver (Sonic)	96
Pneumatic Tool	85
Pump	76
Rail Saw	90
Rock Drill	98
Roller	74

Temporarily elevated noise and vibration levels could result from construction activities associated with reworking and constructing new TPSS. These activities may include demolition, grading, minor excavation, foundation fabrication, paving and installation of systems components. The increased levels may occur in residential areas and at other noise-sensitive land uses located within 200 feet of the construction activity. No very high noise and vibration producing activity such as pile driving is anticipated to be necessary for this Project. Also, Project construction will move from one location to another with limited time spent at any one location. Thus, this Study's finding is that while construction noise and perhaps vibration levels would be briefly elevated they will not be substantial and will not create impacts if the best practices provided in Section 3.5.2 of this report are required by contract.

3.4.2.5 Cumulative Impacts

No cumulative noise impacts are predicted.

3.5 Mitigation

3.5.1 TPSS Operations

With implementation of the noise impact avoidance criteria provided above, no TPSS operations noise or vibration impact will occur and additional mitigation measures are not necessary. The future ambient noise conditions do not include potential cumulative noise conditions as there are no known additional and contributing improvements including any freeway improvements or other planned transportation projects in the vicinity at the time of the preparation of this report. Design and installation best practices will help TPSS sites perform within or under the noise thresholds. BART (or its contractor) will monitor the noise levels post deployment. Noise levels will be compared with the thresholds, and a sound wall or other noise reduction mechanisms will be installed, if threshold is exceeded. Operations and performance standards of recently installed TPSS (e.g., Warm Springs) will additionally inform this entire process of design, installation and operations.

3.5.2 Temporary Construction Activity

The duration and noise levels associated with construction activities required to refurbish or newly construct any individual TPSS facility are expected to be limited in duration and scale. Thus the temporary construction activity would not cause substantial changes to the environment. Guidance regarding mitigation of construction noise is provided by FTA in the Transit Noise and Vibration Impact Assessment manual (FTA 2006) Chapter 12.

The following good practice measures will be applied by contract Specifications to Project construction as appropriate to minimize temporary construction noise and vibration:

- All equipment powered by internal combustion engines shall be equipped with effective mufflers and silencers in good repair.
- All compressed air and hydraulically driven equipment shall be equipped with the manufacturer's "quiet package" if available.
- Avoid nighttime construction activities affecting residential neighborhoods.
- Locate stationary construction equipment as far as possible from noise-sensitive use.
- Construct temporary noise barriers, such as temporary walls or noise curtains between noise-sensitive receivers and any very noisy activities requiring an extended duration.

- Rout construction-related truck traffic to roadways that will cause the least disturbance to nearby residents.
- Use alternative construction methods if necessary to minimize the use of impact and high vibration equipment (e.g., vibratory compactors) near sensitive land use.

4.0 CONCLUSION

The study performed by TMP to satisfy the FTA noise and vibration impact assessment process is summarized in this report. Based on determination of existing environmental noise and application of the FTA noise impact criteria, the study team was able to develop Project operational noise limits and construction noise and vibration reduction measures that will avoid noise and vibration impacts. The recommended noise limits and project features presented in this report are expected to benefit both the Project and the occupants of sensitive land use located adjacent to Project construction including the required TPSS sites. Design and installation best practices will help TPSS sites perform within or under the noise thresholds while BART (or its contractor) will monitor the noise levels post deployment to maintain current operational thresholds; and employ any additional measures to bring it under the thresholds, if necessary.

5.0 REFERENCES

AECOM. June 2016. BART Hayward Maintenance Complex Project. Admin Draft Second Addendum to the Final Initial Study/Mitigated Negative Declaration.

Bay Area Rapid Transit. September 2015. Geographic Data Base file (BART.gdb)

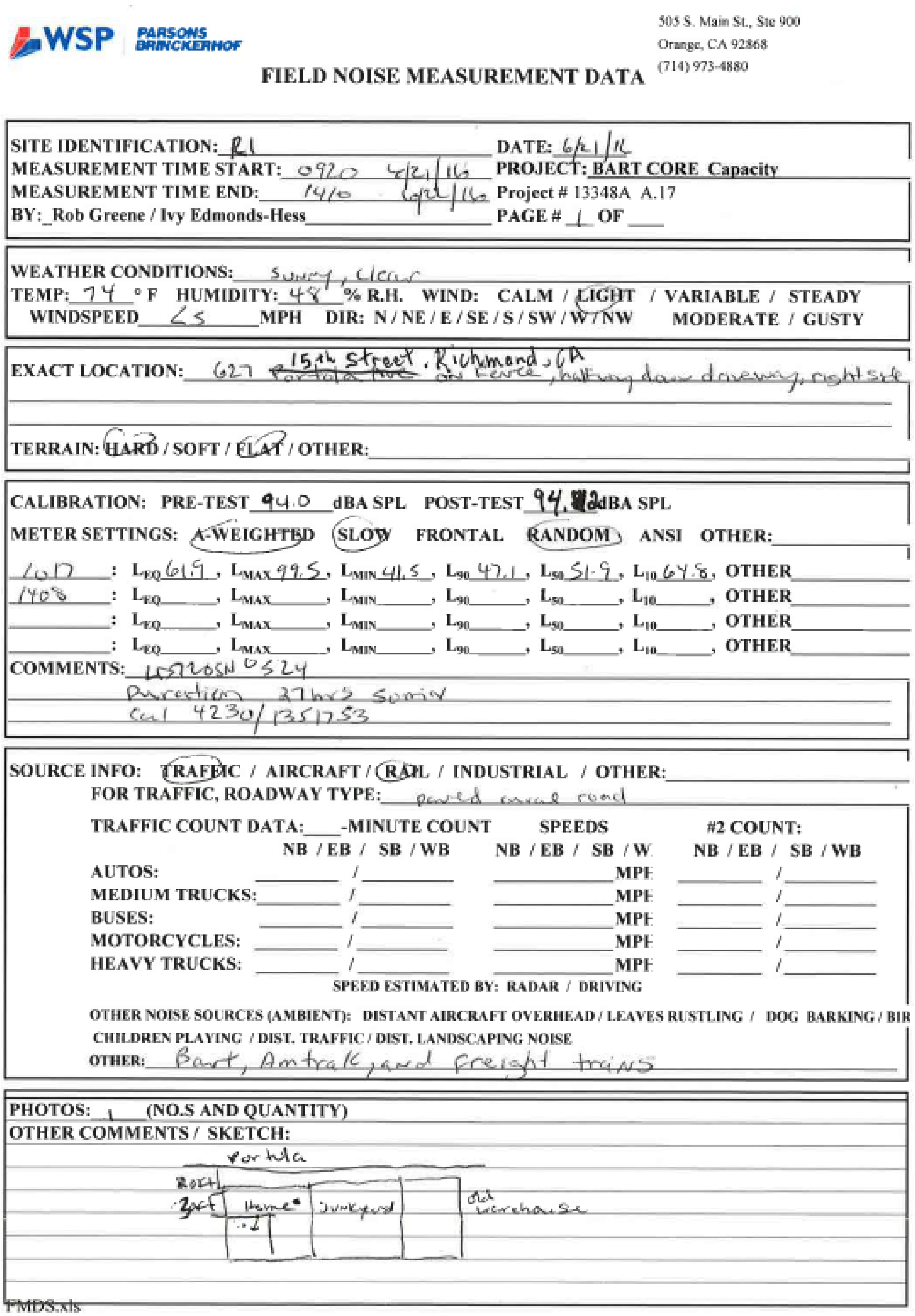
City of San Francisco. December 2008. “Noise Layer” from San Francisco Traffic Noise Model.

Federal Transit Administration (FTA). May 2006. *Transit Noise and Vibration Impact Assessment.* Final Report No. FTA-VA-90-1003-06. Office of Planning and Environment. Washington, DC.

6.0 PREPARERS

This report was prepared by Rob Greene, INCE, Board Certified, with the assistance of Ivy Edmonds-Hess, Kevin Keller, AICP, Michael Lieu, and Teresea Colomac.

APPENDIX A - Field Measurement Data Sheets



WSP | PARSONS BRINCKERHOF

505 S. Main St., Ste 900
Orange, CA 92868
(714) 973-4880

FIELD NOISE MEASUREMENT DATA

SITE IDENTIFICATION: R1
DATE: 6/21/16
MEASUREMENT TIME START: 0920 4/21/16
PROJECT: BART CORE Capacity
MEASUREMENT TIME END: 1410 6/22/16
Project # 13348A A.17
BY: Rob Greene / Ivy Edmonds-Hess
PAGE # 1 **OF** ___

WEATHER CONDITIONS: Sunny, clear
TEMP: 74 °F **HUMIDITY:** 48 % R.H. **WIND:** CALM / [✓ LIGHT] / VARIABLE / STEADY
WINDSPEED <5 **MPH** **DIR:** N / NE / E / SE / S / SW / W / NW MODERATE / GUSTY

EXACT LOCATION: 627 ~~Portola Ave~~ 15th Street, Richmond, CA on fence, halfway down driveway, right side

TERRAIN: [✓ HARD] / SOFT / [✓ FLAT] / OTHER:

CALIBRATION: PRE-TEST 94.0 dBA SPL POST-TEST 94.2 dBA SPL
METER SETTINGS: [✓ A-WEIGHTED] [✓ SLOW] FRONTAL [✓ RANDOM] ANSI OTHER:

1017 : L_{EQ} 61.9, L_{MAX} 99.5, L_{MIN} 41.5, L_{90} 47.1, L_{50} 51.9, L_{10} 64.8, OTHER
1408 : L_{EQ}, L_{MAX}, L_{MIN}, L_{90}, L_{50}, L_{10}, OTHER
: L_{EQ}, L_{MAX}, L_{MIN}, L_{90}, L_{50}, L_{10}, OTHER
: L_{EQ}, L_{MAX}, L_{MIN}, L_{90}, L_{50}, L_{10}, OTHER

COMMENTS: LxT2SN 0524
Duration 27hrs 5min
Cal 4230/1351753

SOURCE INFO: [✓ TRAFFIC] / AIRCRAFT / [✓ RAIL] / INDUSTRIAL / OTHER:
FOR TRAFFIC, ROADWAY TYPE: paved arterial road

TRAFFIC COUNT DATA: ___-MINUTE COUNT **SPEEDS** **#2 COUNT:**

	NB / EB /	SB / WB	NB / EB / SB / W		NB / EB /	SB / WB
AUTOS:				MPH		
MEDIUM TRUCKS:				MPH		
BUSES:				MPH		
MOTORCYCLES:				MPH		
HEAVY TRUCKS:				MPH		

SPEED ESTIMATED BY: RADAR / DRIVING

OTHER NOISE SOURCES (AMBIENT): DISTANT AIRCRAFT OVERHEAD / LEAVES RUSTLING / DOG BARKING / BIR
CHILDREN PLAYING / DIST. TRAFFIC / DIST. LANDSCAPING NOISE
OTHER: Bart, Amtrak, and freight trains

PHOTOS: 1 **(NO.S AND QUANTITY)**
OTHER COMMENTS / SKETCH:

FMDS.xls

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505 S. Main St., Ste 900
Orange, CA 92868
(714) 973-4880

FIELD NOISE MEASUREMENT DATA

SITE IDENTIFICATION: R1A
DATE: 6/21/16
MEASUREMENT TIME START: 10:45
PROJECT: BART CORE Capacity
MEASUREMENT TIME END:
Project # 13348A A.17
BY: Rob Greene / Ivy Edmonds-Hess
PAGE # 1 OF

WEATHER CONDITIONS:
TEMP: 72 °F HUMIDITY: 54 % R.H. WIND: CALM / [✓ LIGHT] / VARIABLE / STEADY
WINDSPEED <5 MPH DIR: N / NE / [✓ E] / SE / S / SW / W / NW MODERATE / GUSTY

EXACT LOCATION: 1317 Roosevelt Richmond (dead end of Roosevelt) in street

TERRAIN: [✓ HARD] / SOFT / [✓ FLAT] / OTHER:

CALIBRATION: PRE-TEST ~~[illegible]~~ 93.8 dBA SPL POST-TEST 93.8 dBA SPL
METER SETTINGS: A-WEIGHTED SLOW FRONTAL RANDOM ANSI OTHER:

#1 1045 : L_{EQ} 57.3, L_{MAX} 80.3, L_{MIN} 42.3, L_{90} 44.0, L_{50} 45.3, L_{10} 55.0, OTHER
#2 1101 : L_{EQ} 52.7, L_{MAX} 66.8, L_{MIN} 41.5, L_{90} 42.8, L_{50} 45.0, L_{10} ~~[illegible]~~ 55.2, OTHER
1117 Freight train: L_{EQ} 70.0, L_{MAX} 93.8, L_{MIN} 41.5, L_{90} 42.8, L_{50} 45.0, L_{10} 60.0, OTHER Sel 98.8
1120 Amtrak : L_{EQ} 77.2, L_{MAX} 82.9, L_{MIN} 55.5, L_{90} 64.2, L_{50} 72.3, L_{10} 82.1, OTHER Sel 90.9 directio

COMMENTS: LD820 SN 1232
Cal 4230/1351753

SOURCE INFO: TRAFFIC / AIRCRAFT / [✓ RAIL] / INDUSTRIAL / OTHER:
FOR TRAFFIC, ROADWAY TYPE:

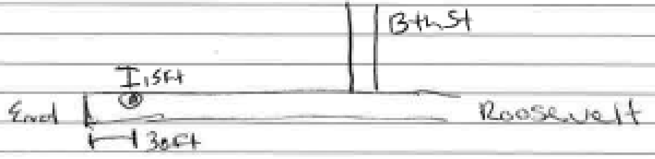
TRAFFIC COUNT DATA: ___-MINUTE COUNT

	-MINUTE COUNT NB / EB	SB / WB	SPEEDS NB / EB / SB / W	#2 COUNT: NB / EB	SB / WB
AUTOS:			MPH		
MEDIUM TRUCKS:			MPH		
BUSES:			MPH		
MOTORCYCLES:			MPH		
HEAVY TRUCKS:			MPH		

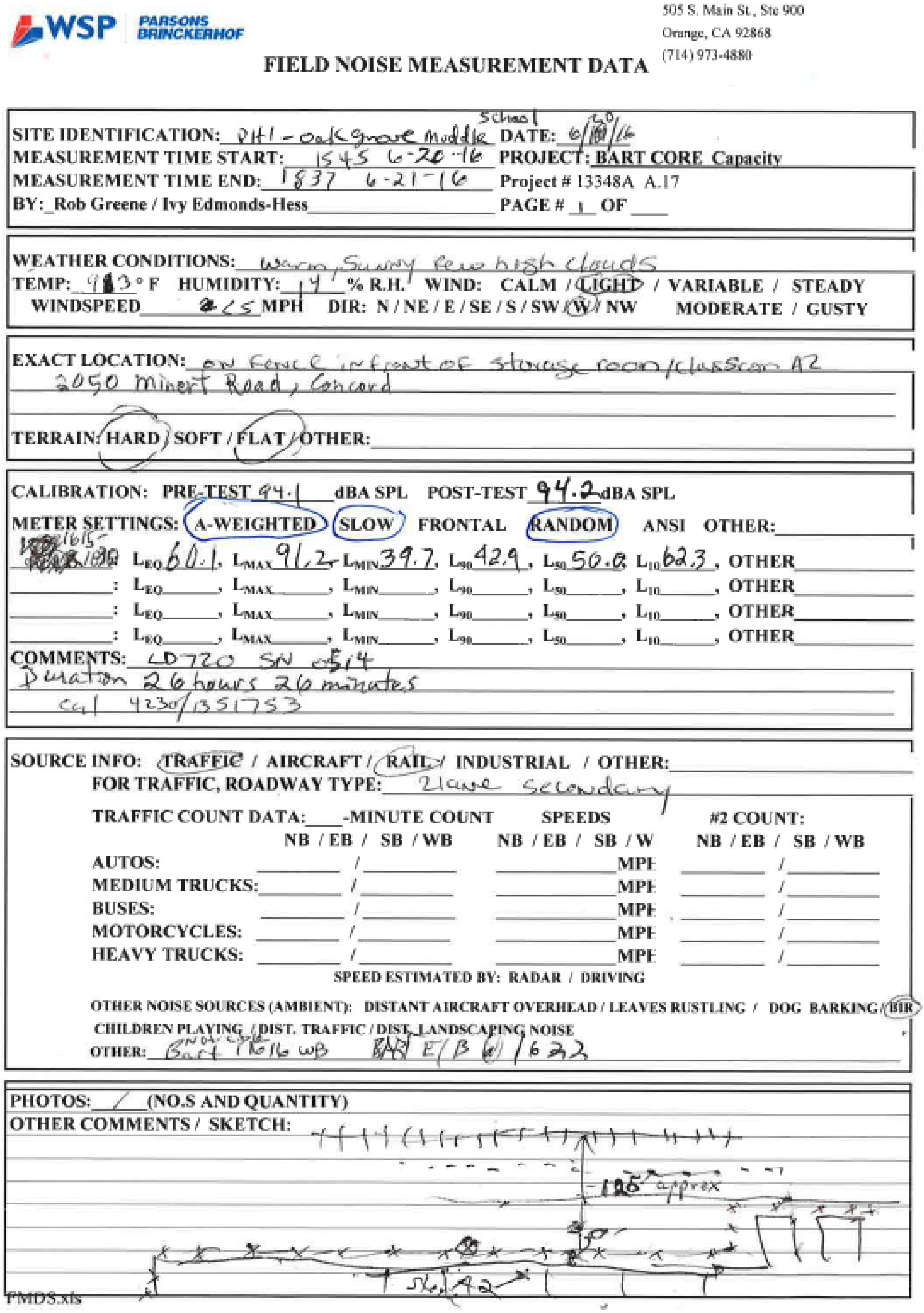
SPEED ESTIMATED BY: RADAR / DRIVING

OTHER NOISE SOURCES (AMBIENT): DISTANT AIRCRAFT OVERHEAD / LEAVES RUSTLING / DOG BARKING / [✓ BIRD] Hawk
CHILDREN PLAYING / DIST. TRAFFIC / DIST. LANDSCAPING NOISE
#1 OTHER: Train horn; distant BART (slow) AMTRAK 174. full speed
#2 ///// BART (slow) Distant train horn

PHOTOS: ✓ (NO.S AND QUANTITY)
OTHER COMMENTS / SKETCH:



FMDS.xls



505 S. Main St., Ste 900
Orange, CA 92868
(714) 973-4880

FIELD NOISE MEASUREMENT DATA

SITE IDENTIFICATION: RH1 - Oak Grove Middle School **DATE:** 6/30/16
MEASUREMENT TIME START: 1545 6-20-16 **PROJECT:** BART CORE Capacity
MEASUREMENT TIME END: 1837 6-21-16 **Project #** 13348A A.17
BY: Rob Greene / Ivy Edmonds-Hess **PAGE #** 1 **OF** ___

WEATHER CONDITIONS: Warm, Sunny few high clouds
TEMP: 93 °F **HUMIDITY:** 14 % R.H. **WIND:** CALM / [✓ LIGHT] / VARIABLE / STEADY
WINDSPEED <5 MPH **DIR:** N / NE / E / SE / S / SW / [✓ W] / NW MODERATE / GUSTY

EXACT LOCATION: on fence in front of storage room/classroom A2
2050 Minert Road, Concord

TERRAIN: [✓ HARD] / SOFT / [✓ FLAT] / OTHER: ___

CALIBRATION: PRE-TEST 94.1 dBA SPL POST-TEST 94.2 dBA SPL
METER SETTINGS: [✓ A-WEIGHTED] [✓ SLOW] FRONTAL [✓ RANDOM] ANSI OTHER: ___

1615-	L_{EQ} 60.1	L_{MAX} 91.2	L_{MIN} 39.7	L_{90} 42.9	L_{50} 50.0	L_{10} 62.3	OTHER
:	L_{EQ}	L_{MAX}	L_{MIN}	L_{90}	L_{50}	L_{10}	OTHER
:	L_{EQ}	L_{MAX}	L_{MIN}	L_{90}	L_{50}	L_{10}	OTHER
:	L_{EQ}	L_{MAX}	L_{MIN}	L_{90}	L_{50}	L_{10}	OTHER

COMMENTS: LD720 SN 0514
Duration 26 hours 26 minutes
cal 4230/1351753

SOURCE INFO: [✓ TRAFFIC] / AIRCRAFT / [✓ RAIL] / INDUSTRIAL / OTHER: ___
FOR TRAFFIC, ROADWAY TYPE: 2 lane secondary

TRAFFIC COUNT DATA: ___-MINUTE COUNT

	-MINUTE COUNT NB / EB / SB / WB	SPEEDS NB / EB / SB / W	#2 COUNT: NB / EB / SB / WB
AUTOS:	/	MPH	/
MEDIUM TRUCKS:	/	MPH	/
BUSES:	/	MPH	/
MOTORCYCLES:	/	MPH	/
HEAVY TRUCKS:	/	MPH	/

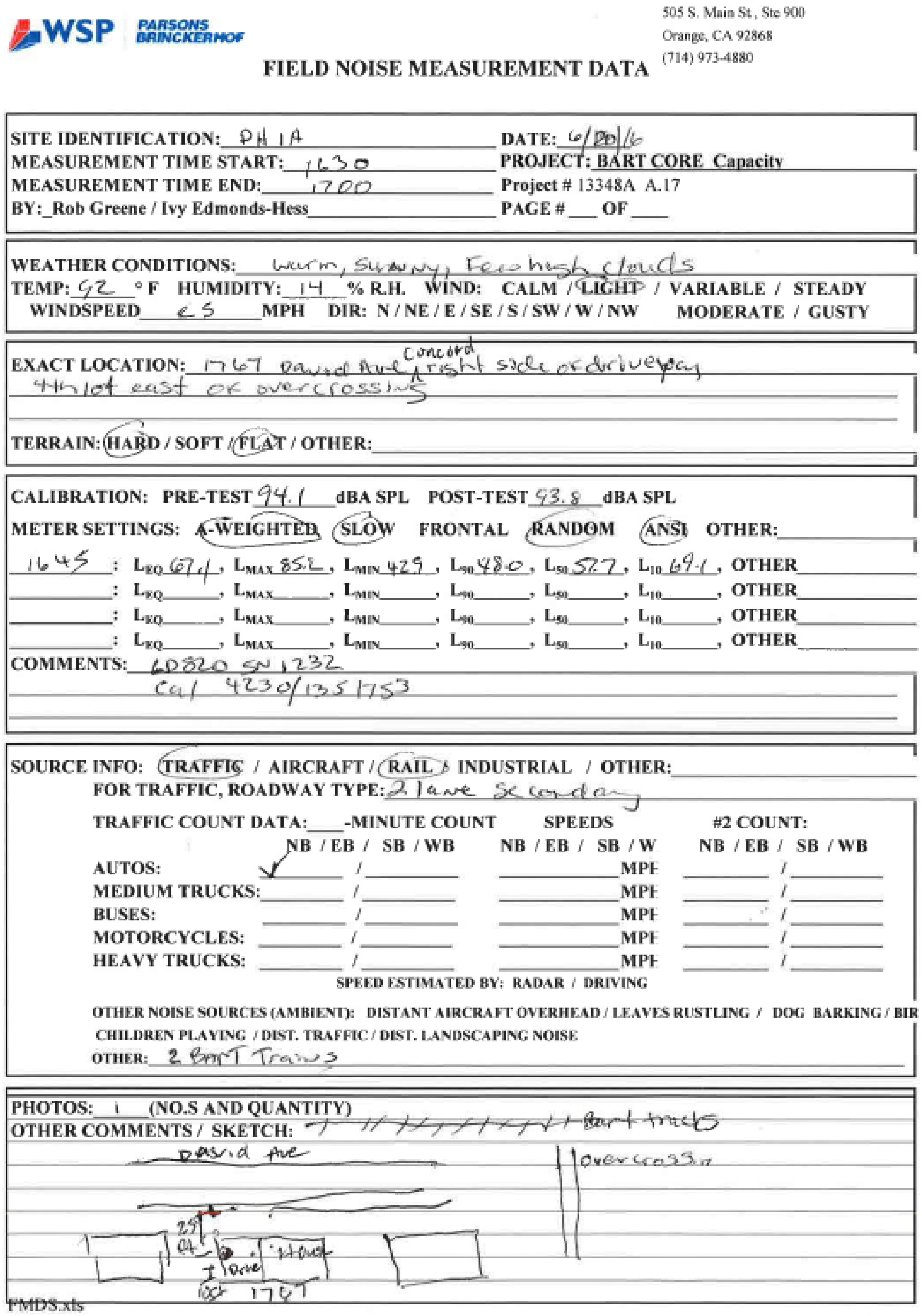
SPEED ESTIMATED BY: RADAR / DRIVING

OTHER NOISE SOURCES (AMBIENT): DISTANT AIRCRAFT OVERHEAD / LEAVES RUSTLING / DOG BARKING / [✓ BIR]
CHILDREN PLAYING / DIST. TRAFFIC / DIST. LANDSCAPING NOISE
OTHER: Bart 1616 WB BART E/B @ 1622

PHOTOS: / (NO.S AND QUANTITY)
OTHER COMMENTS / SKETCH:

125' approx
SL, A2

PMDS.xls



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Orange, CA 92868
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FIELD NOISE MEASUREMENT DATA

SITE IDENTIFICATION: PH 1A
DATE: 6/20/16
MEASUREMENT TIME START: 1630
PROJECT: BART CORE Capacity
MEASUREMENT TIME END: 1700
Project # 13348A A.17
BY: Rob Greene / Ivy Edmonds-Hess
PAGE # ___ **OF** ___

WEATHER CONDITIONS: warm, sunny, few high clouds
TEMP: 92 **° F** **HUMIDITY:** 14 **% R.H.** **WIND:** CALM / [✓ LIGHT] / VARIABLE / STEADY
WINDSPEED <5 **MPH** **DIR:** N / NE / E / SE / S / SW / W / NW MODERATE / GUSTY

EXACT LOCATION: 1767 David Ave Concord right side of driveway
4th lot east of overcrossing

TERRAIN: [✓ HARD] / SOFT / [✓ FLAT] / OTHER:

CALIBRATION: **PRE-TEST** 94.1 **dBA SPL** **POST-TEST** 93.8 **dBA SPL**
METER SETTINGS: [✓ A-WEIGHTED] [✓ SLOW] FRONTAL [✓ RANDOM] [✓ ANSI] OTHER:

1645 : L_{EQ} 67.4, L_{MAX} 85.2, L_{MIN} 42.9, L_{90} 48.0, L_{50} 52.7, L_{10} 69.1, OTHER
: L_{EQ}, L_{MAX}, L_{MIN}, L_{90}, L_{50}, L_{10}, OTHER
: L_{EQ}, L_{MAX}, L_{MIN}, L_{90}, L_{50}, L_{10}, OTHER
: L_{EQ}, L_{MAX}, L_{MIN}, L_{90}, L_{50}, L_{10}, OTHER

COMMENTS: LD820 SN 1232
Cal 4230/135 1753

SOURCE INFO: [✓ TRAFFIC] / AIRCRAFT / [✓ RAIL] / INDUSTRIAL / OTHER:
FOR TRAFFIC, ROADWAY TYPE: 2 lane secondary

TRAFFIC COUNT DATA: ___ **-MINUTE COUNT**			**SPEEDS**		**#2 COUNT:**	
	NB / EB /	**SB / WB**	**NB / EB / SB / W**		**NB / EB /**	**SB / WB**
AUTOS:	✓	/		**MPH**		/
MEDIUM TRUCKS:		/		**MPH**		/
BUSES:		/		**MPH**		/
MOTORCYCLES:		/		**MPH**		/
HEAVY TRUCKS:		/		**MPH**		/

SPEED ESTIMATED BY: RADAR / DRIVING

OTHER NOISE SOURCES (AMBIENT): DISTANT AIRCRAFT OVERHEAD / LEAVES RUSTLING / DOG BARKING / BIR
CHILDREN PLAYING / DIST. TRAFFIC / DIST. LANDSCAPING NOISE
OTHER: 2 BART Trains

PHOTOS: 1 **(NO.S AND QUANTITY)**
OTHER COMMENTS / SKETCH: Bart tracks

David Ave
overcrossing
25
04
1st house
Drive
1 lot
1767

FMDS.xls

505 S. Main St., Ste 900
Orange, CA 92868
(714) 973-4880

FIELD NOISE MEASUREMENT DATA

SITE IDENTIFICATION: RH2
DATE: 6/20/16
MEASUREMENT TIME START: 1720 6/20/16
PROJECT: BART CORE Capacity
MEASUREMENT TIME END: 1110 6/22/16
Project # 13348A A.17
BY: Rob Greene / Ivy Edmonds-Hess
PAGE # 1 **OF** ____

WEATHER CONDITIONS: Warm, Sunny + high clouds
TEMP: 93 °F **HUMIDITY:** 15 % R.H. **WIND:** CALM / [✓ LIGHT] / [✓ VARIABLE] / STEADY
WINDSPEED < 5 MPH **DIR:** N / NE / E / SE / S / SW / W / NW MODERATE / GUSTY

EXACT LOCATION: 1211 Bentley St backyard
Concord

TERRAIN: [✓ HARD] / SOFT / [✓ FLAT] / OTHER:

CALIBRATION: PRE-TEST 93.9 dBA SPL POST-TEST 94.0 dBA SPL
METER SETTINGS: [✓ A-WEIGHTED] [✓ SLOW] FRONTAL [✓ RANDOM] ANSI OTHER:

1740 : L_{EQ} 68.1, L_{MAX} 98.7, L_{MIN} 39.1, L_{90} 45.5, L_{50} 61.5, L_{10} 72.4, OTHER
-1110 : L_{EQ} ____, L_{MAX} ____, L_{MIN} ____, L_{90} ____, L_{50} ____, L_{10} ____, OTHER
____ : L_{EQ} ____, L_{MAX} ____, L_{MIN} ____, L_{90} ____, L_{50} ____, L_{10} ____, OTHER
____ : L_{EQ} ____, L_{MAX} ____, L_{MIN} ____, L_{90} ____, L_{50} ____, L_{10} ____, OTHER

COMMENTS: LD720 SN 0636
Duration 41hrs 30min
Cal 9230/1351753

SOURCE INFO: [✓ TRAFFIC] / AIRCRAFT / [✓ RAIL] / INDUSTRIAL / OTHER:
FOR TRAFFIC, ROADWAY TYPE: four lane arterial

TRAFFIC COUNT DATA: ___-MINUTE COUNT

	-MINUTE COUNT		SPEEDS		#2 COUNT:	
	NB / EB	SB / WB	NB / EB / SB / W		NB / EB	SB / WB
AUTOS:	/			MPH		
MEDIUM TRUCKS:	/			MPH		
BUSES:				MPH		
MOTORCYCLES:				MPH		
HEAVY TRUCKS:				MPH		

SPEED ESTIMATED BY: RADAR / DRIVING

OTHER NOISE SOURCES (AMBIENT): DISTANT AIRCRAFT OVERHEAD / LEAVES RUSTLING / DOG BARKING / BIR
CHILDREN PLAYING / DIST. TRAFFIC / DIST. LANDSCAPING NOISE
OTHER: distant rail

PHOTOS: 1 (NO.S AND QUANTITY)
OTHER COMMENTS / SKETCH:

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FIELD NOISE MEASUREMENT DATA

SITE IDENTIFICATION: PH2-A ST1
DATE: 6-22-16
MEASUREMENT TIME START: 0850
PROJECT: BART CORE Capacity
MEASUREMENT TIME END: 0940
Project # 13348A A.17
BY: Rob Greene / Ivy Edmonds-Hess
PAGE # 1 **OF** 1

WEATHER CONDITIONS: Clear sunny
TEMP: 71 ° F **HUMIDITY:** 49 % R.H. **WIND:** CALM / [✓ LIGHT] / [✓ VARIABLE] / STEADY
WINDSPEED 3-4 MPH **DIR:** N / NE / E / SE / S / SW / W / NW MODERATE / GUSTY

EXACT LOCATION: Rear yard 493 Geni Ct- Walnut Creek

TERRAIN: [✓ HARD] / SOFT / [✓ FLAT] / OTHER:

CALIBRATION: PRE-TEST 93.9 dBA SPL POST-TEST 94.0 dBA SPL Cal 4230/1351753
METER SETTINGS: [✓ A-WEIGHTED] [✓ SLOW] FRONTAL [✓ RANDOM] [✓ ANSI] OTHER:

0915-0930: L_{EQ} 57.6, L_{MAX} 73.9, L_{MIN} 45.7, L_{90} 48.0, L_{50} 50.4, L_{10} 54.7, OTHER
: L_{EQ} , L_{MAX} , L_{MIN} , L_{90} , L_{50} , L_{10} , OTHER
: L_{EQ} , L_{MAX} , L_{MIN} , L_{90} , L_{50} , L_{10} , OTHER
: L_{EQ} , L_{MAX} , L_{MIN} , L_{90} , L_{50} , L_{10} , OTHER

COMMENTS: mostly front end loader noise from site plus two BART trains - generally very quiet except for trains pass by
LD 820 SN 1732

SOURCE INFO: TRAFFIC / AIRCRAFT / [✓ RAIL] / INDUSTRIAL / OTHER:
FOR TRAFFIC, ROADWAY TYPE:

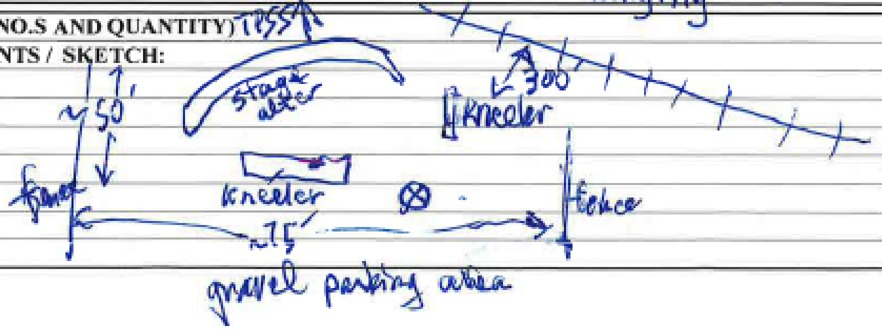
TRAFFIC COUNT DATA: ____-MINUTE COUNT

	NB / EB / SB / WB		SPEEDS NB / EB / SB / W	#2 COUNT: NB / EB / SB / WB	
AUTOS:			MPH		
MEDIUM TRUCKS:			MPH		
BUSES:			MPH		
MOTORCYCLES:			MPH		
HEAVY TRUCKS:			MPH		

SPEED ESTIMATED BY: RADAR / DRIVING

OTHER NOISE SOURCES (AMBIENT): DISTANT AIRCRAFT OVERHEAD / LEAVES RUSTLING / DOG BARKING / [✓ BIRD]
CHILDREN PLAYING / [✓ DIST. TRAFFIC] / [✓ DIST. LANDSCAPING NOISE] backup alarm / siren
front end loader banging
OTHER: BART train 11

PHOTOS: ✓ (NO.S AND QUANTITY) 1255
OTHER COMMENTS / SKETCH:



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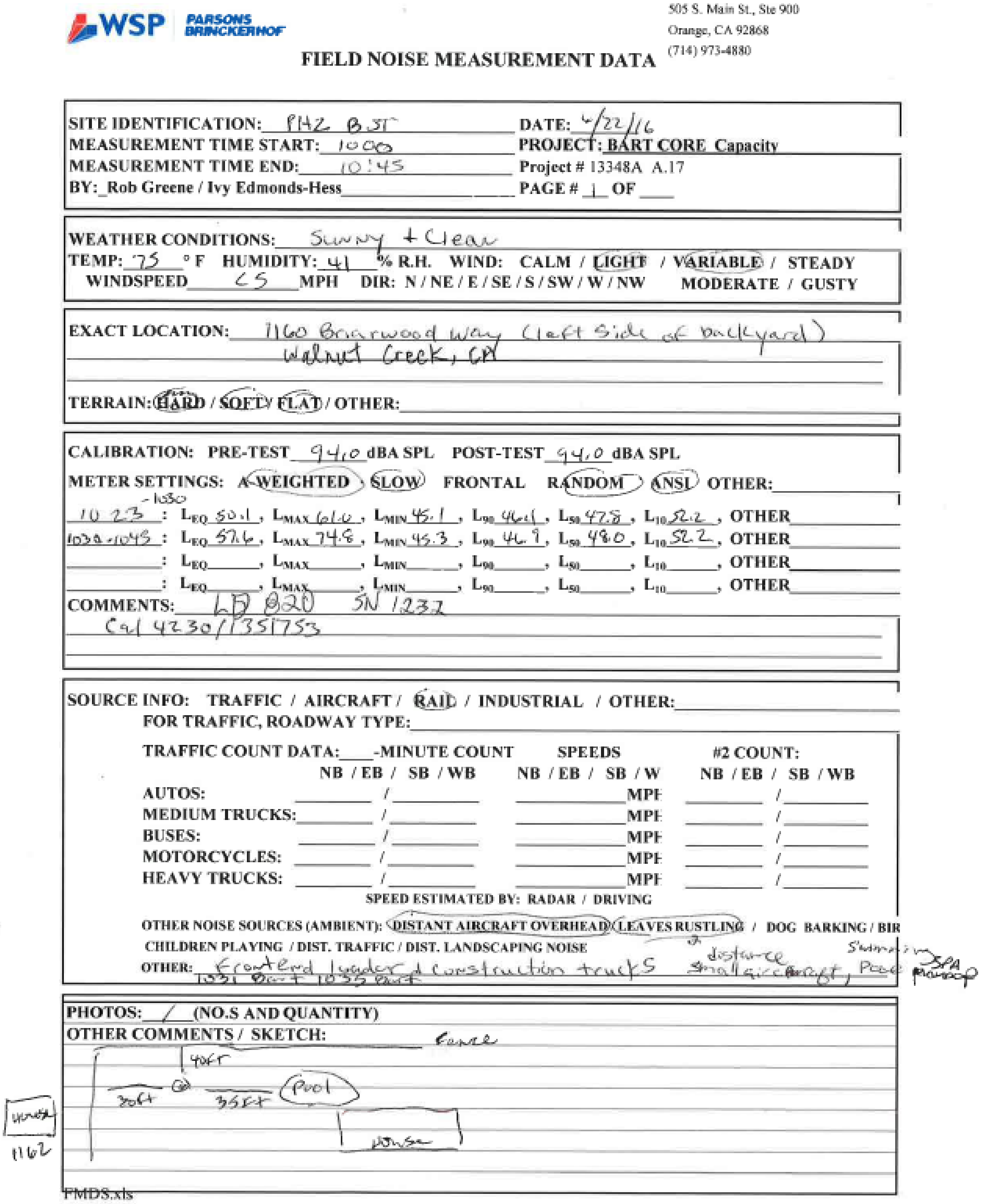

WSP PARSONS BRINCKERHOFF

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FIELD NOISE MEASUREMENT DATA

SITE IDENTIFICATION: PH2 B3T
MEASUREMENT TIME START: 1000
MEASUREMENT TIME END: 10:45
BY: Rob Greene / Ivy Edmonds-Hess
DATE: 4/22/16
PROJECT: BART CORE Capacity
Project # 13348A A.17
PAGE # 1 **OF** ___

WEATHER CONDITIONS: Sunny + Clear
TEMP: 75 °F **HUMIDITY:** 41 % R.H. **WIND:** CALM / [✓ LIGHT] / [✓ VARIABLE] / STEADY
WINDSPEED <5 MPH **DIR:** N / NE / E / SE / S / SW / W / NW **MODERATE / GUSTY**

EXACT LOCATION: 1160 Briarwood Way (left side of backyard)
Walnut Creek, CA

TERRAIN: [✓ HARD] / [✓ SOFT] / [✓ FLAT] / OTHER: ___

CALIBRATION: PRE-TEST 94.0 dBA SPL POST-TEST 94.0 dBA SPL
METER SETTINGS: [✓ A-WEIGHTED] [✓ SLOW] FRONTAL [✓ RANDOM] [✓ ANSI] OTHER: ___

1023 -1030 : L_{EQ} 50.1, L_{MAX} 61.6, L_{MIN} 45.1, L_{90} 46.1, L_{50} 47.8, L_{10} 52.2, OTHER ___
1030-1045 : L_{EQ} 57.6, L_{MAX} 74.8, L_{MIN} 45.3, L_{90} 46.9, L_{50} 48.0, L_{10} 52.2, OTHER ___
___ : L_{EQ} ___, L_{MAX} ___, L_{MIN} ___, L_{90} ___, L_{50} ___, L_{10} ___, OTHER ___
___ : L_{EQ} ___, L_{MAX} ___, L_{MIN} ___, L_{90} ___, L_{50} ___, L_{10} ___, OTHER ___

COMMENTS: LD 820 SN 1232
Cal 4230/1351753

SOURCE INFO: TRAFFIC / AIRCRAFT / [✓ RAIL] / INDUSTRIAL / OTHER: ___
FOR TRAFFIC, ROADWAY TYPE: ___

TRAFFIC COUNT DATA: ___-MINUTE COUNT

	NB / EB / SB / WB	SPEEDS NB / EB / SB / W	#2 COUNT: NB / EB / SB / WB
AUTOS:	/	MPH	/
MEDIUM TRUCKS:	/	MPH	/
BUSES:	/	MPH	/
MOTORCYCLES:	/	MPH	/
HEAVY TRUCKS:	/	MPH	/

SPEED ESTIMATED BY: RADAR / DRIVING

OTHER NOISE SOURCES (AMBIENT): [✓ DISTANT AIRCRAFT OVERHEAD] [✓ LEAVES RUSTLING] / DOG BARKING / BIR
CHILDREN PLAYING / DIST. TRAFFIC / DIST. LANDSCAPING NOISE
OTHER: Frontend loader & construction trucks distance small aircraft, Swimming Pool SPA pump
1331 Bart 1035 Bart

PHOTOS: / (NO.S AND QUANTITY)
OTHER COMMENTS / SKETCH:

Fence
40ft
30ft
35ft
Pool
House
House
1162

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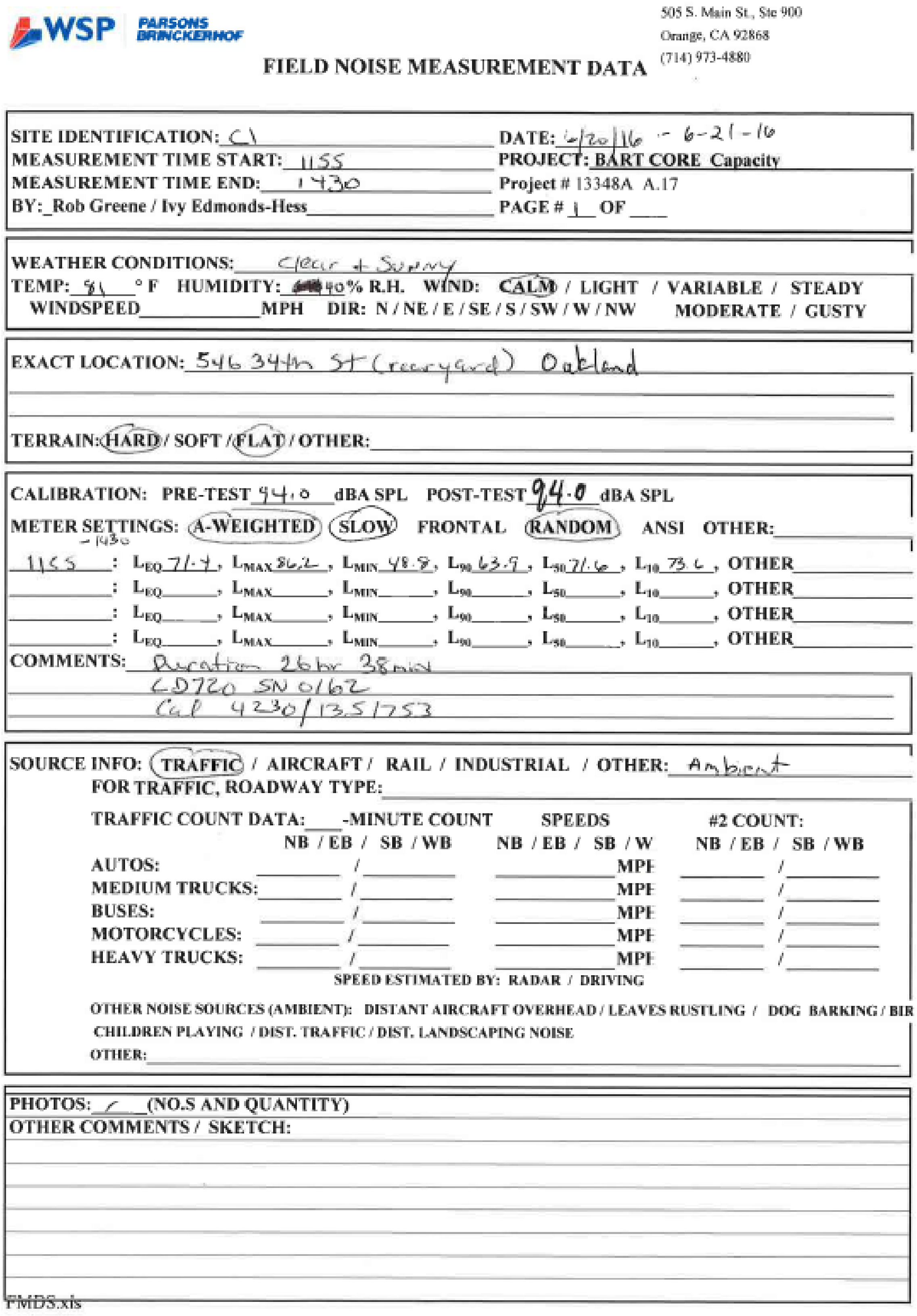


505 S. Main St., Ste 900
Orange, CA 92868
(714) 973-4880

FIELD NOISE MEASUREMENT DATA

SITE IDENTIFICATION: C1
DATE: 6/20/16 - 6-21-16
MEASUREMENT TIME START: 1155
PROJECT: BART CORE Capacity
MEASUREMENT TIME END: 1430
Project # 13348A A.17
BY: Rob Greene / Ivy Edmonds-Hess
PAGE # 1 **OF** ___

WEATHER CONDITIONS: Clear + Sunny
TEMP: 81 °F **HUMIDITY:** 40% R.H. **WIND:** [✓ CALM] / LIGHT / VARIABLE / STEADY / MODERATE / GUSTY
WINDSPEED ______ MPH **DIR:** N / NE / E / SE / S / SW / W / NW

EXACT LOCATION: 546 34th St (rearyard) Oakland

TERRAIN: [✓ HARD] / SOFT / [✓ FLAT] / OTHER: ______

CALIBRATION: PRE-TEST 94.0 **dBA SPL POST-TEST** 94.0 **dBA SPL**
METER SETTINGS: [✓ A-WEIGHTED] [✓ SLOW] FRONTAL [✓ RANDOM] ANSI OTHER: ______

1155 - 1430: L_{EQ} 71.4, L_{MAX} 86.2, L_{MIN} 48.8, L_{90} 63.9, L_{50} 71.6, L_{10} 73.6, OTHER ______
______: L_{EQ} ____, L_{MAX} ____, L_{MIN} ____, L_{90} ____, L_{50} ____, L_{10} ____, OTHER ______
______: L_{EQ} ____, L_{MAX} ____, L_{MIN} ____, L_{90} ____, L_{50} ____, L_{10} ____, OTHER ______
______: L_{EQ} ____, L_{MAX} ____, L_{MIN} ____, L_{90} ____, L_{50} ____, L_{10} ____, OTHER ______

COMMENTS: Duration 26hr 38min
LD720 SN 0162
Cal 4230/135 1753

SOURCE INFO: [✓ TRAFFIC] / AIRCRAFT / RAIL / INDUSTRIAL / OTHER: Ambient
FOR TRAFFIC, ROADWAY TYPE: ______

TRAFFIC COUNT DATA: ___ **-MINUTE COUNT**

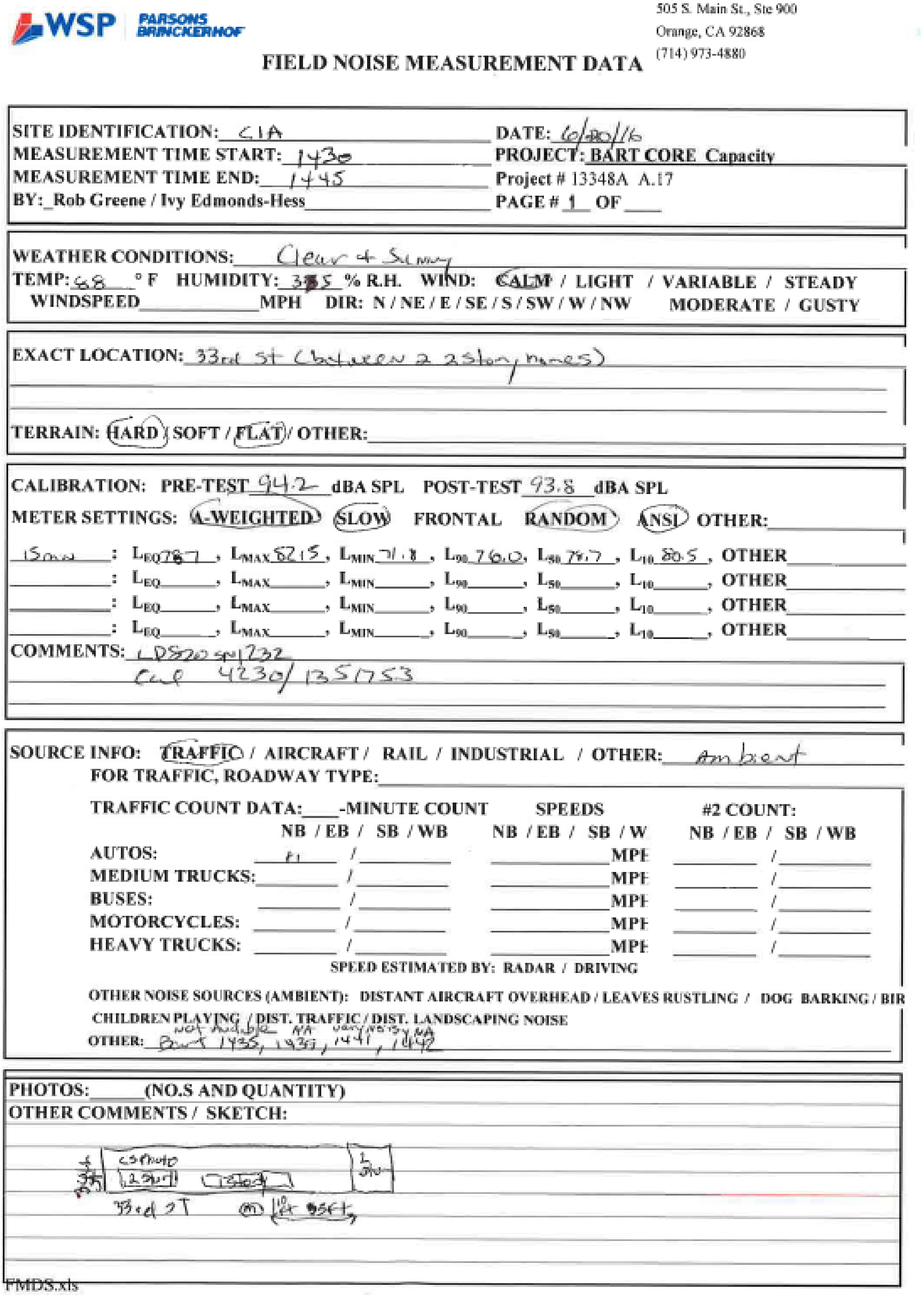
	NB / EB	SB / WB	SPEEDS NB / EB / SB / W		#2 COUNT: NB / EB	SB / WB
AUTOS:				MPH		
MEDIUM TRUCKS:				MPH		
BUSES:				MPH		
MOTORCYCLES:				MPH		
HEAVY TRUCKS:				MPH		

SPEED ESTIMATED BY: RADAR / DRIVING

OTHER NOISE SOURCES (AMBIENT): DISTANT AIRCRAFT OVERHEAD / LEAVES RUSTLING / DOG BARKING / BIR CHILDREN PLAYING / DIST. TRAFFIC / DIST. LANDSCAPING NOISE
OTHER: ______

PHOTOS: ✓ **(NO.S AND QUANTITY)**
OTHER COMMENTS / SKETCH:

FMDS.xls



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FIELD NOISE MEASUREMENT DATA

SITE IDENTIFICATION: C1A
MEASUREMENT TIME START: 1430
MEASUREMENT TIME END: 1445
BY: Rob Greene / Ivy Edmonds-Hess
DATE: 6/30/16
PROJECT: BART CORE Capacity
Project # 13348A A.17
PAGE # 1 **OF** ___

WEATHER CONDITIONS: Clear + Sunny
TEMP: 68 ° F **HUMIDITY:** 35 % R.H. **WIND:** [✓ CALM] / LIGHT / VARIABLE / STEADY / MODERATE / GUSTY
WINDSPEED ___ **MPH** **DIR:** N / NE / E / SE / S / SW / W / NW

EXACT LOCATION: 33rd st (between 2 2story homes)

TERRAIN: [✓ HARD] / SOFT / [✓ FLAT] / OTHER: ___

CALIBRATION: PRE-TEST 94.2 dBA SPL POST-TEST 93.8 dBA SPL
METER SETTINGS: [✓ A-WEIGHTED] [✓ SLOW] FRONTAL [✓ RANDOM] [✓ ANSI] OTHER: ___

15min : L_{EQ} 78.7, L_{MAX} 82.5, L_{MIN} 71.8, L_{90} 76.0, L_{50} 78.7, L_{10} 80.5, OTHER ___
___ : L_{EQ} ___, L_{MAX} ___, L_{MIN} ___, L_{90} ___, L_{50} ___, L_{10} ___, OTHER ___
___ : L_{EQ} ___, L_{MAX} ___, L_{MIN} ___, L_{90} ___, L_{50} ___, L_{10} ___, OTHER ___
___ : L_{EQ} ___, L_{MAX} ___, L_{MIN} ___, L_{90} ___, L_{50} ___, L_{10} ___, OTHER ___

COMMENTS: LD820 sn 1232
Cal 4230/ 135753

SOURCE INFO: [✓ TRAFFIC] / AIRCRAFT / RAIL / INDUSTRIAL / OTHER: Ambient
FOR TRAFFIC, ROADWAY TYPE: ___

TRAFFIC COUNT DATA: ___ **-MINUTE COUNT**

	-MINUTE COUNT NB / EB	SB / WB	SPEEDS NB / EB / SB / W	#2 COUNT: NB / EB	SB / WB
AUTOS:	#1		MPH		
MEDIUM TRUCKS:			MPH		
BUSES:			MPH		
MOTORCYCLES:			MPH		
HEAVY TRUCKS:			MPH		

SPEED ESTIMATED BY: RADAR / DRIVING

OTHER NOISE SOURCES (AMBIENT): DISTANT AIRCRAFT OVERHEAD / LEAVES RUSTLING / DOG BARKING / BIR
CHILDREN PLAYING / DIST. TRAFFIC / DIST. LANDSCAPING NOISE
OTHER: Bart 1435, 1439, 1441, 1442
not audible NA very noisy NA

PHOTOS: ___ **(NO.S AND QUANTITY)**
OTHER COMMENTS / SKETCH:

cs Photo
2 story
3 story
2 story
33 ST
33rd ST
@ 10ft 35ft

FMDS.xls

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505 S. Main St., Ste 900
Orange, CA 92868
(714) 973-4880

FIELD NOISE MEASUREMENT DATA

SITE IDENTIFICATION: CI 51 extra #B
DATE: 6-21-16
MEASUREMENT TIME START: 1500
PROJECT: BART CORE Capacity
MEASUREMENT TIME END: ______
Project # 13348A A.17
BY: Rob Greene / Ivy Edmonds-Hess
PAGE # 1 OF 1

WEATHER CONDITIONS: Clear sunny hot
TEMP: 86 °F HUMIDITY: 36 % R.H. WIND: CALM / [✓ LIGHT] / VARIABLE / STEADY
WINDSPEED <5 MPH DIR: N / NE / E / SE / S / SW / W / NW MODERATE / GUSTY

EXACT LOCATION: Grove Shafter Park - midway between fence along 34th St and play equipment

TERRAIN: [✓ HARD] / SOFT / [✓ FLAT] / OTHER: ______

CALIBRATION: PRE-TEST 93.8 dBA SPL POST-TEST 93.8 dBA SPL
METER SETTINGS: [✓ A-WEIGHTED] [✓ SLOW] FRONTAL [✓ RANDOM] [✓ ANSI] OTHER: ______

1611-1926: L_{EQ} 75.7, L_{MAX} 99.7, L_{MIN} 69.9, L_{90} 73.6, L_{50} 75.6, L_{10} 77.2, OTHER ______
______: L_{EQ} ______, L_{MAX} ______, L_{MIN} ______, L_{90} ______, L_{50} ______, L_{10} ______, OTHER ______
______: L_{EQ} ______, L_{MAX} ______, L_{MIN} ______, L_{90} ______, L_{50} ______, L_{10} ______, OTHER ______
______: L_{EQ} ______, L_{MAX} ______, L_{MIN} ______, L_{90} ______, L_{50} ______, L_{10} ______, OTHER ______

COMMENTS: LD 820 SN 1232
Cal 4230 1351753

SOURCE INFO: [✓ TRAFFIC] / AIRCRAFT / [✓ RAIL] / INDUSTRIAL / OTHER: ______
FOR TRAFFIC, ROADWAY TYPE: Freeway

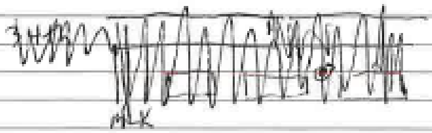
TRAFFIC COUNT DATA: ___-MINUTE COUNT SPEEDS 70 #2 COUNT:

	NB / EB	SB / WB	NB / EB	SB / WB	NB / EB	SB / WB
AUTOS:	✓			MPH		
MEDIUM TRUCKS:	✓			MPH		
BUSES:				MPH		
MOTORCYCLES:	✓			MPH		
HEAVY TRUCKS:	✓			MPH		

SPEED ESTIMATED BY: RADAR / DRIVING

OTHER NOISE SOURCES (AMBIENT): DISTANT AIRCRAFT OVERHEAD / LEAVES RUSTLING / DOG BARKING / BIR
CHILDREN PLAYING / DIST. TRAFFIC / DIST. LANDSCAPING NOISE
OTHER: car horn on local street

PHOTOS: ______ (NO.S AND QUANTITY)
OTHER COMMENTS / SKETCH:



FMDS.xls

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505 S. Main St., Ste 900
Orange, CA 92868
(714) 973-4880

FIELD NOISE MEASUREMENT DATA

SITE IDENTIFICATION: 31 ST

DATE: 6/21/16

MEASUREMENT TIME START:

PROJECT: BART CORE Capacity

MEASUREMENT TIME END:

Project # 13348A A.17

BY: Rob Greene / Ivy Edmonds-Hess

PAGE # 1 **OF** 1

WEATHER CONDITIONS: sunny, hot, clear

TEMP: 80 °F **HUMIDITY:** 36 % R.H. **WIND:** CALM / [✓ LIGHT] / VARIABLE / STEADY

WINDSPEED 15 **MPH** **DIR:** N / NE / E / SE / S / SW / W / NW MODERATE / GUSTY

EXACT LOCATION: 625 34th St (left side of driveway)

TERRAIN: [✓ HARD] / SOFT / [✓ FLAT] / OTHER:

CALIBRATION: PRE-TEST 93.8 dBA SPL POST-TEST 93.8 dBA SPL

METER SETTINGS: [✓ A-WEIGHTED] [✓ SLOW] FRONTAL [✓ RANDOM] [✓ ANSI] OTHER:

1540–1555	L_{EQ} 75.7	L_{MAX} 81.1	L_{MIN} 69.3	L_{90} 73.2	L_{50} 75.5	L_{10} 77.3	OTHER
	L_{EQ}	L_{MAX}	L_{MIN}	L_{90}	L_{50}	L_{10}	OTHER
	L_{EQ}	L_{MAX}	L_{MIN}	L_{90}	L_{50}	L_{10}	OTHER
	L_{EQ}	L_{MAX}	L_{MIN}	L_{90}	L_{50}	L_{10}	OTHER

COMMENTS: several BART trains all audible one w/ wheel flats

LD820 SN 1732 Cal 4230/135/753

SOURCE INFO: [✓ TRAFFIC] / AIRCRAFT / [✓ RAIL] / INDUSTRIAL / OTHER:

FOR TRAFFIC, ROADWAY TYPE: Freeway

TRAFFIC COUNT DATA: ____-MINUTE COUNT

	NB / EB	SB / WB	SPEEDS NB / EB / SB / W		#2 COUNT: NB / EB	SB / WB
AUTOS:	✓			MPH		
MEDIUM TRUCKS:	✓			MPH		
BUSES:				MPH		
MOTORCYCLES:				MPH		
HEAVY TRUCKS:	✓			MPH		

SPEED ESTIMATED BY: RADAR / DRIVING

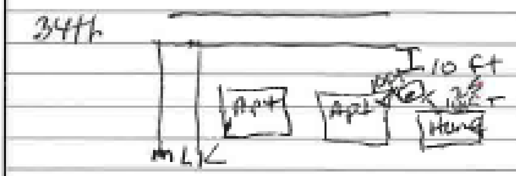
OTHER NOISE SOURCES (AMBIENT): DISTANT AIRCRAFT OVERHEAD / LEAVES RUSTLING / DOG BARKING / BIR

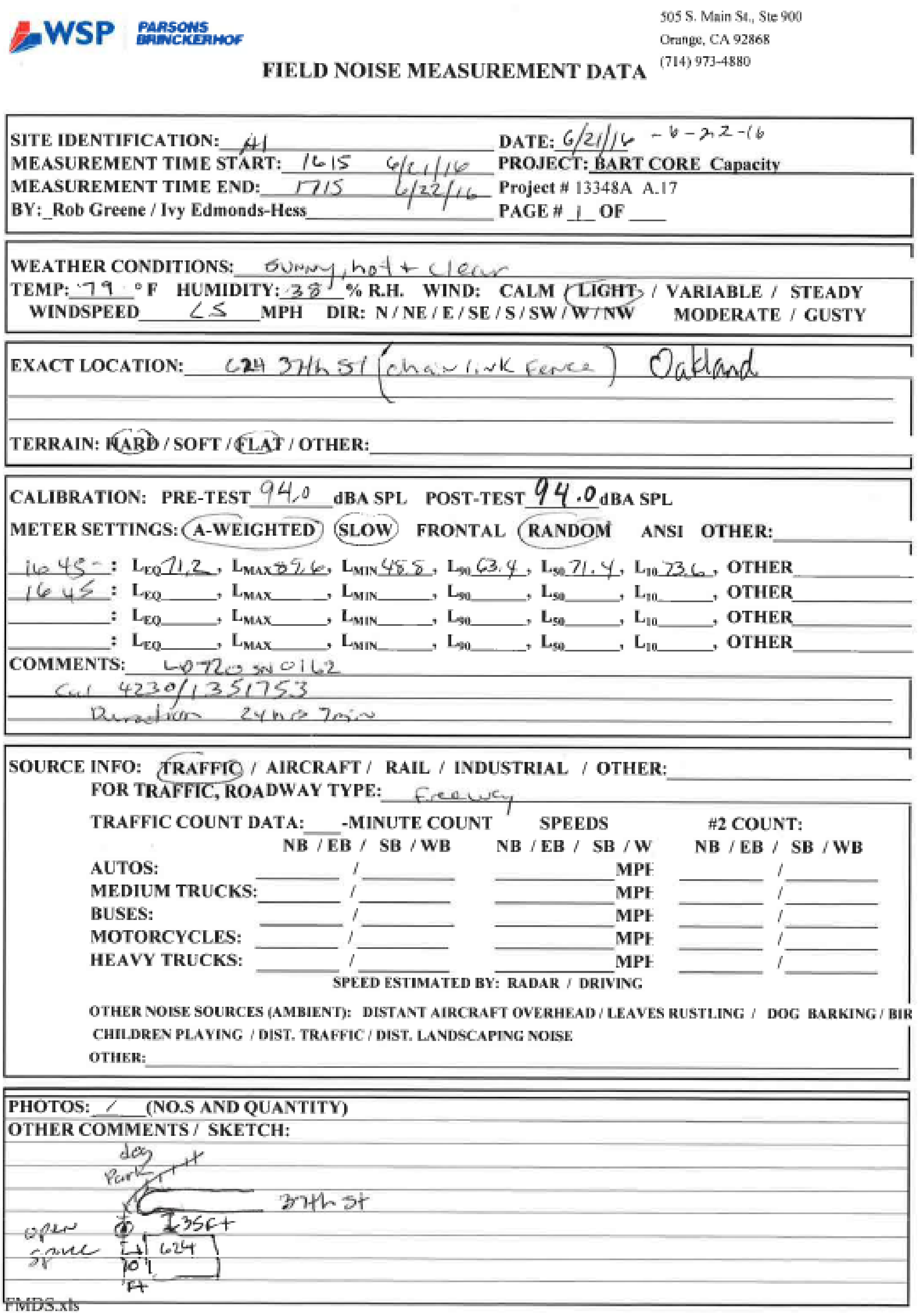
CHILDREN PLAYING / DIST. TRAFFIC / DIST. LANDSCAPING NOISE

OTHER: 1542 Bart 1551

PHOTOS: ______ (NO.S AND QUANTITY)

OTHER COMMENTS / SKETCH:





WSP PARSONS BRINCKERHOFF

505 S. Main St., Ste 900
Orange, CA 92868
(714) 973-4880

FIELD NOISE MEASUREMENT DATA

SITE IDENTIFICATION: A1
MEASUREMENT TIME START: 1615 6/21/16
MEASUREMENT TIME END: 1715 6/22/16
BY: Rob Greene / Ivy Edmonds-Hess
DATE: 6/21/16 - 6-22-16
PROJECT: BART CORE Capacity
Project # 13348A A.17
PAGE # 1 **OF** ____

WEATHER CONDITIONS: sunny, hot + clear
TEMP: 79 °F **HUMIDITY:** 38 % R.H. **WIND:** CALM / [✓ LIGHT] / VARIABLE / STEADY / MODERATE / GUSTY
WINDSPEED < 5 MPH **DIR:** N / NE / E / SE / S / SW / W / NW

EXACT LOCATION: 624 37th St (chain link fence) Oakland

TERRAIN: [✓ HARD] / SOFT / [✓ FLAT] / OTHER: ____

CALIBRATION: PRE-TEST 94.0 dBA SPL POST-TEST 94.0 dBA SPL
METER SETTINGS: [✓ A-WEIGHTED] [✓ SLOW] FRONTAL [✓ RANDOM] ANSI OTHER: ____

1645- : L_{EQ} 71.2, L_{MAX} 89.6, L_{MIN} 45.5, L_{90} 63.4, L_{50} 71.4, L_{10} 73.6, OTHER ____
1645 : L_{EQ} ____, L_{MAX} ____, L_{MIN} ____, L_{90} ____, L_{50} ____, L_{10} ____, OTHER ____
____ : L_{EQ} ____, L_{MAX} ____, L_{MIN} ____, L_{90} ____, L_{50} ____, L_{10} ____, OTHER ____
____ : L_{EQ} ____, L_{MAX} ____, L_{MIN} ____, L_{90} ____, L_{50} ____, L_{10} ____, OTHER ____

COMMENTS: LD720 SN 0162
Cal 4230/1351753
Duration 24 hr 7 min

SOURCE INFO: [✓ TRAFFIC] / AIRCRAFT / RAIL / INDUSTRIAL / OTHER: ____
FOR TRAFFIC, ROADWAY TYPE: Freeway

TRAFFIC COUNT DATA: ___-MINUTE COUNT

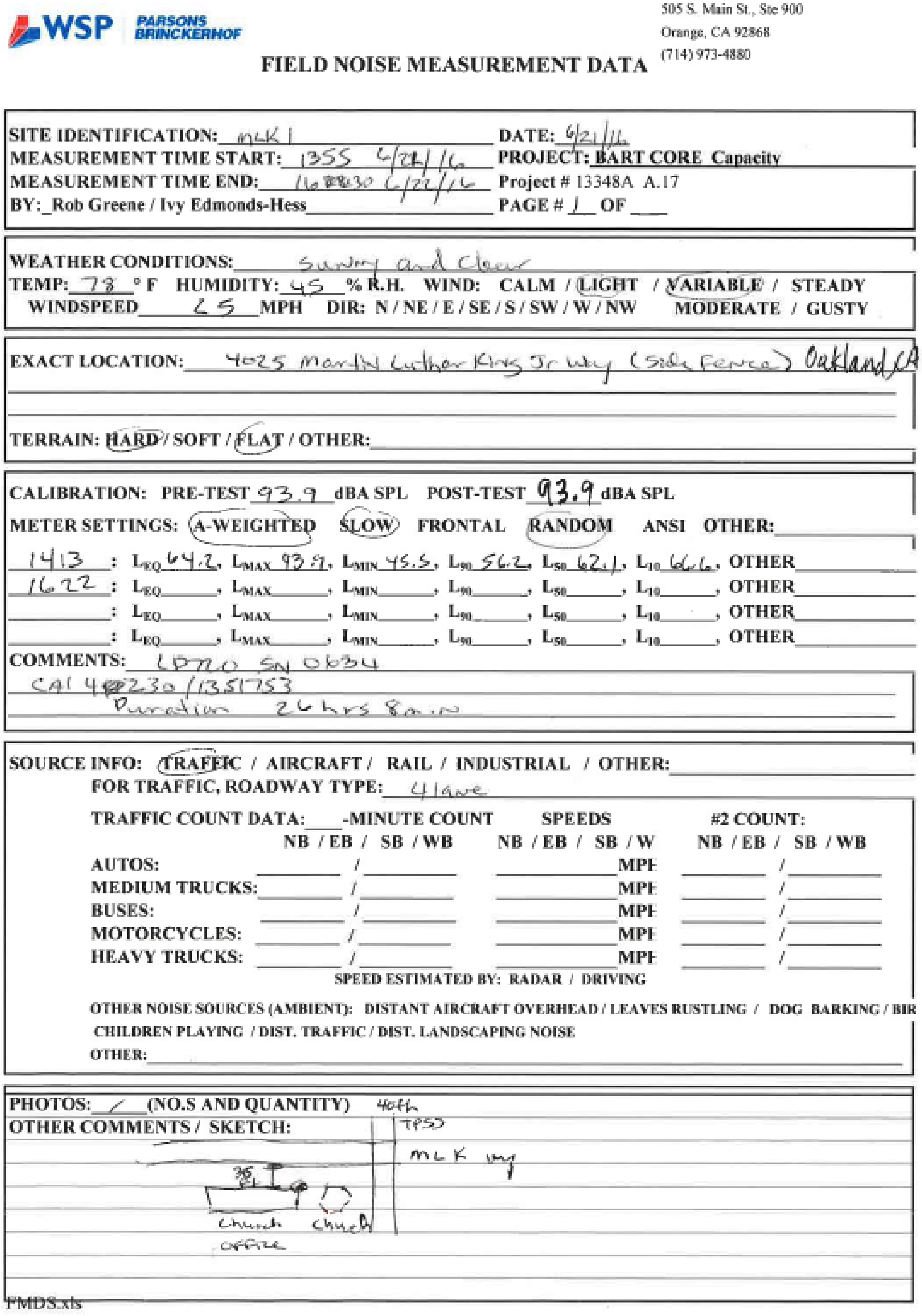
	NB / EB / SB / WB	SPEEDS NB / EB / SB / W	#2 COUNT: NB / EB / SB / WB
AUTOS:	/	MPH	/
MEDIUM TRUCKS:	/	MPH	/
BUSES:	/	MPH	/
MOTORCYCLES:	/	MPH	/
HEAVY TRUCKS:	/	MPH	/

SPEED ESTIMATED BY: RADAR / DRIVING

OTHER NOISE SOURCES (AMBIENT): DISTANT AIRCRAFT OVERHEAD / LEAVES RUSTLING / DOG BARKING / BIR
CHILDREN PLAYING / DIST. TRAFFIC / DIST. LANDSCAPING NOISE
OTHER: ____

PHOTOS: / (NO.S AND QUANTITY)
OTHER COMMENTS / SKETCH:

FMDS.xls



WSP | PARSONS BRINCKERHOFF

505 S. Main St., Ste 900
Orange, CA 92868
(714) 973-4880

FIELD NOISE MEASUREMENT DATA

SITE IDENTIFICATION: MLK 1
DATE: 6/21/16
MEASUREMENT TIME START: 1355 6/21/16
PROJECT: BART CORE Capacity
MEASUREMENT TIME END: 16 30 6/22/16
Project # 13348A A.17
BY: Rob Greene / Ivy Edmonds-Hess
PAGE # 1 **OF** ___

WEATHER CONDITIONS: Sunny and Clear
TEMP: 73 **° F HUMIDITY:** 45 **% R.H. WIND:** CALM / [✓ LIGHT] / [✓ VARIABLE] / STEADY
WINDSPEED <5 **MPH DIR:** N / NE / E / SE / S / SW / W / NW MODERATE / GUSTY

EXACT LOCATION: 4025 Martin Luther King Jr Way (Side Fence) Oakland CA

TERRAIN: [✓ HARD] / SOFT / [✓ FLAT] / OTHER:

CALIBRATION: PRE-TEST 93.9 **dBA SPL POST-TEST** 93.9 **dBA SPL**
METER SETTINGS: [✓ A-WEIGHTED] [✓ SLOW] FRONTAL [✓ RANDOM] ANSI OTHER:

1413	L_{EQ} 64.2	L_{MAX} 93.9	L_{MIN} 45.5	L_{90} 56.2	L_{50} 62.1	L_{10} 66.6	OTHER
1622	L_{EQ}	L_{MAX}	L_{MIN}	L_{90}	L_{50}	L_{10}	OTHER
	L_{EQ}	L_{MAX}	L_{MIN}	L_{90}	L_{50}	L_{10}	OTHER
	L_{EQ}	L_{MAX}	L_{MIN}	L_{90}	L_{50}	L_{10}	OTHER

COMMENTS: LD720 SN 0634
CAL 4 230/1351753
Duration 26hrs 8min

SOURCE INFO: [✓ TRAFFIC] / AIRCRAFT / RAIL / INDUSTRIAL / OTHER:
FOR TRAFFIC, ROADWAY TYPE: 4 lane

TRAFFIC COUNT DATA: ___-MINUTE COUNT

	MINUTE COUNT NB / EB	SB / WB	SPEEDS NB / EB / SB / W	#2 COUNT: NB / EB	SB / WB
AUTOS:			MPH		
MEDIUM TRUCKS:			MPH		
BUSES:			MPH		
MOTORCYCLES:			MPH		
HEAVY TRUCKS:			MPH		

SPEED ESTIMATED BY: RADAR / DRIVING

OTHER NOISE SOURCES (AMBIENT): DISTANT AIRCRAFT OVERHEAD / LEAVES RUSTLING / DOG BARKING / BIR
CHILDREN PLAYING / DIST. TRAFFIC / DIST. LANDSCAPING NOISE
OTHER:

PHOTOS: ✓ **(NO.S AND QUANTITY)** 40th
OTHER COMMENTS / SKETCH:

PMDS.xls

505 S. Main St., Ste 900
Orange, CA 92868
(714) 973-4880

FIELD NOISE MEASUREMENT DATA

SITE IDENTIFICATION: MLK 1A ST
MEASUREMENT TIME START: 1455
MEASUREMENT TIME END:
BY: Rob Greene / Ivy Edmonds-Hess
DATE: 6/22/16
PROJECT: BART CORE Capacity
Project # 13348A A.17
PAGE # 1 OF ___

WEATHER CONDITIONS: clear sunny
TEMP: 76 ° F HUMIDITY: 43 % R.H. WIND: CALM / [✓ LIGHT] / [✓ VARIABLE] / STEADY
WINDSPEED 6-7 MPH DIR: N / NE / E / SE / S / SW / [✓ W] / NW MODERATE / GUSTY

EXACT LOCATION: 656 39th st corner of stairs

TERRAIN: [✓ HARD] / SOFT / [✓ FLAT] / OTHER:

CALIBRATION: PRE-TEST 94.0 dBA SPL POST-TEST 93.8 dBA SPL B&K 4230/1351759
METER SETTINGS: [✓ A-WEIGHTED] [✓ SLOW] FRONTAL [✓ RANDOM] [✓ ANSI] OTHER:

1522–: L_{EQ} 62.4, L_{MAX} 72.5, L_{MIN} 58.7, L_{90} 60.3, L_{50} 61.7, L_{10} 63.5, OTHER
1530: L_{EQ}, L_{MAX}, L_{MIN}, L_{90}, L_{50}, L_{10}, OTHER
1530-1545: L_{EQ} 62.1, L_{MAX} 77.9, L_{MIN} 57.7, L_{90} 60.2, L_{50} 61.7, L_{10} 63.4, OTHER
: L_{EQ}, L_{MAX}, L_{MIN}, L_{90}, L_{50}, L_{10}, OTHER

COMMENTS: LD 820 SN 1232

SOURCE INFO: [✓ TRAFFIC] / AIRCRAFT / RAIL / INDUSTRIAL / OTHER:
FOR TRAFFIC, ROADWAY TYPE: 4-lane arterial

TRAFFIC COUNT DATA: ___-MINUTE COUNT

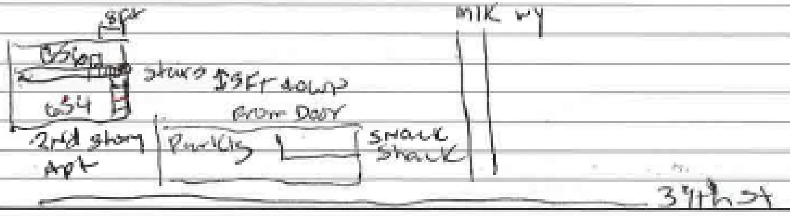
39th local street

	NB / EB	SB / WB MLK	SPEEDS NB / EB / SB / W		#2 COUNT: NB / EB	SB / WB
AUTOS:	1 car	✓		MPH		
MEDIUM TRUCKS:	0	✓		MPH		
BUSES:	0	✓		MPH		
MOTORCYCLES:	0			MPH		
HEAVY TRUCKS:	0			MPH		

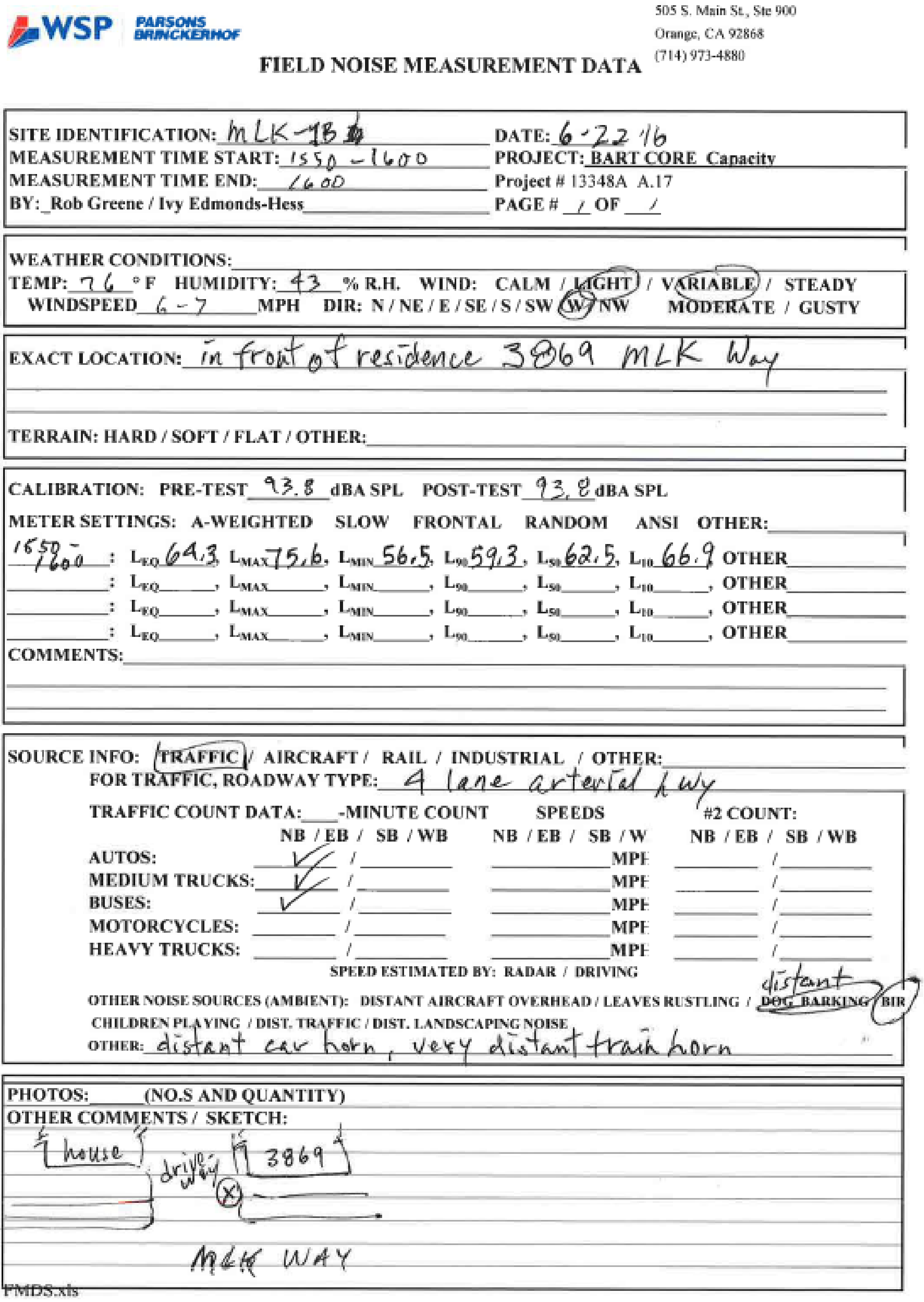
SPEED ESTIMATED BY: RADAR / DRIVING

OTHER NOISE SOURCES (AMBIENT): DISTANT AIRCRAFT OVERHEAD / LEAVES RUSTLING / DOG BARKING / [✓ BIR]
CHILDREN PLAYING / DIST. TRAFFIC / DIST. LANDSCAPING NOISE
OTHER: Car horn 1534

PHOTOS: / (NO.S AND QUANTITY)
OTHER COMMENTS / SKETCH:



FMDS.xls



505 S. Main St., Ste 900
Orange, CA 92868
(714) 973-4880

FIELD NOISE MEASUREMENT DATA

SITE IDENTIFICATION: MLK-1B
DATE: 6-22-16
MEASUREMENT TIME START: 1550 – 1600
PROJECT: BART CORE Capacity
MEASUREMENT TIME END: 1600
Project # 13348A A.17
BY: Rob Greene / Ivy Edmonds-Hess
PAGE # 1 **OF** 1

WEATHER CONDITIONS:
TEMP: 76 **°F** **HUMIDITY:** 43 **% R.H.** **WIND:** CALM / [✓ LIGHT] / [✓ VARIABLE] / STEADY
WINDSPEED 6 - 7 **MPH** **DIR:** N / NE / E / SE / S / SW / [✓ W] / NW MODERATE / GUSTY

EXACT LOCATION: in front of residence 3869 MLK Way

TERRAIN: HARD / SOFT / FLAT / OTHER:

CALIBRATION: PRE-TEST 93.8 dBA SPL POST-TEST 93.8 dBA SPL
METER SETTINGS: A-WEIGHTED SLOW FRONTAL RANDOM ANSI OTHER:

1550 – 1600: L_{EQ} 64.3, L_{MAX} 75.6, L_{MIN} 56.5, L_{90} 59.3, L_{50} 62.5, L_{10} 66.9 OTHER
: L_{EQ}, L_{MAX}, L_{MIN}, L_{90}, L_{50}, L_{10}, OTHER
: L_{EQ}, L_{MAX}, L_{MIN}, L_{90}, L_{50}, L_{10}, OTHER
: L_{EQ}, L_{MAX}, L_{MIN}, L_{90}, L_{50}, L_{10}, OTHER

COMMENTS:

SOURCE INFO: [✓ TRAFFIC] / AIRCRAFT / RAIL / INDUSTRIAL / OTHER:
FOR TRAFFIC, ROADWAY TYPE: 4 lane arterial hwy

TRAFFIC COUNT DATA: ___-MINUTE COUNT			**SPEEDS**	**#2 COUNT:**	
	NB / EB	**SB / WB**	**NB / EB / SB / W**	**NB / EB**	**SB / WB**
AUTOS:	✓		MPH		
MEDIUM TRUCKS:	✓		MPH		
BUSES:	✓		MPH		
MOTORCYCLES:			MPH		
HEAVY TRUCKS:			MPH		

SPEED ESTIMATED BY: RADAR / DRIVING

OTHER NOISE SOURCES (AMBIENT): DISTANT AIRCRAFT OVERHEAD / LEAVES RUSTLING / ~~DOG~~ distant BARKING / [✓ BIR]
CHILDREN PLAYING / DIST. TRAFFIC / DIST. LANDSCAPING NOISE
OTHER: distant car horn, very distant train horn

PHOTOS: ______ **(NO.S AND QUANTITY)**
OTHER COMMENTS / SKETCH:

house
driveway
3869
MLK WAY

FMDS.xls

APPENDIX B - Measurement Site Photographs

Figure B-1. Site LT-R1: 627 15th Street, Richmond, CA
(Rear yard adjacent to Portola Ave. view toward "Richmond" TPSS)

Figure B-2. Site LT-R1: 627 15th Street, Richmond, CA

(Rear of house adjacent to Portola Ave and across from "Richmond" TPSS)

Figure B-3. Site ST-R1A: 1317 Roosevelt, Richmond, CA (near “Richmond” TPSS)

Figure B-4. Site ST-R1A: 1317 Roosevelt, Richmond, CA

Figure B-5. Site LT-PH1: Oak Grove Middle School. 2050 Minert Road, Concord, CA (across street from "David/Minert" TPSS site)

Figure B-6. Site ST-PH1A: 1767 David Avenue, Concord, CA (at set back of houses near "David/Minert" TPSS site)

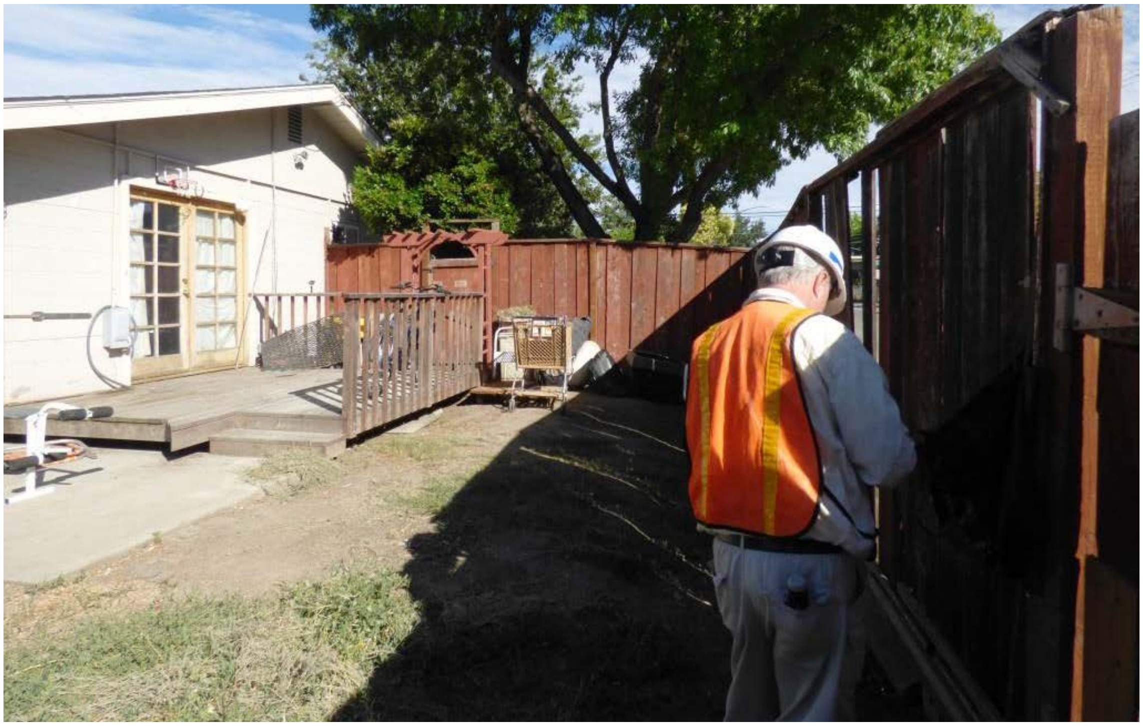


Figure B-7. Site LT-PH2: 1211 Bentley Street, Concord, CA (Adjacent to Bancroft; near “Bancroft/David” TPSS site)

Figure B-8. Site ST-PH2A: 493 Geni Court, Walnut Creek, CA (rear yard adjacent to shrine on property)

Figure B-9. Site ST-PH2B: 1160 Briarwood Way, Walnut Creek, CA (rear yard)

Figure B-10. Site LT-C1: 546 34th Street, Oakland, CA. (Rear of apartment building next to TPSS site "Caltrans C"

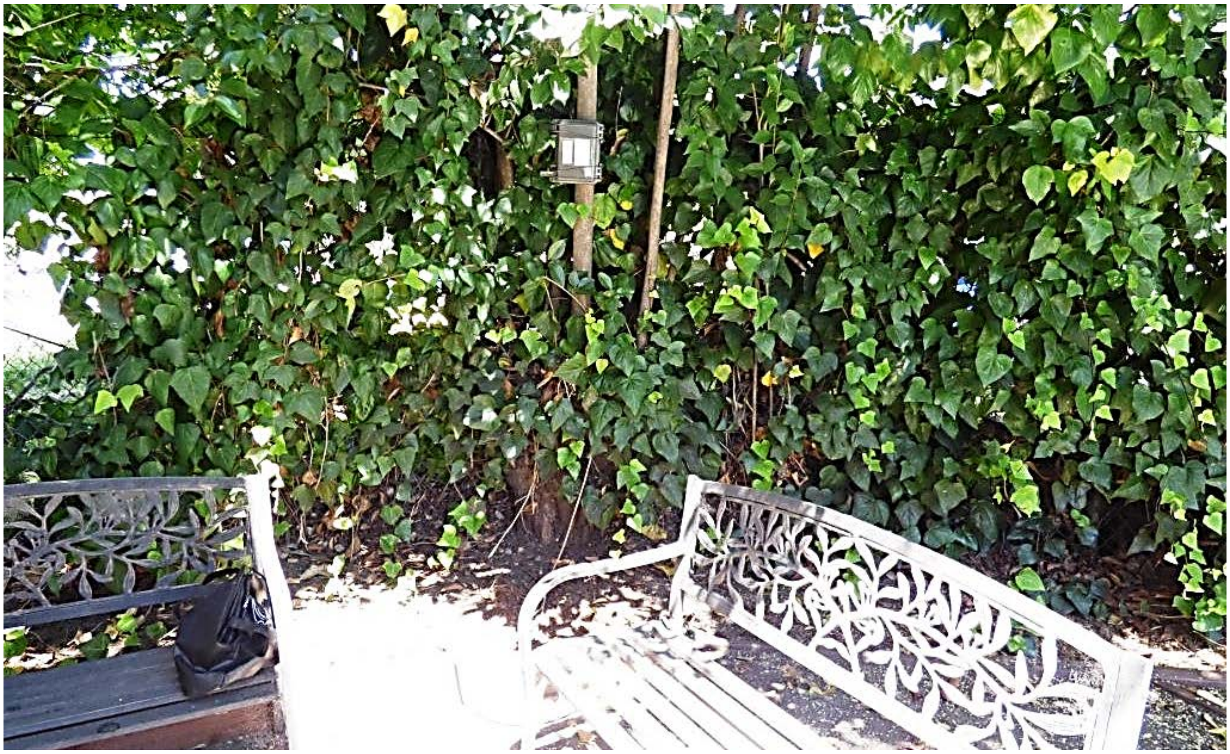


Figure B-11. Site LT-C1: 546 34th Street, Oakland, CA. (LT monitor location at rear of apartment building)

Figure B-12. Site ST-C1A: 33rd Street, Oakland, CA.
(By side yards of two houses with acoustic view of “Caltrans C” and “MLK/34th” TPSS sites)

Figure B-13. Site ST-C1B: Grove Shafter Park, Oakland, CA.
(acoustic view of "Caltrans C" and "MLK/34th" TPSS sites)

Figure B-14. Site ST-B1: 625 34th Street, Oakland, CA. (near "MLK/34th" TPSS site)

Figure B-15. Site ST-B1: 625 34th Street, Oakland, CA. (near “MLK/34th” TPSS site)

Figure B-16. Site LT-A1: 624 37th Street, Oakland, CA. (Apartment building near “Caltrans A” TPSS site)

Figure B-17. Site LT-MLK1: 4025 Martin Luther King Junior Way, Oakland, CA.
(Between church and residential facility near "MLK/40th" TPSS site)

Figure B-18. Site ST-MLK1A: 654/656 39th Street, Oakland, CA. (view toward "MLK/40th" TPSS site, see next figure)

Figure B-19. Site ST-MLK1A: 656 39th Street, Oakland, CA. (view to “MLK/40th” TPSS site)

Figure B-20. Site ST-MLK1B: 3869 Martin Luther King Junior Way, Oakland, CA. (near “MLK/40th” TPSS site)

Appendix J

Executive Decision Document – Adopt Transbay Corridor Core Capacity Project and Meeting Minutes

EXECUTIVE DECISION DOCUMENT

GENERAL MANAGER APPROVAL:		**GENERAL MANAGER ACTION REQ'D:**		
DATE: 9/7/2016 11/9/16		**BOARD INITIATED ITEM:** No		
Originator/Prepared by: Duncan Watry **Dept:** Planning, Development and Construction **Signature/Date:** 11/7/16	**General Counsel** 11/7/16 [ ]	**Controller/Treasurer** 11/8/16 [ ]	**District Secretary** [ ]	**BARC** Powers 9 Nov 2016 [ ]

Status: **Routed**	Date Created: **9/7/2016**

TITLE:

Adopt Transbay Corridor Core Capacity Project

NARRATIVE :

PURPOSE:
To obtain BART Board adoption of the Transbay Corridor Core Capacity Project with a finding that the Project is statutorily exempt from the California Environmental Quality Act (CEQA) in accordance with the Public Resources Code, Section 21080(b)(10).

DISCUSSION:
BART's Transbay Corridor Core Capacity Project is a candidate for funding under the Federal Transit Administration's (FTA) Capital Investment Grant (CIG) Program. The CIG Program provides discretionary funding to qualified projects and is a major source of funds for New Starts and Core Capacity projects nationwide. The purpose of the Transbay Corridor Core Capacity Project is to reduce patron crowding and to serve the future demand generated by the development anticipated in the region as part of Plan Bay Area. Federal legislation authorizing the CIG Program requires that the proposed Core Capacity project increase peak capacity by at least 10 percent. BART's proposed project will increase peak capacity by over 25 percent. BART's Transbay Corridor Core Capacity Project consists of four project elements required to enable BART to increase train frequencies and lengthen trains in the Transbay Corridor:

- Train Control Modernization Project (TCMP);
- 306 Additional Railcars;
- Hayward Maintenance Complex (HMC) Phase 2; and
- Traction Power Substations (TPSS).

BART has packaged these four project elements into one Core Capacity Project for purposes of seeking funding in the CIG Program. BART is seeking $900 million in CIG funding for this program. Attachment A provides a more detailed description of the Transbay Corridor Core Capacity Project and details on each of the constituent project elements.

To receive CIG Program funding, eligible projects progress in discrete phases beginning with Project Development and culminating in a Full-Funding Grant Agreement (FFGA) and implementation. An FFGA is the mechanism by which FTA commits to a multi-year funding program for qualified projects. BART's Transbay Core Capacity Project was admitted into the Project Development Phase on August 28, 2015. By statute, the Project Development Phase can only last up to two years. During this period BART must complete a number of FTA requirements for the CIG Program, including completion of all required environmental documentation, both under CEQA and under the National Environmental Policy Act (NEPA). BART is anticipating initiating completion of CEQA with this BART Board action today, completing CEQA with the subsequent 35-day statute of limitations period, and completing NEPA by the FTA by the end of December 2016. BART will apply for entry into the Engineering Phase of the CIG Program in mid-2017, and BART staff anticipates an FFGA will be requested in 2019.

The HMC Phase 2 elements of the project have already completed environmental documentation through both CEQA and NEPA through the following actions and, accordingly, are not included in the Statutory Exemption action in this EDD:

- May 26, 2011: the BART Board adopted the Final Negative Declaration for the Hayward Maintenance Complex Project - Phases 1 and 2 (CEQA);
- September 21, 2011: FTA approved a Categorical Exclusion from NEPA review for HMC Phases 1 and 2; and

- May 9, 2013: the BART Board adopted an Addendum to the Negative Declaration (demolishing Building 3 and replacing it with a new building for the Component Repair Shop) for Phase 1 (CEQA).

For the other three project elements in the Transbay Corridor Core Capacity Project, BART staff is proceeding with two related environmental processes.

Counsel has determined that for CEQA purposes, the Train Control Modernization Project, the 306 additional railcars and the Traction Power Substations all fall within the definition of projects described in the Public Resources Code, Section 21080(b), which provides for Statutory Exemptions (SE) to CEQA for specific types of projects. This section states:

> (b) [CEQA] does not apply to any of the following activities:
> (10) A project for the institution or increase of passenger or commuter services on rail or highway rights-of-way already in use, including modernization of existing stations and parking facilities.

For projects qualifying for an SE, no further analysis is needed to qualify for the exemption. It is sufficient to adopt the project through an agency's Board, and file a Notice of Exemption (NOE) with the State Office of Planning and Research (OPR). When BART files the NOE with OPR, a 35-day statute of limitations period begins. During this 35-day period, a lawsuit may be filed or other legal action taken on the Board's decision. If no legal action is taken, the SE is final. BART has recently finalized the location of all TPSS project elements, which allows this CEQA action to go forward at this point.

BART staff met with FTA staff to determine the appropriate NEPA process, which will follow the CEQA process. BART staff anticipates that a documented Categorical Exclusion (CE) is the likely NEPA process, as the three project elements are within existing transportation rights-of-way (ROW) and construction of the project elements is not expected to have significant impacts.

FISCAL IMPACT:
Approval of the Resolution is a requirement for BART to receive future funds from FTA for the constituent projects. This action will have no fiscal impact on unprogrammed District Reserves.

ALTERNATIVES:
The Board could decline to adopt the Project. In this case, the Statutory Exemption would still apply to the three project components, as the SE is based on the facts of the project, not on the Board action. However, the statute of limitations would be 180 days instead of 35 days. This would delay the schedule to complete FTA's Project Development process, and could make BART ineligible to receive the CIG funds on the schedule anticipated (BART is seeking $900 million in CIG funds). This, in turn, could delay implementation of the project elements in the Project.

RECOMMENDATION:
It is recommended that the Board adopt the following motion:

MOTION:
The BART Board of Directors hereby:

1. Finds that the following three project elements that are components of the Transbay Corridor Core Capacity Project:

- Train Control Modernization Project;
- 306 Additional Railcars; and
- Traction Power Substations (5 locations).

are exempt from the requirements of the California Environmental Quality Act in accordance with the Public Resources Code, Section 21080(b)(10);

2. Adopts the four-project-element Transbay Corridor Core Capacity Project; and

3. Directs staff to file Notice of Exemption.

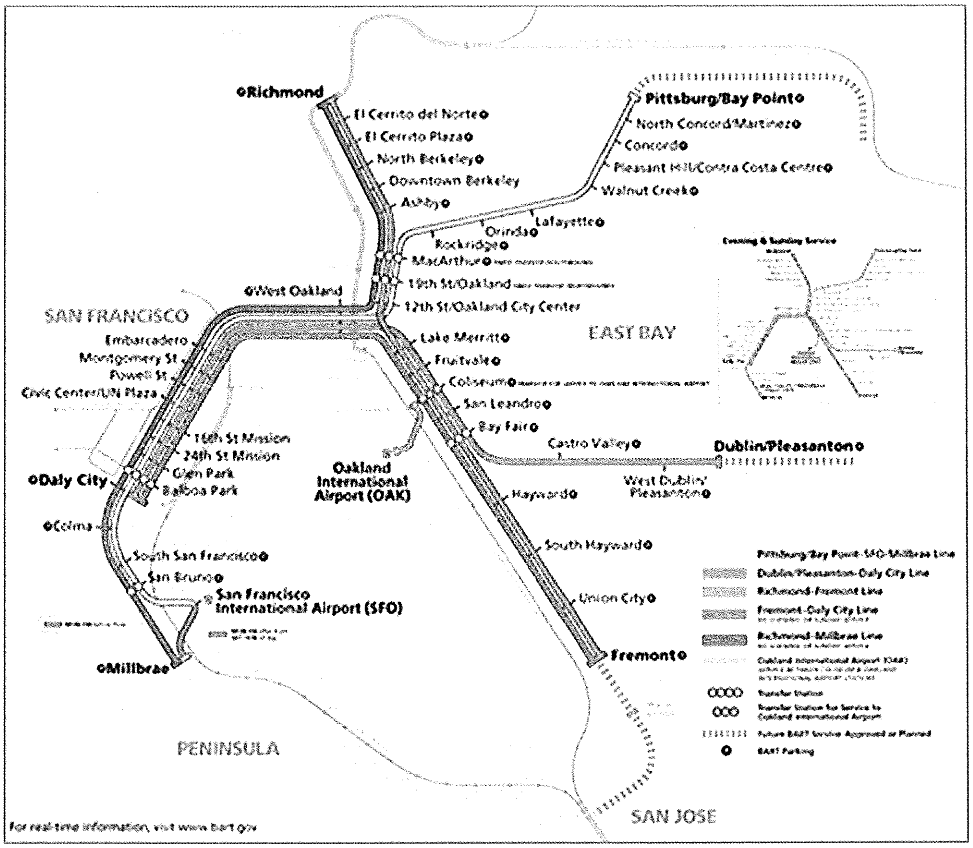
Attachment A

BART Transbay Corridor Core Capacity Project

Project Description

The San Francisco Bay Area Rapid Transit (BART) system currently consists of 104 route miles of heavy rail transit serving 45 stations in San Francisco, in the East Bay, and on the Peninsula. An additional 15 route miles and 3 stations are under construction south of Fremont, and an additional 10 miles and 2 stations are under construction east of Pittsburg/Bay Point. The system operates as five lines designated by different colors – Yellow, Green, Red, Orange and Blue. Four of these lines – all but the Orange Line – merge into a single double-track alignment connecting San Francisco and Oakland, which operates through the Transbay Tube. BART also operates the Oakland Airport Connector as an independent line. Figure 1 shows the existing system.

Figure 1: BART System



On the main trunk of the BART system, from the Oakland Wye to Daly City, BART currently operates a maximum of 23 trains per hour in the peak direction. Train lengths vary, but currently average 8.9 cars per train in the peak. Between Oakland and San Francisco, the trains are crowded, and ridership is growing. As the system expands and as the core continues to attract development, further increases in ridership are expected.

Attachment A

BART is proposing a package of strategic investments that will increase capacity between San Francisco and Oakland by more than 30 percent. The Transbay Corridor Core Capacity Project will allow BART to operate up to 30 ten-car trains per hour on the existing system, maximizing throughput in the most heavily used part of its system. The package includes four elements: additional vehicles, Phase 2 of the Hayward Maintenance Complex, a communications-based train control system, and additional traction power.

306 Additional Railcars. In order for BART to achieve a regular schedule of 28-30 ten-car trains through the corridor, BART will require a total fleet size of 1,081 vehicles. BART currently has 775 new rail vehicles on order, which will allow us to completely replace our aged fleet of 669 vehicles and to expand the fleet by 106. When this order is completed, BART will need 306 more vehicles to get to the total requirement of 1,081.

Of the 306 additional cars required, 252 are needed for BART to operate 28-30 ten-car trains per hour on the four lines (Red, Blue, Green and Yellow) that operate through the Transbay Tube. The remaining 54 are to increase capacity on the Orange Line (which does not operate through the Transbay Tube), to increase our ready reserve fleet, and to increase our spare ratio to the industry standard.

Hayward Maintenance Center, Phase 2. The current storage capacity across BART's yards and tail tracks is 893 vehicles. To accommodate the additional 306 new vehicles, BART intends to expand the Hayward Maintenance Complex (HMC) to provide storage for 25 ten-car trains, or 250 additional vehicles. The yard will be constructed with access to the existing yard and electrified such that it may serve as a fully operational vehicle storage facility. Although the HMC is several miles from the Transbay Corridor, as defined, this is the only practical site to store the additional cars that are part of the Transbay Core Capacity Project. The HMC Phase 2 project has already been through independent CEQA and NEPA processes, and is not included in the CEQA approval being sought as part of the Statutory Exemption, but is listed in this attachment so that a complete description of the project is included.

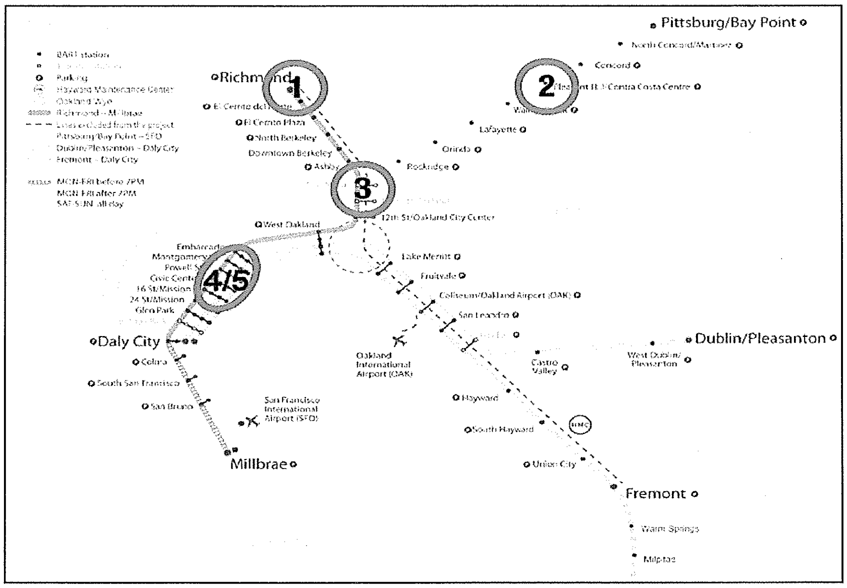
Train Control Modernization Project (Communications-Based Train Control). To achieve the shorter headways needed to operate 28 regularly-scheduled trains per hour through the Transbay Tube and to allow 30 trains per hour capability, BART will replace its existing train control systems with a new Communications Based Train Control System. BART has developed an eight-phase implementation program that will begin by testing CBTC equipment on the existing test track adjacent to the HMC. Once the CBTC equipment has been sufficiently proven on test tracks, BART will implement CBTC along the mainline tracks starting from the system's endpoint in Millbrae and expanding north into downtown San Francisco, through the Transbay Tube, and into the East Bay, extending to Richmond, Pittsburg-Bay Point, Dublin/Pleasanton, and to Berryessa.

In order to achieve higher frequency service in the peak hour, CBTC is required along the tracks leading up to and through the Transbay Tube. Once CBTC phases 1 through phase 4 and a portion of phase 5 have been implemented, frequencies can be increased in the Transbay Corridor. The scope of the CBTC project includes installation of lineside equipment within BART's existing right-of-way throughout the entire system.

Traction Power Substations. BART has conducted traction power simulations to assess the power requirements associated with operating 28-30 regularly-scheduled ten-car trains through the Transbay Tube per hour. The simulation assumed 30 trains per hour, and included simulations of various delay scenarios that would lead to bunched trains, providing a safety factor or contingency in the analysis. It also assumed the electrical profile of BART's new vehicles as well as the communications-based train control system necessary to operate trains this frequently. The simulation revealed specific areas along BART's mainline where the traction power requirements exceed the capacity available from BART's existing traction power system. Five sites have been identified for new substations (Figure 2):

1. Richmond - RYE Gap Breaker Conversion
2. Pleasant Hill - David Ave and Minert Road
3. Oakland – near MacArthur station on 34th Street
4. Downtown San Francisco - Civic Center Station (West Concourse Level)
5. Downtown San Francisco - Montgomery Station (Center of Station Concourse Level)

Figure 2: General Location of Additional TPSS Substations



Although two of these sites, Richmond and Pleasant Hill, are outside that part of the system where demand exceeds capacity, added power is needed at these points in the system in order for BART to operate the added service through the Transbay Tube at the higher frequencies. Four alternate sites have been identified in case one or more of these five sites proves to be unfeasible.

Attachment A

The three locations in the East Bay are all within existing BART or Caltrans right-of-way and are at-grade locations. The two sites in San Francisco are located below grade within existing BART stations, and include two new required emergency vents per station. BART will build these vents to conform to current code, which allows these vents to be built at-grade within the sidewalk right-of-way above the stations.

BART is also undertaking a major program to replace and upgrade the existing traction power system. While this program will increase the amount of power available for train operation, it is not considered to be part of the Core Capacity Project.

SAN FRANCISCO BAY AREA RAPID TRANSIT DISTRICT
300 Lakeside Drive, P.O. Box 12688, Oakland, CA 94604-2688

Board of Directors
Minutes of the 1,775th Meeting
November 17, 2016

A regular meeting of the Board of Directors was held November 17, 2016, convening at 9:04 a.m. in the Board Room, 344 20th Street, Oakland, California. President Radulovich presided; Kenneth A. Duron, District Secretary.

Directors present: Directors Blalock, Keller, McPartland, Murray, Raburn, Saltzman, and Radulovich.

Absent: Director Mallett. Director Josefowitz entered the Meeting later.

Consent Calendar items brought before the Board were:

1. Approval of Minutes of the Meeting of October 27, 2016.
2. District Base Pay Schedules.
3. Extension of Time for Agreement No. 6M2020, Brokerage Services for an Owner Controlled Insurance Program (OCIP).
4. Employee Recruitment and Relocation for Chief of Police.
5. Award of Contract No. 47BS-152A, Accessibility Improvements at Various BART Stations.

Director Saltzman made the following motions as a unit. Director Raburn seconded the motions, which carried by unanimous electronic vote. Ayes – 7: Directors Blalock, Keller, McPartland, Murray, Raburn, Saltzman, and Radulovich. Noes - 0. Absent – 2: Directors Josefowitz and Mallett.

1. That the Minutes of the Meeting of October 27, 2016, be approved.
2. That the base pay schedule in effect July 1, 2016, be approved.
3. That the Controller/Treasurer be authorized to extend the time of performance under Agreement No. 6M2020, with Aon Risk Services, to provide brokerage services for an OCIP, for an additional 12 months, to November 30, 2017; and that the original not-to-exceed amount for the Agreement remain at $7,500,000.00.
4. That the General Manager or her designee be authorized, in conformance with established District procedures governing the procurement of professional services, to obtain executive search services to identify

suitable candidates both inside and outside of California for the Police Chief position; and that the General Manager be authorized to enter into a relocation agreement, if necessary, in an amount not to exceed $18,000.00 for each position, in accordance with Management Procedure Number 70, New Employee Relocation Expense Reimbursement.

5. That the General Manager be authorized to award Contract No. 47BS-152A, Accessible Improvements at Various Stations, to Federal Solutions Group, Inc., for the Bid price of $735,777.00, pursuant to notification to be issued by the General Manager and subject to the District's protest procedures and Federal Transit Administration's requirements related to protests.

Director Saltzman, Chairperson of the Administration Committee, brought the matter of Communications Agreement with the San Francisco Municipal Transportation Agency (SFMTA) to Extend Commercial Fiber and Cellular Infrastructure to the SFMTA Underground System before the Board. Mr. Travis Engstrom, Manager of Information Systems, presented the item. Director McPartland moved that the General Manager be authorized to execute a Communications Agreement with the SFMTA, authorizing the District to negotiate license agreements with telecommunications carriers on behalf of the SFMTA, to extend the existing underground commercial fiber and cellular infrastructure in the District underground to the SFMTA underground system, for a fifteen (15) year term plus two five-year renewal periods. Director Murray seconded the motion.

Director Josefowitz entered the Meeting.

The item was briefly discussed. The motion carried by unanimous electronic vote. Ayes – 8: Directors Blalock, Josefowitz, Keller, McPartland, Murray, Raburn, Saltzman, and Radulovich. Noes - 0. Absent – 1: Director Mallett.

Director McPartland, Chairperson of the Engineering and Operations Committee, brought the matter of State of California Department of General Services Voyager Fuel Card Program before the Board. Ms. Adwoa Oni, Manager, Procurement & Contracts, Maintenance Administration, presented the item. Director Blalock moved that the General Manager be authorized to enter into an Agreement with U.S. Bank Voyager Fleet Systems, Inc., for participation in the State of California DGS CAL-Card Program, reference Participating Addendum No. 7-16-99-27 DGS-OFA-OPPS-06, for the period November 1, 2016, through December 31, 2018. The item was discussed. Director Keller seconded the motion, which carried by unanimous electronic vote. Ayes – 8: Directors Blalock, Josefowitz, Keller, McPartland, Murray, Raburn, Saltzman, and Radulovich. Noes - 0. Absent – 1: Director Mallett.

Director McPartland brought the matter of Award of Agreement to Provide Stand-by Emergency Medical and Advanced Life Support Services at West Oakland Station before the Board. Mr. Shawn Jackson, Principal Administrative Analyst, presented the item. The item was discussed. Director Blalock moved that the General Manager be authorized to execute Agreement No. 6M8125, with Paramedics Plus, to provide Stand-by Emergency and Advance Life Support Services for stations and underground trackway between West Oakland Station and the downtown Oakland stations, for a not-to-exceed price of $1,623,000.00. Director Saltzman seconded the motion, which carried by unanimous electronic vote. Ayes – 8: Directors Blalock, Josefowitz, Keller, McPartland, Murray, Raburn, Saltzman, and Radulovich. Noes - 0. Absent – 1: Director Mallett.

Director McPartland brought the matter of Change Order to Contract No. 79HM-120, SFTS MB, with Manson Construction Co. Inc., for Impact of Stub Wall Design Issues (C.O. No. 49) before the Board. Mr. Thomas Horton, Group Manager, Earthquake Safety Program, presented the item. Director Blalock moved that the General Manager be authorized to execute Change Order No. 49, Impact of Stub Wall Design Issues, in the not-to-exceed amount of $431,785.89, to Contract No. 79HM-120, SFTS MB, with Manson Construction Company, Inc. President Radulovich seconded the motion, which carried by unanimous electronic vote. Ayes – 8: Directors Blalock, Josefowitz, Keller, McPartland, Murray, Raburn, Saltzman, and Radulovich. Noes - 0. Absent – 1: Director Mallett.

Director McPartland brought the matter of Quarterly Performance Report, First Quarter Fiscal Year 2017 - Service Performance Review, before the Board. Mr. Paul Oversier, Assistant General Manager, Operations, presented the item. The item was discussed.

Director Raburn, Chairperson of the Planning, Public Affairs, Access, and Legislation Committee, brought the matter of Transbay Corridor Core Capacity Project before the Board. Mr. Duncan Watry, Principal Planner, presented the item.

Chris Finn addressed Board.

The item was discussed.

Director McPartland exited the Meeting.

Director Keller made the following motions as a unit.

1. That the Board finds that the following three project elements that are components of the Transbay Core Capacity Project – Train Control Modernization Project, 306 Additional Railcars, and Traction Power Substations (5 locations) – are exempt from the requirements of the California Environmental Quality Act in accordance with the Public Resources Code, Section 21080(b)(10).

2. Adoption of the four-project-element Transbay Corridor Core Capacity Project.

3. That staff be directed to file Notice of Exemption.

Director Saltzman seconded the motions, which carried by unanimous electronic vote. Ayes – 7: Directors Blalock, Josefowitz, Keller, Murray, Raburn, Saltzman, and Radulovich. Noes - 0. Absent – 2: Directors Mallett and McPartland.

Director Raburn brought the matter of BART Station Access Policy: Draft Performance Measures and 4-Year Work Plan, before the Board. Ms. Hannah Lindelof, Principal Planner, and Mr. Robert Powers, Assistant General Manager, Planning, Development, and Construction, presented the item. The item was discussed.

Director Raburn brought the matter of Transit Oriented Development Policy: Draft Performance Measures and 4-Year Work Plan, before the Board. Mr. Sean Brooks, Department Manager, Real Estate and Property Development, and Ms. Abigail Thorne-Lyman, Manager of Planning, presented the item.

The following individuals addressed the Board.
Ann Chang
Geeta Rao
Jerry Grace

The item was discussed.

Director McPartland re-entered the Meeting.

Discussion continued.

Joel Ramos addressed the Board.

Discussion continued.

President Radulovich announced that the order of agenda items would be changed.

President Radulovich called for Public Comment. Jerry Grace addressed the Board.

President Radulovich announced that the Board would enter into closed session under Item 10-A (Conference with Labor Negotiators), and Items 10-B and 10-C (Conference with Legal Counsel) of the regular Meeting agenda, and that the Board would reconvene in open session at the conclusion of that closed session.

The Board Meeting recessed at 1:03 p.m.

The Board Meeting reconvened in closed session at 1:12 p.m.

Directors present: Directors Blalock, Keller, McPartland, Murray, Raburn, Saltzman, and Radulovich.

Absent: Director Mallett. Director Josefowitz entered the Meeting later.

Director Josefowitz entered the Meeting.

Directors Josefowitz and Murray exited the Meeting.

The Board Meeting recessed at 3:39 p.m.

The Board Meeting reconvened in open session at 3:40 p.m.

Directors present: Directors Blalock, Keller, McPartland, Raburn, and Radulovich.

Absent: Directors Josefowitz, Mallett, Murray, and Saltzman.

President Radulovich announced that there were no announcements to be made on Items 10-A and 10-B.

President Radulovich announced that under Item 10-C (Smith v. BART) of the agenda, the Board authorized settlement of the litigation for the amount of $3.1 million; and that the vote was as follows: Ayes – 6: Directors Blalock, Keller, McPartland, Raburn, Saltzman, and Radulovich. Noes - 0. Absent – 3: Directors Josefowitz, Mallett, and Murray.

President Radulovich announced that the General Manager's Report and Board Matters would be continued to a future Meeting.

The Meeting was adjourned at 3:41 p.m.

Kenneth A. Duron
District Secretary

Appendix K

Hayward Maintenance Complex Noise and Vibration Technical Memorandum

WILSON IHRIG & ASSOCIATES
ACOUSTICAL AND VIBRATION CONSULTANTS

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BART – Hayward Maintenance Complex

Noise and Vibration Technical Report

November 22, 2010
Revised May 03, 2011

Prepared for:
PGH Wong Engineering.

By:
Wilson, Ihrig & Associates, Inc.

Carlos H. Reyes
Senior Consultant
and
Deborah A. Jue
Associate Principal

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Executive Summary

This report by Wilson, Ihrig and Associates, Inc. (WIA) presents results of the noise and vibration environmental impact assessment for the Bay Area Rapid Transit (BART) Hayward Maintenance Complex (HMC Project). The assessment of noise and vibration impacts from operations and construction has been performed following the procedure described in the Federal Transit Administration (FTA) guidance manual "Transit Noise and Vibration Impact Assessment"[1].

The proposed Project would include adding up to six crossovers or turnouts in the area south of Whipple Road (on the mainline tracks, test track and yard lead), adding storage tracks to the northeast of the existing Hayward Yard to accommodate up to a maximum of 250 BART cars, implementing a new traction power station for new tracks on the east side of the Hayward Yard, and erecting a new Overhaul Shop (replacing an existing building). The Project includes upgrades to the three remaining buildings (component repair shop, central warehouse, and Maintenance and Engineering (M&E) shop storage area). Information used to prepare this draft report was obtained from preliminary drawings of the proposed Hayward Maintenance Complex provided by BART, received August 24, 2010, and project description revisions and updated topographic information received by WIA in March 2011.

The primary variables and assumptions that were used in the noise and vibration models include:

- Cumulative noise levels were estimated based on the future schedule proposed for the Silicon Valley Rapid Transit Project (SVRTP).
- Proposed BART future operations (SVRTP) on the main line would bring 271 trains through the Hayward Maintenance Complex during the daytime and 44 trains at night (in both directions of travel).
- Future yard operations for the analysis were estimated at 80 train movements during daytime and 40 during nighttime hours. This number includes the current dispatch activities (60 trains) which would originate on the west side of the HMC and the new activities on the east.
- Operations on the test track for the cumulative noise analysis would be 12 trains per hour from 7 am to 11 pm. This schedule is a worst-case condition for the noise modeling, and it includes the future expected trains from SVRT car commissioning. The train consist is assumed to be 4 cars long with operational speeds of 30 to 40 mph south of Whipple Road.
- A sound wall to reduce noise (recommended as sound walls SW-01 SW-02 and SW-03 in this report) would be installed prior to the start of construction work. Therefore, it was assumed to be part of the "existing" conditions for assessing construction noise impacts.
- Phase 1 construction includes all work related to the west side of the Hayward Yard, including the new Overhaul Shop and associated crossovers and trackwork, a non-rail vehicle storage area and an enhanced vehicle inspection area (east side).
- Phase 2 construction would implement work related to the east side of the Hayward Yard, including at least one flyover, new storage tracks, associated crossovers and trackwork and third rail power, communications, and train control systems.

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[1] Federal Transit Administration. Transit Noise and Vibration Impact Assessment. FTA-VA-90-1003-06, May 2006

- Construction work on the test track and storage areas would be performed mostly during daytime hours. However, there would be some activities at the staging areas during the nighttime hours that will be performed not closer than 200 feet from any residential receptor located north of Whipple Road. Construction work involving mainline tracks would be done during nighttime hours and weekends, with the exception that no nighttime construction will be conducted north of Whipple Road. New switch installation would typically be done during nights and weekends (Phase 1 and Phase 2). However, flyover construction (pile driving) and preparation for construction involving the mainline would be done during daytime.

Noise and vibration measurements were conducted near the Project site to obtain the environmental ambient settings and to supplement the general information presented in the FTA guidance manual. Ambient noise was obtained at four sites along the eastern residential area near the Project. Ground surface vibration and wayside noise from BART train passbys were obtained at three locations along the existing BART mainline. In addition, noise and ground vibration measurements from BART trains passbys on crossovers, and current operations from the existing Main Shop building were obtained at the Hayward Yard.

The criteria used to assess potential impact from BART operations are those recommended by the FTA. The FTA noise criteria are based on the increase in total (Project + Existing) noise level over the existing ambient noise due to operations of the project or combination of projects, and the amount of noise increase determines whether a *Severe, Moderate or No Impact* occurs. *Noise Impact* has been determined for those receptors with *Severe Impact* and *Moderate Impact* (as defined by FTA). Noise control measures have been evaluated for both categories of impacts.

The operational FTA vibration criteria are level-based criteria depending on the land use at the receptor and the frequency of the events. The level of service expected for BART for 2030 would be classified as a system with *Frequent Events*. The vibration analysis was based on a field-derived set of vibration attenuation curves specific to the site. Adjustments have been made to the curve to account for speed, special trackwork, and the building vibration response (BVR).

The criteria for assessing noise and vibration from construction activities are also based on the FTA criteria. The FTA noise criteria are specified in terms of 8-hour equivalent noise level (L_{eq}) for residential, commercial and industrial land uses. The criterion applicable to residences in the vicinity of the project would be 80 dBA for daytime and 70 dBA for nighttime construction. This revised report includes corrections to the evaluation criteria previously used to evaluate nighttime construction noise.

The criteria for assessing vibration effects from construction activities have been divided into two categories: interference with human activity (annoyance) and building damage (impact). The applicable criteria for evaluating potential annoyance are identical to those used to assess annoyance during train operations by land use category (e.g., Category 2 for residential homes). The FTA criteria relating to potential cosmetic cracking due to building vibration are applicable to four categories, considering different building structures. All residential buildings in the vicinity of the Project could be categorized as engineered concrete and masonry (Category II) with a threshold of 0.3 in/sec.

Operational Noise and Vibration Assessment Results

Noise

Results of the analysis show a potential for wayside *Noise Impact* on sensitive receptors near crossovers P100, P100B, P101 and P102 (see Figure 6 for location of these crossovers). The impact expected would be associated with the increase in wayside noise levels from trains crossing the turnout frogs.

The Phase 1 of the Project (which includes crossover P100 and P102) would generate *Noise Impact* at three single-family homes along 11th Street near the crossover P100. Trains crossing the gap at crossover P102 would also generate noise impacts at 14 single-family residences at the Innovation Homes community[2]. The increase associated with the Project would be up to 2.7 dBA. Sound walls are the recommended noise mitigation control for reducing the level of impact to *No Impact*. The height of sound walls required to mitigate *Noise Impacts* from Phase 1 would be 10 to 13 feet tall measured from BART top-of-rail.

Phase 2 of the project would generate a *Severe Impact* at nine single-family residences on La Brea Terrace. The impact is due to the increase in noise levels associated with crossover P100B. Noise impact is also projected from crossover P101 at six single-family homes located on Carrara Terrace.

With the exception of receptors at La Brea Terrace, all noise impacts generated by the Project would be at a level of *Moderate Impact* as defined by FTA. A sound wall at the BART east property line is the recommended noise mitigation measure to reduce both *Severe* and *Moderate* impacts to *No Impact*. The height of the wall would range between 9-feet and 14-feet tall measured from top-of-rail depending on the final location selected for the sound wall. The schematic of the location and preliminary height of sound walls is presented in the report. However, the specific location and height of sound walls would be addressed later in detail during final design, when further details about track and receiver elevation, track location and other pertinent information would be available.

BART operations at the train storage area and the new HMC would result in *No Noise Impacts* from the additional activities. The increase due to operation on residences located east to the Yard would be 1.2 dBA and lower. Consequently, no mitigation measures would be necessary.

No Noise Impacts are expected from the new traction power substation. *No Noise Impacts* are expected for the Enhanced Vehicle Inspection Area.

Vibration

Results of the vibration evaluation show *Vibration Impact* from implementing the HMC Project at 10 single-family residences during Phase 1 of the Project and at 20 additional single-family residences during Phase 2 (Twenty-four residences would be impacted if Phase 2 is considered by itself). All residences identified with a *Vibration Impact* are located at the Innovation Homes. The impact would be associated with trains crossing the frog at crossover P100B, P101 and P102 and the proximity to the sensitive receptors (60 to 120 feet).

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[2] Innovation Homes are the single-family community in Union City east of the BART tracks, south of Whipple Road and north of Dry Creek.

Vibration levels associated with BART trains on the crossovers would exceed the FTA criterion by up to 7 VdB during Phase 1 and up to 12 VdB during Phase 2. Recommended mitigation measures include relocating the crossover switches 130 feet or further away from homes, or installing track mitigation measures such as tire-derived aggregate or floating slab track at the location of P100B, P101 and P102. Recommended vibration mitigation measures would reduce the level of impact to *No Vibration Impact*. Schematics of the recommended extent of the vibration mitigation are presented in the report.

Finally, *No Vibration Impact* is expected from train movements at the east storage tracks. Consequently, no mitigation measures would be needed.

Construction Noise and Vibration Assessment

Construction activities for the HMC Project evaluated include the use of heavy equipment such as excavators and compactors, track installation equipment such as ballast tampers and ballast regulators, and pile drivers (specifically for the flyover). The construction of the Project would occur in two phases: Phase 1 includes the construction of the all Yard elements on the west side of the Hayward Yard (new Overhaul Shop and related trackwork plus the enhanced vehicle inspection area), and Phase 2 includes all Yard elements related to the east side storage tracks, including new storage tracks, flyovers and traction power.

Noise

Construction noise resulting from activities during Phase 1 and Phase 2 of the Project were compared against the FTA criteria (daytime and nighttime) to determine the degree of potential impact and the noise mitigation measure to implement. The analyses include activity caused by the use of heavy equipment and by the equipment expected during track installation (including ballast tamping and regulating).

Airborne noise impacts would occur as follows:

- Heavy Equipment: General construction activities would result in *Noise Impacts* at noise sensitive receptors. Including the effect of the existing sound wall at the residential development and new sound walls constructed as part of the Project, impacts would occur at single-family residences at the Innovation Homes development (South of Whipple Road) during nighttime construction hours as follows:
    - Phase 1 would generate *No Noise Impact*
    - Phase 2 would generate *Noise Impacts* at 15 homes during nighttime construction
- Track installation: Construction activities during track installation would generate a *Noise Impact* for residences within 100 feet of daytime construction activities or within 300 feet of nighttime track-laying activities, assuming an unobstructed line of sight. With the effect of new sound walls recommended as part of the Project and constructed prior to start construction:
    - Impacted residences would include single-family residences at the Innovation Homes development (South of Whipple Road) during nighttime construction hours.

    - Phase 1 would generate *No Noise Impact* during either daytime or nighttime construction.
    - Phase 2 would generate *Noise Impact* at 15 homes during nighttime construction.

- Vibratory pile drivers for the flyover(s) would be used during installation of foundation footings. Noise Impact from a vibratory pile driver is expected to generate impact at residences that are located within 140 feet during daytime. No nighttime pile driving would be conducted for the Project.
    - The closest residences t*o the pile d*riving zone are expected to be about 400 feet and farther. Since no nighttime pile driving work would be conducted, *No Noise Impacts* are projected from pile driving activities.

Unshielded construction staging areas (CSA) would generate noise impacts if they are located closer than 70 feet from residential land uses in the case of daytime operations and closer than 200 feet away for nighttime operations. Two construction staging areas are proposed, one on the southwestern portion of the expansion area and one on the existing M&E storage area at the southeast corner of the existing yard. Noise projected from the staging areas would potentially cause a Noise Impact for sensitive receptors (e.g., single family homes) within 70 feet from the staging area during daytime activity and within 200 feet during nighttime activity. The closest homes to the southwestern staging area would be located at least 250 feet from the staging area, resulting in No Noise Impact during both daytime and nighttime operations. Similarly, there would be No Noise Impact from operations on the southeast staging area during daytime hours. However, to ensure that residential homes located approximately 150 feet from the southeast staging area do not experience significant nighttime noise impacts, a buffer zone of approximately 50 feet will be maintained along BART's east property line where no noise-generating activity will be permitted during nighttime construction

Vibration

This report evaluates the effect of annoyance and building damage on nearby sensitive receptors due to construction-induced vibration activities during Phase 1 and Phase 2. The result of the analysis shows that due to the distance between the construction site and the residential homes during both Phases 1 and 2, the vibration from all construction equipment would be well below the threshold of cosmetic building damage. *No Vibration Impacts* from construction activities would be expected during for the Project. However, there is a potential for vibration annoyance at receptors that are located within 100 feet of any vibratory construction sources.

- Phase 1 would generate vibration annoyance at 26 residences in the Innovation Homes Development during trackwork and switch installation activities from crossovers P100 and P102.
- Phase 2 would generate vibration annoyance at 29 residences in the Innovation Homes Development during trackwork and switch installation activities from crossovers P100B, P101, P103 and P104.

The use of a pile driver during construction could potentially generate annoyance to receptors located within 190 feet of the activity. However the closest distance to nearby residences from pile driving activities at the flyover is 400 feet resulting in vibration that would be below the threshold for vibration annoyance.

Construction-induced vibration form staging areas would be expected to be below the threshold of building damage and annoyance at all times. Consequently *No Vibration Impacts* are expected from staging areas.

Conclusions and Recommendations

The proposed project would generate noise and/or vibration impacts for which noise or vibration control measures should be implemented. The recommended noise or vibration control measures would eliminate the impacts.

Operations Phase 1 – West Side Improvements

- *Moderate Noise Impacts* at seventeen receptors near crossovers P100 and P102. Noise impacts would be reduced to a level of *No Impact* by implementing a sound wall.
- *Vibration Impact* at 10 single-family residences south of Whipple Road due to crossover P102 should be reduced to *No Impact* by either relocating the crossover 130 feet or further from any residential home or implementing track mitigation measures such as the use of tire-derived aggregate (TDA) or a floating slab track-bed (FST).

Operations Phase 2 – East Side Improvements

- *Moderate Noise Impacts* at six receptors near crossovers P101. Noise impacts would be reduced to a level of *No Impact* by implementing a sound wall.
- *Severe Noise Impacts* at nine receptors near crossovers P100B. Noise impacts would be reduced to a level of *No Impact* by implementing a sound wall.
- *Vibration Impact* at twenty-four single-family residences south of Whipple Road due to crossover P100B and P101. *Vibration Impact* should be reduced to *No Impact* by either relocating the crossover 130 feet or further from any residential home or implementing track mitigation measures such as the use of tire-derived aggregate (TDA) or a floating slab track-bed (FST).

East Storage

- *No Noise Impacts* and *No Vibration Impacts* are expected due to activities in the East Yard Expansion.

Construction

Phase 1 – West Side Improvements

- *Noise Impacts* at 15 residences would be generated during track installation if construction is scheduled during nighttime hours. A temporary noise barrier or temporary relocation of residents to a hotel should be implemented during nighttime work to reduce impacts along Messina Terrace and La Bonita Terrace to a level that would be No Impact.
- *No Vibration Impacts* would damage buildings during Phase 1 construction. There is a potential for vibration annoyance at 26 residences during track installation.

Phase 2 – East Side Improvements

- *Noise Impact* at 15 residences for nighttime construction during track installation. Noise control measures such as temporary noise barrier, or temporary relocation of residents to a hotel should be implemented during nighttime work to mitigate the nighttime noise impacts at receptors located along Messina Terrace and La Bonita Terrace in the Innovation Homes complex.
- *No Noise Impact* during eastside storage track installation north of Whipple Road because the work would be conducted during the daytime hours.
- *No Noise Impacts* from vibratory pile driving and therefore no noise control would be required.
- *No Vibration Impact* would be expected during construction of the flyover aerial structure, but there is a potential for vibration annoyance at 32 single-family homes at the Innovation Homes during track construction.

Staging Areas

- After implementing a 50 feet buffer zone along the east boundary of the BART property near the southeastern staging area, *No Noise Impacts* are expected from staging areas. Therefore, no noise mitigation would be needed.
- *No Vibration Impacts* are expected from staging areas. Therefore, no vibration control measures would be required.

Introduction

This report prepared by WIA presents results of the noise and vibration impact assessment from the Hayward Maintenance Complex (HMC Project). The Project includes incorporating new special trackwork (i.e., turnouts and crossovers) in the Hayward Yard, but also some new special trackwork in the mainline and test track south of the Yard, building a storage area for up to a maximum of 250 cars and new traction power substation to the east of the Hayward Yard, two flyover structures (north and south), upgrades to the Maintenance and Engineering (M&E) yard, shops, a new Overhaul Shop and storage for non-revenue maintenance equipment located to the west of the Hayward Yard.

Measurements of the ambient background noise in the residential areas near the project, and the typical noise and vibration from train passbys were obtained by WIA in September 2009. Site-specific wayside noise and ground vibration measurements from BART train passbys were also obtained. This report presents the results of these measurements and also projected levels of noise and vibration from BART operations due to the Project.

Noise and Vibration Measurements

WIA obtained measurements of the environmental ambient noise, as well as passby noise and vibration from train operations at several locations near the project site. The purpose of the field measurements was to evaluate the existing environmental conditions in the area of the project and also to obtain the baseline for the noise and vibration analysis.

Long-term Ambient Noise Measurements

Ambient noise measurements were obtained at four locations between September 15 and September 20, 2009. Figure 1 and Figure 2 show an aerial view of the measurements locations. A description of the monitoring locations and photographs of the sites are presented in the following pages.

Long-term noise measurements were obtained by means of calibrated, precision, logging sound level meters over a 6-day period. All noise-measuring instruments used during the noise survey meet ANSI S1.4-1993 specifications for Type I Sound Level Meters. The sound level meters monitored the level of noise continuously providing statistics of the noise level over consecutive one-hour intervals. The measured hourly equivalent noise levels (L_{eq}) were used to calculate the daily Day-Night Noise Level (DNL or L_{dn}) over each 24-hour period measured.

Ambient noise at location N1 is dominated by BART train passbys, local traffic, and train noise from the nearby freight/Amtrak track (including train horn noise from the grade crossing at Whipple Road). The Day-Night noise level (L_{dn} or DNL) was 64 dBA. There is a partial sound wall at the BART property line that provides some shielding to BART train noise. The hourly equivalent noise levels are shown in Figure A- 1 (see Appendix A).

Similarly, ambient noise at location N2 is dominated by BART train noise, local traffic, and train noise from the nearby freight/Amtrak track. The ambient noise level ranged between 59 and 61 dBA L_{dn} with an average of 60 dBA. The lower noise level obtained at N2 compared with location N1 is a result of the more effective (i.e., higher) sound wall at location N2. The height of the sound wall for residences located north of Boyle Street is about 12 feet. The hourly equivalent noise levels are shown in Figure A- 2 (see Appendix A).

Location N3 was selected to characterize ambient noise for residences located in the Innovation Homes residential complex. The noise monitor was hung from a light pole on Calle La Mirada Common to provide representative ambient noise levels at these residences. Even though this location may experience higher noise levels due to motor vehicle traffic than most homes facing the alignment, this location provided the most suitable measurement site to obtain BART passby noise unshielded from the two-story homes. The ambient noise at N3 ranged between 59 and 64 dBA with an average of 62 dBA. Due to the proximity of the residential homes to the grade crossing at Whipple Road, freight train horn noise dominates noise levels measured during night hours. Figure A- 3 in Appendix A shows the hourly equivalent noise levels obtained at N3.

Finally, ambient noise at location N4 is dominated by train noise (Amtrak, UPRR and BART trains) and noise from activities from the existing Hayward Yard. The L_{dn} ranged from 63 to 68 dBA with an average of 67 dBA. Weekday noise levels remained very stable at about 67 to 68 dBA. Figure A-4 in Appendix A shows the hourly equivalent noise levels obtained at N4 between September 15 and September 21, 2009.

Table 1 summarizes the existing day-night ambient noise levels at the four locations.

Location N1

Noise logger was hung from a street light pole at the corner of 11th Street and D Street at approximately 130 feet from BART tracks.

Location N2

Noise logger was hung from street light pole in front of 33240 11th Street at approximately 120 feet from BART tracks.

Location N3

The noise logger was hung from a street light pole on Calle La Mirada Common in the Innovation Homes residential community. The monitor was approximately 200 feet from BART tracks.

Location N4

Noise logger was hung from a utility pole on Gressel Street, east to the Hayward Yard at a distance of approximately 70 feet from the active UPRR freight rail (shared with Amtrak) and 400 feet from the BART Hayward Yard.

Table 1 – Summary of the existing daily ambient noise levels (Day-night level) in the proximity of the project

Location	Tues, 15	Wed, 16	Thu, 17	Fri, 18	Sat, 19	Sun, 20	Avg.
11th Street and D Street	64	64	65	63	61	64	64
11th Street (Park)	60	60	61	60	59	60	60
Calle Innovation Homes	62	61	63	62	62	59	62
Gressel Street	68	67	67	68	66	63	67

Source: WIA, September 2009

Short-term Noise and Vibration Measurements

Noise Measurements of BART Train Passby

WIA performed measurements of airborne noise from train passbys at four locations to characterize the typical noise levels of BART trains operating on tangent track and special trackwork (i.e., turnouts and crossovers). The data were also used to calibrate the noise increase due to special trackwork in the noise model and to compare the modeled sound wall reduction with that measured for an existing sound wall.

Figure 1 and Figure 2 shows the locations chosen for the passby test. The equipment setup used during noise measurements is shown in Figure 3 (left photo). Several revenue train passbys were recorded on September 15 and September 17, 2009 at each measurement location. Subsequently, the data recorded in the field were analyzed in the WIA laboratory using a Larson Davis 2900 real time analyzer to obtain the frequency spectra and the overall noise level from each train passby. BART trains recorded at all locations were either 3-cars or 4-cars long, traveling at approximately 70 mph.

Measurements of wayside noise at location S1 were obtained at the corner of 11th Street and D Street at a distance of 125 feet from the northbound BART mainline track. The distance selected for S1 represents the setback distance from the BART main track to residences on 11th Street. There is a sound wall at the BART property line that runs from the Dry Creek Park to D Street. However, the sound wall steps down to the height of the BART tracks or lower by the time it reaches D Street. There is no sound wall south of D Street. This measurement location is representative of wayside noise levels with no sound wall on tangent track. The measured wayside noise levels of five train passbys ranged between 68 and 73 dBA with an average of 70 dBA.

Location S2 was located at the Dry Creek Park. The microphone was placed 135 feet from the northbound BART main track, which is the typical setback distance to the residential single-family homes on 11th Street. There is a 9-foot high sound wall at the measurement location that provides shielding to BART passby noise. The distance from the single-family homes to the sound wall is about 70 feet. The typical overall A-weighted noise level obtained at location S2 ranged between 62 and 65 dBA with an average of 63 dBA, which is about 7 dBA lower than that obtained at location S1.

Similarly, wayside noise was recorded at location S3 to characterize BART train passby noise for the Innovation Homes. The microphone location was about 70 feet from the northbound BART mainline track, which is the typical distance between the track and homes at this residential complex. The results show wayside noise levels from seven BART train passbys ranging from 62 to 68 dBA with an average of 65 dBA. There is an existing noise wall at the property line (top of the embankment) that provides shielding of the train noise to ground level receptors. The height of the wall is 7.5 feet from the receiver's ground elevation.

Locations S1 through S3 provided a characterization of BART trains operating on tangent track. At Location S4 adjacent to the Hayward Yard, WIA recorded noise from revenue trains operating through a crossover. Measurements at the Hayward Yard were performed at interlock 77, which is the turnout connecting the mainline tracks with the test track. The noise measurement equipment was positioned at 70 feet and 125 feet from the northbound mainline, which corresponds to the typical distance from BART tracks to homes located on 11th Street and at the Innovation Homes. A total of eight train passbys were recorded at a speed of 70 mph. The dataset included 3-car to 5-car long trains. The noise levels ranged from 79 to 81 dBA at the 70 foot location and 77 to 79 at 125 foot location. The increase associated with the crossover was 8 dBA for the 125-foot location

Table 2 shows the comparison of the data for airborne noise from train passby obtained at the three sites. It was observed that the existing sound wall provides a noise reduction of 7 dBA, when compared to the scenario of no sound walls measured at location S1.

Table 2 – Summary of wayside noise level from BART train passbys

Location ID	Description	Type of track	Distance from near track CL, feet	Wayside Noise Level, dBA (1)
S-1	11th Street and D Street	Tangent	125	70
S-2	11th Street (Park)	Tangent	125	63 (2)
S-3	Innovation Homes	Tangent	70	65 (2)
S-4	Hayward Yard	Crossover	70	79
			125	78

Note:
(1) Microphone located at 5 feet from existing ground elevation
(2) Passby noise level obtained behind the existing barrier wall

Source: WIA 2009

Ground Vibration Measurements of BART Train Passby

As for the measurement of noise from BART train passbys, recordings of ground vibration from BART train passbys was obtained at four measurement sites. Three measurement sites were selected to characterize ground vibration from BART trains operating on tangent track and one location for BART trains operating on special trackwork. The data were also used to obtain the site-specific ground vibration attenuation curve versus distance for application in the projection model.

Ground vibration was measured using Mark Products Type L282LBU 4.5 Hz geophones and a Teac LX10 solid-state multi-channel recording system. Figure 3 shows the typical equipment setup used during the data collection. Geophones were placed at distances between 40 feet and 270 feet from the nearest BART mainline track. The overall ground vibration velocity level obtained from each BART train passby was plotted against the distance and a regression analysis was applied to fit the measured data. The least square regression method was used for all measured vibration presented in this report. Figure 4 shows the results of the measurement at all five locations.

Vibration location V-1 was located at the corner of 11th Street and D Street. Geophones were located at distances of 75, 122, 172 and 222 feet from the northbound BART mainline track. Four northbound BART trains were recorded traveling at 70 mph at V-1. This measurement location was chosen to characterize ground vibration from BART trains on residences at 11th Street between Stone Street and E Street. The typical ground vibration level measured at the setback distance of homes from BART tracks was 59 VdB.

Measurement location V-2 was located inside the Dry Creek Park on 11th Street. Vibration geophones were set at 70, 120, 220, and 270 feet from the northbound BART track. Results of the analysis of four BART train passbys show ground vibration levels of about 62 VdB at the typical location of the closest homes to mainline track. This measurement location was used for residences located on 11th Street to Stone Street.

Similar to location V-2, location V-2A was located on the north side of the Dry Creek Park as an effort to estimate ground vibration for single-family residences on La Vita Terrace and La Brea Terrace (both located north to the creek), and to study the effect of ground vibration from BART trains due to the proximity of the creek. Geophones were located at 70, 120, 220, and 270 feet from the nearest northbound BART track. As shown in Figure 4, ground vibration at location V-2A was lower than V-2 up to 80 feet, but higher for all distances beyond. Loose local soil at the park could be the main reason driving the results, and the creek could be the explanation for the slower decay rate at distances further than 80 feet. Since residences north to the creek are 60 to 70 feet from the nearest BART track and 30 to 35 feet from the test track, for the purpose of the analysis we have used V-2 as the representative vibration location for residences on La Vita and La Brea Terrace at the Innovation Homes.

Vibration inside the Innovation Homes complex (Location V-3) was characterized at the park on Calle La Mirada Common. The vibration sensors were placed on the ground at a distance of 75, 95, 120, 170 and 195 feet from the northbound BART mainline track. Four train passbys were recorded and plotted against the distance. The result shows that at the typical distance to the homes (70 to 90 feet), ground vibration ranged from 65 to 67 VdB.

Measurements of ground vibration were also performed at the Hayward Yard (Location V-4) in September 17, 2009 near the interlock switch 77 connecting the mainline with the test track. Five geophones were set at 40, 70, 80, 120 and 180 feet from the crossover frog. The passbys of eight northbound trains at 70 mph were recorded and later analyzed to obtain the frequency spectra and overall vibration level; the overall vibration was then used in a regression analysis. Figure 4 shows the curve obtained from the analysis. Vibration levels from operations on the crossover are 12 VdB higher than those obtained on tangent track at 50 feet (location V-2). However, the decay rate with distance is much higher than for tangent track. This is explained by the fact that vibration from trains operating through the crossover acts like a discrete point source while a train passby is more like a line source. Figure 4 shows that at a distance of 180 feet, ground vibration from BART trains operating on the turnout of the crossover is identical to that obtained for tangent track.

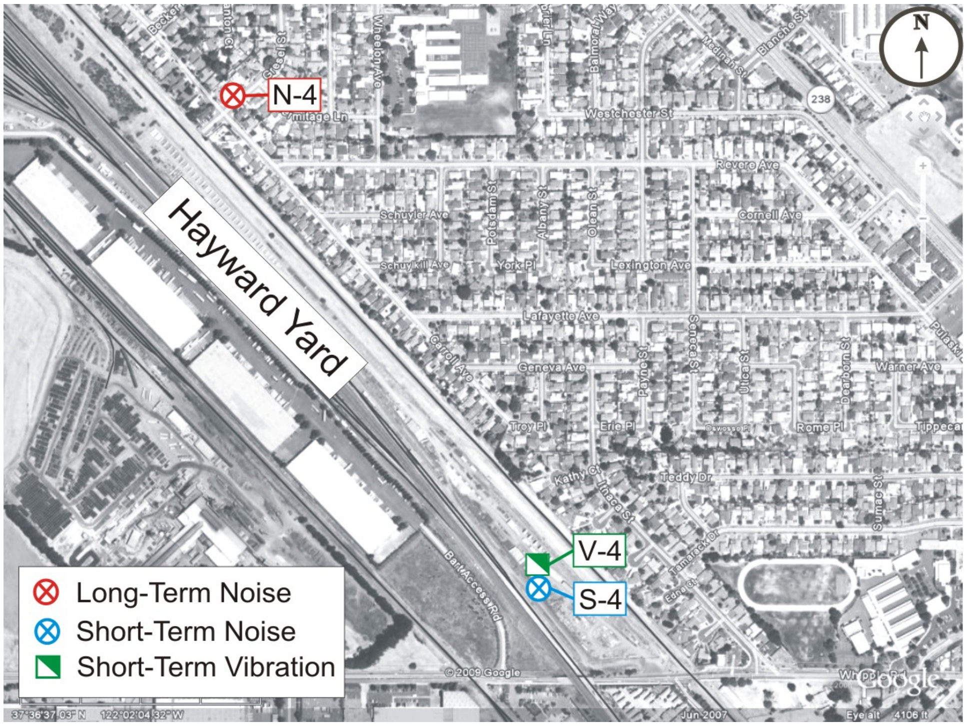

Figure 1 – Long-term and short-term noise and vibration measurement locations (N of Whipple Rd)

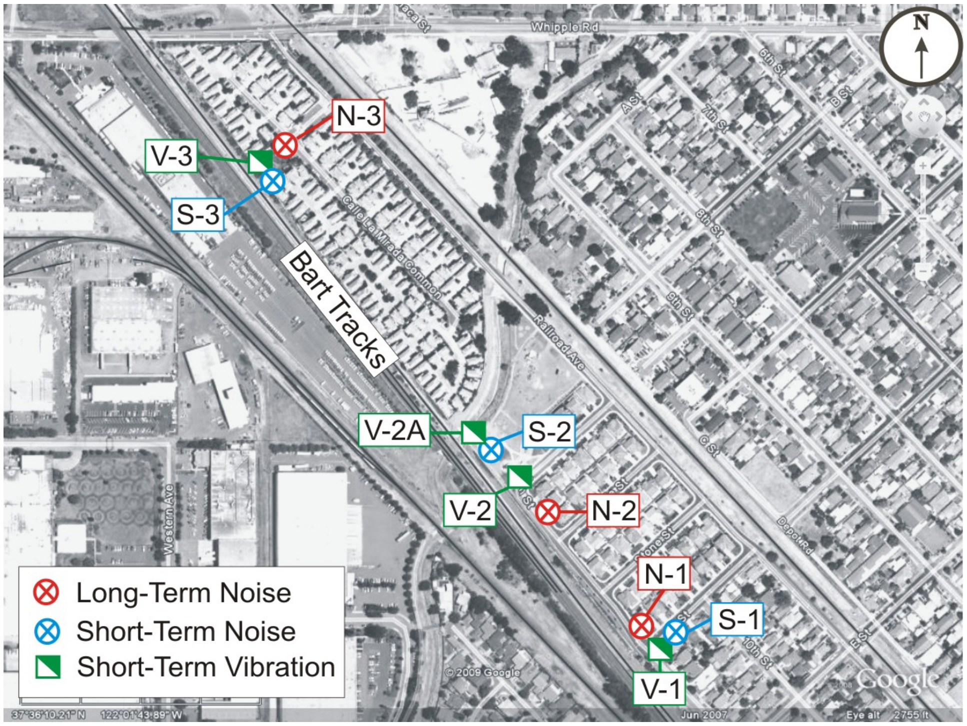

Figure 2 – Long-term and short-term noise and vibration measurement locations (S of Whipple Rd)

Figure 3 – Equipment setup used for noise and vibration passby measurements

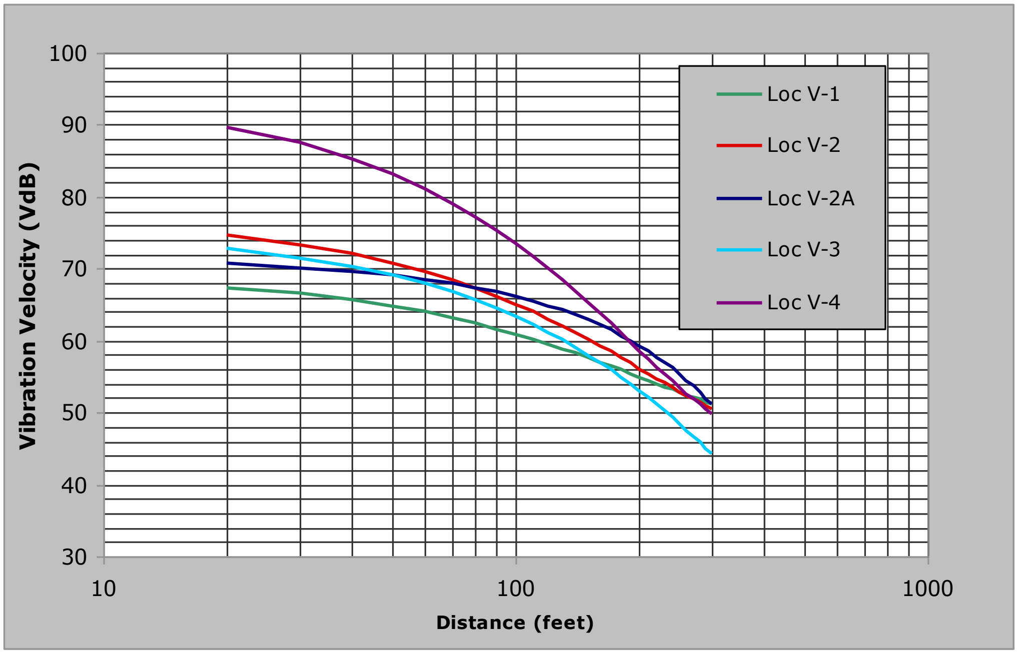

Figure 4 – Projected ground vibration levels versus distance from BART train passby on tangent and special trackwork based on site specific measurements

Applicable Noise and Vibration Policies

FTA Noise Criteria

The FTA Guidance Manual provides three levels of criteria for assessment of noise impact from rail transit projects: *No Impact*, *Moderate Impact* and *Severe Impact*. These sets of criteria depend on the existing outdoor ambient noise and the type of land use.

Noise sensitive land-use is grouped into three categories: Category 1, Category 2 and Category 3. The criteria are shown graphically in Figure 5 for the Category 1 and Category 2 land uses.

The FTA guidelines specify a particular noise metric to be used depending on the specific land-use (e.g., residential). The L_{dn} is typically used for residential uses and the worst-hour L_{eq} is typically used for office use. Thus, the ambient measurements described in the previous section were conducted to characterize the existing environments accordingly.

Table 3 describes the FTA land-use categories and specifies the appropriate noise metric and the criterion for each Category. The FTA noise impact thresholds, as indicated in Figure 5 are based on the increase of the existing ambient noise level associated with operations of the Project or in combination with other new planned projects (i.e., cumulative impact).

Table 3 - FTA Land Use Categories and Metrics for Transit Noise Impact Criteria

Land Use Category	Noise Metric (dBA)	Description of Land Use Category
1	Outdoor L_{eq}(h)	Tracts of land where quiet is an essential element in their intended purpose. This category includes lands set aside for serenity and quiet, and such land uses as outdoor amphitheaters and concert pavilions, as well as National Historic Landmarks with significant outdoor use.
2	Outdoor L_{dn}	Residences and building where people normally sleep. This category includes homes, hospitals and hotels where a nighttime sensitivity to noise is assumed to be of utmost importance.
3	Outdoor L_{eq} (h)	Institutional land uses primarily daytime and evening use. This category includes schools, libraries, and churches where it is important to avoid interference with such activities as speech, meditation and concentration on reading material. Buildings with interior spaces where quiet is important, such as medical offices, conference rooms, recording studios and concert halls fall into this category. Places for meditation or study associated with cemeteries, monuments, museums. Certain historical sites, parks and recreational facilities are also included.

Source: FTA, May 2006.

The FTA noise impact thresholds, as shown graphically in Figure 5 below, are based on the noise exposure increase over the existing ambient noise level associated with the projected future noise level (created by the project or combination of new projects). Two levels of noise impact are defined by the FTA guidelines: *Moderate Impact* and *Severe Impact*. The range between both the upper (*Severe Impact*) and lower curves (*Moderate Impact*) represents an area where it has been observed that the increase in cumulative noise exposure is noticeable to most people, but generally not sufficient to cause an adverse reaction by the surrounding communities. The FTA Guidelines established the threshold on the upper area as the limit above which a substantial percentage of receptors in the vicinity of the Project may be highly annoyed.

For the BART HMC Project, *Noise Impact* would be indicated when noise exposure levels exceed the threshold for *Severe Impact* and *Moderate Impact* as defined by the FTA Guidelines. Mitigation measures would be evaluated on sensitive receptors identified with either category of impact. Noise in the *Severe Impact* range has the greatest adverse effect on the community, requiring mitigation unless extenuating circumstances prevent it, if mitigation is found not to be feasible or prudent. *Moderate Impacts* also require consideration and adoption of mitigation measures when it is considered reasonable to do so.

Source: FTA, May 2006.

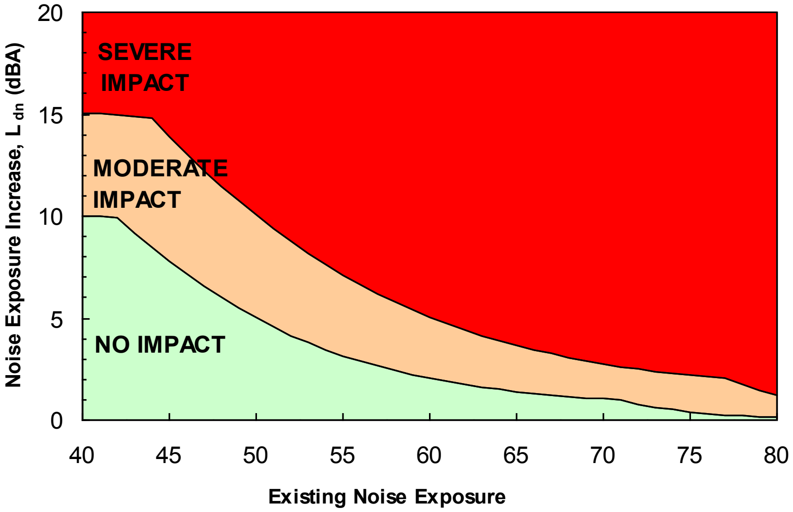

Figure 5 – Allowable Increase in Cumulative Noise Levels for FTA Category 1 and 2

FTA Vibration Criteria

The ground-borne vibration criteria for the FTA General Assessment analysis accounts for the frequency of events, where *Frequent Events* are defined as more than 70 events (trains) per day, *Occasional Events* are for between 30 and 70 events per day, and *Infrequent Events* for less than 30 events per day. Additionally, FTA provides separate criteria (not included in any Category presented above) for buildings that are especially sensitive to vibration (e.g., research laboratories). There are currently no special buildings in the area of the Project.

In year 2030, BART is expected to run a total of 315 trains daily once the Silicon Valley Rapid Project (SVRTP) is in place. However, even with the current train schedule, BART can be categorized as a system with *Frequent Events*. Similarly, future operation of the test track falls into the *Frequent Event* Category (more than 70 events per day). The current test track activities are considered by the FTA guidelines as *Occasional Events*.

The FTA guidelines group vibration sensitive land uses into three categories: High Sensitivity, Residential and Institutional. Table 4 shows the description of each land use category applied to the analysis. Vibration sensitive land uses in the proximity of the HMC Project are Category 2 exclusively. No Category 1 or 3 land uses were identified in the area of the Project.

Table 4 – Category of Land Use for the FTA Vibration Analysis

Vibration Category	Description of Land Use Category
Category 1 - High Sensitivity	"Included in Category 1 are buildings where vibration would interfere with operations within the building, including levels that may be well below those associated with human annoyance." "Typical land uses covered by Category 1 are: vibration-sensitive research and manufacturing, hospital with vibration-sensitive equipment, and university research operations."
Category 2 - Residential	"This category covers all residential land uses and any buildings where people sleep, such hotels and hospitals. No differentiation is made between different types of residential areas."
Category 3 - Institutional	"Vibration Category 3 includes schools, churches, other institutions, and quiet offices that do not have vibration-sensitive equipment, but still have the potential for activity interference. Although it is generally appropriate to include office buildings in this category, it is not appropriate to include all buildings that have any office space."

Source: FTA, May 2006.

Table 5 - FTA Ground-borne Vibration Impact Criteria for General Assessment

Land Use Category	GBV Impact Levels (VdB re 1 micro-inch/sec)		
	Frequent Events	Occasional Events	Infrequent Events
Category 1	65 VdB	65 VdB	65 VdB
Category 2	72 VdB	75 VdB	80 VdB
Category 3	75 VdB	78 VdB	83 VdB

Source: FTA, May 2006.

Noise and Vibration Impact Assessment

The noise and vibration assessment in this report evaluates the construction and operational noise and vibration impacts of the Project, including BART train movements on the east storage tracks, the new Overhaul Shop, the Maintenance and Engineering (M&E) yard, shops, and storage for non-revenue maintenance equipment, and the new traction power substation.

The alignment evaluated in this report includes both the south and north dispatch flyovers shown in Figure 6. The Phase 1 Project proposes implementing two new crossovers between the southbound and northbound tracks in the area of 11th Street (crossovers P100 and P102)[3]. This special trackwork would be located approximately 150 feet from the nearest single-family homes on 11th Street. Also during Phase 1, the Project would provide access to the Hayward Maintenance Complex (HMC). Crossovers proposed for accessing the HMC include a single turnout off the southbound main track (crossover P102) which is located approximately 95 feet from the nearest homes. Figure 6 shows the location of these new crossovers.

During Phase 2, a new No. 15 crossover (crossover P101 in Figure 6) would be placed between the northbound track and the test track just south of the Whipple Road overpass. The distance between P101 and the closest sensitive receptors would be about 60 feet.

Two crossovers (P103 and P104) on the dispatch and reception lead track would be located just south of the Whipple Road overpass at a distance of approximately 130 feet from the closest sensitive receptors. Both crossovers P103 and P104 would be implemented during Phase 2 of the Project.

The Project also includes site improvements to 20 acres of undeveloped land to the northeast of the Yard that would provide storage tracks to accommodate up to a maximum of 250 cars, and a traction power substation to the south end of the east storage area. The location of these improvements is shown in Figure 6.

Finally, the proposed project would acquire three properties to the west of the existing Hayward Yard to accommodate the new maintenance complex that would include a new overhaul shop, component repair shop, central warehouse, and the maintenance and engineering shop and storage.

The primary variables and assumptions that were used in the noise and vibration models include:

- Alignment on ballast and tie tracks except on the aerial structure for which a direct fixation system was assumed.
- Cumulative noise levels were estimated based on the future schedule proposed for the Silicon Valley Rapid Transit Project (SVRTP).
- Proposed BART future operations (SVRTP) on the main line would bring 271 trains through the Hayward Maintenance Complex during the daytime and 44 trains at night (in both directions of travel).
- BART future trains operations would be 10-cars long (700 feet) during peak-hour operation and 5-cars long (350 feet) during off-peak operations. BART vehicles on the test track would be 4-cars long (280 feet).

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[3] Labels given to crossovers in this report are intended for identification purpose only.

- Maximum BART train speed on the main line and test track would be 70 mph. BART maximum speed on the storage and yard lead tracks would be 30 mph.
- Ground vibration projections use a locally derived ground vibration curve obtained by field measurements.
- To establish interior vibration levels, an adjustment of +3 VdB was applied to account for the general response of wood-framed residential structures.
- Future yard operations for the analysis were estimated at 80 train movements during daytime and 40 during nighttime hours. This number includes the current dispatch activities (60 trains) which would originate on the west side of the HMC and the new activities on the east.
- A 34.5 KVA track power substation was assumed for the east storage area. The reference sound exposure level used in calculations was 99 dBA at 50 feet.
- Operations on the test track for the cumulative noise analysis would be 12 trains per hour from 7 am to 11 pm. This schedule is a worst-case condition for the noise modeling. This schedule assumes the future train activities expected from future car commissioning. The train activity is associated with the testing of the new vehicles on the test track before BART accepts them for service. The train consist is assumed to be 4 cars long with operational speeds of 30 to 40 mph south of Whipple Road.

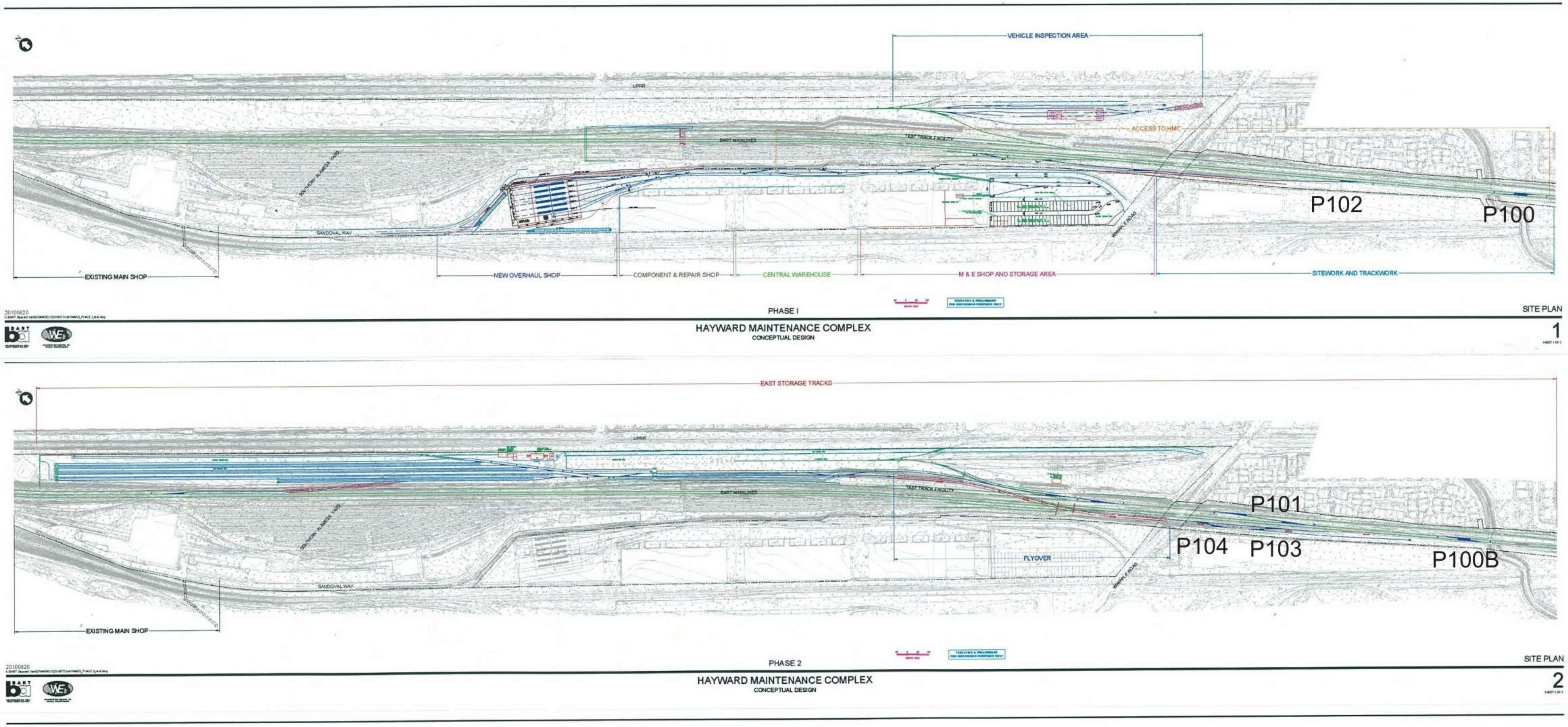

Figure 6 – Hayward Maintenance Complex. Phase 1 (top) and Phase 2 (bottom) conceptual design plan view

Noise Assessment

Methodology

BART Operational Noise Analysis

The assessment of wayside noise impacts from operations of BART trains in the vicinity of the Hayward Yard Project was done in accordance with the FTA Guidance Manual. The FTA guidelines provide two levels of analysis during an environmental analysis: Screening and General Assessment. The assessment of potential noise impacts due to BART operations as part of the Project were based on the level described by FTA as General Assessment. The FTA Criteria are based on the relative change in the cumulative noise exposure that would occur, using the "day-night" noise level descriptor (L_{dn}) for residential or other buildings with nighttime occupancy and peak hour L_{eq} for buildings with daytime occupancy only. WIA obtained the existing ambient noise levels along the corridor in September of 2009.

Cumulative noise levels due to the Project depend on train length, speed and distance from both tracks to the buildings. The projected wayside noise levels also account for the noise shielding effects of the existing sound walls.

For the purpose of this analysis, the current schedule of BART trains on the Fremont to Richmond and Fremont to Daly City lines indicates 204 daytime trains and 52 nighttime trains through the Hayward Yard (in both directions of travel). Traffic on the mainline is projected to receive additional trains from two proposed BART extension projects: Warm Springs Project (WSX) and the Silicon Valley Rapid Transit Project (SVRTP). The WSX project is expected to operate with a similar number of trains as the current schedule. However for the SVRTP, BART proposes to operate 271 trains through the Hayward Yard during the daytime and 44 trains at night (in both directions of travel), which is approximately 59 trains per day greater than the current schedule. BART trains operating on the SVRT Project will be 10-cars long (700 feet) during peak-hour operation and 5-cars long (350 feet) during off-peak operation[4].

Cumulative noise levels were estimated based on the future schedule proposed for the SVRT Project, which represents a conservative approach for the Hayward Yard Expansion considering the proposed opening date for the SVRT Project is unknown. Figure 7 shows the projected unshielded day-night noise level versus distance expected from future BART operations on tangent track (year 2030).

Additional adjustments to the unshielded noise exposure in Figure 7 include those that account for increases due to the crossovers, speed changes at the storage and yard lead tracks, and the reduction of noise level provided by existing sound walls.

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[4] Silicon Valley Rapid Transit Project. Line Segment Wayside Noise Report, December 2006. Prepared by Wilson, Ihrig and Associates, Inc.

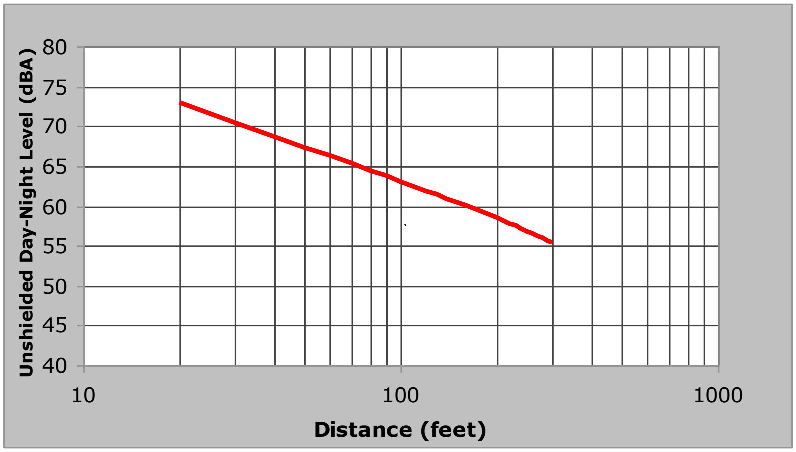

Figure 7 – Projected unshielded day-night noise level of BART trains on at-grade ballast and tie tracks at 70 mph with 12-minute headways (future condition).

Hayward Yard Operations

Noise from BART operations as part of the HMC Project include BART train movements on proposed tracks and crossovers, and noise from the traction power substation constructed at the south end of the storage track area to provide power to the storage tracks.

The methodology to assess wayside noise was taken from the FTA guidance manual. The reference sound exposure level (SEL) specified in the guidance manual is 118 dBA for 20 train movements during peak hour activities. The HMC East storage expansion proposes adding 40 train movements during daytime hours and 20 train movements during nighttime hours to the existing train movements (originated on the west side of the Yard). This represents a doubling of yard traffic, with half (60 trains) operating from the west side of the Hayward Yard and half (60 trains) operating from the east side of the yard. This assumption represents a worst case condition for noise modeling.

The unshielded noise levels from the 34.5 KVA substation were projected to nearby residences and the level compared to the FTA criteria shown in Figure 5. The reference sound exposure used in the calculation was 99 dBA at 50 feet. We understand that BART requires its substations meet the National Electrical Manufacturers Association (NEMA) rating. The maximum NEMA ratings, which are specified in terms of the average sound level, are 60 dBA for a self-cooled ventilated system, 59 for a self-cooled sealed and 67 dBA for a ventilated forced air cooled. These sound levels are much quieter than that specified in the FTA guidance. Therefore, following the FTA procedure will be a conservative approach for this project.

Noise from future operations on the new overhaul shop, component repair shop, maintenance and engineering shop and storage, and central warehouse was based on field measurements performed on the existing main shop at the Hayward Yard. Noise measurements and field observations performed by WIA during July 2010 helped to determine an outdoor sound exposure level of 96 dBA (at 50 feet) from typical activities from the Main Shop. Such activities included impact wrenches during dissemble and ensemble of train’s truck, PA announcements, overhead cranes operation, and steam cleaning.

Projected Cumulative Noise

Operational

The impact assessment for noise is based on the comparison of the increased levels (L_{dn}) associated with BART operations with the impact threshold presented in Figure 5.

Table 6 and Table 7 show the results of the projected cumulative noise levels from BART train operations on the proposed HMC Project for Phase 1 and Phase 2 respectively. Projected noise levels in the tables include the effect of BART train operations on the mainline (future schedule), and BART operations on the new crossovers (including future test track operations). The summary of the results are as follows:

Phase 1 - West Side Improvements

There would be potential for *Moderate Noise Impact* at three single-family residences located on 11th Street due to the increase associated with the proposed crossover P100.

Noise impacts are also projected at about 14 single-family homes that would be located directly opposite to crossover P102 which connects the southbound main line with the southbound dispatch and reception lead. The increase in noise level expected on residences at Alicante Terrace and Carrara Terrace would be 2.0 to 2.7 dBA resulting in *Moderate Impact*.

Phase 2 – East Side Improvements

Operations of BART trains on crossover P100B would result in a *Severe Noise Impact* at nine single-family residences located on La Brea Terrace due to the noise increase associated with the BART trains from crossover P100B and the distance from the crossover to the residences.

Also six single-family homes located on Carrara Avenue would receive a *Moderate Impact* due to crossover P101 that would be connecting the northbound mainline with the test track. There are other homes near this crossover; however noise levels from operations of BART trains on the test track at the crossover P101 would be reduced by the shielding provided from the existing retaining wall. Thus, for the single-family homes at Messina and La Bonita Terrace there would be *No Noise Impact*. Consequently noise mitigation measures would only be considered for the homes on Carrara Avenue.

North of Whipple Road, the project would slightly increase the cumulative noise levels at nearby single-family homes due to trains on the aerial flyover. However, the increase would be below the threshold for Moderate Noise Impact. As a result, *No Noise Impact* is expected from BART operations on the aerial guideway and therefore, no additional mitigation measures would be needed on the aerial guideway.

Table 6 – Projected cumulative noise levels from BART operations on the HMC Expansion (Project) for Phase 1

				FTA Criteria		Cumulative Noise Levels No Noise Control				Cumulative Noise Levels With Noise Control			
Location	**Land Use**	**Dist. to nearest track CL (ft)**	**Amb. Level L_{dn}** (except as noted)	**Moderate Impact**	**Severe Impact**	**Projected Total[1] L_{dn} or L_{eq} (dBA)**	**Increase (dBA)**	**Imp. Type**	**# of Bldgs with Imp.**	**Projected Total[1] L_{dn} or L_{eq} (dBA)**	**Increase (dBA)**	**Imp. Type**	**# of Bldgs with Imp.**
11th St btwn Stone St & Boyle St.	SFR	135 xo	60	2.0	5.0	62	2.0	NI	0	---			
11th St and Boyle St.	SFR	140 xo	60	2.0	5.0	63	2.7	MI	3	62	1.7	NI	0
Dry Creek Park	Park	120xo	60[2]	4.6	9.0	63[2]	2.8	NI	0	---			
La Brea Terrace	SFR	75	62	1.7	4.4	64	1.6	NI	0	---			
Alicante Terrace	SFR	75 xo	62	1.7	4.4	65	2.7	MI	7	64	1.7	NI	0
Carrara Terrace	SFR	80 xo	62	1.7	4.4	64	2.0	MI	7	63	1.3	NI	0
Messina Terrace	SFR	85	62	1.7	4.4	63	0.5	NI	0	---			
La Bonita Terrace	SFR	90	63	1.6	4.1	63	0.0	NI	0	---			

Notes:
(1) Include noise levels from future BART train operations on mainline and crossover and the projected existing adjusted ambient noise levels.
(2) Leq is the metric for FTA Category 3 sensitive receptors
xo : crossover switch

SFR: Single-family residence building
NI : No Impact as defined by FTA
MI : Moderate Impact as defined by FTA
SI: Severe Impact as defined by FTA

Source: WIA 2010

Table 7 – Projected cumulative noise levels from BART operations on the HMC Expansion (Project) Phase 2

Location	Land Use	Dist. to nearest track CL (ft)	Amb. Level L_{dn} (except as noted	FTA Criteria		Cumulative Noise Levels No Noise Control				Cumulative Noise Levels With Noise Control			
				Moderate Impact	Severe Impact	Projected Total[1] L_{dn} or L_{eq} (dBA)	Increase (dBA)	Imp. Type	# of Bldgs with Imp.	Projected Total[1] L_{dn} or L_{eq} (dBA)	Increase (dBA)	Imp. Type	# of Bldgs with Imp.
11th St btwn Stone St & Boyle St.	SFR	135 xo	60	2.0	5.0	61	1.4	NI	0	---			
11th St and Boyle St.	SFR	140 xo	60	2.0	5.0	62	1.7	NI	0	---			
Dry Creek Park	Park	120xo	60[2]	4.6	9.0	62[2]	1.8	NI	0	---			
La Brea Terrace	SFR	75 xo	62	1.7	4.4	67	4.7	SI	9	64	1.4	NI	0
Alicante Terrace	SFR	75 xo	62	1.7	4.4	64	1.5	NI	0	---			
Carrara Terrace	SFR	80 xo	62	1.7	4.4	65	2.5	MI	6	63	1.3	NI	0
Messina Terrace	SFR	85 xo	62	1.7	4.4	63	1.4	NI	0	---			
La Bonita Terrace	SFR	90 xo	63	1.6	4.1	63	0.4	NI	0	---			

Notes:
(1) Include noise levels from future BART train operations on mainline and crossover and the projected existing adjusted ambient noise levels.
(2) Leq is the metric for FTA Category 3 sensitive receptors
xo : crossover switch

SFR: Single-family residence building
NI : No Impact as defined by FTA
MI : Moderate Impact as defined by FTA
SI: Severe Impact as defined by FTA

Source: WIA 2010

Table 8 – Projected cumulative noise levels from activities at the proposed east train storage, west side improvements, and traction power substation

				FTA Criteria					
Location	**Land Use**	**Range of Typical Dist. (ft)**	**Amb. Level L_{dn}**	**Moderate Impact**	**Severe Impact**	**Projected Total L_{dn} (dBA)**	**Increase (dBA)**	**Imp. Type**	**# Bldgs w/Imp**
Ithaca Ave between Whipple Road and Troy Place	SFR	630 – 2,900	70	1.0	2.8	70	0.1	NI	0
Carroll Ave between Troy Place and Gressel St	SFR	320 – 1,400	69	1.1	2.9	69	0.3	NI	0
Carroll Ave between Gressel St. and Becker Place	SFR	170 – 1,100	67	1.2	3.1	68	1.1	NI	0
Carroll Ave between Becker Pl. and Fairway Street	SFR	200 – 1,400	67	1.2	3.1	68	1.0	NI	0
Carroll Ave north of Fairways Street	SFR	370 – 2,500	67	1.2	3.1	67	0.2	NI	0

SFR: Single-family residence building
NI : No Impact as defined by FTA

Source: WIA 2010

Hayward Yard (Train Storage, HMC, Traction Power Substation and Enhanced Vehicle Inspection Area)

The assessment of cumulative noise impacts resulting from BART operations on the proposed storage expansion is presented in Table 8. Noise levels in the table account for train movements at lower speed during storage, noise from the traction power substation, operations on the aerial structures for the dispatch flyover, and operations on the new Hayward Maintenance Complex (HMC).

Results of the analysis show that BART operations on the proposed storage tracks and other tracks associated with it would increase the existing ambient conditions of nearby residences by a range between 0.1 and 1.1 dBA. The increase would result in *No Impact* as defined by FTA. Therefore, no noise mitigation measurements would be required.

Noise levels from the traction power substation are projected to be below the criteria for noise impact and therefore, no noise mitigation would be needed. Similarly, operations of the HMC would generate cumulative noise levels below the threshold of impact resulting in *No Impact* as per FTA.

The Enhanced Vehicle Inspection Area will be used to inspect vehicles as they are delivered to the Hayward Yard before going into service on the BART system. It is expected that up to two vehicles per month might be delivered on average. Most of the time the vehicles will be stationary during which time noise generation will be minimal, since most of the inspection work will be conducted inside the vehicle and when outdoors power tools will be used infrequently if at all. Movement of the train will generate low levels of noise considering the low speeds into and out of the Inspection Area. Considering the low levels of noise generated and their infrequent occurrence, *No Noise Impact* is expected for the Enhanced Vehicle Inspection Area.

Mitigation Measures

Based on the results of the noise assessment, there is a potential for noise impact on nearby residences due to implementing the Project. Noise mitigation measures were evaluated for those receptors with *Moderate Impact* and *Severe Impact*

A sound wall is the primary noise mitigation evaluated for reducing cumulative noise impacts from operations associated with the HMC Project. Other measures evaluated included relocation of the crossovers and building sound insulation. Noise mitigation controls for reducing impacts are:

Sound Walls

Project sound walls must typically have a minimum surface density of 4 lb/ft^2 to be considered effective. Implementation of these sound walls would provide approximately 10 dBA but not more than a 15 dBA reduction in overall wayside noise levels. Concrete block masonry, poured-in-place, or pre-cast concrete walls would be acceptable as construction materials. Table 9, Table 10, Figure 8 and Figure 9 shows the approximate location, height and length of sound walls for reducing noise impacts to *No Impact* per FTA criteria for Phase 1 and Phase 2 of the Project.

The recommended height of each sound wall ranges from 9 to 14 feet and would be located at the BART east property line which varies between 65 and 75 feet from the northbound main track. A total of 980 linear feet of sound wall would be required during Phase 1 and 790 feet during Phase 2.

The specific location and height of sound walls would be addressed later in detail during final design when further details about track and receiver elevation, track location and other pertinent information would be available.

Table 9 – Summary of minimum recommended sound wall mitigation for the HMC Project Phase 1

Sound Wall ID	Location	SW (1) Height (feet)	SW length (feet)
	11th St between Stone St & Boyle St.	---	---
SW-01	11th St and Boyle St.	10	320
	La Brea Terrace	---	---
SW-02	Alicante Terrace	10	320
SW-02	Carrara Terrace	13	340
	Messina Terrace	---	---
	La Bonita Terrace	---	---

Note:

(1) Approximate height from BART top-of-rail

Source: WIA 2010

Table 10 – Summary of minimum recommended sound wall mitigation for the HMC Project Phase 2

Sound Wall ID	Location	SW (1) Height (feet)	SW length (feet)
	11th St between Stone St & Boyle St.	---	---
	11th St and Boyle St.	---	---
SW-03	La Brea Terrace	9	380
	Alicante Terrace	---	---
SW-04	Carrara Terrace	14	410
	Messina Terrace	---	---
	La Bonita Terrace	---	---

Note:

(1) Approximate height from BART top-of-rail

Source: WIA 2010

Building Sound Insulation

For noise sensitive receptors at ground level the outdoor noise from HMC train operations can be mitigated with a feasible height sound wall to achieve the FTA Criteria, but the sound wall is not tall enough to mitigate noise levels at upper stories, and possible physical improvement to building exterior-to-interior sound insulation may be necessary and should be evaluated after construction of the project is completed. The interior noise levels for stories above ground level at the Innovation Homes facing the BART ROW could potentially be exposed to noise that is in excess of the FTA criterion even with the recommended sound walls. These residences should be evaluated to determine if improved building noise insulation may be needed as additional mitigation beyond the recommended sound walls.

This additional type of mitigation (improving sound insulation) has been used around freeways and airport projects, but not yet implemented on a BART project, although this approach to noise impact mitigation has been included in the Warm Springs Extension project as well as in the Silicon Valley Rapid Transit project (now referred to as the Berryessa Extension project). The VTA Capitol Corridor LRT project implemented a formal process that evaluated the need for improving building insulation on a case-by-case basis as noise mitigation where sound walls were not the preferred option.

Improving individual building insulation can be evaluated on a case-by-case basis using the generally accepted criterion (i.e., California State and local building codes) of a maximum interior noise for residences of 45 dBA L_{dn}. Generally speaking windows are the building element that determines whether or not a building exterior provides the amount of exterior-to-interior noise reduction to achieve an interior noise level of 45 dBA L_{dn} or lower. In general, windows must provide a Sound Transmission Class (STC) rating of greater than 27 for this to be achieved. The greater the exterior noise level is, the higher the window STC rating required. Based on visual observations in the field, the current construction elements of the buildings at the Innovation Homes should provide a STC rating higher than 27. Therefore, future train operations from the HMC Project should achieve an L_{dn} of 45 dBA interior or less. Consequently improving building insulation by replacing the existing windows on a case-by-case basis may not be necessary. However, it is not possible to verify this condition at the present time, and therefore it is recommended to that this should be evaluated on a case-by-case basis once the HMC Project has been completed and trains are operating.

Figure 8 – Location and minimum recommended extent of sound wall for Phase 1

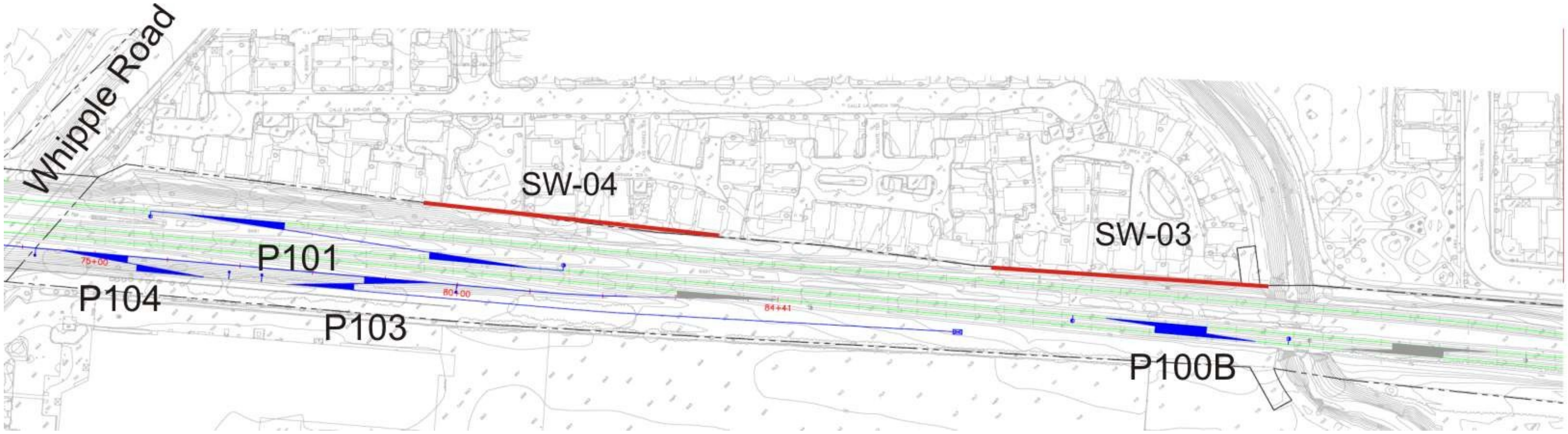

Figure 9 - Location and minimum recommended extent of sound wall for Phase 2

Vibration Assessment

Methodology

BART Operational Vibration Analysis

To assess the potential for ground-borne vibration impact, results of the curves derived from the measured ground vibration at the four sites were compared against the FTA criteria presented in Table 5. The methodology to assess the potential for vibration impacts for the Hayward Maintenance Complex Project is identical to the General Assessment presented in the FTA Guidance Manual. The General Assessment method uses only an overall level and applies adjustments to account for different vibration factors. The analysis presented herein uses a locally derived ground vibration curve obtained by field measurements instead of a generalized one. Adjustments to the curves were made to account for train speed at the east storage tracks, the elevated guideway, and increases due to building vibration response (BVR), which generally amplifies ground-borne vibration for residential buildings.

For practical reasons, vibration measurements in the area of the project were performed on the ground surface outside residential homes. To establish interior vibration levels, an adjustment of +3 VdB was applied to account for the general response of wood-framed residential structures such as those observed at all receptors in the area of the project. This adjustment is sometimes referred to as the building vibration response (BVR).

The BVR represents the response of a particular building, type or class of building structures relative to the vibration observed at the ground's surface at the building façade closest to the tracks. The response of the building includes the foundation coupling loss, floor-to-floor attenuation and resonant amplification of vibrating room surfaces (floors/ceilings and walls) that may apply to a specific receiving area. Generic building response data are contained in a report by Nelson and Saurenman[5], and in *State-of-the-Art Review: Prediction and Control of Ground-borne Noise and Vibration from Rail Transit Trains*[6]. WIA also maintains a database of measured building vibration responses for similar building construction on several rail transit projects in the Bay Area and southern California.

Speed adjustments to the curves obtained from field measurements were applied to BART trains on the storage and lead tracks. The speed adjustment is $20 \times \log\left({}^{Speed}\!\!/_{Speed_{ref}} \right)$, with 70 mph as the reference speed. For the analysis herein, the maximum speed at the east storage and lead tracks were assumed to be 30 mph.

Separate analyses were conducted for each alternative evaluated and compared against the applicable criteria. Operations of BART trains on the mainline can be categorized as *Frequent Events* per the

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[5] Nelson, J. T. and H. J. Saurenman, *A Prediction Procedure for Rail Transportation Groundborne Noise and Vibration*, Transportation Research Record 1143, Presented at the January 1987, A1F04 Committee Meeting of the Transportation Research Board.

[6] U.S. Dept. of Transportation, *State-of-the-Art Review: Prediction and Control of Groundborne Noise and Vibration from Rail Transit Trains*, UMTA-MA-06-0049-83-4, December 1983.

FTA guidelines. Based on the information provided by BART [7] current dispatch activities at the Hayward Yard (60 trains) would continue to originate out of the west side of the facility. Yard operations for the analysis were estimated at 80 train movements during daytime and 40 during nighttime hours. For the purpose of modeling, we have assumed that half of the train movements would be originated from the west side and half from the east side of the facility.

Projected Ground Vibration

Operational

The impact assessment for vibration is based on the overall vibration levels associated with BART operations projected to the location of vibration sensitive receptors. When vibration levels exceed the criteria shown in Table 5, then a *Vibration Impact* is identified. Vibration mitigation measures have been evaluated to reduce the vibration to the level of *No Impact*.

Phase 1 – West Side Improvements

Table 11 shows the results of the assessment during Phase 1. As presented in the table, there would be no *Vibration Impacts* from train operations on the proposed single crossover P100 along 11th Street. Vibration sensitive receptors would be located far enough away such that the vibration levels would be below the 72 VdB criterion. Therefore, no vibration mitigation measures would be needed.

BART trains crossing the switch P102 would generate a *Vibration Impact* at approximately six residential homes located on Alicante Terrace and four homes located on Carrara Terrace. The vibration levels are projected 6 to 7 VdB over the FTA criteria and primarily due to the proximity between the receptors and the crossover P102 (85 to 90 feet). Mitigation measures would be needed at the location of crossover P102 to reduce the level of impact to *No Impact*.

Phase 2 – East Side Improvements

In the vicinity of crossover P101 vibration levels associated with trains crossing the crossover frog would be 8 to 12 VdB in excess of the FTA criterion resulting in *Vibration Impact* at 15 residences on La Bonita and Carrara Terrace (eight single-family homes at La Bonita Terrace and seven at Carrara Terrace). Four of the seven single-family residences on Carrara identified with a *Vibration Impact* would be impacted as discussed above for Phase 1. Mitigation measures are recommended to reduce the level to *No Impact*.

In addition, vibration impact is expected at those receptors located within 130 feet from the turnout P100B. The overall vibration criteria would be exceeded with this option by up to 4 VdB on residences located on La Brea Terrace (9 single-family homes) resulting in *Vibration Impact*. Vibration mitigation measures for the crossover P100B would be required to reduce the level of impact to *No Impact*.

Vibration levels from BART train operation on crossovers P103 and 104 would be below the FTA criterion. Consequently, no vibration mitigation measures would be necessary. Lower vibration levels are due to the distance to/from residences and the slower train operational speed on the dispatch track.

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[7] Data Request for the Hayward Yard Project. Provided by BART – Data_Request2.doc

Hayward Yard

Activities from BART trains at the proposed East Storage area would be below the FTA criterion. Train movements are expected to occur at a lower speed and although the vibration would be higher than those on tangent track, based on the measured data for the crossover at the Hayward Yard, the adjusted vibration (adjusted for speed) would be below the FTA criterion resulting in *No Vibration Impact*. Consequently, no mitigation measures would be required.

Vibration Mitigation Measures

As discussed above, results of the vibration assessment for the HMC Project shows that vibration levels expected from BART operations on crossover switches would exceed the FTA criteria resulting in potential for *Vibration Impact*. Vibration mitigation measures are recommended to reduce the Project impact to *No Impact*.

The location of the mitigation measures under the track such as tire-derived aggregate (TDA) or floating slab track (FST) is presented in Table 13. The mitigation control should extend a minimum of 75 feet on both sides of the crossover frog to account for the length of one BART car. However, the actual extent of the mitigation control would be determined during final design. In addition to tire-derived aggregate and floating slab track, new measures to mitigate vibration may arise from new technology and may be found to be appropriate mitigation.

Tire-Derived Aggregate (TDA)

The use of shredded scrap tires as a vibration-isolating medium for rail is a relatively recent technology. TDA as a vibration reduction medium consists of construction with a compacted layer of shredded tires approximately 12 inches thick located below the sub-ballast and ballast layers of track. This system has been installed at selected locations on two transit systems, on the San Jose VTA Vasona Line and at Denver's TREX light rail line. Recent investigation indicates that the performance is more effective than a ballast mat, but less effective, particularly at lower frequencies when compared to the performance of a floating slab track-bed system.

The schematic of the typical extent recommended for TDA mitigation on the crossovers is shown in Figure 10. As indicated in the figure, vibration mitigation would be required on both frogs, and the minimum recommended is 100 feet before the point of switch. On the turnout P102, the minimum extent is 100 feet from the point of switch to the south and 100 feet to the north on both the main southbound track and the turnout track. The schematic of the vibration mitigation is indicated in Figure 11.

Floating Slab Tracks

This approach basically consists of a massive concrete slab supported on elastomeric elements, normally natural rubber. Several designs have been successfully used for heavy rail transit systems such as in Washington DC, Atlanta, Boston, Toronto and on the BART system. This specific design consists of precast concrete slabs that are normally 6-feet long and supported vertically on four natural rubber pads per slab. Each slab is held in place in the lateral direction by natural rubber "side pads" that bear against a curb constructed in a concrete bathtub (shallow retained cut). In the longitudinal direction, natural rubber pads separate adjacent slabs. All of the horizontal (lateral and longitudinal) restraint pads are pre-compressed during installation. One of the most significant design parameters of the floating slab track-bed is the fundamental natural frequency of the track-bed in the vertical direction. The appropriate floating slab natural frequency depends on the ground-borne vibration frequencies, which require reduction. Floating slab track-bed designs to date have been in the 8 to 16 Hz range.

Table 11 – Projected vibration levels from BART trains operations on the HMC for Phase 1

Location	Land Use	Dist. to closest XO (ft)	FTA Criterion	GBV from XO	Impact	# of Rec. with Impact
11th St between Stone St & Boyle St.	SFR	200	72	62	NI	0
11th St and Boyle St.	SFR	150	72	68	NI	0
La Brea Terrace	SFR	170	72	65	NI	0
Alicante Terrace	SFR	85	72	79	I	6
Carrara Terrace	SFR	90	72	78	I	4
Messina Terrace	SFR	---	72	----	NI	0
La Bonita Terrace	SFR	---	72	---	NI	0

Notes:
xo : crossover switch
GBV: Groundborne Vibration
SFR: Single-family residence building
NI : No Impact as defined by FTA
I : Impact as defined by FTA

Source: WIA 2010

Table 12 – Projected vibration levels from BART trains operations on the HMC for Phase 2

Location	Land Use	Dist. to closest XO (ft)	FTA Criterion	GBV from XO	Impact	# of Rec. with Impact
11th St between Stone St & Boyle St.	SFR	---	72	---	NI	0
11th St and Boyle St.	SFR	---	72	---	NI	0
La Brea Terrace	SFR	100	72	76	I	9
Alicante Terrace	SFR	220	72	59	NI	0
Carrara Terrace	SFR	80	72	80	I	7
Messina Terrace	SFR	120	70	70	NI	0
La Bonita Terrace	SFR	60	72	84	I	8

Notes:
xo : crossover switch
GBV: Groundborne Vibration
SFR: Single-family residence building
NI : No Impact as defined by FTA
I : Impact as defined by FTA

Source: WIA 2010

Table 13 – Recommended location of vibration mitigation for the HMC Project

Crossover #	Phase 1	Phase 2
P100B	No	Yes[1]
P100	No	No
P101	No	Yes [1]
P102	Yes[1]	No
P103	No	No
P104	No	No

Notes:
(1) Mitigation extent will be determined during final design.

Source: WIA 2010

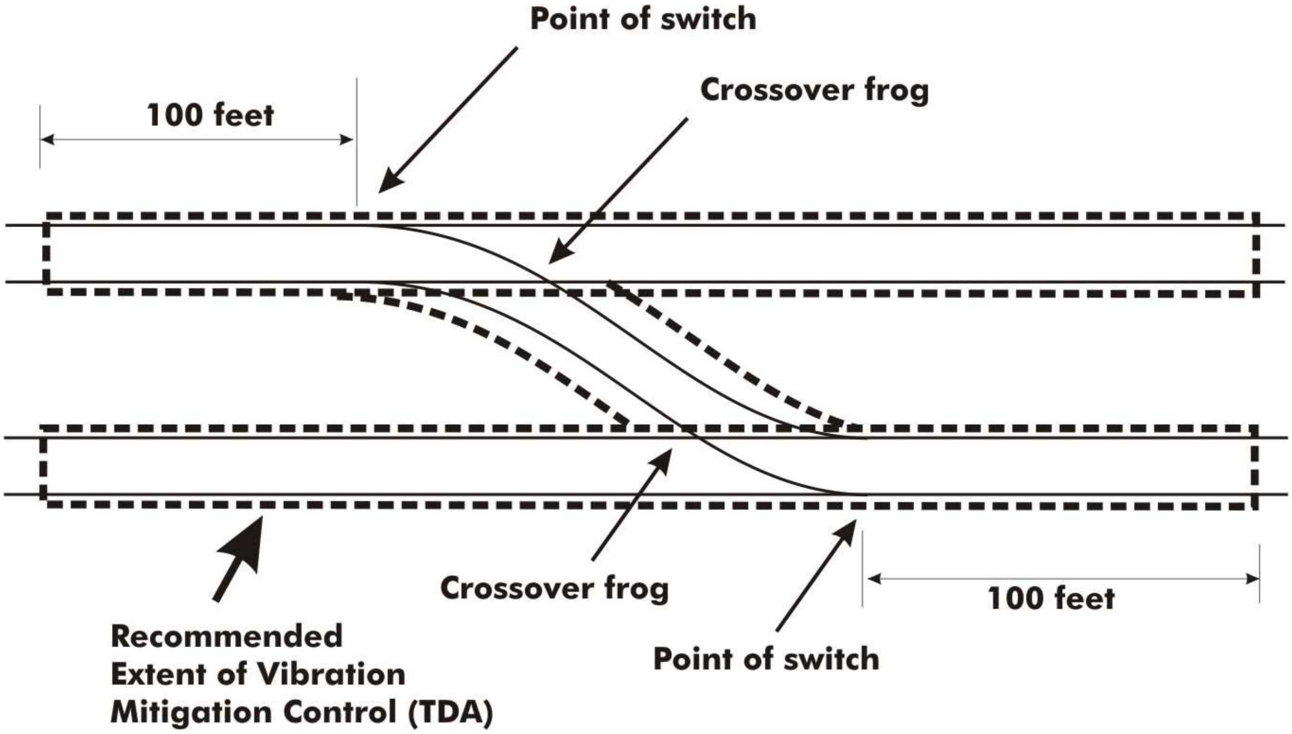

Figure 10 – Schematic of the vibration mitigation extent for Tire-Derived Aggregate (TDA) on crossover track

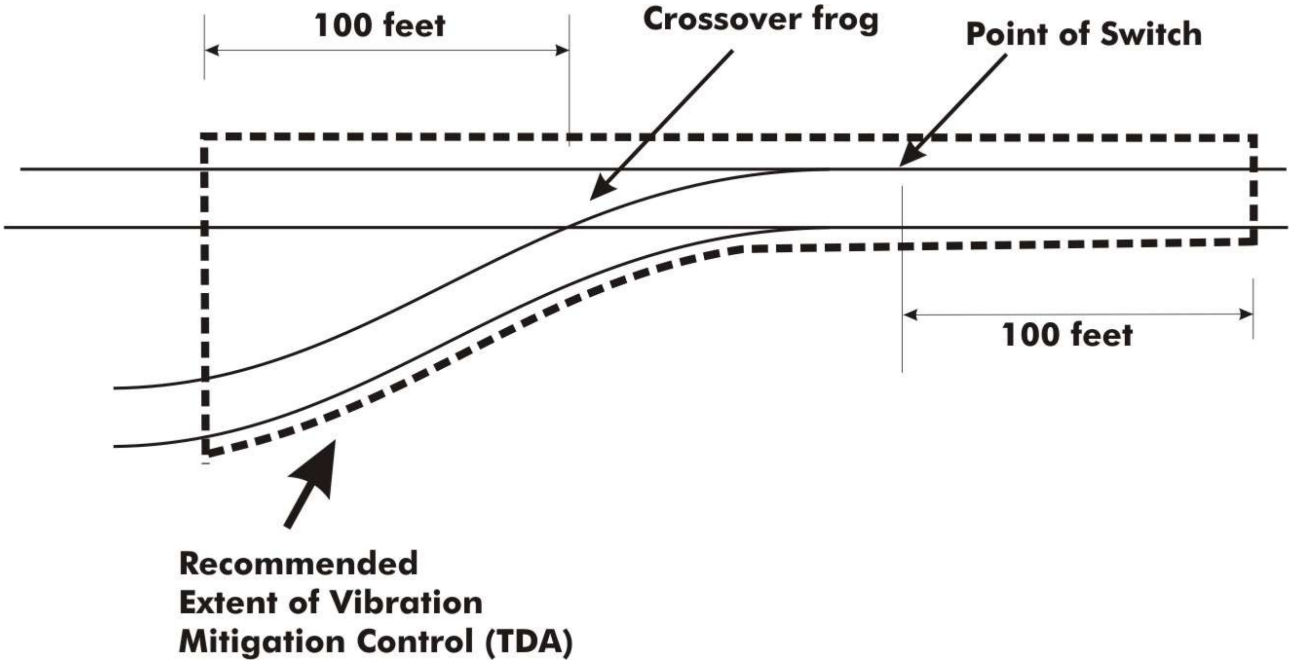

Figure 11 - Schematic of the vibration mitigation extent for Tire-Derived Aggregate (TDA) on crossover P102

Construction Noise and Vibration Impact Assessment

Construction of the BART HMC Project is proposed in two phases. Phase 1 construction includes all improvements related to the west side of the Hayward Yard. This would include demolition of one warehouse, replaced by a new Overhaul Shop, and construction of new tracks to connect the west side improvements to the BART mainline. Phase 1 would include some basic civil construction, such as grading, installing utilities, track work, and rail turnouts required for the storage tracks at both the west side of the Yard and south of Whipple Road. Of the switches south of Whipple Road, switches P100 and P102 would be installed in Phase 1. Phase 2 construction would include all improvements related to the east side of the Yard and the new east side storage tracks. This would include construction of the storage tracks, connecting tracks between the new storage tracks and the BART mainline tracks, third rail power, train control and one or both flyovers. Switches P100B, P101, P103 and P104 would be installed during Phase 2. Further, construction activities which involve the mainline tracks would be conducted during nighttime hours (10 pm to 7 am) to minimize interference with revenue train operations, while other construction activities, including preparation for construction involving mainline tracks, would generally be conducted within the daytime hours (7 am to 10 pm).

The primary variables and assumptions that were used for the noise and vibration construction models include:

- Phase 1 construction includes all work related to the west side of the Hayward Yard, including the new Overhaul Shop and associated crossovers and trackwork, a non-rail vehicle storage area, and vehicle inspection facilities on the east side.
- Phase 2 construction would implement work related to the east side of the Hayward Yard, including at least one flyover, new storage tracks, associated crossovers and trackwork and third rail power, communications, and train control systems.
- Construction work on the test track and storage areas would be performed during daytime hours. Construction work involving mainline tracks would be done during nighttime hours and weekends, with the exception that no nighttime construction will be conducted north of Whipple Road. New switch installation on the mainline would typically be done during nights and weekends (Phase 1 and Phase 2). However, flyover construction (pile driving) and preparation for construction involving the mainline would be done during daytime.
- A sound wall to reduce operational noise from some of the new crossovers (P100, P102, P100B and P101) would be installed prior to start any construction work. Therefore it was assumed as part of the “existing” condition for the construction noise analysis.

There would be two staging areas, one located at the northeast end of the Hayward Yard and another at the southeast end of the Yard (currently used as a secured storage area).

- Construction areas north of Whipple Road would be accessed through the current Hayward Yard entrance on Whipple Road and through the driveway from Whipple Road to the four warehouse on the west side. Additionally, there would be three construction access points considered for construction activities south of Whipple Road: through the industrial property west of the BART mainline (south of Whipple Road), by the service road along the north side of Dry Creek, and from F Street.

Noise and Vibration Policies

BART criteria for assessing noise and vibration impact from construction activities are based on the FTA guidelines. FTA guidelines are presented in Table 14. The criteria are specified in terms of 8-hour equivalent noise level (L_{eq}) for residential, commercial and industrial land uses. The criterion for most land uses near the Project would be 80 dBA for daytime construction and 70 dBA for nighttime construction. The FTA guidelines also recommend that for urban areas with high ambient noise levels, such as the area in the vicinity of the Project, the construction noise should not exceed ambient noise +10 dBA.

Table 14 – Guidelines for Assessing Construction Noise Impact by FTA

	8-hour L_{eq} (dBA)	
Land Use	**Day**	**Night**
Residential	80	70
Commercial	85	85
Industrial	90	90

Source: FTA, May 2006.

The criteria for evaluating groundborne vibration due to construction activities are those specified in the FTA guidelines. The criteria have been divided into two categories: interference with human activity (annoyance) and building damage. The guidelines presented by FTA indicate that building damage would be the primary concern for evaluating construction activities, primarily due to the temporary nature of the activity. Nonetheless, both annoyance and potential building damage are evaluated herein. For evaluating potential annoyance due to construction vibration activities, the applicable criteria are the levels presented in Table 5 for the corresponding FTA land use category (e.g., Category 2 for residential homes).

Humans are sensitive to groundborne vibration at much lower levels than that which may cause structural damage or even cosmetic damage. Consequently, vibration levels associated with potential building damage are significantly higher than those used in assessing annoyance.

The FTA criteria relating to potential cosmetic cracking due to building vibration are presented in Table 15. The criteria are applicable in four categories, considering different building structures. Based on visual observation by WIA during the noise and vibration survey, most buildings could be included in the Category II as listed below in Table 15 with a threshold of 0.3 in/sec. No historic structures, which could be subject to Category IV criteria, have been identified in the vicinity of the Project.

Table 15 – FTA Construction Vibration Damage Criteria

Building Category	Peak Particle Velocity (PPV)
I. Reinforced-concrete, steel or timber (no plaster)	0.5 in/sec (12.7 mm/s)
II. Engineered concrete and masonry (no plaster)	0.3 in/sec (7.6 mm/s)
III. Non-engineered timber and masonry buildings	0.2 in/sec (5.1 mm/s)

IV. Buildings extremely susceptible to vibration damage	0.12 in/sec (3 mm/s)

Source FTA, 2006

Noise and Vibration Methodologies

Construction noise varies depending on the construction process, type of equipment involved, location of the construction site with respect to sensitive receptors, the schedule proposed to carry out each task (e.g., hours and days of the week) and the duration of the construction work. The assessment of potential significant noise effects due to construction of the BART HMC Project is based on the standards and procedures described in the FTA Guidance Manual and the Federal Highway Administration (FHWA) RCNM model[8]. This analysis of construction noise assumes that noise will decrease at a rate of 6 dB per doubling of the distance from the construction site.

There would be a number of noise sources associated with the proposed Project. Some of the equipment involved during construction of Phase 1 and Phase 2 of the project would include the use backhoes, pile drivers, mounted jack hammer (hoe ram), excavators, dozers, compactors, and vibratory rollers. Construction activities associated with track installation would include the use of cranes, rail saws, compressors, pumps, generators, a ballast regulator, and ballast tamper. Phase 2 would require the use of a pile driver for construction of the flyover(s).

Maximum noise levels and use factors presented in Table 16 were applied to estimate the potential negative effects due to construction activities. The table also shows the project phase where the equipment was assumed to be used.

Table 16 – Construction Equipment Noise Levels and Use Factor

Equipment	Acoustical Use Factor for Noise (percentage)	Typical Maximum Noise Level (L_{max}) at 50 feet from Source, dBA	Phase involved
Backhoe	40	78	1 & 2
Pile driver (sonic)	20	96	2
Compactor	20	83	1 & 2
Excavator	40	81	1 & 2
Dozer	40	82	1 & 2
Mounted Jack Hammer (hoe ram)	20	88	1
Pneumatic Tool	50	85	1 & 2
Concrete Pump Truck	20	81	1 & 2
Ballast Equalizer, Tamper	20	82 – 83	1 & 2
Rail saw	20	90	1 & 2

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[8] Federal Highway Administration – *FHWA Roadway Construction Noise Model*. Final Report January 2006.

Vibratory Concrete Mixer	20	80	1 & 2
Crane	16	81	1 & 2

Sources: FHWA RCNM, January 2006 and FTA, May 2006, WIA 2010.

The analysis herein includes the noise effects from staging areas. Noise from construction staging areas is likely to be generated by trucks, cranes and other mobile and stationary equipment. There would be two staging areas, one located at the southeast end of the Hayward Yard, another at the southwest of the Yard located at the undeveloped outdoor area near the new M&E shop.

The projected levels of noise generated by construction activities and construction staging areas were compared against the criteria presented in Table 14. Noise control measures were investigated and proposed for those areas where noise from construction activities is expected to exceed the recommended criteria.

The assessment of potentially significant impact due to construction-induced vibration for the Project is based on the standard procedures described in the FTA Guidance Manual. Construction vibration varies according to the construction procedure, type of equipment involved and location of the construction site with respect to sensitive receptors. Buildings in the vicinity of the construction activities respond to vibration differently depending primarily on their structural characteristics.

As for the noise analysis, the assessment for vibration impacts separately evaluates the use of heavy equipment during construction and the specialized equipment expected during track installation.

Table 17 shows the equipment assumed for this analysis. Vibration reference levels are presented in terms of the peak-particle velocity (PPV) and their approximate vibration level (i.e., in VdB), at a reference distance of 25 feet. The table only shows the equipment expected to have the greatest impact.

Vibration levels associated with each piece of equipment presented in Figure 12 were projected as a function of distance following the equation $PPV_{equip} = PPV_{ref} \times 25 / D)^n$ in inch/sec, where *D* is the distance from the equipment (in feet) and *n* is a value related to the vibration attenuation rate through the ground. A value of *n* equal to 1.5 was used in the analysis.

Table 17 – Construction equipment vibration levels

Equipment	PPV at 25 feet (in/sec)	Approximate Vibration Velocity Level at 25 feet, VdB
Pile Driver (sonic)	0.730	105
Vibratory Roller	0.200	94
Hoe Ram	0.089	87
Large Bulldozer	0.090	87
Caisson Drilling	0.089	87

Equipment	PPV at 25 feet (in/sec)	Approximate Vibration Velocity Level at 25 feet, VdB
Jack Hammer	0.035	79

Source: FTA, May 2006 and WIA archives

In assessing interference with human activity (annoyance) due to construction, the vibration is characterized by the root-mean-square (r.m.s.) vibration level. The expected levels of vibration were projected by using the equation $L_v(D) = L_v(25ft) - 30\log(D/25)$ in VdB (ref: 1 micro-in-sec), where $L_v(25ft)$ is the reference vibration level measured at 25 feet, and D is the distance from the equipment in feet.

The projected levels of vibration generated by construction activities were compared to the applicable criteria. Generic forms of vibration control measures are presented in those areas where vibration from construction activities is expected to exceed the applicable criterion.

Figure 12 shows the expected PPV with distance for each method/piece of equipment evaluated. Similarly, Figure 13 shows the expected vibration levels as a function of distance for the equipment involved during construction.

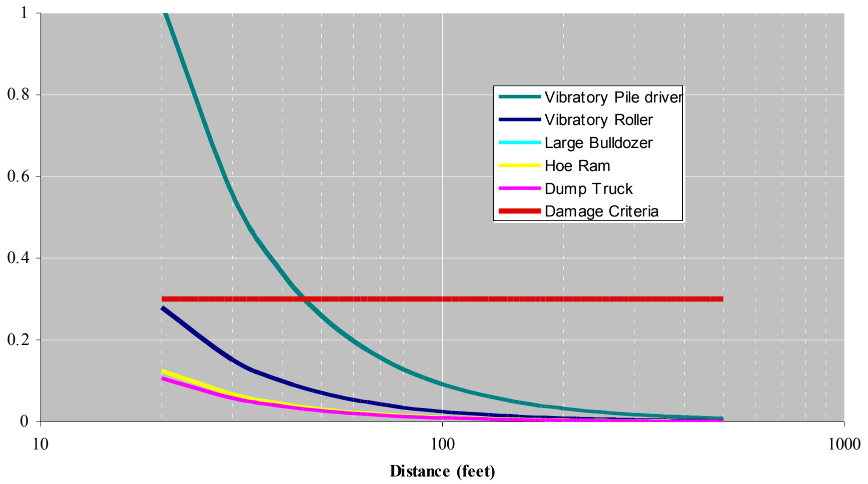

Figure 12 – Expected Ground Vibration (PPV) due to Construction Activities for the BART HMC Project

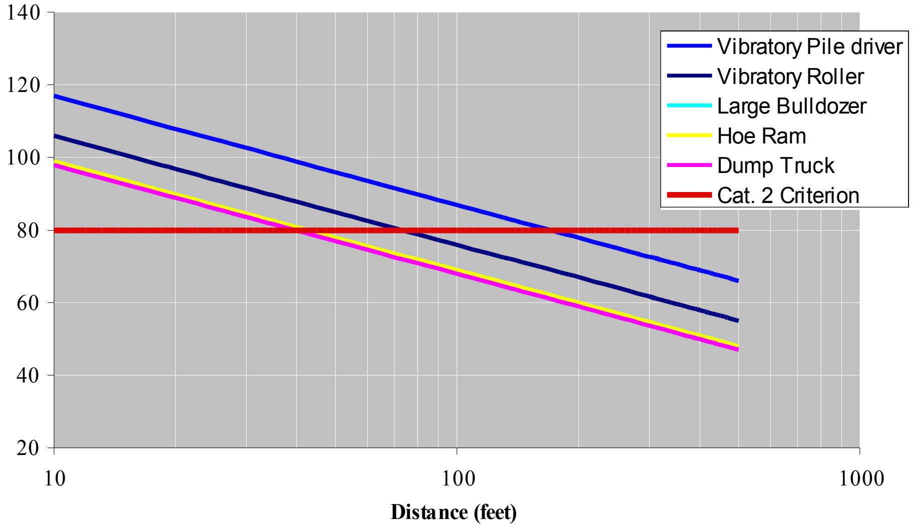

Figure 13 – Expected Vibration Levels (VdB) versus Distance due to Construction Activities for the BART HMC Project Vibration Impact Assessment

Projected Construction Noise and Vibration

Noise

Based on this preliminary analysis, noise levels during Project construction with the use of heavy equipment would typically range between 61 to 85 dBA, depending on the distance of the construction activity to the noise sensitive receptor.

Table 18 and Table 19 show the projected range of noise levels expected from the use of heavy equipment during construction and track installation for Phase 1 and Phase 2, respectively. The tables present the range of noise levels expected for each group of receptors. The expected effect of existing sound barriers at the Innovation Homes complex has been included for the noise calculations.

Heavy Equipment

Results of the analysis show that residential receptors located within 75 feet of heavy equipment would be exposed to a *Noise Impact* during daytime construction, assuming an unobstructed line of sight. This distance would be extended to 190 feet (unobstructed) if construction activities are executed during nighttime.

During Phase 1 construction, the typical noise levels from heavy equipment would range from 53 to 69 dBA at nearby sensitive receptors. As presented in Table 18, with the existing sound walls and the Project sound walls at Innovation Homes, *No Noise Impact* is expected. Similarly, residences located along 11th Street would receive *No Noise Impact* during construction of Phase 1.

During Phase 2, *Noise Impacts* are expected at 15 homes located at the Innovation Homes development during nighttime construction. Therefore, noise mitigation measures are recommended to reduce the level of impact to *No Impact*. Mitigation measures are presented later in this report. No daytime construction noise impacts are expected at the Innovation homes. Residences located along Ithaca Street and Carroll Avenue would have *No Noise Impact* from heavy equipment.

Track Installation

The use of ballast tamping and ballast regulators would generate a *Noise Impact* for residences within 100 feet of daytime construction activities or within 300 feet of nighttime track-laying activities, including crossover switch installation.

During Phase 1, there would be *No Noise Impacts* from construction activities related to track installation. Therefore no noise mitigation is necessary.

For Phase 2, track installation activities would cause a nighttime Noise Impact at 15 homes located at the Innovation Homes development even with the existing and the Project sound walls. Noise control measures would be required to reduce the level to No Impact. Mitigation measures including compliance with the nighttime construction noise criterion, temporary noise barriers, and/or temporary relocation of residences to hotels should be implemented for these receptors located on Messina Terrace and La Bonita Terrace. A detailed discussion on these mitigation measures is presented later in this report.

During Phase 2 no nighttime construction will be conducted north of Whipple Road. Consequently no noise impacts are expected for homes located on Ithaca Street or Carroll Avenue.

Flyover Construction

One or both flyovers would be constructed during Phase 2 of the project, and the estimated noise from pile driving for the aerial structure is also shown in Table 19. We have assumed for the analysis herein, that the construction would use sonic or vibratory pile drivers, which in general produce lower noise levels than an impact pile driver. However, while vibratory pile drivers do not produce peak noise levels as high as impact pile drivers, they can generate high levels of noise if not shielded properly.

Pile driving is expected to exceed the FTA noise criteria for residential receptors only within 140 feet of operation. If pile driving is schedule at night, after 10 pm or earlier than 7 am, the area of *Noise Impact* could be extended up to 420 feet from the alignment right-of-way. Since no nighttime work would be conducted north of Whipple Road for Phase 2, pile driving would occur only during the daytime resulting in *No Noise Impact*.

Staging Areas

Two construction staging areas are proposed, one on the southwestern portion of the expansion area and one on the existing M&E storage area at the southeast corner of the existing yard. Noise projected from the staging areas would potentially cause a Noise Impact for sensitive receptors (e.g., single family homes) within 70 feet from the staging area during daytime activity and within 200 feet during nighttime activity. The closest homes to the southwestern staging area would be located at least 250 feet from the staging area, resulting in *No Noise Impact* during both daytime and nighttime operations. Similarly, there would be *No Noise Impact* from operations on the southeast staging area during daytime hours. However, some of the residential homes along Ithaca Street (specifically on Margo Court, Edna Court, Wendy Court, Fay Court and Kathy Court) are located approximately 150 feet from the southeast staging area. To ensure that those homes do not experience significant nighttime noise impacts, a buffer zone of approximately 50 feet will be maintained where no noise-generating activity will be permitted during nighttime construction. The buffer zone will extend along the property line within the BART property and will be sufficiently wide to ensure that a minimum of 200 feet is maintained between the staging area and the nearby homes. With implementation of the buffer zone, there would be *No Noise Impact* on these homes.

Other Considerations

Trucks would be required to transport equipment, and supplies. The California Vehicle Code limits vehicle noise emission levels of new highway trucks built after 1987 to 80 dBA at a distance of 50 feet from the centerline of travel under any condition of operation, including acceleration and deceleration, in any gear. Older, noisier trucks may still be in use, but a reasonable approach to construction equipment noise control would be to specify that the contractor's trucks meet current regulations for new trucks.

For construction activities occurring north of Whipple Road, trucks would be accessing the Project area at the current access to the Hayward Yard on Whipple Road, which is approximately 150 feet from residences along Ithaca Street. Noise levels at residences could potentially reach up to 63 dBA resulting in *No Noise Impact*. For the purpose of calculations we have assumed about 20 trucks per hour (1 minute each).

Three construction access points are under consideration for activities occurring south of Whipple Road or for equipment that would be too large to go under the Whipple Road Bridge. The truck traffic considered from any of the three access points would be very low, on the order of 5 to 6 trucks per day. Noise levels at residences located north of the Dry Creek would experience the highest noise levels from truck traffic for the three access points in consideration. However, hourly noise levels would be on the order of 57 dBA or lower resulting in *No Noise Impact*. If the access option from F Street is selected, a temporary access road may need to be constructed along the west side of the BART mainline. The distance to the nearest sensitive receptors would be 50 feet or farther from truck operation, resulting in a noise level below 50 dBA and therefore *No Noise Impact*.

As a practical matter, new diesel trucks produce markedly lower noise levels during normal operation than those allowed by the Vehicle Code. Trucks would also idle as they are loaded and unloaded. We have assumed that trucks would idle for no more than 5 minutes (a more restrictive time limit may be imposed for air quality); trucks that sit in place for longer than 5 minutes should turn off their engines.

Audible backup alarms on moving equipment may generate neighborhood complaints because the sound of the alarm is tonal, since it is meant to be heard and to attract attention. Backup alarms for haul trucks must be audible above the surrounding ambient noise level at a distance of up to 200 feet[9]. In areas of high ambient noise or congested traffic, a motion-detected braking system or administrative controls such as flaggers/observers may be used in lieu of an audible alarm[10]. The characteristics of the alarm tone means that backup alarms are often designed to be higher than the ambient, typically by at least 5 dBA. Many alarms are preconfigured to be higher than a worst-case construction/industrial operating environment by 10 to 15 dBA. Thus, since the construction noise environment at 50 feet behind any piece of moving machinery may be as high as 70 to 90 dBA,

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[9] California Occupational Safety and Health Administration, Title 8, Section 1592(a)

[10] Cal-OSHA, Title 8, Section 1592(b)

backup alarms are typically designed to emit a sound as loud as 85 to 115 dBA. Some alarm devices measure the ambient noise level and adjust their output accordingly. One example is a "smart alarm" which adjusts the alarm level so that it is 5 dBA above the ambient, with a range of 77 to 97 dBA. An alarm level of 97 dBA would correspond to a noise level of 63 dBA at a distance of 200 ft[11]. If truck operations are proposed during the nighttime hours, alternative measures such as strobe lights or administrative controls (i.e. Flag person) can be used to replace audible backup alarms. The contractor should be precluded from using audible backup alarms at night, if at all feasible.

Vibration Construction Assessment

Two types of potential construction-induced vibration effects were evaluated for the BART HMC Project: *Annoyance* and *Building Damage*. The criterion used in assessing annoyance is contained in the FTA guidance manual and presented in the operational analysis section. The criteria relating to potential cosmetic damage (i.e., cracking) due to building vibration is 0.3 in/sec PPV based on the FTA guidelines.

Annoyance from construction activities would likely occur at 55 sensitive receptors in the vicinity of the Project (34 of which occur for both Phase 1 and Phase 2 of the Project), that are located within 100 feet of any heavy equipment. Specifically, vibration annoyance would be expected during installation of crossover P100 and P102 at residences located on La Brea Terrace, Alicante Terrace, and Carrara Terrace (26 homes, Phase 1), and installation of crossover P100B, P101, P103 and P104 at residences located on La Brea, Carrara Terrace, Messina Terrace, and La Bonita Terrace (29 homes, Phase 2).

The use of heavy equipment during construction of the Project would generate peak velocity levels that would be well below the threshold of cosmetic damage. Consequently, construction of the Project would result in *No Vibration Impact* from equipment or activities that would potentially cause building damage. Refer to Table 20 and Table 21.

Flyover Construction

Vibration velocity levels during pile driving (vibratory pile driver) would be 0.02 in/sec PPV or lower at all residences in the vicinity of the project. The use of a pile driver during construction of the north and south elevated structures (flyovers) could potentially generate annoyance to receptors located within 220 feet of the activity. A similar vibration magnitude is also expected from heavy, dropped objects or handling of heavy plates in the work areas, although these would be very infrequent. Potential for building damage would be expected from pile driving activities located 50 feet or closer to any building. It is expected that the closest distance between pile driving and homes would be 300 feet. Table 21 shows the expected vibration levels from construction activities using heavy equipment for Phase 2. The highest PPV is expected during vibratory compaction at a level that would be 0.04 in/sec PPV which is well below the 0.3 in/sec criterion. Consequently, there would be no potential for building damage from construction of the flyover option, resulting in *No Vibration Impact.*

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[11] SAE J994-2003 Standard specifies that alarm noise levels are measured at a distance of 1.2 m (4 ft).

Construction Noise and Vibration Control Measures

This section discusses recommended noise and vibration control measures to reduce impacts due to the Project. Control measure recommendations are presented separately for each source and/or phase of the project.

As presented in the previous section, due to the duration of construction activities for the Project, a *Vibration Impact* would be expected only where construction activities exceed the threshold for building damage. However, some vibration control policies are recommended to be implemented by the contractor to minimize the potential annoyance on nearby residential properties.

Noise

To eliminate construction noise impacts, construction activities should be performed in accordance with the criteria presented in Table 14 of this report. However, as discussed in this analysis, it may not be possible to comply with the criteria with the use of typical construction equipment. A new noise barrier to control noise from train operations, as discussed above, would help to reduce the construction noise and avoid impacts for homes on 11th Street and some homes in the Innovation Homes complex, but additional control measures would be required for the Phase 2 nighttime track installation impacts at the Innovation Homes complex; for these homes, the nighttime noise could exceed the criterion, but the measures listed below would mitigate the effects of the noise. The following noise control measures are recommended for incorporation into the construction phase of Project:

- Where feasible, require the Contractor to comply with a Performance Standard of 80 dBA 8-hour Leq during the daytime and 70 dBA 8-hour Leq during the nighttime at the property line of the sensitive receptor.
- Prior to construction, require the Contactor to prepare a Noise Control and Monitoring Report, in which the contractor indicates what noise levels they expect to generate, noise control measures they intend to implement, and how they intend to monitor and document construction noise and complaints.
- Locate noisy equipment as far as possible from noise sensitive receptors. In addition, the use of temporary barriers should be employed around the equipment.
- Use temporary noise barriers along the working area and or project right-of-way. Barriers/curtains must achieve a Sound Transmission Class (STC) of 30 or greater in accordance with ASTM Test Method E90 and be constructed from material having a surface density of at least 4 lb/sq. ft. to ensure adequate transmission loss.
- When nighttime or 24-hour construction will be required, BART and the contractor shall coordinate with residents to ensure that the affected residents are fully informed about the upcoming construction. Residents will be given the option of sleeping in hotel rooms at BART expense for the duration of the nighttime construction in areas where construction is expected to exceed the FTA criterion. Residents that work nights and sleep days in locations where construction noise is expected to exceed the FTA criterion will be given the same option.

- Require ambient sensitive (“smart”) backup alarms, SAE Class D, or limit to SAE Class C (97 dB) for vehicles over 2.5 cubic yard haulage capacity, or Cal-OSHA/DOSHA-approved methods that avoid backup noise for vehicles under 2.5 cubic yard haulage capacity.
- Fit silencers to combustion engines. Ensure that equipment has effective, quality mufflers installed, in good working condition.
- Switch off engines or reduce to idle when not in use.
- Lubricate and maintain equipment regularly. Well-maintained equipment is normally quieter than a non-maintained one.
- Construction-related truck traffic should be re-routed along roadways that would produce the least disturbance to sensitive receptors.

Vibration

No permanent vibration impacts have been indicated, but the construction could cause temporary annoyance during construction activities when heavy equipment is used. To avoid vibration-induced annoyance due to construction activities, the vibration associated with these activities should be kept below the annoyance criteria. The contractor should be encouraged to select equipment and methods that would reduce potential for building damage and also annoyance to nearby residents. Some recommended vibration controls include:

- Require the Contractor to comply with a Performance Standard of 0.3 in/sec PPV any building at any time.
- Encourage the Contractor to minimize vibration annoyance by maintaining vibration levels at 80 VdB or less at any building at any time.
- Prior to construction, require the Contactor to prepare a Vibration Control and Monitoring Report, in which the contractor indicates what vibration levels they expect to generate, vibration control measures they intend to implement, and how they intend to monitor and document construction vibration and complaints.
- Avoid the use of impact pile drivers. Instead favor the use of sonic or vibratory impact driver. It is also encouraged to use “quiet” or “silent” piling technologies, if it is possible to implement.
- When nighttime or 24-hour construction will be required BART and the contractor shall coordinate with residents to ensure that the affected residents are fully informed about the upcoming construction. Residents will be given the option of sleeping in hotel rooms at BART expense for the duration of the nighttime construction in areas where construction is expected to exceed the FTA criterion. Residents that work nights and sleep days in locations where construction vibration is expected to exceed the FTA criterion will be given the same option.
- Monitor vibration during construction to ensure compliance with the criterion for building damage for buildings within 40 feet from construction activities. Conduct a pre-construction crack survey at these structures.
- Plan routes for hauling material out of the Project site that would cause the least annoyance.

- High amplitude vibration methods such as vibratory pile driving and soil compaction using large truck-mounted compactors should be restricted to areas beyond 50 feet and 20 feet respectively of residential structures or wood-framed buildings. Otherwise, temporary accommodations away from construction should be coordinated between BART and the residents.

Table 18 – Projected Noise Levels and Impacts from Using Heavy Equipment during Phase 1 Construction (West Side and New Shop)

					Expected Noise Levels from Heavy Equipment Construction and Track Installation With Noise Control, L_{eq} (dBA)[1]									
	Dist. to Const. (ft)		Criteria		Heavy Equipment					Track Installation				
							Impact Type					Impact Type		
Location	**Nearest**	**Farthest**	**Day**	**Night**	**Nearest**	**Farthest**	**Day**	**Night**	**# Impacts**	**Nearest**	**Farthest**	**Day**	**Night**	**# Impacts**
11th between D & Stone St	500	500	80	70	62	62	NI	NI	0	66	66	NI	NI	0
11th between Stone St & Boyle St	400	400	80	70	64	64	NI	NI	0	68	68	NI	NI	0
11th between and Boyle St	150	300	80	70	64	58	NI	NI	0	62	56	NI	NI	0
La Brea Terrace	170	550	80	70	63	53	NI	NI	0	61	50	NI	NI	0
Alicante Terrace	85	550	80	70	69	53	NI	NI	0	67	50	NI	NI	0
Carrara Terrace	85	500	80	70	69	54	NI	NI	0	67	51	NI	NI	0
Messina Terrace	120	250	80	70	67	61	NI	NI	0	65	59	NI	NI	0
La Bonita Terrace	150	350	80	70	65	58	NI	NI	0	63	56	NI	NI	0
Ithaca Street between Whipple Rd and Carroll Ave	540	650	80	70	61	59	NI	NI	0	66	64	NI	NI	0
Carroll Ave between Troy Place and Gressel St.	540	650	80	70	61	59	NI	NI	0	66	64	NI	NI	0
Carroll Ave between Gressel St. and Becker Place	540	650	80	70	61	59	NI	NI	0	66	64	NI	NI	0
Carroll Ave between Becker Place and Fairway Street	660	660	80	70	59	59	NI	NI	0	64	64	NI	NI	0
Carroll Avenue north of Fairway Street	660	660	80	70	59	59	NI	NI	0	64	64	NI	NI	0

Notes
Day: from 7 am to 10 pm
Night: from 10 pm to 7 am.
I : Impact
NI: No Impact.
1: Includes the effect of existing sound walls and new project sound walls SW-01, SW-02 and SW-03 implemented at the start of construction. See Figure 9 for location of sound walls.

Source: WIA 2010

Table 19 – Projected Noise Levels and Impacts from Using Heavy Equipment during Phase 2 Construction (East Side and Flyovers)

					Expected Noise Levels from Heavy Equipment Construction and Track Installation With Noise Control, L_{eq} (dBA)[1]													
	Dist. to Const. (ft)		Criteria		Heavy Equipment									Track Installation				
							Impact Type					Impact Type				Impact Type		
Location	Nearest	Farthest	Day	Night	Nearest	Farthest	Day	Night	# Impacts	Dist. to pile driving	Level	Day	Night	Nearest	Farthest	Day	Night	# Impacts
11th between D & Stone St	500	500	80	70	62	62	NI	NI	0	2600	55	NI	n/a[4]	66	66	NI	NI	0
11th between Stone St & Boyle St	320	320	80	70	66	66	NI	NI	0	2400	55	NI	n/a[4]	70	70	NI	NI	0
11th between and Boyle St	350	500	80	70	57	54	NI	NI	0	2200	56	NI	n/a[4]	54	51	NI	NI	0
La Brea Terrace	75	250	80	70	70	60	NI	NI	0	1500	59	NI	n/a[4]	68	57	NI	NI	0
Alicante Terrace	180	300	80	70	63	58	NI	NI	0	1300	61	NI	n/a[4]	60	56	NI	NI	0
Carrara Terrace	80	300	80	70	70	58	NI	NI	0	1000	63	NI	n/a[4]	67	56	NI	NI	0
Messina Terrace	60	300	80	70	73	59	NI	I	7	600	67	NI	n/a[4]	71	57	NI	I	7
La Bonita Terrace	60	250	80	70	73	61	NI	I	8	400	71	NI	n/a[4]	71	59	NI	I	8
Ithaca Street between Whipple Rd and Carroll Ave	150	400	80	70	72	64	NI	n/a[3]	0	400	71	NI	n/a[3,4]	77	68	NI	n/a[2]	0
Carroll Ave between Troy Place and Gressel St.	150	350	80	70	72	65	NI	n/a[3]	0	400	71	NI	n/a[3,4]	77	69	NI	n/a[2]	0
Carroll Ave between Gressel St. and Becker Place	200	300	80	70	70	66	NI	n/a[3]	0	300	73	NI	n/a[3,4]	74	71	NI	n/a[2]	0
Carroll Ave between Becker Place and Fairway Street	150	400	80	70	72	64	NI	n/a[3]	0	350	72	NI	n/a[3,4]	77	68	NI	n/a[2]	0
Carroll Avenue north of Fairway Street	150	350	80	70	72	65	NI	n/a[3]	0	1400	60	NI	n/a[3,4]	77	69	NI	n/a[2]	0

Notes
Day: from 7 am to 10 pm
Night: from 10 pm to 7 am
I : Impact
NI: No Impact.
n/a: Not Applicable.
1: Includes the effect of existing sound walls and new project sound walls implemented at the start of construction
2: Since track installation activities in this area would not affect the mainline and would thus be conducted during the daytime, no nighttime noise impact has been evaluated.
3: No nighttime work would be conducted north of Whipple Road.
4: No pile driving would be conducted at night for the flyover construction.

Source: WIA 2010

Table 20 – Summary of Vibration Induced by Heavy Equipment during Phase 1 Construction

Location	Distance (feet)	Land Use	Vibration Criteria		Projected Maximum Vibration during Heavy Equipment Construction				
			Building Damage (in/sec)	Annoyance VdB, re: 1 micro-in/sec	Bldg Damage			Annoyance	
					PPV (in/sec)	Impact Type	# of Imp.	Vibration Level, VdB	Exceed Criterion
11th between D & Stone St	500	SFR	0.3	80	< 0.01	NI	0	58	No
11th between Stone St & Boyle St	400	SFR	0.3	80	< 0.01	NI	0	61	No
11th between and Boyle St	150	SFR	0.3	80	< 0.01	NI	0	74	No
La Brea Terrace	170 – 550	SFR	0.3	80	≤ 0.03	NI	0	57 – 72	Yes
Alicante Terrace	85 – 550	SFR	0.3	80	≤ 0.03	NI	0	57 – 81	Yes
Carrara Terrace	85 – 500	SFR	0.3	80	≤ 0.03	NI	0	58 – 81	Yes
Messina Terrace	120 – 250	SFR	0.3	80	≤ 0.02	NI	0	67 – 77	No
La Bonita Terrace	150 – 350	SFR	0.3	80	≤ 0.01	NI	0	63 – 74	No
Ithaca Street between Whipple Rd and Carroll Ave	540 – 660	SFR	0.3	80	< 0.01	NI	0	55 – 57	No
Carroll Ave between Troy Place and Gressel St.	540 – 660	SFR	0.3	80	< 0.01	NI	0	56 – 57	No
Carroll Ave between Gressel St. and Becker Place	540 – 660	SFR	0.3	80	< 0.01	NI	0	55 – 57	No
Carroll Ave between Becker Place and Fairway Street	660	SFR	0.3	80	< 0.01	NI	0	54	No
Carroll Avenue north of Fairway Street	660	SFR	0.3	80	< 0.01	NI	0	45	No

Notes
SFR: Single-family residence
NI : No Impact as per FTA
I : Impact as per FTA

Source: WIA 2010

Table 21 – Summary of Vibration Induced by Heavy Equipment during Phase 2 Construction

Location	Distance (feet)	Land Use	Vibration Criteria		Projected Maximum Vibration during Heavy Equipment Construction				
					Bldg Damage			Annoyance	
			Building Damage (in/sec)	Annoyance VdB, re: 1 micro-in/sec	PPV (in/sec)	Impact Type	# of Imp.	Vibration Level, VdB	Temporary Exceedance
11th between D & Stone St	500	SFR	0.3	80	≤ 0.02	NI	0	58	No
11th between Stone St & Boyle St	320	SFR	0.3	80	≤ 0.02	NI	0	64	No
11th between and Boyle St	350 – 500	SFR	0.3	80	≤ 0.02	NI	0	58 – 63	No
La Brea Terrace	75 – 250	SFR	0.3	80	≤ 0.04	NI	0	65 – 83	Yes
Alicante Terrace	180 – 300	SFR	0.3	80	≤ 0.01	NI	0	65 – 71	No
Carrara Terrace	80 – 300	SFR	0.3	80	≤ 0.03	NI	0	65 – 82	Yes
Messina Terrace	60 – 300	SFR	0.3	80	0.01 – 0.05	NI	0	67 – 86	Yes
La Bonita Terrace	60 – 250	SFR	0.3	80	0.01 – 0.05	NI	0	67 – 86	Yes
Ithaca Street between Whipple Rd and Carroll Ave	150 – 400	SFR	0.3	80	≤ 0.01	NI	0	61 – 74	No
Carroll Ave between Troy Place and Gressel St.	150 – 350	SFR	0.3	80	≤ 0.01	NI	0	63 – 74	No
Carroll Ave between Gressel St. and Becker Place	200 – 300	SFR	0.3	80	≤ 0.01	NI	0	65 – 70	No
Carroll Ave between Becker Place and Fairway Street	150 – 400	SFR	0.3	80	≤ 0.01	NI	0	61 – 74	No
Carroll Avenue north of Fairway Street	150 – 350	SFR	0.3	80	≤ 0.01	NI	0	63 – 74	No

Notes
SFR: Single-family residence
NI : No Impact as per FTA
I : Impact as per FTA

Source: WIA 2010

Appendix A Long-term Noise Survey Plots

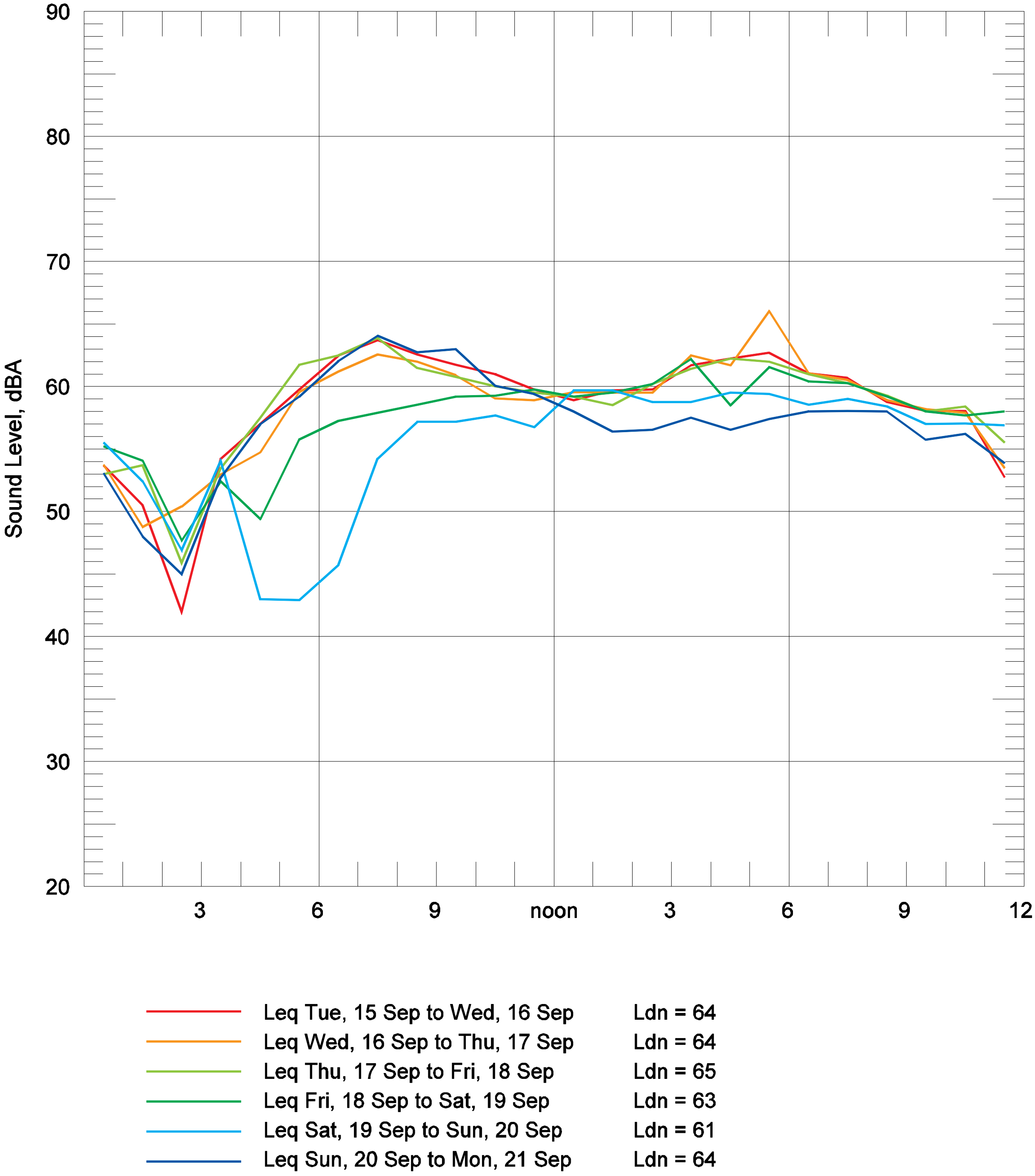

Figure A- 1 – Summary of the hourly equivalent noise level obtained at location N1 for six consecutive days.

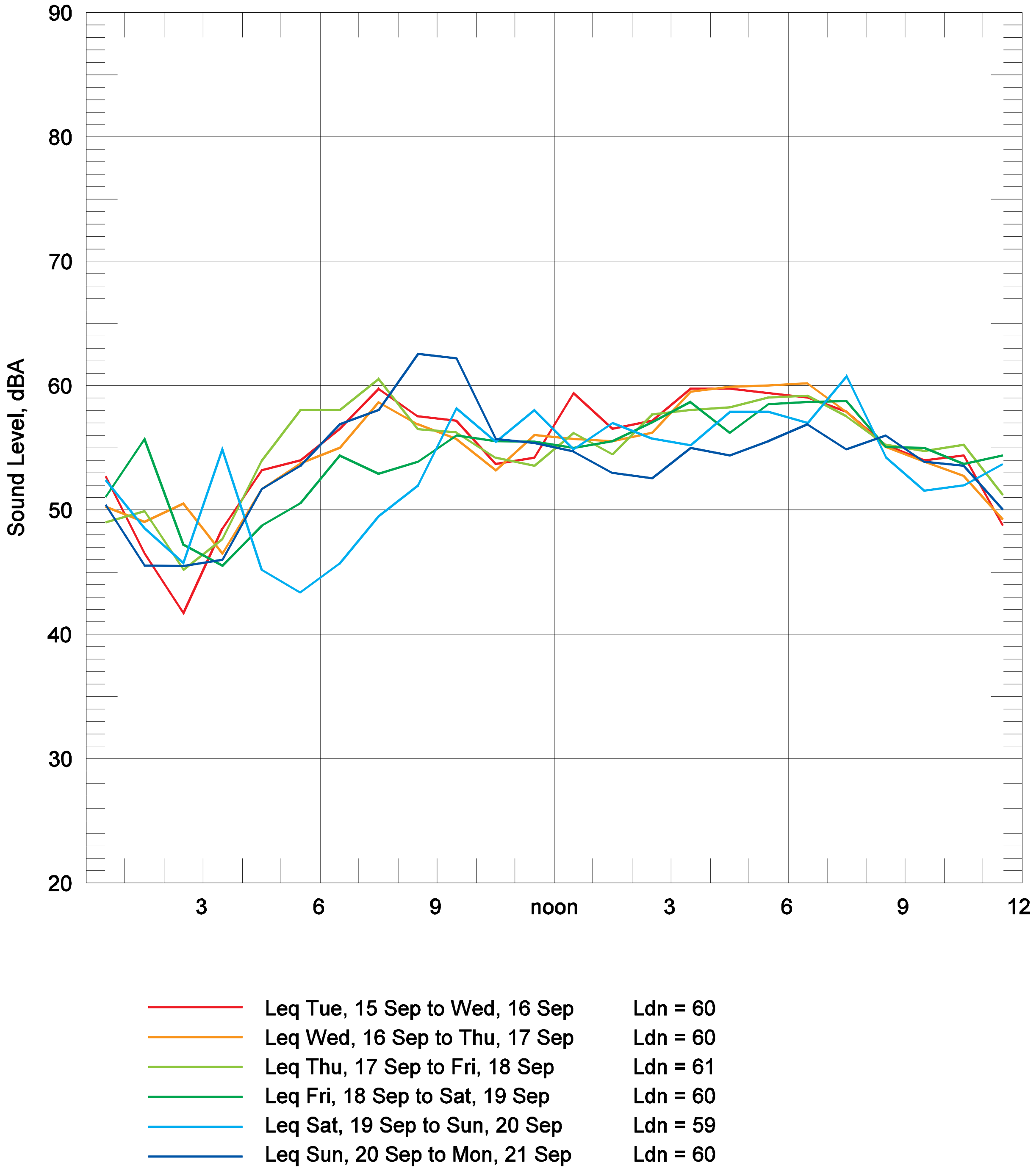

Figure A- 2 – Summary of the hourly equivalent noise level obtained at location N2 for six consecutive days.

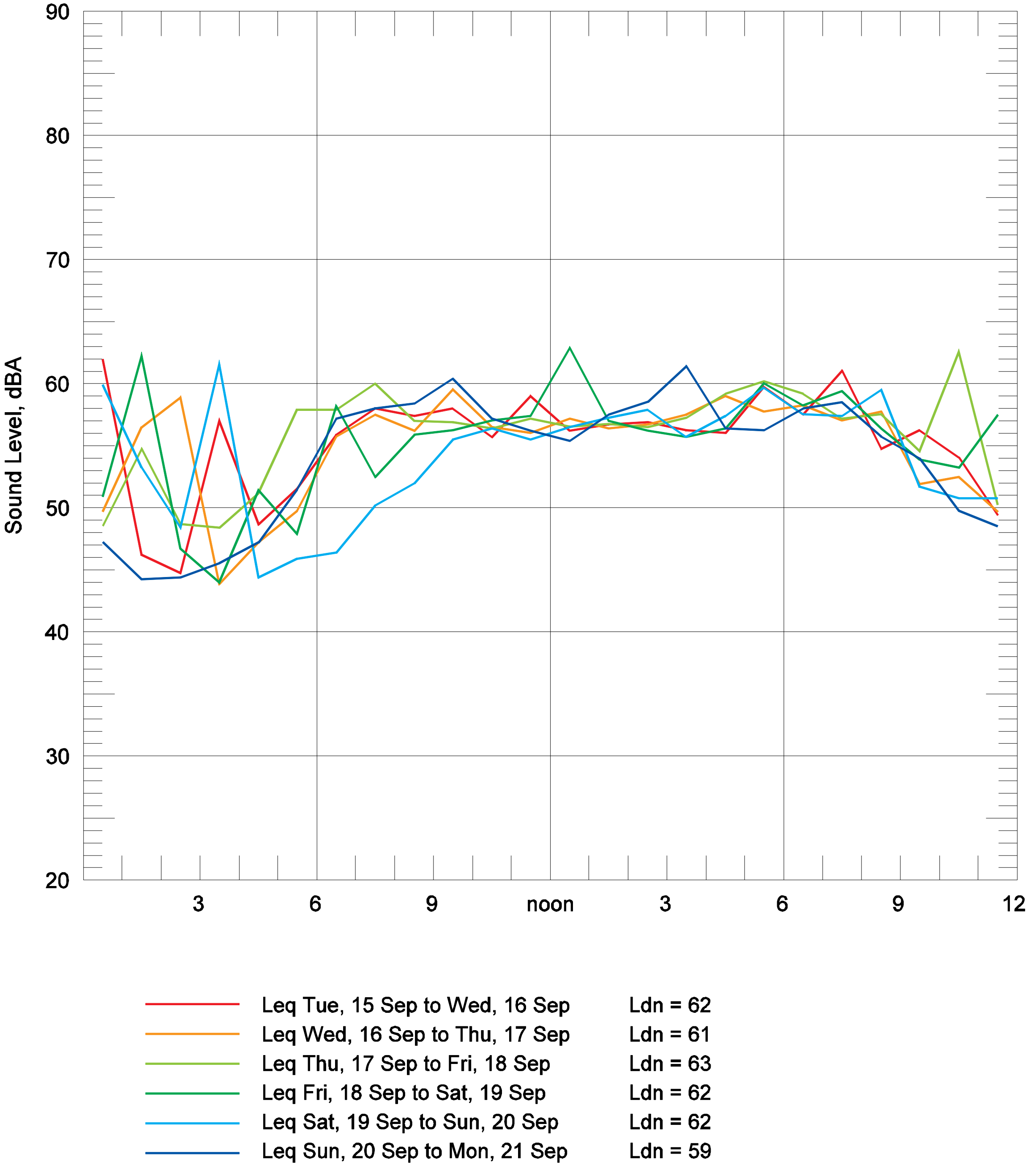

Figure A- 3 – Summary of the hourly equivalent noise level obtained at location N3 for six consecutive days.

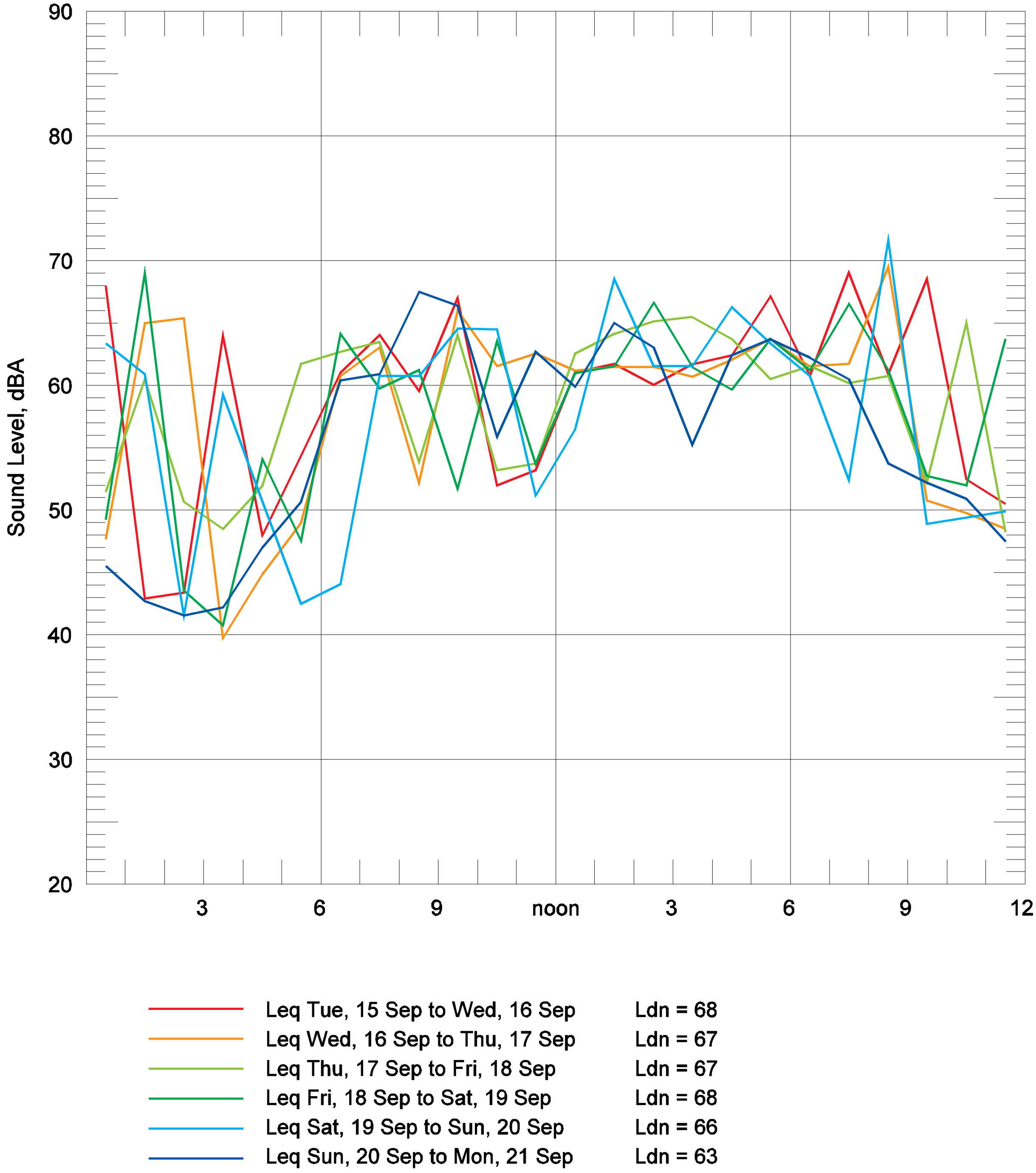

Figure A- 4 – Summary of the hourly equivalent noise level obtained at location N4 for six consecutive days.

Appendix L

Hayward Maintenance Complex Noise and Vibration Technical Memorandum Addendum 1

WILSON IHRIG & ASSOCIATES
ACOUSTICAL AND VIBRATION CONSULTANTS

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Memorandum

24 October 2014

To: David Corona, PGH Wong
From: Deborah Jue, Wilson, Ihrig
Subject: BART Hayward Maintenance Complex, Contract No. 01RQ-120, Sound Wall SW-03

As requested, Wilson, Ihrig & Associates has evaluated the noise control effect of the existing flyover structure near homes on La Brea Terrace with regards to future noise from the BART Hayward Maintenance Complex (HMC) Project.

Our previous analysis[1], completed in 2011, evaluated the noise mitigation requirements for the HMC project, including the effect of new crossovers and turnouts, flyover tracks and added train activity on the test tracks and the new Warm Springs Extension. In that analysis, it was determined that adding a crossover (P100B) to connect the T2 track to the mainline track would increase the noise to nine homes on La Brea Terrace by 4.7 dBA, which would exceed the project impact threshold of 4.4 dBA[2] The BART Facilities Standard (BFS) defers to the methodology and guidance established by the Federal Transit Administration (FTA). For an environment with an existing noise environment of about 62 Ldn, a noise increase of 1.7 dBA is a Moderate Impact and a noise increase of 4.4 dBA is a Severe Impact. The FTA recommends that noise mitigation be provided for Severe Impacts, with leeway granted to agencies to consider adoption of mitigation measures for Moderate Impacts when it is considered reasonable to do so.

In September 2014, PGH Wong requested clarification from Wilson Ihrig to determine whether the existing flyover structure was included in the noise analysis, and this memo incorporates the results of this clarification analysis.

Figure 1 shows an aerial image of the subject area, along with an excerpt of the engineering plan drawing from sheet C151. In our 2011 analysis, sound wall SW-03, 9 ft above top-of-rail (TOR), was identified to reduce the noise impact nine homes from the new crossover. The effect of the existing right-of-way (ROW) sound wall was incorporated into the 2011 analysis, but the flyover structure was not.

Using field verified elevation information for the flyover structure and current engineering information for the TOR elevations provided by PGH Wong, the noise impact for each building was analyzed in further detail, as summarized in Table 1 below. As shown in the table, the noise increase at all homes is

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[1] "BART – Hayward Maintenance Complex – Noise and Vibration Technical Report," submitted to PGH Wong, revised March 25, 2011.

[2] This threshold was determined based on the existing, measured noise level to calculate an allowable noise increase. A noise increase over the threshold would require noise control measures, per FTA noise impact analysis methodology.

4.4 dBA or less, thus the noise impact threshold of 4.4 dBA will not be exceeded. No sound wall is required in this area to mitigate a Severe Impact.

However, since there is a Moderate Impact at five of these homes, it is also necessary to consider if noise mitigation would be reasonable and feasible. Based on the updated topographic information, the top of the ROW sound wall would have to be 87 ft, extending from about 10+00 to 11+30 to protect Building #1, and extending from 9+00 to 11+30 to reduce the noise at Buildings #1 through #5. It would probably be more effective to put a short wall on the flyover structure, say, extending the minimum height to a total elevation of 85 ft.

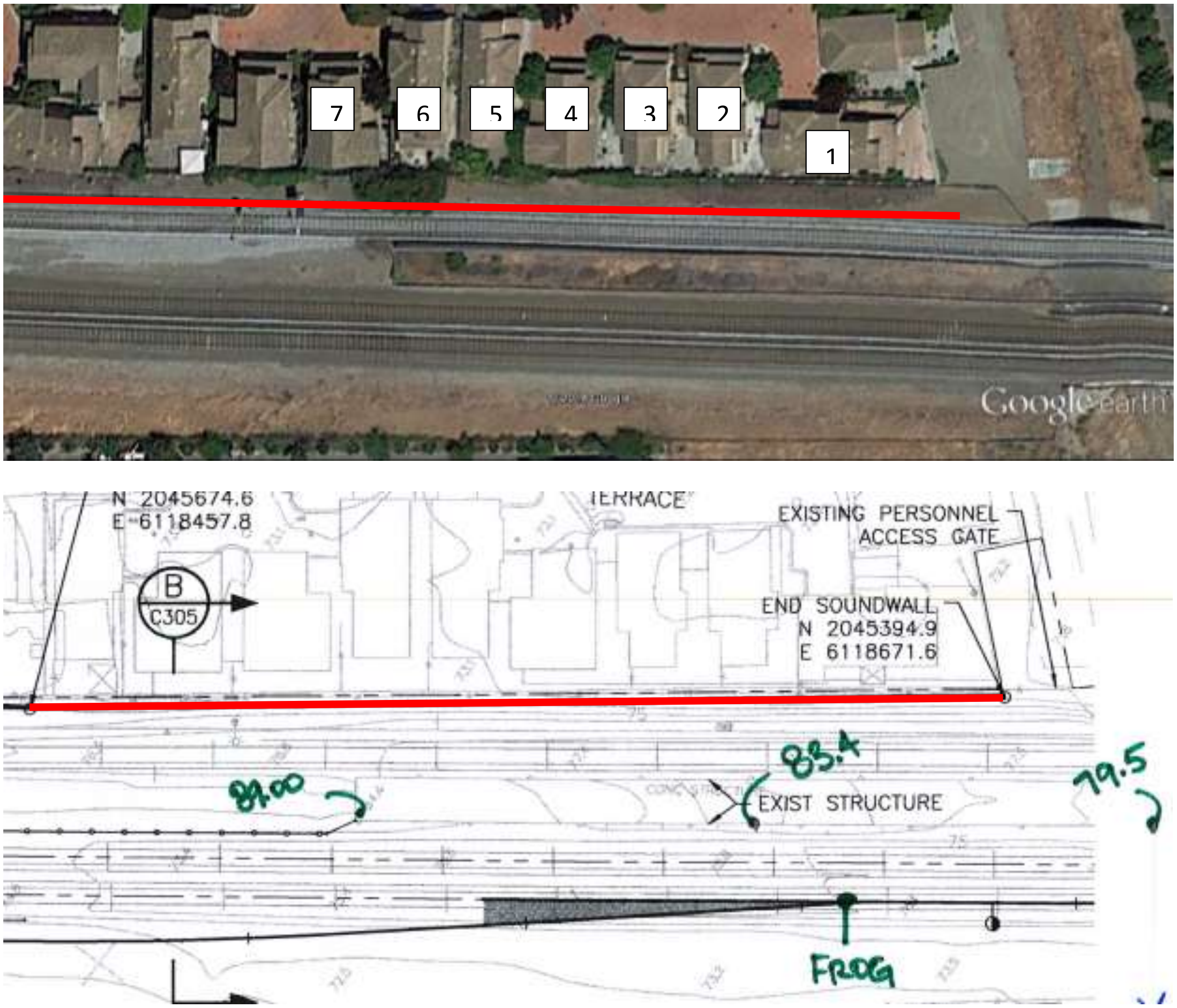

Figure 1 Aerial Image and Markup on Drawing C151 for Soundwall SW-03

Table 1 Noise Re-Analysis for Track T2 to Track A2 frog

Building	TOR el (ft)	Flyover structure el[1] (ft)	Existing Noise (Ldn)		Future Noise (Ldn)		Noise Increase (dBA)	
			Ground Fl	Second Fl	Ground Fl	Second Fl	Ground Fl	Second Fl
1	76.54	80.6	61.9	64.5	65.4	68.9	3.5	4.4
2	76.3	82.7	60.7	62.7	62.8	66.3	2.1	3.6
3	76.22	83.4	60.8	62.9	62.6	66.0	1.9	3.1
4	76.05	83.4	60.8	62.9	62.4	65.6	1.6	2.7
5	75.9	83.4	60.6	62.4	61.9	64.4	1.3	2.1
6	75.87	83.4	60.6	62.5	61.5	63.8	0.8	1.3
7	75.77	83.4	61.1	64.5	62.1	66.1	1.0	1.6
Note 1: Elevation determined where the structure blocks line of sight from the frog to the receiving building								

Appendix M

Hayward Maintenance Complex Noise and Vibration Technical Memorandum Addendum 2

WILSON IHRIG
ACOUSTICS, NOISE & VIBRATION

CALIFORNIA
WASHINGTON
NEW YORK

WI #14-130.1

MEMORANDUM

February 13, 2017

To: Etty Mercurio, AECOM

From: Deborah Jue

Subject: BART Hayward Maintenance Complex, BART Contract No. 6M8069, Task A6.01
U-Wall Study

As requested, Wilson Ihrig has re-evaluated the noise control effect of the existing flyover/u-wall structure near one home on La Brea Terrace with regard to future noise from the BART Hayward Maintenance Complex (HMC) Project. This effect was originally reviewed in October 2014 to confirm whether a sound wall along the ROW[1] would be necessary with the U-wall. With the geometry available at the time, Wilson Ihrig concluded that extending the height of the U-wall structure a modest amount would be satisfactory to reduce the noise impact from the new turnout to the residences marked as #1 to 5 in Figure 1 below.

However, some construction timing issues have come to bear which would make it extremely difficult to access the track area, and additional elevations were measured at the U-wall structure and at the middle of the exposed window for the residence to determine if it would be possible to eliminate all changes to the U-wall structure. Figure 1 also illustrates an excerpt of a new drawing based on this new information.

Wilson Ihrig originally reviewed the noise impact at this area in 2011[2] and evaluated the noise mitigation requirements for the HMC project including the effect of new crossovers and turnouts, flyover tracks and added train activity on the test tracks and the new Warm Springs Extension. In that analysis, it was determined that the noise impact threshold is a 1.7 dBA noise increase for a Moderate Impact and a noise increase of 4.4 dBA for a Severe Impact for an environment with an existing noise environment of about 62 Ldn. The FTA recommends that noise mitigation be provided

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[1] "BART Hayward Maintenance Complex, Contract No. 01RQ-120, Sound Wall SW-03," memo submitted to PGH Wong, 24 October 2014.

[2] "BART – Hayward Maintenance Complex – Noise and Vibration Technical Report," submitted to PGH Wong, revised March 25, 2011.

for Severe Impacts, with leeway granted to agencies to consider adoption of mitigation measures for Moderate Impacts when it is considered reasonable to do so.

With the new geometry information reflected in Figure 1, the noise increase from the turnout will not exceed the threshold for Moderate Impacts. Thus, no further analysis of noise control is required. See Table 1.

Table 1 Noise Re-analysis for frog at Building 1

Building	TOR el (ft)	U-wall Structure el (ft)	Existing Noise (Ldn)		Future Noise (Ldn)		Noise Increase (dBA)	
			Ground Fl	Second Fl	Ground Fl	Second Fl	Ground Fl	Second Fl
1	76.59	84.04	61.9	64.5	61.6	65.9	-0.3	1.4

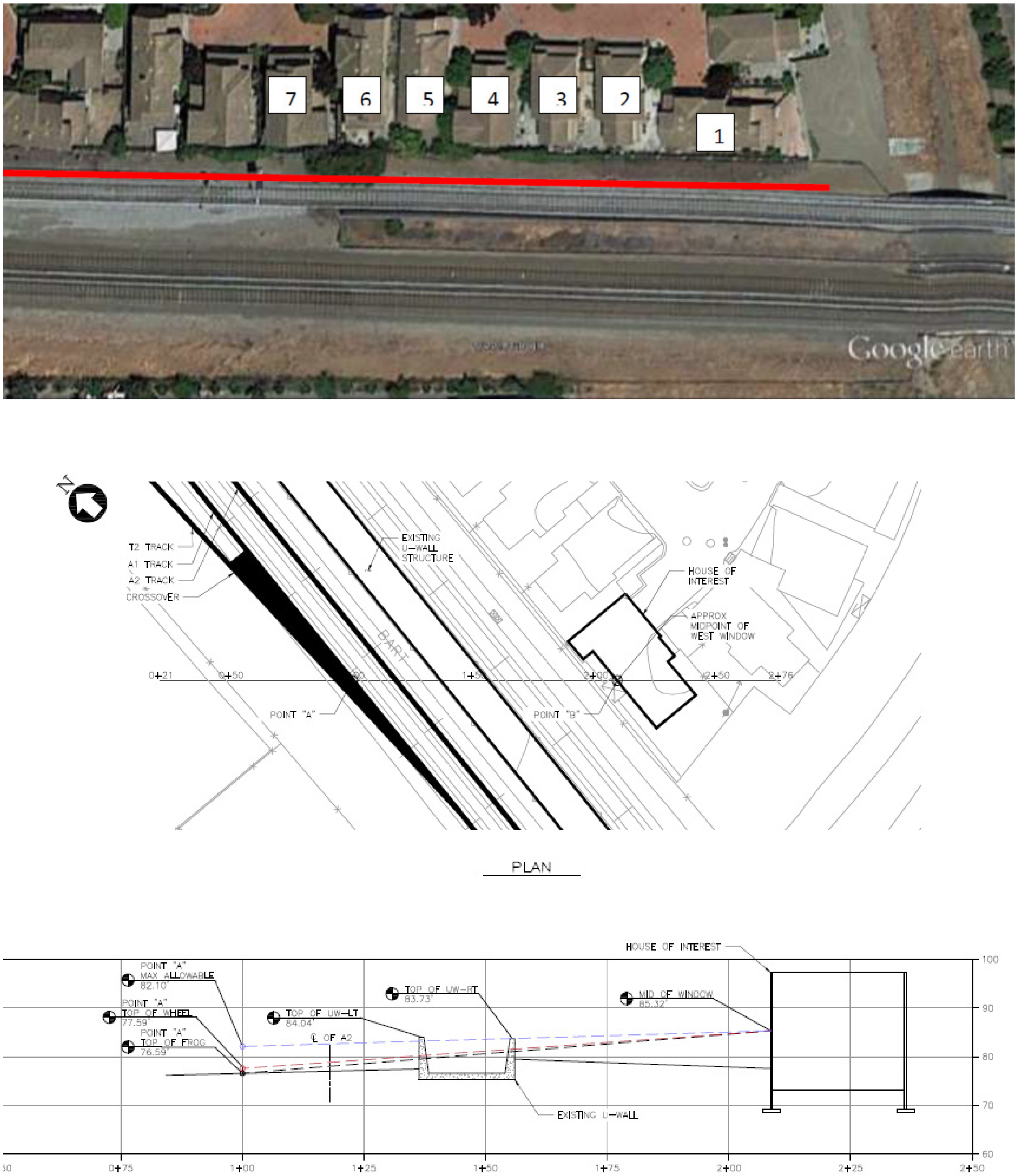

Figure 1 Updated geometries for building #1

Appendix N

Hayward Maintenance Complex Environmental Justice Analysis

HAYWARD MAINTENANCE COMPLEX ENVIRONMENTAL JUSTICE ANALYSIS

Submitted to FTA with HMC Initial Study / Mitigated Negative Declaration

Environmental Justice Analysis prepared by Wilbur Smith Associates

Public Participation Report prepared by MIG

August 2011

Hayward Maintenance Complex Environmental Justice Analysis

INTRODUCTION

This report includes an analysis of the communities that could be affected by the BART Hayward Maintenance Complex project. The purpose of the Environmental Justice analysis is to consider whether project-related significant impacts disproportionately affect minorities or low income populations. Pursuant to Executive Order 12898 and the Department of Transportation (DOT) Order 5610.2 to Address Environmental Justice in Minority Populations and Low-Income Populations (published April 15, 1997), NEPA documents must analyze health and environmental effects on minorities and low-income populations living near a proposed project.

Executive Order 12898 and the subsequent guidelines issued by the Department of Transportation and the U.S. Environmental Protection Agency (EPA) require consideration of the impacts on minority and low-income "populations." Pursuant to Federal Transit Administration (FTA) Circular 4702.1A "Title VI and Title VI-Dependent Guidelines for FTA Recipients," BART defines predominately minority or low-income populations by census tract where the total minority population percentage and the total low-income population percentage exceed the system-wide average for each population in BART's four-county service area. For purposes of this analysis, a "community" is defined by a Census Block Group. This report identifies whether the relevant communities may be Environmental Justice populations, defined as either predominately minority or predominately low-income per federal guidelines.

The Hayward Yard is one of four rail vehicle maintenance facilities serving the BART system (Hayward, Concord, Richmond, and Daly City) with train storage, train washing, and general maintenance facilities for the BART fleet. In addition, Hayward Yard has a parts warehouse and can provide accident and component repair, which is not available at the other BART maintenance yards.

The 88-acre Hayward Yard, including currently undeveloped BART-owned property on the east side which is being proposed for expansion, is located in the City of Hayward just north of Whipple Road and south of Industrial Parkway (Figure 1 and Figure 2). Tracks at the south end of the Hayward Yard extend into Union City. The yard has a long and narrow configuration and is oriented north-south along both sides of the BART mainline tracks. The yard currently has train storage tracks and maintenance facilities to the west of the BART mainline tracks and maintenance-of-way[1] materials storage to the east of the mainline tracks. Motor vehicles access the main shop and the yard west of the mainline tracks from Sandoval Way, and access the yard east of the mainline from Whipple Road.

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[1] Maintenance-of-way refers to the material, equipment, and operations necessary to maintain the track and right-of-way.

Source: Microsoft Streets and Trips, 2009.

PBS&J

FIGURE **1**

Project Location

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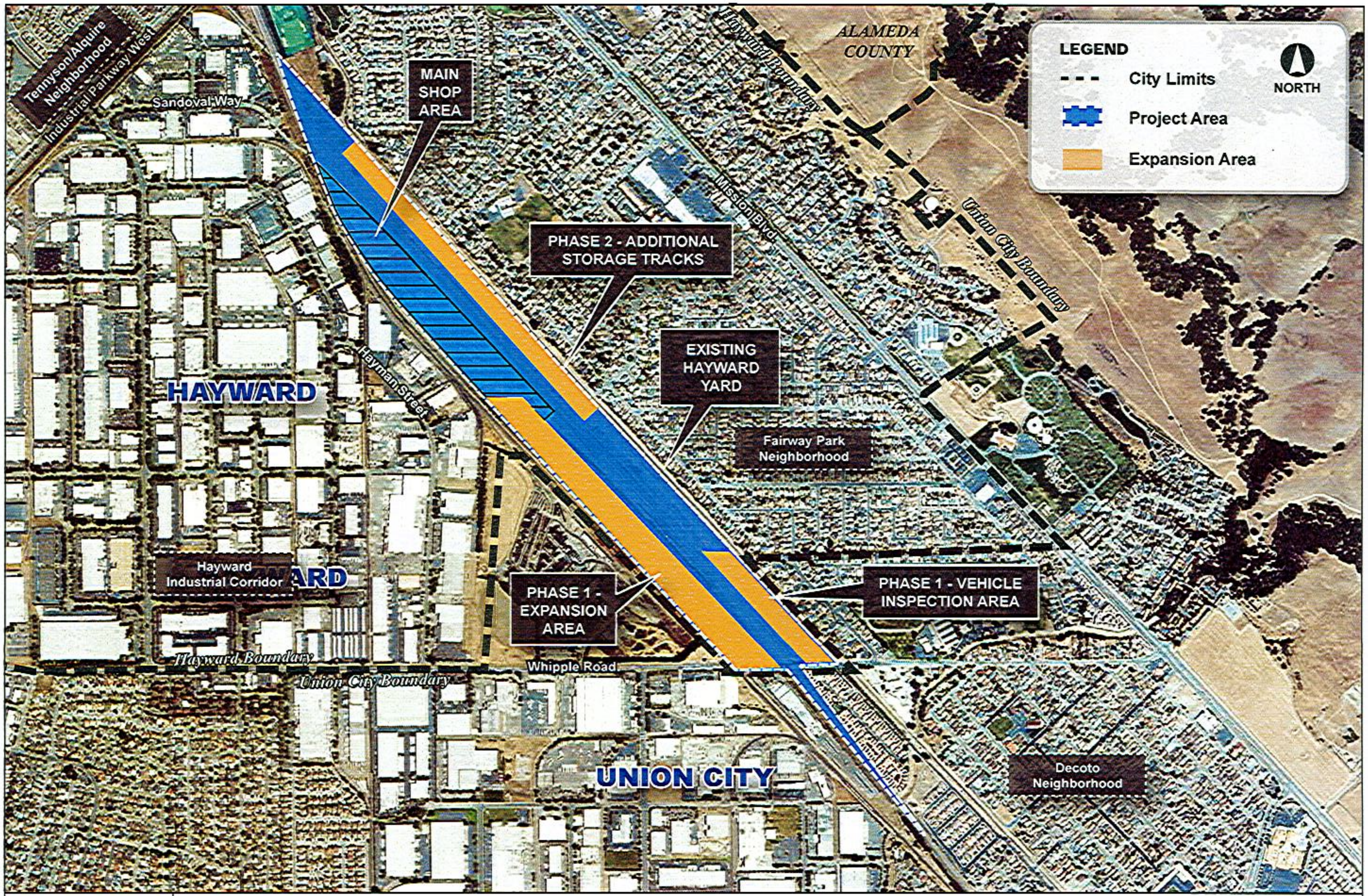
Hayward Maintenance Complex



Source: Environmental Data Resources, Inc., 2009; Google Earth, 2009; PBS&J, 2010.

PBS&J®

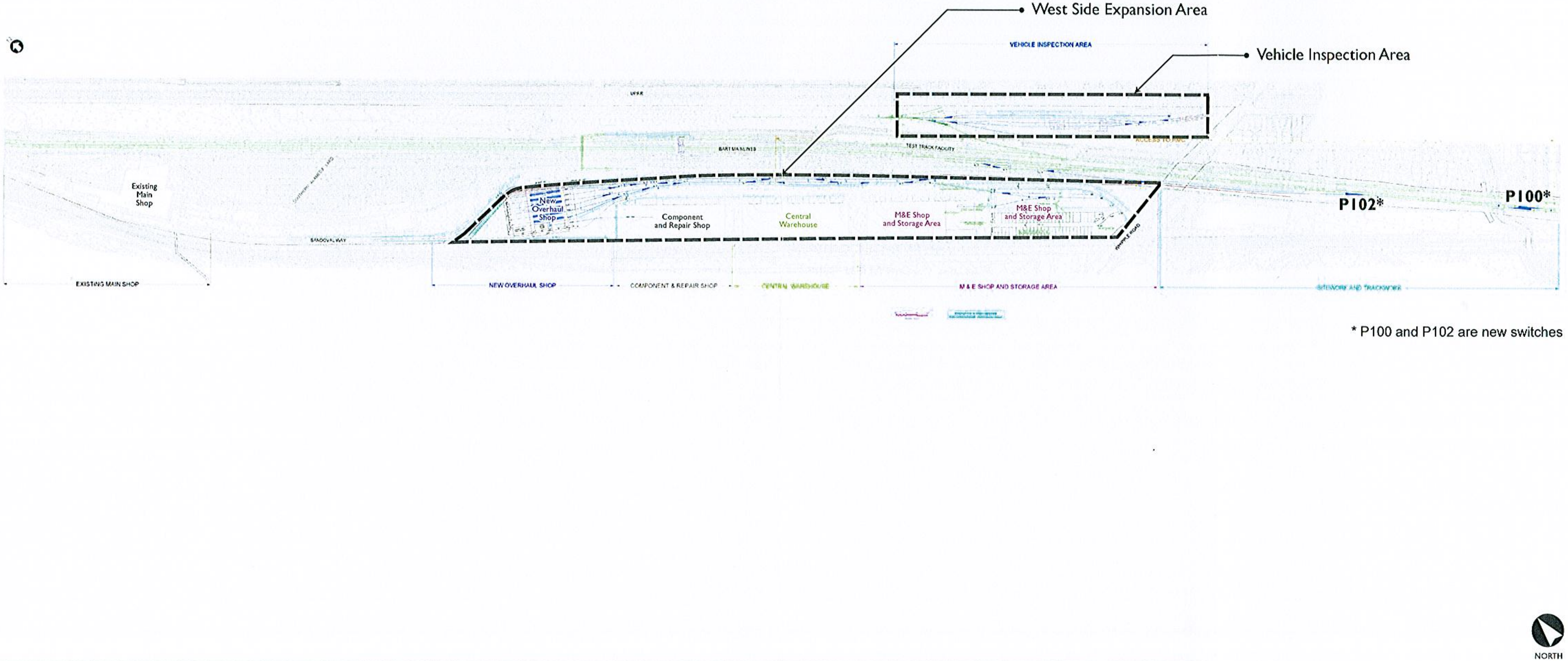
FIGURE 2
Project Site and Context

The proposed project primarily would consist of acquisition and improvement to three properties on the west side of the existing Hayward Yard and the construction of a maximum 250-car storage area on undeveloped BART property on the east side of the Hayward Yard. Implementation of the proposed project would occur in two phases. The proposed Phase 1 expansion would result in construction of new facilities and yard modifications to the west of the existing yard and mainline tracks. BART would acquire three properties containing four warehouses adjacent to the west side of the existing Hayward Yard. The properties collectively total approximately 28 acres. BART would reconfigure the properties for use as an integrated maintenance complex that would include a new vehicle level overhaul shop, component repair shop, central warehouse, and maintenance and engineering shop and storage area. Phase 1 would also include improvements to the Vehicle Inspection Area on the east side of the existing yard near the Whipple Road gate. Figure 3 shows the proposed site plan for the Phase 1 expansion.

Under the Phase 2 expansion, a new 13-acre BART storage area would be constructed in the northeast quadrant of the maintenance yard. This portion of the yard is currently undeveloped and consists of a level grassy field, with a smattering of small trees and bushes. These storage tracks would be connected with the mainline tracks using two flyovers to reduce potential disruption to test track activity and mainline traffic. Under both Phase 1 and Phase 2 new track turnouts would be installed to connect the new facilities to the existing yard and mainline tracks. Figure 4 shows the proposed site plan for the east side of the existing yard and mainline tracks under the proposed Phase 2 expansion.

ENVIRONMENTAL CONDITIONS

As described in Item 9, Land Use and Planning, of the Initial Study/Mitigated Negative Declaration (IS/MND) for the proposed project, the project site is surrounded by a variety of commercial, industrial, and residential uses. The BART Hayward Maintenance Complex and BART tracks are adjacent to existing residential neighborhoods in both Hayward and Union City. In Hayward, the Tennyson/Alquire Neighborhood is located north of the project site, and the Fairway Park Neighborhood is located to the east of the project site. In Union City, the Decoto Neighborhood is located southeast of the project site. Because these neighborhoods are relatively large and extend some distance from the Hayward Maintenance Complex, for the purpose of the present analysis, these neighborhoods were further divided into Census Block Groups. Census Block Groups are the smallest geographic unit for which population data are available for minority status and income levels allowing for a more focused Environmental Justice analysis. Table 1 identifies the Census Block Groups within 0.5 miles of the proposed project. A description of the minority status and income levels of the residents of these Census Block Groups is presented below under "Identification of Environmental Justice Communities."



* P100 and P102 are new switches

PBSJ

FIGURE 3
Phase 1 Site Plan

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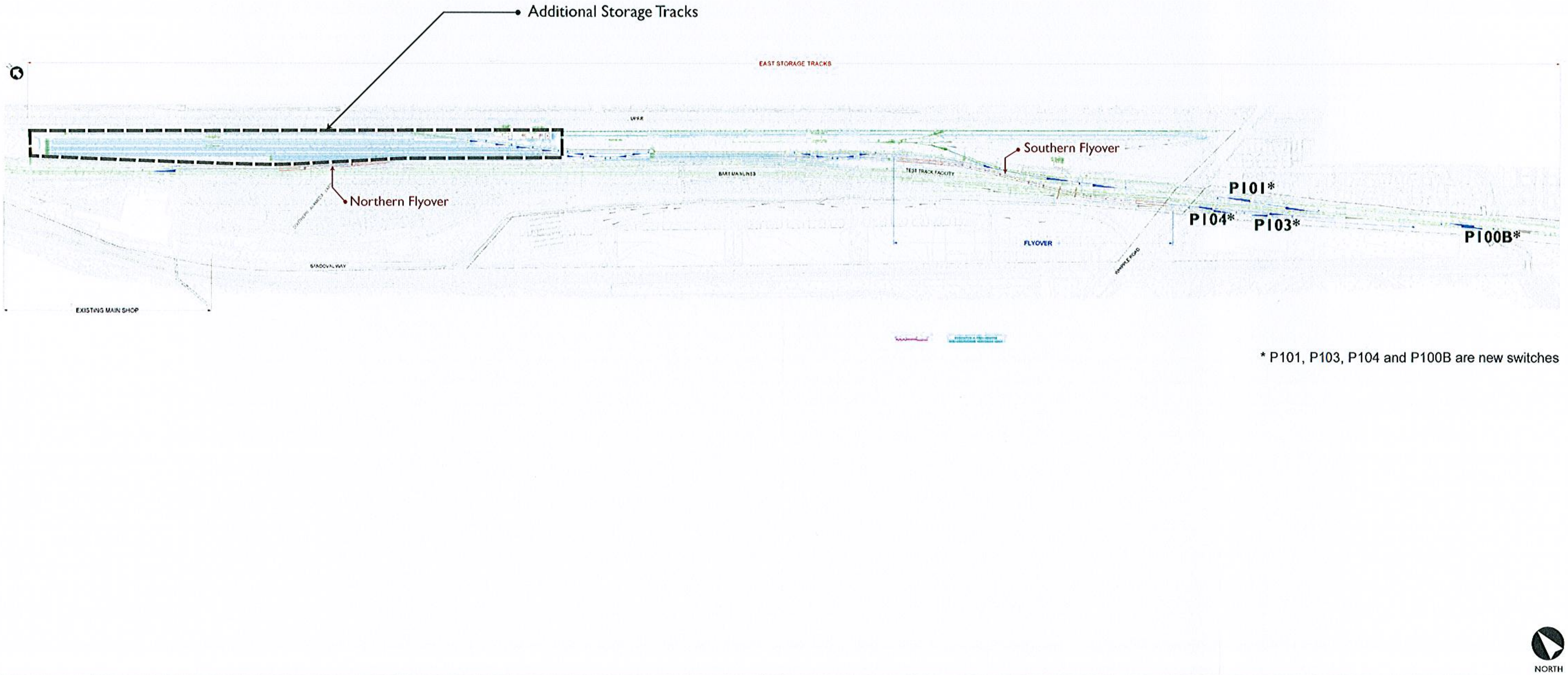
Source: BART, 2009.

Hayward Maintanance Complex



* P101, P103, P104 and P100B are new switches

FIGURE 4
Phase 2 Site Plan

Source: BART, 2009.

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Table 1
Census Block Groups Within 0.5 Mile of the Proposed Project Site

Municipality	Census Tract	Census Block Group
City of Hayward	4351.01	4
City of Hayward	4351.01	5
City of Hayward	4382.02	2
City of Hayward	4382.02	3
City of Hayward	4382.02	4
City of Hayward	4381	1
City of Hayward	4381	2
City of Hayward	4381	3
City of Hayward	4381	4
City of Hayward	4381	5
City of Hayward	4381	6
City of Hayward	4380	2
Union City	4380	1
Union City	4403.01	1
Union City	4403.01	2
Union City	4403.01	3
Union City	4403.08	1
Union City	4403.08	2
Union City	4402	1
Union City	4402	2
Union City	4402	3
Union City	4402	4

Source: U.S. Census Bureau, 2000.

APPROACH TO ENVIRONMENTAL JUSTICE ANALYSIS

To determine if the proposed BART Hayward Maintenance Complex project would result in disproportionate impacts on minority and/or low income populations, a five-step method was used. Step 1 identifies potential environmental impacts of the project. Steps 2-4 consider the socioeconomic characteristics of the affected population and whether the residents would be considered Environmental Justice communities. Step 5 evaluates whether the Environmental Justice populations, if present, would be disproportionately affected. The five steps are described below.

1. *Identify Potential Effects* – As required by NEPA and CEQA, a broad range of project-related impacts have been evaluated in the IS/MND. These include effects on transportation, land use, socioeconomics, visual quality, cultural resources, community services, utilities, geology, soils, seismicity, hydrology and water quality, biological resources, noise and vibration, air quality, and hazardous materials. The descriptions of potential impacts for these topic areas and measures to protect the environment and human health are documented in Items 1 through 18 of the Environmental Checklist contained in the IS/MND.
2. *Determine the Affected Geographic Area* – For most environmental topic areas, the geographic area affected by the project includes those uses directly adjacent to the Hayward Maintenance

Complex and the related trackwork necessary for trains to enter and leave the facilities. For the purposes of this study, the affected geographic area has been delineated by the Census Block Groups within 0.5 miles of the project site (Affected Geographic Area), as presented in Figure 5. Land use, socioeconomic, noise and vibration, aesthetic, and most physical environmental effects, if any, would be experienced within this Affected Geographic Area. It is important to note, however, that impacts associated with environmental topic areas such as greenhouse gas emissions, air quality, and traffic may affect a larger geographic area than depicted in Figure 5.

3. *Determine the Demographic Characteristics of the Affected Geographic Area and the Reference Community (the Reference Community is the population against which to compare the demographics of the affected geographic area, in this case the Reference Community is the BART four-county service area*[2]*)* – For the Affected Geographic Area and BART service area, the demographic characteristics were identified based on data gathered from the 2000 Census. The 2010 Census has been released, but demographic information at the Census Block Group level is not yet available. Accordingly, the 2000 Census represents the most recent demographic data available. These demographic characteristics include:
    a. Total population;
    b. Percent of population of minority status[3] in the Affected Geographic Area;[4]
    c. Percent of population of low-income status[5] in the Affected Geographic Area;
    d. Percent of population of minority status in the BART service area; and
    e. Percent of population of low-income status in the BART service area.

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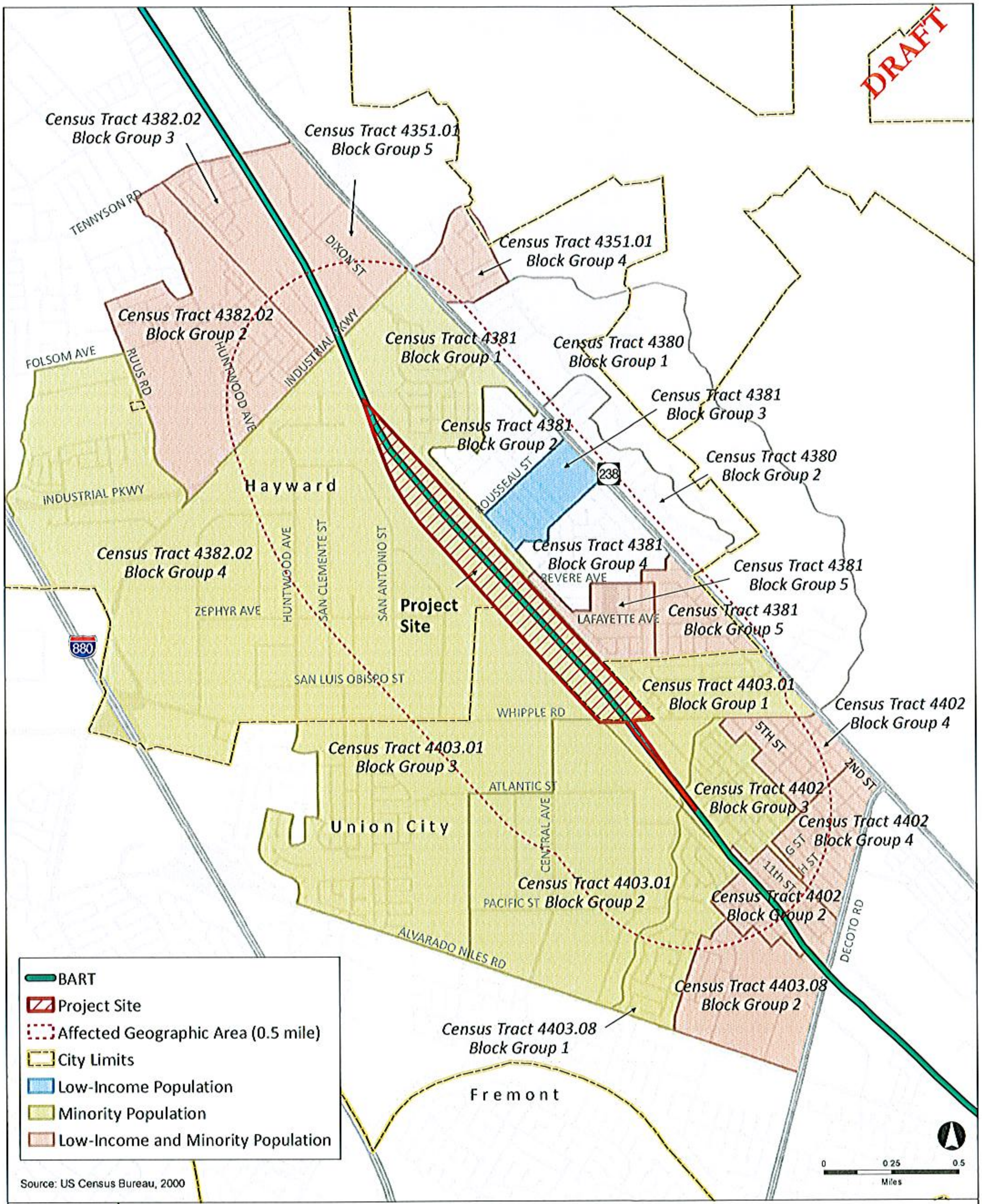
[2] The BART service area includes the total population from the following four counties: Alameda, Contra Costa, San Francisco, and San Mateo.

[3] Based on the DOT Order to Address Environmental Justice in Minority Populations and Low-Income Populations, a minority person is defined as someone who is American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or Other Pacific Islander, or Hispanic or Latino.

[4] Figure 5 presents the project site and identifies the Census Block Groups within the affected area.

[5] Pursuant to Federal Transit Administration (FTA) Circular 4702.1A "Title VI and Title VI-Dependent Guidelines for FTA Recipients," BART defines predominately low-income populations where the total low-income population percentage exceeds the system-wide average (21.6%) for each population in BART's four-county service area. A census tract is thus predominately low-income in BART's service area if more than 21.6% of the tract's households have incomes under 200% of the federal poverty level. For a single person household, 200% of the federal poverty level in 2008 was $21,982. For a two adult, two child household, the 200% threshold was $43,668.



Source: US Census Bureau, 2000

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FIGURE 5

Environmental Justice Populations

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BART Hayward Maintenance Complex

4. *Determine if the Affected Populations Include Environmental Justice Communities* – The affected populations are those populations within the Affected Geographic Area. The following criteria were used to determine if the affected Census Block Group is an Environmental Justice community:[6]

   a. *Minority* - In order to identify minority populations geographically, a percentage threshold for minority residents living in the Affected Geographic Area was calculated. Using year 2000 census data, the total population within the BART four-county service area was first determined. The total minority population within the BART service area was then calculated for all of the census tracts in this service area, and the percentage of minorities was determined to be 52.7. This includes persons who self identified themselves as American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or other Pacific Islander, or Hispanic or Latino. If the minority population percentage of an individual Census Block Group (community) within the Affected Geographic Area was greater than the BART service area percentage of 52.7, then the community was identified as a minority Census Block Group.

   b. *Income* - Using the 2000 Census, the percentage of low-income population within the Affected Geographic Area that is under 200 percent of the federal poverty level was determined. Similar to the method for identifying minority populations described above, if the percentage of the low-income population for a Census Block Group was found to be greater than 21.6 percent (the percentage of the population below the 200 percent poverty level in the BART four-county service area), the Census Block Group was identified as a low-income community.

   If the ethnicity or income characteristics of a Census Block Group exceeded either of the thresholds identified, it was considered an Environmental Justice community.

5. *Determine Whether the Significant Unavoidable Effects of the Project Would Disproportionately Affect Environmental Justice Communities* – This analysis assesses whether significant project-related impacts would have a disproportionately high and adverse effect ("disproportionate effect") on Environmental Justice populations. A disproportionate effect is defined as an effect that is predominantly borne, appreciably more severe, or of a greater magnitude in areas with Environmental Justice populations than in areas with non-Environmental Justice populations.

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[6] These criteria are based on guidance from relevant documents issued by federal agencies. These include:

- Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," February 11, 1994, 59 Federal Register at 7630.
- U.S. Environmental Protection Agency, "Interim Final Guidance for Incorporating Environmental Justice Concerns in EPA's NEPA Compliance Analysis, Office of Federal Activities," September 30, 1997.
- Federal Highway Administration, "Interim Guidance: Addressing Environmental Justice in the Environmental Assessment (EA)/Environmental Impact Statement (EIS)." March 2, 1999.
- Metropolitan Transportation Commission, "Equity Analysis Report", February 2009.

IDENTIFICATION OF ENVIRONMENTAL JUSTICE COMMUNITIES

Minority Status

The data in Table 2 compare the minority characteristics of the Census Block Groups within the Affected Geographic Area with the minority population percentages of BART's four-county service area. In addition, Table 2 identifies which of the Census Block Groups conform to the definition of Environmental Justice community based on minority populations. The boundaries of these Environmental Justice communities are presented in Figure 5. Using the methodology described above, 17 Census Block Groups were determined to be Environmental Justice communities based on minority populations.

Table 2
Minority Status of Census Block Groups in the Hayward Maintenance Complex Vicinity

Census Tract and Block Group	Total	American Indian/ Alaskan Native	Black	Asian	Hispanic	Native Hawaiian/ Pacific Islander	Percent Minority (Block Group)	Percent Minority (BART Service Area)	EJ Minority Community?
Census Tract 4351.01 Block Group 4	712	1	89	111	181	3	54	53	Yes
Census Tract 4351.01 Block Group 5	2871	8	526	688	942	85	78	53	Yes
Census Tract 4380 Block Group 1	1942	19	118	288	449	7	45	53	No
Census Tract 4380 Block Group 2	1079	14	37	111	271	13	41	53	No
Census Tract 4381 Block Group 1	1687	4	131	770	334	32	75	53	Yes
Census Tract 4381 Block Group 2	931	1	69	108	293	8	51	53	No
Census Tract 4381 Block Group 3	979	5	124	71	283	6	50	53	No
Census Tract 4381 Block Group 4	1292	9	99	157	367	4	49	53	No
Census Tract 4381 Block Group 5	1127	7	48	56	625	6	66	53	Yes
Census Tract 4381 Block Group 6	1093	8	55	57	583	1	64	53	Yes
Census Tract 4382.02 Block Group 2	3997	11	354	1232	808	97	63	53	Yes
Census Tract 4382.02 Block Group 3	1099	3	63	198	345	12	56	53	Yes
Census Tract 4382.02 Block Group 4	1593	7	54	602	257	17	59	53	Yes
Census Tract 4402 Block Group 1	1756	4	44	119	1393	1	89	53	Yes
Census Tract 4402 Block Group 2	1676	1	51	169	1266	1	89	53	Yes
Census Tract 4402, Block Group 3	1418	6	21	73	1197	7	92	53	Yes
Census Tract 4402 Block Group 4	1496	7	18	66	1309	1	94	53	Yes
Census Tract 4403.01 Block Group 1	1183	6	28	292	541	2	73	53	Yes
Census Tract 4403.01 Block Group 2	285	0	29	195	24	1	87	53	Yes
Census Tract 4403.01 Block Group 3	3247	6	221	1444	775	26	76	53	Yes
Census Tract 4403.08 Block Group 1	1613	2	99	391	776	7	79	53	Yes
Census Tract 4403.08 Block Group 2	1299	0	78	332	614	12	80	53	Yes

Source: US Census Bureau, 2000.

INCOME LEVELS

Based on low-income data presented in Table 3, 11 of the Census Block Groups comprising the Affected Geographic Area would be considered Environmental Justice populations.

Table 3
Low-Income Status of Census Block Groups in the Hayward Maintenance Complex Vicinity

Census Tract and Block Group	Total Population	Low-Income Persons[a]	Non-Low-Income Persons[a]	Percent Low-Income (Affected Geographic Area)	Percent Low-Income (BART Service Area)	EJ Low-Income Community?
Census Tract 4351.01 Block Group 4	716	181	535	25	22	Yes
Census Tract 4351.01 Block Group 5	2,863	897	1,966	31	22	Yes
Census Tract 4380 Block Group 1	1,827	244	1,583	13	22	No
Census Tract 4380 Block Group 2	1,071	86	985	8	22	No
Census Tract 4381 Block Group 1	1,619	75	1,544	5	22	No
Census Tract 4381 Block Group 2	950	47	903	5	22	No
Census Tract 4381 Block Group 3	987	307	680	31	22	Yes
Census Tract 4381 Block Group 4	1,410	248	1,162	18	22	No
Census Tract 4381 Block Group 5	1,137	305	832	27	22	Yes
Census Tract 4381 Block Group 6	967	250	717	26	22	Yes
Census Tract 4382.02 Block Group 2	3,930	922	3,008	23	22	Yes
Census Tract 4382.02 Block Group 3	1,011	400	611	40	22	Yes
Census Tract 4382.02 Block Group 4	1,638	166	1,472	10	22	No
Census Tract 4402 Block Group 1	1,726	595	1,134	34	22	Yes
Census Tract 4402 Block Group 2	1,706	606	1,100	36	22	Yes
Census Tract 4402 Block Group 3	1,363	252	1,111	18	22	No
Census Tract 4402 Block Group 4	1,481	422	1,059	28	22	Yes
Census Tract 4403.01 Block Group 1	1,246	211	1,035	17	22	No
Census Tract 4403.01 Block Group 2	293	26	267	9	22	No
Census Tract 4403.01 Block Group 3	3,206	638	2,568	20	22	No
Census Tract 4403.08 Block Group 1	1,618	253	1,365	16	22	No
Census Tract 4403.08 Block Group 2	1,294	377	917	29	22	Yes

Source: US Census Bureau, 2000.

Note:

[a] Low-Income threshold is 200 percent of the federal poverty line.

Summary of EJ Communities

As identified in Table 2 and Table 3 above, there are a total of 18 Census Block Groups were determined to be Environmental Justice communities based on minority status and low-income status within the Affected Geographic Area. These 18 Environmental Justice communities include 7 Census Block Groups that were predominately minority populations, 1 Census Block Group that was a predominately low-income population, and 10 Census Block Groups that were both predominately minority and low-income populations.

IMPACT ASSESSMENT AND MITIGATION MEASURES

Construction and operation of the BART Hayward Maintenance Complex project would affect all of the study area Census Block Groups. The IS/MND determined that with proper mitigation measures incorporated into the design, construction, and operations of the complex, the proposed project would not result in adverse environmental effects. The environmental topic areas that would require mitigation measures are Aesthetics, Air Quality, Biological Resources, Cultural Resources, Greenhouse Gas Emissions, Hazards and Hazardous Materials, Hydrology and Water Quality, Noise and Vibration, and Transportation/Traffic. For all other environmental topics, the IS/MND concludes that the environmental effects would not be adverse.

The following assessment is intended to describe the adverse effects of the proposed project, since they represent the effects that could disproportionately affect Environmental Justice communities in the project area. In addition, this report section summarizes the mitigation measures that would be implemented to reduce the intensity and severity of the adverse effects. The analysis presented below is from Section VI, Environmental Checklist, of the Hayward Maintenance Complex IS/MND.

Aesthetics. Construction of the proposed crossover switches south of Whipple Road could require the removal of trees to the west of the BART mainline to provide track access. These trees currently screen views from residents east of the BART mainline toward the existing industrial buildings to the west. The removal of these trees could alter views from the residential area and increase the visibility of the industrial building complex to the west. Many of these residences south of Whipple Road and east of the BART mainline are in Environmental Justice communities (Census Tract 4403.01 Block Group 1 and Census Tract 4402 Block Group 3). Implementation of Mitigation Measure VQ-1 would ensure that if construction activities require the removal of existing trees near industrial buildings, BART shall plant replacement trees at a 1:1 ratio. Therefore, construction of the proposed project would not have adverse effects on the aesthetic quality of the project area. Additionally, with the implementation of Mitigation Measure VQ-1, the potentially affected Environmental Justice communities would not experience adverse visual impacts.

Air Quality. During the construction of Phase 2, if clearing, grubbing, grading, fill transport were to occur simultaneously with other construction activities, nitrous oxide (NO_X) emissions would be above the Bay Area Air Quality Management District (BAAQMD) construction equipment emissions threshold for a significant adverse effect. In addition, emissions of small particulate matter (PM_{10} and $PM_{2.5}$) would result from soil-disturbing construction activities. These dust emissions could disturb sensitive residential receptors, including Environmental Justice populations, to the north, northeast, and east of the project site.

Mitigation Measure AQ-1 would ensure that construction activities under Phase 2 to the north and south of Whipple Road would not take place concurrently, thereby resulting in a reduction of NO_X construction equipment emissions to below the BAAQMD standards. Mitigation Measure AQ-2 would ensure implementation of best management practices (BMPs) throughout the project site to inhibit fugitive dust.

With these mitigation measures, the proposed project would not have an adverse affect on air quality nor on the potentially affected Environmental Justice communities.

Biological Resources. The IS/MND identifies two potential wetlands adjacent to the east side expansion area of the Hayward Maintenance Complex. The first exists along an artificial drainage channel that follows the eastern edge of the BART tracks. With the exception of a 0.01-acre area, the channel contains no wetland vegetation or other wetland characteristics. The second wetland is a 1.2-acre depression north of the project site. The project could disturb these wetlands during construction or change the hydrology, water quality, or water quantity in this wetland after the project's completion, thus resulting in an indirect adverse effect. To avoid wetland disturbance, Mitigation Measure BIO-1 would ensure that these wetlands are not directly affected during construction through avoidance by installing orange exclusionary fence around the sensitive areas and compliance with the National Pollutant Discharge Elimination System (NPDES) general permits.

The west side expansion area could also provide nesting habitat for a wide variety of native birds. Tree and shrub removal during the nesting season (March 1 to September 15) could result in the loss of active bird nests. Mitigation Measures BIO-2 and BIO-3 would place restrictions on habitat alteration and require a nesting bird survey in those instances where tree and shrub removal is unavoidable. In the event that construction activities necessitate the removal of trees listed on the City of Hayward's or Union City's Tree Preservation Ordinance, Mitigation Measure BIO-4 would require BART to retain a certified arborist to survey the trees proposed for removal and identify trees that would qualify as "protected trees" under the Cities' Tree Preservation Ordinance. BART would ensure replacement of "protected trees" at a 1:1 ratio.

Together, Mitigation Measures BIO-1 through BIO-4 would reduce potentially adverse effects to wetlands, nesting birds, and protected trees. Consequently, there would be no adverse effects to natural resources in and around the project site as a result of construction and operation of the proposed Hayward Maintenance Complex project.

Cultural Resources. Although the archival research and site visit performed for the IS/MND did not identify any prehistoric cultural resources at the project site, the region has a record of prehistoric use. Therefore, if any prehistoric resources are located subsurface within the project area, project-related ground-disturbing activities could have an adverse affect on those resources. Similarly, the cultural resources assessment did not identify Native American burial grounds within the project site, but absence of surface indicators does not preclude the possibility of buried human remains. Accordingly, Mitigation Measures CR-1 and CR-2 would ensure that if prehistoric materials or human remains were to be discovered during construction, ground-breaking activities near the discovery shall be halted and the appropriate authorities would be notified, thereby avoiding potentially adverse effects to cultural resources.

Greenhouse Gas Emissions. Although the BAAQMD has not promulgated quantitative significance criteria for construction-related Greenhouse Gas Emissions (GHG), the BAAQMD encourages lead agencies to implement best management practices (BMPs) (including the use of alternative-fueled construction vehicles/equipment, locally sourced building materials, and recycling or reusing at least 50 percent of construction waste). With the implementation of the BMPs described in Mitigation Measure

GHG-1, the short-term construction related GHG emissions would not have an adverse affect on greenhouse gas emissions and related climate change effects.

Hazards and Hazardous Materials. An Environmental Database Report (EDR) prepared for the IS/MND identified an Underground Storage Tank (UST) containing Volatile Organic Compounds (VOC) at a nearby chemical process facility (Univar, USA). The UST was removed in the 1990s, but soil and groundwater contamination from VOCs were reported by the property owner. The contamination is restricted to the Univar property and therefore would not be encountered during construction and operation activities associated with the proposed Hayward Maintenance Complex project. Nevertheless, the potential of exposing unknown contaminated material (both groundwater and soil) still exists, given the proximity of the project site to the known groundwater contamination. In addition, the west side expansion area (the Phase 1 construction site) is currently used for warehouse and light industrial uses. Given the history of warehouse and light industrial land uses at the site, it is possible that unreported releases of hazardous materials may have occurred.

The following measures from the IS/MND would reduce the potential for adverse affects to human health and safety from accidental exposure to hazardous materials. Mitigation Measure HAZ-1 would require that BART complete a Phase I environmental site assessment (ESA) to investigate potential hazardous materials around the proposed project site, and additional research including a file review with the Alameda County Department of Environmental Health and with the Regional Water Quality Control Board (RWQCB). If the Phase I investigation reveals potential environmental contamination along or beneath the proposed project's footprint, Mitigation Measure HAZ-2 requires that BART determine whether a Phase II soil and groundwater investigation is warranted prior to construction. Furthermore, Mitigation Measure HAZ-3 requires that if hazardous materials are identified in soil and groundwater at levels that present a health or environmental risk, BART shall ensure that remediation is conducted at contaminated sites pursuant to applicable laws and regulations. In the event that hazardous materials are encountered during construction after implementation of the above described mitigation measures, BART's contractor shall cease work in the vicinity of the suspect material and the applicable regulatory agency shall be notified. Collectively, with these mitigation measures in place, there would be no adverse hazardous materials effects and potential exposure to contaminated soil and groundwater would also not be adverse.

Hydrology and Water Quality. The proposed project would result in a net increase in impervious surface cover at the Hayward Maintenance Complex, which would increase the flow and volume of stormwater runoff entering the stormwater system and local drainages. This increase in flow could exceed the existing stormwater drainage system capacity leading to localized flooding. Mitigation Measure HYD-1 would require BART to design both off-site and on-site drainage systems so that surface water flow would not exceed the conveyance capacity of existing downstream drainage structures. The downstream channels to which the project site runoff is routed contain levees that are only partially accredited or are not rated to contain the entire 100-year flood event. Implementation of the above mentioned mitigation measure would ensure that the proposed project would not result in surface runoff flows greater those that already exist. As a result, potential flood hazard risks to residents in the vicinity of the proposed Hayward Maintenance Complex project would not be adverse.

Noise and Vibration. As discussed under Item 12, Noise and Vibration, in the IS/MND, implementation of Phase 1 of the proposed project would have operational and construction noise and vibration impacts.

Noise. There would be moderate noise impacts on three single-family residences on 11th Street due to the proximity (about 135 feet) to proposed crossover P100 in the track modification area south of Whipple Road. There would also be moderate impacts to 14 single-family residences on Alicante Terrace and Carrara Terrace due to the proximity to proposed crossover P102. These residences are in Census Tract 4403.01 Block Group 1 and Census Tract 4402 Block Group 3, respectively, which are Environmental Justice communities on the basis of minority status.

Implementation of Phase 2 of the proposed project would adversely affect additional residences. There would be severe impacts on nine single-family residences on La Brea Terrace due to increased noise levels associated with operation of proposed crossover P100B. Additionally, there would be moderate noise impacts to six single-family homes on Carrara Avenue (Census Tract 4403.01 Block Group 1) due to proposed crossover P101. Noise impacts associated with Phase1 and Phase 2 would be reduced by implementation of Mitigation Measure NO-1, which calls for construction of sound walls to attenuate the noise level increase from increased train movement along the BART tracks. In addition, implementation of Mitigation Measure NO-2 would require additional noise reduction measures to lessen noise impacts to the upper levels of these residences from train movement. Specifically, BART shall measure indoor noise levels on a case-by-case basis following project implementation and will implement a formal program of building sound insulation improvement as necessary to meet the Federal Transit Administration (FTA) criterion for indoor noise levels. The sound wall and additional noise attenuation measures would effectively reduce potential operational noise effects for sensitive residential land uses to acceptable levels.

During construction of the proposed Hayward Maintenance Complex improvements, noise levels would temporarily increase at the adjacent land uses, the extent of the increase being dependent on the type of construction equipment, timing, duration of activities, and distance to the receptor. Results from the IS/MND show that there would be no adverse impacts to residences during construction of Phase 1, and that, without mitigation, there would be adverse construction noise impacts during Phase 2 of the proposed project. In the absence of mitigation, the following residences would be adversely affected by construction noise during Phase 2 of the proposed project:

- Seven residences along Messina Terrace (Census Tract 4403.01 Block Group 1);
- Eight residences along La Bonita Terrace (Census Tract 4403.01 Block Group 1);

Implementation of Mitigation Measure NO-3 would require BART to incorporate construction noise BMPs to ensure that the proposed project would not have adverse noise effects.

Vibration. The vibration analysis for Phases 1 and 2 indicated that the highest levels of operational vibration would occur near the proposed crossovers south of Whipple Road. The proposed crossovers south of Whipple Road would be constructed as part of the Phase 2 expansion. As a result of the Phase 1 expansion, vibration levels from use of the proposed P102 crossover would exceed the FTA criterion for acceptable vibration levels. The following residences would be adversely affected:

- Six residences on Alicante Terrace; and
- Four residences on Carrara Terrace.

Under the Phase 2 expansion, the following residences would be adversely affected by vibration levels:

- Eight single-family homes on La Bonita Terrace;
- Seven residences on Carrara Terrace; and
- Nine single-family residences on La Brea Terrace.

In total, 10 residences would experience adverse vibration effects from Phase 1 and 24 residences from Phase 2. All of the residences identified above are within Census Tract 4402 Block Group 3, an Environmental Justice community. Mitigation Measure NO-4 would ensure that BART incorporate vibration-reducing technology to meet FTA standards for operational groundborne vibration. As a result, with implementation of Mitigation Measure NO-4, these residents would not experience adverse operational vibration effects.

Construction-related vibration impacts were evaluated in terms of the potential for annoyance and building damage based on FTA guidelines and thresholds. Vibration annoyance would be expected during installation of proposed crossovers P100 and P102 at 26 residences on La Brea Terrace, Alicante Terrace, and Carrara Terrace during Phase 1. During Phase 2, vibration annoyance would be expected to occur during installation of proposed crossovers P100B, P101, P103, and P104 at 29 residences on La Brea, Carrara Terrace, Messina Terrace, and La Bonita Terrace. The construction contractor shall select equipment and methods that would reduce potential annoyance to nearby residents under Mitigation Measure NO-5 in the IS/MND. With implementation of the above mentioned mitigation measures, residents of Census Tract 4403.01 Block Group 1 and Census Tract 4402 Block Group 3, both designated as Environmental Justice communities, would not experience adverse vibration impacts from the proposed project.

Transportation/Traffic. Phase 1 construction activities would generate approximately 3,110 construction truck trips, and Phase 2 construction activities would generate approximately 7,600 construction truck trips. Primary access to the construction areas would be from Whipple Road connecting to/from Interstate 880 to the west and State Route 238 to the east. The scheduling of truck trips is unknown at this time. Whether the peak construction activity would occur during the AM and PM peak hours or be continuous throughout the day would affect existing roadways and intersections. Since project-specific daily construction truck activity is undetermined at this time, the proposed project is conservatively assumed to have an adverse affect on local circulation. Mitigation Measure TR-1 would ensure that the contractor prepare and implement a Construction Phasing and Traffic Management Plan that would anticipate and avoid potential conflicts between existing traffic conditions and construction-related truck trips.

In addition, the transportation analysis concluded that there is an existing line-of-sight hazard for vehicles exiting the west side expansion area driveway to travel southbound along Whipple Road. Mitigation Measure TR-2 requires BART to reconfigure the approach to Whipple Road for the west side expansion area driveway by narrowing the mouth of the intersection and removing vegetation that impedes vehicle line of sight.

With implementation of the recommended mitigation measures, the construction and operation of the proposed Hayward Maintenance Complex would not have adverse effects on transportation and local circulation.

DETERMINATION OF DISPROPORTIONATE EFFECTS

As described in the "Approach" section of this report, the final step in conducting an Environmental Justice analysis is to determine whether the proposed project would have a disproportionate effect on Environmental Justice communities. The purpose of the preceding impact assessment summary of the IS/MND was to disclose the adverse environmental effects of the proposed Hayward Maintenance Complex project. Without implementation of mitigation measures described in the above assessment, the proposed project would result in the following disproportionate adverse environmental effects:

- **Aesthetics** - construction activities could require the removal of existing trees near the industrial building located south of Whipple Road. The removal of these trees could adversely affect views from the Environmental Justice population east of the BART mainline tracks and increase the visibility of the industrial building complex to the west.
- **Biological Resources** - implementation of the proposed project (both Phases 1 and 2) would require tree and shrub removal in preparation for project construction and at the potential access point at the industrial property along the west side of the mainline tracks just south of Whipple Road. Tree and shrub removal during the nesting season could result in the loss of active bird nests. This effect would affect the Environmental Justice populations in the Whipple Road location (Census Tract 4403, Block Groups 1, 2, and 3).
- **Noise and Vibration** - construction and operation of the proposed crossovers south of Whipple would result in adverse impacts to residents in Census Tract 4403.01 Block Group 1 and Census Tract 4402 Block Group 3, which are all identified as Environmental Justice communities.

However, in every instance that the proposed project was found to adversely affect Environmental Justice communities, feasible mitigation measures were identified that would eliminate or reduce the adverse effects to acceptable levels, and no further mitigation measures would be necessary. Furthermore, due to operational and engineering specifications that prescribe the location of the crossover tracks in a manner that can connect the BART mainline with the maintenance and storage areas, there are no feasible alternatives for modifying the location of the crossovers out of an Environmental Justice community. With implementation of the recommended measures, all adverse effects to Environmental Justice populations have been mitigated to less-than-significant levels.

The noise and vibration impacts associated with BART trackwork, involving crossovers and turnouts, are common throughout the BART system and have been identified for a number of recent BART projects, including the Central Contra Costa County Crossover project, the West Dublin/Pleasanton Station project, and the proposed extension to Livermore. In these other instances, the affected sensitive receptors were non-Environmental Justice communities. The types of mitigation recommended for those projects are comparable to those proposed for environmental justice communities near the Hayward Maintenance Complex. The notable difference is that for the BART Hayward Maintenance Complex project, BART is offering affected residents more protection with temporary lodging during the construction period. Accordingly, the mitigation strategy followed by BART does not disadvantage or result in disproportionate impacts on Environmental Justice communities; rather, it seeks to reduce the noise and vibration effects to any and all sensitive receptors to those levels considered acceptable by FTA and BART standards and, in this instance, goes beyond the mitigation proposed for other recent BART construction projects bordered by non-Environmental Justice communities. Therefore, based on the above discussion and analysis, the proposed project would not cause disproportionately high and adverse effects on any minority or low-income populations and proposed mitigation measures are comparable to or better than those offered to non-environmental justice populations near other BART projects.

Furthermore, the potential alternatives to the proposed project are to construct a new facility or to expand the capabilities at other BART maintenance yards in Daly City, Concord, and Richmond. A new facility would be prohibitively expensive and is not a feasible option. Expansion at the other maintenance facilities could occur but may pose adverse effects that cannot be mitigated (e.g., both Daly City and Concord are surrounded by development and further expansion would adversely affect surrounding communities) and would be unacceptable from an operational perspective, since a goal in siting a maintenance/storage facility is to locate it at or near the end of a BART service line. Expanding facilities not at the southern end of the Richmond – Fremont line would not serve the project objectives. Accordingly, there are no feasible options that would result in lesser effects to minority of low-income populations.

PUBLIC INVOLVEMENT

Public participation is a critical component in the proper implementation of Executive Order 12898 and the FTA, EPA, and Department of Transportation's (DOT) guidance on incorporating Environmental Justice into the NEPA process, as well as Title VI of the 1964 Civil Rights Act. Further, the Council on Environmental Quality's (CEQ) regulations requires agencies to make diligent efforts to involve the public throughout the NEPA process. Participation of low-income populations, minority populations, or tribal populations may require adaptive or innovative approaches to overcome linguistic, institutional, cultural, economic, historical, or other potential barriers to effective participation in the decision-making processes of federal agencies under customary NEPA procedures.[7]

During the IS/MND process BART conducted public outreach efforts throughout the Affected Geographic Area. On October 21, 2010 BART held a public meeting at New Haven Adult School in Union City to describe the proposed project to the public and seek public input. The meeting was announced via a mailer to approximately 5,200 addresses within a 1-mile radius of 150 Sandoval Street (street address of the Hayward Yard), and distribution of 250 flyers to 25 community-based and municipal organizations. In addition, in November 2010 BART presented the proposed project to

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[7] Council on Environmental Quality, "Environmental Justice: Guidance Under the National Environmental Policy Act," December 10, 1997.

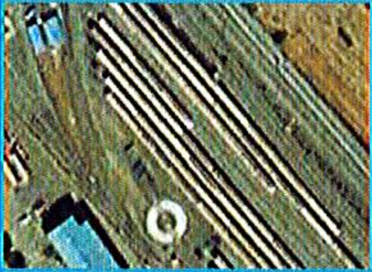
boardmembers of a local homeowners' association in the La Mirada Commons neighborhood in the City of Union City at their request.

The IS/MND was made available for review and comment on December 3, 2010. The Notice of Availability was made public via newspaper advertisements in the San Francisco Chronicle, the Tri City Voice, and Sing Tao (in Chinese), and BART's website in six languages. The IS/MND was posted on BART's website and the executive summary was made available in English, Spanish, Chinese, Korean, Vietnamese, and Tagalog. Related documents such as the noise and vibration technical study were posted to the BART website as well. Hard copies and CDs of the IS/MND were made available at the Union City and Hayward City Halls and main libraries as well as at BART offices. A meeting to receive public comment on the IS/MND, pursuant to CEQA, was held on December 15 at New Haven Adult School in Union City. In addition, an informational meeting was held on December 14 before the Hayward City Council.

To provide the communities with additional time to review and comment on the IS/MND, BART extended the typical 30-day comment period, which would have concluded in early January 2011, to mid-February and convened an additional meeting to allow public comment on the proposed project and its effects. The notice announcing the extension of the public review period and the additional public meeting was posted on the BART website, a mailer was distributed to approximately 3,000 addresses in five languages, and a newspaper advertisement was published in the San Francisco Chronicle, the Tri City Voice, El Mundo (in Spanish), the Philippine News (in Tagalog), and Sing Tao (in Chinese). The additional meeting was held on January 20, 2011 at the Fairway Park Baptist Church in Hayward.

November 18, 2010

BART



Hayward Maintenance Complex
Public Participation Report

San Francisco Bay Area Rapid Transit District

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I. Introduction

Report Purpose

On October 21, 2010, BART hosted a public meeting to discuss and solicit input from community members regarding the proposed Hayward Maintenance Complex (HMC) project. The purpose of the HMC project is to implement BART's Strategic Maintenance Plan and to accommodate an expanded fleet. Project construction will take place over Phase 1 and 2, with Phase 1 construction potentially commencing in 2012.

This report describes BART's process for conducting the outreach meeting; documents the process for collecting public input; reports the comments and questions received; and summarizes the results of community opinion.

San Francisco Bay Area Rapid Transit District (BART)

The San Francisco Bay Area Rapid Transit District (BART) is a rail rapid transit system that travels through 26 cities in four counties. The District is made up of three counties: Alameda, Contra Costa and San Francisco. While San Mateo County is not a represented part of the BART District, it is served by six BART stations. Opened in 1972, BART is governed by a directly-elected nine-member Board of Directors.

BART's five service lines cover 104 miles, and serve an average weekday ridership of 360,000 passengers. There are 43 BART stations, all with intermodal access and some with connections to bus, ferry and other rail systems.

Proposed Hayward Maintenance Complex (HMC) Project

BART's Strategic Maintenance Plan, adopted in 2008, calls for scheduled maintenance and an overhaul approach to car and track maintenance. The Plan aims to improve long-term car reliability and passenger service on the BART system, and is being rolled out over the next several years. The HMC project is identified in the Plan as a priority measure to achieve its goal to expand BART's maintenance and operations capacity in order to accommodate future riders from BART expansions, including to San Jose, East Contra Costa County, Oakland Airport Connector and Livermore.

The HMC proposed project objectives are to provide:

- Facilities for a revenue vehicle Strategic Maintenance Program;
- Capacity for vehicle maintenance and component repair for an expanding fleet;
- A central materials warehouse;

- Enlarged Maintenance and Engineering (M&E) yard, shops, and storage for non-revenue maintenance equipment;
- Enhanced facilities for the Vehicle Inspection area.
- Additional storage tracks for up to 250 additional BART cars; and
- Increased flexibility for BART operations.

The 88-acre Hayward Yard site is located in the City of Hayward, Alameda County. The Yard is west of one existing Union Pacific Railroad (UPRR) rail line and east of a second. It is south of Industrial Parkway in Hayward, with tracks extending southward past Whipple Road to D Street in Union City. One of four rail vehicle maintenance facilities serving the BART system, the Yard provides train storage, train washing, and general maintenance facilities for the BART fleet. The Hayward Yard, unlike the other three facilities, includes a parts warehouse with resources to provide accident-related and component repair. Approximately 280 employees, distributed over 24 hours and a number of shifts, work at the facility.

The improvements proposed in this project will transform the existing facility into the Hayward Maintenance Complex. The proposed project primarily consists of acquisition and improvement to three properties totaling 28 acres on the west side of the existing Hayward Yard and the construction of a maximum 250-BART car storage area on the undeveloped BART property on the site's east side.

A new vehicle overhaul shop, component repair shop, central warehouse, and maintenance and engineering shop and storage area will be built on the west side during Phase 1. On the east side of the BART property, rail car access would be added, existing maintenance operations and storage would move to the west side, and an enhanced vehicle inspection area is also planned for Phase 1.

Additional storage for up to 250 cars and connecting trackwork on the east side is planned for Phase 2. These new storage facilities will accommodate the projected future fleet expansion. Development of the HMC project would increase employment at the Yard. BART estimates that 132 of the 350 future employees would be existing Hayward Yard employees and 218 employees would be new to the site.

Environmental analysis is currently underway. The environmental analysis will determine any project impacts and mitigations. These studies are in compliance with the California Environmental Quality Act (CEQA), the National Environmental Policy Act (NEPA) and Federal Transit Administration (FTA) guidelines. The Draft Initial Study and Mitigated Negative Declaration

(IS/MND) is anticipated to be available for public review in December 2010. There will be at least a 30-day opportunity for the public to provide comments on the environmental document. The BART Board will consider HMC project approval in early 2011. If the Board approves the project, BART staff will complete project design, secure funding, acquire adjacent property, and commence construction.

Community members could expect construction-related traffic, noise, and vibration impacts. Environmental impact reports suggest new operations would increase noise and vibration in the area and new facilities would visually alter the existing complex. Initial assessment indicates that measures can be taken to mitigate all environmental impacts.

The funding for the HMC project is to be determined and BART is currently seeking Phase 1 funding. BART staff set up the October 21 outreach meeting as a way to offer a description of the proposed project to the public and receive input from all potentially affected communities. There will also be a public comment meeting to receive comments on the draft environmental document.

II. Process for Soliciting Public Comment

Consistent with BART's Public Participation Plan completed in May 2010, BART conducted outreach for and hosted one community meeting in the Hayward Yard area to solicit feedback from the public on certain aspects of the proposed HMC project. Community meeting participants had the opportunity to ask questions and provide feedback.

Outreach

BART conducted outreach for the meetings using the following methods:

- Mailings to residents (4,600) and businesses (600) within one mile of the HMC site
- BART website announcement
- Bay Area Media, both print and online
- "In person" outreach in nearby communities
- Creation of trilingual flyer and mailer in English, Spanish and Tagalog (see Appendix A)
- Distribution of postcards, flyers and community bulletins through the following local community-based and municipal organizations:
    - Afghan & International Refugees Support Services
    - Alameda County One Stop Career Center
    - Centro de Servicios
    - Continental Mobile Home Park
    - Daison Japan (Asian Market)
    - Eden Area YMCA
    - Eden Youth Center
    - Hayward City Hall
    - Hayward Day Labor Center
    - Hayward Family Resource Center
    - Hillview Baptist Church
    - Hillview Crest Elementary School
    - Kennedy Community Center
    - La Familia Counseling Services
    - Lincoln Child Center
    - Marina Food (Asian Supermarket)
    - Masjid Abubaker Siddiq (Mosque)
    - New Haven Adult School
    - Nichiren Buddhist Center International Center
    - Our Lady of the Rosary Parish
    - Rental Housing Owners Association of Hayward
    - South Hayward Parish
    - Spanish Ranch Mobile Home Park No. 2
    - Tiburcio Vasquez Health Center

- Union City Library
- Union City Police Department
- Union City, City Hall

Community Meeting

The community meeting was held Thursday, October 21, 2010 at New Haven Adult School at 600 G Street in Union City between 6:00 and 7:30 PM. Refreshments were available at the meeting. Four community members attended the meeting. The low turnout was possibly due to the fact that the San Francisco Giants were in a National League playoff game that evening. At the meeting, participants were asked to sign in and were provided a project brief and other BART informational materials. BART staff person Amanda Martinez opened the meeting with welcoming remarks and introduced BART Project Planning Manager Ellen Smith. BART staff briefly reviewed the agenda and meeting purpose, followed by a presentation about the HMC project, which described the project purpose, need, elements, and the environmental analysis and review timeline.

Following the presentation, Ms. Smith opened the meeting for HMC project questions and comments. The small group size allowed for significant discussion and for participants to ask questions and make multiple comments. The small group size also allowed the participants to discuss specific aspects of the project with the Project Manager, Project Planning Manager, environmental consultant and Community Relations Manager. A graphic recorder took notes and recorded comments and questions on large scale wallgraphic paper.

Below is a summary of the key questions and comments received at the meeting, organized by topic.

III. Public Comments

Community Meeting Questions on HMC

Project Construction

Participants asked questions regarding project construction impacts and timeline. These questions and answers are summarized below.

- Please describe the construction scenario of Phase 1 and 2.
  - *BART planning staff is still determining the construction scenario details.*

- What will happen during Phase 1 and 2 of construction?
  - *Phase 1 includes improvements to the west side of the future HMC property, and eastside vehicle inspection area construction. Phase 2 includes track construction on the east side of the property.*
- Are the warehouse properties the only parcels planned for acquisition?
  - *Yes.*

Project Design

Meeting participants asked questions related to project design; questions and answers are summarized below.

- Will there be any changes to the adjacent bridge?
  - *Union City is undertaking an unrelated seismic improvement project on the Whipple Road Bridge.*
  - *BART will construct a retaining wall under the west side of the Whipple Road Bridge parallel to the BART tracks. The bridge itself would not be affected.*
- Please clarify the location of the east and west side of the property.
  - *The west side of the property adjoins the existing warehouse buildings and the east side adjoins the proposed storage and transfer tracks.*
- What is a "switch"?
  - *A switch is the mechanical structure used where two tracks come together or diverge.*
- Will there be new track?
  - *There will be one new track south of the Whipple Avenue Bridge, which will be constructed during Phase I.*
- Will there be sound walls?
  - *Noise impact studies are being conducted and the results will determine if sound walls are necessary. If noise mitigation measures are necessary, then sound walls would be constructed.*

Environmental Review

Meeting participants asked questions about the environmental review process and analysis; questions and answers are summarized below.

- In terms of noise, please define "less than significant."
  - *The Federal Transit Administration has thresholds for what are considered acceptable levels of transit-related noise. The noise and vibration report being prepared will compare project-generated noise with those thresholds. If the project noise is not above those designated thresholds, the impact is considered less than significant.*

- What is the existing sound level at the Hayward Yard and adjacent neighborhoods?
    - *The existing sound levels will be reported in the noise and vibration study.*
- Where will the draft environmental document be publicly available?
    - *In December 2010, the document will be available in the BART office, on the BART website, and in hard copy format at local libraries and city offices. BART could also send an electronic version of the document to meeting participants for those leaving contact information.*

General Project Questions

Participants asked general BART-related questions pertaining to the proposed project; the discussion is described below.

- How will the project be funded?
    - *BART, Federal and local agency resources will fund the proposed project; cities and local jurisdictions will not fund the project. Finding funding for Phase 1 is a priority.*
- What is the relationship and property line between Carter industries (an adjacent property owner) and BART?
    - *BART and Carter Industries are adjacent property owners, with the fence probably marking the property line.*
- Where else is BART maintenance currently conducted?
    - *Existing BART maintenance shops are located in Daly City, Richmond, and Concord. Why expand the HMC?*
- HMC is strategically located close to future BART extension projects, and will serve the future fleet as the central point of the system shifts southward. Does BART maintain partnerships with local jurisdictions?
    - *Yes. Cities will not be asked to fund the proposed project.*
- *How does BART prioritize projects?*
    - *Priority projects meet District and community goals, have available funding and support.*

Community Meeting Comments on HMC

Participants commented on the proposed HMC project; comments are listed below.

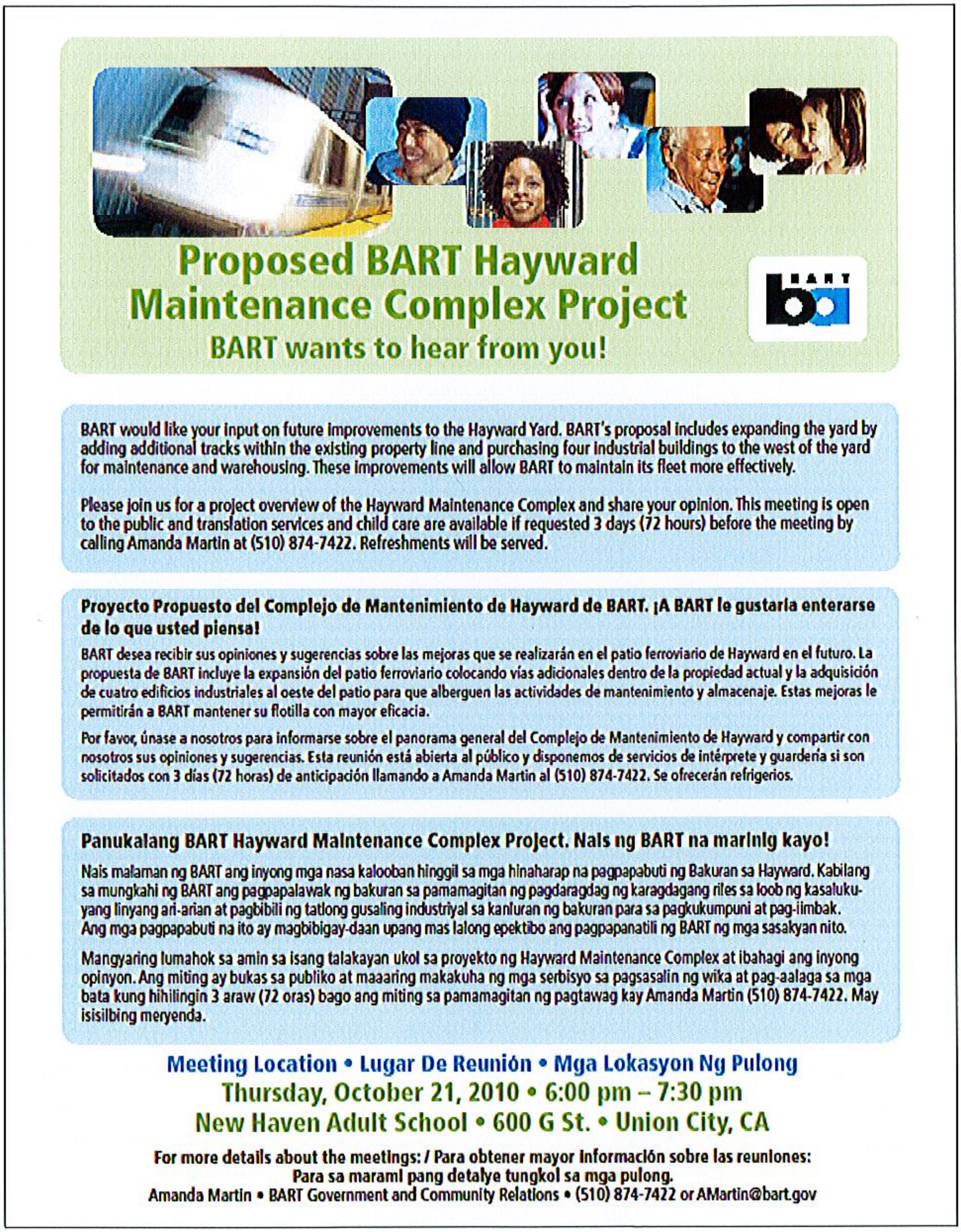
- There doesn't seem to be room for the proposed new track.
- My neighborhood is currently too noisy; the existing sound wall doesn't mitigate noise and vibration from the Yard.

Participants requested additional information and future actions including:

- Include a cross-section and/or photo simulation of the project in the informational brochure.
- Conduct a mailing to local neighbors when the draft environmental document is available for public review.
- Provide the environmental document online, send a CD to meeting participants, in local city halls, and provide a clear and accessible link to the document.

BART agreed to these three requests.

Appendix A: Outreach Materials



Proposed BART Hayward Maintenance Complex Project

BART wants to hear from you!

BART would like your input on future improvements to the Hayward Yard. BART's proposal includes expanding the yard by adding additional tracks within the existing property line and purchasing four industrial buildings to the west of the yard for maintenance and warehousing. These improvements will allow BART to maintain its fleet more effectively.

Please join us for a project overview of the Hayward Maintenance Complex and share your opinion. This meeting is open to the public and translation services and child care are available if requested 3 days (72 hours) before the meeting by calling Amanda Martin at (510) 874-7422. Refreshments will be served.

Proyecto Propuesto del Complejo de Mantenimiento de Hayward de BART. ¡A BART le gustaria enterarse de lo que usted piensa!

BART desea recibir sus opiniones y sugerencias sobre las mejoras que se realizarán en el patio ferroviario de Hayward en el futuro. La propuesta de BART incluye la expansión del patio ferroviario colocando vías adicionales dentro de la propiedad actual y la adquisición de cuatro edificios industriales al oeste del patio para que alberguen las actividades de mantenimiento y almacenaje. Estas mejoras le permitirán a BART mantener su flotilla con mayor eficacia.

Por favor, únase a nosotros para informarse sobre el panorama general del Complejo de Mantenimiento de Hayward y compartir con nosotros sus opiniones y sugerencias. Esta reunión está abierta al público y disponemos de servicios de intérprete y guardería si son solicitados con 3 días (72 horas) de anticipación llamando a Amanda Martin al (510) 874-7422. Se ofrecerán refrigerios.

Panukalang BART Hayward Maintenance Complex Project. Nais ng BART na marinig kayo!

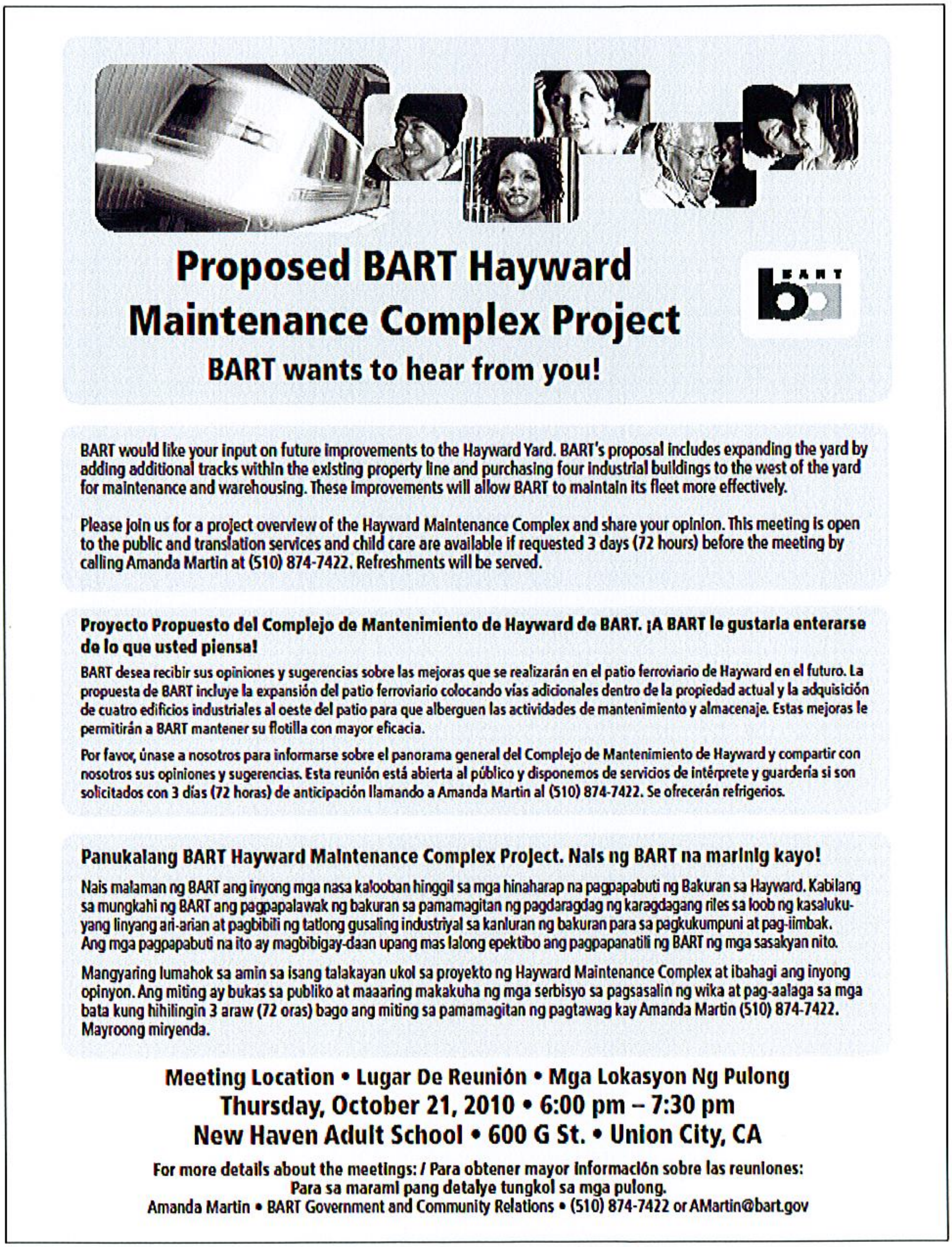
Nais malaman ng BART ang inyong mga nasa kalooban hinggil sa mga hinaharap na pagpapabuti ng Bakuran sa Hayward. Kabilang sa mungkahi ng BART ang pagpapalawak ng bakuran sa pamamagitan ng pagdaragdag ng karagdagang riles sa loob ng kasalukuyang linyang ari-arian at pagbibili ng tatlong gusaling industriyal sa kanluran ng bakuran para sa pagkukumpuni at pag-iimbak. Ang mga pagpapabuti na ito ay magbibigay-daan upang mas lalong epektibo ang pagpapanatili ng BART ng mga sasakyan nito.

Mangyaring lumahok sa amin sa isang talakayan ukol sa proyekto ng Hayward Maintenance Complex at ibahagi ang inyong opinyon. Ang miting ay bukas sa publiko at maaaring makakuha ng mga serbisyo sa pagsasalin ng wika at pag-aalaga sa mga bata kung hihilingin 3 araw (72 oras) bago ang miting sa pamamagitan ng pagtawag kay Amanda Martin (510) 874-7422. May isisilbing meryenda.

Meeting Location • Lugar De Reunión • Mga Lokasyon Ng Pulong
Thursday, October 21, 2010 • 6:00 pm – 7:30 pm
New Haven Adult School • 600 G St. • Union City, CA

For more details about the meetings: / Para obtener mayor información sobre las reuniones:
Para sa marami pang detalye tungkol sa mga pulong.
Amanda Martin • BART Government and Community Relations • (510) 874-7422 or AMartin@bart.gov

Figure 1: Hayward Maintenance Complex Meeting Flyer



Proposed BART Hayward Maintenance Complex Project

BART wants to hear from you!

BART would like your input on future improvements to the Hayward Yard. BART's proposal includes expanding the yard by adding additional tracks within the existing property line and purchasing four industrial buildings to the west of the yard for maintenance and warehousing. These improvements will allow BART to maintain its fleet more effectively.

Please join us for a project overview of the Hayward Maintenance Complex and share your opinion. This meeting is open to the public and translation services and child care are available if requested 3 days (72 hours) before the meeting by calling Amanda Martin at (510) 874-7422. Refreshments will be served.

Proyecto Propuesto del Complejo de Mantenimiento de Hayward de BART. ¡A BART le gustaría enterarse de lo que usted piensa!

BART desea recibir sus opiniones y sugerencias sobre las mejoras que se realizarán en el patio ferroviario de Hayward en el futuro. La propuesta de BART incluye la expansión del patio ferroviario colocando vías adicionales dentro de la propiedad actual y la adquisición de cuatro edificios industriales al oeste del patio para que alberguen las actividades de mantenimiento y almacenaje. Estas mejoras le permitirán a BART mantener su flotilla con mayor eficacia.

Por favor, únase a nosotros para informarse sobre el panorama general del Complejo de Mantenimiento de Hayward y compartir con nosotros sus opiniones y sugerencias. Esta reunión está abierta al público y disponemos de servicios de intérprete y guardería si son solicitados con 3 días (72 horas) de anticipación llamando a Amanda Martin al (510) 874-7422. Se ofrecerán refrigerios.

Panukalang BART Hayward Maintenance Complex Project. Nais ng BART na marinig kayo!

Nais malaman ng BART ang inyong mga nasa kalooban hinggil sa mga hinaharap na pagpapabuti ng Bakuran sa Hayward. Kabilang sa mungkahi ng BART ang pagpapalawak ng bakuran sa pamamagitan ng pagdaragdag ng karagdagang riles sa loob ng kasalukuyang linyang ari-arian at pagbibili ng tatlong gusaling industriyal sa kanluran ng bakuran para sa pagkukumpuni at pag-iimbak. Ang mga pagpapabuti na ito ay magbibigay-daan upang mas lalong epektibo ang pagpapanatili ng BART ng mga sasakyan nito.

Mangyaring lumahok sa amin sa isang talakayan ukol sa proyekto ng Hayward Maintenance Complex at ibahagi ang inyong opinyon. Ang miting ay bukas sa publiko at maaaring makakuha ng mga serbisyo sa pagsasalin ng wika at pag-aalaga sa mga bata kung hihilingin 3 araw (72 oras) bago ang miting sa pamamagitan ng pagtawag kay Amanda Martin (510) 874-7422. Mayroong miryenda.

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Figure 2: Hayward Maintenance Complex Meeting Mailer

Attachment B
Summary of Outreach related to Proposed Hayward Maintenance Complex Project
October 2010 through February 2011

October 2010

Title VI public participation meeting held October 21 to describe the proposed project to the public and seek input.

- New Haven Adult School, Union City
- Court reporter and wall-graphic recording

Meeting made public via:

- Mailer to approximately 5,200 addresses within 1-mile radius of Hayward Yard street address
- Distribution of 250 flyers to 25 community-based and municipal organizations
- email blast from City of Hayward

November 2010

Responded to request from a homeowners' association and made presentation to Boardmembers

December 2010

Draft Initial Study/Mitigated Negative Declaration made available for review and comment Dec 3, 2010

Notice of availability made public via:

- BART website (www.bart.gov/hmc) – information in 6 languages
- Presentation at Hayward City Council meeting December 14
- Newspaper ads in San Francisco Chronicle, Tri City Voice, Sing Tao (in Chinese)
- Attempted mailer to 3000 addresses but mailhouse failed to map and mail correctly

Draft IS/MND availability:

- Draft IS/MND available via BART website
- Executive Summary in English, Spanish, Chinese, Korean, Vietnamese and Tagalog on BART website
- Related documents, including Noise and Vibration study, available via BART website
- Copies available at Hayward and Union City City Halls and main libraries
- CDs available at Hayward and Union City City Halls and main libraries
- Copies available at BART offices
- Executive Summary available at December 15 comment meeting
- CDs made available upon request

Presentation to Hayward City Council December 14

Comment meeting held Wednesday, December 15 at New Haven Adult School, Union City

- Participants included Hayward, Union City staff, reporter, individuals related to industrial property
- Court reporter recorded presentation

January 2011

Comment period for draft is.mnd extended to February 11, 2011 (70 days total) and additional comment meeting added

Notice of extension and second comment meeting made public via:

- Mailer sent to approximately 3000 addresses within ½ mile of Hayward Yard perimeter in 5 languages
- BART website (www.bart.gov/hmc) – information in 6 languages
- Newspaper ads in San Francisco Chronicle, Tri City Voice, El Mundo (in Spanish), Philippine News (in Tagalog), Sing Tao (in Chinese) -- various dates in mid-January
- Information provided to Hayward and Union City staff
- Article in Oakland Tribune and Bay Area News Group papers, January 5, 2011

Open house and public hearing January 20, 2011 Fairway Park Baptist Church, Hayward

- 30 participants including 2 Hayward City Councilmembers
- "Community meeting" approach
- Court reporter recorded presentation and comments

Appendix O

EJ Communities Minority and Low Income Mapping and Tables on Proposed Substation Locations

EJ Minorities and Low Income Communities

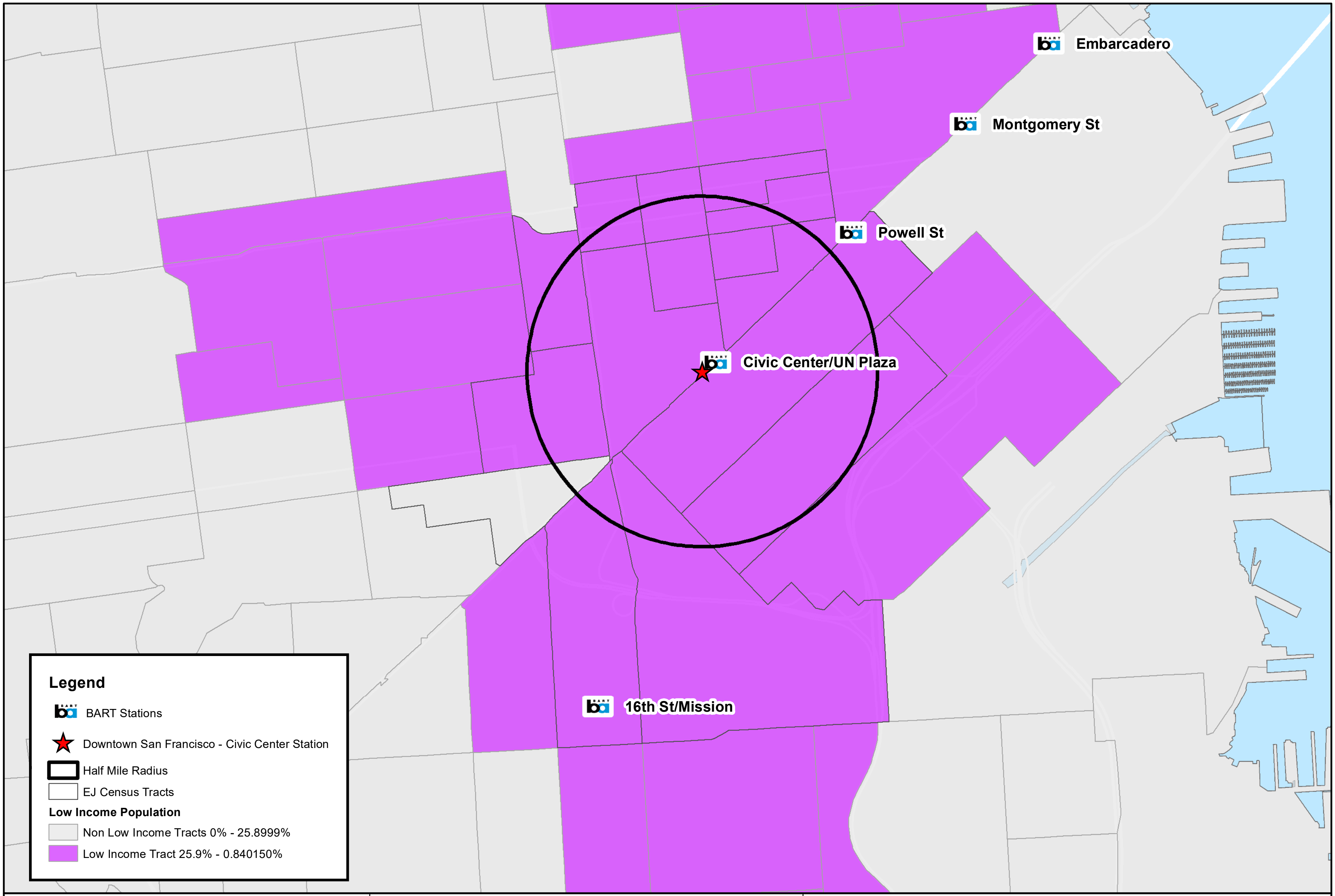
Civic Center Census Tract	*Total Population*	*Minority Population*	*Percentage minority*	*Total Population*	*Low Income Populaton*	*Percentage Low Income*
Census Tract 122.01	4576	3187	70%	4576	2112	46%
Census Tract 122.02	3079	2081	68%	3079	1776	58%
Census Tract 123.01	1790	1238	69%	1790	1322	74%
Census Tract 123.02	2518	1495	59%	2474	1258	51%
Census Tract 124.01	4613	3603	78%	4610	3481	76%
Census Tract 124.02	3393	2004	59%	3055	1367	45%
Census Tract 125.01	3547	2574	73%	3469	2757	79%
Census Tract 125.02	4120	3577	87%	3940	2857	73%
Census Tract 160	2552	1281	50%	2552	699	27%
Census Tract 162	2604	1073	41%	2604	841	32%
Census Tract 168.02	2957	1248	42%	2955	746	25%
Census Tract 176.01	7220	5289	73%	7196	3964	55%
Census Tract 177	1654	935	57%	1654	540	33%
Census Tract 178.02	4307	2515	58%	4298	1407	33%
Census Tract 201	5257	3422	65%	5203	2652	51%
Total (1/2 mile buffer)	**54187**	**35522**	**66%**	**53455**	**27779**	**52%**

Montgomery Census Tract	*Total Population*	*Minority Population*	*Percentage minority*	*Total Population*	*Low Income Populaton*	*Percentage Low Income*
Census Tract 105	2606	1040	40%	2606	454	17%
Census Tract 113	3058	2480	81%	3029	1720	57%
Census Tract 117	1547	1079	70%	1495	566	38%
Census Tract 118	1740	1623	93%	1740	1269	73%
Census Tract 119.02	2625	1480	56%	2625	1010	38%
Census Tract 121	3876	1898	49%	3340	1242	37%
Census Tract 123.01	1790	1238	69%	1790	1322	74%
Census Tract 123.02	2518	1495	59%	2474	1258	51%
Census Tract 176.01	7220	5289	73%	3469	2757	79%
Census Tract 178.01	3066	2272	74%	3054	1765	58%
Census Tract 611	4488	4300	96%	4488	3592	80%
Census Tract 615	12391	6068	49%	12149	2089	17%
Total (1/2 mile buffer)	**46925**	**30262**	**64%**	**42259**	**19044**	**45%**

Oakland 34th and I-980 Census Tract	*Total Population*	*Minority Population*	*Percentage minority*	*Total Population*	*Low Income Populaton*	*Percentage Low Income*
Census Tract 4010	5505	3946	72%	5486	2502	46%
Census Tract 4011	4240	2151	51%	4240	1318	31%
Census Tract 4012	2345	1009	43%	2323	480	21%
Census Tract 4013	3815	2874	75%	3517	1953	56%
Census Tract 4014	4297	3470	81%	4246	2876	68%
Census Tract 4015	2131	1288	60%	2131	1011	47%
Total (1/2 mile buffer)	**22333**	**14738**	**66%**	**21943**	**10140**	**46%**
Concord - Minert Road	*Total Population*	*Minority Population*	*Percentage minority*	*Total Population*	*Low Income Populaton*	*Percentage Low Income*
Census Tract 3372	7736	3424	44%	7491	1671	22%
Census Tract 3381.02	3727	1512	41%	3717	267	7%
Census Tract 3382.01	3528	1023	29%	3435	446	13%
Total (1/2 mile buffer)	**14991**	**5959**	**40%**	**14643**	**2384**	**16%**
Richmond RYE Gap Breaker	*Total Population*	*Minority Population*	*Percentage minority*	*Total Population*	*Low Income Populaton*	*Percentage Low Income*
Census Tract 3730	3648	3567	98%	3596	1778	49%
Census Tract 3750	4829	4676	97%	4782	3010	63%
Census Tract 3760	5968	5750	96%	5957	3638	61%
Census Tract 3770	6821	6247	92%	6784	4082	60%
Total (1/2 mile buffer)	**21266**	**20240**	**95%**	**21119**	**12508**	**59%**

TITLE VI ANALYSIS: Downtown San Francisco - Civic Center Station: Low Income Population

Date: 7/31/2017



Data provided by numerous sources:
BART, U.S. Census 2010 and ACS 2010-2014
The BART Service Area is 4 Counties: Alameda, Contra Costa, San Francisco and San Mateo

Map Displayed in North American Datum 1983
State Plane California III FIPS 0403 US Feet

San Francisco Bay Area Rapid Transit District
EGIS - BART Office of the CIO
300 Lakeside Dr. 11th Floor, Oakland, CA 94612

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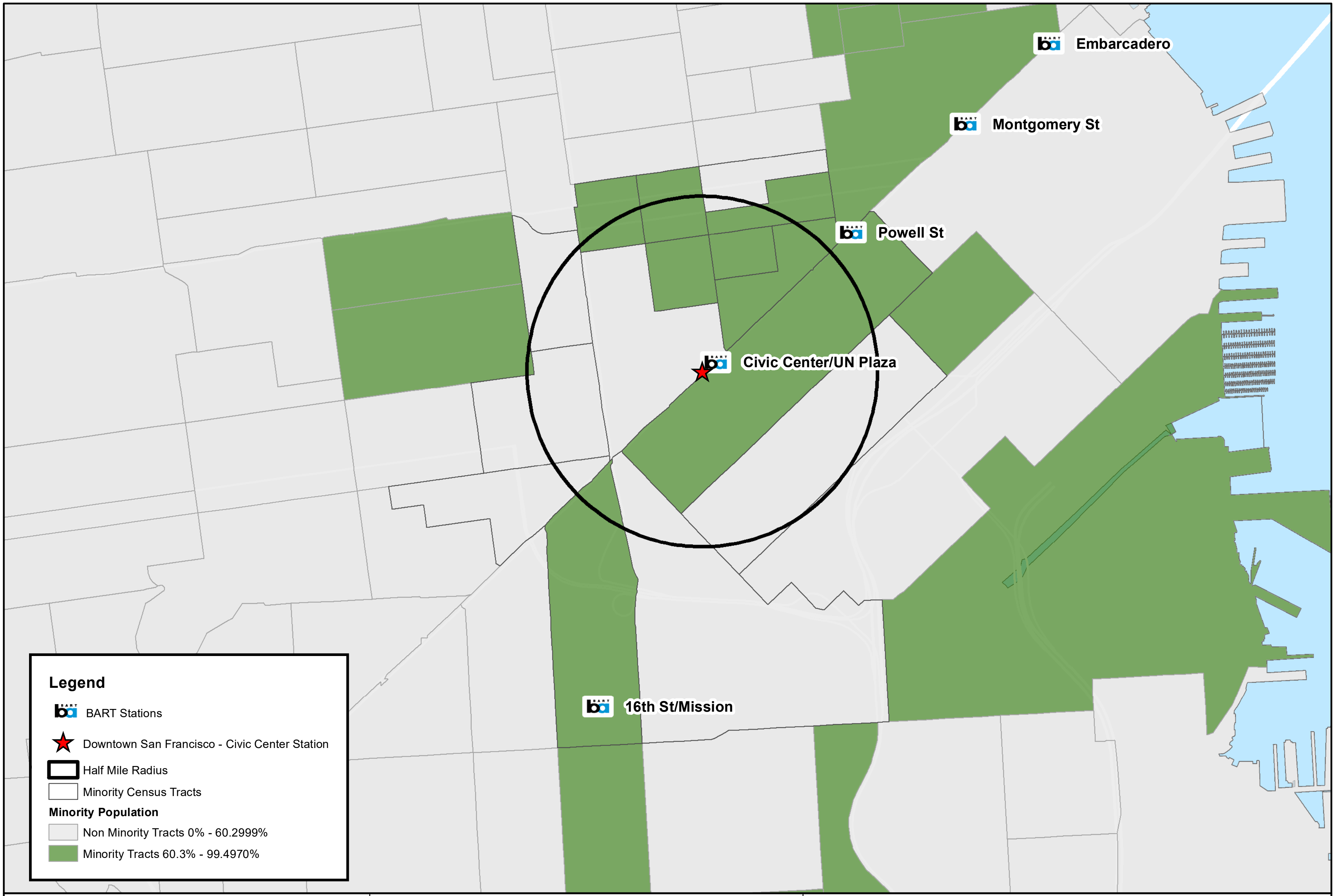

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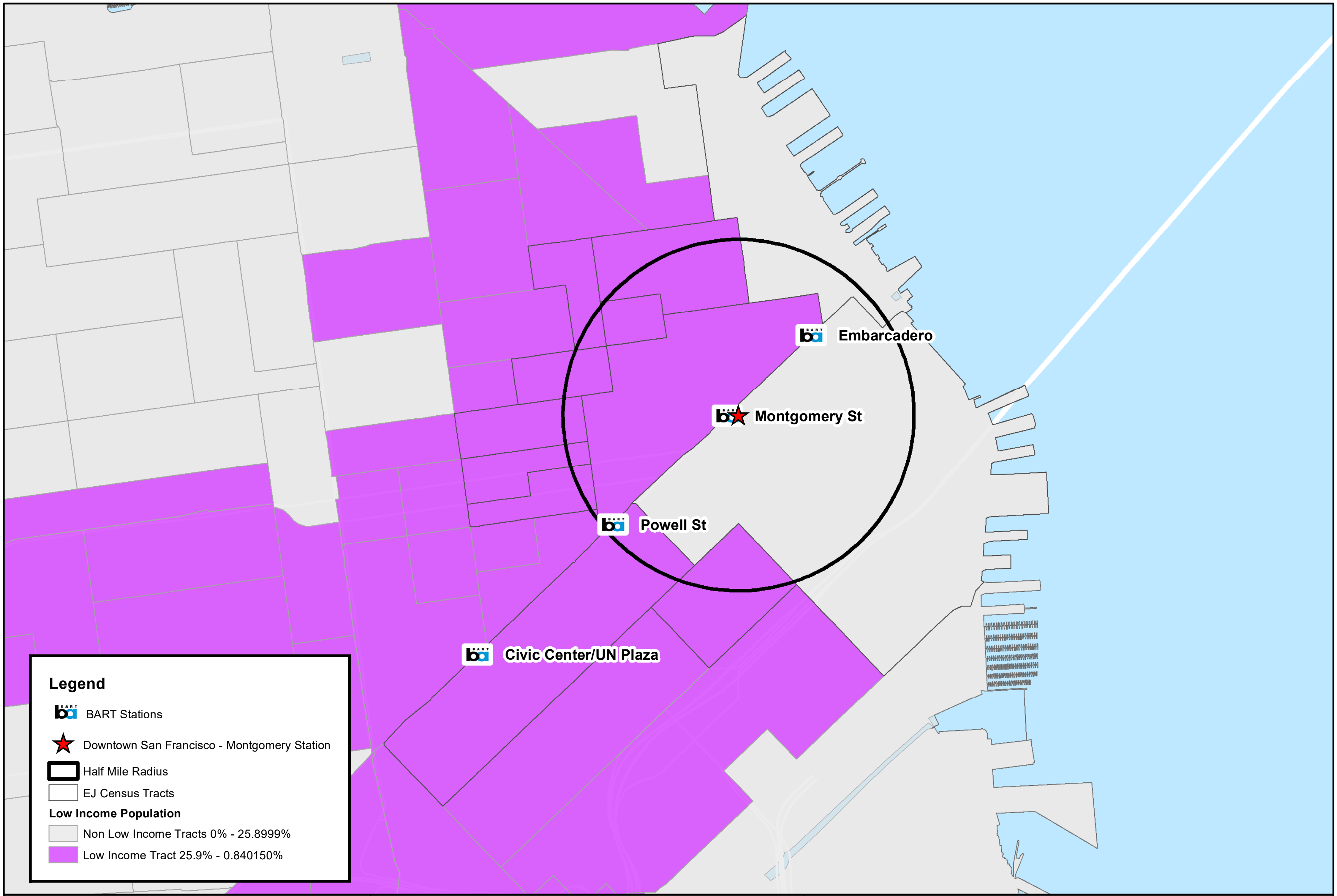
TITLE VI ANALYSIS: Downtown San Francisco - Montgomery Station: Low Income Population

Date: 7/31/2017



Data provided by numerous sources:
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N

0 0.25 0.5 1 Miles

Map Displayed in North American Datum 1983
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0 0.25 0.5 1 Miles

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Map Displayed in North American Datum 1983
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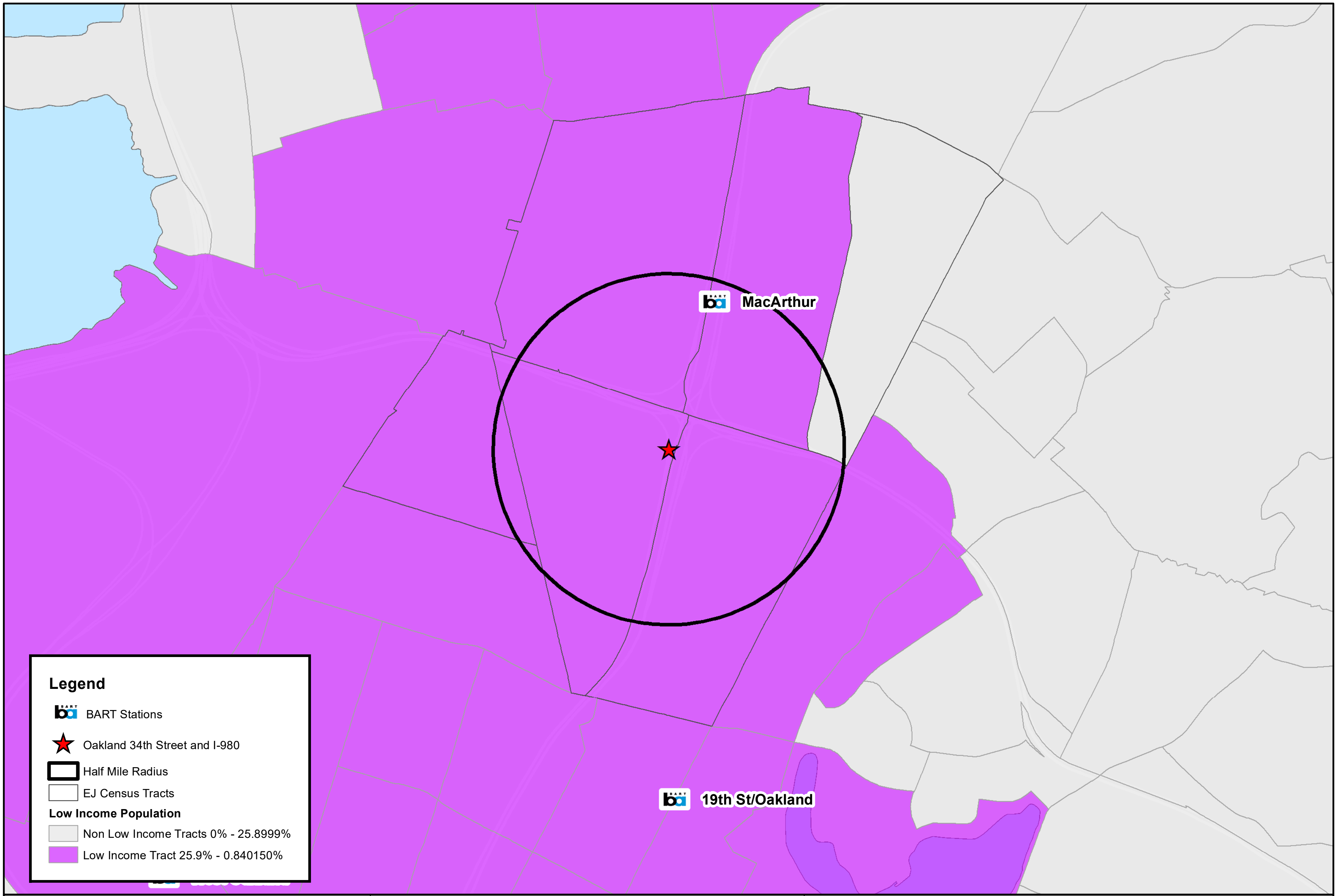
TITLE VI ANALYSIS: Oakland 34th Street and I-980 Substation: Low Income Population

Date: 7/31/2017



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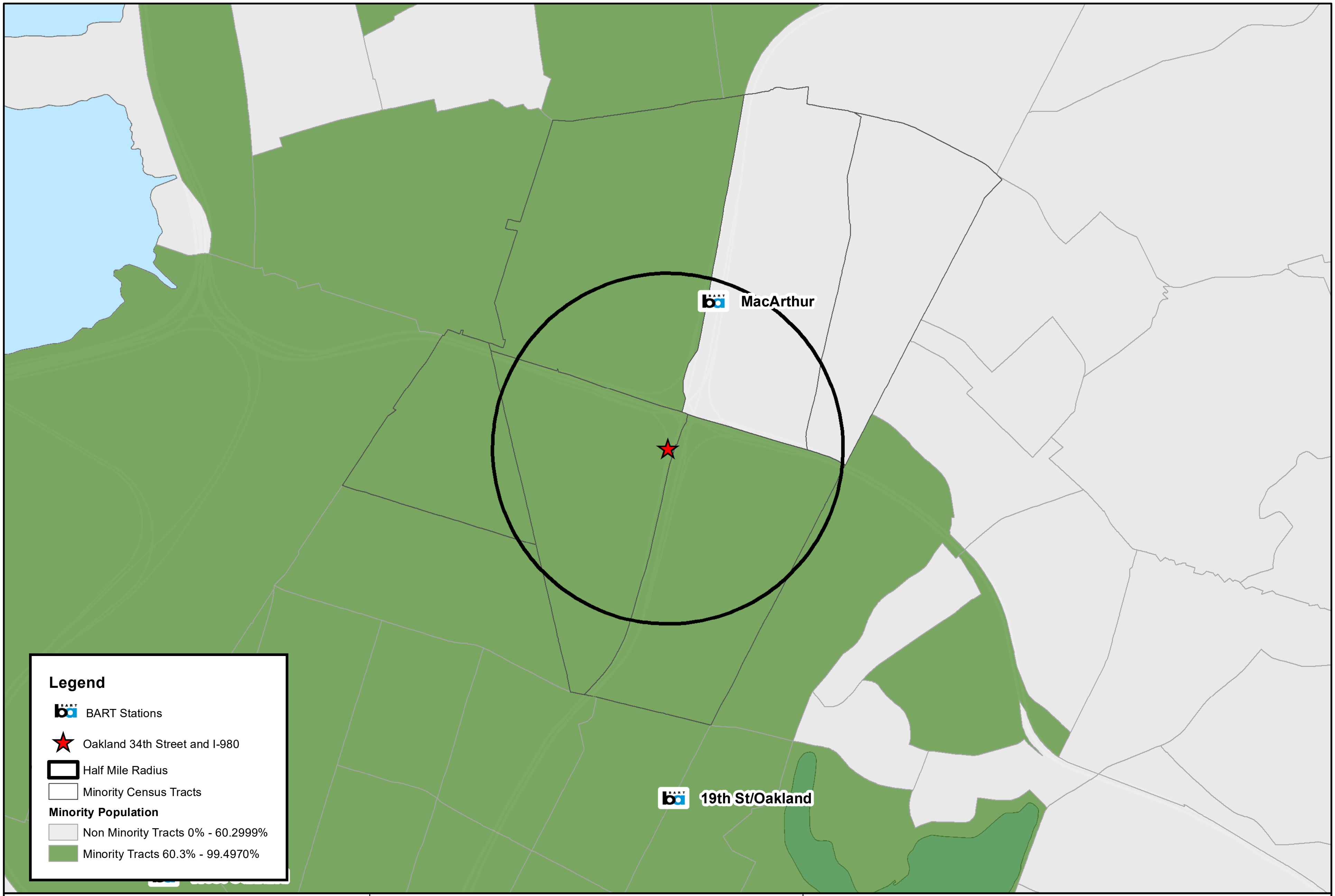

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0 0.25 0.5 1 Miles
Map Displayed in North American Datum 1983
State Plane California III FIPS 0403 US Feet

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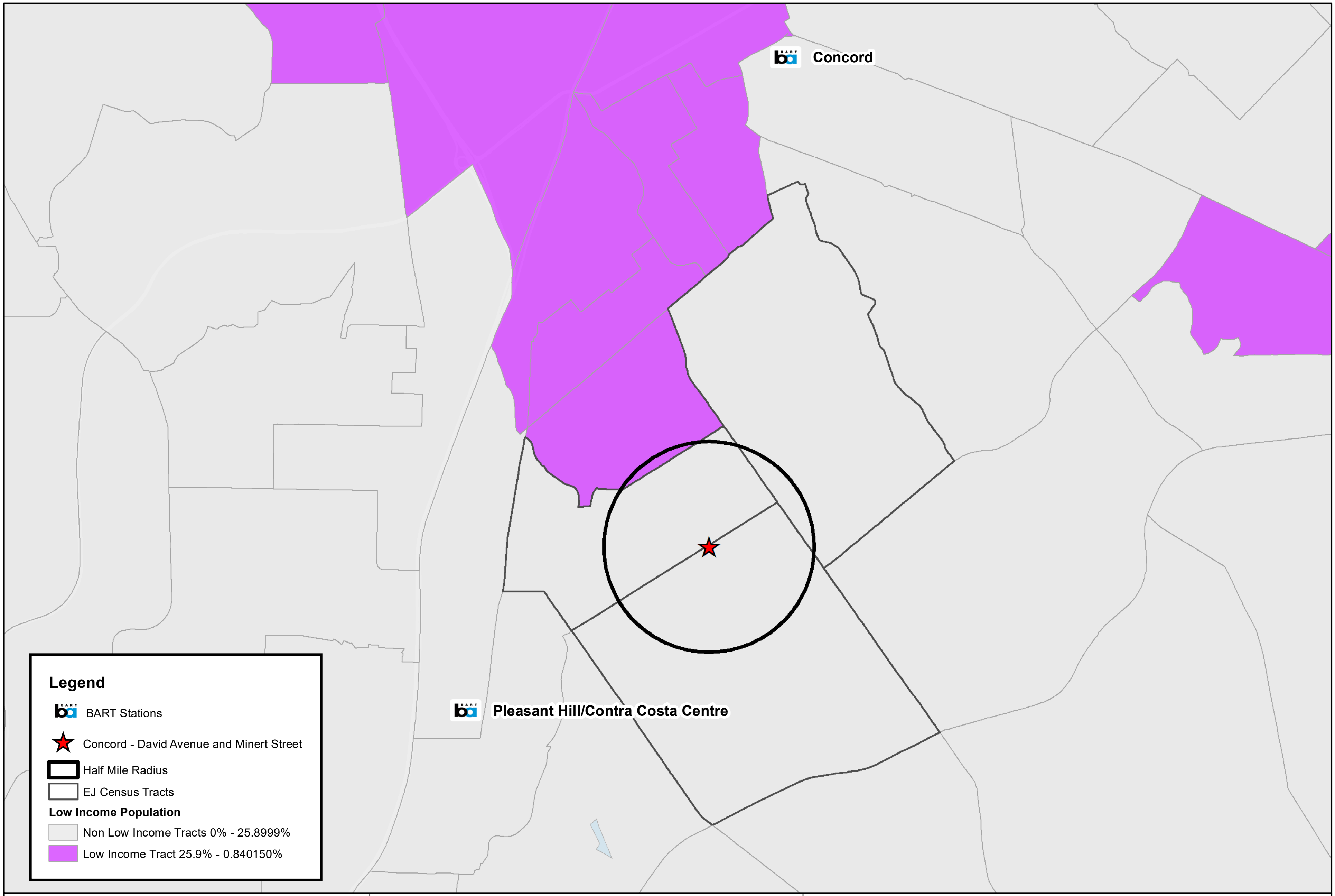
TITLE VI ANALYSIS: Concord - David Avenue and Minert Street Substation: Low Income Population

Date: 7/31/2017



Data provided by numerous sources:
BART, U.S. Census 2010 and ACS 2010-2014
The BART Service Area is 4 Counties: Alameda, Contra Costa, San Francisco and San Mateo

Miles
N
0 0.4 0.8 1.6
Map Displayed in North American Datum 1983
State Plane California III FIPS 0403 US Feet

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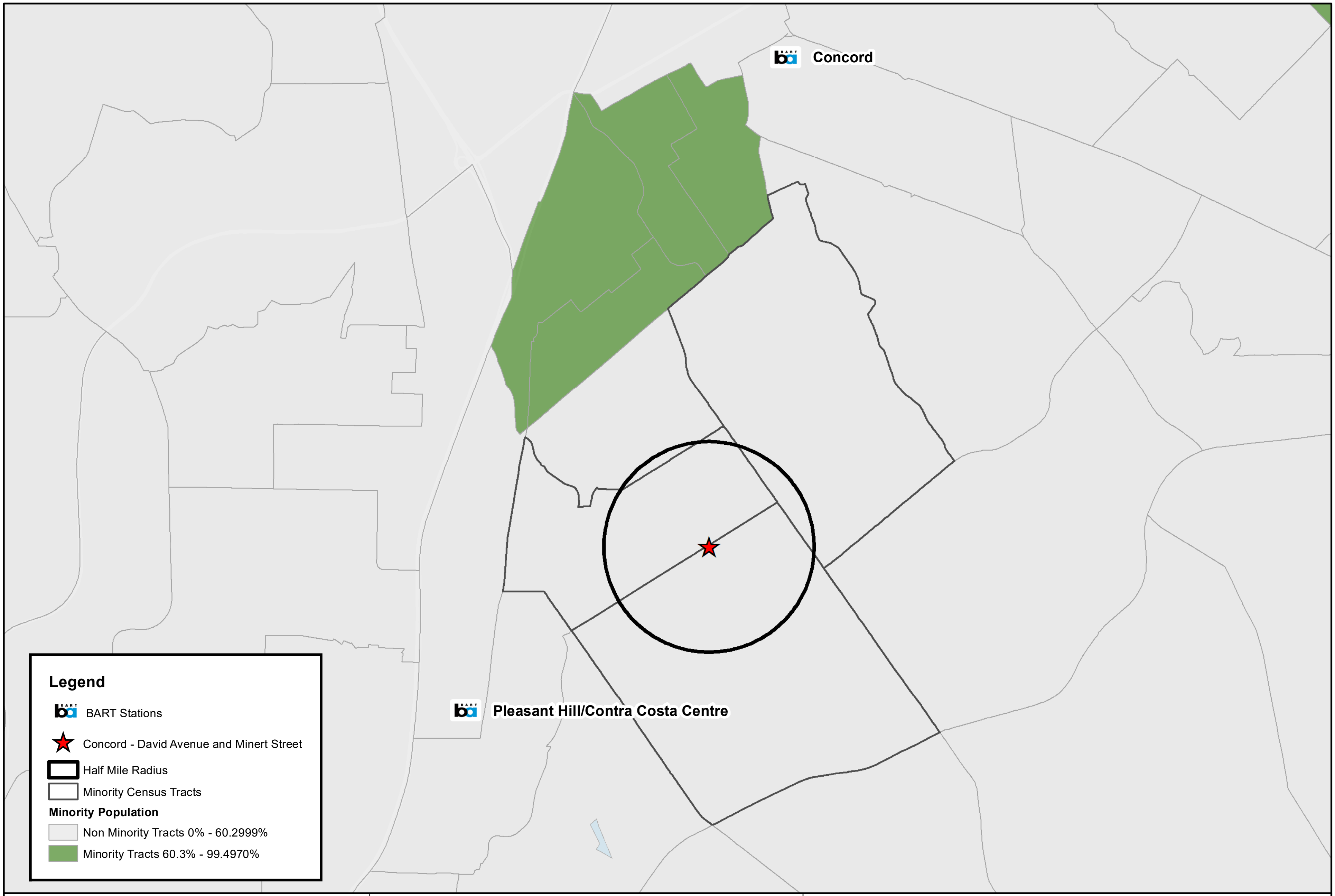
Date: 7/31/2017



Data provided by numerous sources:
BART, U.S. Census 2010 and ACS 2010-2014
The BART Service Area is 4 Counties: Alameda, Contra Costa, San Francisco and San Mateo

N

0 0.4 0.8 1.6 Miles

Map Displayed in North American Datum 1983
State Plane California III FIPS 0403 US Feet

San Francisco Bay Area Rapid Transit District
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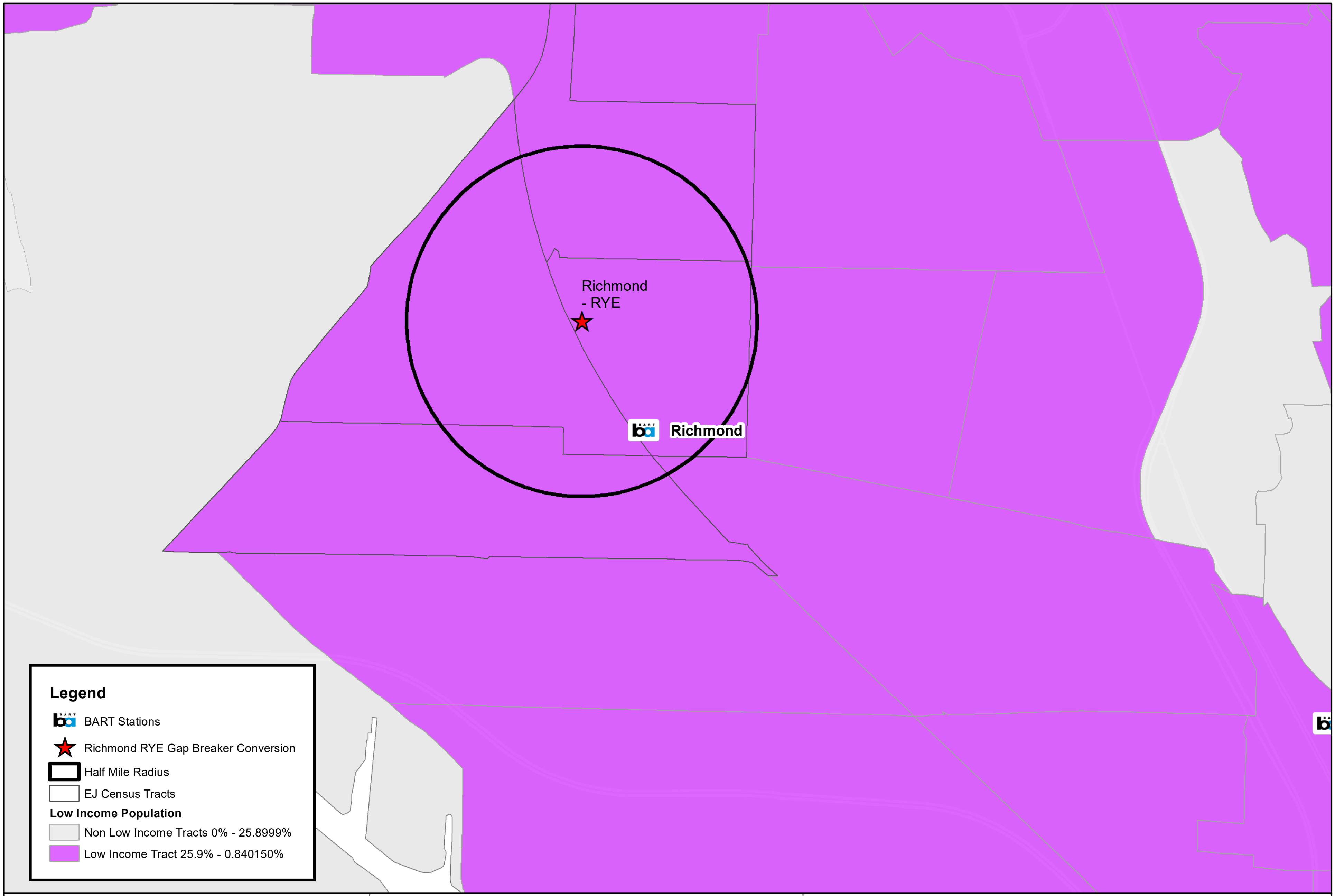
300 Lakeside Dr. 11th Floor, Oakland, CA 94612

TITLE VI ANALYSIS: Richmond - RYE Gap Breaker Conversion: Low Income Population

Date: 7/31/2017



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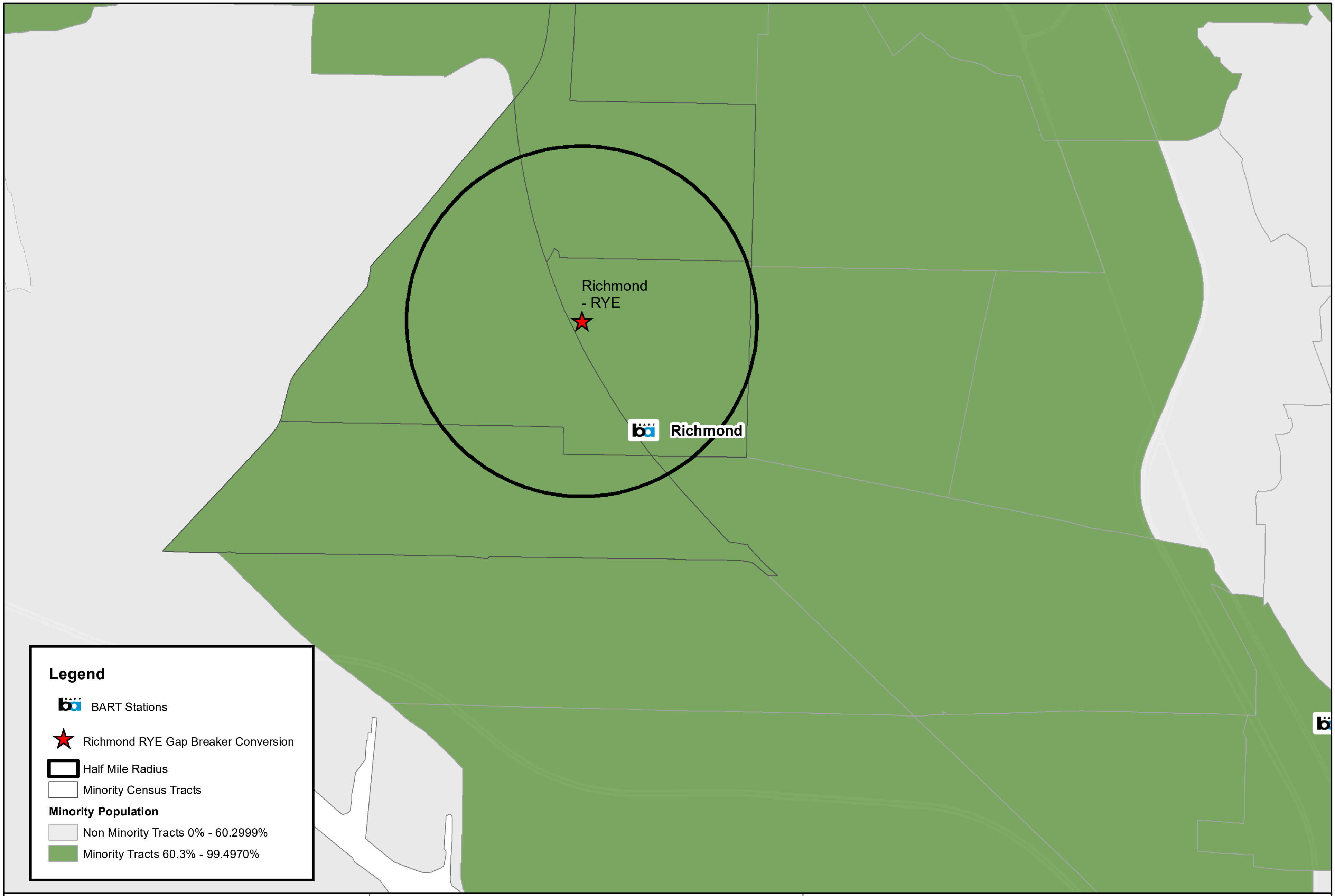

Legend

- BART Stations
- ★ Richmond RYE Gap Breaker Conversion
- Half Mile Radius
- ☐ Minority Census Tracts

Minority Population

- ☐ Non Minority Tracts 0% - 60.2999%
- 🟩 Minority Tracts 60.3% - 99.4970%

Data provided by numerous sources:
BART, U.S. Census 2010 and ACS 2010-2014
The BART Service Area is 4 Counties: Alameda, Contra Costa, San Francisco and San Mateo

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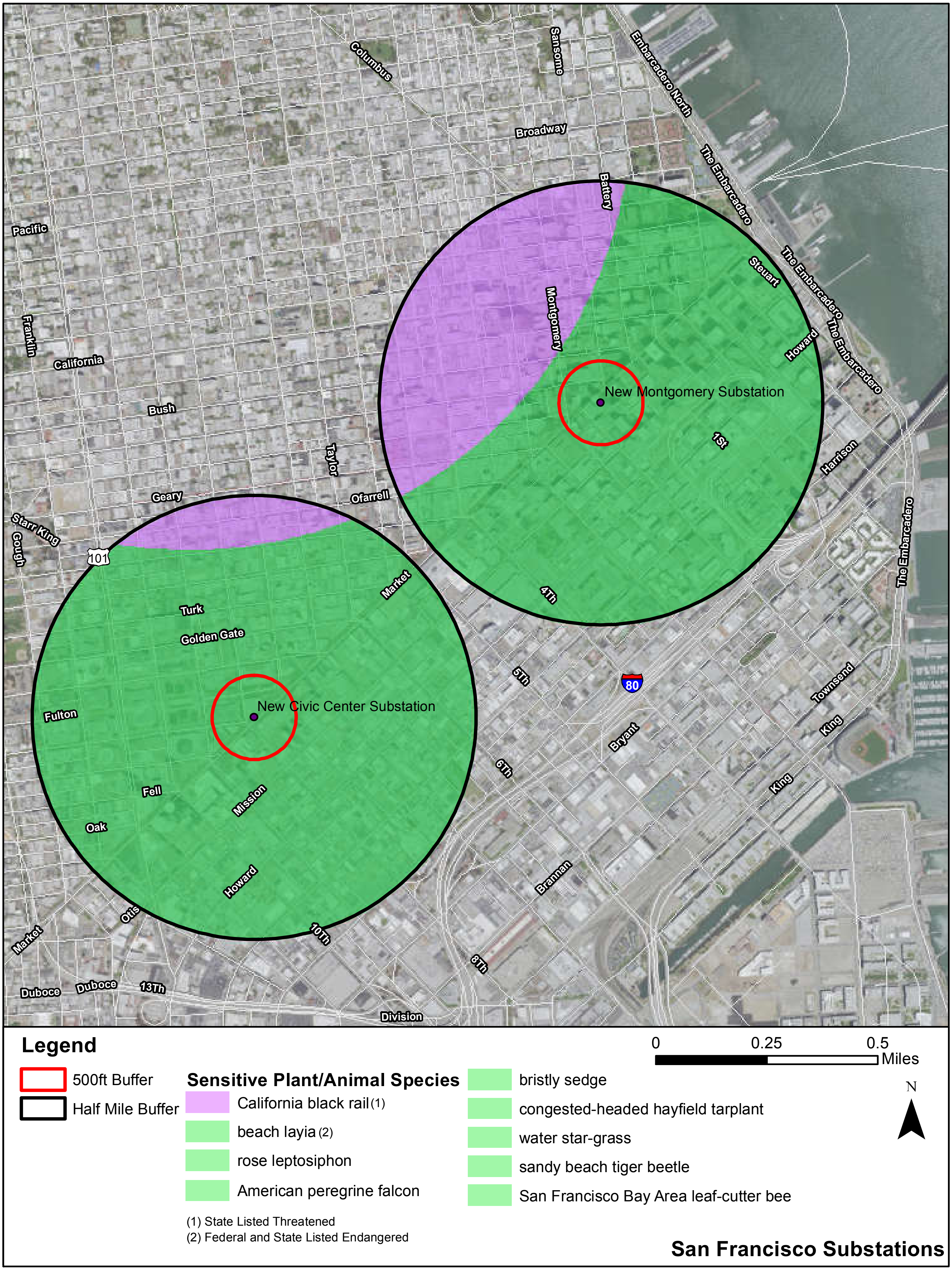
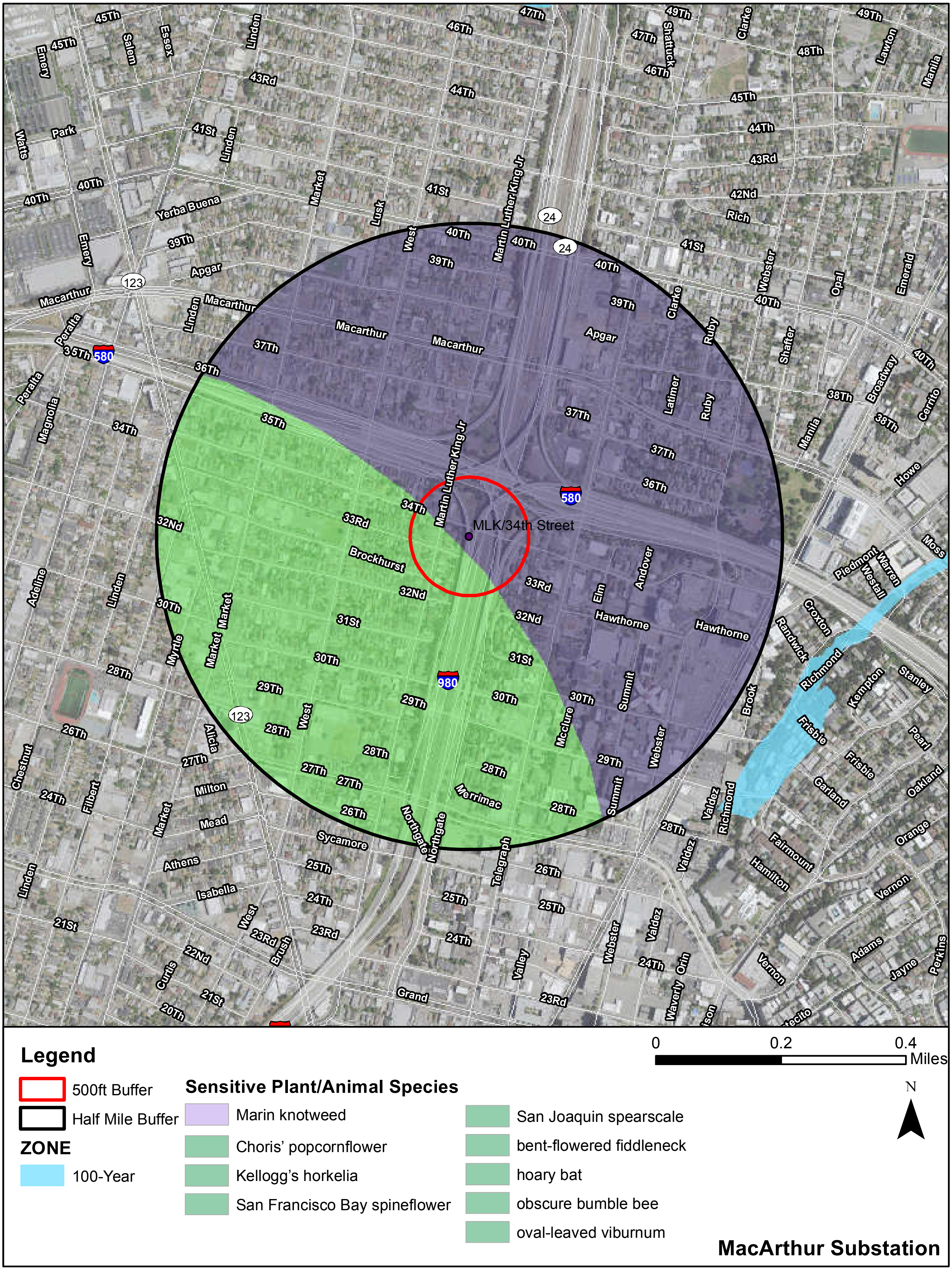
Appendix P

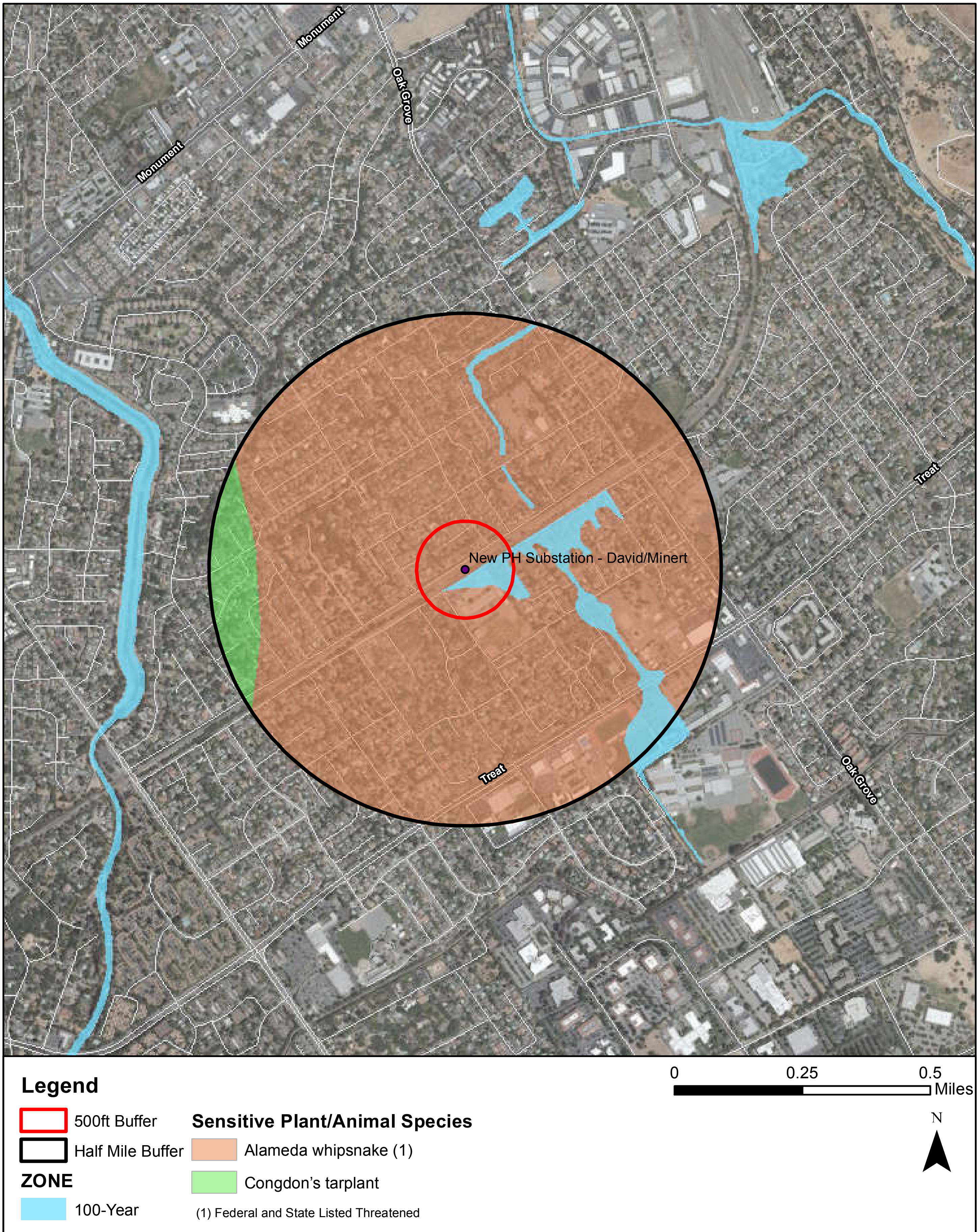
CCNB&FEMA mapping of the substations



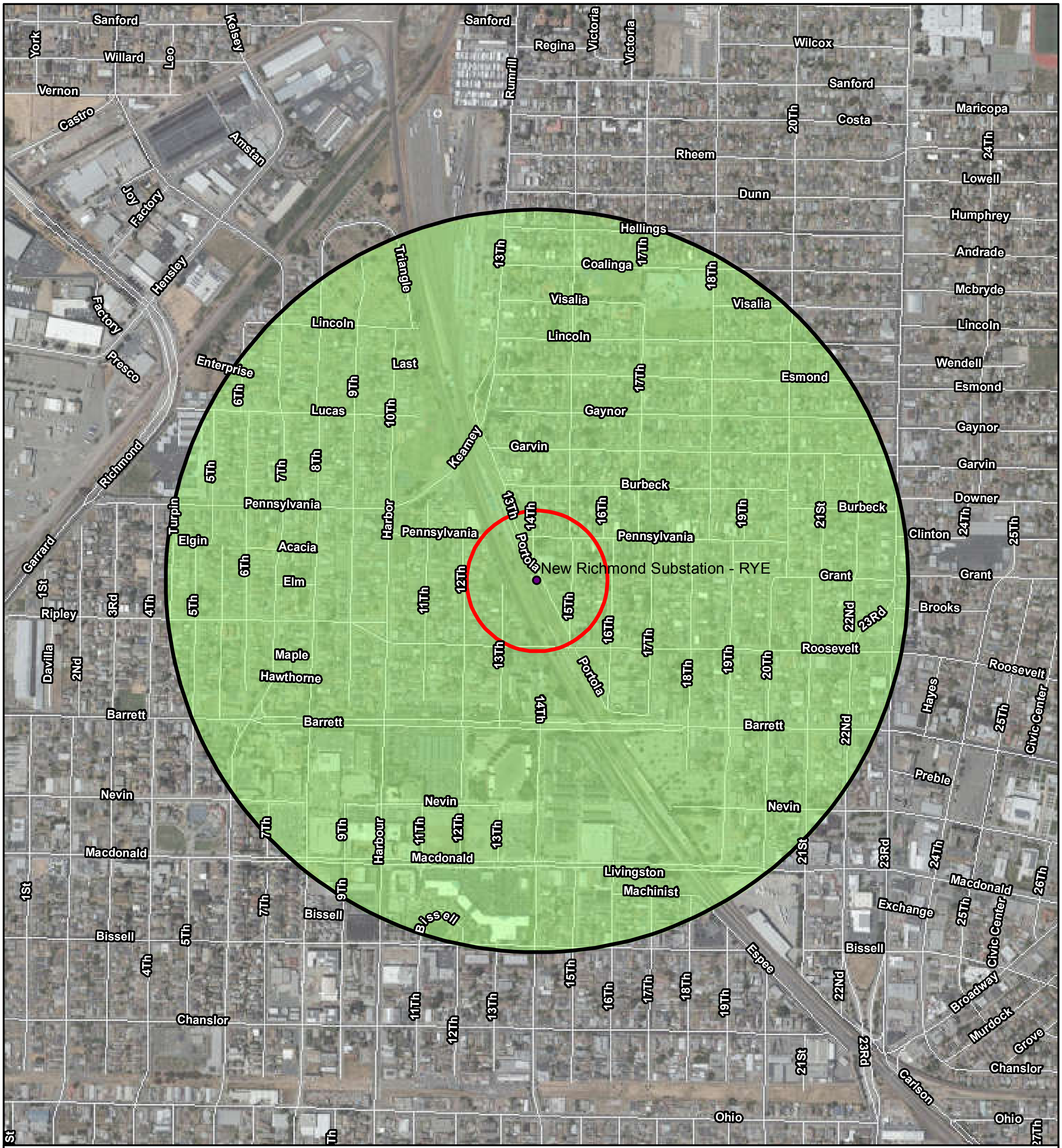
San Francisco Substations



MacArthur Substation



Pleasant Hill Substations



Legend

🟥 500ft Buffer

⬛ Half Mile Buffer

Sensitive Plant/Animal Species

🟩 Alameda whipsnake
(Federal and State Listed Threatened)

Richmond Substation