West Berkeley Circulation Master Plan

Quiet Zone Study
Draft Existing Conditions Report

Prepared for the City of Berkeley

March 28, 2008

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TECH MEMO 1: EXISTING CONDITIONS

The purpose of the Berkeley Railroad Quiet Zone Study is to explore the potential for implementation of a Quiet Zone on the Union Pacific Railroad (UP) corridor through the City of Berkeley. This will be accomplished in three distinct tasks:

Task 1: Description of Existing Conditions
Task 2: Description of Future Conditions
Task 3: Performance of the Quiet Zone Analysis

This Memorandum presents the findings of the Existing Conditions analysis with an introduction on the benefits and requirements for establishment of a Quiet Zone. It describes existing freight and passenger rail operations in Berkeley and details the City's seven at-grade railroad crossings. The understanding of rail operations and the circumstances applicable to each at-grade crossing are essential to the development of a plan to create a Quiet Zone. This Memorandum reviews rail operations and grade crossing conditions, including warning devices, vehicular traffic volumes, and accident history. Land uses along the rail corridor and motor vehicle and rail traffic generators in the study area are also discussed. The study area is shown on **Figure 1**.

STUDY CONTEXT

According to federal regulations, trains are required to blow their horns at they approach at-grade crossings with roadways.[1] The horn sounding is a safety measure to alert motorists and pedestrians intending to cross the tracks that a train is approaching.

The western portion of Berkeley surrounding the UP rail corridor has historically been devoted to industrial land uses. Current development pressures are changing this focus to a desire for less industrial development and more office, commercial and residential development. While train horns had little impact on adjacent industries, the horn noise has a much greater effect on residents and office workers and the attractiveness of these properties for this type of development. In addition, train traffic has increased, resulting in more frequent sounding of train horns.

A potential solution to reduce the impacts of train horn noise is to establish a Quiet Zone for the seven at-grade crossings in Berkeley. Quiet Zones are areas where locomotive engineers are not required to sound train warning horns as they approach an at-grade crossing. Quiet Zone designations are authorized by the Federal Railroad Administration (FRA), the federal agency with oversight for the safety of the national rail system.

[1] The regulation can be downloaded at http://www.fra.dot.gov/downloads/safety/trainhorn_2005/amended_final_rule_081706.pdf

STUDY AREA
FIGURE 1

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QUIET ZONES AND THE QUIET ZONE PROCESS

Quiet Zones may be established by the public authority (city, county, or state) having jurisdiction over traffic enforcement by one of two alternative methods:

(1) LOCAL AGENCY DESIGNATION

The local public authority may designate Quiet Zones when the safety measures at each grade crossing comply fully with one or more FRA "pre-approved" sets of measures (termed Supplemental Safety Measures or SSMs) that have been determined to provide sufficient risk reduction. The SSMs must be sufficient to reduce the Quiet Zone risk index below the Nationwide Significant Risk Threshold, or below the Risk Index with Horns. The approved safety measures include:

- Installation of four-quadrant gates with constant warning time devices and power out indicators. Gates must meet prescribed requirements to extend across the entire span of the roadway.
- Installation of two-quadrant gates with constant warning time devices and power out indicators, and with median dividers or similar roadway channelization to preclude vehicles crossing the center of the road to drive around lowered gates.
- Temporary or permanent closure of a grade crossing. Temporary closing allows closing during night hours so a locomotive horn does not need to be used, but requires use of the horn during daytime hours when the grade crossing is in use.

(2) FRA REVIEW AND DESIGNATION

At the request of the local public authority, the FRA may designate Quiet Zones having safety measures other than FRA's pre-approved measures. The local public authority must form a diagnostic team to evaluate each crossing and recommend actions sufficient to determine risk. In addition, the community must undertake periodic monitoring and reporting to ensure that risk levels remain acceptable. FRA provides an on-line calculating program to aid in determining the reduction in risk levels that the safety measures provide. Safety measures may include combinations of the following:

- Four-quadrant or two-quadrant gates that do not meet the strict SSM standards that apply to locally designated Quiet Zones.
- Additional non-engineering Alternative Safety Measures (ASMs) such as programmed enforcement, public education, and photo enforcement. Periodic monitoring and reporting is required.
- Additional engineering ASMs including any measures not specified. An example of an engineering ASM would be adjustment of crossing geometry or sight distances to reduce risk. Periodic monitoring and reporting is required.

For both methods of establishing a Quiet Zone, some common steps apply:

- The local public authority must provide notice to the railroad, state agencies, law enforcement, private crossing owners, and to other interested parties describing the safety measures to be employed, and affording the public an opportunity to comment.
- The local public authority and/or the railroad must provide updated information for FRA's grade crossing inventory.

Once the local public authority decides to establish a Quiet Zone (or alternatively the FRA approves a Quiet Zone), the public authority must notify the railroad and other agencies of the effective date, and must periodically reaffirm that all requirements are met. Should the authority ultimately determine that a Quiet Zone no longer serves its purpose or that it does not meet the basic requirements, it may terminate the Quiet Zone.

Any local public authority considering establishment of a Quiet Zone is encouraged to work informally with both the affected railroad company, the FRA, and the California Public Utilities Commission (which shares safety oversight at rail-highway crossings with the FRA) prior to initiating the formal steps necessary to designate a Quiet Zone.

Successful implementation of a Quiet Zone will require concurrence by the California Public Utilities Commission and Union Pacific Railroad.

RAIL OPERATIONS IN BERKELEY

Rail service in Berkeley is provided along the Union Pacific Railroad (UP) right-of-way within the 3rd Street corridor of Berkeley. Although this corridor is often referred to as the 3rd Street corridor, it is reserved for rail use only and does not include through traffic access. The corridor is located on the west edge of Berkeley adjacent to Interstate 80 between the bulk of the city and the waterfront. The UP Martinez Subdivision tracks provide an important link in the region's freight and passenger rail network. Local and regional freight and passenger traffic traveling from the Bay Area to Sacramento, the Central Valley, and all along the West Coast from Seattle to San Diego all rely on use this corridor to move goods and people.

The UP right-of-way contains only two main tracks through Berkeley. Passing sidings, east and west of the main tracks, are currently out-of-service, or these tracks have been removed entirely. In the past, a number of local spurs from the UP mainline provided connections to the manufacturing and industrial areas in Berkeley. While these connections are no longer in use, many of the physical rail lines are still embedded in local streets creating an impediment to bicycle and pedestrian travel and complicating auto and heavy vehicle travel in the area.

FREIGHT OPERATIONS – UP AND BNSF

The UP and Burlington Northern Santa Fe Railway (BNSF) operate local and regional freight traffic through Berkeley. While the tracks are owned by UP and UP operates the majority of freight service, BNSF operates freight trains on the corridor via trackage rights. In total, approximately 30 freight trains pass through Berkeley every day. Since there no rail shippers are served within the study area, all freight traffic is through traffic. Freight train operations are summarized in **Table 1** below.

Trains in the northbound direction are primarily headed for UP's major Northern California classification yard in Roseville or for transcontinental destinations such as Chicago, Kansas City or St. Louis. Southbound, most trains are headed to the Port of Oakland or UP's Oakland area classification yards. Trains are also bound for shippers along the East Bay rail routes to San Jose and also to Southern California. Freight trains include various sorts of traffic, from containers and trailers on flatcars or double-stack intermodal cars, to set-up automobiles and general carload traffic, such as boxcars, gondolas, tank cars and lumber carriers.

Future freight train growth will largely be a function of growth experienced at the Port of Oakland. Recent improvements requested by the Metropolitan Transportation Commission (MTC) would help the port increase its level of activity, thus increasing rail activity through Berkeley. Twelve improvement projects were recently proposed including a $325 million truck-train terminal at the port and $315 million worth of track improvements between Richmond and Martinez.

The existing double-tracked mainline could support upwards of 80-100 trains per day. Estimates for freight volumes in Year 2030 are between 50-60 trains per day, leaving little room for passenger train expansion. The addition of a third track through the corridor would support both freight and passenger expansion plans.

Table 1: Freight Train Operations Summary	
Trains per day	30
Trains per time of day	Evenly spread through day
Typical train length (average)	7,000'
Maximum timetable speed	40 mph
Typical speeds	20-30 mph
Growth rate in trains	3% per year
Train horn rules	GCOR[2]

[2] A General Code of Operating Rules (GCOR) has been adopted by all western railroads as a common set of rules. Requirements to sound train horns under various conditions are included. The GCOR can be found at http://gsee.sdf-us.org/signals/docs/pdf/gcor/gcor_4-2000.pdf

PASSENGER OPERATIONS - AMTRAK

Amtrak has rights under federal law to operate intercity and long distance passenger rail service on the UP tracks through Berkeley. Long distance operations occur once a day in each direction on both the California Zephyr (Emeryville – Chicago) and the Coast Starlight (Seattle – Los Angeles). Regional service is provided daily on the Capitol Corridor (Sacramento – San Jose) and San Joaquin (Bakersfield – Oakland) services. Only Capitol Corridor trains stop at the Berkeley Amtrak Station, located below the University Avenue overpass. Passenger train operations are summarized in **Table 2**.

The long distance services contribute four trains per day to the corridor and the regional services add a total of 40 daily trains (32-Capitol Corridor, 8-San Joaquin). In total, passenger operations contribute to 44 daily trains running through Berkeley, and 4-5 trains per hour in both the AM and PM peak hours.

Currently, the Capitol Corridor service has reached the peak in terms of allowable trains it can run on Caltrans' current contract with the UP. (Caltrans sponsors the Capital Corridor and San Joaquin trains; Amtrak operates the service.) Allowing additional passenger trains through this agreement may result in a compromise of freight activity that the UP would have to agree to.

When the Capitol Corridor train is stopped at the Berkeley Amtrak Station, a hold out rule applies which prohibits other trains traveling in either direction to enter the station area to board and alight passengers. Northbound trains stopped at the Berkeley Station also trigger the crossing gates at Hearst Avenue and Addison Way to drop, even if a train does not block the intersection. This results in two gate drops (one while the train is stopped at the station and one while it passes through) and two disruptions to the roadway traffic stream on each street.

Table 2: Passenger Train Operations Summary

Trains per day	44
Trains per time of day	Operating hours 6am – 10pm
Typical train length (average)	700'
Maximum timetable speed	50 mph
Typical speeds	35-45 mph
Growth rate in trains	Limited by UP Agreement
Train horn rules	GCOR

Berkeley Station

The Berkeley Amtrak Station is located at University Avenue and 3rd Street, below the University Avenue overpass (**Figure 2**). The station is unstaffed but is equipped with two ticket vending machines that allow passengers to pre-purchase boarding passes. The University Avenue overpass provides shelter for passengers waiting on the platform below. The station is also equipped with a pay phone and wayfinding map for the City of Berkeley and waterfront areas. A $2.4 million upgrade of the station was recently completed in September 2005 by the Berkeley Redevelopment Agency.

Figure 2: Berkeley Amtrak Station

AT-GRADE CROSSINGS IN BERKELEY

There are seven at-grade rail crossings in Berkeley as shown in **Table 3** and on **Figure 1**. The at-grade crossings are all located on public roadways; the crossing configurations, warning devices, roadway traffic characteristics, land uses and the issues which may affect the application of a Quiet Zone are described below. A summary and photographic record of each crossing can be found in the crossing inventory report in Appendix A.

The land use composition along the Berkeley rail corridor between the Gilman Street and Bancroft Way at-grade crossings is a mix of industrial, office and commercial facilities. This westernmost portion of the area was developed as part of the East Bay industrial belt that has slowly integrated a mix of commercial and residential uses. A residential core comprised of primarily single family, bungalow style properties is located between Camelia Street and Dwight Way, from 6th Street to just west of San Pablo Avenue. The closest residential properties are three blocks (approximately 1000 feet) from the railroad corridor. Vibrant commercial corridors are present along the full length of San Pablo Avenue and University Avenue and on 4th Street between University Avenue and Virginia Street. University Avenue and San Pablo Avenue have historically been strong commercial corridors while 4th Street has been seen the introduction of commercial activity in the past 20 years. New infill along San Pablo Avenue and changes along University Avenue east of San Pablo Avenue may lead to new developments in the West Berkeley area.

This discussion also includes the accident history for each crossing. Records of accidents occurring at grade crossings are maintained by the Federal Railroad Administration (FRA) as part of its grade crossing database. From 1975 through December 2007, 22 collisions were reported in the FRA at-grade crossing collision database[3] at the seven Berkeley at-grade crossings and are summarized in **Table 4** on the following page. In addition to the grade crossing incidents, a man was struck and killed on November 15, 2007 by a California Zephyr train as he was crossing the tracks heading for a gap in a fence on the west side of the tracks across from the Berkeley station. While not occurring at a grade crossing, this incident and the factors surrounding it could affect the Quiet Zone analysis.

Table 3: Berkeley At-Grade Crossings (north to south)

Crossing	ADT	Land Use
Gilman Street	19,900	Industrial/Office
Camelia Street	400	Industrial
Cedar Street	3,400	Industrial/Office
Virginia Street	1,800	Industrial/Office
Hearst Avenue	5,600	Commercial
Addison Street	2,500	Industrial/Office/Commercial/Vacant
Bancroft Way	800	Industrial/Office

[3] http://safetydata.fra.dot.gov

Table 4: At-Grade Crossing Accidents						
At-Grade Crossings	User Involved in Accidents			Total At-Grade Accidents	Severity	
	Auto/ Truck[1]	Pedestrian	Other[2]		Injuries	Fatalities
Gilman Street	0	1	0	1	0	1
Camelia Street	5	0	0	5	0	1
Cedar Street	5	0	0	5	1	0
Virginia Street	1	0	0	1	1	0
Hearst Avenue	1	0	0	1	0	0
Addison Street	7	0	1	8	2	1
Bancroft Way	0	1	0	1	0	1
Total	**19**	**2**	**1**	**22**	**4**	**4**

1. Auto/Truck users include standard size automobiles, vans, buses, and heavy vehicles.
2. Other users include motorcycles, bicycles, and various other motorized vehicles.
Source: Federal Railroad Administration (FRA) at-grade crossing collision database; http://safetydata.fra.dot.gov/

GILMAN STREET

Gilman Street, the northernmost crossing, crosses the Martinez Subdivision Tracks 1 and 2. In addition, there are two out-of-service drill (support) tracks, one on either side of the active tracks. Concrete crossing panels are in place for all four tracks.

Motor vehicle flow is two-way over the crossing with one traffic lane in each direction. This crossing has the heaviest traffic of the Berkeley at-grade crossings with 19,900 Average Daily Traffic[4] (ADT). An interchange with Interstate 80 is located about 700 feet west of the grade crossing accounting for the heavy traffic volumes. Railroad advance warning signs, railroad crossing symbols, and stop lines are included on both approaches although the pavement markings on the westbound approach are quite faded. The at-grade crossing is protected by automatic two-quadrant gates, warning bells and flashing lights.

Surrounding land uses are industrial and office uses. Specific establishments include The Tannery, Berkeley Recycling, Pacific Steel Casting Company and Terminal Manufacturing.

4 Average Daily Traffic (ADT) - is defined as the total traffic volume during a given period (from 1 to 365 days) divided by the number of days in that period. Current ADT volumes can be determined by continuous traffic counts or periodic counts. Where only periodic traffic counts are taken, ADT volume can be established by applying correction factors such as for season or day of week. For roadways having traffic in two directions, the ADT includes traffic in both directions unless specified otherwise. 24-hour tube counts were taken at the grade crossing locations on January 22-26, 2008 to measure ADT.

One grade crossing accident was reported at the Gilman Street at-grade crossing occurring on December 1, 2007 when a pedestrian was struck and killed by a passenger train while crossing the tracks. The train was traveling at approximately 79 mph. The incident occurred in early evening hours under clear weather conditions.

CAMELIA STREET

Camelia Street crosses the Martinez Subdivision Tracks 1 and 2. In addition, there are two out-of-service drill tracks, one on either side of the active tracks. The easternmost drill track has mostly been removed; the warning gate has been placed within this track alignment. Concrete crossing panels are in place for all four tracks.

Motor vehicle flow is two-way over the crossing with one traffic lane in each direction. This crossing carries the least traffic of the Berkeley at-grade crossings with only 400 Average Daily Traffic (ADT). Railroad advance warning signs, railroad crossing symbols, and stop lines are included on both approaches. The at-grade crossing is protected by automatic two-quadrant gates, warning bells and flashing lights. There are additional flashing lights cantilevered over the eastbound approach.

Surrounding land uses are primarily industrial including Berkeley Forge and Tool, Pacific Steel Casting Company, and the Trumer Brauerei.

Five grade crossing accidents were reported at Camelia Street resulting in one fatality. These include:

- On November 3, 1980, an automobile stopped on the tracks was struck by a freight train traveling at approximately 38 mph. The incident occurred in early morning hours under foggy conditions. No injuries were sustained; $500 in property damage was reported.
- On August 24, 1994, an automobile stalled on the tracks was struck by a passenger train traveling at approximately 55 mph. The incident occurred in late evening hours under clear conditions. No injuries were sustained; $2,500 in property damage was reported.
- On January 26, 2001, a truck-trailer stopped on the crossing was struck by a passenger train traveling at 40 mph. The incident occurred during midday under cloudy weather conditions. No injuries were sustained; $15,000 in property damage was reported.
- On September 3, 2001, an automobile drove around the gates and was struck by a passenger train while moving over the crossing at 15 mph. The train was traveling at approximately 60 mph. The incident occurred during the late morning under clear weather conditions. No injuries were sustained; $2,375 in property damages was reported.

- On October 15, 2002, an automobile stopped on the crossing was struck by a passenger train traveling at 77 mph. The incident occurred during evening hours under cloudy weather conditions. The automobile driver was killed; $5,000 in property damage was reported.

CEDAR STREET

Cedar Street crosses the Martinez Subdivision Tracks 1 and 2. In addition, there are two out-of-service drill tracks, one on either side of the mainline, and one out-of-service spur track connecting to the western drill track. The easternmost drill track and the westernmost drill track south of the grade crossing have mostly been removed; the warning gate has been placed within the easternmost drill track alignment. Concrete crossing panels are in place for all five tracks.

Motor vehicle flow is two-way over the crossing with one traffic lane in each direction. This crossing carries 3,400 Average Daily Traffic (ADT). Railroad advance warning signs, railroad crossing symbols, and stop lines are included on both approaches. The at-grade crossing is protected by automatic two-quadrant gates, warning bells and flashing lights. There are additional flashing lights cantilevered over the eastbound approach.

Surrounding land uses are a mix of industrial and office uses including JM Recycling, Potters Studio, Stonehouse California Olive Oil, OC Jones & Sons, and Berkeley Ready Mix Company.

Five accidents were reported on the Cedar Street grade crossing resulting in one injury. These include:

- On July 15, 1975, a truck did not stop at the warning gates and was struck by a freight train. Both vehicles were traveling less than 5 mph. The incident occurred at midday under clear weather conditions. No injuries were sustained; $100 in property damage was reported.
- On November 4, 1977, a truck did not stop at the warning gates and was stuck by a freight train. The truck and train were traveling at 30 mph and 50 mph, respectively. The incident occurred during midday under cloudy weather conditions. No injuries were sustained; $2,000 in property damage was reported.
- On January 15, 1981, an automobile moving across the tracks was struck by a light loco (engine with no cars). Both vehicles were traveling at less than 5 mph. The incident occurred during the evening under cloudy weather conditions. No injuries were sustained; $400 in property damage was reported.
- On March 8, 1986, an automobile stalled on the tracks was struck by a freight train traveling at an estimated 52 mph. The incident occurred during late night hours under rainy conditions. No injuries were sustained; $3,000 in property damage was reported.

- On December 6, 2000, a truck drove around the gates and was struck by a passenger train traveling at 45 mph. The incident occurred during early evening hours under clear weather conditions. The truck driver was injured; $15,000 in property damage was reported.

VIRGINIA STREET

Virginia Street crosses the Martinez Subdivision Tracks 1 and 2. In addition, there are two out-of-service drill tracks, one on either side of the active tracks. The easternmost drill track has mostly been removed; the warning gate has been placed within this track alignment. Concrete crossing panels are in place for all four tracks.

Motor vehicle flow is two-way over the crossing with one traffic lane in each direction. This crossing carries 1,800 Average Daily Traffic (ADT). Railroad advance warning signs, railroad crossing symbols, and stop lines are included on both approaches although the pavement markings are quite faded on both approaches. The at-grade crossing is protected by automatic two-quadrant gates, warning bells and flashing lights.

Surrounding land uses are primarily industrial and office uses including Berkeley Ready Mix Company, office buildings and two parking lots.

One accident was reported at the Virginia Street grade crossing on August 9, 1999, and involved an automobile moving across the tracks at 8 miles per hour after having driven around the gates. The accident occurred during the late morning hours under cloudy conditions when the vehicle passed by a first train and was struck by a second train (passenger) traveling at 54 miles per hour. The driver was injured during the incident, and $18,000 in property damage was reported.

HEARST AVENUE

Hearst Avenue crosses the Martinez Subdivision Tracks 1 and 2. In addition, there are two out-of-service drill tracks, one on either side of the active tracks. The easternmost drill track has mostly been removed; the warning gate has been placed within this track alignment. Concrete crossing panels are in place for all four tracks.

Motor vehicle flow is two-way over the crossing with one traffic lane in each direction. This crossing carries 5,600 Average Daily Traffic (ADT). Railroad advance warning signs, railroad crossing symbols, and stop lines are included on both approaches. The at-grade crossing is protected by automatic two-quadrant gates, warning bells and flashing lights.

Surrounding land uses are primarily commercial including stores and restaurants of the 4th Street shopping area and the parking lots to support this activity. This section of Hearst is also signed as a pick-up zone for day laborers. Truitt and White Lumber yard is located on the west side of the railroad corridor. The Berkeley Amtrak Station is located approximately 500 feet south of this grade crossing under the University Avenue overpass.

One accident was reported at the grade crossing with Hearst Avenue on February 27, 1982 when an automobile stalled on the tracks was hit by a freight train traveling at an estimated 48 miles per hour. The incident occurred in late night hours under cloudy conditions. No injuries were sustained, but $500 in property damage was reported.

ADDISON STREET

Addison Street crosses the Martinez Subdivision Tracks 1 and 2. In addition, there are two out-of-service drill tracks, one on either side of the active tracks. The easternmost drill track has mostly been removed; the warning gate has been placed within this track alignment. Concrete crossing panels are in place for all four tracks.

Motor vehicle flow is two-way over the crossing with one traffic lane in each direction. This crossing carries 2,500 Average Daily Traffic (ADT). Railroad advance warning signs, railroad crossing symbols, and stop lines are included on both approaches. The at-grade crossing is protected by automatic two-quadrant gates, warning bells and flashing lights. There are additional flashing lights cantilevered over the westbound approach. Addison Street is designated as a bikeway between 4th and 2nd Streets providing access to Aquatic Park as well as a connection to the pedestrian/bike bridge over Interstate 80.

Surrounding land uses are primarily industrial, office and retail including Audubon Cellars, Plexxikon Inc., Goetz Construction, Western Pacific Supply and Takara Sake. The property on the northwest corner is vacant. The property on the northeast corner is striped for a restaurant (currently closed) parking lot.

Eight accidents were reported at the Addison Street grade crossing resulting in one fatality and two injuries. These are:

- On July 2, 1976, a truck did not stop at the crossing and was struck by a freight train. The truck and the train were traveling at 15 mph and 55 mph, respectively. The incident occurred in morning hours under clear weather conditions. The truck driver was killed and a railroad employee was injured; $10,000 in property damage was reported.
- On October 5, 1980, an automobile was stalled on the crossing and struck by a passenger train traveling at 40 mph. The incident occurred in the evening hours under clear weather conditions. No injuries were sustained; $500 in property damage was reported.

- On August 17, 1981, an automobile was stalled on the crossing and struck by a passenger train traveling at 40 mph. The incident occurred in the evening hours under clear weather conditions. No injuries were sustained; $500 in property damage was reported.
- On March 26, 1988, an automobile was stalled on the crossing and struck by a light locomotive (engine with no cars) traveling at 52 mph. The incident occurred in the evening hours under clear weather conditions. No injuries were sustained; $3,000 in property damage was reported.
- On April 6, 1988, a truck was stopped on the crossing and struck by a freight train traveling at an estimated 55 mph. The incident occurred in the late night hours under clear weather conditions. No injuries were sustained; $3,000 in property damage was reported.
- On July 21, 1999, an automobile was stopped on the crossing and struck by a freight train traveling at an estimated 8 mph. The incident occurred in the late evening hours under clear weather conditions. No injuries were sustained; $3,000 in property damage was reported.
- On August 18, 2001, a motorcycle was stalled on the crossing and struck by a passenger train traveling at an estimated 17 mph. The incident occurred during the evening hours under clear weather conditions. The motorcycle driver was injured; $1,000 in property damage was reported.
- On May 8, 2002, an automobile drove around the gates and was struck by a freight train. The automobile and train were traveling at 45 mph and 48 mph, respectively. The incident occurred at midday under clear weather conditions. No injuries were sustained; $5,000 in property damage was reported.

BANCROFT WAY

Bancroft Way crosses the Martinez Subdivision Tracks 1 and 2. In addition, there are two out-of-service drill tracks, one on either side of the active tracks. The easternmost drill track has mostly been removed; the warning gate has been placed within this track alignment. Concrete crossing panels are in place for all four tracks.

Motor vehicle flow is two-way over the crossing with one traffic lane in each direction. This crossing carries a low traffic volume with 800 Average Daily Traffic (ADT). Railroad advance warning signs are included on both approaches; the crossing does not have pavement railroad crossing symbols or stop lines. The at-grade crossing is protected by automatic two-quadrant gates, warning bells and flashing lights. Bancroft Way is designated as a bicycle route between 9th Street and its terminus at Aquatic Park.

Surrounding land uses are primarily industrial and office uses including American Soil and Stone Products, Aquatic Gardens office park, Peerless Lighting, and H & B Auto Repair.

A single accident was reported at the Bancroft Way grade crossing on February 1, 2005, when a pedestrian crossing the tracks was struck and killed by a freight train traveling at 40 miles per hour. The incident occurred in the early morning hours under clear weather conditions.

ROADWAY CHARACTERISTICS

GRADE CROSSING LAYOUTS AND ADJACENT INTERSECTION CONFIGURATION

All of the crossing angles between the roadway and rail lines are in the 60 to 90-degree category used by the FRA (non-skewed crossing). In fact, all of the seven at-grade crossing roadways are perpendicular to the rail lines. The rail lines are located between and parallel to 4th and 2nd Streets. Each grade crossing roadway intersects with 4th and 2nd Streets within 400 feet of the rail crossing; none of these intersections are signalized. A rule of thumb in traffic planning is that a distance of 400 feet or more between a crossing and an adjacent intersection should be sufficient to prevent queuing of traffic extending from the crossing into the intersection. Where the distance is less than 400 feet and the adjacent intersection is signalized, some additional traffic studies might be merited in order to enhance safety at the intersection which could be affected by queue overspill. This potential queuing is currently not a concern for the Berkeley at-grade crossings; however, the impact of queue overspill on the grade crossing must be considered if signalizing the 2nd or 4th Street intersections is proposed as part of future development.

MOTOR VEHICLE TRAFFIC AND DELAY

Traffic delay and queuing at the grade crossings is a factor of volume of vehicular traffic and delay time due to warning gate drop times. Observations at these locations show that the crossing gates tend to drop approximately 20 seconds prior to train arrival and remain down for 10 seconds following the clearing of the intersection. The total time that the gate is down depends upon the size and speed of the train. On average the San Joaquin trains occupy the intersection for 5 seconds and the Capitol Corridor trains for 20 seconds. Average total gate drop time for San Joaquin trains is about 30 seconds with 40 seconds for Capitol Corridor trains. Due to the longer length of most freight trains, gate drop times on average were higher.

Average Daily Traffic and Level-of-Service for each crossing is shown in Table 5. With the exception of Gilman Street, vehicle traffic at the crossings is relatively low for an urbanized area, and the crossings operate at acceptable levels-of-service. Gilman Street operates at LOS F. Primary traffic generators in the area include Interstate 80 on/off-ramps at Gilman Street including bypass traffic to avoid Interstate congestion and the 4th Street shopping area.

The analysis methodology used to evaluate vehicular traffic delays and queuing at the study area crossings has been taken from the National Cooperative Highway Research Program (NCHRP) Report 288, *Evaluating Grade-Separated Rail and Highway Crossing Alternatives*, published by the Transportation

Research Board, National Research Council, Washington D.C., in 1987. See Appendix A, Section IV, pages 34 through 36. Additional methodology information was obtained from the Transportation Research Record (TRR) 1754, Paper No. 01-3051, *Methodology for Evaluating Highway-Railway Grade Separations*, Washington D.C., 2001, pp. 77-80. A summary of the methodology as it has been applied to this study can be found in Appendix B of this report.

With the exception of Gilman Street, the findings show that the average delay for each vehicle that was delayed due to train movements was between 0 and 4.5 minutes. Time of delay averaged over total traffic using the crossing ranged from 0 to 32.1 seconds. The average queue length of motor vehicles stopped at the crossing per lane ranged from 0 vehicles for Camelia Street and Bancroft Way, 1-3 vehicles for Cedar Street, Virginia Street and Addison Street, and 6 vehicles for Hearst Avenue. Gilman Street has an average delay for each vehicle delayed of 11.3 minutes, an average delay per vehicle of 81.4 seconds and an average queue length of approximately 50 vehicles. Future plans to grade-separate the Gilman Street rail crossing would mitigate this unacceptable delay and queuing.

Table 5: Average Daily Traffic, Level-of-Service, Queuing and Delay

Cross Street Name	Average Daily Traffic	Level-of-Service	Average Delay for each Vehicle Delayed (min/veh)	Average Delay per Vehicle (sec/veh)	Average Queue Length per Lane (feet)
Gilman Street	19,900	F	11.3	81.4	1,035
Camelia Street	400	A	0.0	0.0	0
Cedar Street	3,400	C	2.9	21.2	45
Virginia Street	1,800	C	2.9	20.0	25
Hearst Avenue	5,600	D	4.5	32.1	115
Addison Street	2,500	B	2.0	14.4	25
Bancroft Way	800	A	0.0	0.0	0

Source: Adavant Consulting, 2008

PEDESTRIAN/BICYCLE TRAFFIC

The bicycle facilities in the vicinity of the at-grade crossings include a designated bikeway on Addison Street and a bicycle route on Bancroft Way. Both these facilities provide connection to Aquatic Park, the bicycle/pedestrian bridge over Interstate 80, the Berkeley Marina, and the Bay Trail. Many of the roadways do not have sidewalks. Even when sidewalks are provided, the pedestrian connection is not carried across the railroad tracks. In some locations there are significant hazards to pedestrians, bicycles, and disabled persons.

SAFETY ISSUES

The following safety issues were noted during site visits to the study area. It will be necessary to address these issues to establish a Quiet Zone in Berkeley either to satisfy the FRA's "pre-approved" sets of measures (termed Supplemental Safety Measures or SSMs) or non-engineering Alternative Safety Measures (ASMs).

The number of tracks to be crossed is noted on both the advance warning signage and also on the warning gates themselves. At the grade crossings in Berkeley, this signage is not consistent as shown in **Figure 3**. There is confusion as to how many tracks are actually present since some are active and others are not. In fact, some of the trackage has been removed on either side of the crossing panel. In some cases, the warning devices have been placed within the easternmost track alignment (**Figure 4**).

Camelia Street | Cedar Street

Figure 3: Signage inconsistencies

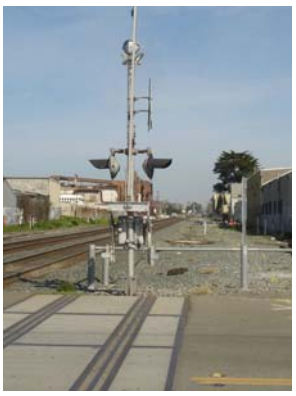
			
Camelia Street	Cedar Street	Virginia Street	Bancroft Way

Figure 4: Warning gate in track alignment

Figure 5: 3rd Street Sign

Although the rail corridor is referred to as 3rd Street (**Figure 5**), there is no publicly maintained street within the right-of-way. Concrete barriers and fences have been installed at most of the crossings to minimize trespassing by both vehicles and pedestrians. However, there are some parcels that do not have other access except for the '3rd Street. As shown in **Figure 6**, public access is available; sometimes the railroad right-of-way is fenced off but sometimes it is not.

	
Gilman Street	Camelia Street

Figure 6: Vehicle access to rail ROW

Parking in most of Berkeley is at a premium; the demand for parking is no different in the study area. Vehicles are often parked in the railroad right-of-way, directly on the out-of-service tracks and very close to the mainline tracks as shown in **Figure 7**.

	
Gilman Street	Camelia Street
Figure 7: Vehicles parked in rail ROW	

Many of the crossings have driveways or access roads that enter the roadway within 60 feet of the track as shown in **Figure 8**. In some cases, these driveways are within the quadrant protected by the warning devices with the result that an exiting vehicle would not be warned or required to stop in the case of an approaching train. Examples of this configuration are shown in **Figure 9**.

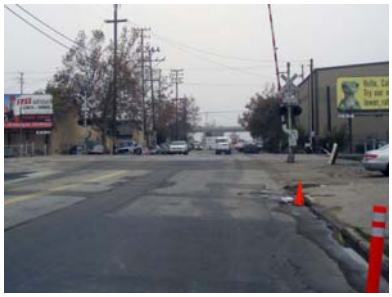
		
Gilman Street	Cedar Street	Virginia Street
		
Virginia Street	Hearst Avenue	Bancroft Way

Figure 8: Driveways near rail ROW

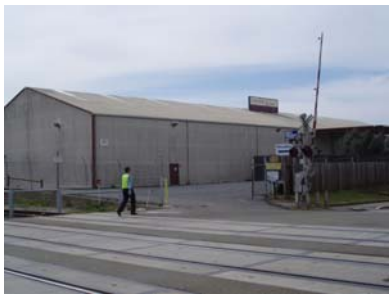
		
Cedar Street	Cedar Street	Addison Street
		
Bancroft Way	Bancroft Way	

Figure 9: Driveways in rail ROW

Driveways located within 60 feet of the track are also an issue for vehicles entering the driveways. Depending on the volume entering a particular driveway there may be a potential for vehicles to be stopped on the railroad right-of-way because of queuing at driveway entrance as shown in **Figure 10**.

Figure 10: Queuing at Hearst Ave driveway

Loitering, trespassing and pedestrian crossings within the railroad right-of-way are a consideration for establishing a Quiet Zone as well as a general safety concern for the City (**Figure 11**). Pedestrian activity is especially high near the Amtrak Station and the 4th Street shopping area. In addition, Hearst Avenue is a designated pick-up location for day laborers within close proximity to the railroad corridor. Workers waiting in this area and vehicles stopping in the vicinity of the tracks should not be encouraged.

Gilman Street

Hearst Avenue

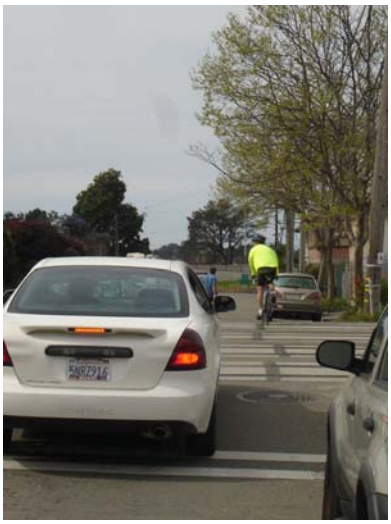
Figure 11: Pedestrians in railroad right-of-way

The pedestrian pathway across the tracks is generally not improved even at locations where sidewalks are provided on either side of the tracks as shown in **Figure 12**. Industrial land uses and high volumes of truck traffic are generally not conducive to walking; pedestrian facilities are usually limited and, when provided, in poor repair. In particular, improvements should be provided to Addison Street as the primary pedestrian and bicycle route to Aquatic Park and the pedestrian/bicycle overpass over Interstate 80.

Cedar Street

Virginia Street

Bancroft Way



Addison Street

Figure 12: Pedestrian/bicycle access

Appendix A
At-Grade Crossing Inventory Report

Crossing Name: Gilman Street

Project Number: 1

FRA No: 751199P

Railroad: Union Pacific Railroad

Milepost: 7.06

Crossing Information

Warning Device:	Automatic two-quadrant gates, warning bells, & flashing lights
No. of Tracks:	3 (2 main; 1 other out-of-service)
Smallest Xing Angle:	60 to 90
No. of Total Daily Trains:	74
No. of Daily Trains during Daylight hours:	50
Max. TImetable Speed:	79 (passenger) - 70 (freight)

Land Use Information

Type of Development:	Industrial/Office

Highway Information

No. of Lanes:	2
Paved Roadway:	Yes
RR Advance Warning Signs:	Yes
Pavement Markings:	Stop lines & RR Xing symbols
AADT (Annual Average Daily Traffic):	19,900
Intersection Less than 400 ft:	Yes
Is Intersection Signalized:	No
Years of Accident Data:	32
Number of Accidents:	1

Railroad Looking North

Railroad Looking South

Highway Looking East

Highway Looking West

Crossing Surface:

Concrete

Crossing Name: Camelia Street **Project Number:** 2

FRA No: 751198H

Railroad: Union Pacific Railroad **Milepost:** 6.90

Crossing Information

Warning Device:	Automatic two-quadrant gates, warning bells, & flashing lights
No. of Tracks:	3 (2 main; 1 other out-of-service)
Smallest Xing Angle:	60 to 90
No. of Total Daily Trains:	74
No. of Daily Trains during Daylight hours:	50
Max. TImetable Speed:	79 (passenger) - 70 (freight)

Land Use Information

Type of Development: Industrial

Highway Information

No. of Lanes:	2
Paved Roadway:	Yes
RR Advance Warning Signs:	Yes
Pavement Markings:	Stop lines & RR Xing symbols
AADT (Annual Average Daily Traffic):	400
Intersection Less than 400 ft:	Yes
Is Intersection Signalized:	No
Years of Accident Data:	32
Number of Accidents:	5

Railroad Looking North

Railroad Looking South

Highway Looking East

Highway Looking West

Crossing Surface:

Concrete

3/28/2008

Crossing Name: Cedar Street **Project Number:** 3

FRA No: 751183T

Railroad: Union Pacific Railroad **Milepost:** 6.70

Crossing Information

Warning Device:	Automatic two-quadrant gates, warning bells, & flashing lights
No. of Tracks:	3 (2 main; 1 other out-of-service)
Smallest Xing Angle:	60 to 90
No. of Total Daily Trains:	74
No. of Daily Trains during Daylight hours:	50
Max. TImetable Speed:	79 (passenger) - 70 (freight)

Land Use Information

Type of Development: Industrial/Office

Highway Information

No. of Lanes:	2
Paved Roadway:	Yes
RR Advance Warning Signs:	Yes
Pavement Markings:	Stop lines & RR Xing symbols
AADT (Annual Average Daily Traffic):	3,400
Intersection Less than 400 ft:	Yes
Is Intersection Signalized:	No
Years of Accident Data:	32
Number of Accidents:	5

Railroad Looking North

Railroad Looking South

Highway Looking East

Highway Looking West

Crossing Surface:

Concrete

Crossing Name: Virginia Street

Project Number: 4

FRA No: 751181E

Railroad: Union Pacific Railroad

Milepost: 6.60

Crossing Information

Warning Device:	Automatic two-quadrant gates, warning bells, & flashing lights
No. of Tracks:	3 (2 main; 1 other out-of-service)
Smallest Xing Angle:	60 to 90
No. of Total Daily Trains:	74
No. of Daily Trains during Daylight hours:	50
Max. TImetable Speed:	79 (passenger) - 70 (freight)

Land Use Information

Type of Development:	Industrial/Office

Highway Information

No. of Lanes:	2
Paved Roadway:	Yes
RR Advance Warning Signs:	Yes
Pavement Markings:	Stop lines & RR Xing symbols
AADT (Annual Average Daily Traffic):	1,800
Intersection Less than 400 ft:	Yes
Is Intersection Signalized:	No
Years of Accident Data:	32
Number of Accidents:	1

Railroad Looking North

Railroad Looking South

Highway Looking East

Highway Looking West

Crossing Surface:

Concrete

Crossing Name: Hearst Avenue **Project Number:** 5

FRA No: 751179D

Railroad: Union Pacific Railroad **Milepost:** 6.30

Crossing Information

Warning Device:	Automatic two-quadrant gates, warning bells, & flashing lights
No. of Tracks:	3 (2 main; 1 other out-of-service)
Smallest Xing Angle:	60 to 90
No. of Total Daily Trains:	74
No. of Daily Trains during Daylight hours:	50
Max. TImetable Speed:	79 (passenger) - 70 (freight)

Land Use Information

Type of Development: Commercial

Highway Information

No. of Lanes:	2
Paved Roadway:	Yes
RR Advance Warning Signs:	Yes
Pavement Markings:	Stop lines & RR Xing symbols
AADT (Annual Average Daily Traffic):	5,600
Intersection Less than 400 ft:	Yes
Is Intersection Signalized:	No
Years of Accident Data:	32
Number of Accidents:	1

Railroad Looking North

Railroad Looking South

Highway Looking East

Highway Looking West

Crossing Surface:

Concrete

Crossing Name: Addison Street **Project Number:** 6

FRA No: 751177P

Railroad: Union Pacific Railroad **Milepost:** 6.10

Crossing Information

Warning Device:	Automatic two-quadrant gates, warning bells, & flashing lights
No. of Tracks:	3 (2 main; 1 other out-of-service)
Smallest Xing Angle:	60 to 90
No. of Total Daily Trains:	74
No. of Daily Trains during Daylight hours:	50
Max. TImetable Speed:	79 (passenger) - 70 (freight)

Land Use Information

Type of Development:	Industrial/Office/Commercial

Highway Information

No. of Lanes:	2
Paved Roadway:	Yes
RR Advance Warning Signs:	Yes
Pavement Markings:	Stop lines & RR Xing symbols
AADT (Annual Average Daily Traffic):	2,500
Intersection Less than 400 ft:	Yes
Is Intersection Signalized:	No
Years of Accident Data:	32
Number of Accidents:	10

Railroad Looking North

Railroad Looking South

Highway Looking East

Highway Looking West

Crossing Surface:

Concrete

Crossing Name: Bancroft Way **Project Number:** 7

FRA No: 751176H

Railroad: Union Pacific Railroad **Milepost:** 5.90

Crossing Information

Warning Device:	Automatic two-quadrant gates, warning bells, & flashing lights
No. of Tracks:	3 (2 main; 1 other out-of-service)
Smallest Xing Angle:	60 to 90
No. of Total Daily Trains:	74
No. of Daily Trains during Daylight hours:	50
Max. TImetable Speed:	79 (passenger) - 70 (freight)

Land Use Information

Type of Development: Industrial/Office

Highway Information

No. of Lanes:	2
Paved Roadway:	Yes
RR Advance Warning Signs:	Yes
Pavement Markings:	None
AADT (Annual Average Daily Traffic):	800
Intersection Less than 400 ft:	Yes
Is Intersection Signalized:	No
Years of Accident Data:	32
Number of Accidents:	1

Railroad Looking North

Railroad Looking South

Highway Looking East

Highway Looking West

Crossing Surface:

Concrete

Appendix B
Queuing, LOS and Delay Analysis

ASSUMPTIONS

ADT Growth Projections
Average annual growth rate from 2000: 1.0% per year

Estimated train length
Local: 700 feet
Through: 7,000 feet

Gate down time (per train)
t= [50 + [(3600 * (L+12*n)) / (5280* Savg)]/60

where:
- t = amount of time per train the crossing is closed (min.)
- L = train length (feet)
- n = number of highway lanes
- Savg = average train speed at the crossing (mph)

Probability of delay per day
P = T / m

where:
- P = probabiliy of delay per day
- T = total amount of time the crossing is closed during the day (min.)
- m = 1,440 minutes in a day

Vehicles delayed per day
N = P * V

where:
- N = number of vehicles delayed per day
- P = probability of delay per day
- V = ADT

Duration of daily delay
D = [(T/2 + 0.167) * N + (N/n)^2] /3600

where:
- D = total delay per day (vehicle-hours)
- N = number of vehicles delayed per day
- n = number of highway lanes
- (N/n)^2 = total delay from queue dissipation
- T = total amount of time the crossing is closed during the day (min.)
  (T/2 is the average delay per vehicle delayed by the train operation)
- 0.167 delay (in minute, eq. 10 seconds) attributable to deceleration and acceleration and delay experienced while waiting for traffic to flow freely aftre the train has passed

Average delay for each vehicle delayed
A = 60 * D / N

where:
- A = average daily delay for each vehicle delayed (min./veh.)
- D = total delay per day (vehicle-hours)
- N = number of vehicles delayed per day

Average delay for all vehicles
a = 3600 * D / V

where:
- a = average daily delay per vehicle (sec./veh.)
- D = total delay per day (vehicle-hours)
- V = ADT

Level of service

Stopped delay per vehicle (sec)	Level of service
0.0	A
5.0	B
15.0	C
25.0	D
40.0	E
60.0	F

Average queue length per lane
Lq = (C * P * A * Vh) / 60

where:
- Lq = length of queue (feet)
- C = average car length: 35 feet
- P = probabiliy of delay per day
- A = average daily delay for each vehicle delayed (min./veh.)
- Vh = number of vehicles per hour per lane in the primary direction

Vh = (0.10 * V * 0.6) / n * f

where:
- 0.11 peak hour factor (11%) ***(based on counts)***
- V = ADT
- 0.6 directional split for primary direction (60%/40%) ***(based on counts)***
- n = number of highway lanes for the primary direction
- f = lane use adjustment factor

Source: HCM 2000, Table 10-23, p. 10-26

No. of lanes in lane group	Traffic in most heavily traveled lane	Lane utilization adjustment factor (f)
1	100.0%	1.000
2	52.5%	0.952
3	36.7%	0.908
4	30.0%	0.833

Table A: Vehicular Traffic, Delays, LOS and Queuing at Study Area Crossings

Xing No.		Mile Post Number	Cross Street Name	No. of Traffic Lanes	Average daily traffic	Pax. Train Speed (mph)	Freight Train Speed (mph)	Estimated average number of trains per day		Average gate down time per train (min.)		Probability of delays per day	Average no. of vehicles delayed per day	Average delay per day (veh-hours)	Average delay for each vehicle delayed (min./veh.)	Average delay per vehicle (sec./veh.)	Estimated Level of Service at the Crossing	Avg. veh, per hour per lane in the primary direction	Avg. queue length per lane (feet)
					2007			2007				2007	2007	2007	2007	2007	2007	2007	2007
								Pax.	Freight	Pax.	Freight								
1	751199P	7.06	GILMAN ST	2	19,900	35	25	44	30	1.2	4.0	11.9%	2,380	450	11.3	**81.4**	**F**	1,310	1,035
2	751198H	6.90	CAMELIA ST	2	400	35	25	44	30	1.2	4.0	11.9%	50	0	0.0	0.0	A	30	0
3	751183T	6.70	CEDAR ST	2	3,400	35	25	44	30	1.2	4.0	11.9%	410	20	2.9	21.2	C	220	45
4	751181E	6.60	VIRGINIA ST	2	1,800	35	25	44	30	1.2	4.0	11.9%	210	10	2.9	20.0	C	120	25
5	751179D	6.30	HEARST ST	2	5,600	35	25	44	30	1.2	4.0	11.9%	670	50	4.5	32.1	D	370	115
6	751177P	6.10	ADDISON ST	2	2,500	35	25	44	30	1.2	4.0	11.9%	300	10	2.0	14.4	B	170	25
7	751176H	5.90	BANCROFT WY	2	800	35	25	44	30	1.2	4.0	11.9%	100	0	0.0	0.0	A	50	0