

Agenda Report

TO: CITY COUNCIL

DATE: January 29, 2007

FROM: CITY MANAGER

SUBJECT: AMEND THE CAPITAL IMPROVEMENT PROGRAM TO DEFINE A TRAIN ARRIVAL INFORMATION SYSTEM AS A NOISE REDUCTION PROJECT FOR THE PASADENA GOLD LINE STATIONS

RECOMMENDATION

It is recommended that the City Council amend the Capital Improvement Program (CIP) to include a train arrival information system as a noise reduction project for the Pasadena Gold Line stations (Attachment "B" of the Agenda Report).

BACKGROUND

The "Noise Mitigation for Freeway Stations" project is one of the projects in the City's Gold Line Phase I – Project Enhancements. The Gold Line Phase I – Project Enhancements are included in the City's CIP and are primarily funded by Gold Line Surplus Funds. The CIP includes \$5,216,000 appropriated for the Gold Line Phase I – Project Enhancements, with a budget of \$3,000,000 designated for the "Noise Mitigation for Freeway Stations" project. At Council's direction, staff conducted further analysis to define actual construction projects that could be undertaken as the "Noise Mitigation for Freeway Stations" projects. The following summarizes the projects studied, the basis for rejecting certain projects, and the reason the "train arrival information system" project is proposed to be added to the CIP.

An independent study conducted by the Los Angeles to Pasadena MTA Blue Line Construction Authority in July 2004 concluded that the noise levels at three Gold Line Light Rail Stations along the 210 Freeway are above acceptable levels. In addition to evaluating the noise levels at the Lake Avenue, Allen Avenue and Sierra Madre Villa Avenue stations, the study identified potential solutions to mitigate the noise impacts. Public Works staff also conducted a separate study in January 2004, which specifically addressed soundwall alternatives at these three stations.

On May 23, 2005 City Council awarded a contract to CH2M Hill to prepare a noise mitigation alternatives study consisting of an in-depth analysis of the noise mitigation alternatives identified in the two previous studies and other feasible alternatives that would effectively mitigate the noise levels at the three light rail stations along the 210 Freeway. Each potential alternative was evaluated to determine its technical,

operational, and financial feasibility. Since any feasible alternatives would require State of California Department of Transportation (Caltrans) and Los Angeles County Metropolitan Transportation Authority (MTA) approval, the study was prepared in coordination with these two agencies.

The CH2M Hill study includes two phases; the alternatives development phase and the Project Study Report Equivalent (PSRE) phase. The alternatives development phase was recently completed and consists of documentation research, preparation of a baseline noise analysis (existing conditions), development of the alternatives analysis framework and development of feasible alternatives. This phase concluded with an agency stakeholder meeting on December 18, 2006. The stakeholder meeting was attended by City staff, Caltrans and MTA and the purpose of the meeting was to obtain feedback on the proposed mitigation strategies analyzed in the alternatives development phase.

The proposed mitigation strategies addressed in the CH2M Hill study (Attachment "A") consist of rejected alternatives, possible alternatives that were screened for feasibility, and one feasible alternative recommended for further study in the PSRE phase. The rejected alternatives include dispensing of earplugs, white or pink noise, opaque soundwalls and enclosed platforms. The screened alternatives include the installation of a rubberized asphalt concrete (AC) overlay on the 210 Freeway to reduce road noise, clear soundwall panels affixed to the existing platforms, and clear soundwall panels affixed atop the existing concrete barriers located between the railway tracks and the freeway.

Caltrans raised concerns for the rubberized asphalt alternative due to constructability, maintenance, and temporary impact to freeway operations. Additionally, the rubberized asphalt overlay alternative may only provide a reduction of approximately 4dBA. One key concern with the clear walls on platform alternative is the potential need to automate train operations to fit with automated openings in the clear walls. Thus, the automated openings would be a concern for both operations and emergency response. Additionally, a full redesign of the platform would be necessary.

Based on the alternative screening, the clear soundwall panels affixed atop the existing concrete barriers was recommended for further study and was the focus of discussion at the December 18, 2006 stakeholder meeting. This alternative was recommended for further study due to the high noise reduction with the least prohibitive constraints. The CH2M Hill study indicates that this alternative could provide a noise level reduction of approximately 10 decibels (dBA). However, since the existing noise levels on the platforms of the freeway stations are considerably high (84-88 dBA); a 10 dBA noise reduction would not achieve standard acceptable noise levels.

Caltrans staff is currently conducting crash tests and working to obtain Headquarters approval to use the clear panel sound barrier technology on State transportation facilities. However, to date Caltrans Headquarters has not approved the clear panel soundwalls for the subject application.

Additionally, MTA staff stated that the following issues would need to be addressed: the clear panels' potential encroachment into the light rail train (LRT) dynamic envelope; impacts to the LRT operations during construction; and the need for LRT single-tracking during construction.

CH2M Hill performed further research and analysis to address the issues discussed at the stakeholder meeting. CH2M Hill conducted structural calculations for the existing 210 Freeway median barriers which show that the existing barriers and their foundations do not possess sufficient mass to resist overturning under typical wind loads if the clear soundwall panels were affixed to the barrier. Therefore, replacement of the existing barriers would be necessary to accommodate construction of soundwalls along both sides of each of the Gold Line stations at Lake Avenue, Allen Avenue, and Sierra Madre Villa Avenue. The total project cost for demolishing the existing barrier, installing a foundation system and new barrier, and installing clear soundwall panels atop the new barrier at all three stations would be approximately \$5.3M. This estimated total project cost includes environmental clearance, engineering, administration, construction engineering and construction.

The cost to implement the clear soundwall panels on traffic barrier significantly exceeds the project budget and this alternative would not achieve noise reduction to the full standard acceptable levels. In addition, Caltrans has not approved this technology for use on State transportation facilities. Based upon this information, it is recommended that this alternative not be taken forward for further study.

During the development of noise mitigation alternatives, staff investigated a potential alternative that was not analyzed in the CH2M Hill study. This alternative consists of a real-time arrival information system for the Gold Line LRT's. Under this alternative, LRT patrons would be able to determine when the next train or trains will arrive at each freeway station. Electronic message boards displaying real-time train arrival information with voice option would be placed in locations just outside of the freeway station platforms to allow LRT riders to time their entrance onto the station platforms and minimize their exposure to the noise levels on the platforms. Potential locations for these electronic message boards and comfort amenities are inside the parking structure just north of the entrance to the pedestrian bridge at the Sierra Madre Villa Station, the landing area at street level at the Allen Station and on the Lake Avenue bridge just north and south of the elevator entrance at the Lake Station.

At a December 18, 2006 stakeholder meeting, MTA staff supported further investigation of the train arrival information alternative. San Francisco Municipal Railway, Santa Clara Valley Transportation Authority, and several east coast transit agencies are some of the agencies utilizing the train arrival information system. MTA is also exploring the possibility of applying this technology for the Green Line Stations along the 105 Freeway. Staff believes the implementation of the train arrival information system would be an important benefit for all six Gold Line stations in Pasadena. This would provide train arrival information for riders awaiting the next train.

The total cost for the train arrival information system at all six Gold Line stations in Pasadena plus the comfort amenity areas at the three freeway stations would be approximately \$500,000 to \$1,000,000. The estimated cost for operation and maintenance of the train arrival system would be approximately \$2,000 per year.

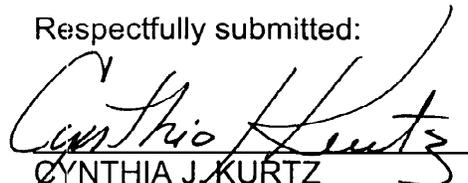
Upon approval of this CIP amendment, staff will issue a Request for Proposal (RFP) to potential system vendors to provide detailed information on construction, functionality, maintenance and operations of the train arrival information system, in addition to a detailed cost estimate. The RFP would also include that the proposing vendors provide environmental analysis and documentation required to obtain environmental clearance under the California Environmental Quality Act (CEQA).

A more detailed description of the train arrival information system noise reduction project is included in Attachment "B."

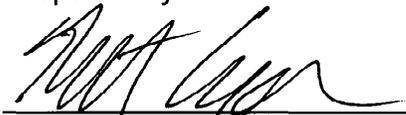
FISCAL IMPACT

The Gold Line Phase I Project Enhancements - Noise Mitigation for Freeway Stations Project (Budget Account No. 75506) is included in the current Capital Improvement Program and there are sufficient funds available to study the new alternative.

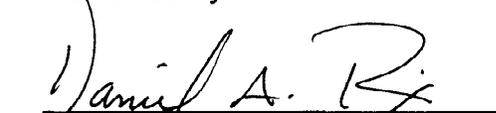
Respectfully submitted:


CYNTHIA J. KURTZ
City Manager

Prepared by:

for 
Andrew R. Muth, Principal Engineer
Department of Public Works

Reviewed by:


Daniel A. Rix, City Engineer
Department of Public Works

Approved by:


Martin Pastucha, Director
Department of Public Works

ATTACHMENT A

TECHNICAL MEMORANDUM

CH2MHILL

Alternative Development and Screening for Gold Line Noise Study along Interstate 210 from Lake Avenue to Sierra Madre Villa.

PREPARED FOR: City of Pasadena
PREPARED BY: Melissa de la Peña
COPIES: Farshad Farhang
Project File
DATE: May 10, 2006

INTRODUCTION AND BACKGROUND

The City of Pasadena has retained CH2M HILL to provide preliminary engineering design services for the mitigation of elevated noise levels at the Gold Line stations along the 210 Freeway located between Lake Avenue and Sierra Madre Villa. The stations included in this study comprise the final three stops of the Gold Line light rail.

This Technical Memorandum is a follow-up to the Evaluation Criteria Memorandum, in which the existing characteristics of the project area are described in more detail, including information regarding Gold Line service to the stations. The purpose of this memo is to develop and screen feasible solutions for noise mitigation at the platforms, using the criteria developed in the previous memorandum and provide conceptual design for the proposed alternatives. The project location and the vicinity map are shown in Appendix A.

CRITERIA SUMMARY

Listed below are the evaluation criteria that were developed in the previous memorandum and used in this study:

- Safety
- Constructability
- Noise Reduction
- Non-Standard Features
- Disruption of Service
- Versatility

□ Cost

These criteria and specific issues of each are fully described in the Evaluation Criteria Technical Memorandum.

ALTERNATIVE DEVELOPMENT PROCESS

Throughout the development of potential solutions and alternatives, all stakeholders encouraged creative thinking and were open to providing feedback whenever possible. Several brainstorming sessions and field visits took place, during which various alternatives were both initiated and eliminated. Members of City, Caltrans, and Metro staff exchanged valuable lessons learned on many of the alternatives brought to the table.

The list of alternatives was then reevaluated and narrowed down to a smaller list which would be comprised of those to be moved forward into the screening process. Screened alternatives would be chosen if they were reasonably feasible within the constraints expressed by the stakeholders. Following is a list of alternatives that were not found to be feasible, and the reasons for being rejected.

Rejected Alternative	Stakeholder Concerns
Earplugs Dispensed	<p>Does not adequately address the need of the project.</p> <p>Difficult to monitor use.</p> <p>Potential for additional rubbish at stations.</p> <p>Would cut down noise to the point of compromising user awareness of surroundings.</p>
White or Pink Noise	<p>Not a practical application.</p> <p>Would require additional power and specialized equipment.</p> <p>Noise reduction would not be adequate.</p>
Opaque Soundwalls	<p>Emergency response prefers having station visibility.</p> <p>Sight Lines for riders and freeway traffic need to be maintained.</p> <p>Conventional walls would require extensive reconstruction between rail and freeway, impacting constructibility.</p> <p>Not aesthetically feasible for riders on platform.</p> <p>May give people on platform the sense that the "hidden" condition of the platform could compromise their safety.</p>
Enclosed Platforms	<p>OCS poles on platform would need to penetrate through any type of enclosure.</p> <p>Additional power required to facilitate comfort within the enclosure (A/C, lighting, door-automation, etc.) would overwhelm existing power system at station.</p> <p>Escape criteria from platform will need to be revisited.</p> <p>Could require major upgrades to existing electrical and structural system.</p>

ALTERNATIVES SCREENED

For the alternatives which moved forward into the screening process, the Evaluation Criteria were reviewed for each. Some of the proposed alternatives were a mix of feasible and non-feasible elements, but could potentially provide sufficient benefit to qualify for further investigation. Following is a brief description of alternatives that were chosen for screening and any initial concerns expressed. More detailed descriptions of the alternatives will be given below, in the screening analysis

Possible Alternative	Initial Stakeholder Concerns
Rubberized Asphalt – New pavement section overlaid on I-210 traveled way	Innovative technology has made progress, however continues to be a maintenance concern. Needs further study to assess feasibility. Researching with City of Clairemont was recommended, since they have done some extensive studies.
Clear Walls on Platforms- Wall panels would be fixed on the platform, creating a barrier between passengers and train	Would require ADA accessibility to train through openings in wall, which unless automated, would jeopardize much of the noise reduction that could be provided. If doors were to be automated, train would have to stop at exact same location every time, which is currently not the case. Access to platform from refuge area below (on tracks) needs to be maintained.
Clear Walls on Barrier- Wall panels would be fixed on the existing barrier between the railroad tracks and freeway	Material not yet Caltrans-approved for crash safety Hardware for wall connection may need more clearance than available between train and barrier. Potential maintenance issues not yet known

SCREENING ANALYSIS AND RESULTS

The alternatives screened for feasibility are described below, with further detail on the benefits and concerns associated with each. Appendix B includes the Screening Analysis Tables developed for each of the alternatives, and they provide an overview of which criteria are (and are not) a concern with regards to the success of the screened alternatives.

Rubberized Asphalt

This alternative would involve repaving the entire traveled way width on I-210 with rubberized asphalt, for approximately ¼ mile before and after the station, in both directions. The main benefit of this alternative is that there are no impacts to the station or train operations, and the existing lane configuration of the freeway, ultimately, will not change. This solution is not unprecedented, and there are current examples, such as extensive research by Arizona Department of Transportation, that would be beneficial to research.

The main concerns for this alternative are constructability, maintenance, and temporary impact to freeway operations. From an area-of-impact perspective, this has the largest concern of the three. Total repaved area would be approximately 420,000 square feet per station, and approximately 29 acres total for all three stations. Another issue in implementing this alternative is the fact that all work would be done within Caltrans right-of-way, on live lanes of traffic.

With rubberized asphalt being an innovative approach, there may be maintenance concerns. The actual noise reduction provided is also questionable at this time, and may not be sufficient to address the problem. Studies done in Arizona have shown an average noise reduction of 4 dBA (ranging from 2 to 10 dBA).

Unless Caltrans is willing to accept this as an alternative, it is not a feasible solution. The concerns outweigh the benefits in this screening.

Clear Walls on Platform

In order to implement this alternative, clear wall panels would need to be affixed to the existing platform, near the passenger loading/unloading area (See Attachment C for cross-section). From a train operation standpoint, this has similar implications as the Enclosed Platform Alternative, which was rejected. However, this alternative had less concern with regards to additional features necessary to keep a comfortable passenger environment within the enclosure. A strong benefit to this alternative would be the relative ease of wall panel installation on the platform, and minimal disturbance to rail or freeway operations.

One key concern with this alternative is the potential need to automate train operations to fit with automated openings on the soundwalls. Currently, train operations are manual, and the cars do not necessarily stop in the same location. Any change in operation would require additional instruction for train operators, as well. Emergency response may have issue with the fact that the path would not be open between the train and platform in the case that the doors on the train and the soundwalls do not align properly.

ADA compliance is critical on the platforms, with a need to provide sufficient clear space and adequate openings in the doors for accessibility. Additionally, installation of these walls would create an additional load of approximately 20 tons per platform (Attachment C), which would potentially compromise the structural integrity of the station.

This alternative is not feasible since it would be difficult to implement without a full redesign of the platform. Also, the sound reduction benefits would be compromised with the need for designing the soundwalls with openings for access to the train.

Clear Walls on Barrier

This alternative proposes to affix clear soundwall panels on the existing barrier between the railroad tracks and the freeway. The walls would be approximately 12' in height (above the freeway pavement elevation) and would run approximately 50' (4 to 5 times the distance between the platform edge and the barrier) to either side of the platform limits.

Lake station, being the most constrained with regards to clearance between the railroad and the freeway (see Evaluation Criteria for station descriptions), this was used as a case study to identify whether or not there is sufficient space in which to affix the soundwalls to the barrier.

Attachment D shows dimensions in the most constrained point of the station, which is in the southwest corner, in the eastbound direction. It also delineates the dynamic envelope of the train, which is 0.78' per Metro guidelines. The clearance here reduces to less than 9", which is typically the distance necessary to install the wall panels with the standard fixtures.

Research on the possibility of modifying the fixture to fit it within the available space offered a favorable response from a manufacturer.

Another requirement that may need to be addressed in the design phase is access gates on the soundwalls. The proposed lengths of the soundwalls are less than 300 meters (or 985'), which is Caltrans' minimum standard spacing for access gates. Metro standards may still require an access gate for emergency response purposes at the platforms.

This alternative would provide a significant noise reduction (likely more than 10 dBA) with the least prohibitive constraints. It also is associated with a "balanced" impact between the rail and road. Additionally this solution is applicable to all three stations, to create a consistent design throughout the corridor, which could be implemented at other locations with similar station configurations.

DESIGN RECOMMENDATIONS

Feasible Alternatives

Initial results of the screening analysis gave forth 1 recommended alternative to pursue in preliminary design. Other screened alternatives could be revisited in the case that stakeholders agree to support/approve the implementation of the proposed alternative, if applicable.

Clear walls on barrier would be the most effective alternative to propose at the Gold Line Stations for noise mitigation. Screening analysis identified strong benefits, with minimal concerns. Noise reduction would exceed the amount identified as "noticeable" in the Evaluation Criteria Memorandum, and installation of the wall could have some additional safety benefits (such as being an extra layer of protection between the train and freeway traffic).

The clearance issue at Lake Avenue Station seems to be one that could be addressed with additional design of the panel supports/framing, and these would only need to be fabricated and installed for one station, in one direction. The rest of the project could be done with conventional supports. Caltrans approval of the proposed material for the soundwalls would also be required, although these products meet the requirements outlined in NCHRP Report No. 350 for test level 3 (basic level for high-speed highways) and test level 4 (increased level for truck collisions).

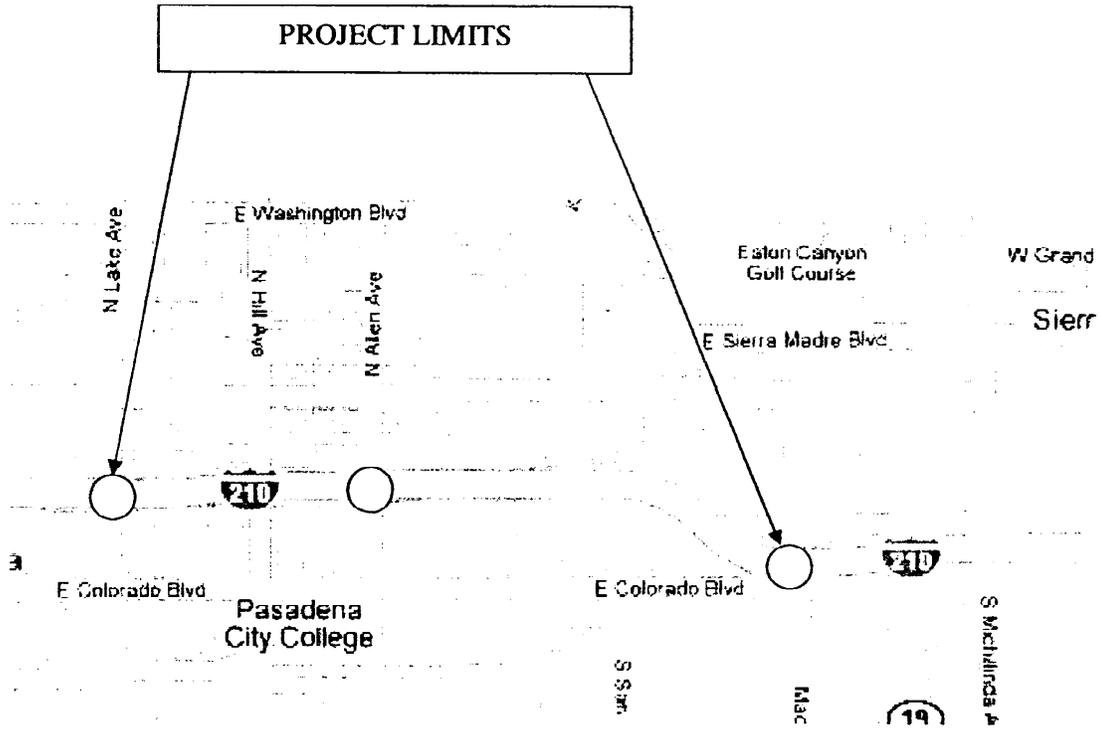
REFERENCES

California Department of Transportation. *Standard Specifications*. July, 1995.

California Department of Transportation. *Highway Design Manual*. Fifth Edition. July 1, 1995.

Los Angeles County Metropolitan Transportation Authority. *Metro LRT Design Criteria Manual*. Revision 1. July 1, 2005.

APPENDIX A
VICINITY MAP



VICINITY MAP

APPENDIX B
ALTERNATIVE SCREENING TABLES

RUBBERIZED ASPHALT - ALTERNATIVE SCREENING

Criteria	Level of Concern			
	None	Low	Medium	High
1. Safety				
Platform obstructions	X			
Rider Visibility	X			
Sense Awareness	X			
Operations Safety		X		
2. Constructability				
Required construction area				X
Estimated construction time			X	
Integrity of station elements to modify or retrofit	X			
Operations during construction				X
Concurrent construction			X	
3. Noise Reduction				X
4. Non-Standard Features				
Barrier Design	X			
Platform Clearances	X			
ADA Compliance	X			
Dynamic Envelope	X			
Lane/Shoulder Widths			X	
Clear Zones	X			
5. Disruption of Service				X
6. Adaptability to Stations		X		
7. Cost			X	
Notes	Maintenance issues, cost, and effectiveness for noise mitigation are not fully known at this time, since not commonly used.			

CLEAR WALL ON PLATFORM - ALTERNATIVE SCREENING

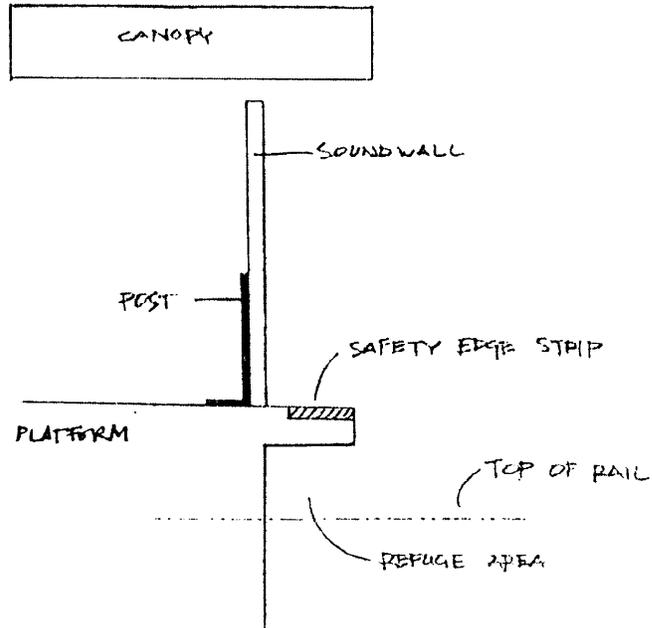
Criteria	Level of Concern			
	None	Low	Medium	High
1. Safety				
Platform obstructions			X	
Rider Visibility	X			
Sense Awareness	X			
Operations Safety				X
2. Constructability				
Required construction area			X	
Estimated construction time		X		
Integrity of station elements to modify or retrofit				X
Operations during construction			X	
Concurrent construction		X		
3. Noise Reduction				X
4. Non-Standard Features				
Barrier Design	X			
Platform Clearances			X	
ADA Compliance				X
Dynamic Envelope				X
Lane/Shoulder Widths	X			
Clear Zones			X	
5. Disruption of Service			X	
6. Adaptability to Stations				X
7. Cost				X
Notes	Would require new train-running system with automated stops and doors on the wall. Openings on wall would compromise noise mitigation benefits.			

CLEAR WALL ON BARRIER - ALTERNATIVE SCREENING

Criteria	Level of Concern			
	None	Low	Medium	High
1. Safety				
Platform obstructions	X			
Rider Visibility	X			
Sense Awareness	X			
Operations Safety			X	
2. Constructability				
Required construction area			X	
Estimated construction time		X		
Integrity of station elements to modify or retrofit		X		
Operations during construction				X
Concurrent construction			X	
3. Noise Reduction	X			
4. Non-Standard Features				
Barrier Design			X	
Platform Clearances				X
ADA Compliance	X			
Dynamic Envelope				X
Lane/Shoulder Widths			X	
Clear Zones			X	
5. Disruption of Service				X
6. Adaptability to Stations			X	
7. Cost			X	
Notes	Would definitely provide a noticeable noise reduction and require least modification to existing elements.			

APPENDIX C
SOUNDWALL ON PLATFORM

ASSUMPTIONS: WEIGHT OF FRAMES = 34 LF x 6 LBS. x 2 FRAMES
 = 408 LBS WEIGHT OF PANEL
 = 10 x 14 x 4.7 PCF
 = 686 LBS WEIGHT OF POST
 = 14 x 25 = 350 LBS.
 WEIGHT PER LF = 144.4 LBS.



CALCULATION PER STATION:

ASSUME 150' x 2 LENGTH / STATION PLATFORM
 = 300'

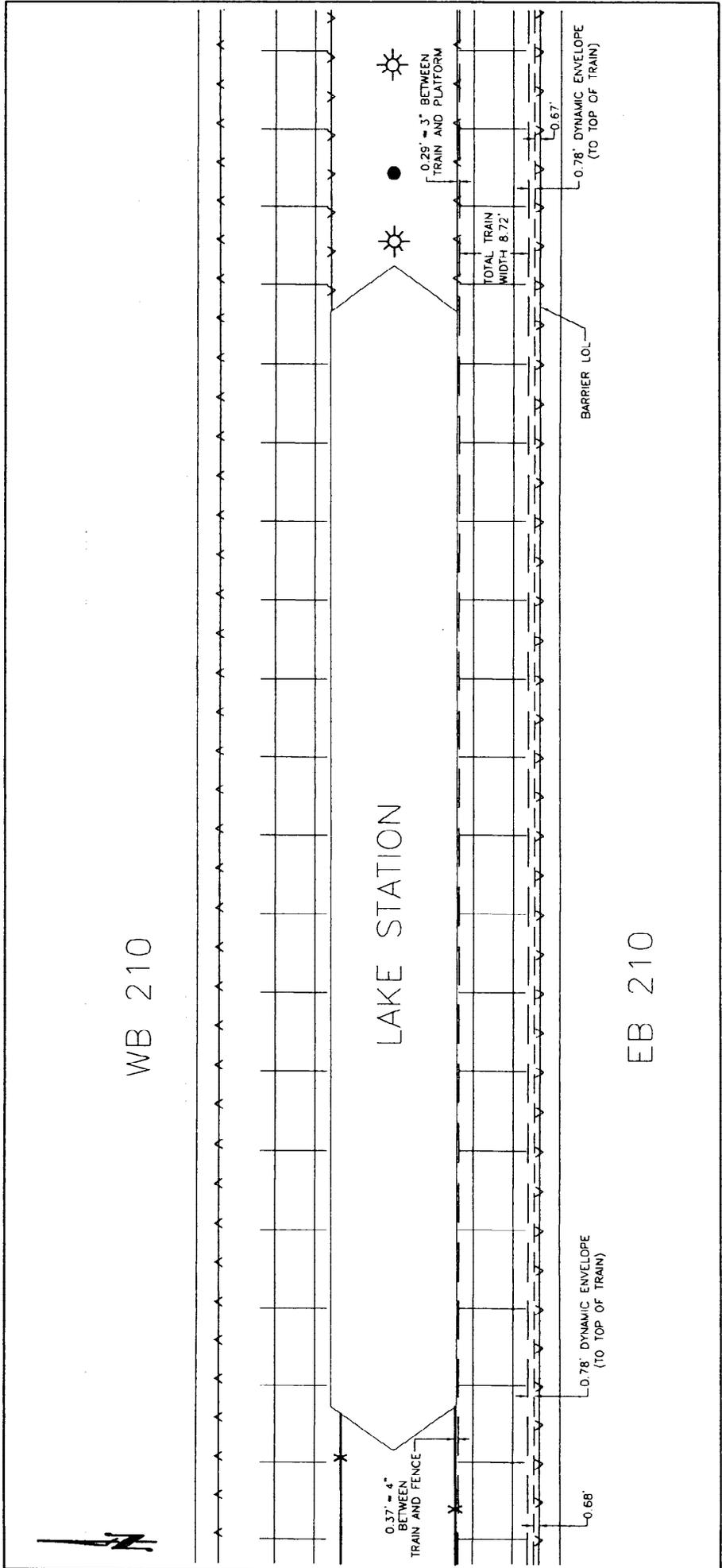
WALL WEIGHT = 300' x 144.4 = 43,320 LBS.

APPENDIX D
LAKE STATION CLEARANCE FOR SOUNDWALL ON BARRIER

WB 210

LAKE STATION

EB 210



Clear Sound Wall on Barrier Alternative for Gold Line Noise Study along Interstate 210 from Lake Avenue to Sierra Madre Villa

PREPARED FOR: City of Pasadena
PREPARED BY: Mike Cooper
COPIES: Farshad Farhang
Melissa de la Peña
Project File
DATE: January 8, 2007
PROJECT NUMBER: 332468.01.02.01

INTRODUCTION AND BACKGROUND

The City of Pasadena has retained CH2M HILL to provide preliminary engineering design services for the mitigation of elevated noise levels at the Gold Line stations along the 210 Freeway located between Lake Avenue and Sierra Madre Villa. The stations included in this study comprise the final three stops of the Gold Line light rail.

This Technical Memorandum is a follow-up to the Alternative Development and Screening Memorandum, in which the following options were suggested: rubberized asphalt concrete (AC) overlay on the 210 Freeway to reduce road noise; clear soundwall panels affixed to the existing platforms; and, clear soundwall panels affixed atop the existing concrete barriers located between the railway tracks and the freeway. This current Memorandum presents the results of an investigation into the feasibility of mounting clear panels atop or to the back side of the existing concrete barriers.

ANALYSIS ASSUMPTIONS AND RESULTS

Calculations were performed to assess the overall stability of the combined barrier/soundwall system when subjected to lateral wind pressure. A 10-foot-tall clear panel was assumed to be affixed atop or to the back of a barrier of standard height (2 feet 8 inches). From a review of available photographs, the barriers separating the railway tracks from the 210 Freeway appear to comprise a vertical face on the station side and a variable slope "Jersey" face on the freeway side. This configuration is not consistent with current Caltrans standard barrier shapes, but it is similar to a "Type 50E" barrier shape that was included in older versions of their Standard Plans (January, 1988, for example). For the purposes of the stability analysis, the Type 50E shape was assumed with top and bottom widths of 8 and 17 inches, respectively. The barrier's weight was calculated to be 372 pounds per linear foot with its center of gravity located 6 inches (0.50 feet) from the vertical face.

At the Lake Avenue Station, there is a separation in grade between the freeway and the railway tracks, and it appears that the barrier was constructed on top of a short concrete retaining wall (railway track elevation is below the roadway elevation). At the Allen

Avenue and Sierra Madre Villa Stations, railway and roadway elevation is nearly the same, and it appears that the barrier was cast directly on the AC pavement. It is the barrier at the latter two stations that was reviewed, with the assumption that the barrier does not extend beneath the pavement.

The Caltrans structures design publication *Memo to Designers 22-1* defines the design criteria to be used for soundwalls. For soundwalls on traffic barriers, the design wind pressure is defined as 27 pounds per square foot (psf). General Notes included in Cyro Industries' drawings for their Paraglas Soundstop® indicate their panel system is designed for 46 psf. An assessment of soundwall/barrier stability was made for both wind pressures (i.e., 27 and 46 psf). Per *Memo to Designers 22-1*, "external stability" (resistance to tipping or sliding when subjected to a lateral load) must be considered in the design of soundwall systems. Safety Factors of 1.50 for overturning and 1.20 for sliding are required.

For wind loads of 27 and 46 psf, the lateral pressure on the 12-foot 8-inch barrier/soundwall system is equal to 342 and 583 pounds per foot, respectively (pressure times height). The center of pressure is located 6 feet 4 inches above the bottom of the barrier, resulting in an overturning (tipping) moment, M_{OT} , of 2,165 and 3,689 foot-pounds per foot for the 27 and 46 psf wind load, respectively. With its weight of 372 pounds per foot and center of gravity 0.5 feet from the vertical face, the barrier's ability to resist overturning is only 186 foot-pounds per foot (resisting moment, M_R , equal to weight times moment arm). The Safety Factor against overturning is determined by dividing M_R by M_{OT} . This results in calculated Safety Factors of 0.09 and 0.05 (for 27 and 46 psf, respectively), which is significantly less than the value of 1.50 required by the design criteria. A Safety Factor less than 1.00 indicates instability (i.e., failure). Sliding resistance was not calculated, but it is also expected to be less than the demand, though not as dramatically as with overturning.

RECOMMENDATIONS

If the glass soundwall panels are to be mounted to the concrete barriers that separate the railway tracks from the 210 Freeway, then additional measures will be required to stabilize the system. One alternative would be to remove the existing barriers and install new barriers founded on deep foundations (cast-in-drilled-hole concrete piles or a trench footing, consistent with Caltrans standard details for soundwalls on barriers). The rough cost for demolishing the existing barrier, and installing a foundation system and new barrier is anticipated to be on the order of \$250 to \$300 per foot of barrier, not including traffic control and roadway reconstruction. The cost for traffic control will likely be significant as it would entail closing a traffic lane on the 710 Freeway to provide adequate room for construction.

A second alternative would be to provide a lateral "prop" at the top of the glass panel framing system and connect it to the train station canopy for stability. This could be done with tubular steel elements placed at the same spacing as the glass panel framing system. The canopy framing system and train's dynamic envelope would need to be investigated further to determine if this option is truly feasible.

REFERENCES

California Department of Transportation, *Memo to Designers 22-1*, August 2004

ATTACHMENT "B"

TECHNICAL MEMORANDUM

Train Arrival Information System Noise Reduction Project for the Pasadena Gold Line Stations

BACKGROUND

During the development of Noise Mitigation Alternatives for the Gold Line Freeway Stations, staff investigated a potential project alternative that was not analyzed in the CH2M Hill study. This alternative consists of a real-time arrival information system for the Gold Line Light Rail Trains (LRTs), similar to that being proposed for the City's ARTS Bus system. At each freeway station, LRT patrons would be able to determine when the next train or trains would arrive. Satellite technology and advanced computer modeling would track trains on their routes as each train would be fitted with a satellite tracking system. Taking into account the actual position of the trains and their scheduled stops, the system would be capable of estimating and constantly updating train arrivals with a high degree of accuracy. The train arrival predictions would also be made available on the World Wide Web and to wireless devices such as internet-capable cell phones and Personal Digital Assistants (PDAs).

Under this alternative, electronic message boards displaying real-time train arrival information with voice option would be placed in locations just outside of the freeway station platforms to allow LRT riders to time their entrance onto the station platforms and minimize their exposure to the noise levels on the platforms. Additionally, these locations could be supplemented with furniture and be either partially or fully enclosed to provide added comfort to the LRT patrons. Potential locations for these electronic message boards and comfort amenities are inside the parking structure just north of the entrance to the pedestrian bridge at the Sierra Madre Villa Station, the landing area at street level at the Allen Station and on the Lake Avenue bridge just north and south of the elevator entrance at the Lake Station.

Staff recently performed a field investigation to obtain approximate noise level readings at each of the freeway stations using a hand-held noise meter. The results show that the potential locations for the electronic message boards and comfort amenities currently experience maximum noise levels ranging from 5 dBA to 10 dBA less than the respective freeway platforms. The addition of enclosures could reduce the noise levels at these locations by an additional 5 dBA to 10 dBA.

At a December 18 stakeholder meeting, MTA staff supported further investigation of the train arrival information alternative. MTA staff was also interested in exploring the possibility of applying this technology for their Green Line Stations along the 105 Freeway, which also experience noise levels significantly higher than acceptable standards.

San Francisco Municipal Railway, Santa Clara Valley Transportation Authority, and several east coast transit agencies are some of the agencies utilizing the train arrival information system.

The total cost to implement the train arrival information system and comfort amenity areas at the three freeway Gold Line stations in Pasadena plus the comfort amenity areas would be approximately \$500,000 to \$1,000,000. The estimated cost for operation and maintenance of the train arrival system would be approximately \$2,000 per year. These total costs are less than the \$3M appropriated in the Fiscal Year 2007 CIP.

Upon approval of a CIP amendment, staff will issue a Request for Proposal (RFP) to potential system vendors to provide detailed information on construction, functionality, maintenance and operations of the train arrival information system, in addition to a detailed cost estimate. The RFP would also include that the proposing vendors provide environmental analysis and documentation required to obtain environmental clearance under the California Environmental Quality Act (CEQA).

RECOMMENDATIONS

It is recommended that the City Council amend the Capital Improvement Program (CIP) to define a train arrival information system as a noise reduction project for the Pasadena Gold Line stations.