Los Angeles to Pasadena Metro Blue Line Construction Authority

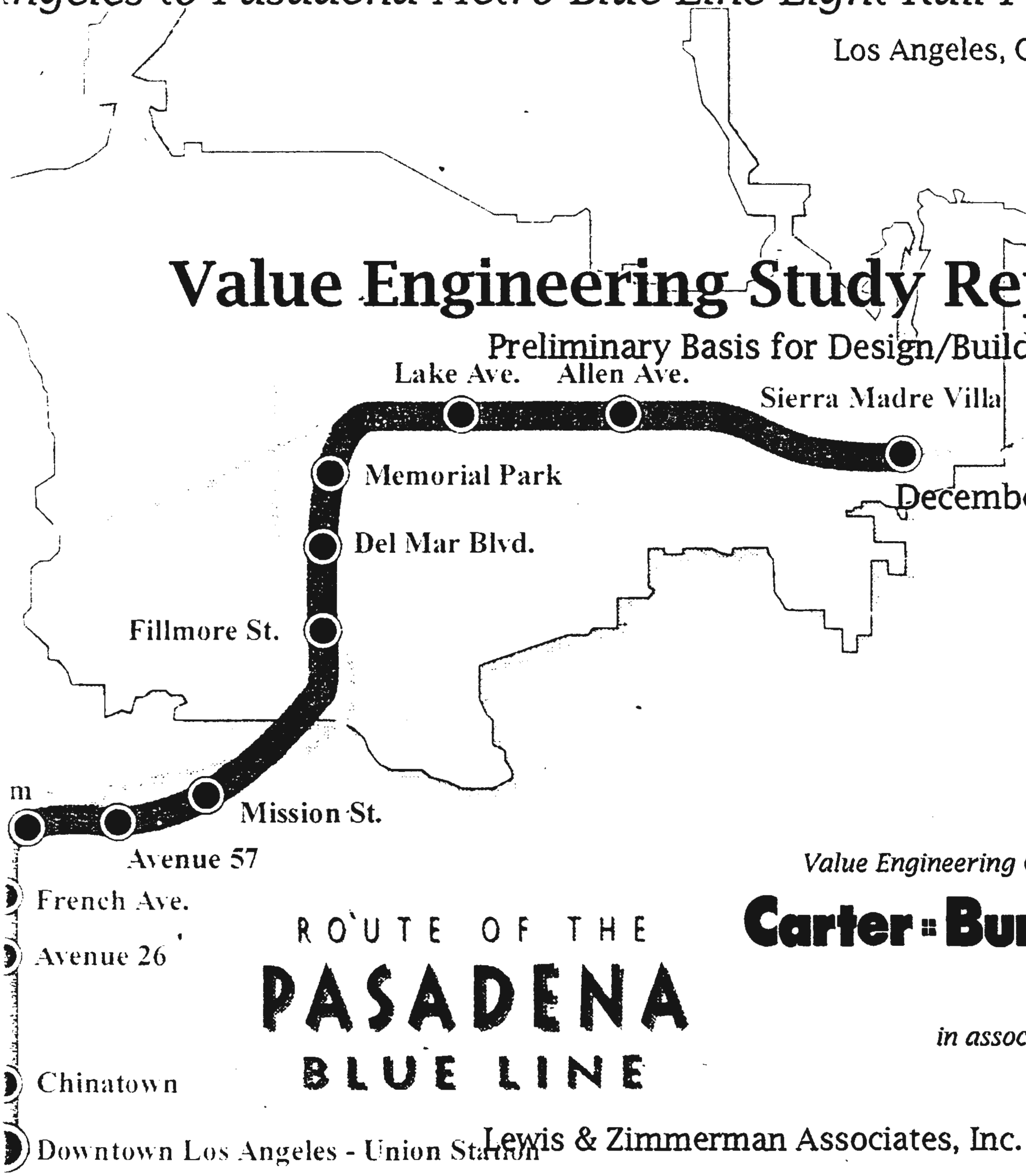
ngeles to Pasadena Metro Blue Line Light Rail Project

Los Angeles, California

Value Engineering Study Report

Preliminary Basis for Design/Build Design

December 1999



ROUTE OF THE
PASADENA
BLUE LINE

Value Engineering Consultant

Carter :: Burgess

in association with

Lewis & Zimmerman Associates, Inc.

Carter :: Burgess

Consultants in Planning, Engineering, Architecture,
Construction Management and Related Services

December 22, 1999

Mr. Richard Thorpe
Chief Executive Officer
Los Angeles to Pasadena Metro Blue Line Construction Authority
625 Fair Oaks Avenue, Suite 200
South Pasadena, CA 91030

re: Los Angeles to Pasadena Metro Blue Line Light Rail Project
Value Engineering Study Report

Dear Mr. Thorpe:

Carter-Burgess, Inc. in association with Lewis & Zimmerman Associates, Inc. is pleased to submit 20 copies of the final value engineering (VE) study report documenting the results of the study conducted on the referenced project the week of October 18, 1999. The report documents numerous opportunities for cost reduction and value enhancement that will permit the Authority to reach its cost and quality goals for the project.

Following this letter is a table entitled "Final Disposition of Value Engineering Alternatives" that documents the decisions of the Joint Review Group with respect to the value alternatives presented for consideration. Their decisions take into consideration the recommendations of the Peer Review Team that previously reviewed the alternatives with the VE team.

We look forward to the assisting the Authority with other aspects of the project to ensure that the project remains on schedule and on budget and delivers to its constituency an efficient transit system.

Sincerely yours,

Carter-Burgess, Inc.

Thomas J. Stone

Thomas Stone, PE
Principal

Lewis & Zimmerman Associates, Inc.

Howard Greenfield

Howard B. Greenfield, PE, CVS
Vice President

Attachment

Carter & Burgess, Inc.

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EXECUTIVE SUMMARY

INTRODUCTION

This value engineering (VE) study report documents the events and results of the VE study conducted by Carter-Burgess, Inc. in association with Lewis & Zimmerman Associates, Inc. for the Los Angeles to Pasadena Metro Blue Line Construction Authority (Authority), under its contract to provide "Value Engineering and Other Technical Services." The subject of the study was the "Draft Preliminary Basis for Design/Build Design for the Pasadena Blue Line Light Rail Project." The study was conducted during October 18 - 22, 1999. Participating on the study team were representatives from the staffs of Carter-Burgess, Inc.; Lewis & Zimmerman Associates, Inc.; TEC Management Consultants, Inc.; Elcon Associates, Inc.; and Ninyo & Moore, Inc.

Team members were divided into four subgroups:

- Guideway, trackwork, civil and drainage
- Stations
- Yard and Shops plus Union Station and Chinatown Station
- Systems

to allow concentration on the major aspects of the project.

The study followed the six-phase VE Job Plan including:

- Information Gathering (including a site visit)
- Function Analysis
- Creative Idea Generation
- Evaluation/Judgment of Creative Ideas
- Idea Development
- Presentation of Alternatives

Results of the study were presented to a Peer Review Team made up of representatives from other light rail transit properties who reviewed the alternatives and worked with the VE team to recommend which should be considered for implementation by the Authority.

PROJECT DESCRIPTION

The Pasadena Blue Line Light Rail Project constructs 13.9 miles of light rail infrastructure, mostly along a former Atchison Topeka and Santa Fe Railroad right-of-way from Union Station in downtown Los Angeles, California north through South Pasadena and on to where Sierra Madre Villa Boulevard crosses under the Interstate 210 (I-210) in Pasadena. Along the route, 13 raised platform stations will be constructed, including three that are designated as "landmark stations," to

serve the refurbished Long Beach Blue Line P865 Sumitomo rail cars planned for use on this line. Each train will consist of up to three, 90-foot long, articulated cars.

The route starts with slightly elevated track section on embankment at Union Station leading to a 2,700+ foot aerial section through the Chinatown section of Los Angeles, where an elevated station will be located. After this, the alignment proceeds across the Los Angeles River on a new bridge previously constructed for the project and continues at grade to Old Town Pasadena. Along this stretch it crosses below Figueroa Street in a cut-and-cover grade separation and crosses below a four block area in Old Town Pasadena, also in a cut-and-cover tunnel. At the end of this tunnel, the tracks rise to Memorial Park Station that is situated alongside a park and under an apartment building. Seven at-grade stations are located in this section: Avenue 26, French, S.W. Museum, Avenue 57, all in Los Angeles; Mission in South Pasadena; and Fillmore and Del Mar in Pasadena.

Leaving the next station, Memorial Park Station, the alignment goes through an existing tunnel that leads to a grade-separated section in the median of the I-210 freeway. Three stations are located within the freeway segment: Lake Avenue, Allen Avenue, and Sierra Madre Villa. A future extension can continue the line to Claremont.

Just north of Union Station, a light maintenance facility, Midway Yard, is to be constructed. Included will be a car washing building, a maintenance building, a traction power substation and a blowdown building. There also will be trackage to store 36 of the articulated vehicles.

The budgeted cost to complete the project using the design/build project delivery system is approximately $414 million.

CONCERNS AND OBJECTIVES

This project began in the late 1980s as a traditional design/bid/build project funded by the Los Angeles Metropolitan Transportation Authority (MTA). However, as time progressed, the total expected project costs were expected to escalate to almost a billion dollars, and the project was suspended in 1998 after approximately $274 million was expended. The need for the project remained, and thus the State of California authorized the establishment of the Authority to complete the construction within an established budget of $411 million. A requirement for executing the work was that the design/build procurement method would be employed.

When the project was reinstated, 17 individual construction projects remained to be completed. Each of the projects was at a differing level of design completion ranging from about 10% to almost 100%. A *Project Development Status Report* (PDSR) was produced by Gannett Fleming, Inc. on behalf of the Authority. This report summarized a majority of the issues that required resolution if the project were to reach fruition. Reviewing this document, visiting the site, and then determining how the noted issues should be resolved was the VE team's introduction to the project. The review also uncovered areas for potential value enhancement.

Along with reviewing the PDSR and the vast array of documentation addressed by it, the VE team evaluated those documents considered necessary for a design/build team to respond to a Request for

Proposal to design and build the facility. The result of this review was that all the environmental studies, calculations, drawings, specifications, and suspension documents prepared by the EMC (the MTA's former project designer), and the suspension documents prepared by MTA and the MTA's former Construction Management Consultant for the project prior to suspension of the work, should be included in the package given to potential design/build teams. The existing drawings would also be annotated to reflect known areas of change based on resolution of issues presented in the PDSR.

This collection of documents is referred to as the "Draft Preliminary Basis for Design/Build Design for the Pasadena Blue Line Light Rail Project," which served as the basis for the VE team's review. The objective of the study was to:

1) Find opportunities to fine-tune the package so design/build teams will have the ability to develop a cost-effective solution that meets the MTA criteria established for this project, and
2) Identify unnecessary costs in the current project and generate specific ideas that will provide the essential functions using a more cost-effective design, considering both capital and life cycle costs.

SUMMARY OF RESULTS

The VE team generated over 200 conceptual ideas leading to the development of 57 alternatives with cost saving potential, and 39 design suggestions to enhance the project and produce unknown cost savings or in areas other than cost, for consideration by the Peer Review Team and the Authority. All of the alternatives are summarized in the following table entitled *Summary of Potential Cost Savings*. The table is divided into sections corresponding to the various segments of the project and each alternative is assigned a number (Alt. No. including a prefix designating the particular project element) to permit referencing to details provided in the **Results** section of the report. Several of the most significant alternatives are summarized below.

From a construction standpoint, the most costly elements of the project are the structures, including the Figueroa Street underpass, the Old Town Pasadena tunnel section, the Chinatown aerial structure, the cantilevered, cast-in-place concrete retaining walls, and the buildings in the Midway Yard.

The first question to resolve is whether or not the Figueroa Street underpass is required. If not, construction could be greatly simplified and significant costs and time could be saved. However, traffic studies must confirm the ability to delete it from the project. There also is the option of using an overpass in lieu of the underpass that should be explored. Since this issue was considered several years ago, and since the City of Los Angeles probably was involved, close coordination of this item with the City will be required.

If the Figueroa Street underpass remains, then the tunnel can be raised and the track profile grades into and out-of the tunnel lessened by intercepting two sanitary sewer lines currently crossing the tunnel and rerouting them around the depressed area. Along with this, a deep storm water reservoir for the rail line can be relocated under the tunnel to simplify construction, improve operations and save significant costs as described in Alt. No. LAR-2/LAR-3.

Several alternatives provide options for the concrete retaining walls along the alignment. Alt. Nos. CA-1, ASDM-2, ASDM-3, ASDM-4, and Y&S-4 suggest using mechanically stabilized earth walls, highway type concrete median barriers, crib walls or soil nailing to reduce the cost of these walls, as well as the time to construct them.

The extent of retaining walls and the construction of noise barrier walls are areas that require research for cost optimization. The current topographical information is almost nine years old. It will be necessary for the design/build team to verify the accuracy of the information and update the retaining walls to reflect current conditions and needs. With respect to the noise walls, former noise and vibration studies used to delineate requirements were based on old information. A new study should be executed based upon applicable design criteria for noise levels, the current system operating plan, the actual rail vehicles to be used on the line, and a track section similar to that proposed for the Pasadena Metro Blue Line. The results of this study should be the basis for the design/build team to erect noise barriers and vibration control features.

The Midway Yard Maintenance Building will have to be modified to accommodate the wheel-truing machine. The review of the current layout indicates that some minor functions, such as a space to work on vehicle trucks, general work areas for repairing small components, and an employee break room are not included, but probably should be. Development of a new conceptual floor plan incorporating these functions and reconfiguring the existing functions will result in a more usable facility with little cost impact.

Similarly, the yard layout has some dysfunctional elements, such as the potential to bottleneck at the leads to the main line, complex switching between the storage tracks and the bypass track, the potential to block the bypass track at the cleaning platform, emergency evacuation and fire access routing conflicts, etc. These could be improved with some concept modifications and presented to the design/build team for implementation.

Currently, all of the buildings located at the Midway Yard are to be constructed of stick-built structural steel with prefabricated metal panels and some masonry exteriors. This shop area is projected to serve the system for roughly 10 years, thus Alt. No.Y&S-1 suggests that the buildings be pre-engineered to save both time and money.

As designed, the Memorial Park Station requires extensive modification to the apartment building foundation that is to sit above it. This includes underpinning and the elimination of grade beams that provide lateral support for the building columns. The grade beams must be replaced with an alternative support system. By raising the grade of the tracks south of the station and providing a cul-de-sac for the west leg of Holly Street, the station can be raised thus eliminating most of the foundation work and saving substantial costs. Raising the station also allows for improved integration into the adjacent park as shown in Alt. No. DMMP-12. There also is a potential to eliminate the floating slab at the station to save costs, which is documented in Alt. No. DMMP-15.

The tunnel through Old Town Pasadena is an expensive part of the project because it requires the underpinning of numerous old buildings. This could be a risky operation because of its extent and the condition of the buildings. Alt. No. DMMP-7 suggests that reinforced slurry walls could be

installed alongside the building foundations and integrated into the tunnel design to avoid installing underpinning. This reduces project risks as well as saves cost. This includes a reduction in the horizontal clearance requirements that appears technically feasible.

The line segment along Marmion Way between Avenue 50 and Avenue 61 is in a state of flux. The area has to be constructed using a transit treatment that is unique to this section due to its narrowness and the adjacent residential access needs. HNTB Corporation developed some draft alternatives for the area that have not been approved. The concept includes a center overhead catenary system support, two 12-foot wide, one way roads on both sides of the track with mountable curbs leading onto the tracks for vehicles to pass stopped vehicles on the roadways, and 5-foot wide sidewalks on the outside of the roadways. At the intersection with each avenue, four-way stop signs are provided. This is shown in Alt. No. LAR-15.

There is a concern about this concept because it encourages vehicles to use the track area. By working with the Peer Review Team, the VE team identified a design alternative to place the overhead catenary system support poles on the outside edges of the right-of-way, allowing them to also carry the utility power lines. This will allow the tracks to be moved closer together and the roadways to be widened. A full curb will be placed between the roadway and the tracks and a mountable curb placed at the sidewalks. This would reduce the potential for vehicles and pedestrians to enter onto to the tracks, improving the safety of the system. It will also provide additional maneuvering room for vehicles entering the roadway along the tracks from alleys that intersect the roadways.

At the intersection with the major crossing avenues, it will be necessary to decide upon an appropriate pavement treatment that provides the desired aesthetics for the community. Also necessary is a confirmation of vehicle operations, i.e. should a traffic signaling system be installed to permit unimpeded train movement through the corridor at the design speed limit?

With respect to the stations, Union Station is one of the more costly ones because of the underground construction, the five-foot elevation of the tracks, and the direct fixation track structure that is designed for it. Alt. Nos. US-1, US-2, and US-6 would eliminate the underground structures and replace the space in other areas and substitute ballasted track to save costs. Alt. No. US-3 shows how the tracks could be lowered to avoid constructing an expensive retaining wall and embankment. A complete reconfiguration including all of the above will result in a substantial cost savings without affecting the functionality of the station. The feasibility of this alternative needs to be verified.

Another station with a potential for large cost savings is Avenue 26 where long ramps placed between retaining wall structures are required to access the platforms. By adding two elevators to access each platform and sets of stairs, a large cost savings is achieved as noted in Alt. No. A-1. This will make it much easier for the disabled to use the facility, however, it will also require long term maintenance of the elevators.

The key issue surrounding most of the stations is the finalization of their design concepts. Access to Sierra Madre Villa and Allen Avenue is difficult because of vehicular traffic on the streets below the stations. Parking at Avenue 26 and French stations needs to be reviewed, the Union Station

configuration needs resolution, Avenue 57 station has to be integrated into the Marmion Way improvements, and access to the Del Mar station needs to be improved.

There are several areas in the Systems parts of the project that can be made more cost-effective. Alt. No. TC-2 suggests that some of the seldom-used power switches be converted to hand-throw switches to save costs. If coded track circuits are employed in lieu of AC track circuits, both time and money can be saved, as demonstrated in alt. No. TC-4.

Procurement of some of the system-wide elements could be taken out of the hands of the design/build contractor and transferred to either the MTA or the Authority. It is believed that if the MTA provides such things as SCADA, Alt. No. SC-2, the fare collection system, Alt. No. FC-1, the CCTV system, Alt. No. CCTV-2, the dynamic signage, Alt. No. DY-3, and the radio system, Alt. No. RS-2 it could do so as part of its system-wide purchases, thus saving costs for this project.

With respect to traction power, the number, size and location of the traction power substations are in a state of flux. A "load flow" study is needed to identify the system's true needs and develop a cost-effective combination of traction power substations located on sites within the purchased right-of-way. Regardless of who performs this study and locates and sizes the equipment, be it the Authority's Program Manager or the design/build team. The results must be determined and appropriate provisions made for execution. See Alt. No. TP-1/TP-2/TP-3/TP-9.

The inclusion of a fiber optic backbone system to provide several system functions is also being considered. To generate revenue for the Authority, it will be prudent to install several blank conduits in a ductbank along the at-grade and Chinatown aerial portion of the project. These conduits should be leased to communications companies for the installation of fiber optic cables. If the Authority could pre-lease at least one of the conduits, then the leassor can install its cable during construction of the line and the Authority could obtain the rights to use the cable for its communication systems, SCADA, signal control, and other functions. This is examined in Alt. No. CL-1/CL-3/CL-4. This could save significantly by eliminating the need for separate cabling for these subsystems throughout the alignment.

SUMMARY OF POTENTIAL COST SAVINGS

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	LOCATION:	LOS ANGELES TO PASADENA, CALIFORNIA			
PROJECT ELEMENT:	LINE SEGMENTS	PRESENT WORTH OF COST SAVINGS				
ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	INITIAL COST SAVINGS	O & M SAVINGS	TOTAL SAVINGS
	CHINATOWN AERIAL (CA)					
CA-1	Substitute mechanically-stabilized earth walls for cast-in-place concrete retaining walls	1,391,100	1,088,318	302,782	—	302,782
	LA RIVER TO ARROYO SECO (LAR)					
LAR-2/ LAR-3	Realign intersection at Figueroa Street, Pasadena Avenue, and Arroyo Seco and grade separation box structure	199,625	81,090	118,535	—	118,535
LAR-5	Raise track profile at Figueroa Street underpass and place storm water reservoir to under grade separation	6,345,060	4,701,310	1,643,750	—	1,643,750
LAR-7	Place reservoir under Figueroa Street grade separation	680,468	201,966	478,502	—	478,502
LAR-8	Use precast concrete pipe for storm water reservoir	196,944	87,962	108,982	—	108,982
LAR-10	Delete water proofing at storm water reservoir	24,717	0	24,717	—	24,717
LAR-14	Modify slab bridge design between LA River Bridge and Avenue 19 Bridge	DESIGN SUGGESTION				
LAR-15	Delete embedded track on Marmion Way between Avenue 51 and Avenue 61	DESIGN SUGGESTION				

SUMMARY OF POTENTIAL COST SAVINGS

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT		LOCATION: LOS ANGELES TO PASADENA, CALIFORNIA				
PROJECT ELEMENT: LINE SEGMENTS		PRESENT WORTH OF COST SAVINGS				
ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	INITIAL COST SAVINGS	O & M SAVINGS	TOTAL SAVINGS
	ARROYO SECO TO DELMAR (ASDM)					
ASDM-1	Use a combination of concrete retaining walls and manufactured noise barrier walls where practical	DESIGN SUGGESTION				
ASDM-2	Use concrete median barrier for low retaining walls in lieu of cast-in-place earth walls	DESIGN SUGGESTION				
ASDM-3	Use crib wall in lieu of cast-in-place concrete for low retaining walls	406,600	243,960	162,640	—	162,640
ASDM-4	Use mechanically stabilized earth walls in lieu of cast-in-place concrete retaining walls	2,712,250	2,373,525	338,725	—	338,725
	DEL MAR TO MEMORIAL PARK (DMMP)					
DMMP-7	Use reinforced slurry walls in lieu of underpinning buildings at tunnel section	10,092,290	9,650,337	441,953	—	441,953
DMMP-12	Close Holly Street to vehicular traffic and raise track profile at Memorial Park Station	2,769,000	1,431,000	1,338,000	—	1,338,000
DMMP-15	Replace floating slab with vertical vibration isolation walls	4,297,800	3,532,860	764,940	—	764,940

SUMMARY OF POTENTIAL COST SAVINGS

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	LOCATION:	LOS ANGELES TO PASADENA, CALIFORNIA			
PROJECT ELEMENT:	LINE SEGMENTS	PRESENT WORTH OF COST SAVINGS				
ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	INITIAL COST SAVINGS	O & M SAVINGS	TOTAL SAVINGS
	MEMORIAL PARK TO SIERRA MADRE (MPSM)					
MPSM-1	Use existing drainage system/facilities along I-210 Freeway section	525,107	0	525,107	—	525,107
MPSM-2	Raise station platform foundations at Lake Avenue	208,663	0	208,663	—	208,663
MPSM-4	Lower track profile from Station 625+00 to Station 690+30	466,013	0	466,013	—	466,013
	LINE SEGMENTS - GLOBAL (LSG)					
LSG-1	Simplify track drainage with side ditches or single track drain pipe as appropriate	72,725	0	72,725	—	72,725
LSG-2	Confirm existing site conditions in retaining wall areas to minimize extent and size of retaining walls	DESIGN SUGGESTION				
LSG-3	Use single pour construction for station platforms	72,725	0	72,725	—	72,725
LSG-5	Replace requirement for high strength rail in curves with R>2,000 ft.	67,000	57,500	9,500	—	9,500
LSG-6	Delete high strength rail in stations and crossovers and use standard rail	325,806	244,352	81,454	—	81,454
LSG-7	Replace U-69 rail with standard T-rail for guardrail	DESIGN SUGGESTION				
LSG-11	Stipulate high strength rail for curves with R<2,000 ft.	DESIGN SUGGESTION				

SUMMARY OF POTENTIAL COST SAVINGS

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT		LOCATION: LOS ANGELES TO PASADENA, CALIFORNIA				
PROJECT ELEMENT: STATIONS		PRESENT WORTH OF COST SAVINGS				
ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	INITIAL COST SAVINGS	O & M SAVINGS	TOTAL SAVINGS
	GLOBAL (G)					
G-1	Replace the skylights with standard roofing at each canopy	1,688,400	1,541,400	147,000	—	147,000
G-3	Raise canopy eave height from 9 ft. 3 in. to 10 ft. to reduce vandalism	DESIGN SUGGESTION				
G-8	Use constant section umbrella arms at the station canopies	257,000	160,000	97,000	—	97,000
G-11	Evaluate quantity of platform luminaries required and reduce current number if possible	DESIGN SUGGESTION				
G-12	Use fewer MTA standard lighting fixtures on platforms	136,080	94,080	42,000	67,897	109,897
G-14A	Upgrade the platform prewarning strip to aluminum in lieu of paint	12,040	49,000	(36,960)	55,217	18,257
G-14B	Upgrade the platform prewarning strip to colored concrete in lieu of paint	12,040	32,340	(20,300)	55,217	34,919
G-17	Limit the art at the stations to applied art versus integral art	DESIGN SUGGESTION				
G-20	Standardize station platform benches at standard stations	DESIGN SUGGESTION				
G-25	Coordinate station signage with general illumination	DESIGN SUGGESTION				
G-26	Construct station communication vaults and associated utility rough-ins	DESIGN SUGGESTION				
G-27	Tie "Calgary" gates at station platforms to system controls	DESIGN SUGGESTION				
G-28	Reduce minimum landscaping requirements	DESIGN SUGGESTION				

SUMMARY OF POTENTIAL COST SAVINGS

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT		LOCATION:	LOS ANGELES TO PASADENA, CALIFORNIA		
PROJECT ELEMENT: STATIONS			PRESENT WORTH OF COST SAVINGS			
ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	INITIAL COST SAVINGS	O & M SAVINGS	TOTAL SAVINGS
	AVENUE 26 (A)					
A-1	Delete retaining walls and ramps and use elevators at Avenue 26	944,000	412,500	531,500	(105,319)	426,181
A-4	Add the Avenue 26 parking lot back into the project to enhance community linkage	DESIGN SUGGESTION				
A-7	Provide for hydrogen sulfide monitoring at Avenue 26 Station electrical vault	DESIGN SUGGESTION				
A-10	Use spread footings at Avenue 26 Station in lieu of drilled piers to support platforms	141,760	0	141,760	—	141,760
A-12	At Avenue 26 Station provide only one ramp instead of two ramps	229,760	0	229,760	—	229,760
A-13	Repair the failing retaining wall on the west side of Avenue 26 Station	DESIGN SUGGESTION				
	FRENCH (F)					
F-4	Add 16 - 20 parking spaces at French Station on the west side of the tracks	DESIGN SUGGESTION				

SUMMARY OF POTENTIAL COST SAVINGS

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	LOCATION: LOS ANGELES TO PASADENA, CALIFORNIA				
PROJECT ELEMENT:	STATIONS	PRESENT WORTH OF COST SAVINGS				
ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	INITIAL COST SAVINGS	O & M SAVINGS	TOTAL SAVINGS
	SW MUSEUM (SW)					
SW-2	Step footings along the retaining wall to reduce cost and improve constructibility at SW Museum Station	DESIGN SUGGESTION				
	AVENUE 57 (A57)					
A57-2	Modify finish on sound wall at Avenue 57 Station	DESIGN SUGGESTION				
A57-3	Incorporate the Marmion Way corridor Improvements into the project	DESIGN SUGGESTION				
	MISSION (M)					
M-1	Move Mission Station northbound platform 8.8 ft. south	DESIGN SUGGESTION				
M-3	At Mission Station, protect the Liquid Amber (Sweet Gum) Trees in place versus moving the trees	DESIGN SUGGESTION				
M-5	At Mission Station, modify adjacent exterior walls of storage buildings to provide a two-hour fire rating in lieu of constructing a freestanding wall	96,600	20,690	75,910	(4,491)	71,419

SUMMARY OF POTENTIAL COST SAVINGS

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT		LOCATION: LOS ANGELES TO PASADENA, CALIFORNIA				
PROJECT ELEMENT: STATIONS				PRESENT WORTH OF COST SAVINGS		
ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	INITIAL COST SAVINGS	O & M SAVINGS	TOTAL SAVINGS
	FILLMORE (FI)					
FI-1	Use the standard canopy in lieu of station specific canopy at Fillmore Station	264,600	135,000	129,600	—	129,600
	DEL MAR (D)					
D-2	Use double acting pedestrian gates at Del Mar Station track crossing	DESIGN SUGGESTION				
D-3	At Del Mar station, allow platform access/egress at both ends of the platforms	DESIGN SUGGESTION				
	MEMORIAL PARK (MP)					
MP-3	Modify the Memorial Park Station platform canopy	450,000	216,900	233,100	—	233,100
	LAKE (L)					
L-4	At Lake Avenue Station, eliminate provision for future escalator and redirect east side of stairs from Lake Avenue Overpass	95,750	0	95,750	—	95,750

SUMMARY OF POTENTIAL COST SAVINGS

PROJECT: **PASADENA BLUE LINE LIGHT RAIL PROJECT** LOCATION: **LOS ANGELES TO PASADENA, CALIFORNIA**

PROJECT ELEMENT: **STATIONS**

ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	INITIAL COST SAVINGS (PRESENT WORTH OF COST SAVINGS)	O & M SAVINGS (PRESENT WORTH OF COST SAVINGS)	TOTAL SAVINGS (PRESENT WORTH OF COST SAVINGS)
	ALLEN (AL)					
AL-5	Coordinate bus stops and pedestrian crosswalks at Sierra Madre Villa and Allen Stations with the City of Pasadena	DESIGN SUGGESTION				
	SIERRA MADRE (SM)					
SM-1	Delay construction of Sierra Madre Villa Station to be concurrent with construction of the park and ride or construct the pedestrian bridge now	DESIGN SUGGESTION				

SUMMARY OF POTENTIAL COST SAVINGS

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT		LOCATION: LOS ANGELES TO PASADENA, CALIFORNIA				
PROJECT ELEMENT: STATIONS		PRESENT WORTH OF COST SAVINGS				
ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	INITIAL COST SAVINGS	O & M SAVINGS	TOTAL SAVINGS
	UNION STATION (US)					
US-1	Reduce the size of the below grade passenger vestibule at Union Station	1,123,000	0	1,123,000	—	1,123,000
US-2	Relocate Communications & Signaling and Layover Rooms from tunnel to above grade	142,800	0	142,800	—	142,800
US-3	Eliminate raising the track approximately 5 ft. above the existing grade at the Union Station Platform	1,000,000	0	1,000,000	—	1,000,000
US-4	Add crossover tracks on each side of station to make double crossovers and allow the use of the east, west and pocket track with either side of the platform	0	300,000	(300,000)	—	(300,000)
US-6	Replace slab/direct fixation track system in Union Station with ballast/tie track system	254,809	74,816	179,993	—	179,993
US-7	Reduce extent canopy at Union Station	220,140	112,320	107,820	—	107,820
US-8	Delay construction of west track at Union Station Platform until headways are decreased	661,300	0	661,300	—	661,300
	CHINATOWN STATION (CS)					
CS-1 to CS-5	Revise Chinatown Station concept	DESIGN SUGGESTION				

SUMMARY OF POTENTIAL COST SAVINGS

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT **LOCATION:** LOS ANGELES TO PASADENA, CALIFORNIA

PROJECT ELEMENT: YARD AND SHOPS (Y&S)

				PRESENT WORTH OF COST SAVINGS		
ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	INITIAL COST SAVINGS	O & M SAVINGS	TOTAL SAVINGS
Y&S-1	Use prefabricated metal building frame and building skin for all buildings in lieu of custom steel structures	1,340,000	440,000	900,000	—	900,000
Y&S-2	Simplify the existing HVAC system in the office area by replacing the VAV system with a number of single zone units.	152,000	80,000	72,000	—	72,000
Y&S-3	Modify track layout in yard to improve train movements	0	567,190	(567,190)	—	(567,190)
Y&S-4	Replace cantilevered cast-in-place concrete retaining walls with chain link fence retainer matting	269,500	113,300	156,200	—	156,200
Y&S-6	Use soil nail walls in lieu of retaining walls	483,264	224,250	259,014	—	259,014

SUMMARY OF POTENTIAL COST SAVINGS

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT LOCATION: LOS ANGELES TO PASADENA, CALIFORNIA

PROJECT ELEMENT: SYSTEMS

ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	PRESENT WORTH OF COST SAVINGS INITIAL COST SAVINGS	O & M SAVINGS	TOTAL SAVINGS
	TRAIN CONTROL (TC)					
TC-2	Use hand throw switches instead of electrically powered switches at selected locations	97,400	543,175	428,225	—	428,225
TC-3	Verify interlocking quantities	DESIGN SUGGESTION				
TC-4	Install coded track circuits in lieu of AC track circuits	2,062,750	1,672,500	390,250	—	390,250
TC-5	Use a microprocessor based train control system	DESIGN SUGGESTION				
TC-6	Use LED signal heads in lieu of incandescent lights at highway crossings	84,740	127,110	(42,370)	—	(42,370)
TC-7	Use prefabricated in lieu of cast-in-place concrete foundations for train control features	DESIGN SUGGESTION				
	SYSTEM SECURITY (SS)					
SS-1	Provide intrusion detectors in tunnel sections	DESIGN SUGGESTION				
SS-2	Hire an outside company to monitor intrusion/fire detection in traction power substations	0	0	0	(2,600/month)	(429,000)
SS-3	Include Public Address System in fiber optic backbone	DESIGN SUGGESTION				

SUMMARY OF POTENTIAL COST SAVINGS

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	LOCATION:	LOS ANGELES TO PASADENA, CALIFORNIA			
PROJECT ELEMENT:	SYSTEMS	PRESENT WORTH OF COST SAVINGS				
ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	INITIAL COST SAVINGS	O & M SAVINGS	TOTAL SAVINGS
	FARE COLLECTION (FC)					
FC-1	Have MTA procure fare collection system	2,040,000	326,026	1,713,974	—	1,713,974
FC-3	Include ATM at ticket vending machines	DESIGN SUGGESTION				
	SCADA SYSTEM (SC)					
SC-2	Have MTA provide the SCADA system with its next system wide SCADA upgrade	DESIGN SUGGESTION				
SC-3	Provide fiber optic backbone only for SCADA system	2,720,600	3,035,030	(314,430)	—	(314,430)

SUMMARY OF POTENTIAL COST SAVINGS

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	LOCATION:	LOS ANGELES TO PASADENA, CALIFORNIA			
PROJECT ELEMENT:	SYSTEMS	PRESENT WORTH OF COST SAVINGS				
ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	INITIAL COST SAVINGS	O & M SAVINGS	TOTAL SAVINGS
	TRACTION POWER (TP)					
TP-1/TP-2/TP-3/TP-9	The Program Manager shall perform "load flow" study and confirm the size, number and locations of traction power substations	DESIGN SUGGESTION				
TP-4	Use single feed to Baker Street traction power substation	133,800	44,600	89,200	—	89,200
TP-5	Use low resistance grounding for traction power	446,000	334,500	111,500	—	111,500
TP-6	Use appropriate cable insulation	892,000	785,500	106,500	—	106,500
	CABLE LEASING (CL)					
CL-1/CL-3/CL-4	Install conduits for fiber optic cables throughout the alignment and lease use of conduits	DESIGN SUGGESTION				
	CLOSED CIRCUIT TELEVISION (CCTV)					
CCTV-2	Provide closed circuit television at selected critical locations	DESIGN SUGGESTION				
CCTV-4	Have MTA procure CCTV	543,919	81,548	462,371	—	462,371

SUMMARY OF POTENTIAL COST SAVINGS

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT		LOCATION: LOS ANGELES TO PASADENA, CALIFORNIA				
PROJECT ELEMENT: SYSTEMS		PRESENT WORTH OF COST SAVINGS				
ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	INITIAL COST SAVINGS	O & M SAVINGS	TOTAL SAVINGS
	DYNAMIC SIGNAGE (DY)					
DY-2	Sell advertising on dynamic signage at stations	DESIGN SUGGESTION				
DY-3	Replace dynamic signage with Closed Circuit Television screens	751,867	751,867	0	—	0
DY-5	Have MTA procure dynamic signage	751,867	112,780	639,087	—	639,087
	RADIO SYSTEM (RS)					
RS-2	Have MTA procure radio system	2,367,145	355,072	2,012,073	—	2,012,073
	EMERGENCY TELEPHONE SYSTEM (ETS)					
ETS-1	MTA will procure emergency telephone system	1,311,240	131,124	1,180,116	—	1,180,116
ETS-2	Include ETS in fiber optic backbone	1,311,240	631,368	679,872	—	679,872
ETS-4	Lease dedicated telephone lines for emergency telephone system	1,311,240	44,600	1,266,640	(528,570)	782,670

Study Results

STUDY RESULTS

INTRODUCTION

The results are the major feature of a VE study since they represent the benefits that can be realized on the project by the owner, users and designer/build team. The results will directly affect the project design and will require coordination between representatives of the Long Beach to Pasadena Metro Blue Line Construction Authority (Authority) and its Peer Review Team to determine the disposition of each alternative.

The results of the study are presented as alternatives for change. These may be in the form of VE alternatives (accompanied by cost estimates) or design suggestions (without cost estimates). Each alternative consists of a summary of the original design, a description of the proposed change, a cost comparison, and an evaluation of the advantages and disadvantages. Each alternative is accompanied by a brief narrative to compare the original design and the proposed change. Sketches, where appropriate, are also presented. The cost comparisons reflect unit quantities, whenever possible, for determining overall cost. Unit prices used in the development of the alternatives were taken from the Detailed Construction Cost Estimates, prepared by EMC prior to the suspension of the project. When unit prices were not available in the project estimates, nationally-based unit price databases were used.

Each design suggestion (DS) contains the same information as the VE alternatives, except that no cost information is included. Design suggestions are presented to bring attention to areas of the design that, in the opinion of the VE team, should be changed for reasons other than cost. Examples of these reasons include improved operation, ease of maintenance, ease of construction, safer working conditions, etc. In addition, some ideas cannot be quantified in terms of cost with the design information provided; these are also presented as design suggestions and are intended to improve the quality of the project.

Summaries of the alternatives and design suggestions that were developed during the study are provided on the table entitled *Summary of Potential Cost Savings* that is segregated into project elements to consolidate the ideas relating to each topic. An alternative number facilitates referencing among the *Creative Idea Listing and Evaluation*, and summary table. The alternative number incorporates the following prefixes to designate the project elements:

CA	=	Chinatown Aerial	**FI**	=	Filmore Station
LAR	=	Los Angeles River to Arroyo Seco	**D**	=	Del Mar Station
ASDM	=	Arroyo Seco to Del Mar	**MP**	=	Memorial Park Station
DMMP	=	Del Mar to Memorial Park	**L**	=	Lake Avenue Station
MPSM	=	Memorial Park to Del Mar	**AL**	=	Allen Avenue Station
LSG	=	Line Segments - Global	**SM**	=	Sierra Madre Villa Station
G	=	Stations - Global	**US**	=	Union Station
A	=	Avenue 26 Station	**CS**	=	Chinatown Station
F	=	French Station	**Y&S**	=	Yard and Shops
SW	=	Southwest Museum Station	**TC**	=	Train Control
A57	=	Avenue 57 Station	**SS**	=	System Security
M	=	Mission Station	**FC**	=	Fare Collection System

SC	=	SCADA System	**DY**	=	Dynamic Signage
TP	=	Traction Power System	**RS**	=	Radio System
CL	=	Cable Leasing	**ETS**	=	Emergency Telephone System
CCTV	=	Closed Circuit Television System			

The summary sheets for the various elements are used as dividers for the alternatives detailed.

KEY ISSUES

This project began in the late 1980s as a traditional design/bid/build project funded by the Los Angeles Metropolitan Transportation Authority (MTA). However, as time progressed, the total expected project costs were expected to escalate to almost a billion dollars and the project was suspended in 1998 after approximately $274 million was expended. The need for the project remained and thus the State of California authorized the establishment of the Authority to complete the construction within an established budget of $411 million. A requirement for executing the work was that the design/build procurement method would be employed.

When the project was reinstated, 17 individual construction projects remained to be completed. Each of the projects was at a differing level of design completion ranging from about 10% to almost 100%. Gannett Fleming, Inc. who was working with the Authority on a temporary basis to start-up the project, produced a Project Development Status Report (PDSR). This report summarized a majority of the issues that required resolution if the project was to reach fruition. Reviewing this document, visiting the site, and then determining how the noted issues should be resolved was the VE team's introduction to the project. The review also uncovered areas for potential value enhancement.

Along with reviewing the PDSR and the vast array of documentation addressed by it, the VE team evaluated those documents considered necessary for a design/build team to respond to a Request for Proposal to design and build the facility. The result of this review was that all the environmental studies, calculations, drawings, specifications, and suspension documents prepared by the EMC (the MTA's former project designer), and the suspension documents prepared by MTA and the MTA's former Construction Management Consultant for the project prior to suspension of the work, should be included in the package given to potential design/build teams. The existing drawings would also be annotated to reflect areas that would change based on resolution of issues presented in the PDSR.

With a concept for the design/build package developed, it was now necessary optimize it along with appropriate design features. Those issues identified during the PDSR review that could be resolved by the Carter-Burgess/Lewis & Zimmerman Team were to be opened for the development of creative solutions. Some general open design issues uncovered were:

- What is the acceptable concept for each station?
- What should be done in the Midway Yard?
- What needs to be incorporated into the project for noise and vibration control?
- How should the Authority proceed with Union Station?
- What are the system-wide system concepts for the project?
- What are the sizes and number of traction power substations required and where should they be located?
- How can the expensive structural elements of the project be performed more cost-effectively?

The other challenge for the VE team was to identify areas of unnecessary cost in the project and generate alternatives that will provide the essential functions at the lowest capital and/or life cycle cost.

RESULTS OF THE STUDY

The VE team developed 57 alternatives with cost saving potential and 39 design suggestions. All of the alternatives and design suggestions are detailed below following this narrative of those key alternatives addressing the issues noted above.

From a construction standpoint, the most costly elements of the project are the structures, including the Figueroa Street underpass, the Old Town Pasadena tunnel section, the Chinatown aerial structure, the cantilevered, cast-in-place concrete retaining walls, and the buildings in the Midway Yard.

The first question to resolve is whether or not the Figueroa Street underpass is required. If not, construction could be greatly simplified and significant costs and time could be saved. However, traffic studies must confirm the ability to delete it from the project. There also is the option of using an overpass in lieu of the underpass that should be explored. Since this issue was considered several years ago, and since the City of Los Angeles probably was involved, close coordination of this item with the City will be required.

If the Figueroa Street underpass remains, then the tunnel can be raised and the track profile grades into and out-of the tunnel lessened by intercepting two sanitary sewer lines currently crossing the tunnel and rerouting them around the depressed area. Along with this, a deep storm water reservoir for the rail line can be relocated under the tunnel to simplify construction, improve operations and save significant costs as described in Alt. No. LAR-2/LAR-3.

Several alternatives provide options for the concrete retaining walls along the alignment. Alt. Nos. CA-1, ASDM-2, ASDM-3, ASDM-4, and Y&S-4 suggest using mechanically stabilized earth walls, highway type concrete median barriers, crib walls or soil nailing to reduce the cost of these walls, as well as the time to construct them.

The extent of retaining walls and the construction of noise barrier walls are areas that require research for cost optimization. The current topographical information is almost nine years old. It will be necessary for the design/build team to verify the accuracy of the information and update the retaining walls to reflect current conditions and needs. With respect to the noise walls, former noise and vibration studies used to delineate requirements were based on old information. A new study should be executed based upon applicable design criteria for noise levels, the current system operating plan, the actual rail vehicles to be used on the line, and a track section similar to that proposed for the Pasadena Metro Blue Line. The results of this study should be the basis for the design/build team to erect noise barriers and vibration control features.

The Midway Yard Maintenance Building will have to be modified to accommodate the wheel-truing machine. The review of the current layout indicates that some minor functions, such as a space to work on vehicle trucks, general work areas for repairing small components, and an employee break room are not included, but probably should be. Development of a new conceptual floor plan incorporating these functions and reconfiguring the existing functions will result in a more usable facility with little cost impact.

Similarly, the yard layout has some dysfunctional elements, such as the potential to bottleneck at the leads to the main line, complex switching between the storage tracks and the bypass track, the potential to block the bypass track at the cleaning platform, emergency evacuation and fire access routing conflicts, etc. These could be improved with some concept modifications and presented to the design/build team for implementation.

Currently, all of the buildings located at the Midway Yard are to be constructed of stick-built structural steel with prefabricated metal panels and some masonry exteriors. This shop area is projected to serve the system for roughly 10 years, thus Alt. No.Y&S-1 suggests that the buildings be pre-engineered to save both time and money.

As designed, the Memorial Park Station requires extensive modification to the apartment building foundation that is to sit above it. This includes underpinning and the elimination of grade beams that provide lateral support for the building columns. The grade beams must be replaced with an alternative support system. By raising the grade of the tracks south of the station and providing a cul-de-sac for the west leg of Holly Street, the station can be raised thus eliminating most of the foundation work and saving substantial costs. Raising the station also allows for improved integration into the adjacent park as shown in Alt. No. DMMP-12. There also is a potential to eliminate the floating slab at the station to save costs, which is documented in Alt. No. DMMP-15.

The tunnel through Old Town Pasadena is an expensive part of the project because it requires the underpinning of numerous old buildings. This could be a risky operation because of its extent and the condition of the buildings. Alt. No. DMMP-7 suggests that reinforced slurry walls could be installed alongside the building foundations and integrated into the tunnel design to avoid installing underpinning. This reduces project risks as well as saves cost. This includes a reduction in the horizontal clearance requirements that appears technically feasible.

The line segment along Marmion Way between Avenue 50 and Avenue 61 is in a state of flux. The area has to be constructed using a transit treatment that is unique to this section due to its narrowness and the adjacent residential access needs. HNTB Corporation developed some draft alternatives for the area that have not been approved. The concept includes a center overhead catenary system support, two 12-foot wide, one way roads on both sides of the track with mountable curbs leading onto the tracks for vehicles to pass stopped vehicles on the roadways, and 5-foot wide sidewalks on the outside of the roadways. At the intersection with each avenue, four-way stop signs are provided. This is shown in Alt. No. LAR-15.

There is a concern about this concept because it encourages vehicles to use the track area. By working with the Peer Review Team, the VE team identified a design alternative to place the overhead catenary system support poles on the outside edges of the right-of-way, allowing them to also carry the utility power lines. This will allow the tracks to be moved closer together and the roadways to be widened. A full curb will be placed between the roadway and the tracks and a mountable curb placed at the sidewalks. This would reduce the potential for vehicles and pedestrians to enter onto to the tracks, improving the safety of the system. It will also provide additional maneuvering room for vehicles entering the roadway along the tracks from alleys that intersect the roadways.

At the intersection with the major crossing avenues, it will be necessary to decide upon an appropriate pavement treatment that provides the desired aesthetics for the community. Also necessary is a confirmation of vehicle operations, i.e. should a traffic signaling system be installed to permit unimpeded train movement through the corridor at the design speed limit?

With respect to the stations, Union Station is one of the more costly ones because of the underground construction, the five-foot elevation of the tracks, and the direct fixation track structure that is designed for it. Alt. Nos. US-1, US-2, and US-6 would eliminate the underground structures and replace the space in other areas and substitute ballasted track to save costs. Alt. No. US-3 shows how the tracks could be lowered to avoid constructing an expensive retaining wall and embankment. A complete reconfiguration including all of the above will result in a substantial cost savings without affecting the functionality of the station. The feasibility of this alternative needs to be verified.

Another station with a potential for large cost savings is Avenue 26 where long ramps placed between retaining wall structures are required to access the platforms. By adding two elevators to access each platform and sets of stairs, a large cost savings is achieved as noted in Alt. No. A-1. This will make it much easier for the disabled to use the facility, however, it will also require long term maintenance of the elevators.

The key issue surrounding most of the stations is the finalization of their design concepts. Access to Sierra Madre Villa and Allen Avenue is difficult because of vehicular traffic on the streets below the stations. Parking at Avenue 26 and French stations needs to be reviewed, the Union Station configuration needs resolution, Avenue 57 station has to be integrated into the Marmion Way improvements, and access to the Del Mar station needs to be improved.

There are several areas in the Systems parts of the project that can be made more cost-effective. Alt. No. TC-2 suggests that some of the seldom-used power switches be converted to hand-throw switches to save costs. If coded track circuits are employed in lieu of AC track circuits, both time and money can be saved, as demonstrated in alt. No. TC-4.

Procurement of some of the system-wide elements could be taken out of the hands of the design/build contractor and transferred to either the MTA or the Authority. It is believed that if the MTA provides such things as SCADA, Alt. No. SC-2, the fare collection system, Alt. No. FC-1, the CCTV system, Alt. No. CCTV-2, the dynamic signage, Alt. No. DY-3, and the radio system, Alt. No. RS-2 it could do so as part of its system-wide purchases, thus saving costs for this project.

With respect to traction power, the number, size and location of the traction power substations are in a state of flux. A "load flow" study is needed to identify the system's true needs and develop a cost-effective combination of traction power substations located on sites within the purchased right-of-way. Regardless of who performs this study and locates and sizes the equipment, be it the Authority's Program Manager or the design/build team. The results must be determined and appropriate provisions made for execution. See Alt. No. TP-1/TP-2/TP-3/TP-9.

The inclusion of a fiber optic backbone system to provide several system functions is also being considered. To generate revenue for the Authority, it will be prudent to install several blank conduits in a ductbank along the at-grade and Chinatown aerial portion of the project. These conduits should be leased to communications companies for the installation of fiber optic cables. If the Authority could pre-lease at least one of the conduits, then the leassor can install its cable during construction of the line and the Authority could obtain the rights to use the cable for its communication systems, SCADA, signal control, and other functions. This is examined in Alt. No. CL-1/CL-3/CL-4. This could save significantly by eliminating the need for separate cabling for these subsystems throughout the alignment.

EVALUATION OF ALTERNATIVES

When reviewing the study results, the reader should consider each part of an alternative or design suggestion on its own merit. There may be a tendency to disregard an alternative because of concern about one part of it. Each area within an alternative that is acceptable should be considered for use in the final design, even if the entire alternative is not implemented.

Cost is the primary basis of comparison for alternative designs. To ensure that costs are comparable within the alternatives proposed by the VE team, the designer's cost estimate, where possible, is used as the pricing basis.

All alternatives were developed independently of each other. However, some of the alternatives are mutually exclusive and some are interrelated, so acceptance of one may preclude the acceptance of another or may not yield the total of the cost savings shown for each alternative. The reader should evaluate those alternatives carefully in order to select the combination of ideas with the greatest beneficial impact on the project considering both cost and other project value objectives.

CONSIDERATIONS AND ASSUMPTIONS

In the preparation of this report and the alternatives that follow, the VE team made certain assumptions with respect to conditions that may occur in the future. In addition, the VE team reviewed the project documentation, depending solely upon the information provided and relying on that information as being true, complete, and accurate. The following considerations and assumptions should be read in connection with the report:

- The alternatives rendered herein are as of the date of this report. The VE team assumes no duty to monitor events after the date, or to advise or incorporate in the alternatives, any new previously unknown technology.

- The VE team assumes that there are no material documents affecting the design or construction costs which were not seen. The existence of such documents will necessarily alter the alternatives contained herein.

- The VE team does not warrant the feasibility of these alternatives or the advisability of their implementation. It is the sole responsibility of the designer, in accord with the owner, to explore the technical feasibility and make the determination of implementation.

SUMMARY OF POTENTIAL COST SAVINGS

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	**LOCATION:**	**LOS ANGELES TO PASADENA, CALIFORNIA**			
PROJECT ELEMENT:	**LINE SEGMENTS**		**PRESENT WORTH OF COST SAVINGS**			
ALT. NO.	**DESCRIPTION**	**ORIGINAL COST**	**ALTERNATIVE COST**	**INITIAL COST SAVINGS**	**O & M SAVINGS**	**TOTAL SAVINGS**
	CHINATOWN AERIAL (CA)					
CA-1	Substitute mechanically-stabilized earth walls for cast-in-place concrete retaining walls	1,391,100	1,088,318	302,782	—	302,782
	LA RIVER TO ARROYO SECO (LAR)					
LAR-2/ LAR-3	Realign intersection at Figueroa Street, Pasadena Avenue, and Arroyo Seco and shorten tunnel	199,625	81,090	118,535	—	118,535
LAR-5	Raise track profile at Figueroa Street underpass and place storm water reservoir to under tunnel	6,345,060	4,701,310	1,643,750	—	1,643,750
LAR-7	Place reservoir under Figueroa Street tunnel	680,468	201,966	478,502	—	478,502
LAR-8	Use precast concrete pipe for storm water reservoir	196,944	87,962	108,982	—	108,982
LAR-10	Delete water proofing at storm water reservoir	24,717	0	24,717	—	24,717
LAR-14	Modify slab bridge design between LA River Bridge and Avenue 19 Bridge	DESIGN SUGGESTION				
LAR-15	Delete embedded track on Marmion Way between Avenue 51 and Avenue 61	DESIGN SUGGESTION				

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	CA-1
DESCRIPTION: FOR	SUBSTITUTE MACHANICALLY STABLIZED EARTH WALLS CAST-IN-PLACE CONCRETE RETAINING WALLS	SHEET NO.	1 of 6

ORIGINAL DESIGN: (Sketch attached X)

Cast-in-place concrete, cantilevered retaining walls are used for the track embankments at both ends of the Chinatown Aerial section of track.

ALTERNATIVE: (Sketch attached X)

Use mechanically stabilized earth walls for retaining the embankment.

ADVANTAGES:

- Save time.
- Reduces construction time

DISADVANTAGES:

- None apparent.

DISCUSSION:

Mechanically stabilized earth walls are commonly used for this application. They are used throughout California by Caltrans, as well as every other State Highway Department. There has also been limited use on transit systems around the country. Significant cost savings are generated by making the substitution. Note that the south wall can be extended 200 feet + towards Union Station.

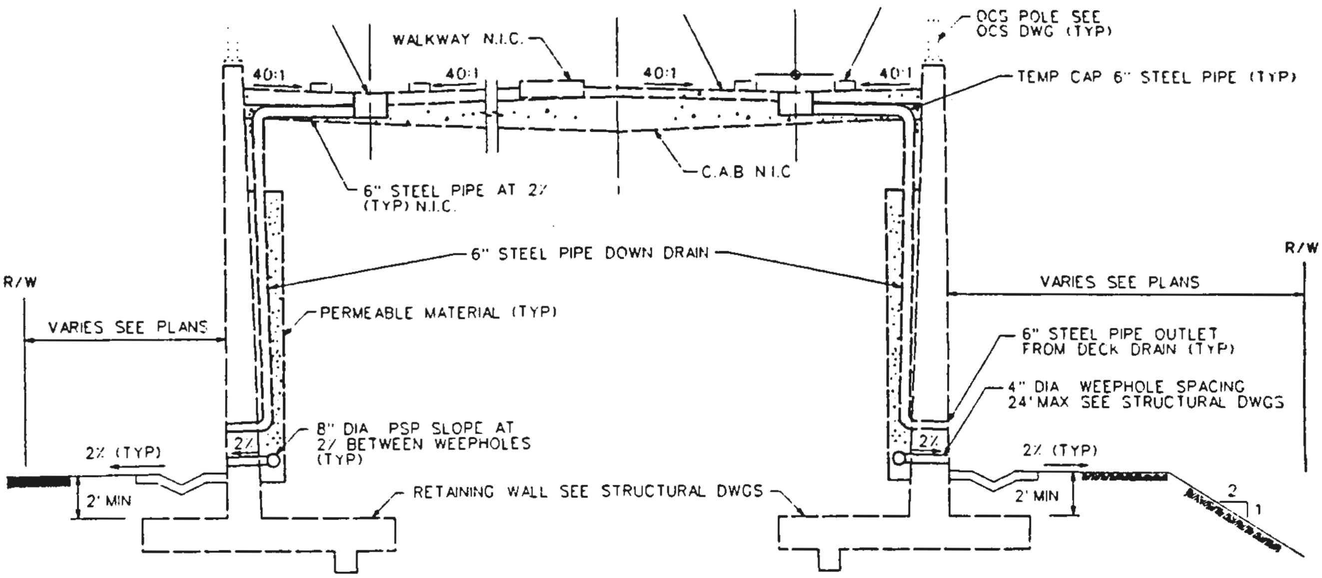
COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 1,391,100	$	$ 1,391,100
ALTERNATIVE	$ 1,088,318	$	$ 1,088,318
SAVINGS	$ 302,782	$	$ 302,782

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

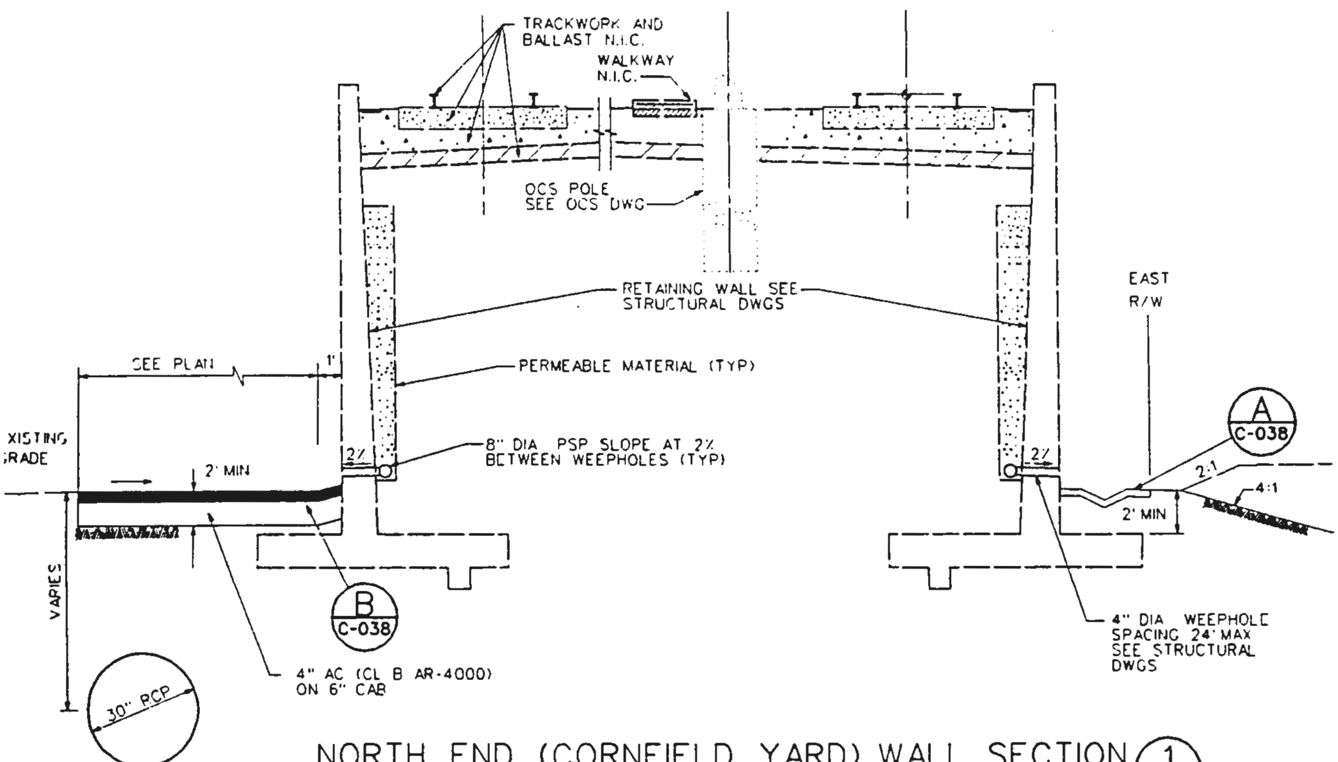
ALTERNATIVE NO. CA-1

☑ AS DESIGNED ☐ ALTERNATIVE

SHEET NO. 2 of 6



UNION STATION WALL SECTION 2 C-038 C-031
NO SCALE



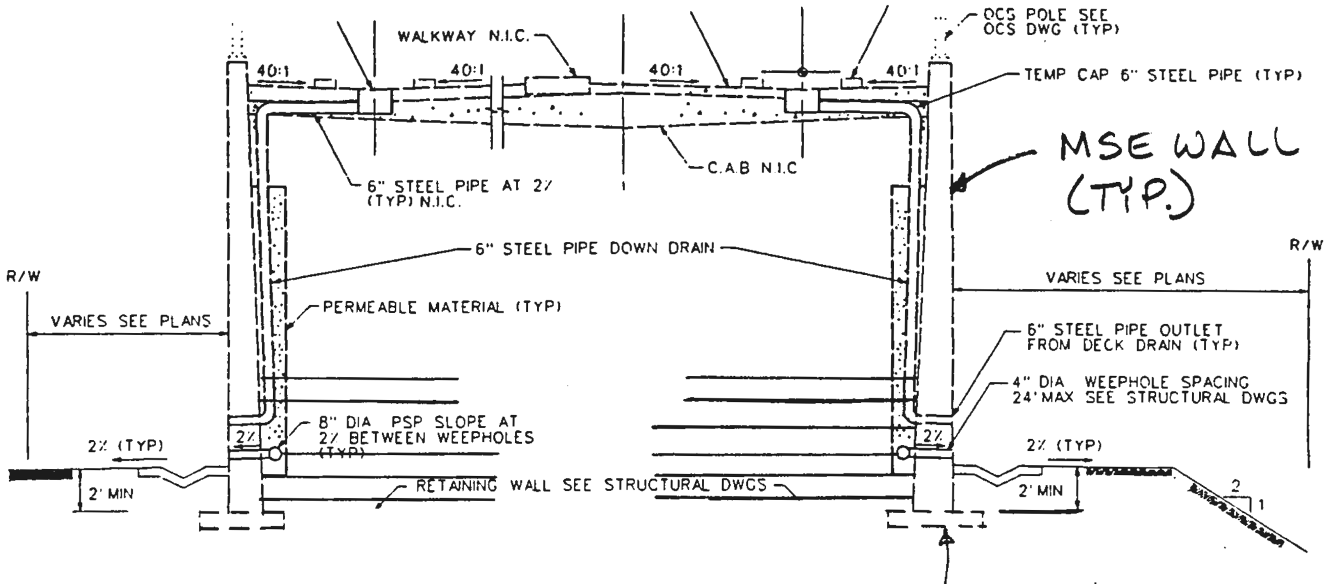
NORTH END (CORNFIELD YARD) WALL SECTION 1 C-038 C-031
NO SCALE

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

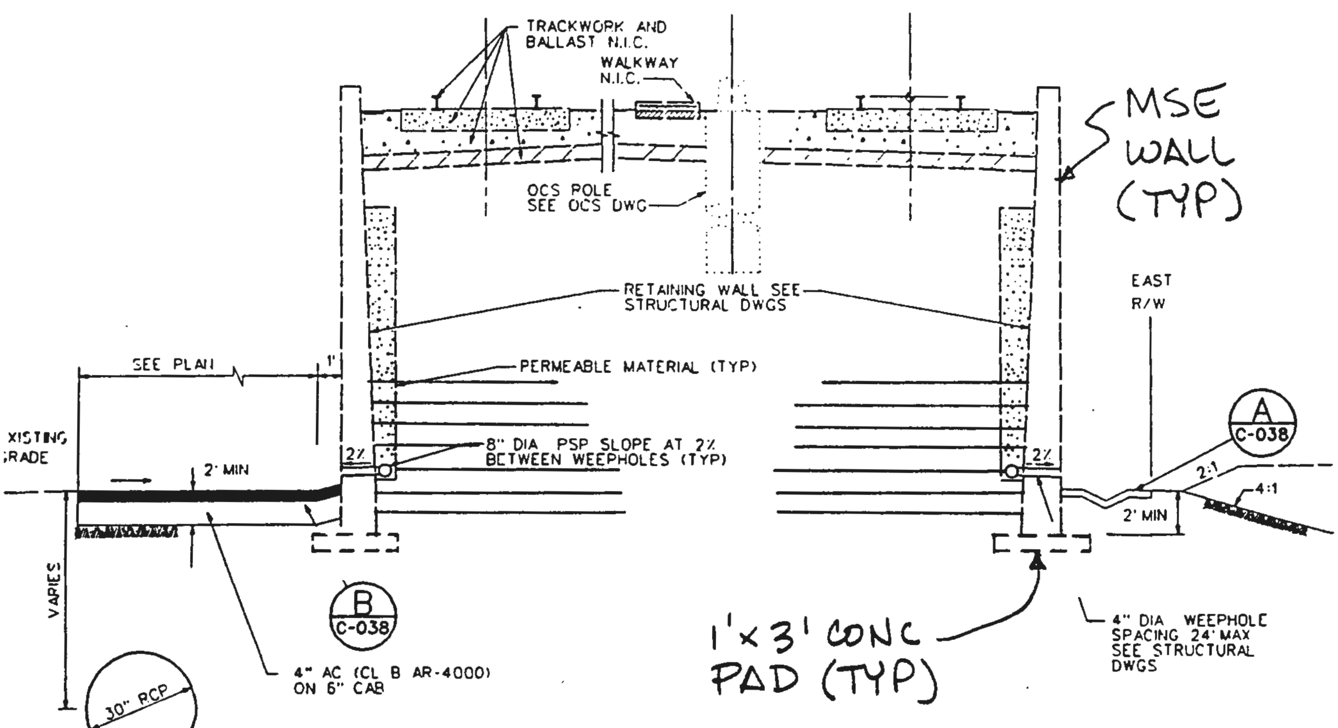
ALTERNATIVE NO. CA-1

☐ AS DESIGNED ☑ ALTERNATIVE

SHEET NO. 3 of 6



UNION STATION WALL SECTION 2 C-038 C-031
NO SCALE



NORTH END (CORNFIELD YARD) WALL SECTION 1 C-038 C-031
NO SCALE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. CA-1
		SHEET NO. 4 of 6

South Retaining Walls

72' × 65.71 ft³/ft × 2	=	9462 ft³
72 × 53.30 × 2	=	7675
71 × 45.75 × 2	=	6496
2 × 1 × 18 × 2	=	72
		23,705 ÷ 27 = 878 cy

North Retain. Walls

48' × 108.88 × 2	=	10,452
48' × 85.67 × 2	=	8,224
48' × 61.00 × 2	=	5856
24' × 52.33 × 2	=	2,512
48' × 46.30 × 2	=	4,445
72' × 38.75 × 2	=	5,580
72' × 33.24 × 2	=	4,786
72' × 28.69 × 2	=	4,131
48' × 23.58 × 2	=	2,264
48' × 17.41 × 2	=	1,671
11' × 14.05 × 2	=	309
		50,230 ft³ ÷ 27 = 1860 cy

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. CA-1
	SHEET NO. 5 of 6

Area of Walls

South Retaining Walls

$71 \times 18 \times 2 = 2556 \text{ ft}^2$

$72 \times 20 \times 2 = 2880$

$72 \times 22 \times 2 = 3168$

8604 ft^2

North Retaining Walls

$48 \times 28 \times 2 = 2688 \text{ ft}^2$

$48 \times 26 \times 2 = 2496$

$48 \times 24 \times 2 = 2304$

$24 \times 22 \times 2 = 1056$

$48 \times 20 \times 2 = 1920$

$72 \times 18 \times 2 = 2592$

$72 \times 16 \times 2 = 2304$

$72 \times 14 \times 2 = 2016$

$48 \times 12 \times 2 = 1152$

$48 \times 10 \times 2 = 960$

$11 \times 8 \times 2 = 176$

$19,664 \text{ ft}^2$

COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. CA-1
	SHEET NO. 6 of 6

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
CONCRETE FOR RETAINING WALLS	CY	2738	450	1,232,100			
BACKFILL-IMPORTED	CY	10,600	15.00	159,000			
MSE WALL	SF				28268	38.50	1,088,318
Sub-Total				1,391,100			1,088,318
Mark-Up at %							
TOTAL							

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	**ALTERNATIVE NO.**	LAR-2 LAR-3
DESCRIPTION:	**REALIGN INTERSECTION AT FIGUEROA, PASADENA AVENUE AND ARROY SECO AND SHORTEN GRADE SEPARATION BOX STRUCTURE**	**SHEET NO.**	1 of 6

ORIGINAL DESIGN: (Sketch attached)

The complex intersection at Figueroa Street, Pasadena Avenue, Arroyo Seco and Marmion Way forces length of grade separation box structure to be 393.5 linear feet (lf).

ALTERNATIVE: (Sketch attached X) Pink

Culda-sac for Arroyo Seco, rotate Pasadena at intersection and kick out both Pasadena and Marmion way to reduce tunnel length. (see alternate study of raising grade) (see LAR-5).

Reduce bover section by 200 l.f.

ADVANTAGES:

- Reduced tunnel area.
- Reduce cost.
- Increased safety.

DISADVANTAGES:

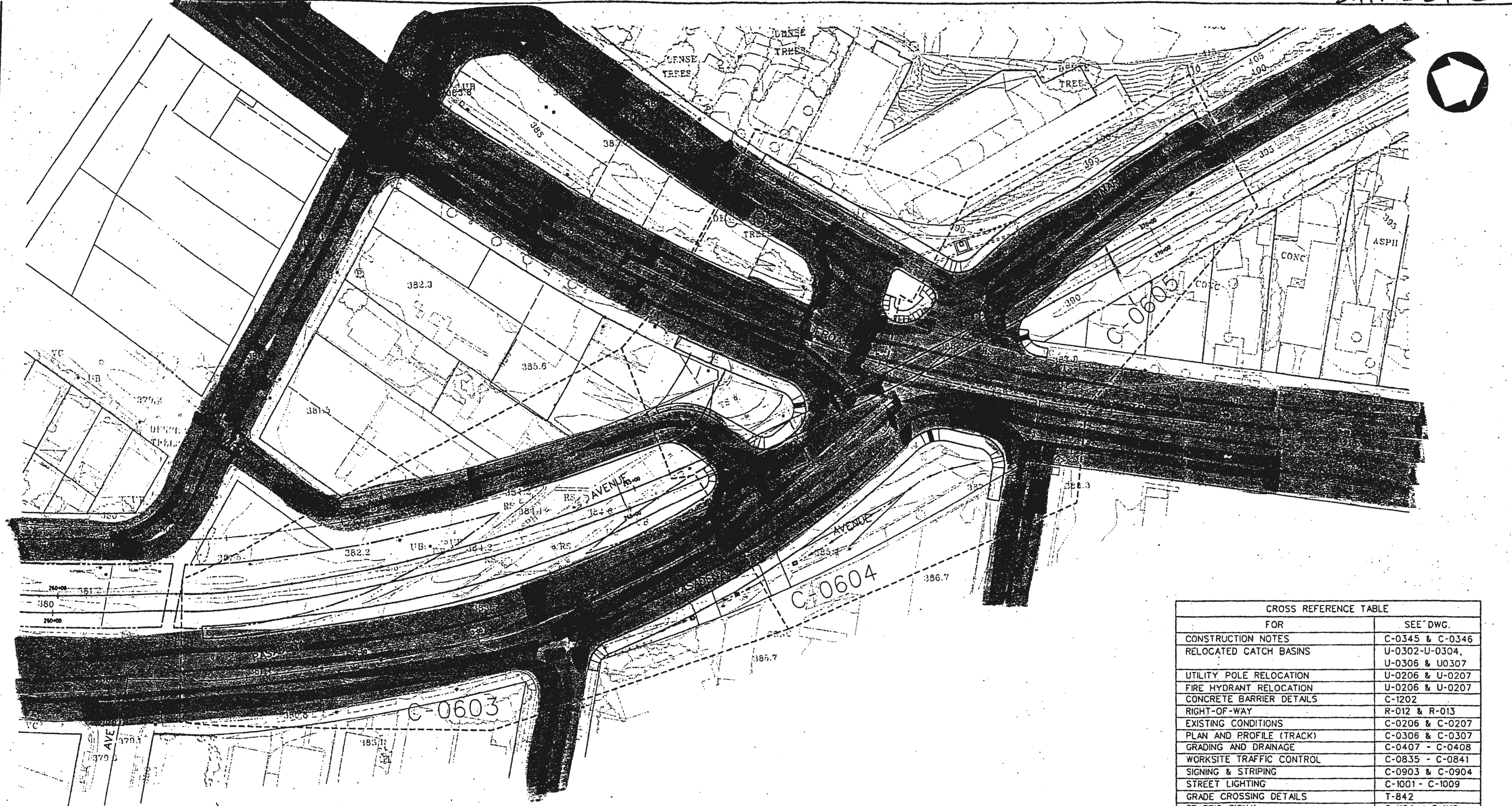
- Does not allow Arroyo Seco to connect to Pasadena Avenue
- Narrows Marmion Way

DISCUSSION:

This alternative eliminates the connection of Arroyo Seco to Pasadena Avenue thus, avoiding an unsafe condition whereby two intersections are less than 100 ft. apart. Access to the properties abutting Arroyo Seco is maintained via Avenue 37.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 118.535	$	$
ALTERNATIVE	$	$	$
SAVINGS	$ 118,535	$	$ 118,535

LAR-2/LAR-3
Sht. 2 of 6



CROSS REFERENCE TABLE	
FOR	SEE DWG.
CONSTRUCTION NOTES	C-0345 & C-0346
RELOCATED CATCH BASINS	U-0302-U-0304, U-0306 & U0307
UTILITY POLE RELOCATION	U-0206 & U-0207
FIRE HYDRANT RELOCATION	U-0206 & U-0207
CONCRETE BARRIER DETAILS	C-1202
RIGHT-OF-WAY	R-012 & R-013
EXISTING CONDITIONS	C-0206 & C-0207
PLAN AND PROFILE (TRACK)	C-0306 & C-0307
GRADING AND DRAINAGE	C-0407 - C-0408
WORKSITE TRAFFIC CONTROL	C-0835 - C-0841
SIGNING & STRIPING	C-0903 & C-0904
STREET LIGHTING	C-1001 - C-1009
GRADE CROSSING DETAILS	T-842
TRAFFIC SIGNAL	C-1104 - C-1110
EXISTING UNDERGROUND UTILITIES	U-0101 - U-0117
EXISTING OVERHEAD UTILITIES	U-0151 - U-0167
STREET IMPROVEMENTS	C-0601 - C-0612
U-SECTION LAYOUT	S-0601 - S-0611
PUMP STATION LAYOUT	S-0612 - S0616

40' 20' 0 40' 80'
1" = 40'

REV	DATE	BY	APPR	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	4/15/98			37247	6/30/00	KENNETH T. STEELE	ISSUED FOR SOLICITATION

DESIGNED BY S. MCCRACKEN
DRAWN BY Z. CSANYI
CHECKED BY J. MULROONEY
IN CHARGE K. STEELE
DATE 4/15/98

REGISTERED PROFESSIONAL ENGINEER KENNETH T. STEELE No. 37247 Exp. 6/30/00 CIVIL STATE OF CALIFORNIA

LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY
PASADENA BLUE LINE

SUBMITTED Kenneth T Steele 4/20/98

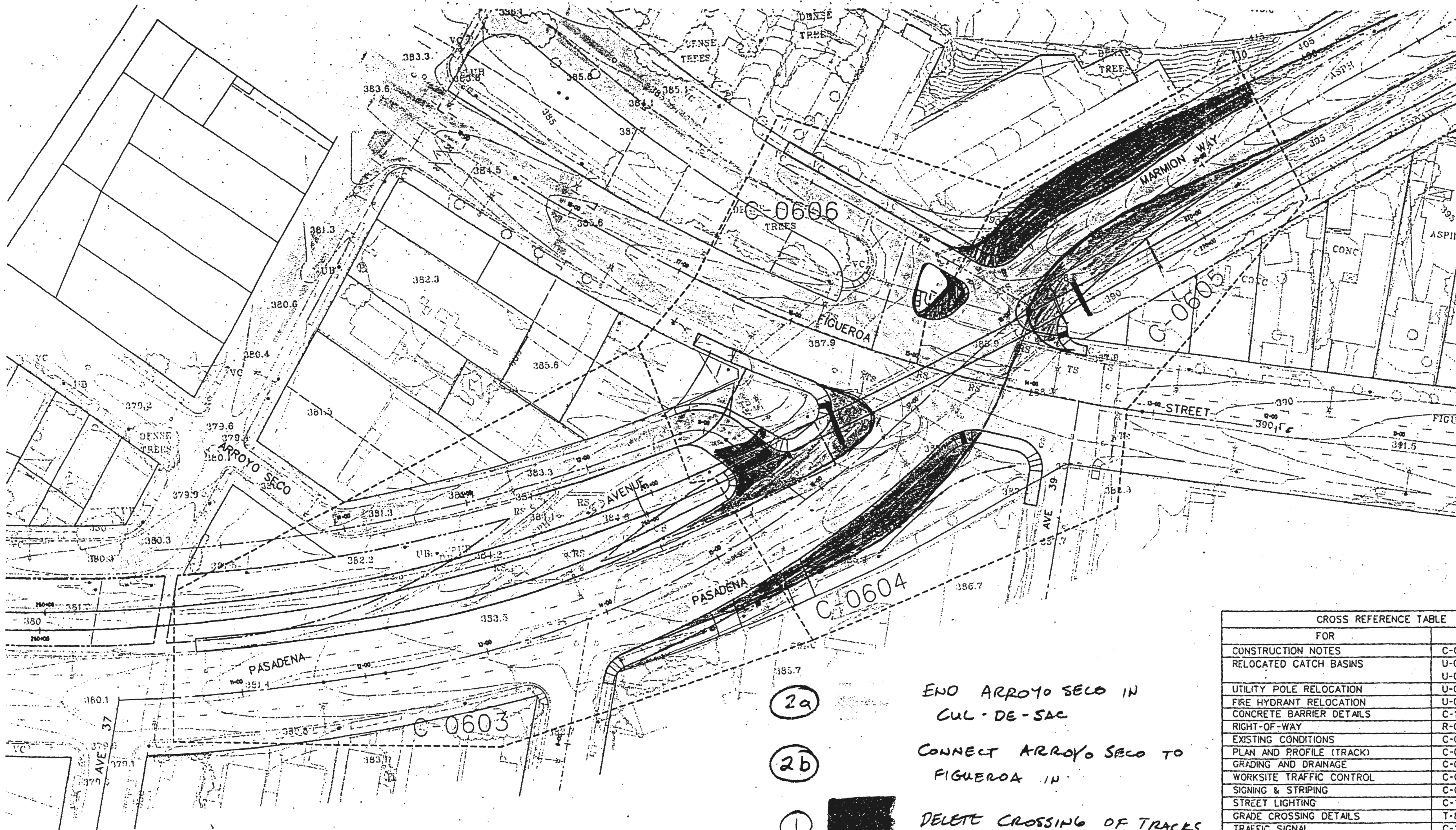
ENGINEERING MANAGEMENT CONSULTANT
APPROVED

LAUPT TO PASADENA
L.A. RIVER TO ARROYO SECO LINE SEGMENT
ROADWAY IMPROVEMENT SITE PLAN
PASADENA AVENUE
AVE.37 TO 300' N\O FIGUEROA ST.

CONTRACT NO C6420
DRAWING NO C-0600 REV 0
SCALE 1"=40'
SHEET NO 148

37

Sht. 3 of 6



(2a) END ARROYO SECO IN CUL-DE-SAC

(2b) CONNECT ARROYO SECO TO FIGUEROA IN

(1) DELETE CROSSING OF TRACKS AT ARROYO SECO

ALTERNATIVE

40' 20' 0 40' 80'
1" = 40'

CROSS REFERENCE TABLE	
FOR	SEE DWG.
CONSTRUCTION NOTES	C-0345 & C-0346
RELOCATED CATCH BASINS	U-0302-U-0304, U-0306 & U0307
UTILITY POLE RELOCATION	U-0206 & U-0207
FIRE HYDRANT RELOCATION	U-0206 & U-0207
CONCRETE BARRIER DETAILS	C-1202
RIGHT-OF-WAY	R-012 & R-013
EXISTING CONDITIONS	C-0206 & C-0207
PLAN AND PROFILE (TRACK)	C-0306 & C-0307
GRADING AND DRAINAGE	C-0407 - C-0408
WORKSITE TRAFFIC CONTROL	C-0835 - C-0841
SIGNING & STRIPING	C-0903 & C-0904
STREET LIGHTING	C-1001 - C-1009
GRADE CROSSING DETAILS	T-842
TRAFFIC SIGNAL	C-1104 - C-1110
EXISTING UNDERGROUND UTILITIES	U-0101 - U-0117
EXISTING OVERHEAD UTILITIES	U-0151 - U-0167
STREET IMPROVEMENTS	C-0601 - C-0612
U-SECTION LAYOUT	S-0601 - S-0611
PUMP STATION LAYOUT	S-0612 - S0616

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	4/15/98			37247	6/30/00	KENNETH T. STEELE	ISSUED FOR SOLICITATION

DESIGNED BY S. MCCRACKEN
DRAWN BY Z. CSANYI
CHECKED BY J. MULROONEY
IN CHARGE K. STEELE
DATE 4/15/98

REGISTERED PROFESSIONAL ENGINEER KENNETH T. STEELE No. 37247 Exp. 6/30/00 CIVIL STATE OF CALIFORNIA

LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY
PASADENA BLUE LINE

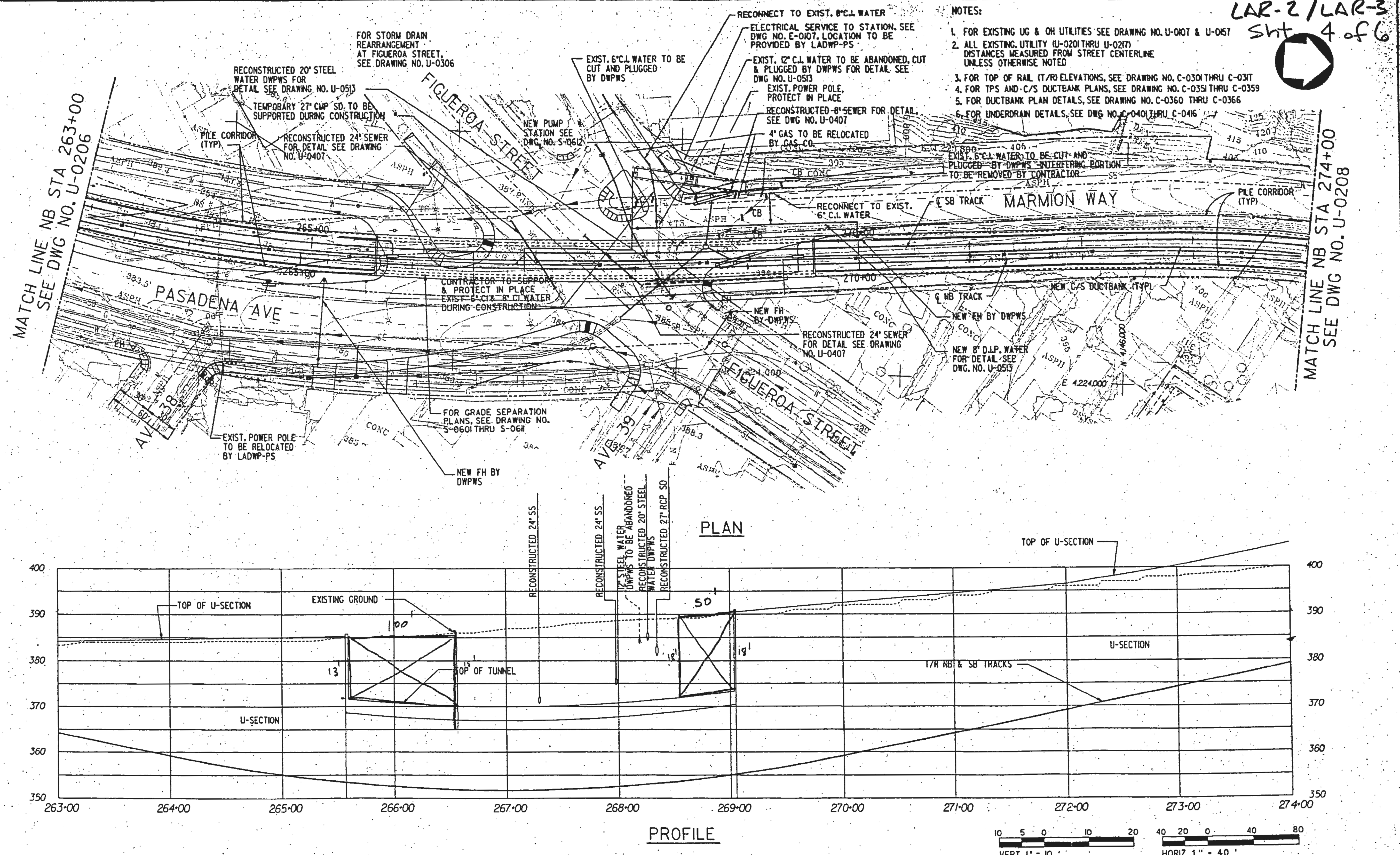
SUBMITTED Kenneth T. Steele 4/20/98
ENGINEERING MANAGEMENT CONSULTANT
APPROVED

LAUPT TO PASADENA
L.A. RIVER TO ARROYO SECO LINE SEGMENT
ROADWAY IMPROVEMENT SITE PLAN
PASADENA AVENUE
AVE.37 TO 300'N\O FIGUEROA ST.

CONTRACT NO C6420
DRAWING NO C-0600 REV 0
SCALE 1"=40'
SHEET NO 148

38

ALTERNATIVE NO.
LAR-2/LAR-3
Sht. 4 of 6



REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	4/15/98			21646	9/30/01	ROBERT F. SEEMAN	ISSUED FOR SOLICITATION

DESIGNED BY R. SEEMAN
DRAWN BY Z. CSANYI
CHECKED BY K. STEELE
IN CHARGE K. STEELE
DATE 4/15/98

REGISTERED PROFESSIONAL ENGINEER ROBERT F. SEEMAN No. 21646 Exp. 9/30/01 CIVIL STATE OF CALIFORNIA

LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY
PASADENA BLUE LINE

SUBMITTED 4/15/98
APPROVED

LAUPT TO PASADENA
L.A. RIVER TO ARROYO SECO LINE SEGMENT
COMPOSITE UTILITY
REARRANGEMENT PLAN
SHEET 7 OF 17

CONTRACT NO C6420
DRAWING NO U-0207 REV. 0
SCALE HORIZ 1" = 40' VERT 1" = 10'
SHEET NO 364

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

ALTERNATIVE NO. LAR-2 LAR-3

SHEET NO. 5 of 6

REDUCE BACKFILL STREET WORK IS A WASH

DELETE STRUCTURAL ROOF

2' x 30' x 150' = 9,000 ÷27 = 333.3 C.Y.

ADD SIDE WALLS FOR U-SECTION

$$\left.\begin{array}{l} 50' \times 18' \times 2' = 1{,}800 \\ 100 \times 14 \times 2 = 2{,}800 \end{array}\right\} 4600 \div 27 = 170 \text{ C.Y.}$$

ADD HAULING OFF SOIL

100' x 14' x 30' + 50' x 18' x 30' = 69,000 cf ÷27 = 2,555.5 C.Y.

NET ~~0~~ DUE TO DOUBLE HANDLING DOUBLE HAULING AND STOCK PILING

DELETE RECOMPACTION

SEE ABOVE VOLUME 2,555 CY

COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

ALTERNATIVE NO. LAR-2 LAR-3

SHEET NO. 6 of 6

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
DELETE TUNNEL ROOF STRUCTURAL CONCRETE	CY	333.3	450	$150,000			
ADD U-WALL SECTION STRUCTURAL CONCRETE	CY				170	450	76,500
STRUCTURAL BACKFILL RECOMPACTION	CY	2555	15	38,325			
Sub-Total				188,325			76,500
Mark-Up at %							
TOTAL							

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	LAR-5
DESCRIPTION: AND	**RAISE TRACK PROFILE FOR FIGUEROA STREET UNDERPASS PLACE RESERVOIR UNDER TUNNEL**	SHEET NO.	1 of 9

ORIGINAL DESIGN: (Sketch attached)

The track profile of the Figueroa Street grade separation is low enough to allow two, 24-inch diameter sanitary sewers to be replaced in kind once the box structure is constructed. An independent underground reservoir with sump pump station is provided for storing storm water and then pumping storm water to either the city sanitary sewer or storm drain system. The reservoir is located at the northwest corner of Figueroa Street and Marmion Way and about 55 feet below grade.

ALTERNATIVE: (Sketch attached X)

Intercept the two sanitary sewers on the cast side of the new grade separation box structure. Provide a 36-inch diameter sanitary sewer along the east grade of the tunnel and "U-Section" of the light rail line. Connect the sanitary saver line to the existing sanitary sewer at the intersection of Arroyo Seco Avenue and 37 Avenue. Raise the track profile so that the control for the box structure is the bottom of the 27-inch diameter storm drain in Figueroa Street. Reconfigure the storm water reservoir and place it under a portion of the tunnel. Locate the sump pumps station at the northeast corner of Figueroa Street and the light rail crossing.

ADVANTAGES:

- Saves cost.
- Reduces excavator.
- Saves time.
- Reduces the track grades from + and – 5.00% to about –2.0% and + 3.8%.

DISADVANTAGES:

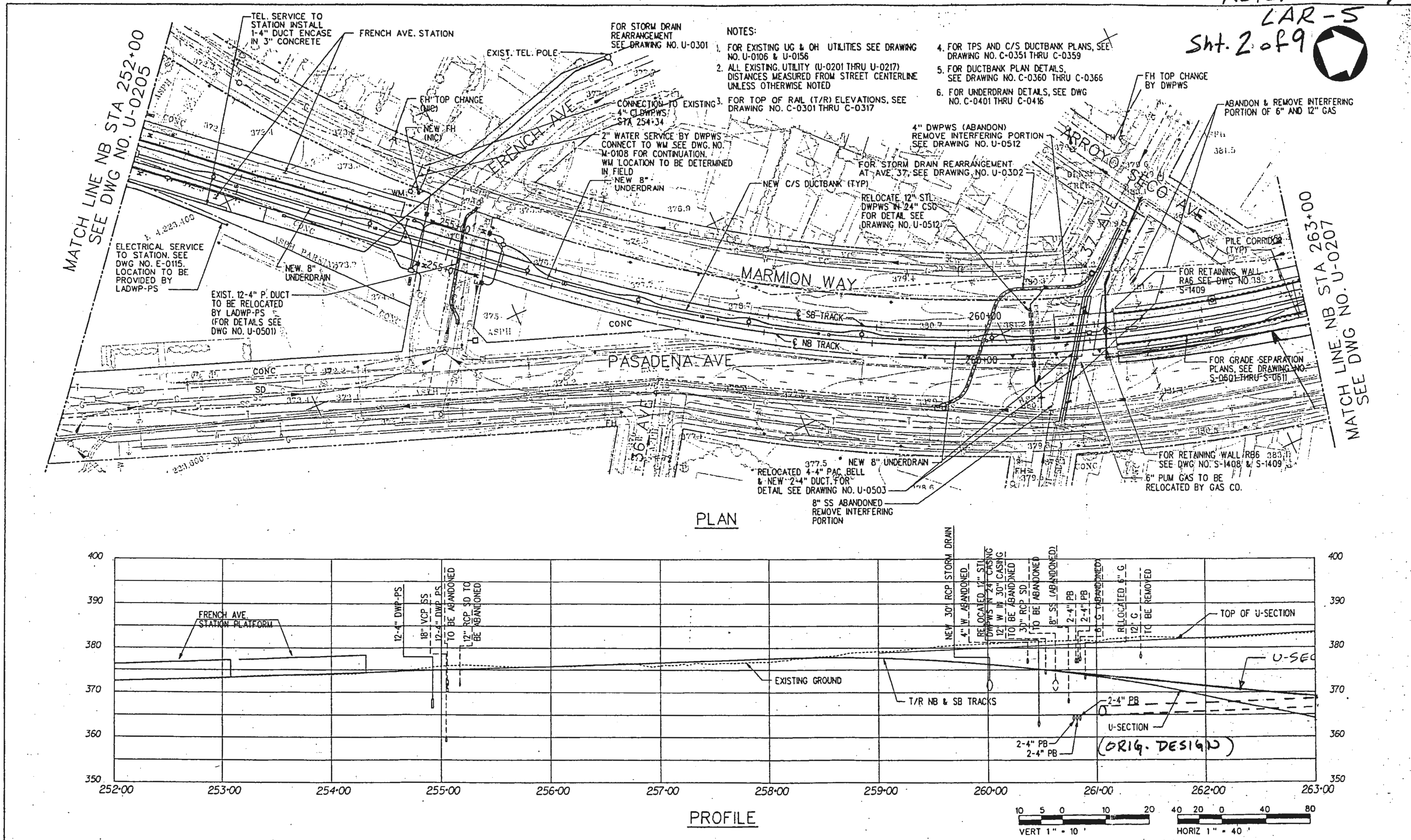
- Requires confirmation that route of new sewer is clear.

DISCUSSION:

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 6,345,060	$	$ 6,345,060
ALTERNATIVE	$ 4,701,310	$	$ 4,701,310
SAVINGS	$ 1,643,750	$	$ 1,643,750

ALTERNATIVE No. LAR-5

Sht. 2 of 9



REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	4/15/98			21646	9/30/01	ROBERT F. SEEMAN	ISSUED FOR SOLICITATION

DESIGNED BY R. SEEMAN
DRAWN BY Z. CSANYI
CHECKED BY K. STEELE
IN CHARGE K. STEELE
DATE 4/15/98

REGISTERED PROFESSIONAL ENGINEER ROBERT F. SEEMAN No. 21646 Exp. 9/30/01 CIVIL STATE OF CALIFORNIA

LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

PASADENA BLUE LINE

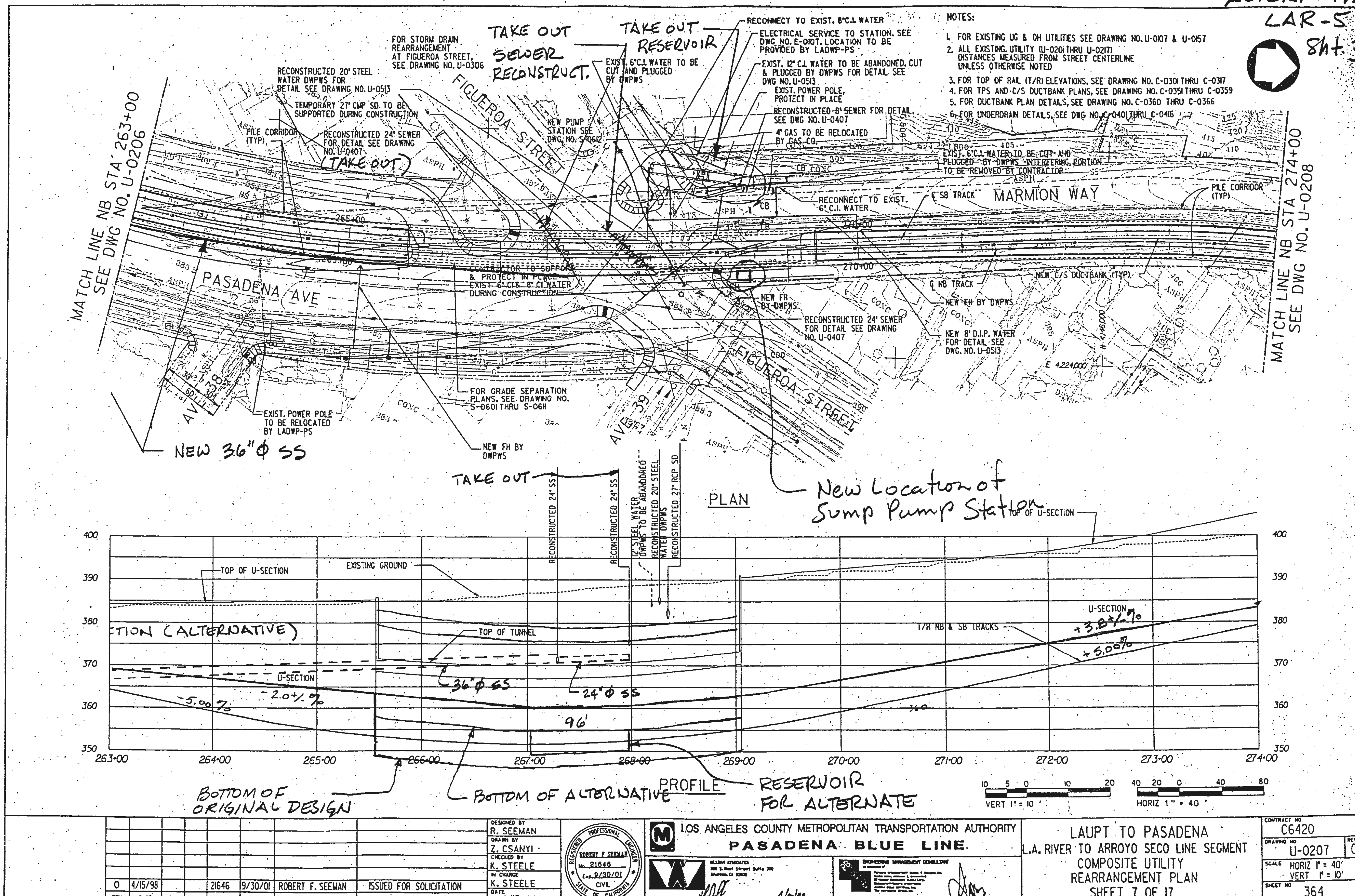
SUBMITTED 4/10/98

APPROVED

LAUPT TO PASADENA
L.A. RIVER TO ARROYO SECO LINE SEGMENT
COMPOSITE UTILITY REARRANGEMENT PLAN
SHEET 6 OF 17

CONTRACT NO C6420
DRAWING NO U-0206 REV 0
SCALE HORIZ 1" = 40' VERT 1" = 10'
SHEET NO 363

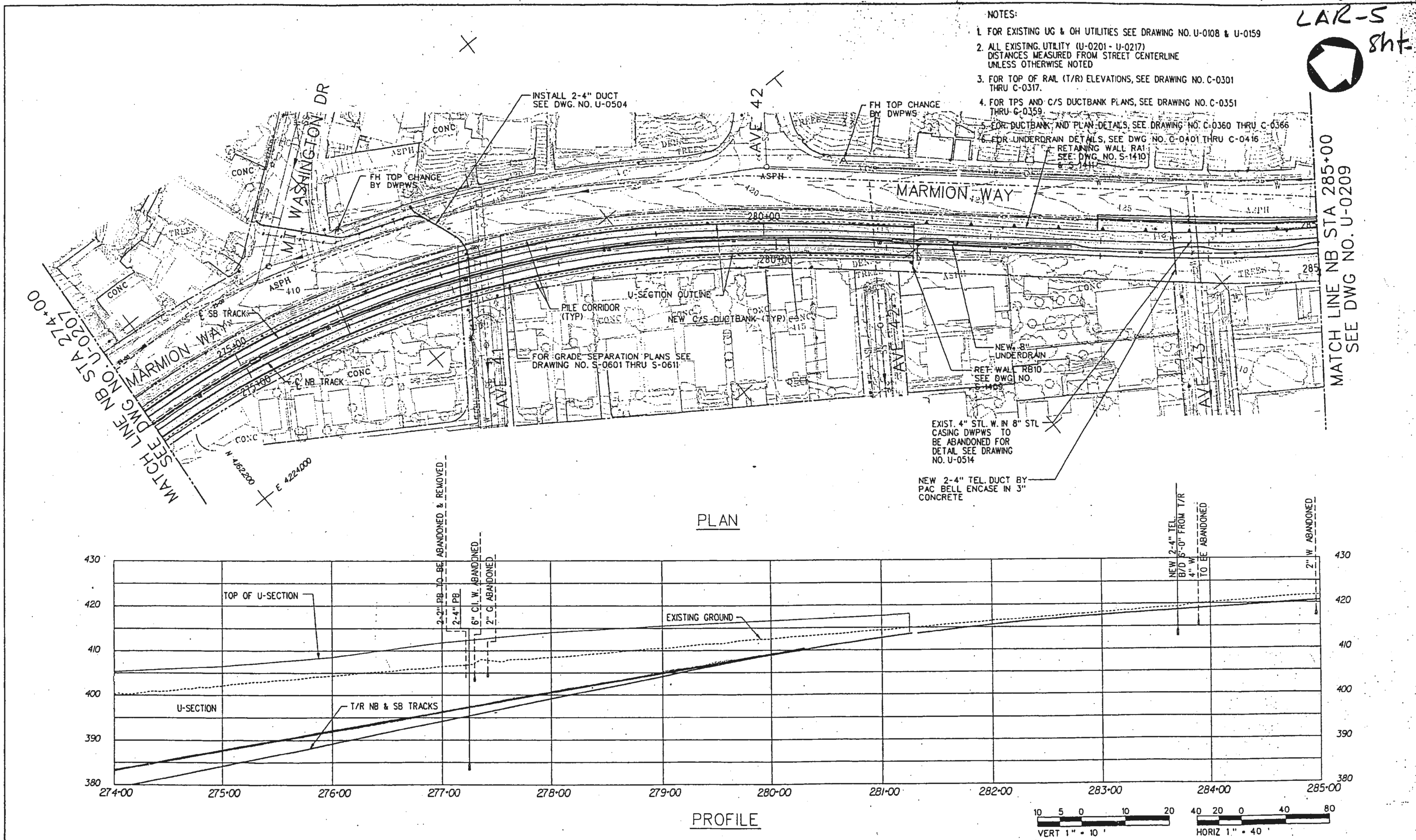
ALTERNATIVE NO
LAR-5
sht 3 of 9



ALTERNATIVE NO. LAR-5 sht 4 of 9

NOTES:

1. FOR EXISTING UG & OH UTILITIES SEE DRAWING NO. U-0108 & U-0159
2. ALL EXISTING UTILITY (U-0201 - U-0217) DISTANCES MEASURED FROM STREET CENTERLINE UNLESS OTHERWISE NOTED
3. FOR TOP OF RAIL (T/R) ELEVATIONS, SEE DRAWING NO. C-0301 THRU C-0317.
4. FOR TPS AND C/S DUCTBANK PLANS, SEE DRAWING NO. C-0351 THRU C-0359.
5. FOR DUCTBANK AND PLAN DETAILS, SEE DRAWING NO. C-0360 THRU C-0366
6. FOR UNDERDRAIN DETAILS, SEE DWG NO. C-0401 THRU C-0416



0	4/15/98			21646	9/30/01	ROBERT F. SEEMAN	ISSUED FOR SOLICITATION
REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY R. SEEMAN
DRAWN BY Z. CSANYI
CHECKED BY K. STEELE
IN CHARGE K. STEELE
DATE 4/15/98

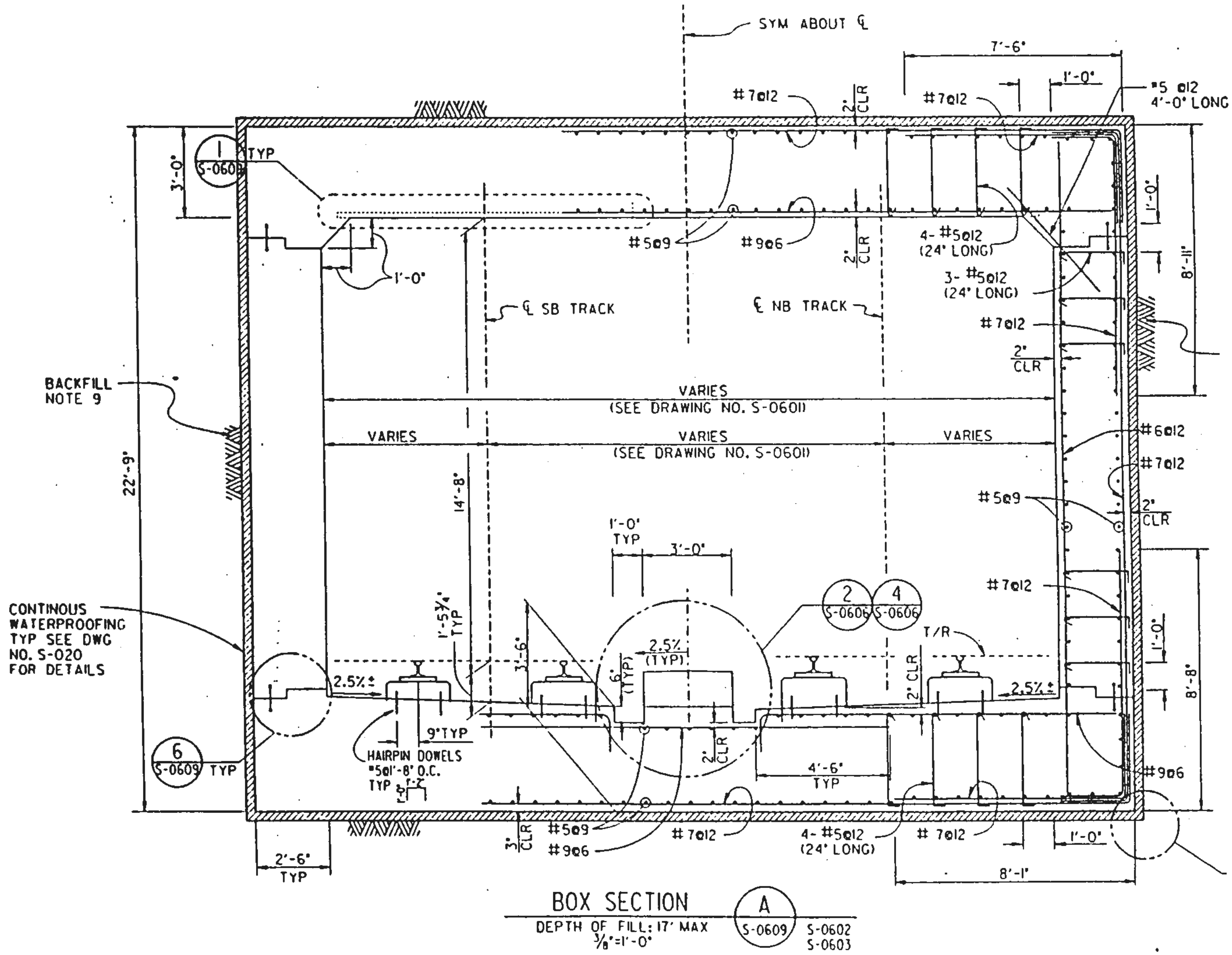
REGISTERED PROFESSIONAL ENGINEER ROBERT F. SEEMAN No. 21646 Exp. 9/30/01 CIVIL STATE OF CALIFORNIA

LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY
PASADENA BLUE LINE

SUBMITTED 4/20/98 APPROVED

LAUPT TO PASADENA
L.A. RIVER TO ARROYO SECO LINE SEGMENT
COMPOSITE UTILITY REARRANGEMENT PLAN
SHEET 8 OF 17

CONTRACT NO C6420
DRAWING NO U-0208 REV 0
SCALE HORIZ 1" = 40' VERT 1" = 10'
SHEET NO 365



PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

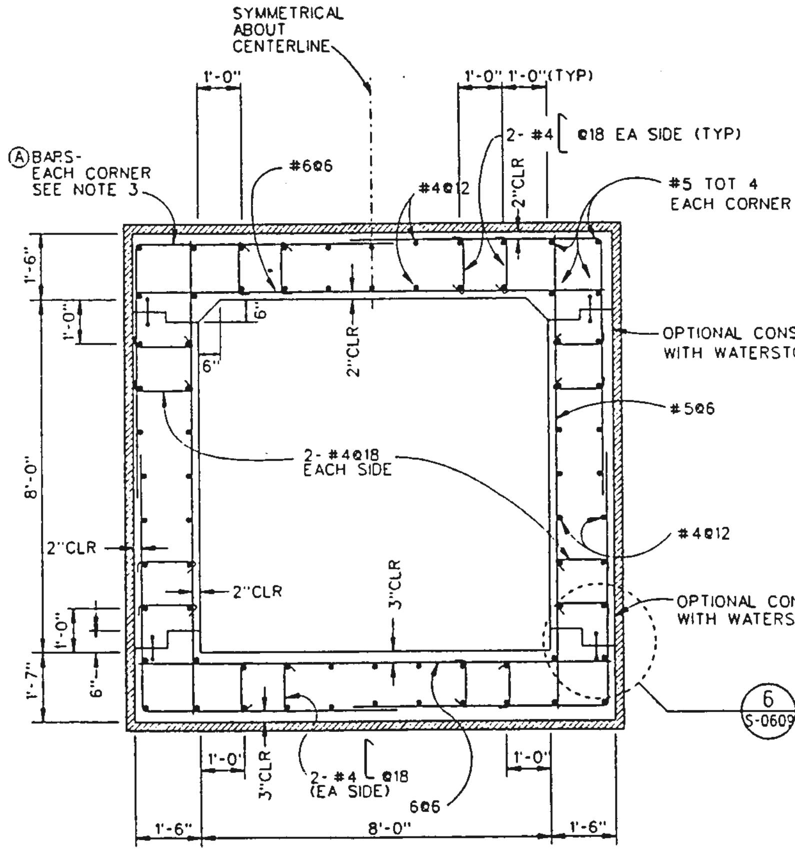
☑ AS DESIGNED ☐ ALTERNATIVE

SKETCHES

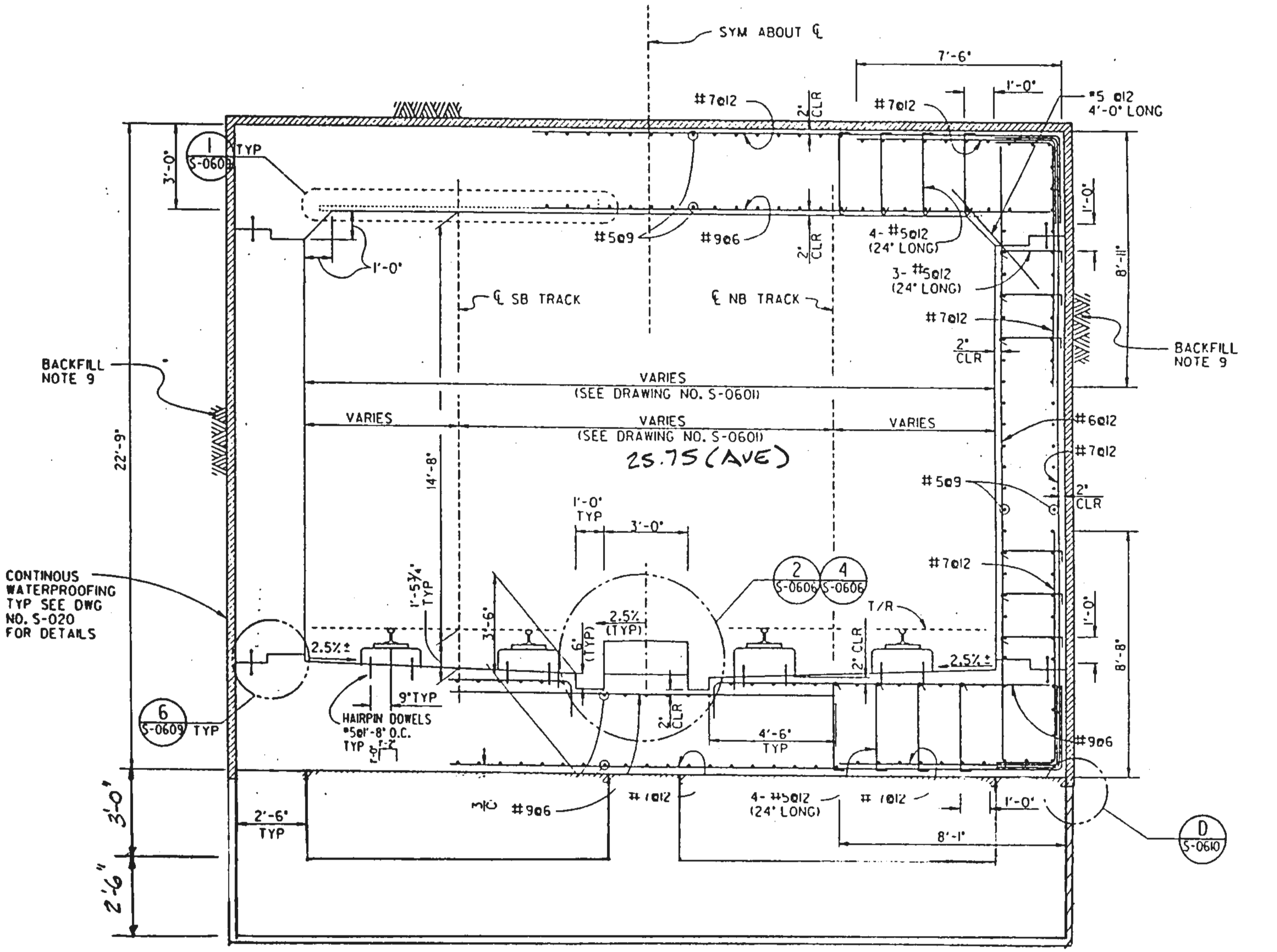
ALTERNATIVE NO. LAR-5

SHEET NO. 5 of 9

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. LAR-5
	☐ AS DESIGNED ☐ ALTERNATIVE	SHEET NO. 6 of 9



RESERVOIR BOX - TYPICAL SECTION C S-0613 S-0612
1/2" = 1'-0"



BOX SECTION
DEPTH OF FILL: 17' MAX
3/8"=1'-0"
A S-0609 S-0602 S-0603

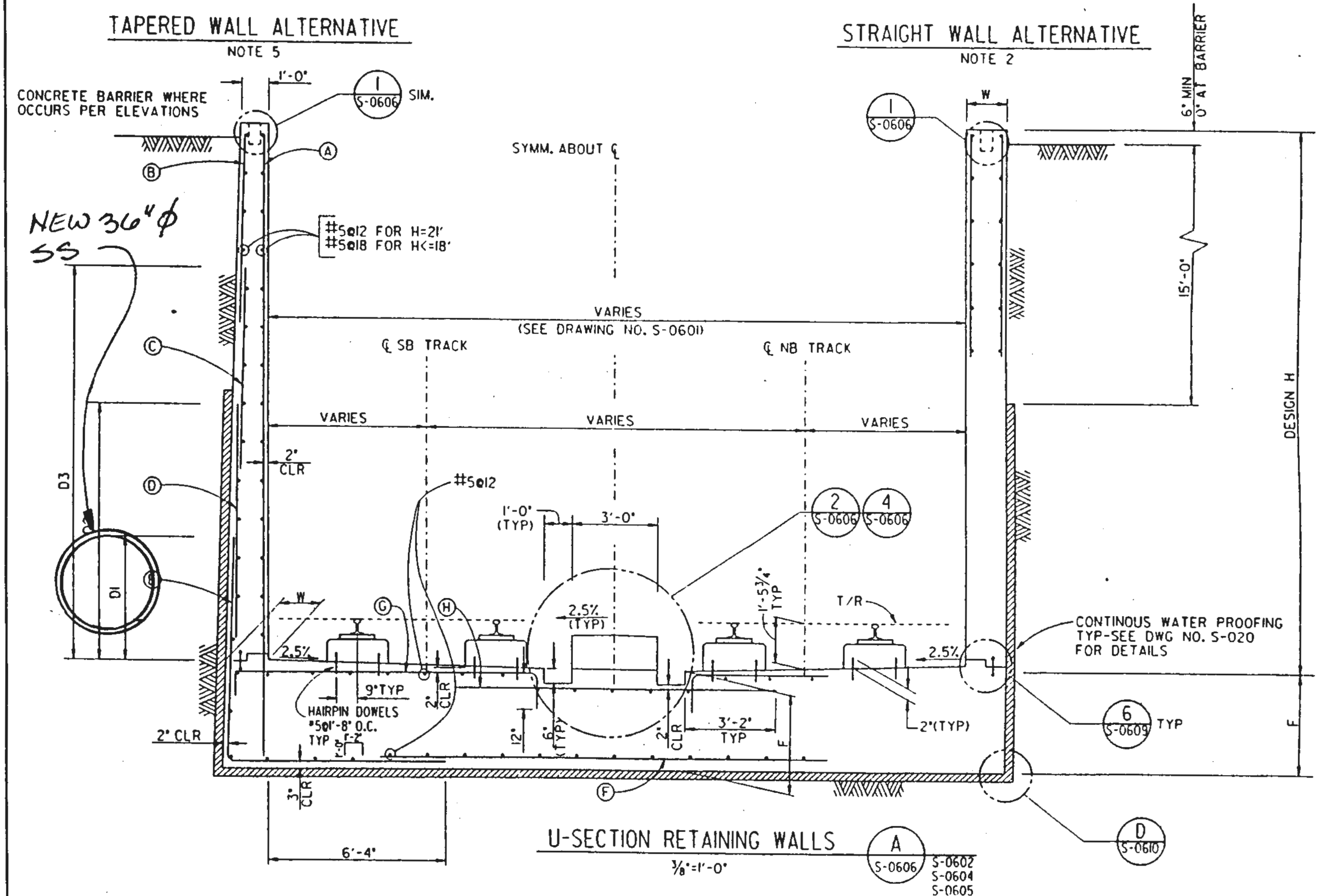
PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

☐ AS DESIGNED
☑ ALTERNATIVE

SKETCHES

ALTERNATIVE NO. LAR-5

SHEET NO. 7 of 9



PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

☑ AS DESIGNED

☑ ALTERNATIVE

ALTERNATIVE NO. LAP-5

SHEET NO. 8 of 9

SKETCHES

COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. LAR-5
	SHEET NO. 9 of 9

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
SHORING SAVINGS	SF	29,480	34.00	1,002,320			
EXCAVATION SAVINGS	CY	11,580	12.00	138,960			
CONCRETE FOR RESERVOIR	CY	212	450	- 95,400	133	450	59,850
CONCRETE FOR U-WALLS	CY	10,890	450	4,900,500	9840	450	4,428,000
CONCRETE FOR WALL	CY	36	450	16,200			
AT ENDS OF TUNNEL							
STRUTS	CY	300	600	180,000	274	600	164,400
24"φ SS	LF	142	40	5,680	79	40	3,160
36"φ SS	LF				765	60	45,900
15"φ DRAIN LINE	LF	100	60	6,000			
(PIPE JACKED)							
Sub-Total				6,345,060			4,701,310
Mark-Up at %							
TOTAL							

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	LAR-7
DESCRIPTION:	PLACE RESERVOIR UNDER FIGUEROA STREET GRADE SEPARATION	SHEET NO.	1 of 6

ORIGINAL DESIGN: (Sketch attached)

The storm water reservoir is to be placed at the northwest corner of Figueroa Street and Marmion Way intersection. The reservoir is to be located 55 feet below grade.

ALTERNATIVE: (Sketch attached X)

Reconfigure the storm water reservoir and place it below part of the Figueroa Street grade separation box structure. Move the sump pump station at the northeast corner of the light rail crossing of Figueroa Street.

ADVANTAGES:

- Saves cost.
- Easier to construct.
- May avoid a contaminated soil area.

DISADVANTAGES:

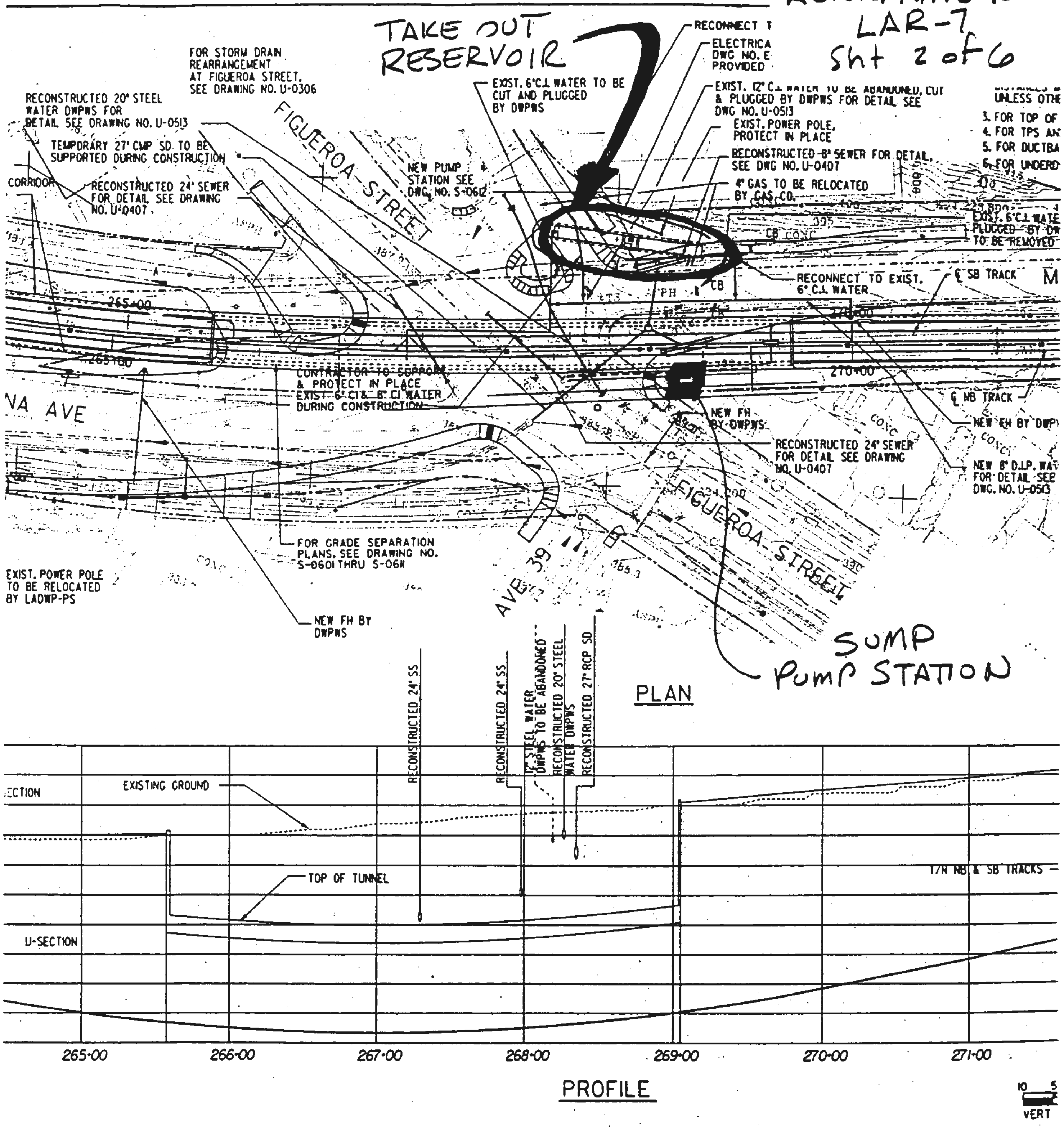
- None apparent.

DISCUSSION:

Moving the storm water reservoir under the box structure consolidates the deep excavation to one location thus saving shoring and excavation costs. It also avoids digging in an area with potential petrochemical wastes.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 680,468	$	$ 680,468
ALTERNATIVE	$ 201,966	$	$ 201,966
SAVINGS	$ 478,502	$	$ 478,502

ALTERNATIVE NO. LAR-7
Sht 2 of 6



'01	ROBERT F. SEEMAN	ISSUED FOR SOLICITATION	DESIGNED BY R. SEEMAN; DRAWN BY Z. CSANYI; CHECKED BY K. STEELE; IN CHARGE K. STEELE; DATE 4/15/98
ES	SEAL HOLDER	DESCRIPTION	

REGISTERED PROFESSIONAL ENGINEER ROBERT F. SEEMAN No. 21646 Exp. 9/30/01 CIVIL STATE OF CALIFORNIA

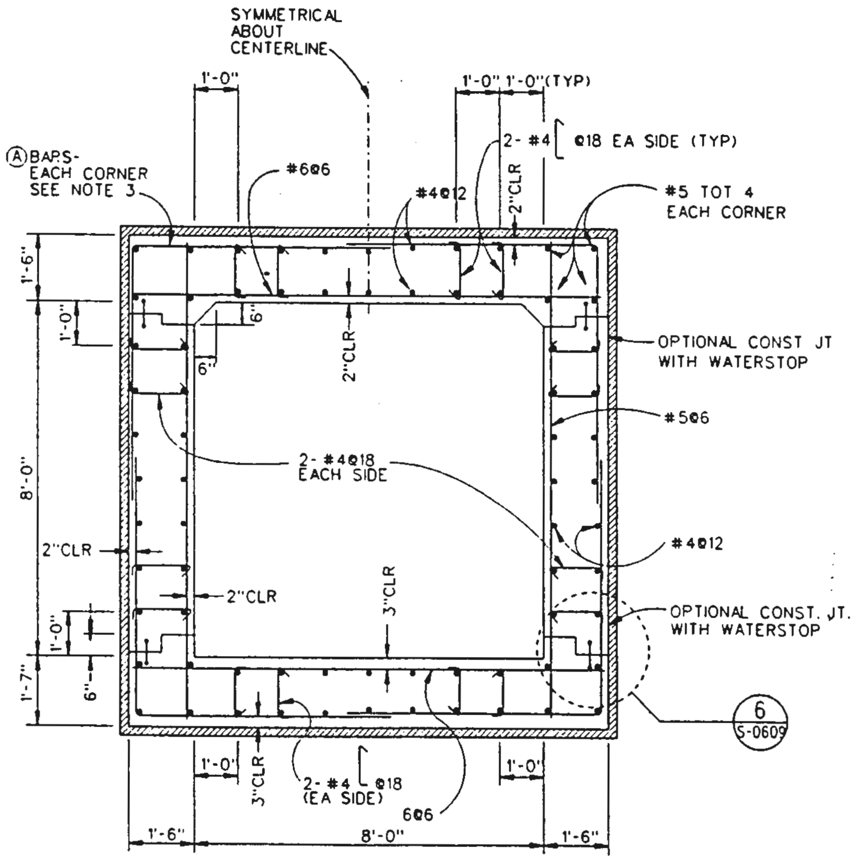
LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORIT

PASADENA BLUE LINE

SUBMITTED 4/ /98

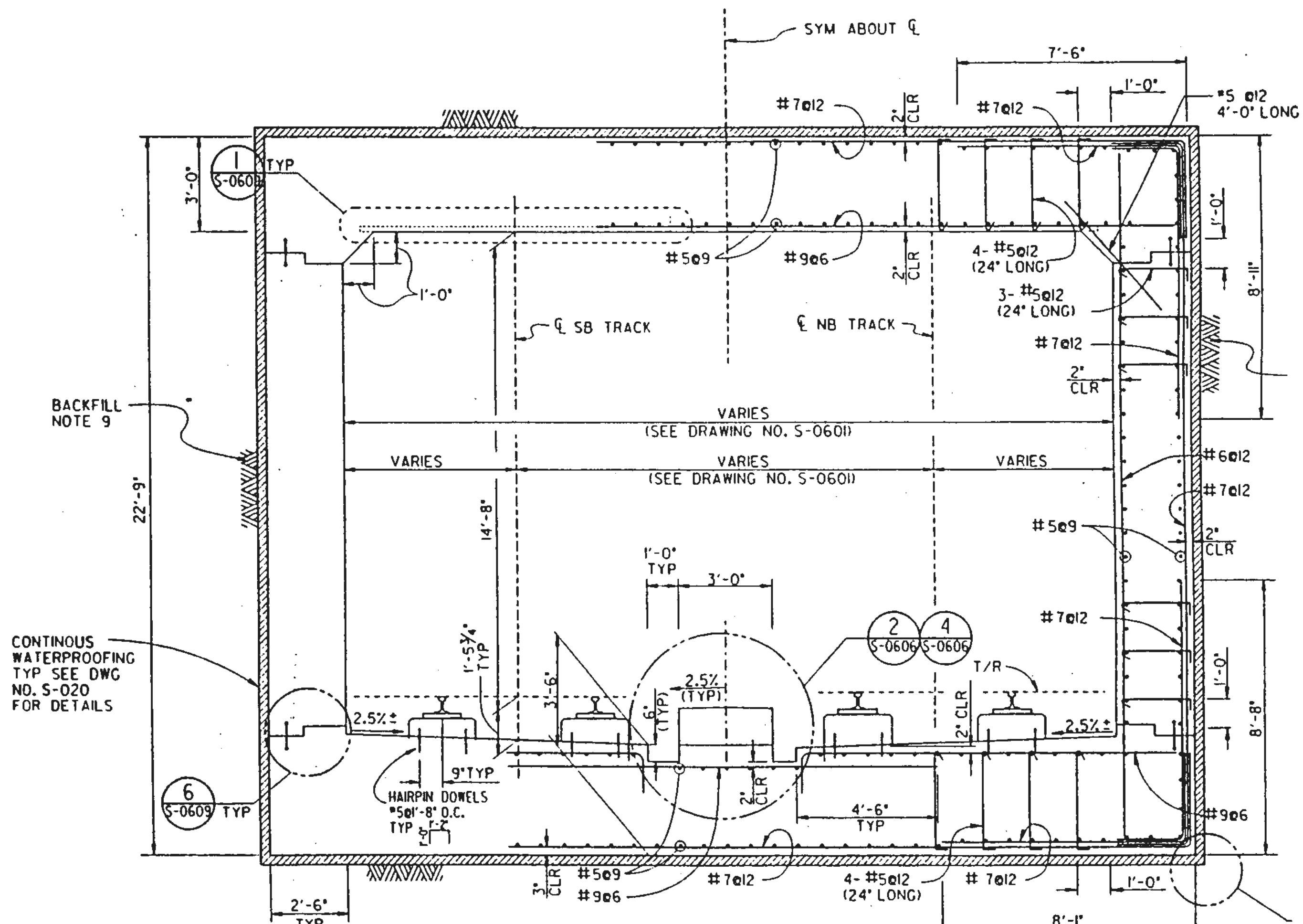
APPROVED

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. LAR-7
	☑ AS DESIGNED ☐ ALTERNATIVE	SHEET NO. 3 of 6



RESERVOIR BOX - TYPICAL SECTION C S-0613 S-0612

½" = 1'-0"



BOX SECTION

DEPTH OF FILL: 17' MAX
3/8"=1'-0"

A
S-0609
S-0602
S-0603

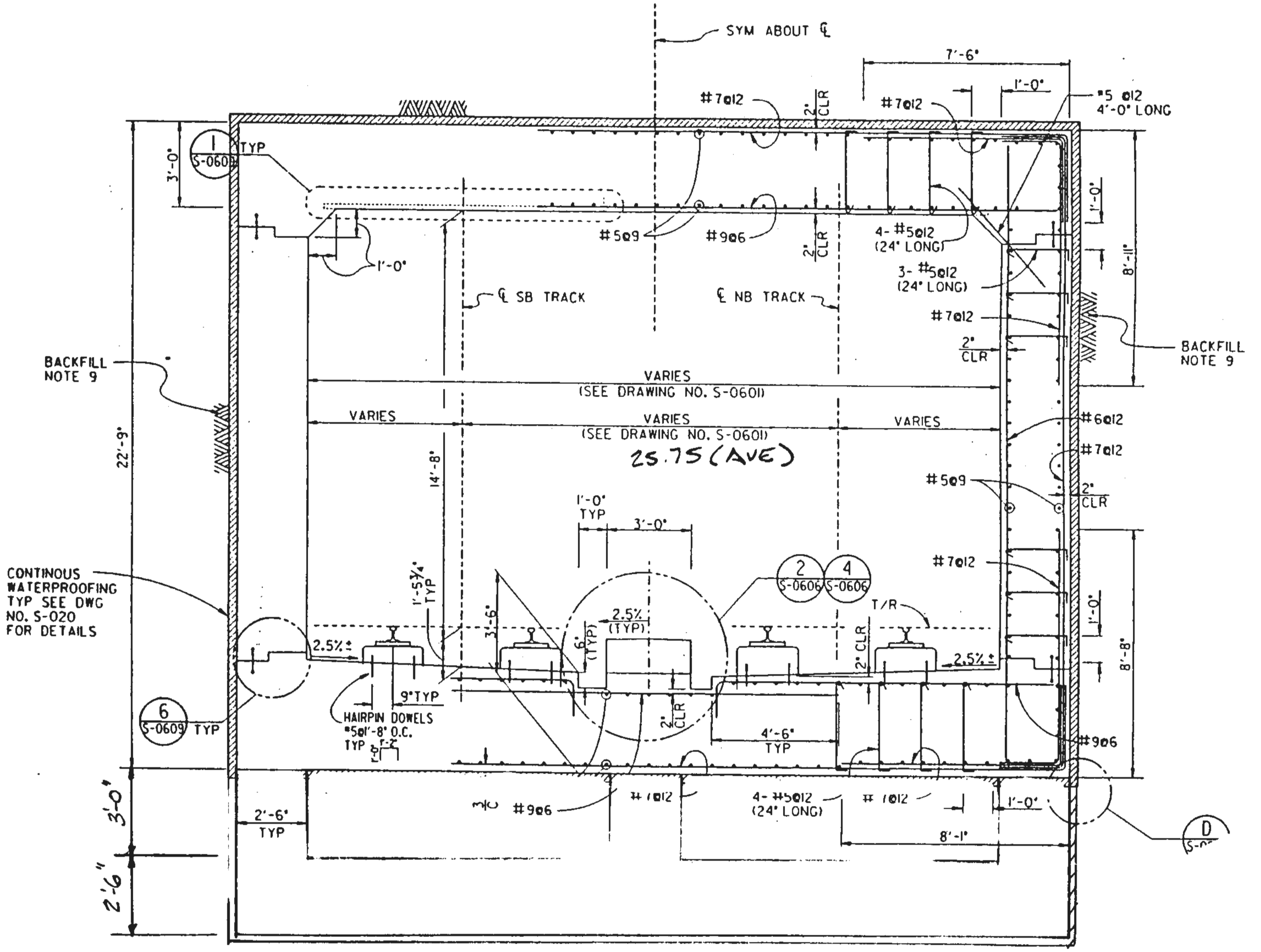
SKETCHES

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

☑ AS DESIGNED ☐ ALTERNATIVE

ALTERNATIVE NO. LAR-7

SHEET NO. 4 of 6



BOX SECTION

DEPTH OF FILL: 17' MAX
⅜"=1'-0"

A S-0609 S-0602 S-0603

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

☐ AS DESIGNED

☑ ALTERNATIVE

ALTERNATIVE NO. LAR-7

SHEET NO. 5 of 6

SKETCHES

COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

ALTERNATIVE NO. LAR-7

SHEET NO. 6 of 6

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
SHEETING	SF	13,860	34.00	471,240	1056	34.00	35,904
EXCAVATION	CY	3,585	29.00	100,380	601	12.00	7212
BACKFILL	CY	3,137	4.00	12,548			
CONCRETE (EXCLUSIVE OF SUMP PUMP STATION)	CY	214	450	96,300	353	450.00	158,850
Sub-Total				680,468			201,966
Mark-Up at %							
TOTAL							

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	LAR-8
DESCRIPTION:	USE PRECAST CONCRETE PIPE FOR STORM WATER RESERVOIR	SHEET NO.	1 of 3

ORIGINAL DESIGN: (Sketch attached)

A cast-in-place concrete structure is provided for the storm water reservoir at the intersection of Figueroa Street and Marmion Way.

ALTERNATIVE: (Sketch attached)

Use 120 inch diameter reinforced concrete pipe (RCP, Class V, heavy wall with custom fabricated ends and transition sections (factory cast) for the reservoir.

ADVANTAGES:

- Time savings.
- Cost savings.

DISADVANTAGES:

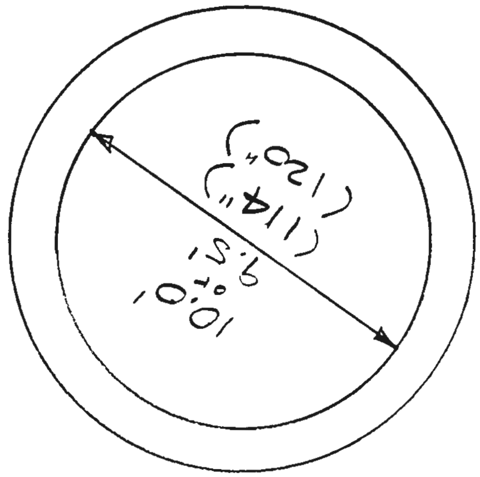
- Design preferences.

DISCUSSION:

This reservoir is just a short deep sewer; therefore using sewer pipe will save time and money over installing a cast-in-place concrete box.

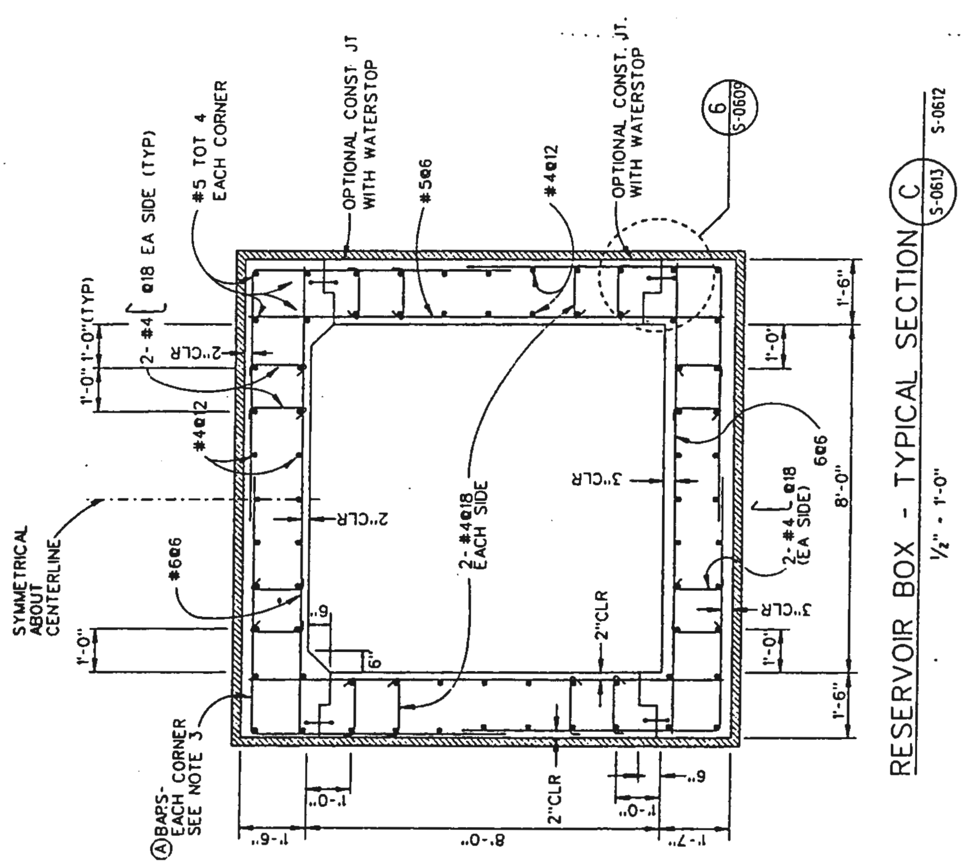
COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 196,944	$	$ 196,944
ALTERNATIVE	$ 87,962	$	$ 87,962
SAVINGS	$ 108,982	$	$ 108,982

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. LAR-8
	☑ AS DESIGNED ☑ ALTERNATIVE	SHEET NO. 2 of 3



$A = \pi\left(\frac{9.5}{2}\right)^2 = 70.9\ ft^2$

ALTERNATE



$A = 8 \times 8 = 64\ sf$

AS DESIGNED

COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

ALTERNATIVE NO. LAR 8

ALTERNATE STORM WATER DETENSION STRUCTURE

SHEET NO. 3 of 3

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
4000 PSI Concrete Box							
Section	CY	336.5	450-	151,429			
GR. 60 Rein. Bar	LBS	26,000	0.80	20,800			
Bentonite Panels	SF	1062	3.50	24,215			
120" RCP, Class 5	LF				155	392.-	60,760
120" RCP Tran. Tee	EA				2	780.-	1,560
120" RCP-Cast End	EA				2	250-	500
Butyl Rubber Gasket	LF				1000	4.-	4,000
& Sealant							
Labor & Equip To	TONS				248	85.25	21,142
Place							
Sub-Total				196,444			87,962
Mark-Up at %							
TOTAL							

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	LAR-10
DESCRIPTION:	DELETE WATER PROOFING AT STORM WATER RESERVOIR	SHEET NO.	1 of 3

ORIGINAL DESIGN: (Sketch attached)

Waterproof the entire concrete box structure used for a storm water reservoir.

ALTERNATIVE: (Sketch attached)

Delete waterproofing.

ADVANTAGES:

- Saves cost

DISADVANTAGES:

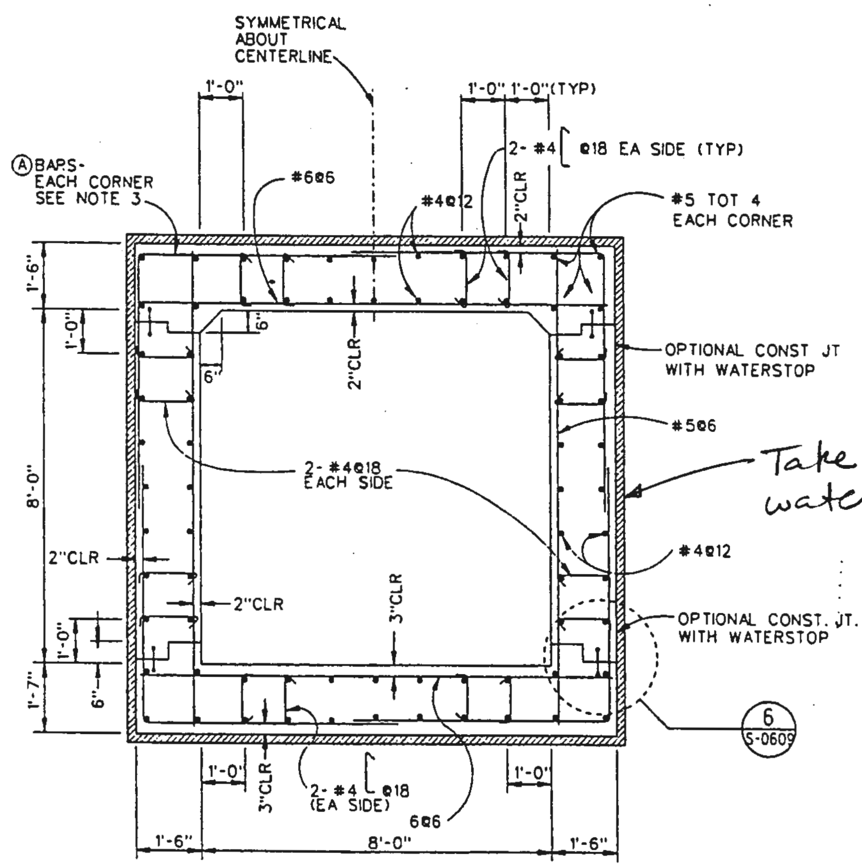
- None apparent

DISCUSSION:

The reservoir contains water thus; there is no need to waterproof it. No apparent hazardous material runoff is foreseen. Sewer pipes, which this reservoir essentially is, are not usually waterproofed.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 24,717	—	$ 24,717
ALTERNATIVE	$ 0	—	$ 0
SAVINGS	$ 24,717	—	$ 24,717

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. LAR-10
	☑ AS DESIGNED ☑ ALTERNATIVE	SHEET NO. 2 of 3



RESERVOIR BOX - TYPICAL SECTION (C) S-0613 S-0612

½" = 1'-0"

COST WORKSHEET

PROJECT: **PASADENA BLUE LINE LIGHT RAIL PROJECT** ALTERNATIVE NO. LAR 10

Delete Waterproofing at Detension Structure SHEET NO. 3 of 3

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
Bentonite Panels	SF	7062	3.50	24,717			
Waterproofing							
Sub-Total				24,717.-			
Mark-Up at %							
TOTAL							

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	LAR-14
DESCRIPTION:	MODIFY THE CURRENT DESIGN OF THE SLAB BRIDGE BETWEEN LA RIVER BRIDGE AND AVENUE 19	SHEET NO.	1 of 2

ORIGINAL DESIGN: (Sketch attached)

The current design includes the installation of multiple piles at regularly spaced bent locations along the slab bridge structure between the Los Angles River Bridge and Avenue 19 Bridge. The piles conflict with the existing gravity wall along the east side of the trackway. Average elevation from top of rail to existing ground in this section is approximately 3 ft.

ALTERNATIVE:

The design/build contractor should review opportunities to simplify the track support structures to reduce construction costs. Potential options include a modified slab structure or possibly additional or modified retaining walls to enable simple embankment construction with no bridge structure.

ADVANTAGES:

- Reduces impacts to existing structures
- Reduces cost

DISADVANTAGES:

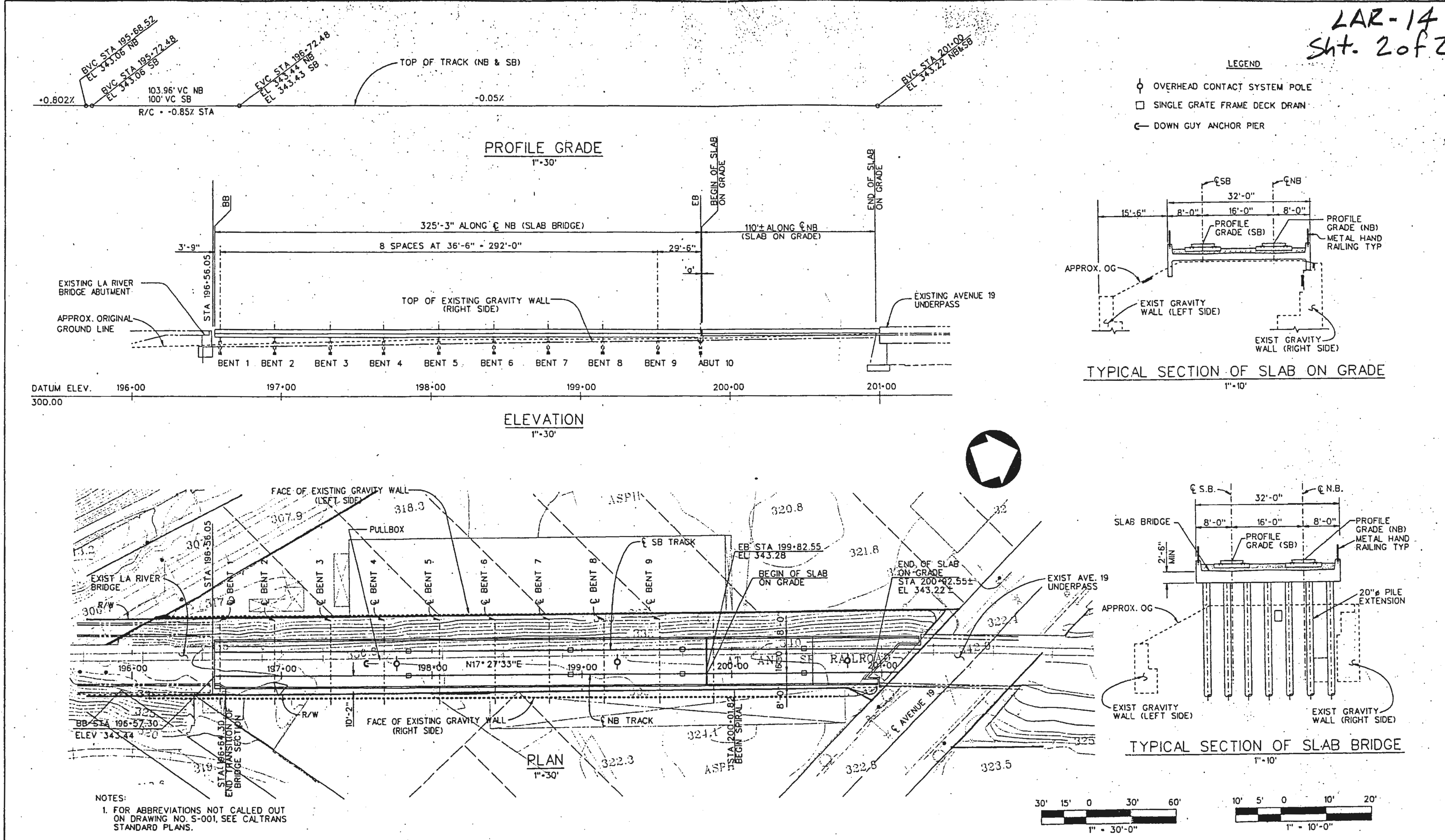
- None apparent

DISCUSSION:

This should be the responsibility of the design/build contractor.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS			

ALTERNATIVE NO.
LAR-14
Sht. 2 of 2



NOTES:

1. FOR ABBREVIATIONS NOT CALLED OUT ON DRAWING NO. S-001, SEE CALTRANS STANDARD PLANS.
2. FOR C/S DUCTBANK DETAILS SEE DRAWING NO. S-1513.

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	4/15/98			48409	6/30/00	PETER LIU	ISSUED FOR SOLICITATION

DESIGNED BY E. JOHNSON
DRAWN BY J. LOVIN
CHECKED BY L. HE/G. JIAO
IN CHARGE D. ANDERSON
DATE 4/15/98

PROFESSIONAL ENGINEER PETER L. LIU No. 48409 Exp. 6/30/00 CIVIL STATE OF CALIFORNIA

LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY
PASADENA BLUE LINE

SUBMITTED 4/21/98
APPROVED

LAUPT TO PASADENA
L.A. RIVER TO ARROYO SECO LINE SEGMENT
SLAB BRIDGE
LA RIVER TO N. AVE. 19
GENERAL PLAN

CONTRACT NO C6420
DRAWING NO S-1501 REV 0
SCALE AS NOTED
SHEET NO 523

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	LAR-15
DESCRIPTION: AVENUE	**DELETE EMBEDDED TRACK ON MARMION WAY FROM 51 TO 57 AVENUE**	SHEET NO.	1 of 3

ORIGINAL DESIGN: (Sketch attached)

The section of trackway along Marmion Way runs in a corridor bounded by private residential homes and commercial establishments and has been the subject of a special study conducted by MTA, the City of Los Angeles, and CPUC. HNTB corporation then produced a draft report with designs for potential streetscapes. An embedded track section was developed for this area and shown in the sketch.

ALTERNATIVE: (Sketch attached)

Eliminate the embedded trackway options. Take out the center overhead catenary system (OCS) poles and use side poles. Move the tracks closer together and widen roadways on both sides of the tracks. Use mountable curbs at the sidewalks.

ADVANTAGES:

- Reduces track costs.
- Discourages pedestrian "meandering" on the trackway.
- Reduces long-term rail maintenance costs.

DISADVANTAGES:

- None apparent. There are ballasted track options included in the urban design options.

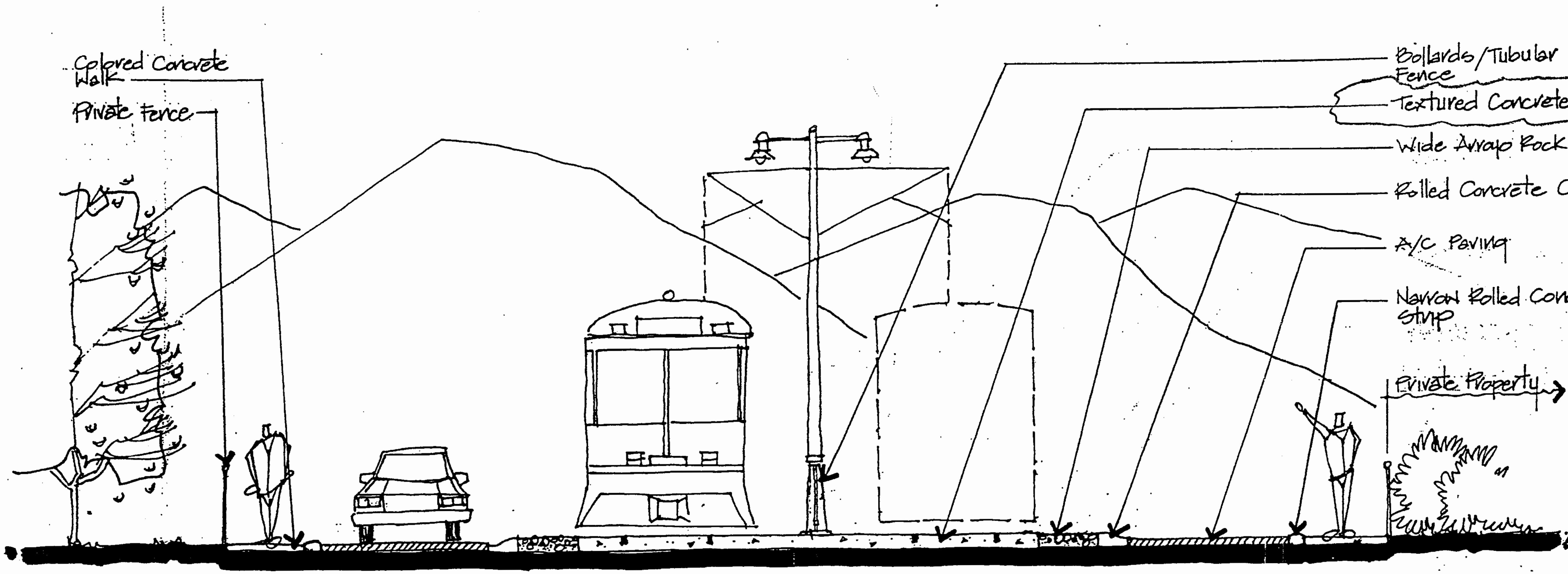
DISCUSSION:

There is no real need to embed the trackway along the back of these properties, particularly if trespassing along the trackway is to be discouraged. By moving the OCS poles to the sides, more room is provided in the road section to accommodate vehicle passing and turn movements into the roadways from driveways and cross streets.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	**DESIGN SUGGESTION**		
SAVINGS			

ALTERNATIVE NO.
LAR-15
Sht. 2 of 3

Marmion Way Corridor
Pasadena Blue Line
Phase 2
Concept Report
January 3, 1997



ALTERNATIVE IB

SECTION

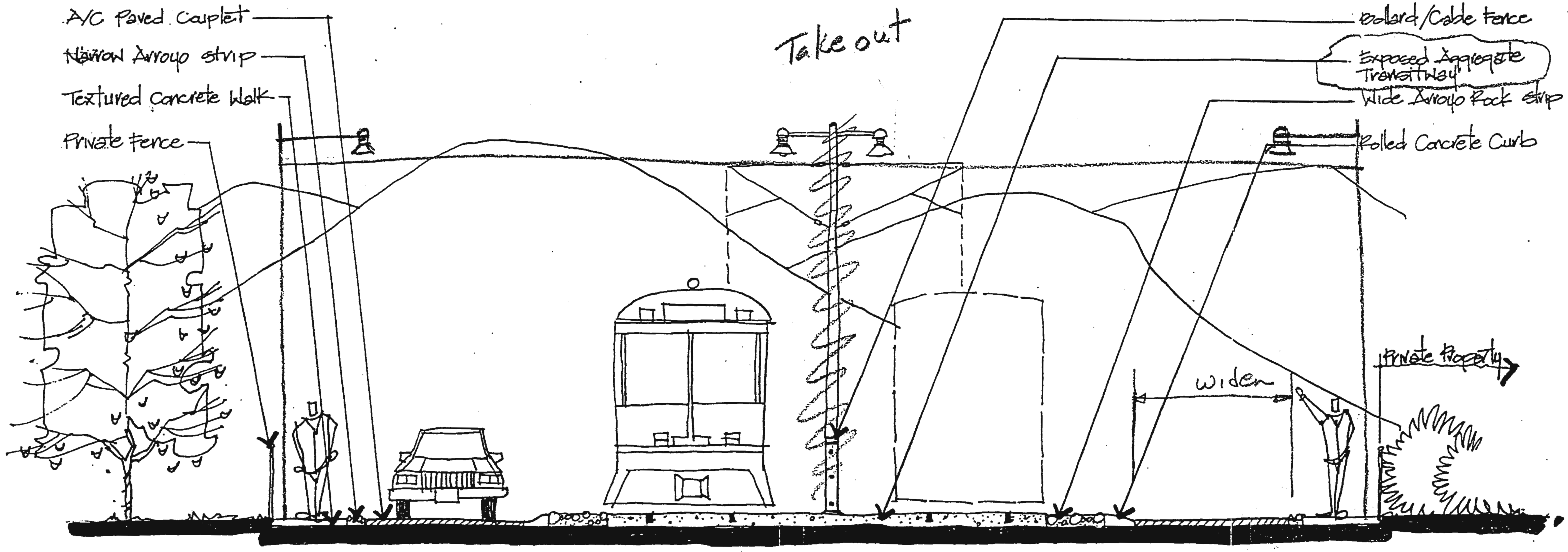
DRAFT

AS DESIGNED

HNTB

ALTERNATIVE NO.
LAR-15
Sht. 3 of 3

Marmion Way Corridor
Pasadena Blue Line
Phase 2
Concept Report
January 3, 1997



ALTERNATIVE IA

SECTION

DRAFT

ALTERNATIVE

SUMMARY OF POTENTIAL COST SAVINGS

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	LOCATION:	LOS ANGELES TO PASADENA, CALIFORNIA			
PROJECT ELEMENT:	LINE SEGMENTS	PRESENT WORTH OF COST SAVINGS				
ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	INITIAL COST SAVINGS	O & M SAVINGS	TOTAL SAVINGS
	ARROYO SECO TO DELMAR (ASDM)					
ASDM-1	Use a combination of concrete retaining walls and manufactured noise barrier walls where practical	DESIGN SUGGESTION				
ASDM-2	Use concrete median barrier for low retaining walls in lieu of cast-in-place earth walls	DESIGN SUGGESTION				
ASDM-3	Use crib wall in lieu of cast-in-place concrete for low retaining walls	406,600	243,960	162,640	—	162,640
ASDM-4	Use mechanically stabilized earth walls in lieu of cast-in-place concrete retaining walls	2,712,250	2,373,525	338,725	—	338,725
	DEL MAR TO MEMORIAL PARK (DMMP)					
DMMP-7	Use reinforced slurry walls in lieu of underpinning buildings at tunnel section	10,092,290	9,650,337	441,953	—	441,953
DMMP-12	Close Holly Street to vehicular traffic and raise track profile at Memorial Park Station	2,769,000	1,431,000	1,338,000	—	1,338,000
DMMP-15	Replace floating slab with vertical vibration isolation walls	4,297,800	3,532,860	764,940	—	764,940

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	ASDM-1
DESCRIPTION:	USE A COMBINATION OF CONCRETE RETAINING WALLS AND MANUFACTURED NOISE BARRIER WALLS WHERE ECONOMICAL	SHEET NO.	1 of 1

ORIGINAL DESIGN:

The current design uses extended concrete retaining walls with acoustical spray coat for noise mitigation.

ALTERNATIVE:

Use pre-manufactured noise barrier walls in lieu of extended concrete retaining walls.

ADVANTAGES:

- Improves noise mitigation
- Manufactured panels may be more aesthetically acceptable

DISADVANTAGES:

- None apparent except that cost may increase

DISCUSSION:

This approach should be considered by the design/build contractor, only if cost reductions are possible.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS			

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	**ALTERNATIVE NO.**	ASDM-2
DESCRIPTION:	**USE CONCRETE MEDIAN BARRIERS FOR LOW RETAINING WALLS IN LIEU OF CAST-IN-PLACE CONCRETE RETAINING WALLS**	**SHEET NO.**	1 of 1

ORIGINAL DESIGN: (Sketch attached)

All earth-retaining structures are cast-in-place concrete cantilever retaining walls.

ALTERNATIVE: (Sketch attached)

Use standard Caltrans concrete median barriers in lieu of short retaining walls (up to 3 ft. above grade).

ADVANTAGES:

- Reduces construction time.
- Reduces construction cost.

DISADVANTAGES:

- None apparent

DISCUSSION:

It is common practice t use concrete median barriers for retaining material up to 3 feet high.

Design suggestion

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$	$	$
ALTERNATIVE	$	$	$

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	ASDM-3
DESCRIPTION:	USE CRIB WALLS IN LIEU OF CAST-IN-PLACE CONCRETE FOR LOW RETAINING WALLS	SHEET NO.	1 of 5

ORIGINAL DESIGN:

All retaining walls are designed as cantilevered, cast-in-place concrete walls.

ALTERNATIVE:

Use crib walls for short retaining walls. Allow walls to be adorned with live plantings.

ADVANTAGES:

- More economical
- Accelerates construction time
- Reduces maintenance

DISADVANTAGES:

- Architecturally-less flexibile
- MSE wall is difficult to trench for utilities after installation

DISCUSSION:

Typically, D/B contractors propose this type of wall to produce cost savings. Providing low maintenance plantings, such as bouganvilla, integrated in the walls, has proven to be a maintenance savings because it guards against graffiti.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 406,600	—	$ 406,600
ALTERNATIVE	$ 243,960	—	$ 243,960
SAVINGS	$ 162,640	—	$ 162,640

ALTERNATIVE NO

Carter • Burgess

Job Name: ASDM-3
Date: 10/21/99 Sheet 2 of 5
By: K. Helmuth

ASDM-3 (Retaining Wall Area - 4' retained or less)

C6440

Sheet 394							
		(A)	(B)	(C)	(D_1)	(D_2)	E
	SIDE	STA FROM	TO	Length B-A	Avg Retained Ht. + 1' where req. (w. Screen or Dec. wall)	Avg Retaining Wall Ht.	Area (SF) C×D
	SS	416+00	417+90				
				190	4.5		855
	SS	417+90	418+50				
				60	6		360
	SS	418+50	419+50				
				100	6.5		650
	SS	421+20	421+55	35	6		210
Sheet 395							
	NS	416+00	417+20	120	5		600
	NS	417+70	418+85	115	5		575
	NS	418+85	419+75	90	3.5		315
	NS	419+75	420+80	105	3.25		341
	NS	422+25	425+30	305		5	1525
Sheet 396							
	SS	422+40	425+00	260		4.75	1235
	SS	425+00	428+00	300	3		900
Sheet 398							
	NS	433+50	434+95	145		5.5	798
Sheet 399							
	SS	434+60	437+65	305		4.5	1373

ALTERNATIVE No.

Job Name: ASDM-3

Date: 10/21/99 Sheet 3 of 5

By: K. Helmuth

Carter • Burgess

ASDM-3 (Con't)

C6440

	SIDE	Ⓐ STA FROM	Ⓑ TO	Ⓒ Length B-A	Ⓓ₁ Avg. Retained Ht. +1' when appl. (w Screen or Dec. Wall)	Ⓓ₂ Avg. Retaining Wall Hgt.	Ⓔ Area (SF) C×D
Sheet 400							
	SS	450+70	453+80	310		—	1890
	SS	454+33	456+00	167		—	952
Sheet 401							
	SS	562+38	563+04	66		5.5	363
Sheet 402							
	SS	466+60	469+50	290	5		1450
	SS	471+20	471+50	30	3.5		105
Sheet 403							
	NS	470+50	470+70	20		5.5	110
	NS	470+70	471+60	90	—		425
	NS	471+60	471+80	20		4.5	90
	NS	472+20	475+00	280		—	1730
Sheet 404							
	SS	471+50	472+40	90	—		360
	SS	474+47	474+67	20		5.5	110
	SS	475+40	476+20	80	4		320
Sheet 405							
	NS	483+95	486+90	295		5.25	1549

Carter • Burgess

Job Name: ALTERNATIVE NO. ASDM-3
Date: 10/21/99 Sheet 4 of 5
By: K. Helmuth

ASDM-3 (Con't)
C6440

		Ⓐ	Ⓑ	Ⓒ	Ⓓ₁	Ⓓ₂	Ⓔ
	SIDE	STA FROM	TO	Length B-A	Avg. Retained Ht +1' when appl. (w screen or Dec. Wall)	Avg. Retaining Wall Hgt.	Area (SF) C×D
Sheet	406						
	SS	488+50	490+40	190		4	760
Sheet	407						
	SS	494+80	496+30	150	3.25		488
Sheet	408						
	NS	496+30	497+70	140	3.75		525
	SS	503+70	505+50	80		4.75	380
Sheet	409	505+50	509+40	390		6.5	2535
	SS	509+40	510+40	100	5		500
	SS	510+40	511+20	80		6.75	540
Sheet	410	521+18	521+54	36		9	324
Sheet							

Totals -

Ret. Wall Only	16,264 SF	← USE ONLY THIS
w/ Screen or Decorative -	8979 SF	
	25,243	

COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT							ALTERNATIVE NO. ASDM-3 SHEET NO. 5 of 5
CONSTRUCTION ITEM		*ORIGINAL ESTIMATE*			*PROPOSED ESTIMATE*		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
Low Retaining Walls	SF	16,264	25	406,600	16,264	15	243,960
Sub-Total				406,600			243,960
Mark-Up at %							
TOTAL							

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	ASDM-4
DESCRIPTION:	USE MECHANICALLY-STABILIZED EARTH WALLS IN LIEU OF CANTILEVERED CAST-IN-PLACE CONCRETE RETAINING WALLS	SHEET NO.	1 of 6

ORIGINAL DESIGN:

Cast-in-place concrete, cantilevered retaining walls are used in all locations.

ALTERNATIVE:

Use mechanically-stabilized earth (MSE) walls in lieu of cast-in-place concrete retaining walls for the construction of retained embankments for walls higher than 8 ft.

ADVANTAGES:

- Reduces construction time
- Reduces construction cost

DISADVANTAGES:

- Possible conflict between tie back straps and station platform foundation
- Possible conflict with future utility/conduit construction, if needed

DISCUSSION:

The use of MSE walls is common in elevated embankment construction and saves significant costs.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 2,712,250	—	$ 2,712,250
ALTERNATIVE	$ 2,373,525	—	$ 2,373,525
SAVINGS	$ 338,725	—	$ 338,725

CALCULATIONS

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. ASDM-4
		SHEET NO. 2 of 6

Wall No	L	H(< 10')	H ≥ 10'	AREA (< 10')	AREA (≥ 10')
RA10	48'	6'		* 288	
RB 1	168'	6'		*1,008	
	96'	8'		* 768	
	13'		10'		*130
RB 2	68'	8'		* 544	
RB 3	60'	6'		* 360	
RB 4	133'	6'		* 798	
RA 11	52'	6		* 312	
RB 5	122'	6'		* 732	
RB 6	68'	8'		* 544	
	8'		10'		* 80
	81.5		12'		* 978
RB 10	11	8		* 88	
RA 6	18'	8		* 144	
	38'		14		532
RA 1	41.5		12		498
	288		14		4032
	312		12		3,744
	34.5	8		276	
RB7	50	6		300	
	120	8		960	
	72		12		864
	30		14		420
	248		16		3968
	50		14		700
	120		12		240
	164		14		2296
	26		18		468
Subtotal				1,536	17,762

* = wall not appropriate for MSE

CALCULATIONS

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

ALTERNATIVE NO. ASDM-4

SHEET NO. 3 of 6

Wall No	L	H(<10)	H(≥10')	Area (<10')	Area (≥10')
RB7 (Cont)	34		20		680
	56		18		1008
	40		16		640
	40		12		480
	40		10		400
	36	8		288	
RA2	8	6		48	
	24	8		192	
	32		10		320
	56		12		672
	72		14		1008
	96		16		1536
	288		18		5184
	192		20		3840
	72		18		1296
	48		16		768
	96		14		1344
	48		12		576
	120		10		1200
	24	8		192	
	14	6		84	
RB8	61		10		610
	60		12		720
	30		14		420
	30		16		480
	129		18		2322
	50		16		800
	71		14		994
	39		16		624
	20		14		280
	Subtotal			804	28,202

CALCULATIONS

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

ALTERNATIVE NO. ASDM - 4

SHEET NO. 4 of 6

Wall No	L	H (<10')	H (≥10')	AREA (<10')	AREA (≥10')
RB 8 (Cont)	10		12		120
	80		10		800
	80		12		960
	50		10		500
	18	8	-	144	
RA 3	75		12		900
	149		10		2980
	76		12		912
	50		14		700
	50		12		600
	25		10		250
	36	8		288	
	108		10		1080
	24		12		288
	48		10		480
	168		12		2016
	26	8		208	
	20	6		120	
RA 8	219	6		* 1314	
RB 11	165	6		* 990	
RA 7	24	6		* 144	
	192	8		* 1536	
	12	6		* 72	
Subtotal				760	12586
Total				3100	58,550

* = wall not appropriate for MSE

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

ALTERNATIVE NO. ASDM-4

SHEET NO. 5 of 6

Costs

	MSE	CIP	Δ
< 10'	$ 38.50/SF	$25.00	$13.50
≥ 10'	$ 38.50/SF -	$45.00	($ 11.50)

COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

ALTERNATIVE NO. ASDM-4

SHEET NO. 6 of 6

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
Wall < 10'	SF	3100	25.00	77,500	3100	38.50	119,350
Wall ≥ 10'	SF	58550	45.00	2,634,750	58550	38.50	2,254,175
Sub-Total				2,712,250			2,373,525
Mark-Up at %							
TOTAL							

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	DMMP-7
DESCRIPTION:	**USE REINFORCED SLURRY WALL IN LIEU OF UNDERPINNING FOUNDATIONS AT TUNNEL**	SHEET NO.	1 of 9

ORIGINAL DESIGN: (Sketch attached)

Where buildings about the proposed rail tunnel, conventional hand mined piers are to be installed below existing foundations. The piers are to be constructed of reinforced concrete to 10 ft. below tunnel box invert slab.

ALTERNATIVE: (Sketch attached)

Construct a reinforced concrete slurry support wall adjacent to building footing. Wall to extend 10'-0 below tunnel box invert slab and to be used as one side of train tunnel box section. Decrease the inside dimension of the box to 24-ft– 2 in. to permit installation of slurry wall.

ADVANTAGES:

- Six months less construction time for tunnel section.
- Saves cost
- Reduces settlement risk

DISADVANTAGES:

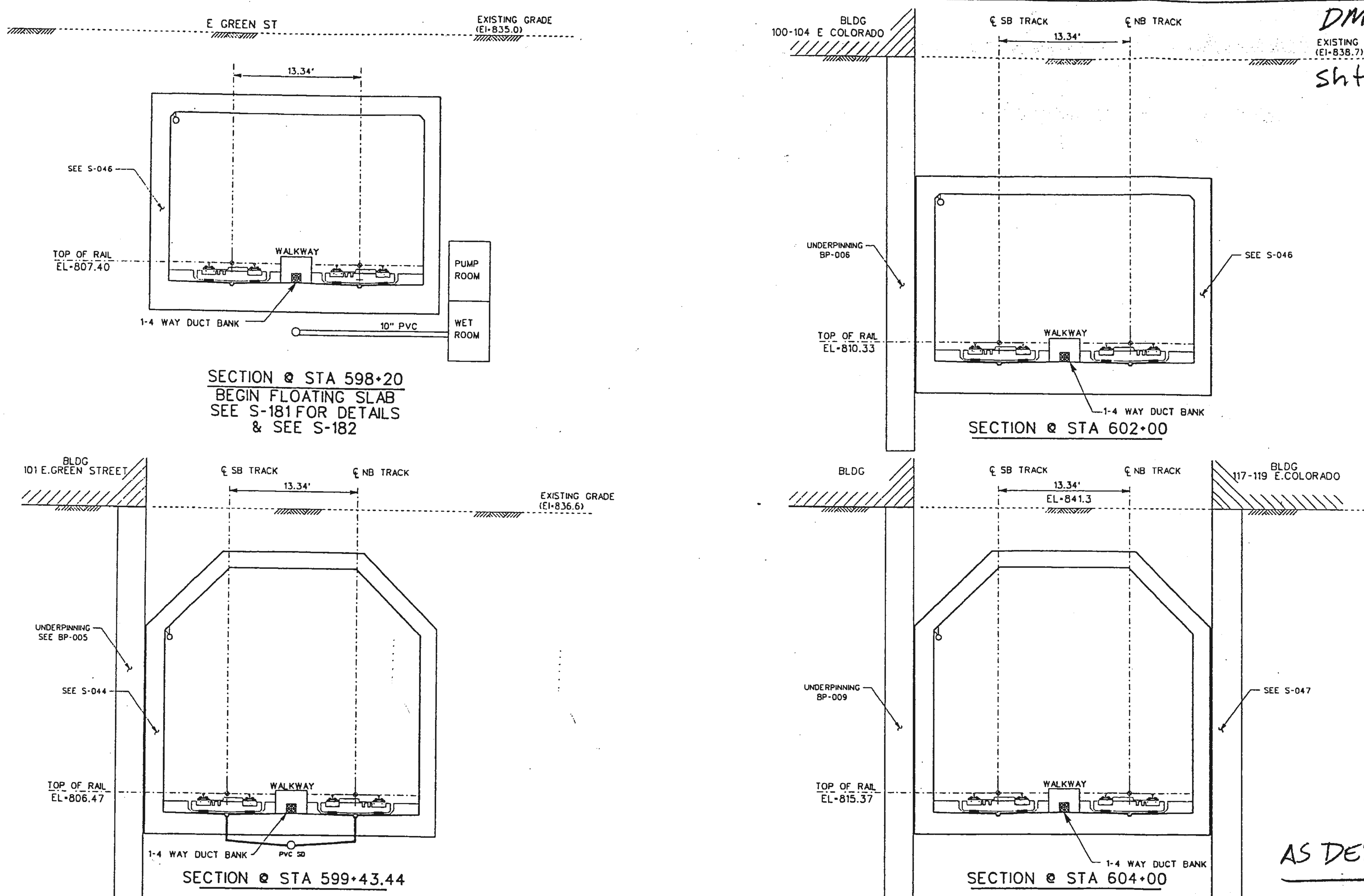
- Requires working around protruding footings of existing building
- Must carefully use equipment adjacent to an existing building
- Community must be informed of any proposed change and assured of its viability.

DISCUSSION:

The alternative seeks to substitute slurry wall construction for the underpinning of existing buildings adjacent to the proposed tunnel. If the slurry equipment can be employed considering the closeness of the buildings and the protrusion of the existing footings, then cost savings could result. The D/B contractor should be given this option along with others he may develop for the underpinning design.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 10,092,290	$	$ 10,092,290
ALTERNATIVE	$ 9,650,337	$	$ 9,650,337
SAVINGS	$ 441,953	$	$ 441,953

ALTERNATIVE NO.
DMMP-7
sht. 2 of 9



AS DESIGNED

0	3/12/98			35639	9/30/99	JOSEPH Y. WANG	ISSUED FOR SOLICITATION
REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY J.WANG
DRAWN BY J.DAMIAN
CHECKED BY N.W.WEINBERG
IN CHARGE N.W.WEINBERG
DATE 3/12/98

REGISTERED PROFESSIONAL ENGINEER JOSEPH Y. WANG No. 35639 CIVIL STATE OF CALIFORNIA

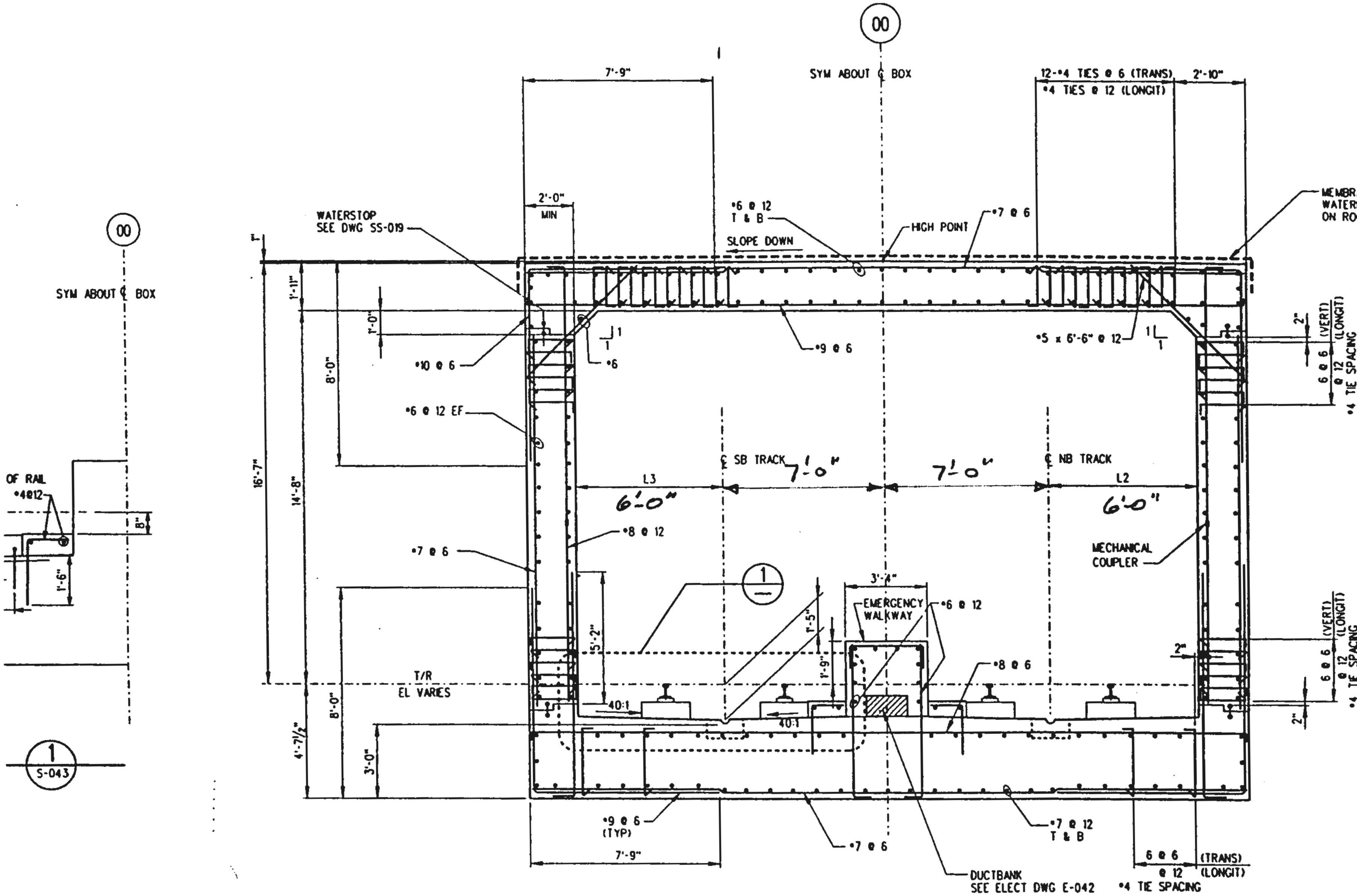
LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY
PASADENA BLUE LINE

LOCKMAN & ASSOCIATES
CONSULTING ENGINEERS and PLANNERS
SUBMITTED
ENGINEERING MANAGEMENT CONSULTANT
APPROVED

LAUPT TO PASADENA
DEL MAR TO MEMORIAL PARK LINE SEGMENT
CROSS SECTIONS
SHEET 4 OF 7

CONTRACT NO C6450
DRAWING NO C-010
REV 0
SCALE NO SCALE
SHEET NO 028

10-MAR-1998 15:01 Plotted By: vorter's



SECTION

A
S-043

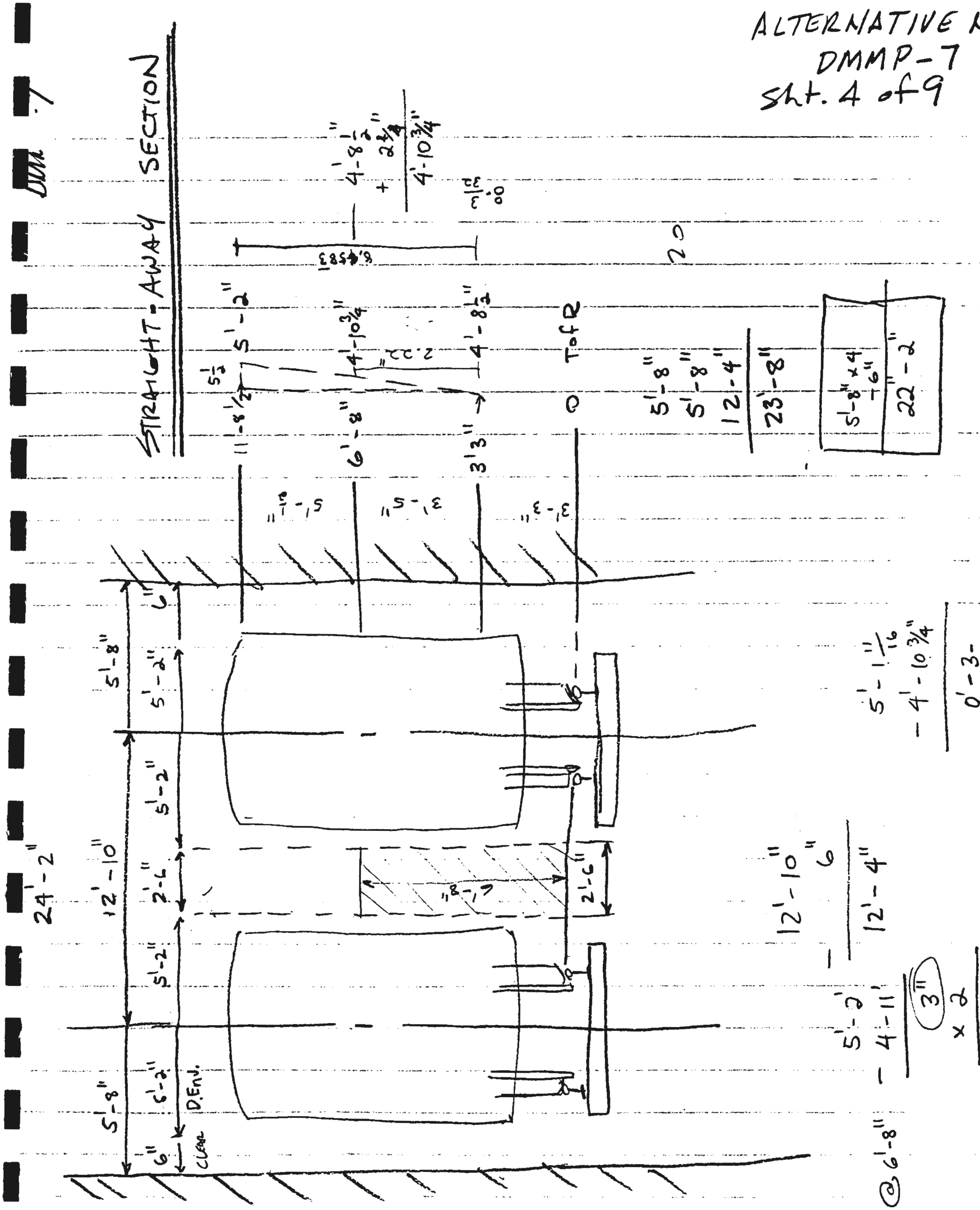
S-035
S-039

⅜" - 1'-0"

NOTES : 1. TYPICAL SECTION BETWEEN STA NB 596+90.00 TO STA NB 598+20.00
2. FOR ELEVATION OF TOP OF RAIL, SEE CIVIL DWGS.
3. FOR LOCATIONS OF RIGHT OF WAY, SEE ROW DWGS.
4. FOR L2 AND L3 DIMENSIONS, SEE DWGS S-104 AND S-105.
5. FOR CORROSION PROTECTION REQUIREMENT, SEE DWGS CP-006 AND CP-007.

ALTERNATIVE DC.
DMMP-7
Sht 3 of 9

ALTERNATIVE NO.
DMMP-7
Sht. 4 of 9



ALTERNATIVE NO.

Carter • Burgess

Job Name: DMMP-7
Date: / /
Sheet 5 of 9
By:

							EXC. SUPPORT
STATION	573+40	576+90	U-WALL SECTION	350'	11	3850
	576+90	608+58	TUNNEL SECTION	1168'	26	30368
	608+58	611+88	U-WALL SECTION	330'	12	3960
						38178
						X 2
		LF				
	SHT 135	105				76356
	136	120				
	137	99.5				
	138	136				
	139	71				
	140	121				
	141	33.5				
	142	113				
	143	115				
	144	57				
UNDERPINNING		971 x 26	50,492 SF.			(50,492)

TOTAL CONTRACTOR DESIGNED 25,864 SF

ALTERNATIVE NO.

Carter ▪ Burgess

Job Name: DMMP - 7
Date: 10/21/94 Sheet 6 of 9
By: K. Patnan

MASON UNDERPINNING

					Conc.	Wd. LAGNG
101 E Green Street						
	QUANTITY	L	W	D	CY.	
	18	5'0	3'0	41'3	412.5	1184.0
100-104 E Colorado Blvd.						
	4	5'0	3'6	34	88.148	1872
	6	5'0	3'6	37	143.888	
	3	5'0	3'6	35	68.055	
99 E Colorado Blvd.						
	8	5'0	3'6	37	191.851	860
	7	5'0	3'6	35	158.796	
117-119 E Colorado Blvd.						
	1	6'0	3'6	21	16.80	—
	6	5'0	3'0	21	70.0	
	3	4'6	4'0	21	42.93	
	1	4'6	x 4'0	23	15.33	
	9	5'0	x 3'0	23	115.00	
	5	4'0	x 4'0	23	40.89	
	3	4'6	x 4'0	24.5	49.0	
	1	4'0	4'0	24.5	14.52	
	6	5'0	3'0	24.5	81.67	
	1	4'6	4'0	25.5	17.00	
	3	5'0	3'0	25.5	42.5	
	2	5'0	4'0	25.5	37.78	
					1,570.658	
						4,466

ALTERNATIVE NO.

Carter • Burgess

Job Name: DMMP-7
Date: 10/21/99 Sheet 7 of 9
By: R. Pa/kan

110-114 E. Union Street.						
					Conc	Wd. Lagging.
5	5-0	4-0	25.5		94.44	
4	5-0	4-0	26.5		78.52	530
2	5-0	4-0	27.5		40.74	
48 N. Raymond.						
3	6-0	4-6	23-0		69.0	518
2	5-0	4-0	23-0		34.07	
4	5-0	3-0	23-0		47.77	
3	5-0	4-0	21-5		51.11	
2	6-0	4-0	21-5		38.22	
2	5-0	3-0	20-0		22.22	
1	5-0	4-0	20-0		14.81	
1	6-0	4-6	20-0		20.0	
99 E Union Street.						
4	5-0	3-0	23-0		51.11	288
109-121 E Union Street						
3	5-0	3-0	23-0		38.33	936
4	5-0	3-0	24-6		54.44	
7	5-0	3-0	26-0		101.11	
95 N. Arroyo Parkway						
3	5-0	3-0	20		33.33	560
6	5-0	3-0	22		73.33	
8	5-0	3-0	24		106.66	
					959.23	
						2832.

Carter • Burgess

ALTERNATIVE NO.

Job Name: DMMP - 7

Date: 10/21/99 Sheet 8 of 9

By: R. Palma

110 E. Holly Street.

				Conc	Wd Lagging
6	5'0	3'0	26'0	86.66	378
2	5'0	3'0	24'0	26.66	
		This Page		113.32	378
		Page 1		1570.66	4466
		Page 2		959.23	28.32
				2643.21	4872.32

COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

ALTERNATIVE NO. DMMP-7

SHEET NO. 9 of 9

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
Major Underpinning	Cy.	2643	820.25	2,167,920			
4X Wood Lagging	SF.	4873	18.00	87,714			
U-Wall Section	LF.	680	3000	2,040,000	680	3000	2,040,000
Subway Box	LF	1168	3330	3,889,440	197	3330	656,010
Floating Slab	TF	2336	440	1,027,840	2336	440	1,027,840
Soldier Pile & Lag. Ex. Sup.	SF.	25864	34.00	879,376	25864	34.00	879,376
2'6 Perm. Slurry Wall	CY				2589	788.67	2,041,866
Modified Tunnel							
- Box Section w/ One							
Side Exposed Slurry							
Wall, in Lieu of Formed	LF				971	3095	3,005,245
Concrete Wall.							
Sub-Total				10,081,290			9,650,337
Mark-Up at %							
TOTAL							

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	DMMP-12
DESCRIPTION:	CLOSE HOLLY STREET TO VEHICLE TRAFFIC AND RAISE TRACK PROFILE NORTH OF UNION STREET THROUGH MEMORIAL PARK STATION	SHEET NO.	1 of 7

ORIGINAL DESIGN:

The current design provides for a grade-separated crossing of Holly Street with a depressed Memorial Park Station beneath the overhang of the Civic Center West apartment building. The current difference in elevation between top of rail and existing ground at the south end of platform at Memorial Park Station is approximately 12 ft. This will require costly excavation and building foundation support measures.

ALTERNATIVE:

Increase the track gradient from 4% to 6% between Union Station and the Holly Street cul-de-sac, thereby raising the platform elevation at the south end of Memorial Station by approximately 8 ft.

ADVANTAGES:

- Reduces tunneling, Memorial Park Station and building foundation support costs substantially
- Reduces cost of ramp structures to the station substantially

DISADVANTAGES:

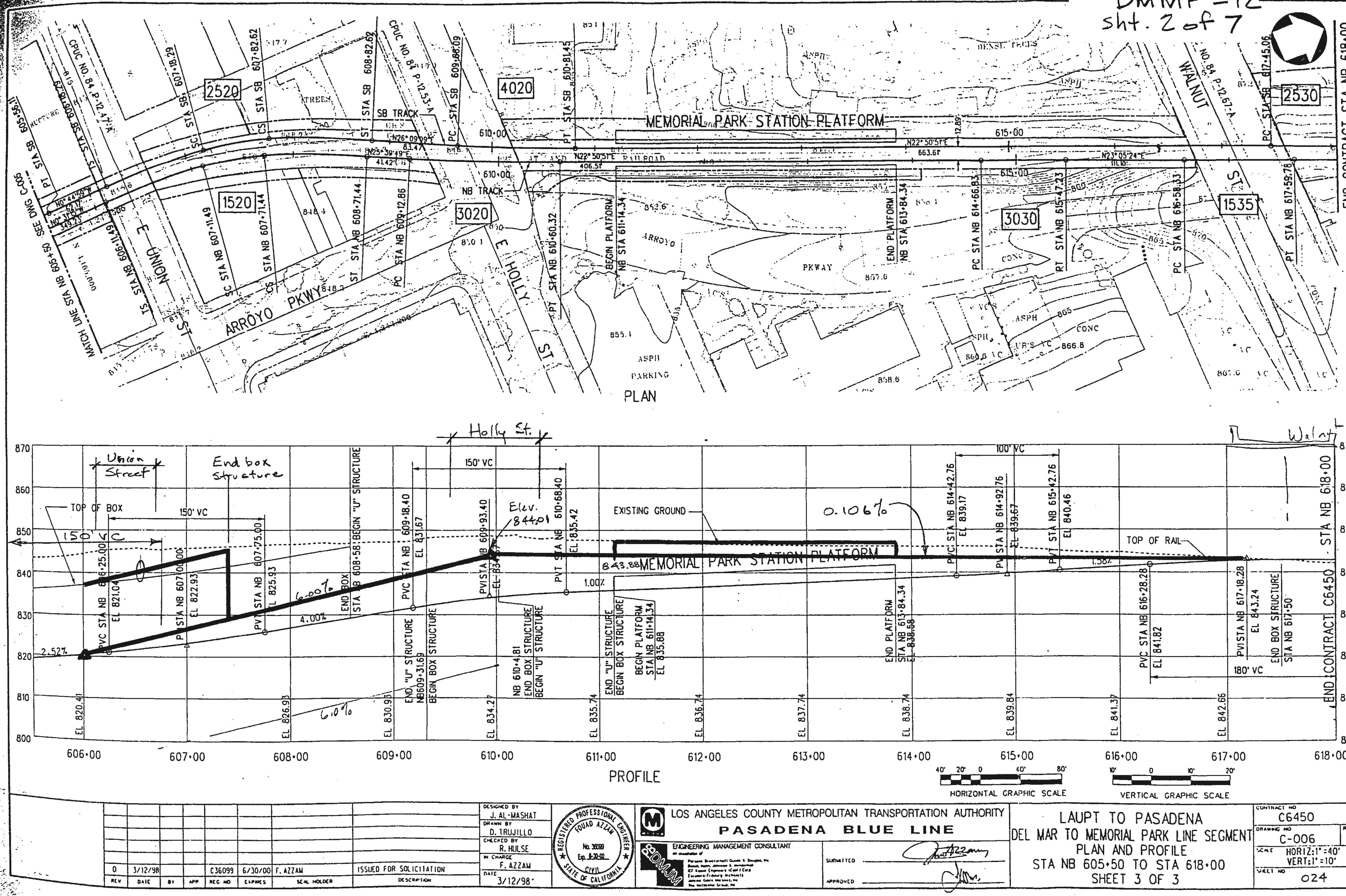
- Requires the closing of Holly Street to vehicular traffic, however an elevated pedestrian crossing along the south side of Holly Street is feasible
- Reduces vertical clearance from top of rail to 39-in. storm drain on Union Street by 13 ft. (desired minimum is 14 ft.) allowing 1 ft. for a pipe support structure
- A brief 6% track gradient is incorporated between Union Street and Holly Street
- Requires significant redesign

DISCUSSION:

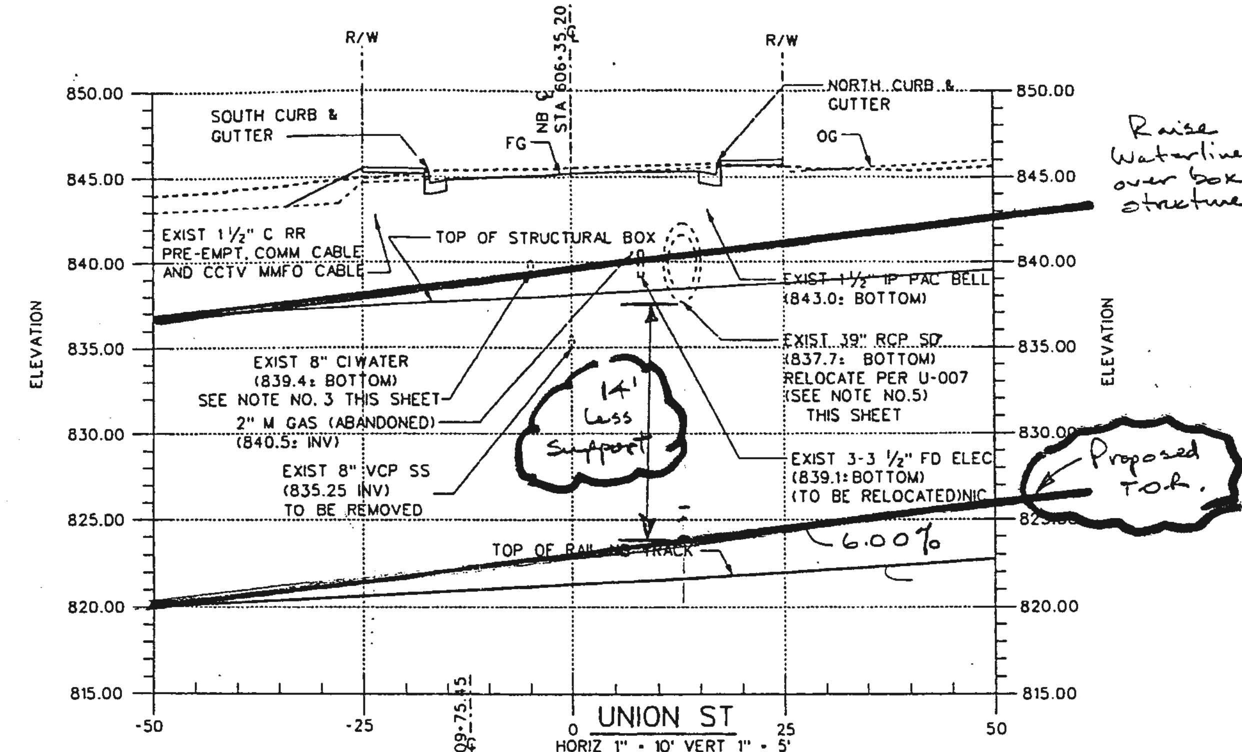
This concept is not possible without closing Holly Street to vehicular traffic, but the cost saving potential is substantial. The City of Pasadena must agree to the street closure

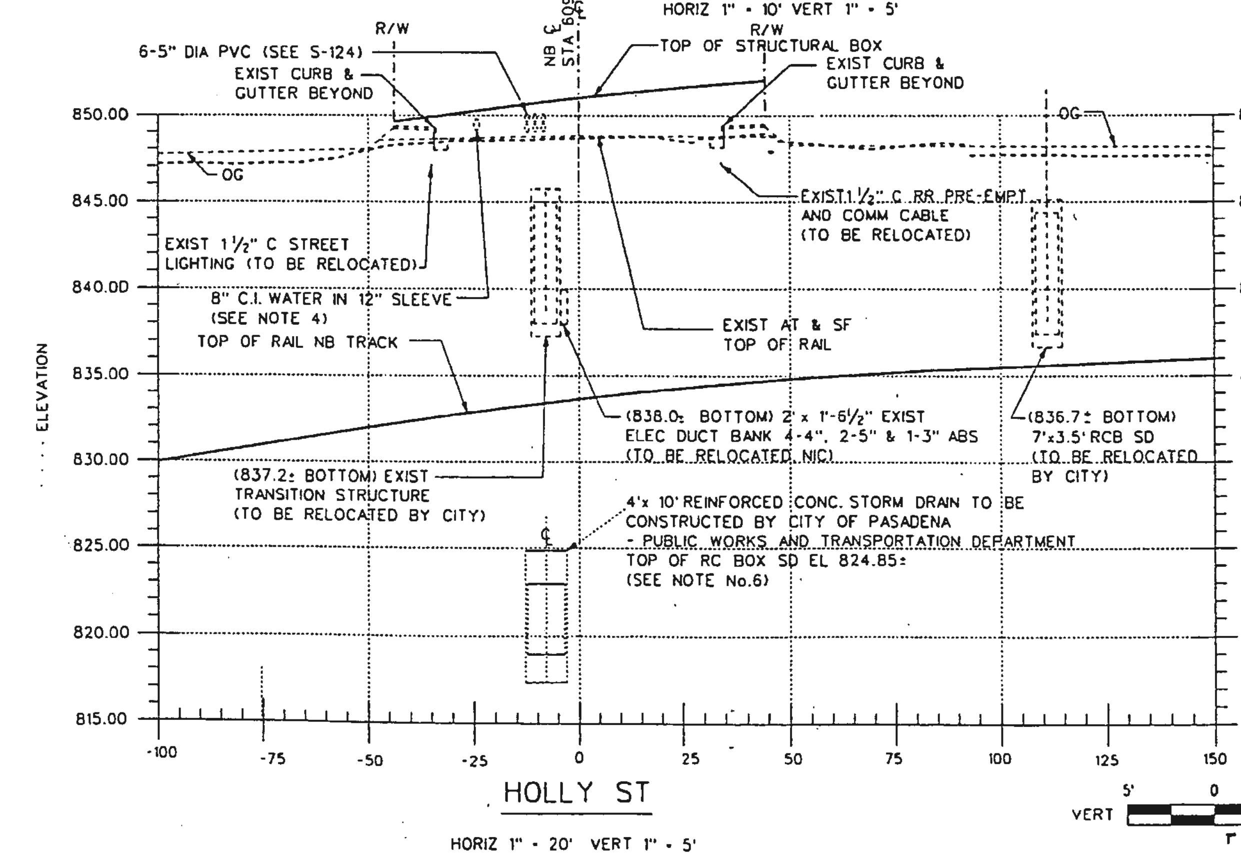
COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 2,769,000	---	$ 2,769,000
ALTERNATIVE	$ 1,431,000	---	$ 1,431,000
SAVINGS	$ 1,338,000	---	$ 1,338,000

ALTERNATIVE NO. DMMP-12
sht. 2 of 7



ALTERNATIVE NO.
DMMP-12
Sht. 3 of 7





NOTES:

1. STREET CROSS SECTIONS DEPICT EXISTING UTILITIES IN RELATION TO TRACK PROFILE AND TOP OF STRUCTURAL BOX.
2. SECTIONS VIEWED LOOKING TO WEST
3. THE EXISTING 8" C.I. WATER AT UNION ST. WILL BE REPLACED BY 8" FLANGED DUCTILE IRON PIPE IN ITS ORIGINAL LOCATION PRIOR TO CUT AND COVER CONSTRUCTION AND TO BE SUPPORTED IN PLACE DURING CONSTRUCTION.
4. HOLLY ST. 8" C.I. WATER WILL BE INSTALLED AND VERTICAL ADJUSTMENT AS REQUIRED BY 8" FLANGED DUCTILE IRON PIPE BY DWP OF CITY OF PASADENA AFTER CUT AND COVER CONSTRUCTION. A 12" SLEEVE IN TOP BOX SLAB IS REQUIRED. (SEE S-121 AND S-124)
5. EXISTING 39" RCP STORM DRAIN WILL BE REPLACED BY D.I. PIPE TO ITS ORIGINAL LOCATION PER PLAN AN PROFILE SEE DWG NO. U-007
6. THE NEW STORM ORAIN WILL BE CONSTRUCTED BY DWP CITY OF PASADENA PRIOR OT CUT AND COVER CONSTRUCTION. CONTRACTOR SHOULD COORDINATE WITH THE CITY.
7. THE ELECTRICAL DUCT BANKS AT BOTH UNION ST. AND HOLLY ST. WILL ONLY BE RELOCATED PER PLANS, SPECIFICATIONS AND SHOP DRAWINGS OF PASADENA WATER AND POWER DEPARTMENT.

HORIZ 10' 0 10' 20' 1" = 10'-0"

VERT 5' 0 5' 10' 1" = 5'-0"

HORIZ 20' 10' 0 20' 40' 1" = 20'-0"

RLV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	3/12/98			35639	9/30/99	JOSEPH Y. WANG	ISSUED FOR SOLICITATION

DESIGNED BY J.WANG
DRAWN BY J.DAMIAN
CHECKED BY N.W.WEINBERG
IN CHARGE N.W.WEINBERG
DATE 3/12/98

REGISTERED PROFESSIONAL ENGINEER JOSEPH T. WANG No. 35639 Exp. 9/30/99 CIVIL STATE OF CALIFORNIA

LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY
PASADENA BLUE LINE

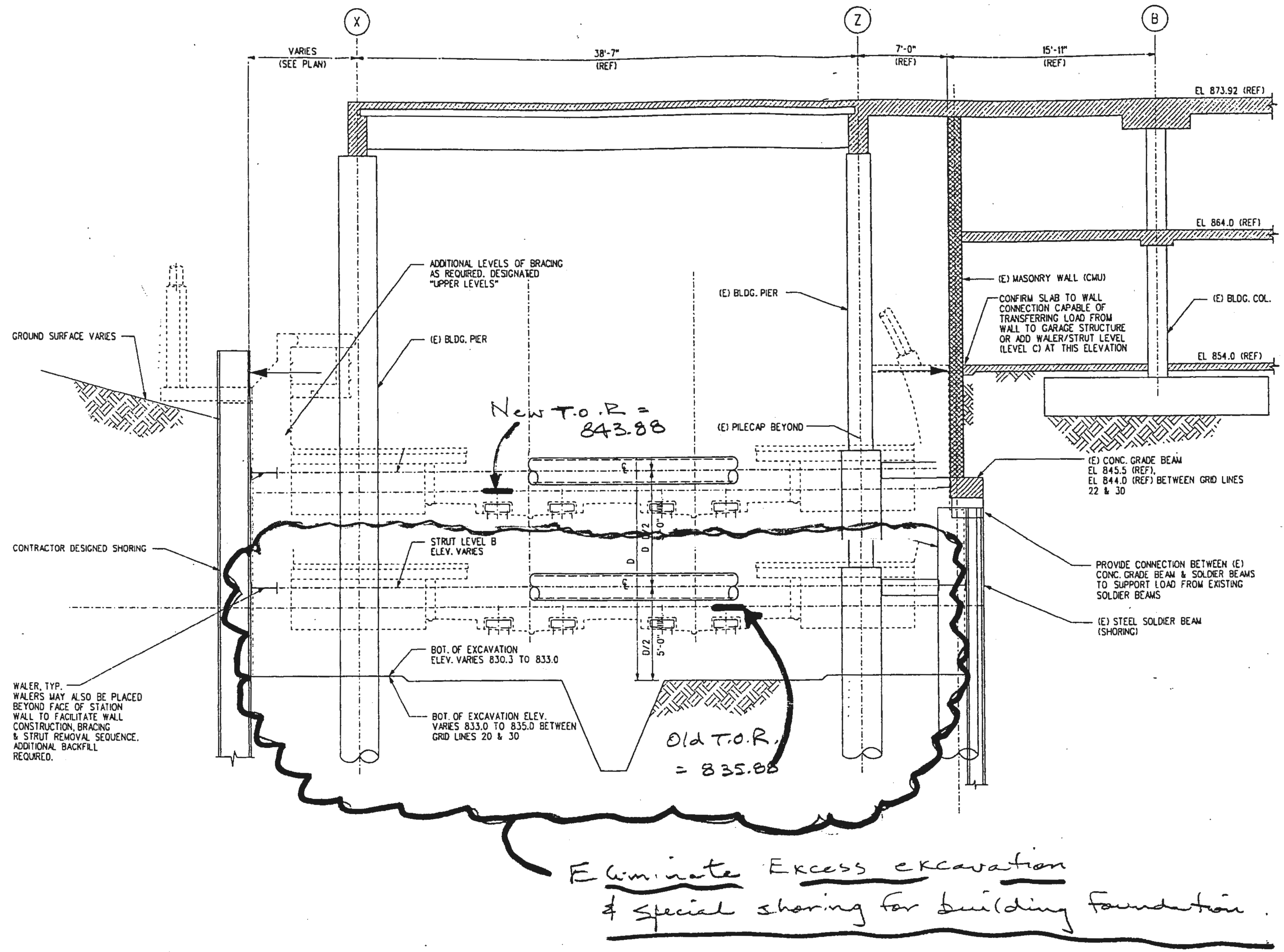
LOCKMAN & ASSOCIATES
CONSULTING ENGINEERS and PLANNERS
SUBMITTED
ENGINEERING MANAGEMENT CONSULTANT
APPROVED

LAUPT TO PASADENA
DEL MAR TO MEMORIAL PARK LINE SEGMENT
STREET AND UTILITIES
SECTIONS
SHEET 2 OF 2

CONTRACT NO C6450
DRAWING NO U-027
REV 0
SCALE AS NOTED
SHEET NO 097

11-MAY-1998 15:41 L:\remote\pas\jl\sd\jlu027.plg
Plotted 9y:sd1

ALTERNATIVE NO.
DMMP-12
Sht. 4 of 7



EXCAVATION SHORING PROCEDURES AND SEQUENCE (MINIMUM REQUIREMENTS)

1) INSTALL EXCAVATION BULKHEAD(SOLDIER BEAMS OR EQUIVALENT) ON WEST SIDE OF EXCAVATION.

2) INSTALL "UPPER LEVEL" OF BRACING (STRUTS AND WALERS OR TIEBACKS) AS REQUIRED TO SUPPORT WEST SIDE OF EXCAVATION. IF BRACING IS ACROSS SITE TO THE CCW BUILDING, BRACING SHALL ONLY BE AT FLOOR LEVELS. INSTALL LAGGING (WOOD OR SHOTCRETE) ON A CONTINUOUS BASIS AS THE EXCAVATION PROCEEDS.

3) EXCAVATE TO BASE OF EXISTING GRADE BEAM AT APPOXIMATELY ELEV. 844 FEET AND INSTALL LEVEL "A" STRUTS AND WALERS. CONSTRUCT CONNECTIONS BETWEEN TOPS OF EXISTING SOLDIER BEAMS AND EXISTING CONCRETE GRADE BEAM OR WALER TO TRANSMIT DESIGN EARTH PRESSURES. PRELOAD STRUTS.

4) EXCAVATE ONE-HALF OF THE WAY TO THE BOTTOM OF FINAL EXCAVATION EXECEPT AS NOTED AND INSTALL LEVEL "B" STRUTS AND WALERS. WALERS TO ENGAGE ALL OF THE EXISTING SOLDIER BEAMS AND BUILDING CAISSONS AS INDICATED. PRELOAD STRUTS. INSTALL LAGGING ON A CONTINUOUS BASIS AS THE EXCAVATION PROCEEDS.

5) CONTINUE EXCAVATION TO FINAL GRADE. INSTALL LAGGING ON A CONTINUOUS BASIS AS THE EXCAVATION PROCEEDS.

6) CAST STATION INVERT SLAB FOR THE FULL WIDTH OF STATION AS INDICATED.

7) AFTER INVERT SLAB HAS CURED FOR A MINIMUM OF 7 DAYS, RESHORE AS NECESSARY AND THEN REMOVE LEVEL "B" STRUTS AND WALERS.

8) CONTINUE CONSTRUCTION OF STATION WALLS. RESHORE AS NECESSARY AND THEN REMOVE LEVEL "A" STRUTS AND WALERS.

9) CONTINUE CONSTRUCTION OF STATION WALLS. RESHORING AS NECESSARY AND THEN REMOVING ALL OTHER LEVELS OF BRACING.

THESE MINIMUM EXCAVATION SHORING REQUIREMENTS ARE IN ADDITION TO THE REQUIREMENTS ON DRAWINGS SS-002 THROUGH SS-004. WHERE CONFLICTS ARISE, THE MORE STRINGENT DESIGN REQUIREMENTS SHALL CONTROL.

STRUCTURAL STEEL SHALL BE ASTM A36 FOR WALERS AND ASTM A500, GRADE A OR ASTM A53, GRADE B FOR PIPES (STRUTS)

WOOD LAGGING SHALL BE NOMINAL 4X ROUGH MINIMUM.

STRUT PRE-LOADS SHALL BE A MINIMUM OF 25% OF DESIGN LOAD.

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	3/12/98			S 3114	6/30/00	J.A. DAL PINO	ISSUED FOR SOLICITATION

DESIGNED BY S. BROWN
DRAWN BY M. WILSON
CHECKED BY R. DENIO
IN CHARGE J.A. DAL PINO
DATE 3/12/98

REGISTERED PROFESSIONAL ENGINEER JOHN A. DAL PINO No. 3114 Exp. 6/30/00 STRUCTURAL STATE OF CALIFORNIA

LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY
PASADENA BLUE LINE

Degenkolb Engineers
SUBMITTED
ENGINEERING MANAGEMENT CONSULTANT
APPROVED

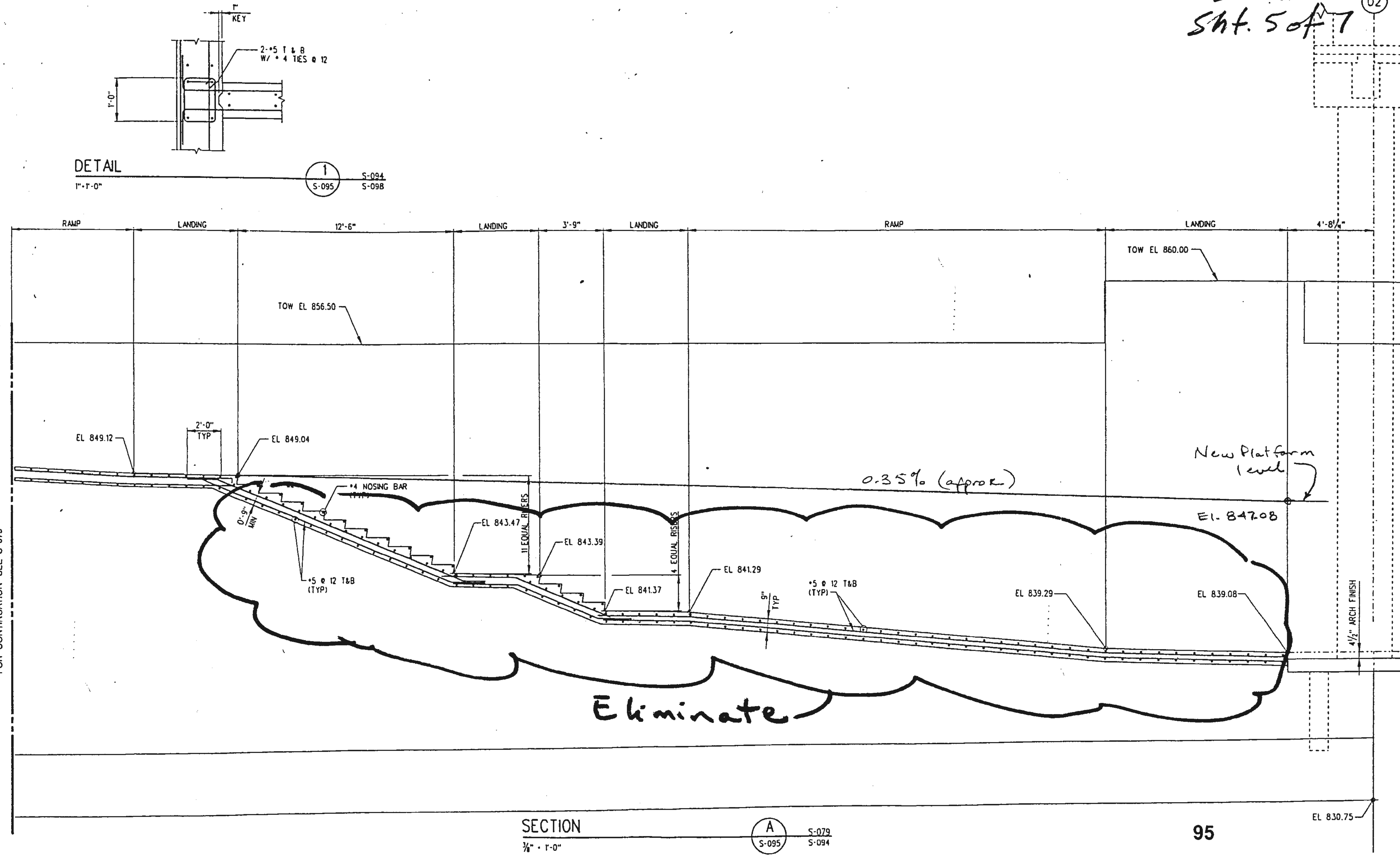
LAUPT TO PASADENA
DEL MAR TO MEMORIAL PARK LINE SEGMENT
MEMORIAL PARK STATION
TRANSVERSE SECTION
SHEET 1 OF 2

CONTRACT NO C6450
DRAWING NO S-201
REV 0
SCALE 1/4" = 1'-0"
SHEET NO 213

ALTERNATIVE NO.

DMMP-12

Sht. 5 of 7



95

REV	DATE	BY	APP	REC NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	3/12/98			SE2587	3/31/00	MING YANG YEH	ISSUED FOR SOLICITATION

DESIGNED BY JYC
DRAWN BY JDS
CHECKED BY MYY
IN CHARGE MYY
DATE 3/12/98

LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY
PASADENA BLUE LINE

MING YANG YEH & ASSOCIATES, INC.
Structural Engineers

SUBMITTED

ENGINEERING MANAGEMENT CONSULTANT

APPROVED

LAUPT TO PASADENA
DEL MAR TO MEMORIAL PARK LINE SEGMENT
HOLLY STREET RAMPS/STAIR NO 3
SECTION & DETAIL
SHEET 1 OF 3

CONTRACT NO C6450
DRAWING NO S-095
REV 0
SCALE AS NOTED
SHEET NO 256

10-MAR-1998 20:34

Plotted By: vorter-s

ALTERNATIVE NO.

Carter • Burgess

Job Name: DMMP-12

Date: / / Sheet 6 of 7

By:

EXCAVATION

609+88 617+20 130' 9'0 1'0

1/2 (130 x 9 =) = 3285
x 46
÷ 27 = 5,597 cy

606+00 609+90 390' 9'0 1'0

1/2 (390 x 9) 1755
x 37.5
÷ 27 = 2437.5 cy.

width 46
29
75
37.5

8,034.5 cy.

Backfill.

1/2 (60 x 5) = 300 x
28.91
8673 ÷ 27 = 321 cy.

COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT
Close Holly Street / Raise track profile and Memorial Park station.

ALTERNATIVE NO. DMMP-12

SHEET NO. 7 of 7

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
EXCAVATION (DELETE)	CY	8,035	28.00	224,480			
BACKFILL (DELETE	CY	321	20.00	6,240			
SUBWAY BOX SECTION	LF.	188	4131.-	776,628			
4X WOOD LAGGING in							
ASSUMED EXIST SUPP. BMS.	SF	2160	9.00	19,440			
WEST SIDE EXCAV. SUPP. SYS.	SF.	8194	18.75	153,638	3856	18.75	72,300
STAIRS & RAMPS	CY	34	300	10,200			
RETAINING WALLS							
U-WALL SECTION	LF	526	3000	1,578,000	444	3000	1,332,000
RETAINING WALL	SF				1080	25-	27,000
Sub-Total				2,769,126			1,431,300
Mark-Up at %							
TOTAL							

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	DMMP-15
DESCRIPTION:	REPLACE FLOATING SLAB WITH VERTICAL VIBRATION ISOLATION WALLS	SHEET NO.	1 of 5

ORIGINAL DESIGN: (Sketch attached)

The design stipulates pre-cast floating slab within box-structure, U-wall structure, and open depressed grade Memorial Park Station. The track is DF Type 1 (assumed as nominal Direct Fixation stiffness) and DF Type 2 (assumed as a "soft" Direct Fixation stiffness DMMP – 15 A).

ALTERNATIVE: (Sketch attached)

Use direct fixation (DF) or ballasted cross-tie (preferred option) track with vibration barrier walls.

ADVANTAGES:

- Improved ground vibration mitigation at full transmitted vibration frequency bandwidth
- Reduced maintenance cost
- Saves cost

DISADVANTAGES:

- Increases foundation depth

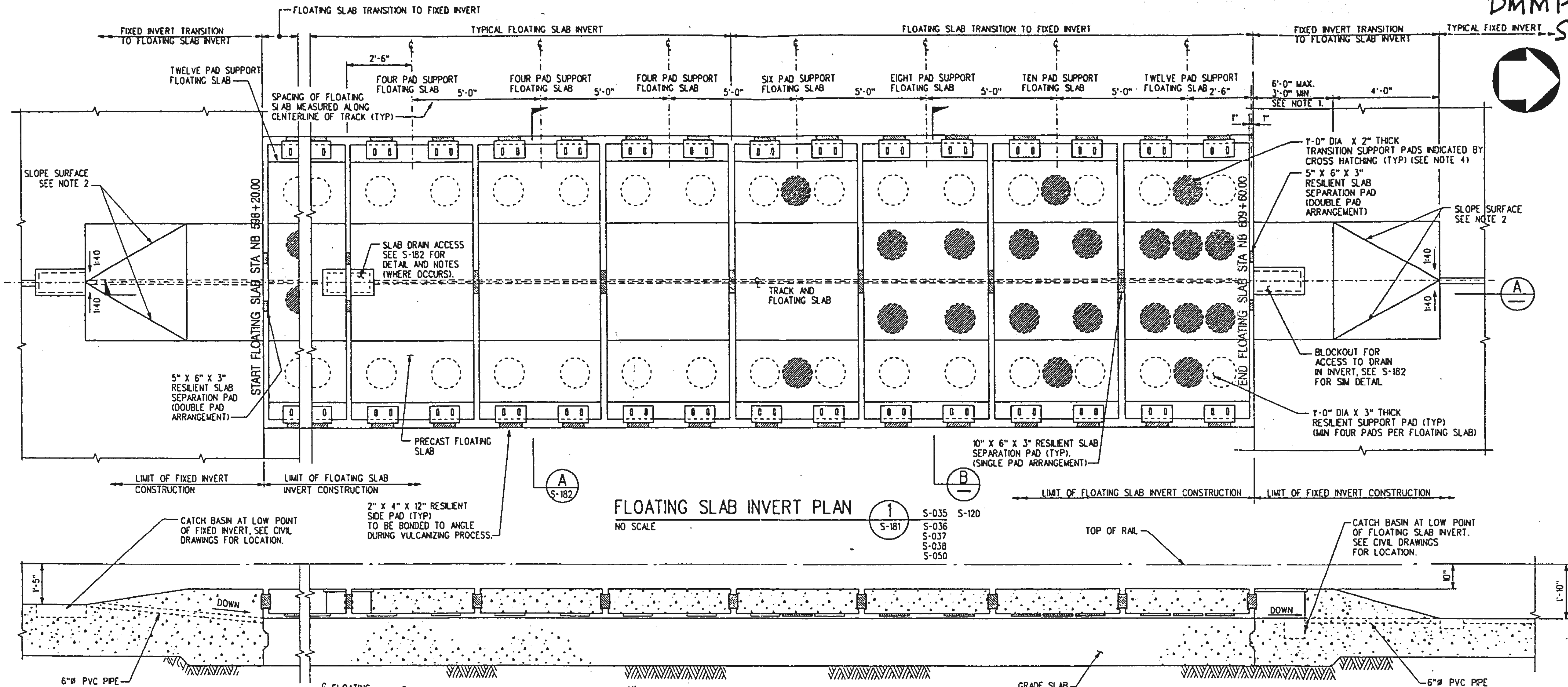
DISCUSSION:

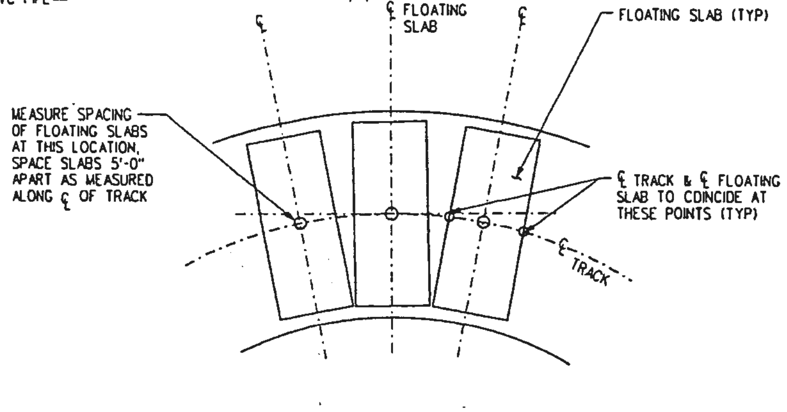
The floating slab isolates vibrations to ground with frequencies of 50 hz and above. These slabs amplify frequencies between 15 – 40 hz introduced into the ground. The ground will transform vibration energy into low frequency waves inherent in the ground geophysics. A train will impress rail deflection waves on the order of 3 – 18 hz (depending on train speed) on the support. Track deflections of these frequencies will not be isolated (nor even mitigated) by floating slabs.

Ground walls effectively mitigate ground vibrations at the primary train-generated vibration.

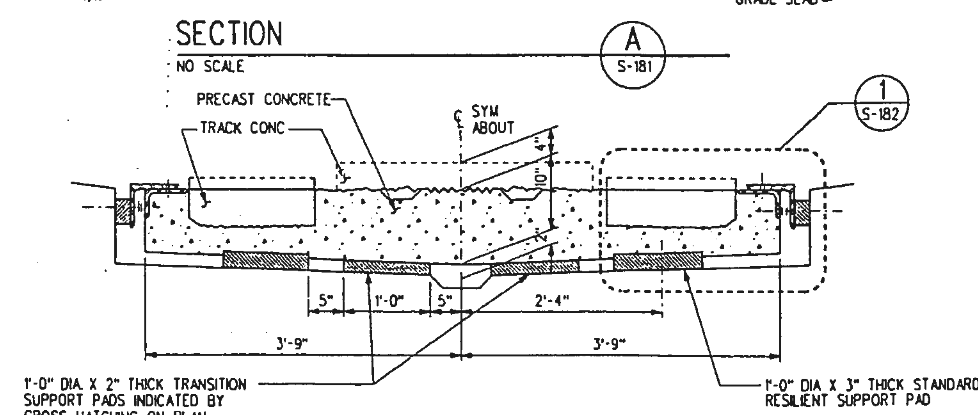
COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 4,297,800	$	$ 4,297,800
ALTERNATIVE	$ 3,532,860	$	$ 3,532,860
SAVINGS	$ 764,940	$	$ 764,940

ALTERNATIVE NO.
DMMP-15
Sht. 2 of 5





FLOATING SLAB ON CURVE LAYOUT
NO SCALE



SECTION B S-181
NO SCALE

NOTES:

1. THIS DIMENSION TO BE ADJUSTED TO SUIT LAYOUT OF FLOATING SLABS AS ACCEPTED BY THE AUTHORITY OR ITS DESIGNEE.
2. SLOPE SURFACE AS INDICATED TO MATCH TYPICAL FIXED INVERT.
3. TWO FLOATING SLABS WITH BLOCKOUTS TO BE PROVIDED OVER INVERT DRAINS OR CLEANOUTS. SEE MECHANICAL DRAWINGS FOR LOCATIONS. THE CENTERLINE OF THE SPACE BETWEEN THE FLOATING SLABS TO BE LOCATED WITHIN 2 INCHES OF THE CENTERLINE OF THE DRAIN OR CLEANOUT.
4. CONTRACTOR MAY CHOOSE TO USE 12 - 1'-0" DIA X 3" THICK STANDARD PAD AND 1" BLOCKOUT AT PAD LOCATION TO SUPPORT THE TRANSITION FLOATING SLAB.
5. FOR LOCATION OF BLOCKOUTS FOR ACCESS TO DRAIN IN INVERT SLAB, SEE C-061.

AS DESIGNED

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	3/12/98			C32584	6/30/01	NAYAN P. PANDYA	ISSUED FOR SOLICITATION

DESIGNED BY R. WONG
DRAWN BY R.BAUTISTA
CHECKED BY A.LAUW
IN CHARGE N.PANDYA
DATE 3/12/98

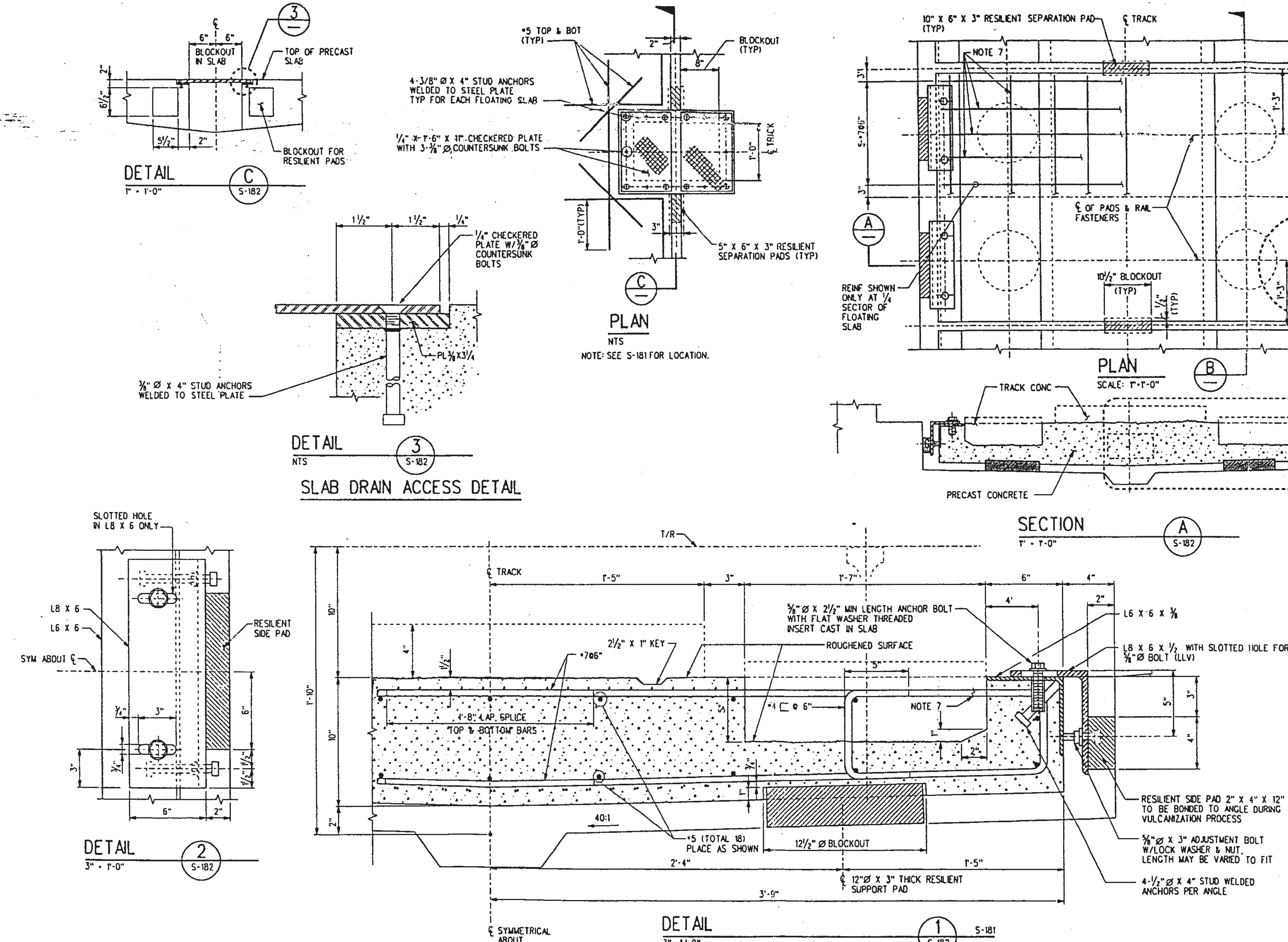
REGISTERED PROFESSIONAL ENGINEER NAYANKUMAR P. PANDYA No. 32584 Exp. 6-30-01 CIVIL STATE OF CALIFORNIA

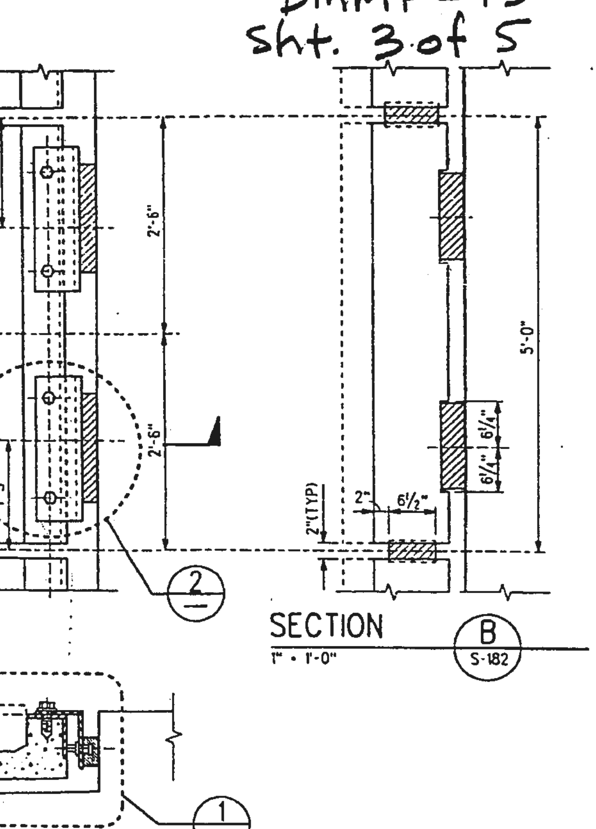
LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY
PASADENA BLUE LINE
ENGINEERING MANAGEMENT CONSULTANT
SUBMITTED
APPROVED

LAUPT TO PASADENA
DEL MAR TO MEMORIAL PARK LINE SEGMENT
FLOATING SLAB DETAILS
SHEET 1 OF 2

CONTRACT NO C6450
DRAWING NO S-181
REV 0
SCALE AS NOTED
SHEET NO 204

ALTERNATIVE NO. DMMP-15
Sht. 3 of 5





NOTES:

1. PRIOR TO PLACING THE PRECAST SLAB, THE CONTRACTOR SHALL CHECK THE PLANE OF THE CONCRETE SURFACE ON WHICH THE SLAB IS TO BE PLACED.
2. ANY SINGLE PAD SUPPORT SLAB POINT SHALL BE PERMITTED TO BE VERTICALLY OUT OF THE PLANE DESCRIBED BY THE OTHER THREE POINTS BY THE MAXIMUM OF ±1/8". ANY POINT OR POINTS OUT OF PLANE BY MORE THAN ±1/8" SHALL BE BROUGHT TO ACCEPTABLE TOLERANCES BY THE USE OF RESILIENT RUBBER SHIMS. THE HORIZONTAL DIMENSIONS OF THE SHIM SHALL BE SIMILAR TO THE DIMENSIONS OF THE RESILIENT BOTTOM SUPPORT PADS. THE SHIMS SHALL BE PLACED WITHIN THE BLOCKOUT PROVIDED IN THE SOFFIT OF THE SLAB.
3. THE CENTERLINE OF THE PRECAST SLAB PRIOR TO AND AFTER THE STRESSING OF THE SIDE PADS SHALL NOT VARY FROM THE TRACK CENTERLINE BY MORE THAN 1/4".
4. THE DISTANCE BETWEEN ADJACENT SLABS SHALL NOT VARY BY MORE THAN ± 1/4" FROM THE DIMENSION INDICATED.
5. SUBSEQUENT TO PLACEMENT OF THE PRECAST SLABS EACH OF THE FOUR RESILIENT SIDE PADS SHALL BE EVENLY COMPRESSED 1/4" TO WITHIN TOLERANCE OF ± 1/16" AFTER THE SIDE PADS ARE COMPRESSED, THE NUT AND LOCK WASHER OF THE ADJUSTMENT BOLT SHALL BE TIGHTENED.
6. TWO FLOATING SLABS WITH BLOCKOUTS TO BE PROVIDED OVER INVERT DRAINS FOR CLEANOUTS AT 100' OC
7. REINFORCING BARS MAY BE CUT AS REQUIRED TO PROVIDE CLEARANCE FOR THE RAIL FASTENER ASSEMBLY.
8. ALL RESILIENT PAD DIMENSIONS ARE UNCOMPRESSED.
9. ALL MISCELLANEOUS STEEL SHALL BE GALVANIZED.

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	3/12/98			C32584	6/30/01	NAYAN P. PANDYA	ISSUED FOR SOLICITATION

DESIGNED BY R. WONG
DRAWN BY R. BAUTISTA
CHECKED BY A. LAUW
IN CHARGE N. PANDYA
DATE 3/12/98

REGISTERED PROFESSIONAL ENGINEER NAYANKUMAR P. PANDYA No. 32584 Exp. 6-30-01 CIVIL STATE OF CALIFORNIA

LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY
PASADENA BLUE LINE
ENGINEERING MANAGEMENT CONSULTANT
SUBMITTED
APPROVED

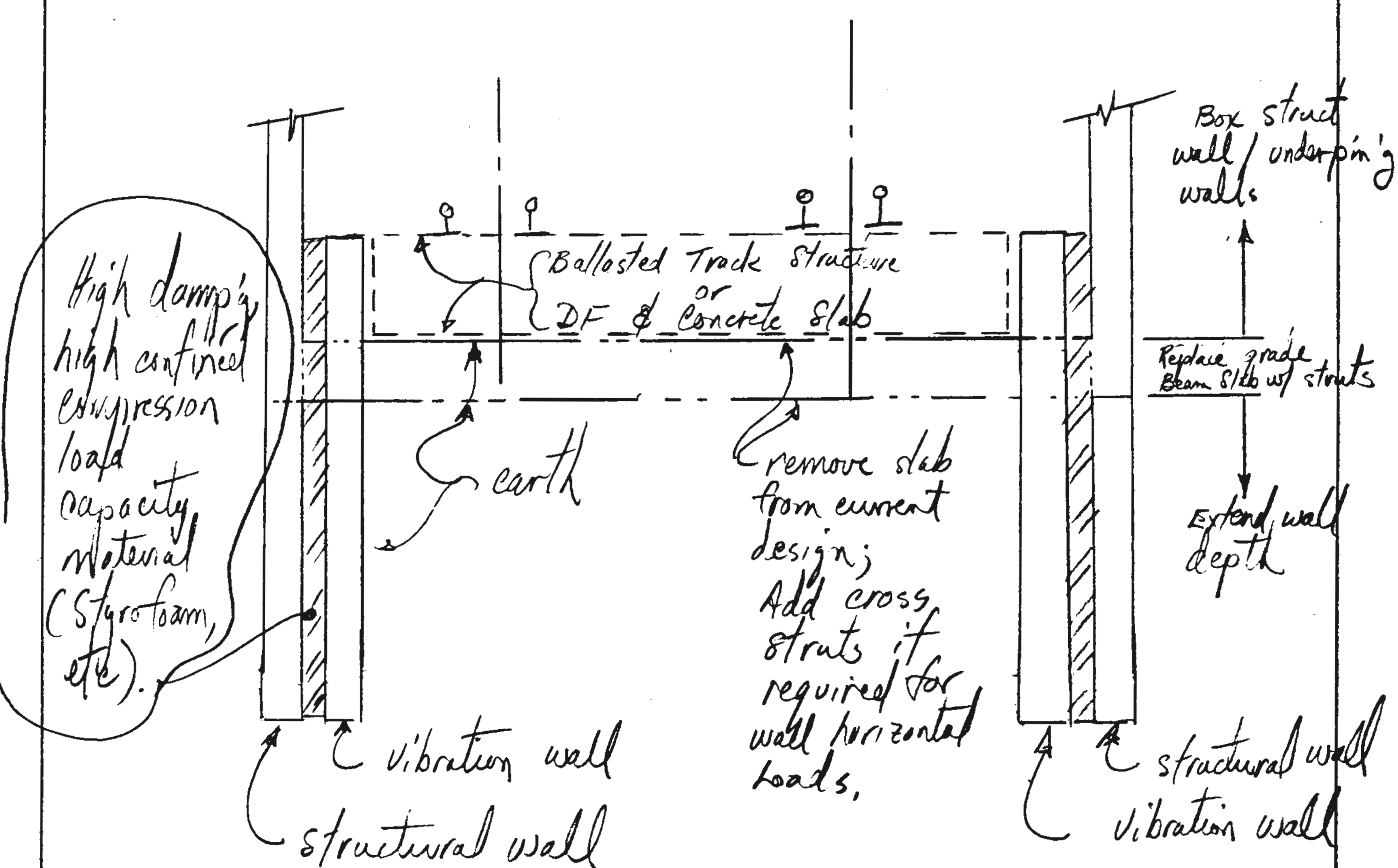
LAUPT TO PASADENA
DEL MAR TO MEMORIAL PARK LINE SEGMENT
FLOATING SLAB DETAILS
SHEET 2 OF 2

CONTRACT NO C6450
DRAWING NO S-182
REV 0
SCALE AS NOTED
SHEET NO 205

Plotted By: czcroved 07-MAY-1998 15:25

SKETCHES

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. DMMP-15
☐ AS DESIGNED	☒ ALTERNATIVE	SHEET NO. 4 of 5



COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

ALTERNATIVE NO. DMMP-5

SHEET NO. 5 of 5

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
Floating Slab – double track	LF	3770	1140	4,297,800	3099	1140	3,532,860
Sub-Total				4,297,800			3,532,860
Mark-Up at %							
TOTAL							

SUMMARY OF POTENTIAL COST SAVINGS

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	LOCATION:	LOS ANGELES TO PASADENA, CALIFORNIA			
PROJECT ELEMENT:	LINE SEGMENTS			PRESENT WORTH OF COST SAVINGS		
ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	INITIAL COST SAVINGS	O & M SAVINGS	TOTAL SAVINGS
	MEMORIAL PARK TO SIERRA MADRE (MPSM)					
MPSM-1	Use existing drainage system/facilities along I-210 Freeway section	525,107	0	525,107	—	525,107
MPSM-2	Raise station platform foundations at Lake Avenue	208,663	0	208,663	—	208,663
MPSM-4	Lower track profile from Station 625+00 to Station 690+30	466,013	0	466,013	—	466,013
	LINE SEGMENTS - GLOBAL (LSG)					
LSG-1	Simplify track drainage with side ditches or single track drain pipe as appropriate	72,725	0	72,725	—	72,725
LSG-2	Confirm existing site conditions in retaining wall areas to minimize extent and size of retaining walls	DESIGN SUGGESTION				
LSG-3	Use single pour construction for station platforms	72,725	0	72,725	—	72,725
LSG-5	Replace requirement for high strength rail in curves with R>2,000 ft.	67,000	57,500	9,500	—	9,500
LSG-6	Delete high strength rail in stations and crossovers and use standard rail	325,806	244,352	81,454	—	81,454
LSG-7	Replace U-69 rail with standard T-rail for guardrail	DESIGN SUGGESTION				
LSG-11	Stipulate high strength rail for curves with R<2,000 ft.	DESIGN SUGGESTION				

VALUE ENGINEERING ALTERNATIVE

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT **ALTERNATIVE NO.** MP-SM 1

DESCRIPTION: USE EXISTING DRAINAGE SYSTEM / FACILITIES ALONG FREEWAY SECTION **SHEET NO.** 1 of 4

ORIGINAL DESIGN: (Sketch attached)

There is a new pipe system designed along the entire trough section, Station 622+00 to Station 684+78, along the I-210 freeway.

ALTERNATIVE: (Sketch attached)

Verify that the existing drainpipe is usable by verifying the class of pipe (strength). If sufficient, use the existing system instead of the designed system.

ADVANTAGES:

- Eliminates approximately 6,200 LF of 24 in.- 39 in. diameter reinforced concrete drain pipe
- Decreases construction time

DISADVANTAGES:

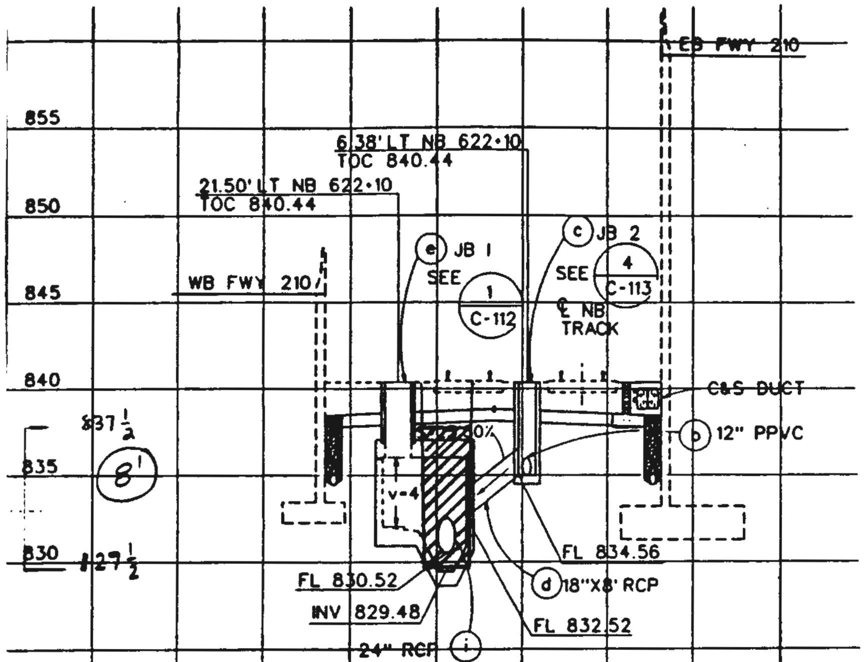
- None apparent

DISCUSSION:

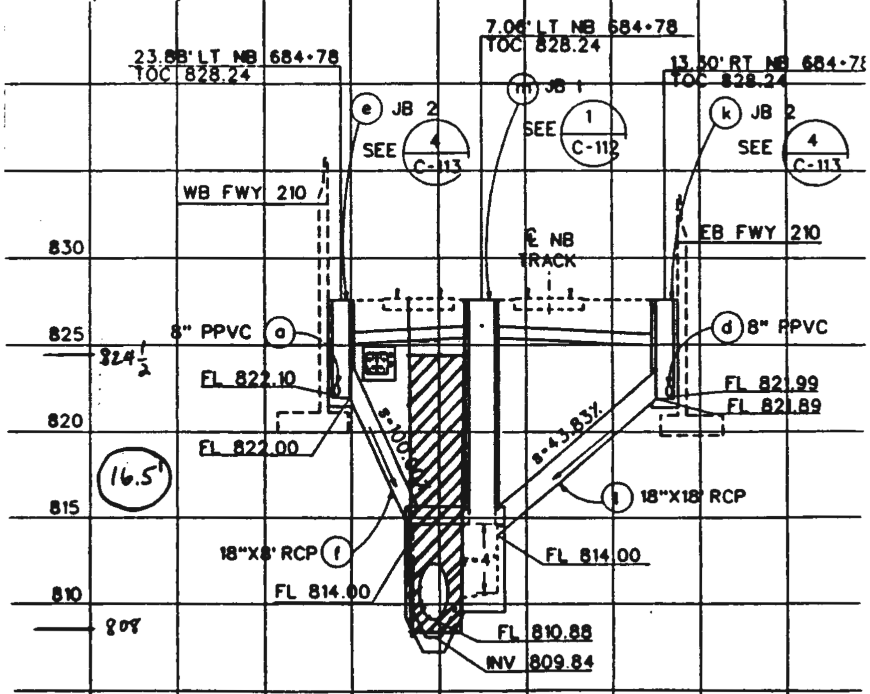
The Authority needs to verify strength and quality of existing pipe to assure suitability for usage.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 525,107	$	$ 525,107
ALTERNATIVE	$ 0	$	$ 0
SAVINGS	$ 525,107	$	$ 525,107

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT		ALTERNATIVE NO. MP-SM 1
☐ AS DESIGNED	☐ ALTERNATIVE	SHEET NO. 2 of 4



DRAINAGE SYSTEM NO 1



DRAINAGE SYSTEM NO 15

EXCAVATION: @ 622+10

6' × 8' = 48 sf.

@ 684+70

8' × 16.5' = 132 sf.

6,220 l.f

END AREA METHOD

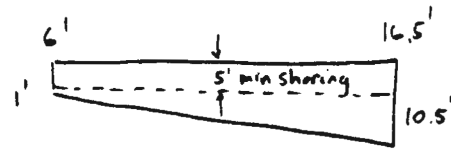
(48 + 132)/2 * 6220

= 90 × 6220 = 559,800 cf

⇒ 559,800 ÷ 27 = 20,733 1/3 cy

20,733 cy

SHORING



NEED CONSTANT SHORING
∴ USE TRENCH BOX

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

ALTERNATIVE NO. MP SM 1

SHEET NO. 3 of 4

PIPE MATERIAL & INSTALLATION COST

STATIONING OF PIPE	24"	27"	30"	33"	39"	
622+10 → 626+00	398'					
631+00	502					
636+10	506'					
641+00	484'					
646+00		494'				
651+00		494'				
656+10		504'				
661+00		484'				
664+13			308'			
670+90			674'			
673+79				284'		
677+00					316'	
682+00					498'	
684+78					274'	
	1890 LF	1976 LF	982 LF	284 LF	1088 LF	Σ 6,220 LF
MEANS PIPE + INSTALLATION	\$36/LF	\$42/LF	\$70/LF	\$77/LF	\$83.50/LF	
	\$68,040	\$82,992	\$68,740	\$21,868	\$90,848	Σ \$332,488

COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

ALTERNATIVE NO. MP-SM 1

SHEET NO. 4 of 4

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
24" RCP	LF	1890	36	68,040			
27" RCP	LF	1976	42	82,992			
30" RCP	LF	982	70	68,740			
33" RCP	LF	284	77	-21,868			
39" RCP	LF	1088	83.50	90,848			
EXCAVATION, BACKFILL	CY	20,733	$9	186,597			
SHORING	LF	6,022	$1	6,022			
Sub-Total				525,107			
Mark-Up at %							
TOTAL							

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	**ALTERNATIVE NO.**	**MPSM-2**
DESCRIPTION:	**RAISE STATION PLATFORM FOUNDATIONS AT LAKE AVENUE**	**SHEET NO.**	1 of 5

ORIGINAL DESIGN: (Sketch attached)

The station platform foundations at Lake Avenue are about 12 ft. deep to avoid adjacent parallel drainpipe.

ALTERNATIVE: (Sketch attached)

Shift drainpipe south to eliminate design constraint and make station footing shallower.

ADVANTAGES:

- Reduces excavation and depth of structural wall
- Decreases construction cost
- Reduces construction time

DISADVANTAGES:

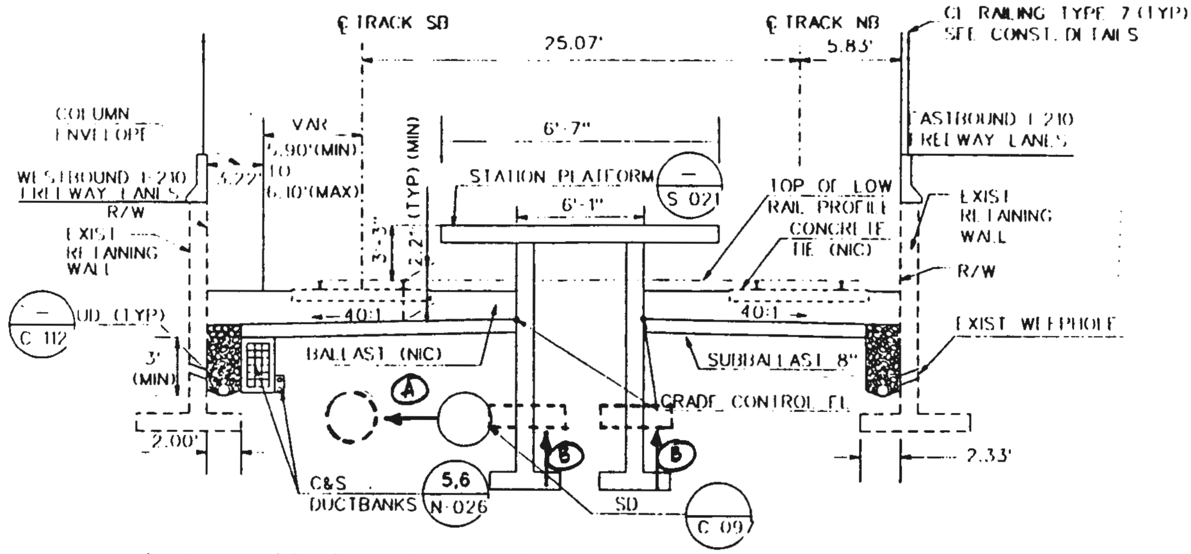
- None apparent

DISCUSSION:

The designer needs to verify structural design and check seismic factors.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 208,663	—	$ 208,663
ALTERNATIVE	$ 0	—	$ 0
SAVINGS	$ 208,663	—	$ 208,663

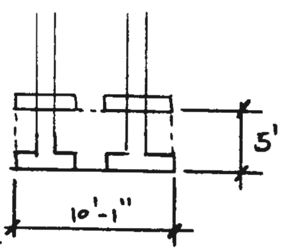
PROJECT: **PASADENA BLUE LINE LIGHT RAIL PROJECT**		ALTERNATIVE NO. MPSM-2
☑ AS DESIGNED	☑ ALTERNATIVE	SHEET NO. 2 of 5



TYPICAL SECTION 7 - LAKE AVE STATION AT OVERCROSSING COLUMNS
TRACK NB STA 665+22 TO NB STA 666+42
GRADE CONTROL EL - TOP OF RAIL 2.10'

(A) SHIFT DRAIN PIPE THROUGH STATION AREA

(B) DECREASE DEPTH OF STATION FOOTINGS



74-6"
74-6"
43-8"
192-8" = LENGTH OF SECTION B

STRUC. EXC. 5' x 10'-1" x 192'-8" = 9,713.6 cf ÷ 27 = 359.76 ≈ 360 c.y.

STRUC. CONC. 2 x 0.5' x 5' = 5 sf. of wall 5 sf. x 192.67' = 963.4 cf ÷ 27 = 36 cy

STRUC BACKFILL 360 - 36 = 324 cy

ALTERNATIVE NO. MPSM-2
Sht. 3 of 5

REV	DATE	BY	SUB	APP	DESCRIPTION

SPONSORING AGENCY

ENGINEERING MANAGEMENT CONSULTANT

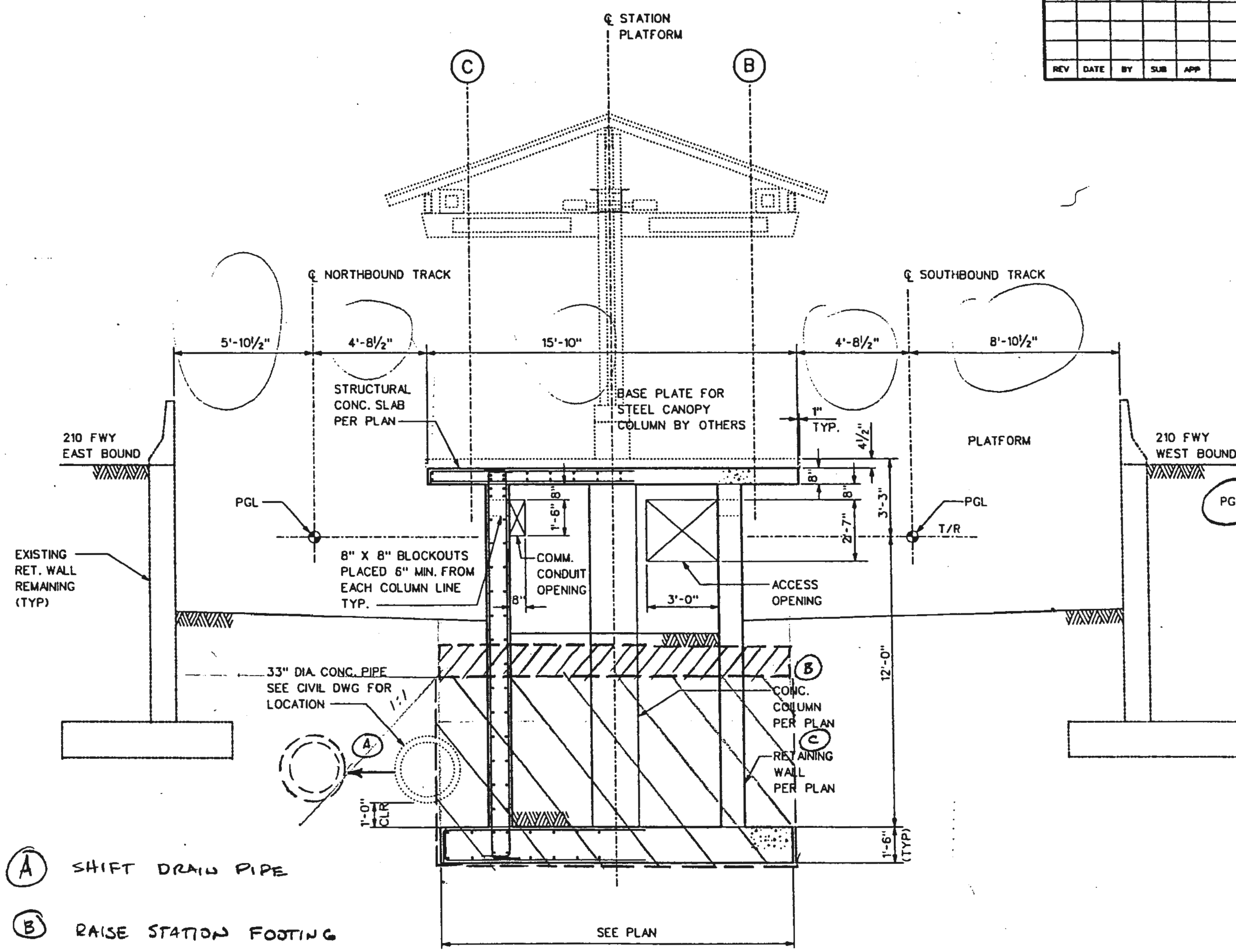
APPROVED

DIST	COUNTY
07	LA

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
JOHN R. ARIAS
No. 1963
Exp. 9/30/97
STRUCTURAL
STATE OF CALIFORNIA

McLEAN & SCHULTZ
888 SOUTH FIGUEROA SUITE 650
LOS ANGELES, CA 90017



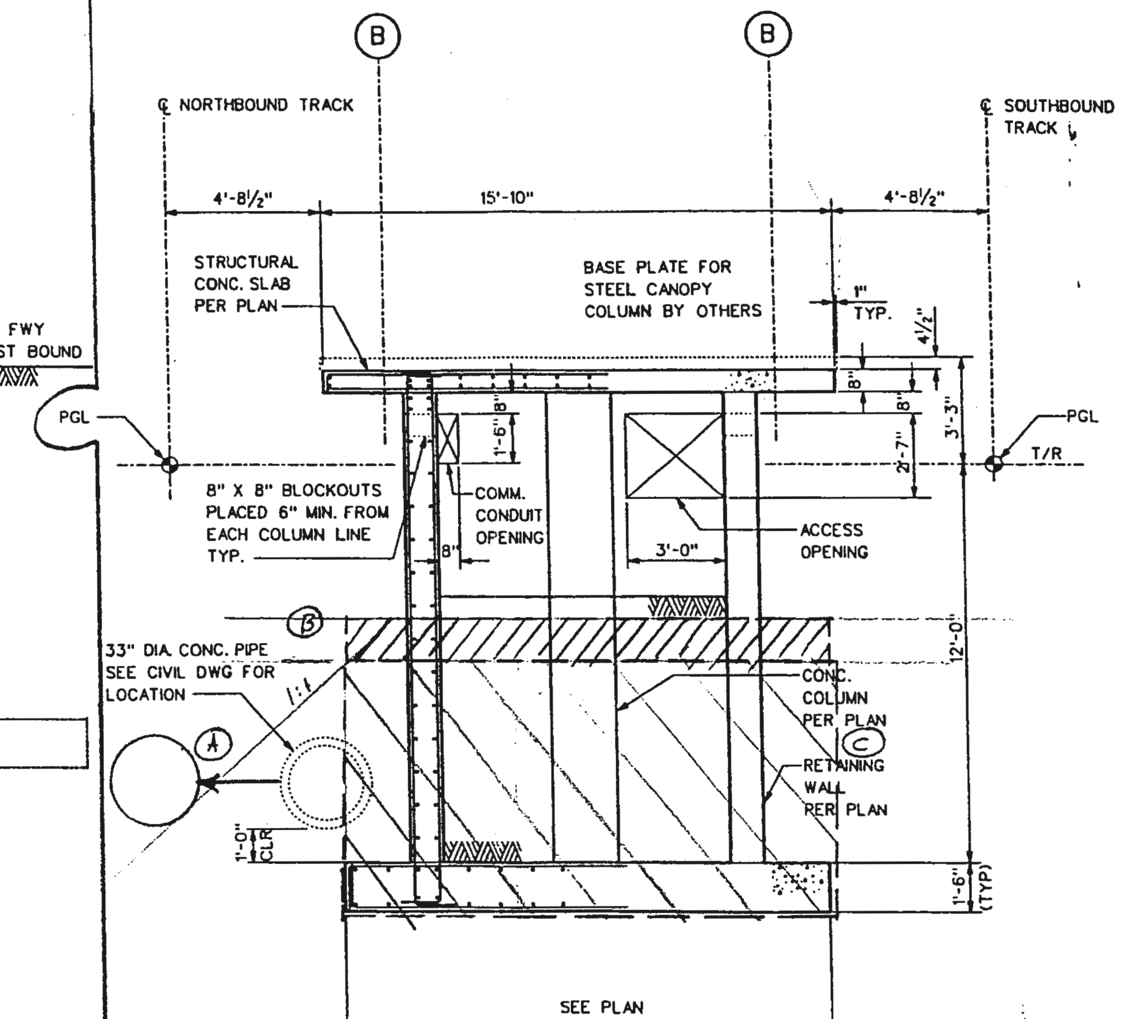
Ⓐ SHIFT DRAIN PIPE

Ⓑ RAISE STATION FOOTING

Ⓒ ELIMINATE STRUCTURAL WALL AND STRUCTURAL EXC

LOADING PLATFORM SECTION (A)

PRELIMINARY



LOADING PLATFORM SECTION (A)

110

DESIGN OVERSIGHT	DESIGN	By M.MARTINEZ	Checked	LAYOUT	By M.MARTINEZ	Checked	
DESIGN DATE	DETAILS	By M.BAZAN	Checked	SPECIFICATIONS	By		
	QUANTITIES	By	Checked				

PREPARED FOR THE
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

JOHN R. ARIAS
PROJECT ENGINEER

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU
EA

PASADENA BLUE LINE

BRIDGE NO.	LAKE AVENUE STATION
POST MILE 26.0	SECTION-TRANSVERSE NO.2

DISREGARD PRINTS BEARING EARLIER REVISION DATES

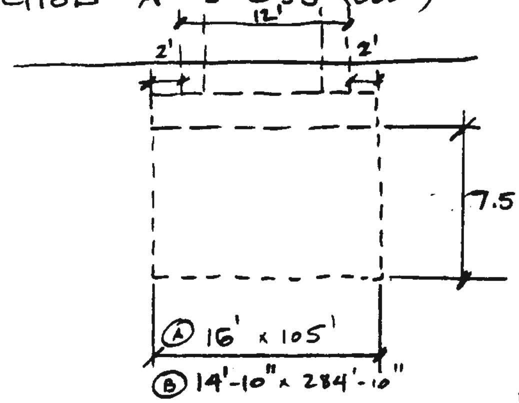
REVISION DATES (PRELIMINARY STAGE ONLY)

CONTRACT NO C6460
DRAWING NO S-035
REV
SCALE ⅜"-1'-0"
SHEET NO

SKETCHES

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. MPSM-2
	☐ AS DESIGNED ☑ ALTERNATIVE	SHEET NO. 4 of 5

SECTION A S-035 (ELEV) S024, 25, 26 (PLAN)



DELETE 12" STRUCTURAL WALL SECTION

11' x 7.5' x 2(ea.) = 15 sf

15 x 389.83' = 5,847.5 cf ÷ 27 = 216.6 cy

STRUC. EXC. 16' x 7.5' x 105 = 12,600 cf.

12,600 ÷ 27 = 466.67 cy

14.833' x 7.5' x 284.833' = 31,687 cf

31,687 ÷ 27 = 1,173.6 cy

101'-4"
157'-6"
11'-3"
14'-0"
11'-3"
90'-0"
4'-6"
389'-10"

COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

ALTERNATIVE NO. HP.SM-2

SHEET NO. 5 of 5

CONSTRUCTION ITEM		CALCULATION OF NET CHAN ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
STRUCTURAL EXCAVATION	CY	360	30	10,800			
STRUCTURAL BACKFILL	CY	324	20	6,480			
STRUCTURAL CONCRETE	CY	36	450	16,200			
				-			
STRUC EXC	CY	1,640.3	30	49,209			
STRUC BF	CY	1,423.7	20	28,474			
STRUC CONC	CY	216.6	450	97,470			
Sub-Total				208,633			
Mark-Up at %							
TOTAL							

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	MPSM-4
DESCRIPTION:	LOWER TRACK PROFILE FROM STATION 625 + 00 TO 690 + 30	SHEET NO.	1 of 5

ORIGINAL DESIGN: (Sketch attached)

The original design raises the track profile up to 2 ft. above the existing Atchison Topeka and Santa Fe (AT&SF) Railroad Track from Station 625+00 (Morengo Tunnel) to Station 690+30 (approximate location where track profile meets adjacent freeway profile). This results in burying all the retaining wall weep holes and requires a dual track/weep hole drainage system along the walls on both sides of the track.

ALTERNATIVE: (Sketch attached)

Lower track profile to approximately the location of the existing AT&SF track.

ADVANTAGES:

- Simplifies drainage system
- Reduces imported embankment requirements
- Saves cost

DISADVANTAGES:

- None apparent

DISCUSSION:

The reasons for the track profile being raised should be re-evaluated to determine their applicability. Lowering the track profile will also affect the access stairs and elevators to the Lake Avenue Station.

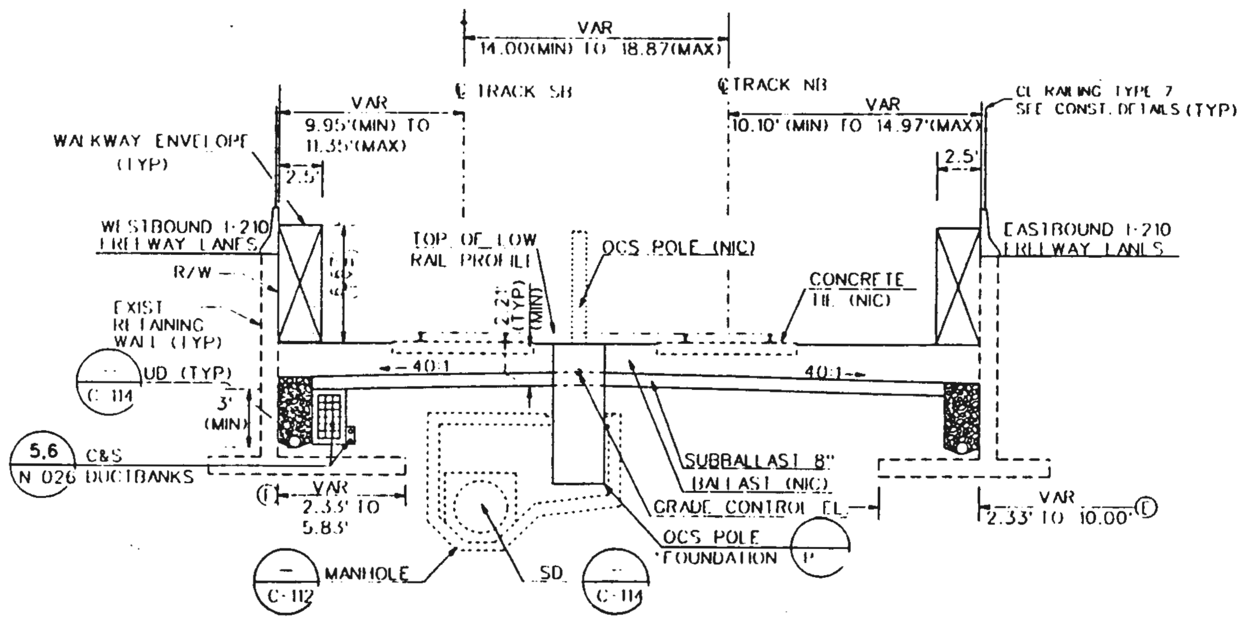
COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 466,013	—	$ 466,013
ALTERNATIVE	$ 0	—	$ 0
SAVINGS	$ 466,013	—	$ 466,013

PROJECT: **PASADENA BLUE LINE LIGHT RAIL PROJECT**

ALTERNATIVE NO. M PSM 4

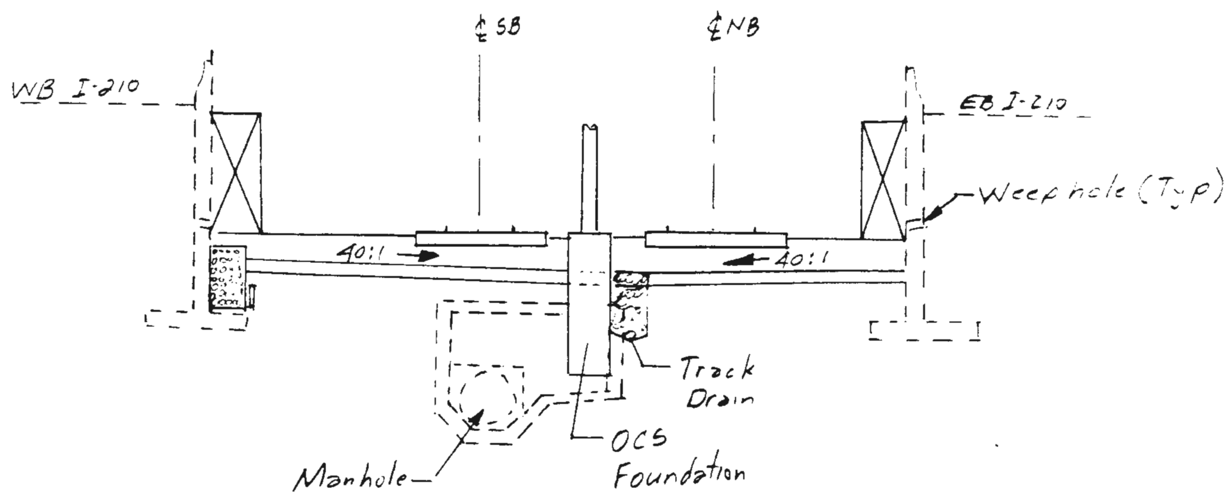
☒ AS DESIGNED ☐ ALTERNATIVE

SHEET NO. 2 of 5



TYPICAL SECTION 3 - TANGENT

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT		ALTERNATIVE NO. MDSM 4
☐ AS DESIGNED	☒ ALTERNATIVE	SHEET NO. 3 of 5



PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. MDSM 4
		SHEET NO. 4 of 5

Quantities

1) Underdrain Pipe (8" perforated PVC)

69030 - 62500 = 6,530 LF

2) Embankment (assume 2.00' average depth)

$2' \times 40' \times 6530' \div 27 \frac{CY}{CF} = 19,350\ CY$

Unit prices

Underdrain

8" PPVC — \$7.10

Permeable material

$3' \times 1.5' \times 1' \div 27 \frac{CY}{CF} = 0.1667\ CY$ @ \$24.00/CY — \$4.00

Excavation (Backhoe)

0.1667 CY × \$5.70/CY — \$1.00

\$12.10 LF

COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

ALTERNATIVE NO. MPSM 4

SHEET NO. 5 of 5

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			Reduction PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
Underdrain Pipe	LF				6,530	12.10	79,013
(Incl permeable							
material)							
Embankment	CY				19,350	20.00	387,000
Sub-Total							466,013
Mark-Up at %							
TOTAL							

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	**LSG-1**
DESCRIPTION:	**SIMPLIFY TRACK DRAINAGE WITH SIDE DITCHES OR SINGLE DRAIN PIPE, AS APPROPRIATE**	SHEET NO.	1 of 13

ORIGINAL DESIGN: (Sketch attached)

The original design generally uses a single underdrain for track drainage, with the underdrain generally located between northbound (NB) and southbound (SB) tracks. Local variations include double underdrains, no drains and side drains. The current design includes walkways at top of ballast and dirt berms within the ballast section.

ALTERNATIVE: (Sketch attached)

Use side ditches in place of underdrains. In conjunction with this, move the walkway from the top of ballast to the top of subgrade, along with other simplifications of the section that reduce capital and maintenance costs. Where applicable, crown subgrades that slope to the side ditches below and outside the toe of sub ballast.

ADVANTAGES:

- Reduces construction cost
- Reduces likelihood of drain clog (removes difficult/impossible maintenance)
- Drainage away from tracks at all locations improved maintenance access

DISADVANTAGES:

- None apparent

DISCUSSION:

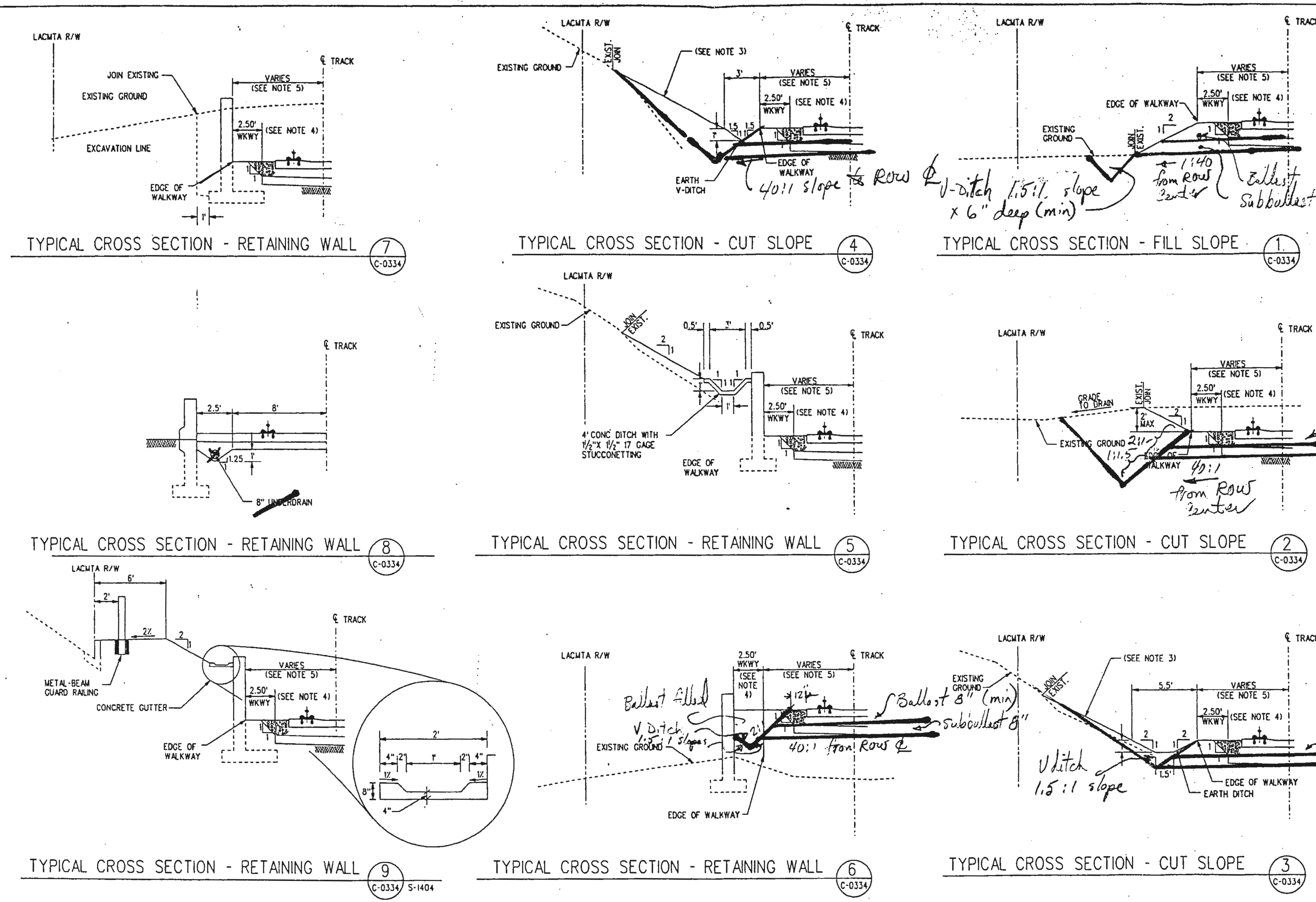
This alternative seeks to remove entirely subdrains, particularly those disturbing the century-old compacted base. It also seeks to remove walkways and berms within the ballast section to locate outside the ballast sections (to top of subgrade).

The prior railroad operated for over a century within the current right-of-way configuration that relied nearly exclusively on side ditches for drainage. The century-old subgrade offers stability from train compaction that cannot be attained by any construction means. The LRT implementation disturbs this highly compacted base by trenching through its middle, and counter-directing its crown to the track center. Such implementations set the stage for worse drainage conditions by directing flows into the track. The center drain will eventually have reduced or stopped flows. Reduced drainage is difficult to inspect with underground facilities. Back-up drains will flood the trade subgrade, created by the track becoming self-drainage in this design, rather than self-draining.

Weakened subgrades and standing water are effects. The LRT construction has a 2.5 foot walkway at top of the ballast in many configurations with a water-directing berm as part of the walkway. The walkway at top of ballast encourages foot traffic at tie ends. This foot traffic is a detriment to ballast retention. Personnel using the walkway are in hazardous positions during operations. The walkway should be moved to top of fill at toe of ballast for safety and cost reduction.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 72,725	—	$ 72,725
ALTERNATIVE	$ 0	—	$ 0
SAVINGS	$ 72,725	—	$ 72,725

ALTERNATIVE NO. LSG-1
Sht. 2 of 13



GENERAL NOTES:

1. FOR TRACK TYPICAL SECTIONS, SEE DWG NO. C-0331 & C-0332.
2. ALL END CONDITIONS ON THIS SHEET ARE SHOWN FOR SOUTHBOUND TRACK ONLY, APPLY SAME CONDITION TO NORTHBOUND TRACK WHERE NECESSARY.
3. SLOPE VARIES TO 1.5:1. SEE DWG NO. C-0402 THRU C-0416.
4. FOR GRADING WITHIN BALLASTED SECTION, SEE DWG NO. C-0331 THRU C-0333. WALKWAY LOCATED WITHIN RAILS AND ALONG OUTSIDE. FOR SPECIFIC LOCATIONS SEE DWG NO. T-0850 & T-0851.
5. FOR DIMENSIONS, SEE OFFSET TABLE ON DWG NO. C-0335. FOR OFFSET TO RETAINING WALLS, SEE DWG NO. S-1401 THRU S-1425.

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	4/15/98			C046084	12/31/98	JACQUELINE PATTERSON	ISSUED FOR SOLICITATION

DESIGNED BY J. P. MAHONEY
DRAWN BY M. A. ESPINO
CHECKED BY R. L. DEMA-ALA
IN CHARGE J. L. PATTERSON
DATE 4/15/98

REGISTERED PROFESSIONAL ENGINEER JACQUELINE L. PATTERSON No. C046084 EXP. 12/31/98 CIVIL STATE OF CALIFORNIA

LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY
PASADENA BLUE LINE

SUBMITTED Jacqueline L Patterson
APPROVED

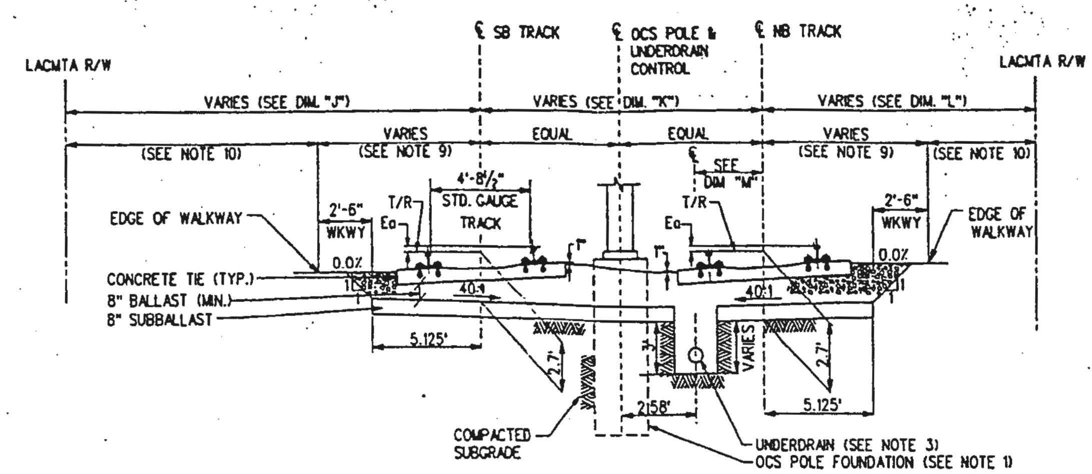
LAUPT TO PASADENA
L.A. RIVER TO ARROYO SECO LINE SEGMENT
TYPICAL SECTIONS
END CONDITIONS
SHEET 4 OF 5

CONTRACT NO C6420
DRAWING NO C-0334 REV 0
SCALE 1/4" = 1'
SHEET NO 115

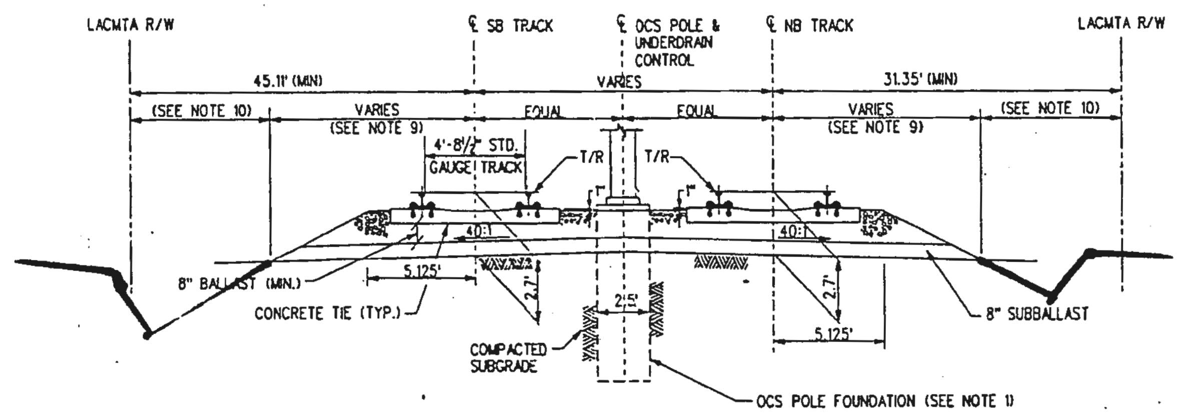
ALTERNATIVE NO.
LSG-1
Sht. 3 of 13

NOTES:

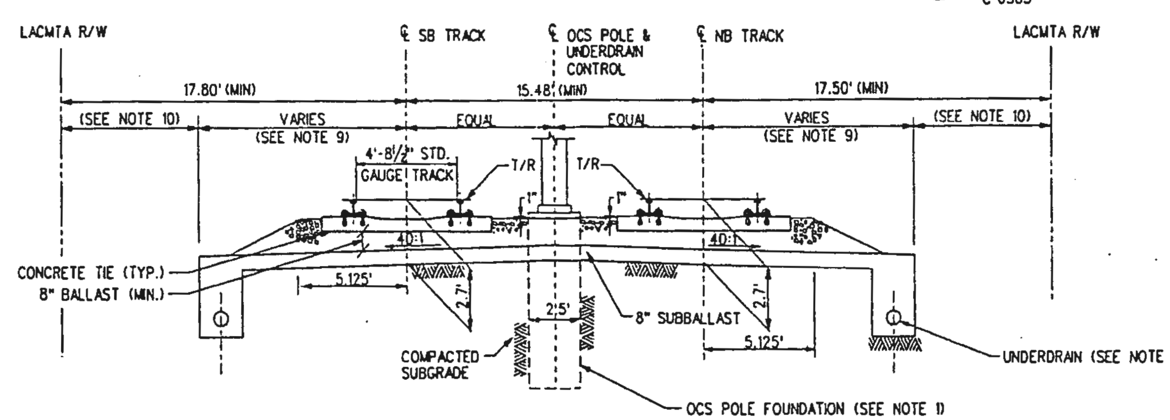
1. FOR OCS POLE FOUNDATION SCHEDULE, SEE DWG NO. OC-001 TO OC-004.
2. FOR RETAINING WALL AND SOUND WALL LOCATIONS & DETAILS, SEE DWG NO. S-1401 TO S-1425 AND S-1321 TO S-1323 RESPECTIVELY.
3. FOR UNDERDRAIN LAYOUT AND DITCH LOCATIONS, SEE DWG NO. C-0401 TO C-0416.
4. FOR COMMUNICATION AND SIGNAL DUCTBANK LOCATIONS & SECTIONS, SEE DWG NO. C-0351 THRU C-0366.
5. FOR DITCH DETAILS, SEE DWG NO. C-0371
6. ALL TIES ARE SUPPLIED BY LACMTA AND ARE 8'-3" CONCRETE UNLESS NOTED OTHERWISE.
7. FOR ACTUAL SUPERELEVATION, Ea, SEE DWG NO. C-0203 & C-0204
8. FOR TOP OF RAIL ELEVATIONS, SEE DWG NO. C-0301 TO C-0317.
9. FOR DIMENSIONS, SEE OFFSET TABLES ON DWG NO. C-0335.
10. FOR GRADING OUTSIDE BALLASTED SECTION, SEE DWG C-0334.



TYPICAL CROSS SECTION - SUPERELEVATED TRACKS (C / C-0332) C-0303 C-0309 C-0304 C-0310 C-0306 C-0311 C-0308



TYPICAL CROSS SECTION - NO UNDERDRAIN
(STA NB 238+72.05 TO STA NB 246+10) (D / C-0332) C-0304 C-0305



TYPICAL CROSS SECTION - WITH UNDERDRAIN
(STA NB 364+47 TO STA NB 365+94.96)
(STA NB 369+19.49 TO STA NB 370+75) (E / C-0332) C-0316

STA NB TRACK STATIONING FROM	STA NB TRACK STATIONING TO	DIMENSION "J" MIN. CLEARANCE TO SB SIDE R/W (FROM SB TRACK) (FT.)	DIMENSION "K" MINIMUM TRACK CENTERS (FT.)	DIMENSION "L" MIN. CLEARANCE TO NB SIDE R/W (FROM NB TRACK) (FT.)	DIMENSION "M" MIN. OFFSET OF ℄ UNDERDRAIN (FROM NB TRACK) (FT.)
224+13.73	238+72.05	16.97'	14.00	13.82'	4.75
255+15.30	264+00*	27.50'	13.45	8.13'	4.15
282+74.65*	287+53.40	12.71'	13.33	23.15'	4.09
300+91.08	311+71.08	16.98'	15.00	10.93'	4.92

*FROM STA NB 264+00 THRU STA NB 282+74.65, SEE GRADE SEPARATION DRAWINGS.

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0	4/15/98			C046084	12/31/98	JACQUELINE PATTERSON	ISSUED FOR SOLICITATION

DESIGNED BY J. P. MAHONEY
DRAWN BY M. A. ESPINO
CHECKED BY R. L. DEMA-ALA
IN CHARGE J. L. PATTERSON
DATE 4/15/98

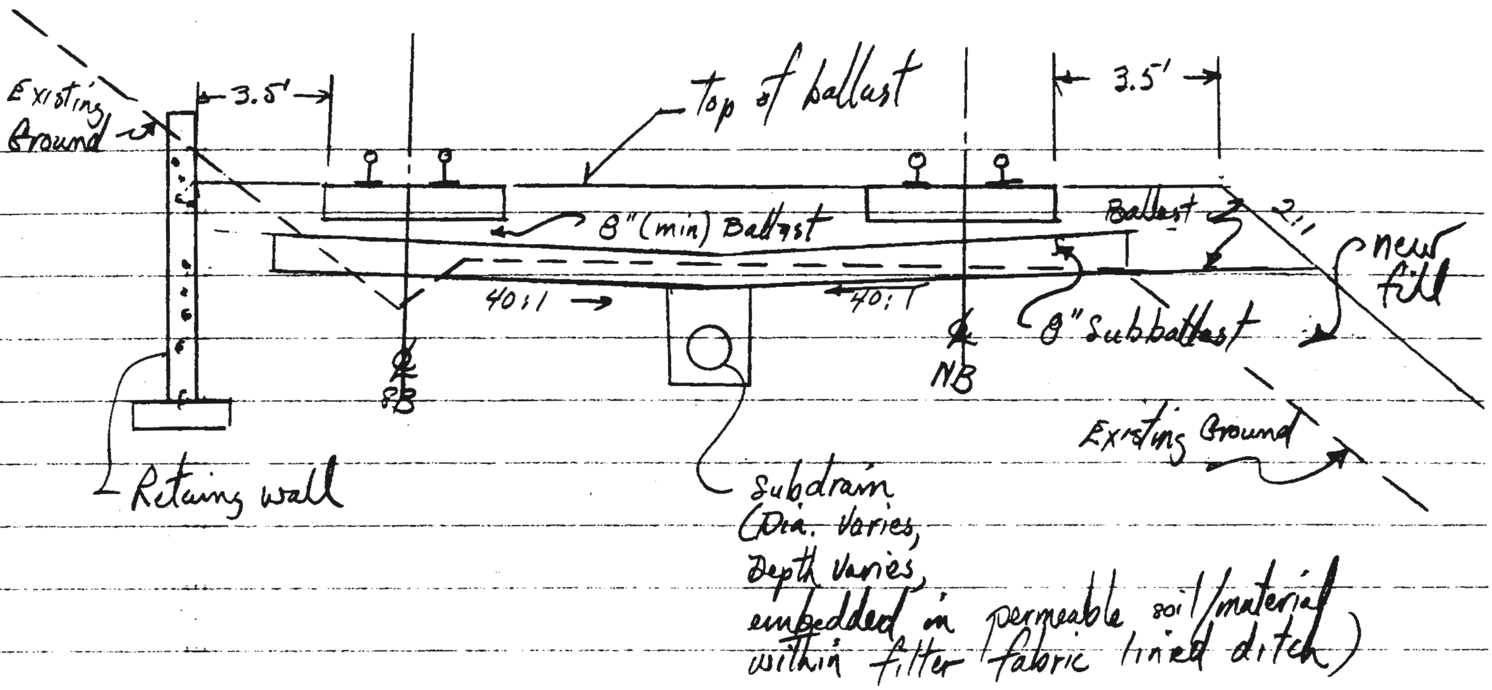
REGISTERED PROFESSIONAL ENGINEER JACQUELINE L. PATTERSON No. C046084 EXP. 12/31/98 CIVIL STATE OF CALIFORNIA

LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY
PASADENA BLUE LINE

PATTERSON & ASSOCIATES, INC. 725 TOWN & COUNTRY ROAD - SUITE 100 ORANGE, CA 92868
SUBMITTED Jacqueline L Patterson
ENGINEERING MANAGEMENT CONSULTANT
APPROVED

LAUPT TO PASADENA
L.A. RIVER TO ARROYO SECO LINE SEGMENT
TYPICAL SECTIONS
SHEET 2 OF 5

CONTRACT NO C6420
DRAWING NO C-0332
REV 0
SCALE ¼" = 1'
SHEET NO 113



Current Typical Section

Generalized section (for estimating purposes)
Ref Contract Drawings for
LA River to Arroyo Seco Line Segment
Contract C6420

Reference Drawings	Sheet Number
C-0331	112
C-0332	113
C-0333	114
C-0334	115
C-0335	116

Quantitities per foot of right of way

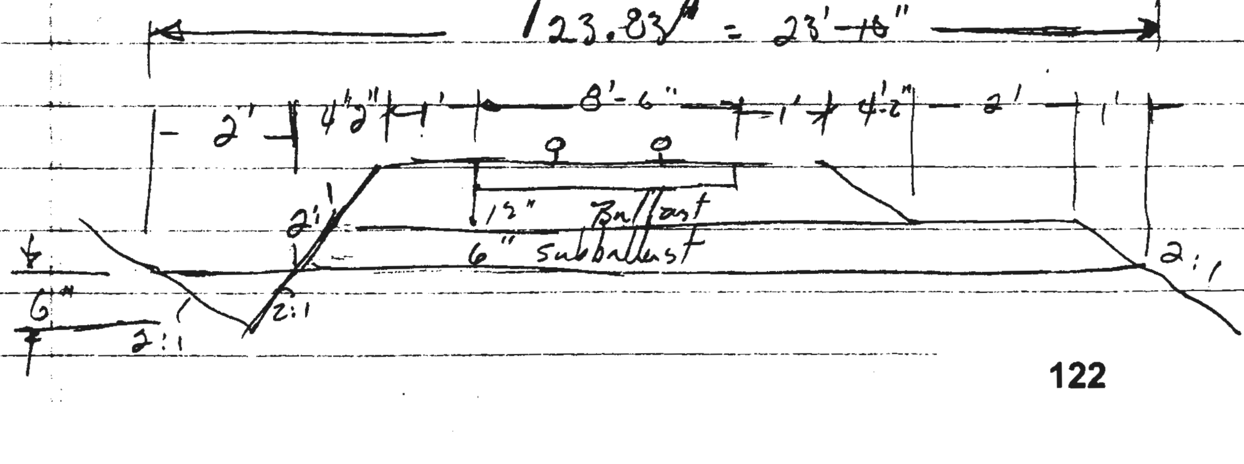
	Qty	Units	Cost/unit	Cost
Excavation	0.50	yd³	$28	$14.00
Fill	1.85	yd³	$20	$37.00
Retaining Wall	5	ft³	$25	$125.00
Subdrain Sand filler	0.15	yd³	$20 mater Labor per ft	$20.00
Pipe (assume 8 φ)	1.0	1 ft		
Ballast	1.42	yd³	$12.95	$18.39
Subballast	0.81	yd³	$12.95	$10.49

Total ROW per ft. $224.88

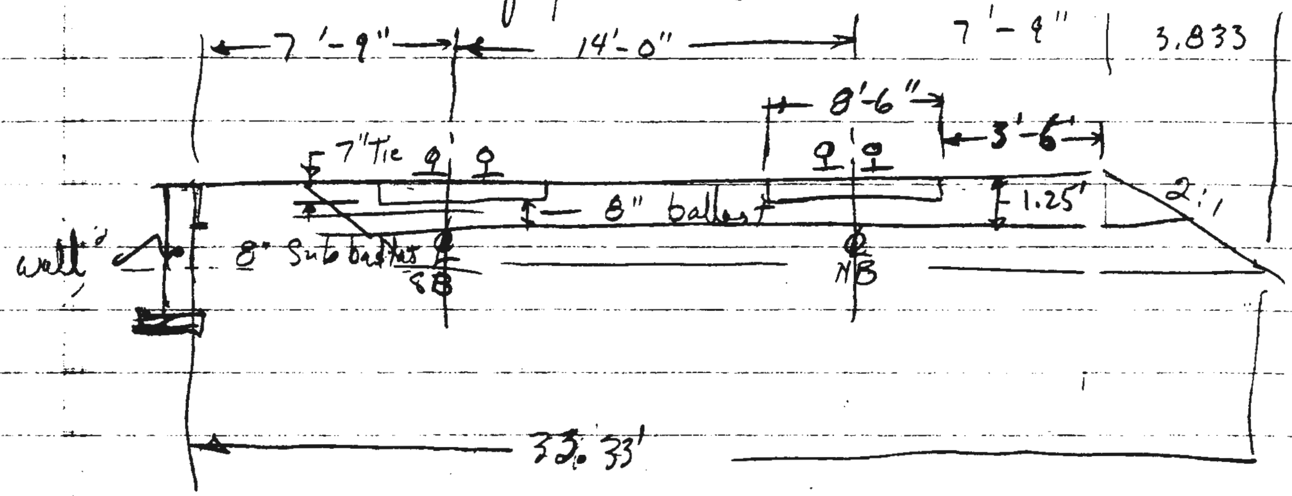
Excavation

Retaining wall 18" wide x 60" deep = 7.5 ft³
Side hill 2' wide x 45° slope (assume) = 2 ft³
Sub drain 2' deep x 2' wide (assumed) = 4 ft³
13.5 ft³ ≅ .5 yd

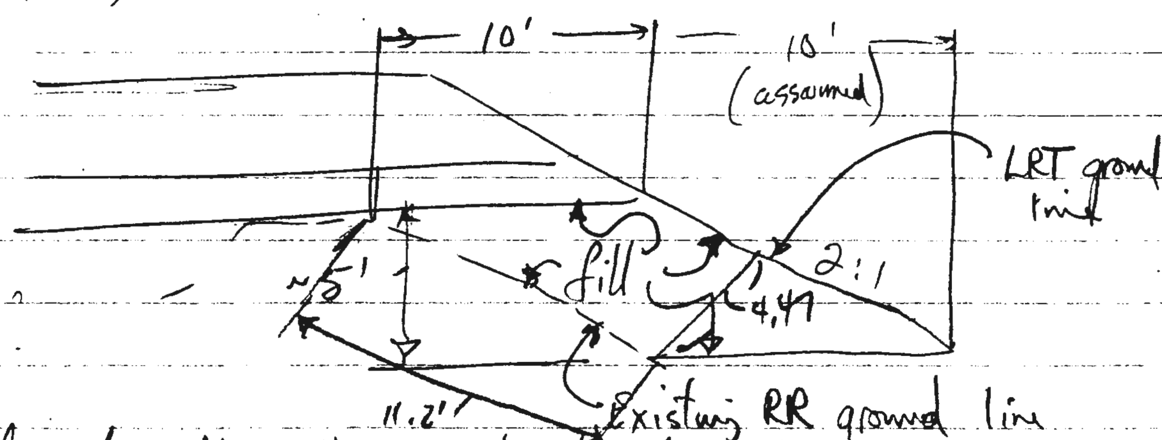
fill for current LRT X section
assume existing top of grade:



Assume LRT Top of Grade



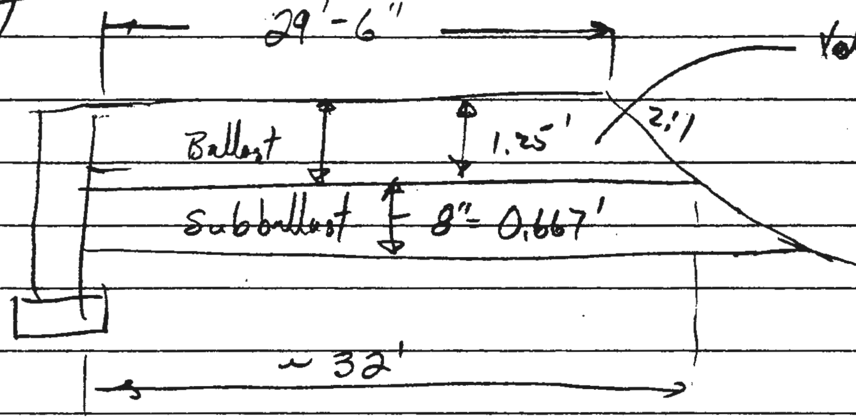
assume fill quantity is extended transit section beyond existing railroad section (33.33' - 23.83' = 9.5')



Fill volume ≅ 11.2' × 4.47' = 50 ft²
= 1,856 yd³

LRT Quantities — Current Section

Ballast



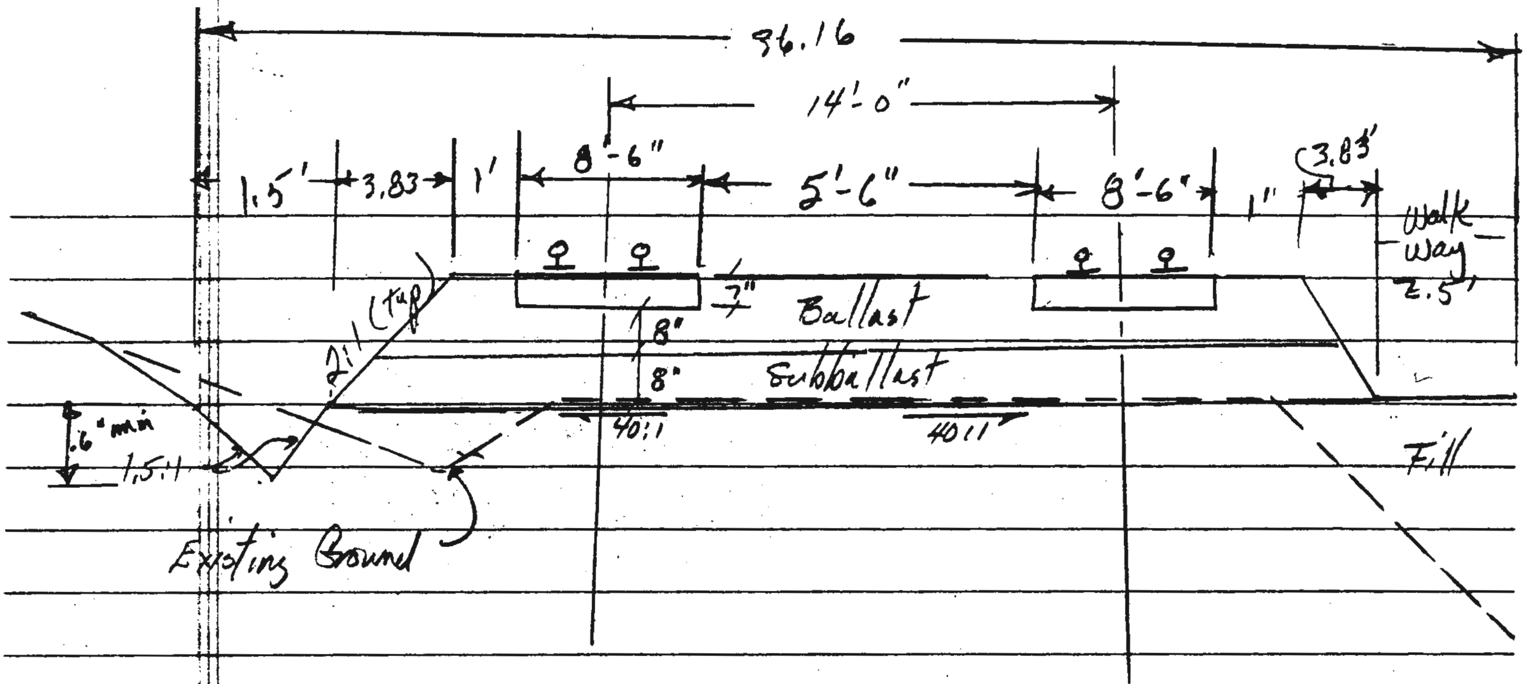
~~Volume = 38.343.75 ft~~ per route ~~ft~~

= 1.42 yd³

$$\text{Subballast} = 32' \times 8" + 8" \text{ (2:1, 16")} \quad \frac{(0.67')(1.33')}{2}$$

$$= 32'(0.67') + \frac{(0.67')(1.33')}{2}$$

$$= 21.8856 \text{ ft}^3 = 0.81 \text{ yd}^3$$



Alternative Section

General Concept:

- Side ditches (limit under drain to street crossings, overpasses where flow continuity is required)
- Move walkway from ballast section to toe of ballast (top of fill)
- Subgrade Slope away from operating tracks.

Quantities per foot of right of way

	Qty	Units	Cost/unit	Cost
Excavation	1	ft	$5	$5
Fill	2.28	yd^3	$20	$45.6
Ballast	1.25	yd^3	$12.95	$16.19
Sub ballast	0.765	yd^3	$12.95	$9.91

Total RW $76.7

Include Retaining Wall 125.00

≈ $200.00

Alternative Qty.

Excavation -

Assume Alternative Section is very similar to existing cross section (for previous railroad). Assume excavation or fill for profile elevation differences are proportional (ie savings are proportional to amount of cut or fill)

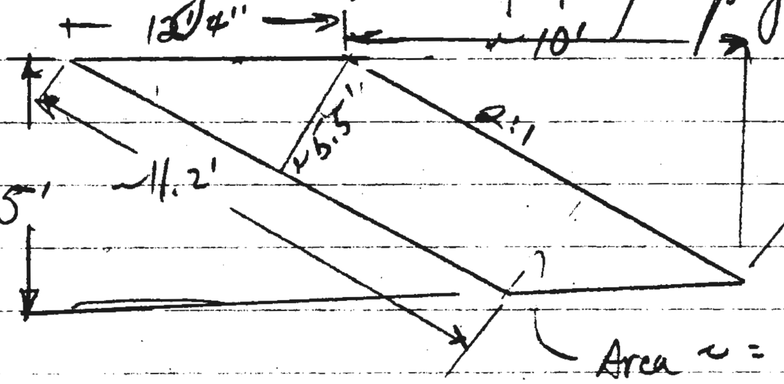
Side ditch shaping is $5 per ditch foot, generally.

Fill

Assume Subgrade for Alternative ~ 12.3 ft wider than existing ground

Assume wider subgrade is fill ~ 5' deep.

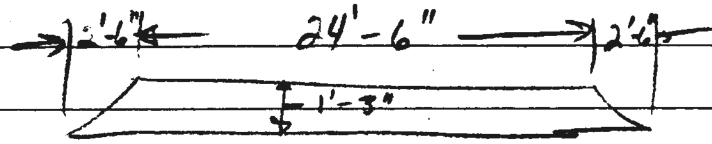
Fill volume along 1 route foot of project:



Area ~ = 5.5 x 11.2
= 61.61 ft^2
= 2.28 yd^3 per ft

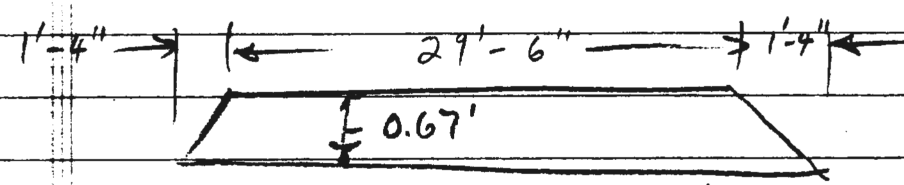
Alternative Section

Ballast quantity



Area	ft^2
24.5 x 1.25 =	
2.5 x 1.25 =	
ft^2 =	33.75
yd^3 =	1.25

Sub ballast Qty



Area	ft^2
29.5 * 0.67' =	
1.33' * 0.67' =	
ft^2 =	20.66
yd^3 =	0.765

Application Notes

Side ditches may replace single or double under drains, ballast walkways, one at least one side at

	From Station	To Station	Distance
Contract 6420	238+72	246+10	728
	384+40	387+50	310
	397+50	400+76.35	326.35
	410+50	413+50	300
			1664.35 ft

Total length package 6420
196+56 to 416+00 ⇒ 21944 ft

Length of application (% of Total Length) = 7.5%

$\frac{1664.35}{21,944} = 0.0758$

Current plan cost $\$225^{00}$ / route foot
Alternative plan cost $\$200^{00}$ / route foot
Savings 25^{00} / route foot

Applicable length 1664 route feet

Min. Available Savings = 1664' x $\$25^{00}$ for Contract 6420
= $41,600

Assume same percent applicability for package 6440
Sta 416+00 to 582+00 (16,600 feet) x 7.5% = 1245'
Svgs 6440 = 1245' x $25/ft Svgs = $31125

Total Svgs = $41,600 (Contract 6420) + $31125 (6440)
= $72725

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	LSG-2
DESCRIPTION:	CONFIRM EXISTING SITE CONDITIONS IN RETAINING WALL AREAS AND MINIMIZE THE EXTENT AND SIZE OF RETAINING WALLS	SHEET NO.	1 of 1

ORIGINAL DESIGN:

In some sections, the current retaining wall is based on old (1992) topographic mapping information. Design notes on some of the drawings indicate that wall heights must be reviewed relative to actual ground elevations.

ALTERNATIVE:

The extent of retaining walls and retaining wall heights may be decreased at a number of locations with updated site surveys and/or new topographic mapping.

ADVANTAGES:

- Reduces retaining wall heights
- Reduces extend of retaining walls

DISADVANTAGES:

- A new topographic survey is required

DISCUSSION:

It is the Design/Build Contractor's responsibility to verify existing conditions and the need for retaining walls.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS			

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	**LSG-3**
DESCRIPTION:	**USE SINGLE POUR CONSTRUCTION FOR STATION PLATFORMS**	SHEET NO.	1 of 1

ORIGINAL DESIGN:

The current design calls for a second concrete finishing pour on the surface of station platforms.

ALTERNATIVE:

Allow the contractor to construct the station platforms in one single pour as long as quality control of the finished surface can be maintained.

ADVANTAGES:

- May reduce construction cost

DISADVANTAGES:

- Finished surface may not meet quality standards

DISCUSSION:

The design/build contractor is responsible to consider and implement this approach.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 72,725	—	$ 72,725
ALTERNATIVE	$ 0	—	$ 0
SAVINGS	$ 72,725	—	$ 72,725

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	LSG-5
DESCRIPTION:	DELETE REQUIREMENTS FOR HIGH STRENGTH RAIL IN CURVES HAVING RADII GREATER THAN 2,000 FT.	SHEET NO.	1 of 1

ORIGINAL DESIGN:

The design specifies high strength rail at some locations with curve radii that are greater than 2,000 ft.

ALTERNATIVE:

Comply with design criteria that require high strength rail only for curve radii that are less than 2,000 ft.

ADVANTAGES:

- Complies with criteria
- Saves cost

DISADVANTAGES:

- None apparent

DISCUSSION:

Curves with radii 2000 ft. or greater do not incur significant side wear because the geometry is within the self-steering capacity of wheel sets with normally worn wheel profiles and better. Assume 5,000 curve feet with radii >2000 ft. and designated for high strength rail.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 67,000	—	$ 67,000
ALTERNATIVE	$ 57,500	—	$ 57,500
SAVINGS	$ 9,500	—	$ 9,500

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	LSG-6
DESCRIPTION:	REPLACE HIGH STRENGTH RAIL IN STATIONS AND CROSSOVERS WITH STANDARD RAIL	SHEET NO.	1 of 1

ORIGINAL DESIGN:

The design stipulates high strength rail in stations per critieria. It also stipulates high strength over the limits of crossovers, not a criteria requirement, and in embedded track along Marmion Way.

ALTERNATIVE:

Use standard high tolerance carbon rail in these locations.

ADVANTAGES:

- Saves cost
- Performance in tangent equal to high strength rail (low exposure to side wear)

DISADVANTAGES:

- None apparent

DISCUSSION:

10,624 feet of track is designated for high strength rail that is used for stations, around turnouts, and in embedded track.

#115 High Strength Rail @ $800/ton = $15.33/rail ft. = $30.667/tk ft. = $325,806
#115 Standard Strength Rail @ $600/ton = $11.50/rail ft. = $23/tk ft. = $244,352

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 325,806	—	$ 325,806
ALTERNATIVE	$ 244,352	—	$ 244,352
SAVINGS	$ 81,454	—	$ 81,454

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	LSG-7
DESCRIPTION:	REPLACE U-69 RAIL WITH STANDARD T-RAIL FOR GUARDRAIL	SHEET NO.	1 of 2

ORIGINAL DESIGN: (Sketch attached)

The design requires U-69 rail for guardrail.

ALTERNATIVE:

Use T-rail.

ADVANTAGES:

- Reduces cost
- Greater lateral load capacity (increases safety margin)
- Eases maintenance and replacement

DISADVANTAGES:

- None apparent.

DISCUSSION:

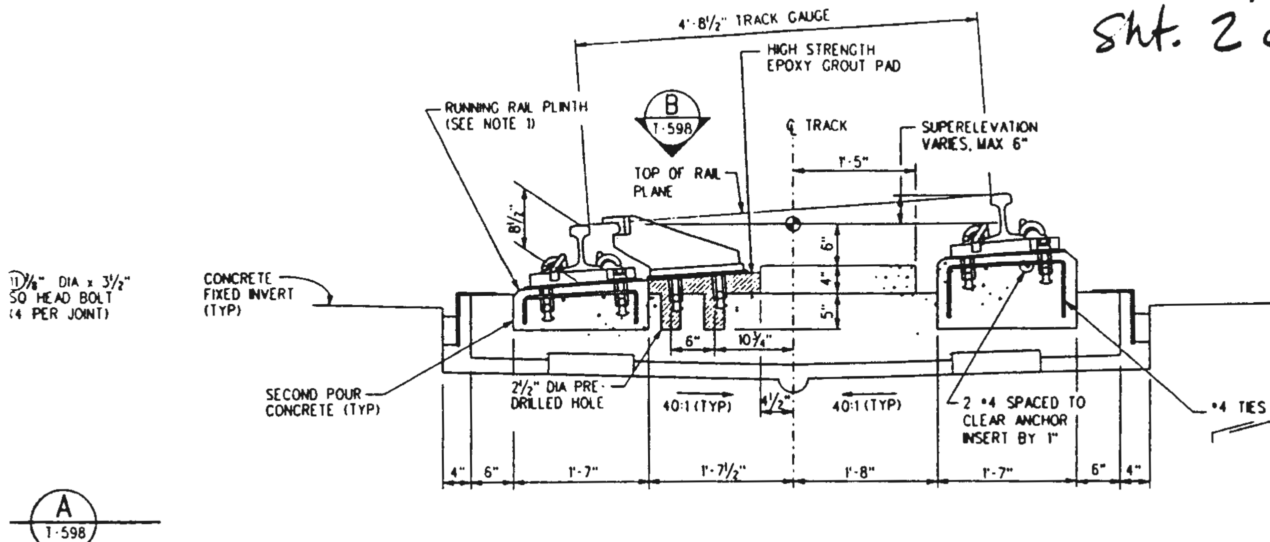
U-69 rail guardrail with brackets costs $20 per track foot.
T-rail with provisions as guardrail costs $12 per track foot.

The U-69 rail guardrail is not necessary in this application.

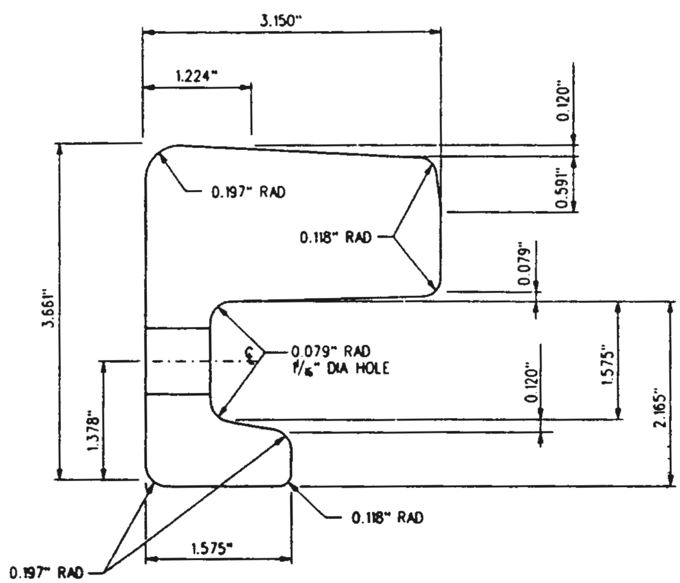
COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS			

ALTERNATIVE NO.

LSG-7
Sht. 2 of 2



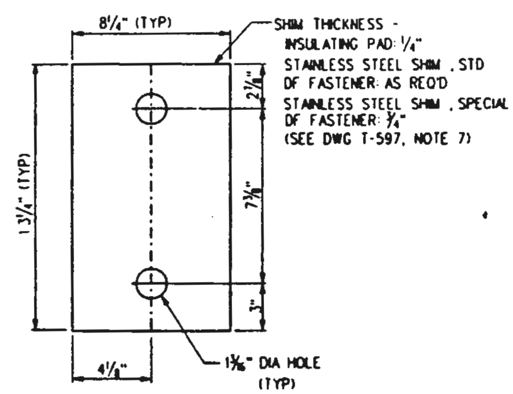
DF TRACK-PFS-RESTRAINING RAIL (ONE RAIL)



U-69 RAIL
UNIT WEIGHT: 61.1 lb/yd

136

597



INSULATING PAD AND STEEL BASEPLATESHIM DETAIL

NOTES:
THE RUNNING RAIL PLINTH SHALL BE POURED FIRST BEFORE PLACEMENT OF RESTRAINING RAIL FASTENER PAD.

AS DESIGNED

GELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY PASADENA BLUE LINE NEERING MANAGEMENT CONSULTANT SUBMITTED *Joseph R. V...* APPROVED	LAUPT TO PASADENA DEL MAR TO MEMORIAL PARK LINE SEGMENT RESTRAINING RAIL DETAILS SHEET 2 OF 2	CONTRACT NO C6450 DRAWING NO T-598 REV 0 SCALE NO SCALE SHEET NO 079

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	**LSG-11**
DESCRIPTION:	**STIPULATE HIGH STRENGTH RAIL FOR CURVES WITH RADII LESS THAN 2,000 FT.**	SHEET NO.	1 of 1

ORIGINAL DESIGN:

Some curves have not received a design designation for high strength rail (non-compliance with design criteria).

ALTERNATIVE:

Comply with design criteria and require high strength rail in specified curves.

ADVANTAGES:

- Reduces maintenance

DISADVANTAGES:

- None apparent

DISCUSSION:

Curve Nos. (partial list) 1410, 1420, 1430, 1270, 2410, 2420, 2430, 2270, 1412, 1427, 1431, 2412, 2422 and 2431 are affected.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	**DESIGN SUGGESTION**		
SAVINGS			

SUMMARY OF POTENTIAL COST SAVINGS

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT		LOCATION: LOS ANGELES TO PASADENA, CALIFORNIA				
PROJECT ELEMENT: STATIONS		PRESENT WORTH OF COST SAVINGS				
ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	INITIAL COST SAVINGS	O & M SAVINGS	TOTAL SAVINGS
	GLOBAL (G)					
G-1	Replace the skylights with standard roofing at each canopy	1,688,400	1,541,400	147,000	—	147,000
G-3	Raise canopy eave height from 9 ft. 3 in. to 10 ft. to reduce vandalism	DESIGN SUGGESTION				
G-8	Use constant section umbrella arms at the station canopies	257,000	160,000	97,000	—	97,000
G-11	Evaluate quantity of platform luminaries required and reduce current number if possible	DESIGN SUGGESTION				
G-12	Use fewer MTA standard lighting fixtures on platforms	136,080	94,080	42,000	67,897	109,897
G-14A	Upgrade the platform prewarning strip to aluminum in lieu of paint	12,040	49,000	(36,960)	55,217	18,257
G-14B	Upgrade the platform prewarning strip to colored concrete in lieu of paint	12,040	32,340	(20,300)	55,217	34,919
G-17	Limit the art at the stations to applied art versus integral art	DESIGN SUGGESTION				
G-20	Standardize station platform benches at standard stations	DESIGN SUGGESTION				
G-25	Coordinate station signage with general illumination	DESIGN SUGGESTION				
G-26	Construct station communication vaults and associated utility rough-ins	DESIGN SUGGESTION				
G-27	Tie "Calgary" gates at station platforms to system controls	DESIGN SUGGESTION				
G-28	Reduce minimum landscaping requirements	DESIGN SUGGESTION				

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	**G-1**
DESCRIPTION:	**REPLACE THE SKYLIGHTS WITH STANDARD ROOFING AT EACH CANOPY**	SHEET NO.	1 of 3

ORIGINAL DESIGN:

The original design at each canopy specifies 100 square feet of laminated glass skylight.

ALTERNATIVE: (Sketch attached)

Replace the skylight with standard roofing.

ADVANTAGES:

- Reduces first cost
- Reduces vandalism

DISADVANTAGES:

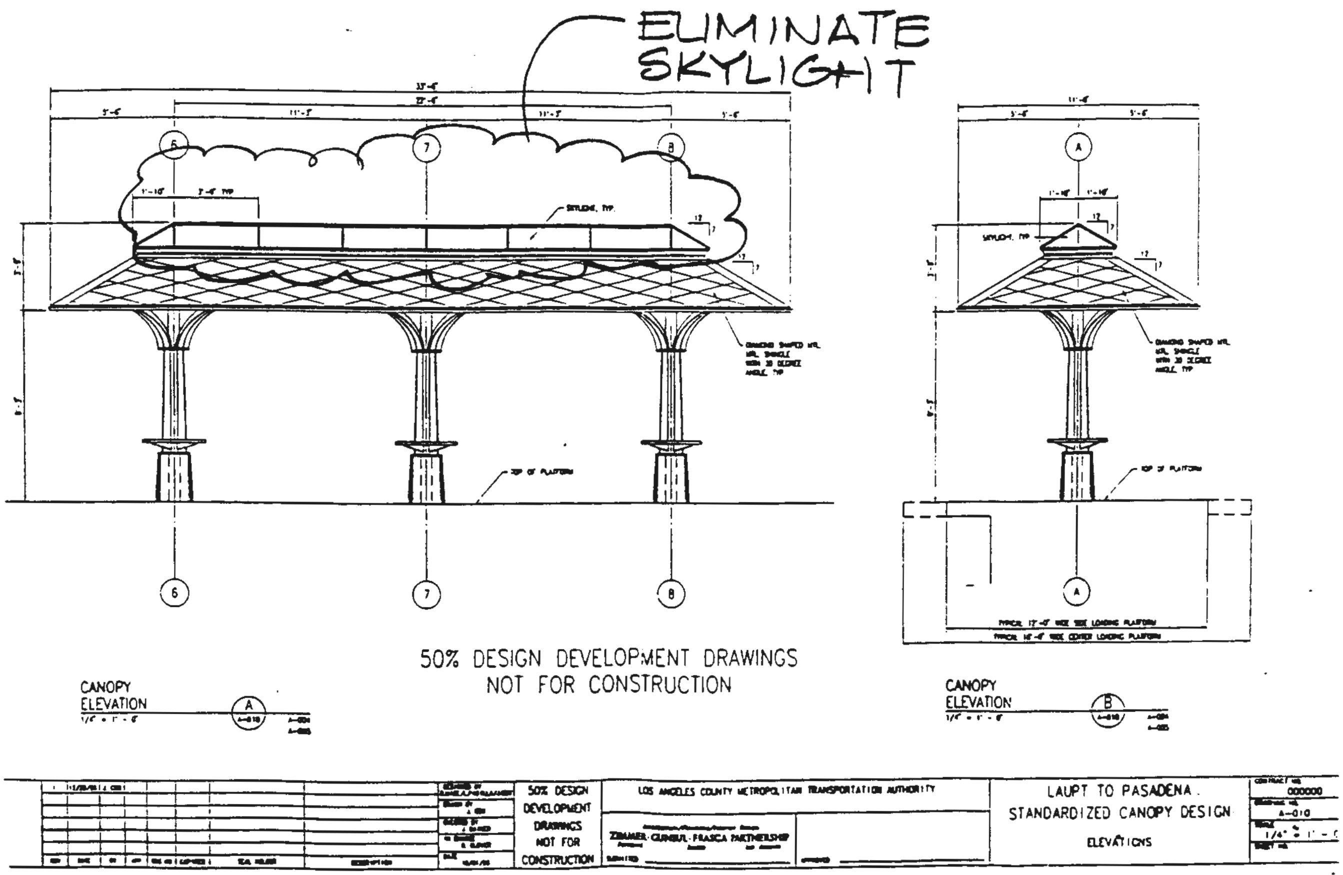
- Reduces aesthetics
- Reduces public appeal

DISCUSSION:

The canopies are being erected to shade patrons from the sun. Installing a skylight defeats the purpose and adds cost.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 1,688,400	—	$ 1,688,400
ALTERNATIVE	$ 1,541,400	—	$ 1,541,400
SAVINGS	$ 147,000	—	$ 147,000

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	**ALTERNATIVE NO.** G-1
	☐ **AS DESIGNED** ☒ **ALTERNATIVE**	**SHEET NO.** 2 of 3



COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. G-1
ELIMINATE SKYLIGHT @ CANOPY	SHEET NO. 3 of 3

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
STRUCTURAL COLUMNS	EA	42	20,000	840,000	42	20,000	840,000
LAMINATED GLASS W/	EA	42	18500	777,000			
METAL SHINGLES				-			
STAINLESS STEEL LEAN BAR	EA	42	1,700	71,400	42	1,700	71,400
METAL STANDING SEAM ROOF	EA				42	15,000	630,000
Sub-Total							
Mark-Up at %							
TOTAL				1,688,400			1,541,400

Δ 147,000

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	**G-3**
DESCRIPTION:	**RAISE CANOPY EAVE HEIGHT FROM 9 FT. 3 IN. TO 10 FT. TO REDUCE VANDALISM**	SHEET NO.	1 of 1

ORIGINAL DESIGN:

The standard canopy design has an eave height of 9 ft. 3 in. above the platform level.

ALTERNATIVE:

Raise the eave height to 10 ft. above the platform level.

ADVANTAGES:

- Reduces risk of vandalism by keeping people off structure
- Virtually no cost difference

DISADVANTAGES:

- Slightly reduces weather protection
- Requires minor canopy design modifications

DISCUSSION:

Raising the canopy an additional 9 in. greatly reduces the risk of vandalism to the canopy structure by keeping all but the few great jumpers out of leaping range. Similar studies at schools show that the percentage of students who can jump 10 in. is small compared to those who can reach 9 in.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	**DESIGN SUGGESTION**		
SAVINGS			

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	**G-8**
DESCRIPTION:	**USE CONSTANT SECTION UMBRELLA AT THE STATION CANOPIES**	SHEET NO.	1 of 4

ORIGINAL DESIGN: (Sketch attached)

The canopy column is constructed of steel members that change in size. The canopy plans call for a variable section of a ¾ in. plate (4 in. - 6 in. linear change) on the lower part of the base and double 4 in. × 3 in. × ½ in. angle curved section at the top part of the column.

ALTERNATIVE: (Sketch attached)

Use a constant section from the base to top. It is suggested that a 4 in. × 2 in. × ¼ in. tube be welded to the central pipe column. Four of these 4 in. × 2 in. steel tube sections will form the umbrella arms of the column.

ADVANTAGES:

- Saves cost
- Simplifies fabrication
- Reduces maintenance

DISADVANTAGES:

- Changes the look slightly

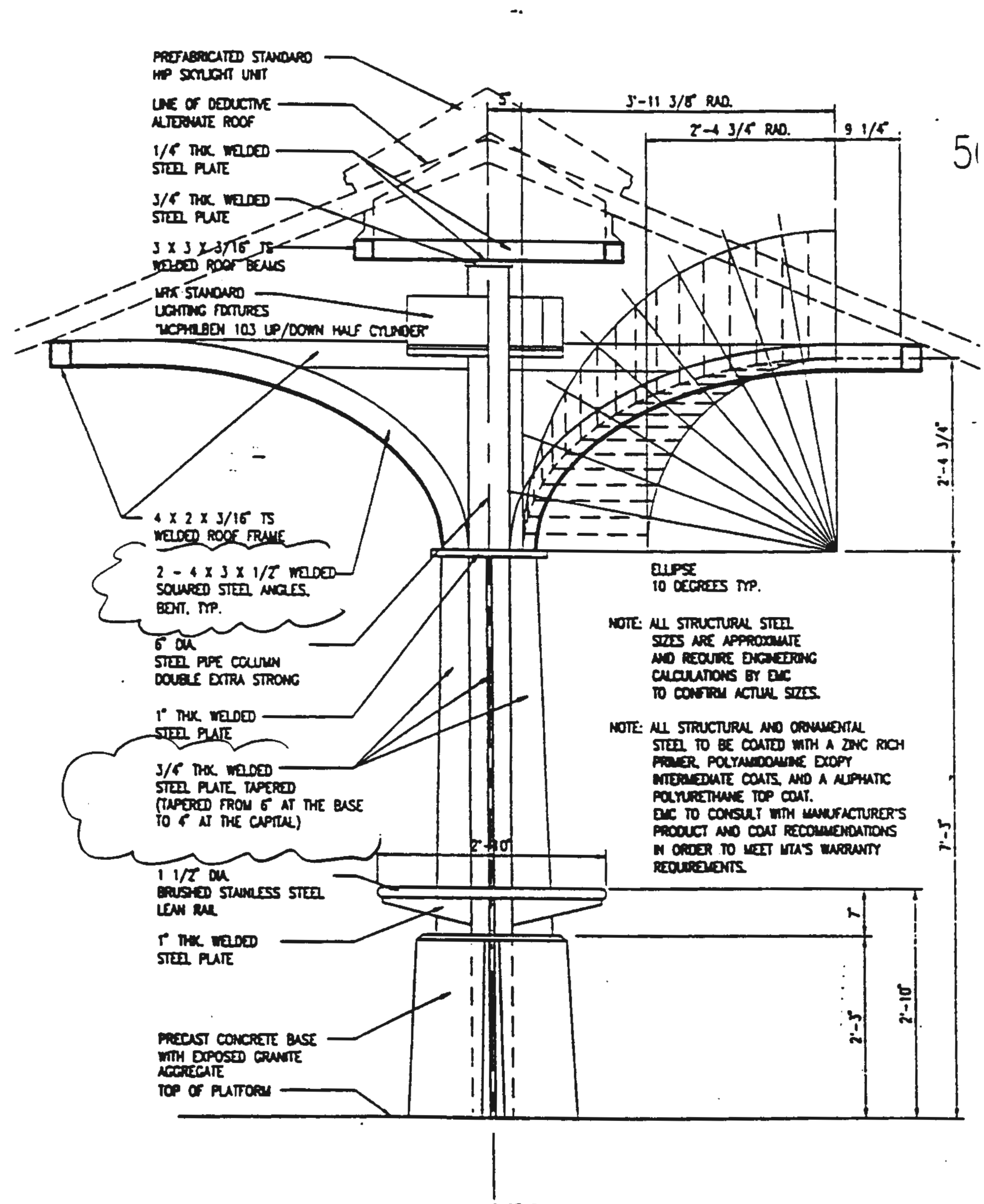
DISCUSSION:

Simplifying the construction of the canopy will reduce required maintenance while maintaining the gracious aesthetics.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 257,000	—	$ 257,000
ALTERNATIVE	$ 160,000	—	$ 160,000
SAVINGS	$ 97,000	—	$ 97,000

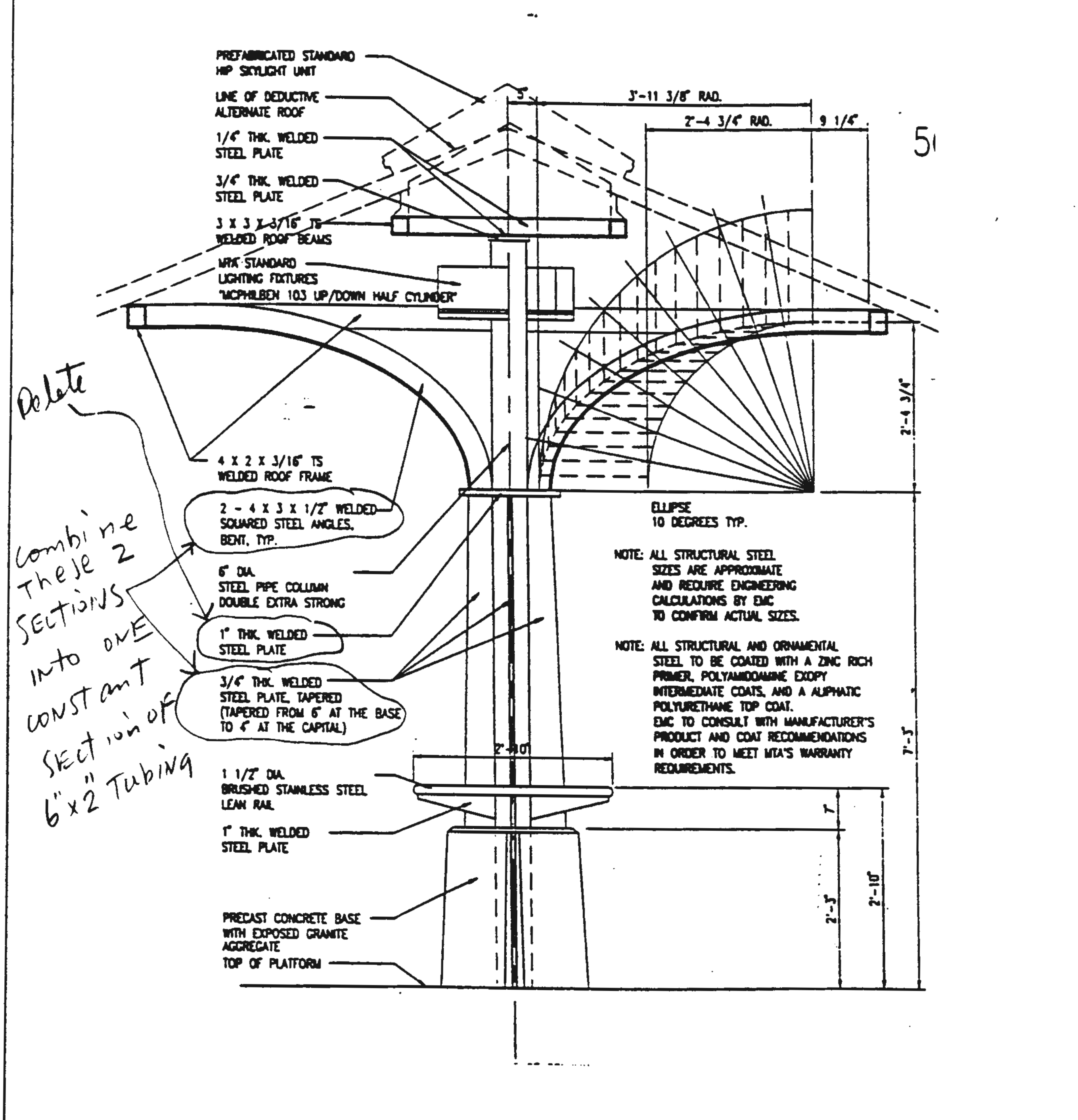
PROJECT: **PASADENA BLUE LINE LIGHT RAIL PROJECT** ALTERNATIVE NO. G-8

☒ AS DESIGNED ☐ ALTERNATIVE SHEET NO. 2 of 4



SKETCHES

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	G-8
	☐ AS DESIGNED ☒ ALTERNATIVE	SHEET NO.	3 of 4



COST WORKSHEET

PROJECT: **PASADENA BLUE LINE LIGHT RAIL PROJECT**

ALTERNATIVE NO. G-8

SHEET NO. 4 of 4

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
3/4" VARIABLE Depth (6" to 4") PLATE	piece	504	360	$ 180,000			
(2) 4x3x1/2" ∠ Bent to curve	piece	504	140	$ 72,000			
1" Thk. WELDED PLATE	piece	126	40	5,000			
4x2x1/4" Tubing	piece	504	320				160,000
Sub-Total				257,000			160,000
Mark-Up at %							
TOTAL							

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	G-11
DESCRIPTION:	EVALUATE QUANTITY OF PLATFORM LUMINARIES REQUIRED AND REDUCE CURRENT NUMBER , IF POSSIBLE	SHEET NO.	1 of 1

ORIGINAL DESIGN:

Station platforms at illuminated by a pair of metal-halide down lights mounted 180° apart on 12 ft. tall standards located 22 ft. 6 in. on center. Documentation of lighting distribution chosen (Type I - Type V) is unavailable for review.

ALTERNATIVE:

Calculate the use of different luminaire distribution types to determine if fewer luminaries will maintain the MTA standard level of illuminance, maximum-to-minimum ratio, and average-to-minimum ratio.

ADVANTAGES:

- May reduce cost

DISADVANTAGES:

- A study is required

DISCUSSION:

The MTA system-wide Criteria Table 7-20 defines standard illumination requirements. A variation in luminaire distribution types may result in wider spacing possibilities. This, in turn, impacts pole placement in the open platform areas between canopies. It may be possible to reduce the number of fixtures while still maintaining the required MTA lighting levels.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS			

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	**ALTERNATIVE NO.**	**G-12**
DESCRIPTION:	**USE FEWER MTA STANDARD LIGHT FIXTURES ON PLATFORMS**	**SHEET NO.**	1 of 4

ORIGINAL DESIGN:

The standard canopy design indicates up/down half-cylinder lighting fixtures, McPhilben No. 103 Series, tow at each canopy column. The remainder of platform gets standard cylinder shaped fixtures.

ALTERNATIVE: (Sketch attached)

Use Standard MTA Fixture Type DD, as recommended on Electrical Standard Sheet No. ES-061, at all 42 canopies. Use Standard Type A fixture for remainder of the platform, as before.

ADVANTAGES:

- More than one manufacturer produces cylinder-shaped unit
- One supplier, standard components, per station
- Reduces per unit cost based on larger quantity

DISADVANTAGES:

- None apparent

DISCUSSION:

A review of the various stations indicates different lighting fixtures were chosen to perform the same function at different stations. Standardizing the canopy structure provides an opportunity to also standardize the look throughout each entire station and save costs.

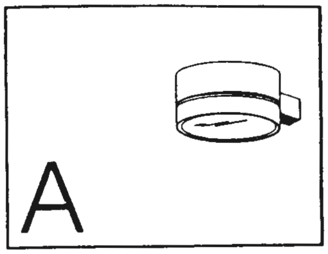
COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 136,080	$ 67,897	$ 203,977
ALTERNATIVE	$ 94,080	$ 0	$ 94,080
SAVINGS	$ 42,000	$ 67,897	$ 109,897

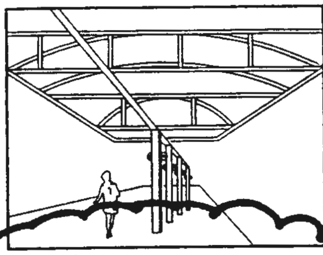
PROJECT: **PASADENA BLUE LINE LIGHT RAIL PROJECT**

ALTERNATIVE NO. G12

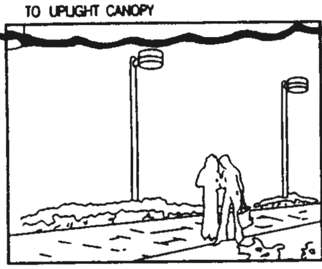
☐ AS DESIGNED ☒ ALTERNATIVE

SHEET NO. 2 of 4

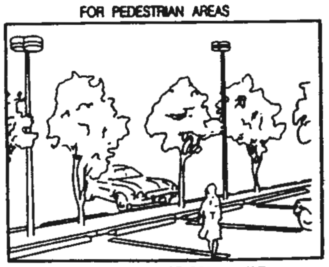




GLOWTOP (TYPE DD), ALSO RECOMMENDED TO UPLIGHT CANOPY

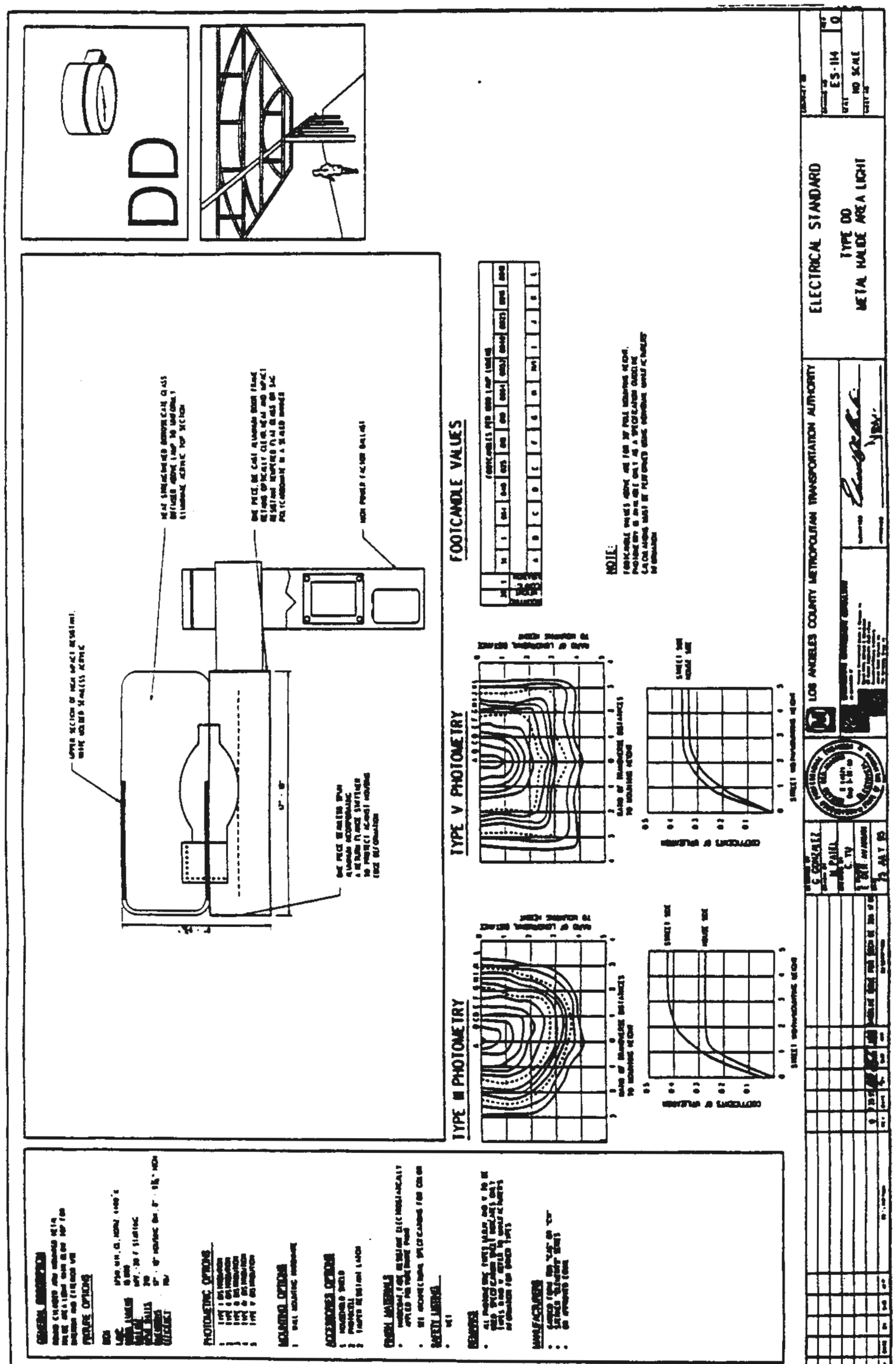


METAL HALIDE (A1 OR A2) FOR PEDESTRIAN AREAS



HIGH PRESSURE SODIUM (A3) FOR VEHICULAR AREAS ONLY

ELECTRICAL STANDARD TYPE A HIGH INTENSITY DISCHARGE AREA LIGHT	CONTRACT NO DRAWING NO ES-061 REV 1 SCALE NO SCALE SHEET NO



COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. G12
	SHEET NO. 3 of 4

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
McPHILBEN 103 - HALF CYL.							
DIRECT / INDIRECT	EA	252	540	136,080			
(6/CANOPY) x 42 LOC'NS				-			
GARDCO FORM 10 CW							
GLOW TOP	EA				168	560	94 080
(4/CANOPY) x 42 LOC'NS							
Sub-Total				136,080			94,080
Mark-Up at %							
TOTAL							

LIFE CYCLE COST ANALYSIS

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. G 12
DESCRIPTION: USE FEWER MTA STANDARD LIGHT FIXTURES	SHEET NO. 1 of 1

	BASE	ALTERNATE
LIFE CYCLE PERIOD 30 Years INTEREST RATE 6 %		
A. INITIAL COST		
Useful Life (Years)		
INITIAL COST SAVINGS		
B. RECURRENT COSTS (Annual Expenditures)		
1. Maintenance		
2. Operating		
3. Energy 2 FIXTURES 225 WATTS EA x 42 = 18.9 KW		
4. 12 hrs PER DAY / YEAR (4380 HRS)		
5. 4380 hrs x 18.9 = 82,782 KW/HR x .06/KWHR	4,966.92	
6.		
Total Annual Costs	4,966.92	
Present Worth Factor	13.67	
Present Worth of RECURRENT COSTS	67,897	

C. SINGLE EXPENDITURES	Year	Amount	PW Factor	Present Worth	Present Worth
Salvage Value					
Present Worth of SINGLE EXPENDITURES					

D. Total Recurrent Costs & Single Expenditures (B + C)		
RECURRENT COSTS & SINGLE EXPENDITURES SAVINGS		
E. *TOTAL PRESENT WORTH COST (A + D)*		
TOTAL LIFE CYCLE SAVINGS		

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	**G-14A**
DESCRIPTION:	**UPGRADE THE PLATFORM PRE-WARNING STRIPE TO ALUMINUM IN LIEU OF PAINT**	SHEET NO.	1 of 3

ORIGINAL DESIGN:

The pre-warning stripe on the platform edge is a painted 6 in. stripe for all 13 stations. There are 540 linear feet of stripe at each station.

ALTERNATIVE:

Provide an 1/8 in. thick, colored, anodized aluminum checker plate pre-warning stripe. The stripe will be embedded in the second concrete pour for a flush finish.

ADVANTAGES:

- Provides increased safety
- Reduces maintenance cost
- Significantly higher level of durability

DISADVANTAGES:

- Increases initial cost

DISCUSSION:

The proposed alternative of utilizing a checkered plate pre-warning stripe instead of a painted stripe provides a higher degree of slip resistance and lower maintenance cost.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 12,040	$ 55,217	$ 67,257
ALTERNATIVE	$ 49,000	$ 0	$ 49,000
SAVINGS	$ (36,960)	$ 55,217	$ 18,257

~02

COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

ALTERNATIVE NO. G-14A

UPGRADE PLATFORM PRE-WARNING STRIPE

SHEET NO. 2 of 3

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
Epoxy Paint Stripe	SF	3500	3.44	12040			
Aluminimum stripe	SF				3500	14.00	49,000
Sub-Total				12040			49,000
Mark-Up at %							
TOTAL							

LIFE CYCLE COST ANALYSIS

PROJECT: PASADENA BLUE LINE	ALTERNATIVE NO. G-14A
DESCRIPTION: PLATFORM PRE-WARNING STRIPE	SHEET NO. 3 of 3

LIFE CYCLE PERIOD 30 Years INTEREST RATE 6 %				BASE	ALTERNATE
A. INITIAL COST					
Useful Life (Years)					
INITIAL COST SAVINGS					
B. RECURRENT COSTS (Annual Expenditures)					
1. Maintenance					
2. Operating					
3. Energy					
4. PAINTING					
5.					
6.					
Total Annual Costs					
Present Worth Factor					
Present Worth of RECURRENT COSTS					
C. SINGLE EXPENDITURES	Year	Amount	PW Factor	Present Worth	Present Worth
Painting		4013	13.76	55,219	
Salvage Value					
Present Worth of SINGLE EXPENDITURES					
D. Total Recurrent Costs & Single Expenditures (B + C)					
RECURRENT COSTS & SINGLE EXPENDITURES SAVINGS					
E. *TOTAL PRESENT WORTH COST (A + D)*					
TOTAL LIFE CYCLE SAVINGS					

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	G-14B
DESCRIPTION:	UPGRADE THE PLATFORM PRE-WARNING STRIPE TO COLORED CONCRETE IN LIEU OF PAINT	SHEET NO.	1 of 3

ORIGINAL DESIGN:

The pre-warning stripe on the platform edge is a painted 6 in. stripe.

ALTERNATIVE:

Use a stripe of colored concrete for the platform pre-warning stripe. Place concrete in a separate pour.

ADVANTAGES:

- Provides increased safety
- Reduces maintenance cost
- Significantly higher level of durability

DISADVANTAGES:

- Increases initial cost

DISCUSSION:

The proposed alternative stripe provides a long-term advantage over a painted warning stripe because of its lower nominal maintenance cost. The painted finish will require high recurring maintenance over the life span of the station and will not provide a durable finish due to constant food traffic.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 12,040	$ 55,219	$ 67,259
ALTERNATIVE	$ 32,340	$ 0	$ 32,340
SAVINGS	$ (20,300)	$ 55,219	$ 34,919

COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. G-14B
	SHEET NO. 2 of 3

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
A Epoxy Paint Warning Stripe	SF	3500	3^{44}	12,040			
Aluminum Prewarning Stripe	S.F.				3500	14^{00}	49,000
TOTAL A				12,040			49,000
B Epoxy Paint Warning Stripe	SF	3500	3^{44}	12,040			
Color in Concrete (lb/20/cy)					10,500	0^{08}	840
Extra form	LF				10,500	3^{00}	31,500
TOTAL B				12040			32,340
Sub-Total							
Mark-Up at %							
TOTAL							

LIFE CYCLE COST ANALYSIS

PROJECT: PASADENA BLUE LINE	ALTERNATIVE NO. G-14B
DESCRIPTION: PLATFORM PRE-WARNING STRIPE	SHEET NO. 3 of 3

LIFE CYCLE PERIOD 30 Years		BASE	ALTERNATE
INTEREST RATE 6 %			

A. INITIAL COST

Useful Life (Years)

INITIAL COST SAVINGS

B. RECURRENT COSTS (Annual Expenditures)

1. Maintenance
2. Operating
3. Energy
4. PAINTING
5.
6.

Total Annual Costs

Present Worth Factor

Present Worth of RECURRENT COSTS

C. SINGLE EXPENDITURES	Year	Amount	PW Factor	Present Worth	Present Worth
Painting		4013	13.76	55,219	

Salvage Value

Present Worth of SINGLE EXPENDITURES

D. Total Recurrent Costs & Single Expenditures (B + C)

RECURRENT COSTS & SINGLE EXPENDITURES SAVINGS

E. *TOTAL PRESENT WORTH COST (A + D)*

TOTAL LIFE CYCLE SAVINGS

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	G-17
DESCRIPTION:	LIMIT THE ART AT THE STATIONS TO APPLIED ART VERSUS INTEGRAL ART	SHEET NO.	1 of 2

ORIGINAL DESIGN:

The intent of the art at each station is to integrate it with the structure, landscaping and hardscape.

ALTERNATIVE:

Set strict guidelines on the use of art at the "non-landmark" stations. Art would be limited to either site art or art that could be applied to the stations structure.

ADVANTAGES:

- Simplifies art integration

DISADVANTAGES:

- Restricts the artist's options

DISCUSSION:

The current art budget is 1.8 million dollars. Integrating the art in such a way as to not impede the design/build contractor is essential to ensure a smooth running project.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS			

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

ALTERNATIVE NO. G-17

SHEET NO. 2 of 2

LIMIT ART AT THE STATIONS TO APPLIED ART VERSUS INTEGRAL ART.

Art:

Status:

- o Art allowance may be reduced from original amount due to cost containment and value engineering.
- o Art is significantly integrated with architecture, landscape and site design.
- o Line artists' designs are completed and involve relief on retaining walls.
- o Stations artists' designs are completed at approximately the same percentage as each respective station.
- o Redesign may be required where station site design has changed.
- o Minor redesign will be required at landmark stations for value engineering.
- o Major redesign will be required at community serving stations due to standardization of components, with allowance per station.

Recommendations:

- o Original artists* should be retained for redesign.
- o Alternative 1 – Contract with each City for the administrative portion of their art allowance to administer redesign, community input, City approval, MTA approval and value engineering as needed to provide design package within budget to design/build contractor.
- o Alternative 2 - .Contract with MTA same as above.

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	**ALTERNATIVE NO.**	**G-20**
DESCRIPTION:	**STANDARDIZE STATION PLATFORM BENCHES AT STANDARD STATIONS**	**SHEET NO.**	1 of 1

ORIGINAL DESIGN:

There are currently different bench designs at each station platform.

ALTERNATIVE:

Provide standardized benches at all standard stations.

ADVANTAGES:

- Maintains quality level
- Reduces unit costs
- Reduces maintenance and replacement costs

DISADVANTAGES:

- Reduces individuality

DISCUSSION:

To maintain a standard quality level and to reduce costs, utilize a standard bench design at all standard stations. Standardized benches will reduce maintenance and replacement costs over the long-term.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS			

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	G-25
DESCRIPTION:	COORDINATE STATION SIGNAGE WITH GENERAL ILLUMINATION	SHEET NO.	1 of 1

ORIGINAL DESIGN:

Platform signage is shown mounted on the lighting standards at four locations, two perpendicular to HID luminaire positions, and two centered directly below and bisecting the fixtures.

ALTERNATIVE:

Evaluate movement of signage away form light standards to provide even illumination and reduce glare on the sign face. Verify that signage construction involves high contrast and uses matte, rather than glossy, finishes.

ADVANTAGES:

- Enhances station illumination
- Ensures signs can be read

DISADVANTAGES:

- None apparent

DISCUSSION:

MTA Design Criteria Section 6.17, Appendix A references Section 10.3 o the Americans with Disabilities Act. That legislation, Section 10.3.1 (11) states "illumination levels in the areas where signage is located shall be uniform and shall minimize glare on signs." HID sources provide intense illumination directly below the lamp focal point. The experience of a passenger in a wheelchair looking up at a sign (and into the downlight) will mimic the visual impairment caused by a photographic flashcubes exploding, on a larger scale.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS			

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	G-26
DESCRIPTION:	CONSTRUCT STATION COMMUNICATIONS VAULTS AND ASSOCIATED UTILITY ROUGH-INS	SHEET NO.	1 of 1

ORIGINAL DESIGN: (Sketch attached)

Cost cutting measures removed all communications system components from the project. Subsequent preliminary engineering drawings indicate no provisions at the stations to house the necessary communication equipment.

ALTERNATIVE: (Sketch attached)

Build the below platform communications vault now and stub conduits out to facilitate future wiring installations. Openings for a ventilation system should be formed and sealed over with knockout panels.

ADVANTAGES:

- Provides consistency of construction station to station
- Avoids future cost of modifying structures to accommodate needed communication

DISADVANTAGES:

- Increases cost minimally

DISCUSSION:

The systems required for line operation must ultimately be provided for the line to function. The front-end equipment needs should be met now, so the completed stations show no evidence of separate responsibilities for different components.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS			

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	G-27
DESCRIPTION:	TIE CALGARY GATES AT STATION PLATFORMS TO SYSTEM CONTROLS	SHEET NO.	1 of 1

ORIGINAL DESIGN:

The original design documents are not clear on the nature of the control mechanism for the Calgary (pedestrian) gates at each station.

ALTERNATIVE:

Tie the Calgary (pedestrian) gates to the system controls.

ADVANTAGES:

- Enhances public safety
- Provides automatic operation

DISADVANTAGES:

- None apparent

DISCUSSION:

The pedestrian gates should be operated and controlled by the system controls to prevent the public from entering track areas when trains are in the proximity of the stations. The gates are not currently tied to the system controls.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS			

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	G-28
DESCRIPTION:	REDUCE MINIMUM LANDSCAPING REQUIREMENTS	SHEET NO.	1 of 1

ORIGINAL DESIGN:

Each station has a different landscaping design that is related to the community context and community image for the area in which it is located. The extent of the landscaping and the types of plantings (and corresponding irrigation) are different for each station and require community consensus.

ALTERNATIVE:

Based on the landscape design for each station that has or will need community consensus, the sizes of the plant material containers when installed should be reduced as follows:

36 in. box tree → Reduce to 24 in. box
24 in. box tree → Reduce to 15 gallon

15 gallon shrub or vine → Reduce to 5 gallon
5 gallon shrub or vine → Reduce to 1 gallon

ADVANTAGES:

- The design intent remains the same. The plant materials can be expected to grow to the originally specified size in approximately two years. Eventually the plants will obtain the desired sizes and the mature design intent will be achieved
- The designs do not have to be revisited with the communities
- Smaller containers of plant material, when properly maintained, are generally healthier in the long-term
- The use of mechanized equipment for moving plants will not be necessary
- Saves cost, approximately 10% for all the stations' landscape materials and installation costs

DISADVANTAGES:

- Reducing the size of the plant material containers results in the plants taking longer to become established. Smaller plants are more susceptible to vandalism and damage. More plant replacement may be required over the first one to three years

DISCUSSION:

By maintaining the design intent and reducing the sizes of the plant materials, the landscaping for each station will eventually develop as desired by the designers and each community. It will just take longer.

A capital cost savings of approximately 10% an be expected overall, for all the station landscape materials including labor for installation.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS			

SUMMARY OF POTENTIAL COST SAVINGS

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	**LOCATION:**	**LOS ANGELES TO PASADENA, CALIFORNIA**			
PROJECT ELEMENT:	**STATIONS**		PRESENT WORTH OF COST SAVINGS			
ALT. NO.	**DESCRIPTION**	**ORIGINAL COST**	**ALTERNATIVE COST**	**INITIAL COST SAVINGS**	**O & M SAVINGS**	**TOTAL SAVINGS**
	AVENUE 26 (A)					
A-1	Delete retaining walls and ramps and use elevators at Avenue 26	944,000	412,500	531,500	(105,319)	426,181
A-4	Add the Avenue 26 parking lot back into the project to enhance community linkage	DESIGN SUGGESTION				
A-7	Provide for hydrogen sulfide monitoring at Avenue 26 Station electrical vault	DESIGN SUGGESTION				
A-10	Use spread footings at Avenue 26 Station in lieu of drilled piers to support platforms	141,760	0	141,760	—	141,760
A-12	At Avenue 26 Station provide only one ramp instead of two ramps	343,300	33,500	309,800	—	309,800
A-13	Repair the failing retaining wall on the west side of Avenue 26 Station	DESIGN SUGGESTION				
	FRENCH (F)					
F-4	Add 16 - 20 parking spaces at French Station on the west side of the tracks	DESIGN SUGGESTION				

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	**A-1**
DESCRIPTION:	**DELETE RAMPS AND RETAINING WALLS AND ADD ELEVATORS AT AVENUE 26 STATION**	SHEET NO.	1 of 6

ORIGINAL DESIGN: (Sketch attached)

The Avenue 26 Station contains long ramps on each side of the track to access the platforms from the street.

ALTERNATIVE: (Sketch attached)

Eliminate the ramps and retaining walls by adding two elevators on each side of the tracks to transport people. Retain the steps. Reduce the extent of the retaining wall to around the elevator and stairs.

ADVANTAGES:

- Reduces retaining wall and ramp costs
- Eliminates pile foundation
- Improves usability of station for the elderly and handicapped

DISADVANTAGES:

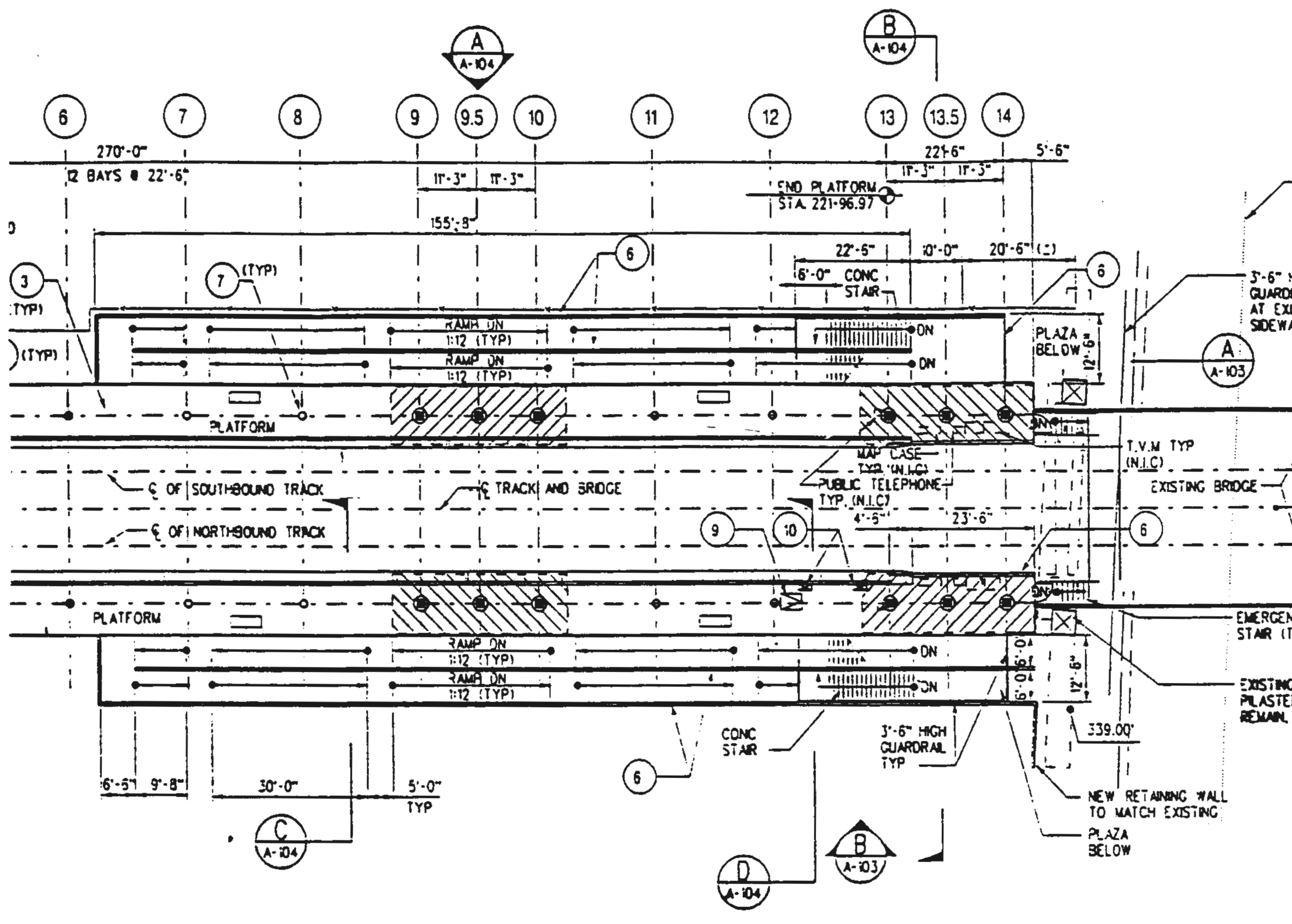
- Increase elevator cost
- Long-term maintenance issues with elevators

DISCUSSION:

The Avenue 26 Station has extremely long ramps. Eliminating the ramps and providing stairs and elevators improve the usability of the station while reducing cost.

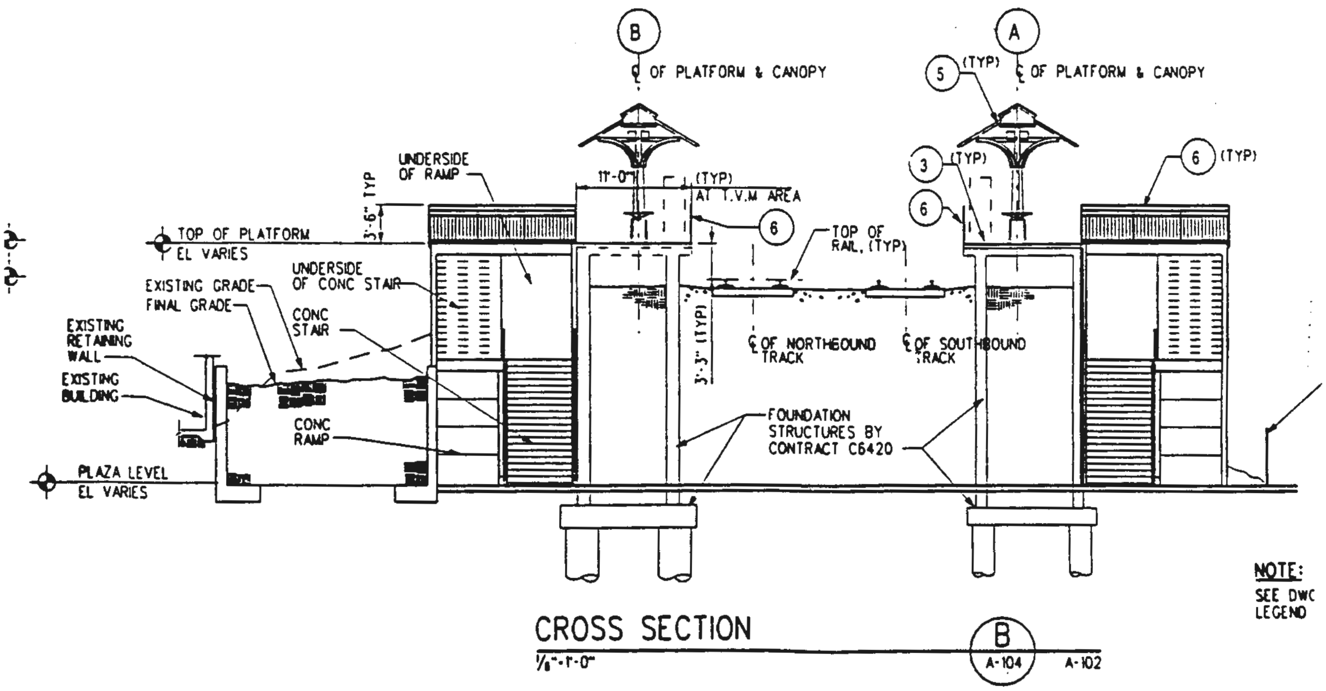
COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 944,000	$ 0	$ 944,000
ALTERNATIVE	$ 412,500	$ 105,319	$ 517,819
SAVINGS	$ 531,500	$ (105,319)	$ 426,181

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT		ALTERNATIVE NO. A-1
	☒ AS DESIGNED	☐ ALTERNATIVE	SHEET NO. 2 of 6

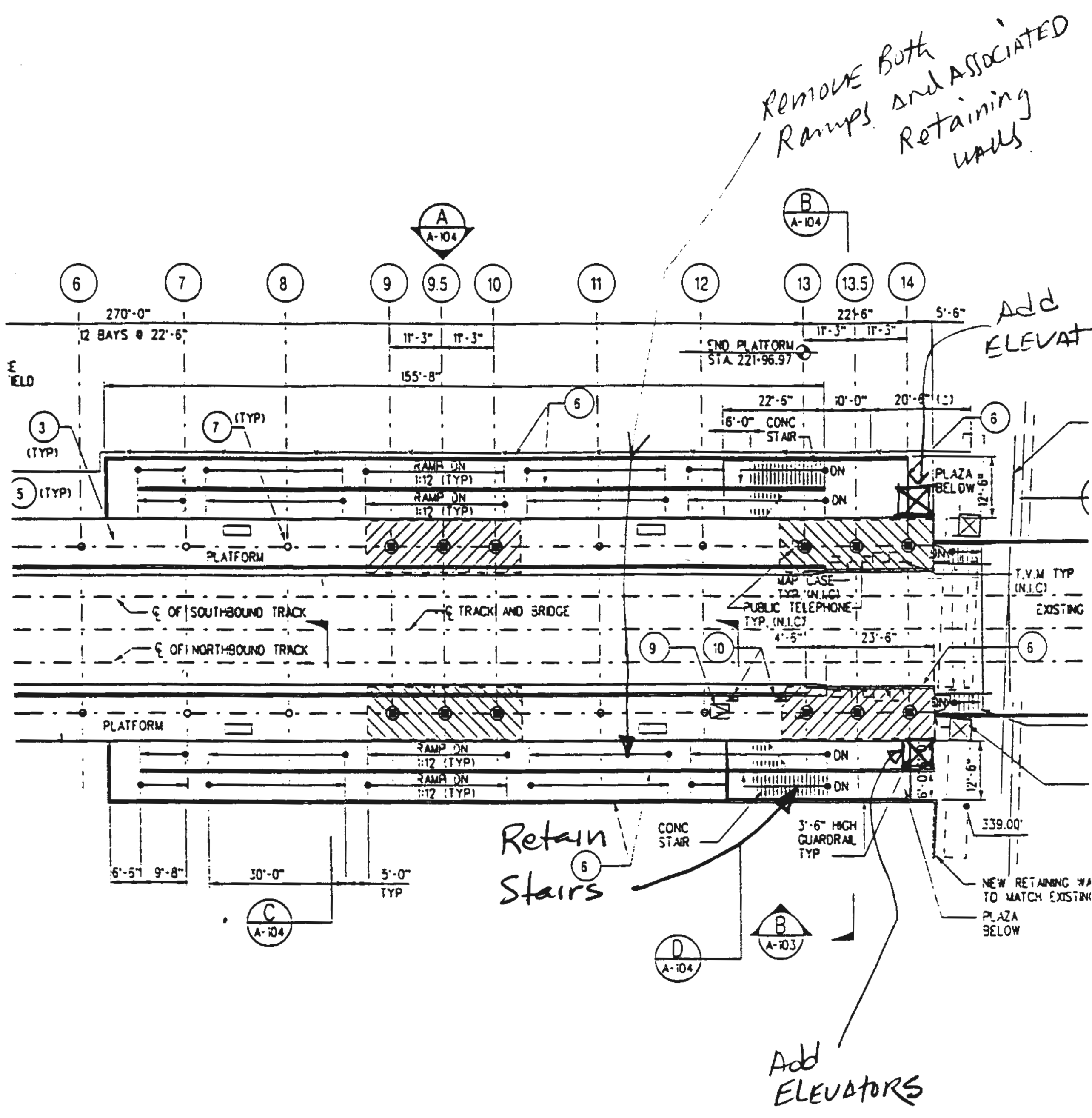


Station and Ramps Plan

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT		ALTERNATIVE NO. A-1
	☒ AS DESIGNED	☐ ALTERNATIVE	SHEET NO. 3 of 6



PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	A-1
	☐ AS DESIGNED ☒ ALTERNATIVE	SHEET NO.	4 of 6



COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

ALTERNATIVE NO. A-1

SHEET NO. 5 of 6

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
Ramp Slab 6"	C.Y	80	$350	28,000			0
Retaining walls @ Ramp	C.Y	160	$500	80,000			0
Retaining wall @ station platform	C.Y.	1100	$500	550,000	150	$350	52,500
Pile Foundation supporting the Retaining wall 30"ϕ	C.Y	260	$450	117,000			0
Ramp Railing 42" Ht	ft	800	$30	24,000			0
PILE CAP Slabs	C.Y	300	$350	105,000			0
Fill and compaction	C.Y	8,000	$5	40,000			0
Elevators					4	60,000	240,000
Structural FRAMES for Elev.					4	30,000	120,000
Sub-Total				944,000			412,500
Mark-Up at %							
TOTAL				944,000			412,500

LIFE CYCLE COST ANALYSIS

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. A-1
DESCRIPTION: ELIMINATE RETAINING WALL & USE ELEVATOR INSTEAD	SHEET NO. 6 of 6

	BASE	ALTERNATE
LIFE CYCLE PERIOD ____ Years INTEREST RATE ____ %		
A. INITIAL COST		
Useful Life (Years)		
INITIAL COST SAVINGS		
B. RECURRENT COSTS (Annual Expenditures)		
1. Maintenance — MAINTENANCE AGREEMENT @ 2400/YEAR.	2400-	
2. Operating — CLEANING 1 HR WEEK @ 100-	5,200-	
3. Energy — 442 kw/hr @ .06/kwhr ×2	54-	
4.		
5.		
6.		
Total Annual Costs	7,654.00	
Present Worth Factor	13.76	
Present Worth of RECURRENT COSTS	105,319.00	

C. SINGLE EXPENDITURES	Year	Amount	PW Factor	Present Worth	Present Worth
Salvage Value					
Present Worth of SINGLE EXPENDITURES					

D. Total Recurrent Costs & Single Expenditures (B + C)		
RECURRENT COSTS & SINGLE EXPENDITURES SAVINGS		
E. *TOTAL PRESENT WORTH COST (A + D)*		
TOTAL LIFE CYCLE SAVINGS		

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	A-4
DESCRIPTION:	ADD AVENUE 26 STATION PARKING LOT BACK INTO THE PROJECT TO ENHANCE COMMUNITY LINKAGE	SHEET NO.	1 of 4

ORIGINAL DESIGN:

The original design deletes the earlier parking lot on the west side of the Avenue 26 Station in response to concerns over the presence of potentially hazardous materials in the fill material.

ALTERNATIVE: (Sketch attached)

Incorporate the parking lot in the design.

ADVANTAGES:

- Enhances community linkage
- Reduces traffic congestion caused by drop-off vehicles, if no park-and-ride lot is available
- Paving for parking lot may effectively remediate lead and petroleum hydrocarbon contamination at the site, which should be done anyway

DISADVANTAGES:

- Increases initial capital cost, although this cost could be required to remediate the site independent of the Pasadena Blue Line Construction

DISCUSSION:

Earlier concerns over contamination led to the elimination of parking lot at the Avenue 26 Station. This area is mix of residential and commercial use resulting in a need for parking facilities. The addition of the parking lot reduces grade separation problems at the station. The contamination on the site needs to be addressed rather than ignored. The creation of the station will increase the use of the area. It is likely that the remediation for the site will be to cap the site with asphalt. It may be possible to obtain funds from MTA for the remediation, thus reducing the cost of the parking (cost increase is $155,000).

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS			

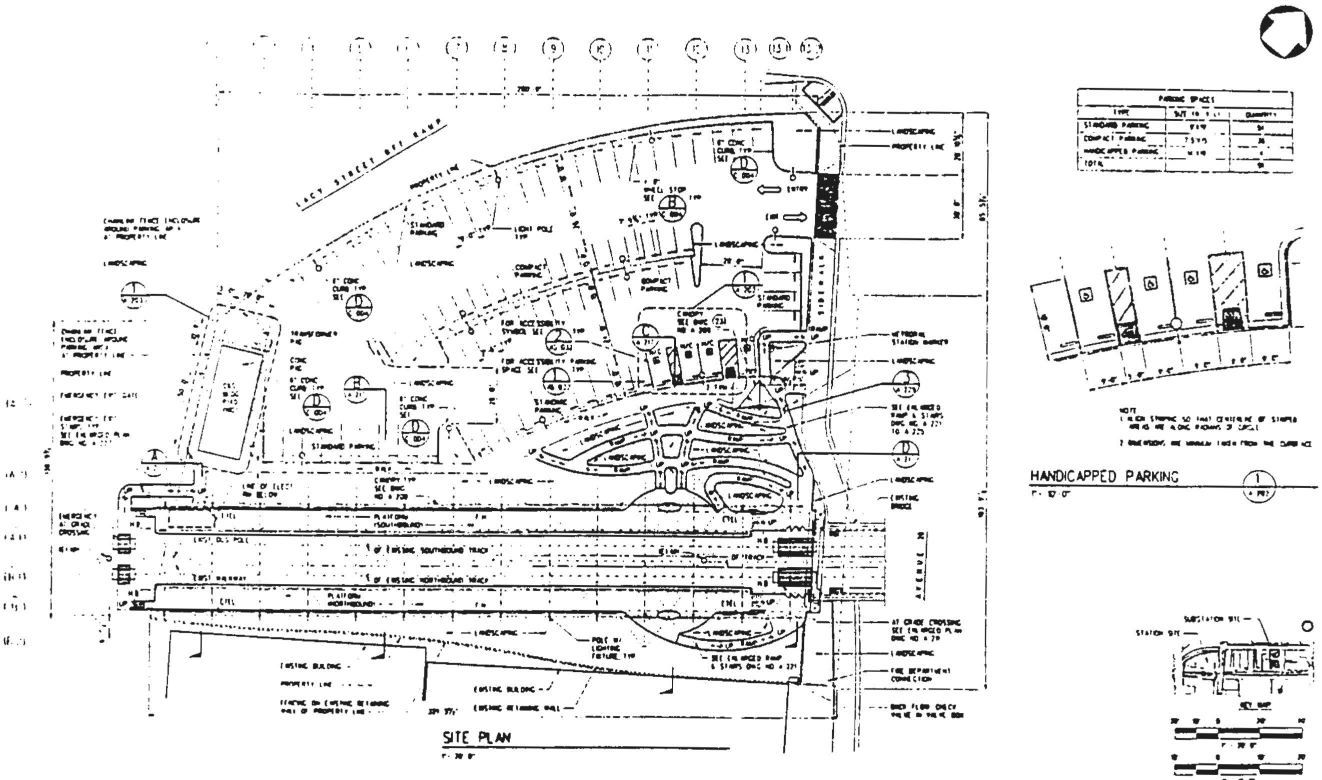
SKETCHES

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

ALTERNATIVE NO. A 4

☐ AS DESIGNED ☒ ALTERNATIVE

SHEET NO. 2 of 4

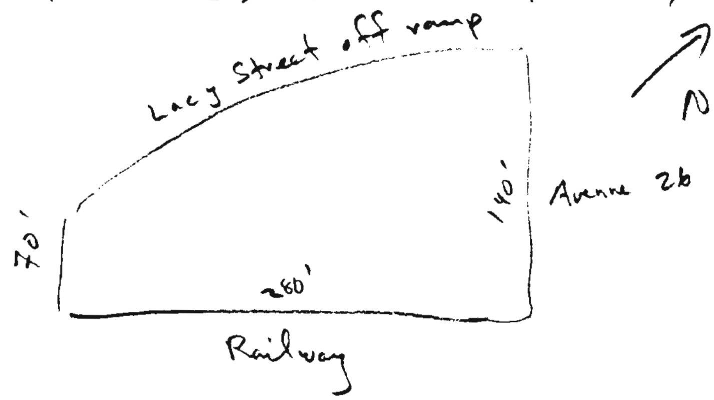


PREVIOUS DESIGN
W/ PARKING

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. A 4
		SHEET NO. 3 of 4

CALCULATE APPROXIMATE AREA OF PARKING LOT

REFERENCE: DRAWING A-202, CONTRACT C6480



$$\text{Area} = \frac{70+140}{2} \times 280 = 29{,}400 \text{ square feet}$$

COST WORKSHEET

PROJECT: **PASADENA BLUE LINE LIGHT RAIL PROJECT**
ADD PARKING LOT BACK INTO PROJECT TO ENHANCE COMMUNITY LINKAGE

ALTERNATIVE NO. A 4

SHEET NO. 4 of 4

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
FINE GRADE	SY				3266	2.20	7185
IMPORT FILL	CY				730	11.62	8,482
COMPACT SHEEPSFOOT	CY				730	3.17	2,314
PREP. & ROLL BASE	SF				29400	1.73	50,862
AGGREGATE BASE	CY				730	15.35	11,205
PAVING 2" BASE 1" WARE	SF				29400	1.64	48,216
PAINT PARKING LINES	EA				91	12.-	1,092
LANDSCAPING	LS				1		5,000
Drainage					1	EACH	20,000
Sub-Total							
Mark-Up at %							
TOTAL							154,356

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	A-7
DESCRIPTION:	PROVIDE FOR HYDROGEN SULFIDE MONITORING AT AVENUE 26 STATION ELECTRICAL VAULT	SHEET NO.	1 of 1

ORIGINAL DESIGN:

The Avenue 26 Station design includes an enclosed electrical room.

ALTERNATIVE:

Incorporate hydrogen sulfide monitoring in the enclosed electrical room design.

ADVANTAGES:

- Increases safety

DISADVANTAGES:

- Adds cost

DISCUSSION:

The final report, Phase I and Phase II Environmental Site Assessment, Metro Rail Pasadena Blue Line, Parcels PA-074, PA-076 and PA-041, Los Angeles, California, LRM 492-94 by BYSC Environmental, Inc., dated January 17, 1995, reports hydrogen sulfide odor in one sample from flat area (parking lot) west of the railway. If a sufficient amount is present, it could accumulate in the enclosed vault and create potential hazard to workers. Monitoring will alert workers of this danger.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS			

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	A-10
DESCRIPTION:	USE SPREAD FOOTINGS AT AVENUE 26 STATION IN LIEU OF DRILLED PIERS	SHEET NO.	1 of 8

ORIGINAL DESIGN:

The Avenue 26 Station design shows that foundation support for the station platform, ramps and stairs is cast-in-drilled-holed (CIDH) piers. The reason stated for the CIDH foundation is potentially bad fill.

ALTERNATIVE:

Use spread footings in lieu of CIDH piers.

ADVANTAGES:

- Reduces cost
- Speeds up construction
- Reduces material export/disposal

DISADVANTAGES:

- Possibly more settlement

DISCUSSION:

One exploratory boring (B-R) was drilled near the railway embankment and it had a few pieces of brick, asphalt and tile. Environmental borings drilled in the parking lot area to the north encountered some waste material. Based on aerial photo review (attached), the railway embankment predates the waste fill. Borings indicate the railway embankment in granular. Since the station structures will be relatively light and the fill is +70 years old, settlements are anticipated to be minor and should occur soon after construction.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 141,760	—	$ 141,760
ALTERNATIVE	$ 0	—	$ 0
SAVINGS	$ 141,760	—	$ 141,760

A-10

BORING 12

Coordinates
N-4,141,910
E-4,221,265

DATE DRILLED: August 25, 1992
EQUIPMENT USED: 24" - Diameter Bucket
ELEVATION 356

Sht. 2 of 8

ELEVATION	DEPTH (ft.)	OVA (ppm)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	BLOWS/FT.*	SAMPLE LOC.	SOIL	DESCRIPTION
355				7.2	111	2	■	SM	ARTIFICIAL FILL (af) (to 16') SILTY SAND - fine to medium, about 30% Gravel, some Cobbles (to 10" in size), few pieces of brick, asphalt, concrete and tile, brown
				11.7	110	<1	■		
350	5			9.6	103	<1	■		
				9.0	101	<1	■	SP SM	SAND and SILTY SAND - fine to coarse, about 30% Gravel, brown; Pieces of concrete and bricks
345	10			2.7	121	1	■		Few Boulders (to 14" in size)
				7.2	100	1	■		
340	15							SW	ALLUVIUM (Qal) SAND - well graded, about 30% Gravel, some Cobbles (to 8" in size), greyish brown
335	20			1.8	117	16	■		
	25			4.7	114	8	■	SP	SAND - fine to medium, about 20% Gravel, light brown (BORING TERMINATED AT A DEPTH OF 25' DUE TO AN OBSTRUCTION)

NOTE: Boring was terminated at depth of 5' due to existing 10" - diameter metal pipe at a depth of 5' and redrilled at a new location about 140' to the south. Water not encountered. Raveling from 0' to 9' and caving from 9' to 24' (to 4' in diameter).

* Number of blows required to drive Law/Crandall Sampler 12". Driving weight 1,600 lbs. Stroke = 12"

Note: The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB L92045.AE4 DATE 11/10/92 F.T. SJ/GMC DR. k O.E. MS CHKD JB/sk

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A-1.12

IN RR R.O.W.
W. OF 110 FWY

3/3
A-10

BORING 49

Coordinates
N-4,141,470
E-4,220,675

DATE DRILLED: December 15 & 16, 1992
EQUIPMENT USED: 5" - Diameter Rotary Wash
TIME DRILLED: Start: 7:00 am; Finish: 11:00 am (12/15)
Start: 7:00 am; Finish: 11:00 am (12/16)
ELEVATION 354

ELEVATION	DEPTH (ft.)	OVA (ppm)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	BLOWS/FT.*	SOIL	DESCRIPTION
							SM	ARTIFICIAL FILL (af) (to 18') SILTY SAND - fine to medium, some coarse, about 10% Gravel, light brown Sht. 3 of 8
				6.3	119	12		
350				11.7	121	9		
	5			6.2	122	14		Fine to coarse Sand, about 25% Gravel
				8.4	111	15		
345	10	5		8.6	116	35		
		5	24					Pieces of glass
340	15			8.7	130	75 for 10"		Some pieces of decayed wood
335		10	52				SM	ALLUVIUM (Qal) SILTY SAND - fine to medium, light brown
	20						SP	SAND - fine to medium, about 25% Gravel, light greyish brown
		10		7.7	110	75 for 10"		
330							SW	SAND - well graded, about 35% Gravel, light brown
	25		25 55 20 for 1"					
325				3.8	121	75 for 10"		
	30		78					
320	35			11.3	129	75 for 8"		
315	40		85				SP SM	SAND and SILTY SAND - fine to medium, some coarse, about 5% Gravel, light brown

(CONTINUED ON FOLLOWING PLATE)

Note: The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB L92045.AE4 DATE 1/5/93 F.T. AR DR. lk O.E. MS CHKD

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.49a

A-10

BORING 49 (Continued)

DATE DRILLED: December 15 & 16, 1992
EQUIPMENT USED: 5" - Diameter Rotary Wash
TIME DRILLED: Start: 7:00 am; Finish: 11:00 am (12/15)
Start: 7:00 am; Finish: 11:00 am (12/16)

Sht. 4 of 8

ELEVATION	DEPTH (ft.)	OVA (ppm)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	BLOWS/FT.*	SAMPLE LOC.	USCS	DESCRIPTION
310		5		7.0	120	75 for 10"	■		
	45								
		5		6.2	122	75 for 11"	■	SW	OLDER ALLUVIUM (Qalo) SAND - well graded, about 25% Gravel, light brown
305	50								
				12.6	121	75 for 10"	■		Layers of fine Sand
300	55								
		35	35 75 for 5"						Greyish blue
295	60								
		5		12.7	114	50	■		Light grey
290	65								
		10	100						Thin layer of Silt
285	70								
		5		10.7	119	50	■		
280									Lenses of Silt
	75	35	35 50 25 for 2"						
								ML	SANDY SILT - light brown
275	80							SP	SAND - fine to medium, light brownish grey

(CONTINUED ON FOLLOWING PLATE)

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB L92045.AE4 DATE 11/10/92 F.T. TC DR. lk O.E. MS MS CHKD JB DK

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.49b

A-10

BORING 49 (Continued)

DATE DRILLED: December 15 & 16, 1992
EQUIPMENT USED: 5" - Diameter Rotary Wash
TIME DRILLED: Start: 7:00 am; Finish: 11:00 am (12/15)
Start: 7:00 am; Finish: 11:00 am (12/16)

Sht. 5 of 8

ELEVATION	DEPTH (ft.)	OVA (ppm)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	BLOWS/FT.*	SAMPLE LOC.	SOIL	DESCRIPTION
		5		16.8	107	75	■		
270									
	85	55	100						
								SW	SAND - well graded, some Gravel, light brownish grey
265									
	90	5		10.1	123	60	■		
260									
	95	5	75						Layer of Silty Sand Layer of Sandy Silt
255									Layer of Sandy Silt
	100	5		8.6	119	75 for 6"	■		
250									
	105								

NOTE: Drilling mud used in drilling process. To obtain future water level measurements and sampling, installed 2"- diameter PVC pipe to a depth of 100'. Pipe perforated between depths of 20' and 100'. Backfilled with Sand to within 12' of ground surface. Bentonite plug placed between depths of 8' and 12' and was grouted with cement above 8'. Water level measured in the well at a depth of 60' on 12/30/92.

*Number of blows required to drive Law/Crandall Sampler 12".
Driving Weight = 400 lbs.; Stroke = 24"

JOB L92045.AE4 DATE 1/5/93 F.T. AR DR. lk O.E. MS CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.49c

ALTERNATIVE NO:
A-10
Sht. 6 of 8

FINAL REPORT

PHASE I AND PHASE II ENVIRONMENTAL SITE ASSESSMENT METRO RAIL PASADENA BLUE LINE

PARCELS PA-074, PA-076, PA-077 AND PA-041

LOS ANGELES, CALIFORNIA

LRA 492-94

Prepared for:

Los Angeles County
Metropolitan Transportation Authority

Prepared by:

SC Environmental, Inc.
3637 Honeyglen Way
Ontario, CA 91761

January 17,1995

3.8.2 Parcel PA-041 (Avenue 26)

The photos from the 1990's show the site in its current configuration with several areas of stockpiled materials at the site. An area of what appears to be a slight discoloration was observed in the center of the site in the 1993 photos. Commercial properties were visible to the southeast and northeast of the site.

The photos from the 1980's show the site used for storage. Vehicles were visible at the site.

The photos from the 1950's show a greater amount of vegetation at the site. There was not a 110/5 Freeway intersection at that time, neither was there a freeway exit ramp adjacent to the northwest. An unidentified commercial building with a smaller building at its rear, was visible adjacent to the subject parcel to the northwest in the location of what is now the freeway exit ramp, directly southeast of the terminus of Lacy Street. This building is identified as an electrical manufacturing facility with a rear brick smelting furnace on the 1920 Sanborn Fire Insurance Map. The subject site appeared to be unpaved with materials storage along Avenue 26. The center of the subject site contained what appeared to be a trash pile. The area that is now the southwest corner of the site appeared to be darker colored. The adjacent property to the southwest appeared to be occupied by vehicles and was apparently used for waste disposal. There appeared to be an excavation or pond adjacent to the southwest of the site.

The photos from 1952-1953 show the presence of rectangular objects stored at the southwest rear of the site. The rear southwest area of the site also contained what appeared to be above ground tanks. Small sheds were present at the northeast side of the property along Avenue 26.
The photos from the 1940's showed the site to be covered by vegetation. What appeared to be a dirt road was observed traversing the site from the side presently occupied by the freeway exit ramp, near the intersection with Avenue 26. What appeared to be a large pile of trash or refuse was visible in the center of the site. The site adjacent to the northwest across and including what is now the freeway exit ramp, appeared to be used as a trash dump. Rectangular-shaped boxes or containers were stored at the northeast edge of the property along Avenue 26.

The photos from the 1930's show the site to be mostly covered by vegetation with no indications of the presence of trash piles or disposal activities at the site. There was no indication of stored material at the site. The industrial facility across the railroad track to the southeast had several aboveground storage tanks. What appeared to be ponds were present adjacent to and southwest of the site.

3.9 Sanborn Maps

A search for Sanborn Fire Insurance Map coverage of the sites was made. Copies of the Sanborn Maps reviewed are included in Appendix F. A discussion of the findings from a review of the Sanborn maps is presented below:

3.9.1 Parcels PA-075, PA-076, and PA-077 (Arroyo Seco Park)

COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT
Use Spread Footings at Ave 26 Sta In Lieu of Piles

ALTERNATIVE NO. A 10

SHEET NO. 8 of 8

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	~~UNITS~~	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
24 inch DIA CIDH PIER 40FT		80	$1160	$ 92,800	-0-		0
36 inch DIA CIDH PIER 40FT		24	$2040	$ 48,960	-0-		0
The pilecaps in the estimate will serve as the spread foundations resulting in a wash on associated cost (pile caps versus spread foundations).							
Sub-Total							
Mark-Up at %							
TOTAL				$141,760			-0-

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	A-12
DESCRIPTION:	AVENUE 26-PROVIDE ONLY ONE RAMP INSTEAD OF TWO RAMPS	SHEET NO.	1 of 6

ORIGINAL DESIGN: (Sketch attached A-1)

The original design provides ramps and stairs on both sides of the Station down to Avenue 26. A pedestrian crossover is also provided at the north end of the Station on the Avenue 26 bridge.

ALTERNATIVE: (Sketch attached A-2)

Provide ramp and stairs on west side of Station only. Relocate Station platforms 20' to the south to provide pedestrian cross-over off of the Avenue 26 bridge.

ADVANTAGES:

- Reduces construction costs.
- Eliminates TVM and MZP case on NB platform.

DISADVANTAGES:

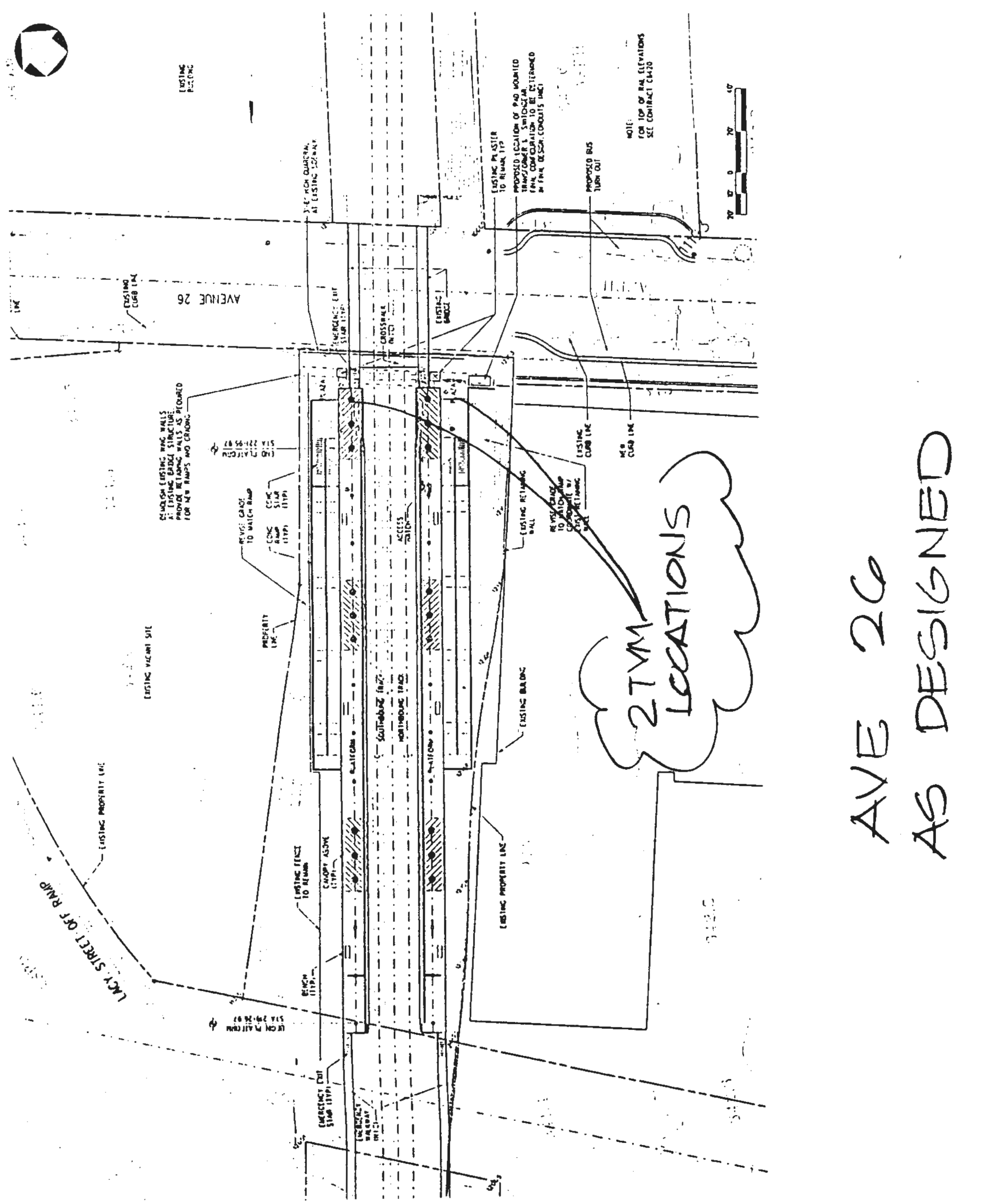
- Requires all passengers using NB platform to cross tracks.

DISCUSSION:

The original pedestrian crossover, which is located on the Avenue 26 bridge was apparently intended for emergency use. This crossover will have to be located off of the bridge for daily use by moving entry for the Station 20 feet south. Creating a single entry for the Station will simplify the use of the Station by reducing confusion of the users.

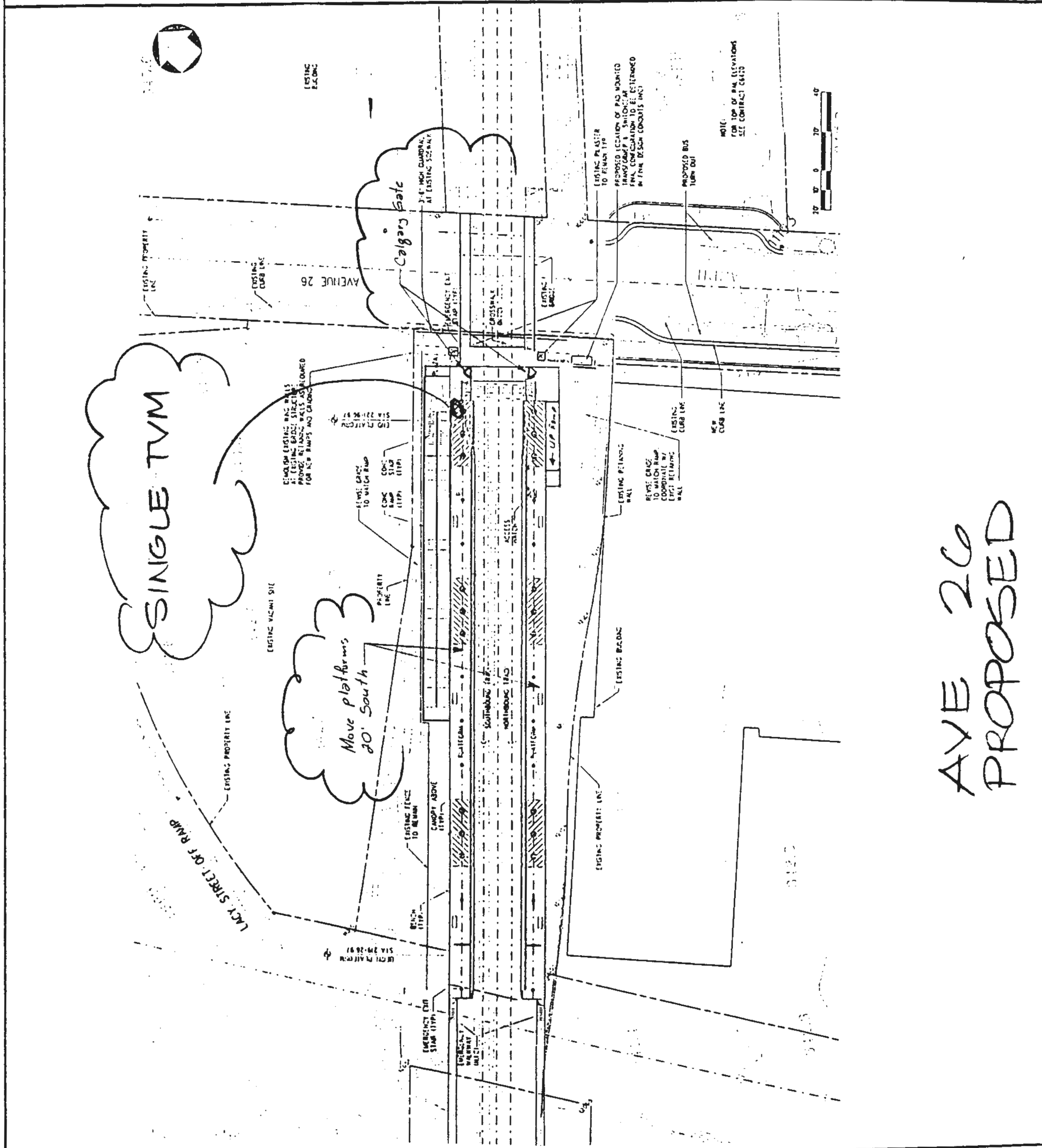
COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 229,760	$ 0	$ 229,760
ALTERNATIVE	$ 0	$ 0	$ 0
SAVINGS	$ 229,760	$ 0	$ 229,760

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. A-12
☒ AS DESIGNED	☐ ALTERNATIVE	SHEET NO. 2 of 6



SKETCHES

PROJECT: **PASADENA BLUE LINE LIGHT RAIL PROJECT**		ALTERNATIVE NO. A-12
☐ AS DESIGNED	☒ ALTERNATIVE	SHEET NO. 3 of 6



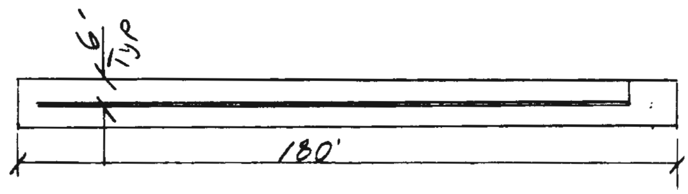
PROJECT: **PASADENA BLUE LINE LIGHT RAIL PROJECT**

ALTERNATIVE NO. A-12

SHEET NO. 4 of 6

REMOVE:

Ramp



180' x 6' x 2 = 2,160 SF

Stairs (Assume 7" rise, 11" tread & 20' vertical climb)

$\frac{20}{.5833}$ = 34 risers

34 x .9167 = 31.16' tread

Add 6' landing : 37'

37' x 6' = 222 SF

Railing

Ramp 180' + 12' + 180' = 372'

Stairs 37' + 12' + 37' = 86'

478'

Retaining Wall (Assumed average H = 14')

180' x 14' = 2,520 SF

TVM & Map Case

1 each

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. A-12
	SHEET NO. 5 of 6

ADD

Ramp 60'x6' + 15'x6' = 450 SF

Calgary Gate
2 each
(Assumed the emergency crossover did not have them)

Railing
60' + 20' + 20' = 100 LF

COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

ALTERNATIVE NO. A-12

SHEET NO. 6 of 6

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
REMOVALS							
Ramp	SF				2,160	2.00	(4,320)
Stairs	SF				222	36	(7,992)
Railing	LF				478	$126	(60,228)
Retaining Wall	SF				2,520	38	(95,760)
TVM & Map Case	EA				1	65,000	(65,000)
							(233,260)
ADD							
Ramp	SF				450	2.00	900
Railing	LF				100	$126	12,600
Calgary Gate	EA				2	10,000	20,000
							33,500
Sub-Total							(199,760)
Mark-Up at %							
TOTAL							

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	A-13
DESCRIPTION:	REPAIR FAILING RETAINING WALL ON WEST SIDE OF AVENUE 26 STATION	SHEET NO.	1 of 1

ORIGINAL DESIGN:

The top of the existing retaining wall on the south side of the railway southwesterly of Avenue 26 has deflected so that it is leaning against the adjacent building. The wall of the adjacent building is cracked.

ALTERNATIVE:

Replace the defected section of the retaining wall.

ADVANTAGES:

- Avoids increasing damage to building when rail system operates

DISADVANTAGES:

- Adds cost

DISCUSSION:

Vibrations from the Blue Line operations will be transmitted directly to the wall of the adjacent building if the retaining wall remains in contact with the building. Implementing this design suggestion will avoid direct transmission of these vibrations to the wall of the existing building and prevent further damage.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS			

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	F-4
DESCRIPTION:	AT FRENCH STATION ADD 16 - 20 PARKING SPACES IN AREA WEST OF LINE	SHEET NO.	1 of 3

ORIGINAL DESIGN:

The original design does not address the land that is owned by MTA on the west side of the tracks at French Station.

ALTERNATIVE: (Sketch attached)

Add a parking area on the west side of the tracks on the MTA land.

ADVANTAGES:

- Increases parking spaces
- Increases safety by providing access from west side of tracks without crossing tracks

DISADVANTAGES:

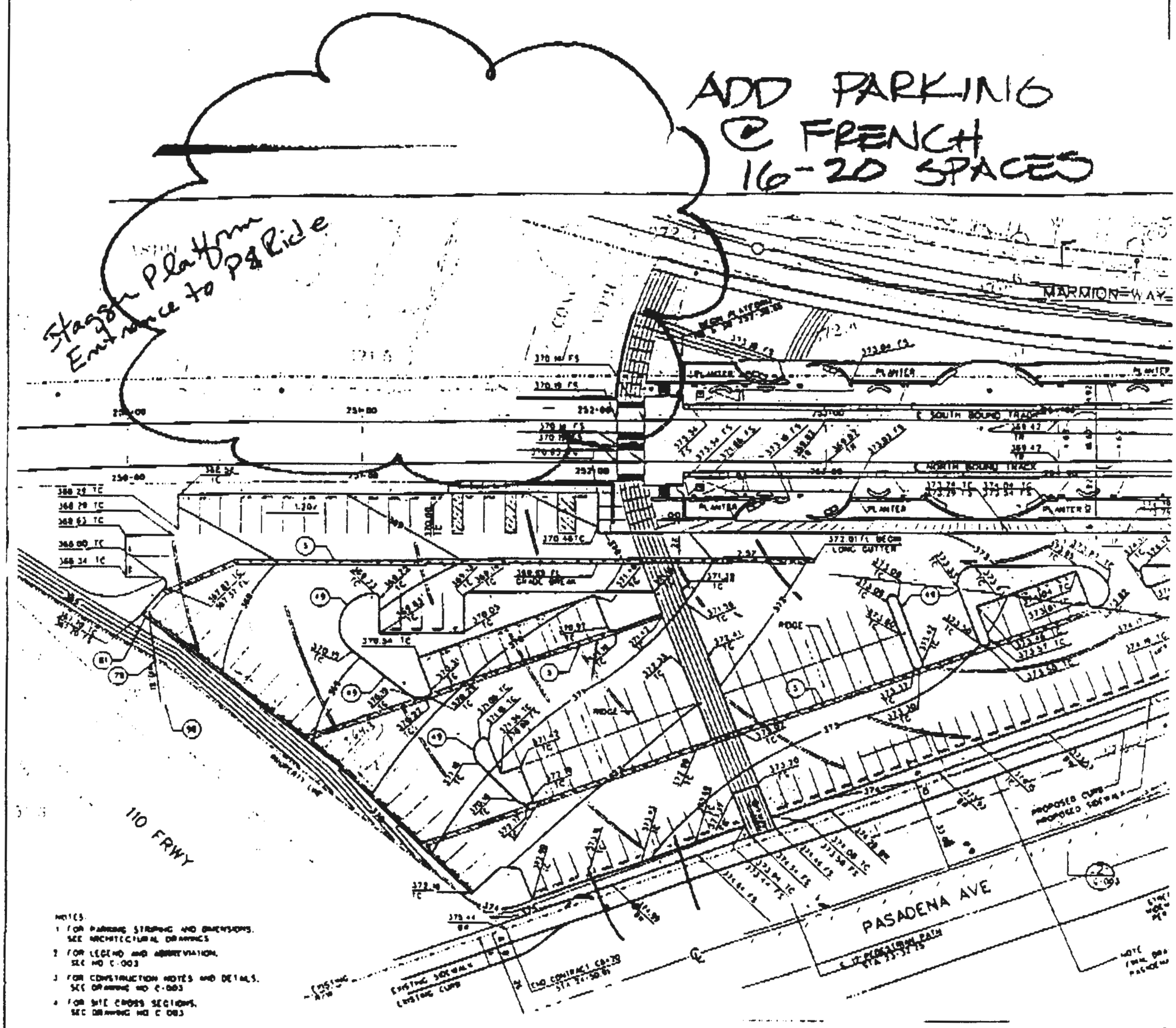
- Increases cost

DISCUSSION:

The original design incorporates all parking in one lot on the east side of the tracks, although MTA owns property on the west side of the tracks also. The construction cost increase to the project is approximately $20,000.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS			

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	F-4
	☐ AS DESIGNED ☒ ALTERNATIVE	SHEET NO.	2 of 3



PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	F-4
		SHEET NO.	3 of 3

CALCULATE AREA FOR PAVING

20 SPACES @ 9 x 18 = 3,240 square feet
actual parking area

AREA TO BE PAVED WILL LIKELY BE
TRAPAZOIDAL

$$\frac{40 + 20}{2} \times 120 = 3,600 \text{ square feet}$$

say 4,000 square feet

assume 4" asphaltic concrete
over 6" Class II aggregate base

SUMMARY OF POTENTIAL COST SAVINGS

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT		LOCATION: LOS ANGELES TO PASADENA, CALIFORNIA				
PROJECT ELEMENT: STATIONS		PRESENT WORTH OF COST SAVINGS				
ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	INITIAL COST SAVINGS	O & M SAVINGS	TOTAL SAVINGS
	SW MUSEUM (SW)					
SW-2	Step footings along the retaining wall to reduce cost and improve constructibility at SW Museum Station	DESIGN SUGGESTION				
	AVENUE 57 (A57)					
A57-2	Modify finish on sound wall at Avenue 57 Station	DESIGN SUGGESTION				
A57-3	Incorporate the Marmion Way corridor Improvements into the project	DESIGN SUGGESTION				
	MISSION (M)					
M-1	Move Mission Station northbound platform 8.8 ft. south	DESIGN SUGGESTION				
M-3	At Mission Station, protect the Liquid Amber (Sweet Gum) Trees in place versus moving the trees	DESIGN SUGGESTION				
M-5	At Mission Station, modify adjacent exterior walls of storage buildings to provide a two-hour fire rating in lieu of constructing a freestanding wall	96,600	20,690	75,910	(4,491)	71,419

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	SW-2
DESCRIPTION:	STEP FOOTINGS ALONG RETAINING WALL TO REDUCE COST AND IMPROVE CONSTRUCTIBILITY AT SW MUSEUM STATION	SHEET NO.	1 of 3

ORIGINAL DESIGN: (Sketch attached)

At the SW Museum Station, the side retaining wall along the sidewalk is on a sloping grade. The bottom of the wall footing remains constant, ignoring the grade change.

ALTERNATIVE: (Sketch attached)

Step footings following finish grades and maintain tops 2 ft. below the finish grades.

ADVANTAGES:

- Cost-effective
- Improves constructibility

DISADVANTAGES:

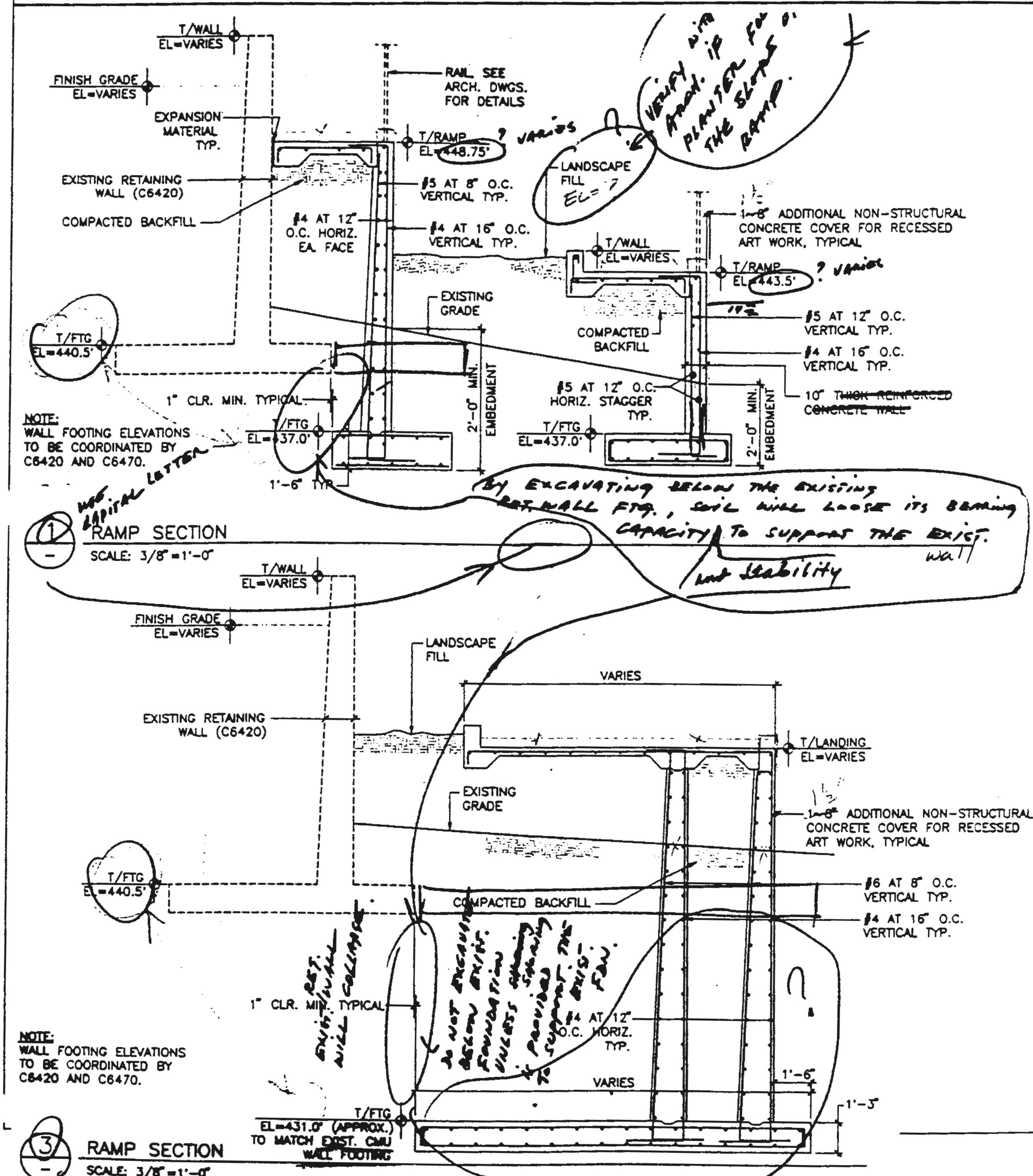
- None apparent

DISCUSSION:

Per the plans, at some point the footing is lower than the existing retaining wall that runs parallel to the track. This condition would undermine the existing wall and entail some extra shoring cost. The plans are incomplete and the grades are not clearly shown, so no cost estimate for the savings can be established at this time.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS			

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT		ALTERNATIVE NO. SW-2
❑ AS DESIGNED	❑ ALTERNATIVE	SHEET NO. 2 of 3

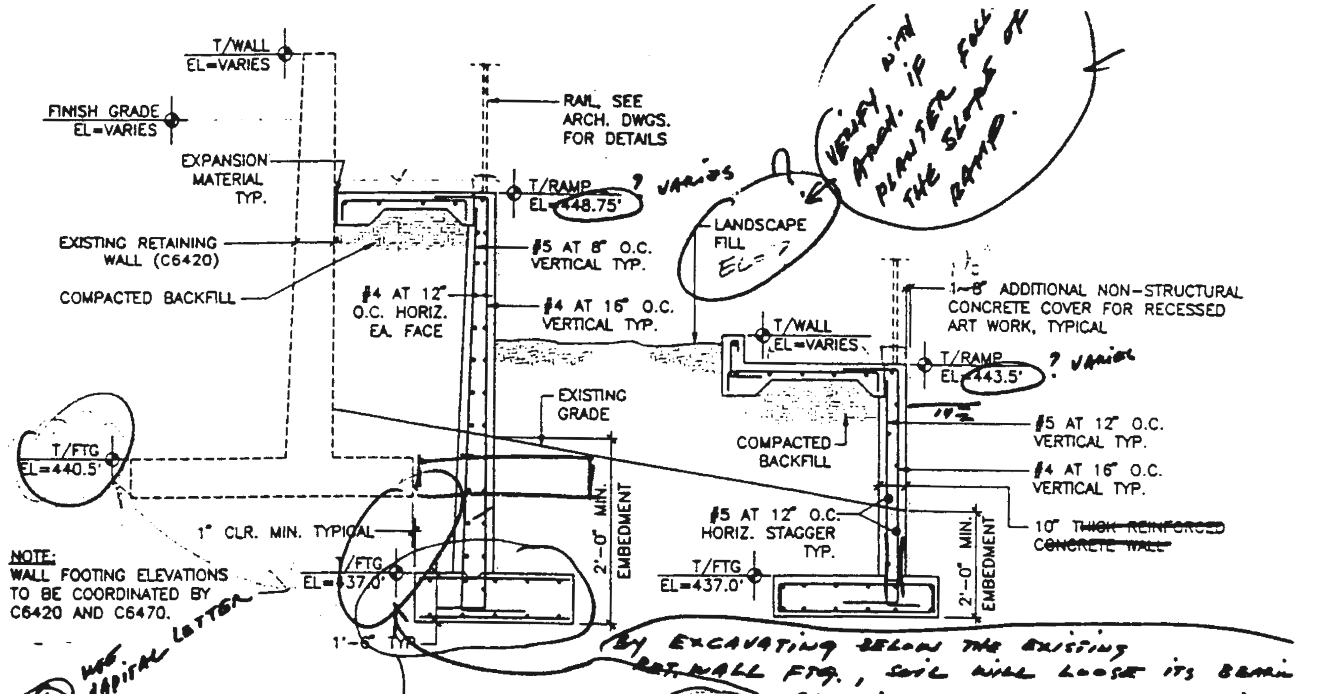


PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

ALTERNATIVE NO. SW-2

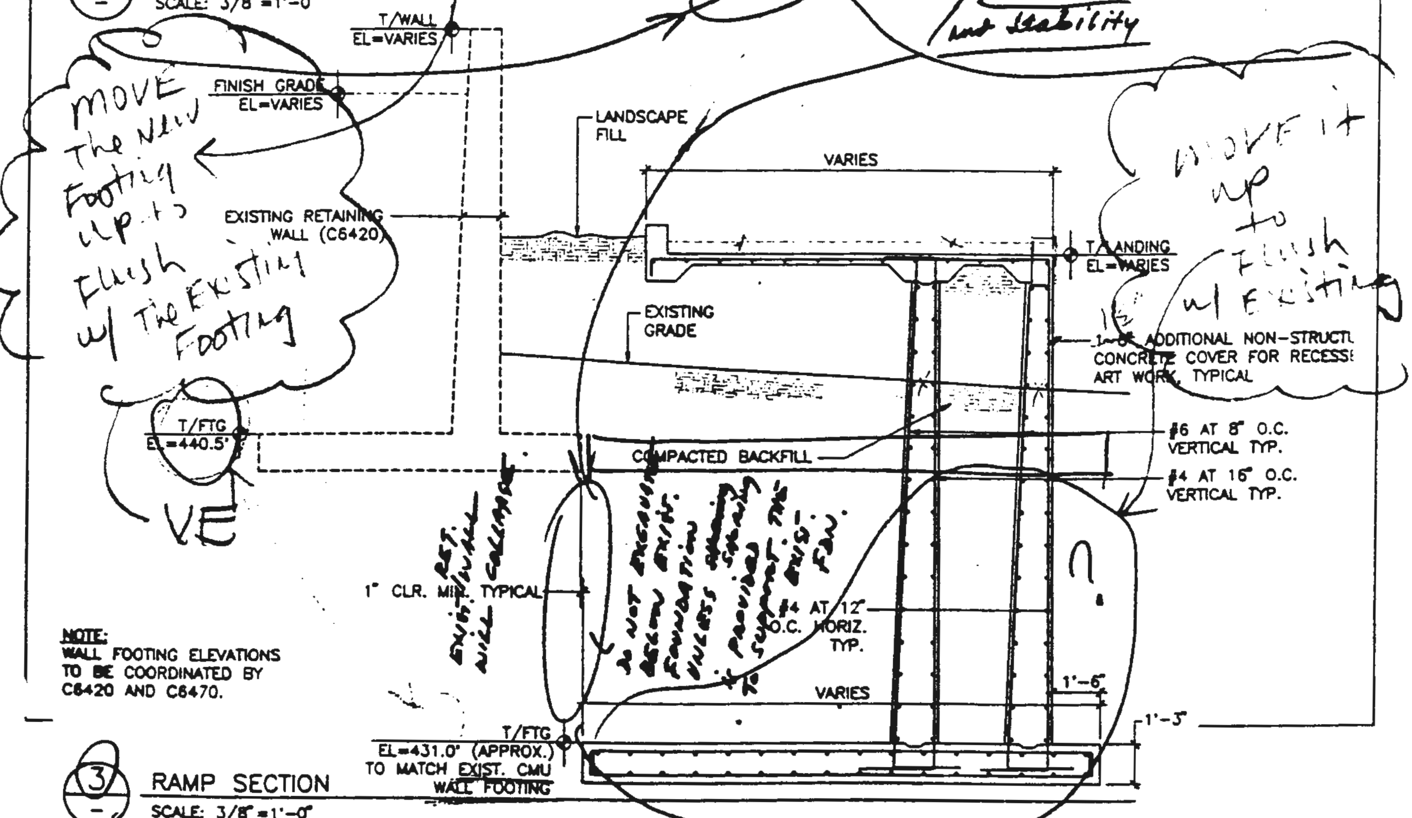
☐ AS DESIGNED ☒ ALTERNATIVE

SHEET NO. 3 of 3



RAMP SECTION

SCALE: 3/8"=1'-0"



RAMP SECTION

SCALE: 3/8"=1'-0"

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	A57-2
DESCRIPTION:	MODIFY FINISH ON SOUND WALL AT AVENUE 57 STATION	SHEET NO.	1 of 1

ORIGINAL DESIGN:

The PBL mitigation measure consolidation report requires a sound wall at Avenue 57 Station for noise mitigation. The report suggests a standard concrete block wall to achieve this. This station is in the middle of the Marmion Way corridor.

ALTERNATIVE:

Add a stucco finish to the wall.

ADVANTAGES:

- Reflects intent of design criteria for Marmion Way corridor

DISADVANTAGES:

- Adds minor cost

DISCUSSION:

The Marmion Way corridor report by HNTB Corporation recommends streetscape enhancements between Avenue 51 and Avenue 60, including special paving, etc. A raw concrete block wall at the Avenue 57 Station is not an appropriate solution in terms of the area upgrade. This design suggestion recommends a stucco finish on the sound wall that relates to the character of the neighborhood environment, as well as to the corridor upgrade.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS			

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	A57-3
DESCRIPTION:	INCORPORATE MARMION WAY CORRIDOR IMPROVEMENTS INTO THE PROJECT	SHEET NO.	1 of 2

ORIGINAL DESIGN:

The at-grade trains are planned to operate at the speed of parallel traffic along Marmion Way between Avenues 50 and 61. Intersection control is to be achieved with traffic signals. No special treatment of the intersections is currently shown.

ALTERNATIVE: (Sketch attached)

Incorporate one of the urban design upgrade suggested in the HNTB Corporation concept report dated, January 3, 1997. This design calls for creating a streetscape at each track by adding paving and landscaping.

ADVANTAGES:

- Accommodates access for emergency vehicles
- Enhances corridor

DISADVANTAGES:

- Potential for collision of trains, motor vehicles and pedestrians
- Requires community approval
- Adds cost for construction and maintenance

DISCUSSION:

The Marmion Way corridor is a 10-block section of the Pasadena Blue Line through a historical, residential and commercial area. Community concerns about livability, pedestrian safety, motor vehicle access within the district were addressed in a series of community meetings. An agreement was reached to operate in "street running mode" with intersection upgrade to control trains, cars and pedestrians where the right of way intersects local streets. Train speed will be limited to 20 mph. Additional construction costs above baseline are estimated to be in the range of $985,000.

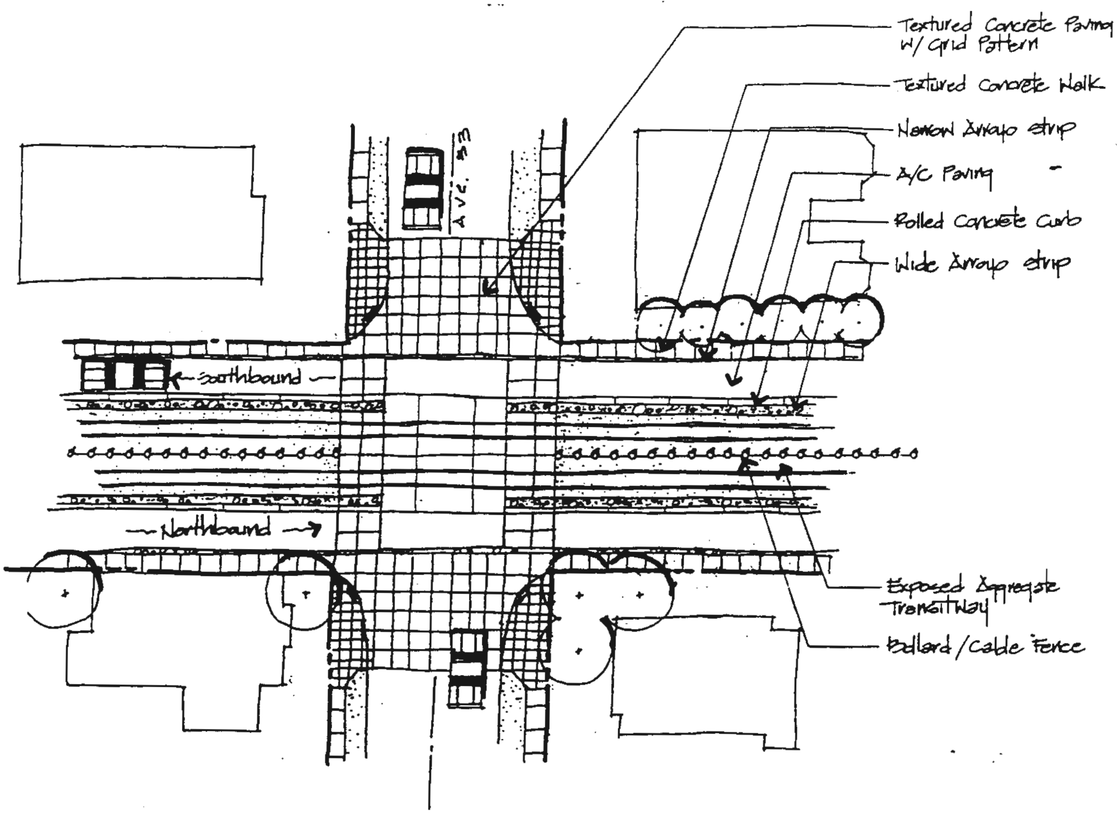
COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS			

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

ALTERNATIVE NO. A5?.3

☐ AS DESIGNED ☒ ALTERNATIVE

SHEET NO. 2 of 2



ALTERNATIVE IA'

PLAN

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	**M-1**
DESCRIPTION:	**MOVE MISSION STATION NORTHBOUND PLATFORM 8.8 FT. SOUTH**	SHEET NO.	1 of 3

ORIGINAL DESIGN: (Sketch attached)

At Mission Station, the split station platforms are staggered to maximize the clearance between the front of the train at the platform and the at-grade street crossing ahead of the train.

ALTERNATIVE: (Sketch attached)

Move the northbound platform to the south 8.8 ft.

ADVANTAGES:

- Provides greater separation between end of platform and the upstream at-grade crossing
- Increases operational clearance from Mission/Meridian intersection

DISADVANTAGES:

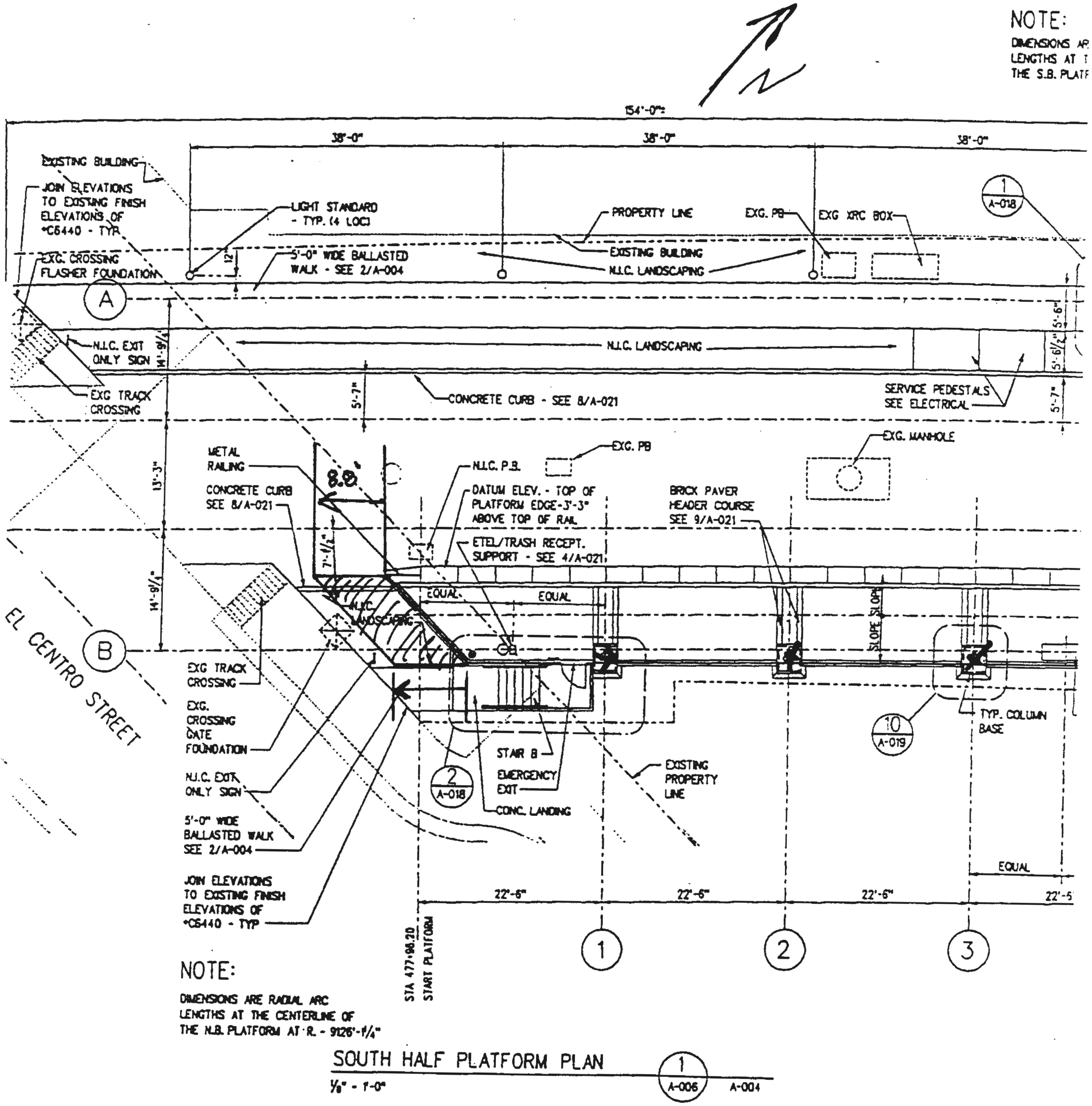
- Reduces separation between start of platform and the downstream at-grade crossing

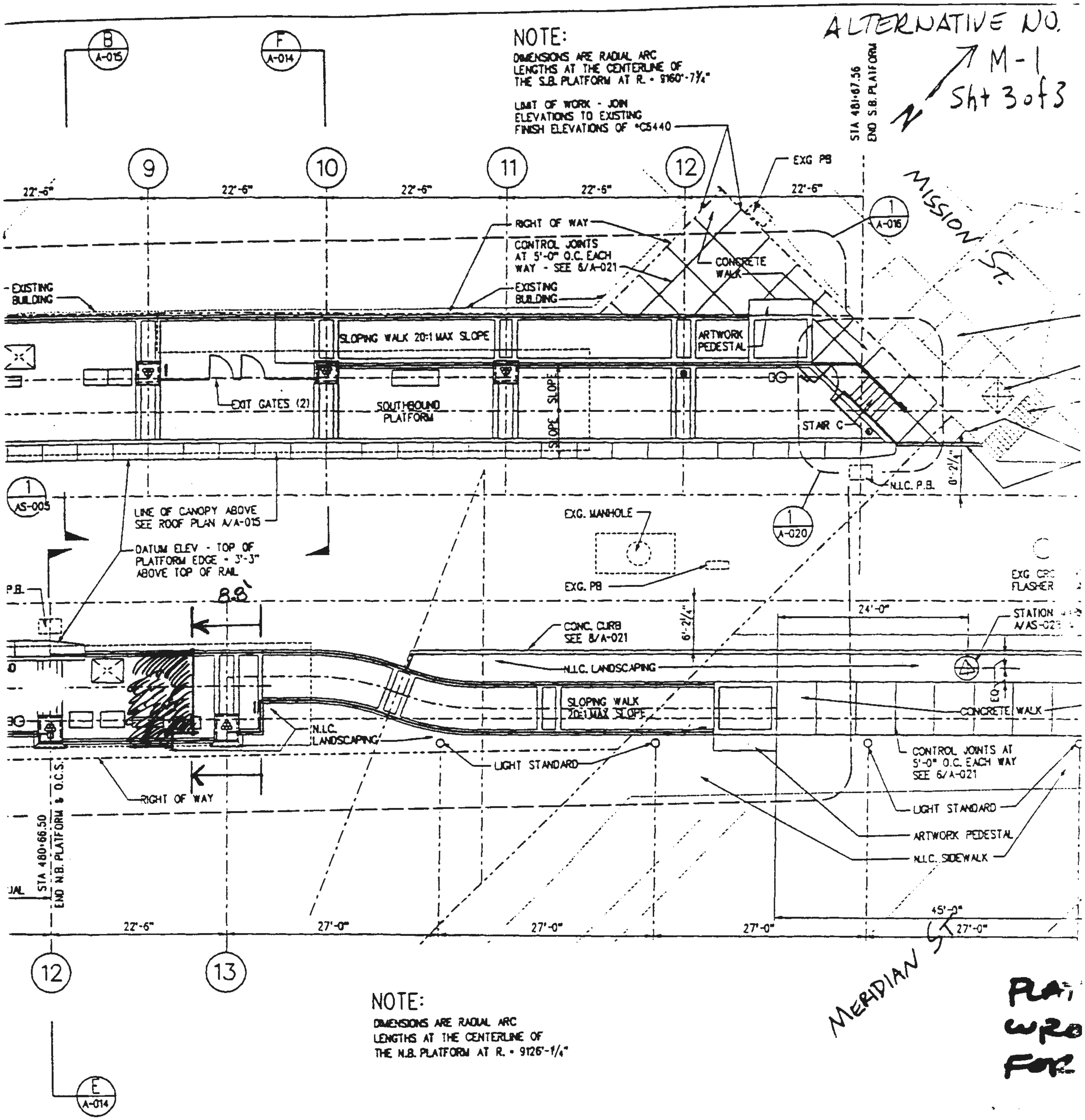
DISCUSSION:

In the PDSR, the MTA requests this change. It does not appear that moving the station creates major problems. If adopted, the location of the insulated joints and street signals will have to be reviewed.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	**DESIGN SUGGESTION**		
SAVINGS			

ALTERNATIVE NO.
M-1
Sht. 2 of 3





203

DESIGNED BY	G.FLORES
DRAWN BY	H.YUKI
CHECKED BY	T.SHIDA
IN CHARGE	E.LADOWICZ
DATE	4/26/95

LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

PASADENA BLUE LINE

LADOWICZ & ASSOCIATES

SUBMITTED

APPROVED

LAUPT T

MISSION/FILL

MISSION

PLATFORM

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	**M-3**
DESCRIPTION:	**AT MISSION STATION PROTECT THE SWEET GUM TREES IN PLACE IN LIEU OF MOVING THEM**	SHEET NO.	1 of 2

ORIGINAL DESIGN:

The original design intent is unclear concerning the sweet gum trees located along the right-of-way at Mission Station. Conversations concerning the trees have suggested moving and replacing the trees.

ALTERNATIVE:

The alternative is to protect the trees in place during construction.

ADVANTAGES:

- Maintains the symbolism of the trees

DISADVANTAGES:

- Contractor may accidentally damage the trees during construction

DISCUSSION:

The nine trees hold a symbolic place in the community. A review of the placement of these trees indicate two potential options for maintaining the trees. With care, the trees can remain in place through and after the construction.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	**DESIGN SUGGESTION**		
SAVINGS			

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. M-3
	SHEET NO. 2 of 2

Pasadena Blue Line
Mission Station – Memorial Trees

Existing memorial trees at Mission Station:

9 – Liquidambar styraciflua, Sweet Gum

Height: Approximately 25' to30'

Trunk Diameter: Varies from5-1/2" to 8-1/2" with two trees with multiple smaller dia. trunks

Spacing: Varies from 13' to 18' o.c.

Locations: Varies from 33" to 61" from P.L. fence

Roots: Generally no roots lifting surface; one or two trees have some minor lifting

Expected impacts from project:

Root loss on one side of tree due to excavation.
Potential minimal, if any foliage loss on an on-going basis in Blue Line right-of-way

Recommendations for transplanting:

Option 1: Leave in place
Hand excavate and hand cut roots
Protect during construction
Pros: Impacts on only one side of root system
Cons: Potential damage during construction (extent unknown – dependent on care taken)

Option 2: Box and relocate
72" to 84" box
Must be transplanted during dormant period
Pros: Relocates trees for protection during construction and operations
Cons: Impacts to entire root system and tree; potential for decline and loss of one or more trees from transplanting

Final determination and recommendations should be made by a certified arborist

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	**M-5**
DESCRIPTION:	**AT MISSION STATION MODIFY ADJACENT EXTERIOR WALLS OF STORAGE BUILDINGS FOR TWO-HOUR FIRE RATING IN LIEU OF USING A FREE-STANDING WALL**	SHEET NO.	1 of 4

ORIGINAL DESIGN: (Sketch attached)

Construct a free standing wall between Mission Station and the adjacent storage buildings to achieve a two-hour fire separation.

ALTERNATIVE:

Modify the existing exterior walls of the storage building to Mission to achieve a two-hour rating.

ADVANTAGES:

- Reduces cost significantly
- Reduces construction schedule

DISADVANTAGES:

- Requires coordination with owner of storage buildings
- Needs continuing maintenance over time
- Disrupts storage structures

DISCUSSION:

The proximity of Mission Station to the shared property line between the station and adjacent storage buildings require a two-hour fire separation based on Uniform Building Code requirements. The freestanding wall is a viable option in terms of constructibility, but is an expensive solution due to the structural requirements.

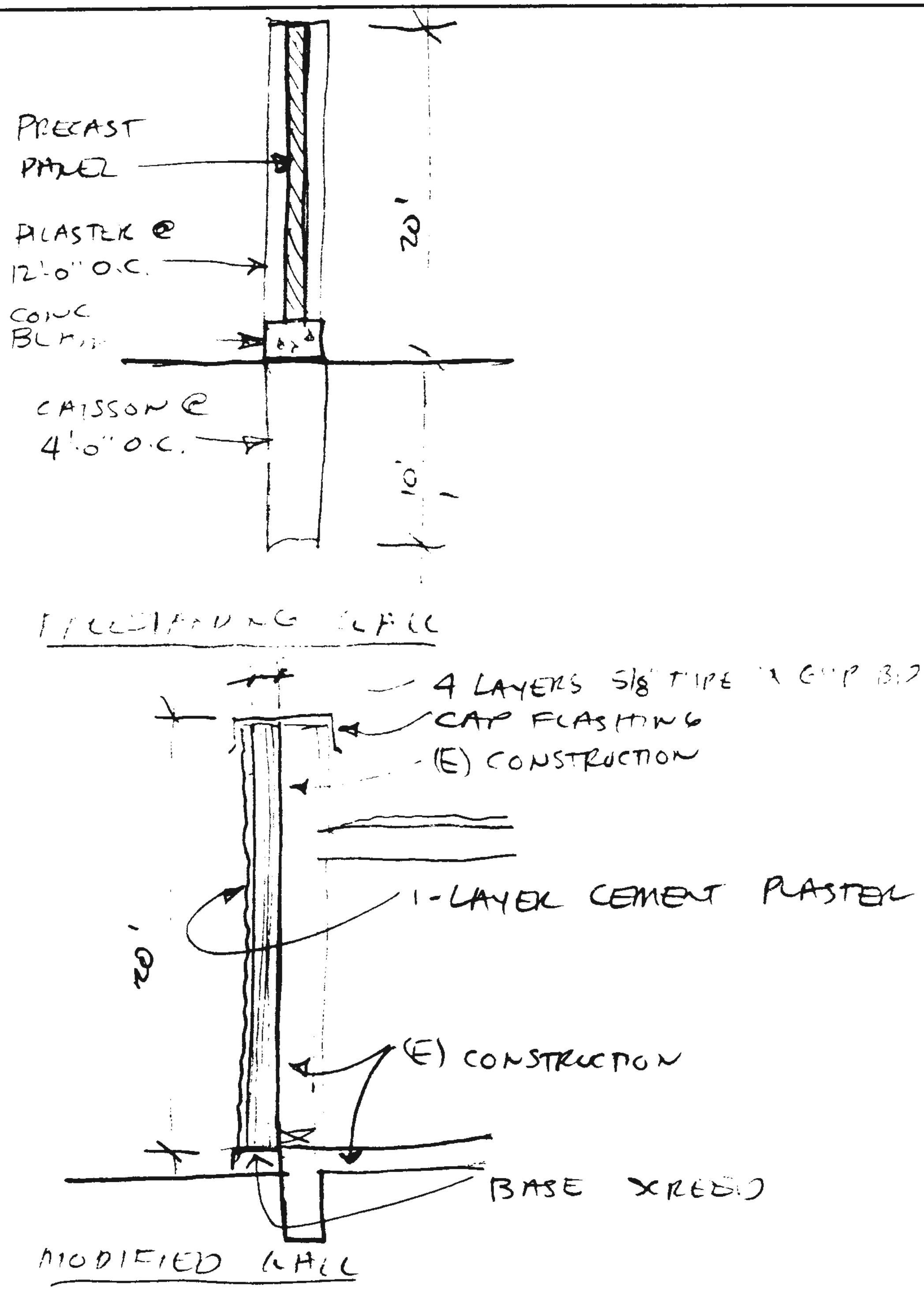
Modifying the exterior walls of the storage building is the least costly option and is also easily constructible. This option requires stripping the stucco off the exterior walls and furring out with fire resistive construction to achieve the two-hour rating. The fire department needs to review this option as an alternative solution. It should not be assumed to be valid until approved.

Because the South Pasadena Fire Department has not approved sprinklering the storage buildings to achieve a two-hour rating, sprinklering is assumed not to be a viable option. Drawbacks to the wall upgrade option include disruption to the storage facility during construction, possible loss of income to owner and building security.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 96,600	$ 0	$ 96,600
ALTERNATIVE	$ 20,690	$ 4,491	$ 25,181
SAVINGS	$ 75,910	$ (4,491)	$ 71,419

SKETCHES

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. M-5
	❑ AS DESIGNED ❑ ALTERNATIVE	SHEET NO. 2 of 4



COST WORKSHEET

PROJECT: **PASADENA BLUE LINE LIGHT RAIL PROJECT**

ALTERNATIVE NO. M-5

SHEET NO. 3 of 4

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
FREESTANDING WALL							
CAISSONS	EA	40	$360	14,400			
BM (CONC)	LF	160	20	3,200			
PILASTER	EA	15	1,000	15,000			
PRECAST PANELS	SF	20	3,200	64,000			
MODIFIED STORAGE							
BUILDING WALLS							
4 LAYER 5/8" TYPE "X" GYP. BD	SF				3200	2.56	8,192
LATH & PLASTER (1")	SF				3200	2.94	9,408
3 COAT PAINT SYSTEM	SF				3200	.51	1,632
ALUM CAP FLASHING	LF				160	3.66	586
BASE FLASHING	LF				160	2.45	392
[illegible] ENDS	LF				80	6.00	[illegible]
Sub-Total							
Mark-Up at %							
TOTAL				96,600			20,690

LIFE CYCLE COST ANALYSIS

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT | ALTERNATIVE NO. M-5
DESCRIPTION: | SHEET NO. 4 of 4

LIFE CYCLE PERIOD 30 Years
INTEREST RATE 6% %

BASE | ALTERNATE

A. INITIAL COST $ 20,690
Useful Life (Years) 30

INITIAL COST SAVINGS $ 75,910

B. RECURRENT COSTS (Annual Expenditures)

1. Maintenance
2. Operating
3. Energy
4.
5.
6.

Total Annual Costs
Present Worth Factor
Present Worth of RECURRENT COSTS 0

C. SINGLE EXPENDITURES	Year	Amount	PW Factor	Present Worth	Present Worth
REPAINTING	5	$326	13.76	$4491	

OCCURS EVERY 5 YEARS @ A COST OF $1632. MAKE INTO AN ANNUAL COST OF $1632/5 = 326

Salvage Value

Present Worth of SINGLE EXPENDITURES 4491

D. Total Recurrent Costs & Single Expenditures (B + C)

RECURRENT COSTS & SINGLE EXPENDITURES SAVINGS

E. *TOTAL PRESENT WORTH COST (A + D)*

TOTAL LIFE CYCLE SAVINGS

SUMMARY OF POTENTIAL COST SAVINGS

PROJECT: **PASADENA BLUE LINE LIGHT RAIL PROJECT** LOCATION: **LOS ANGELES TO PASADENA, CALIFORNIA**

PROJECT ELEMENT: **STATIONS**

PRESENT WORTH OF COST SAVINGS

ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	INITIAL COST SAVINGS	O & M SAVINGS	TOTAL SAVINGS
	FILLMORE (FI)					
FI-1	Use the standard canopy in lieu of station specific canopy at Fillmore Station	264,600	135,000	129,600	—	129,600
	DEL MAR (D)					
D-2	Use double acting pedestrian gates at Del Mar Station track crossing	DESIGN SUGGESTION				
D-3	At Del Mar station, allow platform access/egress at both ends of the platforms	DESIGN SUGGESTION				
	MEMORIAL PARK (MP)					
MP-3	Modify the Memorial Park Station platform canopy	450,000	216,900	233,100	—	233,100
	LAKE (L)					
L-4	At Lake Avenue Station, eliminate provision for future escalator and redirect east side of stairs from Lake Avenue Overpass	95,750	0	95,750	—	95,750

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	**FI-1**
DESCRIPTION:	**USE STANDARD CANOPY IN LIEU OF STATION-SPECIFIC CANOPY AT FILLMORE STATION**	SHEET NO.	1 of 4

ORIGINAL DESIGN: (Sketch attached)

The original design incorporates a special design for the canopy at Fillmore Station.

ALTERNATIVE: (Sketch attached)

Use the standard canopy design at the Fillmore Station.

ADVANTAGES:

- Provides uniformity among stations
- Reduces cost

DISADVANTAGES:

- None apparent

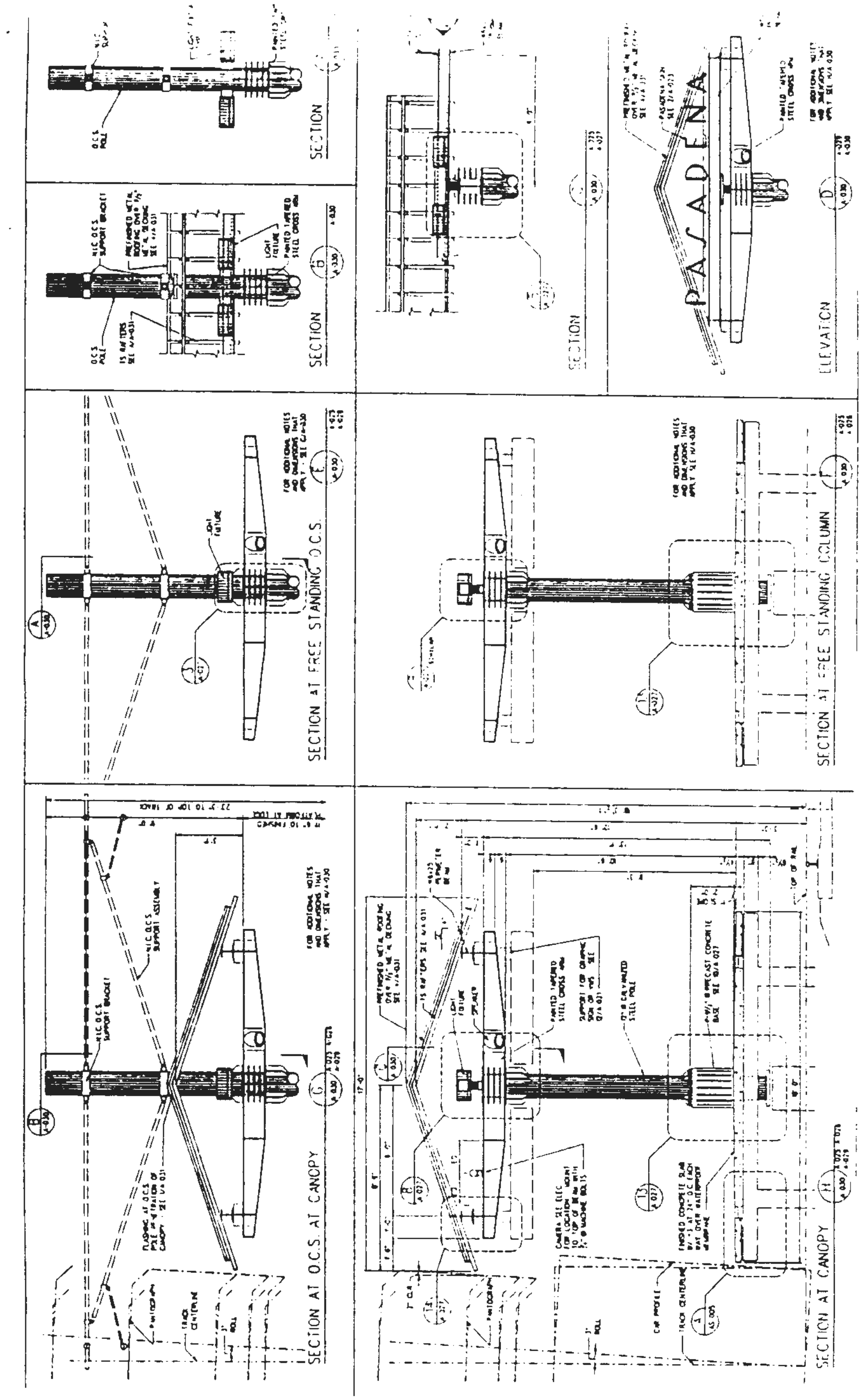
DISCUSSION:

The use of a standardized canopy, except at landmark stations, has been adopted to provide uniformity and control costs. Fillmore Station is not a landmark station and, therefore, should have a standard canopy.

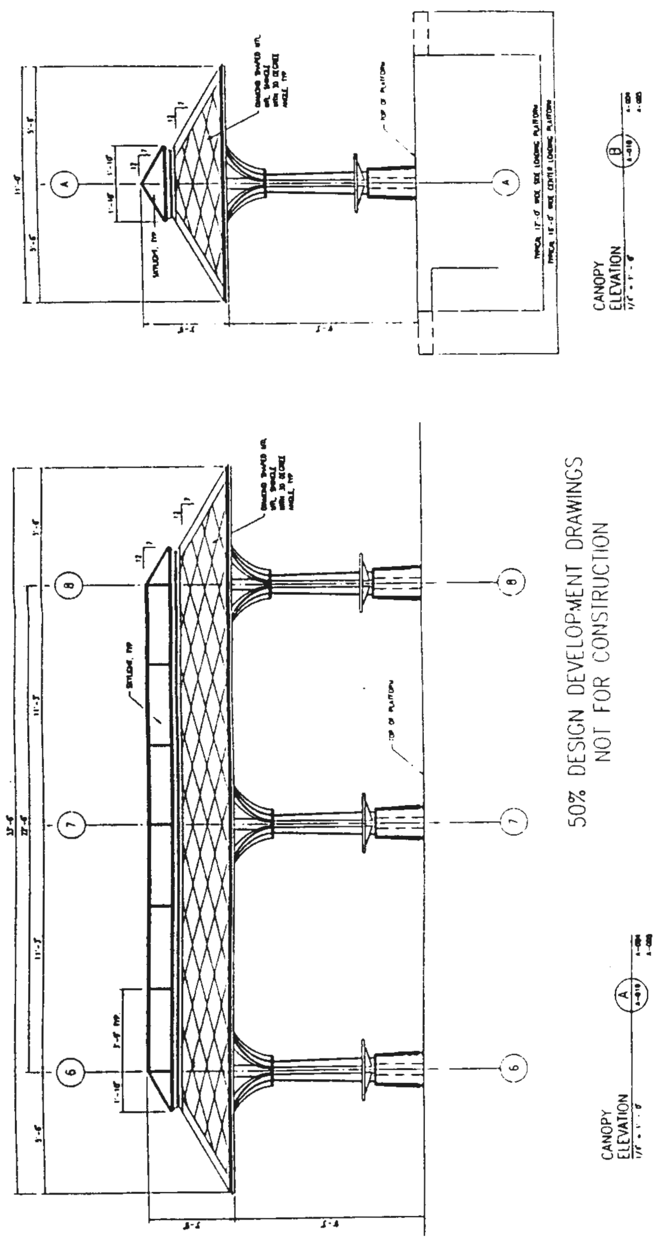
COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 264,600	—	$ 264,600
ALTERNATIVE	$ 135,000	—	$ 135,000
SAVINGS	$ 129,600	—	$ 129,600

SKETCHES

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. FI-1
	☑ AS DESIGNED ☐ ALTERNATIVE	SHEET NO. 2 of 4



PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT		ALTERNATIVE NO. FI-1
	☐ AS DESIGNED	☐ ALTERNATIVE	SHEET NO. 3 of 4



COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

ALTERNATIVE NO. FI-1

SHEET NO. 4 of 4

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
Canopy	EA	3	88,200	264,600	3	45,000	135,000
Sub-Total							
Mark-Up at %							
TOTAL				264,600			135,000

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	D-2
DESCRIPTION:	USE DOUBLE ACTING PEDESTRIAN GATES AT DEL MAR STATION TRAFFIC CROSSING	SHEET NO.	1 of 1

ORIGINAL DESIGN: (Sketch attached)

At Del Mar Station, the pedestrian crossing gates open away from the tracks, allowing people to exit the track area with the gates swinging in the direction of travel. This station is expected to see a large number of tourists at Rose Bowl time and during other events.

ALTERNATIVE: (Sketch attached)

Use double acting gates (gates that can swing in both directions) to ease circulation across tracks during times of heavy use, such as Rose Bowl times, etc.

ADVANTAGES:

- Allows for reduced crossing time at tracks during game days
- Simplifies crowd control

DISADVANTAGES:

- Increases gate cost slightly

DISCUSSION:

Crowd control through gateways is significantly easier when the gates swing in the direction of travel. Opening toward oneself in crowded conditions causes traffic jams and could be a safety concern by keeping people on the tracks.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS			

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	D-3
DESCRIPTION:	AT DEL MAR STATION ALLOW PLATFORM ACCESS/EGRESS AT ENDS OF PLATFORMS	SHEET NO.	1 of 3

ORIGINAL DESIGN: (Sketch attached)

At the Del Mar Station, the original design provides passenger access to the platforms from the north end only. Due to the high passenger load during special events at the Rose Bowl, there are special canopy requirements which could impact the right-of-way and the bus terminal.

ALTERNATIVE: (Sketch attached)

Provide passenger access to both ends of the platform to split ingress/egress and reduce potential for conflicts.

ADVANTAGES:

- Could allow use of standard canopy and lights
- Eliminates potential conflict with bus terminal

DISADVANTAGES:

- Requires additional TVM and map cases
- Requires additional Calgary gates and grade crossing

DISCUSSION:

Exiting calculations indicate a potential problem during special events at the Rose Bowl when all passengers must use a single exit. By providing an additional exit, the efficiency of the Station will be improved. In addition, there is the potential that some passengers may try to exit the platform and cross the tracks in an unsafe manner.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTIONS		
SAVINGS			

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	D-3
DESCRIPTION:	AT DEL MAR STATION ALLOW PLATFORM ACCESS/EXIT AT ENDS OF PLATFORMS	SHEET NO.	1 of 3

ORIGINAL DESIGN: (Sketch attached)

At the Del Mar Station, the original design provides passenger access to the platforms from the north end only. Due to the high passenger load during the special events at the Rose Bowl, there are special canopy requirements which could impact the right-of-way and the bus terminal.

ALTERNATIVE: (Sketch attached)

Provide passenger access to both ends of the platform to split ingress/egress and reduce potential for conflicts.

ADVANTAGES:

- Could allow use of standard canopy and lights
- Eliminates potential conflict with bus terminal

DISADVANTAGES:

- Requires additional TVM and map cases
- Requires additional Calgary gates and grade crossing

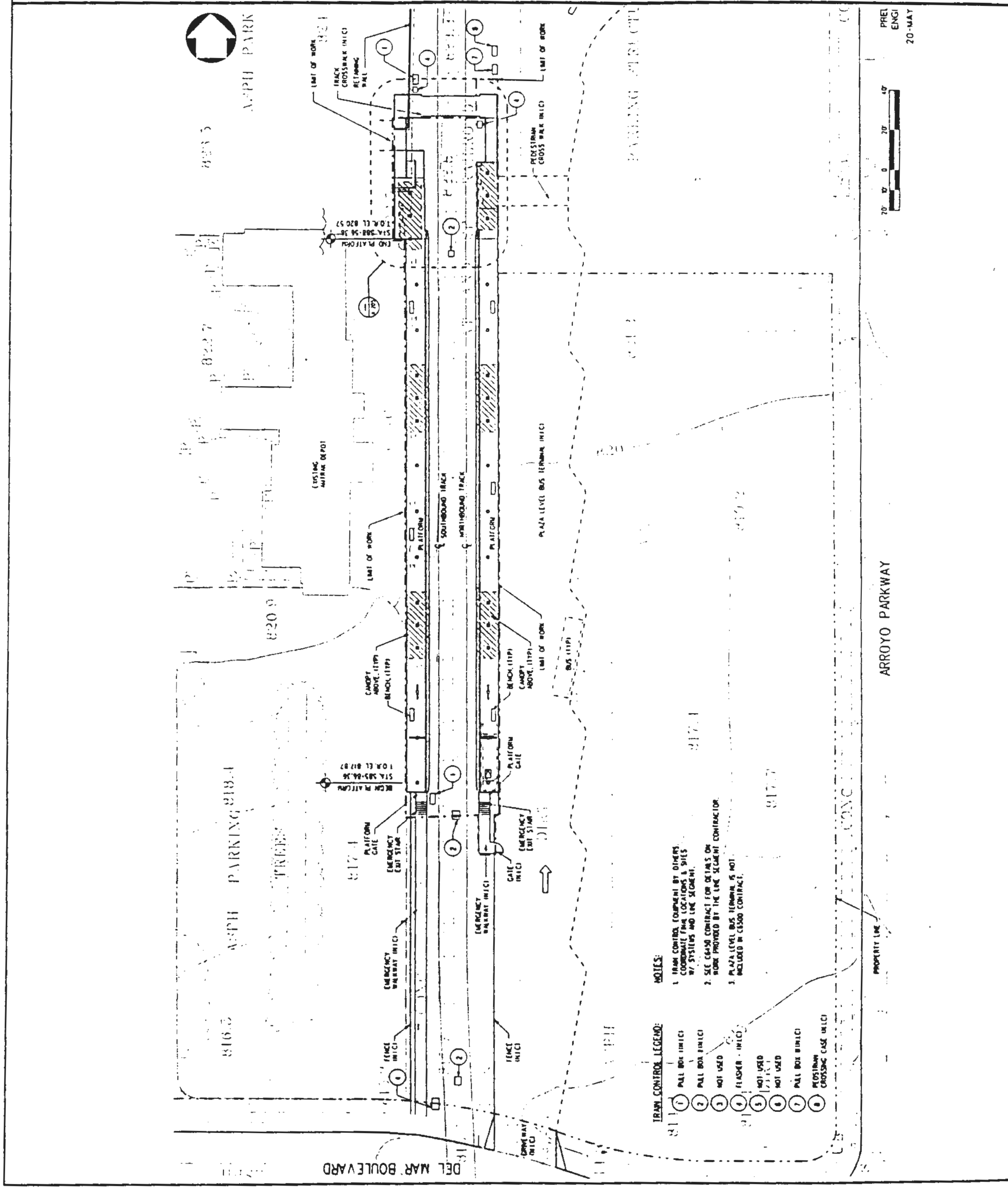
DISCUSSION:

Existing calculations indicate a potential problem during special evens at the Rose Bowl when all passengers must use a single exit. By providing an additional exit, the efficiency of the station will be improved. In addition, there is the potential that some passengers may try to exit the platform and cross the tracks in an unsafe manner.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS			

PROJECT: **PASADENA BLUE LINE LIGHT RAIL PROJECT** ALTERNATIVE NO. D-3

☒ AS DESIGNED ☐ ALTERNATIVE SHEET NO. 2 of 3



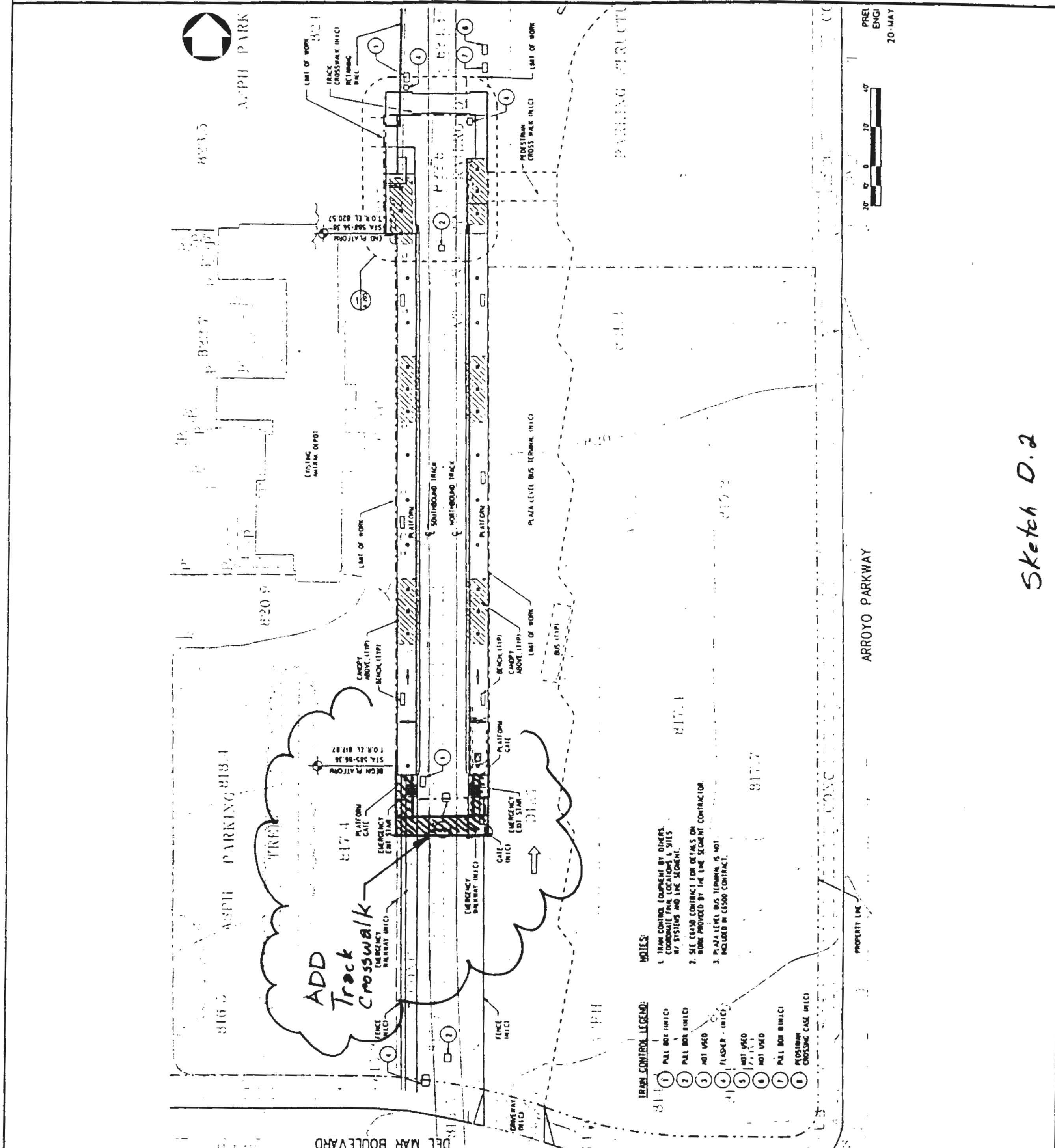
Sketch D.1

PROJECT: **PASADENA BLUE LINE LIGHT RAIL PROJECT**

ALTERNATIVE NO. D-3

☐ AS DESIGNED ☒ ALTERNATIVE

SHEET NO. 3 of 3



VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	MP-3
DESCRIPTION:	MODIFY MEMORIAL PARK STATION PLATFORM CANOPY	SHEET NO.	1 of 4

ORIGINAL DESIGN: (Sketch attached)

The platform canopy structure is a trellis-type structure consisting of a series of 12 in. × 12 in. tube arches at 30 ft. on center and 12 in. × 2 in. tube infill at 12 in. on center perpendicular to the main arches.

ALTERNATIVE: (Sketch attached)

Attach an arched canopy directly to the apartment building structure above and provide an interlocking linear stainless steel slat ceiling to eliminate views of the underside of decking and the rear wall.

ADVANTAGES:

- Blocks view of underside of deck and exposed piping
- Blocks view of rear wall of building
- Creates acoustical cavity between arched ceiling and building structure
- Reduces cost significantly
- Reduces problems with birds

DISADVANTAGES:

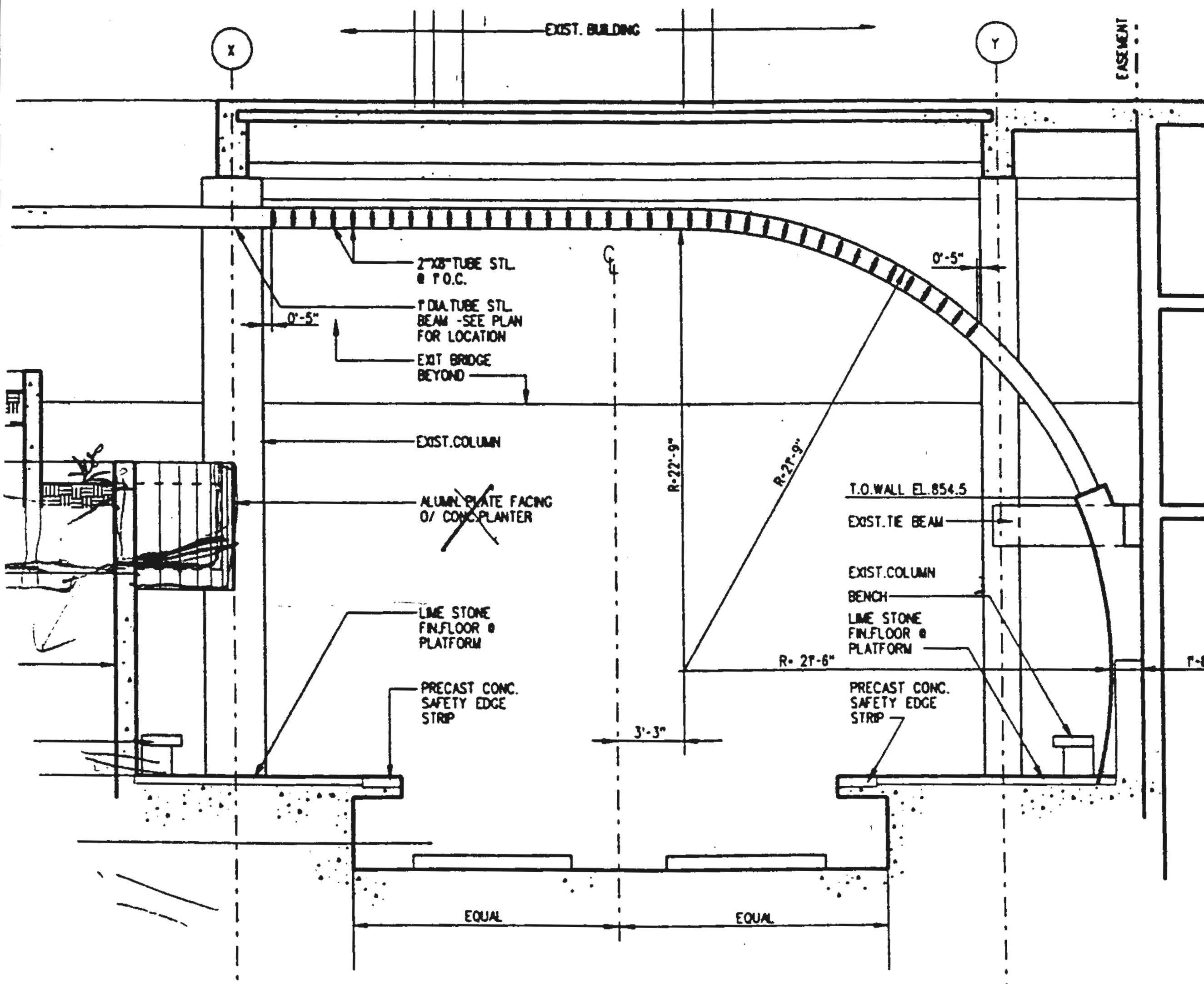
- Adds redesign costs

DISCUSSION:

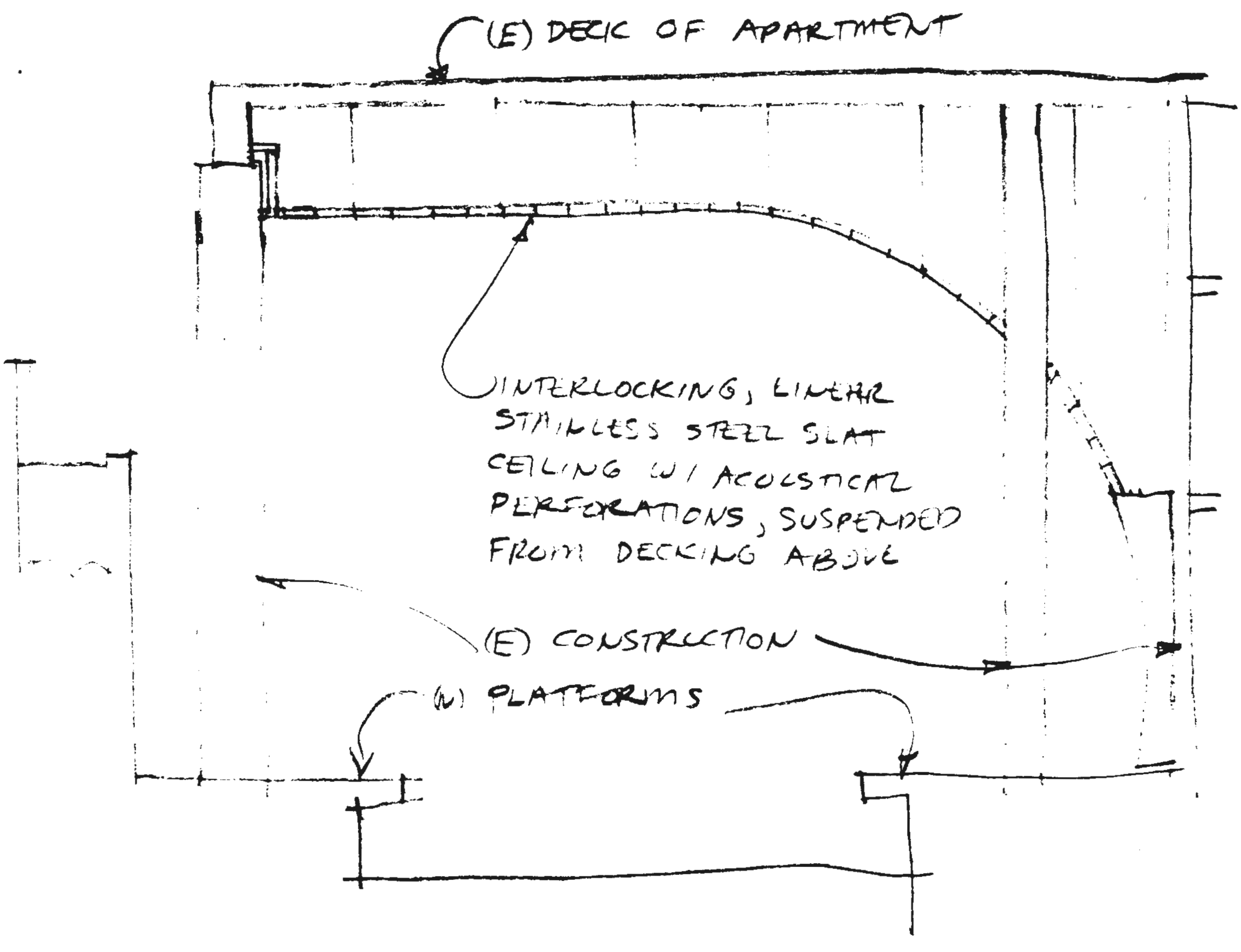
The current design is double the cost of the alternative and allows the underside of the of decking, piping and rear wall of the apartment building to remain exposed to view. The alternative canopy hangs directly from the structure. This ceiling system completely conceals the apartment building structure and provides a significant cavity for acoustical insulation, if recommended by future acoustical studies. The alternative solution requires nominal maintenance over its life span.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 450,000	—	$ 450,000
ALTERNATIVE	$ 216,900	—	$ 216,900
SAVINGS	$ 233,100	—	$ 233,100

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT		ALTERNATIVE NO. MP-3
☒ AS DESIGNED	☐ ALTERNATIVE	SHEET NO. 2 of 4



PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. MP-3
☐ AS DESIGNED	☒ ALTERNATIVE	SHEET NO. 3 of 4



COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

ALTERNATIVE NO. MP-3

SHEET NO. 4 of 4

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
STRUCT. STEEL TRELLIS	SF	18,000	25.00	450,000			
CANOPY							
LINEAR CEILING	SF				18,000	12.05	216,900
Sub-Total				450,000			216,900
Mark-Up at %							
TOTAL							

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	**L-4**
DESCRIPTION:	**AT LAKE AVENUE STATION ELIMINATE PROVISIONS FOR A FUTURE ESCALATOR AND REDIRECT EAST SIDE STAIRS FROM LAKE AVENUE OVERCROSSING**	SHEET NO.	1 of 5

ORIGINAL DESIGN: (Sketch attached)

The platform at the Lake Avenue Station begins approximately 80 ft. east of the edge of the Lake Avenue over-crossing of the I-210 freeway. The beginning of the station passenger loading platform is set to allow for a future escalator on the east side of the Lake Avenue over-crossing.

ALTERNATIVE: (Sketch attached)

Replace the original east side stair/elevator layout with a mirror image of the west side. Begin the platform 75 ft. west of current location, moving the platform closer to the overpass.

ADVANTAGES:

- Eliminates 75 ft. of platform
- Reduces distance passengers must walk to trains
- Simplifies construction by using duplicate forms

DISADVANTAGES:

- Passengers using east stairs will have to reverse walking direction to/from passenger platform
- Eliminates the possibility of easily installing a future escalator

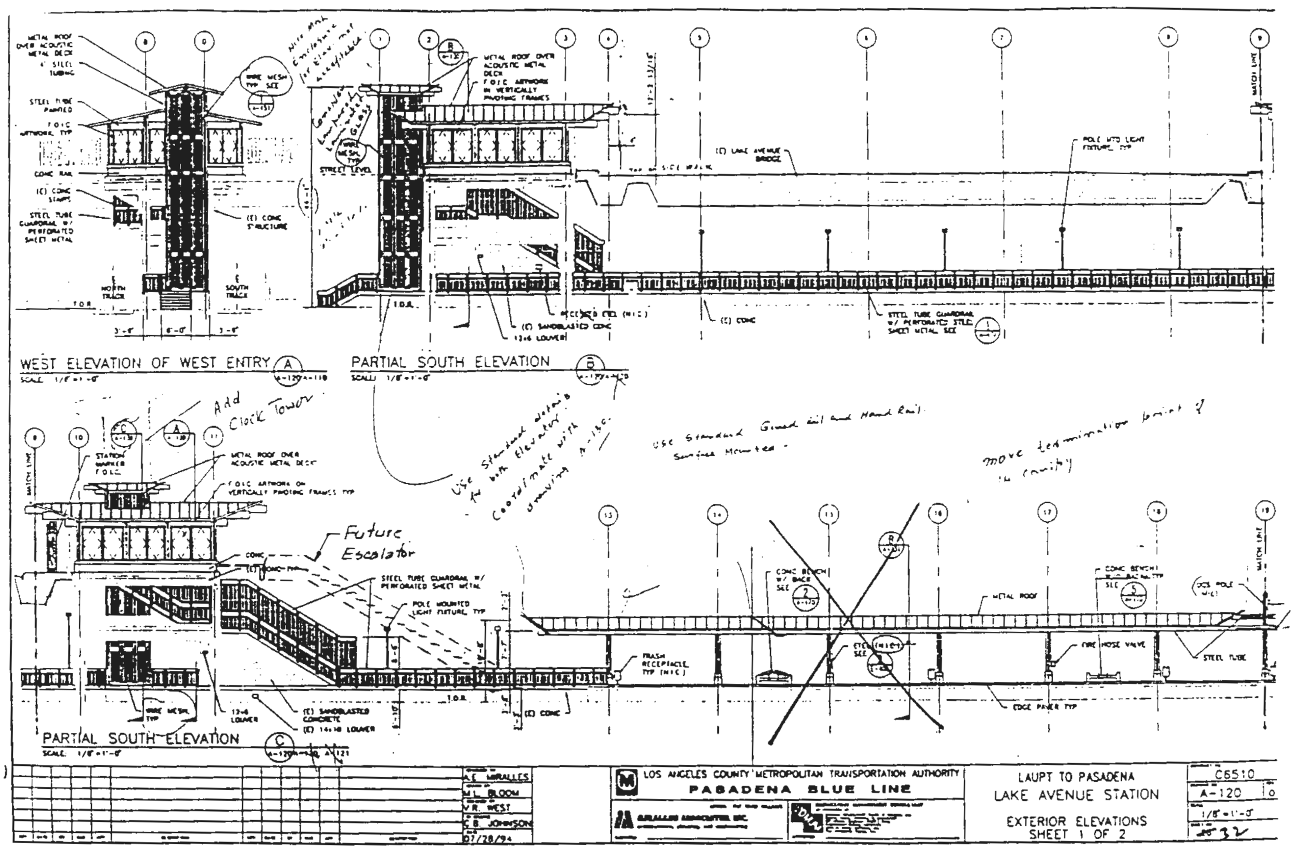
DISCUSSION:

Simplifying the stair construction will improve the first cost of the project while improving the usability of the station. Passenger walking distances will be shortened by this change.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 97,750	—	$ 97,750
ALTERNATIVE	$ 0	—	$ 0
SAVINGS	$ 97,750	—	$ 97,750

SKETCHES

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. L-4
☒ AS DESIGNED	☐ ALTERNATIVE	SHEET NO. 2 of 5

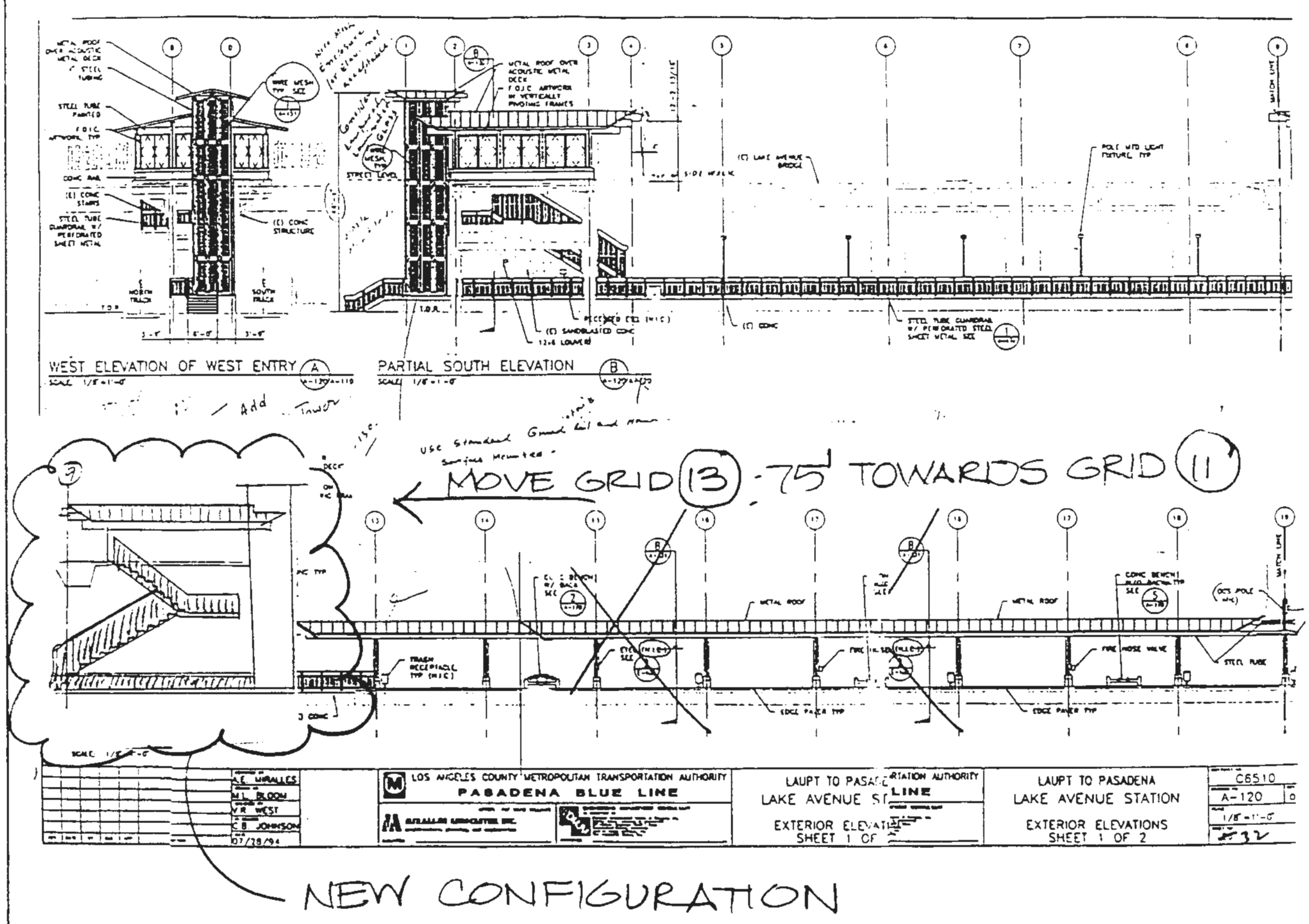


PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

ALTERNATIVE NO. L-4

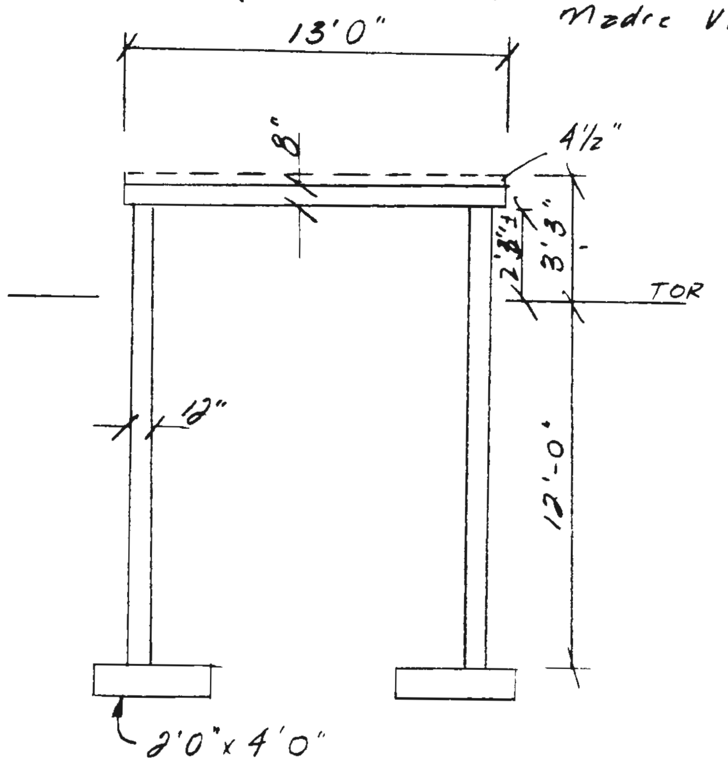
☐ AS DESIGNED ☒ ALTERNATIVE

SHEET NO. 3 of 5



PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. L-4
		SHEET NO. 4 of 5

Platform Section (See S-034, Memorial Park to Sierra Madre Villa Plans)



Concrete quantity

13' x .67' = 8.71 CF

14.25' x 1' x 2 = 28.50 CF

2' x 4' x 2 16.00 CF

53.21 CF/FT

= 1.97 CF/FT

use 2.0 CF/FT

2 CY/FT x 75' = 150 CY ⟸

ELIMINATE 75' OF HANDRAIL EACH SIDE.

ELIMINATE 1 LIGHT.

COST WORKSHEET

PROJECT: **PASADENA BLUE LINE LIGHT RAIL PROJECT**

ALTERNATIVE NO. L-4

SHEET NO. 5 of 5

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
Concrete	CY				150	500	$75,000
Handrail	LF				150	126	$18,750
Light pole & Illuminaire	EA				1	2000	2,000
Sub-Total							95,750.00
Mark-Up at %							
TOTAL							

SUMMARY OF POTENTIAL COST SAVINGS

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT		**LOCATION:**	LOS ANGELES TO PASADENA, CALIFORNIA		
PROJECT ELEMENT:	STATIONS		PRESENT WORTH OF COST SAVINGS			
ALT. NO.	**DESCRIPTION**	**ORIGINAL COST**	**ALTERNATIVE COST**	**INITIAL COST SAVINGS**	**O & M SAVINGS**	**TOTAL SAVINGS**
	ALLEN (AL)					
AL-5	Coordinate bus stops and pedestrian crosswalks at Sierra Madre Villa and Allen Stations with the City of Pasadena	DESIGN SUGGESTION				
	SIERRA MADRE (SM)					
SM-1	Delay construction of Sierra Madre Villa Station to be concurrent with construction of the park and ride or construct the pedestrian bridge now	DESIGN SUGGESTION				

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	**AL-5**
DESCRIPTION:	**COORDINATE BUS STOPS AT PEDESTRIAN CROSSWALKS FOR ALLEN AND SIERRA MADRE VILLA STATIONS WITH THE CITY OF PASADENA**	SHEET NO.	1 of 3

ORIGINAL DESIGN: (Sketch attached)

The original design for the Allen Station and Sierra Madre Villa Station do not indicate bus pullout areas.

ALTERNATIVE:

Coordinate the bus pullouts with the City of Pasadena to ensure passengers are dropped off near a pedestrian crosswalk.

ADVANTAGES:

- Enhances safety

DISADVANTAGES:

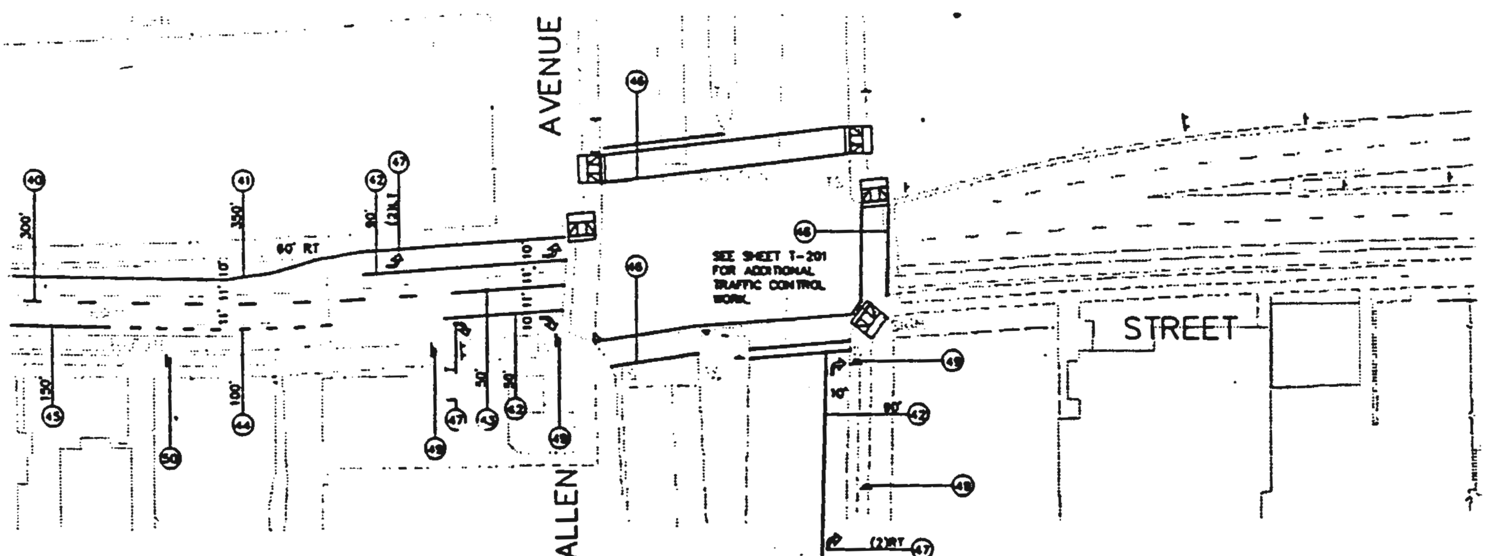
- Requires some redesign

DISCUSSION:

The intent of this suggestion is to avoid passengers jay-walking across Allen Avenue and Sierra Madre Villa Boulevard in a low light-intensity area. This will involve coordination with the traffic lights a the I-210 off ramps.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS			

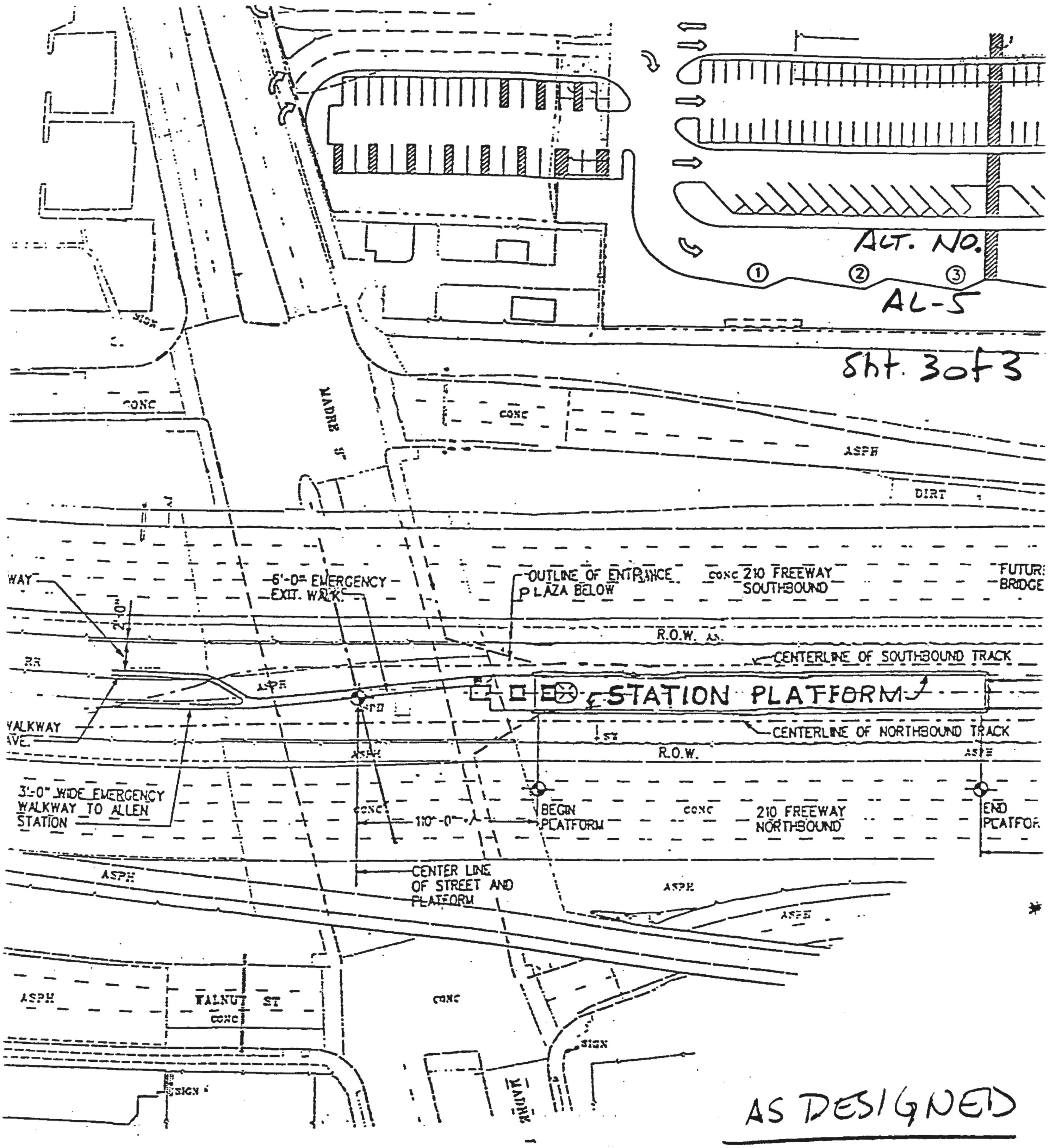
ALTERNATIVE NO.
AL-5
Sht. 2 of 3



SIGNING AND STRIPING

AS DESIGNED

DESIGNED BY B. ASHBA	LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY PASADENA BLUE LINE	LAUPT TO PASADE
DRAWN BY B. ASHBA	ASHBA ENGINEERS LTD. POST OFFICE BOX 90833 LONG BEACH, CALIFORNIA 90809 (310) 985-1044	ALLEN AVENUE S
CHECKED BY R. MIDDAG	DMJM	SIGNING AND STR
IN CHARGE B. ASHBA		ALLEN/CORSO
DATE 07/28/94		



SIERRA MADRE VILLA STATION

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	SM-1
DESCRIPTION:	DELAY CONSTRUCTION OF SIERRA MADRE VILLA STATION TO BE CONCURRENT WITH THE CONSTRUCTION OF THE PARK AND RIDE LOT	SHEET NO.	1 of 3

ORIGINAL DESIGN:

The original design is to provide a freeway station with passenger access occurring under the freeway at the east side of Sierra Madre Villa Boulevard. The access area will contain stairs and one elevator up to the station. At a future date, the City of Pasadena will construct a park-and- ride lot on the north side of I-210. Access to the park- and-ride lot will be by a future pedestrian bridge over southbound I-210. The Sierra Madre Villa Boulevard Overpass has not been retrofitted for seismic requirements.

ALTERNATIVE:

Further investigate the pedestrian access requirements at the Sierra Madre Villa Station and modify the station as required. It may be reasonable to delay construction of the bridge retrofit and station construction until the park-and-ride lot is a committed design project. An alternative is to build the pedestrian bridge now and provide a landing at the future park-and-ride lot. The VE team understands that additional material is available for the layout of the station and may change some of the ideas/concerns raised here.

ADVANTAGES:

Defer Station
- Reduces first Cost
- Assures that the right design is developed to address the area needs

Build Pedestrian Bridge now
- Improves connectivity of project

DISADVANTAGES:

Defer Station
- Requires additional money sources be located later
- Eliminates the driver layover area.

Build Pedestrian Bridge Now
- Requires additional funding now

DISCUSSION:

Pedestrian access to the station via Sierra Madre Villa Boulevard will be extremely difficult. The current roadway section contains minimal room for bus pullouts. At the north side of the underpass, there are three freeway exit lanes and two freeway entrance lanes. At the south side of the underpass there is a four-lane frontage road on the west, two fly-over lanes and two freeway entry lanes. This underpass is located in a commercial area. Most likely, traffic to the station will be by bus or single occupant vehicle. Currently pedestrian traffic is not allowed to cross Sierra Madre Villa Boulevard except at adjacent streets that are over one block away from the station entrance. It appears unlikely that the passenger entrance under the overpass will be highly frequented. The need for a second stair, future escalator and future elevator is minimal.

A reasonable alternative is to delay construction of the station so that construction is concurrent with the construction of the park-and-ride lot and pedestrian bridge. The approximate savings to the project for the station alone are $3 million dollars. Additional savings in bridge reconstruction has not been determined.

Another option for the project is to build a drop-off area in the future park-and-ride lot and to build the pedestrian bridge now. This will increase the cost of the project but improve the usability of the station. This will add about $1,200,000 to the project cost. Additional research will be required to develop a more reliable cost.

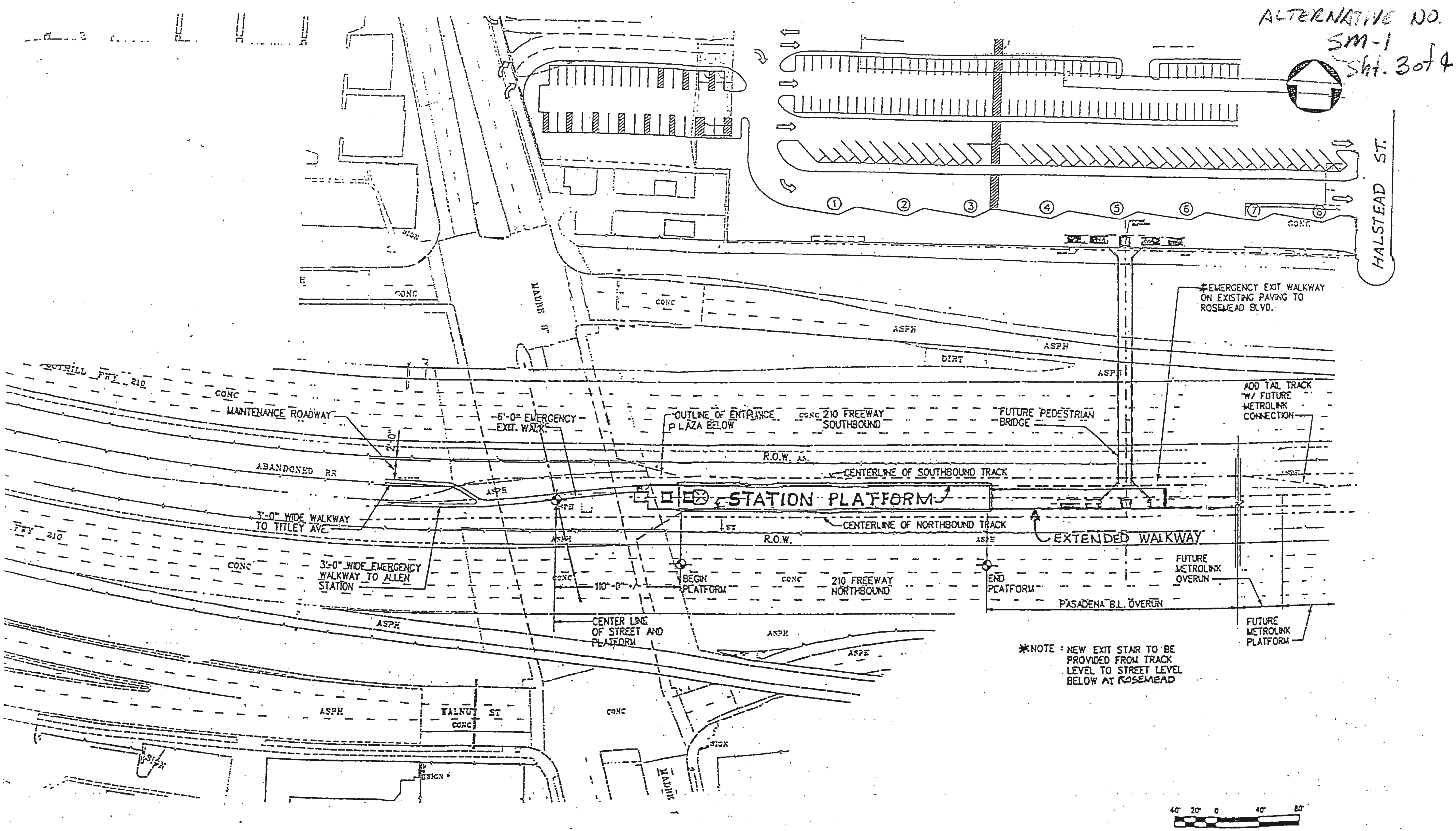
COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS			

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	**SM-1**
DESCRIPTION:	**DELAY CONSTRUCTION OF SIERRA MADRE VILLA STATION TO BE CONCURRENT WITH THE CONSTRUCTION OF THE PARK AND RIDE LOT**	SHEET NO.	2 of 4

DISCUSSION Continued:

A reasonable alternative is to delay construction of the station so that construction is concurrent with the construction of the park-and-ride lot and pedestrian bridge. The approximate savings to the project for the station alone are $3 million. Additional savings in bridge reconstruction has not been determined.

Another option for the project is to build a drop-off area in the future park-and-ride lot and to build the pedestrian bridge now. This will increase the cost of the project but improve the usability of the station. This will add $500,000 to the project cost. Additional research will be required to develop a more reliable cost.



SIERRA MADRE VILLA STATION

COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT
SIERRA MADRE VILLA
PEDESTRIAN BRIDGE

ALTERNATIVE NO. SM-1

SHEET NO. 4 of 4

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
BRIDGE	SF				1700	110	187,000
ELEVATOR	EA				2	70,000	140,000
MISC					1	10,000	10,000
DEMO BUILDING					1	EA	150,000
PAVE MINOR PARKING							
AREA							
Sub-Total							
Mark-Up at %							
TOTAL							487,000

SUMMARY OF POTENTIAL COST SAVINGS

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT		LOCATION: LOS ANGELES TO PASADENA, CALIFORNIA				
PROJECT ELEMENT: STATIONS				PRESENT WORTH OF COST SAVINGS		
ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	INITIAL COST SAVINGS	O & M SAVINGS	TOTAL SAVINGS
	UNION STATION (US)					
US-1	Reduce the size of the below grade passenger vestibule at Union Station	1,123,000	0	1,123,000	—	1,123,000
US-2	Relocate Communications & Signaling and Layover Rooms from tunnel to above grade	142,800	0	142,800	—	142,800
US-3	Eliminate raising the track approximately 5 ft. above the existing grade at the Union Station Platform	1,000,000	0	1,000,000	—	1,000,000
US-4	Add crossover tracks on each side of station to make double crossovers and allow the use of the east, west and pocket track with either side of the platform	0	300,000	(300,000)	—	(300,000)
US-6	Replace slab/direct fixation track system in Union Station with ballast/tie track system	254,809	74,816	179,993	—	179,993
US-7	Reduce extent canopy at Union Station	220,140	112,320	107,820	—	107,820
US-8	Delay construction of west track at Union Station Platform until headways are decreased	661,300	0	661,300	—	661,300
	CHINATOWN STATION (CS)					
CS-1 to CS-5	Revise Chinatown Station concept	DESIGN SUGGESTION				

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	**US-1**
DESCRIPTION:	**REDUCE THE SIZE OF THE BELOW GRADE PASSENGER VESTIBULE AT UNION STATION**	SHEET NO.	1 of 4

ORIGINAL DESIGN: (Sketch attached)

A 6,000 sf passenger vestibule is provided below-grade (under platform) adjacent to the existing access tunnel. Three stairways and an elevator serve the space with provisions for a future escalator.

ALTERNATIVE: (Sketch attached)

Reduce the size of the passenger vestibule located below-grade at Union Station. Move the elevator closer to the access tunnel and wrap a single stair around the elevator up to the station platform to lessen underground construction. The smaller floor plan is approximately 1,000 sf.

ADVANTAGES:

- Reduces cost of construction by $1 million
- Shortens construction schedule
- Eliminates some conflicts with existing below-grade utilities
- Reduces the underground station area that must be maintained
- Eliminates potential area for loitering and possible security problems

DISADVANTAGES:

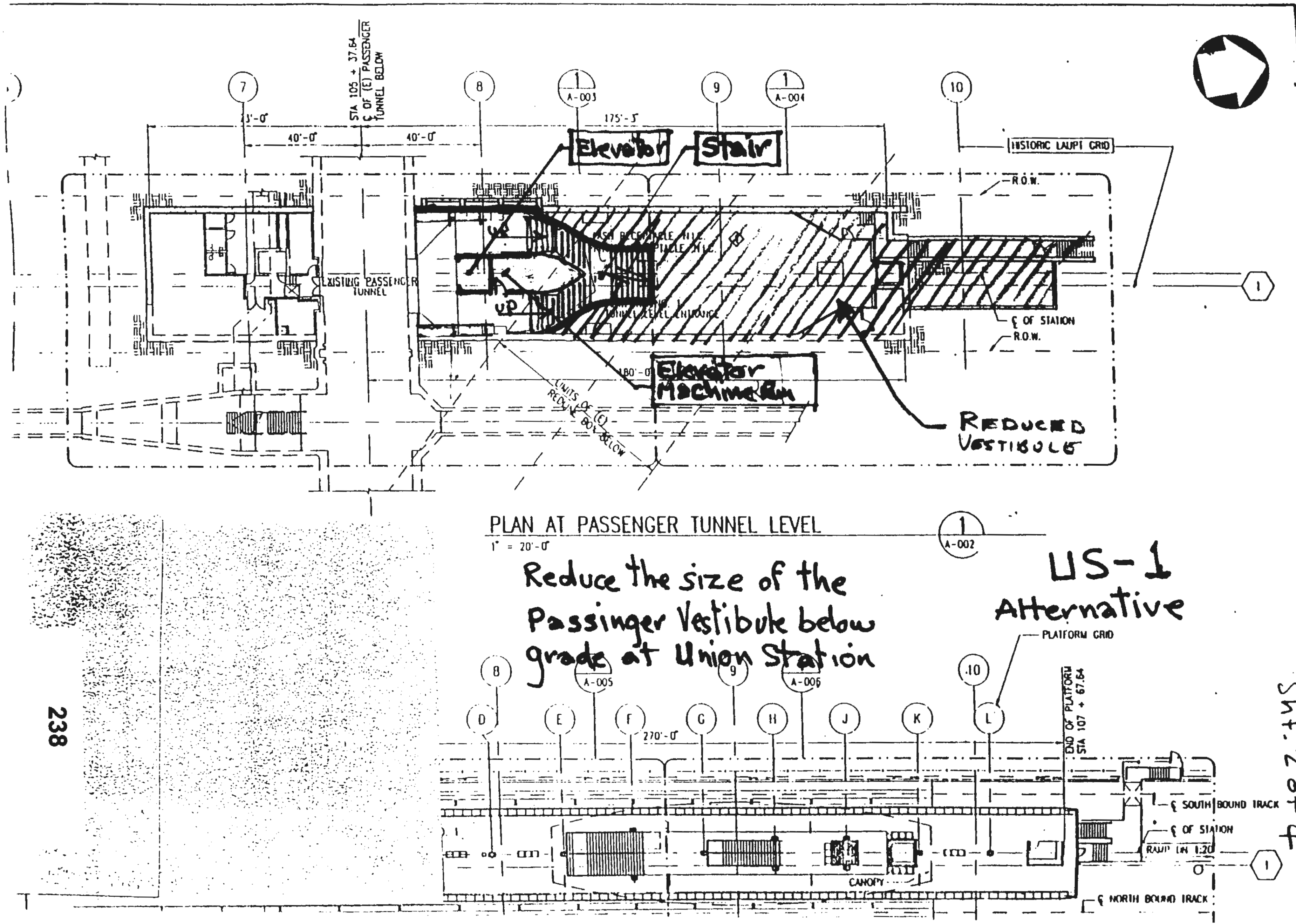
- None apparent

DISCUSSION:

Reducing the size of the current vestibule will provide a significant cost savings. Limiting underground construction reduces cost by limiting conflicts with existing underground utilities and reducing the amount of cast-in-place concrete, architectural finishes, mechanical and electrical systems. Provisions for a future escalator, a second elevator, or a second stair can be provided in the final design.

The width of the stairway (as indicated in attached sketch) will need to be widened to allow adequate flow off the station platform. The reduction in poured-in-place concrete work is significant for this alternative. The existing retaining wall can be left in place and does not need to be removed or modified. Excavation and shoring to protect surrounding structures and at-grade elements is also reduced or eliminated. There are fewer conflicts and relocation of existing utilities during construction. These changes will speed construction and will offset the time to make design changes. Since a large vestibule area is available in the main station, there is no need to create a redundant area with high security risk. The savings of $1.1 million is a significant gain in addition to aforementioned gains.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 1,123,000	—	$ 1,123,000
ALTERNATIVE	$ 0	—	$ 0
SAVINGS	$ 1,123,000	—	$ 1,123,000



Reduce the size of the Passinger Vestibule below grade at Union Station

US-1 Alternative

ALTERNATIVE NO. US-1

Sht. 2 of 4

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

ALTERNATIVE NO. US-1

SHEET NO. 3 of 4

Reduce the size of the Passinger Vestibule below grade at Union Station

Original Design	7,450 SF		
Alternative	1,430 SF		
Savings	6,020 SF	80%	

UNION STATION

COST WORKSHEET

PROJECT: **PASADENA BLUE LINE LIGHT RAIL PROJECT**

ALTERNATIVE NO. VS-1

REDUCE SIZE OF PASSENGER VESTIBULE BELOW GRADE

SHEET NO. 4 of 4

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
DEMOLITION	SF	5080	10 -	50 800			
EXCAVATION	CY	11200	26 -	291,200			
SOIL DISPOSAL	CY	14000	5 -	70,000			
CONCRETE - AVERAGE				-			
FOR WALLS, FLOOR, CEILING	CY	1920	350 -	672 000			
INTERIOR FINISHES	SF	9820	4 -	39 280			
TOTAL			#	1,123,280			# 0
Sub-Total							
Mark-Up at %							
TOTAL			#	1,123,280		#	0

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	US-2
DESCRIPTION:	**RELOCATE COMMUNICATIONS AND SIGNALING AND LAYOVER ROOMS FROM TUNNEL TO ABOVE GRADE AT UNION STATION**	SHEET NO.	1 of 7

ORIGINAL DESIGN: (Sketch attached)

The Light rail operator's layover room and a Communications and Signaling (C&S) room are located at the tunnel level below the proposed Union Station platform. This will require excavating on the east side of the existing passenger tunnel around the existing electrical room, ductbanks and utilities. The operator layover room is approximately 520 sf including break room, ejector room, and a women's and men's restroom. The communications and signaling room is approximately 1,520 sf. Access to these rooms is through the Union Station below-grade tunnel. Mechanical equipment for these rooms is located at-grade above the rooms and south of the station platform.

ALTERNATIVE: (Sketch attached)

Relocate the existing light rail operator's layover room to grade level at the south end of the platform between the cargo ramp (emergency exit) and southbound track. At-grade construction is to match platform design and finishes used for supervisor room at the north end of the station platform which consist of the following:

- Structural metal studs and joists
- Insulated metal wall panel
- Insulated metal roof panel

The C&S room is to be relocated to Station 116.14 at the end of the retaining wall and the beginning of the Chinatown aerial section. An alternative location is at the existing substation and maintenance shops at existing Electrical Substation Site east of Metrolink Track No.6. Additional development of the control systems needs will determine the best location.

ADVANTAGES:

- Reduces cost of construction
- Shortens construction schedule
- Eliminates conflicts with below grade utilities

DISADVANTAGES:

- None apparent

DISCUSSION:

Analysis of the control systems area indicates that the current 2,680 square foot space allowed for equipment is much larger than needed, thus adding excessive cost.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 142,800	—	$ 142,800
ALTERNATIVE	$ 0	—	$ 0
SAVINGS	$ 142,800	—	$ 142,800

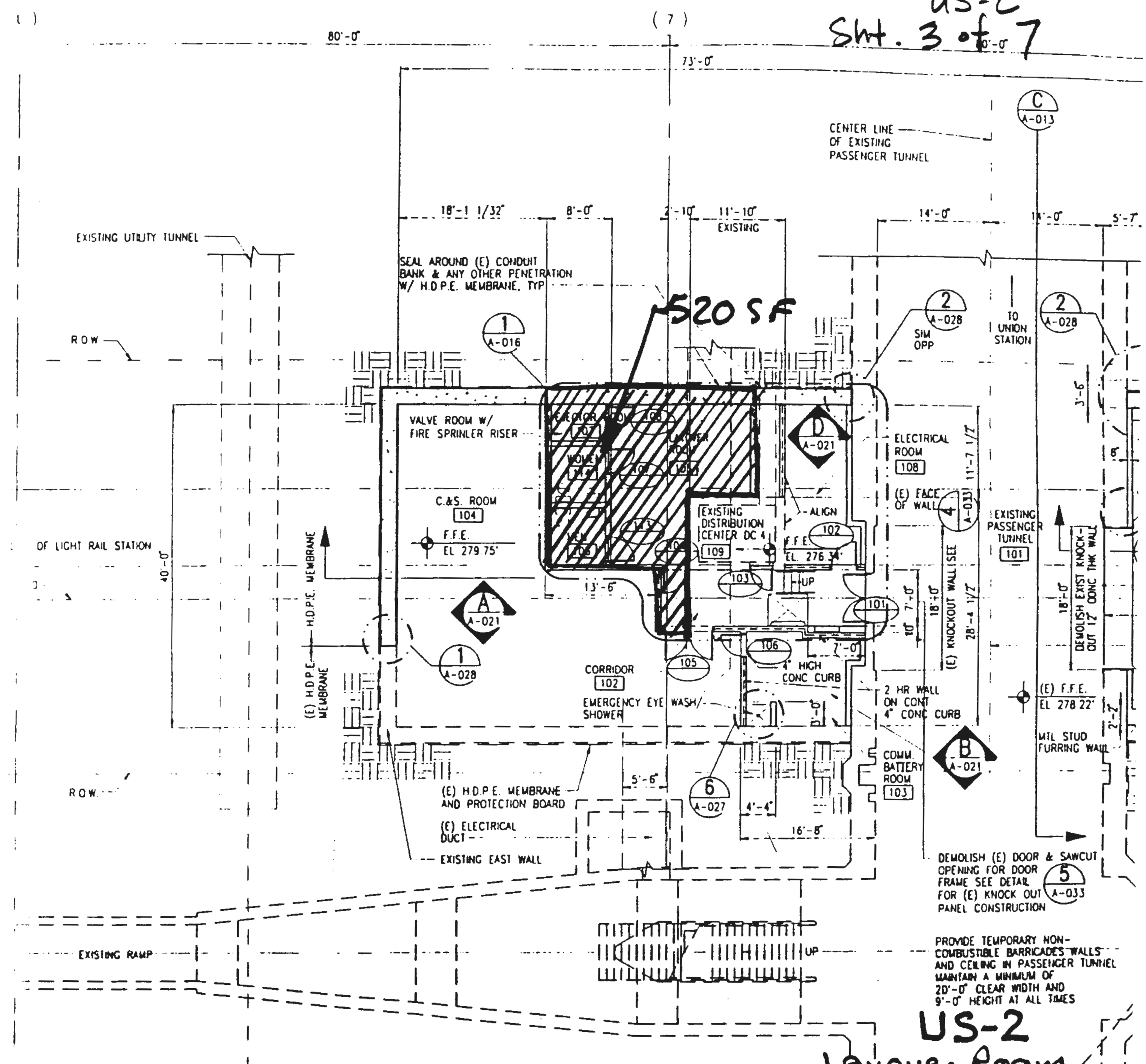
PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	**US-2**
DESCRIPTION:	**RELOCATE COMMUNICATIONS AND SIGNALING(C&S) AND LAYOVER ROOM FROM TUNNEL TO ABOVE GRADE AT UNION STATION**	SHEET NO.	2 of 7

DISCUSSION Continued:

This alternative, to move both the C&S and the Layover rooms, eases complex below-grade construction in an area full of existing electrical ductbanks and utility piping. Above-grade construction can be a prefabricated building or simple framed metal stud construction with metal siding or masonry veneer. The reduction in cast-in-place concrete work is significant for this alternative. The existing east retaining wall can be left in place and does not need to be removed or modified. Excavation and shoring to protect surrounding structures and at grade elements are also reduced or eliminated. There is less conflict and relocation or support of existing utilities during construction. These changes will speed construction and will offset the time to redesign the station, saving $125,000.

Access to layover room will no longer require train operators to go into a tunnel room. Thus, operators will be adjacent to station platform and be able to monitor their rail cars.

ALTERNATIVE NO. US-2
Sht. 3 of 7



243

(E) H.D.P.E. MEMBRANE & PROTECTION BOARD ON INTERIOR SUFACES OF (E) EAST WALL & RETURNS
LEVEL ENTRANCE INTERIOR ELEVATIONS SEE C/A-020
...ATING TO STAIR & SLAB OPENINGS ARE TO FACE OF STRUCT CONC
...EMBRANE DETAILS SEE SHEET SS-036
...ET A-001 FOR FINISHES
...H SLAB OVER STRUCT SLAB, TYP.
...JOINT IN PLATFORM ARCHITECTURAL SLAB, SEE B/A-020

PLAN AT PASSENGER TUNNEL LEVEL - SOUTH (1 / A-003)
1/8" = 1'-0"

REV	DATE	BY	SUB	APP	DESCRIPTION
1	5-25-95	MTA			C32243 ADDENDUM #3 5/25/95
0	5-1-95				ISSUED FOR BID

DESIGNED BY B. AMADOR
DRAWN BY J. ORLANDO
CHECKED BY N. MARTINEZ
IN CHARGE B. AMADOR
DATE APRIL 21 1995

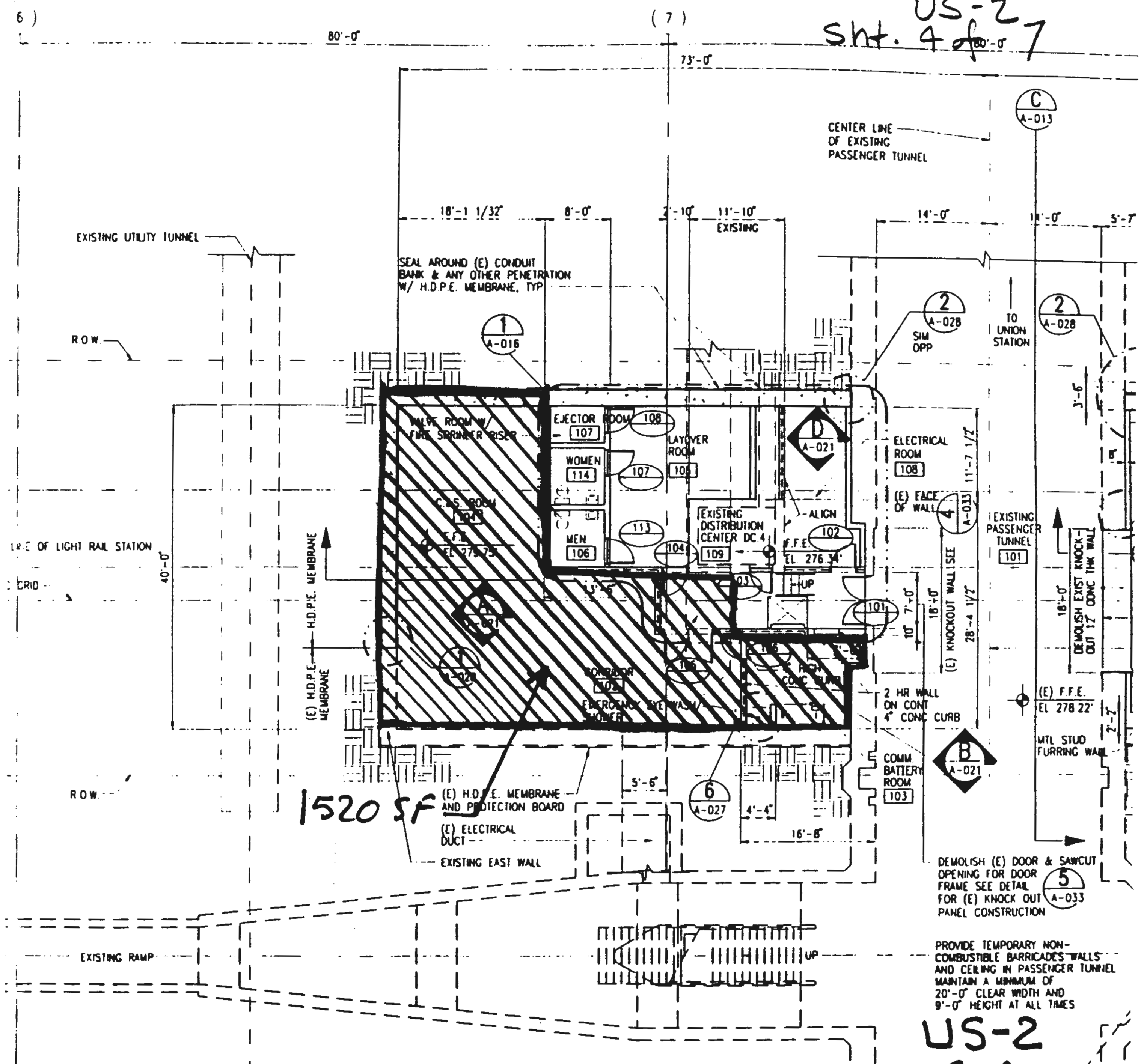
A SIGNED & SEALED ORIGINAL OF REV 0 OF THIS DRAWING IS MAINTAINED BY MTA

LOS ANGELES COUNTY METROPOLITAN...
PASADENA

MARTINEZ AMADOR ARCHITECTS, INC.

SUBMITTED WILLIAM J. AMADOR #C20348 EXP 3-31-97

ALTERNATIVE NO. US-2 Sht. 4 of 7



(E) H.D.P.E. MEMBRANE & PROTECTION BOARD ON INTERIOR SUFACES OF (E) EAST WALL & RETURNS
...NEL LEVEL ENTRANCE INTERIOR ELEVATIONS SEE C/A-020
...ONS RELATING TO STAIR & SLAB OPENINGS ARE TO FACE OF STRUCT CONC
...P.E. MEMBRANE DETAILS SEE SHEET SS-036
...SHEET A-001 FOR FINISHES
...' ARCH SLAB OVER STRUCT SLAB, TYP.
... JOINT IN PLATFORM ARCHITECTURAL SLAB, SEE B/A-020

244

PLAN AT PASSENGER TUNNEL LEVEL - SOUTH

1/8" = 1'-0"

REV	DATE	BY	SUB	APP	DESCRIPTION
1	9-25-95	MTA			C38243 ADDENDUM #3 12/21/95
0	8-1-95				ISSUED FOR BID

DESIGNED BY B. AMADOR
DRAWN BY J. ORLANDO
CHECKED BY N. MARTINEZ
IN CHARGE B. AMADOR
DATE APRIL 21 1995

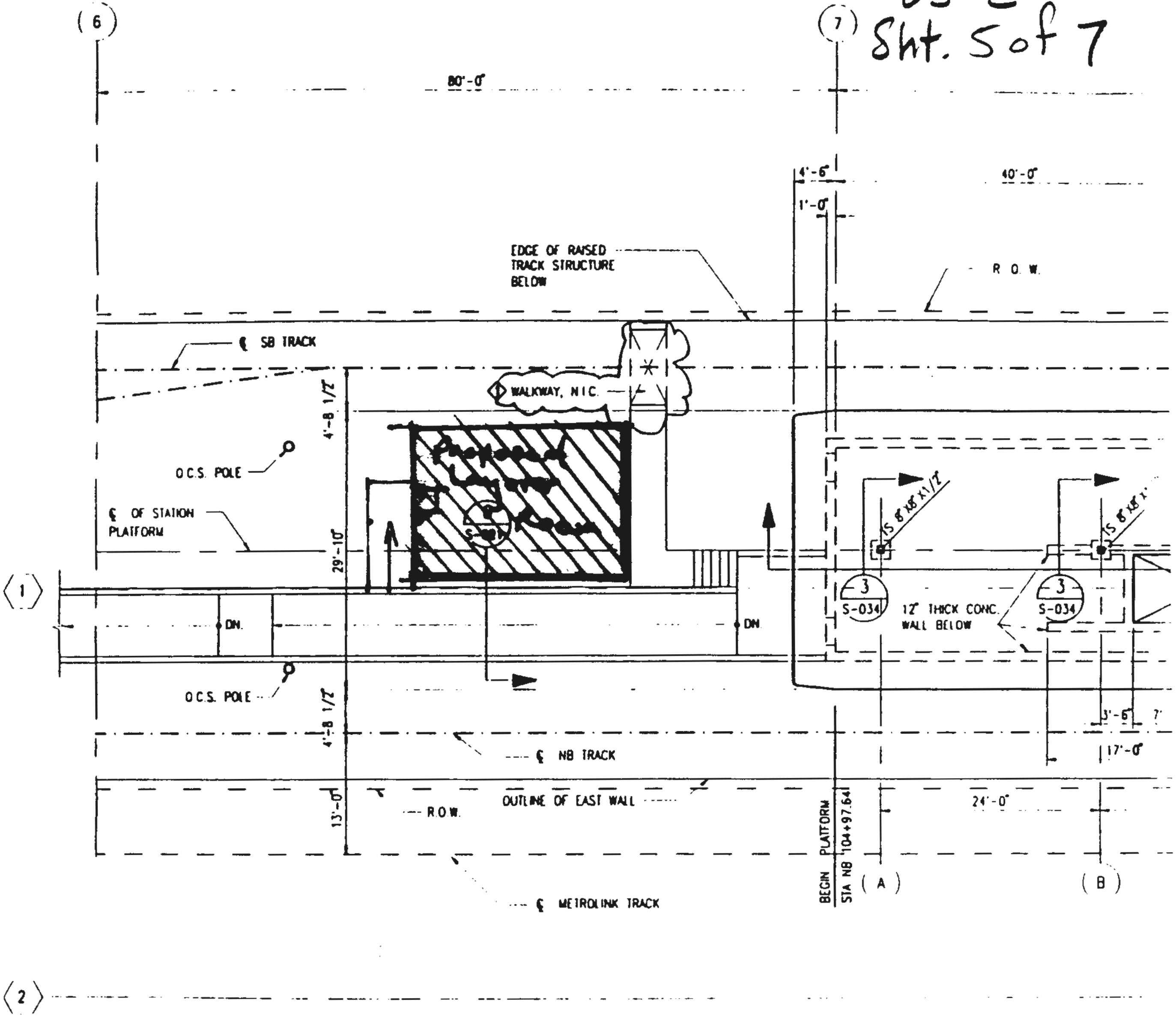
A SIGNED & SEALED ORIGINAL OF REV 0 OF THIS DRAWING IS MAINTAINED BY MTA

LOS ANGELES COUNTY METROPOLITAN...
PASADENA...

MARTINEZ AMADOR ARCHITECTS, INC.
SUBMITTED WILLIAM J. AMADOR #C20348 EXP 3-31-97

A-003
P 84

ALTERNATIVE NO. US-2 Sht. 5 of 7



CONCRETE BEAM SCHEDULE				
TYPE	WIDTH	DEPTH	HORIZONTAL REINF.	TIES
B-1	24"	24"	4 - #7 (T) & (B)	#4 @ 12" O.C.
B-2	36"	24"	6 - #7 (T) & (B)	#4 @ 12" O.C.
B-3	36"	24"	7 - #7 (T) & (B)	#4 @ 12" O.C.
B-4	36"	24"	7 - #8 (T) & (B)	#4 @ 12" O.C.
B-5	12"	36"	2 - #6 (T) & (B)	#3 @ 12" O.C.

PLATFORM LEVEL DECK

TOP OF PLATFORM CONCRETE EL=300.12'

NOTES:

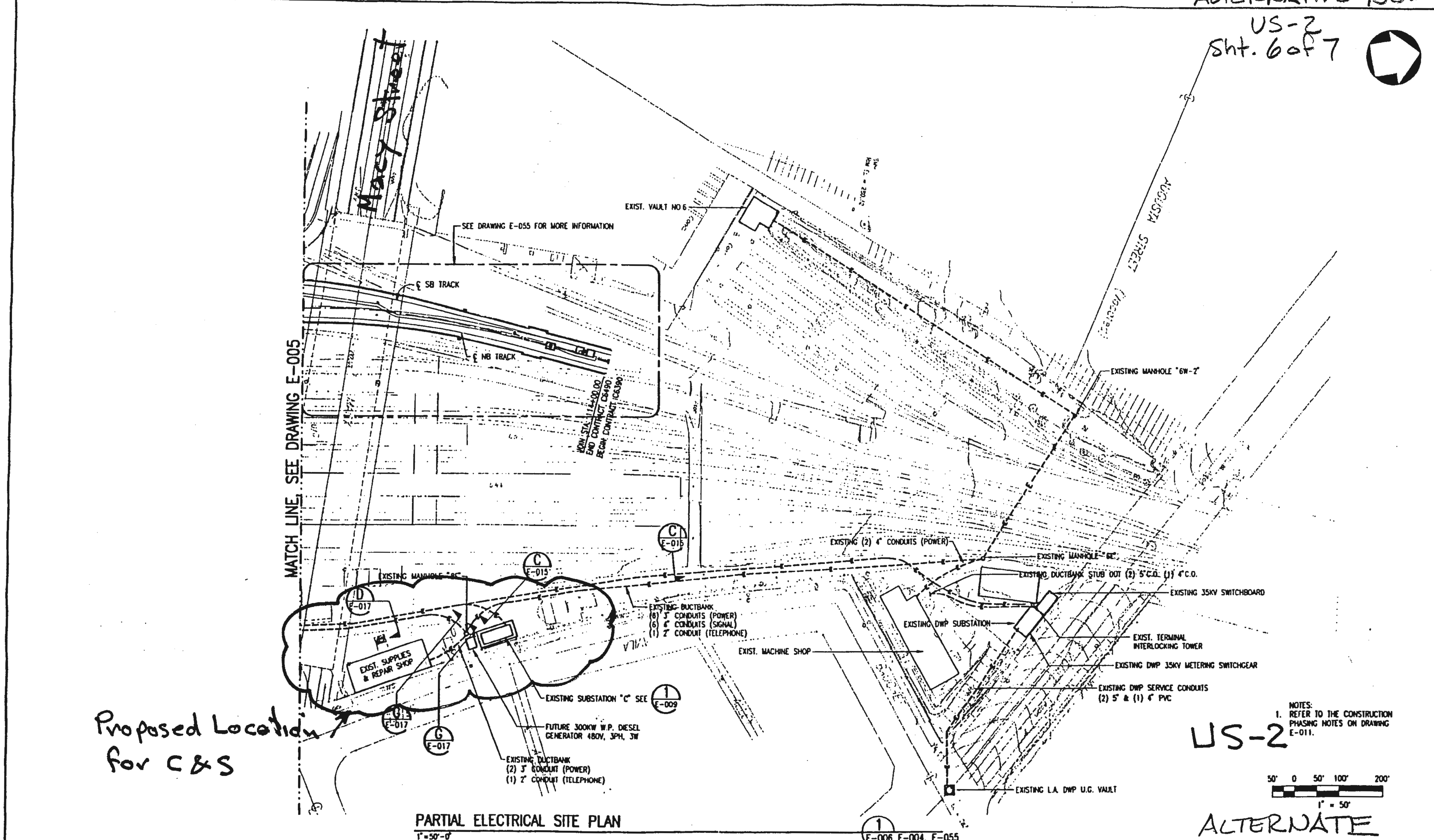
1. 12" THICKNESS CONCRETE POUR IN PLACE D
2. B-1 INDICATES CONCRETE BEAM S. E
3. WATERSTOPS ARE REQUIRED IN ALL JOINTS FC
4. OMIT WATERSTOP FOR INTERIOR SLABS AND IN

REV	DATE	BY	APPR	DESCRIPTION
1				C32243 ADDENDUM #3 12/3/96
0	6/1/95			ISSUED FOR BID

DESIGNED BY T. CHUNG
DRAWN BY R. KWAN
CHECKED BY M. YEH
IN CHARGE M. YEH
DATE 4/21/1995

A SIGNED & SEALED ORIGINAL OF REV 0 OF THIS DRAWING IS MAINTAINED BY MTA

ALTERNATIVE NO. US-2 Sht. 6 of 7



DESIGNED BY J. McDOWELL
DRAWN BY D. EDDOW
CHECKED BY R. RANDALL
IN CHARGE F. BROWN
DATE 26 APRIL 95

0 | ISSUED FOR BID

REGISTERED PROFESSIONAL ENGINEER FREDERICK R. BROWN No. 6679 EXP. SEPT. 1996 ELECTRICAL STATE OF CALIFORNIA

LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY
PASADENA BLUE LINE

SRP ENGINEERING — CONSULTING ELECTRICAL & MECHANICAL ENGINEERS AS A SUBCONSULTANT TO MARTINEZ WAGOR ARCHITECTS, INC.

ENGINEERING MANAGEMENT CONSULTANT

LAUPT TO PASADENA
UNION STATION PLATFORM NO. 1

PARTIAL ELECTRICAL SITE PLAN - SHEET 2 OF 2

CONTRACT NO C6490
DRAWING NO E-006
REV 0
SCALE 1"=50'
SHEET NO 163

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT
Relocate Communications and Signaling (C&S) and Layover Room from to above grade at Union Station

ALTERNATIVE NO. US-2

SHEET NO. 7 of 7

Relocate C&S Room Designed Underground	1,520	SF
Relocate Layover Room " " "	520	SF
Total underground	2,040	SF
Total Alternative at grade	2,040	SF

Savings 2,040 X \$70 = \$142,800

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	**US-3**
DESCRIPTION:	**ELIMINATE RAISING THE TRACK APPROXIMATELY 5 FT. ABOVE EXISTING GRADE AT THE UNION STATION PLATFORM**	SHEET NO.	1 of 6

ORIGINAL DESIGN: (Sketch attached)

The current design requires constructing retaining walls and developing the top of the new track approximately 5 ft. above existing-grade (or 3.5 ft. above top of rail placed at-grade).

ALTERNATIVE: (Sketch attached)

Develop the new track at the existing grade elevation. Demolish unneeded parts of previously constructed east retaining wall.

ADVANTAGES:

- Saves construction cost of over $1 million
- Shortens construction period

DISADVANTAGES:

- Slightly increases slope on track approaching/leaving Union Station
- More difficult design with any future extensions across the busway/freeway. Ability to do so must be verified.

DISCUSSION:

Raising the elevation for the rail and associated platform is apparently being done for the following two reasons:

1. to reduce the grade of the track north of the station as the track descends from the high point over the private rail car siding, and
2. to provide sufficient height to permit a future southward extension of the light rail line over the El Monte Busway and the 101 Freeway

The eastern retaining wall has already been constructed at a cost of approximately $1 million to accommodate the grade change.

However, developing the Union Station platform closer to the existing-grade eliminates the need for a west retaining wall plus, substantial quantities of fill material. The grade of the track, as it descends from clearing the private rail car siding, increases from 2.99% to approximately 3.4% for the 1,000 ft. long slope. This compares favorably to the design criteria, which permits a maximum slope of 4% for long grades (over 1,000 ft.) and 5% for short grades.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 1,000,000	—	$ 1,000,000
ALTERNATIVE	$ 0	—	$ 0
SAVINGS	$ 1,000,000	—	$ 1,000,000

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	**US-3**
DESCRIPTION:	**ELIMINATE RAISING THE TRACK APPROXIMATELY 5 FT. ABOVE EXISTING GRADE AT THE UNION STATION PLATFORM**	SHEET NO.	2 of 6

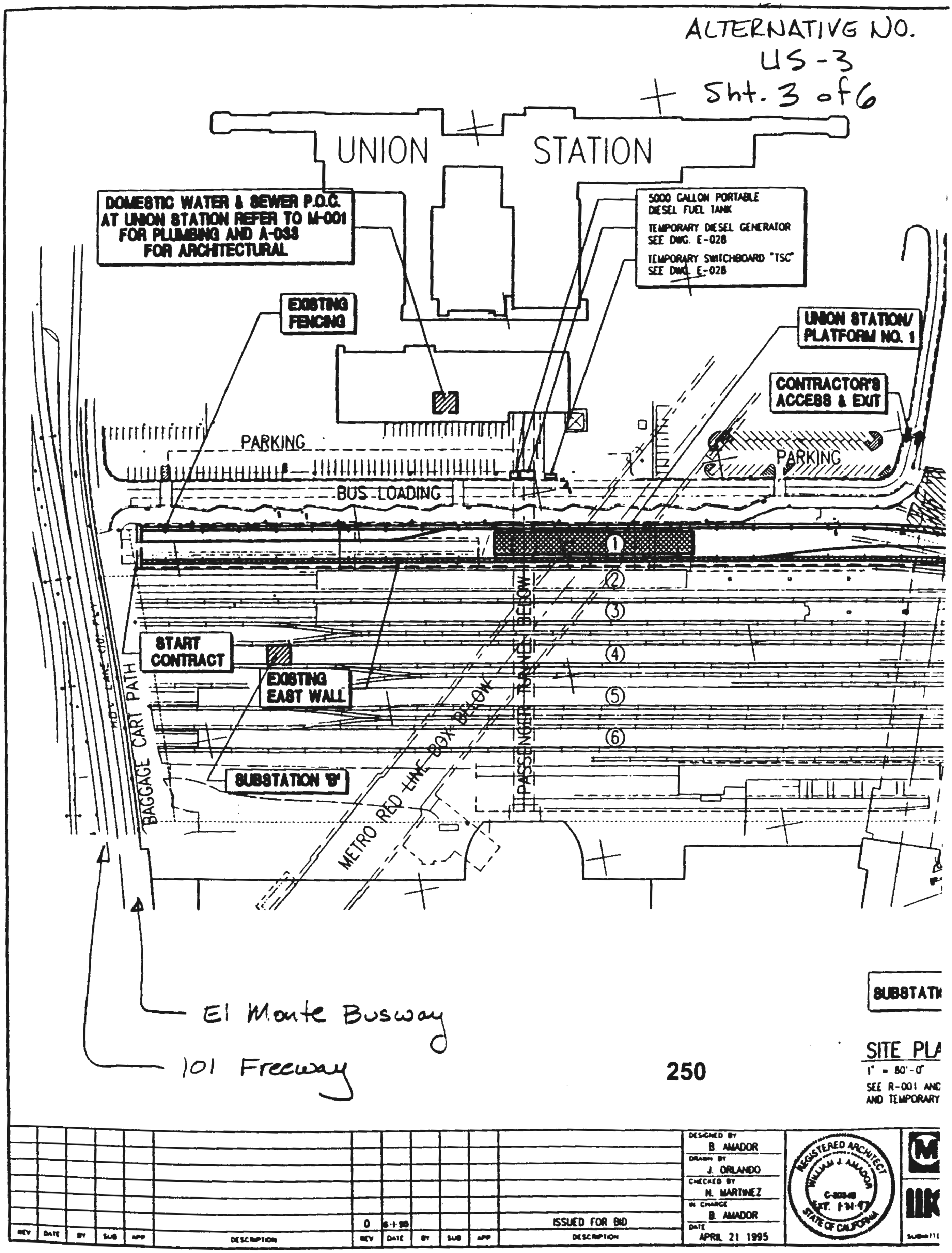
DISCUSSION Continued:

Not raising the track over the existing-grade may complicate a possible extension of the light rail line south from Union Station. Such an extension must cross the El Monte Busway and 101 Freeway immediately south of the Union Station. Maintaining the flexibility, of some day extending the light rail line is prudent and should be included in the design, if possible, at a reasonable cost. However, to date there is no formal planning or environmental documentation that includes such an extension, neither is there an indication of funding for a future southern extension. On the contrary, planning and environmental studies have considered only extensions to Claremont and Glendale, as well as into the Long Beach Blue Line Subway in the downtown. As a result, it can only be concluded that an extension across the busway/freeway has a low probability of ever being pursued. In addition, no documentation was found comparing the relative elevations of the busway/freeway and the light rail track. Insufficient data was available to determine if the extra 3.5 ft. of track elevation is crucial to spanning the busway/freeway.

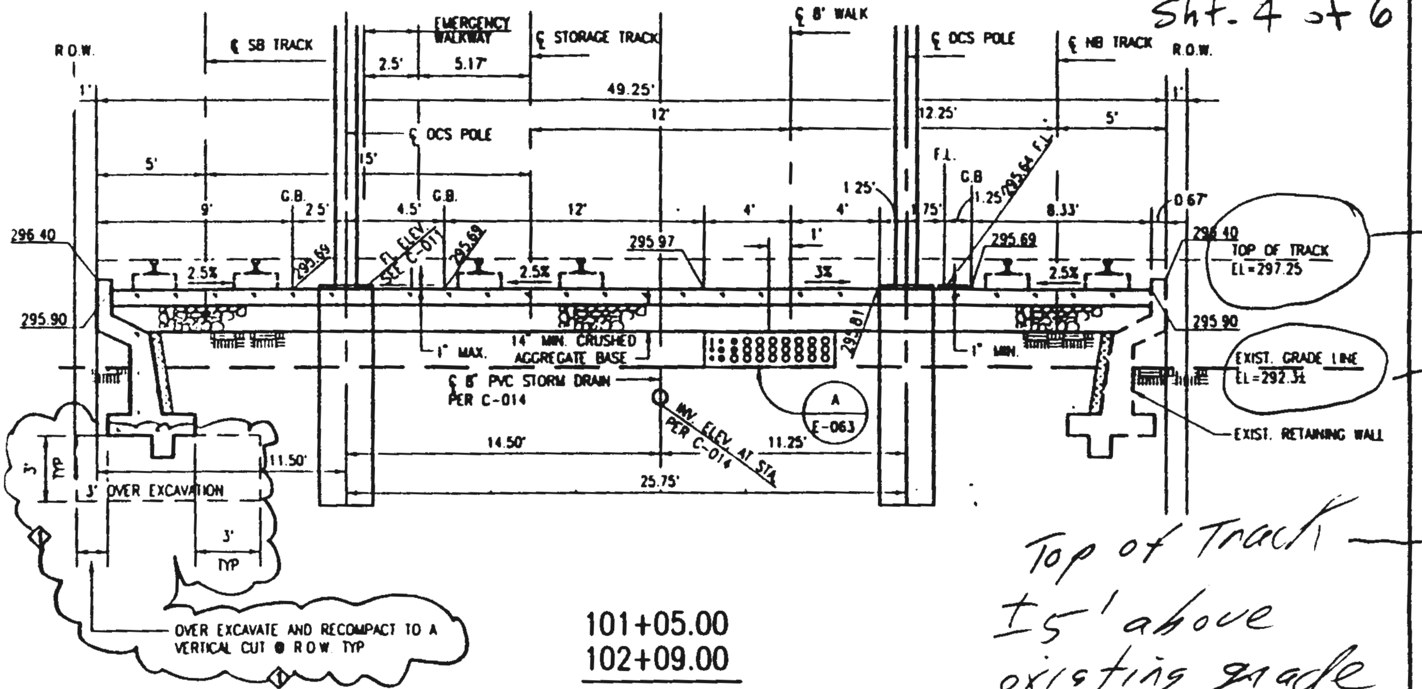
The previously constructed east retaining wall is demolished to match existing-grade in the platform area and would be reduced in height as it approaches the abutment for the Chinatown aerial structure.

Eliminating the west retaining wall is compatible with eliminating/reducing the underground rooms (discussed in US-1 and US-4), the west retaining wall provides support for the roof of the underground rooms and serves as the west wall for the rooms.

Summarily, it can be concluded that there is no valid reason to raise the track above existing grade. With a substantial cost benefit, it is well worth of consideration.

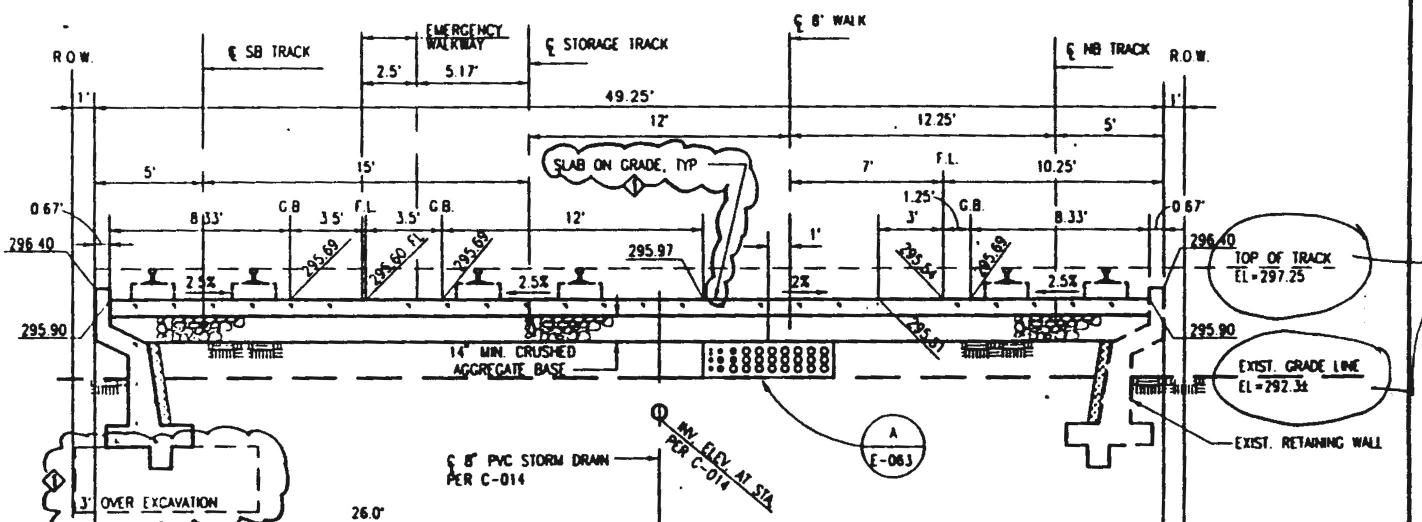

ALTERNATIVE NO.
US-3
Sht. 3 of 6
UNION STATION
DOMESTIC WATER & SEWER P.O.C. AT UNION STATION REFER TO M-001 FOR PLUMBING AND A-033 FOR ARCHITECTURAL
5000 GALLON PORTABLE DIESEL FUEL TANK
TEMPORARY DIESEL GENERATOR SEE DWG. E-028
TEMPORARY SWITCHBOARD "TSC" SEE DWG. E-028
EXISTING FENCING
UNION STATION/ PLATFORM NO. 1
CONTRACTOR'S ACCESS & EXIT
PARKING
PARKING
BUS LOADING
1
2
3
4
5
6
START CONTRACT
EXISTING EAST WALL
SUBSTATION 'B'
BAGGAGE CART PATH
METRO RED LINE BOX BELOW
PASSENGER TUNNEL BELOW
El Monte Busway
101 Freeway
250
SUBSTATI
SITE PLA
1" = 80'-0"
SEE R-001 AND
AND TEMPORARY
0
5-1-95
ISSUED FOR BID
REV
DATE
BY
SUB
APP
DESCRIPTION
DESIGNED BY
B. AMADOR
DRAWN BY
J. ORLANDO
CHECKED BY
N. MARTINEZ
IN CHARGE
B. AMADOR
DATE
APRIL 21 1995
REGISTERED ARCHITECT
WILLIAM J. AMADOR
C-20340
EXP. 1-31-97
STATE OF CALIFORNIA

ALTERNATIVE NO. US-3
Sht. 4 of 6



101+05.00
102+09.00

Top of Track
±5' above
existing grade



101+22.27
102+02.27
102+82.27

)TES

REFERANCE ONLY AND IS
ACT.

GUY ANCHOR PIERS, OC-001,
INGS FOR OCS POLE FOUNDATION

HORIZONTAL AND VERTICAL SCALES

4' 0 4' 8'

1" = 4'-0"

LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY
PASADENA BLUE LINE

PREPARED IN THE OFFICE OF
LOCKMAN & ASSOCIATES
BUILDING ENGINEERS AND PLANNERS

LELAND F. JOHNSON #13560 EXP 3-31-07

ENGINEERING MANAGEMENT CONSULTANT

K.N. MURTHY

LAUPT TO PASADENA
UNION STATION PLATFORM NO.1

SECTIONS
(SHEET 1 OF 5)

CONTRACT NO	C6490
DRAWING NO	C-019
REV	1
SCALE	1" = 4'-0"
SHEET NO	31

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. US-3
		SHEET NO. 5 of 6

Track slope into Union Station

As Designed	Rise	30'	3.00%	Slope approximate
	Run	1000'		
VE Alternate	Rise	33.5'	3.35%	Slope approximate
	Run	1000'		

Slope for new descending track into Union Station:

As Designed – 2.99% slope;

starts at PVI @ Sta 110+90 w/ Ele = 297.25
ends @ Sta 121+10, Ele = 327.80

Rise 30' over 1000'+

As Proposed in Alternate – assume begin & end slope at same stations & that vertical curve changes only slightly.

COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. U5 - 3
	SHEET NO. 6 of 6

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
West Retaining Wall	Each	1	$1M	$1,000,000	0		$0
Sub-Total							
Mark-Up at %							
TOTAL							

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	US-4
DESCRIPTION:	**ADD CROSSOVER ON EACH SIDE OF THE STATION TO MAKE DOUBLE CROSSOVERS AND ALLOW THE USE OF THE EAST, WEST AND POCKET TRACK WITH EITHER SIDE OF THE PLATFORM**	SHEET NO.	1 of 3

ORIGINAL DESIGN:

A crossover is provided from the west track to the east track north of the platform to allow trains to approach the platform using either track. No crossover is provided to permit trains leaving the platform to move from the west track to the east track. A pocket track is provided south of the platform to permit storing a train. This pocket track connects only to the west track.

ALTERNATIVE: (Sketch attached)

North of the platform, provide a crossover from the west track to east track for trains leaving the platform. Connect the pocket track to the east track as well as to the west track.

ADVANTAGES:

- Enhances operational capability

DISADVANTAGES:

- Increases capital cost

DISCUSSION:

The present design is reportedly based on 15 minute headways. At 15 minute headways, only one side of the platform is needed for passenger loading. The arrangement of the crossover implies that the east side of the platform will be the primary passenger loading position. Therefore, most trains will crossover from the west track to the east track north of the platform. No crossover is being provided for trains from the west side of the platform to access the east track and then proceed northbound using the "right-hand" track. Should the operation require a second loading position (i.e., use the west side of the platform) a crossover from the west track to the east track north of the station will be required. A second loading position will be an operating convenience with headways in the 15 minute range and an operating necessity with headways in the 7 – 8 minute range.

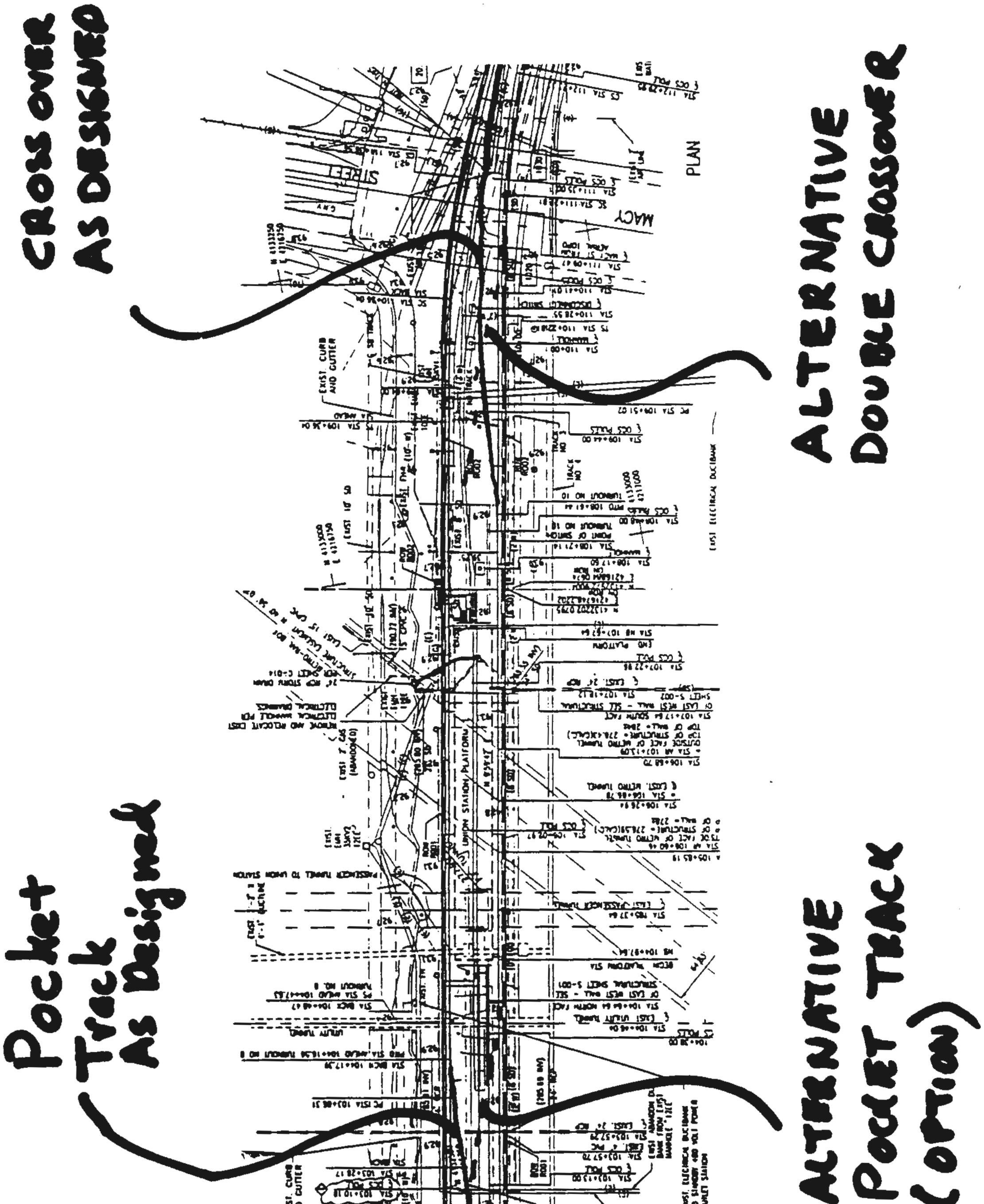
The addition of a crossover from the west track to the east track will permit trains that load on the west side of the platform to proceed northward and enter the east track. Two switches (one standard and one special for curved track) and approximately 250 ft. of track will be required.

The pocket track south of the platform only connects to the west track. With the east track being the primary train loading position, the pocket track should logically be connected to the east track as well as to the west. An equilateral turnout will be required on the pocket track. To accommodate this extra connection, the pocket track will likely shift eastward and require a waiver from the design criteria for proximity of a switch to the platform.

These suggested improvements to operation capability will merit adoption for only a $300,000 capital cost increase.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 0	---	$ 0
ALTERNATIVE	$ 300,000	---	$ 300,000
SAVINGS	$ (300,000)	---	$ (300,000)

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. US - 4
	☐ AS DESIGNED ☒ ALTERNATIVE	SHEET NO. 2 of 3



COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. US-4
	SHEET NO. 3 of 3

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
Crossover Track							
New Track	lf				250	40	10,000
No. 8 Switch -- Std	Ea				1	40,000	40,000
No. 8 Switch Spcl	Ea				1	50,000	50,000
Signalization for Crossover	Ea				1	200,000	200,000
Total							300,000
Sub-Total							300,000
Mark-Up at %							
TOTAL							

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	US-6
DESCRIPTION:	REPLACE CONCRETE SLAB/DIRECT FIXATION TRACK SYSTEM IN UNION STATION WITH BALLAST/TIE TRACK SYSTEM	SHEET NO.	1 of 4

ORIGINAL DESIGN:

A concrete slab/direct fixation track system is used in Union Station.

ALTERNATIVE: (Sketch attached)

Construct a ballast/tie track system in Union Station.

ADVANTAGES:

- Saves capital cost

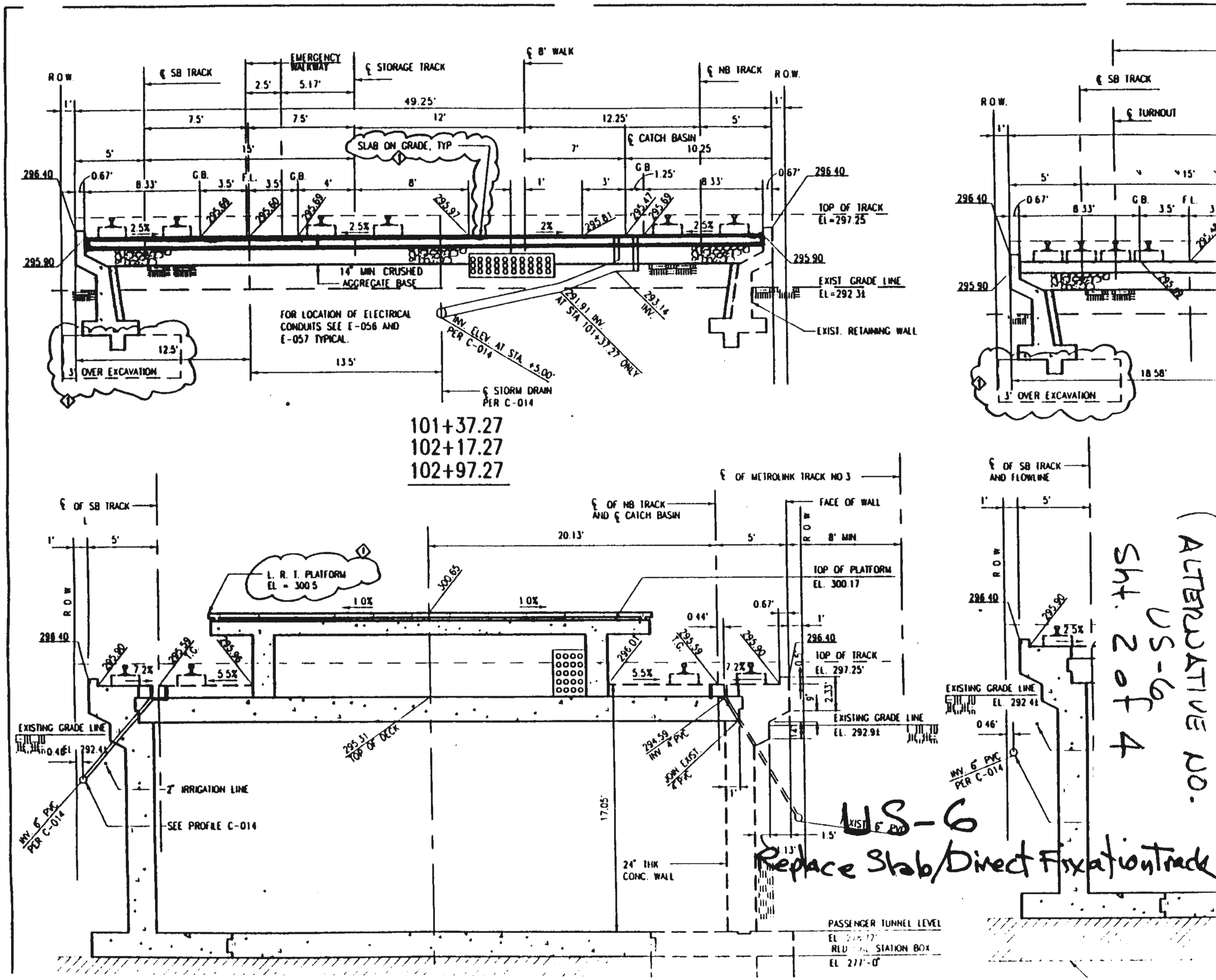
DISADVANTAGES:

- None apparent

DISCUSSION:

The track within Union Station is fixed to a slab rather than ties on ballast. A portion of this slab spans the passenger tunnel and existing subterranean electrical vault. Other portions of the slab serves as a roof to the underground rooms which are being considered for elimination/reduction (see Alt. Nos. US-1 and US-2). A substantial portion of the slab is placed on crushed aggregate. A ballast and tie track system could be developed at a lower cost. This will be particularly true if Alt. Nos. US-1 and US-2 are implemented.

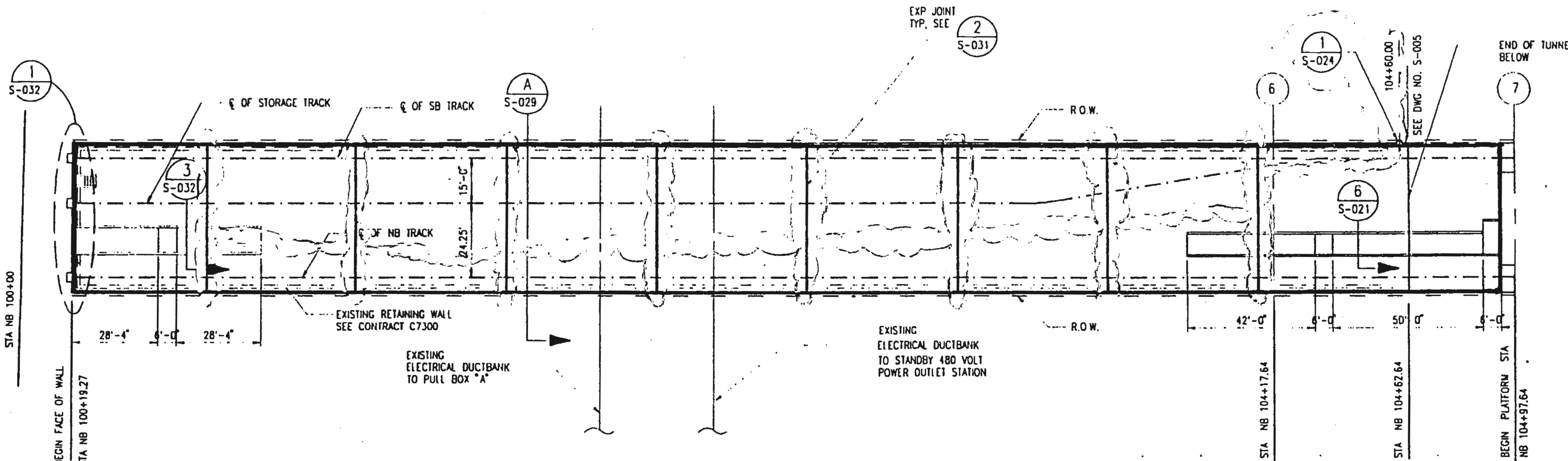
COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 254,809	—	$ 254,809
ALTERNATIVE	$ 74,816	—	$ 74,816
SAVINGS	$ 179,993	—	$ 179,993



(ALTERNATIVE NO. US-6 Sht. 2 of 4

US-6
Replace Slab/Direct Fixation track

ALTERNATIVE NO.
US-6
Sht. 3 of 4



AERIAL TRACK DECK PLAN

SCALE: 1" = 20'-0"

NOTES:

1. SEE CIVIL DRAWINGS C-004 AND C-005 FOR TOP OF CURB PROFILE
2. SEE CIVIL DRAWINGS C-006, C-007, C-008 AND C-009 FOR EXISTING CONDITION
3. SEE CIVIL DRAWINGS C-016, C-017, AND C-018 FOR DECK FINISH ELEVATIONS.
4. 9" THICK CONCRETE SLAB W/#5 @ 12" O.C. EACH WAY TYPICAL
5. PROVIDE STIRRUPS FOR TRACKWORK SECOND POUR CONCRETE TYPICAL

   SECOND POUR AND TRACKWORK N.I.C. TYPICAL SEE DETAIL 7 S-031
6. ALIGN EXP JOINTS ON SLAB WITH EXP JOINTS ON EAST AND WEST WALLS.

LEGEND:

⊠ = OVERHEAD CONTACT SYSTEM POLE N.I.C.
□ = DOWNGUY N.I.C.

US-6
Replace Slab/Direct Fixation Track

20' 10' 0 20' 40'
1" = 20'-0"

REV	DATE	BY	SUB	APP	DESCRIPTION
1	2-23-96				ADDENDUM #3 12/21/96
0	6/1/95				ISSUED FOR BID

DESIGNED BY T. CHUNG
DRAWN BY R. KWAN
CHECKED BY M. YEH
IN CHARGE M. YEH
DATE 4/21/1995

A SIGNED & SEALED ORIGINAL OF REV 0 OF THIS DRAWING IS MAINTAINED BY MTA

LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY
PASADENA BLUE LINE

MING YANG YEH & ASSOCIATES, INC.
Structural Engineers
131 West Green Street, Pasadena, California 91105
Tel (818) 449 9886 Fax: (818) 449-9086
AS A SUB-CONSULTANT TO MARTINEZ ARCHITECTS, INC
SUBMITTED MING YANG YEH #2587 EXP 3-31-96

ENGINEERING MANAGEMENT CONSULTANT
APPROVED K.N. MURTHY

LAUPT TO PASADENA
UNION STATION PLATFORM NO.1

AERIAL TRACK DECK PLAN
SHEET 1 OF 3

CONTRACT NO C6490
DRAWING NO S-026
REV 1
SCALE 1"=20'-0"
SHEET NO 62

COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT					ALTERNATIVE NO. US-6		
REPLACE SLAB/DIRECT FIXATION TRACK					SHEET NO. 4 of 4		
CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
REMOVE 47.91' x 478.37'							
SCREEDWORK 6EA x 478'	LF	2868	2—	5736			
EXPANSION JOINTS	LF	1052	2 64	2777			
CONCRETE SLAB 9" THK	SF	22919	3—	68,757			
REBAR, #5 @ 12" OC/EW	LB	52,840	0 71	37,517			
CONCRETE FINISH	SF	22,919	0 50	11,460			
CONCRETE CURE	SF	22919	0 12	2750			
DIRECT FIXATION TRACK	TF	478.37	263—	125,812			
ADD							
BALLAST	TON				1132	12—	13584
TRACK ON BALLAST	TF				478.37	128—	61,232
Sub-Total							
Mark-Up at %							
TOTAL				254,809			$74,816

260

SAVINGS = 179,993

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	US-7
DESCRIPTION:	REDUCE CANOPY AT UNION STATION	SHEET NO.	1 of 6

ORIGINAL DESIGN: (Sketch attached)

The canopy design of Union Station is unique compared with any other station on the line. It has a curved profile. The canopy covers a significant amount (3,450 sf) of the platform.

ALTERNATIVE: (Sketch attached)

Reduce the size of the canopy and match other Union Station canopies in design and materials. The new size will be 1,870 square feet, which reduces materials by 1,580 sq.ft.

ADVANTAGES:

- Reduces project cost
- Matches other Union Station platforms canopies providing a uniform station appearance.
- Simplifies construction

DISADVANTAGES:

- None apparent

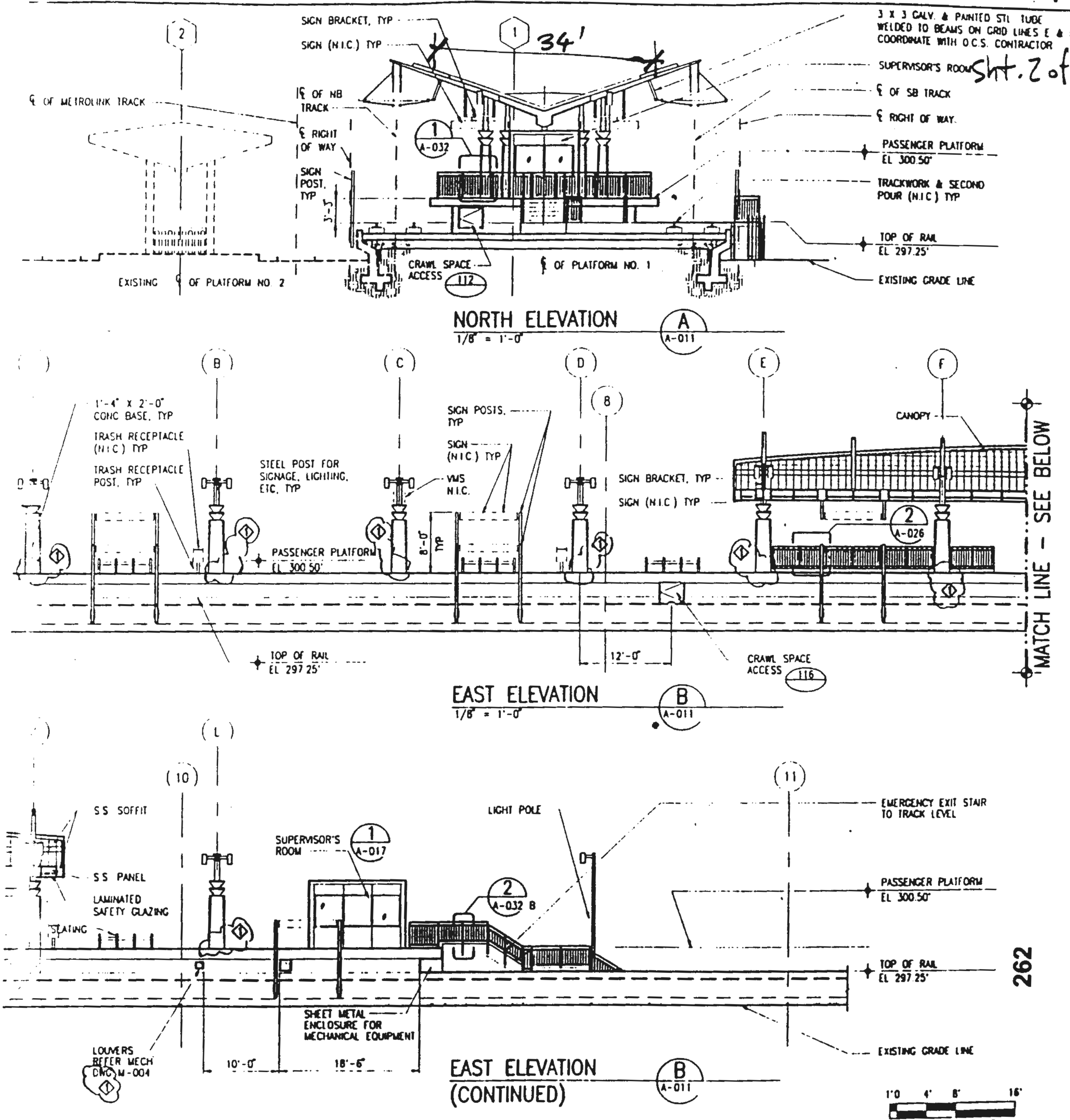
DISCUSSION:

Because access and egress to this station platform is through an underground tunnel, providing a unique canopy does not appear to be an important design factor. Elimination of curved profile and size will help reduce project cost and time for construction.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 220,140	—	$ 220,140
ALTERNATIVE	$ 112,320	—	$ 112,320
SAVINGS	$ 107,820	—	$ 107,820

ALTERNATIVE NO. US-7

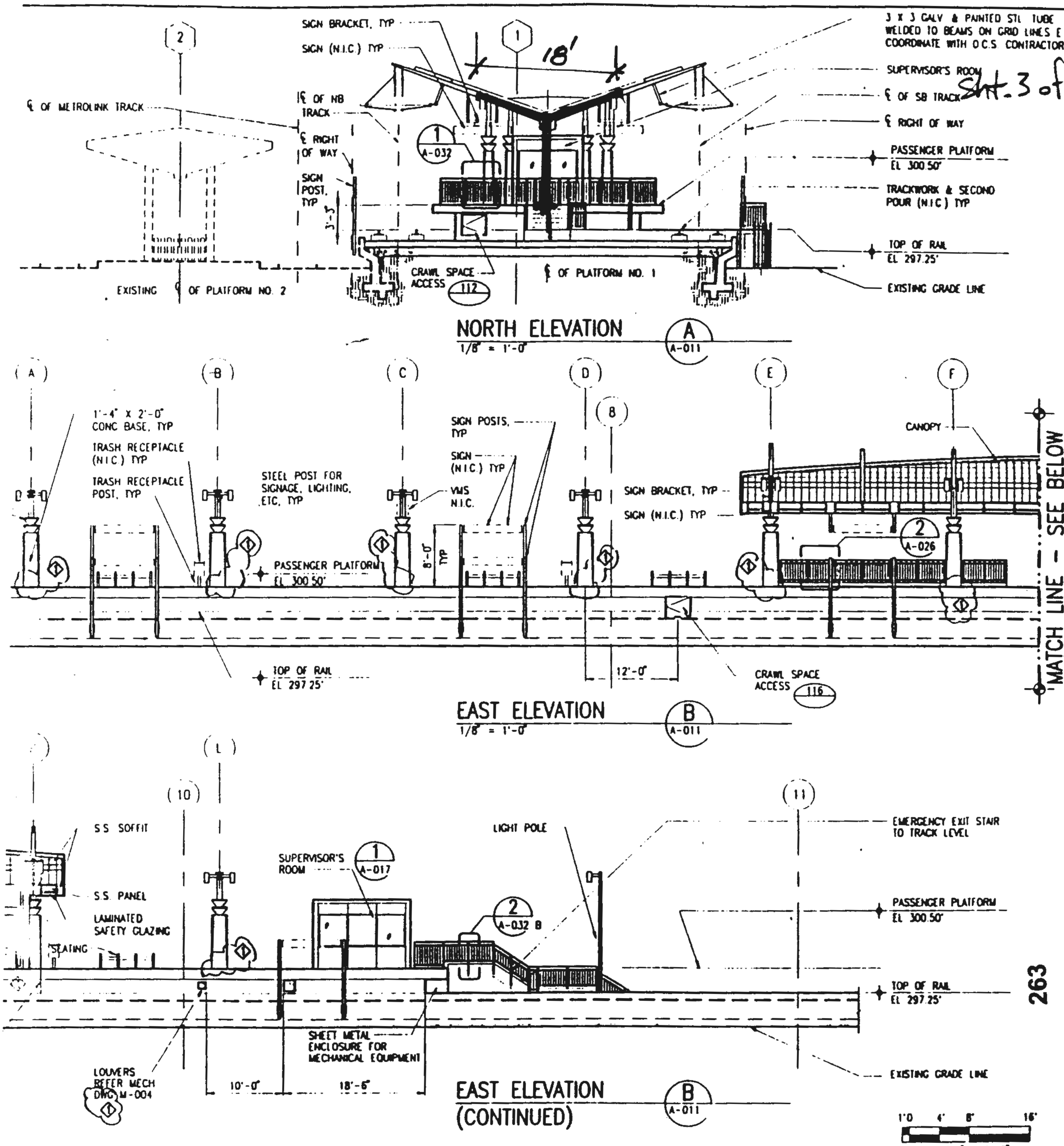
Sht. 2 of



262

LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY PASADENA BLUE LINE MARTINEZ AMADOR ARCHITECTS, INC. WILLIAM J. AMADOR C20348 EXP 3-31-97 ENGINEERING MANAGEMENT CONSULTANT — K.N. MURTHY	LAUPT TO PASADENA UNION STATION PLATFORM NO.1 EXTERIOR ELEVATIONS – NORTH, EAST AND AT BEGIN CONTRACT 100+17.27	CONTRACT NO C6490 DRAWING NO A-011 SCALE 1/8" = 1'-0" SHEET NO 92

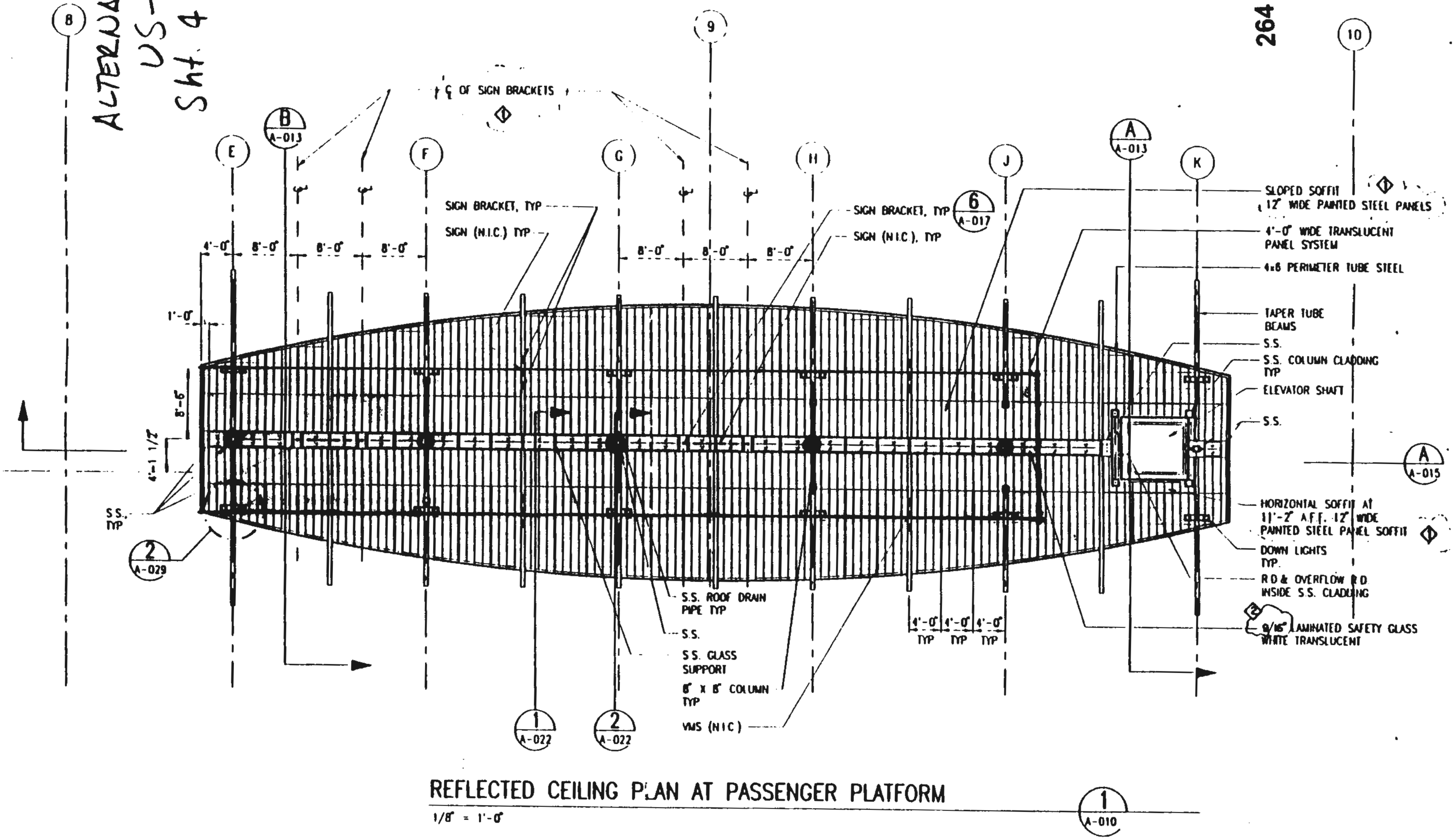
ALTERNATIVE NO. US-7



263

LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY PASADENA BLUE LINE		LAUPT TO PASADENA UNION STATION PLATFORM NO.1	CONTRACT NO C6490
MARTINEZ AMADOR ARCHITECTS, INC. WILLIAM J. AMADOR C20348 EXP 3-31-97	ENGINEERING MANAGEMENT CONSULTANT K.N. MURTHY	EXTERIOR ELEVATIONS - NORTH, EAST AND AT BEGIN CONTRACT 100+17.27	DRAWING NO A-011 SCALE 1/8" = 1'-0" SHEET NO 92

ALTERNATIVE No
US-7
Sht. 4 of 6



REFLECTED CEILING PLAN AT PASSENGER PLATFORM

1/8" = 1'-0"

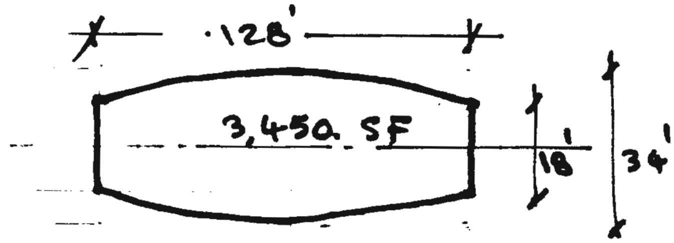
CALCULATIONS

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

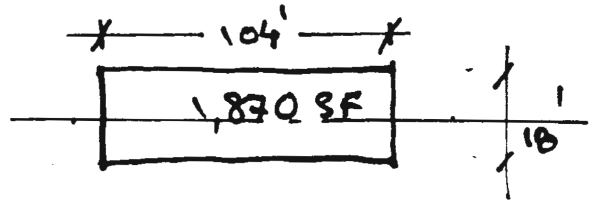
ALTERNATIVE NO. US-7

SHEET NO. 5 of 6

Original Design



Alternative



Original	3,450 SF
Alternative	1,870 SF
Saving	1,580 SF

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

ALTERNATIVE NO. US-7

UNION STATION PLATFORM #1 CANOPY

SHEET NO. 6 of 6

PRESENT DESIGN OF CANOPY

$18' \times 128' = \quad = 2,304$ SF

$[(34-18)/2](128)(\frac{2}{3})(2) = 1,365$

3,669 SF

3,669 SF × \$60/SF = \$220,140

PROPOSED DESIGN OF CANOPY

$104' \times 18' = \quad 1,872$ SF

1,872 SF × \$60/SF \$112,320

SAVINGS ≈ \$107,820

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	**US-8**
DESCRIPTION:	**DELAY CONSTRUCTION OF WEST TRACK AT UNION STATION PLATFORM UNTIL HEADWAYS ARE DECREASED**	SHEET NO.	1 of 3

ORIGINAL DESIGN:

The Union Station platform is served by tracks on both the east and west sides.

ALTERNATIVE: (Sketch attached)

Delay construction of the west track.

ADVANTAGES:

- Delays capital cost until additional capacity is needed

DISADVANTAGES:

- Reduces operational flexibility and redundancy in the near term

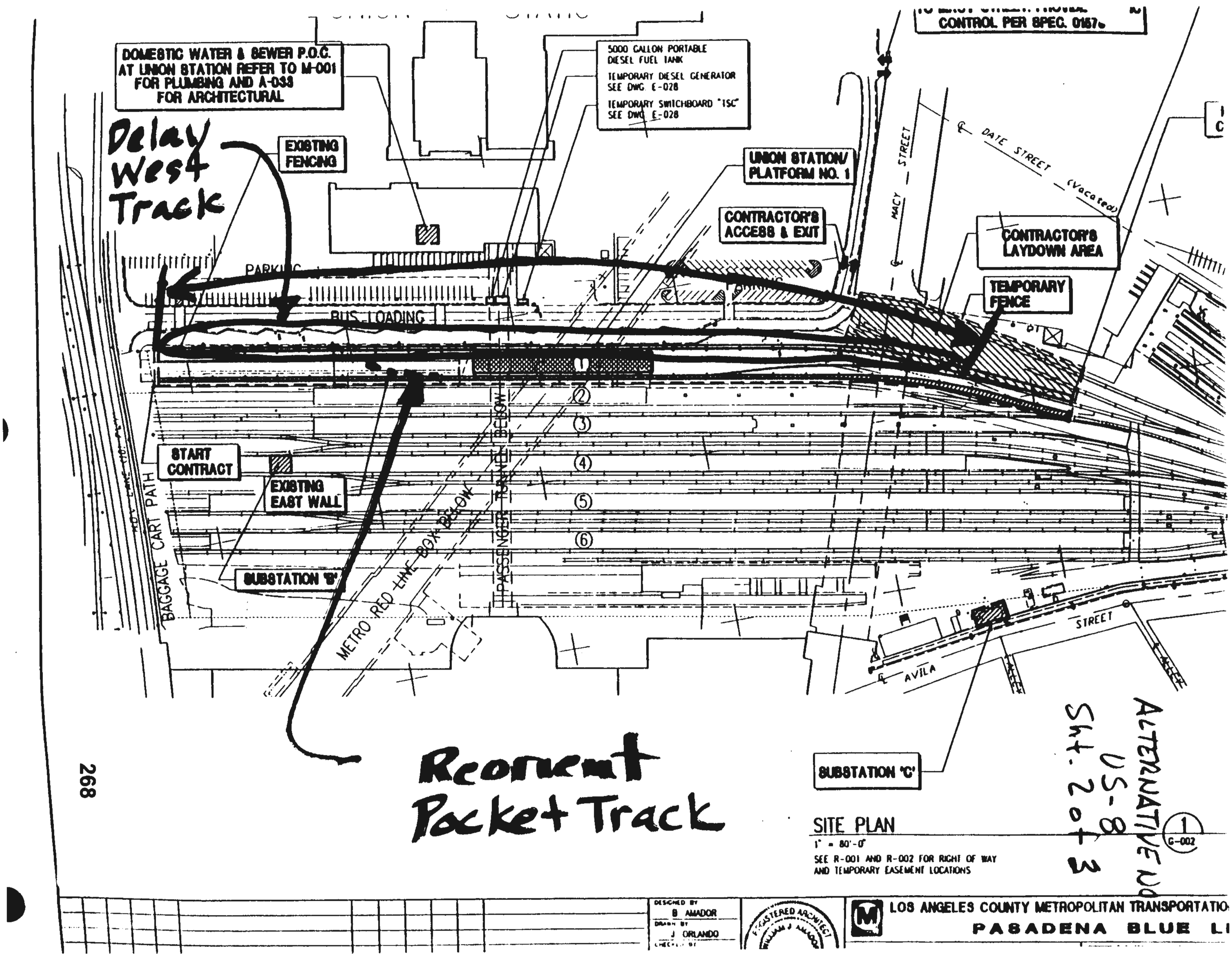
DISCUSSION:

The original design provides a crossover from the west track for trains approaching the Union Station platform. With headways of approximately 15 minutes, during the initial years of light rail operation, trains will load passengers primarily on the east side of the platform. The west side of the platform will be lightly uses. As headways are shortened in future years, the west side of the platform will begin to be utilized on a consistent basis.

Should budget constraints require reductions in the initial investment, the construction of the west track, costing $661,300, could be delayed until the headways require using both sides of the platform. The pocket track would be reoriented to connect with the east track rather than the west.

This capital cost should only be delayed if the construction funds are unavailable during the initial years.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 661,300	—	$ 661,300
ALTERNATIVE	$ 0	—	$ 0
SAVINGS	$ 661,300	—	$ 661,300


CONTROL PER SPEC. 0157
DOMESTIC WATER & SEWER P.O.C. AT UNION STATION REFER TO M-001 FOR PLUMBING AND A-033 FOR ARCHITECTURAL
5000 GALLON PORTABLE DIESEL FUEL TANK
TEMPORARY DIESEL GENERATOR SEE DWG. E-028
TEMPORARY SWITCHBOARD "TSC" SEE DWG. E-028
Delay West Track
EXISTING FENCING
UNION STATION/ PLATFORM NO. 1
CONTRACTOR'S ACCESS & EXIT
MACY STREET
DATE STREET (Vacated)
CONTRACTOR'S LAYDOWN AREA
TEMPORARY FENCE
PARKING
BUS LOADING
START CONTRACT
EXISTING EAST WALL
SUBSTATION 'B'
BAGGAGE CART PATH
METRO RED LINE BOX BELOW
PASSENGER TUNNEL BELOW
AVILA STREET
SUBSTATION 'C'
Reorient Pocket Track
ALTERNATIVE US-8
Sht. 2 of 3
268
SITE PLAN
1" = 80'-0"
SEE R-001 AND R-002 FOR RIGHT OF WAY AND TEMPORARY EASEMENT LOCATIONS
1 G-002
DESIGNED BY B. AMADOR
DRAWN BY J. ORLANDO
CHECKED BY
LOS ANGELES COUNTY METROPOLITAN TRANSPORTATIO
PASADENA BLUE LI

COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

UNION STATION TRACK CONSTRUCTION DELAY

ALTERNATIVE NO. US-8

SHEET NO. 3 of 3

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
DELETE WEST TRACK	TF	1306	178.38	232,958			
113+25 TO 100+19							
DELETE #8 TURNOUT	EA	1	38350	-38350			
TOTAL DELETE				$271 308			
[illegible]	LS			250,000			
OCS				140,000			
TOTAL				661,300			
Sub-Total				661,300			
Mark-Up at %							
TOTAL							

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	CS-1 to CS-5
DESCRIPTION:	REVISE DESIGN FOR CHINA TOWN STATION	SHEET NO.	1 of 3

ORIGINAL DESIGN: (Sketch attached)

A conceptual design for the China Town Station has been developed that includes a cloud theme "wing-shaped" canopy.

ALTERNATIVE: (Sketch attached)

Redesign the station to match traditional Chinese architecture.

ADVANTAGES:

- Saves costs
- Conforms with traditional designs

DISADVANTAGES:

- Community approval required

DISCUSSION:

When passengers enter the China Town Station they should immediately recognize its symbolism. However, it is believed that the current station design may present a confusing picture to the using public. It was noted that the design has been approved by the China Town community, but the source of the approval is unknown. A more recognizable design, such as portrayed on the attached sketch, should be developed by the Authority and presented along with the current design to the community for their selection. Placing an artist's rendering of both designs in the local newspapers is one means of achieving this goal; another being to conduct a public meeting at which time both concepts would be exhibited. It is also believed that the more traditional alternative design will be less costly to construct.

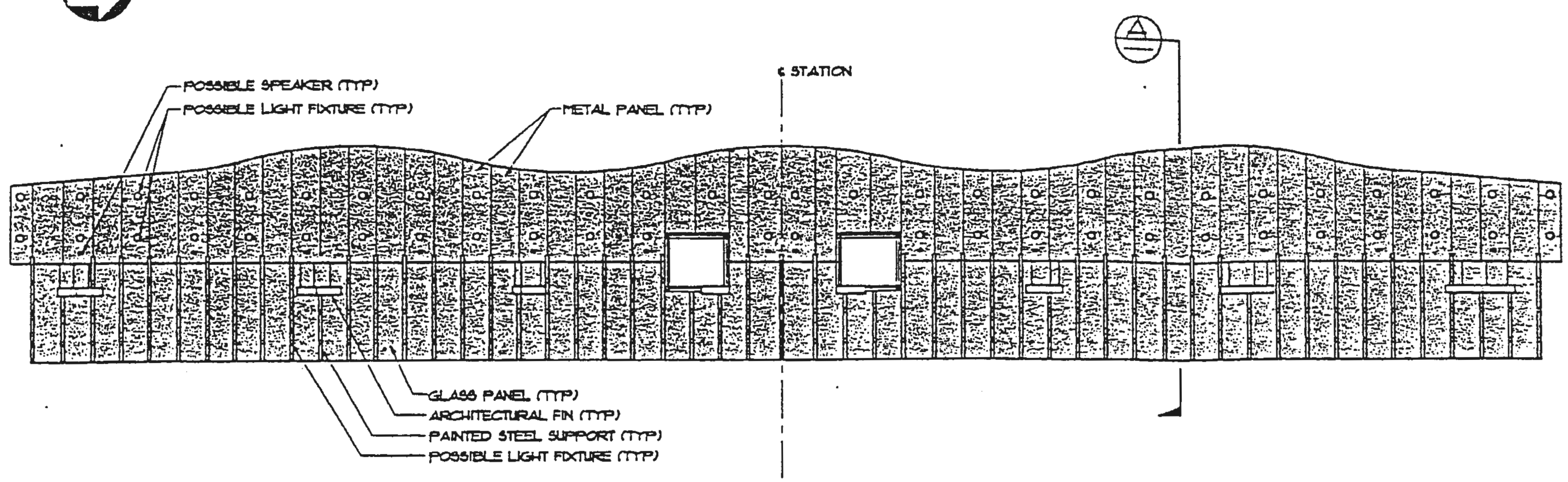
With respect to the "wing-shaped" canopy, it is believed that it will act as an inverted airfoil. In a strong Santa Ana wind condition, the inverted airfoil will create a downward force that will tend to rotate the canopy and then cause uplift on the opposite side. Combined with what appears to be an already weak joint where the horizontal section meets the support column, a structural failure could occur. This should be carefully checked by the designers.

The fans in the current design are curved and appear to internally incorporate I-beams that act as station canopy supports. The bending of I-beams into a curved shape is an expensive process. By straightening the fans, straight I-beams could be used and costs saved.

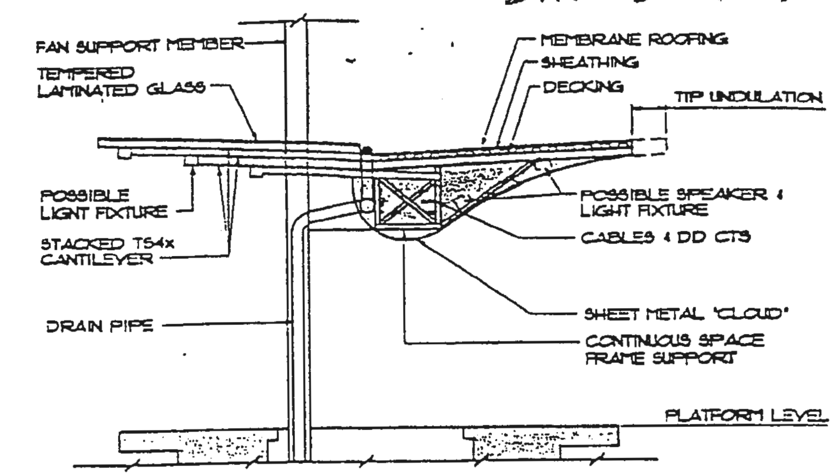
COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS			

ALTERNATIVE NO.

CS-1 → CS-5
Sht. 2 of 3

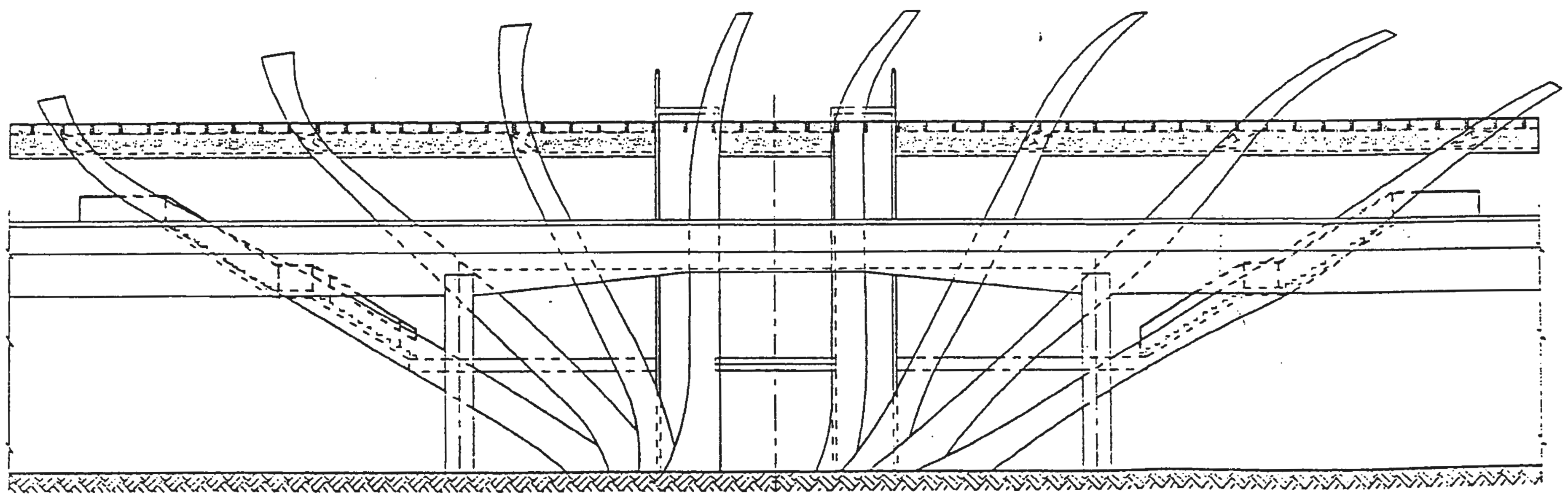


REFLECTED CEILING (HALF) PLAN
SCALE 1"=10'-0"



TYPICAL ROOF SECTION (A)
SCALE 1/4"=1'-0"

Figure 2.7 Plan of the Station Canopy



ROOF ELEVATION
SCALE 1"=10'-0"

AS DESIGNED

THE PREPARATION OF THIS DRAWING HAS BEEN FINANCED IN PART THROUGH A GRANT FROM THE U.S. DEPARTMENT OF TRANSPORTATION, FEDERAL TRANSIT ADMINISTRATION, UNDER THE FEDERAL TRANSIT ACT OF 1964, AS AMENDED, AND IN PART BY THE TAXES OF THE CITIZENS OF LOS ANGELES COUNTY AND OF THE STATE OF CALIFORNIA.

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY K. PETERSON
DRAWN BY M. SPARLING
CHECKED BY
IN CHARGE E. CASTELLANI
DATE 10 MAR 98

LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY
PASADENA BLUE LINE

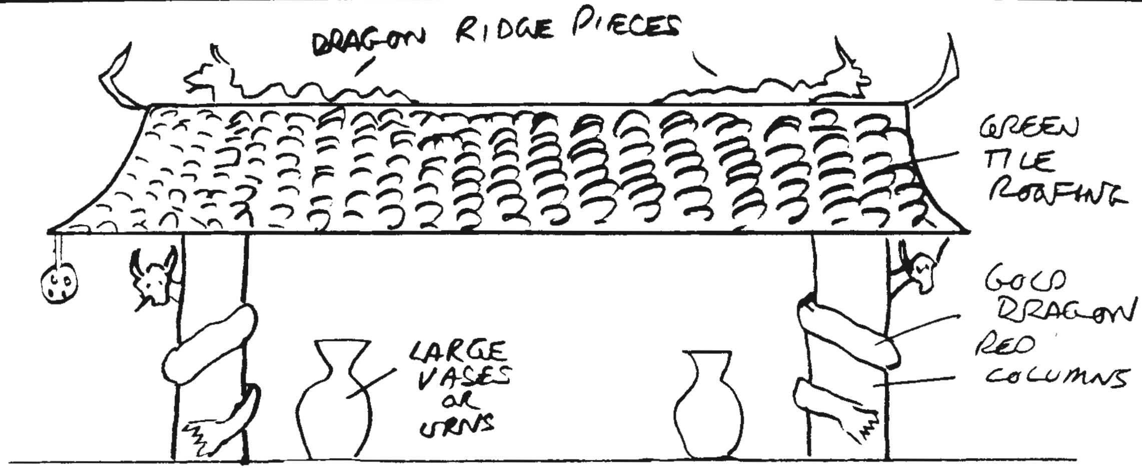
SUBMITTED
APPROVED

LAUPT TO PASADENA
CHINATOWN STATION STRUCTURE
ARCHITECTURAL
ROOF - REFLECTED CEILING
PLAN, ELEVATION & SECTION

CONTRACT NO
DRAWING NO PEA-04
REV
SCALE AS SHOWN
SHEET NO 7

SKETCHES

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. CS-1 thru CS-5
	☐ AS DESIGNED ☑ ALTERNATIVE	SHEET NO. 3 of 3



PROPOSED CHINATOWN STATION

Sketch 2-2

SUMMARY OF POTENTIAL COST SAVINGS

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	LOCATION: LOS ANGELES TO PASADENA, CALIFORNIA				
PROJECT ELEMENT:	YARD AND SHOPS (Y&S)		PRESENT WORTH OF COST SAVINGS			
ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	INITIAL COST SAVINGS	O & M SAVINGS	TOTAL SAVINGS
Y&S-1	Use prefabricated metal building frame and building skin for all buildings in lieu of custom steel structures	1,340,000	440,000	900,000	—	900,000
Y&S-2	Simplify the existing HVAC system in the office area by replacing the VAV system with a number of single zone units.	152,000	80,000	72,000	—	72,000
Y&S-3	Modify track layout in yard to improve train movements	0	567,190	(567,190)	—	(567,190)
Y&S-4	Replace cantilevered cast-in-place concrete retaining walls with chain link fence retainer matting	269,500	113,300	156,200	—	156,200
Y&S-6	Use soil nail walls in lieu of retaining walls	483,264	224,250	259,014	—	259,014

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	**Y&S-1**
DESCRIPTION:	**USE PREFABRICATED METAL BUILDING FRAME AND BUILDING SKIN FOR ALL BUILDINGS IN LIEU OF CUSTOM STEEL STRUCTURES**	SHEET NO.	1 of 13

ORIGINAL DESIGN: (Sketch attached)

There are four buildings, including Maintenance Building, Blow Down, Car Wash, and Department of Water & Power (DWP) Buildings, on this site. The Traction Power Substation (TPSS) structures are currently prefabricated and covered in the Systems portion of the work. All other structures are a combination of steel frame and concrete masonry unit (CMU) bearing walls used for the building structural systems. The exterior building skin is CMU from finish grade to eight feet and factory insulated metal panels from eight feet to the roof. Prefabricated concrete roof planks are used for the roofs at Blow Down, Car Wash and DWP Buildings. Metal form deck with concrete topping and insulation is used for Maintenance Building floor and roof construction. Roofs have minimum slope and are covered with a built-up roofing system. Roof drains and interior roof drain leaders are used to direct storm water to grade.

ALTERNATIVE: (Sketch attached)

Use a prefabricated metal building framing system, exterior metal wall panels, and metal roof for the Maintenance Building, Blow Down, Car Wash and DWP Buildings. The structural system for Car Wash and Blow Down buildings is to be a rigid steel frame. A combination of cross bracing and portal frames is to be used for required for lateral stability. The Maintenance Building will have a structural steel frame. The use of a rigid frame system or conventional steel framing at the Maintenance Building would be left to the discretion of the Design/ Build Team in order to minimize project schedule and construction costs. Because the DWP building is being constructed for another agency, a metal building may not be selected. Building construction materials and systems should be reviewed with Department of Water and Power before advertising for a Design/Build Team. If the DWP building can also be a prefabricated structure, it will eliminate the need for precast concrete and masonry work on the project.

Maintenance Buildings and DWP Building will be insulated with standard batt insulation with vinyl facing. Walls are protected with metal linear panel up to approximately 7 feet above finished floor. Interior partitions and office walls are framed with metal studs and finished with gypsum wallboard. The Blow Down Building will have interior liner panel on all walls and ceilings. Gutters and exterior downspouts are used to drain metal roofs. Since the Car Wash building is unheated, it will not require any roof or wall insulation or an interior liner panel. It is suggested that all structural steel in the Blow Down Building and Car Wash building be given a field applied epoxy coating.

Building dimensions and interior clearances shall closely match existing plans. All interior mezzanines, pits, jib cranes, equipment, plumbing, HVAC, rooms and layouts shall remain the same excluding exceptions indicated on the attached Maintenance Building sketch.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 1,340,000	—	$ 1,340,000
ALTERNATIVE	$ 440,000	—	$ 440,000
SAVINGS	$ 900,000	—	$ 900,000

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	Y&S-1
DESCRIPTION:	**PREFABRICATED METAL BUILDING FRAME AND BUILDING SKIN**	SHEET NO.	2 of 13

ADVANTAGES:

- Reduces project cost with less expensive building materials
- Speeds construction schedule by eliminating masonry work and steel-masonry interface
- Since the Midway Yard is considered to be a 10-year (temporary) operation, proposed construction closely matches life span

DISADVANTAGES:

- None apparent

DISCUSSION:

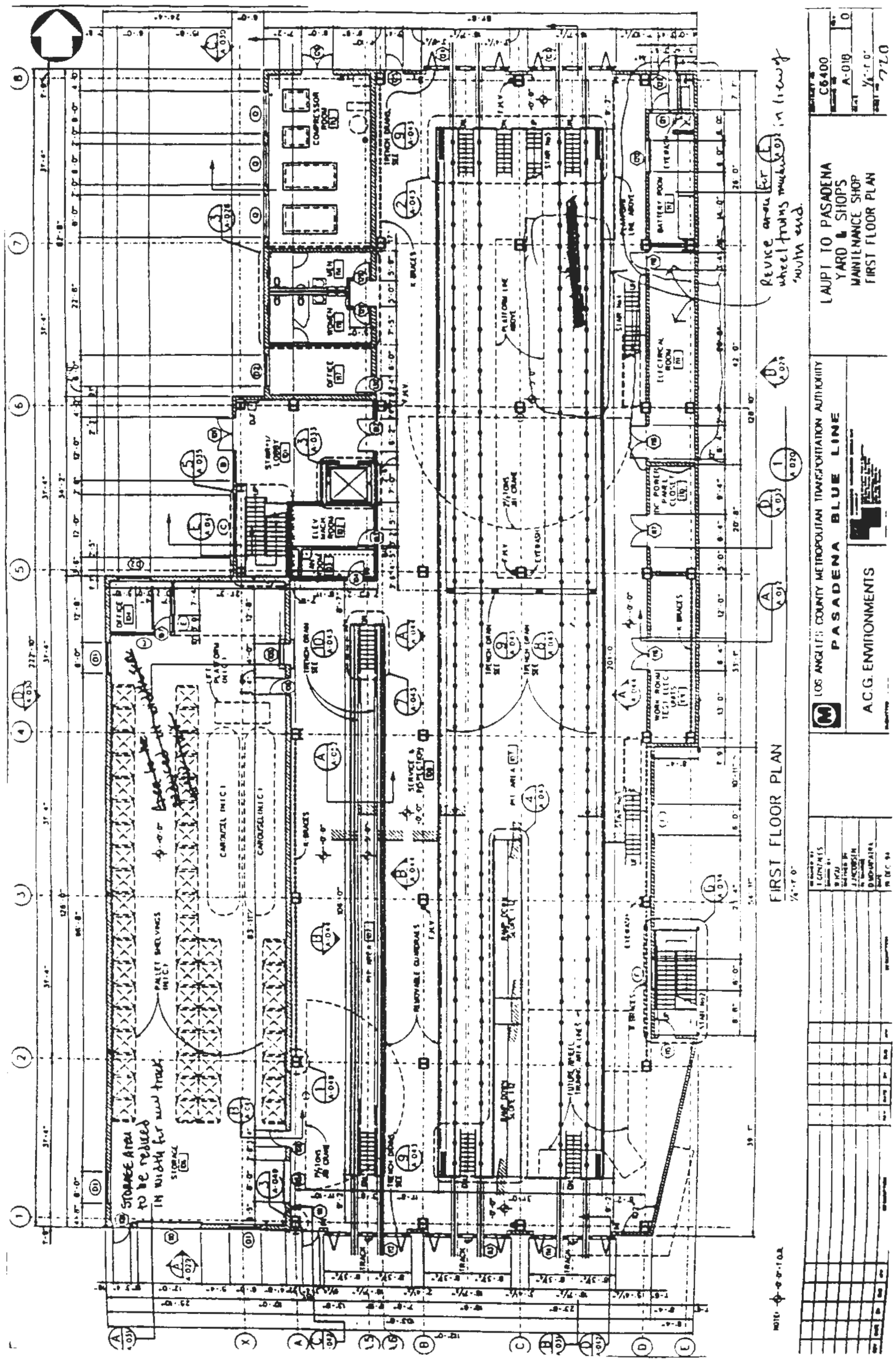
This alternative reduces the cost of the proposed Midway Yard buildings by $900,000 without impairing any operations. The proposed metal panel is a high quality architectural finish. Considering the project's industrial location and low visibility from the general public, building aesthetics is also not expected to be an important consideration. Eliminating the masonry work from this portion of the project and the interface between precast concrete, masonry, and steel framing, will help reduce construction time. All considered, the proposed alternative is sensible and economical for the intended life cycle of the structures, meeting all operational needs.

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

ALTERNATIVE NO. Y&S-1

☒ AS DESIGNED ☐ ALTERNATIVE

SHEET NO. 3 of 13



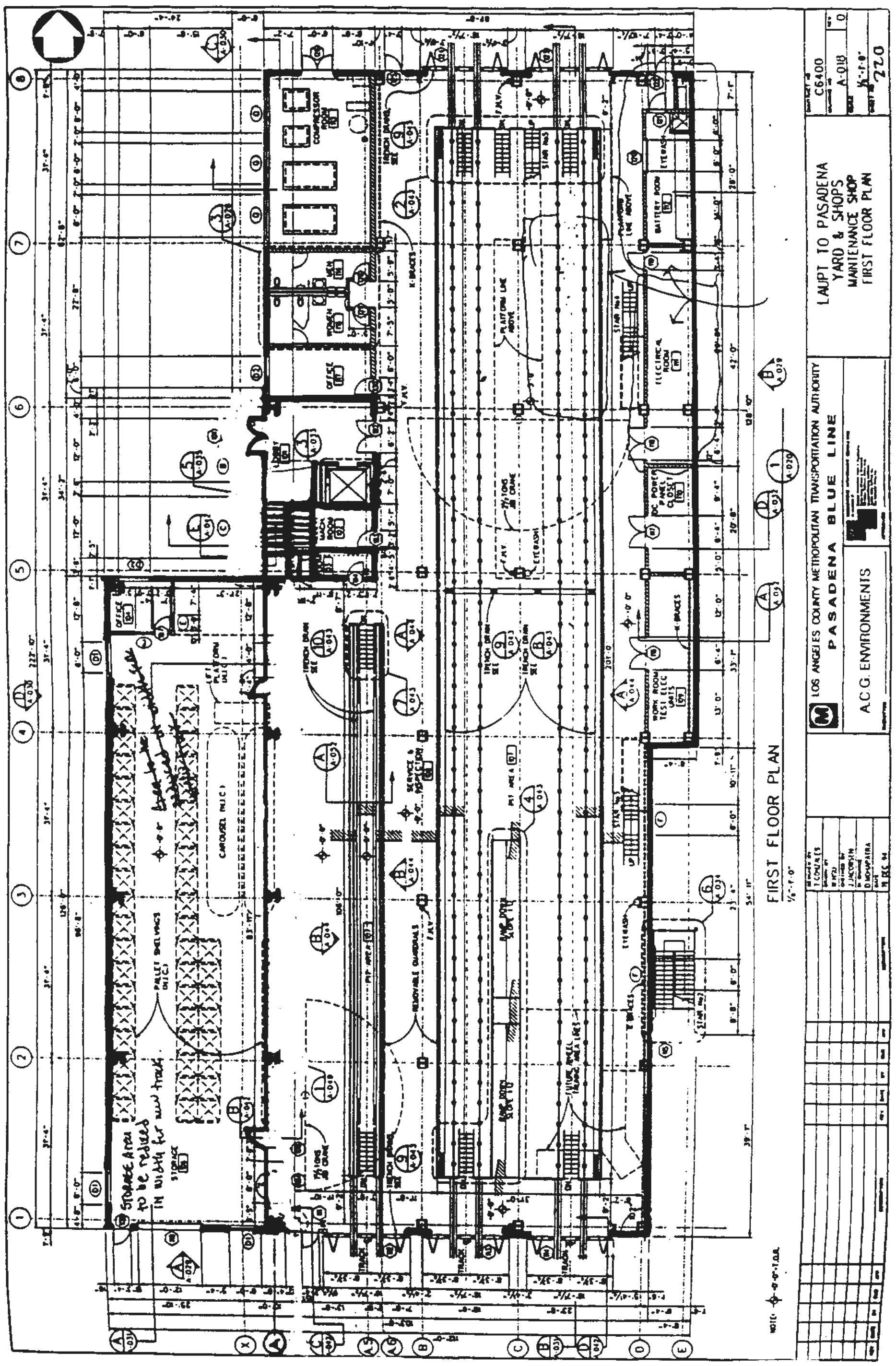
SKETCHES

PROJECT: **PASADENA BLUE LINE LIGHT RAIL PROJECT**

ALTERNATIVE NO. YS-1

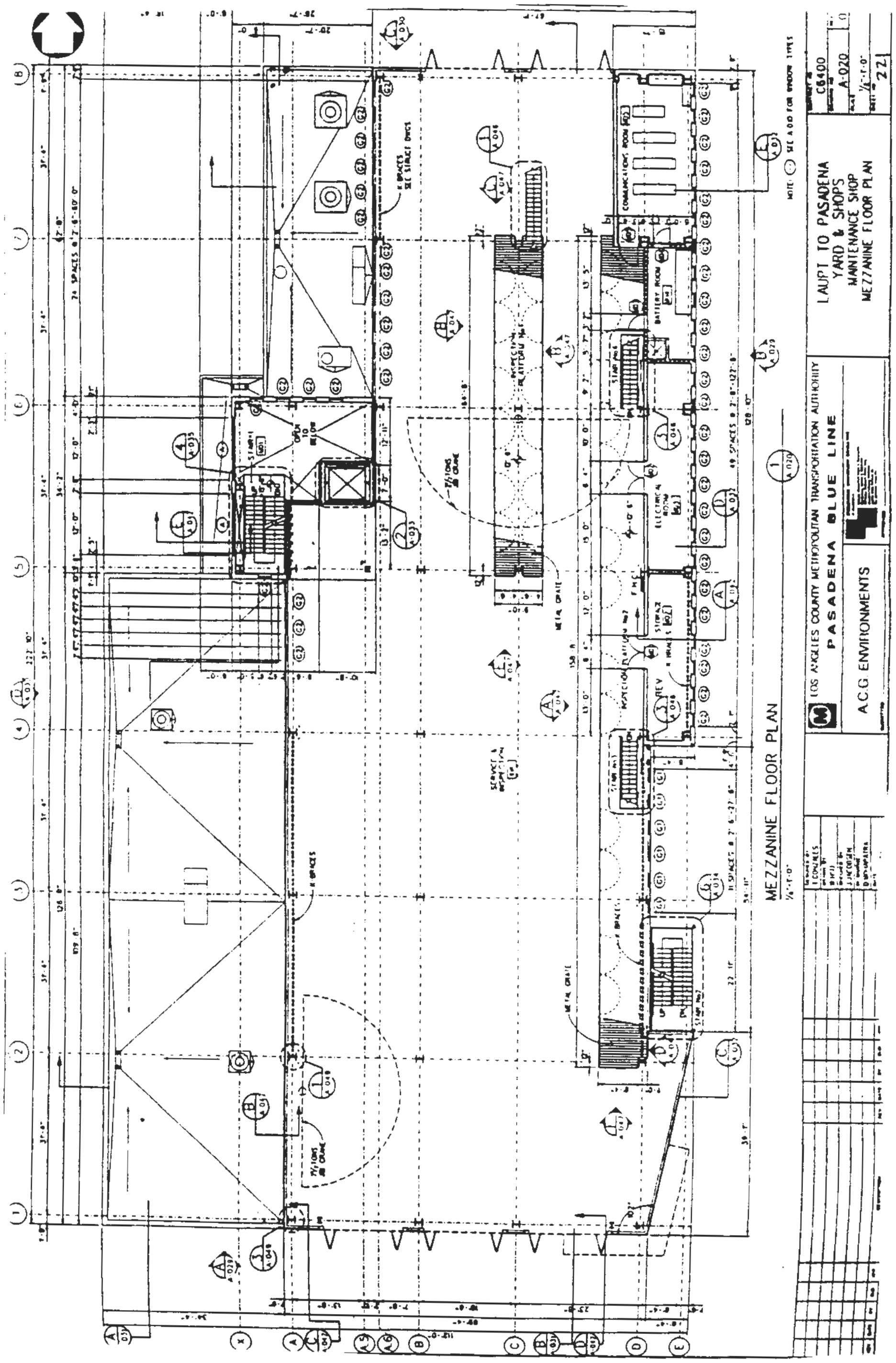
☐ AS DESIGNED ☒ ALTERNATIVE

SHEET NO. 4 of 13



PROJECT: **PASADENA BLUE LINE LIGHT RAIL PROJECT** ALTERNATIVE NO. Y&S-1

☒ AS DESIGNED ☐ ALTERNATIVE SHEET NO. 5 of 13

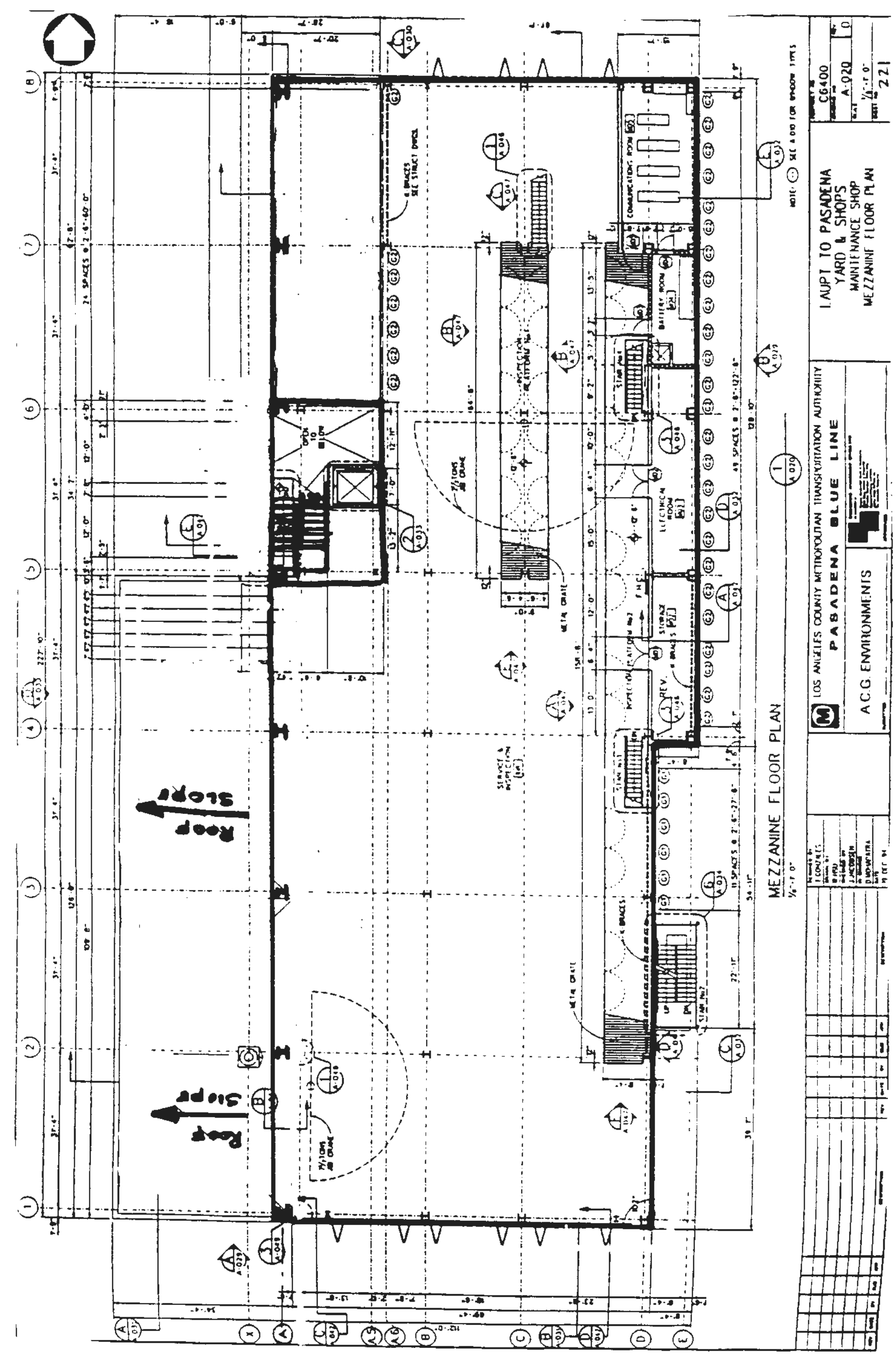


PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

ALTERNATIVE NO. Y&S-1

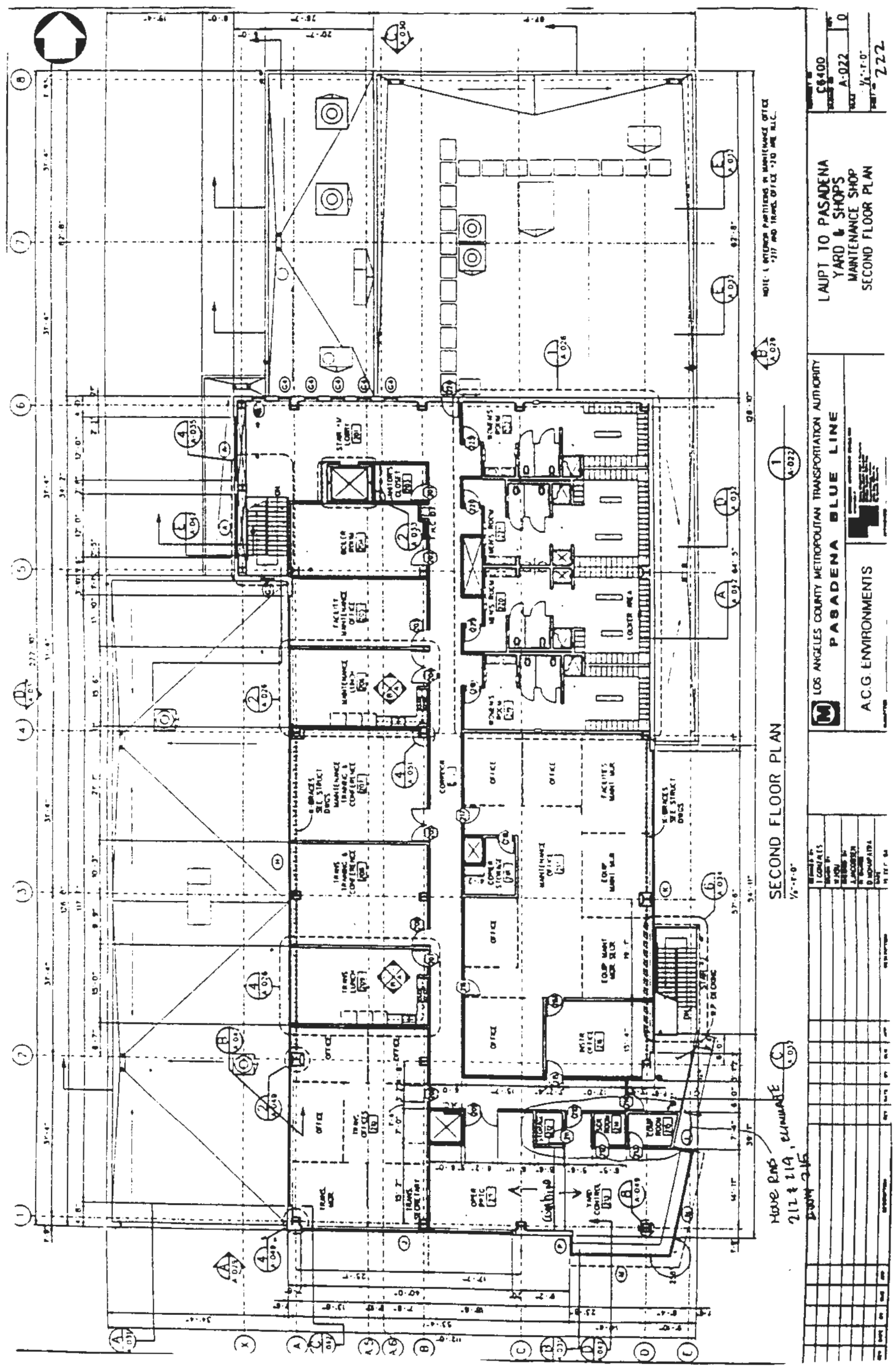
☐ AS DESIGNED ☒ ALTERNATIVE

SHEET NO. 6 of 13



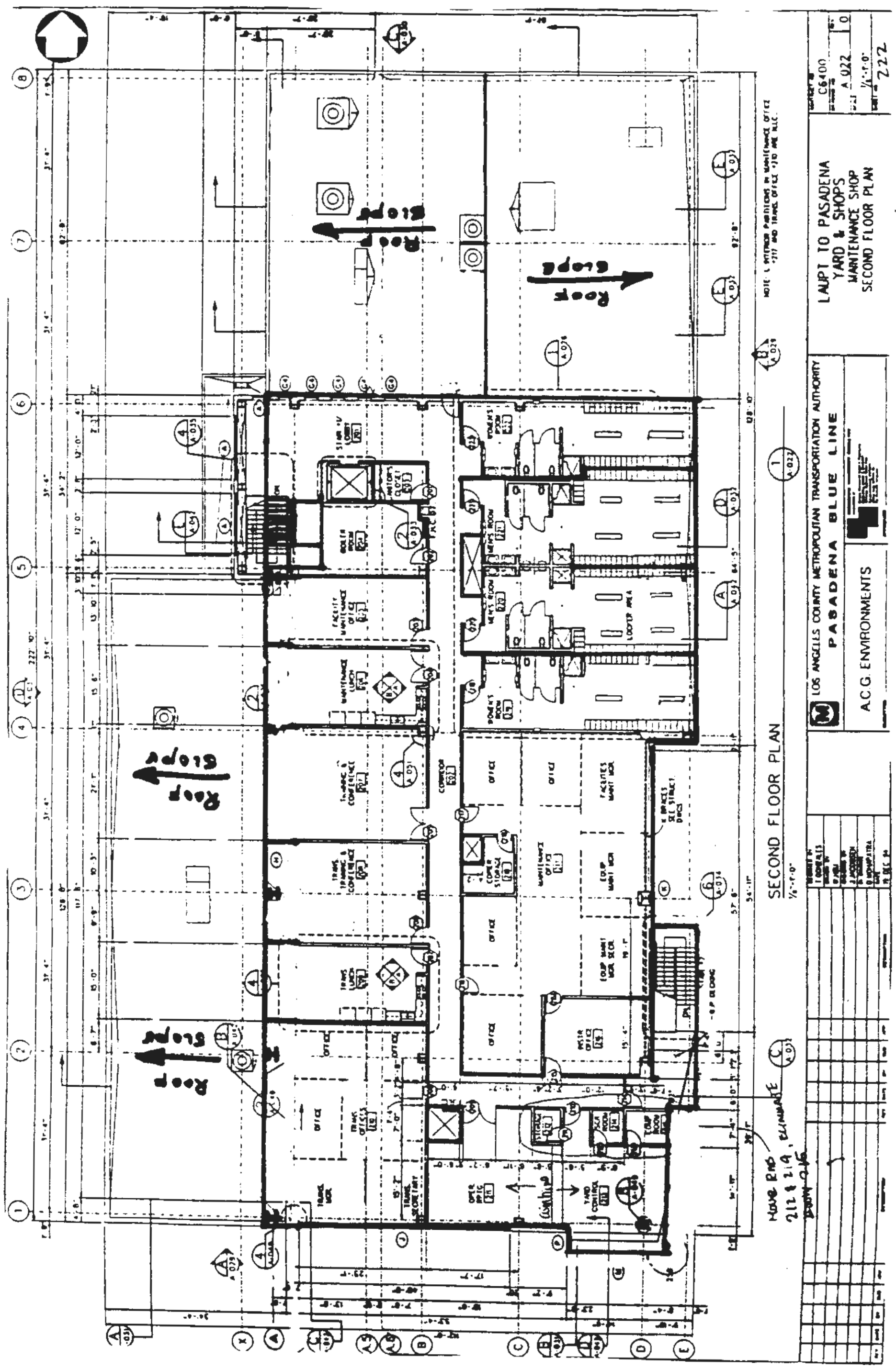
SKETCHES

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT		ALTERNATIVE NO. Y&S-1
	☒ AS DESIGNED	☐ ALTERNATIVE	SHEET NO. 7 of 13



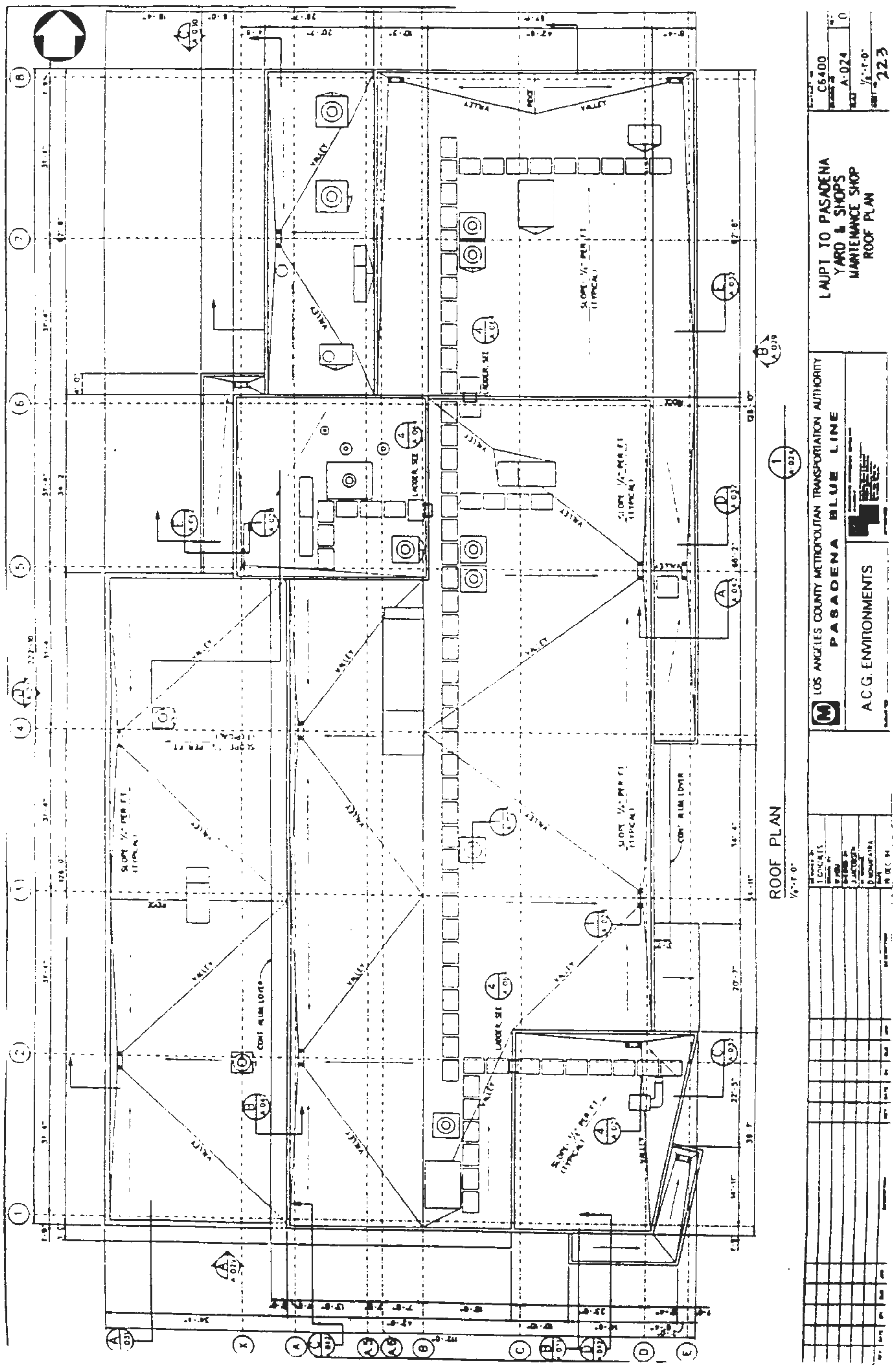
SKETCHES

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT		ALTERNATIVE NO. Y&S-1
	☐ AS DESIGNED	☒ ALTERNATIVE	SHEET NO. 8 of 13

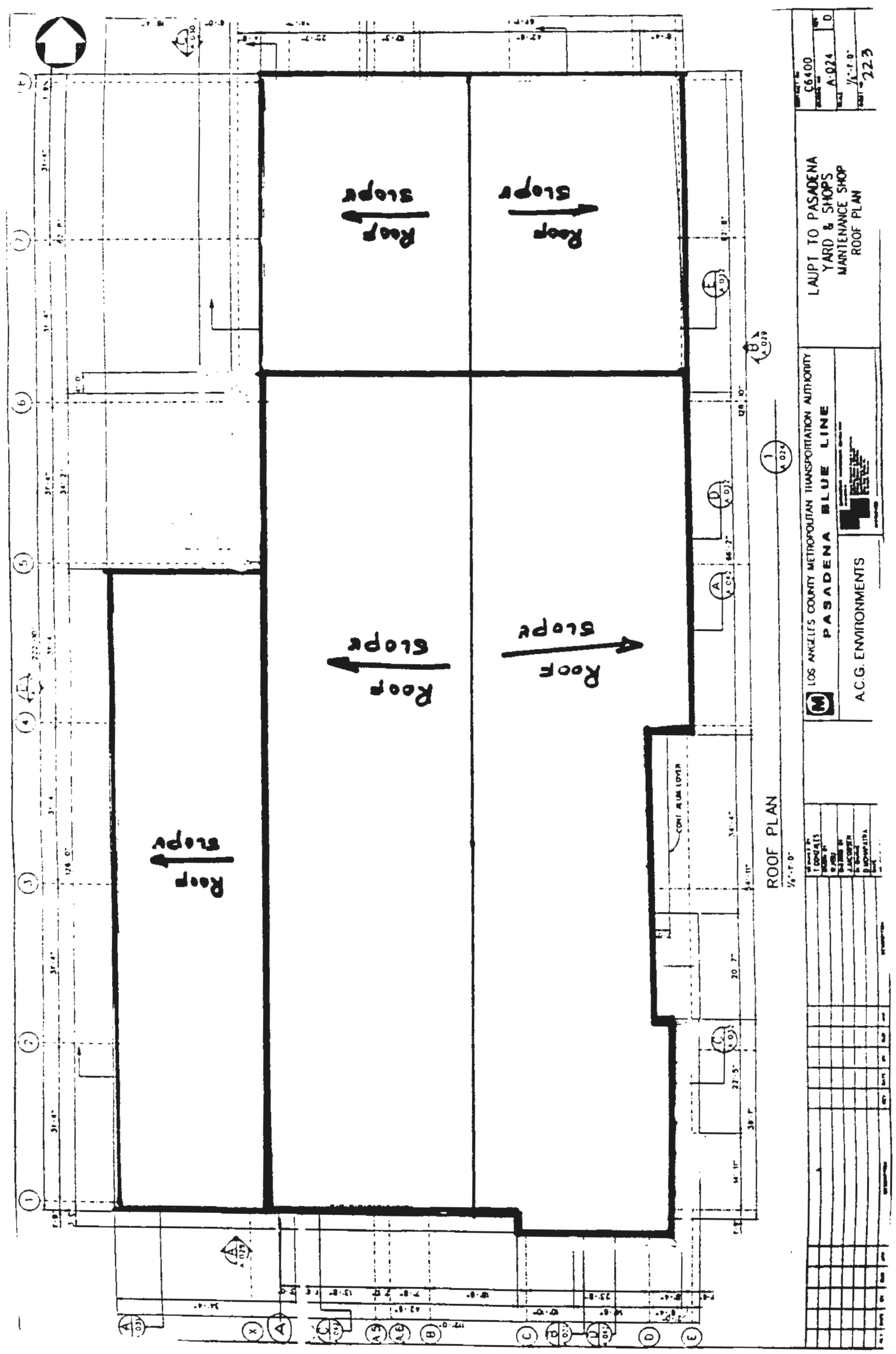


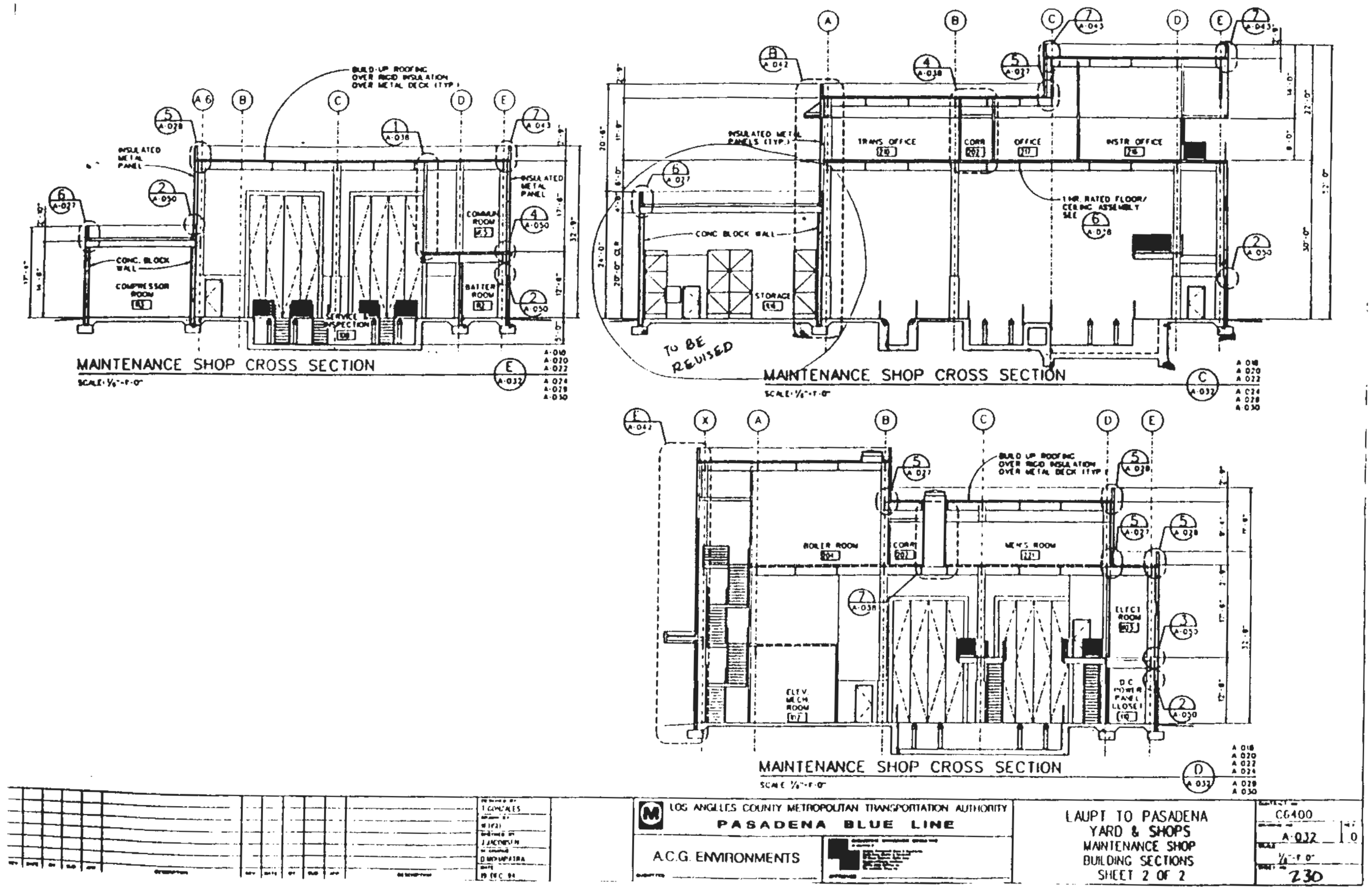
SKETCHES

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. Y#5-1
☒ AS DESIGNED	☐ ALTERNATIVE	SHEET NO. 9 of 13



PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. Y45-1
	☐ AS DESIGNED ☒ ALTERNATIVE	SHEET NO. 10 of 13





SKETCHES

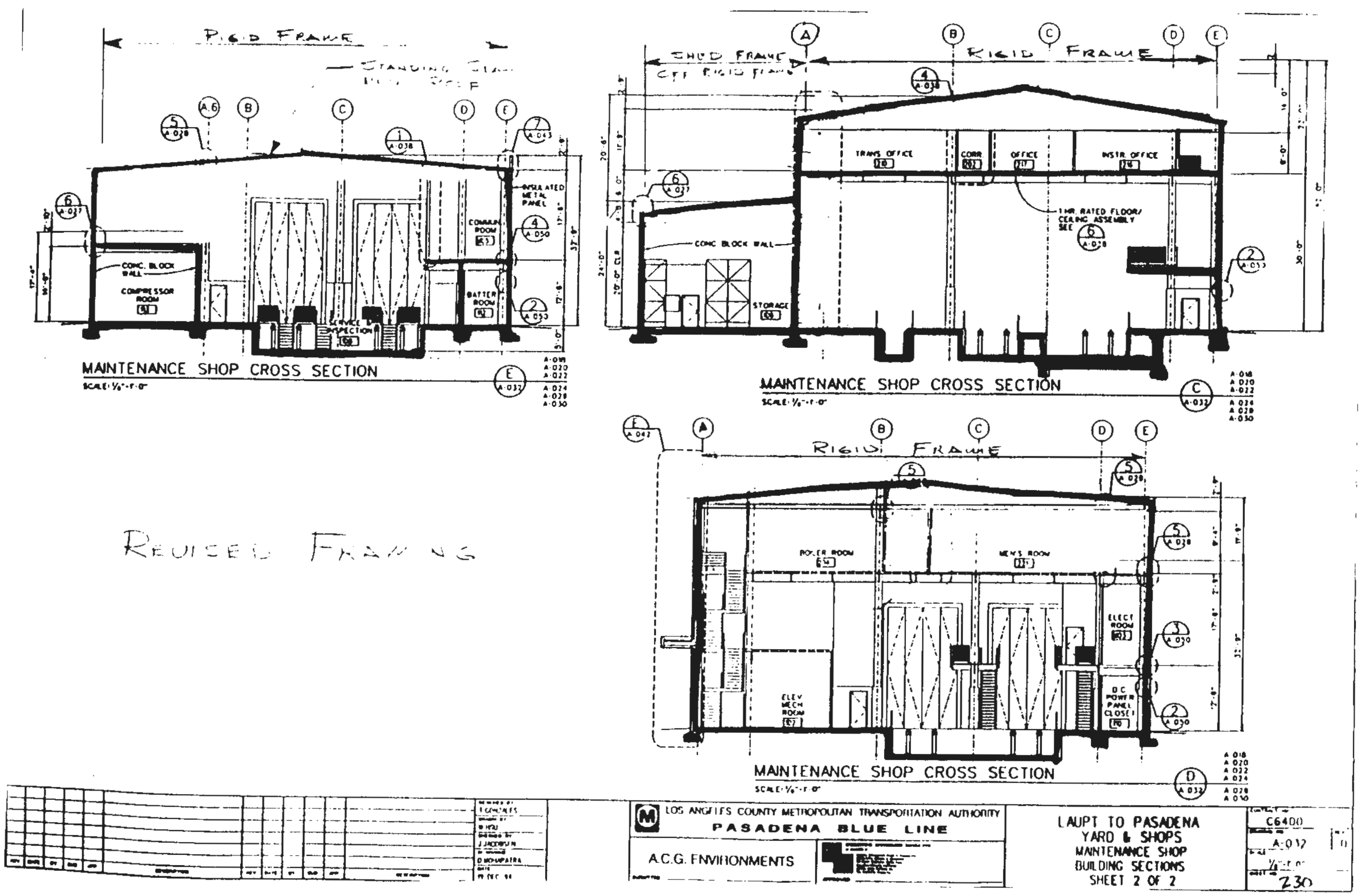
ALTERNATIVE NO. 145-1

SHEET NO. 11 of 13

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

☒ AS DESIGNED

☐ ALTERNATIVE



PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

☐ AS DESIGNED

☒ ALTERNATIVE

SKETCHES

ALTERNATIVE NO. Y4S-1

SHEET NO. 12 of 13

Steve Silkworth

COST WORKSHEET

PROJECT: **PASADENA BLUE LINE LIGHT RAIL PROJECT**

ALTERNATIVE NO. Y&S-1

SHEET NO. 13of 13

CONSTRUCTION ITEM		*ORIGINAL ESTIMATEh*			*PROPOSED ESTIMATE*		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
Masonry	S.F.	20,736	15.00	311,040			
Insulated metal panel	S.F.	37,100	22.00	816,200			
Metal panel	S.F.				57,836	2.50	144,590
Liner panel	S.F.				20,736	1.50	31,104
Built-up roof system & deck	S.F.	34,784	5.00	173,920			
Standing seam roof	S.F.				34,784	3.00	104,352
Rigid roof insulation	S.F.	34,784	1.50	52,176			
Vinyl covered batt insulation	S.F.				92,620	.75	69,465
Re-engineering and drawings	L.S.						100,000
Sub-Total				1,353,336			449,511
Mark-Up at %							
TOTAL				1,353,336			449,511

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	**Y&S-2**
DESCRIPTION:	**SIMPLIFY THE EXISTING HVAC SYSTEM IN THE OFFICE BY REPLACING THE VAV SYSTEM WITH A NUMBER OF SINGLE ZONE UNITS**	SHEET NO.	1 of 4

ORIGINAL DESIGN: (Sketch attached)

The original design uses a 29 ton variable air volume (VAV) roof top unit with 19 VAV boxes, each equipped with hot water heating coils to maintain the comfort of the personnel in the 8,200 sf office area. The hot water heating coils are served by a small hot water boiler. The boiler is located in a second floor, 350 sf boiler room, along with expansion tanks, water treatment, and two circulating pumps. Each VAV box is equipped with a three-way control valve, thermostat and a central control system.

ALTERNATIVE: (Sketch attached)

Install four 7½ ton single rooftop units with electric cooling, gas heating, and airside economizer cycles. The units can be zoned to separate the maintenance personnel from operations personnel and each exposure can have its zone of control.

ADVANTAGES:

- Saves cost
- Reduces ductwork
- Eliminates 19 VAV boxes
- Eliminates hot water heating system
- Simplifies the control systems
- Frees-up the boiler room space for another function

DISADVANTAGES:

- Requires more roof openings

DISCUSSION:

Both systems provide comfortable working conditions. The single zone rooftop units are more fitting for the proposed 10-year life of this building. This system is simpler to install, start-up, balance and maintain. It requires no chemical treatment and no water piping above the ceiling.

The current system is a very good system, but it gives a level of control that exceeds the requirements of this application. Almost every room has its own thermostat. The VAV box approach requires reheat, which forces the addition of the boiler system.

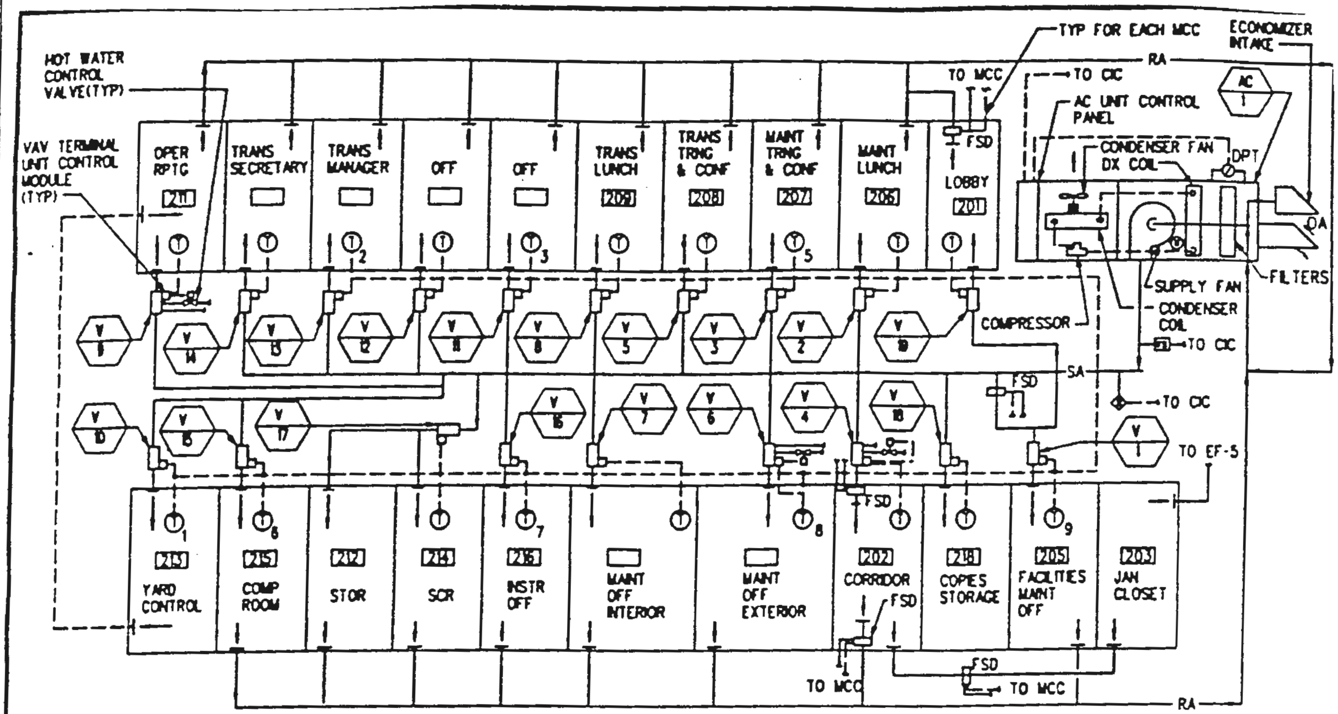
COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 152,000	—	$ 152,000
ALTERNATIVE	$ 80,000	—	$ 80,000
SAVINGS	$ 72,000	—	$ 72,000

PROJECT: **PASADENA BLUE LINE LIGHT RAIL PROJECT**

ALTERNATIVE NO. Y&S2

☒ AS DESIGNED ☐ ALTERNATIVE

SHEET NO. 2 of 4



MAINTENANCE SHOP 2ND FLOOR
AIR CONDITIONING SYSTEM

1 M-021 M-009 M-018

SKETCHES

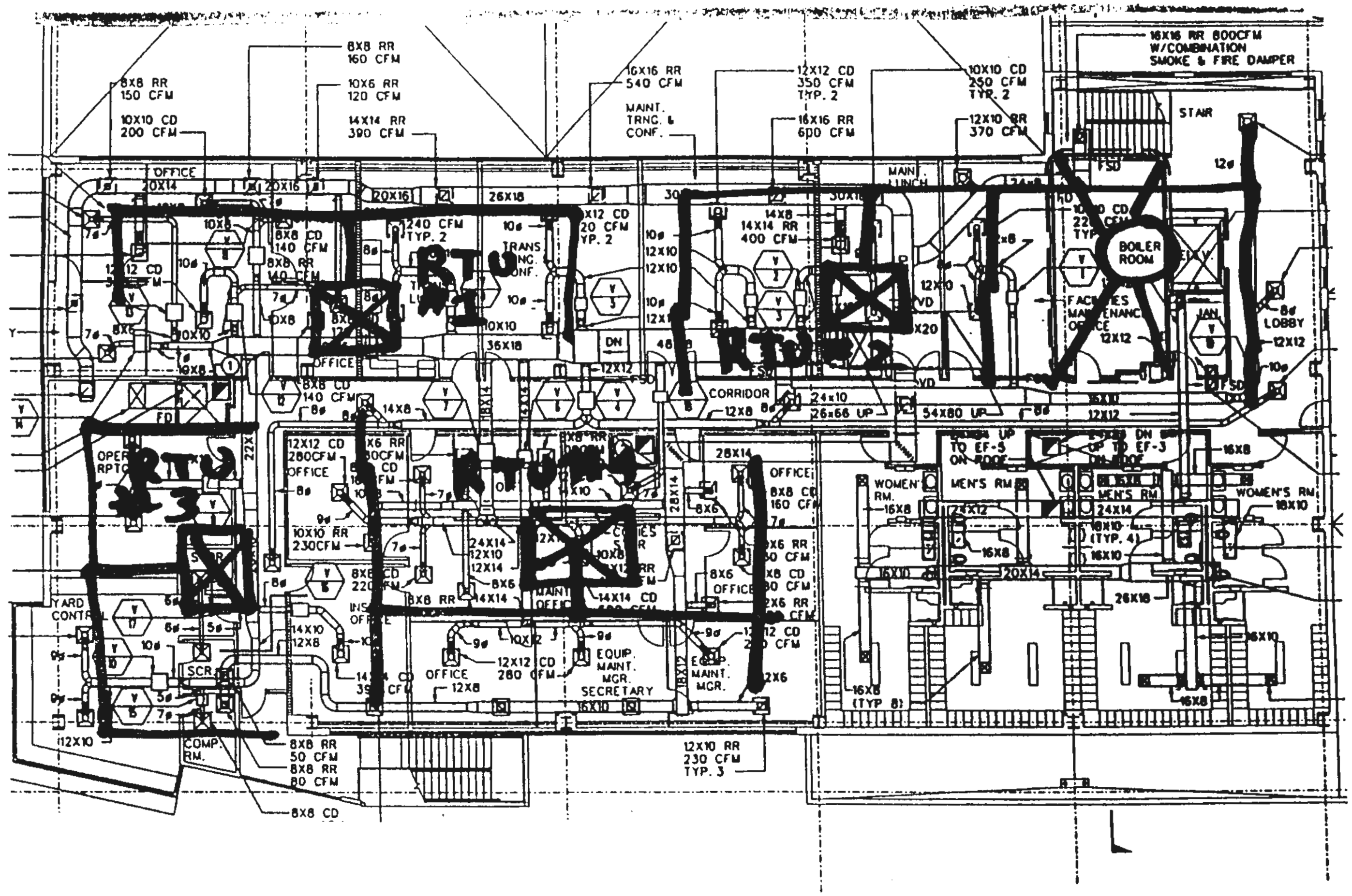
ALTERNATIVE NO. 165-2

SHEET NO. 3 of 4

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

☐ AS DESIGNED

☒ ALTERNATIVE



SECOND FLOOR PLAN

1/4"=1'-0"

COST WORKSHEET

PROJECT: **PASADENA BLUE LINE LIGHT RAIL PROJECT**

ALTERNATIVE NO. Y&S-2

SHEET NO. 4 of 4

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
29 TON VAV ROOF TOP UNIT	LS	1	30000	30000			
BOILER	LS	1	15000	15000			
PUMPS	LS	2	1500	3000			
HOT WATER PIPING	LS	1	5000	5000			
DUCTWORK	LS	1	50000	50000	1	25000	25000
VAV BOXES	EA	19	1000	19000			
CONTROLS	LS	1	30000	30000			
7 ½ TON ROOF TOP UNIT	LS				4	10000	40000
RE-DESIGN	LS				1	15000	15000
Sub-Total				$152,000			$80,000
Mark-Up at %							
TOTAL							

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	**Y&S-3**
DESCRIPTION:	**MODIFY TRACKWORK IN YARD TO IMPROVE TRAIN MOVEMENTS**	SHEET NO.	1 of 3

ORIGINAL DESIGN:

The Midway Yard and Shop site is extremely narrow immediately north of the Pasadena Blue Line crossing of the LA River. This area contains the entry and exit lead tracks that connect the Yard and Shops to the main line (Track Nos. 3 and 9). This area also contains the car wash and auto access road to the yard and shops. The car wash straddles the westernmost track (Track No. 3) and will interfere with light rail vehicles exiting the yard. Although several crossovers in this vicinity permit using Track No. 9 as an exit track. This configuration will cause a bottleneck for trains entering and leaving the yard, particularly during peak period pullouts.

ALTERNATIVE:

Add a new track to the west of Track No. 3 within the access roadway. Place the tracks flush with asphalt driving surface. The low volume auto/truck traffic (less than 200 vehicles per day) will be light rail system employees and the occasional delivery trucks. The guard stationed at the Baker Street entrance and/or a traffic signal system will be used to control auto/truck movements when light rail vehicles are using the new track.

ADVANTAGES:

- Adds capacity for train traffic in and out of the yard

DISADVANTAGES:

- Adds capital cost
- On-going need to coordinate light rail vehicle and auto/truck traffic
- Minor safety concerns

DISCUSSION:

The current design will limit the capacity to pull trains into and out-of the yard particularly if the car wash is in use. This alternative will permit greater flexibility in both the scheduling of trains into and out-of the yard and the car wash operations.

These improvements can be adopted for an outlay of $65,000.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 0	—	$ 0
ALTERNATIVE	$ 567,190	—	$ 567,190
SAVINGS	$ (567,190)	—	$ (567,190)

ALTERNATIVE NO. Y#5-3
Sht. 2 of 3

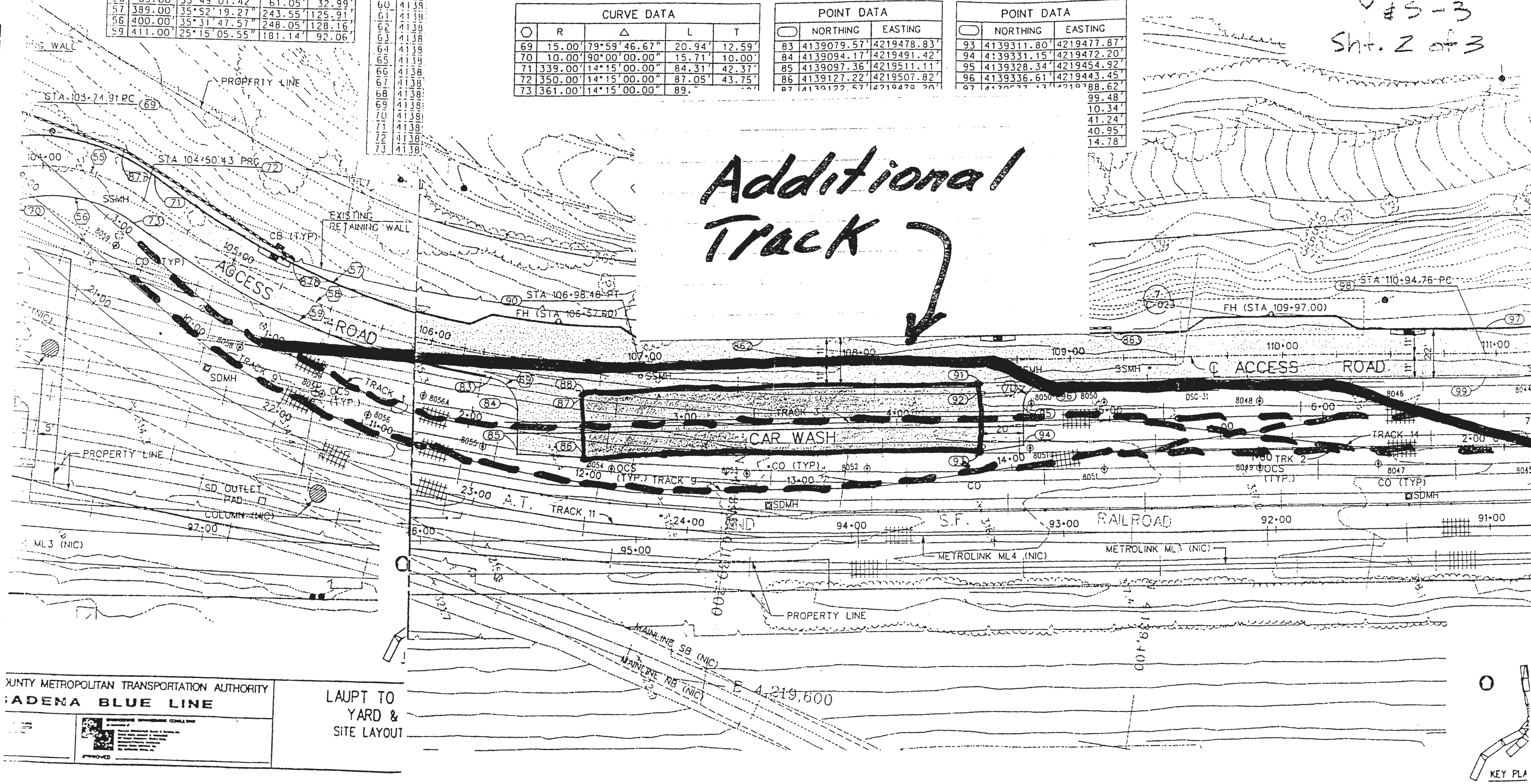
47	5.00'	78°29'07.89"	6.85'	4.08'
48	100.00'	25°17'15.59"	44.14'	22.43'
49	120.00'	25°17'15.59"	52.96'	26.92'
50	50.00'	32°58'08.84"	28.77'	14.80'
51	85.00'	21°57'25.95"	32.57'	16.49'
52	100.00'	21°57'25.95"	38.32'	19.40'
53	115.00'	21°57'25.95"	44.07'	22.31'
54	95.00'	54°26'01.81"	90.25'	48.86'
55	80.00'	54°05'30.12"	75.53'	40.84'
56	65.00'	53°49'01.42"	61.05'	32.99'
57	389.00'	35°52'19.27"	243.55'	125.91'
56	400.00'	35°31'47.57"	248.05'	128.16'
59	411.00'	25°15'05.55"	181.14'	92.06'

51	41385
52	41385
53	41386
54	41386
55	41390
56	41386
57	41385
58	41386
59	41390
60	4138
61	4139
62	4139
63	4138
64	4139
65	4139
66	4138
67	4138
68	4138
69	4139
70	4138
71	4138
72	4138
73	4138

CURVE DATA				
○	R	△	L	T
69	15.00'	79°59'46.67"	20.94'	12.59'
70	10.00'	90°00'00.00"	15.71'	10.00'
71	339.00'	14°15'00.00"	84.31'	42.37'
72	350.00'	14°15'00.00"	87.05'	43.75'
73	361.00'	14°15'00.00"	89.	[illegible]

POINT DATA		
⬭	NORTHING	EASTING
83	4139079.57'	4219478.83'
84	4139094.17'	4219491.42'
85	4139097.36'	4219511.11'
86	4139127.22'	4219507.82'
87	4139122.57'	4219479.20'

POINT DATA		
⬭	NORTHING	EASTING
93	4139311.80'	4219477.87'
94	4139331.15'	4219472.20'
95	4139328.34'	4219454.92'
96	4139336.61'	4219443.45'
97	[illegible]	42197 88.62'
		99.48'
		10.34'
		41.24'
		40.95'
		14.78'



OUNTY METROPOLITAN TRANSPORTATION AUTHORITY
ADENA BLUE LINE
LAUPT TO YARD & SITE LAYOUT

REV	DATE	BY	SUB	APP	DESCRIPTION	REV	DATE	BY	SUB	APP	DESCRIPTION

DESIGNED BY R. L. ITURALDE
DRAWN BY R. G. NIERE
CHECKED BY E. B. PEREIRA
IN CHARGE M. R. URSUA
DATE 19 DEC 94

LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY
PASADENA BLUE LINE
SUBMITTED
APPROVED

LAUPT TO PASA
YARD & SHOP
SITE LAYOUT - 6

COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

ALTERNATIVE NO. ~~T~~45-3

SHEET NO. 3 of 3

CONSTRUCTION ITEM		NEW WORK ~~ORIGINAL~~ ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/UNIT	TOTAL	NO. UNITS	COST/UNIT	TOTAL
BALLAST	TONS	546	12.95	7070			
PLACE BALLAST	TONS	546	6.53	3,565			
TIES, CONC.	EA	218	76.—	16568			
UNLOAD TIES	EA	218	3.90	850			
PLACE TIES	EA	218	6.50	1417			
RAILS	TF	600	100.27	60162			
UNLOAD RAILS	LF	1200	0.88	1056			
WELD RAILS	EA	18	105	1890			
THERMITE WELDS	EA	2	704	1408			
PULL RAILS POSITION	TF	600	0.60	360			
FASTEN RAIL	TF	600	19.04	11425			
TRACK GEOMETRY CAR	TF	600	0.51	306			
MOB + DEMOB CAR	LS	600	0.79	474			
RAIL GRINDING	TF	600	0.62	372			
MOB-DEMOB GRINDER	TF	600	0.63	378			
PADS, PLATE	EA	27	24.76	669			
[illegible] PAD	EA	27	27.50	750			
BOND INSUL PAD	EA	2	562	1124			
PICK UP OTM	EA	164	0.16	26			
FINAL RAIL ALIGN	TF	600	1.20	720			
				$110,590	=	178.38	/TF
#8 S-X OVER	EA	1	79900	* 79,900			
#8 LATERAL TURNOUTS	EA	2	38350	* 76,700			
Signalization				$300,000 *			
Sub-Total				$567,190			
Mark-Up at %							
TOTAL							

* DOES NOT

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	**Y&S-4**
DESCRIPTION:	**REPLACE CANTILEVERED CAST-IN-PLACE CONCRETE RETAINING WALLS WITH CHAIN LINK FENCE RETAINER MATTING**	SHEET NO.	1 of 14

ORIGINAL DESIGN:

The retaining walls at the Midway Yard are designed as cantilevered, cast-in-place concrete with cast-in-hole drilled piles and a fence at the top.

ALTERNATIVE:

Use chain link retainer matting against the bank. Install soil nails and plates holding down the chain link fencing against rock face.

ADVANTAGES:

- Eases installation
- Stops all rock fall
- Saves cost

DISADVANTAGES:

- Geotechnical investigation is required to confirm applicability

DISCUSSION:

This alternative eliminates 456 ft. of expensive concrete retaining walls RW-2, RW-3 and RW-6, which will not stop all the loose rocks.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 269,500	—	$ 269,500
ALTERNATIVE	$ 113,300	—	$ 113,300
SAVINGS	$ 156,200	—	$ 156,200

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT		ALTERNATIVE NO. YAS-4
☒ AS DESIGNED	☐ ALTERNATIVE	SHEET NO. 2 of 14

RETAINING WALL RW-2 DRW C-120, SHT # 92 & S-038 DRW # 203

FOOTINGS

H = 6' FOOTING KEY = B × D = 1'0" × 1'6" × 211/27 = 12 CY
L = 211 FOOTING SLAB = F × W = 1'-0" × 4'-4" × 211'/27 = 34 CY
46 CY

H = 8' FOOTING KEY = B × D = 1'-0" × 1'-11" × 138/27 = 10 CY
L = 138' FOOTING SLAB = F × W = 1'-0" × 6'-8" 138/27 = 34 CY
44 CY

H = 10' FOOTING KEY = B × D = 1'-6" × 2'-8" × 86'/27 = 13 CY
L = 86' FOOTING SLAB = F × W = 1'-6" × 9'-6" × 86/27 = 46 CY
59 CY

TOTAL FOOTING EXCAVATION = 149 CY
TOTAL " CONCRETE = 149 CY × 1.03 = 153 CY
TOTAL SOIL DISPOSAL = 149 × 1.25 SWELL = 186 CY

FOOTING FORMWORK

H = 6', L = 211' 1'0" × 2 × 211' + 4'-4" × 1'-0" × 2 = 431 SF
H = 8' L = 138' 1'0" × 2 × 138' + 6'-8" × 1'-0" × 2 = 290 SF
H = 10' L = 86' 1'6" × 2' × 86' 9'6" × 1'-6" × 2 = 286.5 SF
TOTAL 1007.50 SF

KEYWAYS = 1 1/2" × 3 1/2" = 435'

REBAR USE H = 8' AS AVRG, LB/LF OF RUN

a.) #4 @ 8" = 6'-6" × 1.5 × 0.667 = 6.50
d) #5 @ 18" = 1'-6" × 2/3 × 1.034 = 1.04
b) #5 @ 18" = 6 × 1'-0" × 1.034 × 2/3 = 4.12
G) #5 @ 12" = 6' × 1.034 = 6.20
h) #5 @ 18" = 4 × 1'-0" × 1.034 = 4.14
i) —
22.00 LB/LF × 138/44 CY = 70 LB/CY

153 CY × 1.10 × 70 LB/CY = 11,780 LB or 5.9 TON

SKETCHES

PROJECT: **PASADENA BLUE LINE LIGHT RAIL PROJECT** ALTERNATIVE NO. Y4S-4

☒ AS DESIGNED RW-2 ☐ ALTERNATIVE SHEET NO. 3 of 14

WALL FORM WORK

H=6', L=211, 6'×211'×2 + 8"×6'×2 = 2540 SF

H=8', L=138' 8'×138'×2 + 8"×8'×2 = 2219 SF

H=10', L=86' 10'×86'×2 + 10"×10'×2 = 1737 SF

6,496 SF

REBAR

b) —

c) #5 × 5 × 11'0" = 5.17

d) #5 × 5 × 9'-6" = 49.12

e) #4 × 3 × 1'0" = 2.00

56.29 × 1.1 = 62 LB/LF × 138'/44 = 194.5

153 CY × 194.5 LB/CY = 29,750 LB = 14.68 TON

CONCRETE, WALL

H=6', L=211', T=8" = 31.25 CY

H=8', L=138', T=8" = 27.25 CY

H=10', L=86', T=10" = 26.50 CY

85 CY

FOOTING EXCAVATION	=	149 CY	× \$15.75	=	\$2376
SOIL DISPOSAL	=	186 CY	× 3.31	=	616
FOOTING FORMWORK	=	1008 SF	× 6.05	=	6100
FOOTING REBAR	=	11,800 LB	× 0.71	=	8378
FOOTING KEYWAY	=	435 LF	× 0.38	=	165
FOOTING CONCRETE	=	153 CY	× 110	=	16995
WALL FORMWORK	=	6500 SF	× 5.39	=	35,035
WALL REBAR	=	29,750 LB	× 0.71	=	21123
WALL CONCRETE	=	85 CY	× 120.—	=	10200
WALL FINISH	=	6800 SF	× 1.20	=	8160
WALL CURING	=	6800 SF	× 0.12	=	816

109,964

SAY \$110,000

SKETCHES

PROJECT: **PASADENA BLUE LINE LIGHT RAIL PROJECT** ALTERNATIVE NO. Y4S-4

☒ AS DESIGNED ☐ ALTERNATIVE SHEET NO. 4 of 14

RW-3 FOOTINGS

H=6', L=21.5' KEY 1'-0" × 1'-6" × 21.5 / 27 = 1.3 CY

SLAB 1'-0" × 4'-4" × 21.5/27 = 3.5 CY

H=8', L'=62.5 KEY 1'-0" × 1'-11" × 62.5/27 = 4.7 CY

SLAB 1'-0" × 6'-8" × 62.5/27 = 15.5 CY

25 CY

TOTAL EXCAVATION = 25 CY
TOTAL SOIL DISPOSAL = 56 CY
TOTAL FOOTING CONC = 25 CY

FOOTING FORMWORK

H=6', L=21.5' 1'-0" × 21'-6" × 2 + 4'-4" × 1'-0" × 2 = 52 SF

H=8', L=62.5 1'-0" × 62.5 × 2 + 1'-0" × 6'-8" × 2 = 139 SF

KEYWAY 1 1/2" × 3 1/2" = 84 LF

REBAR USE 8'H @ AVRG ~ + 70 LB/CY × 25 = 1750 LB

WALL FORMWORK

H=6', L=21.5' 6' × 21.5 × 2 + 8" × 6' × 2 = 266 SF

H=8', L=62.5 8 × 62.5 × 2 + 8" × 8' × 2 = 1011 SF

1277 SF

REBAR = 16 CY × 194.5 LB/CY = 6140 LB

concrete =
H=6', L=21.5', T=8"
H=8', L=62.5' T=8"
} 15.5 × 1.03 = 16 CY

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. YaS-4
	☐ AS DESIGNED ☐ ALTERNATIVE	SHEET NO. 5 of 14

RW – 3

FOOTING EXCAVATION	=	25 CY	× 15^{75}	394
FOOTING DISPOSAL	=	31 CY	× 3^{31}	103
FOOTING CONCRETE	=	25 CY	× 110^{-} =	2750
FOOTING FORMS	=	191 SF	× 6^{05} =	1156
FOOTING REBAR	=	1750 LB	0^{71} =	1243
WALL FORMS	=	1277 SF	5^{39} =	6883
WALL REBAR	=	3112 LB	0^{71} =	2209
WALL CONC	=	16 CY	120^{-}	1920
WALL FINISH	=	1330 SF	1^{20}	1596
WALL CURE	=	1330 SF	0^{12}	160
				$16,8[illegible]

SKETCHES

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO. Y4S-4
	☒ AS DESIGNED ☐ ALTERNATIVE	SHEET NO. 6 of 14

RW-6 C-121-, SHT-93 W/PILES CIDH PILE WALL

$H=6', L=45^{5}'$
$H=8', L=46'$
$H=10', L=47'$
$H=12', L=48'$
186^{5} LF = 58 CAISSONS

$H=6', L=45^{5}, D=2'\phi, E=12'\times14, S=3.2'$ $\#=14$ EA

$A=1^2\pi$, $V=\pi(6+12)(14) = \underline{29^{3}\text{ CY}}$

$H=8', L=46', D=2'\phi, E=16'\times14, S=3.2,$ $\#=14$

$A=1^2\pi$, $V=\pi(8'+16')(14) = \underline{39\text{ CY}}$

$H=10', L=47', D=2'\phi, E=20', S=3.2,$ $\#=15$

$A=1^2\pi$, $V=\pi(10+20)(15) = \underline{52\text{ CY}}$

$H=12', L=48', D=2', E=20'\times, S=3.2$ $\#=15$

$A=1^2\pi$ $V=\pi(12+20)(15) = \underline{56\text{ CY}}$

TOTAL CAISSON EXCAVATION = 177 CY
" " concrete = 177 CY
" SOIL DISPOSAL = 221 CY

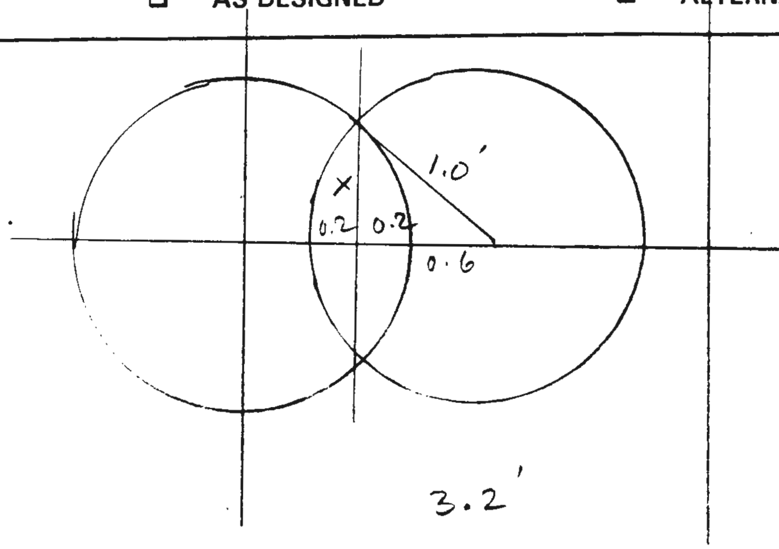
REBAR STRAIGHT = #9 × 6 EA × 1518 LF × 3.4 × 1.19% = 36850 LB
COIL = (1518/0.5)(2π)(0.376)(1.0625) = ~~7620 LB~~

44,470 LB

SKETCHES

PROJECT: **PASADENA BLUE LINE LIGHT RAIL PROJECT** ALTERNATIVE NO. Y&S-4

☐ AS DESIGNED ☐ ALTERNATIVE SHEET NO. 7 of 14



$\sqrt{1.0^2 - 0.8^2} = x = 0.6$

$(0.2)(0.6 \times 2)(\frac{2}{3})(2) = 0.32$ SF $\times 2 = 0.64$ SF

$1^2\pi - 0.64 = 2.50$ SF

Conc

H=6', 8' × 13EA = 104'

H=8', 10' × 13EA = 130'

H=10', 12' × 14EA = 168'

H=12', 14' × 14EA = 196' 598' × 2.50SF/27 = 55 CY Conc

EXCAVATION = 54 × 2' = 108', 588' − 108 = 490' × 2.50/27 = 45 CY

SONO TUBE

H=6' 27EA × 6' = 162

H=8 27 × 8 216

H=10 29 × 10 290

H=12 29 × 12 348 1016 LF of 2'0" DIAM

SKETCHES

PROJECT: **PASADENA BLUE LINE LIGHT RAIL PROJECT** ALTERNATIVE NO. Y4S-4

☒ AS DESIGNED ☐ ALTERNATIVE SHEET NO. 8 of 14

EXCAVATION = 177 CY + 46 CY = 223 CY

SOIL DISPOSAL = = 279 CY

4000 PSI CONC = 177 CY

LEAN CONC = 56 CY

SONO TUBE = 1016 LF of 2'-0" DIAM

REBAR = 44,470 LB

SAND BLAST SURFACE

(27 EA) × (3/4)(2)(π)(6') = 763.4

(27 EA)(3/4)(2)(π)(8) = 1017.9

(29)(3/4)(2)(π)(10) = 1366.6

(29)(3/4)(2)(π)(12) = 1639.9

4,787.8 SF

SAY 4800 SF

PILE CAP

FORMWORK 8' × 186.5 + 3' × 2' × 2 = 1504 SF

REBAR 5.75 #4 × 186 EA 715 LB

#5 × 12 × 186' 2331 LB

#4 × 2'-7 1/2" × 186 326 LB × 1.1 = 3710 LB

CALCULATIONS

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. Y4S-4
	SHEET NO. 9 of 14

PILE CAP concrete

$3'0" \times 2'0" \times 186'/27 =$ 41.33 cy

$-((1^2)\pi + 2.50) \times 116 \times 1' =$ 24.23

17.10 cy

FINISH/CURE

$2' \times 2 \times 186' + 3 \times 186' + 3'0 \times 2 =$ 1308 SF

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	Y4S-4
	☐ AS DESIGNED ☐ ALTERNATIVE	SHEET NO.	10 of 14

RW-6, CIDH PILE WALL

			$
EXCAVATION	—	1482 CF × 15.15 =	22453
SOIL DISPOSAL	—	279 CY × 3.31 =	924
4000 PSI CONC.	—	177 CY × 114.30 =	20231
LEAN CONC	—	56 CY × 65.95 =	3693
SONO TUBE, 2' ⌀	—	1016 LF × 28.38	28834
REBAR	—	44,470 LB × 0.71	31,574
SAND BLAST	—	4,788 SF × 2.32	11,108
PILE CAP FORMS	—	1504 SF × 11.55	17371
REBAR		3710 LB × 0.71	2634
concrete	—	18 CY × 120.–	2160
FINISH	—	1308 SF × 1.20	1570
CURE	—	1308 SF × 0.12	157.–
			$142,709

SUMMARY

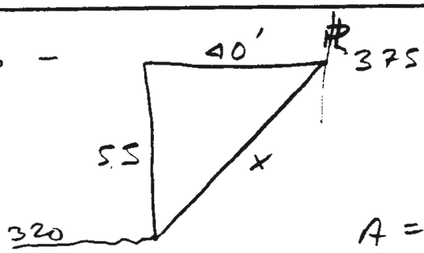
RW-2 = 110,000
RW-3 = 16,800
RW-6 = 142,700

$269,500 FOR RETAINING WALLS RW-2, 3, 6

PROJECT: **PASADENA BLUE LINE LIGHT RAIL PROJECT** ALTERNATIVE NO. Y4S-4

☐ AS DESIGNED ☐ ALTERNATIVE SHEET NO. 11 of 14

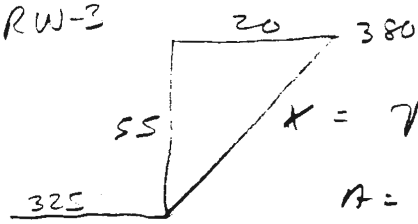
RW-6 -



$x = \sqrt{40^2 + 55^2} = 68'$

$A = 68' \times 186' = \underline{12{,}648 \text{ SF}}$

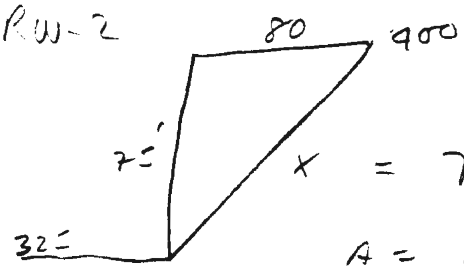
RW-3



$x = \sqrt{55^2 + 20^2} = 58.5'$

$A = 58.5' \times 84' = 4916 \text{ SF}$

RW-2



$x = \sqrt{75^2 + 80^2} = 110'$

$A = 110 \times 349' = \underline{38{,}390 \text{ SF}}$

55954 SF

SAY 56,000 SF OF SOIL NAILED CHAINLINK FENCING

SKETCHES

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT		ALTERNATIVE NO. Y4S-4
☐ AS DESIGNED	☒ ALTERNATIVE	SHEET NO. 12 of 14

DRILL ROCK BOLT HOLE 1"ϕ @ 30 MIN FOR 10'-0" HOLE
or $68 / HOLE

½" ROD, THREADED 16 / ROD 10' LONG

PLATE 6"×6"×¼" w/ ½" HOLE $5

GROUT

$1"\phi \times 10' = ((0.5)^2\pi)(10)(12) = 94\frac{1}{4}$ CU IN

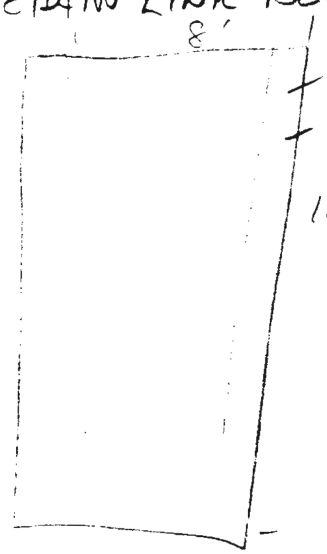
$1/2"\phi \times 10' = (0.25)^2\pi(10)(12) = -23.6$ CU IN

70.68 CU IN

$70.68/1728 = 0.041$ CF

$0.041 \text{ CF} \times \$150/\text{CF} = \$7$

CHAIN LINK FENCING



17 ROCK BOLTS × $68/EA	= 1156
17 PLATES × $5/EA	85
17 GROUTINGS × $7/EA	119
NUTS 17 × 0^{25}	13
CHAIN LINK 9' × 100 × 0^{86}	774
	$2147

$2147/800 SF = 2^{69}/SF

56000 SF × 2^{69}/SF = $150,640

264,500 − 150,700 = $118,800 SAVINGS

COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. Y&S-4
RETAINING WALL RW-2 & RW-3	SHEET NO. 13 of 14

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
RW-2							
FOOTING EXCAVATION	CY	149	15.35	2,376			
SOIL DISPOSAL	CY	186	3.31	616			
FOOTING FORM WORK	SF	1008	6.05	- 6,100			
FOOTING REBAR	LB	11800	0.71	8,378			
FOOTING KEYWAY	LF	435	0.38	165			
FOOTING CONCRETE	CY	153	110.-	16,995			
WALL FORMWORK	SF	6500	5.39	35,035			
WALL REBAR	LB	29750	0.71	21,123			
WALL FINISH	SF	6800	1.20	8160			
WALL CURE	SF	6800	0.12	816			
WALL CONCRETE	CY	85	120.-	10,200			
TOTAL RW-2				$109,964			
RW-3							
FOOTING EXCAVATION	25	CY	15.35	384			
SOIL DISPOSAL	31	CY	3.31	103			
FOOTING FORMS	191	SF	6.05	1156			
FOOTING CONCRETE	25	CY	110.-	2750			
FOOTING REBAR	1750	LB	0.71	1243			
WALL FORMS	1277	SF	5.39	6883			
WALL REBAR	3112	LB	0.71	2209			
WALL CONCRETE	16	CY	120	1920			
WALL FINISH	1330	SF	1.20	1596			
WALL CURE			0.12	160			
TOTAL RW-3 Sub-Total				$16,818			
Mark-Up at %							
TOTAL							

COST WORKSHEET

PROJECT: **PASADENA BLUE LINE LIGHT RAIL PROJECT**

ALTERNATIVE NO. YAS-4

SHEET NO. 14 of 14

RETAINING WALL RW-6

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM RW-6	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
PILE EXCAVATION	LF	1482	15.15	22,453			
SOIL DISPOSAL	CY	279	3.31	924			
4000 PSI CONCRETE	CY	177	114.30	20,231			
LEAN CONCRETE	CY	56	65.95	3693			
2'0"Ø SONO TUBE	LF	1016	28.38	28834			
REBAR	LB	44,470	0.71	31,574			
SAND BLAST	SF	4788	2.32	11108			
PILE CAP FORMS	SF	1504	11.55	17,371			
" " REBAR	LB	3710	0.71	2634			
" " CONCRETE	CY	18	120.–	2160			
" " FINISH	SF	1308	1.20	1570			
" " CURE	SF	1308	0.12	157			
TOTAL RW-6				$142,709			
SOIL NAILS & CL MESH	56,000 SF						
							$
DRILL 2"Ø HOLES × 10'	EA				1190	68.–	80,920
6" × 6" × 1/4" PLATES	EA				1190	5.–	5,950
GROUT HOLES	EA				1190	7.–	8,330
ROD 1/2"Ø × 10'L	EA				1190	5.–	5,950
NUTS, 1/2"Ø	EA				1190	0.75	893
CHAINLINK MESH	SF				63000	0.86	54,180
							$156,223
Sub-Total				$269,500			156,223
Mark-Up at %							
SAVINGS TOTAL				$113,277			

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	**Y&S-6**
DESCRIPTION:	**USE SOIL NAIL WALLS IN LIEU OF RETAINING WALLS**	SHEET NO.	1 of 3

ORIGINAL DESIGN: (Sketch attached)

Conventional cantilevered cast-in-place concrete retaining walls are used at the base of the natural slope on the west side of the Midway Yard.

ALTERNATIVE: (Sketch attached)

Use soil nail wall for walls which cut into the formational slope.

ADVANTAGES:

- Reduces cost
- Takes less horizontal space
- Eases maintenance (debris on ground, not in swale)

DISADVANTAGES:

- No drainage swale provided and debris containment is limited

DISCUSSION:

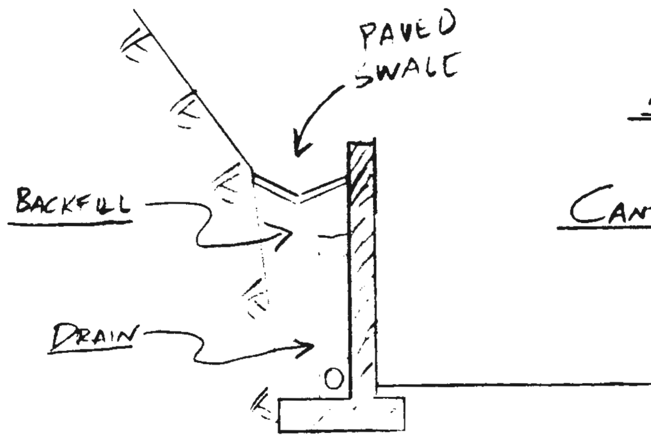
Soil nail wall construction appears feasible for retaining walls RW-1 through RW-4, RW-6 and RW-7 in the Midway Yard. Note that the unit areas of the soil nail wall are less than that for the cantilever wall because the soil nail wall does not have freeboard on top or footing embedment at the bottom.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 483,264	—	$ 483,264
ALTERNATIVE	$ 224,250	—	$ 224,250
SAVINGS	$ 254,014	—	$ 254,014

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. YS-6
	☐ AS DESIGNED ☐ ALTERNATIVE	SHEET NO. 2 of 3

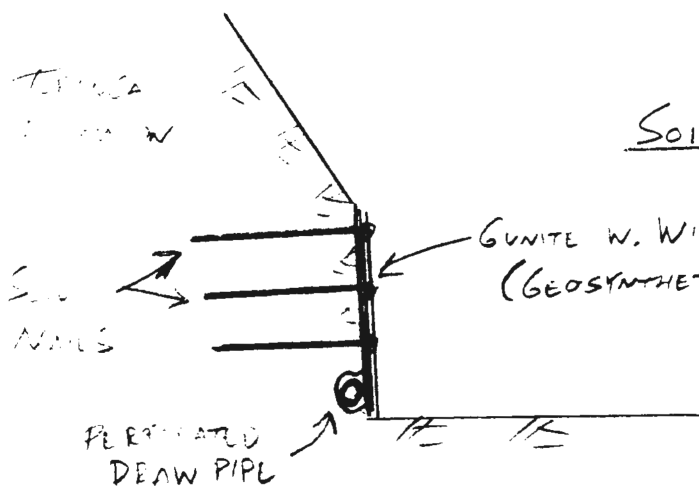
AS DESIGNED

CANTILEVER RETAINING WALL



ALTERNATIVE

SOIL NAIL WALL



COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

ALTERNATIVE NO. YS-6

SHEET NO. 3 of 3

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
Retaining Wall RW-1	SF	1118	$36	40,248	757	$30	
" " RW-2	"	3686	"	132,696	2153	"	
" " RW-3	"	630	"	22,680	375	"	
" " RW-4	"	2678	"	96,408	1400	"	
" " RW-6	"	1688	"	60,768	1128	"	
" " RW-7	"	3624	"	130,464	1659	"	
Sub-Total							
Mark-Up at %							
TOTAL		13,424	$36	483,264	7475	$30	$224,250

SUMMARY OF POTENTIAL COST SAVINGS

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT	LOCATION: LOS ANGELES TO PASADENA, CALIFORNIA					
PROJECT ELEMENT: SYSTEMS		PRESENT WORTH OF COST SAVINGS				
ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	INITIAL COST SAVINGS	O & M SAVINGS	TOTAL SAVINGS
	TRAIN CONTROL (TC)					
TC-2	Use hand throw switches instead of electrically powered switches at selected locations	97,400	543,175	428,225	—	428,225
TC-3	Verify interlocking quantities	DESIGN SUGGESTION				
TC-4	Install coded track circuits in lieu of AC track circuits	2,062,750	1,672,500	390,250	—	390,250
TC-5	Use a microprocessor based train control system	DESIGN SUGGESTION				
TC-6	Use LED signal heads in lieu of incandescent lights at highway crossings	84,740	127,110	(42,370)	—	(42,370)
TC-7	Use prefabricated in lieu of cast-in-place concrete foundations for train control features	DESIGN SUGGESTION				
	SYSTEM SECURITY (SS)					
SS-1	Provide intrusion detectors in tunnel sections	DESIGN SUGGESTION				
SS-2	Hire an outside company to monitor intrusion/fire detection in traction power substations	0	0	0	(2,600/month)	(429,000)
SS-3	Include Public Address System in fiber optic backbone	DESIGN SUGGESTION				

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	**TC-2**
DESCRIPTION:	**USE HAND THROW SWITCHES IN LIEU OF ELECTRONICALLY POWERED SWITCHES**	SHEET NO.	1 of 2

ORIGINAL DESIGN:

The assumption is that all G4 switches in the design are electrically powered.

ALTERNATIVE:

Change 31 yard switches and 16 main line switches to non-powered switches.

ADVANTAGES:

- Reduces cost
- Decreases TWC loop requirements

DISADVANTAGES:

- Decreases functionality

DISCUSSION:

There are a total of 64 switches on the main line and yard section. In order to save costs, some could be changed from powered to non-powered switches. The selected switches are ones that will be seldomly used, thus the affect on functionally will be minimal.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 97,400	—	$ 97,400
ALTERNATIVE	$ 543,175	—	$ 543,175
SAVINGS	$ 428,225	—	$ 428,225

COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

ALTERNATIVE NO. TC-2

SHEET NO. 2 of 2

CONSTRUCTION ITEM		*ORIGINAL ESTIMATE*			*PROPOSED ESTIMATE*		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
Powered Switches	64	64	15,000	960,000	17	15000	255,000
Non Powered Switches			6,000	0	47	6000	282,000
Sub-Total				960,000			537,000
Mark-Up at 11.5 **%**				11400			6175
TOTAL				971,400			543,175

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	**TC-3**
DESCRIPTION:	**VERIFY INTERLOCKING QUANTITIES**	SHEET NO.	1 of 1

ORIGINAL DESIGN:

There are nine interlockings included in the original design. As shown in PBL Contract H0060, Contract Drawing Sheets Q-011 to Q-035.

ALTERNATIVE:

Evaluate the operating plan, MTA maintenance requirements and system safety requirements to determine if the quantity of interlocking could be reduced.

ADVANTAGES:

- Saves cost

DISADVANTAGES:

- Decreases flexibility

DISCUSSION:

Based upon other properties, the cost of each interlocking (including special trackwork and train control systems) is approximately $1million. If operations permit, reducing the current number will save costs.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	**DESIGN SUGGESTION**		
SAVINGS			

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	**TC-4**
DESCRIPTION:	**INSTALL CODED TRACK CIRCUITS IN LIEU OF AC TRACK CIRCUITS**	SHEET NO.	1 of 2

ORIGINAL DESIGN:

Contract H0060 Specification Section 16 specifies 100 hz, AC track circuits.

ALTERNATIVE:

Use coded track circuits.

ADVANTAGES:

- Increases functionality
- Decreases maintenance
- Eliminates the majority of line signal cabling
- Easier and less expensive to accommodate bi-directional operation.
- Saves cost

DISADVANTAGES:

- Not compatible with Long Beach Blue Line

DISCUSSION:

The original design using 100 hz AC track circuits requires cabling between blocks. Coded track circuits sends the cable signal commands through the rail eliminating the need for the majority of cabling and conduit.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 2,062,750	—	$ 2,062,750
ALTERNATIVE	$ 1,672,500	—	$ 1,672,500
SAVINGS	$ 390,250	—	$ 390,250

COST WORKSHEET

PROJECT: **PASADENA BLUE LINE LIGHT RAIL PROJECT**

ALTERNATIVE NO. TC-4

SHEET NO. 2 of 2

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
AC Track Circuits	LS	1		1,000,000	0		0
Signal Cable	FT	50,000	7.00	350,000	0		
3" Conduit	FT	50,000	10.00	500,000	0		
[illegible] Track Circuit	LS	0		-0	1		1,500,000
Sub-Total				1,850,000			1,500,000
Mark-Up at 11.5%				212,750			172,500
TOTAL				2,062,750			1,672,500

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	**TC-5**
DESCRIPTION:	**USE A MICROPROCESSOR BASED TRAIN CONTROL SYSTEM**	SHEET NO.	1 of 1

ORIGINAL DESIGN:

PBL Specification Section 3.2.1.D specifies that the contractor has the option to use a relay based or a microprocessor based train control system.

ALTERNATIVE:

Specify that the D/B team install a microprocessor based system.

ADVANTAGES:

- Eases maintenance
- Enhances flexibility

DISADVANTAGES:

- None apparent

DISCUSSION:

It is strongly recommended that the PBL opt for a microprocessor-based system. Microprocessor based systems are standard for new systems (Utah, Denver, San Jose, St. Louis) in recent years.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	**DESIGN SUGGESTION**		
SAVINGS			

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	**TC-6**
DESCRIPTION:	**USE LED SIGNAL HEADS IN LIEU OF INCANDESCENT LAMPS FOR HIGHWAY CROSSINGS**	SHEET NO.	1 of 2

ORIGINAL DESIGN:

Specification Section 17-2.6A specifies incandescent flasher lamps for highway crossings.

ALTERNATIVE:

Use red LED signal flashers.

ADVANTAGES:

- Extends life
- Reduces maintenance
- Increases visibility

DISADVANTAGES:

- Increases initial cost

DISCUSSION:

LED signals are the latest signal head technology and are currently being used on Utah Transit Authority (UTA) property.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 84,740	—	$ 84,740
ALTERNATIVE	$ 127,110	—	$ 127,110
SAVINGS	$ (42,370)	—	$ (42,370)

COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

ALTERNATIVE NO. TC-6

SHEET NO. 2 of 2

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
INCANDESCENT SIGNAL	EA	380	200	76000	0		
LED SIGNAL	EA	0		0	380	300	114000
Sub-Total				76,000			114000
Mark-Up at 15 %				8740			13110
TOTAL				84,740			127,110

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	TC-7
DESCRIPTION:	**USE PREFABRICATED IN LIEU OF CAST-IN-PLACE CONCRETE FOUNDATIONS FOR TRAIN CONTROL FEATURES**	SHEET NO.	1 of 1

ORIGINAL DESIGN:

PBL Contract H0060, Sheet Q-110 requires cast-in-place concrete foundations for all-grade crossing cases (approximately 28 total).

ALTERNATIVE:

Use steel or precast concrete foundations in lieu of the cast-in-place concrete foundations.

ADVANTAGES:

- Reduces cost
- Eases installation
- Eases relocation, if needed

DISADVANTAGES:

- None apparent

DISCUSSION:

Precast or steel foundations are common in the transit and freight railroad industries.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	**DESIGN SUGGESTION**		
SAVINGS			

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	SS-1
DESCRIPTION:	**PROVIDE INTRUSION DETECTORS IN THE LONG GRADE SEPARATED SECTIONS OF THE PRJECT**	SHEET NO.	1 of 1

ORIGINAL DESIGN:

The original design does not address how or if intrusion detectors shall be provided in the tunnel sections.

ALTERNATIVE:

Provide intrusion detectors so that a train or the public can be identified when in the presence of the detector.

ADVANTAGES:

- Provides safer operation
- Better surveillance

DISADVANTAGES:

- Adds cost

DISCUSSION:

Knowing the presence of the public in a contained space is important to the successful safe operation of the transit system. By installing a series of detectors a train can be distinguished from an individual.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS			

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	SS-2
DESCRIPTION:	**HIRE AN OUTSIDE COMPANY TO MONITOR INTRUSION/FIRE DETECTION IN TRACTION POWER SUBSTATION**	SHEET NO.	1 of 1

ORIGINAL DESIGN:

There is no intrusion or fire detection system on the PBL Drawings or Specifications. The Metro Green Line incorporates these functions in the SCADA System.

ALTERNATIVE:

Hire an outside company that specializes in alarm and fire/smoke detection to install and monitor the detection equipment.

ADVANTAGES:

- Reduces initial cost
- Reduces MTA personnel requirements

DISADVANTAGES:

- Lack of control over equipment

DISCUSSION:

The estimated costs include leasing equipment from an outside company and a separate telephone line for each traction power substation.

13TPSS x $200/month = $2,600/month

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 0	$ 0	$ 0
ALTERNATIVE	$ 0	$ (429,000)	$ 0
SAVINGS	$ 0	$ (429,000)	$ (429,000)

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	SS-3
DESCRIPTION:	INCLUDE THE PUBLIC ADDRESS SYSTEM IN THE FIBER OPTIC BACKBONE	SHEET NO.	1 of 1

ORIGINAL DESIGN:

No public address (PA) system is shown on plans, specifications or in cost estimates. It was removed for cost containment.

ALTERNATIVE:

Provide a PA system similar to the Long Beach/LA (LBLA) Blue Line, i.e., remotely controlled, standalone PA system at each station and use the fiber optic backbone system for transmission.

ADVANTAGES:

- Provides public information
- Provides event announcements
- Enhances safety

DISADVANTAGES:

- Adds cost

DISCUSSION:

Installing the PA system provides a necessary safety feature.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS			

SUMMARY OF POTENTIAL COST SAVINGS

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	**LOCATION:**	**LOS ANGELES TO PASADENA, CALIFORNIA**			
PROJECT ELEMENT:	**SYSTEMS**		**PRESENT WORTH OF COST SAVINGS**			
ALT. NO.	**DESCRIPTION**	**ORIGINAL COST**	**ALTERNATIVE COST**	**INITIAL COST SAVINGS**	**O & M SAVINGS**	**TOTAL SAVINGS**
	FARE COLLECTION (FC)					
FC-1	Have MTA procure fare collection system	2,040,000	326,026	1,713,974	—	1,713,974
FC-3	Include ATM at ticket vending machines	DESIGN SUGGESTION				
	SCADA SYSTEM (SC)					
SC-2	Have MTA provide the SCADA system with its next system wide SCADA upgrade	DESIGN SUGGESTION				
SC-3	Provide fiber optic backbone only for SCADA system	2,720,600	3,035,030	(314,430)	—	(314,430)

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	FC-1
DESCRIPTION:	HAVE MTA PROCURE FARE COLLECTION SYSTEM	SHEET NO.	1 of 2

ORIGINAL DESIGN:

The fare collection system is to be compatible with the existing system.

ALTERNATIVE:

Have MTA procure the fare collection system.

ADVANTAGES:

- Reduces cost
- Eliminates markup

DISADVANTAGES:

- None apparent

DISCUSSION:

Eliminating fare collection and deferring its procurement to the MTA does reduce costs on this contract, but requires MTA to raise equivalent or approximate costs to procure such equipment. However, the equipment will match existing equipment on other lines and there is a potential to save cost because of buying agreements already in place.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 2,040,000	---	$ 2,040,000
ALTERNATIVE	$ 326,026	---	$ 326,026
SAVINGS	$ 1,713,974	---	$ 1,713,974

COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT
MTA PROCURE FARE COLLECTION SYSTEM

ALTERNATIVE NO. FC-1

SHEET NO. 2 of 2

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
FARE COLL. SYS	LS				—	-	292,400
FARE COLL. SYS.	EA	34	*60,000	2,040,000			
Sub-Total				2,040,000			292,400
Mark-Up at 11.5 %				—			33,626
TOTAL				2,040,000			326,026

* Revised

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	FC-3
DESCRIPTION:	INCLUDE ATM AT TICKET VENDING MACHINES	SHEET NO.	1 of 1

ORIGINAL DESIGN:

The current design includes ticket vending machines to dispense tickets only.

ALTERNATIVE:

Interface electronically ticket vending machine (TVM) with automatic teller machine (ATM), utilizing existing ATM/TVM designs, if available.

ADVANTAGES:

- More convenient
- No real money to handle

DISADVANTAGES:

- Requires more space

DISCUSSION:

Negotiate the use of ATM machines with a local bank for revenue and convenience to customers. Cashless transactions are safer, although it provides an option for the customer to obtain cash.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS			

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	SC-2
DESCRIPTION:	HAVE MTA PROVIDE A SCADA SYSTEM WITH THE NEXT SYSTEM-WIDE SCADA UPGRADE	SHEET NO.	1 of 1

ORIGINAL DESIGN:

The current Pasadena Blue Line design, does not include a SCADA system. The Long Beach Blue Line has a SCADA product manufactured by Harris.

ALTERNATIVE:

Consider not providing SCADA in this design and have MTA provide it with its next scheduled SCADA upgrade.

ADVANTAGES:

- Reduces project cost

DISADVANTAGES:

- Reduces initial monitoring
- Increases operating costs

DISCUSSION:

Coordinate delivery of upgraded SCADA at MTA with SCADA requirements for Pasadena Blue Line (PBL). Phase construction to receive new SCADA during PBL construction. The MTA is currently evaluating new SCADA throughout its system.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS			

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	SC-3
DESCRIPTION:	PROVIDE FIBER OPTIC BACKBONE ONLY FOR FUTURE SCADA SYSTEM	SHEET NO.	1 of 2

ORIGINAL DESIGN:

A conduit ductbank is designed to cover approximately 50% of the alignment. The ductbank consists of concrete encased, Schedule 40 conduits along bridges, aerial structures, cut and cover sections, grade crossings and crossovers. The rest of the alignment is an aerial installation.

ALTERNATIVE:

Install a ductbank consisting of six concrete encased 4 inch Type EB conduits from Union Station to the Freeway I-210. Install aerial cable along Freeway I-210 to the Sierra Madre Villa Station. The alternative includes ductbanks covering approximately 75% of alignment. Provide one fiber optic cable to serve as the transit system's communications backbone. Use the backbone for the future SCADA system.

ADVANTAGES:

- Eases installation
- Increases reliability

DISADVANTAGES:

- Costs approximately 12% more

DISCUSSION:

The Authority should determine if there is interest in leasing a portion of the ductbank (approximately 4 inch conduits) by a telephone company or other entity. If so, the installation of the ductbanks will need to meet Telco or another entity's requirements.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 2,720,600	—	$ 2,720,600
ALTERNATIVE	$ 3,035,030	—	$ 3,035,030
SAVINGS	$ (314,430)	—	$ (314,430)

COST WORKSHEET

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. SC-3
		SHEET NO. 2 of 2

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
System ductbank	ft	39000	$60	2,340,000	54000	$48	2,592,000
Manholes		100	$1000	100,000	130	$1000	130,000
Sub-Total				2,440,000			2722000
Mark-Up at %				[illegible]			[illegible]30
TOTAL				2720600			3035030

SUMMARY OF POTENTIAL COST SAVINGS

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT **LOCATION:** LOS ANGELES TO PASADENA, CALIFORNIA

PROJECT ELEMENT: SYSTEMS

ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	INITIAL COST SAVINGS	O & M SAVINGS	TOTAL SAVINGS
		PRESENT WORTH OF COST SAVINGS				
	TRACTION POWER (TP)					
TP-1/TP-2/TP-3/TP-9	The Program Manager shall perform "load flow" study and confirm the size, number and locations of traction power substations	DESIGN SUGGESTION				
TP-4	Use single feed to Baker Street traction power substation	133,800	44,600	89,200	—	89,200
TP-5	Use low resistance grounding for traction power	446,000	334,500	111,500	—	111,500
TP-6	Use appropriate cable insulation	892,000	785,500	106,500	—	106,500
	CABLE LEASING (CL)					
CL-1/CL-3/CL-4	Install conduits for fiber optic cables throughout the alignment and lease use of conduits	DESIGN SUGGESTION				
	CLOSED CIRCUIT TELEVISION (CCTV)					
CCTV-2	Provide closed circuit television at selected critical locations	DESIGN SUGGESTION				
CCTV-4	Have MTA procure CCTV	543,919	81,548	462,371	—	462,371

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	**TP-1/ TP-2/TP-3/TP-9**
DESCRIPTION:	**PERFORM "LOAD FLOW" STUDY AND CONFIRM THE SIZE, NUMBER AND LOCATIONS OF TRACTION POWER SUBSTATIONS**	SHEET NO.	1 of 1

ORIGINAL DESIGN:

The project began with 14 traction power substations (TPSSs) located along the alignment and at the Midway Yard. A cost containment effort reduced the number to nine (9), but two (2) were added back into the project and an additional TPSS is also being reconsidered for inclusion in the project. The additional substations are needed because the alignment generally rises from the south to the north and there are some steep grades in some portions. Also, the size and location of the individual TPSSs have not been finalized.

ALTERNATIVE:

Perform a "load flow" study based on an up-to-date operating plan, track profile, and the type of vehicle to be employed. Using the data obtained from the study and the fact that the Authority has obtained right-of-way in several locations to place TPSSs, determine the number and size of the TPSSs considering the sites available. Then arrange for the electric utility companies to supply power to the designated locations.

ADVANTAGES:

- Allows development of a cost-effective design
- Provides power system integrity
- Provides accurate utility requirements

DISADVANTAGES:

- None apparent

DISCUSSION:

In order to develop an efficient, cost-effective traction power supply system, it is imperative to determine what is necessary based on the actual system characteristics and then use the available TPSSs sites to best supply the needs. The "load flow" study will allow this to occur.

The question arises as to who should perform the study, the Authority's Program Manager or the design/build team. If the Program Manager performs the study, then the system is set for the design/build team to price out. If the study is left to the design/build team, then additional options arise because it may chose to select alternative TPSS sites. However, they will also be burdened with the need to obtain site approvals from the various City agencies and communities along with the purchase of the property in a timely manner. This may cause them to return to the existing sites. Even if they use the existing sites, the design/build team may select a different mix of equipment sizes and locations to supply traction power that will accommodate their equipment procurement and thus prove more cost-effective.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	**DESIGN SUGGESTION**		
SAVINGS			

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	**TP-4**
DESCRIPTION:	**USE A SINGLE ELECTRICAL FEED TO THE BAKER STREET TRACTION POWER SUBSTATION**	SHEET NO.	1 of 3

ORIGINAL DESIGN:

Two incoming electrical feeders and associated disconnect switches are provided to supply 34.5 kV power for the Baker Street traction power substation by the City of Los Angeles, Department of Water and Power (DWP).

ALTERNATIVE:

Use one incoming feeder from DWP.

ADVANTAGES:

- Saves cost

DISADVANTAGES:

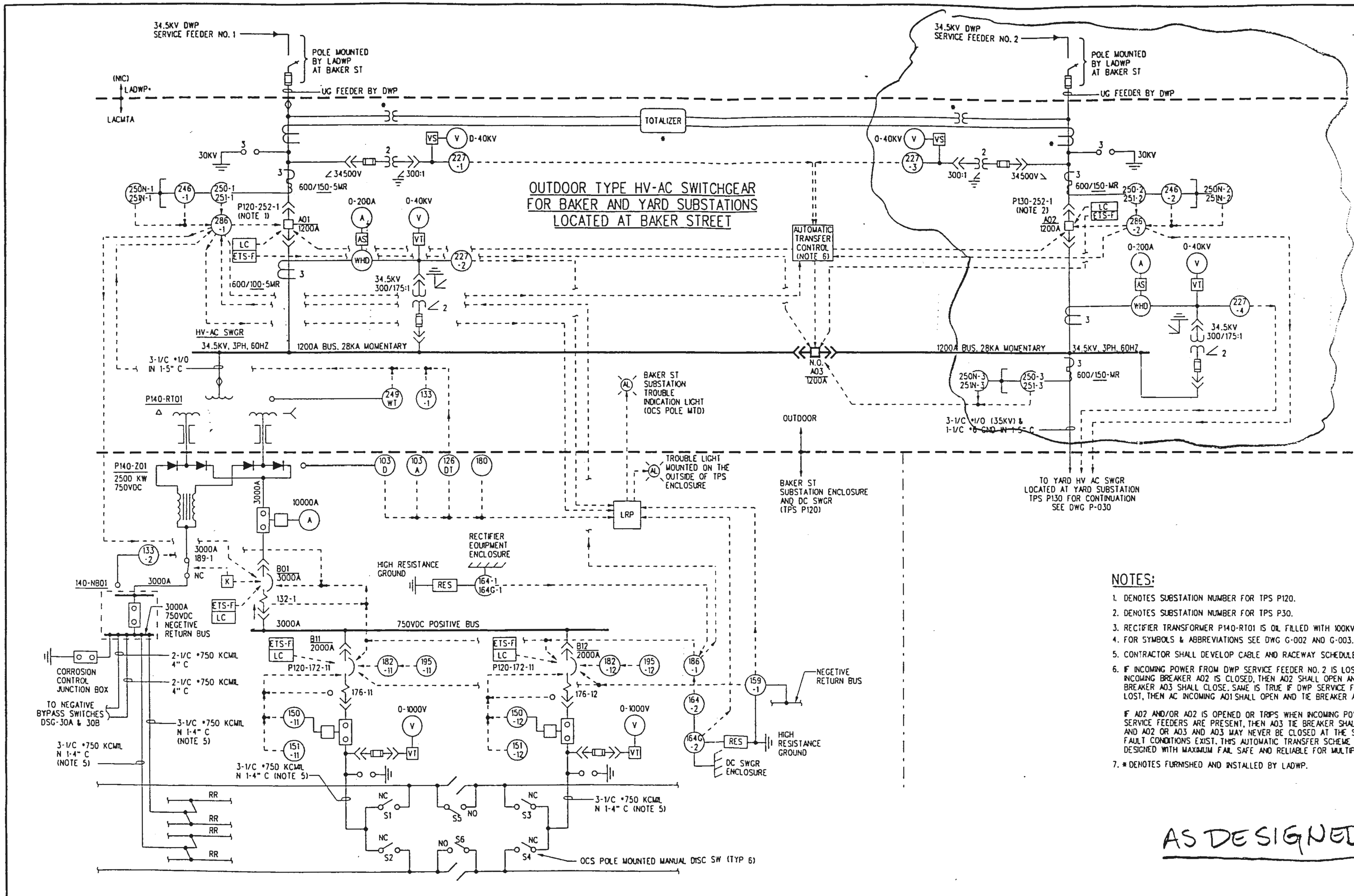
- Decreases reliability

DISCUSSION:

A single feeder supply is consistent with other mainline substations supplied by DWP, SCE and PWP.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 133,800	—	$ 133,800
ALTERNATIVE	$ 44,600	—	$ 44,600
SAVINGS	$ 89,200	—	$ 89,200

ALTERNATIVE NO.
TP-4
Sht. 2 of 3



NOTES:

1. DENOTES SUBSTATION NUMBER FOR TPS P120.
2. DENOTES SUBSTATION NUMBER FOR TPS P30.
3. RECTIFIER TRANSFORMER P140-RT01 IS OIL FILLED WITH 100KVA TERTIARY WINDING.
4. FOR SYMBOLS & ABBREVIATIONS SEE DWG G-002 AND G-003.
5. CONTRACTOR SHALL DEVELOP CABLE AND RACEWAY SCHEDULES.
6. IF INCOMING POWER FROM DWP SERVICE FEEDER NO. 2 IS LOST WHILE AC INCOMING BREAKER A02 IS CLOSED, THEN A02 SHALL OPEN AND THEN TIE BREAKER A03 SHALL CLOSE. SAME IS TRUE IF DWP SERVICE FEEDER NO.1 IS LOST, THEN AC INCOMING A01 SHALL OPEN AND TIE BREAKER A03 SHALL CLOSE.

   IF A02 AND/OR A02 IS OPENED OR TRIPS WHEN INCOMING POWER FROM DWP SERVICE FEEDERS ARE PRESENT, THEN A03 TIE BREAKER SHALL REMAIN OPEN A01 AND A02 OR A03 AND A03 MAY NEVER BE CLOSED AT THE SAME TIME WHEN FAULT CONDITIONS EXIST. THIS AUTOMATIC TRANSFER SCHEME (ATS) SHALL BE DESIGNED WITH MAXIMUM FAIL SAFE AND RELIABLE FOR MULTIPLE OPERATIONS.
7. * DENOTES FURNISHED AND INSTALLED BY LADWP.

334

AS DESIGNED

DEMOBILIZATION SUSPENSION SUBMITTAL

27-FEB-1998

DESIGNED BY	A PATEL
DRAWN BY	K ALBRIGHT
CHECKED BY	S SIMS
IN CHARGE	P DINETZ

LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY
PASADENA BLUE LINE
ENGINEERING MANAGEMENT CONSULTANT
SUBMITTED

LAUPT TO PASADENA
TRACTION ELECTRIFICATION SYSTEM
BAKER STREET TPS P120
METERING & RELAYING

CONTRACT NO	H0070
DRAWING NO	P-008
REV	0
SCALE	NO SCALE

23-FEB-1998

COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. TR-4
	SHEET NO. 3 of 3

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
Incoming feeder Breaker and associated cabling	ea	3	$40,000	$120,000	1	40,000	40,000
Sub-Total				$120,000			$40,000
Mark-Up at %				13,800			4,600
TOTAL				133,800			$4[illegible]

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	**TP-5**
DESCRIPTION:	**USE LOW RESISTANCE GROUNDING FOR TRACTION POWER**	SHEET NO.	1 of 2

ORIGINAL DESIGN:

Enclosure ground relaying is specified as a high resistance grounding system as shown on Page 16380-11, Paragraph 2.3.H of Contract H0070 documents.

ALTERNATIVE:

Use low resistance grounding.

ADVANTAGES:

- Reduces cost

DISADVANTAGES:

- Requires immediate shutdown on fault
- Does not meet standard and must be approved by MTA

DISCUSSION:

The width of the substation could be reduced by approximately 5 ft., saving 200 square feet of space in each substation.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 446,000	—	$ 446,000
ALTERNATIVE	$ 334,500	—	$ 334,500
SAVINGS	$ 111,500	—	$ 111,500

COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

ALTERNATIVE NO. TP-5

SHEET NO. 2 of 2

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/UNIT	TOTAL	NO. UNITS	COST/UNIT	TOTAL
Traction Power Substation Bldgs existing 20'x40 with High Resistance Grounding (approx 15'x40' with Low Resistance Grounding)	ea.	10	$40,000	$400,000	10	30000	$300,000
Sub-Total				$400,000			$300,000
Mark-Up at %				$46000			34 500
TOTAL				$446,000			334,500

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	TP-6
DESCRIPTION:	USE APPROPRIATE CABLE INSULATION	SHEET NO.	1 of 2

ORIGINAL DESIGN:

In the specification for Contract H0060, Page 24-6, 2.5.D, it states that 480 volt power cable shall be 2,000 volt rated.

ALTERNATIVE:

For 480 volt power cables, use 600 volt rated cable.

ADVANTAGES:

- Reduces cost

DISADVANTAGES:

- Reduces life

DISCUSSION:

It is common practice to use 600 volt insulation for a 480 volt system. The cost savings noted is related to signal cables only.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 892,000	—	$ 892,000
ALTERNATIVE	$ 785,500	—	$ 785,500
SAVINGS	$ 106,500	—	$ 106,500

COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO. CM-7 TR6
	SHEET NO. 2 of 2

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
1kV Brz shld							
TC cable	LF	200,000	$4	$800,000	200,000	$3.50	$700,000
(various sizes:			(Av)			(Av)	
3PR#14, 4PR#14,				-			
2C#4, 12C#14,							
2-1C#8)							
Reference:							
H0060, Train							
control verification							
Estimate for							
ROD 2001							
File: R05-H0060-							
PM220							
Sub-Total				$800,000			$700,000
Mark-Up at 11.5 %				92,000			$80,500
TOTAL				$892,000			$785,500

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	CL-1/CL-3/ CL-4
DESCRIPTION:	INSTALL CONDUITS FOR FIBER OPTIC CABLES THROUGHOUT THE ALIGNMENT AND LEASE USE OF CONDUITS	SHEET NO.	1 of 1

ORIGINAL DESIGN:

Part of the alignment has provisions for the installation of empty conduits in a duct bank that are suitable for the installation of fiber optic cable. No effort has taken place to lease these conduits to other entities.

ALTERNATIVE:

Install six empty conduits in a ductbank along the at-grade and China Town aerial segments of the light rail system alignment. Engage a program to pre-lease use of these conduits to communication companies whom would install their fiber optic cables in the void conduits. Conduct a public campaign to alert potential users of the opportunity. When leasing conduit space, make provisions for the MTA to use the fiber optic cable for its needs, such as telephone and data communications, closed circuit television, SCADA, signaling functions, etc.

ADVANTAGES:

- Provides yearly revenue for the MTA
- Reduces the cost of installing communication systems needed to operate the light rail system

DISADVANTAGES:

- May require an initial capital expenditure before the conduit space is totally leased

DISCUSSION:

Other transit properties have leased conduits in their right-of-way to fiber optic cable companies to obtain yearly revenue as well as to serve the communication needs of the transit system. A potential revenue stream of $800,000 per year could be generated for this system. Also, if the conduit capacity can be pre-leased, then the Authority can take advantage of using the private cable for its own needs also avoiding the requirement to install a communication backbone system of its own.

If a pre-lease agreement cannot be executed prior to the issuance of the design/build contract, then the responsibility of securing a lease along with an incentive to do so could be included in the design/build contract.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS			

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	**CCTV-2**
DESCRIPTION:	**PROVIDE CLOSED CIRCUIT TELEVISION AT SELECTED CRITICAL LOCATIONS**	SHEET NO.	1 of 1

ORIGINAL DESIGN:

The Closed Circuit Television (CCTV) was removed from the original design during a cost cutting effort.

ALTERNATIVE:

Utilized closed circuit television at critical points only, possibly a single camera at a station. Use pan and tilt for more coverage.

ADVANTAGES:

- Adds to system security

DISADVANTAGES:

- Adds cost

DISCUSSION:

By placing a single camera at a strategic and critical location the basic security needs of the project can be met.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	**DESIGN SUGGESTION**		
SAVINGS			

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	CCTV-4
DESCRIPTION:	HAVE MTA PROCURE CCTY	SHEET NO.	1 of 2

ORIGINAL DESIGN:

No Closed Circuit Television (CCTV) is shown on plans, specifications, or in cost estimates. Assume a CCTV system comparable to LBLA Blue Line, i.e., 2 CCTV camera per platform with fiber optic backbone to central control, are desired.

ALTERNATIVE:

Have the MTA provide the same system as above for this project. The design/build contractor will install support hooks and conduit only. If provided by MTA, assume 15% of original cost for coordination of installation provisions.

ADVANTAGES:

- Enhances security
- Through volume buying agreements, MTA could procure equipment at a lower cost

DISADVANTAGES:

- Adds maintenance cost

DISCUSSION:

The MTA would order this system as part of ongoing replacement orders for existing systems, thus deriving cost benefits for the quantity orders and removing a line item from this contract. This allows standardizations of components. The Authority would reimburse the MTA for the procurement.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 543,919	---	$ 543,919
ALTERNATIVE	$ 81,548	---	$ 81,548
SAVINGS	$ 462,371	---	$ 462,371

COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT
CLOSED CIRCUIT TELEVISION

ALTERNATIVE NO. CCTV-4

SHEET NO. 2 of 2

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
DISTRIBUTION SYSTEM	LS	1	6700	6700			
CCTV CAMERAS	EA	32	2800	89600			
VIDEO MODULATORS	EA	32	1300	41600			
VIDEO CABLE	CF	32	140	4480			
POWER SUPPLIES	EA	16	820	13120			
CCTV POWER CABLE	CF	32	135	4320			
FO CABLE	CF	800	410	328000			
CCTV COORDINATION							73137
Sub-Total				487820			73137
Mark-Up at %				56099			8411
TOTAL				543919			81548

SUMMARY OF POTENTIAL COST SAVINGS

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT	LOCATION: LOS ANGELES TO PASADENA, CALIFORNIA					
PROJECT ELEMENT: SYSTEMS				PRESENT WORTH OF COST SAVINGS		
ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	INITIAL COST SAVINGS	O & M SAVINGS	TOTAL SAVINGS
	DYNAMIC SIGNAGE (DY)					
DY-2	Sell advertising on dynamic signage at stations	DESIGN SUGGESTION				
DY-3	Replace dynamic signage with Closed Circuit Television screens	751,867	751,867	0	—	0
DY-5	Have MTA procure dynamic signage	751,867	112,780	639,087	—	639,087
	RADIO SYSTEM (RS)					
RS-2	Have MTA procure radio system	2,367,145	355,072	2,012,073	—	2,012,073
	EMERGENCY TELEPHONE SYSTEM (ETS)					
ETS-1	MTA will procure emergency telephone system	1,311,240	131,124	1,180,116	—	1,180,116
ETS-2	Include ETS in fiber optic backbone	1,311,240	631,368	679,872	—	679,872
ETS-4	Lease dedicated telephone lines for emergency telephone system	1,311,240	44,600	1,266,640	(528,570)	782,670

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	DY-2
DESCRIPTION:	SELL ADVERTISING ON DYNAMIC SIGNAGE AT STATIONS	SHEET NO.	1 of 1

ORIGINAL DESIGN:

The current design does not address advertising as a revenue generator.

ALTERNATIVE:

Sell advertising for dynamic signage to generate revenue.

ADVANTAGES:

- Generates revenue
- Communicates with riders

DISADVANTAGES:

- Adds software costs

DISCUSSION:

Dynamic signage is a good way to communicate information to riders and the public not using the train facilities. It also provides means of generating revenue if advertising rights are sold.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS			

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	DY-3
DESCRIPTION:	REPLACE DYNAMIC SIGNAGE WITH CLOSED CIRCUIT TELEVISION SCREENS	SHEET NO.	1 of 2

ORIGINAL DESIGN:

No dynamic signage is shown on plans, specification or in cost estimates. Assume dynamic signage comparable to the Long Beach LA Blue Line, i.e., two read boards per platform with fiber optic backbone to central control.

ALTERNATIVE:

Provide a system similar to above utilizing Closed Circuit Television (CCTV) monitors for display. Unit costs used are based on bid figures from Tri-Met west side project escalated at 6% per year.

ADVANTAGES:

- Provides display flexibility
- Has revenue potential
- Provides electrical isolation

DISADVANTAGES:

- Vandal target

DISCUSSION:

The installation of dynamic signage utilizing CCTV monitors allows graphic displays, system updates and advertising. Display of train information including train status and destination is aesthetically pleasing, as well as informative.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 751,867	—	$ 751,867
ALTERNATIVE	$ 751,867	—	$ 751,867
SAVINGS	$ 0	—	$ 0

COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT — ALTERNATIVE NO. DY-3

DYNAMIC SIGNAGE — SHEET NO. 2 of 2

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
READER BOARD	EA	32	5730	183360			
TRANSCEIVERS	EA	32	1620	51840			
F/O CABLE	CF	800	410	328000			
ACCESS & MULTIPLEX SYS	LS	1	98000	- 98000			
POWER SUPPLIES	EA	16	820	13120			
CCTV	EA				32	5730	183360
TRANSCEIVERS	EA				32	1620	51840
F/O CABLE	CF				800	410	328000
ACCESS & MULTIPLEX SYS	LS				1	98000	98000
POWER SUPPLIES	EA				16	820	13120
Sub-Total				674320			674320
Mark-Up at %				77547			77547
TOTAL				751867			751867

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	DY-5
DESCRIPTION:	**HAVE MTA OR AUTHORITY PROCURE DYNAMIC SIGNAGE**	SHEET NO.	1 of 2

ORIGINAL DESIGN:

No dynamic signage is shown on plans, specifications or in estimates. Assume dynamic signage comparable to Long Beach LA Blue Line, i.e., two reader boards per platform with fiber optic backbone to central control.

ALTERNATIVE:

The same system as above is to be provided by the MTA. The design/build contractor will only provide conduit and attachments. Assume 15% of original cost for coordination of installation provisions.

ADVANTAGES:

- Through volume buying agreements, MTA could procure the equipment at a lower cost
- Compatibility becomes a non-issue

DISADVANTAGES:

- Requires additional coordinator

DISCUSSION:

The MTA can order the system as part of its ongoing replacement/upgrade activities, deriving cost benefits from quantity orders and removing a line item from the design/build contract. The Authority would reimburse the MTA for the procurement.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 751,867	---	$ 751.867
ALTERNATIVE	$ 112,780	---	$ 112.780
SAVINGS	$ 639,087	---	$ 639.087

COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

DYNAMIC SIGNAGE

ALTERNATIVE NO. DY-5

SHEET NO. 2 of 2

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
DYNAMIC SIGNAGE	LS	1		674320			
SIGNAGE COORDINATION							101148
Sub-Total				674320			101148
Mark-Up at %				77547			11632
TOTAL				751867			112780

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**PASADENA BLUE LINE LIGHT RAIL PROJECT**	ALTERNATIVE NO.	**RS-2**
DESCRIPTION:	**HAVE MTA PRODUCE THE RADIO SYSTEM**	SHEET NO.	1 of 2

ORIGINAL DESIGN:

A trunked radio system with corresponding radio units as conceived in Contract H0010 is provided.

ALTERNATIVE:

The same system is to be provided by the MTA. Assume 15% of original cost for the coordination of installation provisions.

ADVANTAGES:

- Compatibility becomes a non-issue
- Through volume buying agreements MTA can procure equipment at a lower cost

DISADVANTAGES:

- Requires coordinator

DISCUSSION:

The MTA would order this system to assure compatibility and interchangeability with its existing system, deriving cost benefits of quantity orders and removing line item from the design/build contract. The Authority would reimburse MTA for the procurement.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 2,367,145	---	$ 2,367,145
ALTERNATIVE	$ 355,072	---	$ 355,072
SAVINGS	$ 2,012,073	---	$ 2.012.073

COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

RADIO SYSTEM

ALTERNATIVE NO. RS-2

SHEET NO. 2 of 2

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
RADIO SYSTEM	LS	1	2123000	2123000			
RADIO SYSTEM COORDINATION	LS			-	1	318450	318450
Sub-Total				2123000			318450
Mark-Up at %				244145			36621
TOTAL				2367145			355072

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	ETS-1
DESCRIPTION:	HAVE MTA PROCURE EMERGENCY TELEPHONE SYSTEM	SHEET NO.	1 of 3

ORIGINAL DESIGN: (Sketch attached)

An emergency telephone system is to be provided and installed by design/build contractor.

ALTERNATIVE:

The same system is to be provided and installed by the MTA. The design/build contractor will install conduit system only. Assume 10% of the original cost for coordination of installation provisions.

ADVANTAGES:

- Compatibility becomes a non-issue
- Eliminates cost

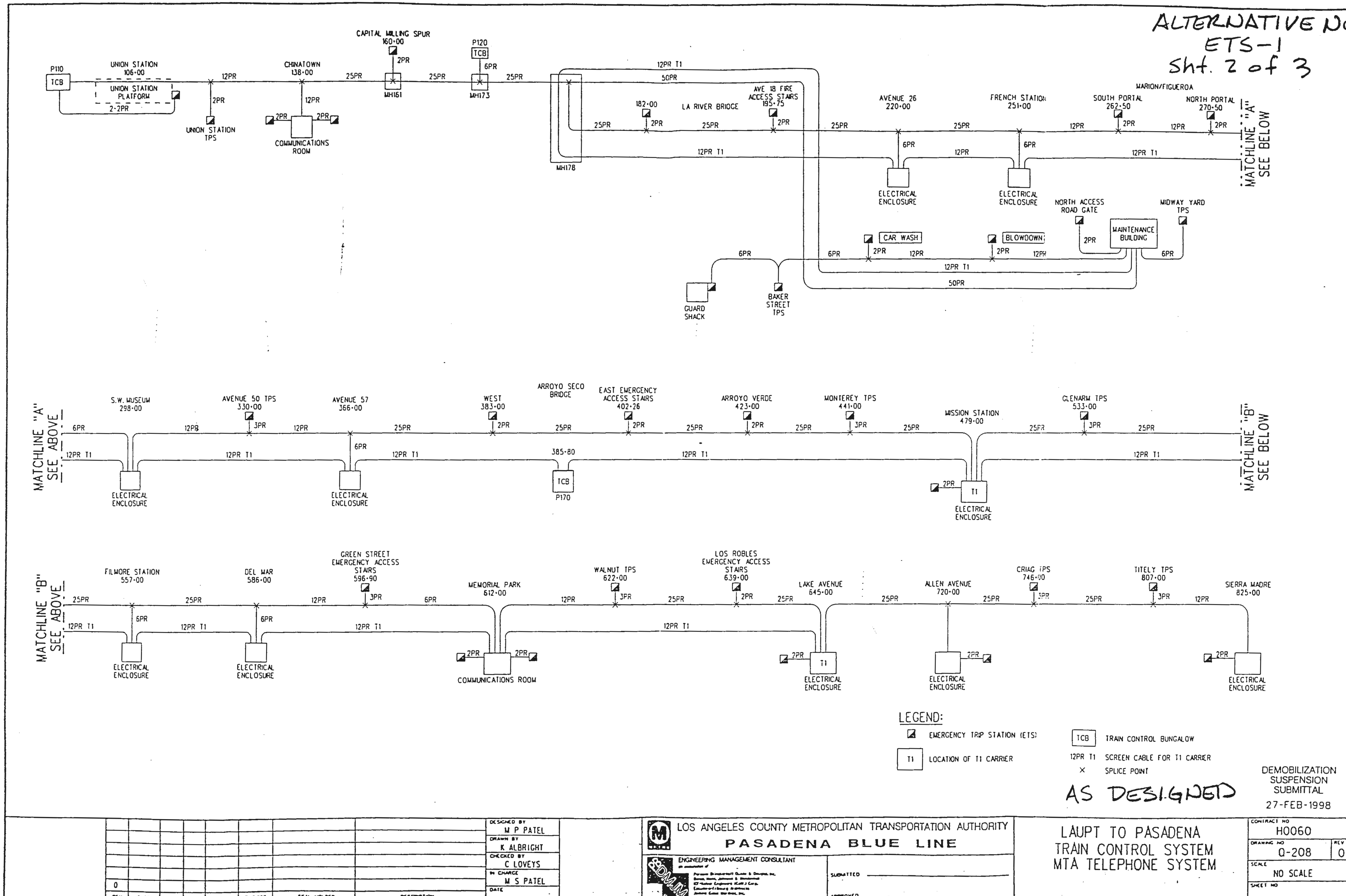
DISADVANTAGES:

- Requires coordination

DISCUSSION:

The MTA is to order this system as part of ongoing replacement orders deriving cost benefits of obtaining quantity orders and removing a line item from contract. The Authority would reimburse the MTA for its procurement.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 1,311,240	---	$ 1.311.240
ALTERNATIVE	$ 131,124	---	$ 131.124
SAVINGS	$ 1,180,116	---	$ 1.180.116


ALTERNATIVE NO. ETS-1
Sht. 2 of 3
P110
TCB
UNION STATION 106·00
UNION STATION PLATFORM
2-2PR
12PR
2PR
UNION STATION TPS
CHINATOWN 138·00
25PR
12PR
COMMUNICATIONS ROOM
CAPITAL MILLING SPUR 160·00
MH161
P120
TCB
6PR
MH173
MH178
12PR T1
50PR
182·00
LA RIVER BRIDGE
AVE 18 FIRE ACCESS STAIRS 195·75
AVENUE 26 220·00
FRENCH STATION 251·00
MARION/FIGUEROA
SOUTH PORTAL 262·50
NORTH PORTAL 270·50
ELECTRICAL ENCLOSURE
NORTH ACCESS ROAD GATE
MIDWAY YARD TPS
MAINTENANCE BUILDING
CAR WASH
BLOWDOWN
GUARD SHACK
BAKER STREET TPS
MATCHLINE "A" SEE BELOW
MATCHLINE "A" SEE ABOVE
S.W. MUSEUM 298·00
AVENUE 50 TPS 330·00
AVENUE 57 366·00
WEST 383·00
ARROYO SECO BRIDGE
385·80
TCB
P170
EAST EMERGENCY ACCESS STAIRS 402·26
ARROYO VERDE 423·00
MONTEREY TPS 441·00
MISSION STATION 479·00
GLENARM TPS 533·00
T1
MATCHLINE "B" SEE BELOW
MATCHLINE "B" SEE ABOVE
FILMORE STATION 557·00
DEL MAR 586·00
GREEN STREET EMERGENCY ACCESS STAIRS 596·90
MEMORIAL PARK 612·00
COMMUNICATIONS ROOM
WALNUT TPS 622·00
LOS ROBLES EMERGENCY ACCESS STAIRS 639·00
LAKE AVENUE 645·00
ALLEN AVENUE 720·00
CRIAG TPS 746·00
TITELY TPS 807·00
SIERRA MADRE 825·00
3PR
LEGEND:
EMERGENCY TRIP STATION (ETS)
TCB TRAIN CONTROL BUNGALOW
T1 LOCATION OF T1 CARRIER
12PR T1 SCREEN CABLE FOR T1 CARRIER
× SPLICE POINT
AS DESIGNED
DEMOBILIZATION SUSPENSION SUBMITTAL
27-FEB-1998
DESIGNED BY M P PATEL
DRAWN BY K ALBRIGHT
CHECKED BY C LOVEYS
IN CHARGE M S PATEL
DATE
REV DATE BY APP REC NO EXPIRES SEAL HOLDER DESCRIPTION
0
LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY
PASADENA BLUE LINE
ENGINEERING MANAGEMENT CONSULTANT
SUBMITTED
APPROVED
LAUPT TO PASADENA
TRAIN CONTROL SYSTEM
MTA TELEPHONE SYSTEM
CONTRACT NO H0060
DRAWING NO Q-208
REV 0
SCALE NO SCALE
SHEET NO

COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT — ALTERNATIVE NO. ETS-1

EMERGENCY TELEPHONE SYSTEM — SHEET NO. 3 of 3

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
TELEPHONE SYSTEM	LS	1	1176000	1176000			
TELEPHONE SYSTEM COORDINATION	LS			-	1	117600	117600
Sub-Total				1176000			117600
Mark-Up at %				135240			13524
TOTAL				1311240			131124

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	ETS-2
DESCRIPTION:	INCLUDE ETS IN FIBER OBTIC BACKBONE	SHEET NO.	1 of 3

ORIGINAL DESIGN: (Sketch attached)

The original design utilizes copper telephone cable throughout, which is cut back to a copper backbone for the yard and shop area only. This is to be provided by the Authority.

ALTERNATIVE:

Use fiber optic cable system backbone (use multi-Fiber, Multi-mode cable). Note that unit costs used in the cost comparison are based on bid figures from Tri-Met Westside Project escalated at 6% per year.

ADVANTAGES:

- Requires less conduit
- Shares cost with other systems
- Electrical isolation provided

DISADVANTAGES:

- None apparent.

DISCUSSION:

The employment of a multi-mode, multi-fiber optic cable for the emergency telephone system allows shared usage by several systems and allows running the cable either underground or aerially. Fiber optic cable allows electrical isolation of various portions of the system.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 1,311,240	---	$ 1,311,240
ALTERNATIVE	$ 631,368	---	$ 631,368
SAVINGS	$ 679,872	---	$ 679,872

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	ETS-2
DESCRIPTION:	INCLUDE ETS IN FIBER OPTIC BACKBONE	SHEET NO.	1 of 3

ORIGINAL DESIGN: (Sketch attached)

The original design utilizes copper telephone cable throughout, which is cut back to a copper backbone for the yard and shop area only. This is to be provided by the MTA.

ALTERNATIVE:

Use fiber optic cable for system backbone (use multi-Fiber, Multi-mode cable). Note that unit costs used in the cost comparison are based on bid figures from Tri-Met Westside Project escalated at 6% per year.

ADVANTAGES:

- Requires less conduit
- Shares cost with other systems
- Electrical isolation provided

DISADVANTAGES:

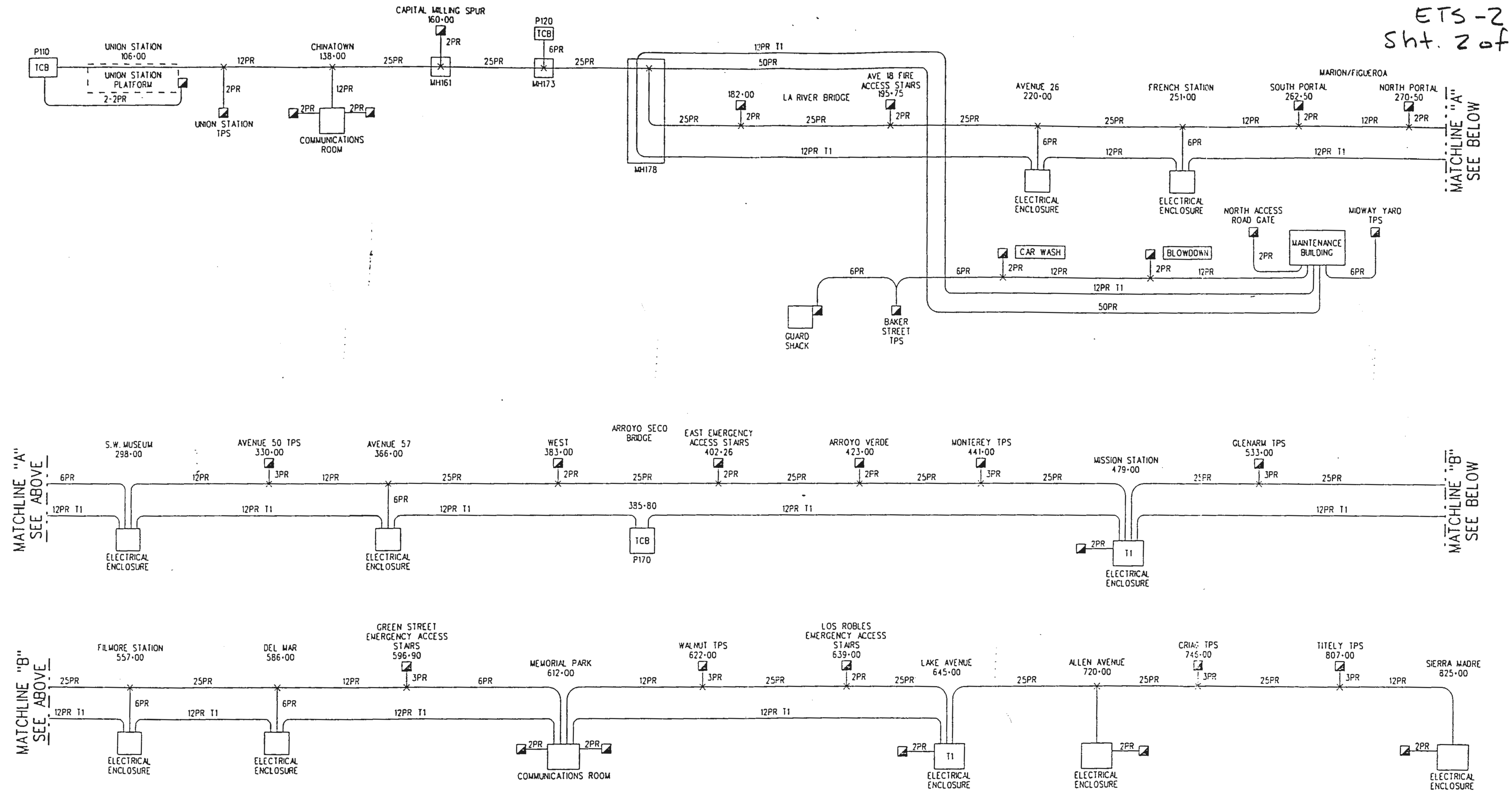
- None apparent

DISCUSSION:

The employment of a multi-mode, multi-fiber optic cable for the emergency telephone system allows shared usage by several systems and allows running the cable either underground or aerially. Fiber optic cable allows electrical isolation of various portions of the system.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 1,311,240	—	$ 1,311,240
ALTERNATIVE	$ 631,368	—	$ 631,368
SAVINGS	$ 679,872	—	$ 679,872

ALTERNATIVE NO. ETS-2
Sht. 2 of 3



LEGEND:

◪	EMERGENCY TRIP STATION (ETS)	TCB	TRAIN CONTROL BUNGALOW
T1	LOCATION OF T1 CARRIER	12PR T1	SCREEN CABLE FOR T1 CARRIER
		X	SPLICE POINT

AS DESIGNED

DEMOBILIZATION SUSPENSION SUBMITTAL
27-FEB-1998

REV	DATE	BY	APP	REC NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0							

DESIGNED BY M P PATEL
DRAWN BY K ALBRIGHT
CHECKED BY C LOVEYS
IN CHARGE M S PATEL
DATE

LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY
PASADENA BLUE LINE
ENGINEERING MANAGEMENT CONSULTANT

SUBMITTED
APPROVED

LAUPT TO PASADENA
TRAIN CONTROL SYSTEM
MTA TELEPHONE SYSTEM

CONTRACT NO H0060
DRAWING NO 0-208
REV 0
SCALE NO SCALE
SHEET NO

COST WORKSHEET

EMERGENCY TELEPHONE SYSTEM

PROJECT: **PASADENA BLUE LINE LIGHT RAIL PROJECT**

EMERGENCY TELEPHONE SYSTEM

ALTERNATIVE NO. ETS-2

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
TELEPHONE SYSTEM	LS	1	1,176000	1176000			
FIBER/OPTIC CABLE	CF			-	800	410	328000
MULTIMODE TRANSCEIVER	EA				29	1620	46980
ETEL SET	EA				32	1430	45760
PABX	EA				1	145510	145510
Sub-Total				1176000			566250
Mark-Up at 11.5 %				135240			65118
TOTAL				1311240			631368

VALUE ENGINEERING ALTERNATIVE

PROJECT:	PASADENA BLUE LINE LIGHT RAIL PROJECT	ALTERNATIVE NO.	ETS-4
DESCRIPTION:	LEASE DEDICATED TELEPHONE LINES FOR EMERGENCY TELEPHONE SYSTEM	SHEET NO.	1 of 4

ORIGINAL DESIGN: (Sketch attached)

The telephone system is to be provided and installed per attached drawing.

ALTERNATIVE: (Sketch attached)

Lease dedicated phone lines from the telephone company for emergency telephone system. Assume $100/month per line lease fee. Assume $1,250 per hands-free emergency telephone set.

ADVANTAGES:

- Minimal installation
- Requires no cable maintenance
- Saves cost

DISADVANTAGES:

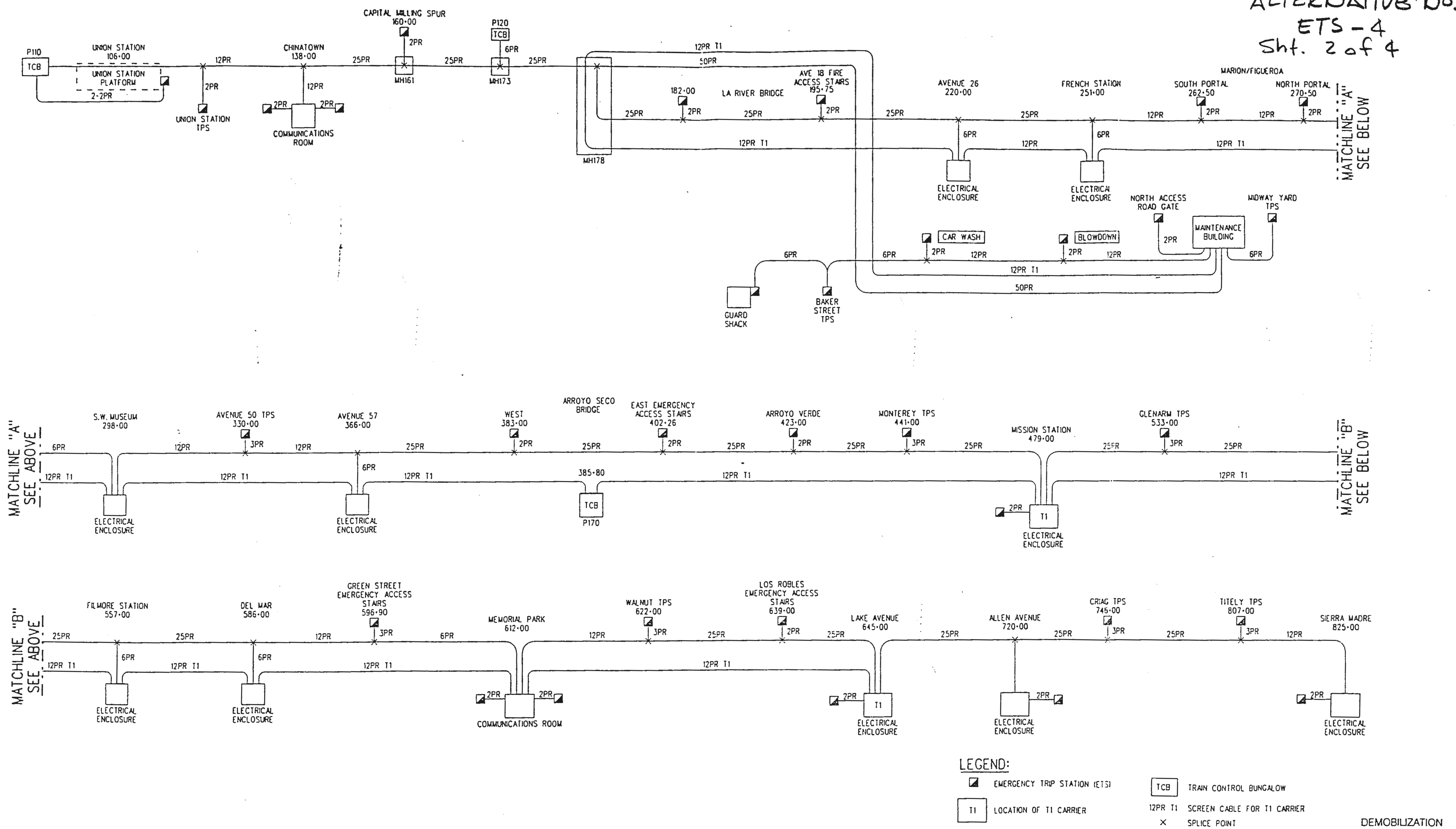
- Monthly charge
- No equipment control
- MTA does not own the lines

DISCUSSION:

Lease a dedicated phone line for each location needing an emergency telephone to reduce cable installation and maintenance costs.

COST SUMMARY	INITIAL COST	RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 1,311,240	$ 0	$ 1,311,240
ALTERNATIVE	$ 44,600	$ 528,570	$ 573,170
SAVINGS	$ 1,266,640	$ (528,570)	$ 782,670

ALTERNATIVE NO.
ETS-4
Sht. 2 of 4



AS DESIGNED

DEMOBILIZATION SUSPENSION SUBMITTAL
27-FEB-1998

DESIGNED BY	M P PATEL
DRAWN BY	K ALBRIGHT
CHECKED BY	C LOVEYS
IN CHARGE	M S PATEL
DATE	

REV	DATE	BY	APP	REC NO	EXPIRES	SEAL HOLDER	DESCRIPTION
0							

LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY
PASADENA BLUE LINE
ENGINEERING MANAGEMENT CONSULTANT

SUBMITTED
APPROVED

LAUPT TO PASADENA
TRAIN CONTROL SYSTEM
MTA TELEPHONE SYSTEM

CONTRACT NO H0060
DRAWING NO 0-208 REV 0
SCALE NO SCALE
SHEET NO

SKETCHES

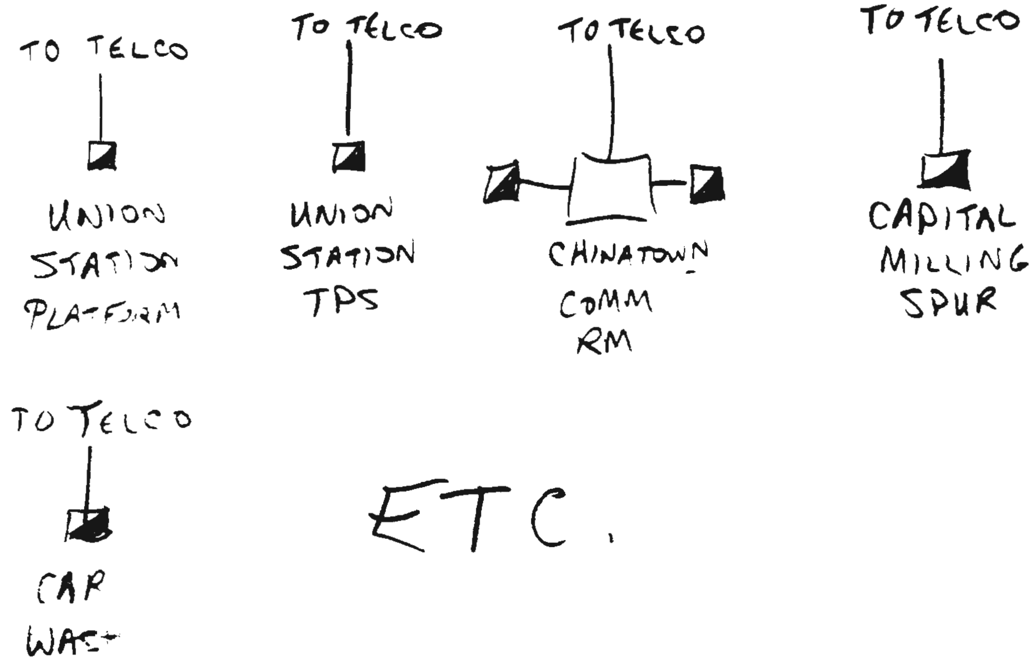
EMERGENCY TELEPHONE SYSTEM

PROJECT: **PASADENA BLUE LINE LIGHT RAIL PROJECT**

ALTERNATIVE NO. ETS-4

☐ AS DESIGNED ☑ ALTERNATIVE

SHEET NO. 3 of 4



COST WORKSHEET

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT

EMERGENCY TELEPHONE SYSTEM

ALTERNATIVE NO. ETS-4

SHEET NO. 4 of 4

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. UNITS	COST/ UNIT	TOTAL	NO. UNITS	COST/ UNIT	TOTAL
TELEPHONE SYSTEM	LS	1	1176000	1176000			
ETEL SET	EA				32	1250	40000
Sub-Total				1176000			40000
Mark-Up at %				135240			4600
TOTAL				1311240			44600

Project Description

Project Description

PROJECT DESCRIPTION

1.1 Project Development History

For almost twenty years, the plans of the agencies responsible for planning, designing and building transit facilities in Los Angeles, California have included building a rail transit line between the cities of Los Angeles, South Pasadena and Pasadena. Serious work on the line began in 1988 when the Los Angeles County Transportation Commission (LACTC), one of the predecessor agencies of the Metropolitan Transportation Authority (MTA), initiated the preparation of a draft Environmental Impact Report (EIR) for the project. After revisions in 1989, the LACTC certified that the project's final EIR had been prepared in accordance with the California Environmental Quality Act (CEQA).

Between 1990 and 1993, the project moved forward through Preliminary Engineering, the preparation of a Supplemental EIR to analyze impacts of alternatives and the adoption of a project budget and sequential opening plan. In 1993 the LACTC approved revisions to the project components and an increase in the recommended budget. During the next three years, the project progress was impeded by a series of economic events and funding constraints, all of which appeared to impact negatively the MTA financial plans and development programs.

In late 1996, the Federal Transit Administration became so concerned about the MTA's financial commitments that it demanded a recovery plan to address a major shortfall in its capital funding program. After an extensive financial analysis, the MTA, in early 1998, suspended for a period of six to eighteen months, the ongoing design and construction of three separate rail transit projects as it had insufficient local funds to complete its capital construction program.

The 13.9-mile Metro Pasadena Blue Line was one of the projects suspended after almost 10 years in the planning and design phases. This project had evolved into 37 design packages with 50-55% of the design completed, a substantial amount of right-of-way acquired and about 10% of the construction budget either complete or underway, primarily retrofit of existing bridges and a new bridge over the LA River.

In mid-1998 the MTA moved to close down all the suspended projects as it became increasingly clear that it lacked the financial capacity to restart them and take them to completion. As a result, considerable effort in the state legislature led to the signing in September 1998, of the SB-1847 legislation creating the Los Angeles to Pasadena Blue Line Metro Construction Authority (the Authority) as a separate entity as of January 1, 1999.

1.2 The Role of the Los Angeles to Pasadena Metro Blue Line Construction Authority

The Board of Directors of the Authority consists of a representative of the Cities of Los Angeles, South Pasadena and Pasadena and an appointee to represent the MTA and the San Gabriel Valley Council of Governments.

Legislation SB-1847 requires the Authority to adopt an Administrative Code, develop and submit a series of Project Implementation, Financial, Project Management and System Safety Plans to the Governor, the Legislature and the CTC. After completing these submissions and receiving Caltrans approval of its policies and procedures, accounting systems, internal controls and other systems, the Authority will have

the funds available and legislative powers to complete the design and construction of the 13.9 mile Phase 1 of the Pasadena Blue Line. The Authority is a single purpose Agency focused entirely on the completion of construction of the first phase and any extensions further to the east to the vicinity of the City of Claremont.

After careful review of the financial issues and estimated costs, the Authority adopted a financial plan including a budget and estimate to complete the project from its present status, both based on using the design-build method of project delivery. A critical element in the Authority's efforts to restart the project and move it forward expeditiously is to get a good engineering definition of the design status and to complete a comprehensive value engineering program. These activities will lead to a firm basis for incorporating the current project design at the appropriate levels of completion into the design-build procurement documents to be developed by the Authority.

Gannett Fleming, Inc. performed the first task for the Authority by producing the Project Development Status Report, dated August 19, 1999 that describes the current status of the various elements of the project. This report formed part of the basis of the value engineering study and descriptions of project elements are excerpted from it and presented below.

2. PROJECT DESCRIPTION

2.1 General Description of the Project

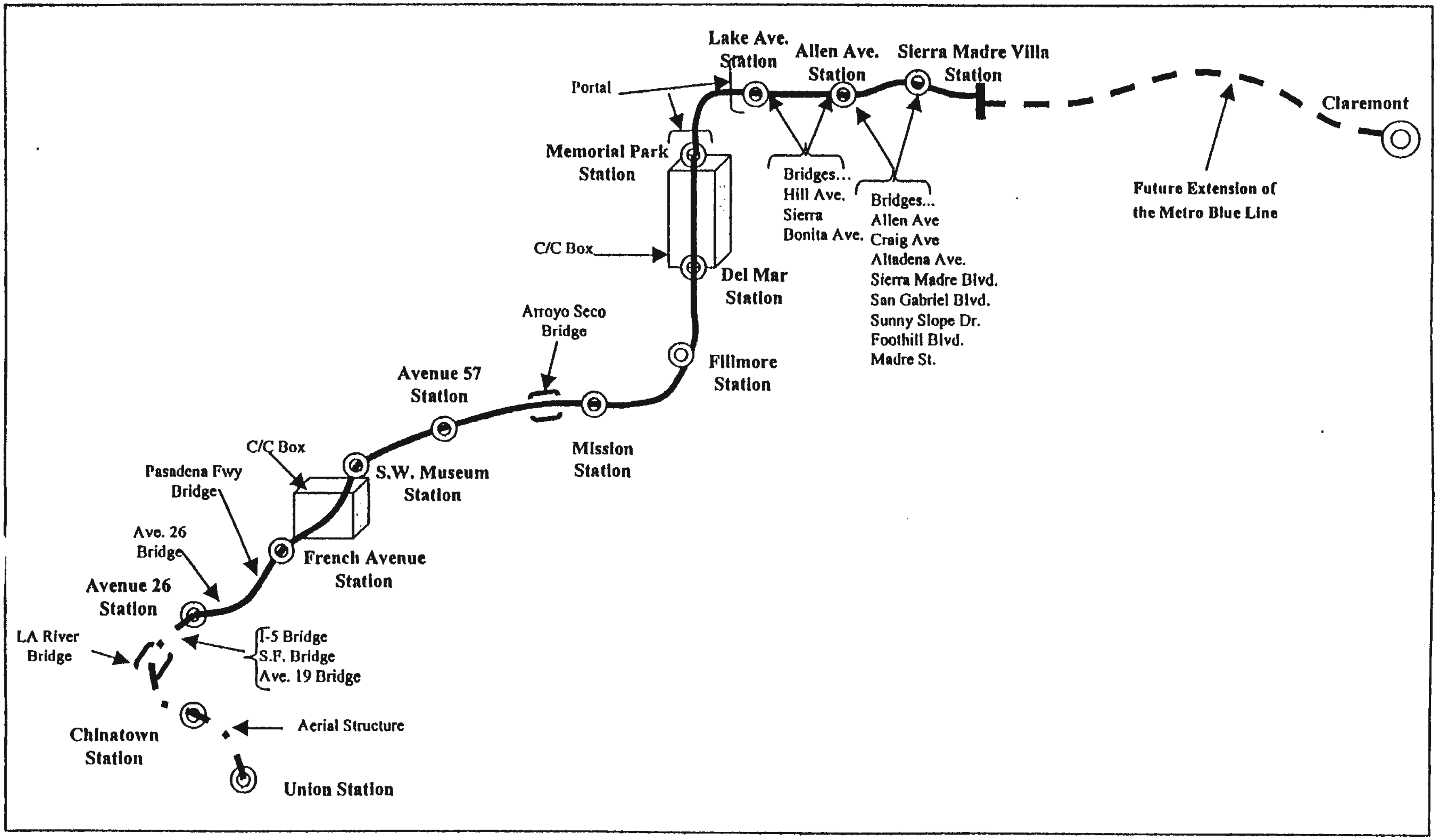
The Los Angeles to Pasadena Metro Blue Line first phase is a 13.9 mile portion of an ultimate 34-35 mile light rail link between the San Gabriel Valley in the northeast of Los Angeles County and Downtown Los Angeles. The alignment links both the existing east-west I-210 freeway right-of-way and north-south leg of the former Atchison, Topeka and Sante Fe railroad right-of-way. The first phase route, commencing downtown at Union Station, passes through the City of Los Angeles' communities of Chinatown, Lincoln Heights, Mount Washington and Highland Park, the City of South Pasadena and the City of Pasadena. From the initial terminus in the freeway median in northeast Pasadena, the route is planned to extend eastward through Arcadia, Irwindale, Azusa, Glendora, San Dimas and La Verne to Claremont. The accompanying Figure on the next page shows the proposed route.

The rail service will be provided by trains of up to three single-articulated cars operating on a conventional, double track, electrified line with thirteen stations spaced between 0.75 and 2.2 miles apart. Station locations have been selected to maximize access for passengers arriving by bus, private car or on foot. Most of the route uses an at-grade alignment due to the availability of the existing rights-of-way. Grade separated sections are required through Chinatown (2,670 feet elevated), under the Figueroa St./Marmion Way intersection (380 ft) and under four blocks in the Old Pasadena downtown.

Phase 1 expenditures to date by the MTA have been $274.3 million and the new Construction Authority has established a budget of $414.1 million to complete the initial phase by the projected revenue operating date of 2003.

METRO BLUE LINE
LIGHT RAIL PROJECT

the Los Angeles to Pasadena Blue Line



March 1999

2.2 The Design and Construction of Fixed Facilities

2.2.1 Fixed Facilities Constructed

The construction of fixed facilities for the following contracts has been completed: C6410 – Los Angeles Rive Bridge; C6430 – Arroyo Seco Bridge; and C6435 – retrofit of 12 steel and concrete bridges. The completion date for Contract C6410 was June 30, 1997; Contract C6430 July 16, 1997; and C6435 November 14, 1997. The 12 steel and concrete bridges are: Lacy Street, Arroyo Seco Parkway, Lake Avenue, Hill avenue, Sierra Bonito Avenue, Allen Avenue, Craig Avenue, Altadena Drive, Sierra Madre Boulevard, Sunnyslope Avenue, Foothill Boulevard, and Madre Street.

2.2.2 Fixed Facilities in Design

Design development to date has defined most of the fixed facilities required for the initial phase of the line. Definition of the infrastructure needed for the line segments has advanced to a near final level of design and contract document completion, with the exception of the 3 to 4 mile portion along the I-210 freeway median in Pasadena. Design in this segment requires resolution of several elements and drawings were in progress at the time of suspension.

The primary components making up the line segments of fixed facilities to be built are:

- A 2,700 ft aerial structure through Chinatown between Union Station and the Santa Fe Cornfield Yard on the west side of the Los Angeles River linking to a new bridge over the river,

- A mostly at-grade segment using the former A.T & S. F. railroad right-of-way from the river crossing through the Mt. Washington, Lincoln Heights and Highland Park communities for a distance of 4 miles. The segment also includes a cut-and-cover grade separation of the Figueroa Street/Marmion Way intersection.

- A 2.4 mile at-grade continuation of the railroad right-of-way through the City of South Pasadena, extending from the upgraded Pasadena Freeway bridge at Arroyo Seco Park to the existing rail underpass of Fair Oaks Avenue on the City's northern border with Pasadena.

- The 1.8-mile north-south leg of the route in Pasadena from the Fair Oaks crossing to the entrance of the existing rail tunnel under the I-210 freeway made up of at-grade right-of-way and a 1,200-ft underground section beneath four blocks of Old Pasadena.

- And finally, the 4-mile at-grade segment running east-west in the median of the I-210 freeway to the Sierra Madre Villa Station area on the eastern boundary of Pasadena.

The other components of the fixed facilities include the thirteen stations and the light maintenance and storage yard installation on the west bank of the Los Angeles River north of Chinatown. Design of the stations had progressed to a much less advanced level than the line segments at the time of project suspension. In fact, cost containment recommendations have meant reverting to further preliminary engineering for some Stations as in-progress designs became inapplicable. Union, Avenue 26, French Ave., Mission, Fillmore, Del Mar and Sierra Madre Villa stations are in this category while Chinatown was at the concept design stage. Design of the remaining stations at Southwest Museum, Avenue 57, Memorial Park, Lake Ave. and Allen Ave. were in progress with structural and civil elements near completion and station finishes under development.

The Midway storage yard and maintenance will serve as a satellite yard accommodating up to 40 vehicles. The facility will include buildings for light maintenance, car cleaning, blow-down operations, personnel support and consumable parts storage. Design and drawing preparation was in progress towards pre-final level prior to the cost containment activity.

The line infrastructure has been divided into five segments with limits corresponding to major right-of-way features or city boundaries, resulting in two in the City of Los Angeles, one for the City of South Pasadena portion and the remaining two in the City of Pasadena. Stations are included as individual components within a section.

The design development status of the Midway Yard and Shops complex and its associated mainline interface is described separately in Section 3.4.

2.3 System Components

Systems components required for the Pasadena Blue line initial phase include:

2.3.1 Traction Power System (H0070)

Traction Power supply system comprises prefabricated, outdoor substations with high voltage AC switch gear and DC and AC disconnect switches and an overhead contact system including catenary support structures for mainline and yard tracks and emergency telephone system (ETS) subsystem.

2.3.2 Train Control System (H0060)

The bi-directional/interlocking wayside Train Control system includes prefabricated communications and signaling buildings (Train Control Building/TCB), grade crossing gates and pedestrian flashing signals. The Project alignment includes both at-grade and separated (aerial/subsurface) ROW with speed control by cab signaling operation and street traffic signals. The majority of track work will be ballasted with concrete ties. A portion of the track will also be rubberized-panels at grade crossing, direct fixation, and wood ties at special track work requirements.

2.3.3 Radio System/Operation (H0030)

The radio system with auxiliary and fixed site equipment for radio frequency shade zones as required for the central dispatching and communication operations shall be furnished by the MTA before the suspension of the Project. As dictated by the MTA, the radio system operations shall be compatible to the Metro Rail system operations, such as the Metro Red Line, Green Line and Metro Blue Line (Long Beach) alignment.

2.3.4 Fare Collection System (H0040)

The Fare Collection system comprises ticket vending machines, supplemental change storage units, concentrators/multiplexers and modems, spare cash boxes, bill vaults and ticket stock shall be designed and implemented that is compatible with the standard Metro rail revenue operation for LA to Pasadena Metro Blue Line project by the MTA.

2.3.5 Telephone System (H0010)

The telephone system comprises standard telephone equipment and wires/cables using shared conduits with Fare Collection system, including station under-platform enclosure, junction boxes and conduit extension for emergency and/or public pay phones. As dictated by the MTA, the radio system operations shall be compatible to the Metro Rail system operations, such as the Metro Red Line, Green Line and Metro Blue Line (Long Beach) alignment.

2.3.6 Signage Subsystem (H0080)

The signage system comprises independent display subsystems, static signage and wayside signage, for conveying patron platform messages and station/site identification, including operation warnings, restricted access notices, and public safety warning along the tracks. It may be displayed by pre-printed messages and special post with standard rail operating/six functional signs along the tracks as mile maker, speed limit, station approach, rail crossing, post-mounted warning /restricted access, and fence-mounted signs.

2.3.7 Communication Subsystem

The core objective of design and implementation of communication system operation for LA to Pasadena Metro Blue Line project shall be defined to be compatible with standard communication operations implemented by the MTA throughout the metro rail system, including the Metro Red, Green and Blue Line (Long Beach) operations. However, the Safety and Security Communication (SSC) System has been deleted from the contract due to cost containment measure (1996), the major SSC requirements (mandated by the CPUC) would have to be reapplied under a separate contract (or be included in the Telephone system contract of sharing conduit space). The MTA has not decided the best approach yet. The Authority needs to determine which part of the D/B contract should be utilized to implement the SSC requirements per CPUC code.

2.4 Project Owner Purchased Materials

The Metro Pasadena Blue Line has completed the purchase requirement for Contract P2100, Pre-cast Concrete and P2110 Direct Fixation Fasteners for the entire Los Angeles to Pasadena Metro Blue Line alignment of track works. The concrete ties and Type I rail fasteners are stockpiled at the Johnson and Johnson facility near the future Sierra Madre Villa Station park-and-ride site. The procurement of running rails (P2090) for the 13.9-mile dual-route alignment has been completed. The rails are stockpiled at the site as PA-018 property along the Alameda Street and the medium of I-210 Freeway. Some of the running rails was part of the surplus materials from the construction of the Metro Blue Line (Long Beach) and Metro Green Line.

3.0 SECTION 3

Section 3 describes the nineteen major components into which the Project has been divided for the purpose of the status review. Component numbers have been assigned starting from the Union Station end of the line and continuing northward as the components occur along the right-of-way.

3.1 Components in the City of Los Angeles

3.1.1 COMPONENT No. 1: Union Station to LA River — MTA Ref. C6390
Location: Mile 0.1 to mile 1.5

This component comprises the first and southernmost segment of the line extending from the existing platform number 1 at Union Station to the crossing of the L.A. River north of Chinatown. From the at-grade station platform at Union Station, the alignment ascends a ramp to reach a 2,766' long aerial structure which crosses private car tracks in the station yard before entering the median of Vignes St. The structure extends along Vignes St. to Main St. where it curves north to parallel realigned Alameda and North Spring Streets on the west side. North of College St. the structure crosses Southern Pacific Transportation property (Cornfield Yard) and returns to grade on the east side of Broadway. The Chinatown Station is located north of College Street within this segment.

3.1.2 COMPONENT No. 5: LA River to Arroyo Seco — MTA Ref. C6420
Location: Mile 1.5 to Mile 5.6

This segment of the Pasadena Blue Line (PBL) is 4.1 miles long, starting 430 feet south of the bridge where the former AT and SF railroad right-of-way crosses the LA River and extending to the east end of the Arroyo Seco bridge, the right- of-way crossing of the Pasadena Freeway, north of Arroyo Seco Park. The route follows the former AT and SF right-of-way through the Mt. Washington and Highland Park communities.

The PBL alignment is mostly at-grade, except for seven existing/rehabilitated bridge overpasses (LA River, N. Avenue 19, San Fernando Road, Golden State Freeway (I-5), W. Avenue 26, Arroyo Seco Flood Control and Pasadena Freeway, and Pasadena Freeway – Arroyo Seco Viaduct), and a 380 ft. long underground box structure section with 1,600 ft. long transition retaining walls at the intersection of Pasadena Ave., Figueroa St. and Marmion Way, The line segment contains four stations (Avenue 26, French Avenue, Southwest Museum and Avenue 57). Approximately half of this segment alignment is segregated from adjacent streets, a quarter runs alongside city streets (Pasadena Avenue and Marmion Way), and the remainder is within the median of Marmion Way. The segment is entirely within the City of Los Angeles.

3.1.3 COMPONENT No. 2: Union Station — MTA Ref. C6491
Location: Mile 0.0 to mile 0.1

This light rail terminal station will be developed on land formally occupied by platform 1 of Union Station providing a convenient vertical passenger transfer to the Metro Red Line beneath the station. The work will include 300 ft of guideway on retained fill, an at-grade center platform with a connecting passenger ramp and stair to the Union Station passenger tunnel and station finishes. A new platform canopy, station furniture, fare collection equipment and all mechanical and electrical services will be provided.

3.1.4 COMPONENT No. 3 : Chinatown Station — MTA Ref. C6390/91
Location: Mile 0.7 (Sta. 137+40)

This component comprises the first line station north of the Union Station terminal. Included in this status report are the architectural design, station finish elements and the structural elements. Chinatown Station (along with Southwest Museum and Memorial Park) is designated as a landmark

station. The station, located within the Chinatown Aerial Structure, has an elevated center platform and includes an Upper Level Mezzanine planned to eventually connect via pedestrian bridges to neighboring developments.

Extensive public consultation was undertaken in developing the design concept. Elements of Fung Shui and I Ching have been incorporated into the design, requiring that some MTA standards be relaxed. A complete design report discusses the elements of the station and how they are derived. Given the long history and extensive community input to this station planning, the background reports will be important input to the completion of the design, providing an understanding of the development of the station concept.

3.1.5 COMPONENT No. 6 : Avenue 26 Station — MTA Ref. C6480

Location: Mile 2.18 (Sta. 219+27)

Avenue 26 station site is immediately north of the Golden State Freeway in Lincoln Heights and is bounded by the freeway and industrial buildings on the south and east, Lacy Street freeway off-ramp to the west and Avenue 26 to the north. The PBL track profile and hence, the station are elevated approximately 22 to 25 feet above Avenue 26 on an earth embankment. The location of this side platform station is severely constrained by the existing overpass structures.

During the early design stages, a parking lot was to be constructed to the west of the station, with all passenger access via a single station entrance at that location. Soil investigations identified high potential for contamination in the parking area, so the concept was revised to eliminate the parking and provide two access points, one for each platform. After completion of the cost containment reports, the station concept was revised to provide a flight of stairs and a ramp to each platform from the Avenue 26 sidewalk. Bus bays will be created on both sides of the street for easy transfer to the local bus network.

This station will have the new standard canopy covering 30% of each side platform, along with all other standard system features. Due to the access constraints, there will be no direct access between platforms. All transfers will be via the Avenue 26 sidewalk. To allow for evacuation, emergency egress is provided at both ends of each platform.

3.1.6 COMPONENT No. 7 : French Avenue Station — MTA Ref. C6480

Location: Mile 2.77 (Sta. 250+34)

The French Avenue station in Mt. Washington is located at-grade between Marmion Way and Pasadena Avenue on the west and east and the Golden State Freeway and French Avenue on the south and north sides. Due to alignment design restrictions, the side platforms are staggered, in part allowing French Avenue to remain open to traffic. Pedestrians can transfer between platforms by crossing PBL tracks along the French Avenue sidewalk near the north end of the station.

Surface parking is provided for approximately 125 cars adjacent to the western (southbound) platform. Separate entrances to each of the platforms are provided at the north end of the station giving direct access to the parking area.

The station will incorporate the standard canopy, designed as part of the cost containment analysis. It will cover 30% of the platform length. The station will also incorporate the other standardized features including brushed concrete platforms, fiberglass edge-warning tiles, pole-mounted lighting

and benches. Ticket vending machines, map cases and telephones will be provided at each platform. An emergency exit stair is included at the south end of each platform to provide an alternate exit for evacuation.

3.1.7 COMPONENT No. 8 : Southwest Museum Station — MTA Ref. C6470
Location: Mile 3.67 (Sta. 297+83)

Southwest Museum station (along with Chinatown and Memorial Park) is designated as a landmark station. This centre platform station is located parallel to Marmion Way at Museum Drive in the Highland Park Community. The platform is on a raised embankment with access provided via stairs and ramps from both Marmion Way on the west side and Woodside Drive on the east.

The station concept and layout will not be modified from the pre-final submittal made in 1994. Some cost containment measures will be included, but the present canopy and artwork design will be maintained in tribute to Terry Sandoval, the deceased artist who helped design it. An emergency egress route is provided at the south end of the station.

3.1.8 COMPONENT No. 9: Avenue 57 Station — MTA Ref. C6470
Location: Mile 4.97 (Sta. 366+61)

The Avenue 57 station is located in the centre of the Marmion Way corridor between Avenue 57 and Avenue 59 in Highland Park. Construction of the station will require the closure of Avenue 58. The centre platform station will be accessed from the sidewalk of Avenue 57, south of the station. This station will be finished with the new standard canopy covering 30% of the platform length. An emergency egress is included from the north end of the platform.

An existing City of Los Angeles parking lot is located immediately east of Marmion Way and adjacent to the station. Initial plans were to upgrade this facility, but the recommendation of the cost containment report was to leave the lot in city hands as it can be improved in the future if required.

This station is located along the Marmion Way corridor, the subject of a separate urban design study by HNTB. This study recommends a streetscaping plan including some landscaping in this area to respond to local community concerns. The recommendations have yet to be incorporated into the station plans.

3.2 Components in the City of South Pasadena

3.2.1 COMPONENT No. 10: Arroyo Seco to Fair Oaks Ave. — MTA Ref. C6440
(South Pasadena Line Segment)
Location: Mile 5.6 to Mile 8.0

This segment of the Pasadena Blue Line is 2.4 miles long, starting at the east end of the Arroyo Seco bridge, near the southern boundary of South Pasadena, and terminating at the existing Fair Oaks Avenue overpass of the former A.T and S.F. railroad right-of-way, near the City's north boundary. It follows the former railroad right-of-way mostly at-grade, with level street crossings, except for an existing / rehabilitated bridge overpass at the Pasadena Freeway adjacent to Fremont Avenue. One station, at Mission Street, falls within this segment. Most of the segment runs within valleys, along embankments, and through flat right-of-way sections between the residential street grid. A portion of

this segment runs alongside Hawthorne Street. The entire segment is within the City of South Pasadena.

3.2.2 COMPONENT No. 11: Mission St. Station MTA Ref. C6475
Location: Mile 7.2 (South Pasadena Line Segment)

Mission Station with staggered side-platforms is the only station located in the City of South Pasadena. The station is situated in the block bounded by El Centro St., Glendon Way, Mission St. and Meridian Ave. At this location, the tracks run diagonally across the neighborhood crossing several local streets. Station platforms are staggered to allow for as much clearance beyond the station as possible in the event a train overshoots the platform while stopping.

Due to its location on Mission Street, the site will become the gateway for PBL riders entering the Mission Street district and a focal point for community activity related to use of the PBL by South Pasadena citizens. Immediately adjacent to the northbound platform on the east side is Heritage Park, a small treed triangular park containing a museum building and monument. The platform access facilities are laid out parallel to the MTA right-of-way to preserve as much of the park as possible and retain its community function.

3.3 Components in the City of Pasadena

3.3.1 COMPONENT No. 14: Fair Oaks Ave. to Memorial Park Line Segment
MTA Ref. #C6440 (north part) and C6450
Location: Mile 8.0 to 9.8 - Pasadena (southern segment)

This line segment extends from the City of Pasadena's southern boundary near the Fair Oaks Avenue overpass of the former AT and SF railroad right-of-way to the existing Walnut Street overpass of the right-of-way at the northern end of Memorial Park between Holly and Walnut Streets immediately north of Old Pasadena. The segment follows the right-of-way northward for 9,300 feet and comprises a combination of at-grade alignment and a 1,200-foot grade-separated section to take the line under the City blocks between Green Street, Colorado Blvd. and Holly Street.

Three stations, at Fillmore Street, Del Mar Blvd. and on the east edge of Memorial Park are located within this segment and the at-grade portion includes level crossings at several cross streets as well as the depressed U-shaped transition structures to lower the alignment for the underground section.

The right-of-way is narrow for most of its length and there are ten listed historical structures that will require underpinning to construct the underground box section by the cut and cover method each side of Colorado Blvd. Track will be supported on ties and ballast in the at-grade portion and by direct fixation to the structure in the transitions and below grade box section.

3.3.2 COMPONENT No. 16: Memorial Pk to Sierra Madre/Villa Line Segment
MTA Ref. #C6460
Location: Mile 9.8 to Mile 13.86 (Pasadena)

This segment of the line extends from the north end of Memorial Park Station, between Holly and Walnut Streets in Old Pasadena and follows the former AT and SF railroad right-of-way northward through the existing Marengo tunnel under the eastbound lanes of the 210 Foothill Freeway. From the tunnel it continues eastward along the railroad right-of-way within the freeway median for

approximately 4 miles (20,600ft) terminating at the proposed Sierra Madre Villa Station located immediately east of the Madre St. underpass. This section of the line is mostly at-grade or depressed between existing retaining walls in the median. Two other stations to serve Pasadena are located at the Lake Avenue and Allen Avenue freeway crossings within this segment.

3.3.3 COMPONENT No. 12: Fillmore St. Station MTA Ref. C6475
Location: Mile 8.6 (Sta. 556+80)

This centre-platform station is located immediately north of Fillmore Street between Arroyo Parkway and Raymond Avenue in the southern part of the City of Pasadena. Surrounding the site is a commercial and industrial corridor that paralleled the AT & SF Railway right-of-way. This station will serve the southern portion of the Raymond/Arroyo Parkway section of the corridor as well as residential communities along the southern boundary of Pasadena and northern areas in South Pasadena. A Park and Ride lot with 159 parking stalls and a bus loading/unloading platform is included southwest of the station platform.

The station location is based on the closure of Fillmore Ave. at the PBL right-of-way, leaving a short cul-de-sac from both Raymond Ave. and Arroyo Parkway for access to the station facilities.

3.3.4 COMPONENT No. 13: Del Mar Station MTA Ref. C6500
Location: Mile 9.2 (Sta. 585+86)

Del Mar Station is located immediately north of Del Mar Boulevard between Raymond Avenue and Arroyo Parkway in Pasadena. The City of Pasadena will be constructing a Transit Centre adjacent to the station to provide bus connections and underground parking. Connections to the station to support local redevelopment will also be established. The station will be at-grade with side platforms. This station was converted from a centre platform configuration as part of the cost containment measures after review of the emergency access/egress requirements and concerns about passenger volumes at major events such as the Rose Parade.

Del Mar Station will be one of the stations utilizing the new standard canopy design and consideration of integrating the historic Santa Fe terminal building adjacent to the site into the overall site development has been proposed.

3.3.5 COMPONENT No. 16: Memorial Park Station MTA Ref. C6520
Location: Mile 9.7 (Sta. 611+14)

Memorial Park Station, together with Chinatown and Southwest Museum Stations, is designated as a landmark station. The station is located two blocks north of the centre of Old Pasadena adjacent to Memorial Park. It will be constructed under the Civic Centre West (CCW) apartments which straddle the alignment.

The station will be depressed below the existing grade required by the grade separation of Holly Street immediately to the south. Station construction will require some modifications to the existing grade beam and retaining wall under the apartment building complex. Some operating speed restrictions to reduce noise and vibration impacts on the apartment building may be necessary.

Two side platforms will be constructed. The columns for the apartment building will intrude into the platform area, but sufficient circulation space can still be developed around the columns. Passenger access will be via ramps and stairs at the south end of the station, and ticket vending equipment, map

cases and telephones will be provided for each platform. An emergency exit will be provided at the north end of each platform.

A canopy structure comprised of tubular steel sections will be constructed along the majority of the platform length, screening the exposed underside of the apartment structure, but still allowing daylight to enter from the stepped retaining walls along the park side (west side) of the station.

3.3.6 COMPONENT No. 17: Lake Ave. Station — MTA Ref. C6510
Location: Mile 10.7 (Sta. 664+38)

This center platform station is located west of Lake Avenue in the median of the Foothills Freeway (I-210) in Pasadena. Lake Avenue passes over the freeway, permitting connections from the east and west side of the Lake Ave. Overpass down to the platform. Improvements to the overpass were completed by the City of Pasadena and include bus bays for local service connections to the PBL.

The station will include the typical freeway canopy and several cost containment measures including a brushed concrete platform, standardized light fixtures and fiberglass edge-warning tiles. The City of Pasadena has requested that a clock tower, funded by the City, be included as part of the western stair/elevator access structure.

3.3.7 COMPONENT No. 18: Allen Station — MTA Ref. C6510
Location: Mile 11.7 (Sta. 719+27)

This center platform station is located in the median of the Foothills Freeway (I-210) west of Allen Avenue in Pasadena. Allen Ave. passes under the freeway, with sloped embankments on both sides of the road. Passenger access to the platform will be from a street level concourse built into the embankment on the west side of Allen Avenue with stair and elevator connections to the east end of the platform. Construction of the retaining walls and station entrance through the abutment wall was completed under contract C6435. No parking will be provided at this station, but there will be bus bays on both sides of Allen Avenue to allow for local bus transfers.

The station will include the typical freeway canopy and several cost containment measures including a brushed concrete platform, standardized light fixtures and fiberglass edge-warning tiles.

3.3.8 COMPONENT No. 19: Sierra Madre Villa Station — MTA Ref. C6491
Location: Mile 13.8 (Sta. 824+20)

Sierra Madre Villa Station is at the northeastern end of this first phase of the line. Located in the median of the Foothills Freeway (I-210) just east of Madre Street, this station will include special trackwork to turn trains around for their return trip to Los Angeles. The station will comprise a centre platform with stairs and an elevator to take passengers from the platform through the underpass sub-structure to the east side of Madre Street.

Design of this station was deferred earlier in the project, and has only advanced to the conceptual level. The station will include a typical freeway station canopy that will also be used at Lake and Allen stations. The 40-foot Santa Fe right-of-way will result in a minimal separation between passengers and the adjacent freeway traffic. Concept drawings, prepared for the proposed combined Union and Sierra Madre Villa design-build station contract, were not available from MTA at the time this report was prepared.

3.4 COMPONENT No. 4: Midway Yards and Shops — MTA Ref. C6400

Location: Mile 1.5 to mile 1.6

Train storage, inspection, cleaning and light maintenance will take place at a new facility developed at the former Midway yard on the west bank of the Los Angeles River just north of the Broadway Street Bridge between Chinatown and Lincoln Heights. The facility will serve as a satellite yard accommodating 36 vehicles including operational and maintenance spare vehicles. Buildings will house light duty maintenance tracks, car cleaning, blowdown operations, car wash, consumable parts storage and personnel support facilities on a mezzanine.

The yard area will contain storage tracks, access tracks, an operators platform, traction power substation, train control and communications bungalow, parking and access and circulation roads. A maintenance-of-way building or storage facility is not included in present site development.

The site is located adjacent to existing Metrolink tracks, providing the opportunity to transfer light rail vehicles to the MTA Long Beach Shops for heavy repair, wheel truing and paint and body work.

The estimated cost to construct the transit system using the design/build procurement system is approximately $320 million.

Value Analysis & Conclusions

VALUE ANALYSIS AND CONCLUSION

GENERAL

This section describes the procedure used during the value engineering study on the Pasadena Metro Blue Line Light Rail Project. The "Draft Preliminary Basis for the Design/Build Package" developed by the Carter & Burgess/Lewis & Zimmerman team from documents obtained from the Los Angeles Metropolitan Transportation Authority (MTA, the former developer of the project) and the Project Development Status Report (PDSR) prepared by Gannett Fleming, Inc. for the Los Angeles to Pasadena Metro Blue Line Construction Authority (Authority) formed the basis of the VE team's review. The procedure is followed by separate narratives and conclusions concerning:

- Value Engineering Workshop Participants
- Cost Model and Economic Data
- Cost Model
- Function Analysis
- Creative Idea Listing and Judgment of Ideas

A systematic approach was used in the VE study and the key procedures involved were organized into three distinct parts: 1) pre-study preparation; 2) VE workshop effort; and 3) post-study. A Task Flow Diagram, which outlines each of the procedures, included in the VE study is attached for reference.

To efficiently carry out the tasks, the VE team was divided into the following four groups to address the major segments of the project:

Team 1	—	Line Segments
Team 2	—	Stations
Team 3	—	Midway Yard and Shops, Union Station and Chinatown Station
Team 4	—	Systems

Over the course of the study, the groups interacted with each other to resolve common issues.

PRE-STUDY PREPARATION

Pre-workshop preparation for the VE effort consisted of scheduling study participants and tasks; gathering necessary background information on the facility; and compiling project data into a cost histogram or graphic function analysis and model. Information relating to the design, construction, and operation of the facility is important as it forms the basis of comparison for the study effort. Information relating to funding, project planning, operating needs, systems evaluations, basis of cost, and construction was also a part of the analysis.

To get ready for the VE study, the team first reviewed the PDSR. The PDSR identifies the outstanding issues resulting from the suspension of the project by the MTA that must be addressed in order to bring the project to a successful completion. Team members then received a presentation of the project from James

Value Engineering Study Task Flow Diagram

Preparation Effort

Coordinate Project →
- Verify Schedule
- Suggest Format for Designer Presentation
- Outline Project Responsibilities
- Outline Needed Background Data
- Define *Project Value Objectives*
- Identify Project Constraints

Prepare for Workshop →
- Collect Project Data
- Distribute Data to Team Members
- Verify Cost Data
- Team Members Become Familiar with Project

Construct Cost Models →
- Construct Cost Models
- Construct Graphic Function Analysis
- Outline High Cost Areas

LCC Model
- Process Areas
- Staffing
- Chemicals
- Energy
- User Impact

Workshop Effort

Information Phase →
- Introduction by VETL
- Project Description and Presentation by Designer
- Outline Owner Requirements
- Review Project Data
- Visit Project Site (Alt.)

Function Identification and Analysis Phase →
- Analyze Project Costs and Energy Usage
- Perform Function Analysis and FAST Diagram
- Identify High Cost and Energy Areas
- Calculate Cost/Worth Ratios
- Identify Paradigms

List Ideas Generated During Function Analysis

Creative Phase →
- Introduction by VETL
- Creative Idea Listing:
  - Quantity of Ideas
  - Association of Ideas

Brainstorming

Creative Thinking
- Group & Individual

Use Checklist for Ideas

Evaluation Phase →
- Eliminate Impractical Ideas
- Rank Ideas with Advantages/Disadvantages
- Evaluate Alternatives (Include Non-Economic considerations: Safety, Reliability, Environment, Aesthetics, O & M, etc.)
- Select Best Ideas for Implementation

Development Phase →
- Develop Proposed Alternatives
- Prepare Alternative Design Sketches
- Estimate Costs
- Perform Life Cycle Comparison
  - Initial Cost
  - Redesign Cost
  - O & M Cost
  - LCC Cost

Presentation Phase
- Summarize Findings
- Present VE Ideas to Owner/User/Designer
- Oral Presentation

Post-Workshop Effort

VE Study Report →
- Prepare Preliminary VE Report
- Designer Prepares Responses to VE Report
- Owner Evaluates Recommendations

Implementation Phase →
- Participate in Implementation Meeting with Owner/User/Designer/VE Team, as needed
- Prepare Final VE Report

Final Acceptance
- Redesign by Designer

Ball of Gannett Fleming, Inc., which is assisting the Authority on a temporary basis as it restarts the project. A site visit followed his presentation.

The team then began an in-depth study of the issues enumerated in the PDSR. To accomplish this, it became familiar with the vast array of documents prepared by the MTA and EMC (the MTA's design consultant) and researched these documents to decide how to best resolve each individual issue. The project document reviewed included the following:

- Union Station
- Chinatown Station - C6391
- Avenue 26 Station - C6480
- French Avenue Station - C6480
- S.W. Museum Station - C6470
- Avenue 57 Station - C6470
- Mission Street Station - C6475
- Fillmore Street Station - C6475
- Del Mar Blvd Station - C6500
- Memorial Park Station - C????
- Lake Avenue Station - C6510
- Allen Avenue Station - C6510
- Sierra Madre Villa Station - C6490

Special Considerations - Line Sections

- Union Station area
- Chinatown Aerial Section - C6390
- LA River Bridge (construction completed) - C6410
- LA River to Arroyo Seco - C6420
- Arroyo Seco Bridge (construction completed) - C6430
- Miscellaneous 13 Bridges (construction completed) - C6435
- Arroyo Seco to Del Mar - C6440
- Del Mar to Memorial Park - C6450
- Memorial Park to Sierra Madre Villa - C6460
- Yard and Shop Complex - C6400
- Signal System - defined by contract documents H0060
- Traction Power System - defined by contract documents H0070
- Telephone system - no documents available
- Radio System - MTA furnished
- Digital Communications - no documents available
- CCTV - no documents available
- Central Control
- Signage - no documents available
- Trackwork

Options considered during the PDSR review were to:

- have the soon to be named Program Manager resolve them prior to issuing the Request for Proposals for contracting with a design/build team,
- have the design/build team address them during its design process,
- have the PDSR review team address the issue at a later date, or
- submit the issue to value engineering.

Topics identified for VE would be worked on during the workshop segment of the procedure. As the team reviewed the documents, it formulated a Draft Preliminary Basis for Design/Build. This was deemed to be: all drawing and specifications produced to date, (irregardless of level of completion), annotations on the drawings to indicate areas where issues require resolution and thus changes may occur, (accomplished during the PDSR review), suspension documents prepared by EMC, the MTA and the MTA's construction manager, the PDSR, the environmental studies, the MTA design criteria, and as-built drawings of existing works. This became the basis for the VE study.

VALUE ENGINEERING WORKSHOP EFFORT

The VE workshop was a five-day study effort. During the workshop, the VE job plan was followed. The job plan guided the search for high-cost areas in the project and included procedures for developing alternative solutions for consideration. It included six phases:

- Information Phase
- Function Identification and Analysis Phase
- Creative Phase
- Evaluation Phase
- Development Phase
- Presentation Phase

Information Phase

The information phase was conducted in during the PDSR review, as noted above.

Function Identification and Analysis Phase

Based on the data provided in the cost histogram and cost model, the VE team defined the functions that the project elements were required to accomplish using the active verb/measurable noun combinations (sometimes modified by one or more adjectives) to obtain a more in-depth understanding of the intent. The cost to accomplish the functions were also identifed.

Creative Phase

This VE study phase involved the creation and listing of ideas. During this phase, the VE team developed as many means as possible to provide the necessary functions within the project at a lower cost to the owner, or to improve the quality of the project. Judgment of the ideas was restricted at this point. The VE team was looking for a large quantity of ideas and association of ideas. Over 50 ideas were generated.

Future Program Manager and design/build teams may wish to review the creative ideas worksheets since they may contain ideas which can be further evaluated for potential use in the design.

Evaluation Phase

During this phase of the workshop, the VE team judged the ideas generated during the creative phase. Advantages and disadvantages were discussed to find the best ideas for development. Ideas found to be irrelevant or not worthy of additional study were discarded. Those, which represented the greatest potential for cost savings or improvement to the project, were then developed further.

The VE team would like to develop all ideas, but time constraints usually limit the number which can be developed. Therefore, each idea was compared with the present design concept in terms of how well it met the design intent. Advantages and disadvantages were discussed and recorded and the ideas were rated on a scale of one to five, with the best ideas rated five. Generally, only ideas rated four or higher were developed into alternatives. In cases where there was little cost impact, but an improvement to the project was anticipated, the designation DS, for design suggestion, was used. The design team should review this listing for possible incorporation of ideas into the project.

The creative listing was re-evaluated frequently during the process of developing alternatives. As the relationship between creative ideas became more clearly defined, their importance and ratings may have been changed, or they may have been combined into a single alternative. For these reasons, some of the originally high-rated items may not have been developed into alternatives.

Development Phase

During the development phase, each highly-rated idea was expanded into a workable solution. The development consisted of a description of the recommended design, life cycle cost comparisons, where applicable, and a descriptive evaluation of the advantages and disadvantages of the proposed alternatives. Each alternative was written with a brief narrative to compare the original design to the proposed change. Sketches and design calculations, where appropriate, were also prepared in this part of the study. The VE alternatives are included in the section entitled: *Study Results*.

Presentation Phase

The last phase of the VE study was the presentation of the alternatives. On the last day of the VE study, the VE team made an informal presentation of the developed alternatives to the Authority, its Peer Review Team, and Jim Ball. The purpose of the presentation was to give the parties a briefing on the developed alternatives so that they would have an opportunity to ask questions of the VE team prior to the conclusion of the workshop and the onset of their review.

POST-WORKSHOP EFFORT

The post-study portion of the study includes the preparation of this Value Engineering Study Report. The Peer Review Team will analyze each alternative and prepare a response, recommending either incorporating the alternative into the project, offering modifications before implementation, or presenting reasons for rejection. At the conclusion of the review, an implementation meeting was conducted by the Authority to decide which alternatives should be implemented.

VALUE ENGINEERING PARTICIPANTS

The VE team was organized to provide specific expertise on the project elements involved. Team members consisted of a multidisciplinary group with professional planning, design and construction experience and a working knowledge of VE procedures. They were divided into subgroups to facilitate the reviews of the major aspects of the project. Participating on the VE team were:

	TEAM 1 – LINE SEGMENTS	
Howard B. Greenfield, PE, CVS	VE Team Leader	Lewis & Zimmerman Assoc.
Laurence E. Daniels, PE	Railroad Technology Engineer	Carter & Burgess, Inc.
Keith Helmuth, PE	Traffic Engineer	Carter & Burgess, Inc.
Carl Wallace, PE	Civil Engineer	Carter & Burgess, Inc.
Robert Palnau	Cost Engineer	Carter & Burgess, Inc.
Erik Olsen, RCE, GE	Geotechnical Engineer	Ninyo & Moore, Inc.
	TEAM 2 – STATIONS	
Jill Nelson, PE	Team Leader	Lewis & Zimmerman Assoc.
Mary Jane Roberts-Adams, PE	Electrical Engineer	Carter 8 Burgess, Inc.
Todd Whitaker, RA	Architect	Carter 8 Burgess, Inc.
Donald H. Roper	Cost Estimator	Lewis & Zimmerman Assoc.
Albert Chou, PE, SE	Structural Engineer	Carter 8 Burgess, Inc.
R. Leonard Allen, PE, GE	Environmental Engineer	Ninyo & Moore, Inc.
Lauren Melendre, LA	Landscape Architect	Melendre, Inc.
James Schroeder, PE	Civil Engineer	Carter & Burgess, Inc.
	TEAM 3 – YARD AND SHOPS, UNION STATION AND CHINATOWN STATION	
Rudolph Kempter, PE	Team Leader	Lewis & Zimmerman Assoc.
Rodney Smith, PE	Rail Operations	Carter & Burgess, Inc.
Stephen Silkworth, RA	Maintenance	Carter & Burgess, Inc.
Mack Wallace, PE	Mechanical Engineer	Carter & Burgess, Inc.
Ramsis Elfiki, PE	Civil Engineer	TEC Management Consultants
Charles C. Munroe III, CPE	Cost Estimator	TEC Management Consultants
	TEAM 4 – SYSTEMS	
Roger Behle, PE	Team Leader	Lewis & Zimmerman Assoc.
Thomas W. DeBernard	Systems Engineer	Carter & Burgess, Inc.
Inder K. Chawla, PE	Systems Engineer	Elcon Associates, Inc.
Michael McDonald, PE	Systems Engineer	Elcon Associates, Inc.
	SENIOR MANAGEMENT	
Tom Stone, PE	Project Manager	Carter & Burgess, Inc.
Robert S. Newland, PE	Assistant Project Manager	Carter & Burgess, Inc.
Peter Hackley, PE	Assistant Project Manager	Carter & Burgess, Inc.
Charles Robinson, PE	Civil Engineer	TEC Management, Inc.

Although most team members were assigned to a specific group, many moved back and forth between groups to address common issues.

DESIGNER'S PRESENTATION

An overview of the project was presented on Monday, October 4, 1999 by James Ball of Gannett Fleming, Inc. The purpose of this meeting, in addition to being an integral part of the Information Phase of the VE study, was to bring the VE team "up-to-speed" regarding the overall project. Additionally, the meeting afforded the project team the opportunity to highlight in greater detail those areas of the facilities requiring additional or special attention. All team members attended.

VALUE ENGINEERING TEAM'S PRESENTATION

On Friday morning, October 22, 1999, the VE team presented the developed alternatives and design suggestions to the Authority and its Peer Review Team composed of:

- John D. Claflin, Assistant General Manager, Regional Transportation District, Denver, CO
- Bill Houppermans, Chief Engineer Link Light Rail, Sound Transit, Seattle, WA
- John W. Haggerty, PE, Design Engineer, Metropolitan Transit Development Board, San Diego, CA

The purpose of the presentation was to relay the results of the study and answer questions that would clarify the intent of the alternatives and facilitate their evaluation. Summaries of the alternatives and design suggestions were provided to attendees to accelerate the review process.

In addition to the VE team and Peer Review Team, the following attended this presentation:

- Richard Thorpe, CEO, Los Angeles to Pasadena Metro Blue Line Construction Authority
- Joe Seibold, PE, Encino, CA Officer Manager, Carter & Burgess, Inc.
- Tim Coffey, President, TEC Management Consultants, Inc.
- James G. Ball, P. Eng., PMO Manager, Pasadena Blue Line, Gannett Fleming, Inc.

At the conclusion of the presentation, draft copies of the unedited VE alternatives and design suggestions were distributed to the Peer Review Team, Richard Thorpe and James Ball.

ECONOMIC DATA

Economic criteria used for evaluation of the alternatives for the Pasadena Blue Line Light Rail Project were developed by the VE team with information gathered from estimates prepared by the EMC project team. To express costs in a meaningful manner, the VE alternatives are presented on the basis of base construction costs found in the estimates. No mark-ups were added to account for contractor mobilization, overhead and profit. Similarly, no costs were added for the necessary redesign.

For the purposes of calculating present worth life cycle costs, a discount rate of 6% and a 30 year study period were used, yielding a present worth factor for annual expenditures of 13.76.

COST MODEL

A cost model was constructed from the data presented in the cost estimates prepared by EMC. It shows the break-down of costs for each of the line segments, each station, the yard and shops, the systems components, and procurement and miscellaneous items.

The VE team also prepared Pareto charts or cost histograms for the project. The Pareto format identifies high cost areas by portraying them in a hierarchical structure. By perusing the project data and these cost models, the VE team identified the following as the best probable areas of potential cost savings.

- Line Segments, specifically the LA River to Arroyo Seco and Del Mar to Memorial Park
- Union Station and Sierra Madre Villa Station
- Memorial Park Station
- Traction Power Substations
- Shop Buildings
- Yard Site Work

COST MODEL
PROJECT SUMMARY

TOTAL CONSTRUCTION	TOTAL ENGINEERING & ADMINISTRATION	CONTIGENCY 11.50%	TOTAL
$312,551,222	$109,657,000	$48,553,946	$470,762,168

Revised Budget Cost to Complete	Delta
$469,640,000	$1,122,168 0.24%

LINE SEGMENTS	STATIONS	YARDS &SHOPS	SYSTEMS	PROCUREMENT & MISCELLANEOUS
$129,054,505	$33,884,349	$33,593,463	$57,736,654	$58,282,251

Revised Project Budget - **The Cost to Complete**
(Table No. 2, Column 11)

Engineering & Administration:

General Engineering	$16,496,000
Construction Management	$17,023,000
Special Consultants	$9,584,000
Project Administration	$14,471,000
Sub Total	$57,574,000
Real Estate	$18,694,000
Master Agreements	$9,400,000
Project Revenue	($1,297,000)
Special Programs	$5,636,000
Owners Insurance	$19,650,000
Sub Total	$52,083,000
Total	**$109,657,000**

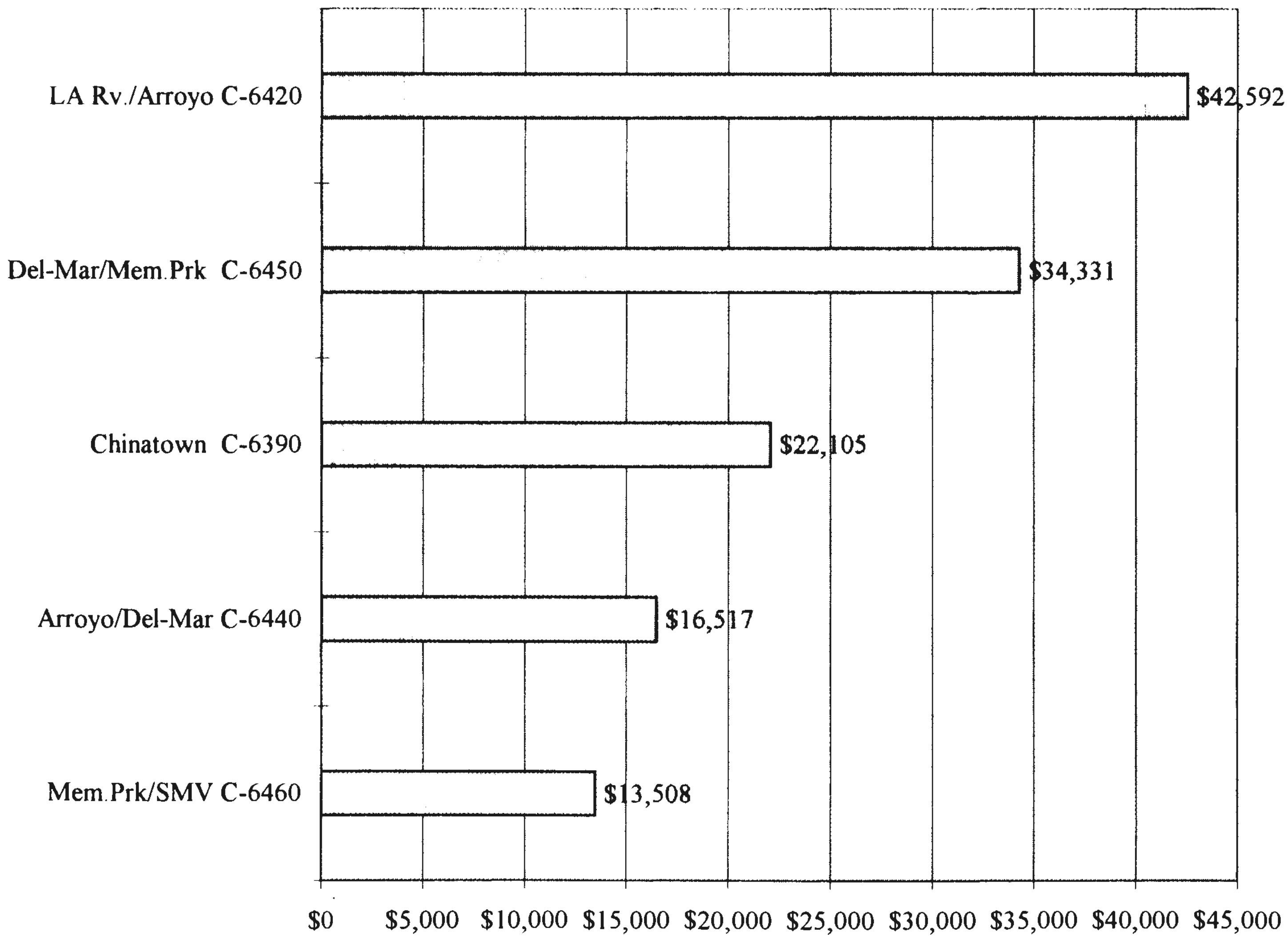
COST MODEL
LINE SEGMENTS

LINE SEGMENTS
$129,054,505

	C-6390 Chinatown Aerial	C-6420 LA River to Arroyo Seco	C-6440 Arroyo Seco to Del-Mar	C-6450 Del-Mar to Memorial Prk.	C-6460 Memorial Prk. Sierra Madre
Total	$22,105,355	$42,592,423	$16,517,066	$34,331,237	$13,508,424
Gen Reqmnts	$3,017,417	$2,613,998	$2,404,259	$3,344,630	$1,710,524
Sitework	$5,731,221	$19,725,004	$7,287,595	$16,570,994	5,832,816
Concrete	$10,722,729	$14,852,723	$2,876,876	$9,631,085	3,173,636
Masonry		$56,076	$351,019	$39,649	
Metals	$311,682	$153,266	$68,865	$91,412	$193,214
Thermal / Moisture	$46,570	224,630	$38,976	$243,948	$92,173
Door Windows				$18,465	
Finishes	$31,577	$22,862	$102,340	$4,579	
Mechanical	$110,046		$278,177	$819,312	$709,481
Electrical	$1,389,741	$3,183,142	$2,486,563	$2,079,977	$1,796,580
Escalation	$744,372	$1,760,722	622,396	$1,487,186	

METRO BLUE LINE LIGHT RAIL PROJECT

LINE SEGMENTS



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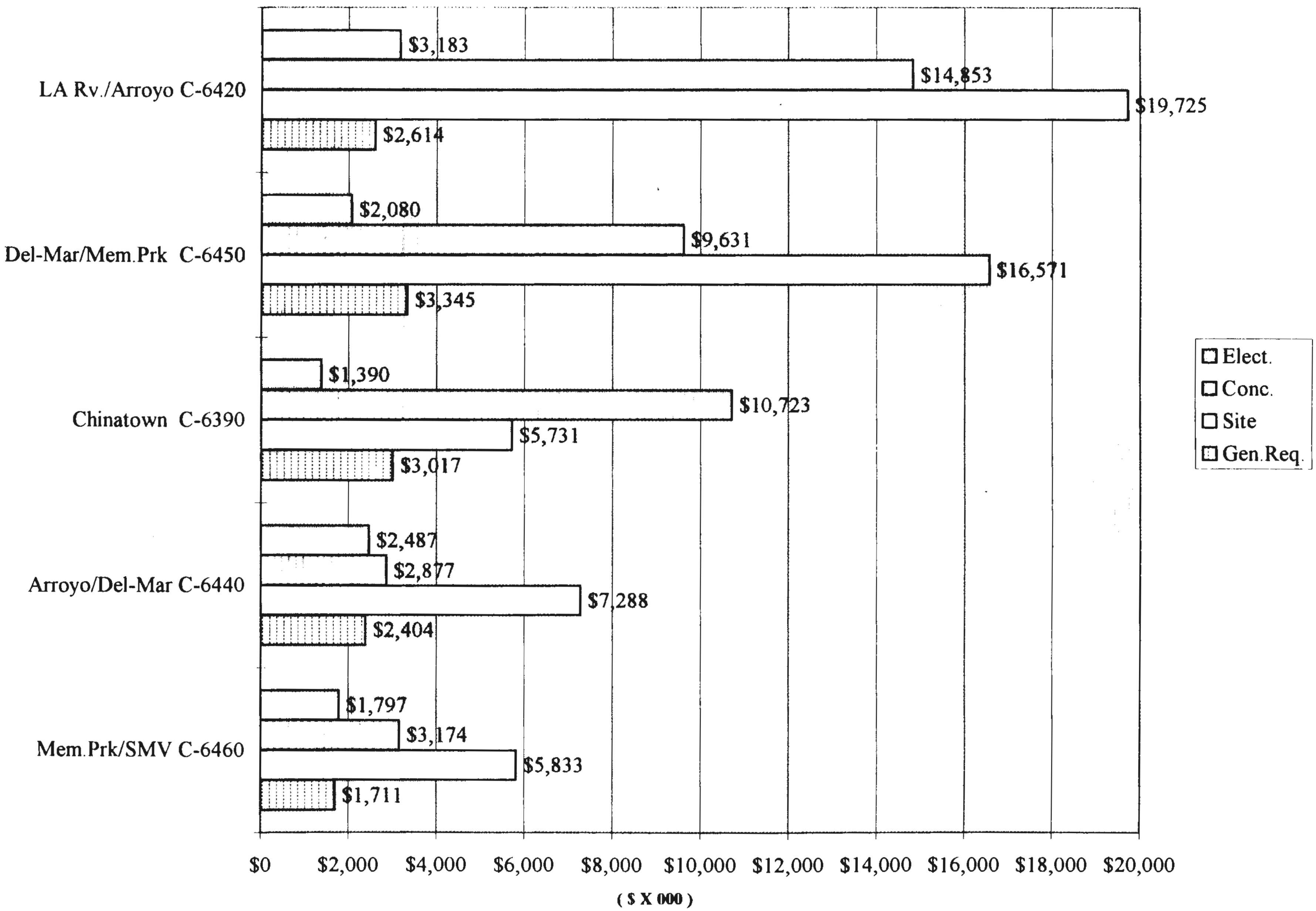
METRO BLUE LINE LIGHT RAIL PROJECT

LINE SEGMENTS
MAJOR DISCIPLINES



METRO BLUE LINE LIGHT RAIL PROJECT
LOS ANGELES TO PASADENA
VALUE ENGINEERING STUDY

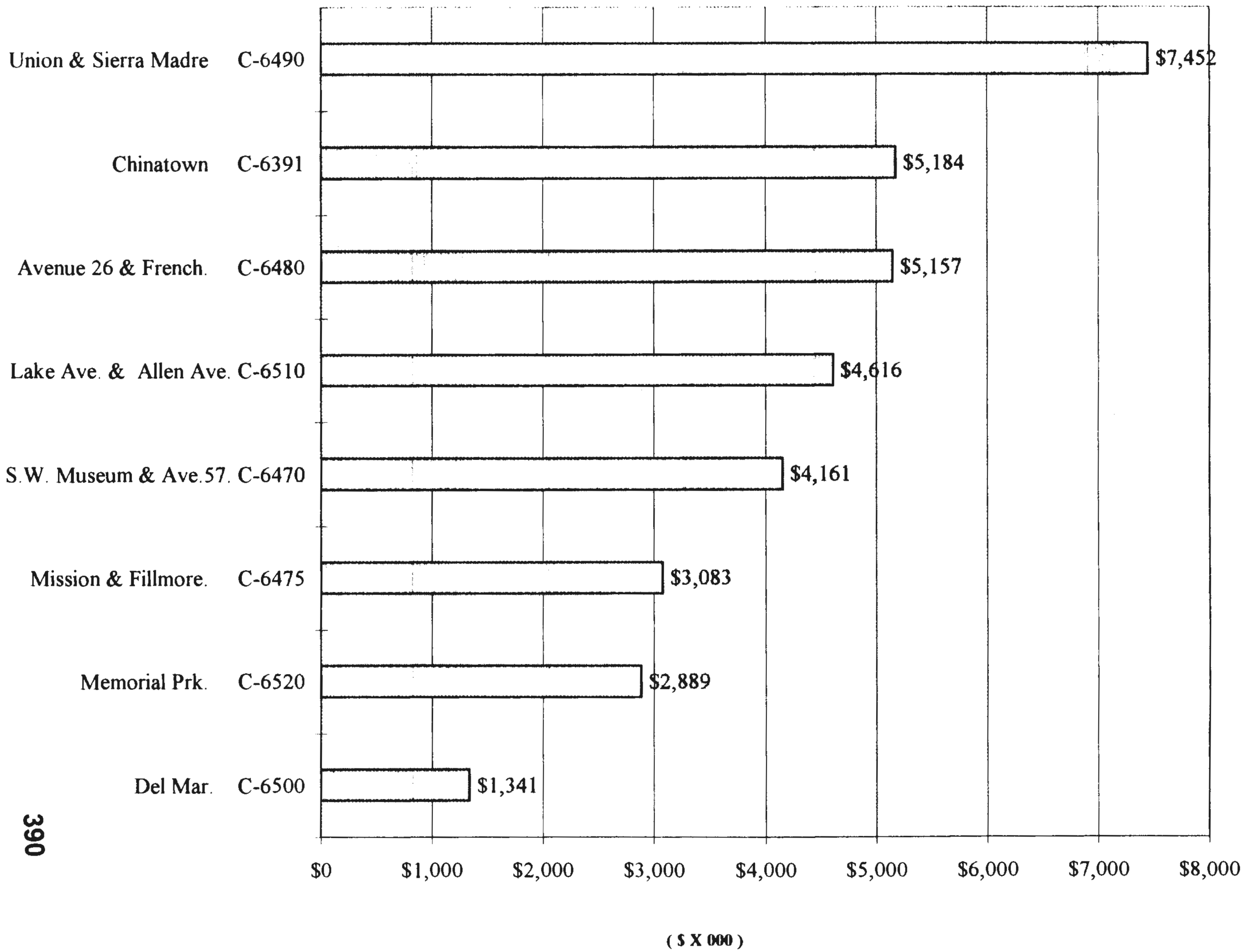
COST MODEL
STATIONS

STATIONS
$33,884,349

	C-6490 Union & Sierra Madre	C-6391 Chinatown	C-6480 Avenue 26 & French	C-6470 S.W. Museum & Avenue 57	C-6475 Mission & Fillmore	C-6500 Del Mar	C-6520 Memorial Park	C-6510 Lake Ave. & Allen Ave.
Station total	$7,452,000	$5,184,193	$5,157,391	$4,161,000	$3,083,667	$1,340,660	$2,889,438	$4,616,000
Gen Reqmnts		$60	$276,256		$483,075	$253,876	$354,575	
Site		$355,875	$1,394,555		$495,302	$4,420	$22,749	
Concrete		$2,247,214	$1,242,408		$740,496	$66,195	$35,516	
Masonry							$35	
Metals		$1,389,173	$879,646		$248,614	$215,856	$1,166,337	
Thermal / Moisture		$31,868	$2,671			$319	$8,822	
Door/Windows		$123,204			$8,909	$11,167	$34,135	
Finishes		$37,274	$17,868		$91,356	$62,442	$200,925	
Specialties			$73,215		$55,288	$7,265	$88,680	
Furnishjings					$135,578			
Mechanical		$259,200						
Electrical		$648,000	$604,317		$825,049	$596,952	$585,941	
Adjusted Allowance							$275,913	
Escalation		$92,325	$666,455			$122,168	$115,810	

METRO BLUE LINE LIGHT RAIL PROJECT

STATIONS

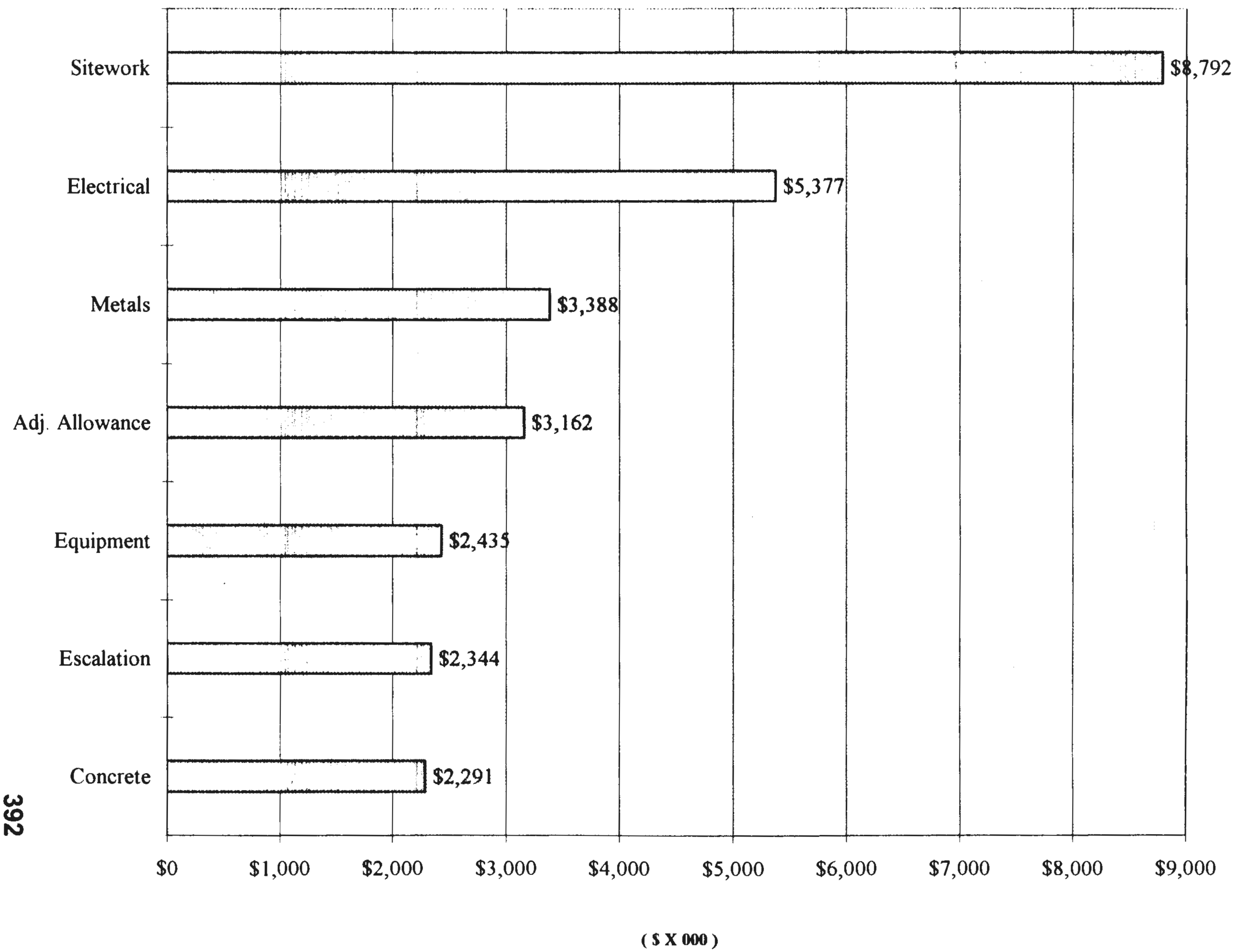


COST MODEL
YARDS & SHOPS

- **C-6400 YARDS & SHOPS** — $33,593,463
  - Gen Reqmnts — $1,583,600
  - Sitework — $8,791,571
  - Concrete — $2,291,080
  - Masonry — $404,058
  - Metals — $3,387,802
  - Wood & Plastic — $8,308
  - Thermal / Moisture — $1,415,438
  - Door/Windows — $339,651
  - Finishes — $426,728
  - Specialties — $92,745
  - Equipment — $2,435,179
  - Furfnishings — $492
  - Special Const. — $13,375
  - Conveying Systems — $173,271
  - Mechanical — $1,347,822
  - Electrical — $5,377,388
  - Adjusted Allowance — 3,161,587
  - Escalation — $2,343,368

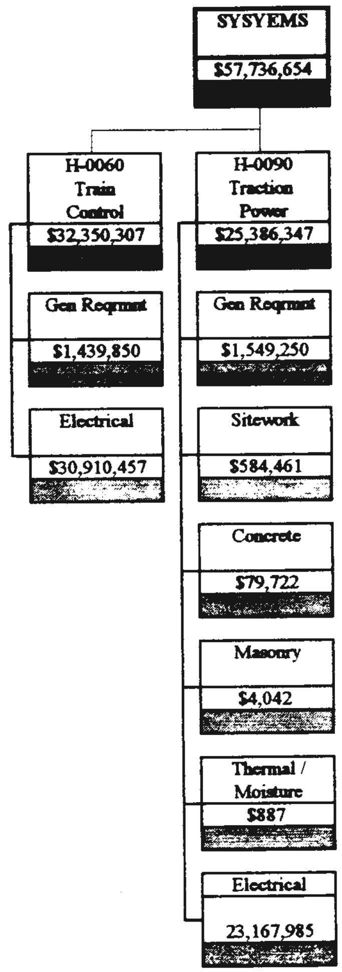
METRO BLUE LINE LIGHT RAIL PROJECT

YARDS AND SHOPS



METRO BLUE LINE LIGHT RAIL PROJECT
LOS ANGELES TO PASADENA
VALUE ENGINEERING STUDY

COST MODEL
SYSTEMS



METRO BLUE LINE LIGHT RAIL PROJECT
LOS ANGELES TO PASADENA
VALUE ENGINEERING STUDY

COST MODEL
PROCURMENT & MISCELLENOUS

- **PROCUREMENT** — $14,863,783
  - P-2070 Special Trackwork — $5,039,245
    - Gen Reqmnts — $59,120
    - Sitework — $4,980,125
  - P-2110 Rail Fasteners — $1,709,379
    - Gen Reqmnts — $39,000
    - Sitework — $1,670,379
  - P-2120 Hi-Rail Vehicles — $1,403,370
    - Vehicles — $1,210,000
    - Escalation — $193,370
  - H-0110 Elevators & Escalators — $3,553,789
    - Gen Reqmnts — $289,925
    - Metals — $252,852
    - Conveying Systems — $3,011,012
  - P-0822 Pre-Cast Ties — $2,533,000
  - H-0100 Rail Maint. Equipment — $625,000
- **MISCELLANEOUS ITEMS** — $43,418,468
  - C-6630 Systemwide Fence — $4,060,000
  - C-6650 Landscaping LAUPT/LA Rv. — $709,700
  - C-6660 Landscaping LA Rv/Del Mar — $2,483,765
  - C-6670 Landscaping Del Mar/SMV — $1,768,000
  - H-0080 Signs & Graphics — $2,996,000
  - C-6620 Project Wrap-Up — $3,635,000
  - C-6610 Hazardous Waste — $6,459,000 3
  - C6570 Utility Relocate LA — $2,980,000 1
  - C-6580 Utility Relocate South Pas. — $1,127,000 2
  - C-6590 Utility Relocate Pas. — $2,519,000
  - H0030 Radio System — $2,123,000
  - H-0040 Fare Collection — $2,924,000
  - Testing Intergration testing — $9,634,000

1,2 Reduced by $2m.($1m/each)
Cost to Complete Budget (CCB)
3 Reduced by $3m. (CCB)

FUNCTION ANALYSIS

A Function Analysis of the Pasadena Metro Blue Line Light Rail Project was prepared during the VE study to: (1) define the requirements for each project element, and (2) to ensure a complete and thorough understanding by the VE Team of the basic function(s) needed to attain a given requirement.

During this VE study, the VE team defined the functions of the specific elements of the project under consideration and viewed the cost and established their worth, or target cost, in order determine where poor value exists.

The key areas of poor value that evolved from the function analysis were:

- Cast-in-place concrete retaining walls
- Track drainage
- Building structures
- Traction Power Substations
- Tunnel construction
- Station Canopies
- Communication Systems

FUNCTION ANALYSIS

PROJECT: LA TO PASADENA BLUE LINE   LOCATION: CA

ELEMENT: FUNCTION:

NO.	DESCRIPTION	FUNCTION VERB	FUNCTION NOUN	FUNCTION KIND	COST (000)	WORTH (000)	COMMENTS
	STATIONS						
		ACCESS	TRAIN	B			
		STORE	PEOPLE	B			
		ORGANIZE	PEOPLE	S			
		COLLECT	FARE	S			
		INFORM	PEOPLE	S			
		TRANSFER	PEOPLE	S			

Function defined as : Action Verb, Measurable Noun

Kind: B = Basic; S = Secondary; RS = Required/Secondary; HO = Higher Order; A = Assumed; O = Unwanted

Cost/Worth Ratio = ________ (Total Cost + Basic Worth)

FUNCTION ANALYSIS

PROJECT: LA TO PASADENA BLUE LINE **LOCATION:** CA

ELEMENT: **FUNCTION:**

NO.	DESCRIPTION	FUNCTION VERB	FUNCTION NOUN	FUNCTION KIND	COST (000)	WORTH (000)	COMMENTS
	CANOPY	STOP	RAIN	S			
		PROTECT	PASSENGERS	B			
		SHADE	PEOPLE	S			
		IDENTIFY	LOCATION	B			
		SUPPORT	LIGHTS	S			
	LIGHTS						
		DETER	CRIME	S			
		ILLUMINATE	STRUCTURE	B			

Function defined as :	Action Verb Measurable Noun	Kind:	B = Basic S = Secondary RS = Required/Secondary	HO = Higher Order A = Assumed O = Unwanted	Cost/Worth Ratio = ________ (Total Cost + Basic Worth)		

FUNCTION ANALYSIS

PROJECT: LA TO PASADENA BLUE LINE LOCATION: CA

ELEMENT: FUNCTION:

NO.	DESCRIPTION	FUNCTION VERB	FUNCTION NOUN	FUNCTION KIND	COST (000)	WORTH (000)	COMMENTS
	TUNNEL	AVOID	TRAFFIC	B			
		AVOID	CONGESTION	S			
		REDUCE	COLLISIONS	B			
		SEPARATE	TRAFFIC	B			
	RESERVOIR	STORE	STORMWATER				
	UNDERPINNING	SUPPORT	STRUCTURES	S			

Function defined as : Action Verb, Measurable Noun

Kind: B = Basic; S = Secondary; RS = Required/Secondary; HO = Higher Order; A = Assumed; O = Unwanted

Cost/Worth Ratio = ________ (Total Cost ÷ Basic Worth)

CREATIVE IDEA LISTING AND JUDGMENT OF IDEAS

During the creative phase of the VE study, more than 200 ideas were generated using conventional brainstorming techniques as recorded on the following pages entitled *Creative Idea Listing and Evaluation.* For organizational purposes only, the ideas are grouped by project element, and assigned an alternate number to facilitate the tracking of an idea through the VE process. The alternate number includes one of the following lettered prefixes to indicate the project element and a number to indicate the order in which the idea was conceived:

CA	=	Chinatown Aerial	**L**	=	Lake Avenue Station
LAR	=	Los Angeles River to Arroyo Seco	**AL**	=	Allen Avenue Station
ASDM	=	Arroyo Seco to Del Mar	**SM**	=	Sierra Madre Villa Station
DMMP	=	Del Mar to Memorial Park	**US**	=	Union Station
MPSM	=	Memorial Park to Del Mar	**CS**	=	Chinatown Station
LSG	=	Line Segments - Global	**Y&S**	=	Yard and Shops
G	=	Stations - Global	**TC**	=	Train Control
A	=	Avenue 26 Station	**SS**	=	System Security
F	=	French Station	**FC**	=	Fare Collection System
SW	=	Southwest Museum Station	**SC**	=	SCADA System
A57	=	Avenue 57 Station	**TP**	=	Traction Power System
M	=	Mission Station	**CL**	=	Cable Leasing
FI	=	Filmore Station	**CCTV**	=	Closed Circuit Television System
D	=	Del Mar Station	**DY**	=	Dynamic Signage
MP	=	Memorial Park Station	**RS**	=	Radio System
			ETS	=	EmergencyTelephone System

These ideas were then discussed, highlighting their advantages and disadvantages. The VE team compared each of the ideas with the as-designed solution determining whether it improved value, was equal in value, or lessened the value of the presented solution in terms of:

- Initial Cost
- Safety
- Maintainability
- Compliance with criteria
- Right-of-way impacts
- Life Cycle Cost (Operations & Maintenance)
- Functionality
- Political Acceptability
- Constructibility
- System Security
- Ease of Operations

Based on the information provided during the designer's presentation and a review of the documents, these were the important project value objectives identified by the VE team.

The ideas for were then ranked on a scale of one to five, as noted below, with the higher number indicating the best match on how well the VE team believed the idea met these value objectives overall.

IDEA RANKING SYSTEM	POINTS
• Excellent Idea	5
• Good Idea	4
• Fair Idea	3
• Idea with disadvantages	2
• Poor Idea/ Drop	1

Typically, all ideas rated four or five are developed into formal alternatives and included in the **Study Results** section of the report. When this is not the case, an idea was combined with another related idea or discarded as a result of additional research which indicated the concept as not being cost-effective or technically feasible. Some ideas were judged to have minimal cost impacts on the project but provide enhancements in the form of improved operations, efficiency, constructibility or potential to save unknown or hidden costs. These were designated a "design suggestion" (DS) and is also used when an idea increases cost resulting from improving the functionality of the project or system and is deemed to be of significant value to the owner, operator or designer.

We encourage the reader to review the Creative Idea Listing as the design progresses since it may suggest additional ideas which can be applied to the design as conditions change.

CREATIVE IDEA LISTING AND EVALUATION

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT   LOCATION: LOS ANGELES, CALIFORNIA

ELEMENT/DISCIPLINE: DEL MAR TO MEMORIAL PARK (DMMP)   SHEET NO.

NO.	IDEA DESCRIPTION	RATING
DMMP-1	Delete floating slab in tunnel section through walnut	4
DMMP-2	Delete tunnel	2
DMMP-3	Place one track at grade and reduce tunnel width	1
DMMP-4	Raise tunnel profile by moving SS at Colorado	2
DMMP-5	Combine underpinning with box structure	3
DMMP-6	Use drilled piers in lieu of underpinning	4
DMMP-7	Slurry wall in I.L.O. of underpinning with independent ground vibration wall	4
DMMP-8	Build a heavy slab at grade to support buildings and mine under slab to create tunnel	2
DMMP-9	Use T-rail for restraining rail in place of U-69 rail	5
DMMP-10	Eliminate tunnel and use an aerial line	2
DMMP-11	Delete roof of tunnel and use struts with walkways	5
DMMP-12	Close Holly Street, raise elevation of station, use center platform, add elevator	4
DMMP-13	Use a center platform I.L.O. 2 side platforms	2
DMMP-14	Move station south	2
DMMP-15	Provide additional isolation of LRT structure from apartment at Holly Street	4
	CHINATOWN AERIAL (CA)	
CA-1	Use Mechanically stabilized earth walls I.L.O. cantilevered cast-in-place concrete walls	4

Rating: 1→2 = Not to be Developed; 3 = Marginal Idea/Cost cutting; 4→5 = Most likely to be Developed; DS = Design Suggestion

CREATIVE IDEA LISTING AND EVALUATION

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT   LOCATION: LOS ANGELES, CALIFORNIA

ELEMENT/DISCIPLINE: ARROYO SECO TO DEL MAR (ASDM)   SHEET NO.

NO.	IDEA DESCRIPTION	RATING
ASDM-1	Use manufactured walls for sound barriers	DS
ASDM-2	Use Jersey Barriers for low retaining walls	DS
ASDM-3	Use crib walls for low retaining walls	DS
ASDM-4	Use reinforced earth retaining walls	4
ASDM-5	Use surface drainage I.L.O. piped drainage	
	MEMORIAL PARK TO SIERRA MADRE VILLA (MPSM)	
MPSM-1	Use existing drainage system (24 – 39 inch diameter drains) 4 miles	4
MPSM-2	Raise station platform foundations at Lake Avenue	4
MPSM-3	Eliminate second elevator at Allen Avenue and at Sierra Madre	4
MPSM-4	Lower track grade at freeway section	5

Rating: 1→2 = Not to be Developed; 3 = Marginal Idea/Cost cutting; 4→5 = Most likely to be Developed; DS = Design Suggestion

CREATIVE IDEA LISTING AND EVALUATION

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT	LOCATION: LOS ANGELES, CALIFORNIA

ELEMENT/DISCIPLINE: Tunnel SHEET NO. 1 of 1

NO.	IDEA DESCRIPTION		RATING
Figueroa tunnel	Avoid traffic congestion	B	
Reservoir	Store storm waters	S	
Colorado Street Tunnel	Separate traffic	B	
Linderpinning	Support structures	S	

Slurry wall cross struts for underpin and independent ground vibrations wall for track structure restraint. Use ballasted track or DF.

Rating: 1→2 = Not to be Developed; 3 = Marginal Idea/Cost cutting;
4→5 = Most likely to be Developed; DS = Design Suggestion

CREATIVE IDEA LISTING AND EVALUATION

PROJECT: **PASADENA BLUE LINE LIGHT RAIL PROJECT**		LOCATION: **LOS ANGELES, CALIFORNIA**
ELEMENT/DISCIPLINE: **Evaluation Criteria**		SHEET NO. 1 of 1
NO.	IDEA DESCRIPTION	RATING
	Cost	
	Safety	
	Politics	
	Maintainability	
	Operations	
	Constructibility	
	R.O.W.	
	Compliance with criteria	
	Functionality	
	P.O	

Rating: 1→2 = Not to be Developed; 3 = Marginal Idea/Cost cutting; 4→5 = Most likely to be Developed; DS = Design Suggestion

CREATIVE IDEA LISTING AND EVALUATION

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT		LOCATION: LOS ANGELES, CALIFORNIA
ELEMENT/DISCIPLINE:		SHEET NO.
NO.	IDEA DESCRIPTION	RATING
	Use of tye-back retaining walls	
	Union Station Tail Track	
	Reduce # of turnouts	
	Unified track construction contract	
	Eliminate Marmior/ Figueroa grade seration	
	Colorado stacked rail section	
	Cost containment items/review	
	Storm sump configuration	
	Relative Strutted U/Box lengths	
	Track simplification (Marmion Way)	
	A) Remove retaining walls	
	B) Economise retaining walls	
	Track Drainage	

Rating: 1→2 = Not to be Developed; 3 = Marginal Idea/Cost cutting;
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CREATIVE IDEA LISTING AND EVALUATION

PROJECT: **PASADENA BLUE LINE LIGHT RAIL PROJECT**	LOCATION: **LOS ANGELES, CALIFORNIA**	
ELEMENT/DISCIPLINE: **L.A. RIVER TO ARROYO SECO (LAR)**		SHEET NO.

NO.	IDEA DESCRIPTION	RATING
LAR-1	Delete Figueroa grade separation	2
LAR-2	Reconfigure streets at Figueroa underpass	DS
LAR-3	Move or eliminate Arroyo-Seco connection to Pasadena Avenue	DS
LAR-4	Aerial Crossing over Figueroa Avenue	2
LAR-5	Raise profile of Figueroa Avenue (reduce portion of 20' ext grade to top of tunnel) (add parallel SS)	5
LAR-6	Water reservoir – reconfigure	See others
LAR-7	Place water reservoir directly below tunnel	5
LAR-8	Use pipe for reservoir and riser in place of cast-in-place concrete box	5
LAR-9	Reduce size of storm water	2
LAR-10	Delete waterproofing of storm water reservoir	4
LAR-11	With higher tunnel option divert some of the track drainage into existing storm drain reduce or eliminate ***vose?***	4
LAR-12	Obtain new existing topographic information and review need for retaining walls	DS
LAR-13	Reuse existing retaining walls at east side of Southwest Museum Station	3
LAR-14	Allow D/B contractor to redesign slab bridge between L.A. River Bridge and Avenue 19 Bridge	DS
LAR-15	Delete embedded track on Marmion Way from 51 Avenue to 57 Avenue slabs purpose unclear	4
LAR-16	Use pads under I.L.O. floating slab (French System/Marta)	
LAR-17	Allow D/B contractor to save 19th Avenue Bridge and San Fernando underpass	?
LAR-18	Delete retaining wall RA-6 at send ***Fig. Grade Sep.??***	?
LAR-19	Coordinate tractor power vaults at stations	DS
LAR-20	Reduce extent of Avenue 26 station foundations (D/B review)	4
LAR-21	Reduce extent of French Avenue stations foundations (D/B review)	DS

Rating: 1→2 = Not to be Developed; 3 = Marginal Idea/Cost cutting; 4→5 = Most likely to be Developed; DS = Design Suggestion

CREATIVE IDEA LISTING AND EVALUATION

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT LOCATION: LOS ANGELES, CALIFORNIA

ELEMENT/DISCIPLINE: LINE SEGMENTS – GLOBAL (LSG) SHEET NO.

NO.	IDEA DESCRIPTION	RATING
LSG-1	Simplify track drainage system – make uniform throughout	4
LSG-2	Make D/B contractor responsible for setting extent of retaining walls	DS
LSG-3	Allow single concrete pour for stations platforms	DS
LSG-4	Consolidate track contract	N/A
LSG-5	Delete requirement for high strength rails at curves greater than 2,000 feet	4
LSG-6	Delete requirement for high strength rails at stations	4
LSG-7	Use T-rail for restraining rail in lieu of U-69 rail	4
LSG-8	Substitute single cross-overs for double cross-overs	4
LSG-9	Use surface drainage in lieu of sub-drains	4
LSG-10	Use engineered fabric under ballast to direct flow to drain	3
LSG-11	Designate curb with radii less than 2,000 feet with high strength rail	DS

Rating: 1→2 = Not to be Developed; 3 = Marginal Idea/Cost cutting;
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CREATIVE IDEA LISTING AND EVALUATION

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT LOCATION: LOS ANGELES, CALIFORNIA

ELEMENT/DISCIPLINE: DEL MAR TO MEMORIAL PARK (DMMP) SHEET NO.

NO.	IDEA DESCRIPTION	RATING
DMMP-1	Delete floating slab in tunnel section through walnut	4
DMMP-2	Delete tunnel	2
DMMP-3	Place one track at grade and reduce tunnel width	1
DMMP-4	Raise tunnel profile by moving SS at Colorado	5
DMMP-5	Combine underpinning with box structure	See Others
DMMP-6	Use drilled piers in lieu of underpinning	4
DMMP-7	Slurry wall in I.L.O. of underpinning with independent ground vibration wall	4
DMMP-8	Build a heavy slab at grade to support buildings and mine under slab to create tunnel	2
DMMP-9	Use T-rail for restraining rail in place of U-69 rail	See LSG-7
DMMP-10	Eliminate tunnel and use an aerial line	2
DMMP-11	Delete roof of tunnel and use struts with walkways	5
DMMP-12	Close Holly Street, raise elevation of station, use center platform, add elevator	4
DMMP-13	Use a center platform I.L.O. 2 side platforms	2
DMMP-14	Move station south	2
DMMP-15	Provide additional isolation of LRT structure from apartment at Holly Street	4
	CHINATOWN AERIAL (CA)	
CA-1	Use Mechanically stabilized earth walls I.L.O. cantilevered cast-in-place concrete walls	4

Rating: 1→2 = Not to be Developed; 3 = Marginal Idea/Cost cutting; 4→5 = Most likely to be Developed; DS = Design Suggestion

CREATIVE IDEA LISTING AND EVALUATION

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT LOCATION: LOS ANGELES, CALIFORNIA

ELEMENT/DISCIPLINE: ARROYO SECO TO DEL MAR (ASDM) SHEET NO.

NO.	IDEA DESCRIPTION	RATING
ASDM-1	Use manufactured walls for sound barriers	DS
ASDM-2	Use Jersey Barriers for low retaining walls	DS
ASDM-3	Use crib walls for low retaining walls	DS
ASDM-4	Use reinforced earth retaining walls	4
ASDM-5	Use surface drainage I.L.O. piped drainage	See LSG-1
	MEMORIAL PARK TO SIERRA MADRE VILLA (MPSM)	
MPSM-1	Use existing drainage system (24 – 39 inch diameter drains) 4 miles	4
MPSM-2	Raise station platform foundations at Lake Avenue	4
MPSM-3	Eliminate second elevator at Allen Avenue and at Sierra Madre	4
MPSM-4	Lower track grade at freeway section	5

Rating: 1→2 = Not to be Developed; 3 = Marginal Idea/Cost cutting;
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CREATIVE IDEA LISTING AND EVALUATION

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT LOCATION: LOS ANGELES, CALIFORNIA

ELEMENT/DISCIPLINE: Tunnel SHEET NO. 1 of 1

NO. IDEA DESCRIPTION RATING

Figueroa tunnel	Avoid traffic congestion	B
Reservoir	Store storm waters	S
Colorado Street Tunnel	Separate traffic	B
Linderpinning	Support structures	S

Slurry wall cross struts for underpin and independent ground vibrations wall for track structure restraint. Use ballasted track or DF.

Rating: 1→2 = Not to be Developed; 3 = Marginal Idea/Cost cutting;
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CREATIVE IDEA LISTING AND EVALUATION

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT		LOCATION: LOS ANGELES, CALIFORNIA
ELEMENT/DISCIPLINE: Evaluation Criteria		SHEET NO. 1 of 1
NO.	IDEA DESCRIPTION	RATING
	Cost	
	Safety	
	Politics	
	Maintainability	
	Operations	
	Constructibility	
	R.O.W.	
	Compliance with criteria	
	Functionality	
	P.O	

Rating: 1→2 = Not to be Developed; 3 = Marginal Idea/Cost cutting; 4→5 = Most likely to be Developed; DS = Design Suggestion

CREATIVE IDEA LISTING AND EVALUATION

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT	LOCATION: LOS ANGELES, CALIFORNIA
ELEMENT/DISCIPLINE:	SHEET NO.

NO.	IDEA DESCRIPTION	RATING
	Use of tye-back retaining walls	
	Union Station Tail Track	
	Reduce # of turnouts	
	Unified track construction contract	
	Eliminate Marmior/ Figueroa grade seration	
	Colorado stacked rail section	
	Cost containment items/review	
	Storm sump configuration	
	Relative Strutted U/Box lengths	
	Track simplification (Marmion Way)	
	A) Remove retaining walls	
	B) Economise retaining walls	
	Track Drainage	

Rating: 1→2 = Not to be Developed; 3 = Marginal Idea/Cost cutting;
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CREATIVE IDEA LISTING AND EVALUATION

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT	LOCATION: LOS ANGELES, CALIFORNIA
ELEMENT/DISCIPLINE: L.A. RIVER TO ARROYO SECO (LAR)	SHEET NO.

NO.	IDEA DESCRIPTION	RATING
LAR-1	Delete Figueroa grade separation	2
LAR-2	Reconfigure streets at Figueroa underpass	DS
LAR-3	Move or eliminate Arroyo-Seco connection to Pasadena Avenue	DS
LAR-4	Aerial Crossing over Figueroa Avenue	2
LAR-5	Raise profile of Figueroa Avenue (reduce portion of 20' ext grade to top of tunnel) (add parallel SS)	5
LAR-6	Water reservoir – reconfigure	See others
LAR-7	Place water reservoir directly below tunnel	5
LAR-8	Use pipe for reservoir and riser in place of cast-in-place concrete box	5
LAR-9	Reduce size of storm water	2
LAR-10	Delete waterproofing of storm water reservoir	4
LAR-11	With higher tunnel option divert some of the track drainage into existing storm drain reduce or eliminate ***vose?***	4
LAR-12	Obtain new existing topographic information and review need for retaining walls	DS
LAR-13	Reuse existing retaining walls at east side of Southwest Museum Station	3
LAR-14	Allow D/B contractor to redesign slab bridge between L.A. River Bridge and Avenue 19 Bridge	DS
LAR-15	Delete embedded track on Marmion Way from 51 Avenue to 57 Avenue slabs purpose unclear	4
LAR-16	Use pads under I.L.O. floating slab (French System/Marta)	
LAR-17	Allow D/B contractor to save 19th Avenue Bridge and San Fernando underpass	?
LAR-18	Delete retaining wall RA-6 at send ***Fig. Grade Sep.??***	?
LAR-19	Coordinate tractor power vaults at stations	DS
LAR-20	Reduce extent of Avenue 26 station foundations (D/B review)	4
LAR-21	Reduce extent of French Avenue stations foundations (D/B review)	DS

Rating: **1→2 = Not to be Developed; 3 = Marginal Idea/Cost cutting;**
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CREATIVE IDEA LISTING AND EVALUATION

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT LOCATION: LOS ANGELES, CALIFORNIA

ELEMENT/DISCIPLINE: LINE SEGMENTS – GLOBAL (LSG) SHEET NO.

NO.	IDEA DESCRIPTION	RATING
LSG-1	Simplify track drainage system – make uniform throughout	4
LSG-2	Make D/B contractor responsible for setting extent of retaining walls	DS
LSG-3	Allow single concrete pour for stations platforms	DS
LSG-4	Consolidate track contract	N/A
LSG-5	Delete requirement for high strength rails at curves greater than 2,000 feet	4
LSG-6	Delete requirement for high strength rails at stations	4
LSG-7	Use T-rail for restraining rail in lieu of U-69 rail	4
LSG-8	Substitute single cross-overs for double cross-overs	4
LSG-9	Use surface drainage in lieu of sub-drains	4
LSG-10	Use engineered fabric under ballast to direct flow to drain	3
LSG-11	Designate curb with radii less than 2,000 feet with high strength rail	4

Rating: 1→2 = Not to be Developed; 3 = Marginal Idea/Cost cutting;
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CREATIVE IDEA LISTING AND EVALUATION

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT   LOCATION: LOS ANGELES, CALIFORNIA

ELEMENT/DISCIPLINE: DEL MAR TO MEMORIAL PARK (DMMP)   SHEET NO.

NO.	IDEA DESCRIPTION	RATING
DMMP-1	Delete floating slab in tunnel section through walnut	4
DMMP-2	Delete tunnel	2
DMMP-3	Place one track at grade and reduce tunnel width	1
DMMP-4	Raise tunnel profile by moving SS at Colorado	2
DMMP-5	Combine underpinning with box structure	3
DMMP-6	Use drilled piers in lieu of underpinning	4
DMMP-7	Slurry wall in I.L.O. of underpinning with independent ground vibration wall	4
DMMP-8	Build a heavy slab at grade to support buildings and mine under slab to create tunnel	2
DMMP-9	Use T-rail for restraining rail in place of U-69 rail	5
DMMP-10	Eliminate tunnel and use an aerial line	2
DMMP-11	Delete roof of tunnel and use struts with walkways	5
DMMP-12	Close Holly Street, raise elevation of station, use center platform, add elevator	4
DMMP-13	Use a center platform I.L.O. 2 side platforms	2
DMMP-14	Move station south	2
DMMP-15	Provide additional isolation of LRT structure from apartment at Holly Street	4
	CHINATOWN AERIAL (CA)	
CA-1	Use Mechanically stabilized earth walls I.L.O. cantilevered cast-in-place concrete walls	4

Rating: 1→2 = Not to be Developed; 3 = Marginal Idea/Cost cutting; 4→5 = Most likely to be Developed; DS = Design Suggestion

CREATIVE IDEA LISTING AND EVALUATION

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT LOCATION: LOS ANGELES, CALIFORNIA

ELEMENT/DISCIPLINE: ARROYO SECO TO DEL MAR (ASDM) SHEET NO.

NO.	IDEA DESCRIPTION	RATING
ASDM-1	Use manufactured walls for sound barriers	DS
ASDM-2	Use Jersey Barriers for low retaining walls	DS
ASDM-3	Use crib walls for low retaining walls	DS
ASDM-4	Use reinforced earth retaining walls	4
ASDM-5	Use surface drainage I.L.O. piped drainage	
	MEMORIAL PARK TO SIERRA MADRE VILLA (MPSM)	
MPSM-1	Use existing drainage system (24 – 39 inch diameter drains) 4 miles	4
MPSM-2	Raise station platform foundations at Lake Avenue	4
MPSM-3	Eliminate second elevator at Allen Avenue and at Sierra Madre	4
MPSM-4	Lower track grade at freeway section	5

Rating: 1→2 = Not to be Developed; 3 = Marginal Idea/Cost cutting;
4→5 = Most likely to be Developed; DS = Design Suggestion

CREATIVE IDEA LISTING AND EVALUATION

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT LOCATION: LOS ANGELES, CALIFORNIA

ELEMENT/DISCIPLINE: STATIONS- GLOBAL (G) SHEET NO.

NO.	IDEA DESCRIPTION	RATING
G-1	Eliminate skylight at canopy.	4
G-2	Add concertina wire to edges of canopy.	2
G-3	Increase height of canopy to reduce vandalism.	4
G-4	Eliminate leaning rail.	3
G-5	Verify that canopy layout works with train cars	1
G-6	Relocate canopies to better service cars (See G-5)	1
G-7	Prefabricate canopy and deliver to site.	2
G-8	Use constant section at umbrella arms.	5
G-9	Connect canopy at precast, eliminate structural pipe through slab.	3
G-10	Use two lights for up and down lighting.	2
G-11	Reduce number of lights.	DS
G-12	Use an alternate light fixture at canopy and between canopies.	4
G-13	Use fewer poles with higher luminaries in industrial areas.	2
G-14	Use a permanent warning stripe versus painted.	5
G-15	Locate traction power substations at passenger stations and combined in vault.	2
G-16	Make art site art.	3
G-17	Require all art to be applied, not integral.	5
G-18	Use polycarbonate in lieu of glass at sky lights.	1
G-19	Perform station estimate to get starting point.	DS
G-20	Use standard bench at all standard stations.	5
G-21	Standardize light standards (See G-10)	2
G-22	Make vault at-grade.	1
G-23	Are bike racks in project? (Yes, in design criteria)	2
G-24	Add anti-graffiti requirements to project for walls, etc. (included in specs).	1
G-25	Verify that sign location versus illumination do not conflict.	DS
G-26	Add to each station communications room and empty conduits for future MTA use.	DS

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CREATIVE IDEA LISTING AND EVALUATION

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT   LOCATION: LOS ANGELES, CALIFORNIA

ELEMENT/DISCIPLINE: STATIONS   SHEET NO.

NO.	IDEA DESCRIPTION	RATING
	GLOBAL (G) (Continued)	
G-27	Calgary gates should be operated by systems	DS
G-28	Reduce plant size in landscape areas	DS
	AVENUE 26 (A)	
A-1	Eliminate retaining walls and use elevators.	4
A-2	Eliminate dirt and build with side walls and lids (See A-1).	3
A-3	Build on top of existing berm (See A-6)	3
A-4	Put parking lot back in project. Investigate amount of contaminated soil.	4
A-5	Eliminate station.	1
A-6	Build path on berm in lieu of retaining walls.	3
A-7	Add monitoring to electrical vaults for hydrogen sulfide.	D.S.
A-8	Look at PDSR relative to bus pullouts.	2
A-9	Determine if piles needed for platform supports.	3
A-10	Use spread foundations in lieu of piles (See A-9)	4
A-11	Eliminate exit stairs	3
A-12	Ramp on one side only.	4
A-13	Repair failing retaining walls	DS

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CREATIVE IDEA LISTING AND EVALUATION

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT   LOCATION: LOS ANGELES, CALIFORNIA

ELEMENT/DISCIPLINE: STATIONS – FRENCH (F)   SHEET NO.

NO.	IDEA DESCRIPTION	RATING
F-1	Reduce wall at parking lot, height and material.	3
F-2	Add crossing at parking lot for southbound station access (verify at-grade)	3
F-3	Use a tunnel to connect southbound station platform and parking.	2
F-4	Add 16 to 20 cars parking lot on north in addition to 125 car lot on south.	4
F-5	Eliminate wall (reduces parking)	3

Rating: 1→2 = Not to be Developed; 3 = Marginal Idea/Cost cutting;
4→5 = Most likely to be Developed; DS = Design Suggestion

CREATIVE IDEA LISTING AND EVALUATION

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT   LOCATION: LOS ANGELES, CALIFORNIA

ELEMENT/DISCIPLINE: STATIONS   SHEET NO.

NO.	IDEA DESCRIPTION	RATING
	SW MUSEUM (SW)	
SW-1	Investigate with line group why station is 20 feet above grade, reduce if possible.	3
SW-2	Step footings along retaining wall to improve constructability, existing retaining wall will be unbalanced.	D.S.
SW-3	Look at means of reducing graffiti at all walls.	3
SW-4	Separate SW Museum Station as D/B/B project (so public can see something happen)	3
SW-5	Shift station south to reduce retaining walls.	2
	AVENUE 57 (A57)	
A57-1	Add noise protection to houses along line.	2
A57-2	Per MMCR sound wall will be added. Add stucco veneer finish to CMU wall	DS
A57-3	Integrate Marmion Way plan into project.	DS
	MISSION (M)	
M-1	Move platform 8.8 feet south	DS
M-2	Provide freestanding firewall as part of station and delete an sprinklering (See M-5)	3
M-3	Move trees, do not replace	DS
M-4	Storage building, is it on tracks?	1
M-5	Modify existing wall to get 2-hour fire rating	5
M-6	Future acquisition of building for parking	2
M-7	Center platform	2
	FILLMORE (FI)	
FI-1	Upgrade standard canopy	5

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CREATIVE IDEA LISTING AND EVALUATION

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT   LOCATION: LOS ANGELES, CALIFORNIA

ELEMENT/DISCIPLINE: STATIONS   SHEET NO.

NO.	IDEA DESCRIPTION	RATING
	DEL MAR (D)	
D-1	Move signage to allow even illumination	DS
D-2	Use double acting gates to assist pedestrian flow	DS
D-3	Revise station to allow exiting at both ends to simplify crowd control	DS
	MEMORIAL PARK (MP)	
MP-1	Revise track line to eliminate some underpinning.	3
MP-2	Set strict performance criteria on noise and vibration.	2
MP-3	Simplify canopy.	4
MP-4	Eliminate canopy.	1
MP-5	Use escalator/elevator and eliminate retaining wall.	2
MP-6	Protect top of canopy curve from access (attractive nuisance).	3
MP-7	Use center platform and eliminate retaining walls.	2
	LAKE AVENUE (L)	
L-1	Add crosswalk at bus stop and eliminate one elevator.	3
L-2	Add crosswalk at bus stop and eliminate one set of stairs.	3
L-3	Put bus lanes at center of Lake Ave. and build only one elevator and stair.	2
L-4	Move station toward Lake Ave.	4
L-5	Use a simpler elevator (less frills) and only one side (See L-1)	3
L-6	Simplify lobby ceiling at elevator.	3

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CREATIVE IDEA LISTING AND EVALUATION

PROJECT: **PASADENA BLUE LINE LIGHT RAIL PROJECT** LOCATION: **LOS ANGELES, CALIFORNIA**

ELEMENT/DISCIPLINE: **STATIONS** SHEET NO.

NO.	IDEA DESCRIPTION	RATING
	ALLEN AVENUE (AL)	
AL-1	Add a pedestrian activated crosswalk.	2
AL-2	Add full height chain link fence under overpass to stop jaywalking.	2
AL-3	Add access from both sides of Allen with stair and elevator.	2
AL-4	Add elevated walk to direct passengers to intersections.	2
AL-5	Coordinate with city to locate bus stops at crosswalks on east side. East side does not have direct access across street.	D.S.
AL-6	Defer station, build platform now.	2
	SIERRA MADRE VILLA (SM)	
SM-1	Review Sierra Madre Station	DS
SM-2	Review traffic flow at Madre and I-210 ramps to determine pedestrian access	2
SM-3	Coordinate with city to locate bus stops at crosswalks on west side. West side does not have direct access across street.	2
SM-4	Review layout at elevator to improve safety.	3
SM-5	Revise plaza layout at Madre Street (See SM-4)	3
SM-6	Use one stair.	3
SM-7	Add 2nd Access and elevator.	2
SM-8	Plan for future elevator on west side.	S

Rating: 1→2 = Not to be Developed; 3 = Marginal Idea/Cost cutting;
4→5 = Most likely to be Developed; DS = Design Suggestion

CREATIVE IDEA LISTING AND EVALUATION

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT   LOCATION: LOS ANGELES, CALIFORNIA

ELEMENT/DISCIPLINE: UNION STATION   SHEET NO.

NO.	IDEA DESCRIPTION	RATING
US-1	Reduce station size to accomdate wide stairs only	5
US-2	Relocate communications and signaling and layover room from below grade to above grade.	4
US-3	Lower tracks	4
US-4	Add crossover tracks at each side of station	
US-5	Change station finishes	5
US-6	Replace slab with ballast tie track	4
US-7	Reduce extent of canopy at Union Station	5
US-8	Delay construction of west tract at platform	5
	CHINATOWN STATION	
CS-1	Simplify design	DS
CS-2	Revalidate design concept with citizens groups	DS
CS-3	Consider wind effect on cloud theming	DS
CS-4	Revise column fins to simplify construction	DS
CS-5	Verify station interfaces with aerial section and surrounding neighborhoods	DS
	YARDS AND SHOPS	
Y&S-1	Use a prefabricated metal building	5
Y&S-2	Simplify HVAC by using single zone units instead of VAV	4
Y&S-3	Modify track layout in yard to improve train movements	4
Y&S-4	Modify retaining wall design	DS
Y&S-5	Add pit at dead end of track	2
Y&S-6	Eliminate turntables	2

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CREATIVE IDEA LISTING AND EVALUATION

PROJECT: **PASADENA BLUE LINE LIGHT RAIL PROJECT** LOCATION: **LOS ANGELES, CALIFORNIA**

ELEMBNT/DISCIPLINE: **SYSTEMS** **SHEET NO.**

NO.	IDEA DESCRIPTION	RATING
	EMERGENCY TELEPHONE SYSTEM (ETS)	
ETS-1	MTA procure emergency telephone system	4
ETS-2	Include ETS in fiber optic backbone	4
ETS-3	Use radio based system	2
ETS-4	Dedicated phone lines for emergency phone system	4
	SYSTEM SECURITY (SS)	
SS-1	Provide intrusion detectors on cut and covers	DS
SS-2	Hire outside company to monitor intrusion/fire detection in TPSS	4
SS-3	Include PA in fiber optic backbone	4
	FARE COLLECTION SYSTEM (FCS)	
FC-1	MTA procure fare collection system	4
FC-2	Single TVM per platform	3
FC-3	Include ATM at ticket vending machines (TVM) station	DS
FC-4	Eliminate backbone - independent systems	3
FC-5	Lease equipment	3
FC-6	Eliminate FC equipment	3
FC-7	On-board fare collection	3
	SCADA SYSTEM (SC)	
SC-1	Eliminate SCADA	3
SC-2	Have MTA provide with next SCADA upgrade	DS
SC-3	Provide fiberoptic backbone only	5
SC-4	Use common backbone with other systems	4
SC-5	Use radio for backbone	3
SC-6	Lease SCADA system	3
SC-7	Dial-up polling	3

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CREATIVE IDEA LISTING AND EVALUATION

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT LOCATION: LOS ANGELES, CALIFORNIA

ELEMENT/DISCIPLINE: SYSTEMS SHEET NO.

NO.	IDEA DESCRIPTION	RATING
	TRACTION POWER (TP)	
TP-1	Verify number of substations	DS
TP-2	Verify locations of substations	DS
TP-3	Power system study	DS
TP-4	Use single feeds to substations	4
TP-5	Use low resistance grounding	4
TP-6	Use appropriate cable insulation	5
TP-7	Use oil-filled transformer	3
TP-8	MTA procurement of substations	3
TP-9	Verify size of substations	DS
	TRAIN CONTROL (TC)	
TC-1	Wayside signaling	3
TC-2	Use hand throw switches instead of power switches	4
TC-3	Verify interlocking quantities	DS
TC-4	Install coded track circuit instead of AC track circuits	5
TC-5	Microprocessor based system	DS
TC-6	LED signal heads for Xings	5
TC-7	Pre-fab vs. poured in place concrete foundations	DS
TC-8	Lower rated impedance bonds (mini-bonds)	DS
TC-9	Design, build, install and lease back	3
	COMMUNICATIONS (CM)	
CM-1	Run all cable aerial	3
CM-2	Run all underground in a ductbank	3
CM-3	Run cable in trench	3

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CREATIVE IDEA LISTING AND EVALUATION

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT	LOCATION: LOS ANGELES, CALIFORNIA
ELEMENT/DISCIPLINE: SYSTEMS	SHEET NO.

NO.	IDEA DESCRIPTION	RATING
	COMMUNICATIONS (CM)	
CM-4	Copper cable only	3
CM-5	Fiber optic cable only	3
CM-6	MTA procure cable	3+
CM-7	Lower voltage rating on cable	4
	CABLE LEASING (CL)	
CL-1	Attain cable lease before installing	DS
CL-2	Eliminate cable lease	2
CL-3	Publicly offer cable lease	DS
CL-4	Lease extra conduit installed in ductbank	DS
CL-5	Install other utilities in trench	3+
	CLOSED CIRCUIT TELEVISION (CCTV)	
CCTV-1	Eliminate CCTV	3
CCTV-2	Select critical locations	DS
CCTV-3	Lease equipment	3
CCTV-4	MTA procure CCTV	4
	DYNAMIC SIGNAGE (DY)	
DY-1	Eliminate dynamic signage	3
DY-2	Sell advertising	DS
DY-3	Replace dynamic signage with CCTV screens	4
DY-4	Lease equipment	3
DY-5	MTA procure dynamic signage	4

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CREATIVE IDEA LISTING AND EVALUATION

PROJECT: PASADENA BLUE LINE LIGHT RAIL PROJECT   LOCATION: LOS ANGELES, CALIFORNIA

ELEMENT/DISCIPLINE: SYSTEMS   SHEET NO.

NO.	IDEA DESCRIPTION	RATING
	RADIO SYSTEM (RS)	
RS-1	Eliminate radio system	2
RS-2	MTA procure radio system	4
RS-3	Use radio for voice only	DS
RS-4	Lease radio system	DS

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