

# ROSECRANS MARQUARDT GRADE SEPARATION

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## Alternatives Development Report

PREPARED FOR:



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# Alternatives Development Report

FOR

## Rosecrans/Marquardt Grade Separation Project

January 26, 2016

Submitted to:



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LIST OF ABBREVIATIONS

AASHTO	American Association of State and Highway Transportation Officials
ADA	Americans with Disabilities Act
BNSF	Burlington Northern Santa Fe
CEQA	California Environmental Quality Act
CHSRA	California High Speed Rail Authority
CHV	Chevron
CIDH	Cast-in-Drilled-Hole
CIP/PS	Cast-in-Place / Prestressed
CP	Control Point
CPUC	California Public Utilities Commission
CRM	Crimson Pipeline
DSM	Deep Soil Mixed
EA	Environmental Assessment
EIR	Environmental Impact Report
HCM	Highway Capacity Manual
HDM	Highway Design Manual
HSR	High Speed Rail
LACSD	Los Angeles County Sanitation District
LOTB	Log of Test Borings
Metro	Los Angeles County Metropolitan Transportation Authority
MSE	Mechanically Stabilized Earth
NEPA	National Environmental Policy Act
PS&E	Plans, Specifications, and Estimate
SCE	Southern California Edison
SCG	Southern California Gas Company
SCRRA	Southern California Regional Rail Authority
TWC	Time Warner Cable
UPRR	Union Pacific Railroad

## 1. Executive Summary

The Los Angeles County Metropolitan Transportation Authority (Metro) has contracted with Biggs Cardosa Associates (BCA) to develop alternatives, gain environmental clearance, and produce final design documents to grade separate Rosecrans Avenue, Marquardt Avenue, and the Burlington North Santa Fe (BNSF) Railway in the City of Santa Fe Springs.

The existing intersection of Rosecrans/Marquardt Avenue and the BNSF Railway has been rated the most hazardous grade crossing in the state by the California Public Utilities Commission (CPUC). The current configuration of the rail tracks crossing the intersection on a diagonal, coupled with over 45,000 vehicles and 112 trains using this crossing daily, drives the need for a grade separation. The goals of the project include:

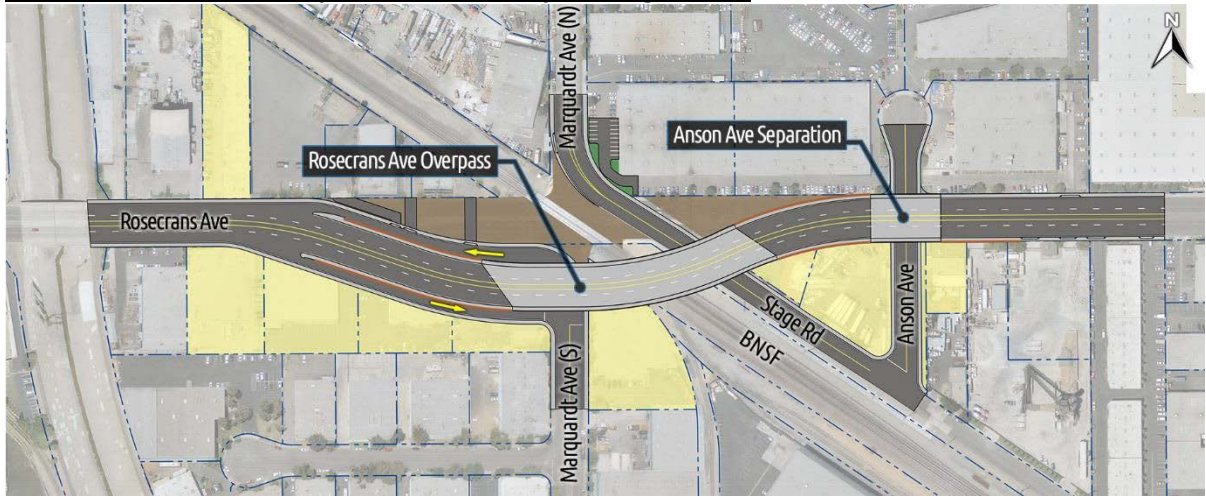
- Improve safety by separating pedestrians and vehicles from trains at the railroad crossing.
- Enhance mobility and quality of life for the community.
- Minimize disruption to residents, businesses, and the community during construction.



*Figure 1. Plan View – Existing Conditions*

BCA has evaluated two overpass and two underpass alternatives that will fulfill the purpose and needs of the project. The four alternatives are briefly described on the following pages.

### Alternative 1: Offset Overpass with One-Way Frontage Roads



*Figure 2. Alternative 1 – Plan View*

Alternative 1 realigns Rosecrans Avenue to the south and over the BNSF tracks. Two one-way frontage roads are provided on the west approach to connect Rosecrans Avenue to the southern leg of Marquardt Avenue, and to provide local access to businesses. The northern leg of Marquardt Avenue is connected to Stage Road. Anson Avenue is extended south to connect to Stage Road. Two roadway bridge structures are provided along the re-aligned portion of Rosecrans Avenue: one over the tracks, and one over Anson Avenue.

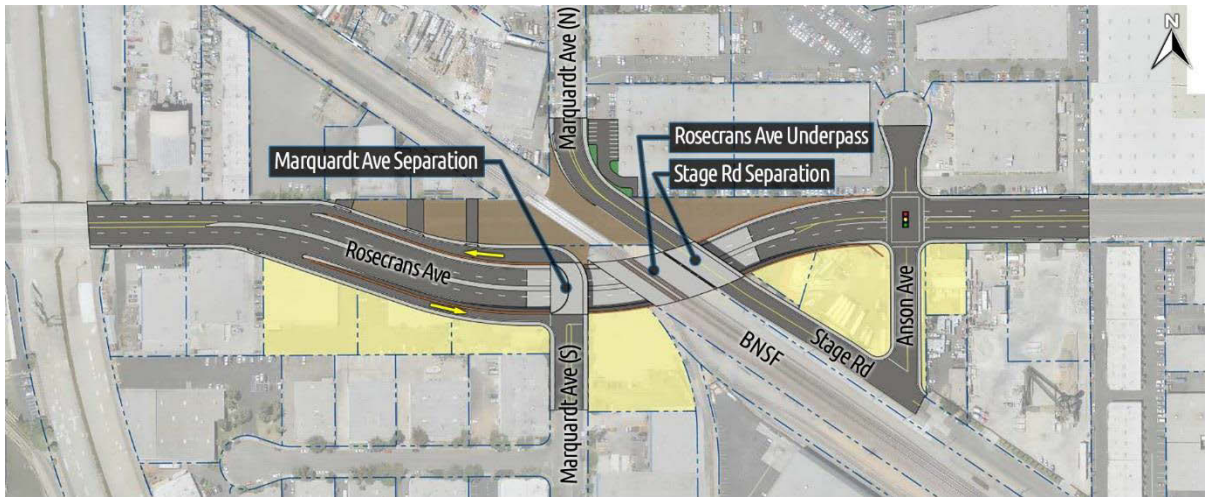
### Alternative 2: Offset Overpass with Connector Roads



*Figure 3. Alternative 2 – Plan View*

Alternative 2 realigns Rosecrans Avenue to the south and over the BNSF tracks. The southern leg of Marquardt is extended under the overpass and connects to Rosecrans Avenue. The northern leg of Marquardt Avenue is connected to Stage Road. A connector road is provided to connect the northern leg of Marquardt Avenue and Stage Road to Rosecrans Avenue. Anson Avenue is connected to the new connector road (no bridge structure required). Signalized intersections are provided to the west and east of the overpass structure.

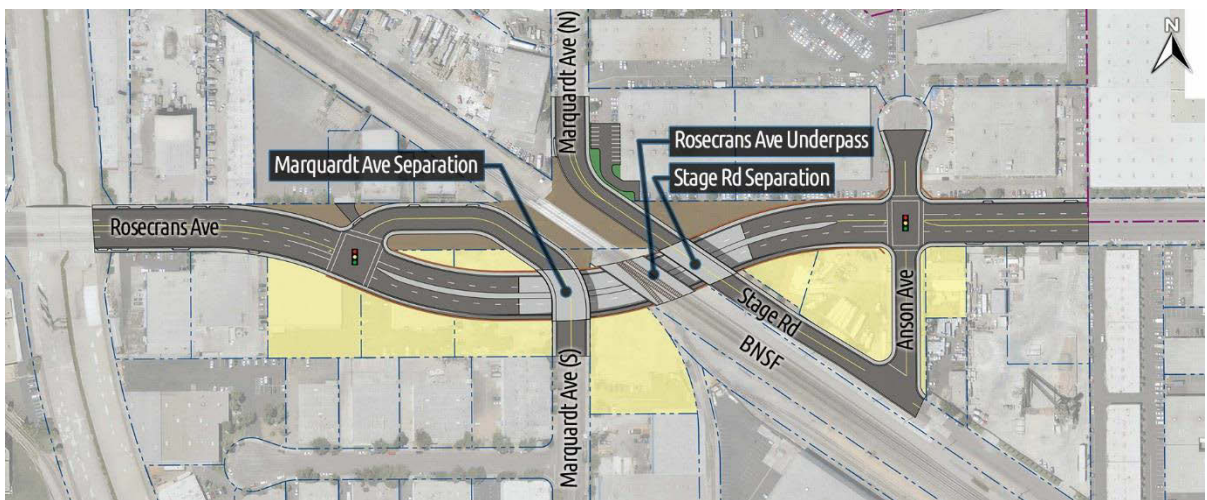
**Alternative 3: Offset Underpass with One-Way Frontage Roads**



*Figure 4. Alternative 3 – Plan View*

Alternative 3 realigns Rosecrans Avenue to the south, depressing the roadway underneath the BNSF tracks. One-way frontage roads are provided on the west side to connect the south leg of Marquardt Avenue to Rosecrans Avenue, and to provide local access to businesses. The north leg of Marquardt Avenue is connected to Stage Road over the depressed roadway. Anson Avenue is extended to the south, through a signalized intersection at Rosecrans Avenue, to provide a connection between Rosecrans Avenue and Stage Road. Two roadway separation bridge structures and one railroad underpass structure are provided.

**Alternative 4: Offset Underpass with Connector Roads**



*Figure 5. Alternative 4 – Plan View*

Alternative 4 realigns Rosecrans Avenue to the south, depressing the roadway underneath the BNSF tracks. The south leg of Marquardt Avenue is extended over the depressed roadway and connected to the west side of Rosecrans Avenue. The north leg of Marquardt Avenue is connected to Stage Road. Anson Avenue will be extended to the south to connect to Stage Road. This maintains connectivity between Stage Road and Rosecrans Avenue, but requires a signalized intersection through Rosecrans Avenue. Two roadway separation bridge structures and one railroad underpass structure are provided.



The alternatives are summarized in Table 1.

Table 1. Executive Summary Table

Alternative	Summary	Construction Costs*	Right-of-Way Costs*	Capital Cost
<b>1 Offset Overpass with One- Way Frontage Roads</b>	<ul style="list-style-type: none"> <li>▪ Moderate impact to vehicular traffic during construction</li> <li>▪ Requires moderate utility relocations</li> <li>▪ Eliminates direct connectivity between the north leg of Marquardt Avenue and Rosecrans Avenue</li> <li>▪ Reduced access to properties along frontage roads</li> <li>▪ Allows flexibility for a BNSF/HSR shared corridor</li> <li>▪ No shoofly required</li> <li>▪ Impacts 24 industrial parcels</li> </ul>	\$41.91M	\$73.50M	\$115.41M
<b>2 Offset Overpass with Connector Roads</b>	<ul style="list-style-type: none"> <li>▪ Minimal impact to vehicular traffic during construction</li> <li>▪ Requires minimal utility relocations</li> <li>▪ Maintains connectivity between Rosecrans Avenue, Marquardt Avenue, and Stage Road</li> <li>▪ Allows flexibility for a BNSF/HSR shared corridor</li> <li>▪ No shoofly required</li> <li>▪ Impacts 25 industrial parcels</li> </ul>	\$39.31M	\$68.25M	\$107.56M
<b>3 Offset Underpass with One- Way Frontage Roads</b>	<ul style="list-style-type: none"> <li>▪ Significant impact to vehicular traffic during construction</li> <li>▪ Requires significant utility relocations</li> <li>▪ Maintains connectivity between Rosecrans Avenue, Marquardt Avenue, and Stage Road</li> <li>▪ Reduced access to properties along frontage roads</li> <li>▪ Requires a railroad shoofly and multi-phased rail bridge construction</li> <li>▪ Requires joint BNSF/HSR bridge</li> <li>▪ Impacts 24 industrial parcels</li> </ul>	\$75.98M	\$56.44M	\$132.41M
<b>4 Offset Underpass with Connector Roads</b>	<ul style="list-style-type: none"> <li>▪ Significant impact to vehicular traffic during construction</li> <li>▪ Requires significant utility relocations</li> <li>▪ Requires a railroad shoofly and multi-phased rail bridge construction</li> <li>▪ Requires joint BNSF/HSR bridge</li> <li>▪ Impacts 21 industrial parcels</li> </ul>	\$73.55M	\$55.13M	\$128.67M

\* Construction and right-of-way costs include a 25% contingency.  
See Appendix H for cost estimate breakdowns.



Each of the alternatives presented in this document is feasible. Other alternatives were considered but are not feasible, including lowering the BNSF tracks into a trench under Rosecrans Avenue or shifting Rosecrans Avenue to the north. The Coyote Creek Channel is located too close to the grade crossing to completely lower the tracks under Rosecrans Avenue. Additionally, lowering the tracks would adversely impact area businesses by eliminating the BNSF spur and storage tracks. Because of the diagonal nature of the crossing, shifting Rosecrans Avenue to the north would reduce the distance between the crossing and the Coyote Creek Channel. Project limits and property impacts would be extended to the west, and complete reconstruction of the existing bridge over the Coyote Creek Channel would be required. Alternatives that maintained Rosecrans Avenue in its current alignment were also evaluated, but were excluded from further consideration due to significant impacts to traffic and businesses during construction, high right-of-way costs, and substantial utility relocations. Similarly, alternatives that raised or lowered Marquardt Avenue resulted in unacceptable right-of-way impacts. Marquardt Avenue would need to be raised approximately 30 feet for an overpass, or lowered approximately 26 feet for an underpass. Significant property acquisition along Marquardt Avenue would be required up to 1,000 feet to the north and south of the intersection with Rosecrans Avenue due to loss of access.

Underpass alternatives (Alternatives 3 and 4) present significant challenges. Nearly every utility within the project limits would be unearthed or in conflict by depressing Rosecrans Avenue under the BNSF tracks, and would require relocation. Challenges are most significant for gravity lines that would need to be routed around the depression. To construct the underpass structure, the BNSF tracks would need to be temporarily re-aligned (shoofly), resulting in a longer duration of construction, increased cost, and would require a new temporary at-grade crossing. The California High Speed Rail Authority (CHSRA) has conceptual designs that would potentially provide high speed rail service through this area. An underpass structure would require widening or reconstructing the underpass structure to accommodate high speed rail. BNSF and CHSRA would also share ownership of the structure. Another challenge is the potentially high groundwater table. If encountered during construction of the depressed roadway, the collection and treatment of groundwater could add significant cost and delay the project. A pump station would be required for the sump area. All of these challenges make underpass alternatives, while feasible, less desirable than the overpass alternatives.

Overpass alternatives require less utility relocations, do not require shoofly tracks, accommodate future high speed rail tracks, and promote positive roadway drainage (no pump station required). Alternative 1 was developed on a curved alignment to minimize the skew crossing the tracks, and to make room for one-way frontage roads. The footprint for Alternative 1 overlaps a significant portion of the existing alignment of Rosecrans Avenue, resulting in utility and traffic impacts for Alternative 1 that are more significant than those in Alternative 2.



Table 2. Alternatives Comparison Matrix

	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Right-of-way impacts	9 Full / 5 Partial	8 Full / 7 Partial	7 Full / 2 Partial	7 Full / 2 Partial
Traffic impacts during construction	Closed 6 months	Rosecrans open	Closed 30 months	Closed 30 months
Access to businesses (during construction)	Moderate impacts	Minimal impacts	Moderate impacts	Moderate impacts
Access to businesses (post-construction)	Full access	Full access	Full access	Full access
Extent of utility relocations	Moderate	Minimal	Significant	Significant
Duration of construction	22-26 months	18-22 months	36-40 months	36-40 months
Impacts to railroad operations	Minimal (no shoofly)	Minimal (no shoofly)	Requires shoofly tracks	Requires shoofly tracks
Accommodates future high speed rail	Yes	Yes	Bridge conflict	Bridge conflict
Visual impact to surrounding community	Overhead structure	Overhead structure	Underpass	Underpass
Capital cost	\$115.41M	\$107.56M	\$132.41M	\$128.67M

Legend



Preferred



Acceptable



Does not meet project goals

Alternative 2, although subject to somewhat higher right-of-way impacts, satisfies all project goals with the lowest cost. Connectivity between Rosecrans Avenue, Marquardt Avenue, Stage Road, and Anson Avenue is maintained through the use of signalized intersections and a two-way connector road. Most of the utilities currently in the existing roadway can remain in their existing alignment, shortening the duration of construction. Structures are located outside of the BNSF right-of-way, meaning that a third BNSF mainline and future high speed rail tracks could be installed without requiring bridge widening or partial demolition and reconstruction. A vast majority of construction activities for this alternative occur outside of the existing footprint of Rosecrans Avenue, meaning that impacts to rail, vehicular, and pedestrian traffic will be minimal. Disruptions to residents, businesses, and the community during construction will be lessened. Alternative 2 will enhance mobility and quality of life for the community.

For these reasons, the recommended alternative for the Rosecrans/Marquardt Grade Separation project is Alternative 2. Alternative 2 is recommended to be advanced into the environmental clearance phase, and the Plans, Specifications, and Estimate (PS&E) phase.

## 2. Introduction



Figure 6. Aerial View of Intersection

The Los Angeles County Metropolitan Transportation Authority (Metro) is partnering with the Burlington Northern Santa Fe (BNSF) Railway, the City of Santa Fe Springs, and Caltrans to grade separate the intersection of Rosecrans Avenue, Marquardt Avenue, and the BNSF right-of-way.

The Rosecrans/Marquardt Grade Separation Project, located at milepost 157.8 on the BNSF San Bernardino Subdivision, received California Environmental Quality Act (CEQA) clearance in 2003 with the Third Track and Grade Separation Project on the Burlington Northern Santa Fe Railway Company East - West Main Line Railroad Track Environmental Impact Report (EIR) SCH #2002041111 (Triple Track Project). The objective

of the Triple Track Project is to increase the efficiency of the BNSF main east-west corridor to better accommodate existing and future freight and passenger service, and to allow specific increases in the speed and volume of planned intercity and commuter rail passenger service. Specific improvements include:

- Installation of a specific set of grade separations to substantially enhance safety and traffic flow on surface streets throughout the rail corridor; and
- Installation of a third main track to enhance the efficiency of train movement along this corridor to ensure passenger service operates on a frequent and reliable schedule.

Several grade separations were environmentally cleared with the environmental document. Two of the proposed grade separations, Passons and Valley View, have been completed. Rosecrans/Marquardt was one of the environmentally cleared grade separation projects.

The Rosecrans/Marquardt at-grade crossing was listed in the California Public Utilities Commission (CPUC) Section 190 decision, dated February 10, 2014, as the number-one most hazardous crossing in the state.

The purpose of this grade separation project is to improve safety, and to alleviate the current and potential traffic impacts and hazards posed by the existing at-grade rail crossing.

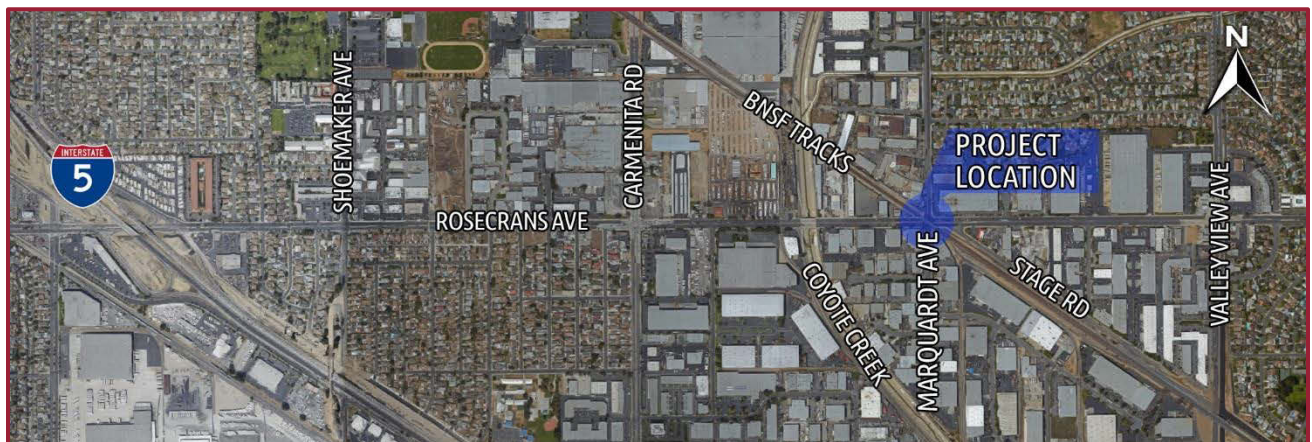


Figure 7. Location Map (Imagery ©2015 Google, Map Data ©2015 Google)



### 3. Background

The project is located at milepost 157.8 along the BNSF East-West San Bernardino Subdivision in the City of Santa Fe Springs. The scope of the project is such that it will also have some impacts in the City of La Mirada to the north along Marquardt Avenue and to the east on Rosecrans Avenue.

On a daily basis, this rail corridor serves approximately 55 long distance and local freight trains, as well as an average of 57 passenger trains for both Metrolink commuter and Amtrak. This rail corridor is the second busiest inter-city passenger rail corridor in the nation. The majority of the long distance freight traffic goes in and out of the Ports of Long Beach and Los Angeles through the Alameda Corridor and BNSF's Hobart Yard in the City of Commerce. This line is a critical link for the movement of goods from the Ports to the rest of the country. In addition, this corridor has been identified by the California High-Speed Rail Authority (CHSRA) as a viable shared corridor alternative. This alternative would result in three mainline BNSF tracks and two additional tracks to be shared by CHSRA, Metrolink, and Amtrak.

BNSF has been planning the addition of a third mainline track for well over a decade. The project included several grade separations, including the recently opened Valley View Avenue Grade Separation immediately to the southeast of this project. The Rosecrans/Marquardt Grade Separation was one of the planned grade separations, was environmentally cleared, and the final design was completed between 2003 and 2005. Funding was not available at the time in order to construct the Rosecrans/Marquardt Grade Separation. At the time, environmental clearance and the final design could not have foreseen the addition of high speed rail through this corridor. It is for this reason that the grade separation concepts are being reevaluated.

### 4. Purpose and Need

The existing intersection of Rosecrans/Marquardt Avenue and the BNSF Railway is an at-grade rail crossing with significant daily traffic. In addition to approximately 112 trains traversing this intersection on a daily basis, over 45,000 vehicles cross this intersection in any 24-hour period. The tracks are oriented diagonally through the road intersection, complicating sight lines between roadway and rail traffic. As a result of this heavy traffic, and in conjunction with the diagonal nature of the track crossing, the intersection has experienced an above average proportion of traffic incidents, including five fatalities, three of which occurred within the past three years. The CPUC Section 190 program has rated this intersection as the most hazardous grade crossing in the state of California. A key component to this rating is safety, as this crossing has 26 incidents on record with the Federal Railroad Administration resulting in six injuries and four fatalities, and crosses all modes of transportation with incidents involving 16 autos, six trucks, and four pedestrians. A grade separation is needed to remove the hazardous grade crossing.

Project goals include:

- Improve safety by separating pedestrians and vehicles from trains at the railroad crossing.
- Enhance mobility and quality of life for the community.
- Minimize disruption to residents, businesses, and the community during construction.

In order to meet these goals, alternatives are analyzed considering the following criteria:

- Traffic impacts during construction
- Required utility relocations
- Access to businesses during construction
- Right-of-way impacts
- Impacts to railroad operations
- Project costs

The alternatives evaluated in this report address the project's purpose and seek to meet these goals and provide the best possible grade separation alternatives for the community and stakeholders.

## 5. Existing Conditions

### 5.1. Configuration

Rosecrans Avenue is a four-lane major arterial (classified six lanes) running east-west. At the intersection with the BNSF tracks, Marquardt Avenue and Stage Road (both two-lane secondary arterials) also intersect with Rosecrans Avenue. The border between the City of Santa Fe Springs and the City of La Mirada is located immediately to the east of the project limits on Rosecrans Avenue, and immediately to the north on Marquardt Avenue. The City of Norwalk is located to the west on Rosecrans Avenue. The Coyote Creek Channel is located west of the intersection, and includes a bikeway. The south leg of Marquardt Avenue terminates at the Coyote Creek Channel.



**Figure 8. Regional Map**

The Coyote Creek Bikeway, running along Coyote Creek, is an existing Class I bicycle facility. The Gateway Cities Council of Governments Strategic Transportation Plan includes a planned Class II bikeway between Coyote Creek and Valley View Avenue along Rosecrans Avenue. Bus routes are also located on Rosecrans Avenue in the project vicinity including Norwalk Transit Route 5, with approximately 20 busses daily each way, and Metro Line 460, with over 40 busses daily each way. Motorist, cyclist, bus, and emergency vehicle access will need to be provided at all times during construction of the grade separation project.



## 5.2. Land Use

Properties along Rosecrans Avenue and Marquardt Avenue in the City of Santa Fe Springs are of industrial land uses, and are zoned as heavy manufacturing (M-2). Further north, within the City of La Mirada, land use becomes low density residential, zoned as single family (R-1).

## 5.3. Railroad Operations

The BNSF corridor consists of two existing railroad tracks within a 100-foot wide right-of-way. On average, 57 passenger trains and 55 freight trains traverse the grade crossing daily. It is anticipated that these volumes will increase. To the southeast of the grade crossing, a spur track provides rail service to numerous industries, and a number of storage tracks are located adjacent to the main tracks. These spur and storage tracks are of importance to BNSF's operations. Construction of any of the alternatives will have to be done in a manner that will minimize disruptions to BNSF's operations.

A third BNSF track is planned for this corridor, and CHSRA has also identified this corridor for high speed rail (refer to Section 6.2 for additional details). Alternatives must accommodate the third BNSF track, and must not preclude future high speed rail.

## 5.4. Utilities

The Rosecrans/Marquardt intersection is crossed by numerous transmission level franchise utility systems. Southern California Edison (SCE) has two 66 kV aerial systems along the north side of Rosecrans Avenue and along Marquardt Avenue, south of Rosecrans Avenue. The 66 kV system also extends north along Marquardt Avenue on the west side of the road. Both Chevron and Crimson Pipeline have several oil/fuel pipelines ranging from 6 inches to 12 inches running parallel to the BNSF in Stage Road and crossing Rosecrans Avenue. Verizon has a major duct-bank in Rosecrans Avenue near the south curb line. Verizon and AT&T share a major duct-bank system running along Rosecrans Avenue in an eastbound lane, as well as feeding into Stage Road and Marquardt Avenue. If relocated, it is important that these transmission facilities only move once because of cost and duration.

In addition to the transmission systems noted, there are also many distribution lines, including SCE 12 kV overhead and underground lines in Rosecrans Avenue, Marquardt Avenue, and Stage Road, Time Warner in Rosecrans Avenue and Marquardt Avenue, Southern California Gas Company in Rosecrans Avenue, and Verizon in Marquardt Avenue south of the intersection. Verizon Wireless has an aerial system on joint poles with SCE on Marquardt Avenue, north of Rosecrans Avenue, and on Rosecrans Avenue, east of Marquardt Avenue.

The Los Angeles County Sanitation District (LACSD) has two main sewer systems that run through the project area. The first system is a 33-inch trunk sewer that runs parallel with the railroad corridor on the south westerly side and then turns to the west in Rosecrans Avenue. The second system includes an 18-inch sewer in Stage Road that connects to a 24-inch trunk sewer that runs to the west in Rosecrans Avenue. There is a 12-inch City of Santa Fe Springs sewer in Marquardt Avenue north of Rosecrans Avenue that connects to the latter LACSD system. The City sewer system in Marquardt Avenue south of Rosecrans Avenue is not impacted by any of the alternatives.

There are also several City of Santa Fe Springs water lines that exist within the project area. A 16-inch water line is located on the north side of Rosecrans Avenue west of the rail crossing and turns south along the east side of Marquardt Avenue. A separate 12-inch water line runs north-south in Marquardt Avenue crossing the intersection and the rail crossing. The 8-inch water line on the south side of Rosecrans Avenue turns south along the north side of Stage Road. An 8-inch water line also connects the 12-inch line in Marquardt Avenue



north of the intersection to the 8-inch line in Rosecrans Avenue through Anson Avenue and an easement in the parcel located in the northeast quadrant of the Rosecrans Avenue and Marquardt Avenue intersection.

Appendix F includes an exhibit depicting existing utilities in the project area.

## 6. Adjacent Projects

Alternatives have been evaluated with consideration of future adjacent projects. These projects include the BNSF Triple Track Project and the California High Speed Rail Project. Alternatives should accommodate these projects to the fullest extent feasible.

### 6.1. BNSF Triple Track Project

The planning and implementation of the BNSF Triple Track Project, which adds a third main line track to the rail corridor, has been ongoing for over 15 years. Grade separating Rosecrans/Marquardt will facilitate the completion of one of the missing links in the triple track network. The third main line track currently terminates to the north of the Rosecrans/Marquardt intersection, at Control Point (CP) La Mirada (milepost 157.7), with a turnout located just north of Coyote Creek. To the south, the third main line track has been installed just past the recently completed Valley View Avenue grade separation, at CP Valley View (milepost 158.7). With the Rosecrans/Marquardt grade separation constructed, the third main line track can be added on the east side, closing this 1.2 mile gap in triple track, resulting in over 21 miles of continuous triple track through the San Bernardino Subdivision from CP Soto in Los Angeles to the Fullerton Junction.

### 6.2. California High Speed Rail Project

The BNSF corridor has been identified as the proposed corridor for the Los Angeles to Anaheim segment of the California High-Speed Train. CHSRA's Alternatives Analysis Report has been completed and the planning work continues through this corridor. While there is significant planning and engineering work still to be done by CHSRA, it is important that the Rosecrans/Marquardt Grade Separation project not preclude high speed rail from using this corridor.

Based on review of available documents and discussions with the stakeholders, it appears that the Expanded Shared-Track Alternative may be the most feasible through this corridor, though a final determination has not been made. This alternative would provide for three dedicated BNSF tracks and two dedicated passenger tracks for CHSRA, Metrolink and Amtrak. The Shared-Track Alternative would require a wider right-of-way, with the additional right-of-way acquisition currently proposed on the westerly side of the existing BNSF right-of-way.

## 7. Environmental and Permitting

The Rosecrans/Marquardt grade separation, along with several others, was environmentally cleared under the California Environmental Quality Act (CEQA) in 2003 with the Third Track and Grade Separation Project on the BNSF Railroad East-West Main Line Railroad Track EIR SCH #2002041111. Subsequently, a draft Environmental Assessment (EA) was prepared in 2005 pursuant to the National Environmental Policy Act (NEPA), but was never completed due to the lack of project funding.

Additional and/or updated environmental documentation is warranted because of the passage of time since the 2003 EIR was complete, and because the project features will change from what was previously analyzed. It should be noted that per Section 15282(g) of CEQA, as set forth by Section 21080.13 of the Public Resources Code, railroad grade separation projects are statutorily exempt under CEQA. However, because the project was previously analyzed under the 2003 program EIR, and because federal funds may be sought after (which would require NEPA clearance), the environmental documentation and Technical Studies will be updated accordingly as part of this project. Technical Studies prepared for the 2003 EIR and 2005 EA will be reviewed and analyzed to the extent feasible to support the updated project alternative. As part of this project, the following Technical Studies are anticipated:

- Phase I Site Assessment
- Phase II Site Assessment (if needed)
- Relocation Impact Study
- Community Impact Assessment

## 8. Community Outreach

Community outreach for the Rosecrans/Marquardt grade separation will include a multitude of meetings and special events that will be coordinated based on project and stakeholder needs. Several methods to send project information and meeting notices to the appropriate parties will be utilized. Receiving input from the stakeholders and the community is of great importance to Metro and the project team.

A Stakeholder Database has been compiled and will be updated as needed throughout the duration of the project. This database is the hub of information for records regarding phone calls, direct mail, emails, meeting attendance, notifications and community feedback. The Project Stakeholder Database consists of Southern California Association of Governments' elected officials list, city stakeholder lists, and chamber of commerce lists. A hotline and project website will also be established, and will be used to obtain contacts within the community. The main categories of the database include:

- City Officials,
- Resource Agencies,
- Project Partners and Consultant Team,
- Institutions,
- Business / Employment / Retail / Commercial Centers,
- Residents/Property Owners,
- Sensitive Receptors (hospitals, schools, military, etc.),
- Transportation Organizations/Agencies,
- Environmental Justice Groups,
- Community-Based Organizations,
- Industry Groups,
- Emergency Responders, and
- Other Interested Stakeholders.

Meetings will take place during the alternatives analysis, environmental clearance and design phases. The different meeting styles to be setup include briefings of elected officials and government agencies, one-on-one meetings with property and business owners, meetings with stakeholders and also general public meetings. The briefing of government agencies and elected officials on the progress and status of the project is necessary as an informational tool to be able to address the correct current facts of the project. The briefing of property and business owners is necessary to gain information as to infringe least as possible on business operations. General public meetings are important for every group of stakeholders to attend to gain general knowledge of the project.

General materials used during the project for public outreach include many forms such as hardcopy, electronic and telecommunication materials, as shown in Table 3. Materials that are to be used during meetings include PowerPoint presentations, display boards, project video, sign-in sheets, agendas, and public comment cards.

**Table 3. Public Outreach Materials**

<u>Hardcopy Outreach Materials</u>	<u>Electronic Outreach Methods</u>	<u>Telecommunication Outreach Methods</u>
<ul style="list-style-type: none"> <li>▪ Direct mail</li> <li>▪ Local newspaper advertisements</li> <li>▪ Street banners</li> <li>▪ Project Fact Sheet</li> <li>▪ FAQs</li> <li>▪ Meeting notices (postcards, take-ones, etc.)</li> </ul>	<ul style="list-style-type: none"> <li>▪ Project websites</li> <li>▪ Links to other agencies</li> <li>▪ Facebook page</li> <li>▪ Twitter account</li> <li>▪ Blogs</li> <li>▪ E-blasts</li> <li>▪ Project Fact Sheet</li> <li>▪ FAQs</li> <li>▪ Flipping Book</li> <li>▪ Meeting notices</li> </ul>	<ul style="list-style-type: none"> <li>▪ Hotline with live representative (workweek hours) or voicemail option</li> <li>▪ Individual phone calls</li> </ul>

## 9. Geotechnical Considerations

To explore the subsurface conditions prior to conducting proper testing, as-built Log-of-Test-Borings (LOTB) sheets were obtained from three overcrossing and one undercrossing projects, all within a 7,300 foot proximity of the site. The materials encountered are stated to be alluvial, continental and marine deposits. The estimated groundwater level, based on Caltrans as-built plans, the Seismic Zone Report for the Whittier Quadrangle, and the State Water Resources Control Board, is assumed to be located at approximately 9 to 33 feet below ground surface. Per LOTB sheets from Caltrans as-built plans for the Carmenita Road Overcrossing (Bridge No. 53-0214), the Alondra Boulevard Overcrossing (Bridge No. 53-0630), the Shoemaker Avenue Overcrossing (Bridge No. 53-1015), and the Rosecrans Avenue Undercrossing (Bridge No. 53-0634), the groundwater level was found to be in the range of 9 to 33 feet below ground surface.

The Rosecrans/Marquardt grade separation site is not located within an Alquist-Priolo Earthquake Fault Zone or within 1,000 feet of a fault that is not zoned, therefore additional fault rupture studies are not required. Per the LOTB of the as-built sheets, there are isolated layers at various depths that are possibly comprised of liquefiable materials.



## 10. Design Parameters

### 10.1. Roadways

The roadways within the project limits are located within the jurisdiction of the City of Santa Fe Springs. The City of La Mirada is located immediately to the north and to the east of the project limits. The railroad corridor is owned and maintained by the BNSF Railway. Passenger services are provided by Amtrak and Metrolink along this corridor.

The governing design standards for the horizontal and vertical roadway alignments are the City of Santa Fe Springs standards, American Association of State Highway and Transportation Officials (AASHTO) Policy on Geometric Design of Highways and Streets, Caltrans Highway Design Manual, and the BNSF/UPRR Guidelines for Railroad Grade Separation Projects. All four alternatives being considered comply with Americans with Disabilities Act (ADA) requirements. The specific design parameters incorporated into the alternatives include the following:

#### Design Speed

The design speed for a street is generally set to 5 to 10 miles per hour (mph) over the posted speed limit. There are three streets within the immediate area of the at-grade crossing that will be impacted by a grade separation: Rosecrans Avenue, Marquardt Avenue and Stage Road. The proposed design speeds are:

- Rosecrans Avenue                      V = 45 mph
- Marquardt Avenue (south)          V = 40 mph
- Marquardt Avenue (north)         V = 45 mph
- Stage Road                                V = 45 mph

Rosecrans Avenue is currently posted with a speed limit of 45 mph. Based on meetings with the City of Santa Fe Springs, it was determined that a 45 mph design speed with a corresponding posted speed of 40 mph would be appropriate for Rosecrans Avenue through the project limits. A 50 mph design speed is not feasible because it would extend the project limits, affecting the bridge over Coyote Creek and requiring additional right-of-way.

For Marquardt Avenue and Stage Road, site constraints will limit the ability to include horizontal curves that meet the desired design speed, resulting in a need to include advisory speed signs.

#### Horizontal Alignment

- Transitions & Curves                      Caltrans minimum requirement for the design speed
- Superelevation                              None proposed
- Sight Distance                                Caltrans minimum corner sight distance

#### Vertical Alignment

- Crest Curves                                 AASHTO Stopping Sight Distance
- Sag Curves                                    AASHTO Comfortable Speed for Well-lit Roadways

#### Vertical Clearances

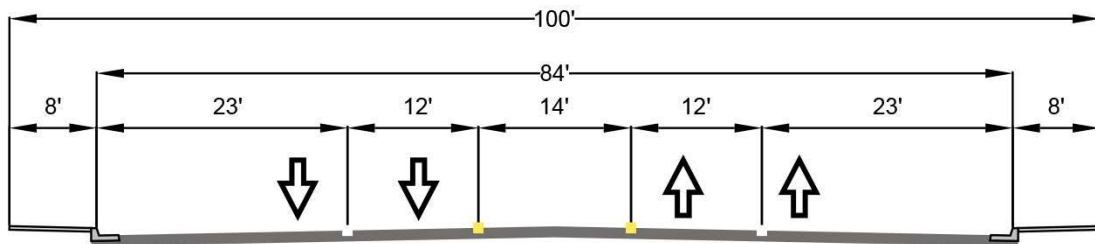
- Road over Road                              16'-0"
- Road under Rail                              16'-6" (Steel Structure)
- BNSF Rail (Permanent)                    23'-4"
- BNSF Rail (Temporary)                    21'-0" (Requires CPUC Approval – See Section 10.2)
- High Speed Rail                               27'-0"

**Truck Size**

- Caltrans 2010 (US)                      CA LEGAL-65

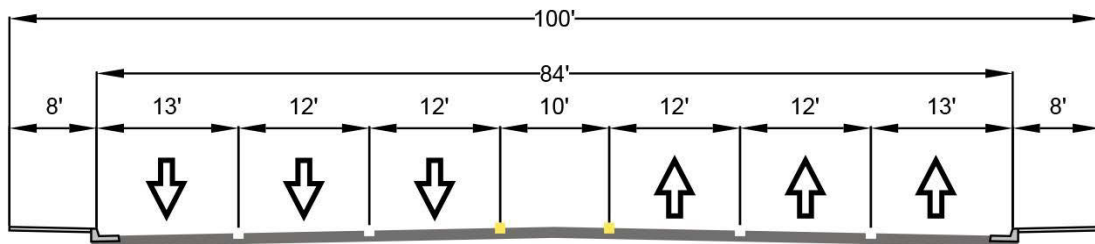
**Typical Section – Per City of Santa Fe Springs Circulation Element**

- Rosecrans Avenue (Major Arterial)                      84' curb-to-curb with 8' sidewalks, total 100' right-of-way width  
Two lanes in each direction with striped median
- Marquardt Avenue (Secondary Arterial)                      64' curb-to-curb, 5' sidewalk on one side  
Two lanes in each direction with striped median
- Stage Road (Secondary Arterial)                      46' curb-to-edge of pavement, no sidewalk  
One lane in each direction



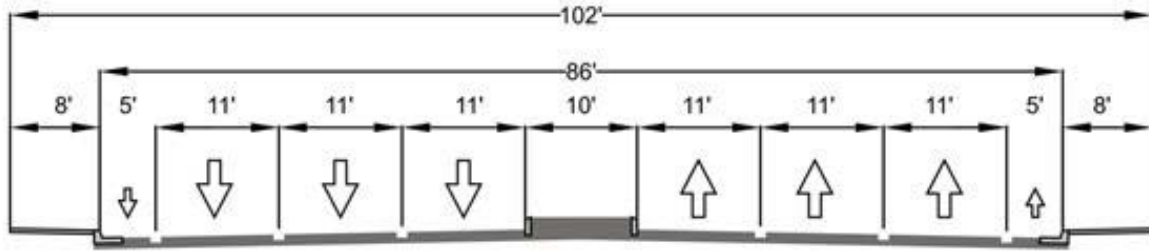
*Figure 9. Existing Rosecrans Avenue Typical Section*

Rosecrans Avenue is currently striped for two lanes in each direction (Figure 9). The project alternatives developed herein assume the same 84-foot curb-to-curb width with 8-foot sidewalks that exists today. This project is not a capacity-increasing project and Rosecrans Avenue will be striped to match the current roadway configuration. However, the street width is sufficient to accommodate three lanes in each direction and a center median per the City Circulation Element (Figure 10).



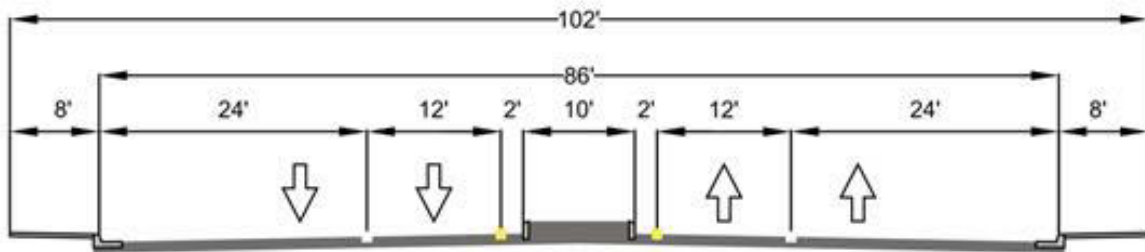
*Figure 10. Future Six Lane Configuration (City Circulation Element)*

It is important to note that Rosecrans Avenue is also designated as a future Class II bike facility due to the anticipated inclusion of Class II bike lanes between Coyote Creek and Valley View Avenue. With an 84-foot curb-to-curb width, there is insufficient space to accommodate these bike lanes while maintaining standard 12-foot travel lanes, 13-foot curb lanes and a 10-foot center median. In order to not preclude future needs, the ultimate street width was discussed with the City of Santa Fe Springs and Metro and resulted in the following agreed upon typical section (Figure 11).



**Figure 11. Capacity for Future Six Lanes with Bike Lanes (11' Lane Widths, 8' Sidewalks)**

This ultimate typical section would accommodate bike lanes in the future by increasing the curb-to-curb width to 86 feet along with reducing the travel lane width from 12 feet to 11 feet. The sidewalks would remain at 8 feet, increasing the overall right-of-way width to 102 feet. This would accommodate the ultimate six lanes of travel, raised center median, Class II bike lanes and sidewalks. Until the City of Santa Fe Springs implements the ultimate condition, the project will maintain the existing number of lanes, as shown in Figure 12.



**Figure 12. Proposed Project Typical Section**

### Active Transportation Elements

The project will provide features for both pedestrians and bicyclists to provide connectivity through the project site, as well as access to the adjacent parcels. Rosecrans Avenue and Marquardt Avenue will include sidewalks on both sides of the street. Stage Road will be limited to a sidewalk only on the east side due to the space limitations along the BNSF railroad corridor. Sidewalks will comply with ADA requirements, including sidewalk width, clearances, crosswalks, and longitudinal grades.

A Class II striped bike lane is planned on Rosecrans Avenue, connecting the Class I bike path along Coyote Creek to the Class II bike lane on Valley View Avenue. A Class II facility requires a minimum 5 foot on-street striped lane. The 5 foot bike lane includes the gutter width. The project will accommodate this future Class II bike lane, but will not implement it. The City of Santa Fe Springs will implement a Class II bike lane in the future.

## 10.2. Railroad

The BNSF/UPRR Guidelines for Railroad Grade Separation Projects require the following for overpass structures:

- A minimum permanent vertical clearance, per the Code of Federal Regulations, of 23'-4" measured from the top of the highest rail to the lowest obstruction under the structure.
- A minimum temporary vertical construction clearance of 21'-0" from the top of the highest rail to the lowest obstruction under the structure. However, standard minimum clearance required by the CPUC is 22'-6". The CPUC may consider granting a waiver for temporary vertical clearances during construction of less than 22'-6".
- A minimum temporary horizontal construction clearance of 15'-0" measured perpendicular from the centerline of the nearest track to all physical obstructions.
- Fence and barrier rail on the overpass structure that extends to the limits of the BNSF right-of-way, and a minimum combined barrier and fencing height of 8'-0" for curved fence and 10'-0" for straight fence.

For underpass structures:

- A minimum permanent vertical clearance of 16'-6" over the entire roadway width for steel superstructures with five or more beams or four or more deck plate girders per track.
- A maximum skew angle of 30 degrees for steel superstructures measured between the centerline of bridge supports and a line perpendicular to the centerline of track. The underpass alternatives presented in this report are skewed greater than 30 degrees, and would require a design exception or waiver from BNSF.

For both overpass and underpass alternatives, construction activities should not interfere with railroad operations. The BNSF/UPRR Guidelines recommend the use of an overpass structure to avoid interruption to railroad operations.

## 10.3. High Speed Rail

The alternatives contained herein reflect an overall rail corridor width of 109 feet through the project site. This accounts for the existing BNSF right-of-way width of 100 feet plus an additional 9 feet of right-of-way to accommodate the planned high speed rail. It is anticipated that this additional 9 feet will be along the westerly side of the corridor. CHSRA would operate in the easterly 45 feet of the corridor. This configuration is still in the planning stages and is subject to change.

CHSRA design criteria requires a standard vertical clearance of 27'-0" over the proposed high speed rail tracks. The overpass alternatives presented in this report were developed to meet the minimum BNSF vertical clearance of 24'-0" in order to minimize impacts to right-of-way and to the Coyote Creek Channel. With the complex geometry of the high skew between the roadway and the rail, clearances above 24'-0" are anticipated over the HSR tracks, however, a full 27'-0" clearance envelope is not expected. CHSRA has the flexibility to meet their 27'-0" clearance requirement by lowering their track profile under the bridge.

## 11. Overpass Alternatives

Overpass alternatives raise Rosecrans Avenue over the BNSF tracks and adjacent roadways. A key advantage of overpass alternatives is that they provide flexibility for railroad operations. Unlike underpass alternatives, overpasses would not require shoofly tracks to construct the structures. This will reduce costs and the duration of construction.

### 11.1. Alternative 1: Offset Overpass with One-Way Frontage Roads

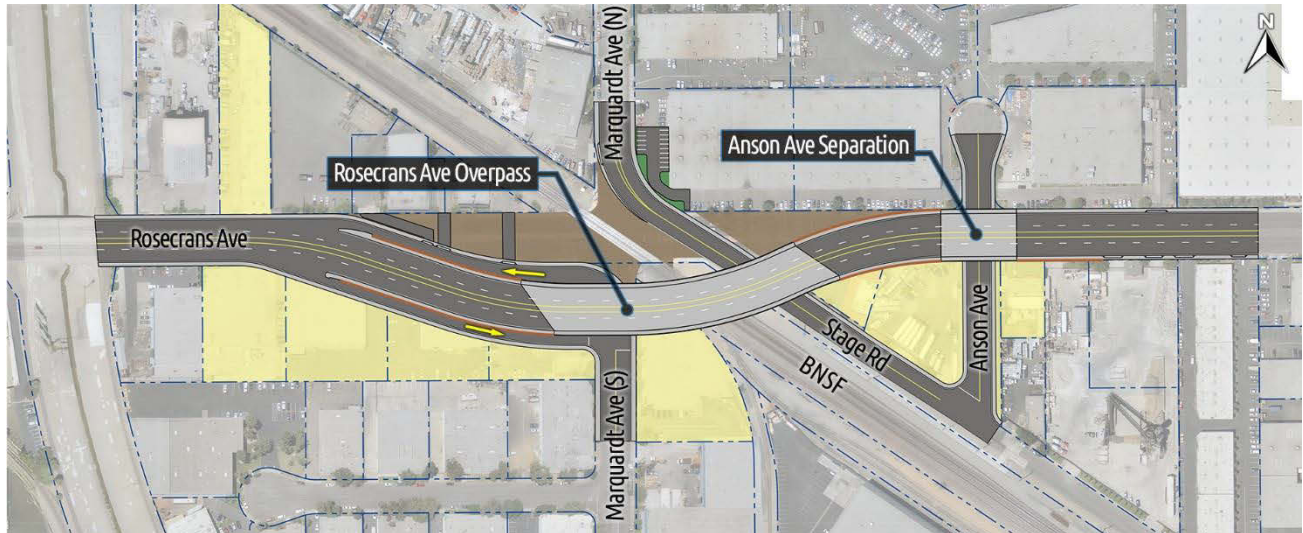


Figure 13. Alternative 1 – Plan View

#### 11.1.1. Geometry – Horizontal and Vertical

##### **Horizontal Layout**

The proposed Rosecrans Avenue will be realigned to the south outside of the existing roadway footprint through the overpass. The new alignment is based on a 45 mph design speed that includes horizontal curves with a radius of 750' and no superelevation. There are tangent sections between the horizontal curves ranging from 33' to 185' in length. The intent of the new roadway alignment was to reduce the skew to the greatest extent possible as it crosses the railroad corridor. The resulting alignment minimizes the area across the railroad corridor and reduces the length of the bridge spans.

Marquardt Avenue, south of Rosecrans Avenue, will maintain partial connectivity to Rosecrans Avenue with the use of frontage roads. Due to the loss of northbound right turn and westbound left turn movements, Marquardt Avenue (south) will only be accessible to Rosecrans Avenue in the eastbound travel direction, west of the railroad corridor.

Marquardt Avenue, north of Rosecrans Avenue, will be connected to the extension of Stage Road that will pass under the Rosecrans Avenue Overpass bridge. Due to the constraints of the railroad corridor and adjacent parcels, the alignment includes a 175' horizontal curve that does not meet the 45 mph design speed for the two streets. It is recommended that the curve be posted with an advisory speed of 15 mph. The direct connection to Rosecrans Avenue will be severed for both Marquardt Avenue (north) and Stage Road. Access to Rosecrans Avenue will be through the use of Iseli Road (not shown) which is a two-lane road between Rosecrans Avenue and Stage Road; however, this road is not designed to carry a high volume of traffic.



Due to the elevation change, Anson Avenue cannot be connected directly to Rosecrans Avenue. It will be extended to the south under Rosecrans Avenue and be connected to Stage Road through one of the acquired parcels.

### **Profile**

For this alternative, Rosecrans Avenue is being raised over Marquardt Avenue (south), the BNSF railroad corridor, Stage Road and the extension of Anson Avenue. While the minimum vertical clearance over a roadway is 16', the controlling factor in setting this profile was the 23'-4" vertical clearance allowed over the BNSF railroad tracks for the permanent condition. The standard for the temporary condition during construction is preferred to meet a 21'-6" vertical clearance. However, with the type of bridge proposed, falsework is not expected to be required over the railroad tracks and is therefore not considered as part of the profile design. Factoring in the estimated 8' structure depth and an additional 1' allowance for crossfall, the roadway surface will be a minimum of 32'-4" above the BNSF tracks.

The vertical curves for the Overpass provide a design speed of 45 mph. The tangent grades were fixed at 5% maximum to meet ADA standards.

HSR is planned for this corridor and their project is currently in the conceptual planning stages. Based on coordination with the CHSRA, the desired right-of-way width of the railroad corridor would be 109' through the project area, with the assumption that that the additional 9' would be added to the westerly side of the existing 100' railroad right-of-way. The proposed geometry for Rosecrans Avenue and Marquardt Avenue (south) accommodates this additional 9' of right-of-way. An agreement between CHSRA and BNSF is not in place at this time; however, the alternatives were developed to not preclude the future use of this corridor by CHSRA. The standard vertical clearance for HSR is 27'. While the vertical clearance for this alternative meets the BNSF clearance standards across the conceptual 109' right-of-way width, this grade separation project may not be able to accommodate the HSR vertical clearance requirements without additional right-of-way impacts and potential reconstruction of the bridge over the Coyote Creek. It is assumed that the HSR track profiles can be set lower than the BNSF track elevation in order to approach their vertical clearance requirements.

Appendix A contains plan and profile exhibits for Alternative 1.

#### 11.1.2. Structures

Two bridge structures and retaining walls will be provided to support the raised profile of Rosecrans Avenue: the Rosecrans Avenue Overpass and the Anson Avenue Separation.

The proposed Rosecrans Avenue Overpass is a four-span precast, prestressed concrete "wide-flange" girder bridge over Marquardt Avenue, the BNSF right-of-way, and Stage Road. Precast girders eliminate the need for falsework over the BNSF tracks, and will improve the speed of bridge construction. A precast deck panel system is proposed to further improve the speed of construction, resulting in less impacts to the railroad. Bents will be multi-column bents consisting of six-foot diameter concrete columns on seven-foot diameter cast-in-drilled-hole (CIDH) concrete piles. Abutments will be bent-type abutments with a configuration similar to the adjacent bents, and located immediately adjacent to a three-sided or wrap-around retaining wall.

The Anson Avenue Separation is a single-span cast-in-place, prestressed concrete box girder bridge, a very common structure type. Similar to the Rosecrans Avenue Overpass, the abutments will be bent-type abutments consisting of six-foot diameter concrete columns on seven-foot diameter CIDH concrete piles.

Potential retaining wall systems include Mechanically Stabilized Earth (MSE) retaining walls and the T-WALL® Retaining Wall system. Wall heights range up to 36 feet high, at which conventional cast-in-place retaining walls are not economical. Large settlements due to the raised embankment are also anticipated. MSE and T-



WALL® systems are capable of retaining these large heights, and of accommodating settlement concerns. The wall type will be evaluated further in the Type Selection Report and PS&E phase.

General plans for the Rosecrans Avenue Overpass and Anson Avenue Separation are located in Appendix G.

### 11.1.3. Right-of-Way Impacts

Refer to Appendix E for exhibits showing anticipated right-of-way impacts. These impacts include full acquisitions, fee acquisitions, and preliminary temporary construction easements. Other easements (e.g. utility easements) will be determined during the PS&E phase for the preferred alternative.

Alternative 1 impacts 24 properties, with 9 of those properties requiring full acquisition. A number of parcels on the south side are needed to realign Rosecrans Avenue to the south. On the north side, the proximity of a building to the edge of the right-of-way, and the loss of access due to a grade differential, will result in a full acquisition. Temporary construction easements are shown along the frontage of many parcels for sidewalk construction, landscape removal/replacement, parking lot reconfigurations, and other temporary needs. The extent of work performed under temporary construction easements will be further defined and discussed with affected property owners during the PS&E phase.

### 11.1.4. Utilities

Alternative 1 will require the relocation of the SCE 66 kV and 12 kV aerial systems in the area of the Marquardt/Rosecrans intersection. Steel poles will be required to span the realigned portion of Rosecrans Avenue. The SCE 12 kV underground system along Rosecrans Avenue will be relocated parallel to the realigned Rosecrans Avenue roadway along with a relocation at the north end of Stage Road. The Southern California Gas Company 4 inch line will be relocated south of realigned Rosecrans Avenue west of Marquardt Avenue, and north of Rosecrans Avenue east of Marquardt Avenue. The AT&T and Verizon system along Rosecrans Avenue, east of Marquardt Avenue, will require relocation into the new Rosecrans Avenue alignment. Time Warner and Verizon Wireless are on joint poles with SCE along Rosecrans Avenue and will get relocated with SCE. It is assumed that no oil/fuel lines will be in conflict.

The proposed sewer trunk mains will be relocated into acquired parcels or utility easements to facilitate a single relocation. The Los Angeles County Sanitation District has a 24-inch trunk sewer and a 33-inch trunk sewer that will be in conflict with the overpass bridge and retaining wall foundations. Therefore, the two trunk sewers will be relocated to a proposed utility corridor proposed along the south side, but located outside of the overpass footprint.

The proposed water lines are also expected to be completed in a single relocation, avoiding the cost of temporary facilities. With Rosecrans Avenue being raised above existing grade, the water lines will need to be relocated outside of the overpass and embankment footprint. At the west end, the City of Santa Fe Springs' 16-inch water line will be moved into a utility easement just north of the Rosecrans Avenue right-of-way. On the other end, the City's 8-inch water line will be moved to the south side of Rosecrans Avenue and reconnected to the water line in Stage Road through the proposed extension of Anson Avenue.

Appendix F includes preliminary utility relocation plans for Alternative 1.

### 11.1.5. Drainage

The drainage design for Alternative 1 involves minimal modifications to the existing storm drain system (County of Los Angeles, System RDD-049) in Rosecrans Avenue. The proposed drainage patterns will remain consistent with the existing conditions. The stormwater runoff from the Overpass will be collected with new catch basins along the realigned Rosecrans Avenue and conveyed to RDD-049. The existing storm drain system discharges into the Coyote Creek North Fork Channel, a concrete lined trapezoidal channel. The stormwater runoff on the north leg of Marquardt Avenue will be collected by storm drain laterals, and conveyed to the

existing RDD-049 storm drain system. Runoff and discharge levels into the Coyote Creek North Fork Channel for Alternative 1 will be similar to existing levels. The runoff from the south leg of Marquardt Avenue will continue to drain southerly to the existing catch basins.

#### 11.1.6. Railroad Considerations

The proposed overpass structure does not have any columns or footings within the BNSF railroad right-of-way. It is assumed that no construction or modification of rail facilities will be required for Alternative 1, with the exception of the removal of the existing grade crossing. Existing crossing signal equipment and precast concrete grade crossing panels will be salvaged and delivered to BNSF. Existing asphalt, concrete, and other surface improvements will be demolished and removed.

Railroad flagging services from BNSF will be required for work performed from within the BNSF right-of-way or with equipment (such as cranes) that could potentially foul the track. Based on the scope of construction work for Alternative 1, it is assumed that railroad flagging services will be required for eighteen months with an average of five flagger workdays per week. Railroad flagging services will be required for bridge construction, grade crossing phasing, and grade crossing demolition. Erection of precast bridge girders will occur over active tracks under Form B restrictions.

## 11.2. Alternative 2: Offset Overpass with Connector Roads



Figure 14. Alternative 2 – Plan View

### 11.2.1. Geometry – Horizontal and Vertical

#### Horizontal Layout

This alternative also proposes to realign Rosecrans Avenue to the south, but the street will remain parallel to the existing alignment, approximately 125' south of the existing Rosecrans Avenue centerline. The realigned portion of the street will extend further east and west than Alternative 1 and will have a pair of 750' horizontal reversing curves without superelevation at each end in order to meet the 45 mph minimum design speed. The intent of this alignment is to lessen impacts to the existing footprint of Rosecrans Avenue. This will result in better opportunities for construction staging with less roadway closures, and will reduce the number of utility relocations. In the final condition, the existing street footprint can be used for street connectivity as described below.

Marquardt Avenue (south) will maintain full connectivity to Rosecrans Avenue with the extension of the street using the existing footprint of Rosecrans Avenue. It would terminate at a signalized intersection west of the current Rosecrans Avenue and Marquardt Avenue intersection. At the proposed intersection, a cul-de-sac is proposed on the south side of Rosecrans Avenue in order to provide access to adjacent parcels. Due to physical constraints, it is recommended to post the extension of Marquardt Avenue with an advisory speed of 15 mph due to horizontal curves under the Rosecrans Avenue overpass bridge and at the intersection with Rosecrans Avenue.

Similar to Alternative 1, Marquardt Avenue (north) will be connected to the extension of Stage Road that will stay at grade, passing under the Rosecrans Avenue Overpass bridge. One benefit to this alternative is that it proposes a connector road utilizing the existing footprint of Rosecrans Avenue that will join the new Marquardt Avenue (north)/Stage Road to Rosecrans Avenue. The connector road will terminate at a signalized intersection with Rosecrans Avenue and an assumed stop-controlled intersection with Marquardt Avenue/Stage Road. Traffic signal warrants will be prepared for this intersection to determine if a traffic signal is justified.

Anson Avenue will be joined to the connector road, providing access to Rosecrans Avenue, Marquardt Avenue (north) and Stage Road.

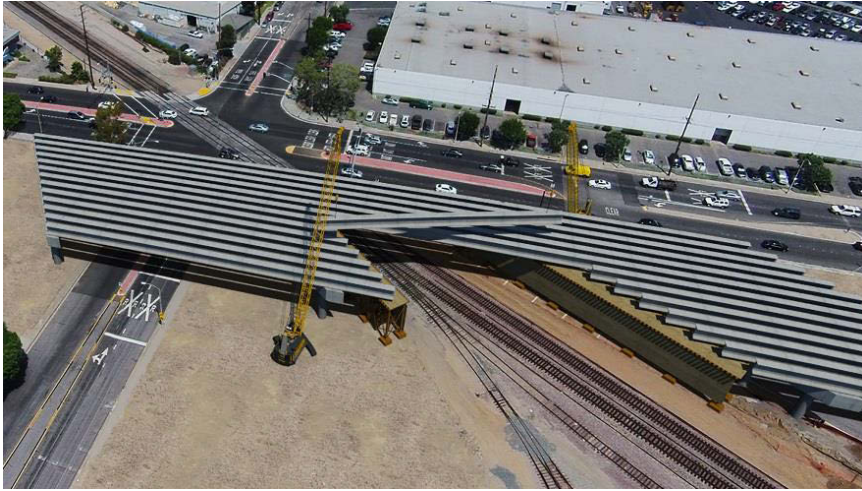
## Profile

Alternative 2 proposes to raise Rosecrans Avenue over Marquardt Avenue, the BNSF railroad corridor, and Stage Road. The vertical information described in Alternative 1 (Section 11.1.1) applies to this alternative as well.

Appendix B contains plan and profile exhibits for Alternative 2.

### 11.2.2. Structures

The proposed Rosecrans Avenue Overpass is a four-span precast, prestressed concrete “wide-flange” girder over Marquardt Avenue, the BNSF right-of-way, and Stage Road.



**Figure 15. Temporary Bents for Precast Girder Erection & Splicing**

A key consideration for precast girders is the shipping length for transporting the girders from the precast concrete plant to the Rosecrans/Marquardt site. Due to long span lengths, the precast girders will be shipped in smaller segments and spliced on site. Temporary bents (Figure 15) will be required to support the girders during splicing, including temporary bents within the BNSF right-of-way. These bents will be located horizontally a minimum of 15-feet from the centerline of track in conformance with BNSF’s

minimum required construction clearances. Girders are spliced using post-tensioning, which provides continuity across the individual precast girder segments, and reduces girder stresses to allow for a shallower structure depth than that of a structure which utilizes pre-tensioning only.

An innovative bridge deck system utilizing precast, prestressed deck panels will be considered (Figure 16). Precast deck panels are shipped to the job site in approximately eight-foot lengths, and are erected on the girders using a crane. Once in place, the top mat of deck reinforcement is installed and a cast-in-place concrete overlay is placed. There are two significant advantages to this system: 1) the speed of deck placement is improved by using partial depth precast elements and 2) the aesthetics of the underside of the deck is improved over using another type of stay-in-place form system (e.g. steel stay-in-place deck forms). The precast deck panel system will reduce impacts to the railroad, including less Form B (train speed restrictions), less railroad flagging time, and less waiting time for the Contractor.



**Figure 16. Precast Deck Panels**



*Figure 17. Bent-Type Abutment*

Bents will be multi-column bents consisting of six-foot diameter columns on seven-foot diameter CIDH concrete piles. Bent-type abutments (Figure 17) with the same configuration as the adjacent bents are proposed. This system employs a bent immediately adjacent to a three-sided wrap-around retaining wall. The multi-column bent supports the bridge's vertical load, and a three-sided or wrap-around retaining wall retains the embankment. An approach slab is used to span the gap between the bent-type abutment and the retaining wall, bearing on the bent on

one side and on the embankment fill on the other side. Compared to conventional abutments, for which a large number of piles would be required to resist vertical and lateral loads, bent-type abutments will reduce cost. The bent is efficient and cost effective in resisting vertical loads, while the retaining wall effectively handles the lateral loads. Separating the vertical and lateral load resisting systems results in improved economy.

The raised embankment for Rosecrans Avenue will be supported by either MSE walls or the T-WALL® Retaining Wall System. Similar to Alternative 1, wall heights along the embankment vary, with the maximum wall height at approximately 36-feet high. Conventional cast-in-place cantilevered retaining walls are not economical at this height, and would require very thick and wide footings for a spread footing foundation, or a large number of piles for a deep foundation. The Preliminary Geotechnical Memorandum (Appendix G) notes that spread footing foundations would likely not be feasible at the Rosecrans/Marquardt site, meaning that these conventional retaining walls would need to be founded on expensive pile systems. Another concern is the large anticipated settlements under the weight of the raised embankment. Conventional cantilevered retaining walls could exhibit significant cracking and deterioration under differential settlements.

MSE walls (Figure 18) employ the use of straps or geogrids attached to precast concrete panels and embedded into the embankment soil, which creates a reinforced soil zone to stabilize the wall. The system is widely used in California, inexpensive, capable of supporting large heights of retained soil, and is capable of handling significantly large differential settlements. The challenge with MSE walls is that the straps or geogrids complicate the installation and replacement of utilities underneath the roadway section.

The T-WALL® Retaining Wall System (Figure 19) is composed of precast concrete units that are stacked to form the retaining wall. Each unit consists of a face and stem. The T-WALL® system permits the installation and replacement of utilities, is quick to install, is relatively inexpensive when compared to conventional cast-in-place



*Figure 18. MSE Wall Construction (© Reinforced Earth)*

cantilevered retaining walls, and is capable of handling significantly large differential settlements. The challenge for T-WALL® is that the system is proprietary and relatively new in California. An alternate design for an MSE wall or cast-in-place wall may be required to ensure competitive bidding.

Both MSE and T-WALL® systems are feasible, and will be evaluated further in the PS&E phase.

A general plan for the Rosecrans Avenue Overpass is located in Appendix G.



Figure 19. T-WALL® Construction (© Neel Company)

### 11.2.3. Right-of-Way Impacts

Refer to Appendix E for exhibits showing anticipated right-of-way impacts. These impacts include full acquisitions, fee acquisitions, and preliminary temporary construction easements. Other easements (e.g. utility easements) will be determined during the PS&E phase for the preferred alternative.

Alternative 2 impacts 25 properties, with 8 of those properties requiring full acquisition. A number of parcels on the south side are needed to re-align Rosecrans Avenue to the south. Re-grading of Anson Avenue may impact the parking areas to the north of the cul-de-sac, and temporary construction easements are included for these properties. Similar to Alternative 1, temporary construction easements are needed along the frontage of some parcels for sidewalk construction, landscape removal/replacement, parking lot reconfigurations, and other temporary needs. The extent of work performed under temporary construction easements will be further defined and discussed with affected property owners during the PS&E phase.

### 11.2.4. Utilities

Similar to Alternative 1, Alternative 2 will require the relocation of the SCE 66 kV and 12 kV aerial systems in the area of the Marquardt/Rosecrans intersection. Steel poles will be required to span the realigned portion of Rosecrans Avenue. The SCE 12 kV underground system along Rosecrans Avenue will be relocated parallel to the realigned Rosecrans Avenue along with a relocation at the north end of Stage Road. The SCE system at the intersection of Stage Road and Rosecrans Avenue will be relocated to span over the raised portion of Rosecrans Avenue. The Southern California Gas Company 4 inch line will be protected with some minor relocation(s) necessary. The AT&T and Verizon system along Rosecrans Avenue, east of Marquardt Avenue, will require undergrounding into the new Rosecrans Avenue alignment. Time Warner and Verizon Wireless are on joint poles with SCE along Rosecrans Avenue and will get relocated with SCE. It is assumed that no oil/fuel lines will be in conflict.

For this alternative, the Los Angeles County Sanitation District 33-inch trunk sewer will be in conflict with the overpass bridge foundations just west of the railroad corridor. The proposed new location of the sewer can be handled with a single relocation and will utilize the area within an acquired parcel and the existing Marquardt Avenue street right-of-way.

Appendix F includes preliminary utility relocation plans for Alternative 2.

### 11.2.5. Drainage

The drainage design for Alternative 2 is similar to Alternative 1, which involves minimal modifications to the existing storm drain system (County of Los Angeles, System RDD-049) in Rosecrans Avenue. The proposed drainage patterns will remain consistent with the existing conditions. The stormwater runoff from the Overpass will be collected with new catch basins along the realigned Rosecrans Avenue and conveyed to RDD-049. The existing storm drain system discharges into the Coyote Creek North Fork Channel, a concrete lined trapezoidal channel. The stormwater runoff on the north leg of Marquardt Avenue will be collected by storm drain laterals, and conveyed to the existing RDD-049 storm drain system. Runoff and discharge levels into the Coyote Creek North Fork Channel for Alternative 2 will be similar to existing levels. The runoff from the south leg of Marquardt Avenue will continue to drain southerly to the existing catch basins.

### 11.2.6. Railroad Considerations

The proposed Alternative 2 railroad considerations are the same as described above in Alternative 1 (Section 11.1.6). No construction or modification of rail facilities will be required. With the removal of the grade crossing, existing crossing signal equipment and precast concrete grade crossing panels will be salvaged and delivered to BNSF. Existing asphalt, concrete, and other surface improvements will be demolished and removed. Railroad flagging services will be required for eighteen months with an average of five flagger workdays per week. Erection of precast bridge girders will occur over active tracks under Form B restrictions.

## 12. Underpass Alternatives

Underpass alternatives depress Rosecrans Avenue underneath the BNSF tracks and adjacent roadways. Shoo-fly tracks will be required to maintain railroad operations during construction, increasing cost and lengthening the duration of construction. Depressing the roadway will require significant utility relocations, which are especially challenging for the gravity lines (e.g. sewers and storm drains). Another significant challenge for underpass alternatives is accommodating future HSR. A structure constructed for BNSF will require widening, or partial demolition and reconstruction, to accommodate HSR. A benefit of the underpass alternatives is that they require less right-of-way acquisition.

### 12.1. Alternative 3: Offset Underpass with Frontage Roads

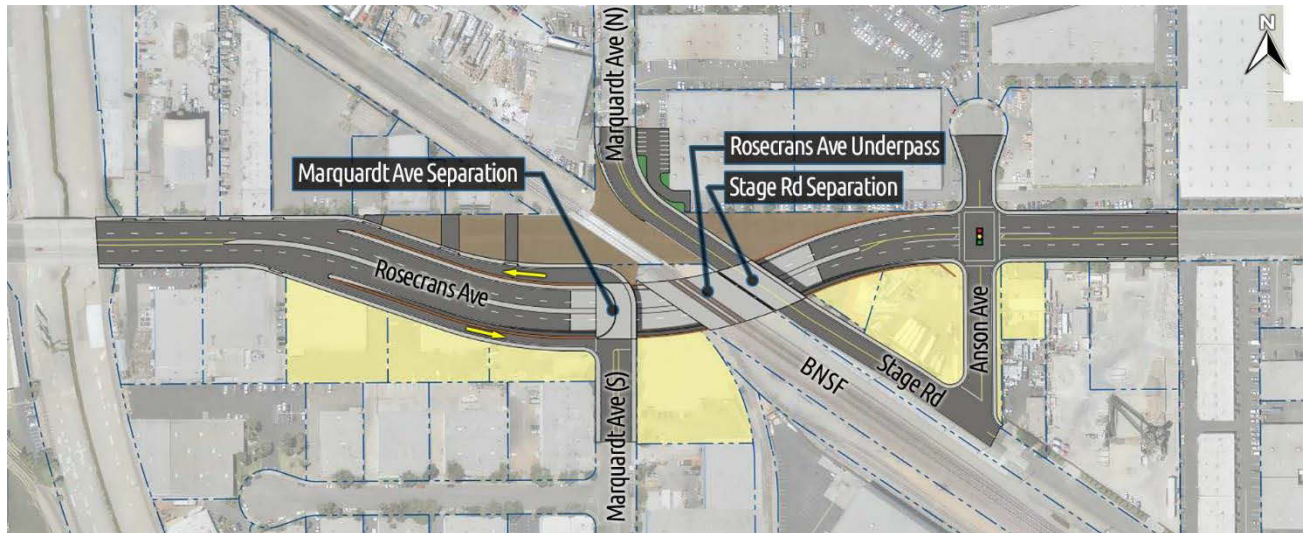


Figure 20. Alternative 3 – Plan View

#### 12.1.1. Geometry – Horizontal and Vertical

##### Horizontal Layout

For this alternative, the proposed horizontal realignment of Rosecrans Avenue and the impacts to Marquardt Avenue (south) are the same as described in Alternative 1 (Section 11.1.1).

Marquardt Avenue (north) will also be connected to the extension of Stage Road in this alternative, as discussed in Alternative 1. It will stay at-grade on its own roadway bridge across the lowered portion of Rosecrans Avenue. The connection to Rosecrans Avenue will be maintained through the extension of Anson Avenue to Stage Road.

Anson Avenue will maintain its connectivity directly to Rosecrans Avenue. This intersection will be signalized due to an anticipated increase in volumes with the connection to Stage Road and Marquardt Avenue (north).

##### Profile

Alternative 3 proposes to lower Rosecrans Avenue under Marquardt Avenue (south), the BNSF railroad corridor, and Stage Road. The minimum vertical clearance allowed by BNSF for an underpass is 16'-6" for steel superstructures. For Marquardt Avenue (south) and Stage Road, the minimum vertical clearance is 16'. The structure depth for the rail bridge is estimated to be approximately 7' and is therefore the controlling factor in the design of the profile. Factoring in the bridge depth and minimum vertical clearance, the roadway surface will be a minimum of 23'-6" below the BNSF tracks.



The vertical curves for the Underpass provide a design speed of 45 mph. The tangent grades were fixed at 5% maximum to meet ADA standards.

HSR is still in the conceptual planning stages and there are many unknowns in regards to the BNSF and HSR track configuration, whether they would share a single bridge, or if separate bridges are required. Another unknown is if the CHSRA Design Criteria would exceed the requirements of BNSF. Therefore, this alternative assumes a roadway profile alignment that will lower Rosecrans Avenue under one railroad bridge that spans the existing 100' railroad right-of-way.

Appendix C contains plan and profile exhibits for Alternative 3.

### 12.1.2. Structures

Three bridge structures are required for Alternative 3 to maintain roadway and rail traffic over the depressed portion of Rosecrans Avenue.

Two roadway bridges, the Marquardt Avenue Separation and the Stage Road Separation, are two-span cast-in-place, prestressed (CIP/PS) concrete slab bridges. Minimal structure depths and low construction costs make this type of structure preferable. A bent composed of five-foot diameter concrete columns on six-foot diameter CIDH concrete piles will be located in the median of Rosecrans Avenue. Abutments will be either secant pile or deep soil mixed (DSM) type walls.

A railroad bridge, the Rosecrans Avenue Underpass, will carry the BNSF tracks over Rosecrans Avenue. The proposed superstructure is a two-span steel deck plate girder bridge that is the full 100' width of the BNSF right-of-way. This structure type is acceptable to BNSF, and permits future widening of the structure if high speed rail tracks are installed in the future. The skew angle of the structure (varies, 43 degrees maximum) violates the BNSF maximum skew angle of 30 degrees, and would require a design exception or waiver from BNSF. The bent in the raised median of Rosecrans Avenue would consist of five-foot diameter columns to maintain aesthetic consistency between the columns of the three adjacent bridges. Below grade, the columns will be supported on seven-foot diameter CIDH concrete piles. A larger and stiffer pile is required for the railroad structure to force any potential plastic hinges to form in a location that can be inspected following a seismic event. Similar to the roadway bridges, the Underpass would utilize either secant pile or DSM walls as abutments.

Construction of the Underpass will consist of multiple phases, and will require shifting the BNSF tracks using shoofly tracks (refer to Section 12.1.6). A two-track shoofly will be placed to the north of the existing tracks, and the southerly half of the railroad bridge will be constructed in the first stage. In the second stage, railroad traffic will be shifted onto the new structure, the shoofly tracks will be removed, and the northerly half of the bridge will be completed. To limit significant temporary shoring requirements, top-down construction will be employed. Top-down construction involves installing abutments, bents, and retaining walls from the existing ground surface, then using those permanent structures as excavation support while Rosecrans Avenue is being excavated to a lower grade. Suitable top-down systems include secant pile walls and DSM walls.

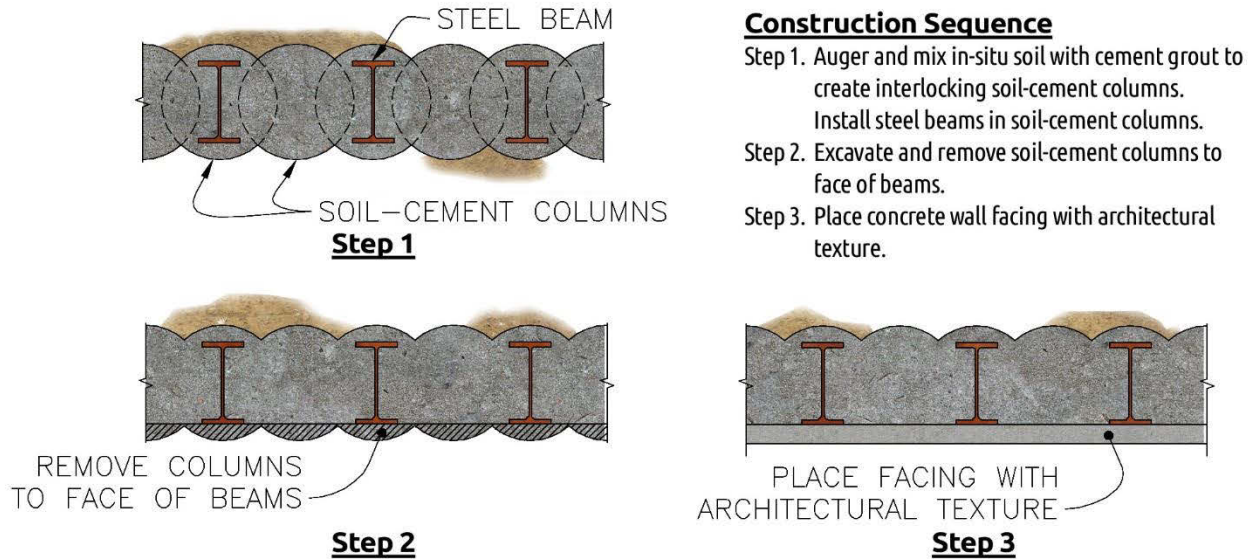


Figure 21. DSM Wall Construction Sequence

DSM walls (Figure 21) are constructed by mixing and partly replacing the in-situ soils with a stronger cement material. Multiple augers are advanced simultaneously into the ground to create an interlocking system of soil-cement columns. These soil-cement columns are relatively weak and unable to support large excavations, so a stiff element like a steel beam is typically installed before the soil-cement columns cure. In doing so, the system essentially acts like a soldier pile and lagging system, with steel soldier piles and the soil-cement columns functioning as the lagging. DSM wall systems are relatively inexpensive and are quick to install, but pose some challenges because of the flexibility of the wall. Temporary or permanent tie-backs, or struts, are necessary to increase the stiffness of the wall. Tie-backs would not be permitted underneath the BNSF tracks, and could interfere with utilities and adjacent buildings. Below grade struts could be used, but could interfere with utilities, and would still require temporary tie-backs until the struts could be constructed.

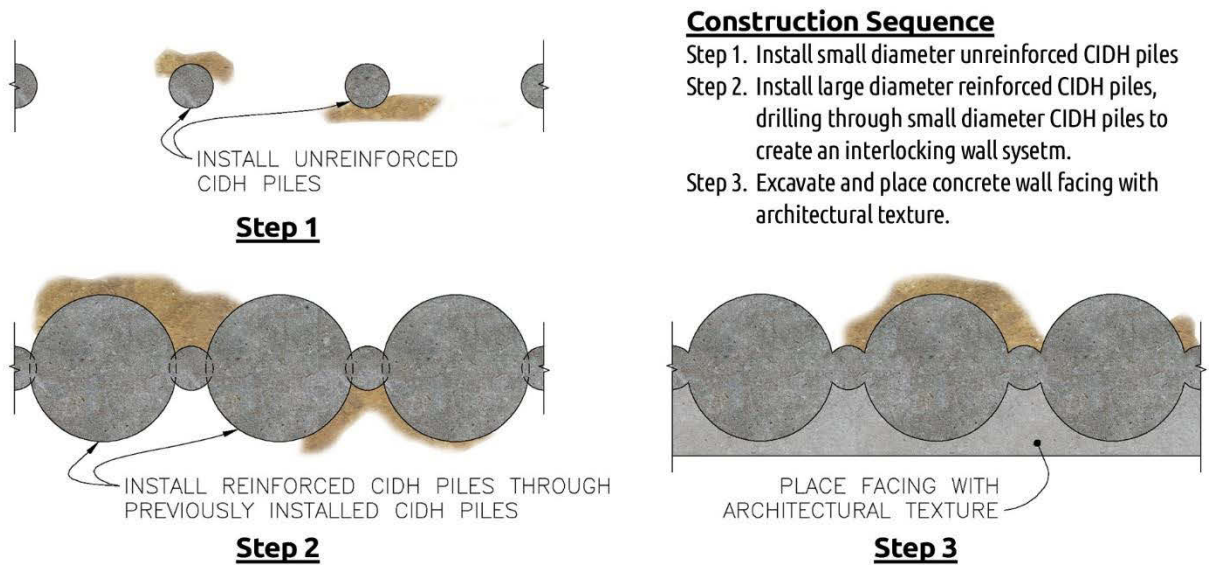


Figure 22. Secant Pile Wall Construction Sequence



Secant pile walls (Figure 22) use a combination of small unreinforced CIDH piles and larger reinforced CIDH piles. The unreinforced piles, approximately 18" in diameter, are installed first. The larger piles, approximately five feet in diameter, are drilled in between the smaller piles, with a portion overlapping the smaller piles. A reinforcing cage or steel beam is installed in the larger pile. The system forms an interlocking retaining wall, with the larger reinforced piles acting as soldier piles, and the smaller unreinforced piles acting as lagging. This wall system is relatively stiff, and would not require tie-backs or struts during or after excavation of the lowered section of Rosecrans Avenue.

General plans for the Rosecrans Avenue Underpass, Marquardt Avenue Separation, and Stage Road Separation are located in Appendix G.

### 12.1.3. Right-of-Way Impacts

Refer to Appendix E for exhibits showing anticipated right-of-way impacts. These impacts include full acquisitions, fee acquisitions, and preliminary temporary construction easements. Other easements (e.g. utility easements) will be determined during the PS&E phase for the preferred alternative.

Alternative 3 impacts 22 properties, with 7 of those properties requiring full acquisition. A number of parcels on the south side are needed to re-align Rosecrans Avenue to the south. Temporary construction easements are needed along the frontage of some parcels for sidewalk construction, landscape removal/replacement, parking lot reconfigurations, and other temporary needs. The extent of work performed under temporary construction easements will be further defined and discussed with affected property owners during the PS&E phase.

### 12.1.4. Utilities

Alternative 3 will require the relocation of the SCE 66 kV and 12 kV aerial systems along Rosecrans Avenue from approximately 400 feet west of Marquardt Avenue to approximately 250 east of Anson Avenue, as well as spanning Rosecrans Avenue and continuing 500 feet to the south along Marquardt Avenue. Steel poles will be required to span the realigned portion of Rosecrans Avenue. The SCE 12 kV underground system along Rosecrans Avenue will be relocated parallel to the realigned Rosecrans Avenue roadway. The Southern California Gas Company 4 inch line will be relocated to the north of Rosecrans Avenue from approximately 350 west of Anson Avenue to approximately 350 east of Anson Avenue. The AT&T and Verizon systems along Rosecrans Avenue will require relocation parallel to and south of the new Rosecrans Avenue alignment. Time Warner and Verizon Wireless are on joint poles with SCE along Rosecrans Avenue, and will get relocated with SCE. Time Warner will also have an underground relocation along the new Marquardt Avenue (north) and to the west of Rosecrans Avenue. Three Chevron and two Crimson pipelines will be relocated parallel to their existing position from just north of Rosecrans Avenue to the area of the new Anson Avenue/Stage Road intersection.

The Los Angeles County Sanitation District sewer system connecting to Marquardt Avenue (north) and Stage Road will be in conflict with the proposed underpass alternative. Utilizing a proposed utility corridor similar to Alternative 1 (Section 11.1.4), it is expected to relocate the sewer lines only once into their final proposed location. The sewers in Marquardt Avenue (north) and Stage Road will cross the railroad corridor in two separate locations and they will be in a steel encasement installed using the jack and bore method to avoid disruption to train operations. They will both connect back to the existing 24-inch trunk sewer in Rosecrans at the west end of the project footprint. The 33-inch trunk sewer and 42-inch storm drain will be relocated in the same manner as in Alternative 1 through the proposed utility corridor.

There are a number of City of Santa Fe Springs water lines that will require relocation for this alternative. The 16-inch water line in Rosecrans Avenue will be relocated once into the same proposed utility corridor as the trunk sewers and will connect back to the line in Marquardt Avenue (south). It is assumed that the 12-inch



water line running north-south in Marquardt Avenue will require a temporary relocation and then be placed into the proposed Marquardt Avenue Separation bridge in its final condition. The 8-inch water lines in Rosecrans Avenue, east of the railroad corridor, and in Anson Avenue, will be lowered along with the lowered Rosecrans Avenue and connect to the water line in Stage Road through the proposed extension of Anson Avenue.

Appendix F includes preliminary utility relocation plans for Alternative 3.

#### 12.1.5. Drainage

The drainage design for Alternative 3 will require a storm water pump station facility to pump storm water collected in the depressed portion of Rosecrans Avenue.

The grade separation sump storm flows will be collected in a catch basin at the low point created in Rosecrans Avenue, and conveyed by gravity to the pump station site. The subarea that contributes to the pump station inflow has been developed based on potential re-routing of existing drainage patterns in the project area. Preliminary hydrology calculations indicate that the maximum anticipated design 50-year peak flows in the grade separation subarea will be 23 cubic feet per second (cfs) or 10,300 gallons per minute (gpm).

The assumed static lift required between the pump station wetwell collecting runoff flows from the bottom of the underpass depression, and the discharge storm drain system, is 40-feet. As-built plans for the Rosecrans Avenue Storm Drain System show that the storm drain system is designed to convey 10-year runoff. The downstream reach of the Rosecrans Avenue storm drain will need to be upsized to accommodate the 50-year runoff collected at the sump to adequately discharge the runoff to Coyote Creek North Fork Channel. A challenge with discharging to Coyote Creek is that, if the channel does not have adequate capacity to handle this additional flow, runoff will have to be temporarily held and discharged at a rate that the channel can accommodate.

#### **Pump Capacity**

The storm drain pump station design capacity is defined by the estimated design 50-year peak flow of 23 cfs of runoff entering the sump created in Rosecrans Avenue. The pump station wetwell would be sized with a 10% buffer in capacity, to allow for inefficient operation if debris enters the pumps, and other potential contingencies. A concept configuration of two duty pumps, and one low flow sump pump, would be utilized. The two duty pumps would provide capacity for one-half of the design flow each (11.5 cfs; 5,150 gpm), to cover the total flow range up to the peak flow. During storm events less than the 50-year design event, the duty pumps will alternate, so that each pump is used equally.

The low flow sump pump will be used primarily to drain the wet well after rain events, and it will also be configured to operate as the duty pump during very low flow events. The sump pump capacity is based on the minimum criteria of emptying the pump station sump in 2-hours, and will also be defined by the need to match the specific inflow hydrograph by all pumping units. At the concept level, a sump pump capacity of 1.1 cfs (500 gpm) has been assumed. The sump pump must also be capable of handling grit and small solids.

### 12.1.6. Railroad Considerations

Alternative 3 results in greater impacts to the railroad facilities than Alternatives 1 and 2. This alternative consists of constructing a two-span railroad bridge over the proposed lowered portion of Rosecrans Avenue that will extend the full width of the 100' BNSF right-of way. The existing turnout in BNSF Main Track 2, adjacent to the east side of the Rosecrans/Marquardt crossing, provides service for three siding tracks, an industrial spur track, and a lead track that provides to a significant number of BNSF customers. All five of these connections as well as the two BNSF Main Tracks must remain in service during construction. Several rail phasing alternatives were examined but only one of these alternatives was considered feasible.

In order to maintain operations on the BNSF Main Tracks, two shoofly tracks would be constructed twenty feet north from the centerline of BNSF Main Track 1. The shoofly track geometry was designed to accommodate existing design speeds of 79 mph for passenger rail and 55 mph for freight rail traffic.

Maintaining access to the spur and siding tracks immediately to the south of the grade crossing is critical. The spur track services 20 properties, as depicted in Figure 23. To provide service to the three siding tracks (one of which is also a yard lead for the BNSF yards in La Mirada) and the industrial spur, a number 9 right-hand turnout will be located in Main Track 2 just east of the proposed bridge location. Three additional number 9 turnouts will be tied in to form a ladder to connect the three siding tracks and the industrial spur into the new lead.

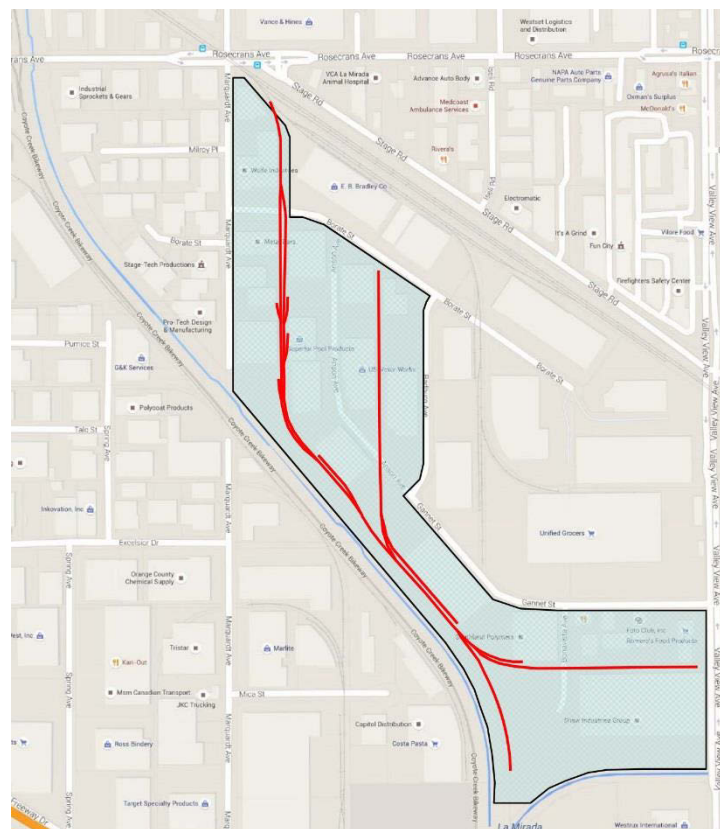
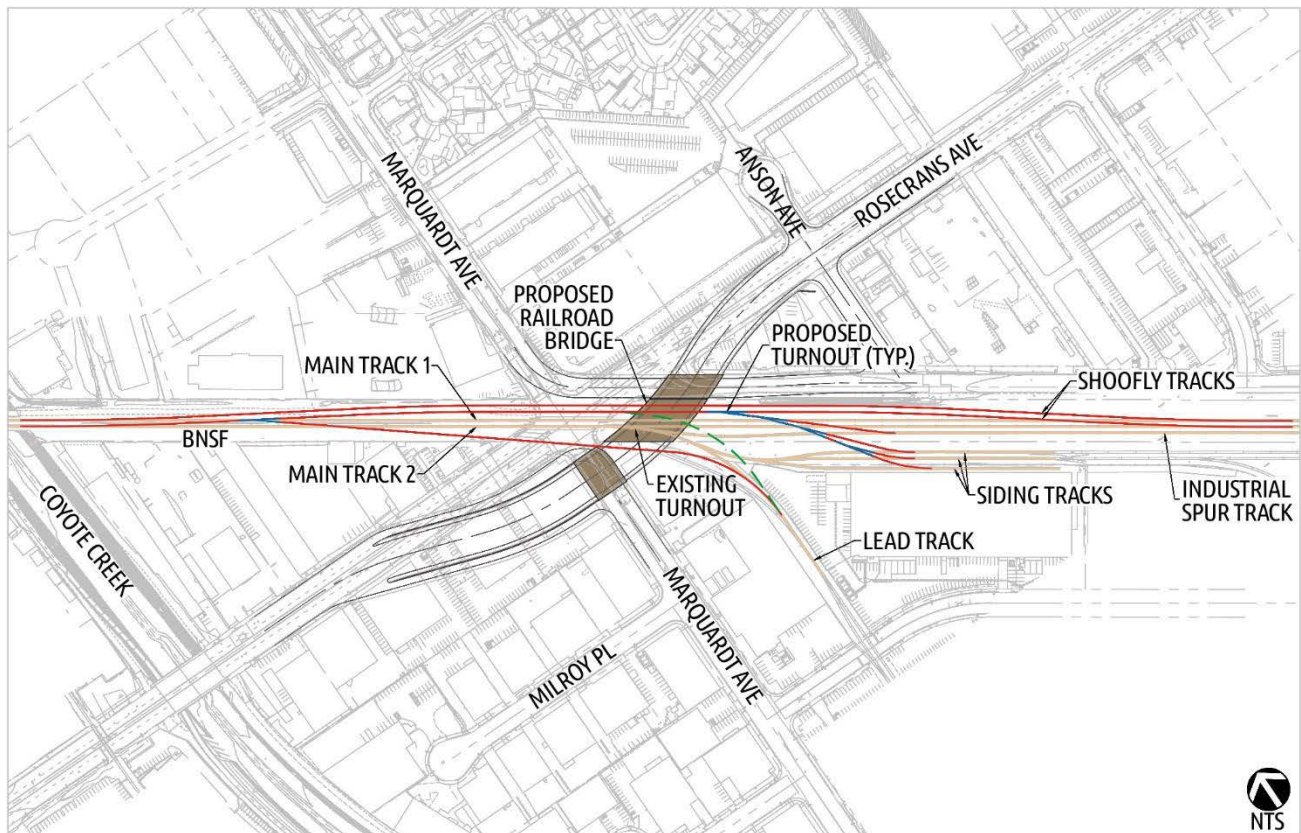


Figure 23. Spur Track Service Area

In initial attempts, the lead track was tied into Main Track 2 as far east as possible but needed the use of curves significantly in excess of 9°30'. The resulting alignment (shown as the green dashed line in Figure 24) also encroaches too far into the footprint of the proposed bridge to allow for phased construction of the bridge and mainline tracks. Further attempts led to providing a connection to this lead track with a proposed

turnout in the tangent section of the Main Track 2 shoofly west of the proposed bridge. This alignment, however, possesses many negative components. It requires the construction of a third track within the existing Rosecrans/Marquardt grade crossing, a significant length of new track, the temporary construction easement on an adjacent parcel, and a new grade crossing for this third track in a configuration that will likely not be approved by the CPUC. But most importantly, it requires the need to construct the bridge between active shoofly and lead tracks which is not a desired situation. These components will also add construction costs and lengthen the construction duration. With this shoofly alignment concept, both of the Main Tracks and connections to the sidings and lead tracks can be moved back to their existing locations with a two-phased bridge construction. The previously removed turnouts could then be replaced with the new turnouts used for the shoofly connections. Restoration of the Main Tracks and replacement of temporarily removed track would be constructed from new rail, ties, and other track material salvaged from the shoofly track construction.



**Figure 24. Underpass Shoofly Concept**

Upon completion of the bridge and underpass, the existing crossing signal equipment and precast concrete grade crossing panels will be salvaged and delivered to BNSF. Existing asphalt, concrete, and other surface improvements will be demolished and removed as part of the phasing of roadway construction.

Both the railroad bridge construction and rail construction are being performed at grade within the railroad right-of-way. Railroad flagging services from BNSF will be required to protect any crew that is not separated from rail traffic with a barrier at a safe distance from the tracks. A separate railroad flagger will be required for equipment and crews that are not close enough to be safely protected by a single flagger. Based on the scope of construction work for Alternative 3, it is assumed that railroad flagging services will be required for eighteen months with an average of two flaggers at five workdays each per week. Flagging services will be required for rail construction, bridge construction, crossing phasing, and crossing demolition.

## 12.2. Alternative 4: Offset Underpass with Connector Roads

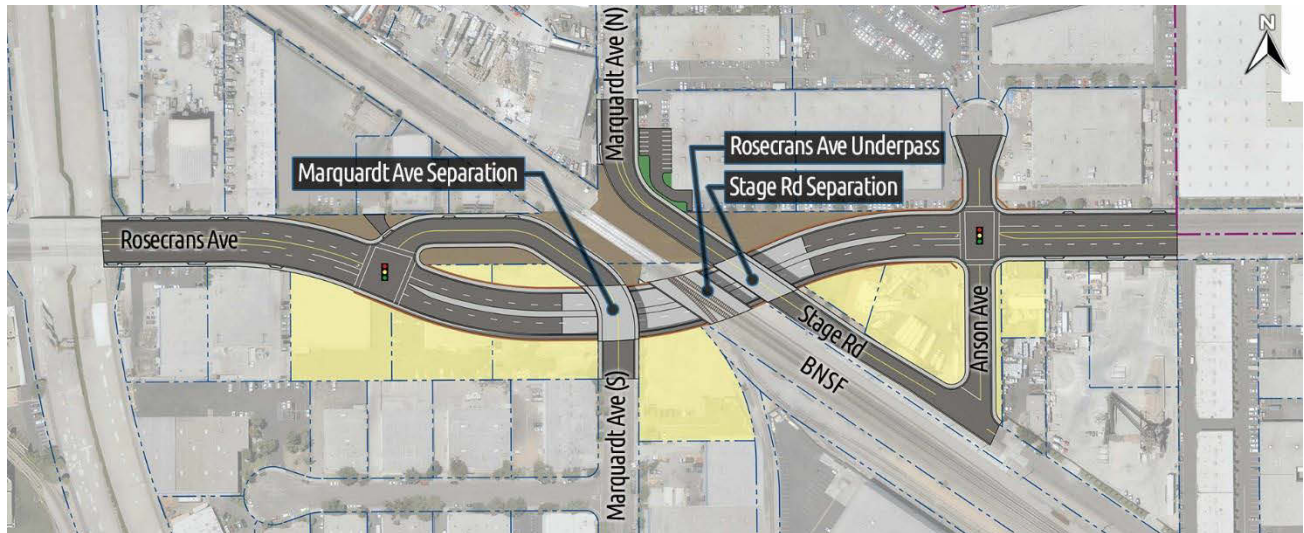


Figure 25. Alternative 4 – Plan View

### 12.2.1. Geometry – Horizontal and Vertical

#### Horizontal Layout

For this alternative, the proposed realignment of Rosecrans Avenue is similar to the alignment described in Alternative 1 (Section 11.1.1).

Marquardt Avenue (south) will stay at grade and be extended across the lowered Rosecrans Avenue on a roadway bridge. It will continue through the existing footprint of Rosecrans Avenue and connect to the realigned Rosecrans Avenue at a signalized intersection, similar to Alternative 2. The horizontal curves utilize a 130' radius in order to maximize the use of the existing footprint of Rosecrans Avenue, and therefore, an advisory speed of 15 mph is recommended.

Marquardt Avenue (north) will also be connected to the extension of Stage Road in this alternative similarly to the other alternatives. It will stay at grade on its own roadway bridge across the lowered portion of Rosecrans Avenue. The direct connection to Rosecrans Avenue will be severed for both Marquardt Avenue (north) and Stage Road. Access to Rosecrans Avenue will be provided through an extension of Anson Avenue, as proposed in Alternatives 1 and 3.

Anson Avenue will maintain its connectivity to Rosecrans Avenue in the same fashion as it does today.

#### Profile

The vertical information described in Alternative 3 (Section 12.1.1) applies to this alternative as well.

Appendix D contains plan and profile exhibits for Alternative 4.

### 12.2.2. Structures

Similar to Alternative 3 (Section 12.1.2), three bridge structures will carry the roadways and railroad over the depressed portion of Rosecrans Avenue.

The Marquardt Avenue Separation and the Stage Road Separation will be CIP/PS concrete box girder bridges. The Rosecrans Avenue Underpass will be a steel deck plate girder bridge. The skew of this structure (varies, 51 degrees maximum) is greater than BNSF's maximum allowable skew of 30 degrees, and would require a design exception or waiver. Multi-column bents will be located in the raised median of Rosecrans Avenue, and abutments will be composed of either DSM or secant pile walls. Refer to Section 12.1.2 for a description of the bridge structures and retaining wall systems.

General plans for the Rosecrans Avenue Underpass, Marquardt Avenue Separation, and Stage Road Separation are located in Appendix G.

### 12.2.3. Right-of-Way Impacts

Refer to Appendix E for exhibits showing anticipated right-of-way impacts. These impacts include full acquisitions, fee acquisitions, and preliminary temporary construction easements. Other easements (e.g. utility easements) will be determined during the PS&E phase for the preferred alternative.

The baseline configuration for Alternative 4 impacts 21 properties, with 6 of those properties requiring full acquisition. One additional full take would be required if Anson Avenue is extended to Stage Road. A number of parcels on the south side are needed to re-align Rosecrans Avenue to the south. Similar to Alternative 3, temporary construction easements are needed along the frontage of some parcels for sidewalk construction, landscape removal/replacement, parking lot reconfigurations, and other temporary needs. The extent of work performed under temporary construction easements will be further defined and discussed with affected property owners during the PS&E phase.

### 12.2.4. Utilities

Utility relocations for Alternative 4 are similar to Alternative 3 (Section 12.1.4). For the water lines, one difference is that the connection to the water line in Stage Road will be relocated through an acquired parcel since the proposed extension of Anson Avenue is not part of the baseline alternative.

Appendix F includes preliminary utility relocation plans for Alternative 4.

### 12.2.5. Drainage

The drainage design for Alternative 4 is similar to Alternative 3 (Section 12.1.5) where a storm water pump station facility is required to pump storm water collected in the depressed area created by the underpass grade separation.

The grade separation sump storm flows will be collected in a catch basin at the low point created in Rosecrans Avenue, and conveyed by gravity to the pump station site. The subarea that contributes to the pump station inflow has been developed based on potential re-routing of existing drainage patterns in the project area. Preliminary hydrology calculations indicate that the maximum anticipated design 50-year peak flows in the grade separation subarea will be 23 cubic feet per second (cfs) or 10,300 gallons per minute (gpm).

The assumed static lift required between the pump station wetwell collecting runoff flows from the bottom of the underpass depression, and the discharge storm drain system, is 40-feet. As-built plans for the Rosecrans Avenue Storm Drain System show that the storm drain system is designed to convey 10-year runoff. The downstream reach of the Rosecrans Avenue storm drain will need to be upsized to accommodate the 50-year runoff collected at the sump to adequately discharge the runoff to Coyote Creek North Fork Channel. The



same potential challenges discussed under Alternative 3 regarding the capacity of Coyote Creek would be faced with this alternative.

Refer to Section 12.1.5 for a description of the pump station design capacity.

#### 12.2.6. Railroad Considerations

Alternative 4 consists of the same rail bridge and scope of construction associated with rail facilities as described in Alternative 3 (Section 12.1.6). The same shoofly configuration and temporary reconfiguration of the sidings and lead tracks is also proposed for Alternative 4. Estimated scope and cost of rail related construction and flagging services are identical to Alternative 3.

### 13. Alternatives Withdrawn from Consideration

Alternatives withdrawn from consideration include those which depressed the BNSF tracks (trench) under the roadways, those which shifted the alignment of Rosecrans to the north, and those which raised or lowered Marquardt Avenue.

#### 13.1. Trench for BNSF Tracks

A trench is not feasible due to the close proximity of the Coyote Creek Channel. The BNSF tracks would need to be lowered approximately 30 feet below existing grade to provide adequate vertical clearance underneath Rosecrans Avenue (which would remain at-grade). With the longitudinal slopes permitted by BNSF, it would be impossible to return the tracks to existing grade at the bridge over the Coyote Creek Channel. Depressing the tracks would therefore sever this flood control channel, located less than 0.25 miles northwest of the railroad crossing. Eliminating the flood control channel is not feasible.

Other key concerns are the industrial spur tracks, lead track, and storage tracks to the southeast of the grade crossing. These tracks are important to BNSF's operations, and the connection to these tracks would be severed by any lowering of the tracks. Similarly, raising the BNSF tracks would sever the spur, lead, and storage tracks from the mainline tracks. Modifications to the rail elevations (lowering or raising) are not feasible.

#### 13.2. Shift Rosecrans Avenue to the North

Realigning Rosecrans to the north is not feasible due to the skewed orientation of the BNSF tracks with the Rosecrans/Marquardt intersection. Avoiding impacts to the Coyote Creek Bridge is a key goal, and realigning Rosecrans to the north would reduce the distance between the critical point of vertical clearance over (or under) BNSF's right-of-way and Coyote Creek. Reconstruction of the Coyote Creek Bridge would be necessary, resulting in added project costs, and requiring coordination with Los Angeles County Flood Control, the U.S. Army Corps of Engineers, the Regional Water Quality Control Board, and the California Department of Fish and Wildlife.

#### 13.3. Raise or Lower Marquardt Avenue

Raising or lowering Marquardt Avenue to connect to the raised or lowered portion of Rosecrans Avenue was considered. Raising or lowering Marquardt Avenue is not feasible due to significant right-of-way impacts, primarily due to the loss of access to the properties from Marquardt Avenue, extending approximately 1,000 feet to the north and south of Rosecrans Avenue. As a result, the vast majority of fronting properties within these limits would require full acquisition and relocation, adding significant project costs and greatly affecting the surrounding businesses.

### 14. Recommended Alternative

The three goals of the project guided the development of each of the alternatives. Additionally, each of the four alternatives was evaluated on their consistency with the key project considerations, which provides a direct comparison between the alternatives. The summary of this comparison is shown in Table 4.

*Table 4. Alternatives Comparison Matrix*

	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Right-of-way impacts	9 Full / 5 Partial	8 Full / 7 Partial	7 Full / 2 Partial	7 Full / 2 Partial
Traffic impacts during construction	Closed 6 months	Rosecrans open	Closed 30 months	Closed 30 months
Access to businesses (during construction)	Moderate impacts	Minimal impacts	Moderate impacts	Moderate impacts
Access to businesses (post-construction)	Full access	Full access	Full access	Full access
Extent of utility relocations	Moderate	Minimal	Significant	Significant
Duration of construction	22-26 months	18-22 months	36-40 months	36-40 months
Impacts to railroad operations	Minimal (no shoofly)	Minimal (no shoofly)	Requires shoofly tracks	Requires shoofly tracks
Accommodates future high speed rail	Yes	Yes	Bridge conflict	Bridge conflict
Visual impact to surrounding community	Overhead structure	Overhead structure	Underpass	Underpass
Capital cost	\$115.41M	\$107.56M	\$132.41M	\$128.67M

Legend



Preferred



Acceptable



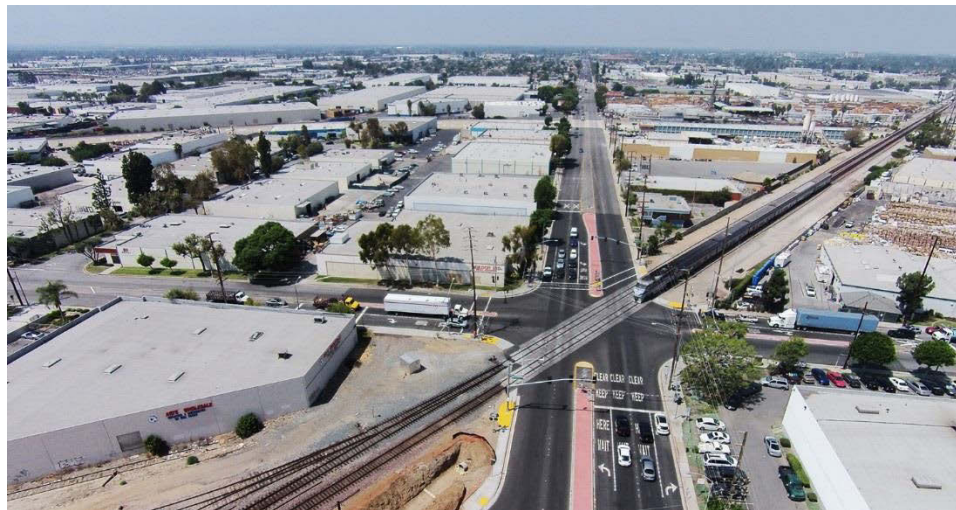
Does not meet project goals

Alternative 2, although subject to somewhat higher right-of-way impacts, satisfies all project goals with the lowest cost. Connectivity between Rosecrans Avenue, Marquardt Avenue, Stage Road, and Anson Avenue is maintained through the use of signalized intersections and a connector road. Utilities currently in the existing roadway can remain in their existing alignment, shortening the duration of construction. Structures are located outside of the BNSF right-of-way, meaning that a third BNSF mainline and future HSR tracks could be installed without requiring bridge widening or partial demolition and reconstruction. A vast majority of construction activities for this alternative occur outside of the existing footprint of Rosecrans Avenue, meaning that impacts to rail, vehicular, and pedestrian traffic will be minimal. Disruptions to residents, businesses, and the community during construction will be lessened. Alternative 2 will enhance mobility and

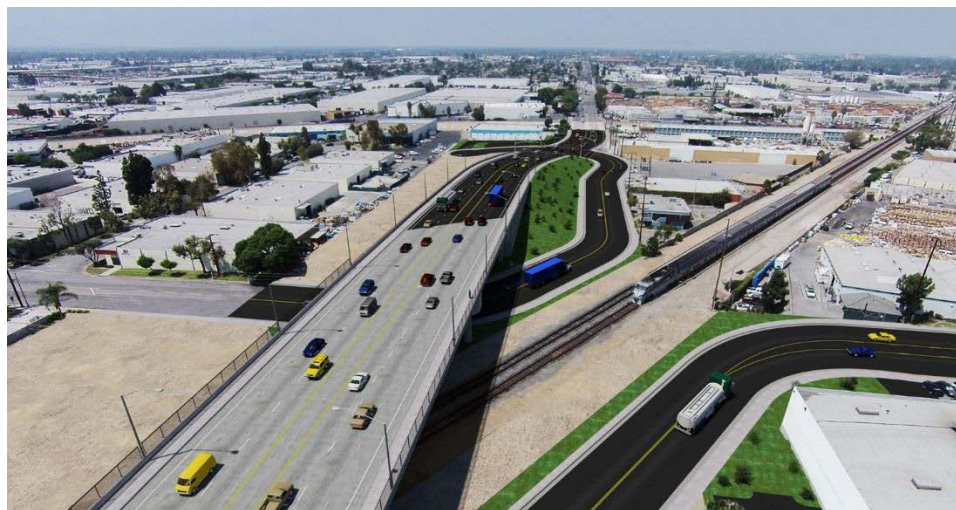
quality of life for the community. For these reasons, the recommended alternative for the Rosecrans/Marquardt Grade Separation project is Alternative 2. Alternative 2 is recommended to be advanced into the environmental clearance phase, and the PS&E phase.



**Figure 26. Recommended Alternative – Plan View of Alternative 2**



**Figure 27. Aerial View of Existing Conditions**



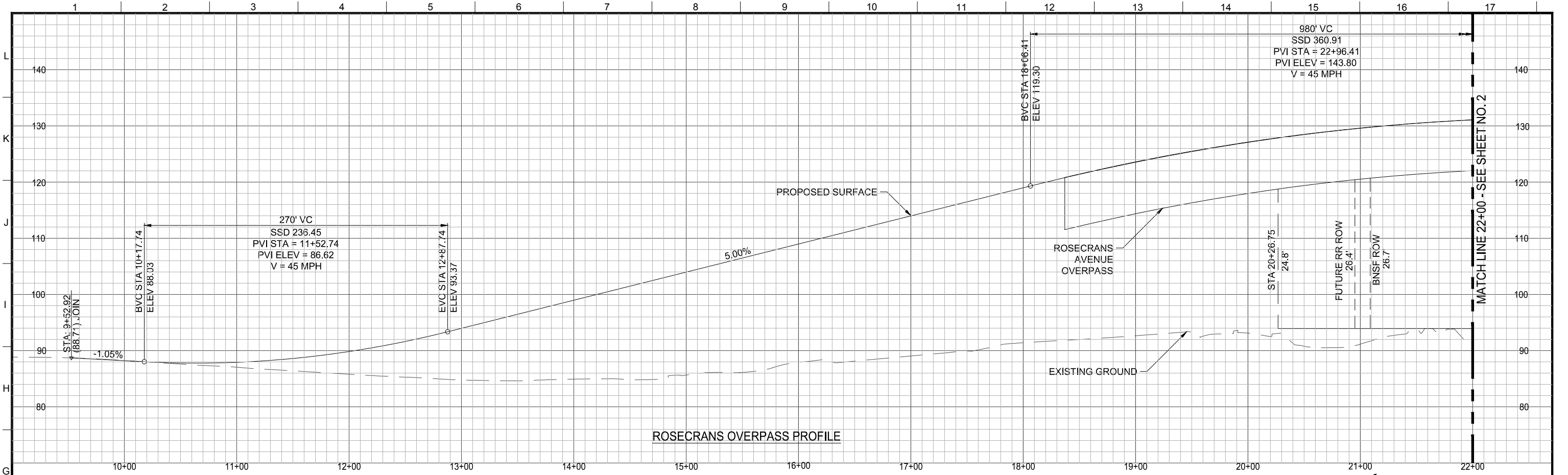
**Figure 28. Photosimulation of Proposed Conditions for Recommended Alternative – Alternative 2**



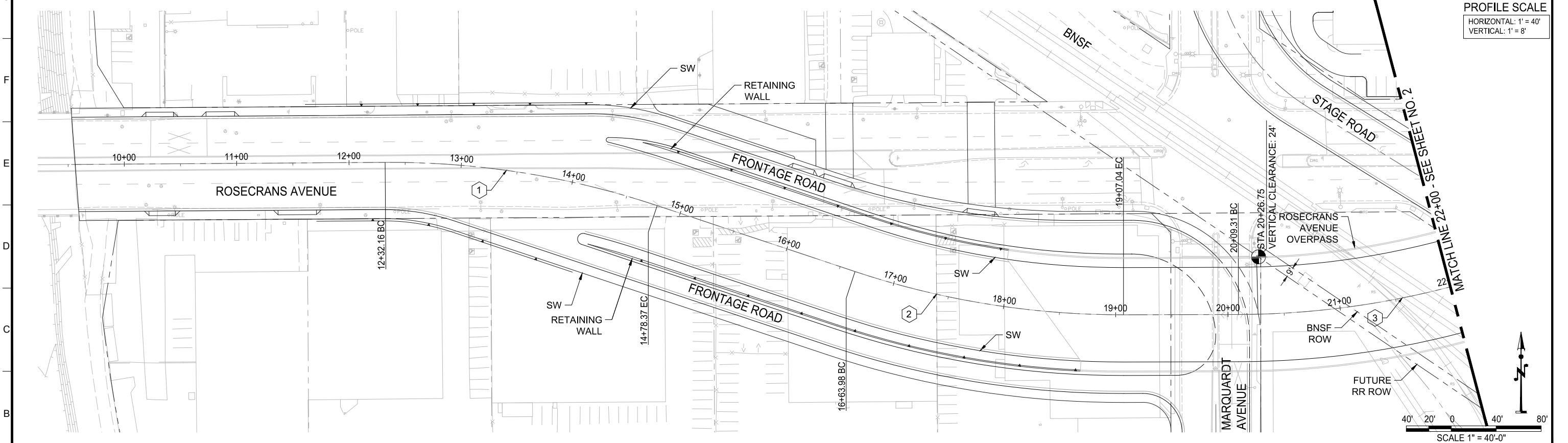
## Appendix A: Alternative 1

Plan and Profile

J:\63556\_Metro\_Rosecrans-Marquardt\_CS\00\_CADD\Design\_Documents\Phase 1\PL-ALT 1.dwg 9/18/15 13:20



PROFILE SCALE  
 HORIZONTAL: 1" = 40'  
 VERTICAL: 1" = 8'



CURVE TABLE				
④	DELTA/BRG	RADIUS	LENGTH	TANGENT
①	S80° 58' 38"E	750.00	246.21	246.21
②	S80° 51' 25"E	750.00	243.06	243.06
③	N77° 51' 35"E	750.00	314.13	314.13

FOR  
 INFORMATION  
 ONLY  
 NOT FOR  
 CONSTRUCTION

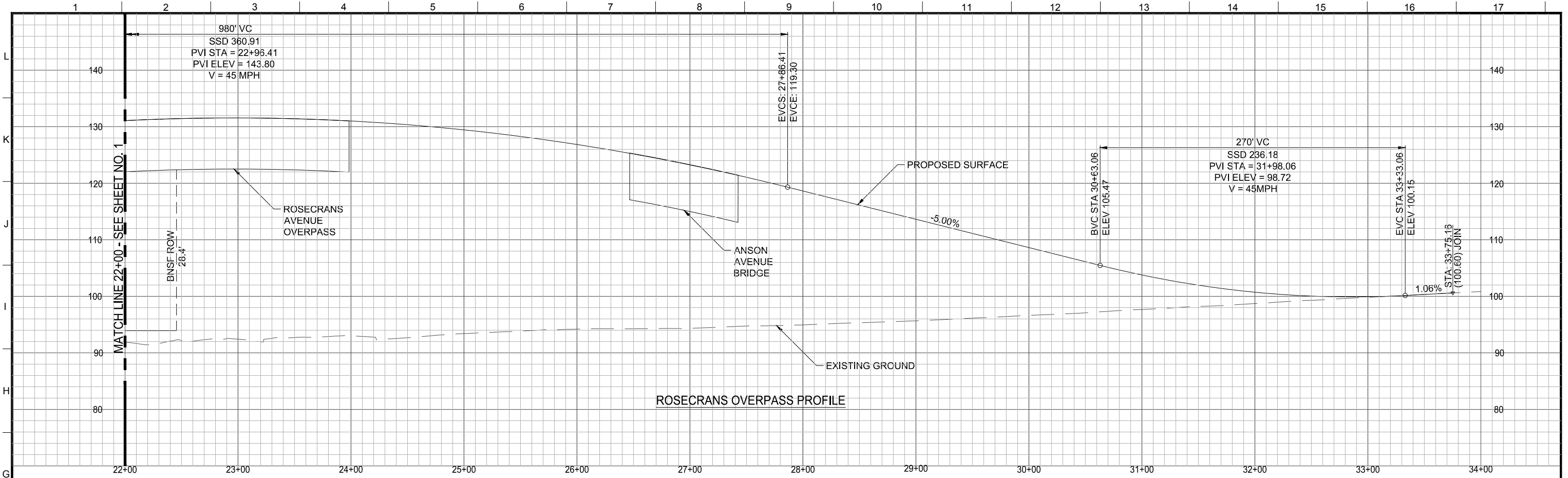


**HNTB**  
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 Santa Ana, CA 92707  
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ROSECRANS / MARQUARDT  
 GRADE SEPARATION PROJECT  
 ALTERNATIVE 1  
 PLAN & PROFILE  
 SANTA FE SPRINGS, CA

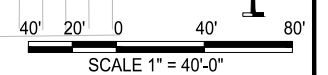
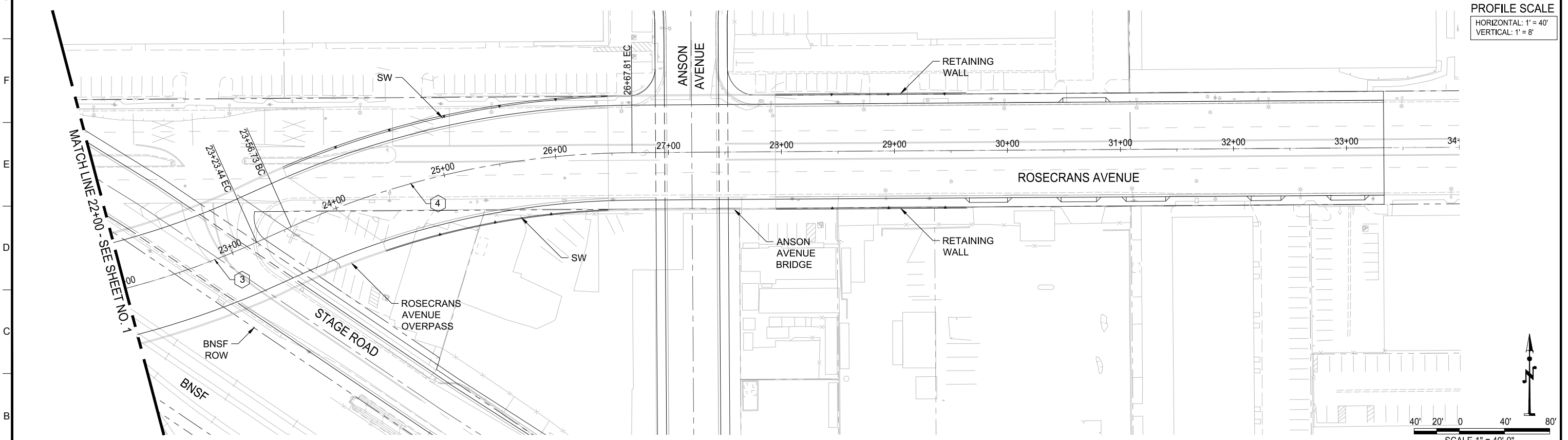
DRAWING NO.  
 SHEET 1 OF 2 SHEETS

J:\63556\_Metro\_Rosecrans-Marquardt\_CS\00\_CADD\Design\_Documents\Phase 1\PL-ALT 1.dwg 9/18/15 13:20



ROSECRANS OVERPASS PROFILE

PROFILE SCALE  
 HORIZONTAL: 1" = 40'  
 VERTICAL: 1" = 8'



CURVE TABLE			
DELTA/BRG	RADIUS	LENGTH	TANGENT
③ N77° 51' 35"E	750.00	314.13	314.13
④ N77° 44' 35"E	750.00	311.08	311.08

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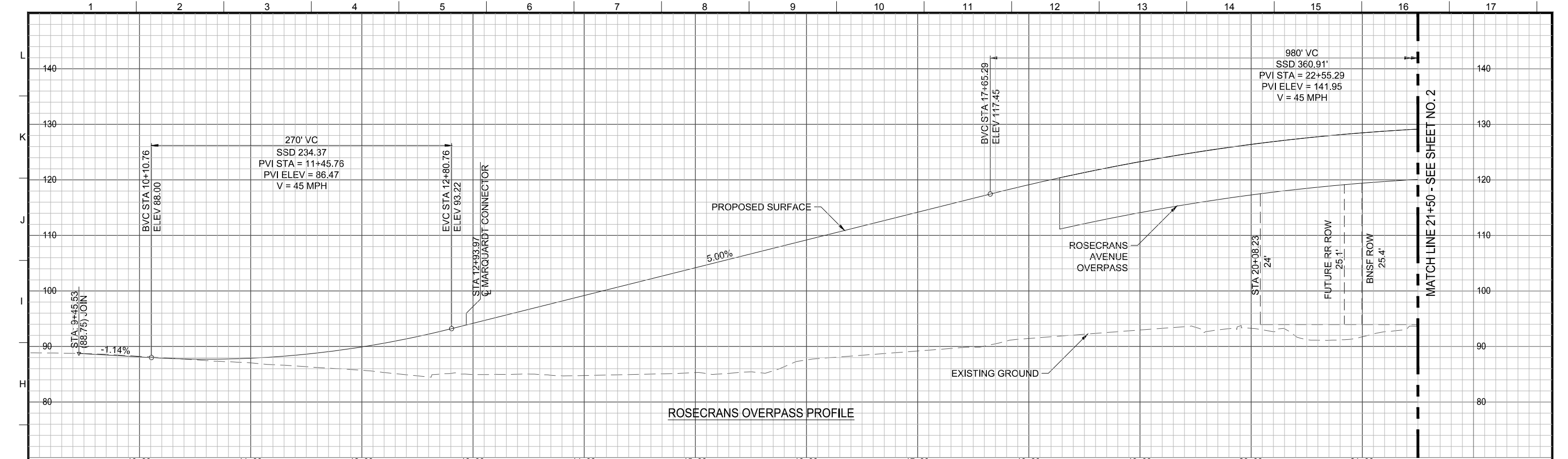
ROSECRANS / MARQUARDT  
 GRADE SEPARATION PROJECT  
 ALTERNATIVE 1  
 PLAN & PROFILE  
 SANTA FE SPRINGS, CA

DRAWING NO.  
 SHEET 2 OF 2 SHEETS



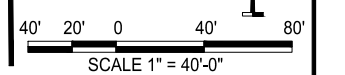
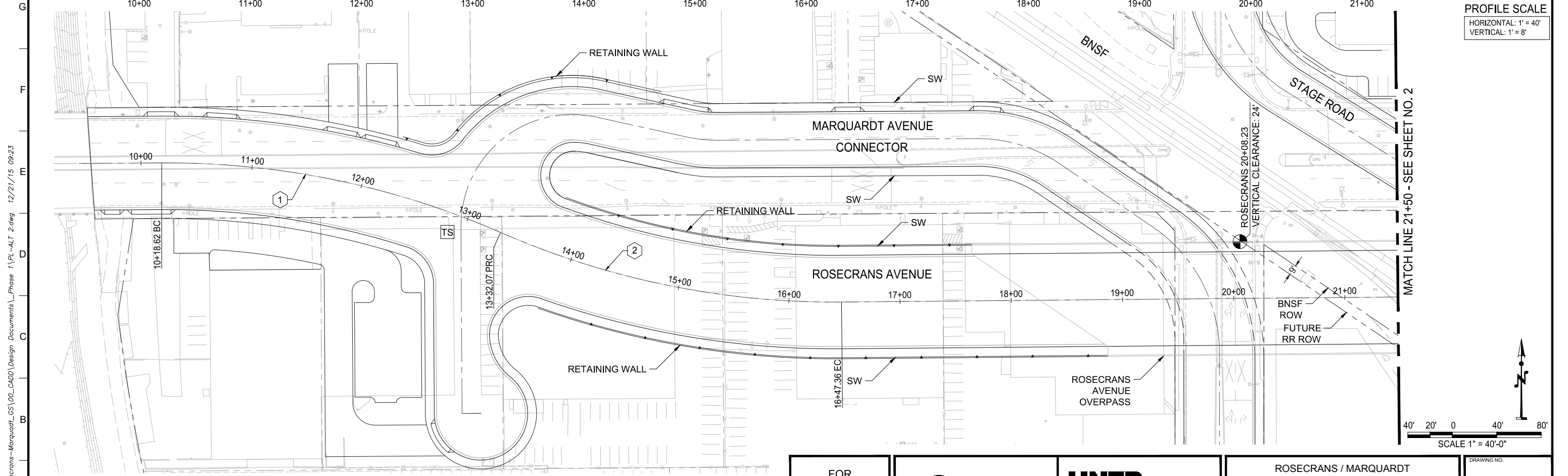
## Appendix B: Alternative 2

Plan and Profile



ROSECRANS OVERPASS PROFILE

PROFILE SCALE  
 HORIZONTAL: 1" = 40'  
 VERTICAL: 1" = 8'



CURVE TABLE				
#	DELTA/BRG	RADIUS	LENGTH	TANGENT
①	S78° 24' 32"E	750.00	313.45	313.45
②	S78° 28' 45"E	750.00	315.29	315.29

FOR  
 INFORMATION  
 ONLY  
 NOT FOR  
 CONSTRUCTION

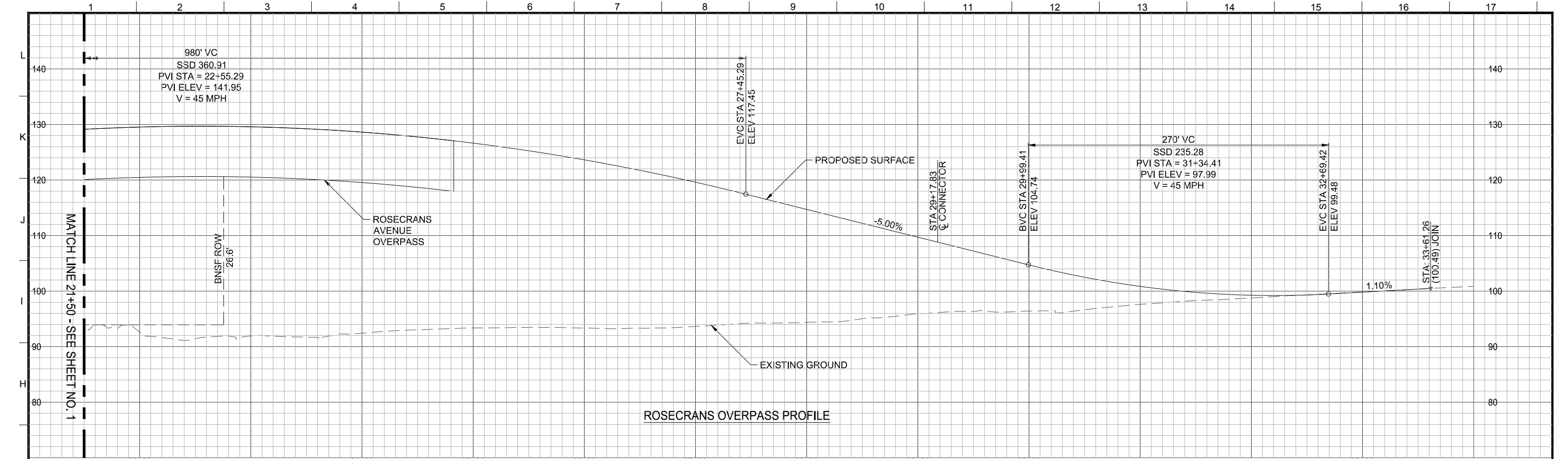


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ROSECRANS / MARQUARDT  
 GRADE SEPARATION PROJECT  
 ALTERNATIVE 2  
 PLAN & PROFILE  
 SANTA FE SPRINGS, CA

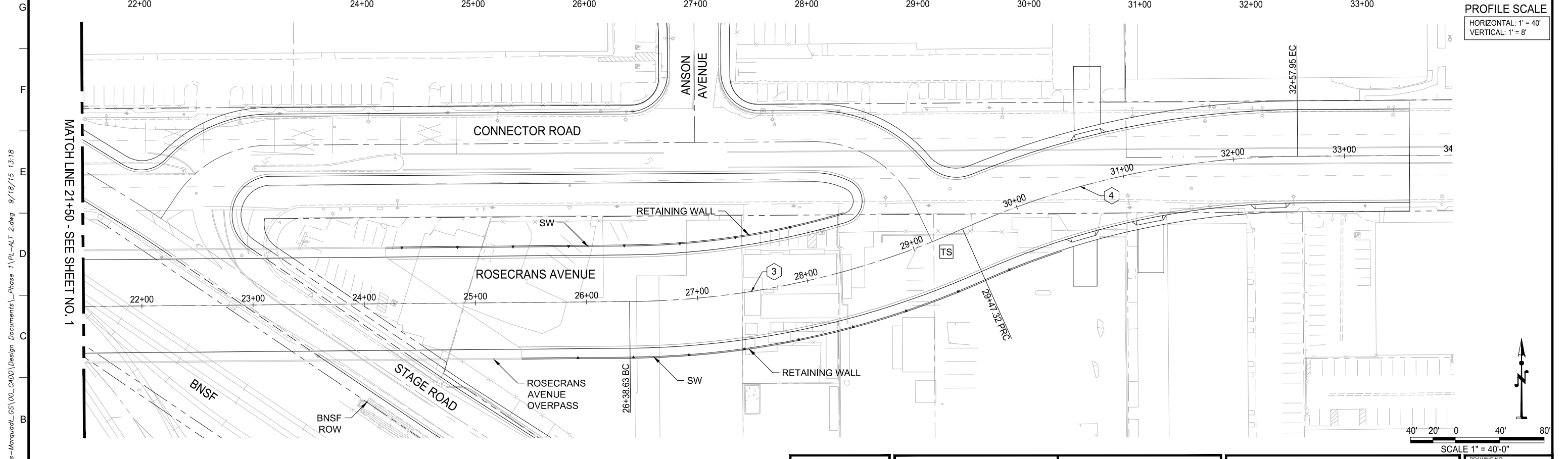
DRAWING NO.  
 SHEET 1 OF 2 SHEETS

J:\63556\_Metro\_Rosecrans-Marquardt\GS\00\_CADD\Design Documents\Phase 1\PL-ALT 2.dwg 12/21/15 09:23



ROSECRANS OVERPASS PROFILE

PROFILE SCALE  
 HORIZONTAL: 1" = 40'  
 VERTICAL: 1" = 8'



CURVE TABLE				
④	DELTA/BRG	RADIUS	LENGTH	TANGENT
③	N77° 41' 12"E	750.00	308.69	308.69
④	N77° 45' 38"E	750.00	310.62	310.62

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 GRADE SEPARATION PROJECT  
 ALTERNATIVE 2  
 PLAN & PROFILE  
 SANTA FE SPRINGS, CA

DRAWING NO.  
 SHEET 2 OF 2 SHEETS

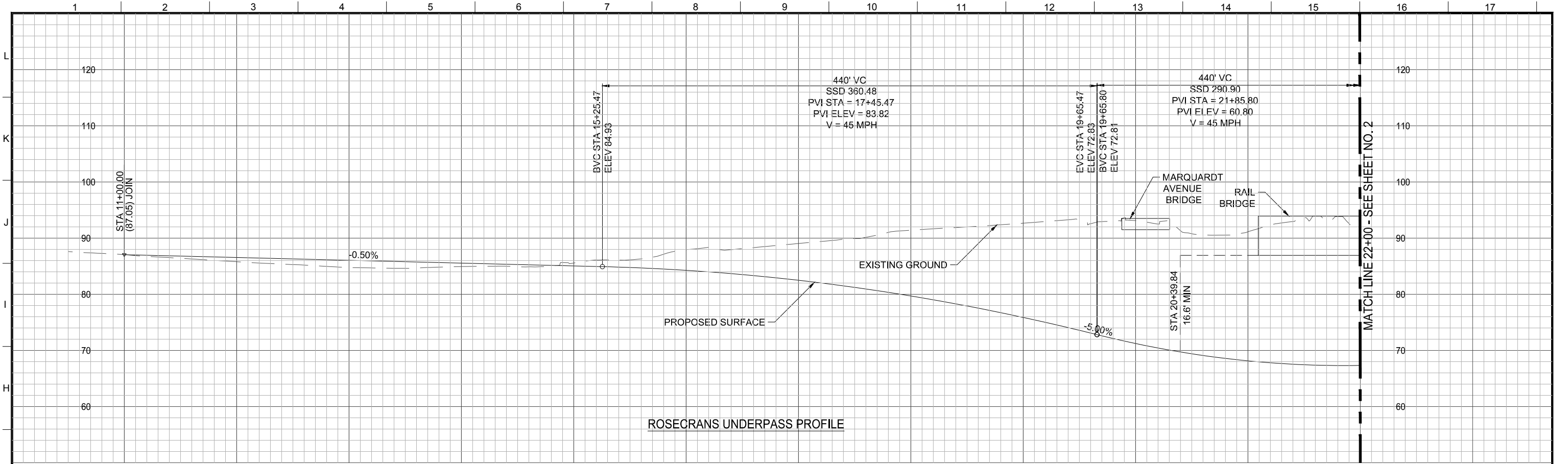
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## Appendix C: Alternative 3

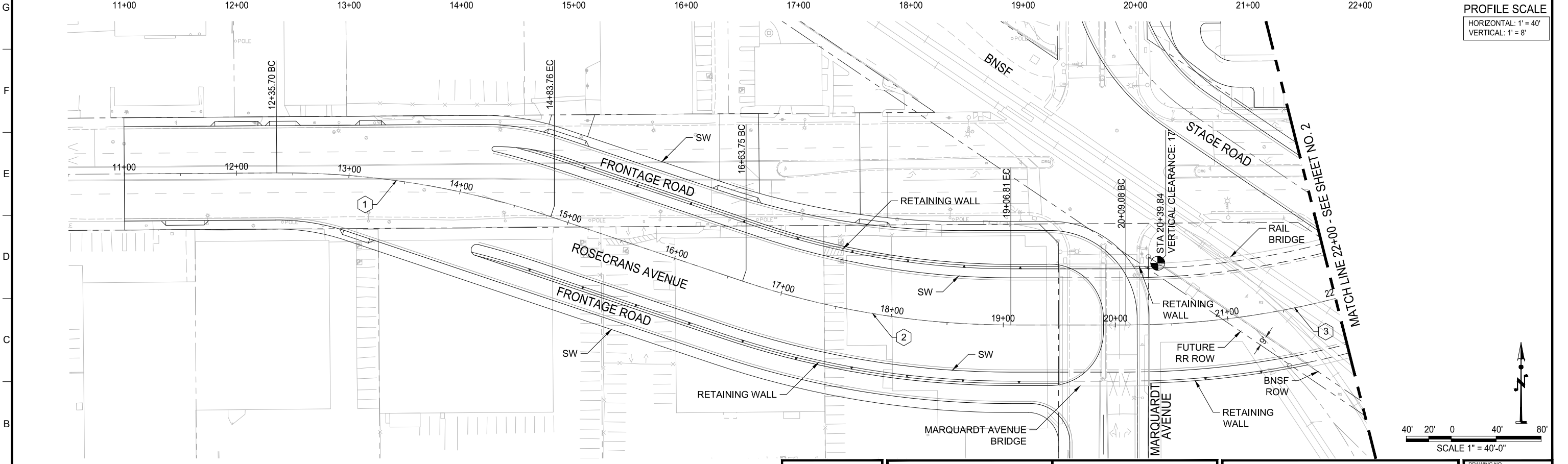
Plan and Profile

J:\63556\_Metro\_Rosecrans-Marquardt\_CS\00\_CADD\Design\_Documents\Phase 1\PL-ALT 3.dwg 9/18/15 13:04



ROSECRANS UNDERPASS PROFILE

PROFILE SCALE  
 HORIZONTAL: 1" = 40'  
 VERTICAL: 1" = 8'



CURVE TABLE				
②	DELTA/BRG	RADIUS	LENGTH	TANGENT
①	S80° 54' 24"E	750.00	248.06	248.06
②	S80° 42' 57"E	750.00	243.06	243.06
③	N78° 00' 04"E	750.00	314.13	314.13

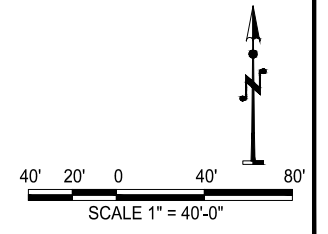
FOR INFORMATION ONLY  
 NOT FOR CONSTRUCTION

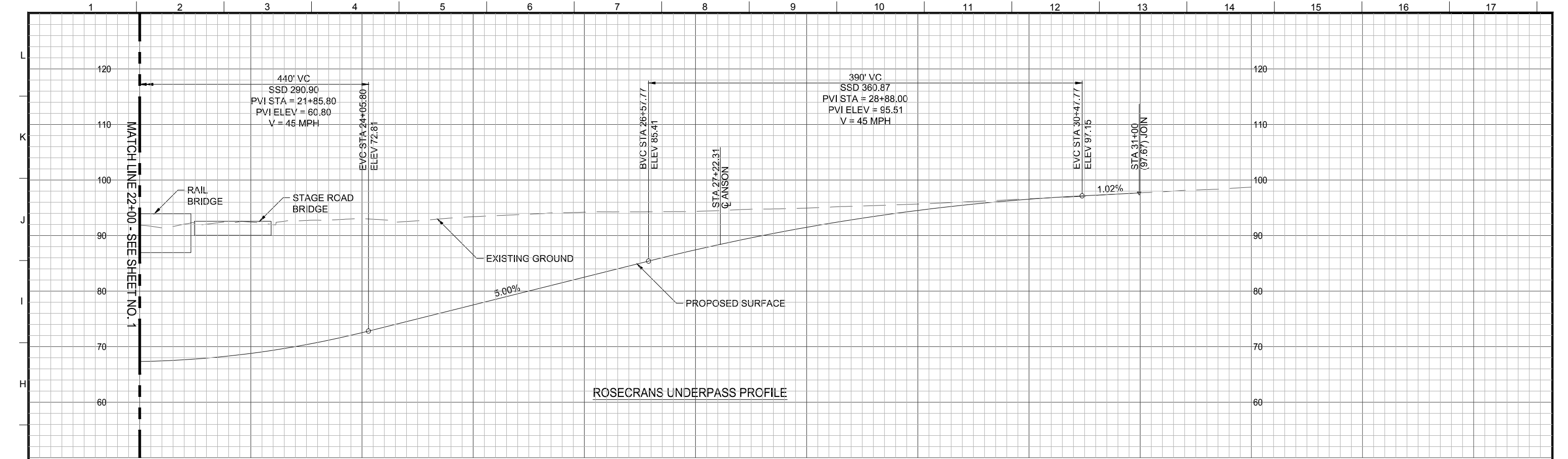


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ROSECRANS / MARQUARDT  
 GRADE SEPARATION PROJECT  
 ALTERNATIVE 3  
 PLAN & PROFILE  
 SANTA FE SPRINGS, CA

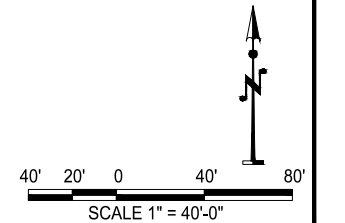
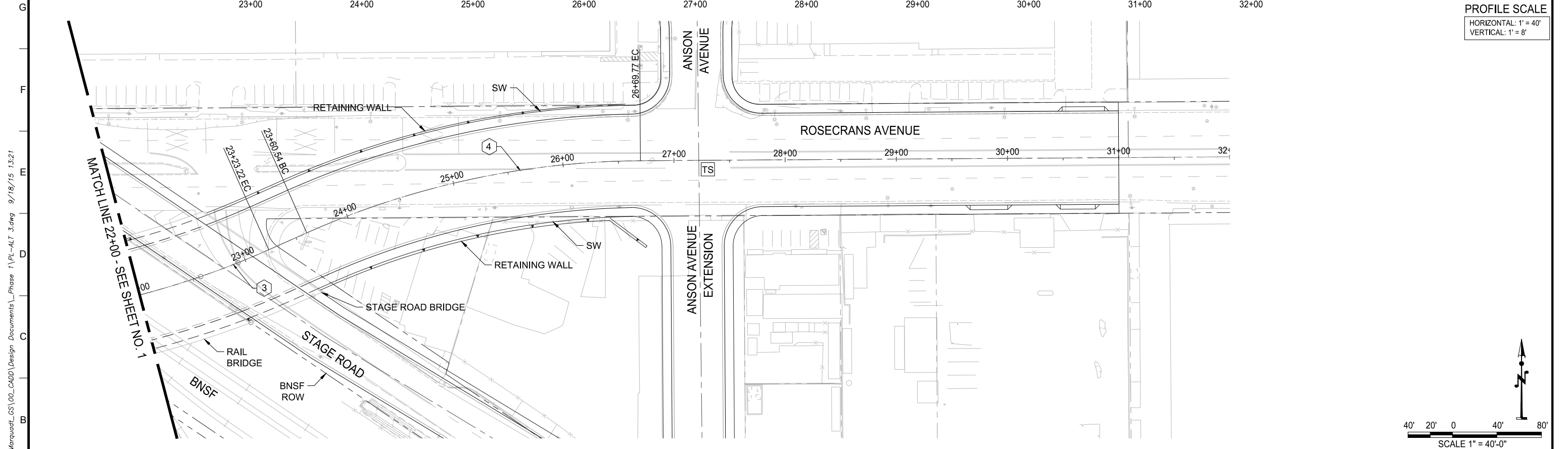
DRAWING NO.  
 SHEET 1 OF 2 SHEETS





ROSECRANS UNDERPASS PROFILE

PROFILE SCALE  
 HORIZONTAL: 1" = 40'  
 VERTICAL: 1" = 8'



CURVE TABLE				
#	DELTA/BRG	RADIUS	LENGTH	TANGENT
③	N78° 00' 04"E	750.00	314.13	314.13
④	N77° 48' 50"E	750.00	309.23	309.23

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 GRADE SEPARATION PROJECT  
 ALTERNATIVE 3  
 PLAN & PROFILE  
 SANTA FE SPRINGS, CA

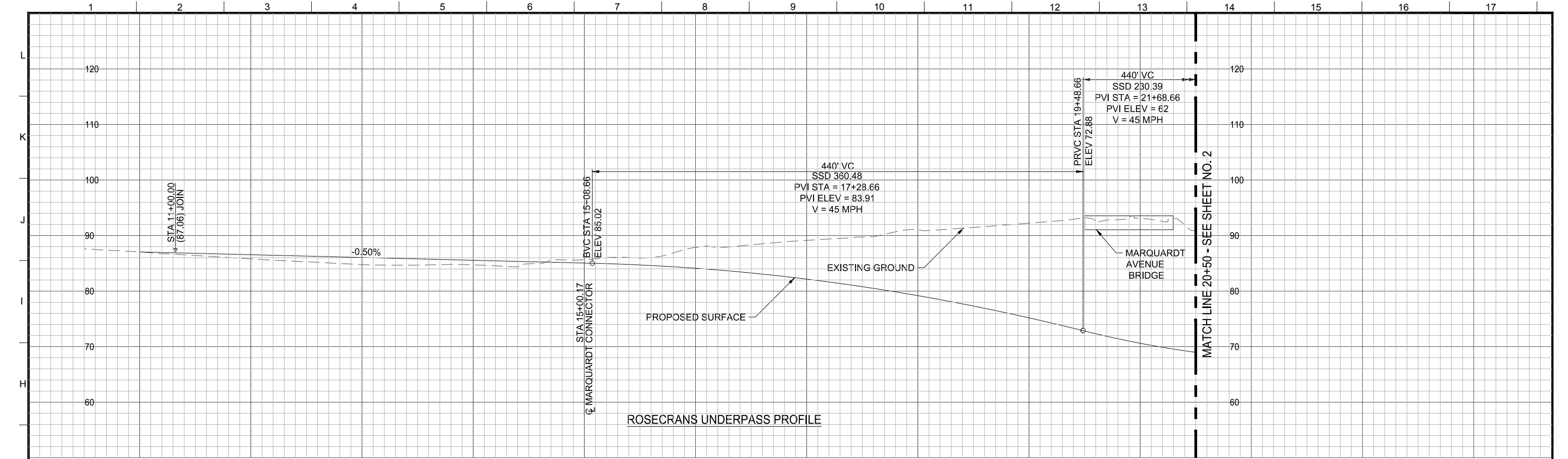
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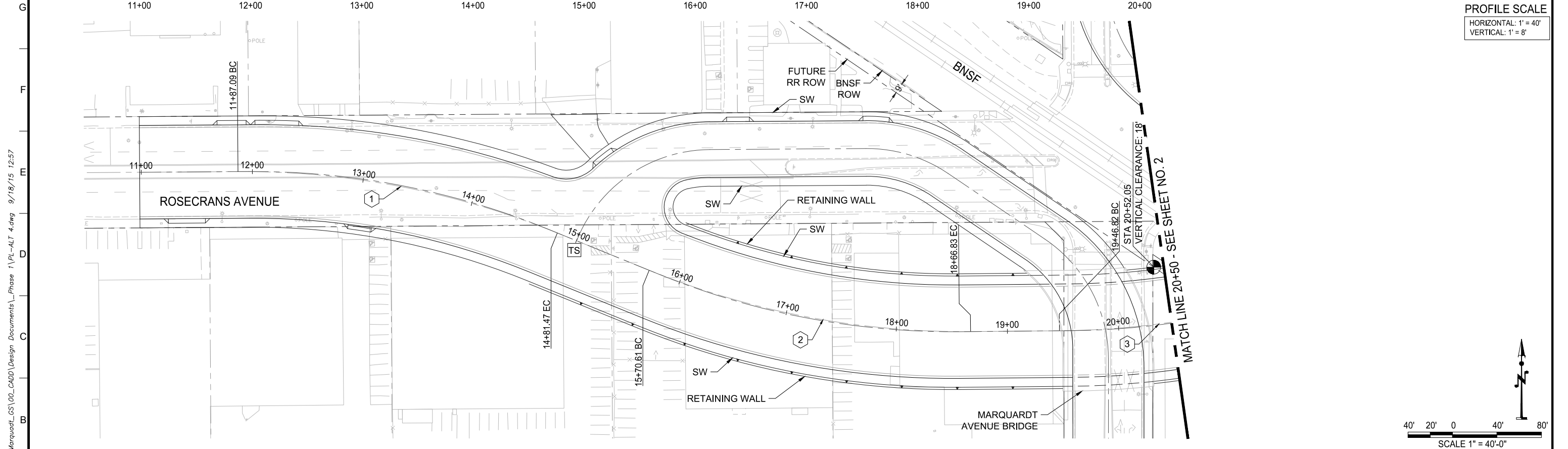
## Appendix D: Alternative 4

Plan and Profile



ROSECRANS UNDERPASS PROFILE

PROFILE SCALE  
 HORIZONTAL: 1" = 40'  
 VERTICAL: 1" = 8'



CURVE TABLE				
#	DELTA/BRG	RADIUS	LENGTH	TANGENT
①	S79° 08' 13"E	750.00	294.38	294.38
②	S79° 12' 27"E	750.00	296.22	296.22
③	N78° 09' 47"E	750.00	296.22	296.22

FOR  
 INFORMATION  
 ONLY  
 NOT FOR  
 CONSTRUCTION

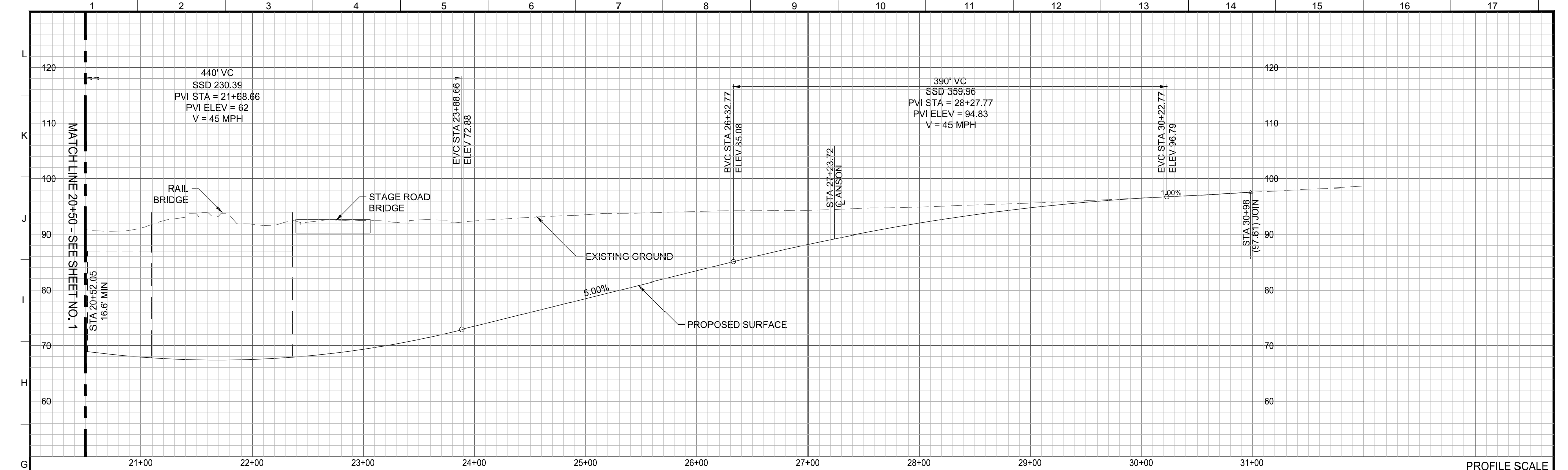


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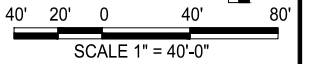
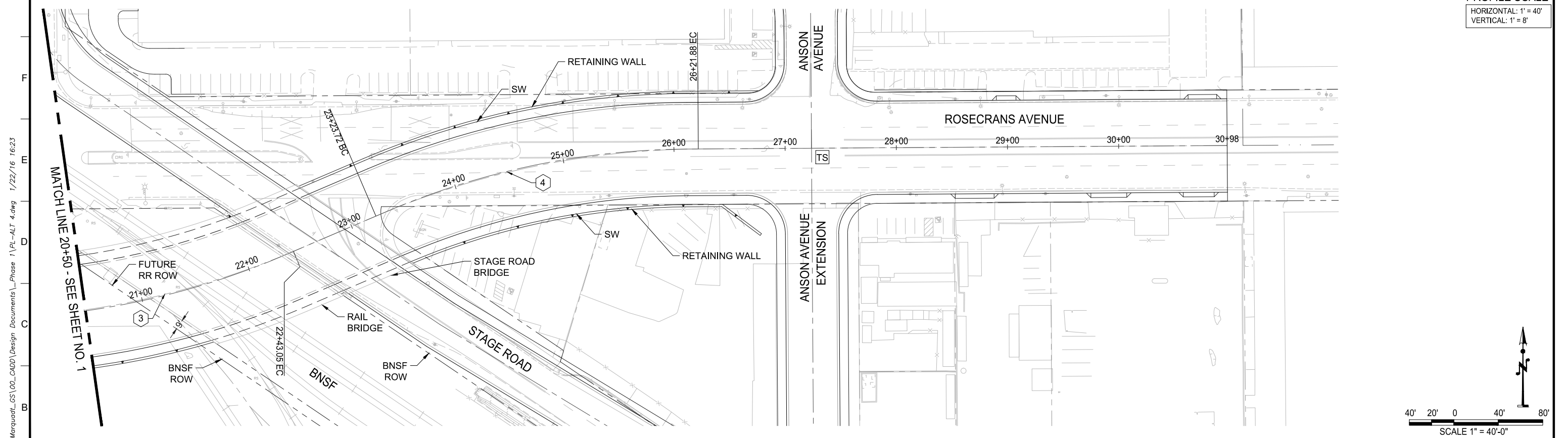
ROSECRANS / MARQUARDT  
 GRADE SEPARATION PROJECT  
 ALTERNATIVE 4  
 PLAN & PROFILE  
 SANTA FE SPRINGS, CA

DRAWING NO.  
 SHEET 1 OF 2 SHEETS

J:\63556\_Metro\_Rosecrans-Marquardt\_CS\00\_CADD\Design\_Documentis\Phase 1\PL-ALT 4.dwg 9/18/15 12:57



PROFILE SCALE  
HORIZONTAL: 1" = 40'  
VERTICAL: 1" = 8'



CURVE TABLE			
Δ	DELTA/BRG	RADIUS	LENGTH TANGENT
③	N78° 09' 47"E	750.00	296.22 296.22
④	N78° 14' 13"E	750.00	298.16 298.16

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Santa Ana, CA 92707  
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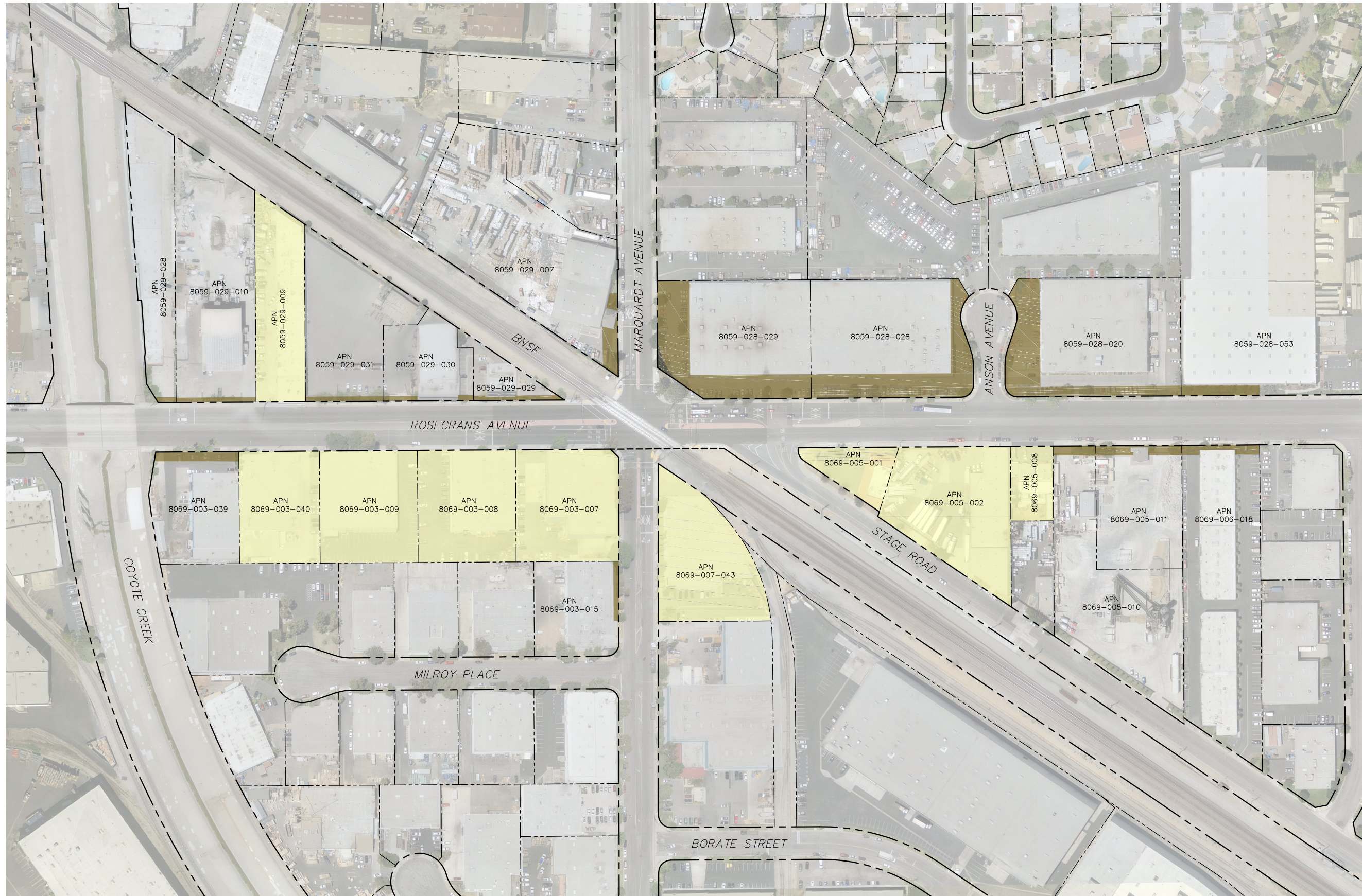
ROSECRANS / MARQUARDT  
GRADE SEPARATION PROJECT  
ALTERNATIVE 4  
PLAN & PROFILE  
SANTA FE SPRINGS, CA

DRAWING NO.  
SHEET 2 OF 2 SHEETS

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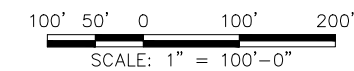
## Appendix E: Right-of-Way Exhibits

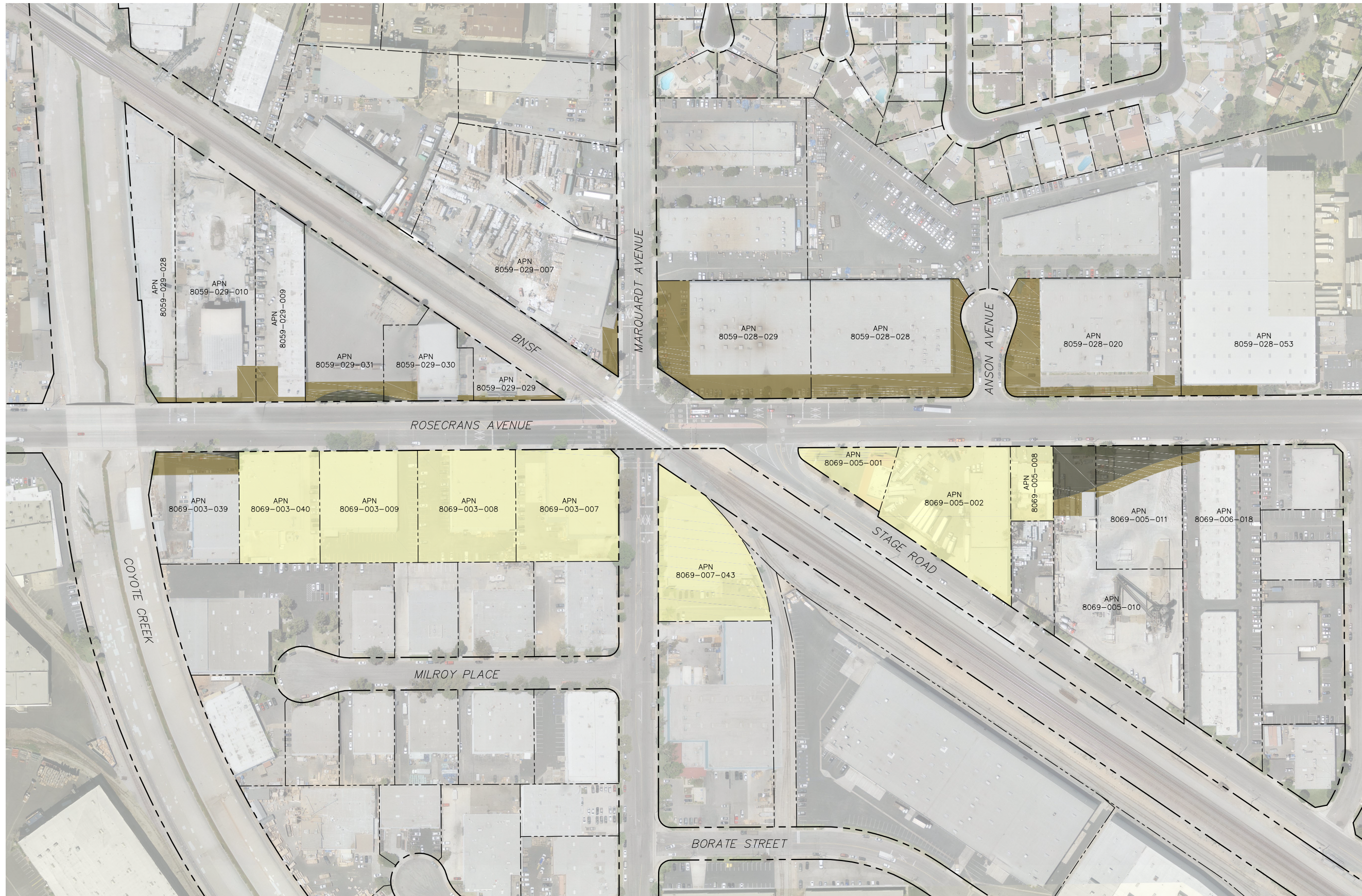


- LEGEND**
- FULL ACQUISITION
  - PARTIAL ACQUISITION
  - TEMPORARY CONSTRUCTION EASEMENT (TCE)



**ROSECRANS/MARQUARDT GRADE SEPARATION PROJECT**  
 RIGHT-OF-WAY EXHIBIT | ALTERNATIVE 1

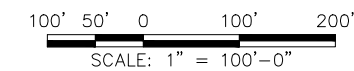


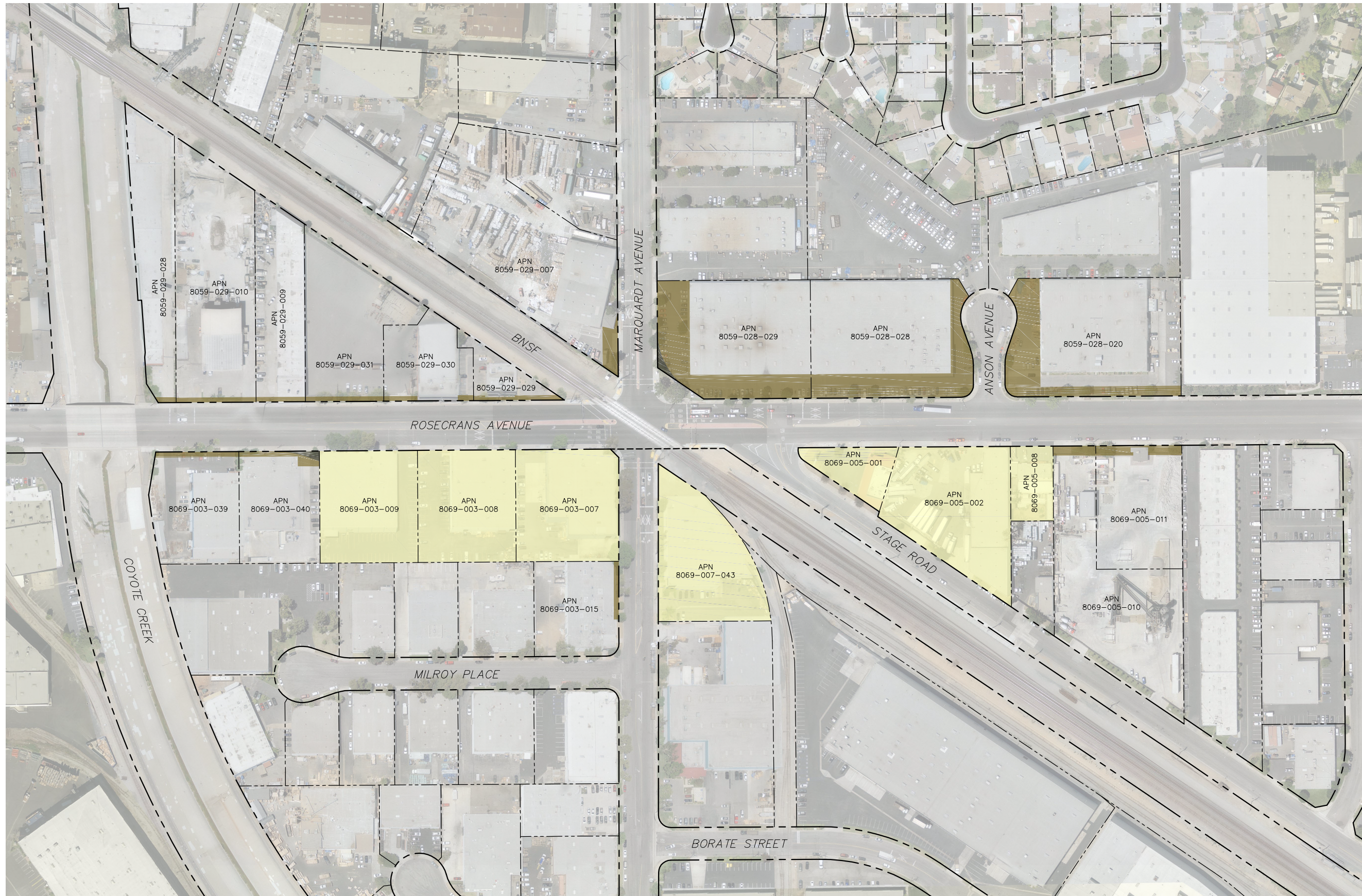


- LEGEND**
- FULL ACQUISITION
  - PARTIAL ACQUISITION
  - TEMPORARY CONSTRUCTION EASEMENT (TCE)



**ROSECRANS/MARQUARDT GRADE SEPARATION PROJECT**  
 RIGHT-OF-WAY EXHIBIT | ALTERNATIVE 2





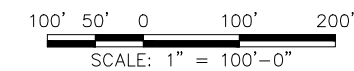
- LEGEND**
- FULL ACQUISITION
  - PARTIAL ACQUISITION
  - TEMPORARY CONSTRUCTION EASEMENT (TCE)

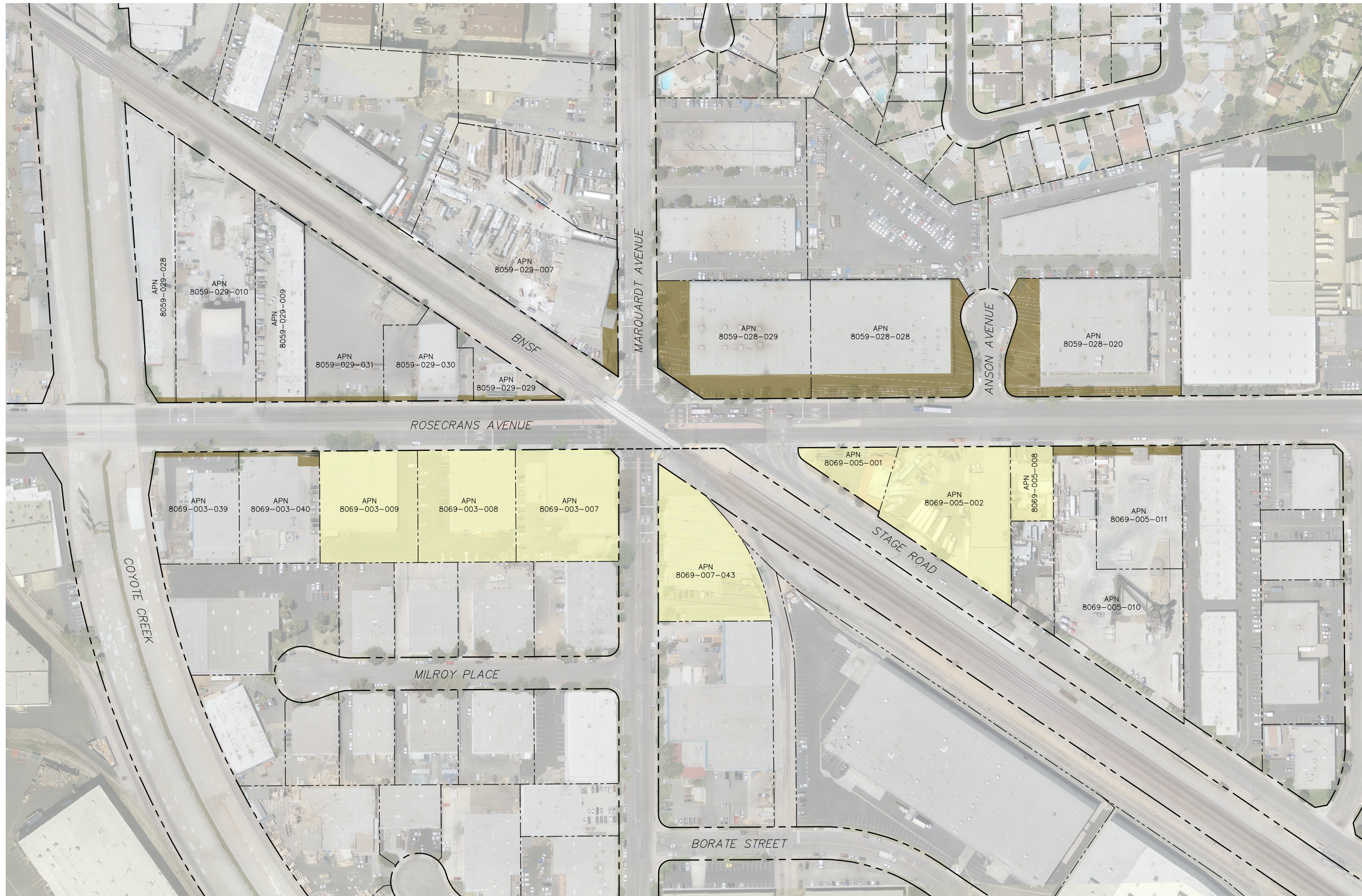


**Metro**

# ROSECRANS/MARQUARDT GRADE SEPARATION PROJECT

RIGHT-OF-WAY EXHIBIT | ALTERNATIVE 3





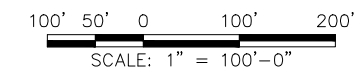
- LEGEND**
- FULL ACQUISITION
  - PARTIAL ACQUISITION
  - TEMPORARY CONSTRUCTION EASEMENT (TCE)



**Metro**

# ROSECRANS/MARQUARDT GRADE SEPARATION PROJECT

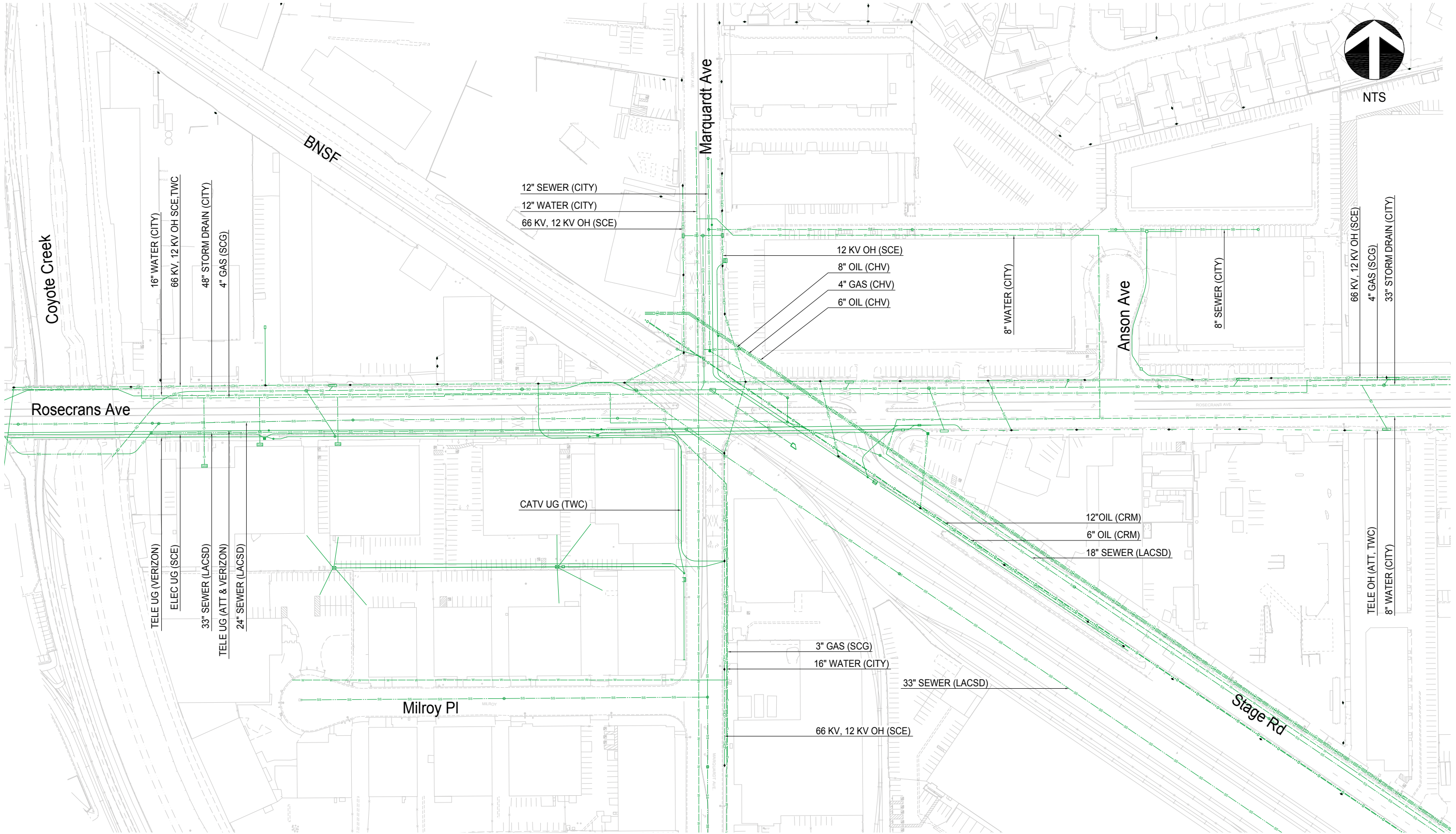
RIGHT-OF-WAY EXHIBIT | ALTERNATIVE 4





## Appendix F: Utility Exhibits

FILE NAME: J:\163556\_Metro\_Rosecrans-Marquardt\_GS100\_CADD\Exhibits\_Phase 1\EXIST UTILITY.dwg PLOTTED: Monday, December 21, 2015 - 7:55am USER: jmartinez



NTS



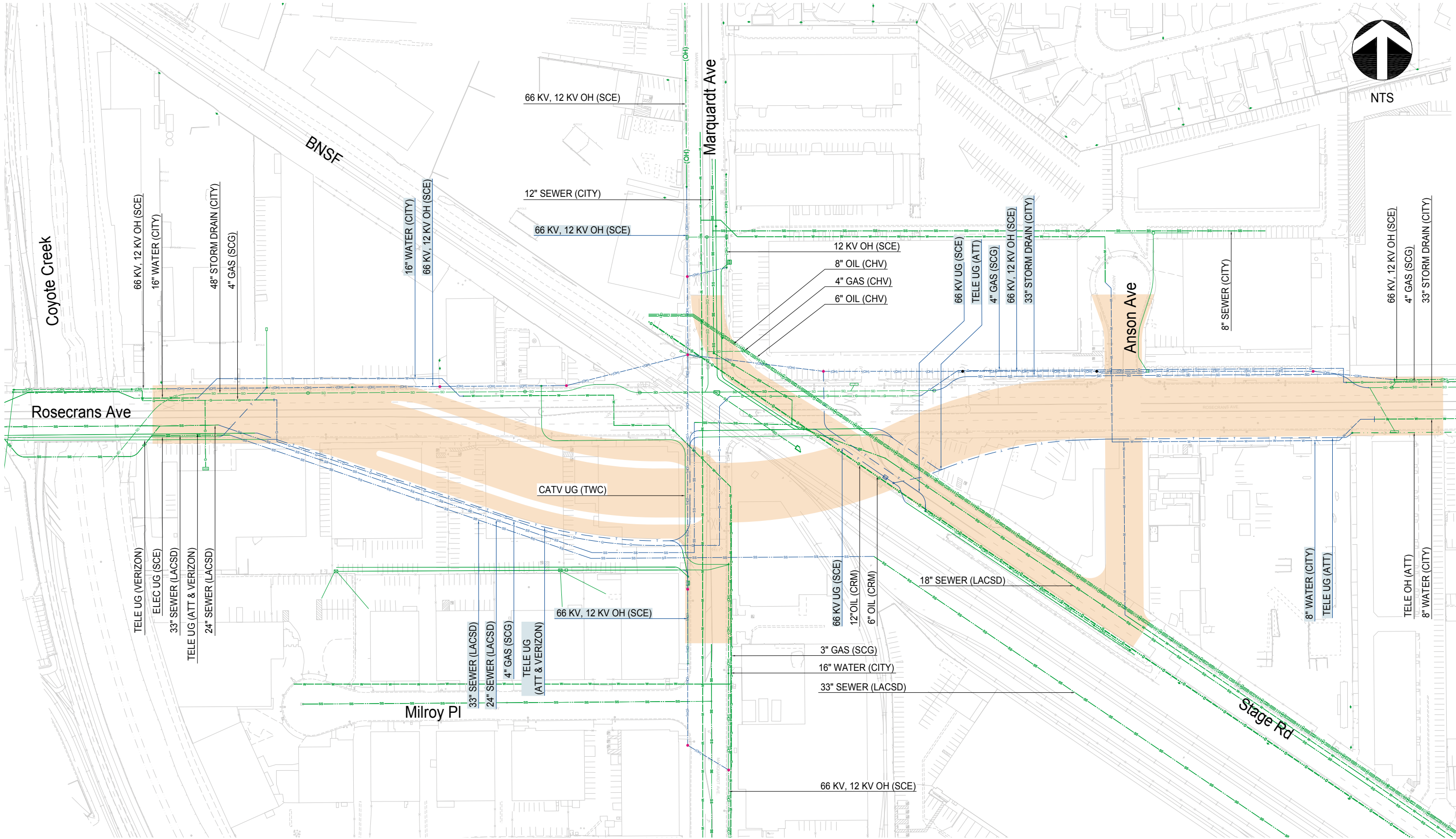
**ROSECRANS/MARQUARDT GRADE SEPARATION PROJECT**  
 PROPOSED UTILITY EXHIBIT | EXISTING

**LEGEND**

- ALTERNATIVE FOOTPRINT
- EXISTING UTILITY
- PROPOSED UTILITY
- PROPOSED STEEL POLE
- PROPOSED WOOD POLE



FILE NAME: J:\163556\_Metro\_Rosecrans-Marquardt\_Phase 1\PROP UTIL-ALT 1.dwg PLOTTED: Thursday, September 17, 2015 - 4:54pm USER: jymartinez



### ROSECRANS/MARQUARDT GRADE SEPARATION PROJECT PROPOSED UTILITY EXHIBIT | ALTERNATIVE 1

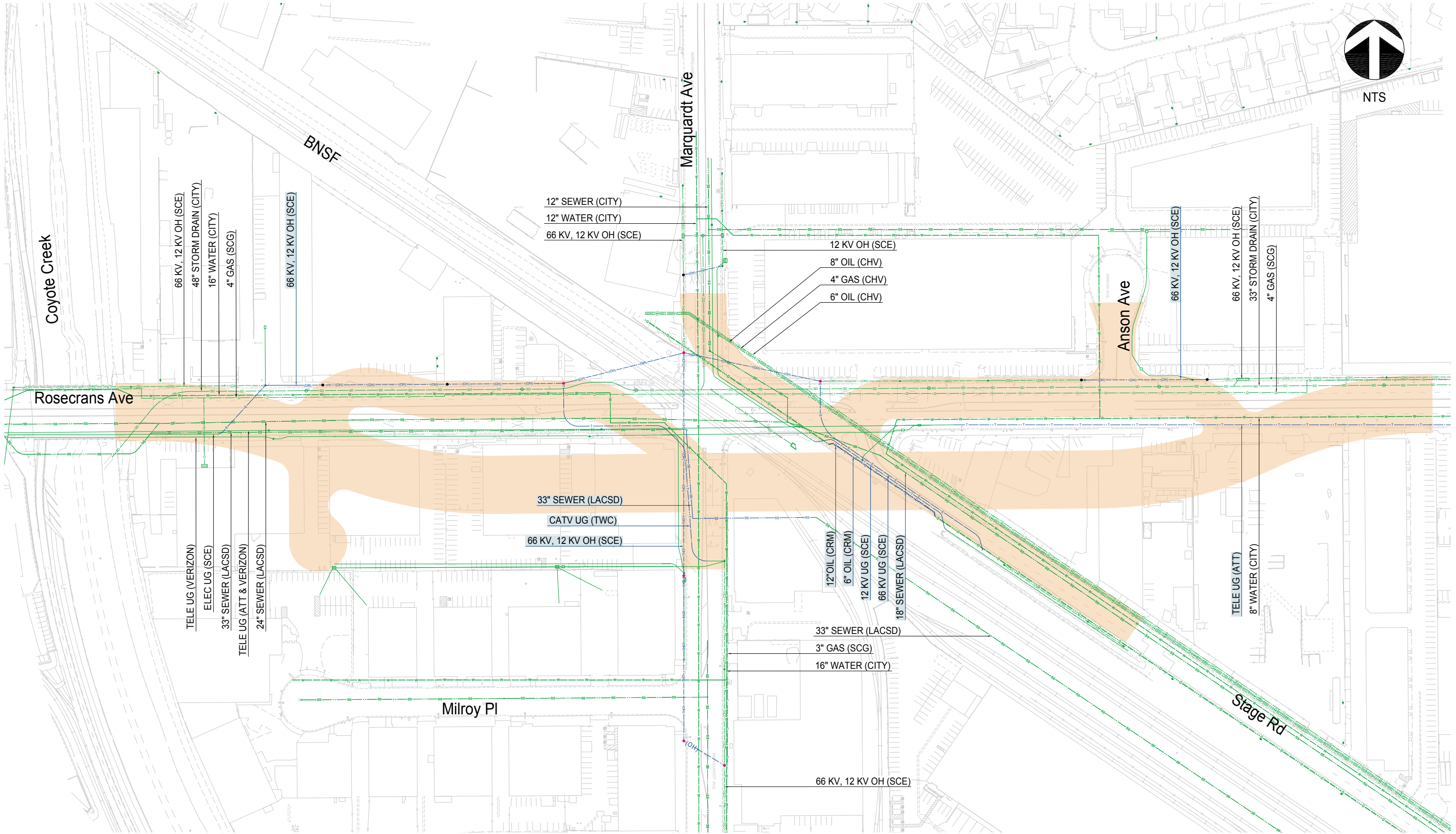
LEGEND	
	ALTERNATIVE FOOTPRINT
	EXISTING UTILITY
	PROPOSED UTILITY
	PROPOSED STEEL POLE
	PROPOSED WOOD POLE



FILE NAME: J:\6356\_Metro\_Rosecrans-Marquardt\_GS100\_CADD\Exhibits\_Phase 1\PROP UTIL-ALT 2.dwg PLOTTED: Thursday, September 17, 2015 - 4:54pm USER: jymartinez



NTS



**ROSECRANS/MARQUARDT GRADE SEPARATION PROJECT**  
 PROPOSED UTILITY EXHIBIT | ALTERNATIVE 2

**LEGEND**

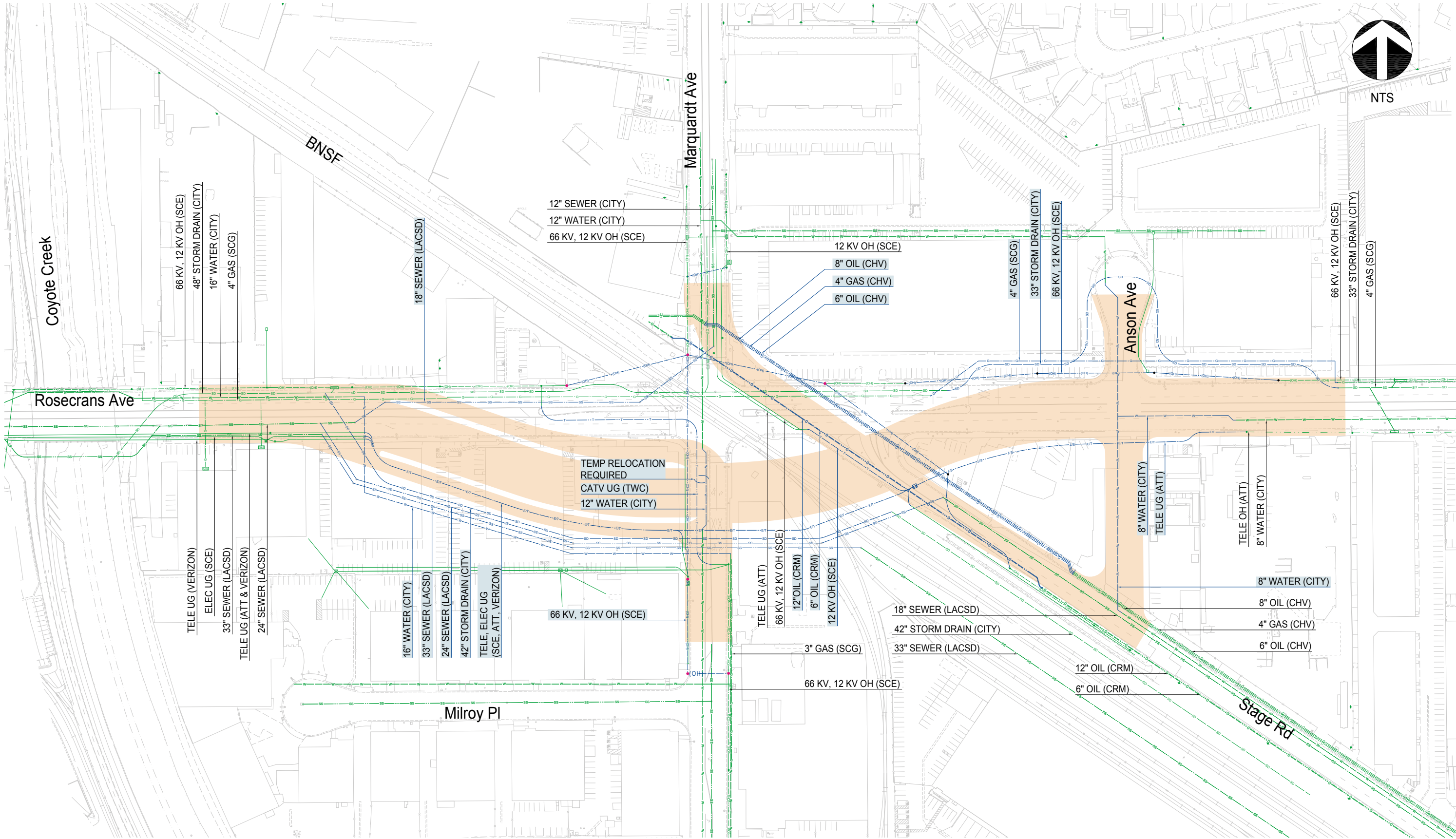
- ALTERNATIVE FOOTPRINT
- EXISTING UTILITY
- PROPOSED UTILITY
- PROPOSED STEEL POLE
- PROPOSED WOOD POLE



FILE NAME: J:\63556\_Metro\_Rosecrans-Marquardt\_Phase 1\PROP UTIL-ALT 3.dwg PLOTTED: Thursday, September 17, 2015 - 4:53pm USER: jymartinez



NTS



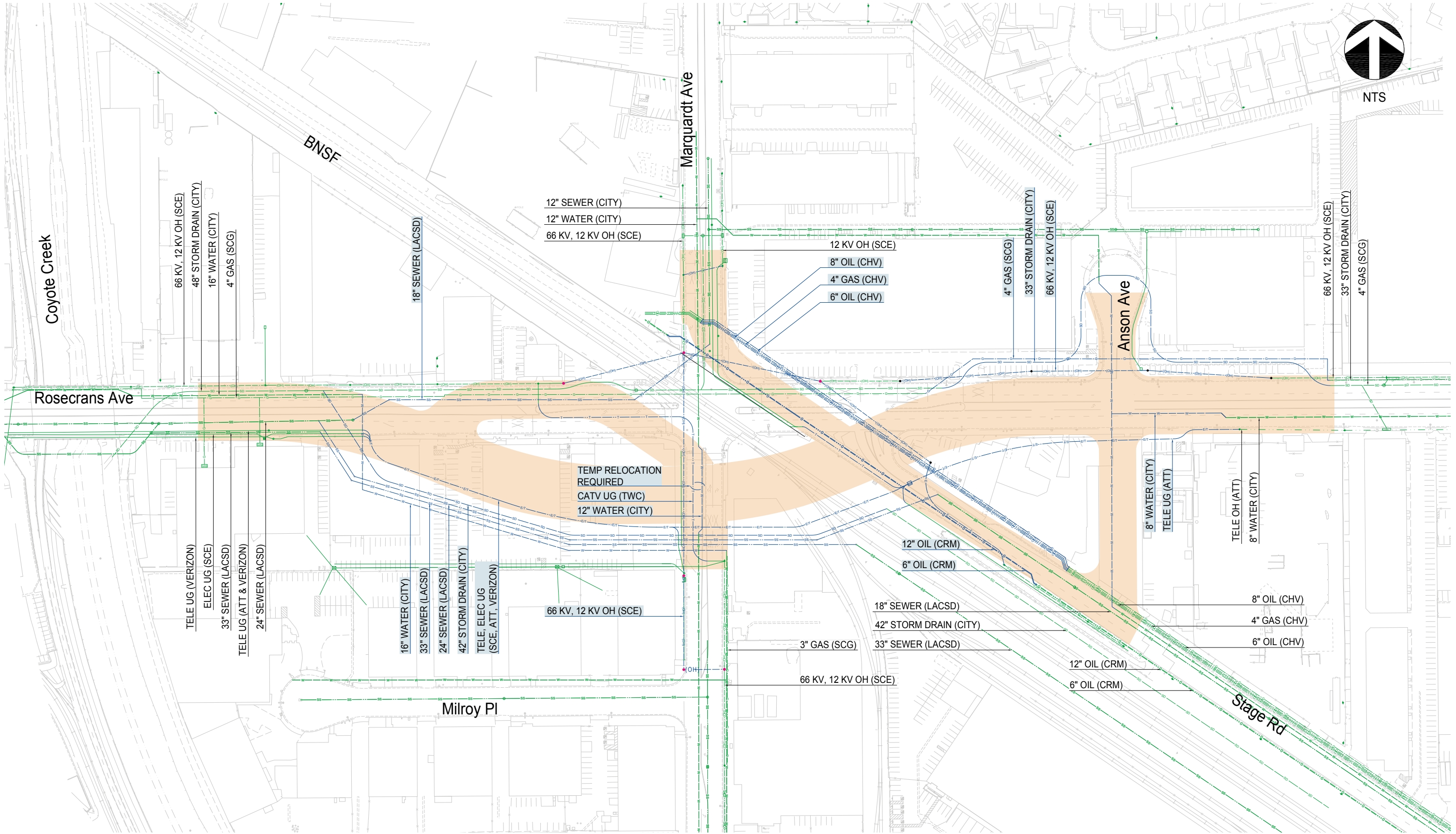
**ROSECRANS/MARQUARDT GRADE SEPARATION PROJECT**  
 PROPOSED UTILITY EXHIBIT | ALTERNATIVE 3

**LEGEND**

- ALTERNATIVE FOOTPRINT
- EXISTING UTILITY
- PROPOSED UTILITY
- PROPOSED STEEL POLE
- PROPOSED WOOD POLE



FILE NAME: J:\63556\_Metro\_Metro\_Marquardt\_GS100\_CADD\Exhibits\_Phase 1\PROP UTIL-ALT 4.dwg PLOTTED: Thursday, January 21, 2016 - 6:04pm USER: brix



# ROSECRANS/MARQUARDT GRADE SEPARATION PROJECT

## PROPOSED UTILITY EXHIBIT | ALTERNATIVE 4

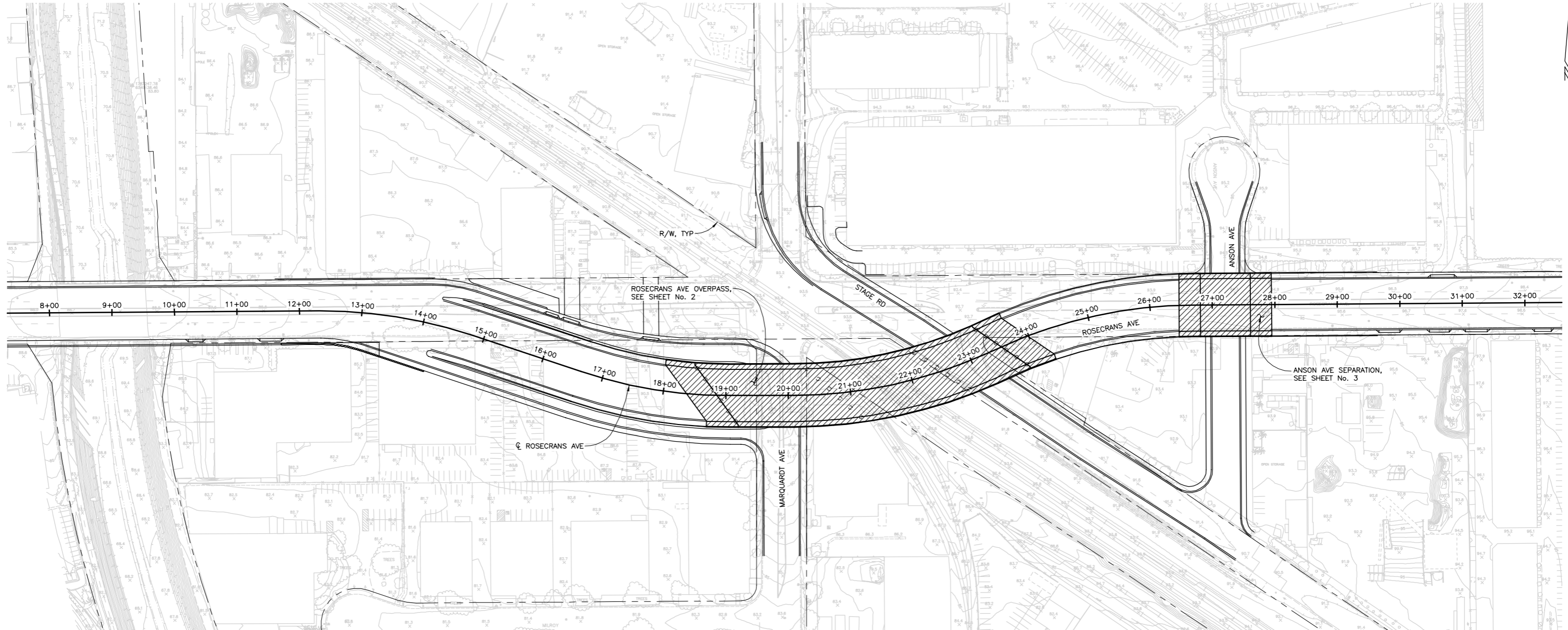
**LEGEND**

- ALTERNATIVE FOOTPRINT
- EXISTING UTILITY
- PROPOSED UTILITY
- PROPOSED STEEL POLE
- PROPOSED WOOD POLE





Appendix G: Structure Exhibits  
Preliminary Geotechnical Report



**BRIDGE KEY PLAN**  
NO SCALE

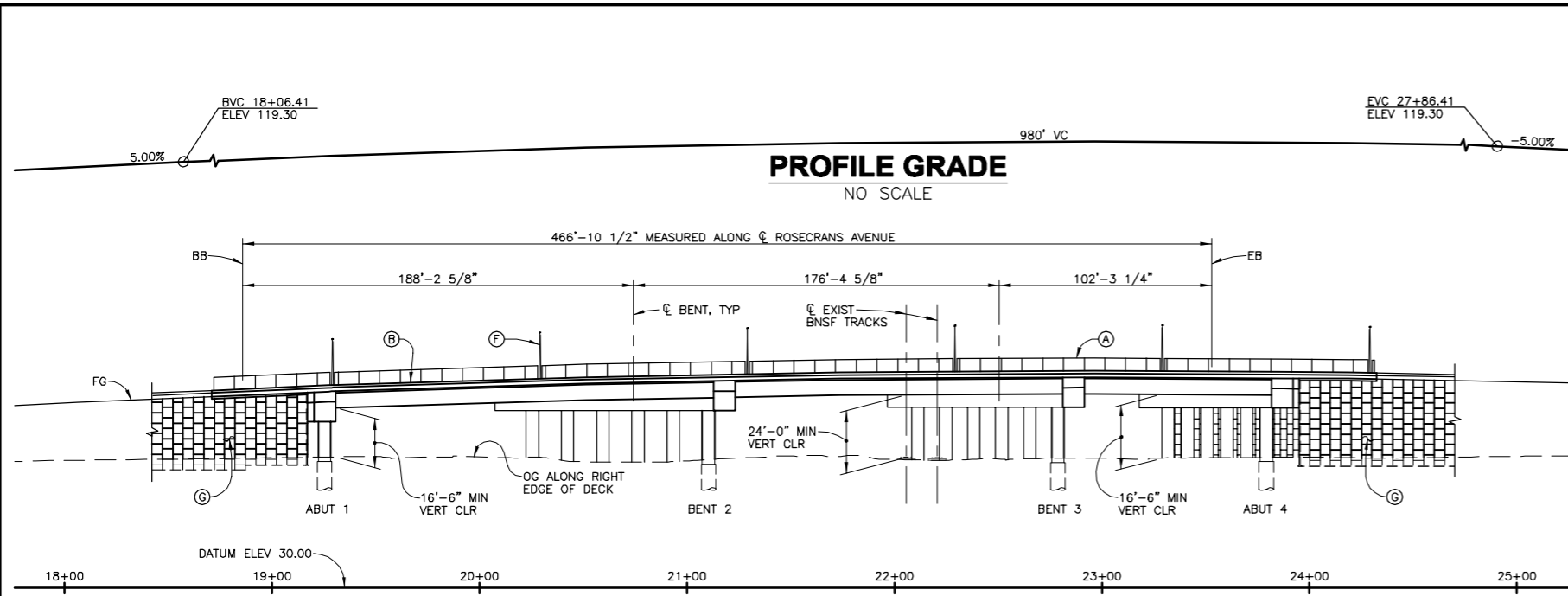
LEGEND:  
 INDICATES BRIDGE STRUCTURE

ATTENTION  
 All utilities shown in this plan are based on available records. It shall be the sole responsibility of the contractor to verify existing utilities by contacting utility agencies and to avoid damaging existing utilities during excavation.  
 FOR UNDERGROUND SERVICE ALERT CALL:  
 1-800-422-4133

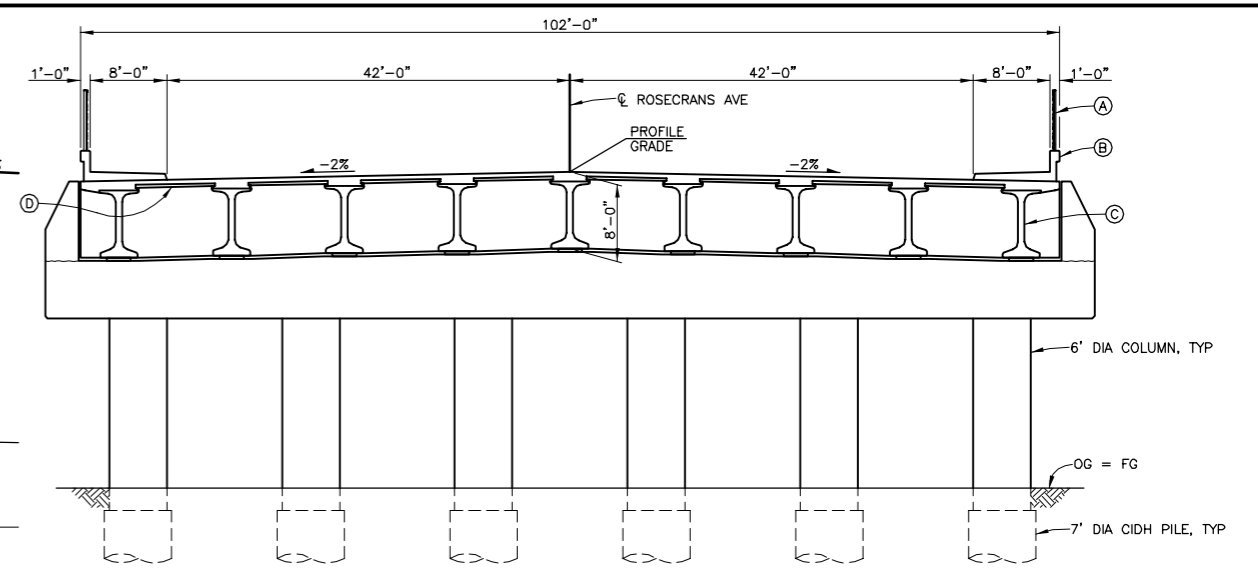
PLANS PREPARED BY:  
**BIGGS CARDOSA ASSOCIATES INC**  
 STRUCTURAL ENGINEERS  
 500 So. Main St, Suite 400  
 Orange, California 92668  
 714-550-4660  


NO	REVISIONS	APPR	DATE
CITY OF SANTA FE SPRINGS ENGINEERING DEPARTMENT SANTA FE SPRINGS, CALIF.			
KEY PLAN - ALTERNATIVE 1 ROSECRANS/MARQUARDT GRADE SEPARATION SANTA FE SPRINGS CALIFORNIA			
APPROVED			
CITY ENGINEER		RCE NO.	DATE
RECOMMENDED		ASSISTANT CITY ENGINEER	RCE NO. DATE
SUBMITTED		PROJECT ENGINEER	RCE NO. DATE
DRAWN BY D. MANCINI		CHECKED BY E. PHEIFER	
		SHT. 1 OF 3 SHS	

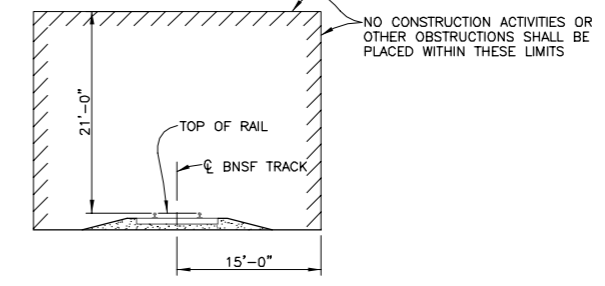
2015001\_1\_S1



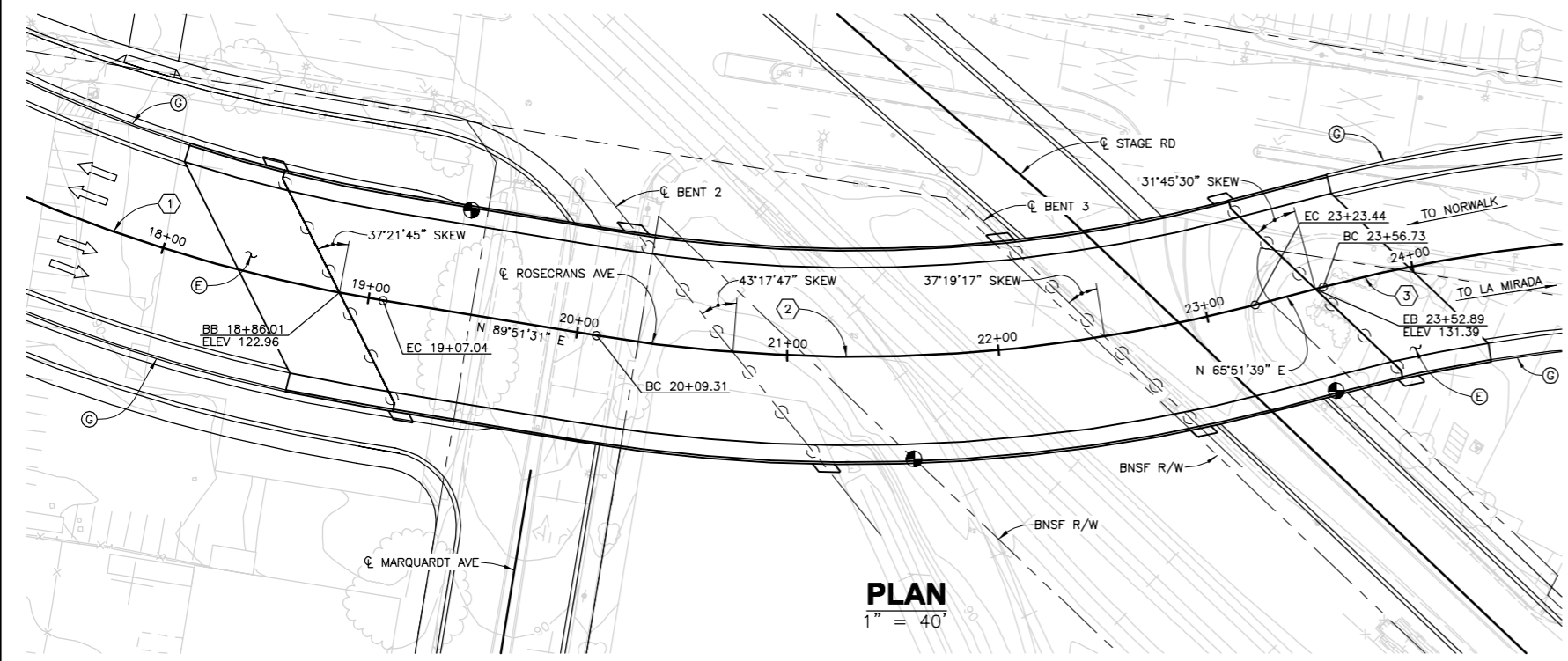
**DEVELOPED ELEVATION**  
1" = 40'



**TYPICAL SECTION**  
SCALE: 1" = 10'



**BNSF MINIMUM CONSTRUCTION CLEARANCE ENVELOPE**  
SCALE: NO SCALE



**PLAN**  
1" = 40'

- NOTES:**
- (A) CHAIN LINK RAILING TYPE 7
  - (B) CONCRETE BARRIER TYPE 26
  - (C) PC/PS CONCRETE SPLICED "WIDE FLANGE" GIRDER
  - (D) PC/PS DECK PANELS
  - (E) APPROACH SLAB TYPE N(30S) (MOD)
  - (F) STREET LIGHTING
  - (G) RETAINING WALL
- LEGEND:**
- INDICATES POINTS OF MINIMUM VERTICAL CLEARANCE
  - ➔ INDICATES TRAFFIC DIRECTION

CURVE ALIGNMENT DATA				
No.	R	Δ	TANGENT	LENGTH
①	750.00'	18°34'07"	122.61'	243.06'
②	750.00'	23°59'53"	159.40'	314.13'
③	750.00'	23°45'54"	157.81'	311.08'

ROSECRANS AVENUE OVERPASS	
DATE OF ESTIMATE	9/01/2015
STRUCTURE DEPTH	8'-0"
LENGTH	466'-10 1/2"
WIDTH	102'-0"
AREA	47,622 SF
COST PER SQUARE FOOT INCLUDES 10% MOBILIZATION AND 25% CONTINGENCY	\$290
<b>TOTAL COST</b>	<b>\$13,810,000</b>

**ATTENTION**  
All utilities shown in this plan are based on available records. It shall be the sole responsibility of the contractor to verify existing utilities by contacting utility agencies and to avoid damaging existing utilities during excavation.  
FOR UNDERGROUND SERVICE ALERT CALL:  
1-800-422-4133

**PLANS PREPARED BY:**  
**BIGGS CARDOSA ASSOCIATES INC.**  
STRUCTURAL ENGINEERS  
500 So. Main St., Suite 400  
Orange, California 92668  
714-350-4660

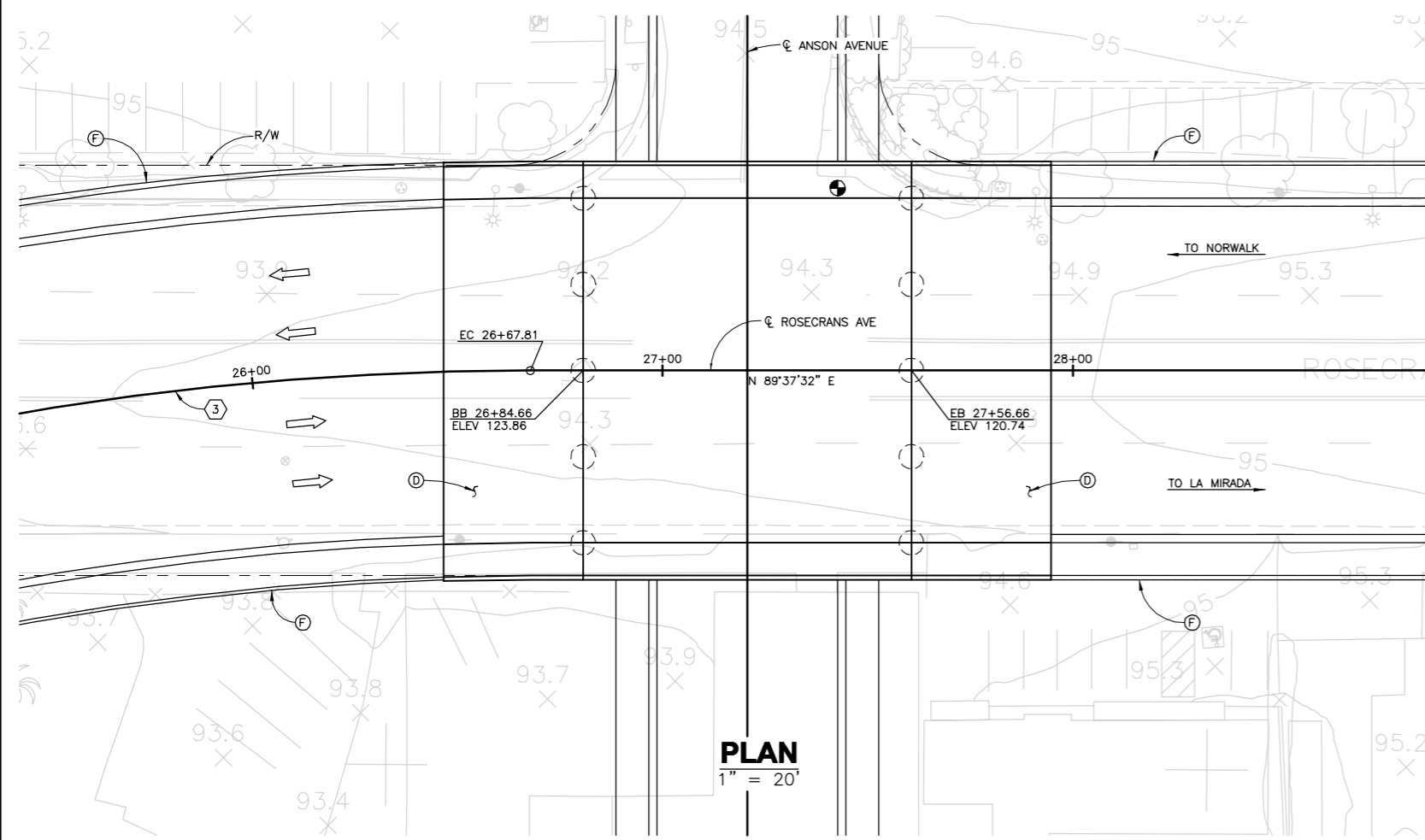
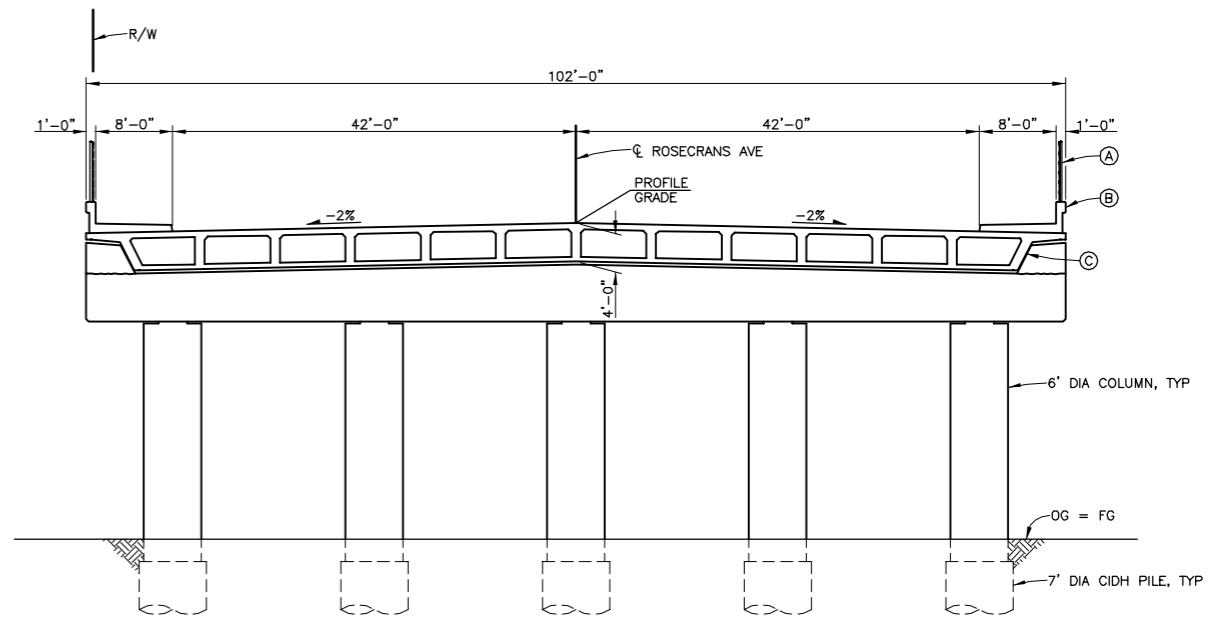
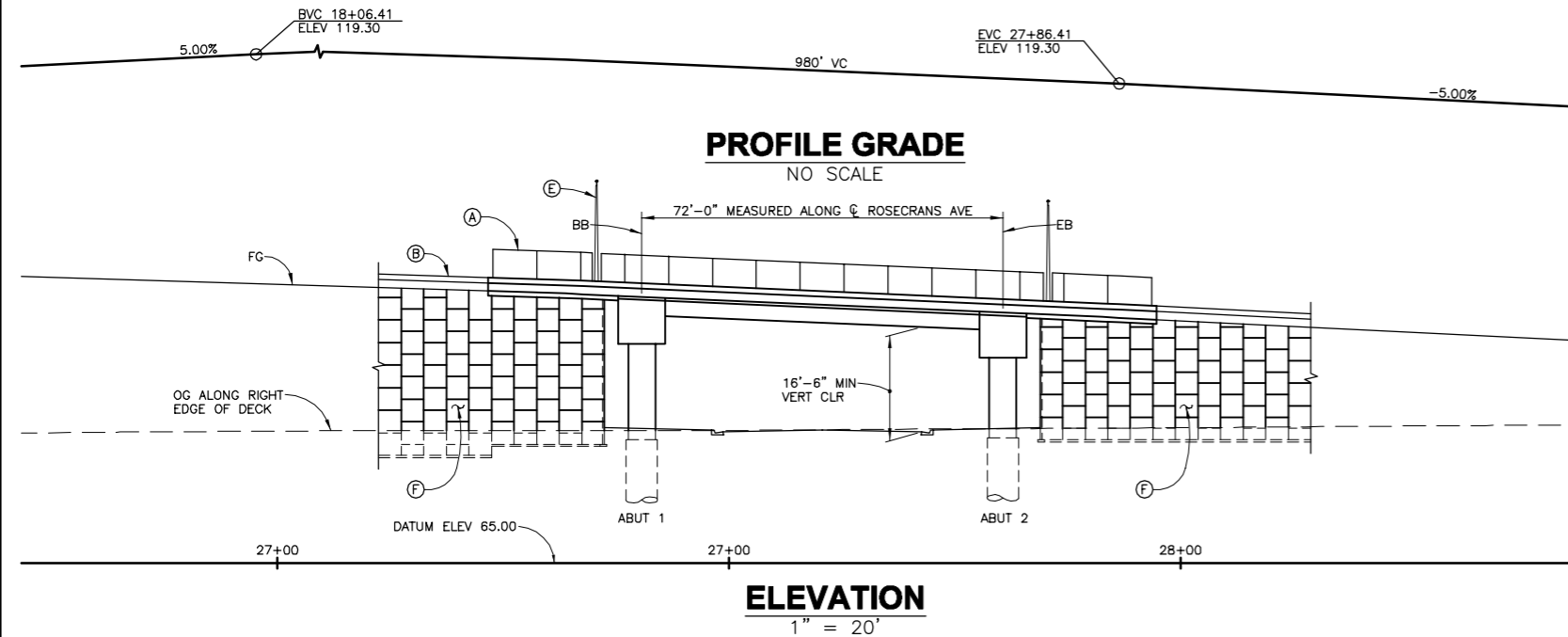
REVISIONS			APPR	DATE
NO.				

**CITY OF SANTA FE SPRINGS**  
ENGINEERING DEPARTMENT  
SANTA FE SPRINGS, CALIF.

**GENERAL PLAN - ALTERNATIVE 1**  
**ROSECRANS/MARQUARDT**  
GRADE SEPARATION  
SANTA FE SPRINGS  
CALIFORNIA

APPROVED: \_\_\_\_\_  
RECOMMENDED: \_\_\_\_\_  
SUBMITTED: \_\_\_\_\_  
PROJECT ENGINEER: \_\_\_\_\_  
DRAWN BY: D. MANCINI  
CHECKED BY: E. PHEIFER

2 OF 3 SHTS



- NOTES:**
- (A) CHAIN LINK RAILING TYPE 7
  - (B) CONCRETE BARRIER TYPE 26
  - (C) CIP PC/PS CONCRETE BOX GIRDER
  - (D) APPROACH SLAB TYPE N(30S) (MOD)
  - (E) STREET LIGHTING
  - (F) RETAINING WALL
- LEGEND:**
- INDICATES POINT OF MINIMUM VERTICAL CLEARANCE
  - INDICATES TRAFFIC DIRECTION

CURVE ALIGNMENT DATA				
No.	R	Δ	TANGENT	LENGTH
(3)	750.00'	23°45'54"	157.81	311.08'

ANSON AVENUE SEPARATION	
DATE OF ESTIMATE	9/01/2015
STRUCTURE DEPTH	4'-0"
LENGTH	72'-0"
WIDTH	102'-0"
AREA	7,344 SF
COST PER SQUARE FOOT INCLUDES 10% MOBILIZATION AND 25% CONTINGENCY	\$415
TOTAL COST	\$3,048,000

**ATTENTION**

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FOR UNDERGROUND SERVICE ALERT CALL:  
1-800-422-4133

PLANS PREPARED BY:

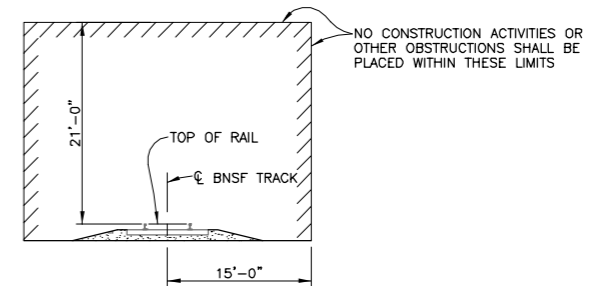
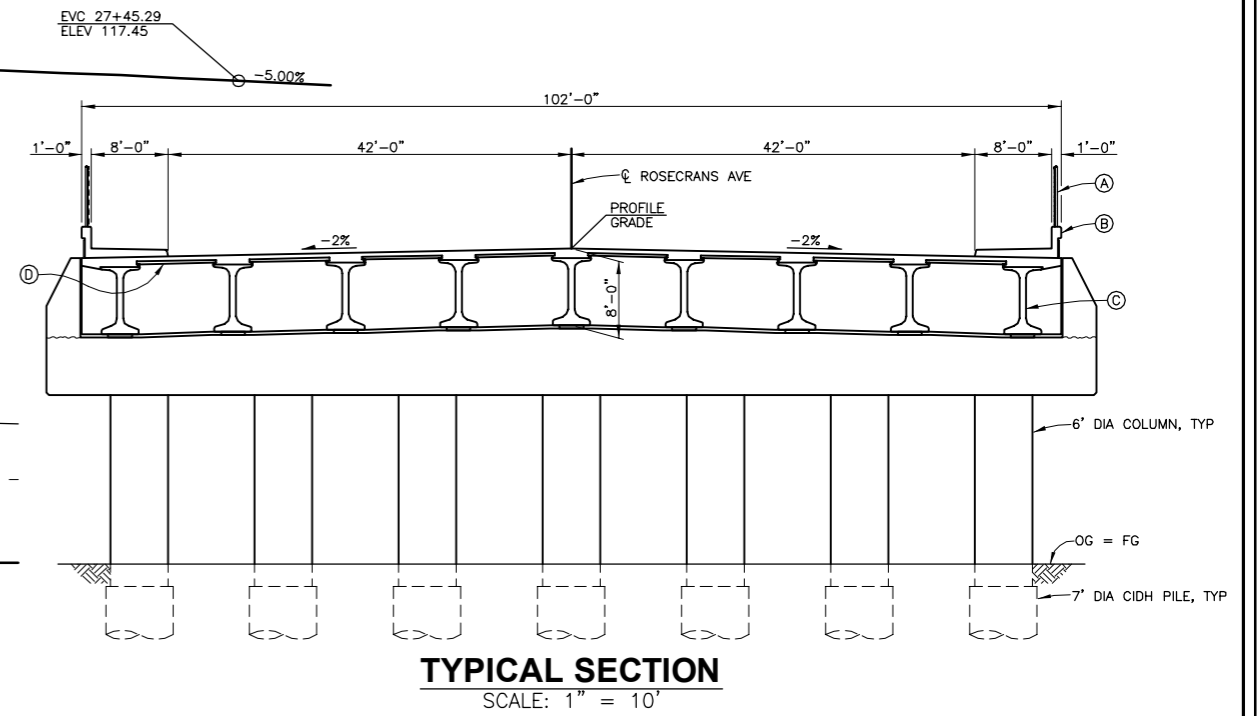
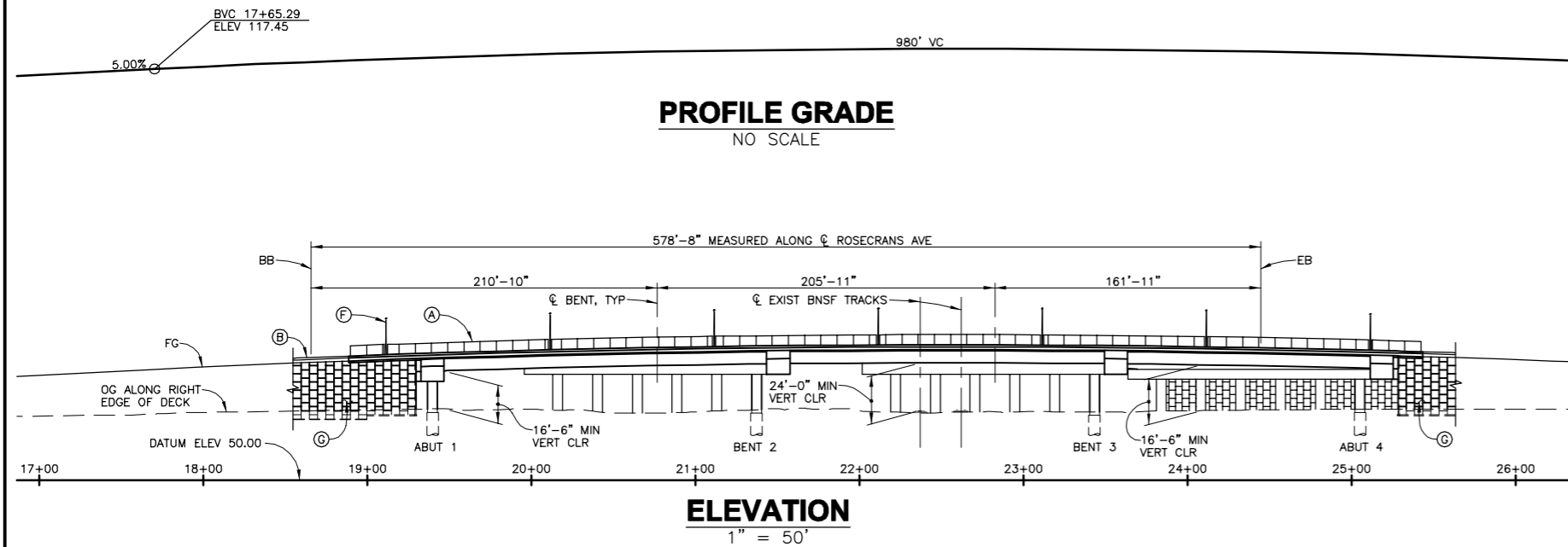
**BIGGS CARDOSA ASSOCIATES INC**  
STRUCTURAL ENGINEERS  
500 So. Main St, Suite 400  
Orange, California 92668  
714-350-4660

REVISIONS			APPR	DATE
NO.				

CITY OF SANTA FE SPRINGS  
ENGINEERING DEPARTMENT SANTA FE SPRINGS, CALIF.

GENERAL PLAN - ALTERNATIVE 1  
ROSECRANS/MARQUARDT  
GRADE SEPARATION  
SANTA FE SPRINGS  
CALIFORNIA

APPROVED			
RECOMMENDED	CITY ENGINEER	RCE NO.	DATE
SUBMITTED	ASSISTANT CITY ENGINEER	RCE NO.	DATE
	PROJECT ENGINEER	RCE NO.	DATE
DRAWN BY	CHECKED BY		
D. MANCINI	E. PHEIFER	3 OF 3 SHTS	

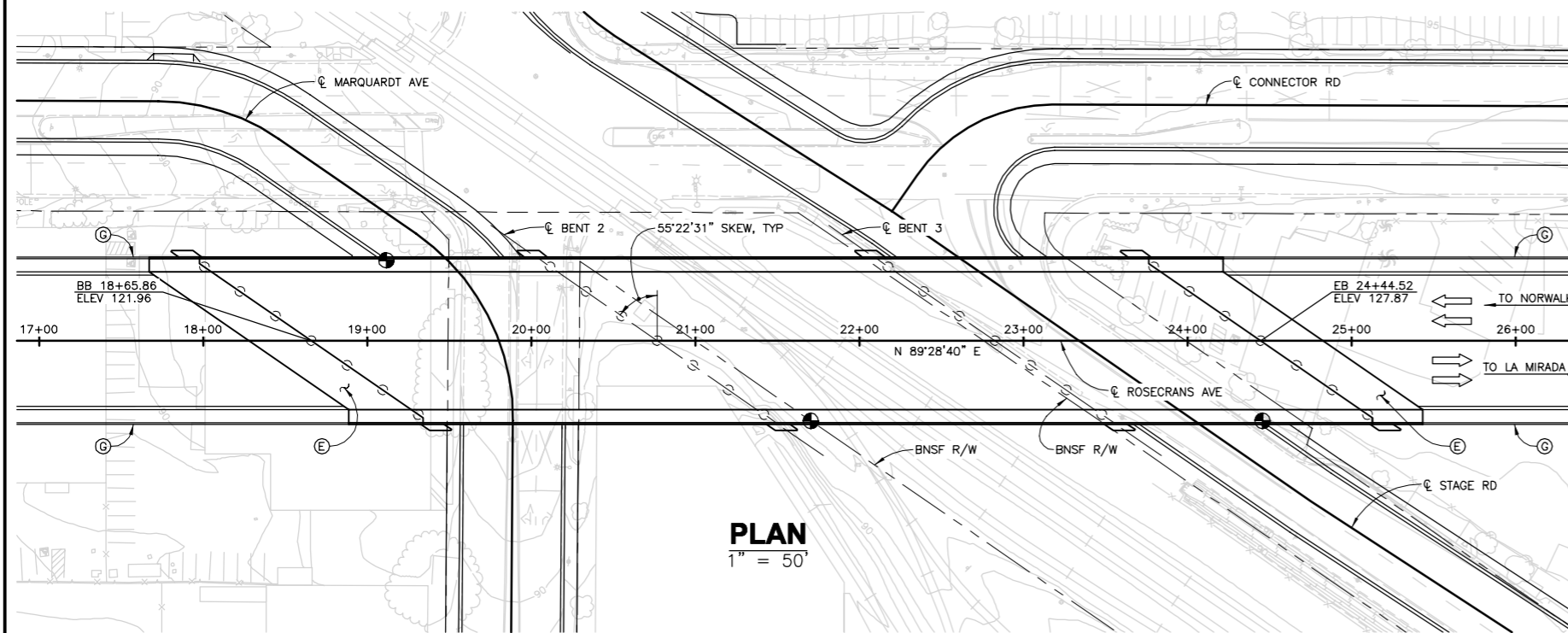


**BNSF MINIMUM CONSTRUCTION CLEARANCE ENVELOPE**  
SCALE: NO SCALE

- NOTES:**
- (A) CHAIN LINK RAILING TYPE 7
  - (B) CONCRETE BARRIER TYPE 26
  - (C) PC/PS CONCRETE SPLICED "WIDE FLANGE" GIRDER
  - (D) PC/PS DECK PANELS
  - (E) APPROACH SLAB TYPE N(30S) (MOD)
  - (F) STREET LIGHTING
  - (G) RETAINING WALL

- LEGEND:**
- INDICATES POINTS OF MINIMUM VERTICAL CLEARANCE
  - INDICATES TRAFFIC DIRECTION

DATE OF ESTIMATE	9/01/2015
STRUCTURE DEPTH	8'-0"
LENGTH	578'-8"
WIDTH	102'-0"
AREA	59,024 SF
COST PER SQUARE FOOT INCLUDES 10% MOBILIZATION AND 25% CONTINGENCY	\$290
TOTAL COST	\$17,117,000

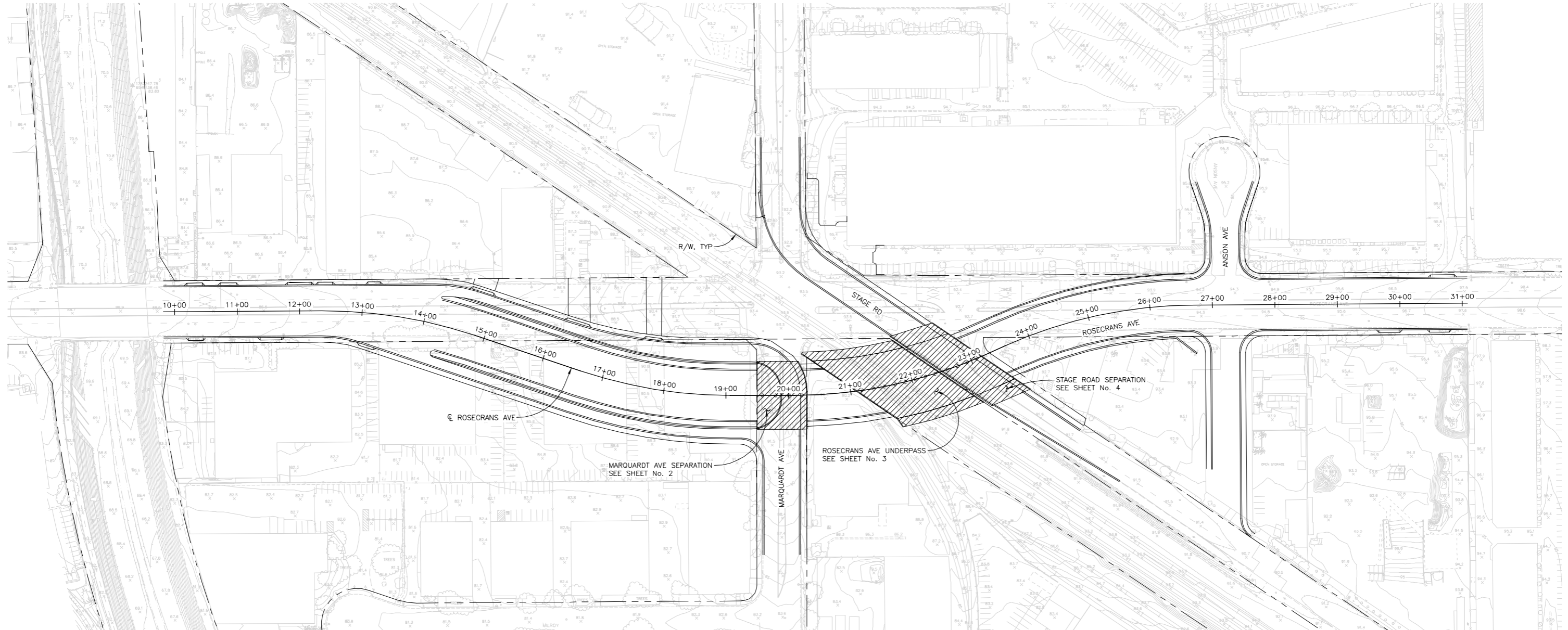


**ATTENTION**  
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FOR UNDERGROUND SERVICE ALERT CALL:  
1-800-422-4133

PLANS PREPARED BY:  
**BIGGS CARDOSA ASSOCIATES INC**  
STRUCTURAL ENGINEERS  
500 So. Main St., Suite 400  
Orange, California 92668  
714-350-4660



NO	REVISIONS	APPR	DATE
CITY OF SANTA FE SPRINGS ENGINEERING DEPARTMENT SANTA FE SPRINGS, CALIF.			
GENERAL PLAN - ALTERNATIVE 2 ROSECRANS/MARQUARDT GRADE SEPARATION SANTA FE SPRINGS CALIFORNIA			
APPROVED	CITY ENGINEER	RCE NO.	DATE
RECOMMENDED	ASSISTANT CITY ENGINEER	RCE NO.	DATE
SUBMITTED	PROJECT ENGINEER	RCE NO.	DATE
DRAWN BY	CHECKED BY	SHT. 1 OF 1 SHS	
D. MANCINI	E. PHEIFER		



**BRIDGE KEY PLAN**  
NO SCALE

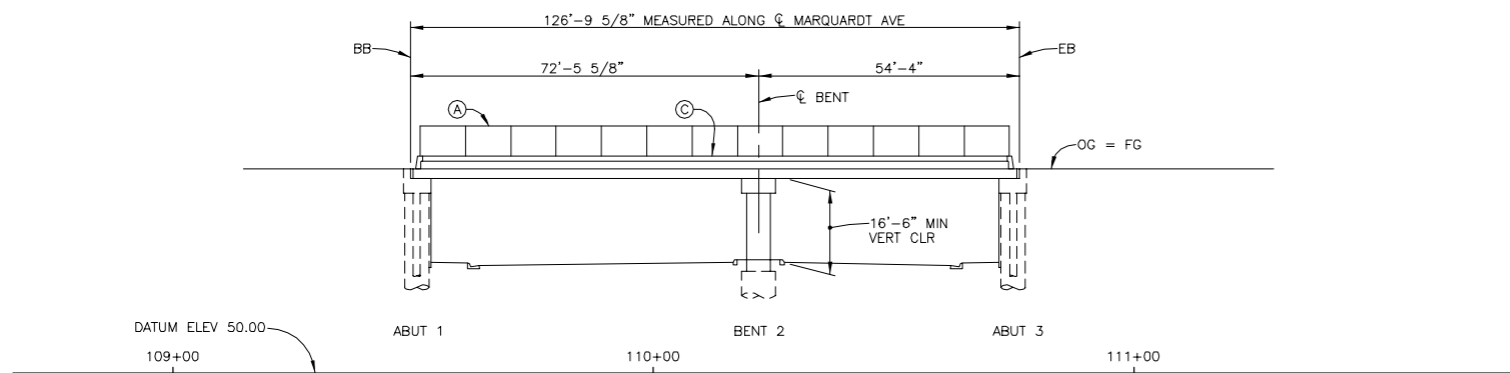
LEGEND:  
 INDICATES BRIDGE STRUCTURE

ATTENTION  
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 FOR UNDERGROUND SERVICE ALERT CALL:  
 1-800-422-4133

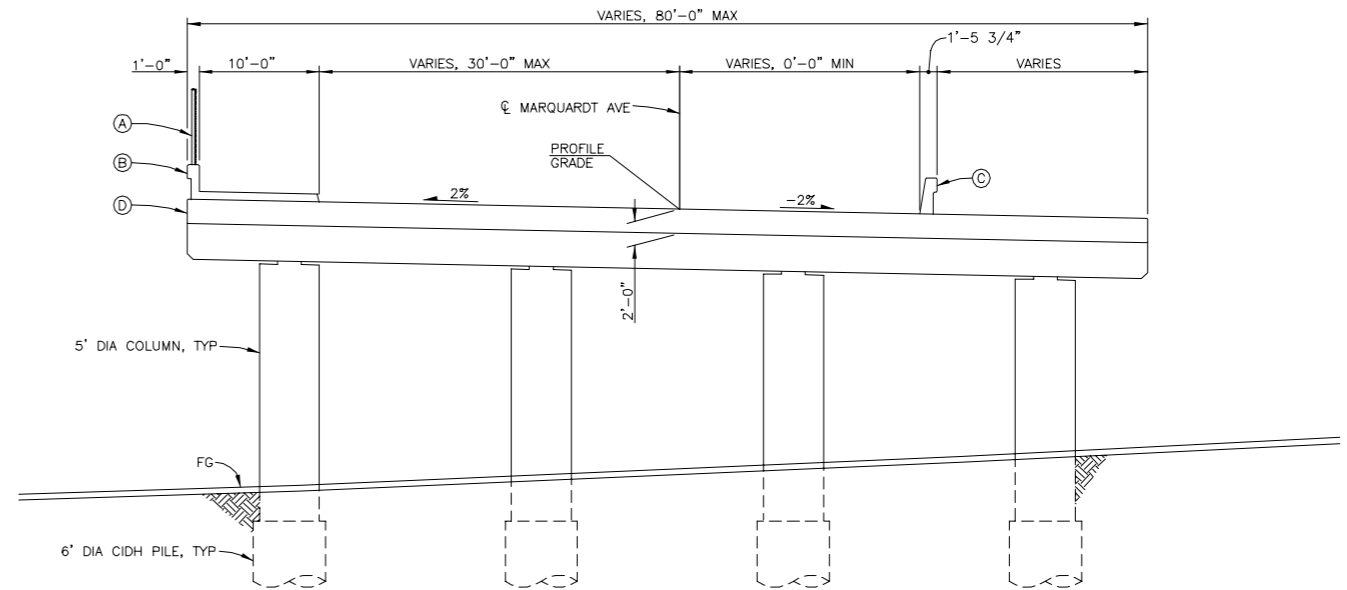
PLANS PREPARED BY:  
**BIGGS CARDOSA ASSOCIATES INC**  
 STRUCTURAL ENGINEERS  
 500 So. Main St., Suite 400  
 Orange, California 92668  
 714-550-4660

NO	REVISIONS	APPR	DATE
CITY OF SANTA FE SPRINGS ENGINEERING DEPARTMENT SANTA FE SPRINGS, CALIF. <b>KEY PLAN – ALTERNATIVE 3</b> <b>ROSECRANS/MARQUARDT</b> <b>GRADE SEPARATION</b> <b>SANTA FE SPRINGS</b> <b>CALIFORNIA</b>			
APPROVED			
CITY ENGINEER		RCE NO.	DATE
RECOMMENDED		RCE NO.	DATE
SUBMITTED		RCE NO.	DATE
PROJECT ENGINEER		RCE NO.	DATE
DRAWN BY	CHECKED BY	SHT. 1 OF 4 SHTS	
D. MANCINI	E. PHEIFER		

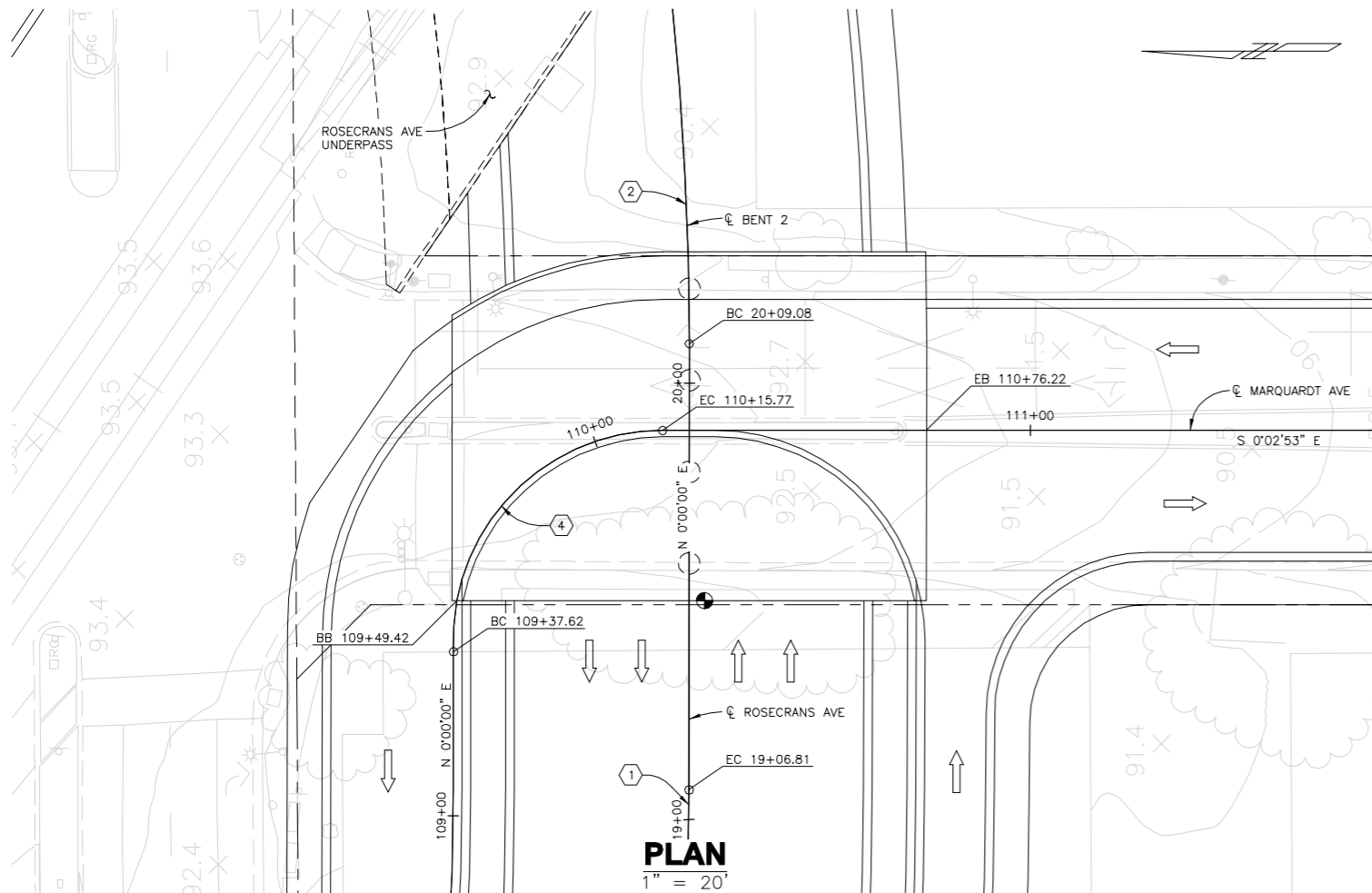
2015001\_3\_S1



**ELEVATION**  
1" = 20'



MARQUARDT AVE SEPARATION  
**TYPICAL SECTION**  
SCALE: 1/8" = 1'-0"



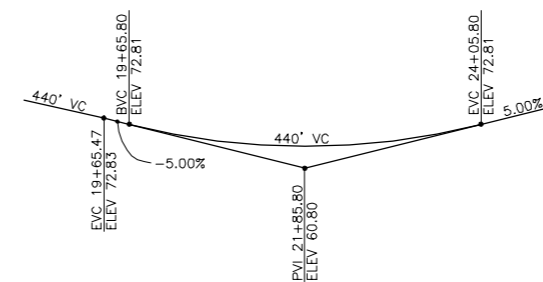
**PLAN**  
1" = 20'

CURVE ALIGNMENT DATA				
No.	R	Δ	TANGENT	LENGTH
①	750.00'	18°34'07"	122.61'	243.06'
②	750.00'	23°59'53"	159.40'	314.13'
④	48.00'	93°16'49"	50.83'	78.15'

- NOTES:**
- Ⓐ CHAIN LINK RAILING TYPE 7
  - Ⓑ CONCRETE BARRIER TYPE 26
  - Ⓒ CONCRETE BARRIER TYPE 736
  - Ⓓ CIP/PS CONCRETE SLAB
- LEGEND:**
- ⊙ INDICATES POINT OF MINIMUM VERTICAL CLEARANCE
  - ➔ INDICATES TRAFFIC DIRECTION

MARQUARDT AVE SEPARATION	
DATE OF ESTIMATE	9/01/2015
STRUCTURE DEPTH	2'-0"
LENGTH*	108'-8"
WIDTH	80'-0" & VARIES
AREA	8,693 SF
COST PER SQUARE FOOT INCLUDES 10% MOBILIZATION AND 25% CONTINGENCY	\$275
<b>TOTAL COST</b>	<b>\$2,391,000</b>

\* LENGTH MEASURED ALONG STRAIGHT LINE FROM ABUT 1 TO ABUT 3



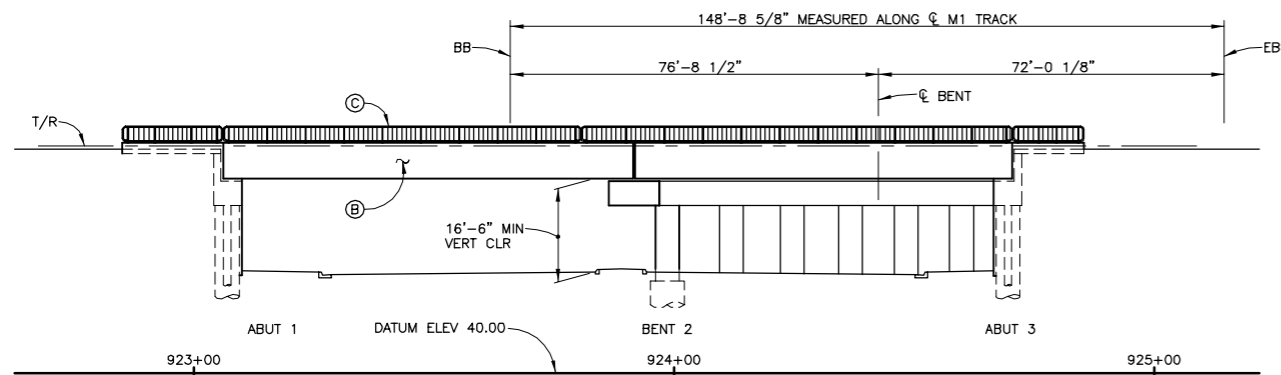
**ROSECRANS AVE PROFILE**  
SCALE: NO SCALE

**ATTENTION**  
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FOR UNDERGROUND SERVICE ALERT CALL:  
1-800-422-4133

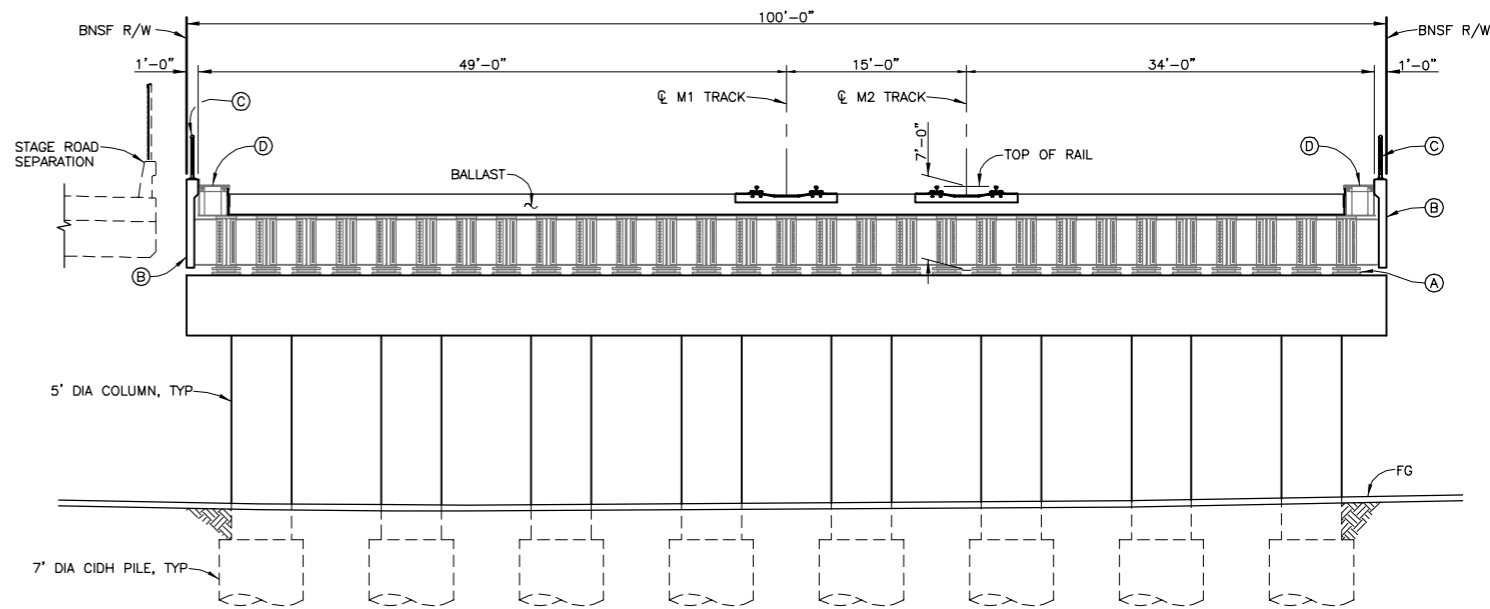
PLANS PREPARED BY:  
**BIGGS CARDOSA ASSOCIATES INC**  
STRUCTURAL ENGINEERS  
500 So. Main St., Suite 400  
Orange, California 92668  
714-550-4665



NO	REVISIONS	APPR	DATE
CITY OF SANTA FE SPRINGS ENGINEERING DEPARTMENT SANTA FE SPRINGS, CALIF.			
GENERAL PLAN - ALTERNATIVE 3 ROSECRANS/MARQUARDT GRADE SEPARATION SANTA FE SPRINGS CALIFORNIA			
APPROVED			
RECOMMENDED	CITY ENGINEER	RCE NO.	DATE
SUBMITTED	ASSISTANT CITY ENGINEER	RCE NO.	DATE
	PROJECT ENGINEER	RCE NO.	DATE
DRAWN BY	CHECKED BY		
D. MANCINI	E. PHEIFER	SHT. 2 OF 4 SHTS	

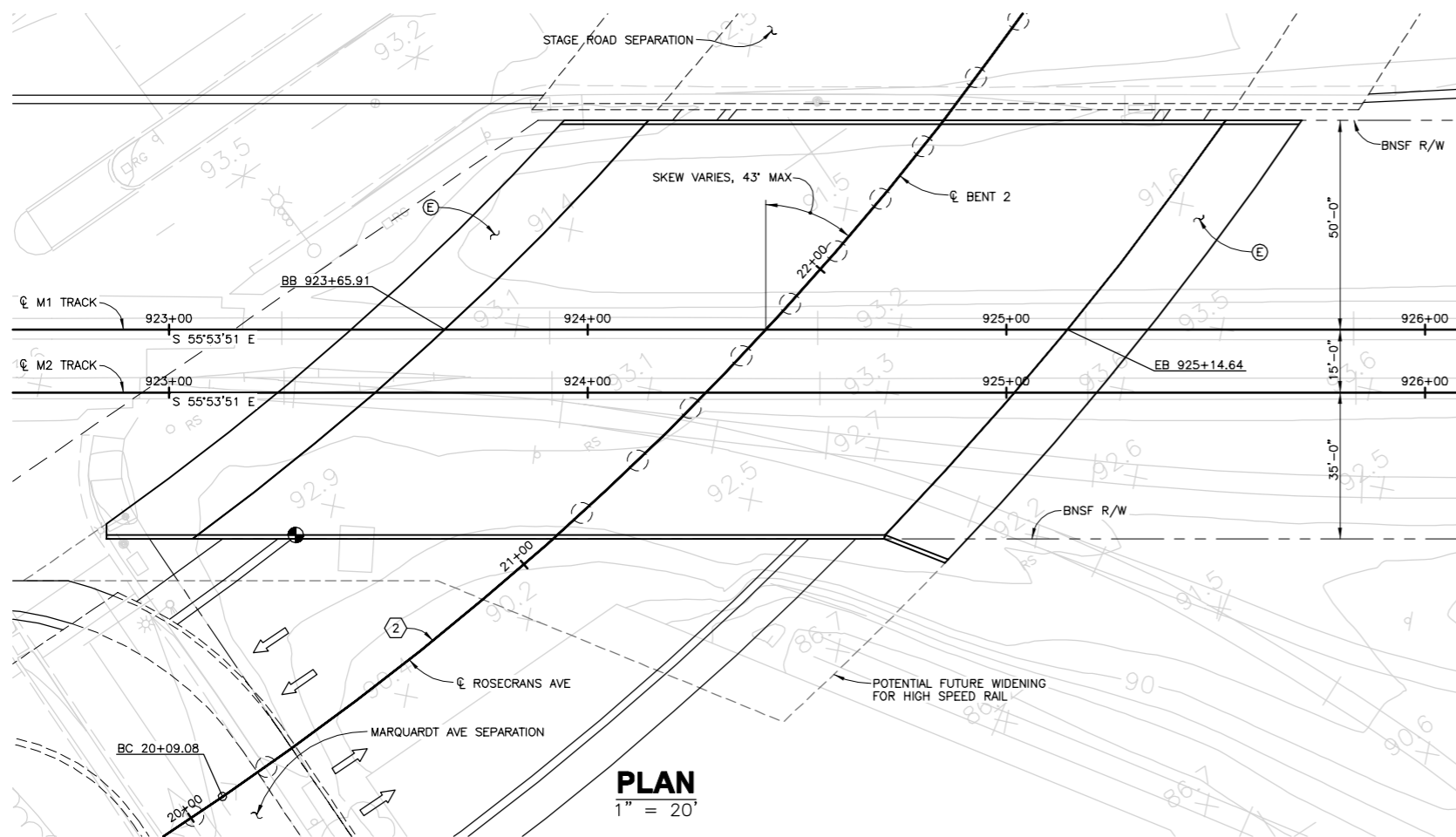


**ELEVATION**  
1" = 20'



ROSECRANS AVENUE UNDERPASS

**TYPICAL SECTION**  
SCALE: 1/8" = 1'-0"



**PLAN**  
1" = 20'

CURVE ALIGNMENT DATA				
No.	R	Δ	TANGENT	LENGTH
(2)	750.00'	23°59'53"	159.40'	314.13'

**NOTES:**

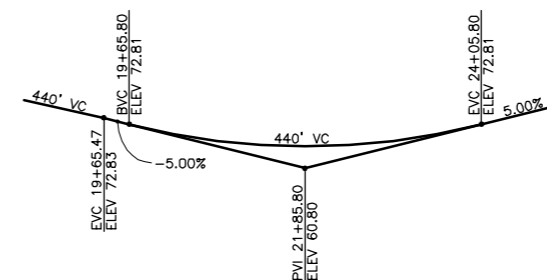
- (A) STEEL DECK PLATE GIRDER BRIDGE
- (B) PRECAST FACADE PANELS
- (C) HAND RAILING
- (D) WALKWAY
- (E) APPROACH SLAB

**LEGEND:**

- ⊙ INDICATES POINT OF MINIMUM VERTICAL CLEARANCE
- ➔ INDICATES TRAFFIC DIRECTION

**ROSECRANS AVENUE UNDERPASS**

DATE OF ESTIMATE	9/01/2015
STRUCTURE DEPTH	7'-0"
LENGTH	148'-8 5/8"
WIDTH	100'-0"
AREA	14,872 SF
COST PER SQUARE FOOT INCLUDES 10% MOBILIZATION AND 25% CONTINGENCY	\$1,400
TOTAL COST	\$20,821,000



**ROSECRANS AVE PROFILE**  
SCALE: NO SCALE

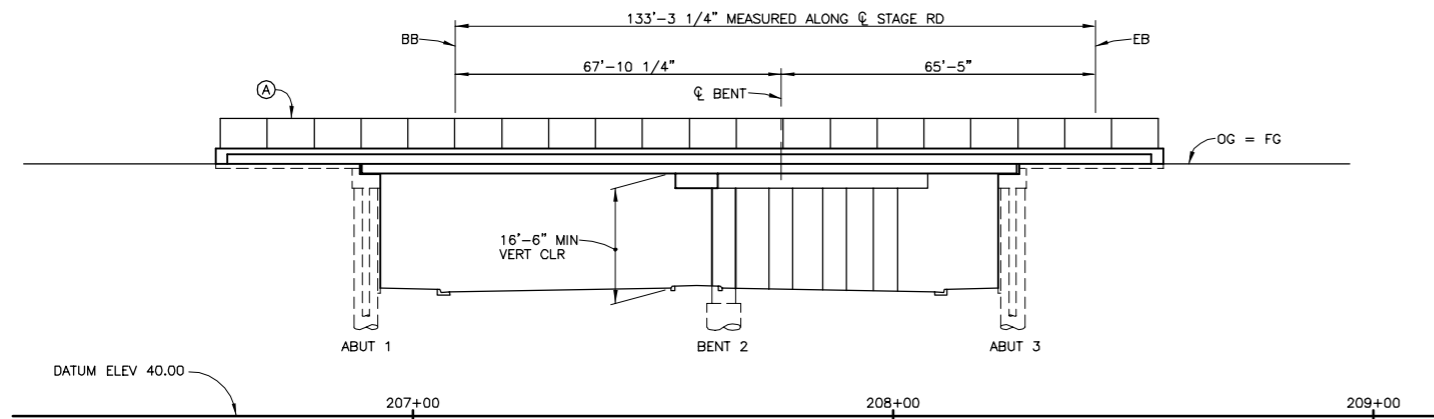
**ATTENTION**  
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FOR UNDERGROUND SERVICE ALERT CALL:  
1-800-422-4133

PLANS PREPARED BY:

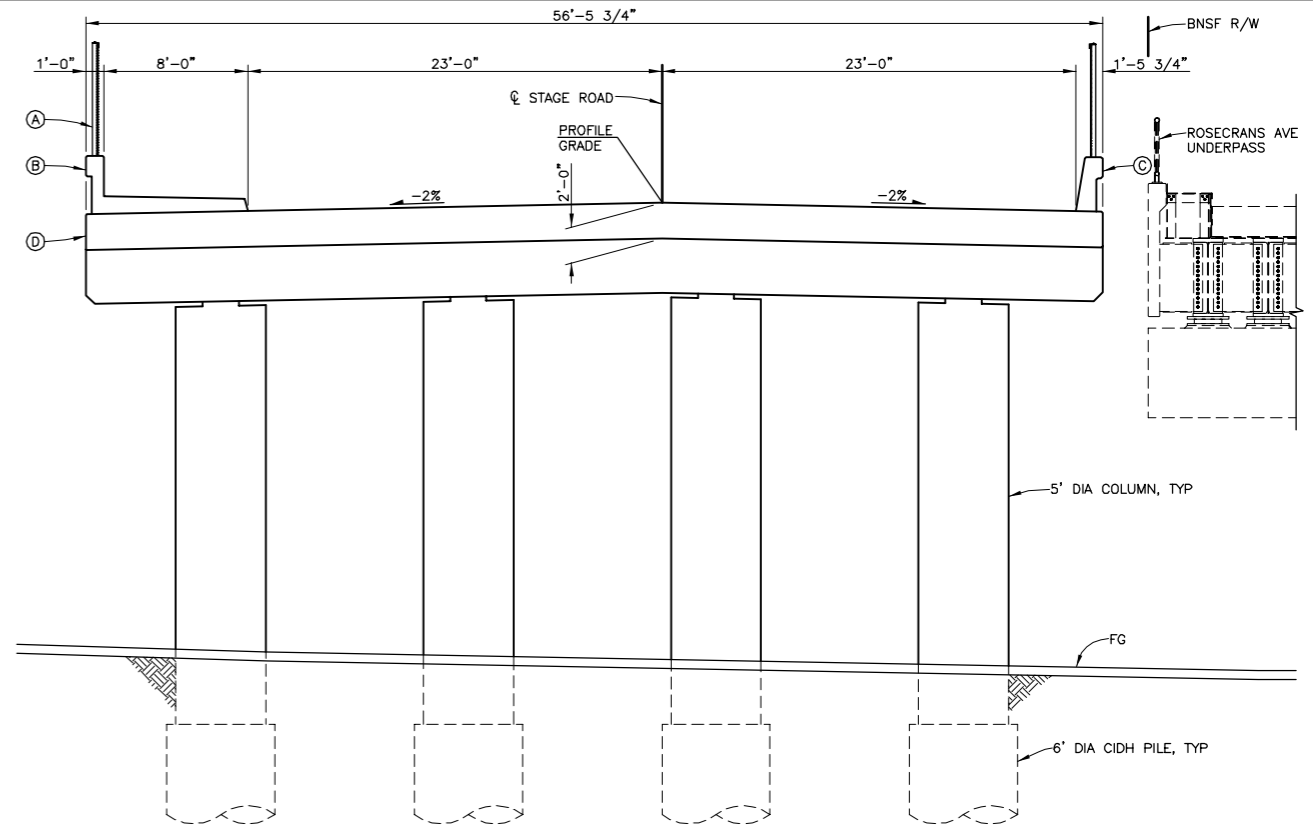
**BIGGS CARDOSA ASSOCIATES INC**  
STRUCTURAL ENGINEERS  
500 So. Main St., Suite 400  
Orange, California 92668  
714-350-4660



NO.	REVISIONS	APPR.	DATE
CITY OF SANTA FE SPRINGS ENGINEERING DEPARTMENT SANTA FE SPRINGS, CALIF.			
GENERAL PLAN - ALTERNATIVE 3 ROSECRANS/MARQUARDT GRADE SEPARATION SANTA FE SPRINGS CALIFORNIA			
APPROVED			
RECOMMENDED	CITY ENGINEER	RCE NO.	DATE
SUBMITTED	ASSISTANT CITY ENGINEER	RCE NO.	DATE
	PROJECT ENGINEER	RCE NO.	DATE
DRAWN BY	CHECKED BY		
D. MANCINI	E. PHEIFER	3	4
		SHT.	OF

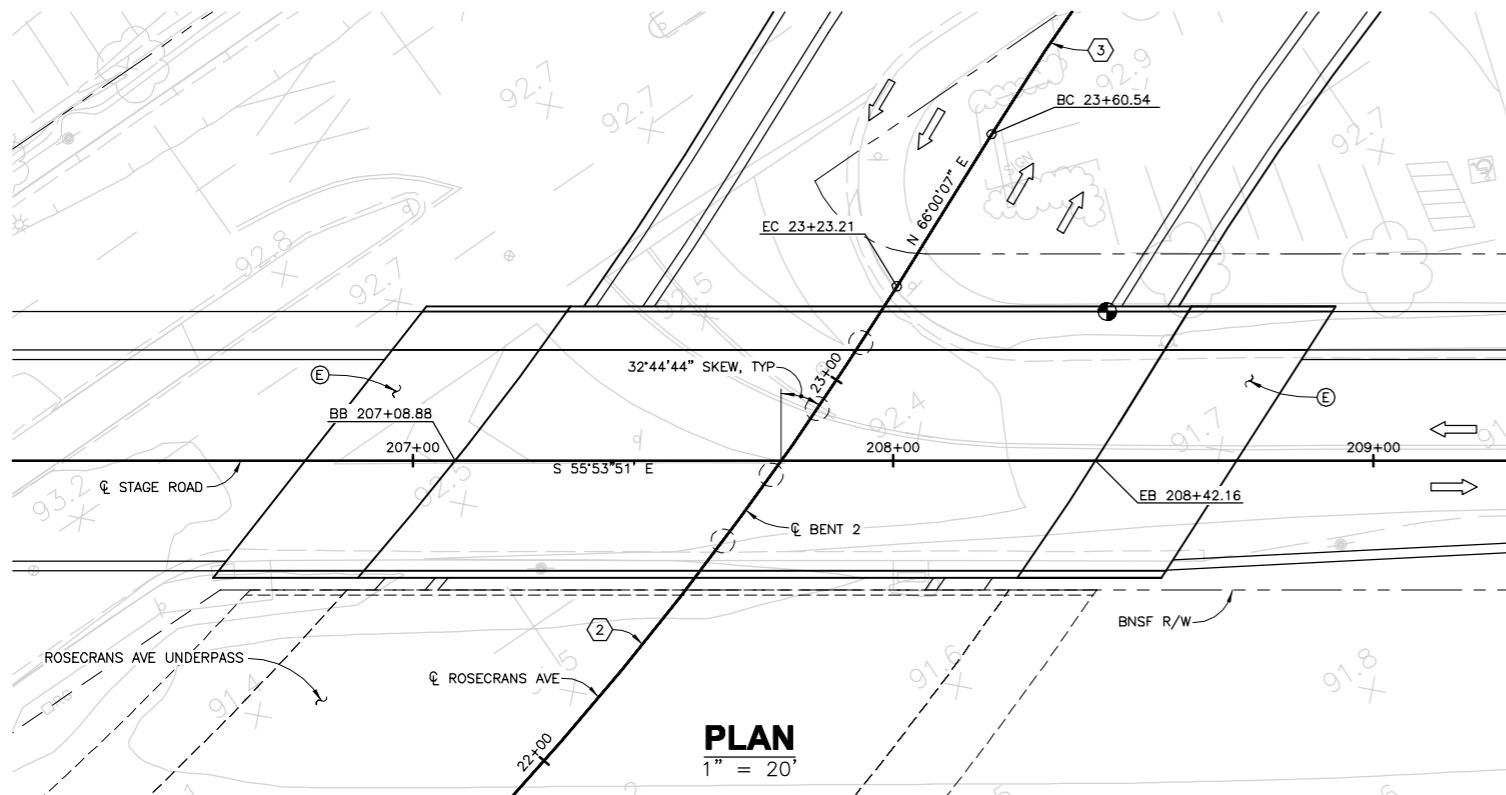


**ELEVATION**  
1" = 20'



STAGE ROAD SEPARATION  
**TYPICAL SECTION**  
SCALE: 3/16" = 1'-0"

CURVE ALIGNMENT DATA				
No.	R	Δ	TANGENT	LENGTH
②	750.00'	23°59'53"	159.40'	314.13'
③	750.00'	23°37'25"	156.84'	309.23'

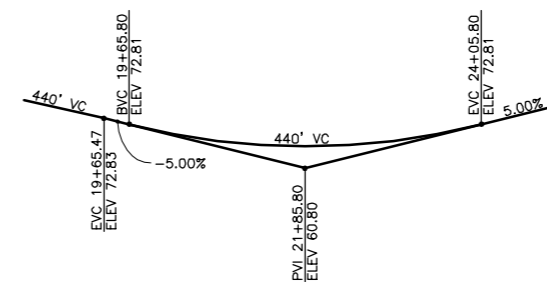


**PLAN**  
1" = 20'

- NOTES:**
- (A) CHAIN LINK RAILING TYPE 7
  - (B) CONCRETE BARRIER TYPE 26
  - (C) CONCRETE BARRIER TYPE 736
  - (D) CIP/PS CONCRETE SLAB
  - (E) APPROACH SLAB TYPE N(30S)
- LEGEND:**
- ⊙ INDICATES POINT OF MINIMUM VERTICAL CLEARANCE
  - ⇨ INDICATES TRAFFIC DIRECTION

**STAGE ROAD SEPARATION**

DATE OF ESTIMATE	9/01/2015
STRUCTURE DEPTH	2'-0"
LENGTH	133'-3 1/4"
WIDTH	64'-0"
AREA	8,530 SF
COST PER SQUARE FOOT INCLUDES 10% MOBILIZATION AND 25% CONTINGENCY	\$275
TOTAL COST	\$2,346,000



**ROSECRANS AVE PROFILE**  
SCALE: NO SCALE

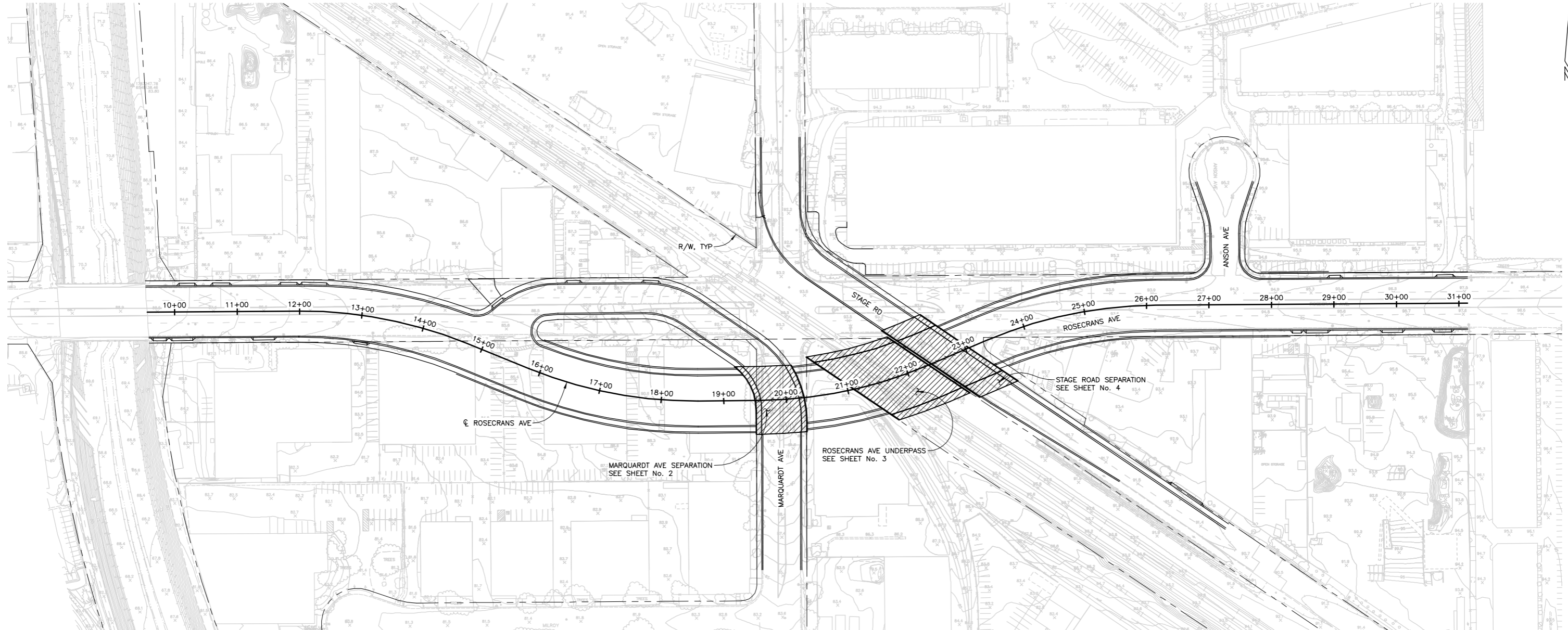
**ATTENTION**  
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FOR UNDERGROUND SERVICE ALERT CALL:  
1-800-422-4133

PLANS PREPARED BY:

**BIGGS CARDOSA ASSOCIATES INC**  
STRUCTURAL ENGINEERS  
500 So. Main St., Suite 400  
Orange, California 92668  
714-550-4660



NO	REVISIONS	APPR	DATE
CITY OF SANTA FE SPRINGS ENGINEERING DEPARTMENT SANTA FE SPRINGS, CALIF.			
GENERAL PLAN - ALTERNATIVE 3 ROSECRANS/MARQUARDT GRADE SEPARATION SANTA FE SPRINGS CALIFORNIA			
APPROVED			
RECOMMENDED	CITY ENGINEER	RCE NO.	DATE
SUBMITTED	ASSISTANT CITY ENGINEER	RCE NO.	DATE
	PROJECT ENGINEER	RCE NO.	DATE
DRAWN BY	CHECKED BY	SHT. 4 OF 4 SHS	
D. MANCINI	E. PHEIFER		



**BRIDGE KEY PLAN**  
NO SCALE

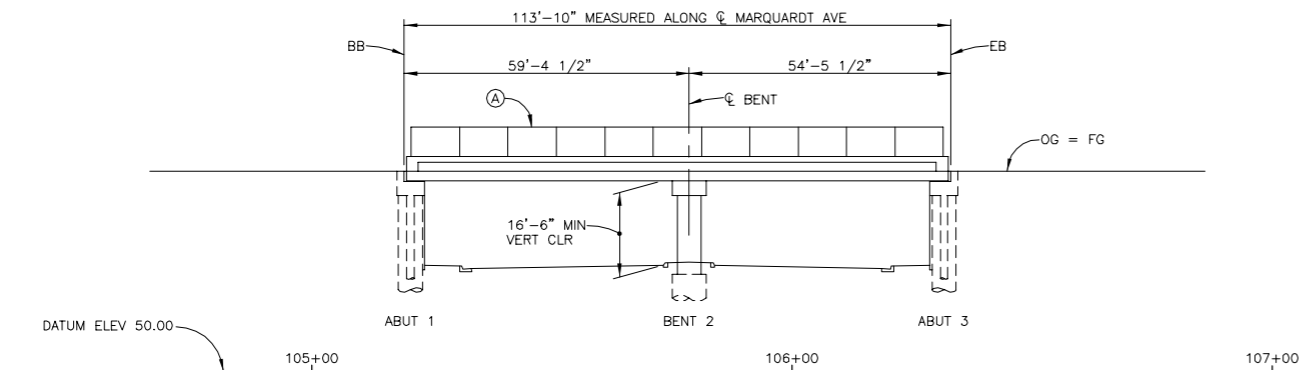
LEGEND:  
 INDICATES BRIDGE STRUCTURE

ATTENTION  
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 FOR UNDERGROUND SERVICE ALERT CALL:  
 1-800-422-4133

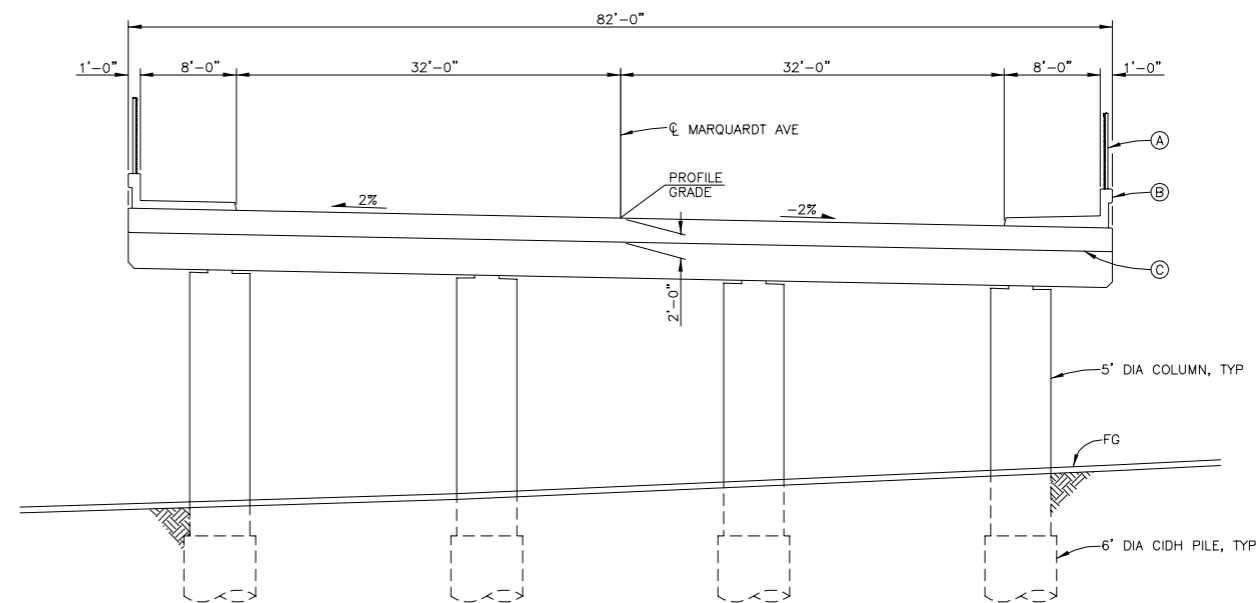
PLANS PREPARED BY:  
**BIGGS CARDOSA ASSOCIATES INC**  
 STRUCTURAL ENGINEERS  
 500 So. Main St, Suite 400  
 Orange, California 92668  
 714-350-4660

NO	REVISIONS	APPR	DATE
CITY OF SANTA FE SPRINGS ENGINEERING DEPARTMENT SANTA FE SPRINGS, CALIF.			
KEY PLAN - ALTERNATIVE 4 ROSECRANS/MARQUARDT GRADE SEPARATION SANTA FE SPRINGS CALIFORNIA			
APPROVED			
CITY ENGINEER		RCE NO.	DATE
RECOMMENDED		ASSISTANT CITY ENGINEER	RCE NO. DATE
SUBMITTED		PROJECT ENGINEER	RCE NO. DATE
DRAWN BY	CHECKED BY	SHT. 1 OF 4 SHTS	
D. MANCINI	E. PHEIFER		

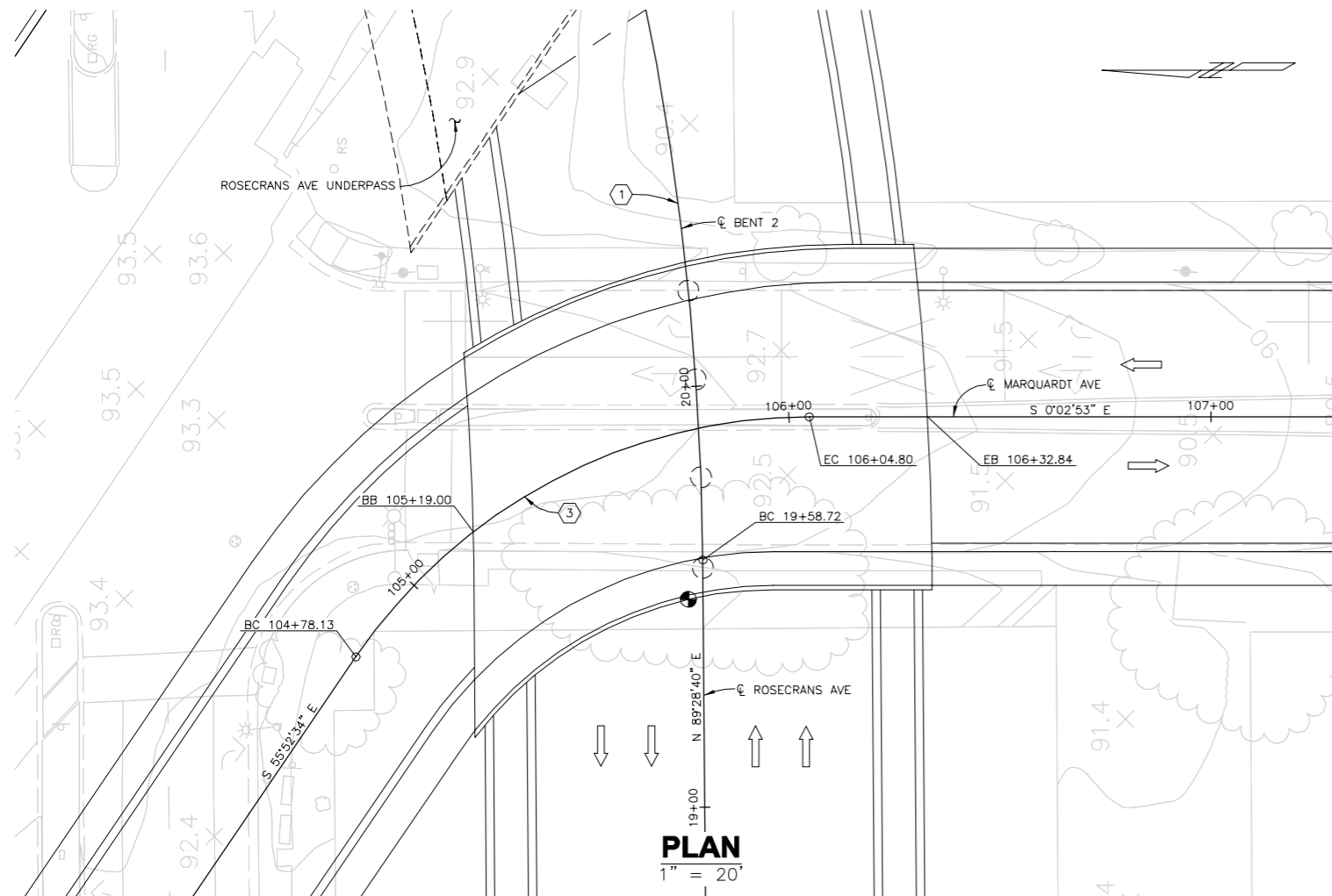
2015001\_4\_S1



**ELEVATION**  
1" = 20'



MARQUARDT AVE SEPARATION  
**TYPICAL SECTION**  
SCALE: 1/8" = 1'-0"



**PLAN**  
1" = 20'

CURVE ALIGNMENT DATA				
No.	R	Δ	TANGENT	LENGTH
①	700.00'	22°37'47"	140.06'	276.47'
③	130.00'	55°49'41"	68.87'	126.67'

**NOTES:**

- Ⓐ CHAIN LINK RAILING TYPE 7
- Ⓑ CONCRETE BARRIER TYPE 26
- Ⓒ CIP/PS CONCRETE SLAB

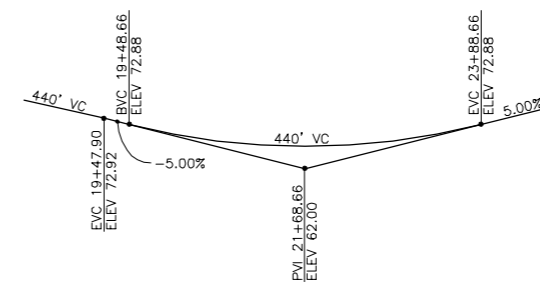
**LEGEND:**

- ⊙ INDICATES POINT OF MINIMUM VERTICAL CLEARANCE
- ➔ INDICATES TRAFFIC DIRECTION

**MARQUARDT AVE SEPARATION**

DATE OF ESTIMATE	9/01/2015
STRUCTURE DEPTH	2'-0"
LENGTH*	108'-8"
WIDTH	82'-0"
AREA	8,910 SF
COST PER SQUARE FOOT INCLUDES 10% MOBILIZATION AND 25% CONTINGENCY	\$275
TOTAL COST	\$2,450,000

\* LENGTH MEASURED ALONG STRAIGHT  
LINE FROM ABUT 1 TO ABUT 3



**ROSECRANS AVE PROFILE**  
SCALE: NO SCALE

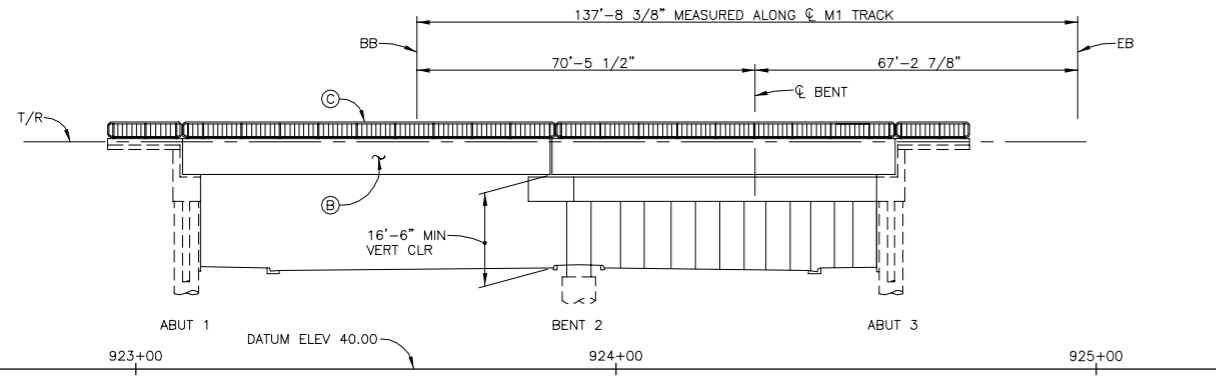
**ATTENTION**  
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FOR UNDERGROUND SERVICE ALERT CALL:  
1-800-422-4133

PLANS PREPARED BY:

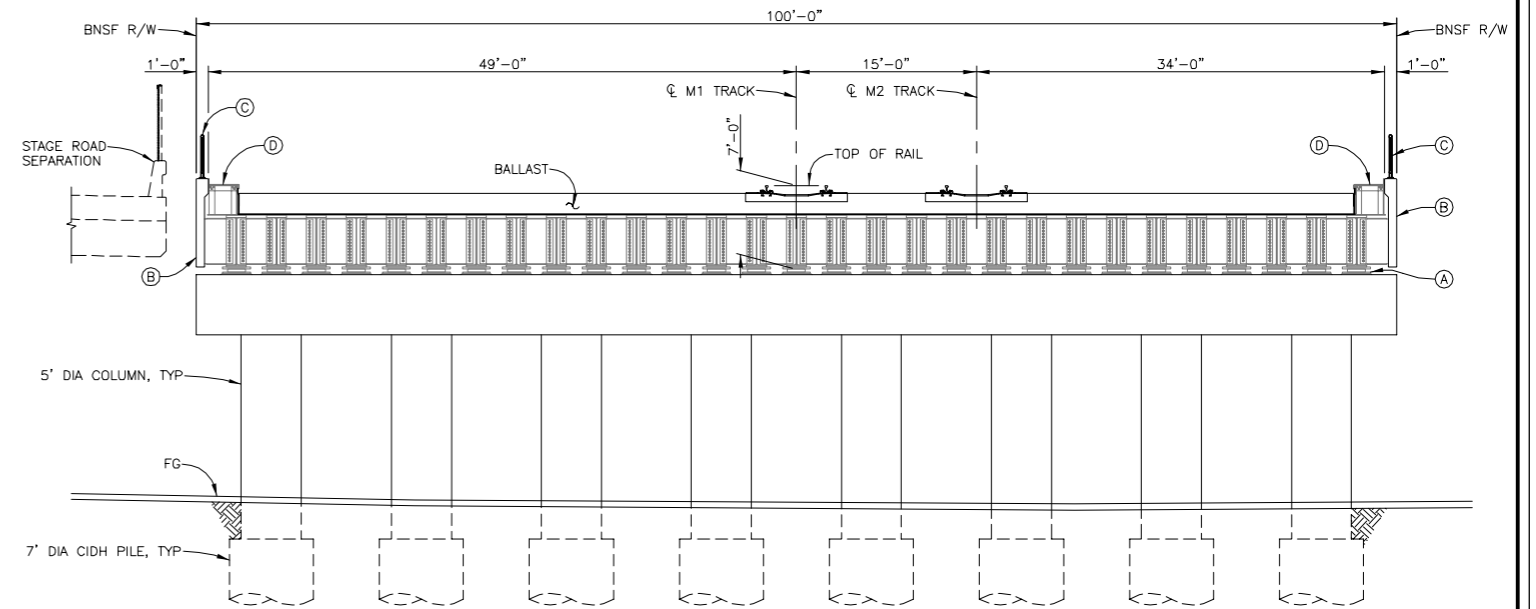
**BIGGS CARDOSA  
ASSOCIATES INC**  
STRUCTURAL ENGINEERS  
500 So. Main St., Suite 400  
Orange, California 92668  
714-550-4660



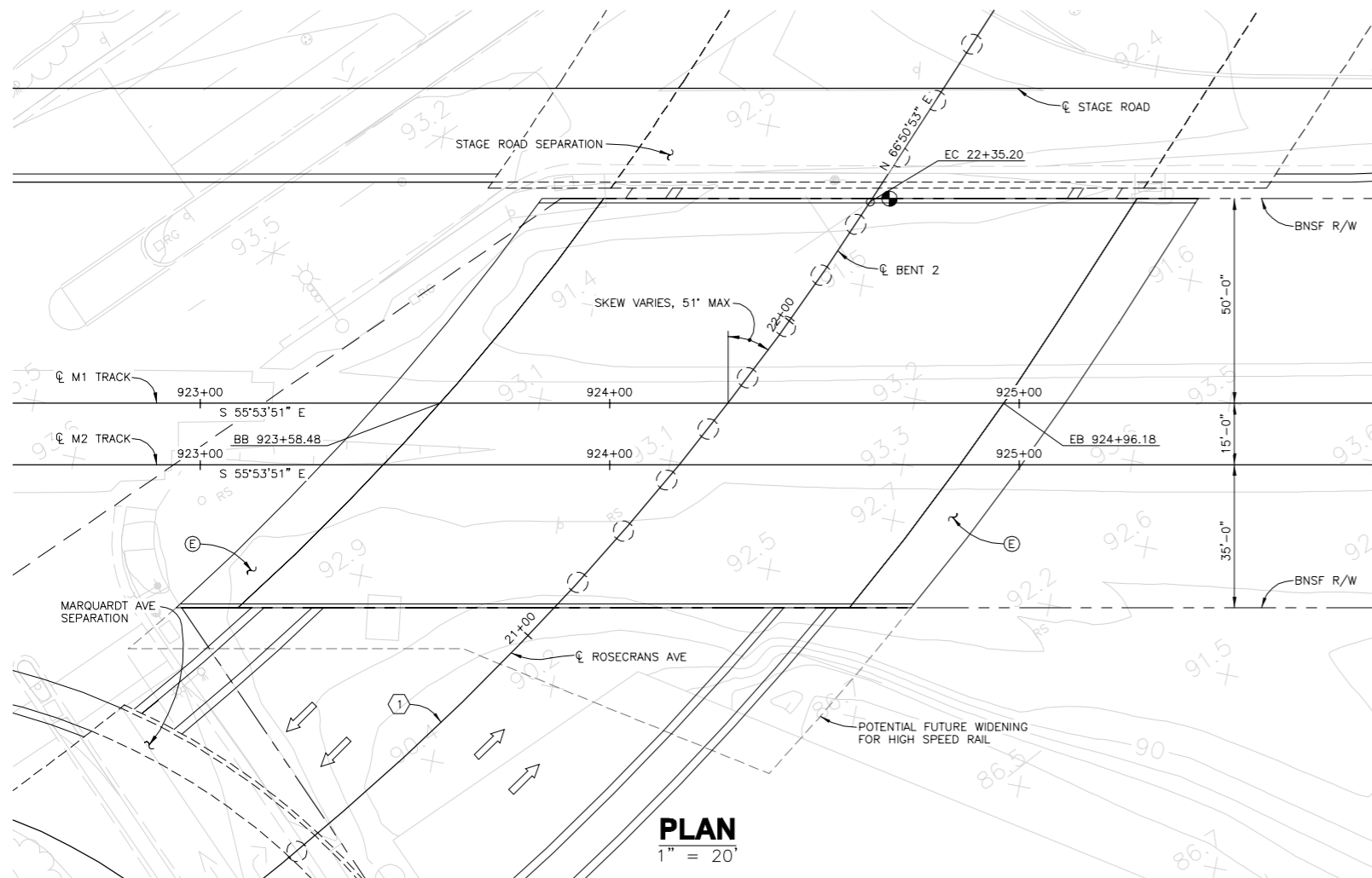
NO	REVISIONS	APPR	DATE
CITY OF SANTA FE SPRINGS ENGINEERING DEPARTMENT SANTA FE SPRINGS, CALIF.			
GENERAL PLAN - ALTERNATIVE 4 ROSECRANS/MARQUARDT GRADE SEPARATION SANTA FE SPRINGS CALIFORNIA			
APPROVED			
RECOMMENDED	CITY ENGINEER	RCE NO.	DATE
SUBMITTED	ASSISTANT CITY ENGINEER	RCE NO.	DATE
	PROJECT ENGINEER	RCE NO.	DATE
DRAWN BY	CHECKED BY		
D. MANCINI	E. PHEIFER		
			SHT. 2 OF 4 SHS



**ELEVATION**  
1" = 20'



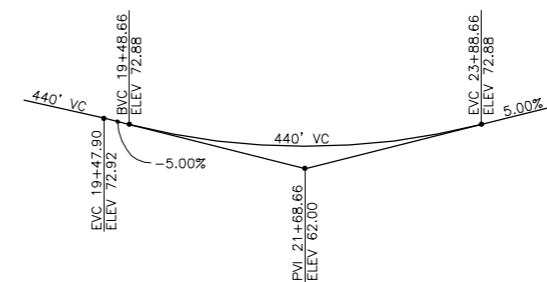
ROSECRANS AVE UNDERPASS  
**TYPICAL SECTION**  
SCALE: 1/8" = 1'-0"



CURVE ALIGNMENT DATA				
No.	R	Δ	TANGENT	LENGTH
①	700.00'	22°37'47"	140.06'	276.47'

- NOTES:**
- (A) STEEL DECK PLATE GIRDER BRIDGE
  - (B) PRECAST FACADE PANELS
  - (C) HAND RAILING
  - (D) WALKWAY
  - (E) APPROACH SLAB
- LEGEND:**
- ⊙ INDICATES POINT OF MINIMUM VERTICAL CLEARANCE
  - ➔ INDICATES TRAFFIC DIRECTION

ROSECRANS AVE UNDERPASS	
DATE OF ESTIMATE	9/01/2015
STRUCTURE DEPTH	7'-0"
LENGTH	137'-8 3/8"
WIDTH	100'-0"
AREA	13,770 SF
COST PER SQUARE FOOT INCLUDES 10% MOBILIZATION AND 25% CONTINGENCY	\$1,400
TOTAL COST	\$19,278,000



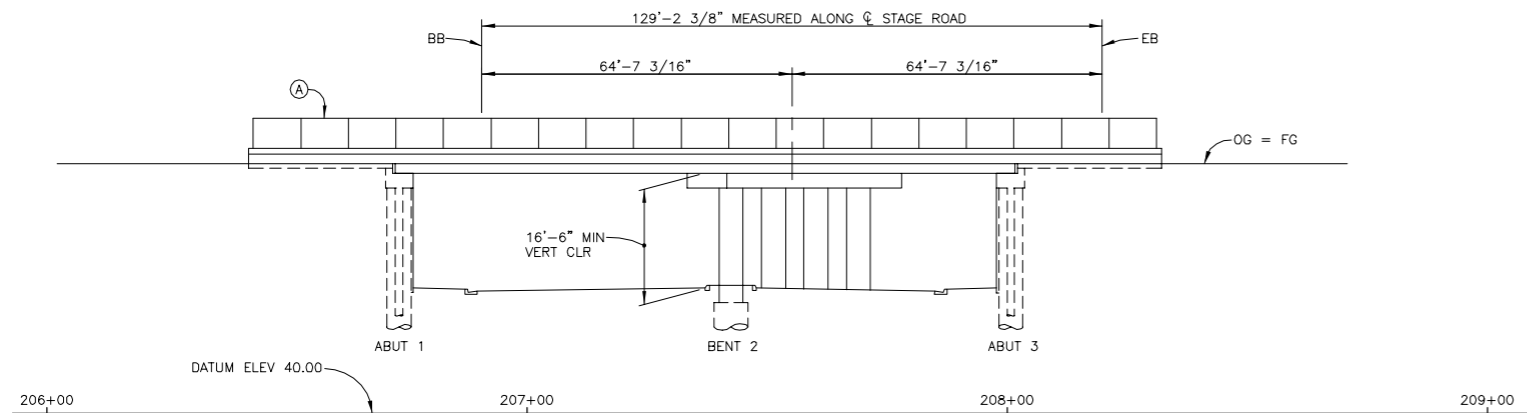
**ROSECRANS AVE PROFILE**  
SCALE: NO SCALE

**ATTENTION**  
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1-800-422-4133

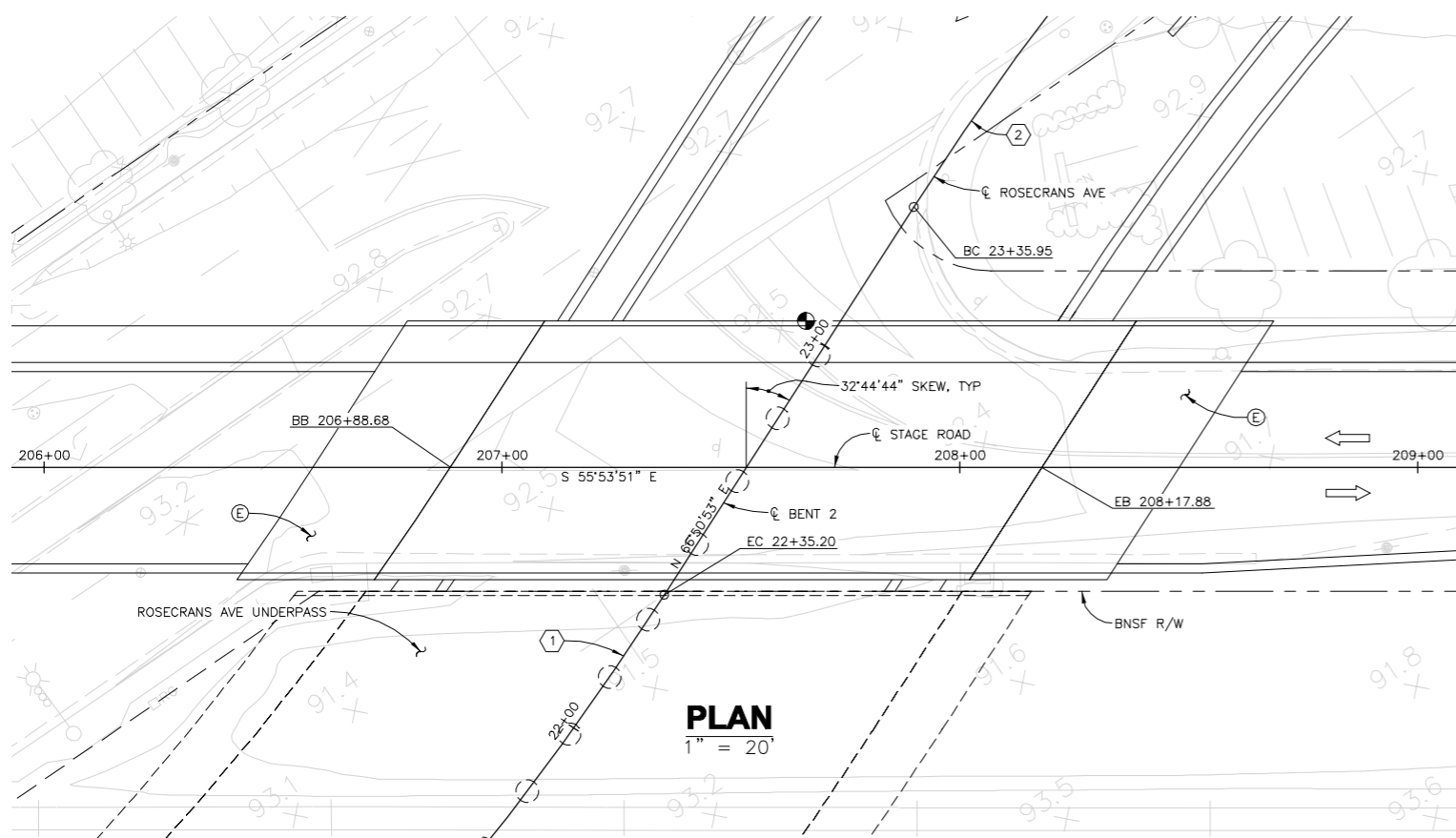
PLANS PREPARED BY:  
**BIGGS CARDOSA ASSOCIATES INC**  
STRUCTURAL ENGINEERS  
500 So. Main St., Suite 400  
Orange, California 92668  
714-550-4665



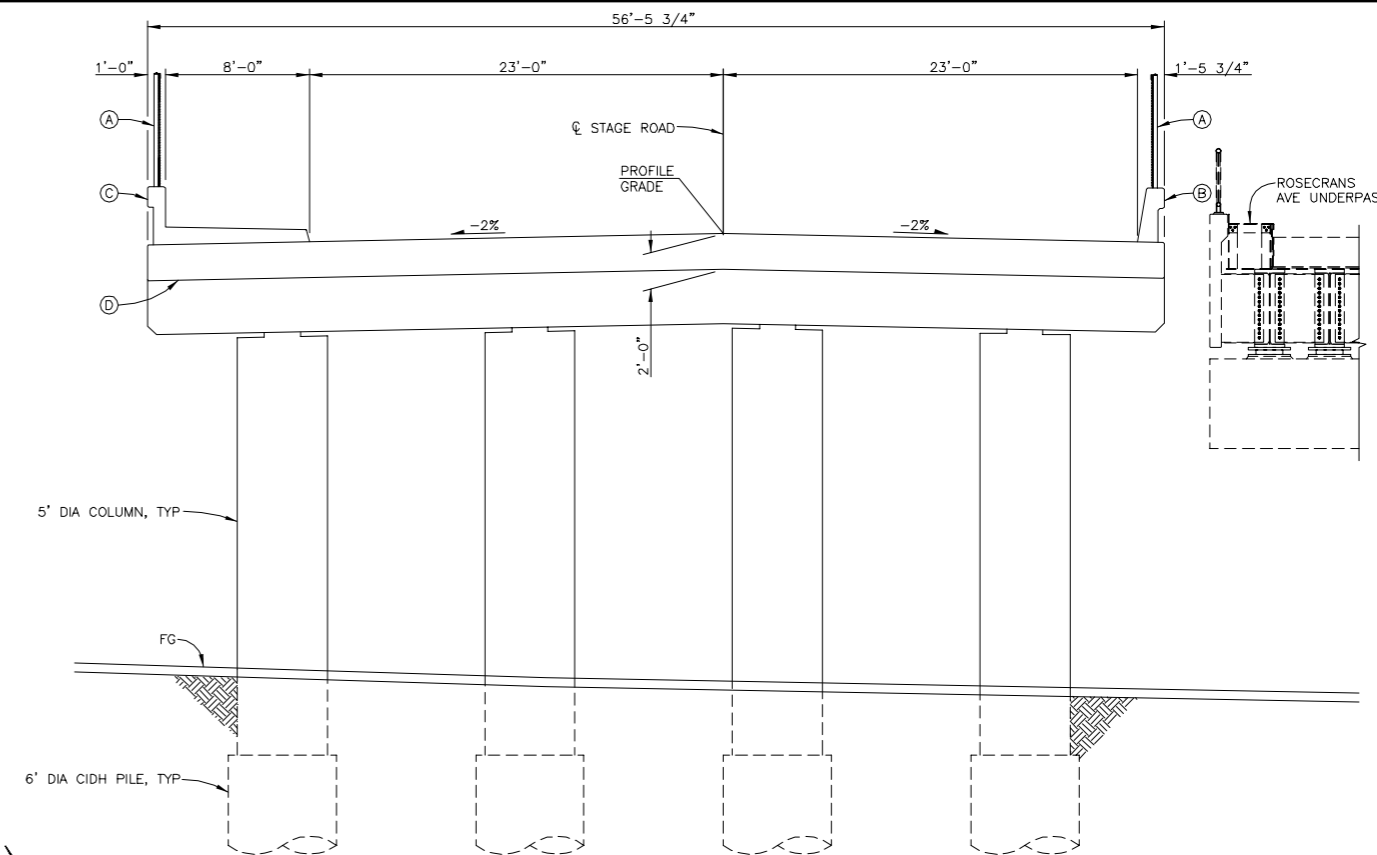
NO	REVISIONS	APPR	DATE
CITY OF SANTA FE SPRINGS ENGINEERING DEPARTMENT SANTA FE SPRINGS, CALIF.			
GENERAL PLAN - ALTERNATIVE 4 ROSECRANS/MARQUARDT GRADE SEPARATION SANTA FE SPRINGS CALIFORNIA			
APPROVED			
RECOMMENDED	CITY ENGINEER	RCE NO.	DATE
SUBMITTED	ASSISTANT CITY ENGINEER	RCE NO.	DATE
	PROJECT ENGINEER	RCE NO.	DATE
DRAWN BY	CHECKED BY		
D. MANCINI	E. PHEIFER		
		SHT. 3	OF 4



**ELEVATION**  
1" = 20'



**PLAN**  
1" = 20'



**TYPICAL SECTION**  
SCALE: 3/16" = 1'-0"

CURVE ALIGNMENT DATA				
No.	R	Δ	TANGENT	LENGTH
①	700.00'	22°37'47"	140.06'	276.47'
②	700.00'	22°46'39"	141.00'	278.28'

**STAGE ROAD SEPARATION**

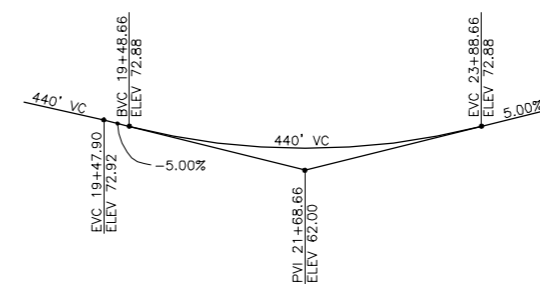
DATE OF ESTIMATE	9/01/2015
STRUCTURE DEPTH	2'-0"
LENGTH	129'-2 3/8"
WIDTH	56'-5 3/4"
AREA	7,297 SF
COST PER SQUARE FOOT INCLUDES 10% MOBILIZATION AND 25% CONTINGENCY	\$275
TOTAL COST	\$2,007,000

**NOTES:**

- (A) CHAIN LINK RAILING TYPE 7
- (B) CONCRETE BARRIER TYPE 736
- (C) CONCRETE BARRIER TYPE 26
- (D) CIP/PS CONCRETE SLAB
- (E) APPROACH SLAB TYPE N(30S)

**LEGEND:**

- ⊙ INDICATES POINT OF MINIMUM VERTICAL CLEARANCE
- ⇨ INDICATES TRAFFIC DIRECTION



**ROSECRANS AVE PROFILE**  
SCALE: NO SCALE

**ATTENTION**  
All utilities shown in this plan are based on available records. It shall be the sole responsibility of the contractor to verify existing utilities by contacting utility agencies and to avoid damaging existing utilities during excavation.  
FOR UNDERGROUND SERVICE ALERT CALL:  
1-800-422-4133

PLANS PREPARED BY:

**BIGGS CARDOSA ASSOCIATES INC**  
STRUCTURAL ENGINEERS  
500 So. Main St., Suite 400  
Orange, California 92668  
714-550-4660



NO	REVISIONS	APPR	DATE
CITY OF SANTA FE SPRINGS ENGINEERING DEPARTMENT SANTA FE SPRINGS, CALIF.			
GENERAL PLAN - ALTERNATIVE 4 ROSECRANS/MARQUARDT GRADE SEPARATION SANTA FE SPRINGS CALIFORNIA			
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	PROJECT ENGINEER	RCE NO.	DATE
DRAWN BY	CHECKED BY		
D. MANCINI	E. PHEIFER		
			SHT. 4 OF 4 SHS



# Earth Mechanics, Inc.

Geotechnical & Earthquake Engineering

August 31, 2015

EMI Project No. 15-132

Biggs Cardosa Associates, Inc.  
500 S. Main St., Suite 400  
Orange, CA 92868

Attention: Mr. Miguel A Carbuccia

Subject: Preliminary Geotechnical Report  
Rosecrans-Marquardt Grade Separation Project  
Santa Fe Springs, California

Dear Mr. Carbuccia:

Attached please find the Preliminary Geotechnical Report for the Rosecrans-Marquardt Grade Separation Project. The report is intended to provide preliminary geotechnical information to assist Biggs Cardosa Associates, Inc. in preparing the preliminary cost estimate and alternative analysis for the project.

Conclusions and recommendations given in this report are considered preliminary and should be verified in the future by conducting site-specific geotechnical field investigations, laboratory soil testing, and analyses.

We appreciate the opportunity to provide geotechnical design services for this project. If you have any questions, please call us.

Sincerely,

EARTH MECHANICS, INC.



(Ranjan) J. G. Gunaranjan, GE 2970  
Project Engineer



Lino Cheang, GE 2345  
Project Manager

JGG/jgg,lcc

**PRELIMINARY GEOTECHNICAL REPORT**  
**ROSECRANS-MARQUARDT GRADE SEPARATION PROJECT**  
**SANTA FE SPRINGS, CALIFORNIA**

Prepared for:

Biggs Cardoso Associates, Inc.  
500 S. Main St., Suite 400  
Orange, CA 92868

Prepared By:

Earth Mechanics, Inc.  
17800 Newhope Street, Suite B  
Fountain Valley, California 92708

EMI Project No. 15-132

August 31, 2015

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## APPENDIX

Appendix A. As-Built Log of Test Borings Sheets

## **1.0 INTRODUCTION**

This Preliminary Geotechnical Report presents preliminary geotechnical information for the Rosecrans-Marquardt Grade Separation (GS) Project. The purpose of this report is to provide preliminary geotechnical information to assist Biggs Cardosa Associates, Inc. (Biggs Cardosa) in preparing the preliminary cost estimates and alternative analysis for the project. A Site Location Map is presented in Figure 1.

The recommendations provided in this report are based on subsurface information contained on Log-of-Test-Borings (LOTB) sheets included with the As-Built Plans of nearby bridges along Interstate 5. The recommendations contained in this memorandum should be considered as preliminary. Final design recommendations will be developed after completion of a site-specific field investigation during the PS&E phase.

## **2.0 PROJECT DESCRIPTION AND PROPOSED IMPROVEMENTS**

### **2.1 Project Description**

The Los Angeles County Metropolitan Transportation Authority (Metro) is partnering with the BNSF Railway, the City of Santa Fe Springs, and Caltrans Division of Rail to develop a grade separation at the intersection of Rosecrans Avenue and Marquardt Avenue and the BNSF right-of-way. The project site is located at milepost 157.8 on the BNSF San Bernardino Subdivision in the City of Santa Fe Springs. At the project location, BNSF tracks runs in a northwest-southeast direction. Currently, both Rosecrans Avenue and Marquardt Avenue are at-grade crossing with the BNSF tracks. Marquardt Avenue is running in a north-south direction while Rosecrans Avenue is running in an east-west direction.

The objective of the project was to increase the efficiency of the BNSF main east-west corridor to better accommodate existing and future freight and passenger service and to allow specific increases in the speed and volume of planned intercity and commuter rail passenger service. The purpose of the grade separation project is to alleviate the current and potential traffic impacts and hazards posed by the existing at-grade rail crossing.



**Earth Mechanics, Inc.**  
 Geotechnical & Earthquake Engineering

**SITE LOCATION MAP**

Figure 1

Rosecrans-Marquardt Grade Separation

**Project No.** 15-132

**Date:** 07-01-2015

## 2.2 Proposed Improvements

Two Overpass and two Underpass alternatives are being considered for the Alternatives Analysis phase. Plan views of these four alternatives are presented in Figure 2.

A three-span precast prestressed concrete “wide flange” girder bridge supported on bent-type abutments is proposed for the Overpass alternatives (Alternatives 1 and 2) over the BNSF tracks. Alternative 1 also includes a single-span cast-in-place prestressed box girder supported on bent-type abutments spanning over Anson Avenue. Foundation type for the bent-type abutments and bents is 7-foot diameter CIDH concrete pile extensions.

Two-span structures are proposed for the Underpass alternatives. Both Underpass alternatives (Alternatives 3 and 4) consist of three separate structures: a railroad bridge, and Stage Road and Marquardt Avenue bridges crossing the depressed Rosecrans Avenue. Bridge abutments will be supported on top of a secant pile wall composed of a single row of reinforced 5-foot diameter Cast-in-Drilled-Hole (CIDH) concrete piles spaced at 6 feet on-center, with 2-foot diameter unreinforced and overlapping CIDH piles in-between. The secant pile wall will act as an abutment wall and will provide vertical support for the bridge as well as lateral support for the earth behind the walls. A Deep Soil Mixing (DSM) wall with W-sections as reinforcing members can also be considered as an option to the secant pile wall. The center bent is supported on 7-foot diameter CIDH concrete pile extensions.

Retaining walls are required for the depressed roadway in the Underpass alternatives. Wall types could include conventional cantilevered wall, and top-down walls such as secant/tangent pile wall, soldier pile wall with and without ground anchors, soil nail wall, or ground anchored walls. For the Overpass alternatives, a Mechanically Stabilized Earth (MSE) or a T-WALL® retaining wall system is proposed at the approach embankments.



Alternative 1



Alternative 2



Alternative 3



Alternative 4



**Earth Mechanics, Inc.**  
Geotechnical & Earthquake Engineering

Rosecrans-Marquardt Grade Separation

Proposed Improvements

Figure 2

**Project No.** 15-132

**Date:** 07-01-2015

### 3.0 PHYSICAL SETTINGS AND SUBSURFACE SOIL CONDITIONS

#### 3.1 Climate

The weather in the Los Angeles area is a Mediterranean-type climate with warm dry summers and mild winters. As is typical of a Mediterranean climate, most rainfall occurs in the winter months. The winter rains accompany northern Pacific storms that generally originate in the Gulf of Alaska region and sweep across California from the northwest. Occasional showers can occur during the summer months due to hot moist monsoonal air masses that spread northerly from the Gulf of Mexico and Gulf of California.

Another typical Los Angeles Basin weather characteristic results from the juxtaposition of cool marine waters and dry hot desert air. As the moist marine air masses drift over colder water, a bank of low clouds and fog is formed which creeps inland for only a short distance before evaporating completely. Characteristically, this deck of clouds reaches inland as far as the bordering hills and mountains during the night, and then recedes to the vicinity of the coast during the day.

The average maximum temperatures in the project area are about 78°F, and the average minimum temperatures are about 56°F. The warmest months are July through September when the maximum temperature averages about 88°F. The record high temperature in the project area is 108°F. The hottest temperatures are commonly associated with Santa Ana winds which involve adiabatic heating due to a high-pressure cell over the Great Basin in Nevada and Utah to the east. The coolest months are December through February when the average low is about 48°F. The lowest temperature recorded in the project area is 30°F. Freezing temperatures occur rarely in the winter months, but generally do not result in a hard freeze.

The average annual precipitation is about 13.5 inches. The wettest months are December through February when rainfall ranges from about 2 to 3.5 inches per month. The driest month is July when virtually no precipitation is likely. Although snowfall is possible in the surrounding mountain ranges and rarely in the inland valleys, no snowfall is likely within the Los Angeles Basin.

#### 3.2 Physiography, Topography, and Drainage

The proposed project site is in the northeastern part of the Los Angeles Basin. The Los Angeles Basin is a large low-lying coastal plain bordered by the Santa Monica Mountains on the north, the Repetto and Puente Hills on the northeast, the Santa Ana Mountains on the east, and the San Joaquin Hills on the south. The western margin of the basin is open to the Pacific Ocean except for one prominent hill, the Palos Verdes Hills or Peninsula. The floor of the Los Angeles Basin is a relatively flat surface rising gently from sea level along the coastline to an apron of uplifted terrain along the base of the surrounding mountains which rise abruptly to a few thousand feet above the plain. The apron of elevated terrain surrounding the basin floor includes the Santa Monica, La Brea, Montebello, and Santa Fe Springs plains. The flat basin floor is interrupted in a few localities by small hills, the most prominent of which are a northwest-southeast trending alignment of hills and mesas extending from the Newport Beach area on the south to the Beverly Hills area on the north.

The northwest-trending alignment of hills is due to folding and geological fault displacements along the Newport-Inglewood Structural Zone (NISZ). The NISZ divides the basin floor into two major plains, the Downey-Tustin Plain on the northeast and the Torrance Plain on the southwest.

The floor of the Los Angeles Basin is directly underlain by unconsolidated Quaternary-age sandy sediments. These generally could be subdivided into loose unconsolidated Holocene-age sediments which cover the bulk of the basin, and late-Pleistocene materials which comprise the surface over much of the uplifts of the NISZ and the marginal plains. Hard rocks occur only in the mountains surrounding the basin and at depths ranging from about 5,000 feet to as much as 30,000 feet in the deepest part of the central basin.

The principal drainages in the region are the San Gabriel River and the Rio Hondo River which drains from the high San Gabriel Mountains and flows southerly towards the Ocean. Locally the Coyote Creek flows proximal to the project site.

### **3.3 Stratigraphy**

The project site is underlain by deep alluvial, continental and marine deposits, which unconformably overlie basement complex of the Peninsular Ranges. The geologic formations in the area, following the nomenclature of Dibblee (2001), in descending stratigraphic order are:

- Quaternary Older Alluvium; Late to Early Pleistocene (Qoa); and
- La Habra Formation; Late to Early Pleistocene (Qlh and Qlhc); and
- San Pedro Formation, Early Pleistocene (Qsp); and
- Fernando Formation, Early Pleistocene to Pliocene (Tfs, Tf, and Tfr).

The project vicinity is underlain by thick Holocene to Pleistocene deposits of clay, silt, sand, and gravel deposited by the San Gabriel River. The central block of the Los Angeles basin is underlain by over 10,000 feet of Cretaceous to Pleistocene age sediments overlying crystalline basement rock (Norris and Webb, 1990).

### **3.4 Geologic Structure**

The proposed project is located along the central block of the Los Angeles Basin. The central block consists of a broad synclinal sag that is bounded by the NISZ to the west and by the Elsinore fault zone on the east.

The region consists of several major active fault systems including the NISZ, Elsinore fault zone (Whittier Section), Puente Hills blind thrust fault system (Santa Fe Springs fault and Coyote Hills fault), and the Elysian Park (lower) blind thrust fault. The NISZ and Elsinore fault zone are identified as Alquist-Priolo (AP) Earthquake Fault Zones defined by the Alquist-Priolo Earthquake Hazards Act of 1972 revised in 1994. The AP faults not only represent earthquake shaking hazards, but have a potential for surface ground rupture. The type and magnitude of the seismic hazard affecting the site are dependent on the distance and causative faults and the intensity and magnitude of the seismic event. The NISZ is located approximately 9.9 miles southwest of the project site while the Elsinore fault zone is located approximately 5.4 miles northeast of the project site. The Puente Hills and Elysian Park blind thrust faults are also

considered active and are not delineated within an AP fault zone as they are not well defined. The blind thrust faults are not mapped by USGS as they are buried faults that show little to no surficial expression to delineate any fault trace. The fault locations are shown on Figure 3.

### 3.5 Geologic Hazards

The principal geologic hazards at the project site are considered to be surface fault rupture, liquefaction, and ground shaking. Potential of surface fault rupture is addressed in Section 0.

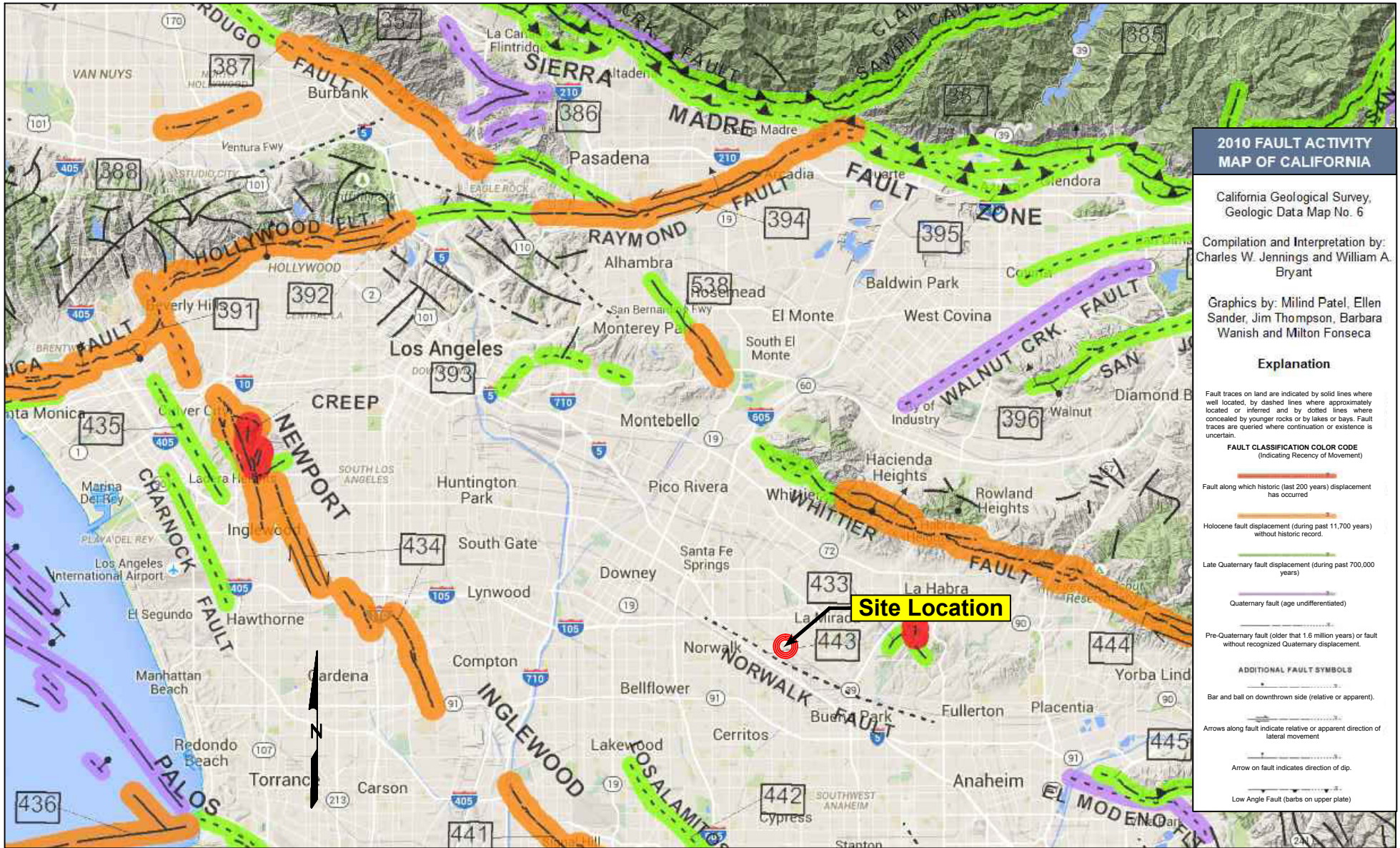
Shallow groundwater is anticipated at the project site based on available existing data. Moderate to severe ground shaking should be anticipated if an earthquake occurs on nearby active faults, particularly faults associated with the Elysian Park fault system and Puente Hills fault system. These site conditions also create a potential for liquefaction. Soil liquefaction is addressed in Section 0.

### 3.6 Seismicity

The project corridor is in seismically active southern California. The present-day seismotectonic stress field in the Los Angeles region is one of north-northeasterly compression. This is indicated by the geologic structures, by earthquake focal-mechanism solutions, and by geodetic measurements. These data suggest crustal shortening of between 5 and 9 mm/year in the north-south direction across the Greater Los Angeles area and about 2.5 mm/year elongation in the east-west direction (Argus et al., 1999).

Earthquakes in the Los Angeles region occur primarily as loose clusters along the Newport-Inglewood Structural Zone, along the southern margin of the Santa Monica Mountains, the margin between the Santa Susana-San Fernando Valley and the southern margin of the San Gabriel Mountains, and in the Coyote Hills-Puente Hills area. Although historical earthquakes have occurred in proximity to known faults, they are often difficult to directly associate with mapped faults. Ward (1994) estimated that about 40% of seismic moment cannot be associated with known faults. Part of this difficulty is due to the fact that the basin is underlain by several poorly known subsurface thrust faults, generally referred to as blind thrust faults.

The largest historical earthquake within the Los Angeles Basin was the 1933 Long Beach event which had a magnitude of about  $M_w=6.4$  ( $M_L=6.3$ ). This earthquake did not rupture the ground surface but is believed to have been associated with the southern part of the Newport-Inglewood Structural Zone, a major strike-slip fault in the Los Angeles Basin (Benioff, 1938). The association was based on abundant ground failures along the NISZ trend but no unequivocal surface rupture was identified. Reevaluation of the seismicity data by Hauksson and Gross (1991) relocated the 1933 earthquake hypocenter to a depth of about 6 miles below the Huntington Beach-Newport Beach city boundary.



**2010 FAULT ACTIVITY MAP OF CALIFORNIA**

California Geological Survey,  
Geologic Data Map No. 6

Compilation and Interpretation by:  
Charles W. Jennings and William A. Bryant

Graphics by: Milind Patel, Ellen Sander, Jim Thompson, Barbara Wanish and Milton Fonseca

**Explanation**

Fault traces on land are indicated by solid lines where well located, by dashed lines where approximately located or inferred and by dotted lines where concealed by younger rocks or by lakes or bays. Fault traces are queried where continuation or existence is uncertain.

**FAULT CLASSIFICATION COLOR CODE**  
(Indicating Recency of Movement)

- Fault along which historic (last 200 years) displacement has occurred
- Holocene fault displacement (during past 11,700 years) without historic record.
- Late Quaternary fault displacement (during past 700,000 years)
- Quaternary fault (age undifferentiated)
- Pre-Quaternary fault (older than 1.6 million years) or fault without recognized Quaternary displacement.

**ADDITIONAL FAULT SYMBOLS**

- Bar and ball on downthrown side (relative or apparent).
- Arrows along fault indicate relative or apparent direction of lateral movement
- Arrow on fault indicates direction of dip.
- Low Angle Fault (barbs on upper plate)

Other major earthquakes in the region include the 1994 Northridge and the 1971 San Fernando earthquake. The 1994 earthquake had a moment magnitude ( $M_W$ ) of about 6.7 ( $M_S=6.8$ ,  $M_L=6.4$ ), and occurred on a southerly dipping subsurface fault which was unknown prior to the earthquake. The main shock occurred at a depth of about 19 km. Earthquake aftershocks clearly defined the rupture surface dipping about 35 degrees southerly from a depth of about 2 or 3 km to 23 km (Hauksson et al, 1995). The causative fault was never identified with certainty. The event could have occurred on an eastern extension of the Oakridge fault (Yeats and Huftile, 1995), a southerly dipping feature fault bounding the Ventura Basin and the Santa Susana Mountains.

The largest earthquake reported for the Elsinore fault zone in historical time was a magnitude 6.0 earthquake in 1910. This event is believed to have been centered in the Temescal Valley/Glen Ivy Springs area south of the project area (Weber, 1977). Speculations have been made in the literature that a large earthquake occurring in 1812 may have been associated with the Elsinore fault but recent investigations (Weldon et al, 2004) postulate that this event occurred on the San Andreas fault near Wrightwood.

The 1987 Whittier earthquake ( $M_L=5.9$ ,  $M_W=5.9$ ) occurred on subsurface faults dipping under the Puente Hills to about 10 miles beneath the San Gabriel Basin (Shaw and Shearer, 1999). This event did not rupture the ground surface.

### 3.7 Surface Water

The principal streams in the project site vicinity are the San Gabriel River and Rio Hondo River, which flow south from the San Gabriel Mountains and through the Whittier Narrows and down towards the pacific ocean. The San Gabriel River is located approximately 4 miles west of the project site, while the Rio Hondo River is located approximately 6.8 miles northwest of the site. Locally, the Coyote Creek meanders south to southwest and is located approximately 1,000 feet west of the project site.

The proposed site does not cross any drainage or tributary; therefore, scour potential should not be a design issue.

### 3.8 Subsurface Soil Conditions

Subsurface information is obtained from as-built LOTB sheets of the following nearby structures along the I-5 freeway. Copies of these as-built LOTB sheets are presented in Appendix A.

- Carmenita Road Overcrossing (Bridge No. 53-0214) (1955 and 1998). This bridge is located about 4,200 feet southwest of the project site.
- Alondra Boulevard Overcrossing (Bridge No. 53-0630) (1955). This bridge is located about 5,300 feet south of the project site.
- Shoemaker Avenue Overcrossing (Bridge No. 53-1015) (1955 and 1998). This bridge is located about 5,500 feet southwest of the project site.
- Rosecrans Avenue Undercrossing (Bridge No. 53-0634) (1955). This bridge is located about 7,300 feet west of the project site.

As-built LOTB sheets from the nearby structures indicate that the upper 50 to 60 feet of subsurface materials at the project site consist predominantly of alternating layers of very loose to medium dense sand and silty sand with a few interbedded layers of soft to medium stiff cohesive soils (sandy silt, clayey silts, silty clay, and clay with varying amounts of sand). The thickness of each alternating layer varies between about 5 and 20 feet. Below the upper 50 to 60 feet, the materials are medium dense to very dense sand, silty sand, gravelly sand, sandy gravel, and gravel with a few interbedded layers of medium stiff to stiff cohesive soils (sandy silt, clayey silts, silty clay, and clay with varying amounts of sand) down to the deepest boring depth of about 98 feet. Occasional cobbles were reported within the drilled depths in some borings.

### 3.9 Groundwater

Groundwater data were obtained from several sources and the findings are summarized below:

- Caltrans as-built LOTB sheets: As shown in Appendix A, groundwater was encountered between 9 and 33 feet below the ground surface. These measurements were taken in 1953 and 1996.
- Seismic Hazard Zone Report for the Whittier Quadrangle (CGS, 1998): Historical groundwater contour map shows a depth of 8 feet; however, this contour map appears to have been developed based on relatively limited field data.
- State Water Resources Control Board (<http://www.geotracker.waterboards.ca.gov>): a monitoring well (designated as SL2043F156) is located approximately 2,000 feet northwest of the project site. Based on the well readings recorded between 2000 and 2014, the groundwater table varied between depths of 19 and 21 feet.

Based on the above information, our best estimate groundwater depth is between 8 and 33 feet. Groundwater depths will be measured from site-specific soil borings conducted during the PS&E phase.

## 4.0 PRELIMINARY SEISMIC RECOMMENDATIONS

### 4.1 Seismic Design

Overpass Alternatives: The preliminary design ARS curve was determined using the Caltrans ARS Online website (2012a). The key parameters for determining the preliminary design ARS curve are listed in Table 1.

**Table 1. Key Parameters for Determining Preliminary Design ARS Curve**

Site Coordinates	Latitude = 33.90248611 deg	Longitude = -118.0378556 deg
Shear Wave Velocity, $V_s^{30}$	771 feet/sec	
Peak Ground Acceleration (PGA)	0.605 g	

The peak ground acceleration (PGA) is the zero-period spectral acceleration on the ARS curve. Using the information presented in the as-built LOTB sheets from the nearby structures, a small-strain shear wave velocity ( $V_s^{30}$ ) was calculated using the SPT correlations (Caltrans, 2012d). A preliminary design ARS curve was developed for a  $V_s^{30}$  value of 771 feet/sec and it is presented in Figure 4 together with the digitized coordinates.

Underpass Alternatives: The Underpass alternatives should be designed using seismic design criteria established by the American Railway Engineering and Maintenance-of-Way Association (AREMA, 2013).

Site-specific probabilistic ground motion parameters were developed using the web-based USGS Probabilistic Seismic Hazard Analysis (PSHA) software. The probabilistic analysis was performed using three New Generation Attenuation equations; the NGA equations are by Day et al., (2008), Campbell and Bozorgnia (2008), and Chiou and Youngs (2008). Peak Ground Accelerations (PGA's) were determined based on Latitude of 33° 54' 8.95" N and Longitude of 118° 2' 16.28" W, and an average shear wave velocity ( $V_s^{30}$ ) of 771 feet/sec for the upper 100 feet of subsurface soils. The horizontal PGA values are shown in Table 2.

**Table 2. Seismic Design Parameters for Underpass Alternatives**

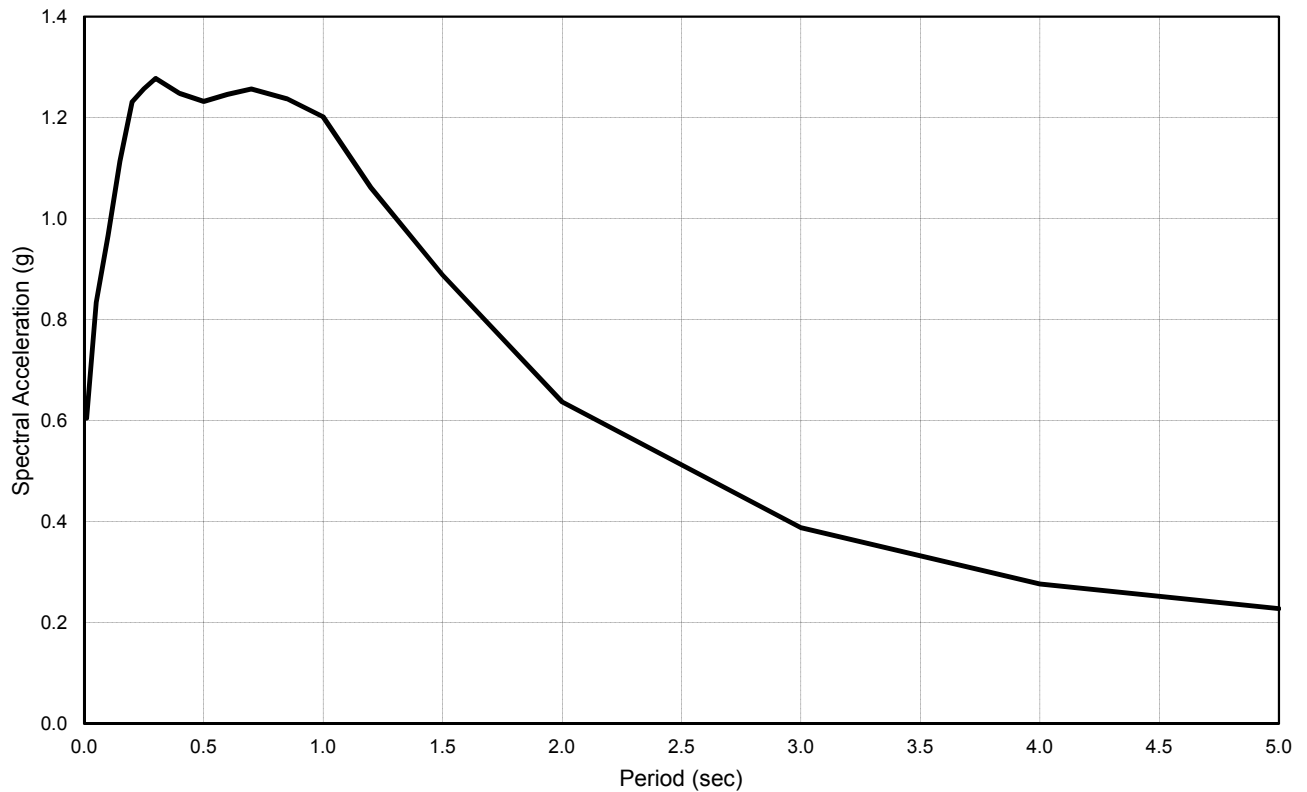
<b>Ground Motion Level (Frequency)</b>	<b>Return Period (Years)</b>	<b>PGA (g)</b>	<b>Site Coefficient, S</b>
1 (occasional)	100	0.24	1.5
2 (rare)	500	0.42	
3 (very rare)	2,400	0.68	

The structural engineer can use the data provided in Table 2 to develop the site-specific response spectrum following the procedure outlined in Section 1.4 of Chapter 9 of the AREMA manual (AREMA, 2013).

## 4.2 Liquefaction Potential

Based on the subsurface information and groundwater data presented in the attached as-built LOTB sheets from the nearby structures, some isolated layers of potential liquefiable materials were encountered at various depths below the ground water table. However, these isolated layers do not appear to represent a continuous horizontal soil layer.

The Seismic Hazard Zone map (CGS, 1999) shows that the proposed GS is located outside the area with liquefaction hazard potential. However, a portion of the proposed western approach embankment appears to fall into the area with liquefaction hazard potential.



Latitude = 33.9025°  
 Longitude = -118.0379°  
 Damping Ratio = 5%  
 Vs30 = 771 ft/s

Peak Ground Acceleration (PGA) = 0.605

Spectral Coordinates			
Period (sec)	Design Acc. (g)	Period (sec)	Design Acc. (g)
0.010	0.605	0.850	1.237
0.050	0.834	1.000	1.202
0.100	0.967	1.200	1.062
0.150	1.114	1.500	0.889
0.200	1.231	2.000	0.637
0.250	1.257	3.000	0.388
0.300	1.278	4.000	0.277
0.400	1.248	5.000	0.228
0.500	1.232		
0.600	1.246		
0.700	1.257		



**Earth Mechanics, Inc.**  
 Geotechnical and Earthquake Engineering

**Rosecrans-Marquardt Grade  
 Separation**

Project No. 15-132

Date: 07/01/15

**Preliminary Design ARS Curve for  
 Overpass Alternatives**

Figure 4

A detailed liquefaction assessment will be conducted using site-specific soil borings to be performed later during PS&E phase of the project and the above conclusions will need to be confirmed. If the subsurface soils are confirmed to have a high liquefaction potential, we will design the bridge foundation to incorporate the effects of soil liquefaction and this can generally be accomplished by deepening the foundation.

### **4.3 Surface Fault Rupture**

The potential of surface fault rupture at this bridge site is anticipated to be low. In addition, per Caltrans Memo to Designer 20-10 (Caltrans, 2013a), since the subject structures do not fall within an Alquist-Priolo Earthquake Fault Zone or within 1,000 feet of an unzoned fault that is Holocene or younger in age, further fault rupture studies will not be needed.

## **5.0 PRELIMINARY FOUNDATION RECOMMENDATION**

### **5.1 Bridge Foundation Design**

Per Caltrans Memorandum dated March 10, 2014, LRFD Service-I Limit State, Strength Limit State, and Construction Limit State load combinations should be used for design of the abutment foundations. The LRFD Service-I Limit State, Strength Limit State, and Extreme Event Limit State load combinations should be used for the design of the bent foundations (Caltrans 2014 amendments to AASHTO 2012).

Due to presence of the relatively weak near-surface soils and based on the axial pile load demands provided by the structural designers, spread footing is not considered feasible for support of the proposed structures.

For the Underpass alternatives, secant pile wall (SPW) or deep soil mixing (DSM) is proposed at the abutments, and 7-foot diameter CIDH pile extensions are proposed at the center bent. The SPW composed of a single row of reinforced 5-foot diameter CIDH piles spaced at 6 feet on-center, with 2-foot diameter un-reinforced and overlapping CIDH piles in-between. The DSM wall is constructed by mechanically mixing soil with cement slurry to form a single row of overlapping soil-cement columns. W-sections inserted within the soil-cement columns are used to provide flexural rigidity and vertical load carrying capability.

Preliminary axial pile load demands were calculated by the structural designers using the LRFD method. The required nominal resistances and estimated pile lengths for the 7-foot diameter CIDH pile are presented in Table 3. Estimated lengths for the 5-foot diameter secant pile and deep soil mixing column at the Underpass abutments can be determined using the equations provided immediately after Table 3.

**Table 3. Summary of Preliminary Foundation Recommendations**

Alternative	Support	Foundation Type	Nominal Resistance (kips)	Estimated Pile Length (feet)
Alternative 1 (Overpass)	Abutment 1	7-foot CIDH	3,100	85
	Bent 2		4,460	119
	Bent 3		4,460	119
	Abutment 4		2,750	76
Alternative 2 (Overpass)	Abutment 1	7-foot CIDH	2,720	75
	Bent 2		4,580	122
	Bent 3		4,580	122
	Abutment 4		2,720	75
Alternative 3 (Underpass)	Abuts 1 & 3	SPW or DSM <sup>1</sup>	See paragraphs below table	
	Bent 2	7-foot CIDH	3,860	105
Alternative 4 (Underpass)	Abuts 1 & 3	SPW or DSM <sup>1</sup>	See paragraphs below table	
	Bent 2	7-foot CIDH	3,820	104

<sup>1</sup> SPW = Secant Pile Wall; DSM = Deep Soil Mixing.

**Secant Pile Wall (SPW):** Only the portion of the 5-foot diameter CIDH pile extending below the surface of the depressed roadway will be providing axial soil resistance. Side friction of each of these closely-spaced 5-foot diameter CIDH pile in kips is equal to unit skin friction (fs) multiply by the surface area in square feet. A “fs” value of 1.0 ksf is recommended for preliminary foundation design. For example, a 50-foot long pile (below the depressed roadway) will develop a nominal resistance of 785 kips (1 ksf x 3.1416 x 5’ diameter x 50’ length). The above equation can be used to estimate the required length of the 5-foot diameter CIDH pile based on the single-pile axial load demands as determined by the structural designers.

**Deep Soil Mixing (DSM):** Similar to the secant pile wall, only the portion of the soil-cement columns extending below the surface of the depressed roadway will be providing axial soil resistance. Nominal resistance of the overlapping soil-cement column (Q) in kips is as follows:

$$Q = 0.0072 * p * z^2$$

where:

p = rectangle perimeter in feet; the rectangle dimensions can be determined using the outer limits of the overlapping soil-cement columns.

z = soil-cement column depth below the depressed roadway in feet.

For example, a 80’ long by 5’ wide by 50’ deep DSM (below the depressed roadway) will develop a nominal resistance of about 3,050 kips (0.0072 x 170 feet perimeter x 50<sup>2</sup> ft<sup>2</sup> depth). This equation can be used to estimate the depth of the DSM based on the total per-support axial load demands as determined by the structural designers.

Settlement Period: Fill will be placed at the approaches for the new bridge for the Overpass alternatives. Maximum settlement induced by the fills is estimated to be about 3 inches. For cost estimating purposes, a waiting period of 21 days is recommended for pile construction at the abutments. The above settlement magnitude and settlement period will need to be evaluated using site-specific borings and laboratory test results obtained during the PS&E phase of the project.

## **5.2 Retaining Walls, Underpass Alternatives**

Retaining walls are required for the depressed Rosecrans Avenue in the Underpass alternatives. Wall types could include conventional cantilevered wall, and top-down walls such as secant/tangent pile wall, soldier pile wall with and without ground anchors, soil nail wall, or ground anchored walls.

If shallow groundwater is encountered, then the conventional cantilevered wall and secant pile wall similar to those used at the abutments for the Underpass alternatives are feasible because these wall types can be designed and constructed to accommodate hydrostatic pressure. If groundwater is well below the depressed roadway, then secant/tangent pile wall, soldier pile wall with and without ground anchors, soil nail wall or ground anchored wall are also feasible. We anticipate that soldier pile walls that are taller than 12 feet will require one or more levels of ground anchors.

Conventional cantilevered walls will require a temporary back-cut or temporary shoring which will result in a larger construction footprint as compared to the top-down walls. Soil nails and ground anchors will require permanent easements which may or may not be available.

Final selection of the wall type will occur during PS&E and will likely depend on the site-specific subsurface conditions, cost and right-of-way constraints.

## **5.3 Retaining Walls, Overpass Alternatives**

Based on existing soil information, both MSE walls and T-WALL® are expected to be feasible for the Overpass alternatives.

Due to the presence of weak surficial soils, some degree of remedial earthwork (overexcavation and recompaction) will be required below the MSE walls or T-WALL® base, and leveling pads to create a uniform foundation on which the embankments and walls can be constructed. The overexcavation should range across the width of the MSE walls or T-WALL® structure and extend certain distance in front of the front face of the wall and behind the end of the wall stem. Overexcavation depths will be determined using site-specific soil borings data during the PS&E phase.

Analysis will also be conducted during PS&E to evaluate the global stability of the MSE wall or T-WALL® embankment under static and seismic conditions once the wall layout and profile sheets become available.

## 6.0 ROADWAY

### 6.1 Embankment Settlement

As mentioned before, Rosecrans-Marquardt GS involves raising or depressing the existing Rosecrans Avenue over or under the railroad tracks. New fill embankments are proposed for the approaches to the GS. The south side of the approach embankments will be retained by MSE walls or the T-WALL® retaining wall system, while the north side of the approach embankments will be an engineered sloped earthen embankment. The maximum fill thickness at the approaches is about 36 feet in height above the existing ground. Calculated maximum settlement is estimated to be about 3 inches.

### 6.2 Stability of Embankment Slopes

Fill embankments should be globally stable for a maximum slope gradient of 2H:1V or flatter. Fill slopes with a gradient of 2H:1V or flatter should be surficially stable. If slope paving is proposed for fill slopes with a gradient of 1.5H:1V, surficial stability is also not a design concern. If slope paving is not used for the 1.5H:1V slopes, it is recommended that the upper 4 feet of the new 1.5H:1V slope face be covered with materials with a minimum internal friction angle of 32 degrees and a minimum cohesion of 230 psf. This select material should be properly keyed and benched into the sloping ground. In all cases, proper maintenance with erosion protection and drainage control in accordance with Section 21 of Caltrans Standard Specifications (Caltrans, 2010) are also recommended.

Stability of fill embankments should be evaluated during the final design phase using subsurface data obtained from site specific soil borings.

### 6.3 Pavement Sections

R-value of the subgrade soils is anticipated to be greater than 30. For preliminary design of flexible pavement sections, a design R-value of 30 is assumed.

Preliminary flexible pavement sections were determined using Traffic Indices between 9 and 15 and a design life of 20 years. Flexible pavement sections were determined in accordance with Chapter 630 of the Caltrans Highway Design Manual (Caltrans, 2012c). Undrained pavement sections are assumed for the proposed roadways. Preliminary pavement sections are presented in Table 4.

**Table 4. Flexible Pavement Structural Sections**

Traffic Index	Design R-Value	Undrained Flexible Pavement Structure Sections (Design Life of 20 years)
9.0	30	0.50" HMA-A / 0.95" AB
10.0		0.50" HMA-A / 1.20" AB
11.0		0.55" HMA-A / 1.35" AB
12.0		0.60" HMA-A / 1.50" AB
13.0		0.65" HMA-A / 1.65" AB
14.0		0.90" HMA-A / 1.35" AB
15.0		0.90" HMA-A / 1.60" AB

*Note: HMA-A = Hot-Mix Asphalt- Type A; AB = Aggregate Base (Class 2).*

## 7.0 SOIL CORROSION AND CULVERT MATERIALS

Soil corrosion test results are not available; therefore, corrosion potential of on-site soils is not known. Based on EMI's experience, clayey soils have a higher tendency to be corrosive, whereas sands and silts tend to be non-corrosive. Onsite soils within the project area are composed of both coarse-grained sandy soils and fine-grained silts and clays and soil corrosivity may become a design issue. A soil corrosion study should be performed during the PS&E phase.

According to the Caltrans Corrosion Guidelines (Caltrans, 2012b), soils are considered corrosive if the pH is 5.5 or less, or chloride content is 500 parts per million (ppm) or greater, or sulfate content is 2,000 ppm or greater.

For preliminary cost estimating purposes, culvert material recommendations are provided in Table 5 for the following two assumed conditions:

- (1) non-corrosive soils having a pH equal to 7.0, soluble chloride content less than 500 ppm, soluble sulfate less than 2,000 ppm, and minimum resistivity of 1,500 ohm-cm; and
- (2) mildly-corrosive conditions assuming soil has a minimum resistivity of 800 ohm-cm, chloride content of 600 ppm, sulfate content of 1,000 ppm, and pH equal to 7.0.

**Table 5. Preliminary Recommendations for Culvert Materials**

Culvert Material	Non-Corrosive Soils	Mildly-Corrosive Soils
Reinforced Concrete Pipe (RCP)	Standard concrete mix design should be suitable for RCP. Type IP (MS) modified cement or Type II modified cement is recommended.	For chloride resistant RCP, a cement content of 640 lb/cubic yard should be used in the mix design. Concrete cover should be a minimum 2 inches.
Corrugated Steel Pipe (CSP)	Minimum 10-gage pipe or 16-gage pipe with bituminous coating on the soil side of the pipe.	Minimum 8-gage pipe or 14-gage pipe with bituminous coating on the soil side of the pipe.

<b>Culvert Material</b>	<b>Non-Corrosive Soils</b>	<b>Mildly-Corrosive Soils</b>
Aluminum or Aluminized Steel Pipe	Aluminum pipe can be used if abrasive conditions do not exist. Aluminized steel pipe can be used.	Should not be used due to corrosive soil conditions.
Plastic Pipe	Plastic pipe may be used; however, abrasion should be evaluated by the project civil engineer.	Plastic pipe may be used; however, abrasion should be evaluated by the project civil engineer.

*Notes:*

*1. Recommendations are for an estimated service life of 50 years.*

*2. Culvert materials were determined using the CULVERT4 computer program developed by Caltrans.*

## 8.0 ADDITIONAL FIELD WORK AND LABORATORY TESTING

EMI recommends excavating exploratory borings throughout the project area, during the PS&E phase of the project, to investigate site-specific soils and conditions and to collect samples of subsurface soils for laboratory testing. A soil exploratory program was recommended for the Overcrossing Alternate "O4" during the proposal stage of this project. This program consists of three borings drilled near the proposed bridge supports and seven borings drilled near the proposed approaches embankments. The depth of the bridge borings is up to 150 feet, whereas the depth of the proposed embankment borings ranges between 50 and 70 feet. In addition, three shallow borings (10 feet deep) will be drilled for pavement design.

Samples recovered during the field investigation will be transported to the laboratory for testing. All of the soil samples will be visually classified and moisture content/density tests will be performed. Additional samples will be selected for sieve analysis, #200 wash, corrosion, direct shear tests, triaxial tests, consolidation tests, R-value, and compaction characteristics. Other laboratory tests may be required depending upon the nature of the soils encountered during the investigation.

## 9.0 LIMITATIONS

This Preliminary Geotechnical Report is intended for use by Metro, Biggs Cardosa Associates, Inc. and the City of Santa Fe Springs for the Rosecrans-Marquardt Grade Separation Project. This report is based on the project as described herein and the available published subsurface information. The described earth materials and subsurface conditions are presumed to be representative of the project site.

Data, opinions, and recommendations contained herein are applicable to the project which is the subject of this report. Data, opinions, and recommendations herein have no applicability to any other design elements or to any other locations, and any and all subsequent users accept any and all liability resulting from any use or reuse of the data, opinions, and recommendations without the prior written consent of EMI.

Services performed by EMI were conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions. No other representation, expressed or implied, and no warranty or guarantee is included or intended.

## 10.0 REFERENCES

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## **Appendix A**

### **As-Built Log of Test Boring (LOTB) Sheets**

**Carmenita Road Overcrossing (Bridge No. 53-0214)**

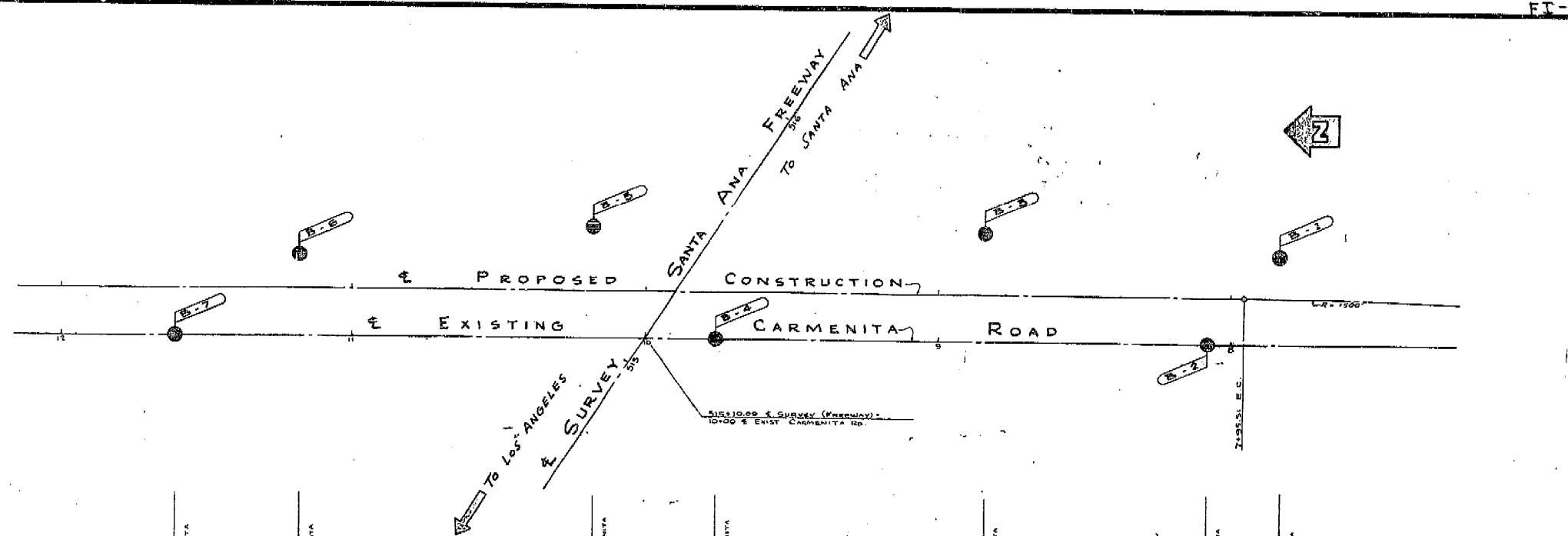
**Alondra Boulevard Overcrossing (Bridge No. 53-0630)**

**Shoemaker Avenue Overcrossing (Bridge No. 53-1015)**

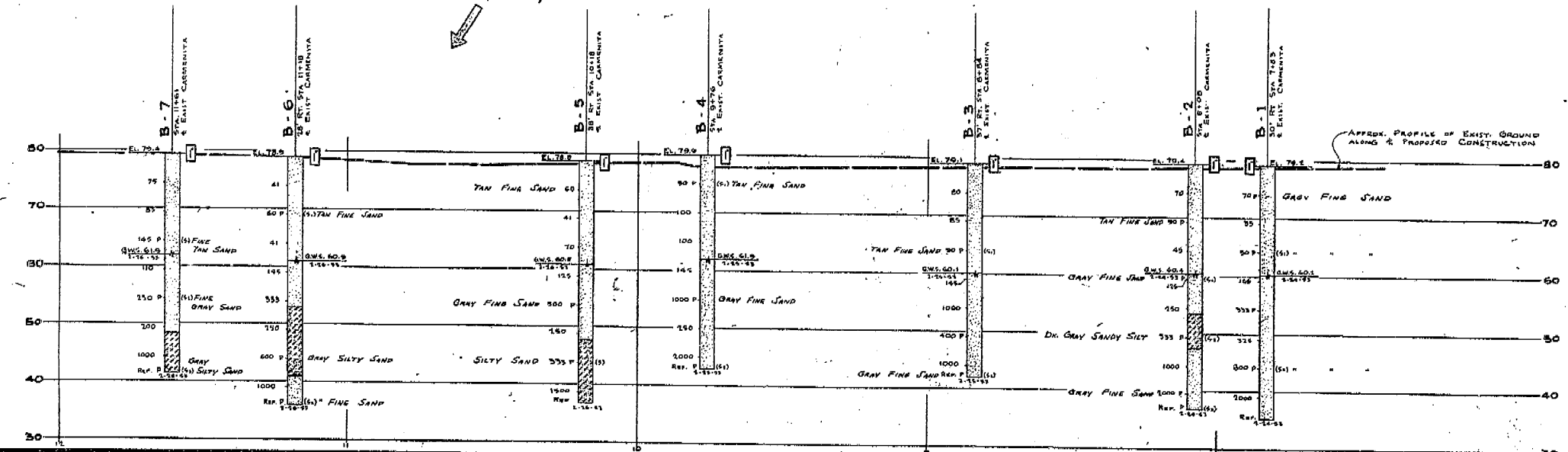
**Rosecrans Avenue Undercrossing (Bridge No. 53-0634)**

FED. ROAD DIST. NO.	STATE	PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
2	CAL.			45	64

APPROVED: *[Signature]*  
 JANUARY 25 1954



**AS BUILT PLANS**  
 Contract No. 54-14VC19  
 Date Completed \_\_\_\_\_  
 Document No. 70002101

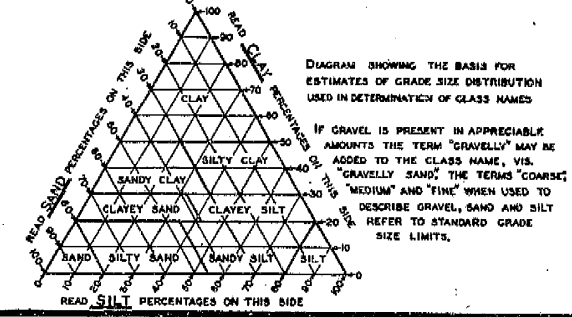


Test Boring By Bridge Dept.

**AS BUILT** NO CORRECTIONS  
 CORRECTIONS BY \_\_\_\_\_  
 DATE \_\_\_\_\_

B.M. #30-B  
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 STAMPED "STATE B.M. 30-B-41"  
 119' RT. STATION 516+24.  
 ELEV. 79.100

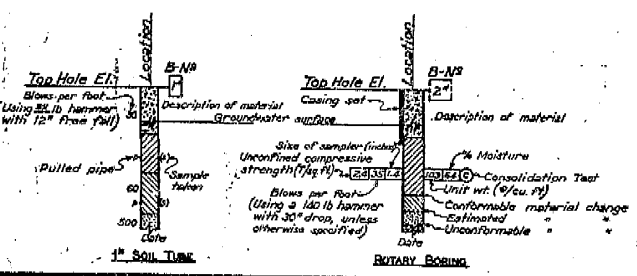
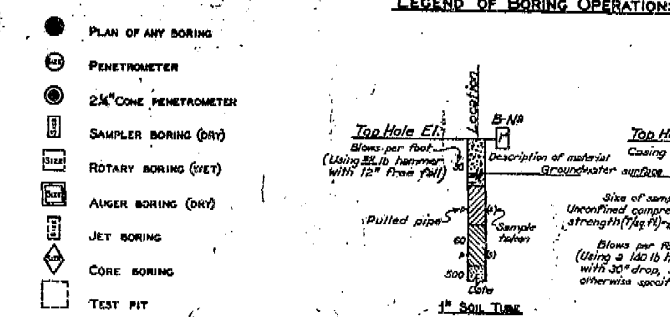
**CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS**



**LEGEND OF EARTH MATERIALS**

GRAVEL	SILTY CLAY OR CLAYEY SILT
SAND	PEAT AND/OR ORGANIC CLAY
SILT	FILLED MATERIAL
CLAY	IGNEOUS ROCK
SANDY CLAY OR CLAYEY SAND	SEDIMENTARY ROCK
SANDY SILT OR SILTY SAND	METAMORPHIC ROCK

**LEGEND OF BORING OPERATIONS**



**NOTES**

THE CONTRACTOR'S ATTENTION IS DIRECTED TO SECTION 2, ARTICLE (C) OF THE STANDARD SPECIFICATIONS AND TO THE SPECIAL PROVISIONS ACCOMPANYING THIS SET OF PLANS. CLASSIFICATION OF EARTH MATERIAL AS SHOWN ON THIS SHEET IS BASED UPON FIELD INSPECTION AND IS NOT TO BE CONSTRUED TO IMPLY MECHANICAL ANALYSIS. PENETROMETER BORINGS HAVING A RATE OF PENETRATION MEASURED IN SECONDS PER FOOT ARE DRIVEN WITH A #2 WHIEMAN-TERRY AIR HAMMER AT 115 PSI.

STATE OF CALIFORNIA  
 DEPARTMENT OF PUBLIC WORKS  
 SECTION OF HIGHWAYS

**CARMENITA ROAD O.C.**

**LOG OF TEST BORINGS**

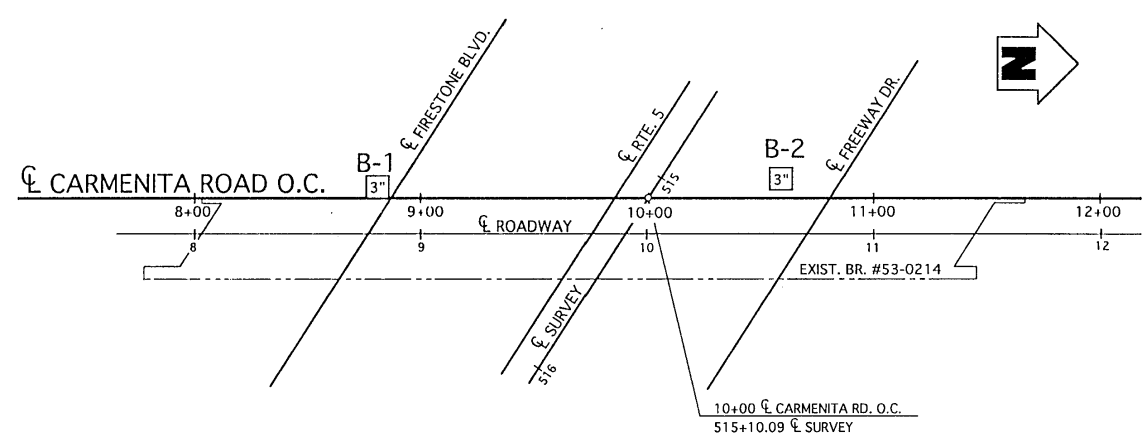
SCALE: HORIZ. 1" = 20' VERT. 1" = 10' BRIDGE 55-214 FILE: 6-3387-6 DRAWING

PUBLIC DRAWING NO. P-3387 (12)

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.  
 DATE 1/19/54 SIGNATURE *[Signature]* TITLE *[Title]*

DIST.	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
07	LA	5	1.2/5.1	80	109
W.C. Cain REGISTERED GEOLOGIST No. 732 Exp. 9-30-96 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA					
11-11-96					
PLANS APPROVAL DATE					

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF ELECTRONIC COPIES OF THIS PLAN SHEET.



PLAN  
1" = 40'

**BENCH MARK**

BM Elev. 97.65  
THE PAVING NOTCH SPOT ELEVATION AT INTERSECTION OF B.B. & C/L CARMENITA ROAD., AT STA. 08+01.69.

BM Elev. 99.15  
THE PAVING NOTCH SPOT ELEVATION AT INTERSECTION OF E.B. & C/L CARMENITA ROAD., AT STA. 11+44.26.

(AS BUILT PLAN)

**LEGEND OF BORING OPERATIONS**

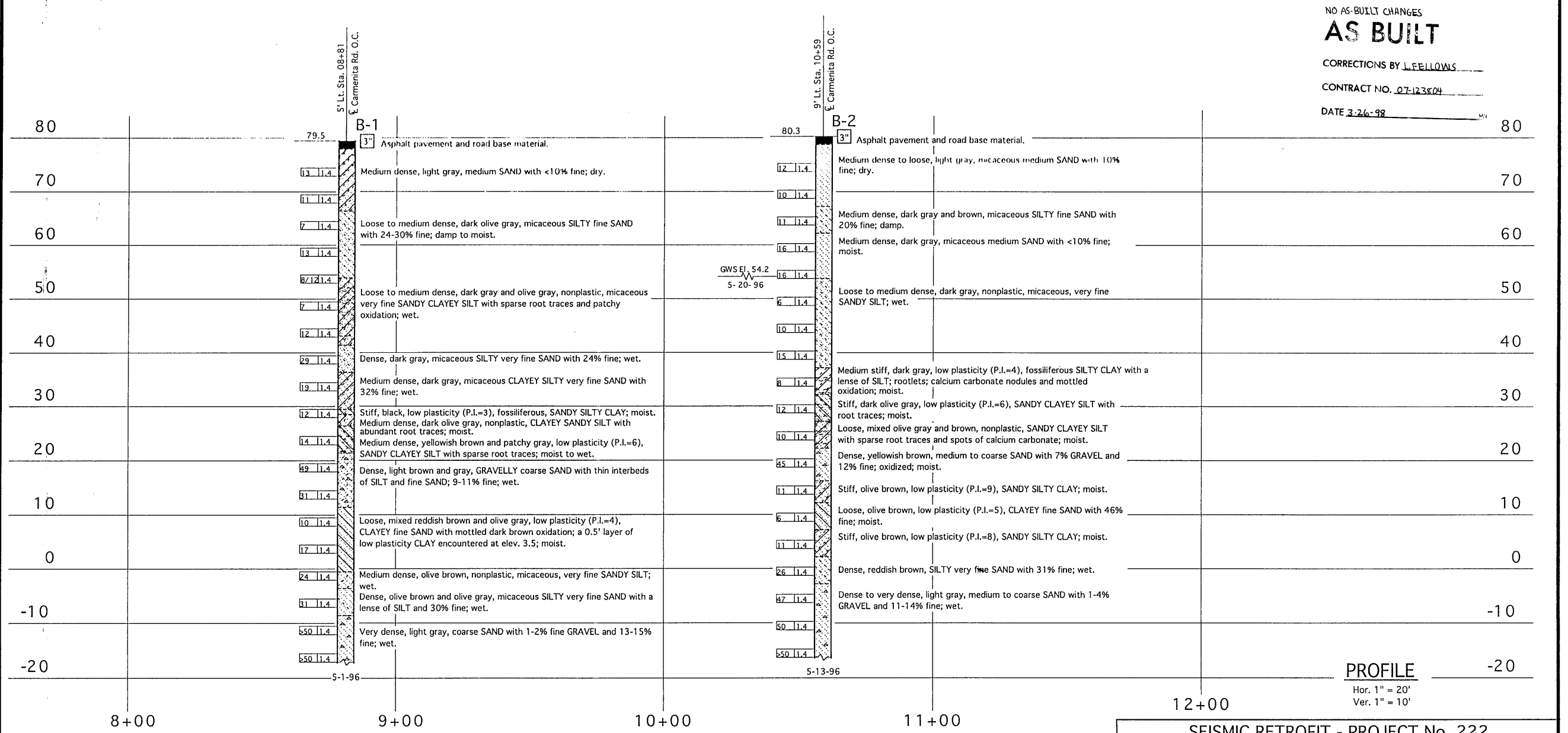
**FUNCTIONS**  
 PENETROMETER  
 SAMPLE BOTTLE  
 ROTARY BORING  
 TEST PIT  
 DIAMOND CORE BORING  
 JET BORING  
 ELECTRONIC CORE PENETROMETER

**LEGEND OF EARTH MATERIALS**  
 GRAVEL  
 SAND  
 SILT  
 CLAY  
 SANDY CLAY  
 CLAYEY SAND  
 SANDY SILT  
 SILTY SAND  
 SILTY CLAY  
 CLAYEY SILT  
 PEAT AND/OR ORGANIC MATTER  
 FILL MATERIAL  
 IGNEOUS ROCK  
 SEDIMENTARY ROCK  
 METAMORPHIC

**CONSISTENCY CLASSIFICATION FOR SOILS**  
 According to the Standard Penetration Test

Penetration Index (Blows / Ft)	Cohesive	Consistency			
		Very Soft	Soft	Stiff	Very Stiff
0-4	Granular	Very Loose	Loose	Slightly compact	Compact
5-9				Dense	Very Dense
10-19					
20-34					
35-69					
>70					

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.



NO AS-BUILT CHANGES  
**AS BUILT**  
 CORRECTIONS BY L. FELLOWS  
 CONTRACT NO. 07-123804  
 DATE 3-26-98

**PROFILE**  
 Hor. 1" = 20'  
 Ver. 1" = 10'

<b>ENGINEERING SERVICE CENTER</b>		<b>STRUCTURE FOUNDATIONS</b>		FIELD INVESTIGATION BY: F. GERAMI		State of CALIFORNIA DEPARTMENT OF TRANSPORTATION		DIVISION OF STRUCTURES STRUCTURE MAINTENANCE DESIGN		BRIDGE NO. 53-0214 POST MILE 2.41		<b>SEISMIC RETROFIT - PROJECT No. 222</b> <b>CARMENITA ROAD OVERCROSSING</b> <b>LOG OF TEST BORINGS 1 OF 2</b>		
DRAWN BY	Jma Jimenez	6-96									REVISION DATES (PRELIMINARY STAGE ONLY)		SHEET	OF
CHECKED BY	Faramarz Gozami	7-96											10	11

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS → 0 1 2 3

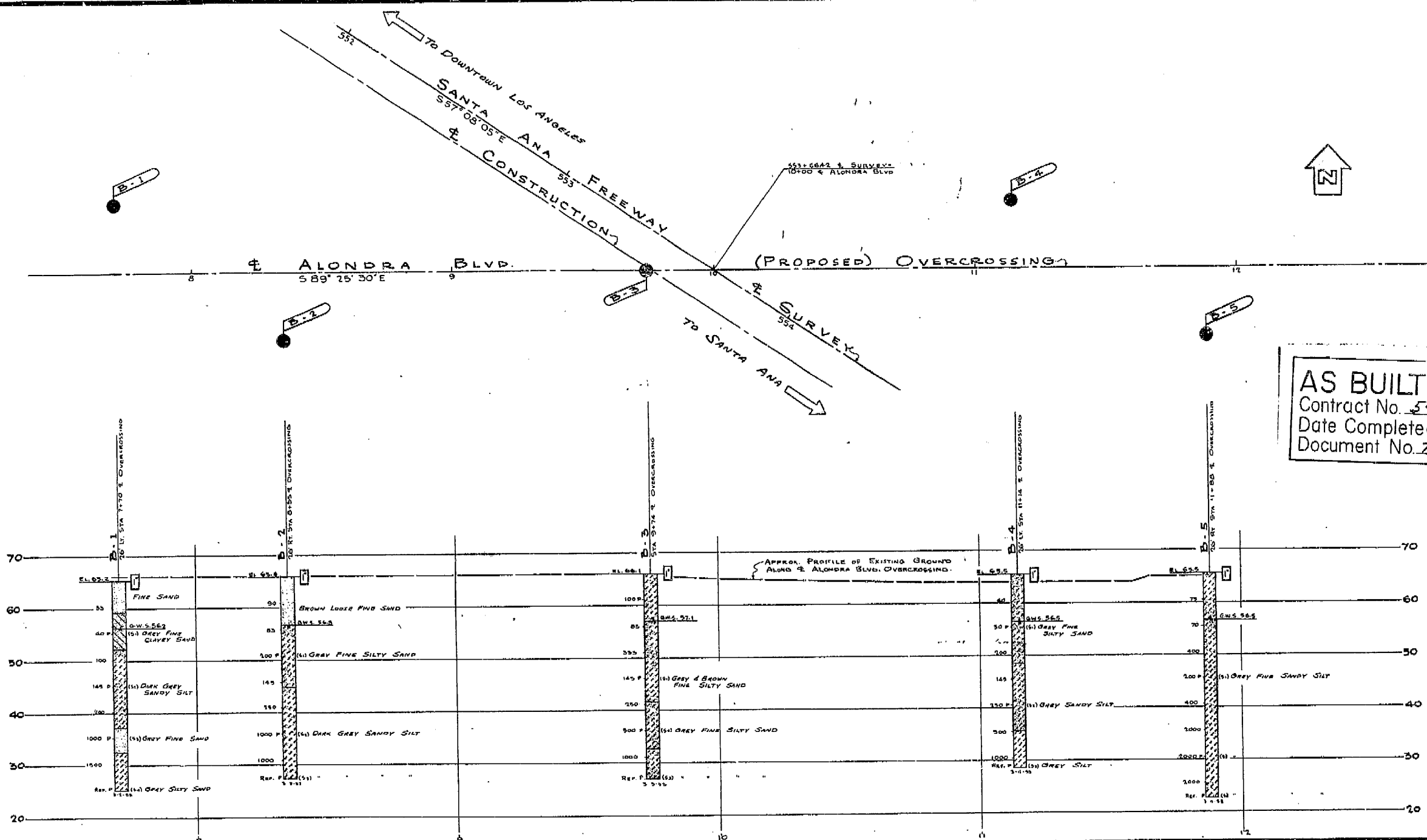
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EA: 123801

DISH & GAND PRINTS BEARING EARLIER REVISION DATES →

MICROFILM

**AS BUILT PLANS**  
 Contract No. 54-14VC-19  
 Date Completed \_\_\_\_\_  
 Document No. 70002101

BRIDGE DEPARTMENT

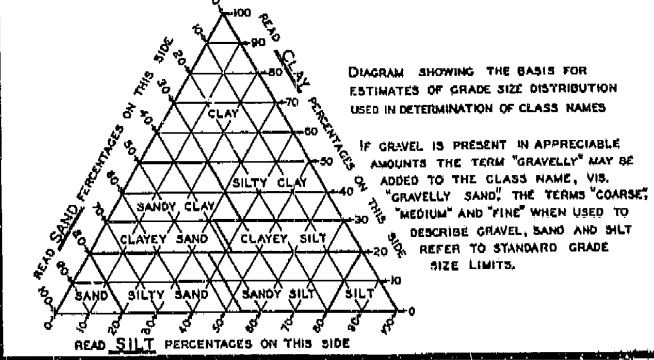


Test Boring By Bridge Dept.

**AS BUILT**  
 CORRECTIONS BY NO CORRECTIONS  
 DATE 8-19-55  
*[Signature]*

B.M. #33  
 Bronze Tablet in Conc. Mon.  
 Stamped "State B.M. 33-B-41"  
 92.8' Rt. Sta. 555+10.  
 Elev. 63.950

**CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS**



**LEGEND OF EARTH MATERIALS**

- GRAVEL
- SAND
- SILT
- CLAY
- SANDY CLAY OR CLAYEY SAND
- SANDY SILT OR SILTY SAND
- SILTY CLAY OR CLAYEY SILT
- PEAT AND/OR ORGANIC CLAY
- FILLED MATERIAL
- IGNEOUS ROCK
- SEDIMENTARY ROCK
- METAMORPHIC ROCK

**LEGEND OF BORING OPERATIONS**

- PLAN OF ANY BORING
  - PENETROMETER
  - 2 1/2" CONE PENETROMETER
  - SAMPLER BORING (DRY)
  - ROTARY BORING (WET)
  - AUGER BORING (DRY)
  - JET BORING
  - CORE BORING
  - TEST PIT
- 
- Diagram illustrating boring operations: Location, Top Hole El., Blows per foot (Using 32 lb hammer with 12" Free Fall), Casing set, Description of material, Groundwater surface, Size of sampler (feet), Unconfined compressive strength (lb./sq. ft.), Sample taken, Pulled pipe, 1" SOIL TIME, Blows per foot (Using a 140 lb hammer with 30" drop, unless otherwise specified), % Moisture, Consolidation Test (Unit wt. (γ<sub>sat</sub>, γ<sub>w</sub>)), Estimated, Conformance material change, Unconformable, Date, BENTONITE.

**NOTES**

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**ALONDRA BLVD. OVERCROSSING**

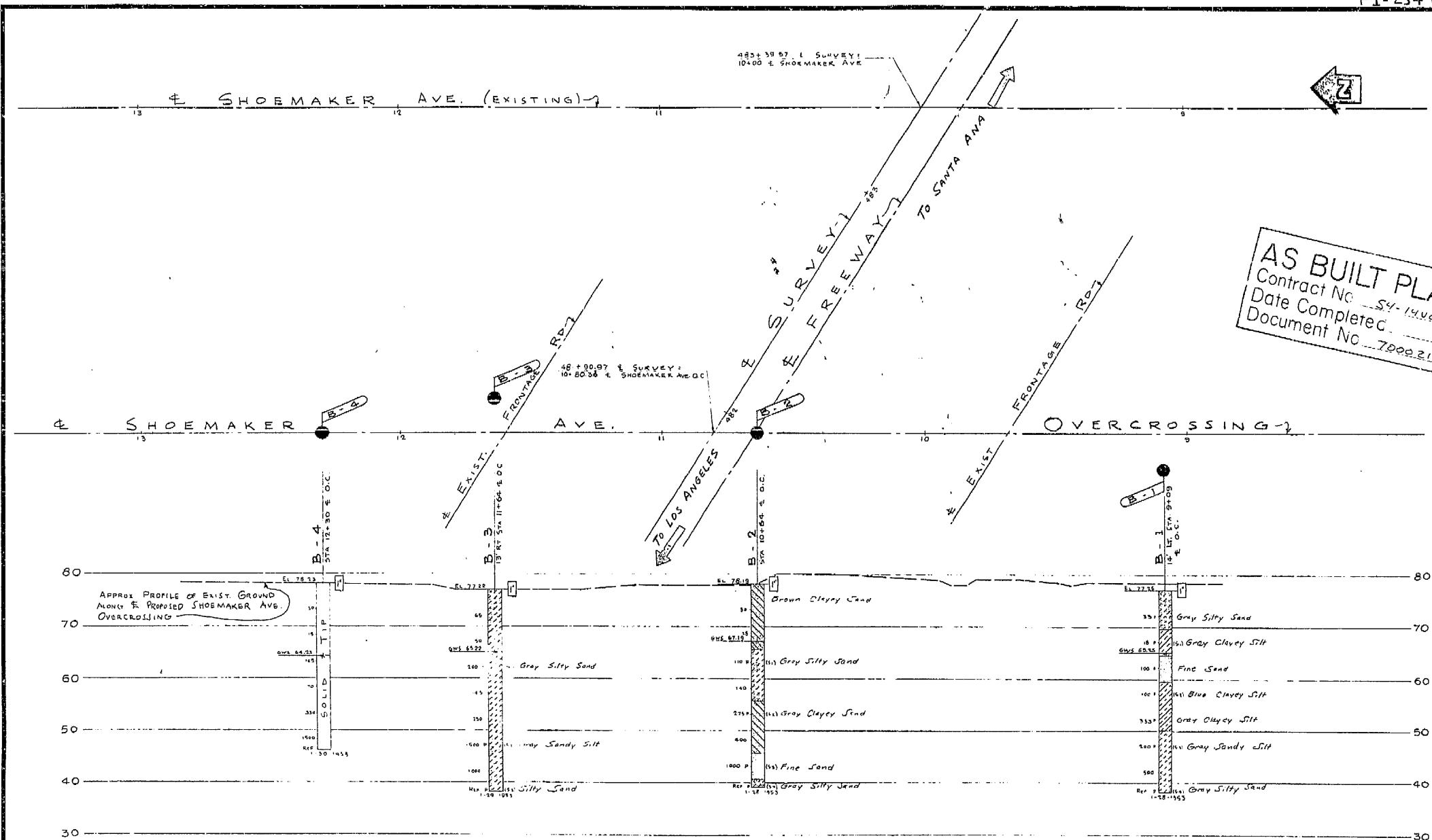
**LOG OF TEST BORINGS**

SCALE: HORIZ. 1" = 20' VERT. 1" = 10'  
 BRIDGE 53-630 FILE 0-3306-7-4 DRAWING  
 PREL. DRAWING NO. P-3306 15

FED. ROAD DIST. NO.	STATE	PROJ. NO.	FISCAL YEAR	WORK NO.	TOTAL SHEETS
2	CAL.			36	64

DIST.	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
VII	LA	174	B	5	9

APPROVED: *[Signature]*  
 CIVIL ENGINEER - LICENSE NO. 12345  
 JANUARY 25 1954



**AS BUILT PLANS**  
 Contract No. 54-14.06.13  
 Date Completed  
 Document No. 7000.2178

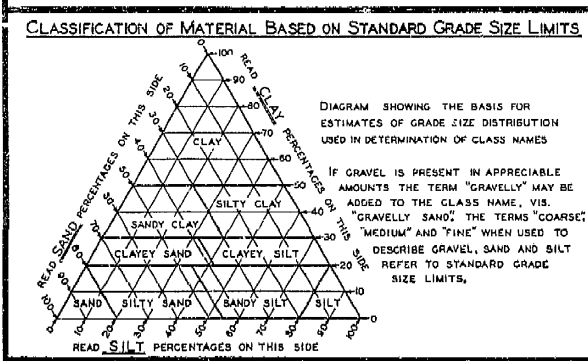
Test Boring By Bridge Dept.

**AS BUILT**

NO CORRECTIONS  
 DATE 12-19-55

B.M. 27-B-41  
 NAIL IN CORNER CONE MEN. WITH BRASS DISK STAMPED  
 "STATE BM 27-B-41" 30.1 FT. RT. STA. 807 SHOEMAKER  
 AVE. 10' N 4 T. 3' HIGH IN W SIDE PP #814952 E  
 ELEV. 77.09

B.M. 597  
 STANDARD DISK "597 1932" IN SOUTH P.C.C. CULVERT  
 N.W. 360' NW ALONG S.P.R.R. FROM INTERSECTION OF  
 S.P.R.R. & SHOEMAKER AVE.  
 ELEV. 77.31



**LEGEND OF EARTH MATERIALS**

	GRAVEL		SILTY CLAY OR CLAYEY SILT
	SAND		PEAT AND/OR ORGANIC CLAY
	SILT		FILLED MATERIAL
	CLAY		IGNEOUS ROCK
	SANDY CLAY OR CLAYEY SAND		SEDIMENTARY ROCK
	SANDY SILT OR SILTY SAND		METAMORPHIC ROCK

**LEGEND OF BORING OPERATIONS**

	PLAN OF ANY BORING
	PENETROMETER
	2 1/2" CONE PENETROMETER
	SAMPLER BORING (DRY)
	ROTARY BORING (WET)
	AUGER BORING (DRY)
	JET BORING
	CORE BORING
	TEST PIT

**NOTES**

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STATE OF CALIFORNIA  
 DEPARTMENT OF PUBLIC WORKS  
 DIVISION OF HIGHWAYS

**SHOEMAKER AVE. O.C.**

**LOG OF TEST BORINGS**

NO. 1	1	20'	BRIDGE 53-1015	FILE	DRAWING
SCALE: HORIZ. 1" = 20'	VERT. 1" = 10'				P-3304-6

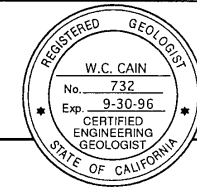
PREL. DRAWING NO. P. 3304.12

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE AS-BUILT PLANS TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN ACCORDANCE WITH THE AUTHORITY PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE 1/21/54 SIGNATURE: *[Signature]* TITLE: *[Title]*

DIST.	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
07	LA	5	1.2/5.1	92	109

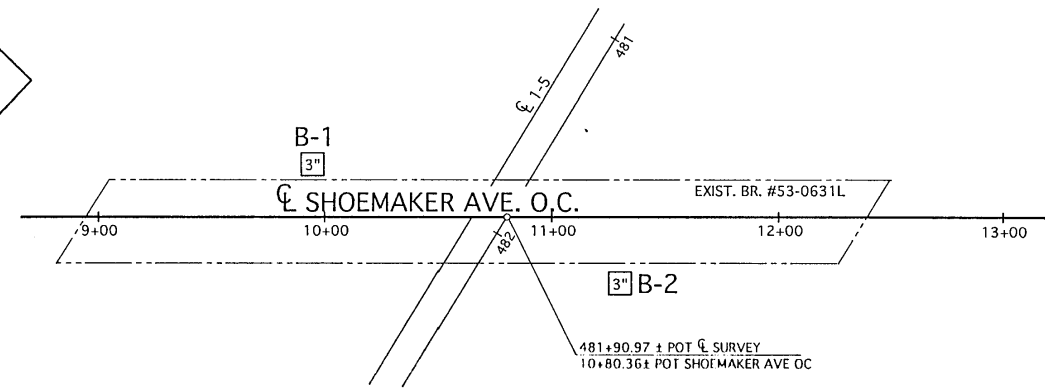
W. C. Cain



11-11-96  
PLANS APPROVAL DATE

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF ELECTRONIC COPIES OF THIS PLAN SHEET.

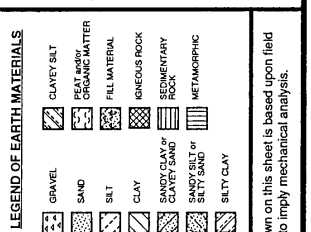
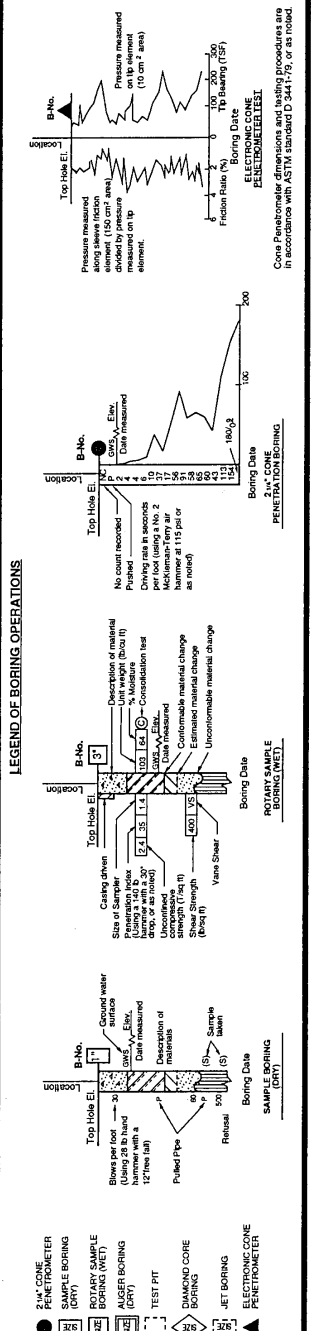
**BENCH MARK**  
 BM Elev. 97.82±  
 THE PAVING NOTCH SPOT ELEVATION AT INTERSECTION OF B.B. & C/L SHOEMAKER AVE. O.C., AT STA. 8+92.64±.  
 BM Elev. 100.26±  
 THE PAVING NOTCH SPOT ELEVATION AT INTERSECTION OF E.B. & C/L SHOEMAKER AVE. O.C., AT STA. 12+41.18±.  
 (AS BUILT PLAN)



PLAN  
1" = 40'

NO AS-BUILT CHANGES  
**AS BUILT**

CORRECTIONS BY J. FELLOWS  
 CONTRACT NO. 07-123804  
 DATE 3-26-98



CONSISTENCY CLASSIFICATION OF SOILS	
Granular	Cohesive
Very Loose	Very Soft
Loose	Soft
Slightly compact	Stiff
Compact	Very Stiff
Dense	Hard
Very Dense	Very Hard

Elevation (ft)	Description	Stationing	Notes
80	Asphalt pavement and road base material.	80.5	B-1
70	Loose, brown, SILTY fine SAND with 29% fine; dry.	6 11.4	
60	Loose, light gray, nonplastic, micaceous, very fine SANDY SILT; dry.	8 11.4	
50	Loose, olive gray, micaceous, very fine SAND with lense of SILT and 10% fine; damp.	10 11.4	
40	Loose, dark olive gray, low plasticity (P.I.=3-4), CLAYEY SILT with sparse rootlets and calcium carbonate nodules; moist.	6 11.4	
30	Loose, dark gray, nonplastic, micaceous SILT with sparse rootlets and calcium carbonate nodules; moist to wet at elev. 44.8.	10 11.4	
20	Dense, dark gray, micaceous, SILTY very fine SAND with 41% fine; wet.	25 11.4	
10	Soft, very dark gray to black, medium plasticity (P.I.=17) CLAY with abundant root traces and organic odor; moist.	8 11.4	
0	Medium stiff, dark olive gray, low plasticity (P.I.=10), SANDY CLAY with spots and blebs of calcium carbonate; moist.	7 11.4	
-10	Dense to medium dense, reddish brown, SILTY coarse SAND with 21% fine; wet.	27 11.4	
-20	Very loose, light brown, SILTY fine SAND with lenses of SILT; wet.	12/24 11.4	
-30	Very dense to dense, light brown and gray, coarse SAND with few COBBLES; 8-10% fine GRAVEL and 11-13% fine; wet.	50 11.4	
	Medium dense, dark olive gray and patchy brown, non plastic, micaceous, CLAYEY SANDY SILT; wet.	49 11.4	
	Medium dense to dense, dark brown and grayish brown, nonplastic, CLAYEY SILTY fine SAND with 16-35 % fine; wet.	13 11.4	
	Very dense, olive brown, CLAYEY coarse SAND with 8% GRAVEL and 14% fine; wet.	44/250 11.4	
	Very dense to medium dense, olive gray and patchy brown, non plastic, micaceous CLAYEY SILT; moist.	22/36 11.4	
	Dense, olive gray, SILTY fine SAND with 25% fine; wet.	12 11.4	
	Medium dense, olive gray and patchy brown, nonplastic, CLAYEY SILT; moist.	12 11.4	
	Medium dense, dark gray, micaceous, SILTY fine SAND with 18% fine; moist.	26 11.4	
	Loose, dark gray, nonplastic, micaceous CLAYEY SILT with sparse root casts; wet.	9 11.4	
	Dense, dark gray, micaceous CLAYEY fine SAND with 16% fine; wet.	27 11.4	
	Medium stiff, dark olive gray, low plasticity (P.I.=9), SILTY CLAY with abundant calcium carbonate nodules; moist.	6 11.4	
	Dense, brown, nonplastic, CLAYEY coarse SAND with 10% GRAVEL and 27% fine; wet.	26 11.4	
	Dense, brown, SILTY coarse SAND with 10-14% GRAVEL and 11-13% fine; wet.	35 11.4	
	Dense to very dense, gray and brown, SANDY GRAVEL with occasional COBBLES; lense of fine SAND and 15-18% fine; wet.	44 11.4	
	Dense to very dense, gray and brown, SANDY GRAVEL with occasional COBBLES; lense of fine SAND and 15-18% fine; wet.	50 11.4	
	Medium dense to dense, dark olive gray, micaceous SILTY fine to medium SAND with lense of SILT and calcium carbonate nodules; wet.	18 11.4	
	Medium stiff, olive gray, low plasticity (P.I.=12), SILTY CLAY; wet.	8/18 11.4	
	Medium dense, dark gray, nonplastic, CLAYEY SILT; wet.	5-2-96	

PROFILE  
Hor. 1" = 20'  
Ver. 1" = 10'

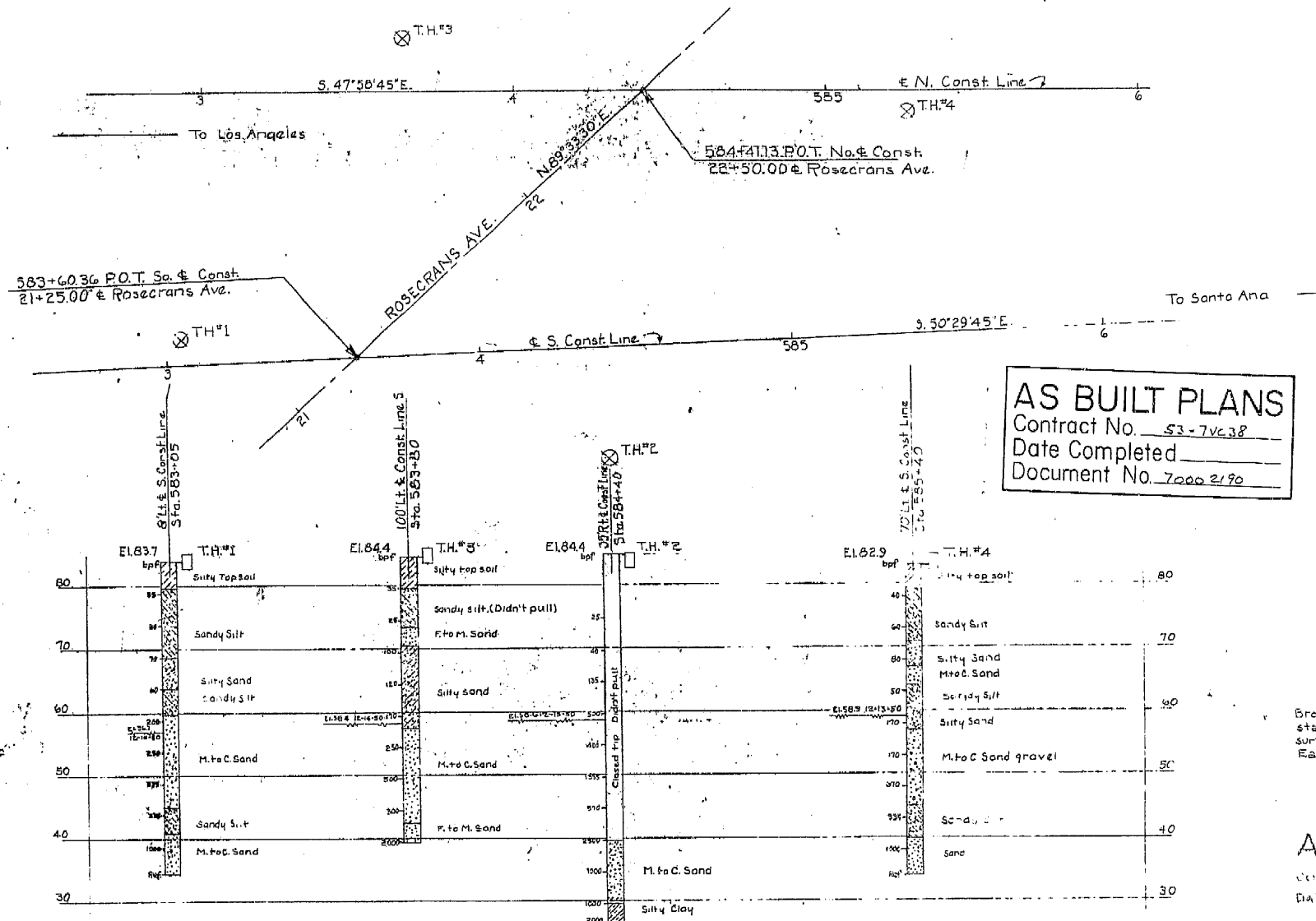
ENGINEERING SERVICE CENTER		STRUCTURE FOUNDATIONS		FIELD INVESTIGATION BY: F. GERAMI		State of CALIFORNIA DEPARTMENT OF TRANSPORTATION		DIVISION OF STRUCTURES STRUCTURE MAINTENANCE DESIGN		BRIDGE NO. 53-1015 POST MILE 3.04		SEISMIC RETROFIT - PROJECT No. 222	
DRAWN BY: Jma Jarama 6-96		CHECKED BY: Faramarz Gerami 7-96										SHOEMAKER AVE. OVERCROSSING	
												LOG OF TEST BORINGS 1 OF 2	
CU: 07264 EA: 123801												REVISION DATES (PRELIMINARY STAGE ONLY)	
DISREGARD PRINTS BEARING EARLIER REVISION DATES												SHEET 11 OF 12	

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS → 0 1 2 3

F1-405 (B)

FED. ROAD DIST. NO.	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS
2	CAL.		123	123

DATE: OCT 27 1952  
 DRAWN BY: [Signature]  
 CHECKED BY: [Signature]



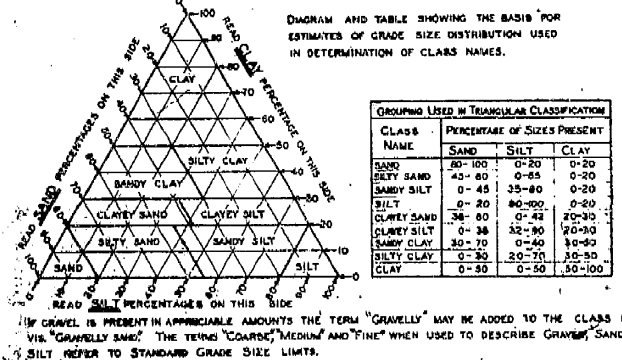
**AS BUILT PLANS**  
 Contract No. 53-7vc.38  
 Date Completed \_\_\_\_\_  
 Document No. 7000 2190

Test Boring By Bridge Dept. 12-15-50  
 NOTE: Plans for fact are filed to...  
 falling free one foot.

BM # 25  
 Bronze tablet in concrete monument stamped "State BM 25-B-41" 1.5' below surface 120' N of 1+80 on Rosecrans Ave., East of Firestone. Elev. 82.941

**AS BUILT**  
 CONNECTIONS BY [Signature]  
 DATE \_\_\_\_\_

**CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS**



**LEGEND OF BORING OPERATIONS**

- ⊗ PLAN OF ANY BORING
  - 1" SAMPLER BORING
  - ROTARY WASH BORING
  - 1" CLOSED SAMPLER DRIVEN
  - ⊙ CORE BORING
  - ⊕ 2 1/2" PENETROMETER DRIVEN
  - 2" SAMPLER BORING
  - 2" TO 5" AUGER BORING
  - 6" TO 20" AUGER BORING
  - CASING DRIVEN
  - JET BORING
  - (S) SAMPLE TAKEN
- THE APPROPRIATE BORING SYMBOLS DESIGNATING THE METHOD OF OPERATION ARE SHOWN AT THE UPPER RIGHT-HAND CORNER OF THE RESPECTIVE BORING. WHERE TOOL CHANGES WERE MADE DURING THE BORING OPERATION, SYMBOLS ARE SHOWN AT THE POINT OF CHANGE.

**LEGEND OF EARTH MATERIALS**

- GRAVEL - G
- SAND - S
- SILT - SI
- CLAY - C
- SILTY SAND - SI S
- CLAYEY SAND - C S
- SANDY SILT - S SI
- CLAYEY SILT - C SI
- SANDY CLAY - SC
- SILTY CLAY - SI C
- PEAT - O
- SANDSTONE - SS
- SHALE - SH
- BROKEN ROCK (FRAGMENTS) - BR
- ROCK - R

**ABBREVIATIONS**

- EL. 69.4 ELEVATION OF GROUND AT TEST HOLE
- bpf BLOWS PER FOOT - (SEE NOTE ABOVE)
- P PULLED PIPE
- M MOISTURE AS % DRY WEIGHT
- EL. 62.3 ELEVATION OF GROUND WATER AND DATE

**NOTES**

THE CONTRACTOR'S ATTENTION IS DIRECTED TO SECTION 2, ARTICLE (c) OF THE STANDARD SPECIFICATIONS AND TO THE SPECIAL PROVISIONS ACCOMPANYING THIS SET OF PLANS.  
 CLASSIFICATION OF EARTH MATERIAL AS SHOWN ON THIS SHEET IS BASED UPON FIELD INSPECTION AND IS NOT TO BE CONSTRUED TO IMPLY MECHANICAL ANALYSIS.

**ROSECRANS AVENUE UNDERCROSSING**  
**LOG OF TEST BORINGS**  
 Horizontal: 1"=20'  
 Vertical: 1"=5'  
 SHEET NO. 53-634 DRAWING NO. C-2607-11

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.  
 DATE 9/24/54 SIGNATURE [Signature] TITLE [Title]



## Appendix H: Cost Estimates



ROSECRANS/MARQUARDT GRADE SEPARATION PROJECT  
City of Santa Fe Springs, CA  
Metro Contract No. PS2415-3420  
**ALTERNATIVE 1 - SUMMARY**



Item No.	Description	Amount
1	ROADWAY ITEMS	\$14,900,774
2	STRUCTURE ITEMS	\$27,011,000
	<b>SUBTOTAL CONSTRUCTION COSTS</b>	<b>\$41,911,774</b>
3	RIGHT-OF-WAY	\$73,500,000
	<b>CAPITAL COST</b>	<b>\$115,411,774</b>



**ROSECRANS/MARQUARDT GRADE SEPARATION PROJECT**  
**City of Santa Fe Springs, CA**  
**Metro Contract No. PS2415-3420**  
**PRELIMINARY PROJECT COST ESTIMATE - ALTERNATIVE 1**



**Metro**

Item No.	Description	Unit	Quantity	Unit Price	Amount
<b>1. ROADWAY ITEMS</b>					
<b>1.1 EARTHWORK</b>					<b>\$4,135,500</b>
1.1-1	CLEARING AND GRUBBING (REMOVALS)	LS	1	\$500,000.00	\$500,000
1.1-2	REMOVE PAVEMENT (REMOVALS)	SF	300,000	\$5.00	\$1,500,000
1.1-3	UNCLASSIFIED EXCAVATION	CY	6,800	\$35.00	\$238,000
1.1-4	UNCLASSIFIED FILL	CY	126,500	\$15.00	\$1,897,500
<b>1.2 STRUCTURAL SECTION</b>					
					<b>\$2,442,880</b>
1.2-1	CRUSHED AGGREGATE BASE	CY	12,600	\$50.00	\$630,000
1.2-2	ASPHALT CONCRETE	TON	11,360	\$100.00	\$1,136,000
1.2-3	ASPHALT CONCRETE (PARKING LOT)	TON	280	\$150.00	\$42,000
1.2-4	CONCRETE SIDEWALK	SF	57,870	\$6.00	\$347,220
1.2-5	PCC CURB AND GUTTER	LF	8,900	\$25.00	\$222,500
1.2-6	PCC CURB ONLY	LF	1,220	\$18.00	\$21,960
1.2-7	CONCRETE DRIVEWAY	SF	3,600	\$12.00	\$43,200
<b>1.3 RAILROAD RELATED ITEMS</b>					
					<b>\$495,000</b>
1.3-1	RAILROAD FLAGGING (1 EACH FOR 18 MONTHS)	DAY	390	\$1,000.00	\$390,000
1.3-2	CROSSING DEMOLITION	LS	1	\$75,000.00	\$75,000
1.3-3	SALVAGE RAILROAD CROSSING PANELS & SIGNAL EQUIPMENT	LS	1	\$30,000.00	\$30,000



**ROSECRANS/MARQUARDT GRADE SEPARATION PROJECT**  
**City of Santa Fe Springs, CA**  
**Metro Contract No. PS2415-3420**  
**PRELIMINARY PROJECT COST ESTIMATE - ALTERNATIVE 1**



**Metro**

Item No.	Description	Unit	Quantity	Unit Price	Amount
<b>1.4 DRAINAGE / UTILITIES</b>					<b>\$2,289,050</b>
1.4-1	STORM DRAIN - 24" RCP	LF	200	\$350.00	\$70,000
1.4-2	LATERALS - 18" RCP	LF	240	\$250.00	\$60,000
1.4-3	CATCH BASIN (7-FT)	EA	4	\$8,500.00	\$34,000
1.4-4	CATCH BASIN (14-FT)	EA	4	\$10,000.00	\$40,000
1.4-5	REMOVE EXISTING CATCH BASIN	EA	1	\$1,000.00	\$1,000
1.4-6	JUNCTION STRUCTURE	EA	5	\$8,000.00	\$40,000
1.4-7	WATER - 8" DIP	LF	1,050	\$175.00	\$183,750
1.4-8	WATER - 16" DIP	LF	500	\$250.00	\$125,000
1.4-9	SEWER - 24" VCP (INCLUDING MANHOLES)	LF	1,080	\$360.00	\$388,800
1.4-10	SEWER - 33" VCP (INCLUDING MANHOLES)	LF	1,150	\$410.00	\$471,500
1.4-11	SOUTHERN CALIFORNIA EDISON RELOCATION**	LS	1	\$1,750,000.00	\$1,750,000
1.4-12	SOUTHERN CALIFORNIA GAS COMPANY RELOCATION	LS	1	\$110,000.00	\$110,000
1.4-13	VERIZON RELOCATION	LS	1	\$340,000.00	\$340,000
1.4-14	AT&T RELOCATION	LS	1	\$210,000.00	\$210,000
1.4-15	TIME WARNER CABLE RELOCATION	LS	1	\$110,000.00	\$110,000
	* Utility relocations shown above (shaded) are considered in franchise, and are listed for information only. These are not included in the overall capital cost. ** 50% of the SCE relocation is included in the overall capital cost to account for engineered steel poles.				
<b>1.5 LANDSCAPING</b>					<b>\$275,180</b>
1.5-1	IRRIGATION	SF	46,460	\$3.00	\$139,380
1.5-2	PLANTING	SF	46,460	\$2.00	\$92,920
1.5-3	OTHER SURFACE TREATMENT	SF	5,360	\$8.00	\$42,880



**ROSECRANS/MARQUARDT GRADE SEPARATION PROJECT**  
**City of Santa Fe Springs, CA**  
**Metro Contract No. PS2415-3420**  
**PRELIMINARY PROJECT COST ESTIMATE - ALTERNATIVE 1**



**Metro**

Item No.	Description	Unit	Quantity	Unit Price	Amount
<b>1.6 TRAFFIC &amp; LIGHTING</b>					<b>\$800,000</b>
1.6-1	STREET LIGHTING	LS	1	\$225,000.00	\$225,000
1.6-2	SIGNING & STRIPING	LS	1	\$75,000.00	\$75,000
1.6-3	TRAFFIC HANDLING	LS	1	\$500,000.00	\$500,000
<b>1.7 MISCELLANEOUS</b>					<b>\$600,000</b>
1.7-1	SWPPP & IMPLEMENTATION	LS	1	\$300,000.00	\$300,000
1.7-2	EROSION CONTROL	LS	1	\$300,000.00	\$300,000
<b>ROADWAY SUBTOTAL</b>					<b>\$11,037,610</b>
<b>ROADWAY MOBILIZATION (10%)</b>					<b>\$1,103,761</b>
<b>ROADWAY CONTINGENCIES (25%)</b>					<b>\$2,759,403</b>
<b>ROADWAY TOTAL</b>					<b>\$14,900,774</b>
<b>2. STRUCTURE ITEMS</b>					
2.1	BRIDGE (ROSECRANS AVENUE OVERPASS)	SF	47,622	\$290.00	\$13,810,000
2.2	BRIDGE (ANSON AVENUE SEPARATION)	SF	7,344	\$415.00	\$3,048,000
2.3	RETAINING WALLS (MECHANICALLY STABILIZED EARTH WALL)	SF	92,300	\$110.00	\$10,153,000
<b>STRUCTURE SUBTOTAL</b>					<b>\$27,011,000</b>
<b>STRUCTURE MOBILIZATION (0% - UNIT PRICES INCLUDE 10% MOBILIZATION)</b>					<b>\$0</b>
<b>STRUCTURE CONTINGENCIES (0% - UNIT PRICES INCLUDE 25% CONTINGENCY)</b>					<b>\$0</b>
<b>STRUCTURE TOTAL</b>					<b>\$27,011,000</b>
<b>3. RIGHT-OF-WAY</b>					
<i>Note: Right-of-way acquisition costs include relocation, goodwill, demolition &amp; support costs.</i>					
3.1	FULL ACQUISITIONS, ROADWAY EASEMENTS, AND TEMPORARY CONSTRUCTION EASEMENTS	LS	1	\$56,000,000.00	\$56,000,000
3.2	UTILITY EASEMENTS (TO BE DETERMINED) (5% OF ITEM No. 3.1)	LS	1	\$2,800,000.00	\$2,800,000
<b>RIGHT-OF-WAY SUBTOTAL</b>					<b>\$58,800,000</b>
<b>RIGHT-OF-WAY CONTINGENCIES (25%)</b>					<b>\$14,700,000</b>
<b>RIGHT-OF-WAY TOTAL</b>					<b>\$73,500,000</b>



ROSECRANS/MARQUARDT GRADE SEPARATION PROJECT

City of Santa Fe Springs, CA  
Metro Contract No. PS2415-3420  
**ALTERNATIVE 2 - SUMMARY**



**Metro**

Item No.	Description	Amount
1	ROADWAY ITEMS	\$14,457,265
2	STRUCTURE ITEMS	\$24,850,000
	<b>SUBTOTAL CONSTRUCTION COSTS</b>	<b>\$39,307,265</b>
3	RIGHT-OF-WAY	\$68,250,000
	<b>CAPITAL COST</b>	<b>\$107,557,265</b>



**ROSECRANS/MARQUARDT GRADE SEPARATION PROJECT**  
**City of Santa Fe Springs, CA**  
**Metro Contract No. PS2415-3420**  
**PRELIMINARY PROJECT COST ESTIMATE - ALTERNATIVE 2**



**Metro**

Item No.	Description	Unit	Quantity	Unit Price	Amount
<b>1. ROADWAY ITEMS</b>					
<b>1.1 EARTHWORK</b>					<b>\$3,908,000</b>
1.1-1	CLEARING AND GRUBBING (REMOVALS)	LS	1	\$500,000.00	\$500,000
1.1-2	REMOVE PAVEMENT (REMOVALS)	SF	290,000	\$5.00	\$1,450,000
1.1-3	UNCLASSIFIED EXCAVATION	CY	6,400	\$35.00	\$224,000
1.1-4	UNCLASSIFIED FILL	CY	115,600	\$15.00	\$1,734,000
<b>1.2 STRUCTURAL SECTION</b>					
					<b>\$2,841,120</b>
1.2-1	CRUSHED AGGREGATE BASE	CY	15,500	\$50.00	\$775,000
1.2-2	ASPHALT CONCRETE	TON	13,240	\$100.00	\$1,324,000
1.2-3	ASPHALT CONCRETE (PARKING LOT)	TON	710	\$150.00	\$106,500
1.2-4	CONCRETE SIDEWALK	SF	61,700	\$6.00	\$370,200
1.2-5	PCC CURB AND GUTTER	LF	8,860	\$25.00	\$221,500
1.2-6	CONCRETE DRIVEWAY	SF	3,660	\$12.00	\$43,920
<b>1.3 RAILROAD RELATED ITEMS</b>					
					<b>\$495,000</b>
1.3-1	RAILROAD FLAGGING (1 EACH FOR 18 MONTHS)	DAY	390	\$1,000.00	\$390,000
1.3-2	CROSSING DEMOLITION	LS	1	\$75,000.00	\$75,000
1.3-3	SALVAGE RAILROAD CROSSING PANELS & SIGNAL EQUIPMENT	LS	1	\$30,000.00	\$30,000



**ROSECRANS/MARQUARDT GRADE SEPARATION PROJECT**  
**City of Santa Fe Springs, CA**  
**Metro Contract No. PS2415-3420**  
**PRELIMINARY PROJECT COST ESTIMATE - ALTERNATIVE 2**



**Metro**

Item No.	Description	Unit	Quantity	Unit Price	Amount
<b>1.4 DRAINAGE / UTILITIES</b>					<b>\$1,054,450</b>
1.4-1	STORM DRAIN - 24" RCP	LF	210	\$350.00	\$73,500
1.4-2	LATERALS - 18" RCP	LF	330	\$250.00	\$82,500
1.4-3	CATCH BASIN (7-FT)	EA	3	\$8,500.00	\$25,500
1.4-4	CATCH BASIN (14-FT)	EA	4	\$10,000.00	\$40,000
1.4-5	JUNCTION STRUCTURE	EA	4	\$8,000.00	\$32,000
1.4-6	SEWER - 33" VCP (INCLUDING MANHOLES)	LF	370	\$435.00	\$160,950
1.4-7	SOUTHERN CALIFORNIA EDISON RELOCATION**	LS	1	\$1,280,000.00	\$1,280,000
1.4-8	SOUTHERN CALIFORNIA GAS COMPANY RELOCATION	LS	1	\$20,000.00	\$20,000
1.4-9	VERIZON RELOCATION	LS	1	\$262,000.00	\$262,000
1.4-10	AT&T RELOCATION	LS	1	\$135,000.00	\$135,000
1.4-11	TIME WARNER CABLE RELOCATION	LS	1	\$54,000.00	\$54,000
	* Utility relocations shown above (shaded) are considered in franchise, and are listed for information only. These are not included in the overall capital cost. ** 50% of the SCE relocation is included in the overall capital cost to account for engineered steel poles.				
<b>1.5 LANDSCAPING</b>					<b>\$435,515</b>
1.5-1	IRRIGATION	SF	62,655	\$3.00	\$187,965
1.5-2	PLANTING	SF	62,655	\$2.00	\$125,310
1.5-3	OTHER SURFACE TREATMENT	SF	15,280	\$8.00	\$122,240
<b>1.6 TRAFFIC &amp; LIGHTING</b>					<b>\$1,375,000</b>
1.6-1	TRAFFIC SIGNALS	LS	1	\$750,000.00	\$750,000
1.6-2	STREET LIGHTING	LS	1	\$300,000.00	\$300,000
1.6-3	SIGNING & STRIPING	LS	1	\$75,000.00	\$75,000
1.6-4	TRAFFIC HANDLING	LS	1	\$250,000.00	\$250,000



**ROSECRANS/MARQUARDT GRADE SEPARATION PROJECT**  
**City of Santa Fe Springs, CA**  
**Metro Contract No. PS2415-3420**  
**PRELIMINARY PROJECT COST ESTIMATE - ALTERNATIVE 2**



**Metro**

Item No.	Description	Unit	Quantity	Unit Price	Amount
<b>1.7 MISCELLANEOUS</b>					<b>\$600,000</b>
1.7-1	SWPPP & IMPLEMENTATION	LS	1	\$300,000.00	\$300,000
1.7-2	EROSION CONTROL	LS	1	\$300,000.00	\$300,000
<b>ROADWAY SUBTOTAL</b>					<b>\$10,709,085</b>
<b>ROADWAY MOBILIZATION (10%)</b>					<b>\$1,070,909</b>
<b>ROADWAY CONTINGENCIES (25%)</b>					<b>\$2,677,271</b>
<b>ROADWAY TOTAL</b>					<b>\$14,457,265</b>
<b>2. STRUCTURE ITEMS</b>					
2.1	BRIDGE (ROSECRANS AVENUE OVERPASS)	SF	59,024	\$290.00	\$17,117,000
2.2	RETAINING WALLS (MECHANICALLY STABILIZED EARTH WALL)	SF	70,300	\$110.00	\$7,733,000
<b>STRUCTURE SUBTOTAL</b>					<b>\$24,850,000</b>
<b>STRUCTURE MOBILIZATION (0% - UNIT PRICES INCLUDE 10% MOBILIZATION)</b>					<b>\$0</b>
<b>STRUCTURE CONTINGENCIES (0% - UNIT PRICES INCLUDE 25% CONTINGENCY)</b>					<b>\$0</b>
<b>STRUCTURE TOTAL</b>					<b>\$24,850,000</b>
<b>3. RIGHT-OF-WAY</b>					
<i>Note: Right-of-way acquisition costs include relocation, goodwill, demolition &amp; support costs.</i>					
3.1	FULL ACQUISITIONS, ROADWAY EASEMENTS, AND TEMPORARY CONSTRUCTION EASEMENTS	LS	1	\$52,000,000.00	\$52,000,000
3.2	UTILITY EASEMENTS (TO BE DETERMINED) (5% OF ITEM No. 3.1)	LS	1	\$2,600,000.00	\$2,600,000
<b>RIGHT-OF-WAY SUBTOTAL</b>					<b>\$54,600,000</b>
<b>RIGHT-OF-WAY CONTINGENCIES (25%)</b>					<b>\$13,650,000</b>
<b>RIGHT-OF-WAY TOTAL</b>					<b>\$68,250,000</b>



ROSECRANS/MARQUARDT GRADE SEPARATION PROJECT  
City of Santa Fe Springs, CA  
Metro Contract No. PS2415-3420  
**ALTERNATIVE 3 - SUMMARY**



Item No.	Description	Amount
1	ROADWAY ITEMS	\$37,049,171
2	STRUCTURE ITEMS	\$38,928,000
	<b>SUBTOTAL CONSTRUCTION COSTS</b>	<b>\$75,977,171</b>
3	RIGHT-OF-WAY	\$56,437,500
	<b>CAPITAL COST</b>	<b>\$132,414,671</b>



**ROSECRANS/MARQUARDT GRADE SEPARATION PROJECT**  
**City of Santa Fe Springs, CA**  
**Metro Contract No. PS2415-3420**  
**PRELIMINARY PROJECT COST ESTIMATE - ALTERNATIVE 3**



**Metro**

Item No.	Description	Unit	Quantity	Unit Price	Amount
<b>1. ROADWAY ITEMS</b>					
<b>1.1 EARTHWORK</b>					<b>\$4,676,600</b>
1.1-1	CLEARING AND GRUBBING (REMOVALS)	LS	1	\$500,000.00	\$500,000
1.1-2	REMOVE PAVEMENT (REMOVALS)	SF	270,000	\$5.00	\$1,350,000
1.1-3	UNCLASSIFIED EXCAVATION	CY	80,760	\$35.00	\$2,826,600
<b>1.2 STRUCTURAL SECTION</b>					
					<b>\$2,597,560</b>
1.2-1	CRUSHED AGGREGATE BASE	CY	13,170	\$50.00	\$658,500
1.2-2	ASPHALT CONCRETE	TON	10,050	\$100.00	\$1,005,000
1.2-3	ASPHALT CONCRETE (PARKING LOT)	TON	260	\$150.00	\$39,000
1.2-4	CONCRETE SIDEWALK	SF	57,200	\$6.00	\$343,200
1.2-5	PCC CURB AND GUTTER	LF	7,860	\$25.00	\$196,500
1.2-6	PCC CURB ONLY	LF	3,660	\$18.00	\$65,880
1.2-7	CONCRETE DRIVEWAY	SF	3,290	\$12.00	\$39,480
1.2-8	PORTLAND CONCRETE CEMENT	CY	1,000	\$250.00	\$250,000
<b>1.3 RAILROAD RELATED ITEMS</b>					
					<b>\$9,996,800</b>
1.3-1	RAILROAD FLAGGING (2 EACH FOR 18 MONTHS)	DAY	780	\$1,000.00	\$780,000
1.3-2	INSTALL TRACK	TF	5,800	\$300.00	\$1,740,000
1.3-3	REINSTALL SALVAGED TRACK (FROM SHOOFLY)	TF	3,700	\$200.00	\$740,000
1.3-4	CONSTRUCT GRADE CROSSING TRACK	TF	700	\$2,500.00	\$1,750,000
1.3-5	SHIFT TRACK	TF	1,520	\$90.00	\$136,800
1.3-6	INSTALL NEW NO. 9 TURNOUT	EA	5	\$175,000.00	\$875,000
1.3-7	R/M AND REINSTALL NO. 9 TURNOUT	EA	3	\$95,000.00	\$285,000
1.3-8	R/M NO. 9 TURNOUT (SALVAGE & PALLETIZE)	EA	5	\$15,000.00	\$75,000
1.3-9	REMOVE AND REINSTALL NO. 9 TURNOUT	EA	2	\$90,000.00	\$180,000
1.3-10	REMOVE TRACK (DISPOSE)	TF	3,700	\$40.00	\$148,000



**ROSECRANS/MARQUARDT GRADE SEPARATION PROJECT**  
**City of Santa Fe Springs, CA**  
**Metro Contract No. PS2415-3420**  
**PRELIMINARY PROJECT COST ESTIMATE - ALTERNATIVE 3**



**Metro**

Item No.	Description	Unit	Quantity	Unit Price	Amount
1.3-11	REMOVE TRACK (SALVAGE)	TF	5,800	\$50.00	\$290,000
1.3-12	REMOVE SHOOFLY CROSSING	TF	700	\$60.00	\$42,000
1.3-13	CROSSING DEMOLITION	LS	1	\$75,000.00	\$75,000
1.3-14	SALVAGE RAILROAD CROSSING PANELS & SIGNAL EQUIPMENT	LS	1	\$30,000.00	\$30,000
1.3-15	RAILROAD SIGNAL SYSTEM MODIFICATIONS & RESTORATION	LS	1	\$1,500,000.00	\$1,500,000
1.3-16	RELOCATE SIGNAL/COMM. HOUSE	EA	2	\$550,000.00	\$1,100,000
1.3-17	PROTECT/MODIFY FACILITIES IN BNSF R/W	LS	1	\$250,000.00	\$250,000
<b>1.4 DRAINAGE / UTILITIES</b>					<b>\$8,094,750</b>
1.4-1	STORM DRAIN - 24" RCP	LF	500	\$350.00	\$175,000
1.4-2	LATERALS - 18" RCP	LF	230	\$250.00	\$57,500
1.4-3	CATCH BASIN (7-FT)	EA	4	\$8,500.00	\$34,000
1.4-4	CATCH BASIN (14-FT)	EA	2	\$10,000.00	\$20,000
1.4-5	PUMP STATION	LS	1	\$3,000,000.00	\$3,000,000
1.4-6	JUNCTION STRUCTURE	EA	3	\$8,000.00	\$24,000
1.4-7	CONCRETE COLLAR	EA	1	\$500.00	\$500
1.4-8	REMOVE EXISTING CATCH BASIN	EA	1	\$1,000.00	\$1,000
1.4-9	WATER - 8" DIP	LF	800	\$175.00	\$140,000
1.4-10	WATER - 12" DIP	LF	150	\$200.00	\$30,000
1.4-11	WATER - 12" DIP (TEMPORARY)	LF	200	\$200.00	\$40,000
1.4-12	WATER - 16" DIP	LF	820	\$250.00	\$205,000
1.4-13	SEWER - 18" VCP (INCLUDING MANHOLES)	LF	670	\$350.00	\$234,500
1.4-14	SEWER - 24" VCP (INCLUDING MANHOLES)	LF	1,150	\$365.00	\$419,750
1.4-15	SEWER - 33" VCP (INCLUDING MANHOLES)	LF	1,000	\$410.00	\$410,000
1.4-16	36" STEEL CASING (JACK & BORE)	LF	140	\$900.00	\$126,000
1.4-17	60" STEEL CASING (JACK & BORE)	LF	160	\$1,200.00	\$192,000



**ROSECRANS/MARQUARDT GRADE SEPARATION PROJECT**  
**City of Santa Fe Springs, CA**  
**Metro Contract No. PS2415-3420**  
**PRELIMINARY PROJECT COST ESTIMATE - ALTERNATIVE 3**



**Metro**

Item No.	Description	Unit	Quantity	Unit Price	Amount
1.4-18	SOUTHERN CALIFORNIA EDISON RELOCATION**	LS	1	\$2,105,000.00	\$2,105,000
1.4-19	SOUTHERN CALIFORNIA GAS COMPANY RELOCATION	LS	1	\$48,000.00	\$48,000
1.4-20	VERIZON RELOCATION	LS	1	\$580,000.00	\$580,000
1.4-21	AT&T RELOCATION	LS	1	\$337,000.00	\$337,000
1.4-22	TIME WARNER CABLE RELOCATION	LS	1	\$170,000.00	\$170,000
1.4-23	VERIZON WIRELESS RELOCATION	LS	1	\$55,000.00	\$55,000
1.4-24	CHEVRON RELOCATION	LS	1	\$860,000.00	\$860,000
1.4-25	CRIMSON PIPELINE RELOCATION	LS	1	\$1,073,000.00	\$1,073,000
	* Utility relocations shown above (shaded) are considered in franchise, and are listed for information only. These are not included in the overall capital cost. ** 50% of the SCE relocation is included in the overall capital cost to account for engineered steel poles.				
<b>1.5 LANDSCAPING</b>					<b>\$353,120</b>
1.5-1	IRRIGATION	SF	61,920	\$3.00	\$185,760
1.5-2	PLANTING	SF	61,920	\$2.00	\$123,840
1.5-3	OTHER SURFACE TREATMENT	SF	5,440	\$8.00	\$43,520
<b>1.6 TRAFFIC &amp; LIGHTING</b>					<b>\$1,125,000</b>
1.6-1	TRAFFIC SIGNALS	LS	1	\$300,000.00	\$300,000
1.6-2	STREET LIGHTING	LS	1	\$250,000.00	\$250,000
1.6-3	SIGNING & STRIPING	LS	1	\$75,000.00	\$75,000
1.6-4	TRAFFIC HANDLING	LS	1	\$500,000.00	\$500,000
<b>1.7 MISCELLANEOUS</b>					<b>\$600,000</b>
1.7-1	SWPPP & IMPLEMENTATION	LS	1	\$300,000.00	\$300,000
1.7-2	EROSION CONTROL	LS	1	\$300,000.00	\$300,000
<b>ROADWAY SUBTOTAL</b>					<b>\$27,443,830</b>
<b>ROADWAY MOBILIZATION (10%)</b>					<b>\$2,744,383</b>
<b>ROADWAY CONTINGENCIES (25%)</b>					<b>\$6,860,958</b>
<b>ROADWAY TOTAL</b>					<b>\$37,049,171</b>



**ROSECRANS/MARQUARDT GRADE SEPARATION PROJECT**  
**City of Santa Fe Springs, CA**  
**Metro Contract No. PS2415-3420**  
**PRELIMINARY PROJECT COST ESTIMATE - ALTERNATIVE 3**



**Metro**

Item No.	Description	Unit	Quantity	Unit Price	Amount
<b>2. STRUCTURE ITEMS</b>					
2.1	BRIDGE (ROSECRANS AVENUE UNDERPASS)	SF	14,872	\$1,400.00	\$20,821,000
2.2	BRIDGE (MARQUARDT AVENUE SEPARATION)	SF	8,693	\$275.00	\$2,391,000
2.3	BRIDGE (STAGE ROAD SEPARATION)	SF	8,530	\$275.00	\$2,346,000
2.4	RETAINING WALLS (SECANT PILE)	SF	38,200	\$350.00	\$13,370,000
<b>STRUCTURE SUBTOTAL</b>					<b>\$38,928,000</b>
<b>STRUCTURE MOBILIZATION (0% - UNIT PRICES INCLUDE 10% MOBILIZATION)</b>					<b>\$0</b>
<b>STRUCTURE CONTINGENCIES (0% - UNIT PRICES INCLUDE 25% CONTINGENCY)</b>					<b>\$0</b>
<b>STRUCTURE TOTAL</b>					<b>\$38,928,000</b>
<b>3. RIGHT-OF-WAY</b>					
<i>Note: Right-of-way acquisition costs include relocation, goodwill, demolition &amp; support costs.</i>					
3.1	FULL ACQUISITIONS, ROADWAY EASEMENTS, AND TEMPORARY CONSTRUCTION EASEMENTS	LS	1	\$43,000,000.00	\$43,000,000
3.2	UTILITY EASEMENTS (TO BE DETERMINED) (5% OF ITEM No. 3.1)	LS	1	\$2,150,000.00	\$2,150,000
<b>RIGHT-OF-WAY SUBTOTAL</b>					<b>\$45,150,000</b>
<b>RIGHT-OF-WAY CONTINGENCIES (25%)</b>					<b>\$11,287,500</b>
<b>RIGHT-OF-WAY TOTAL</b>					<b>\$56,437,500</b>



ROSECRANS/MARQUARDT GRADE SEPARATION PROJECT

City of Santa Fe Springs, CA  
Metro Contract No. PS2415-3420  
**ALTERNATIVE 4 - SUMMARY**



**Metro**

Item No.	Description	Amount
1	ROADWAY ITEMS	\$37,142,037
2	STRUCTURE ITEMS	\$36,405,000
	<b>SUBTOTAL CONSTRUCTION COSTS</b>	<b>\$73,547,037</b>
3	RIGHT-OF-WAY	\$55,125,000
	<b>CAPITAL COST</b>	<b>\$128,672,037</b>



**ROSECRANS/MARQUARDT GRADE SEPARATION PROJECT**  
**City of Santa Fe Springs, CA**  
**Metro Contract No. PS2415-3420**  
**PRELIMINARY PROJECT COST ESTIMATE - ALTERNATIVE 4**



**Metro**

Item No.	Description	Unit	Quantity	Unit Price	Amount
<b>1. ROADWAY ITEMS</b>					
<b>1.1 EARTHWORK</b>					<b>\$4,601,350</b>
1.1-1	CLEARING AND GRUBBING (REMOVALS)	LS	1	\$500,000.00	\$500,000
1.1-2	REMOVE PAVEMENT (REMOVALS)	SF	270,000	\$5.00	\$1,350,000
1.1-3	UNCLASSIFIED EXCAVATION	CY	78,610	\$35.00	\$2,751,350
<b>1.2 STRUCTURAL SECTION</b>					
					<b>\$2,486,700</b>
1.2-1	CRUSHED AGGREGATE BASE	CY	12,760	\$50.00	\$638,000
1.2-2	ASPHALT CONCRETE	TON	9,690	\$100.00	\$969,000
1.2-3	ASPHALT CONCRETE (PARKING LOT)	TON	170	\$150.00	\$25,500
1.2-4	CONCRETE SIDEWALK	SF	52,870	\$6.00	\$317,220
1.2-5	PCC CURB AND GUTTER	LF	7,660	\$25.00	\$191,500
1.2-6	PCC CURB ONLY	LF	2,040	\$18.00	\$36,720
1.2-7	CONCRETE DRIVEWAY	SF	3,230	\$12.00	\$38,760
1.2-8	PORTLAND CONCRETE CEMENT	CY	1,080	\$250.00	\$270,000
<b>1.3 RAILROAD RELATED ITEMS</b>					
					<b>\$9,996,800</b>
1.3-1	RAILROAD FLAGGING (2 EACH FOR 18 MONTHS)	DAY	780	\$1,000.00	\$780,000
1.3-2	INSTALL TRACK	TF	5,800	\$300.00	\$1,740,000
1.3-3	REINSTALL SALVAGED TRACK (FROM SHOOFLY)	TF	3,700	\$200.00	\$740,000
1.3-4	CONSTRUCT GRADE CROSSING TRACK	TF	700	\$2,500.00	\$1,750,000
1.3-5	SHIFT TRACK	TF	1,520	\$90.00	\$136,800
1.3-6	INSTALL NEW NO. 9 TURNOUT	EA	5	\$175,000.00	\$875,000
1.3-7	R/M AND REINSTALL NO. 9 TURNOUT	EA	3	\$95,000.00	\$285,000
1.3-8	R/M NO. 9 TURNOUT (SALVAGE & PALLETIZE)	EA	5	\$15,000.00	\$75,000
1.3-9	REMOVE AND REINSTALL NO. 9 TURNOUT	EA	2	\$90,000.00	\$180,000
1.3-10	REMOVE TRACK (DISPOSE)	TF	3,700	\$40.00	\$148,000



**ROSECRANS/MARQUARDT GRADE SEPARATION PROJECT**  
**City of Santa Fe Springs, CA**  
**Metro Contract No. PS2415-3420**  
**PRELIMINARY PROJECT COST ESTIMATE - ALTERNATIVE 4**



**Metro**

Item No.	Description	Unit	Quantity	Unit Price	Amount
1.3-11	REMOVE TRACK (SALVAGE)	TF	5,800	\$50.00	\$290,000
1.3-12	REMOVE SHOOFLY CROSSING	TF	700	\$60.00	\$42,000
1.3-13	CROSSING DEMOLITION	LS	1	\$75,000.00	\$75,000
1.3-14	SALVAGE RAILROAD CROSSING PANELS & SIGNAL EQUIPMENT	LS	1	\$30,000.00	\$30,000
1.3-15	RAILROAD SIGNAL SYSTEM MODIFICATIONS & RESTORATION	LS	1	\$1,500,000.00	\$1,500,000
1.3-16	RELOCATE SIGNAL/COMM. HOUSE	EA	2	\$550,000.00	\$1,100,000
1.3-17	PROTECT/MODIFY FACILITIES IN BNSF R/W	LS	1	\$250,000.00	\$250,000
<b>1.4 DRAINAGE / UTILITIES</b>					<b>\$8,038,750</b>
1.4-1	STORM DRAIN - 24" RCP	LF	500	\$350.00	\$175,000
1.4-2	LATERALS - 18" RCP	LF	70	\$250.00	\$17,500
1.4-3	CATCH BASIN (7-FT)	EA	3	\$8,500.00	\$25,500
1.4-4	CATCH BASIN (14-FT)	EA	2	\$10,000.00	\$20,000
1.4-5	PUMP STATION	LS	1	\$3,000,000.00	\$3,000,000
1.4-6	JUNCTION STRUCTURE	EA	2	\$8,000.00	\$16,000
1.4-7	WATER - 8" DIP	LF	800	\$175.00	\$140,000
1.4-8	WATER - 12" DIP	LF	160	\$200.00	\$32,000
1.4-9	WATER - 12" DIP (TEMPORARY)	LF	200	\$200.00	\$40,000
1.4-10	WATER - 16" DIP	LF	820	\$250.00	\$205,000
1.4-11	SEWER - 18" VCP (INCLUDING MANHOLES)	LF	670	\$350.00	\$234,500
1.4-12	SEWER - 24" VCP (INCLUDING MANHOLES)	LF	1,150	\$365.00	\$419,750
1.4-13	SEWER - 33" VCP (INCLUDING MANHOLES)	LF	1,000	\$410.00	\$410,000
1.4-14	36" STEEL CASING (JACK & BORE)	LF	140	\$900.00	\$126,000
1.4-15	60" STEEL CASING (JACK & BORE)	LF	160	\$1,200.00	\$192,000



**ROSECRANS/MARQUARDT GRADE SEPARATION PROJECT**  
**City of Santa Fe Springs, CA**  
**Metro Contract No. PS2415-3420**  
**PRELIMINARY PROJECT COST ESTIMATE - ALTERNATIVE 4**



**Metro**

Item No.	Description	Unit	Quantity	Unit Price	Amount
1.4-16	SOUTHERN CALIFORNIA EDISON RELOCATION**	LS	1	\$2,105,000.00	\$2,105,000
1.4-17	SOUTHERN CALIFORNIA GAS COMPANY RELOCATION	LS	1	\$48,000.00	\$48,000
1.4-18	VERIZON RELOCATION	LS	1	\$580,000.00	\$580,000
1.4-19	AT&T RELOCATION	LS	1	\$337,000.00	\$337,000
1.4-20	TIME WARNER CABLE RELOCATION	LS	1	\$170,000.00	\$170,000
1.4-21	VERIZON WIRELESS RELOCATION	LS	1	\$55,000.00	\$55,000
1.4-22	CHEVRON RELOCATION	LS	1	\$860,000.00	\$860,000
1.4-23	CRIMSON PIPELINE RELOCATION	LS	1	\$1,073,000.00	\$1,073,000
	* Utility relocations shown above (shaded) are considered in franchise, and are listed for information only. These are not included in the overall capital cost. ** 50% of the SCE relocation is included in the overall capital cost to account for engineered steel poles.				
<b>1.5 LANDSCAPING</b>					<b>\$214,020</b>
1.5-1	IRRIGATION	SF	38,340	\$3.00	\$115,020
1.5-2	PLANTING	SF	38,340	\$2.00	\$76,680
1.5-3	OTHER SURFACE TREATMENT	SF	2,790	\$8.00	\$22,320
<b>1.6 TRAFFIC &amp; LIGHTING</b>					<b>\$1,575,000</b>
1.6-1	TRAFFIC SIGNALS	LS	1	\$750,000.00	\$750,000
1.6-2	STREET LIGHTING	LS	1	\$250,000.00	\$250,000
1.6-3	SIGNING & STRIPING	LS	1	\$75,000.00	\$75,000
1.6-4	TRAFFIC HANDLING	LS	1	\$500,000.00	\$500,000
<b>1.7 MISCELLANEOUS</b>					<b>\$600,000</b>
1.7-1	SWPPP & IMPLEMENTATION	LS	1	\$300,000.00	\$300,000
1.7-2	EROSION CONTROL	LS	1	\$300,000.00	\$300,000
<b>ROADWAY SUBTOTAL</b>					<b>\$27,512,620</b>
<b>ROADWAY MOBILIZATION (10%)</b>					<b>\$2,751,262</b>
<b>ROADWAY CONTINGENCIES (25%)</b>					<b>\$6,878,155</b>
<b>ROADWAY TOTAL</b>					<b>\$37,142,037</b>



**ROSECRANS/MARQUARDT GRADE SEPARATION PROJECT**  
**City of Santa Fe Springs, CA**  
**Metro Contract No. PS2415-3420**  
**PRELIMINARY PROJECT COST ESTIMATE - ALTERNATIVE 4**



**Metro**

Item No.	Description	Unit	Quantity	Unit Price	Amount
<b>2. STRUCTURE ITEMS</b>					
2.1	BRIDGE (ROSECRANS AVENUE UNDERPASS)	SF	13,770	\$1,400.00	\$19,278,000
2.2	BRIDGE (MARQUARDT AVENUE SEPARATION)	SF	8,910	\$275.00	\$2,450,000
2.3	BRIDGE (STAGE ROAD SEPARATION)	SF	7,297	\$275.00	\$2,007,000
2.4	RETAINING WALLS (SECANT PILE)	SF	36,200	\$350.00	\$12,670,000
<b>STRUCTURE SUBTOTAL</b>					<b>\$36,405,000</b>
<b>STRUCTURE MOBILIZATION (0% - UNIT PRICES INCLUDE 10% MOBILIZATION)</b>					<b>\$0</b>
<b>STRUCTURE CONTINGENCIES (0% - UNIT PRICES INCLUDE 25% CONTINGENCY)</b>					<b>\$0</b>
<b>STRUCTURE TOTAL</b>					<b>\$36,405,000</b>
<b>3. RIGHT-OF-WAY</b>					
<i>Note: Right-of-way acquisition costs include relocation, goodwill, demolition &amp; support costs.</i>					
3.1	FULL ACQUISITIONS, ROADWAY EASEMENTS, AND TEMPORARY CONSTRUCTION EASEMENTS	LS	1	\$42,000,000.00	\$42,000,000
3.2	UTILITY EASEMENTS (TO BE DETERMINED) (5% OF ITEM No. 3.1)	LS	1	\$2,100,000.00	\$2,100,000
<b>RIGHT-OF-WAY SUBTOTAL</b>					<b>\$44,100,000</b>
<b>RIGHT-OF-WAY CONTINGENCIES (25%)</b>					<b>\$11,025,000</b>
<b>RIGHT-OF-WAY TOTAL</b>					<b>\$55,125,000</b>