CARLSBAD VILLAGE DOUBLE TRACK - RAILROAD TRENCH ALTERNATIVE ECONOMIC ANALYSIS AND FEASIBILITY STUDY

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Prepared for:

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Table of Contents

ATTACHMENTS

1. EXECUTIVE SUMMARY

This report documents the study of two additional alternatives for the Carlsbad Village Double Track project. The Carlsbad Village Double Track project constructs a second railroad track from Cassidy Street in Oceanside south to Tamarack Avenue in Carlsbad. The At-Grade Alternative would construct a second track at the existing ground level, modify the at-grade street crossings, and construct a double-track bridge over Buena Vista Lagoon. The two new alternatives would include grade separation of the railroad tracks by constructing them in a trench, beneath the existing street elevations. The first alternative, known as the Short Trench Alternative, would construct the double track railroad lowered in a trench passing under vehicular overpasses at Grand Avenue, Carlsbad Village Drive, and Oak Avenue, with pedestrian overpasses at Beech Ave/Carlsbad Village Station and Chestnut Avenue. The second alternative is the Long Trench Alternative, which would construct a railroad trench passing under vehicular overpasses at Grand Avenue, Carlsbad Village Drive, Oak Avenue, Chestnut Avenue, and Tamarack Avenue, with a pedestrian overpass at Beech Ave/Carlsbad Village Station. Both trench alternatives would require replacement of the Carlsbad Boulevard Overcrossing with a new bridge spanning the tracks.

Current conditions include only four locations for pedestrians and vehicles to cross the railroad tracks in the 1.8 miles between Buena Vista Lagoon and Agua Hedionda Lagoon, one grade separated and three at-grade. By grade separating the tracks in a trench, additional crossings can be added at Oak Avenue and Chestnut Avenue, and potentially others along the railroad Right-of-Way. The Long Trench Alternative would construct a vehicular crossing at Chestnut Avenue, while the Short Trench Alternative would construct a pedestrian crossing at Chestnut Avenue. The grade separated crossings will eliminate delays to traffic and emergency responders caused by at-grade crossing gate arms that remain down as trains approach and pass by.

Construction of either trench alternative would first require a temporary shoofly track be constructed to allow railroad operations to continue throughout construction. An impact of the temporary shoofly track is a temporary loss of parking at the station and in the area east of the tracks between Grand Avenue and Oak Avenue. The historic Carlsbad Santa Fe Depot located between Grand Avenue and Carlsbad Village Drive would need to be relocated prior to construction.

Based on geotechnical borings taken in the project area from 2013 and 2016, the trench would be located below the water table and require specialized design and construction techniques for trench retaining walls and waterproofing of the trench in groundwater. Several options were studied for the trench structure. The most viable retaining wall structure type is a secant pile wall system with horizontal struts for bracing in the deepest portion. This type of wall creates an effective seal from groundwater and can be constructed prior to excavation which reduces the volume of dewatering needed. A sealed trench floor is required which will result in a buoyant force trying to lift the trench structure. A mass concrete base is proposed to withstand the buoyant force due to the groundwater. Additional options presented in the report are deep soil mixing walls or slurry diaphragm walls, and the use of tie-down anchors in the trench floor to reduce the weight of concrete needed. Future phases of the project would require an extensive groundwater monitoring program and analysis to confirm the proper design groundwater depth.

The Long Trench Alternative would require the acquisition of three single family residential parcels located east of existing railroad Right-of-Way, just south of Tamarack Avenue. The existing Right-of-Way is narrow in this location and there are utilities (a 48-inch sewer and 84-inch storm drain) located on the east side of the tracks which must be relocated to construct this alternative. A feasible place to relocate them is to shift them east into the subject parcels. The Short Trench Alternative does not require any Right-of-Way acquisitions.

The Short Trench Alternative would have a total project investment between $215 million and $235 million (2016), while the Long Trench Alternative would have a total project investment between $320 million and $350 million (2016). These costs include a 30% contingency on the estimated construction cost to account for the preliminary nature of the design. Future maintenance costs due to the trench alternatives would include maintenance of storm drain pump stations required to drain the trench, maintenance of bridges and retaining walls, and elevator maintenance at the train station.

The preferred minimum vertical clearance on the Los Angeles-San Diego-San Luis Obispo (LOSSAN) corridor is 26 ft. North County Transit District (NCTD) has indicated that, with concurrence from Burlington Northern and Santa Fe (BNSF) Railway, the minimum vertical clearance may be reduced to 24 ft. If the minimum clearance used for design were 24 ft., the construction cost of the project would be reduced by an estimated $14 million for the Long Trench Alternative, and $8 million for the Short Trench Alternative.

2. PROJECT DESCRIPTION

The City of Carlsbad (City), in cooperation with the San Diego Association of Governments (SANDAG), has initiated this Feasibility Study for the Carlsbad Village Double Track project. The Study documents the feasibility of two additional alternatives for this project. These two alternatives would include grade separation of the railroad tracks and construction of the second track. In addition, the City commissioned a detailed economic analysis of the alternatives as a companion document to the Feasibility Study (Attachment A).

2.1 Project Location

The project study area is in San Diego County in the cities of Carlsbad and Oceanside along approximately 2.6 miles of the railroad corridor from Agua Hedionda Lagoon to Cassidy Street. See Attachment B for a larger location map.

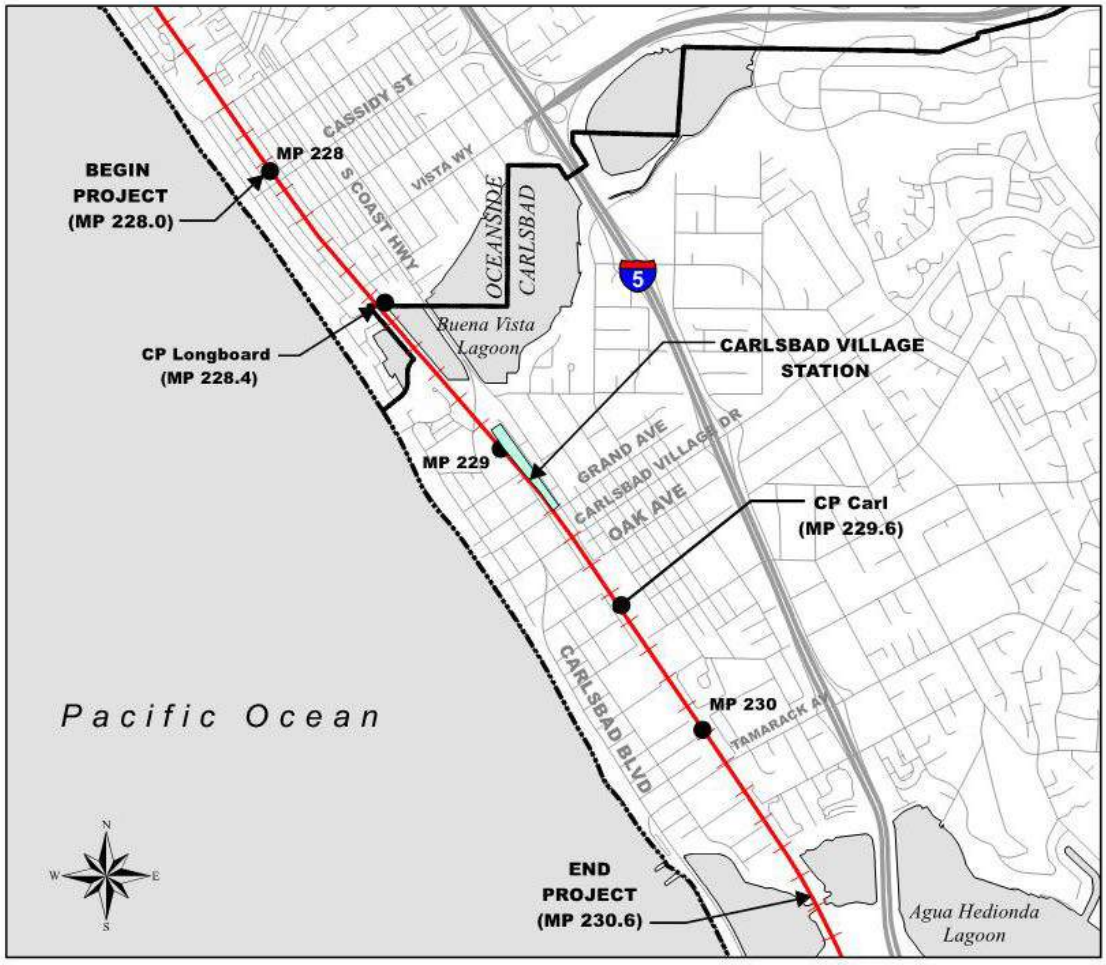


Figure 2.1: Location Map

2.2 Existing Facilities

The California Southern Railroad, a subsidiary of the Atchison, Topeka, and Santa Fe Railway, was constructed from 1881 to 1885. It provided a connection between what is now the City of Barstow and San Diego. At its most southern end the railway began in what is now National City proceeding northward to the City of Oceanside, then northeast through Temecula Canyon and on toward Barstow. The California Southern Railroad formed the original railroad right-of-way through the City of Carlsbad that is still in use today. The San Diego Northern Railway, a subsidiary of NCTD, purchased the tracks from Atchison, Topeka, and Santa Fe Railway in 1994. NCTD dissolved the San Diego Northern Railway Corporation in 2002.

Currently, NCTD, Amtrak, and BNSF Railway operate rail services through the LOSSAN Corridor, operating through the project site. NCTD's COASTER trains and six Amtrak Pacific Surfliner trains stop at the Carlsbad Village station.

The existing tracks consist of a double track section from the Agua Hedionda railroad bridge to Control Point (CP) Carl, located at Pine Avenue. At CP Carl the tracks are reduced to a single track going north through Carlsbad Village Station, under the Carlsbad Boulevard Overpass and across Buena Vista Lagoon to CP Longboard. The tracks return to double track north of the turnout at CP Longboard continuing north through Oceanside.

The area surrounding the railroad right-of-way between Carlsbad Boulevard and Oak Avenue has developed into the downtown commercial area of Carlsbad and is known as Carlsbad Village. The area between Oak Avenue and Tamarack Avenue is known as the Barrio and is considered Carlsbad's first neighborhood, initially settled in the early 1900s. The City has completed several revitalization projects in the area with more planned in the future.

Within the Carlsbad Village area there are three at-grade railroad crossings: one at Carlsbad Village Drive, one at Grand Avenue, and one at the Carlsbad Village Station platform; and one grade separated crossing at Carlsbad Drive. Farther south there is one more at-grade crossing located at Tamarack Avenue. There is approximately 0.8 miles between the crossings at Carlsbad Village Drive and Tamarack Avenue where there is no access for pedestrians or vehicles across the railroad tracks.

The Carlsbad Village Station is located just north of Grand Avenue on the east side of the railroad tracks. It includes a parking lot and a station building with restrooms. Across the tracks there is a bus depot operated by NCTD with six saw-tooth bus bays. Near the center of the station platform there is an at-grade pedestrian crossing leading from the bus depot to the train station.

Between Grand Avenue and Carlsbad Village Drive, the existing track is bordered by a green space known as Rotary Park to the west and the current location of the historic Carlsbad Santa Fe Depot to the east. The historic Carlsbad Santa Fe Depot is currently utilized by the City of Carlsbad as a Visitor's Center. North of the bus station and immediately west of the NCTD right-of-way is the Army/Navy Academy athletic fields. Farther north, beyond Buena Vista Lagoon, the track corridor is located between single family home developments.

2.3 Current Rail Services

Current rail services that run through the project area include NCTD COASTER, Amtrak Pacific Surfliner, and BNSF freight trains. The following table provides typical numbers of trains per day passing through the project area.

Table 2.1: LOSSAN Service Levels (Oceanside to San Diego)

Operator/Line	2016 Service Levels
Intercity (All Stop)	22
Commuter	22
BNSF Freight	6
TOTAL	50

Current passenger service schedules are available at octa.net/OCTA2015/Components/SurflinerLanding/assets/Pacific-Surfliner-Schedule.pdf.

There are typically 4-6 freight trains operating on the San Diego Subdivision daily.

SANDAG provides an Assistance to Transit Operations and Planning (ATOP) program that monitors the performance of the region's transit system. The latest data available for fiscal year 2013 showed an average of 620 daily riders departing and arriving on the COASTER at the Carlsbad Village Station with the vast majority of riders departing the station travelling south on the COASTER.

2.4 Previous Studies

At-Grade Double-Tracking Alternative

Previous studies of the Carlsbad Village Double Track project have focused on at-grade alternatives for double-tracking. A Project Study Report prepared by RailPros, Inc. in August 2011 recommended that an at-grade second track alignment be constructed to the east of the existing track maintaining 18 ft. track centers through the station area, Grand Ave, and Carlsbad Village Drive.

An Alternatives Analysis Report was prepared by T.Y. Lin International in April 2014 that studied various alternatives for at-grade double-tracking and recommended a preferred alternative that shifted the existing track 3 ft. west and constructed a new track 15 ft. east of the existing track. The project limits for an At-Grade Alternative would be similar to the trench alternatives on the north end, however to the south the at-grade double-tracking would end north of Chestnut Avenue where it meets up with existing double-track.

Regional Planning

San Diego Forward: The Regional Plan, approved by SANDAG in October 2015 evaluated regional grade separations providing rankings based on certain criteria. The grade separation of Grand Avenue/Carlsbad Village Drive received a relative ranking of 23rd among railroad grade separation projects, and had an estimated cost of $110 million (2014$). The grade separation of Tamarack Avenue was evaluated separately and given a ranking of 25th with an estimated cost of $90 million (2014$). See Attachment C for a summary of the evaluations from The Regional Plan.

Local Planning

The City of Carlsbad is currently in the process of completing the Village and Barrio Master Plan. The plan was released for public review in November 2015 and in January 2016 the public review period concluded. Hearings before the Planning Commission and City Council were scheduled to take place in May and June 2016. One of the most transformative concepts in the Draft Village and Barrio Master Plan is supporting trenching of the railroad tracks along with double tracking to create a more connected network of streets across the tracks. The Draft plan also includes transit oriented development opportunities at the Carlsbad Village Station site, and the Village Central Green concept introduced in the Plan would cover the trenched railroad tracks with a park area.

3. PURPOSE AND NEED

Project Need

The 351-mile Los Angeles-San Diego-San Luis Obispo (LOSSAN) rail corridor serves as a vital link for passenger and freight movements in San Diego County. The LOSSAN corridor is the second busiest intercity passenger rail line in the United States. Additionally, the corridor is the only viable freight rail link between San Diego and the rest of the nation. Currently, because of single track through the northern part of the project area, trains must wait at a siding whenever a COASTER train is loading or unloading passengers at the Carlsbad Village Station. Additionally, meeting or passing trains must take turns using the single track, which reduces operational flexibility and results in cascading delays. Double tracking this segment directly supports the objective of SANDAG, NCTD, Amtrak, and BNSF Railway to increase the efficiency of this rail corridor, not only to accommodate existing train volumes, but also to provide for future demand for rail services on the LOSSAN corridor.

In a letter addressed to the California Coastal Commission on July 17, 2014, the City of Carlsbad provided comments on the draft North Coast Corridor Public Works Plan and Transportation and Resource Enhancement Program (PWP/TREP). Included in the comments was a request to require SANDAG to conduct environmental review of both an at-grade railroad option and a trench alternative.

Project Purpose

Double tracking this segment directly supports the objective of SANDAG, NCTD, Amtrak and BNSF Railway. In addition to supporting mobility in the region the City of Carlsbad would like to address and improve the items noted in the letter by studying trench alternatives. Trenching through the City of Carlsbad will provide much improved and safer connections to coastal resources and the coastline for residents, visitors, and train riders; as well as allow increases in railroad volumes without negatively impacting the on-street traffic in the City.

4. SCOPE OF WORK

The scope of this study is to evaluate the feasibility of constructing a grade separated double track railroad in a trench structure through Carlsbad Village. This report evaluates two alternatives:

Short Trench Alternative

- Lower the railroad in a trench to pass under an overpass at Carlsbad Boulevard, Beech Avenue, Grand Avenue, Carlsbad Village Drive, Oak Avenue, and Chestnut Avenue.

- Maintain Tamarack Avenue as an at-grade crossing.
- Minimize impacts to on-street traffic during construction.
- Minimize impacts to railroad operations during construction.
- Provide double-tracking from Cassidy Street in Oceanside to the Agua Hedionda Lagoon Bridge.

Long Trench Alternative

- Lower the railroad in a trench to pass under an overpass at Carlsbad Boulevard, Beech Avenue, Grand Avenue, Carlsbad Village Drive, Oak Avenue, Chestnut Avenue, and Tamarack Avenue.
- Minimize impacts to on-street traffic during construction.
- Minimize impacts to railroad operations during construction.
- Provide double-tracking from Cassidy Street in Oceanside to the Agua Hedionda Lagoon Bridge.

5. PROJECT BENEFITS

The benefits of trenching the railroad tracks through Carlsbad Village include roadway circulation, improved beach access, public safety, first response, and railroad operations, environmental benefits such as noise reduction and visual improvements, and economic benefits.

5.1 Roadway Circulation and Beach Access

By grade separating the railroad tracks and eliminating the at-grade crossings, traffic circulation on the roads within the Carlsbad Village area will see a reduction in delays due to crossing gates. Certain vehicles such as commercial buses, passenger-carrying vehicles, and vehicles carrying hazardous materials are required to stop at all at-grade railroad crossings, per Section 22452 "Railroad Crossings", of the California Vehicle Code. This restriction imposes further delay on following vehicles, especially since there are two bus routes, NCTD Breeze routes 321 and 325, which cross the railroad tracks at Grand Avenue. Grade separation of these crossings would eliminate these delays for both the NCTD buses and following vehicles.

With the tracks lowered in a trench, bridges can be constructed at Oak Avenue and Chestnut Avenue where there is currently no access across the tracks; and there is potential to connect other streets west of the tracks to the Coastal Rail Trail via bike/pedestrian overpasses. The Long Trench Alternative provides a vehicular crossing at both Oak Avenue and Chestnut Avenue. This will provide a greater benefit to vehicular traffic when compared to the Short Trench Alternative, which would provide only one new vehicular crossing at Oak Avenue.

Beach access for residents east of the tracks will be improved by adding the additional crossings, allowing bikes and pedestrians additional safe access points over the railroad tracks. Currently, residents who live between Carlsbad Village Drive and Tamarack Avenue cross the tracks at Carlsbad Village Drive and Tamarack Avenue, requiring them to travel up to an additional 0.4 miles to cross the tracks. If grade separated crossings were made at Chestnut Avenue and Oak Avenue, it would reduce the distance required for many of these residents east of the tracks to access the beach and downtown areas.

5.2 Public Safety and First Response

Emergency access response times would also improve with the grade separation of the tracks and the addition of grade separated crossings at Oak Avenue for the Short Trench Alternative or both Oak Avenue and Chestnut Avenue for the Long Trench Alternative. The nearest fire station is located about 0.8 miles east of the railroad tracks on Carlsbad Village Drive. At times emergency response to locations west of the railroad tracks can be impeded by trains sitting idle at the station and as trains pass through the at-grade crossings. Elimination of the at-grade crossings would provide improved reliability for emergency response west of the railroad tracks.

Elimination of the at-grade crossings would provide safety benefits for pedestrians and vehicles crossing the tracks. Certain express trains travel through the existing at-grade crossings at up to 90 miles per hour without stopping. Railroad related incidents are tracked by the Federal Railroad Administration (FRA), San Diego Sheriff's Office Train Deputies, and Carlsbad Computer Aided Dispatch. Since the year 2000 there have been 22 incidents involving trains and either pedestrians or vehicles, resulting in 19 fatalities and 4 injuries in the Carlsbad area. Grade separation will eliminate these types of incidents.

5.3 Railroad Operations

Grade separating the tracks will lessen maintenance needs at grade crossings and yield security benefits for NCTD. The grade separated crossings would no longer require maintenance for the grade crossing warning devices and crossing arms. The tracks would be made more secure because the trench would create a positive barrier preventing trespassers from fouling the tracks and possibly endangering themselves and disrupting railroad operations.

The benefits of double tracking the area from CP Longboard to CP Carl are the removal of the single track bottleneck where trains currently must wait for trains travelling in the opposite direction to clear the single track section prior to entering. This project combined with others in the corridor, will reduce travel times for passengers, improve system reliability, facilitate goods movement, help to reduce passenger and truck volumes on Interstate 5, and provide for increased passenger and freight rail services in the future.

5.4 Environmental Benefits

The railroad trench alternative will provide benefits to the area including visual and noise. The visual aesthetics of the area will be improved by placing the railroad tracks in a trench. The road crossings will no longer require crossing arms, and will be lined by architectural features such as decorative iron fencing rather than the railroad tracks.

With the railroad tracks lowered in a trench, the trench walls will provide a reduction in noise impacts from passing trains when compared to tracks at grade. Additionally, crossing bells will no longer be required once the tracks are grade separated.

5.5 Economic Benefits

Economic benefits of trenching the railroad tracks were detailed in the Economic Study: LOSSAN Corridor Improvement Options – Carlsbad Area by RSG, Inc./Kimley-Horn and Associates, Inc./dBF Associates (See Attachment A). Benefits listed in the study include increased property values, additional interest in redevelopment in the area, increased development density near transit, increased property taxes, and job creation. Additionally, the study relates an economic benefit to lives saved by grade separating the railroad tracks and to the reduction in delay at the railroad crossings.

The reduction in traffic congestion and noise, as well as increased walkability could make property in the area more desirable, which can raise property values and improve the experience of visitors to the area. Higher property values would increase property taxes and be more attractive to developers. Lower noise levels and improved walkability may increase the number of visitors to the area and lead to generation of higher sales tax revenues.

6. DESIGN CONSIDERATIONS

6.1 Trench Cross Section and Clearance Requirements

The proposed railroad trench would consist of two railroad tracks with 15 ft. track center spacing, a 15-foot-wide access road, and drainage ditches on each side. The drainage ditches are shown as grated to allow them to be incorporated into the access road width, thereby reducing the overall trench width. According to NCTD requirements the minimum horizontal distance from a retaining wall to the nearest track centerline is 15 ft. The edge of the access road must be located a minimum of 10 ft. clear from the nearest track centerline.

Within the station area the minimum track centerline spacing would be 18 ft. to allow for an inter-track fence. Platform edges are set at 5'-5" from track centerlines and the minimum width required by NCTD for station platforms is 16 ft. Additional width would be added to the trench at specific locations for stairs, ramps, and other improvements.

The minimum vertical clearance required at all overpasses and from permanent overhead struts would be 26 ft. from top of rail.

Access to the trench would be provided at either end of the trench through an access road running along the west side of the tracks. The access road could include a turn-around location prior to or after the station. A turn-around area (if provided) should accommodate up to a 35-foot-long vehicle, preferably able to turn around without fouling the tracks. If no turn-around is included the access road should be continuous through the station to allow maintenance vehicles to pass through the trench and exit the opposite end. Access through the station could be provided by adding crossing panels through the station and allowing maintenance vehicles to drive over the tracks.

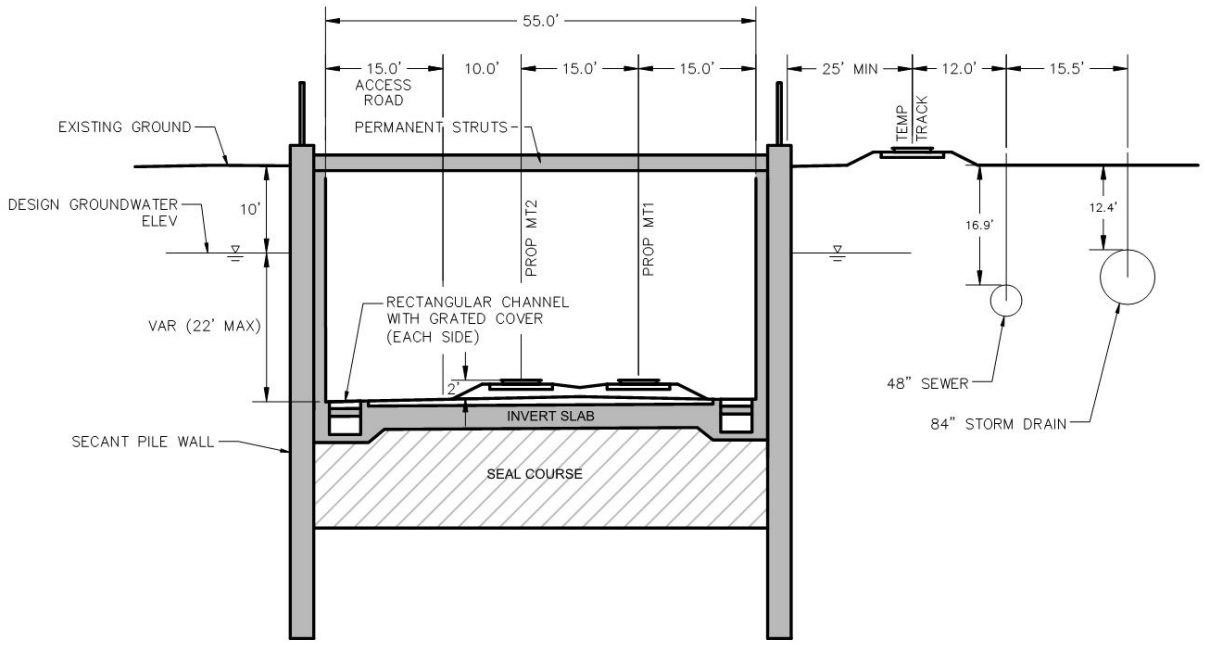


Figure 6.1: Typical Section of Trench (Looking North)

6.2 Track Geometry

The design speed used for both permanent and shoofly track designs shall be 90 mph for passenger and 55 mph for freight. The track geometry shall be designed per the latest revision of the SANDAG Design Criteria Volume III LOSSAN Corridor in San Diego County.

Vertical Profile

The track profile shown in the plan and profile exhibits represents the top of rail elevation. The trench floor slab would be set approximately 2 ft. below top of rail to allow for ties and ballast. Both the Short Trench Alternative and the Long Trench Alternative have generally similar vertical profiles for the trench section, but differ in the northerly approach to Tamarack Avenue. Beginning at the south end of the project limits, the existing double tracks cross Agua Hedionda Lagoon at a 0.00% grade for both alternatives.

Short Trench Northbound Approach

Because Tamarack Avenue remains as an at-grade crossing, similar to existing conditions, moving north the profile increases at a 0.79% grade up through a reverse vertical curve up to the Tamarack Avenue at-grade crossing. The short trench alternative matches the existing grade across Tamarack Avenue. The profile then transitions to -1.15% grade through a 1,000 ft. crest vertical curve, then begins to flatten out after transitioning out of a 675 ft. sag curve.

Long Trench Northbound Approach

Tamarack Avenue becomes a grade-separated crossing with the long trench alternative. North of the Agua Hedionda Lagoon Bridge, the profile transitions to -1.09% grade through an 800 ft. crest vertical curve south of Tamarack Avenue then passes under an overpass at Tamarack in a 900 ft. sag vertical curve.

Trench Profile

The proposed track profile through the trench section was set based on the required vertical clearance of 26 ft. between the top of rail and overpass structures. A roadway bridge structure depth of 2.25 ft. was assumed for design of the trench profile beneath each overpass. The preliminary track profiles were designed with the assumption that the existing road profiles will be raised 1.5 ft. at Grand Avenue and Carlsbad Village Drive, and 0.5 ft. at Tamarack Avenue to reduce the depth of the trench. This can be accomplished by modifications to the roadway profile on Washington Street, and the driveways east of the tracks. This requires the struts to be shifted higher by extending the top of the retaining wall above the existing grade about 2 ft.

With the track elevations set beneath each overpass profile grades were extended out to vertical curves at each end of the trench. The minimum top of rail elevation is 13.65 ft. for the Long Trench and 14.38 ft. for the Short Trench. Through the station the track profile is set at 0.39% coming out of the trench. Passing under Carlsbad Boulevard, the track profile is proposed to be about 3 ft. lower than the existing track elevation. This requires the replacement of the existing bridge structure at Carlsbad Boulevard due to the existing spread footings at the bridge, which would be undermined by the proposed track elevation under the bridge.

Buena Vista Lagoon Crossing

The profile grade across Buena Vista Lagoon was set based on the required bridge depth and results of the *Buena Vista Lagoon Bridge Fluvial Hydraulics Analysis* (Everest International Consultants, February 2014). This study analyzed the 100-year flood depth in the lagoon, including the effects of tidal influences, scour, and sea level rise, and required the proposed track elevation to be set about 5 ft. higher than the existing lagoon bridge. North of the lagoon the track profile matches back into existing near Cassidy Street in Oceanside.

Horizontal Alignment

The horizontal alignment of the tracks is constrained by the narrow right-of-way at two locations: near Tamarack Avenue and on the west side of the existing station. At the station the tracks would need to be constructed in the existing location with one track set 18 ft. to the east in order to avoid significant impacts to existing Washington Street and infrastructure, as well as an existing church located on the south side of Carlsbad Village Drive. The existing right-of-way between Carlsbad Village Drive and Tamarack Avenue is 200-foot-wide, however south of Tamarack it becomes 100-foot-wide for around 300 ft. then gradually widens closer to the Lagoon.

The short trench alternative would shift the tracks west at Tamarack to avoid impacting an existing 48-inch sewer line and 84-inch storm drain. Since the short trench option would be at-grade where the existing right-of-way narrows south of Tamarack there are no additional right-of-way requirements for this option.

The long trench alternative would shift the tracks to the east at Tamarack to provide space between the trench walls and the existing right-of-way line for a sewer and storm drain line, without impacting the properties on the west side of the right-of-way. As a result of shifting the tracks to the east the existing 48-inch sewer and 84-inch storm drain would need to be relocated farther east. This requires additional right-of-way along the east side, south of Tamarack.

6.3 Station Design

The proposed grade separation would require a below grade station. The current NCTD standard is to provide a 1,000-foot-long platform on each side. The tracks would be separated by 18 ft. within the platform area to allow for construction of an inter-track fence. The inter-track fence would be a barrier to prevent pedestrians from crossing the tracks to access the opposite platform. A pedestrian overpass would provide access between the platforms. Access across the tracks would also be available on the Grand Avenue overpass. Elevators and stairs would be included on each platform. The minimum platform width would be 16 ft. with small portions narrowed to a minimum of 12 ft.

The existing station building would be demolished. The new station design could include a restroom facility to replace the restrooms located within the existing building and platform shelters or covered areas. Station amenities should be consistent with other recent station projects completed on the corridor.

A portion of the existing parking lot would be temporarily removed during construction of the trench and temporary shoofly track and station platform. The final design would enable a new parking configuration that better utilizes the property.

6.4 Drainage

Several options for providing drainage of storm water from the trench were discussed during the preparation of this report. Typically, a gravity flow swale would be preferred but in this case the middle of the trench is lower than the ends, so a swale would not work.

Another solution was to bore a storm drain line west out of the trench at the low points to an ocean outfall. The benefit of this is that it requires less future maintenance than a pump station would. There are a number of challenges associated with this. First, the environmental permitting of a new ocean outfall would be very difficult, if allowed at all. If this were pursued it would be beneficial to modify an existing outfall location. The second issue is that the elevation of the low point in the trench would place the storm drain around 9 ft. above sea level at the trench. High tides have reached up to 7 ft. recently and with the possibility of sea level rise the storm drain may not function in the future during high tides. The pipe would also need to be constructed at a very flat slope, roughly 0.15%, in order to stay above sea level. This can be problematic for trenchless installation because it requires a very high degree of accuracy that is not always achievable with trenchless installation methods. Third, the construction of the storm drain by boring would require the contractor to bore through the trench wall, creating an entry point for groundwater. It would be difficult to maintain a sealed condition at the pipe connections.

Another approach that has been used on other railroad trench projects, and is recommended in this report, is to provide storm drain pump stations at low points. Since each end of the trench is at a higher elevation than the middle of the trench, water would be collected at low points into underground sumps, then pumped out to existing City storm drains. The design of the pump systems would maintain the 100-year headwater depths below the railroad ballast. The proposed Long Trench Alternative would require two pump stations, while the proposed Short Trench Alternative would require one pump station. Sub-drains consisting of pervious pipes would be constructed within the track bed allowing for drainage of the sub-grade.

Offsite drainage from the west would be conveyed parallel to the tracks along the top of the wall in either open channels or buried storm drain. The short trench alternative would connect the parallel storm drain into the existing storm drain system in Tamarack Drive. The long trench would require the parallel storm drain to continue south past Tamarack to the end of the retaining walls where it could cross the tracks and join the existing 84-inch storm drain. A 20-foot wide area between the right-of-way line and the retaining walls would be provided south of Tamarack for storm drain and sewer.

Near the station existing storm drains that cross the tracks would be re-routed to flow north parallel the tracks along the outside of the trench to the end of the retaining walls where the runoff would enter a ditch along the side of the tracks, eventually entering Buena Vista Lagoon.

Due to the expected groundwater level being higher than the trench floor the use of infiltration BMPs would not be feasible. Water quality within the trench could be maintained through the use of media filters prior to pumping the storm water. Additionally, runoff from low flow storms could be stored then released via a low flow pump at a specified flow rate to minimize increases in runoff. An additional option for enhanced water quality is to pump low flows into the City sewer system, to then be treated at the Encina Water Pollution Control Facility. This would require concurrence from the City of Carlsbad, and verification that the treatment facility and sewer system have sufficient capacity for added flows. The next phase of the project should explore this further in a Water Quality Technical Report and Preliminary Drainage Report.

6.5 Utilities

Utility information was requested and obtained from AT&T, Carlsbad Municipal Water District (CMWD), City of Carlsbad, City of Oceanside, Cox Communication, Crown Castle International, Southern California Gas Co., San Diego Gas and Electric (SDG&E), Time Warner Cable (TWC), and Verizon. Letters were sent to each utility owner requesting electronic media or hard copies of record as-built drawings.

AT&T Transmission, Crown Castle International, and City of Oceanside Traffic Signals provided response letters stating that they have no active facilities within the project vicinity. The remaining utility companies provided mapping of their facilities in the area (the City of Carlsbad and Carlsbad Municipal Water District provide access to as-built drawings online through its Document Management System. As-built research in the City of Oceanside was completed at the City Engineering Counter).

Existing utilities in the project area were mapped based on the provided as-built drawings, aerial topography, aerial photos, site visits, and survey data. The existing utilities mapped were overlaid onto the proposed design and all mapped impacts were noted.

It is anticipated that all water lines, gas lines, underground electrical, and communication lines crossing the trench can be relocated to either be attached to the proposed overpass bridges, or placed on separate utility structures. Where gravity sewer lines cross the trench the system would be modified to flow parallel the trench to a point where the track profile is high enough for the sewer to pass under while maintaining the proper slope and clearances.

An existing 48-inch sewer line exists along the east side of the existing tracks. The pipe has approximately 16 ft. of cover. In certain locations the temporary shoofly track would be placed over the existing pipe. The depth is such that live loads from railroads are diminished and it is anticipated that the pipes can accommodate the railroad tracks. During the design phase of the project this assumption should be validated by structural calculations. Where manholes are located under the shoofly track they will require modifications to lower the rim, and possibly provide additional structural support.

There is a Verizon fiber optic line that runs parallel the existing tracks which will require relocation. This relocation would occur through the trench and also at the Buena Vista Lagoon crossing where the line would be relocated from the existing bridge to the new bridge.

A 12-inch gas line owned by SDG&E parallels the tracks within the right-of-way. Between Carlsbad Blvd and the proposed station, the gas line would need to be relocated. A new storm drain line is required between the right-of-way and retaining wall, as well as an existing sewer line. This does not leave enough room for the gas line and therefore it is anticipated that the gas line would be relocated between Carlsbad Blvd. and Grand Ave.

6.6 Right-of-Way

Between Carlsbad Village Drive and Tamarack Avenue, the existing railroad Right-of-Way width is 200 ft. South of Tamarack Avenue the Right-of-Way is 100-foot-wide for a short distance, then gradually widening moving south toward Agua Hedionda Lagoon. The narrowed segment of Right-of-Way south of Tamarack Avenue is insufficient to construct the Long Trench Alternative. In addition to fitting the proposed trench in the Right-of-Way there is a 48-inch sewer and an 84-inch storm drain, along with several smaller utilities that parallel the tracks and need to be located outside the trench. The Long Trench Alternative would require acquisition of three single family residential properties located along the east side of the existing Right-of-Way south of Tamarack Avenue. The Short Trench Alternative does not require the acquisition of any new Right-of-Way.

6.7 Railroad Signaling

Signal improvements would include wayside signals within the trench and associated signal houses located outside the trench, temporary grade crossing warning devices and instrument houses, temporary control points at each end of the trench, and positive train control (PTC) infrastructure. It is anticipated that wayside signals would be located at either end of the station, near Tamarack Avenue, and near Cassidy Street. PTC is communicated via fiber optic cabling that runs adjacent to the existing tracks within the right-of-way. It will require relocation outside the trench to allow for continuous use during construction. The temporary shoofly track would cross several streets at grade, requiring the modifications to the grade crossing warning devices. This could include relocation of crossing arms and flashing light assemblies as well as relocation of associated signal houses if they are in conflict with the work area or shoofly track alignment.

6.8 Geotechnical

The Technical Memorandum included in Attachment H was prepared by Earth Mechanics, Inc. (EMI) in May 2016 to discuss the geotechnical setting of the proposed trench alternatives as well as the feasibility of retaining wall types. Data from borings taken by Southern California Soil Testing in 2016, EMI at the station in 2013 along with data from as-built log of test borings at the Carlsbad Boulevard Overpass, and info from the State Water Resources Control Board Geotracker website were utilized as sources of information for the geotechnical memorandum.

The proposed trench alternatives are anticipated to be excavated primarily through the shallow terrace deposits and Santiago Formation. The soil types expected to be encountered during trench excavation will be predominantly medium dense to dense clayey sand and soft sandstone with occasional claystone and siltstone interlayering. Site soils are not expected to present a rippability problem and can be excavated using conventional earthmoving equipment.

The borings encountered groundwater as high as elevation +28 ft. mean sea level (about 13 ft. below ground level). As-builts from the seismic retrofit showed a similar groundwater elevation at about 15 ft. below ground level. The natural grade does not vary significantly with the project limits and it is anticipated that groundwater will generally be between 10 and 20 ft. below natural grade. The final top of rail elevation within the trench will be 10 to 20 ft. below the water table. The trench walls and trench slab will need to be designed to resist hydrostatic earth pressures.

Groundwater is likely to be encountered during excavation for the trench as well as overpass foundations. Groundwater will need to be controlled during construction of retaining walls, retaining wall footings, overpass foundations, and the trench base slab. Any seepage or groundwater removed from an excavation would need to be tested and disposed of in compliance with all applicable local, state, and federal laws. A comprehensive groundwater monitoring program should be conducted as part of the design of either trench alternative. Seasonal variations, variations in groundwater levels along the length of the trench should be monitored as well as potential groundwater flow that might affect design and construction of the trench.

For sidewall support of the trench and at the bridge abutments, both bottom-up and top-down construction methodologies are geotechnically feasible. The most challenging geotechnical issue will be constructing deep cut retaining walls in the presence of shallow groundwater.

For a conventional bottom-up construction method, it is anticipated that there is insufficient right-of-way to lay back the excavations so some form of shoring will be required. Site soils are not conducive to driven sheet piling due to the shallow Santiago Formation and soil nail walls are not suited for construction below the groundwater table. Drilled soldier pile walls with lagging are feasible; however, lagging installation below the groundwater will not be water-tight so the excavation will need to be continually pumped. Additionally, the cut heights are expected to exceed the practical limits for cantilever soldier piles so either ground anchors (tie-backs), internal struts or bracing will be required to resist lateral earth loading.

For top-down construction, site soils are expected to be conducive to both secant pile wall and slurry wall construction. Both secant pile walls and slurry walls are effective methods to seal off water which would eliminate or reduce the expense of pumping and disposal of groundwater from the excavation during construction. Due to the anticipated excavation heights, internal bracing or ground anchors will most likely be required. Secant pile walls are generally more common in the western United States; however, recently slurry walls have started to be used more frequently on the west coast. Projects on the west coast where slurry walls have been used require a substantial quantity of work to offset the mobilization cost of the equipment which is much larger than conventional Cast-In-Drilled-Hole (CIDH) pile construction equipment and usually has to come from the east coast. At this time secant piles are assumed to be the most feasible option for top-down construction.

Recently, ground improvement techniques have been incorporated into secant pile wall design and construction to eliminate the time and expense of shaft stabilization (casing and/or slurry). Jet grouting, Cutter Soil Mixing (CSM), and Cement Deep Soil Mixing (CDSM) are examples of methods that have been used to inject and mix cementous grout with native soils to create a soil grout column of sufficient strength to be used for temporary lateral earth support. The vertical reinforcing in the secondary piles is stabbed into the soil-grout column while the mixture is still wet. Due to the high relative density of the Santiago Formation, site soils are anticipated to be more conducive to CSM and CDSM than jet grouting. Pre-drilling the soil column with a flighted auger can also be used in advance of ground improvement techniques to facilitate grout injection and soil mixing.

At the bridge overpasses, the abutments would be supported on CIDH piles that would provide lateral support for the trench and also carry the axial superstructure loads. The CIDH piles at these locations would need to extend deeper below the trench slab to develop the necessary axial capacity from side friction to support the structural loads.

6.9 Trench Structure

The trench structure will consist of a wall and invert slab system, which will be required to support approximately 32 ft. of trench cut at the grade separations, a temporary shoofly track running along the east edge of the trench and will support abutment loads for the overpass structures. The system also has to work under high ground water conditions both for temporary construction and for permanent configuration. A typical section for the trench is shown in Figure 6.1.

Constraints

Some of the constraints affecting the trench construction include:

- Proximity of existing utilities
- High groundwater table
- At least one temporary shoofly track needs to stay operational during construction
- Vertical clearance under the overpass structures
- Available Right-of-Way
- Dense Santiago formational material at relatively shallow depths

Trench Structural Elements Evaluation Criteria

Structural feasibility of several trench systems and their associated components were evaluated for this project based on the following criteria:

1) *Applicability to Soil conditions*: As discussed in Section 6.7, the proposed trenches are anticipated to be excavated primarily through the shallow terrace deposits and Santiago Formation. The soil types expected to be encountered during trench excavation will be predominately medium dense to dense clayey sand and soft sandstone with occasional claystone and siltstone interlayering. The Santiago Formation was able to be easily excavated with a hollow-stem auger drilling equipment and exhibited soil-like behavior during sampling and did not require rock coring. However, this material is not expected to be conducive to pile driving, per the technical memorandum in Appendix F.

2) *Groundwater Control*: Based on the proximity of the site to the Pacific Ocean and the groundwater elevations encountered in the borings, shallow groundwater is anticipated along the trench alignment. Natural grade does not vary significantly within the project limits and it is anticipated that groundwater will be generally between 10 and 20 ft. below natural grade. During construction, wall systems that require dewatering and treating large volumes of water could be prohibitively expensive. Also in the final configuration, wall system is expected to be watertight. Any seepage water that has to be disposed off-site would have to be treated.

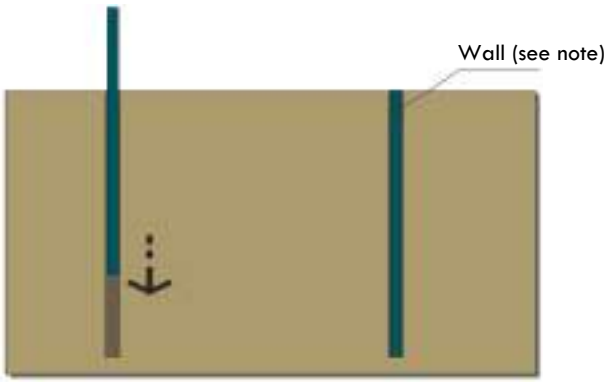
3) *Bridge Abutment Loading*: The long trench option will include construction of 7 overpass structures along the grade-separated trench alignment while the short trench option will include construction of 6 overpass structures. The wall/slab invert system of the trench structure is proposed to be integrated with the bridge abutments at these crossings and should be able to resist the vertical abutment loads from these overpass structures. Thus wall systems requiring fewer modifications to accommodate the bridge abutments are preferred from cost and schedule perspective.

4) *Construction Duration and Impacts*: The trench alignment passes through both business and residential area of the City of Carlsbad and hence the noise and traffic impacts of the construction need to be considered. Wall systems that use construction equipment with smaller impact footprints are preferred. A single shoofly track will be operational during the entire duration of trench construction and hence a wall system is preferred that will minimize the construction duration and lead to early operation of the double tracks.

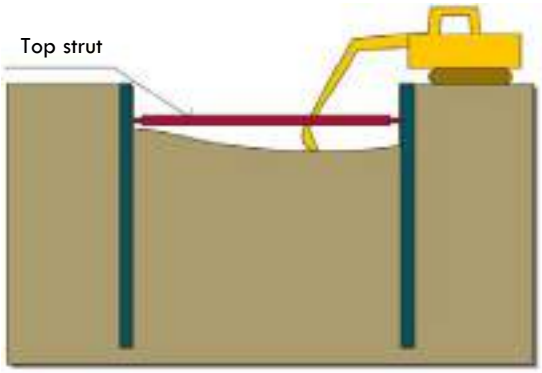
5) *Utility/Right-of-Way (ROW) conflicts*: The ROW limits and utility layouts are shown in Attachments C & D. The close proximity of the trench walls to the utilities and right-of-way limits precludes the use of tiebacks and soil nails in certain locations.

Wall Systems

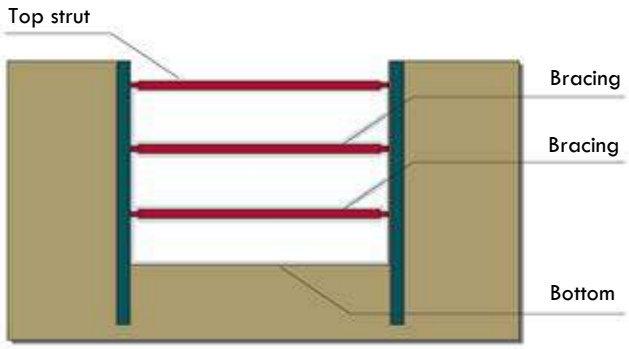
Due to close proximity of utilities and ROW limits and the need to maintain a dry excavation to avoid dewatering, a top down construction is proposed for the wall. A schematic of a typical top down construction wall system is shown in Figure 6.2.



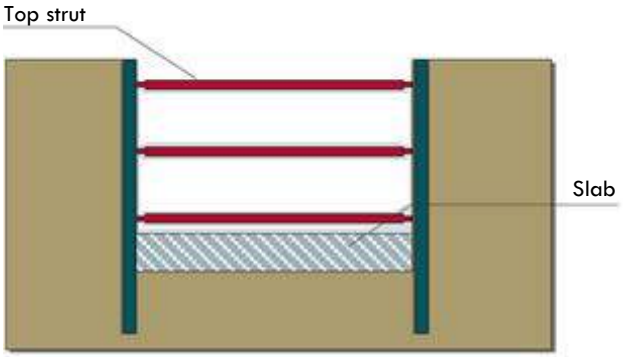
Stage 1: Construction of wall



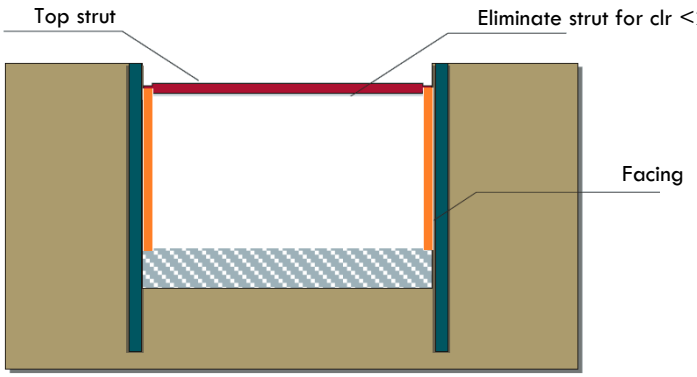
Stage 2: Construction of top strut



Stage 3: Excavation and bracing



Stage 4: Construction of invert slab



Stage 5: Construction of wall facing

Note: The schematics shown above are applicable for any wall system with top down construction in which the wall acts as a structural system and shoring for constructing the trench.

Figure 6.2: Schematic of Construction Staging for Top-down Wall Systems
("Construction of Secant Pile Wall", Land Transport Authority, Singapore, October 2004)

The wall systems considered for feasibility analysis include:

a) *Secant Pile Walls* are formed by top down construction of overlapping concrete piles. The secant piles are reinforced with either steel rebar or with steel beams and are constructed by either drilling under mud or augering. Primary piles are installed first with secondary piles constructed in between primary piles once the latter gain sufficient strength. This wall system provides an effective method to seal off water into an excavation, which will eliminate or reduce the expense of pumping and disposal of groundwater from the excavation during construction.

b) *Slurry-Diaphragm Walls* consist of top down construction of excavated panels which are filled with soil-bentonite slurry to prevent caving. After design depth is reached, the slurry is displaced with concrete pumped through a tremie pipe and steel reinforcement cage is inserted into the panel. However, slurry walls are more suitable as curtain cutoff walls to slow down migration of groundwater and other contaminants and are usually not used as permanent structural elements. Considerable reinforcing and thicker sections will be required to provide the structural strength to hold back soil pressures on the unsupported side of the trench. Secant pile walls are generally more common in the eastern United States; however, recently slurry walls have started to be used more frequently on the west coast. Projects on the west coast where slurry walls have been used require a substantial quantity of work to offset the mobilization cost of the equipment which is much larger than conventional CIDH pile construction equipment (per the technical memorandum in Appendix F).

c) *Deep Soil Mixing (DSM) Walls* also consist of top down construction by creating columns of ground improvement by mechanically mixing the soil with cementitious binder slurry. The process constructs rows of overlapping columns. H-piles are usually inserted into the columns for lateral capacity. A bracing system with tiebacks may also be used as an alternative to the H-piles. At this project location some predrilling may be required into the Santiago formation before the soil mixing operation, which will increase the cost for the DSM walls (per the technical memorandum in Appendix F). Also, similar to the slurry walls, DSM walls are more commonly used as temporary shoring and are usually not used as permanent structural elements.

d) *Cantilever Walls* are cast-in-place reinforced concrete structures. These wall systems consist of constructing a wall stem and footing in stages from the bottom up. A standard benched cut cannot be used at this project since this will require the excavation to be dewatered during construction. The exorbitant costs associated with pumping and treating large volumes of water, combined with the adverse environmental impacts associated with mitigation of water infiltration and the ROW and utility constraints will probably not allow a traditional cantilever wall construction. Sheetpiling is the preferred shoring option for cantilever walls in which the vertical members are typically driven or vibrated from the original ground surface to a specified depth. However, this system is ruled out at

the project location due to the shallow Santiago Formation that is not conducive to driving the sheetpiles. The construction operation also will have noise impacts on the neighborhood. Thus a temporary water-sealed shoring system (similar to the three wall systems described above) will be required to get to the bottom of the footing. Thus a standard cantilever wall construction may not be feasible for this project unless a top-down method of construction is used for shoring.

e) *Soil Nail Walls* are constructed through top down excavation in lifts of approximately 5 ft. and the excavated soil is passively reinforced with grouted tension-resisting steel elements (nails) that can be design for permanent or temporary support. The nails increase the shear strength of the reinforced soil mass and limit displacement during and after excavation. A shotcrete facing is constructed to provide local resistance to raveling. Soil nail walls cannot be constructed with anchors below the water table and at locations where the wall is in close proximity to utilities or within the zone of influence of a railroad track. However, soil nail walls may be considered for the beginning and end segments of the trench which are above the ground water table where the proximity of adjacent utilities and right-of-way limits permit. Also for the trench sections with groundwater, it may be possible to come up with a hybrid system consisting of secant piles below the groundwater table and soil nail walls above the water table. Careful consideration will be needed for any seasonal water fluctuations or sea level rise to determine the design water table for such hybrid system.

f) *Soldier Piles with Lagging* is a top down excavation support technique where vertical steel piles are lowered into a drilled hole and grouted at regular intervals along the proposed wall location. Wood lagging is placed between the soldier piles as excavation proceeds. For excavations of small height, the walls are typically cantilevered. The walls can be tied-back or braced where additional lateral support is required. Since the excavation between the piles to install the lagging is open excavation, this system cannot be used without dewatering. Also the installation rate for soldier pile walls is usually slower than other wall systems (per the technical memorandum in Appendix F).

g) *MSE Walls* are gravity structures consisting of alternating layers of granular backfill and linear metallic and/or polymer based, high-adherence soil reinforcing strips to which a modular precast concrete facing is attached. Its strength and stability are derived from the frictional interaction between the granular backfill and the reinforcements that creates a unique composite construction material. A mechanical connection between the facing panels and the soil reinforcing strips is achieved by way of a special tie strip embed and high strength nut/bolt/washer assembly. MSE walls are usually fill walls and hence is not applicable for this project location due to close proximity R/W, utilities and the presence of groundwater.

A comparison of eight different wall systems in terms of the Structural Elements Evaluation Criteria have been summarized in Table 6.1.

Table 6.1: Wall System Evaluation Summary

Wall Type	Applicability to Soil Conditions	Groundwater Control	Bridge Abutment Loading	Construction Duration and Impact	Utility/ROW Conflicts
Secant Pile Wall	✓	✓	✓	✓	✓
Slurry-Diaphragm Wall	✓	✓	✓	✓	✓
Deep Soil Mixing (DSM) Wall	✓	✓	✓	✓	✓
Cantilever Wall without Shoring	✓	✗	✓	✓	✗
Cantilever Wall with Sheetpile Shoring	✗	✓	✓	✗	✓
Soil Nail Wall	✓	✗	✗	✓	✗
Soldier Piles and Lagging	✓	✗	✓	✗	✓
MSE Walls	✗	✗	✓	✓	✗

Legend: ✗ Criteria not satisfied
✓ Criteria satisfied

Invert Slab and Seal Course Systems

Due to the trench depth below the groundwater level a method of keeping the railroad trench dry must be included in the design. There are two ways to dry the trench. One is to provide a drainage system that drains the groundwater into a basin within the trench where it would be pumped out to the lagoon or storm drain system. The other option is to seal off the trench from the water, similar to what has been done in the Alemeda Corridor and Reno ReTrac railroad trench projects. Although the pumping option may have a cost savings, it is not proposed in this report for the following reasons:

- The groundwater would require testing and treatment prior to discharging to the storm drain or lagoon.
- The impacts of permanently lowering the groundwater in the area would need evaluation of the environmental effects as well as impacts to any current uses of the groundwater.

- There would be a risk of flooding the railroad tracks in the case that the pump systems failed, resulting in impacts to commuters, freight movement, and possible damage to the track bed. Pump systems could fail due to mechanical failure or clogging of a drain line.

- NCTD has stated that they would not allow groundwater to enter the trench.

For trench sections below groundwater, a structural concrete invert slab is proposed between the walls to seal off the base of the trench from groundwater. Sealing of the trench would create a buoyant force that would act to lift the approximately 32-foot-tall x 55-foot-wide trench section. The invert slab is proposed to be designed as a strut system at the bottom of the wall which will reduce the embedment length of the piles. Along the majority of the trench, the secant piles/slurry wall will only need to extend far enough below the trench slab to resist the temporary lateral earth loads until the bottom slab is poured. These temporary lateral loads can be reduced by adding temporary bracing systems over the height of the wall. Some of the invert slab options include:

a) *Cast-in-place Concrete Slab*: Designing a cast-in-place invert slab thick enough to resist the buoyancy forces by virtue of dead load only is one of the simplest design approaches. However, the thicker the slab gets, the buoyancy forces also increase proportionally. Thus this approach by itself could result in an uneconomical design for high ground water because of dewatering. A cast-in place slab may be used in combination with a seal course or jet grouting as described below.

b) *Seal Course*: The seal course is a concrete slab placed underwater by the tremie placement method and is constructed thick enough so that its weight is sufficient to resist uplift from buoyant forces. A seal course also seals the entire bottom of an excavation and prevents subsurface water from entering the excavation.

c) *Jet grouting*: Jet grouting is a top-down soil treatment used to create in-situ, cemented soil formations. The method uses pressurized fluids to segregate and remove some of the soil particles and replace them and blend them with a soil/cement mixture that can provide high strength and low permeability. This jet grouted zone then acts as a seal for the invert slab and ballast. The advantage of the jet grouting method, as compared to a seal course, is that the treated zone can be constructed before starting the excavation. This can help to reduce the depth of excavation and wall embedment zone. In some instances, tiedowns may also be used to hold down the treated zone itself against the buoyant forces, thus resulting in a thinner seal course.

Struts

Since the trench will have two opposing walls a strut brace can be used between the walls, with available vertical clearance over 26 ft., to resist the lateral soil pressures. Since wall tiebacks cannot be used due to close proximity of utilities and R/W boundaries, the wall design can be optimized by designing the strut as a beam-column between the two walls of the trench with compression loads produced by the lateral soil pressures and moments produced by the strut self-weight. To speed construction the struts can be precast and connected to the wall over waler beams.

The construction staging for the Alameda Corridor, located in Los Angeles, California, which has similar proportions to the proposed CVDT is shown in Figure 6.3.

(a)

(b)

(c)

(d)

(a) Excavation of the trench after installation of secant piles and top struts
(b) Construction of invert slab and wall facing
(c) Ballast placement
(d) Completed trench

Figure 6.3: Expected Construction Staging

Note: Photos shown are from the of the construction of the Alameda Corridor, in Los Angeles County, CA, which had similar constraints as the Carlsbad Village Double Track Trench project, such as limited right-of-way and close proximity to underground utilities.

(Photos courtesy: Eric Brown, Earth Mechanics)

Trench Typical Section

The trench walls may be divided into several segments based on the following criteria:

- Presence of groundwater
- Presence of utilities in close proximity to wall
- Presence of shoofly track next to excavation
- Adjacent to overpass structure

Wall segments for the long trench option with groundwater, utility and shoofly impacts are summarized in Table 6.2. Typical sections of the trench are shown in Figures 6.4 and 6.5.

Table 6.2: Wall Segments with Groundwater, Utility, and Shoofly Impacts along Long Trench Alignment

Wall Segment Limits	Side of Wall	Utility Conflicts	Groundwater	Live Rail near Excavation	Max. Height of Wall (ft) from Top of Slab
Sta 2357+00 to 2353+28	East	No	No	Yes	10
	West	Yes	No	No	10
Sta 2353+28 to 2341+28	East	No	Yes	Yes	28
	West	Yes	Yes	No	28
Sta 2341+28 to 2334+66	East	No	Yes	Yes	32
	West	No	Yes	No	32
Sta 2334+66 to 2298+50	East	Yes	Yes	Yes	32
	West	No	Yes	No	32
Sta 2298+50 to 2290+75	East	Yes	Yes	Yes	32
	West	No	Yes	No	32
Sta 2290+75 to 2282+65	East	Yes	No	Yes	28
	West	No	No	No	28
Sta 2282+65 to 2279+00	East	No	No	Yes	10
	West	No	No	No	10

Legend: Yes Has design impact
No No design impact

Note: Carlsbad Village Station Platform limits are from STA 2339+50 to STA 2349+50

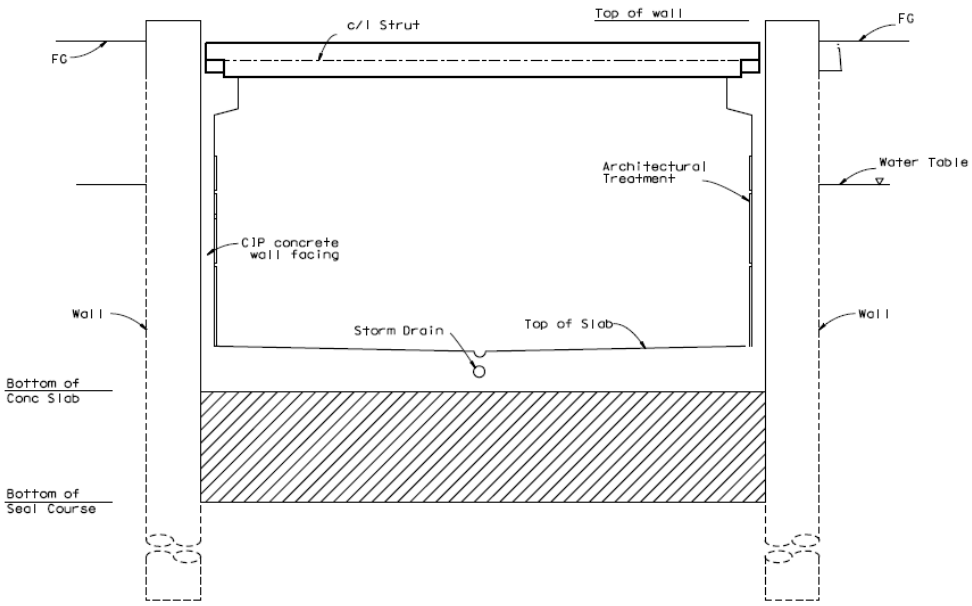


Figure 6.4: Cross Section of Trench System with Walls, Seal Course, and Permanent Strut (Wall height to bottom of ballast, H > 28 ft. only)

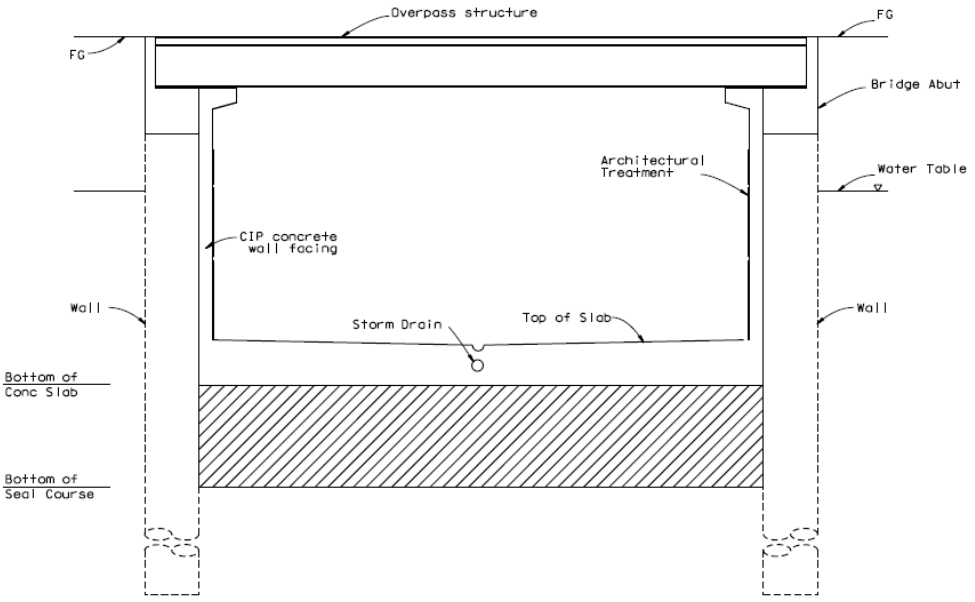


Figure 6.5: Cross Section of Trench System at Overpass Structures

Cost Evaluation

The cost for the trench structure was estimated through discussions with specialty contractors, field experts, and published construction cost data from Caltrans. These wall costs, neglect the costs for temporary construction lateral support systems. The estimated cost in Table 6.3 does not include the cost of roadway excavation, contingency and escalation costs. Contingency and escalation costs should be included to reflect the preliminary level of design at the feasibility study level and are shown later in the overall project cost.

Table 6.3: Estimated Cost for Trench Structure

Wall Height to Bottom of Ballast (ft)	Long Trench Wall Length (ft)	Short Trench Wall Length (ft)	Estimate for Walls / sq ft [1]	Estimate for Invert Slab/cy [2]	Estimate for Seal Course/cy [3]	Estimate for Struts/ft of wall length [4]	Estimated Long Trench Structure Cost [5]	Estimated Short Trench Structure Cost [5]
10 ft max	1,472	1,086	$ 65				$ 800,000	$ 570,000
10 ft to 28 ft	4,020	3,962	$ 110	$ 475	$ 150		$ 18,200,000	$ 21,690,000
28 ft to 32 ft	10,106	3,955	$ 110	$ 475	$ 150	$ 900	$ 74,700,000	$ 28,910,000
TOTAL (without contingencies)							$ 93,700,000	$ 51,170,000

Notes:

1 Estimate for walls is based on $65/sq ft. for soil nail walls for H<15 ft. with no utility impacts (Caltrans Contract Cost Data) and $110/sq ft. for secant pile wall system (Sunil Arora, Senior Project Manager, Hayward Baker Inc.)

2 Estimate for invert slab is based on Caltrans Contract Cost Data

3 Estimate for seal course is based on Caltrans Contract Cost Data

4 Estimate for struts is based on $12,000/precast strut and $500/CY for support beam (bid data from Carroll Canyon DAR Retaining Walls, San Diego, California)

5 Cost estimate backups for the long trench and short trench options are shown in Appendix D and Appendix E. All estimates are in 2016 costs.

Summary of Trench Structure Evaluation

A preliminary structural evaluation of feasible trench systems for the CVDT project has been performed. This includes looking at both wall and invert slab systems considering the relevant project constraints and conflicts. Based on these studies, the feasible wall systems for trench sections under the groundwater level include: a) Secant pile wall; b) Slurry wall and c) Deep-Soil-Mixing Wall. The invert slab is proposed to be a combination of cast-in-place slab and seal course. An opinion of preliminary costs also are provided for the different options. Further detailed structural and geotechnical investigations are necessary to develop a preferred alternative. During final design of the project the trench structure should evaluate the potential of using slope paving above the design groundwater elevation and the recommended wall systems above below the design water table. This could potentially be included where the right-of-way allows enough room for the paved slope.

6.10 Bridge Structures

A total of six overpass structures would be needed for the grade separated short trench option and seven structures would be needed for the long trench option. The overpass structures constructed directly over the trench are proposed to be single span Precast/Prestressed Girder structures supported on abutments which are made integral with the trench walls. The precast structure type is an attractive alternative because of reduced construction time and elimination of falsework. The Carlsbad Boulevard Overpass and the Buena Vista Lagoon Bridge would be multi-span structures which would be constructed outside the limits of the trench.

Tamarack Avenue Overpass (Long Trench Only)

The Long Trench Alternative would construct a vehicular bridge on Tamarack Avenue over the proposed trench. The proposed bridge was assumed to match the existing configuration of the road, with a 5 ft. sidewalk on each side, a 10-foot-wide median, a single 12 ft. lane in each direction, and 6 ft. bike lanes. The overall bridge dimensions would be 60' wide by 55' long single span structure. It is assumed that phased bridge construction would be required to allow the road to remain open during construction.

Chestnut Avenue Overpass

The Short Trench Alternative would construct the Chestnut Avenue Overpass as a pedestrian overpass. A vehicular crossing would not work in the Short Trench Alternative because the track profile cannot maintain 26 ft. of vertical clearance to the overpass and still reach the existing grade at Tamarack Avenue. The pedestrian overpass is proposed to be raised approximately 7 ft. above existing grade to provide the clearance to the pedestrian overpass. This would require stairs and an ADA accessible ramp to access the bridge on each side of the trench.

The Long Trench Alternative would construct the Chestnut Avenue Overpass as a vehicular crossing connecting the existing street on each side of the railroad right-of-way. The new crossing would include a sidewalk in each direction and match the width of the existing Chestnut Avenue. The overall bridge dimensions would be 56-foot-wide by 55-foot-long single span structure.

Oak Avenue Overpass

Both the short and long trench alternatives would construct a vehicular crossing connecting the existing street on each side of the railroad right-of-way. The new crossing would include a sidewalk in each direction and match the width of the existing Oak Avenue. The overall bridge dimensions would be 46-foot-wide by 55-foot-long single span structure.

Carlsbad Village Drive Overpass

The existing Carlsbad Village Drive is an at-grade crossing with 2-vehicular lanes in each direction. Both the long and short trench alternatives would match the existing configuration of the road, with a 5 ft. sidewalk on each side, a 10-foot-wide median, two 12 ft. lanes in each direction, and 6 ft. bike lanes. The overall bridge dimensions would be 84-foot-wide by 55-foot-long single span structure. It is assumed that phased bridge construction would be required to allow the road to remain open during construction.

Grand Avenue Overpass

The Grand Avenue Overpass would be similar to the Carlsbad Village Drive Overpass with overall bridge dimensions of 84-foot-wide by 55-foot-long single span structure.

Beech Avenue Pedestrian Overpass

A pedestrian overpass would be constructed at Beech Avenue to connect the Carlsbad Village Station platforms on either side of the tracks. The overpass structure would be 12-foot-wide by 62-foot-long single span structure.

Carlsbad Boulevard Overpass

The existing Carlsbad Boulevard Overpass structure would have to be replaced with both trench alternatives. The track profile for both trench alternatives would undermine the existing spread footings at the bridge piers. The replacement of this bridge was not included in the At-Grade Alternative because that alternative did not undermine the existing spread footings at the bridge piers.

The proposed bridge was assumed to match the existing configuration of the road, with a 5 ft. sidewalk on each side, a 10-foot-wide median, a single 12 ft. lane in each direction, and 6 ft. bike lanes. The overall bridge dimensions would be 60-foot-wide by 170-foot-long three span structure. It is assumed that phased bridge construction would be required to allow the road to remain open during construction.

Buena Vista Lagoon Bridge

The Buena Vista Lagoon Bridge was previously designed to a 30% level in preparation of the Carlsbad Village Double Track Alternative Analysis Report in 2013. The recommended structure type for the Buena Vista Lagoon Bridge was a 7-span Cast-in-Place/Prestressed (CIP/PS) Concrete Box Girder structure. The bridge will consist of 45 ft. maximum span lengths for a total bridge length of 294 ft. The structure depth will be 6 ft. Abutments will be short seat abutments on shaft pile foundations. Bents will be multi-column, 5 ft. diameter circular columns. 7 ft. diameter CIDH piles were the preferred foundation alternative. The potential artesian groundwater condition present at the site will require the contractor to use slurry displacement methods with a weighted drilling fluid during CIDH pile construction.

Overpass Structure Cost Evaluation

The cost for the Buena Vista Lagoon Bridge was estimated in the Carlsbad Village Double Track Alternative Analysis Report in 2013. The cost of the other overpass structures have been estimated based on Comparative Bridge Costs published by Caltrans, January 2015 for PC/PS Girder alternative. The estimated costs for the long trench and short trench alternatives are summarized in Table 6.4.

Table 6.4: Cost Estimate for Overpass Structures, 2016 Costs

Bridge Name	sq ft	$/sq ft	Bridge Removal	Short Trench Total	Long Trench Total
Buena Vista Lagoon	9,899	285	$ 1,200,000	$ 4,020,000	$ 4,020,000
Carlsbad Blvd	10,200	250	$ 750,000	$ 3,300,000	$ 3,300,000
Beech Ave	744	200	$ 0	$ 149,000	$ 149,000
Grand Ave	4,620	225	$ 0	$ 1,040,000	$ 1,040,000
Carlsbad Village Drive	4,620	225	$ 0	$ 1,040,000	$ 1,040,000
Oak Avenue	2,750	200	$ 0	$ 550,000	$ 550,000
Chestnut Ave	2,750	200	$ 0	$ 156,000	$ 550,000
Tamarack Drive	3,300	225	$ 0	$ 0	$ 743,000
			SUBTOTAL	$10,256,000	$11,393,000
			10% Mobilization	$ 1,025,000	$ 1,139,000
			TOTAL	$11,281,000	$12,532,000

6.11 Constructability

Due to the ongoing operations through the LOSSAN corridor, project construction would require phasing to maintain operation of the tracks. Construction of the grade separation would require a temporary shoofly track and temporary station platform. The first phase of construction could include replacement of the Carlsbad Boulevard Overpass, construction of the new double track Buena Vista Lagoon Bridge, installation of a temporary No. 24 turnout on either end of the trench, and construction of a temporary shoofly track. The temporary station platform would be located within the existing station parking lot on the east side of the shoofly track. The second phase of construction could include construction of the trench, overpasses, two new tracks, COASTER station, and then removal of the shoofly track and temporary station.

As a consequence of the construction of the shoofly track and temporary station platform there will be a temporary loss of parking. Approximately half of the existing parking lot at the station would be taken out during construction. This could necessitate the construction of additional parking on a vacant lot just north of the existing parking lot. To construct the temporary shoofly track parking would be temporarily removed adjacent to the Carlsbad Santa Fe Depot between Grand Avenue and Carlsbad Village Drive, and between Carlsbad Village Drive and Oak Avenue.

In addition to keeping railroads operating during construction the on-street traffic must also be maintained. Construction on existing streets crossing the tracks should be planned to minimize disruptions. One possible solution includes the use of precast bridge elements to install bridges over one shorter duration road closure. Construction of the Oak Avenue Overpass first could provide relief during closures of Grand Avenue and Carlsbad Village Drive by maintaining two railroad crossings open at all times, which would be similar to the existing condition. The overpass at Carlsbad Boulevard could be replaced by constructing the bridge in phases, half at a time. This would allow the road to remain open during construction.

The construction of temporary at-grade crossings along the shoofly track would require California Public Utilities Commission (CPUC) GO 88-B authorization to modify an existing public crossing. A GO 88-B application would be required for the crossing at Carlsbad Boulevard, Grand Avenue, Carlsbad Village Drive, Tamarack Avenue, and the pedestrian crossing at the existing station. A Formal Application for a new public crossing would be required at Oak Avenue and at Chestnut Avenue, these would then require a GO 88-B authorization to modify them to grade separated at the end of construction.

The excavation of the trench would require removal of almost 400,000 cubic yards of earth for the Short Trench and over 600,000 cubic yards of earth for the Long Trench. It is anticipated that the removal would be trucked offsite to an approved disposal location by the contractor. The most direct path for trucks removing materials would be along Tamarack Avenue to I-5 or Carlsbad Village Drive to I-5. The export of materials would take roughly eight to twelve months to complete. Additional truck traffic is expected due to the delivery of materials and equipment; however, the volume would be small compared to during export of soil.

6.12 Operation and Maintenance

A benefit of trenching is that the operations and maintenance costs for the grade crossing warning devices and gate arms would be eliminated. The proposed trench alternatives would require maintenance of the retaining walls, overpass structures, elevators at the station, and storm drain pump stations. Estimated annual operation and maintenance costs related to the proposed trench alternatives are shown in the following table. A maintenance agreement to cover these costs would be required between the City and NCTD. The costs shown were based on available public information from various sources, the actual costs of maintenance may vary greatly depending on the agency, final design conditions, and the environment.

Table 6.5: Estimated Annual Operation and Maintenance Costs

Activity	Short Trench Annual Cost (2016$)	Long Trench Annual Cost (2016$)
Bridge Maintenance[1]	$ 6,000	$ 7,000
Retaining Wall/Trench Maintenance[2]	$ 8,000	$ 12,000
Elevator Operation & Maintenance[3]	$ 8,000	$ 8,000
Storm Drain Pump Station Operation & Maintenance[4]	$ 4,000	$ 8,000

Notes:

1 Annual bridge maintenance costs were calculated from Bridge Cost x 4% divided by the life of the bridge (100 years). A discount rate of 4% is currently used by Caltrans for Life Cycle Cost Analysis.

2 Retaining Walls, Trench Slab, and Waterproofing only. Costs were calculated with $0.50/sf divided by the design life of the wall (100 years), based on data from the City of Seattle Asset Management Status and Conditions Report, 2010.

3 Maintenance costs per the Standard Services agreement between KONE Elevator and MTS for Maintenance and Repair of three elevators from 2010 to 2014, reduced by 1/3 for two elevators. The ThyssenKrupp Elevator online energy calculator was used to calculate energy cost (thyssenkruppelevator.com/Tools/energy-calculator)

4 Annual cost per pump were taken from the City of Alameda Capital Improvements Projects Fiscal Years 2013-2014 Annual Maintenance Projects for Storm Drain Pump Station Maintenance, divided by ten pump stations in the City of Alameda.

7. ENVIRONMENTAL CONSTRAINTS

The following discusses the potential environmental impacts to select relevant issue areas associated with construction and operation of a Short or Long Trench Alternative for the Carlsbad Village Double Track Project. The information contained in this section is taken primarily from existing reports prepared for the Carlsbad Village Double Track Project.

7.1 Aesthetics and Scenic Resources

Short Trench or Long Trench Alternative

In comparison to the At-Grade Alternative the implementation of a Short Trench or Long Trench Alternative, the Carlsbad Village area would be improved from its existing visual quality and visual response once construction is completed. Carlsbad Village would maintain office, commercial, and residential development, and could be expanded to include parkland and community meeting spaces around or within the railroad right-of-way. The Proposed Action would modify the railroad infrastructure and alter the existing landform due to the elimination of at-grade crossings and construction of trench throughout the developed segment. It is anticipated construction of the project with either trench alternative would occur over a 40 - 48-month time frame, compared to an 18 – 30-month timeframe for an At-Grade alternative. Upon completion of construction, the rail and trains would not be as visible because they would be below the ground surface.

During construction, the existing setting along the railroad Right-of-Way (ROW) both within Carlsbad Village and in areas to the south, and at the Carlsbad Village Station would be highly disturbed. Construction activities would take place primarily within the railroad ROW with construction-related traffic impacting haul routes into and out of the City. Construction would involve numerous pieces of large, heavy equipment. Tandem dump trucks would be used to haul excavated materials from the site and cement trucks and flatbed trucks would be used to bring in cement and other construction materials. Assuming 18 cubic yards of excavated material per tandem dump truck, between 16,000 and 30,000 round trips would be required for the short trench and long trench alternatives, respectively, just to haul excavated material. Construction activities would last for between 10 and 18 months longer than would construction activities for the at grade project. During much of this time, the train would run on a relocated track (shoofly) along the existing ground surface, east of the existing track. Within the Carlsbad Village, construction activity would be much more pronounced due to the effort required to build a shoofly, excavate the trench, demo and reconstruct City streets, relocate utilities, construct the walls trench bottom, and demo the shoofly. Work on the shoofly would require demolition of the existing station building and a temporary station would be provided to the east.

7.2 Air Quality and Greenhouse Gas Emissions

Short Trench Alternative

Air Quality and Greenhouse Gas Emissions (GHG) during construction would substantially increase with the Short Trench Alternative compared to the At-Grade Alternative due to the increase in truck trips associated with the construction of the shoofly, excavation of the trench, demolition and reconstruction City streets, relocation of utilities, construction of the trench walls, trench bottom, and demolition of the shoofly. Operation of a double track within a trench would result in air quality and GHG offsets due to reduced vehicular idling at railroad at-grade crossings as the vehicular traffic and rail traffic would be separated and the grade crossing would be removed. The LOSSAN Program EIR/EIS recommends several best management practices (BMPs) to ensure that air quality and GHG impacts are minimized during project-level construction phases to the maximum extent practicable. Therefore, BMPs will be implemented during construction.

Long Trench Alternative

Air Quality and GHG impacts associated with the construction of the Long Trench Alternative would be proportionately greater than those associated with the Short Trench Alternative discussed above.

7.3 Biological Resources and Wetlands

Short Trench or Long Trench Alternative

Vegetation Communities

Similar to the At-Grade Alternative the construction of the either the Short Trench or Long Trench Alternative would primarily result in direct, permanent impacts to habitat immediately adjacent to the existing tracks, which is classified as either non-native vegetation, urban/developed, or disturbed habitat. The exception to this is within the immediate vicinity of the lagoon where creation of a second track (inclusive of removal of the existing bridge and construction of a new bridge and wider embankment) would result in permanent impacts to open water and coastal and valley freshwater marsh, predominantly located on the east side of the existing tracks. Note that work in the lagoon would remain the same with an At-Grade alternative or either trench alternative. In addition, construction of the second track south of the lagoon would permanently impact thin portions of disturbed Diegan coastal sage scrub and eucalyptus woodland. Impacts would require mitigation, similar to the At-Grade Project.

Federally Listed Species

Similar to the At-Grade Alternative, the trench alternatives would have the following impacts related to federally listed species.

Light-Footed Clapper Rail. Construction of either the Short Trench or Long Trench Alternative would likely result in the same level of take of the light-footed clapper rail as a result of permanent and temporary loss of habitat associated with the bridge replacement and berm widening, elevated noise levels during construction, and temporary night lighting during construction. The trench alternatives occur south of the Carlsbad Boulevard Overhead; and therefore, impacts to Buena Vista Lagoon and supported species are not expected.

San Diego and Riverside Fairy Shrimp. The federally listed endangered San Diego and Riverside fairy shrimp could potentially be present within low-lying areas, parallel to the railroad tracks. The Potential Area of Impact for either the Short Trench or Long Trench Alternative extends beyond the study area that was previously surveyed for San Diego and Riverside fairy shrimp for the CVDT project. Impacts to fairy shrimp are not expected as the disturbed ROW south of the Carlsbad Village Drive Study Area was previously impacted by the Carlsbad Double Track Project, and no fairy shrimp were reported during environmental clearance for that project. A biologist would be required to conduct surveys to determine if a direct or indirect impact to fairy shrimp would result with the implementation of the Short Trench or Long Trench Alternative.

Coastal California Gnatcatcher (CGN). There is a low potential for federally listed threatened coastal CGN to occupy the isolated patch of Diegan coastal sage scrub (DCSS) south of the lagoon. Based on the low potential for presence and distance to potentially suitable habitat from the project footprint (approximately 68 ft.), elevated noise levels from construction would not be expected to adversely affect CGN individuals by disrupting normal behavioral patterns including, but not limited to breeding, feeding, or sheltering. The trench alternatives occur south of the Carlsbad Boulevard Overhead; and therefore, impacts to any CGN in the isolated DCSS habitat area would not occur.

California Least Tern. The California least tern is an opportunistic forager and was observed foraging over/within the lagoon during the biological surveys. Although there are no potential nesting sites within the Biological Study Area (BSA) and no active nesting in the lagoon, indirect impacts could occur to this species from alteration of foraging habitat as a result of elevated turbidity during construction. In addition, there would be a permanent reduction in available open water surface within which foraging may occur as a result of the addition of the second track. However, the permanent loss of open water foraging habitat would be considered minimal, with only an approximate total loss of 0.07 acres (0.05% of the lagoon). As a result, it is expected that the California least tern would utilize other portions

of Buena Vista Lagoon if local foraging habitat losses would occur. If present during construction, the temporary construction activities are expected to reduce local foraging area. While the permanent footprint of the project constitutes a negligible portion of the total open water in the lagoon, inadequate control of turbidity during construction could result in an adverse impact to temporarily affected foraging areas. However, these impacts may be reduced by controlling turbidity generation to a small footprint area around the construction zone during the summer least tern breeding season. In addition, consultation between the FRA and the USFWS under Section 7 of the federal ESA would be required, which would identify mitigation measures to reduce impacts to federally listed species. Section 7 consultation has not yet occurred. The trench alternatives occur south of the Carlsbad Boulevard Overhead; and therefore, impacts to Buena Vista Lagoon and supported species are not expected.

Jurisdictional Waters of the U.S. and Coastal Wetlands.

Similar to the At-Grade Alternative, both trench alternatives will result in impacts to waters of the US and coastal wetlands associated with the bridge and embankment work in the lagoon. The trenches themselves may impact track ditches that are determined to jurisdiction by the Army Corps of Engineers and/or California Coastal Commission. Such impacts would require avoidance, minimization, and mitigation of impacts in accordance with the following permits by regulatory federal agencies:

1) USACE, CWA Section 404 permit for placement of dredged or fill material within waters of the US;

2) RWQCB, CWA Section 401 state water quality certification/waiver for an action that may result in degradation of waters of the US; and

3) CCC, Coastal Zone Management Act Consistency Determination.

Wildlife Movement/Corridors and Nursery Sites

Due to the already limited corridors for wildlife within the project site and the presence of the existing railroad corridor, the Short Trench or Long Trench Alternative are not expected to result in adverse changes to present wildlife movement patterns or intensity.

The project footprint does not include any identified nursery sites. The project would result in direct permanent and temporary impacts to habitat of marsh nesting birds. There are no anticipated adverse impacts to nursery sites as a result of implementation of either the Short Trench or Long Trench Alternative.

Migratory Bird Treaty Act (MBTA)

Avian species could potentially nest in the onsite habitats; therefore, the Short Trench or Long Trench Alternative could result in adverse impacts to active bird and/or raptor nests (if present at time of construction) under the federal MBTA.

7.4 Community Impacts and Environmental Justice

Short Trench or Long Trench Alternative

Substantial community disruption would be expected during construction. Construction of the Short Trench Alternative would occur entirely within NCTD Right-of-Way, while the Long Trench Alternative would require acquisition of three single family residential properties. Community movement opportunities and coastal access would be substantially impacted during construction by construction-related traffic as well as by temporary street and sidewalk closures. The Short Trench or Long Trench Alternative would therefore periodically isolate a neighborhood during construction. It could also periodically separate residences from community facilities near the project area during construction.

The Short Trench or Long Trench Alternative would not isolate any portion of a neighborhood or ethnic group, nor would it separate residences from community facilities near the project area once construction is complete. Likewise, the Short Trench or Long Trench Alternative would not result in any adverse community impacts or disproportionate impacts on minority or low-income populations located within the project area once construction is complete. By replacing at-grade crossings with grade separated crossings, either trench alternative would ultimately enhance community movement opportunities throughout the vicinity of the project. This is in contrast to the At-Grade Alternative which would maintain the division of the community by the approximately 100-year-old railroad ROW. Traffic delays due to grade crossing gate arms would be eliminated by the grade separation of the existing crossings. Additionally, the new vehicular crossings at Oak Avenue in the Short Trench Alternative or Oak Avenue and Chestnut Avenue in the Long Trench Alternative would provide enhanced traffic circulation in the area.

Pedestrian movement across the railroad Right-of-Way would be restricted by the trench, but crossing safety would be improved by the addition of grade separated crossings.

7.5 Cultural and Historical Resources

Short Trench or Long Trench Alternatives

The Short Trench and Long Trench Alternatives include plans to relocate the Carlsbad Santa Fe Depot from its current location. The Carlsbad Santa Fe Depot has been listed in the National Register of Historic Places (NRHP) since 1993. Direct effects to the Carlsbad Santa Fe Depot were not assessed in ASM's 2013 Cultural and Historical Resource Evaluation Report for the CVDT project, as relocating the Carlsbad Depot was not proposed at that time. Moving this structure to a new location would be considered an adverse effect on a historic property.

A formal assessment of effects for the Short Trench or Long Trench Alternative, including preparation of mitigation recommendations will be required should either alternative move forward to environmental clearance. If the relocation of the Carlsbad Depot is determined to be an adverse effect under Section 106 of the NHPA, the State Historic Preservation Officer (SHPO) will require the preparation of a Historic Property Treatment Plan (HPTP) that will detail mitigation measures designed to protect and preserve the structure.

The HPTP will identify the character defining features of the building and assess their current condition. Recommendations will be made pertaining to the best practices to employ in moving the building that will ensure preservation of those features, as well as approaches to minimally impact the historic fabric of the building. Recommendations will also be made pertaining to the siting, foundation construction, building reassembly, and restoration work after the move has taken place. The HPTP will be in compliance with guidance provided in the National Park Service Technical Report, *Moving Historic Buildings* (Curtis 1975).

Mitigation measures appropriate to relocation of a historic building include documentation of the building prior to the relocation in the form of a Historic American Building Survey (HABS) and monitoring of the relocation by a qualified Historic Architect. Rehabilitation of the building following the relocation, if required, should be in accordance with the Secretary of the Interior's *Standards for the Treatment of Historic Properties* and the National Parks Service Preservation Briefs, Bulletins, and Technical Reports.

In addition, due to the depth of excavation that would be required for either trench alternative, there is a greater chance of impacting buried archaeological resources. Therefore, SHPO may require archaeological monitoring during construction.

7.6 Geology and Soils

Short Trench or Long Trench Alternative

Either trench alternative has the potential to result in impacts associated with groundwater, strong seismic shaking, liquefaction, seismically induced settlement, and corrosive soils. In particular, the trenches would be built at a bottom elevation that is below the groundwater table. However, with the implementation of mitigation measures during final design and construction, impacts would be reduced to a negligible level.

7.7 Hazardous Materials and Hazardous Waste

Short Trench or Long Trench Alternative

Similar to the At-Grade Project, due to the intrusive nature of the construction involved for the project, it is recommended that preliminary media sampling (surface and near surface soils in particular) be conducted prior to commencing any intrusive work at the site to confirm whether contaminants are or are not present at the subject property. The subject property's historic use as an active railroad since the 1880's may provide for the presence of creosote, heavy metals (such as arsenic), petroleum based compounds, and other non-metal herbicide compounds. If these contaminants are present, they may pose a risk to human health (site workers and the public within the vicinity of the subject property) from the inhalation of dust or direct contact with skin or eyes. Furthermore, the contaminants may pose a risk to natural habitat or sensitive species in the open area around the lagoon, and may threaten the water quality of the lagoon. As such, potential impacts to human and/or environmental health resulting from exposure to contaminants potentially present on the project site would be considered adverse. However, preliminary media sampling would identify the location, if any, of potential contaminants on the project site and measures to reduce their exposure would be developed at that time.

In addition, an ACM and lead-based paint survey of the Carlsbad Santa Fe Depot is recommended if the building would be disturbed during construction or modified as part of the Short Trench or Long Trench Alternatives.

7.8 Hydrology and Floodplains

Short Trench or Long Trench Alternative

Typical construction related impacts to hydrology and floodplains may include flooding, soil erosion, stormwater runoff, and sedimentation. However, implementation of a Storm Water Pollution Prevention Plan (SWPPP) including the proper use of construction BMPs would reduce construction related hydrology and floodplain impacts to a negligible level. Both the Short Trench and Long Trench Alternative require construction of substantial new areas of impermeable surfaces in the trench bottom. Because the horizontal alignment of the trench bottom necessary to allow for overheads to be constructed at grade, gravity drainage of storm water from the bottom of the trench is not possible. With the Long Trench Option two pump stations will be required to dewater the trench bottom during rain events and one pump station would be required with the Short Trench Option. Long term storm water Best Management Practices will be required for compliance with NCTD's non-traditional small MS4 permit under Order No. 2013-0001-DWQ.

7.9 Land Use, Zoning, and Property Acquisitions

Short Trench or Long Trench Alternative

Construction of the Short Trench Alternative would occur entirely within the NCTD ROW, and no temporary property acquisition would be required. Construction of the Long Trench Alternative would not occur entirely within the NCTD ROW, and property acquisition would be required. Temporary construction access would be provided through existing NCTD maintenance access roads. Implementation of either of the trench alternatives would not result in a significant impact that could not be reduced to a level less than significant with the implementation of mitigation. As such, either trench alternative would support the corresponding elements of the General Plans (i.e. Noise Element, Public Safety Element) for Carlsbad and Oceanside, and there would be no construction-related impacts to existing land uses, zoning, or properties.

7.10 Noise and Vibration

Short Trench or Long Trench Alternative

Construction Related Noise

Temporary noise during excavation of a trench and construction of the new tracks and the stations has the potential of being intrusive to residents and businesses near the construction sites. Most of the construction would consist of trenching and earthwork removal, site preparation, concrete work, and laying new track. Therefore, initially during trenching and earth removing operations, construction noise levels would be higher and would occur for a longer period of time. However, as the trench gets deeper the noise from construction equipment would be shielded from the surrounding community reducing noise that would otherwise occur from construction activities associated with an At-Grade Project.

Due to the increase in truck trips that would be associated with trench construction, it is recommended that additional analysis be completed, should either of the trench alternatives be selected to move forward, to determine if a trench alternative would result in a temporary construction noise impact along likely haul routes to and from the site. In addition, potential vibration impacts to the Carlsbad Santa Fe Depot would need to be evaluated.

Similar to the At-Grade Project, construction activities would be carried out in compliance with all applicable local noise regulations. In addition, specific residential property line noise limits would be developed during final design and included in the construction specifications for the Proposed Action, and noise monitoring would be performed during construction to verify compliance with the limits. Furthermore, the noise control measures identified below would be implemented as needed to meet the noise limit standards.

Operational Noise

Based on FRA criteria moderate noise impacts from train operations were identified at certain residential locations for the At-Grade Project in the year 2030. According to ATS Consulting, an acoustical consulting firm specializing in rail and highway, when compared to an At-Grade Alternative a trench alternative would substantially reduce train noise to the community.

Included in the economic analysis (See Attachment H), is noise analysis by dBF, a noise and vibration consultant. dBF found that construction of a trench alternative would reduce noise levels by up to 12 dBA Leq. For reference, train horn systems required by 49 CFR Part 222 to be blown as trains approach at-grade crossings must provide a minimum sound level of 92 dBA and a maximum of 110 dBA when measured 100 ft. from the centerline of the nearest track.

7.11 Parks and Recreational Areas

Short Trench or Long Trench Alternative

While there would be no direct impacts to other nearby parks by physical encroachment onto the property, the two other nearest parks and athletic fields may be impacted by construction noise and vibration. These include Lions Club Park in Oceanside, and the Army and Navy Academy's athletic fields in Carlsbad. Located at the northern end of the project site, Lions Club Park is within 100 ft. of the permanent and temporary impact areas, and directly across Cassidy Street from the entrance to the temporary access road that would provide ingress/egress for construction vehicles. The Army and Navy Academy's athletic fields are located immediately south of and directly adjacent to the ROW and the permanent impact area. Both parks are close enough to the project site to be potentially impacted by construction noise and vibration as a consequence of implementation of the either trench alternative. However, as further discussed above in Section 1.10, Noise and Vibration, construction activities for the trench alternatives would need to be analyzed to determine compliance with all applicable local noise regulations. Noise and vibration control measures would be required to be implemented, as necessary, to reduce construction-generated noise and vibration impacts to a negligible level.

7.12 Public Health and Safety

Short Trench or Long Trench Alternative

Trench alternatives would allow for the removal of existing railroad related traffic control at intersections. This would reduce wait times at the at-grade railroad crossings when trains are passing through the project area. Separating pedestrians and vehicles from train operations through the project area would substantially reduce the potential for accidents involving pedestrians/vehicles and trains, enhancing public safety.

Traffic control personnel would ensure that protection of vehicles and pedestrians at the railroad crossings would be maintained during work on any safety feature such as crossing gates and signals. Therefore, there would be no construction related impacts to public health or safety as a result of the implementation of the either the Short Trench or Long Trench Alternative.

7.13 Relocation Impacts

Short Trench or Long Trench Alternative

For both the Short and Long Trench Alternatives, the historic Carlsbad Santa Fe Depot would have to be relocated. For the Long Trench Alternative, a few properties south of Tamarack with single family homes would have to be acquired. Relocation of the Depot would be conducted in accordance with a Treatment Plan to be negotiated with the SHPO. The single family residences would receive fair market value and relocation benefits in accordance with federal law.

7.14 Water Quality and Water Resources

Short Trench or Long Trench Alternative

Similar to the At-Grade Alternative, the construction activities associated with the trench alternatives may have the potential to generate runoff that would discharge pollutants into Buena Vista Lagoon and/or Agua Hedionda Lagoon, which are both listed as Section 303(d) impaired water bodies. Construction discharges could result in a water quality impact. However, with the implementation of a SWPPP and construction BMPs, impacts to water quality would be reduced to a negligible level.

Both the Short Trench and Long Trench Alternative require construction of new areas of impermeable surfaces in the trench bottom. Long term storm water Best Management Practices will be required for compliance with NCTD's non-traditional small MS4 permit under Order No. 2013-0001-DWQ.

7.15 Section 4(f) Evaluation

Short Trench or Long Trench

Park and Recreation Areas. Similar to At-Grade Project, a total of 42 acres of parkland within one-half mile of the Project area would qualify for protection as parkland under Section 4(f), however, the parkland is located outside of the either trench alternative's permanent and temporary impact area. There would be no direct impacts to other nearby parks by physical encroachment onto the property. Two other parks may be indirectly impacted by construction noise and vibration. These include Lions Club Park in Oceanside, and the Army and Navy Academy's athletic fields in Carlsbad. However, Lions Club Park is within NCTD's ROW and so is it not a 4(f) resource, and the Army and Navy Academy's athletic fields in Carlsbad is privately-owned and so it is not a 4(f) resource.

Wildlife and Waterfowl Refuges. Similar to the At-Grade Alternative, a total of 100 acres of the Buena Vista Lagoon Ecological Reserve (and adjacent City of Carlsbad open space land) is within one-half mile of the Short Trench or Long Trench Alternative and would therefore qualify for protection under Section 4(f). However, because either trench alternative's permanent and temporary impact area do not encroach on this land, there would be no direct impacts. Construction of the new double-track bridge over Buena Vista Lagoon would be limited to within the NCTD ROW.

Historic and Cultural Resources. As discussed above under Cultural and Historical Resources, a Short Trench or Long Trench Alternative would require the relocation of the Carlsbad Santa Fe Depot. Relocating this structure to a new location would be considered an adverse effect on a historic property, which is also a 4(f) resource.

A formal assessment of effects for the Carlsbad Village Double Track Long and Short Trench alternatives will need to be completed, including preparation of mitigation recommendations. If the relocation of the Carlsbad Depot is determined to be an adverse effect under Section 106 of the NHPA, the State Historic Preservation Officer (SHPO) will require the preparation of a Historic Property Treatment Plan (HPTP) that will detail mitigation measures designed to protect and preserve the structure. The implementation of the mitigation measures developed as part of the HPTP and approved by SHPO would likely reduce Section 4f impacts to below a level of significance.

7.16 Paleontological Resources

Short Trench or Long Trench Alternative

Similar to the At-Grade Project, due to the moderate paleontological sensitivity of the old paralic deposits underlying the site, excavation associated with construction of either the Short Trench or Long Trench Alternative would have the potential to uncover significant paleontological resources. Implementation of paleontological monitoring during construction would ensure that any potential impacts to paleontological resources potentially located within old paralic deposits would be reduced to a negligible level.

8. PROJECT SCHEDULE

Project Milestone	Milestone Target Date
Begin Environmental	12/2017
Circulate Draft Environmental Document	6/2019
PA & ED	5/2020
Begin PS&E	8/2020
Ready to List	8/2022
Award	3/2023
Construction Complete	7/2027

9. PROJECT FUNDING

To date, capital improvement projects along the San Diego section of the LOSSAN rail corridor have been funded through a number of public sources at the federal, state, and local levels. As shown in Section 10 below, costs for either trench alternative are significant and funds would be difficult to secure from any one source, especially in the current financial climate at the federal and state levels in particular. The region's *TransNet* transportation sales tax program funds set aside for the LOSSAN corridor have been programmed for other improvement projects. Given these factors, the City of Carlsbad may wish to fund a portion of the design and/or construction with local resources.

The Carlsbad Village Double Track project, for example, has been funded through a combination of Federal Railroad Administration (FRA) and local *TransNet* funds for the preliminary engineering and environmental documentation stages only ($5.7 million).

10. PROJECT COST

The estimated construction costs were established based on preliminary design data and cost data from Caltrans, recent projects, drilling sub-contractors, field experts and engineers. The project costs shown are inclusive of all of the overpasses listed in this report. A contingency totaling 30% of the construction cost is added to each estimate to account for the preliminary nature of the design included with this report. Costs are escalated from 2016 dollars to 2023 dollars based on the *TransNet* Early Action Program Escalation Rates (transnettrip.com/TrendsRisksIssues/Escalation.aspx).

At this preliminary level of analysis, costs are shown as ranges. However, Attachments A, F, and G use a cost in the middle of each range for planning and analysis purposes.

Short Trench

The total estimated project cost of the Short Trench Alternative, which includes a 30% contingency, ranges between $215 million and $235 million in 2016 dollars, with a construction cost between $145 million and $165 million. The escalated project cost ranges between $260 million and $285 million in 2023, the planned year of expenditure.

Long Trench

The total estimate project cost of the Long Trench Alternative, which includes a 30% contingency, ranges between $320 million and $350 million in 2016 dollars, with a construction cost between $215 million and $235 million. The escalated project cost ranges between $385 million and $425 million in 2023, the planned year of expenditure.

Potential Cost Savings with Change in Vertical Clearance Required

NCTD has indicated that the minimum vertical clearance may be changed to 24 ft. with concurrence from BNSF Railway. The estimated change in costs due to the lower vertical clearance are shown in Table 10.1 below.

Table 10.1: Costs for 24-ft. and 26-ft. Vertical Clearance

	Long Trench		Short Trench	
	26-ft. Vertical Clearance	**24-ft. Vertical Clearance**	**26-ft. Vertical Clearance**	**24-ft. Vertical Clearance**
Construction Cost (2016$)	$215m-$235m	$201m-$221m	$145m-$165m	$137m-$157m
Construction Cost Change	N/A	$14m	N/A	$8m
Project Cost (2016$)	$320m-$350m	$299m-$329m	$215m-$235m	$204m-$224m
Project Cost Change	N/A	$21m	N/A	$11m

Cost Comparison with Other Railroad Trench Projects

Table 10.2 below shows comparison of the estimated construction cost for the proposed CVDT trench project with two other trench structures completed recently for grade separated rail corridors, the San Gabriel Trench Grade Separation Project, San Gabriel, California and the Reno Transportation Rail Access Corridor (ReTRAC) project, Reno, Nevada. Each of these railroad trench projects had similar conditions to the proposed Carlsbad Village Railroad Trench; including construction below groundwater in urban areas and installation of a temporary shoofly track during construction. The San Gabriel Trench was awarded in 2012 and is expected to complete construction in 2017. The Reno ReTRAC project was constructed from 2002 to 2006.

A railroad trench was constructed in Solana Beach, Ca in the late 1990s. This trench is about 6,000-foot-long and lowered the Solana Beach COASTER Station and grade separated Lomas Santa Fe Drive. The construction cost of the Solana Beach trench was $17.7 million in 1998. This translates to a cost of around $43.3 million in 2016 dollars, or $7,214 per foot (2016). Although this trench is the only other railroad trench that has been constructed on the LOSSAN corridor, it is not considered comparable to the proposed trench in Carlsbad because this project was not constructed below the groundwater table which allowed for cheaper construction techniques. Mainly, it was constructed with steep cut slopes rather than walls for the majority of its length, which is not considered a viable option for the Carlsbad Village Trench.

Table 10.2: Comparison of CVDT Proposed Cost with Recently Completed Similar Trench Structures in 2016

Project	Total Construction Cost ($ millions)	Max. Trench Height (ft)[4]	Trench Width (ft)	Trench Length (ft)	Adjusted 2016 Cost / LF of Trench[3]
Reno Transportation Rail Access Corridor[1]	$171 (2002)	33	54	10560	$39,803
San Gabriel Trench Grade Separation[2]	$173 (2012)	30	51	7920	$33,681
CVDT Long Trench (With 30% Contingency)	$226 (2016)	32	55	8100	$27,852
CVDT Short Trench (With 30% Contingency)	$155 (2016)	32	55	5700	$27,263

Notes:

1 ReTRAC trench cost is based on "Digging It", Cover Story, AGC of America, May/June 2005

2 San Gabriel trench cost is based on "California construction authority receives six bids for San Gabriel trench", Rail News, Progressive Railroading, 6/26/2012

3 Cost adjustments are based on Quarterly Highway Construction Cost Index published by the California Department of Transportation from the 2nd Quarter of 2016, see Table 10.3 below.

4 Above top of rail

Table 10.3: Comparison of CVDT Proposed Cost with Recently Completed Similar Trench Structures in 2016

Project	Project Year	Cost Index, Project Year[1]	Cost Index, 2nd Quarter of 2016	Unadjusted Cost/LF	Adjusted 2016 Cost/LF
Reno Transportation Rail Access Corridor	2002	53.1	130.75	$16,165	$39,803
San Gabriel Trench Grade Separation	2012	84.6	130.75	$21,793	$33,681
CVDT At-Grade Alternative	2016	106.2	130.75	$5,106	$5,106

Note:

[1] See Quarterly Highway Construction Cost Index published by the California Department of Transportation from the 2nd Quarter of 2016, Price Index for Selected Highway Construction Items 2007=100, Fisher Formula **http://www.dot.ca.gov/hq/esc/oe/cost_index/historical_reports/CCI_2QTR_2016.pdf**

Cost Comparison with At-Grade Double Tracking

The At-Grade Alternative is estimated to have a total construction cost of $42 million and a total project cost of $62 million (in 2016 dollars) based on the previously completed 30% design. The northern limit of the At-Grade Alternative would be the same as that of the trench alternatives, however the southern limit for the At-Grade Alternative would be just north of Chestnut Avenue. The total length of the two trench alternatives would be longer due to the length required to bring the track profiles back to grade and to extend the trench through the Tamarack crossing. The cost per foot for the At-Grade Alternative would be approximately $5,000 per foot. In Table 10.4 below the costs of each trench alternative is compared with the at-grade double tracking alternative based on cost per linear foot (LF) of project. This includes the length of the project outside of the trench since this is the only way to compare the at-grade project with the trench alternatives.

Table 10.4: Comparison of CVDT Trench Construction Cost Estimates with At-Grade Double Tracking in 2016

Project	2016 Total Construction Cost ($ millions)	Project Length (LF)	2016 Cost/LF of Project
CVDT Long Trench (With 30% Contingency)	$226	13,458	$16,763
CVDT Short Trench (With 30% Contingency)	$155	11,116	$13,979
CVDT At-Grade Alternative (With 30% Contingency)[1]	$42	8,226	$5,106

Note:

[1] The CVDT At-Grade Alternative cost is based on the 30% Engineer's Estimate of Probable Cost included in the Alternatives Analysis Report from 2014, by T.Y. Lin International

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12. PROJECT PERSONNEL

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ATTACHMENT A:

ECONOMIC STUDY: LOSSAN CORRIDOR IMPROVEMENT OPTIONS-CARLSBAD AREA

Prepared for:

SANDAG

City of Carlsbad California

ECONOMIC STUDY

1/17/2017

Economic Study Assessing LOSSAN Corridor Improvement Options – City of Carlsbad

Prepared by RSG, Inc.,
Kimley-Horn and Associates, Inc., and
dBF Associates

Table of Contents

Economic Study

Economic Study Assessing LOSSAN Corridor Improvement Options – City of Carlsbad

EXECUTIVE SUMMARY

Three different alternatives have been proposed in connection with the double tracking of the Los Angeles-San Diego-San Luis Obispo ("LOSSAN") rail corridor through the City of Carlsbad ("City" or "Carlsbad"), primarily through downtown Carlsbad (commonly called "Carlsbad Village"). This Economic Study ("Study") has been prepared to project the economic and fiscal impacts throughout San Diego County ("County") of the following three alternatives:

1. Double tracking entirely at-grade ("At-grade")
2. Double tracking with a railroad trench from the Carlsbad Boulevard/Highway 101 overpass to north of Tamarack Avenue ("Short Trench")
3. Double tracking with a railroad trench from the Carlsbad Boulevard/Highway 101 overpass to north of the Agua Hedionda Lagoon railroad bridge ("Long Trench")

This Study has been prepared for inclusion in the *Carlsbad Village Double Track - Railroad Trench Alternative Feasibility Study* ("Feasibility Study") for the San Diego Association of Governments ("SANDAG") and Carlsbad, prepared by T.Y. Lin International. The Feasibility Study analyzes the technical feasibility, design considerations, environmental constraints, schedule, and cost of the three alternatives.

An important distinction must be made between fiscal and economic impacts. Fiscal impacts, such as property and sales taxes, represent a direct revenue benefit to local public agencies. Per industry standards, this Study focuses on fiscal impacts expected to result directly from the three alternatives. Additional fiscal impacts can be expected to accrue to public agencies indirectly. Economic impacts—such as the values of lives and time saved, as well as economic output—are distributed more broadly and may not be reflected directly in public agencies' finances. This Study considers both categories of impacts, specifically the following:

- The value of lives saved and injuries avoided
- The value of time saved by motorists and pedestrians
- Property values
- Property taxes
- Retail and restaurant sales
- Sales taxes
- Construction impacts
- Transient occupancy taxes
- Vacancy and lease rates
- Job creation
- Emergency response delays
- Displacement

Where possible, the projected values have been calculated as a range with "Low," "Middle," and/or "High" points due to the uncertainty associated with projecting economic and fiscal impacts. It is important to note that

the actual impacts of the three rail improvement alternatives will depend on, and occur within the context of, many factors and trends. This Study focuses on the impacts expected to occur solely due to the three alternatives.

Figure A below summarizes the results of this analysis and provides a side-by-side comparison of these impacts under each alternative during a 99-year period. Figures B and C portray these results graphically.

Economic Study - LOSSAN Corridor Carlsbad Improvement Options

Summary of Economic and Fiscal Impacts - 3 Scenarios

Figure A

*All Numbers Expressed in 2016 **Million** Dollars*

	At-grade			Short Trench			Long Trench		
	Low	Middle	High	Low	Middle	High	Low	Middle	High
Construction Cost									
Total Cost	**$62.0**			**$224.1**			**$335.1**		
Value of Lives Saved and Injuries Avoided									
Total Value	**($228.9)**	**($406.9)**	**($567.9)**	**$363.2**	**$645.6**	**$901.2**	**$484.7**	**$861.6**	**$1,202.7**
Economic Impacts									
Value of Time Saved	($7.2)			$10.9			$12.7		
Secondary Economic Output of Construction	$35.4			$139.2			$208.1		
Property Value	($171.6)			$3,432.0			$3,432.0		
Retail and Restaurant Sales	$0.0			$1,922.1	$6,890.2	$15,785.5	$1,958.4	$7,642.8	$17,003.2
Total Economic Impacts	**($143.4)**			**$5,504.2**	**$10,472.3**	**$19,367.6**	**$5,611.2**	**$11,295.6**	**$20,656.0**
Fiscal Impacts									
Additional Sales Tax	$0.0			$19.2	$68.9	$157.9	$19.6	$76.4	$170.0
Property Tax due to Reduced Noise, Traffic Congestion	($1.7)			$34.3			$34.3		
Property Tax due to Reduced Noise	($1.7)			$1.6	$2.0	$2.3	$2.9	$3.3	$3.7
Property Tax due to Improved Beach Access	$0.0			$2.6			$2.6		
Transient Occupancy Tax	$0.0			$0.0			$0.0		
Total Fiscal Impacts	**($1.7)**			**$56.1**	**$105.8**	**$194.8**	**$56.5**	**$113.4**	**$207.0**

The **At-grade alternative** has the lowest **construction cost** of the three alternatives at **$62.0 million**. The results of the data analysis indicate negative **value of lives saved** and negative **economic and fiscal impacts** (estimated as ranging **from -$228.9 million to -$567.9 million, at -$143.4 million, and at -$1.7 million, respectively**), primarily due to loss of life and time, as well as changes in property values. Trespasser incidents resulting in motorist and pedestrian death could potentially be reduced with crossing improvements and fencing of the railroad corridor made in the At-grade alternative. The current construction cost estimate for the At-grade alternative includes new quadrant gates and crossing modifications. However, there is a lack of data showing the statistical effect these improvements have in preventing incidents. Furthermore, the At-grade alternative includes a pedestrian underpass at Beech Avenue, which would likely help to reduce trespasser incidents and boost property values by improving beach access. As with crossing modifications, there is a lack of data showing the exact statistical effect of the underpass. The primary cause of the At-grade's negative economic and fiscal impacts is the expectation of an increase in lives lost as train traffic and the opportunity for accidents increases (see Figure D). Other causes include a decline in property values due to higher noise and traffic congestion levels, and greater delays due to traffic congestion.

The **Short Trench** has a significantly higher **construction cost of $224.1 million**, but has estimated fiscal and economic benefits in the billions of dollars, the most prominent of which are the expected additional retail sales, higher property values, and the value of lives saved. Other significant benefits include the economic output resulting from construction, additional sales tax revenues, and greater property tax revenues. In total, the **value**

of lives saved plus economic benefits of the Short Trench are estimated **between $5.87 billion and $20.27 billion,** while **fiscal impacts** are estimated **from $56.1 million to $194.8 million.**

The **Long Trench** has the highest **construction cost,** estimated at **$335.1 million,** as well as the highest fiscal and economic benefits. Overall, the **value of lives saved plus economic benefits range from $6.10 billion to $21.86 billion. Fiscal benefits** are estimated **between $56.5 million and $207.0 million.**

It should be noted that after the analysis for the Study was completed, the required vertical clearance for the project was changed from 26 feet to 24 feet. Since the analysis was already complete, it was not changed. However, RSG notes that a lower required vertical clearance would allow for lower construction costs in the Short Trench and Long Trench alternatives, which would correspond to a reduced construction duration as well as lower economic impacts of construction. As described in the Feasibility Study, the reduction equals 5-6% of the construction cost estimates identified in this Study.

Figure B – Total Projected Economic Impacts

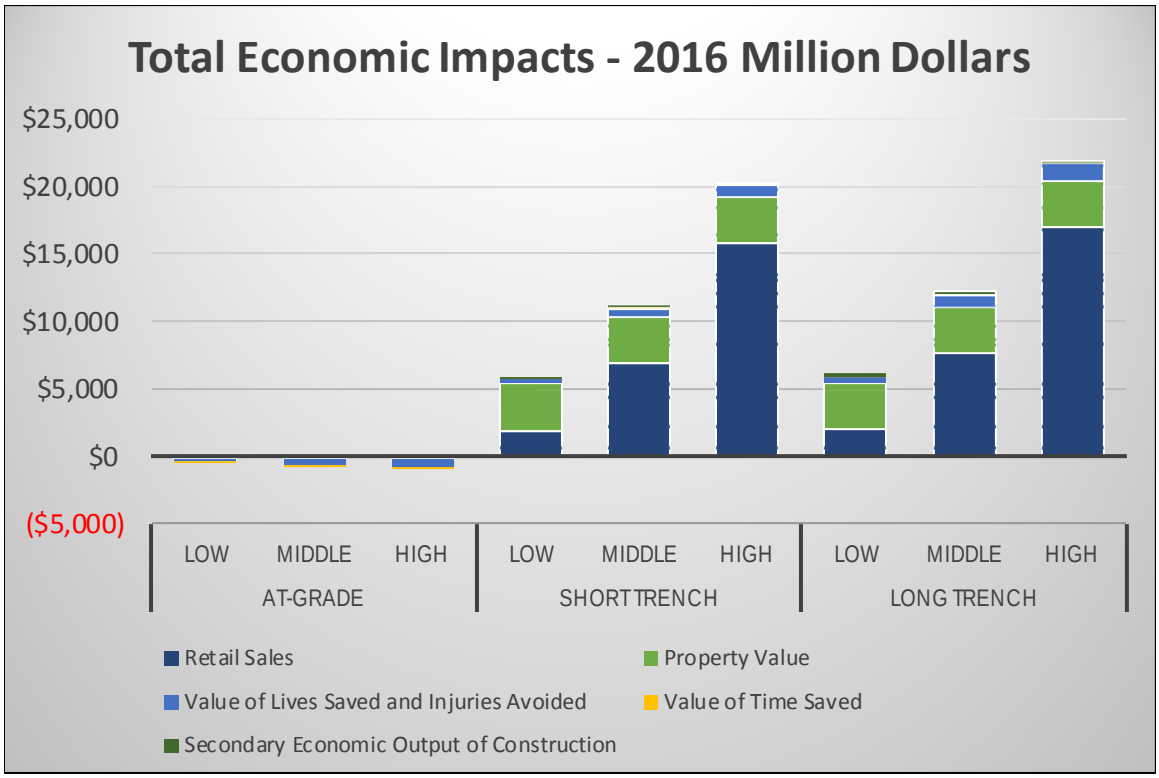


Figure C – Total Projected Fiscal Impacts

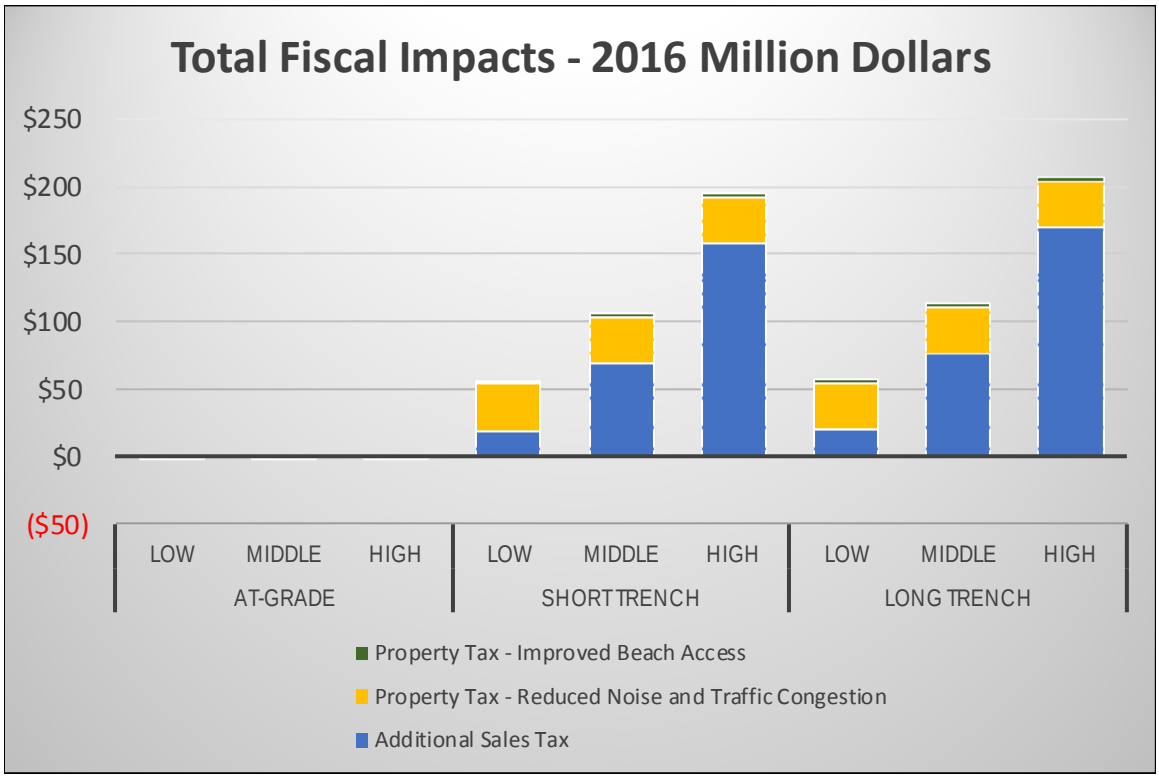
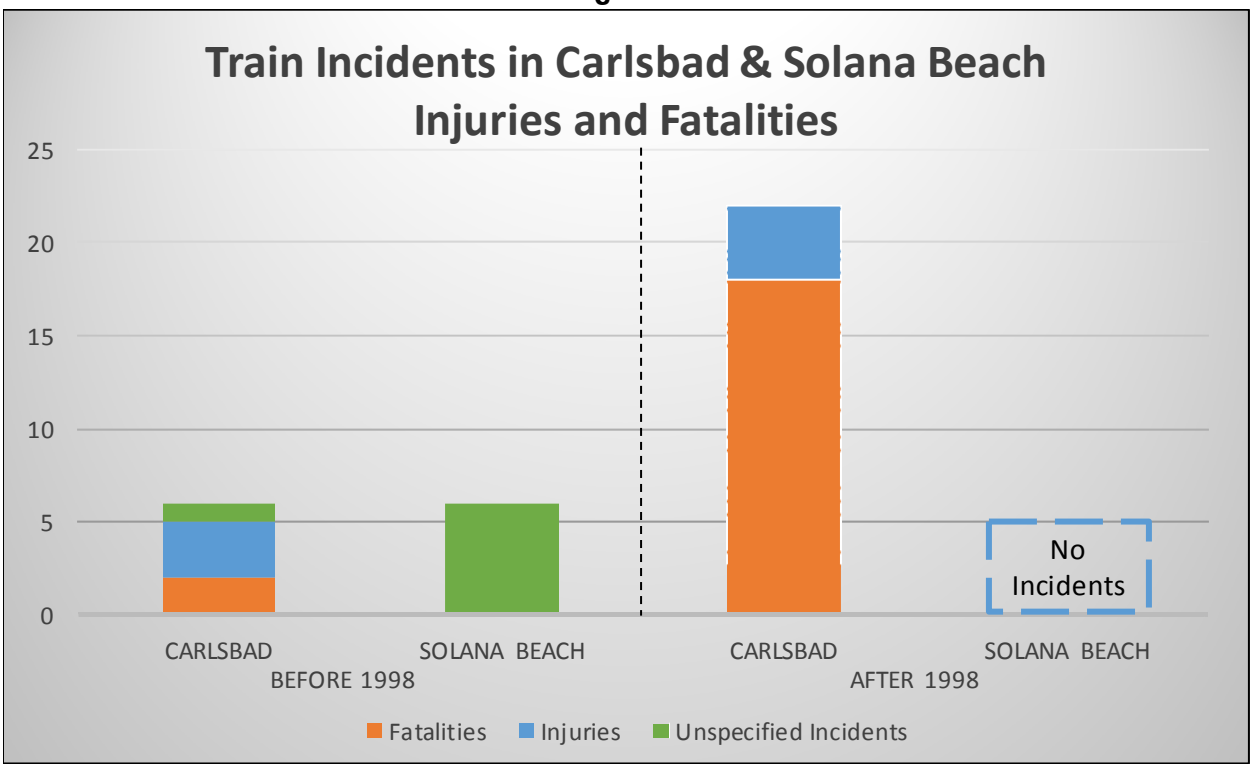


Figure D



INTRODUCTION AND BACKGROUND

Three different alternatives have been proposed in connection with the double tracking of the LOSSAN rail corridor through the City of Carlsbad, primarily through the Carlsbad Village area. This Carlsbad Village Double Track project would construct a second railroad track from Cassidy Street in Oceanside south to Tamarack Avenue in Carlsbad. The introduction of a second line will increase regional rail mobility by reducing bottlenecks that frequently occur in the corridor. Placing the rail line in a grade-separated trench to reduce noise and traffic congestion and improve safety conditions is an alternative being considered as part of these improvements. Because the costs of trenching a rail line are significant, comparing the costs and benefits of each alternative is important in determining which alternative is most feasible and provides the greatest net benefit.

This Study estimates the economic and fiscal benefits, as well as costs, of three alternatives for the Carlsbad Village Double Track project. This Study will be included in the *Carlsbad Village Double Track - Railroad Trench Alternative Feasibility Study* for SANDAG and Carlsbad, prepared by T.Y. Lin International.

ALTERNATIVES

The three alternatives of the Carlsbad Village Double Track project are as follows:

1. **At-grade** double tracking from the Buena Vista Lagoon railroad bridge south to connect to existing double track just south of Carlsbad Village Drive. Includes a new pedestrian underpass at Beech Avenue.
2. **Short Trench** double tracking would construct a trench to lower the railroad level beginning at the Carlsbad Boulevard/Highway 101 overpass south to end north of Tamarack Avenue. Includes a new complete (i.e., vehicular and pedestrian) overpass at Oak Avenue and a pedestrian overpass at Chestnut Avenue.
3. **Long Trench** double tracking would construct a trench to lower the railroad level beginning at the Carlsbad Boulevard/Highway 101 overpass south to end just north of the Agua Hedionda Lagoon railroad bridge. Includes new complete overpasses at Oak and Chestnut Avenues.

RSG, Inc. ("RSG") projected the economic and fiscal benefits with critical assistance from Kimley-Horn and Associates, Inc. ("Kimley-Horn") for traffic impact analysis (Appendix 2) and dBF Associates ("dBF") for noise impact analysis (Appendix 3).

This Study does not address capital and operating costs for the proposed rail infrastructure and future operations, only construction costs. All three alternatives include double tracking, and assume that rail traffic receives priority over vehicular and pedestrian traffic. Therefore, it is expected that all three alternatives would provide similar economic benefits and costs with regard to increased train service and operations. This Study therefore focuses on existing conditions in the Carlsbad area and projects the difference in economic and fiscal impacts resulting from each of the above alternatives.

STUDY AREAS

In assessing a multitude of different economic and fiscal impacts resulting from a specific project, some of these impacts may affect a smaller radius around the project site, while others may affect a larger area of a community or even the region. For example, sales taxes will be generated locally, i.e., within the Coastal Corridor, as defined below. Such impacts will primarily benefit the Carlsbad Village area. The economic impacts of construction, meanwhile, will be spread throughout the County as construction workers spend their earnings in those communities where they live and shop. Therefore, in order to provide a comprehensive, accurate and conservative analysis, certain economic and fiscal impacts require evaluation for Carlsbad or a larger area as a whole, while others need to be evaluated at the smaller sub-area level as these impacts will be more localized.

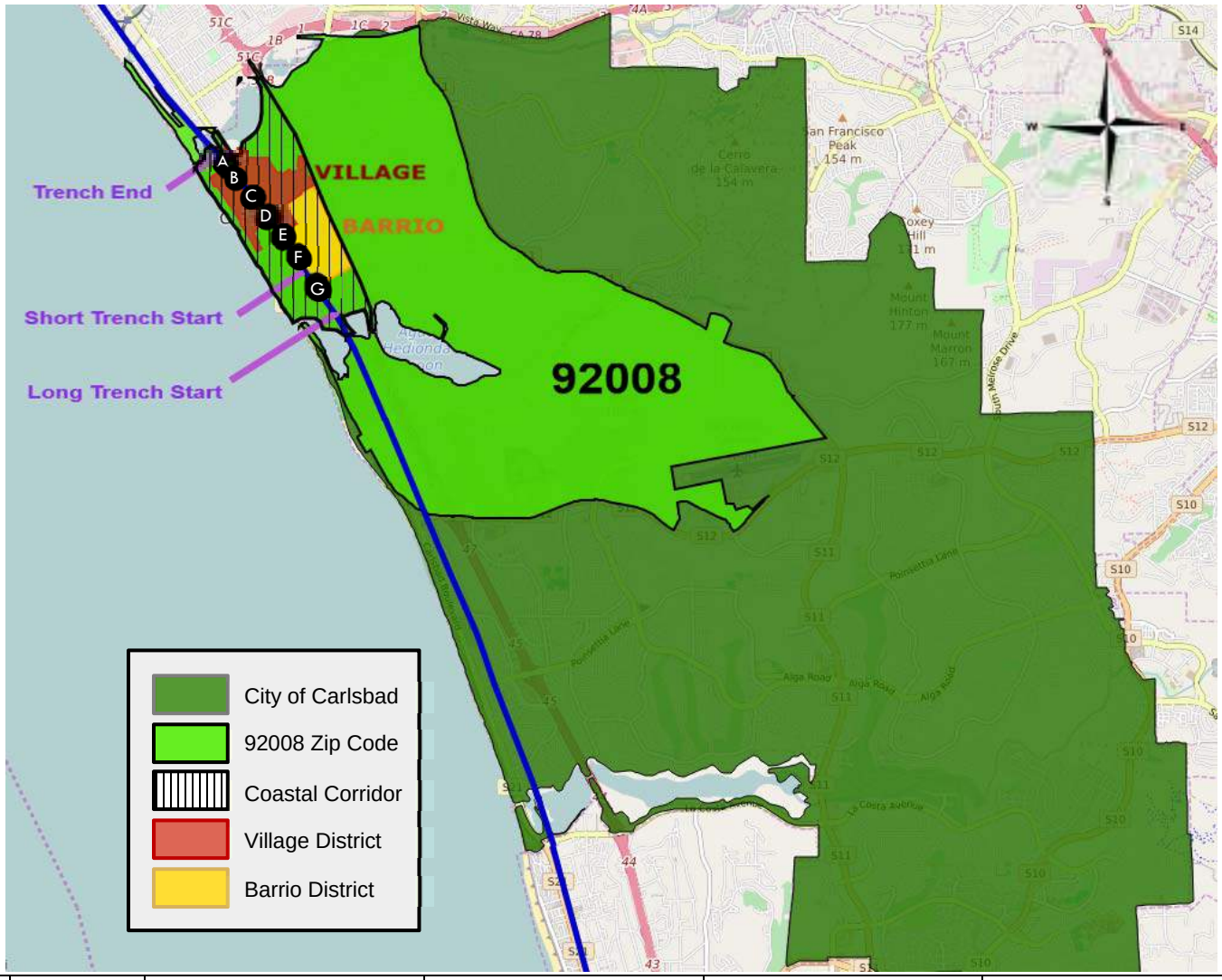
The first step in the process of (1) identifying existing conditions (to establish a baseline for projecting economic impacts) and (2) evaluating economic impacts for this Study was to define "Study Areas." In reviewing the project site, land uses, and available data sources for use in the analysis, the following Study Areas, shown in Figure 1, were designated for the purposes of this Study:

1. **Village-Barrio District** - designated in Carlsbad's Village and Barrio Master Plan. The Village portion of this area is based on the legal boundary of the Village Master Plan and Design Manual, the predecessor to the Village and Barrio Master Plan, and is shown in Figure 1. The Barrio portion is bounded by Tamarack Avenue to the south, Interstate 5 to the east, the Village to the north, and the railroad tracks to the west.
2. **Coastal Corridor** – generally bounded by the Pacific Ocean to the west, the Buena Vista Lagoon to the north, Interstate 5 to the east, and the Agua Hedionda Lagoon to the south. This subarea includes the Village-Barrio District and surrounding land. It is also referred to as Carlsbad Village in this Study.
3. **92008 zip code** area within the City, includes the Coastal Corridor and land south of the Agua Hedionda lagoon and east of Interstate 5.
4. **Carlsbad** geographic boundaries. This area covers all land within City boundaries, including the 92008 zip code.

This Study summarizes existing conditions at each of the four Study Areas for which data is available. The Study Areas were selected in part because the impacts were considered as possibly occurring at different levels within the geographic location of the City. However, research and analysis (see Appendix 1 for references) indicated that the economic and fiscal impacts themselves would occur within the Coastal Corridor Study Area. While local impacts will benefit regional entities (such as the County), measurable changes in economic metrics are expected to occur only within the Coastal Corridor. (See Methodology description on page 26 for more information.)

In addition to the Study Areas, Figure 1 illustrates the potential trenched areas and crossings of the three double track alternatives listed in the previous section. The Short Trench would extend between the existing Carlsbad Boulevard highway overpass (identified as "A" in Figure 1) and just north of Tamarack Avenue ("G"), between Hemlock Avenue and Redwood Avenue. The Long Trench would extend between the Carlsbad Boulevard highway overpass ("A") and approximately 0.3 miles south of Tamarack Avenue ("G") at Olive Avenue. Crossings are identified by letter in the map portion of Figure 1 and explained in the table portion of Figure 1.

Figure 1 – Map of Double Track Alternatives, Study Areas, and Rail Crossings



	Street Name	Existing Conditions	At-grade Alternative	Short Trench Alternative	Long Trench Alternative
A	Carlsbad Blvd.	Overpass	Overpass	Overpass	Overpass
B	Beech Ave.	No Access	Underpass	Overpass	Overpass
C	Grand Ave.	At-grade Crossing	At-grade Crossing	Overpass	Overpass
D	Carlsbad Village Dr.	At-grade Crossing	At-grade Crossing	Overpass	Overpass
E	Oak Ave.	No Access	No Access	Overpass	Overpass
F	Chestnut Ave.	No Access	No Access	Overpass	Overpass
G	Tamarack Ave.	At-grade Crossing	At-grade Crossing	At-grade Crossing	Overpass

EXISTING CONDITIONS

An analysis of existing conditions within all four (4) Study Areas was conducted to establish the baseline conditions from which economic impacts would be assessed for the following metrics.

- Property Values
- Commercial Activity
- Employment
- Sales Tax
- Property Sales by Land Use
- Transit Occupancy Tax
- Train Incidents
- Walkability/Livability

The results of these analyses are presented below.

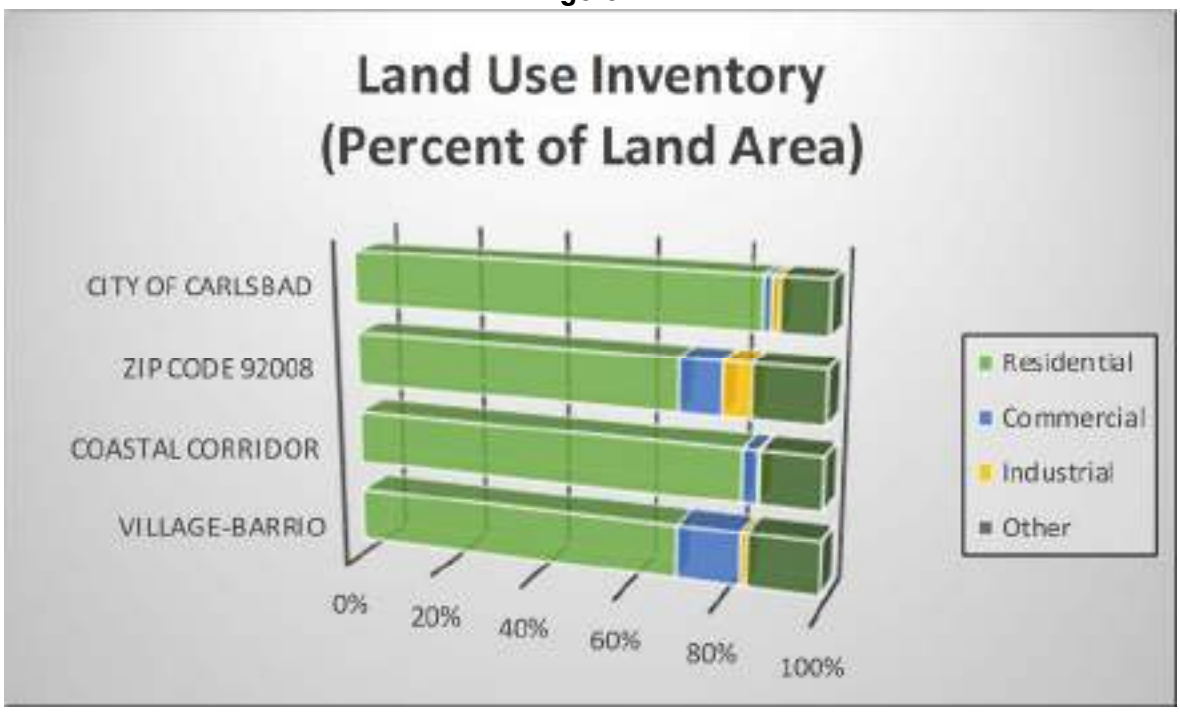
Property Values

By Land Area

Carlsbad is primarily a residential community – residential is the dominant land use type in all Study Areas, as demonstrated in Figure 2. More specifically, **70% to 87% of the land use by area in the Study Areas is residential**. Commercial uses vary by Study Area, with the Village-Barrio area at the highest percentage of commercial at 13%, followed by the 92008 area at 9%. The Coastal Corridor and City have a lower percentage of commercial uses, at 3% and 1.5%, respectively.

Industrial uses are low at below 2% for all areas except 92008 at 6% of land area. Other uses include agricultural, institutional, recreational, and rural. Figure 2 below presents land use information by land area.

Figure 2

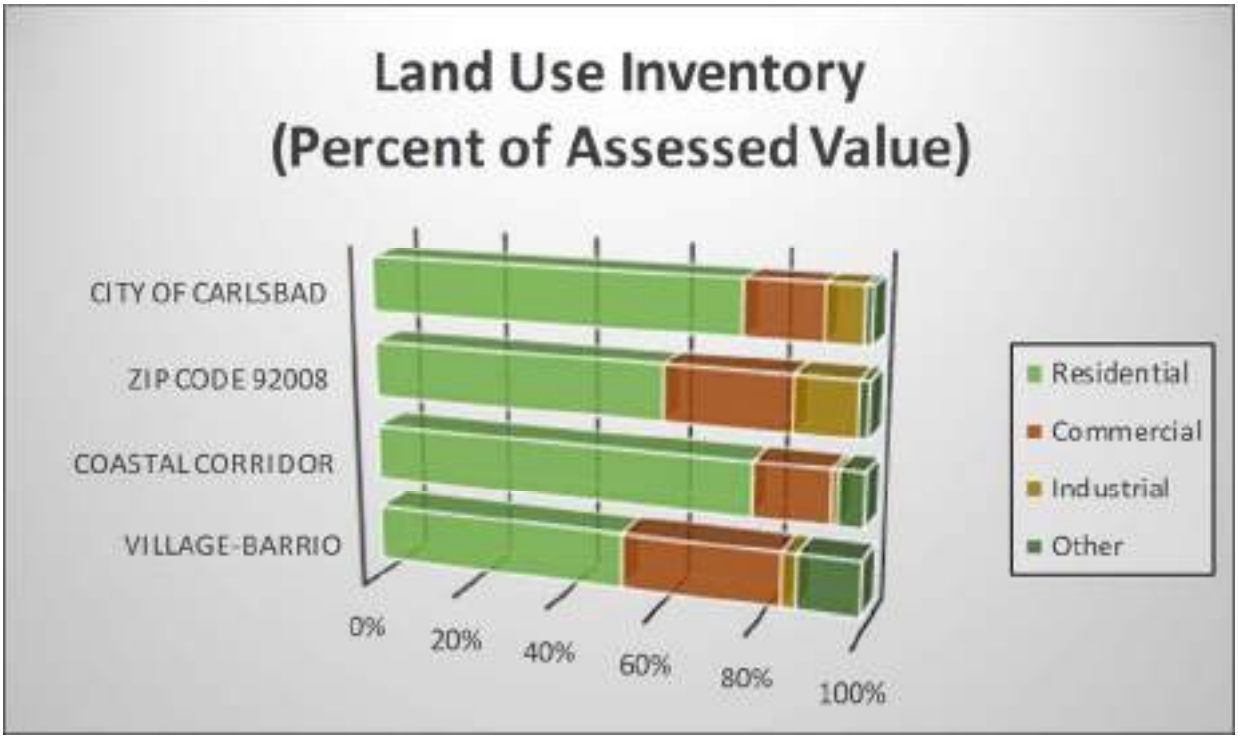


By Assessed Value

The fiscal year 2015-16 total assessed valuation of the City Study Area is estimated at $25 billion (according the 2015-16 San Diego County Equalized Assessment Roll). The 2015-16 assessed value of the remaining Study Areas are $675 million in Village Barrio, $1.7 billion in the Coastal Corridor, and $7.4 billion in 92008.

Land uses by assessed valuation were also examined as an economic indicator of real estate values in each Study Area. As shown in Figure 3, **residential uses represent a smaller percentage of assessed value than the percentage of land area. In contrast, commercial property represents a higher percentage of assessed value and a lower percentage of land area.** As stated in the above section, the percentage commercial property *by land area* for the Study Areas ranges from 1% to 13%, while the percentage by assessed value is 15% to 32% (Figure 3). The percentage of total assessed value for industrial uses is somewhat higher at 1% to 6%.

Figure 3



Secured Property Tax Revenue

The City, County, school districts, and special districts receive a portion of the property taxes applied to all property to pay for municipal and regional services. Property taxes in California are generally levied at the rate of 1% of assessed value and are distributed among taxing entities as determined generally by Proposition 13, Senate Bill 154, and Assembly Bill 8. Each taxing entity is assigned a property tax rate that represents that entity's share or portion of the 1% property tax levy.

More specifically, property taxes are calculated by applying the 1% tax rate (referenced above) to the total assessed valuation of property, as determined by county assessors. This property tax revenue is then apportioned to each taxing entity based on each entity's proportional share of the 1% tax rate. For example, the City's tax rate in the Village is approximately 22%. Therefore, the City receives approximately 22% of all property taxes paid for the Village area.

The estimated total amount of property tax revenues for fiscal year 2015-16 in each Study Area is depicted in Figure 4.

Figure 4

City Share of Secured Property Taxes

Carlsbad's share of the 1% general tax levy varies slightly by Study Area, but ranges from 16% to 22% (the lowest overall City tax rate is in the City Study Area, while the highest City tax rate is in the Village-Barrio area). The rates vary because each taxing entity's share of property taxes is set for a specified "Tax Rate Area." The City's share of property taxes in each Study Area depends on the Tax Rate Areas contained in the Study Area and the City's share of property taxes within those Tax Rate Areas. The estimated City share of property taxes within the Study Areas is listed below.

- Village-Barrio: $1.5 million
- Coastal Corridor: $3.5 million
- 92008: $13.2 million
- City: $41.2 million

It is important to note that these estimates exclude unsecured and state assessed property. Therefore, these amounts do not track exactly to Carlsbad's budget documents.

Commercial Activity

Lease Rates/Square Foot

2016 Quarter 1 real estate data for retail and office uses was obtained from CoStar. **Restaurant lease rates were unavailable as the vacancy rate was 0% in all Study Areas.**

Figure 5

As shown in Figure 5, lease rates for office uses are very similar for all Study Areas. However, retail lease rates for Carlsbad are higher than the remaining subareas.

Vacancy Rates

2016 Quarter 1 vacancy rates, obtained from CoStar (as shown in Figure 6), indicate **very low retail vacancy rates in all Study Areas (ranging from 1% to 4%). Office vacancy rates in the Village-Barrio and Coastal Corridor are also very low at 3.5% and 3.7%,** respectively. However, **office vacancies in the 92008 and City Study Areas are much higher at 18% and 16%,** respectively.

Figure 6

Business Licenses/Revenue/Turnover

Business license information for fiscal years 2013-14 and 2014-15 was obtained from Carlsbad city staff and is only available on a city-wide basis, rather than a Study Area basis. This data indicates the following changes over this time period:

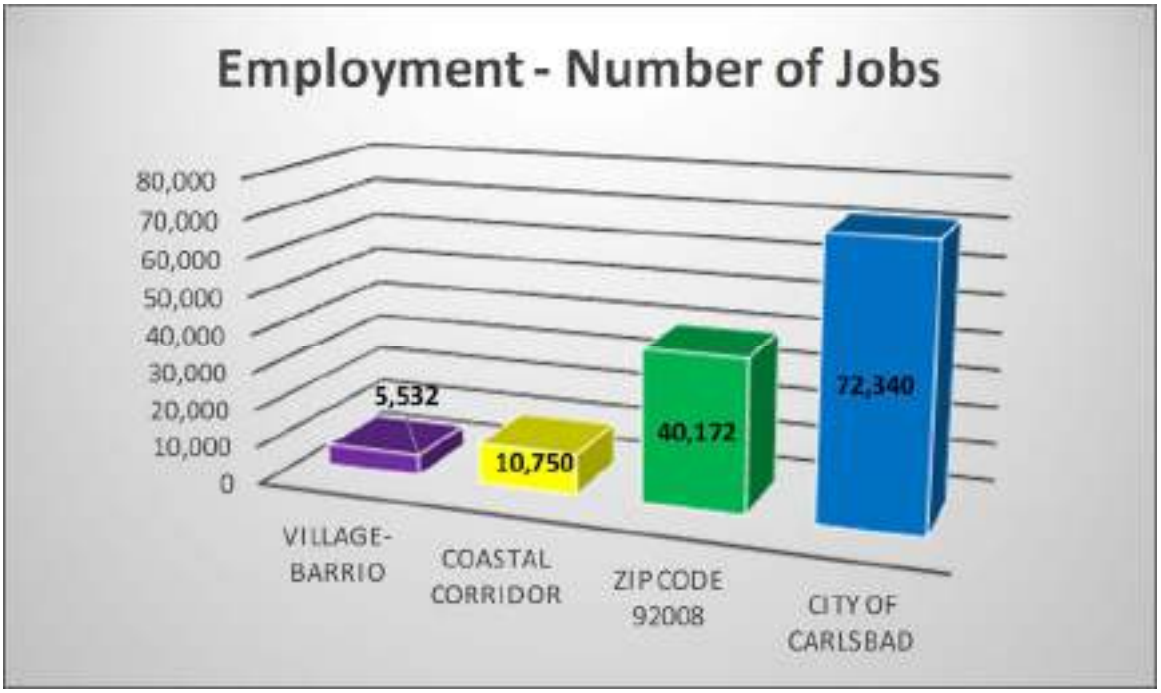
- New business licenses increased by 1%
- Business license revenues increased by 9%
- An average of 1,130 new licenses and 1,064 unrenewed licenses

Employment

Number of Jobs

The total number of jobs in each Study Area (Figure 7) indicates that the Coastal Corridor Study Area comprises less than 15% of the total jobs in Carlsbad. Jobs in Village-Barrio represent less than 8% of total City jobs.

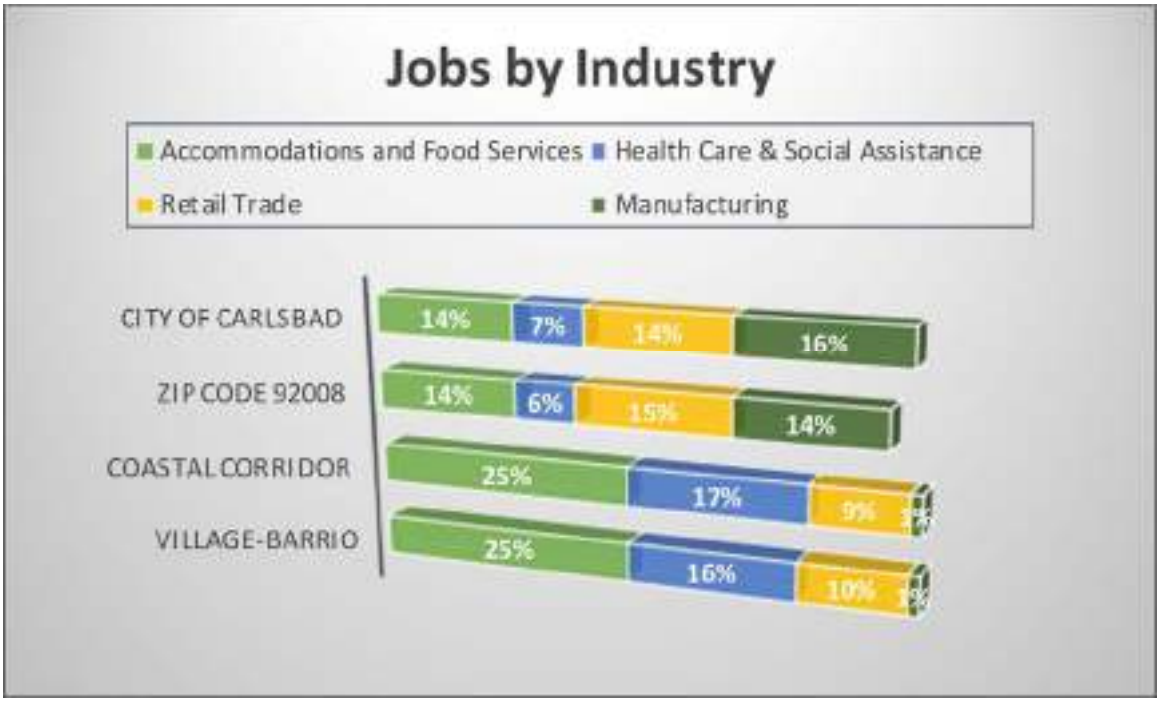
Figure 7



Jobs by Industry

Figure 8 illustrates a breakdown of jobs in selected key industries, in each Study Area. **The Village-Barrio and Coastal Corridor Study Areas have similar breakdowns, with the majority of jobs in the Accommodation and Food Service (restaurants and hotels) and Health Care and Social Assistance industries.** Both areas have a relatively small percentage of workers in Retail Trade and Manufacturing.

Figure 8



In contrast, **the 92008 and City Study Areas show jobs in Accommodation and Food Service, Retail Trade and Manufacturing industries at similar levels (about 15% of the workforce in each industry),** with the smallest percentage in Health Care and Social Assistance.

Number of Residents Working and Living in Area

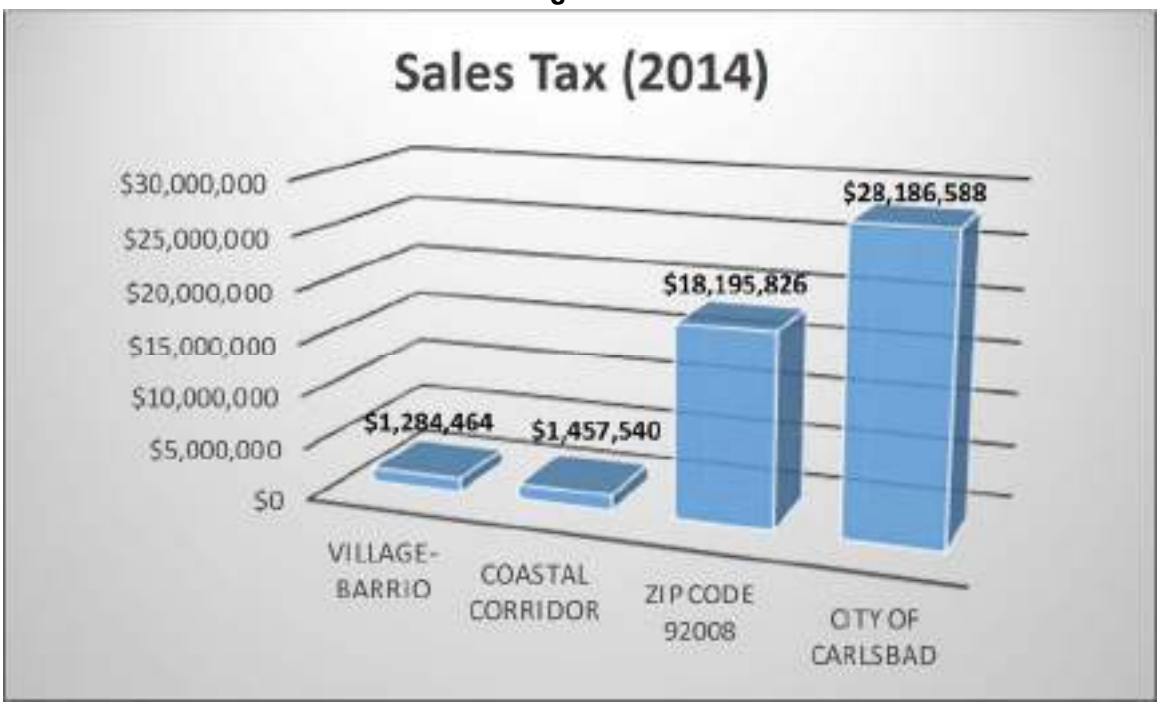
Data from the 2010-2014 American Community Survey (five-year estimates) was obtained to determine the percentage of working Carlsbad residents who also live in Carlsbad. This information was available for the 92008 and Carlsbad Study Areas, but could not be aggregated for the Village-Barrio and Coastal Corridor Areas specifically.

The percentages of workers who both live and work in the same area was very similar for both the 92008 and Carlsbad Study Areas at 38% and 36%, respectively. These figures reflect the large proportion of local residents (62% to 64%) who work elsewhere and local workers who live elsewhere and commute to their jobs, which contributes to traffic congestion in the County.

Sales Tax

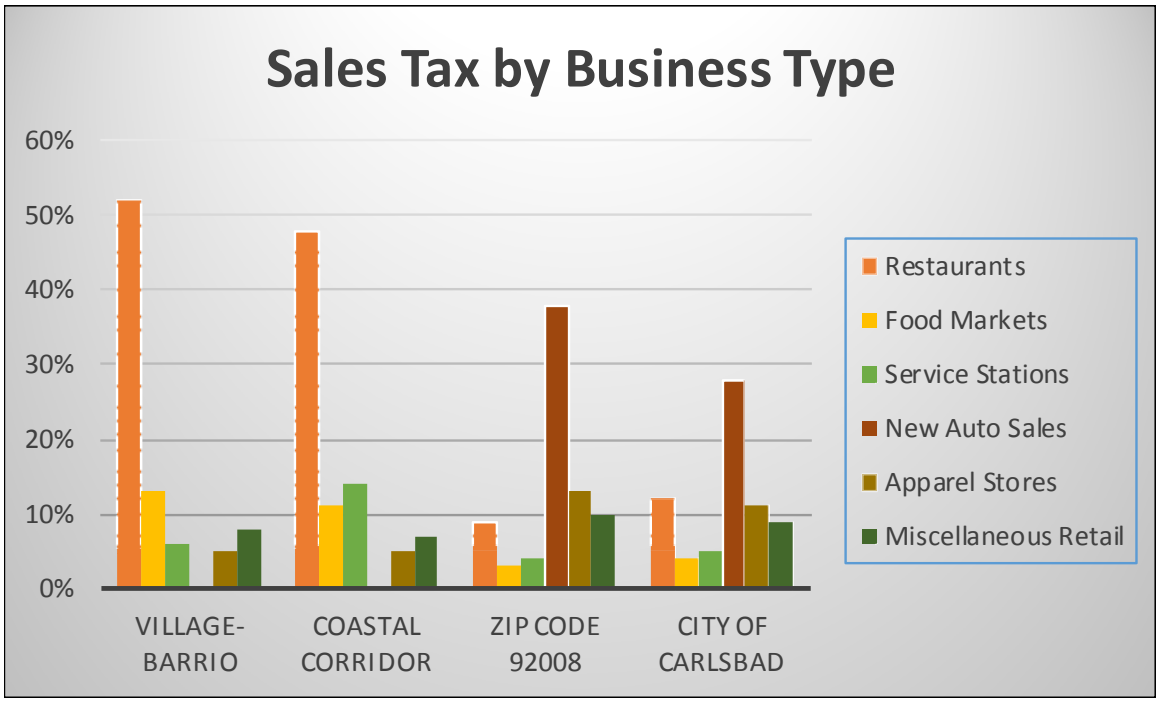
Figure 9 presents the total estimated sales tax receipts in 2014 for each Study Area. **The Coastal Corridor, which includes the Village-Barrio Study Area, generated 5% of the total sales tax revenue in Carlsbad as a whole.**

Figure 9



Similar to the Jobs by Industry (described previously and shown in Figure 8), **the sales tax by business type (as a percentage of the total sales tax generated within a Study Area) in the Village-Barrio and Coastal Corridor Study areas are very similar. The 92008 and City Study Areas also show sales tax percentages that are similar as well.** This information is depicted in Figure 10.

Figure 10



Property Sales by Land Use

Data on monthly sales by land use (residential and commercial) for calendar years 2014 and 2015 was obtained from Metroscan, a CoreLogic company that provides assessment roll information, including property sales. This data was aggregated by Study Area as a factor contributing to projected future increases in assessed value.

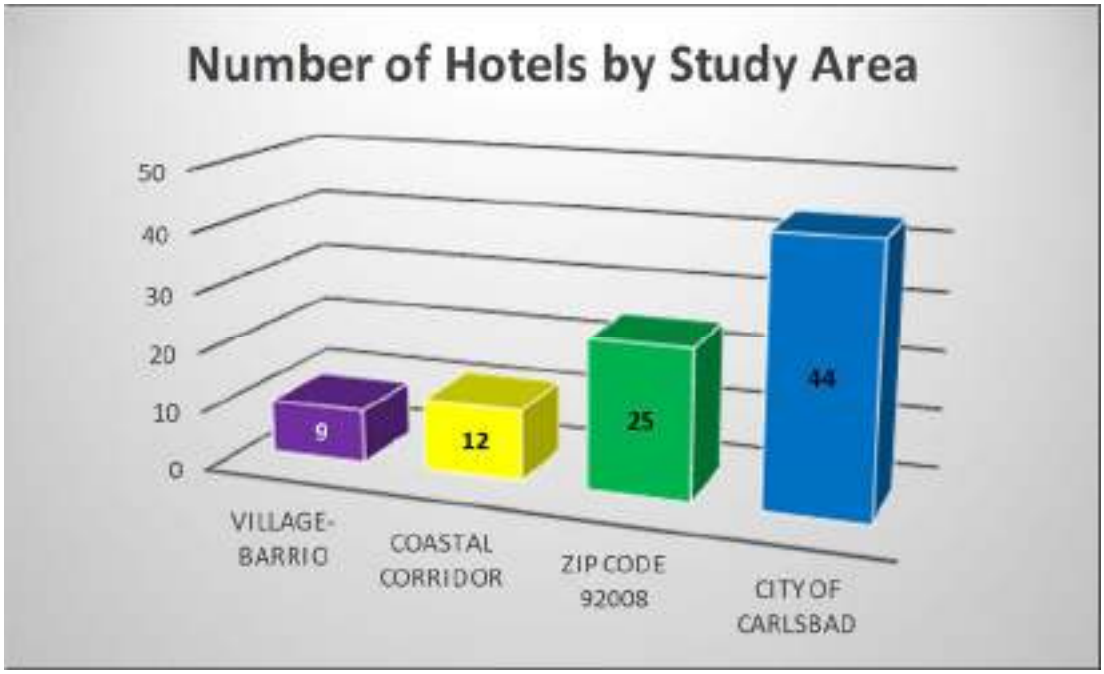
When a property is sold for a higher price than the existing assessed value per the equalized County roll (the basis for property taxes), increased property taxes are generated from that property for all taxing entities, including Carlsbad and the County. On average, **monthly sales in all Study Areas in 2014 and 2015 represented less than 1% of the total assessed value of that particular Study Area.**

Transient Occupancy Tax

Transient occupancy taxes ("TOT") result from a fee charged on hotel room stays and are based on a percentage of the nightly room rate. Carlsbad has a 10% TOT rate, which also applies to homeowners in coastal neighborhoods who rent out part or all of their homes through services such as Airbnb.com or VRBO.com.

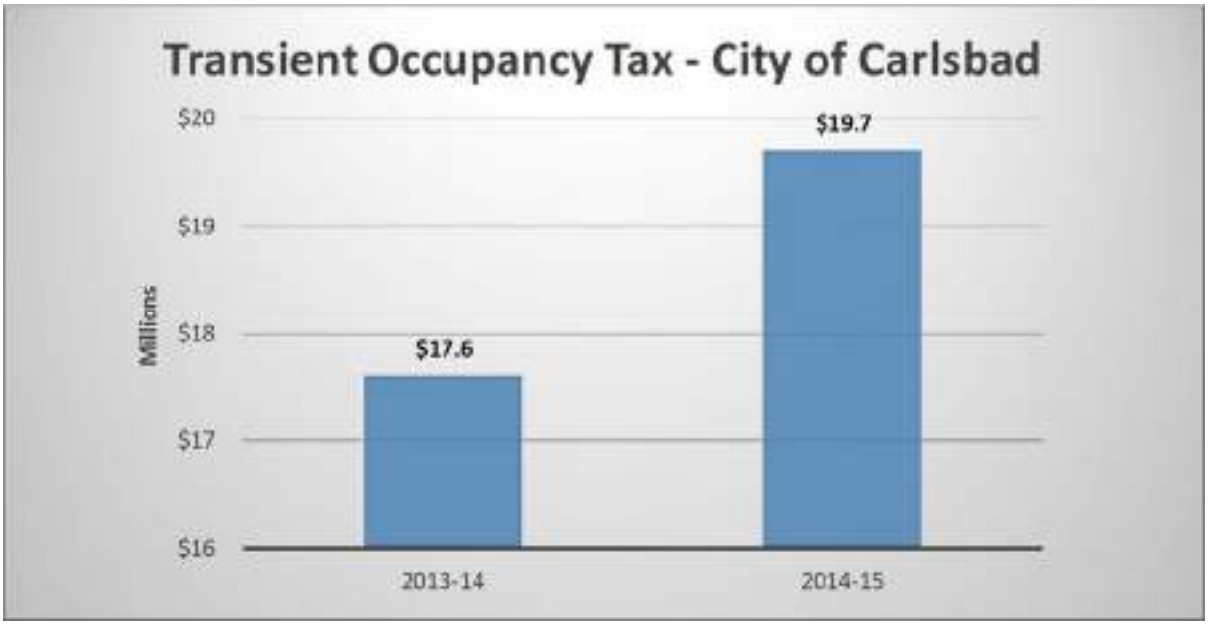
The number of hotels, by Study Area, is shown in Figure 11. Twelve (12) hotels are located in the Coastal Corridor, representing 27% of the total hotels located in Carlsbad.

Figure 11



TOT revenue from fiscal years 2013-14 and 2014-15 is presented in Figure 12. These revenues increased significantly by 12% during this time period.

Figure 12



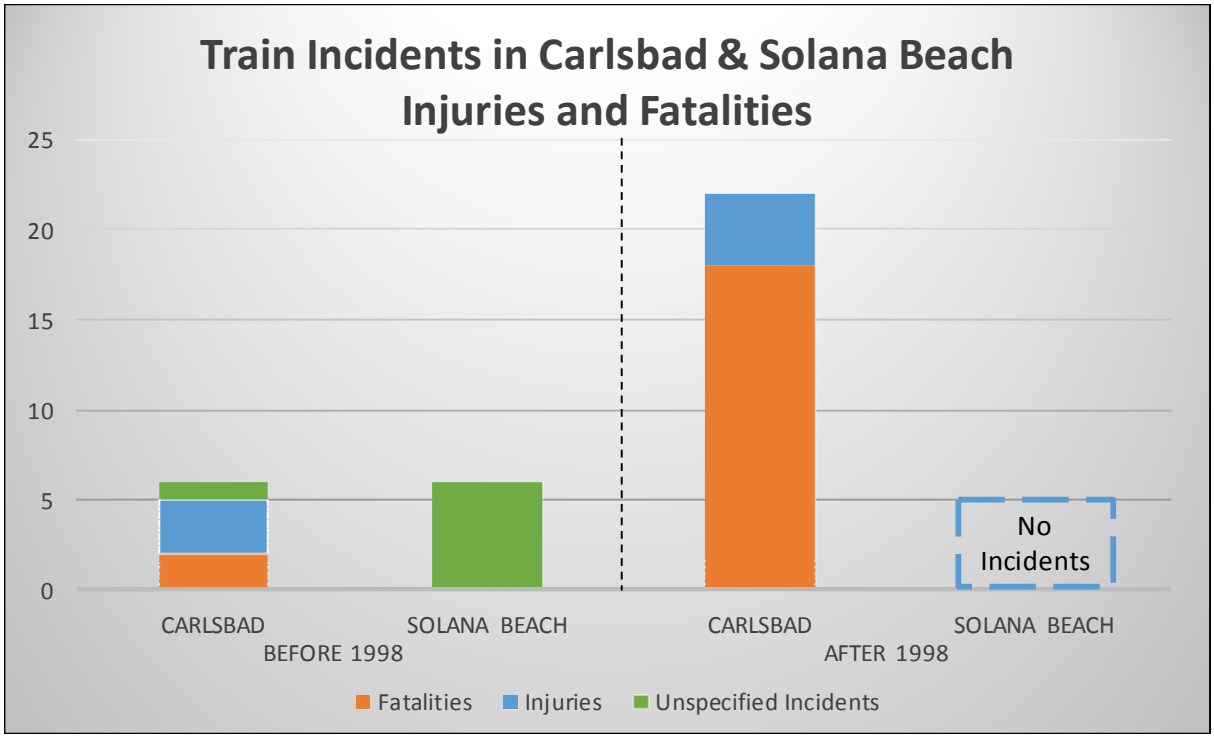
Train Incidents

Incident data from Federal Railroad Administration, the California Highway Patrol's Computer Aided Dispatch, and the San Diego County Sheriff's Department reports show that Carlsbad and Solana Beach each had **six (6) trespasser incidents (injuries or fatalities) from 1979 to 1998,** a nearly 20-year period. However, the number of **incidents increased dramatically in Carlsbad** with 22 incidents reported **between 1998 and 2015,**

a 17-year period. During this same time, Solana Beach, which separated its railroad grade in 1998, experienced zero trespasser incidents. Looking at injuries and fatalities, the number of incidents in Carlsbad between 1998 and 2015 total **18 fatalities and four (4) injuries over 17 years**.

Figure 13 tracks all injuries and fatalities since 1979.

Figure 13



Walkability/Livability

According to Walk Score's website, a Walk Score measures the walkability of an address or an area. The website's algorithm analyzes various walking routes and their proximity to nearby amenities. Points are given based on addresses' distance to various types of amenities. A score is then assigned on a scale from 0 to 100:

- 90-100, "Walker's Paradise,"
- 70-89, "Very Walkable,"
- 50-69, "Somewhat Walkable,"
- 25-49, "Car-Dependent," and
- 0-24, "Car-Dependent."

Living in a "walkable" community is considered desirable by many demographic groups, most often empty nesters and millennials. According to Gary Pivo of the University of Arizona Urban Planning Program and Responsible Property Investment Center and Jeffrey D. Fisher of the Indiana University Kelly School of Business and Benecki Center for Real Estate Studies measuring Walk Scores, "the benefits of greater walkability were capitalized into higher office, retail, and apartment values." Each location within a city can have a different Walk Score.

Figure 14 presents Walk Scores for locations throughout the Coastal Corridor, including on both sides of the railroad tracks, along Chestnut and Oak Avenues (where additional crossings would be added), and on opposite

sides of Carlsbad Village Drive. Figure 15 these locations. **All Walk Scores range between 70 and 95, or Very Walkable and Walker's Paradise** (per Walk Score data).

Figure 14 – Walk Scores in Select Coastal Corridor Locations

Address	Side of Tracks	Walk Score
525 Chestnut Ave	East	87
431 Oak Ave	East	95
2751 Madison St	East	90
3183 Madison St	East	93
303 Chestnut Ave	West	70
354 Oak Ave	West	91
3244 Lincoln St	West	84
2775 Carlsbad Blvd	West	92

These high Walk Scores, especially scores in the 90s on Oak Avenue, Madison Street, and Carlsbad Boulevard, indicate that there are likely to be many pedestrians walking throughout the Coastal Corridor. However, the prevalence of pedestrian activity can also increase the risk for accidents at train crossings.

According to Walk Score representatives, the company does not have the ability to predict how a score will change based on changes to the road and pedestrian networks. Therefore, there is no currently established method to estimate the change in due to additional crossings at Oak and Chestnut Avenues.

Figure 15 – Map of Walk Score Locations

COMPARABLE ANALYSIS

Case Studies

Case studies provide a comparable analysis to accurately project the economic impacts from a proposed project, in this case the proposed railroad improvement alternatives, based on the actual economic impacts realized from similar, completed projects.

Other Trenching Projects

In California over the past 30 years, there have been a relatively small number of projects involving railroad trenching, with the majority of grade separation projects involving either a road underpass or overpass for rail lines or roads. The grade separation projects over the last 20 years that did involve trenching include the Solana Beach project (completed in 1998), the San Gabriel project (in progress, part of the larger Alameda Corridor East line) and the Alameda Corridor project. The San Gabriel Trench is not yet complete and therefore could not be used as a case study for this analysis. The completed Alameda Corridor project involves rail lines that run through Los Angeles County cities including Compton, Lynwood, and South Gate with surrounding land uses that are largely industrial. The geographic location and the land use characteristics are not comparable to the Carlsbad portion of the LOSSAN corridor, as Carlsbad is a beach-adjacent tourist destination with a concentration of retail, office, hospitality and service uses in addition to residential uses.

Though not located in California, the trenching project completed in Reno, Nevada in 2005 was also examined as a comparable analysis for this Study. Significant research and coordination with city staff, local developers, and documentation was completed by RSG staff to identify case study data. However, no economic studies were completed in connection with this project. Reno and Carlsbad are very different communities geographically (located in different states and Carlsbad being directly on the coast) with differing land use patterns and zoning, making this project a less-than-suitable candidate for a comparable analysis. Additionally, there is an absence of available economic data for the time period immediately prior to the trenching (for example, historic sales tax data). Therefore, there is no available historic data to compare to current economic conditions to assess the economic impacts of this project.

LOSSAN North San Diego County Submarkets

The next step taken in identifying appropriate comparable case studies was to examine other North County coastal submarkets along the LOSSAN rail corridor – Oceanside, Carlsbad, Encinitas and Solana Beach. A comparison of metrics around grade-separated and at-grade rail crossings within the same city would reduce the possibility of unrelated factors (such as those that differ between cities – land uses, walkability, types of businesses, etc.) affecting the difference in metrics. A case study provides a real-world example of a similar completed project or improvement and the resulting economic and financial impacts realized in the area around the project or improvement.

There are three grade-separated pedestrian crossings in Oceanside and one such crossing in Encinitas. However, these crossings are not comparable because there is no vehicular access at these locations.

There are grade-separated crossings (bridges over the rail line) in Carlsbad (at Palomar Airport Road, Poinsettia Lane, and Avenida Encinas) and Encinitas (at La Costa Avenue). However, these crossings are located in areas with limited surrounding development and/or are not mixed-use, walkable environments. These characteristics contrast strongly to the Coastal Corridor's land uses and character and therefore do not provide a good comparison.

Encinitas has a grade-separated crossing at Encinitas Boulevard/B Street, in its downtown area. However, this crossing is not comparable because the rail line is elevated. An elevated rail line provides the benefit of reduced traffic congestion and reduced noise from train horns and crossing bells. However, it does not reduce train wheel and engine noise. dBF's analysis shows that most of the noise reduction within a rail corridor resulting from grade separation is related to wheel and engine noise.

Data on median home values, for example, shows that homes in the immediate vicinity (within a half-mile radius) of the Encinitas Boulevard/B Street intersection are valued approximately 5.4% higher than median homes in the immediate vicinity of downtown Encinitas's at-grade crossings, D Street and E Street. This supports the slightly higher benefit of 8.5% found for a reduction in both traffic congestion and noise shown later in this report and based on a more complete methodology (see Property Values section, Residential Property subsection on page 35).

It is worth noting here that noise and traffic are, of course, not the only factors in home values and other economic metrics. Available data and this Study's limited scope do not allow for a complete comparison of all factors. RSG has nonetheless attempted to mitigate the potential role of other factors by selecting areas similar in development pattern, proximity to the beach, and other likely influential factors, i.e., to hold those variables "constant" as much as possible.

LOSSAN Corridor Submarkets

In an effort to examine all comparable case studies available, data from other coastal submarkets along the LOSSAN rail corridor with both an at-grade railroad crossing and a grade-separated crossing was reviewed: Grover Beach-Pismo Beach, San Clemente, Carlsbad, and Encinitas. However, when identifying land uses and development patterns around the crossings located in Grover Beach and San Clemente, each have limited development within a half-mile radius of their grade-separated crossings. Grover Beach's grade-separated crossing involves the US 101 freeway and neighbors the Pismo Beach Wastewater Treatment Plant. San Clemente's grade-separate crossing is surrounded by the San Onofre Group Camp Site on one side and cliffs leading to the Pacific Ocean on the other side. As such, these locations could not be considered comparable for the purposes of an economic analysis due to the significant differences in the character of the areas surrounding the crossings. Encinitas includes a downtown, grade-separated crossing with an elevated rail line (Encinitas Boulevard/B Street), as described in the previous section. A comparison of this crossing to Encinitas's downtown, at-grade rail crossings provided partial support to a more complete methodology described later in this report.

Based on the findings above from the various approaches to establishing appropriate case studies, Solana Beach was deemed to be the sole case study that possessed a sufficient number of similarities with the proposed rail improvements, community characteristics, and geographic location on the coast for a comprehensive analysis. Solana Beach is located near Carlsbad, is a beach-adjacent community with similar land uses to those particularly within the Coastal Corridor Study Area, has a rail line that is grade separated by trenching, and provides some historical economic data prior to the completion of the trenching project for comparison.

Property Owner/Developer/Broker Interviews

RSG staff interviewed local real estate professionals actively working in Carlsbad and adjacent communities to obtain:

1. Information on economic impacts resulting from the Solana Beach trenching project completed in 1998; and

2. Professional opinions regarding changes in property values, potential land use changes, new development/redevelopment, and other expected economic changes resulting from the proposed rail alternatives.

The professionals interviewed include the following:

- Brett Farrow – an architect/builder with recent commercial projects in San Diego, Cardiff-by-the-Sea, and Carlsbad. In particular, Mr. Farrow is completing a commercial project in Carlsbad on the west side of State Street in the Village-Barrio Study Area near the rail line. Mr. Farrow is also the architect working on the proposed mixed-use development project at the Solana Beach train station (a large part of the 1998 trenching project in Solana Beach).
- John Dewald - the developer of the mixed use Pacific Station Project including 47 residential units and a Whole Foods located in downtown Encinitas directly adjacent to the rail line. Mr. Dewald is the chosen developer for the proposed Solana Beach train station project referenced above and, as such, has experience with development projects adjacent to both at-grade and grade separated rail lines.
- Dave Hodges – a commercial property owner and one of the creators of the Cedros Design District in Solana Beach. Mr. Hodges owned a number of properties before the trenching project and improved and repositioned his properties after the trenching was completed in 1998. He witnessed the transformation of the Cedros Design District that resulted from this project
- Hil Mercado - an experienced commercial real estate broker with Voit in North County with over past 30 years of brokerage experience, including:
    - Acted as the broker representing the seller of the Forum in Carlsbad
    - Involved with the leasing of the Premium Outlet Centers in Carlsbad
    - Represented the sellers of the Pacific Station and Ranch projects in Encinitas
    - Involved in the sale and/or lease of dozens of properties along the 101 in North County coastal cities.

A summary of the professional opinions related to the railroad alternatives are presented below and on the next page.

Property Values

- Increased beach access resulting from the trenching alternatives (particularly under the Long Trench alternative) will significantly increase property values in downtown Carlsbad and the Coastal Corridor Study Area.
- 5-10% increase in property values within four (4) blocks of trenching area along the corridor.
- Reduced noise will equate to higher rents, new construction, and increased demand in the Coastal Corridor Study Area.
- Commercial rents for properties adjacent to the railroad tracks have remained the same in the last 2-3 years in Carlsbad.
- A high-end grocer will look to locate in downtown Carlsbad if the trenching project moves forward
- Solana Beach experienced the following after trenching:
    - Proposed train station mixed-use project
    - Transition from industrial use to retail and residential uses
    - Increased visitors and population downtown supporting new and existing retail uses

Redevelopment

- The proposed improvements, particularly the Long Trench, will provide tremendous benefit to the Coastal Corridor with additional beach access.
- Demand from millennials and empty nesters for a walkable downtown area with beach access.
- Developers and retailers are now looking at the Village in particular after the potential trenching was announced.
- Development adjacent to trench areas is appealing because:
    - Underground parking doesn't have to be shore-cast
    - Development savings ($500,000 cost savings was estimated for recent Encinitas project if rail line had been trenched)
- Tracks are intimidating for pedestrians – they stop pedestrian flow and disconnect the downtown area.
- Benefits in Solana Beach
    - Proposed train station project and land use changes would not have occurred without trenching
    - Many property owners made building improvements after trenching was complete
    - Trenching allowed for more development *(traffic constraints would have limited new development)*

Land Use

- Trenching (particularly the Long Trench) will:
    - Transform land uses as there are very few north San Diego County cities with transit and a vibrant, walkable downtown adjacent to the beach
    - Encourage residential and mixed-use development in downtown Carlsbad
    - Increase development intensities, including residential, near transit
    - Increase development density near transit further SANDAG Smart Growth goals (San Diego Forward Plan)
- Carlsbad would experience double the transformation of Solana Beach (because Solana Beach is a slow-growth city)

In particular, the proposed Solana Beach train station project (which all of the real estate professionals' interviews stated would not have occurred without the trenching project there) will further SANDAG's Smart Growth goals of development clustered near rail transit in walkable communities to reduce reliance on automobiles and reduce urban sprawl.

PROJECTION OF ECONOMIC AND FISCAL IMPACTS

Assumptions

The analysis presented below details the projections of economic and fiscal impacts resulting from the three rail improvement alternatives; At-grade, Short Trench, and Long Trench. All analyses were completed for all three alternatives and presented in graphs and charts to aid in the comparison of the alternatives. Due to the fact that the proposed rail improvements under all three alternatives have an economic useful life of 99 years, costs and values have been calculated for a 99-year period following completion of construction (except for lives saved, which begin when construction is started). The net present value of all projected values is calculated to provide an appropriate comparison to estimated construction costs. All numbers contained in this section are in 2016 dollars, except where noted.

When possible, the projected values have been calculated as a range with "Low," "Middle," and/or "High" points due to the uncertainty associated with projecting economic and fiscal impacts. It is important to note that the actual impacts of the three rail improvement alternatives will depend on many factors, including City staff's, elected officials', and local stakeholders' openness to changes, as well as local, regional, state, national, and global economic trends and policies.

An important distinction must be made between fiscal and economic impacts. Fiscal impacts, such as property and sales taxes, represent a direct revenue benefit to local public agencies. Economic impacts—such as the values of lives and time saved, as well as economic output—are distributed more broadly and may not be reflected directly on public agencies' finances. Nonetheless, both impacts provide measurable benefits to residents, businesses, visitors, and government agencies.

Methodology

The methodology utilized in this Study attempts to project the impacts of the At-grade, Short Trench, and Long Trench scenarios. Of course, none of the improvement alternatives would occur in a vacuum. The Study does not suggest that the impacts it identifies will be the only resulting changes to occur. Other factors, including those mentioned above, will compound changes to all of the measured impacts, some by enhancing impacts and others by diminishing them.

The results of the research and analysis (see Appendix 1 for references) indicated that the majority of the economic and fiscal impacts will occur within the Coastal Corridor Study Area. Based on data collected, the previously described conversations with professionals, as well as academic and professional literature on economic impacts, it is not expected that the improvement alternatives will directly impact economic metrics outside of the Coastal Corridor. For example, sales and property values (and therefore sales taxes and property taxes) are not expected to increase for retailers and properties outside of the Coastal Corridor Study Area. However, the impacts within the Coastal Corridor will benefit Carlsbad, the County, and other taxing entities. Similarly, construction will have indirect impacts beyond the Coastal Corridor based on goods purchased for construction and local spending by construction employees.

Lives Saved and Injuries Avoided

Value of Statistical Life

Definition and Background

The value of lives saved and injuries avoided is calculated using the US Department of Transportation's "Guidance on Treatment of the Economic Value of a Statistical Life in US Department of Transportation Analyses – 2016 Adjustment" ("DOT Guidelines") and data on fatalities and injuries.

The DOT Guidelines use a term "value of statistical life" or "VSL." This term is intended to represent "not the valuation of life as such, but the valuation of reductions in risks." **Revised most recently in 2016,** the DOT Guidelines recommend that policy analyses use **$9.6 million as the VSL**. This means that an average individual would pay $960 to reduce the risk of death by one in 10,000. The policy guidelines assume a linear relationship between risk and willingness to pay.

The DOT Guidelines arrive at a $9.6 million measure for the VSL by surveying 12 published studies calculating VSL in the Bureau of Labor Statistics' Census of Fatal Occupational Injuries and updating a 2015 baseline value based on changes in prices and real incomes. Among those 12, the DOT Guidelines exclude outliers. Due to the uncertainty of making decisions where lives are at stake, the DOT Guidelines require the use of low ($5.4 million) and high ($13.4 million) alternatives for the VSL. Furthermore, the DOT Guidelines provide a factor to apply in the case of injuries. For critical injuries, this factor is 0.593. This analysis assumes that all non-fatal injuries involving trains will be critical.

INCIDENT DATA (INJURIES AND FATALITIES)

Current Conditions

The incident data was obtained from the Federal Railroad Administration, the California Highway Patrol's Computer Aided Dispatch, and the San Diego County Sheriff's Department reports. **The data in Figure 13, shows that while Carlsbad and Solana Beach each had six trespasser incidents from 1979 to 1998, Solana Beach had no incidents in the 17 years after 1998 (after the trenching project there was complete), but Carlsbad had 22 incidents,** including 18 fatalities and four (4) injuries over 17 years in Carlsbad. Incidents include accidents involving a train and either vehicles or pedestrians. The incident increase in Carlsbad may be due partly to the cluster of restaurants and other commercial businesses directly adjacent to the rail corridor. Regardless of the reason for the incidents, this Study focuses on the potential cost and benefit of increased or reduced incidents in the double tracking alternatives.

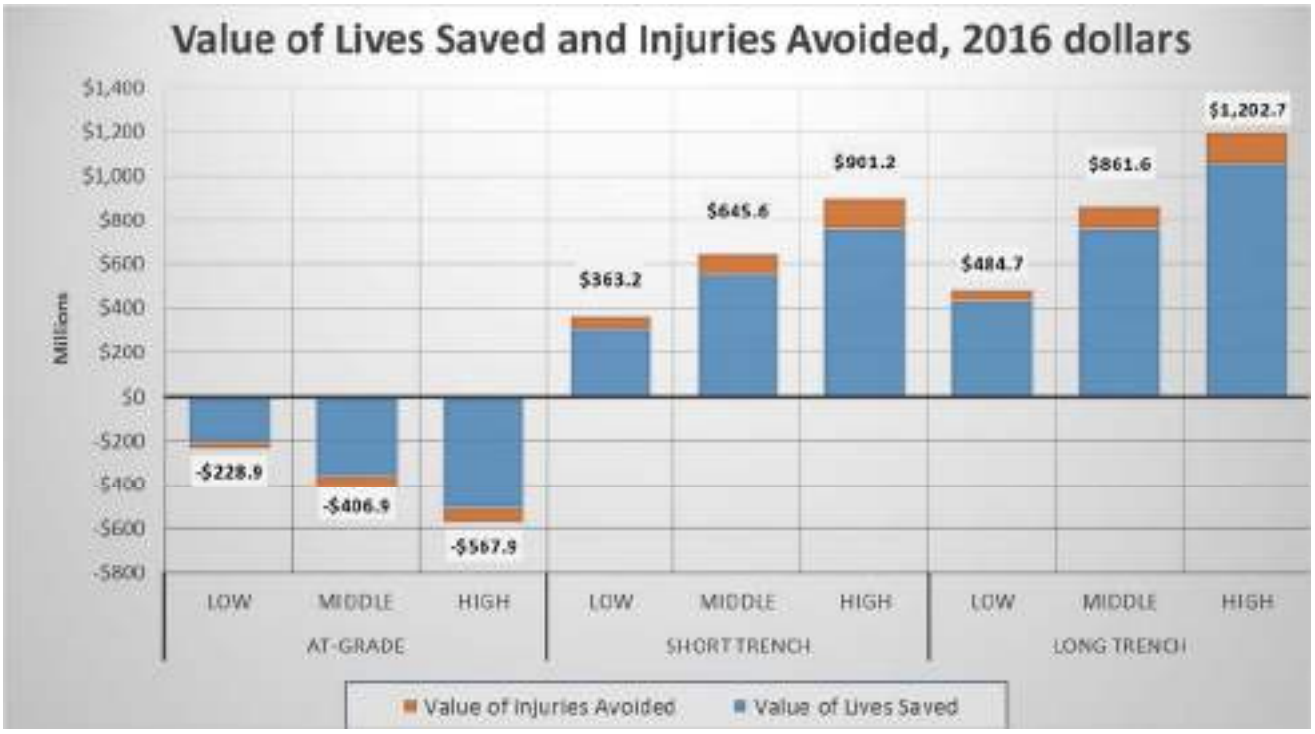
At-grade Alternative (Cost)

Double tracking would allow for increased train frequency. Using Kimley-Horn's traffic analysis, RSG calculated that an increase in gate down times (based on increased train frequency) would result in a corresponding increase in the opportunity for incidents, both vehicular and pedestrian. RSG increased the incident frequency measurement starting in 2035 (the same year in which Kimley-Horn shows gate down times increasing) by the same factor as the increase in gate down times (2.17 for the Short Trench area and 2.18 for the Long Trench area).

The results of this analysis suggest that the total number of incidents (including injuries and fatalities) per year would increase from a current level of approximately 1.00 (Short Trench) and 1.29 (Long Trench) per year to approximately 2.17 (Short Trench, 1.00 * 2.17 = 2.17) and 2.82 (Long Trench, 1.294 * 2.183 = 2.82) per year in years 2035 through 2121. Given the VSL, the total *cost* in statistical lives would total between $229 million and $568 million over the 99-year period.

This information is illustrated in Figure 16.

Figure 16



Note on Methodology

Incidents could potentially be reduced with crossing improvements, fencing of the railroad corridor, and the pedestrian underpass made in the At-grade alternative. The current construction cost estimate for the At-grade alternative includes new quadrant gates and crossing modifications. However, there is a lack of data showing the effect these improvements have in preventing incidents.

Short Trench and Long Trench Alternatives (Lives Saved)

The data for Solana Beach incidents, as seen in Figure 13, shows that there have been no incidents (injuries or fatalities) in the 18 years since the trenching was completed there. Because Solana Beach provides a very similar example—with double tracking, grade separation, and increased train frequency—it serves as the most appropriate case study. Therefore, this analysis assumes that the proposed Short Trench and Long Trench alternatives, which would separate the railroad grade from the street, would eliminate all incidents. The most recent DOT Guidelines use 2015 as a base year and recommend applying an inflation factor based on the growth of real incomes and the consumer price index. The inflation factor accounts for the increasing amount that people are expected to pay to reduce their risk of fatal injury as their incomes rise and the cost of safety measures rises. We noted that from 2013 to 2015, this factor averaged a 2% annual growth. The inflation factor allows for a more accurate measurement of the VSL from 2016 to 2121. A 4% discount rate was applied to represent the relative value of future VSL in 2016 dollars.

In total, the value of lives saved and injuries avoided during the 99-year period ranges from **$363 million to $901 million for the Short Trench and between $485 million and $1.2 billion for the Long Trench**. These figures take into account the increased incident rate as described for the At-grade alternative and therefore should not be added to the total cost in statistical lives in the At-grade alternative.

Value of Time Saved

Delay Times

Kimley-Horn's analysis identifies the daily average delay at the at-grade crossing locations on Grand Avenue, Carlsbad Village Drive, and Tamarack Avenue under existing and future (in 2035, with higher train frequency) conditions for most of the year and for the summer season (Appendix 2). This information was used to calculate the total annual delay in vehicle-hours under the three alternatives:

- The At-grade delay represents the additional delay caused by increasing train frequency.
- The Short Trench delay represents the decrease in delay within the Short Trench area, starting in 2027 based on current train frequency and changing in 2035 based on increased train frequency.
- The Long Trench delay shows the same thing for the Long Trench area.

RSG calculated total annual delays using Kimley-Horn's analysis of current and future delays at three crossings:

- Grand Avenue
- Carlsbad Village Drive
- Tamarack Avenue

The Short Trench would eliminate delays at only the first two crossings because it would leave Tamarack Avenue as an at-grade crossing. The Long Trench would eliminate delays at all three crossings.

Kimley-Horn's analysis includes an average daily and weekly delays and vehicle trips at each intersection, including an estimate based on measurements taken in the spring and an adjustment for the busier summer season. Current delays are based on existing train and vehicle traffic levels. Future delays are based on 2035 projections using *Infrastructure Development Plan for the LOSSAN Rail Corridor in San Diego* County to calculate expected future train volume and SANDAG Series 13 to calculate expected future vehicle volume, both provided by SANDAG.

RSG used the summer season delays as 25% of the year and converted the daily delays and vehicle trips into annual delays. Current annual delays equal 10,719 hours in the Short Trench (i.e., at Grand Avenue and Carlsbad Village Drive) and 12,846 hours in the Long Trench (i.e., all three intersections listed above). Future annual delays are projected to equal 28,823 hours in the Short Trench and 33,623 hours in the Long Trench.

Delay Costs

The California Department of Transportation ("Caltrans") recommends economic parameters for life-cycle benefit-cost analysis (cost is presented in the Construction section) to assess the benefit of transportation investment. These parameters include an average vehicle occupancy rate of 1.15 people per vehicle and an average value of time of $12.50 per person-hours, which includes all people. Applying these parameters to the total annual delays provides the total annual value of time saved. These annual values are inflated at a 1.6% annual rate based on the US Department of Transportation's guidelines for valuing travel time in economic analysis. The same 4% discount rate used in other portions of this analysis is applied here.

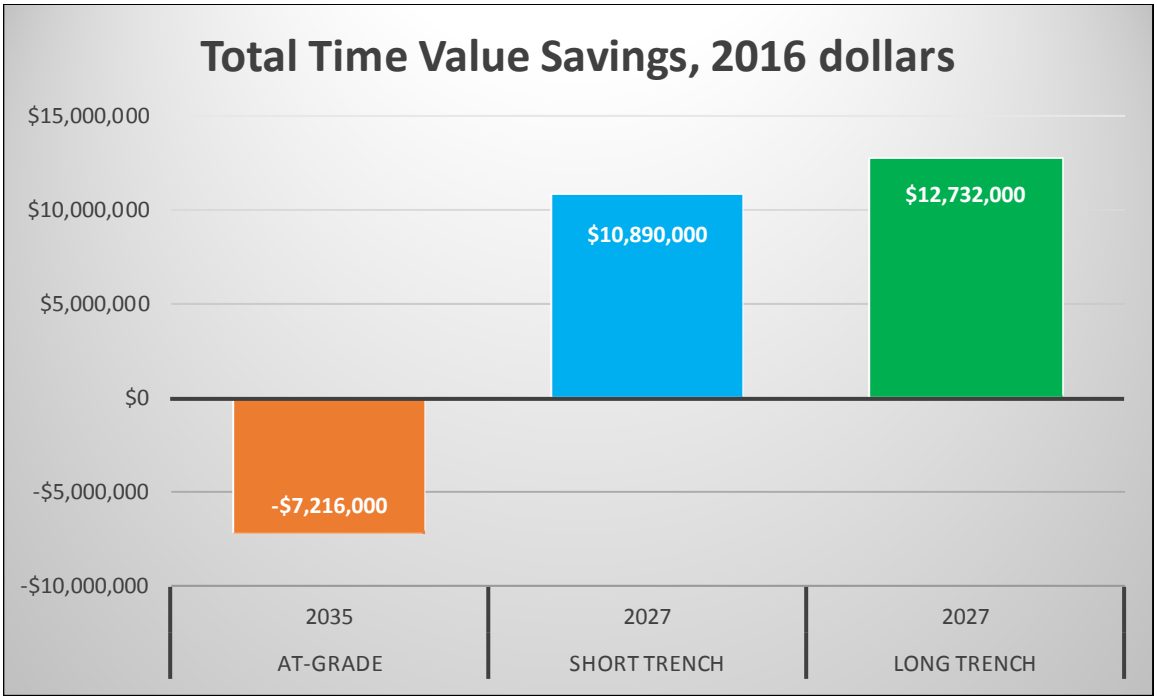
Multiplying the delays in hours by Caltrans' parameters, the results of this analysis are provided below and shown in Figure 17.

- At-grade would **increase the value of time lost due to delays by approximately $7.2 million** over 99 years due to increased traffic.

- Short Trench would **save close to $10.9 million** over 99 years, including as train frequencies and traffic increase
- Long Trench would **save more than $12.7 million** in the same period and with the same conditions as the Short Trench.

It is important to note that the trenching alternatives' figures take into account the increased train frequency and therefore should not be added to the total cost in value of time lost or saved in the At-grade alternative.

Figure 17



Sales Taxes

Solana Beach Case Study

As stated previously in this Study, the Solana Beach trenching project (completed in 1998) is the sole case study utilized as this project and location possess sufficient similarities in geographic location, community characteristics and other factors to provide meaningful data. The growth in sales taxes since 1997 in the "Solana Beach Rail Corridor," shown in Figure 18 and defined to represent the portion of Solana Beach within approximately four blocks of the rail line, was compared with the growth in the remainder of Solana Beach. This remaining area is essentially all of the city of Solana Beach except the "Solana Beach Rail Corridor" and is also shown in Figure 18. Data was available for four defined primary commercial centers:

- Cedros Design District
- Highway 101 Corridor
- Lomas Santa Fe Plaza
- Town Centre West

These centers contribute approximately 80% of Solana Beach's sales tax revenues. Because these areas are the only portion of Solana Beach's sales tax revenues that are geographically identified, these commercial

areas were utilized to represent the Solana Beach Rail Corridor (Cedros Design District and Highway 101 Corridor) and the remainder of Solana Beach (Lomas Santa Fe Plaza and Town Centre West).

Sales taxes grew at a higher rate from 1997 to 2015 in the Solana Beach Rail Corridor than in the remainder of Solana Beach. This accelerated growth could have occurred for multiple reasons, including the corridor's proximity to the beach, its dense land use pattern, and the efforts of the Cedros Merchants Association and the Cedros Property Owners Association—two organizations advocating for growth in the Cedros Design District.

Figure 18 – Map of Solana Beach Rail Corridor and Remainder of Solana Beach

It is important to note that proximity to the beach, a dense land use pattern, and a supportive business association (the Carlsbad Village Association) are also factors present in the Coastal Corridor. However, sales tax growth in the Coastal Corridor has trailed behind the growth in the rest of Carlsbad, even when excluding fast-growth commercial sectors and centers such as automobile dealerships, the Carlsbad Premium Outlets and other shopping centers in Carlsbad.

Analysis and Assumptions ("DD" Approach)

In order to determine if the at-grade rail crossings are the factor negatively affecting sales tax growth, a difference in differences ("DD") approach was taken in this analysis. More specifically, the use of a comparable area as a control (i.e., Solana Beach) neutralizes the effect of variables that are similar between the two areas to suggest that the identified difference (grade separation) affects the resulting variable (sales tax revenue growth).

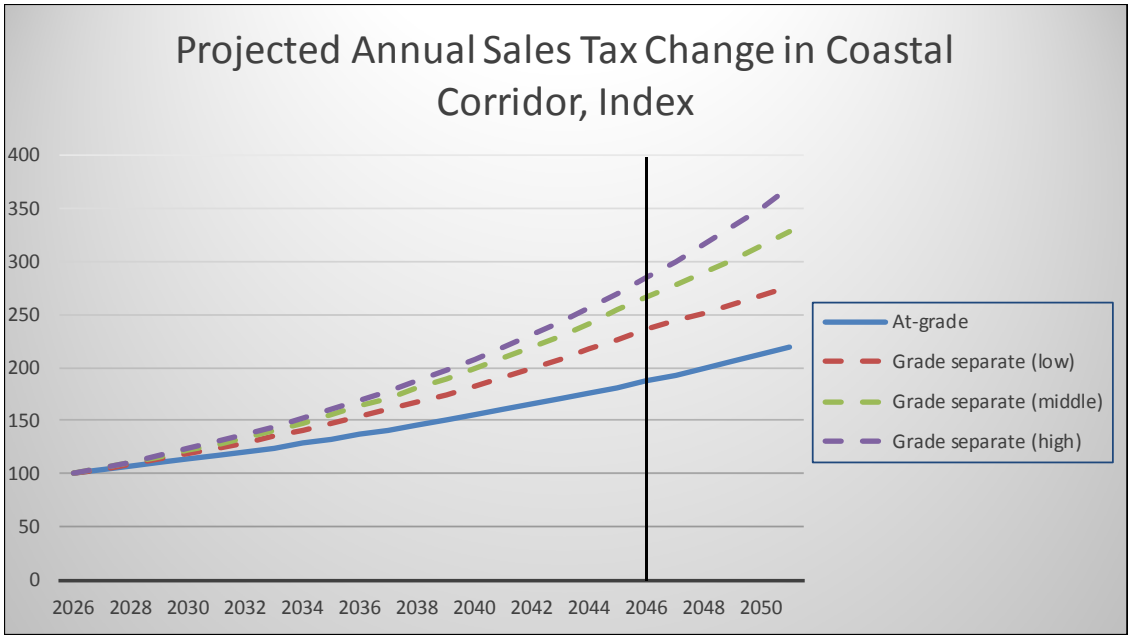
It is important to note that one adjustment is necessary due to one stark contrast between the two cities. Almost half of Solana Beach's retail space is concentrated in its rail corridor. When compared with Carlsbad, the remainder of Solana Beach has a relatively small and unchanging amount of retail space. Carlsbad, on the other hand has such large sales tax producers like Legoland, the automobile dealerships, Carlsbad Premium Outlets, the Shoppes at Carlsbad (formerly known as Plaza Camino Real), and The Forum. These sources account for large portions of Carlsbad's overall sales tax growth since 1997.

The DD approach and the comparison of sales taxes in Solana Beach and its rail corridor suggest that separating the railroad and street grades will allow the Coastal Corridor to grow its sales, and the taxes thereon, significantly faster than its current growth (2.9% annually in the Short Trench Area and 3.2% annually in the Long Trench Area). Due to the contrast in the cities described above, adjustments in the projected sales tax growth rate are necessary. It cannot be assumed that sales in the Coastal Corridor will grow faster than sales in the remainder of Carlsbad at the same difference as sales in the Solana Beach Rail Corridor grew compared to the remainder of Solana Beach. Rather than expecting sales taxes to grow faster in the Coastal Corridor than in the rest of Carlsbad, this analysis conservatively sets the two growth rates equal to each other going into the future. Additionally, certain sectors' and centers' exceptional growth in sales tax generation were excluded from the definition of "the rest of Carlsbad" under the "Low," "Middle," and "High" sales tax projections in order to estimate a range of potential sales tax growth. More specifically, the following describes which centers and sectors were excluded from each scenario:

- Low - excludes the Coastal Corridor, auto sales, and the Carlsbad Premium Outlets (4.4% annual growth),
- Middle - excludes only the Coastal Corridor (5.0% annual growth),
- High - excludes the Coastal Corridor, auto sales, the Carlsbad Premium Outlets, and Plaza Camino Real (5.4% annual growth).

Because Legoland files as a single retailer, its sales tax generation data cannot be isolated. Therefore, it could not be excluded in any of the scenarios of this analysis. The implications of the DD approach for Carlsbad sales taxes in the At-grade and grade-separated scenarios are shown indexed in Figure 19.

Figure 19

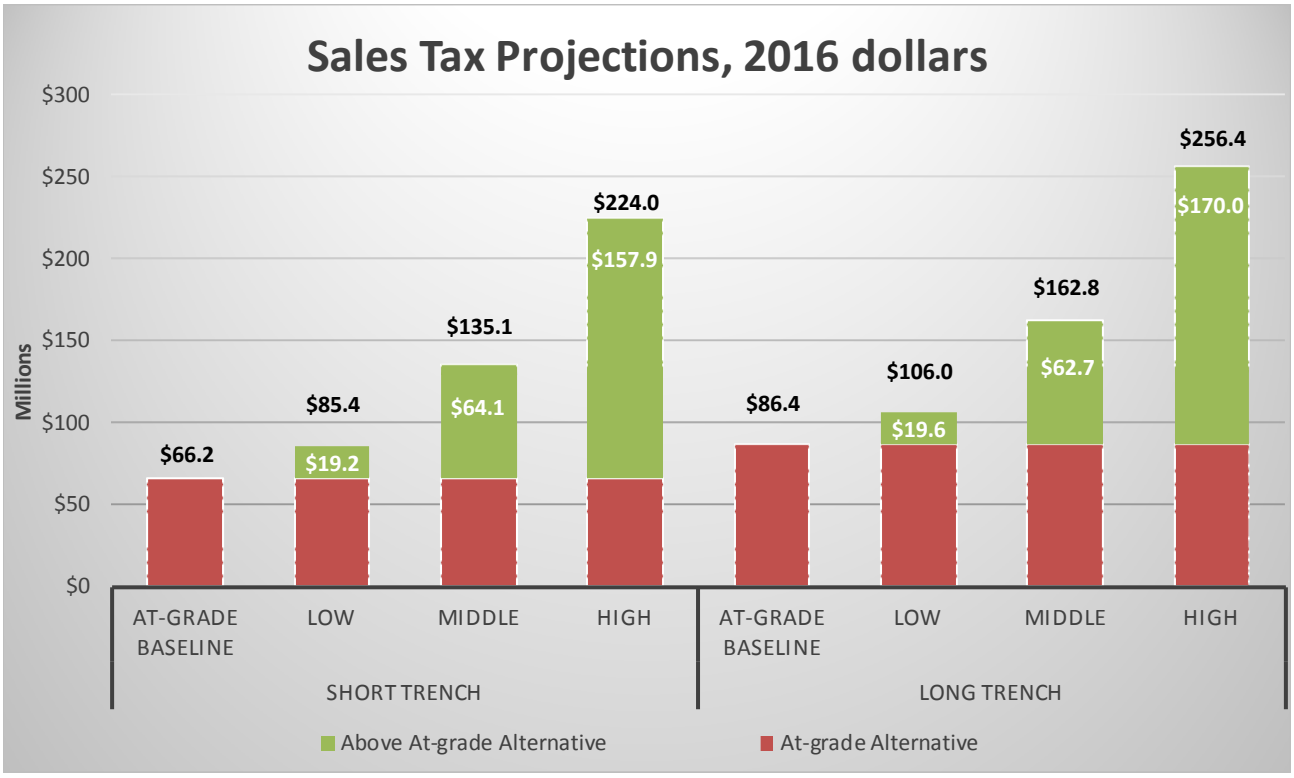


The index shows growth by representing sales taxes for a given year in relation to the sales taxes in 2026 (the latter being indexed at 100). Because the comparison to Solana Beach provides only approximately 20 years of data, the analysis (over 99 years) includes the higher growth rates described above for the first 20 years after construction is complete. In the Low scenario, the comparison then applies the Short Trench's and Long Trench's lower historical sales tax growth rates of 2.9% and 3.2% for the remaining years, 21 to 99. In the Middle scenario, the comparison uses the average rates of 4.1% and 4.3% in the Short Trench and Long Trench, respectively, for years 21 to 99. These rates are the averages of the lower historical sales tax growth rates and the higher annual growth rate used in the High scenario. Finally, in the High scenario, the comparison continues with the rest of Carlsbad's higher annual growth rate of 5.4% for all 99 years. The change from the higher growth rates to the lower growth rates is marked by a vertical line in Figure 19.

Sales Tax Projections

The resulting sales tax projections are presented in Figure 20. To show the difference between the At-grade scenario and the trenching scenarios more clearly, Figure 20 identifies the expected sales tax revenues in the At-grade alternative (separately for the Short Trench and Long Trench areas) as a baseline. Additional sales taxes generated due to grade separation and its associated impacts are shown in a different color.

Figure 20



In the Short Trench alternative, these growth rates translate to between $19.2 million and $157.9 million (2016 dollars) in additional sales taxes generated for Carlsbad within the Coastal Corridor over 99 years.

Additional retail sales resulting from greater economic activity would likely occur at first at existing retailers, increasing their sales per square foot, and then create demand for new retail development. RSG estimates that sales could increase at existing retailers from the current level of approximately $179 per square foot to the current level in the Solana Beach Retail Corridor at $189 per square foot. Once Coastal Corridor retailers' sales increase to an average of $189 per square foot, it is estimated that additional sales will result from new

development at the rate of $189 per square foot of new development. Based on this assumption, new sales could generate demand for up to 1,180,000 square feet of new commercial development in the Short Trench area. Actual new commercial development may be limited by factors such as land use limitations and the permitting process.

In the Long Trench alternative, the growth rates described earlier in this section translate to between $19.6 million and $170.0 million (2016 dollars) in additional sales taxes generated for Carlsbad within the Coastal Corridor over 99 years. Using the same approach regarding the sales capacity of existing retailers and new retail development RSG estimates that new sales as presented in Figure 20 could generate demand for as many as 1,377,000 square feet of new commercial development in the Long Trench area.

The increase in sales may generate additional sales tax revenues for the County of San Diego and the State of California. However, given Carlsbad's location within the County, economic development literature suggests that additional sales occurring in the Coastal Corridor will displace sales that would have occurred elsewhere in the County. Almost all, if not all, of the additional sales would have likely occurred elsewhere in the State. Therefore, this analysis assumes that the sales tax impact on the County and the State would be negligible.

Property Taxes

Carlsbad, County, and other taxing entities annually receive a portion of the ad valorem property taxes from all real property to pay for municipal and regional services. These property taxes are based on the assessed value of all property. Proposition 13 limits property taxes to 1% of assessed value and value increases to 2% per year, except when ownership changes. The effects of reduced traffic and noise on assessed values and property taxes will therefore be realized as properties are sold. **This Study assumes that the double track alternatives will not affect the rate of property re-sale (also called turnover).** Higher market prices may encourage some people to sell their home, while improved beach access and lower levels of traffic congestion and noise may influence some people to remain in their homes longer. Still other homeowners may sell their home based on relocation for work, family changes, or other factors independent of market home prices.

The trenching alternatives' impacts would be evidenced in a difference between market values. The value "capture" resulting from the difference between a Proposition 13-limited assessed value for a property that previously sold many years ago and that same property's sale and resulting re-assessment at market/sale value would occur with and without the trenching alternatives.

Property within the Coastal Corridor that may have been held by the same property owner for many years will be sold during the 99-year period. The result will be a very large jump in assessed value and property taxes. However, the focus of this Study is to determine the difference in property taxes between the At-grade scenario and grade-separated double tracking. Therefore, what is being projected in this section is only the *difference* resulting from a property turning over for a higher value than it would otherwise in the same situation.

For example (hypothetical), a property purchased in 1982 for $100,000, with a 2016 assessed value of $180,000, would likely be assessed in 2026 for approximately $220,000. If this property is sold in 2026 for $800,000 under the At-grade alternative, it would sell for $865,000 in a grade-separated alternative. The gain in assessed value of $580,000 ($800,000 - $220,000) for this hypothetical property would occur regardless of which double tracking alternative is implemented. Because this Study accepts that grade separation would not affect the timing of property sales, as explained above, the grade-separated alternatives would provide solely the additional $65,000 ($865,000 - $800,000) assessed value gain.

By reducing traffic congestion and noise, the trenching alternatives would increase that market/sale value a single time by an amount that can be determined using the DD approach introduced in the Sales Tax section.

Only this difference in sale value can be attributed to the trenching alternatives and only on the first property sale, aside from the associated 2% increase for each following year. Subsequent property sales would result in re-assessments in the same amount regardless of trenching.

As another example, assuming a home assessed at $500,000 would sell at a market price of $600,000 in the absence of trenching. If trenching would increase the market price to $650,000, it would account only for the increase of $50,000 ($650,000 - $600,000) when the property sells. The other $100,000 increase ($600,000 - $500,000), the value capture, would occur with and without trenching. Over 10 years, these new assessed values would likely increase annually by 2%, from $600,000 to approximately $730,000 and from $650,000 to approximately $790,000. If the home is sold again after 10 years in the absence of trenching for $780,000, the expected market price at that later time with trenching would be expected close to $840,000. The difference between the re-assessment value captures in the absence of trenching ($780,000 - $730,000 = $50,000) and with trenching ($840,000 - $790,000 = $50,000) are equal, demonstrating that the impact of trenching only applies to the first property sale.

Short Trench and Long Trench Alternatives

The Short Trench and Long Trench alternatives could support increased property values and property taxes in Carlsbad Village in two ways. First, by separating the railroad grade and thereby reducing traffic congestion and noise, these alternatives could make property throughout Carlsbad Village more desirable and raise the values thereof. Second, by adding crossings at Oak and Chestnut Avenues, the trenching alternatives would improve beach access for residents in certain areas east of the tracks, similarly increasing the desirability and values of those residents' homes.

Reduced Noise and Traffic Congestion Impacts

To estimate the impact of reduced noise and traffic congestion, we looked at the closest and most similar comparable example of a trenched rail line – Solana Beach.

Residential Property

Comparing the Solana Beach rail corridor to the rest of Solana Beach shows that home values in the two areas are about equal. The DD approach suggests that Coastal Corridor home values, currently on average approximately 8.5% less than home values in the rest of Carlsbad, will increase until they are about equal.

A turnover analysis (which summarizes the number of homes sold each year) shows that approximately 60% of homes in the Coastal Corridor have sold at least once within the last 10 years, while some homes are not sold for as long as 50 years. The projection of residential property tax growth due to reduced noise and traffic mimics the historical turnover rate of approximately 6% of homes sold each year during the first 10 years following trench construction completion, and approximately 1% of homes sold each year thereafter. This approach results in modeling historical turnover as closely as possible, with 60% of homes sold at least once within 10 years and 100% of homes sold at least once within 50 years. Properties can be sold more than once, but value changes associated with subsequent sales are not considered to result from the trenching as described earlier in the Property Taxes section. As the reduced noise and traffic congestion is expected to increase the homes' sale price, its effect is cumulative, accounting for the initial assessed value increase and each corresponding annual 2% increase afterwards.

Commercial Property

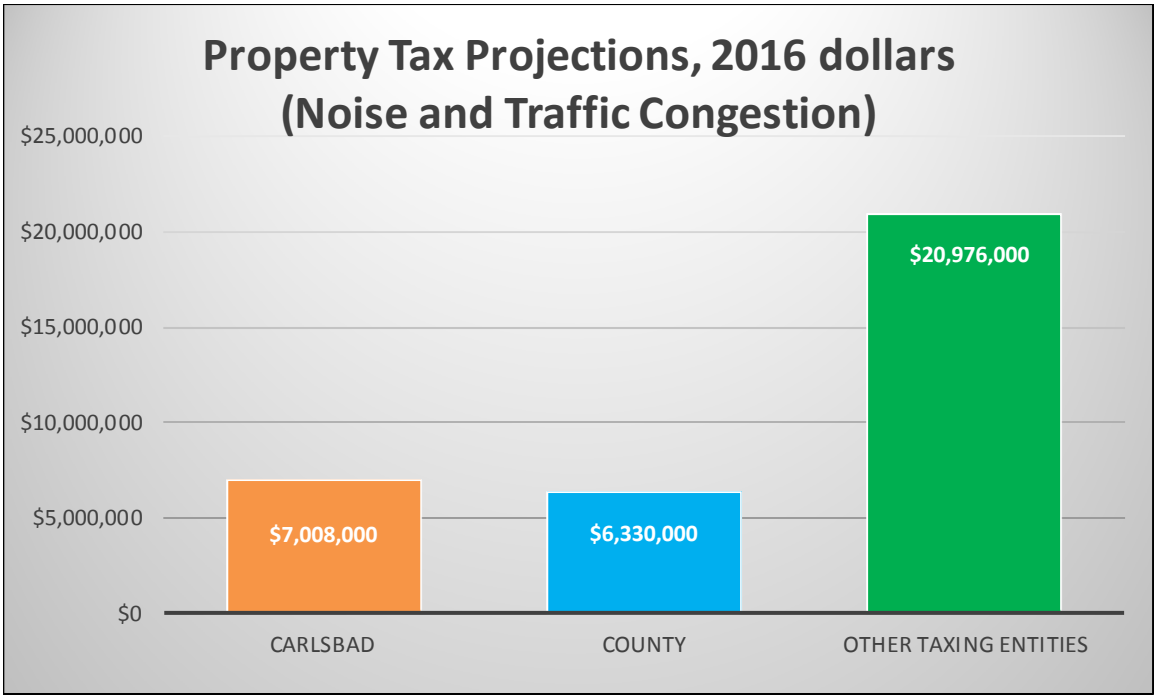
Commercial properties would also grow in value. There is a relationship between lease rates and property value for commercial properties such that a percentage change in a market's average lease rate corresponds to the percentage change in the market's value of all properties. The average lease rate in the Solana Beach

Rail Corridor is approximately 15% lower than it is in the rest of Solana Beach. Meanwhile, the Coastal Corridor has an average lease rate almost 39% lower than in the rest of Carlsbad. Based on the DD approach, we estimate that Coastal Corridor lease rates would increase to the point at which they would be about 15% lower than lease rates elsewhere in Carlsbad if the railroad grade were separated.

From the turnover analysis, we found that commercial properties in Carlsbad Village have sold less frequently than residential properties. Approximately 50% of commercial properties have sold in the last 10 years. The projection of commercial property tax growth models turnover based on historical data such that approximately 5% of commercial properties will be sold each year during the first 10 years after construction is complete, and approximately 1% of commercial properties are sold each year thereafter. This results in the model having 50% of commercial properties sold at least once within 10 years and 100% of commercial properties sold at least once within 60 years, paralleling the historical commercial turnover. The conditions of subsequent sales not considered to result from trenching and properties' annual 2% increase following the first sale accounted for by trenching, as described in the Property Taxes section, also apply to commercial properties.

In total, residential and commercial property taxes for properties located in the Coastal Corridor are expected to increase $34.3 million (in 2016 dollars) over 99 years due to noise and traffic reduction (Figure 21).

Figure 21



While these changes would occur within the Coastal Corridor only, their effects would extend farther. Projected property taxes to the different taxing entities, based on a weighted distribution of property taxes in the Coastal Corridor are:

- Carlsbad – approximately $7 million.
- County – $6.3 million.
- Other Taxing Entities (Includes Carlsbad Unified School District, Educational Revenue Augmentation Fund, several related elementary and secondary educational funds, Mira Costa Community College

District, and special districts (such as Tri-City Hospital District and Carlsbad Municipal Water District) – approximately $21.0 million

Impacts of Reduced Noise Alone (Subset of Total Property Value Impacts)

Property value and associated tax revenue estimated using the DD approach with Solana Beach as a comparison (discussed above) should account for value changes resulting from changes in noise and traffic congestion. The impacts of the noise reduction discussed in this particular section are a part of the total impacts identified above and not additional impacts to those stated above.

Construction noise would affect property values for a short period of time. However, this impact would only occur for properties adjacent to the tracks, which already experience high noise levels from train operations. Therefore, construction noise is not expected to impact home values significantly. Moreover, the construction term in the context of a 99-year period is relatively small. Even if construction noise affected property values in the short term, that effect would be overwhelmed by the long-term increase in property values.

A reduction in noise is expected to increase property values for single family homes. This effect is not expected to apply to multi-family residential and commercial properties due to the unique premium placed on single family homes in "quiet" neighborhoods. To estimate the noise reduction impact in dollars, RSG conducted an initial analysis of recent home sales, which did not provide usable results, and subsequently examined peer-reviewed studies on the relationship of noise and property values, which provided a usable methodology.

dBF, the noise and vibration consultant, analyzed the change in noise for the Short Trench and Long Trench scenarios (see Appendix 3). dBF's findings show that both the Short Trench and Long Trench alternatives would reduce noise levels by up to 12 dBA Leq[1], with additional analysis showing the magnitude and spatial distribution of the noise reduction. Specifically, the noise reductions would range between 0-3 and 9 dBA Leq in various segments of the Short Trench and Long Trench areas as shown in Figures 22 and 23. The magnitude of the noise reduction would depend on the trench depth at each point along the rail line. A reduction of 12 dBA Leq would occur at the railroad-street crossings, but would be so limited in geographic coverage that it would not affect a significant number of properties. The noise analysis looked at the three scenarios and provided the following:

- Maps of impact areas affected by trenching (replicated in Figures 22 and 23) and
- Degree of noise reduction in each impact area (identified by number of dBA Leq in Figures 22 and 23).

[1] dBA is an "A-weighted" decibel, a measure of noise adjusted to account for the range-limited sensitivity of human hearing. Leq is the average dBA level during a period of time. It is the preferred method of recording sound levels, especially for community noise.

Figure 22 – Short Trench Noise Impact Areas

Figure 23 – Long Trench Noise Impact Areas

Property Values Approach

RSG's initial analysis explored recent home sales to evaluate how noise may influence the value of a home. We analyzed home sale values from several Carlsbad tract developments; within each tract development, the homes were separated into two groups. The first group included homes located next to a highly trafficked street, whereas the homes of the second group were more interior to the development and were not adjacent to a busy street. The goal was to control for the impact of noise by attributing the difference in sales price to the premium a homebuyer is willing to pay for a home located in a quieter area, all other things being equal. The findings of this approach were inconclusive, as the data showed a mixed relationship between home value and proximity to a busy street. RSG attributes this result to the difficulty in finding homes that are exactly identical, even in the same tract development, and each difference in home qualities potentially resulting in differences in sale price.

Study Survey Approach

As an alternative methodology, RSG examined peer-reviewed journals and federal reports, leading to three studies describing the empirical evidence linking home values and noise ("Noise-Value Reports"). The Noise-Value Reports are

- "Highway noise and property values: a survey of recent evidence" by J.P. Nelson,
- "Federal Highway Cost Allocation Study" by the Federal Highway Administration ("FHWA"), and
- "The impact of traffic noise on the values of single-family houses" by M. Wilhelmsson.

The Noise-Value Reports assigned a monetary value to noise in terms of a percent discount for each increased decibel of noise above 55 dBA Leq, a common threshold for what is considered "noisy". The noise discounts presented in Figure 24 show a consistent range of impact.

Figure 24 – Decrease in Assessed Value per Increased dBA Leq

Minimum	Mean	Maximum	Source
0.16%	0.40%	0.63%	Nelson
0.14%	0.40%	0.88%	FHWA
	0.60%		Wilhelmsson

A reduction rate of 0.6% per decibel was selected:

- This rate was cited in the most recent study and fell within the ranges of the two other studies.
- The Noise-Value Reports suggest using a larger noise discount effect for higher income neighborhoods, such as those found in the Coastal Corridor.

It should be noted that the Noise-Value Reports focus on value reductions due to noise increase, while RSG's analysis applies this relationship in reverse. Also, the Noise-Value Reports consider changes in values among single-family homes only. Studies addressing the impacts on rental units and other non-residentially zoned properties are not available. Therefore, the impacts on these uses are not included as part of this analysis.

The reduction rate was applied to the total home value of each impact area in order to determine the potential range of noise impacts. In both Long Trench and Short Trench scenarios, the noise reduction effects amplify in the middle of the trench – by Chestnut Ave where it is deepest – and gradually taper moving north and south towards the lagoons, where the trench would be shallower.

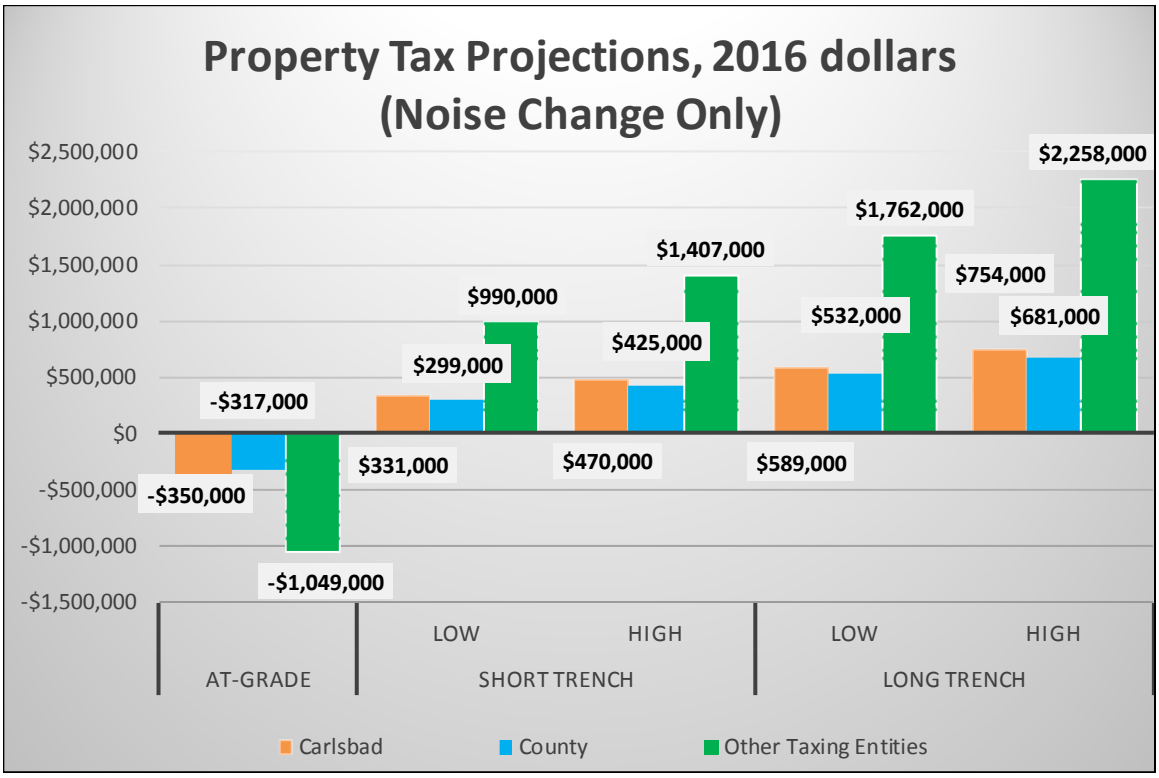
Referencing dBF's noise reduction maps, the total home value was identified within each of the areas delineated in the map and high and low noise discounts were applied to the total home values. For example, in the areas

that show a noise reduction of 3 to 6 decibels, using a noise discount rate of 0.6% per decibel, the low value increase is 1.8% and the high value increase is 3.6%.

The property turnover assumptions detailed previously in this Study were applied to this analysis in order to calculate increased property tax revenues.

As shown in Figure 25, **increased property values resulting from noise reduction alone in the Short Trench scenario are expected to generate between $1.6 and $2.3 million (2016 dollars) in property taxes over 99 years. In the Long Trench scenario, this estimate ranges from $2.9 million to $3.7 million.** The distribution among taxing entities is similar as previously described. Carlsbad would receive from $331,000 to $470,000 in the Short Trench scenario and between $589,000 and $754,000 in the Long Trench. The County's expected benefit ranges from $299,000 to $425,000 in the Short Trench and from $532,000 to $681,000 in the Long Trench. Other taxing entities would be expected to receive between $990,000 and $1.4 million in the Short Trench and between $1.8 million and $2.3 million in the Long Trench.

Figure 25



At-grade

dBF refrained from predicting changes in the average noise level in the At-grade scenario because double tracking could affect the character of train traffic and because it would have required a more specific analysis. The character of train traffic could be altered by freight trains running during daytime hours, whereas they are currently restricted to nighttime and one mid-day off-peak trip. The more specific analysis would require a survey of the number and type of trains passing through the Coastal Corridor each hour, which was beyond the scope of the noise evaluation.

According to dBF, the At-grade alternative would increase the average noise level by approximately 3 dBA Leq, which represents an approximate doubling, if double tracking simply doubled the existing train frequency.

To evaluate the property value and tax impact of the At-grade scenario, the analysis assumes that double tracking would do exactly that and would not change the train traffic character significantly.

The doubling in noise in the **At-grade alternative could reduce property values so that tax revenues would decline by approximately $1.7 million (2016 dollars) for all taxing entities over 99 years.** Carlsbad's portion of this potential decline is $350,000. The County could lose $317,000, while the other taxing entities could lose more than $1.0 million.

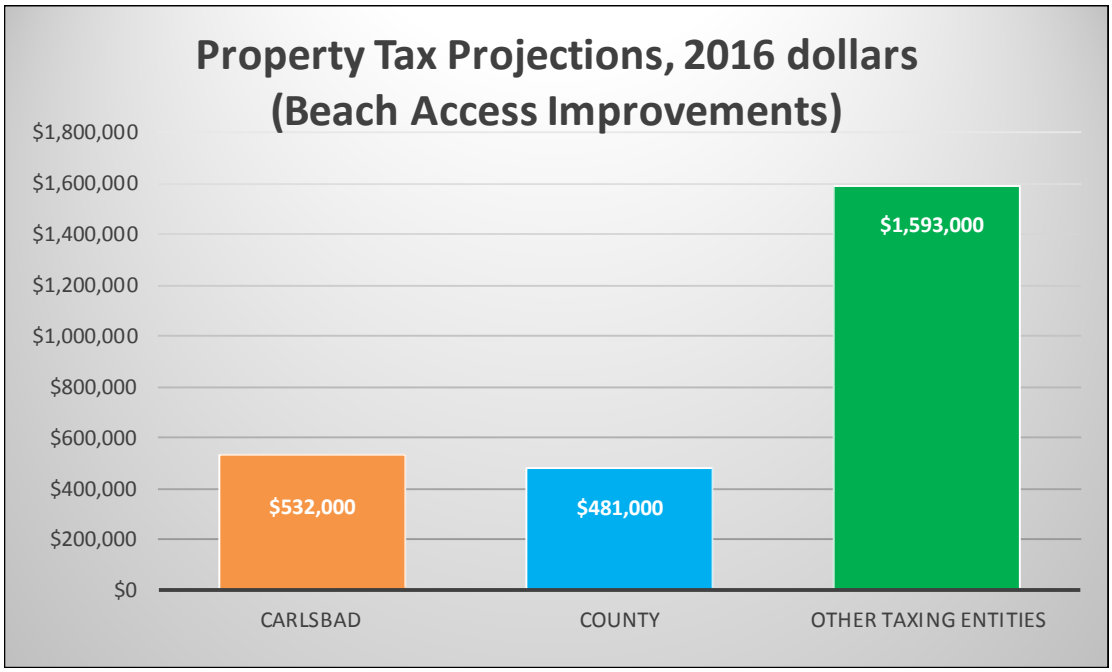
Impacts of Improved Beach Access

The additional crossings at Oak and Chestnut Avenues would improve beach access for residents living east of the railroad tracks, south of the midpoint between Carlsbad Village Drive and Oak Avenue, and north of Magnolia Avenue. RSG expects that this improved access may increase the median home value of this area within about 4 blocks of the railroad to the point that it will match the median home value in areas east of the tracks located closer to existing crossings (Carlsbad Village Drive and Tamarack Avenue). The areas are shown in Figure 26 based on their existing beach access. Residents living in the Poor Beach Access area would benefit from the additional railroad crossings and would likely see increased home values. Some residents on Oak and Chestnut Avenues may see increased traffic if their streets provide additional railroad crossings, but this would represent a relatively minor impact compared to the increased values for homes in the Poor Beach Access area with improved beach access.

Figure 26 – Map of Good Beach Access and Poor Beach Access Areas

Proposition 13 limits the impact of property value increases due to improved beach access in the same way that it does for property value increases due to noise and traffic congestion. In total, the **improved beach access is expected to increase property taxes over 99 years by approximately $2.6 million in 2016 dollars.** It is important to note that the methodology used here suggests that these value increases are additional to the value increases resulting from reduced noise and traffic congestion. Carlsbad and the County are expected to receive approximately $530,000 and $480,000, respectively. Other taxing entities would receive approximately $1.6 million. This information is illustrated in Figure 27.

Figure 27



Construction Impacts

Construction costs for the LOSSAN corridor increase as the amount of proposed trenching increases. The total construction costs for the Long Trench alternative is estimated at $335.1 million; for the Short Trench alternative, estimated construction costs total $224.1 million. The At-grade alternative with no trenching is projected to cost $62.0 million. All construction costs described here are in 2016 dollars. Construction costs were provided in the Feasibility Study and other supporting data from T.Y. Lin. Cost estimates were calculated using data from Caltrans, recent projects' drilling sub-contractors, field experts, and engineers.

Although there could be local negative economic impacts during the construction period, construction would be phased to minimize these negative impacts. For example, in the grade-separated alternatives, new crossings would be added before the existing at-grade crossings are removed. Nonetheless, road closures and construction vehicle traffic will likely reduce ease of access and shopper visits for local retailers. In addition, the proximity of the temporary shoofly track used during construction to the community would require trains to travel at lower speeds during construction, potentially creating negative regional economic impacts.

These impacts would occur for the length of construction. According to the Feasibility Study and discussions with T.Y. Lin, the length of construction is expected to be four and a half years for the Long Trench, four years for the Short Trench, and two years for the At-grade alternative. Focusing on local impacts, as this Study does, construction's impacts on retail access and shopper visits is difficult to estimate exactly given the many variables involved and retailers' ability to adapt (e.g., by extending business hours). What is certain is that the Short

Trench's negative economic impacts of construction will be about double that of the At-grade alternative, and the Long Trench's impacts will be about 2.25 times as large.

It should be noted that after the analysis for the Study was completed, the required vertical clearance for the project was changed from 26 feet to 24 feet. Since the analysis was already complete, it was not changed. However, RSG notes that a lower required vertical clearance would allow for lower construction costs in the Short Trench and Long Trench alternatives, which would correspond to a reduced construction duration as well as lower economic impacts of construction. As described in the Feasibility Study, the reduction equals 5-6% of the construction cost estimates identified in this Study.

Economic Impacts of Construction

Aside from the limited, potential negative concurrent economic impacts, construction will generate employment opportunities outside of the construction itself, add labor income to the market area, and add value to the gross regional product. For the purpose of this analysis, RSG used the IMPLAN model to measure the economic impacts of construction for Carlsbad and the County. IMPLAN is an input-output analysis software tool that tracks the interdependence among various producing and consuming sectors of the economy. According to MIG, Inc., the creators of IMPLAN, the software measures the relationship between a given set of demands for final goods and services and the inputs required to satisfy those demands. IMPLAN publishes countywide data on an annual basis; this analysis utilized the 2014 San Diego County dataset (the latest available) to calculate direct, indirect, and induced impacts.

Carlsbad was defined using its four zip codes: 92008, 92009, 92010, and 92011. RSG analyzed the direct, indirect, and induced effects for employment, labor income, and total economic output from construction. The various types of effects are described below:

- Direct Effect – Refers to the direct effects resulting from construction costs.
- Indirect Effect – Represents changes in sales, jobs, and income within the businesses that supply goods and services for the construction. Indirect effects impact surrounding and related businesses.
- Induced Effect – Regional changes resulting from additional spending earned either directly or indirectly from the construction.

The direct effects correspond to the cost and employment of the construction itself. Indirect and induced effects together ("Total Secondary Effects") demonstrate the impact of construction on the local economy, which is the focus of this Study. The results of the IMPLAN analysis are depicted in Figures 28 and 29.

Carlsbad Impacts

The construction of the At-grade alternative will result in 121 new secondary jobs and generate more than $18.2 million in secondary economic output in Carlsbad. The Short Trench would create 607 new secondary jobs and almost $91.6 million in secondary economic output, and the Long Trench would provide 907 new secondary jobs and more than $136.9 million in secondary economic output in Carlsbad.

County Impacts

Based on the nature of indirect and induced effects, indirect effects are relatively concentrated geographically, while induced effects can spread over larger areas. For this reason, when we look at effects on the County level, indirect effects increase slightly and induced effects increase more significantly. Overall, the At-grade alternative generates 195 new secondary jobs and almost $27.7 million in secondary economic output in the County. The Short Trench would produce 981 new secondary jobs and almost $139.2 million in secondary

economic output, and the Long Trench would lead to 1,467 new secondary jobs and more than $208.1 million in secondary economic output Countywide. These effects include those occurring within Carlsbad.

Figure 28

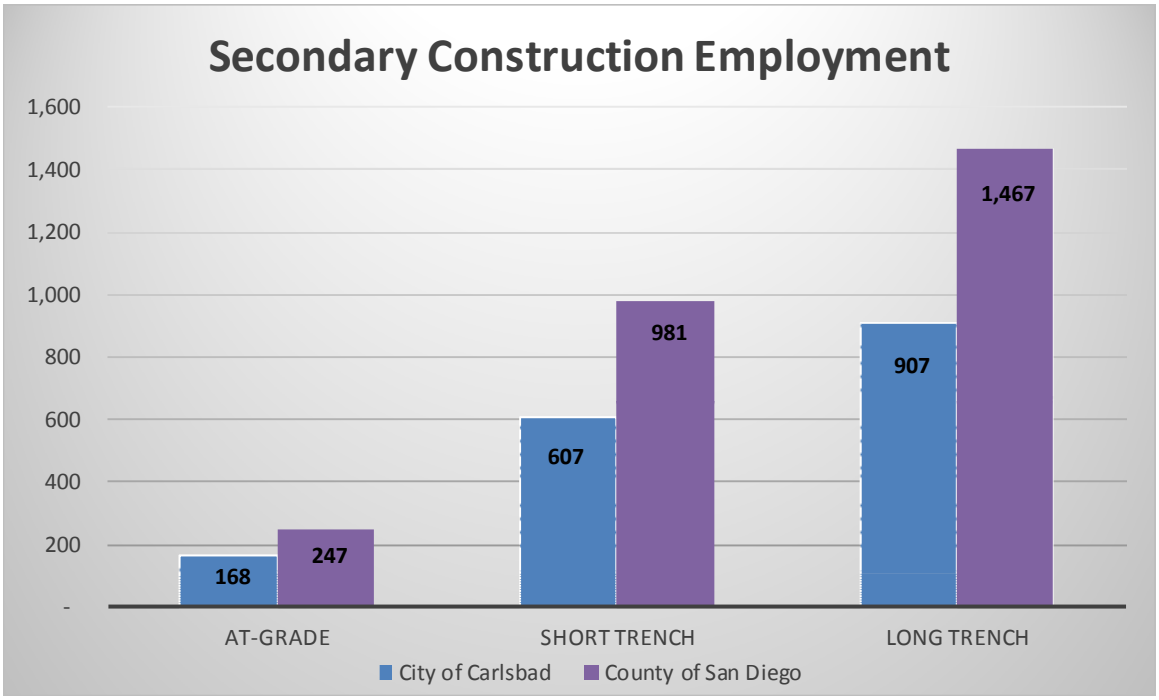
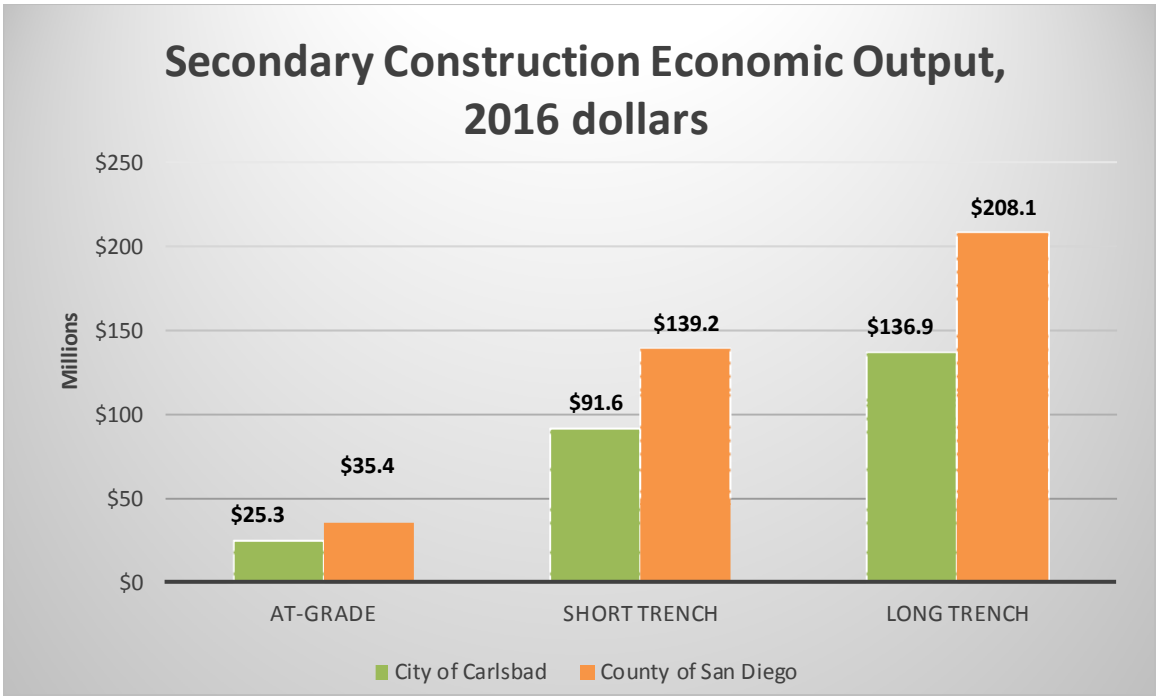


Figure 29



Transient Occupancy Taxes

RSG analyzed room rates at Carlsbad hotels to identify the impact of proximity to the rail line on hotel rates. The analysis suggests that proximity to the beach and to Legoland play a larger and tremendous role in determining hotel room rates than proximity to the railroad. Hotels that are close to the beach or Legoland and the railroad have consistently higher room rates and appear to cater to a higher-paying clientele than hotels that are not in close proximity to these locations.

RSG communicated with Brandon Feighner, Director at CBRE Hotels' Valuation and Advisory Services, who evaluates hotel development and room rates throughout Southern California. Based on his experience, Mr. Feighner noted that unless access is added where there was no access previously or access is completely removed, change in access (what would occur with additional railroad crossings and crossings' grade separation) is not likely to impact hotel room or occupancy rates in a measurable way.

RSG also communicated with several hotel operators in the Coastal Corridor. One operator of a hotel located within several blocks of the railroad indicated that trenching would likely not affect their hotel. Two other hotel operators—one located very close to the railroad and the other within about a half mile—indicated that trenching would likely help hotels in the Coastal Corridor.

Additionally, increased TOT revenues from AirBnB and VRBO were considered as part of this analysis. The City currently allows short term vacation rentals in the general area within the Coastal Corridor. The City's ordinance allows homeowner's associations to prohibit short term rentals for member homeowners. Because of the lack of vacant residential land within the designated short term rental area, and the likelihood that additional housing units added as a result of the future redevelopment of existing properties may be higher density than single family residential (meaning that homeowner's associations are likely for future residential units in this specific area), there is a lack of evidence that the number of short term vacation rentals will substantially increase in the future. It is likely that nightly rates for existing short term rental properties and the number of units will increase over time, resulting in additional TOT to the City, but these revenues are difficult to predict with certainty given a lack of data.

Another factor that contributes to the challenge of projecting TOT revenues in the Coastal Corridor would be community support of additional hotel development in this area.

Based on the data gathered, the finding that the role of proximity to the beach and to Legoland significantly outweigh the role of proximity to the railroad, input from Mr. Feighner (a hotel specialist), and local hotel operators, RSG believes that the Short Trench and Long Trench alternatives will likely contribute to higher room rates and occupancy rates in the Coastal Corridor, which would lead to greater TOT revenue for Carlsbad. Similarly, increased noise and traffic congestion associated with the At-grade alternative may reduce room and occupancy rates. However, there is currently insufficient quantitative data readily available to identify the scope of the impact of double tracking or trenching on TOT revenue.

Vacancy and Lease Rates

The Coastal Corridor's retail vacancy rate is currently less than half of the retail vacancy rate in the rest of Carlsbad. It is not expected to change significantly as a result of grade separation. This is partly based on a DD comparison to Solana Beach, where the retail vacancy rate in the rail corridor and in the rest of Solana Beach are approximately equal.

More specifically, the average lease rate in the Solana Beach Rail Corridor is approximately 15% lower than it is in the rest of Solana Beach. The Coastal Corridor has an average lease rate almost 39% lower than in the

rest of Carlsbad. Based on the DD approach, we estimate that Coastal Corridor lease rates would increase to the point at which they would be about 15% lower than lease rates elsewhere in Carlsbad if the railroad grade were separated. The impact of this change in lease rates on property values and taxes is provided in the Property Taxes section of this Study.

Job Creation

As greater economic activity resulting from trenching leads to retail sales increases in the Coastal Corridor, the increases will contribute both to increased sales at existing retailers as well as demand for new retail development. As referenced in the Sales Taxes section, RSG estimates that sales could increase at existing retailers from the current level of approximately $179 per square foot to the current level in the Solana Beach Retail Corridor at $189 per square foot. Once Coastal Corridor retailers' sales increase to an average of $189 per square foot, it is estimated that additional sales will result from new development at the rate of $189 per square foot of new development. Based on this assumption, new sales could generate demand for as many as 1,180,000 square feet of new commercial development in the Short Trench area and up to 1,377,000 new square feet in the Long Trench area. The amount of this real estate demand that is realized, as stated in the Sales Taxes section, may be limited by land use limitations, the permitting process, and other similar factors.

Based on the peak sales numbers identified as part of the sales tax projections, the associated estimated growth in retail square footage, current retail square footage of approximately 741,000 square feet, and existing retail-based (i.e., Retail Trade plus Accommodation and Food Services) employment of 2,196, local employment could increase from 0 jobs (in the "Low" projection for both trenching alternatives) to 3,500 or 4,083 jobs (in the "High" projection for the Short Trench and Long Trench alternatives, respectively).

Emergency Response

Train activity on the railroad can sometimes delay emergency responders. Fire Station 1, which serves the Coastal Corridor, reported three delays due to trains, ranging from 4.5 minutes to 7.5 minutes within a three-month period from February to April. One of these delays involved an ambulance, and the other two delays involved a fire truck.

The National Fire Protection Association recommends a standard for fire departments to have "the first arriving engine company at a fire suppression incident" within 4 minutes and "the full first alarm assignment" at the incident within 8 minutes. Firetactics.com estimates that an average fire can double in size every 60 seconds. Brain damage starts to occur within 3 to 5 minutes following a heart attack. Delays of 4.5 to 7.5 minutes for emergency responders can have serious consequences, sometimes being the different between life and death. These statistics are not intended to suggest that railroad crossing delays cause any of the mentioned outcomes; they simply underscore the importance of rapid emergency responses and the potential qualitative impact of delays.

There is an extreme amount of uncertainty in calculating the fiscal and economic impacts of reducing emergency response delays, particularly with one delay per month noted. The delays are not significant enough to affect Carlsbad's cost of emergency response services. Nor is it clear that the delays would lead to significantly different results in the cause of the emergency response. Ambulances and fire trucks respond to life-threatening situations as well as to non-urgent situations. At the very least, however, the comparison of current delays and what those delay times could mean in specific circumstances is provided as a qualitative consideration for the potential benefits of the trenching alternatives.

At-grade double tracking will likely increase the emergency response delays due to increased train frequency. Increased activity resulting in the trenching alternatives may increase local vehicle traffic, but this is

likely to be offset by eliminating railroad crossing delays. Therefore, it is not expected that the trenching alternatives would contribute to emergency response delays related to increased traffic activity. **The Short Trench and Long Trench alternatives are expected to eliminate emergency response delays by separating the railroad grade from the street grade.**

Displacement (Long Trench)

According to the *Double Track – Railroad Trench Alternative Feasibility Study* prepared in July 2016, the Short Trench could be constructed within the current railroad right-of-way, while **the Long Trench would require acquisition of three single family residential properties. The same study estimates that property acquisition of those three single family residential properties would cost $7,350,000. This is included in the Long Trench construction cost estimate.**

This section addresses the Long Trench alternative's displacement impact on private development only. **For the At-grade and Short Trench alternatives, the displacement impact on private development is $0.**

CONCLUSION

The results of a comprehensive economic and fiscal analysis of the proposed rail improvements in the City of Carlsbad:

At-grade Alternative

- Construction cost - $62.0 million.
- Value of lives saved – ($228.9) to ($567.9) million
- Economic impacts – ($143.4) million
- Direct fiscal impacts – ($1.7) million

Short Trench Alternative

- Construction cost - $224.1 million
- Value of lives saved - $363.2 to 901.2 million
- Economic benefits - $5.50 to $19.37 billion
- Direct fiscal impacts - $56.1 to $194.8 million

Long Trench Alternative

- Construction cost - $335.1 million
- Value of lives saved - $484.7 million to $1.20 billion
- Economic benefits - $5.61 to $20.66 billion
- Direct fiscal benefits - $56.5 to $207.0 million

APPENDIX 1 - REFERENCES

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APPENDIX 2 - TRAFFIC EVALUATION FOR LOSSAN RAIL CORRIDOR IMPROVEMENT OPTIONS, PREPARED BY KIMLEY-HORN AND ASSOCIATES, INC.

MEMORANDUM

To: Hitta Mosesman, RSG

From: Leo Espelet, P.E., T.E.

Kimley-Horn and Associates, Inc.

Date: July 27, 2016

Subject: Traffic Evaluation for LOSSAN Rail Corridor Improvement Options

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The following memo has been prepared to evaluate the traffic effects associated with the railroad improvements for the Los Angeles-San Diego-San Luis Obispo (LOSSAN) rail corridor.

The LOSSAN rail corridor runs from the San Diego – Sante Fe Depot Station to San Luis Obispo. Within the City of Carlsbad there are three at-grade crossings; Grand Avenue, Carlsbad Village Drive, and Tamarack Avenue. There are also three train services that utilize the corridor within the City of Carlsbad; freight, Coaster Rail, and Amtrak Rail.

The railroad improvement alternatives include options for keeping the at-grade crossings or creating grade separated crossings at each location. Two scenarios were analyzed as part of the traffic evaluation, which are listed below:

Existing Conditions

- Existing Conditions (traffic volumes and train frequencies) with at grade crossings
- Existing Conditions with grade separated crossings

Future 2035 Conditions

- Future 2035 Conditions (traffic volumes and train frequencies) with at grade crossings
- Future 2035 Conditions with grade separated crossings

DATA COLLECTION

Vehicle arrivals, gate down times, train frequencies, and train schedules were determined for both the Existing and Future 2035 Conditions.

Vehicle Arrivals

24-hour road segment data was collected by National Data and Surveying Services (NDS) from February 26, 2016 to March 3, 2016. These counts were collected for each direction of travel for a one-week period in 1 minute intervals at each of the railroad crossing locations. 1-minute counts were used for Existing Condition arrival volumes. Existing Counts are included as an attachment.

Based on SANDAG Series 13 unadjusted average daily traffic volumes, an annual growth rate for each roadway segment with a railroad crossing was determined. These rates were then applied to the

existing arrival volumes to determine the Future 2035 arrival volumes. SANDAG Series 13 volumes are included as an attachment.

Carlsbad experiences a high summer season. The high summer season typically begins in May and runs through August. *Based on the Tourism Industry Study Prepared for the City of Carlsbad, January 2015*, the month with the highest hotel occupancy is July with 89%. In comparison, February has a hotel occupancy of 65%. To account for the increase of activity in Carlsbad in the summer season, a seasonal adjustment of 24% was applied to the existing and future 2035 arrival volumes.

Gate Down Times

Field observations were conducted on March 30, 2016 between 7:00 am and 10:00 am to discern the morning peak hour operations at each of the at-grade crossing locations. Typical gate down times for each type of train service were determined based on these field observations.

Field observation estimates were rounded up to the nearest minute for analysis. At the Grand Avenue and Carlsbad Village Drive railroad crossings the gate down time was assumed to be four minutes for southbound Coaster trains due to the fact that the gates remained down the whole time the train was stopped at the Carlsbad Village Station. At the same locations, the gate down for northbound Coaster trains and Pacific Surfliner trains (both directions) was assumed to be two minutes and one minute respectively. At the Tamarack railroad crossing the gate down time was assumed to be one minute for all train types.

Gate down times were assumed to be the same for both Existing and Future 2035 Conditions. It should be noted that Amtrak service (Pacific Surfliner trains) may not stop at the Carlsbad Village Station in the future. This would not change the analysis, as the gate down time for Pacific Surfliner trains is already assumed to be the minimum amount of time (1 minute).

Train Frequency and Schedule

Existing train frequency and schedule was obtained from the Southern California Passenger Rail System Map and Time Tables, effective October 5, 2015. The frequency and schedule did not include freight trains, therefore freight trains were not included in the analysis. Existing schedule is included as an attachment.

Future Service Level Assumptions from Oceanside to San Diego were provided by SANDAG in the *Infrastructure Development Plan for the LOSSAN Rail Corridor in San Diego County, dated August 2013.* On Table 3-2 it was assumed that Intercity Lines would increase by 14 trains with a frequency goal of 60 minutes and Commuter Lines would increase by 32 trains with a peak frequency of 20 minutes and a non-peak frequency of 60 – 90 minutes. These assumptions were applied to the existing weekday and weekend train schedules to estimate a Future 2035 Condition schedule. Assumed future schedules are included as an attachment.

With the future schedule and increased train frequency the total gate down times would increase by more than double. **Table 1** displays the gate down times under Existing and Future 2035 Conditions for the at grade crossing locations.

Table 1 Daily Gate Down Times

Schedule	Gate Down Time (min)	
	Existing	Future 2035
Grand Ave & Carlsbad Village Dr		
Weekday	84	167
Weekend	46	120
Tamarack Ave		
Weekday	44	92
Weekend	30	76

DATA ANALYSIS

Cumulative traffic delay times were determine for each railroad crossing location for each scenario. The analysis process includes determining the vehicular delay at each railroad crossing on a typical weekday, Saturday, and Sunday.

As shown above, the analysis scenarios include at grade and grade separated crossing options. Grade separated crossings put the train and vehicles on separate levels, therefore there are no conflicts between the two modes of transportation and no associated vehicular delay.

To evaluate the impacts of the at-grade crossings, a spreadsheet tool was created to determine the total delay for each train arriving at each crossing over the course of a day. The total delay was determined starting at the time the gate goes down and continued until the queue was fully dissipated. It was assumed that the vehicle queues are completely dissipated before the next train arrives at the crossing. Daily average delay per vehicle was then calculated by dividing the sum of the total delay by the number of vehicles arriving at the crossing.

Delay will vary by time of day, because it is dependent on the amount of crossing traffic. It is important to note that many of the vehicles arriving at the crossing will not be delayed by the train, but they are included in the calculation of average delay. The same way that average delay is computed for signalized intersections.

AVERAGE DELAY

Daily average delay was calculated at the at-grade crossing locations on Grand Avenue, Carlsbad Village Drive, and Tamarack Avenue under Existing, Future 2035, and Summer Seasonal Conditions. Average delay calculations are included as an attachment.

Grand Avenue

Grand Avenue is classified as a Village Street between Ocean Street and Interstate 5, per the Carlsbad General Plan Mobility Element, that provides access to the Carlsbad Village Station. At the railroad crossing, the roadway is currently one lane in each direction with a raised center median. No changes in geometry are assumed for the Future 2035 Condition. **Table 2** displays the daily average delay for the Grand Avenue railroad crossing under Existing and Future 2035 Conditions with the at-grade crossing option.

As shown in the table, under Existing Conditions the average daily delay is expected to be less than 7 seconds during a typical weekday day and less than 4 seconds during a weekend day. The total typical weekly delay is expected to be less than 37 seconds in both the eastbound and westbound directions. Under Existing Conditions during a typical weekday day, the maximum hourly delay was found to be approximately 26 seconds.

Table 2 Grand Avenue Summary of Delay

	Direction	Typical Weekday Day		Saturday		Sunday		*Typical Week*	
		Delay (a)	ADT	Delay (a)	ADT	Delay (a)	ADT	*Delay (b)*	AWT
Existing	Eastbound	5.95	2,765	2.12	3,590	3.01	2,891	***34.88***	***20,306***
	Westbound	5.60	2,791	3.11	3,402	3.12	2,600	***34.23***	***19,957***
Existing *Summer Season*	Eastbound	6.26	3,283	2.18	4,320	3.20	3,427	***36.68***	***24,162***
	Westbound	5.90	3,334	3.26	4,072	3.23	3,080	***35.99***	***23,822***
Future 2035	Eastbound	12.94	2,768	10.11	3,594	10.53	2,896	***85.34***	***20,330***
	Westbound	12.99	2,796	10.68	3,408	11.96	2,601	***87.59***	***19,989***
Future 2035 *Summer Season*	Eastbound	13.57	3,286	10.69	4,324	11.12	3,432	***89.66***	***24,186***
	Westbound	13.69	3,339	11.40	4,078	12.61	3,081	***92.46***	***23,854***

ADT = Average daily traffic
AWT = Average weekly traffic (calculated by multiplying the typical weekday ADT by 5 and adding the Saturday and Sunday ADT)
(a) Delay refers to the average control delay for the entire day, measured in seconds per vehicle.
(b) Delay refers to the average control delay for the entire week, measured in seconds per vehicle and calculated by multiplying the typical weekday delay by 5 and adding the Saturday and Sunday delay.

Under Future Conditions, the average daily delay is expected to be less than 14 seconds during a typical weekday and weekend day. The total typical weekly delay is expected to be less than 93 seconds in both the eastbound and westbound directions. Under Future 2035 Conditions during a typical weekday day, the maximum hourly delay was found to be approximately 36 seconds.

Carlsbad Village Drive

Carlsbad Village Drive classified is an Identity Street south of Interstate 5, per the Carlsbad General Plan Mobility Element, that provides access to the beach, Interstate 5, and further east. At the railroad crossing, the roadway is currently two lanes in each direction with a raised center median and bike lanes. No changes in geometry are assumed for the Future 2035 Condition.

Table 3 displays the daily average delay for the Carlsbad Village Drive railroad crossing under Existing and Future 2035 Conditions with the at-grade crossing option.

Table 3 Carlsbad Village Drive Summary of Delay

	Direction	Typical Weekday Day		Saturday		Sunday		*Typical Week*	
		Delay (a)	ADT	Delay (a)	ADT	Delay (a)	ADT	*Delay (b)*	*AWT*
Existing	Eastbound	6.10	6,107	2.70	7,690	3.57	6,583	***36.77***	***44,808***
	Westbound	6.31	6,364	3.72	8,229	3.97	6,699	***39.24***	***46,748***
Existing *Summer Season*	Eastbound	6.57	7,463	2.99	9,422	6.68	8,035	***42.52***	***54,772***
	Westbound	6.78	7,799	4.19	10,100	4.65	8,179	***42.74***	***57,274***
Future 2035	Eastbound	14.32	6,213	12.52	7,911	14.20	6,742	***98.32***	***45,718***
	Westbound	15.74	6,504	15.15	8,496	13.97	6,887	***107.82***	***47,903***
Future 2035 *Summer Season*	Eastbound	15.94	7,579	14.59	9,673	15.73	8,214	***110.02***	***55,782***
	Westbound	13.06	7,955	20.53	10,414	16.47	8,406	***102.30***	***58,595***

ADT = Average daily traffic
AWT = Average weekly traffic (calculated by multiplying the typical weekday ADT by 5 and adding the Saturday and Sunday ADT)
(a) Delay refers to the average control delay for the entire day, measured in seconds per vehicle.
(b) Delay refers to the average control delay for the entire week, measured in seconds per vehicle and calculated by multiplying the typical weekday delay by 5 and adding the Saturday and Sunday delay.

As shown in the table, under Existing Conditions the average daily delay is expected to be less than 7 seconds during a typical weekday day and less than 5 seconds during a weekend day. The total typical weekly delay is expected to be less than 43 seconds in both the eastbound and westbound directions. Under Existing Conditions during a typical weekday day, the maximum hourly delay was found to be approximately 24 seconds.

Under Future Conditions, the average daily delay is expected to be less than 16 seconds during a typical weekday and less than 21 seconds during a weekend day. The total typical weekly delay is expected to be less than 111 seconds in both the eastbound and westbound directions. Under Future 2035 Conditions during a typical weekday day, the maximum hourly delay was found to be approximately 37 seconds.

Tamarack Avenue

Tamarack Avenue is classified as a Connector Street, per the Carlsbad General Plan Mobility Element, that provides access to the beach and Carlsbad Boulevard, Interstate 5, and further east. At the railroad crossing, the roadway is currently one lane in each direction with a raised center median and bike lanes.

Table 4 displays the daily average delay for the Tamarack Avenue railroad crossing under Existing and Future 2035 Conditions with the at-grade crossing option.

Table 4 Tamarack Avenue Summary of Delay

	Direction	Typical Weekday Day		Saturday		Sunday		*Typical Week*	
		Delay (a)	ADT	Delay (a)	ADT	Delay (a)	ADT	*Delay (b)*	*AWT*
Existing	Eastbound	2.00	5,298	1.53	5,722	1.32	5,105	***12.85***	***37,317***
	Westbound	1.89	5,180	1.59	5,713	1.62	5,035	***12.66***	***36,648***
Existing *Summer Season*	Eastbound	2.25	6,450	1.78	6,977	1.50	6,211	***14.53***	***45,438***
	Westbound	2.12	6,316	1.80	6,965	1.84	6,106	***14.24***	***44,651***
Future 2035	Eastbound	4.29	5,298	3.72	5,722	3.31	5,105	***29.98***	***37,317***
	Westbound	4.38	5,180	3.67	5,713	3.66	5,035	***29.23***	***36,648***
Future 2035 *Summer Season*	Eastbound	4.79	6,450	4.28	6,977	3.68	6,211	***31.91***	***45,438***
	Westbound	4.89	6,316	4.14	6,965	4.08	6,106	***32.67***	***44,651***

ADT = Average daily traffic
AWT = Average weekly traffic (calculated by multiplying the typical weekday ADT by 5 and adding the Saturday and Sunday ADT)
(a) Delay refers to the average control delay for the entire day, measured in seconds per vehicle.
(b) Delay refers to the average control delay for the entire week, measured in seconds per vehicle and calculated by multiplying the typical weekday delay by 5 and adding the Saturday and Sunday delay.

As shown in the table, under Existing Conditions the average daily delay is expected to be less than 3 seconds during a typical weekday and weekend day. The total typical weekly delay is expected to be less than 15 seconds in both the eastbound and westbound directions. Under Existing Conditions during a typical weekday day, the maximum hourly delay was found to be approximately 6 seconds.

Under Future Conditions, the average daily delay is expected to be less than 5 seconds during a typical weekday and weekend day. The total typical weekly delay is expected to be less than 33 seconds in both the eastbound and westbound directions. Under Future 2035 Conditions during a typical weekday day, the maximum hourly delay was found to be approximately 13 seconds.

QUEUEING ANALYSIS

Queueing analysis was performed for each direction of travel and determined for each railroad crossing location for each scenario on a typical weekday day. **Table 5** displays the maximum queue for each of the railroad crossing locations. Daily queue fluctuations charts are included as an attachment.

As shown in the table, at the Grand Avenue at-grade crossing under Existing Conditions, the maximum queue is expected to be 21 and 17 vehicles in the eastbound and westbound directions respectively. Under Future Conditions, the maximum queue is expected to be 27 and 25 vehicles in the eastbound and westbound directions respectively.

At the Carlsbad Village Drive at-grade crossing under Existing Conditions, the maximum queue is expected to be 36 and 38 vehicles in the eastbound and westbound directions respectively. Under Future Conditions, the maximum queue is expected to be 45 and 55 vehicles in the eastbound and westbound directions respectively.

At the Tamarack Avenue at-grade crossing under Existing Conditions, the maximum queue is expected to be 17 and 20 vehicles in the eastbound and westbound directions respectively. Under Future Conditions, the maximum queue is expected to be 17 and 20 vehicles in the eastbound and westbound directions respectively.

Table 5 Maximum Vehicular Queue

	Direction	Queue (veh)		
		Grand Ave	Carlsbad Village Dr	Tamarack Ave
Existing	Eastbound	17	29	14
	Westbound	14	31	16
Existing *Summer Season*	Eastbound	21	36	17
	Westbound	17	38	20
Future 2035	Eastbound	22	36	14
	Westbound	20	44	16
Future 2035 *Summer Season*	Eastbound	27	45	17
	Westbound	25	55	20

CONCLUSIONS

As shown in the analysis above, the increase in train schedule and frequency expected in the future will have an impact on vehicular operations at the existing at-grade crossing within the City of Carlsbad. Specifically in terms of average delay per week, the expected increase in train frequency and growth in traffic more than doubled the average delay at each crossing. Percent increases at each railroad crossing are listed below.

- **Grand Avenue – *150%***
- **Carlsbad Village Drive – *171%***
- **Tamarack Avenue – *132%***

Attachments

- Existing Counts
- SANDAG Series 13 Volumes
- Existing Train Schedule
- Assumed Future 2035 Schedule
- Average Delay Calculation Model
- Daily Queue Fluctuations

Prepared by NDS/ATD

VOLUME

Grand Ave Bet. Railroad Crossing & State St

Day: Friday
Date: 2/26/2016

City: Carlsbad
Project #: CA16_4057_001

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	3,643	3,323	6,966

AM Period	NB	SB	EB		WB		TOTAL		PM Period	NB	SB	EB		WB		TOTAL	
00:00			13		10		23		12:00			79		74		153	
00:15			13		8		21		12:15			69		66		135	
00:30			9		6		15		12:30			64		54		118	
00:45			9	44	8	32	17	76	12:45			63	275	54	248	117	523
01:00			15		4		19		13:00			62		68		130	
01:15			9		10		19		13:15			72		66		138	
01:30			10		6		16		13:30			71		54		125	
01:45			4	38	2	22	6	60	13:45			53	258	63	251	116	509
02:00			2		1		3		14:00			74		74		148	
02:15			8		0		8		14:15			70		46		116	
02:30			1		1		2		14:30			51		60		111	
02:45			6	17	0	2	6	19	14:45			71	266	69	249	140	515
03:00			0		2		2		15:00			60		62		122	
03:15			0		0		0		15:15			70		67		137	
03:30			0		1		1		15:30			49		71		120	
03:45			2	2	3	6	5	8	15:45			65	244	67	267	132	511
04:00			1		0		1		16:00			69		62		131	
04:15			1		0		1		16:15			81		62		143	
04:30			2		0		2		16:30			67		56		123	
04:45			2	6	6	6	8	12	16:45			62	279	85	265	147	544
05:00			5		2		7		17:00			57		62		119	
05:15			6		8		14		17:15			69		69		138	
05:30			5		5		10		17:30			57		66		123	
05:45			7	23	9	24	16	47	17:45			83	266	63	260	146	526
06:00			5		8		13		18:00			73		44		117	
06:15			9		14		23		18:15			56		51		107	
06:30			14		21		35		18:30			65		37		102	
06:45			22	50	34	77	56	127	18:45			64	258	41	173	105	431
07:00			21		32		53		19:00			57		49		106	
07:15			21		25		46		19:15			64		41		105	
07:30			25		29		54		19:30			49		36		85	
07:45			31	98	42	128	73	226	19:45			50	220	29	155	79	375
08:00			15		32		47		20:00			33		28		61	
08:15			25		42		67		20:15			32		36		68	
08:30			33		34		67		20:30			39		25		64	
08:45			37	110	54	162	91	272	20:45			38	142	24	113	62	255
09:00			43		55		98		21:00			47		25		72	
09:15			59		52		111		21:15			28		20		48	
09:30			54		52		106		21:30			47		31		78	
09:45			48	204	47	206	95	410	21:45			38	160	27	103	65	263
10:00			59		51		110		22:00			34		14		48	
10:15			54		49		103		22:15			34		21		55	
10:30			55		52		107		22:30			32		21		53	
10:45			58	226	62	214	120	440	22:45			27	127	20	76	47	203
11:00			45		57		102		23:00			40		21		61	
11:15			51		52		103		23:15			18		17		35	
11:30			55		43		98		23:30			23		18		41	
11:45			67	218	59	211	126	429	23:45			31	112	17	73	48	185
TOTALS				1036		1090		2126	TOTALS				2607		2233		4840
SPLIT %				48.7%		51.3%		30.5%	SPLIT %				53.9%		46.1%		69.5%

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	3,643	3,323	6,966

AM Peak Hour			11:45	11:45	11:45	PM Peak Hour			15:45	16:45	16:00
AM Pk Volume			279	253	532	PM Pk Volume			282	282	544
Pk Hr Factor			0.883	0.855	0.869	Pk Hr Factor			0.870	0.829	0.925
7 - 9 Volume	0	0	208	290	498	4 - 6 Volume	0	0	545	525	1070
7 - 9 Peak Hour			08:00	08:00	08:00	4 - 6 Peak Hour			16:00	16:45	16:00
7 - 9 Pk Volume	0	0	110	162	272	4 - 6 PK Volume	0	0	279	282	544
Pk Hr Factor	0.000	0.000	0.743	0.750	0.747	Pk Hr Factor	0.000	0.000	0.861	0.829	0.925

Prepared by NDS/ATD

VOLUME

Grand Ave Bet. Railroad Crossing & State St

Day: Saturday
Date: 2/27/2016

City: Carlsbad
Project #: CA16_4057_001

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	3,590	3,402	6,992

AM Period	NB	SB	EB		WB		TOTAL		PM Period	NB	SB	EB		WB		TOTAL	
00:00			21		17		38		12:00			66		79		145	
00:15			22		19		41		12:15			56		62		118	
00:30			20		16		36		12:30			80		69		149	
00:45			14	77	5	57	19	134	12:45			64	266	58	268	122	534
01:00			12		13		25		13:00			70		64		134	
01:15			19		12		31		13:15			63		76		139	
01:30			27		21		48		13:30			67		53		120	
01:45			32	90	16	62	48	152	13:45			57	257	58	251	115	508
02:00			19		9		28		14:00			69		61		130	
02:15			11		6		17		14:15			54		59		113	
02:30			2		2		4		14:30			58		50		108	
02:45			4	36	1	18	5	54	14:45			65	246	63	233	128	479
03:00			0		0		0		15:00			66		43		109	
03:15			1		1		2		15:15			74		58		132	
03:30			3		3		6		15:30			63		57		120	
03:45			2	6	0	4	2	10	15:45			62	265	66	224	128	489
04:00			2		2		4		16:00			56		68		124	
04:15			1		3		4		16:15			55		50		105	
04:30			3		1		4		16:30			49		66		115	
04:45			4	10	2	8	6	18	16:45			60	220	73	257	133	477
05:00			2		2		4		17:00			55		71		126	
05:15			3		4		7		17:15			50		44		94	
05:30			2		6		8		17:30			51		50		101	
05:45			4	11	3	15	7	26	17:45			74	230	44	209	118	439
06:00			2		6		8		18:00			74		46		120	
06:15			4		15		19		18:15			52		39		91	
06:30			6		13		19		18:30			59		39		98	
06:45			11	23	17	51	28	74	18:45			59	244	42	166	101	410
07:00			12		20		32		19:00			45		32		77	
07:15			17		27		44		19:15			40		37		77	
07:30			19		14		33		19:30			39		25		64	
07:45			28	76	30	91	58	167	19:45			33	157	34	128	67	285
08:00			22		32		54		20:00			40		20		60	
08:15			20		33		53		20:15			36		23		59	
08:30			37		50		87		20:30			33		24		57	
08:45			47	126	49	164	96	290	20:45			33	142	24	91	57	233
09:00			44		54		98		21:00			29		30		59	
09:15			42		42		84		21:15			32		24		56	
09:30			38		41		79		21:30			28		33		61	
09:45			54	178	53	190	107	368	21:45			41	130	32	119	73	249
10:00			49		72		121		22:00			51		33		84	
10:15			53		42		95		22:15			36		23		59	
10:30			58		81		139		22:30			38		28		66	
10:45			82	242	89	284	171	526	22:45			36	161	23	107	59	268
11:00			49		65		114		23:00			26		24		50	
11:15			86		91		177		23:15			30		26		56	
11:30			74		80		154		23:30			24		21		45	
11:45			81	290	83	319	164	609	23:45			27	107	15	86	42	193
TOTALS				1165		1263		2428	TOTALS				2425		2139		4564
SPLIT %				48.0%		52.0%		34.7%	SPLIT %				53.1%		46.9%		65.3%

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	3,590	3,402	6,992

AM Peak Hour			11:15	11:15	11:15	PM Peak Hour		12:30	12:00	12:30
AM Pk Volume			307	333	640	PM Pk Volume		277	268	544
Pk Hr Factor			0.892	0.915	0.904	Pk Hr Factor		0.866	0.848	0.913
7 - 9 Volume	0	0	202	255	457	4 - 6 Volume	0	450	466	916
7 - 9 Peak Hour			08:00	08:00	08:00	4 - 6 Peak Hour		17:00	16:15	16:15
7 - 9 Pk Volume	0	0	126	164	290	4 - 6 Pk Volume	0	230	260	479
Pk Hr Factor	0.000	0.000	0.670	0.820	0.755	Pk Hr Factor	0.000	0.777	0.890	0.900

Prepared by NDS/ATD

VOLUME

Grand Ave Bet. Railroad Crossing & State St

Day: Sunday
Date: 2/28/2016

City: Carlsbad
Project #: CA16_4057_001

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	2,891	2,600	5,491

AM Period	NB	SB	EB		WB		TOTAL		PM Period	NB	SB	EB		WB		TOTAL	
00:00			30		14		44		12:00			59		66		125	
00:15			16		11		27		12:15			58		68		126	
00:30			24		14		38		12:30			68		47		115	
00:45			28	98	12	51	40	149	12:45			58	243	53	234	111	477
01:00			22		23		45		13:00			57		59		116	
01:15			14		12		26		13:15			51		62		113	
01:30			22		22		44		13:30			60		68		128	
01:45			40	98	15	72	55	170	13:45			57	225	43	232	100	457
02:00			17		10		27		14:00			65		49		114	
02:15			14		5		19		14:15			65		43		108	
02:30			5		4		9		14:30			72		49		121	
02:45			2	38	6	25	8	63	14:45			57	259	71	212	128	471
03:00			3		2		5		15:00			49		56		105	
03:15			5		1		6		15:15			60		59		119	
03:30			3		1		4		15:30			66		47		113	
03:45			3	14	2	6	5	20	15:45			65	240	51	213	116	453
04:00			2		2		4		16:00			48		53		101	
04:15			1		0		1		16:15			63		48		111	
04:30			2		0		2		16:30			55		46		101	
04:45			0	5	5	7	5	12	16:45			39	205	58	205	97	410
05:00			2		3		5		17:00			41		60		101	
05:15			3		3		6		17:15			48		44		92	
05:30			1		2		3		17:30			54		26		80	
05:45			2	8	6	14	8	22	17:45			65	208	41	171	106	379
06:00			4		5		9		18:00			45		28		73	
06:15			5		4		9		18:15			53		29		82	
06:30			6		12		18		18:30			33		16		49	
06:45			7	22	14	35	21	57	18:45			29	160	21	94	50	254
07:00			9		16		25		19:00			41		17		58	
07:15			9		15		24		19:15			34		15		49	
07:30			10		14		24		19:30			17		14		31	
07:45			19	47	33	78	52	125	19:45			33	125	17	63	50	188
08:00			16		35		51		20:00			25		19		44	
08:15			14		33		47		20:15			20		11		31	
08:30			30		39		69		20:30			26		16		42	
08:45			28	88	35	142	63	230	20:45			20	91	10	56	30	147
09:00			34		46		80		21:00			19		10		29	
09:15			38		38		76		21:15			16		12		28	
09:30			37		50		87		21:30			12		11		23	
09:45			45	154	58	192	103	346	21:45			21	68	2	35	23	103
10:00			38		64		102		22:00			10		14		24	
10:15			37		43		80		22:15			9		4		13	
10:30			51		36		87		22:30			3		3		6	
10:45			59	185	55	198	114	383	22:45			7	29	6	27	13	56
11:00			55		52		107		23:00			8		10		18	
11:15			55		50		105		23:15			9		4		13	
11:30			73		63		136		23:30			8		3		11	
11:45			66	249	55	220	121	469	23:45			7	32	1	18	8	50
TOTALS				1006		1040		2046	TOTALS				1885		1560		3445
SPLIT %				49.2%		50.8%		37.3%	SPLIT %				54.7%		45.3%		62.7%

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	2,891	2,600	5,491

AM Peak Hour			11:30	11:30	11:30	PM Peak Hour		13:45	12:45	12:00
AM Pk Volume			256	252	508	PM Pk Volume		259	242	477
Pk Hr Factor			0.877	0.926	0.934	Pk Hr Factor		0.899	0.890	0.946
7 - 9 Volume	0	0	135	220	355	4 - 6 Volume	0	413	376	789
7 - 9 Peak Hour			08:00	08:00	08:00	4 - 6 Peak Hour		17:00	16:15	16:00
7 - 9 Pk Volume	0	0	88	142	230	4 - 6 Pk Volume	0	208	212	410
Pk Hr Factor	0.000	0.000	0.733	0.910	0.833	Pk Hr Factor	0.000	0.800	0.883	0.923

Prepared by NDS/ATD

VOLUME

Grand Ave Bet. Railroad Crossing & State St

Day: Monday
Date: 2/29/2016

City: Carlsbad
Project #: CA16_4057_001

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	2,742	2,709	5,451

AM Period	NB	SB	EB		WB		TOTAL		PM Period	NB	SB	EB		WB		TOTAL	
00:00			6		3		9		12:00			60		60		120	
00:15			0		3		3		12:15			60		58		118	
00:30			7		6		13		12:30			66		53		119	
00:45			0	13	3	15	3	28	12:45			62	248	64	235	126	483
01:00			1		1		2		13:00			51		58		109	
01:15			0		2		2		13:15			63		51		114	
01:30			1		0		1		13:30			65		57		122	
01:45			4	6	2	5	6	11	13:45			58	237	41	207	99	444
02:00			2		2		4		14:00			50		61		111	
02:15			1		0		1		14:15			53		43		96	
02:30			2		1		3		14:30			50		51		101	
02:45			1	6	0	3	1	9	14:45			62	215	49	204	111	419
03:00			0		3		3		15:00			48		55		103	
03:15			0		0		0		15:15			37		51		88	
03:30			0		2		2		15:30			52		54		106	
03:45			1	1	3	8	4	9	15:45			53	190	58	218	111	408
04:00			3		1		4		16:00			54		43		97	
04:15			2		0		2		16:15			48		47		95	
04:30			1		3		4		16:30			62		67		129	
04:45			1	7	3	7	4	14	16:45			56	220	67	224	123	444
05:00			7		2		9		17:00			43		58		101	
05:15			1		2		3		17:15			47		55		102	
05:30			7		7		14		17:30			49		35		84	
05:45			4	19	8	19	12	38	17:45			54	193	42	190	96	383
06:00			17		7		24		18:00			49		34		83	
06:15			3		17		20		18:15			40		35		75	
06:30			9		23		32		18:30			43		39		82	
06:45			17	46	36	83	53	129	18:45			35	167	40	148	75	315
07:00			11		52		63		19:00			33		24		57	
07:15			21		43		64		19:15			30		17		47	
07:30			27		33		60		19:30			32		21		53	
07:45			25	84	42	170	67	254	19:45			22	117	19	81	41	198
08:00			31		35		66		20:00			29		26		55	
08:15			25		35		60		20:15			31		12		43	
08:30			26		35		61		20:30			21		23		44	
08:45			47	129	40	145	87	274	20:45			23	104	13	74	36	178
09:00			39		52		91		21:00			21		15		36	
09:15			30		47		77		21:15			15		5		20	
09:30			37		51		88		21:30			26		15		41	
09:45			37	143	45	195	82	338	21:45			30	92	10	45	40	137
10:00			45		50		95		22:00			13		10		23	
10:15			57		42		99		22:15			10		6		16	
10:30			60		50		110		22:30			12		5		17	
10:45			62	224	56	198	118	422	22:45			6	41	4	25	10	66
11:00			44		53		97		23:00			6		3		9	
11:15			45		58		103		23:15			16		5		21	
11:30			60		45		105		23:30			7		3		10	
11:45			51	200	41	197	92	397	23:45			11	40	2	13	13	53
TOTALS				878		1045		1923	TOTALS				1864		1664		3528
SPLIT %				45.7%		54.3%		35.3%	SPLIT %				52.8%		47.2%		64.7%

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	2,742	2,709	5,451

AM Peak Hour			11:45	10:30	11:45	PM Peak Hour			12:00	16:30	12:00
AM Pk Volume			237	217	449	PM Pk Volume			248	247	483
Pk Hr Factor			0.898	0.935	0.935	Pk Hr Factor			0.939	0.922	0.958
7 - 9 Volume	0	0	213	315	528	4 - 6 Volume	0	0	413	414	827
7 - 9 Peak Hour			08:00	07:00	08:00	4 - 6 Peak Hour			16:00	16:30	16:30
7 - 9 Pk Volume	0	0	129	170	274	4 - 6 PK Volume	0	0	220	247	455
Pk Hr Factor	0.000	0.000	0.686	0.817	0.787	Pk Hr Factor	0.000	0.000	0.887	0.922	0.882

Prepared by NDS/ATD

VOLUME

Grand Ave Bet. Railroad Crossing & State St

Day: Tuesday
Date: 3/1/2016

City: Carlsbad
Project #: CA16_4057_001

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	2,801	2,664	5,465

AM Period	NB	SB	EB		WB		TOTAL		PM Period	NB	SB	EB		WB		TOTAL	
00:00			1		2		3		12:00			75		52		127	
00:15			7		1		8		12:15			72		45		117	
00:30			4		3		7		12:30			61		54		115	
00:45			5	17	3	9	8	26	12:45			66	274	60	211	126	485
01:00			3		2		5		13:00			46		58		104	
01:15			2		1		3		13:15			48		50		98	
01:30			3		3		6		13:30			51		60		111	
01:45			2	10	0	6	2	16	13:45			57	202	60	228	117	430
02:00			0		1		1		14:00			58		41		99	
02:15			1		1		2		14:15			54		46		100	
02:30			0		0		0		14:30			58		53		111	
02:45			0	1	0	2	0	3	14:45			52	222	65	205	117	427
03:00			1		0		1		15:00			65		65		130	
03:15			0		1		1		15:15			49		33		82	
03:30			1		1		2		15:30			48		50		98	
03:45			2	4	0	2	2	6	15:45			72	234	66	214	138	448
04:00			1		1		2		16:00			62		56		118	
04:15			1		0		1		16:15			46		50		96	
04:30			1		2		3		16:30			52		67		119	
04:45			3	6	3	6	6	12	16:45			61	221	68	241	129	462
05:00			5		1		6		17:00			66		57		123	
05:15			2		0		2		17:15			58		54		112	
05:30			3		6		9		17:30			53		38		91	
05:45			7	17	15	22	22	39	17:45			43	220	47	196	90	416
06:00			12		7		19		18:00			51		44		95	
06:15			11		19		30		18:15			57		36		93	
06:30			13		18		31		18:30			42		47		89	
06:45			13	49	32	76	45	125	18:45			33	183	38	165	71	348
07:00			18		34		52		19:00			47		36		83	
07:15			24		30		54		19:15			35		25		60	
07:30			26		35		61		19:30			24		22		46	
07:45			21	89	47	146	68	235	19:45			43	149	18	101	61	250
08:00			22		35		57		20:00			24		20		44	
08:15			30		39		69		20:15			29		10		39	
08:30			31		34		65		20:30			35		19		54	
08:45			38	121	52	160	90	281	20:45			29	117	7	56	36	173
09:00			37		43		80		21:00			23		15		38	
09:15			37		28		65		21:15			26		14		40	
09:30			23		40		63		21:30			20		11		31	
09:45			50	147	32	143	82	290	21:45			16	85	11	51	27	136
10:00			42		47		89		22:00			11		7		18	
10:15			41		58		99		22:15			15		9		24	
10:30			43		30		73		22:30			11		4		15	
10:45			43	169	54	189	97	358	22:45			6	43	4	24	10	67
11:00			46		39		85		23:00			9		7		16	
11:15			45		50		95		23:15			11		5		16	
11:30			41		53		94		23:30			8		0		8	
11:45			53	185	54	196	107	381	23:45			8	36	3	15	11	51
TOTALS				815		957		1772	TOTALS				1986		1707		3693
SPLIT %				46.0%		54.0%		32.4%	SPLIT %				53.8%		46.2%		67.6%

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	2,801	2,664	5,465

AM Peak Hour			11:45	11:15	11:45	PM Peak Hour			12:00	16:30	12:00
AM Pk Volume			261	209	466	PM Pk Volume			274	246	485
Pk Hr Factor			0.870	0.968	0.917	Pk Hr Factor			0.913	0.904	0.955
7 - 9 Volume	0	0	210	306	516	4 - 6 Volume	0	0	441	437	878
7 - 9 Peak Hour			08:00	08:00	08:00	4 - 6 Peak Hour			16:45	16:30	16:30
7 - 9 Pk Volume	0	0	121	160	281	4 - 6 Pk Volume	0	0	238	246	483
Pk Hr Factor	0.000	0.000	0.796	0.769	0.781	Pk Hr Factor	0.000	0.000	0.902	0.904	0.936

Prepared by NDS/ATD

VOLUME

Grand Ave Bet. Railroad Crossing & State St

Day: Wednesday
Date: 3/2/2016

City: Carlsbad
Project #: CA16_4057_001

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	2,931	2,933	5,864

AM Period	NB	SB	EB		WB		TOTAL		PM Period	NB	SB	EB		WB		TOTAL	
00:00			12		7		19		12:00			59		72		131	
00:15			6		4		10		12:15			46		56		102	
00:30			1		1		2		12:30			50		38		88	
00:45			1	20	1	13	2	33	12:45			58	213	64	230	122	443
01:00			1		3		4		13:00			61		74		135	
01:15			2		0		2		13:15			58		64		122	
01:30			1		0		1		13:30			65		46		111	
01:45			1	5	2	5	3	10	13:45			71	255	57	241	128	496
02:00			2		0		2		14:00			55		55		110	
02:15			2		1		3		14:15			65		49		114	
02:30			0		3		3		14:30			53		51		104	
02:45			1	5	0	4	1	9	14:45			64	237	65	220	129	457
03:00			1		3		4		15:00			59		78		137	
03:15			1		1		2		15:15			66		55		121	
03:30			2		1		3		15:30			64		58		122	
03:45			1	5	1	6	2	11	15:45			54	243	56	247	110	490
04:00			0		1		1		16:00			67		66		133	
04:15			0		0		0		16:15			64		58		122	
04:30			3		0		3		16:30			54		59		113	
04:45			0	3	2	3	2	6	16:45			67	252	74	257	141	509
05:00			4		2		6		17:00			54		66		120	
05:15			3		3		6		17:15			61		85		146	
05:30			5		4		9		17:30			68		63		131	
05:45			6	18	13	22	19	40	17:45			50	233	78	292	128	525
06:00			13		8		21		18:00			69		56		125	
06:15			11		12		23		18:15			67		54		121	
06:30			14		20		34		18:30			51		44		95	
06:45			12	50	30	70	42	120	18:45			37	224	34	188	71	412
07:00			18		36		54		19:00			34		40		74	
07:15			13		37		50		19:15			23		26		49	
07:30			22		32		54		19:30			26		37		63	
07:45			15	68	41	146	56	214	19:45			34	117	19	122	53	239
08:00			26		26		52		20:00			40		19		59	
08:15			37		34		71		20:15			21		16		37	
08:30			29		41		70		20:30			28		19		47	
08:45			41	133	37	138	78	271	20:45			30	119	12	66	42	185
09:00			33		26		59		21:00			20		20		40	
09:15			47		42		89		21:15			33		13		46	
09:30			42		41		83		21:30			27		9		36	
09:45			49	171	48	157	97	328	21:45			19	99	8	50	27	149
10:00			40		56		96		22:00			20		10		30	
10:15			40		29		69		22:15			12		7		19	
10:30			46		44		90		22:30			11		5		16	
10:45			42	168	54	183	96	351	22:45			13	56	8	30	21	86
11:00			49		51		100		23:00			7		7		14	
11:15			47		55		102		23:15			6		3		9	
11:30			50		60		110		23:30			16		5		21	
11:45			56	202	58	224	114	426	23:45			6	35	4	19	10	54
TOTALS				848		971		**1819**	**TOTALS**				2083		1962		**4045**
SPLIT %				46.6%		53.4%		**31.0%**	**SPLIT %**				51.5%		48.5%		**69.0%**

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	2,931	2,933	5,864

AM Peak Hour			11:15	11:30	**11:15**	**PM Peak Hour**			13:30	17:00	**16:45**
AM Pk Volume			212	246	**457**	**PM Pk Volume**			256	292	**538**
Pk Hr Factor			0.898	0.854	**0.872**	**Pk Hr Factor**			0.901	0.859	**0.921**
7 - 9 Volume	0	0	201	284	**485**	**4 - 6 Volume**	0	0	485	549	**1034**
7 - 9 Peak Hour			08:00	07:00	**08:00**	**4 - 6 Peak Hour**			16:00	17:00	**16:45**
7 - 9 Pk Volume	0	0	133	146	**271**	**4 - 6 Pk Volume**	0	0	252	292	**538**
Pk Hr Factor	0.000	0.000	0.811	0.890	**0.869**	**Pk Hr Factor**	0.000	0.000	0.940	0.859	**0.921**

Prepared by NDS/ATD

VOLUME

Grand Ave Bet. Railroad Crossing & State St

Day: Thursday
Date: 3/3/2016

City: Carlsbad
Project #: CA16_4057_001

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	2,765	2,791	5,556

AM Period	NB	SB	EB		WB		TOTAL		PM Period	NB	SB	EB		WB		TOTAL	
00:00			7		2		9		12:00			48		71		119	
00:15			2		5		7		12:15			54		55		109	
00:30			5		2		7		12:30			65		44		109	
00:45			2	16	4	13	6	29	12:45			48	215	59	229	107	444
01:00			2		4		6		13:00			53		52		105	
01:15			1		1		2		13:15			44		32		76	
01:30			2		3		5		13:30			51		53		104	
01:45			3	8	4	12	7	20	13:45			76	224	47	184	123	408
02:00			1		0		1		14:00			67		56		123	
02:15			2		1		3		14:15			61		54		115	
02:30			0		0		0		14:30			55		54		109	
02:45			0	3	4	5	4	8	14:45			55	238	49	213	104	451
03:00			0		0		0		15:00			59		61		120	
03:15			0		1		1		15:15			48		47		95	
03:30			5		1		6		15:30			50		57		107	
03:45			1	6	1	3	2	9	15:45			58	215	55	220	113	435
04:00			0		0		0		16:00			55		67		122	
04:15			0		1		1		16:15			40		49		89	
04:30			2		1		3		16:30			55		48		103	
04:45			1	3	1	3	2	6	16:45			43	193	69	233	112	426
05:00			5		2		7		17:00			53		59		112	
05:15			2		4		6		17:15			61		52		113	
05:30			4		6		10		17:30			42		54		96	
05:45			12	23	9	21	21	44	17:45			51	207	58	223	109	430
06:00			10		6		16		18:00			55		60		115	
06:15			9		11		20		18:15			48		37		85	
06:30			10		28		38		18:30			48		39		87	
06:45			17	46	39	84	56	130	18:45			36	187	33	169	69	356
07:00			13		33		46		19:00			43		25		68	
07:15			16		27		43		19:15			48		28		76	
07:30			24		35		59		19:30			25		37		62	
07:45			29	82	28	123	57	205	19:45			29	145	24	114	53	259
08:00			28		28		56		20:00			26		31		57	
08:15			27		40		67		20:15			39		23		62	
08:30			30		32		62		20:30			36		16		52	
08:45			36	121	38	138	74	259	20:45			25	126	20	90	45	216
09:00			23		41		64		21:00			39		13		52	
09:15			44		35		79		21:15			14		10		24	
09:30			31		43		74		21:30			26		13		39	
09:45			33	131	41	160	74	291	21:45			19	98	19	55	38	153
10:00			45		41		86		22:00			22		16		38	
10:15			44		53		97		22:15			13		12		25	
10:30			26		37		63		22:30			21		12		33	
10:45			58	173	48	179	106	352	22:45			10	66	9	49	19	115
11:00			41		56		97		23:00			14		10		24	
11:15			51		60		111		23:15			11		9		20	
11:30			46		56		102		23:30			15		4		19	
11:45			48	186	71	243	119	429	23:45			13	53	5	28	18	81
TOTALS				798		984		**1782**	**TOTALS**				1967		1807		**3774**
SPLIT %				44.8%		55.2%		**32.1%**	**SPLIT %**				52.1%		47.9%		**67.9%**

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	2,765	2,791	5,556

AM Peak Hour			11:45	11:15	**11:45**	**PM Peak Hour**			13:45	16:45	**13:45**
AM Pk Volume			215	258	**456**	**PM Pk Volume**			259	234	**470**
Pk Hr Factor			0.827	0.908	**0.958**	**Pk Hr Factor**			0.852	0.848	**0.955**
7 - 9 Volume	0	0	203	261	**464**	**4 - 6 Volume**	0	0	400	456	**856**
7 - 9 Peak Hour			08:00	08:00	**08:00**	**4 - 6 Peak Hour**			16:30	16:45	**16:30**
7 - 9 Pk Volume	0	0	121	138	**259**	**4 - 6 Pk Volume**	0	0	212	234	**440**
Pk Hr Factor	0.000	0.000	0.840	0.863	**0.875**	**Pk Hr Factor**	0.000	0.000	0.869	0.848	**0.973**

Prepared by NDS/ATD

VOLUME

Carlsbad Village Dr Bet. Railroad Crossing & State St

Day: Friday
Date: 2/26/2016

City: Carlsbad
Project #: CA16_4057_002

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	7,331	7,596	14,927

AM Period	NB	SB	EB		WB		TOTAL		PM Period	NB	SB	EB		WB		TOTAL	
00:00			8		8		16		12:00			153		150		303	
00:15			13		13		26		12:15			152		133		285	
00:30			13		8		21		12:30			131		168		299	
00:45			8	42	7	36	15	78	12:45			128	564	121	572	249	1136
01:00			6		5		11		13:00			128		130		258	
01:15			10		5		15		13:15			133		139		272	
01:30			6		6		12		13:30			135		113		248	
01:45			3	25	5	21	8	46	13:45			141	537	137	519	278	1056
02:00			1		2		3		14:00			139		98		237	
02:15			0		5		5		14:15			161		121		282	
02:30			3		2		5		14:30			133		151		284	
02:45			9	13	5	14	14	27	14:45			136	569	149	519	285	1088
03:00			1		0		1		15:00			137		152		289	
03:15			6		3		9		15:15			125		141		266	
03:30			3		0		3		15:30			132		132		264	
03:45			0	10	4	7	4	17	15:45			146	540	127	552	273	1092
04:00			1		4		5		16:00			135		149		284	
04:15			5		1		6		16:15			153		127		280	
04:30			4		10		14		16:30			146		147		293	
04:45			4	14	6	21	10	35	16:45			114	548	108	531	222	1079
05:00			10		11		21		17:00			148		163		311	
05:15			12		14		26		17:15			131		155		286	
05:30			23		23		46		17:30			132		146		278	
05:45			25	70	18	66	43	136	17:45			174	585	133	597	307	1182
06:00			19		27		46		18:00			167		113		280	
06:15			23		43		66		18:15			141		128		269	
06:30			33		47		80		18:30			118		124		242	
06:45			34	109	74	191	108	300	18:45			139	565	125	490	264	1055
07:00			45		77		122		19:00			121		116		237	
07:15			60		82		142		19:15			103		110		213	
07:30			67		106		173		19:30			108		101		209	
07:45			75	247	103	368	178	615	19:45			103	435	96	423	199	858
08:00			69		91		160		20:00			91		65		156	
08:15			74		102		176		20:15			82		79		161	
08:30			81		97		178		20:30			88		86		174	
08:45			71	295	91	381	162	676	20:45			87	348	78	308	165	656
09:00			77		110		187		21:00			58		79		137	
09:15			107		91		198		21:15			69		90		159	
09:30			102		86		188		21:30			59		64		123	
09:45			99	385	119	406	218	791	21:45			45	231	55	288	100	519
10:00			103		113		216		22:00			43		62		105	
10:15			103		127		230		22:15			41		47		88	
10:30			91		104		195		22:30			58		47		105	
10:45			110	407	125	469	235	876	22:45			46	188	46	202	92	390
11:00			111		116		227		23:00			34		32		66	
11:15			111		117		228		23:15			36		20		56	
11:30			137		132		269		23:30			27		22		49	
11:45			120	479	149	514	269	993	23:45			28	125	27	101	55	226
TOTALS				2096		2494		4590	TOTALS				5235		5102		10337
SPLIT %				45.7%		54.3%		30.7%	SPLIT %				50.6%		49.4%		69.3%

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	7,331	7,596	14,927

AM Peak Hour			11:30	11:45	11:45	PM Peak Hour			17:30	17:00	17:00
AM Pk Volume			562	600	1156	PM Pk Volume			614	597	1182
Pk Hr Factor			0.918	0.893	0.954	Pk Hr Factor			0.882	0.916	0.950
7 - 9 Volume	0	0	542	749	1291	4 - 6 Volume	0	0	1133	1128	2261
7 - 9 Peak Hour			07:45	07:30	07:45	4 - 6 Peak Hour			17:00	17:00	17:00
7 - 9 Pk Volume	0	0	299	402	692	4 - 6 Pk Volume	0	0	585	597	1182
Pk Hr Factor	0.000	0.000	0.923	0.948	0.972	Pk Hr Factor	0.000	0.000	0.841	0.916	0.950

Prepared by NDS/ATD

VOLUME

Carlsbad Village Dr Bet. Railroad Crossing & State St

Day: Saturday
Date: 2/27/2016

City: Carlsbad
Project #: CA16_4057_002

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	7,690	8,229	15,919

AM Period	NB	SB	EB		WB		TOTAL		PM Period	NB	SB	EB		WB		TOTAL	
00:00			23		26		49		12:00			150		172		322	
00:15			31		26		57		12:15			128		195		323	
00:30			27		22		49		12:30			136		161		297	
00:45			23	104	15	89	38	193	12:45			131	545	173	701	304	1246
01:00			18		19		37		13:00			164		172		336	
01:15			12		18		30		13:15			142		179		321	
01:30			41		19		60		13:30			146		195		341	
01:45			19	90	12	68	31	158	13:45			116	568	156	702	272	1270
02:00			12		9		21		14:00			147		157		304	
02:15			23		10		33		14:15			157		140		297	
02:30			6		6		12		14:30			121		134		255	
02:45			7	48	3	28	10	76	14:45			156	581	164	595	320	1176
03:00			5		3		8		15:00			137		133		270	
03:15			6		1		7		15:15			148		149		297	
03:30			3		5		8		15:30			156		159		315	
03:45			4	18	2	11	6	29	15:45			145	586	122	563	267	1149
04:00			3		2		5		16:00			172		128		300	
04:15			3		5		8		16:15			149		134		283	
04:30			7		5		12		16:30			147		122		269	
04:45			3	16	4	16	7	32	16:45			149	617	144	528	293	1145
05:00			6		5		11		17:00			136		132		268	
05:15			10		11		21		17:15			130		135		265	
05:30			13		9		22		17:30			123		141		264	
05:45			14	43	12	37	26	80	17:45			168	557	155	563	323	1120
06:00			14		22		36		18:00			145		106		251	
06:15			15		27		42		18:15			135		121		256	
06:30			20		29		49		18:30			111		116		227	
06:45			24	73	69	147	93	220	18:45			100	491	110	453	210	944
07:00			35		45		80		19:00			105		90		195	
07:15			23		63		86		19:15			106		103		209	
07:30			47		54		101		19:30			96		82		178	
07:45			50	155	80	242	130	397	19:45			91	398	81	356	172	754
08:00			74		85		159		20:00			79		83		162	
08:15			63		99		162		20:15			61		78		139	
08:30			72		103		175		20:30			73		88		161	
08:45			105	314	104	391	209	705	20:45			94	307	72	321	166	628
09:00			110		129		239		21:00			86		54		140	
09:15			95		113		208		21:15			72		82		154	
09:30			110		114		224		21:30			79		59		138	
09:45			111	426	114	470	225	896	21:45			56	293	62	257	118	550
10:00			115		147		262		22:00			57		65		122	
10:15			155		112		267		22:15			70		60		130	
10:30			112		154		266		22:30			58		48		106	
10:45			135	517	183	596	318	1113	22:45			53	238	59	232	112	470
11:00			114		113		227		23:00			37		59		96	
11:15			167		210		377		23:15			50		39		89	
11:30			116		177		293		23:30			44		43		87	
11:45			154	551	189	689	343	1240	23:45			23	154	33	174	56	328
TOTALS				2355		2784		5139	TOTALS				5335		5445		10780
SPLIT %				45.8%		54.2%		32.3%	SPLIT %				49.5%		50.5%		67.7%

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	7,690	8,229	15,919

AM Peak Hour			11:15	11:15	11:15	PM Peak Hour			15:30	12:45	12:45
AM Pk Volume			587	748	1335	PM Pk Volume			622	719	1302
Pk Hr Factor			0.879	0.890	0.885	Pk Hr Factor			0.904	0.922	0.955
7 - 9 Volume	0	0	469	633	1102	4 - 6 Volume	0	0	1174	1091	2265
7 - 9 Peak Hour			08:00	08:00	08:00	4 - 6 Peak Hour			16:00	17:00	16:00
7 - 9 Pk Volume	0	0	314	391	705	4 - 6 Pk Volume	0	0	617	563	1145
Pk Hr Factor	0.000	0.000	0.748	0.940	0.843	Pk Hr Factor	0.000	0.000	0.897	0.908	0.954

Prepared by NDS/ATD

VOLUME

Carlsbad Village Dr Bet. Railroad Crossing & State St

Day: Sunday
Date: 2/28/2016

City: Carlsbad
Project #: CA16_4057_002

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	6,583	6,699	13,282

AM Period	NB	SB	EB		WB		TOTAL		PM Period	NB	SB	EB		WB		TOTAL	
00:00			36		31		67		12:00			150		155		305	
00:15			33		35		68		12:15			138		165		303	
00:30			23		19		42		12:30			149		174		323	
00:45			23	115	16	101	39	216	12:45			153	590	156	650	309	1240
01:00			19		12		31		13:00			139		162		301	
01:15			25		20		45		13:15			136		169		305	
01:30			21		14		35		13:30			128		134		262	
01:45			27	92	18	64	45	156	13:45			126	529	135	600	261	1129
02:00			21		14		35		14:00			128		146		274	
02:15			13		10		23		14:15			136		126		262	
02:30			16		13		29		14:30			143		152		295	
02:45			15	65	5	42	20	107	14:45			137	544	128	552	265	1096
03:00			6		4		10		15:00			130		126		256	
03:15			3		8		11		15:15			143		108		251	
03:30			10		1		11		15:30			130		124		254	
03:45			8	27	3	16	11	43	15:45			141	544	138	496	279	1040
04:00			8		6		14		16:00			137		131		268	
04:15			3		4		7		16:15			150		97		247	
04:30			3		2		5		16:30			130		128		258	
04:45			5	19	3	15	8	34	16:45			125	542	129	485	254	1027
05:00			3		4		7		17:00			140		122		262	
05:15			8		6		14		17:15			124		138		262	
05:30			3		14		17		17:30			126		113		239	
05:45			6	20	22	46	28	66	17:45			133	523	98	471	231	994
06:00			13		23		36		18:00			145		93		238	
06:15			15		22		37		18:15			130		81		211	
06:30			8		31		39		18:30			103		93		196	
06:45			15	51	42	118	57	169	18:45			89	467	80	347	169	814
07:00			25		26		51		19:00			76		59		135	
07:15			23		48		71		19:15			73		71		144	
07:30			36		55		91		19:30			75		52		127	
07:45			52	136	78	207	130	343	19:45			65	289	56	238	121	527
08:00			38		65		103		20:00			67		54		121	
08:15			51		80		131		20:15			64		46		110	
08:30			69		85		154		20:30			57		33		90	
08:45			82	240	100	330	182	570	20:45			47	235	40	173	87	408
09:00			66		112		178		21:00			48		29		77	
09:15			79		93		172		21:15			38		26		64	
09:30			84		99		183		21:30			33		22		55	
09:45			86	315	143	447	229	762	21:45			38	157	34	111	72	268
10:00			112		139		251		22:00			33		35		68	
10:15			93		126		219		22:15			29		14		43	
10:30			96		119		215		22:30			17		16		33	
10:45			129	430	125	509	254	939	22:45			17	96	8	73	25	169
11:00			125		137		262		23:00			14		5		19	
11:15			130		141		271		23:15			11		12		23	
11:30			142		146		288		23:30			14		4		18	
11:45			114	511	156	580	270	1091	23:45			7	46	7	28	14	74
TOTALS				2021		2475		4496	TOTALS				4562		4224		8786
SPLIT %				45.0%		55.0%		33.9%	SPLIT %				51.9%		48.1%		66.1%

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	6,583	6,699	13,282

AM Peak Hour			11:45	11:45	11:45	PM Peak Hour			12:00	12:30	12:00
AM Pk Volume			551	650	1201	PM Pk Volume			590	661	1240
Pk Hr Factor			0.918	0.934	0.930	Pk Hr Factor			0.964	0.950	0.960
7 - 9 Volume	0	0	376	537	913	4 - 6 Volume	0	0	1065	956	2021
7 - 9 Peak Hour			08:00	08:00	08:00	4 - 6 Peak Hour			16:15	16:30	16:30
7 - 9 Pk Volume	0	0	240	330	570	4 - 6 Pk Volume	0	0	545	517	1036
Pk Hr Factor	0.000	0.000	0.732	0.825	0.783	Pk Hr Factor	0.000	0.000	0.908	0.937	0.989

Prepared by NDS/ATD

VOLUME

Carlsbad Village Dr Bet. Railroad Crossing & State St

Day: Monday
Date: 2/29/2016

City: Carlsbad
Project #: CA16_4057_002

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	5,842	6,285	12,127

AM Period	NB	SB	EB		WB		TOTAL		PM Period	NB	SB	EB		WB		TOTAL	
00:00			5		7		12		12:00			126		132		258	
00:15			6		5		11		12:15			137		145		282	
00:30			4		3		7		12:30			126		156		282	
00:45			5	20	4	19	9	39	12:45			111	500	110	543	221	1043
01:00			2		1		3		13:00			98		130		228	
01:15			5		4		9		13:15			105		122		227	
01:30			2		2		4		13:30			113		125		238	
01:45			5	14	2	9	7	23	13:45			93	409	123	500	216	909
02:00			4		4		8		14:00			126		103		229	
02:15			5		3		8		14:15			129		101		230	
02:30			3		2		5		14:30			112		104		216	
02:45			5	17	1	10	6	27	14:45			113	480	124	432	237	912
03:00			2		2		4		15:00			119		106		225	
03:15			4		1		5		15:15			112		115		227	
03:30			1		2		3		15:30			114		98		212	
03:45			5	12	4	9	9	21	15:45			101	446	107	426	208	872
04:00			3		2		5		16:00			113		101		214	
04:15			2		3		5		16:15			126		95		221	
04:30			7		5		12		16:30			131		122		253	
04:45			3	15	8	18	11	33	16:45			102	472	119	437	221	909
05:00			10		12		22		17:00			107		115		222	
05:15			19		9		28		17:15			120		132		252	
05:30			11		19		30		17:30			111		109		220	
05:45			20	60	21	61	41	121	17:45			130	468	137	493	267	961
06:00			14		16		30		18:00			107		102		209	
06:15			25		35		60		18:15			103		119		222	
06:30			27		50		77		18:30			98		121		219	
06:45			41	107	85	186	126	293	18:45			84	392	101	443	185	835
07:00			40		79		119		19:00			84		72		156	
07:15			54		104		158		19:15			60		72		132	
07:30			49		93		142		19:30			60		75		135	
07:45			59	202	88	364	147	566	19:45			69	273	68	287	137	560
08:00			69		90		159		20:00			77		46		123	
08:15			60		94		154		20:15			63		56		119	
08:30			65		97		162		20:30			64		32		96	
08:45			76	270	84	365	160	635	20:45			52	256	44	178	96	434
09:00			78		93		171		21:00			56		28		84	
09:15			78		71		149		21:15			22		29		51	
09:30			86		100		186		21:30			42		33		75	
09:45			101	343	84	348	185	691	21:45			36	156	24	114	60	270
10:00			86		106		192		22:00			33		17		50	
10:15			102		111		213		22:15			22		23		45	
10:30			80		112		192		22:30			21		12		33	
10:45			102	370	114	443	216	813	22:45			17	93	20	72	37	165
11:00			101		108		209		23:00			17		7		24	
11:15			105		115		220		23:15			14		9		23	
11:30			98		132		230		23:30			8		6		14	
11:45			107	411	140	495	247	906	23:45			17	56	11	33	28	89
TOTALS				1841		2327		4168	TOTALS				4001		3958		7959
SPLIT %				44.2%		55.8%		34.4%	SPLIT %				50.3%		49.7%		65.6%

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	5,842	6,285	12,127

AM Peak Hour			11:45	11:45	11:45	PM Peak Hour			12:00	12:00	12:00
AM Pk Volume			496	573	1069	PM Pk Volume			500	543	1043
Pk Hr Factor			0.905	0.918	0.948	Pk Hr Factor			0.912	0.870	0.925
7 - 9 Volume	0	0	472	729	1201	4 - 6 Volume	0	0	940	930	1870
7 - 9 Peak Hour			08:00	07:15	08:00	4 - 6 Peak Hour			16:00	17:00	17:00
7 - 9 Pk Volume	0	0	270	375	635	4 - 6 Pk Volume	0	0	472	493	961
Pk Hr Factor	0.000	0.000	0.888	0.901	0.980	Pk Hr Factor	0.000	0.000	0.901	0.900	0.900

Prepared by NDS/ATD

VOLUME

Carlsbad Village Dr Bet. Railroad Crossing & State St

Day: Tuesday
Date: 3/1/2016

City: Carlsbad
Project #: CA16_4057_002

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	5,920	6,326	12,246

AM Period	NB	SB	EB		WB		TOTAL		PM Period	NB	SB	EB		WB		TOTAL	
00:00			5		8		13		12:00			99		146		245	
00:15			10		6		16		12:15			104		120		224	
00:30			10		8		18		12:30			99		128		227	
00:45			5	30	3	25	8	55	12:45			121	423	134	528	255	951
01:00			4		5		9		13:00			108		101		209	
01:15			1		4		5		13:15			111		116		227	
01:30			2		5		7		13:30			106		110		216	
01:45			2	9	2	16	4	25	13:45			118	443	114	441	232	884
02:00			2		3		5		14:00			116		114		230	
02:15			3		3		6		14:15			112		90		202	
02:30			4		1		5		14:30			106		109		215	
02:45			1	10	3	10	4	20	14:45			105	439	102	415	207	854
03:00			0		3		3		15:00			123		118		241	
03:15			7		3		10		15:15			98		106		204	
03:30			1		0		1		15:30			109		107		216	
03:45			4	12	6	12	10	24	15:45			113	443	114	445	227	888
04:00			5		6		11		16:00			111		123		234	
04:15			6		5		11		16:15			95		109		204	
04:30			3		4		7		16:30			103		109		212	
04:45			9	23	6	21	15	44	16:45			128	437	132	473	260	910
05:00			5		8		13		17:00			134		144		278	
05:15			8		10		18		17:15			116		142		258	
05:30			10		20		30		17:30			109		134		243	
05:45			16	39	25	63	41	102	17:45			136	495	126	546	262	1041
06:00			19		15		34		18:00			102		131		233	
06:15			28		30		58		18:15			112		121		233	
06:30			28		32		60		18:30			89		90		179	
06:45			39	114	71	148	110	262	18:45			73	376	119	461	192	837
07:00			51		96		147		19:00			97		91		188	
07:15			44		91		135		19:15			74		72		146	
07:30			50		97		147		19:30			68		65		133	
07:45			56	201	91	375	147	576	19:45			66	305	60	288	126	593
08:00			63		59		122		20:00			65		50		115	
08:15			75		89		164		20:15			83		52		135	
08:30			51		88		139		20:30			81		58		139	
08:45			83	272	91	327	174	599	20:45			58	287	43	203	101	490
09:00			88		98		186		21:00			47		30		77	
09:15			94		87		181		21:15			56		49		105	
09:30			97		94		191		21:30			57		41		98	
09:45			77	356	107	386	184	742	21:45			38	198	25	145	63	343
10:00			103		85		188		22:00			29		14		43	
10:15			94		93		187		22:15			37		23		60	
10:30			120		123		243		22:30			38		18		56	
10:45			77	394	88	389	165	783	22:45			18	122	21	76	39	198
11:00			91		104		195		23:00			25		12		37	
11:15			105		120		225		23:15			18		10		28	
11:30			97		124		221		23:30			18		12		30	
11:45			124	417	148	496	272	913	23:45			14	75	3	37	17	112
TOTALS				1877		2268		**4145**	**TOTALS**				4043		4058		**8101**
SPLIT %				45.3%		54.7%		**33.8%**	**SPLIT %**				49.9%		50.1%		**66.2%**

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	5,920	6,326	12,246

AM Peak Hour			11:45	11:45	**11:45**	**PM Peak Hour**			17:00	16:45	**17:00**
AM Pk Volume			426	542	**968**	**PM Pk Volume**			495	552	**1041**
Pk Hr Factor			0.859	0.916	**0.890**	**Pk Hr Factor**			0.910	0.958	**0.936**
7 - 9 Volume	0	0	473	702	**1175**	**4 - 6 Volume**	0	0	932	1019	**1951**
7 - 9 Peak Hour			08:00	07:00	**08:00**	**4 - 6 Peak Hour**			17:00	16:45	**17:00**
7 - 9 Pk Volume	0	0	272	375	**599**	**4 - 6 PK Volume**	0	0	495	552	**1041**
Pk Hr Factor	0.000	0.000	0.819	0.966	**0.861**	**Pk Hr Factor**	0.000	0.000	0.910	0.958	**0.936**

Prepared by NDS/ATD

VOLUME

Carlsbad Village Dr Bet. Railroad Crossing & State St

Day: Wednesday
Date: 3/2/2016

City: Carlsbad
Project #: CA16_4057_002

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	6,035	6,504	12,539

AM Period	NB	SB	EB		WB		TOTAL		PM Period	NB	SB	EB		WB		TOTAL	
00:00			7		3		10		12:00			125		113		238	
00:15			6		4		10		12:15			104		122		226	
00:30			7		6		13		12:30			96		113		209	
00:45			5	25	4	17	9	42	12:45			111	436	129	477	240	913
01:00			3		5		8		13:00			109		126		235	
01:15			3		2		5		13:15			108		122		230	
01:30			6		4		10		13:30			132		125		257	
01:45			5	17	8	19	13	36	13:45			110	459	118	491	228	950
02:00			3		3		6		14:00			124		119		243	
02:15			3		3		6		14:15			103		111		214	
02:30			4		4		8		14:30			119		100		219	
02:45			4	14	0	10	4	24	14:45			125	471	131	461	256	932
03:00			2		2		4		15:00			116		129		245	
03:15			5		3		8		15:15			117		137		254	
03:30			1		1		2		15:30			117		109		226	
03:45			5	13	5	11	10	24	15:45			137	487	144	519	281	1006
04:00			4		2		6		16:00			109		125		234	
04:15			4		6		10		16:15			116		131		247	
04:30			5		4		9		16:30			138		141		279	
04:45			6	19	14	26	20	45	16:45			112	475	129	526	241	1001
05:00			9		8		17		17:00			121		157		278	
05:15			9		24		33		17:15			115		139		254	
05:30			14		18		32		17:30			136		119		255	
05:45			18	50	18	68	36	118	17:45			152	524	135	550	287	1074
06:00			19		18		37		18:00			134		142		276	
06:15			23		33		56		18:15			124		128		252	
06:30			23		35		58		18:30			121		104		225	
06:45			46	111	80	166	126	277	18:45			88	467	102	476	190	943
07:00			47		72		119		19:00			113		72		185	
07:15			58		82		140		19:15			60		71		131	
07:30			46		92		138		19:30			65		74		139	
07:45			56	207	76	322	132	529	19:45			71	309	59	276	130	585
08:00			47		76		123		20:00			82		60		142	
08:15			68		91		159		20:15			75		74		149	
08:30			72		96		168		20:30			79		45		124	
08:45			77	264	88	351	165	615	20:45			49	285	44	223	93	508
09:00			77		86		163		21:00			46		48		94	
09:15			76		77		153		21:15			56		38		94	
09:30			91		94		185		21:30			38		35		73	
09:45			96	340	105	362	201	702	21:45			28	168	18	139	46	307
10:00			77		89		166		22:00			33		31		64	
10:15			91		106		197		22:15			28		28		56	
10:30			73		131		204		22:30			21		19		40	
10:45			82	323	103	429	185	752	22:45			29	111	17	95	46	206
11:00			73		86		159		23:00			21		13		34	
11:15			106		125		231		23:15			10		10		20	
11:30			110		112		222		23:30			16		18		34	
11:45			110	399	119	442	229	841	23:45			14	61	7	48	21	109
TOTALS				1782		2223		4005	TOTALS				4253		4281		8534
SPLIT %				44.5%		55.5%		31.9%	SPLIT %				49.8%		50.2%		68.1%

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	6,035	6,504	12,539

AM Peak Hour			11:15	11:15	11:15	PM Peak Hour			17:30	16:30	17:00
AM Pk Volume			451	469	920	PM Pk Volume			546	566	1074
Pk Hr Factor			0.902	0.938	0.966	Pk Hr Factor			0.898	0.901	0.936
7 - 9 Volume	0	0	471	673	1144	4 - 6 Volume	0	0	999	1076	2075
7 - 9 Peak Hour			08:00	08:00	08:00	4 - 6 Peak Hour			17:00	16:30	17:00
7 - 9 Pk Volume	0	0	264	351	615	4 - 6 Pk Volume	0	0	524	566	1074
Pk Hr Factor	0.000	0.000	0.857	0.914	0.915	Pk Hr Factor	0.000	0.000	0.862	0.901	0.936

Prepared by NDS/ATD

VOLUME

Carlsbad Village Dr Bet. Railroad Crossing & State St

Day: Thursday
Date: 3/3/2016

City: Carlsbad
Project #: CA16_4057_002

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	6,107	6,364	12,471

AM Period	NB	SB	EB		WB		TOTAL		PM Period	NB	SB	EB		WB		TOTAL	
00:00			13		6		19		12:00			122		105		227	
00:15			7		6		13		12:15			130		130		260	
00:30			10		9		19		12:30			99		116		215	
00:45			6	36	2	23	8	59	12:45			131	482	131	482	262	964
01:00			3		0		3		13:00			122		128		250	
01:15			7		2		9		13:15			123		114		237	
01:30			10		3		13		13:30			104		111		215	
01:45			4	24	8	13	12	37	13:45			141	490	112	465	253	955
02:00			5		0		5		14:00			113		128		241	
02:15			6		1		7		14:15			123		105		228	
02:30			1		3		4		14:30			102		118		220	
02:45			1	13	2	6	3	19	14:45			119	457	126	477	245	934
03:00			3		2		5		15:00			109		119		228	
03:15			2		4		6		15:15			125		108		233	
03:30			2		5		7		15:30			110		98		208	
03:45			3	10	2	13	5	23	15:45			99	443	108	433	207	876
04:00			2		2		4		16:00			115		115		230	
04:15			8		6		14		16:15			119		114		233	
04:30			6		5		11		16:30			117		96		213	
04:45			5	21	9	22	14	43	16:45			122	473	120	445	242	918
05:00			8		13		21		17:00			114		127		241	
05:15			14		16		30		17:15			111		133		244	
05:30			17		24		41		17:30			94		123		217	
05:45			20	59	20	73	40	132	17:45			139	458	123	506	262	964
06:00			27		22		49		18:00			132		114		246	
06:15			26		29		55		18:15			124		88		212	
06:30			27		54		81		18:30			130		123		253	
06:45			38	118	84	189	122	307	18:45			87	473	95	420	182	893
07:00			52		76		128		19:00			79		78		157	
07:15			57		69		126		19:15			68		67		135	
07:30			52		81		133		19:30			77		91		168	
07:45			63	224	85	311	148	535	19:45			59	283	60	296	119	579
08:00			67		84		151		20:00			61		76		137	
08:15			67		103		170		20:15			70		51		121	
08:30			56		77		133		20:30			77		50		127	
08:45			69	259	91	355	160	614	20:45			63	271	55	232	118	503
09:00			81		80		161		21:00			61		62		123	
09:15			82		73		155		21:15			43		34		77	
09:30			81		73		154		21:30			42		47		89	
09:45			104	348	98	324	202	672	21:45			43	189	30	173	73	362
10:00			101		96		197		22:00			27		35		62	
10:15			88		94		182		22:15			31		31		62	
10:30			96		104		200		22:30			18		23		41	
10:45			92	377	120	414	212	791	22:45			25	101	24	113	49	214
11:00			112		122		234		23:00			25		14		39	
11:15			102		139		241		23:15			24		13		37	
11:30			110		134		244		23:30			19		14		33	
11:45			85	409	132	527	217	936	23:45			21	89	11	52	32	141
TOTALS				1898		2270		4168	TOTALS				4209		4094		8303
SPLIT %				45.5%		54.5%		33.4%	SPLIT %				50.7%		49.3%		66.6%

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	6,107	6,364	12,471

AM Peak Hour			11:30	11:00	11:30	PM Peak Hour			17:45	17:00	12:15
AM Pk Volume			447	527	948	PM Pk Volume			525	506	987
Pk Hr Factor			0.860	0.948	0.912	Pk Hr Factor			0.944	0.951	0.942
7 - 9 Volume	0	0	483	666	1149	4 - 6 Volume	0	0	931	951	1882
7 - 9 Peak Hour			08:00	08:00	08:00	4 - 6 Peak Hour			16:00	17:00	17:00
7 - 9 Pk Volume	0	0	259	355	614	4 - 6 Pk Volume	0	0	473	506	964
Pk Hr Factor	0.000	0.000	0.938	0.862	0.903	Pk Hr Factor	0.000	0.000	0.969	0.951	0.920

Prepared by NDS/ATD

VOLUME

Tamarack Ave Bet. Railroad Crossing & Hibiscus Cir

Day: Friday
Date: 2/26/2016

City: Carlsbad
Project #: CA16_4057_003

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	5,964	5,851	11,815

AM Period	NB	SB	EB		WB		TOTAL		PM Period	NB	SB	EB		WB		TOTAL	
00:00			6		6		12		12:00			105		79		184	
00:15			6		4		10		12:15			79		70		149	
00:30			9		11		20		12:30			66		84		150	
00:45			2	23	5	26	7	49	12:45			77	327	77	310	154	637
01:00			3		1		4		13:00			97		100		197	
01:15			4		4		8		13:15			104		81		185	
01:30			4		3		7		13:30			87		83		170	
01:45			1	12	2	10	3	22	13:45			108	396	80	344	188	740
02:00			1		1		2		14:00			118		82		200	
02:15			3		0		3		14:15			149		77		226	
02:30			1		2		3		14:30			106		119		225	
02:45			2	7	1	4	3	11	14:45			118	491	133	411	251	902
03:00			2		0		2		15:00			122		130		252	
03:15			1		1		2		15:15			88		112		200	
03:30			1		0		1		15:30			115		138		253	
03:45			0	4	0	1	0	5	15:45			115	440	145	525	260	965
04:00			5		0		5		16:00			125		99		224	
04:15			4		0		4		16:15			118		101		219	
04:30			7		2		9		16:30			138		102		240	
04:45			7	23	4	6	11	29	16:45			123	504	123	425	246	929
05:00			10		6		16		17:00			105		115		220	
05:15			23		20		43		17:15			121		121		242	
05:30			23		23		46		17:30			135		117		252	
05:45			27	83	43	92	70	175	17:45			149	510	85	438	234	948
06:00			31		23		54		18:00			188		89		277	
06:15			44		30		74		18:15			111		95		206	
06:30			60		68		128		18:30			109		72		181	
06:45			55	190	77	198	132	388	18:45			81	489	71	327	152	816
07:00			71		101		172		19:00			80		66		146	
07:15			86		93		179		19:15			66		64		130	
07:30			99		132		231		19:30			62		78		140	
07:45			73	329	136	462	209	791	19:45			51	259	47	255	98	514
08:00			91		96		187		20:00			45		47		92	
08:15			75		107		182		20:15			52		60		112	
08:30			83		115		198		20:30			34		49		83	
08:45			75	324	89	407	164	731	20:45			50	181	29	185	79	366
09:00			71		77		148		21:00			27		42		69	
09:15			105		82		187		21:15			34		37		71	
09:30			84		96		180		21:30			35		47		82	
09:45			89	349	86	341	175	690	21:45			32	128	42	168	74	296
10:00			72		89		161		22:00			28		41		69	
10:15			73		87		160		22:15			27		41		68	
10:30			88		69		157		22:30			31		39		70	
10:45			79	312	90	335	169	647	22:45			22	108	21	142	43	250
11:00			110		93		203		23:00			19		22		41	
11:15			87		118		205		23:15			10		19		29	
11:30			114		80		194		23:30			17		6		23	
11:45			110	421	89	380	199	801	23:45			8	54	12	59	20	113
TOTALS				2077		2262		4339	TOTALS				3887		3589		7476
SPLIT %				47.9%		52.1%		36.7%	SPLIT %				52.0%		48.0%		63.3%

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	5,964	5,851	11,815

AM Peak Hour			11:00	07:30	07:30	PM Peak Hour			17:15	15:00	17:15
AM Pk Volume			421	471	809	PM Pk Volume			593	525	1005
Pk Hr Factor			0.923	0.866	0.876	Pk Hr Factor			0.789	0.905	0.907
7 - 9 Volume	0	0	653	869	1522	4 - 6 Volume	0	0	1014	863	1877
7 - 9 Peak Hour			07:15	07:30	07:30	4 - 6 Peak Hour			17:00	16:45	16:45
7 - 9 Pk Volume	0	0	349	471	809	4 - 6 Pk Volume	0	0	510	476	960
Pk Hr Factor	0.000	0.000	0.881	0.866	0.876	Pk Hr Factor	0.000	0.000	0.856	0.967	0.952

Prepared by NDS/ATD

VOLUME

Tamarack Ave Bet. Railroad Crossing & Hibiscus Cir

Day: Saturday
Date: 2/27/2016

City: Carlsbad
Project #: CA16_4057_003

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	5,722	5,713	11,435

AM Period	NB	SB	EB		WB		TOTAL		PM Period	NB	SB	EB		WB		TOTAL	
00:00			6		15		21		12:00			111		116		227	
00:15			14		12		26		12:15			118		87		205	
00:30			7		11		18		12:30			105		114		219	
00:45			13	40	10	48	23	88	12:45			107	441	124	441	231	882
01:00			10		10		20		13:00			92		109		201	
01:15			9		5		14		13:15			100		114		214	
01:30			6		6		12		13:30			87		102		189	
01:45			10	35	6	27	16	62	13:45			99	378	96	421	195	799
02:00			10		6		16		14:00			100		111		211	
02:15			4		4		8		14:15			110		102		212	
02:30			3		0		3		14:30			104		96		200	
02:45			4	21	9	19	13	40	14:45			122	436	120	429	242	865
03:00			1		4		5		15:00			100		95		195	
03:15			7		2		9		15:15			108		104		212	
03:30			6		5		11		15:30			105		113		218	
03:45			3	17	5	16	8	33	15:45			101	414	106	418	207	832
04:00			1		0		1		16:00			110		86		196	
04:15			5		0		5		16:15			129		111		240	
04:30			4		2		6		16:30			118		107		225	
04:45			5	15	4	6	9	21	16:45			90	447	108	412	198	859
05:00			2		3		5		17:00			132		101		233	
05:15			9		12		21		17:15			100		110		210	
05:30			7		18		25		17:30			86		122		208	
05:45			10	28	24	57	34	85	17:45			129	447	69	402	198	849
06:00			11		28		39		18:00			132		93		225	
06:15			23		20		43		18:15			111		54		165	
06:30			26		31		57		18:30			85		57		142	
06:45			24	84	48	127	72	211	18:45			70	398	60	264	130	662
07:00			31		48		79		19:00			64		65		129	
07:15			41		47		88		19:15			46		53		99	
07:30			49		61		110		19:30			42		51		93	
07:45			55	176	66	222	121	398	19:45			44	196	43	212	87	408
08:00			59		78		137		20:00			48		54		102	
08:15			68		82		150		20:15			48		50		98	
08:30			90		82		172		20:30			45		51		96	
08:45			79	296	96	338	175	634	20:45			45	186	41	196	86	382
09:00			84		119		203		21:00			35		36		71	
09:15			100		105		205		21:15			40		48		88	
09:30			114		85		199		21:30			42		33		75	
09:45			110	408	107	416	217	824	21:45			45	162	45	162	90	324
10:00			88		110		198		22:00			24		24		48	
10:15			130		111		241		22:15			23		28		51	
10:30			112		95		207		22:30			27		26		53	
10:45			121	451	140	456	261	907	22:45			28	102	22	100	50	202
11:00			119		135		254		23:00			22		19		41	
11:15			119		116		235		23:15			23		15		38	
11:30			117		103		220		23:30			19		15		34	
11:45			120	475	108	462	228	937	23:45			5	69	13	62	18	131
TOTALS				2046		2194		4240	TOTALS				3676		3519		7195
SPLIT %				48.3%		51.7%		37.1%	SPLIT %				51.1%		48.9%		62.9%

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	5,722	5,713	11,435

AM Peak Hour			10:15	10:45	10:45	PM Peak Hour			16:15	12:30	16:15
AM Pk Volume			482	494	970	PM Pk Volume			469	461	896
Pk Hr Factor			0.927	0.882	0.929	Pk Hr Factor			0.888	0.929	0.933
7 - 9 Volume	0	0	472	560	1032	4 - 6 Volume	0	0	894	814	1708
7 - 9 Peak Hour			08:00	08:00	08:00	4 - 6 Peak Hour			16:15	16:45	16:15
7 - 9 Pk Volume	0	0	296	338	634	4 - 6 Pk Volume	0	0	469	441	896
Pk Hr Factor	0.000	0.000	0.822	0.880	0.906	Pk Hr Factor	0.000	0.000	0.888	0.904	0.933

Prepared by NDS/ATD

VOLUME

Tamarack Ave Bet. Railroad Crossing & Hibiscus Cir

Day: Sunday
Date: 2/28/2016

City: Carlsbad
Project #: CA16_4057_003

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	5,105	5,035	10,140

AM Period	NB	SB	EB		WB		TOTAL		PM Period	NB	SB	EB		WB		TOTAL	
00:00			23		16		39		12:00			102		121		223	
00:15			11		7		18		12:15			104		96		200	
00:30			12		9		21		12:30			127		88		215	
00:45			11	57	6	38	17	95	12:45			87	420	125	430	212	850
01:00			10		5		15		13:00			94		106		200	
01:15			6		10		16		13:15			88		95		183	
01:30			7		3		10		13:30			99		88		187	
01:45			12	35	7	25	19	60	13:45			90	371	85	374	175	745
02:00			2		5		7		14:00			103		109		212	
02:15			12		7		19		14:15			112		86		198	
02:30			3		6		9		14:30			106		86		192	
02:45			5	22	4	22	9	44	14:45			98	419	99	380	197	799
03:00			4		4		8		15:00			95		112		207	
03:15			4		2		6		15:15			119		101		220	
03:30			1		2		3		15:30			94		118		212	
03:45			0	9	2	10	2	19	15:45			94	402	104	435	198	837
04:00			5		2		7		16:00			107		98		205	
04:15			3		2		5		16:15			108		95		203	
04:30			6		2		8		16:30			110		106		216	
04:45			3	17	1	7	4	24	16:45			105	430	81	380	186	810
05:00			2		6		8		17:00			104		117		221	
05:15			3		7		10		17:15			129		85		214	
05:30			7		17		24		17:30			85		79		164	
05:45			10	22	22	52	32	74	17:45			110	428	81	362	191	790
06:00			10		21		31		18:00			129		77		206	
06:15			8		26		34		18:15			96		58		154	
06:30			16		29		45		18:30			81		52		133	
06:45			21	55	33	109	54	164	18:45			63	369	58	245	121	614
07:00			30		39		69		19:00			59		46		105	
07:15			33		48		81		19:15			47		48		95	
07:30			39		50		89		19:30			32		51		83	
07:45			39	141	66	203	105	344	19:45			40	178	29	174	69	352
08:00			53		49		102		20:00			40		37		77	
08:15			44		85		129		20:15			32		33		65	
08:30			63		78		141		20:30			38		33		71	
08:45			87	247	70	282	157	529	20:45			24	134	30	133	54	267
09:00			77		75		152		21:00			21		34		55	
09:15			90		77		167		21:15			29		35		64	
09:30			86		91		177		21:30			19		28		47	
09:45			74	327	92	335	166	662	21:45			21	90	23	120	44	210
10:00			104		107		211		22:00			17		31		48	
10:15			83		86		169		22:15			18		29		47	
10:30			118		99		217		22:30			18		13		31	
10:45			107	412	98	390	205	802	22:45			14	67	13	86	27	153
11:00			107		93		200		23:00			13		12		25	
11:15			111		98		209		23:15			11		6		17	
11:30			95		109		204		23:30			4		12		16	
11:45			108	421	107	407	215	828	23:45			4	32	6	36	10	68
TOTALS				1765		1880		3645	TOTALS				3340		3155		6495
SPLIT %				48.4%		51.6%		35.9%	SPLIT %				51.4%		48.6%		64.1%

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	5,105	5,035	10,140

AM Peak Hour			10:30	11:15	11:45	PM Peak Hour			17:15	15:00	12:00
AM Pk Volume			443	435	853	PM Pk Volume			453	435	850
Pk Hr Factor			0.939	0.899	0.956	Pk Hr Factor			0.878	0.922	0.953
7 - 9 Volume	0	0	388	485	873	4 - 6 Volume	0	0	858	742	1600
7 - 9 Peak Hour			08:00	08:00	08:00	4 - 6 Peak Hour			16:30	16:15	16:30
7 - 9 Pk Volume	0	0	247	282	529	4 - 6 Pk Volume	0	0	448	399	837
Pk Hr Factor	0.000	0.000	0.710	0.829	0.842	Pk Hr Factor	0.000	0.000	0.868	0.853	0.947

Prepared by NDS/ATD

VOLUME

Tamarack Ave Bet. Railroad Crossing & Hibiscus Cir

Day: Monday
Date: 2/29/2016

City: Carlsbad
Project #: CA16_4057_003

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	5,049	4,975	10,024

AM Period	NB	SB	EB		WB		TOTAL		PM Period	NB	SB	EB		WB		TOTAL	
00:00			3		4		7		12:00			86		89		175	
00:15			3		4		7		12:15			81		62		143	
00:30			4		4		8		12:30			77		72		149	
00:45			5	15	4	16	9	31	12:45			75	319	76	299	151	618
01:00			2		0		2		13:00			89		76		165	
01:15			1		1		2		13:15			86		64		150	
01:30			0		4		4		13:30			79		66		145	
01:45			2	5	2	7	4	12	13:45			81	335	66	272	147	607
02:00			2		1		3		14:00			94		75		169	
02:15			1		2		3		14:15			117		65		182	
02:30			4		4		8		14:30			105		92		197	
02:45			2	9	1	8	3	17	14:45			96	412	121	353	217	765
03:00			1		4		5		15:00			88		85		173	
03:15			4		1		5		15:15			85		82		167	
03:30			2		1		3		15:30			86		83		169	
03:45			1	8	1	7	2	15	15:45			102	361	99	349	201	710
04:00			2		1		3		16:00			113		77		190	
04:15			8		3		11		16:15			117		89		206	
04:30			8		1		9		16:30			118		101		219	
04:45			9	27	3	8	12	35	16:45			102	450	87	354	189	804
05:00			10		5		15		17:00			110		83		193	
05:15			17		20		37		17:15			128		95		223	
05:30			18		25		43		17:30			107		97		204	
05:45			24	69	27	77	51	146	17:45			105	450	95	370	200	820
06:00			34		28		62		18:00			102		86		188	
06:15			51		25		76		18:15			91		71		162	
06:30			55		63		118		18:30			77		74		151	
06:45			46	186	78	194	124	380	18:45			66	336	77	308	143	644
07:00			73		123		196		19:00			54		60		114	
07:15			76		116		192		19:15			38		49		87	
07:30			93		143		236		19:30			29		48		77	
07:45			97	339	117	499	214	838	19:45			38	159	49	206	87	365
08:00			78		111		189		20:00			38		37		75	
08:15			70		72		142		20:15			33		28		61	
08:30			82		93		175		20:30			29		29		58	
08:45			98	328	93	369	191	697	20:45			29	129	28	122	57	251
09:00			82		85		167		21:00			22		37		59	
09:15			68		63		131		21:15			25		33		58	
09:30			106		73		179		21:30			27		25		52	
09:45			77	333	85	306	162	639	21:45			29	103	26	121	55	224
10:00			70		73		143		22:00			26		33		59	
10:15			62		70		132		22:15			17		16		33	
10:30			76		70		146		22:30			8		12		20	
10:45			65	273	87	300	152	573	22:45			11	62	10	71	21	133
11:00			66		89		155		23:00			9		12		21	
11:15			85		80		165		23:15			10		10		20	
11:30			92		80		172		23:30			11		7		18	
11:45			59	302	72	321	131	623	23:45			9	39	9	38	18	77
TOTALS				1894		2112		4006	TOTALS				3155		2863		6018
SPLIT %				47.3%		52.7%		40.0%	SPLIT %				52.4%		47.6%		60.0%

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	5,049	4,975	10,024

AM Peak Hour			08:45	07:00	07:00	PM Peak Hour			16:30	14:30	16:30
AM Pk Volume			354	499	838	PM Pk Volume			458	380	824
Pk Hr Factor			0.835	0.872	0.888	Pk Hr Factor			0.895	0.785	0.924
7 - 9 Volume	0	0	667	868	1535	4 - 6 Volume	0	0	900	724	1624
7 - 9 Peak Hour			07:15	07:00	07:00	4 - 6 Peak Hour			16:30	17:00	16:30
7 - 9 Pk Volume	0	0	344	499	838	4 - 6 Pk Volume	0	0	458	370	824
Pk Hr Factor	0.000	0.000	0.887	0.872	0.888	Pk Hr Factor	0.000	0.000	0.895	0.954	0.924

Prepared by NDS/ATD

VOLUME

Tamarack Ave Bet. Railroad Crossing & Hibiscus Cir

Day: Tuesday
Date: 3/1/2016

City: Carlsbad
Project #: CA16_4057_003

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	5,087	5,111	10,198

AM Period	NB	SB	EB		WB		TOTAL		PM Period	NB	SB	EB		WB		TOTAL	
00:00			2		5		7		12:00			94		70		164	
00:15			6		7		13		12:15			75		71		146	
00:30			5		4		9		12:30			60		81		141	
00:45			3	16	4	20	7	36	12:45			79	308	68	290	147	598
01:00			5		5		10		13:00			75		72		147	
01:15			3		2		5		13:15			64		72		136	
01:30			5		2		7		13:30			88		75		163	
01:45			4	17	2	11	6	28	13:45			99	326	71	290	170	616
02:00			3		1		4		14:00			96		59		155	
02:15			3		4		7		14:15			92		82		174	
02:30			3		5		8		14:30			105		87		192	
02:45			1	10	1	11	2	21	14:45			84	377	98	326	182	703
03:00			3		1		4		15:00			86		85		171	
03:15			2		1		3		15:15			91		98		189	
03:30			5		1		6		15:30			105		92		197	
03:45			1	11	1	4	2	15	15:45			104	386	102	377	206	763
04:00			1		0		1		16:00			108		94		202	
04:15			7		2		9		16:15			114		89		203	
04:30			11		2		13		16:30			97		85		182	
04:45			17	36	8	12	25	48	16:45			97	416	102	370	199	786
05:00			11		7		18		17:00			109		104		213	
05:15			18		14		32		17:15			119		101		220	
05:30			23		24		47		17:30			115		106		221	
05:45			21	73	37	82	58	155	17:45			127	470	89	400	216	870
06:00			28		27		55		18:00			121		91		212	
06:15			47		25		72		18:15			114		75		189	
06:30			45		68		113		18:30			74		91		165	
06:45			64	184	82	202	146	386	18:45			75	384	83	340	158	724
07:00			71		112		183		19:00			69		72		141	
07:15			64		106		170		19:15			52		61		113	
07:30			94		125		219		19:30			50		53		103	
07:45			86	315	152	495	238	810	19:45			46	217	41	227	87	444
08:00			65		89		154		20:00			31		51		82	
08:15			55		92		147		20:15			36		40		76	
08:30			95		94		189		20:30			29		35		64	
08:45			66	281	88	363	154	644	20:45			37	133	46	172	83	305
09:00			75		73		148		21:00			26		49		75	
09:15			74		80		154		21:15			28		38		66	
09:30			62		77		139		21:30			15		23		38	
09:45			78	289	85	315	163	604	21:45			26	95	30	140	56	235
10:00			84		66		150		22:00			25		20		45	
10:15			74		55		129		22:15			14		19		33	
10:30			73		65		138		22:30			19		13		32	
10:45			71	302	69	255	140	557	22:45			14	72	13	65	27	137
11:00			84		77		161		23:00			8		14		22	
11:15			81		66		147		23:15			8		9		17	
11:30			89		79		168		23:30			16		11		27	
11:45			79	333	77	299	156	632	23:45			4	36	11	45	15	81
TOTALS				1867		2069		3936	TOTALS				3220		3042		6262
SPLIT %				47.4%		52.6%		38.6%	SPLIT %				51.4%		48.6%		61.4%

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	5,087	5,111	10,198

AM Peak Hour			11:15	07:00	07:00	PM Peak Hour			17:15	16:45	17:00
AM Pk Volume			343	495	810	PM Pk Volume			482	413	870
Pk Hr Factor			0.912	0.814	0.851	Pk Hr Factor			0.949	0.974	0.984
7 - 9 Volume	0	0	596	858	1454	4 - 6 Volume	0	0	886	770	1656
7 - 9 Peak Hour			07:00	07:00	07:00	4 - 6 Peak Hour			17:00	16:45	17:00
7 - 9 Pk Volume	0	0	315	495	810	4 - 6 Pk Volume	0	0	470	413	870
Pk Hr Factor	0.000	0.000	0.838	0.814	0.851	Pk Hr Factor	0.000	0.000	0.925	0.974	0.984

Prepared by NDS/ATD

VOLUME

Tamarack Ave Bet. Railroad Crossing & Hibiscus Cir

Day: Wednesday
Date: 3/2/2016

City: Carlsbad
Project #: CA16_4057_003

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	5,163	5,191	10,354

AM Period	NB	SB	EB		WB		TOTAL		PM Period	NB	SB	EB		WB		TOTAL	
00:00			8		4		12		12:00			104		88		192	
00:15			6		3		9		12:15			91		71		162	
00:30			2		8		10		12:30			74		78		152	
00:45			4	20	7	22	11	42	12:45			82	351	76	313	158	664
01:00			6		1		7		13:00			64		69		133	
01:15			0		2		2		13:15			78		80		158	
01:30			1		0		1		13:30			84		80		164	
01:45			1	8	3	6	4	14	13:45			88	314	77	306	165	620
02:00			0		1		1		14:00			87		69		156	
02:15			2		2		4		14:15			94		70		164	
02:30			2		2		4		14:30			85		109		194	
02:45			1	5	1	6	2	11	14:45			97	363	115	363	212	726
03:00			1		0		1		15:00			83		109		192	
03:15			0		3		3		15:15			113		107		220	
03:30			5		0		5		15:30			110		99		209	
03:45			2	8	0	3	2	11	15:45			98	404	83	398	181	802
04:00			2		1		3		16:00			107		84		191	
04:15			4		2		6		16:15			103		75		178	
04:30			10		2		12		16:30			118		97		215	
04:45			10	26	4	9	14	35	16:45			112	440	88	344	200	784
05:00			7		6		13		17:00			114		105		219	
05:15			16		16		32		17:15			119		106		225	
05:30			23		27		50		17:30			115		101		216	
05:45			23	69	35	84	58	153	17:45			127	475	83	395	210	870
06:00			40		26		66		18:00			102		84		186	
06:15			42		26		68		18:15			98		62		160	
06:30			46		68		114		18:30			72		71		143	
06:45			64	192	73	193	137	385	18:45			70	342	65	282	135	624
07:00			51		109		160		19:00			53		65		118	
07:15			86		106		192		19:15			65		61		126	
07:30			132		116		248		19:30			44		64		108	
07:45			92	361	139	470	231	831	19:45			33	195	50	240	83	435
08:00			91		99		190		20:00			29		44		73	
08:15			89		92		181		20:15			43		44		87	
08:30			73		92		165		20:30			47		44		91	
08:45			63	316	90	373	153	689	20:45			31	150	44	176	75	326
09:00			83		72		155		21:00			29		42		71	
09:15			68		72		140		21:15			21		46		67	
09:30			66		88		154		21:30			23		48		71	
09:45			77	294	77	309	154	603	21:45			25	98	27	163	52	261
10:00			67		81		148		22:00			20		24		44	
10:15			83		62		145		22:15			12		24		36	
10:30			84		71		155		22:30			15		15		30	
10:45			86	320	74	288	160	608	22:45			10	57	20	83	30	140
11:00			71		74		145		23:00			8		12		20	
11:15			74		74		148		23:15			14		19		33	
11:30			88		83		171		23:30			10		15		25	
11:45			83	316	83	314	166	630	23:45			7	39	5	51	12	90
TOTALS				1935		2077		4012	TOTALS				3228		3114		6342
SPLIT %				48.2%		51.8%		38.7%	SPLIT %				50.9%		49.1%		61.3%

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	5,163	5,191	10,354

AM Peak Hour			07:30	07:00	07:15	PM Peak Hour			17:00	14:30	17:00
AM Pk Volume			404	470	861	PM Pk Volume			475	440	870
Pk Hr Factor			0.765	0.845	0.868	Pk Hr Factor			0.935	0.957	0.967
7 - 9 Volume	0	0	677	843	1520	4 - 6 Volume	0	0	915	739	1654
7 - 9 Peak Hour			07:30	07:00	07:15	4 - 6 Peak Hour			17:00	16:45	17:00
7 - 9 Pk Volume	0	0	404	470	861	4 - 6 Pk Volume	0	0	475	400	870
Pk Hr Factor	0.000	0.000	0.765	0.845	0.868	Pk Hr Factor	0.000	0.000	0.935	0.943	0.967

Prepared by NDS/ATD

VOLUME

Tamarack Ave Bet. Railroad Crossing & Hibiscus Cir

Day: Thursday
Date: 3/3/2016

City: Carlsbad
Project #: CA16_4057_003

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	5,298	5,180	10,478

AM Period	NB	SB	EB		WB		TOTAL		PM Period	NB	SB	EB		WB		TOTAL	
00:00			6		2		8		12:00			86		101		187	
00:15			5		8		13		12:15			99		69		168	
00:30			3		5		8		12:30			79		80		159	
00:45			2	16	3	18	5	34	12:45			70	334	82	332	152	666
01:00			2		4		6		13:00			78		63		141	
01:15			1		3		4		13:15			98		81		179	
01:30			1		2		3		13:30			67		86		153	
01:45			4	8	3	12	7	20	13:45			79	322	90	320	169	642
02:00			2		2		4		14:00			90		73		163	
02:15			0		1		1		14:15			76		76		152	
02:30			3		1		4		14:30			108		68		176	
02:45			2	7	2	6	4	13	14:45			92	366	88	305	180	671
03:00			4		1		5		15:00			123		95		218	
03:15			0		2		2		15:15			88		94		182	
03:30			6		3		9		15:30			106		87		193	
03:45			1	11	1	7	2	18	15:45			87	404	71	347	158	751
04:00			2		0		2		16:00			116		84		200	
04:15			2		0		2		16:15			107		78		185	
04:30			6		1		7		16:30			102		112		214	
04:45			9	19	6	7	15	26	16:45			95	420	108	382	203	802
05:00			11		7		18		17:00			123		94		217	
05:15			13		17		30		17:15			114		109		223	
05:30			19		24		43		17:30			132		111		243	
05:45			20	63	30	78	50	141	17:45			112	481	103	417	215	898
06:00			36		25		61		18:00			146		83		229	
06:15			48		32		80		18:15			103		83		186	
06:30			57		61		118		18:30			82		95		177	
06:45			53	194	65	183	118	377	18:45			80	411	67	328	147	739
07:00			81		110		191		19:00			60		71		131	
07:15			87		107		194		19:15			59		45		104	
07:30			107		103		210		19:30			49		55		104	
07:45			96	371	129	449	225	820	19:45			45	213	44	215	89	428
08:00			77		111		188		20:00			49		53		102	
08:15			65		84		149		20:15			33		50		83	
08:30			86		94		180		20:30			35		40		75	
08:45			84	312	89	378	173	690	20:45			43	160	31	174	74	334
09:00			69		72		141		21:00			31		32		63	
09:15			84		70		154		21:15			36		35		71	
09:30			84		98		182		21:30			36		34		70	
09:45			76	313	70	310	146	623	21:45			30	133	35	136	65	269
10:00			67		93		160		22:00			13		26		39	
10:15			73		71		144		22:15			16		25		41	
10:30			75		70		145		22:30			11		14		25	
10:45			79	294	80	314	159	608	22:45			15	55	24	89	39	144
11:00			76		73		149		23:00			14		22		36	
11:15			87		80		167		23:15			13		11		24	
11:30			109		79		188		23:30			19		15		34	
11:45			67	339	87	319	154	658	23:45			6	52	6	54	12	106
TOTALS				1947		2081		**4028**	**TOTALS**				3351		3099		**6450**
SPLIT %				48.3%		51.7%		**38.4%**	**SPLIT %**				52.0%		48.0%		**61.6%**

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	5,298	5,180	10,478

AM Peak Hour			07:00	07:15	**07:00**	**PM Peak Hour**			17:15	16:30	**17:15**
AM Pk Volume			371	450	**820**	**PM Pk Volume**			504	423	**910**
Pk Hr Factor			0.867	0.872	**0.911**	**Pk Hr Factor**			0.863	0.944	**0.936**
7 - 9 Volume	0	0	683	827	**1510**	**4 - 6 Volume**	0	0	901	799	**1700**
7 - 9 Peak Hour			07:00	07:15	**07:00**	**4 - 6 Peak Hour**			17:00	16:30	**17:00**
7 - 9 Pk Volume	0	0	371	450	**820**	**4 - 6 Pk Volume**	0	0	481	423	**898**
Pk Hr Factor	0.000	0.000	0.867	0.872	**0.911**	**Pk Hr Factor**	0.000	0.000	0.911	0.944	**0.924**

CARLSBAD TRAFFIC VOLUME COMPARISON

	Existing ADT	SANDAG Series 13			Growth Rate
		2012	2035	2050	
Grand Ave	5,860	1,000	1,100	1,100	0.002511
Carslbad Village Drive	12,862	9,200	9,800	10,100	0.002459
Tamarack Ave	10,574	5,200	5,500	5,400	0.000994

Notes:

- Existing ADT based on M-F average counts from February 26 - March 3.

- Grand Ave. roadway segment between the railroad tracks and State St. was unavailable, therefore volume just east of State St. was identifiea

- SANDAG Series 13 adjusted volumes were unavailable as of 4/21/2016, therefore unadjusted volumes are presented

- Grand Ave roadway segment volumes between the railroad tracks and Roosevelt St. was unavailable, therefore the volume just east of Roosevelt St. was identified.

Series 13

2012

2035

* Link Unadjusted Volume says 5.5

2050


MGRA: 14296
MGRA: 14298
MGRA: 14299
MGRA: 14082
MGRA: 14301
MGRA: 14303
MGRA: 14306
MGRA: 14304
MGRA: 14302
MGRA: 14300
TAZ: 818
MGRA: 14305
MGRA: 14320
MGRA: 14307
MGRA: 14353
MGRA: 14311
TAZ: 823
MGRA: 14310
MGRA: 14321
MGRA: 14087
TAZ: 829
MGRA: 14314
MGRA: 14315
TAZ: 828
MGRA: 14323
MGRA: 14322
MGRA: 14358
MGRA: 14325
MGRA: 14359
MGRA: 14316
TAZ: 835
MGRA: 14326
MGRA: 14373
MGRA: 14329
TAZ: 841
MGRA: 14330
MGRA: 14319
MGRA: 14331
MGRA: 14337
MGRA: 14361
MGRA: 14374
MGRA: 14333
MGRA: 14334
TAZ: 849
MGRA: 14376
MGRA: 14362
MGRA: 14375
MGRA: 14335
TAZ: 859
MGRA: 14338
MGRA: 14340
MGRA: 14339
MGRA: 14379
MGRA: 14378
MGRA: 14377
MGRA: 14380
TAZ: 880
MGRA: 14381
MGRA: 14364
MGRA: 14341
MGRA: 14365
MGRA: 14366
MGRA: 14343
MGRA: 14367
TAZ: 900
MGRA: 14368
MGRA: 14345
MGRA: 14369
MGRA: 14370
Carlsbad Village
Carlsbad State Beach
Faire Shopping Center
Chase Field
Eureka Pl
Village Dr
Anchor Way
Nautical Dr
Hibiscus Cir
Maple Ave
Acacia Ave
Juniper Ave
Hemlock Ave
Redwood Ave
Carlsbad Blvd
Grand Ave
Christiansen Way
Washington St
Oak Ave
Pine Ave
Palm Ave
Avocado Ln
Camellia Pl
Magnolia Ave
Tamarack Ave
Cannon Rd

v

Southern California Passenger Rail **SYSTEM MAP and TIMETABLES**

Schedule information for trains between

- *San Luis Obispo*
- *Santa Barbara*
- *Ventura*
- *Los Angeles*
- *Orange County*
- *San Diego*

Effective October 5, 2015

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Passenger Rail Station

- Amtrak Coast Starlight®
- Amtrak Pacific Surfliner®
- COASTER
- Metrolink
- SPRINTER (Light Rail)

Passenger Rail Service

- Amtrak Coast Starlight®
- Amtrak Pacific Surfliner®(LOSSAN Corridor)
- COASTER
- Metrolink Ventura County Line
- Metrolink Antelope Valley Line
- Metrolink San Bernardino Line
- Metrolink Riverside Line
- Metrolink 91 Line
- Metrolink Orange County Line
- Metrolink Inland Empire-Orange County Line
- SPRINTER (Light Rail)
- Amtrak San Joaquin®
- San Joaquin Thruway Bus
- Amtrak Southwest Chief®
- Amtrak Sunset Limited®

LOSSAN **NORTHBOUND** TIMETABLE

Effective October 5, 2015

Amtrak.com · AmtrakCalifornia.com · GoNCTD.com · metrolinktrains.com

MONDAY THROUGH FRIDAY (PAGE 1 OF 3)

San Diego to San Luis Obispo	TRANSIT CONNECTIONS	DEPARTURE/ ARRIVAL	METROLINK	METROLINK	METROLINK	METROLINK	METROLINK	METROLINK	METROLINK	METROLINK	METROLINK	METROLINK	METROLINK	PACIFIC SURFLINER	METROLINK	METROLINK	METROLINK	METROLINK	METROLINK	METROLINK	METROLINK	METROLINK	PACIFIC SURFLINER	COASTER	METROLINK	METROLINK	METROLINK	PACIFIC SURFLINER	METROLINK	METROLINK	METROLINK	COASTER	METROLINK	COAST STARLIGHT	San Diego to San Luis Obispo
TRAIN SERVICE NUMBER			681	901	201	601	101	701	103	603	203	703	761	605	903	705	683	205	905	607	907	763	631	685	207	800	565	107	687	633	635	802	14	TRAIN SERVICE NUMBER
San Diego-Santa Fe Depot		DP																				6:00a	6:28a				7:05a				7:46a			San Diego-Santa Fe Depot
San Diego-Old Town																						R 6:07a	6:34a				R 7:12a				7:52a			San Diego-Old Town
Sorrento Valley																						–	6:55a				–				8:15a			Sorrento Valley
Solana Beach																						6:38a	7:04a				7:42a				8:24a			Solana Beach
Encinitas																						–	7:09a				–				8:29a			Encinitas
Carlsbad Poinsettia																						–	7:17a				–				8:35a			Carlsbad Poinsettia
Carlsbad Village																						–	7:25a				–				8:42a			Carlsbad Village
Oceanside						4:37a				5:16a				5:45a						6:39a		6:58a	7:30a			7:37a	7:57a				8:48a			Oceanside
San Clemente Pier						–				–				–						–		–				–	–							San Clemente Pier
San Clemente North Beach						5:00a				5:39a				6:09a						7:02a		–				8:00a	–							San Clemente North Beach
San Juan Capistrano						5:09a				5:48a				6:18a						7:11a		7:30a				8:09a	8:30a							San Juan Capistrano
Laguna Niguel/Mission Viejo			4:05a			5:15a				5:54a				6:24a						7:17a		–		7:55a		8:15a	–		8:40a	8:55a		9:05a		Laguna Niguel/Mission Viejo
Irvine			4:14a			5:24a				6:03a				6:33a			7:10a			7:26a		7:44a		8:04a		8:24a	8:45a		8:49a	9:04a		9:14a		Irvine
Tustin			4:22a			5:31a				6:10a				6:40a			7:17a			7:34a		–		8:12a		8:31a	–		8:56a	9:10a		9:21a		Tustin
Santa Ana			4:28a			5:38a				6:17a			B5:25a	6:47a			7:24a			7:40a		7:55a		8:18a		8:38a	8:56a		9:02a	9:16a		9:27a		Santa Ana
Orange			4:33a			5:43a				6:22a				6:52a			7:29a			7:45a		–		8:23a		8:43a	–		9:07a	9:21a		9:32a		Orange
Anaheim			4:37a			5:47a				6:26a				6:56a			7:33a			7:49a		8:04a		8:27a			9:05a		9:11a	9:25a				Anaheim
Fullerton			4:46a			5:56a		•6:16a		6:35a		•6:43a	B5:50a	7:05a		•7:29a	7:41a			7:58a		8:13a		8:36a			9:14a		9:19a	9:40a				Fullerton
Buena Park			•4:53a			•6:02a		•6:23a		•6:41a		•6:50a		•7:11a		•7:37a	•7:48a			•8:05a		–		•8:42a			–		•9:24a					Buena Park
Norwalk/Santa Fe Springs			•5:00a			•6:10a		•6:31a		•6:49a		•6:58a		•7:19a		•7:44a	•7:55a			•8:12a		–		•8:50a			–		•9:31a					Norwalk/Santa Fe Springs
Commerce		↓	–			–		–		•6:59a		–		•7:29a		–	–			•8:22a		–		•9:01a			–		–					Commerce
Los Angeles Union Station		AR	5:28a			6:40a		7:05a		7:20a		7:32a	B6:35a	7:50a		8:18a	8:20a			8:45a		8:46a		9:27a			9:50a		10:10a					Los Angeles Union Station
		DP		5:38a	6:30a		6:52a		7:15a		7:30a		7:35a		8:00a			8:25a	8:30a		8:55a	9:10a			9:40a			9:50a						10:10a	
Glendale				•5:48a	6:41a		7:01a		7:25a		7:40a		7:48a		•8:10a			8:36a	•8:40a		•9:05a	9:22a			9:50a			10:00a						–	Glendale
Downtown Burbank				•5:54a	6:47a		7:07a		7:31a		7:46a		–		•8:16a			8:42a	•8:46a		•9:11a	–			9:56a			10:06a						–	Downtown Burbank
Burbank-Bob Hope Airport				6:01a			7:12a		7:36a				8:00a		8:25a				8:55a		9:20a	9:32a						10:11a						R 10:29a	Burbank-Bob Hope Airport
Van Nuys							•7:23a		•7:43a				8:10a									9:42a						•10:19a						R 10:40a	Van Nuys
Northridge							•7:31a		•8:00a				–									–						•10:28a						–	Northridge
Chatsworth							•7:38a		8:10a				8:32a									9:54a						10:35a						–	Chatsworth
Simi Valley							•7:52a						8:45a									10:06a												R 11:11a	Simi Valley
Moorpark							8:10a						8:57a									–												–	Moorpark
Camarillo													9:10a									10:30a												–	Camarillo
Oxnard													9:21a									10:43a												11:44a	Oxnard
East Ventura	1												–									–												–	East Ventura
Ventura	1												9:35a									10:59a												–	Ventura
Carpinteria													10:06a									11:21a												–	Carpinteria
Santa Barbara													10:22a									D11:45a												12:40p	Santa Barbara
Goleta	1												10:34a									11:58a												–	Goleta
Lompoc-Surf													11:40a																					–	Lompoc-Surf
Guadalupe-Santa Maria	2												12:16p																					–	Guadalupe-Santa Maria
Grover Beach		↓											12:35p									B1:45p												–	Grover Beach
San Luis Obispo		AR											1:00p									B2:15p												3:35p	San Luis Obispo

NOTES

Boarding information is available at each station.

- Amtrak Coast Starlight®
- Amtrak Pacific Surfliner®
- COASTER
- METROLINK

- Bus
- Bus Rapid Transit
- LAX Flyaway
- Light Rail Transit
- Subway

– Train does not stop at this station
R Stops only to receive passengers
D Stops only to discharge passengers
COASTER fares and passes are accepted on Pacific Surfliner for travel between San Diego and Oceanside

DP Departure time
AR Arrival time
a AM times
p PM times

• Train may leave up to five minutes ahead of schedule.
* Sorrento Valley COASTER Connection shuttle service not available for this train.
B Amtrak California Thruway Bus Service: Advanced reservations required.
Amtrak California Thruway Bus Service: Arrives/departs from Santa Barbara. There is no bus service to Goleta.

↳ Connecting trains: connections between Amtrak, Metrolink, and COASTER are not guaranteed.
1 Transit is within walking distance to the train station.
2 On demand transit service. Call transit operator for service.

Northbound Monday-Friday schedule continued on next page.

LOSSAN **NORTHBOUND** TIMETABLE

Effective October 5, 2015

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MONDAY THROUGH FRIDAY (PAGE 2 OF 3)

San Diego to San Luis Obispo	TRANSF. CONNECTIONS	DEPARTURE/ ARRIVAL	PACIFIC SURFLINER	METROLINK	METROLINK	PACIFIC SURFLINER	COASTER	METROLINK	METROLINK	PACIFIC SURFLINER	METROLINK	METROLINK	COASTER	METROLINK	PACIFIC SURFLINER	METROLINK	METROLINK	METROLINK	METROLINK	PACIFIC SURFLINER	METROLINK	METROLINK	COASTER	METROLINK	METROLINK	METROLINK	METROLINK	METROLINK	METROLINK	San Diego to San Luis Obispo
TRAIN SERVICE NUMBER			567	209	211	769	639	635	109	573	213	804	645	909	777	115	155	215	217	579	806	641	651	117	219	119	285	808	609	TRAIN SERVICE NUMBER
San Diego-Santa Fe Depot		DP	8:20a			9:25a	9:48a			10:42a			12:37p		12:00p					1:40p			2:16p							San Diego-Santa Fe Depot
San Diego-Old Town			R 8:27a			R 9:32a	9:54a			R 10:49a			12:44p		–					–			2:22p							San Diego-Old Town
Sorrento Valley			8:49a			–	10:14a			11:12a			1:04p*		–					–			2:42p*							Sorrento Valley
Solana Beach			8:58a			10:03a	10:23a			11:21a			1:14p		12:34p					2:14p			2:55p							Solana Beach
Encinitas			9:05a			–	10:31a			11:27a			1:23p		–					–			3:03p							Encinitas
Carlsbad Poinsettia			9:12a			–	10:37a			11:32a			1:29p		–					–			3:08p							Carlsbad Poinsettia
Carlsbad Village			9:18a			–	10:43a			11:38a			1:36p		–					–			3:14p							Carlsbad Village
Oceanside			9:24a			10:18a	10:50a			11:46a			1:42p		12:53p					2:31p		3:01p	3:20p						3:26p	Oceanside
San Clemente Pier			–			–				–					–					–		–							–	San Clemente Pier
San Clemente North Beach			–			–				–					–					–		3:24p							3:49p	San Clemente North Beach
San Juan Capistrano			9:57a			10:48a				12:18p					1:25p					3:05p		3:34p							3:59p	San Juan Capistrano
Laguna Niguel/Mission Viejo			–			–		11:30a		–		12:30p			–					–	3:25p	3:40p						4:00p	4:10p	Laguna Niguel/Mission Viejo
Irvine			10:13a			11:03a		11:39a		12:35p		12:39p			1:40p					3:20p	3:34p	3:49p						4:09p	4:19p	Irvine
Tustin			–			–		11:45a		–		12:46p			–					–	3:41p	3:56p						4:16p	4:27p	Tustin
Santa Ana			10:23a			11:15a		11:51a		12:45p		12:53p			1:51p					3:30p	3:47p	4:02p						4:22p	4:32p	Santa Ana
Orange			–			–		11:56a		–		12:58p			–					–	3:52p	4:07p						4:27p	4:37p	Orange
Anaheim			10:33a			11:24a		12:00p		12:53p					2:00p					3:38p		4:11p							4:41p	Anaheim
Fullerton			10:42a			11:34a		12:15p		1:03p					2:10p					3:49p		4:25p							4:49p	Fullerton
Buena Park			–			–				–					–					–									•4:57p	Buena Park
Norwalk/Santa Fe Springs			–			–				–					–					–									•5:03p	Norwalk/Santa Fe Springs
Commerce		↓	–			–				–					–					–									–	Commerce
Los Angeles Union Station		AR	11:19a			12:10p	→		→	1:40p					2:45p					4:25p			→						5:35p	Los Angeles Union Station
		DP		11:20p	12:00p	12:30p			12:50p	↳	1:55p			2:50p	3:05p	3:15p	3:35p	3:45p	4:00p				4:33p	4:45p	5:10p	5:35p			↳	
Glendale				11:30p	12:11p	12:42p			1:00p		2:05p			•3:00p	3:17p	3:25p	3:45p	3:55p	4:10p				4:43p	4:55p	5:20p	–				Glendale
Downtown Burbank				11:36p	12:17p	–			1:06p		2:11p			•3:06p	–	3:31p	3:51p	4:01p	4:16p				4:49p	5:01p	5:26p	5:49p				Downtown Burbank
Burbank-Bob Hope Airport						12:52p			1:11p					3:15p	3:27p	3:36p	3:56p						4:54p		5:31p					Burbank-Bob Hope Airport
Van Nuys						1:02p			1:18p						3:37p	3:43p	4:03p						5:01p		5:38p					Van Nuys
Northridge						–			1:26p						–	3:51p	4:11p						5:09p		5:46p					Northridge
Chatsworth						1:14p			1:33p						3:49p	3:58p	4:20p						5:16p		5:53p					Chatsworth
Simi Valley						1:26p			•1:45p						4:01p	•4:10p							•5:28p		•6:05p					Simi Valley
Moorpark						1:39p			2:05p						–	4:27p							•5:40p		•6:17p					Moorpark
Camarillo						1:54p									4:27p								5:51p		6:28p					Camarillo
Oxnard						2:05p									4:38p								6:01p		6:38p					Oxnard
East Ventura	1					–									–								6:20p		6:57p					East Ventura
Ventura	1					2:19p									4:57p															Ventura
Carpinteria						2:47p									5:21p															Carpinteria
Santa Barbara						*D 3:05p*									5:43p															Santa Barbara
Goleta	1					3:18p									5:55p															Goleta
Lompoc-Surf															7:01p															Lompoc-Surf
Guadalupe-Santa Maria	2					Ⓑ5:05p									7:37p															Guadalupe-Santa Maria
Grover Beach		↓				Ⓑ5:30p									7:54p															Grover Beach
San Luis Obispo		AR				Ⓑ5:15p									8:35p															San Luis Obispo

NOTES

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- Amtrak Pacific Surfliner®
- COASTER
- METROLINK

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- Bus Rapid Transit
- LAX Flyaway
- Light Rail Transit
- Subway

– Train does not stop at this station
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DP Departure time
AR Arrival time
a AM times
p PM times

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Northbound Monday-Friday schedule continued on next page. 5

LOSSAN **NORTHBOUND** TIMETABLE

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MONDAY THROUGH FRIDAY (PAGE 3 OF 3)

San Diego to San Luis Obispo	Transit Connections	Departure/ Arrival	Pacific Surfliner	Metrolink	Metrolink	Metrolink	Metrolink	Metrolink	Coaster	Metrolink	Metrolink	Pacific Surfliner	Coaster	Metrolink	Coaster	Coaster	Metrolink	Metrolink	Metrolink	Metrolink	Metrolink	Coaster	Pacific Surfliner	Coaster	Metrolink	Pacific Surfliner	San Diego to San Luis Obispo
TRAIN SERVICE NUMBER			583	221	121	810	689	812	653	223	123	785	655	643	657	661	707	225	911	814	227	663	591	665	645	595	TRAIN SERVICE NUMBER
San Diego-Santa Fe Depot		DP	2:40p						3:45p			4:00p	4:26p		4:52p	5:34p						6:25p	6:45p	7:10p		9:00p	San Diego-Santa Fe Depot
San Diego-Old Town			R 2:47p						3:51p			R 4:07p	4:33p		4:58p	5:40p						6:32p	R 6:52p	7:16p		R 9:07p	San Diego-Old Town
Sorrento Valley			–						4:12p			–	4:53p		5:19p	6:02p						6:52p	–	7:36p*		9:29p*	Sorrento Valley
Solana Beach			3:20p						4:23p			4:40p	5:06p		5:28p	6:12p						7:04p	7:22p	7:46p		9:38p	Solana Beach
Encinitas			–						4:29p			–	5:10p		5:34p	6:18p						7:10p	–	7:53p		9:44p	Encinitas
Carlsbad Poinsettia			–						4:35p			–	5:16p		5:42p	6:27p						7:16p	–	7:59p		9:49p	Carlsbad Poinsettia
Carlsbad Village			–						4:42p			–	5:22p		5:50p	6:33p						7:22p	–	8:05p		9:55p	Carlsbad Village
Oceanside			3:41p					4:27p	4:48p →			5:00p	5:28p		5:55p	6:39p						7:27p →	7:38p	8:13p		10:01p	Oceanside
San Clemente Pier			4:03p					–				5:22p											–			–	San Clemente Pier
San Clemente North Beach			–					4:50p				–											–			–	San Clemente North Beach
San Juan Capistrano			4:20p					4:59p				5:33p											8:08p			10:31p	San Juan Capistrano
Laguna Niguel/Mission Viejo			–			4:45p		5:20p				–		5:50p						6:35p			–		8:50p	–	Laguna Niguel/Mission Viejo
Irvine			4:35p			4:55p	5:10p	5:29p				5:49p		5:59p						6:44p			8:28p		9:01p	10:47p	Irvine
Tustin			–			5:01p	5:17p	5:36p				–		6:05p						6:51p			–		9:08p	–	Tustin
Santa Ana			4:46p			5:07p	5:22p	5:43p				6:00p		6:11p						6:57p			8:39p		9:13p	10:58p	Santa Ana
Orange			–		Connects from Metrolink 609 & Pacific Surfliner 583	5:12p →	5:27p	5:48p				–		6:16p						7:02p			–		9:18p	–	Orange
Anaheim			4:55p				5:31p					6:08p		6:20p									8:48p		9:22p	11:06p	Anaheim
Fullerton			5:05p				5:39p					6:17p		6:35p →			• 6:49p						8:58p		9:35p	11:15p	Fullerton
Buena Park			–				• 5:46p					–					• 6:55p						–			–	Buena Park
Norwalk/Santa Fe Springs			–				• 5:53p					–					• 7:01p						–			–	Norwalk/Santa Fe Springs
Commerce		↓	–				–					–					–						–			–	Commerce
Los Angeles Union Station		AR	5:40p				6:20p			↓	↓	6:55p					7:40p						9:35p			11:52p	Los Angeles Union Station
		DP		→ 5:50p	5:55p					6:30p	6:40p	7:15p						7:40p	7:45p		9:25p		B 9:50p				
Glendale				6:00p	6:05p					6:40p	6:50p	7:27p						7:50p	• 7:55p		9:35p		B 10:05p				Glendale
Downtown Burbank				6:06p	6:11p					6:46p	6:56p	–						7:56p			9:41p						Downtown Burbank
Burbank-Bob Hope Airport					6:16p						7:01p	7:37p															Burbank-Bob Hope Airport
Van Nuys					6:23p						7:08p	7:47p											B 10:30p				Van Nuys
Northridge					6:31p						7:16p	–															Northridge
Chatsworth					6:38p						7:23p	7:59p											B 10:50p				Chatsworth
Simi Valley					• 6:50p						• 7:35p	8:11p											B 11:10p				Simi Valley
Moorpark					7:08p						• 7:47p	–											B 11:25p				Moorpark
Camarillo											7:58p	8:35p											B 11:35p				Camarillo
Oxnard											8:14p	8:46p											B 11:45p				Oxnard
East Ventura	1										8:37p	–															East Ventura
Ventura	1																						B 11:59p				Ventura
Carpinteria																							B 12:15p				Carpinteria
Santa Barbara												D 9:50p											B 12:35a				Santa Barbara
Goleta	1											10:03p											B 12:50a				Goleta
Lompoc-Surf																											Lompoc-Surf
Guadalupe-Santa Maria	2																										Guadalupe-Santa Maria
Grover Beach		↓										B 11:50p															Grover Beach
San Luis Obispo		AR										B 12:15a															San Luis Obispo

Boarding information is available at each station.

NOTES

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- Amtrak Pacific Surfliner®
- COASTER
- METROLINK

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- Bus Rapid Transit
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– Train does not stop at this station
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DP Departure time
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p PM times

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Northbound Saturday and Sunday schedule on next page.

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SATURDAY & SUNDAY

San Diego to San Luis Obispo	TRANSIT CONNECTIONS	DEPARTURE/ ARRIVAL	PACIFIC SURFLINER	METROLINK	PACIFIC SURFLINER	METROLINK	PACIFIC SURFLINER	COAST STARLIGHT	METROLINK	METROLINK	PACIFIC SURFLINER	METROLINK	PACIFIC SURFLINER	COASTER	METROLINK	PACIFIC SURFLINER	METROLINK	PACIFIC SURFLINER	METROLINK	COASTER	METROLINK	PACIFIC SURFLINER	METROLINK	METROLINK	PACIFIC SURFLINER	COASTER	METROLINK	PACIFIC SURFLINER	METROLINK	METROLINK	PACIFIC SURFLINER	COASTER	PACIFIC SURFLINER	San Diego to San Luis Obispo
TRAIN SERVICE NUMBER			1761	261	763	751	565	14	661	753	567	263	769	681	663	573	265	777	665	685	267	579	858	269	583	689	860	785	667	271	591	693	595	TRAIN SERVICE NUMBER
San Diego-Santa Fe Depot		DP			6:00a		7:05a				8:20a		9:25a	9:48a		10:42a		12:00p		12:27p		1:40p			2:40p	3:18p		4:00p			6:45p	7:10p	9:00p	San Diego-Santa Fe Depot
San Diego-Old Town					R 6:07a		R 7:12a				R 8:27a		R 9:32a	9:54a		R 10:49a		–		12:33p		–			R 2:47p	3:25p		R 4:07p			R 6:52p	7:16p	R 9:07p	San Diego-Old Town
Sorrento Valley					–		–				8:49a*		–	10:17a*		11:12a*		–		12:54p*		–			–	3:47p*		–			–	7:36p*	9:29p*	Sorrento Valley
Solana Beach					6:38a		7:41a				8:58a		10:03a	10:25a		11:21a		12:34p		1:02p		2:14p			3:20p	3:56p		4:40p			7:22p	7:46p	9:38p	Solana Beach
Encinitas					–		–				9:05a		–	10:31a		11:27a		–		1:08p		–			–	4:02p		–			–	7:53p	9:44p	Encinitas
Carlsbad Poinsettia					–		–				9:12a		–	10:36a		11:32a		–		1:14p		–			–	4:08p		–			–	7:59p	9:49p	Carlsbad Poinsettia
Carlsbad Village					–		–				9:18a		–	10:43a		11:38a		–		1:22p		–			–	4:15p		–			–	8:05p	9:55p	Carlsbad Village
Oceanside					6:58a		7:57a		8:15a		9:24a		10:18a	10:51a→	11:22a	11:46a		12:53p	1:20p	1:28p		2:31p	2:50p		3:41p	4:20p→	4:30p	5:00p	5:30p		7:38p	8:13p	10:01p	Oceanside
San Clemente Pier					–		–		8:34a		–		–		11:42a	–		–	1:40p			–	3:09p		4:03p		4:49p	5:22p	5:51p				–	San Clemente Pier
San Clemente North Beach					–		–		8:37a		–		–		11:44a	–		–	1:42p			–	3:14p		–		4:54p	–	5:53p		–		–	San Clemente North Beach
San Juan Capistrano					7:30a		8:30a		8:46a		9:57a		10:48a		11:54a	12:18p		1:25p	1:52p			3:05p	3:23p		4:20p		5:03p	5:33p	6:03p		8:08p		10:31p	San Juan Capistrano
Laguna Niguel/Mission Viejo					–		–		8:51a		–		–		12:00p	–		–	1:57p			–	3:28p		–		5:08p	–	6:10p		–		–	Laguna Niguel/Mission Viejo
Irvine					7:44a		8:45a		9:00a		10:13a		11:03a		12:10p	12:35p		1:40p	2:06p			3:20p	3:37p		4:35p		5:17p	5:49p	6:20p		8:28p		10:47p	Irvine
Tustin					–		–		9:06a		–		–		12:16p	–		–	2:12p			–	3:43p		–		5:23p	–	6:26p		–		–	Tustin
Santa Ana			B5:25a		7:55a		8:56a		9:12a		10:23a		11:15a		12:23p	12:45p		1:51p	2:18p			3:30p	3:50p		4:46p		5:30p	6:00p	6:33p		8:39p		10:58p	Santa Ana
Orange					–		–		9:17a		–		–		12:28p	–		–	2:23p			–	3:55p		–		5:35p	–	6:38p		–		–	Orange
Anaheim					8:04a		9:05a		9:21a		10:33a		11:24a		12:33p	12:53p		2:00p	2:27p			3:38p			4:55p			6:08p	6:45p		8:48p		11:06p	Anaheim
Fullerton			B5:50a		8:13a	•8:29a	9:14a		9:29a	•9:49a	10:42a		11:34a		12:41p	1:03p		2:10p	2:35p			3:49p			5:05p			6:17p	6:53p		8:58p		11:15p	Fullerton
Buena Park					–	•8:36a	–		9:36a	•9:56a	–		–		12:47p	–		–	2:40p			–			–			–	7:00p		–		–	Buena Park
Norwalk/Santa Fe Springs					–	•8:44a	–		9:44a	•10:04a	–		–		12:54p	–		–	2:47p			–			–			–	7:07p		–		–	Norwalk/Santa Fe Springs
Commerce		↓			–	–	–		–	–	–		–		–	–		–	–			–			–			–	–		–		–	Commerce
Los Angeles Union Station		AR	B6:35a		8:46a	9:20a	9:50a		10:30a	10:40a	11:19a		12:10p		1:35p	1:40p		2:45p	3:35p			4:25p			5:40p			6:55p	7:50p		9:35p		11:52p	Los Angeles Union Station
		DP	7:50a	8:45a	9:10a			10:10a				11:40a	12:30p				2:15p	3:05p		3:50p			5:25p					7:15p		8:55p	B9:50p			
Glendale			8:02a	8:55a	9:22a			–				11:50a	12:42p				2:25p	3:17p		4:00p			5:35p					7:27p		9:05p	B10:05p			Glendale
Downtown Burbank			–	9:02a	–			–				11:57a	–				2:32p	–		4:07p			5:42p					–		9:12p				Downtown Burbank
Burbank-Bob Hope Airport			8:12a		9:32a			R 10:29a					12:52p					3:27p										7:37p						Burbank-Bob Hope Airport
Van Nuys			8:21a		9:37a			R 10:40a					1:02p					3:37p										7:47p			B10:30p			Van Nuys
Northridge			–		–			–					–					–										–						Northridge
Chatsworth			8:33a		9:49a			–					1:14p					3:49p										7:59p			B10:50p			Chatsworth
Simi Valley			8:45a		10:01a			R 11:11a					1:26p					4:01p										8:11p			B11:10p			Simi Valley
Moorpark			8:57a		–			–					1:39p					–										–			B11:25p			Moorpark
Camarillo			9:10a		10:25a			–					1:54p					4:27p										8:35p			B11:35p			Camarillo
Oxnard			9:21a		10:38a			11:44a					2:05p					4:38p										8:46p			B11:45p			Oxnard
East Ventura	1		–		–			–					–					–										–						East Ventura
Ventura	1		9:35a		10:54a			–					2:19p					4:57p										9:00p			B11:59p			Ventura
Carpinteria			10:06a		11:16a			–					2:47p					5:21p										9:22p			B12:15a			Carpinteria
Santa Barbara			10:22a		D 11:40a			12:40p					D 3:05p					5:43p										D 9:50p			B12:35a			Santa Barbara
Goleta	1		10:34a		11:53a			–					3:18p					5:55p										10:03p			B12:50a			Goleta
Lompoc-Surf			11:40a					–										7:01p																Lompoc-Surf
Guadalupe-Santa Maria	2		12:16p					–					B5:05p					7:37p																Guadalupe-Santa Maria
Grover Beach		↓	12:35p		B1:45p			–					B5:30p					7:54p										B11:50p						Grover Beach
San Luis Obispo		AR	1:00p		B2:15p			3:35p					B5:15p					8:35p										B12:15a						San Luis Obispo

NOTES

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- Amtrak Pacific Surfliner®
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- Light Rail Transit
- Subway

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DP Departure time
AR Arrival time
a AM times
p PM times

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* Sorrento Valley COASTER Connection shuttle service not available for this train.
B Amtrak California Thruway Bus Service: Advanced reservations required.
Amtrak California Thruway Bus Service: Arrives/departs from Santa Barbara. There is no bus service to Goleta.

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Southbound Monday-Friday schedule on next page.

LOSSAN **SOUTHBOUND** TIMETABLE

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MONDAY THROUGH FRIDAY (PAGE 1 OF 3)

San Luis Obispo to San Diego	TRANSIT CONNECTIONS	DEPARTURE/ ARRIVAL	COASTER	COASTER	METROLINK	COASTER	METROLINK	METROLINK	COASTER	COASTER	METROLINK	PACIFIC SURFLINER	METROLINK	METROLINK	METROLINK	METROLINK	METROLINK	METROLINK	PACIFIC SURFLINER	METROLINK	METROLINK	METROLINK	METROLINK	METROLINK	COASTER	METROLINK	METROLINK	METROLINK	PACIFIC SURFLINER	METROLINK	METROLINK	METROLINK	METROLINK	San Luis Obispo to San Diego
TRAIN SERVICE NUMBER			630	634	700	636	803	200	638	640	805	562	100	900	807	682	202	102	564	204	282	104	809	811	644	600	206	106	566	280	910	902	108	TRAIN SERVICE NUMBER
San Luis Obispo		DP																																San Luis Obispo
Grover Beach																																		Grover Beach
Guadalupe-Santa Maria	2																																	Guadalupe-Santa Maria
Lompoc-Surf																																		Lompoc-Surf
Goleta	1																																	Goleta
Santa Barbara																																		Santa Barbara
Carpinteria																																		Carpinteria
Ventura	1																																	Ventura
East Ventura	1																	5:25a				6:03a					6:42a							East Ventura
Oxnard																		5:39a				6:17a					6:56a							Oxnard
Camarillo																		5:49a				6:27a					7:06a							Camarillo
Moorpark													5:04a					6:00a				6:38a					7:17a							Moorpark
Simi Valley													5:17a					6:13a				6:51a					7:30a							Simi Valley
Chatsworth													5:28a					6:24a				7:02a					7:41a						8:25a	Chatsworth
Northridge													5:33a					6:29a				7:07a					7:46a						8:30a	Northridge
Van Nuys													5:41a					6:37a				7:15a					7:54a						8:38a	Van Nuys
Burbank-Bob Hope Airport													5:49a	6:13a				6:45a				7:23a					8:02a			8:30p	8:35a	8:46a	Burbank-Bob Hope Airport
Downtown Burbank								5:30a					•5:55a	•6:17a			•6:31a	•6:52a		•7:03a	•7:25a	•7:30a					•7:51a	•8:08a		•8:27a	•8:35p	•8:39a	•8:52a	Downtown Burbank
Glendale		↓						5:37a					•6:02a	•6:23a			•6:38a	•6:59a		•7:09a	–	•7:37a					•7:58a	•8:15a		•8:33a	•8:40p	•8:45a	•8:59a	Glendale
Los Angeles Union Station		AR						5:53a					6:15a	6:38a			6:55a	7:14a		7:26a	7:42a	7:50a					8:17a	8:30a		8:55a	8:55p	9:02a	9:17a	Los Angeles Union Station
		DP			5:45a							6:15a				6:45a			7:25a							8:00a		8:30a						
Commerce					–							–				–			–							–		–						Commerce
Norwalk/Santa Fe Springs					6:06a							–				7:06a			–							8:21a		–						Norwalk/Santa Fe Springs
Buena Park					6:12a							–				7:12a			–							8:27a		–						Buena Park
Fullerton					•6:19a							6:44a				7:19a			7:55a							8:34a		9:00a						Fullerton
Anaheim												6:52a				•7:28a			8:03a							8:43a		9:09a						Anaheim
Orange							• 5:57a				• 6:29a	–			• 7:05a	• 7:33a			–				• 7:51a	• 8:16a		8:47a		–						Orange
Santa Ana							• 6:03a				• 6:35a	7:00a			• 7:11a	• 7:39a			8:11a				• 7:57a	• 8:22a		8:53a		9:20a						Santa Ana
Tustin							• 6:09a				• 6:41a	–			• 7:17a	• 7:45a			–				• 8:03a	• 8:28a		8:59a		–						Tustin
Irvine							• 6:18a				6:55a	7:12a			• 7:26a	• 7:54a			8:26a				• 8:12a	• 8:37a		• 9:08a		9:30a						Irvine
Laguna Niguel/Mission Viejo							• 6:26a					–			7:40a	8:15a			–				8:25a	8:50a		• 9:17a		–						Laguna Niguel/Mission Viejo
San Juan Capistrano							• 6:32a					7:25a							8:42a							• 9:23a		9:49a						San Juan Capistrano
San Clemente North Beach							• 6:43a					–							–							• 9:33a		–						San Clemente North Beach
San Clemente Pier							–					–							–							–		10:00a						San Clemente Pier
Oceanside			5:13a	6:00a		6:39a	7:13a		7:18a	7:42a		8:05a							9:14a						9:42a	10:10a		10:25a						Oceanside
Carlsbad Village			5:17a	6:05a		6:43a			7:22a	7:47a		–							–						9:47a			–						Carlsbad Village
Carlsbad Poinsettia			5:23a	6:11a		6:49a			7:28a	7:53a		–							–						9:53a			–						Carlsbad Poinsettia
Encinitas			5:29a	6:17a		6:54a			7:34a	7:58a		–							–						9:58a			–						Encinitas
Solana Beach			5:35a	6:23a		7:00a			7:40a	8:05a		8:19a							9:28a						10:02a			10:42a						Solana Beach
Sorrento Valley			5:44a*	6:32a		7:10a			7:51a	8:15a		–							–						10:12a*			–						Sorrento Valley
San Diego-Old Town		↓	6:05a	6:53a		7:32a			8:14a	8:38a		–							D 10:02a						10:34a			D11:12a						San Diego-Old Town
San Diego-Santa Fe Depot		AR	6:13a	7:00a		7:40a			8:20a	8:45a		9:00a							10:10a						10:43a			11:25a						San Diego-Santa Fe Depot

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MONDAY THROUGH FRIDAY (PAGE 2 OF 3)

San Luis Obispo to San Diego	TRANSIT CONNECTIONS	DEPARTURE/ ARRIVAL	COASTER	METROLINK	PACIFIC SURFLINER	METROLINK	METROLINK	METROLINK	METROLINK	PACIFIC SURFLINER	METROLINK	PACIFIC SURFLINER	METROLINK	METROLINK	METROLINK	COASTER	COASTER	METROLINK	METROLINK	METROLINK	PACIFIC SURFLINER	METROLINK	COASTER	METROLINK	METROLINK	METROLINK	METROLINK	METROLINK	METROLINK	COASTER	PACIFIC SURFLINER	METROLINK	METROLINK	San Diego to San Luis Obispo
TRAIN SERVICE NUMBER			648	632	768	110	210	212	813	572	112	774	815	634	214	654	656	216	684	218	580	817	660	602	220	116	702	686	904	662	582	640	704	TRAIN SERVICE NUMBER
San Luis Obispo		DP			Ⓑ3:50a							6:50a																						San Luis Obispo
Grover Beach					Ⓑ4:15a							7:10a																						Grover Beach
Guadalupe-Santa Maria	2											7:26a																						Guadalupe-Santa Maria
Lompoc-Surf												8:00a																						Lompoc-Surf
Goleta	1				6:35a							9:08a																						Goleta
Santa Barbara					6:49a							9:22a																			Ⓑ12:55p			Santa Barbara
Carpinteria					7:04a							9:37a																						Carpinteria
Ventura	1				7:29a							9:59a																			Ⓑ1:25p			Ventura
East Ventura	1				–							–																						East Ventura
Oxnard					7:43a							10:13a																			Ⓑ1:50p			Oxnard
Camarillo					7:54a							10:32a																						Camarillo
Moorpark					8:08a	8:25a						–														2:25p								Moorpark
Simi Valley					8:23a	8:38a						10:57a														2:38p								Simi Valley
Chatsworth					8:40a	8:49a					10:50a	11:09a														2:49p								Chatsworth
Northridge					–	8:54a					10:55a	–														2:54p								Northridge
Van Nuys					8:56a	9:02a					11:03a	11:23a														3:02p								Van Nuys
Burbank-Bob Hope Airport					9:04a	9:10a					11:11a	11:30a														3:10p			3:37p					Burbank-Bob Hope Airport
Downtown Burbank					–	•9:16a	•9:45a	•10:36a			•11:17a	–			•12:16p			•1:15p		•2:28p					• 3:10p	• 3:16p			• 3:41p					Downtown Burbank
Glendale		↓			9:16a	• 9:23a	• 9:54a	•10:42a			•11:26a	11:40a			• 12:22p			• 1:22p		• 2:34p					• 3:17p	• 3:23p			• 3:47p					Glendale
Los Angeles Union Station		AR			9:35a	9:42a	10:11a	11:00a			11:40a	12:10p			12:40p			1:40p		2:50p					3:35p	3:40p			4:00p		Ⓑ3:35p			Los Angeles Union Station
		DP			9:55a					11:15a		12:30p							2:15p		3:00p			3:20p			3:40p	3:50p			4:10p		4:20p	
Commerce					–					–		–							–		–			3:34p			–	4:04p			–		–	Commerce
Norwalk/Santa Fe Springs					–					–		–							2:38p		–			3:44p			4:03p	4:14p			–		4:41p	Norwalk/Santa Fe Springs
Buena Park					–					–		–							2:44p		–			3:51p			4:09p	4:20p			–		4:47p	Buena Park
Fullerton				10:00a	10:25a					11:45a		1:00p		1:35p					2:50p		3:30p			3:57p			• 4:15p	4:27p			4:40p	4:50p	•4:54p	Fullerton
Anaheim				10:08a	10:36a					11:54a		1:09p		1:43p					• 2:55p		3:38p			4:06p				• 4:36p			4:48p	4:59p		Anaheim
Orange				10:12a	–				•11:21a	–		–	• 1:29p	1:47p					• 2:59p		–	•3:51p		4:10p				• 4:41p			–	5:03p		Orange
Santa Ana				10:17a	10:45a				•11:27a	12:03p		1:18p	• 1:35p	1:52p					• 3:05p		3:46p	•3:57p		4:16p				• 4:47p			4:56p	5:09p		Santa Ana
Tustin				10:23a	–				•11:33a	–		–	• 1:41p	1:58p					• 3:11p		–	•4:03p		4:22p				• 4:53p			–	5:15p		Tustin
Irvine				10:30a	10:58a				•11:41a	12:18p		1:29p	• 1:49p	2:05p					• 3:19p		3:56p	•4:12p		• 4:33p				5:00p			5:07p	5:23p		Irvine
Laguna Niguel/Mission Viejo				10:45a	–				12:00p	–		–	• 1:57p	2:20p					3:40p		–	4:25p		• 4:41p							–	5:35p		Laguna Niguel/Mission Viejo
San Juan Capistrano					11:13a					12:34p		1:44p	• 2:03p								4:12p			• 4:48p							5:23p			San Juan Capistrano
San Clemente North Beach					–					–		–	• 2:17p								–			• 5:02p							–			San Clemente North Beach
San Clemente Pier					11:23a					–		–	–								–			–							–			San Clemente Pier
Oceanside			11:05a		11:47a					1:09p		2:19p	2:50p			2:32p	3:34p				4:45p		5:04p	5:30p						5:40p	5:56p			Oceanside
Carlsbad Village			11:10a		–					–		–				2:37p	3:40p				–		5:09p							5:45p	–			Carlsbad Village
Carlsbad Poinsettia			11:16a		–					–		–				2:43p	3:47p				–		5:16p							5:51p	–			Carlsbad Poinsettia
Encinitas			11:21a		–					–		–				2:49p	3:52p				–		5:21p							5:57p	–			Encinitas
Solana Beach			11:29a		12:01a					1:24p		2:33p				2:54p	3:58p				5:02p		5:29p							6:03p	6:12p			Solana Beach
Sorrento Valley			11:39a*		–					–		–				3:05p*	4:08p				–		5:38p							6:17p	–			Sorrento Valley
San Diego-Old Town		↓	11:59a		D 12:32p					D 1:55p		D 3:07p				3:28p	4:30p				D 5:30p		6:01p							6:42p	D 6:55p			San Diego-Old Town
San Diego-Santa Fe Depot		AR	12:06p		12:40p					2:03p		3:15p				3:36p	4:37p				5:50p		6:08p							6:49p	7:03p			San Diego-Santa Fe Depot

NOTES

Boarding information is available at each station.

- Amtrak Coast Starlight®
- Amtrak Pacific Surfliner®
- COASTER
- METROLINK

- Bus
- Bus Rapid Transit
- LAX Flyaway
- Light Rail Transit
- Subway

– Train does not stop at this station
R Stops only to receive passengers
D Stops only to discharge passengers
COASTER fares and passes are accepted on Pacific Surfliner for travel between San Diego and Oceanside

DP Departure time
AR Arrival time
a AM times
p PM times

• Train may leave up to five minutes ahead of schedule.
* Sorrento Valley COASTER Connection shuttle service not available for this train.
Ⓑ Amtrak California Thruway Bus Service: Advanced reservations required.
Amtrak California Thruway Bus Service: Arrives/departs from Santa Barbara. There is no bus service to Goleta.

↳ Connecting trains: connections between Amtrak, Metrolink, and COASTER are not guaranteed.
[1] Transit is within walking distance to the train station.
[2] On demand transit service. Call transit operator for service.

Southbound Monday-Friday schedule continued on next page.

LOSSAN **SOUTHBOUND** TIMETABLE

Effective October 5, 2015

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MONDAY THROUGH FRIDAY (PAGE 3 OF 3)

San Luis Obispo to San Diego	TRANSIT CONNECTIONS	DEPARTURE/ ARRIVAL	METROLINK	METROLINK	METROLINK	METROLINK	PACIFIC SURFLINER	METROLINK	METROLINK	METROLINK	METROLINK	METROLINK	METROLINK	METROLINK	METROLINK	METROLINK	PACIFIC SURFLINER	METROLINK	COAST STARLIGHT	METROLINK	PACIFIC SURFLINER	San Luis Obispo to San Diego
TRAIN SERVICE NUMBER			222	604	906	688	784	150	706	606	224	118	608	708	642	790	226	11	644	796	TRAIN SERVICE NUMBER
San Luis Obispo		DP					Ⓑ 10:30a									1:35p		3:20p		Ⓑ 3:40p	San Luis Obispo
Grover Beach							Ⓑ 10:55a									1:55p		–		Ⓑ 4:10p	Grover Beach
Guadalupe-Santa Maria	2															2:11p		–			Guadalupe-Santa Maria
Lompoc-Surf																2:51p		–			Lompoc-Surf
Goleta	1						1:50p									3:57p		–		6:45p	Goleta
Santa Barbara							2:04p									4:12p		6:02p		6:59p	Santa Barbara
Carpinteria							2:19p									4:27p		–		7:15p	Carpinteria
Ventura	1						2:41p									4:49p		–		7:37p	Ventura
East Ventura	1						–									–		–		–	East Ventura
Oxnard							2:57p									5:07p		D 7:05p		7:51p	Oxnard
Camarillo							3:08p									–		–		8:02p	Camarillo
Moorpark							3:20p					4:57p				5:36p		–		–	Moorpark
Simi Valley							3:35p					5:10p				5:54p		D 7:48p		8:38p	Simi Valley
Chatsworth							3:52p	4:40p				5:27p				6:12p		–		8:50p	Chatsworth
Northridge							–	4:45p				5:32p				–		–		–	Northridge
Van Nuys							4:14p	4:53p				5:45p				6:31p		D 8:22p		9:06p	Van Nuys
Burbank-Bob Hope Airport					4:15p		4:22p	5:05p				5:53p				6:39p		D 8:31p		9:13p	Burbank-Bob Hope Airport
Downtown Burbank			• 3:56p		• 4:19p		–	• 5:10p			•5:41p	• 5:59p				–	• 7:53p	–		–	Downtown Burbank
Glendale		↓	• 4:02p		• 4:25p		4:32p	• 5:16p			•5:48p	• 6:06p				6:50p	• 8:00p	–		9:23p	Glendale
Los Angeles Union Station		AR	4:20p		4:40p		4:50p	5:30p			6:10p	6:20p				7:10p	8:25p	9:00p		9:45p	Los Angeles Union Station
		DP	↳	4:30p	↳	4:50p	5:10p		5:30p	5:45p		↳	6:35p	6:45p		7:30p				↳ 10:10p	
Commerce				4:44p		–	–		–	5:59p			–	–		–				–	Commerce
Norwalk/Santa Fe Springs				4:54p		5:11p	–		5:51p	6:09p			6:58p	7:06p		–				–	Norwalk/Santa Fe Springs
Buena Park				5:00p		5:17p	–		5:57p	6:15p			7:04p	7:12p		–				–	Buena Park
Fullerton				5:07p		5:24p	5:40p		•6:04p	6:22p			7:10p	•7:19p	↳ 7:35p	8:00p			10:10p	10:40p	Fullerton
Anaheim				5:16p		•5:33p	5:49p			6:31p			7:18p		7:44p	8:11p			10:19p	10:49p	Anaheim
Orange				5:20p		•5:38p	–			6:35p			7:22p		7:48p	–			10:23p	–	Orange
Santa Ana				5:26p		•5:44p	5:57p			6:41p			7:28p		7:54p	8:20p			10:29p	10:58p	Santa Ana
Tustin				5:32p		•5:50p	–			6:47p			7:34p		8:00p	–			10:35p	–	Tustin
Irvine				•5:41p		•5:59p	6:09p			•6:56p			•7:42p		8:08p	8:32p			10:44p	11:08p	Irvine
Laguna Niguel/Mission Viejo				•5:49p		6:15p	–			•7:04p			•7:51p		8:20p	–			10:53p	–	Laguna Niguel/Mission Viejo
San Juan Capistrano				•5:56p			6:23p			•7:11p			•7:58p			8:48p			10:58p	11:21p	San Juan Capistrano
San Clemente North Beach				•6:08p			–			•7:23p			•8:08p			–			11:08p	–	San Clemente North Beach
San Clemente Pier				–			–			–			–			–			–	↳ –	San Clemente Pier
Oceanside				6:37p	↳		7:00p			7:51p			8:40p	↳		9:17p			11:37p	11:53p	Oceanside
Carlsbad Village							7:06p									9:22p				11:58p	Carlsbad Village
Carlsbad Poinsettia							7:12p									9:28p				12:04a	Carlsbad Poinsettia
Encinitas							7:18p									9:34p				12:10a	Encinitas
Solana Beach							7:24p									9:40p				12:16a	Solana Beach
Sorrento Valley							7:34p*									9:52p*				12:26a*	Sorrento Valley
San Diego-Old Town		↓					D 7:56p									D 10:17p				12:52a	San Diego-Old Town
San Diego-Santa Fe Depot		AR					8:07p									10:25p				1:00a	San Diego-Santa Fe Depot

Boarding information is available at each station.

NOTES

- Amtrak Coast Starlight®
- Amtrak Pacific Surfliner®
- COASTER
- METROLINK

- Bus
- Bus Rapid Transit
- LAX Flyaway
- Light Rail Transit
- Subway

– Train does not stop at this station
R Stops only to receive passengers
D Stops only to discharge passengers
COASTER fares and passes are accepted on Pacific Surfliner for travel between San Diego and Oceanside

DP Departure time
AR Arrival time
a AM times
p PM times

• Train may leave up to five minutes ahead of schedule.
* Sorrento Valley COASTER Connection shuttle service not available for this train.
Ⓑ Amtrak California Thruway Bus Service: Advanced reservations required.
Amtrak California Thruway Bus Service: Arrives/departs from Santa Barbara. There is no bus service to Goleta.

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1 Transit is within walking distance to the train station.
2 On demand transit service. Call transit operator for service.

Southbound Saturday and Sunday schedule on next page.

LOSSAN **SOUTHBOUND** TIMETABLE

Effective October 5, 2015

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SATURDAY & SUNDAY

San Luis Obispo to San Diego	TRANSIT CONNECTIONS	DEPARTURE/ ARRIVAL	PACIFIC SURFLINER	COASTER	PACIFIC SURFLINER	METROLINK	METROLINK	PACIFIC SURFLINER	METROLINK	COASTER	METROLINK	PACIFIC SURFLINER	METROLINK	METROLINK	PACIFIC SURFLINER	COASTER	PACIFIC SURFLINER	METROLINK	METROLINK	PACIFIC SURFLINER	METROLINK	PACIFIC SURFLINER	METROLINK	METROLINK	PACIFIC SURFLINER	METROLINK	COAST STARLIGHT	PACIFIC SURFLINER	San Luis Obispo to San Diego
TRAIN SERVICE NUMBER			562	680	564	260	857	566	660	684	859	768	662	262	572	688	774	264	664	266	580	752	582	268	666	784	754	1790	270	11	796	TRAIN SERVICE NUMBER
San Luis Obispo		DP										Ⓑ3:50a					6:50a									Ⓑ10:30a		2:00p		3:20p	Ⓑ3:40p	San Luis Obispo
Grover Beach												Ⓑ4:15a					7:10a									Ⓑ10:55a		2:20p		–	Ⓑ4:10p	Grover Beach
Guadalupe-Santa Maria	2																7:26a											2:36p		–		Guadalupe-Santa Maria
Lompoc-Surf																	8:00a											3:16p		–		Lompoc-Surf
Goleta	1											6:35a					9:08a									1:50p		4:22p		–	6:45p	Goleta
Santa Barbara												6:49a					9:22a						Ⓑ12:55p			2:04p		4:40p		6:02p	6:59p	Santa Barbara
Carpinteria												7:04a					9:37a									2:19p		4:55p		–	7:15p	Carpinteria
Ventura	1											7:29a					9:59a						Ⓑ1:25p			2:41p		5:21p		–	7:37p	Ventura
East Ventura	1											–					–									–		–		–	–	East Ventura
Oxnard												7:43a					10:13a						Ⓑ1:50p			2:57p		5:35p		D 7:05p	7:51p	Oxnard
Camarillo												7:54a					10:32a									3:08p		–		–	8:02p	Camarillo
Moorpark												8:08a					–									3:20p		6:04p			–	Moorpark
Simi Valley												8:23a					10:57a									3:35p		6:20p		D 7:48p	8:38p	Simi Valley
Chatsworth												8:40a					11:09a									3:52p		6:33p		–	8:50p	Chatsworth
Northridge												–					–									–		–		–	–	Northridge
Van Nuys												8:56a					11:23a									4:14p		6:45p		D 8:22p	9:06p	Van Nuys
Burbank-Bob Hope Airport												9:04a					11:30a									4:22p		6:53p		D 8:31p	9:13p	Burbank-Bob Hope Airport
Downtown Burbank						•8:00a						–		•10:35a			–	•12:48p		•2:13p				•3:59p		–		–	•7:53p	–	–	Downtown Burbank
Glendale		↓				•8:07a						9:16a		•10:42a			11:40a	•12:55p		•2:20p				•4:05p		4:32p		7:04p	•8:00p	–	9:23p	Glendale
Los Angeles Union Station		AR				8:25a						9:35a		11:00a			12:10p	1:15p		2:40p			Ⓑ3:35p	4:30p		4:50p		7:20p	8:20p	9:00p	9:45p	Los Angeles Union Station
		DP	6:15a		7:25a			8:30a	8:50a			9:55a	10:45a		11:15a		12:30p		2:00p		3:00p	3:15p	4:10p		4:40p	5:10p	7:15p	7:40p			10:10p	
Commerce			–		–			–	–			–	–		–		–		–		–	–	–		–	–	–	–			–	Commerce
Norwalk/Santa Fe Springs			–		–			–	9:11a			–	11:06a		–		–		2:21p		–	3:36p	–		5:01p	–	7:36p	–			–	Norwalk/Santa Fe Springs
Buena Park			–		–			–	9:17a			–	11:12a		–		–		2:27p		–	3:42p	–		5:07p	–	7:42p	–			–	Buena Park
Fullerton			6:44a		7:55a			9:00a	9:23a			10:25a	11:18a		11:45a		1:00p		2:33p		3:30p	• 3:49p	4:40p		5:13p	5:40p	• 7:49p	8:10p			10:40p	Fullerton
Anaheim			6:52a		8:03a			9:09a	9:31a			10:36a	11:26a		11:54a		1:09p		2:41p		3:38p		4:48p		5:21p	5:49p		8:21p			10:49p	Anaheim
Orange			–		–		•8:43a	–	9:35a		• 10:08a	–	11:30a		–		–		2:45p		–		–		5:25p	–		–			–	Orange
Santa Ana			7:00a		8:11a		•8:48a	9:20a	9:40a		• 10:13a	10:45a	11:35a		12:03p		1:18p		2:50p		3:46p		4:56p		5:30p	5:57p		8:30p			10:58p	Santa Ana
Tustin			–		–		•8:54a	–	9:46a		• 10:19a	–	11:41a		–		–		2:56p		–		–		5:36p	–		–			–	Tustin
Irvine			7:12a		8:26a		•9:01a	9:30a	9:53a		• 10:26a	10:58a	11:48a		12:18p		1:29p		3:03p		3:56p		5:07p		5:43p	6:09p		8:42p			11:08p	Irvine
Laguna Niguel/Mission Viejo			–		–		•9:10a	–	10:03a		• 10:35a	–	11:57a		–		–		3:12p		–		–		5:52p	–		–			–	Laguna Niguel/Mission Vijeo
San Juan Capistrano			7:25a		8:42a		•9:16a	9:49a	10:08a		• 10:40a	11:13a	12:02p		12:34p		1:44p		3:17p		4:12p		5:23p		5:57p	6:23p		8:55p			11:21p	San Juan Capistrano
San Clemente North Beach			–		–		•9:34a	–	• 10:20a		• 10:55a	–	•12:16p		–		–		• 3:26p		–		–		• 6:07p	–		–			–	San Clemente North Beach
San Clemente Pier			–		–		•9:39a	10:00a	•10:25a		• 11:00a	11:23a	•12:19p		–		–		• 3:28p		–		–		• 6:10p	–		–			–	San Clemente Pier
Oceanside			8:05a	8:36a	9:14a		10:20a→	10:25a	11:02a→	11:07a	11:45a	11:47a	12:55p		1:09p	1:50p	2:19p		4:15p		4:45p		5:56p		6:55p→	7:03p		9:24p			11:53p	Oceanside
Carlsbad Village			–	8:41a	–			–		11:12a		–			–	1:55p	–				–		–			7:09p		9:29p			11:58p	Carlsbad Village
Carlsbad Poinsettia			–	8:47a	–			–		11:18a		–			–	2:01p	–				–		–			7:15p		9:35p			12:04a	Carlsbad Poinsettia
Encinitas			–	8:53a	–			–		11:24a		–			–	2:07p	–				–		–			7:20p		9:41p			12:10a	Encinitas
Solana Beach			8:19a	8:59a	9:28a			10:42a		11:30a		12:01p			1:24p	2:13p	2:33p				5:02p		6:12p			7:26p		9:49p			12:16a	Solana Beach
Sorrento Valley			–	9:09a*	–			–		11:40a*		–			–	2:23p*	–				–		–			7:36p*		10:01p*			12:26a*	Sorrento Valley
San Diego-Old Town		↓	–	9:30a	D 10:02a			D 11:12a		12:02p		D 12:32p			D 1:55p	2:45p	D 3:07p				D 5:30p		D 6:55p			D 7:58p		D 10:26p			D 12:52a	San Diego-Old Town
San Diego-Santa Fe Depot		AR	9:00a	9:36a	10:10a			11:25a		12:10p		12:40p			2:03p	2:53p	3:15p				5:50p		7:03p			8:07p		10:34p			1:00a	San Diego-Santa Fe Depot

Boarding information is available at each station.

NOTES

- Amtrak Coast Starlight®
- Amtrak Pacific Surfliner®
- COASTER
- METROLINK

- Bus
- Bus Rapid Transit
- LAX Flyaway
- Light Rail Transit
- Subway

– Train does not stop at this station
R Stops only to receive passengers
D Stops only to discharge passengers
COASTER fares and passes are accepted on Pacific Surfliner for travel between San Diego and Oceanside

DP Departure time
AR Arrival time
a AM times
p PM times

• Train may leave up to five minutes ahead of schedule.
* Sorrento Valley COASTER Connection shuttle service not available for this train.
Ⓑ Amtrak California Thruway Bus Service: Advanced reservations required.
Amtrak California Thruway Bus Service: Arrives/departs from Santa Barbara. There is no bus service to Goleta.

↳ Connecting trains: connections between Amtrak, Metrolink, and COASTER are not guaranteed.
[1] Transit is within walking distance to the train station.
[2] On demand transit service. Call transit operator for service.

11

LOSSAN **CONNECTING TRANSIT**

Effective October 5, 2015

Amtrak.com | AmtrakCalifornia.com | GoNCTD.com | metrolinktrains.com

STATION	TRANSIT CONNECTIONS	OPERATOR
Anaheim	Bus	OCTA, ART
Buena Park	Bus	OCTA
Burbank-Bob Hope Airport	Bus	Metro
Camarillo	Bus	VISTA
Carlsbad Poinsettia	Bus	NCTD
Carlsbad Village	Bus	NCTD
Carpinteria	Bus	SBMTD
Chatsworth	Bus, Bus Rapid Transit	Metro, Santa Clarita Transit, Simi Valley Transit
Commerce	Bus	Commerce Bus
Downtown Burbank	Bus	Burbank Bus, Glendale Beeline, Metro
East Ventura	Bus[1]	Gold Coast Transit
Encinitas	Bus	NCTD
Fullerton	Bus	OCTA
Glendale	Bus	Glendale Beeline, Metro
Goleta	Bus[1]	SBMTD
Grover Beach	Bus	SCAT
Guadalupe-Santa Maria	Bus[2]	SMOOTH Inc.
Irvine	Bus	OCTA, Irvine Shuttle
Laguna Niguel/Mission Viejo	Bus	OCTA
Lompoc-Surf		
Los Angeles Union Station	Bus, LAX Flyaway, Light Rail Transit, Subway	AVTA, Foothill Transit, LADOT, LAWA, Metro, Santa Clarita Transit, Santa Monica Big Blue Bus, Torrance Transit
Moorpark	Bus	VISTA
Northridge	Bus	LADOT, Metro
Norwalk/Santa Fe Springs	Bus	Norwalk Transit
Oceanside	Bus, Light Rail Transit	NCTD, RTA
Orange	Bus	OCTA
Oxnard	Bus	Gold Coast Transit, VISTA
San Clemente North Beach	Bus	OCTA
San Clemente Pier	Bus	OCTA
San Diego-Old Town	Bus, Light Rail Transit	MTS
San Diego-Santa Fe Depot	Bus, Light Rail Transit, Bus Rapid Transit	MTS
San Juan Capistrano	Bus	OCTA
San Luis Obispo	Bus	SLO Transit
Santa Ana	Bus	OCTA
Santa Barbara	Bus	SBMTD
Simi Valley	Bus	Simi Valley Transit
Solana Beach	Bus	NCTD
Sorrento Valley	Bus	MTS
Tustin	Bus	OCTA, Irvine Shuttle
Van Nuys	Bus	LADOT, Metro
Ventura	Bus[1]	Gold Coast Transit

Bus | Bus Rapid Transit | LAX Flyaway | Light Rail Transit | Subway

[1] Transit is within walking distance to the train station. [2] On demand transit service. Call transit operator for service.

OPERATOR	WEBSITE	PHONE
ART (Anaheim Resort Transit)	rideart.org	(888) 364-2787
AVTA (Antelope Valley Transit Authority)	avta.com	(661) 945-9445
Burbank Bus	burbankbus.org	(818) 246-4258
Commerce Bus	ci.commerce.ca.us	(323) 722-4805
Foothill Transit	foothilltransit.org	1(800) RIDE-INFO (800-743-3463)
Glendale Beeline	glendalebeeline.com	(818) 548-3960
Gold Coast Transit District	goldcoasttransit.org	(805) 487-4222
Irvine Shuttle	irvineshuttle.net	(949) 72-GOBUS (46287)
LADOT (Los Angeles Department of Transportation)	ladottransit.com	(213, 310, 323 or 818) 808-2273
LAWA (Los Angeles World Airports)	lawa.org	(310) 646-5252
Metro (Los Angeles County Metropolitan Transportation Authority)	metro.net	(323) GO-METRO (323) 466-3876)
MTS (San Diego Metropolitan Transit System)	sdmts.com	(619) 233-3004
NCTD (North County Transit District)	gonctd.com	(760) 966-6500
Norwalk Transit	ci.norwalk.ca.us	(562) 929-5700
OCTA (Orange County Transportation Authority)	octa.net	(714) 636-RIDE (7433)
RTA (Riverside Transit Agency)	riversidetransit.com	(951) 565-5002
Santa Clarita Transit	santaclaritatransit.com	(661) 294-1BUS (1287)
Santa Monica Big Blue Bus	bigbluebus.com	(310) 451-5444
SBMTD (Santa Barbara Metropolitan Transit District)	sbmtd.gov	(805) 963-3366
SCT (South Coast Transit)	slorta.org	(805) 541-2228
Simi Valley Transit	simivalley.org	(805) 583-6700
SLO Transit (City of San Luis Obispo)	slotransit.org	(805) 541-2877
SMOOTH Inc.	smoothinc.org	(805) 922-8476
Torrance Transit	torranceca.gov	(310) 618-6266
VISTA (Ventura County Transportation Commission)	goventura.org	(800) 438-1112

Weekday 2035

Grand/Carlsbad Village			Tamarack		
Time - Gate Down			**Time - Gate Down**		
O	**Service Type**	**Direction**	**O**	**Service Type**	**Direction**
5:15	Coaster	SB	0:07	Pacific Surfliner	SB
5:56	Pacific Surfliner	NB	5:18	Coaster	SB
6:03	Coaster	SB	5:55	Pacific Surfliner	NB
6:08	Pacific Surfliner	SB	6:08	Coaster	SB
6:15	Coaster	SB	6:10	Pacific Surfliner	SB
6:25	Coaster	NB	6:20	Coaster	SB
6:41	Coaster	SB	6:25	Coaster	NB
6:56	Pacific Surfliner	NB	6:46	Coaster	SB
7:07	Pacific Surfliner	SB	6:55	Pacific Surfliner	NB
7:16	Pacific Surfliner	NB	7:09	Pacific Surfliner	SB
7:20	Coaster	SB	7:15	Pacific Surfliner	NB
7:25	Coaster	NB	7:24	Coaster	NB
7:28	Pacific Surfliner	SB	7:25	Coaster	SB
7:36	Pacific Surfliner	NB	7:29	Pacific Surfliner	SB
7:45	Coaster	SB	7:35	Pacific Surfliner	NB
7:50	Pacific Surfliner	SB	7:47	Coaster	SB
7:55	Pacific Surfliner	NB	7:49	Pacific Surfliner	SB
8:07	Pacific Surfliner	SB	7:54	Pacific Surfliner	NB
8:15	Pacific Surfliner	NB	8:09	Pacific Surfliner	SB
8:25	Coaster	NB	8:14	Pacific Surfliner	NB
8:28	Pacific Surfliner	SB	8:25	Coaster	NB
8:35	Pacific Surfliner	NB	8:29	Pacific Surfliner	SB
8:42	Coaster	NB	8:34	Pacific Surfliner	NB
8:45	Coaster	SB	8:41	Coaster	NB
8:50	Pacific Surfliner	SB	8:48	Pacific Surfliner	SB
8:55	Pacific Surfliner	NB	8:50	Coaster	SB
9:16	Pacific Surfliner	SB	8:54	Pacific Surfliner	NB
9:18	Pacific Surfliner	NB	9:17	Pacific Surfliner	NB
9:42	Coaster	NB	9:18	Pacific Surfliner	SB
9:45	Coaster	SB	9:42	Coaster	NB
10:16	Pacific Surfliner	NB	9:50	Coaster	SB
10:27	Pacific Surfliner	SB	10:15	Pacific Surfliner	NB
10:43	Coaster	NB	10:29	Pacific Surfliner	SB
10:46	Coaster	SB	10:42	Coaster	NB
11:08	Coaster	SB	10:50	Coaster	SB
11:27	Pacific Surfliner	SB	11:13	Coaster	SB
11:38	Pacific Surfliner	NB	11:29	Pacific Surfliner	SB
11:43	Coaster	NB	11:37	Pacific Surfliner	NB
11:49	Pacific Surfliner	SB	11:43	Coaster	NB
12:08	Coaster	SB	11:51	Pacific Surfliner	SB
12:21	Pacific Surfliner	NB	12:13	Coaster	SB
12:43	Coaster	NB	12:43	Coaster	NB
13:06	Coaster	SB	12:50	Pacific Surfliner	NB
13:11	Pacific Surfliner	SB	13:11	Coaster	SB
13:21	Pacific Surfliner	NB	13:13	Pacific Surfliner	SB
13:36	Coaster	NB	13:20	Pacific Surfliner	NB
14:21	Pacific Surfliner	SB	13:35	Coaster	NB
14:29	Pacific Surfliner	NB	14:23	Pacific Surfliner	SB
14:35	Coaster	SB	14:28	Pacific Surfliner	NB
15:14	Coaster	NB	14:40	Coaster	SB
15:21	Pacific Surfliner	SB	15:13	Coaster	NB
15:35	Coaster	NB	15:23	Pacific Surfliner	SB
15:38	Coaster	SB	15:36	Coaster	NB
15:39	Pacific Surfliner	NB	15:38	Pacific Surfliner	NB
15:59	Pacific Surfliner	NB	15:43	Coaster	SB
16:01	Coaster	NB	15:58	Pacific Surfliner	NB
16:19	Pacific Surfliner	NB	16:00	Coaster	NB
16:35	Coaster	SB	16:18	Pacific Surfliner	NB
16:40	Pacific Surfliner	SB	16:39	Pacific Surfliner	SB
16:42	Coaster	NB	16:41	Coaster	NB
16:47	Pacific Surfliner	SB	16:43	Coaster	SB
16:58	Pacific Surfliner	NB	16:49	Pacific Surfliner	SB
17:07	Coaster	SB	16:57	Pacific Surfliner	NB
17:18	Pacific Surfliner	SB	17:12	Coaster	SB
17:20	Pacific Surfliner	NB	17:17	Pacific Surfliner	NB
17:22	Coaster	NB	17:19	Pacific Surfliner	SB
17:38	Pacific Surfliner	SB	17:21	Coaster	NB
17:40	Pacific Surfliner	NB	17:38	Pacific Surfliner	NB
17:43	Coaster	SB	17:40	Pacific Surfliner	SB
17:50	Coaster	NB	17:48	Coaster	SB
17:58	Pacific Surfliner	SB	17:49	Coaster	NB
18:00	Pacific Surfliner	NB	17:58	Pacific Surfliner	NB
18:18	Pacific Surfliner	SB	18:00	Pacific Surfliner	SB
18:20	Pacific Surfliner	NB	18:18	Pacific Surfliner	NB
18:33	Coaster	NB	18:20	Pacific Surfliner	SB
18:38	Pacific Surfliner	SB	18:32	Coaster	NB
18:40	Pacific Surfliner	NB	18:38	Pacific Surfliner	NB
18:43	Coaster	SB	18:40	Pacific Surfliner	SB
19:00	Pacific Surfliner	NB	18:48	Coaster	SB
19:04	Pacific Surfliner	SB	18:59	Pacific Surfliner	NB
19:22	Coaster	NB	19:09	Pacific Surfliner	SB
19:36	Pacific Surfliner	NB	19:21	Coaster	NB
19:43	Coaster	SB	19:35	Pacific Surfliner	NB
20:05	Coaster	NB	19:48	Coaster	SB
20:20	Pacific Surfliner	SB	20:04	Coaster	NB
20:36	Pacific Surfliner	NB	20:22	Pacific Surfliner	SB
21:20	Pacific Surfliner	SB	20:35	Pacific Surfliner	NB
21:55	Pacific Surfliner	NB	21:31	Pacific Surfliner	SB
22:20	Pacific Surfliner	SB	21:54	Pacific Surfliner	NB
22:55	Pacific Surfliner	NB	22:22	Pacific Surfliner	SB
23:54	Pacific Surfliner	NB	22:54	Pacific Surfliner	NB
23:56	Pacific Surfliner	SB	23:54	Pacific Surfliner	NB

Weekend 2035

Grand/Carlsbad Village			Tamarack		
Time - Gate Down			Time - Gate Down		
O	Service Type	Direction	O	Service Type	Direction
6:56	Pacific Surfliner	NB	0:01	Pacific Surfliner	SB
7:07	Pacific Surfliner	SB	6:55	Pacific Surfliner	NB
7:55	Pacific Surfliner	NB	7:09	Pacific Surfliner	SB
8:07	Pacific Surfliner	SB	7:54	Pacific Surfliner	NB
8:39	Coaster	SB	8:09	Pacific Surfliner	SB
8:42	Coaster	NB	8:41	Coaster	NB
9:16	Pacific Surfliner	SB	8:44	Coaster	SB
9:18	Pacific Surfliner	NB	9:17	Pacific Surfliner	NB
9:36	Pacific Surfliner	SB	9:18	Pacific Surfliner	SB
9:39	Coaster	SB	9:38	Pacific Surfliner	SB
9:44	Coaster	NB	9:44	Coaster	SB
9:54	Pacific Surfliner	NB	9:42	Coaster	NB
9:56	Pacific Surfliner	SB	9:54	Pacific Surfliner	NB
10:16	Pacific Surfliner	NB	9:58	Pacific Surfliner	SB
10:27	Pacific Surfliner	SB	10:15	Pacific Surfliner	NB
10:36	Pacific Surfliner	NB	10:29	Pacific Surfliner	SB
10:43	Coaster	NB	10:36	Pacific Surfliner	NB
10:47	Pacific Surfliner	SB	10:42	Coaster	NB
10:56	Pacific Surfliner	NB	10:49	Pacific Surfliner	SB
11:07	Pacific Surfliner	SB	10:56	Pacific Surfliner	NB
11:10	Coaster	SB	11:09	Pacific Surfliner	SB
11:16	Pacific Surfliner	NB	11:15	Coaster	SB
11:27	Pacific Surfliner	SB	11:17	Pacific Surfliner	NB
11:38	Pacific Surfliner	NB	11:29	Pacific Surfliner	SB
11:43	Coaster	NB	11:37	Pacific Surfliner	NB
11:49	Pacific Surfliner	SB	11:43	Coaster	NB
11:58	Pacific Surfliner	NB	11:51	Pacific Surfliner	SB
12:08	Pacific Surfliner	SB	11:58	Pacific Surfliner	NB
12:10	Coaster	SB	12:11	Pacific Surfliner	SB
12:18	Pacific Surfliner	NB	12:15	Coaster	SB
12:29	Pacific Surfliner	SB	12:18	Pacific Surfliner	NB
12:38	Pacific Surfliner	NB	12:31	Pacific Surfliner	SB
12:49	Pacific Surfliner	SB	12:38	Pacific Surfliner	NB
12:51	Pacific Surfliner	NB	12:52	Pacific Surfliner	SB
13:06	Coaster	SB	12:50	Pacific Surfliner	NB
13:11	Pacific Surfliner	SB	13:17	Coaster	SB
13:13	Pacific Surfliner	NB	13:13	Pacific Surfliner	SB
13:22	Coaster	NB	13:15	Pacific Surfliner	NB
13:31	Pacific Surfliner	SB	13:21	Coaster	NB
13:33	Pacific Surfliner	NB	13:32	Pacific Surfliner	SB
13:51	Pacific Surfliner	SB	13:34	Pacific Surfliner	NB
13:53	Coaster	SB	13:53	Pacific Surfliner	SB
13:58	Pacific Surfliner	NB	13:58	Coaster	SB
14:21	Pacific Surfliner	SB	13:55	Pacific Surfliner	NB
14:23	Coaster	NB	14:23	Pacific Surfliner	SB
14:29	Pacific Surfliner	NB	14:21	Coaster	NB
14:41	Pacific Surfliner	SB	14:28	Pacific Surfliner	NB
14:49	Pacific Surfliner	NB	14:43	Pacific Surfliner	SB
14:53	Coaster	SB	14:49	Pacific Surfliner	NB
15:09	Pacific Surfliner	NB	14:58	Coaster	SB
15:20	Pacific Surfliner	SB	15:09	Pacific Surfliner	NB
15:22	Coaster	NB	15:23	Pacific Surfliner	SB
15:39	Pacific Surfliner	NB	15:21	Coaster	NB
15:41	Pacific Surfliner	SB	15:38	Pacific Surfliner	NB
15:53	Coaster	SB	15:43	Pacific Surfliner	SB
16:15	Coaster	NB	15:58	Coaster	SB
16:47	Pacific Surfliner	SB	16:14	Coaster	NB
16:53	Coaster	SB	16:49	Pacific Surfliner	SB
16:58	Pacific Surfliner	NB	16:59	Coaster	SB
17:15	Coaster	NB	16:57	Pacific Surfliner	NB
17:53	Coaster	SB	17:15	Coaster	NB
17:58	Pacific Surfliner	SB	17:58	Coaster	SB
18:00	Pacific Surfliner	NB	18:00	Pacific Surfliner	SB
18:15	Coaster	NB	18:02	Pacific Surfliner	NB
18:36	Pacific Surfliner	NB	18:15	Coaster	NB
18:53	Coaster	SB	18:36	Pacific Surfliner	NB
19:07	Pacific Surfliner	SB	18:58	Coaster	SB
19:36	Pacific Surfliner	NB	19:12	Pacific Surfliner	SB
20:05	Coaster	NB	19:35	Pacific Surfliner	NB
20:08	Pacific Surfliner	SB	20:04	Coaster	NB
20:36	Pacific Surfliner	NB	20:09	Pacific Surfliner	SB
21:27	Pacific Surfliner	SB	20:36	Pacific Surfliner	NB
21:55	Pacific Surfliner	NB	21:32	Pacific Surfliner	SB
22:27	Pacific Surfliner	SB	21:54	Pacific Surfliner	NB
22:55	Pacific Surfliner	NB	22:29	Pacific Surfliner	SB
23:56	Pacific Surfliner	SB	22:55	Pacific Surfliner	NB

Time Gate is Down - Grand & Carlsbad Village[1]

Grand Ave	Sec	Min
SB Coaster	200	3.333333333
NB Coaster	70	1.166666667
Pacific Surfliner	50	0.833333333

Departure Rate[2] 30 veh/min/ln

Time Gate is Down - Tamarack [1]

Grand Ave	Sec	Min
SB Coaster	40	0.666666667
NB Coaster	40	0.666666667
Pacific Surfliner	40	0.666666667

Annual Growth Rates [4]

Grand Ave	0.0025
Carlsbad Village Dr	0.0025
Tamarack Ave	0.001

Notes:

1. Estimated based on field observations, rounded up to the nearest minute for analysis
2. Based on a saturation flow rate of 1,800 pc/hr/ln
3. Time Gate Goes Down - Estimated based on field observations

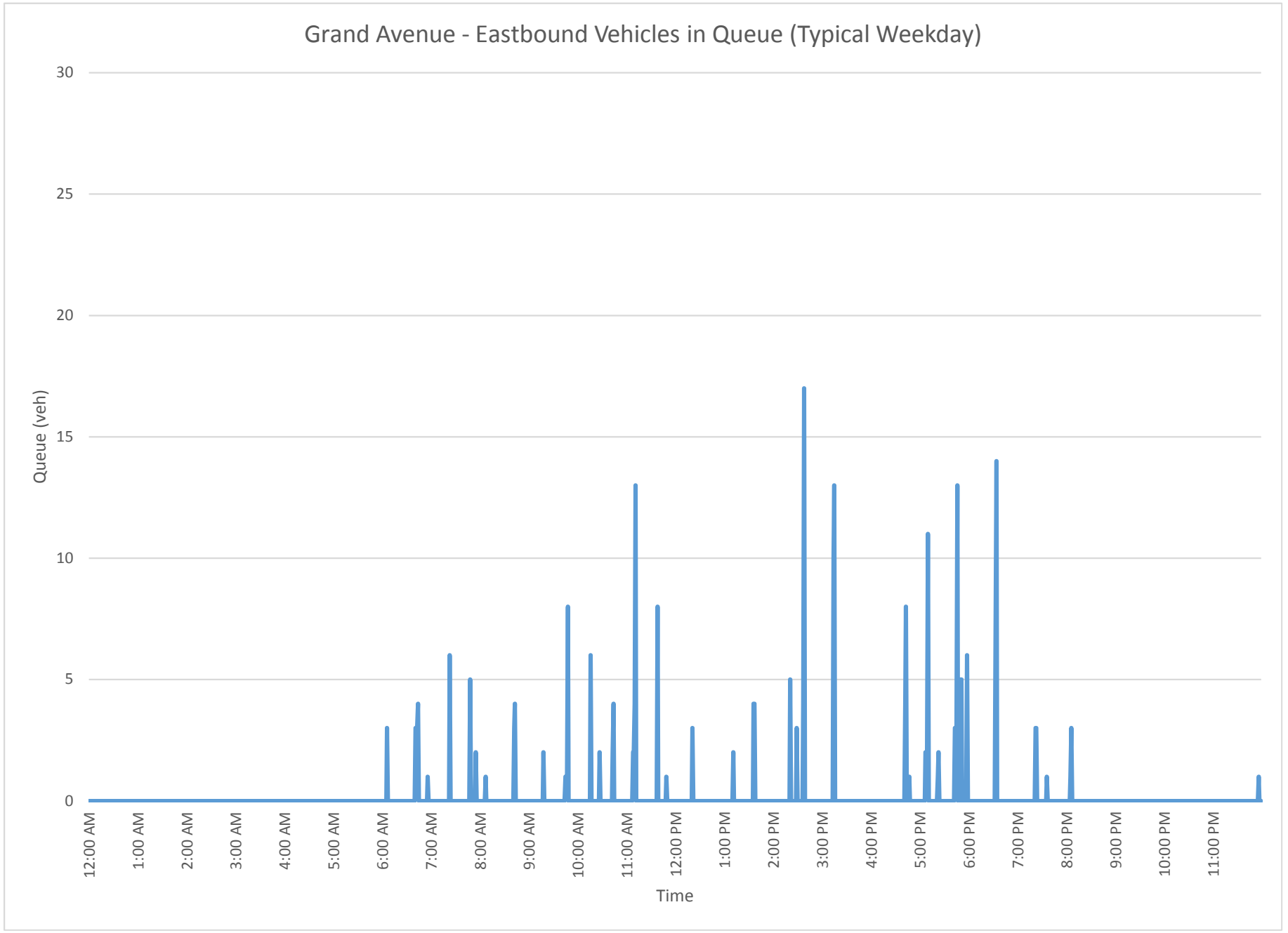
Grand & Carlsbad Village

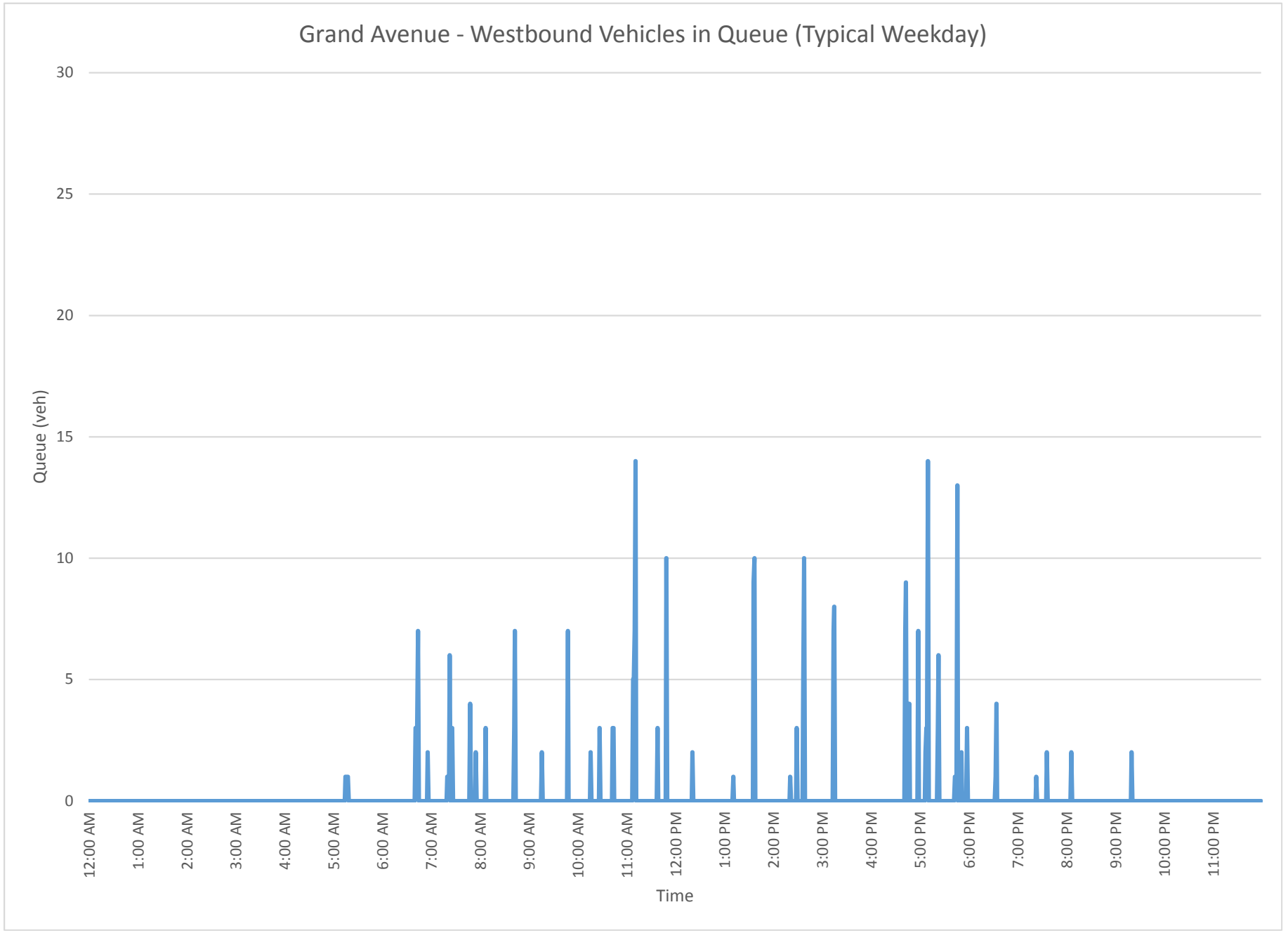
NB Coaster	scheduled time train is at Carlsbad Village Station
NB Surfliner	-2 minutes from scheduled time train is at Oceanside Station
SB Coaster	-2 minutes from scheduled time train is at Carlsbad Village Station
SB Surfliner	+2 minutes from scheduled time train is at Oceanside Station

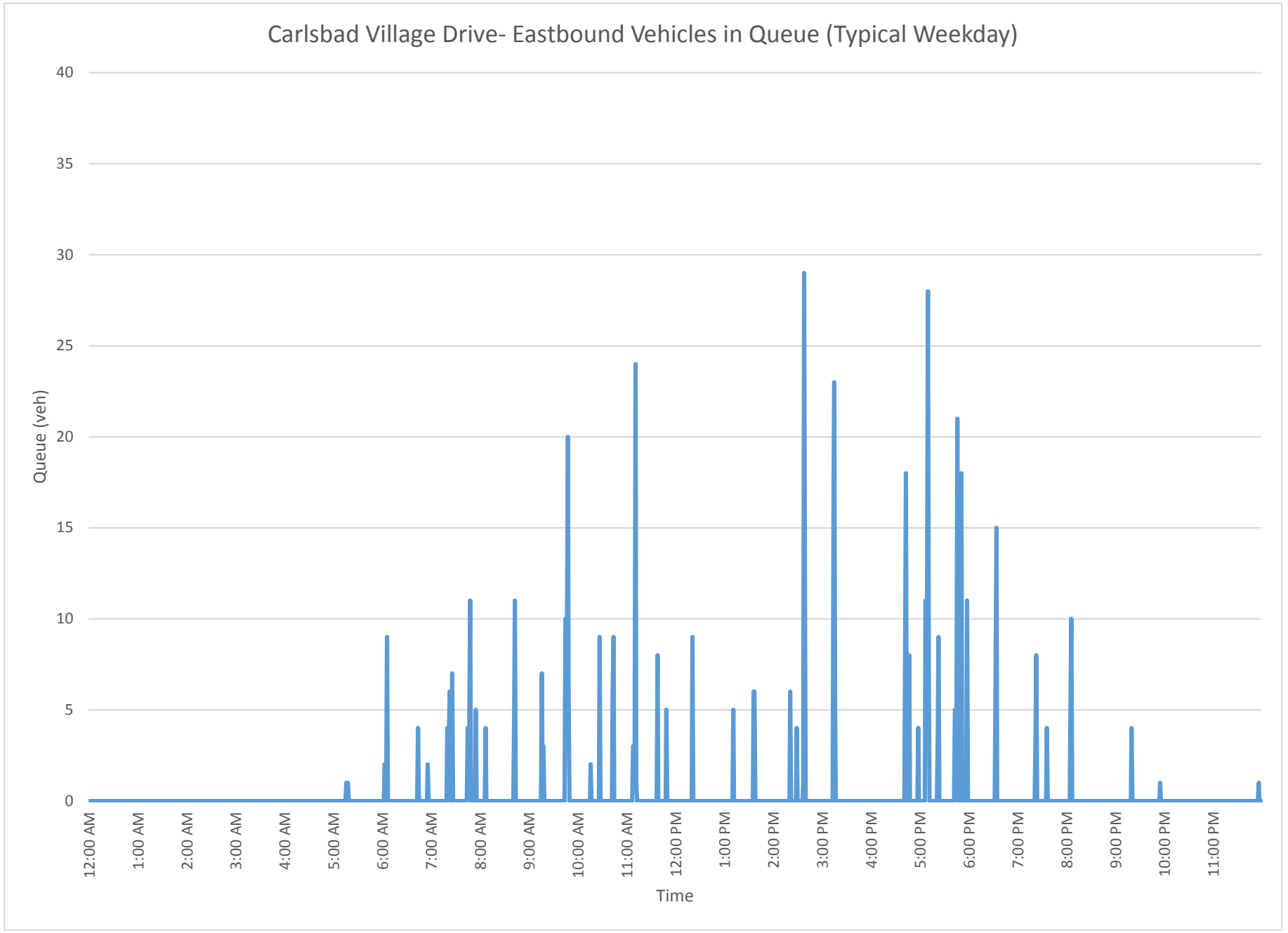
Tamarack Ave

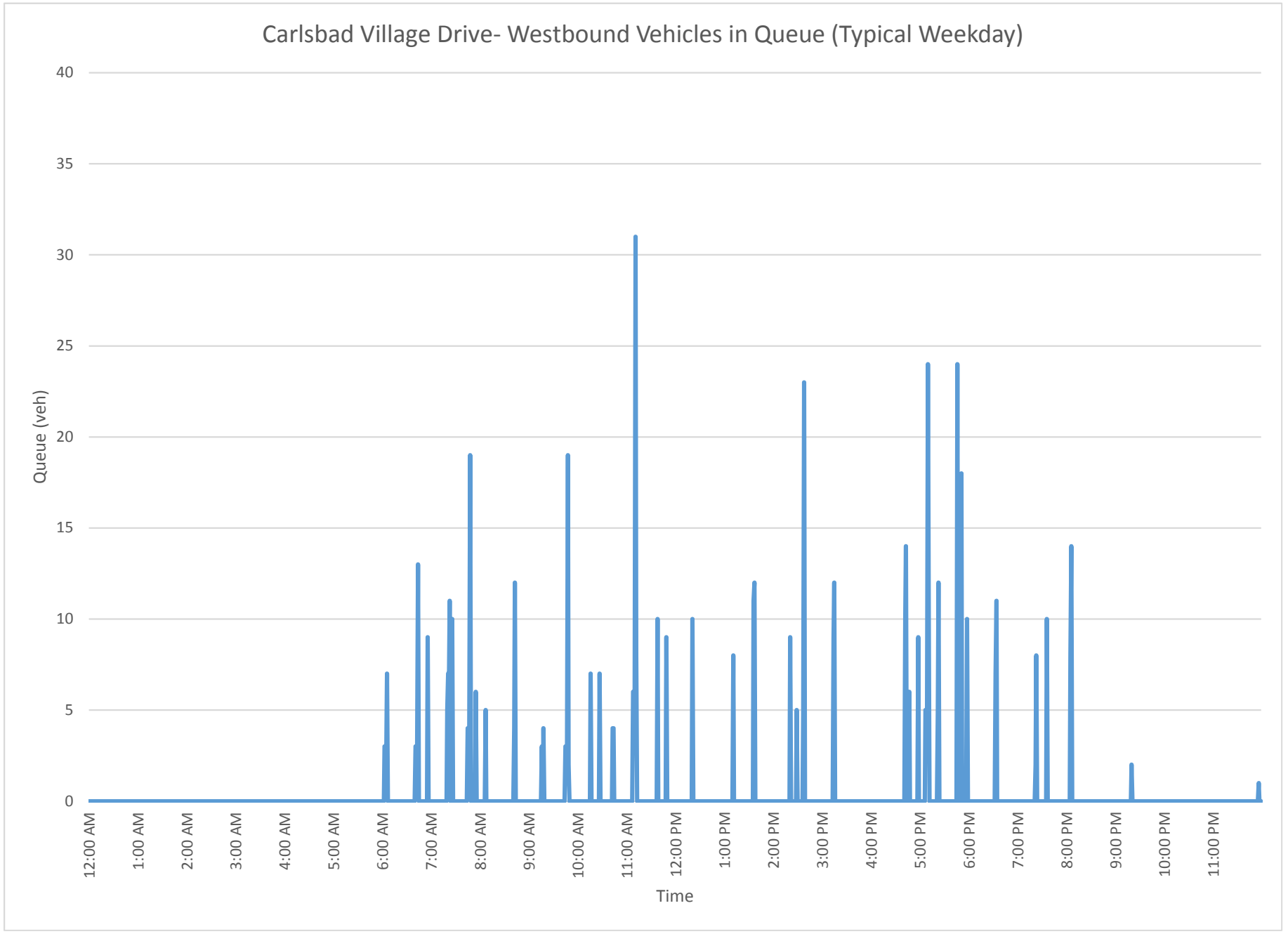
NB Coaster	- 1 minute from scheduled time train is at Carlsbad Village Station
NB Surfliner	-3 minutes from scheduled time train is at Oceanside Station
SB Coaster	+3 minutes from scheduled time train is at Carlsbad Village Station
SB Surfliner	+4 minutes from scheduled time train is at Oceanside Station

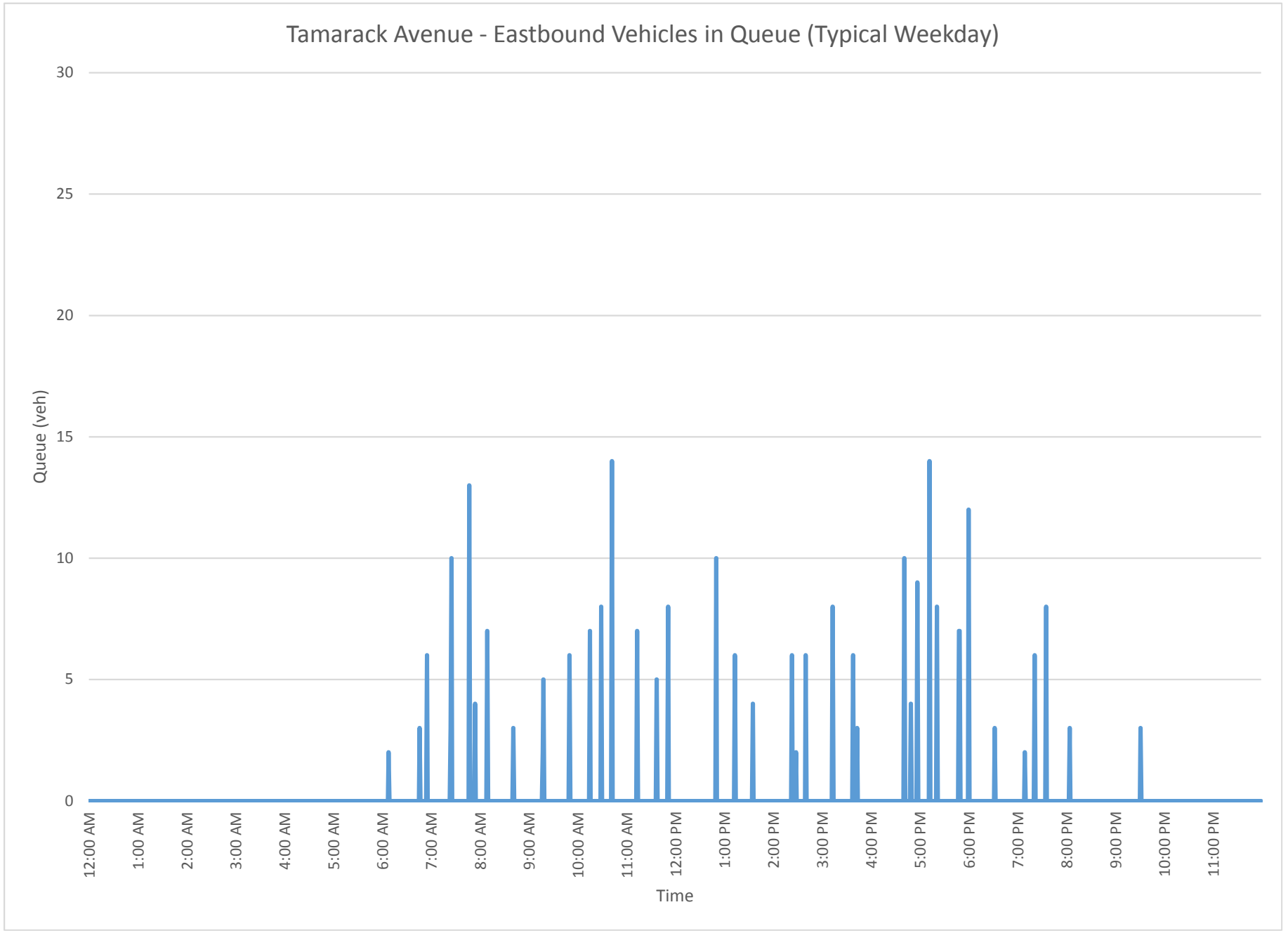
4. Based on SANDAG Series 13 unadjusted volumes

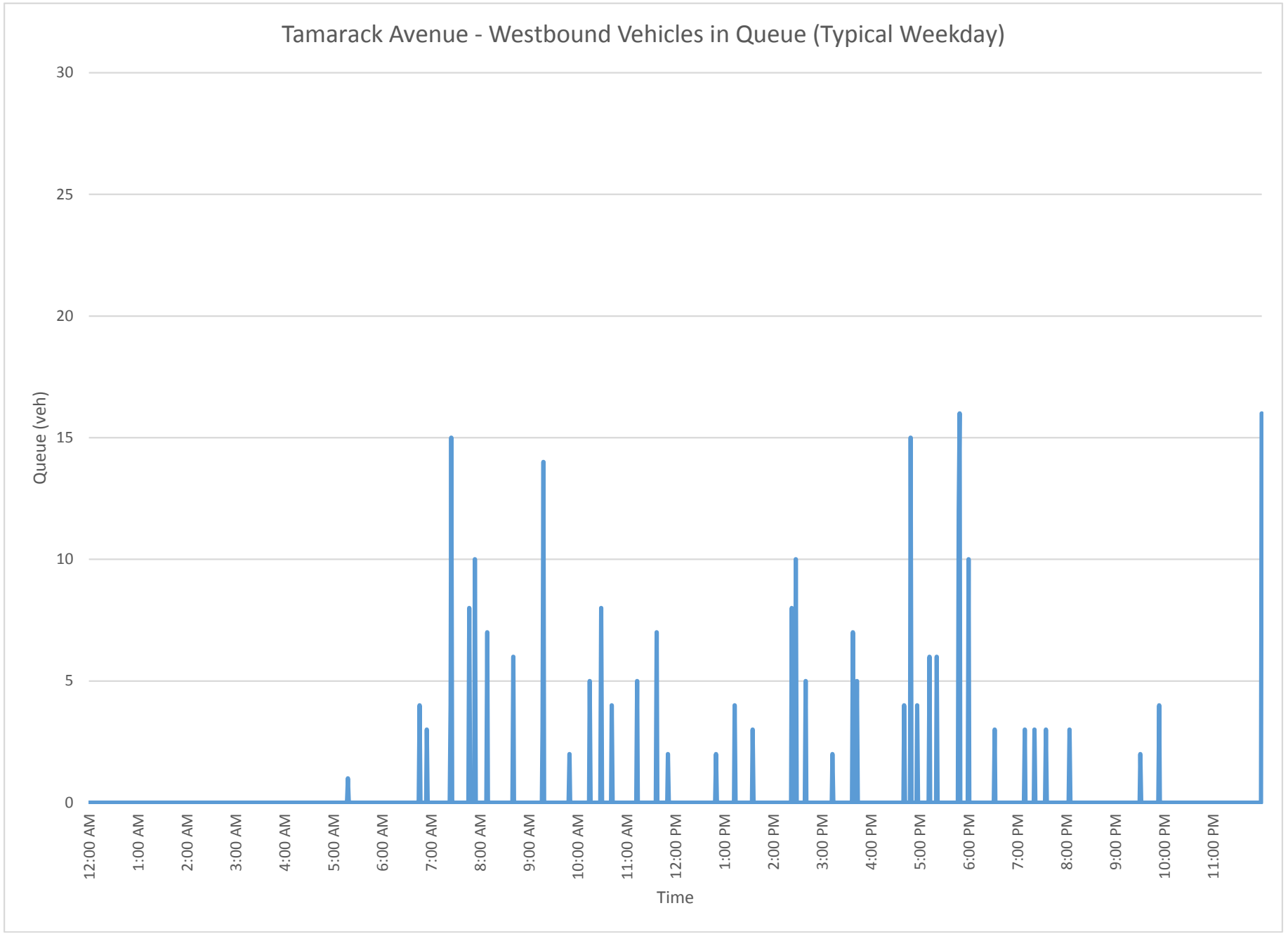

Grand Avenue - Eastbound Vehicles in Queue (Typical Weekday)
Queue (veh)
30
25
20
15
10
5
0
12:00 AM
1:00 AM
2:00 AM
3:00 AM
4:00 AM
5:00 AM
6:00 AM
7:00 AM
8:00 AM
9:00 AM
10:00 AM
11:00 AM
12:00 PM
1:00 PM
2:00 PM
3:00 PM
4:00 PM
5:00 PM
6:00 PM
7:00 PM
8:00 PM
9:00 PM
10:00 PM
11:00 PM
Time


Grand Avenue - Westbound Vehicles in Queue (Typical Weekday)
Queue (veh)
30
25
20
15
10
5
0
12:00 AM
1:00 AM
2:00 AM
3:00 AM
4:00 AM
5:00 AM
6:00 AM
7:00 AM
8:00 AM
9:00 AM
10:00 AM
11:00 AM
12:00 PM
1:00 PM
2:00 PM
3:00 PM
4:00 PM
5:00 PM
6:00 PM
7:00 PM
8:00 PM
9:00 PM
10:00 PM
11:00 PM
Time


Carlsbad Village Drive- Eastbound Vehicles in Queue (Typical Weekday)
Queue (veh)
40
35
30
25
20
15
10
5
0
12:00 AM
1:00 AM
2:00 AM
3:00 AM
4:00 AM
5:00 AM
6:00 AM
7:00 AM
8:00 AM
9:00 AM
10:00 AM
11:00 AM
12:00 PM
1:00 PM
2:00 PM
3:00 PM
4:00 PM
5:00 PM
6:00 PM
7:00 PM
8:00 PM
9:00 PM
10:00 PM
11:00 PM
Time


Carlsbad Village Drive- Westbound Vehicles in Queue (Typical Weekday)
Queue (veh)
40
35
30
25
20
15
10
5
0
12:00 AM
1:00 AM
2:00 AM
3:00 AM
4:00 AM
5:00 AM
6:00 AM
7:00 AM
8:00 AM
9:00 AM
10:00 AM
11:00 AM
12:00 PM
1:00 PM
2:00 PM
3:00 PM
4:00 PM
5:00 PM
6:00 PM
7:00 PM
8:00 PM
9:00 PM
10:00 PM
11:00 PM
Time


Tamarack Avenue - Eastbound Vehicles in Queue (Typical Weekday)
Queue (veh)
30
25
20
15
10
5
0
12:00 AM
1:00 AM
2:00 AM
3:00 AM
4:00 AM
5:00 AM
6:00 AM
7:00 AM
8:00 AM
9:00 AM
10:00 AM
11:00 AM
12:00 PM
1:00 PM
2:00 PM
3:00 PM
4:00 PM
5:00 PM
6:00 PM
7:00 PM
8:00 PM
9:00 PM
10:00 PM
11:00 PM
Time


Tamarack Avenue - Westbound Vehicles in Queue (Typical Weekday)
Queue (veh)
30
25
20
15
10
5
0
12:00 AM
1:00 AM
2:00 AM
3:00 AM
4:00 AM
5:00 AM
6:00 AM
7:00 AM
8:00 AM
9:00 AM
10:00 AM
11:00 AM
12:00 PM
1:00 PM
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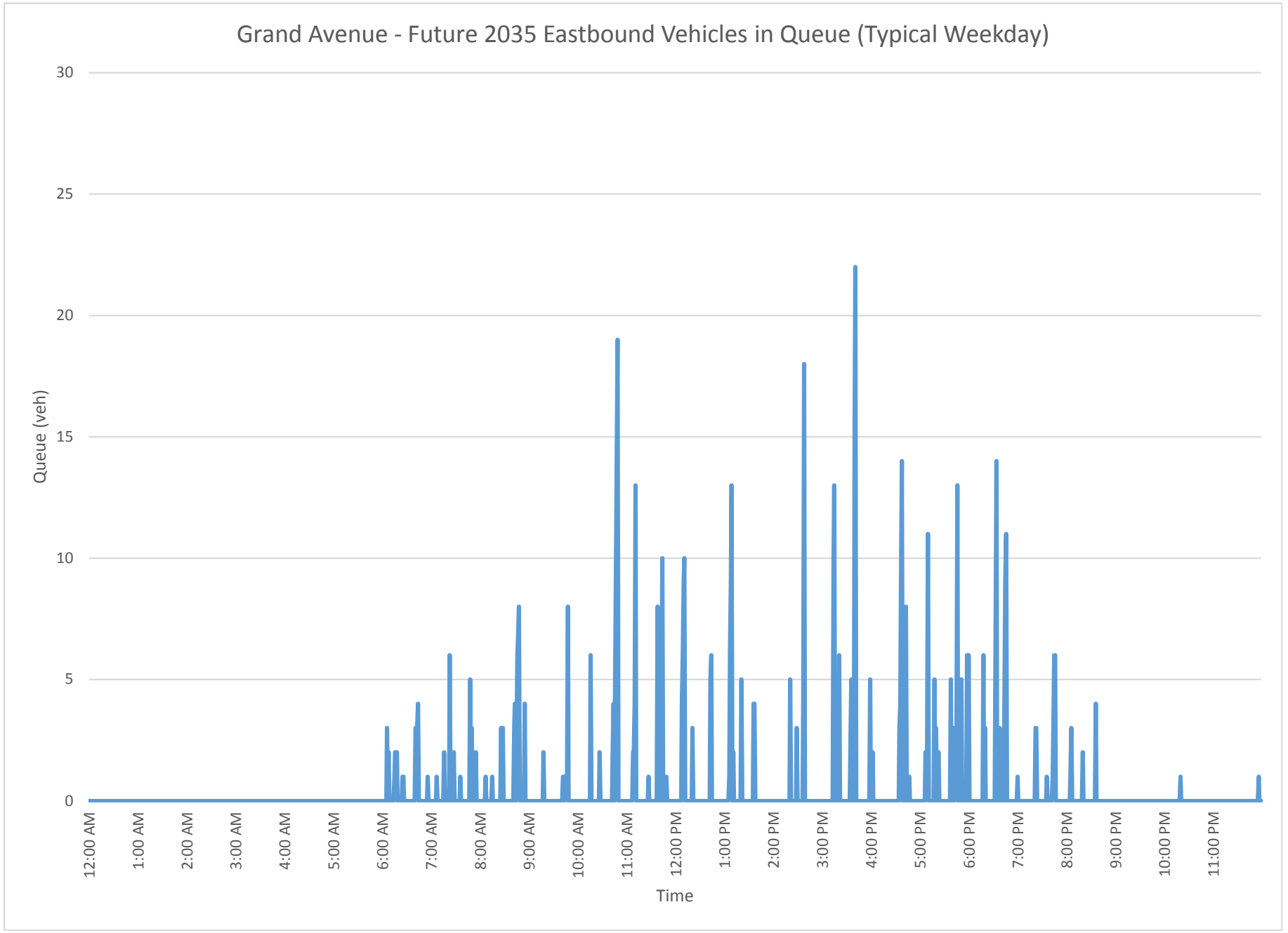
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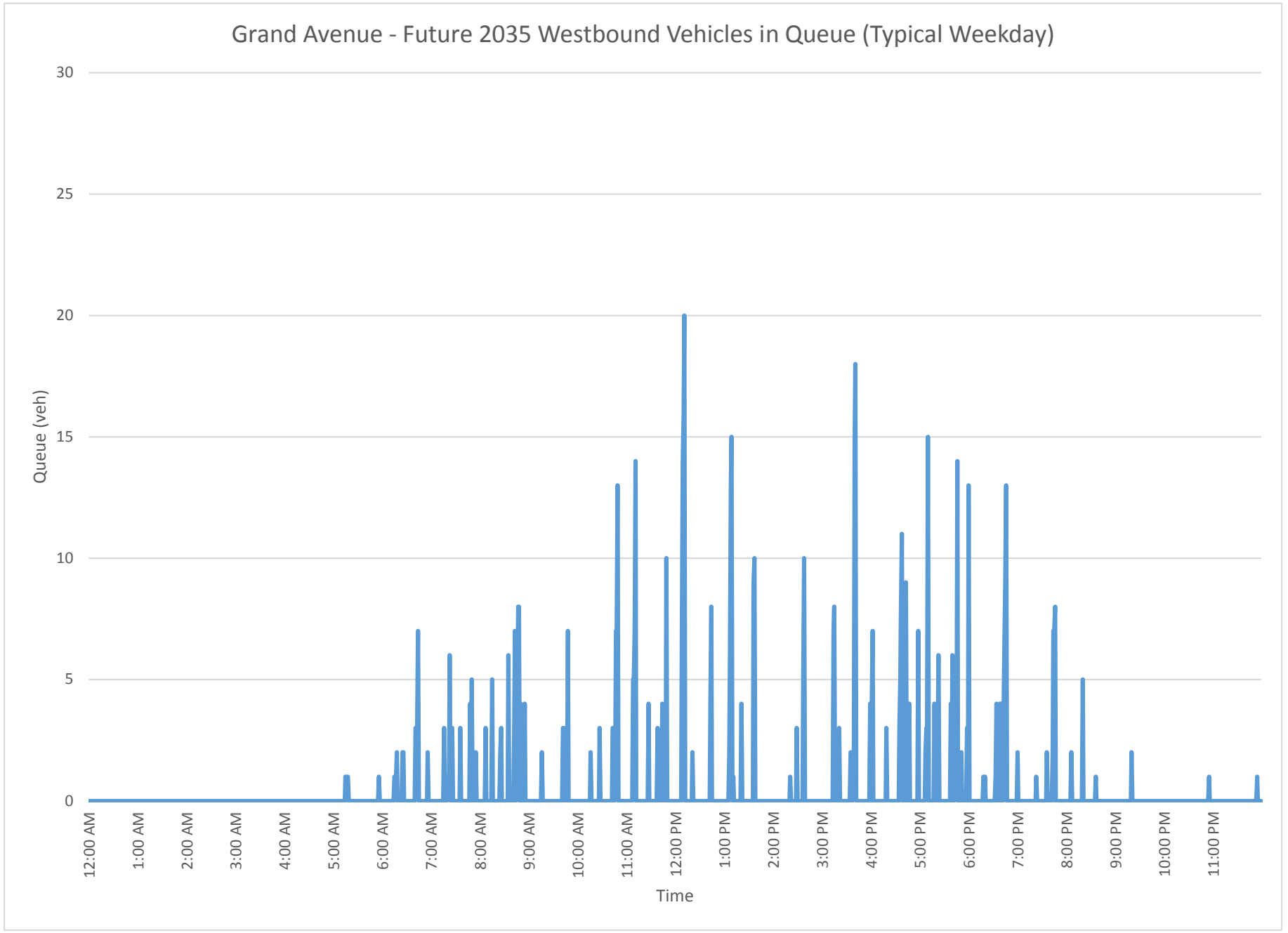
Grand Avenue - Future 2035 Westbound Vehicles in Queue (Typical Weekday)
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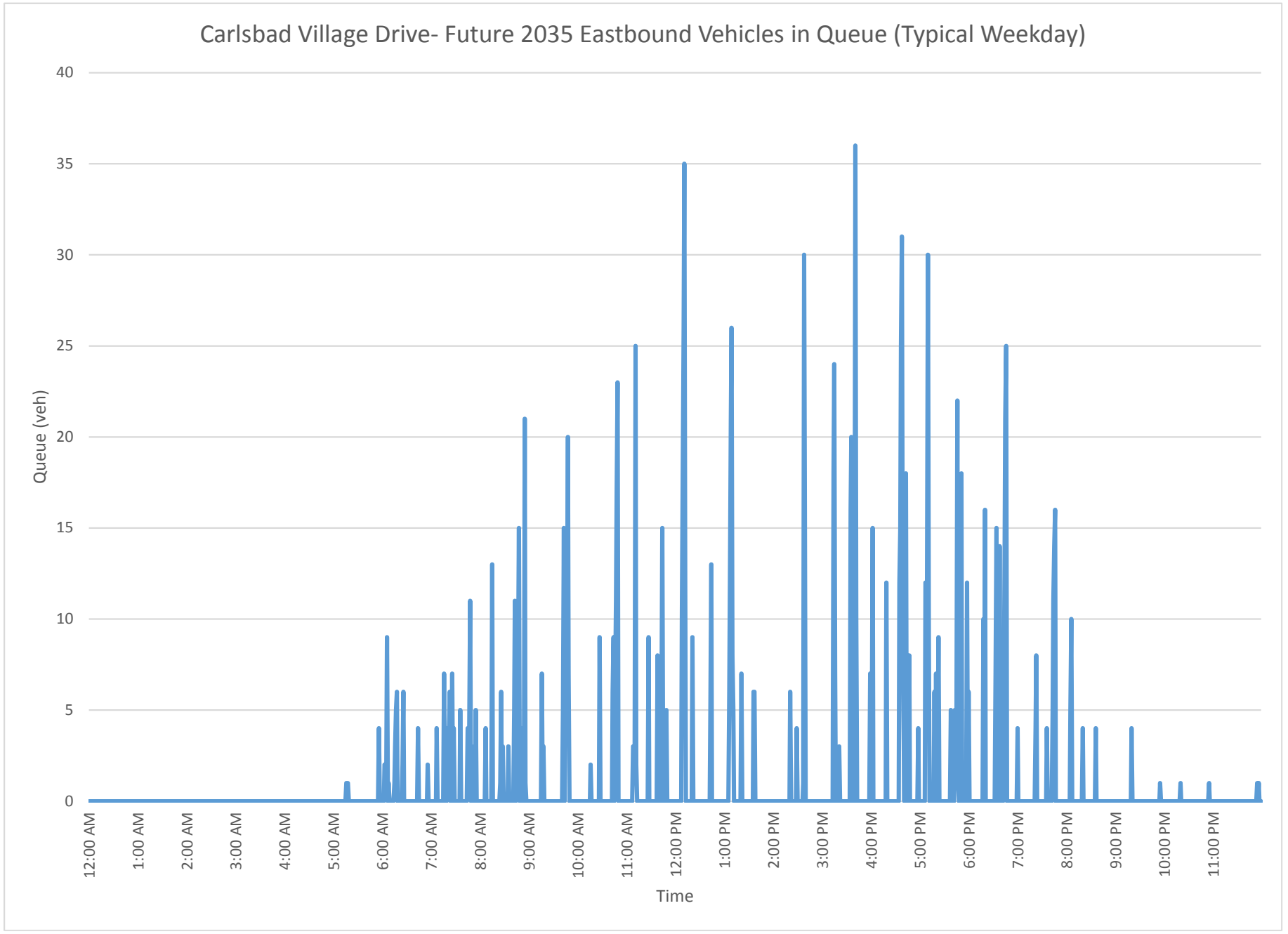
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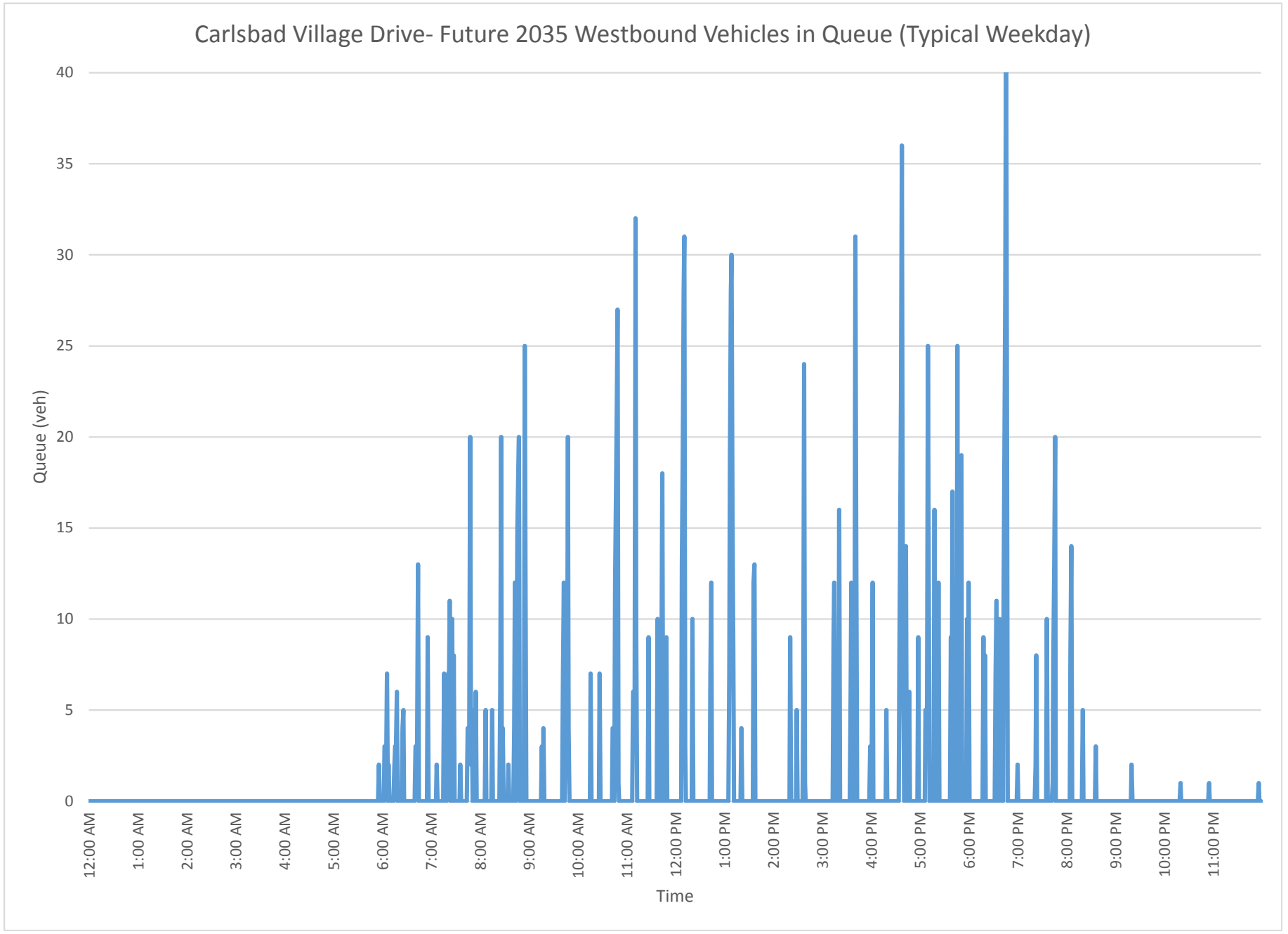
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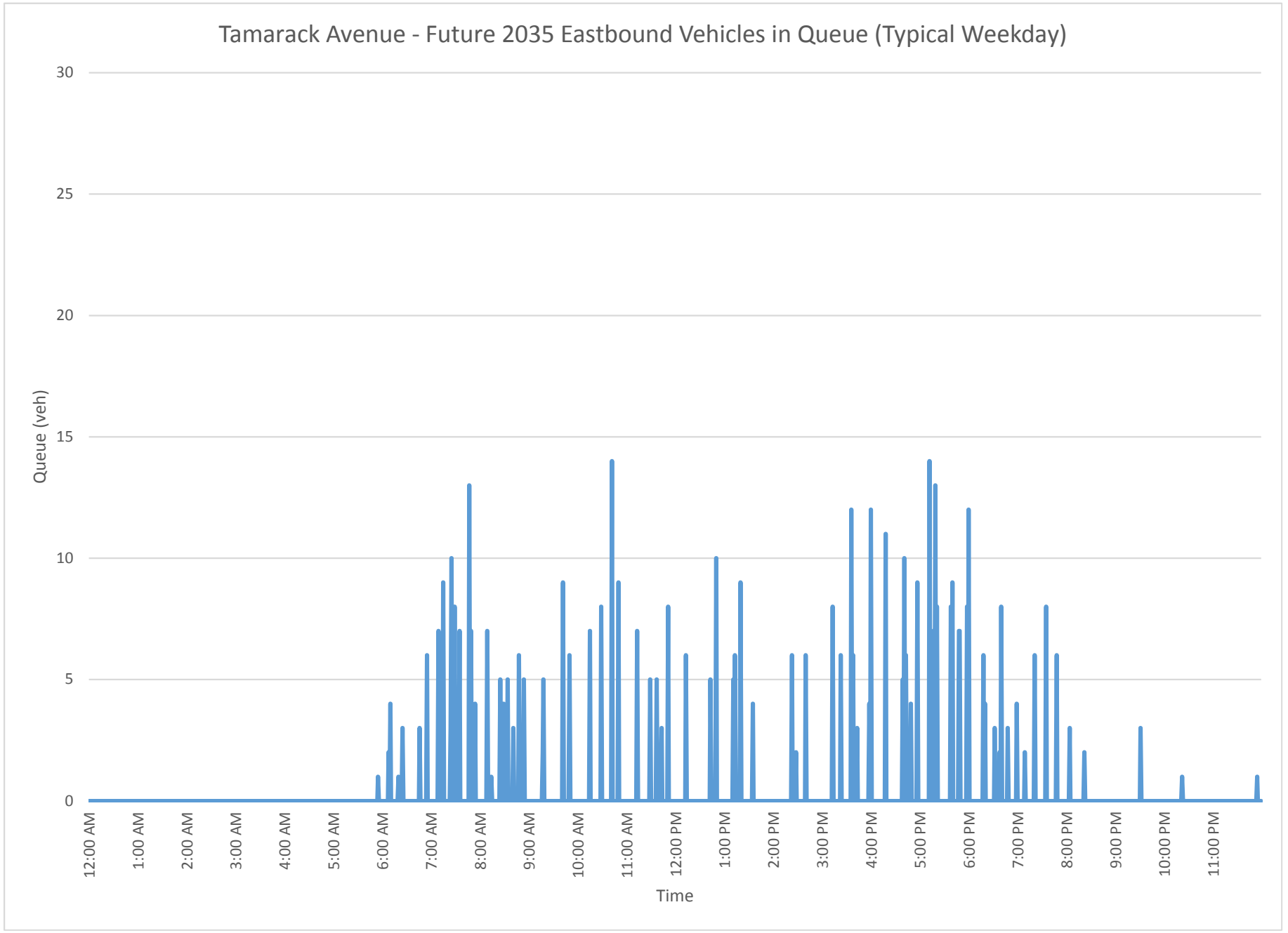
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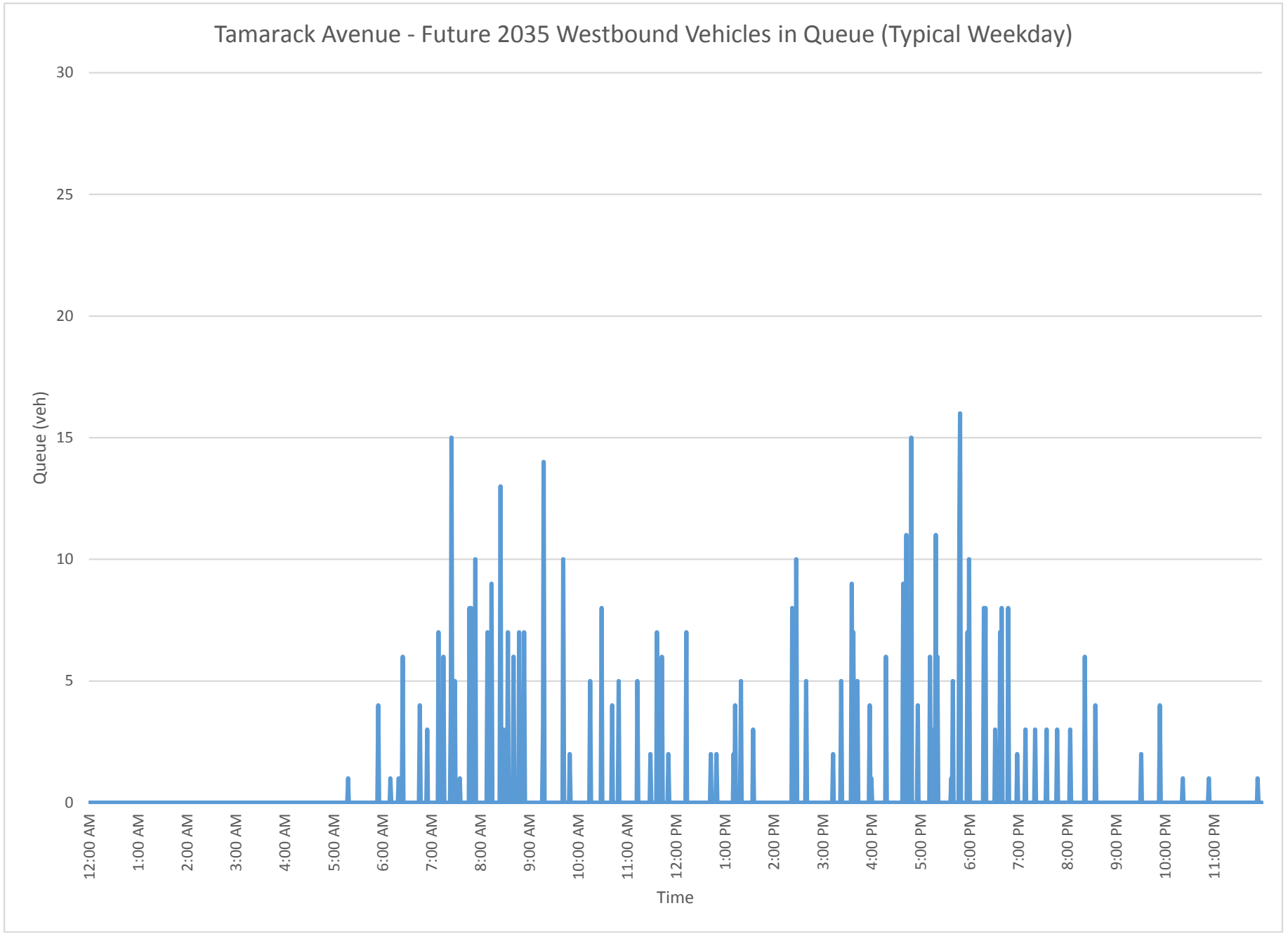
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APPENDIX 3 - CARLSBAD LOSSAN RAIL CORRIDOR ECONOMIC ANALYSIS – NOISE AND VIBRATION EVALUATION, PREPARED BY DBF ASSOCIATES, INC.

dBF Associates, Inc.

3129 Tiger Run Court, Suite 202
Carlsbad, CA 92010
619-609-0712

August 11, 2016

Hitta Mosesman
Rosenow Spevacek Group, Inc.
309 West 4th Street
Santa Ana, CA 92701

Re: Carlsbad LOSSAN Rail Corridor Economic Analysis
Noise and Vibration Evaluation

Ms. Mosesman:

We have evaluated the effects of trenching on rail noise and vibration from the Los Angeles to San Diego (LOSSAN) Corridor within the City of Carlsbad. The purpose of the evaluation was to estimate noise and/or vibration level reductions resulting from reconfiguration of the at-grade rail / roadway crossings to grade-separated crossings by placing the rail line(s) into a trench. Two alternatives were evaluated: the Short Trench alternative removes at-grade crossings with Chestnut Avenue, Carlsbad Village Drive, and Grand Avenue; the Long Trench alternative also removes the at-grade crossing with Tamarack Avenue.

Noise Background

Sound is a physical phenomenon consisting of minute vibrations that travel through a medium, such as air, and are sensed by the human ear. Sound is generally characterized by several variables, including frequency and intensity. Frequency describes the sound's pitch and is measured in cycles per second, or hertz (Hz), whereas intensity describes the sound's loudness and is measured in decibels (dB). Decibels are measured using a logarithmic scale. A sound level of 0 dB is approximately the threshold of human hearing. Normal speech has a sound level of approximately 60 dB. Sound levels above about 120 dB begin to be felt inside the human ear as discomfort and eventually as pain at still higher levels. The minimum change in the sound level of individual events that an average human ear can detect is about 3 dB. The average person perceives a change in sound level of about 10 dB as a doubling (or halving) of the sound's loudness; this relation holds true for sounds of any loudness.

Because of the logarithmic nature of the decibel unit, sound levels cannot be added or subtracted directly and are somewhat cumbersome to handle mathematically. A simple rule is useful, however, in dealing with sound levels. If a sound's intensity is doubled, the sound level increases by 3 dB, regardless of the initial sound level. Thus, for example, 60 dB + 60 dB = 63 dB, and 80 dB + 80 dB = 83 dB.

The normal human ear can detect sounds that range in frequency from about 20 Hz to 20,000 Hz. However, all sounds in this wide range of frequencies are not heard equally well by the human ear, which is most sensitive to frequencies in the range of 1,000 Hz to 4,000 Hz. This frequency dependence can be taken into account by applying a correction to each frequency range to approximate the human ear's sensitivity within each range. This is called A-weighting and is commonly used in measurements of community environmental noise. The A-weighted sound pressure level (abbreviated as dBA) is the sound level with the "A-weighting" frequency correction. In practice, the level of a noise source is conveniently measured using a sound level meter that includes a filter corresponding to the dBA curve.

Because community noise fluctuates over time, a single measure called the Equivalent Sound Level (Leq) is often used to describe the time-varying character of community noise. The Leq is the energy-averaged A-weighted sound level during a measured time interval, and is equal to the level of a continuous steady sound containing the same total acoustical energy over the averaging time period as the actual time-varying sound. The Lmax is the root-mean-square maximum noise levels obtained during a measurement interval.

Noise Effects

The LOSSAN Final Program Environmental Impact Report (EIR) / Environmental Impact Statement (EIS) [September 2007] discusses noise and vibration in Section 3.4. In Section 3.4.3.B, trenching through Carlsbad is addressed, though quantitative benefits are not provided:

> The short trench option through Carlsbad would have fewer potential noise impacts for downtown Carlsbad than the option to leave several crossings at grade through downtown near the Carlsbad Coaster Station. The short trench concept would eliminate the train horn noise and remove the warning bells at the existing at-grade crossing. It would also place part of the alignment underground in a cut-and-cover tunnel, reducing train noise through the center of this coastal community.

Leaving several crossings at grade through the town center would result in continued noise impacts.

Trenching using parallel non-absorptive walls conservatively provides 9 dBA of noise attenuation [Alameda Corridor EIR, January 1993]. The transition from at-grade to fully-trenched (approximately 18 feet deep) corresponds to a range of 0-9 dBA of reduction. However, the range is not linear over the transition length because train movement noise is comprised of wheel and engine noise, and a shallow trench blocks wheel noise while engine noise has a higher acoustic height. At the halfway point from at-grade to fully-trenched, the noise reduction is expected to be approximately 3 dBA; from the halfway point to fully-trenched, the noise reduction is expected to increase linearly to 9 dBA.

During passbys, train horns produce momentary maximum noise levels of 96-110 dBA at 100 feet [U.S. DOT FRA Handbook for Railroad Noise Measurement and Analysis, October 2009]. “Trains … traveling at speeds in excess of 60 mph shall not begin sounding the horn more than one-quarter mile in advance of the nearest public highway-rail grade crossing, even if the advance warning provided by the locomotive horn will be less than 15 seconds in duration.” [49 CFR § 222.21(b)(3), August 2006]

During passbys, freight trains (without horn soundings) were previously measured by dBFA staff at 95-97 dBA Lmax at 50 feet, depending on speed. During passbys, Diesel Multiple Unit (DMU) trains such as NCTD COASTER and Amtrak trains were previously measured by dBFA staff at 77-83 dBA Lmax at 50 feet, depending on speed.

Crossing bells produce noise levels of 75-105 dBA at 10 feet [American Railway Engineering and Maintenance-of-Way Association (AREMA) Communications and Signals Manual of Recommended Practices (C&S Manual), 2013].

During a passby, elimination of horn soundings and crossing bells is expected to result in an average noise reduction of 10 dBA Leq near crossings. Where noise reductions associated with at-grade crossing removal coincide with those associated with trenching, the combined effects would result in a conservative total decrease of 12 dBA Leq. Refer to Figures 1 & 2 for details.

During a passby, elimination of horn soundings and crossing bells may also be expected to lower momentary maximum noise levels by up to approximately 33 dBA [Canadian Transportation Agency Railway Noise Measurement and Reporting Methodology, August 2011]. Where noise reductions associated with at-grade crossing removal coincide with those associated with trenching, the combined effects would result in a decrease ranging from 22-42 dBA Lmax, depending on train type. The decrease in Lmax would be experienced generally uniformly along the trench limits.

Vibration Effects

The Vibration Mitigation Guidelines for the California High-Speed Train Project states:

> A trench can be an effective vibration barrier if it changes the propagation characteristics of the soil. It can be open or solid. Open trenches can be filled with materials such as Styrofoam. Solid barriers can be constructed with sheet piling, rows of drilled shafts filled with either concrete or a mixture of soil and lime, or concrete poured into a trench.

Trenching would not be unquestionably expected to alter the length of the vibration path of travel or soil densities between the tracks and nearby structures. No literature detailing projected or measured vibration changes from trenching was found.

Findings

The Short Trench alternative would reduce noise levels by up to 12 dBA Leq and 22-42 dBA Lmax between approximately Pacific Avenue to Hemlock Street.

The Long Trench alternative would reduce noise levels by up to 12 dBA Leq and 22-42 dBA Lmax between approximately Pacific Avenue to Olive Avenue.

This concludes the memorandum. Please contact me at 619-609-0712 ×102 if you have any questions.

Sincerely,

dBF ASSOCIATES, INC.

Steve Fiedler, INCE
Principal

Attachments

Figure 1. Short Trench Noise Reduction (Leq)
Figure 2. Long Trench Noise Reduction (Leq)

FIGURE 1
Short Trench Noise Reduction (Leq)

FIGURE 2
Long Trench Noise Reduction

ATTACHMENT B:

LOCATION MAP

CARLSBAD VILLAGE DOUBLE TRACK
TRENCH ALTERNATIVE STUDY
LOCATION MAP

ATTACHMENT C:

RAIL MAINLINE CAPACITY AND GRADE SEPARATION EVALUATION SUMMARIES

Table TA 4.22 - 2050 San Diego Regional Goods Movement Strategy – Project Rankings

System/Project	Estimated Cost (millions)	Throughput	Relieves Freight System Bottlenecks/ Capacity Constraints and Reduces Delay	Improves Freight System and/or Modal Safety	Improves Freight System Management/ Efficiency	Provides Critical Modal/ Intermodal Link/ Connectivity	Cost-Effectiveness	Minimizes Community Impacts	Minimizes Environmental/ Habitat Impacts	Total Points	Modal Ranking
		20	20	5	10	10	15	10	10	Out of 100	Rank
Maritime											
Vesta Street Bridge Mobility Connector over Harbor Drive at Naval Base San Diego	$60	15	13	5	0	5	4	10	10	**62**	1
TAMT[1] Enhance Military Project Cargo Capacity, expand open storage	$19	20	15	2	0	5	12	0	5	**59**	2
32nd Street Freeway Access Enhancement	$119	15	16	5	5	5	3	2	5	**56**	3
TAMT Entrance, Rail Line Grade Separation/ Barrio Logan Enhancement	$67	5	13	5	5	5	3	10	10	**56**	3
NCMT[2] Wharf Extension, Vehicle Processing Facility, Berths 24-10 and 24-11	$151	20	14	2	0	5	3	0	10	**54**	5
NCMT Bay Marina Drive, Civic Center Freeway Access Improvements	$7	10	10	2	5	5	3	2	10	**47**	6
Rail Mainline Capacity											
LOSSAN[3] CP San Onofre to CP Pulgas Double-Track	$61	20	15	0	5	5	12	0	5	**62**	1
LOSSAN CP Ponto to CP Moonlight Double-Track	$28	9	8	0	5	5	9	0	5	**41**	2
LOSSAN Sorrento to Miramar Phase II Double-Track	$100	6	15	0	5	5	4	0	5	**40**	3
LOSSAN CP Moonlight to CP Swami Double-Track	$20	3	8	0	5	5	6	0	10	**37**	4
LOSSAN Penasquitos Double-Track	$80	6	11	0	5	5	4	0	5	**36**	5
LOSSAN Carlsbad Village Double-Track	$28	3	9	0	5	5	6	0	5	**33**	6
LOSSAN San Dieguito Bridge/Double-Track	$76	4	6	0	5	5	4	0	5	**28**	7
LOSSAN CP Tecolote to CP Friar Double-Track	$44	3	4	0	5	5	4	0	5	**26**	8
Desert Line Basic Service, Rehabilitation	$182	2	0	0	0	5	3	0	5	**15**	9
Rail Intermodal Capacity											
National City Rail Yard	$7	10	5	5	0	10	12	0	5	**47**	1
Logistics Center South County	$180	20	5	0	0	10	3	0	5	**43**	2
Logistics Center Mid County	$2,130	20	5	0	0	10	3	0	5	**43**	2
Logistics Center North County	$166	20	5	0	0	10	3	0	5	**43**	2

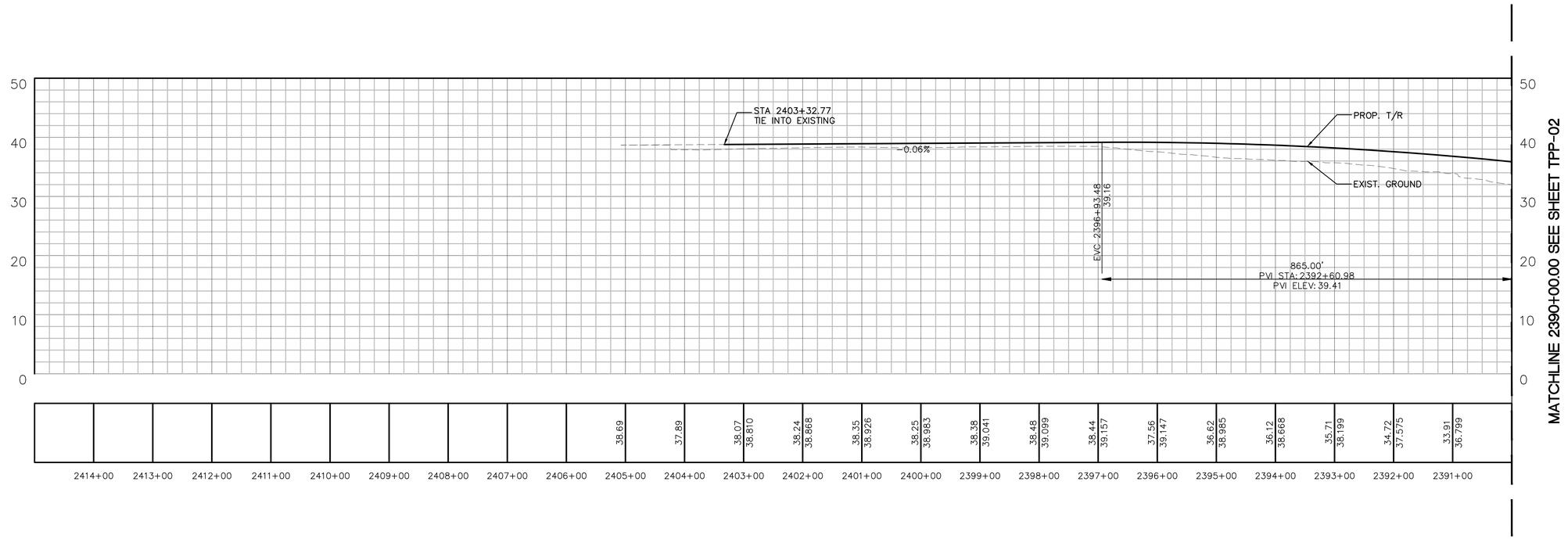
Table TA 4.24 – Rail Grade Separation Rankings

At Grade Crossing Location	Rank	Veh. per Day ADT	Trains per Day	Accidents	Total Points	Estimated Cost to Grade Separate ($2010) (mil)	Assumptions
Washington, Laurel, Hawthorn, Grape, Ash, and Broadway Streets, San Diego	1	263,945	137	8	80.8	$2,200	see note (1)
Taylor Street, San Diego	2	42,670	195	4	62.8	$110	see note (4)
Broadway/Lemon Grove Avenue, Lemon Grove	3	40,403	144	2	57.8	$80	light rail only (4)
Palomar Street, Chula Vista	4	59,337	206	0	55.5	$40	light rail only (4)
H Street, Chula Vista	5	47,596	206	0	53.3	$40	light rail only (4)
E Street, Chula Vista	6	45,658	206	1	50.3	$40	light rail only (4)
Euclid Avenue, San Diego	7	37,000	144	0	46.3	$40	light rail only (4)
Washington St./Sassafras St., San Diego	8	30,345	206	0	46.3	$150	light rail only (4)
Vista Village Drive/Main Street, Vista	9	61,698	67	0	46.0	$60	light rail only (2)
Civic Center Drive, Vista	10	40,782	67	0	46.0	$40	light rail only
28th Street, San Diego	11	33,225	206	0	44.8	$40	light rail only (4)
Ash Street, San Diego	12	30,575	206	0	44.0	$100	light rail only
Broadway, San Diego	13	27,845	144	0	43.3	$110	light rail only
32nd Street, San Diego	14	32,470	206	0	42.5	$40	light rail only (4)
Allison Ave/University Ave/La Mesa Blvd, La Mesa	15	24,700	144	0	40.3	$100	light rail only (4)
Severin Drive, La Mesa	16	13,611	288	2	40.3	$40	light rail only (4)
Sorrento Valley Blvd., San Diego	17	37,990	51	1	39.5	$130	
Melrose Drive, Vista	18	25,921	67	0	31.8	$40	light rail only (2)
El Camino Real, Oceanside	19	35,911	67	0	31.7	$40	light rail only (2)
North Drive, Vista	20	8,793	67	0	29.5	$30	light rail only
Mar Vista Drive, Vista	21	9,665	67	0	28.8	$30	light rail only
Los Angeles Drive, Vista	22	4,291	67	0	28.8	$30	light rail only
Grand Avenue/Carlsbad Village Drive, Carlsbad	23	21,113	51	0	28.3	$110	
Guajome Street, Vista	24	4,152	67	0	28.0	$30	light rail only
Tamarack Avenue, Carlsbad	25	10,568	51	0	23.8	$90	
Cannon Road, Carlsbad	26	12,434	51	0	22.3	$90	
Leucadia Blvd., Encinitas	27	34,000	51	1	22.0	$90	see note (3)
Total						**$3,940**	

(1) Heavy rail trench only from Washington St. to Downtown San Diego estimated at $1.9 billion
(2) Included in the SPRINTER double-track project (West Mission Rd, San Marcos also is included at estimated cost of $40 million)
(3) Included in the COASTER double-track
(4) Included in Blue/Orange Lines frequency enhancements

ATTACHMENT D:

SHORT TRENCH ALTERNATIVE PLAN & PROFILE



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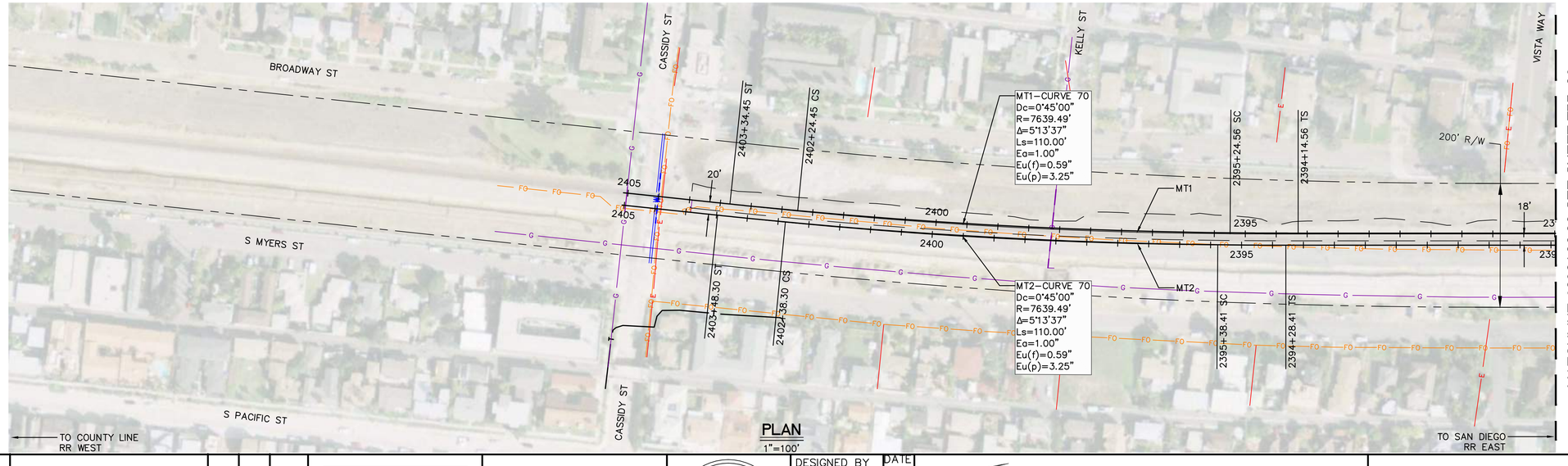

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- PROPOSED RIGHT-OF-WAY ACQUISITIONS
- PROPOSED RETAINING WALL
- PROPOSED GRADING LIMITS
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- FO — FO — EXISTING FIBER OPTIC LINE
- G — EXISTING GAS LINE
- S — EXISTING SEWER LINE
- SD — EXISTING STORM DRAIN LINE
- T — EXISTING TELECOM LINE
- W — EXISTING WATER LINE
- G — PROPOSED GAS LINE
- S — PROPOSED SEWER LINE
- SD — PROPOSED STORM DRAIN LINE
- PROPOSED CONCRETE CHANNEL

PRELIMINARY - NOT FOR CONSTRUCTION

NO.	DATE	REVISIONS	BY	CHK	APRV

NCTD

TYLIN INTERNATIONAL
404 CAMINO DEL RIO SOUTH, SUITE 700 SAN DIEGO, CA 92108
(619) 692-1920 www.tylin.com

REGISTERED PROFESSIONAL ENGINEER
No. _____
Exp. _____
CIVIL
STATE OF CALIFORNIA

DESIGNED BY -	DATE -
DRAWN BY -	-
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SANDAG
San Diego's Regional Planning Agency

CARLSBAD VILLAGE DOUBLE TRACK

SHORT TRENCH ALTERNATIVE TRACK PLAN AND PROFILE

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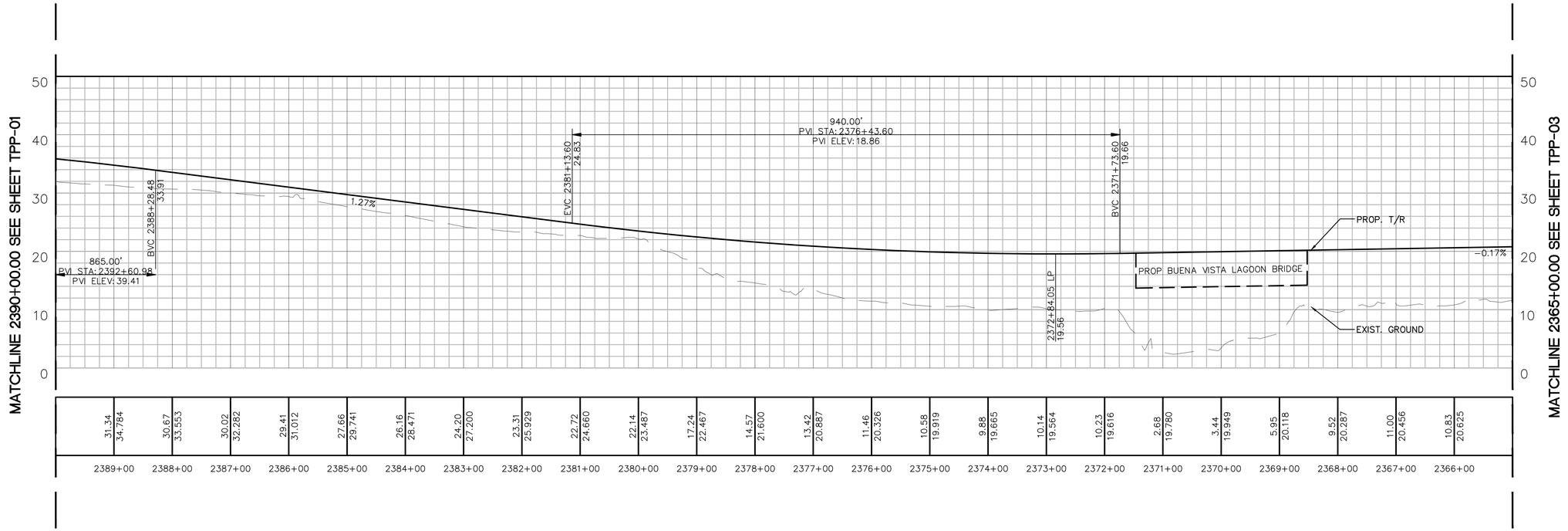

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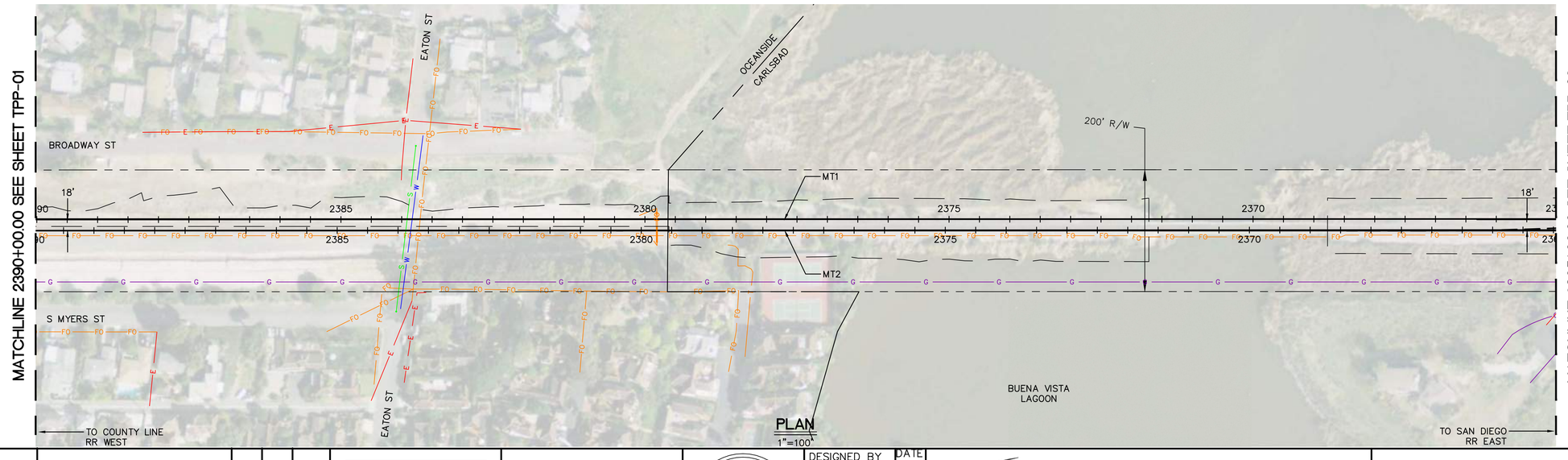

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- PROPOSED CROSSOVER
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- PROPOSED CONCRETE CHANNEL

PRELIMINARY - NOT FOT CONSTRUCTION

NO.	DATE	REVISIONS	BY	CHK	APRV

NCTD

TYLIN INTERNATIONAL
404 CAMINO DEL RIO SOUTH, SUITE 700 SAN DIEGO, CA 92108
(619) 692-1920 www.tylin.com

REGISTERED PROFESSIONAL ENGINEER
No. _____
Exp. _____
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STATE OF CALIFORNIA

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SANDAG
San Diego's Regional Planning Agency

CARLSBAD VILLAGE DOUBLE TRACK

SHORT TRENCH ALTERNATIVE TRACK PLAN AND PROFILE

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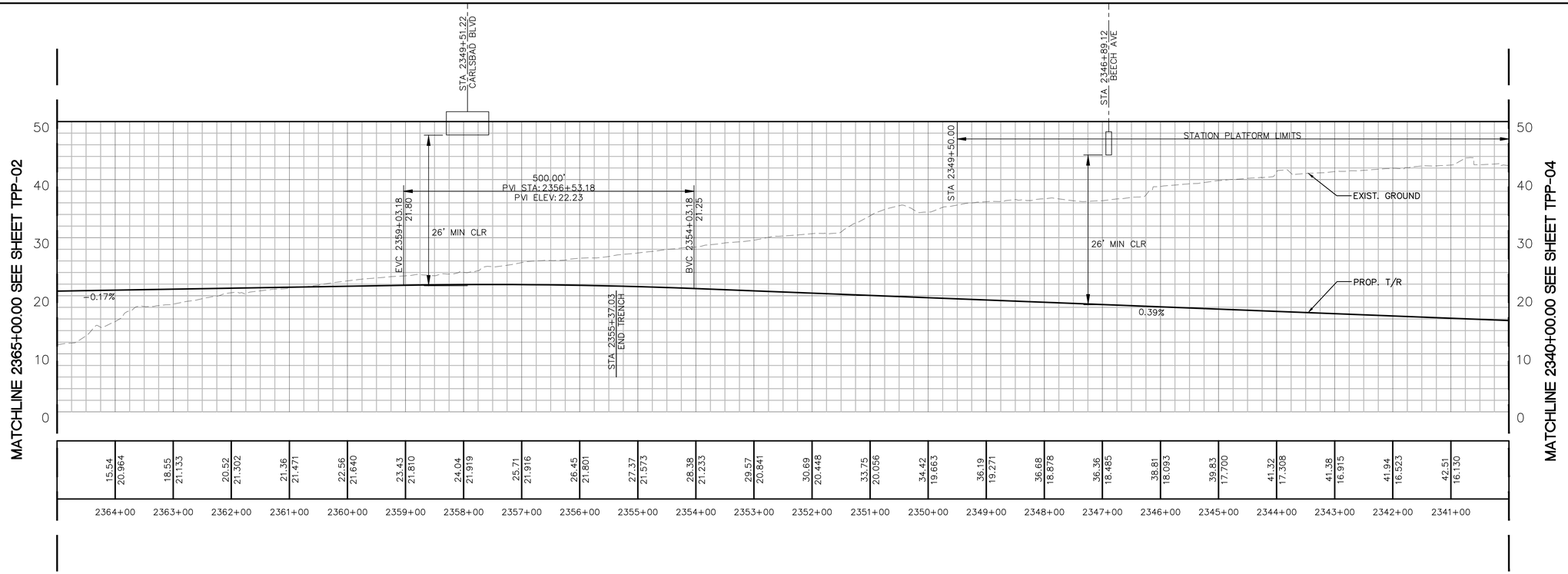

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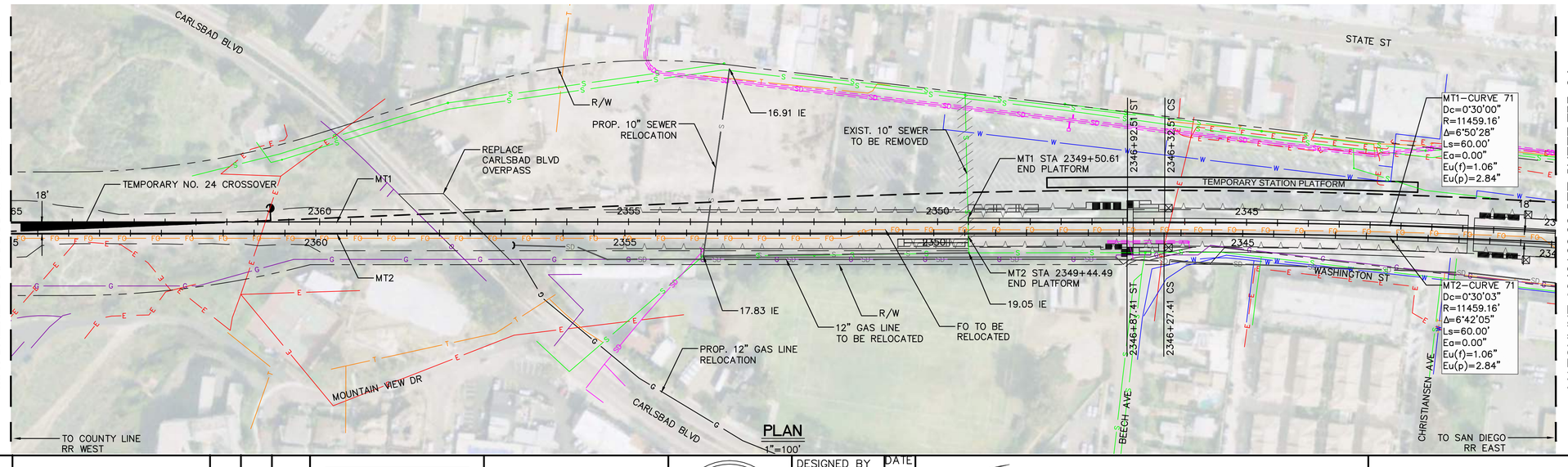

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10 5 0 10 20
VERTICAL SCALE 1"= 10'

LEGEND:

- PROPOSED TRACK
- TEMPORARY SHOOFLY TRACK
- PROPOSED CROSSOVER
- EXISTING RIGHT-OF-WAY
- PROPOSED RIGHT-OF-WAY ACQUISITIONS
- PROPOSED RETAINING WALL
- PROPOSED GRADING LIMITS
- E — EXISTING ELECTRIC LINE
- FO — FO — EXISTING FIBER OPTIC LINE
- G — EXISTING GAS LINE
- S — EXISTING SEWER LINE
- SD — EXISTING STORM DRAIN LINE
- T — EXISTING TELECOM LINE
- W — EXISTING WATER LINE
- G — PROPOSED GAS LINE
- S — PROPOSED SEWER LINE
- SD — PROPOSED STORM DRAIN LINE
- PROPOSED CONCRETE CHANNEL

PRELIMINARY - NOT FOR CONSTRUCTION

NO.	DATE	REVISIONS	BY	CHK	APRV

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DESIGNED BY -	-
DRAWN BY -	-
CHECKED BY -	-
PRJ. ENG. -	-

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CARLSBAD VILLAGE DOUBLE TRACK

SHORT TRENCH ALTERNATIVE TRACK PLAN AND PROFILE

STA 2340+00 TO 2365+00

SCALE: AS SHOWN
CONTRACT NO.
DRAWING NO.: TPP-03
SHEET NO.

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

Revised: June 24, 2016
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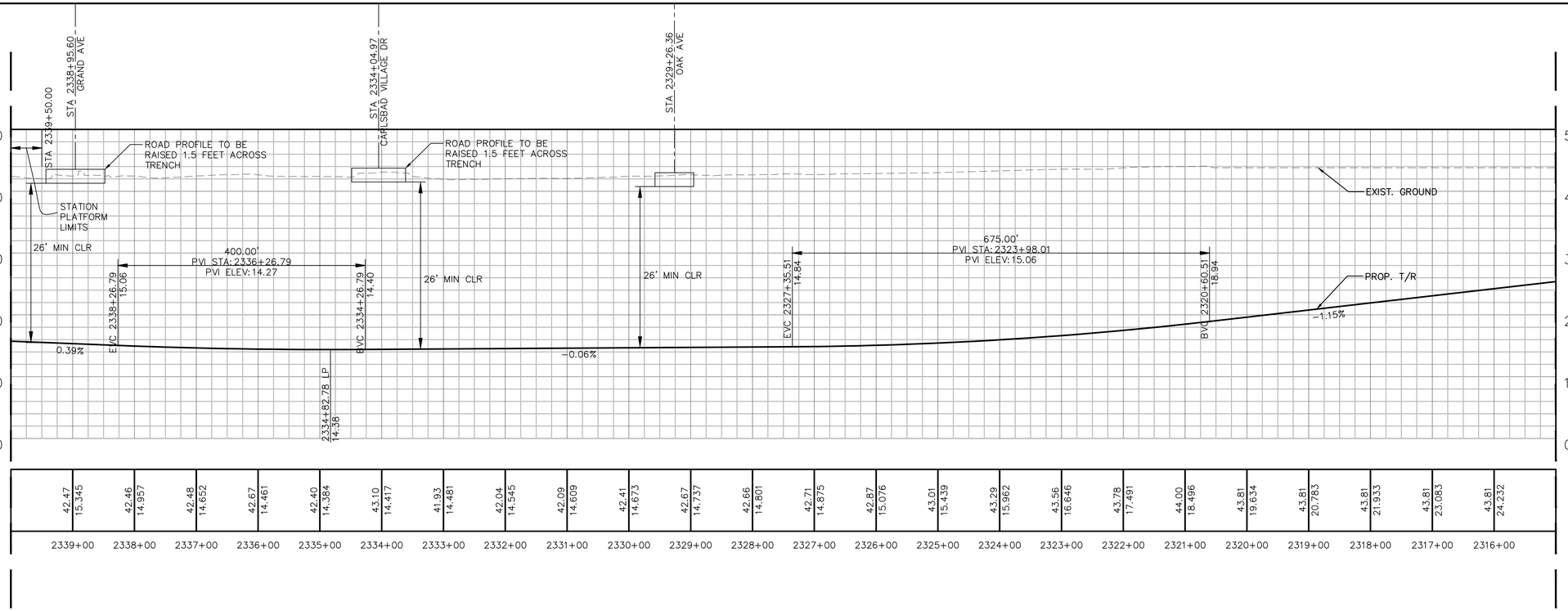
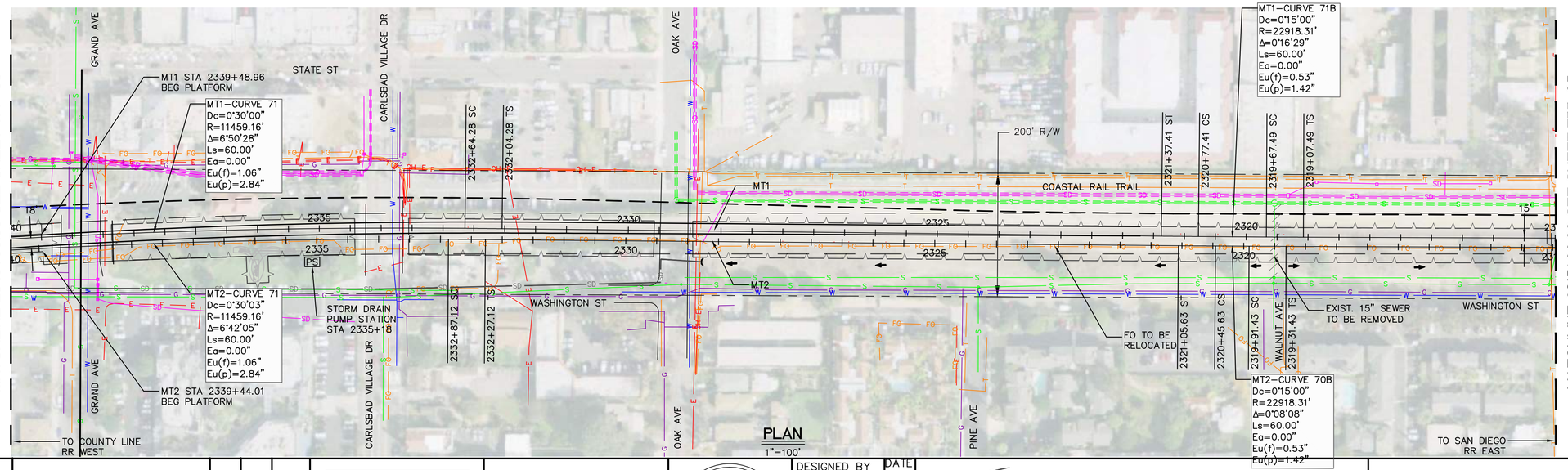


PROFILE

HORIZONTAL 1"=100'
VERTICAL 1"=10'



PLAN

1"=100'

100 50 0 100 200
HORIZONTAL SCALE 1"= 100'

10 5 0 10 20
VERTICAL SCALE 1"= 10'

LEGEND:

- PROPOSED TRACK
- TEMPORARY SHOOFLY TRACK
- PROPOSED CROSSOVER
- EXISTING RIGHT-OF-WAY
- PROPOSED RIGHT-OF-WAY ACQUISITIONS
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- SD PROPOSED STORM DRAIN LINE
- PROPOSED CONCRETE CHANNEL

PRELIMINARY - NOT FOR CONSTRUCTION

NO.	DATE	REVISIONS	BY	CHK	APRV

Revised: June 24, 2016
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DESIGNED BY -	DATE -
DRAWN BY -	-
CHECKED BY -	-
PRJ. ENG. -	-

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San Diego's Regional Planning Agency

CARLSBAD VILLAGE DOUBLE TRACK

SHORT TRENCH ALTERNATIVE TRACK PLAN AND PROFILE

STA 2315+00 TO 2340+00

SCALE: AS SHOWN
CONTRACT NO.
DRAWING NO.: TPP-04
SHEET NO.

FOR REDUCED PLANS
ORIGINAL SCALE IS IN INCHES
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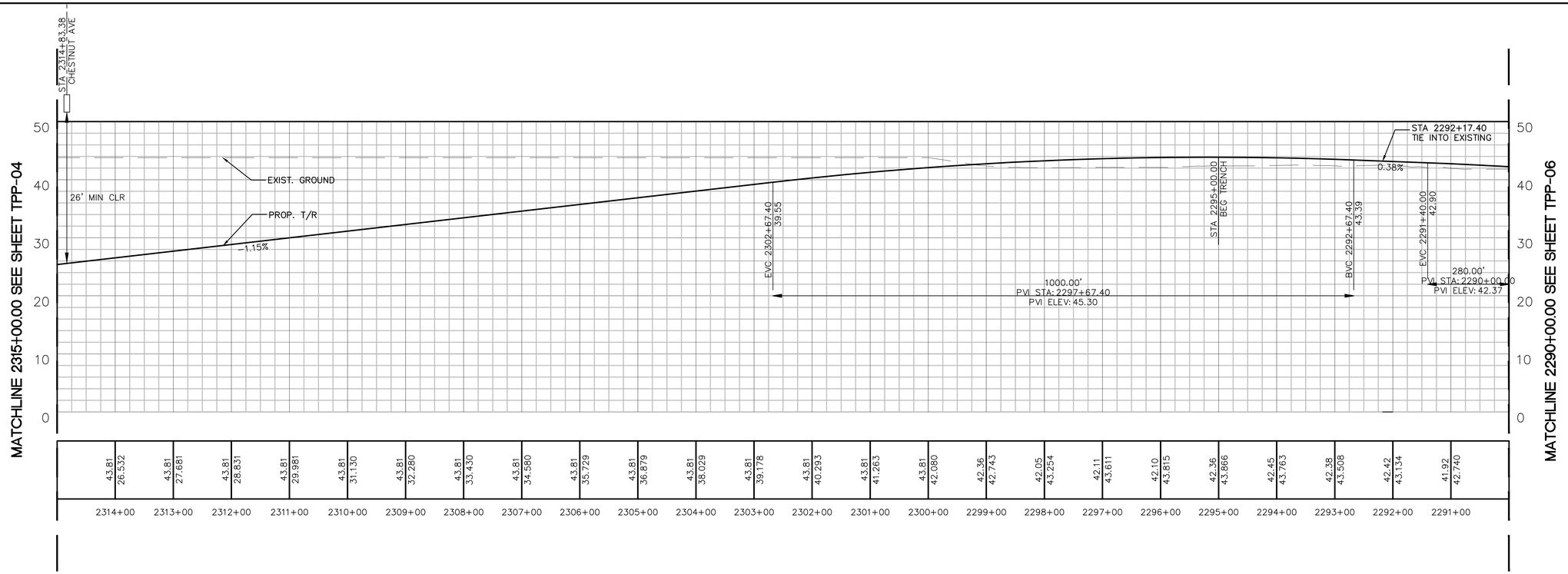
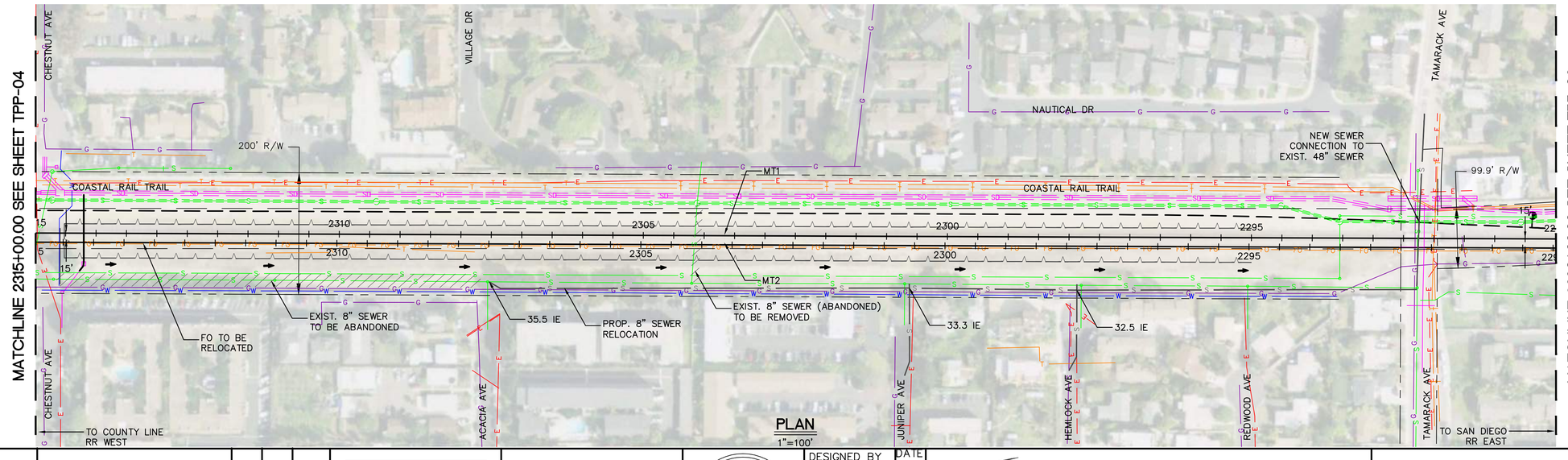


PROFILE

HORIZONTAL 1"=100'
VERTICAL 1"=10'



PLAN

1"=100'

100 50 0 100 200
HORIZONTAL SCALE 1"= 100'

10 5 0 10 20
VERTICAL SCALE 1"= 10'

LEGEND:

- PROPOSED TRACK
- TEMPORARY SHOOFLY TRACK
- PROPOSED CROSSOVER
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DESIGNED BY -	-
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CHECKED BY -	-
PRJ. ENG. -	-

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CARLSBAD VILLAGE DOUBLE TRACK

SHORT TRENCH ALTERNATIVE TRACK PLAN AND PROFILE

STA 2290+00 TO 2315+00

SCALE: AS SHOWN
CONTRACT NO.
DRAWING NO.: TPP-05
SHEET NO.

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

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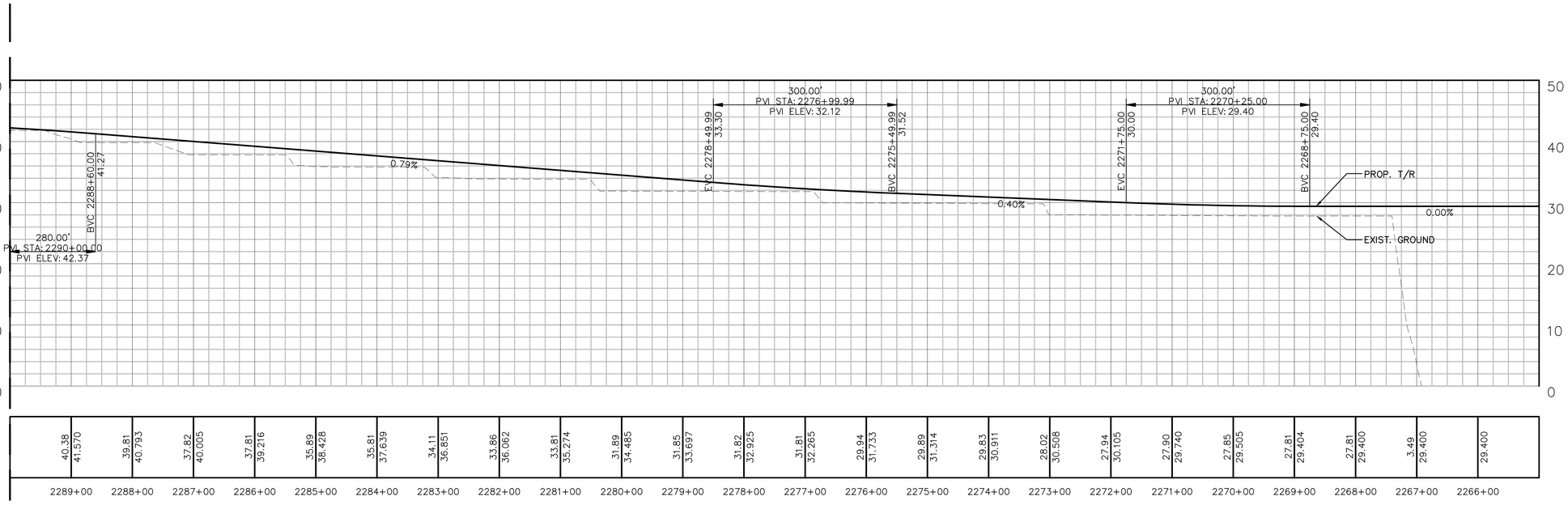
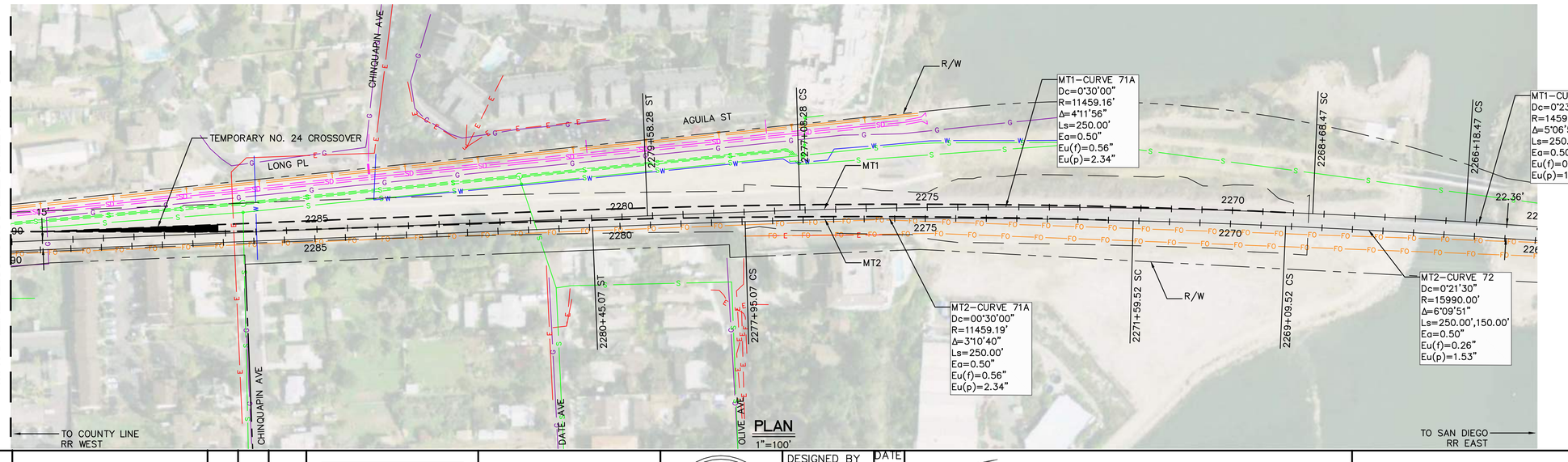


PROFILE

HORIZONTAL 1"=100'
VERTICAL 1"=10'



PLAN

1"=100'

100 50 0 100 200
HORIZONTAL SCALE 1"= 100'

10 5 0 10 20
VERTICAL SCALE 1"= 10'

LEGEND:

- PROPOSED TRACK
- TEMPORARY SHOOFLY TRACK
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PRELIMINARY - NOT FOR CONSTRUCTION

NO.	DATE	REVISIONS	BY	CHK	APRV

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CIVIL
STATE OF CALIFORNIA

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DESIGNED BY -	-
DRAWN BY -	-
CHECKED BY -	-
PRJ. ENG. -	-

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San Diego's Regional Planning Agency

CARLSBAD VILLAGE DOUBLE TRACK

SHORT TRENCH ALTERNATIVE TRACK PLAN AND PROFILE

STA 2265+00 TO 2290+00

SCALE	
AS SHOWN	
CONTRACT NO.	
DRAWING NO. TPP-06	SHEET NO.

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

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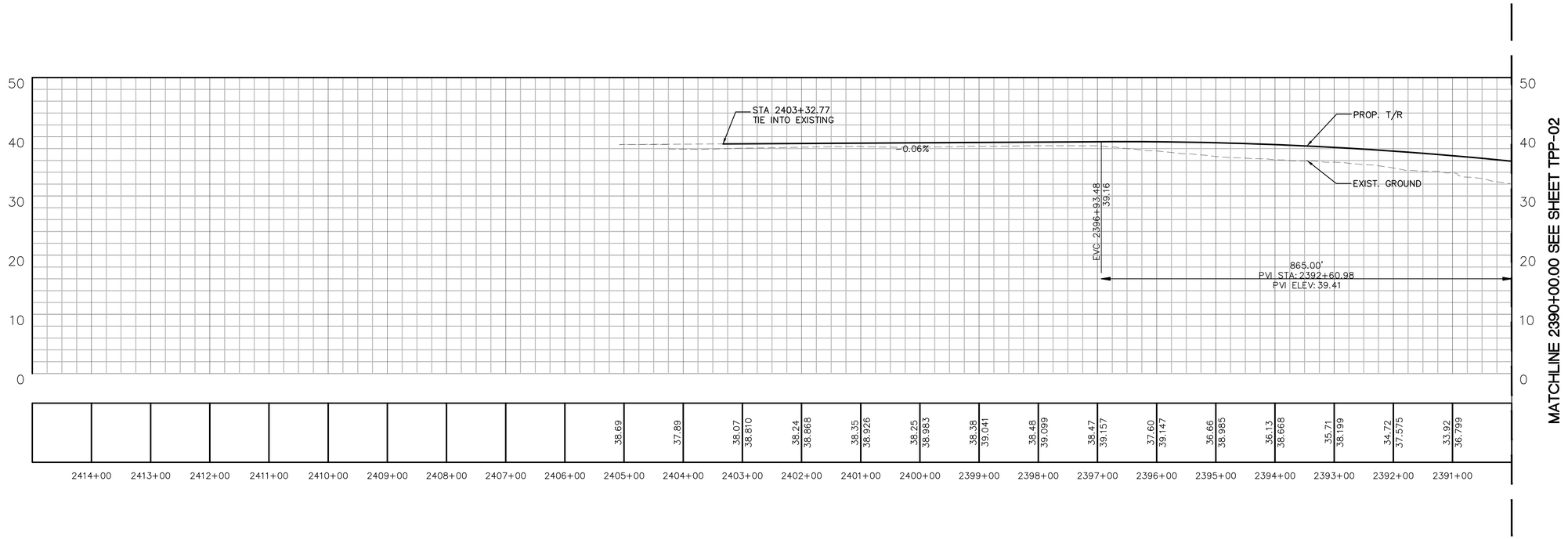
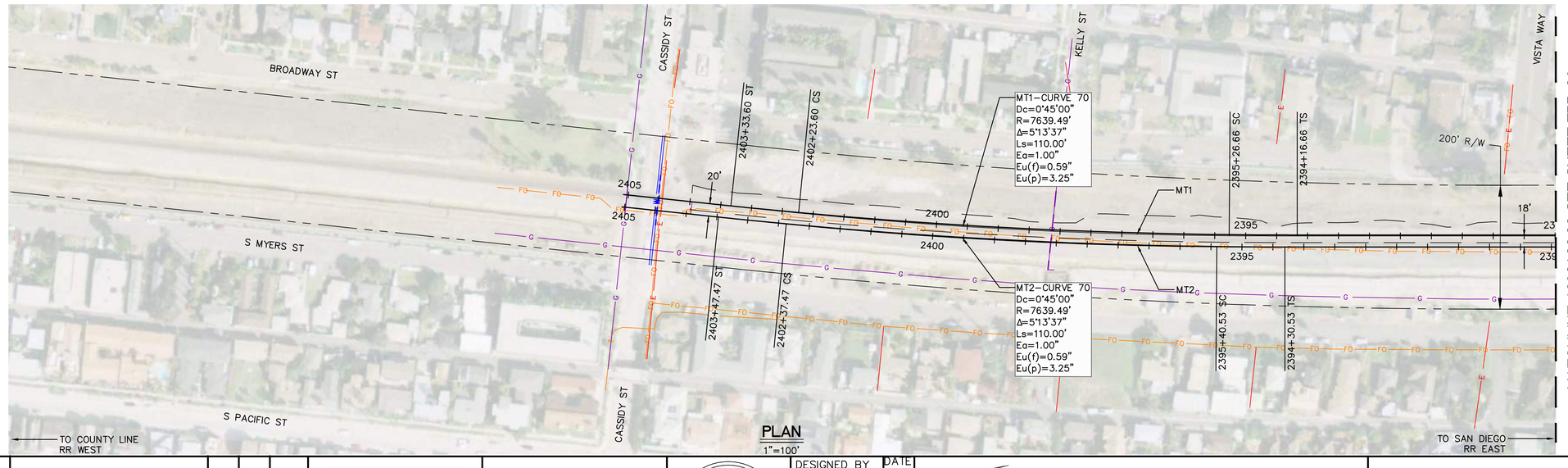
ATTACHMENT E:

LONG TRENCH ALTERNATIVE PLAN & PROFILE



PROFILE

HORIZONTAL 1"=100'
VERTICAL 1"=10'



PLAN

1"=100'

100 50 0 100 200
HORIZONTAL SCALE 1"= 100'

10 5 0 10 20
VERTICAL SCALE 1"= 10'

LEGEND:

- PROPOSED TRACK
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DRAWN BY -	-
CHECKED BY -	-
PRJ. ENG. -	-

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CARLSBAD VILLAGE DOUBLE TRACK

LONG TRENCH ALTERNATIVE TRACK PLAN AND PROFILE

STA 2390+00 TO STA 2415+00

SCALE: AS SHOWN
CONTRACT NO.
DRAWING NO.: TPP-01
SHEET NO.:

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

Revised: June 24, 2016
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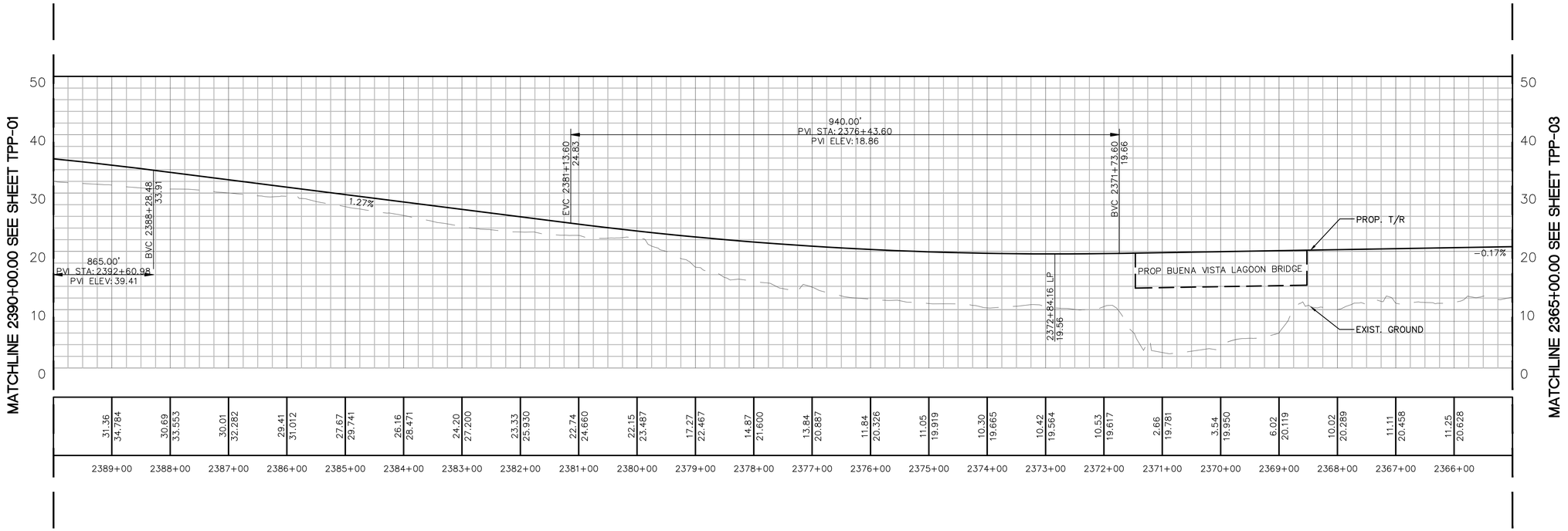
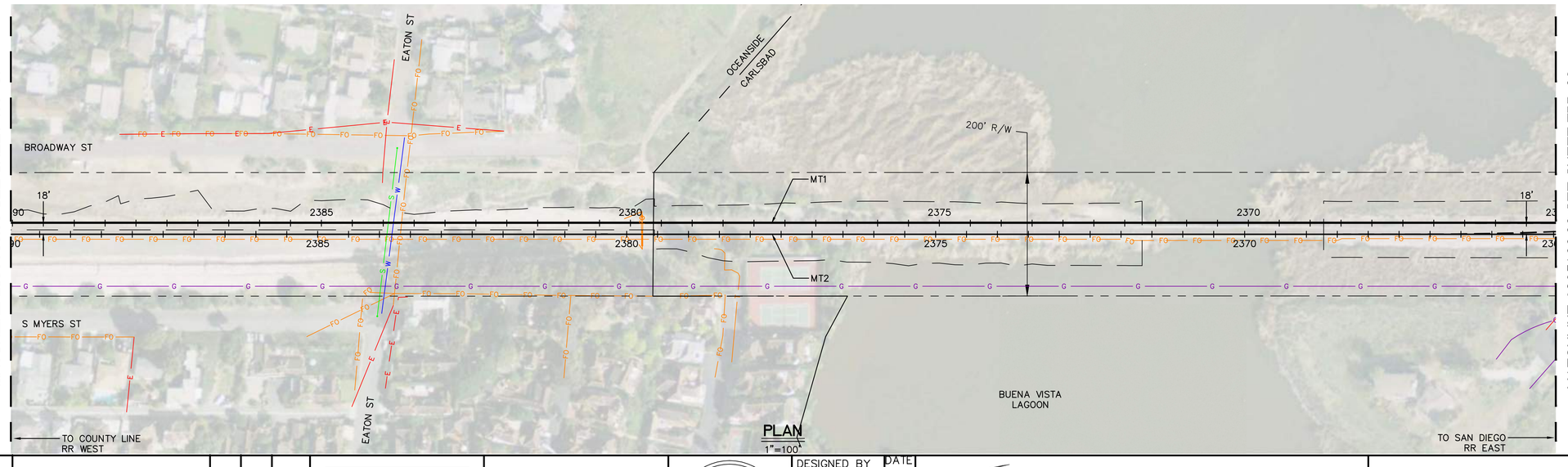


PROFILE

HORIZONTAL 1"=100'
VERTICAL 1"=10'



PLAN

1"=100'

100 50 0 100 200
HORIZONTAL SCALE 1"= 100'

10 5 0 10 20
VERTICAL SCALE 1"= 10'

N

LEGEND:

- PROPOSED TRACK
- TEMPORARY SHOOFLY TRACK
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PRELIMINARY - NOT FOR CONSTRUCTION

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PRJ. ENG. -	-

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San Diego's Regional Planning Agency

CARLSBAD VILLAGE DOUBLE TRACK

LONG TRENCH ALTERNATIVE TRACK PLAN AND PROFILE

STA 2365+00 TO STA 2390+00

SCALE: AS SHOWN
CONTRACT NO.
DRAWING NO.: TPP-02
SHEET NO.

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

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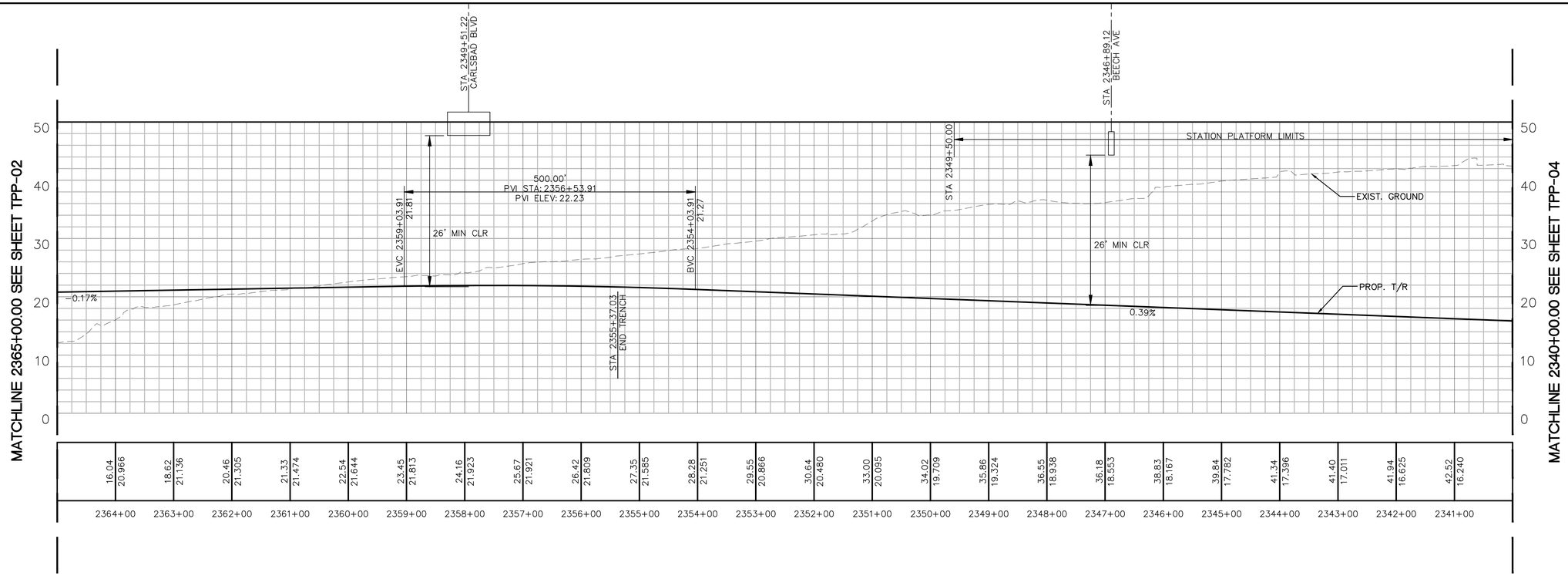
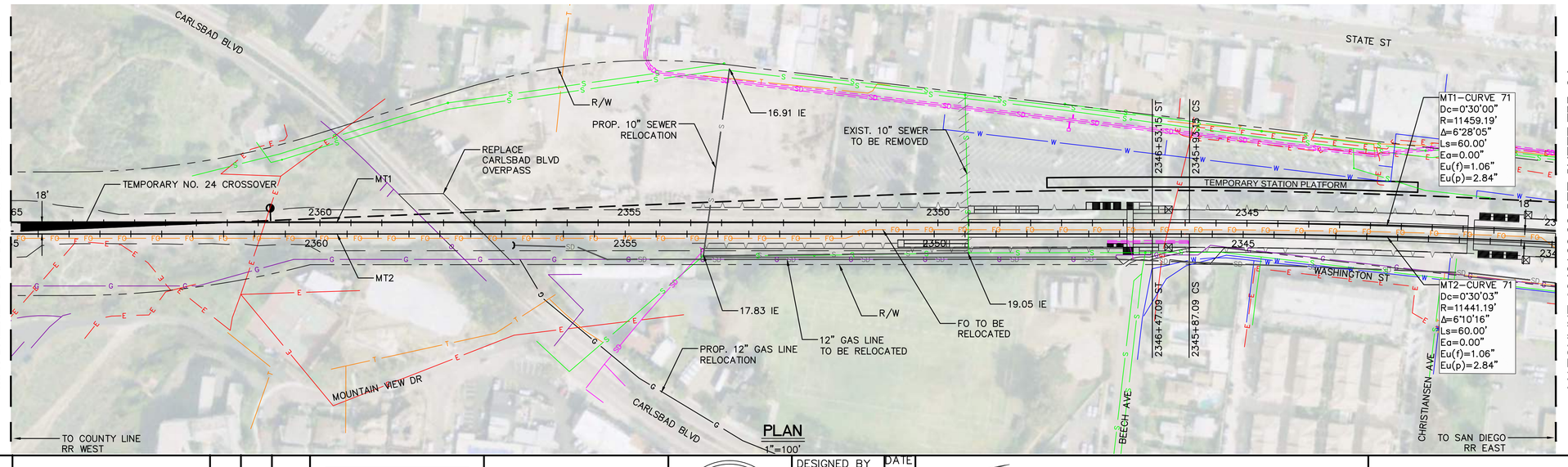


PROFILE

HORIZONTAL 1"=100'
VERTICAL 1"=10'



PLAN

1"=100'

100 50 0 100 200
HORIZONTAL SCALE 1"= 100'

10 5 0 10 20
VERTICAL SCALE 1"= 10'

LEGEND:

- PROPOSED TRACK
- TEMPORARY SHOOFLY TRACK
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PRELIMINARY - NOT FOR CONSTRUCTION

NO.	DATE	REVISIONS	BY	CHK	APRV

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CARLSBAD VILLAGE DOUBLE TRACK

LONG TRENCH ALTERNATIVE TRACK PLAN AND PROFILE

STA 2340+00 TO 2365+00

SCALE	
AS SHOWN	
CONTRACT NO.	
DRAWING NO. TPP-03	SHEET NO.

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

Revised: June 24, 2016
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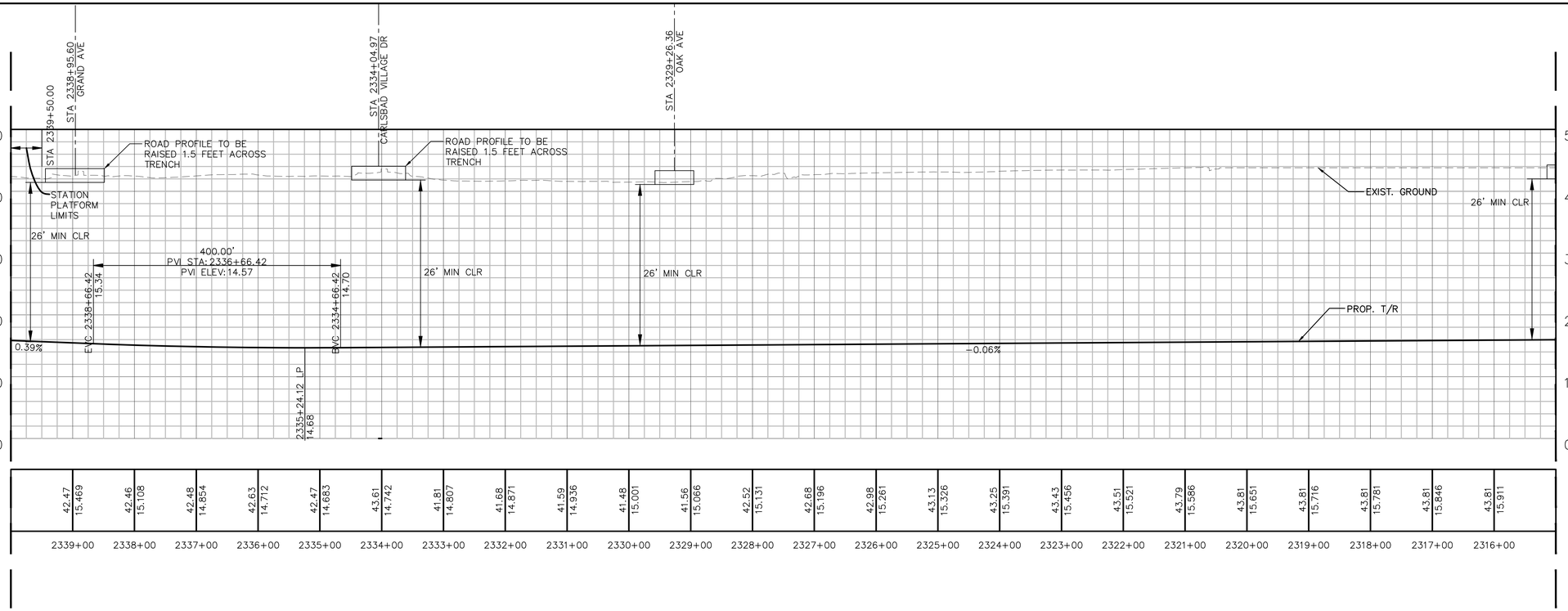
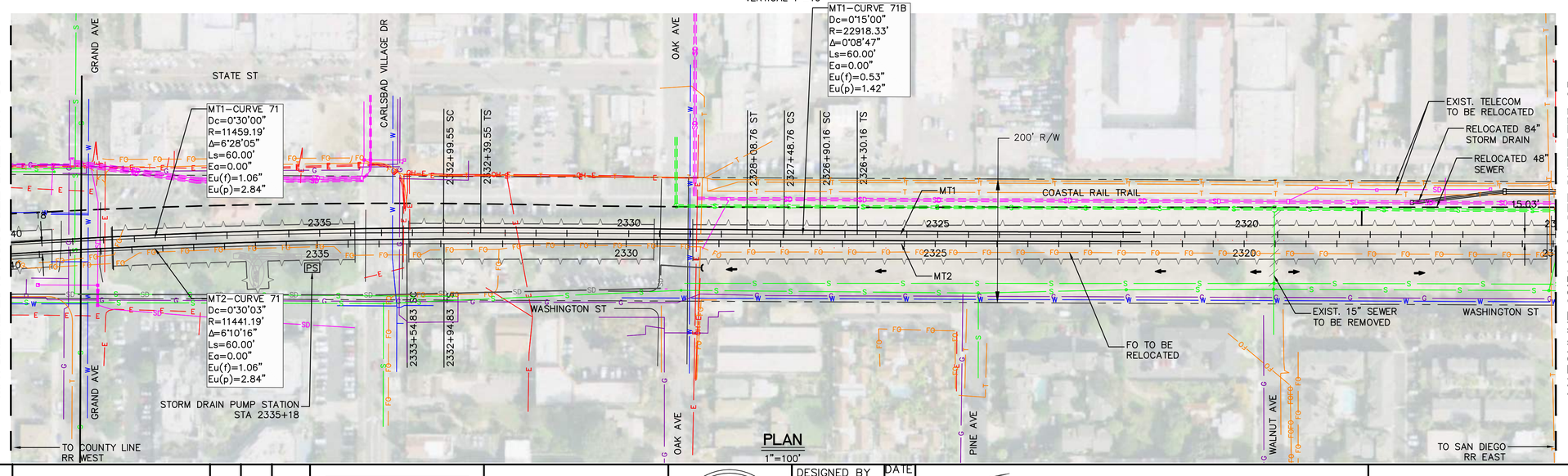


PROFILE

HORIZONTAL 1"=100'
VERTICAL 1"=10'



PLAN

1"=100'

100 50 0 100 200
HORIZONTAL SCALE 1"= 100'

10 5 0 10 20
VERTICAL SCALE 1"= 10'

LEGEND:

- PROPOSED TRACK
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PRELIMINARY - NOT FOR CONSTRUCTION

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PRJ. ENG. -	-

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CARLSBAD VILLAGE DOUBLE TRACK

LONG TRENCH ALTERNATIVE TRACK PLAN AND PROFILE

STA 2315+00 TO 2340+00

SCALE: AS SHOWN
CONTRACT NO.
DRAWING NO.: TPP-04
SHEET NO.

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

Revised: June 24, 2016
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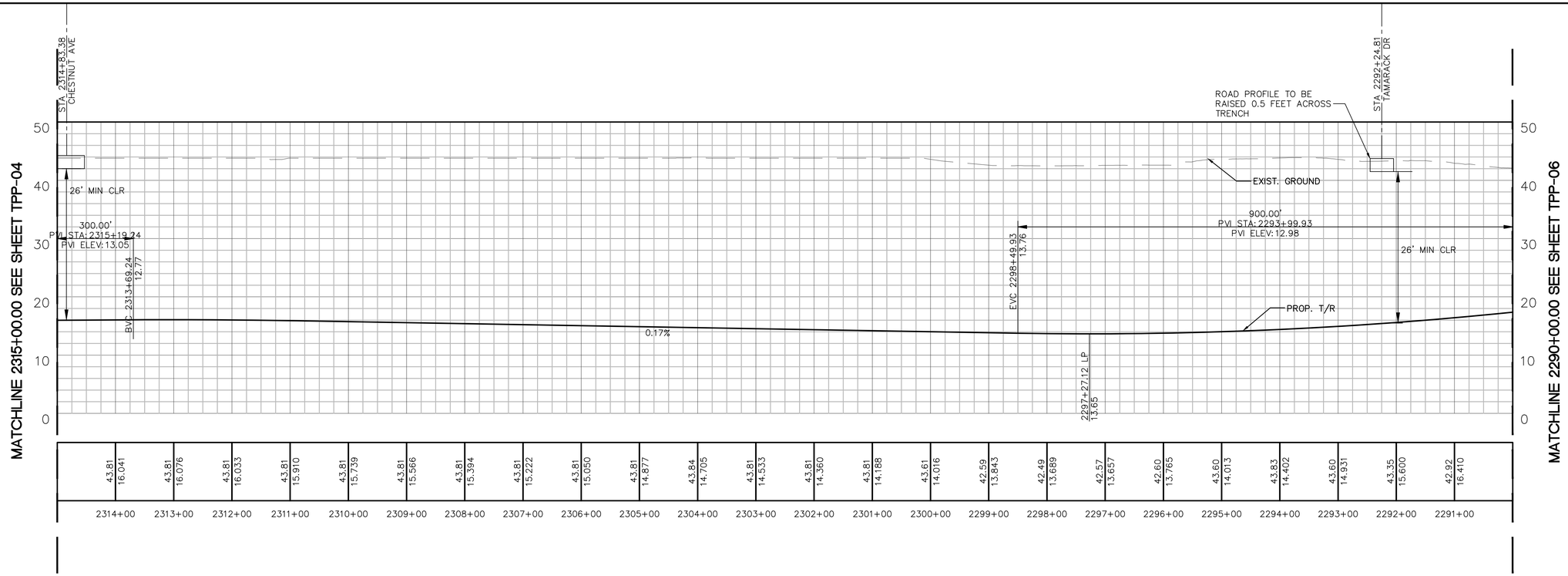
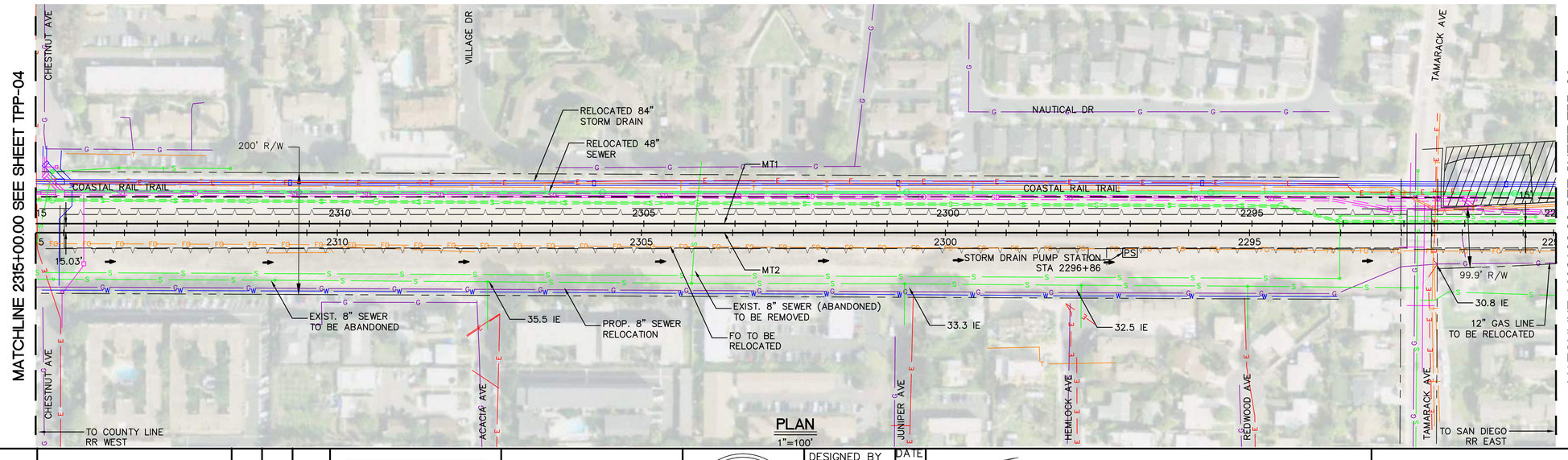


PROFILE

HORIZONTAL 1"=100'
VERTICAL 1"=10'



PLAN

1"=100'

100 50 0 100 200
HORIZONTAL SCALE 1"= 100'

10 5 0 10 20
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PRELIMINARY - NOT FOR CONSTRUCTION

NO.	DATE	REVISIONS	BY	CHK	APRV

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	DATE
DESIGNED BY -	-
DRAWN BY -	-
CHECKED BY -	-
PRJ. ENG. -	-

SANDAG
San Diego's Regional Planning Agency

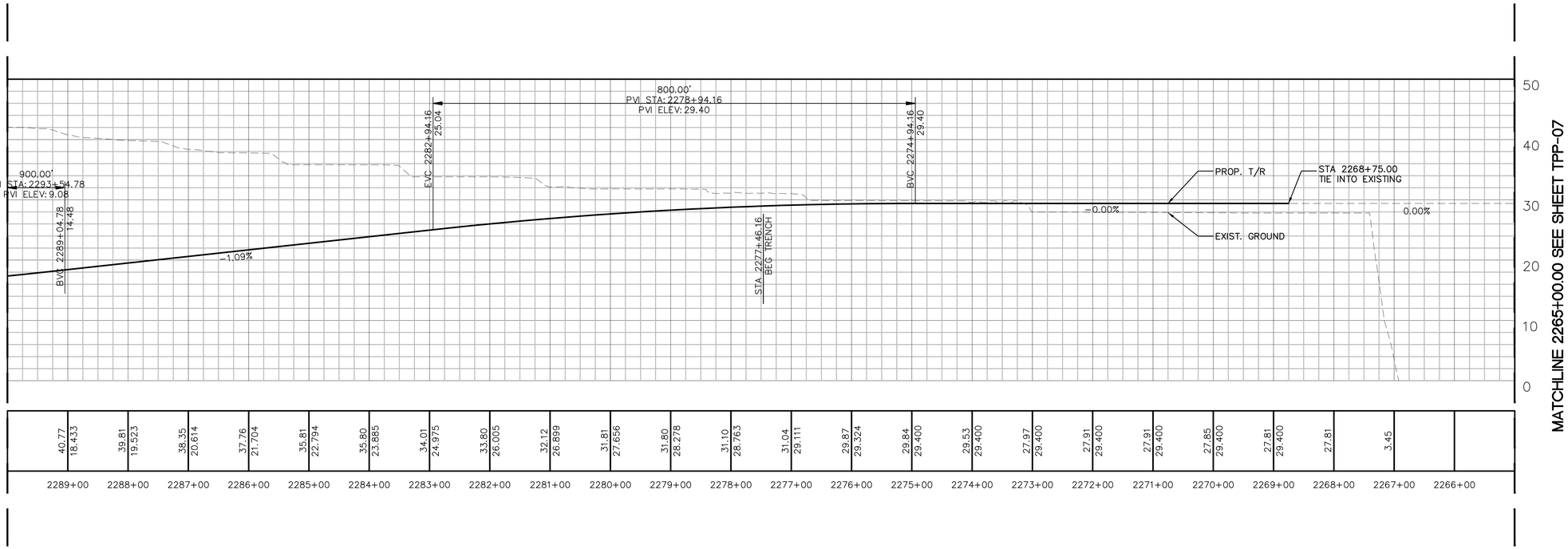
CARLSBAD VILLAGE DOUBLE TRACK

LONG TRENCH ALTERNATIVE TRACK PLAN AND PROFILE

STA 2290+00 TO 2315+00

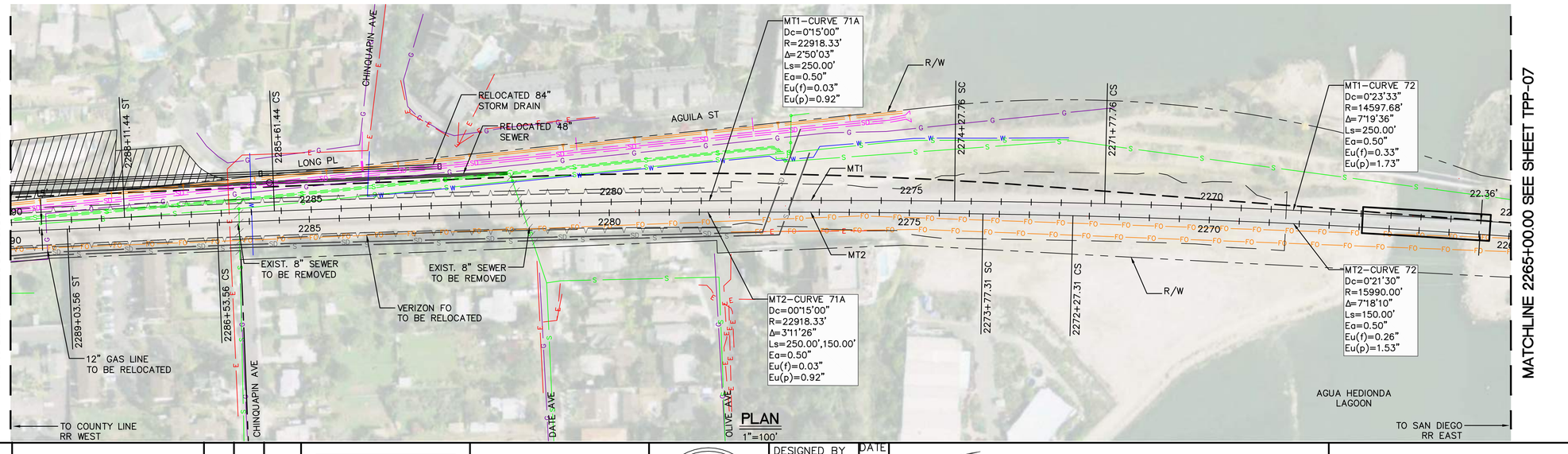
SCALE: AS SHOWN
CONTRACT NO.
DRAWING NO.: TPP-05
SHEET NO.

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



PROFILE

HORIZONTAL 1"=100'
VERTICAL 1"=10'



PLAN

1"=100'

100 50 0 100 200
HORIZONTAL SCALE 1"= 100'

10 5 0 10 20
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LEGEND:

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- W — EXISTING WATER LINE
- G — PROPOSED GAS LINE
- S — PROPOSED SEWER LINE
- SD — PROPOSED STORM DRAIN LINE
- PROPOSED CONCRETE CHANNEL

PRELIMINARY - NOT FOR CONSTRUCTION

NO.	DATE	REVISIONS	BY	CHK	APRV

NCTD

TYLIN INTERNATIONAL
404 CAMINO DEL RIO SOUTH, SUITE 700 SAN DIEGO, CA 92108
(619) 692-1920 www.tylin.com

REGISTERED PROFESSIONAL ENGINEER — No. ----- Exp. ----- CIVIL — STATE OF CALIFORNIA

	DATE
DESIGNED BY -	-
DRAWN BY -	-
CHECKED BY -	-
PRJ. ENG. -	-

SANDAG
San Diego's Regional Planning Agency

CARLSBAD VILLAGE DOUBLE TRACK

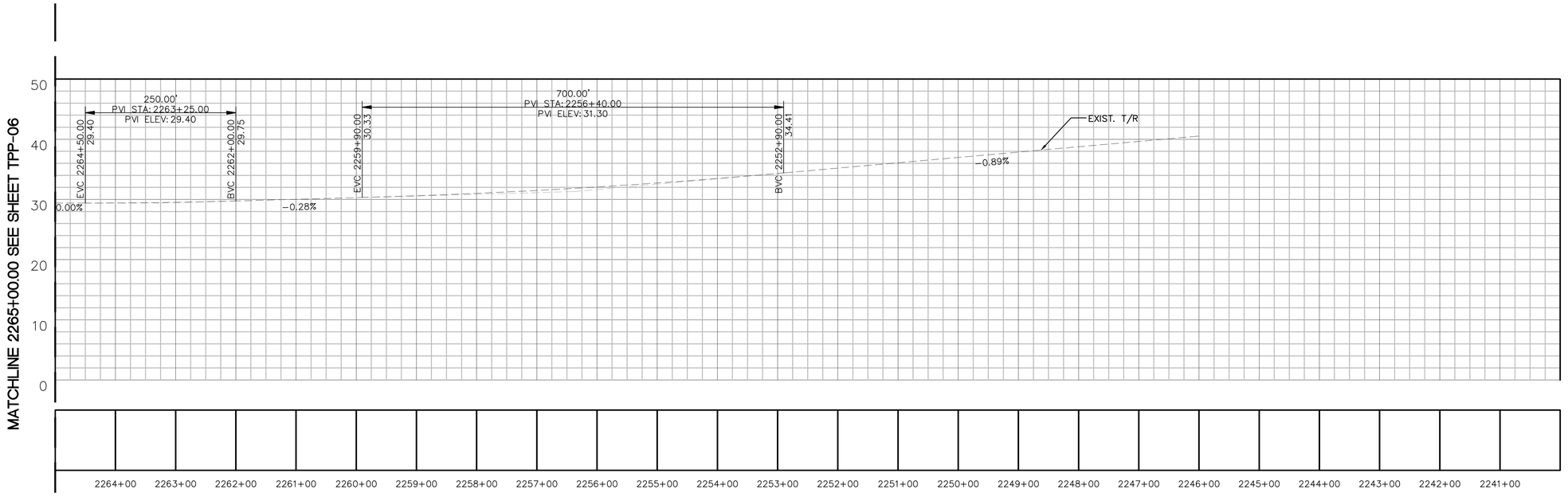
LONG TRENCH ALTERNATIVE TRACK PLAN AND PROFILE

STA 2265+00 TO 2290+00

SCALE: AS SHOWN
CONTRACT NO.
DRAWING NO.: TPP-06
SHEET NO.

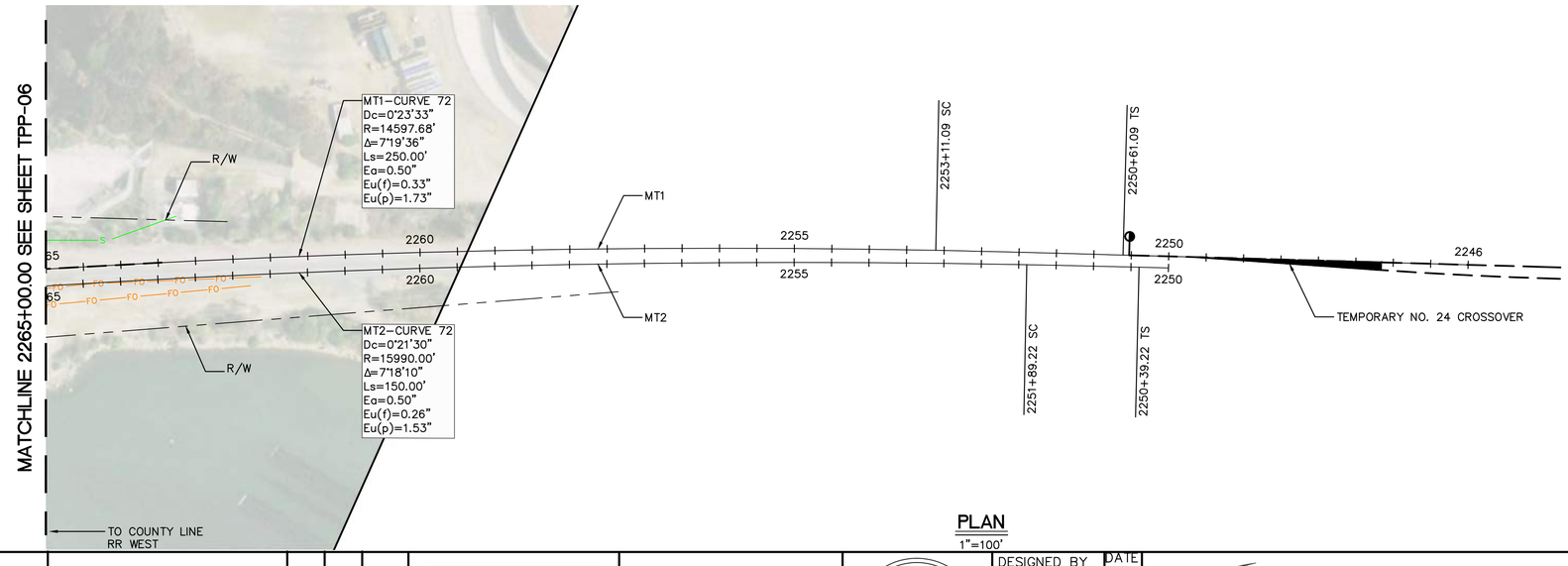
FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES
0 1 2 3

Revised: June 24, 2016
Path: P:\1150\1170_SANDAG On-Call_CN 5001906\1170.07_TO 07_Carlsbad Village Double Track\500_Design\510_Civil\511_CADD\TPP-06 Long Printed:6/24/2016 2:52 PM



PROFILE

HORIZONTAL 1"=100'
VERTICAL 1"=10'



PLAN

1"=100'

TO SAN DIEGO
RR EAST

100 50 0 100 200
HORIZONTAL SCALE 1"= 100'

10 5 0 10 20
VERTICAL SCALE 1"= 10'

LEGEND:

- PROPOSED TRACK
- TEMPORARY SHOOFLY TRACK
- PROPOSED CROSSOVER
- EXISTING RIGHT-OF-WAY
- PROPOSED RIGHT-OF-WAY ACQUISITIONS
- PROPOSED RETAINING WALL
- PROPOSED GRADING LIMITS
- E — EXISTING ELECTRIC LINE
- FO — FO — EXISTING FIBER OPTIC LINE
- G — EXISTING GAS LINE
- S — EXISTING SEWER LINE
- SD — EXISTING STORM DRAIN LINE
- T — EXISTING TELECOM LINE
- W — EXISTING WATER LINE
- G — PROPOSED GAS LINE
- S — PROPOSED SEWER LINE
- SD — PROPOSED STORM DRAIN LINE
- PROPOSED CONCRETE CHANNEL

PRELIMINARY - NOT FOR CONSTRUCTION

NO.	DATE	REVISIONS	BY	CHK	APRV

NCTD

TYLIN INTERNATIONAL
404 CAMINO DEL RIO SOUTH, SUITE 700 SAN DIEGO, CA 92108
(619) 692-1920 www.tylin.com

REGISTERED PROFESSIONAL ENGINEER
No. _____
Exp. _____
CIVIL
STATE OF CALIFORNIA

DESIGNED BY -	DATE -
DRAWN BY -	-
CHECKED BY -	-
PRJ. ENG. -	-

SANDAG
San Diego's Regional Planning Agency

CARLSBAD VILLAGE DOUBLE TRACK

LONG TRENCH ALTERNATIVE TRACK PLAN AND PROFILE

STA 2240+00 TO 2265+00

SCALE: AS SHOWN
CONTRACT NO.
DRAWING NO.: TPP-07
SHEET NO.

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

Revised: March 16, 2016
Path: P:\1150\1170_SANDAG On-Call_CN 5001906\1170.07_TO 07_Carlsbad Village Double Track\500_Design\510_Civil\511_CADD\TPP-07 Long Printed:6/24/2016 2:52 PM

ATTACHMENT F:

SHORT TRENCH ALTERNATIVE COST ESTIMATE

CARLSBAD VILLAGE DOUBLE TRACK

Short Trench Alternative Estimate Design Level: Preliminary

12/6/2016 Estimated By: Philip Brand

Item	Quantity	Unit	Unit Price	Amount	Subtotals
DESIGN					
Alternative Analysis and Environmental	3	%	CCE	$4,659,490	
Design-30% Package	3	%	CCE	$4,659,490	
Design-60% and Permits	3.6	%	CCE	$5,591,389	
Design-90%, Final, Bid Support	3.6	%	CCE	$5,591,389	
SANDAG Administration	3.7	%	CCE	$5,746,705	
NCTD Administration	0.6	%	CCE	$931,898	
				Design Subtotal	**$27,180,361**
RIGHT OF WAY					
Temporary R/W, Easements	1	LS	$80,000	$80,000	
Property Acquisition	0	AC	$0	$0	
R/W Contingency	35	%	R/W Costs	$28,000	
				Right of Way Subtotal	**$108,000**
CONSTRUCTION COST ESTIMATE					
				Construction Cost Estimate (CCE)	**$155,400,000**
ANCILLARY CONSTRUCTION COSTS					
Design Services During Construction	2.76	%	CCE	$4,286,731	
Construction Management and Testing	16	%	CCE	$24,850,616	
SANDAG Const. Admin.	1.7	%	CCE	$2,640,378	
NCTD Const. Admin.	0.35	%	CCE	$543,607	
NCTD Support	4.8	%	CCE	$7,455,184.76	
PTC Survey	1	LS	$400,000	$400,000	
Railroad Flagging Services	10000	Hours	$65	$650,000	
				Ancillary Construction Cost Subtotal	**$40,826,517**
OFF-SITE ENVIRONMENTAL MITIGATION					
Non-Coastal (Freshwater Marsh) Wetlands	3	Acre	$185,000	$555,000	
				Offsite Mitigation Cost Subtotal	**$555,000**
TOTAL PROJECT COST ESTIMATE					**$224,100,000**
COST ESCALATION					
Year of Expenditure	Annual %		Cumulative	Estimated	Escalation
2016	0.00%		0.00%	$224,100,000	$0
2017	2.80%		2.80%	$230,374,800	$6,274,800
2018	2.80%		5.60%	$236,825,294	$12,725,294
2019	2.80%		8.40%	$243,456,403	$19,356,403
2020	2.80%		11.20%	$250,273,182	$26,173,182
2021	2.80%		14.00%	$257,280,831	$33,180,831
2022	2.80%		16.80%	$264,484,694	$40,384,694
2023	2.80%		19.60%	$271,890,266	$47,790,266
			TOTAL EXPENDITURES IN 2016 DOLLARS	$224,100,000	
				TOTAL COST ESCALATION	$47,790,266
				PROJECT COST IN YEAR OF EXPENDITURE DOLLARS	**$271,900,000**

CARLSBAD VILLAGE DOUBLE TRACK

Short Trench Alternative Estimate Design Level: Preliminary

12/6/2016 Estimated By: Philip Brand

Item	Quantity	Unit	Unit Price	Amount	Subtotals
Construction Cost Estimate Based on Preliminary Design					
Trackwork					
Track-136lb CWR, Ties, & Ballast	22960	TF	$285	$6,543,600	
Track-115lb CWR, Ties, & Ballast	300	TF	$285	$85,500	
Subballast	10,118	CY	$64	$647,552	
Track Removal	16489	TF	$40	$659,560	
Track Realignment/Shifting	6933	TF	$70	$485,310	
Temporary Turnout Relocation	1	EA	$200,000	$200,000	
Temporary Turnout	2	EA	$700,000	$1,400,000	
Turnout Removal	2	EA	$40,000	$80,000	
Temporary Shoofly Track	7100	TF	$285	$2,023,500	
Install Insulated Joints	8	PAIR	$10,000	$80,000	
				Trackwork Subtotal	**$12,205,022**
Site Civil					
Clear and Grub	628540	SF	$1	$628,540	
Earthwork-Embankment	27459	CY	$35	$961,065	
Earthwork-Excavation	381453	CY	$20	$7,629,060	
Temporary Embankment/Removal	4000	CY	$55	$220,000	
Temporary Shoring	6600	SF	$30	$198,000	
Dewatering	1	LS	$1,000,000	$1,000,000	
At-grade Xing New Panel	490	LF	$2,400	$1,176,000	
Temporary Fencing and Controls	1	LS	$30,000	$30,000	
Temporary Platform	8700	SF	$8	$69,600	
Inter-track Fence	1230	LF	$50	$61,500	
Platform/Parking/Street Demolition	32000	SF	$2	$64,000	
Station Building Demolition	1	LS	$7,000	$7,000	
Relocate Historic Train Depot	1	LS	$100,000	$100,000	
Construct Station Platform	28050	SF	$8	$224,400	
Construct AC Pavement	126039	SF	$4	$506,677	
Aggregate Base	126039	SF	$2	$231,911.76	
Construct PCC Pavement	3400	SF	$20	$68,000	
Construct Sidewalk	252223	SF	$6	$1,387,227	
Construct Curb and Gutter	2172	LF	$23	$49,956	
Construct Median Curb and Gutter	1107	LF	$23	$25,461	
Truncated Domes	5620	SF	$30	$168,600	
Mini-High Platform	4	EA	$25,000	$100,000	
Construct Type A SD Cleanout	1	EA	$4,500	$4,500	
Construct Type B Curb Inlet	2	EA	$5,500	$11,000	
Fencing	11504	LF	$22	$253,088	
Storm Drain Pump Station	1	EA	$1,000,000	$1,000,000	
Construct Headwall (D-35A)	2	EA	$7,653	$15,306.82	
Construct Type B SD Cleanout	18	EA	$8,009	$144,162	
Install 12" PVC Storm Drain	213	LF	$72	$15,300	
Install 18" PVC Storm Drain	19	LF	$239	$4,532	
Install 30" RCP Storm Drain	1959	LF	$129	$251,986.17	
Install 36" RCP Storm Drain	1274	LF	$150	$190,820	

CARLSBAD VILLAGE DOUBLE TRACK

Short Trench Alternative Estimate Design Level: Preliminary

12/6/2016 Estimated By: Philip Brand

Item	Quantity	Unit	Unit Price	Amount	Subtotals
Remove Storm Drain	487	LF	$62	$30,238	
Concrete Channel	3591	LF	$1,157	$4,154,464	
Drainage DItch	9460	LF	$27	$252,582	
Install 24-inch RCP	95	LF	$115	$10,925	
Install 30-inch RCP	830	LF	$135	$112,050	
Construct Headwall	3	EA	$5,400	$16,200	
Rip-Rap	300	CY	$170	$51,000	
Landscape and Irrigation	1	LS	$75,000	$75,000	
Traffic Control	1	LS	$250,000	$250,000	
Traffic Striping	1	LS	$10,000	$10,000	
				Civil Subtotal	**$21,760,151**
Structures					
Buena Vista Lagoon Bridge	9899	SF	$285	$2,821,215	
Remove Existing Buena Vista Lagoon Bridge	1	LS	$1,200,000	$1,200,000	
Carlsbad Blvd Overpass	10200	SF	$250	$2,550,000	
Remove Existing Carlsbad Blvd Overpass	1	LS	$750,000	$750,000	
Beech Ave Pedestrian Overpass	792	SF	$200	$158,400	
Grand Ave Overpass	5544	SF	$225	$1,247,400	
Carlsbad Village Dr. Overpass	5544	SF	$225	$1,247,400	
Oak Ave Overpass	3036	SF	$200	$607,200	
Chestnut Pedestrian Overpass	792	SF	$200	$158,400	
Stairway Retaining Walls	1000	CY	$650	$650,000	
Construct Concrete Steps	101	CY	$800	$80,800	
Trench Structure	1	LS	$51,170,000	$51,170,000	
				Structures Subtotal	**$62,640,815**
Utility Relocation					
UG Fiber Optic in HDPE Conduit	9565	LF	$50	$478,250	
12-inch HP Gas	1	LF	$125,000	$125,000	
10-inch VCP Sewer	1	LF	$46,500	$46,500	
Street Light and Pull Box	2	EA	$3,000	$6,000	
1-inch Irrigation Service	1	EA	$2,400	$2,400	
Relocate 10-inch water	240	LF	$180	$43,200	
Relocate 1-inch gas	160	LF	$100	$16,000	
Relocate Gas - through bridge	280	LF	$300	$84,000	
Relcoate Water-through bridge	560	LF	$180	$100,800	
Construct Special Case 10ft Manhole @ 48"	1	EA	$14,000	$14,000	
Remove Sewer Pipe	381	LF	$46	$17,709	
Sewer Manhole (3'x5')	12	EA	$5,344	$64,127	
Install 6-inch PVC Sewer Main	152	LF	$92	$13,922	
Install 8-inch PVC Sewer Main	1037	LF	$108	$111,612	
Install 10-inch PVC Sewer Main	1852	LF	$119	$220,592	
Relocate Telecom-through bridge	280	LF	$300	$84,000	
Relocate UG Fiber Optic	9769	LF	$50	$488,450	
Relocate UG Telecom	346	LF	$50	$17,300	
				Utility Relocation Subtotal	**$1,933,862**

CARLSBAD VILLAGE DOUBLE TRACK

Short Trench Alternative Estimate Design Level: Preliminary

12/6/2016 Estimated By: Philip Brand

Item	Quantity	Unit	Unit Price	Amount	Subtotals
Environmental					
SWPPP (Temp Erosion Control)	1	LS	$250,000	$250,000	
Permenant Erosion Control	75000	SF	$1	$75,000	
Onsite Coastal Wetlands	0.6	Acre	$145,000	$87,000	
Onsite Non-Coastal (Southern Willow Scrub)	0.4	Acre	$145,000	$58,000	
Onsite Non-Coastal (Freshwater Marsh)	0.3	Acre	$145,000	$43,500	
Onsite Sensative Uplands	0.2	Acre	$145,000	$29,000	
Monitors - Environmental/Biological	1400	Hours	$150	$210,000	
Monitors - Paleo/Archeology	960	Hours	$150	$144,000	
				Environmental Mitigation Subtotal	**$896,500**
Signal					
CP Carl Removal	1	LS	$130,000	$130,000	
CP Longboard Removal	1	LS	$130,500	$130,500	
Temporary Relocation of CP Longboard	1	LS	$550,000	$550,000	
Installation of Temporary Control Point North	1	LS	$1,400,000	$1,400,000	
Installation of Temporary Control Point South	1	LS	$1,400,000	$1,400,000	
Carlsbad Village Ped Crossing Removal	1	LS	$45,000	$45,000	
Grand Ave Crossing Removal	1	LS	$52,500	$52,500	
Carlsbad Village Dr Crossing Removal	1	LS	$52,500	$52,500	
Grand Ave Temporary Gate Relocation (WB Gates)	1	LS	$500,000	$500,000	
Carlsbad Village Dr Temporary Gate Relocation (WB Gates)	1	LS	$500,000	$500,000	
Tamarack Ave Temporary Gate Relocation (WB Gates)	1	LS	$500,000	$500,000	
Grand Ave Gate Removal	1	LS	$100,000	$100,000	
Carlsbad Village Dr Gate Removal	1	LS	$100,000	$100,000	
Tamarack Ave Gate Removal	1	LS	$100,000	$100,000	
Intermediate Signals 2301/2304 (New)	1	LS	$800,000	$800,000	
Intermediate Signals 2281/2284 (New)	1	LS	$800,000	$800,000	
Intermediate Signals 2291/2293 (New)	1	LS	$875,000	$875,000	
Cassidy St Crossing Modifications	1	LS	$105,000	$105,000	
Tamarack Ave Crossing Modifications	1	LS	$96,000	$96,000	
PTC Modifications	1	LS	$500,000	$500,000	
TMDS Modifications	1	LS	$50,000	$50,000	
NCTD Flagging Support	200	Day	$1,200	$240,000	
NCTD Signal Support	200	Day	$1,200	$240,000	
				Signal Subtotal	**$9,266,500**
Architectural					
Platform Shelter	14	EA	$70,000	$980,000	
Platform Benches	14	LS	$3,900	$54,600	
Tubular Hand Rails	904	LF	$75	$67,800	
Signs	1	LS	$25,000	$25,000	
Restroom Building	1	LS	$300,000	$300,000	
Elevator	2	EA	$180,000	$360,000	
Platform Ammenities	1	LS	$50,000	$50,000	
				Architectural Subtotal	**$1,837,400**
Electrical					
Light Fixtures	1	LS	$160,000	$160,000	
Wiring and Conduit	1	LS	$100,000	$100,000	
Security Cameras and PA System	1	LS	$100,000	$100,000	
Temporary Platform Lighting	1	LS	$40,000	$40,000	
				Electrical Subtotal	**$400,000**

CARLSBAD VILLAGE DOUBLE TRACK

Short Trench Alternative Estimate Design Level: Preliminary

12/6/2016 Estimated By: Philip Brand

Item	Quantity	Unit	Unit Price	Amount	Subtotals
Base Construction Estimate (BCE)					**$110,940,249**
Other Construction Costs					
Contractor Mobilization (once)	7.5	%	BCE	$8,320,519	
Contractor Demobilization (once)	2.5	%	BCE	$2,773,506	
Contingency	30	%	BCE	$33,282,075	
				Other Construction Cost Subtotal	**$44,376,100**
Construction Cost Estimate (CCE)					**$155,316,349**

COST CHANGE WITH 24-FOOT VERTICAL CLEARANCE

Earthwork-Excavation	-29663	CY	$20	-$593,260	
Trench Structure	1	LS	-$4,930,000	-$4,930,000	
Contractor Mobilization (once)	7.5	%	BCE	-$414,245	
Contractor Demobilization (once)	2.5	%	BCE	-$138,081	
Contingency	30	%	BCE	-$1,656,978	
				Construction Cost Change	**-$7,732,564**
DESIGN					**-$1,353,199**
RIGHT-OF-WAY					**$0**
ANCILLARY CONSTRUCTION COSTS					**-$1,980,310**
OFFSITE ENVIRONMENTAL MITIGATION					**$0**
				Project Cost Change	**-$11,066,073**

TRENCH COST ESTIMATE:

Short Trench Option

2' from Top of Rail to Trench Floor

					Average										
	Beg Sta	End Sta	Beg H	End H	Wall H	Wall Length	Tot wall L	Tot Wall area	# of piles	Length of pile	Length of pile	Seal course	Seal course Vol	Slab Th	Slab Concrete
			(ft)	(ft)	(ft)	(ft)	(ft)	(sqft)	(Primary)	(Primary)	(Secondary)	(ft)	(cy)	(ft)	(cy)
Type I Wall	230245.2	230589.9	6	10	8	344.7	344.7	2757.6	0	0	0	0	0	0	0
Secant Wall (With GW)	230589.9	232150.8	10	28	19	1560.83	1560.83	29655.77	392	40	35	9	29656	2	6590
Secant Wall with Struts (Region 1)	232150.8	232735.5	28	32	30	584.76	1169.52	35085.6	148	60.5	50.5	12.5	15431	3	3703
Secant Wall with Struts (Region 2)	232735.5	233426.8	32	32	32	691.28	1382.56	44241.92	174	57.5	52.5	12.5	18242	3	4378
Secant Wall with Struts (Region 3)	233426.8	234128.1	32	28	30	701.3	1402.6	42078	177	55.5	50.5	12.5	18507	3	4442
Secant Wall (With GW)	234128.1	235328.8	28	10	19	1200.68	2401.36	45625.84	302	45	35	9	22813	2	5070
Type I Wall	235328.8	235699.8	10	6	8	371.06	742.12	5936.96	0	0	0	0	0	0	0

Wall Type	Wall Height to bottom of ballast (FT)	Total Wall Length (FT)	Wall Area (FT)	Estimate for Walls / SQFT	Slab Volume (CY)	Estimate for Invert Slab / CY	Seal Course Volume	Estimate for Seal Course / CY	Wall length with Struts (LF)	Estimate for Struts / FT of wall length	Estimated Trench Structure Cost
Type I	**10' max**	1086.82	8694.56	$65	0	$475	0	$150	0	$900	$570,000.00
Secant Pile (No Struts)	**10' to 28'**	3962.19	75281.61	$110	11660	$475	52469	$150	0	$900	$21,690,000.00
Secant Pile + Struts	**28' to 32'**	3954.68	121405.52	$110	12523	$475	52180	$150	1,977	$900	$28,910,000.00
TOTAL											**$51,170,000**

ATTACHMENT G:

LONG TRENCH ALTERNATIVE COST ESTIMATE

CARLSBAD VILLAGE DOUBLE TRACK

Long Trench Alternative Estimate Design Level: Preliminary

12/6/2016 Estimated By: Philip Brand

Item	Quantity	Unit	Unit Price	Amount	Subtotals
DESIGN					
Alternative Analysis and Environmental	3	%	CCE	$6,765,803	
Design-30% Package	3	%	CCE	$6,765,803	
Design-60% and Permits	3.6	%	CCE	$8,169,707	
Design-90%, Final, Bid Support	3.6	%	CCE	$8,169,707	
SANDAG Administration	3.7	%	CCE	$8,429,062	
NCTD Administration	0.6	%	CCE	$1,426,457	
				Design Subtotal	**$39,726,538**
RIGHT OF WAY					
Temporary R/W, Easements	1	LS	$80,000	$80,000	
Property Acquisition	1	LS	$7,350,000	$7,350,000	
R/W Contingency	35	%	R/W Costs	$2,600,500	
				Right of Way Subtotal	**$10,030,500**
CONSTRUCTION COST ESTIMATE					
				Construction Cost Estimate (CCE)	**$225,600,000**
ANCILLARY CONSTRUCTION COSTS					
Design Services During Construction	2.76	%	CCE	$6,224,538	
Construction Management and Testing	16.0	%	CCE	$36,084,281	
SANDAG Const. Admin.	1.7	%	CCE	$3,890,337	
NCTD Const. Admin.	0.35	%	CCE	$778,067	
NCTD Support	4.80	%	CCE	$10,825,284	
PTC Survey	1	LS	$400,000	$400,000	
Railroad Flagging Services	14000	Hours	$70	$980,000	
				Ancillary Construction Cost Subtotal	**$59,182,507**
OFF-SITE ENVIRONMENTAL MITIGATION					
Non-Coastal (Freshwater Marsh) Wetlands	3	Acre	$185,000	$555,000	
				Offsite Mitigation Cost Subtotal	**$555,000**
TOTAL PROJECT COST ESTIMATE					**$335,100,000**
COST ESCALATION					
Year of Expenditure	Annual %		Cumulative	Estimated	Escalation
2016	0.00%		0.00%	$335,100,000	$0
2017	2.80%		2.80%	$344,482,800	$9,382,800
2018	2.80%		5.60%	$354,128,318	$19,028,318
2019	2.80%		8.40%	$364,043,911	$28,943,911
2020	2.80%		11.20%	$374,237,141	$39,137,141
2021	2.80%		14.00%	$384,715,781	$49,615,781
2022	2.80%		16.80%	$395,487,823	$60,387,823
2023	2.80%		19.60%	$406,561,482	$71,461,482
			TOTAL EXPENDITURES IN 2016 DOLLARS	$335,100,000	
				TOTAL COST ESCALATION	$71,461,482
				PROJECT COST IN YEAR OF EXPENDITURE DOLLARS	**$406,600,000**

CARLSBAD VILLAGE DOUBLE TRACK

Long Trench Alternative Estimate Design Level: Preliminary

12/6/2016 Estimated By: Philip Brand

Item	Quantity	Unit	Unit Price	Amount	Subtotals
Construction Cost Estimate Based on Preliminary Design					
Trackwork					
Track-136lb CWR, Ties, & Ballast	23223	TF	$285	$6,618,555	
Track-115lb CWR, Ties, & Ballast	300	TF	$285	$85,500	
Subballast	12,607	CY	$64	$806,848	
Track Removal	16752	TF	$40	$670,080	
Track Realignment/Shifting	4630	TF	$70	$324,100	
Temporary Turnout Relocation	1	EA	$200,000	$200,000	
Temporary No 24 Turnout	2	EA	$700,000	$1,400,000	
Turnout Removal	2	EA	$40,000	$80,000	
Temporary Shoofly Track	8600	TF	$285	$2,451,000	
Install Insulated Joints	8	PAIR	$10,000	$80,000	
				Trackwork Subtotal	**$12,716,083**
Site Civil					
Clear and Grub	760432	SF	$1	$760,432	
Earthwork-Embankment	28401	CY	$35	$994,035	
Earthwork-Excavation	628526	CY	$20	$12,570,520	
Temporary Embankment/Removal	4000	CY	$55	$220,000	
Temporary Shoring	6600	SF	$30	$198,000	
Dewatering	1	LS	$1,800,000	$1,800,000	
At-grade Xing New Panel	356	LF	$2,400	$854,400	
Temporary Fencing and Controls	1	LS	$30,000	$30,000	
Temporary Platform	8700	SF	$8	$69,600	
Inter-track Fence	1230	LF	$50	$61,500	
Platform/Parking/Street Demolition	32000	SF	$2	$64,000	
Station Building Demolition	1	LS	$10,000	$10,000	
Relocate Historic Train Depot	1	LS	$100,000	$100,000	
Construct Station Platform	28050	SF	$8	$224,400	
Construct AC Pavement	139062.6	SF	$4	$559,032	
Aggregate Base	139062.6	SF	$2	$255,875.22	
Construct PCC Pavement	3400	SF	$20	$68,000	
Construct Sidewalk	26775	SF	$6	$147,263	
Construct Curb and Gutter	2172	LF	$23	$49,956	
Construct Median Curb and Gutter	1107	LF	$23	$25,461	
Truncated Domes	5620	SF	$30	$168,600	
Mini-High Platform	2	EA	$25,000	$50,000	
Construct Type A SD Cleanout	1	EA	$4,500	$4,500	
Construct Type B Curb Inlet	2	EA	$5,500	$11,000	
Fencing	15718	LF	$22	$345,796	
Storm Drain Pump Station	2	EA	$1,000,000	$2,000,000	
Install 12" PVC Storm Drain	213	LF	$72	$15,300	
Install 18" PVC Storm Drain	19	LF	$239	$4,532	
Construct Headwall (D-35A)	2	EA	$7,700	$15,400	
Install 30" RCP Storm Drain	1830	LF	$129	$235,393	
Install 36" RCP Storm Drain	1274	LF	$150	$190,820	
Remove 84" RCP SD	3453	LF	$120	$414,360	
Construct Type B SD Cleanout	30	EA	$8,000	$240,000	
84" RCP Storm Drain	3451	LF	$640	$2,208,640	

CARLSBAD VILLAGE DOUBLE TRACK

Long Trench Alternative Estimate Design Level: Preliminary

12/6/2016 Estimated By: Philip Brand

Item	Quantity	Unit	Unit Price	Amount	Subtotals
Remove Storm Drain	595	LF	$62	$36,944	
Remove Sewer Pipe	841	LF	$46	$39,090	
Concrete Channel	3595	LF	$260	$934,700	
Drainage DItch	12966	LF	$27	$346,192	
Install 24-inch RCP	95	LF	$115	$10,925	
Install 30-inch RCP	830	LF	$135	$112,050	
Construct Headwall	3	EA	$5,400	$16,200	
Rip-Rap	300	CY	$170	$51,000	
Landscape and Irrigation	1	LS	$75,000	$75,000	
Traffic Control	1	LS	$300,000	$300,000	
				Civil Subtotal	**$26,888,915**
Structures					
Buena Vista Lagoon Bridge	9899	SF	$285	$2,821,215	
Remove Existing Buena Vista Lagoon Bridge	1	LS	$1,200,000	$1,200,000	
Carlsbad Blvd Overpass	10200	SF	$250	$2,550,000	
Remove Existing Carlsbad Blvd Overpass	1	LS	$750,000	$750,000	
Beech Ave Pedestrian Overpass	660	SF	$200	$132,000	
Grand Ave Overpass	4620	SF	$225	$1,039,500	
Carlsbad Village Dr. Overpass	4620	SF	$225	$1,039,500	
Oak Ave Overpass	2530	SF	$200	$506,000	
Chestnut Ave Overpass	3080	SF	$200	$616,000	
Tamarack Ave Overpass	3300	SF	$225	$742,500	
Stairway Retaining Walls	1000	CY	$650	$650,000	
Construct Concrete Steps	101	CY	$800	$80,800	
Trench Structure	1	LS	$93,700,000	$93,700,000	
				Structures Subtotal	**$105,827,515**
Utility Relocation					
UG Fiber Optic in HDPE Conduit	9565	LF	$50	$478,250	
12-inch HP Gas	1	LF	$125,000	$125,000	
10-inch VCP Sewer	1	LF	$46,500	$46,500	
Street Light and Pull Box	2	EA	$3,000	$6,000	
1-inch Irrigation Service	1	EA	$2,400	$2,400	
Relocate 10-inch water	240	LF	$180	$43,200	
Relocate 1-inch gas	160	LF	$100	$16,000	
Relocate Gas - through bridge	400	LF	$300	$120,000	
Relcoate Water-through bridge	560	LF	$180	$100,800	
Relocate Telecom-through bridge	280	LF	$300	$84,000	
Remove 48" RCP Sewer	3552	LF	$41	$146,200	
Remove Manhole	7	EA	$1,390	$9,727	

CARLSBAD VILLAGE DOUBLE TRACK

Long Trench Alternative Estimate Design Level: Preliminary

12/6/2016 Estimated By: Philip Brand

Item	Quantity	Unit	Unit Price	Amount	Subtotals
Construct Special Case 10ft Manhole @ 48"	3	EA	$14,000	$42,000	
Sewer Manhole (3'x5')	18	EA	$5,500	$99,000	
48" RCP Sewer Main	5314	LF	$210	$1,115,940	
Remove Sewer Pipe	841	LF	$46	$39,090	
Install 6-inch PVC Sewer Main	152	LF	$92	$13,922	
Install 8-inch PVC Sewer Main	755	LF	$108	$81,261	
Install 10-inch PVC Sewer Main	3542	LF	$119	$421,888	
Relocate UG Fiber Optic	9769	LF	$50	$488,450	
Relocate UG Telecom	466	LF	$50	$23,300	
Relocate UG Electric	120	LF	$200	$24,000	
				Utility Relocation Subtotal	**$3,526,927**
Environmental					
SWPPP (Temp Erosion Control)	1	LS	$200,000	$200,000	
Permenant Erosion Control	75000	SF	$1	$75,000	
Onsite Coastal Wetlands	0.6	Acre	$145,000	$87,000	
Onsite Non-Coastal (Southern Willow Scrub)	0.4	Acre	$145,000	$58,000	
Onsite Non-Coastal (Freshwater Marsh)	0.3	Acre	$145,000	$43,500	
Onsite Sensative Uplands	0.2	Acre	$145,000	$29,000	
Monitors - Environmental/Biological	1400	Hours	$150	$210,000	
Monitors - Paleo/Archeology	1840	Hours	$150	$276,000	
				Environmental Mitigation Subtotal	**$978,500**
Signal					
CP Carl Removal	1	LS	$130,000	$130,000	
CP Longboard Removal	1	LS	$130,500	$130,500	
Temporary Relocation of CP Longboard	1	LS	$550,000	$550,000	
Installation of New Single Crossover Control Point North	1	LS	$1,400,000	$1,400,000	
Installation of New Single Crossover Control Point South	1	LS	$1,400,000	$1,400,000	
Carlsbad Village Ped Crossing Removal	1	LS	$45,000	$45,000	
Grand Ave Crossing Removal	1	LS	$52,500	$52,500	
Carlsbad Village Dr Crossing Removal	1	LS	$52,500	$52,500	
Tamarack Ave Crossing Removal	1	LS	$52,500	$52,500	
Grand Ave Temporary Gate Relocation (WB Gates)	1	LS	$500,000	$500,000	
Carlsbad Village Dr Temporary Gate Relocation (WB Gates)	1	LS	$500,000	$500,000	
Tamarack Ave Temporary Gate Relocation (WB Gates)	1	LS	$500,000	$500,000	
Grand Ave Gate Removal	1	LS	$100,000	$100,000	
Carlsbad Village Dr Gate Removal	1	LS	$100,000	$100,000	
Tamarack Ave Gate Removal	1	LS	$100,000	$100,000	
Intermediate Signals 2301/2304 (New)	1	LS	$800,000	$800,000	
Intermediate Signals 2281/2284 (New)	1	LS	$800,000	$800,000	
Intermediate Signals 2291/2293 (New)	1	LS	$875,000	$875,000	
Cassidy St Crossing Modifications	1	LS	$105,000	$105,000	
PTC Modifications	1	LS	$500,000	$500,000	
TMDS Modifications	1	LS	$50,000	$50,000	
NCTD Flagging Support	200	Day	$1,200	$240,000	
NCTD Signal Support	200	Day	$1,200	$240,000	
				Signal Subtotal	**$9,223,000**

CARLSBAD VILLAGE DOUBLE TRACK

Long Trench Alternative Estimate Design Level: Preliminary

12/6/2016 Estimated By: Philip Brand

Item	Quantity	Unit	Unit Price	Amount	Subtotals
Architectural					
Platform Shelter	12	EA	$70,000	$840,000	
Platform Benches	12	EA	$3,900	$46,800	
Tubular Hand Rails	904	LF	$75	$67,800	
Signs	1	LS	$25,000	$25,000	
Construct New Restroom Building	1	LS	$300,000	$300,000	
Elevator	2	EA	$100,000	$200,000	
Platform Ammenities	1	LS	$50,000	$50,000	
				Architectural Subtotal	**$1,529,600**
Electrical					
Light Fixtures	1	LS	$160,000	$160,000	
Wiring and Conduit	1	LS	$100,000	$100,000	
Security Cameras and PA System	1	LS	$100,000	$100,000	
Temporary Platform Lighting	1	LS	$40,000	$40,000	
				Electrical Subtotal	**$400,000**
Base Construction Estimate (BCE)					**$161,090,539**
Other Construction Costs					
Contractor Mobilization (once)	7.5	%	BCE	$12,081,790	
Contractor Demobilization (once)	2.5	%	BCE	$4,027,263	
Contingency	30	%	BCE	$48,327,162	
				Other Construction Cost Subtotal	**$64,436,216**
Construction Cost Estimate (CCE)					**$225,526,755**

COST CHANGE WITH 24-FOOT VERTICAL CLEARANCE

Earthwork-Excavation	-48195	CY	$20	-$963,900	
Trench Structure	1	LS	-$9,300,000	-$9,300,000	
Contractor Mobilization (once)	7.5	%	BCE	-$769,792	
Contractor Demobilization (once)	2.5	%	BCE	-$256,597	
Contingency	30	%	BCE	-$3,079,170	
				Construction Cost Change	**-$14,369,460**
DESIGN					**-$2,531,180**
RIGHT-OF-WAY					**$0**
ANCILLARY CONSTRUCTION COSTS					**-$3,682,892**
OFFSITE ENVIRONMENTAL MITIGATION					**$0**
				Project Cost Change	**-$20,583,532**

TRENCH COST ESTIMATE:

Long Trench Option

2' from Top of Rail to Trench Floor

					Average										
	Beg Sta	End Sta	Beg H	End H	Wall H	Wall Length	Tot wall L	Tot Wall area	# of piles	Length of pile	Length of pile	Seal course	Seal course Vol	Slab Th	Slab Concrete
			(ft)	(ft)	(ft)	(ft)	(ft)	(sqft)	(Primary)	(Primary)	(Secondary)	(ft)	(cy)	(ft)	(cy)
Type I Wall	227900	228265.3	6	10	8	365.26	730.52	5844.16	0	0	0	0	0	0	0
Secant Wall (With GW)	228265.3	229075	10	28	19	809.74	1619.48	30770.12	204	40	35	9	15385	2	3419
Secant Wall with Struts (Region 1)	229075	229849.9	28	32	30	774.93	1549.86	46495.8	195	55.5	50.5	12.5	20450	3	4908
Secant Wall with Struts (Region 2)	229849.9	233466.4	32	32	32	3616.49	7232.98	231455.36	906	57.5	52.5	12.5	95435	3	22904
Secant Wall with Struts (Region 3)	233466.4	234128.3	32	28	30	661.84	1323.68	39710.4	167	55.5	50.5	12.5	17465	3	4192
Secant Wall (With GW)	234128.3	235328.9	28	10	19	1200.68	2401.36	45625.84	302	40	35	9	22813	2	5070
Type I wall	235328.9	235700	10	6	8	371.06	742.12	5936.96	0	0	0	0	0	0	0

Wall Type	Wall Height to bottom of ballast (FT)	Total Wall Length (FT)	Wall Area (FT)	Estimate for Walls / SQFT	Slab Volume (CY)	Estimate for Invert Slab / CY	Seal Course Volume	Estimate for Seal Course / CY	Wall length with Struts (LF)	Estimate for Struts / FT of wall length	Estimated Trench Structure Cost
Type I	10' max	1472.64	11781.12	$65	0	$475	0	$150	$0	$900	$800,000.00
Secant Pile (No Struts)	10' to 28'	4020.84	76395.96	$110	8488	$475	38198	$150	$0	$900	$18,200,000.00
Secant Pile + Struts	28' to 32'	10106.52	317661.56	$110	32004	$475	133350	$150	5,053	$900	$74,700,000.00
TOTAL											**$93,700,000**

ATTACHMENT H:

PRELIMINARY GEOTECHNICAL DESIGN REPORT

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

TECHNICAL MEMORANDUM

DATE: May 23, 2016 **EMI PROJECT NO:** 12-146

PREPARED FOR: Jay Holombo / T.Y. Lin International (TYLin)
Kumar Ghosh / TYlin
Phillip Brand / TYLin

PREPARED BY: Michael Hoshiyama and Eric Brown / Earth Mechanics, Inc. (EMI)

SUBJECT: **Preliminary Geotechnical Design Report**
Carlsbad Village Double Track – Trench Alternative
Carlsbad, California

1.0 Introduction

This technical memorandum has been prepared to provide geotechnical information to assist the designers in evaluating the feasibility of trench alternatives for the LOSSAN Double Track Project through the City of Carlsbad. It is our understanding that SANDAG is considering two track profiles between Buena Vista Lagoon and Agua Hedionda Lagoon that would lower the rail corridor below grade to eliminate at-grade rail and traffic intersections. The recommendations provided in this memorandum are for the Advanced Planning Study only and should be considered preliminary. Final design recommendations will be provided during the PS&E phase of the project if either of the trench alternatives is selected as the preferred alternative.

2.0 Project Location and Description

The Carlsbad Village Double Track is a small part of SANDAG's overall project to provide two rail lines along the LOSSAN corridor between the San Diego/Orange County border and Old Town San Diego. The Carlsbad Village Double Track project limits extend from Vista Avenue to the northern end of the Agua Hedionda Lagoon. The two alternatives under consideration consist of an approximately 25 to 30 ft deep trench that extends between the Carlsbad Boulevard Overpass and Tamarack Drive for the shorter trench option and between the Carlsbad Boulevard Overpass and the northern end of the Agua Hedionda Lagoon for the longer trench option. The project area and approximate limits of the trenches for both options are shown in the Project Location Map (Figure 1). Design exhibits for the two alternatives are included in Attachment 1.

The shorter trench option is approximately 6000 ft in length while the longer trench option is approximately 8400 ft in length. The shorter trench would include six (6) new overpass structures; Carlsbad Boulevard, Beech Avenue (Pedestrian), Grand Avenue, Carlsbad Village Drive, Oak Drive and Chestnut Avenue (Pedestrian). The longer trench option would include the six (6) overpass structures included on the short trench option but the overpass at Chestnut Avenue would be a vehicle overpass as opposed to pedestrian crossing. There would also be a seventh (7^{th}) overpass at Tamarack Drive.

3.0 Site Geology

The project area is within the western portion of the Peninsular Ranges physiographic province, which comprises ranges and valleys extending southeasterly from the Los Angeles-San Bernardino region to the Baja Peninsula in Mexico, between the San Andreas fault on the east and the Pacific Ocean. According to the County of San Diego, the project site is also located within the Coastal Plains Physiographic Province. The Coastal Plain region, ranging from approximately 1 to 12 miles wide, is bounded by the Pacific Ocean to the west, and the Peninsular Ranges to the east. It is characterized by broad, planar mesas gently sloping to the west, incised by deep canyons. The Peninsular Ranges are a group of northwest-southeast trending mountains and valleys between the San Andreas fault on the east and the offshore area called the Continental Borderland. Bedrock in the Peninsular Ranges is predominantly composed of Mesozoic-age granitics. The region surrounding San Diego, including the offshore Continental Borderland area, is transected by a series of long, mostly northwest-trending, strike-slip fault systems. The site is within a series of relatively flat terraces immediately inland from the beach.

The coastal terraces are dissected by westerly flowing streams, most of which are under tidal influences near the coast forming broad tidal flats and estuaries.

The site is underlain by a shallow section of young to old alluvial paralic deposits which consist of gray medium dense to dense sands intertongued with dark gray, soft to stiff silts and clays. The marine and continental paralic deposits are associated estuarine/lagoonal, alluvial, and littoral depositional environments.

The old paralic deposits are underlain by the Santiago Formation which consists of poorly indurated, grey to brownish grey, silty fine grained sandstone. The Santiago Formation also consists of interbeds and lenses of siltstone and claystone.

4.0 Available Subsurface Information

EMI Borings: In January, 2013 EMI performed one boring for the Buena Vista Lagoon bridge replacement and two borings for a pedestrian undercrossing at the Carlsbad Village Station proposed as part of a different alternative. In October and November of 2013, EMI performed two additional borings for the Buena Vista Lagoon bridge replacement. Log-Of-Test-Borings (LOTB's) for both of the bridges provided for that alternative are included in Attachment 2.

Nearby Borings: In addition to the borings performed by EMI, borings performed for the Carlsbad Boulevard OH seismic retrofit and boring logs from the State Water Resources Control Board "GeoTracker" website (http://geotracker.waterboards.ca.gov) for two service stations in the vicinity of the proposed trench alignment were reviewed.

The GeoTracker website provides environmental data for state regulated facilities in California which often contain geotechnical boring logs as part of monitoring well installations. The first service station where soil information is available is located at the intersection of Harding Street and Carlsbad Village Drive and the second service station is located at the intersection of Tamarack Avenue and Jefferson Street.

The LOTB for the Carlsbad Boulevard OH bridge retrofit and boring logs from the two service stations are included in Attachment 2.

Groundwater Investigation by Southern California Soil Testing (SCST): SCST conducted a field investigation for the City of Carlsbad consisting of eight (8) hollow-stem auger borings and one groundwater monitoring well to evaluate the soil and groundwater conditions along the proposed trench alignment. The borings were drilled to depths between 15 and 45 feet below existing grade; generally 10 feet below the proposed trench invert elevation at each location. A copy of the memorandum prepared by SCST summarizing the investigation and groundwater measurements is included in Attachment 3.

Regional Geology Map: A regional geology map of the area was also reviewed to evaluate the different geologic units that will be traversed by the proposed alignments. The regional geology map is included as Figure 2.

5.0 Subsurface Soil Conditions and Groundwater

The three borings performed by EMI for the Buena Vista Lagoon bridge were performed outside the limits of both proposed trench options and encountered soil conditions materially different than all of the other borings that were reviewed. The borings were excavated through the fill carrying the railroad as it passes through the lagoon. Below the fill the borings encountered lagoon marine deposits consisting of predominately sandy soils interrupted with occasional silt and clay layers. This material extended more than 120 ft below grade and no formation was encountered.

All of the other borings that were reviewed were located outside of the footprint of the Buena Vista Lagoon and encountered a combination of fill and terrace deposits overlying Santiago Formation. The fill is generally shallow and extends less than 10 feet below the ground surface. Thickness of the terrace deposits vary along the alignment extending more than 30 ft below grade in most locations. The terrace deposits consist of medium dense to dense sand, clayey sand and sandy clay. The Santiago Formation that lies below the fill and terrace deposits consists of clayey sandstone interbedded with layers of siltstone and claystone. The regional geologic map of the area indicates that the Santiago Formation is the predominant geologic feature along the alignment and no other formations are anticipated to be encountered.

The proposed trenches are anticipated to be excavated primarily through the fill and shallow terrace deposits and potentially encountering Santiago Formation. The soil types expected to be encountered during trench excavation will be predominately medium dense to dense clayey sand and soft sandstone with occasional claystone and siltstone interlayering. Penetration testing in the terrace deposits and Santiago Formation result in high blowcounts; however, they are easily excavated with a hollow-stem auger drilling equipment and exhibit soil-like behavior during sampling and do not require rock coring.

Groundwater: Groundwater was encountered as high as elevation +15 ft MSL (about 20 ft below grade) in the EMI borings at the Carlsbad Village Station and is indicated as being encountered at about the same elevation in one boring for the Carlsbad Boulevard OH. Groundwater is indicated as being encountered at about elevation +50 ft (15 ft below grade) in borings performed at the gas station along Carlsbad Village drive and at about elevation +44 ft (about 18 ft below grade) in the borings performed near Tamarack Avenue.

Groundwater was encountered in six (6) of the nine (9) investigations performed by SCST in April, 2016 as high as elevation +28 ft MSL (13 feet below ground surface). The groundwater

measurements from the SCST investigation are included in their investigation memorandum included in Attachment 2. A table summarizing the results of the groundwater investigation as it appears in the SCST memorandum is reproduced below.

Table 1. Groundwater Observation Results

Boring ID	Location	Existing Elevation Above MSL (ft)	Boring Depth (ft)	Depth to Groundwater (ft)	Depth to Proposed Railroad Trench Bottom (ft)
B-1	Date Ave	38	25	NE	14
B-2	Juniper Ave	44	45	15.5	34
B-3	Acacia Ave	44	40	21.5	32
B-4	Pine Ave/Washington St	44	40	19.5	32
B-5	Beech Ave	36	30	19	19
B-6	Alley West of State St	27	15	NE	6
B-7	Oak Ave	41	40	13	29
B-8	Tamarack Ave	44	45	18	33
B-9	Long Pl	38	30	NE	20

Notes:
(1) Location of Monitoring Well
(2) NE = Not Encountered

Based on the proximity of the site to the Pacific Ocean and the groundwater elevations encountered in the above described borings, shallow groundwater is anticipated along the trench alignment. Natural grade does not vary significantly within the project limits and it is anticipated that groundwater will be generally between 10 and 20 feet below natural grade.

Groundwater should be continually monitored if either trench alternative is selected. Seasonal variations, variations in groundwater levels along the length of the trench should be monitored as well as potential underground flow that might affect design and construction of the trench.

6.0 Seismic Evaluation

The site is in seismically active southern California and is subject to shaking from both local and distant earthquakes. Large events on the nearby Newport Inglewood – Rose Canyon fault zone control seismic design of the project.

Faults

Table 2 lists the nearest active faults, fault type and their maximum earthquake magnitude according to the Caltrans Fault Database (Merriam, 2012). The site to fault distances were determined using the Caltrans ARS Online web tool V2.2.06 (Caltrans, 2013) from the Carlsbad Village Station.

Table 2. Fault Data

Fault	Fault Type (1)	Maximum Earthquake Magnitude	Distance from Site to Fault (miles)	Surface Fault/Blind Fault
Rose Canyon fault zone (Oceanside section)	RLSS	6.8	4.6	Surface
Newport Inglewood (Offshore)	RLSS	6.9	5.5	Surface
Rose Canyon fault zone (Del Mar section)	RLSS	6.8	8.9	Surface

Note:
(1) RLSS = Right Lateral Strike Slip.

Ground Rupture

No major faults are known to extend through the site area so the potential for surface rupture is considered low. No Alquist-Priolo Earthquake Fault Zones have been designated by the California Division of Mines and Geology in the project area.

Seismic Design Criteria

It is our understanding that seismic design of the trench walls and the overpass structures will be based on the American Railway Engineering and Maintenance-of-way Association (AREMA) Manual (AREMA, 2013).

Utilizing AREMA methodology, three levels of seismic risk are considered in design. Per the 2013 Manual for Railway Engineering (AREMA, 2013), the conservative return periods of the design seismic event correspond to the 100 year, the 500 year, and the 2,400 year seismic events. These events correspond to the bridge performance criteria for the Serviceability, Ultimate, and Survivability Limit States, respectively (AREMA, 2013).

The Base Acceleration Coefficients (A_R) were estimated based on data from the 2008 United States Geological Survey (USGS, 2008) National Seismic Hazard Map, for the 100 year, 500 year, and 2400 year return period earthquakes. The Site Coefficient (S) was estimated based on the soil conditions of the project site and AREMA manual. The ARS curve design parameters are presented in Table 3.

Table 3. Geotechnical Input for AREMA (2013) ARS Curve

Average Return Period (Yrs.)	Performance Criteria Limit State	Base Acceleration Coefficient (A_R)	Site Coefficient (S)
100	Serviceability	0.132	1.0
500	Ultimate	0.259	
2400	Survivability	0.483	

7.0 Liquefaction Evaluation

Liquefaction Potential. Based on the site-specific geotechnical investigation and other available geotechnical information, site soils are anticipated to be coarse grained and very dense. Due to the very dense nature of the coarse grained site soils, the liquefaction potential of site soils along the proposed trench alignments is considered low.

Seismically-Induced Settlement: Seismically-induced settlement of dry and partially saturated soils due to strong shaking is expected to be negligible due to the predominately very dense nature of the on-site soils; therefore, seismically induced settlement is not expected to impact the proposed retaining walls and overpass foundations.

8.0 Seismic Slope Instability

All of the trench walls need to be designed to meet AREMA (2013) standards and will be subject to additional lateral seismic earth loading during the design earthquakes. However; since liquefaction is not expected to be an issue for the native deposits, site soils are not expected to experience a loss of strength and impose unmanageable earth pressures on the retaining walls during the design seismic events.

9.0 Groundwater Control

Groundwater measurements indicate groundwater is likely to be encountered during excavation for trenches and overpass structures. Groundwater will need to be controlled during construction of retaining walls, retaining wall footings, overpass foundations and the trench base slab. Trench walls and bridge abutment walls will have to be designed to resist hydrostatic pressures. Any seepage or groundwater removed from a temporary excavation or the completed structure will need to be tested and disposed of in compliance with all applicable local, state and federal requirements.

Waterproofing of the permanent concrete structure can be placed on the exterior side (positive), interior side (negative) or from with the concrete itself (integral systems). In anticipation that the most economic structure will incorporate the shoring system with the permanent structure, positive waterproofing methods are not anticipated. While both negative and integral waterproofing systems are feasible and can be used to severely restrict water flow, some groundwater seepage should be anticipated. Drains and pumps necessary to control surface drainage and stormwater should anticipate the high likelihood of groundwater seepage into the trench.

10.0 Corrosion Evaluation

Samples recovered during the EMI investigation near the Carlsbad Village Station that are anticipated to be representative of soils throughout the project area were tested to determine corrosivity including minimum resistivity, pH, soluble sulfate content, and soluble chloride content. Two soil samples were tested for corrosivity using the procedures described in California Test Methods 417, 422, 532, and 643. The minimum resistivity ranged from 990 to 1,900 ohm-cm. The pH ranged from 8.1 to 9.0. The soluble sulfate ranged from 160 to 300 parts per million (ppm), and the soluble chloride ranged from 144 to 160 ppm. The soil corrosivity test results are summarized in Table 4.

According to Caltrans criteria (Corrosion Guidelines V2.0, 2012), soils are considered corrosive if the pH is 5.5 or less, or sulfate concentration is 2,000 ppm or greater, or chloride concentration is 500 ppm or greater. Based on these test results and Caltrans criteria, the on-site soils are classified to be non-corrosive. However, considering the proximity of the site to the ocean and the exposure of structural elements to salty air, corrosion protection measures should be incorporated into the structural design.

Table 4. Soil Corrosion Test Results

Boring No.	Sample No.	Sample Depth (ft)	Soil Type	Minimum Resistivity (ohm-cm)	pH	Sulfate Content (ppm)	Chloride Content (ppm)
A-13-03	S-3	15	Silty Sand (SM)	1,900	8.1	160	160
A-13-04	S-2	10	Fat Clay (CH)	990	9.0	300	144

11.0 Retaining Wall and Overhead Structure Foundation Recommendations

For sidewall support of the trench and at the bridge abutments, both bottom-up and top-down construction methodologies are geotechnically feasible. The most challenging geotechnical issue will be constructing cut retaining walls below shallow groundwater.

For a conventional bottom-up construction method, it is anticipated that there is insufficient right-of-way to lay back the excavations so some form of shoring will be required. Site soils are not conducive to driven sheet piling due to the shallow Santiago Formation. Soil nail walls are not suited for construction below the groundwater table; however, soil nail walls are feasible at the ends of the trench where the excavation does not extend below groundwater. Soil nail walls can also be used as part of a combination wall where the soil nail wall comprises the upper portion of the wall where the nail excavation daylights above groundwater. The lower portion of the wall is then constructed at the toe of the soil nail wall and is a wall type capable of accommodating the groundwater. It is our understanding that a combination soil nail/secant pile wall was recently used for trench excavation on a design-build project in Reno, Nevada.

Drilled soldier pile walls with lagging are feasible; however, lagging installation below the groundwater will not be water-tight so the excavation will need to be continually pumped. Cut heights are expected to exceed the practical limits for cantilever soldier piles so either ground anchors (tie-backs), internal struts or bracing will be required to resist lateral earth loading.

For top-down construction, site soils are expected to be conducive to both secant pile wall and slurry wall construction. Both secant pile wall and slurry walls are effective methods to seal off water which would eliminate or reduce the expense of pumping and disposal of groundwater from the excavation during construction.

Secant pile walls are generally more common in the western United States; however, recently slurry walls have started to be used more frequently on the west coast. Slurry walls require a substantial quantity of work to offset the mobilization cost of the equipment which is much larger than conventional CIDH pile construction equipment and usually has to be transported from the east coast. Slurry walls are generally better suited for deeper excavations where it becomes difficult to maintain the vertical alignment of individual CIDH piles. Based on conversations with local contractors, it is our understanding that secant pile walls are expected to be more economical than slurry walls for the anticipated excavation depths anticipated for the subject project.

Traditional secant pile walls are constructed with alternating primary (unreinforced) and secondary (reinforced) piles excavated using conventional CIDH pile construction methods. In the presence of shallow groundwater, the drilled shafts need to be stabilized with either

temporary casing or drilling slurry in order to allow installation of the vertical reinforcement (structural steel section or reinforcing cage) and the structural concrete.

Recently, ground improvement techniques have been incorporated into secant pile wall design and construction to eliminate the time and expense of shaft stabilization (casing and/or slurry). Jet grouting, Cutter Soil Mixing (CSM), and Cement Deep Soil Mixing (CDSM) are examples of methods that have been used to inject and mix cementous grout with native soils to create a soil-grout column of sufficient strength to be used for temporary lateral earth support. The vertical reinforcing in the secondary piles is stabbed into the soil-grout column while the mixture is still wet. Due to the high relative density of the Santiago Formation, site soils are anticipated to be more conducive to CSM and CDSM than jet grouting. Pre-drilling the soil column with a flighted auger can also be used in advance of ground improvement techniques to facilitate grout injection and soil mixing.

Similar to soldier pile walls, the excavation heights are expected to exceed the practical limits for cantilever slurry or secant pile walls so ground anchors or internal bracing will be required. Along the majority of the trench, the secant piles/slurry wall would only need to extend far enough below the trench slab to resist the temporary lateral earth loads until the bottom slab is poured. Once the bottom slab is poured, it can then function as a lower strut to resist the permanent lateral earth loads.

At the bridge overpasses, the abutments will be supported on CIDH piles that will provide lateral support for the trench and also carry the axial superstructure loads. The CIDH piles at these locations will need to extend deeper below the trench slab to develop the necessary axial capacity from side friction to support the structural loads. For cost estimating purposes, an average unit skin friction of 1.5 ksf along the embedded portion of the CIDH pile below the trench invert can be used to estimate preliminary pile lengths.

A seal course will need to be poured at the base of the trench to seal off water and facilitate bottom slab and finished trench wall construction. A conventional seal course can be poured under water; however, the depth of the seal course can become substantial due to the thickness required to resist buoyancy. Recently, ground improvement techniques such as jet grouting in combination with vertical ground anchors have been used in lieu of a tremie slab for the temporary seal course. After installation of the CIDH pile walls and prior to performing the mass excavation for the trench, closely spaced jet grout columns on the order of 5-10 ft in height are installed from natural grade at an elevation just below the proposed trench invert. Tie-down ground anchors are then installed through the improved zone to resist buoyant forces against the bottom of the jet grout slab. The mass excavation then proceeds with the tied down jet grout slab functioning as the seal course cutting of seepage as the excavation proceeds below groundwater.

For cost estimating purposes, jet grout columns are typically installed in a triangular grid with approximately 4-6 ft on-center spacing. A bond stress of 7.5 kips per ft of bonded length below the jet grout seal course can be used to estimate the length of 6-inch diameter, gravity grouted vertical tie-down ground anchors.

12.0 Construction Considerations

CIDH Pile Construction. Groundwater will be encountered during drilling; therefore the contractor will need to use a “wet” method of construction for secant pile walls with conventional

CIDH pile construction methods. Segmental casing would be the preferred method of shaft stabilization as it allows greater control of the vertical alignment of the pile. Site soils are expected to be easily excavated with conventional equipment for CIDH piles and slurry walls. Ground anchors (vertical or sub-horizontal), if used, will need to be cased due to the presence of shallow groundwater. Due to the high relative density of the Santiago Formation, pre-drilling is anticipated to be necessary in advance of ground improvement techniques to facilitate grout injection and soil mixing. Site soils are not anticipated to present a rippability problem and can be excavated using conventional earthmoving equipment.

13.0 References

American Association of State Highway and Transportation Officials (AASHTO), 2011, AASHTO LRFD Bridge Design Specifications, Fifth Edition., Washington, DC.

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Kennedy, M.P., and Tan, S.S., 2007, Geologic map of the Oceanside 30'x 60' quadrangle, California: A digital database, http://conservation.ca.gov/cgs/rghm/rgm/Pages/preliminary_geologic_maps.aspx: California Geological Survey, Regional Geologic Map No. 2, scale 1:100,000.

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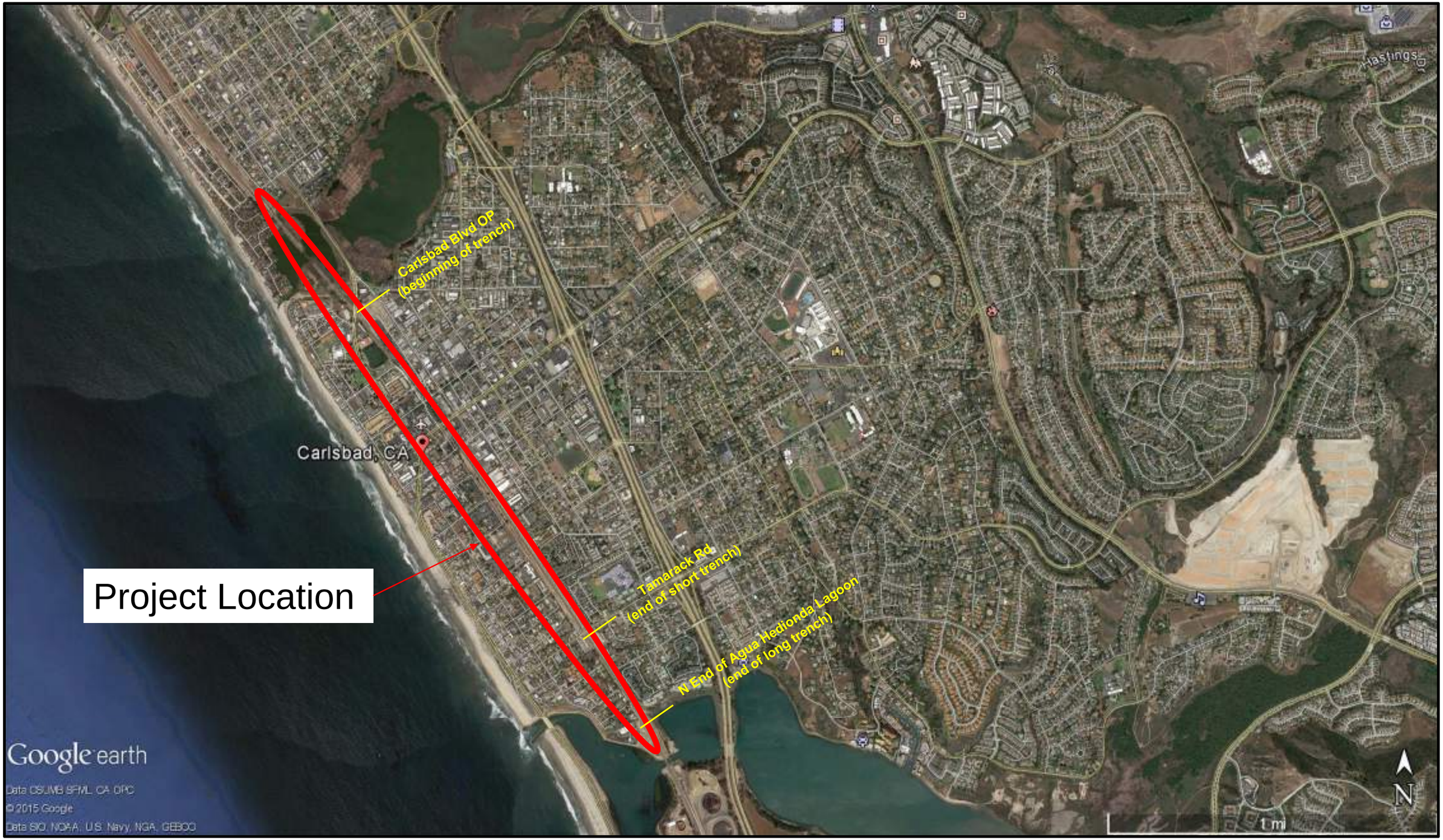
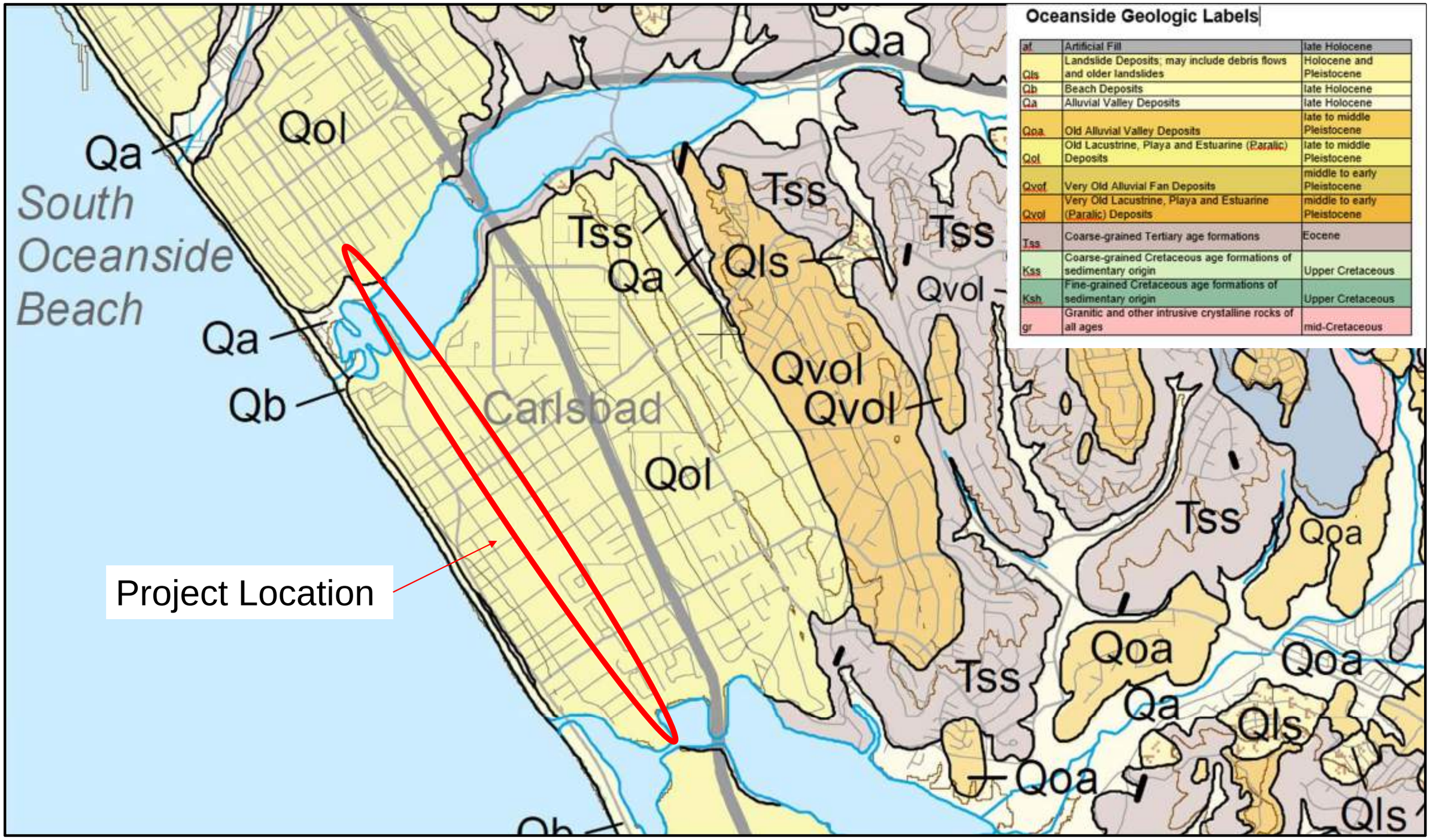


Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	**CARLSBAD VILLAGE DRIVE DOUBLE TRACK – TRENCH ALTERNATIVE**	**PROJECT LOCATION MAP**
	Project No. 12-146 / Date: 5-23-2016	Figure 1



Oceanside Geologic Labels

af	Artificial Fill	late Holocene
Qls	Landslide Deposits; may include debris flows and older landslides	Holocene and Pleistocene
Qb	Beach Deposits	late Holocene
Qa	Alluvial Valley Deposits	late Holocene
Qoa	Old Alluvial Valley Deposits	late to middle Pleistocene
Qol	Old Lacustrine, Playa and Estuarine (Paralic) Deposits	late to middle Pleistocene
Qvof	Very Old Alluvial Fan Deposits	middle to early Pleistocene
Qvol	Very Old Lacustrine, Playa and Estuarine (Paralic) Deposits	middle to early Pleistocene
Tss	Coarse-grained Tertiary age formations	Eocene
Kss	Coarse-grained Cretaceous age formations of sedimentary origin	Upper Cretaceous
Ksh	Fine-grained Cretaceous age formations of sedimentary origin	Upper Cretaceous
gr	Granitic and other intrusive crystalline rocks of all ages	mid-Cretaceous

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

CARLSBAD VILLAGE DRIVE DOUBLE TRACK – TRENCH ALTERNATIVE

Project No. 12-146 | Date: 5-23-2016

Regional Geology Map

Figure 2

ATTACHMENT 1

TRENCH PLAN AND PROFILE

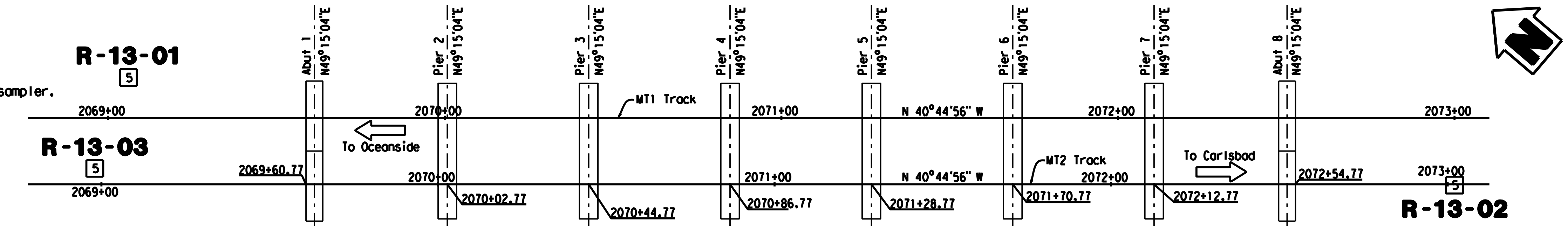
SEE ATTACHMENT C & D OF TRENCH FEASIBILITY STUDY

ATTACHMENT 2

AVAILABLE SUBSURFACE INFORMATION

NOTES:

(1) This LOTB sheet (Boring Record) was prepared in accordance with Caltrans Soil and Rock Logging, Classification and Presentation Manual (2010).
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" drop was used to advance the California Modified sampler.
(4) For Soil Legend, see A10F and A10G



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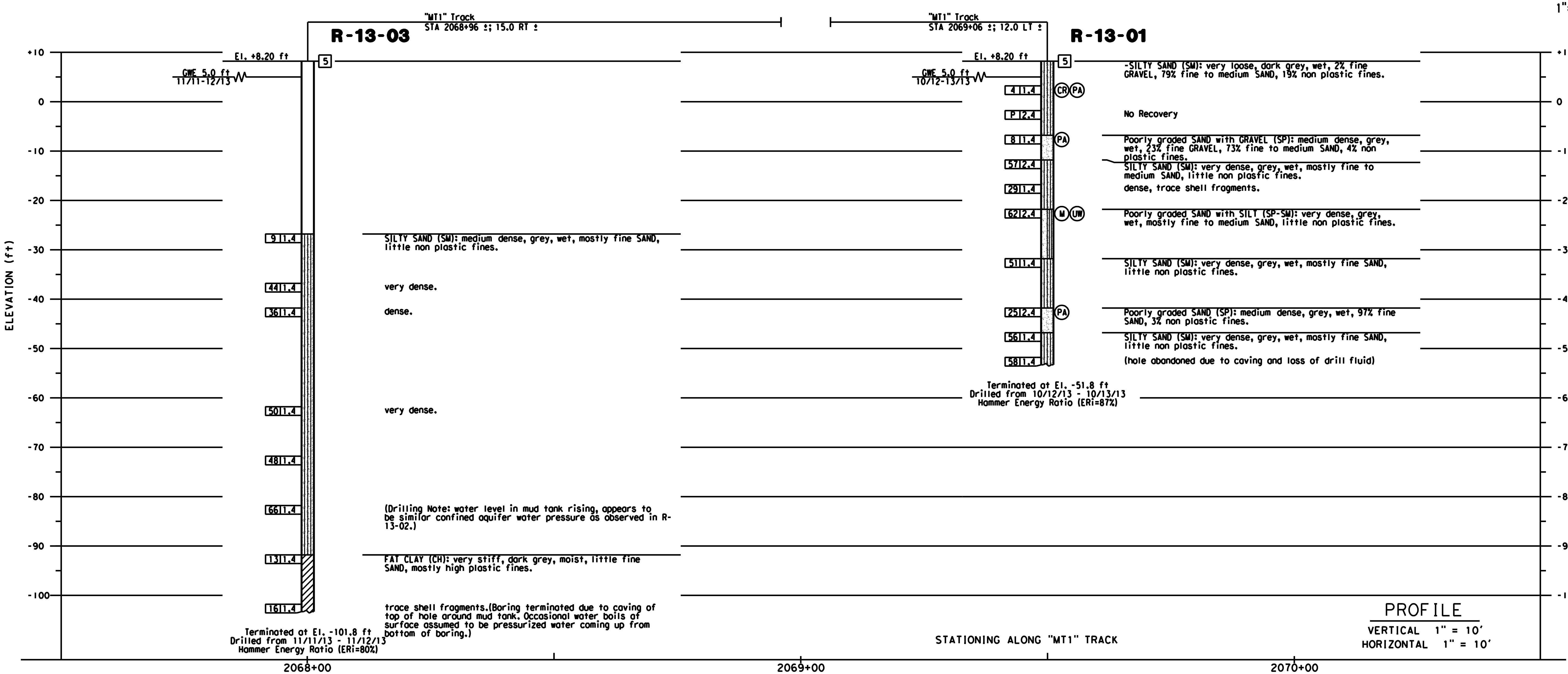


PROFILE

VERTICAL 1" = 10'

HORIZONTAL 1" = 10'

NO.	DATE	REVISIONS	BY	CHK	APRV

N C T D

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

REGISTERED PROFESSIONAL ENGINEER — ERIC BROWN — NO. GE-2606 — EXP. 06-30-2014 — GEOTECHNICAL — STATE OF CALIFORNIA

		DATE
DESIGNED BY	E. Brown	12/18
DRAWN BY	A. Thurairajah	12/19
CHECKED BY	E. Brown	12/20
PRJ. ENG.	E. Brown	-

SANDAG
San Diego's Regional Planning Agency

CARLSBAD VILLAGE DOUBLE TRACK

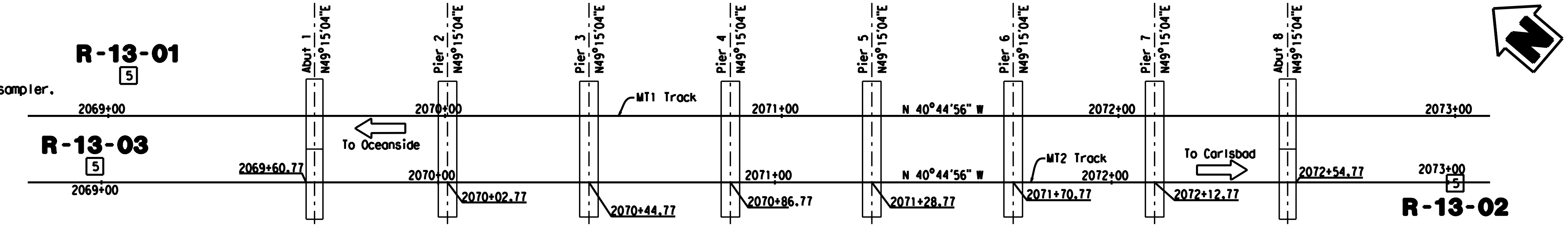
BUENA VISTA LAGOON BRIDGE (REPLACE)
LOG OF TEST BORINGS (LOTB) NO. 1 OF 2

SCALE: AS SHOWN
CONTRACT NO.: -
DRAWING NO.: X-XX
SHEET NO.: XX

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

NOTES:

(1) This LOTB sheet (Boring Record) was prepared in accordance with Caltrans Soil and Rock Logging, Classification and Presentation Manual (2010).
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" drop was used to advance the California Modified sampler.
(4) For Soil Legend, see A10F and A10G



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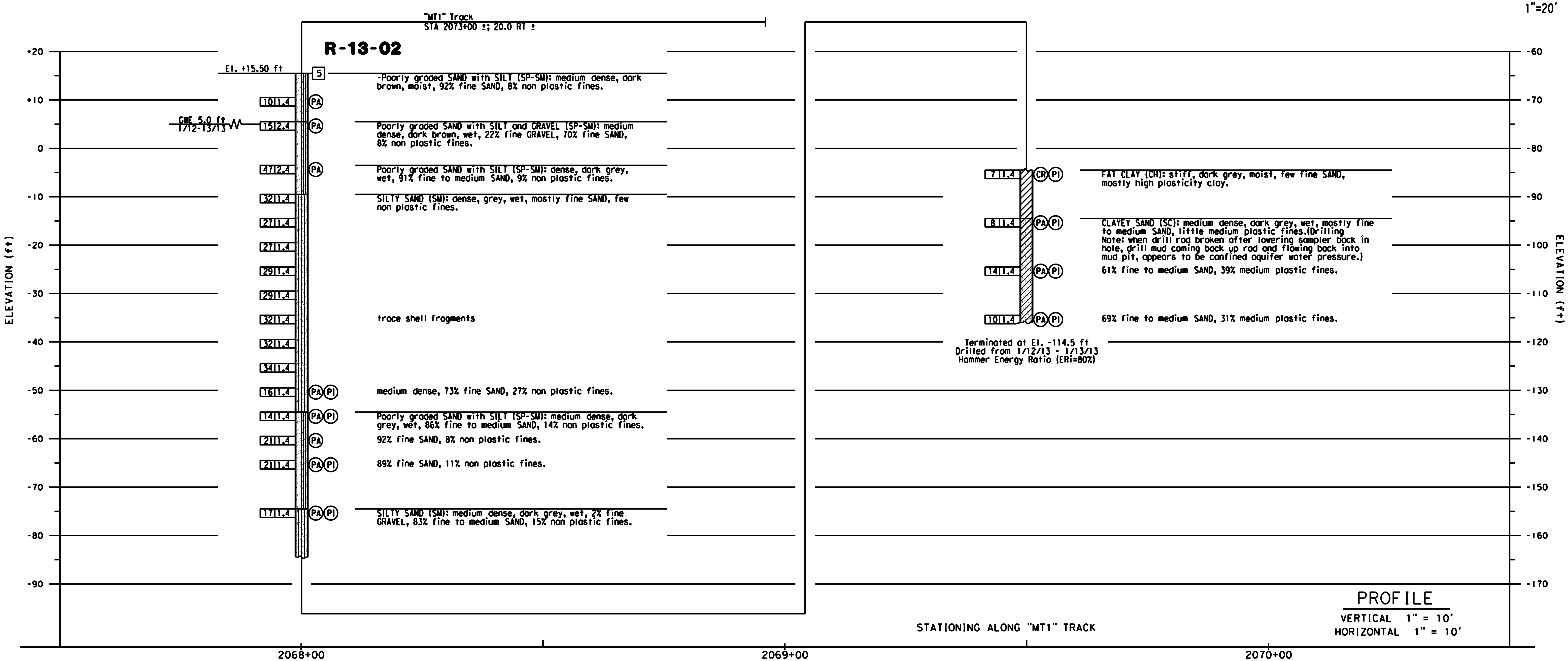


PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 10'

NO.	DATE	REVISIONS	BY	CHK	APRV

N C T D

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

DESIGNED BY	E. Brown	12/18
DRAWN BY	A. Thurairajah	12/19
CHECKED BY	E. Brown	12/20
PRJ. ENG.	E. Brown	-

SANDAG
San Diego's Regional Planning Agency

CARLSBAD VILLAGE DOUBLE TRACK

BUENA VISTA LAGOON BRIDGE (REPLACE)
LOG OF TEST BORINGS (LOTB) NO. 2 OF 2

SCALE: AS SHOWN
CONTRACT NO.: -
DRAWING NO.: X-XX
SHEET NO.: XX

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES

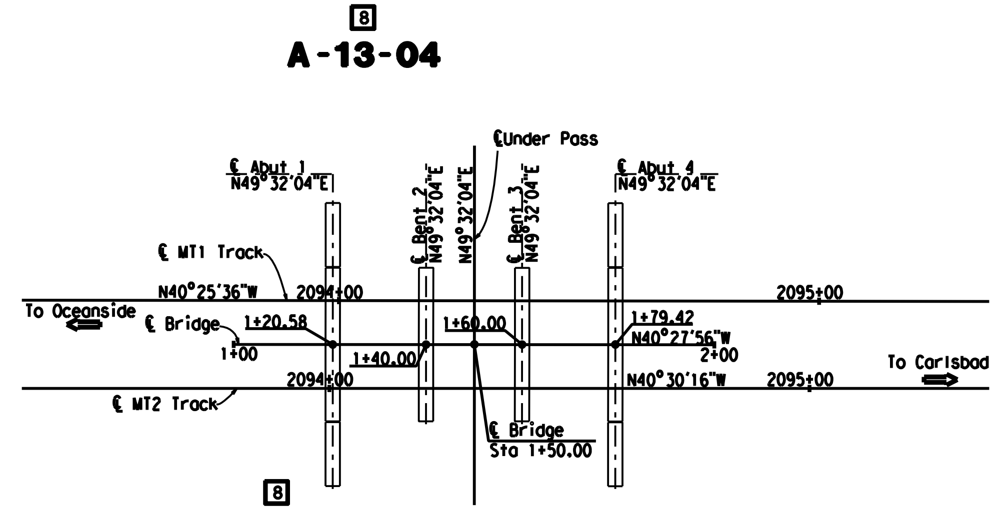
NOTES:

(1) This LOTB sheet (Boring Record) was prepared in accordance with Caltrans Soil and Rock Logging, Classification and Presentation Manual (2010).

(2) 2.4" samples were taken using a California Modified Sampler.

(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" drop was used to advance the California Modified sampler.

(4) For Soil Legend, see A10F and A10G



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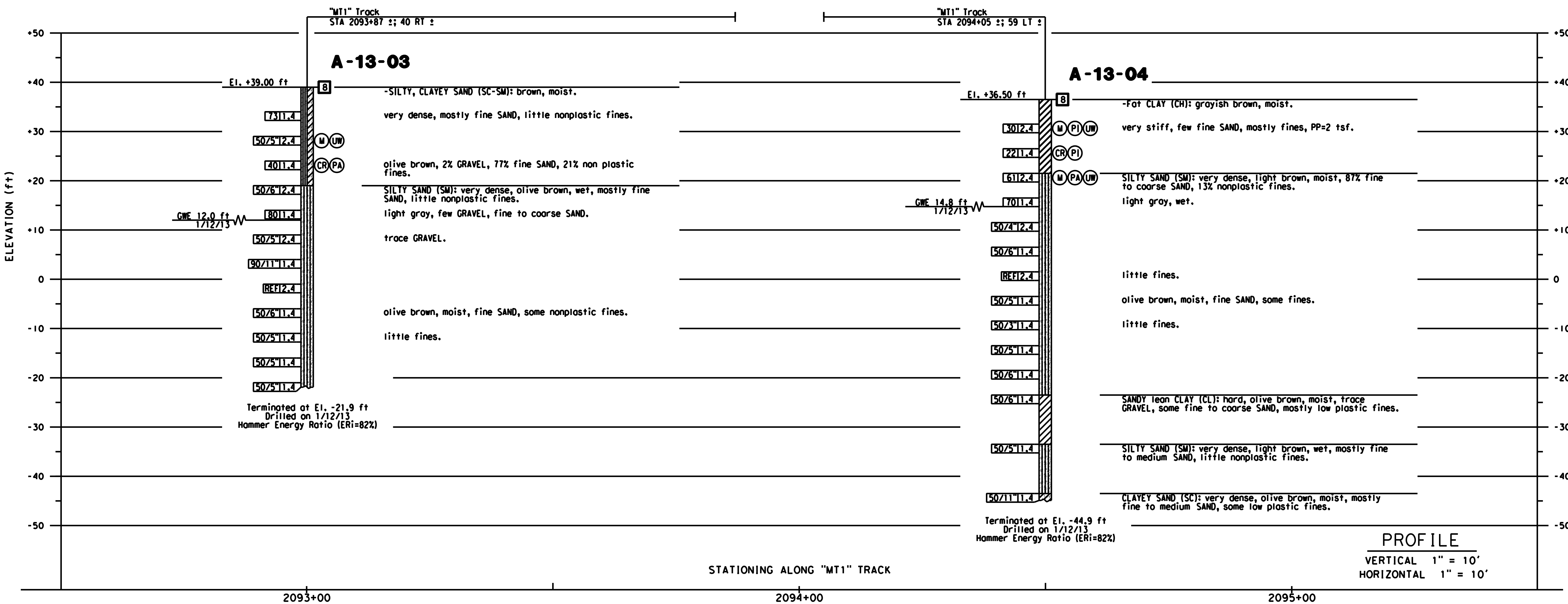


PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 10'

NO.	DATE	REVISIONS	BY	CHK	APRV

N C T D

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

REGISTERED PROFESSIONAL ENGINEER — ERIC BROWN — NO. GE-2806 — EXP. 06-30-2014 — GEOTECHNICAL — STATE OF CALIFORNIA

		DATE
DESIGNED BY	A. Thurairajah	12/18
DRAWN BY	A. Thurairajah	12/19
CHECKED BY	E. Brown	12/20
PRJ. ENG.	E. Brown	-

SANDAG
San Diego's Regional Planning Agency

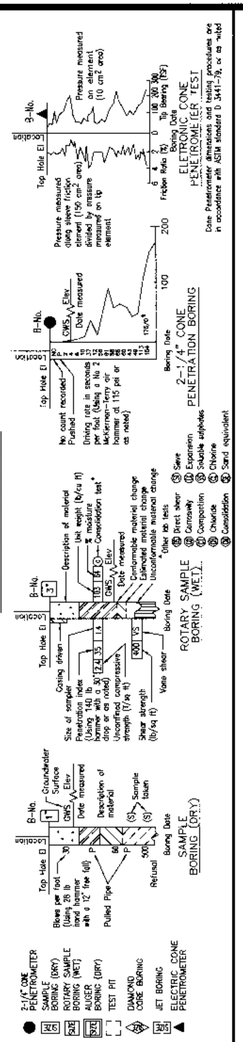
CARLSBAD VILLAGE DOUBLE TRACK

PEDESTRIAN UNDERCROSSING
LOG OF TEST BORINGS (LOTB) NO. 1 OF 1

SCALE: AS SHOWN
CONTRACT NO.: -
DRAWING NO.: X-XX
SHEET NO.: XX

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

LEGEND OF BORING OPERATIONS



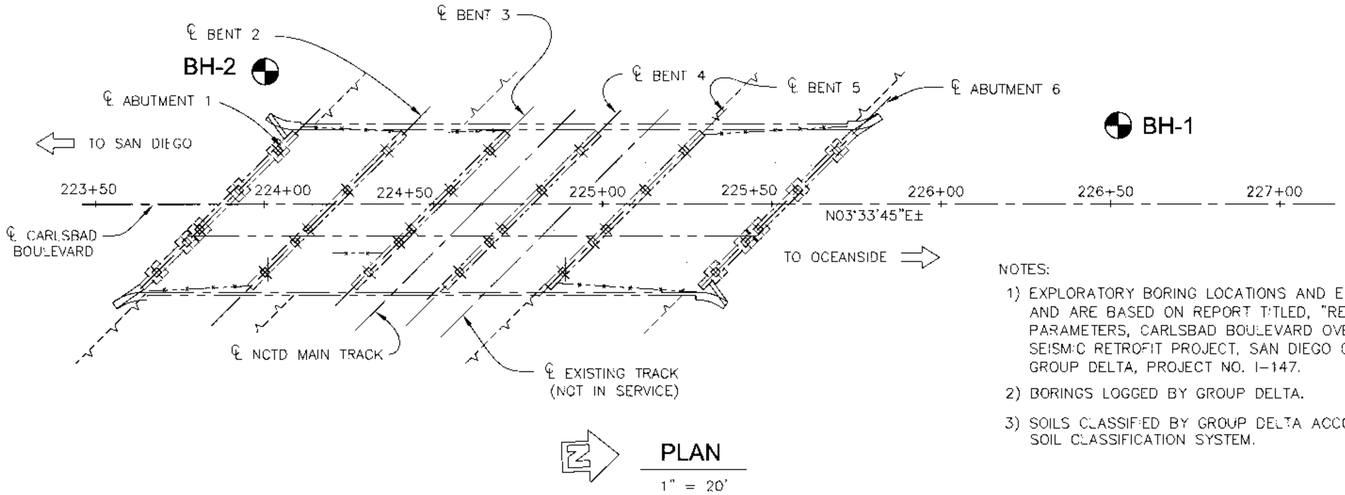
LEGEND OF EARTH MATERIALS

GRAVEL · SAND · SILT · CLAY · SANDY CLAY or CLAYEY SAND · SANDY SILT or SILTY SAND · SILTY CLAY · CLAYEY SILT · PEAT and/or ORGANIC MATTER · FILL MATERIAL · IGNEOUS ROCK · SEDIMENTARY ROCK · METAMORPHIC ROCK

CONSISTENCY CLASSIFICATION FOR SOILS

According to the Standard Penetration Test

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.

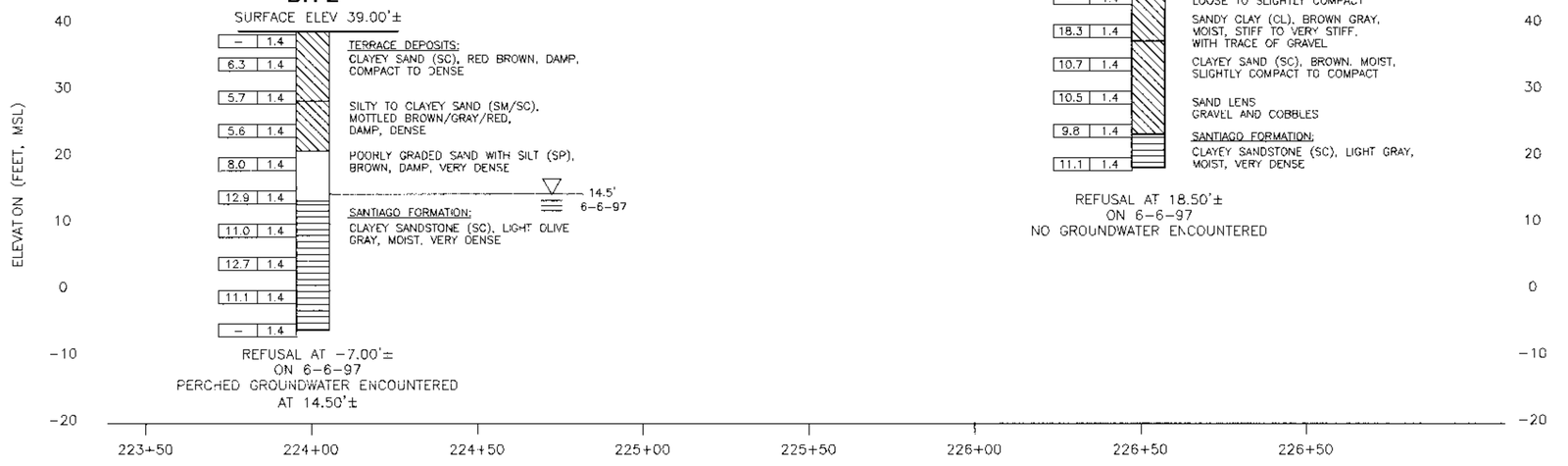


PLAN

1" = 20'

NOTES:

1) EXPLORATORY BORING LOCATIONS AND ELEVATIONS ARE APPROXIMATE AND ARE BASED ON REPORT TITLED, "RECOMMENDED GEOTECHNICAL PARAMETERS, CARLSBAD BOULEVARD OVERHEAD (BR. NO. 57C-134), SEISMIC RETROFIT PROJECT, SAN DIEGO CALIFORNIA", PREPARED BY GROUP DELTA, PROJECT NO. I-147.
2) BORINGS LOGGED BY GROUP DELTA.
3) SOILS CLASSIFIED BY GROUP DELTA ACCORDING TO THE UNIFIED SOIL CLASSIFICATION SYSTEM.



PROFILE

1" = 20' HORIZONTAL
1" = 10' VERTICAL

ORIGINAL SCALE OF FULL SIZE PLANS (INCHES)

0 1 2 3

SIMON WONG ENGINEERING
9968 Hibert Street, Suite 202
San Diego, CA 92131
(858) 566-3113
Job No. 500-581

REGISTERED PROFESSIONAL ENGINEER William T. Plummer No. 050865 Exp. 9-30-05 CIVIL STATE OF CALIFORNIA

"AS BUILT"

RCE 28176 EXP 3-31-08 — 12/1/06 DATE

REVIEWED BY INSPECTOR — 11/30/06 DATE

DATE	INITIAL		DATE	INITIAL	DATE	INITIAL
ENGINEER OF WORK		1 AS BUILT			12/1/06	WEP
		REVISION DESCRIPTION		OTHER APPROVAL		CITY APPROVAL

SHEET 11 — CITY OF CARLSBAD, ENGINEERING DEPARTMENT — SHEETS 11

CARLSBAD BOULEVARD BRIDGE RETROFIT
LOG OF TEST BORINGS

APPROVED WILLIAM E. PLUMMER
DEPUTY CITY ENGINEER — PE 28176 EXPIRES 3/31/06 — DATE 6-13-05

DWN BY: TB
CHKD BY: CS
RVWD BY: [illegible]

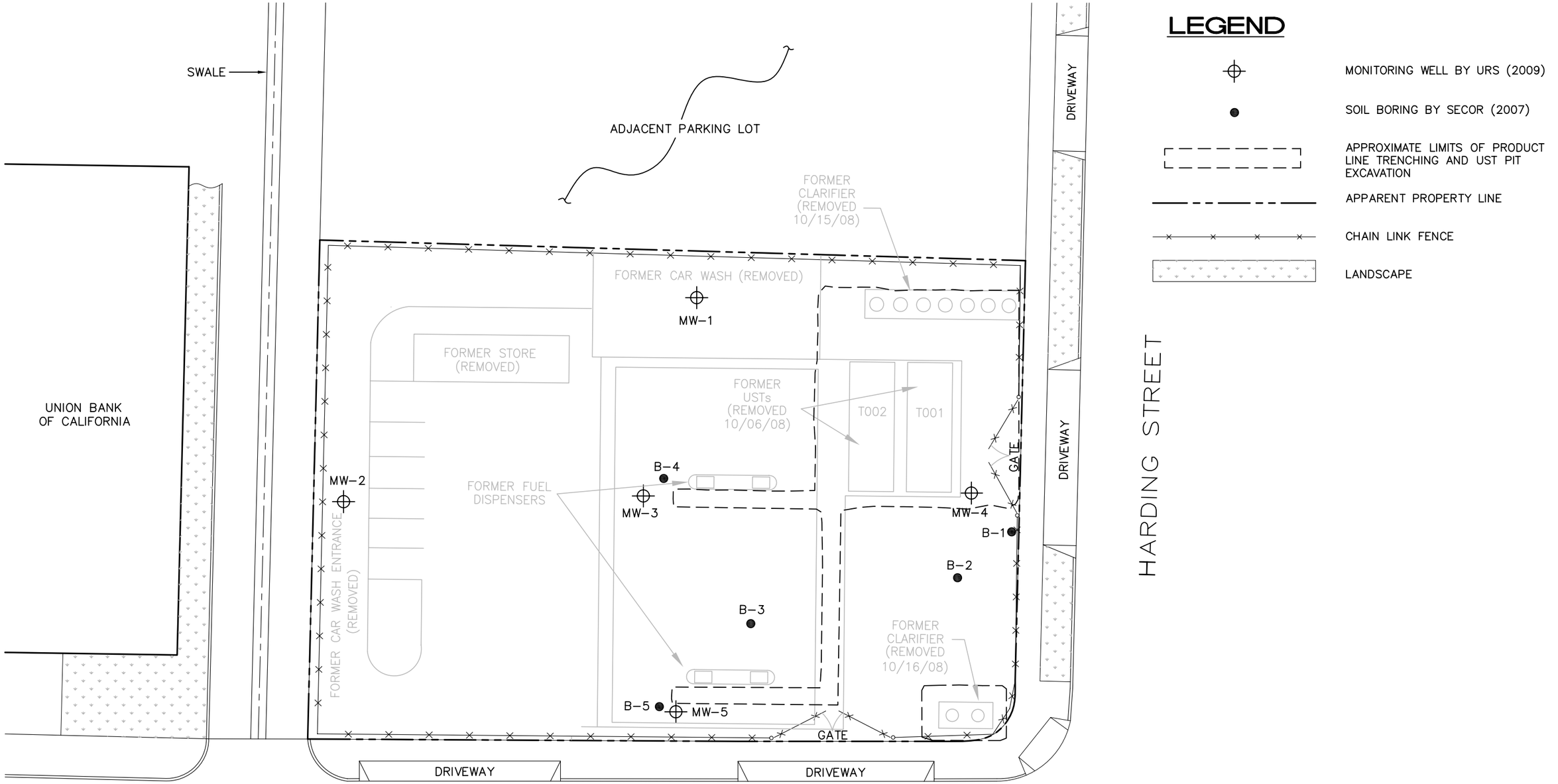
PROJECT NO. 3557-1

DRAWING NO. 416-3

022806

DWG 416-3
11 OF 11

P:\...\CARL-ALL JOB-500-581 REV-03/02/05



LEGEND

- MONITORING WELL BY URS (2009)
- SOIL BORING BY SECOR (2007)
- APPROXIMATE LIMITS OF PRODUCT LINE TRENCHING AND UST PIT EXCAVATION
- APPARENT PROPERTY LINE
- CHAIN LINK FENCE
- LANDSCAPE

SOURCE: William A. Teipe & Associates, Inc., 2009

SITE PLAN
FORMER 76 STATION NO. 5723
880 CARLSBAD VILLAGE DRIVE, CARLSBAD, CA

URS

10 0 10 20 feet
APPROXIMATE SCALE 1"=20'

CHECKED BY:	DATE: 08-18-09	FIG. NO:
PM: KM	PROJ. NO: 29879843	3

J:\Conoco Phillips Company\5723_880 Carlsbad Village Drive\Figures\Site Plan_76 Station No. 5723.dwg Aug 20, 2009 - 11:21am

Project: Former 76 Station No. 5723 Project Location: 880 Carlsbad Village Drive, Carlsbad, CA Project Number: 29879843	**Log of MW-1** Sheet 1 of 1

Date(s) Drilled	7/20/09	Logged By	S. Owens	Checked By	K. Myers
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	10 inches	Total Depth of Borehole	26.5 feet
Drill Rig Type	CME 75	Drilling Contractor	WDC	Approximate Surface Elevation	63.29 feet
Approximate Depth to Groundwater	15 feet	Sampling Method(s)	Split Spoon	Top of Casing Elevation	62.80 feet
Borehole Completion	Groundwater Monitoring Well	Location	See Site Plan	Hammer Data	140 lbs/30" drop

Elevation feet	Depth, feet	SAMPLES: Type Number	SAMPLES: Blows per foot	SAMPLES: Headspace PID, ppm	Graphic Log	MATERIAL DESCRIPTION	Well Schematic	REMARKS AND OTHER TESTS
	0					Air knifed to 5'		
-60								
	5	MW-1-5.5	12	0.0		Loose, moist, strong brown, fine SAND (SP)		No hydrocarbon odor
-55								
	10	MW-1-10.5	53	0.0		Becomes very dense		
-50								
	15	MW-1-15.5	61	1604		Very dense, wet, greenish black, medium SAND (SP), trace silt		Strong hydrocarbon odor
-45						Very dense, wet, brownish yellow, silty fine SAND (SM)		
	20	MW-1-20.5	86	7.6				No hydrocarbon odor
-40								
	25	MW-1-25.5	50/6"	13.1		Becomes moist, pale yellow		
						Bottom of boring at 26.5 feet		
-35								
	30							

Report: ENV_SW_SMPLE_W/CASING EL File: 29879843.GPJ 8/25/09 MW-1

Project: Former 76 Station No. 5723
Project Location: 880 Carlsbad Village Drive, Carlsbad, CA
Project Number: 29879843

Log of MW-2

Sheet 1 of 1

Date(s) Drilled	7/20/09	Logged By	S. Owens	Checked By	K. Myers
Drilling Method	Hollow Stem Auger	Drl. Bit Size/Type	10 inches	Total Depth of Borehole	26.5 feet
Drl Rig Type	CME 75	Drilling Contractor	WDC	Approximate Surface Elevation	62.30 feet
Approximate Depth to Groundwater	15 feet	Sampling Method(s)	Split Spoon	Top of Casing Elevation	61.92 feet
Borehole Completion	Groundwater Monitoring Well	Location	See Site Plan	Hammer Data	140 lbs/30" drop

Elevation feet	Depth, feet	SAMPLES Type Number	SAMPLES Blows per foot	SAMPLES Headspace PID, ppm	Graphic Log	MATERIAL DESCRIPTION	Well Schematic	REMARKS AND OTHER TESTS
62	0					Air knifed to 5'		
60								
	5	MW-2-5.5	25	3.4		Medium dense, moist, strong brown fine SAND (SP)		No hydrocarbon odor
55								
	10	MW-2-10.5	28	5.0				
50								
	15	MW-2-15.5	26	1.0		Dense, wet, yellowish brown, fine SAND (SP)		No hydrocarbon odor
						Hard, wet, light yellowish brown, sandy SILT (ML)		
45								
	20	MW-2-20.5	59	2.2		Very dense moist, pale yellow, silty fine SAND (SM)		No hydrocarbon odor
40								
	25	MW-2-25.5	50/6"	0.5				
35						Bottom of boring at 26.5 feet		
	30							

URS

Report ENV_SAN_SIMPLE_WDCASING.RPT - File: 29879843.GPJ - 8/20/2009 - MW-2

Project: Former 76 Station No. 5723	**Log of MW-3**
Project Location: 880 Carlsbad Village Drive, Carlsbad, CA	Sheet 1 of 1
Project Number: 29879343	

Date(s) Drilled	7/20/09	Logged By	S. Owens	Checked By	K. Myers
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	10 inches	Total Depth of Borehole	26.5 feet
Drill Rig Type	CME 75	Drilling Contractor	WDC	Approximate Surface Elevation	63.61 feet
Approximate Depth to Groundwater	15 feet	Sampling Method(s)	Split Spoon	Top of Casing Elevation	62.91 feet
Borehole Completion	Groundwater Monitoring Well	Location	See Site Plan	Hammer Data	140 lbs/30" drop

Elevation feet	Depth feet	SAMPLES Type / Number	Blows per foot	Headspace PID, ppm	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
	0				Air knifed to 5'	
-60	5	MW-3-5.5	28	1.3	Medium dense, moist, strong brown, fine SAND (SP)	No hydrocarbon odor
-55	10	MW-3-10.5	34	6.4		
-50	15	MW-3-15.5	65	79.9	Becomes very dense, olive ∇ Becomes light yellowish brown	No hydrocarbon odor
-45	20	MW-3-20.5	76	0.0	Becomes yellowish brown Very dense, moist, yellow, silty fine SAND (SM)	No hydrocarbon odor
-40	25	MW-3-25.5	50/6"	0.0	Very dense, moist, yellowish brown, fine SAND (SP) Very dense, moist, yellow, silty fine SAND (SM) Bottom of boring at 26.5 feet	No hydrocarbon odor
-35	30					

URS

Project: Former 76 Station No. 5723 **Project Location:** 880 Carlsbad Village Drive, Carlsbad, CA **Project Number:** 29879843	**Log of MW-4** Sheet 1 of 1

Date(s) Drilled	7/21/09	Logged By	S. Owens	Checked By	K. Myers
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	10 inches	Total Depth of Borehole	26.5 feet
Drill Rig Type	CME 75	Drilling Contractor	WDC	Approximate Surface Elevation	63.72 feet
Approximate Depth to Groundwater	15 feet	Sampling Method(s)	Split Spoon	Top of Casing Elevation	63.16 feet
Borehole Completion	Groundwater Monitoring Well	Location	See Site Plan	Hammer Data	140 lbs/30" drop

Elevation feet	Depth, feet	SAMPLES: Type Number	SAMPLES: Blows per foot	SAMPLES: Headspace PID, ppm	Graphic Log	MATERIAL DESCRIPTION	Well Schematic	REMARKS AND OTHER TESTS
60	0					Air knifed to 5'		
55	5	MW-4-5.5	26	0.0		Medium dense, wet, strong brown, fine SAND (SP)		No hydrocarbon odor
50	10	MW-4-10.5	21	0.0		Dense, moist, yellow, fine SAND (SP)		
45	15	MW-4-15.5	46	15.6		Very dense, wet, olive, fine SAND (SP), trace silt		Some hydrocarbon odor
40	20	MW-4-20.5	50/6"?	1.8		Hard, moist, pale yellow, sandy SILT (ML), fine grained sand, low plasticity		No hydrocarbon odor
35	25	MW-4-25.5	50/6"?	3.1		Becomes light olive gray, trace clay, high plasticity		No hydrocarbon odor
30						Bottom of boring at 26.5 feet		

URS

Report: ENV_BW_SINGLE_WELL.RPT | Log: BORING E... | File: 29879843.GPJ | BORING MW-4

Project: Former 76 Station No. 5723
Project Location: 880 Carlsbad Village Drive, Carlsbad, CA
Project Number: 29979843

Log of MW-5

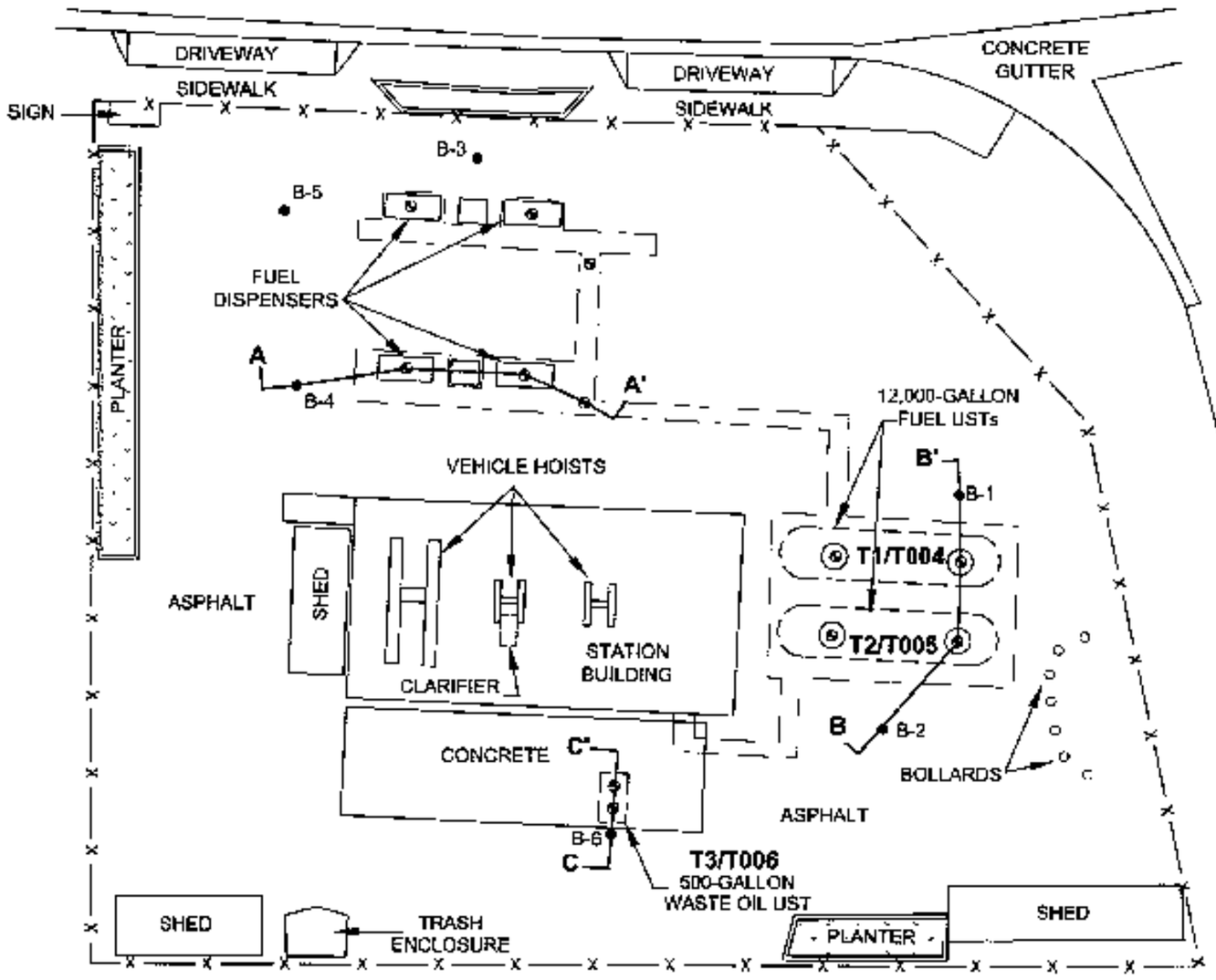
Sheet 1 of 1

Date(s) Drilled	7/21/09	Logged By	S. Owens	Checked By	K. Myers
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	10 inches	Total Depth of Borehole	26.5 feet
Drill Rig Type	CME 75	Drilling Contractor	WDC	Approximate Surface Elevation	63.10 feet
Approximate Depth to Groundwater	15 feet	Sampling Method(s)	Split Spoon	Top of Casing Elevation	62.78 feet
Borehole Completion	Groundwater Monitoring Well	Location	See Site Plan	Hammer Data	140 lbs/30" drop

Elevation feet	Depth, feet	SAMPLES Type Number	Blows per foot	Headspace PID, ppm	Graphic Log	MATERIAL DESCRIPTION	Well Schematic	REMARKS AND OTHER TESTS
	0					Air knifed to 5'		
60								
	5	MW-5-5.5	28	1.8		Medium dense, wet, strong brown, fine SAND (SP)		No hydrocarbon odor
55								
	10	MW-5-10.5	41	0.0				
50								
	15	MW-5-15.5	41	3.7		Very dense, wet, olive gray, fine SAND (SP), trace silt		No hydrocarbon odor
45								
	20	MW-5-20.5	50/6"?	1.2		Very dense, moist, light gray, silty fine SAND (SM)		No hydrocarbon odor
40								
	25	MW-5-25.5	50/6"?	2.1		Very dense, moist, light gray, fine SAND (SP)		No hydrocarbon odor
						Bottom of boring at 26.5 feet		
35								
	30							

URS

Report: ENV_SW_SAMPLE_w_CASING.rpt File: 29979843.GPJ 8/24/2009 MW5



LEGEND

- APPROXIMATE LIMITS OF PRODUCT LINE TRENCHING AND UST PIT EXCAVATION
- ⊙ SOIL SAMPLE LOCATION BY URS (MAY 2009)
- ● B-1 BORING BY SECOR (2007)
- UST UNDERGROUND STORAGE TANK
- A — A' CROSS SECTION LINE
- —— x —— CHAIN LINK FENCE

SOURCE: Base map based on Site Demolition Plan (uncoded) by CPM, LLC

SITE PLAN
FORMER 76 STATION NO. 5927
895 TAMARACK AVENUE, CARLSBAD, CA

URS

10 0 10 20 feet
APPROXIMATE SCALE 1"=25'

CHECKED BY: | DATE: 07-09-09
PM: KW | PROJ. NO: 29879836
FIG. NO: 3

J:\Conoco Phillips Company\5927 - 895 Tamarack Avenue Carlsbad\Figures\Sit 5927 Site Plan.dwg JUL 08, 2009 - 10:38am

Project: Former 76 Station No. 5927 **Project Location:** 895 Tamarack Avenue, Carlsbad, CA **Project Number:** 29879117	**Log of MW-5** Sheet 1 of 1

Date(s) Drilled	03/04/11	Logged By	S. Haber	Checked By	K. Myers
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	10 inches	Total Depth of Borehole	31.5 feet
Drill Rig Type	CME 85	Drilling Contractor	Cascade Drilling	Approximate Surface Elevation	62.63 feet
Approximate Depth to Groundwater	18.65 feet below TOC	Sampling Method(s)	Split Spoon	Top of Casing Elevation	62.13 feet
Borehole Completion	Groundwater Monitoring Well	Location	See Site Plan	Hammer Data	140 lbs/30" drop

Elevation feet	Depth, feet	SAMPLES Type	SAMPLES Number	Blows per foot	Headspace PID, ppm	Graphic Log	MATERIAL DESCRIPTION	Well Schematic	REMARKS AND OTHER TESTS
60	0						4" of asphalt over dry, dark reddish brown (5 YR 3/3), poorly graded fine SAND (SP), trace silt, no odor, no staining		Air knifed to 5' bgs
	5		MW-5-5.5	49	0.1				
50	10		MW-5-10.5	65	0.2				
	15		MW-5-16.5	50/5"	18		Moist, light greyish brown (2.5 Y 6/2), SILT (ML) with fine sand, no odor, no staining		
40	20		MW-5-20	50/5"	20		Less sand, increase in silt, slight hydrocarbon odor		
	25		MW-5-25	50/5"	190				
30	30		MW-5-30	50/4"	100				
30							Bottom of boring at 31.5 feet Groundwater encountered at 18.65 feet below top of casing prior to well development		
	35								

Report: ENV_SW_SAMPLE_WITCASING.RPT, File: 29879117.GPJ, 3/24/2011 - MW-5

URS

Project: Former 76 Station No. 5927 **Project Location:** 695 Tamarack Avenue, Carlsbad, CA **Project Number:** 29879117	**Log of MW-7** Sheet 1 of 1

Date(s) Drilled	03/04/11	Logged By	S. Haber	Checked By	K. Myers
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	10 inches	Total Depth of Borehole	31.5 feet
Drill Rig Type	CME 85	Drilling Contractor	Cascade Drilling	Approximate Surface Elevation	62.73 feet
Approximate Depth to Groundwater	18.80 feet below TOC	Sampling Method(s)	Split Spoon	Top of Casing Elevation	62.05 feet
Borehole Completion	Groundwater Monitoring Well	Location	See Site Plan	Hammer Data	140 lbs/30" drop

Elevation feet	Depth, feet	SAMPLES Type	SAMPLES Number	Blows per foot	Headspace PID, ppm	Graphic Log	MATERIAL DESCRIPTION	Well Schematic	REMARKS AND OTHER TESTS
60	0						9" of asphalt over dry, dark reddish brown (5 YR 3/3), fine SAND with silt (SP-SM), no odor, no staining		Air knifed to 5' bgs
	5		MW-7-5.5	40	0.2				
	10		MW-7-10.5	65	0.4		Dry, very dark grayish brown (10 YR 3/2), poorly graded fine SAND (SP), no odor, no staining		
50							Pale brown (10 YR 6/3), moist		
	15		MW-7-16.6	65	1.5				
	20		MW-7-20	50/6"	2900		Moist, dark yellowish brown (10 YR 3/4), well graded SAND with silt (SW-SM), strong hydrocarbon odor, no staining		
40							Moist, grayish brown (2.5 Y 5/2), SILT with fine sand (ML), strong hydrocarbon odor, no staining		
	25		MW-7-25	50/6"	1800				
	30		MW-7-30	50/6"	1500				
30							Bottom of boring at 31.5 feet Groundwater encountered at 18.80 feet below top of casing prior to well development		
	35								

Report Env_Soil_SAMPLE_W CASING.RL: File: 29879117.GPJ; 3/24/2011 MW-7

URS

Project: Former 76 Station No. 5927
Project Location: 695 Tamarack Avenue, Carlsbad, CA
Project Number: 25879117

Log of MW-8

Sheet 1 of 1

Date(s) Drilled	03/04/11	Logged By	S. Haber	Checked By	K. Myers
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	10 inches	Total Depth of Borehole	31.5 feet
Drill Rig Type	CME 85	Drilling Contractor	Cascade Drilling	Approximate Surface Elevation	63.09 feet
Approximate Depth to Groundwater	21.90 feet below TOC	Sampling Method(s)	Split Spoon	Top of Casing Elevation	63.55 feet
Borehole Completion	Groundwater Monitoring Well	Location	See Site Plan	Hammer Data	140 lbs/30" drop

Elevation feet	Depth, feet	SAMPLES Type	SAMPLES Number	Blows per foot	Headspace PID, ppm	Graphic Log	MATERIAL DESCRIPTION	Well Schematic	REMARKS AND OTHER TESTS
	0						9" of asphalt over dry, dark reddish brown (5 YR 3/3), fine SAND with silt (SP-SM), no odor, no staining		Air knifed to 5' bgs
60	5		MW-8-5.5	50/6"	11				
							Increase in silt		
	10		MW-8-10.5	70	0.1		Decrease in silt		
50							Moist, olive brown (2.5 Y 4/3), poorly graded fine SAND (SP), no odor, no staining		
	15		MW-8-15.5	50/6"	0		With subrounded large gravel		
							Moist, light olive brown (2.5 Y 5/3) to grayish brown (2.5Y 5/2), silty SAND to sandy SILT (SM/ML), no odor, no staining		
	20		MW-8-20	50/6"	0.2		Increase in silt		
40							Moist, grayish brown (2.5 Y 5/2), SILT with sand (ML), slight hydrocarbon odor, no staining		
	25		MW-8-25	50/6"	35				
	30		MW-8-30	50/5"	280				
30	35						Bottom of boring at 31.5 feet Groundwater encountered at 21.90 feet below top of casing prior to well development		

Report ENV SAW SAMPLE W CASING FL: File 25879117.GPJ 3/24/2011 MW-8

URS

ATTACHMENT 3

FIELD INVESTIGATION MEMORANDUM PREPARED BY SCST

SDVOSB . DVBE

SCST, Inc.
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May 11, 2016

SCST No. 150448P3.3
Report No. 1

Mr. Brandon Miles, PE, TE
City of Carlsbad
Public Works – Transportation
1635 Faraday Avenue
Carlsbad, California 92008

Subject: GROUNDWATER OBSERVATIONS
CARLSBAD VILLAGE DOUBLE TRACK
CASSIDY STREET TO TAMARACK AVENUE
CARLSBAD, CALIFORNIA

References: SANDAG (2015), "*Carlsbad Village Double Track, Supplemental Alternative Analysis Report, Attachment C: Short Trench Alternative Plan & Profile",* October.

Dear Mr. Miles:

In accordance with your request SCST, Inc. (SCST) prepared this report to present the results of groundwater level observations performed at the subject site. We understand this project may consist of the design and construction of a double track railroad trench through the Carlsbad Village in Carlsbad, California. The proposed trench alignment is adjacent to the existing North County Transit District railroad tracks from Cassidy Street, Oceanside, California to Tamarack Avenue, Carlsbad, California. Figure 1 presents a site vicinity map.

SCST explored the subsurface conditions by drilling eight exploratory borings and installing one groundwater monitoring well in the public Right-of-Way. The borings were drilled to depths between about 15 and 45 feet below the existing ground surface using a truck-mounted drill rig equipped with a hollow-stem auger. Boring B-4 was constructed as a monitoring well for the purpose of possible future groundwater observations and/or testing. The monitoring well was installed to a depth of about 40 feet below the existing ground surface. Figure 2 shows the approximate locations of the borings and monitoring well. An SCST engineer logged the borings and performed groundwater measurements in general accordance with ASTM D 4750. Groundwater measurements were performed up to 48 hours after drilling. The logs of the borings are presented in Appendix I. Soils are classified according to the Unified Soil Classification System illustrated on Figure I-1. Table 1 summarizes the results of our groundwater observations with respect to the approximate bottom of the planned railroad trench. The elevations used in Table 1 were provided in the referenced Supplemental Analysis Report.

Table 1: Groundwater Observation Results

Boring ID	Location	Existing Elevation Above MSL (ft)	Boring Depth (ft)	Depth to Groundwater (ft)	Depth to Proposed Railroad Trench Bottom (ft)
B-1	Date Avenue	38	25	Not Encountered	14
B-2	Juniper Avenue	44	45	15½	34
B-3	Acacia Avenue	44	40	21½	32
B-4*	Pine Avenue/Washington Street	44	40	19½	32
B-5	Beech Avenue	36	30	19	19
B-6	Alley West of State Street	27	15	Not Encountered	6
B-7	Oak Avenue	41	40	13	29
B-8	Tamarack Avenue	44	45	18	33
B-9	Long Place	38	30	Not Encountered	20

*Location of monitoring well

Based on our field findings, groundwater was observed in six borings at or above the proposed railroad trench bottom. It should be noted that groundwater levels may fluctuate in the future due to rainfall, irrigation, broken pipes, or changes in site drainage. Because groundwater rise or seepage is difficult to predict, such conditions are typically mitigated if and when they occur.

In the performance of our professional services, we comply with that level of care and skill ordinarily exercised by members of our profession currently practicing under similar conditions and in the same locality. The client recognizes that subsurface conditions may vary from those encountered at the boring locations, and that our data, interpretations, and recommendations are based solely on the information obtained by us. We will be responsible for those data, interpretations, and recommendations, but shall not be responsible for interpretations by others of the information developed. Our services consist of professional consultation and observation only, and no warranty of any kind whatsoever, express or implied, is made or intended in connection with the work performed or to be performed by us, or by our proposal for consulting or other services, or by our furnishing of oral or written reports or findings.

If you have any questions, please call us at 619-280-4321.

Respectfully Submitted,
SCST, INC.

Evan Morrill
Staff Engineer

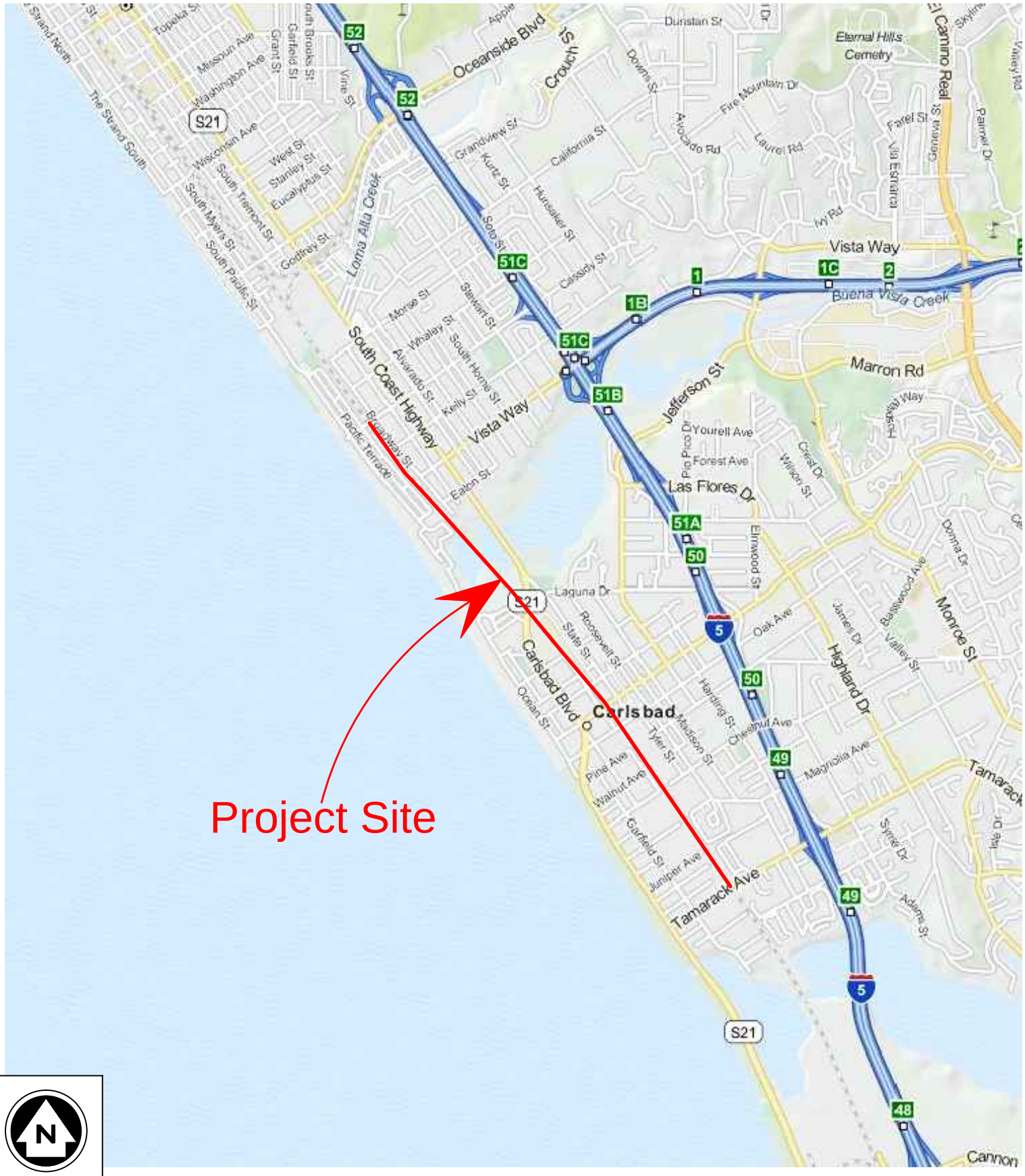
Emil Rudolph, PE, GE 2767
Principal Engineer

Andrew K. Neuhaus, PG, CEG 2591
Senior Geologist

EM:AKN:aw

Attachments: Figure 1 – Site Vicinity Map
Figure 2 – Boring Location Map
Appendix I – Field Investigation

(1) Addressee via e-mail: Brandon.Miles@carlsbadca.gov



SCST, Inc.	SITE VICINITY MAP Carlsbad Village Double Track Carlsbad, California	Date: May, 2016 By: JCU Job No.: 150448P3.3	Figure: 1

SCST LEGEND:

B-9 — Approximate Location of Boring

* — Location of Monitoring Well

NCTD Easement

NOTE: Not to Scale

SCST, Inc.

BORING LOCATION MAP

Carlsbad Village Double Track
Carlsbad, California

Date: May, 2016
By: JCU
Job No.: 150448P3.3

Figure: 2

APPENDIX I
FIELD INVESTIGATION

Our field investigation consisted of drilling 9 borings between April 25, 2016 and April 26, 2016. The borings were drilled to depths between about 15 and 45 feet below the existing ground surface using a truck-mounted drill rig equipped with a hollow stem auger. Figure 2 shows the approximate locations of the borings. The field investigation was performed under the observation of SCST engineer who also logged the borings.

The soils are classified in accordance with the Unified Soil Classification System as illustrated on Figure I-1. Logs of the borings are presented on Figures I-2 through I-20.

SUBSURFACE EXPLORATION LEGEND

UNIFIED SOIL CLASSIFICATION CHART

SOIL DESCRIPTION		GROUP SYMBOL	TYPICAL NAMES
I. COARSE GRAINED, more than 50% of material is larger than No. 200 sieve size.			
GRAVELS More than half of coarse fraction is larger than No. 4 sieve size but smaller than 3".	CLEAN GRAVELS	GW	Well graded gravels, gravel-sand mixtures, little or no fines
		GP	Poorly graded gravels, gravel sand mixtures, little or no fines.
	GRAVELS WITH FINES (Appreciable amount of fines)	GM	Silty gravels, poorly graded gravel-sand-silt mixtures.
		GC	Clayey gravels, poorly graded gravel-sand, clay mixtures.
SANDS More than half of coarse fraction is smaller than No. 4 sieve size.	CLEAN SANDS	SW	Well graded sand, gravelly sands, little or no fines.
		SP	Poorly graded sands, gravelly sands, little or no fines.
		SM	Silty sands, poorly graded sand and silty mixtures.
		SC	Clayey sands, poorly graded sand and clay mixtures.
II. FINE GRAINED, more than 50% of material is smaller than No. 200 sieve size.			
	SILTS AND CLAYS (Liquid Limit less than 50)	ML	Inorganic silts and very fine sands, rock flour, sandy silt or clayey-silt-sand mixtures with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		OL	Organic silts and organic silty clays or low plasticity.
	SILTS AND CLAYS (Liquid Limit greater than 50)	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of medium to high plasticity.
III. HIGHLY ORGANIC SOILS		PT	Peat and other highly organic soils.

SAMPLE SYMBOLS

- ☒ - Bulk Sample
- CAL - Modified California sampler
- CK - Undisturbed Chunk sample
- MS - Maximum Size of Particle
- ST - Shelby Tube
- SPT - Standard Penetration Test sampler

GROUNDWATER SYMBOLS

- ▽ - Water level at time of excavation or as indicated
- - Water seepage at time of excavation or as indicated

LABORATORY TEST SYMBOLS

- AL - Atterberg Limits
- CON - Consolidation
- COR - Corrosivity Tests (Resistivity, pH, Chloride, Sulfate)
- DS - Direct Shear
- EI - Expansion Index
- MAX - Maximum Density
- RV - R-Value
- SA - Sieve Analysis
- UC - Unconfined Compression

SCST, INC.

Carlsbad Village Double Track
Carlsbad, California

By:	EM	Date:	May, 2016
Job Number:	150448P3.3	Figure:	I-1

LOG OF BORING B-1

Date Drilled: 4/25/2016 | Logged by: EM

Equipment: CME-95 | Project Manager: AKN

Elevation (ft): 38 | Depth to Groundwater (ft): Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVEN	SAMPLES: BULK	DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
1	SC	**OLD PARALIC DEPOSITS (Qop)** - CLAYEY SAND, orangish brown, fine to medium grained, moist, medium dense.							
10		Yellowish brown.							
14		Approximate depth of proposed railroad trench bottom.							
17	SM	SILTY SAND, light yellowish brown, fine to medium grained, moist, medium dense.							

BORING CONTINUED ON I-3.

SCST, Inc.

Carslbad Village Double Track

Carlsbad, California

By:	JCU	Date:	May, 2016
Job Number:	150448P3.3	Figure:	I-2

LOG OF BORING B-1 (Continued)

Date Drilled: 4/25/2016 | Logged by: EM

Equipment: CME-95 with 8-inch Diameter Hollow-Stem Auger | Project Manager: AKN

Elevation (ft): 38 | Depth to Groundwater (ft): Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVEN	SAMPLES: BULK	DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
21	SM	**OLD PARALIC DEPOSITS (Qop)** - SILTY SAND, light yellowish brown, fine to medium grained, moist, medium dense.							
22									
23									
24									
25		**BORING TERMINATED AT 25 FEET.**							
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									

SCST, Inc.

Carlsbad Village Double Track
Calrsbad, California

By:	JCU	Date:	May, 2016
Job Number:	150448P3.3	Figure:	I-3

LOG OF BORING B-2

Date Drilled: 4/25/2016 | Logged by: EM

Equipment: CME-95 with 8-inch Diameter Hollow-Stem Auger | Project Manager: AKN

Elevation (ft): 44 | Depth to Groundwater (ft): 15½

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVEN	SAMPLES: BULK	DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
1	SM	**FILL (Qf)** - SILTY SAND with GRAVEL, dark brown, fine to medium grained, fragments of asphalt concrete encountered, moist, medium dense.							
2	SM	**OLD PARALIC DEPOSITS (Qop):** SILTY SAND, dark brown, fine to medium grained, moist, dense.							
3									
4									
5									
6									
7									
8									
9									
10		Brown.							
11									
12									
13	SC	CLAYEY SAND, dark brown, fine to coarse grained, moist, medium dense.							
14									
15		▽ Groundwater encountered at 15½ feet on 4/27/2016.							
16									
17									
18									
19									
20									

BORING CONTINUED ON I-5.

SCST, Inc.

Carlsbad Village Double Track
Carlsbad, California

By:	JCU	Date:	May, 2016
Job Number:	150448P3.3	Figure:	I-4

LOG OF BORING B-2 (Continued)

Date Drilled: 4/25/2016 | Logged by: EM

Equipment: CME-95 with 8-inch Diameter Hollow-Stem Auger | Project Manager: AKN

Elevation (ft): 44 | Depth to Groundwater (ft): 15½

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVEN	SAMPLES: BULK	DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
21	CL	**OLD PARALIC DEPOSITS (Qop)** - SANDY CLAY, light gray brown, fine to medium grained, moist, stiff.							
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34		Approximate depth of proposed railroad trench bottom.							
35		Reddish brown and gray.							
36									
37									
38									
39									
40									

BORING CONTINUED ON I-6.

SCST, Inc.

Carlsbad Village Double Track
Carlsbad, California

By:	JCU	Date:	May, 2016
Job Number:	150448P3.3	Figure:	I-5

LOG OF BORING B-2 (Continued)

Date Drilled: 4/25/2016 | Logged by: EM

Equipment: CME-95 with 8-inch Diamter Hollow-Stem Auger | Project Manager: AKN

Elevation (ft): 44 | Depth to Groundwater (ft): 15½

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVEN	SAMPLES: BULK	DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
41	CL	**OLD PARALIC DEPOSITS (Qop)** - SANDY CLAY, light brown, fine to medium grained, moist, very stiff.							
42									
43									
44									
45		**BORING TERMINATED AT 45 FEET.**							
46									
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									

SCST, Inc.

Carlsbad Village Double Track
Carlsbad, California

By:	JCU	Date:	May, 2016
Job Number:	150448P3.3	Figure:	I-6

LOG OF BORING B-3

Date Drilled: 4/25/2016 | Logged by: EM

Equipment: CME-95 with 8-inch Diameter Hollow-Stem Auger | Project Manager: AKN

Elevation (ft): 44 | Depth to Groundwater (ft): 21½

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVEN	SAMPLES: BULK	DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
1	SM	**FILL (Qf):** SILTY SAND with GRAVEL, light brown, fine to medium grained, moist, medium dense.							
2	SM	**OLD PARALIC DEPOSITS (Qop)**: SILTY SAND, dark brown, fine to medium grained, moist, medium dense.							
3									
4									
5		Brown.							
6									
7									
8									
9									
10									
11									
12									
13		Fragments of light gray clay, dense.							
14									
15									
16		Light brown, dense to very dense.							
17									
18									
19									
20									

BORING CONTINUED ON I-8.

SCST, Inc.

Carlsbad Village Double Track
Carlsbad, California

By:	JCU	Date:	May, 2016
Job Number:	150448P3.3	Figure:	I-7

LOG OF BORING B-3 (Continued)

Date Drilled: 4/25/2016 | Logged by: EM

Equipment: CME-95 with 8-inch Diamter Hollow-Stem Auger | Project Manager: AKN

Elevation (ft): 44 | Depth to Groundwater (ft): 21½

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVEN	SAMPLES: BULK	DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
21		**OLD PARALIC DEPOSITS (Qop):** SILTY SAND, light brown, fine to medium grained, moist, dense to very dense..							
22		▽ Groundwater encountered at 21½ feet on 4/27/2016.							
23									
24									
25									
26									
27									
28									
29									
30		Olive gray.							
31									
32		Approximate depth of proposed railroad trench bottom.							
33									
34									
35									
36									
37									
38									
39									
40									

BORING TERMINATED AT 40 FEET.

SCST, Inc.

Carlsbad Village Double Track
Carlsbad, California

By:	JCU	Date:	May, 2016
Job Number:	150448P3.3	Figure:	I-8

LOG OF BORING B-4

Date Drilled: 4/26/2016 | Logged by: EM

Equipment: CME-95 with 8-inch Diameter Hollow-Stem Auger | Project Manager: AKN

Elevation (ft): 44 | Depth to Groundwater (ft): 19½

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVEN	SAMPLES: BULK	DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
		3 inches of aggregate base.							
1	SM	**FILL (Qf):** SILTY SAND, dark brown, fine to medium grained, moist, medium dense.							
2									
3									
4									
5	SM	**OLD PARALIC DEPOSITS (Qop):** SILTY SAND, brown, fine to medium grained, moist, dense.							
6									
7									
8									
9									
10		Light brown.							
11									
12									
13									
14									
15									
16									
17									
18									
19		▽ Groundwater encountered at 19½ feet on 4/26/2016.							
20									

BORING CONTINUED ON I-10.

SCST, Inc.

Carlsbad Village Double Track
Carlsbad, California

By:	JCU	Date:	May, 2016
Job Number:	150448P3.3	Figure:	I-9

LOG OF BORING B-4 (Continued)

Date Drilled: 4/26/2016 | Logged by: EM

Equipment: CME-95 with 8-inch Diameter Hollow-Stem Auger | Project Manager: AKN

Elevation (ft): 44 | Depth to Groundwater (ft): 19½

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVEN	SAMPLES: BULK	DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
21	SM	**OLD PARALIC DEPOSITS (Qop):** SILTY SAND, light brown, fine to medium grained, wet, dense.							
22		Fine to coarse grained.							
23									
24									
25									
26									
27									
28									
29									
30		Very dense.							
31									
32		Approximate depth of proposed railroad trench bottom.							
33									
34									
35									
36									
37									
38									
39									
40									

BORING TERMINATED AT 40 FEET.

SCST, Inc.

Carlsbad Village Double Track
Carlsbad, California

By:	JCU	Date:	May, 2016
Job Number:	150448P3.3	Figure:	I-10

LOG OF BORING B-5

Date Drilled: 4/26/2016 | Logged by: EM

Equipment: CME-95 with 8-inch Diameter Hollow-Stem Auger | Project Manager: AKN

Elevation (ft): 36 | Depth to Groundwater (ft): 19

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVEN	SAMPLES: BULK	DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
1		**5 inches of asphalt concrete over 5 inches of aggregate base.**							
1	SM	**FILL (Qf):** SILTY SAND, dark brown, fine to medium grained, moist, dense.							
2									
3									
4									
5									
5	CL	**OLD PARALIC DEPOSITS (Qop)**: SANDY LEAN CLAY, light brown, fine to medium grained, moist, stiff.							
6									
7									
8									
9									
10	SM	SILTY SAND, light brown, fine to medium grained, moist, dense.							
11									
12	CL	SANDY LEAN CLAY, brown, fine to medium grained, moist, very stiff.							
13									
14									
15									
16									
17									
18									
19		▽ Approximate depth of proposed railroad trench bottom. Groundwater encountered at 19 feet on 4/26/2016.							
20									

BORING CONTINUED ON I-12.

SCST, Inc.

Carlsbad Village Double Track
Carlsbad, California

By:	JCU	Date:	May, 2016
Job Number:	150448P3.3	Figure:	I-11

LOG OF BORING B-5 (Continued)

Date Drilled: 4/26/2016 | Logged by: EM

Equipment: CME-95 with 8-inch Hollow-Stem Auger | Project Manager: AKN

Elevation (ft): 36 | Depth to Groundwater (ft): 19

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVEN	SAMPLES: BULK	DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
21	CL	**OLD PARALIC DEPOSITS (Qop):** SANDY LEAN CLAY, brown, fine to medium grained, wet, very stiff.							
22									
23		Light brown.							
24									
25									
26									
27									
28		Light olive gray.							
29									
30		**BORING TERMINATED AT 30 FEET.**							
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									

LOG OF BORING B-6

Date Drilled: 4/25/2016 | Logged by: EM

Equipment: CME-95 with 8-inch Diamter Hollow-Stem Auger | Project Manager: AKN

Elevation (ft): 27 | Depth to Groundwater (ft): Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVEN	SAMPLES: BULK	DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
		3 inches of asphalt concrete over 4 inches of aggregate base.							
1	CH	**OLD PARALIC DEPOSITS (Qop):** SANDY FAT CLAY, dark brown, fine to medium grained, moist, stiff.							
2									
3									
4									
5									
6		Approximate depth of proposed railroad trench bottom.							
7		Olive gray.							
8									
9	SC	CLAYEY SAND, olive gray, fine to medium grained, moist, dense.							
10									
11									
12									
13		Some gravel.							
14									
15		**BORING TERMINATED AT 15 FEET.**							
16									
17									
18									
19									
20									

SCST, Inc.

Carlsbad Village Double Track

Carlsbad , California

By:	JCU	Date:	May, 2016
Job Number:	150448P3.3	Figure:	I-13

LOG OF BORING B-7

Date Drilled: 4/26/2016 | Logged by: EM

Equipment: CME-95 with 8-inch Diamter Hollow-Stem Auger | Project Manager: AKN

Elevation (ft): 41 | Depth to Groundwater (ft): 13

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVEN	SAMPLES: BULK	DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
1		**6 inches of asphalt concrete over 7 inches of base.**							
2	SC	**FILL (Qf):** CLAYEY SAND, dark brown, fine to medium grained, moist, medium dense.							
3									
4									
5									
6	SC	**OLD PARALIC DEPOSITS (Qop):** CLAYEY SAND, dark brown, fine to medium grained, moist, dense.							
7									
8									
9									
10	SM	SILTY SAND, light brown, fine to medium grained, moist, dense.							
11									
12									
13		▽ Groundwater encountered at 13 feet on 4/26/2016.							
14		Wet.							
15									
16									
17									
18									
19									
20									

BORING CONTINUED ON I-15.

SCST, Inc.

Carlsbad Village Double Track
Carlsbad, California

By:	JCU	Date:	May, 2016
Job Number:	150448P3.3	Figure:	I-14

LOG OF BORING B-7 (Continued)

Date Drilled: 4/26/2016 | Logged by: EM

Equipment: CME-95 with 8-inch Diameter Hollow-Stem Auger | Project Manager: AKN

Elevation (ft): 41 | Depth to Groundwater (ft): 13

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVEN	SAMPLES: BULK	DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
21	SM	**OLD PARALIC DEPOSITS (Qop):** SILTY SAND, light brown, fine to medium grained, wet, dense.							
22									
23									
24									
25									
26									
27									
28									
29		Approximate depth of proposed railroad trench bottom.							
30	SC	CLAYEY SAND, light brown, fine to coarse grained, wet, very dense.							
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									

BORING TERMINATED AT 40 FEET.

SCST, Inc.

Carlsbad Village Double Track
Carlsbad, California

By:	JCU	Date:	May, 2016
Job Number:	150448P3.3	Figure:	I-15

LOG OF BORING B-8

Date Drilled: 4/25/2016 | Logged by: EM

Equipment: CME-95 with 8-inch Diameter Hollow-Stem Auger | Project Manager: AKN

Elevation (ft): 44 | Depth to Groundwater (ft): 18

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVEN	SAMPLES: BULK	DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
		6 inches of mulch and associated topsoil.							
1	SM	**FILL (Qf)** - SILTY SAND, light brown, fine to medium grained, moist, medium dense.							
2									
3									
4									
5									
6	SC	**OLD PARALIC DEPOSITS (Qop):** CLAYEY SAND, reddish brown, fine grained, moist, dense.							
7									
8									
9									
10									
11									
12									
13									
14									
15									
16	SM	SILTY SAND, light brown, fine to coarse grained, moist, dense.							
17									
18		▽ Groundwater encountered at 18 feet on 4/27/2016.							
19									
20									

BORING CONTINUED ON I-17.

SCST, Inc.

Carlsbad Village Double Track
Carlsbad, California

By:	JCU	Date:	May, 2016
Job Number:	150448P3.3	Figure:	I-16

LOG OF BORING B-8 (Continued)

Date Drilled: 4/25/2016 | Logged by: EM

Equipment: CME-95 with 8-inch Diameter Hollow-Stem Auger | Project Manager: AKN

Elevation (ft): 44 | Depth to Groundwater (ft): 18

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVEN	SAMPLES: BULK	DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
21	SM	**OLD PARALIC DEPOSITS (Qop):** SILTY SAND, light brown, fine to coarse grained, wet, dense.							
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33		Approximate depth of proposed railroad trench bottom.							
34									
35	CL	SANDY LEAN CLAY, gray, fine to medium grained, wet, very stiff.							
36									
37									
38									
39									
40									

BORING CONTINUED ON I-18.

SCST, Inc.

Carlsbad Village Double Track

Carlsbad , California

By:	JCU	Date:	May, 2016
Job Number:	150448P3.3	Figure:	I-17

LOG OF BORING B-8 (Continued)

Date Drilled: 4/26/2016 | Logged by: EM

Equipment: CME-95 with 8-inch Diameter Hollow-Stem Auger | Project Manager: AKN

Elevation (ft): 44 | Depth to Groundwater (ft): 18

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVEN	SAMPLES: BULK	DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
41	CL	**OLD PARALIC DEPOSITS (Qop):** SANDY LEAN CLAY, gray, fine to medium grained, moist, medium dense.							
42									
43									
44									
45		**BORING TERMINATED AT 45 FEET.**							
46									
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									

SCST, Inc.

Carlsbad Village Double Track
Carlsbad, California

By:	JCU	Date:	May, 2016
Job Number:	150448P3.3	Figure:	I-18

LOG OF BORING B-9

Date Drilled: 4/26/2016 | Logged by: EM

Equipment: CME-75 with 8-inch Diameter Hollow-Stem Auger | Project Manager: AKN

Elevation (ft): 38 | Depth to Groundwater (ft): Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVEN	SAMPLES: BULK	DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
		6 Inches of lawn and associated topsoil							
1	SM	**FILL (Qf):** SILTY SAND, dark brown, fine to medium grained, moist, medium dense.							
2									
3									
4	SM	**OLD PARALIC DEPOSITS (Qop):** SILTY SAND, brown, fine grained, moist, dense.							
5									
6									
7									
8		Yellowish brown.							
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20		Approximate depth of proposed railroad trench bottom.							

BORING CONTINUED ON I-20.

SCST, Inc.

Carlsbad Village Double Track
Carlsbad, California

By:	EM	Date:	May, 2016
Job Number:	150448P3.3	Figure:	I-19

LOG OF BORING B-9 (Continued)

Date Drilled: 4/26/20163 | Logged by: EM

Equipment: CME-75 with 8-inch Diameter Hollow-Stem Auger | Project Manager: AKN

Elevation (ft): 38 | Depth to Groundwater (ft): Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVEN	SAMPLES: BULK	DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
21	SW-SM	**OLD PARALIC DEPOSITS (Qop):** WELL-GRADED SAND with SILT, light brown, fine grained, moist, very dense.							
22									
23									
24									
25									
26									
27									
28									
29									
30		**BORING TERMINATED AT 30 FEET.**							
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									

SCST, Inc.

Carlsbad Village Double Track
Carlsbad, California

By:	JCU	Date:	May, 2016
Job Number:	150448P3.3	Figure:	I-20