Los Angeles County
Metropolitan Transportation Authority

West Santa Ana Branch Transit Corridor

Draft EIS/EIR Appendix T
Final Water Resources Impact Analysis Report

Metro

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WEST SANTA ANA BRANCH TRANSIT CORRIDOR PROJECT

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Final Water Resources Impact Analysis Report

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Los Angeles County
Metropolitan Transportation Authority

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ACRONYMS AND ABBREVIATIONS

BMP	best management practice
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
CGP	Construction General Permit for Stormwater Discharges Associated with Construction and Land Disturbance Activities
CWA	Clean Water Act
FEMA	Federal Emergency Management Agency
GSA	Groundwater Sustainability Agency
I-	interstate
IGP	Industrial General Permit
LA	Los Angeles
LACDPW	Los Angeles County Department of Public Works
LACFCD	Los Angeles County Flood Control District
LARWQCB	Los Angeles Regional Water Quality Control Board
LID	low impact development
LRT	light rail transit
LRTP	long-range transportation plan
Metro	Los Angeles County Metropolitan Transportation Authority
mg/L	milligrams per liter
MS4	municipal separate storm sewer system
MSF	maintenance and storage facility
MWD	Metropolitan Water District of Southern California
N/A	not applicable
NFIP	National Flood Insurance Program
NPDES	National Pollutant Discharge Elimination System
Project	West Santa Ana Branch Transit Corridor Project
RHA	Rivers and Harbors Act
ROW	right-of-way
RTP/SCS	Regional Transportation Plan/Sustainable Communities Strategy
RWQCB	Regional Water Quality Control Board
SGMA	Sustainable Groundwater Management Act
SWPPP	stormwater pollution prevention plan

SWRCB	State Water Resources Control Board
TMDL	total maximum daily load
TPSS	traction power substations
U.S.C.	United States Code
USACE	United States Army Corps of Engineers
WDR	waste discharge requirement
WRD	Water Replenishment District of Southern California

1 INTRODUCTION

1.1 Study Background

The West Santa Ana Branch (WSAB) Transit Corridor (Project) is a proposed light rail transit (LRT) line that would extend from four possible northern termini in southeast Los Angeles (LA) County to a southern terminus in the City of Artesia, traversing densely populated, low-income, and heavily transit-dependent communities. The Project would provide reliable, fixed guideway transit service that would increase mobility and connectivity for historically underserved, transit-dependent, and environmental justice communities; reduce travel times on local and regional transportation networks; and accommodate substantial future employment and population growth.

1.2 Alternatives Evaluation, Screening and Selection Process

A wide range of potential alternatives have been considered and screened through the alternatives analysis processes. In March 2010, the Southern California Association of Governments (SCAG) initiated the Pacific Electric Right-of-Way (PEROW)/WSAB Alternatives Analysis (AA) Study (SCAG 2013) in coordination with the relevant cities, Orangeline Development Authority (now known as Eco-Rapid Transit), the Gateway Cities Council of Governments, the Los Angeles County Metropolitan Transportation Authority (Metro), the Orange County Transportation Authority, and the owners of the right-of-way (ROW)—Union Pacific Railroad (UPRR), BNSF Railway, and the Ports of Los Angeles and Long Beach. The AA Study evaluated a wide variety of transit connections and modes for a broader 34-mile corridor from Union Station in downtown Los Angeles to the City of Santa Ana in Orange County. In February 2013, SCAG completed the PEROW/WSAB Corridor Alternatives Analysis Report[1] and recommended two LRT alternatives for further study: West Bank 3 and the East Bank.

Following completion of the AA, Metro completed the WSAB Technical Refinement Study in 2015 focusing on the design and feasibility of five key issue areas along the 19-mile portion of the WSAB Transit Corridor within LA County:

- Access to Union Station in downtown Los Angeles
- Northern Section Options
- Huntington Park Alignment and Stations
- New Metro C (Green) Line Station
- Southern Terminus at Pioneer Station in Artesia

In September 2016, Metro initiated the WSAB Transit Corridor Environmental Study with the goal of obtaining environmental clearance of the Project under the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA).

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[1] Initial concepts evaluated in the SCAG report included transit connections and modes for the 34 mile corridor from Union Station in downtown Los Angeles to the City of Santa Ana. Modes included low speed magnetic levitation (maglev) heavy rail, light rail, and bus rapid transit (BRT).

Metro issued a Notice of Preparation (NOP) on May 25, 2017, with a revised NOP issued on June 14, 2017, extending the comment period. In June 2017, Metro held public scoping meetings in the Cities of Bellflower, Los Angeles, South Gate, and Huntington Park. Metro provided Project updates and information to stakeholders with the intent to receive comments and questions through a comment period that ended in August 2017. A total of 1,122 comments were received during the public scoping period from May through August 2017. The comments focused on concerns regarding the Northern Alignment options, with specific concerns related to potential impacts to Alameda Street with an aerial alignment. Given potential visual and construction issues raised through public scoping, additional Northern Alignment concepts were evaluated.

In February 2018, the Metro Board of Directors approved further study of the alignment in the Northern Section due to community input during the 2017 scoping meetings. A second alternatives screening process was initiated to evaluate the original four Northern Alignment options and four new Northern Alignment concepts. The *Final Northern Alignment Alternatives and Concepts Updated Screening Report* was completed in May 2018 (Metro 2018a). The alternatives were further refined and, based on the findings of the second screening analysis and the input gathered from the public outreach meetings, the Metro Board of Directors approved Build Alternatives E and G for further evaluation (now referred to as Alternatives 1 and 2, respectively, in this report).

On July 11, 2018, Metro issued a revised and recirculated CEQA Notice of Preparation, thereby initiating a scoping comment period. The purpose of the revised Notice of Preparation was to inform the public of the Metro Board's decision to carry forward Alternatives 1 and 2 into the Draft Environmental Impact Statement/Environmental Impact Report (EIS/EIR). During the scoping period, one agency and three public scoping meetings were held in the Cities of Los Angeles, Cudahy, and Bellflower. The meetings provided Project updates and information to stakeholders with the intent to receive comments and questions to support the environmental process. The comment period for scoping ended in August 24, 2018; over 250 comments were received.

Following the July 2018 scoping period, a number of Project refinements were made to address comments received, including additional grade separations, removing certain stations with low ridership, and removing the Bloomfield extension option. The Metro Board adopted these refinements to the project description at their November 2018 meeting.

1.3 Report Purpose and Structure

The purpose of this report is to discuss the Project in relation to hydrology and surface water bodies, water quality, floodplains, and groundwater within the Study Area. The current applicable regulatory setting is described as well as the existing conditions for these resources and potential impacts from construction and operation of the Build Alternatives.

This report identifies, describes, and analyzes potential impacts to water resources that may occur as a result of the Project. Topics discussed include hydrology and surface waters, water quality, floodplains, and groundwater.

The report has seven additional chapters:

- Section 2 – Project Description
- Section 3 – Regulatory Framework

- Section 4 – Affected Environment/Existing Conditions
- Section 5 – Environmental Impacts/Environmental Consequences
- Section 6 – California Environmental Quality Act Determination
- Section 7 – Construction Impacts
- Section 8 – Project Measures and Mitigation Measures
- Section 9 – References

1.4 General Topic Background

Construction and operation of the Project may result in temporary or permanent impacts to hydrology, water resources, and surface and groundwater quality. The Project could change the existing runoff patterns which could also contribute to local flooding. The proposed new river crossings would be constructed within existing floodplains. The Project could also affect water quality in various ways by increasing runoff and exposing stormwater to harmful pollutants through improper handling and treatment. The focus of this analysis is to evaluate the existing regulatory framework and water resources in the Affected Area.

1.5 Methodology for Impact Evaluation

The methodology for the evaluation of impacts to water resources involves an analysis of existing data related to flooding, drainage, water quality, and an assessment of whether the proposed action would substantially degrade surface or groundwater quality; alter drainage patterns in a manner that would cause flooding, erosion, or siltation; result in exposure of people and/or property to water-related hazards; or otherwise conflict with applicable laws related to hydrology and water quality. Impact significance is determined by comparing the project impacts to the CEQA Appendix G Thresholds as summarized in Section 6.

The data were obtained from a variety of local, regional, state, and federal sources. Information regarding the local storm drain and flood control infrastructure was collected from the Los Angeles County Department of Public Works (LACDPW) GIS Data Portal (LACDPW, 2017a). Watershed and surface water quality information was obtained from the LACDPW, the Los Angeles Regional Water Quality Control Board (LARWQCB), and the State Water Resources Control Board (SWRCB). Floodplain information was provided by the Federal Emergency Management Agency (FEMA). Groundwater information was taken from the Metropolitan Water District of Southern California (MWD) and the Water Replenishment District of Southern California (WRD).

Impacts are discussed and analyzed separately for each impact category relative to impacts resulting from construction and operation activities. For example, operational impacts relating to water quality and hydrology are analyzed quantitatively based on changes to impervious area. A quantitative analysis for floodplain impacts is also performed using hydraulic analysis. Each of the alternative alignments were analyzed for potential construction and operations impacts. Construction-related surface water sedimentation impacts can result from erosion and runoff from construction staging areas. Operational impacts, such as increases in polluted stormwater runoff and decreased infiltration resulting from increased impervious surfaces, were analyzed in relation to applicable permits and regulations. Impacts to water quality from rail operations can be quantified based on the length of track because the track operations areas generate and discharge these pollutants in stormwater as non-point source pollution. As pollution generation rates caused by operations are generally similar along the Project guideway alignment, the length of track is therefore a useful way to evaluate and compare Build Alternatives for their magnitude, quality, and location of potential water quality impacts. Existing water quality conditions and identified beneficial uses in the Affected Area watersheds are assessed. Project design features discussed in Section 5.1 are evaluated for their potential to avoid or minimize project impacts. Details of these quantitative analyses and project design features are summarized in each topic in Section 5.

2 PROJECT DESCRIPTION

This section describes the No Build Alternative and the four Build Alternatives studied in the WSAB Transit Corridor Draft EIS/EIR, including design options, station locations, and maintenance and storage facility (MSF) site options. The Build Alternatives were developed through a comprehensive alternatives analysis process and meet the purpose and need of the Project.

The No Build Alternative and four Build Alternatives are generally defined as follows:

- **No Build Alternative -** Reflects the transportation network in the 2042 horizon year without the proposed Build Alternatives. The No Build Alternative includes the existing transportation network along with planned transportation improvements that have been committed to and identified in the constrained Metro 2009 Long Range Transportation Plan (2009 LRTP) (Metro 2009) and SCAG's 2016-2040 Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS) (SCAG 2016), as well as additional projects funded by Measure M that would be completed by 2042.
- **Build Alternatives**: The Build Alternatives consist of a new LRT line that would extend from different termini in the north to the same terminus in the City of Artesia in the south. The Build Alternatives are referred to as:
  - Alternative 1: Los Angeles Union Station to Pioneer Station; the northern terminus would be located underground at Los Angeles Union Station (LAUS) Forecourt
  - Alternative 2: 7th Street/Metro Center to Pioneer Station; the northern terminus would be located underground at 8th Street between Figueroa Street and Flower Street near 7th Street/Metro Center Station
  - Alternative 3: Slauson/A (Blue) Line to Pioneer Station; the northern terminus would be located just north of the intersection of Long Beach Avenue and Slauson Avenue in the City of Los Angeles, connecting to the current A (Blue) Line Slauson Station
  - Alternative 4: I-105/C (Green) Line to Pioneer Station; the northern terminus would be located at I-105 in the city of South Gate, connecting to the C (Green) Line along the I-105

Two design options are under consideration for Alternative 1. Design Option 1 would locate the northern terminus station box at the LAUS Metropolitan Water District (MWD) east of LAUS and the MWD building, below the baggage area parking facility. Design Option 2 would add the Little Tokyo Station along the WSAB alignment. The Design Options are further discussed in Section 2.3.6.

Figure 2-1 presents the four Build Alternatives and the design options. In the north, Alternative 1 would terminate at LAUS and primarily follow Alameda Avenue south underground to the proposed Arts/Industrial District Station. Alternative 2 would terminate near the existing 7th Street/Metro Center Station in the Downtown Transit Core and would primarily follow 8th Street east underground to the proposed Arts/Industrial District Station.

Figure 2-1. Project Alternatives

Source: Metro, 2020

From the Arts/Industrial District Station to the southern terminus at Pioneer Station, Alternatives 1 and 2 share a common alignment. South of Olympic Boulevard, the Alternatives 1 and 2 would transition from an underground configuration to an aerial configuration, cross over the Interstate (I-) 10 freeway and then parallel the existing Metro A (Blue) Line along the Wilmington Branch ROW as it proceeds south. South of Slauson Avenue, which would serve as the northern terminus for Alternative 3, Alternatives 1, 2, and 3 would turn east and transition to an at-grade configuration to follow the La Habra Branch ROW along Randolph Street. At the San Pedro Subdivision ROW, Alternatives 1, 2, and 3 would turn southeast to follow the San Pedro Subdivision ROW and then transition to the Pacific Electric Right-of-Way (PEROW), south of the I-105 freeway. The northern terminus for Alternative 4 would be located at the I-105/C (Green) Line. Alternatives 1, 2, 3, and 4 would then follow the PEROW to the southern terminus at the proposed Pioneer Station in Artesia. The Build Alternatives would be grade-separated where warranted, as indicated on Figure 2-2.

Figure 2-2. Project Alignment by Alignment Type

Source: Metro, 2020

2.1 Geographic Sections

The approximately 19-mile corridor is divided into two geographic sections—the Northern and Southern Sections. The boundary between the Northern and Southern Sections occurs at Florence Avenue in the City of Huntington Park.

2.1.1 Northern Section

The Northern Section includes approximately 8 miles of Alternatives 1 and 2 and 3.8 miles of Alternative 3. Alternative 4 is not within the Northern Section. The Northern Section covers the geographic area from downtown Los Angeles to Florence Avenue in the City of Huntington Park and would generally traverse the Cities of Los Angeles, Vernon, Huntington Park, and Bell, and the unincorporated Florence-Firestone community of LA County (Figure 2-3). Alternatives 1 and 2 would traverse portions of the Wilmington Branch (between approximately Martin Luther King Jr Boulevard along Long Beach Avenue to Slauson Avenue). Alternatives 1, 2, and 3 would traverse portions of the La Habra Branch ROW (between Slauson Avenue along Randolph Street to Salt Lake Avenue) and San Pedro Subdivision ROW (between Randolph Street to approximately Paramount Boulevard).

Figure 2-3. Northern Section

Source: Metro, 2020

2.1.2 Southern Section

The Southern Section includes approximately 11 miles of Alternatives 1, 2, and 3 and includes all 6.6 miles of Alternative 4. The Southern Section covers the geographic area from south of Florence Avenue in the City of Huntington Park to the City of Artesia and would generally traverse the Cities of Huntington Park, Cudahy, South Gate, Downey, Paramount, Bellflower, Cerritos, and Artesia (Figure 2-4). In the Southern Section, all four Build Alternatives would utilize portions of the San Pedro Subdivision and the Metro-owned PEROW (between approximately Paramount Boulevard to South Street).

Figure 2-4. Southern Section

Source: Metro, 2020

2.2 No Build Alternative

For the NEPA evaluation, the No Build Alternative is evaluated in the context of the existing transportation facilities in the Study Area (the Study Area extends approximately 2 miles from either side of the proposed alignment) and other capital transportation improvements and/or transit and highway operational enhancements that are reasonably foreseeable. Because the No Build Alternative provides the background transportation network, against which the Build Alternatives' impacts are identified and evaluated, the No Build Alternative does not include the Project.

The No Build Alternative reflects the transportation network in 2042 and includes the existing transportation network along with planned transportation improvements that have been committed to and identified in the constrained Metro 2009 LRTP and the SCAG 2016 RTP/SCS, as well as additional projects funded by Measure M, a sales tax initiative approved by voters in November 2016. The No Build Alternative includes Measure M projects that are scheduled to be completed by 2042.

Table 2.1 lists the existing transportation network and planned improvements included as part of the No Build Alternative.

Table 2.1. No Build Alternative – Existing Transportation Network and Planned Improvements

Project	To / From	Location Relative to Study Area
Rail (Existing)		
Metro Rail System (LRT and Heavy Rail Transit)	Various locations	Within Study Area
Metrolink (Southern California Regional Rail Authority) System	Various locations	Within Study Area
Rail (Under Construction/Planned)[1]		
Metro Westside D (Purple) Line Extension	Wilshire/Western to Westwood/VA Hospital	Outside Study Area
Metro C (Green) Line Extension[2] to Torrance	96th Street Station to Torrance	Outside Study Area
Metro C (Green) Line Extension	Norwalk to Expo/Crenshaw[3]	Outside Study Area
Metro East-West Line/Regional Connector/Eastside Phase 2	Santa Monica to Lambert Santa Monica to Peck Road	Within Study Area
Metro North-South Line/Regional Connector/Foothill Extension to Claremont Phase 2B	Long Beach to Claremont	Within Study Area
Metro Sepulveda Transit Corridor	Metro G (Orange) Line to Metro E (Expo) Line	Outside Study Area
Metro East San Fernando Valley Transit Corridor	Sylmar to Metro G (Orange) Line	Outside Study Area
Los Angeles World Airport Automated People Mover	96th Street Station to LAX Terminals	Outside Study Area

Project	To / From	Location Relative to Study Area
Metrolink Capital Improvement Projects	Various projects	Within Study Area
California High-Speed Rail	Burbank to LA LA to Anaheim	Within Study Area
Link US[4]	LAUS	Within Study Area
Bus (Existing)		
Metro Bus System (including BRT, Express, and local)	Various locations	Within Study Area
Municipality Bus System[5]	Various locations	Within Study Area
Bus (Under Construction/Planned)		
Metro G (Orange) Line (BRT)	Del Mar (Pasadena) to Chatsworth Del Mar (Pasadena) to Canoga Canoga to Chatsworth	Outside Study Area
Vermont Transit Corridor (BRT)	120th Street to Sunset Boulevard	Outside Study Area
North San Fernando Valley BRT	Chatsworth to North Hollywood	Outside Study Area
North Hollywood to Pasadena	North Hollywood to Pasadena	Outside Study Area
Highway (Existing)		
Highway System	Various locations	Within Study Area
Highway (Under Construction/Planned)		
High Desert Multi-Purpose Corridor	SR-14 to SR-18	Outside Study Area
I-5 North Capacity Enhancements	SR-14 to Lake Hughes Rd	Outside Study Area
SR-71 Gap Closure	I-10 to Rio Rancho Rd	Outside Study Area
Sepulveda Pass Express Lane	I-10 to US-101	Outside Study Area
SR-57/SR-60 Interchange Improvements	SR-70/SR-60	Outside Study Area
I-710 South Corridor Project (Phase 1 & 2)	Ports of Long Beach and LA to SR-60	Within Study Area
I-105 Express Lane	I-405 to I-605	Within Study Area
I-5 Corridor Improvements	I-605 to I-710	Outside Study Area

Source: Metro 2018, WSP 2019

Notes: [1] Where extensions are proposed for existing Metro rail lines, the origin/destination is defined for the operating scheme of the entire rail line following completion of the proposed extensions and not just the extension itself.

[2] Metro C (Green) Line extension to Torrance includes new construction from Redondo Beach to Torrance; however, the line will operate from Torrance to 96th Street.

[3] The currently under construction Metro Crenshaw/LAX Line will operate as the Metro C (Green) Line.

[4] Link US rail walk times included only.

[5] The municipality bus network system is based on service patterns for Bellflower Bus, Cerritos on Wheels, Cudahy Area Rapid Transit, Get Around Town Express, Huntington Park Express, La Campana, Long Beach Transit, Los Angeles Department of Transportation, Norwalk Transit System and the Orange County Transportation Authority.

BRT = Bus Rapid Transit; LAUS = Los Angeles Union Station; LAX = Los Angeles International Airport; VA = Veterans Affairs

2.3 Build Alternatives

2.3.1 Proposed Alignment Configuration for the Build Alternatives

This section describes the alignment for each of the Build Alternatives. The general characteristics of the four Build Alternatives are summarized in Table 2.2. Figure 2-5 illustrates the freeway crossings along the alignment. Additionally, the Build Alternatives would require relocation of existing freight rail tracks within the ROW to maintain existing operations where there would be overlap with the proposed light rail tracks. Figure 2-6 depicts the alignment sections that would share operation with freight and the corresponding ownership.

Table 2.2. Summary of Build Alternative Components

Component	Quantity			
Alternatives	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Alternative 4**
Alignment Length	19.3 miles	19.3 miles	14.8 miles	6.6 miles
Stations Configurations	11 3 aerial; 6 at-grade; 2 underground[3]	12 3 aerial; 6 at-grade; 3 underground	9 3 aerial; 6 at-grade	4 1 aerial; 3 at-grade
Parking Facilities	5 (approximately 2,780 spaces)	5 (approximately 2,780 spaces)	5 (approximately 2,780 spaces)	4 (approximately 2,180 spaces)
Length of underground, at-grade, and aerial	2.3 miles underground; 12.3 miles at-grade; 4.7 miles aerial[1]	2.3 miles underground; 12.3 miles at-grade; 4.7 miles aerial[1]	12.2 miles at-grade; 2.6 miles aerial[1]	5.6 miles at-grade; 1.0 miles aerial[1]
At-grade crossings	31	31	31	11
Freight crossings	10	10	9	2
Freeway Crossings	6 (3 freeway undercrossings[2] at I-710; I-605, SR-91)	6 (3 freeway undercrossings[2] at I-710; I-605, SR-91)	4 (3 freeway undercrossings[2] at I-710; I-605, SR-91)	3 (2 freeway undercrossings[2] at I-605, SR-91)
Elevated Street Crossings	25	25	15	7
River Crossings	3	3	3	1
TPSS Facilities	22[3]	23	17	7
Maintenance and Storage Facility site options	2	2	2	2

Source: WSP, 2020

Notes: [1] Alignment configuration measurements count retained fill embankments as at-grade.

[2] The light rail tracks crossing beneath freeway structures.

[3] Under Design Option 2 – Add Little Tokyo Station, an additional underground station and TPSS site would be added under Alternative 1

Figure 2-5. Freeway Crossings

Source: WSP, 2020

Figure 2-6. Existing Rail Right-of-Way Ownership and Relocation

Source: WSP, 2020

2.3.2 Alternative 1

The total alignment length of Alternative 1 would be approximately 19.3 miles, consisting of approximately 2.3 miles of underground, 12.3 miles of at-grade, and 4.7 miles of aerial alignment. Alternative 1 would include 11 new LRT stations, 2 of which would be underground, 6 would be at-grade, and 3 would be aerial. Under Design Option 2, Alternative 1 would have 12 new LRT stations, and the Little Tokyo Station would be an additional underground station. Five of the stations would include parking facilities, providing a total of up to 2,780 new parking spaces. The alignment would include 31 at-grade crossings, 3 freeway undercrossings, 2 aerial freeway crossings, 1 underground freeway crossing, 3 river crossings, 25 aerial road crossings, and 10 freight crossings.

In the north, Alternative 1 would begin at a proposed underground station at/near LAUS either beneath the LAUS Forecourt or, under Design Option 1, east of the MWD building beneath the baggage area parking facility (Section 2.3.6). Crossovers would be located on the north and south ends of the station box with tail tracks extending approximately 1,200 feet north of the station box. A tunnel extraction portal would be located within the tail tracks for both Alternative 1 terminus station options.

From LAUS, the alignment would continue underground crossing under the US-101 freeway and the existing Metro L (Gold) Line aerial structure and continue south beneath Alameda Street to the optional Little Tokyo Station between 1st Street and 2nd Street (note: under Design Option 2, Little Tokyo Station would be constructed). From the optional Little Tokyo Station, the alignment would continue underground beneath Alameda Street to the proposed Arts/Industrial District Station under Alameda Street between 6th Street and Industrial Street. (Note, Alternative 2 would have the same alignment as Alternative 1 from this point south. Refer to Section 2.3.3 for additional information on Alternative 2.)

The underground alignment would continue south under Alameda Street to 8th Street, where the alignment would curve to the west and transition to an aerial alignment south of Olympic Boulevard. The alignment would cross over the I-10 freeway in an aerial viaduct structure and continue south, parallel to the existing Metro A (Blue) Line at Washington Boulevard. The alignment would continue in an aerial configuration along the eastern half of Long Beach Avenue within the UPRR-owned Wilmington Branch ROW, east of the existing Metro A (Blue) Line and continue south to the proposed Slauson/A Line Station. The aerial alignment would pass over the existing pedestrian bridge at E. 53rd Street. The Slauson/A Line Station would serve as a transfer point to the Metro A (Blue) Line via a pedestrian bridge. The vertical circulation would be connected at street level on the north side of the station via stairs, escalators, and elevators. (The Slauson/A Line Station would serve as the northern terminus for Alternative 3; refer to Section 2.3.4 for additional information on Alternative 3.)

South of the Slauson/A Line Station, the alignment would turn east along the existing La Habra Branch ROW (also owned by UPRR) in the median of Randolph Street. The alignment would be on the north side of the La Habra Branch ROW and would require the relocation of existing freight tracks to the southern portion of the ROW. The alignment would transition to an at-grade configuration at Alameda Street and would proceed east along the Randolph Street median. Wilmington Avenue, Regent Street, Albany Street, and Rugby Avenue would be closed to traffic crossing the ROW, altering

the intersection design to a right-in, right-out configuration. The proposed Pacific/Randolph Station would be located just east of Pacific Boulevard.

From the Pacific/Randolph Station, the alignment would continue east at-grade. Rita Avenue would be closed to traffic crossing the ROW, altering the intersection design to a right-in, right-out configuration. At the San Pedro Subdivision ROW, the alignment would transition to an aerial configuration and turn south to cross over Randolph Street and the freight tracks, returning to an at-grade configuration north of Gage Avenue. The alignment would be located on the east side of the existing San Pedro Subdivision ROW freight tracks, and the existing tracks would be relocated to the west side of the ROW. The alignment would continue at-grade within the San Pedro Subdivision ROW to the proposed at-grade Florence/Salt Lake Station south of the Salt Lake Avenue/Florence Avenue intersection.

South of Florence Avenue, the alignment would extend from the proposed Florence/Salt Lake Station in the City of Huntington Park to the proposed Pioneer Station in the City of Artesia, as shown in Figure 2-4. The alignment would continue southeast from the proposed at-grade Florence/Salt Lake Station within the San Pedro Subdivision ROW, crossing Otis Avenue, Santa Ana Street, and Ardine Street at-grade. The alignment would be located on the east side of the existing San Pedro Subdivision freight tracks and the existing tracks would be relocated to the west side of the ROW. South of Ardine Street, the alignment would transition to an aerial structure to cross over the existing UPRR tracks and Atlantic Avenue. The proposed Firestone Station would be located on an aerial structure between Atlantic Avenue and Florence Boulevard.

The alignment would then cross over Firestone Boulevard and transition back to an at-grade configuration prior to crossing Rayo Avenue at-grade. The alignment would continue south along the San Pedro Subdivision ROW, crossing Southern Avenue at-grade and continuing at-grade until it transitions to an aerial configuration to cross over the LA River. The proposed LRT bridge would be constructed next to the existing freight bridge. South of the LA River, the alignment would transition to an at-grade configuration crossing Frontage Road at-grade, then passing under the I-710 freeway through the existing box tunnel structure and then crossing Miller Way. The alignment would then return to an aerial structure to cross the Rio Hondo Channel. South of the Rio Hondo Channel, the alignment would briefly transition back to an at-grade configuration and then return to an aerial structure to cross over Imperial Highway and Garfield Avenue. South of Garfield Avenue, the alignment would transition to an at-grade configuration and serve the proposed Gardendale Station north of Gardendale Street.

From the Gardendale Station, the alignment would continue south in an at-grade configuration, crossing Gardendale Street and Main Street to connect to the proposed I-105/C Line Station, which would be located at-grade north of Century Boulevard. This station would be connected to the new infill C (Green) Line Station in the middle of the freeway via a pedestrian walkway on the new LRT bridge. The alignment would continue at-grade, crossing Century Boulevard and then over the I-105 freeway in an aerial configuration within the existing San Pedro Subdivision ROW bridge footprint. A new Metro C (Green) Line Station would be constructed in the median of the I-105 freeway. Vertical pedestrian access would be provided from the LRT bridge to the proposed I-105/C Line Station platform via stairs and elevators. To accommodate the construction of the new station platform, the existing Metro C (Green) Line tracks would be widened and, as part of the I-105 Express Lanes Project, the I-105 lanes would be reconfigured. (The I-105/C Line Station would serve

as the northern terminus for Alternative 4; refer to Section 2.3.5 for additional information on this alternative.)

South of the I-105 freeway, the alignment would continue at-grade within the San Pedro Subdivision ROW. In order to maintain freight operations and allow for freight train crossings, the alignment would transition to an aerial configuration as it turns southeast and enter the PEROW. The existing freight track would cross beneath the aerial alignment and align on the north side of the PEROW east of the San Pedro Subdivision ROW. The proposed Paramount/Rosecrans Station would be located in an aerial configuration west of Paramount Boulevard and north of Rosecrans Avenue. The existing freight track would be relocated to the east side of the alignment beneath the station viaduct.

The alignment would continue southeast in an aerial configuration over the Paramount Boulevard/Rosecrans Avenue intersection and descend to an at-grade configuration. The alignment would return to an aerial configuration to cross over Downey Avenue descending back to an at-grade configuration north of Somerset Boulevard. One of the adjacent freight storage tracks at Paramount Refinery Yard would be relocated to accommodate the new LRT tracks and maintain storage capacity. There are no active freight tracks south of the World Energy facility.

The alignment would cross Somerset Boulevard at-grade. South of Somerset Boulevard, the at-grade alignment would parallel the existing Bellflower Bike Trail that is currently aligned on the south side of the PEROW. The alignment would continue at-grade crossing Lakewood Boulevard, Clark Avenue, and Alondra Boulevard. The proposed at-grade Bellflower Station would be located west of Bellflower Boulevard.

East of Bellflower Boulevard, the Bellflower Bike Trail would be realigned to the north side of the PEROW to accommodate an existing historic building located near the southeast corner of Bellflower Boulevard and the PEROW. It would then cross back over the LRT tracks at-grade to the south side of the ROW. The LRT alignment would continue southeast within the PEROW and transition to an aerial configuration at Cornuta Avenue, crossing over Flower Street and Woodruff Avenue. The alignment would return to an at-grade configuration at Walnut Street. South of Woodruff Avenue, the Bellflower Bike Trail would be relocated to the north side of the PEROW. Continuing southeast, the LRT alignment would cross under the SR-91 freeway in an existing underpass. The alignment would cross over the San Gabriel River on a new bridge, replacing the existing abandoned freight bridge. South of the San Gabriel River, the alignment would transition back to an at-grade configuration before crossing Artesia Boulevard at-grade.

East of Artesia Boulevard the alignment would cross beneath the I-605 freeway in an existing underpass. Southeast of the underpass, the alignment would continue at-grade, crossing Studebaker Road. North of Gridley Road, the alignment would transition to an aerial configuration to cross over 183rd Street and Gridley Road. The alignment would return to an at-grade configuration at 185th Street, crossing 186th Street and 187th Street at-grade. The alignment would then pass through the proposed Pioneer Station on the north side of Pioneer Boulevard at-grade. Tail tracks accommodating layover storage for a three-car train would extend approximately 1,000 feet south from the station, crossing Pioneer Boulevard and terminating west of South Street.

2.3.3 Alternative 2

The total alignment length of Alternative 2 would be approximately 19.3 miles, consisting of approximately 2.3 miles of underground, 12.3 miles of at-grade, and 4.7 miles of aerial alignment. Alternative 2 would include 12 new LRT stations, 3 of which would be underground, 6 would be at-grade, and 3 would be aerial. Five of the stations would include parking facilities, providing a total of approximately 2,780 new parking spaces. The alignment would include 31 at-grade crossings, 3 freeway undercrossings, 2 aerial freeway crossings, 1 underground freeway crossing, 3 river crossings, 25 aerial road crossings, and 10 freight crossings.

In the north, Alternative 2 would begin at the proposed WSAB 7th Street/Metro Center Station, which would be located underground beneath 8th Street between Figueroa Street and Flower Street. A pedestrian tunnel would provide connection to the existing 7th Street/Metro Center Station. Tail tracks, including a double crossover, would extend approximately 900 feet beyond the station, ending east of the I-110 freeway. From the 7th Street/Metro Center Station, the underground alignment would proceed southeast beneath 8th Street to the South Park/Fashion District Station, which would be located west of Main Street beneath 8th Street.

From the South Park/Fashion District Station, the underground alignment would continue under 8th Street to San Pedro Street, where the alignment would turn east toward 7th Street, crossing under privately owned properties. The tunnel alignment would cross under 7th Street and then turn south at Alameda Street. The alignment would continue south beneath Alameda Street to the Arts/Industrial District Station located under Alameda Street between 7th Street and Center Street. A double crossover would be located south of the station box, south of Center Street. From this point, the alignment of Alternative 2 would follow the same alignment as Alternative 1, which is described further in Section 2.3.2.

2.3.4 Alternative 3

The total alignment length of Alternative 3 would be approximately 14.8 miles, consisting of approximately 12.2 miles of at-grade, and 2.6 miles of aerial alignment. Alternative 3 would include 9 new LRT stations, 6 would be at-grade and 3 would be aerial. Five of the stations would include parking facilities, providing a total of approximately 2,780 new parking spaces. The alignment would include 31 at-grade crossings, 3 freeway undercrossings, 1 aerial freeway crossing, 3 river crossings, 15 aerial road crossings, and 9 freight crossings. In the north, Alternative 3 would begin at the Slauson/A Line Station and follow the same alignment as Alternatives 1 and 2, described in Section 2.3.2.

2.3.5 Alternative 4

The total alignment length of Alternative 4 would be approximately 6.6 miles, consisting of approximately 5.6 miles of at-grade and 1.0 mile of aerial alignment. Alternative 3 would include 4 new LRT stations, 3 would be at-grade, and 1 would be aerial. Four of the stations would include parking facilities, providing a total of approximately 2,180 new parking spaces. The alignment would include 11 at-grade crossings, 2 freeway undercrossings, 1 aerial freeway crossing, 1 river crossing, 7 aerial road crossings, and 2 freight crossings. In the north, Alternative 4 would begin at the I-105/C Line Station and follow the same alignment as Alternatives 1, 2, and 3, described in Section 2.3.2.

2.3.6 Design Options

Alternative 1 includes two design options:

- **Design Option 1:** LAUS at the Metropolitan Water District (MWD) – The LAUS station box would be located east of LAUS and the MWD building, below the baggage area parking facility instead of beneath the LAUS Forecourt. Crossovers would be located on the north and south ends of the station box with tail tracks extending approximately 1,200 feet north of the station box. From LAUS, the underground alignment would cross under the US-101 freeway and the existing Metro L (Gold) Line aerial structure and continue south beneath Alameda Street to the optional Little Tokyo Station between Traction Avenue and 1st Street. The underground alignment between LAUS and the Little Tokyo Station would be located to the east of the base alignment.
- **Design Option 2:** Add the Little Tokyo Station – Under this design option, the Little Tokyo Station would be constructed as an underground station and there would be a direct connection to the Regional Connector Station in the Little Tokyo community. The alignment would proceed underground directly from LAUS to the Arts/Industrial District Station primarily beneath Alameda Street.

2.3.7 Maintenance and Storage Facility

MSFs accommodate daily servicing and cleaning, inspection and repairs, and storage of light rail vehicles (LRV). Activities may take place in the MSF throughout the day and night depending upon train schedules, workload, and the maintenance requirements.

Two MSF options are evaluated; however, only one MSF would be constructed as part of the Project. The MSF would have storage tracks, each with sufficient length to store three-car train sets and a maintenance-of-way vehicle storage. The facility would include a main shop building with administrative offices, a cleaning platform, a traction power substation (TPSS), employee parking, a vehicle wash facility, a paint and body shop, and other facilities as needed. The east and west yard leads (i.e., the tracks leading from the mainline to the facility) would have sufficient length for a three-car train set. In total, the MSF would need to accommodate approximately 80 LRVs to serve the Build Alternatives' operations plan.

Two potential locations for the MSF have been identified—one in the City of Bellflower and one in the City of Paramount. These options are described further in the following sections.

2.3.8 Bellflower MSF Option

The Bellflower MSF site option is bounded by industrial facilities to the west, Somerset Boulevard and apartment complexes to the north, residential homes to the east, and the PEROW and Bellflower Bike Trail to the south. The site is approximately 21 acres in area and can accommodate up to 80 vehicles (Figure 2-7).

2.3.9 Paramount MSF Option

The Paramount MSF site option is bounded by the San Pedro Subdivision ROW on the west, Somerset Boulevard to the south, industrial and commercial uses on the east, and All American City Way to the north. The site is 22 acres and could accommodate up to 80 vehicles (Figure 2-7).

Figure 2-7. Maintenance and Storage Facility Options

Source: WSP, 2020

3 REGULATORY FRAMEWORK

This section describes federal, state, regional, and local regulations and requirements related to potential water quality, flooding, and hydrology impacts. Permits would be required during construction and operation of the Project to comply with applicable regulations. Where possible, this section identifies whether a specific permit would be required during construction phases, operation, or both; however, exact permit requirements will not be known until specific plans for construction and future operation are finalized and submitted to the applicable resource agencies. Permitting and coordination requirements would depend on the permitting agency and level of impact. These requirements could also depend on the construction phasing and methods of the proposed Build Alternative. During construction, permits from local agencies may be required.

3.1 Federal

The following sections describe federal regulations that are applicable to construction and/or operation of the Project.

3.1.1 Clean Water Act (33 U.S.C. 1251 et seq.)

The Clean Water Act (CWA) of 1972 establishes the basic structure for regulating discharges of pollutants into Waters of the United States and gives the United States Environmental Protection Agency the authority to implement pollution control programs such as setting wastewater standards for industries. In most states, including California, the United States Environmental Protection Agency has delegated this authority to state agencies.

3.1.1.1 Section 303(d)

Section 303(d) of the CWA requires states, territories, and authorized tribes to develop a list of water quality-impaired segments of waterways. The 303(d) list includes water bodies that do not meet water quality standards for the specified beneficial uses of that waterway, even after point sources of pollution have installed the minimum required levels of pollution control technology. The law requires that these jurisdictions establish priority rankings for water bodies on their 303(d) lists and implement a process, called total maximum daily loads (TMDLs), to meet water quality standards. The TMDL process establishes maximum allowable pollutant loadings and provides the basis for establishing water-quality-based standards.

Section 4 describes the existing condition of waterways and groundwater in the Affected Area, established beneficial uses and associated TMDLs. These water quality regulations would be applicable during construction and operation of the Project.

3.1.1.2 Section 401

Section 401 of the CWA requires a State Water Quality Certification to show that the proposed project will comply with state water quality standards for any activity that results in a discharge to a water body. In the event that a proposed Build Alternative requires permitting under CWA Section 404 (described below, Section 404 regulates the discharge of dredged or fill material into Waters of the United States), water quality certification is also required under CWA Section 401. These regulatory requirements are applicable during construction of projects in the vicinity of waterways in the Affected Area, including the

Los Angeles River, the Rio Hondo Channel and the San Gabriel River. In California, the SWRCB and Regional Water Quality Control Boards (RWQCBs) are responsible for reviewing proposed projects and issuing water quality certifications. Coordination with the LARWQCB would occur to determine permit applicability and requirements.

3.1.1.3 Section 402 (National Pollutant Discharge Elimination System)

The National Pollutant Discharge Elimination System (NPDES) permit process provides a regulatory mechanism for the control of point source discharges—a municipal or industrial discharge at a specific location or pipe—to Waters of the United States. Two exceptions that are regulated under the NPDES program are (1) diffuse source discharges caused by general construction activities of more than 1 acre and (2) stormwater discharges in municipal stormwater systems as a separate system in which runoff is carried through a developed conveyance system to specific discharge locations.

3.1.1.4 Section 404

The CWA also requires that a permit be obtained from the United States Army Corps of Engineers (USACE) when discharge of dredged or fill material is proposed within Waters of the United States. Under Section 404 (in 33 United States Code [U.S.C.] 328.3(a)), discharges of dredged or fill materials are regulated to minimize water quality impacts. Coordination with the resource agency would occur to determine permit applicability and requirements.

3.1.2 Rivers and Harbors Act of 1899 (33 U.S.C. 403 and 408)

Section 10 of the Rivers and Harbors Act, as codified in 33 U.S.C. 403, requires a permit for creating obstructions (including excavation and fill activities) to the navigable waters of the United States. Navigable waters are defined as those water bodies subject to the ebb and flow of the tide and/or that are utilized in their natural condition or by reasonable improvements as means to transport interstate or foreign commerce.

Section 14 of the Rivers and Harbors Act, as codified in 33 U.S.C. 408, requires permission for the use, including modifications or alterations, of any flood control facility work built by the United States so that the usefulness of the federal facility is not impaired. The permission for occupation or use is to be granted by "appropriate real estate instrument in accordance with existing real estate regulations."

Approval for any modifications, alterations, or occupation of USACE public works projects is granted through the District's Section 408 program. Public works projects include dams, basins, levees, channels, navigational channels and any other local flood protection works constructed by USACE (e.g., the Los Angeles River). A 408 permit is only required for alterations proposed within lands and real property within USACE jurisdiction. Coordination with the resource agency would occur to determine permit applicability and requirements.

3.1.3 Executive Order 11988 and 13690: Floodplain Management

Executive Order 11988 directs all federal agencies to avoid, to the extent possible, incompatible floodplain development, to be consistent with the standards and criteria of the National Flood Insurance Program (NFIP), and to restore and preserve natural and beneficial floodplain values. Incompatible development includes long-term and short-term adverse impacts associated with the occupancy and modification of floodplains. Executive Order (EO) 13690 amends EO 11988 to establish a federal flood risk management standard and a process for soliciting and considering stakeholder input. EO 13690 was revoked in 2017 by Section 6 of EO 13807, Establishing Discipline and Accountability in the Environmental Review and Permitting Process for Infrastructure. In January 2021, EO 13834 revoked EO 13807; therefore, EO 13690 comes back into effect.

FEMA administers the NFIP and provides floodplain information for many areas of the country through Flood Insurance Studies and their associated Flood Insurance Rate Maps.

3.1.4 National Flood Insurance Act (42 U.S.C. 4001 et seq.)

The purpose of the National Flood Insurance Act is to identify flood-prone areas and provide insurance. The act requires purchase of insurance for developments in special flood hazard areas. The act is applicable to any federally assisted acquisition or construction project in an area identified as having special flood hazards. Projects should avoid construction in, or develop a design to be consistent with, FEMA-identified flood hazard areas.

3.1.5 Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act requires federal agencies to consult with the United States Fish and Wildlife Service, or, in some instances, with the National Oceanic and Atmospheric Administration, National Marine Fisheries Service and with state fish and wildlife resource agencies (such as the California Department of Fish and Wildlife [CDFW]) before undertaking or approving water projects that control or modify surface water resources. The purpose of this consultation is so that wildlife concerns receive equal consideration in the development of water resource projects and are coordinated with the features and footprint (temporary and permanent) of these projects. Federal agencies are required to fully consider these agencies' recommendations in project reports and to include measures to reduce impacts on fish and wildlife in project plans.

3.2 State

The SWRCB and the nine RWQCBs are responsible for the protection of water quality in the state. The SWRCB establishes statewide policies and regulations mandated by federal and state water quality statutes and regulations. The RWQCBs are responsible for the development and implementation of Water Quality Control Plans, also known as Basin Plans, which address regional beneficial uses, water quality characteristics, and water quality problems. The RWQCB is responsible for implementing the Porter-Cologne Water Quality Control Act discussed in Section 3.2.1. The RWQCB is also responsible for issuing Water Quality Certifications pursuant to Section 401 of the CWA, as described above.

All projects resulting in discharges, whether to land or water, are subject to Section 13263 of the California Water Code. Through the mandates of this section, dischargers are required to comply with waste discharge requirements (WDRs) as developed by the RWQCB. WDRs for discharges to surface waters must meet requirements for related NPDES permits presented in Section 3.2.4, Section 3.2.5, and Section 3.3.1.

3.2.1 Porter-Cologne Water Quality Control Act

The Porter-Cologne Water Quality Control Act of 1969 established the principal California program for water quality control. The Act authorizes the SWRCB to adopt, review, and revise policies for all waters of the state (including both surface and groundwater); regulates discharges to surface and groundwater; and directs the RWQCB to develop regional Basin Plans. Section 13170 of the California Water Code also authorizes the SWRCB to adopt water quality control plans on its own initiative. The Act also divides the State of California into nine RWQCB areas. Each RWQCB implements and enforces provisions of the CWA subject to policy guidance and review by the SWRCB. The Affected Area is located in the LARWQCB, Region 4, which has developed the *Water Quality Control Plan, Los Angeles Region* (Basin Plan for the Coastal Watersheds of Los Angeles and Ventura Counties [LARWQCB 1995]).

3.2.2 California Fish and Game Code Section 1602

Section 1602 of the California Fish and Game Code, as administered by the CDFW, mandates that "it is unlawful for any person to substantively divert or obstruct the natural flow or substantially change the bed, channel, or bank of any river, stream, or lake designated by the department, or use any material from the streambeds, without first notifying the department of such activity." Streambed alteration must be permitted by CDFW through a Lake or Streambed Alteration Agreement. CDFW defines streambeds as "a body of water that flows at least periodically or intermittently through a bed or channel having banks and supports fish or other aquatic life" and lakes as "natural lakes and manmade reservoirs." CDFW jurisdiction includes ephemeral, intermittent, and perennial watercourses, and can extend to habitats adjacent to watercourses.

To meet the requirements of Section 1602, entities must notify CDFW of any proposed activity that may substantially modify a river, stream, or lake. The notification requirement applies to work undertaken in or near a river, stream, or lake that flows at least intermittently through a bed or channel. Waterways in the vicinity of the proposed alignments include the Los Angeles River, Rio Hondo, San Gabriel River, and Coyote Creek. Notification of CDFW would be required prior to the start of construction.

3.2.3 State Antidegradation Policy

In accordance with the federal Antidegradation Policy, the state policy was adopted by the SWRCB to maintain high-quality waters in California. This state policy restricts the degradation of surface and groundwaters. Implemented by the RWQCBs, the policy is necessary to achieve the federal CWA's goals and objectives. In particular, the policy protects bodies of water where the existing water quality is higher than necessary for the protection of present and anticipated beneficial uses. Pollutants regulated under the policy can be attributed to, among other sources, industrial, and municipal discharges. The policy requires that any activity that produces or may produce a waste or increased volume or concentration of waste and that discharges or proposes to discharge into high-quality waters is required to meet WDRs to control the discharge and assure that a pollution or nuisance will not occur.

3.2.4 Construction General NPDES Permit

In accordance with CWA Section 402(p), which regulates municipal and industrial stormwater discharges under the NPDES program, the SWRCB adopted the General Permit for Stormwater Discharges Associated with Construction and Land Disturbance Activities (Construction General Permit [CGP]) on September 2, 2009 (Order No. 2009-0009-DWQ [as amended by 2010-0014-DWQ and 2012-0006-DWQ]) (SWRCB 2012).

The main objectives of the CGP are to:

- Reduce erosion from construction projects or activities
- Minimize or eliminate sediment in stormwater discharges from construction projects
- Prevent materials used at a construction site from contacting stormwater

- Implement a sampling and analysis program to monitor construction site runoff
- Eliminate unauthorized nonstormwater discharges from the construction sites
- Implement appropriate measures to reduce potential impacts on waterways both during and after construction projects
- Establish maintenance commitments on post-construction pollution control measures

The CGP requirements apply to any construction project that either results in the disturbance of at least 1 acre of land or is part of a larger common development plan. Additionally, the CGP is required for related construction or demolition activities, including clearing, grading, grubbing, or excavation, or any other activity that results in greater than 1 acre of land disturbance.

Minimum stormwater control requirements under the permit are determined by project risk categories as determined by Section VIII of the CGP. Risk categories include the sediment risk factor and the receiving water risk factor. These are combined to determine a construction site's project risk level. Risk levels are identified as 1, 2, or 3 ranging from lowest to greatest risk to water quality. The project risk level governs the applicable minimum best management practices (BMPs), monitoring requirements, reporting requirements, and the effluent standards used to assess monitoring data and project compliance. Risk Level 1 projects are subject to minimum BMP and visual monitoring requirements; Risk Level 2 projects are subject to Numeric Action Levels and some additional monitoring requirements; and Risk Level 3 projects are subject to Numeric Action Levels and more rigorous monitoring requirements such as receiving water monitoring and, in some cases, bioassessment. Once the project risk level is determined, minimum BMP requirements are specified as to the CGP. BMPs are separated into five overall categories:

- Good site management "housekeeping"
- Nonstormwater management
- Erosion control
- Sediment controls
- Run-on and runoff controls

Post-construction runoff reduction is required by the CGP unless the project is located within an area subject to post-construction standards of an active Phase I or Phase II Municipal Separate Storm Sewer System (MS4) permit that has an approved stormwater management plan. The Project falls within the Los Angeles (LA) County MS4 Permit as described in Section 3.3.1.1 and is therefore not subject to the post-construction requirements within the CGP.

3.2.5 Industrial General NPDES Permit

Amendments made to the CWA in 1987 require that stormwater associated with industrial activities that discharge either directly into surface waters or indirectly through municipal separate storm sewers must be regulated by an NPDES permit. As with the CGP, the SWRCB administers the Industrial General Permit (IGP) (Order No. 2014-0057-DWQ). The proposed Project would be subject to the regulations of this NPDES permit because it is a transportation facility with vehicle maintenance shops and equipment cleaning operations. The Local and Suburban Transit (4111) Standard Industrial Classification Code is applicable to the Project and regulated by the IGP.

3.2.6 Alquist-Priolo Earthquake Fault Zoning Act

The 1972 Alquist-Priolo Earthquake Fault Zoning Act was created with the purpose of mitigating the hazards of fault rupture. Structures for human occupancy are prohibited from placement across the trace of an active fault. This regulation is related to water resources, given the potential hazards of dam failure/inundation caused by strong earthquake ground shaking or a seiche event, erosion, improper siting and/or design, and rapidly rising floodwaters during heavy storm events.

3.2.7 Seismic Hazards Mapping Act

The state's Seismic Hazards Mapping Act (1990) requires the State Geologist to compile maps that identify and describe the seismic hazard zones in California. The mapping area emphasizes urban areas in LA, Ventura, and Orange Counties in Southern California; and Alameda, San Francisco, San Mateo, and Santa Clara Counties in Northern California. This regulation is related to water resources because the Affected Area is susceptible to earthquake movement and related dam failure and inundation. See the *West Santa Ana Branch Transit Corridor Project Final Geotechnical, Subsurface, and Seismic Impact Analysis Report* for more information (Metro 2021b).

3.2.8 Sustainable Groundwater Management Act

Sustainable Groundwater Management Act (SGMA) is enforced by the California Department of Water Resources for the management and use of groundwater in a manner than can be maintained during the planning and implementation horizon without causing undesirable results (DWR 2019a). SGMA requires governments and water agencies of high and medium priority basins to halt overdraft and bring groundwater basins into balanced levels of pumping and recharge. SGMA empowers local agencies to form groundwater sustainability agencies (GSAs) to manage basins sustainably and requires those GSAs to adopt groundwater sustainability plans for crucial groundwater basins in California (DWR 2019b). Water Code §10720.8 identifies adjudicated areas in SGMA, which have an existing defined entity administering the adjudication. Under SGMA, adjudicated portions of basins are exempt from developing a groundwater sustainability plan and forming a GSA. However, the entities administering the adjudications are subject to submitting annual reports. The Central Groundwater Basin lies beneath the project site. It is adjudicated and managed by the WRD.

3.3 Regional

3.3.1 Los Angeles Regional Water Quality Control Board

3.3.1.1 Municipal Separate Storm Sewer System

The MS4 permit requires permittees to implement a Standard Urban Stormwater Management Plan that designates BMPs that must be used in specified categories of development to treat stormwater runoff, control peak flow discharges, and reduce post-project discharge of pollutants from stormwater conveyance systems.

LARWQCB Order No. R4-2012-0175 (as amended by State Water Board Order No. WQ 2015-0075 and LARWQCB Order No. R4-2012-0175-A01, NPDES Permit No. CAS004001, Los Angeles MS4 NPDES permit) was originally adopted on November 8, 2012. This MS4 permit regulates the Los Angeles County Flood Control District (LACFCD), the County of Los Angeles and 84 incorporated cities within the LACFCD (including the cities in the

Affected Area) for discharges of stormwater and urban runoff from MS4s, also called storm drainage systems. The discharges flow to water courses within the LACFCD and into receiving waters of the Los Angeles Region.

The Los Angeles MS4 NPDES permit requires new development and redevelopment projects to have post-construction controls to manage pollutants, pollutant loads, and runoff volume emanating from the project site. New development and redevelopment projects are also required to implement hydrologic control measures to minimize changes in post-development hydrologic stormwater runoff discharge rates, velocities, and durations. This shall be achieved by maintaining pre-project stormwater runoff flow rates and durations.

The Los Angeles MS4 NPDES permit also requires municipalities to develop and implement low impact development (LID) ordinances. Local LID ordinances are incorporated into the city Municipal Codes as identified in Table 3.1.

Care is required for the removal of nuisance water from a construction site (known as dewatering), because of the high turbidity and other pollutants potentially associated with this activity. A number of NPDES permits would regulate different construction activities for the Project, including:

- LARWQCB Order No. R4-2013-0095 (NPDES No. CAG994004), WDRs for Discharges of Groundwater from Construction and Project Dewatering to Surface Waters in Coastal Watersheds of Los Angeles and Ventura Counties (Construction Dewatering Permit), covers discharges to surface water from dewatering activities.
- LARWQCB Order No. 93-010, Waste Discharge Requirements for Specified Discharges to Groundwater in the Santa Clara River and Los Angeles River Basins, covers construction dewatering, and dust control application. The WDR requires that wastewater be analyzed prior to being discharged in order to determine if it contains pollutants in excess of the applicable Basin Plan Water Quality Objectives. Additionally, any wastewater that might be encountered and subsequently discharged to groundwater will need to comply with applicable water quality standards.
- LARWQCB Order No. 91-93, WDRs for Discharge of Non-Hazardous Contaminated Soils and Other Wastes in Los Angeles River and Santa Clara River Basins, protects waters of the state from contamination due to disposal of soils containing moderate concentrations of petroleum hydrocarbons, heavy metals, and other wastes.

3.3.1.2 Basin Plan

The Basin Plan that applies to the Affected Area is the Basin Plan for the Coastal Watersheds of Los Angeles and Ventura Counties (LARWQCB 1995). This plan sets forth the regulatory water quality standards for surface waters and groundwater within the region. The water quality standards address both the designated beneficial uses for each water body and the water quality objectives to meet them. Where multiple designated beneficial uses exist, water quality standards are written to protect the most sensitive use.

3.3.1.3 Total Maximum Daily Loads

In accordance with the federal CWA and the state Porter-Cologne Water Quality Control Act, TMDLs have been developed and incorporated into the Basin Plan for some pollutants identified on the 303(d) list as causing contamination in the Los Angeles and San Gabriel River Watersheds. TMDLs govern the discharge of wastewater, urban runoff, and stormwater. A TMDL establishes a maximum limit for a specific pollutant that can be discharged into a water body without causing it to become impaired. As part of the TMDL compliance process, the Los Angeles River Metals TMDL requires responsible implementation agencies to submit a Coordinated Monitoring Plan to the LARWQCB and an Implementation Plan to describe regulatory and permitting requirements related to the TMDL, as well as BMP evaluation and implementation planning.

3.3.2 Los Angeles County General Plan

The Los Angeles (LA) County *General Plan* sets specific goals and policies in relation to water resources, water supply, water quality and flooding in its Conservation and Natural Resources Element (LA County 2015). The following policies apply to the Project in unincorporated LA County areas. Incorporated areas are regulated by applicable city policies (see Section 3.4, Local)

- Policy C/NR 3.9: Consider the following in the design of a project that is located within a sensitive ecological area, to the greatest extent feasible: Protection of water sources from hydromodification in order to maintain the ecological function of riparian habitats and maintenance of watershed connectivity by capturing, treating, retaining, and/or infiltrating stormwater flows onsite.
- Policy C/NR 5.1: Support the LID philosophy, which seeks to plan and design public and private development with hydrologic sensitivity, including limits to straightening and channelizing natural flow paths, removal of vegetative cover, compaction of soils, and distribution of naturalistic BMPs at regional, neighborhood, and parcel-level scales.
- Policy C/NR 5.2: Require compliance by all county departments with adopted MS4, General Construction, and point source NPDES permits.
- Policy C/NR 5.3: Actively engage with stakeholders in the formulation and implementation of surface water preservation and restoration plans, including plans to improve impaired surface water bodies by retrofitting tributary watersheds with LID types of BMPs.
- Policy C/NR 5.4: Actively engage in implementing all approved Enhanced Watershed Management Programs/Watershed Management Programs and Coordinated Integrated Monitoring Programs/Integrated Monitoring Programs or other County-involved TMDL implementation and monitoring plans.
- Policy C/NR 5.5: Manage the placement and use of septic systems in order to protect nearby surface water bodies.
- Policy C/NR 5.6: Minimize point and nonpoint source water pollution.
- Policy C/NR 5.7: Actively support the design of new and retrofit of existing infrastructure to accommodate watershed protection goals, such as roadway, railway, bridge, and other—particularly—tributary street and greenway interface points with channelized waterways.
- Policy C/NR 6.1: Support the LID philosophy, which incorporates distributed, post-construction parcel-level stormwater infiltration as part of new development.

- Policy C/NR 6.2: Protect natural groundwater recharge areas and regional spreading grounds.
- Policy C/NR 6.3: Actively engage in stakeholder efforts to disperse rainwater and stormwater infiltration BMPs at regional, neighborhood, infrastructure, and parcel-level scales.
- Policy C/NR 6.4: Manage the placement and use of septic systems in order to protect high groundwater.
- Policy C/NR 6.5: Prevent stormwater infiltration where inappropriate and unsafe, such as in areas with high seasonal groundwater, on hazardous slopes, within 100 feet of drinking water wells and in contaminated soils.
- Policy C/NR 7.1: Support the LID philosophy, which mimics the natural hydrologic cycle using undeveloped conditions as a base, in public and private land use planning, and development design.
- Policy C/NR 7.2: Support the preservation, restoration, and strategic acquisition of available land for open space to preserve watershed uplands, natural streams, drainage paths, wetlands, and rivers, which are necessary for the healthy function of watersheds.
- Policy C/NR 7.3: Actively engage with stakeholders to incorporate the LID philosophy in the preparation and implementation of watershed and river master plans, ecosystem restoration projects and other related natural resource conservation aims, and support the implementation of existing efforts, including Watershed Management Programs and Enhanced Watershed Management Programs.
- Policy C/NR 7.4: Promote the development of multi-use regional facilities for stormwater quality improvement, groundwater recharge, detention/attenuation, flood management, retaining nonstormwater runoff, and other compatible uses.

3.3.3 Los Angeles County Code

LA County Code Stormwater Ordinance regulates discharges to the storm drainage system, runoff management requirements and violations of the ordinance (Chapter 12.80, Parts 3-5) (LA County 1998). Applicable sections include:

- Prior to construction activity, all stormwater and runoff pollution mitigation measures must be implemented as required by applicable permits (Section 450)
- Discharges from industrial activities are prohibited unless the discharge is in compliance with an NPDES permit (Section 460)
- All BMPs required by applicable construction activity permits must be in effect during the term of the Project (Section 510)
- All industrial facilities must implement BMPs to the maximum extent practicable (Section 520), including:
  - Termination of nonstormwater discharge to the storm drainage system not specifically authorized by a NPDES permit
  - Exercising general good housekeeping practices
  - Incorporating regular scheduled preventative maintenance into operations
  - Maintaining spill prevention and control procedures
  - Implementing soil erosion control
  - Insuring that stormwater runoff is directed away from operating, processing, fueling, cleaning and storage areas (Order No. 98-0021 Section 1 1998)

The LA County LID Ordinance provides development standards to lessen the adverse impacts of stormwater runoff, minimize pollutant loading from impervious surfaces, and minimize erosion and other hydrogeologic impacts resulting from development and redevelopment (Chapter 12.84) (LA County 1998). The LID development standards require projects to:

- Mimic undeveloped stormwater runoff rates and volumes in any storm event up to and including the 50-year design flood
- Prevent pollutants of concern from leaving the development site in stormwater as the result of storms, up to and including a Water Quality Design Storm Event identified by the Los Angeles MS4 NPDES permit
- Minimize hydromodification impacts to natural drainage systems

3.3.4 Los Angeles County Department of Public Works

The Los Angeles County Department of Public Works (LACDPW) is responsible for planning and implementation of watershed management within LA County. Watershed management plans that pertain to the Affected Area include *A Common Thread Rediscovered – San Gabriel River Corridor Master Plan* (LACDPW 2006a) and the *Los Angeles River Master Plan* (LACDPW et al. 1996). The main goals of these watershed management plans are the protection and enhancement of the rivers for flood protection, recreation, and environmental services.

Flood control facilities and wetland areas along the river corridors are regulated by USACE under the CWA and the Rivers and Harbors Act. The LACDPW is the local sponsor and owner of the Rio Hondo Spreading Grounds and San Gabriel Coastal Basin Spreading Grounds, which are used for groundwater recharge and regional water supply. Therefore, any construction activity in these areas would require approvals from both of these agencies.

3.3.5 Los Angeles County Flood Control District Master Drainage Plan for Los Angeles County

The LACFCD is a division of the LACDPW that provides flood protection, water conservation, and recreation and aesthetic enhancement within its boundaries. The LACFCD encompasses more than 3,000 square miles and 85 cities and has jurisdiction over the vast majority of drainage infrastructure with the incorporated and unincorporated areas of the County. The LACFCD develops master drainage plans to address individual watersheds within the LACDPW's jurisdiction. The plans include proposed drainage facilities to protect upstream and downstream properties from serious damage.

3.3.6 Metropolitan Transportation Authority Water Use and Conservation Policy

In addition to complying with local and regional water conservation regulations, Metro developed its own procedures dictating the use of potable water and conservation (Metro 2009b). Applicable procedures relating to water use and conservation required by Metro include:

- Procedure 2.1: Using Potable Water for Pressure Washing Activities
- Procedure 2.2: Using Potable Water for Construction
- Procedure 2.3: New Construction Planning, Design and Construction; Existing Buildings Operations

3.4 Local

Table 3.1 lists and describes local policies (contained in general plans) and ordinances (contained in municipal codes) related to water resources, water quality, and floodplains. Local jurisdictions have review authority over local improvements and storm drain modifications. Not all of the local jurisdictions that could be affected by the Project have specific general plan policies or ordinances related to water resources; therefore, only those jurisdictions with applicable regulations are listed in Table 3.1.

Table 3.1. Local Policies and Plans

Jurisdiction	Hydrology and Water Resources	Water Quality/ Stormwater Management	Floodplain Protection
City of Los Angeles	Municipal Code (City of Los Angeles 2017) Chapter VI, Article 4	General Plan (City of Los Angeles 2000) Conservation Element, Erosion Policy 2 Mobility Plan, Clean Environments and Healthy Communities Policy 5.5. Municipal Code (City of Los Angeles 2017) Chapter VI, Article 4	N/A
City of Vernon	General Plan (City of Vernon 2015) Circulation and Infrastructure Element, Goal CI-5, Policy CI-5.1-5.2	General Plan (City of Vernon 2015) Circulation and Infrastructure Element, Goal CI-5, Policy CI-5.3-5.4 Municipal Code (City of Vernon) Chapter 21	N/A
City of Huntington Park	General Plan (City of Huntington Park 1991) Open Space and Conservation Element, Goal 2, Policy 2.1 Public Facilities Element Goal 6, Policy 6.1-6.3	General Plan (City of Huntington Park 1991) Open Space and Conservation Element, Goal 2, Policy 2.1 Safety Element, Goal 4, Policy 4.4 Public Facilities Element Goal 6, Policy 6.3 Municipal Code (City of Huntington Park 2017) Title 7, Chapter 9	N/A
City of Bell	N/A	Municipal Code (City of Bell 2017) Title 13, Chapter 8	Municipal Code (City of Bell 2017) Title 17, Chapter 64

Jurisdiction	Hydrology and Water Resources	Water Quality/ Stormwater Management	Floodplain Protection
City of Cudahy	General Plan (City of Cudahy 2010) Land Use Element, Goal 1, Policy 1.8 Conservation Element, Goal 1, Policy 1.1	Municipal Code (City of Cudahy 2015) Title 13, Chapter 8 Title 20	Municipal Code (City of Cudahy 2015) Title 16
City of Bell Gardens	Municipal Code (City of Bell Gardens 2016) Title 11, Chapter 12	General Plan (City of Bell Gardens 1995) Conservation Element, Policy 3 Municipal Code (City of Bell Gardens 2016) Title 11, Chapter 12	Municipal Code (City of Bell Gardens 2016) Title 6, Chapter 25
City of South Gate	General Plan (City of South Gate 2009) Green City Element, Objective GC 3.1, Policy P.1-P.6 Green City Element, Objective GC 4.1, Policy P.1-P.5 Public Facilities Element, Objective PF 7.1, Policy P.1-P.3 Municipal Code (City of South Gate 2017) Title 6, Chapter 67	General Plan (City of South Gate 2009) Green City Element, Objective GC 3.1, Policy P.5 Green City Element, Objective GC 4.1, Policy P.6 Green City Element, Objective GC 5.3, Policy P.1 Green City Element, Objective GC 6.1, Policy P.6 Public Facilities Element, Objective PF 7.2, Policy P.1-P.3 Municipal Code (City of South Gate 2017) Title 6, Chapter 67	Municipal Code (City of South Gate 2017) Title 7, Chapter 47
City of Downey	General Plan (City of Downey 2005) Safety Element, Goal 5.6, Policy 5.6.1-5.6.2 Municipal Code Article V, Section 7	General Plan (City of Downey 2005) Conservation Element, Goal 4.2, Policy 4.2.1 Conservation Element, Goal 4.3, Policy 4.3.1 Municipal Code (City of Downey 2017) Article V, Section 7	Municipal Code (City of Downey 2017) Article VIII, Chapter 8

Jurisdiction	Hydrology and Water Resources	Water Quality/ Stormwater Management	Floodplain Protection
City of Paramount	General Plan (City of Paramount 2007) Public Facilities Element Policy 9	General Plan (City of Paramount 2007) Resource Management Element Policy 21 Public Facilities Element Policy 3, 4 Municipal Code (City of Paramount 2008) Chapter 48	Municipal Code (City of Paramount 2008) Chapter 47
City of Bellflower	General Plan (City of Bellflower 1994) Safety Element, Goal 3, Policy 3.2	General Plan (City of Bellflower 1994) Conservation Element, Goal 1, Policy 1.4, 1.5, 1.6 Municipal Code (City of Bellflower 2017) Title 13, Chapter 20 Title 10, Chapter 4	Municipal Code (City of Bellflower 2017) Title 15, Chapter 36
City of Artesia	General Plan (City of Artesia 2010) Infrastructure Sub-Element, Goal CFI 1, Policy CFI 1.1-1.2 Infrastructure Sub-Element, Goal CFI 2, Policy CFI 2.1 Community Safety Sub-Element, Goal SAF 3, Policy SAF 3.1	General Plan (City of Artesia 2010) Infrastructure Sub-Element, Goal SUS CFI 3, Policy CFI 3.1 Sustainability Element, Goal SUS 4.1, Policy SUS 4.1 Sustainability Element, Goal SUS 6, Policy SUS 6.2 Sustainability Element, Goal SUS 8, Policy SUS 8.3 Municipal Code (City of Artesia 2017) Title 6, Chapter 7	Municipal Code (City of Artesia 2017) Title 8, Chapter 8
City of Cerritos	General Plan (City of Cerritos 2004) Safety Element, Goal SAF-1, Policy SAF-1.1-1.4 Growth Management Element Goal GM-2, Policy GM 2.1-2.4	General Plan (City of Cerritos 2004) Safety Element, Goal SAF-3, Policy SAF-3.5 Conservation Element, Goal CON-5, Policy CON-5.1-5.5 Municipal Code (City of Cerritos 2017) Title 6, Chapter 32 Title 6, Chapter 34	Municipal Code (City of Cerritos 2017) Title 6, Chapter 36

Source: See Section 9 for general plan references.
Note: N/A = not applicable

4 AFFECTED ENVIRONMENT/EXISTING CONDITIONS

The Affected Area for hydrology and water resources includes portions of the Los Angeles River, San Gabriel River, and Ballona Creek Watersheds, along with their major tributaries, including the Rio Hondo Channel, Compton Creek, Los Cerritos Channel, and Coyote Creek. The Affected Area includes the area within 500 feet of the construction footprint and includes the following elements:

- Surface water: Receiving waters of project runoff, including existing drainage infrastructure within LA County
- Groundwater: Aquifers underlying the construction footprint
- Flooding: FEMA-designated flood hazard areas located within the proposed Project' physical footprint, as well as any areas where flood frequency, extent, and duration could be affected by the Project

4.1 Hydrology and Surface Water Bodies

4.1.1 Climate, Precipitation and Topography

The climate in the Affected Area is generally Mediterranean and characterized by two climatic types: valley marginal and high desert. Summers are generally hot and dry, while winters are generally temperate and semi-moist. Overall the area's climate is relatively mild, though summertime high temperatures can average about 90 degrees Fahrenheit and wintertime lows can average in the 40s. Annual precipitation in the Affected Area averages from 13 to 15 inches. Almost all rainfall occurs between October and early May. Precipitation in neighboring mountain areas is substantially higher, reaching 22 inches or more per year.

Based on the LA County *Hydrology Manual* (LACDPW 2006b), the 50-year 24-hour rainfall depths range from 5.5 inches per year in the middle of the Affected Area to 6.2 inches per year in the southern portion of the project corridor.

The Project is located within the coastal plain of LA County, which is generally flat with mild slopes draining south to southwest toward the ocean. The coastal plain is an alluvial lowland area bounded to the north by the Santa Monica Mountains and the Elysian, Repetto, and Puente Hills, and bounded on the east and southeast by the Santa Ana Mountains and the San Joaquin Hills. Topography throughout the coastal plain area is generally defined by gradually sloping land from the foothills of the San Gabriel Mountains to the Pacific Ocean. Ground elevations range from 10,000 feet in the San Gabriel Mountains, to 330 feet near the Los Angeles River's confluence with the Arroyo Seco, to sea level at the mouth of the Los Angeles River.

4.1.2 Storm Drainage Infrastructure

The storm drainage system that exists today generally mirrors the historic locations of rivers and tributaries in the watersheds. Many of the original natural drainages have been engineered to serve as storm drainage for the LACDPW (LACDPW 2006a). Land in the Affected Area is urbanized and largely covered with impervious surfaces associated with areas of asphalt, concrete, buildings and other land uses that concentrate storm runoff. The alternative alignments are primarily along major roadway arterials or rail corridors with existing drainage infrastructure. Figure 4-1 shows the location of major flood control channel crossings, including Los Angeles River, Rio Hondo, and San Gabriel River.

Figure 4-1. Hydrology and Surface Water Bodies

Source: Prepared by Jacobs in 2020

The three existing railroad river crossings are:

- Along the proposed alignment, existing railroad tracks cross the **Los Angeles River** at River Station 672+82.98. At this crossing, the river is a trapezoidal concrete channel with a bottom width of 250 feet (2.25:1 horizontal to vertical ratio) and sides that slope up to 16-foot-wide levees on either side of the channel. There is a middle low-flow channel with an invert slope of 0.184 percent in this area. The existing railroad bridge has four piers and a single track (USACE 1950).
- Existing railroad tracks cross the **Rio Hondo Channel** at River Station 23+86.70. At the crossing, the river is a trapezoidal concrete channel with a bottom width of 100 feet and (2.25:1, horizontal to vertical ratio) sides that slope up to 16-foot-wide levees on either side of the channel. The invert slope at this area is 0.170 percent without a low-flow channel. The existing railroad bridge has two piers and a single track (USACE 1950).
- Existing railroad tracks cross the **San Gabriel River** south of the State Route-91 crossing. At the crossing, the river is a trapezoidal concrete channel with a middle low-flow channel. The existing railroad bridge has four piers and a single track.

Throughout the Affected Area, stormwater and other surface water runoff is conveyed to municipal storm drains that eventually drain to the Los Angeles and San Gabriel Rivers. The storm drainage infrastructure within the Affected Area ranges from small, 6- to 8-inch storm drain lateral connections to a 9.5- by 14-foot reinforced concrete box regional drainage facility. Most small storm drainage systems within the Affected Area are reinforced concrete pipes. However, some alternative pipe materials can be found in the Affected Area, including unreinforced concrete, asbestos cement, brick, corrugated metal, vitrified clay, plastic, and high-density polyethylene. Several regional storm drains cross or are parallel to the proposed alignment.

Ownership and maintenance of the storm drainage infrastructure varies between the local jurisdiction, LACFCD, and the California Department of Transportation. Although USACE and LACFCD share ownership of Los Angeles River and San Gabriel River, locations of all potential river crossings are within LACFCD jurisdiction.

4.1.3 Los Angeles River Watershed

The Affected Area is tributary to the Los Angeles River Watershed and the Rio Hondo Channel and Compton Creek sub-watersheds. The Los Angeles River is 55 miles long with an 824-square-mile watershed ranging from the eastern portions of the Santa Monica Mountains, Simi Hills, and the Santa Susana Mountains in the west to the San Gabriel Mountains in the east. The Los Angeles River originates at the western end of the San Fernando Valley at the confluence of Arroyo Calabasas and Bell Creek. The six major tributaries along the river include Tujunga Wash, Burbank Western Storm Drain, Verdugo Wash, Arroyo Seco, Rio Hondo Channel and Compton Creek (LARWQCB 2017a). The watershed and its tributaries in proximity to the Affected Area are shown on Figure 4-1.

While 324 square miles of the 824-square-mile Los Angeles River Watershed are forest and open space, over half of the watershed is highly developed with commercial, industrial and residential uses (LARWQCB 2017a). Land use within the watershed consists of 37 percent residential, 8 percent commercial, 11 percent industrial and 44 percent open space (LACDPW 2017b).

The Rio Hondo Channel Watershed is a 142-square-mile sub-watershed to the Los Angeles River Watershed. The six major tributaries to the Rio Hondo Channel include the Alhambra, Rubio, Eaton, Arcadia, Santa Anita and Sawpit Washes (San Gabriel and Lower Los Angeles Rivers and Mountains Conservancy 2004). The Rio Hondo is hydraulically connected to the San Gabriel River Watershed because flows from the San Gabriel River are routed to Whittier Narrows Reservoir and through the Rio Hondo during larger flood events (LARWQCB 2017a).

The Compton Creek Watershed is a 42-square-mile sub-watershed to the Los Angeles River Watershed and the last major tributary to enter the Los Angeles River before the Pacific Ocean. The sub-watershed is almost entirely developed, and most of the creek is concrete-lined (John L. Hunter and Associates 2014). Figure 4-2 and Figure 4-3 illustrate the alignment.

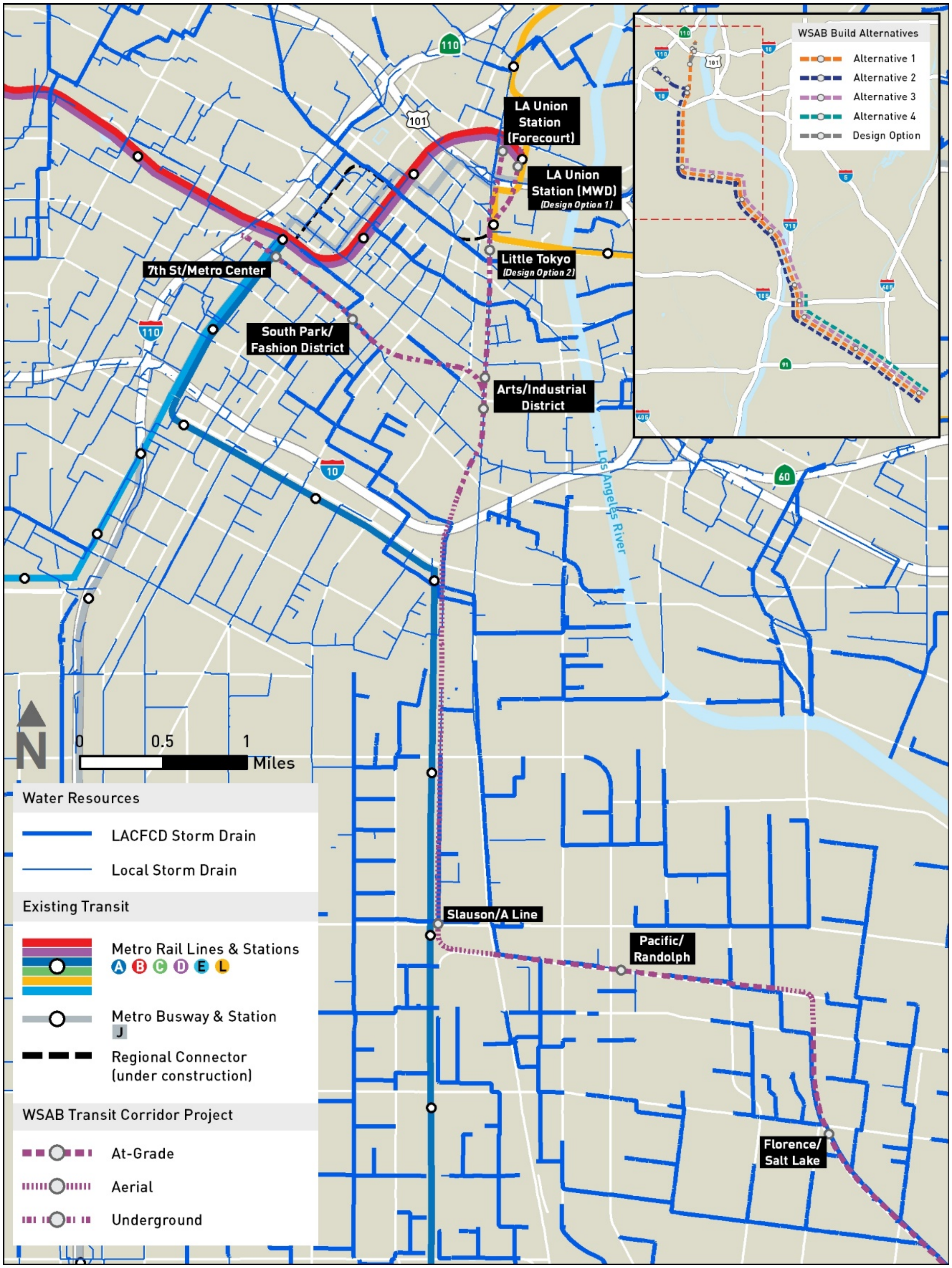
4.1.4 San Gabriel River Watershed

The Affected Area is also tributary to the San Gabriel River Watershed and the Coyote Creek and Los Cerritos Channel sub-watersheds. The San Gabriel River Watershed borders the Los Angeles River Watershed to the east. The entire watershed covers 640 square miles and includes portions of 35 cities in Los Angeles and Orange Counties (LACDPW 2017c). There are four main physiographic areas in the watershed that define the drainage patterns throughout the watershed towards the western boundary; these include the San Gabriel Mountains, San Gabriel and Pomona Valleys, Whittier Narrows and the Los Angeles Coastal Plain (LACDPW 2006a). The San Gabriel River originates in the San Gabriel Mountains in the Angeles National Forest and flows southwest to empty into the Pacific Ocean at Seal Beach, near the LA County and Orange County border. The watershed and its tributaries in proximity to the Project are shown on Figure 4-1. The watershed is hydraulically connected to the Los Angeles River through the Whittier Narrows Reservoir (during high flows from storm events) (LARWQCB 2017b). More than 30 percent of the upper watershed falls within the Angeles National Forest, including large portions of the San Gabriel Mountains. This portion of the watershed also contains the Merced and San Jose Hills and the Puente-Chino Hills. Land use within the watershed consists of 26 percent residential, 15 percent commercial, 50 percent rural and 9 percent other (LACDPW 2017c).

The proposed alignment would terminate just before Coyote Creek. Coyote Creek Watershed is a 165-square-mile sub-watershed to the San Gabriel River Watershed (Orange County 2007). Coyote Creek confluences with the San Gabriel River within the City of Long Beach, north of the Interstate (I)-405 and I-605 interchange.

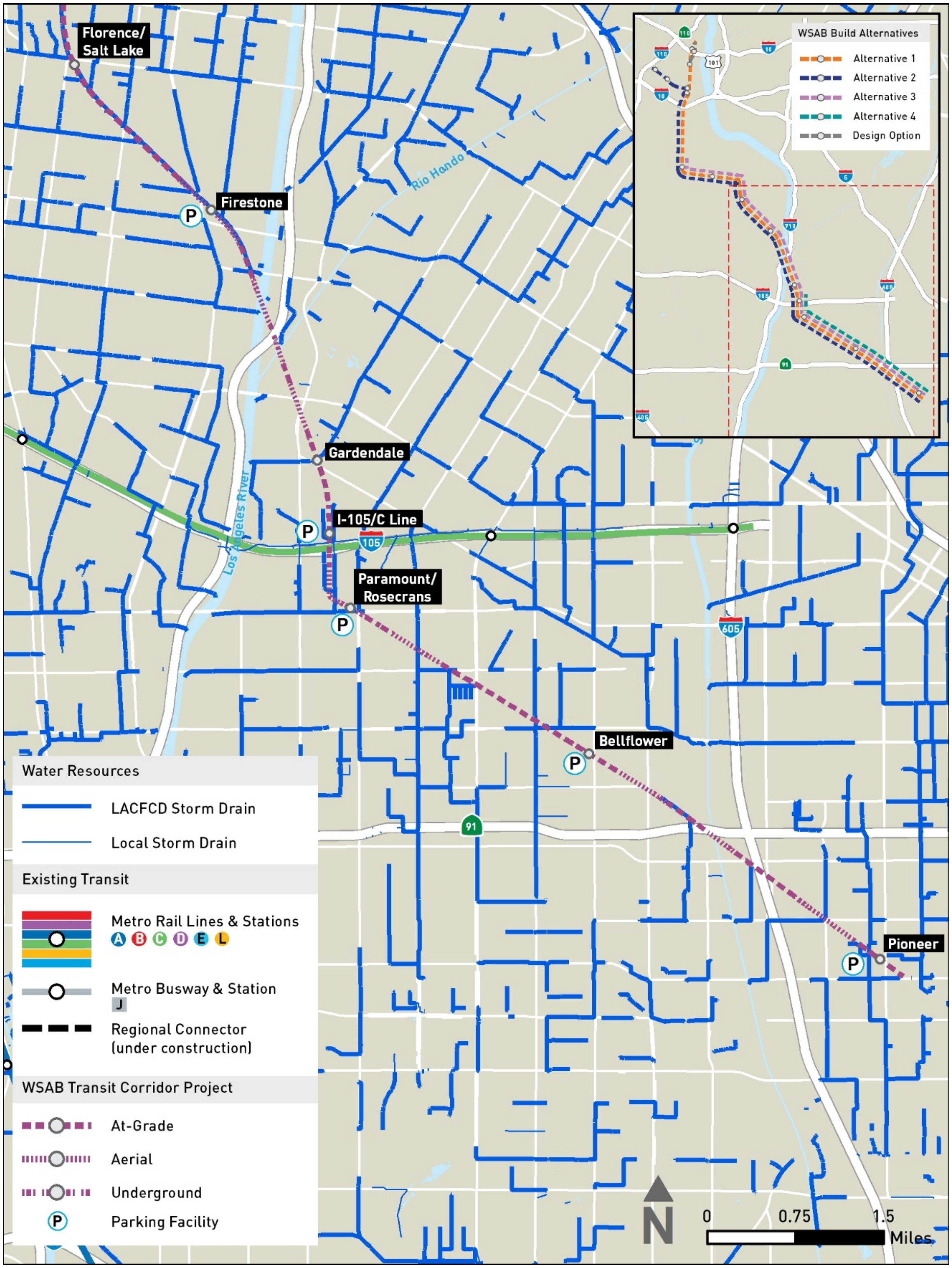
The Affected Area also falls within the Los Cerritos Channel Watershed, which is considered a 28-square mile sub-watershed of the San Gabriel River Watershed. The watershed extends from just north of Interstate (I)-105 in Downey south to Atherton Street in Long Beach, where the Channel discharges into the Los Cerritos Channel Estuary, which, in turn, discharges through Marine Stadium and Alamitos Bay to San Pedro Bay, adjacent to the San Gabriel River (Richard Watson & Associates Inc. 2015).

Figure 4-2. Regional Storm Drain System (1 of 2)



Source: Prepared by Jacobs in 2020

Figure 4-3. Regional Storm Drain System (2 of 2)



Source: Prepared by Jacobs in 2020

4.1.5 Ballona Creek Watershed

A small portion of the Affected Area is within the Ballona Creek Watershed, as shown on Figure 4-1. The Ballona Creek Watershed is located in the coastal plain in the northwestern portion of the Los Angeles Basin with the Santa Monica Mountains on the north and the Baldwin Hills on the south. Ballona Creek flows downstream from the Santa Monica Mountains through Culver City and ultimately into the Pacific Ocean at Playa del Rey. The major tributaries to the Ballona Creek include Centinela Creek, Sepulveda Canyon Channel, Benedict Canyon Channel, and numerous storm drains.

The Ballona Creek Watershed drains an approximately 130-square-mile area consisting primarily of urban developed land. The watershed land use is 64 percent residential, 8 percent commercial, 4 percent industrial and 17 percent open space (LACDPW 2017d).

4.2 Water Quality

The LARWQCB Basin Plan designates beneficial uses for surface and groundwater in the Los Angeles Basin area for both Los Angeles and San Gabriel River Watersheds. The following beneficial uses are listed for the Affected Area and identified in Table 4.1:

- Groundwater Recharge: Uses of water for natural or artificial recharge of groundwater for purposes of future extraction, maintenance of water quality, or halting of saltwater intrusion into freshwater aquifers.
- Industrial Process Supply: Uses of water for industrial activities that depend primarily on water quality.
- Industrial Service Supply: Uses of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, or oil well re-pressurization.
- Municipal and Domestic Supply: Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.
- Rare, Threatened, or Endangered Species: Uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened, or endangered.
- Warm Freshwater Habitat: Uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish or wildlife, including invertebrates.
- Wetland Habitat (WET): Uses of water that support wetland ecosystems, including, but not limited to, preservation or enhancement of wetland habitats, vegetation, fish, shellfish, or wildlife, and other unique wetland functions which enhance water quality, such as providing flood and erosion control, stream bank stabilization, and filtration and purification of naturally occurring contaminants.
- Wildlife Habitat: Uses of water that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates) or wildlife water and food sources.

Table 4.1. Beneficial Uses of Surface Water in the Affected Area

Surface Water Body	Beneficial Uses
Los Angeles River Reach 2 (Carson Street to Rio Hondo Reach 1)	Municipal and Domestic Supply (potential), Industrial Service Supply (potential), Groundwater Recharge, Warm Freshwater Habitat and Wildlife Habitat (potential)
Ballona Creek Reach 1 (above National Boulevard)	Municipal and Domestic Supply (potential), Warm Freshwater Habitat (potential), Wildlife Habitat
Compton Creek	Municipal and Domestic Supply (potential), Groundwater Recharge, Warm Freshwater Habitat, Wildlife Habitat, Wetland Habitat
Rio Hondo Reach 1 (Los Angeles River Reach 2 to Santa Ana Freeway)	Municipal and Domestic Supply (potential), Groundwater Recharge (intermittent), Warm Freshwater Habitat (potential) and Wildlife Habitat (intermittent)
Los Cerritos Channel	Municipal and Domestic Supply (potential), Warm Freshwater Habitat (intermittent), Wildlife Habitat
San Gabriel River Reach 1 (San Gabriel River Estuary to Firestone Boulevard)	Municipal and Domestic Supply (potential), Warm Freshwater Habitat and Wildlife Habitat (potential)
Coyote Creek	Municipal and Domestic Supply (potential), Industrial Service Supply (potential), Industrial Process Supply (potential), Warm Freshwater Habitat, Wildlife Habitat (potential), and Rare, Threatened, or Endangered Species
Inland Surface Waters	Beneficial uses of inland surface waters generally include Water Contact Recreation and Warm Freshwater Habitat, Cold Freshwater Habitat, Inland Saline Water Habitat, or Commercial and Sport Fishing. In addition, inland waters are usually designated as Industrial Service Supply, Industrial Process Supply, Non-contact Water Recreation, Wildlife Habitat, and are sometimes designated as Preservation of Biological Habitats and Rare, Threatened, or Endangered Species

Source: LARWQCB 2011
Note: Beneficial use is existing unless noted as "potential."

Water bodies not meeting the beneficial uses of state water quality standards are placed on the 303(d) List of Water Quality Limited Segments and states are required to develop TMDLs for the pollutants causing the impairment. Table 4.2 lists the pollutants causing impairments in the surface water bodies within the Affected Area. The Project is a redevelopment within these watersheds and is therefore subject to the TMDL standards.

Table 4.2. Section 303(d) List of Impaired Waters in the Affected Area

Water Body	Impairment	Source of Impairment	TMDL Completion Date
Los Angeles River Reach 2 (Carson St to Rio Hondo Reach 1)	Ammonia	Point and Nonpoint Sources	2004
	Copper	Source Unknown	2005
	Indicator Bacteria	Source Unknown	2012
	Lead	Point and Nonpoint Sources	2005
	Nutrients (Algae)	Point and Nonpoint Sources	2004
	Oil	Natural Sources	2019
	Trash	Nonpoint Source, Surface Runoff, Urban Runoff/Storm Sewers	2008
Ballona Creek	Copper	Source Unknown	2005
	Cyanide	Source Unknown	2019
	Indicator Bacteria	Point and Nonpoint Sources	2007
	Lead	Source Unknown	2005
	Toxicity	Source Unknown	2005
	Trash	Source Unknown	2001
	Viruses (enteric)	Point and Nonpoint Sources	2007
	Zinc	Source Unknown	2005
Compton Creek	Benthic Community Effects	Source Unknown	2021
	Copper	Source Unknown	2008
	Indicator Bacteria	Source Unknown	2009
	Lead	Source Unknown	2005
	Trash	Nonpoint Source	2008
	Zinc	Source Unknown	2008
	pH	Point and Nonpoint Sources	2004
Rio Hondo Reach 1 (Los Angeles River Reach 2 to Santa Ana Freeway)	Indicator Bacteria	Source Unknown	2012
	Copper	Source Unknown	2005
	Lead	Point and Nonpoint Source	2005
	Toxicity	Source Unknown	2021
	Zinc	Point and Nonpoint Source	2005
	pH	Point and Nonpoint Source	2004
	Trash	Nonpoint Source, Surface Runoff, Urban Runoff/Storm Sewers	2008

Water Body	Impairment	Source of Impairment	TMDL Completion Date
Los Cerritos Channel	Ammonia	Source Unknown	2015
	Bis(2ethylhexyl)phthalate (DEHP)	Source Unknown	2019
	Copper	Source Unknown	2019
	Indicator Bacteria	Source Unknown	2019
	Lead	Source Unknown	2019
	Trash	Source Unknown	2019
	Zinc	Source Unknown	2019
	pH	Source Unknown	2021
San Gabriel River Reach 1 (San Gabriel River Estuary to Firestone Blvd)	Temperature, water	Source Unknown	2027
	pH	Source Unknown	2009
Coyote Creek	Indicator Bacteria	Source Unknown	2016
	Iron	Source Unknown	2027
	Malathion	Source Unknown	2027
	Toxicity	Source Unknown	2008
	pH	Source Unknown	2019

Source: SWRCB 2016

4.3 Floodplains

LA County is subject to a wide range of flood hazards, including floods caused by intense storms, earthquakes, and failure of manmade structures. The USACE operates and maintains five major flood control reservoirs within the Los Angeles system: the Hansen, Lopez, Santa Fe, Sepulveda, and Whittier Narrows reservoirs. In addition to these reservoirs, LACDPW operates and maintains 14 dams, 149 debris basins, and 27 spreading grounds (LACFCD 2017).

Los Angeles and nearby cities are located in a relatively flat alluvial plain, about 30 miles wide, lying on uplift terraces surrounded by mountain ranges. FEMA Flood Insurance Rate Maps identify areas in LA County and surrounding cities that would be subject to flooding during 100-year and 500-year storm events (100-year and 500-year storms are defined as having a 1 percent and 0.2 percent chance, respectively, of occurring in any given year). FEMA and its local delegates use the 100-year flood zone as the benchmark in administering the NFIP, a voluntary program through which communities enforce floodplain management ordinances in return for federally backed flood insurance.

Figure 4-4 presents the FEMA-established 100-year flood zones for the Los Angeles River, Rio Hondo, San Gabriel River, and Coyote Creek, which are each contained within their engineered banks. Approximately half of the Affected Area is located within larger flood zones designated by FEMA Flood Insurance Rate Maps as "Zone X," which are characterized as "areas of 0.2 percent annual chance of flood; areas of 1 percent annual chance of flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1 percent annual chance of flood." There are no dams, debris basins, or spreading grounds within the Affected Area.

Figure 4-4. FEMA Flood Zones in Affected Area and Major Flood Control Facilities

Source: Prepared by Jacobs in 2020

4.4 Groundwater

This section presents the evaluation of groundwater as a water resource (groundwater supply and quality). Evaluation of groundwater contamination is presented in *West Santa Ana Branch Transit Corridor Project Final Hazardous Materials Impact Analysis Report* (Metro 2021a).

Groundwater basins are formed when sediments, including sand and gravel, fill underground formations that then collect water and serve as underground water reservoirs. The Central Basin underlies the Affected Area, as shown on Figure 4-5. Groundwater is recharged within the Central Basin at the Rio Hondo Coastal Basin Spreading Grounds, San Gabriel Coastal Spreading Grounds and the Dominguez Gap Spreading Grounds.

The Central Basin is part of the Los Angeles Coastal Plain Groundwater Basins, which are incorporated into the Coastal Plain Hydrographic Subunit. The Coastal Plain Hydrographic Subunit contains the Central, West Coast, Santa Monica, and Hollywood Basins. The Central Subbasin, one of the most important basins in the hydrographic subunit, directly underlies the Affected Area. The northeastern portion of the basin underlies the San Gabriel River Watersheds and the northwestern and western portions of the basin underlie the Los Angeles River Watershed. The basin is formed by the Whittier Narrows Fault Zone on the northeast and the Newport-Inglewood Fault on the southwest (LACDPW 2006a). Existing beneficial uses of the Central Basin include municipal and domestic supply, industrial service supply, industrial process supply and agriculture supply (LARWQCB 2011).

Total water storage in the basin is 13.8 million acre-feet, and the natural safe yield is 125,805 acre-feet per year. In comparison, the managed safe yield of the basin is 217,367 acre-feet per year. This higher number is possible because of artificial recharge maintained by the WRD. The depth of the Central Basin is between 1,600 and 2,200 feet (MWD 2007).

The basin is an unconfined aquifer with soils that allow water to percolate through the basin (LACDPW 2006a). Groundwater resources are replenished in the Central Basin through surface and subsurface flow and by direct percolation of precipitation, stream flow, and applied water in the forebay areas (California Department of Water Resources 2004). Natural replenishment of groundwater happens in the Montebello Forebay Spreading Grounds where permeable sediment is exposed at ground surface (California Department of Water Resources 2004). For the Central Basin, this takes place largely in the Whittier Narrows area near the Rio Hondo. As described in the San Gabriel River Corridor Master Plan, the Central Basin relies on the following sources of water (LACDPW 2006a):

- Imported water purchased from the Metropolitan Water District of Southern California (MWD)
- Reclaimed water from local water reclamation plants
- Local runoff and rainfall
- Subsurface flows from adjacent basins

Figure 4-5. Groundwater Basins and Facilities

Source: Prepared by Jacobs in 2020

The main source of potable groundwater in the Central Basin is from the deeper aquifers of the San Pedro Formation (including the Lynwood, Silverado, and Sunnyside Aquifers). The shallower aquifers of the Alluvium and Lakewood Formation locally produce smaller volumes of potable water. In the forebay area, many of the aquifers merge and allow for direct recharge into the deeper aquifers (MWD 2007). Historically, groundwater flow within the basin tended to be from the recharge areas in the northeast to the southwest toward the Pacific Ocean. Central Basin water levels ranged from a high of about 160 feet above mean sea level in the northeast portion of the basin to a low of approximately 90 feet below mean sea level in the Long Beach area (MWD 2007). WRD is designated as Watermaster to monitor groundwater extractions in the basin. Therefore, no groundwater extraction is allowed from the basin without obtaining water rights in the basin.

Historical over-pumping of the Central Basin caused overdraft, seawater intrusion, and other groundwater management problems related to supply and quality. Adjudication of the basins in the early 1960s set a limit on allowable groundwater extractions in order to control the over-pumping (WRD 2019). Under SGMA, adjudicated portions of basins are exempt from developing a groundwater sustainability plan and forming a GSA. However, the WRD is required to submit annual reports to account for proper resource management. LACDPW, WRD, and the United States Geological Survey conduct regional groundwater quality monitoring in the Central Subbasin. Table 4.3 summarizes the results of the WRD's monitoring efforts of the Central Basin for Water Year 2015-2016 (WRD 2017).

Table 4.3. Groundwater Quality in the Central Basin

Constituent	Maximum Contaminant Level	% of Production Wells below Maximum Contaminant Level/ Secondary Maximum Contaminant Level
Total Dissolved Solids	500-1,000 mg/L	100% below 1,000 mg/L 75% below 500 mg/L
Iron	0.3 mg/L for drinking water	89%
Manganese	50 µg/L	84%
Chloride	250-500 mg/L	100% below 500 mg/L
Nitrate	10 mg/L	99%
Trichloroethylene	5 µg/L	92%
Tetrachloroethylene	5 µg/L	94%
Arsenic	10 µg/L	96%
Perchlorate	6 µg/L	99%
Hexavalent Chromium	50 µg/L	100%

Source: WRD 2017
Note: µg/L = micrograms per liter; mg/L = milligrams per liter

5 ENVIRONMENTAL IMPACTS/ENVIRONMENTAL CONSEQUENCES

This section presents the environmental impacts and consequences of the Build Alternatives as they relate to water resources. The following evaluation is based on the existing conditions described in Section 4.

5.1 Project Design Features

The Build Alternatives would cause construction within existing rivers with potential direct and indirect water quality impacts. As a result, the project would be required to comply with various construction permits (e.g., NPDES permits, encroachment permits and USACE 408 permits). Additionally, the Build Alternatives would require an Individual Section 404 Permit from USACE, a 401 Water Quality Certification from the LARWQCB, and a Section 1602 Streambed Alteration Agreement from CDFW prior to the start of construction. A detailed discussion of permitting requirements is included in Section 2. These permits would require project design features to be implemented that would avoid, minimize, or reduce potential for impacts to hydrology, water quality, and floodplains. Permit approvals would be necessary prior to construction and would be contingent on implementing these design features. Therefore, the design features are considered to be part of the Build Alternatives, and Metro would verify that these design features are implemented to avoid and minimize impacts to water quality and water resources.

5.1.1 Project Design Features for Stormwater/Water Quality Management During Operation

To protect surface water quality and maintain pre-development hydrology, the Build Alternatives would implement design features to comply with the LA County MS4 NPDES permit. The project design features listed below would be implemented to minimize the impact to water resources. These design features meet stormwater regulatory requirements, including (1) minimizing or eliminating pollutant sources and (2) implementing structural and nonstructural BMPs to treat and control runoff from both developed and redeveloped areas.

The *West Santa Ana Branch Transit Corridor Project Environmental Study, Sustainability Stormwater Study – Revision 1* (Metro 2020) was developed to: 1) evaluate the feasibility of capturing and managing stormwater and associated pollutants; 2) prioritize projects for future implementation; and 3) identify stormwater related sustainability features and strategies along the project alignment to support Metro sustainability goals and to comply with stormwater quality regulations. The study provides recommendations for LID BMP implementation locations along the project alignment. The following recommendations will be included in the final construction contract as applicable to all Build Alternatives:

- **Stations:** General recommendations for LID BMPs at underground station entrances, at-grade, and aerial stations include bioretention/biofiltration planters for canopy, roof, platform runoff, impervious area disconnection (direction impervious sheet flow to landscape areas), and permeable pavement.
- **Station Parking:** LID BMP implementation recommendations at station parking facilities include: 1) grade parking facilities to perimeter landscaping areas, 2) design

and construct zero height curb or curb cuts to direct parking area sheet flow runoff into landscaping and biofiltration areas, 3) design and construct bioretention/biofiltration within the perimeter (or interior) landscape areas, 4) other LID features such as tree wells and permeable pavement.

- **Maintenance and Storage Facility (MSF):** Recommended LID BMPs for the MSF site options include biofiltration and capture and reuse. Roof rainfall runoff can potentially be collected from the buildings, treated, and stored for use for the wash facilities; however, the feasibility is based on anticipated water demand/usage.
- **Aerial Crossings:** LID BMP implementation recommendations for aerial crossings consist of: 1) lined bioretention/biofiltration with underdrain between columns beneath viaducts, and 2) lined bioretention/biofiltration with underdrain adjacent to crossing/bridge abutments.
- **At-grade Track:** Stormwater sustainability including water quality treatment options along the at-grade tracks is typically limited because of the undesirability of infiltration and vegetation limitations in these areas. However, ballasted track can be considered self-treating areas based upon research conducted by the Colorado Department of Transportation (CDOT 2012).

During final engineering design, the LID BMP recommendations should be validated. Where infiltration BMPs are proposed, site-specific geotechnical investigations should be conducted to verify feasibility of installing the BMPs.

In addition to the LID BMPs recommended by the Sustainability Stormwater Study, the following design features would be applicable to all Build Alternatives:

- To comply with the LA County MS4 NPDES permit and the *Standard Urban Stormwater Mitigation Plan for Los Angeles County and Cities in Los Angeles County* (LACDPW 2000), the Build Alternatives would develop a site-specific LID plan which would implement LID design standards such as incorporating structural and nonstructural treatment controls and hydromodification controls. Other LID design standards would include the following:

  – Not exceed the estimated pre-development rate for developments where the increased peak stormwater discharge rate will result in increased potential for downstream erosion.
  – Conserve natural areas and minimize the extent of disturbed areas
  – Minimize stormwater pollutants of concern.
  – Protect slopes and channels.
  – Provide storm drain system stenciling and signage.
  – Properly design outdoor material storage areas.
  – Properly design trash storage areas.
  – Provide proof of ongoing BMP maintenance.
  – Design standards for structural or treatment control BMPs.
  – Implement pollutant source reduction measures.
  – Design and construct appropriate onsite stormwater management facilities to control peak flow rates and volumes and to capture and treat runoff prior to discharge, especially for pollutant-generating surfaces such as station parking areas, access roads, new local street improvements, reconstructed interchanges, and new or relocated roads and highways.

- Use LID techniques to retain runoff onsite and to reduce offsite runoff, to the extent practical. Consider the use of constructed wetland systems, biofiltration and bioretention systems, wet ponds, organic mulch layers, planting soil beds and vegetated systems (biofilters) such as vegetated swales and grass filter strips.
- Locate all constructed stormwater BMPs outside of natural water bodies and streams.
- Use portions of the maintenance site for onsite infiltration of runoff, if feasible, or for stormwater detention, if not.

- Construct the tunnel and underground stations to preclude groundwater intrusion into the tunnel using a technique similar to that used for the Metro L (Gold) Line tunnels in Boyle Heights. This technique consists of installing a pre-cast concrete lining with rubber gaskets between the tunnel segments to prevent water and gas leakage into the tunnel and stations.
- Tunnel drainage systems would intercept groundwater, stormwater, and tunnel wash water. Treat water to meet municipal standards before it is pumped and discharged to the local storm drain system.
- Comply with the IGP. The IGP requires preparation and implementation of an industrial Stormwater Pollution Prevention Plan (SWPPP), which would identify BMPs to reduce or prevent industrial pollutants in stormwater and authorized nonstormwater discharges. The industrial SWPPP also requires implementation of a Monitoring Implementation Plan and Annual Comprehensive Facility Compliance Evaluation to assess BMP performance. The industrial SWPPP would include site-specific measures such as:

  - Implement nonstructural source control BMPs including good housekeeping, preventative maintenance, spill prevention and response, material handling and storage, waste handling and recycling, employee training, inspections, record keeping and internal reporting, and quality assurance.
  - Construct berms, ditches, or simple curbing to prevent run-on and divert runoff water from around the industrial activity area.
  - Provide cover over materials, chemicals, and pollutant sources to prevent contact with stormwater and unauthorized nonstormwater discharges. Where possible, move outdoor operations indoors.
  - Provide secondary containment around storage tanks and other areas for the purpose of collecting any leaks or spills.
  - Develop a Spill Prevention, Control, and Countermeasures Plan.
  - Designate equipment wash areas.
  - Comply with hazardous materials laws and regulations, including hazardous materials inventory and emergency response planning, risk planning and accident prevention, employee hazard communication, public notification of potential exposure to specific chemicals and proper storage of hazardous materials.

5.1.2 Project Design Features for Flood Protection

For each river crossing, a location hydraulic study (Appendices A, B, and C) was performed to evaluate the bridge structure's effects on the hydraulic conditions within the channel and to estimate the change in water surface elevations within the channel as discussed in Section 5.3.3 (Metro 2017a, 2017b, 2017c). The Build Alternatives would incorporate the following design features for flood protection:

- Establish track elevation to prevent saturation and infiltration of stormwater into the sub-ballast. During the design storm, maintain 2 feet of freeboard between the sub-ballast and the water surface elevation.
- Minimize impacts to existing flood control channels. Design and orient bridge piers to be parallel to the water flow direction.
- Maintain bridge deck low chord elevations to be higher than the existing Union Pacific Railroad rail crossings over the Los Angeles River, Rio Hondo, and San Gabriel River.
- Conduct engineering analysis of channel hydraulics during detailed final design to evaluate impacts to channel water surface elevation and available freeboard.

5.1.3 Project Design Features for Stormwater/Water Quality Management During Construction

The project construction phase would comply with the CGP and prepare a SWPPP. The SWRCB CGP (Order No. 2009-0009-DWQ, as Amended by 2010-0014-DWQ and 2012-0006-DWQ [SWRCB 2012]) establishes three risk levels that are based on site erosion and receiving water risk factors as discussed in Section 3.2.4. A preliminary analysis indicates that most of the Build Alternatives would fall under Risk Level 2. Risk level calculations are included in Appendix D. Risk Level 2 measures would be implemented throughout the project's disturbance area and where construction activities are conducted within or immediately adjacent to sensitive environmental areas (e.g., wetlands, waters of the State/United States, and biological habitats).

The CGP requires preparation and implementation of a SWPPP, which would identify BMPs to minimize potential short-term increases in sediment transport caused by construction, including erosion control requirements, stormwater and nonstormwater management, and channel dewatering for affected stream crossings. These BMPs would include measures to provide permeable surfaces where feasible and to retain and treat stormwater onsite. Other BMPs include strategies to manage the overall amount and quality of stormwater and nonstormwater runoff. The construction SWPPP would include measures to address the following:

- Practices to minimize the contact of construction materials, equipment, and maintenance supplies with stormwater.
- Limiting fueling and other activities using hazardous materials to areas distant from surface water, providing drip pans under equipment and daily checks for vehicle condition.
- Practices to reduce erosion of exposed soil, including soil stabilization, watering for dust control, perimeter silt fences, placement of straw bales, and sediment basins.
- Practices to maintain water quality, including silt fences, stabilized construction entrances, grass buffer strips, ponding areas, organic mulch layers, inlet protection, and sediment traps to settle sediment.

- Practices to capture and provide proper offsite disposal of concrete wash water, including isolation of runoff from fresh concrete during curing to prevent it from reaching the local drainage system, and possible treatment with dry ice or other acceptable means to reduce the alkaline character of the runoff (high pH) that typically results from new concrete.
- Development of a spill prevention and emergency response plan to handle potential fuel or other spills.
- Use of diversion ditches to intercept offsite surface runoff.
- Where feasible, avoidance of areas that may have substantial erosion risk, including areas with erosive soils and steep slopes.
- Where feasible, limit construction to dry periods when flows in water bodies are low or absent.

Groundwater and accumulated precipitation may be encountered during construction in the river, excavation activities, and construction of bridges, structures, and tunnels. Removal of groundwater or accumulated precipitation may trigger a Construction Dewatering Permit or other WDRs as discussed in Section 3.3.1.1. Where dewatering is required, construction activities will be conducted in accordance with the appropriate permit(s) and the Build Alternatives will prepare a BMP or Control Strategy Plan to identify site-specific plans and procedures to be implemented to prevent the generation and potential release of pollutants.

5.2 No Build Alternative

5.2.1 Hydrology and Surface Water Bodies

The No Build Alternative includes existing transportation networks and transportation improvements that have been committed and identified in constrained plans of the *Long-range Transportation Plan* (LRTP) (Metro 2009a) and the *2016-2040 Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS)* (SCAG 2016). The service features include transit, freeway, and arterial operations within and around the Affected Area. As such, the No Build Alternative includes existing, under-construction and planned rail, bus, and highway projects. Table 2.1 lists the projects anticipated by 2042. Planned projects would be subject to separate environmental analysis to evaluate impacts to hydrology and surface water bodies. Implementation of these projects, including operations and maintenance, would be subject to regulatory standards, conditions, and permitting requirements discussed in Section 2 (e.g., CWA and NPDES permit requirements). Compliance with these standards would minimize impacts to hydrology and surface water bodies. Residual impacts are expected to be minor. Therefore, no adverse effects on hydrology and surface water bodies are anticipated from the No Build Alternative.

5.2.2 Water Quality

The No Build Alternative includes existing transportation networks and the transportation improvements that have been committed and identified in constrained plans of the LRTP (Metro 2009a) and the RTP/SCS (SCAG 2016). The service features include transit, freeway, and arterial operations within and around the Affected Area. As such, the No Build Alternative includes existing, under-construction and planned rail, bus, and highway projects. Table 2.1 lists the projects anticipated by 2042. Planned projects would be subject to separate environmental analysis to evaluate impacts to water quality. Implementation of these projects, including operations and maintenance, would be subject to regulatory standards, conditions, and permitting requirements discussed in Section 2 (e.g., CWA and NPDES permit requirements). Compliance with these standards would minimize impacts to water quality. Residual impacts are expected to be minor. Therefore, no adverse effects on water quality are anticipated from the No Build Alternative.

5.2.3 Floodplains

The No Build Alternative includes existing transportation networks and transportation improvements that have been committed and identified in constrained plans of the LRTP (Metro 2009a) and the RTP/SCS (SCAG 2016). The service features include transit, freeway, and arterial operations within and around the Affected Area. As such, the No Build Alternative includes existing, under-construction and planned rail, bus, and highway projects. Table 2.1 lists the projects anticipated by 2042. Planned projects would be subject to separate environmental analysis, including floodplain impact analysis for improvements that may affect floodplains. Construction, maintenance, and storage of these planned projects would be subject to similar standards, conditions, and permitting requirements (e.g., NPDES and USACE 408 permitting), which will avoid, minimize, or mitigate for any floodplain impacts. Therefore, no adverse effects on floodplains are anticipated to occur from the No Build Alternative.

5.2.4 Groundwater

The No Build Alternative includes existing transportation networks along with transportation improvements that have been committed and identified in constrained plans of the LRTP (Metro 2009a) and the RTP/SCS (SCAG 2016). The service features include transit, freeway, and arterial operations within and around the Affected Area. As such, the No Build Alternative includes existing, under-construction and planned rail, bus, and highway projects. Table 2.1 lists the projects anticipated by 2042. Planned projects would be subject to separate environmental analysis to evaluate impacts to groundwater. Implementation of these projects, including operations and maintenance, would be subject to regulatory standards, conditions and permitting requirements discussed in Section 2 (e.g., CWA and NPDES permit requirements). Compliance with these standards would minimize impacts to groundwater. Residual impacts are expected to be negligible. Therefore, no adverse effects on groundwater are anticipated to occur from the No Build Alternative.

5.2.5 Construction

The No Build Alternative includes existing transportation networks and transportation improvements that have been committed and identified in constrained plans of the LRTP (Metro 2009a) and the RTP/SCS (SCAG 2016). The service features include transit, freeway, and arterial operations within and around the Affected Area. As such, the No Build Alternative includes existing, under-construction and planned rail, bus, and highway projects. Table 2.1 lists the projects anticipated by 2042. Planned projects would be subject to separate environmental analysis to evaluate impacts during construction. Implementation of these projects, including all construction-related activities, would be subject to regulatory standards, conditions, and permitting requirements discussed in Section 2 (e.g., CWA and NPDES permit requirements [CGP]). Compliance with these standards and BMPs would minimize impacts during construction. Residual impacts are expected to be minor. Therefore, no adverse effects during construction are anticipated to occur from the No Build Alternative.

5.3 Common Impacts of Build Alternatives

5.3.1 Hydrology and Surface Water Bodies

The following potential impacts to hydrology and surface water bodies are relevant to all alternatives. Alternative-specific impacts are discussed in Sections 5.4 through 5.9.

The Build Alternatives would convert existing pervious areas to impervious areas by increasing the total pavement and roof coverage within the Affected Area. Conversion of pervious to impervious areas decreases infiltration, which increases runoff volume, increases peak flow rates, and changes the timing of the peak flows. This would be applicable to rail operations, stations, parking facilities, local street improvements, MSF, and traction power substations (TPSSs). Development within the already urbanized corridor would also affect existing drainage systems, including local storm drains and regional flood control facilities. Potential impacts are summarized in Sections 5.4 through 5.9. The project design features listed in Section 5.1 include site design and LID stormwater BMPs that would maintain pre-development flow volumes, peak flow rates, and times of concentration. These BMPs would avoid and minimize adverse effects to the project area. Therefore, these potential impacts from all the Build Alternatives would not result in adverse effects to hydrology and surface water bodies.

5.3.2 Water Quality

The following potential impacts to water quality are relevant to all Build Alternatives. Alternative-specific impacts are discussed in the subsections below.

The Build Alternatives would result in new impervious areas that would increase the concentration and total pollutant load in stormwater runoff. Because the Build Alternatives would be in a highly urbanized area and along major roadways and rail corridors, the new impervious area would represent a negligible overall increase in total impervious area with respect to the watersheds and the corresponding potential for increases in pollutant loads in stormwater runoff. Implementation of the Build Alternatives would be subject to the regulatory standards, conditions, and permitting requirements discussed in Section 2 (e.g., CWA and NPDES permit requirements). Project design features listed in Section 5.1 would be implemented to address potential effects and minimize direct impacts to water quality. Therefore, all Build Alternative potential impacts would be minimized and would not result in adverse effects on water quality in the Affected Area.

Rail Operations

Rail operations would contribute pollutants in concentrations and amounts that are typical for transportation facilities, including total suspended solids, metals, oils and grease, and debris. Impacts to water quality from rail operations can be generally quantified by length of track Because the track operations areas collect pollutants and could discharge them in stormwater as non-point source pollution. The length of track is a useful way to compare Build Alternatives for their magnitude, quality, and location of potential water quality impacts. Because the project site is in a highly urbanized area and along major roadways and rail corridors, the character and concentration of pollutants in runoff would be similar to existing conditions. The project design features listed in Section 5.1 include site design and LID stormwater BMPs that would minimize potential direct water quality impacts from rail operations. Therefore, the Build Alternatives would not result in adverse effects on water quality from rail operations.

Stations, Parking Facilities and Local Streets Improvements

Development of stations, parking facilities, and local street improvements would result in potential water quality impacts because of the new impervious surfaces required. Locations of stations and local street improvements are shown on Figure 5-1 and Figure 5-2. Impacts from new impervious surfaces are discussed in Section 5.3.1. In addition to new impervious surfaces, stations and parking facilities (parking is only available at specific stations) would also result in increased vehicle and pedestrian traffic, which is expected to increase loads for pollutants associated with transportation facilities, such as heavy metals, nutrients, pesticides, sediments, trash and debris, oxygen-demanding substances, and oil and grease (CASQA 2003). However, the project design features listed in Section 5.1 include site design and LID stormwater BMPs that would minimize potential direct water quality impacts resulting from stations and parking facilities. Therefore, the Build Alternatives would not result in adverse effects on water quality from these facilities.

Maintenance and Storage Facilities

Development of a MSF would result in potential water quality impacts because of the new impervious surfaces required. Locations of MSFs are shown on Figure 5-1 and Figure 5-2. Impacts from new impervious surfaces are discussed in Section 5.3.1. In addition to new impervious surfaces, the MSF activities are expected to increase pollutant loads for pollutants associated with industrial activities, such as sediment, nutrients, trash, metals, oil and grease, pesticides, and organics (CASQA 2003). However, project design features listed in Section 5.1 include site design and LID stormwater BMPs that would minimize potential direct impacts to water quality associated with MSFs. Therefore, the Build Alternatives would not result in adverse effects on water quality from MSFs.

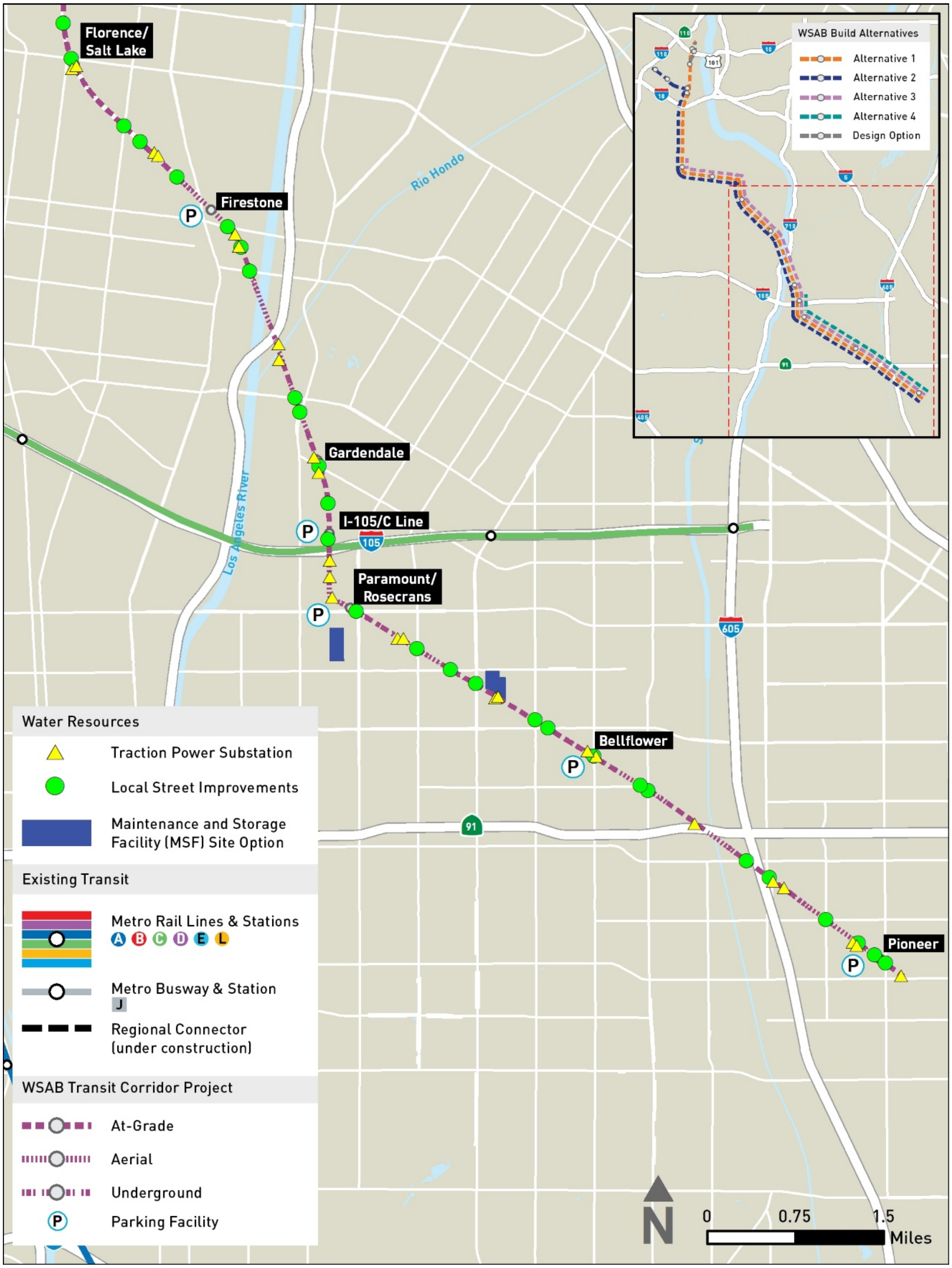
Traction Power Substations

TPSS development would result in potential water quality impacts because of associated new impervious surfaces. TPSS locations are shown on Figure 5-1 and Figure 5-2. Impacts from new impervious surfaces are discussed in Section 5.3.1. In addition to new impervious surfaces, TPSS operations and maintenance are expected to increase loads for pollutants associated with industrial activities, such as sediment, nutrients, trash, metals, oil and grease, and organics (CASQA 2003). However, project design features listed in Section 5.1 include site design and LID stormwater BMPs that would address potential impacts and minimize direct impacts to water quality associated with TPSS facilities. Therefore, the Build Alternatives would not result in adverse effects on water quality from TPSS.

Figure 5-1. Maintenance and Storage Facilities, TPSS Facilities, and Local Street Improvements (1 of 2)

Source: Prepared by Jacobs in 2020

Figure 5-2. Maintenance and Storage Facilities, TPSS Facilities, and Local Street Improvements (2 of 2)



Source: Prepared by Jacobs in 2020

5.3.3 Floodplains

The following potential impacts to floodplains are relevant to all Build Alternatives. Alternative-specific impacts are discussed in Sections 5.4 through 5.9.

The Build Alternatives would cross three major flood control channels, each with FEMA-established floodplains: the Los Angeles River, the Rio Hondo, and the San Gabriel River. Historical floodplains are protected from these rivers by levees and engineered channels constructed by USACE. FEMA-delineated 100-year floodplains are contained within the banks of the flood control channels for all three water bodies. The Build Alternatives would be designed in compliance with Executive Orders 11988 and 13690. Tracks and structures associated with the Build Alternatives would be built above the existing river channel walls or levees. The Build Alternatives would not cause a longitudinal encroachment or result in incompatible development within the floodplain. Therefore, all Build Alternative potential impacts would be minimized, and would not result in adverse effects on floodplains.

For each river crossing, a location hydraulic study (Appendices A, B, and C) was performed to evaluate the bridge structure's effects on the hydraulic conditions within the channel and to estimate the change in water surface elevations within the channel (Metro 2017a, 2017b, 2017c). Table 5.1 shows the base flood used for each hydraulic study. A summary of the floodplains analysis is presented in Sections 5.4 through 5.9.

Table 5.1. Base Floods Used for Floodplain Evaluations

River	Base Flood (cubic feet per second)
Los Angeles River	120,000
Rio Hondo	52,900
San Gabriel River	15,500

Source: LACDPW 2017e; USACE 1991, 2004, 2005, 2011

5.3.4 Groundwater

The following potential impacts to groundwater are relevant to all Build Alternatives. Alternative-specific impacts are discussed in Sections 5.4 through 5.9. This section presents the evaluation of groundwater as a water resource (groundwater supply and quality). Evaluation of groundwater contamination is presented in the Final Hazardous Materials Impact Analysis Report (Metro 2021a).

The Build Alternatives would increase the impervious area, thereby causing a decrease in groundwater recharge. Pervious areas that will be converted include unpaved areas within the rail rights-of-way (ROWs), and currently unpaved parcels that will be developed as the MSF or other rail facilities. Because the Build Alternatives are in a highly urbanized area and along major roadways and rail corridors, the new impervious area would represent a negligible overall increase in total impervious area with respect to the watersheds and the corresponding groundwater recharge areas. Most recharge to the groundwater supply in LA County comes from large, natural stream systems or constructed groundwater recharge basins. To minimize the potential impact of new impervious area, the Build Alternatives would comply with the post-construction and hydromodification requirements of the LA County MS4 NPDES permit (discussed in Section 3.3) and implement the project design features listed in Section 5.1. These design features include LID treatment controls, such as landscaping, to help offset the loss of permeable surfaces. Therefore, all Build Alternative potential impacts would be minimized, and would not result in adverse effects on groundwater.

5.3.5 Construction

Water resources construction impacts were analyzed for the Build Alternatives as a whole and not broken down by alternative because the urban nature of the Affected Area is generally consistent across all alternatives for this activity and the corresponding resources.

Hydrology and Surface Water Quality

The Build Alternatives would require construction activities that could adversely affect hydrology and surface water quality, including the following:

- At-grade facilities, including guideway construction, utility relocations, rail facilities within the rail ROWs, freeway crossings, city street widening and reconstruction, station facilities (stations and parking facilities), MSF, rail service facilities (TPSSs), radio towers, site preparation and demolition, and construction access.
- Aerial facilities, including guideway construction, utility relocations, river crossings, freeway crossings, pedestrian bridges, retained fill guideways, aerial station facilities, site preparation and demolition, and construction access.
- Underground facilities that require construction at the surface, including cut and cover construction, utility relocations, site preparation and demolition, and construction access.

These construction activities could degrade water quality by increasing the risk of discharge of contaminants to surface water. This is especially true where direct discharge may occur, such as at the San Gabriel River, Rio Hondo, and Los Angeles River crossings. Construction would involve ground disturbance (e.g., excavation, stockpiling, and grading) that would expose bare soils to stormwater and could lead to erosion and sedimentation. Construction materials in staging areas would also be exposed to stormwater, and contaminants may be discharged in runoff from the project sites. Other construction impacts to hydrology and surface water quality could include the following:

- Temporary changes in grades and drainage patterns.
- Potential spills of construction materials or equipment maintenance materials.
- Temporary dewatering may be required if groundwater is encountered or if construction occurs during the wet weather season and dewatering of excavations is required.

The Los Angeles River crossing is especially susceptible because of the number and size of piers constructed in the channel. The proximity of flowing water to active construction could provide a direct path for construction-related contaminants to reach surface water. Downstream erosion impacts are minimized because these river channels are lined with concrete.

Construction impacts would be similar for all sections. Construction impacts can be generally quantified by the total disturbance area of the Build Alternatives including both permanent and temporary disturbance areas. Temporary disturbance areas include construction laydown areas and excavation extents for underground stations and column foundations. The total disturbed area ranges depending on alternative as described in Sections 5.4 through 5.9.

To address these temporary impacts, the Build Alternatives would implement the design features discussed in Section 5.1 and would implement a SWPPP that complies with the CGP. Compliance with the CGP requires that, prior to construction, the Contractor identify pollutant sources that could affect water quality and identify, implement, and maintain BMPs to reduce pollutants and nonstormwater discharges in construction site runoff. Implementation of the Construction SWPPP in compliance with the CGP would avoid or minimize discharge of contaminants. For example, good housekeeping BMPs, such as waste management, stockpile management, and trash enclosures, would minimize exposure of construction materials, sediments, trash and debris, and potential contaminants to stormwater. The SWPPP would also include details on construction techniques required to minimize pollutant and other nonstormwater discharges directly to surface waters, such as using cofferdams for in-stream construction. Construction site perimeter controls, such as silt fence and fiber rolls, would minimize discharge of contaminants in stormwater via sheet flow. Erosion on exposed slopes would be minimized using slope stabilization BMPs (e.g., temporary hydraulic mulch). Sediment control BMPs, such as check dams in drainage ditches and inlet barriers, would minimize sediment discharge. The SWPPP would identify the regular maintenance schedule for construction site BMPs and sampling and monitoring plans. Further, construction of the Build Alternatives would comply with construction-related requirements specified in permits obtained from applicable resource agencies (e.g., CDFW and USACE). Compliance with the CGP, other resource agency permits, and implementation of the design features discussed under Section 5.1 would avoid and minimize construction-related impacts to hydrology and water quality. Therefore, all Build Alternative potential impacts would be minimized, and would not result in adverse effects during construction.

Floodplains

All Build Alternatives would require construction activities that could adversely affect floodplains, including the three river crossings that would be constructed within existing floodplain extents. Construction within the river may require temporary coffer dams, which may affect the ability of the flood control channel to contain flood flows or increase nonstormwater discharges. Construction of the aerial structures over the Los Angeles River, Rio Hondo, and San Gabriel River would require new bridge piers within the channel. Earthwork and demolition would be required for new concrete bridge piers, with a substantial construction footprint below the ordinary high-water mark. Construction access would also require construction equipment, materials, and storage inside the channel. Therefore, construction could result in potential impacts to the ordinary high-water mark, banks, or levees under USACE jurisdiction. The placement of the columns that would support the aerial light rail transit (LRT) structure is flexible, and this flexibility would allow potential direct impacts to the riverbed and banks to be avoided. Where construction or aerial LRT structures occur in the Los Angeles River, Rio Hondo, or San Gabriel River, construction activities would comply with all applicable federal and local floodplain regulations, including applicable NFIP regulations described in Section 3.1.3. Furthermore, implementation of project design features discussed in Section 5.1 would avoid and minimize construction-related flooding impacts. Therefore, all Build Alternative potential impacts would be minimized, and would not result in adverse effects during construction.

Groundwater

The Build Alternatives would require construction activities that could adversely affect groundwater, including the following:

- At-grade facilities, including guideway construction, utility relocations, rail facilities within the rail ROWs, freeway crossings, city street widening and reconstruction, station facilities (stations and parking facilities), MSF, rail service facilities (TPSSs), radio towers, site preparation and demolition, and construction access.
- Aerial facilities, including guideway construction, utility relocations, river crossings, freeway crossings, pedestrian bridges, retained fill guideways, aerial station facilities, site preparation and demolition, and construction access.
- Underground facilities, including tunneling, cut and cover construction, utility relocations, site preparation and demolition, and construction access.

These construction activities could affect groundwater through dewatering that may be needed during construction, especially for tunnels or where columns are constructed within the Los Angeles River, the Rio Hondo Channel, and the San Gabriel River. Dewatering may also be needed in excavation areas required for foundation construction, utility installation, and demolition. Dewatering activities can cause impacts to groundwater by temporarily reducing the local groundwater elevation. Groundwater removed from the site as a result of dewatering could potentially come in contact with construction-related contaminants (e.g., fuels, solvents, oils, grease). Spills from construction materials could also inadvertently contaminate groundwater. Dewatering of the construction site would be subject to the requirements of the Construction Dewatering Permit and, therefore, would not cause construction-related impacts to surface or groundwater quality. Furthermore, implementation of project design features discussed in Section 5.1, including good housekeeping and spill prevention BMPs, would avoid and minimize construction-related groundwater impacts. Therefore, all Build Alternative potential impacts would be minimized, and would not result in adverse effects during construction.

5.4 Alternative 1: Los Angeles Union Station to Pioneer Station

5.4.1 Hydrology and Surface Water Bodies

The potential hydrology and surface water body impacts related to Alternative 1, Los Angeles Union Station to Pioneer Station, would be similar for all Build Alternatives and are discussed in Section 5.3.1.

Most of the alignment for Alternative 1, including all stations, would be within the Los Angeles River and San Gabriel River Watersheds. Approximately 1,300 feet of rail would fall within the Ballona Creek watershed. Table 5.2 shows the changes that would occur to the impervious area for Alternative 1 along with stations, local street improvements, and TPSS facilities.

Table 5.2. Alternative 1 Change in Impervious Area

Component	Watershed	Total Disturbed Area[1] (acres)	Existing Impervious Area[2] (acres)	Proposed Impervious Area[3] (acres)	New Impervious Area[4] (acres)
Rail/Stations	Los Angeles River, Ballona Creek, San Gabriel River	199.7	34.6	48.2	13.6
TPSS Facilities	Los Angeles River, San Gabriel River	2.6	1.5	2.6	1.1
Totals	Los Angeles River, Ballona Creek, San Gabriel River	202.3	36.1	50.8	14.7

Source: Prepared by WSP and Jacobs in 2020
Notes:
[1] Total Disturbed Area is the area of disturbed soil generated by Build Alternatives.
[2] Existing Impervious Area is the pre-construction impervious surfaces that exist within the project ROW.
[3] Proposed Impervious Area is the area consisting of replaced impervious surfaces and new impervious surfaces within the project ROW.
[4] New Impervious Area is the conversion of existing pervious (unpaved) areas to impervious area, e.g., the difference between Existing Impervious Area and Proposed Impervious Area = New Impervious Area.
TPSS = traction power substations

By comparison, 32 percent of the Los Angeles River Watershed (169,800 acres), 29 percent of the San Gabriel River Watershed (118,800 acres), and 40 percent of the Ballona Creek Watershed (33,300 acres) are estimated to be impervious based on assumptions of land use type (LARWQCB 2017a; LACDPW 2017c, 2017d; Weston Solutions, Inc. 2005). The Build Alternative would be located in a highly urbanized area and along major roadways and rail corridors. These corridors are predominantly paved surfaces or highly compacted unpaved areas with reduced infiltrative capacity. The increase in impervious area resulting from Alternative 1 (14.7 acres) would affect approximately 0.005 percent of the overall watershed area (320,800 acres total), and would therefore cause a negligible overall decrease in infiltrative capacity in these watersheds.

Alternative 1 would cross several local and regional storm drainage facilities, which are shown on Figure 4-2 and Figure 4-3. Table 5.3 lists the affected LACFCD regional storm drainage systems.

Table 5.3. Alternative 1 Los Angeles County Storm Drains

	Drainage System Name
Alternative 1	BI 0059 – U1 Line A – Central Business
	BI 5203 – U2 – Los Angeles
	BI 0482 – Line A – Fourteenth St
	BU 0058 – Line A – South Central Business
	Hooper Avenue Drain
	BI 001 – U1 Line C – East Compton Creek
	BI 001 – U1 Line B
	East Compton Creek No. 1
	BI 7850 – U1 Line D
	BI 0019 – U1 – Hollydale A
	BI 0559 – Line A
	BI 1106 – U2
	BI 0606 – U1 Line B
	BI 1903 – Unit 1
	BI 1902 – Line A
	BI 0016 – U-A Cerritos-MAP
	MTD 0133 – San Gabriel River
	BI 113 – Dairy Valley
	BI 0533 – U3 Line A - Artesia

Source: LACDPW 2017a

Modifications to local storm drain systems would be required to discharge runoff from the project site. New drainage pipes under at-grade track would collect stormwater to earthen or concrete drainage swales running parallel to the track. Drainage systems within the portions of elevated track and near tunnel portals would collect and discharge stormwater to the existing local stormwater infrastructure. These modifications are required and are not expected to adversely affect existing storm drains because the Build Alternative would not substantially alter the existing drainage patterns.

To minimize impacts to hydrology and water bodies, Alternative 1 would implement the project design features listed in Section 5.1 and maintain pre-development hydrology characteristics. Alternative 1 would comply with the post-construction and hydromodification requirements of the LA County MS4 NPDES permit as discussed in Section 3.3. New or modified storm drainage systems would be designed to meet local and regional standards. Therefore, no adverse effects on hydrology and surface water bodies as a result of Alternative 1 would occur.

5.4.2 Water Quality

The potential water quality impacts related to rail operations, stations, parking facilities, local street improvements, and TPSS facilities would be similar for all Build Alternatives and are discussed in Section 5.3.2.

Figure 5-1 and Figure 5-2 show the location of stations, TPSS facilities, and local street improvements for each alternative. As discussed in Section 5.3.2, impacts to water quality from rail operations can be generally quantified by length of track. Table 5.4 summarizes the length of each type of rail alignment (aerial, at-grade, and below-grade).

Table 5.4. Alternative 1 Aerial, At-Grade, and Underground Track Lengths

Alternative	Length of Aerial Track (miles)	Length of At-Grade Track (miles)	Length of Tunnel (miles)
Alternative 1	4.7	12.3	2.3

Source: Prepared by Metro in 2020

As shown in Table 5.2, Alternative 1 would convert 14.7 acres from pervious to impervious area. Because Alternative 1 is in a highly urbanized area and along major roadways and rail corridors, the reduction in impervious area would be a small benefit to water quality in the watershed. Implementation of Alternative 1 would be subject to regulatory standards, conditions, and permitting requirements discussed in Section 2 (e.g., CWA and NPDES permit requirements). Additionally, project design features listed in Section 5.1 would be implemented to avoid and minimize direct and indirect impacts to water quality. Therefore, no adverse effects on water quality would occur.

5.4.3 Floodplains

The Alternative 1 alignment would cross the Los Angeles River, Rio Hondo, and San Gabriel River. A portion of the alignment is located within Flood Zone X. Operation of the Build Alternative would generally be outside the river channels and therefore protected from flooding except during extreme events.

Within the Los Angeles River and Rio Hondo channels, the new bridge structures would be constructed in the floodplain. To limit impacts to floodwaters and the existing flood control channels, structures would be elevated above existing levees. Because the bridge piers would be built in the channel, they would be subject to flooding. The potential impact to water surface elevation in each river would be less than 1 foot, and flood flows would continue to be fully contained within the channel (Metro 2017a and 2017b).

Inside the San Gabriel River, the new bridge structure would be constructed within the floodplain. To limit impacts to floodwaters and the existing flood control channel, aerial LRT structures would be elevated above the existing channel walls. Because the bridge piers would be built in the channel, they would be subject to flooding. The potential impact to water surface elevation would reduce the water surface within the channel near the project site, and flood flows would continue to be fully contained within the channel (Metro 2017c).

There would be no longitudinal encroachment into the floodplain or impact to beneficial floodplain values. The Build Alternative would not increase flooding risk by supporting incompatible development within the floodplain. Furthermore, compliance with local and federal floodplain regulations would avoid and minimize impacts to the flood control facility. Therefore, no adverse effects on floodplains would occur.

5.4.4 Groundwater

The potential groundwater impacts related to Alternative 1 would be similar for all Build Alternatives and are discussed in Section 5.3.4. This section presents the evaluation of groundwater as a water resource.

Alternative 1 would increase the impervious area, thereby decreasing groundwater recharge. Alternative 1 would convert 14.7 acres from pervious area to new impervious area. This represents a 0.008 percent increase in the impervious area in the watershed, which would cause a negligible impact to groundwater recharge. In comparison, 32 percent of the Los Angeles River Watershed (168,800 acres) and 29 percent of the San Gabriel River Watershed (118,800 acres) are estimated to be impervious based on assumptions of land use type (LARWQCB 2017b; LACDPW 2017b; Weston Solutions, Inc. 2005). Groundwater recharge within the Central Basin is primarily from recharge at the Montebello Forebay Spreading Grounds and by disbursed stormwater infiltration over unpaved land surfaces. By comparison, the entire basin is 177,000 acres (DWR 2004). Because Alternative 1 is in a highly urbanized area and along existing major roadways and rail corridors, the new impervious area would represent a negligible overall increase in total impervious area with respect to the watersheds and the corresponding groundwater recharge areas. To minimize the impacts of new impervious area, Alternative 1 would comply with the post-construction and hydromodification requirements of the LA County MS4 NPDES permit, as discussed in Section 3.1, and would implement the design features discussed in Section 5.1. These design features include LID treatment controls, such as landscaping, to help offset the loss of permeable surfaces. Furthermore, most recharge to the groundwater supply in LA County comes from large, natural stream systems or constructed groundwater recharge basins, which would be minimally affected by the Build Alternatives. Therefore, Alternative 1 impacts to groundwater resources would be minimized and would not result in adverse effects to groundwater.

Within the Alternative 1 alignment, 2.3 miles of tunnel would be built, as shown in Table 5.4. These tunnels are expected to be built below the groundwater table, providing a direct path for groundwater exfiltration. Construction and operation of the tunnels could also provide a path for contaminants to enter groundwater, for example, by exposing soil and groundwater to construction-related contaminants. As discussed in Section 5.1, project design features would be implemented to avoid and minimize direct and indirect impacts to groundwater. For example, the tunnel and underground stations would be constructed to preclude groundwater intrusion into the tunnel using a technique similar to that used for the Metro L (Gold) Line tunnels in Boyle Heights. In the unlikely event that groundwater accumulates in tunnels during operation, the water would be pumped out and treated to meet municipal standards before being discharged to the local sewer system. Therefore, Alternative 1 would not have adverse effects on groundwater would occur.

The Alternative 1 alignment is approximately 3.5 miles southwest of the Rio Hondo Coastal Basin Spreading Grounds, 6 miles north of the Dominguez Gap Spreading Grounds, and 5 miles south of the San Gabriel Coastal Basin Spreading Grounds. These facilities are outside of the Affected Area; therefore, Alternative 1 would have no adverse effects on these groundwater recharge facilities.

5.5 Alternative 2: 7th Street/Metro Center to Pioneer Station

5.5.1 Hydrology and Surface Water Bodies

The potential hydrology and surface water body impacts related to Alternative 2 would be similar for all Build Alternatives and are discussed in Section 5.3.1.

Most of the alignment for Alternative 2, 7th Street/Metro Center to Pioneer Station, including all stations, would be within the Los Angeles River and San Gabriel River Watersheds. Approximately 1,300 feet of rail would fall within the Ballona Creek Watershed. Table 5.5 shows the changes that would occur to impervious areas for Alternative 2, along with stations, local street improvements, and TPSS facilities.

Table 5.5. Alternative 2 Change in Impervious Area

Component	Watershed	Total Disturbed Area[1] (acres)	Existing Impervious Area[2] (acres)	Proposed Impervious Area[3] (acres)	New Impervious Area[4] (acres)
Rail/Stations	Los Angeles River, Ballona Creek, San Gabriel River	199.6	35.0	48.5	13.5
TPSS Facilities	Los Angeles River, San Gabriel River	3.6	2.2	3.6	1.4
Totals	Los Angeles River, Ballona Creek, San Gabriel River	203.2	37.2	52.1	14.9

Source: Prepared by WSP and Jacobs in 2020
Notes:
[1] Total Disturbed Area is the area of disturbed soil generated by Build Alternatives
[2] Existing Impervious Area is the pre-construction impervious surfaces that exist within the project ROW.
[3] Proposed Impervious Area is the area consisting of replaced impervious surfaces and new impervious surfaces within the project ROW.
[4] New Impervious Area is the conversion of existing pervious (unpaved) areas to impervious area, e.g., the difference between Existing Impervious Area and Proposed Impervious Area = New Impervious Area.
TPSS = traction power substations

By comparison, 32 percent of the Los Angeles River Watershed (169,800 acres), 29 percent of the San Gabriel River Watershed (118,800 acres), and 40 percent of the Ballona Creek Watershed (33,300 acres) are estimated to be impervious based on assumptions of land use type (LARWQCB 2017a; LACDPW 2017c and 2017d; Weston Solutions, Inc. 2005). The Build Alternative would be located in a highly urbanized area and along major roadways and rail corridors. These corridors are predominantly paved surfaces or highly compacted unpaved areas with reduced infiltrative capacity. The increase in impervious area resulting from Alternative 2 would affect approximately 0.005 percent of the overall watershed area (320,800 acres total), and would therefore cause a negligible overall decrease in infiltrative capacity in these watersheds.

Alternative 2 would cross several local and regional storm drainage facilities, which are shown on Figure 4-2 and Figure 4-3. Table 5.6 lists the affected LACFCD regional storm drainage systems.

Table 5.6. Alternative 2 Los Angeles County Storm Drains

	Drainage System Name
Alternative 2	BI 0482 – Line A – Fourteenth St
	Seventh Street Drain
	BU 0058 – Line A – South Central Business
	Hooper Avenue Drain
	BI 001 – U1 Line C – East Compton Creek
	BI 001 – U1 Line B
	East Compton Creek No. 1
	BI 7850 – U1 Line D
	BI 0019 – U1 – Hollydale A
	BI 0559 – Line A
	BI 1106 – U2
	BI 0606 – U1 Line B
	BI 1903 – Unit 1
	BI 1902 – Line A
	BI 0016 – U-A Cerritos-MAP
	MTD 0133 – San Gabriel River
	BI 113 – Dairy Valley
	BI 0533 – U3 Line A – Artesia

Source: LACDPW 2017a

Modifications to local storm drain systems would be required to discharge runoff from the project site. New drainage pipes under at-grade track would collect stormwater to earthen or concrete drainage swales running parallel to the track. Drainage systems within the portions of elevated track and near tunnel portals would collect and discharge stormwater to the existing local stormwater infrastructure. These modifications are required and are not expected to adversely affect existing storm drains because the Build Alternative would not substantially alter the existing drainage patterns.

To minimize impacts to hydrology and water bodies, Alternative 2 would implement the project design features listed in Section 5.1 and maintain pre-development hydrology characteristics. Alternative 2 would comply with the post-construction and hydromodification requirements of the LA County MS4 NPDES permit as discussed in Section 3.3. New or modified storm drainage systems would be designed to meet local and regional standards. Therefore, no adverse effects on hydrology and surface water bodies as a result of Alternative 2 would occur.

5.5.2 Water Quality

The potential water quality impacts related to rail operations, stations, parking facilities, local street improvements, and TPSS facilities would be similar for all Build Alternatives and are discussed in Section 5.3.2.

Figure 5-1 and Figure 5-2 show the location of stations, TPSS facilities, and local street improvements for each alternative. As discussed in Section 5.3.2, impacts to water quality from rail operations can be generally quantified by length of track. Table 5.7 summarizes the length of each type of rail alignment (aerial, at-grade, and below-grade).

Table 5.7. Alternative 2 Aerial, At-Grade and Underground Track Lengths

Alternative	Length of Aerial Track (miles)	Length of At-Grade Track (miles)	Length of Tunnel (miles)
Alternative 2	4.7	12.3	2.3

Source: Prepared by Metro in 2020

As shown in Table 5.5, Alternative 2 would convert 14.9 acres from pervious to impervious area. Because Alternative 2 is in a highly urbanized area and along major roadways and rail corridors, the reduction in impervious area would be a small benefit to water quality in the watershed. Implementation of Alternative 2 would be subject to regulatory standards, conditions, and permitting requirements discussed in Section 2 (e.g., CWA and NPDES permit requirements). Additionally, project design features listed in Section 5.1 would be implemented to avoid and minimize direct and indirect impacts to water quality. Therefore, no adverse effects on water quality would occur.

5.5.3 Floodplains

The potential floodplain impacts related to Alternative 2 would be similar for all Build Alternatives and are discussed in Section 5.3.3.

The Alternative 2 alignment would cross the Los Angeles River, Rio Hondo, and San Gabriel River. A portion of the alignment is located within Flood Zone X. Operation of the Build Alternative would generally be outside the river channels and therefore protected from flooding, except during extreme events.

Within the Los Angeles River and Rio Hondo channels, the new bridge structures would be constructed in the floodplain. To limit impacts to floodwaters and the existing flood control channels, structures would be elevated above existing levees. Because the bridge piers would be built in the channel, they would be subject to flooding. The potential impact to water surface elevation in each river would be less than 1 foot, and flood flows would continue to be fully contained within the channel (Metro 2017a, 2017b).

Inside the San Gabriel River, the new bridge structure would be constructed within the floodplain. To limit impacts to floodwaters and the existing flood control channel, aerial LRT structures would be elevated above the existing channel walls. Because the bridge piers would be built in the channel, they would be subject to flooding. The potential impact to water surface elevation would reduce the water surface within the channel near the project site, and flood flows would continue to be fully contained within the channel (Metro 2017c).

There would be no longitudinal encroachment into the floodplain or impact to beneficial floodplain values. The Build Alternative would not increase flooding risk by supporting incompatible development within the floodplain. Furthermore, compliance with local and federal floodplain regulations would avoid and minimize impacts to the flood control facility. Therefore, no adverse effects on floodplains would occur.

5.5.4 Groundwater

The potential groundwater impacts related to Alternative 2 would be similar for all Build Alternatives and are discussed in Section 5.3.4. This section presents the evaluation of groundwater as a water resource.

Groundwater recharge within the Central Basin is primarily from recharge at the Montebello Forebay Spreading Grounds and by disbursed stormwater infiltration over unpaved land surfaces. Because Alternative 2 is in a highly urbanized area and along existing major roadways and rail corridors, the new impervious area would represent a negligible overall increase in total impervious area with respect to the watersheds and the corresponding groundwater recharge areas. To minimize the impacts of new impervious area, Alternative 2 would comply with the post-construction and hydromodification requirements of the LA County MS4 NPDES permit, as discussed in Section 3.1 and would implement the design features discussed in Section 5.1. These design features include LID treatment controls, such as landscaping, to help offset the loss of permeable surfaces. Furthermore, most recharge to the groundwater supply in LA County comes from large, natural stream systems or constructed groundwater recharge basins, which would be minimally affected by the Build Alternatives. Therefore, Alternative 2 impacts to groundwater resources would be minimized and would not result in adverse effects to groundwater.

Within the Alternative 2 alignment, 2.3 miles of tunnel would be built (Table 5.7). These tunnels are expected to be built below the groundwater table, providing a direct path for groundwater exfiltration. Construction and operation of the tunnels could also provide a path for contaminants to enter groundwater (e.g., by exposing soil and groundwater to construction-related contaminants). As discussed in Section 5.1, project design features would be implemented to avoid and minimize direct and indirect impacts to groundwater. For example, the tunnel and underground stations would be constructed to preclude groundwater intrusion into the tunnel using a technique similar to that used for the Metro L (Gold) Line tunnels in Boyle Heights. In the unlikely event that groundwater accumulates in tunnels during operation, the water would be pumped out and treated to meet municipal standards before being discharged to the local sewer system. Therefore, no adverse effects on groundwater would occur.

The Alternative 2 alignment is approximately 3.5 miles southwest of the Rio Hondo Coastal Basin Spreading Grounds, 6 miles north of the Dominguez Gap Spreading Grounds, and 5 miles south of the San Gabriel Coastal Basin Spreading Grounds. These facilities are outside of the Affected Area; therefore, Alternative 2 would not result in adverse effects on these groundwater recharge facilities.

5.6 Alternative 3: Slauson/A (Blue) Line to Pioneer Station

5.6.1 Hydrology and Surface Water Bodies

The potential hydrology and surface water body impacts related to Alternative 3, Slauson/A (Blue) Line to Pioneer Station, would be similar for all Build Alternatives and are discussed in Section 5.3.1.

Most of the alignment for Alternative 3, including all stations, would be within the Los Angeles River and San Gabriel River Watersheds. Table 5.8 shows the changes that would occur to impervious areas for Alternative 3, along with stations, local street improvements, and TPSS facilities.

By comparison, 32 percent of the Los Angeles River Watershed (169,800 acres), 29 percent of the San Gabriel River Watershed (118,800 acres), and 40 percent of the Ballona Creek Watershed (33,300 acres) are estimated to be impervious based on assumptions of land use type (LARWQCB 2017a; LACDPW 2017c, 2017d; Weston Solutions, Inc. 2005). The Build Alternatives would be located in a highly urbanized area and along major roadways and rail corridors. These corridors are predominantly paved surfaces or highly compacted unpaved areas with reduced infiltrative capacity. The increase in impervious area resulting from Alternative 3 would affect approximately 0.003 percent of the overall watershed area (320,800 acres total), and would therefore cause a negligible overall decrease in infiltrative capacity in these watersheds.

Table 5.8. Alternative 3 Change in Impervious Area

Component	Watershed	Total Disturbed Area[1] (acres)	Existing Impervious Area[2] (acres)	Proposed Impervious Area[3] (acres)	New Impervious Area[4] (acres)
Rail/Stations	Los Angeles River, San Gabriel River	180.7	25.6	33.0	7.4
TPSS Facilities	Los Angeles River, San Gabriel River	2.3	1.4	2.3	0.9
Totals	Los Angeles River, San Gabriel River	183.0	27.0	35.3	8.3

Source: Prepared by WSP and Jacobs in 2020
Notes:
[1] Total Disturbed Area is the area of disturbed soil generated by Build Alternatives.
[2] Existing Impervious Area is the pre-construction impervious surfaces that exist within the project ROW.
[3] Proposed Impervious Area is the area consisting of replaced impervious surfaces and new impervious surfaces within the project ROW.
[4] New Impervious Area is the conversion of existing pervious (unpaved) areas to impervious area, e.g., the difference between Existing Impervious Area and Proposed Impervious Area = New Impervious Area.

Alternative 3 would cross several local and regional storm drainage facilities, which are shown on Figure 4-2 and Figure 4-3. Table 5.9 lists the affected LACFCD regional storm drainage systems.

Table 5.9. Alternative 3 Los Angeles County Storm Drains

	Drainage System Name
Alternative 3	Hooper Avenue Drain
	BI 001 – U1 Line C – East Compton Creek
	BI 001 – U1 Line B
	East Compton Creek No. 1
	BI 7850 – U1 Line D
	BI 0019 – U1 – Hollydale A
	BI 0559 – Line A
	BI 1106 – U2
	BI 0606 – U1 Line B
	BI 1903 – Unit 1
	BI 1902 – Line A
	BI 0016 – U-A Cerritos-MAP
	MTD 0133 – San Gabriel River
	BI 113 – Dairy Valley
	BI 0533 – U3 Line A – Artesia

Source: LACDPW 2017a

Modifications to local storm drain systems would be required to discharge runoff from the project site. New drainage pipes under at-grade track would collect stormwater to earthen or concrete drainage swales running parallel to the track. Drainage systems within the portions of elevated track and near tunnel portals would collect and discharge stormwater to the existing local stormwater infrastructure. These modifications are required and are not expected to adversely affect existing storm drains because the Build Alternative would not substantially alter the existing drainage patterns.

To minimize impacts to hydrology and water bodies, Alternative 3 would implement the project design features listed in Section 5.1 and maintain pre-development hydrology characteristics. Alternative 3 would comply with the post-construction and hydromodification requirements of the LA County MS4 NPDES permit (discussed in Section 3.3). New or modified storm drainage systems would be designed to meet local and regional standards. Therefore, Alternative 3 would not result in adverse effects on hydrology and surface water bodies.

5.6.2 Water Quality

The potential water quality impacts related to rail operations, stations, parking facilities, local street improvements, and TPSS facilities would be similar for all alternatives and are discussed in Section 5.3.2.

Figure 5-1 and Figure 5-2 show the location of stations, TPSS facilities, and local street improvements for each alternative. As discussed in Section 5.3.2, impacts to water quality from rail operations can be generally quantified by length of track. Table 5.10 summarizes the length of each type of rail alignment (aerial, at-grade, and below-grade).

Table 5.10. Alternative 3 Aerial, At-Grade and Underground Track Lengths

Alternative	Length of Aerial Track (miles)	Length of At-Grade Track (miles)	Length of Tunnel (miles)
Alternative 3	2.6	12.2	N/A

Source: Prepared by Metro in 2020

As shown in Table 5.10, Alternative 3 would convert 8.3 acres from pervious to impervious area. Because Alternative 3 is in a highly urbanized area and along major roadways and rail corridors, the reduction in impervious area would be a small benefit to water quality in the watershed. Implementation of Alternative 3 would be subject to regulatory standards, conditions, and permitting requirements discussed in Section 2 (e.g., CWA and NPDES permit requirements). Additionally, project design features listed in Section 5.1 would be implemented to avoid and minimize direct and indirect impacts to water quality. Therefore, Alternative 3 would not have adverse effects on water quality.

5.6.3 Floodplains

The potential floodplain impacts related to Alternative 3 would be similar for all Build Alternatives and are discussed in Section 5.3.3.

The Alternative 3 alignment would cross the Los Angeles River, Rio Hondo, and San Gabriel River. A portion of the alignment is located within Flood Zone X. Operation of the Build Alternative would generally be outside the river channels and therefore protected from flooding except during extreme events.

Within the Los Angeles River and Rio Hondo channels, the new bridge structures would be constructed in the floodplain. To limit impacts to floodwaters and the existing flood control channels, structures would be elevated above existing levees. Because the bridge piers would be built in the channel, they would be subject to flooding. The potential impact to water surface elevation in each river would be less than 1 foot, and flood flows would continue to be fully contained within the channel (Metro 2017a and 2017b).

Inside the San Gabriel River, the new bridge structure would be constructed within the floodplain. To limit impacts to floodwaters and the existing flood control channel, aerial LRT structures would be elevated above the existing channel walls. Because the bridge piers would be built in the channel, they would be subject to flooding. The potential impact to water surface elevation would reduce the water surface within the channel near the project site, and flood flows would continue to be fully contained within the channel (Metro 2017c).

There would be no longitudinal encroachment into the floodplain or impact to beneficial floodplain values. The Build Alternative would not increase flooding risk by supporting incompatible development within the floodplain. Furthermore, compliance with local and federal floodplain regulations would avoid and minimize impacts to the flood control facility. Therefore, no adverse effects on floodplains would occur.

5.6.4 Groundwater

The potential groundwater impacts related to Alternative 3 would be similar for all Build Alternatives and are discussed in Section 5.3.4. The level of groundwater impacts would be reduced because the Alternative 3 footprint and total disturbed areas are smaller, and there are no tunnel sections. As discussed in Section 5.1, project design features would be implemented to avoid and minimize direct and indirect impacts to groundwater.

Groundwater recharge within the Central Basin is primarily from recharge at the Montebello Forebay Spreading Grounds and by disbursed stormwater infiltration over unpaved land surfaces. Because Alternative 3 is in a highly urbanized area and along existing major roadways and rail corridors, the new impervious area would represent a negligible overall increase in total impervious area with respect to the watersheds and the corresponding groundwater recharge areas. To minimize the impacts of new impervious area, Alternative 3 would comply with the post-construction and hydromodification requirements of the LA County MS4 NPDES permit, as discussed in Section 3.1 and would implement the design features discussed in Section 5.1. These design features include LID treatment controls, such as landscaping, to help offset the loss of permeable surfaces. Furthermore, most recharge to the groundwater supply in LA County comes from large, natural stream systems or constructed groundwater recharge basins, which would be minimally affected by the Build Alternatives. Therefore, Alternative 3 impacts to groundwater resources would be minimized and would not result in adverse effects to groundwater.

The Alternative 3 alignment is approximately 3.5 miles southwest of the Rio Hondo Coastal Basin Spreading Grounds, 6 miles north of the Dominguez Gap Spreading Grounds, and 5 miles south of the San Gabriel Coastal Basin Spreading Grounds. These facilities are outside of the Affected Area; therefore, Alternative 3 would have no adverse effects on these groundwater recharge facilities.

5.7 Alternative 4: I-105/C (Green) Line to Pioneer Station

5.7.1 Hydrology and Surface Water Bodies

The potential hydrology and surface water body impacts related to Alternative 4, I-105/C (Green) Line to Pioneer Station, would be similar for all alternatives and are discussed in Section 5.3.1.

Most of the alignment for Alternative 4, including all stations, would be within the Los Angeles River and San Gabriel River Watersheds. Table 5.11 shows the changes that would occur to impervious areas for Alternative 4, along with stations, local street improvements, and TPSS facilities.

Table 5.11. Alternative 4 Change in Impervious Area

Component	Watershed	Total Disturbed Area[1] (acres)	Existing Impervious Area[2] (acres)	Proposed Impervious Area[3] (acres)	New Impervious Area[4] (acres)
Rail/Stations	Los Angeles River, San Gabriel River	83.0	9.4	12.3	2.9
TPSS Facilities	Los Angeles River, San Gabriel River	0.8	0.3	0.8	0.5
Totals	Los Angeles River, San Gabriel River	83.8	9.7	13.1	3.4

Source: Prepared by WSP and Jacobs in 2020
Notes:
[1] Total Disturbed Area is the area of disturbed soil generated by Build Alternatives
[2] Existing Impervious Area is the pre-construction impervious surfaces that exist within the project ROW.
[3] Proposed Impervious Area is the area consisting of replaced impervious surfaces and new impervious surfaces within the project ROW.
[4] New Impervious Area is the conversion of existing pervious (unpaved) areas to impervious area, e.g., the difference between Existing Impervious Area and Proposed Impervious Area = New Impervious Area.
TPSS = traction power substations

By comparison, 32 percent of the Los Angeles River Watershed (169,800 acres), 29 percent of the San Gabriel River Watershed (118,800 acres), and 40 percent of the Ballona Creek Watershed (33,300 acres) are estimated to be impervious based on assumptions of land use type (LARWQCB 2017a; LACDPW 2017c, 2017d; Weston Solutions, Inc. 2005). The Build Alternative would be located in a highly urbanized area and along major roadways and rail corridors. These corridors are predominantly paved surfaces or highly compacted unpaved areas with reduced infiltrative capacity. The increase in impervious area resulting from Alternative 1 (14.7 acres) would affect approximately 0.001 percent of the overall watershed area (320,800 acres total), and would therefore cause a negligible overall decrease in infiltrative capacity in these watersheds.

Alternative 4 would cross several local and regional storm drainage facilities, which are shown on Figure 4-2 and Figure 4-3. Table 5.12 lists the affected LACFCD regional storm drainage systems.

Table 5.12. Alternative 4 Los Angeles County Storm Drains

	Drainage System Name
Alternative 4	BI 0019 – U1 – Hollydale A
	BI 0559 – Line A
	BI 1106 – U2
	BI 0606 – U1 Line B
	BI 1903 – Unit 1
	BI 1902 – Line A
	BI 0016 – U-A Cerritos-MAP
	MTD 0133 – San Gabriel River
	BI 113 – Dairy Valley
	BI 0533 – U3 Line A - Artesia

Source: LACDPW 2017a

Modifications to local storm drain systems would be required to discharge runoff from the project site. New drainage pipes under at-grade track would collect stormwater to earthen or concrete drainage swales running parallel to the track. Drainage systems within the portions of elevated track and near tunnel portals would collect and discharge stormwater to the existing local stormwater infrastructure. These modifications are required and are not expected to adversely affect existing storm drains because the Build Alternative would not substantially alter the existing drainage patterns.

To minimize impacts to hydrology and water bodies from, Alternative 4 would implement the project design features listed in Section 5.1 and maintain pre-development hydrology characteristics. Alternative 4 would comply with the post-construction and hydromodification requirements of the LA County MS4 NPDES permit (discussed in Section 3.3). New or modified storm drainage systems would be designed to meet local and regional standards. Therefore, no adverse effects on hydrology and surface water bodies as a result of Alternative 4 would occur.

5.7.2 Water Quality

The potential water quality impacts related to rail operations, stations, parking facilities, local street improvements, and TPSS facilities would be similar for all Build Alternatives and are discussed in Section 5.3.2.

Figure 5-1 and Figure 5-2 show the location of stations, TPSS facilities, and local street improvements for each alternative. As discussed in Section 5.3.2, impacts to water quality from rail operations can be generally quantified by length of track. Table 5.13 summarizes the length of each type of rail alignment (aerial, at-grade, and below-grade).

Table 5.13. Alternative 4 Aerial, At-Grade and Underground Track Lengths

Alternative	Length of Aerial Track (miles)	Length of At-Grade Track (miles)	Length of Tunnel (miles)
Alternative 4	1.0	5.6	N/A

Source: Prepared by Metro in 2020

As shown in Table 5.11, Alternative 4 would convert 3.4 acres from pervious to impervious area. Because Alternative 4 is in a highly urbanized area and along major roadways and rail corridors, the reduction in impervious area would be a small benefit to water quality in the watershed. Implementation of Alternative 4 would be subject to regulatory standards, conditions, and permitting requirements discussed in Section 2 (e.g., CWA and NPDES permit requirements). Additionally, project design features listed in Section 5.1 would be implemented to avoid and minimize direct and indirect impacts to water quality. Therefore, no adverse effects on water quality would occur.

5.7.3 Floodplains

The potential floodplain impacts related to Alternative 4 would be similar to the common impacts of the Build Alternatives discussed in Section 5.3.3 for the San Gabriel River floodplain.

The Alternative 4 alignment would cross the San Gabriel River. A portion of the alignment is located within Flood Zone X. Operation of the Build Alternatives would generally be outside the river channels and therefore protected from flooding except during extreme events.

Inside the San Gabriel River, the new bridge structure would be constructed within the floodplain. To limit impacts to floodwaters and the existing flood control channel, aerial LRT structures would be elevated above the existing channel walls. Because the bridge piers would be built in the channel, they would be subject to flooding. The potential impact to water surface elevation would reduce the water surface within the channel near the Build Alternatives site, and flood flows would continue to be fully contained within the channel (Metro 2017c).

There would be no longitudinal encroachment into the floodplain or impact to beneficial floodplain values. The Build Alternatives would not increase flooding risk by supporting incompatible development within the floodplain. Furthermore, compliance with local and federal floodplain regulations would avoid and minimize impacts to the flood control facility. Therefore, no adverse effects on floodplains would occur.

5.7.4 Groundwater

The potential groundwater impacts related to Alternative 4 would be similar for all Build Alternatives and are discussed in Section 5.3.4. The level of groundwater impacts would be reduced because the Build Alternative footprint and total disturbed areas are smaller, and there are no tunnel sections. As discussed in Section 5.1, project design features would be implemented to avoid and minimize direct and indirect impacts to groundwater.

Groundwater recharge within the Central Basin is primarily from recharge at the Montebello Forebay Spreading Grounds and by disbursed stormwater infiltration over unpaved land surfaces. Because Alternative 4 is in a highly urbanized area and along existing major roadways and rail corridors, the new impervious area would represent a negligible overall increase in total impervious area with respect to the watersheds and the corresponding groundwater recharge areas. To minimize the impacts of new impervious area, Alternative 4 would comply with the post-construction and hydromodification requirements of the LA County MS4 NPDES permit, as discussed in Section 3.1 and would implement the design features discussed in Section 5.1. These design features include LID treatment controls, such as landscaping, to help offset the loss of permeable surfaces. Furthermore, most recharge to the groundwater supply in LA County comes from large, natural stream systems or constructed groundwater recharge basins, which would be minimally affected by the Build Alternatives. Therefore, Alternative 4 impacts to groundwater resources would be minimized and would not result in adverse effects to groundwater.

The Alternative 4 alignment is approximately 3.5 miles southwest of the Rio Hondo Coastal Basin Spreading Grounds, 6 miles north of the Dominguez Gap Spreading Grounds, and 5 miles south of the San Gabriel Coastal Basin Spreading Grounds. These facilities are outside of the Affected Area; therefore, the Build Alternative would have no adverse effects on these groundwater recharge facilities.

5.8 Design Options

5.8.1 Hydrology and Surface Water Bodies

Design Option 1 (MWD) would relocate the northern termini of Alternative 1 to east of the MWD building. Design Option 2 would include the Little Tokyo Station for Alternative 1. The design options are substantially similar to the Build Alternatives in regard to water resources conditions, potential impacts, and effect determinations. Therefore, the design options were not analyzed separately.

5.8.2 Water Quality

Design Option 1 (MWD) would relocate the northern termini of Alternative 1 to east of the MWD building. Design Option 2 would include the Little Tokyo Station for Alternative 1. The design options are substantially similar to the Build Alternatives with regard to water resources conditions, potential impacts, and effect determinations. Therefore, the design options were not analyzed separately.

5.8.3 Floodplains

Design Option 1 would relocate the northern termini of Alternative 1 to east of the MWD building. Design Option 2 would include the Little Tokyo Station for Alternative 1. Design options are outside of the regulatory floodplains.

5.8.4 Groundwater

Design Option 1 would relocate the northern termini of Alternative 1 to east of the MWD building. Design Option 2 would include the Little Tokyo Station for Alternative 1. The design options are substantially similar to the Build Alternatives with regard to groundwater conditions, potential impacts, and effect determinations. Therefore, the design options were not analyzed separately.

5.9 Maintenance and Storage Facility

5.9.1 Hydrology and Surface Water Bodies

The potential for hydrology and surface water body impacts from a MSF would be the result of changes in impervious surface. In addition to the changes in impervious surface resulting from the rail, stations, and TPSS, the Bellflower and Paramount MSF site options would result in 1.3 and 12.7 acres of new impervious area, respectively, as shown in Table 5.14. To minimize impacts to hydrology and water bodies from the MSF, the Build Alternatives would implement the project design features listed in Section 5.1 and maintain pre-development hydrology characteristics. The MSF site options would comply with the post-construction and hydromodification requirements of the LA County MS4 NPDES permit, as discussed in Section 3.3. New or modified storm drainage systems would be designed to meet local and regional standards. Therefore, no adverse effects on hydrology and surface water bodies from the MSF would occur, regardless of facility location.

Table 5.14. Maintenance and Storage Facility Change in Impervious Area

Component	Watershed	Total Disturbed Area[1] (acres)	Existing Impervious Area[2] (acres)	Proposed Impervious Area[3] (acres)	New Impervious Area[4] (acres)
Bellflower MSF	San Gabriel River	21.5	8.8	21.5	12.7
Paramount MSF	Los Angeles River	22.2	20.9	22.2	1.3

Source: Prepared by WSP and Jacobs in 2020
Note:
[1] Total Disturbed Area is the area of disturbed soil generated by Build Alternatives
[2] Existing Impervious Area is the pre-construction impervious surfaces that exist within the project ROW.
[3] Proposed Impervious Area is the area consisting of replaced impervious surfaces and new impervious surfaces within the project ROW.
[4] New Impervious Area is the conversion of existing pervious (unpaved) areas to impervious area, e.g., the difference between Existing Impervious Area and Proposed Impervious Area = New Impervious Area.
TPSS = traction power substations

5.9.2 Water Quality

Water quality impacts associated with MSFs are discussed in Section 5.3.2. Development of MSFs at Bellflower or Paramount would result in water quality impacts because of the new impervious surfaces required. Conversion of pervious to impervious area decreases infiltration, which increases the concentration and total pollutant load in stormwater runoff. In addition to new impervious surfaces, the maintenance and storage activities are expected to increase loads for pollutants associated with industrial activities, such as sediment, nutrients, trash, metals, oil and grease, pesticides, and organics (CASQA 2003). However, design features discussed under the heading “Project Design Features” would be implemented to minimize direct impacts to water quality associated with MSFs. Therefore, the MSF site options would not result in adverse effects related to water quality.

5.9.3 Floodplains

The potential MSF site options are located outside of the 100-year flood zone. Therefore, flooding and flood-related effects would be negligible.

5.9.4 Groundwater

The Bellflower and Paramount MSF site options are outside of groundwater recharge areas. Therefore, no adverse effects on these groundwater recharge facilities would occur as a result of either MSF site option.

6 CALIFORNIA ENVIRONMENTAL QUALITY ACT DETERMINATION

The CEQA requires that effects that are considered to be a “significant impact” be identified in an Environmental Impact Report. One objective of CEQA is to disclose to decision makers and the public the significant environmental effects of the proposed activities. Therefore, in this joint federal and state report, reference to “significant impacts” will be made to fulfill this requirement under CEQA, pursuant to standards of California law, and significant impacts are addressed within this section of the report. The following discussion addresses the questions set forth in Appendix G of the CEQA Guidelines to determine whether the No Project Alternative, the Build Alternatives, the design options, or the MSF would have significant impacts to water resources under CEQA.

6.1 Would the Project violate any applicable water quality standards or WDRs or otherwise substantially degrade surface or groundwater quality?

6.1.1 No Project Alternative

Under the No Project Alternative, implementation of the Build Alternatives would not be introduced into the Affected Area and no changes or impacts consistent with the Build Alternatives would occur. Therefore, there would be no impacts to surface or groundwater quality, and mitigation measures would not be required.

6.1.1.1 Mitigation Measures

No mitigation measures required.

6.1.1.2 Impacts Remaining after Mitigation

No impacts.

6.1.2 Build Alternatives, MSFs, and Design Options

As discussed in Section 5, the Build Alternatives would result in new impervious areas that could increase the concentration and total load of pollutants in stormwater runoff. Additionally, rail operations would contribute pollutants in concentrations and amounts that are typical for transportation facilities, including total suspended solids, metals, oil and grease, and debris. Impacts to water quality from rail operations can be generally quantified by length of track. As more fully described in Section 3.2 and 3.3, the Build Alternatives would be subject to the LA County MS4 NPDES permit and IGP during the operational phase. The MS4 NPDES permit requires implementation of site design, source control, and treatment control BMPs to the maximum extent practical. The IGP requires preparation of an industrial SWPPP and a monitoring plan for industrial facilities, including vehicle maintenance facilities associated with transportation operations. Compliance with these permits would be mandatory and a condition of approval of the final construction permits for construction within public rights-of-way. Compliance with the permits would also meet the TMDL standards. Also, all phases of construction would be subject to the CGP. Therefore, the Build Alternatives would not violate any applicable water quality standards or otherwise substantially degrade surface or groundwater quality, including those defined in

Section 13050 of the California Water Code, and impacts would be less than significant; therefore, mitigation measures would not be required.

6.1.2.1 Mitigation Measures

With implementation of the design features described Section 5.1, operation and maintenance of the Build Alternatives would not result in adverse effects on water quality; therefore, mitigation measures would not be required.

6.1.2.2 Impacts Remaining after Mitigation

Less than significant.

6.2 Would the Project substantially decrease groundwater supplies or interfere substantially with groundwater recharge such that the project may impede sustainable groundwater management of the basin?

6.2.1 No Project Alternative

Under the No Project Alternative, implementation of the Build Alternatives would not be introduced into the Affected Area and no changes or impacts consistent with the Build Alternatives would occur. Therefore, there would be no impacts to groundwater recharge, and mitigation measures would not be required.

6.2.1.1 Mitigation Measures

No mitigation measures required.

6.2.1.2 Impacts Remaining after Mitigation

No impacts.

6.2.2 Build Alternatives, MSFs, and Design Options

The Build Alternatives would result in 3.4 to 14.9 acres of new impervious area, depending on the alternative, within the Central Basin. In addition, the Bellflower and Paramount MSFs would result in 12.7 and 1.3 acres of new impervious area, respectively. Groundwater recharge within the Central Basin is primarily from spreading grounds and over land surfaces. By comparison, the entire basin is 177,000 acres (California Department of Water Resources 2004). Spreading grounds are located along the Los Angeles River, Rio Hondo, and San Gabriel River. The Rio Hondo Coastal Basin Spreading Grounds are located 3.5 miles northeast of the Rio Hondo crossing. The Dominguez Gap Spreading Grounds are located approximately six miles south of the Los Angeles River crossing. The San Gabriel Coastal Basin Spreading Grounds are located approximately five miles north of the San Gabriel River crossing. Direct precipitation on the basin within the proposed Affected Area is not a major source of groundwater recharge. However, groundwater recharge could be impeded if a substantial amount of pervious area were converted to impervious surfaces. The increase in impervious surfaces within the project area would be a negligible fraction of the entire aquifer area and would not affect the spreading grounds; therefore, it would not significantly affect groundwater recharge.

To minimize the impacts of new impervious areas, the Build Alternatives would comply with the post-construction and hydromodification requirements of the LA County MS4 NPDES permit, as discussed in Section 3.3, and would implement the design features discussed Section 5.1. These design features include LID treatment controls, such as landscaping, to help offset the loss of permeable surfaces. Furthermore, most recharge to the groundwater supply in LA County comes from large natural stream systems or constructed groundwater recharge basins. Therefore, impacts to groundwater resources would be minimized, and the Build Alternatives would not result in adverse effects on groundwater.

With implementation of the project design features, operations of the Build Alternatives, MSF, and design options would not substantially degrade groundwater quality, substantially interfere with groundwater recharge, or deplete groundwater resources. Therefore, the impacts would be less than significant, and mitigation measures would not be required.

Further, as discussed in Section 4.10.3 in the Hazards and Hazardous Materials Section of this Draft EIS/EIR, sites with known groundwater contamination are present within the Affected Area for water resources of Alternatives 1, 2, 3, and 4, Design Options 1 and 2, and the Paramount MSF site option. Depending on the alternative selected for implementation and the final design of the Project, it may be necessary to implement long-term groundwater monitoring or dewatering during operation. For example, tunnels may be placed in locations where long-term groundwater dewatering is necessary to prevent tunnel flooding. If this location also corresponds to a known groundwater release site, the dewatering activity would also need to include the handling of contaminated groundwater. If long-term groundwater monitoring or dewatering is necessary at a location where groundwater has been contaminated by hazardous materials, groundwater dewatering would affect operation of the Project by requiring ongoing management or treatment. This would be an adverse effect during operation.

Should long-term contaminated groundwater dewatering be necessary, HAZ PM-2 (Disposal of Groundwater [Operation]) would be implemented. This measure requires LARWQCB consultation and permit compliance, which may include water disposal to the sanitary sewer or the proper onsite management of contaminated groundwater and disposal or recycling of contaminated groundwater offsite at appropriate waste management facilities. With implementation of this project measure, no adverse effects related to groundwater monitoring or dewatering would occur during operation.

6.2.2.1 Mitigation Measures

With implementation of the design features described in Section 5.1, operation and maintenance of the Build Alternatives, the MSF, and design options would not result in adverse effects on groundwater; therefore, mitigation measures would not be required.

6.2.2.2 Impacts Remaining after Mitigation

Less than significant.

6.3 Would the Project substantially alter the existing drainage pattern of the site or area, including the alteration of the course of a stream or river, or through addition of impervious surfaces, in a manner that would result in substantial erosion or siltation onsite or offsite?

6.3.1 No Project Alternative

Under the No Project Alternative, implementation of the Build Alternatives would not be introduced into the Affected Area, and no changes or impacts consistent with the Build Alternatives would occur. Therefore, there would be no impacts to drainage patterns in a manner that would result in substantial erosion or siltation, and mitigation measures would not be required.

6.3.1.1 Mitigation Measures

No mitigation measures required.

6.3.1.2 Impacts Remaining after Mitigation

No impacts.

6.3.2 Build Alternatives, MSFs, and Design Options

The Build Alternatives would require site grading and an overall increase in impervious surfaces; however, it would not substantially alter drainage patterns. The existing topography within the area would be retained and existing storm drainage systems preserved as much as possible for use during project operation. Therefore, the existing drainage pattern of the site and its surroundings would not be changed in a manner that would result in significant erosion or siltation onsite or offsite. Implementation of the Build Alternatives would not substantially increase runoff that could contribute to exceedance of the capacity of stormwater drainage systems. Therefore, the impact would be less than significant, and mitigation measures would not be required.

6.3.2.1 Mitigation Measures

With implementation of the design features described in Section 5.1, operations and maintenance of the Build Alternatives, the MSF, and design options would not affect drainage patterns in a manner that would result in substantial erosion or siltation; therefore, mitigation measures would not be required.

6.3.2.2 Impacts Remaining after Mitigation

Less than significant.

6.4 Would the Project substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river or through the addition of impervious surfaces, in a manner that would substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or offsite?

6.4.1 No Project Alternative

Under the No Project Alternative, implementation of the Build Alternatives would not be introduced into the Affected Area, and no changes or impacts consistent with the Build Alternatives would occur. Therefore, there would be no impacts to drainage patterns in a manner that would result in flooding, and mitigation measures would not be required.

6.4.1.1 Mitigation Measures

No mitigation measures required.

6.4.1.2 Impacts Remaining after Mitigation

No impacts.

6.4.2 Build Alternatives, MSFs, and Design Options

The Build Alternatives would require site grading and an overall increase in impervious surfaces. Storm drains would be modified as needed, and existing storm drainage systems would be preserved as much as possible for use during project operation. The existing topography within the area would be retained and drainage patterns preserved as much as possible. To minimize the impacts of new impervious area, the Build Alternatives would implement the applicable project design features listed in Section 5.1 and maintain pre-development hydrology characteristics. The Build Alternatives would comply with the post-construction and hydromodification requirements of the LA County MS4 NPDES permit, as discussed in Section 3.3. New or modified storm drainage systems would be designed to meet local and regional standards. Therefore, the Build Alternatives would not substantially increase the rate or amount of runoff from the Build Alternatives site, which could cause flooding onsite or offsite; therefore, impacts would be less than significant.

6.4.2.1 Mitigation Measures

With implementation of the design features described in Section 5.1, operation and maintenance of the Build Alternatives, the MSF, and design options would not result in adverse effects related to flooding; therefore, mitigation measures would not be required.

6.4.2.2 Impacts Remaining after Mitigation

Less than significant.

6.5 Would the Project substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river or through the addition of impervious surfaces, in a manner that would create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff?

6.5.1 No Project Alternative

Under the No Project Alternative, implementation of the Build Alternatives would not be introduced into the Affected Area, and no changes or impacts consistent with the Build Alternatives would occur. Therefore, there would be no impacts to drainage patterns in a manner that would contribute to exceedance of the capacity of stormwater drainage systems or provide substantial additional sources of polluted runoff, and mitigation measures would not be required.

6.5.1.1 Mitigation Measures

No mitigation measures required.

6.5.1.2 Impacts Remaining after Mitigation

No impacts.

6.5.2 Build Alternatives, MSFs, and Design Options

The Build Alternatives would not substantially alter drainage patterns or stream courses or substantially increase runoff that would contribute to exceedance of the capacity of stormwater drainage systems, as discussed in Section 5. The Build Alternatives would also not provide additional sources of polluted runoff. Therefore, this impact would be less than significant, and mitigation measures would not be required.

6.5.2.1 Mitigation Measures

With implementation of the design features described in Section 5.1, operation and maintenance of the Build Alternatives, the MSF, and design options would not result in adverse effects related to stormwater runoff; therefore, mitigation measures would not be required.

6.5.2.2 Impacts Remaining after Mitigation

Less than significant.

6.6 Would the Project substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river or through addition of impervious surfaces, in a manner which would impede or redirect flood flows?

6.6.1 No Project Alternative

Under the No Project Alternative, implementation of the Build Alternatives would not be introduced into the Affected Area, and no changes or impacts consistent with the Build Alternatives would occur. Therefore, there would be no impacts to drainage patterns in a manner that would impede or redirect flood flows, and mitigation measures would not be required.

6.6.1.1 Mitigation Measures

No mitigation measures required.

6.6.1.2 Impacts Remaining after Mitigation

No impacts.

6.6.2 Build Alternatives, MSFs, and Design Options

The Build Alternatives would cross three major flood control channels, each with FEMA-established floodplains: the Los Angeles River, the Rio Hondo, and the San Gabriel River. New bridges with piers or columns would be constructed within the flood control channels (Los Angeles River, the Rio Hondo, and the San Gabriel River). While each crossing would result in some change to the water surface elevation in each channel, changes to the water surface elevation at each river crossing are anticipated to be minor.

The floodplains are protected by existing levees or channel walls. The Build Alternatives would not alter the ability of the channel to convey 100-year flows, and there would be negligible change to the floodplain extents. In addition, tracks and structures associated with the Build Alternatives would be built above the existing river channel walls or levees. Therefore, floodplain impacts would be minimized to the greatest extent practicable.

Long-term indirect impacts to floodplains would be unlikely to occur as a result of the Build Alternatives because the floodplains are protected by levees and the surrounding areas are already urbanized. Therefore, the Build Alternatives are not expected to impede or redirect flood flows, and impacts would be less than significant, and mitigation measures would not be required.

6.6.2.1 Mitigation Measures

With implementation of the design features described in Section 5.1, operation and maintenance of the Build Alternatives would not result in adverse effects related to flood flows; therefore, mitigation measures would not be required.

6.6.2.2 Impacts Remaining after Mitigation

Less than significant.

6.7 In flood hazard, tsunami, or seiche zones, risk release of pollutants due to project inundation?

6.7.1 No Project Alternative

Under the No Project Alternative, implementation of the Build Alternatives would not be introduced into the Affected Area, and no changes or impacts consistent with the Build Alternatives would occur. Therefore, there would be no impacts on flood, tsunami, or seiche zones that would increase the risk of pollution due to inundation, and mitigation measures would not be required.

6.7.1.1 Mitigation Measures

No mitigation measures required.

6.7.1.2 Impacts Remaining after Mitigation

No impacts.

6.7.2 Build Alternatives, MSFs, and Design Options

The Build Alternatives would construct new bridges across three major flood control channels: the Los Angeles River, the Rio Hondo, and the San Gabriel River. New bridge deck structures would be built above the existing river channel walls or levees, with new bridge piers or columns built within the channel. Location hydraulic studies have been prepared to evaluate the project's impacts to each river (Appendices A, B, and C). As discussed in Section 5.3.3, the new bridges would raise the water surface elevation within the channel; however, the Build Alternatives would not alter the ability of the channel to convey the 100-year flows and there would be negligible change to the floodplain extents. Therefore, the Build Alternatives are not at risk to release pollutants due to project inundation, and impacts would be less than significant. Additionally, the proposed project alignment would be located more than 20 miles from the ocean and, therefore, would not be located within areas potentially affected by seiches or tsunamis, and no impacts associated with these events would occur.

6.7.2.1 Mitigation Measures

With implementation of the design features described in Section 5.1, operation and maintenance of the Build Alternatives, the MSF, and the design options would not result in adverse effects related to pollutants releases resulting from inundation; therefore, mitigation measures would not be required.

6.7.2.2 Impacts Remaining after Mitigation

Less than significant.

6.8 Would the Project conflict with or obstruct implementation of a water quality control plan or sustainable groundwater management plan?

6.8.1 No Project Alternative

Under the No Project Alternative, implementation of the Build Alternatives would not be introduced into the Affected Area, and no changes or impacts consistent with the Build Alternatives would occur. Therefore, there would be no impacts to implementation of a water quality control plan or sustainable groundwater management plan, and mitigation measures would not be required.

6.8.1.1 Mitigation Measures

No mitigation measures required.

6.8.1.2 Impacts Remaining after Mitigation

No impacts.

6.8.2 Build Alternatives, MSFs, and Design Options

Operation and maintenance activities of the Build Alternatives, MSF, and design options could increase pollutant discharges to stormwater and/or groundwater that are typical for rail facilities (e.g., oils and grease, metals, solvents, pesticides). The Build Alternatives would be subject to the IGP and the LA County MS4 NPDES permit during the operational phase, and the CGP during the construction phase, each pursuant to the Los Angeles Basin Plan. The MS4 NPDES permit requires implementation of site design, source control, and treatment control BMPs to the maximum extent practical. The stormwater IGP (Order No. 2014-0057-DWQ) requires preparation of an industrial SWPPP and a monitoring plan for industrial facilities, including vehicle maintenance facilities associated with transportation operations. Compliance with these permits would be required by the RWQCB as a condition of approval of the 401 Water Quality Certification, or as conditions of various NPDES permits prior to implementation. Also, all phases of construction would be subject to the CGP. The Build Alternative is located within the Central Basin, which is an adjudicated basin and therefore not required to develop a groundwater management plan. The Central Basin is actively management by WRD and subject to annual reporting for monitoring of groundwater levels and quality for proper resource management. Therefore, the Build Alternatives would not obstruct implementation of a water quality control plan or sustainable groundwater management plan, impacts would be less than significant, and mitigation is not required.

6.8.2.1 Mitigation Measures

With implementation of the design features described in Section 5.1, operation and maintenance of the Build Alternatives, the MSF, and the design options would not conflict with or obstruct implementation of a water quality control plan or sustainable groundwater management plan; therefore, mitigation measures would not be required.

6.8.2.2 Impacts Remaining after Mitigation

Less than significant.

7 CONSTRUCTION IMPACTS

Construction activities resulting from the Build Alternatives and design options could adversely affect hydrology and surface water quality, floodplains, and groundwater. Construction activities could degrade water quality by exposing stormwater to construction-related contaminants and exposed soils, construction of the river crossings could affect existing floodplains, and construction dewatering could cause impacts to groundwater resources. To address these temporary impacts, the Build Alternatives would implement the integrated design features discussed in Section 5.1 and would also be required to implement a SWPPP that complies with the CGP. Compliance with the CGP requires that, prior to construction, the Contractor identify pollutant sources that could affect water quality and identify, implement, and maintain BMPs to reduce the identified pollutants and nonstormwater discharges in construction site runoff. Implementation of the SWPPP in compliance with the CGP would avoid or minimize discharge of contaminants and reduce impacts. In addition, any dewatering of the construction site would also be subject to the requirements of a Construction Dewatering Permit and therefore would not cause construction-related impacts to surface or groundwater quality.

Where construction of aerial LRT structures occur in proximity to or over the Los Angeles River, Rio Hondo, or San Gabriel River, construction activities would be required to comply with all applicable federal and local floodplain regulations, including the applicable NFIP regulations described in Section 3.1.3. The Build Alternatives would require various mandatory permits prior to construction, including an Individual Section 404 Permit from the USACE, a USACE 408 permission process, a 401 Water Quality Certification from the LARWQCB, a Section 1602 Streambed Alteration Agreement from CDFW, encroachment permits, and coverage under multiple NPDES permits, as discussed in Section 2. These permits would require project design features to be implemented that would avoid, minimize, or reduce potential for impacts to hydrology, water quality, and floodplains. Permit approvals would be necessary prior to construction and would be contingent on implementing these design features. Furthermore, implementation of project design features, as discussed in Section 5.1, would avoid and minimize construction-related flooding impacts.

Based on this analysis, as presented in and supported by Section 5.6, and with application of the CEQA criteria described above, the construction-related impacts would be less than significant.

7.1 Would the Project violate any applicable water quality standards or WDRs or otherwise substantially degrade surface or groundwater quality?

7.1.1 No Build Alternative

Project-related construction activities would not occur under the No Build Alternative, no construction-related impacts would occur. Therefore, there would be no impacts to surface or groundwater quality, and mitigation measures would not be required.

7.1.1.1 Mitigation Measures

No mitigation measures required.

7.1.1.2 Impacts Remaining after Mitigation

No impacts.

7.1.2 Build Alternatives, MSFs, and Design Options

Construction activities could result in temporary impacts to water quality that could violate water quality standards or degrade surface or groundwater quality. To address these temporary impacts, the Build Alternatives would implement the integrated design features described in Section 5.1 and would also implement a SWPPP that complies with the CGP and applicable water quality standards. Dewatering of the construction site would also be subject to the requirements of the Construction Dewatering Permit. Therefore, the Build Alternatives would not violate applicable water quality standards or WDRs, or otherwise substantially degrade surface or groundwater quality. Impacts would be less than significant, and no mitigation would be required.

7.1.2.1 Mitigation Measures

With implementation of the design features described in Section 5.1, construction of the Build Alternatives would not violate applicable water quality standards or WDRs, or otherwise substantially degrade surface or groundwater quality; therefore, mitigation measures would not be required.

7.1.2.2 Impacts Remaining after Mitigation

Less than significant.

7.2 Would the Project substantially decrease groundwater supplies or interfere substantially with groundwater recharge such that the project may impede sustainable groundwater management of the basin?

7.2.1 No Build Alternative

Project-related construction activities would not occur under the No Build Alternative, no construction-related impacts would occur. Therefore, there would be no impacts to groundwater recharge, and mitigation measures would not be required.

7.2.1.1 Mitigation Measures

No mitigation measures required.

7.2.1.2 Impacts Remaining after Mitigation

No impacts.

7.2.2 Build Alternatives, MSFs, and Design Options

Dewatering activities may cause impacts to groundwater by temporarily reducing the local groundwater elevation. Dewatering of the construction site would be subject to the requirements of the Construction Dewatering Permit and other applicable permits and, therefore, would not cause construction-related impacts to groundwater quality. Furthermore, implementation of the design features described in Section 5.1 also includes a requirement to implement a SWPPP that complies with the CGP. Therefore, the impacts would be less than significant, and mitigation would not be required.

7.2.2.1 Mitigation Measures

With implementation of the design features described under Section 5.1, construction of the Build Alternatives, the MSF, and design options would not result in adverse effects on groundwater; therefore, mitigation measures would not be required.

7.2.2.2 Impacts Remaining after Mitigation

Less than significant.

7.3 Would the Project substantially alter the existing drainage pattern of the site or area, including the alteration of the course of a stream or river, or through addition of impervious surfaces, in a manner that would result in substantial erosion or siltation onsite or offsite?

7.3.1 No Build Alternative

Project-related construction activities would not occur under the No Build Alternative, no construction-related impacts would occur. Therefore, there would be no impacts to drainage patterns in a manner that would result in substantial erosion or siltation, and mitigation measures would not be required.

7.3.1.1 Mitigation Measures

No mitigation measures required.

7.3.1.2 Impacts Remaining after Mitigation

No impacts.

7.3.2 Build Alternatives, MSFs, and Design Options

Construction of the Build Alternatives, MSF, and design options may temporarily increase the impervious area around the project site (e.g., by installing access roads, contractor staging areas, or required localized changes in drainage patterns to control stormwater on and around the project site). Construction activities could temporarily increase the potential for stormwater to come in contact with exposed soils. To address these temporary impacts, the Build Alternatives would implement the integrated design features in Section 5.1 and would implement a SWPPP that complies with the CGP. Construction would minimize new impervious areas and would discharge runoff to existing drainage patterns. Therefore, the impact would be less than significant, and mitigation measures would not be required.

7.3.2.1 Mitigation Measures

With implementation of the design features described under Section 5.1, construction of the Build Alternatives, the MSF, and design options would not affect drainage patterns in a manner that would result in substantial erosion or siltation; therefore, mitigation measures would not be required.

7.3.2.2 Impacts Remaining after Mitigation

Less than significant.

7.4 Would the Project substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river or through the addition of impervious surfaces, in a manner that would substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or offsite?

7.4.1 No Build Alternative

Project-related construction activities would not occur under the No Build Alternative, no construction-related impacts would occur. Therefore, there would be no impacts to drainage patterns in a manner that would result in flooding, and mitigation measures would not be required.

7.4.1.1 Mitigation Measures

No mitigation measures required.

7.4.1.2 Impacts Remaining after Mitigation

No impacts.

7.4.2 Build Alternatives, MSFs, and Design Options

Construction of the Build Alternatives, MSF, and design options may temporarily increase the impervious area around the project site (e.g., by installing access roads, contractor staging areas, or required localized changes in drainage patterns to control stormwater on and around the project site). To address these temporary impacts, the Build Alternatives would implement the integrated design features described in Section 5.1 and would implement a SWPPP that complies with the CGP. Therefore, the Build Alternatives would not substantially increase the rate or amount of runoff from the project site that could cause flooding onsite or offsite, so impacts would be less than significant.

7.4.2.1 Mitigation Measures

With implementation of the design features described Section 5.1, construction of the Build Alternatives, the MSF, and design options would not alter existing drainage patterns or stream courses in a manner that would result in flooding; therefore, mitigation measures are not required.

7.4.2.2 Impacts Remaining after Mitigation

Less than significant.

7.5 Would the Project substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river or through the addition of impervious surfaces, in a manner that would create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff?

7.5.1 No Build Alternative

Project-related construction activities would not occur under the No Build Alternative, no construction-related impacts would occur. Therefore, there would be no impacts to drainage patterns in a manner that would contribute to exceedance of the capacity of stormwater drainage systems or provide substantial additional sources of polluted runoff, and mitigation measures would not be required.

7.5.1.1 Mitigation Measures

No mitigation measures required.

7.5.1.2 Impacts Remaining after Mitigation

No impacts.

7.5.2 Build Alternatives, MSFs, and Design Options

Construction of the Build Alternatives, MSF, and design options may temporarily increase the impervious area around the project site (e.g., by installing access roads, contractor staging areas, or required localized changes in drainage patterns to control stormwater on and around the project site). Construction activities could temporarily increase the potential for stormwater to come in contact with construction-related contaminants. To address these temporary impacts, the Build Alternatives would implement the integrated design features described in Section 5.1 and would implement a SWPPP that complies with the CGP. Therefore, the impact would be less than significant, and mitigation would not be required.

7.5.2.1 Mitigation Measures

With implementation of the design features described under Section 5.1, construction of the Build Alternatives, the MSF, and design options would not alter existing drainage patterns or stream courses in a manner that would exceed the capacity of downstream stormwater management facilities or contribute additional sources of polluted runoff; therefore, mitigation measures would not be required.

7.5.2.2 Impacts Remaining after Mitigation

Less than significant.

7.6 Would the Project substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river or through addition of impervious surfaces, in a manner which would impede or redirect flood flows?

7.6.1 No Build Alternative

Project-related construction activities would not occur under the No Build Alternative, no construction-related impacts would occur. Therefore, there would be no impacts to drainage patterns in a manner that would impede or redirect flood flows, and mitigation measures would not be required.

7.6.1.1 Mitigation Measures

No mitigation measures required.

7.6.1.2 Impacts Remaining after Mitigation

No impacts.

7.6.2 Build Alternatives, MSFs, and Design Options

Construction of the Build Alternatives, MSF, and design options may temporarily increase the impervious area around the project site (e.g., by installing access roads, contractor staging areas, or required localized changes in drainage patterns to control stormwater on and around the project site). These impacts would not substantially increase the rate or volume of stormwater flows. Where construction occurs in the Los Angeles River, the Rio Hondo Channel, or the San Gabriel River, activities would comply with all applicable federal and local floodplain regulations, including applicable NFIP regulations. Furthermore, implementation of the design features described in Section 5.1 require the Contractor to control stormwater runoff from the project site and would avoid and minimize construction-related flooding impacts. Therefore, the Build Alternatives are not expected to impede or redirect flood flows; impacts would be less than significant, and mitigation would not be required.

7.6.2.1 Mitigation Measures

With implementation of the design features described in Section 5.1, construction of the Build Alternatives, the MSF, and design options would not alter drainage patterns or stream courses in a manner that would impede or redirect flood flows; therefore, mitigation measures would not be required.

7.6.2.2 Impacts Remaining after Mitigation

Less than significant.

7.7 In flood hazard, tsunami, or seiche zones, risk release of pollutants due to project inundation?

7.7.1 No Build Alternative

Project-related construction activities would not occur under the No Build Alternative, no construction-related impacts would occur. Therefore, there would be no impacts on flood, tsunami, or seiche zones that would increase the risk of pollution due to inundation, and mitigation measures would not be required.

7.7.1.1 Mitigation Measures

No mitigation measures required.

7.7.1.2 Impacts Remaining after Mitigation

No impacts.

7.7.2 Build Alternatives, MSFs, and Design Options

The Build Alternatives would construct new bridges across three major flood control channels: the Los Angeles River, the Rio Hondo, and the San Gabriel River. New bridge deck structures would be built above the existing river channel walls or levees, with new bridge piers or columns built within the channel. Location hydraulic studies have been prepared to evaluate the project's impacts to each river (Appendices A, B, and C). As discussed in Section 5.3.3, the new bridges would raise the water surface elevation within the channel; however, the Build Alternatives would not alter the ability of the channel to convey the 100-year flows and there would be negligible change to the floodplain extents. Therefore, the Build Alternatives are not at risk to release pollutants due to project inundation, and impacts would be less than significant. Additionally, the proposed project alignment would be located more than 20 miles from the ocean and, therefore, would not be located within areas potentially affected by seiches or tsunamis, and no impacts associated with these events would occur.

7.7.2.1 Mitigation Measures

With implementation of the design features described in Section 5.1, construction of the Build Alternatives, the MSF, and design options would not increase the risk of a release of pollutants due to project inundation; therefore, mitigation measures would not be required.

7.7.2.2 Impacts Remaining after Mitigation

Less than significant.

7.8 Would the Project conflict with or obstruct implementation of a water quality control plan or sustainable groundwater management plan?

7.8.1 No Build Alternative

Project-related construction activities would not occur under the No Build Alternative, no construction-related impacts would occur. Therefore, there would be no impacts to implementation of a water quality control plan or sustainable groundwater management plan, and mitigation measures would not be required.

7.8.1.1 Mitigation Measures

No mitigation measures required.

7.8.1.2 Impacts Remaining after Mitigation

No impacts.

7.8.2 Build Alternatives, MSFs, and Design Options

Construction activities could result in temporary impacts to groundwater resources. To address these temporary impacts, the Build Alternatives would implement the integrated design features described in Section 5.1 and would also implement a SWPPP that complies with the CGP and local water quality control plan. Therefore, the Build Alternatives would not obstruct implementation of a water quality control plan or sustainable groundwater management plan; impacts would be less than significant, and mitigation would not be required.

7.8.2.1 Mitigation Measures

With implementation of the design features described in Section 5.1, operation and maintenance of the Build Alternatives, the MSF, and the design options would not conflict with or obstruct implementation of a water quality control plan or sustainable groundwater management plan; therefore, mitigation measures would not be required.

7.8.2.2 Impacts Remaining after Mitigation

Less than significant.

8 PROJECT MEASURES AND MITIGATION MEASURES

8.1 Project Measures

8.1.1 Operation

The following operation-related project measures would be implemented to avoid, minimize, or reduce the potential for impacts to water resources:

WR PM-1: The project will acquire and comply with all relevant permits identified in Section 2.

WR PM-2: To protect surface water quality and maintain pre-development hydrology, the project would comply with the LA County MS4 NPDES Permit and LA County Standard Urban Stormwater Management Plan. The project would develop a site-specific LID plan, which would implement LID design standards, such as incorporating structural and nonstructural treatment controls and hydromodification controls.

WR PM-3: The project would comply with the IGP through preparation and implementation of an industrial SWPPP, which would identify BMPs to reduce or prevent industrial pollutants in stormwater and authorized non-stormwater discharges. The industrial SWPPP also requires implementation of a monitoring implementation plan and annual comprehensive facility compliance evaluation to assess BMP performance.

8.1.2 Construction

The following construction-related project measures would be implemented to avoid, minimize, or reduce the potential for impacts to water resources:

WR PM-4: The project construction phase would comply with the CGP through preparation and implementation of a construction SWPPP, which would identify BMPs to minimize potential short-term increases in sediment transport caused by construction, including erosion control requirements, stormwater and non-stormwater management, and channel dewatering for affected stream crossings. These BMPs would include measures to provide permeable surfaces where feasible and to retain and treat stormwater onsite. Other BMPs include strategies to manage the overall amount and quality of stormwater and non-stormwater runoff.

WR PM-5: Any removal of groundwater or accumulated precipitation will comply with the Construction Dewatering Permit. Where dewatering is required, construction activities will be conducted in accordance with the appropriate permits, and a BMP or control strategy plan will be prepared to identify site-specific plans and procedures to be implemented to prevent the generation and potential release of pollutants.

8.2 Mitigation Measures

8.2.1 Operation

With implementation of the project design features identified in Section 5.1 and project measures identified in Section 8.1, project operation and maintenance would not result in adverse effects on water resources; therefore, mitigation measures would not be required during operation.

8.2.2 Construction

With implementation of the project design features identified in Section 5.1 and project measures identified in Section 8.1, project construction would not result in adverse effects on water resources; therefore, mitigation measures would not be required during construction.

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APPENDIX A LOS ANGELES RIVER BRIDGE LOCATION HYDRAULIC STUDY

WEST SANTA ANA BRANCH TRANSIT CORRIDOR PROJECT
Contract No. AE5999300

Final
Los Angeles River Bridge Location Hydraulic Study

Task No. 12.3 (Deliverable No. 12.3a)

Prepared for:

Metro
Los Angeles County
Metropolitan Transportation Authority

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June 2021

This Location Hydraulic Study has been prepared by Jacobs under the direction of the following Registered Civil Engineer. The undersigned attests to the technical information contained herein and the qualifications of any technical specialist providing engineering data upon which the recommendations, conclusions, and decisions are based:

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ACRONYMS AND ABBREVIATIONS

AA	Alternatives Analysis
BRT	Bus Rapid Transit
CEQA	California Environmental Quality Act
cfs	cubic feet per second
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
FEMA	Federal Emergency Management Administration
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
ft	Feet
ft/sec	Feet per Second
LA	Los Angeles
LACDPW	Los Angeles County Department of Public Works
LACFCD	Los Angeles County Flood Control District
LARWQCB	Los Angeles Regional Water Quality Control Board
LAUS	Los Angeles Union Station
LRT	Light Rail Transit
LRTP	Long Range Transportation Plan
Metro	Los Angeles County Metropolitan Transportation Authority
MOS	Minimum Operable Segment
MWD	Metropolitan Water District
NEPA	National Environmental Policy Act
OCTA	Orange County Transportation Authority
PEROW	Pacific Electric Right-of-Way
ROW	Right-of-Way
SCAG	Southern California Association of Governments
SR	State Route
TRS	Technical Refinement Study
UPRR	Union Pacific Railroad
USACE	U.S. Army Corps of Engineers
WSAB	West Santa Ana Branch
WSE	Water Surface Elevation

1 INTRODUCTION

1.1 Study Background

The West Santa Ana Branch (WSAB) Transit Corridor (Project) is a proposed light rail transit (LRT) line that would extend from four possible northern termini in southeast Los Angeles (LA) County to a southern terminus in the City of Artesia, traversing densely populated, low-income, and heavily transit-dependent communities. The Project would provide reliable, fixed guideway transit service that would increase mobility and connectivity for historically underserved, transit-dependent, and environmental justice communities; reduce travel times on local and regional transportation networks; and accommodate substantial future employment and population growth.

1.2 Alternatives Evaluation, Screening, and Selection Process

A wide range of potential alternatives have been considered and screened through the alternatives analysis processes. In March 2010, the Southern California Association of Governments (SCAG) initiated the Pacific Electric Right-of-Way (PEROW)/WSAB Alternatives Analysis (AA) Study (SCAG 2013) in coordination with the relevant cities, Orangeline Development Authority (now known as Eco-Rapid Transit), the Gateway Cities Council of Governments, the Los Angeles County Metropolitan Transportation Authority (Metro), the Orange County Transportation Authority, and the owners of the right-of-way (ROW)—Union Pacific Railroad (UPRR), BNSF Railway, and the Ports of Los Angeles and Long Beach. The AA Study evaluated a wide variety of transit connections and modes for a broader 34-mile corridor from Union Station in downtown Los Angeles to the City of Santa Ana in Orange County. In February 2013, SCAG completed the PEROW/WSAB Corridor Alternatives Analysis Report[1] and recommended two LRT alternatives for further study: West Bank 3 and the East Bank.

Following completion of the AA, Metro completed the WSAB Technical Refinement Study in 2015 focusing on the design and feasibility of five key issue areas along the 19-mile portion of the WSAB Transit Corridor within LA County:

- Access to Union Station in downtown Los Angeles
- Northern Section Options
- Huntington Park Alignment and Stations
- New Metro C (Green) Line Station
- Southern Terminus at Pioneer Station in Artesia

In September 2016, Metro initiated the WSAB Transit Corridor Environmental Study with the goal of obtaining environmental clearance of the Project under the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA).

[1] Initial concepts evaluated in the SCAG report included transit connections and modes for the 34 mile corridor from Union Station in downtown Los Angeles to the City of Santa Ana. Modes included low speed magnetic levitation (maglev) heavy rail, light rail, and bus rapid transit (BRT).

Metro issued a Notice of Preparation (NOP) on May 25, 2017, with a revised NOP issued on June 14, 2017, extending the comment period. In June 2017, Metro held public scoping meetings in the Cities of Bellflower, Los Angeles, South Gate, and Huntington Park. Metro provided Project updates and information to stakeholders with the intent to receive comments and questions through a comment period that ended in August 2017. A total of 1,122 comments were received during the public scoping period from May through August 2017. The comments focused on concerns regarding the Northern Alignment options, with specific concerns related to potential impacts to Alameda Street with an aerial alignment. Given potential visual and construction issues raised through public scoping, additional Northern Alignment concepts were evaluated.

In February 2018, the Metro Board of Directors approved further study of the alignment in the Northern Section due to community input during the 2017 scoping meetings. A second alternatives screening process was initiated to evaluate the original four Northern Alignment options and four new Northern Alignment concepts. The *Final Northern Alignment Alternatives and Concepts Updated Screening Report* was completed in May 2018 (Metro 2018). The alternatives were further refined and, based on the findings of the second screening analysis and the input gathered from the public outreach meetings, the Metro Board of Directors approved Build Alternatives E and G for further evaluation (now referred to as Alternatives 1 and 2, respectively, in this report).

On July 11, 2018, Metro issued a revised and recirculated CEQA Notice of Preparation, thereby initiating a scoping comment period. The purpose of the revised Notice of Preparation was to inform the public of the Metro Board's decision to carry forward Alternatives 1 and 2 into the Draft Environmental Impact Statement/Environmental Impact Report (EIS/EIR). During the scoping period, one agency and three public scoping meetings were held in the Cities of Los Angeles, Cudahy, and Bellflower. The meetings provided Project updates and information to stakeholders with the intent to receive comments and questions to support the environmental process. The comment period for scoping ended in August 24, 2018; over 250 comments were received.

Following the July 2018 scoping period, a number of Project refinements were made to address comments received, including additional grade separations, removing certain stations with low ridership, and removing the Bloomfield extension option. The Metro Board adopted these refinements to the project description at their November 2018 meeting.

1.3 Report Purpose

The Project would incur impacts to floodplains as a result of crossings at the Upper Los Angeles River, Rio Hondo and San Gabriel River. This Location Hydraulic Study assessed the existing and expected Project conditions at the Upper Los Angeles River crossing with respect to hydrology, floodplain impacts, hydraulic impacts of the encroachment, property at risk, and environment impacts. The facility is owned and maintained by the Los Angeles County Department of Public Works (LACDPW) and Los Angeles County Flood Control District (LACFCD). Separate Location Hydraulic Studies were prepared for the Rio Hondo and San Gabriel River crossings.

2 PROJECT DESCRIPTION

This section describes the No Build Alternative and the four Build Alternatives studied in the WSAB Transit Corridor Draft EIS/EIR, including design options, station locations, and maintenance and storage facility (MSF) site options. The Build Alternatives were developed through a comprehensive alternatives analysis process and meet the purpose and need of the Project.

The No Build Alternative and four Build Alternatives are generally defined as follows:

- **No Build Alternative -** Reflects the transportation network in the 2042 horizon year without the proposed Build Alternatives. The No Build Alternative includes the existing transportation network along with planned transportation improvements that have been committed to and identified in the constrained Metro 2009 Long Range Transportation Plan (2009 LRTP) (Metro 2009) and SCAG's 2016-2040 Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS) (SCAG 2016), as well as additional projects funded by Measure M that would be completed by 2042.
- **Build Alternatives**: The Build Alternatives consist of a new LRT line that would extend from different termini in the north to the same terminus in the City of Artesia in the south. The Build Alternatives are referred to as:
  - Alternative 1: Los Angeles Union Station to Pioneer Station; the northern terminus would be located underground at Los Angeles Union Station (LAUS) Forecourt
  - Alternative 2: 7th Street/Metro Center to Pioneer Station; the northern terminus would be located underground at 8th Street between Figueroa Street and Flower Street near 7th Street/Metro Center Station
  - Alternative 3: Slauson/A (Blue) Line to Pioneer Station; the northern terminus would be located just north of the intersection of Long Beach Avenue and Slauson Avenue in the City of Los Angeles, connecting to the current A (Blue) Line Slauson Station
  - Alternative 4: I-105/C (Green) Line to Pioneer Station; the northern terminus would be located at I-105 in the city of South Gate, connecting to the C (Green) Line along the I-105

Two design options are under consideration for Alternative 1. Design Option 1 would locate the northern terminus station box at the LAUS Metropolitan Water District (MWD) east of LAUS and the MWD building, below the baggage area parking facility. Design Option 2 would add the Little Tokyo Station along the WSAB alignment. The Design Options are further discussed in Section 2.3.6.

Figure 2-1 presents the four Build Alternatives and the design options. In the north, Alternative 1 would terminate at LAUS and primarily follow Alameda Avenue south underground to the proposed Arts/Industrial District Station. Alternative 2 would terminate near the existing 7th Street/Metro Center Station in the Downtown Transit Core and would primarily follow 8th Street east underground to the proposed Arts/Industrial District Station.

Figure 2-1. Project Alternatives

Source: Metro, 2020

From the Arts/Industrial District Station to the southern terminus at Pioneer Station, Alternatives 1 and 2 share a common alignment. South of Olympic Boulevard, the Alternatives 1 and 2 would transition from an underground configuration to an aerial configuration, cross over the Interstate (I-) 10 freeway and then parallel the existing Metro A (Blue) Line along the Wilmington Branch ROW as it proceeds south. South of Slauson Avenue, which would serve as the northern terminus for Alternative 3, Alternatives 1, 2, and 3 would turn east and transition to an at-grade configuration to follow the La Habra Branch ROW along Randolph Street. At the San Pedro Subdivision ROW, Alternatives 1, 2, and 3 would turn southeast to follow the San Pedro Subdivision ROW and then transition to the Pacific Electric Right-of-Way (PEROW), south of the I-105 freeway. The northern terminus for Alternative 4 would be located at the I-105/C (Green) Line. Alternatives 1, 2, 3, and 4 would then follow the PEROW to the southern terminus at the proposed Pioneer Station in Artesia. The Build Alternatives would be grade-separated where warranted, as indicated on Figure 2-2.

Figure 2-2. Project Alignment by Alignment Type

Source: Metro, 2020

2.1 Geographic Sections

The approximately 19-mile corridor is divided into two geographic sections—the Northern and Southern Sections. The boundary between the Northern and Southern Sections occurs at Florence Avenue in the City of Huntington Park.

2.1.1 Northern Section

The Northern Section includes approximately 8 miles of Alternatives 1 and 2 and 3.8 miles of Alternative 3. Alternative 4 is not within the Northern Section. The Northern Section covers the geographic area from downtown Los Angeles to Florence Avenue in the City of Huntington Park and would generally traverse the Cities of Los Angeles, Vernon, Huntington Park, and Bell, and the unincorporated Florence-Firestone community of LA County (Figure 2-3). Alternatives 1 and 2 would traverse portions of the Wilmington Branch (between approximately Martin Luther King Jr Boulevard along Long Beach Avenue to Slauson Avenue). Alternatives 1, 2, and 3 would traverse portions of the La Habra Branch ROW (between Slauson Avenue along Randolph Street to Salt Lake Avenue) and San Pedro Subdivision ROW (between Randolph Street to approximately Paramount Boulevard).

Figure 2-3. Northern Section

Source: Metro, 2020

2.1.2 Southern Section

The Southern Section includes approximately 11 miles of Alternatives 1, 2, and 3 and includes all 6.6 miles of Alternative 4. The Southern Section covers the geographic area from south of Florence Avenue in the City of Huntington Park to the City of Artesia and would generally traverse the Cities of Huntington Park, Cudahy, South Gate, Downey, Paramount, Bellflower, Cerritos, and Artesia (Figure 2-4). In the Southern Section, all four Build Alternatives would utilize portions of the San Pedro Subdivision and the Metro-owned PEROW (between approximately Paramount Boulevard to South Street).

Figure 2-4. Southern Section

Source: Metro, 2020

2.2 No Build Alternative

For the NEPA evaluation, the No Build Alternative is evaluated in the context of the existing transportation facilities in the Study Area (the Study Area extends approximately 2 miles from either side of the proposed alignment) and other capital transportation improvements and/or transit and highway operational enhancements that are reasonably foreseeable. Because the No Build Alternative provides the background transportation network, against which the Build Alternatives' impacts are identified and evaluated, the No Build Alternative does not include the Project.

The No Build Alternative reflects the transportation network in 2042 and includes the existing transportation network along with planned transportation improvements that have been committed to and identified in the constrained Metro 2009 LRTP and the SCAG 2016 RTP/SCS, as well as additional projects funded by Measure M, a sales tax initiative approved by voters in November 2016. The No Build Alternative includes Measure M projects that are scheduled to be completed by 2042.

Table 2.1 lists the existing transportation network and planned improvements included as part of the No Build Alternative.

Table 2.1. No Build Alternative – Existing Transportation Network and Planned Improvements

Project	To / From	Location Relative to Study Area
Rail (Existing)		
Metro Rail System (LRT and Heavy Rail Transit)	Various locations	Within Study Area
Metrolink (Southern California Regional Rail Authority) System	Various locations	Within Study Area
Rail (Under Construction/Planned)[1]		
Metro Westside D (Purple) Line Extension	Wilshire/Western to Westwood/VA Hospital	Outside Study Area
Metro C (Green) Line Extension[2] to Torrance	96th Street Station to Torrance	Outside Study Area
Metro C (Green) Line Extension	Norwalk to Expo/Crenshaw[3]	Outside Study Area
Metro East-West Line/Regional Connector/Eastside Phase 2	Santa Monica to Lambert Santa Monica to Peck Road	Within Study Area
Metro North-South Line/Regional Connector/Foothill Extension to Claremont Phase 2B	Long Beach to Claremont	Within Study Area
Metro Sepulveda Transit Corridor	Metro G (Orange) Line to Metro E (Expo) Line	Outside Study Area
Metro East San Fernando Valley Transit Corridor	Sylmar to Metro G (Orange) Line	Outside Study Area
Los Angeles World Airport Automated People Mover	96th Street Station to LAX Terminals	Outside Study Area
Metrolink Capital Improvement Projects	Various projects	Within Study Area

Project	To / From	Location Relative to Study Area
California High-Speed Rail	Burbank to LA LA to Anaheim	Within Study Area
Link US[4]	LAUS	Within Study Area
Bus (Existing)		
Metro Bus System (including BRT, Express, and local)	Various locations	Within Study Area
Municipality Bus System[5]	Various locations	Within Study Area
Bus (Under Construction/Planned)		
Metro G (Orange) Line (BRT)	Del Mar (Pasadena) to Chatsworth Del Mar (Pasadena) to Canoga Canoga to Chatsworth	Outside Study Area
Vermont Transit Corridor (BRT)	120th Street to Sunset Boulevard	Outside Study Area
North San Fernando Valley BRT	Chatsworth to North Hollywood	Outside Study Area
North Hollywood to Pasadena	North Hollywood to Pasadena	Outside Study Area
Highway (Existing)		
Highway System	Various locations	Within Study Area
Highway (Under Construction/Planned)		
High Desert Multi-Purpose Corridor	SR-14 to SR-18	Outside Study Area
I-5 North Capacity Enhancements	SR-14 to Lake Hughes Rd	Outside Study Area
SR-71 Gap Closure	I-10 to Rio Rancho Rd	Outside Study Area
Sepulveda Pass Express Lane	I-10 to US-101	Outside Study Area
SR-57/SR-60 Interchange Improvements	SR-70/SR-60	Outside Study Area
I-710 South Corridor Project (Phase 1 & 2)	Ports of Long Beach and LA to SR-60	Within Study Area
I-105 Express Lane	I-405 to I-605	Within Study Area
I-5 Corridor Improvements	I-605 to I-710	Outside Study Area

Source: Metro 2018, WSP 2019
Notes: [1] Where extensions are proposed for existing Metro rail lines, the origin/destination is defined for the operating scheme of the entire rail line following completion of the proposed extensions and not just the extension itself.
[2] Metro C (Green) Line extension to Torrance includes new construction from Redondo Beach to Torrance; however, the line will operate from Torrance to 96th Street.
[3] The currently under construction Metro Crenshaw/LAX Line will operate as the Metro C (Green) Line.
[4] Link US rail walk times included only.
[5] The municipality bus network system is based on service patterns for Bellflower Bus, Cerritos on Wheels, Cudahy Area Rapid Transit, Get Around Town Express, Huntington Park Express, La Campana, Long Beach Transit, Los Angeles Department of Transportation, Norwalk Transit System and the Orange County Transportation Authority.
BRT = Bus Rapid Transit; LAUS = Los Angeles Union Station; LAX = Los Angeles International Airport; VA = Veterans Affairs

2.3 Build Alternatives

2.3.1 Proposed Alignment Configuration for the Build Alternatives

This section describes the alignment for each of the Build Alternatives. The general characteristics of the four Build Alternatives are summarized in Table 2.2. Figure 2-5 illustrates the freeway crossings along the alignment. Additionally, the Build Alternatives would require relocation of existing freight rail tracks within the ROW to maintain existing operations where there would be overlap with the proposed light rail tracks. Figure 2-6 depicts the alignment sections that would share operation with freight and the corresponding ownership.

Table 2.2. Summary of Build Alternative Components

Component	Quantity			
Alternatives	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Alternative 4**
Alignment Length	19.3 miles	19.3 miles	14.8 miles	6.6 miles
Stations Configurations	11 3 aerial; 6 at-grade; 2 underground[3]	12 3 aerial; 6 at-grade; 3 underground	9 3 aerial; 6 at-grade	4 1 aerial; 3 at-grade
Parking Facilities	5 (approximately 2,780 spaces)	5 (approximately 2,780 spaces)	5 (approximately 2,780 spaces)	4 (approximately 2,180 spaces)
Length of underground, at-grade, and aerial	2.3 miles underground; 12.3 miles at-grade; 4.7 miles aerial[1]	2.3 miles underground; 12.3 miles at-grade; 4.7 miles aerial[1]	12.2 miles at-grade; 2.6 miles aerial[1]	5.6 miles at-grade; 1.0 miles aerial[1]
At-grade crossings	31	31	31	11
Freight crossings	10	10	9	2
Freeway Crossings	6 (3 freeway undercrossings[2] at I-710; I-605, SR-91)	6 (3 freeway undercrossings[2] at I-710; I-605, SR-91)	4 (3 freeway undercrossings[2] at I-710; I-605, SR-91)	3 (2 freeway undercrossings[2] at I-605, SR-91)
Elevated Street Crossings	25	25	15	7
River Crossings	3	3	3	1
TPSS Facilities	22[3]	23	17	7
Maintenance and Storage Facility site options	2	2	2	2

Source: WSP, 2020

Notes: [1] Alignment configuration measurements count retained fill embankments as at-grade.

[2] The light rail tracks crossing beneath freeway structures.

[3] Under Design Option 2 – Add Little Tokyo Station, an additional underground station and TPSS site would be added under Alternative 1

Figure 2-5. Freeway Crossings

Source: WSP, 2020

Figure 2-6. Existing Rail Right-of-Way Ownership and Relocation

Source: WSP, 2020

2.3.2 Alternative 1

The total alignment length of Alternative 1 would be approximately 19.3 miles, consisting of approximately 2.3 miles of underground, 12.3 miles of at-grade, and 4.7 miles of aerial alignment. Alternative 1 would include 11 new LRT stations, 2 of which would be underground, 6 would be at-grade, and 3 would be aerial. Under Design Option 2, Alternative 1 would have 12 new LRT stations, and the Little Tokyo Station would be an additional underground station. Five of the stations would include parking facilities, providing a total of up to 2,780 new parking spaces. The alignment would include 31 at-grade crossings, 3 freeway undercrossings, 2 aerial freeway crossings, 1 underground freeway crossing, 3 river crossings, 25 aerial road crossings, and 10 freight crossings.

In the north, Alternative 1 would begin at a proposed underground station at/near LAUS either beneath the LAUS Forecourt or, under Design Option 1, east of the MWD building beneath the baggage area parking facility (Section 2.3.6). Crossovers would be located on the north and south ends of the station box with tail tracks extending approximately 1,200 feet north of the station box. A tunnel extraction portal would be located within the tail tracks for both Alternative 1 terminus station options.

From LAUS, the alignment would continue underground crossing under the US-101 freeway and the existing Metro L (Gold) Line aerial structure and continue south beneath Alameda Street to the optional Little Tokyo Station between 1st Street and 2nd Street (note: under Design Option 2, Little Tokyo Station would be constructed). From the optional Little Tokyo Station, the alignment would continue underground beneath Alameda Street to the proposed Arts/Industrial District Station under Alameda Street between 6th Street and Industrial Street. (Note, Alternative 2 would have the same alignment as Alternative 1 from this point south. Refer to Section 2.3.3 for additional information on Alternative 2.)

The underground alignment would continue south under Alameda Street to 8th Street, where the alignment would curve to the west and transition to an aerial alignment south of Olympic Boulevard. The alignment would cross over the I-10 freeway in an aerial viaduct structure and continue south, parallel to the existing Metro A (Blue) Line at Washington Boulevard. The alignment would continue in an aerial configuration along the eastern half of Long Beach Avenue within the UPRR-owned Wilmington Branch ROW, east of the existing Metro A (Blue) Line and continue south to the proposed Slauson/A Line Station. The aerial alignment would pass over the existing pedestrian bridge at E. 53rd Street. The Slauson/A Line Station would serve as a transfer point to the Metro A (Blue) Line via a pedestrian bridge. The vertical circulation would be connected at street level on the north side of the station via stairs, escalators, and elevators. (The Slauson/A Line Station would serve as the northern terminus for Alternative 3; refer to Section 2.3.4 for additional information on Alternative 3.)

South of the Slauson/A Line Station, the alignment would turn east along the existing La Habra Branch ROW (also owned by UPRR) in the median of Randolph Street. The alignment would be on the north side of the La Habra Branch ROW and would require the relocation of existing freight tracks to the southern portion of the ROW. The alignment would transition to an at-grade configuration at Alameda Street and would proceed east along the Randolph Street median. Wilmington Avenue, Regent Street, Albany Street, and Rugby Avenue would be closed to traffic crossing the ROW, altering

the intersection design to a right-in, right-out configuration. The proposed Pacific/Randolph Station would be located just east of Pacific Boulevard.

From the Pacific/Randolph Station, the alignment would continue east at-grade. Rita Avenue would be closed to traffic crossing the ROW, altering the intersection design to a right-in, right-out configuration. At the San Pedro Subdivision ROW, the alignment would transition to an aerial configuration and turn south to cross over Randolph Street and the freight tracks, returning to an at-grade configuration north of Gage Avenue. The alignment would be located on the east side of the existing San Pedro Subdivision ROW freight tracks, and the existing tracks would be relocated to the west side of the ROW. The alignment would continue at-grade within the San Pedro Subdivision ROW to the proposed at-grade Florence/Salt Lake Station south of the Salt Lake Avenue/Florence Avenue intersection.

South of Florence Avenue, the alignment would extend from the proposed Florence/Salt Lake Station in the City of Huntington Park to the proposed Pioneer Station in the City of Artesia, as shown in Figure 2-4. The alignment would continue southeast from the proposed at-grade Florence/Salt Lake Station within the San Pedro Subdivision ROW, crossing Otis Avenue, Santa Ana Street, and Ardine Street at-grade. The alignment would be located on the east side of the existing San Pedro Subdivision freight tracks and the existing tracks would be relocated to the west side of the ROW. South of Ardine Street, the alignment would transition to an aerial structure to cross over the existing UPRR tracks and Atlantic Avenue. The proposed Firestone Station would be located on an aerial structure between Atlantic Avenue and Florence Boulevard.

The alignment would then cross over Firestone Boulevard and transition back to an at-grade configuration prior to crossing Rayo Avenue at-grade. The alignment would continue south along the San Pedro Subdivision ROW, crossing Southern Avenue at-grade and continuing at-grade until it transitions to an aerial configuration to cross over the LA River. The proposed LRT bridge would be constructed next to the existing freight bridge. South of the LA River, the alignment would transition to an at-grade configuration crossing Frontage Road at-grade, then passing under the I-710 freeway through the existing box tunnel structure and then crossing Miller Way. The alignment would then return to an aerial structure to cross the Rio Hondo Channel. South of the Rio Hondo Channel, the alignment would briefly transition back to an at-grade configuration and then return to an aerial structure to cross over Imperial Highway and Garfield Avenue. South of Garfield Avenue, the alignment would transition to an at-grade configuration and serve the proposed Gardendale Station north of Gardendale Street.

From the Gardendale Station, the alignment would continue south in an at-grade configuration, crossing Gardendale Street and Main Street to connect to the proposed I-105/C Line Station, which would be located at-grade north of Century Boulevard. This station would be connected to the new infill C (Green) Line Station in the middle of the freeway via a pedestrian walkway on the new LRT bridge. The alignment would continue at-grade, crossing Century Boulevard and then over the I-105 freeway in an aerial configuration within the existing San Pedro Subdivision ROW bridge footprint. A new Metro C (Green) Line Station would be constructed in the median of the I-105 freeway. Vertical pedestrian access would be provided from the LRT bridge to the proposed I-105/C Line Station platform via stairs and elevators. To accommodate the construction of the new station platform, the existing Metro C (Green) Line tracks would be widened and, as part of the I-105 Express Lanes Project, the I-105 lanes would be reconfigured. (The I-105/C Line Station would serve

as the northern terminus for Alternative 4; refer to Section 2.3.5 for additional information on this alternative.)

South of the I-105 freeway, the alignment would continue at-grade within the San Pedro Subdivision ROW. In order to maintain freight operations and allow for freight train crossings, the alignment would transition to an aerial configuration as it turns southeast and enter the PEROW. The existing freight track would cross beneath the aerial alignment and align on the north side of the PEROW east of the San Pedro Subdivision ROW. The proposed Paramount/Rosecrans Station would be located in an aerial configuration west of Paramount Boulevard and north of Rosecrans Avenue. The existing freight track would be relocated to the east side of the alignment beneath the station viaduct.

The alignment would continue southeast in an aerial configuration over the Paramount Boulevard/Rosecrans Avenue intersection and descend to an at-grade configuration. The alignment would return to an aerial configuration to cross over Downey Avenue descending back to an at-grade configuration north of Somerset Boulevard. One of the adjacent freight storage tracks at Paramount Refinery Yard would be relocated to accommodate the new LRT tracks and maintain storage capacity. There are no active freight tracks south of the World Energy facility.

The alignment would cross Somerset Boulevard at-grade. South of Somerset Boulevard, the at-grade alignment would parallel the existing Bellflower Bike Trail that is currently aligned on the south side of the PEROW. The alignment would continue at-grade crossing Lakewood Boulevard, Clark Avenue, and Alondra Boulevard. The proposed at-grade Bellflower Station would be located west of Bellflower Boulevard.

East of Bellflower Boulevard, the Bellflower Bike Trail would be realigned to the north side of the PEROW to accommodate an existing historic building located near the southeast corner of Bellflower Boulevard and the PEROW. It would then cross back over the LRT tracks at-grade to the south side of the ROW. The LRT alignment would continue southeast within the PEROW and transition to an aerial configuration at Cornuta Avenue, crossing over Flower Street and Woodruff Avenue. The alignment would return to an at-grade configuration at Walnut Street. South of Woodruff Avenue, the Bellflower Bike Trail would be relocated to the north side of the PEROW. Continuing southeast, the LRT alignment would cross under the SR-91 freeway in an existing underpass. The alignment would cross over the San Gabriel River on a new bridge, replacing the existing abandoned freight bridge. South of the San Gabriel River, the alignment would transition back to an at-grade configuration before crossing Artesia Boulevard at-grade.

East of Artesia Boulevard the alignment would cross beneath the I-605 freeway in an existing underpass. Southeast of the underpass, the alignment would continue at-grade, crossing Studebaker Road. North of Gridley Road, the alignment would transition to an aerial configuration to cross over 183rd Street and Gridley Road. The alignment would return to an at-grade configuration at 185th Street, crossing 186th Street and 187th Street at-grade. The alignment would then pass through the proposed Pioneer Station on the north side of Pioneer Boulevard at-grade. Tail tracks accommodating layover storage for a three-car train would extend approximately 1,000 feet south from the station, crossing Pioneer Boulevard and terminating west of South Street.

2.3.3 Alternative 2

The total alignment length of Alternative 2 would be approximately 19.3 miles, consisting of approximately 2.3 miles of underground, 12.3 miles of at-grade, and 4.7 miles of aerial alignment. Alternative 2 would include 12 new LRT stations, 3 of which would be underground, 6 would be at-grade, and 3 would be aerial. Five of the stations would include parking facilities, providing a total of approximately 2,780 new parking spaces. The alignment would include 31 at-grade crossings, 3 freeway undercrossings, 2 aerial freeway crossings, 1 underground freeway crossing, 3 river crossings, 25 aerial road crossings, and 10 freight crossings.

In the north, Alternative 2 would begin at the proposed WSAB 7th Street/Metro Center Station, which would be located underground beneath 8th Street between Figueroa Street and Flower Street. A pedestrian tunnel would provide connection to the existing 7th Street/Metro Center Station. Tail tracks, including a double crossover, would extend approximately 900 feet beyond the station, ending east of the I-110 freeway. From the 7th Street/Metro Center Station, the underground alignment would proceed southeast beneath 8th Street to the South Park/Fashion District Station, which would be located west of Main Street beneath 8th Street.

From the South Park/Fashion District Station, the underground alignment would continue under 8th Street to San Pedro Street, where the alignment would turn east toward 7th Street, crossing under privately owned properties. The tunnel alignment would cross under 7th Street and then turn south at Alameda Street. The alignment would continue south beneath Alameda Street to the Arts/Industrial District Station located under Alameda Street between 7th Street and Center Street. A double crossover would be located south of the station box, south of Center Street. From this point, the alignment of Alternative 2 would follow the same alignment as Alternative 1, which is described further in Section 2.3.2.

2.3.4 Alternative 3

The total alignment length of Alternative 3 would be approximately 14.8 miles, consisting of approximately 12.2 miles of at-grade, and 2.6 miles of aerial alignment. Alternative 3 would include 9 new LRT stations, 6 would be at-grade and 3 would be aerial. Five of the stations would include parking facilities, providing a total of approximately 2,780 new parking spaces. The alignment would include 31 at-grade crossings, 3 freeway undercrossings, 1 aerial freeway crossing, 3 river crossings, 15 aerial road crossings, and 9 freight crossings. In the north, Alternative 3 would begin at the Slauson/A Line Station and follow the same alignment as Alternatives 1 and 2, described in Section 2.3.2.

2.3.5 Alternative 4

The total alignment length of Alternative 4 would be approximately 6.6 miles, consisting of approximately 5.6 miles of at-grade and 1.0 mile of aerial alignment. Alternative 3 would include 4 new LRT stations, 3 would be at-grade, and 1 would be aerial. Four of the stations would include parking facilities, providing a total of approximately 2,180 new parking spaces. The alignment would include 11 at-grade crossings, 2 freeway undercrossings, 1 aerial freeway crossing, 1 river crossing, 7 aerial road crossings, and 2 freight crossings. In the north, Alternative 4 would begin at the I-105/C Line Station and follow the same alignment as Alternatives 1, 2, and 3, described in Section 2.3.2.

2.3.6 Design Options

Alternative 1 includes two design options:

- **Design Option 1:** LAUS at the Metropolitan Water District (MWD) – The LAUS station box would be located east of LAUS and the MWD building, below the baggage area parking facility instead of beneath the LAUS Forecourt. Crossovers would be located on the north and south ends of the station box with tail tracks extending approximately 1,200 feet north of the station box. From LAUS, the underground alignment would cross under the US-101 freeway and the existing Metro L (Gold) Line aerial structure and continue south beneath Alameda Street to the optional Little Tokyo Station between Traction Avenue and 1st Street. The underground alignment between LAUS and the Little Tokyo Station would be located to the east of the base alignment.
- **Design Option 2:** Add the Little Tokyo Station – Under this design option, the Little Tokyo Station would be constructed as an underground station and there would be a direct connection to the Regional Connector Station in the Little Tokyo community. The alignment would proceed underground directly from LAUS to the Arts/Industrial District Station primarily beneath Alameda Street.

2.3.7 Maintenance and Storage Facility

MSFs accommodate daily servicing and cleaning, inspection and repairs, and storage of light rail vehicles (LRV). Activities may take place in the MSF throughout the day and night depending upon train schedules, workload, and the maintenance requirements.

Two MSF options are evaluated; however, only one MSF would be constructed as part of the Project. The MSF would have storage tracks, each with sufficient length to store three-car train sets and a maintenance-of-way vehicle storage. The facility would include a main shop building with administrative offices, a cleaning platform, a traction power substation (TPSS), employee parking, a vehicle wash facility, a paint and body shop, and other facilities as needed. The east and west yard leads (i.e., the tracks leading from the mainline to the facility) would have sufficient length for a three-car train set. In total, the MSF would need to accommodate approximately 80 LRVs to serve the Project's operations plan.

Two potential locations for the MSF have been identified—one in the City of Bellflower and one in the City of Paramount. These options are described further in the following sections.

2.3.8 Bellflower MSF Option

The Bellflower MSF site option is bounded by industrial facilities to the west, Somerset Boulevard and apartment complexes to the north, residential homes to the east, and the PEROW and Bellflower Bike Trail to the south. The site is approximately 21 acres in area and can accommodate up to 80 vehicles (Figure 2-7).

2.3.9 Paramount MSF Option

The Paramount MSF site option is bounded by the San Pedro Subdivision ROW on the west, Somerset Boulevard to the south, industrial and commercial uses on the east, and All American City Way to the north. The site is 22 acres and could accommodate up to 80 vehicles (Figure 2-7).

Figure 2-7. Maintenance and Storage Facility Options

Source: WSP, 2020

3 SETTING

Existing UPRR tracks cross the Los Angeles River at River Station 672+83. At this crossing, the river is a trapezoidal concrete channel with a bottom width of 250 feet and sides (2.25:1, horizontal to vertical ratio) that slope up to 16-foot-wide levees on either side of the channel. There is a middle low-flow channel with an invert slope of 0.1840 percent in this area. The existing railroad bridge has four piers and a single track (U.S. Army Corps of Engineers [USACE], 1950).

Available engineering documents for the channel include a Los Angeles County Drainage Area Final Feasibility Interim Report (USACE, 1991) and a Los Angeles County Drainage Area Upper Los Angeles River and Tujunga Wash HEC-RAS Hydraulic Models Final Report (USACE 2005). Available records indicate the existing channel depth to be approximately 28.5 feet, with a levee elevation of 114.75 at the existing UPRR bridge crossing. Elevations are given in North American Vertical Datum (1988).

The Project would construct a new bridge north of the existing bridge, as discussed in Section 6.2. The general plan for the bridge is included in Appendix A, along with as-built plans of the existing channel. Figure 3-1 shows the Study Area for this Location Hydraulic Study.

Figure 3-1. Study Area

Source: Jacobs 2020

4 TRAFFIC

The Project area is home to 1.2 million residents and a job center for approximately 584,000 employees. Projections show an increase in the resident population to 1.5 million and an increase in jobs to 670,000 by 2040 (Metrolink 2017). Population and employment densities are five times higher than the Los Angeles County average. This rail corridor is anticipated to serve commuters in a high travel demand corridor by providing relief to the constrained transportation systems currently available to these communities. In addition, the Project is expected to provide a direct connection to the Metro C (Green) Line and the Los Angeles County regional transit network.

No traffic or rail service interruption is expected to occur from the base flood.

5 HYDROLOGIC ANALYSIS

5.1 Hydrologic Characteristics

The Los Angeles River is 55 miles long, with an 824-square-mile watershed. The river extends from the eastern portions of the Santa Monica Mountains, Simi Hills and the Santa Susana Mountains in the west to the San Gabriel Mountains in the east. The Los Angeles River originates at the western end of the San Fernando Valley at the confluence of Arroyo Calabasas and Bell Creek. The six major tributaries along the river include Tujunga Wash, Burbank Western Storm Drain, Verdugo Wash, Arroyo Seco, Rio Hondo and Compton Creek. (Los Angeles Regional Water Quality Control Board [LARWQCB] 2017). The River floodplain is delineated in Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Number 06037C1810F, which is presented in Appendix A.

Topography throughout the coastal plain area is generally defined by gradually sloping land from the foothills of the San Gabriel Mountains to the Pacific Ocean. Ground elevations range from 10,000 feet in the San Gabriel Mountains, to 330 feet near the Los Angeles River's confluence with the Arroyo Saco, to mean sea level at the mouth of the Los Angeles River.

While approximately 324 square miles of the watershed are forest and open space, over half of the watershed is highly developed with commercial, industrial and residential uses (LARWQCB 2017). Land use within the watershed is 37 percent residential, 8 percent commercial, 11 percent industrial and 44 percent open space (LACDPW 2017a).

The annual average precipitation can range from 15.5 inches in the coastal plain to 32.9 inches near the San Gabriel Mountains. Winter storms comprise most of the rainfall within the area, and most precipitation occurs between December and March. January and July are the coldest and warmest months, respectively. (LACDPW 2006)

5.2 Base Flood and Overtopping Flood

Available information to establish the base flood and overtopping flood comes from multiple sources, including the FEMA Flood Insurance Study (FIS) (FEMA 2016), USACE publications, and LACFCD, a division of LACDPW.

The USACE provides design discharges in the Los Angeles County Drainage Area Final Report (USACE 2005). The value reported for the Los Angeles River, 120,000 cubic feet per second (cfs), is referenced by FEMA in the FIS. Because the USACE's study defined the channel's design discharge, USACE has jurisdiction in the flood control channel; because FEMA references the same study, the USACE value is used for the analysis of the base flood.

The overtopping flood for this facility would be an extreme event because the rail bridge is above the channel wall; therefore, any flow in excess of the channel capacity would spill out of the channel. To evaluate overtopping conditions, the channel capacity flow is needed. The LACDPW provided unpublished design flows of the Los Angeles River based on the Capital Flood, which is traditionally used in Los Angeles County for design and evaluation of floodway mapping standards (LACDPW 2006 and 2017b). This value is approximately 13.8 percent higher than the USACE design discharge and is therefore assumed to be an extreme event similar to the overtopping flood. This value is used as the overtopping flow. Table 5.1 summarizes the design flows used in the analysis.

Table 5.1. Los Angeles River Design Flows

Source	Design Flow
Project Design Flood Based on the USACE Design Discharge	120,000 cfs
Overtopping Flood Based on the LACFCD Capital Flood (Unpublished)	136,592 cfs

6 HYDRAULIC ANALYSIS

The basis of the river analysis is the existing USACE HEC-RAS model (version 4.1.0), which USACE provided for this analysis (USACE 2017). Detailed hydraulic analysis is presented in Appendix B.

6.1 Existing Conditions

The hydraulic model for the river was adopted without modification for the purpose of this study. Relevant modeling parameters are summarized below:

- Hydraulic Control: The downstream boundary control is critical depth.
- Bridge Modeling: The existing UPRR bridge is modeled as four separate bridges due to the skew across the river, each bridge with a single pier of 9.7 feet wide in the direction of flow. Each bridge is modeled with low chord elevation of 115 feet, which is between 0.1 to 0.5 feet clear of the existing channel top of bank. Piers have rounded noses; therefore, standard values are used for coefficient of drag (1.33) and pier shape (0.9). No contraction or expansion coefficient is used.
- Debris Factor: The existing bridge piers are modeled without debris factors, and the existing debris noses are not modeled.
- Ineffective Areas and Obstructions: No ineffective areas or obstructions were modeled in the existing conditions model.
- Flow Regime: The mixed flow regime is evaluated for the purpose of this study.
- Channel Roughness: The channel is concrete-lined, and the invert roughness is modeled with a Manning's 'n' = 0.016. Side slopes are modeled as 'n' = 0.04.

6.2 Project Conditions

The Project conditions would construct the new bridge on 9.7-foot-diameter columns. The existing bridge debris noses would be demolished, and new pier walls would be constructed to connect the existing bridge pier wall to the new columns. Pier walls would be seismically isolated from both structures. The new bridge deck would be 33 feet wide and would lay upstream of the existing bridge by approximately 15 feet. The Bridge General Plan is presented in Appendix A. The profile of the new bridge would be slightly higher than the existing bridge. Flows are completely contained in the channel; therefore, the bridge pier lengths were adjusted without change to the high or low chords. Debris factor, ineffective areas and obstructions, flow regime and channel roughness are not changed in the Project conditions model.

The Project would reduce the water surface elevation (WSE) by as much as 0.14 foot (Station 677+05). This impact would occur because flow in the channel near the crossing is generally supercritical (Fr > 1.0), and the hydraulics of the channel require flows to accelerate through the bridge, which constricts the flow area slightly. The flows are contained within the channel, as demonstrated in Figure 6-1. The hydraulic analysis is summarized in Table 6.1.

Table 6.1. Summary of Hydraulics of the Los Angeles River

River Station	Distance from Proposed Bridge Pier No. 3 [miles]	Existing Condition		Project Condition		Project Impact	
		WSE [ft]	Velocity [ft/s]	WSE [ft]	Velocity [ft/s]	WSE [ft]	Velocity [ft/s]
685+00	0.22	110.93	17.41	110.93	17.41	0	0
679+62	0.12	107.35	22.19	107.35	22.19	0	0
679+00	0.11	104.90	25.35	104.90	25.35	0	0
678+05	0.09	103.04	27.33	103.04	27.33	0	0
678+00	0.09	102.96	27.41	102.96	27.41	0	0
677+05	**0.07**	**109.74**	**17.14**	**109.60**	**17.26**	**-0.14**	**0.12**
677+00	0.07	109.79	17.03	109.66	17.15	-0.13	0.12
676+75	0.07	109.74	17.12	109.60	17.23	-0.14	0.11
676+44	0.06	109.65	17.25	109.52	17.36	-0.13	0.11
676+05	0.05	109.54	17.41	109.40	17.53	-0.14	0.12
674+90	0.03	**WSAB Bridge Pier No. 4 / Existing UPRR Bridge Pier No. 4**					
674+65	0.03	108.83	17.74	108.70	17.86	-0.13	0.12
673+53	0.00	**WSAB Bridge Pier No. 3 / Existing UPRR Bridge Pier No. 3**					
673+28	0.00	107.87	18.45	107.81	18.52	-0.06	0.07
672+13	-0.02	**WSAB Bridge Pier No. 2 / Existing UPRR Bridge Pier No. 2**					
671+88	-0.03	106.86	19.09	106.82	19.15	-0.04	0.06
670+76	-0.05	**WSAB Bridge Pier No. 1 / Existing UPRR Bridge Pier No. 1**					
670+51	-0.05	101.35	26.36	101.35	26.36	0	0
669+60	-0.07	101.22	26.26	101.22	26.26	0	0

Note: ft = feet; ft/sec = feet per second

6.3 Overtopping Condition

The overtopping condition is an extreme event with a return frequency likely to be much greater than 100 years. Hydraulic analysis of the overtopping flows indicates that the peak water surface elevations are contained within the channel within the Project reach. Therefore, overtopping of the Project is unlikely.

Figure 6-1. Project Impacts to Los Angeles River Floodplain

7 PROPERTY AT RISK

The inundation area for the Project is contained within the Los Angeles River, which is owned and maintained by LACFCD. Inundation poses no threat to property at risk.

8 RISK ASSESSMENT

8.1 Risk Associated with Implementation

The change in water surface elevation in the Los Angeles River would not result in any significant change in flood risks or damage because flows would continue to be contained within the river channel. Implementation does not have the potential for interruption or termination of emergency service or emergency routes.

8.2 Impacts to Floodplain Values

Natural and beneficial floodplain values include, but are not limited to, fish, wildlife, plants, open space, natural beauty, scientific study, outdoor recreation, agriculture, forestry, natural moderation of floods, water quality maintenance and groundwater recharge. The Los Angeles River is a constructed channel in a developed urban area; therefore, changes to the floodplain are not expected to affect floodplain values. Because it is an engineered waterway with restricted public access, the channel does not provide open space, natural beauty or outdoor recreation value. It also has limited value to support fish, wildlife, and plant habitat.

The Los Angeles Region Basin Plan lists the following existing and potential beneficial uses for Los Angeles River Reach 2 (Carson Street to Rio Hondo Reach 1): Municipal and Domestic Supply (potential), Industrial Service Supply (potential), Groundwater Recharge, Warm Freshwater Habitat and Wildlife Habitat (potential). The Project is not anticipated to adversely affect these values.

8.3 Support of Incompatible Development

The proposed Project would not support incompatible development in the floodplain because it is presently urbanized and protected by the levee.

8.4 Minimization of Floodplain Impact

Impacts to the Los Angeles River floodplain have been minimized by aligning the geometry of the bridge as closely as possible to the existing UPRR bridge and minimizing the length of bridge pier walls by using columns to support the bridge deck.

8.5 Restoration and Preservation of Floodplain Values

Because there would be no significant impacts to the floodplain and floodplain values, no restoration or preservation of floodplain values is required.

9 ALTERNATIVES TO LONGITUDINAL ENCROACHMENT

The Project would have no longitudinal encroachment into existing floodplains.

10 ALTERNATIVES TO SIGNIFICANT ENCROACHMENT

The proposed river crossing is designed to minimize physical impacts to flood control facilities. Therefore, there would be no significant encroachments. No alternatives to significant encroachment are required.

11 EXISTING WATERSHED AND FLOODPLAIN MANAGEMENT PROGRAMS

The Project complies with the existing watershed and floodplain management programs, including the *Los Angeles County Comprehensive Floodplain Management Plan* (LACDPW 2016) and the *Los Angeles River Master Plan (*LACDPW, 1996).

The *Los Angeles County Comprehensive Floodplain Management Plan* describes and coordinates existing flood planning operations, identifies high-risk areas within Los Angeles County, and proposes risk minimization and mitigation strategies, such as working cooperatively with public agencies to minimize flood risk, minimizing development within the floodplain, and providing flood protection by maintaining existing flood control systems. This Project is consistent with these strategies.

12 REFERENCES

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APPENDIX A RELEVANT DESIGN DATA

- Los Angeles River Bridge General Plan
- As-Built Plans
- USACE LAR Design Discharge
- FEMA FIRMette
- LHS Form

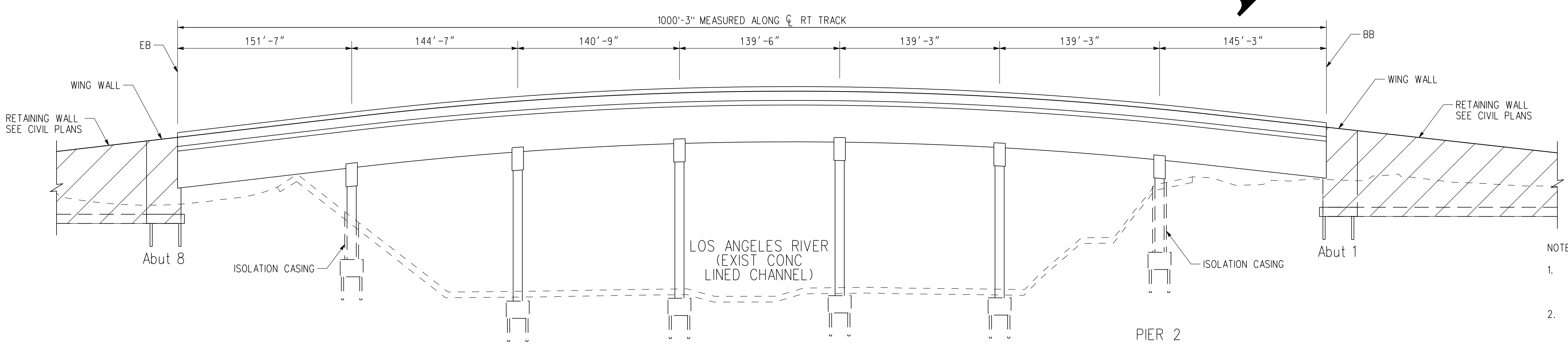
PLAN

LEGEND:

① Paint "LOS ANGELES RIVER BRIDGE"

② Paint bridge number and year constructed

DRAFT



DEVELOPED ELEVATION

200' 100' 0 200' 400'

HORIZ: 1"=200'

50' 0 50' 100'

VERT: 1"=50'

NOTES:

1. For Typical Section and Engineer's Estimate, see "LOS ANGELES RIVER CHANNEL CROSSING - TYPICAL SECTION" sheet.

2. Foundation information shown is preliminary. Geotechnical investigation required for determination of size and type of structure foundation.

3. For additional notes, see "LOS ANGELES RIVER CHANNEL CROSSING - TYPICAL SECTION" sheet.

NOT FOR CONSTRUCTION

THE PREPARATION OF THIS DRAWING HAS BEEN FINANCED IN PART THROUGHT A GRANT FROM THE U.S. DEPARTMENT OF TRANSPORTATION FEDERAL TRANSIT ADMINISTRATION (FTA), UNDER THE FEDERAL TRANSIT ACT OF 1964, AS AMENDED, AND IN PART BY THE TAXES OF THE CITIZENS OF LOS ANGELES COUNTY AND OF THE STATE OF CALIFORNIA.

DESIGNED BY

DRAWN BY

CHECKED BY

IN CHARGE

DATE

Metro

LOS ANGELES COUNTY
METROPOLITAN TRANSPORTATION AUTHORITY

wsp
444 South Flower Street
Suite 800
Los Angeles, CA 90071
TEL (213) 362-9470

SUBMITTED

APPROVED

WEST SANTA ANA BRANCH LRT
STRUCTURAL DRAWING
LOS ANGELES RIVER CHANNEL CROSSING
GENERAL PLAN
STATION 965+20.97 TO 975+21.22

CONTRACT NO AE5999300

DRAWING NO

REV

SCALE

SHEET NO

OF

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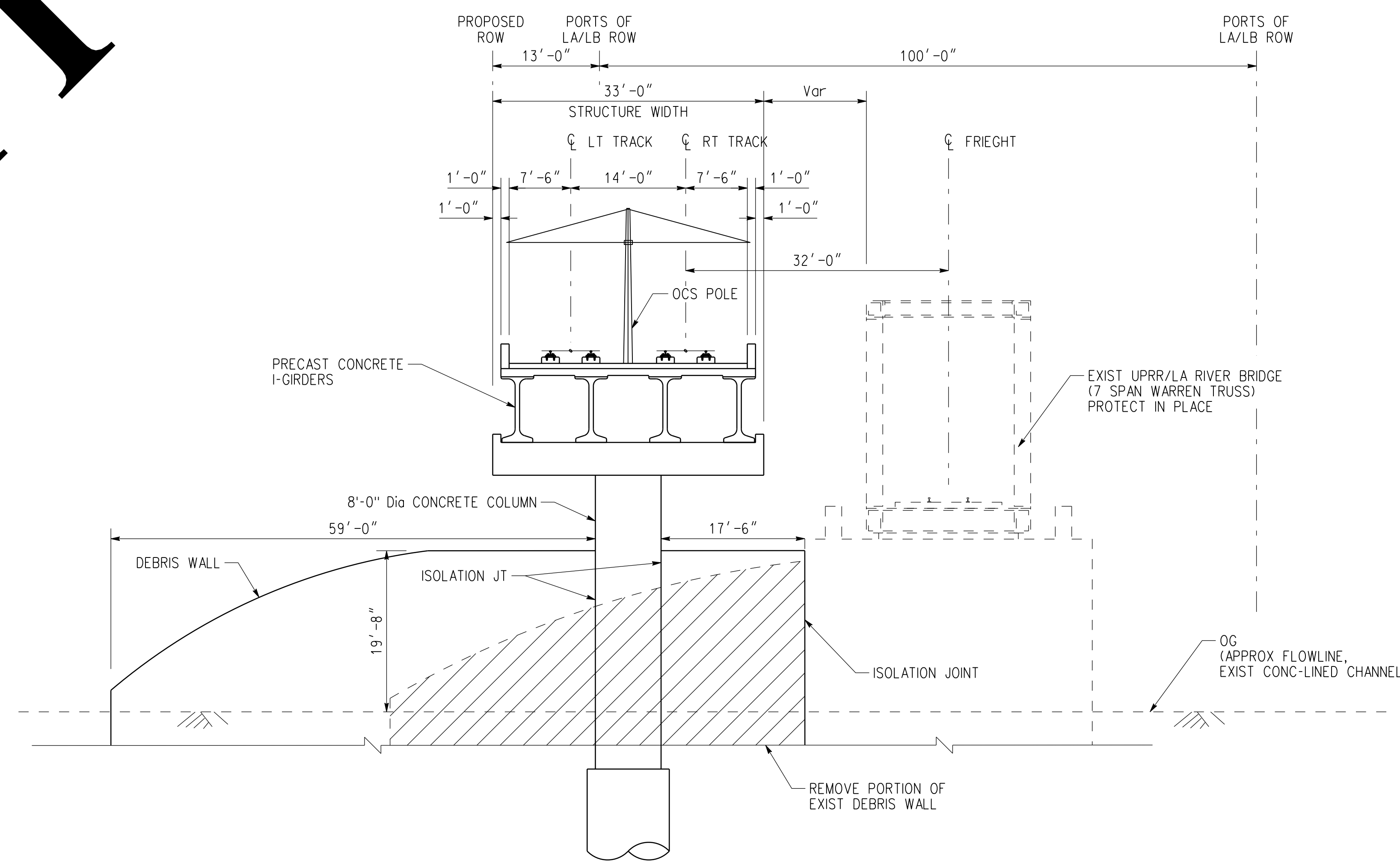

TYPICAL SECTION
SCALE: 1"=40'

NOTE: DIMENSIONS SHOWN ARE PRELIMINARY AND ARE SUBJECT TO CHANGE DURING FINAL DESIGN

NOTES:

1. CONSTRUCT COMBINED 2-TRACK LRT BRIDGE. MAINTAIN 1' SEISMIC GAP TO Exist FREIGHT TRUSS BRIDGE.
2. Foundation information shown is preliminary. Geotechnical investigation required for determination of size and type of structure foundation.
3. SET LRT BRIDGE SOFFIT AT OR ABOVE Exist TOP OF CHANNEL. FREEBOARD TO HIGH WATER LEVEL PENDING CHANNEL HYDRAULICS ANALYSIS.
4. PRECAST SECTIONS USED TO MINIMIZE CONSTRUCTION WITHIN CHANNEL. ASSUME CONSTRUCTION OF CAST-IN-PLACE PIER WALLS WITHIN CHANNEL IS ACCEPTABLE (PENDING APPROVAL FROM GOVERNING WATER AUTHORITY).
5. MAINTAIN FREIGHT TRAFFIC ON Exist TRUSS BRIDGE.
6. PROPOSED LRT BRIDGE SPAN L = 150' (Approx.), MATCH Exist PIER LOCATIONS.
7. ASSUME Exist RAIL BRIDGE IS OPEN-TIE (i.e., NO BALLAST). IF CONFIRMED BALLAST, Exist TOP OF RAIL MAY BE HIGHER THAN CURRENT ASSUMED ELEVATION.
8. DIMENSIONS SHOWN ARE PRELIMINARY AND ARE SUBJECT TO CHANGE DURING FINAL DESIGN.

PROFILE

200' 100' 0 200' 400'
HORIZ: 1"=200'

50' 0 50' 100'
VERT: 1"=50'

NOT FOR CONSTRUCTION

DRAFT

THE PREPARATION OF THIS DRAWING HAS BEEN FINANCED IN PART THROUGHT A GRANT FROM THE U.S. DEPARTMENT OF TRANSPORTATION FEDERAL TRANSIT ADMINISTRATION (FTA), UNDER THE FEDERAL TRANSIT ACT OF 1964, AS AMENDED, AND IN PART BY THE TAXES OF THE CITIZENS OF LOS ANGELES COUNTY AND OF THE STATE OF CALIFORNIA.

DESIGNED BY J. POWELL
DRAWN BY J. POWELL
CHECKED BY TBD
IN CHARGE CHARLES
DATE AUGUST 2018

LOS ANGELES COUNTY
METROPOLITAN TRANSPORTATION AUTHORITY
Metro

wsp
444 South Flower Street
Suite 800
Los Angeles, CA 90071
TEL (213) 362-9470

SUBMITTED
APPROVED

WEST SANTA ANA BRANCH LRT
STRUCTURAL DRAWING
LOS ANGELES RIVER CHANNEL CROSSING
TYPICAL SECTION
STATION 965+20.97 TO 975+21.22

CONTRACT NO AE5999300
DRAWING NO
REV
SCALE
SHEET NO
OF

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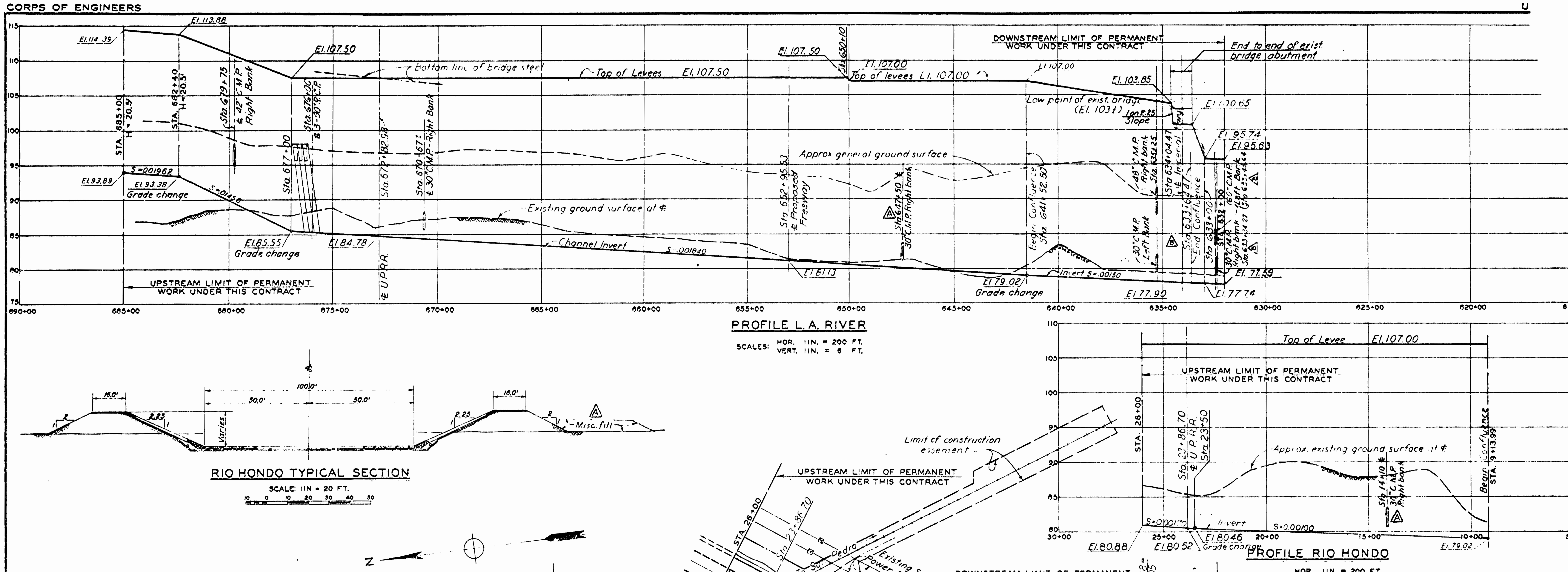
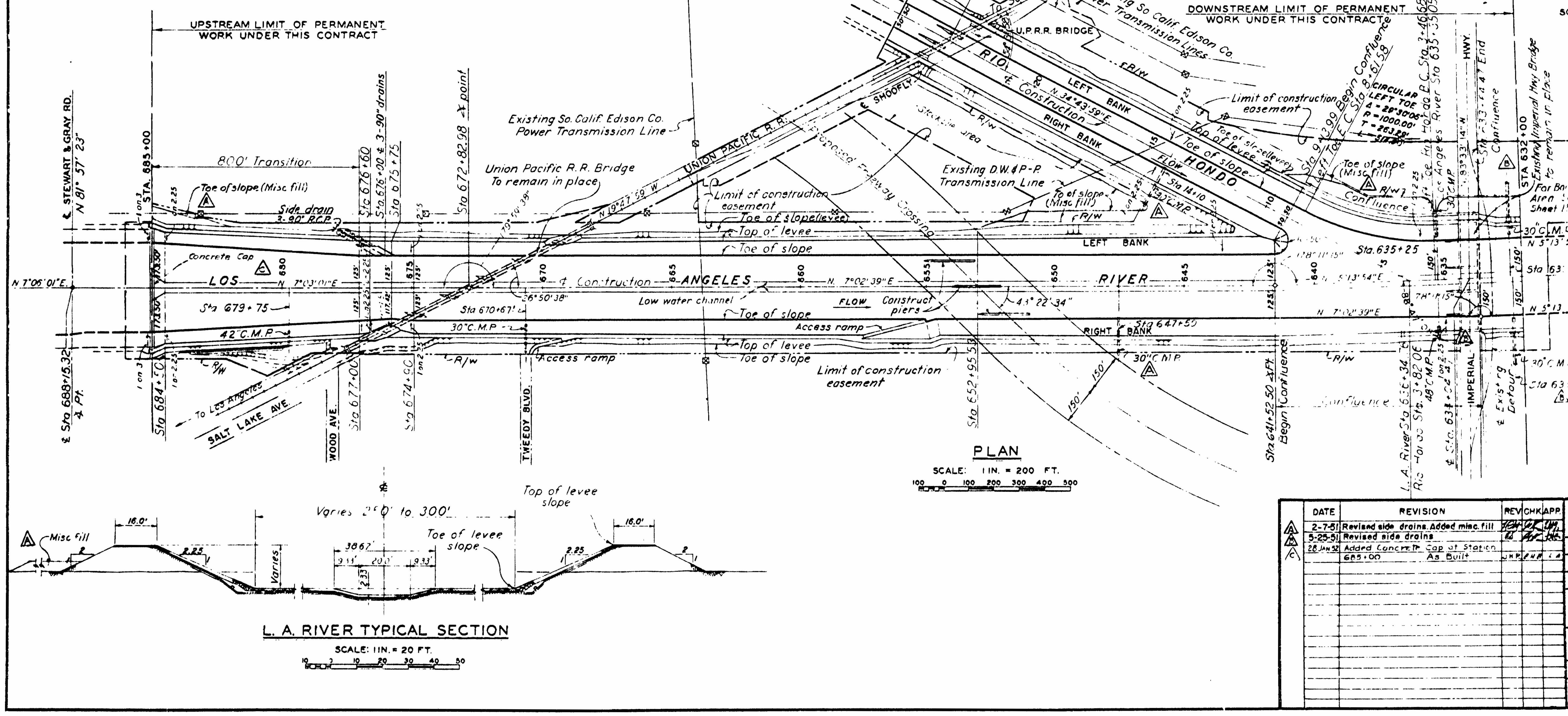




GENERAL NOTES

Utility note: Unless otherwise noted, public utilities will remain in place. Any further removal or relocation of utilities desired by the contractor, other than that noted on the drawings, will be made only with the approval of the owner and at the expense of the contractor.

Channel banks are indicated as left and right looking downstream.

All stations shown are on and are normal to the center line of construction.

All channel cross sections are shown looking downstream.

Stations and dimensions given to expansion joints refer to the center line of the joint.

All dimensions in plan are horizontal unless otherwise noted.

Dimensions shown to existing structures shall be verified in field.

Contractor shall take necessary precaution to protect existing structures.

Figures in circles indicate contract item number under which payment will be made.

D Indicates ½" expansion joint Type "D"

A Indicates ½" expansion joint Type "A"

R/W Indicates permanent channel right of way.

Remove all obstructions within the cut or fill limits unless otherwise noted.

All fences buildings and trees outside the cut or fill limits and within the limits of construction easement may be removed at the option of the contractor unless otherwise noted.

RECORD DRAWING - AS CONSTRUCTED

Contract DA 04-353-Eng 036 Rev C

POSTED BY: JHP DATE: 28 Jan 1952

POSTED BY ______ DATE: ______

POSTED BY ______ DATE: ______

DATUM IS MEAN SEA LEVEL

	DATE	REVISION	REV	CHK	APP
A	2-7-51	Revised side drains. Added misc. fill			
B	5-25-51	Revised side drains			
C	28 JAN 52	Added Concrete Cap at Station 685+00 As Built	JHP		

CORPS OF ENGINEERS, U. S. ARMY
OFFICE OF THE DISTRICT ENGINEER
LOS ANGELES, CALIFORNIA

DRAWN BY E.R.F.
TRACED BY:
CHECKED BY H.D.W. L.B.H. E.K.
SUBMITTED BY: CHIEF DESIGN

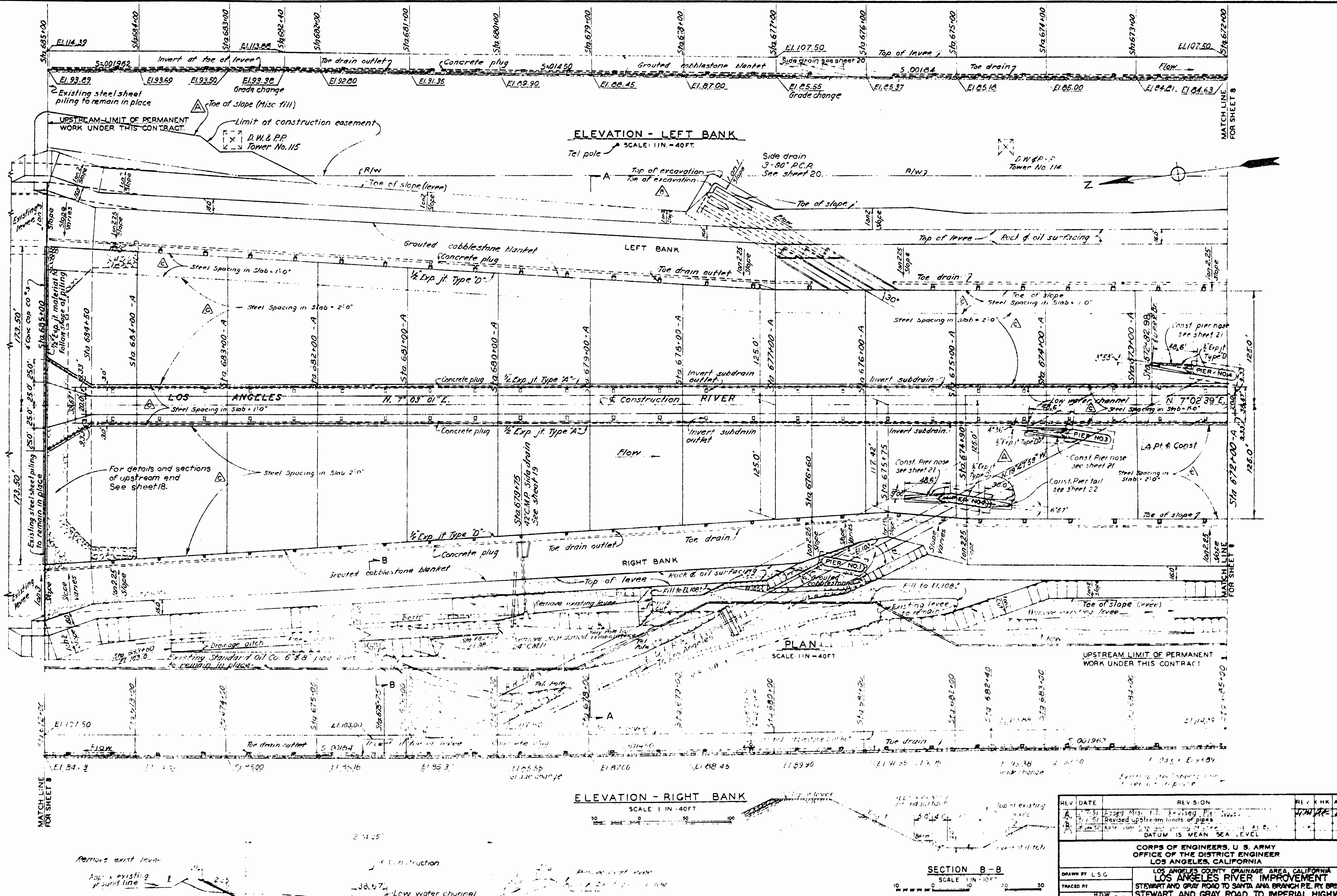
LOS ANGELES COUNTY DRAINAGE AREA, CALIFORNIA
LOS ANGELES RIVER IMPROVEMENT
STEWART AND GRAY ROAD TO SANTA ANA BRANCH P.E. RY. BRIDGE
STEWART AND GRAY ROAD TO IMPERIAL HIGHWAY
PLAN AND PROFILE
STA. 685+00 TO STA. 632+00
RIO HONDO STA. 26+00 TO STA. 9+13.99
STA 685+00 TO STA 632+00 MILE 12.84 TO MILE 11.80

APPROVAL RECOMMENDED: CHIEF ENGINEERING DIVISION
APPROVED: LT. COLONEL C. E. DISTRICT ENGINEER

SCALE AS SHOWN
DATE: DECEMBER 1950

TO ACCOMPANY SPECIFICATIONS CIVENG-04-353-51-13 DATED: 22 JANUARY 1951
SHEET 6 OF 37
FILE NO (D O SERIES) 429/36 REV. C

CORPS OF ENGINEERS U. S. ARMY



REFERENCES

For Plan and Profile ... See sheet 6
For Cross Sections ... See sheets 15 & 16
For Typical Channel & Subsurface Drainage Details ... See sheet 17
For General Notes ... See sheet 6

RECORD DRAWING - AS CONSTRUCTED

POSTED BY ______ DATE ______
POSTED BY ______ DATE ______
POSTED BY ______ DATE ______

REV	DATE	REVISION	REV	CHK	APP
A	7-51	Added Misc. ... Revised Pier Nose			
B	5-51	Revised upstream limits of pipes			
C	28 JAN 52	Added ... As Built			

DATUM IS MEAN SEA LEVEL

CORPS OF ENGINEERS, U. S. ARMY
OFFICE OF THE DISTRICT ENGINEER
LOS ANGELES, CALIFORNIA

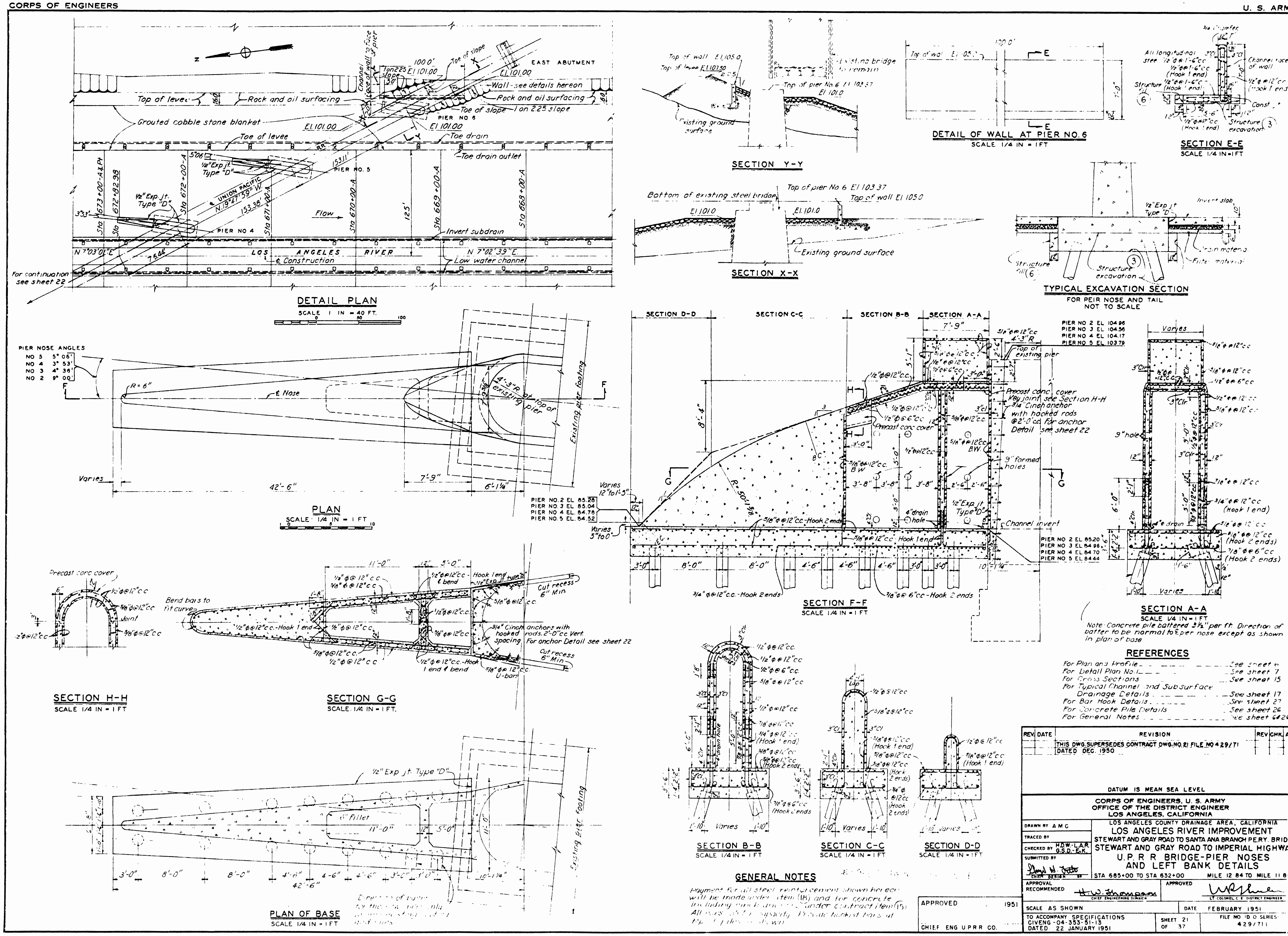
LOS ANGELES COUNTY DRAINAGE AREA, CALIFORNIA
LOS ANGELES RIVER IMPROVEMENT
STEWART AND GRAY ROAD TO SANTA ANA BRANCH P.E. RY. BRIDGE
STEWART AND GRAY ROAD TO IMPERIAL HIGHWAY
DETAIL PLAN NO. 1
STA. 685+00 TO STA. 672+00
STA 685+00 TO STA. 682+00 MILE 12.84 TO MILE 11.84

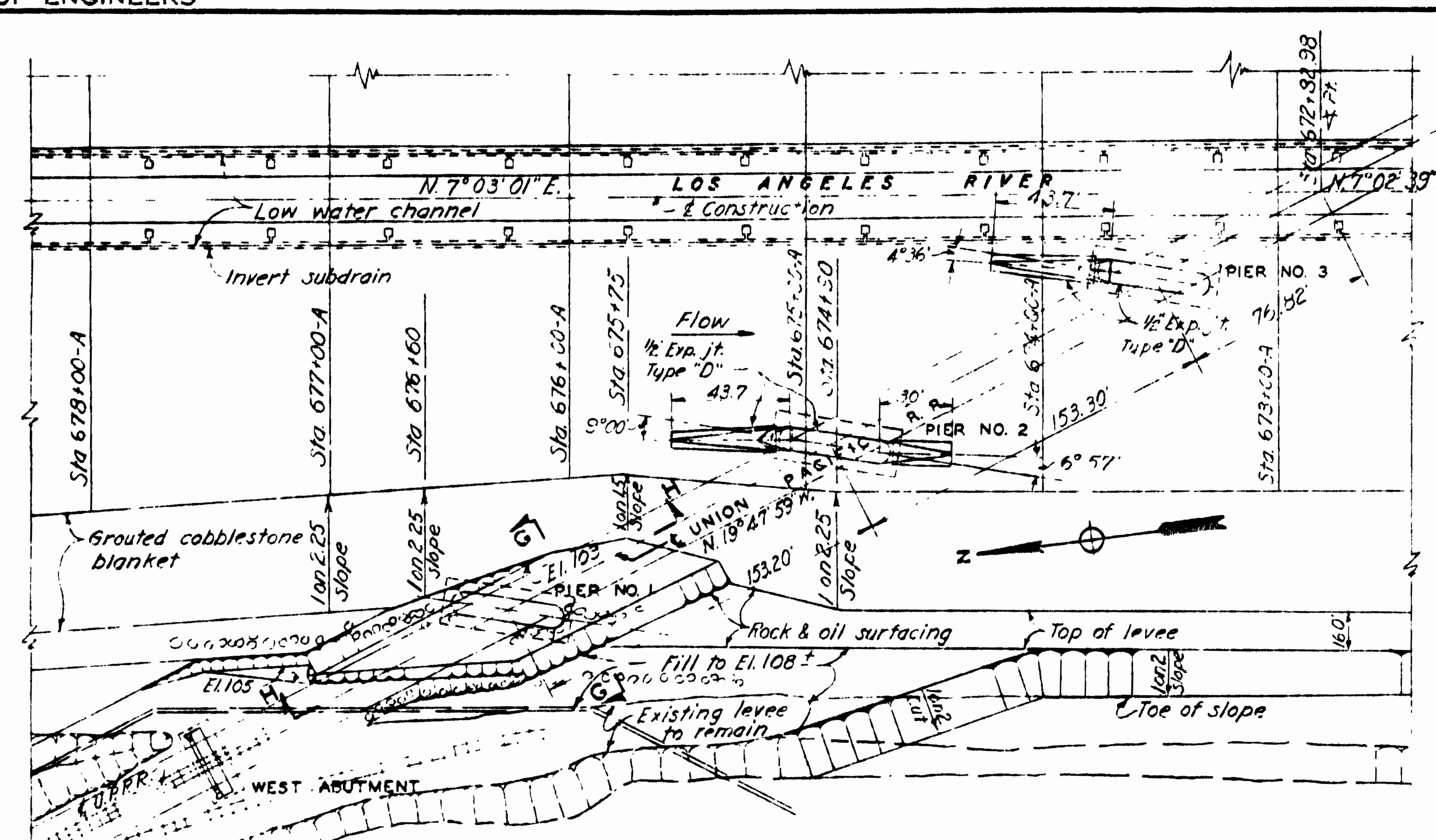
DRAWN BY L S G
TRACED BY
CHECKED BY H.D.W. L.R.H. E K
SUBMITTED BY [signature] CHIEF, DESIGN
APPROVAL RECOMMENDED [signature] CHIEF, ENGINEERING DIVISION
APPROVED: [signature] LT. COLONEL, C. E., DISTRICT ENGINEER

SCALE: 1 IN. = 40 FT.
DATE: DECEMBER 1950

TO ACCOMPANY SPECIFICATIONS CIVENG-04-353-51-13 DATED: 22 JANUARY 1951
SHEET 7 OF 37
FILE NO. (D. O. SERIES) 429/57 REV. "C"

CORPS OF ENGINEERS U. S. ARMY





DETAIL PLAN
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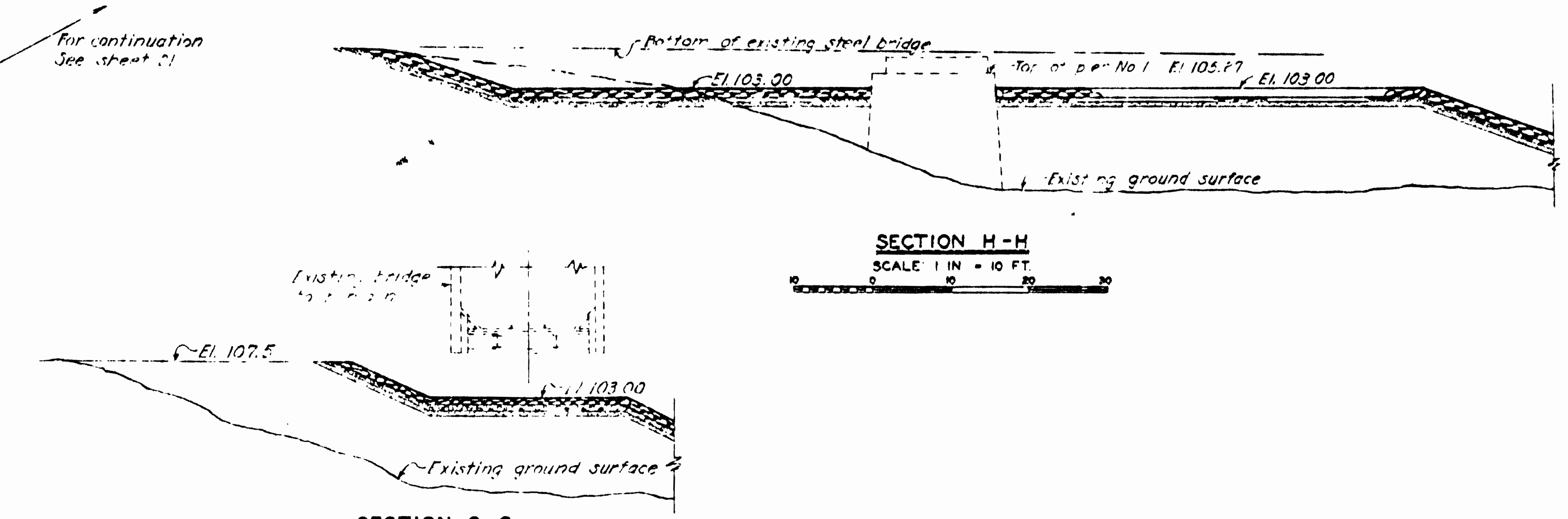
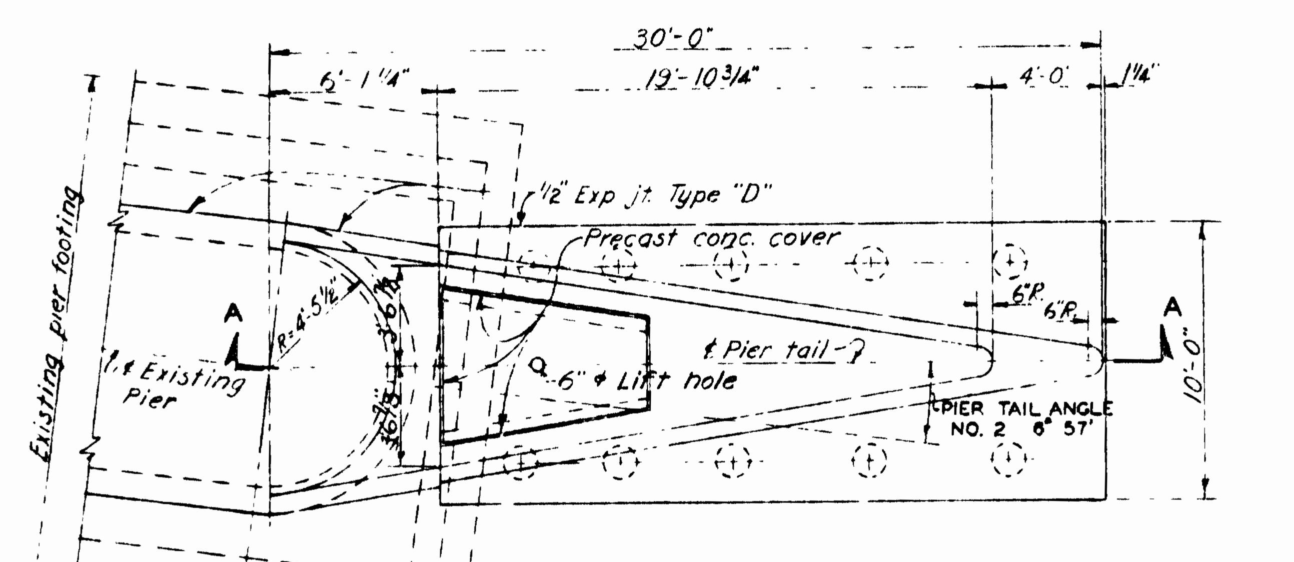
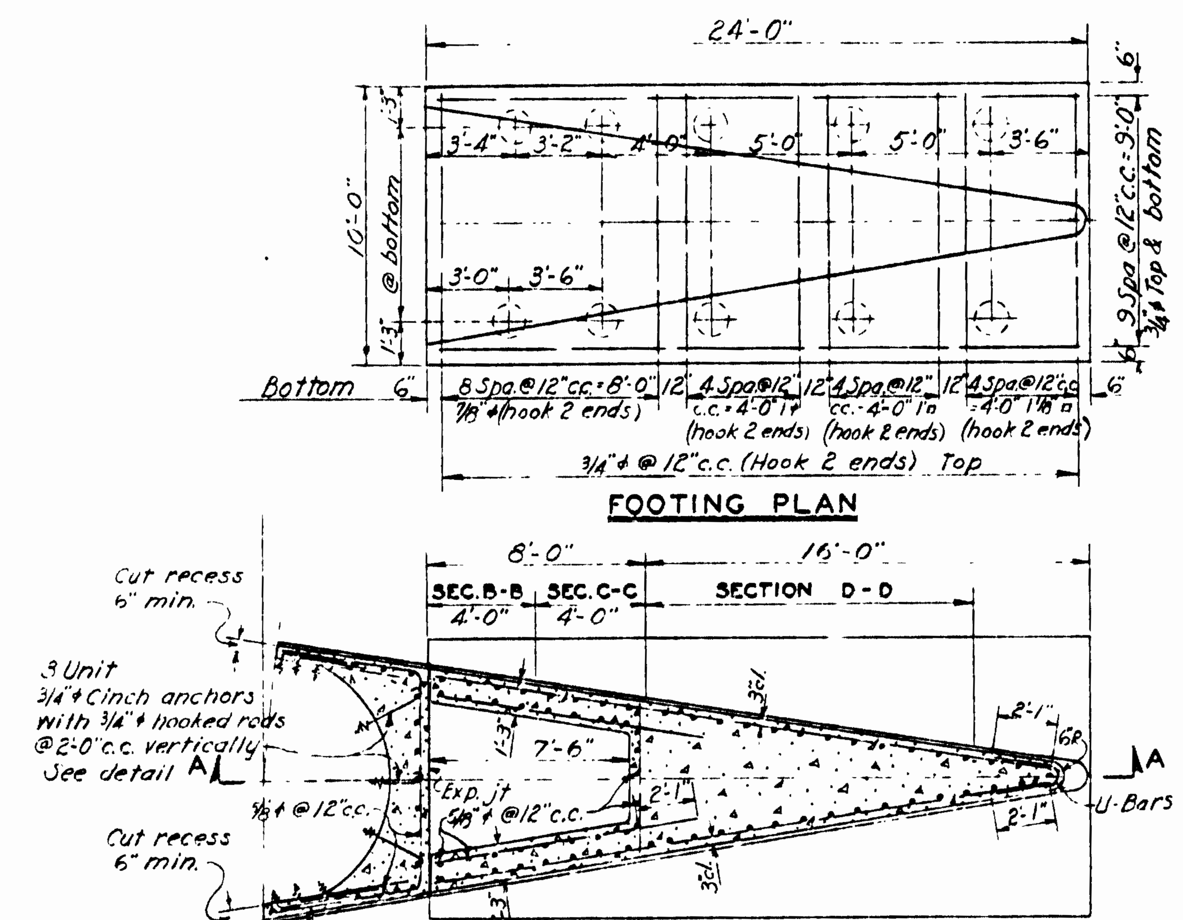


SECTION H-H
SCALE: 1 IN. = 10 FT.

SECTION G-G
SCALE: 1 IN. = 10 FT.

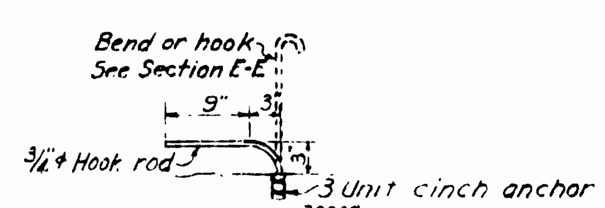


PLAN
PIER TAIL NO. 2



FOOTING PLAN

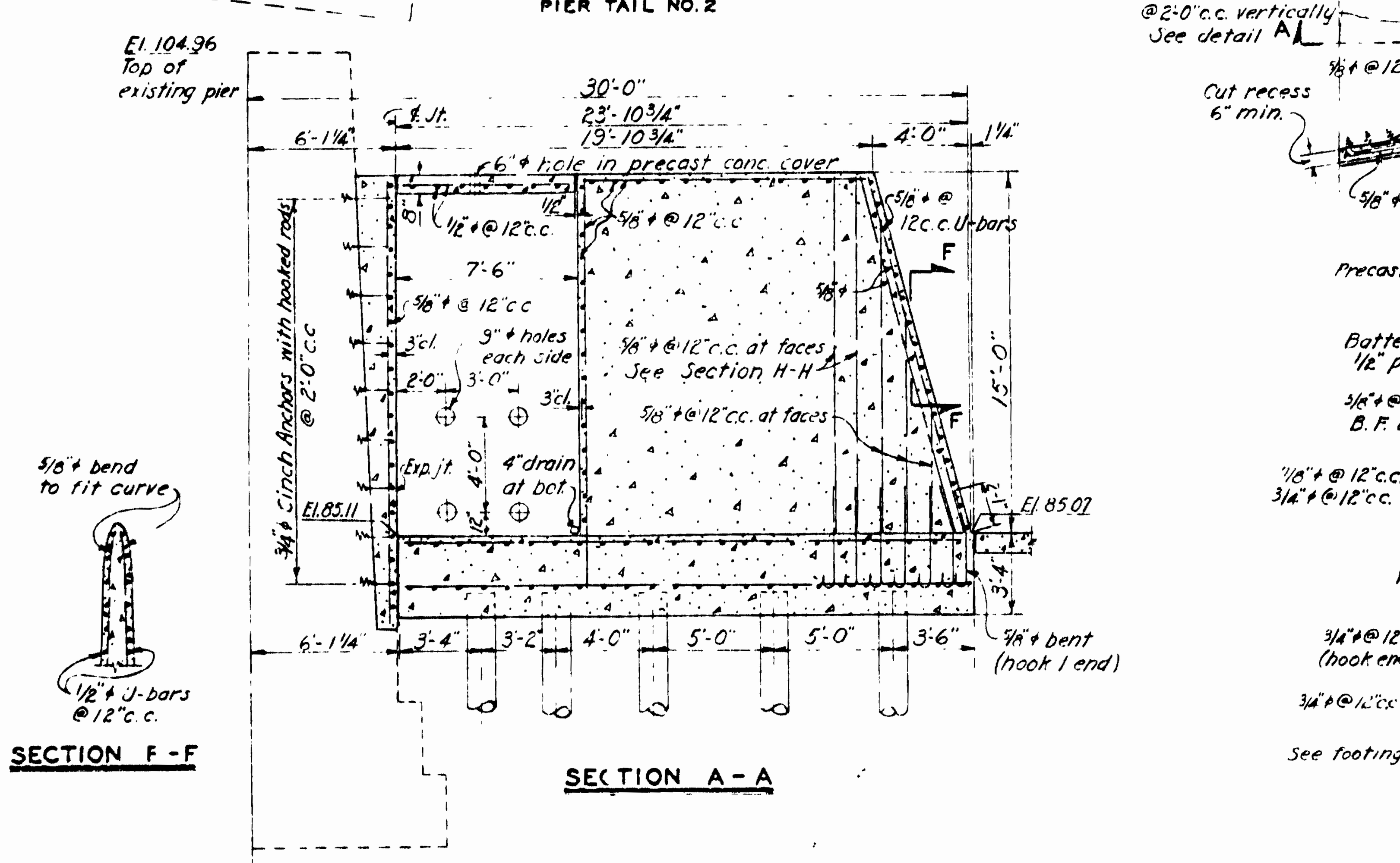
SECTION E-E



ANCHOR DETAIL

GENERAL NOTES

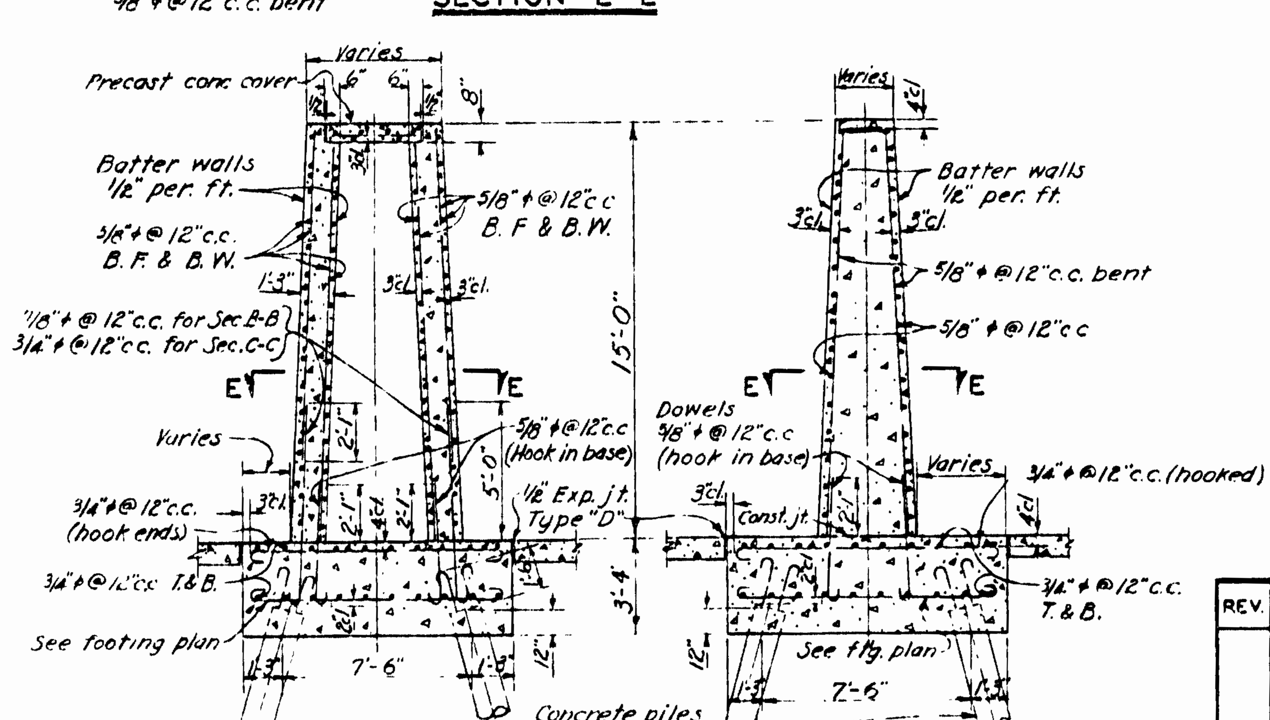
Payment for steel reinforcement shown hereon will be made under contract item (18) and for concrete including cinch anchors under contract item (15)



SECTION F-F

SECTION A-A

TAIL DETAILS - PIER NO. 2
SCALE: 1/4 IN. = 1 FT.



SECTION B-B
SECTION C-C

SECTION D-D

REFERENCE DRAWINGS

For Plan and Profile	See sheet 6
For Detail Plan No. 2	See sheet 8
For Cross Sections	See sheet 15
For Typical Channel and Subsurface Drainage Details	See sheet 17
For Concrete Pile Details	See sheet 26
For Bar Hook Details	See sheet 27
For General Notes	See sheets 6, 21 & 26
For Pier Nose Details	See sheet 21

RECORD DRAWING - AS CONSTRUCTED

DATUM IS MEAN SEA LEVEL

REV.	DATE	REVISION	REV.	CHK.	APP.
	THIS DWG. SUPERSEDES CONTRACT DWG. NO. 22 FILE NO. 429/72 DATED DEC. 1950				

APPROVED ______ 1951

CHIEF ENG. U P R R CO.

CORPS OF ENGINEERS, U. S. ARMY
OFFICE OF THE DISTRICT ENGINEER
LOS ANGELES, CALIFORNIA

DRAWN BY U. E. L.
TRACED BY:
CHECKED BY: H.D.W. L.R.H. G.S.D. E.K.
SUBMITTED BY: [signature] CHIEF, DESIGN

LOS ANGELES COUNTY DRAINAGE AREA, CALIFORNIA
LOS ANGELES RIVER IMPROVEMENT
STEWART AND GRAY ROAD TO SANTA ANA BRANCH PE RY. BRIDGE
STEWART AND GRAY ROAD TO IMPERIAL HIGHWAY
U.P.R.R. BRIDGE - PIER TAIL
AND RIGHT BANK DETAILS
STA. 665+00 TO STA. 632+00 MILE 12.84 TO MILE 11.84

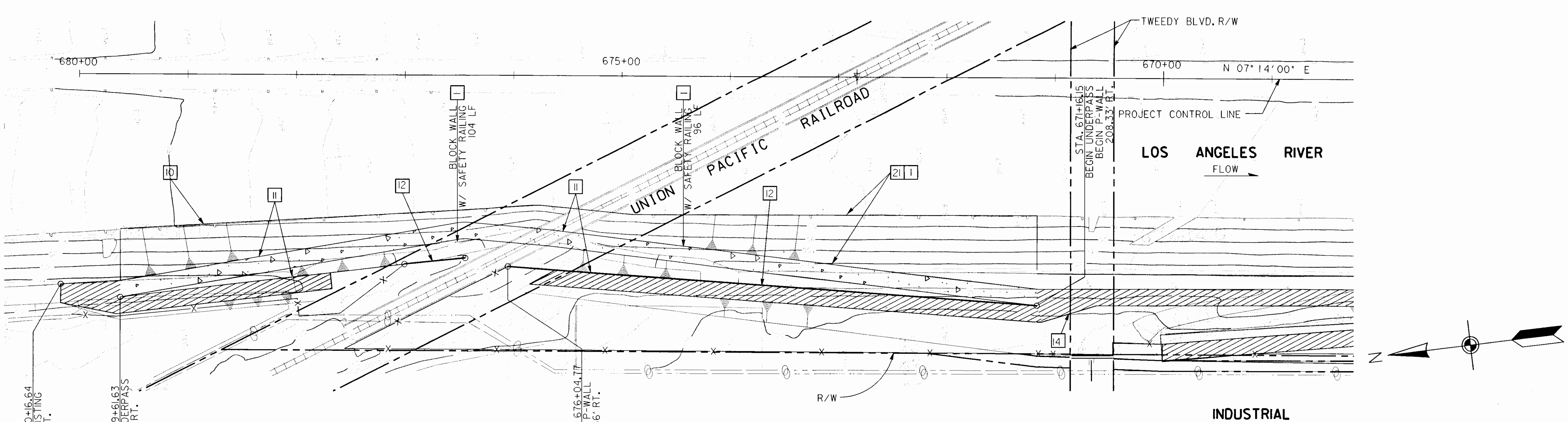
APPROVAL RECOMMENDED: [signature] CHIEF, ENGINEERING DIVISION
APPROVED: [signature] LT. COLONEL, C. E. DISTRICT ENGINEER

SCALE: AS SHOWN
DATE FEBRUARY 1951

TO ACCOMPANY SPECIFICATIONS CIVENG-04-353-51-13 DATED 22 JANUARY 1951

SHEET 22 OF 37

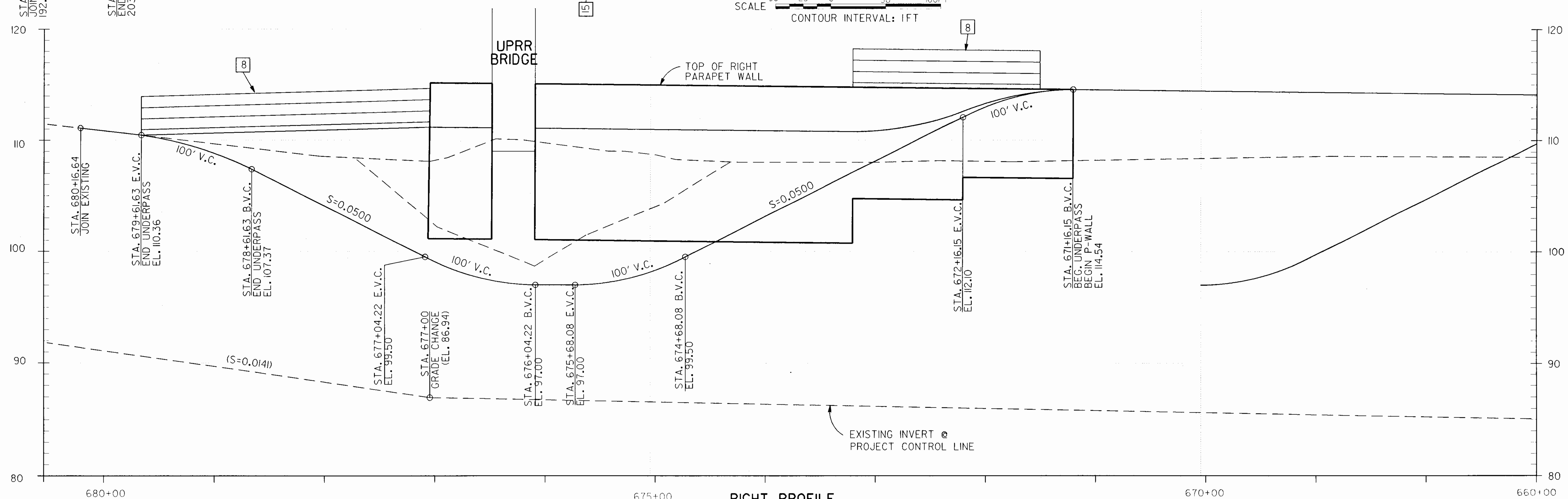
FILE NO. D.O. SERIES 429/72 1



RIGHT PLAN

SCALE 50 25 0 50 100FT

CONTOUR INTERVAL: 1FT



RIGHT PROFILE

HORIZ. SCALE 50 25 0 50 100FT

VERT. SCALE 5 2.5 0 5 10FT

DM5 CONSTRUCTION NOTES:

- [1] REMOVE
- [3] PROTECT IN PLACE
- [4] CONSTRUCT CHAIN LINK FENCE, PER DETAIL SHEET M-3
- [5] CONSTRUCT CHAIN LINK ACCESS GATE PER: ACCESS (A), MAINTENANCE (M), PEDESTRIAN (P), PER DETAIL SHEET M-3
- [8] CONSTRUCT SAFETY RAILING, LIMITS AND DETAILS, PER DETAIL SHEET M-4
- [10] CONSTRUCT 10 INCH THICK REINFORCED CONCRETE CHANNEL INVERT, PER DETAIL SHEET S-1
- [11] CONSTRUCT 8 INCH THICK REINFORCED CONCRETE CHANNEL LINING, PER DETAIL SHEET S-2
- [12] CONSTRUCT PARAPET WALL, PER DETAIL SHEET S-3
- [14] CONSTRUCT TAPER, PER DETAIL SHEET M-1
- [15] JOIN EXISTING BRIDGE ABUTMENT
- [17] TOE OF COMPACTED FILL SLOPE
- [21] CONSTRUCT 12 INCH THICK GROUTED STONE CHANNEL LINING, PER DETAIL SHEET S-1

REGISTERED PROFESSIONAL ENGINEER DAVID L. HUNT NO. 30514 EXP. 3-31-00 CIVIL ENGINEER STATE OF CALIFORNIA

"PF537212"

NOTE:

1. TOPOGRAPHY COMPILED BY PHOTOGRAMMETRIC METHODS ROBERT J. LUNG AND ASSOCIATES, ON APRIL 29, 1993

AS-BUILT

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
REVISIONS			

LOS ANGELES COUNTY DRAINAGE AREA, CALIFORNIA
RIO HONDO/LOS ANGELES RIVER, FROM WHITTIER NARROWS DAM TO PACIFIC OCEAN
LOS ANGELES RIVER IMPROVEMENTS
(UNION PACIFIC RAILROAD TO ROSECRANS BOULEVARD)
RIO HONDO CHANNEL IMPROVEMENTS
(FIRESTONE BOULEVARD TO LOS ANGELES RIVER)
UNDERPASS PLAN & PROFILE
UNION PACIFIC RAILROAD RIGHT LEVEE

DESIGNED BY: K.T./S.M.
DRAWN BY: S.M./Z.C.
CHECKED BY: D.H.

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

WILLDAN
27042 TOWNE CENTRE DRIVE, SUITE 270
FOOTHILL RANCH, CA. 92610

SUBMITTED BY:
THOMAS H. SAGE, P.E.
CHIEF, DESIGN BRANCH

CADD FILE NAME: 500c27.dgn
DACW09-00-B-0002
DISTRICT FILE NO. 470/89

SHEET C-27 OF C-64 SHEETS

Plotted by: smccrack@... Dated: 12/5/2002

US Army Corps
of Engineers
Los Angeles District

Los Angeles County Drainage Area
Upper Los Angeles River and Tujunga Wash
HEC-RAS Hydraulic Models

FINAL REPORT

Prepared By:

US Army Corps of Engineers, Los Angeles District
Engineering Division, Hydrology and Hydraulics Branch
Hydrology and Hydraulics Section

July 2005

Table 2. Design Discharges
(continued)

River / Reach	Subreach	Subreach Stations (ft)	Design Discharge (cfs)
Upper Los Angeles River Reach 1	Fletcher Dr - Blimp St	1420+55.60	78,000
		1403+50.00	83,700
	Blimp St - Golden State Fwy (5)	1366+00.00	83,700
	Golden State Fwy (5) - Pasadena Fwy (110)	1297+00.00	83,700
	Pasadena Fwy (110) - North Broadway	1273+10.00	104,000
	North Broadway - Alhambra Ave	1247+00.00	104,000
	Alhambra Ave - Santa Ana Fwy (5)	1214+00.00	104,000
	Santa Ana Fwy (5) - 4th St	1173+00.00	104,000
	4th St - Olympic Blvd	1142+01.50	104,000
	Olympic Blvd - Washington Blvd	1078+00.00	104,000
	Washington Blvd - Soto St Soto St - Downey Rd	1045+00.00	104,000
		999+00.00	109,500
	Downey Rd - Atlantic Blvd	966+31.66	109,500
	Atlantic Blvd - Randolph St Randolph St - Florence Ave Florence Ave - Stewart & Gray Rd	883+10.00	109,500
	Stewart & Gray Rd - Rio Hondo Channel	685+00.00	120,000
Tujunga Wash	Hansen Dam - Beachy Ave	499+88.27	22,000
	Beachy Ave - Vanowen St	362+00.00	22,000
		351+88.66	29,000
		350+17.68	29,000
	Vanowen St - Magnolia Blvd	222+00.00	29,000
		123+00.00	30,000
	Magnolia Blvd - LA River	110+00.00	30,000

* 1947 revised estimate that increases flow rate based on additional hydrologic information – see Reference 8.

Roughness Values

The Manning's roughness coefficients used for the Upper Los Angeles River and Tujunga Wash models are shown in the HEC-RAS Summary Output tables. These roughness values were derived from the pertinent data tables for design conditions. Certain reaches along the Upper Los Angeles River do not depict the design roughness conditions.

Boundary Conditions

The following table summarizes the boundary conditions (starting water surface at the upstream and downstream ends of the river system reaches) for the Upper Los Angeles River and Tujunga Wash. In the table, "mixed" flow regime indicates the occurrence of both subcritical and supercritical flow within the reach.

LACDA
Upper Los Angeles River
Downey Rd to Rio Hondo
Reach 1

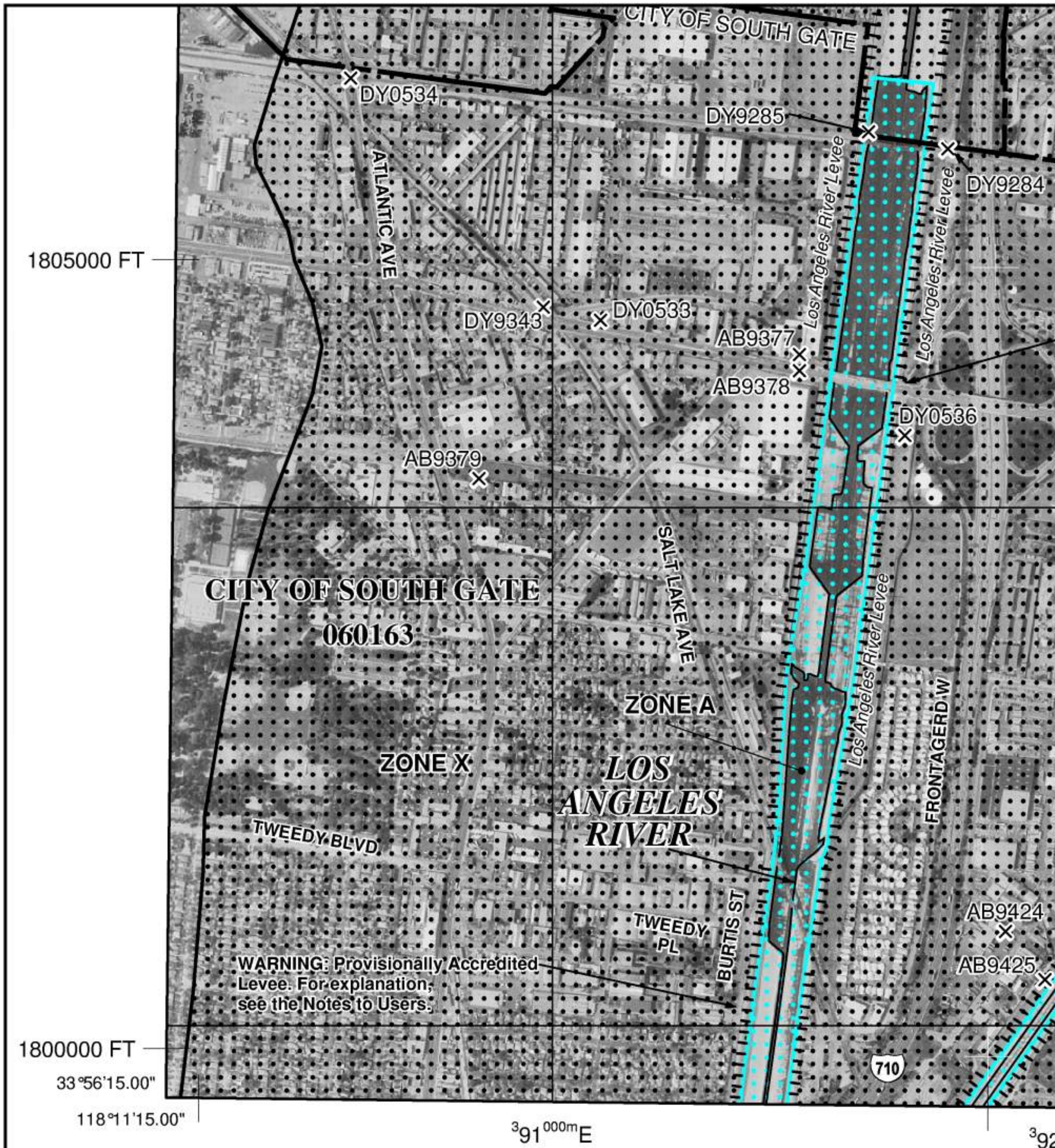
2000 0 2000 Feet

LEGEND

HEC-RAS Cross Sections

Stream Centerline

PLATE 8



...d insurance is available in this community, contact your ...ional Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

NATIONAL FLOOD INSURANCE PROGRAM

NFIP

PANEL 1810F

FIRM

FLOOD INSURANCE RATE MAP

LOS ANGELES COUNTY, CALIFORNIA

AND INCORPORATED AREAS

PANEL 1810 OF 2350

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
BELL GARDENS, CITY OF	060656	1810	F
BELL, CITY OF	060101	1810	F
COMMERCE, CITY OF	060110	1810	F
CUDAHY, CITY OF	060657	1810	F
DOWNEY, CITY OF	060645	1810	F
MAYWOOD, CITY OF	060651	1810	F
MONTEBELLO, CITY OF	060141	1810	F
SOUTH GATE, CITY OF	060163	1810	F
VERNON, CITY OF	060166	1810	F

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
06037C1810F

EFFECTIVE DATE
SEPTEMBER 26, 2008

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

LOCATION HYDRAULIC STUDY FORM *

Floodplain Description:

Los Angeles River Channel.

1. Description of Proposal (include any physical barriers i.e. concrete barriers, soundwalls, etc. and design elements to minimize floodplain impacts)

Construction of a new Metro Light Rail Bridge.

2. ADT:
Current 9,200/4,400 riders (weekday/weekend)
Projected similar or greater

3. Hydraulic Data:
Base Flood Q_{100}= 120,000 CFS WSE100= 109.40
The flood of record, if greater than Q_{100}: Q= n/a CFS WSE= n/a
Overtopping flood Q= 136,592 CFS (approx 500-yr flood) WSE= 111.19
Are NFIP maps and studies available? YES X NO____

4. Is the bridge location alternative within a regulatory floodway ?
YES X NO____

5. Attach map with flood limits outlined showing all buildings or other improvements within the base floodplain.
–See Appendix A

Potential Q_{100} backwater damages:

A.	Residences?	NO X	YES____
B.	Other Bldgs?	NO X	YES____
C.	Crops?	NO X	YES____
D.	Natural and beneficial FLOODPLAIN VALUES?	NO X	YES____

6. Type of Traffic:

A. Emergency supply or evacuation route?	NO X	YES____
B. Emergency vehicle access?	NO X	YES____
C. Practicable detour available?	NO X	YES____
D. School bus or mail route?	NO X	YES ____

7. Estimated duration of traffic interruption for 100-year event hours: 0

8. Estimated value of Q_{100} flood damages (if any) – moderate risk level.

A.	Roadway	$ 0
B	Property	$ 0
	Total	$ 0

9. Assessment of Level of Risk Low X
Moderate____
High________

For High Risk projects, during design phase, additional Design Study Risk Analysis May be necessary to determine design alternative.

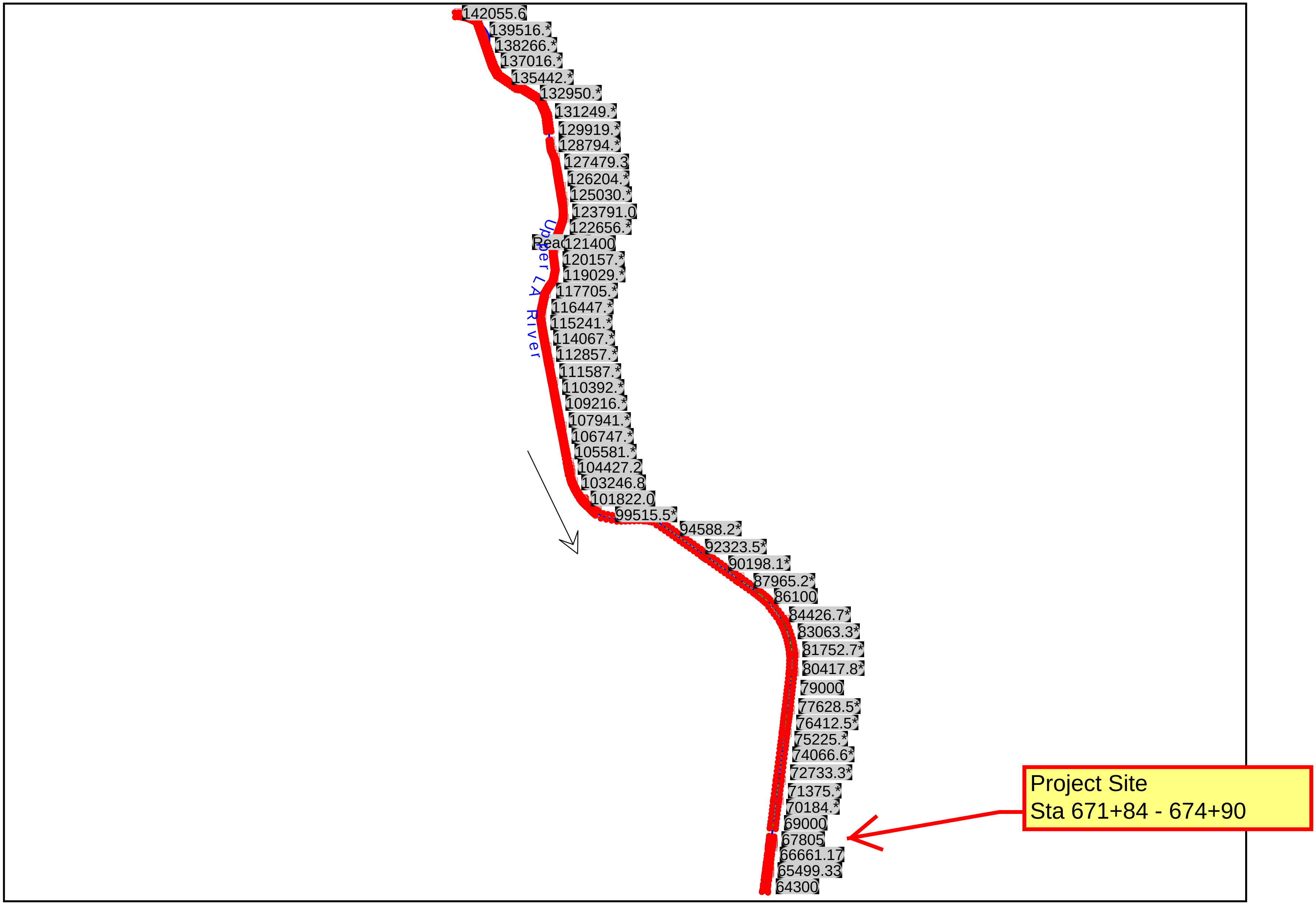
Signature –Hydraulic Engineer [signature] Date 10/29/17
(Item numbers 3,4,5,7,9)

Is there any longitudinal encroachment, significant encroachment, or any support of incompatible
Floodplain development? NO X YES________

If yes, provide evaluation and discussion of practicability of alternatives in accordance with 23 CFR 650.113

Information developed to comply with the Federal requirement for the Location Hydraulic Study shall be retained in the project files.

APPENDIX B HYDRAULIC ANALYSIS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90198.1*
87965.2*
86100
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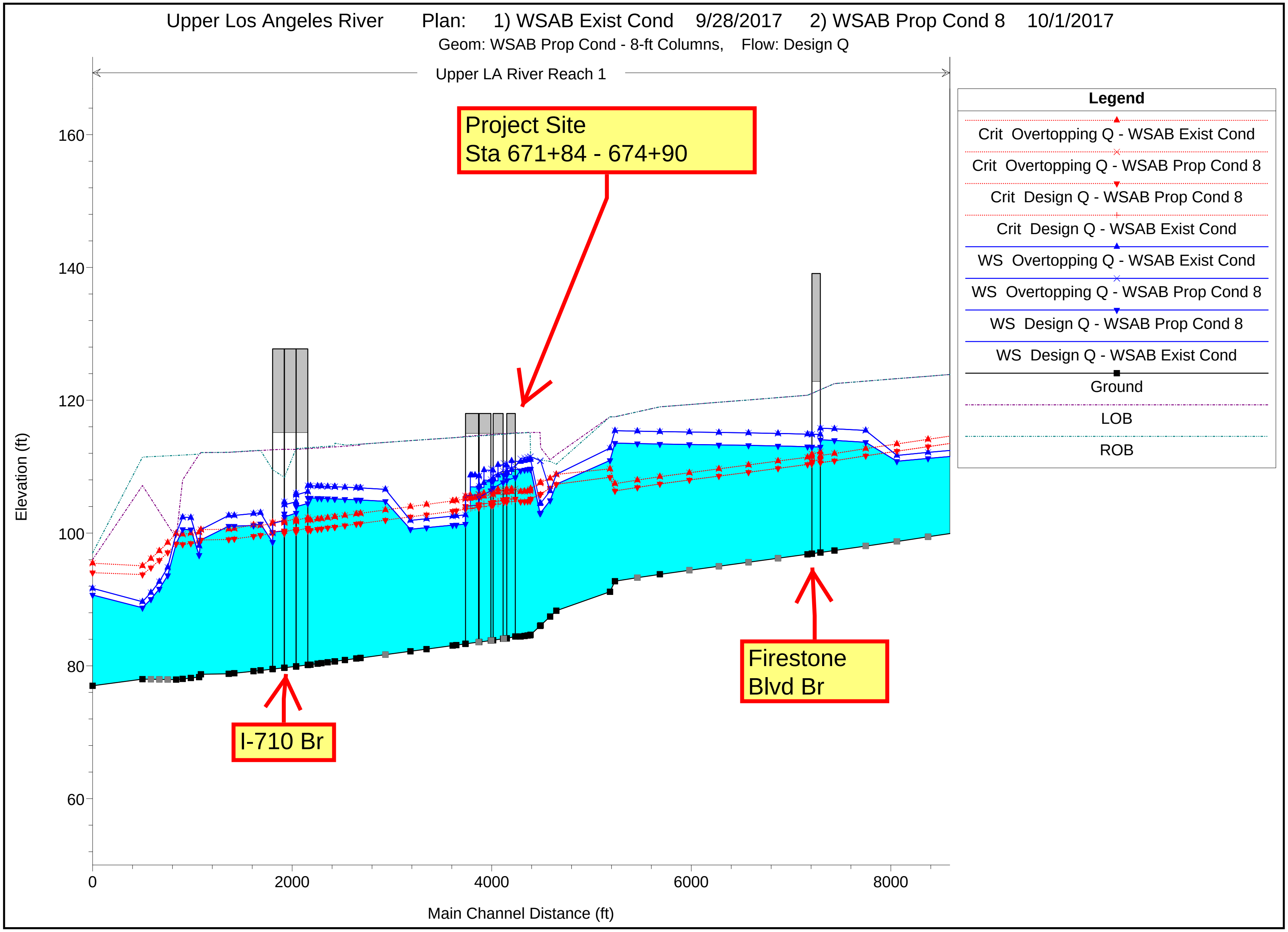
83063.3*
81752.7*
80417.8*
79000
77628.5*
76412.5*
75225.*
74066.6*
72733.3*
71375.*
70184.*
69000
67805
66661.17
65499.33
64300
Upper LA River
Project Site
Sta 671+84 - 674+90



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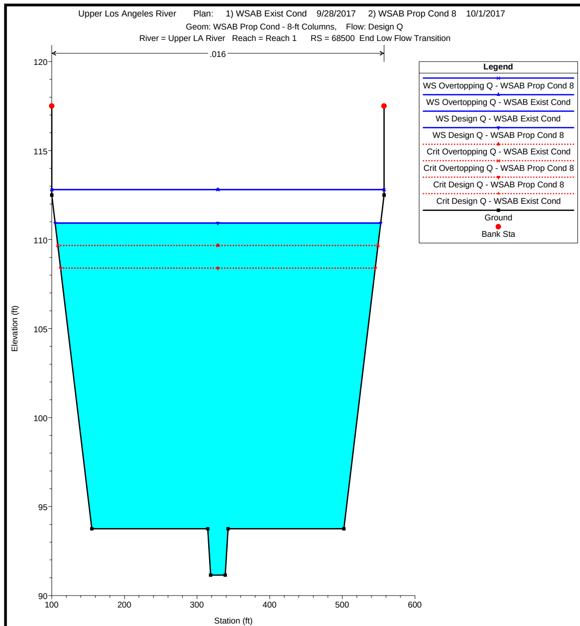
Geom: WSAB Prop Cond - 8-ft Columns, Flow: Design Q
Upper LA River Reach 1
Project Site
Sta 671+84 - 674+90
I-710 Br
Firestone
Blvd Br
Legend
Crit Overtopping Q - WSAB Exist Cond
Crit Overtopping Q - WSAB Prop Cond 8
Crit Design Q - WSAB Prop Cond 8
Crit Design Q - WSAB Exist Cond
WS Overtopping Q - WSAB Exist Cond
WS Overtopping Q - WSAB Prop Cond 8
WS Design Q - WSAB Prop Cond 8
WS Design Q - WSAB Exist Cond
Ground
LOB
ROB
Elevation (ft)
160
140
120
100
80
60
0
2000
4000
6000
8000
Main Channel Distance (ft)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River = Upper LA River Reach = Reach 1 RS = 68500 End Low Flow Transition
.016
Legend
WS Overtopping Q - WSAB Prop Cond 8
WS Overtopping Q - WSAB Exist Cond
WS Design Q - WSAB Exist Cond
WS Design Q - WSAB Prop Cond 8
Crit Overtopping Q - WSAB Exist Cond
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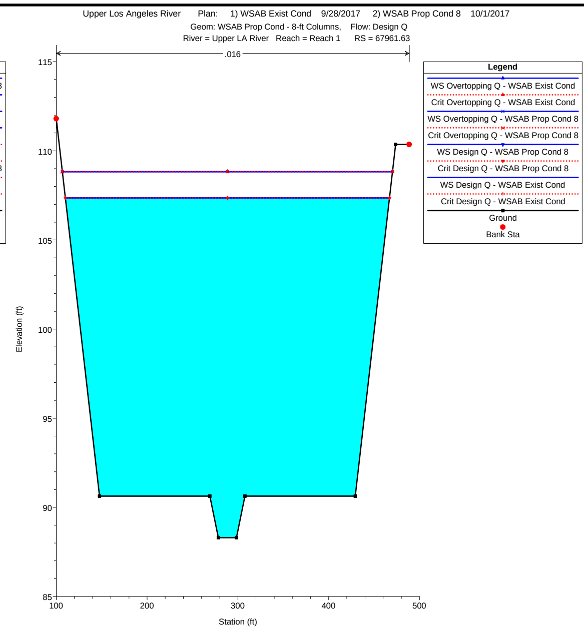
Crit Design Q - WSAB Prop Cond 8
Crit Design Q - WSAB Exist Cond
Ground
Bank Sta
Elevation (ft)
Station (ft)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.016
Legend
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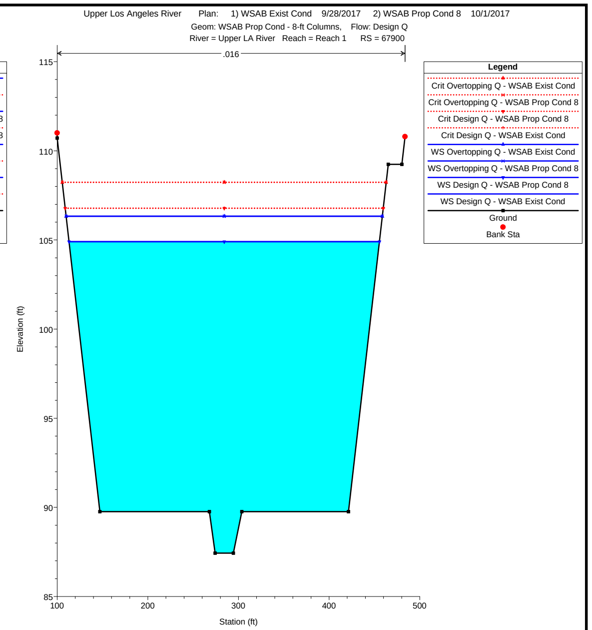
Crit Overtopping Q - WSAB Exist Cond
WS Overtopping Q - WSAB Prop Cond 8
Crit Overtopping Q - WSAB Prop Cond 8
WS Design Q - WSAB Prop Cond 8
Crit Design Q - WSAB Prop Cond 8
WS Design Q - WSAB Exist Cond
Crit Design Q - WSAB Exist Cond
Ground
Bank Sta
Elevation (ft)
Station (ft)


Upper Los Angeles River Plan: 1) WSAB Exist Cond 9/28/2017 2) WSAB Prop Cond 8 10/1/2017
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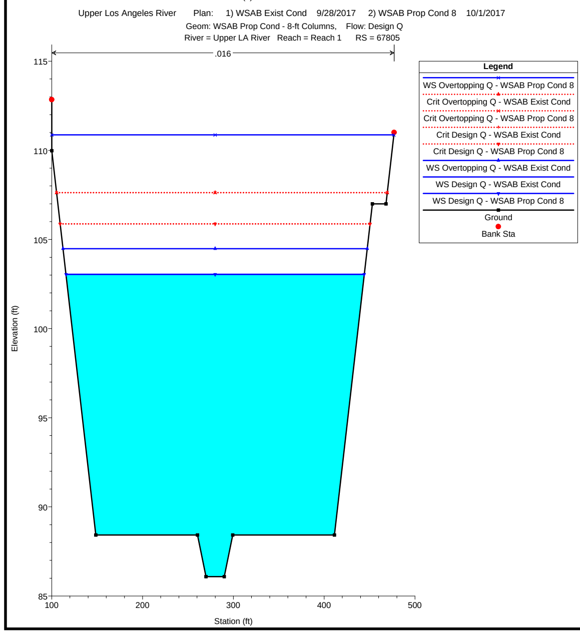
.016
Legend
Crit Overtopping Q - WSAB Exist Cond
Crit Overtopping Q - WSAB Prop Cond 8
Crit Design Q - WSAB Prop Cond 8
Crit Design Q - WSAB Exist Cond
WS Overtopping Q - WSAB Exist Cond
WS Overtopping Q - WSAB Prop Cond 8
WS Design Q - WSAB Prop Cond 8
WS Design Q - WSAB Exist Cond
Ground
Bank Sta
Elevation (ft)
Station (ft)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.016
Legend
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Crit Overtopping Q - WSAB Exist Cond
Crit Overtopping Q - WSAB Prop Cond 8
Crit Design Q - WSAB Exist Cond
Crit Design Q - WSAB Prop Cond 8
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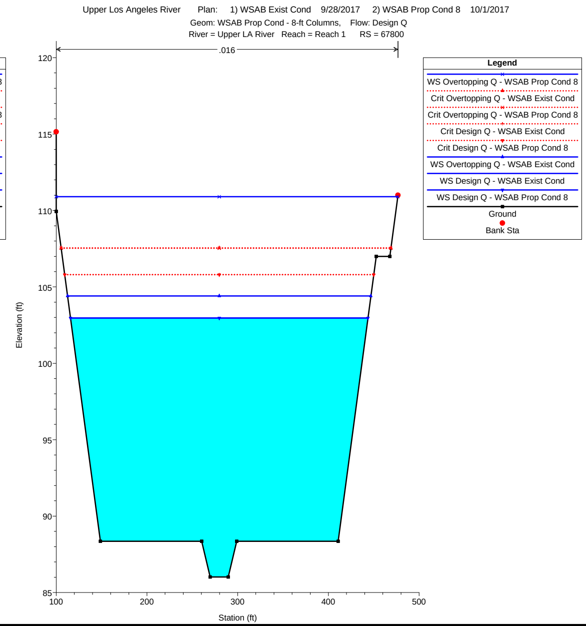
WS Design Q - WSAB Exist Cond
WS Design Q - WSAB Prop Cond 8
Ground
Bank Sta
Elevation (ft)
Station (ft)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.016
Legend
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Crit Overtopping Q - WSAB Prop Cond 8
Crit Design Q - WSAB Exist Cond
Crit Design Q - WSAB Prop Cond 8
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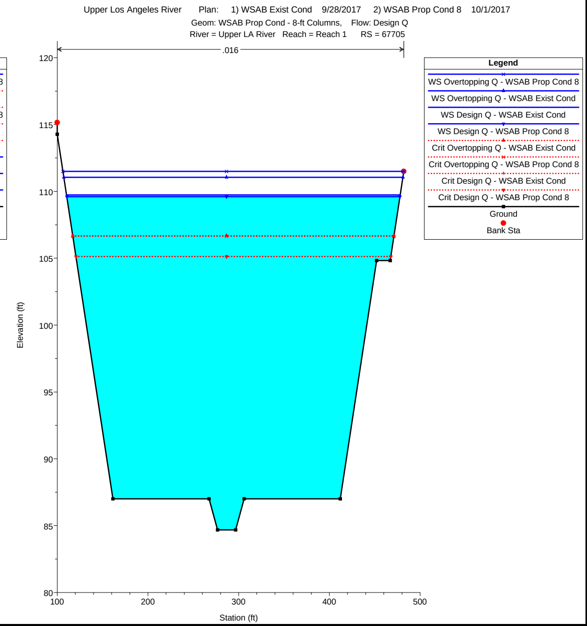
WS Design Q - WSAB Exist Cond
WS Design Q - WSAB Prop Cond 8
Ground
Bank Sta
Elevation (ft)
Station (ft)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.016
Legend
WS Overtopping Q - WSAB Prop Cond 8
WS Overtopping Q - WSAB Exist Cond
WS Design Q - WSAB Exist Cond
WS Design Q - WSAB Prop Cond 8
Crit Overtopping Q - WSAB Exist Cond
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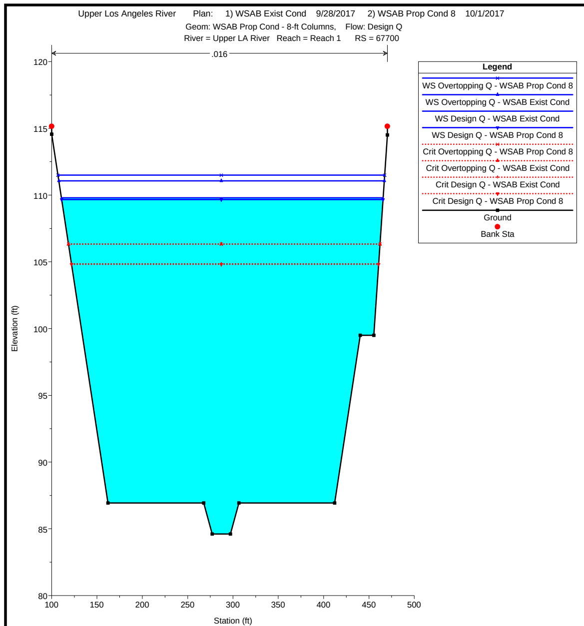
Crit Design Q - WSAB Exist Cond
Crit Design Q - WSAB Prop Cond 8
Ground
Bank Sta
Elevation (ft)
Station (ft)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.016
Legend
WS Overtopping Q - WSAB Prop Cond 8
WS Overtopping Q - WSAB Exist Cond
WS Design Q - WSAB Exist Cond
WS Design Q - WSAB Prop Cond 8
Crit Overtopping Q - WSAB Prop Cond 8
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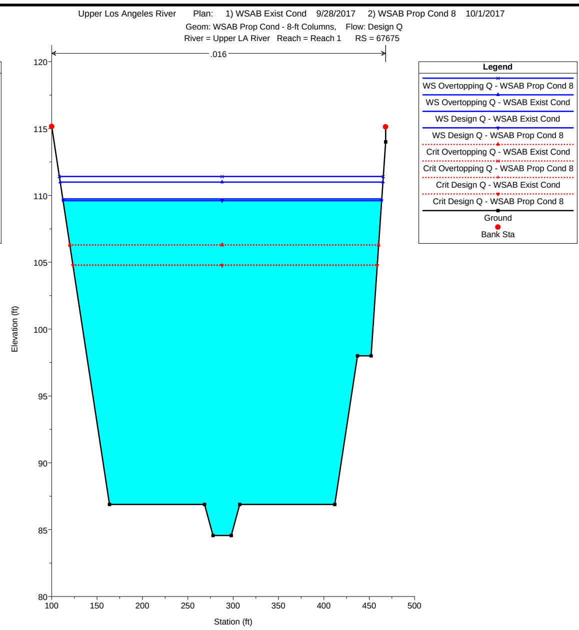
Crit Design Q - WSAB Exist Cond
Crit Design Q - WSAB Prop Cond 8
Ground
Bank Sta
Elevation (ft)
Station (ft)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.016
Legend
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WS Design Q - WSAB Prop Cond 8
Crit Overtopping Q - WSAB Exist Cond
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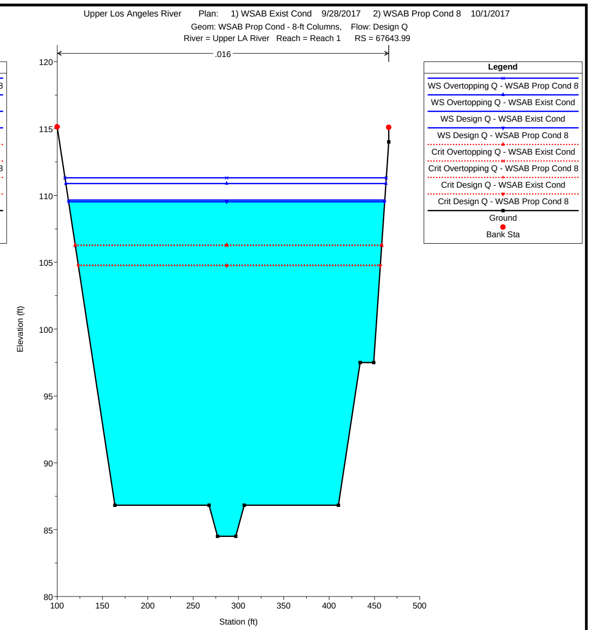
Crit Design Q - WSAB Exist Cond
Crit Design Q - WSAB Prop Cond 8
Ground
Bank Sta
Elevation (ft)
Station (ft)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.016
Legend
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WS Overtopping Q - WSAB Exist Cond
WS Design Q - WSAB Exist Cond
WS Design Q - WSAB Prop Cond 8
Crit Overtopping Q - WSAB Exist Cond
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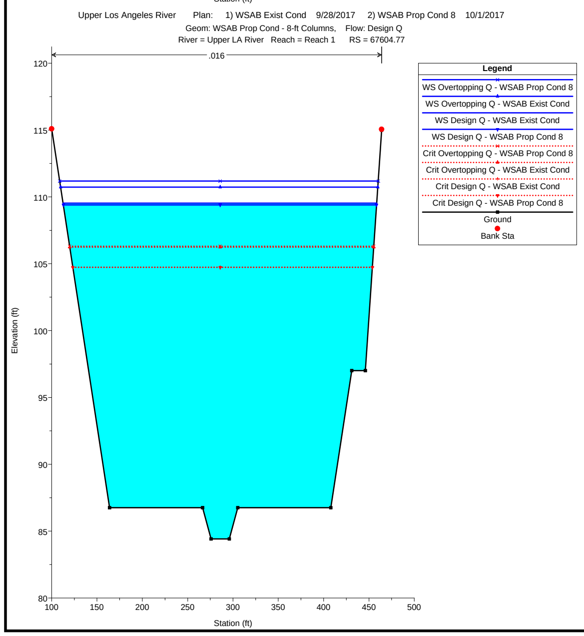
Crit Design Q - WSAB Prop Cond 8
Ground
Bank Sta
Elevation (ft)
Station (ft)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.016
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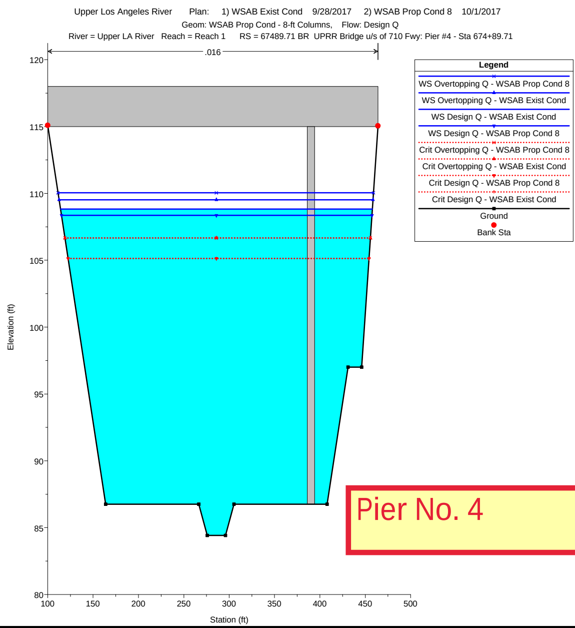
Crit Design Q - WSAB Prop Cond 8
Ground
Bank Sta
Elevation (ft)
Station (ft)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.016
Legend
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WS Overtopping Q - WSAB Exist Cond
WS Design Q - WSAB Exist Cond
WS Design Q - WSAB Prop Cond 8
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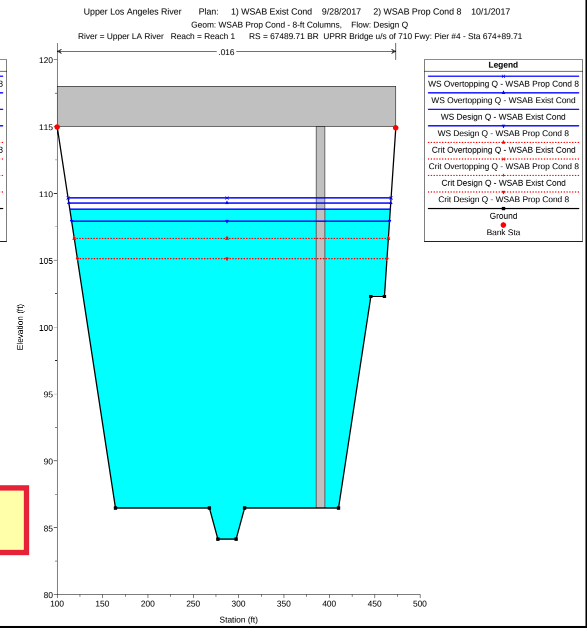
Crit Overtopping Q - WSAB Exist Cond
Crit Design Q - WSAB Prop Cond 8
Crit Design Q - WSAB Exist Cond
Ground
Bank Sta
Pier No. 4
Elevation (ft)
Station (ft)


Upper Los Angeles River Plan: 1) WSAB Exist Cond 9/28/2017 2) WSAB Prop Cond 8 10/1/2017
Geom: WSAB Prop Cond - 8-ft Columns, Flow: Design Q
River = Upper LA River Reach = Reach 1 RS = 67489.71 BR UPRR Bridge u/s of 710 Fwy: Pier #4 - Sta 674+89.71
.016
Legend
WS Overtopping Q - WSAB Prop Cond 8
WS Overtopping Q - WSAB Exist Cond
WS Design Q - WSAB Exist Cond
WS Design Q - WSAB Prop Cond 8
Crit Overtopping Q - WSAB Exist Cond
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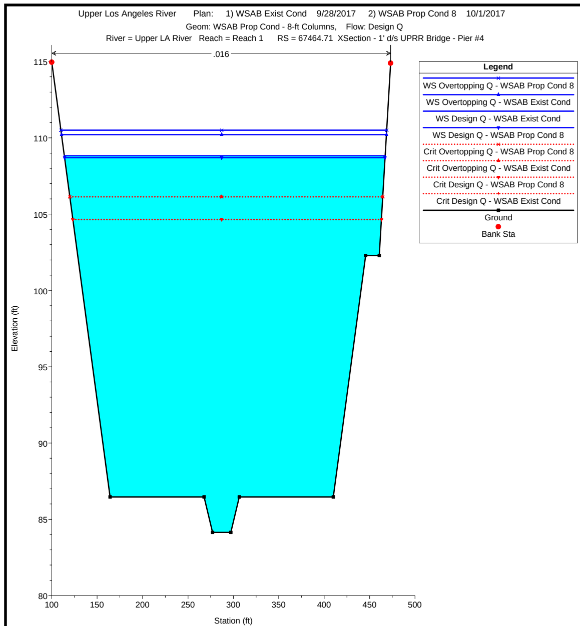
Crit Design Q - WSAB Exist Cond
Crit Design Q - WSAB Prop Cond 8
Ground
Bank Sta
Elevation (ft)
Station (ft)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.016
Legend
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WS Design Q - WSAB Prop Cond 8
Crit Overtopping Q - WSAB Prop Cond 8
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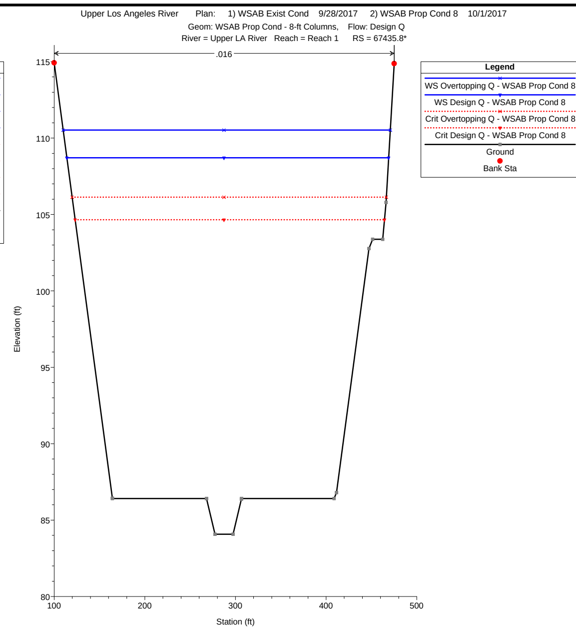
Crit Design Q - WSAB Prop Cond 8
Crit Design Q - WSAB Exist Cond
Ground
Bank Sta
Elevation (ft)
Station (ft)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.016
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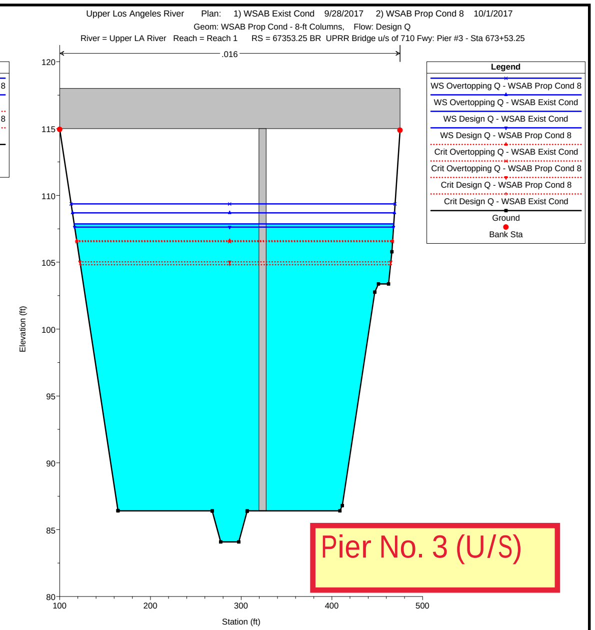
Crit Overtopping Q - WSAB Prop Cond 8
Crit Design Q - WSAB Prop Cond 8
Ground
Bank Sta
Elevation (ft)
Station (ft)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Legend
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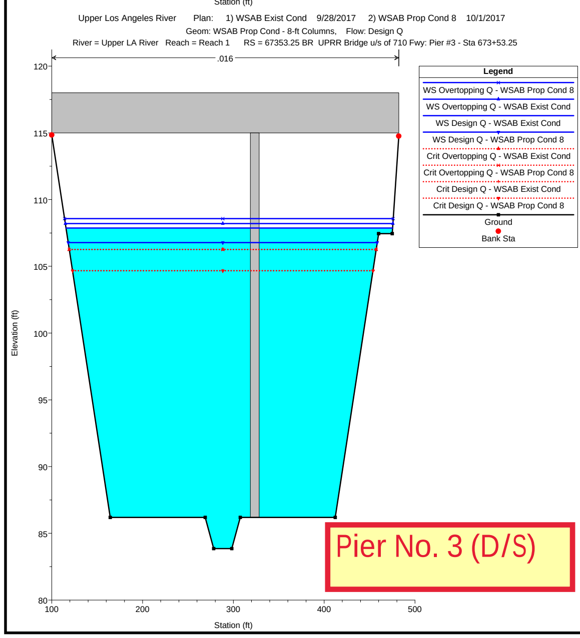
WS Overtopping Q - WSAB Exist Cond
WS Design Q - WSAB Exist Cond
WS Design Q - WSAB Prop Cond 8
Crit Overtopping Q - WSAB Exist Cond
Crit Overtopping Q - WSAB Prop Cond 8
Crit Design Q - WSAB Prop Cond 8
Crit Design Q - WSAB Exist Cond
Ground
Bank Sta
Pier No. 3 (U/S)
Elevation (ft)
Station (ft)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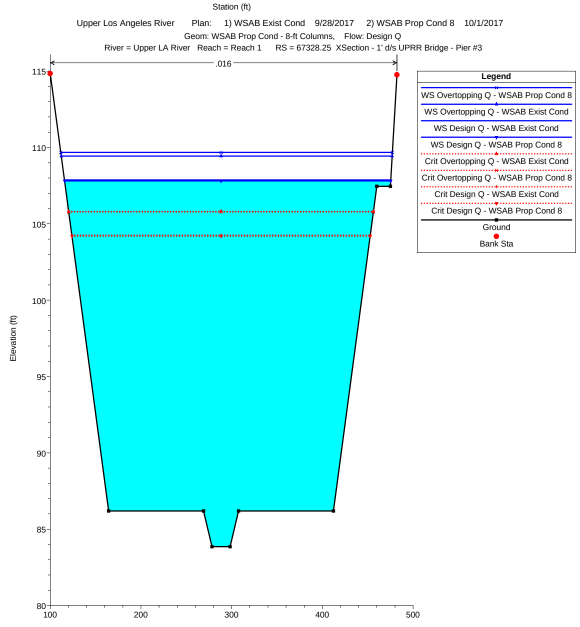
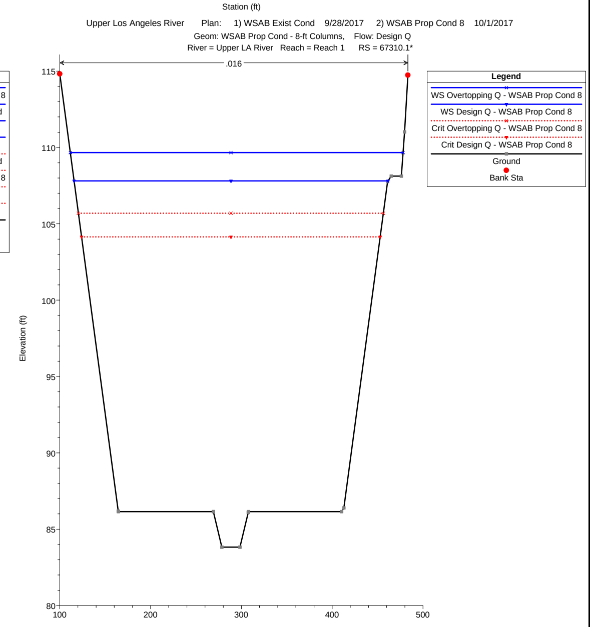
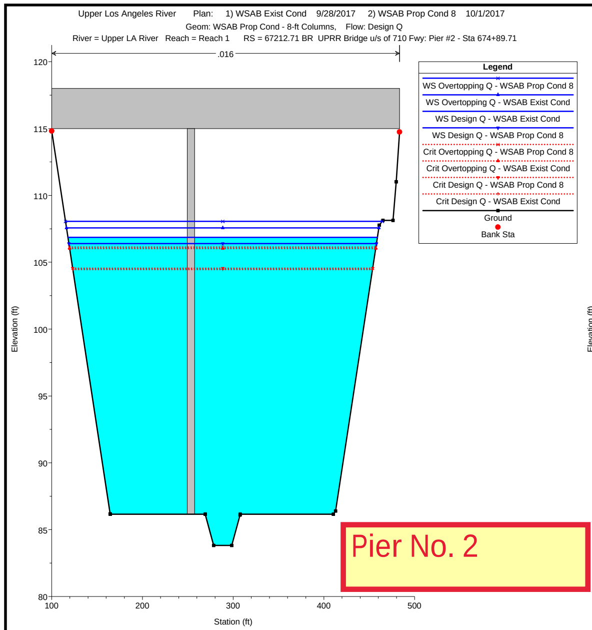
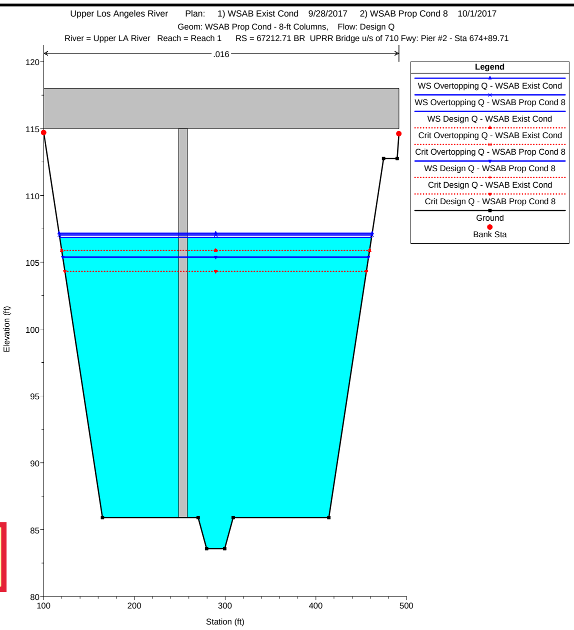
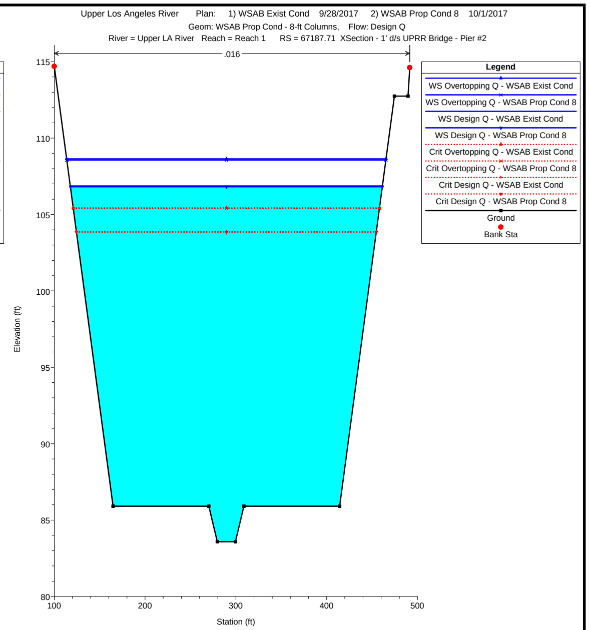
.016
Legend
WS Overtopping Q - WSAB Prop Cond 8
WS Overtopping Q - WSAB Exist Cond
WS Design Q - WSAB Exist Cond
WS Design Q - WSAB Prop Cond 8
Crit Overtopping Q - WSAB Exist Cond
Crit Overtopping Q - WSAB Prop Cond 8
Crit Design Q - WSAB Exist Cond
Crit Design Q - WSAB Prop Cond 8
Ground
Bank Sta
Pier No. 3 (D/S)
Elevation (ft)
Station (ft)

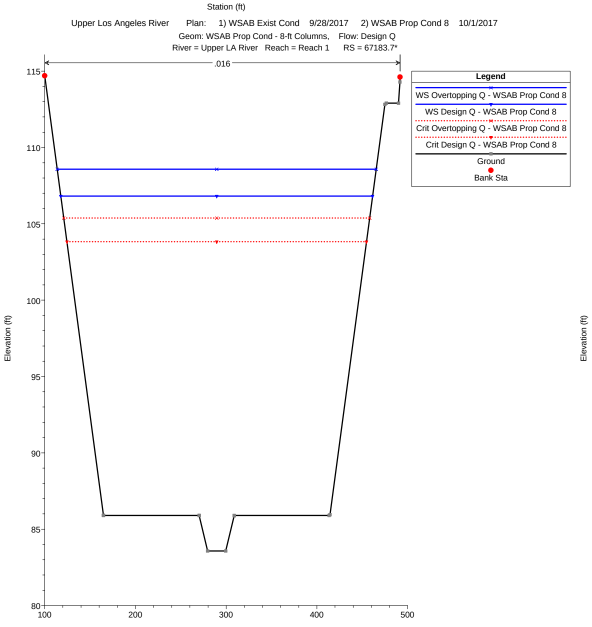

Upper Los Angeles River Plan: 1) WSAB Exist Cond 9/28/2017 2) WSAB Prop Cond 8 10/1/2017
Geom: WSAB Prop Cond - 8-ft Columns, Flow: Design Q
River = Upper LA River Reach = Reach 1 RS = 67328.25 XSection - 1' d/s UPRR Bridge - Pier #3
.016
Legend
WS Overtopping Q - WSAB Prop Cond 8
WS Overtopping Q - WSAB Exist Cond
WS Design Q - WSAB Exist Cond
WS Design Q - WSAB Prop Cond 8
Crit Overtopping Q - WSAB Exist Cond
Crit Overtopping Q - WSAB Prop Cond 8
Crit Design Q - WSAB Exist Cond
Crit Design Q - WSAB Prop Cond 8
Ground
Bank Sta
Elevation (ft)
Station (ft)

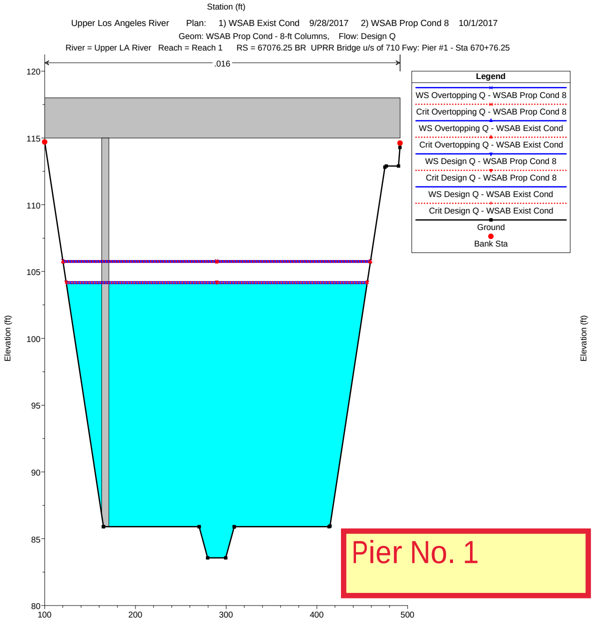

Upper Los Angeles River Plan: 1) WSAB Exist Cond 9/28/2017 2) WSAB Prop Cond 8 10/1/2017
Geom: WSAB Prop Cond - 8-ft Columns, Flow: Design Q
River = Upper LA River Reach = Reach 1 RS = 67310.1*
.016
Legend
WS Overtopping Q - WSAB Prop Cond 8
WS Design Q - WSAB Prop Cond 8
Crit Overtopping Q - WSAB Prop Cond 8
Crit Design Q - WSAB Prop Cond 8
Ground
Bank Sta
Elevation (ft)
Station (ft)

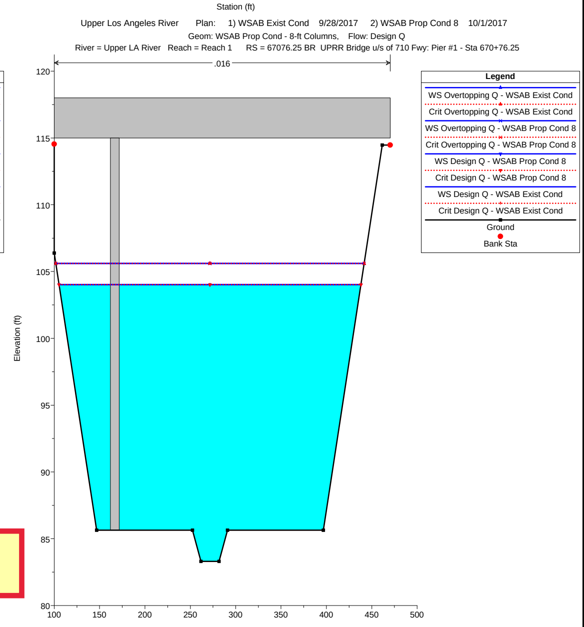

Upper Los Angeles River Plan: 1) WSAB Exist Cond 9/28/2017 2) WSAB Prop Cond 8 10/1/2017
Geom: WSAB Prop Cond - 8-ft Columns, Flow: Design Q
River = Upper LA River Reach = Reach 1 RS = 67212.71 BR UPRR Bridge u/s of 710 Fwy: Pier #2 - Sta 674+89.71
.016
Legend
WS Overtopping Q - WSAB Prop Cond 8
WS Overtopping Q - WSAB Exist Cond
WS Design Q - WSAB Exist Cond
WS Design Q - WSAB Prop Cond 8
Crit Overtopping Q - WSAB Prop Cond 8
Crit Overtopping Q - WSAB Exist Cond
Crit Design Q - WSAB Prop Cond 8
Crit Design Q - WSAB Exist Cond
Ground
Bank Sta
Elevation (ft)
Station (ft)
Pier No. 2

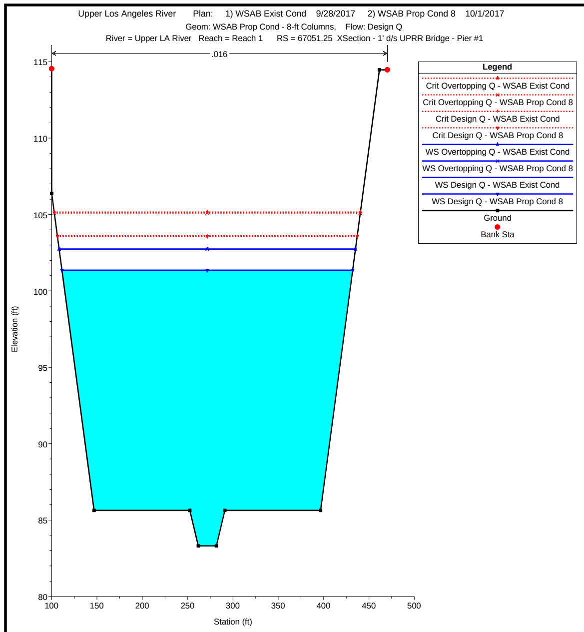

Upper Los Angeles River Plan: 1) WSAB Exist Cond 9/28/2017 2) WSAB Prop Cond 8 10/1/2017
Geom: WSAB Prop Cond - 8-ft Columns, Flow: Design Q
River = Upper LA River Reach = Reach 1 RS = 67212.71 BR UPRR Bridge u/s of 710 Fwy: Pier #2 - Sta 674+89.71
.016
Legend
WS Overtopping Q - WSAB Exist Cond
WS Overtopping Q - WSAB Prop Cond 8
WS Design Q - WSAB Exist Cond
Crit Overtopping Q - WSAB Exist Cond
Crit Overtopping Q - WSAB Prop Cond 8
WS Design Q - WSAB Prop Cond 8
Crit Design Q - WSAB Exist Cond
Crit Design Q - WSAB Prop Cond 8
Ground
Bank Sta
Elevation (ft)
Station (ft)

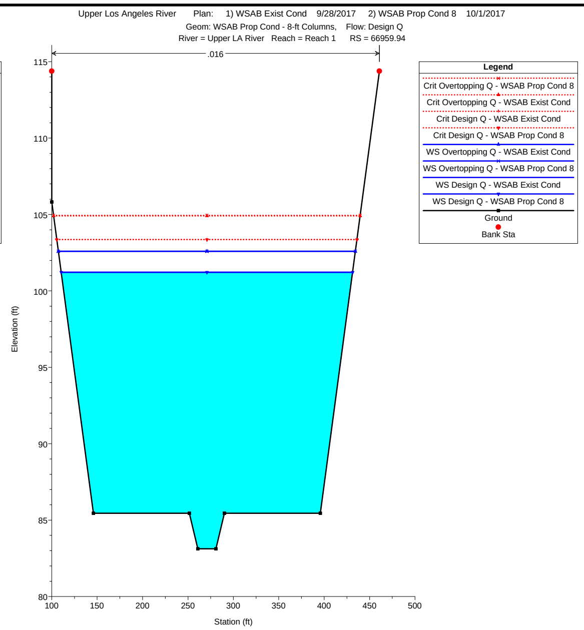

Upper Los Angeles River Plan: 1) WSAB Exist Cond 9/28/2017 2) WSAB Prop Cond 8 10/1/2017
Geom: WSAB Prop Cond - 8-ft Columns, Flow: Design Q
River = Upper LA River Reach = Reach 1 RS = 67187.71 XSection - 1' d/s UPRR Bridge - Pier #2
.016
Legend
WS Overtopping Q - WSAB Exist Cond
WS Overtopping Q - WSAB Prop Cond 8
WS Design Q - WSAB Exist Cond
WS Design Q - WSAB Prop Cond 8
Crit Overtopping Q - WSAB Exist Cond
Crit Overtopping Q - WSAB Prop Cond 8
Crit Design Q - WSAB Exist Cond
Crit Design Q - WSAB Prop Cond 8
Ground
Bank Sta
Elevation (ft)
Station (ft)


Upper Los Angeles River Plan: 1) WSAB Exist Cond 9/28/2017 2) WSAB Prop Cond 8 10/1/2017
Geom: WSAB Prop Cond - 8-ft Columns, Flow: Design Q
River = Upper LA River Reach = Reach 1 RS = 67183.7*
.016
Legend
WS Overtopping Q - WSAB Prop Cond 8
WS Design Q - WSAB Prop Cond 8
Crit Overtopping Q - WSAB Prop Cond 8
Crit Design Q - WSAB Prop Cond 8
Ground
Bank Sta
Elevation (ft)
Station (ft)


Upper Los Angeles River Plan: 1) WSAB Exist Cond 9/28/2017 2) WSAB Prop Cond 8 10/1/2017
Geom: WSAB Prop Cond - 8-ft Columns, Flow: Design Q
River = Upper LA River Reach = Reach 1 RS = 67076.25 BR UPRR Bridge u/s of 710 Fwy: Pier #1 - Sta 670+76.25
.016
Legend
WS Overtopping Q - WSAB Prop Cond 8
Crit Overtopping Q - WSAB Prop Cond 8
WS Overtopping Q - WSAB Exist Cond
Crit Overtopping Q - WSAB Exist Cond
WS Design Q - WSAB Prop Cond 8
Crit Design Q - WSAB Prop Cond 8
WS Design Q - WSAB Exist Cond
Crit Design Q - WSAB Exist Cond
Ground
Bank Sta
Elevation (ft)
Station (ft)
Pier No. 1


Upper Los Angeles River Plan: 1) WSAB Exist Cond 9/28/2017 2) WSAB Prop Cond 8 10/1/2017
Geom: WSAB Prop Cond - 8-ft Columns, Flow: Design Q
River = Upper LA River Reach = Reach 1 RS = 67076.25 BR UPRR Bridge u/s of 710 Fwy: Pier #1 - Sta 670+76.25
.016
Legend
WS Overtopping Q - WSAB Exist Cond
Crit Overtopping Q - WSAB Exist Cond
WS Overtopping Q - WSAB Prop Cond 8
Crit Overtopping Q - WSAB Prop Cond 8
WS Design Q - WSAB Prop Cond 8
Crit Design Q - WSAB Prop Cond 8
WS Design Q - WSAB Exist Cond
Crit Design Q - WSAB Exist Cond
Ground
Bank Sta
Elevation (ft)
Station (ft)


Upper Los Angeles River Plan: 1) WSAB Exist Cond 9/28/2017 2) WSAB Prop Cond 8 10/1/2017
Geom: WSAB Prop Cond - 8-ft Columns, Flow: Design Q
River = Upper LA River Reach = Reach 1 RS = 67051.25 XSection - 1' d/s UPRR Bridge - Pier #1
.016
Legend
Crit Overtopping Q - WSAB Exist Cond
Crit Overtopping Q - WSAB Prop Cond 8
Crit Design Q - WSAB Exist Cond
Crit Design Q - WSAB Prop Cond 8
WS Overtopping Q - WSAB Exist Cond
WS Overtopping Q - WSAB Prop Cond 8
WS Design Q - WSAB Exist Cond
WS Design Q - WSAB Prop Cond 8
Ground
Bank Sta
Elevation (ft)
Station (ft)


Upper Los Angeles River Plan: 1) WSAB Exist Cond 9/28/2017 2) WSAB Prop Cond 8 10/1/2017
Geom: WSAB Prop Cond - 8-ft Columns, Flow: Design Q
River = Upper LA River Reach = Reach 1 RS = 66959.94
.016
Legend
Crit Overtopping Q - WSAB Prop Cond 8
Crit Overtopping Q - WSAB Exist Cond
Crit Design Q - WSAB Exist Cond
Crit Design Q - WSAB Prop Cond 8
WS Overtopping Q - WSAB Exist Cond
WS Overtopping Q - WSAB Prop Cond 8
WS Design Q - WSAB Exist Cond
WS Design Q - WSAB Prop Cond 8
Ground
Bank Sta
Elevation (ft)
Station (ft)

HEC-RAS Output
Exist Condition vs. Proposed
(Some sections are omitted)

HEC-RAS River: Upper LA River Reach: Reach 1

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach 1	68500	Design Q	WSAB Exist Cond	120000.00	91.15	110.93	108.39	115.64	0.000938	17.41	6893.36	448.16	0.78
Reach 1	68500	Design Q	WSAB Prop Cond 8	120000.00	91.15	110.93	108.39	115.64	0.000938	17.41	6893.36	448.16	0.78
Reach 1	68500	Overtopping Q	WSAB Exist Cond	136600.00	91.15	112.80	109.67	117.64	0.000851	17.64	7741.72	457.40	0.76
Reach 1	68500	Overtopping Q	WSAB Prop Cond 8	136600.00	91.15	112.80	109.67	117.64	0.000851	17.64	7741.73	457.40	0.76
Reach 1	67961.63	Design Q	WSAB Exist Cond	120000.00	88.30	107.35	107.35	115.00	0.001566	22.19	5408.60	356.98	1.00
Reach 1	67961.63	Design Q	WSAB Prop Cond 8	120000.00	88.30	107.35	107.35	115.00	0.001566	22.19	5408.61	356.98	1.00
Reach 1	67961.63	Overtopping Q	WSAB Exist Cond	136600.00	88.30	108.83	108.83	117.04	0.001523	22.99	5941.82	363.64	1.00
Reach 1	67961.63	Overtopping Q	WSAB Prop Cond 8	136600.00	88.30	108.83	108.83	117.04	0.001523	22.99	5941.79	363.64	1.00
Reach 1	67900	Design Q	WSAB Exist Cond	120000.00	87.43	104.90	106.78	114.88	0.002308	25.35	4733.85	342.41	1.20
Reach 1	67900	Design Q	WSAB Prop Cond 8	120000.00	87.43	104.90	106.78	114.88	0.002308	25.35	4733.85	342.41	1.20
Reach 1	67900	Overtopping Q	WSAB Exist Cond	136600.00	87.43	106.34	108.24	116.93	0.002205	26.12	5228.91	348.86	1.19
Reach 1	67900	Overtopping Q	WSAB Prop Cond 8	136600.00	87.43	106.34	108.24	116.93	0.002205	26.12	5228.91	348.86	1.19
Reach 1	67805	Design Q	WSAB Exist Cond	120000.00	86.09	103.04	105.87	114.64	0.002804	27.33	4391.48	328.54	1.32
Reach 1	67805	Design Q	WSAB Prop Cond 8	120000.00	86.09	103.04	105.87	114.64	0.002804	27.33	4391.48	328.54	1.32
Reach 1	67805	Overtopping Q	WSAB Exist Cond	136600.00	86.09	104.48	107.63	116.70	0.002648	28.05	4869.70	335.02	1.30
Reach 1	67805	Overtopping Q	WSAB Prop Cond 8	136600.00	86.09	110.87	107.63	116.53	0.000865	19.08	7158.62	376.76	0.77
Reach 1	67800	Design Q	WSAB Exist Cond	120000.00	86.02	102.96	105.80	114.63	0.002826	27.41	4378.10	327.87	1.32
Reach 1	67800	Design Q	WSAB Prop Cond 8	120000.00	86.02	102.96	105.80	114.63	0.002826	27.41	4378.10	327.87	1.32
Reach 1	67800	Overtopping Q	WSAB Exist Cond	136600.00	86.02	104.40	107.55	116.69	0.002666	28.13	4855.69	334.36	1.30
Reach 1	67800	Overtopping Q	WSAB Prop Cond 8	136600.00	86.02	110.91	107.53	116.52	0.000854	19.02	7183.15	376.46	0.77
Reach 1	67705	Design Q	WSAB Exist Cond	120000.00	84.68	109.74	105.13	114.30	0.000695	17.14	7001.07	367.90	0.69
Reach 1	67705	Design Q	WSAB Prop Cond 8	120000.00	84.68	109.60	105.13	114.23	0.000711	17.26	6950.97	367.29	0.70
Reach 1	67705	Overtopping Q	WSAB Exist Cond	136600.00	84.68	111.06	106.68	116.22	0.000736	18.24	7489.94	373.83	0.72
Reach 1	67705	Overtopping Q	WSAB Prop Cond 8	136600.00	84.68	111.50	106.64	116.44	0.000689	17.84	7655.57	375.82	0.70
Reach 1	67700	Design Q	WSAB Exist Cond	120000.00	84.61	109.79	104.86	114.30	0.000655	17.03	7045.01	354.97	0.67
Reach 1	67700	Design Q	WSAB Prop Cond 8	120000.00	84.61	109.66	104.81	114.23	0.000669	17.15	6998.92	354.55	0.68
Reach 1	67700	Overtopping Q	WSAB Exist Cond	136600.00	84.61	111.07	106.32	116.22	0.000701	18.21	7500.59	359.12	0.70
Reach 1	67700	Overtopping Q	WSAB Prop Cond 8	136600.00	84.61	111.49	106.34	116.44	0.000660	17.85	7653.39	360.50	0.68
Reach 1	67675	Design Q	WSAB Exist Cond	120000.00	84.56	109.74	104.80	114.29	0.000659	17.12	7009.45	351.63	0.68
Reach 1	67675	Design Q	WSAB Prop Cond 8	120000.00	84.56	109.60	104.77	114.22	0.000672	17.23	6963.58	351.21	0.68
Reach 1	67675	Overtopping Q	WSAB Exist Cond	136600.00	84.56	110.99	106.30	116.21	0.000708	18.33	7453.35	355.71	0.71
Reach 1	67675	Overtopping Q	WSAB Prop Cond 8	136600.00	84.56	111.42	106.28	116.43	0.000666	17.96	7606.17	357.10	0.69
Reach 1	67643.99	Design Q	WSAB Exist Cond	120000.00	84.50	109.65	104.79	114.27	0.000670	17.25	6957.39	349.11	0.68
Reach 1	67643.99	Design Q	WSAB Prop Cond 8	120000.00	84.50	109.52	104.75	114.20	0.000683	17.36	6911.17	348.68	0.69
Reach 1	67643.99	Overtopping Q	WSAB Exist Cond	136600.00	84.50	110.88	106.29	116.19	0.000722	18.48	7390.53	353.12	0.71
Reach 1	67643.99	Overtopping Q	WSAB Prop Cond 8	136600.00	84.50	111.32	106.26	116.41	0.000678	18.10	7546.17	354.55	0.69
Reach 1	67604.77	Design Q	WSAB Exist Cond	120000.00	84.42	109.54	104.74	114.25	0.000683	17.41	6892.27	346.11	0.69
Reach 1	67604.77	Design Q	WSAB Prop Cond 8	120000.00	84.42	109.40	104.73	114.18	0.000698	17.53	6845.55	345.67	0.69

HEC-RAS River: Upper LA River Reach: Reach 1 (Continued)

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach 1	67604.77	Overtopping Q	WSAB Exist Cond	136600.00	84.42	110.73	106.24	116.16	0.000741	18.69	7308.40	349.99	0.72
Reach 1	67604.77	Overtopping Q	WSAB Prop Cond 8	136600.00	84.42	111.19	106.31	116.38	0.000694	18.29	7467.63	351.47	0.70
Reach 1	67514.71	Design Q	WSAB Exist Cond	120000.00	84.24	109.63	104.71	114.18	0.000660	17.12	7009.00	352.58	0.68
Reach 1	67514.71	Overtopping Q	WSAB Exist Cond	136600.00	84.24	110.87	106.21	116.09	0.000712	18.34	7446.75	356.59	0.71
Reach 1	67489.71			Bridge		Pier No. 4							
Reach 1	67464.71	Design Q	WSAB Exist Cond	120000.00	84.14	108.83	104.65	113.71	0.000744	17.74	6763.94	353.42	0.71
Reach 1	67464.71	Design Q	WSAB Prop Cond 8	120000.00	84.14	108.70	104.66	113.65	0.000759	17.86	6720.30	353.02	0.72
Reach 1	67464.71	Overtopping Q	WSAB Exist Cond	136600.00	84.14	110.21	106.14	115.71	0.000778	18.83	7255.46	357.91	0.74
Reach 1	67464.71	Overtopping Q	WSAB Prop Cond 8	136600.00	84.14	110.50	106.14	115.85	0.000744	18.56	7360.18	358.86	0.72
Reach 1	67435.8*	Design Q	WSAB Prop Cond 8	120000.00	84.08	108.72	104.66	113.63	0.000753	17.79	6744.45	355.05	0.72
Reach 1	67435.8*	Overtopping Q	WSAB Prop Cond 8	136600.00	84.08	110.53	106.13	115.83	0.000738	18.48	7391.90	360.93	0.72
Reach 1	67378.25	Design Q	WSAB Exist Cond	120000.00	83.96	108.86	104.36	113.65	0.000733	17.56	6834.55	359.50	0.71
Reach 1	67378.25	Overtopping Q	WSAB Exist Cond	136600.00	83.96	110.28	106.13	115.65	0.000761	18.60	7345.80	364.09	0.73
Reach 1	67353.25			Bridge		Pier No. 3							
Reach 1	67328.25	Design Q	WSAB Exist Cond	120000.00	83.86	107.87	104.26	113.16	0.000863	18.45	6502.39	359.72	0.76
Reach 1	67328.25	Design Q	WSAB Prop Cond 8	120000.00	83.86	107.81	104.19	113.13	0.000872	18.52	6480.89	359.52	0.77
Reach 1	67328.25	Overtopping Q	WSAB Exist Cond	136600.00	83.86	109.44	105.81	115.23	0.000864	19.32	7070.34	364.81	0.77
Reach 1	67328.25	Overtopping Q	WSAB Prop Cond 8	136600.00	83.86	109.67	105.77	115.33	0.000833	19.09	7155.62	365.57	0.76
Reach 1	67310.1*	Design Q	WSAB Prop Cond 8	120000.00	83.82	107.81	104.15	113.11	0.000823	18.48	6494.22	345.75	0.75
Reach 1	67310.1*	Overtopping Q	WSAB Prop Cond 8	136600.00	83.82	109.66	105.69	115.31	0.000833	19.07	7161.67	366.44	0.76
Reach 1	67237.71	Design Q	WSAB Exist Cond	120000.00	83.68	107.99	103.98	113.08	0.000776	18.11	6624.70	347.76	0.73
Reach 1	67237.71	Overtopping Q	WSAB Exist Cond	136600.00	83.68	109.50	105.54	115.16	0.000800	19.09	7154.87	354.55	0.75
Reach 1	67212.71			Bridge			Pier No. 2						
Reach 1	67187.71	Design Q	WSAB Exist Cond	120000.00	83.58	106.86	103.88	112.53	0.000910	19.09	6284.40	343.79	0.79
Reach 1	67187.71	Design Q	WSAB Prop Cond 8	120000.00	83.58	106.82	103.84	112.51	0.000918	19.15	6267.46	343.57	0.79
Reach 1	67187.71	Overtopping Q	WSAB Exist Cond	136600.00	83.58	108.64	105.44	114.72	0.000892	19.80	6900.17	351.76	0.79
Reach 1	67187.71	Overtopping Q	WSAB Prop Cond 8	136600.00	83.58	108.57	105.39	114.70	0.000901	19.86	6877.35	351.47	0.79
Reach 1	67183.7*	Design Q	WSAB Prop Cond 8	120000.00	83.57	106.82	103.83	112.50	0.000915	19.13	6273.68	343.68	0.79
Reach 1	67183.7*	Overtopping Q	WSAB Prop Cond 8	136600.00	83.57	108.58	105.38	114.69	0.000899	19.84	6883.88	351.58	0.79
Reach 1	67147.91	Design Q	WSAB Exist Cond	120000.00	83.50	106.95	103.81	112.49	0.000883	18.90	6350.48	345.03	0.78
Reach 1	67147.91	Overtopping Q	WSAB Exist Cond	136600.00	83.50	108.72	105.35	114.69	0.000867	19.60	6970.34	353.02	0.78
Reach 1	67116.15	Design Q	WSAB Exist Cond	120000.00	83.44	106.95	103.74	112.46	0.000873	18.83	6373.65	344.94	0.77
Reach 1	67116.15	Overtopping Q	WSAB Exist Cond	136600.00	83.44	108.71	105.29	114.65	0.000853	19.56	6983.71	348.90	0.77

HEC-RAS River: Upper LA River Reach: Reach 1 (Continued)

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach 1	67101.25	Design Q	WSAB Exist Cond	120000.00	83.41	106.95	103.65	112.44	0.000868	18.80	6383.78	344.88	0.77
Reach 1	67101.25	Overtopping Q	WSAB Exist Cond	136600.00	83.41	108.71	105.20	114.63	0.000849	19.53	6993.71	348.84	0.77
Reach 1	67076.25			Bridge		Pier No. 1							
Reach 1	67051.25	Design Q	WSAB Exist Cond	120000.00	83.31	101.35	103.61	112.14	0.002416	26.36	4551.84	320.72	1.23
Reach 1	67051.25	Design Q	WSAB Prop Cond 8	120000.00	83.31	101.35	103.56	112.14	0.002416	26.36	4551.59	320.72	1.23
Reach 1	67051.25	Overtopping Q	WSAB Exist Cond	136600.00	83.31	102.73	105.16	114.33	0.002353	27.32	4999.70	326.95	1.23
Reach 1	67051.25	Overtopping Q	WSAB Prop Cond 8	136600.00	83.31	102.73	105.10	114.33	0.002354	27.32	4999.40	326.94	1.23
Reach 1	66959.94	Design Q	WSAB Exist Cond	120000.00	83.12	101.22	103.36	111.93	0.002387	26.26	4570.06	320.96	1.23
Reach 1	66959.94	Design Q	WSAB Prop Cond 8	120000.00	83.12	101.22	103.36	111.93	0.002387	26.26	4569.83	320.95	1.23
Reach 1	66959.94	Overtopping Q	WSAB Exist Cond	136600.00	83.12	102.59	104.91	114.11	0.002332	27.24	5014.89	327.13	1.23
Reach 1	66959.94	Overtopping Q	WSAB Prop Cond 8	136600.00	83.12	102.59	104.94	114.11	0.002332	27.24	5014.60	327.13	1.23

HEC-RAS Output
Bridge Six Sections

HEC-RAS River: Upper LA River Reach: Reach 1

Reach	River Sta	Profile	Plan	E.G. Elev	W.S. Elev	Crit W.S.	Frctn Loss	C & E Loss	Top Width	Q Left	Q Channel	Q Right	Vel Chnl
				(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)
Reach 1	67604.77	Design Q	WSAB Exist Cond	114.25	109.54	104.74	0.06	0.00	346.11		120000.00		17.41
Reach 1	67604.77	Design Q	WSAB Prop Cond 8	114.18	109.40	104.73			345.67		120000.00		17.53
Reach 1	67604.77	Overtopping Q	WSAB Exist Cond	116.16	110.73	106.24	0.07	0.00	349.99		136600.00		18.69
Reach 1	67604.77	Overtopping Q	WSAB Prop Cond 8	116.38	111.19	106.31			351.47		136600.00		18.29
Reach 1	67514.71	Design Q	WSAB Exist Cond	114.18	109.63	104.71			352.58		120000.00		17.12
Reach 1	67514.71	Overtopping Q	WSAB Exist Cond	116.09	110.87	106.21			356.59		136600.00		18.34
Reach 1	67489.71BR U	Design Q	WSAB Exist Cond	114.10	108.83	105.13			340.26		120000.00		18.43
Reach 1	67489.71BR U	Design Q	WSAB Prop Cond 8	113.97	108.36	105.13			334.27		120000.00		19.01
Reach 1	67489.71BR U	Overtopping Q	WSAB Exist Cond	115.88	109.52	106.66			342.50		136600.00		20.25
Reach 1	67489.71BR U	Overtopping Q	WSAB Prop Cond 8	116.17	110.05	106.67			339.78		136600.00		19.84
							Pier No. 4						
Reach 1	67489.71BR D	Design Q	WSAB Exist Cond	114.04	108.83	105.12			343.72		120000.00		18.33
Reach 1	67489.71BR D	Design Q	WSAB Prop Cond 8	113.67	107.92	105.12			340.78		120000.00		19.24
Reach 1	67489.71BR D	Overtopping Q	WSAB Exist Cond	115.73	109.29	106.63			345.21		136600.00		20.37
Reach 1	67489.71BR D	Overtopping Q	WSAB Prop Cond 8	115.87	109.67	106.63			346.45		136600.00		19.98
Reach 1	67464.71	Design Q	WSAB Exist Cond	113.71	108.83	104.65	0.06	0.00	353.42		120000.00		17.74
Reach 1	67464.71	Design Q	WSAB Prop Cond 8	113.65	108.70	104.66	0.02	0.00	353.02		120000.00		17.86
Reach 1	67464.71	Overtopping Q	WSAB Exist Cond	115.71	110.21	106.14	0.07	0.00	357.91		136600.00		18.83
Reach 1	67464.71	Overtopping Q	WSAB Prop Cond 8	115.85	110.50	106.14	0.02	0.00	358.86		136600.00		18.56
Reach 1	67435.8*	Design Q	WSAB Prop Cond 8	113.63	108.72	104.66			355.05		120000.00		17.79
Reach 1	67435.8*	Overtopping Q	WSAB Prop Cond 8	115.83	110.53	106.13			360.93		136600.00		18.48
Reach 1	67378.25	Design Q	WSAB Exist Cond	113.65	108.86	104.36			359.50		120000.00		17.56
Reach 1	67378.25	Overtopping Q	WSAB Exist Cond	115.65	110.28	106.13			364.09		136600.00		18.60
Reach 1	67353.25BR U	Design Q	WSAB Exist Cond	113.56	107.87	104.81			346.58		120000.00		19.14
Reach 1	67353.25BR U	Design Q	WSAB Prop Cond 8	113.46	107.62	105.03			343.50		120000.00		19.39
Reach 1	67353.25BR U	Overtopping Q	WSAB Exist Cond	115.43	108.70	106.61			349.25		136600.00		20.83
Reach 1	67353.25BR U	Overtopping Q	WSAB Prop Cond 8	115.65	109.37	106.54			349.16		136600.00		20.11
							Pier No. 3						
Reach 1	67353.25BR D	Design Q	WSAB Exist Cond	113.52	107.87	104.67			350.02		120000.00		19.07
Reach 1	67353.25BR D	Design Q	WSAB Prop Cond 8	113.15	106.78	104.67			330.62		120000.00		20.26
Reach 1	67353.25BR D	Overtopping Q	WSAB Exist Cond	115.26	108.20	106.26			351.09		136600.00		21.32
Reach 1	67353.25BR D	Overtopping Q	WSAB Prop Cond 8	115.35	108.58	106.26			352.31		136600.00		20.89
Reach 1	67328.25	Design Q	WSAB Exist Cond	113.16	107.87	104.26	0.07	0.00	359.72		120000.00		18.45
Reach 1	67328.25	Design Q	WSAB Prop Cond 8	113.13	107.81	104.19	0.02	0.00	359.52		120000.00		18.52
Reach 1	67328.25	Overtopping Q	WSAB Exist Cond	115.23	109.44	105.81	0.08	0.00	364.81		136600.00		19.32
Reach 1	67328.25	Overtopping Q	WSAB Prop Cond 8	115.33	109.67	105.77	0.02	0.00	365.57		136600.00		19.09
Reach 1	67310.1*	Design Q	WSAB Prop Cond 8	113.11	107.81	104.15			345.75		120000.00		18.48

HEC-RAS   River: Upper LA River   Reach: Reach 1 (Continued)

Reach	River Sta	Profile	Plan	E.G. Elev	W.S. Elev	Crit W.S.	Frctn Loss	C & E Loss	Top Width	Q Left	Q Channel	Q Right	Vel Chnl
				(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)
Reach 1	67310.1*	Overtopping Q	WSAB Prop Cond 8	115.31	109.66	105.69			366.44		136600.00		19.07
Reach 1	67237.71	Design Q	WSAB Exist Cond	113.08	107.99	103.98			347.76		120000.00		18.11
Reach 1	67237.71	Overtopping Q	WSAB Exist Cond	115.16	109.50	105.54			354.55		136600.00		19.09
Reach 1	67212.71BR U	Design Q	WSAB Exist Cond	113.00	106.86	104.45			333.00		120000.00		19.89
Reach 1	67212.71BR U	Design Q	WSAB Prop Cond 8	112.93	106.39	104.55			330.99		120000.00		20.52
Reach 1	67212.71BR U	Overtopping Q	WSAB Exist Cond	114.94	107.57	106.02			336.17		136600.00		21.78
Reach 1	67212.71BR U	Overtopping Q	WSAB Prop Cond 8	115.12	108.06	106.13			341.12		136600.00		21.32
							Pier No. 2						
Reach 1	67212.71BR D	Design Q	WSAB Exist Cond	112.91	106.86	104.32			334.09		120000.00		19.73
Reach 1	67212.71BR D	Design Q	WSAB Prop Cond 8	112.54	105.39	104.32			327.43		120000.00		21.46
Reach 1	67212.71BR D	Overtopping Q	WSAB Exist Cond	114.75	107.17	105.88			335.48		136600.00		22.09
Reach 1	67212.71BR D	Overtopping Q	WSAB Prop Cond 8	114.73	107.04	105.88			334.89		136600.00		22.25
Reach 1	67187.71	Design Q	WSAB Exist Cond	112.53	106.86	103.88	0.04	0.00	343.79		120000.00		19.09
Reach 1	67187.71	Design Q	WSAB Prop Cond 8	112.51	106.82	103.84	0.00	0.00	343.57		120000.00		19.15
Reach 1	67187.71	Overtopping Q	WSAB Exist Cond	114.72	108.64	105.44	0.04	0.00	351.76		136600.00		19.80
Reach 1	67187.71	Overtopping Q	WSAB Prop Cond 8	114.70	108.57	105.39	0.00	0.00	351.47		136600.00		19.86
Reach 1	67183.7*	Design Q	WSAB Prop Cond 8	112.50	106.82	103.83			343.68		120000.00		19.13
Reach 1	67183.7*	Overtopping Q	WSAB Prop Cond 8	114.69	108.58	105.38			351.58		136600.00		19.84
Reach 1	67116.15	Design Q	WSAB Exist Cond	112.46	106.95	103.74	0.01	0.00	344.94		120000.00		18.83
Reach 1	67116.15	Overtopping Q	WSAB Exist Cond	114.65	108.71	105.29	0.01	0.00	348.90		136600.00		19.56
Reach 1	67101.25	Design Q	WSAB Exist Cond	112.44	106.95	103.65			344.88		120000.00		18.80
Reach 1	67101.25	Overtopping Q	WSAB Exist Cond	114.63	108.71	105.20			348.84		136600.00		19.53
Reach 1	67076.25BR U	Design Q	WSAB Exist Cond	112.25	104.11	104.11			322.98		120000.00		22.89
Reach 1	67076.25BR U	Design Q	WSAB Prop Cond 8	112.33	104.23	104.23			324.02		120000.00		22.85
Reach 1	67076.25BR U	Overtopping Q	WSAB Exist Cond	114.43	105.70	105.70			330.15		136600.00		23.70
Reach 1	67076.25BR U	Overtopping Q	WSAB Prop Cond 8	114.51	105.81	105.81			331.13		136600.00		23.67
							Pier No. 1						
Reach 1	67076.25BR D	Design Q	WSAB Exist Cond	112.15	104.03	104.03			323.07		120000.00		22.87
Reach 1	67076.25BR D	Design Q	WSAB Prop Cond 8	112.15	104.03	104.03			323.07		120000.00		22.87
Reach 1	67076.25BR D	Overtopping Q	WSAB Exist Cond	114.33	105.60	105.60			330.15		136600.00		23.71
Reach 1	67076.25BR D	Overtopping Q	WSAB Prop Cond 8	114.33	105.60	105.60			330.15		136600.00		23.71
Reach 1	67051.25	Design Q	WSAB Exist Cond	112.14	101.35	103.61			320.72		120000.00		26.36
Reach 1	67051.25	Design Q	WSAB Prop Cond 8	112.14	101.35	103.56			320.72		120000.00		26.36
Reach 1	67051.25	Overtopping Q	WSAB Exist Cond	114.33	102.73	105.16			326.95		136600.00		27.32
Reach 1	67051.25	Overtopping Q	WSAB Prop Cond 8	114.33	102.73	105.10			326.94		136600.00		27.32

HEC-RAS River: Upper LA River Reach: Reach 1 (Continued)

Reach	River Sta	Profile	Plan	E.G. Elev	W.S. Elev	Crit W.S.	Frctn Loss	C & E Loss	Top Width	Q Left	Q Channel	Q Right	Vel Chnl
				(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)
Reach 1	66959.94	Design Q	WSAB Exist Cond	111.93	101.22	103.36	0.22	0.00	320.96		120000.00		26.26
Reach 1	66959.94	Design Q	WSAB Prop Cond 8	111.93	101.22	103.36	0.22	0.00	320.95		120000.00		26.26
Reach 1	66959.94	Overtopping Q	WSAB Exist Cond	114.11	102.59	104.91	0.21	0.00	327.13		136600.00		27.24
Reach 1	66959.94	Overtopping Q	WSAB Prop Cond 8	114.11	102.59	104.94	0.21	0.00	327.13		136600.00		27.24

Plan: WSAB Prop Cond 8 Upper LA River Reach 1 RS: 67076.25 Profile: Design Q

E.G. US. (ft)	112.50	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	106.82	E.G. Elev (ft)	112.33	112.15
Q Total (cfs)	120000.00	W.S. Elev (ft)	104.23	104.03
Q Bridge (cfs)	120000.00	Crit W.S. (ft)	104.23	104.03
Q Weir (cfs)		Max Chl Dpth (ft)	20.66	20.72
Weir Sta Lft (ft)		Vel Total (ft/s)	22.85	22.87
Weir Sta Rgt (ft)		Flow Area (sq ft)	5252.74	5247.99
Weir Submerg		Froude # Chl	1.00	1.00
Weir Max Depth (ft)		Specif Force (cu ft)	131675.60	131832.30
Min El Weir Flow (ft)	118.01	Hydr Depth (ft)	16.21	16.24
Min El Prs (ft)	115.00	W.P. Total (ft)	367.92	368.22
Delta EG (ft)	0.29	Conv. Total (cfs)	2870910.0	2865004.0
Delta WS (ft)	5.47	Top Width (ft)	324.02	323.07
BR Open Area (sq ft)	8984.28	Frctn Loss (ft)		
BR Open Vel (ft/s)	22.87	C & E Loss (ft)		
Coef of Q		Shear Total (lb/sq ft)	1.56	1.56
Br Sel Method	Momentum	Power Total (lb/ft s)	100.00	100.00

HEC-RAS Output
Pier No. 1 Detailed Output

Plan: WSAB Prop Cond 8 Upper LA River Reach 1 RS: 67212.71 Profile: Design Q

E.G. US. (ft)	113.11	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	107.81	E.G. Elev (ft)	112.93	112.54
Q Total (cfs)	120000.00	W.S. Elev (ft)	106.39	105.39
Q Bridge (cfs)	120000.00	Crit W.S. (ft)	104.55	104.32
Q Weir (cfs)		Max Chl Dpth (ft)	22.57	21.81
Weir Sta Lft (ft)		Vel Total (ft/s)	20.52	21.46
Weir Sta Rgt (ft)		Flow Area (sq ft)	5846.84	5591.86
Weir Submerg		Froude # Chl	0.86	0.92
Weir Max Depth (ft)		Specif Force (cu ft)	133317.50	132392.60
Min El Weir Flow (ft)	118.01	Hydr Depth (ft)	17.66	17.08
Min El Prs (ft)	115.00	W.P. Total (ft)	380.61	375.22
Delta EG (ft)	0.61	Conv. Total (cfs)	3355518.0	3144916.0
Delta WS (ft)	1.00	Top Width (ft)	330.99	327.43
BR Open Area (sq ft)	8935.13	Frctn Loss (ft)		
BR Open Vel (ft/s)	21.46	C & E Loss (ft)		
Coef of Q		Shear Total (lb/sq ft)	1.23	1.35
Br Sel Method	Momentum	Power Total (lb/ft s)	100.00	100.00

HEC-RAS Output
Pier No. 2 Detailed Output

Plan: WSAB Prop Cond 8   Upper LA River   Reach 1 RS: 67353.25   Profile: Design Q

E.G. US. (ft)	113.63	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	108.72	E.G. Elev (ft)	113.46	113.15
Q Total (cfs)	120000.00	W.S. Elev (ft)	107.62	106.78
Q Bridge (cfs)	120000.00	Crit W.S. (ft)	105.03	104.67
Q Weir (cfs)		Max Chl Dpth (ft)	23.54	22.92
Weir Sta Lft (ft)		Vel Total (ft/s)	19.39	20.26
Weir Sta Rgt (ft)		Flow Area (sq ft)	6188.61	5921.72
Weir Submerg		Froude # Chl	0.81	0.84
Weir Max Depth (ft)		Specif Force (cu ft)	134686.00	133978.50
Min El Weir Flow (ft)	118.01	Hydr Depth (ft)	18.02	17.91
Min El Prs (ft)	115.00	W.P. Total (ft)	395.95	381.11
Delta EG (ft)	0.50	Conv. Total (cfs)	3592837.0	3424414.0
Delta WS (ft)	0.91	Top Width (ft)	343.50	330.62
BR Open Area (sq ft)	8810.79	Frctn Loss (ft)		
BR Open Vel (ft/s)	20.26	C & E Loss (ft)		
Coef of Q		Shear Total (lb/sq ft)	1.09	1.19
Br Sel Method	Momentum	Power Total (lb/ft s)	100.00	100.00

HEC-RAS Output
Pier No. 3 Detailed Output

Plan: WSAB Prop Cond 8   Upper LA River   Reach 1 RS: 67489.71   Profile: Design Q

E.G. US. (ft)	114.18	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	109.40	E.G. Elev (ft)	113.97	113.67
Q Total (cfs)	120000.00	W.S. Elev (ft)	108.36	107.92
Q Bridge (cfs)	120000.00	Crit W.S. (ft)	105.13	105.12
Q Weir (cfs)		Max Chl Dpth (ft)	23.94	23.78
Weir Sta Lft (ft)		Vel Total (ft/s)	19.01	19.24
Weir Sta Rgt (ft)		Flow Area (sq ft)	6313.10	6237.58
Weir Submerg		Froude # Chl	0.77	0.79
Weir Max Depth (ft)		Specif Force (cu ft)	135763.30	135210.00
Min El Weir Flow (ft)	118.01	Hydr Depth (ft)	18.89	18.30
Min El Prs (ft)	115.00	W.P. Total (ft)	389.52	394.51
Delta EG (ft)	0.52	Conv. Total (cfs)	3754823.0	3649213.0
Delta WS (ft)	0.70	Top Width (ft)	334.27	340.78
BR Open Area (sq ft)	8604.99	Frctn Loss (ft)		
BR Open Vel (ft/s)	19.24	C & E Loss (ft)		
Coef of Q		Shear Total (lb/sq ft)	1.03	1.07
Br Sel Method	Momentum	Power Total (lb/ft s)	100.00	100.00

HEC-RAS Output
Pier No. 4 Detailed Output

APPENDIX B RIO HONDO BRIDGE LOCATION HYDRAULIC STUDY

WEST SANTA ANA BRANCH TRANSIT CORRIDOR PROJECT
Contract No. AE5999300

Final
Rio Hondo Bridge
Location Hydraulic Study

Task No. 12.3 (Deliverable No. 12.3a)

Prepared for:

Metro

Los Angeles County
Metropolitan Transportation Authority

Prepared by:

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June 2021

This Location Hydraulic Study has been prepared by JACOBS under the direction of the following Registered Civil Engineer. The undersigned attests to the technical information contained herein and the qualifications of any technical specialist providing engineering data upon which the recommendations, conclusions, and decisions are based:

Robert M. Henderson, P.E.

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ACRONYMS AND ABBREVIATIONS

AA	Alternatives Analysis
BRT	Bus Rapid Transit
CEQA	California Environmental Quality Act
cfs	cubic feet per second
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
FEMA	Federal Emergency Management Administration
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
ft	Feet
ft/sec	Feet per Second
LA	Los Angeles
LACDPW	Los Angeles County Department of Public Works
LACFCD	Los Angeles County Flood Control District
LAUS	Los Angeles Union Station
LRT	Light Rail Transit
LRTP	Long Range Transportation Plan
Metro	Los Angeles County Metropolitan Transportation Authority
MOS	Minimum Operable Segment
MWD	Metropolitan Water District
NEPA	National Environmental Policy Act
OCTA	Orange County Transportation Authority
PEROW	Pacific Electric Right-of-Way
ROW	Right-of-Way
SCAG	Southern California Association of Governments
SGLLARMC	San Gabriel & Lower Los Angeles Rivers and Mountains Conservancy
SR	State Route
TRS	Technical Refinement Study
UPRR	Union Pacific Railroad
USACE	United States Army Corps of Engineers
WSAB	West Santa Ana Branch
WSE	Water Surface Elevation

1 INTRODUCTION

1.1 Study Background

The West Santa Ana Branch (WSAB) Transit Corridor (Project) is a proposed light rail transit (LRT) line that would extend from four possible northern termini in southeast Los Angeles (LA) County to a southern terminus in the City of Artesia, traversing densely populated, low-income, and heavily transit-dependent communities. The Project would provide reliable, fixed guideway transit service that would increase mobility and connectivity for historically underserved, transit-dependent, and environmental justice communities; reduce travel times on local and regional transportation networks; and accommodate substantial future employment and population growth.

1.2 Alternatives Evaluation, Screening, and Selection Process

A wide range of potential alternatives have been considered and screened through the alternatives analysis processes. In March 2010, the Southern California Association of Governments (SCAG) initiated the Pacific Electric Right-of-Way (PEROW)/WSAB Alternatives Analysis (AA) Study (SCAG 2013) in coordination with the relevant cities, Orangeline Development Authority (now known as Eco-Rapid Transit), the Gateway Cities Council of Governments, the Los Angeles County Metropolitan Transportation Authority (Metro), the Orange County Transportation Authority, and the owners of the right-of-way (ROW)—Union Pacific Railroad (UPRR), BNSF Railway, and the Ports of Los Angeles and Long Beach. The AA Study evaluated a wide variety of transit connections and modes for a broader 34-mile corridor from Union Station in downtown Los Angeles to the City of Santa Ana in Orange County. In February 2013, SCAG completed the PEROW/WSAB Corridor Alternatives Analysis Report[1] and recommended two LRT alternatives for further study: West Bank 3 and the East Bank.

Following completion of the AA, Metro completed the WSAB Technical Refinement Study in 2015 focusing on the design and feasibility of five key issue areas along the 19-mile portion of the WSAB Transit Corridor within LA County:

- Access to Union Station in downtown Los Angeles
- Northern Section Options
- Huntington Park Alignment and Stations
- New Metro C (Green) Line Station
- Southern Terminus at Pioneer Station in Artesia

In September 2016, Metro initiated the WSAB Transit Corridor Environmental Study with the goal of obtaining environmental clearance of the Project under the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA).

[1] Initial concepts evaluated in the SCAG report included transit connections and modes for the 34 mile corridor from Union Station in downtown Los Angeles to the City of Santa Ana. Modes included low speed magnetic levitation (maglev) heavy rail, light rail, and bus rapid transit (BRT).

Metro issued a Notice of Preparation (NOP) on May 25, 2017, with a revised NOP issued on June 14, 2017, extending the comment period. In June 2017, Metro held public scoping meetings in the Cities of Bellflower, Los Angeles, South Gate, and Huntington Park. Metro provided Project updates and information to stakeholders with the intent to receive comments and questions through a comment period that ended in August 2017. A total of 1,122 comments were received during the public scoping period from May through August 2017. The comments focused on concerns regarding the Northern Alignment options, with specific concerns related to potential impacts to Alameda Street with an aerial alignment. Given potential visual and construction issues raised through public scoping, additional Northern Alignment concepts were evaluated.

In February 2018, the Metro Board of Directors approved further study of the alignment in the Northern Section due to community input during the 2017 scoping meetings. A second alternatives screening process was initiated to evaluate the original four Northern Alignment options and four new Northern Alignment concepts. The *Final Northern Alignment Alternatives and Concepts Updated Screening Report* was completed in May 2018 (Metro 2018). The alternatives were further refined and, based on the findings of the second screening analysis and the input gathered from the public outreach meetings, the Metro Board of Directors approved Build Alternatives E and G for further evaluation (now referred to as Alternatives 1 and 2, respectively, in this report).

On July 11, 2018, Metro issued a revised and recirculated CEQA Notice of Preparation, thereby initiating a scoping comment period. The purpose of the revised Notice of Preparation was to inform the public of the Metro Board's decision to carry forward Alternatives 1 and 2 into the Draft Environmental Impact Statement/Environmental Impact Report (EIS/EIR). During the scoping period, one agency and three public scoping meetings were held in the Cities of Los Angeles, Cudahy, and Bellflower. The meetings provided Project updates and information to stakeholders with the intent to receive comments and questions to support the environmental process. The comment period for scoping ended in August 24, 2018; over 250 comments were received.

Following the July 2018 scoping period, a number of Project refinements were made to address comments received, including additional grade separations, removing certain stations with low ridership, and removing the Bloomfield extension option. The Metro Board adopted these refinements to the project description at their November 2018 meeting.

1.3 Report Purpose

The Project would incur impacts to floodplains as a result of crossings at the Los Angeles River, Rio Hondo and San Gabriel River. This Location Hydraulic Study assessed the existing and expected Project conditions at the Rio Hondo River crossing with respect to hydrology, floodplain impacts, hydraulic impacts of the encroachment, property at risk and environment impacts. The facility is owned and maintained by the Los Angeles County Department of Public Works (LACDPW) and Los Angeles County Flood Control District (LACFCD). Separate Location Hydraulic Studies were prepared for the Upper Los Angeles River and San Gabriel River crossings.

2 PROJECT DESCRIPTION

This section describes the No Build Alternative and the four Build Alternatives studied in the WSAB Transit Corridor Draft EIS/EIR, including design options, station locations, and maintenance and storage facility (MSF) site options. The Build Alternatives were developed through a comprehensive alternatives analysis process and meet the purpose and need of the Project.

The No Build Alternative and four Build Alternatives are generally defined as follows:

- **No Build Alternative** - Reflects the transportation network in the 2042 horizon year without the proposed Build Alternatives. The No Build Alternative includes the existing transportation network along with planned transportation improvements that have been committed to and identified in the constrained Metro 2009 Long Range Transportation Plan (2009 LRTP) (Metro 2009) and SCAG's 2016-2040 Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS) (SCAG 2016), as well as additional projects funded by Measure M that would be completed by 2042.
- **Build Alternatives**: The Build Alternatives consist of a new LRT line that would extend from different termini in the north to the same terminus in the City of Artesia in the south. The Build Alternatives are referred to as:
  - Alternative 1: Los Angeles Union Station to Pioneer Station; the northern terminus would be located underground at Los Angeles Union Station (LAUS) Forecourt
  - Alternative 2: 7th Street/Metro Center to Pioneer Station; the northern terminus would be located underground at 8th Street between Figueroa Street and Flower Street near 7th Street/Metro Center Station
  - Alternative 3: Slauson/A (Blue) Line to Pioneer Station; the northern terminus would be located just north of the intersection of Long Beach Avenue and Slauson Avenue in the City of Los Angeles, connecting to the current A (Blue) Line Slauson Station
  - Alternative 4: I-105/C (Green) Line to Pioneer Station; the northern terminus would be located at I-105 in the city of South Gate, connecting to the C (Green) Line along the I-105

Two design options are under consideration for Alternative 1. Design Option 1 would locate the northern terminus station box at the LAUS Metropolitan Water District (MWD) east of LAUS and the MWD building, below the baggage area parking facility. Design Option 2 would add the Little Tokyo Station along the WSAB alignment. The Design Options are further discussed in Section 2.3.6.

Figure 2-1 presents the four Build Alternatives and the design options. In the north, Alternative 1 would terminate at LAUS and primarily follow Alameda Avenue south underground to the proposed Arts/Industrial District Station. Alternative 2 would terminate near the existing 7th Street/Metro Center Station in the Downtown Transit Core and would primarily follow 8th Street east underground to the proposed Arts/Industrial District Station.

Figure 2-1. Project Alternatives

Source: Metro, 2020

From the Arts/Industrial District Station to the southern terminus at Pioneer Station, Alternatives 1 and 2 share a common alignment. South of Olympic Boulevard, the Alternatives 1 and 2 would transition from an underground configuration to an aerial configuration, cross over the Interstate (I-) 10 freeway and then parallel the existing Metro A (Blue) Line along the Wilmington Branch ROW as it proceeds south. South of Slauson Avenue, which would serve as the northern terminus for Alternative 3, Alternatives 1, 2, and 3 would turn east and transition to an at-grade configuration to follow the La Habra Branch ROW along Randolph Street. At the San Pedro Subdivision ROW, Alternatives 1, 2, and 3 would turn southeast to follow the San Pedro Subdivision ROW and then transition to the Pacific Electric Right-of-Way (PEROW), south of the I-105 freeway. The northern terminus for Alternative 4 would be located at the I-105/C (Green) Line. Alternatives 1, 2, 3, and 4 would then follow the PEROW to the southern terminus at the proposed Pioneer Station in Artesia. The Build Alternatives would be grade-separated where warranted, as indicated on Figure 2-2.

Figure 2-2. Project Alignment by Alignment Type

Source: Metro, 2020

2.1 Geographic Sections

The approximately 19-mile corridor is divided into two geographic sections—the Northern and Southern Sections. The boundary between the Northern and Southern Sections occurs at Florence Avenue in the City of Huntington Park.

2.1.1 Northern Section

The Northern Section includes approximately 8 miles of Alternatives 1 and 2 and 3.8 miles of Alternative 3. Alternative 4 is not within the Northern Section. The Northern Section covers the geographic area from downtown Los Angeles to Florence Avenue in the City of Huntington Park and would generally traverse the Cities of Los Angeles, Vernon, Huntington Park, and Bell, and the unincorporated Florence-Firestone community of LA County (Figure 2-3). Alternatives 1 and 2 would traverse portions of the Wilmington Branch (between approximately Martin Luther King Jr Boulevard along Long Beach Avenue to Slauson Avenue). Alternatives 1, 2, and 3 would traverse portions of the La Habra Branch ROW (between Slauson Avenue along Randolph Street to Salt Lake Avenue) and San Pedro Subdivision ROW (between Randolph Street to approximately Paramount Boulevard).

Figure 2-3. Northern Section

Source: Metro, 2020

2.1.2 Southern Section

The Southern Section includes approximately 11 miles of Alternatives 1, 2, and 3 and includes all 6.6 miles of Alternative 4. The Southern Section covers the geographic area from south of Florence Avenue in the City of Huntington Park to the City of Artesia and would generally traverse the Cities of Huntington Park, Cudahy, South Gate, Downey, Paramount, Bellflower, Cerritos, and Artesia (Figure 2-4). In the Southern Section, all four Build Alternatives would utilize portions of the San Pedro Subdivision and the Metro-owned PEROW (between approximately Paramount Boulevard to South Street).

Figure 2-4. Southern Section

Source: Metro, 2020

2.2 No Build Alternative

For the NEPA evaluation, the No Build Alternative is evaluated in the context of the existing transportation facilities in the Study Area (the Study Area extends approximately 2 miles from either side of the proposed alignment) and other capital transportation improvements and/or transit and highway operational enhancements that are reasonably foreseeable. Because the No Build Alternative provides the background transportation network, against which the Build Alternatives' impacts are identified and evaluated, the No Build Alternative does not include the Project.

The No Build Alternative reflects the transportation network in 2042 and includes the existing transportation network along with planned transportation improvements that have been committed to and identified in the constrained Metro 2009 LRTP and the SCAG 2016 RTP/SCS, as well as additional projects funded by Measure M, a sales tax initiative approved by voters in November 2016. The No Build Alternative includes Measure M projects that are scheduled to be completed by 2042.

Table 2.1 lists the existing transportation network and planned improvements included as part of the No Build Alternative.

Table 2.1. No Build Alternative – Existing Transportation Network and Planned Improvements

Project	To / From	Location Relative to Study Area
Rail (Existing)		
Metro Rail System (LRT and Heavy Rail Transit)	Various locations	Within Study Area
Metrolink (Southern California Regional Rail Authority) System	Various locations	Within Study Area
Rail (Under Construction/Planned)[1]		
Metro Westside D (Purple) Line Extension	Wilshire/Western to Westwood/VA Hospital	Outside Study Area
Metro C (Green) Line Extension[2] to Torrance	96th Street Station to Torrance	Outside Study Area
Metro C (Green) Line Extension	Norwalk to Expo/Crenshaw[3]	Outside Study Area
Metro East-West Line/Regional Connector/Eastside Phase 2	Santa Monica to Lambert Santa Monica to Peck Road	Within Study Area
Metro North-South Line/Regional Connector/Foothill Extension to Claremont Phase 2B	Long Beach to Claremont	Within Study Area
Metro Sepulveda Transit Corridor	Metro G (Orange) Line to Metro E (Expo) Line	Outside Study Area
Metro East San Fernando Valley Transit Corridor	Sylmar to Metro G (Orange) Line	Outside Study Area
Los Angeles World Airport Automated People Mover	96th Street Station to LAX Terminals	Outside Study Area

Project	To / From	Location Relative to Study Area
Metrolink Capital Improvement Projects	Various projects	Within Study Area
California High-Speed Rail	Burbank to LA LA to Anaheim	Within Study Area
Link US[4]	LAUS	Within Study Area
Bus (Existing)		
Metro Bus System (including BRT, Express, and local)	Various locations	Within Study Area
Municipality Bus System[5]	Various locations	Within Study Area
Bus (Under Construction/Planned)		
Metro G (Orange) Line (BRT)	Del Mar (Pasadena) to Chatsworth Del Mar (Pasadena) to Canoga Canoga to Chatsworth	Outside Study Area
Vermont Transit Corridor (BRT)	120th Street to Sunset Boulevard	Outside Study Area
North San Fernando Valley BRT	Chatsworth to North Hollywood	Outside Study Area
North Hollywood to Pasadena	North Hollywood to Pasadena	Outside Study Area
Highway (Existing)		
Highway System	Various locations	Within Study Area
Highway (Under Construction/Planned)		
High Desert Multi-Purpose Corridor	SR-14 to SR-18	Outside Study Area
I-5 North Capacity Enhancements	SR-14 to Lake Hughes Rd	Outside Study Area
SR-71 Gap Closure	I-10 to Rio Rancho Rd	Outside Study Area
Sepulveda Pass Express Lane	I-10 to US-101	Outside Study Area
SR-57/SR-60 Interchange Improvements	SR-70/SR-60	Outside Study Area
I-710 South Corridor Project (Phase 1 & 2)	Ports of Long Beach and LA to SR-60	Within Study Area
I-105 Express Lane	I-405 to I-605	Within Study Area
I-5 Corridor Improvements	I-605 to I-710	Outside Study Area

Source: Metro 2018, WSP 2019

Notes: [1] Where extensions are proposed for existing Metro rail lines, the origin/destination is defined for the operating scheme of the entire rail line following completion of the proposed extensions and not just the extension itself.

[2] Metro C (Green) Line extension to Torrance includes new construction from Redondo Beach to Torrance; however, the line will operate from Torrance to 96th Street.

[3] The currently under construction Metro Crenshaw/LAX Line will operate as the Metro C (Green) Line.

[4] Link US rail walk times included only.

[5] The municipality bus network system is based on service patterns for Bellflower Bus, Cerritos on Wheels, Cudahy Area Rapid Transit, Get Around Town Express, Huntington Park Express, La Campana, Long Beach Transit, Los Angeles Department of Transportation, Norwalk Transit System and the Orange County Transportation Authority.

BRT = Bus Rapid Transit; LAUS = Los Angeles Union Station; LAX = Los Angeles International Airport; VA = Veterans Affairs

2.3 Build Alternatives

2.3.1 Proposed Alignment Configuration for the Build Alternatives

This section describes the alignment for each of the Build Alternatives. The general characteristics of the four Build Alternatives are summarized in Table 2.2. Figure 2-5 illustrates the freeway crossings along the alignment. Additionally, the Build Alternatives would require relocation of existing freight rail tracks within the ROW to maintain existing operations where there would be overlap with the proposed light rail tracks. Figure 2-6 depicts the alignment sections that would share operation with freight and the corresponding ownership.

Table 2.2. Summary of Build Alternative Components

Component	Quantity			
Alternatives	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Alternative 4**
Alignment Length	19.3 miles	19.3 miles	14.8 miles	6.6 miles
Stations Configurations	11 3 aerial; 6 at-grade; 2 underground[3]	12 3 aerial; 6 at-grade; 3 underground	9 3 aerial; 6 at-grade	4 1 aerial; 3 at-grade
Parking Facilities	5 (approximately 2,780 spaces)	5 (approximately 2,780 spaces)	5 (approximately 2,780 spaces)	4 (approximately 2,180 spaces)
Length of underground, at-grade, and aerial	2.3 miles underground; 12.3 miles at-grade; 4.7 miles aerial[1]	2.3 miles underground; 12.3 miles at-grade; 4.7 miles aerial[1]	12.2 miles at-grade; 2.6 miles aerial[1]	5.6 miles at-grade; 1.0 miles aerial[1]
At-grade crossings	31	31	31	11
Freight crossings	10	10	9	2
Freeway Crossings	6 (3 freeway undercrossings[2] at I-710; I-605, SR-91)	6 (3 freeway undercrossings[2] at I-710; I-605, SR-91)	4 (3 freeway undercrossings[2] at I-710; I-605, SR-91)	3 (2 freeway undercrossings[2] at I-605, SR-91)
Elevated Street Crossings	25	25	15	7
River Crossings	3	3	3	1
TPSS Facilities	22[3]	23	17	7
Maintenance and Storage Facility site options	2	2	2	2

Source: WSP, 2020
Notes: [1] Alignment configuration measurements count retained fill embankments as at-grade.
[2] The light rail tracks crossing beneath freeway structures.
[3] Under Design Option 2 – Add Little Tokyo Station, an additional underground station and TPSS site would be added under Alternative 1

Figure 2-5. Freeway Crossings

Source: WSP, 2020

Figure 2-6. Existing Rail Right-of-Way Ownership and Relocation

Source: WSP, 2020

2.3.2 Alternative 1

The total alignment length of Alternative 1 would be approximately 19.3 miles, consisting of approximately 2.3 miles of underground, 12.3 miles of at-grade, and 4.7 miles of aerial alignment. Alternative 1 would include 11 new LRT stations, 2 of which would be underground, 6 would be at-grade, and 3 would be aerial. Under Design Option 2, Alternative 1 would have 12 new LRT stations, and the Little Tokyo Station would be an additional underground station. Five of the stations would include parking facilities, providing a total of up to 2,780 new parking spaces. The alignment would include 31 at-grade crossings, 3 freeway undercrossings, 2 aerial freeway crossings, 1 underground freeway crossing, 3 river crossings, 25 aerial road crossings, and 10 freight crossings.

In the north, Alternative 1 would begin at a proposed underground station at/near LAUS either beneath the LAUS Forecourt or, under Design Option 1, east of the MWD building beneath the baggage area parking facility (Section 2.3.6). Crossovers would be located on the north and south ends of the station box with tail tracks extending approximately 1,200 feet north of the station box. A tunnel extraction portal would be located within the tail tracks for both Alternative 1 terminus station options.

From LAUS, the alignment would continue underground crossing under the US-101 freeway and the existing Metro L (Gold) Line aerial structure and continue south beneath Alameda Street to the optional Little Tokyo Station between 1st Street and 2nd Street (note: under Design Option 2, Little Tokyo Station would be constructed). From the optional Little Tokyo Station, the alignment would continue underground beneath Alameda Street to the proposed Arts/Industrial District Station under Alameda Street between 6th Street and Industrial Street. (Note, Alternative 2 would have the same alignment as Alternative 1 from this point south. Refer to Section 2.3.3 for additional information on Alternative 2.)

The underground alignment would continue south under Alameda Street to 8th Street, where the alignment would curve to the west and transition to an aerial alignment south of Olympic Boulevard. The alignment would cross over the I-10 freeway in an aerial viaduct structure and continue south, parallel to the existing Metro A (Blue) Line at Washington Boulevard. The alignment would continue in an aerial configuration along the eastern half of Long Beach Avenue within the UPRR-owned Wilmington Branch ROW, east of the existing Metro A (Blue) Line and continue south to the proposed Slauson/A Line Station. The aerial alignment would pass over the existing pedestrian bridge at E. 53rd Street. The Slauson/A Line Station would serve as a transfer point to the Metro A (Blue) Line via a pedestrian bridge. The vertical circulation would be connected at street level on the north side of the station via stairs, escalators, and elevators. (The Slauson/A Line Station would serve as the northern terminus for Alternative 3; refer to Section 2.3.4 for additional information on Alternative 3.)

South of the Slauson/A Line Station, the alignment would turn east along the existing La Habra Branch ROW (also owned by UPRR) in the median of Randolph Street. The alignment would be on the north side of the La Habra Branch ROW and would require the relocation of existing freight tracks to the southern portion of the ROW. The alignment would transition to an at-grade configuration at Alameda Street and would proceed east along the Randolph Street median. Wilmington Avenue, Regent Street, Albany Street, and Rugby Avenue would be closed to traffic crossing the ROW, altering

the intersection design to a right-in, right-out configuration. The proposed Pacific/Randolph Station would be located just east of Pacific Boulevard.

From the Pacific/Randolph Station, the alignment would continue east at-grade. Rita Avenue would be closed to traffic crossing the ROW, altering the intersection design to a right-in, right-out configuration. At the San Pedro Subdivision ROW, the alignment would transition to an aerial configuration and turn south to cross over Randolph Street and the freight tracks, returning to an at-grade configuration north of Gage Avenue. The alignment would be located on the east side of the existing San Pedro Subdivision ROW freight tracks, and the existing tracks would be relocated to the west side of the ROW. The alignment would continue at-grade within the San Pedro Subdivision ROW to the proposed at-grade Florence/Salt Lake Station south of the Salt Lake Avenue/Florence Avenue intersection.

South of Florence Avenue, the alignment would extend from the proposed Florence/Salt Lake Station in the City of Huntington Park to the proposed Pioneer Station in the City of Artesia, as shown in Figure 2-4. The alignment would continue southeast from the proposed at-grade Florence/Salt Lake Station within the San Pedro Subdivision ROW, crossing Otis Avenue, Santa Ana Street, and Ardine Street at-grade. The alignment would be located on the east side of the existing San Pedro Subdivision freight tracks and the existing tracks would be relocated to the west side of the ROW. South of Ardine Street, the alignment would transition to an aerial structure to cross over the existing UPRR tracks and Atlantic Avenue. The proposed Firestone Station would be located on an aerial structure between Atlantic Avenue and Florence Boulevard.

The alignment would then cross over Firestone Boulevard and transition back to an at-grade configuration prior to crossing Rayo Avenue at-grade. The alignment would continue south along the San Pedro Subdivision ROW, crossing Southern Avenue at-grade and continuing at-grade until it transitions to an aerial configuration to cross over the LA River. The proposed LRT bridge would be constructed next to the existing freight bridge. South of the LA River, the alignment would transition to an at-grade configuration crossing Frontage Road at-grade, then passing under the I-710 freeway through the existing box tunnel structure and then crossing Miller Way. The alignment would then return to an aerial structure to cross the Rio Hondo Channel. South of the Rio Hondo Channel, the alignment would briefly transition back to an at-grade configuration and then return to an aerial structure to cross over Imperial Highway and Garfield Avenue. South of Garfield Avenue, the alignment would transition to an at-grade configuration and serve the proposed Gardendale Station north of Gardendale Street.

From the Gardendale Station, the alignment would continue south in an at-grade configuration, crossing Gardendale Street and Main Street to connect to the proposed I-105/C Line Station, which would be located at-grade north of Century Boulevard. This station would be connected to the new infill C (Green) Line Station in the middle of the freeway via a pedestrian walkway on the new LRT bridge. The alignment would continue at-grade, crossing Century Boulevard and then over the I-105 freeway in an aerial configuration within the existing San Pedro Subdivision ROW bridge footprint. A new Metro C (Green) Line Station would be constructed in the median of the I-105 freeway. Vertical pedestrian access would be provided from the LRT bridge to the proposed I-105/C Line Station platform via stairs and elevators. To accommodate the construction of the new station platform, the existing Metro C (Green) Line tracks would be widened and, as part of the I-105 Express Lanes Project, the I-105 lanes would be reconfigured. (The I-105/C Line Station would serve

as the northern terminus for Alternative 4; refer to Section 2.3.5 for additional information on this alternative.)

South of the I-105 freeway, the alignment would continue at-grade within the San Pedro Subdivision ROW. In order to maintain freight operations and allow for freight train crossings, the alignment would transition to an aerial configuration as it turns southeast and enter the PEROW. The existing freight track would cross beneath the aerial alignment and align on the north side of the PEROW east of the San Pedro Subdivision ROW. The proposed Paramount/Rosecrans Station would be located in an aerial configuration west of Paramount Boulevard and north of Rosecrans Avenue. The existing freight track would be relocated to the east side of the alignment beneath the station viaduct.

The alignment would continue southeast in an aerial configuration over the Paramount Boulevard/Rosecrans Avenue intersection and descend to an at-grade configuration. The alignment would return to an aerial configuration to cross over Downey Avenue descending back to an at-grade configuration north of Somerset Boulevard. One of the adjacent freight storage tracks at Paramount Refinery Yard would be relocated to accommodate the new LRT tracks and maintain storage capacity. There are no active freight tracks south of the World Energy facility.

The alignment would cross Somerset Boulevard at-grade. South of Somerset Boulevard, the at-grade alignment would parallel the existing Bellflower Bike Trail that is currently aligned on the south side of the PEROW. The alignment would continue at-grade crossing Lakewood Boulevard, Clark Avenue, and Alondra Boulevard. The proposed at-grade Bellflower Station would be located west of Bellflower Boulevard.

East of Bellflower Boulevard, the Bellflower Bike Trail would be realigned to the north side of the PEROW to accommodate an existing historic building located near the southeast corner of Bellflower Boulevard and the PEROW. It would then cross back over the LRT tracks at-grade to the south side of the ROW. The LRT alignment would continue southeast within the PEROW and transition to an aerial configuration at Cornuta Avenue, crossing over Flower Street and Woodruff Avenue. The alignment would return to an at-grade configuration at Walnut Street. South of Woodruff Avenue, the Bellflower Bike Trail would be relocated to the north side of the PEROW. Continuing southeast, the LRT alignment would cross under the SR-91 freeway in an existing underpass. The alignment would cross over the San Gabriel River on a new bridge, replacing the existing abandoned freight bridge. South of the San Gabriel River, the alignment would transition back to an at-grade configuration before crossing Artesia Boulevard at-grade.

East of Artesia Boulevard the alignment would cross beneath the I-605 freeway in an existing underpass. Southeast of the underpass, the alignment would continue at-grade, crossing Studebaker Road. North of Gridley Road, the alignment would transition to an aerial configuration to cross over 183rd Street and Gridley Road. The alignment would return to an at-grade configuration at 185th Street, crossing 186th Street and 187th Street at-grade. The alignment would then pass through the proposed Pioneer Station on the north side of Pioneer Boulevard at-grade. Tail tracks accommodating layover storage for a three-car train would extend approximately 1,000 feet south from the station, crossing Pioneer Boulevard and terminating west of South Street.

2.3.3 Alternative 2

The total alignment length of Alternative 2 would be approximately 19.3 miles, consisting of approximately 2.3 miles of underground, 12.3 miles of at-grade, and 4.7 miles of aerial alignment. Alternative 2 would include 12 new LRT stations, 3 of which would be underground, 6 would be at-grade, and 3 would be aerial. Five of the stations would include parking facilities, providing a total of approximately 2,780 new parking spaces. The alignment would include 31 at-grade crossings, 3 freeway undercrossings, 2 aerial freeway crossings, 1 underground freeway crossing, 3 river crossings, 25 aerial road crossings, and 10 freight crossings.

In the north, Alternative 2 would begin at the proposed WSAB 7th Street/Metro Center Station, which would be located underground beneath 8th Street between Figueroa Street and Flower Street. A pedestrian tunnel would provide connection to the existing 7th Street/Metro Center Station. Tail tracks, including a double crossover, would extend approximately 900 feet beyond the station, ending east of the I-110 freeway. From the 7th Street/Metro Center Station, the underground alignment would proceed southeast beneath 8th Street to the South Park/Fashion District Station, which would be located west of Main Street beneath 8th Street.

From the South Park/Fashion District Station, the underground alignment would continue under 8th Street to San Pedro Street, where the alignment would turn east toward 7th Street, crossing under privately owned properties. The tunnel alignment would cross under 7th Street and then turn south at Alameda Street. The alignment would continue south beneath Alameda Street to the Arts/Industrial District Station located under Alameda Street between 7th Street and Center Street. A double crossover would be located south of the station box, south of Center Street. From this point, the alignment of Alternative 2 would follow the same alignment as Alternative 1, which is described further in Section 2.3.2.

2.3.4 Alternative 3

The total alignment length of Alternative 3 would be approximately 14.8 miles, consisting of approximately 12.2 miles of at-grade, and 2.6 miles of aerial alignment. Alternative 3 would include 9 new LRT stations, 6 would be at-grade and 3 would be aerial. Five of the stations would include parking facilities, providing a total of approximately 2,780 new parking spaces. The alignment would include 31 at-grade crossings, 3 freeway undercrossings, 1 aerial freeway crossing, 3 river crossings, 15 aerial road crossings, and 9 freight crossings. In the north, Alternative 3 would begin at the Slauson/A Line Station and follow the same alignment as Alternatives 1 and 2, described in Section 2.3.2.

2.3.5 Alternative 4

The total alignment length of Alternative 4 would be approximately 6.6 miles, consisting of approximately 5.6 miles of at-grade and 1.0 mile of aerial alignment. Alternative 3 would include 4 new LRT stations, 3 would be at-grade, and 1 would be aerial. Four of the stations would include parking facilities, providing a total of approximately 2,180 new parking spaces. The alignment would include 11 at-grade crossings, 2 freeway undercrossings, 1 aerial freeway crossing, 1 river crossing, 7 aerial road crossings, and 2 freight crossings. In the north, Alternative 4 would begin at the I-105/C Line Station and follow the same alignment as Alternatives 1, 2, and 3, described in Section 2.3.2.

2.3.6 Design Options

Alternative 1 includes two design options:

- **Design Option 1:** LAUS at the Metropolitan Water District (MWD) – The LAUS station box would be located east of LAUS and the MWD building, below the baggage area parking facility instead of beneath the LAUS Forecourt. Crossovers would be located on the north and south ends of the station box with tail tracks extending approximately 1,200 feet north of the station box. From LAUS, the underground alignment would cross under the US-101 freeway and the existing Metro L (Gold) Line aerial structure and continue south beneath Alameda Street to the optional Little Tokyo Station between Traction Avenue and 1st Street. The underground alignment between LAUS and the Little Tokyo Station would be located to the east of the base alignment.
- **Design Option 2:** Add the Little Tokyo Station – Under this design option, the Little Tokyo Station would be constructed as an underground station and there would be a direct connection to the Regional Connector Station in the Little Tokyo community. The alignment would proceed underground directly from LAUS to the Arts/Industrial District Station primarily beneath Alameda Street.

2.3.7 Maintenance and Storage Facility

MSFs accommodate daily servicing and cleaning, inspection and repairs, and storage of light rail vehicles (LRV). Activities may take place in the MSF throughout the day and night depending upon train schedules, workload, and the maintenance requirements.

Two MSF options are evaluated; however, only one MSF would be constructed as part of the Project. The MSF would have storage tracks, each with sufficient length to store three-car train sets and a maintenance-of-way vehicle storage. The facility would include a main shop building with administrative offices, a cleaning platform, a traction power substation (TPSS), employee parking, a vehicle wash facility, a paint and body shop, and other facilities as needed. The east and west yard leads (i.e., the tracks leading from the mainline to the facility) would have sufficient length for a three-car train set. In total, the MSF would need to accommodate approximately 80 LRVs to serve the Project’s operations plan.

Two potential locations for the MSF have been identified—one in the City of Bellflower and one in the City of Paramount. These options are described further in the following sections.

2.3.8 Bellflower MSF Option

The Bellflower MSF site option is bounded by industrial facilities to the west, Somerset Boulevard and apartment complexes to the north, residential homes to the east, and the PEROW and Bellflower Bike Trail to the south. The site is approximately 21 acres in area and can accommodate up to 80 vehicles (Figure 2-7).

2.3.9 Paramount MSF Option

The Paramount MSF site option is bounded by the San Pedro Subdivision ROW on the west, Somerset Boulevard to the south, industrial and commercial uses on the east, and All American City Way to the north. The site is 22 acres and could accommodate up to 80 vehicles (Figure 2-7).

Figure 2-7. Maintenance and Storage Facility Options

Source: WSP, 2020

3 SETTING

Existing UPRR tracks cross the Rio Hondo at River Station 23+86.70. At the crossing, the river is a trapezoidal concrete channel with a bottom width of 100 feet and sides (2.25:1, horizontal to vertical ratio) that slope up to 16-foot-wide levees on either side of the channel. The invert slope at this area is 0.170 percent without a low-flow channel. The existing railroad bridge has two piers and a single track (U.S. Army Corps of Engineers [USACE] 1950).

Available engineering documents for the channel include a Los Angeles County Drainage Area Final Feasibility Interim Report (USACE 1991) and a Los Angeles County Drainage Area Rio Hondo Channel and Los Angeles River Whittier Narrows Dam to Pacific Ocean Stormwater Management Plan, Phase I (USACE 2004). Additional design flow information was provided by LACDPW. Design documents indicate the top of the channel elevation at the existing crossing is 111.83 feet with an invert elevation of 83.18. Elevations are given in North American Vertical Datum (1988).

The Project would construct a new bridge north of the existing bridge, as discussed in Section 6.2. The general plan for the bridge is included in Appendix A, along with as-built plans of the existing channel. Figure 3-1 shows the Study Area for this Location Hydraulic Study.

Figure 3-1. Study Area

Source: Jacobs 2020

4 TRAFFIC

The Project area is home to 1.2 million residents and a job center for approximately 584,000 employees. Projections show an increase in the resident population to 1.5 million and an increase in jobs to 670,000 by 2040 (Metrolink 2017). Population and employment densities are five times higher than the Los Angeles County average. This rail corridor is anticipated to serve commuters in a high travel demand corridor by providing relief to the constrained transportation systems currently available to these communities. In addition, the Project is expected to provide a direct connection to the Metro C (Green) Line and the Los Angeles County regional transit network.

No traffic or rail service interruption is expected to occur from the base flood.

5 HYDROLOGIC ANALYSIS

5.1 Hydrologic Characteristics

The proposed alignment crosses the Los Angeles River and Rio Hondo, which are both within the Los Angeles River Watershed. The River floodplain is delineated in Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Number 06037C1820F, which is presented in Appendix A.

The Rio Hondo Channel – Reach 4 has an approximately 132-square-mile drainage area above its confluence with the Los Angeles River (USACE 2004). The confluence is near the junction of South Gate, Lynwood and Downey, California. Residential parcels, public parks, a golf course, commercial facilities, industrial facilities, Department of Water and Power rights-of-way and the Rio Hondo Spreading Grounds flank the channel. The Rio Hondo is hydraulically connected to the San Gabriel River Watershed because flows from the San Gabriel River are routed to Whittier Narrows Reservoir and through the Rio Hondo during larger flood events.

Topography throughout the coastal plain area is generally defined by gradually sloping land from the foothills of the San Gabriel Mountains to the Pacific Ocean. Ground elevations range from 10,000 feet in the San Gabriel Mountains, to 330 feet near the Los Angeles River's confluence with the Arroyo Seco, to mean sea level at the mouth of the Los Angeles River.

The annual average precipitation can range from 15.5 inches in the coastal plain to 32.9 inches near the San Gabriel Mountains. Winter storms comprise most of the rainfall within the area, and most precipitation occurs between December and March. January and July are the coldest and warmest months, respectively (LACDPW 2006).

5.2 Base Flood and Overtopping Flood

Available information to establish the base flood (100-year flood) and overtopping flood comes from multiple sources, including the FEMA Flood Insurance Study (FIS) (FEMA 2016), USACE publications, and LACFCD, a division of LACDPW.

The USACE has jurisdiction in the flood control channel and provides design discharges in the Los Angeles County Drainage Area, Rio Hondo Channel and Los Angeles River Stormwater Management Plan (USACE 2004). The value reported for the Rio Hondo, 52,900 cubic feet per second (cfs), exceeds other published values; however, it is consistent with unpublished discharge information provided by the Los Angeles County Department of Public Works (LACDPW 2017). It is therefore considered the most reliable base flood value for the purpose of this study.

No data were available to establish the flood of record. The overtopping flood for this facility would be an extreme event because the rail bridge is above the channel wall; therefore, any flow in excess of the channel capacity would spill out of the channel. To evaluate extreme conditions, the 500-year flood flow is appropriate. This flood event is developed based on the Los Angeles County FIS (FEMA 2016) flood data. The FIS reports the 500-year flood is approximately 2.3 percent greater than the 100-year flood. For a base flood of 52,900 cfs the

500-year event is estimated to be 54,200 cfs. Table 5.1 summarizes the design flows used in the analysis.

Table 5.1. Rio Hondo Design Flows

Source	Design Flow
Base Flood Based on the USACE Design Discharge	52,900 cfs
Overtopping Flood Prorated using 0.2% probability flood	54,200 cfs

6 HYDRAULIC ANALYSIS

The basis of the river analysis is the existing USACE HEC-RAS model (version 4.1.0), which USACE provided for this analysis (USACE 2017). Detailed hydraulic analysis is presented in Appendix B.

6.1 Existing Conditions

The hydraulic model for the river was adopted without modification for the purpose of this study. Relevant modeling parameters are summarized below:

- Hydraulic Control: Downstream water surface is assumed to be Elevation 107.69 (USACE 2004).
- Bridge Modeling: The existing UPRR bridge is modeled as a single bridge without skew. Two bridge pier walls are modeled, each 5 feet wide in the direction of flow. Piers have rounded noses; therefore, standard values are used for coefficient of drag (1.33) and pier shape (0.9). No contraction or expansion coefficient is used.
- Debris Factor: The existing bridge piers are modeled with 9-foot debris width, extending 6 feet deep into flow. Debris noses are not modeled.
- Ineffective Areas and Obstructions: No ineffective areas or obstructions were modeled in the existing conditions model.
- Flow Regime: The mixed flow regime is evaluated for the purpose of this study.
- Channel Roughness: The channel is concrete-lined, and the invert roughness is modeled with a Manning's 'n' = 0.014 to 0.015. Side slopes are modeled as 'n' = 0.04 to 0.06.

6.2 Project Conditions

The Project conditions would construct the new bridge on new bridge piers. The existing bridge pier debris noses would be demolished, and new seismically isolated pier walls would be constructed to connect the existing bridge pier wall to the new columns hydraulically. The new bridge deck would be 33.5 feet wide and would be built 8 to 20 feet upstream of the existing bridge. The Bridge General Plan is presented in Appendix A. The profile of the new bridge would be slightly higher than the existing bridge. Flows are completely contained in the channel; therefore, the bridge pier lengths were adjusted without change to the high or low chords. The new bridge piers are assumed to be as long as the bridge deck is wide in the direction of flow, to provide a slightly conservative impact evaluation. Debris factor, ineffective areas and obstructions, flow regime and channel roughness are not changed in the Project conditions model.

The Project would reduce the water surface elevation (WSE) in the reach near the bridge by as much as 0.62 feet (Station 55+00). This impact would occur because flow in the channel near the crossing is generally supercritical ($Fr > 1.0$), and the hydraulics of the channel require flows to accelerate through the bridge, which constricts the flow area slightly. The flows are contained within the channel as demonstrated in Figure 6-1. The hydraulic analysis is summarized in Table 6.1.

Table 6.1. Summary of Hydraulics of the Rio Hondo

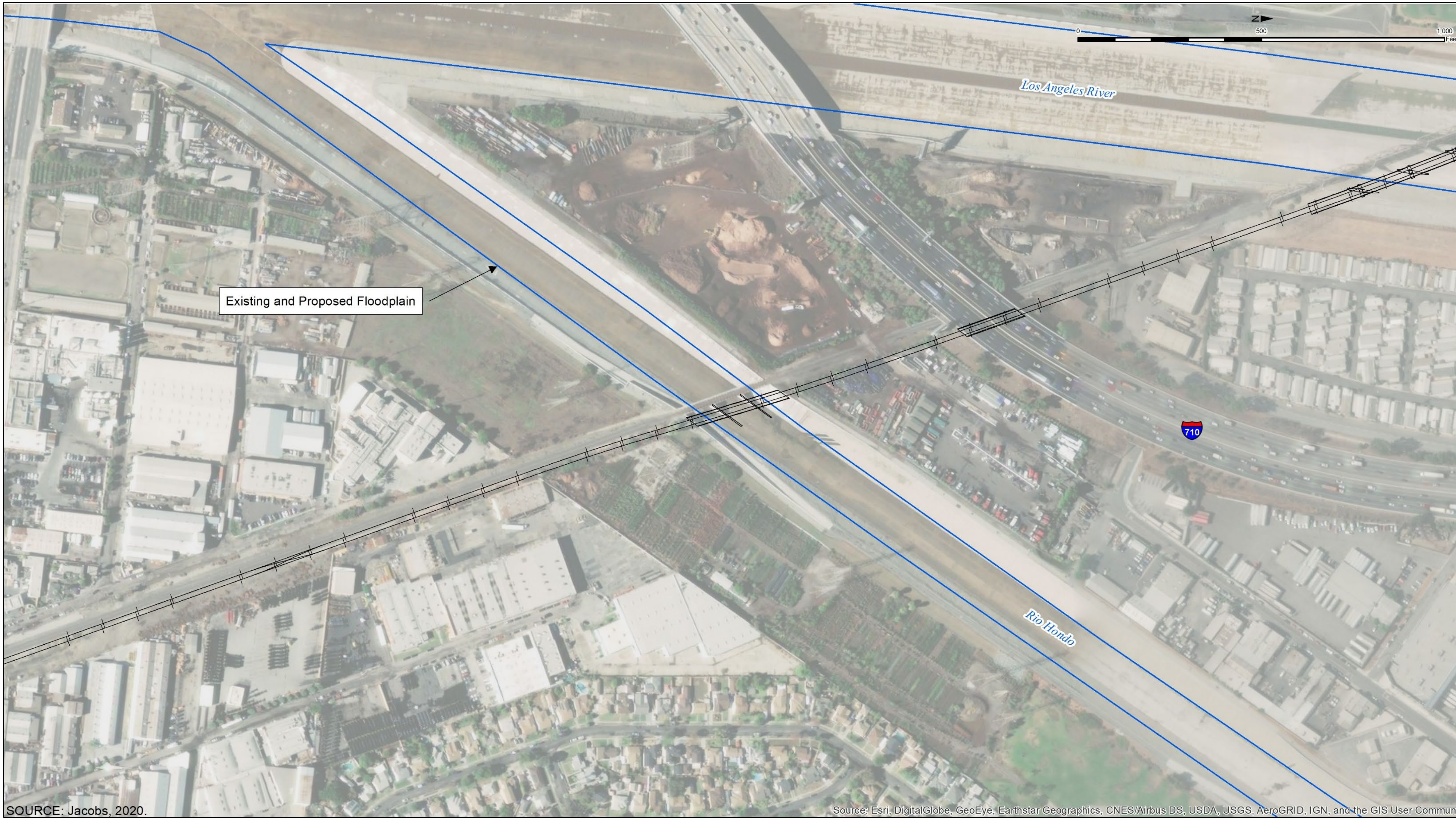
River Station	Distance from the Proposed Bridge [miles]	Existing Condition		Project Condition		Project Impact	
		WSE [ft]	Velocity [ft/s]	WSE [ft]	Velocity [ft/s]	WSE [ft]	Velocity [ft/s]
75+00	0.97	110.07	21.22	110.07	21.22	0	0
70+00	0.87	107.73	23.28	107.73	23.28	0	0
65+00	0.78	109.41	19.45	109.41	19.45	0	0
63+20	0.75	110.36	17.41	110.36	17.41	0	0
62+70	0.74	110.38	17.27	110.38	17.27	0	0
62+28	0.73	**Southern Avenue Bridge**					
61+85	0.72	106.46	22.28	106.46	22.28	0	0
61+35	0.71	108.80	18.74	108.56	19.04	-0.24	0.3
60+00	0.68	108.25	19.36	107.89	19.83	-0.36	0.47
55+00	**0.59**	**107.76**	**18.99**	**107.14**	**19.82**	**-0.62**	**0.83**
50+00	0.50	107.96	17.55	107.43	18.17	-0.53	0.62
45+00	0.40	108.24	16.21	107.76	16.70	-0.48	0.49
43+20	0.37	108.20	16.06	107.70	16.55	-0.5	0.49
42+65	0.36	108.22	15.94	107.73	16.42	-0.49	0.48
42+26	0.35	**Garfield Avenue Bridge**					
41+86	0.34	108.16	15.90	107.65	16.40	-0.51	0.5
41+40	0.33	108.19	15.78	107.69	16.26	-0.5	0.48
40+00	0.31	108.23	15.52	107.73	15.98	-0.5	0.46
35+00	0.21	107.89	15.59	107.34	16.12	-0.55	0.53
30+00	0.12	108.12	14.52	107.59	14.96	-0.53	0.44
25+00	0.02	108.29	13.60	107.78	13.98	-0.51	0.38
24+75	0.02	108.36	13.41	107.86	13.78	-0.5	0.37
23+86	0.00	**WSAB Bridge/Existing UPRR Bridge**					
23+25	-0.01	107.85	13.52	107.85	13.52	0	0
20+00	-0.07	107.85	13.20	107.85	13.20	0	0

Note: ft = feet; ft/sec = feet per second

6.3 Overtopping Condition

Hydraulic analysis of the 500-year flows indicates that the peak water surface elevations are contained within the channel within the Project reach. Therefore, the overtopping event would be an extremely unlikely event with expected return interval greater than the 500 years.

Figure 6-1. Project Impacts to the Rio Hondo Floodplain



7 PROPERTY AT RISK

The inundation area for the Project is contained within the Rio Hondo, which is owned by the USACE and maintained by LACFCD. Inundation poses no threat to property at risk.

8 RISK ASSESSMENT

8.1 Risk Associated with Implementation

The change in water surface elevation in the Rio Hondo would not result in any significant change in flood risks or damage because flows would continue to be contained within the river channel. Implementation does not have the potential for interruption or termination of emergency service or emergency routes.

8.2 Impacts to Floodplain Values

Natural and beneficial floodplain values include, but are not limited to, fish, wildlife, plants, open space, natural beauty, scientific study, outdoor recreation, agriculture, forestry, natural moderation of floods, water quality maintenance and groundwater recharge. The Rio Hondo is a constructed channel in a developed urban area; therefore, changes to the floodplain are not expected to affect floodplain values. Because it is an engineered waterway with restricted public access, the channel does not provide open space, natural beauty or outdoor recreation value. It also has limited value to support fish, wildlife and plant habitat.

The Los Angeles Region Basin Plan lists the following beneficial uses for Rio Hondo Reach 1 (Los Angeles River Reach 2 to Santa Ana Freeway): Municipal and Domestic Supply (potential), Groundwater Recharge (intermittent), Warm Freshwater Habitat (potential) and Wildlife Habitat (intermittent). The Project is not anticipated to adversely affect these values.

8.3 Support of Incompatible Development

The proposed Project would not support incompatible development in the floodplain because it is presently urbanized and protected by the levee.

8.4 Minimization of Floodplain Impact

Impacts to the Rio Hondo floodplain have been minimized by aligning the geometry of the bridge as closely as possible to the existing UPRR bridge and by minimizing the length of new pier walls and orienting them in the direction of flow.

8.5 Restoration and Preservation of Floodplain Values

Because there would be no significant impacts to the floodplain and floodplain values, no restoration or preservation of floodplain values is required.

9 ALTERNATIVES TO LONGITUDINAL ENCROACHMENT

The Project would have no longitudinal encroachment into existing floodplains.

10 ALTERNATIVES TO SIGNIFICANT ENCROACHMENT

The proposed river crossing is designed to minimize physical impacts to flood control facilities. Therefore, there would be no significant encroachments. No alternatives to significant encroachment are required.

11 EXISTING WATERSHED AND FLOODPLAIN MANAGEMENT PROGRAMS

The Project complies with the existing watershed and floodplain management programs, including the *Los Angeles County Comprehensive Floodplain Management Plan* (LACDPW 2016) and the *Rio Hondo Watershed Management Plan* (San Gabriel & Lower Los Angeles Rivers and Mountains Conservancy [SGLLARMC] 2004).

The *Los Angeles County Comprehensive Floodplain Management Plan* describes coordinates existing flood planning operations, identifies high risk areas within LA County, and proposes risk minimization and mitigation strategies, e.g. working cooperatively with public agencies to minimize flood risk, minimizing development within the floodplain, and providing flood protection by maintaining existing flood control systems. This Project is consistent with these strategies.

The *Rio Hondo Watershed Management Plan* provides an organizing framework for municipalities, conservation organizations and individuals to work together to improve the water quality, health, habitat and recreation potential of the Rio Hondo Watershed (SGLLARMC 2004).

12 REFERENCES

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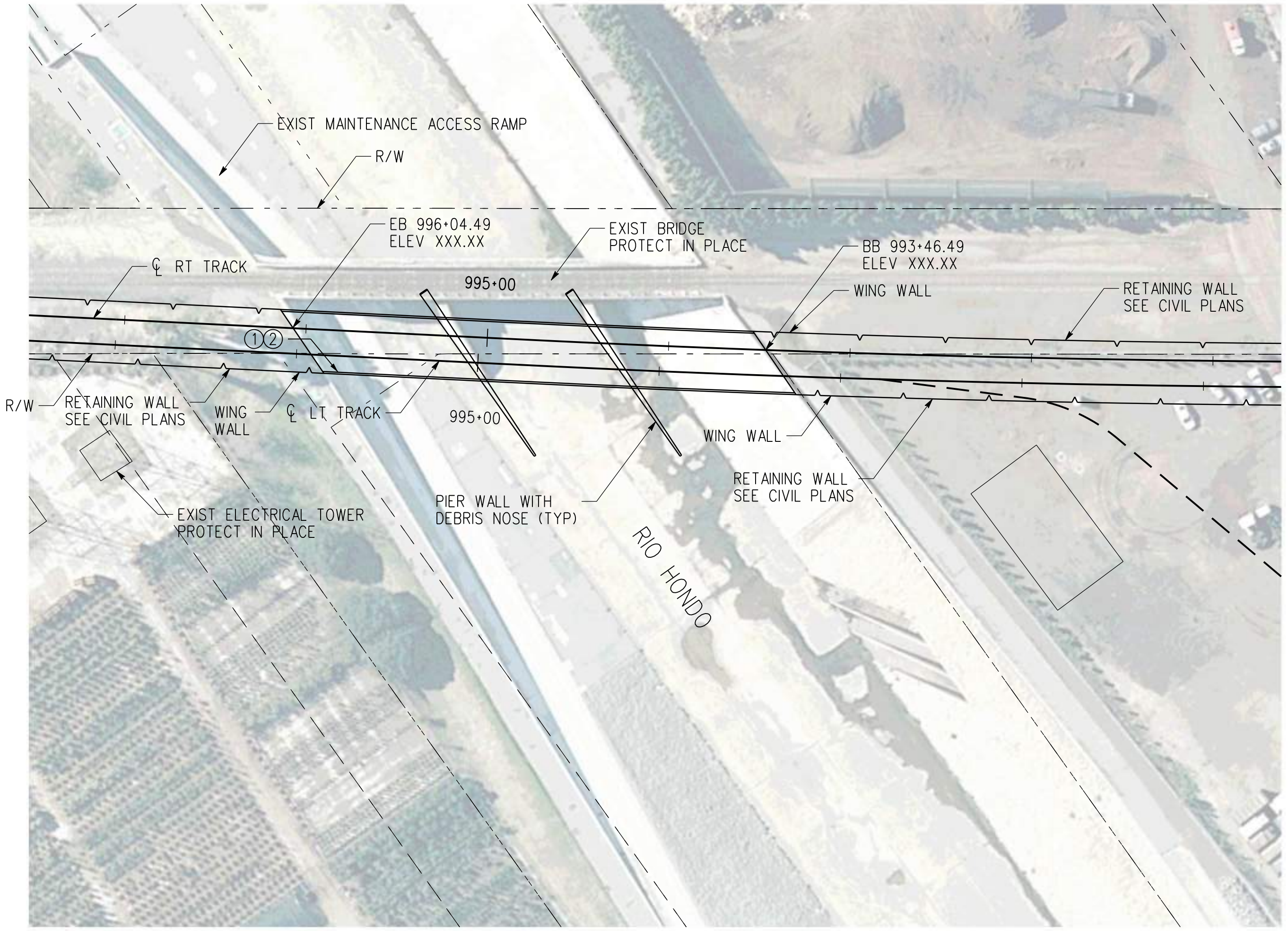
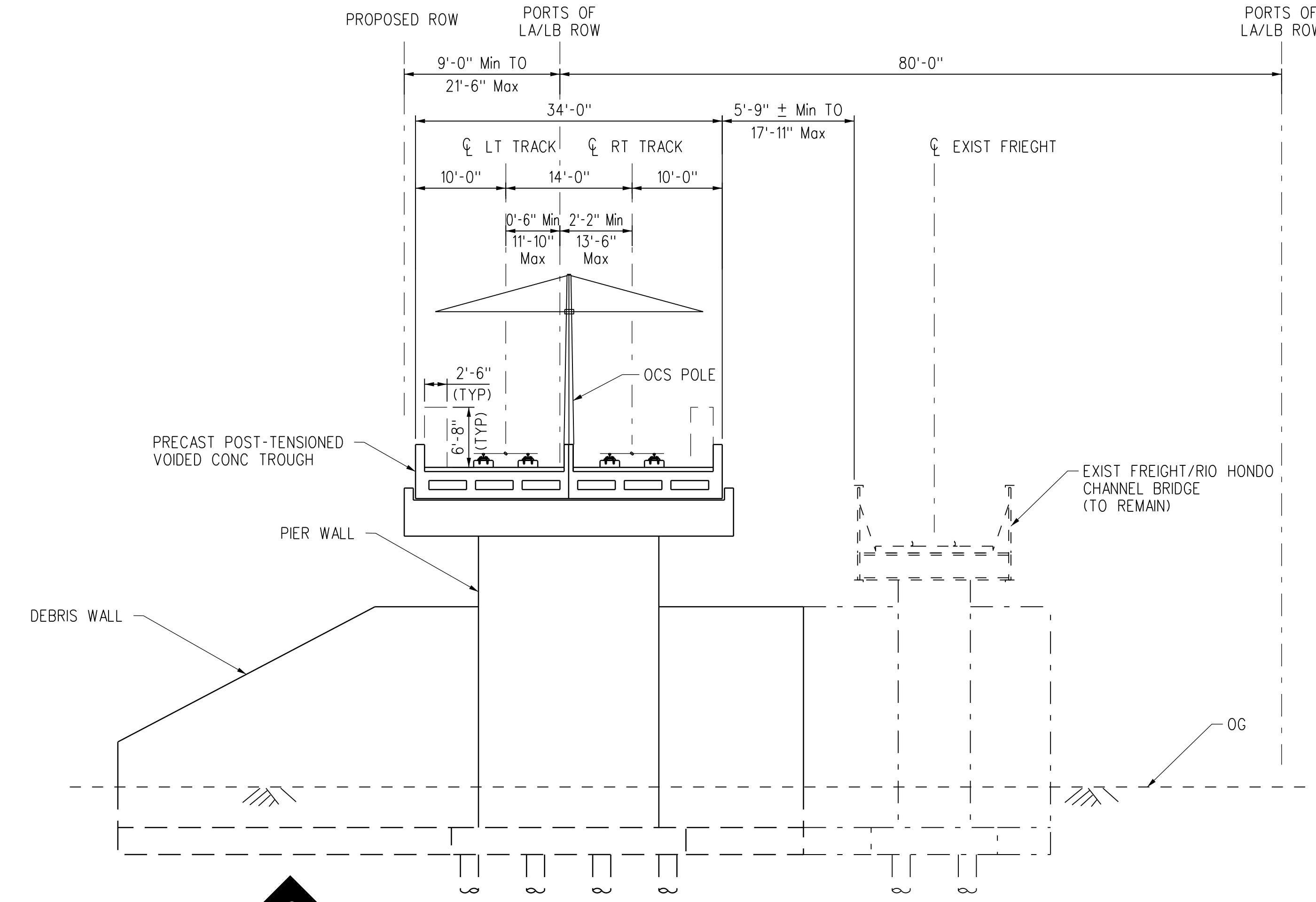
APPENDIX A RELEVANT DESIGN DATA

- Rio Hondo Bridge General Plan
- As-Built Plans
- FEMA FIRMette
- LHS Form



PLAN



TYPICAL SECTION

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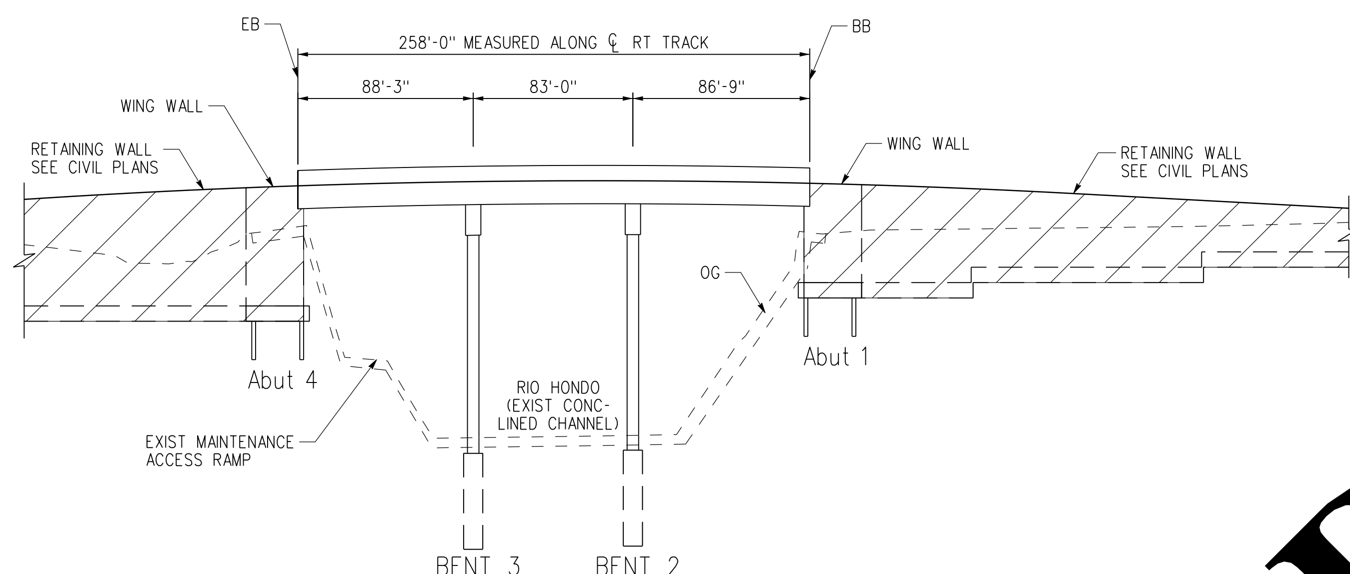


DEVELOPED ELEVATION

DRAFT

LEGEND:

① Paint "RIO HONDO CHANNEL CROSSING"

② Paint bridge number and year constructed

Denotes point of minimum vertical clearance

NOTES:

1. Maintain access to channel via existing maintenance channel ramp. 14'-6" minimum vertical clearance required under falsework.

2. Foundation information shown is preliminary. Geotechnical investigation required for determination of size and type of structure foundation.

200' 100' 0 200' 400'
HORIZ: 1"=200'

50' 0 50' 100'
VERT: 1"=50'

NOT FOR CONSTRUCTION

THE PREPARATION OF THIS DRAWING HAS BEEN FINANCED IN PART THROUGHT A GRANT FROM THE U.S. DEPARTMENT OF TRANSPORTATION FEDERAL TRANSIT ADMINISTRATION (FTA), UNDER THE FEDERAL TRANSIT ACT OF 1964, AS AMENDED, AND IN PART BY THE TAXES OF THE CITIZENS OF LOS ANGELES COUNTY AND OF THE STATE OF CALIFORNIA.

DESIGNED BY	J. POWELL
DRAWN BY	J. POWELL
CHECKED BY	TBD
IN CHARGE	CHARLES
DATE	AUGUST 2018

Metro
LOS ANGELES COUNTY
METROPOLITAN TRANSPORTATION AUTHORITY

WSP
444 South Flower Street
Suite 800
Los Angeles, CA 90071
TEL (213) 362-9470

SUBMITTED
APPROVED

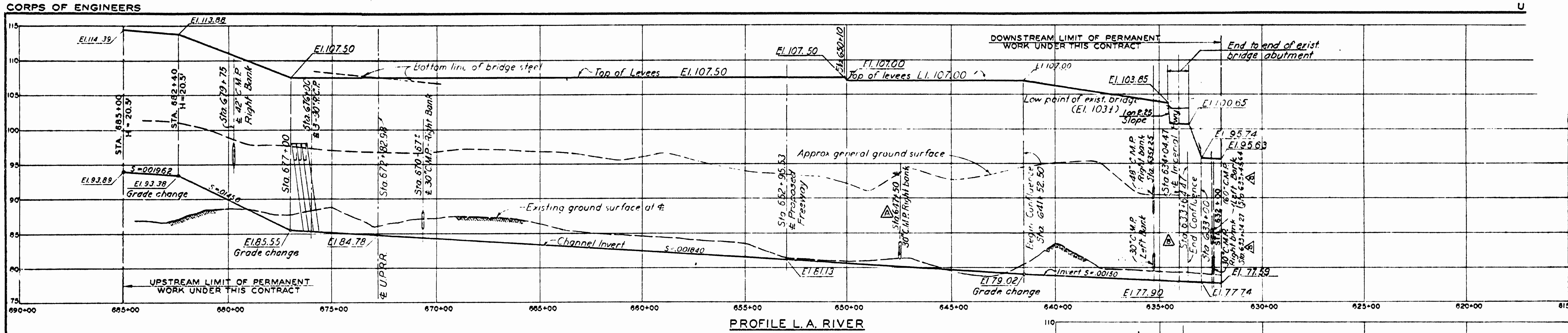
WEST SANTA ANA BRANCH LRT
STRUCTURAL DRAWING
RIO HONDO CHANNEL CROSSING
GENERAL PLAN
STATION 993+46.49 TO 996+04.49

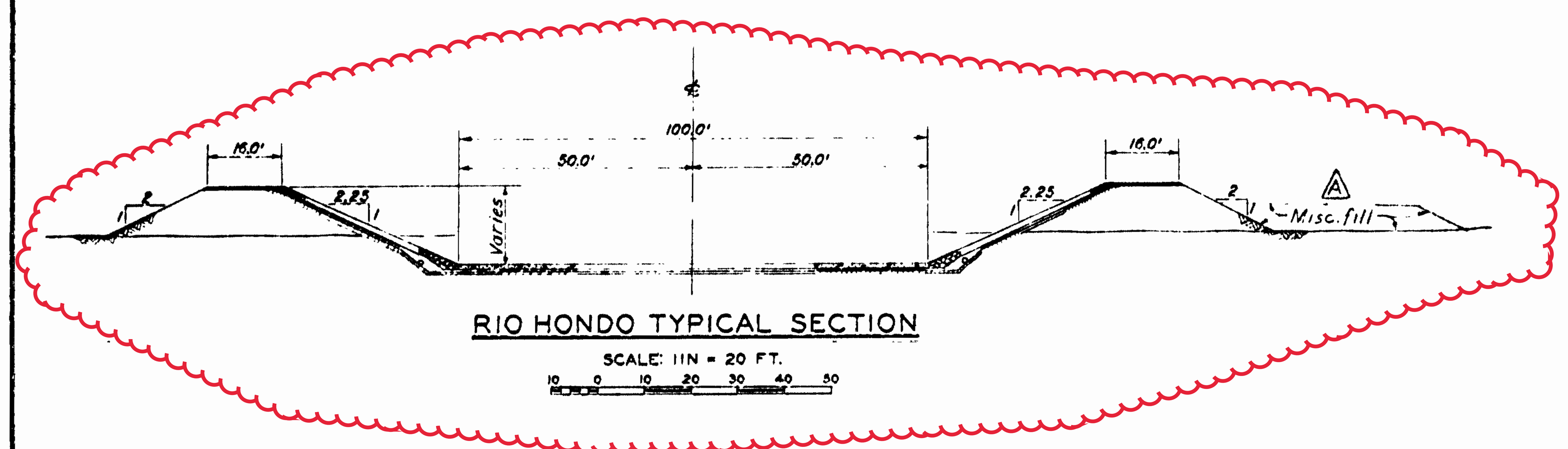
CONTRACT NO AE5999300
DRAWING NO
REV
SCALE
SHEET NO
OF

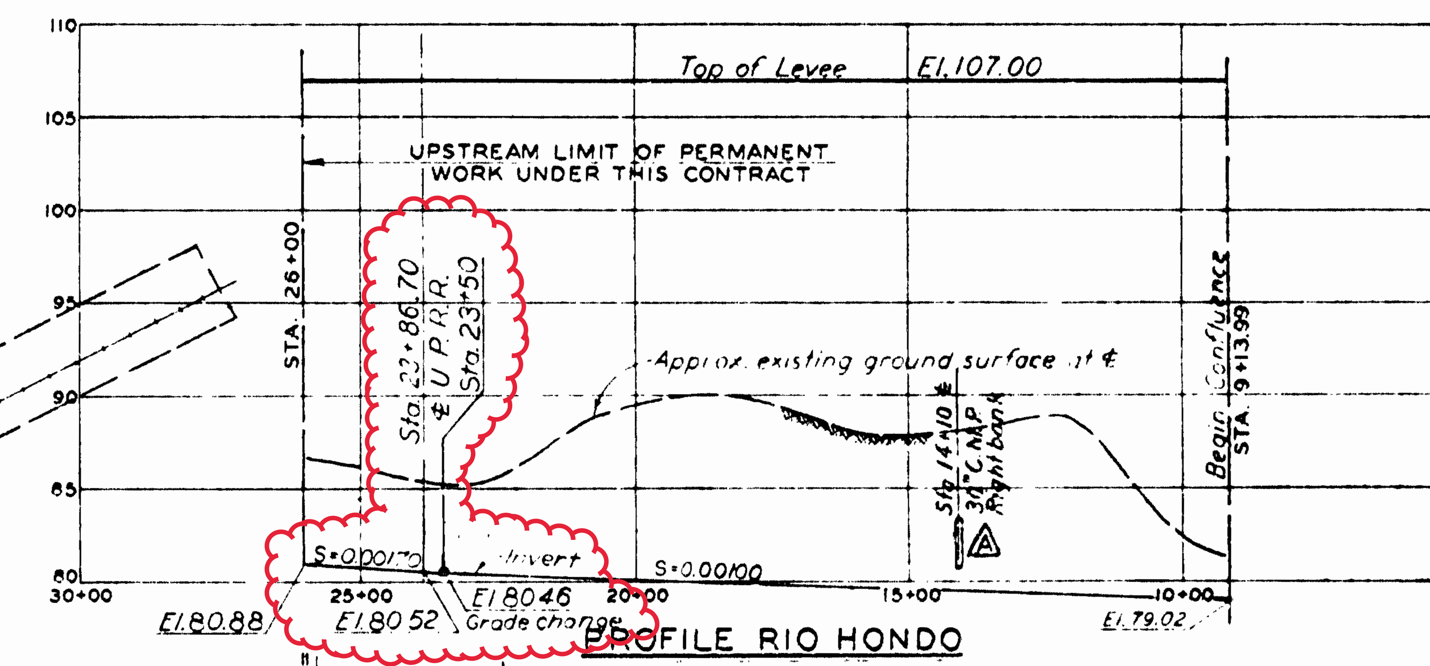
svc-projectwise 16:49 24-AUG-2018 GP 6 - Rio Hondo Channel.plg

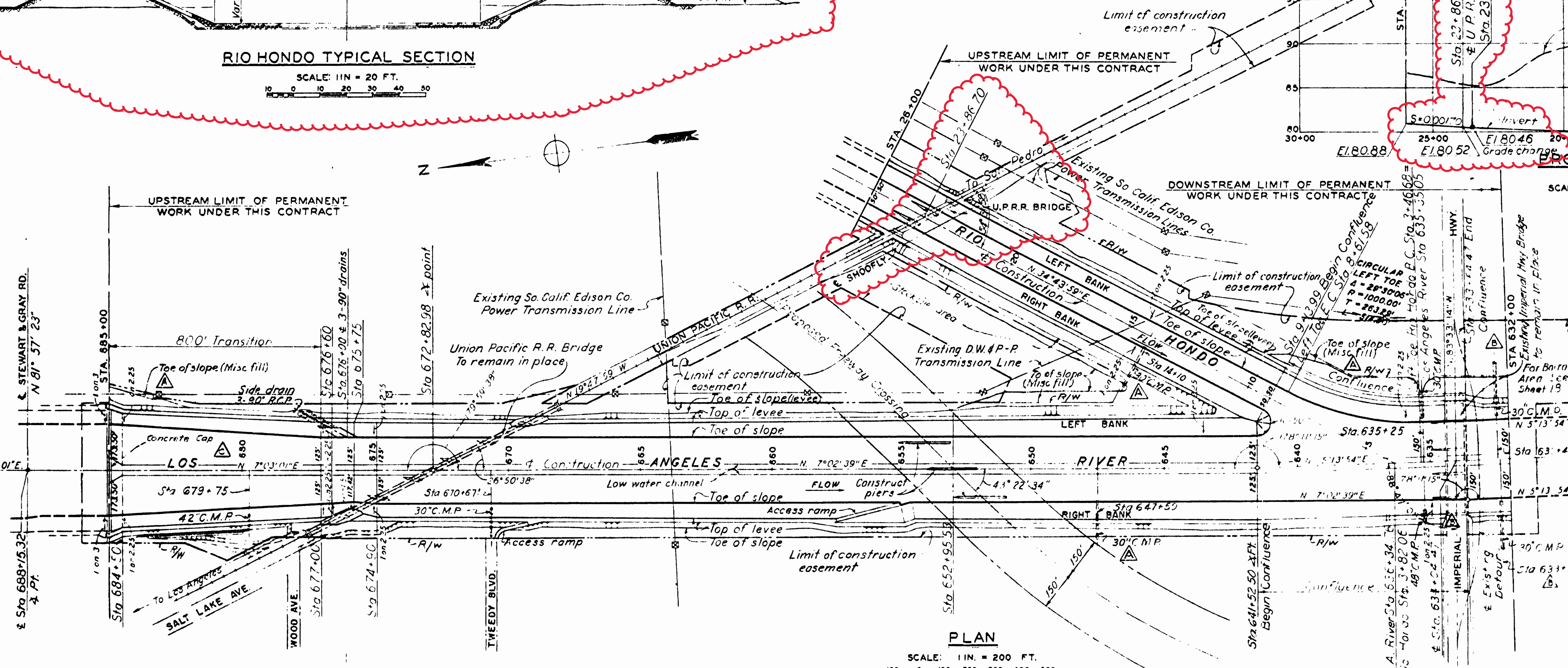
Plot Driver=MTA-half.pen Pentable=bw.plt

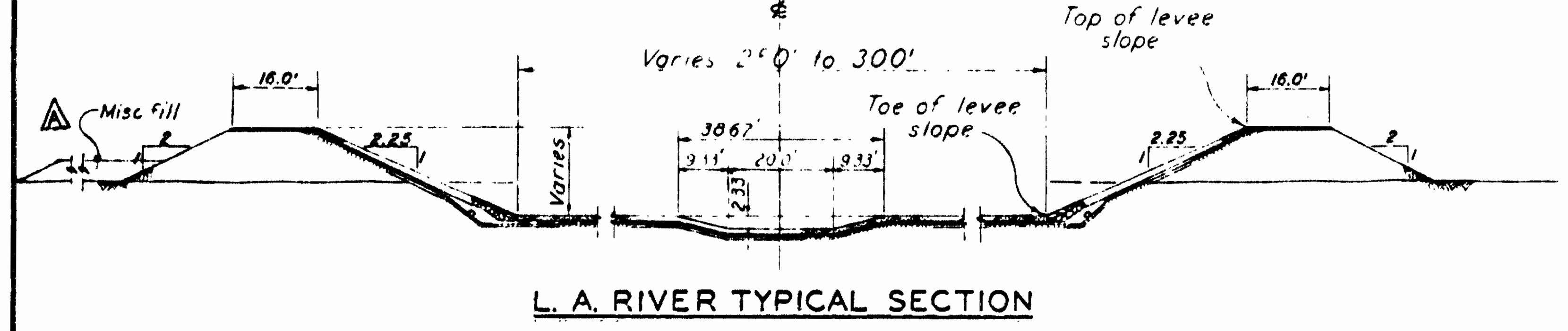
CORPS OF ENGINEERS











GENERAL NOTES

Utility note: Unless otherwise noted, public utilities will remain in place. Any further removal or relocation of utilities desired by the contractor, other than that noted on the drawings, will be made only with the approval of the owner and at the expense of the contractor.

Channel banks are indicated as left and right looking downstream.

All stations shown are on and are normal to the center line of construction.

All channel cross sections are shown looking downstream.

Stations and dimensions given to expansion joints refer to the center line of the joint.

All dimensions in plan are horizontal unless otherwise noted.

Dimensions shown to existing structures shall be verified in field.

Contractor shall take necessary precaution to protect existing structures.

Figures in circles indicate contract item number under which payment will be made.

D Indicates ½" expansion joint Type "D"

A Indicates ½" expansion joint Type "A"

R/W Indicates permanent channel right of way.

Remove all obstructions within the cut or fill limits unless otherwise noted.

All fences buildings and trees outside the cut or fill limits and within the limits of construction easement may be removed at the option of the contractor unless otherwise noted.

RECORD DRAWING - AS CONSTRUCTED

Contract DA 04-353-Eng 036 Rev C

POSTED BY: JHR DATE: 28 Jan 1952

POSTED BY ______ DATE: ______

POSTED BY ______ DATE: ______

DATUM IS MEAN SEA LEVEL

	DATE	REVISION	REV	CHK	APP
A	2-7-51	Revised side drains. Added misc. fill			
B	5-25-51	Revised side drains			
C	28 JAN 52	Added Concrete Cap at Station 685+00 As Built	JHR		

CORPS OF ENGINEERS, U. S. ARMY
OFFICE OF THE DISTRICT ENGINEER
LOS ANGELES, CALIFORNIA

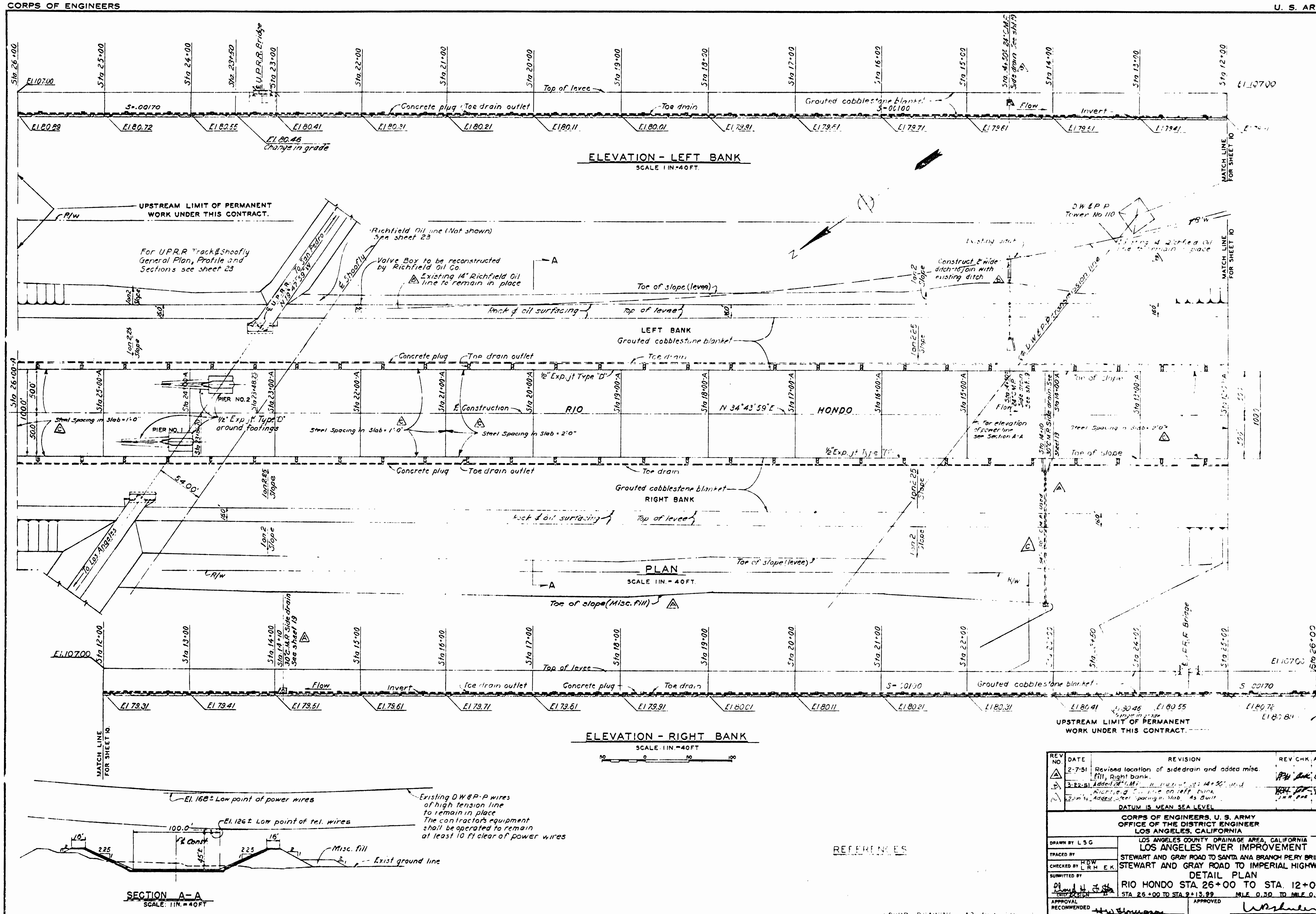
DRAWN BY E.R.F.
TRACED BY:
CHECKED BY H.D.W. L.R.H. E.K.
SUBMITTED BY: CHIEF, DESIGN

LOS ANGELES COUNTY DRAINAGE AREA, CALIFORNIA
LOS ANGELES RIVER IMPROVEMENT
STEWART AND GRAY ROAD TO SANTA ANA BRANCH P.E. RY. BRIDGE
STEWART AND GRAY ROAD TO IMPERIAL HIGHWAY
PLAN AND PROFILE
STA. 685+00 TO STA. 632+00
RIO HONDO STA. 26+00 TO STA. 9+13.99
STA 685+00 TO STA. 632+00 MILE 12.84 TO MILE 11.8

APPROVAL RECOMMENDED: CHIEF, ENGINEERING DIVISION
APPROVED: LT. COLONEL, C. E. DISTRICT ENGINEER

SCALE: AS SHOWN
DATE: DECEMBER 1950

TO ACCOMPANY SPECIFICATIONS CIVENG-04-353-51-13 DATED: 22 JANUARY 1951
SHEET 6 OF 37
FILE NO. (D O SERIES) 429/38 REV. C



REV NO.	DATE	REVISION	REV	CHK	APP
A	2-7-51	Revised location of sidedrain and added misc. fill, Right bank.			
B	3-22-51	Added 24" C.M.P. ... at sta 14+50 and Richfield ... on left bank			
C	9 Jun 52	Added steel spacing in slab. As Built			

DATUM IS MEAN SEA LEVEL

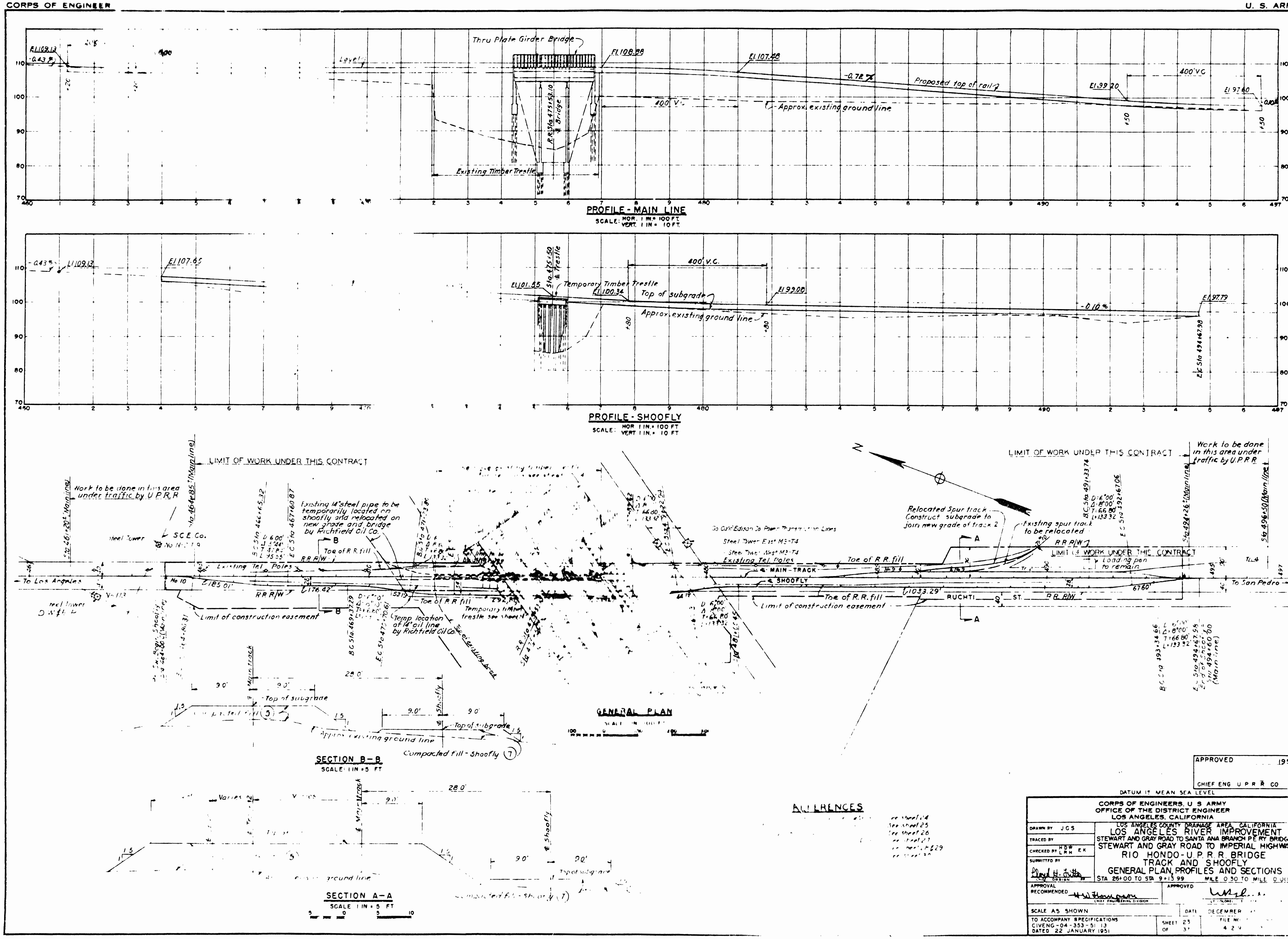
CORPS OF ENGINEERS, U. S. ARMY
OFFICE OF THE DISTRICT ENGINEER
LOS ANGELES, CALIFORNIA

DRAWN BY L S G
TRACED BY
CHECKED BY H.D.W. L.R.H. E.K.
SUBMITTED BY CHIEF, DESIGN

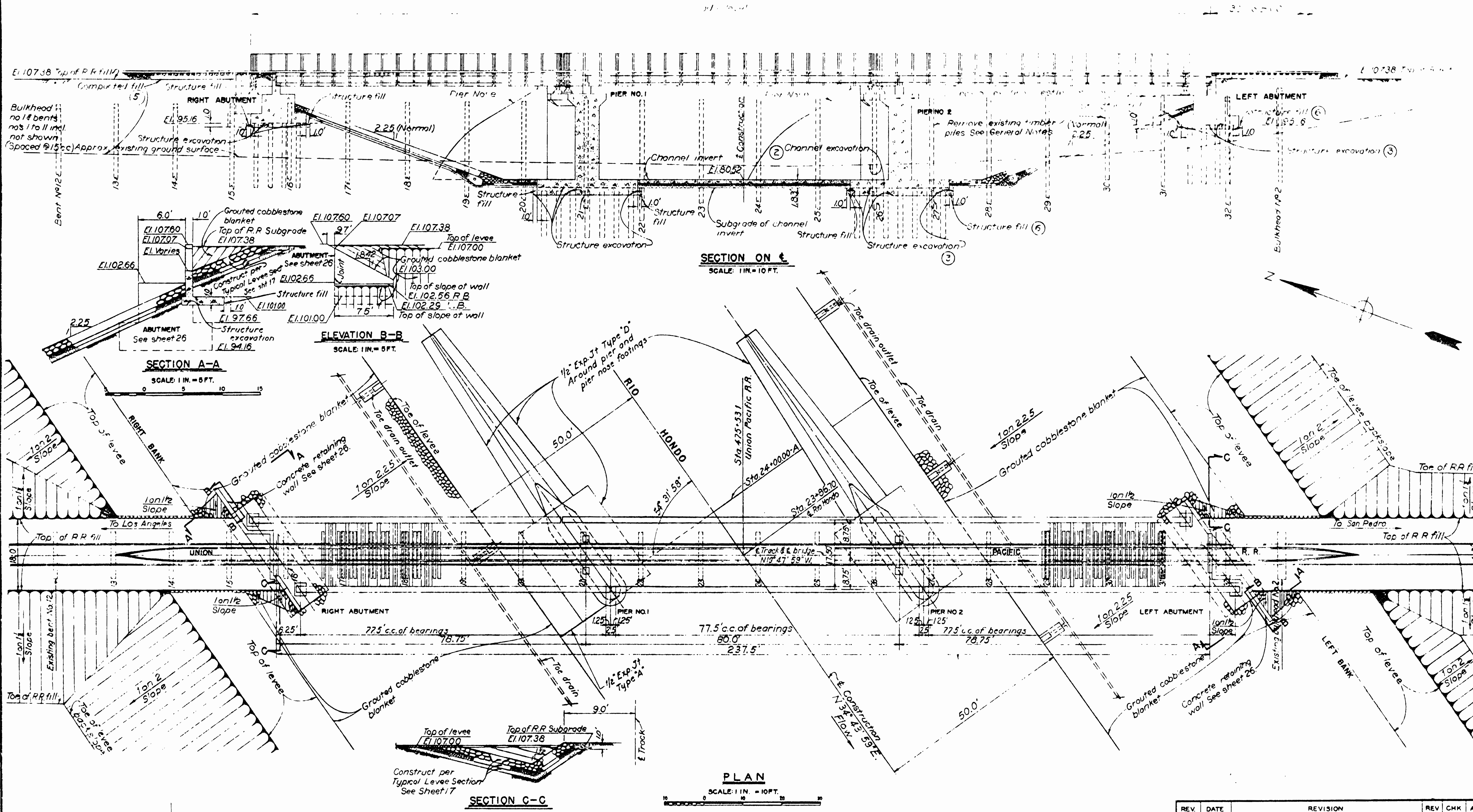
LOS ANGELES COUNTY DRAINAGE AREA, CALIFORNIA
LOS ANGELES RIVER IMPROVEMENT
STEWART AND GRAY ROAD TO SANTA ANA BRANCH P.E.RY BRIDGE
STEWART AND GRAY ROAD TO IMPERIAL HIGHWAY
DETAIL PLAN
RIO HONDO STA. 26+00 TO STA. 12+00
STA. 26+00 TO STA. 9+13.99 MILE 0.30 TO MILE 0.00

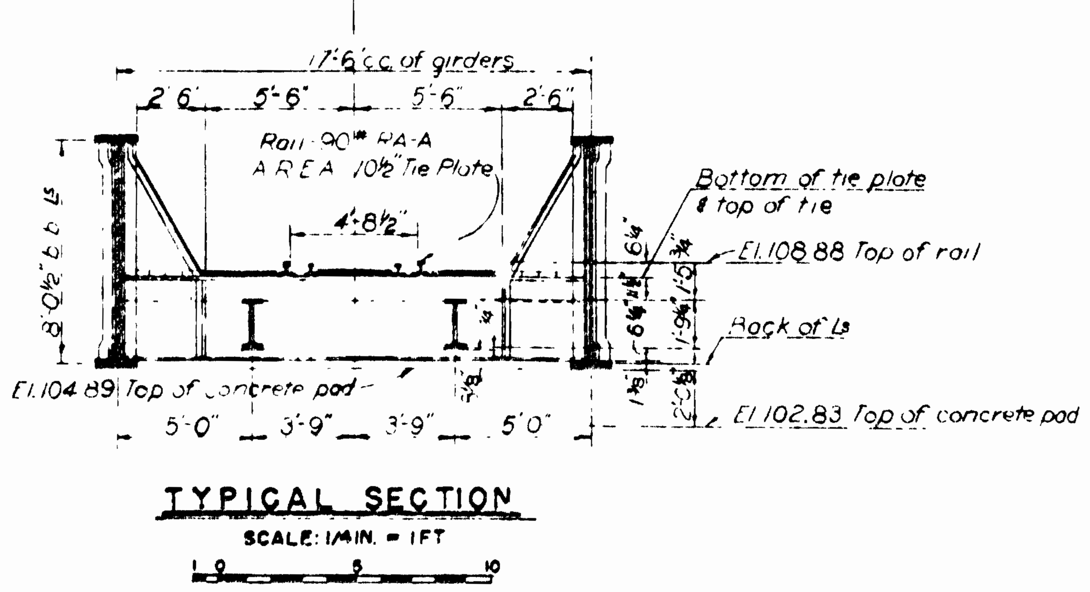
APPROVAL RECOMMENDED — CHIEF, ENGINEERING DIVISION
APPROVED — LT. COLONEL, C. E. DISTRICT ENGINEER

SCALE 1 IN = 40 FT
DATE DECEMBER 1950
TO ACCOMPANY SPECIFICATIONS OC2-CIV-51-13 DATED 9 APRIL 1951
SHEET 12 OF 37
FILE NO. (D.O. SERIES) 429/62 REV C



Thru Plate Girder Bridge
El.108.98
El.107.48
-0.72%
Proposed top of rail
El.99.20
400' V.C.
El.97.60
Approx. existing ground line
Existing Timber Trestle
PROFILE - MAIN LINE
SCALE: HOR. 1 IN. = 100 FT. VERT. 1 IN. = 10 FT.
El.109.13
El.107.65
400' V.C.
Temporary Timber Trestle
El.101.55
El.100.34
Top of subgrade
El.99.00
Approx. existing ground line
-0.10%
El.97.79
PROFILE - SHOOFLY
SCALE: HOR 1 IN. = 100 FT VERT 1 IN. = 10 FT
LIMIT OF WORK UNDER THIS CONTRACT
Work to be done in this area under traffic by U.P.R.R.
Existing 14" steel pipe to be temporarily located on shoofly and relocated on new grade and bridge by Richfield Oil Co.
Relocated Spur track Construct subgrade to join new grade of track 2
Existing spur track to be relocated
Toe of R.R. fill
R.R. R/W
Existing Tel. Poles
MAIN TRACK
SHOOFLY
To Los Angeles
To San Pedro
Limit of construction easement
Temp. location of 14" oil line by Richfield Oil Co.
Temporary timber trestle
RUCHTI ST.
Loading pen to remain
Top of subgrade
Approx. existing ground line
Compacted fill - Shoofly
SECTION B-B
SCALE: 1 IN. = 5 FT
GENERAL PLAN
SECTION A-A
SCALE 1 IN. = 5 FT
REFERENCES
DATUM IS MEAN SEA LEVEL
APPROVED 1951
CHIEF ENG. U.P.R.R. CO.
CORPS OF ENGINEERS, U.S. ARMY
OFFICE OF THE DISTRICT ENGINEER
LOS ANGELES, CALIFORNIA
LOS ANGELES COUNTY DRAINAGE AREA, CALIFORNIA
LOS ANGELES RIVER IMPROVEMENT
STEWART AND GRAY ROAD TO SANTA ANA BRANCH P.E. RY BRIDGE
STEWART AND GRAY ROAD TO IMPERIAL HIGHWAY
RIO HONDO - U.P.R.R. BRIDGE
TRACK AND SHOOFLY
GENERAL PLAN, PROFILES AND SECTIONS
SCALE AS SHOWN
TO ACCOMPANY SPECIFICATIONS CIVENG-04-353-51-13 DATED 22 JANUARY 1951





REFERENCE DRAWINGS

For Track and Shoofly-General Plan, Profiles and Sections — See sheet 23.
For Abutment Details — See sheet 26.
For Pier and Pier Nose Details — See sheet 27
For Superstructure Layout and Pedestal Details — See sheet 28
For Superstructure Details — See sheet 29.
For Pile Bearing Test — See sheet 30

GENERAL NOTES

Existing timber piles within footing areas or where they would interfere with concrete piles to be driven, shall be entirely removed and the voids filled with rammed sand and gravel (31)

Piles within areas to be paved, shall be cut off at either the existing ground line or at a point 2 feet below the subgrade, whichever is lower (31) All other piles shall be cut off at the existing ground line

Stringers and trackwork for existing bridge will be removed by U.P.R.R. Co. for complete work schedule see specifications

APPROVED ----------1951

CHIEF ENG U.P.R.R. CO.

REV.	DATE	REVISION	REV	CHK	APP
		DATUM IS MEAN SEA LEVEL			

CORPS OF ENGINEERS, U. S. ARMY
OFFICE OF THE DISTRICT ENGINEER
LOS ANGELES, CALIFORNIA

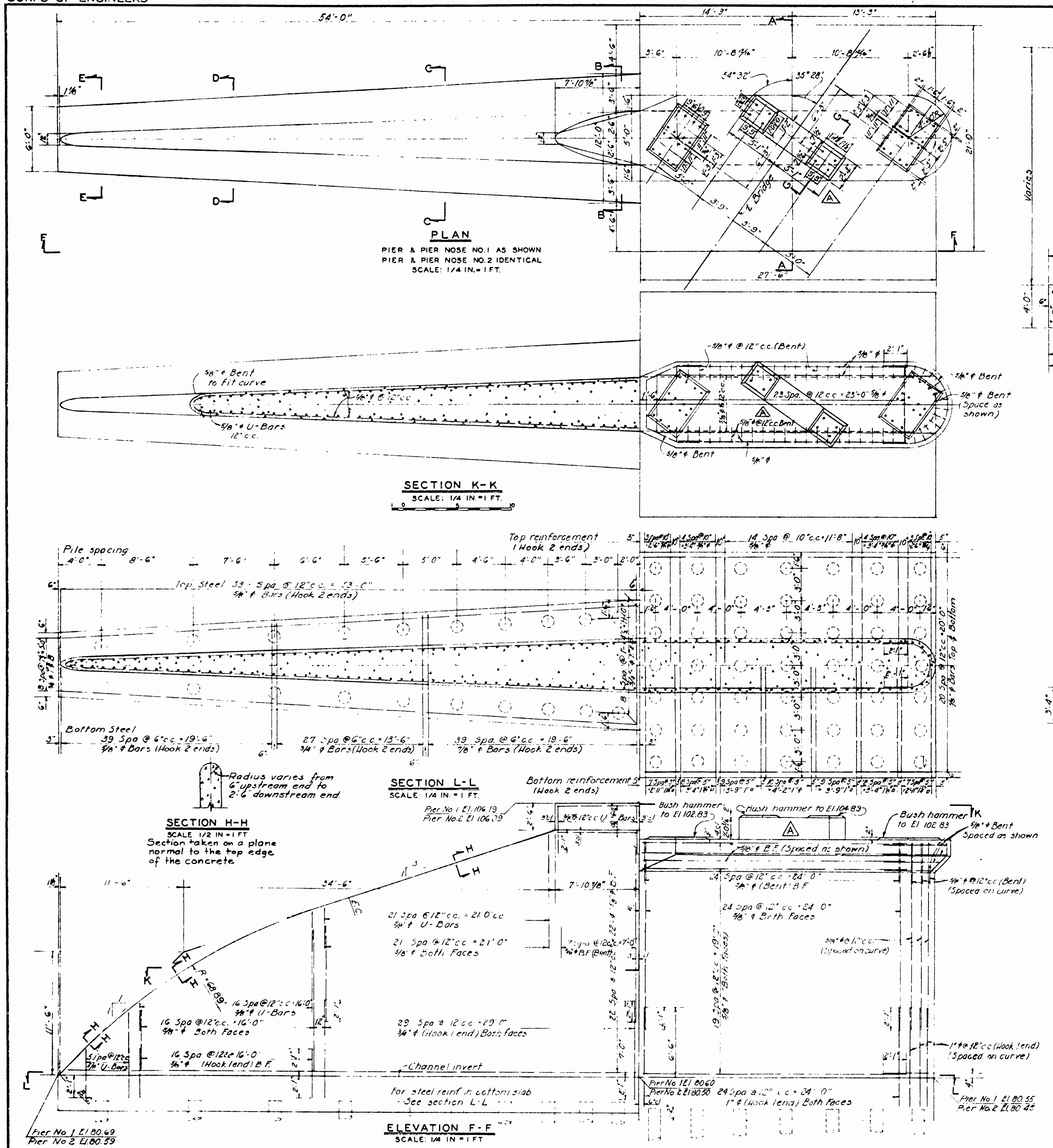
LOS ANGELES COUNTY DRAINAGE AREA, CALIFORNIA
LOS ANGELES RIVER IMPROVEMENT
STEWART AND GRAY ROAD TO SANTA ANA BRANCH P.E. RY. BRIDGE
STEWART AND GRAY ROAD TO IMPERIAL HIGHWAY
RIO HONDO-U.P. R.R. BRIDGE
PLAN AND SECTIONS
STA. 26+00 TO STA. 9+13.99 MILE 0.30 TO MILE 0.00

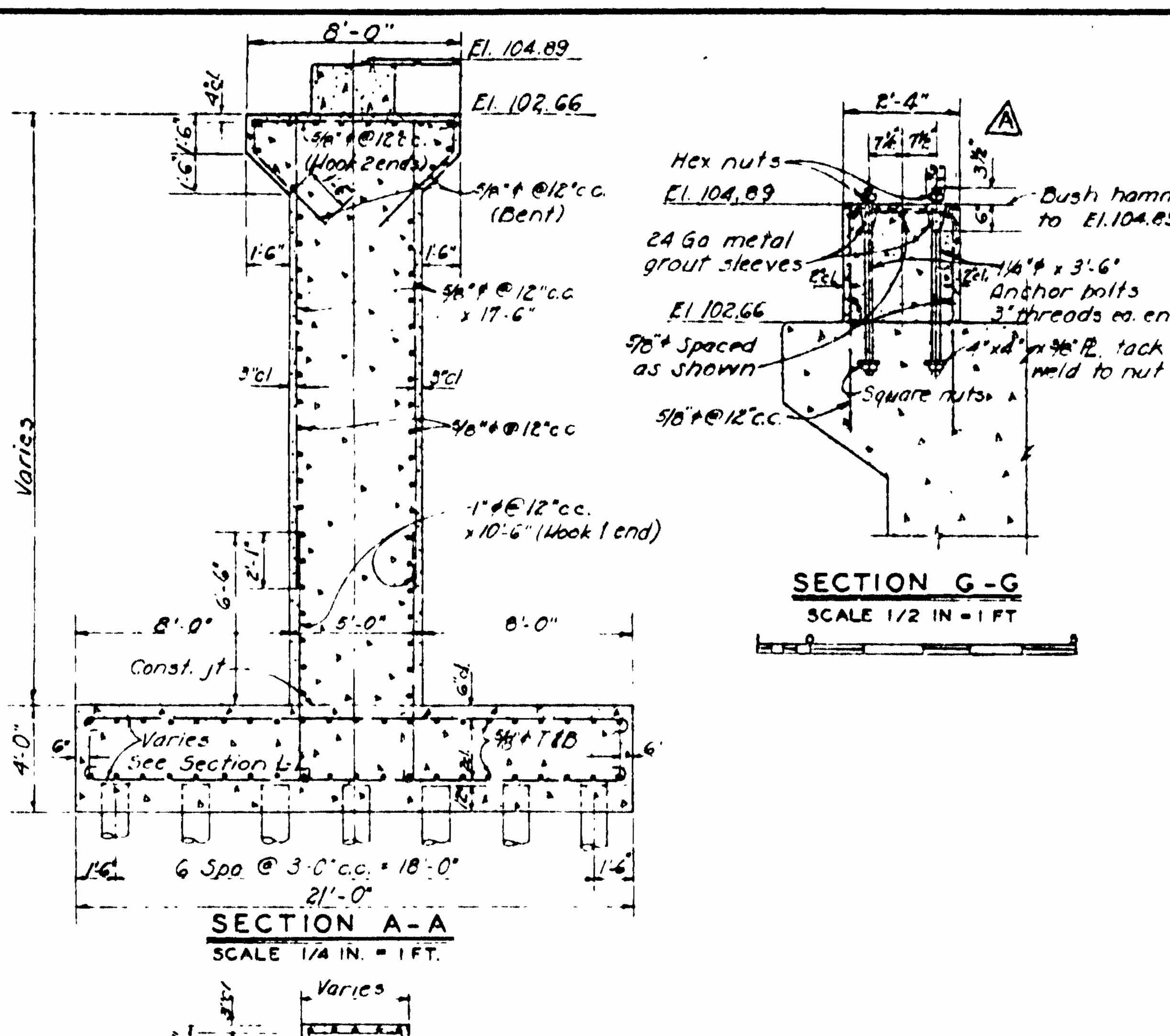
DRAWN BY: D.M.
TRACED BY
CHECKED BY: H.D.W. L.R.H. G.S.D. E.K.
SUBMITTED BY
CHIEF, DESIGN BR.

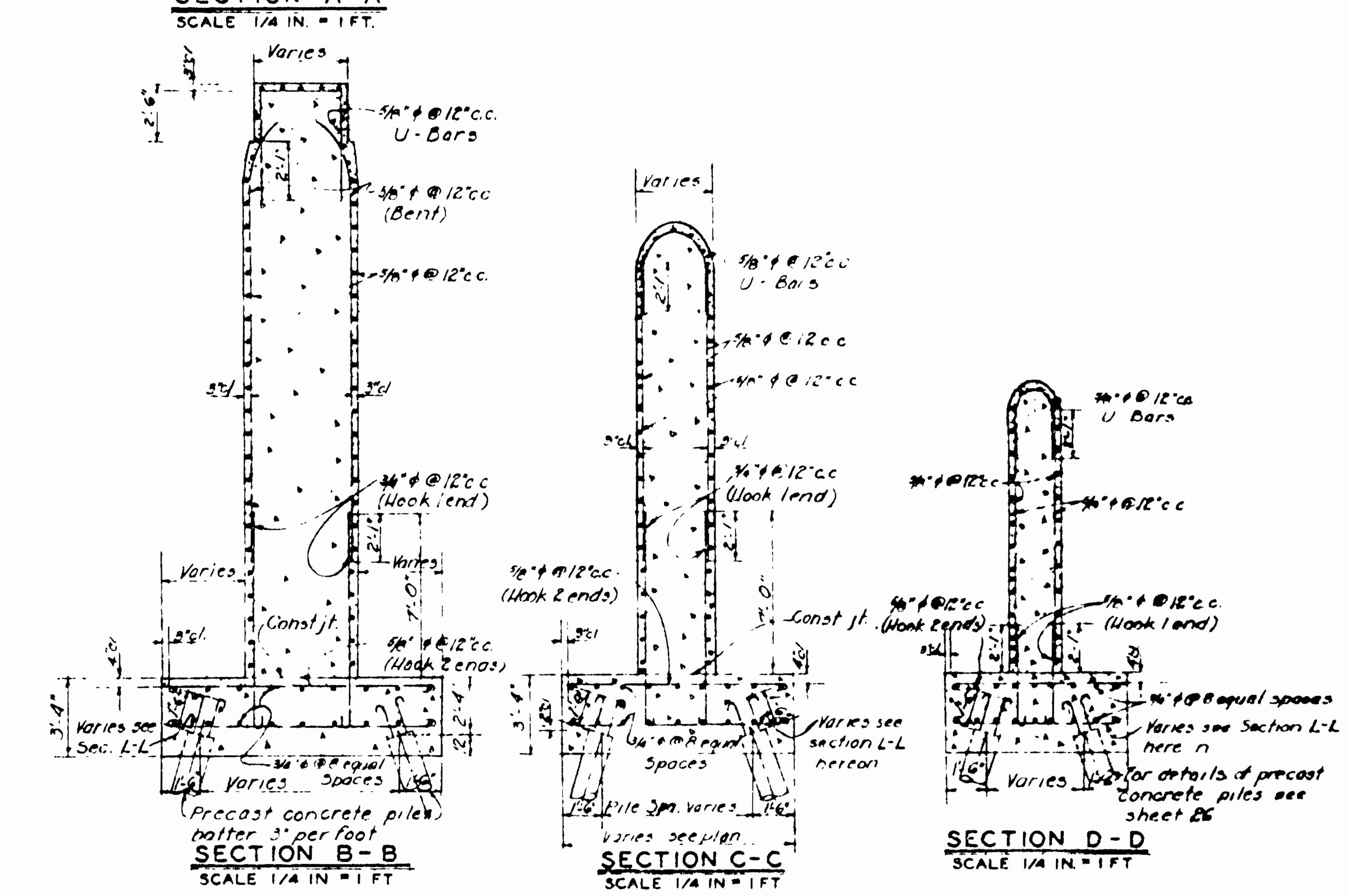
APPROVAL RECOMMENDED: CHIEF, ENGINEERING DIVISION
APPROVED: LT. COLONEL, C. E. DISTRICT ENGINEER

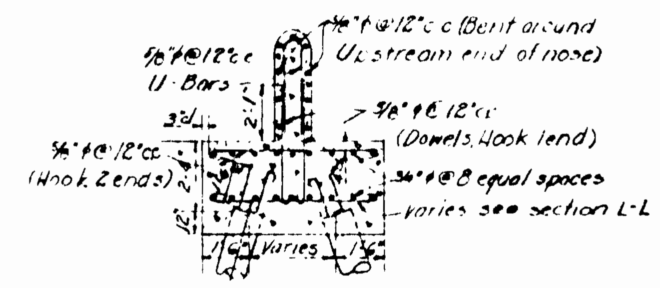
SCALE AS SHOWN — DATE: DECEMBER 1950

TO ACCOMPANY SPECIFICATIONS CIVENG-04-353-51-13 DATED: 22 JANUARY 1951 — SHEET 25 OF 37 — FILE NO. (D.O. SERIES) 429/78

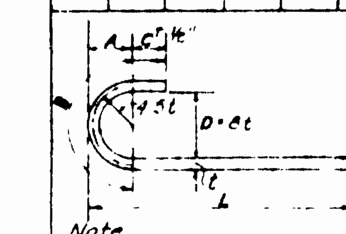








DIMENSIONS FOR 180° HOOKS					
BAR SIZE	A	B	C	D	B-A
1/2"	2 1/2"	10"	3"	4"	7 1/2"
5/8"	3 1/8"	1'-0"	3 1/4"	5"	9"
3/4"	3 3/4"	1'-2"	3 1/2"	6"	10 1/2"
7/8"	4 3/8"	1'-4"	3 3/4"	7"	11 1/2"
1"	5"	1'-6"	4"	8"	1'-1"
1 1/8"	5 5/8"	1'-8"	4 1/4"	9"	1'-2 1/2"
1 1/4"	6 1/4"	1'-10"	4 1/2"	10"	1'-4"



Note
Add length B-A to L in figuring total length of bar

HOOK DETAIL

GENERAL NOTES

For general notes — See sheets 25 & 26
Payment for all steel reinforcement shown hereon will be made under contract item (18) and for concrete under contract item (15)

REFERENCE DRAWING

For Plan and Sections of Bridge — See sheet 25
For Abutment Details — See sheet 26
For Pile Bearing Test — See sheet 30

DATUM IS MEAN SEA LEVEL

RECORD DRAWING - AS CONSTRUCTED
Contract DA 04 353 Eng 1036 — Rev A
POSTED BY: No change — DATE: 31 Jan 1952
POSTED BY: ______ DATE ______
POSTED BY: ______ DATE ______

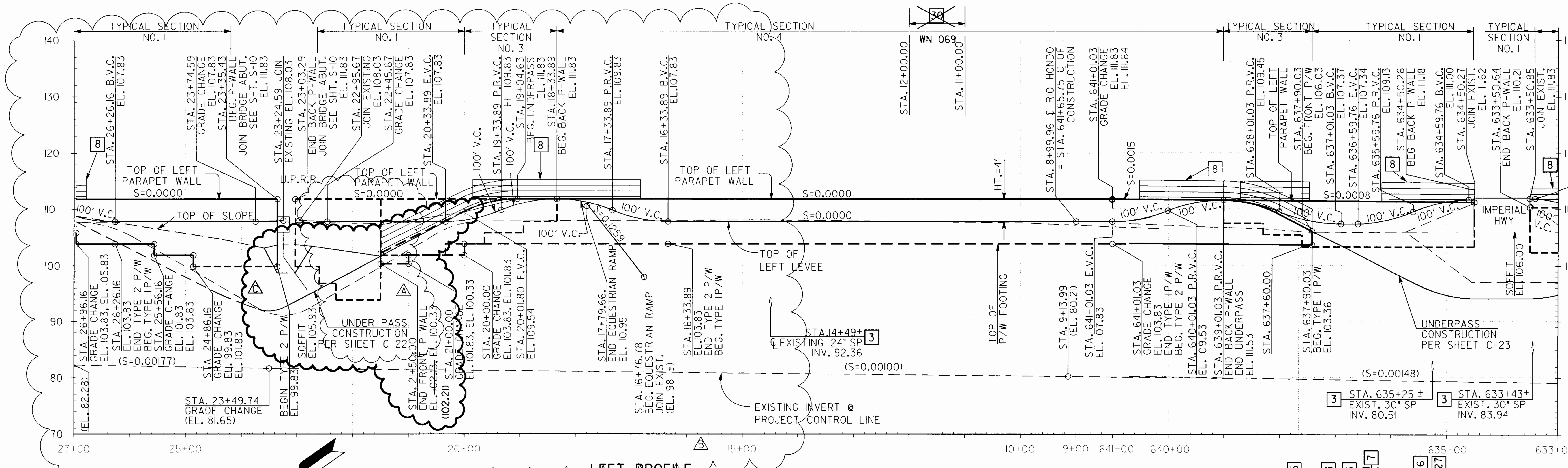
REV	DATE	REVISION	REV	CHK	APP
A	2-16-51	Revised pedestal seat	RLH	[illegible]	

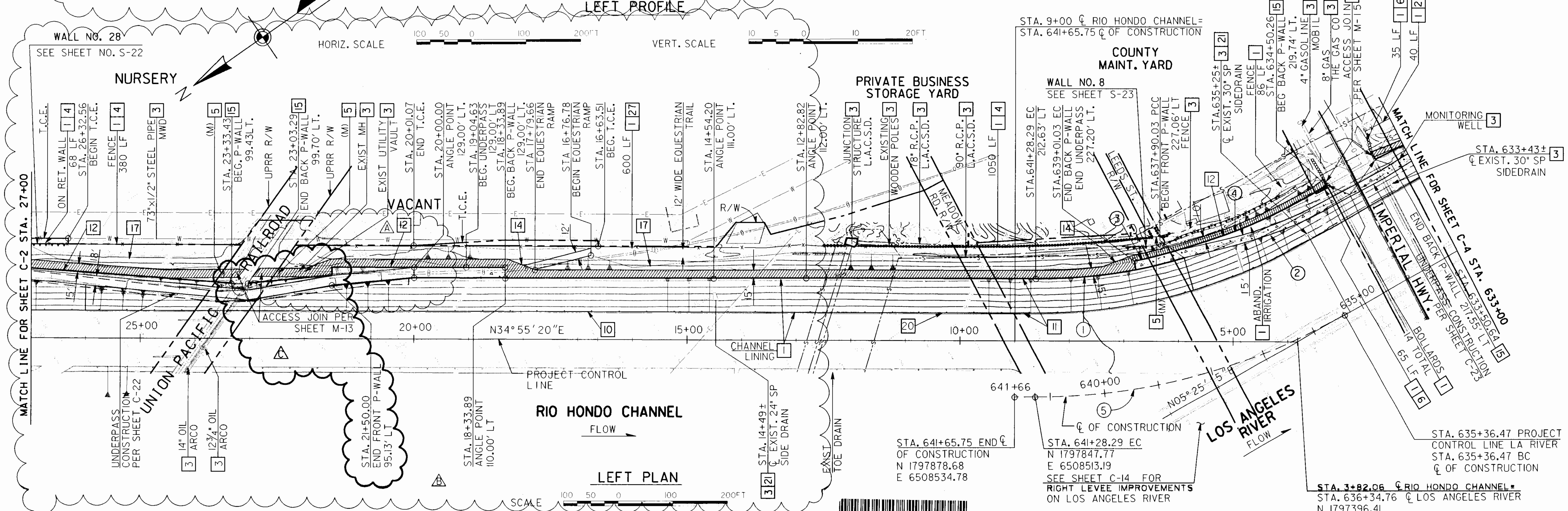
APPROVED 2 - 8 - 1951
S/ L P DREW
FOR CHIEF ENG U P R R CO

CORPS OF ENGINEERS, U. S. ARMY
OFFICE OF THE DISTRICT ENGINEER
LOS ANGELES, CALIFORNIA

LOS ANGELES COUNTY DRAINAGE AREA, CALIFORNIA
LOS ANGELES RIVER IMPROVEMENT
STEWART AND GRAY ROAD TO SANTA ANA BRANCH PE. RY BRIDGE
STEWART AND GRAY ROAD TO IMPERIAL HIGHWAY
RIO HONDO—U. P. R. R. BRIDGE
PIER AND PIER NOSE DETAILS
STA 26+00 TO STA 9+13 99 — MILE 0 30 TO MILE 0 00

DRAWN BY R L H
TRACED BY
CHECKED BY H D W, L R R, G S D, E K
SUBMITTED BY [signature] CHIEF DIVISION
APPROVAL RECOMMENDED: [signature] CHIEF ENGINEERING DIVISION
APPROVED [signature] LT COLONEL C E DISTRICT ENGINEER
SCALE AS SHOWN — DATE DECEMBER 1950
TO ACCOMPANY SPECIFICATIONS CIVENG-04-353-51-13 DATED 22 JANUARY 1951
SHEET 27 OF 37
FILE NO (D O SERIES) 429/77 REV "A"





CURVE DATA				
CURVE	R	Δ	L	T
①	900.00'	17°34'16"	276.01'	139.10
②	800.00'	15°20'18"	214.16'	107.73'
③	884.00'	5°46'19"	89.05'	44.56'
④	1100.00'	13°54'32"	267.03'	134.18'
⑤	1149.41'	29°30'05"	591.82'	302.63'

CONSTRUCTION NOTES:

- [1] REMOVE
- [3] PROTECT
- [4] CONSTRUCT CHAIN LINK FENCE, PER DETAIL SHEET M-3
- [5] CONSTRUCT CHAIN LINK GATE: ACCESS (A), MAINTENANCE (M), PEDESTRIAN (P), PER DETAIL SHEET M-3
- [6] CONSTRUCT ORNAMENTAL FENCING, PER DETAIL SHEET M-5
- [7] CONSTRUCT ORNAMENTAL GATE: ACCESS (A), MAINTENANCE (M), OR PEDESTRIAN (P), PER DETAIL SHEET M-5
- [8] CONSTRUCT SAFETY RAILING, LIMITS AND DETAILS PER DETAIL SHEET M-4
- [10] CONSTRUCT 10" THICK REINFORCED CONCRETE CHANNEL INVERT PER DETAIL SHEET S-1
- [11] CONSTRUCT 8" THICK REINFORCED CONCRETE CHANNEL LINING WITH ONE FOOT MINIMUM COMPACTED FILL PER DETAIL SHEET S-1
- [12] CONSTRUCT PARAPET WALL PER DETAIL SHEET S-3
- [14] CONSTRUCT TAPER PER DETAIL SHEET M-1
- [15] JOIN EXISTING BRIDGE ABUTMENT
- [17] TOE OF COMPACTED FILL SLOPE
- [20] PROTECT MANHOLE FOR SUBDRAIN IF MADE DEFECTIVE DURING CONSTRUCTION, SEE S-2 FOR SUBDRAIN DETAIL
- [21] CONSTRUCT EXPANSION JOINT FOR JOIN TO EXIST. SIDE DRAIN PER DETAIL SHT. S-2
- [27] ~~CONSTRUCT 8' CHAIN LINK FENCE WITH BARBED WIRE FENCE~~
- [30] ~~OMIT P-WALL AND PLANTING CONSTRUCTION FROM CONTRACT PER~~ LOS ANGELES COUNTY ~~SANITATION DISTRICT.~~ CLOSE GAP BETWEEN P-WALL AND ~~BRIDGE WING~~ WALL PER TEMPORARY BARRIER ~~DETAIL ON SHT. M-6.~~

WN 069

NOTE:
1. ~~TOPOGRAPHY COMPILED BY~~ PHOTOGRAMMETRIC METHODS BY ROBERT J. LUNG AND ASSOCIATES, ON APRIL 29, 1993.
2. CROSS SECTIONS PER SHEETS C-39 TO C-44

PF537188

REGISTERED PROFESSIONAL ENGINEER DAVID L. HUNT NO. 30514 EXP. 3-31-00 CIVIL ENGINEER STATE OF CALIFORNIA

AS-BUILT

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
C	REVISED UNDERPASS GEOMETRY RFI058		
B	REVISED UNDERPASS AND P-WALL		
A	NOTE 30 R/W, INVERT PAVING, SAFETY RAILING, P-WALL ALIGNMENT, STRUCT. DETAILS, GAGING STATION AND MISC. CLARIFICATIONS		

REVISIONS

LOS ANGELES COUNTY DRAINAGE AREA, CALIFORNIA
RIO HONDO/LOS ANGELES RIVER, FROM WHITTIER NARROWS DAM TO PACIFIC OCEAN
LOS ANGELES RIVER IMPROVEMENTS
(UNION PACIFIC RAILROAD TO ROSECRANS BOULEVARD)
RIO HONDO CHANNEL IMPROVEMENTS
(FIRESTONE BOULEVARD TO LOS ANGELES RIVER)
RIO HONDO LEFT LEVEE PLAN AND PROFILE
RIO HONDO STA. 27+00 TO LA RIVER STA. 633+00

DESIGNED BY: S.M./C.B.
DRAWN BY: Z.C./R.S.
CHECKED BY: J.M./K.T.
CADD FILE NAME: 500c3.dgn

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

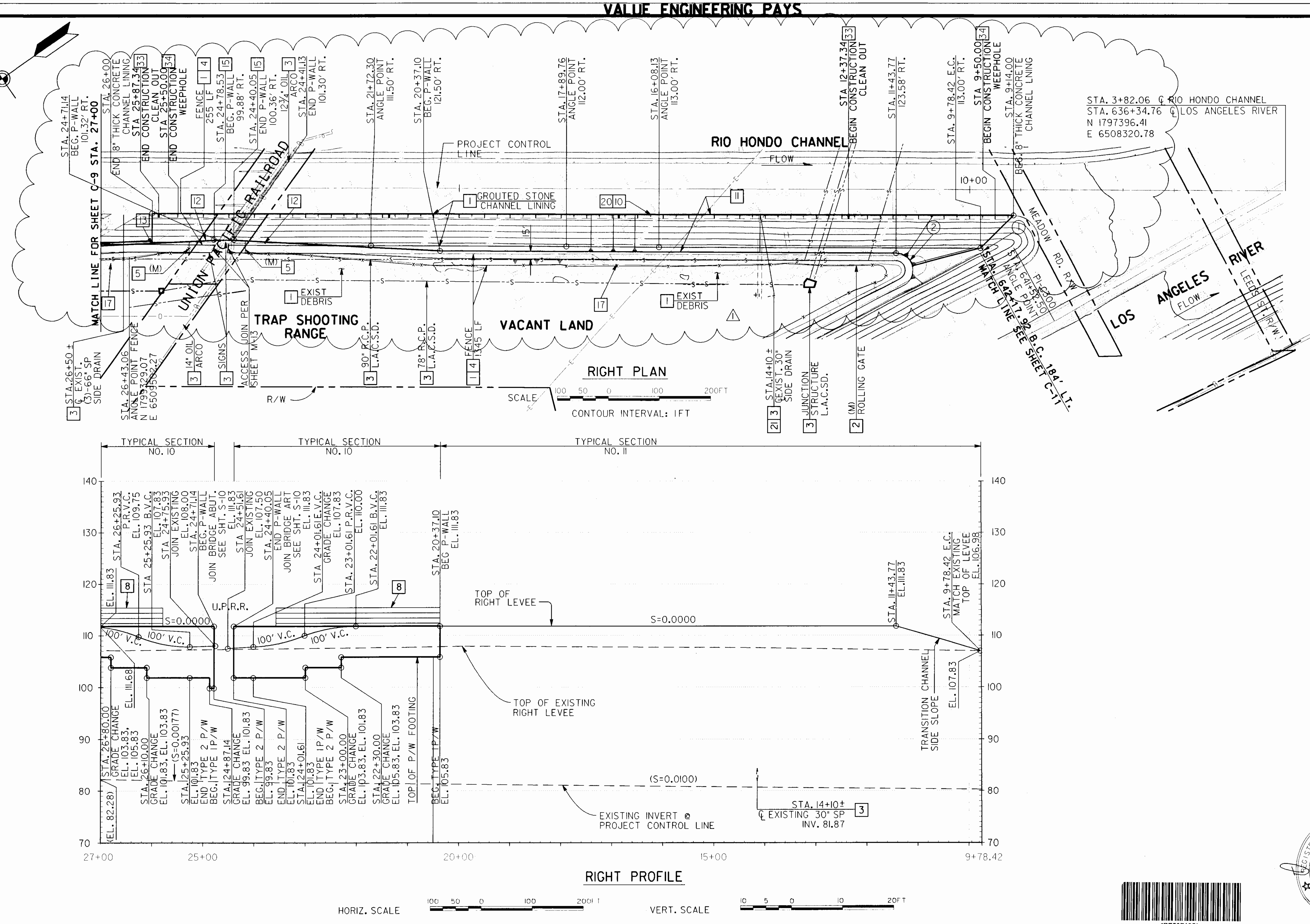
WILLDAN ASSOCIATES
888 S. WEST STREET, SUITE 300
ANAHEIM, CALIFORNIA 92802-1845

SUBMITTED BY:
THOMAS H. SAGE, P.E.
CHIEF, DESIGN BRANCH

DISTRICT FILE NO. 470/65 REV. A
DACW09-00-B-0002

SHEET C-3 OF C-64 SHEETS

Date: 12/5/2002 Plotted by: smcrack@pnspc:q:\jm258\rev_at_rhandupr_underpass\500c03c.dgn



CONSTRUCTION NOTES:

1. REMOVE
2. RELOCATE
3. PROTECT
4. CONSTRUCT CHAIN LINK FENCE, PER DETAIL SHEET M-3
5. CONSTRUCT CHAIN LINK GATE: ACCESS (A), MAINTENANCE (M), PEDESTRIAN (P), PER DETAIL SHEET M-3
8. CONSTRUCT SAFETY RAILING, LIMITS AND DETAILS PER DETAIL SHEET M-4
10. CONSTRUCT 10" THICK REINFORCED CONCRETE CHANNEL INVERT PER DETAIL SHEET S-1
11. CONSTRUCT 8" THICK REINFORCED CONCRETE CHANNEL LINING WITH ONE FOOT MINIMUM COMPACTED FILL PER DETAIL SHEET S-1
12. CONSTRUCT PARAPET WALL PER DETAIL SHEET S-3
13. CONSTRUCT 12 INCH THICK GROUTED STONE CHANNEL LINING DETAIL PER SHEET S-1
15. JOIN EXISTING BRIDGE ABUTMENT
17. TOE OF COMPACTED FILL SLOPE
20. PROTECT MANHOLE FOR SUBDRAIN AND SUBDRAIN SYSTEM IF MADE DEFECTIVE DURING CONSTRUCTION
21. CONSTRUCT EXPANSION JOINT FOR JOIN TO EXIST. SIDE DRAIN PER DETAIL SHT. S-2
33. CONSTRUCT 6" CLEAN OUT Y EVERY 450' PER DETAIL SHT. M-7
34. CONSTRUCT WEEPHOLE APPROXIMATELY 25' FROM EXISTING WEEPHOLE PER DETAIL SHEET M-7

NOTE:
1. TOPOGRAPHY COMPILED BY PHOTOGRAMMETRIC METHODS BY ROBERT J. LUNG AND ASSOCIATES, ON APRIL 29, 1993.
2. CROSS SECTIONS PER SHEETS C-54 TO C-55

CURVE DATA

CURVE	R	Δ	L	T
1	5.00'	152° 18' 40"	13.29'	20.28'
2	33.00'	152° 18' 40"	87.72'	133.90'

AS-BUILT

REVISIONS

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
1	CONSTRUCTION OF WEEPHOLE AND CLEAN OUT ADDED		

LOS ANGELES COUNTY DRAINAGE AREA, CALIFORNIA
RIO HONDO/LOS ANGELES RIVER FROM WHITTIER NARROWS DAM TO PACIFIC OCEAN
LOS ANGELES RIVER IMPROVEMENTS
CENTURY FREEWAY (ROUTE 105) TO LONG BEACH BOULEVARD
RIO HONDO RIGHT LEVEE PLAN AND PROFILE
STA. 27+00 TO STA. 9+14.00

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: S.M./C.B.
DRAWN BY: Z.C./R.S.
CHECKED BY: J.B.M./K.T.

WILLDAN ASSOCIATES
888 S. WEST STREET, SUITE 300
ANAHEIM, CALIFORNIA 92802-1845

SUBMITTED BY: ARTHUR T. SHAK
ACTING CHIEF, DESIGN BRANCH

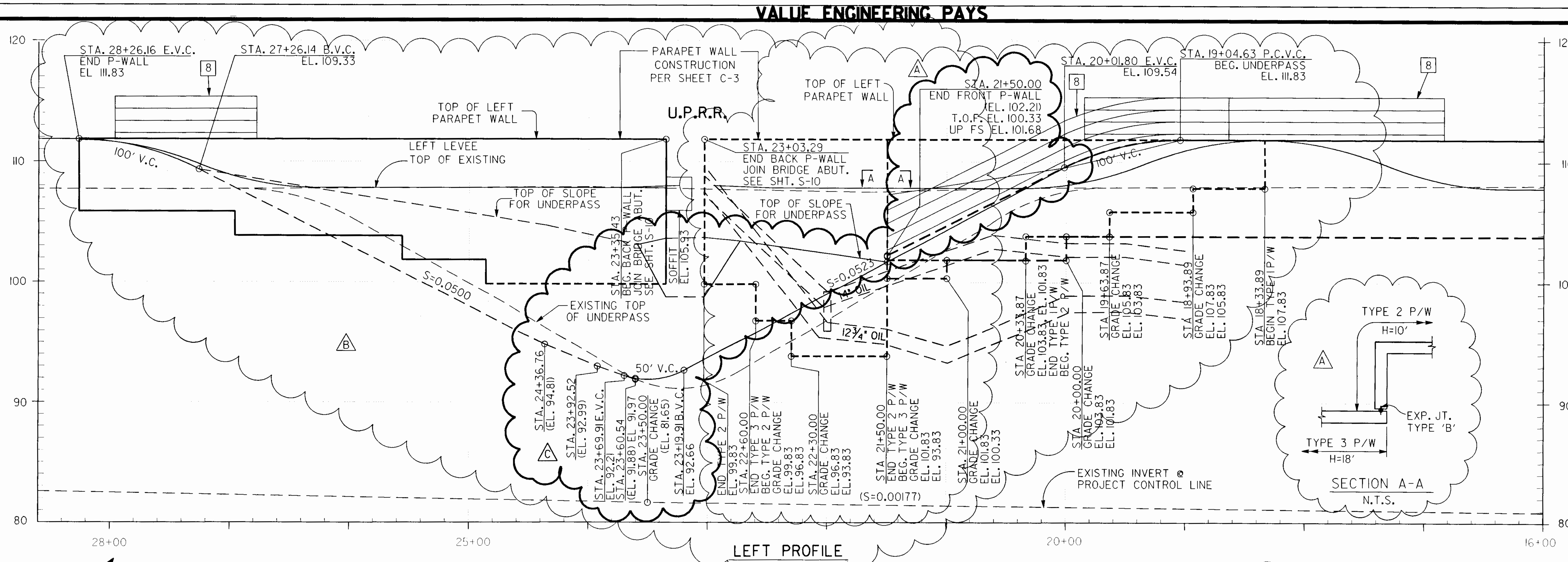
DACW-09-98B-0027
CADD FILE NAME: 500c10.dgn
DISTRICT FILE NO. 72

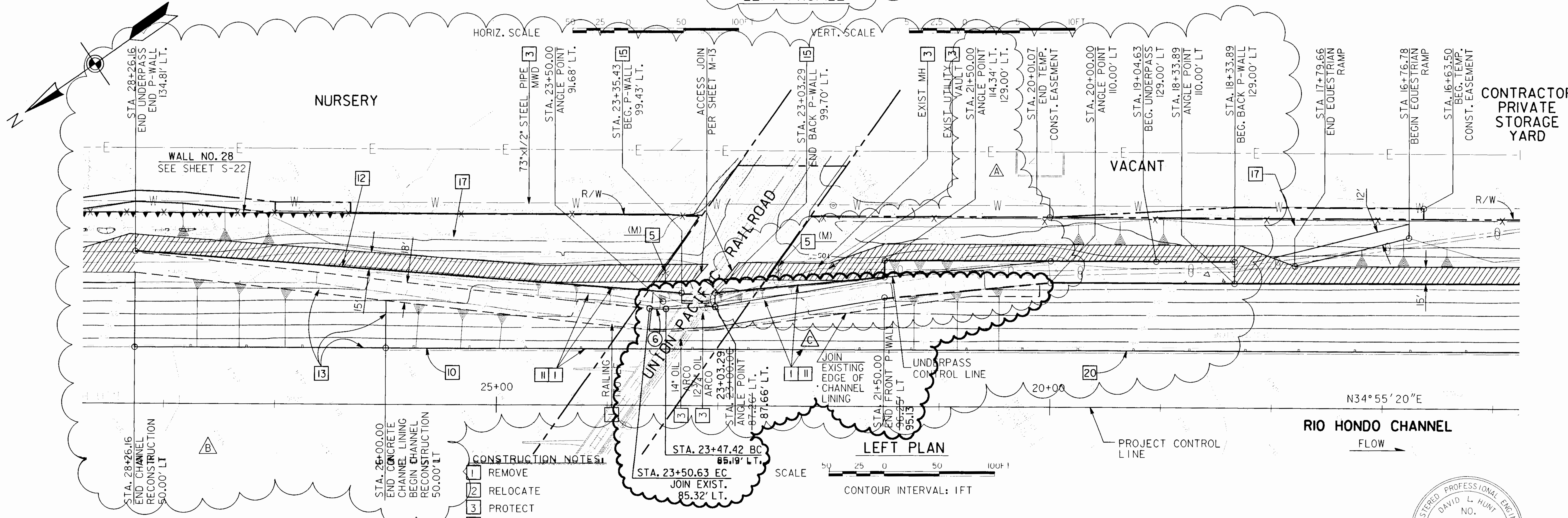
SHEET C-10 OF C-52 SHEETS

REGISTERED PROFESSIONAL ENGINEER DAVID L. HUNT NO. 30514 EXP. 3-31-00 CIVIL ENGINEER STATE OF CALIFORNIA

Plotted by: Date: 12/5/2002

VALUE ENGINEERING PAYS





CURVE DATA				
CURVE	R	Δ	L	T
(1)	900.00'	17°34'16"	276.01'	139.10
(2)	800.00'	15°20'18"	214.16'	107.73'
(3)	884.00'	5°46'19"	89.05'	44.56'
(4)	1100.00'	13°54'32"	267.03'	134.18'
(5)	1149.41'	29°30'05"	591.82'	302.63'
(6)	100.00'	7°31'18"	13.13'	6.57'

CONSTRUCTION NOTES:

1. REMOVE
2. RELOCATE
3. PROTECT
4. CONSTRUCT CHAIN LINK FENCE, PER DETAIL SHEET M-3
5. CONSTRUCT CHAIN LINK GATE: ACCESS (A), MAINTENANCE (M), PEDESTRIAN (P), PER DETAIL SHEET M-3
6. CONSTRUCT ORNAMENTAL FENCING, PER DETAIL SHEET M-5
7. CONSTRUCT ORNAMENTAL GATE: ACCESS (A), MAINTENANCE (M), OR PEDESTRIAN (P), PER DETAIL SHEET M-5
8. CONSTRUCT SAFETY RAILING, LIMITS AND DETAILS PER DETAIL SHEET M-4
10. CONSTRUCT 10" THICK REINFORCED CONCRETE CHANNEL INVERT PER DETAIL SHEET S-1
11. CONSTRUCT 8" THICK REINFORCED CONCRETE CHANNEL LINING WITH ONE FOOT MINIMUM COMPACTED FILL PER DETAIL SHEET S-1
12. CONSTRUCT PARAPET WALL PER DETAIL SHEET S-3
13. CONSTRUCT 12 INCH THICH GROUTED STONE CHANNEL LINING DETAIL PER SHEET S-1
14. CONSTRUCT TAPER PER DETAIL SHEET M-1
15. JOIN EXISTING BRIDGE ABUTMENT
17. TOE OF COMPACTED FILL SLOPE
20. PROTECT MANHOLE FOR SUBDRAIN IF MADE DEFECTIVE DURING CONSTRUCTION, PER DETAIL SHEET S-1

(C) SEE SHEET C-39 FOR CHANNEL LINING SLOPE DETAIL AT UPRR BRIDGE ABUTMENT

PF537207

NOTE:

1. TOPOGRAPHY COMPILED BY PHOTOGRAMMETRIC METHODS BY ROBERT J. LUNG AND ASSOCIATES, ON APRIL 29, 1993

REGISTERED PROFESSIONAL ENGINEER DAVID L. HUNT NO. 30514 EXP. 3-31-00 CIVIL ENGINEER STATE OF CALIFORNIA

AS-BUILT

SAFETY PAYS

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
(A)	REVISED UNDERPASS GEOMETRY RFI 058		
(B)	REVISED UNDERPASS AND P-WALL		
(C)	NOTE 30 R/W, INVERT PAVING, SAFETY RAILING, P-WALL, ALIGNMENT, DETAILS, GRADING STATIONS AND MISC. CLARIFICATIONS		

REVISIONS

LOS ANGELES COUNTY DRAINAGE AREA, CALIFORNIA
RIO HONDO/LOS ANGELES RIVER, FROM WHITTIER NARROWS DAM TO PACIFIC OCEAN
LOS ANGELES RIVER IMPROVEMENTS
(UNION PACIFIC RAILROAD TO ROSECRANS BOULEVARD)
RIO HONDO CHANNEL IMPROVEMENTS
(FIRESTONE BOULEVARD TO LOS ANGELES RIVER)

UNDERPASS PLAN & PROFILE
UNION PACIFIC RAILROAD LEFT LEVEE

DESIGNED BY: S.M./C.B.
DRAWN BY: Z.C./R.S.
CHECKED BY: J.M./K.T.
CADD FILE NAME: 500c22.dgn

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

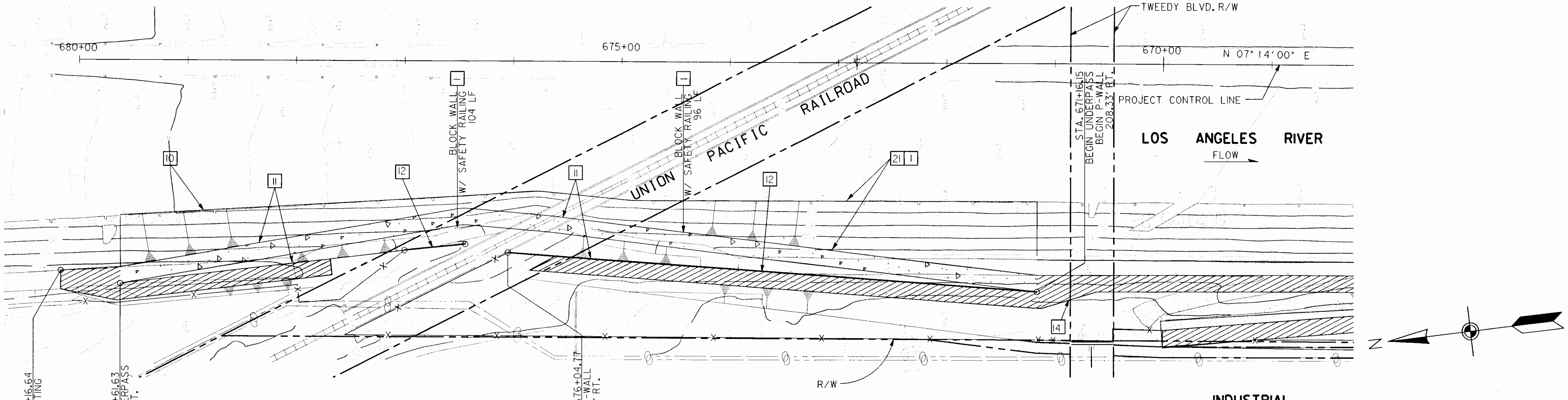
WILLDAN ASSOCIATES
888 S. WEST STREET, SUITE 300
ANAHEIM, CALIFORNIA 92802-1845

SUBMITTED BY: THOMAS M. SAGE, P.E.
CHIEF, DESIGN BRANCH

DISTRICT FILE NO. 470/84 REV. A
DACW09-00-B-0002

SHEET C-22 OF C-64 SHEETS

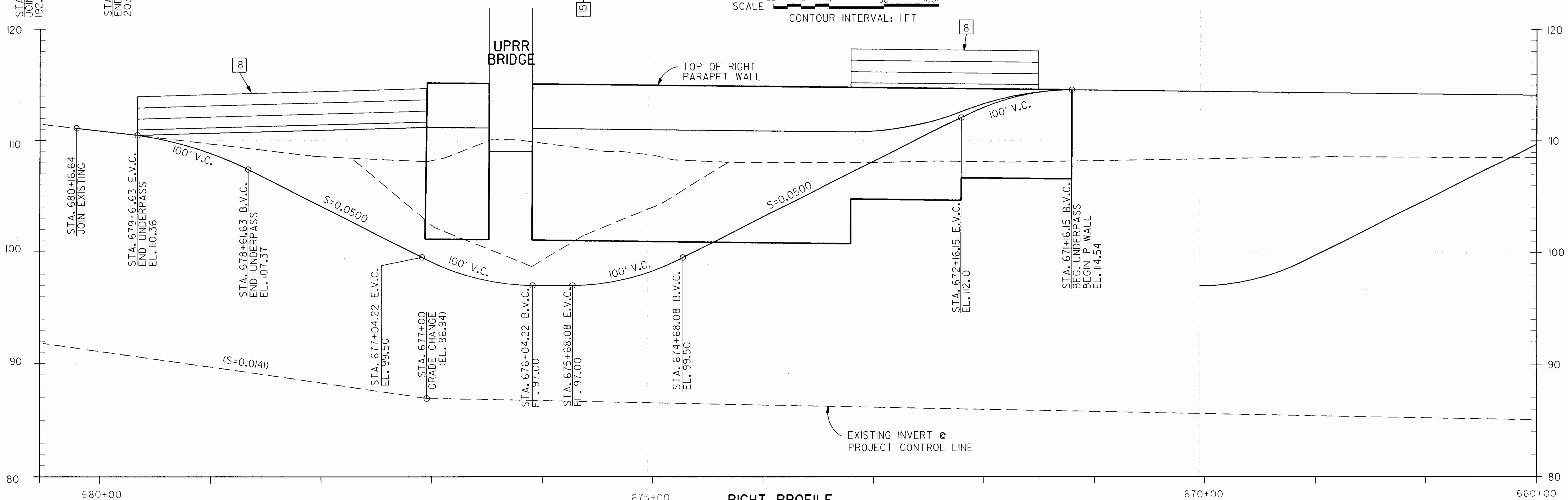
Date: 12/5/2002 Plotted by: smcorrack@gnspc: a:\hill258\rev_at_rhandupr_underpass\500c22c.dgn



RIGHT PLAN

SCALE 50 25 0 50 100FT

CONTOUR INTERVAL: 1FT



RIGHT PROFILE

HORIZ. SCALE 50 25 0 50 100FT

VERT. SCALE 5 2.5 0 5 10FT

DM5 CONSTRUCTION NOTES:

- [1] REMOVE
- [3] PROTECT IN PLACE
- [4] CONSTRUCT CHAIN LINK FENCE, PER DETAIL SHEET M-3
- [5] CONSTRUCT CHAIN LINK ACCESS GATE PER: ACCESS (A), MAINTENANCE (M), PEDESTRIAN (P), PER DETAIL SHEET M-3
- [8] CONSTRUCT SAFETY RAILING, LIMITS AND DETAILS, PER DETAIL SHEET M-4
- [10] CONSTRUCT 10 INCH THICK REINFORCED CONCRETE CHANNEL INVERT, PER DETAIL SHEET S-1
- [11] CONSTRUCT 8 INCH THICK REINFORCED CONCRETE CHANNEL LINING, PER DETAIL SHEET S-2
- [12] CONSTRUCT PARAPET WALL, PER DETAIL SHEET S-3
- [14] CONSTRUCT TAPER, PER DETAIL SHEET M-1
- [15] JOIN EXISTING BRIDGE ABUTMENT
- [17] TOE OF COMPACTED FILL SLOPE
- [21] CONSTRUCT 12 INCH THICK GROUTED STONE CHANNEL LINING, PER DETAIL SHEET S-1

PF537212

NOTE:

1. TOPOGRAPHY COMPILED BY PHOTOGRAMMETRIC METHODS ROBERT J. LUNG AND ASSOCIATES, ON APRIL 29, 1993

REGISTERED PROFESSIONAL ENGINEER DAVID L. HUNT NO. 30514 EXP. 3-31-00 CIVIL ENGINEER STATE OF CALIFORNIA

AS-BUILT

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
REVISIONS			

LOS ANGELES COUNTY DRAINAGE AREA, CALIFORNIA
RIO HONDO/LOS ANGELES RIVER, FROM WHITTIER NARROWS DAM TO PACIFIC OCEAN
LOS ANGELES RIVER IMPROVEMENTS
(UNION PACIFIC RAILROAD TO ROSECRANS BOULEVARD)
RIO HONDO CHANNEL IMPROVEMENTS
(FIRESTONE BOULEVARD TO LOS ANGELES RIVER)
UNDERPASS PLAN & PROFILE
UNION PACIFIC RAILROAD RIGHT LEVEE

DESIGNED BY: K.T./S.M.
DRAWN BY: S.M./Z.C.
CHECKED BY: D.H.

CADD FILE NAME: 500c27.dgn

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

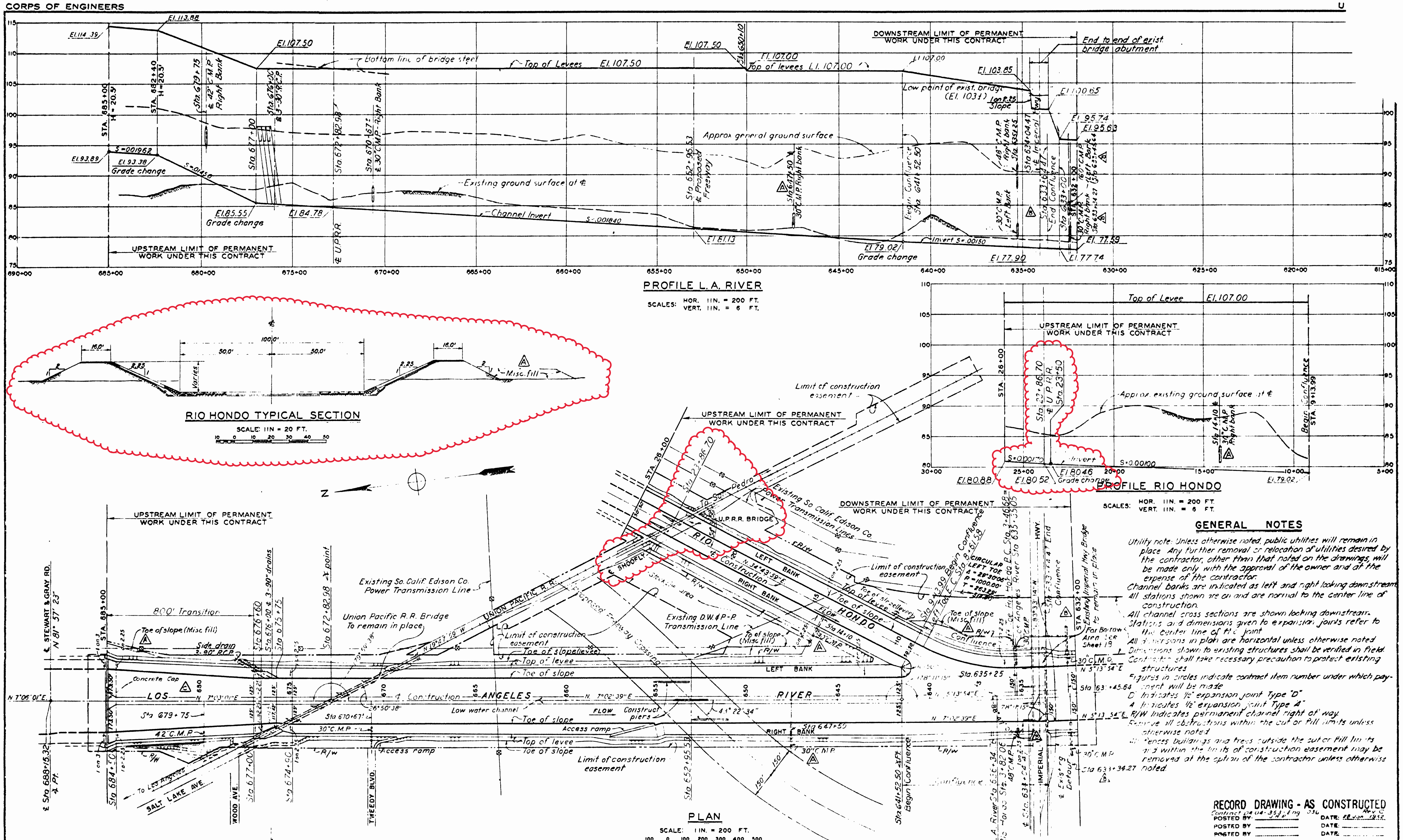
WILLDAN
27042 TOWNE CENTRE DRIVE, SUITE 270
FOOTHILL RANCH, CA. 92610

SUBMITTED BY:
THOMAS H. SAGE, P.E.
CHIEF, DESIGN BRANCH

DISTRICT FILE NO. 470/89
DACW09-00-B-0002

SHEET C-27 OF C-64 SHEETS

Date: 12/5/2002 Plotted by: smcrackxx 500c27.dgn



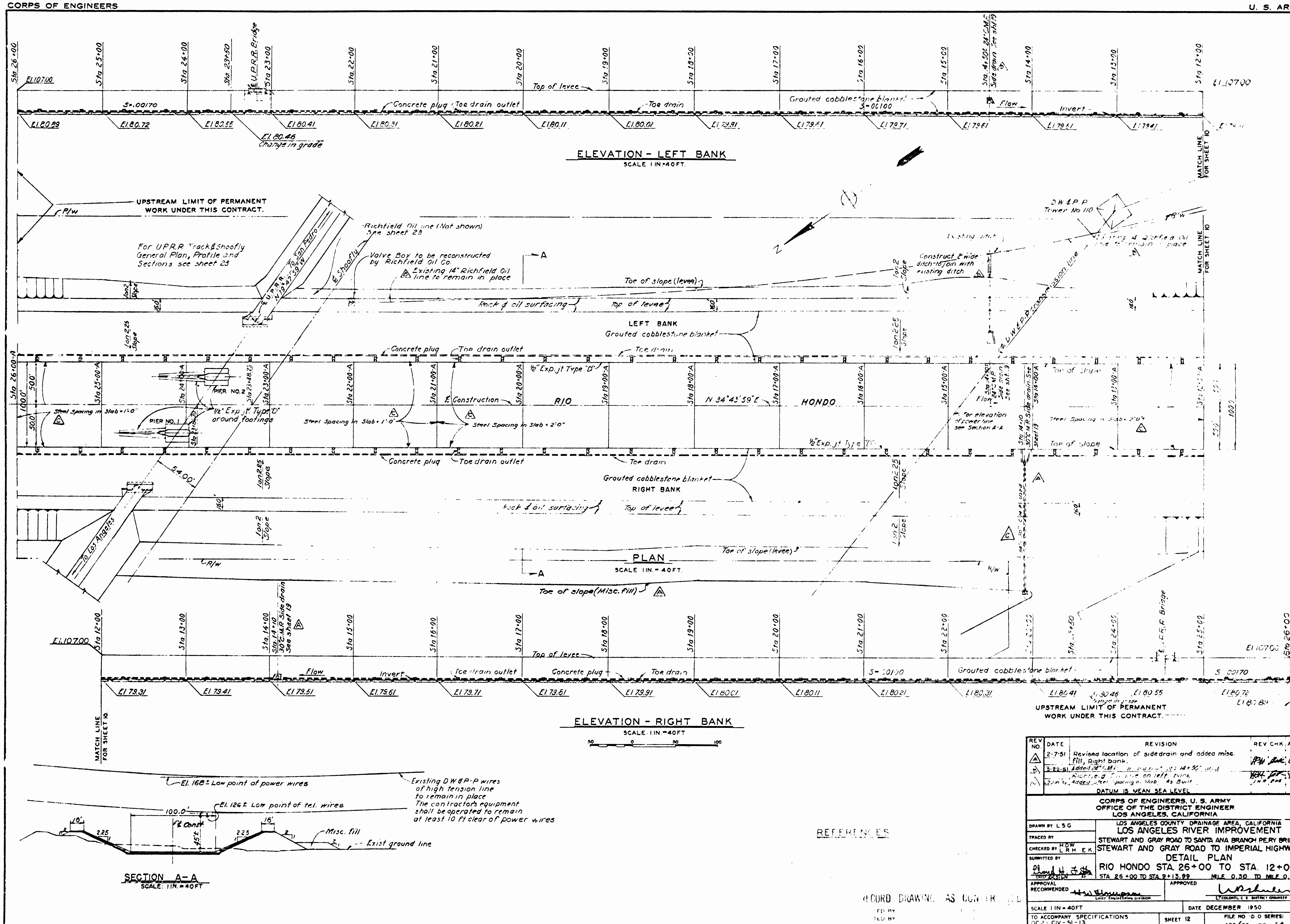
	DATE	REVISION	REV	CHK	APP
A	2-7-51	Revised side drains. Added misc. fill			
B	5-25-51	Revised side drains			
C	28 JAN 52	Added Concrete Cap at Station 685+00 As Built	JHP		

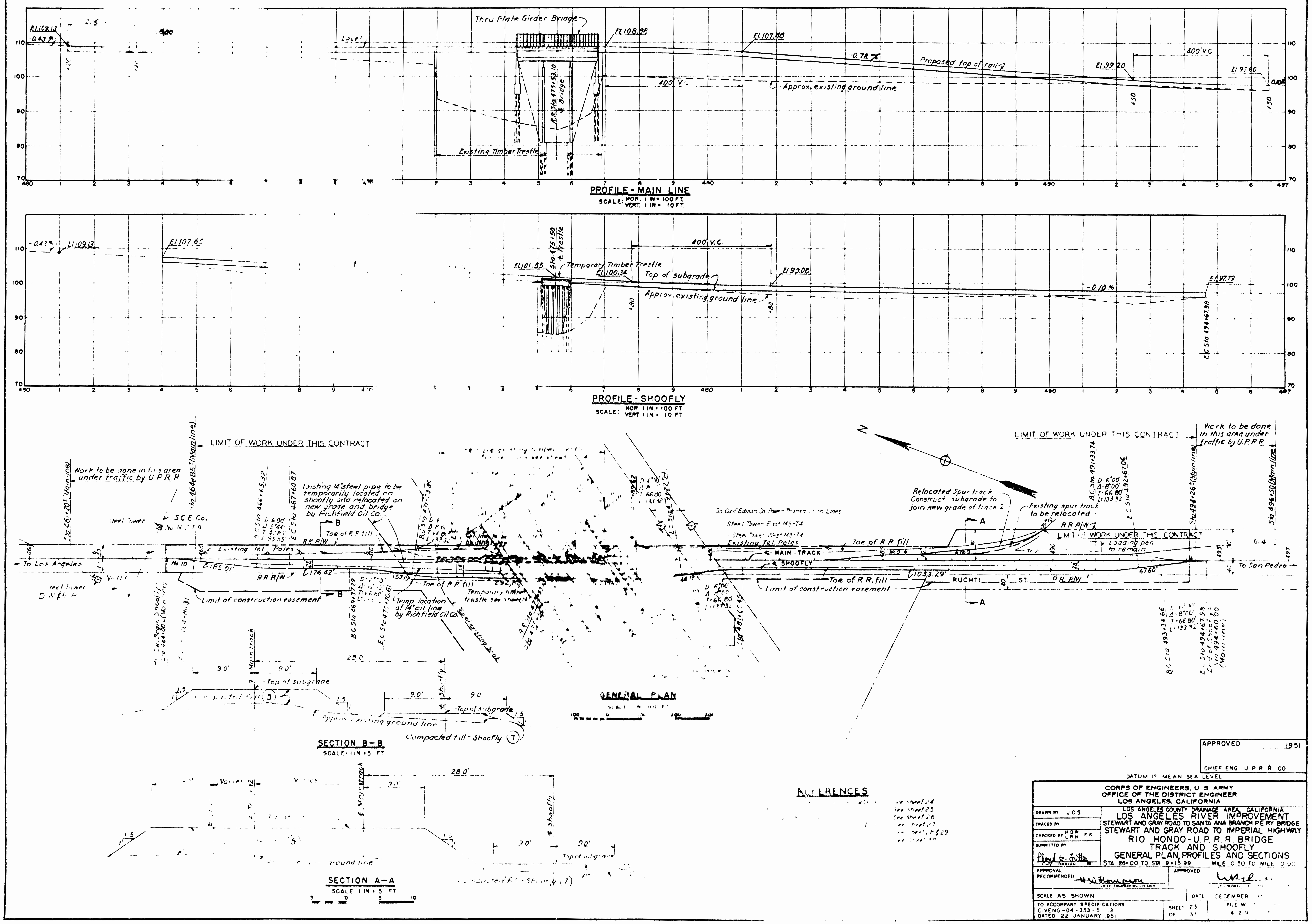
CORPS OF ENGINEERS, U. S. ARMY
OFFICE OF THE DISTRICT ENGINEER
LOS ANGELES, CALIFORNIA

LOS ANGELES COUNTY DRAINAGE AREA, CALIFORNIA
LOS ANGELES RIVER IMPROVEMENT
STEWART AND GRAY ROAD TO SANTA ANA BRANCH P.E. RY. BRIDGE
STEWART AND GRAY ROAD TO IMPERIAL HIGHWAY
PLAN AND PROFILE
STA. 685+00 TO STA. 632+00
RIO HONDO STA. 26+00 TO STA. 9+13.99
STA 685+00 TO STA 632+00 MILE 12.84 TO MILE 11.80

DRAWN BY E.R.F.
TRACED BY:
CHECKED BY H.DW. L.B.H. E.K.
SUBMITTED BY: CHIEF, DESIGN
APPROVAL RECOMMENDED: CHIEF, ENGINEERING DIVISION
APPROVED: LT. COLONEL, C. E. DISTRICT ENGINEER

SCALE: AS SHOWN
DATE: DECEMBER 1950
TO ACCOMPANY SPECIFICATIONS CIVENG-04-353-51-13 DATED: 22 JANUARY 1951
SHEET 6 OF 37
FILE NO. (D.O. SERIES) 429/36 REV. C


ELEVATION - LEFT BANK
SCALE 1 IN.=40 FT.
Top of levee
Concrete plug
Toe drain outlet
Toe drain
Grouted cobblestone blanket
Flow
Invert
El. 80.46
Change in grade
MATCH LINE FOR SHEET 10
UPSTREAM LIMIT OF PERMANENT WORK UNDER THIS CONTRACT.
For U.P.R.R. Track & Shoofly General Plan, Profile and Sections see sheet 23
Richfield Oil line (Not shown) See sheet 23
Valve Box to be reconstructed by Richfield Oil Co.
Existing 14" Richfield Oil line to remain in place
Toe of slope (levee)
Rock & oil surfacing
Top of levee
LEFT BANK
RIO
HONDO
N 34°43'59" E
Construction
Steel Spacing in Slab = 1'-0"
Steel Spacing in Slab = 2'-0"
PIER NO. 1
PIER NO. 2
1/2" Exp. jt. Type "D" around footings
1/2" Exp. jt. Type "D"
RIGHT BANK
Construct & widen ditch to join with existing ditch
D.W.&P.P. Tower No. 110
PLAN
SCALE 1 IN.=40 FT.
Toe of slope (Misc. Fill)
To Los Angeles
ELEVATION - RIGHT BANK
SCALE 1 IN.=40 FT.
SECTION A-A
SCALE: 1 IN.=40 FT.
El. 168± Low point of power wires
El. 126± Low point of tel. wires
Existing D.W.&P.P. wires of high tension line to remain in place. The contractor's equipment shall be operated to remain at least 10 ft clear of power wires
Misc. fill
Exist ground line
REFERENCES
REV. NO. | DATE | REVISION
A | 2-7-51 | Revised location of sidedrain and added misc. fill, Right bank.
B | 3-22-51 | Added 24" C.M.P.
C | As Built
DATUM IS MEAN SEA LEVEL
CORPS OF ENGINEERS, U. S. ARMY
OFFICE OF THE DISTRICT ENGINEER
LOS ANGELES, CALIFORNIA
DRAWN BY L.S.G.
TRACED BY
CHECKED BY H.D.W. L.R.H. E.K.
SUBMITTED BY
CHIEF, DESIGN
LOS ANGELES COUNTY DRAINAGE AREA, CALIFORNIA
LOS ANGELES RIVER IMPROVEMENT
STEWART AND GRAY ROAD TO SANTA ANA BRANCH P.E.RY. BRIDGE
STEWART AND GRAY ROAD TO IMPERIAL HIGHWAY
DETAIL PLAN
RIO HONDO STA. 26+00 TO STA. 12+00
STA. 26+00 TO STA. 9+13.99 MILE 0.30 TO MILE 0.00
APPROVAL RECOMMENDED
CHIEF, ENGINEERING DIVISION
APPROVED
LT. COLONEL, C. E. DISTRICT ENGINEER
SCALE 1 IN.=40 FT.
DATE DECEMBER 1950
TO ACCOMPANY SPECIFICATIONS OC-2-CIV-51-13 DATED 9 APRIL 1951
SHEET 12 OF 37
FILE NO. (D.O. SERIES) 429/62



APPROVED 1951

CHIEF ENG U P R R CO

DATUM IS MEAN SEA LEVEL

CORPS OF ENGINEERS, U S ARMY
OFFICE OF THE DISTRICT ENGINEER
LOS ANGELES, CALIFORNIA

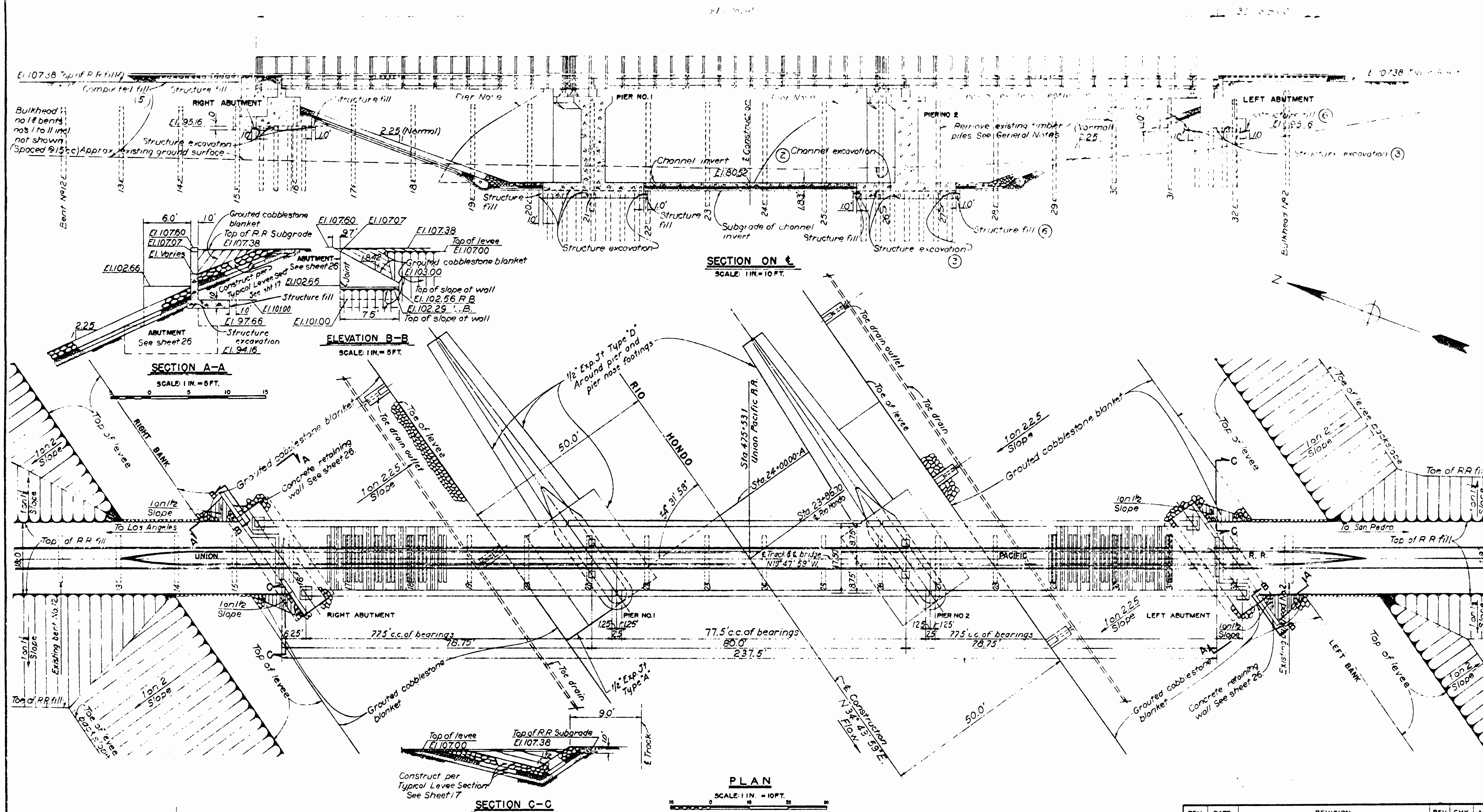
DRAWN BY J C S
TRACED BY
CHECKED BY H D W L R H E K
SUBMITTED BY [signature] CHIEF, DESIGN BR

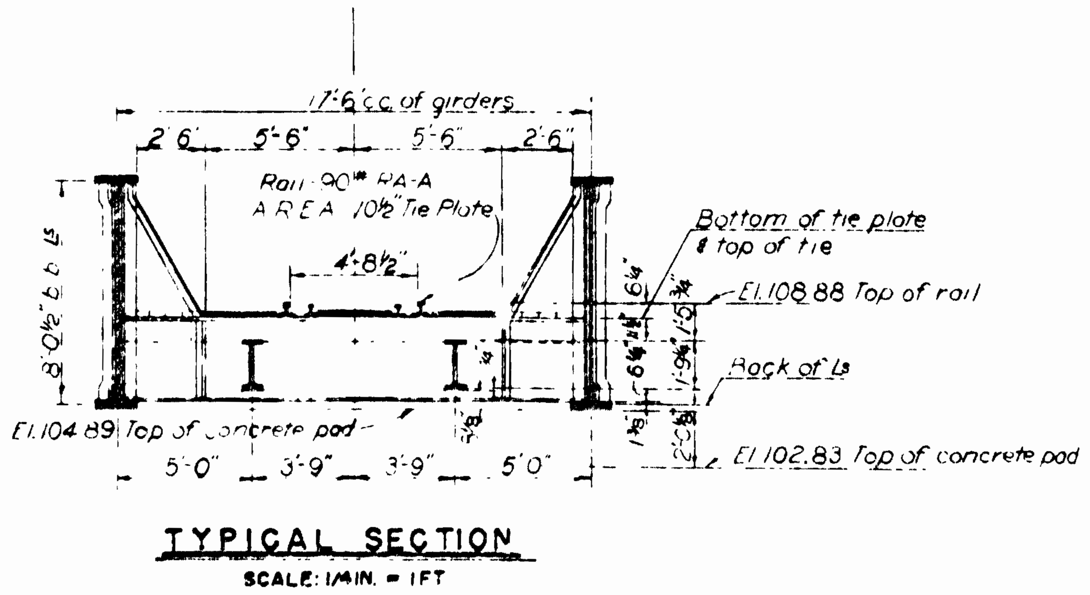
LOS ANGELES COUNTY DRAINAGE AREA, CALIFORNIA
LOS ANGELES RIVER IMPROVEMENT
STEWART AND GRAY ROAD TO SANTA ANA BRANCH P E RY BRIDGE
STEWART AND GRAY ROAD TO IMPERIAL HIGHWAY
RIO HONDO - U. P. R. R. BRIDGE
TRACK AND SHOOFLY
GENERAL PLAN, PROFILES AND SECTIONS
STA 26+00 TO STA 9+13.99 MILE 0.30 TO MILE 0.00

APPROVAL RECOMMENDED [signature] CHIEF, ENGINEERING DIVISION
APPROVED [signature] LT. COLONEL

SCALE AS SHOWN
DATE DECEMBER

TO ACCOMPANY SPECIFICATIONS CIVENG-04-353-51 13 DATED 22 JANUARY 1951
SHEET 23 OF 37
FILE NO 429





REFERENCE DRAWINGS

For Track and Shoofly-General Plan, Profiles and Sections — See sheet 23.
For Abutment Details — See sheet 26.
For Pier and Pier Nose Details — See sheet 27
For Superstructure Layout and Pedestal Details — See sheet 28
For Superstructure Details — See sheet 29.
For Pile Bearing Test — See sheet 30

GENERAL NOTES

Existing timber piles within footing areas or where they would interfere with concrete piles to be driven, shall be entirely removed and the voids filled with rammed sand and gravel (31)

Piles within areas to be paved, shall be cut off at either the existing ground line or at a point 2 feet below the subgrade, whichever is lower (31)
All other piles shall be cut off at the existing ground line

Stringers and trackwork for existing bridge will be removed by U.P.R.R. Co. For complete work schedule see specifications

APPROVED 1951
CHIEF ENG. U.P.R.R. CO.

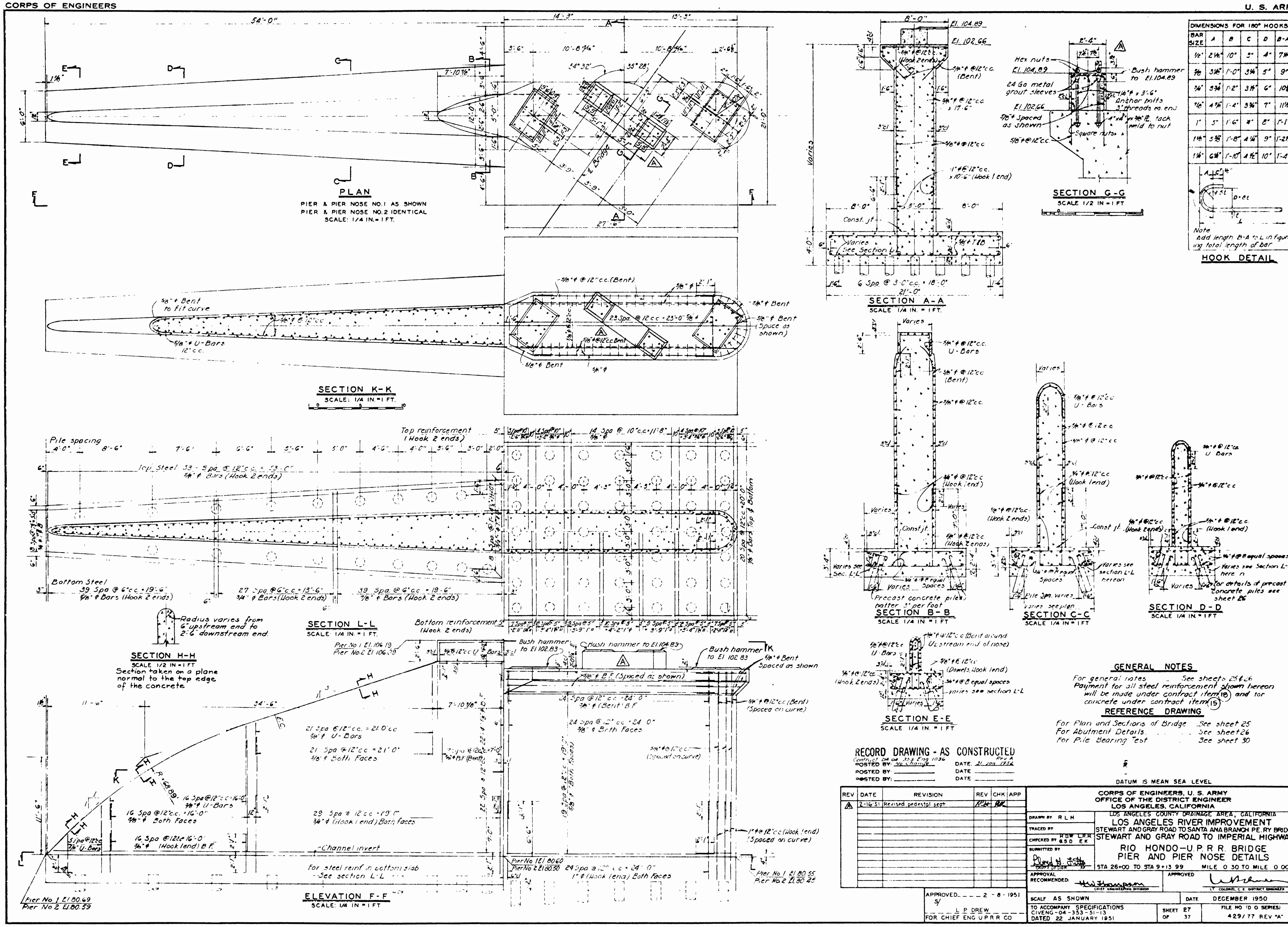
REV.	DATE	REVISION	REV	CHK	APP
		DATUM IS MEAN SEA LEVEL			

CORPS OF ENGINEERS, U. S. ARMY
OFFICE OF THE DISTRICT ENGINEER
LOS ANGELES, CALIFORNIA

LOS ANGELES COUNTY DRAINAGE AREA, CALIFORNIA
LOS ANGELES RIVER IMPROVEMENT
STEWART AND GRAY ROAD TO SANTA ANA BRANCH P.E. RY. BRIDGE
STEWART AND GRAY ROAD TO IMPERIAL HIGHWAY
RIO HONDO - U.P. R.R. BRIDGE
PLAN AND SECTIONS
STA. 26+00 TO STA. 9+13.99 MILE 0.30 TO MILE 0.00

DRAWN BY: D.M.
TRACED BY
CHECKED BY: H.D.W. L.R.H. G.S.D. E.K.
SUBMITTED BY: [signature] CHIEF, DESIGN BR.
APPROVAL RECOMMENDED: [signature] CHIEF, ENGINEERING DIVISION
APPROVED: [signature] LT. COLONEL, C. E. DISTRICT ENGINEER

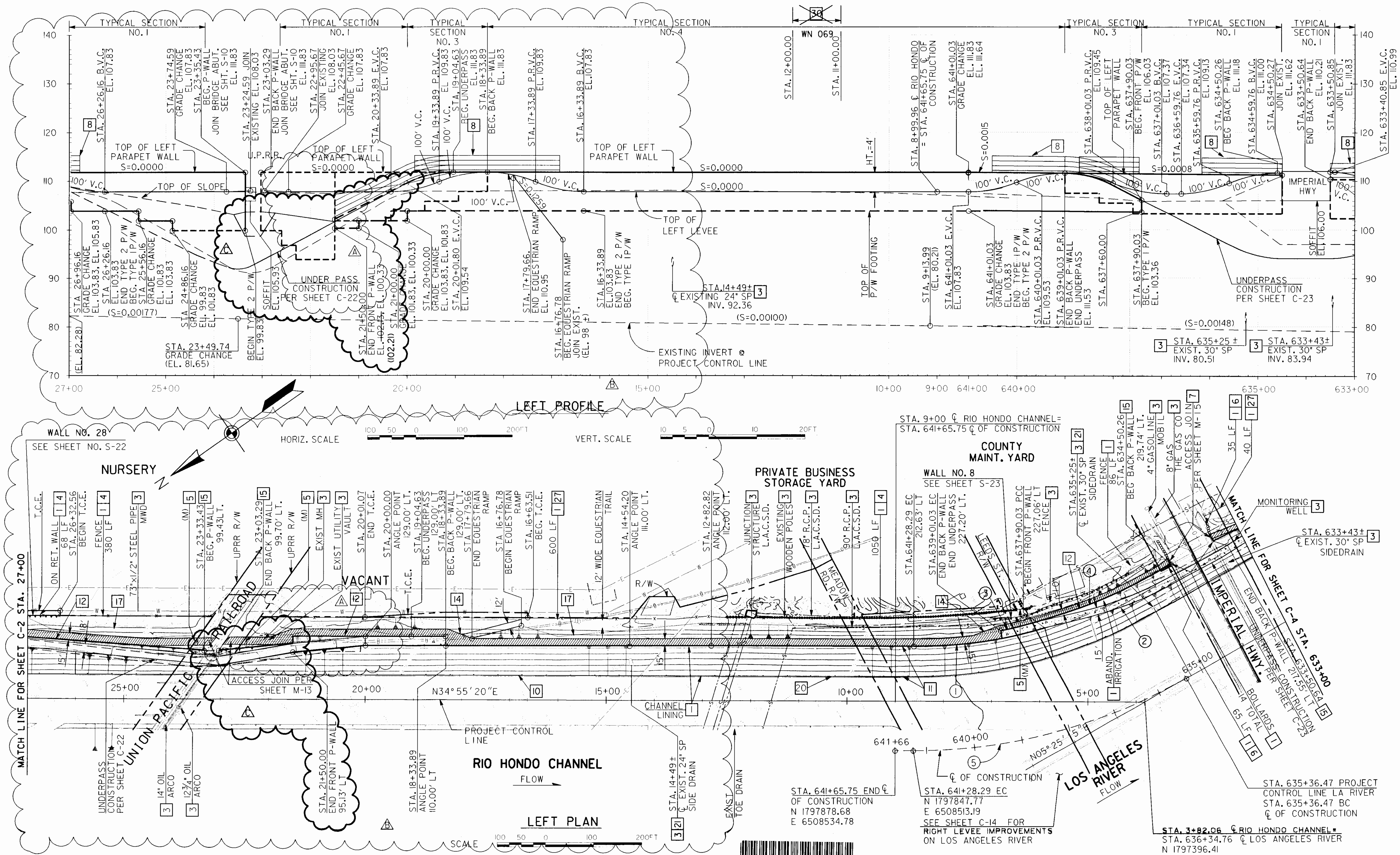
SCALE AS SHOWN
DATE: DECEMBER 1950
TO ACCOMPANY SPECIFICATIONS CIVENG-04-353-51-13 DATED: 22 JANUARY 1951
SHEET 25 OF 37
FILE NO. (D.O. SERIES) 429/75



DIMENSIONS FOR 180° HOOKS

BAR SIZE	A	B	C	D	B-A
1/2"	2 1/2"	10"	3"	4"	7 1/2"
5/8	3 1/8"	1'-0"	3 1/4"	5"	9"
3/4"	3 3/4"	1'-2"	3 1/2"	6"	10 1/4"
7/8"	4 3/8"	1'-4"	3 3/4"	7"	11 5/8"
1"	5"	1'-6"	4"	8"	1'-1"
1 1/8"	5 5/8"	1'-8"	4 1/4"	9"	1'-2 3/8"
1 1/4"	6 1/4"	1'-10"	4 1/2"	10"	1'-4"

VALUE ENGINEERING PAYS



CURVE DATA				
CURVE	R	Δ	L	T
(1)	900.00′	17°34′16″	276.01′	139.10
(2)	800.00′	15°20′18″	214.16′	107.73′
(3)	884.00′	5°46′19″	89.05′	44.56′
(4)	1100.00′	13°54′32″	267.03′	134.18′
(5)	1149.41′	29°30′05″	591.82′	302.63′

CONSTRUCTION NOTES:

- 1 REMOVE
- 3 PROTECT
- 4 CONSTRUCT CHAIN LINK FENCE, PER DETAIL SHEET M-3
- 5 CONSTRUCT CHAIN LINK GATE: ACCESS (A), MAINTENANCE (M), PEDESTRIAN (P), PER DETAIL SHEET M-3
- 6 CONSTRUCT ORNAMENTAL FENCING, PER DETAIL SHEET M-5
- 7 CONSTRUCT ORNAMENTAL GATE: ACCESS (A), MAINTENANCE (M), OR PEDESTRIAN (P), PER DETAIL SHEET M-5
- 8 CONSTRUCT SAFETY RAILING, LIMITS AND DETAILS PER DETAIL SHEET M-4
- 10 CONSTRUCT 10" THICK REINFORCED CONCRETE CHANNEL INVERT PER DETAIL SHEET S-1
- 11 CONSTRUCT 8" THICK REINFORCED CONCRETE CHANNEL LINING WITH ONE FOOT MINIMUM COMPACTED FILL PER DETAIL SHEET S-1
- 12 CONSTRUCT PARAPET WALL PER DETAIL SHEET S-3
- 14 CONSTRUCT TAPER PER DETAIL SHEET M-1
- 15 JOIN EXISTING BRIDGE ABUTMENT
- 17 TOE OF COMPACTED FILL SLOPE
- 20 PROTECT MANHOLE FOR SUBDRAIN IF MADE DEFECTIVE DURING CONSTRUCTION, SEE S-2 FOR SUBDRAIN DETAIL
- 21 CONSTRUCT EXPANSION JOINT FOR JOIN TO EXIST. SIDE DRAIN PER DETAIL SHT. S-2
- 27 CONSTRUCT 8′ CHAIN LINK FENCE WITH BARBED WIRE FENCE
- 30 OMIT P-WALL AND PLANTING CONSTRUCTION FROM CONTRACT PER LOS ANGELES COUNTY SANITATION DISTRICT. CLOSE GAP BETWEEN P-WALL AND BRIDGE WING WALL PER TEMPORARY BARRIER DETAIL ON SHT. M-6.

WN 069

NOTE:

1. TOPOGRAPHY COMPILED BY PHOTOGRAMMETRIC METHODS BY ROBERT J. LUNG AND ASSOCIATES, ON APRIL 29, 1993.
2. CROSS SECTIONS PER SHEETS C-39 TO C-44

PF537188

REGISTERED PROFESSIONAL ENGINEER DAVID L. HUNT NO. 30514 EXP. 3-31-00 CIVIL ENGINEER STATE OF CALIFORNIA

AS-BUILT

SAFETY PAYS

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
C	REVISED UNDERPASS GEOMETRY RF1058		
B	REVISED UNDERPASS AND P-WALL		
A	NOTE 30 R/W, INVERT PAVING, SAFETY RAILING, P-WALL ALIGNMENT, STRUCT. DETAILS, GAGING STATION AND MISC. CLARIFICATIONS		

REVISIONS

LOS ANGELES COUNTY DRAINAGE AREA, CALIFORNIA
RIO HONDO/LOS ANGELES RIVER, FROM WHITTIER NARROWS DAM TO PACIFIC OCEAN
LOS ANGELES RIVER IMPROVEMENTS
(UNION PACIFIC RAILROAD TO ROSECRANS BOULEVARD)
RIO HONDO CHANNEL IMPROVEMENTS
(FIRESTONE BOULEVARD TO LOS ANGELES RIVER)
RIO HONDO LEFT LEVEE PLAN AND PROFILE
RIO HONDO STA. 27+00 TO LA RIVER STA. 633+00

DESIGNED BY: S.M./C.B.
DRAWN BY: Z.C./R.S.
CHECKED BY: J.M./K.T.
CADD FILE NAME: 500c3.dgn

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

WILLDAN ASSOCIATES
888 S. WEST STREET, SUITE 300
ANAHEIM, CALIFORNIA 92802-1845

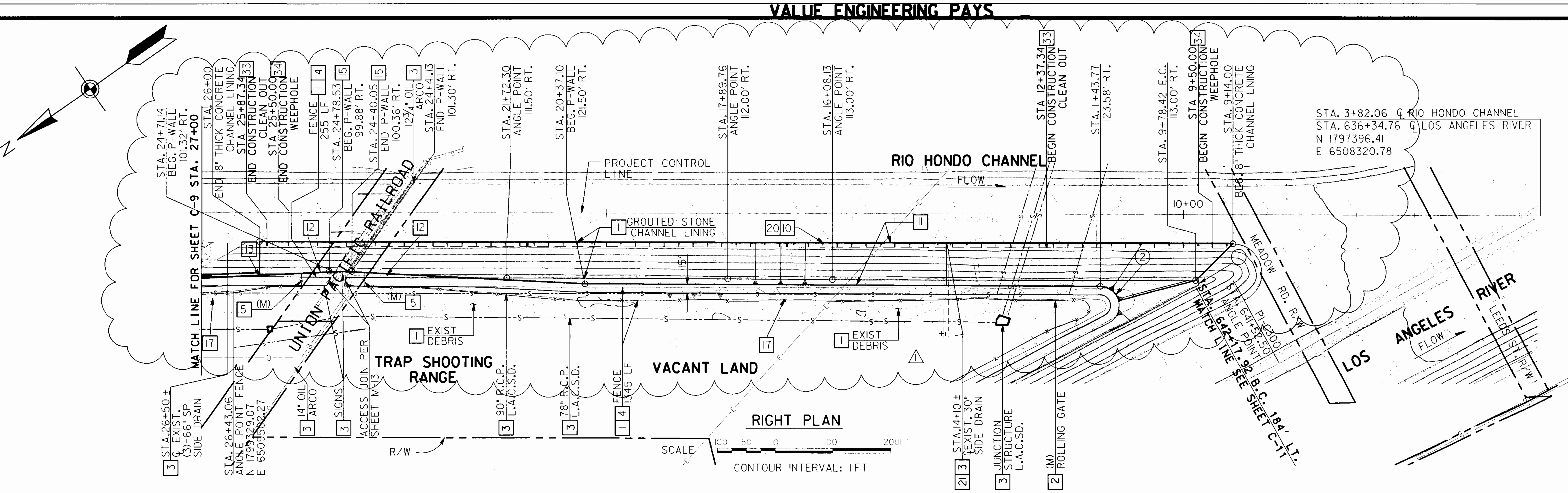
SUBMITTED BY: THOMAS H. SAGE, P.E.
CHIEF, DESIGN BRANCH

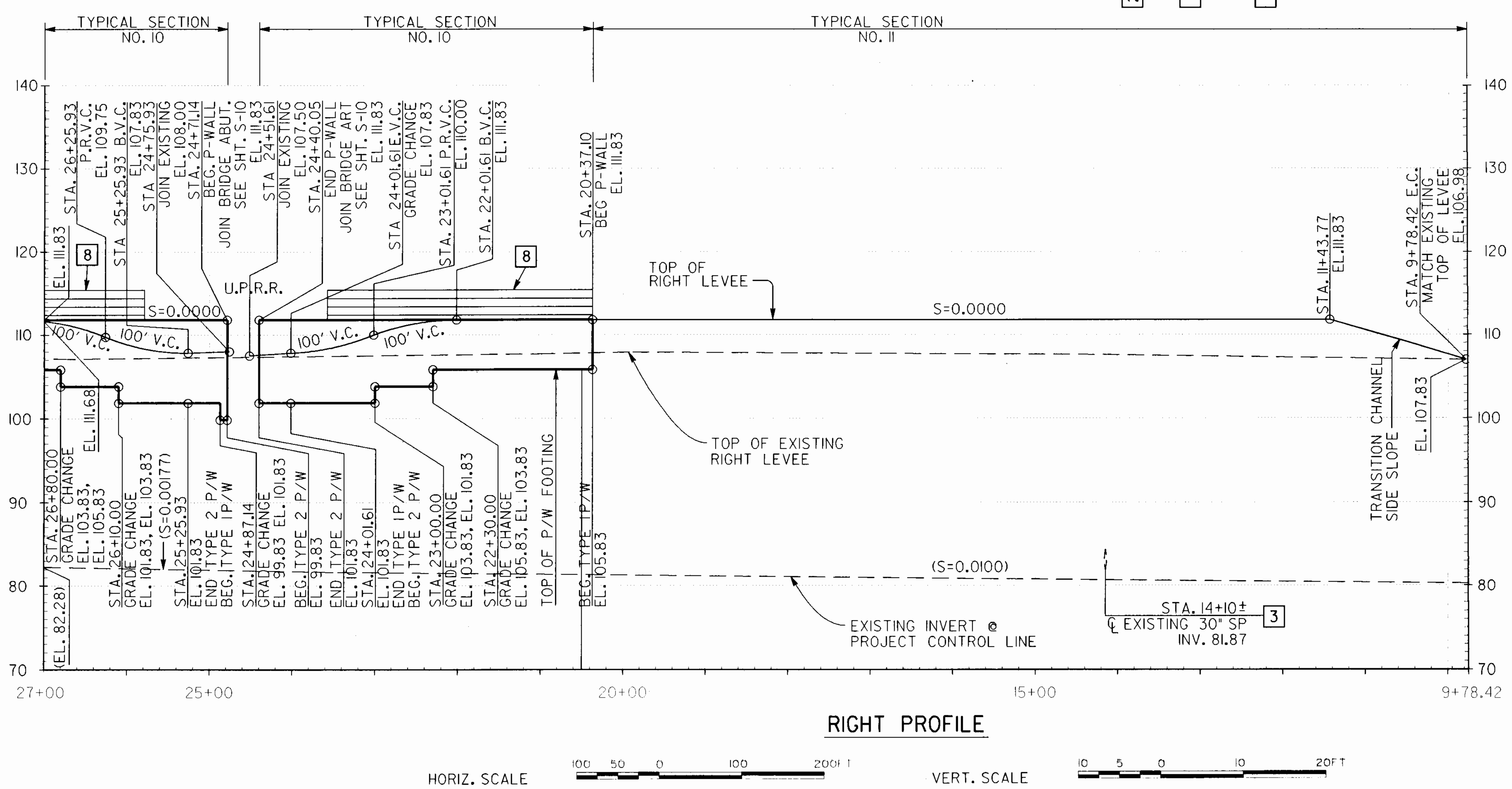
DISTRICT FILE NO. 470/65 REV. A
DACW09-00-B-0002

SHEET C-3 OF C-64 SHEETS

Date: 12/5/2002 Plotted by: smcrack@mspc:q:\jm1258\rev_at_rhandupr_underpass\500c03c.dgn

VALUE ENGINEERING PAYS





CONSTRUCTION NOTES:

1 REMOVE
2 RELOCATE
3 PROTECT
4 CONSTRUCT CHAIN LINK FENCE, PER DETAIL SHEET M-3
5 CONSTRUCT CHAIN LINK GATE: ACCESS (A), MAINTENANCE (M), PEDESTRIAN (P), PER DETAIL SHEET M-3
8 CONSTRUCT SAFETY RAILING, LIMITS AND DETAILS PER DETAIL SHEET M-4
10 CONSTRUCT 10" THICK REINFORCED CONCRETE CHANNEL INVERT PER DETAIL SHEET S-1
11 CONSTRUCT 8" THICK REINFORCED CONCRETE CHANNEL LINING WITH ONE FOOT MINIMUM COMPACTED FILL PER DETAIL SHEET S-1
12 CONSTRUCT PARAPET WALL PER DETAIL SHEET S-3
13 CONSTRUCT 12 INCH THICK GROUTED STONE CHANNEL LINING DETAIL PER SHEET S-1
15 JOIN EXISTING BRIDGE ABUTMENT
17 TOE OF COMPACTED FILL SLOPE
20 PROTECT MANHOLE FOR SUBDRAIN AND SUBDRAIN SYSTEM IF MADE DEFECTIVE DURING CONSTRUCTION
21 CONSTRUCT EXPANSION JOINT FOR JOIN TO EXIST. SIDE DRAIN PER DETAIL SHT. S-2
33 CONSTRUCT 6" CLEAN OUT Y EVERY 450' PER DETAIL SHT. M-7
34 CONSTRUCT WEEPHOLE APPROXIMATELY 25' FROM EXISTING WEEPHOLE PER DETAIL SHEET M-7

NOTE:
1. TOPOGRAPHY COMPILED BY PHOTOGRAMMETRIC METHODS BY ROBERT J. LUNG AND ASSOCIATES, ON APRIL 29, 1993.
2. CROSS SECTIONS PER SHEETS C-54 TO C-55

CURVE DATA

CURVE	R	Δ	L	T
1	5.00'	152° 18' 40"	13.29'	20.28'
2	33.00'	152° 18' 40"	87.72'	133.90'

REVISIONS

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
1	CONSTRUCTION OF WEEPHOLE AND CLEAN OUT ADDED		

LOS ANGELES COUNTY DRAINAGE AREA, CALIFORNIA
RIO HONDO/LOS ANGELES RIVER FROM WHITTIER NARROWS DAM TO PACIFIC OCEAN
LOS ANGELES RIVER IMPROVEMENTS
CENTURY FREEWAY (ROUTE 105) TO LONG BEACH BOULEVARD
RIO HONDO RIGHT LEVEE PLAN AND PROFILE
STA. 27+00 TO STA. 9+14.00

U.S. ARMY ENGINEER DISTRICT, LOS ANGELES, CORPS OF ENGINEERS
DESIGNED BY: S.M./C.B. DRAWN BY: Z.C./R.S. CHECKED BY: J.B.M./K.T.
WILLDAN ASSOCIATES, 888 S. WEST STREET, SUITE 300, ANAHEIM, CALIFORNIA 92802-1845
SUBMITTED BY: ARTHUR T. SHAK, ACTING CHIEF, DESIGN BRANCH
DISTRICT FILE NO. 72 DACW-09-98B-0027 CADD FILE NAME: 500c10.dgn

REGISTERED PROFESSIONAL ENGINEER DAVID L. HUNT NO. 30514 EXP. 3-31-00 CIVIL ENGINEER STATE OF CALIFORNIA

PF537195

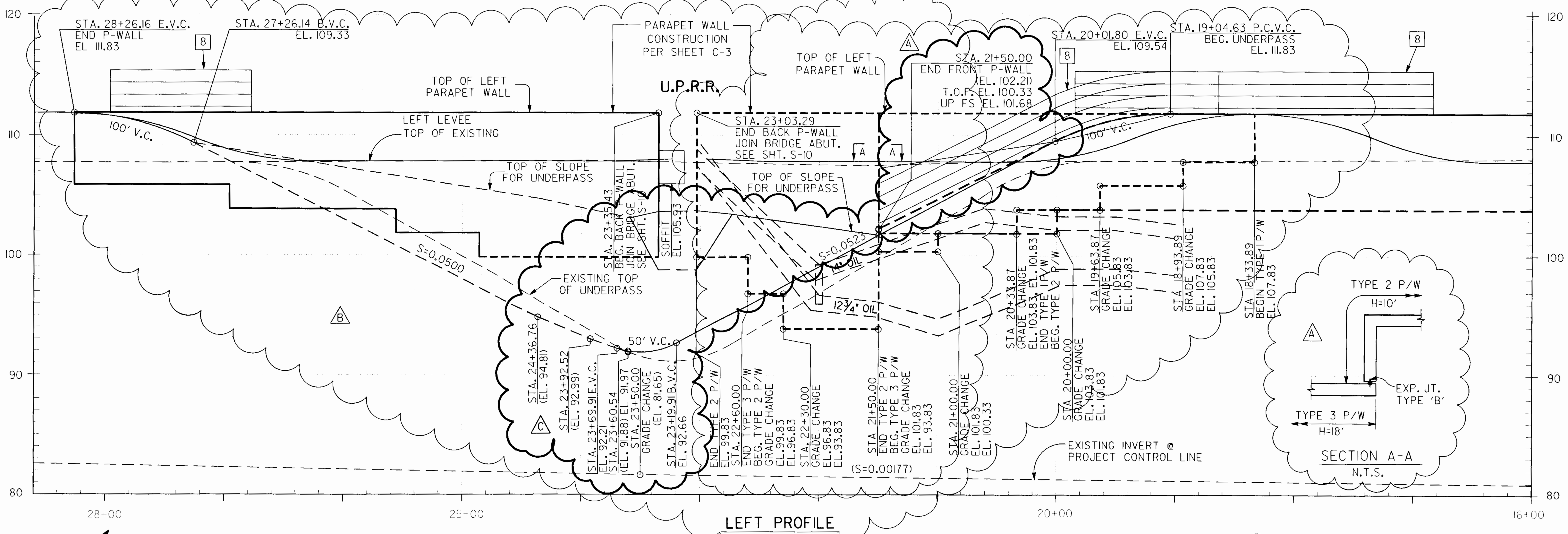
AS-BUILT

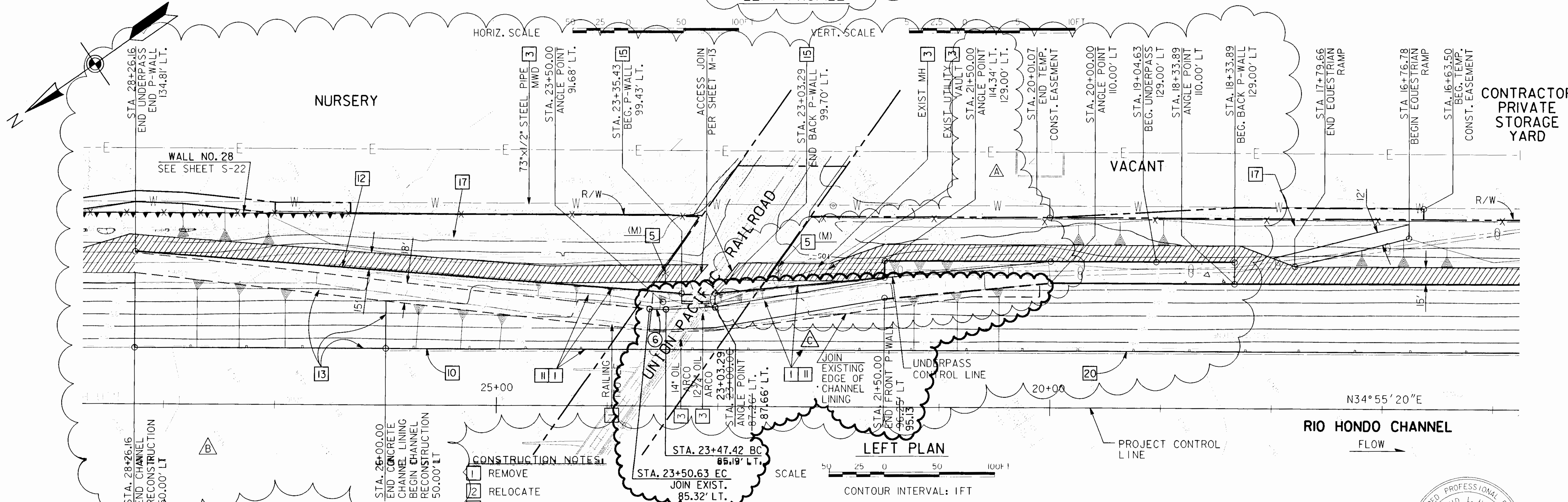
SHEET C-10 OF C-52 SHEETS

SAFETY PAYS

Plotted by: dmccracken Date: 12/5/2002

VALUE ENGINEERING PAYS





CONSTRUCTION NOTES:

1. REMOVE
2. RELOCATE
3. PROTECT
4. CONSTRUCT CHAIN LINK FENCE, PER DETAIL SHEET M-3
5. CONSTRUCT CHAIN LINK GATE: ACCESS (A), MAINTENANCE (M), PEDESTRIAN (P), PER DETAIL SHEET M-3
6. CONSTRUCT ORNAMENTAL FENCING, PER DETAIL SHEET M-5
7. CONSTRUCT ORNAMENTAL GATE: ACCESS (A), MAINTENANCE (M), OR PEDESTRIAN (P), PER DETAIL SHEET M-5
8. CONSTRUCT SAFETY RAILING, LIMITS AND DETAILS PER DETAIL SHEET M-4
10. CONSTRUCT 10' THICK REINFORCED CONCRETE CHANNEL INVERT PER DETAIL SHEET S-1
11. CONSTRUCT 8" THICK REINFORCED CONCRETE CHANNEL LINING WITH ONE FOOT MINIMUM COMPACTED FILL PER DETAIL SHEET S-1
12. CONSTRUCT PARAPET WALL PER DETAIL SHEET S-3
13. CONSTRUCT 12 INCH THICH GROUTED STONE CHANNEL LINING DETAIL PER SHEET S-1
14. CONSTRUCT TAPER PER DETAIL SHEET M-1
15. JOIN EXISTING BRIDGE ABUTMENT
17. TOE OF COMPACTED FILL SLOPE
20. PROTECT MANHOLE FOR SUBDRAIN IF MADE DEFECTIVE DURING CONSTRUCTION, PER DETAIL SHEET S-1

(C) SEE SHEET C-39 FOR CHANNEL LINING SLOPE DETAIL AT UPRR BRIDGE ABUTMENT

CURVE DATA

CURVE	R	Δ	L	T
1	900.00'	17°34'16"	276.01'	139.10
2	800.00'	15°20'18"	214.16'	107.73'
3	884.00'	5°46'19"	89.05'	44.56'
4	1100.00'	13°54'32"	267.03'	134.18'
5	1149.41'	29°30'05"	591.82'	302.63'
6	100.00'	7°31'18"	13.13'	6.57'

NOTE:

1. TOPOGRAPHY COMPILED BY PHOTOGRAMMETRIC METHODS BY ROBERT J. LUNG AND ASSOCIATES, ON APRIL 29, 1993

REGISTERED PROFESSIONAL ENGINEER DAVID L. HUNT NO. 30514 EXP. 3-31-00 CIVIL ENGINEER STATE OF CALIFORNIA

PF537207

AS-BUILT

SAFETY PAYS

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
(A)	REVISED UNDERPASS GEOMETRY RFI 058		
(B)	REVISED UNDERPASS AND P-WALL		
(C)	NOTE 30 R/W, INVERT PAVING, SAFETY RAILING, P-WALL ELIMINATED, DETAILS, GRADING REVISION AND MISC. CLARIFICATIONS		

REVISIONS

LOS ANGELES COUNTY DRAINAGE AREA CALIFORNIA
RIO HONDO/LOS ANGELES RIVER FROM WHITTIER NARROWS DAM TO PACIFIC OCEAN
LOS ANGELES RIVER IMPROVEMENTS
(UNION PACIFIC RAILROAD TO ROSECRANS BOULEVARD)
RIO HONDO CHANNEL IMPROVEMENTS
(FIRESTONE BOULEVARD TO LOS ANGELES RIVER)

UNDERPASS PLAN & PROFILE
UNION PACIFIC RAILROAD LEFT LEVEE

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: S.M./C.B.
DRAWN BY: Z.C./R.S.
CHECKED BY: J.M./K.T.

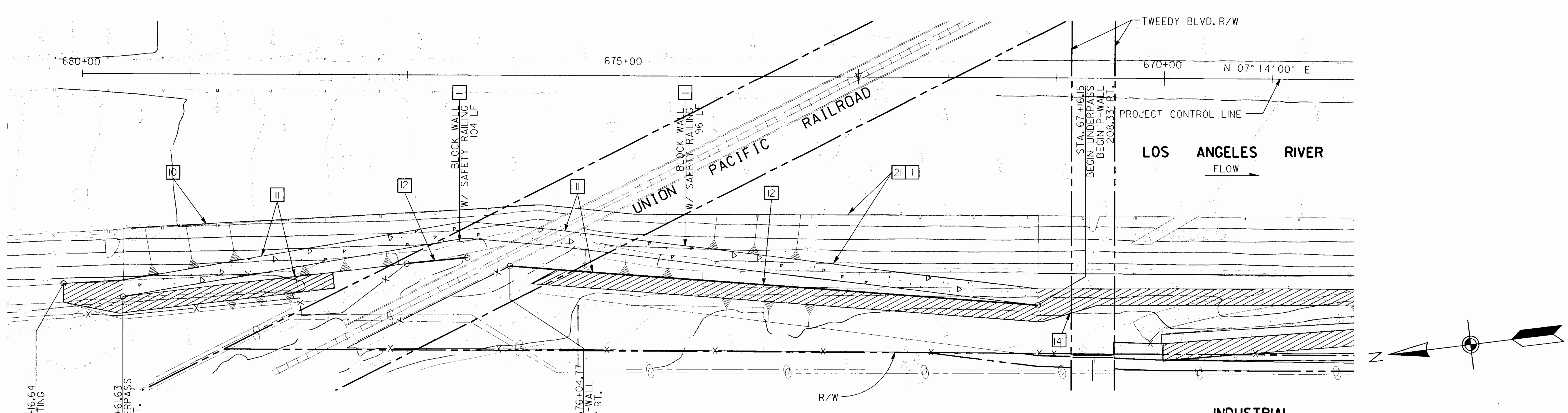
WILLDAN ASSOCIATES
888 S. WEST STREET, SUITE 300
ANAHEIM, CALIFORNIA 92802-1845

SUBMITTED BY: THOMAS M. SAGE, P.E.
CHIEF, DESIGN BRANCH

DISTRICT FILE NO. 470/84 REV. A
DACW09-00-B-0002
CADD FILE NAME: 500c22.dgn

SHEET C-22 OF C-64 SHEETS

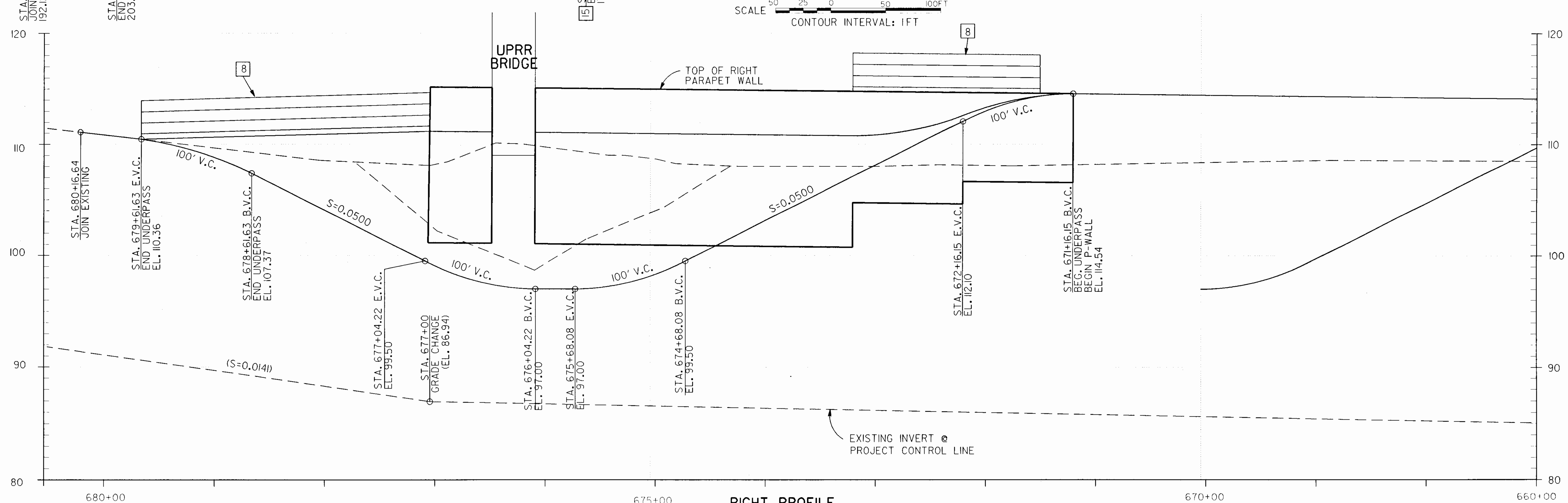
Date: 12/5/2002
Plotted by: smccrack@gnsbcad:\h\258\rev_at\handuprr_underpass\500c22c.dgn



RIGHT PLAN

SCALE 50 25 0 50 100FT

CONTOUR INTERVAL: 1FT



RIGHT PROFILE

HORIZ. SCALE 50 25 0 50 100FT

VERT. SCALE 5 2.5 0 5 10FT

DM5 CONSTRUCTION NOTES:

- [1] REMOVE
- [3] PROTECT IN PLACE
- [4] CONSTRUCT CHAIN LINK FENCE, PER DETAIL SHEET M-3
- [5] CONSTRUCT CHAIN LINK ACCESS GATE PER: ACCESS (A), MAINTENANCE (M), PEDESTRIAN (P), PER DETAIL SHEET M-3
- [8] CONSTRUCT SAFETY RAILING, LIMITS AND DETAILS, PER DETAIL SHEET M-4
- [10] CONSTRUCT 10 INCH THICK REINFORCED CONCRETE CHANNEL INVERT, PER DETAIL SHEET S-1
- [11] CONSTRUCT 8 INCH THICK REINFORCED CONCRETE CHANNEL LINING, PER DETAIL SHEET S-2
- [12] CONSTRUCT PARAPET WALL, PER DETAIL SHEET S-3
- [14] CONSTRUCT TAPER, PER DETAIL SHEET M-1
- [15] JOIN EXISTING BRIDGE ABUTMENT
- [17] TOE OF COMPACTED FILL SLOPE
- [21] CONSTRUCT 12 INCH THICK GROUTED STONE CHANNEL LINING, PER DETAIL SHEET S-1

PF537212

REGISTERED PROFESSIONAL ENGINEER DAVID L. HUNT NO. 30514 EXP. 3-31-00 CIVIL ENGINEER STATE OF CALIFORNIA

NOTE:

1. TOPOGRAPHY COMPILED BY PHOTOGRAMMETRIC METHODS ROBERT J. LUNG AND ASSOCIATES, ON APRIL 29, 1993

AS-BUILT

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

LOS ANGELES COUNTY DRAINAGE AREA, CALIFORNIA
RIO HONDO/LOS ANGELES RIVER, FROM WHITTIER NARROWS DAM TO PACIFIC OCEAN
LOS ANGELES RIVER IMPROVEMENTS
(UNION PACIFIC RAILROAD TO ROSECRANS BOULEVARD)
RIO HONDO CHANNEL IMPROVEMENTS
(FIRESTONE BOULEVARD TO LOS ANGELES RIVER)
UNDERPASS PLAN & PROFILE
UNION PACIFIC RAILROAD RIGHT LEVEE

DESIGNED BY: K.T./S.M.
DRAWN BY: S.M./Z.C.
CHECKED BY: D.H.

CADD FILE NAME: 500c27.dgn

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

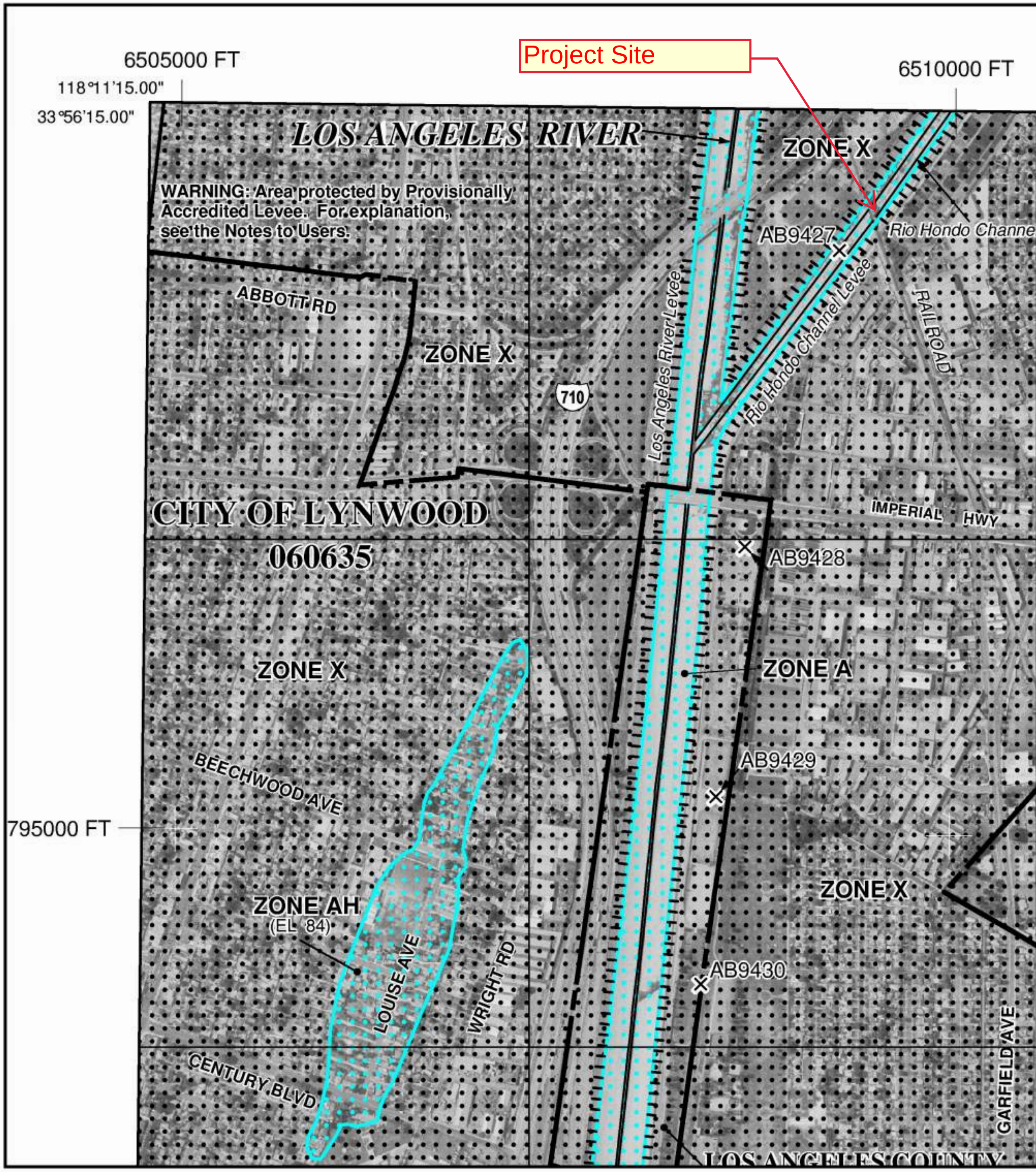
WILLDAN
27042 TOWNE CENTRE DRIVE, SUITE 270
FOOTHILL RANCH, CA. 92610

SUBMITTED BY:
THOMAS H. SAGE, P.E.
CHIEF, DESIGN BRANCH

DISTRICT FILE NO. 470/89
DACW09-00-B-0002

SHEET C-27 OF C-64 SHEETS

Plotted by: smcpackdgnspec.dgn\rh2581500c27.dgn
Date: 12/5/2002



ional Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1820F

FIRM

FLOOD INSURANCE RATE MAP

LOS ANGELES COUNTY, CALIFORNIA

AND INCORPORATED AREAS

PANEL 1820 OF 2350

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
LOS ANGELES COUNTY	065043	1820	F
BELLFLOWER, CITY OF	060102	1820	F
COMPTON, CITY OF	060111	1820	F
DOWNEY, CITY OF	060645	1820	F
LONG BEACH, CITY OF	060136	1820	F
LYNWOOD, CITY OF	060635	1820	F
PARAMOUNT, CITY OF	065049	1820	F
SOUTH GATE, CITY OF	060163	1820	F

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
06037C1820F

EFFECTIVE DATE
SEPTEMBER 26, 2008

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

LOCATION HYDRAULIC STUDY FORM *

Floodplain Description:

Rio Hondo Channel.

1. Description of Proposal (include any physical barriers i.e. concrete barriers, soundwalls, etc. and design elements to minimize floodplain impacts)

Construction of a new Metro Light Rail Bridge.

2. ADT:
Current ______9,200/4,400 riders (weekday/weekend)
Projected _____similar or greater _____

3. Hydraulic Data:
Base Flood Q_{100}= _____52,900_____ CFS WSE100= ______107.86_____
The flood of record, if greater than Q_{100}: Q= n/a____ CFS WSE= _______n/a____
Overtopping flood Q= _______54,200__ CFS (approx 500-yr flood) WSE= ______107.88
Are NFIP maps and studies available? YES___X_____ NO__________

4. Is the bridge location alternative within a regulatory floodway ?
YES___X_____ NO__________

5. Attach map with flood limits outlined showing all buildings or other improvements within the base floodplain.
–See Appendix A

Potential Q_{100} backwater damages:

A. Residences? NO___X_____ YES_________
B. Other Bldgs? NO___X_____ YES_________
C. Crops? NO___X_____ YES_________
D. Natural and beneficial
FLOODPLAIN VALUES? NO___X_____ YES________

6. Type of Traffic:

A. Emergency supply or evacuation route? NO___X_____ YES_________
B. Emergency vehicle access? NO___X_____ YES_________
C. Practicable detour available? NO___X_____ YES_________
D. School bus or mail route? NO___X_____ YES _________

7. Estimated duration of traffic interruption for 100-year event hours: _____0______

8. Estimated value of Q_{100} flood damages (if any) – moderate risk level.

A.	Roadway	$ 0
B	Property	$ 0
	Total	$ 0

9. Assessment of Level of Risk Low__X_____
Moderate____
High________

For High Risk projects, during design phase, additional Design Study Risk Analysis May be necessary to determine design alternative.

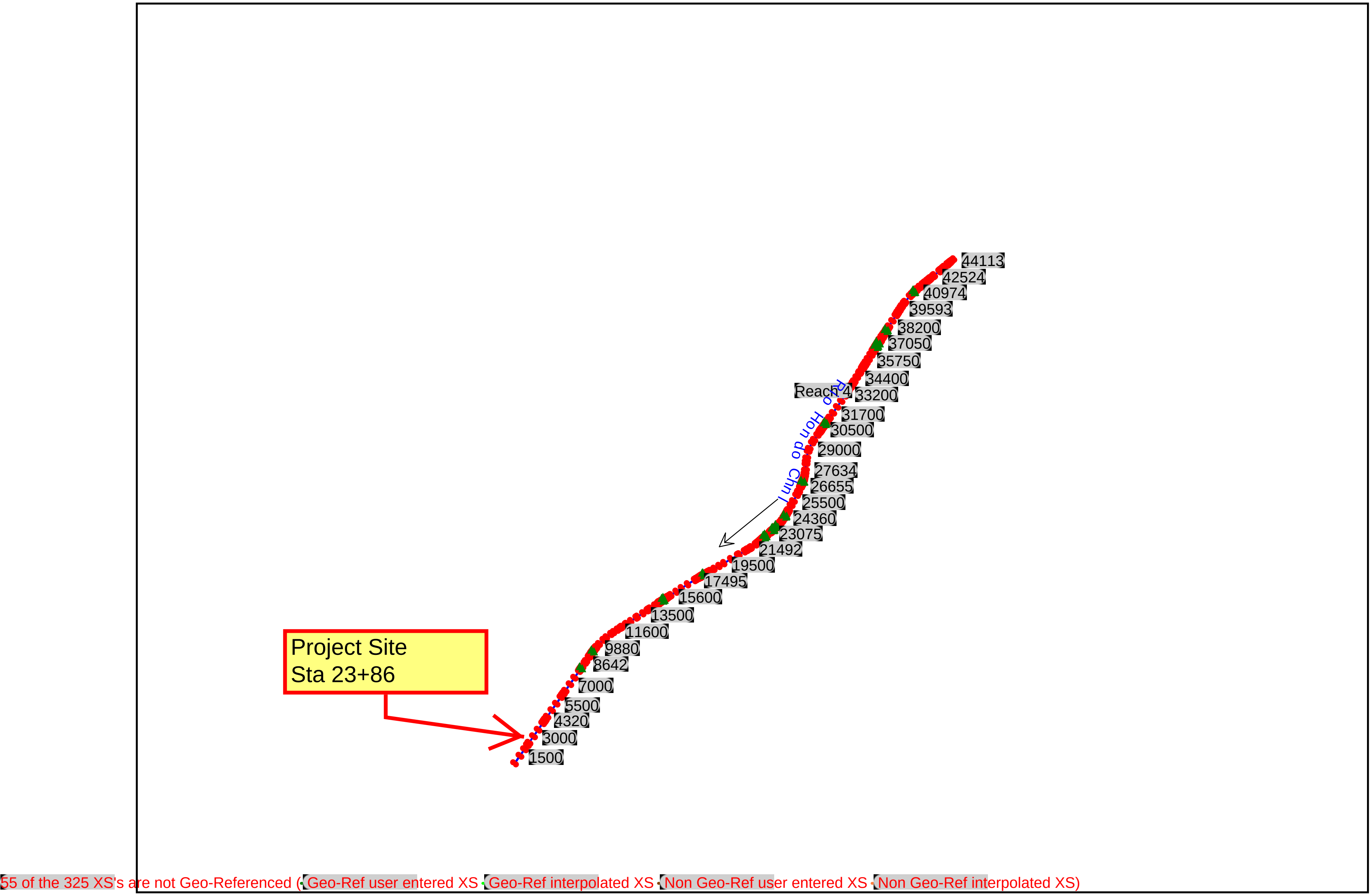
Signature –Hydraulic Engineer ________________Date__10/29/17_____
(Item numbers 3,4,5,7,9)

Is there any longitudinal encroachment, significant encroachment, or any support of incompatible
Floodplain development? NO___X_____YES________

If yes, provide evaluation and discussion of practicability of alternatives in accordance with 23 CFR 650.113

Information developed to comply with the Federal requirement for the Location Hydraulic Study shall be retained in the project files.

APPENDIX B HYDRAULIC ANALYSIS



44113
42524
40974
39593
38200
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35750
34400
Reach 4
33200
Rio Hon do Chnl
31700
30500
29000
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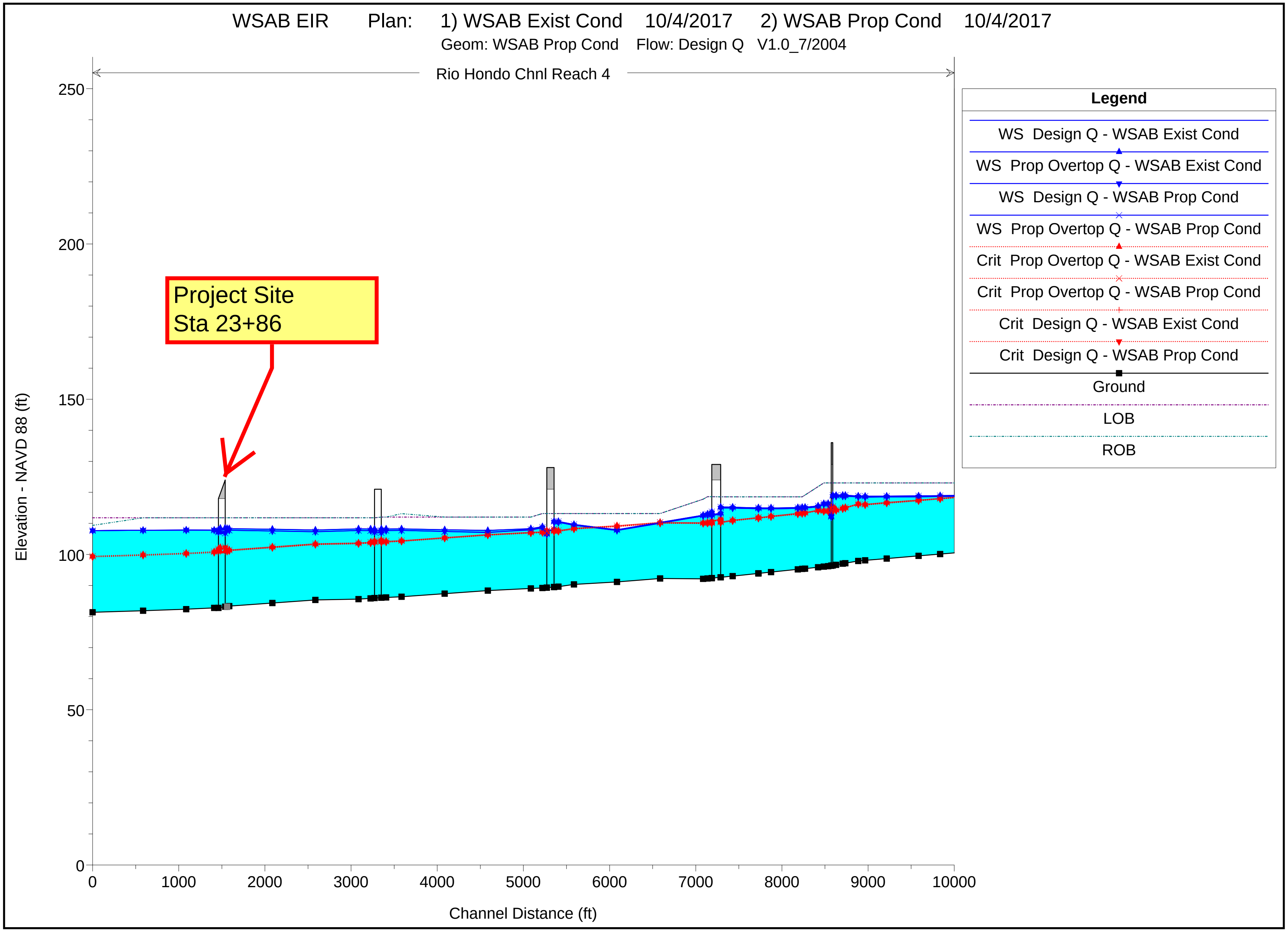
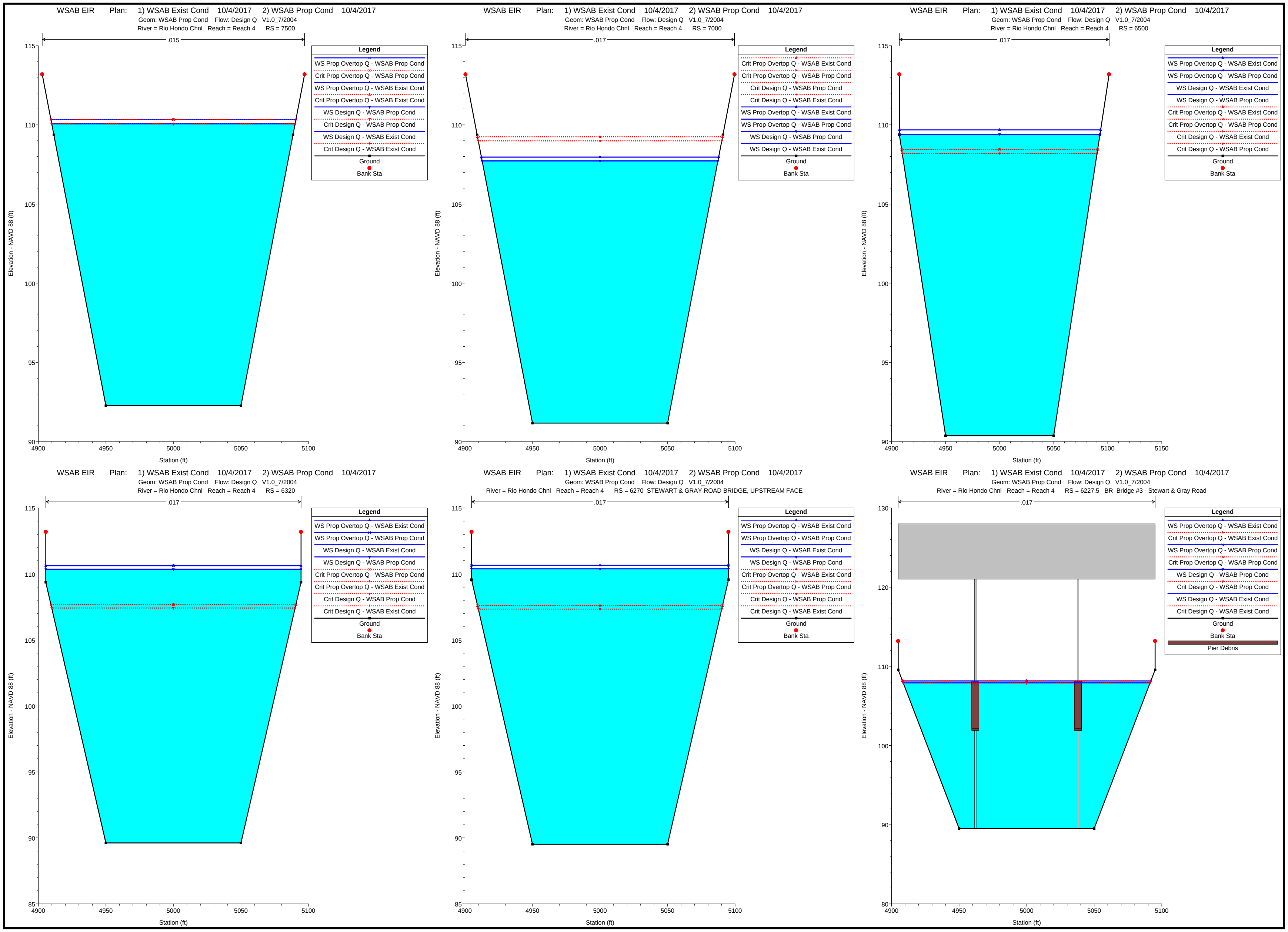
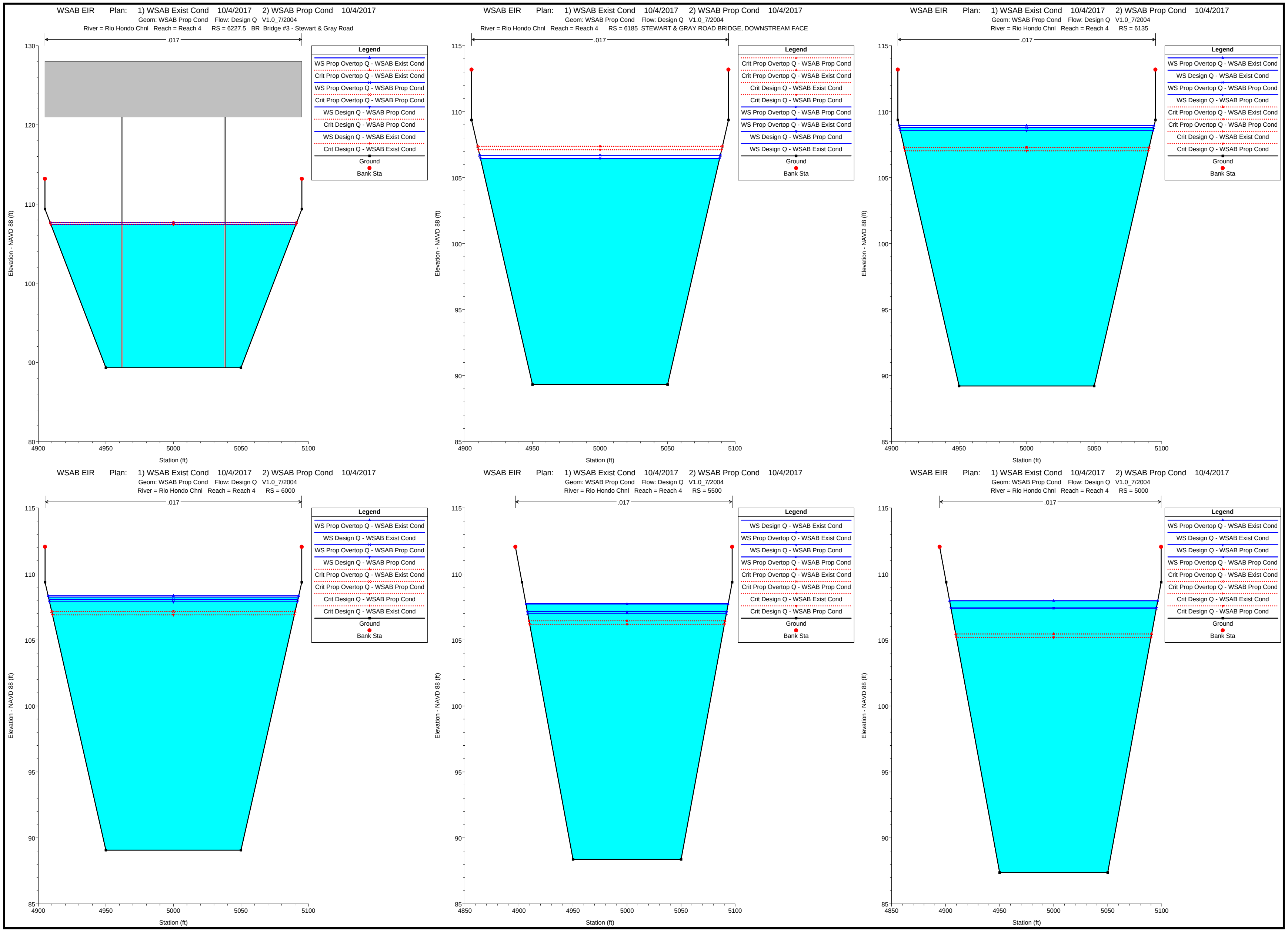
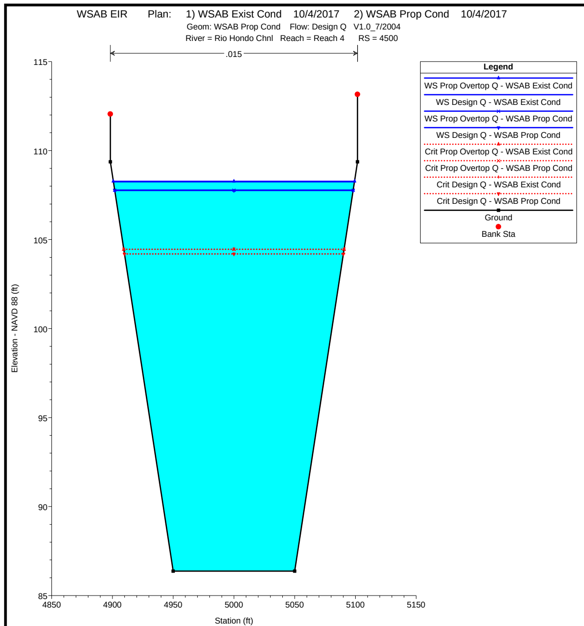
26655
25500
24360
23075
21492
19500
17495
15600
13500
11600
9880
8642
7000
5500
4320
3000
1500
Project Site
Sta 23+86
55 of the 325 XS's are not Geo-Referenced (Geo-Ref user entered XS Geo-Ref interpolated XS Non Geo-Ref user entered XS Non Geo-Ref interpolated XS)

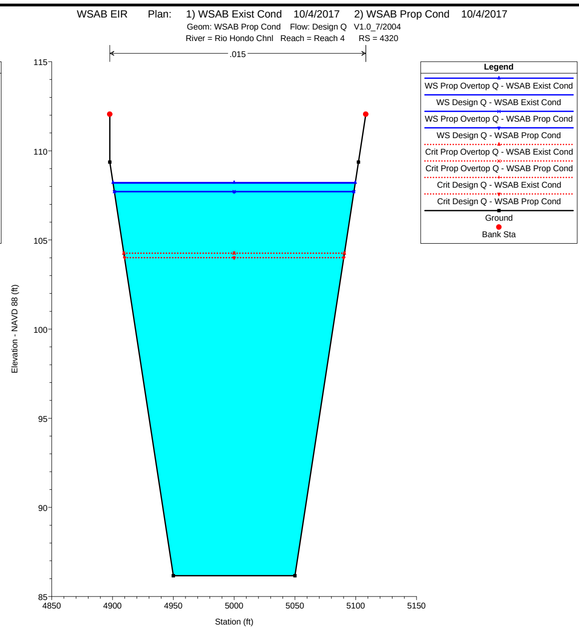


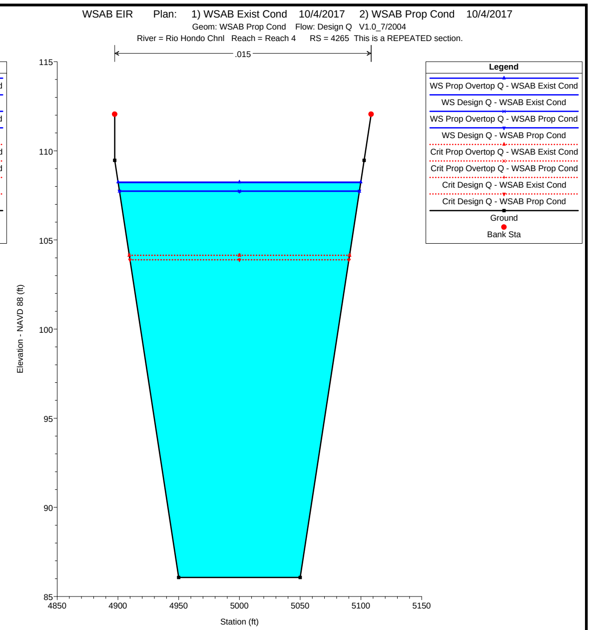
WSAB EIR Plan: 1) WSAB Exist Cond 10/4/2017 2) WSAB Prop Cond 10/4/2017
Geom: WSAB Prop Cond Flow: Design Q V1.0_7/2004
Rio Hondo Chnl Reach 4
Project Site
Sta 23+86
Legend
WS Design Q - WSAB Exist Cond
WS Prop Overtop Q - WSAB Exist Cond
WS Design Q - WSAB Prop Cond
WS Prop Overtop Q - WSAB Prop Cond
Crit Prop Overtop Q - WSAB Exist Cond
Crit Prop Overtop Q - WSAB Prop Cond
Crit Design Q - WSAB Exist Cond
Crit Design Q - WSAB Prop Cond
Ground
LOB
ROB
Elevation - NAVD 88 (ft)
0
50
100
150
200
250
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
Channel Distance (ft)

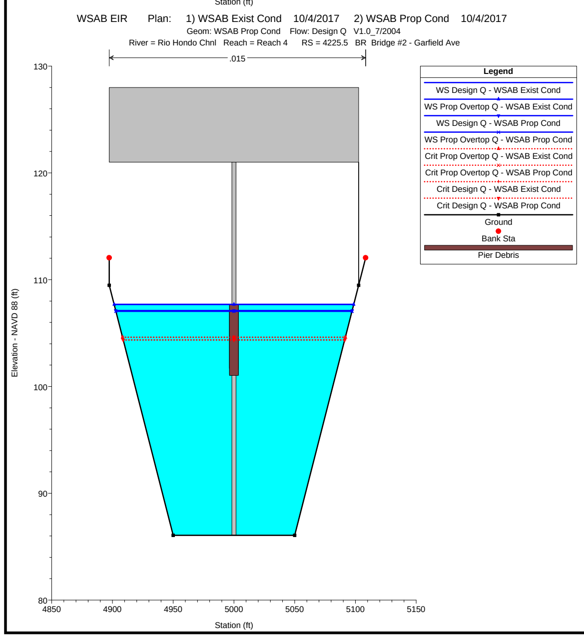

WSAB EIR Plan: 1) WSAB Exist Cond 10/4/2017 2) WSAB Prop Cond 10/4/2017
Geom: WSAB Prop Cond Flow: Design Q V1.0_7/2004
River = Rio Hondo Chnl Reach = Reach 4 RS = 7500
.015
Legend
WS Prop Overtop Q - WSAB Prop Cond
Crit Prop Overtop Q - WSAB Prop Cond
WS Prop Overtop Q - WSAB Exist Cond
Crit Prop Overtop Q - WSAB Exist Cond
WS Design Q - WSAB Prop Cond
Crit Design Q - WSAB Prop Cond
WS Design Q - WSAB Exist Cond
Crit Design Q - WSAB Exist Cond
Ground
Bank Sta
Elevation - NAVD 88 (ft)
Station (ft)
WSAB EIR Plan: 1) WSAB Exist Cond 10/4/2017 2) WSAB Prop Cond 10/4/2017
Geom: WSAB Prop Cond Flow: Design Q V1.0_7/2004
River = Rio Hondo Chnl Reach = Reach 4 RS = 7000
.017
Legend
Crit Prop Overtop Q - WSAB Exist Cond
Crit Prop Overtop Q - WSAB Prop Cond
Crit Design Q - WSAB Prop Cond
Crit Design Q - WSAB Exist Cond
WS Prop Overtop Q - WSAB Exist Cond
WS Prop Overtop Q - WSAB Prop Cond
WS Design Q - WSAB Prop Cond
WS Design Q - WSAB Exist Cond
Ground
Bank Sta
Elevation - NAVD 88 (ft)
Station (ft)
WSAB EIR Plan: 1) WSAB Exist Cond 10/4/2017 2) WSAB Prop Cond 10/4/2017
Geom: WSAB Prop Cond Flow: Design Q V1.0_7/2004
River = Rio Hondo Chnl Reach = Reach 4 RS = 6500
.017
Legend
WS Prop Overtop Q - WSAB Exist Cond
WS Prop Overtop Q - WSAB Prop Cond
WS Design Q - WSAB Exist Cond
WS Design Q - WSAB Prop Cond
Crit Prop Overtop Q - WSAB Exist Cond
Crit Prop Overtop Q - WSAB Prop Cond
Crit Design Q - WSAB Exist Cond
Crit Design Q - WSAB Prop Cond
Ground
Bank Sta
Elevation - NAVD 88 (ft)
Station (ft)
WSAB EIR Plan: 1) WSAB Exist Cond 10/4/2017 2) WSAB Prop Cond 10/4/2017
Geom: WSAB Prop Cond Flow: Design Q V1.0_7/2004
River = Rio Hondo Chnl Reach = Reach 4 RS = 6320
.017
Legend
WS Prop Overtop Q - WSAB Exist Cond
WS Prop Overtop Q - WSAB Prop Cond
WS Design Q - WSAB Exist Cond
WS Design Q - WSAB Prop Cond
Crit Prop Overtop Q - WSAB Prop Cond
Crit Prop Overtop Q - WSAB Exist Cond
Crit Design Q - WSAB Prop Cond
Crit Design Q - WSAB Exist Cond
Ground
Bank Sta
Elevation - NAVD 88 (ft)
Station (ft)
WSAB EIR Plan: 1) WSAB Exist Cond 10/4/2017 2) WSAB Prop Cond 10/4/2017
Geom: WSAB Prop Cond Flow: Design Q V1.0_7/2004
River = Rio Hondo Chnl Reach = Reach 4 RS = 6270 STEWART & GRAY ROAD BRIDGE, UPSTREAM FACE
.017
Legend
WS Prop Overtop Q - WSAB Exist Cond
WS Prop Overtop Q - WSAB Prop Cond
WS Design Q - WSAB Exist Cond
WS Design Q - WSAB Prop Cond
Crit Prop Overtop Q - WSAB Prop Cond
Crit Prop Overtop Q - WSAB Exist Cond
Crit Design Q - WSAB Prop Cond
Crit Design Q - WSAB Exist Cond
Ground
Bank Sta
Elevation - NAVD 88 (ft)
Station (ft)
WSAB EIR Plan: 1) WSAB Exist Cond 10/4/2017 2) WSAB Prop Cond 10/4/2017
Geom: WSAB Prop Cond Flow: Design Q V1.0_7/2004
River = Rio Hondo Chnl Reach = Reach 4 RS = 6227.5 BR Bridge #3 - Stewart & Gray Road
.017
Legend
WS Prop Overtop Q - WSAB Exist Cond
Crit Prop Overtop Q - WSAB Exist Cond
WS Prop Overtop Q - WSAB Prop Cond
Crit Prop Overtop Q - WSAB Prop Cond
WS Design Q - WSAB Prop Cond
Crit Design Q - WSAB Prop Cond
WS Design Q - WSAB Exist Cond
Crit Design Q - WSAB Exist Cond
Ground
Bank Sta
Pier Debris
Elevation - NAVD 88 (ft)
Station (ft)

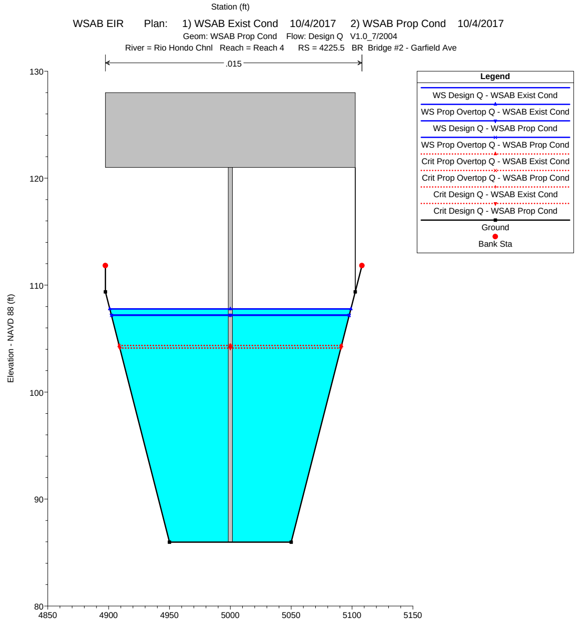

WSAB EIR Plan: 1) WSAB Exist Cond 10/4/2017 2) WSAB Prop Cond 10/4/2017
Geom: WSAB Prop Cond Flow: Design Q V1.0_7/2004
River = Rio Hondo Chnl Reach = Reach 4 RS = 6227.5 BR Bridge #3 - Stewart & Gray Road
Legend
WS Prop Overtop Q - WSAB Exist Cond
Crit Prop Overtop Q - WSAB Exist Cond
WS Prop Overtop Q - WSAB Prop Cond
Crit Prop Overtop Q - WSAB Prop Cond
WS Design Q - WSAB Prop Cond
Crit Design Q - WSAB Prop Cond
WS Design Q - WSAB Exist Cond
Crit Design Q - WSAB Exist Cond
Ground
Bank Sta
WSAB EIR Plan: 1) WSAB Exist Cond 10/4/2017 2) WSAB Prop Cond 10/4/2017
Geom: WSAB Prop Cond Flow: Design Q V1.0_7/2004
River = Rio Hondo Chnl Reach = Reach 4 RS = 6185 STEWART & GRAY ROAD BRIDGE, DOWNSTREAM FACE
WSAB EIR Plan: 1) WSAB Exist Cond 10/4/2017 2) WSAB Prop Cond 10/4/2017
Geom: WSAB Prop Cond Flow: Design Q V1.0_7/2004
River = Rio Hondo Chnl Reach = Reach 4 RS = 6135
WSAB EIR Plan: 1) WSAB Exist Cond 10/4/2017 2) WSAB Prop Cond 10/4/2017
Geom: WSAB Prop Cond Flow: Design Q V1.0_7/2004
River = Rio Hondo Chnl Reach = Reach 4 RS = 6000
WSAB EIR Plan: 1) WSAB Exist Cond 10/4/2017 2) WSAB Prop Cond 10/4/2017
Geom: WSAB Prop Cond Flow: Design Q V1.0_7/2004
River = Rio Hondo Chnl Reach = Reach 4 RS = 5500
WSAB EIR Plan: 1) WSAB Exist Cond 10/4/2017 2) WSAB Prop Cond 10/4/2017
Geom: WSAB Prop Cond Flow: Design Q V1.0_7/2004
River = Rio Hondo Chnl Reach = Reach 4 RS = 5000
.017
Elevation - NAVD 88 (ft)
Station (ft)

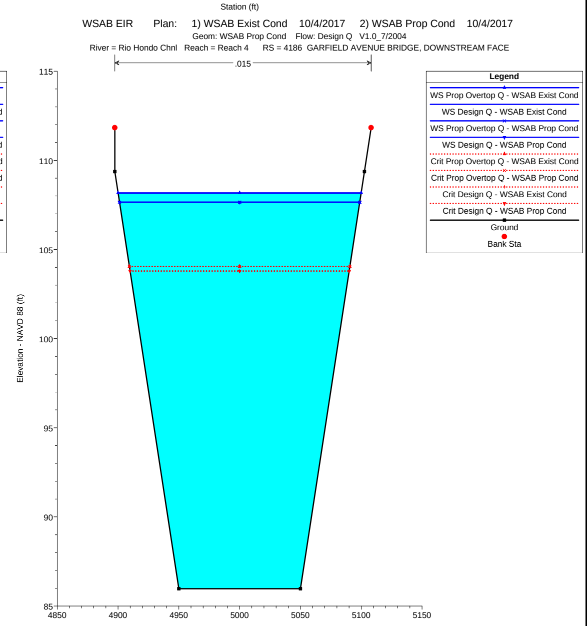

WSAB EIR Plan: 1) WSAB Exist Cond 10/4/2017 2) WSAB Prop Cond 10/4/2017
Geom: WSAB Prop Cond Flow: Design Q V1.0_7/2004
River = Rio Hondo Chnl Reach = Reach 4 RS = 4500
.015
Legend
WS Prop Overtop Q - WSAB Exist Cond
WS Design Q - WSAB Exist Cond
WS Prop Overtop Q - WSAB Prop Cond
WS Design Q - WSAB Prop Cond
Crit Prop Overtop Q - WSAB Exist Cond
Crit Prop Overtop Q - WSAB Prop Cond
Crit Design Q - WSAB Exist Cond
Crit Design Q - WSAB Prop Cond
Ground
Bank Sta
Elevation - NAVD 88 (ft)
Station (ft)

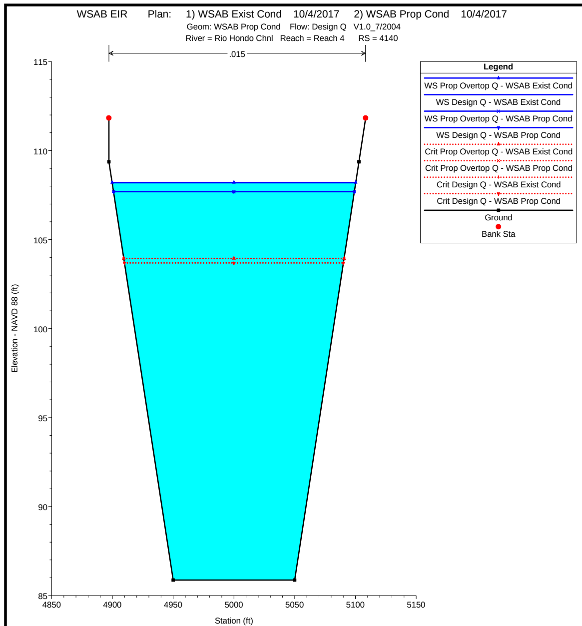

WSAB EIR Plan: 1) WSAB Exist Cond 10/4/2017 2) WSAB Prop Cond 10/4/2017
Geom: WSAB Prop Cond Flow: Design Q V1.0_7/2004
River = Rio Hondo Chnl Reach = Reach 4 RS = 4320
.015
Legend
WS Prop Overtop Q - WSAB Exist Cond
WS Design Q - WSAB Exist Cond
WS Prop Overtop Q - WSAB Prop Cond
WS Design Q - WSAB Prop Cond
Crit Prop Overtop Q - WSAB Exist Cond
Crit Prop Overtop Q - WSAB Prop Cond
Crit Design Q - WSAB Exist Cond
Crit Design Q - WSAB Prop Cond
Ground
Bank Sta
Elevation - NAVD 88 (ft)
Station (ft)

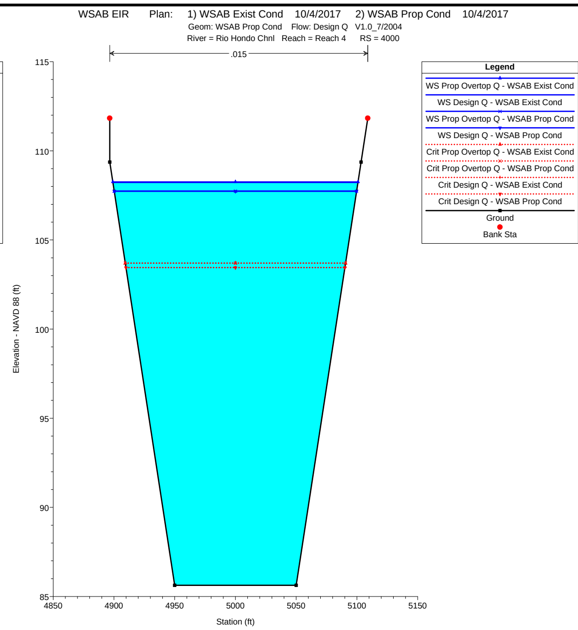

WSAB EIR Plan: 1) WSAB Exist Cond 10/4/2017 2) WSAB Prop Cond 10/4/2017
Geom: WSAB Prop Cond Flow: Design Q V1.0_7/2004
River = Rio Hondo Chnl Reach = Reach 4 RS = 4265 This is a REPEATED section.
.015
Legend
WS Prop Overtop Q - WSAB Exist Cond
WS Design Q - WSAB Exist Cond
WS Prop Overtop Q - WSAB Prop Cond
WS Design Q - WSAB Prop Cond
Crit Prop Overtop Q - WSAB Exist Cond
Crit Prop Overtop Q - WSAB Prop Cond
Crit Design Q - WSAB Exist Cond
Crit Design Q - WSAB Prop Cond
Ground
Bank Sta
Elevation - NAVD 88 (ft)
Station (ft)

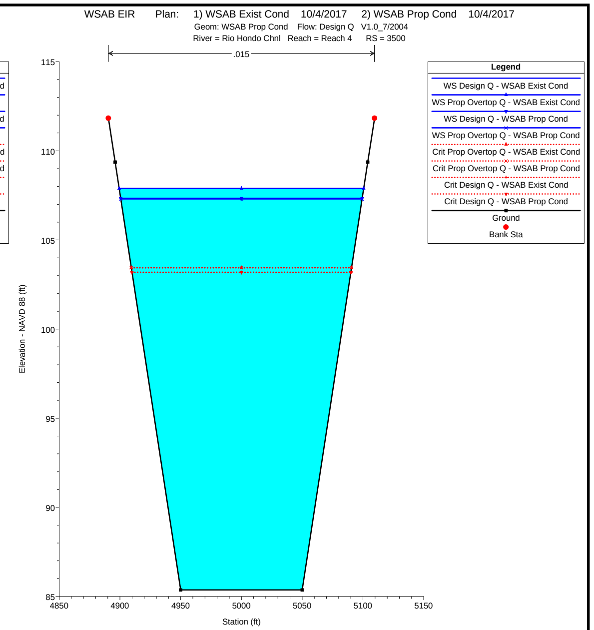

WSAB EIR Plan: 1) WSAB Exist Cond 10/4/2017 2) WSAB Prop Cond 10/4/2017
Geom: WSAB Prop Cond Flow: Design Q V1.0_7/2004
River = Rio Hondo Chnl Reach = Reach 4 RS = 4225.5 BR Bridge #2 - Garfield Ave
.015
Legend
WS Design Q - WSAB Exist Cond
WS Prop Overtop Q - WSAB Exist Cond
WS Design Q - WSAB Prop Cond
WS Prop Overtop Q - WSAB Prop Cond
Crit Prop Overtop Q - WSAB Exist Cond
Crit Prop Overtop Q - WSAB Prop Cond
Crit Design Q - WSAB Exist Cond
Crit Design Q - WSAB Prop Cond
Ground
Bank Sta
Pier Debris
Elevation - NAVD 88 (ft)
Station (ft)

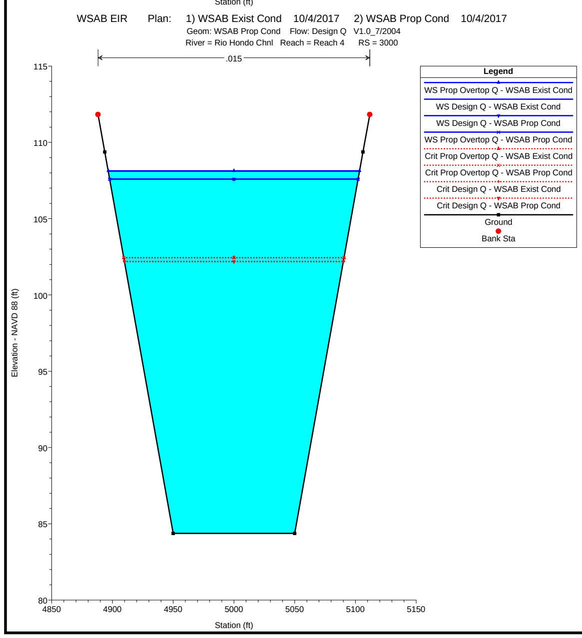

WSAB EIR Plan: 1) WSAB Exist Cond 10/4/2017 2) WSAB Prop Cond 10/4/2017
Geom: WSAB Prop Cond Flow: Design Q V1.0_7/2004
River = Rio Hondo Chnl Reach = Reach 4 RS = 4225.5 BR Bridge #2 - Garfield Ave
.015
Legend
WS Design Q - WSAB Exist Cond
WS Prop Overtop Q - WSAB Exist Cond
WS Design Q - WSAB Prop Cond
WS Prop Overtop Q - WSAB Prop Cond
Crit Prop Overtop Q - WSAB Exist Cond
Crit Prop Overtop Q - WSAB Prop Cond
Crit Design Q - WSAB Exist Cond
Crit Design Q - WSAB Prop Cond
Ground
Bank Sta
Elevation - NAVD 88 (ft)
Station (ft)

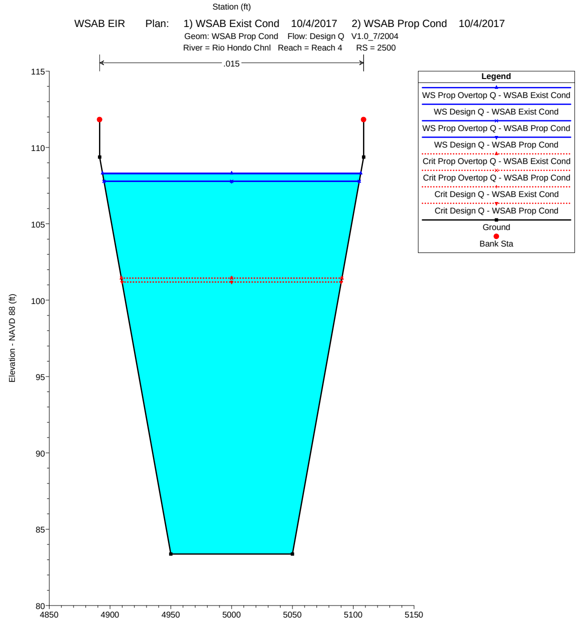

WSAB EIR Plan: 1) WSAB Exist Cond 10/4/2017 2) WSAB Prop Cond 10/4/2017
Geom: WSAB Prop Cond Flow: Design Q V1.0_7/2004
River = Rio Hondo Chnl Reach = Reach 4 RS = 4186 GARFIELD AVENUE BRIDGE, DOWNSTREAM FACE
.015
Legend
WS Prop Overtop Q - WSAB Exist Cond
WS Design Q - WSAB Exist Cond
WS Prop Overtop Q - WSAB Prop Cond
WS Design Q - WSAB Prop Cond
Crit Prop Overtop Q - WSAB Exist Cond
Crit Prop Overtop Q - WSAB Prop Cond
Crit Design Q - WSAB Exist Cond
Crit Design Q - WSAB Prop Cond
Ground
Bank Sta
Elevation - NAVD 88 (ft)
Station (ft)

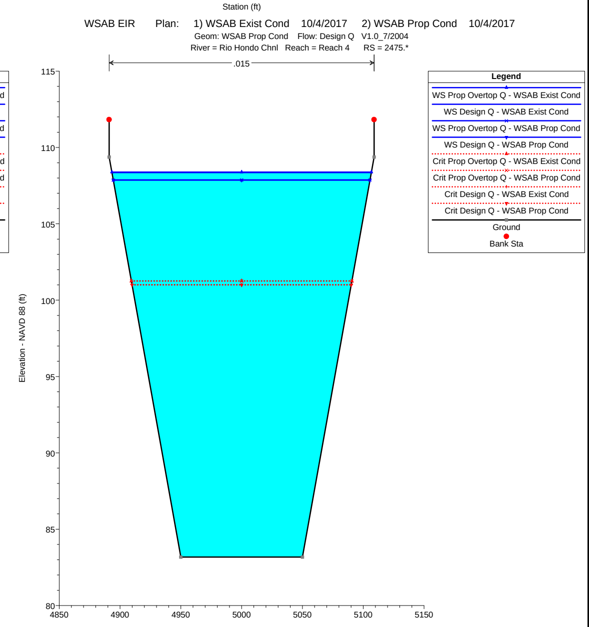

WSAB EIR Plan: 1) WSAB Exist Cond 10/4/2017 2) WSAB Prop Cond 10/4/2017
Geom: WSAB Prop Cond Flow: Design Q V1.0_7/2004
River = Rio Hondo Chnl Reach = Reach 4 RS = 4140
.015
Legend
WS Prop Overtop Q - WSAB Exist Cond
WS Design Q - WSAB Exist Cond
WS Prop Overtop Q - WSAB Prop Cond
WS Design Q - WSAB Prop Cond
Crit Prop Overtop Q - WSAB Exist Cond
Crit Prop Overtop Q - WSAB Prop Cond
Crit Design Q - WSAB Exist Cond
Crit Design Q - WSAB Prop Cond
Ground
Bank Sta
Elevation - NAVD 88 (ft)
Station (ft)

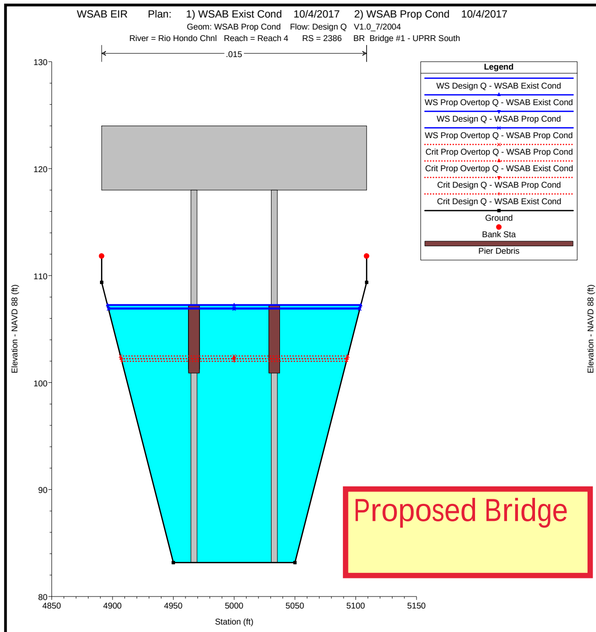

WSAB EIR Plan: 1) WSAB Exist Cond 10/4/2017 2) WSAB Prop Cond 10/4/2017
Geom: WSAB Prop Cond Flow: Design Q V1.0_7/2004
River = Rio Hondo Chnl Reach = Reach 4 RS = 4000
.015
Legend
WS Prop Overtop Q - WSAB Exist Cond
WS Design Q - WSAB Exist Cond
WS Prop Overtop Q - WSAB Prop Cond
WS Design Q - WSAB Prop Cond
Crit Prop Overtop Q - WSAB Exist Cond
Crit Prop Overtop Q - WSAB Prop Cond
Crit Design Q - WSAB Exist Cond
Crit Design Q - WSAB Prop Cond
Ground
Bank Sta
Elevation - NAVD 88 (ft)
Station (ft)

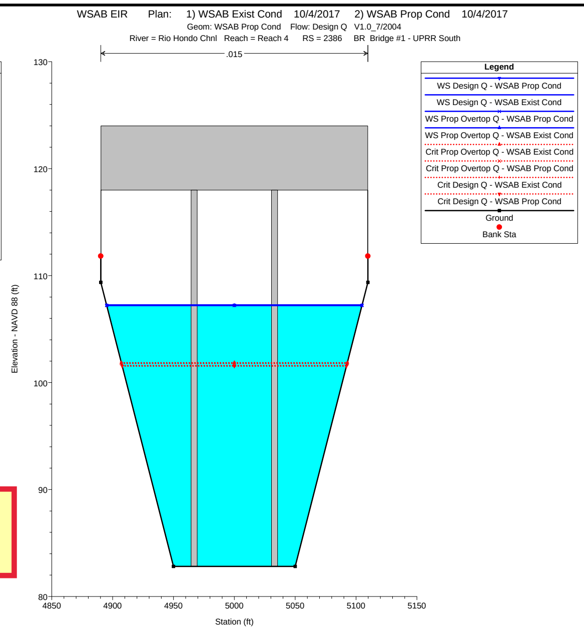

WSAB EIR Plan: 1) WSAB Exist Cond 10/4/2017 2) WSAB Prop Cond 10/4/2017
Geom: WSAB Prop Cond Flow: Design Q V1.0_7/2004
River = Rio Hondo Chnl Reach = Reach 4 RS = 3500
.015
Legend
WS Design Q - WSAB Exist Cond
WS Prop Overtop Q - WSAB Exist Cond
WS Design Q - WSAB Prop Cond
WS Prop Overtop Q - WSAB Prop Cond
Crit Prop Overtop Q - WSAB Exist Cond
Crit Prop Overtop Q - WSAB Prop Cond
Crit Design Q - WSAB Exist Cond
Crit Design Q - WSAB Prop Cond
Ground
Bank Sta
Elevation - NAVD 88 (ft)
Station (ft)

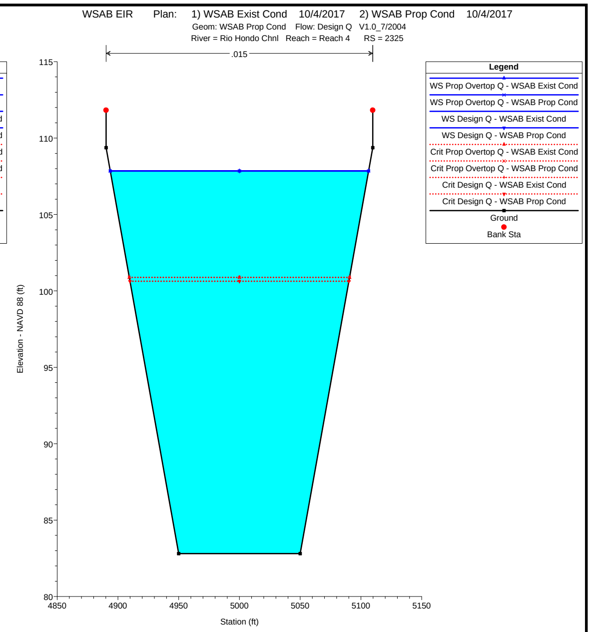

WSAB EIR Plan: 1) WSAB Exist Cond 10/4/2017 2) WSAB Prop Cond 10/4/2017
Geom: WSAB Prop Cond Flow: Design Q V1.0_7/2004
River = Rio Hondo Chnl Reach = Reach 4 RS = 3000
.015
Legend
WS Prop Overtop Q - WSAB Exist Cond
WS Design Q - WSAB Exist Cond
WS Design Q - WSAB Prop Cond
WS Prop Overtop Q - WSAB Prop Cond
Crit Prop Overtop Q - WSAB Exist Cond
Crit Prop Overtop Q - WSAB Prop Cond
Crit Design Q - WSAB Exist Cond
Crit Design Q - WSAB Prop Cond
Ground
Bank Sta
Elevation - NAVD 88 (ft)
Station (ft)

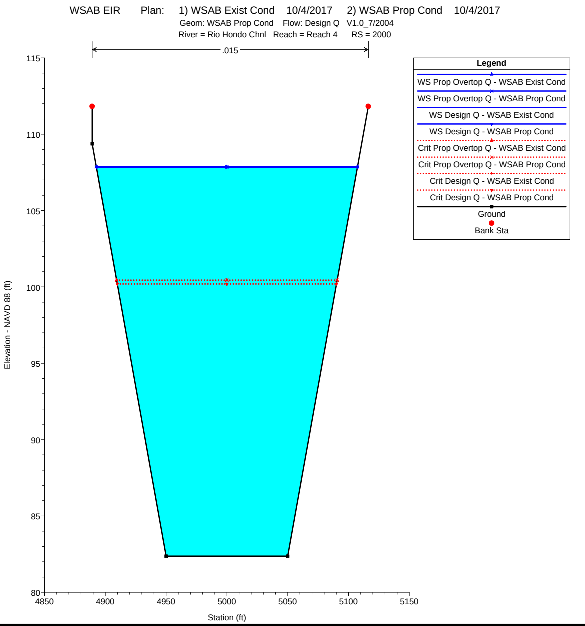

WSAB EIR Plan: 1) WSAB Exist Cond 10/4/2017 2) WSAB Prop Cond 10/4/2017
Geom: WSAB Prop Cond Flow: Design Q V1.0_7/2004
River = Rio Hondo Chnl Reach = Reach 4 RS = 2500
.015
Legend
WS Prop Overtop Q - WSAB Exist Cond
WS Design Q - WSAB Exist Cond
WS Prop Overtop Q - WSAB Prop Cond
WS Design Q - WSAB Prop Cond
Crit Prop Overtop Q - WSAB Exist Cond
Crit Prop Overtop Q - WSAB Prop Cond
Crit Design Q - WSAB Exist Cond
Crit Design Q - WSAB Prop Cond
Ground
Bank Sta
Elevation - NAVD 88 (ft)
Station (ft)


WSAB EIR Plan: 1) WSAB Exist Cond 10/4/2017 2) WSAB Prop Cond 10/4/2017
Geom: WSAB Prop Cond Flow: Design Q V1.0_7/2004
River = Rio Hondo Chnl Reach = Reach 4 RS = 2475.*
.015
Legend
WS Prop Overtop Q - WSAB Exist Cond
WS Design Q - WSAB Exist Cond
WS Prop Overtop Q - WSAB Prop Cond
WS Design Q - WSAB Prop Cond
Crit Prop Overtop Q - WSAB Exist Cond
Crit Prop Overtop Q - WSAB Prop Cond
Crit Design Q - WSAB Exist Cond
Crit Design Q - WSAB Prop Cond
Ground
Bank Sta
Elevation - NAVD 88 (ft)
Station (ft)


WSAB EIR Plan: 1) WSAB Exist Cond 10/4/2017 2) WSAB Prop Cond 10/4/2017
Geom: WSAB Prop Cond Flow: Design Q V1.0_7/2004
River = Rio Hondo Chnl Reach = Reach 4 RS = 2386 BR Bridge #1 - UPRR South
.015
Legend
WS Design Q - WSAB Exist Cond
WS Prop Overtop Q - WSAB Exist Cond
WS Design Q - WSAB Prop Cond
WS Prop Overtop Q - WSAB Prop Cond
Crit Prop Overtop Q - WSAB Prop Cond
Crit Prop Overtop Q - WSAB Exist Cond
Crit Design Q - WSAB Prop Cond
Crit Design Q - WSAB Exist Cond
Ground
Bank Sta
Pier Debris
Proposed Bridge
Elevation - NAVD 88 (ft)
Station (ft)


WSAB EIR Plan: 1) WSAB Exist Cond 10/4/2017 2) WSAB Prop Cond 10/4/2017
Geom: WSAB Prop Cond Flow: Design Q V1.0_7/2004
River = Rio Hondo Chnl Reach = Reach 4 RS = 2386 BR Bridge #1 - UPRR South
.015
Legend
WS Design Q - WSAB Prop Cond
WS Design Q - WSAB Exist Cond
WS Prop Overtop Q - WSAB Prop Cond
WS Prop Overtop Q - WSAB Exist Cond
Crit Prop Overtop Q - WSAB Exist Cond
Crit Prop Overtop Q - WSAB Prop Cond
Crit Design Q - WSAB Exist Cond
Crit Design Q - WSAB Prop Cond
Ground
Bank Sta
Elevation - NAVD 88 (ft)
Station (ft)


WSAB EIR Plan: 1) WSAB Exist Cond 10/4/2017 2) WSAB Prop Cond 10/4/2017
Geom: WSAB Prop Cond Flow: Design Q V1.0_7/2004
River = Rio Hondo Chnl Reach = Reach 4 RS = 2325
.015
Legend
WS Prop Overtop Q - WSAB Exist Cond
WS Prop Overtop Q - WSAB Prop Cond
WS Design Q - WSAB Exist Cond
WS Design Q - WSAB Prop Cond
Crit Prop Overtop Q - WSAB Exist Cond
Crit Prop Overtop Q - WSAB Prop Cond
Crit Design Q - WSAB Exist Cond
Crit Design Q - WSAB Prop Cond
Ground
Bank Sta
Elevation - NAVD 88 (ft)
Station (ft)


WSAB EIR Plan: 1) WSAB Exist Cond 10/4/2017 2) WSAB Prop Cond 10/4/2017
Geom: WSAB Prop Cond Flow: Design Q V1.0_7/2004
River = Rio Hondo Chnl Reach = Reach 4 RS = 2000
.015
Legend
WS Prop Overtop Q - WSAB Exist Cond
WS Prop Overtop Q - WSAB Prop Cond
WS Design Q - WSAB Exist Cond
WS Design Q - WSAB Prop Cond
Crit Prop Overtop Q - WSAB Exist Cond
Crit Prop Overtop Q - WSAB Prop Cond
Crit Design Q - WSAB Exist Cond
Crit Design Q - WSAB Prop Cond
Ground
Bank Sta
Elevation - NAVD 88 (ft)
Station (ft)

HEC-RAS Output
Exist Condition vs. Proposed
(Some sections are omitted)

HEC-RAS River: Rio Hondo Chnl Reach: Reach 4

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach 4	7500	Design Q	WSAB Exist Cond	52900.00	92.27	110.07	110.07	117.06	0.001459	21.22	2492.82	180.14	1.01
Reach 4	7500	Design Q	WSAB Prop Cond	52900.00	92.27	110.07	110.07	117.06	0.001459	21.22	2492.84	180.14	1.01
Reach 4	7500	Prop Overtop Q	WSAB Exist Cond	54200.00	92.27	110.34	110.34	117.40	0.001449	21.32	2541.94	181.36	1.00
Reach 4	7500	Prop Overtop Q	WSAB Prop Cond	54200.00	92.27	110.34	110.34	117.40	0.001449	21.32	2541.95	181.36	1.00
Reach 4	7000	Design Q	WSAB Exist Cond	52900.00	91.17	107.73	108.99	116.14	0.002441	23.28	2272.16	174.50	1.14
Reach 4	7000	Design Q	WSAB Prop Cond	52900.00	91.17	107.73	108.99	116.14	0.002441	23.28	2272.16	174.50	1.14
Reach 4	7000	Prop Overtop Q	WSAB Exist Cond	54200.00	91.17	107.96	109.24	116.48	0.002434	23.43	2313.39	175.56	1.14
Reach 4	7000	Prop Overtop Q	WSAB Prop Cond	54200.00	91.17	107.96	109.24	116.48	0.002434	23.43	2313.39	175.56	1.14
Reach 4	6500	Design Q	WSAB Exist Cond	52900.00	90.37	109.41	108.19	115.28	0.001462	19.45	2719.78	185.59	0.90
Reach 4	6500	Design Q	WSAB Prop Cond	52900.00	90.37	109.41	108.19	115.28	0.001462	19.45	2719.78	185.59	0.90
Reach 4	6500	Prop Overtop Q	WSAB Exist Cond	54200.00	90.37	109.68	108.45	115.62	0.001455	19.57	2769.04	186.19	0.89
Reach 4	6500	Prop Overtop Q	WSAB Prop Cond	54200.00	90.37	109.68	108.45	115.62	0.001455	19.57	2769.04	186.19	0.89
Reach 4	6320	Design Q	WSAB Exist Cond	52900.00	89.62	110.36	107.42	115.06	0.001048	17.41	3039.35	188.88	0.76
Reach 4	6320	Design Q	WSAB Prop Cond	52900.00	89.62	110.36	107.42	115.06	0.001048	17.41	3039.35	188.88	0.76
Reach 4	6320	Prop Overtop Q	WSAB Exist Cond	54200.00	89.62	110.62	107.67	115.40	0.001045	17.54	3089.57	188.88	0.76
Reach 4	6320	Prop Overtop Q	WSAB Prop Cond	54200.00	89.62	110.62	107.67	115.40	0.001045	17.54	3089.57	188.88	0.76
Reach 4	6270	Design Q	WSAB Exist Cond	52900.00	89.52	110.38	107.34	115.01	0.001028	17.27	3063.47	190.22	0.76
Reach 4	6270	Design Q	WSAB Prop Cond	52900.00	89.52	110.38	107.34	115.01	0.001028	17.27	3063.47	190.22	0.76
Reach 4	6270	Prop Overtop Q	WSAB Exist Cond	54200.00	89.52	110.65	107.60	115.35	0.001025	17.40	3114.57	190.22	0.76
Reach 4	6270	Prop Overtop Q	WSAB Prop Cond	54200.00	89.52	110.65	107.60	115.35	0.001025	17.40	3114.57	190.22	0.76
Reach 4	6227.5			Bridge									
Reach 4	6185	Design Q	WSAB Exist Cond	52900.00	89.32	106.46	107.12	114.16	0.002152	22.28	2374.58	177.12	1.07
Reach 4	6185	Design Q	WSAB Prop Cond	52900.00	89.32	106.46	107.12	114.16	0.002152	22.28	2374.59	177.12	1.07
Reach 4	6185	Prop Overtop Q	WSAB Exist Cond	54200.00	89.32	106.69	107.37	114.51	0.002149	22.43	2416.64	178.18	1.07
Reach 4	6185	Prop Overtop Q	WSAB Prop Cond	54200.00	89.32	106.69	107.37	114.51	0.002149	22.43	2416.64	178.18	1.07
Reach 4	6135	Design Q	WSAB Exist Cond	52900.00	89.21	108.80	107.03	114.26	0.001316	18.74	2823.12	188.17	0.85
Reach 4	6135	Design Q	WSAB Prop Cond	52900.00	89.21	108.56	107.03	114.19	0.001377	19.04	2777.79	187.08	0.87
Reach 4	6135	Prop Overtop Q	WSAB Exist Cond	54200.00	89.21	108.94	107.29	114.56	0.001345	19.02	2849.49	188.80	0.86
Reach 4	6135	Prop Overtop Q	WSAB Prop Cond	54200.00	89.21	108.78	107.29	114.52	0.001386	19.22	2819.47	188.08	0.87
Reach 4	6000	Design Q	WSAB Exist Cond	52900.00	89.07	108.25	106.90	114.06	0.001435	19.36	2732.65	185.01	0.89
Reach 4	6000	Design Q	WSAB Prop Cond	52900.00	89.07	107.89	106.90	114.00	0.001537	19.83	2667.25	183.44	0.92
Reach 4	6000	Prop Overtop Q	WSAB Exist Cond	54200.00	89.07	108.34	107.16	114.37	0.001478	19.70	2750.74	185.45	0.90
Reach 4	6000	Prop Overtop Q	WSAB Prop Cond	54200.00	89.07	108.07	107.16	114.33	0.001558	20.07	2700.04	184.23	0.92
Reach 4	5500	Design Q	WSAB Exist Cond	52900.00	88.37	107.76	106.19	113.36	0.001367	18.99	2784.99	187.26	0.87
Reach 4	5500	Design Q	WSAB Prop Cond	52900.00	88.37	107.14	106.19	113.24	0.001543	19.82	2669.07	184.45	0.92

HEC-RAS River: Rio Hondo Chnl Reach: Reach 4 (Continued)

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach 4	5500	Prop Overtop Q	WSAB Exist Cond	54200.00	88.37	107.73	106.45	113.63	0.001444	19.50	2779.07	187.11	0.89
Reach 4	5500	Prop Overtop Q	WSAB Prop Cond	54200.00	88.37	107.02	106.45	113.53	0.001656	20.47	2648.24	183.94	0.95
Reach 4	5000	Design Q	WSAB Exist Cond	52900.00	87.37	107.96	105.19	112.75	0.001094	17.55	3013.72	192.67	0.78
Reach 4	5000	Design Q	WSAB Prop Cond	52900.00	87.37	107.43	105.19	112.56	0.001206	18.17	2911.24	190.27	0.82
Reach 4	5000	Prop Overtop Q	WSAB Exist Cond	54200.00	87.37	107.97	105.45	112.99	0.001148	17.98	3013.85	192.68	0.80
Reach 4	5000	Prop Overtop Q	WSAB Prop Cond	54200.00	87.37	107.40	105.45	112.80	0.001272	18.65	2906.25	190.15	0.84
Reach 4	4500	Design Q	WSAB Exist Cond	52900.00	86.37	108.24	104.20	112.32	0.000680	16.21	3263.40	198.42	0.70
Reach 4	4500	Design Q	WSAB Prop Cond	52900.00	86.37	107.76	104.20	112.09	0.000740	16.70	3168.07	196.25	0.73
Reach 4	4500	Prop Overtop Q	WSAB Exist Cond	54200.00	86.37	108.27	104.45	112.54	0.000711	16.58	3269.52	198.56	0.72
Reach 4	4500	Prop Overtop Q	WSAB Prop Cond	54200.00	86.37	107.77	104.45	112.31	0.000774	17.09	3171.33	196.32	0.75
Reach 4	4320	Design Q	WSAB Exist Cond	52900.00	86.17	108.20	104.00	112.20	0.000663	16.06	3294.14	199.12	0.70
Reach 4	4320	Design Q	WSAB Prop Cond	52900.00	86.17	107.70	104.00	111.96	0.000721	16.55	3196.63	196.90	0.72
Reach 4	4320	Prop Overtop Q	WSAB Exist Cond	54200.00	86.17	108.22	104.26	112.41	0.000693	16.43	3299.47	199.24	0.71
Reach 4	4320	Prop Overtop Q	WSAB Prop Cond	54200.00	86.17	107.71	104.26	112.17	0.000756	16.94	3198.75	196.95	0.74
Reach 4	4265	Design Q	WSAB Exist Cond	52900.00	86.07	108.22	103.89	112.16	0.000649	15.94	3318.55	199.67	0.69
Reach 4	4265	Design Q	WSAB Prop Cond	52900.00	86.07	107.73	103.89	111.92	0.000706	16.42	3221.42	197.47	0.72
Reach 4	4265	Prop Overtop Q	WSAB Exist Cond	54200.00	86.07	108.25	104.14	112.37	0.000678	16.30	3324.30	199.80	0.70
Reach 4	4265	Prop Overtop Q	WSAB Prop Cond	54200.00	86.07	107.74	104.14	112.13	0.000739	16.81	3224.06	197.53	0.73
Reach 4	4225.5			Bridge									
Reach 4	4186	Design Q	WSAB Exist Cond	52900.00	85.97	108.16	103.79	112.08	0.000645	15.90	3326.18	199.84	0.69
Reach 4	4186	Design Q	WSAB Prop Cond	52900.00	85.97	107.65	103.79	111.83	0.000703	16.40	3226.02	197.57	0.72
Reach 4	4186	Prop Overtop Q	WSAB Exist Cond	54200.00	85.97	108.18	104.04	112.29	0.000675	16.27	3330.50	199.94	0.70
Reach 4	4186	Prop Overtop Q	WSAB Prop Cond	54200.00	85.97	107.65	104.04	112.04	0.000738	16.80	3226.51	197.58	0.73
Reach 4	4140	Design Q	WSAB Exist Cond	52900.00	85.87	108.19	103.69	112.05	0.000631	15.78	3352.84	200.45	0.68
Reach 4	4140	Design Q	WSAB Prop Cond	52900.00	85.87	107.69	103.69	111.80	0.000686	16.26	3253.37	198.20	0.71
Reach 4	4140	Prop Overtop Q	WSAB Exist Cond	54200.00	85.87	108.21	103.94	112.26	0.000659	16.14	3357.75	200.56	0.70
Reach 4	4140	Prop Overtop Q	WSAB Prop Cond	54200.00	85.87	107.70	103.94	112.00	0.000720	16.65	3254.63	198.23	0.72
Reach 4	4000	Design Q	WSAB Exist Cond	52900.00	85.63	108.23	103.45	111.97	0.000602	15.52	3409.01	201.70	0.67
Reach 4	4000	Design Q	WSAB Prop Cond	52900.00	85.63	107.73	103.45	111.70	0.000654	15.98	3309.90	199.48	0.69
Reach 4	4000	Prop Overtop Q	WSAB Exist Cond	54200.00	85.63	108.26	103.70	112.17	0.000629	15.87	3414.62	201.83	0.68
Reach 4	4000	Prop Overtop Q	WSAB Prop Cond	54200.00	85.63	107.74	103.70	111.90	0.000685	16.36	3312.01	199.53	0.71
Reach 4	3500	Design Q	WSAB Exist Cond	52900.00	85.37	107.89	103.19	111.66	0.000610	15.59	3393.23	201.34	0.67
Reach 4	3500	Design Q	WSAB Prop Cond	52900.00	85.37	107.34	103.19	111.37	0.000669	16.12	3282.38	198.85	0.70
Reach 4	3500	Prop Overtop Q	WSAB Exist Cond	54200.00	85.37	107.89	103.44	111.85	0.000640	15.98	3392.75	201.33	0.69
Reach 4	3500	Prop Overtop Q	WSAB Prop Cond	54200.00	85.37	107.31	103.44	111.56	0.000707	16.54	3276.15	198.71	0.72

HEC-RAS River: Rio Hondo Chnl Reach: Reach 4 (Continued)

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach 4	3000	Design Q	WSAB Exist Cond	52900.00	84.37	108.12	102.19	111.39	0.000500	14.52	3643.10	206.85	0.61
Reach 4	3000	Design Q	WSAB Prop Cond	52900.00	84.37	107.59	102.19	111.07	0.000543	14.96	3535.63	204.50	0.63
Reach 4	3000	Prop Overtop Q	WSAB Exist Cond	54200.00	84.37	108.13	102.45	111.56	0.000523	14.86	3646.55	206.93	0.62
Reach 4	3000	Prop Overtop Q	WSAB Prop Cond	54200.00	84.37	107.59	102.44	111.24	0.000571	15.34	3534.34	204.47	0.65
Reach 4	2500	Design Q	WSAB Exist Cond	52900.00	83.37	108.29	101.19	111.16	0.000416	13.60	3888.84	212.13	0.56
Reach 4	2500	Design Q	WSAB Prop Cond	52900.00	83.37	107.78	101.18	110.82	0.000450	13.98	3782.68	209.87	0.58
Reach 4	2500	Prop Overtop Q	WSAB Exist Cond	54200.00	83.37	108.32	101.45	111.32	0.000435	13.92	3895.04	212.26	0.57
Reach 4	2500	Prop Overtop Q	WSAB Prop Cond	54200.00	83.37	107.79	101.44	110.98	0.000471	14.32	3784.61	209.91	0.59
Reach 4	2475.*	Design Q	WSAB Exist Cond	52900.00	83.18	108.36	101.01	111.15	0.000400	13.41	3943.75	213.28	0.55
Reach 4	2475.*	Design Q	WSAB Prop Cond	52900.00	83.18	107.86	101.00	110.81	0.000432	13.78	3838.59	211.05	0.57
Reach 4	2475.*	Prop Overtop Q	WSAB Exist Cond	54200.00	83.18	108.39	101.26	111.31	0.000418	13.72	3950.95	213.43	0.56
Reach 4	2475.*	Prop Overtop Q	WSAB Prop Cond	54200.00	83.18	107.88	101.25	110.97	0.000452	14.11	3841.71	211.12	0.58
Reach 4	2450	Design Q	WSAB Exist Cond	52900.00	83.00	108.42	100.83	111.14	0.000386	13.24	3995.64	214.38	0.54
Reach 4	2450	Prop Overtop Q	WSAB Exist Cond	54200.00	83.00	108.46	101.08	111.30	0.000403	13.54	4003.74	214.55	0.55
Reach 4	2397	Design Q	WSAB Exist Cond	52900.00	82.95	108.41	100.77	111.12	0.000383	13.21	4004.78	214.58	0.54
Reach 4	2397	Prop Overtop Q	WSAB Exist Cond	54200.00	82.95	108.45	101.02	111.28	0.000400	13.51	4012.77	214.75	0.55
Reach 4	2386			Bridge			Proposed Bridge						
Reach 4	2375	Design Q	WSAB Exist Cond	52900.00	82.86	107.85	100.68	110.70	0.000411	13.55	3905.06	212.48	0.56
Reach 4	2375	Prop Overtop Q	WSAB Exist Cond	54200.00	82.86	107.86	100.93	110.85	0.000431	13.87	3907.36	212.53	0.57
Reach 4	2325	Design Q	WSAB Exist Cond	52900.00	82.81	107.85	100.63	110.68	0.000409	13.52	3914.04	212.67	0.56
Reach 4	2325	Design Q	WSAB Prop Cond	52900.00	82.81	107.85	100.63	110.68	0.000409	13.52	3914.04	212.67	0.56
Reach 4	2325	Prop Overtop Q	WSAB Exist Cond	54200.00	82.81	107.86	100.88	110.83	0.000428	13.84	3916.23	212.71	0.57
Reach 4	2325	Prop Overtop Q	WSAB Prop Cond	54200.00	82.81	107.86	100.88	110.83	0.000428	13.84	3916.23	212.71	0.57
Reach 4	2000	Design Q	WSAB Exist Cond	52900.00	82.37	107.85	100.19	110.55	0.000382	13.20	4008.79	214.66	0.54
Reach 4	2000	Design Q	WSAB Prop Cond	52900.00	82.37	107.85	100.19	110.55	0.000382	13.20	4008.79	214.66	0.54
Reach 4	2000	Prop Overtop Q	WSAB Exist Cond	54200.00	82.37	107.86	100.45	110.70	0.000401	13.51	4011.05	214.71	0.55
Reach 4	2000	Prop Overtop Q	WSAB Prop Cond	54200.00	82.37	107.86	100.45	110.70	0.000401	13.51	4011.05	214.71	0.55

HEC-RAS Output
Bridge Six Sections Near Proposed Bridge

HEC-RAS River: Rio Hondo Chnl Reach: Reach 4

Reach	River Sta	Profile	Plan	E.G. Elev	W.S. Elev	Crit W.S.	Frctn Loss	C & E Loss	Top Width	Q Left	Q Channel	Q Right	Vel Chnl
				(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)
Reach 4	4186	Design Q	WSAB Exist Cond	112.08	108.16	103.79	0.03	0.00	199.84		52900.00		15.90
Reach 4	4186	Design Q	WSAB Prop Cond	111.83	107.65	103.79	0.03	0.00	197.57		52900.00		16.40
Reach 4	4186	Prop Overtop Q	WSAB Exist Cond	112.29	108.18	104.04	0.03	0.00	199.94		54200.00		16.27
Reach 4	4186	Prop Overtop Q	WSAB Prop Cond	112.04	107.65	104.04	0.03	0.00	197.58		54200.00		16.80
Reach 4	4140	Design Q	WSAB Exist Cond	112.05	108.19	103.69	0.09	0.00	200.45		52900.00		15.78
Reach 4	4140	Design Q	WSAB Prop Cond	111.80	107.69	103.69	0.09	0.00	198.20		52900.00		16.26
Reach 4	4140	Prop Overtop Q	WSAB Exist Cond	112.26	108.21	103.94	0.09	0.00	200.56		54200.00		16.14
Reach 4	4140	Prop Overtop Q	WSAB Prop Cond	112.00	107.70	103.94	0.10	0.00	198.23		54200.00		16.65
Reach 4	2450	Design Q	WSAB Exist Cond	111.14	108.42	100.83	0.02	0.00	214.38		52900.00		13.24
Reach 4	2450	Prop Overtop Q	WSAB Exist Cond	111.30	108.46	101.08	0.02	0.00	214.55		54200.00		13.54
Reach 4	2397	Design Q	WSAB Exist Cond	111.12	108.41	100.77			214.58		52900.00		13.21
Reach 4	2397	Prop Overtop Q	WSAB Exist Cond	111.28	108.45	101.02			214.75		54200.00		13.51
Reach 4	2386 BR U	Design Q	WSAB Exist Cond	110.88	107.27	101.99			191.46		52900.00		15.23
Reach 4	2386 BR U	Design Q	WSAB Prop Cond	110.80	106.95	102.21	0.08	0.00	188.97		52900.00		15.73
Reach 4	2386 BR U	Prop Overtop Q	WSAB Exist Cond	111.03	107.22	102.25			191.24		54200.00		15.65
Reach 4	2386 BR U	Prop Overtop Q	WSAB Prop Cond	110.95	106.89	102.48	0.08	0.00	188.67		54200.00		16.18
Reach 4	2386 BR D	Design Q	WSAB Exist Cond	110.73	107.24	101.59			199.72		52900.00		14.98
Reach 4	2386 BR D	Design Q	WSAB Prop Cond	110.71	107.26	101.54	0.03	0.00	200.00		52900.00		14.92
Reach 4	2386 BR D	Prop Overtop Q	WSAB Exist Cond	110.88	107.20	101.85			199.55		54200.00		15.38
Reach 4	2386 BR D	Prop Overtop Q	WSAB Prop Cond	110.86	107.22	101.80	0.03	0.00	199.84		54200.00		15.32
Reach 4	2375	Design Q	WSAB Exist Cond	110.70	107.85	100.68	0.02	0.00	212.48		52900.00		13.55
Reach 4	2375	Prop Overtop Q	WSAB Exist Cond	110.85	107.86	100.93	0.02	0.00	212.53		54200.00		13.87
Reach 4	2325	Design Q	WSAB Exist Cond	110.68	107.85	100.63	0.13	0.00	212.67		52900.00		13.52
Reach 4	2325	Design Q	WSAB Prop Cond	110.68	107.85	100.63	0.13	0.00	212.67		52900.00		13.52
Reach 4	2325	Prop Overtop Q	WSAB Exist Cond	110.83	107.86	100.88	0.13	0.00	212.71		54200.00		13.84
Reach 4	2325	Prop Overtop Q	WSAB Prop Cond	110.83	107.86	100.88	0.13	0.00	212.71		54200.00		13.84

Plan: WSAB Prop Cond   Rio Hondo Chnl   Reach 4 RS: 2386   Profile: Design Q

E.G. US. (ft)	110.81	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	107.86	E.G. Elev (ft)	110.80	110.71
Q Total (cfs)	52900.00	W.S. Elev (ft)	106.95	107.26
Q Bridge (cfs)	52900.00	Crit W.S. (ft)	102.21	101.54
Q Weir (cfs)		Max Chl Dpth (ft)	23.77	24.45
Weir Sta Lft (ft)		Vel Total (ft/s)	15.73	14.92
Weir Sta Rgt (ft)		Flow Area (sq ft)	3363.22	3544.70
Weir Submerg		Froude # Chl	0.66	0.62
Weir Max Depth (ft)		Specif Force (cu ft)	61207.40	62365.68
Min El Weir Flow (ft)	124.01	Hydr Depth (ft)	17.80	17.72
Min El Prs (ft)	118.00	W.P. Total (ft)	334.16	308.16
Delta EG (ft)	0.13	Conv. Total (cfs)	1553082.0	1789296.0
Delta WS (ft)	0.01	Top Width (ft)	188.97	200.00
BR Open Area (sq ft)	5645.87	Frctn Loss (ft)	0.08	0.03
BR Open Vel (ft/s)	15.73	C & E Loss (ft)	0.00	0.00
Coef of Q		Shear Total (lb/sq ft)	0.73	0.63
Br Sel Method	Energy only	Power Total (lb/ft s)	4891.08	4890.24

HEC-RAS Output
Proposed Bridge Detailed Output

APPENDIX C SAN GABRIEL RIVER BRIDGE LOCATION HYDRAULIC STUDY

WEST SANTA ANA BRANCH TRANSIT CORRIDOR PROJECT
Contract No. AE5999300

Final
San Gabriel River Bridge
Location Hydraulic Study

Task No. 12.3 (Deliverable No. 12.3a)

Prepared for:

Metro

Los Angeles County
Metropolitan Transportation Authority

Prepared by:

WSP USA, Inc.
444 South Flower Street
Suite 800
Los Angeles, California 90071

June 2021

This Location Hydraulic Study has been prepared by JACOBS under the direction of the following Registered Civil Engineer. The undersigned attests to the technical information contained herein and the qualifications of any technical specialist providing engineering data upon which the recommendations, conclusions, and decisions are based:

Robert M. Henderson, P.E.

CONTRIBUTORS

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ACRONYMS AND ABBREVIATIONS

AA	Alternatives Analysis
BRT	Bus Rapid Transit
CEQA	California Environmental Quality Act
cfs	cubic feet per second
CP	Concentration Point
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
FEMA	Federal Emergency Management Administration
FIRM	Flood Insurance Rate Map
ft	foot/feet
ft/sec	feet per second
LA	Los Angeles
LACDPW	Los Angeles County Department of Public Works
LACFCD	Los Angeles County Flood Control District
LAUS	Los Angeles Union Station
LRT	Light Rail Transit
LRTP	Long Range Transportation Plan
Metro	Los Angeles County Metropolitan Transportation Authority
MWD	Metropolitan Water District
NEPA	National Environmental Policy Act
OCTA	Orange County Transportation Authority
PEROW	Pacific Electric Right-of-Way
ROW	Right-of-Way
SCAG	Southern California Association of Governments
TRS	Technical Refinement Study
UPRR	Union Pacific Railroad
USACE	U.S. Army Corps of Engineers
WSAB	West Santa Ana Branch
WSE	Water Surface Elevation

1 INTRODUCTION

1.1 Study Background

The West Santa Ana Branch (WSAB) Transit Corridor (Project) is a proposed light rail transit (LRT) line that would extend from four possible northern termini in southeast Los Angeles (LA) County to a southern terminus in the City of Artesia, traversing densely populated, low-income, and heavily transit-dependent communities. The Project would provide reliable, fixed guideway transit service that would increase mobility and connectivity for historically underserved, transit-dependent, and environmental justice communities; reduce travel times on local and regional transportation networks; and accommodate substantial future employment and population growth.

1.2 Alternatives Evaluation, Screening, and Selection Process

A wide range of potential alternatives have been considered and screened through the alternatives analysis processes. In March 2010, the Southern California Association of Governments (SCAG) initiated the Pacific Electric Right-of-Way (PEROW)/WSAB Alternatives Analysis (AA) Study (SCAG 2013) in coordination with the relevant cities, Orangeline Development Authority (now known as Eco-Rapid Transit), the Gateway Cities Council of Governments, the Los Angeles County Metropolitan Transportation Authority (Metro), the Orange County Transportation Authority, and the owners of the right-of-way (ROW)—Union Pacific Railroad (UPRR), BNSF Railway, and the Ports of Los Angeles and Long Beach. The AA Study evaluated a wide variety of transit connections and modes for a broader 34-mile corridor from Union Station in downtown Los Angeles to the City of Santa Ana in Orange County. In February 2013, SCAG completed the PEROW/WSAB Corridor Alternatives Analysis Report[1] and recommended two LRT alternatives for further study: West Bank 3 and the East Bank.

Following completion of the AA, Metro completed the WSAB Technical Refinement Study in 2015 focusing on the design and feasibility of five key issue areas along the 19-mile portion of the WSAB Transit Corridor within LA County:

- Access to Union Station in downtown Los Angeles
- Northern Section Options
- Huntington Park Alignment and Stations
- New Metro C (Green) Line Station
- Southern Terminus at Pioneer Station in Artesia

In September 2016, Metro initiated the WSAB Transit Corridor Environmental Study with the goal of obtaining environmental clearance of the Project under the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA).

[1] Initial concepts evaluated in the SCAG report included transit connections and modes for the 34 mile corridor from Union Station in downtown Los Angeles to the City of Santa Ana. Modes included low speed magnetic levitation (maglev) heavy rail, light rail, and bus rapid transit (BRT).

Metro issued a Notice of Preparation (NOP) on May 25, 2017, with a revised NOP issued on June 14, 2017, extending the comment period. In June 2017, Metro held public scoping meetings in the Cities of Bellflower, Los Angeles, South Gate, and Huntington Park. Metro provided Project updates and information to stakeholders with the intent to receive comments and questions through a comment period that ended in August 2017. A total of 1,122 comments were received during the public scoping period from May through August 2017. The comments focused on concerns regarding the Northern Alignment options, with specific concerns related to potential impacts to Alameda Street with an aerial alignment. Given potential visual and construction issues raised through public scoping, additional Northern Alignment concepts were evaluated.

In February 2018, the Metro Board of Directors approved further study of the alignment in the Northern Section due to community input during the 2017 scoping meetings. A second alternatives screening process was initiated to evaluate the original four Northern Alignment options and four new Northern Alignment concepts. The *Final Northern Alignment Alternatives and Concepts Updated Screening Report* was completed in May 2018 (Metro 2018). The alternatives were further refined and, based on the findings of the second screening analysis and the input gathered from the public outreach meetings, the Metro Board of Directors approved Build Alternatives E and G for further evaluation (now referred to as Alternatives 1 and 2, respectively, in this report).

On July 11, 2018, Metro issued a revised and recirculated CEQA Notice of Preparation, thereby initiating a scoping comment period. The purpose of the revised Notice of Preparation was to inform the public of the Metro Board's decision to carry forward Alternatives 1 and 2 into the Draft Environmental Impact Statement/Environmental Impact Report (EIS/EIR). During the scoping period, one agency and three public scoping meetings were held in the Cities of Los Angeles, Cudahy, and Bellflower. The meetings provided Project updates and information to stakeholders with the intent to receive comments and questions to support the environmental process. The comment period for scoping ended in August 24, 2018; over 250 comments were received.

Following the July 2018 scoping period, a number of Project refinements were made to address comments received, including additional grade separations, removing certain stations with low ridership, and removing the Bloomfield extension option. The Metro Board adopted these refinements to the project description at their November 2018 meeting.

1.3 Report Purpose

The Project would incur impacts to floodplains as a result of crossings at the Los Angeles River, Rio Hondo and San Gabriel River. This Location Hydraulic Study assessed the existing and expected Project conditions at the San Gabriel River crossing with respect to hydrology, floodplain impacts, hydraulic impacts of the encroachment, property at risk and environment impacts. The facility is owned and maintained by the Los Angeles County Department of Public Works (LACDPW) and Los Angeles County Flood Control District (LACFCD). Separate Location Hydraulic Studies were prepared for the Rio Hondo and Upper Los Angeles River crossings.

2 PROJECT DESCRIPTION

This section describes the No Build Alternative and the four Build Alternatives studied in the WSAB Transit Corridor Draft EIS/EIR, including design options, station locations, and maintenance and storage facility (MSF) site options. The Build Alternatives were developed through a comprehensive alternatives analysis process and meet the purpose and need of the Project.

The No Build Alternative and four Build Alternatives are generally defined as follows:

- **No Build Alternative -** Reflects the transportation network in the 2042 horizon year without the proposed Build Alternatives. The No Build Alternative includes the existing transportation network along with planned transportation improvements that have been committed to and identified in the constrained Metro 2009 Long Range Transportation Plan (2009 LRTP) (Metro 2009) and SCAG's 2016-2040 Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS) (SCAG 2016), as well as additional projects funded by Measure M that would be completed by 2042.
- **Build Alternatives**: The Build Alternatives consist of a new LRT line that would extend from different termini in the north to the same terminus in the City of Artesia in the south. The Build Alternatives are referred to as:
  - Alternative 1: Los Angeles Union Station to Pioneer Station; the northern terminus would be located underground at Los Angeles Union Station (LAUS) Forecourt
  - Alternative 2: 7th Street/Metro Center to Pioneer Station; the northern terminus would be located underground at 8th Street between Figueroa Street and Flower Street near 7th Street/Metro Center Station
  - Alternative 3: Slauson/A (Blue) Line to Pioneer Station; the northern terminus would be located just north of the intersection of Long Beach Avenue and Slauson Avenue in the City of Los Angeles, connecting to the current A (Blue) Line Slauson Station
  - Alternative 4: I-105/C (Green) Line to Pioneer Station; the northern terminus would be located at I-105 in the city of South Gate, connecting to the C (Green) Line along the I-105

Two design options are under consideration for Alternative 1. Design Option 1 would locate the northern terminus station box at the LAUS Metropolitan Water District (MWD) east of LAUS and the MWD building, below the baggage area parking facility. Design Option 2 would add the Little Tokyo Station along the WSAB alignment. The Design Options are further discussed in Section 2.3.6.

Figure 2-1 presents the four Build Alternatives and the design options. In the north, Alternative 1 would terminate at LAUS and primarily follow Alameda Avenue south underground to the proposed Arts/Industrial District Station. Alternative 2 would terminate near the existing 7th Street/Metro Center Station in the Downtown Transit Core and would primarily follow 8th Street east underground to the proposed Arts/Industrial District Station.

Figure 2-1. Project Alternatives

Source: Metro, 2020

From the Arts/Industrial District Station to the southern terminus at Pioneer Station, Alternatives 1 and 2 share a common alignment. South of Olympic Boulevard, the Alternatives 1 and 2 would transition from an underground configuration to an aerial configuration, cross over the Interstate (I-) 10 freeway and then parallel the existing Metro A (Blue) Line along the Wilmington Branch ROW as it proceeds south. South of Slauson Avenue, which would serve as the northern terminus for Alternative 3, Alternatives 1, 2, and 3 would turn east and transition to an at-grade configuration to follow the La Habra Branch ROW along Randolph Street. At the San Pedro Subdivision ROW, Alternatives 1, 2, and 3 would turn southeast to follow the San Pedro Subdivision ROW and then transition to the Pacific Electric Right-of-Way (PEROW), south of the I-105 freeway. The northern terminus for Alternative 4 would be located at the I-105/C (Green) Line. Alternatives 1, 2, 3, and 4 would then follow the PEROW to the southern terminus at the proposed Pioneer Station in Artesia. The Build Alternatives would be grade-separated where warranted, as indicated on Figure 2-2.

Figure 2-2. Project Alignment by Alignment Type

Source: Metro, 2020

2.1 Geographic Sections

The approximately 19-mile corridor is divided into two geographic sections—the Northern and Southern Sections. The boundary between the Northern and Southern Sections occurs at Florence Avenue in the City of Huntington Park.

2.1.1 Northern Section

The Northern Section includes approximately 8 miles of Alternatives 1 and 2 and 3.8 miles of Alternative 3. Alternative 4 is not within the Northern Section. The Northern Section covers the geographic area from downtown Los Angeles to Florence Avenue in the City of Huntington Park and would generally traverse the Cities of Los Angeles, Vernon, Huntington Park, and Bell, and the unincorporated Florence-Firestone community of LA County (Figure 2-3). Alternatives 1 and 2 would traverse portions of the Wilmington Branch (between approximately Martin Luther King Jr Boulevard along Long Beach Avenue to Slauson Avenue). Alternatives 1, 2, and 3 would traverse portions of the La Habra Branch ROW (between Slauson Avenue along Randolph Street to Salt Lake Avenue) and San Pedro Subdivision ROW (between Randolph Street to approximately Paramount Boulevard).

Figure 2-3. Northern Section

Source: Metro, 2020

2.1.2 Southern Section

The Southern Section includes approximately 11 miles of Alternatives 1, 2, and 3 and includes all 6.6 miles of Alternative 4. The Southern Section covers the geographic area from south of Florence Avenue in the City of Huntington Park to the City of Artesia and would generally traverse the Cities of Huntington Park, Cudahy, South Gate, Downey, Paramount, Bellflower, Cerritos, and Artesia (Figure 2-4). In the Southern Section, all four Build Alternatives would utilize portions of the San Pedro Subdivision and the Metro-owned PEROW (between approximately Paramount Boulevard to South Street).

Figure 2-4. Southern Section

Source: Metro, 2020

2.2 No Build Alternative

For the NEPA evaluation, the No Build Alternative is evaluated in the context of the existing transportation facilities in the Study Area (the Study Area extends approximately 2 miles from either side of the proposed alignment) and other capital transportation improvements and/or transit and highway operational enhancements that are reasonably foreseeable. Because the No Build Alternative provides the background transportation network, against which the Build Alternatives' impacts are identified and evaluated, the No Build Alternative does not include the Project.

The No Build Alternative reflects the transportation network in 2042 and includes the existing transportation network along with planned transportation improvements that have been committed to and identified in the constrained Metro 2009 LRTP and the SCAG 2016 RTP/SCS, as well as additional projects funded by Measure M, a sales tax initiative approved by voters in November 2016. The No Build Alternative includes Measure M projects that are scheduled to be completed by 2042.

Table 2.1 lists the existing transportation network and planned improvements included as part of the No Build Alternative.

Table 2.1. No Build Alternative – Existing Transportation Network and Planned Improvements

Project	To / From	Location Relative to Study Area
Rail (Existing)		
Metro Rail System (LRT and Heavy Rail Transit)	Various locations	Within Study Area
Metrolink (Southern California Regional Rail Authority) System	Various locations	Within Study Area
Rail (Under Construction/Planned)[1]		
Metro Westside D (Purple) Line Extension	Wilshire/Western to Westwood/VA Hospital	Outside Study Area
Metro C (Green) Line Extension[2] to Torrance	96th Street Station to Torrance	Outside Study Area
Metro C (Green) Line Extension	Norwalk to Expo/Crenshaw[3]	Outside Study Area
Metro East-West Line/Regional Connector/Eastside Phase 2	Santa Monica to Lambert Santa Monica to Peck Road	Within Study Area
Metro North-South Line/Regional Connector/Foothill Extension to Claremont Phase 2B	Long Beach to Claremont	Within Study Area
Metro Sepulveda Transit Corridor	Metro G (Orange) Line to Metro E (Expo) Line	Outside Study Area
Metro East San Fernando Valley Transit Corridor	Sylmar to Metro G (Orange) Line	Outside Study Area
Los Angeles World Airport Automated People Mover	96th Street Station to LAX Terminals	Outside Study Area

Project	To / From	Location Relative to Study Area
Metrolink Capital Improvement Projects	Various projects	Within Study Area
California High-Speed Rail	Burbank to LA LA to Anaheim	Within Study Area
Link US[4]	LAUS	Within Study Area
Bus (Existing)		
Metro Bus System (including BRT, Express, and local)	Various locations	Within Study Area
Municipality Bus System[5]	Various locations	Within Study Area
Bus (Under Construction/Planned)		
Metro G (Orange) Line (BRT)	Del Mar (Pasadena) to Chatsworth Del Mar (Pasadena) to Canoga Canoga to Chatsworth	Outside Study Area
Vermont Transit Corridor (BRT)	120th Street to Sunset Boulevard	Outside Study Area
North San Fernando Valley BRT	Chatsworth to North Hollywood	Outside Study Area
North Hollywood to Pasadena	North Hollywood to Pasadena	Outside Study Area
Highway (Existing)		
Highway System	Various locations	Within Study Area
Highway (Under Construction/Planned)		
High Desert Multi-Purpose Corridor	SR-14 to SR-18	Outside Study Area
I-5 North Capacity Enhancements	SR-14 to Lake Hughes Rd	Outside Study Area
SR-71 Gap Closure	I-10 to Rio Rancho Rd	Outside Study Area
Sepulveda Pass Express Lane	I-10 to US-101	Outside Study Area
SR-57/SR-60 Interchange Improvements	SR-70/SR-60	Outside Study Area
I-710 South Corridor Project (Phase 1 & 2)	Ports of Long Beach and LA to SR-60	Within Study Area
I-105 Express Lane	I-405 to I-605	Within Study Area
I-5 Corridor Improvements	I-605 to I-710	Outside Study Area

Source: Metro 2018, WSP 2019

Notes: [1] Where extensions are proposed for existing Metro rail lines, the origin/destination is defined for the operating scheme of the entire rail line following completion of the proposed extensions and not just the extension itself.

[2] Metro C (Green) Line extension to Torrance includes new construction from Redondo Beach to Torrance; however, the line will operate from Torrance to 96th Street.

[3] The currently under construction Metro Crenshaw/LAX Line will operate as the Metro C (Green) Line.

[4] Link US rail walk times included only.

[5] The municipality bus network system is based on service patterns for Bellflower Bus, Cerritos on Wheels, Cudahy Area Rapid Transit, Get Around Town Express, Huntington Park Express, La Campana, Long Beach Transit, Los Angeles Department of Transportation, Norwalk Transit System and the Orange County Transportation Authority.

BRT = Bus Rapid Transit; LAUS = Los Angeles Union Station; LAX = Los Angeles International Airport; VA = Veterans Affairs

2.3 Build Alternatives

2.3.1 Proposed Alignment Configuration for the Build Alternatives

This section describes the alignment for each of the Build Alternatives. The general characteristics of the four Build Alternatives are summarized in Table 2.2. Figure 2-5 illustrates the freeway crossings along the alignment. Additionally, the Build Alternatives would require relocation of existing freight rail tracks within the ROW to maintain existing operations where there would be overlap with the proposed light rail tracks. Figure 2-6 depicts the alignment sections that would share operation with freight and the corresponding ownership.

Table 2.2. Summary of Build Alternative Components

Component	Quantity			
Alternatives	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Alternative 4**
Alignment Length	19.3 miles	19.3 miles	14.8 miles	6.6 miles
Stations Configurations	11 3 aerial; 6 at-grade; 2 underground[3]	12 3 aerial; 6 at-grade; 3 underground	9 3 aerial; 6 at-grade	4 1 aerial; 3 at-grade
Parking Facilities	5 (approximately 2,780 spaces)	5 (approximately 2,780 spaces)	5 (approximately 2,780 spaces)	4 (approximately 2,180 spaces)
Length of underground, at-grade, and aerial	2.3 miles underground; 12.3 miles at-grade; 4.7 miles aerial[1]	2.3 miles underground; 12.3 miles at-grade; 4.7 miles aerial[1]	12.2 miles at-grade; 2.6 miles aerial[1]	5.6 miles at-grade; 1.0 miles aerial[1]
At-grade crossings	31	31	31	11
Freight crossings	10	10	9	2
Freeway Crossings	6 (3 freeway undercrossings[2] at I-710; I-605, SR-91)	6 (3 freeway undercrossings[2] at I-710; I-605, SR-91)	4 (3 freeway undercrossings[2] at I-710; I-605, SR-91)	3 (2 freeway undercrossings[2] at I-605, SR-91)
Elevated Street Crossings	25	25	15	7
River Crossings	3	3	3	1
TPSS Facilities	22[3]	23	17	7
Maintenance and Storage Facility site options	2	2	2	2

Source: WSP, 2020

Notes: [1] Alignment configuration measurements count retained fill embankments as at-grade.

[2] The light rail tracks crossing beneath freeway structures.

[3] Under Design Option 2 – Add Little Tokyo Station, an additional underground station and TPSS site would be added under Alternative 1

Figure 2-5. Freeway Crossings

Source: WSP, 2020

Figure 2-6. Existing Rail Right-of-Way Ownership and Relocation

Source: WSP, 2020

2.3.2 Alternative 1

The total alignment length of Alternative 1 would be approximately 19.3 miles, consisting of approximately 2.3 miles of underground, 12.3 miles of at-grade, and 4.7 miles of aerial alignment. Alternative 1 would include 11 new LRT stations, 2 of which would be underground, 6 would be at-grade, and 3 would be aerial. Under Design Option 2, Alternative 1 would have 12 new LRT stations, and the Little Tokyo Station would be an additional underground station. Five of the stations would include parking facilities, providing a total of up to 2,780 new parking spaces. The alignment would include 31 at-grade crossings, 3 freeway undercrossings, 2 aerial freeway crossings, 1 underground freeway crossing, 3 river crossings, 25 aerial road crossings, and 10 freight crossings.

In the north, Alternative 1 would begin at a proposed underground station at/near LAUS either beneath the LAUS Forecourt or, under Design Option 1, east of the MWD building beneath the baggage area parking facility (Section 2.3.6). Crossovers would be located on the north and south ends of the station box with tail tracks extending approximately 1,200 feet north of the station box. A tunnel extraction portal would be located within the tail tracks for both Alternative 1 terminus station options.

From LAUS, the alignment would continue underground crossing under the US-101 freeway and the existing Metro L (Gold) Line aerial structure and continue south beneath Alameda Street to the optional Little Tokyo Station between 1st Street and 2nd Street (note: under Design Option 2, Little Tokyo Station would be constructed). From the optional Little Tokyo Station, the alignment would continue underground beneath Alameda Street to the proposed Arts/Industrial District Station under Alameda Street between 6th Street and Industrial Street. (Note, Alternative 2 would have the same alignment as Alternative 1 from this point south. Refer to Section 2.3.3 for additional information on Alternative 2.)

The underground alignment would continue south under Alameda Street to 8th Street, where the alignment would curve to the west and transition to an aerial alignment south of Olympic Boulevard. The alignment would cross over the I-10 freeway in an aerial viaduct structure and continue south, parallel to the existing Metro A (Blue) Line at Washington Boulevard. The alignment would continue in an aerial configuration along the eastern half of Long Beach Avenue within the UPRR-owned Wilmington Branch ROW, east of the existing Metro A (Blue) Line and continue south to the proposed Slauson/A Line Station. The aerial alignment would pass over the existing pedestrian bridge at E. 53rd Street. The Slauson/A Line Station would serve as a transfer point to the Metro A (Blue) Line via a pedestrian bridge. The vertical circulation would be connected at street level on the north side of the station via stairs, escalators, and elevators. (The Slauson/A Line Station would serve as the northern terminus for Alternative 3; refer to Section 2.3.4 for additional information on Alternative 3.)

South of the Slauson/A Line Station, the alignment would turn east along the existing La Habra Branch ROW (also owned by UPRR) in the median of Randolph Street. The alignment would be on the north side of the La Habra Branch ROW and would require the relocation of existing freight tracks to the southern portion of the ROW. The alignment would transition to an at-grade configuration at Alameda Street and would proceed east along the Randolph Street median. Wilmington Avenue, Regent Street, Albany Street, and Rugby Avenue would be closed to traffic crossing the ROW, altering

the intersection design to a right-in, right-out configuration. The proposed Pacific/Randolph Station would be located just east of Pacific Boulevard.

From the Pacific/Randolph Station, the alignment would continue east at-grade. Rita Avenue would be closed to traffic crossing the ROW, altering the intersection design to a right-in, right-out configuration. At the San Pedro Subdivision ROW, the alignment would transition to an aerial configuration and turn south to cross over Randolph Street and the freight tracks, returning to an at-grade configuration north of Gage Avenue. The alignment would be located on the east side of the existing San Pedro Subdivision ROW freight tracks, and the existing tracks would be relocated to the west side of the ROW. The alignment would continue at-grade within the San Pedro Subdivision ROW to the proposed at-grade Florence/Salt Lake Station south of the Salt Lake Avenue/Florence Avenue intersection.

South of Florence Avenue, the alignment would extend from the proposed Florence/Salt Lake Station in the City of Huntington Park to the proposed Pioneer Station in the City of Artesia, as shown in Figure 2-4. The alignment would continue southeast from the proposed at-grade Florence/Salt Lake Station within the San Pedro Subdivision ROW, crossing Otis Avenue, Santa Ana Street, and Ardine Street at-grade. The alignment would be located on the east side of the existing San Pedro Subdivision freight tracks and the existing tracks would be relocated to the west side of the ROW. South of Ardine Street, the alignment would transition to an aerial structure to cross over the existing UPRR tracks and Atlantic Avenue. The proposed Firestone Station would be located on an aerial structure between Atlantic Avenue and Florence Boulevard.

The alignment would then cross over Firestone Boulevard and transition back to an at-grade configuration prior to crossing Rayo Avenue at-grade. The alignment would continue south along the San Pedro Subdivision ROW, crossing Southern Avenue at-grade and continuing at-grade until it transitions to an aerial configuration to cross over the LA River. The proposed LRT bridge would be constructed next to the existing freight bridge. South of the LA River, the alignment would transition to an at-grade configuration crossing Frontage Road at-grade, then passing under the I-710 freeway through the existing box tunnel structure and then crossing Miller Way. The alignment would then return to an aerial structure to cross the Rio Hondo Channel. South of the Rio Hondo Channel, the alignment would briefly transition back to an at-grade configuration and then return to an aerial structure to cross over Imperial Highway and Garfield Avenue. South of Garfield Avenue, the alignment would transition to an at-grade configuration and serve the proposed Gardendale Station north of Gardendale Street.

From the Gardendale Station, the alignment would continue south in an at-grade configuration, crossing Gardendale Street and Main Street to connect to the proposed I-105/C Line Station, which would be located at-grade north of Century Boulevard. This station would be connected to the new infill C (Green) Line Station in the middle of the freeway via a pedestrian walkway on the new LRT bridge. The alignment would continue at-grade, crossing Century Boulevard and then over the I-105 freeway in an aerial configuration within the existing San Pedro Subdivision ROW bridge footprint. A new Metro C (Green) Line Station would be constructed in the median of the I-105 freeway. Vertical pedestrian access would be provided from the LRT bridge to the proposed I-105/C Line Station platform via stairs and elevators. To accommodate the construction of the new station platform, the existing Metro C (Green) Line tracks would be widened and, as part of the I-105 Express Lanes Project, the I-105 lanes would be reconfigured. (The I-105/C Line Station would serve

as the northern terminus for Alternative 4; refer to Section 2.3.5 for additional information on this alternative.)

South of the I-105 freeway, the alignment would continue at-grade within the San Pedro Subdivision ROW. In order to maintain freight operations and allow for freight train crossings, the alignment would transition to an aerial configuration as it turns southeast and enter the PEROW. The existing freight track would cross beneath the aerial alignment and align on the north side of the PEROW east of the San Pedro Subdivision ROW. The proposed Paramount/Rosecrans Station would be located in an aerial configuration west of Paramount Boulevard and north of Rosecrans Avenue. The existing freight track would be relocated to the east side of the alignment beneath the station viaduct.

The alignment would continue southeast in an aerial configuration over the Paramount Boulevard/Rosecrans Avenue intersection and descend to an at-grade configuration. The alignment would return to an aerial configuration to cross over Downey Avenue descending back to an at-grade configuration north of Somerset Boulevard. One of the adjacent freight storage tracks at Paramount Refinery Yard would be relocated to accommodate the new LRT tracks and maintain storage capacity. There are no active freight tracks south of the World Energy facility.

The alignment would cross Somerset Boulevard at-grade. South of Somerset Boulevard, the at-grade alignment would parallel the existing Bellflower Bike Trail that is currently aligned on the south side of the PEROW. The alignment would continue at-grade crossing Lakewood Boulevard, Clark Avenue, and Alondra Boulevard. The proposed at-grade Bellflower Station would be located west of Bellflower Boulevard.

East of Bellflower Boulevard, the Bellflower Bike Trail would be realigned to the north side of the PEROW to accommodate an existing historic building located near the southeast corner of Bellflower Boulevard and the PEROW. It would then cross back over the LRT tracks at-grade to the south side of the ROW. The LRT alignment would continue southeast within the PEROW and transition to an aerial configuration at Cornuta Avenue, crossing over Flower Street and Woodruff Avenue. The alignment would return to an at-grade configuration at Walnut Street. South of Woodruff Avenue, the Bellflower Bike Trail would be relocated to the north side of the PEROW. Continuing southeast, the LRT alignment would cross under the SR-91 freeway in an existing underpass. The alignment would cross over the San Gabriel River on a new bridge, replacing the existing abandoned freight bridge. South of the San Gabriel River, the alignment would transition back to an at-grade configuration before crossing Artesia Boulevard at-grade.

East of Artesia Boulevard the alignment would cross beneath the I-605 freeway in an existing underpass. Southeast of the underpass, the alignment would continue at-grade, crossing Studebaker Road. North of Gridley Road, the alignment would transition to an aerial configuration to cross over 183rd Street and Gridley Road. The alignment would return to an at-grade configuration at 185th Street, crossing 186th Street and 187th Street at-grade. The alignment would then pass through the proposed Pioneer Station on the north side of Pioneer Boulevard at-grade. Tail tracks accommodating layover storage for a three-car train would extend approximately 1,000 feet south from the station, crossing Pioneer Boulevard and terminating west of South Street.

2.3.3 Alternative 2

The total alignment length of Alternative 2 would be approximately 19.3 miles, consisting of approximately 2.3 miles of underground, 12.3 miles of at-grade, and 4.7 miles of aerial alignment. Alternative 2 would include 12 new LRT stations, 3 of which would be underground, 6 would be at-grade, and 3 would be aerial. Five of the stations would include parking facilities, providing a total of approximately 2,780 new parking spaces. The alignment would include 31 at-grade crossings, 3 freeway undercrossings, 2 aerial freeway crossings, 1 underground freeway crossing, 3 river crossings, 25 aerial road crossings, and 10 freight crossings.

In the north, Alternative 2 would begin at the proposed WSAB 7th Street/Metro Center Station, which would be located underground beneath 8th Street between Figueroa Street and Flower Street. A pedestrian tunnel would provide connection to the existing 7th Street/Metro Center Station. Tail tracks, including a double crossover, would extend approximately 900 feet beyond the station, ending east of the I-110 freeway. From the 7th Street/Metro Center Station, the underground alignment would proceed southeast beneath 8th Street to the South Park/Fashion District Station, which would be located west of Main Street beneath 8th Street.

From the South Park/Fashion District Station, the underground alignment would continue under 8th Street to San Pedro Street, where the alignment would turn east toward 7th Street, crossing under privately owned properties. The tunnel alignment would cross under 7th Street and then turn south at Alameda Street. The alignment would continue south beneath Alameda Street to the Arts/Industrial District Station located under Alameda Street between 7th Street and Center Street. A double crossover would be located south of the station box, south of Center Street. From this point, the alignment of Alternative 2 would follow the same alignment as Alternative 1, which is described further in Section 2.3.2.

2.3.4 Alternative 3

The total alignment length of Alternative 3 would be approximately 14.8 miles, consisting of approximately 12.2 miles of at-grade, and 2.6 miles of aerial alignment. Alternative 3 would include 9 new LRT stations, 6 would be at-grade and 3 would be aerial. Five of the stations would include parking facilities, providing a total of approximately 2,780 new parking spaces. The alignment would include 31 at-grade crossings, 3 freeway undercrossings, 1 aerial freeway crossing, 3 river crossings, 15 aerial road crossings, and 9 freight crossings. In the north, Alternative 3 would begin at the Slauson/A Line Station and follow the same alignment as Alternatives 1 and 2, described in Section 2.3.2.

2.3.5 Alternative 4

The total alignment length of Alternative 4 would be approximately 6.6 miles, consisting of approximately 5.6 miles of at-grade and 1.0 mile of aerial alignment. Alternative 3 would include 4 new LRT stations, 3 would be at-grade, and 1 would be aerial. Four of the stations would include parking facilities, providing a total of approximately 2,180 new parking spaces. The alignment would include 11 at-grade crossings, 2 freeway undercrossings, 1 aerial freeway crossing, 1 river crossing, 7 aerial road crossings, and 2 freight crossings. In the north, Alternative 4 would begin at the I-105/C Line Station and follow the same alignment as Alternatives 1, 2, and 3, described in Section 2.3.2.

2.3.6 Design Options

Alternative 1 includes two design options:

- **Design Option 1:** LAUS at the Metropolitan Water District (MWD) – The LAUS station box would be located east of LAUS and the MWD building, below the baggage area parking facility instead of beneath the LAUS Forecourt. Crossovers would be located on the north and south ends of the station box with tail tracks extending approximately 1,200 feet north of the station box. From LAUS, the underground alignment would cross under the US-101 freeway and the existing Metro L (Gold) Line aerial structure and continue south beneath Alameda Street to the optional Little Tokyo Station between Traction Avenue and 1st Street. The underground alignment between LAUS and the Little Tokyo Station would be located to the east of the base alignment.
- **Design Option 2:** Add the Little Tokyo Station – Under this design option, the Little Tokyo Station would be constructed as an underground station and there would be a direct connection to the Regional Connector Station in the Little Tokyo community. The alignment would proceed underground directly from LAUS to the Arts/Industrial District Station primarily beneath Alameda Street.

2.3.7 Maintenance and Storage Facility

MSFs accommodate daily servicing and cleaning, inspection and repairs, and storage of light rail vehicles (LRV). Activities may take place in the MSF throughout the day and night depending upon train schedules, workload, and the maintenance requirements.

Two MSF options are evaluated; however, only one MSF would be constructed as part of the Project. The MSF would have storage tracks, each with sufficient length to store three-car train sets and a maintenance-of-way vehicle storage. The facility would include a main shop building with administrative offices, a cleaning platform, a traction power substation (TPSS), employee parking, a vehicle wash facility, a paint and body shop, and other facilities as needed. The east and west yard leads (i.e., the tracks leading from the mainline to the facility) would have sufficient length for a three-car train set. In total, the MSF would need to accommodate approximately 80 LRVs to serve the Project's operations plan.

Two potential locations for the MSF have been identified—one in the City of Bellflower and one in the City of Paramount. These options are described further in the following sections.

2.3.8 Bellflower MSF Option

The Bellflower MSF site option is bounded by industrial facilities to the west, Somerset Boulevard and apartment complexes to the north, residential homes to the east, and the PEROW and Bellflower Bike Trail to the south. The site is approximately 21 acres in area and can accommodate up to 80 vehicles (Figure 2-7).

2.3.9 Paramount MSF Option

The Paramount MSF site option is bounded by the San Pedro Subdivision ROW on the west, Somerset Boulevard to the south, industrial and commercial uses on the east, and All American City Way to the north. The site is 22 acres and could accommodate up to 80 vehicles (Figure 2-7).

Figure 2-7. Maintenance and Storage Facility Options

Source: WSP, 2020

3 SETTING

The Project would cross the San Gabriel River at the existing UPRR bridge south of the State Route 91 crossing, as shown in Figure 3-1. At the crossing, approximately 11.1 miles downstream of the Whittier Narrows Dam and 5.76 miles upstream of the confluence with Coyote Creek, the river is a trapezoidal concrete channel with a middle low-flow channel. The existing railroad bridge has four piers and a single track.

Available engineering documents for the channel include the *Los Angeles County Drainage Area Final Feasibility Interim Report, Part I Hydrology Technical Report Base Conditions*. Available records indicate the existing channel depth to be approximately 20 feet, with a levee elevation of Elevation 76.28 feet. Elevations are given in North American Vertical Datum (1988).

The Project would remove and replace the existing bridge, as discussed in Section 6.2. The general plan for the bridge is included in Appendix A, along with as-built plans of the existing channel. Figure 3-1 shows the Study Area for this Location Hydraulic Study.

Figure 3-1. Study Area

Source: Jacobs 2020

4 TRAFFIC

The Project area is home to 1.2 million residents and a job center for approximately 584,000 employees. Projections show an increase in the resident population to 1.5 million and an increase in jobs to 670,000 by 2040 (Metrolink 2017). Population and employment densities are five times higher than the Los Angeles County average. This rail corridor is anticipated to serve commuters in a high travel demand corridor by providing relief to the constrained transportation systems currently available to these communities. In addition, the Project is expected to provide a direct connection to the Metro C (Green) Line and the Los Angeles County regional transit network.

No traffic or rail service interruption is expected to occur from the base flood.

5 HYDROLOGIC ANALYSIS

5.1 Hydrologic Characteristics

The Southern Section of the Project lies within the San Gabriel River Watershed. The entire watershed covers 640 square miles and includes portions of 35 cities in Los Angeles and Orange Counties. The River floodplain is delineated in Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Number 06037C1840F, which is presented in Appendix A.

The San Gabriel River originates in the San Gabriel Mountains in the Angeles National Forest and flows southwest to empty into the Pacific Ocean at Seal Beach, near the Los Angeles County and Orange County border. The watershed is hydraulically connected to the Los Angeles River through the Whittier Narrows Reservoir (during high flows from storm events). More than 30 percent of the upper watershed falls within the Angeles National Forest, including large portions of the San Gabriel Mountains. This portion of the watershed also contains the Merced and San Jose Hills and the Puente-Chino Hills. Land use within the watershed 26 percent residential, 15 percent commercial, 50 percent rural, and 9 percent other (LACDPW 2017b).

The annual average precipitation ranges from 15.5 inches in the coastal plain to 32.9 inches near the San Gabriel Mountains. Winter storms comprise most of the rainfall within the area, and most precipitation occurs between December and March. January and July are the coldest and warmest months, respectively (LACDPW 2006).

5.2 Base Flood and Overtopping Flood

Available information to establish the base flood and overtopping record comes from the U.S. Army Corps of Engineers (USACE 1991), the FEMA Flood Insurance Study for Los Angeles County (FEMA 2016), and the LACFCD, a division of the LACDPW (LACDPW 2017a). The USACE has jurisdiction in the flood control channel and provides simulated 100-year discharges in the *Los Angeles County Drainage Area Final Feasibility Interim Report* (USACE 1991).

The USACE *Final Feasibility Interim Report* provides flow values at concentration points located upstream and downstream of the Project site. Based on the USACE's published data, the expected 100-year flow at the Project site could range from 12,200 cubic feet per second (cfs) to 17,200 cfs. For example, near Firestone Boulevard (Concentration Point [CP]-56), the design flow is 12,200 cfs. Upstream of the confluence with Coyote Creek (CP-58), the design flow is 17,200 cfs. Based on the location of the Project crossing, a linear interpolation gives an approximate 100-year discharge of 14,100 cfs. In comparison, the Los Angeles County Flood Control District provides a design discharge for this reach of 15,500 cfs, based on original hydrology for the channel (LACDPW 2017a). The higher value is used as the base flood to provide a slightly conservative estimate of water surface impact.

No data were available to establish the flood of record. The overtopping flood for this facility would be an extreme event because the rail bridge is above the channel wall; therefore, any flow in excess of the channel capacity would spill out of the channel. To evaluate overtopping conditions, the channel capacity flow is needed. The channel capacity discharge is based on data provided in the *Los Angeles County Drainage Area Final Feasibility Interim Report* (USACE 1991). Table 5.1 summarizes the design flows used in the analysis.

Table 5.1. San Gabriel River Design Flows

Source	Design Flow
Base Flood Based on the LACDPW	15,500 cfs
Overtopping Flood Based on USACE 1991	19,500 cfs

6 HYDRAULIC ANALYSIS

The basis of the river analysis is the existing USACE HEC-RAS model (version 4.1.0), which USACE provided for this analysis (USACE 2017). Detailed hydraulic analysis is presented in Appendix B.

6.1 Existing Conditions

The hydraulic model for the river was adopted without modification for the purpose of this study. Relevant modeling parameters are summarized below:

- Hydraulic Control: The downstream water surface elevation is assumed to be Elevation 5.27 feet, based on the existing USACE model.
- Bridge Modeling: The existing UPRR bridge is modeled as two separate bridges due to the skew across the river. Each bridge has a single pier ranging from 1.14 feet to 2.28 feet wide in the direction of flow. Each bridge is modeled with low chord elevation of 74.57 feet, which provides no clearance to the existing channel top of bank. Piers have rounded noses; therefore, standard values are used for coefficient of drag (1.33) and pier shape (0.9). No contraction or expansion coefficient is used.
- Debris Factor: The existing bridge piers are modeled without debris factors, and the existing debris noses are not modeled.
- Ineffective Areas and Obstructions: No ineffective areas or obstructions were modeled in the existing conditions model.
- Flow Regime: The mixed flow regime is evaluated for the purpose of this study.
- Channel Roughness: The channel is concrete-lined, and the invert roughness is modeled with a Manning's 'n' = 0.013. Side slopes are modeled as 'n' = 0.013.

6.2 Project Conditions

The proposed bridge would have two tracks and a bridge deck width of 31.5 feet. It would be supported on new bridge piers constructed in line with the flow direction. The existing bridge pier debris noses would be demolished and reconstructed. The Bridge General Plan is presented in Appendix A.

The profile of the new bridge would be slightly higher than the existing bridge. Flows are completely contained in the channel; therefore, the bridge pier lengths were adjusted without change to the high or low chords. Debris Factor, Ineffective Areas and Obstructions, Flow Regime and Channel Roughness are not changed in the Project conditions model.

The Project would reduce the water surface elevation (WSE) in the reach near the bridge by as much as 3.75 feet (Station 538+00). This would occur because flow conditions at this location become supercritical in the Project condition, and therefore the new water surface would be substantially lower than existing conditions. The flows are contained within the channel as demonstrated in Figure 6-1. Table 6-1 summarizes the hydraulic analysis.

Table 6-1. Summary of Hydraulics of the San Gabriel River

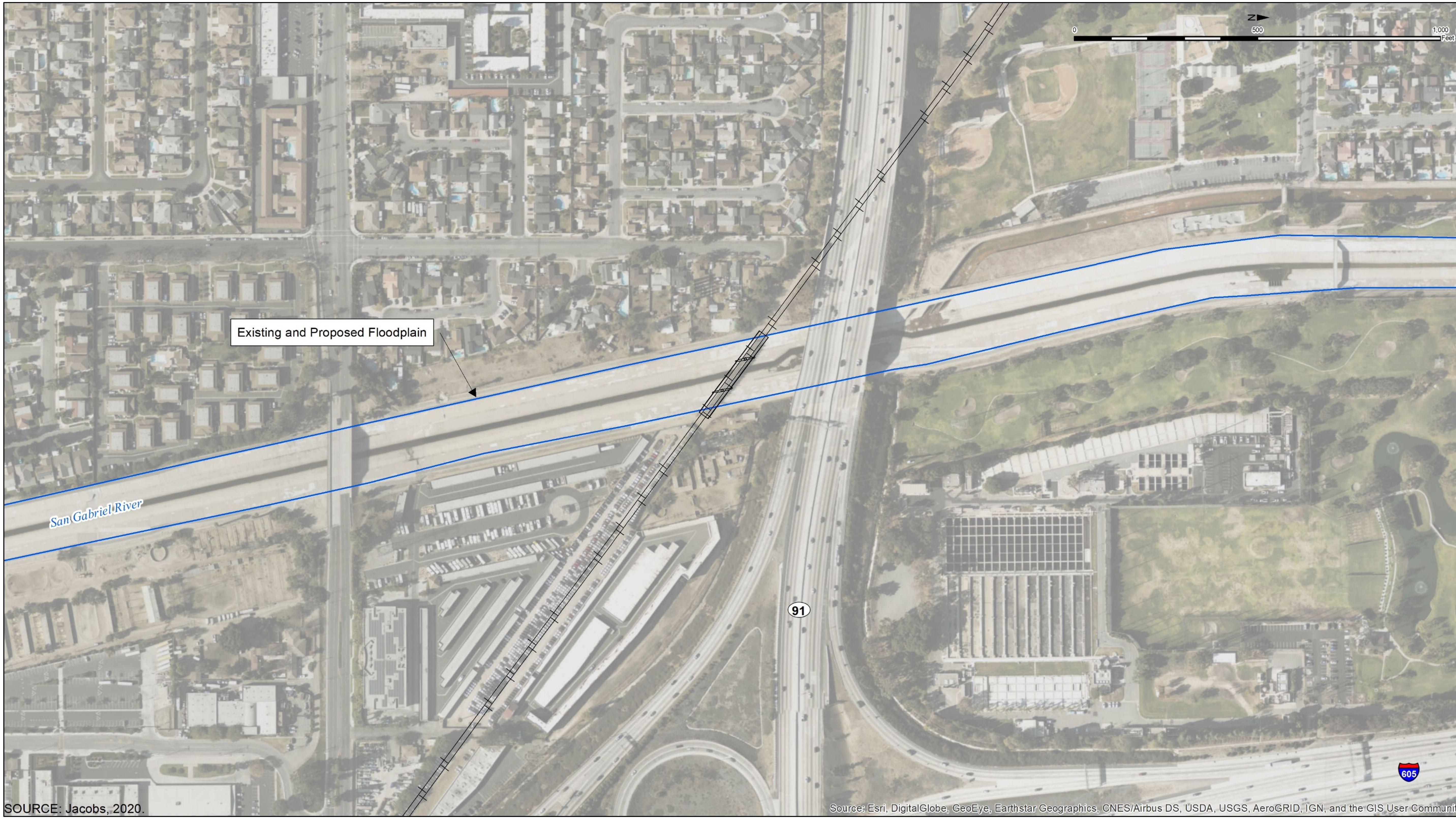
River Station	Distance from the Replacement Bridge [miles]	Existing Condition		Project Condition		Project Impact	
		WSE [ft]	Velocity [ft/s]	WSE [ft]	Velocity [ft/s]	WSE [ft]	Velocity [ft/s]
545+00	0.26	68.56	19.46	68.56	19.46	0	0
544+00	0.24	68.34	19.46	68.34	19.46	0	0
543+35	0.23	68.23	19.42	68.23	19.42	0	0
542+10	0.20	67.91	19.5	67.91	19.5	0	0
541+00	0.18	67.67	19.48	67.67	19.48	0	0
540+00	0.16	66.27	21.12	66.27	21.12	0	0
539+30	0.15	66.21	20.8	66.21	20.8	0	0
538+00	**0.13**	**69.97**	**12.43**	**66.22**	**19.98**	**-3.75**	**7.55**
536+20	0.09	69.98	11.98	69.66	12.39	-0.32	0.41
535+86	0.09	69.99	11.89	69.66	12.3	-0.33	0.41
535+36	0.08	69.99	11.76	69.67	12.16	-0.32	0.4
535+06	0.07	70	11.66	69.68	12.06	-0.32	0.4
534+04	0.05	**Interstate 605 Bridge**					
533+02	0.03	69.3	12.05	68.9	12.57	-0.4	0.52
532+64	0.02	69.29	11.99	68.89	12.5	-0.4	0.51
532+14	0.02	69.3	11.86	68.9	12.35	-0.4	0.49
531+93	0.01	69.09	12.32	68.63	12.95	-0.46	0.63
531+60	0.01	**WSAB Bridge Pier No. 2/Existing UPRR Bridge**					
531+33	0.00	68.47	12.58	68.31	12.8	-0.16	0.22
530+99	-0.01	**WSAB Bridge Pier No. 1/Existing UPRR Bridge**					
530+72	-0.01	68.2	12.64	67.86	13.14	-0.34	0.5
530+52	-0.02	67.82	13.19	67.82	13.19	0	0
529+50	-0.03	66.88	14.7	66.88	14.7	0	0
529+00	-0.04	66.9	14.48	66.9	14.48	0	0

Note: ft = feet; ft/sec = feet per second

6.3 Overtopping Condition

Hydraulic analysis of the overtopping flood indicates that the peak water surface elevations would remain contained within the channel in the Project reach. Therefore, the overtopping event would be extremely unlikely.

Figure 6-1. Project Impacts to San Gabriel River



7 PROPERTY AT RISK

The inundation area for the Project is contained within the San Gabriel River, which is owned by USACE and maintained by LACFCD. Inundation poses no threat to property at risk.

8 RISK ASSESSMENT

8.1 Risk Associated with Implementation

The change in water surface elevation in the San Gabriel River would not result in any significant change in flood risks or damage because flows would continue to be contained within the river channel. Implementation does not have the potential for interruption or termination of emergency service or emergency routes.

8.2 Impacts to Floodplain Values

Natural and beneficial floodplain values include, but are not limited to, fish, wildlife, plants, open space, natural beauty, scientific study, outdoor recreation, agriculture, forestry, natural moderation of floods, water quality maintenance and groundwater recharge. The San Gabriel River is a constructed channel in a developed urban area; therefore, changes to the floodplain are not expected to affect floodplain values. Because it is an engineered waterway with restricted public access, the channel does not provide open space, natural beauty or outdoor recreation value. It also has limited value to support fish, wildlife and plant habitat.

The Los Angeles Region Basin Plan lists the following beneficial uses for San Gabriel River Reach 1 (San Gabriel River Estuary to Firestone Boulevard): Municipal and Domestic Supply (potential), Warm Freshwater Habitat and Wildlife Habitat (potential) Los Angeles Regional Water Quality Control Board (LARWQCB 1995). The Project is not anticipated to adversely affect these values

8.3 Support of Incompatible Development

The proposed Project would not support incompatible development in the floodplain because it is presently urbanized and protected by the channel.

8.4 Minimization of Floodplain Impact

Impacts to the San Gabriel River floodplain have been minimized by aligning the geometry of the bridge as closely as possible to the existing UPRR bridge, by minimizing the length of bridge pier walls to support the bridge deck and by orienting new pier walls in the direction of flow.

8.5 Restoration and Preservation of Floodplain Values

Because there would be no significant impacts to the floodplain and floodplain values, no restoration or preservation of floodplain values is required.

9 ALTERNATIVES TO LONGITUDINAL ENCROACHMENT

The Project would have no longitudinal encroachment into existing floodplains.

10 ALTERNATIVES TO SIGNIFICANT ENCROACHMENT

The proposed river crossing is designed to minimize physical impacts to flood control facilities. Therefore, there would be no significant encroachments. No alternatives to significant encroachment are required.

11 EXISTING WATERSHED AND FLOODPLAIN MANAGEMENT PROGRAMS

The Project complies with the existing watershed and floodplain management programs, including the *Los Angeles County Comprehensive Floodplain Management Plan* (LACDPW 2016).

The *Los Angeles County Comprehensive Floodplain Management Plan* coordinates existing flood planning operations, identifies high risk areas within LA County, and proposes risk minimization and mitigation strategies, e.g. working cooperatively with public agencies to minimize flood risk, minimizing development within the floodplain, and providing flood protection by maintaining existing flood control systems. This Project is consistent with these strategies.

12 REFERENCES

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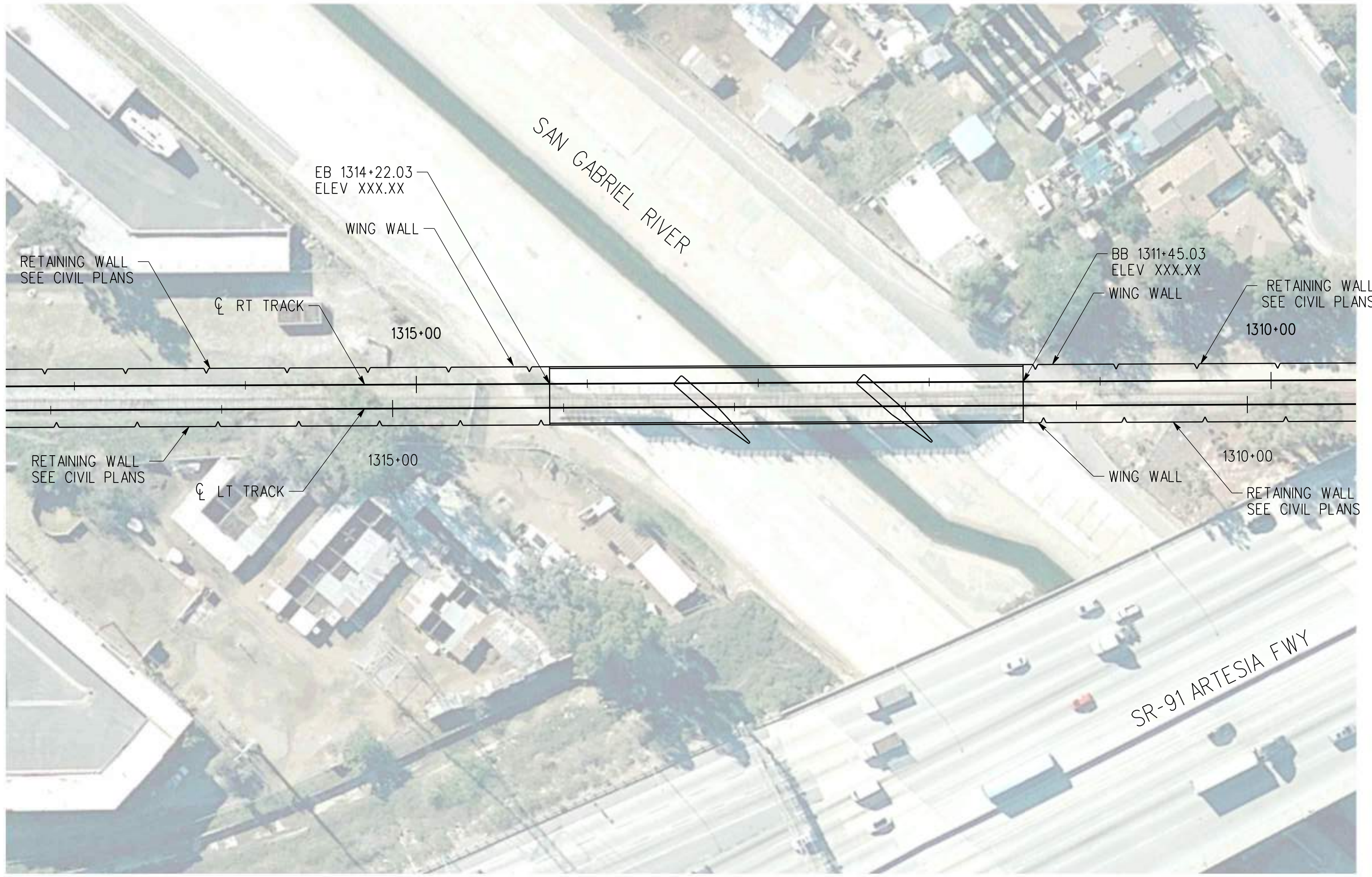
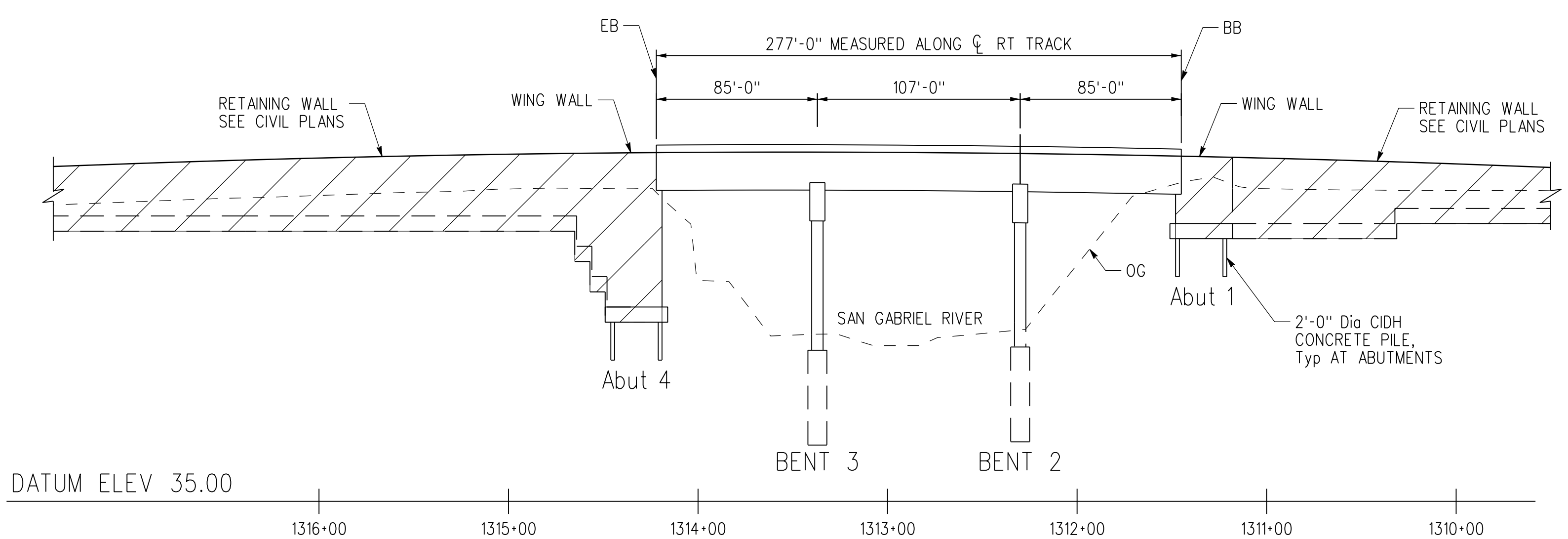
APPENDIX A RELEVANT DESIGN DATA

- San Gabriel River Bridge General Plan
- As-Built Plans
- FEMA FIRMette
- LHS Form

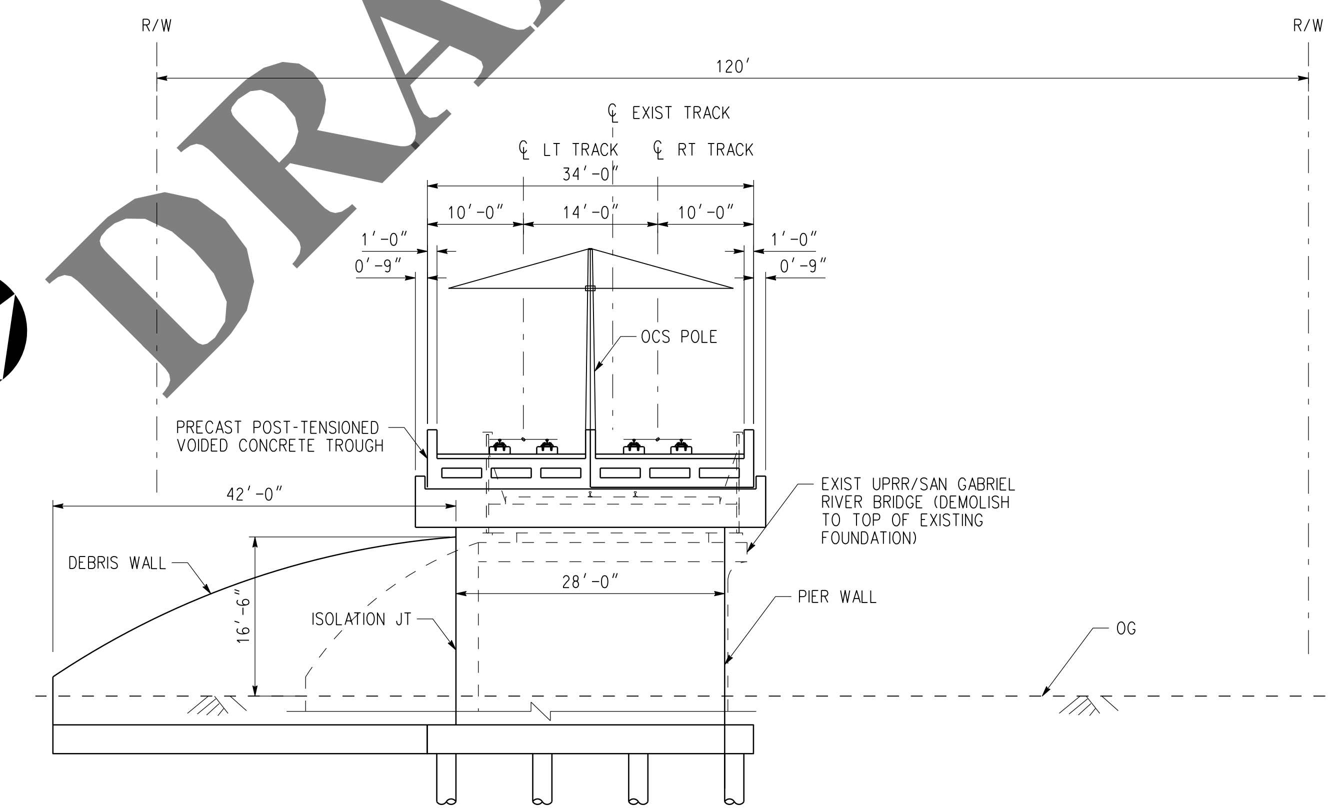


PLAN



DEVELOPED ELEVATION

DRAFT



TYPICAL SECTION

SCALE: 1"=40'

LEGEND:

① Paint "SAN GABRIEL RIVER CHANNEL CROSSING"

② Paint bridge number and year constructed

NOTES:

1. Design subject to revision pending coordination with Drainage Engineers. Length of debris wallpreliminary.

2. Foundation information shown is preliminary. Geotechnical investigation required for determination of size and type of structure foundation.

200' 100' 0 200' 400' — HORIZ: 1"=200'

50' 0 50' 100' — VERT: 1"=50'

NOT FOR CONSTRUCTION

THE PREPARATION OF THIS DRAWING HAS BEEN FINANCED IN PART THROUGHT A GRANT FROM THE U.S. DEPARTMENT OF TRANSPORTATION FEDERAL TRANSIT ADMINISTRATION (FTA), UNDER THE FEDERAL TRANSIT ACT OF 1964, AS AMENDED, AND IN PART BY THE TAXES OF THE CITIZENS OF LOS ANGELES COUNTY AND OF THE STATE OF CALIFORNIA.

DESIGNED BY	J. POWELL
DRAWN BY	J. POWELL
CHECKED BY	TBD
IN CHARGE	CHARLES
DATE	AUGUST 2018

Metro

LOS ANGELES COUNTY
METROPOLITAN TRANSPORTATION AUTHORITY

WSP
444 South Flower Street
Suite 800
Los Angeles, CA 90071
TEL (213) 362-9470

SUBMITTED

APPROVED

WEST SANTA ANA BRANCH LRT
STRUCTURAL DRAWING
SAN GABRIEL RIVER CHANNEL CROSSING
GENERAL PLAN
STATION 1311+45.03 TO 1314+22.03

CONTRACT NO AE5999300

DRAWING NO

REV

SCALE

SHEET NO OF

svc-projectwise 16:49 24-AUG-2018 GP 15 - San GabrielRiver Channel.plg

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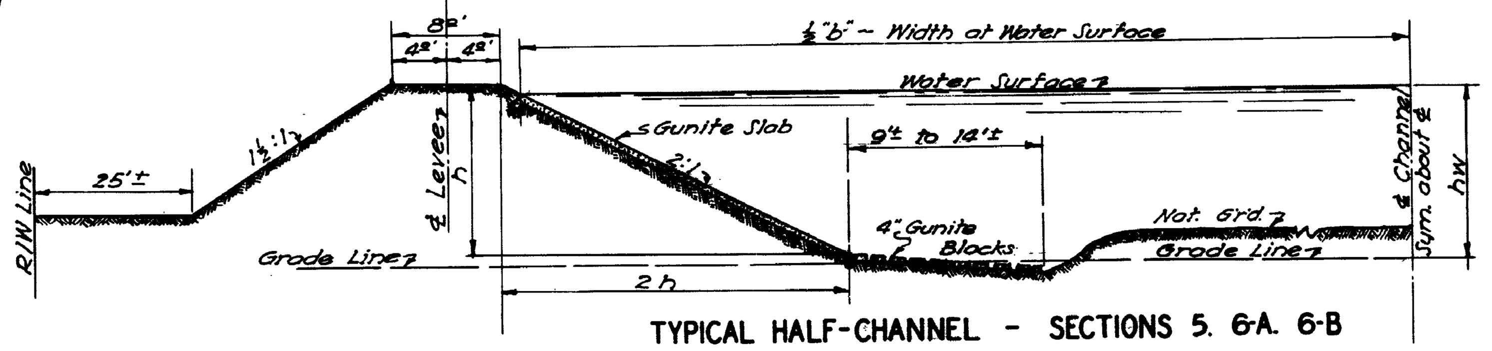


TYPICAL HALF-CHANNEL - SECTIONS 5. 6-A. 6-B

THEORETICAL HYDRAULIC ELEMENTS								
Section	b	h	hw	n	A□'	s	V	Q - c.f.s.
5	277'±	14'±	12.0	.023	3,030	.00175	12.7	38,500
6-A & B	"	"	11.8	"	2,990	.00191-	12.9	38,600

REFERENCES
U.S.G.S.
PL 55 Sh. 12
6RW 17-18

REVISIONS		
MARK	DATE	DESCRIPTION

LOS ANGELES COUNTY
FLOOD CONTROL DISTRICT

SAN GABRIEL RIVER
ROSS AVENUE TO RAILROAD AVENUE
PLAN, PROFILE & SECTIONS.

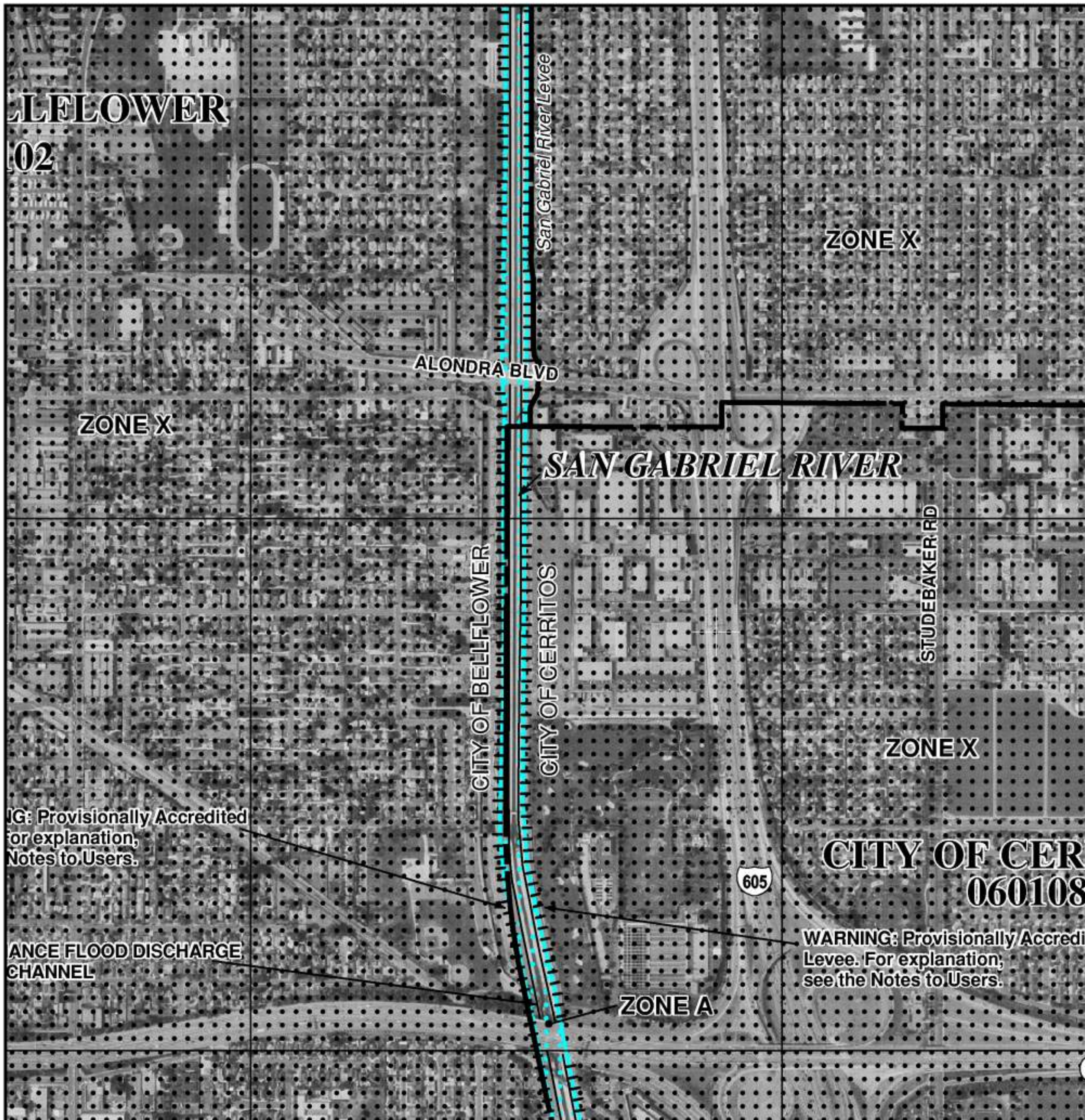
APPROVED BY
CHIEF ENGINEER

Chief Des. Engr.

DATE MAY 1931

NO. 6—D11.
SHEET 4. OF 13

COMPREHENSIVE PLAN-FIVE YEAR PLAN



$^{3}97^{000m}E$ $^{3}98^{000m}E$ JOINS

he Flood Insurance Study report for this jurisdiction.

ce is available in this community, contact your insurance
d Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'

METERS
0 300 600

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1840F

FIRM
FLOOD INSURANCE RATE MAP
LOS ANGELES COUNTY, CALIFORNIA
AND INCORPORATED AREAS

PANEL 1840 OF 2350

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
BELLFLOWER, CITY OF	060102	1840	F
CERRITOS, CITY OF	060108	1840	F
DOWNEY, CITY OF	060645	1840	F
NORWALK, CITY OF	060652	1840	F
SANTA FE SPRINGS, CITY OF	060158	1840	F

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
06037C1840F

EFFECTIVE DATE
SEPTEMBER 26, 2008

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

LOCATION HYDRAULIC STUDY FORM *

Floodplain Description:

San Gabriel River Channel.

1. Description of Proposal (include any physical barriers i.e. concrete barriers, soundwalls, etc. and design elements to minimize floodplain impacts)

Construction of a new Metro Light Rail Bridge.

2. ADT:
Current 9,200/4,400 riders (weekday/weekend)
Projected similar or greater

3. Hydraulic Data:
Base Flood Q_{100}= 15,500 CFS WSE_{100}= 68.63
The flood of record, if greater than Q_{100}: Q= n/a CFS WSE= n/a
Overtopping flood Q= 19,500 CFS (approx 500-yr flood) WSE= 70.37
Are NFIP maps and studies available? YES X NO

4. Is the bridge location alternative within a regulatory floodway ?
YES X NO

5. Attach map with flood limits outlined showing all buildings or other improvements within the base floodplain.
–See Appendix A

Potential Q_{100} backwater damages:

A. Residences? NO X YES
B. Other Bldgs? NO X YES
C. Crops? NO X YES
D. Natural and beneficial
FLOODPLAIN VALUES? NO X YES

6. Type of Traffic:

A. Emergency supply or evacuation route? NO X YES
B. Emergency vehicle access? NO X YES
C. Practicable detour available? NO X YES
D. School bus or mail route? NO X YES

7. Estimated duration of traffic interruption for 100-year event hours: 0

8. Estimated value of Q_{100} flood damages (if any) – moderate risk level.

A.	Roadway	$____0____
B	Property	$____0____
	Total	$____0____

9. Assessment of Level of Risk Low__X_____
Moderate____
High________

For High Risk projects, during design phase, additional Design Study Risk Analysis May be necessary to determine design alternative.

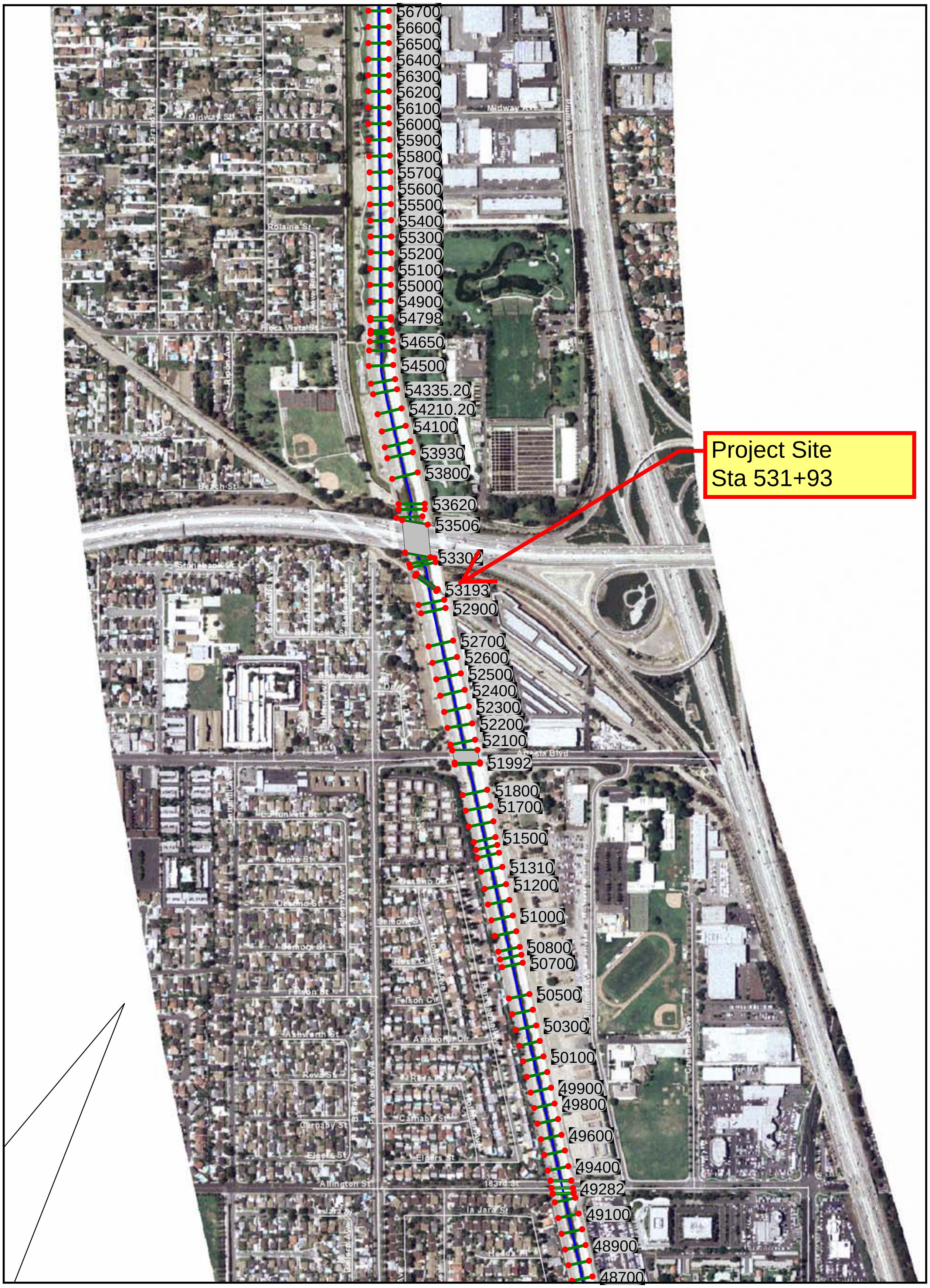
Signature –Hydraulic Engineer ________________________Date__10/29/17_____
(Item numbers 3,4,5,7,9)

Is there any longitudinal encroachment, significant encroachment, or any support of incompatible
Floodplain development? NO___X_____YES________

If yes, provide evaluation and discussion of practicability of alternatives in accordance with 23 CFR 650.113

Information developed to comply with the Federal requirement for the Location Hydraulic Study shall be retained in the project files.

APPENDIX B HYDRAULIC ANALYSIS



Project Site
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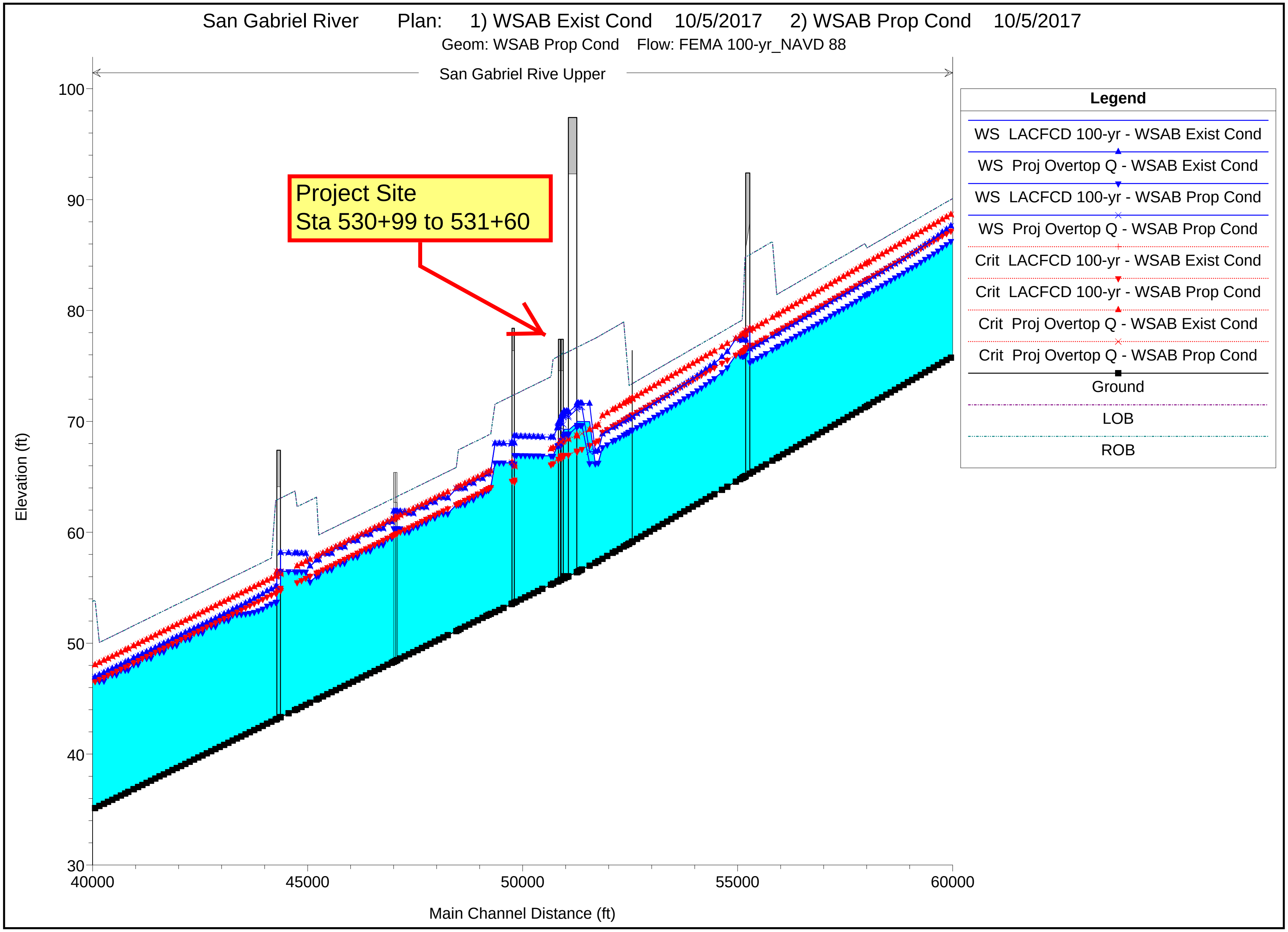
San Gabriel River Plan: 1) WSAB Exist Cond 10/5/2017 2) WSAB Prop Cond 10/5/2017
Geom: WSAB Prop Cond Flow: FEMA 100-yr_NAVD 88
San Gabriel Rive Upper
Project Site
Sta 530+99 to 531+60
Legend
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WS Proj Overtop Q - WSAB Exist Cond
WS LACFCD 100-yr - WSAB Prop Cond
WS Proj Overtop Q - WSAB Prop Cond
Crit LACFCD 100-yr - WSAB Exist Cond
Crit LACFCD 100-yr - WSAB Prop Cond
Crit Proj Overtop Q - WSAB Exist Cond
Crit Proj Overtop Q - WSAB Prop Cond
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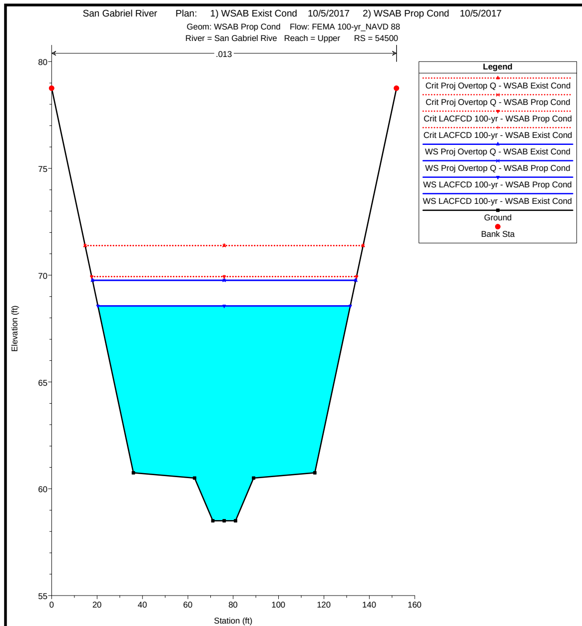
60000
Main Channel Distance (ft)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Geom: WSAB Prop Cond Flow: FEMA 100-yr_NAVD 88
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Legend
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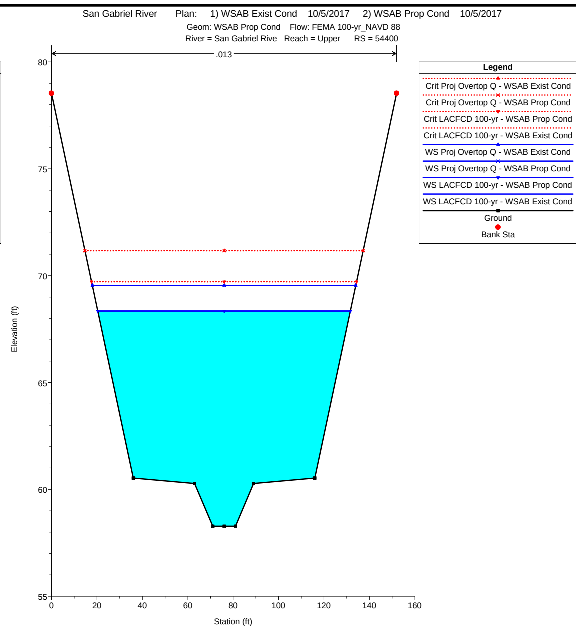
Crit Proj Overtop Q - WSAB Prop Cond
Crit LACFCD 100-yr - WSAB Prop Cond
Crit LACFCD 100-yr - WSAB Exist Cond
WS Proj Overtop Q - WSAB Exist Cond
WS Proj Overtop Q - WSAB Prop Cond
WS LACFCD 100-yr - WSAB Prop Cond
WS LACFCD 100-yr - WSAB Exist Cond
Ground
Bank Sta
Elevation (ft)
Station (ft)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Geom: WSAB Prop Cond Flow: FEMA 100-yr_NAVD 88
River = San Gabriel Rive Reach = Upper RS = 54400
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Legend
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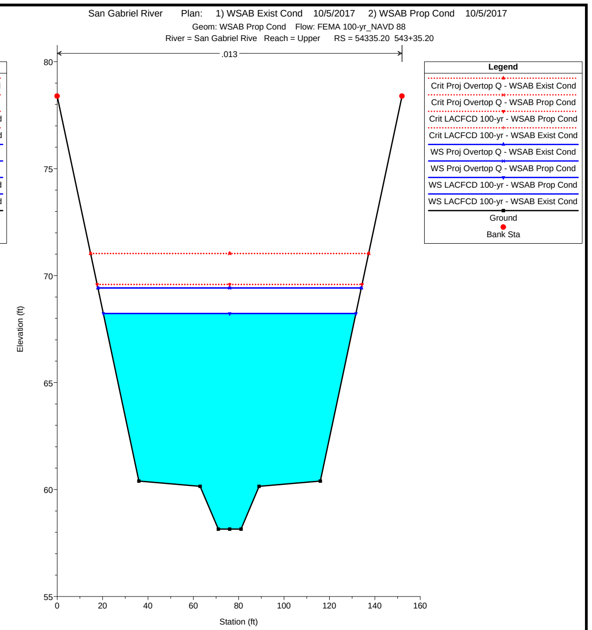
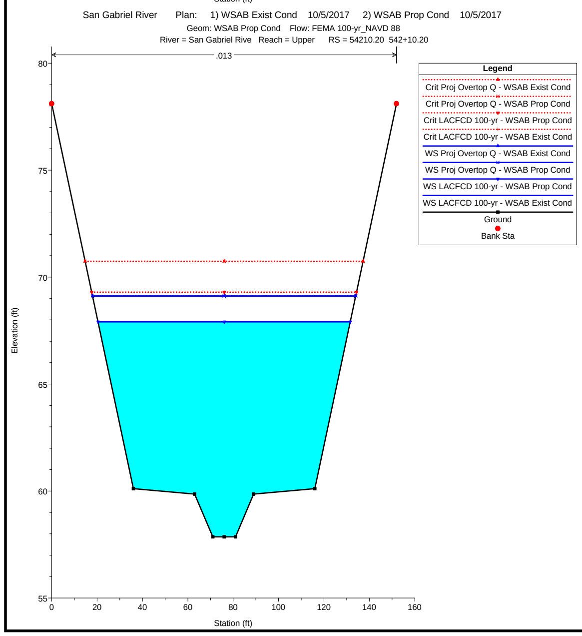
Crit Proj Overtop Q - WSAB Prop Cond
Crit LACFCD 100-yr - WSAB Prop Cond
Crit LACFCD 100-yr - WSAB Exist Cond
WS Proj Overtop Q - WSAB Exist Cond
WS Proj Overtop Q - WSAB Prop Cond
WS LACFCD 100-yr - WSAB Prop Cond
WS LACFCD 100-yr - WSAB Exist Cond
Ground
Bank Sta
Elevation (ft)
Station (ft)


San Gabriel River Plan: 1) WSAB Exist Cond 10/5/2017 2) WSAB Prop Cond 10/5/2017
Geom: WSAB Prop Cond Flow: FEMA 100-yr_NAVD 88
River = San Gabriel Rive Reach = Upper RS = 54335.20 543+35.20
.013
Legend
Crit Proj Overtop Q - WSAB Exist Cond
Crit Proj Overtop Q - WSAB Prop Cond
Crit LACFCD 100-yr - WSAB Prop Cond
Crit LACFCD 100-yr - WSAB Exist Cond
WS Proj Overtop Q - WSAB Exist Cond
WS Proj Overtop Q - WSAB Prop Cond
WS LACFCD 100-yr - WSAB Prop Cond
WS LACFCD 100-yr - WSAB Exist Cond
Ground
Bank Sta
Elevation (ft)
Station (ft)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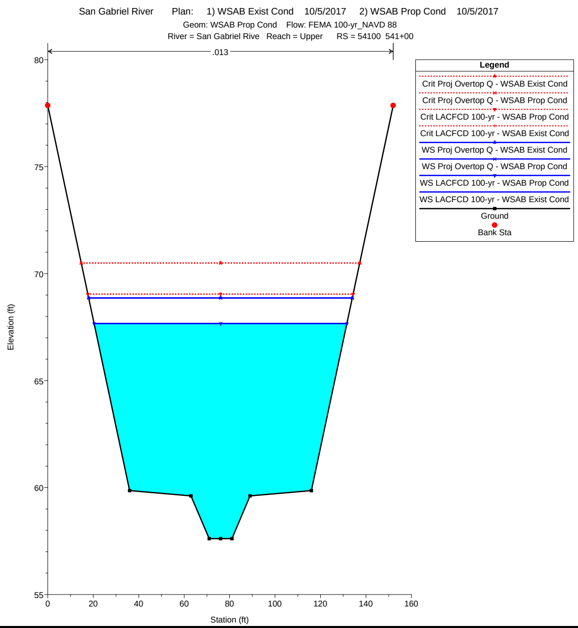
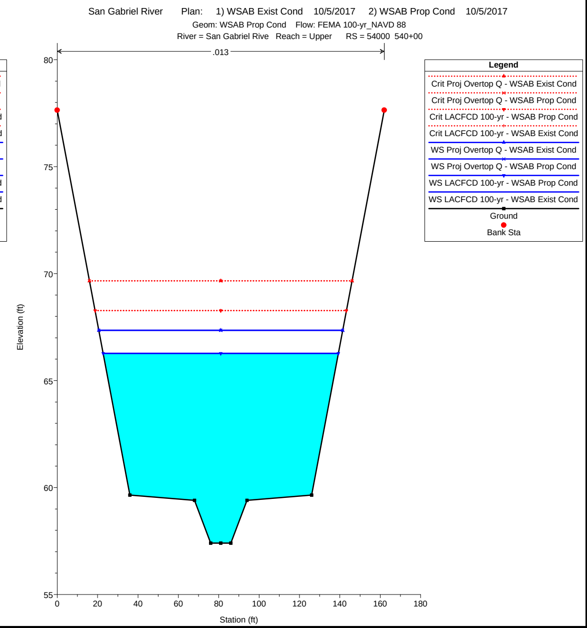
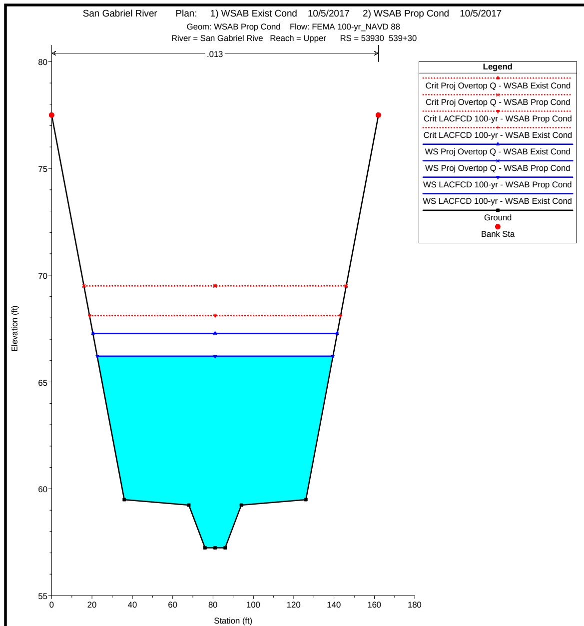
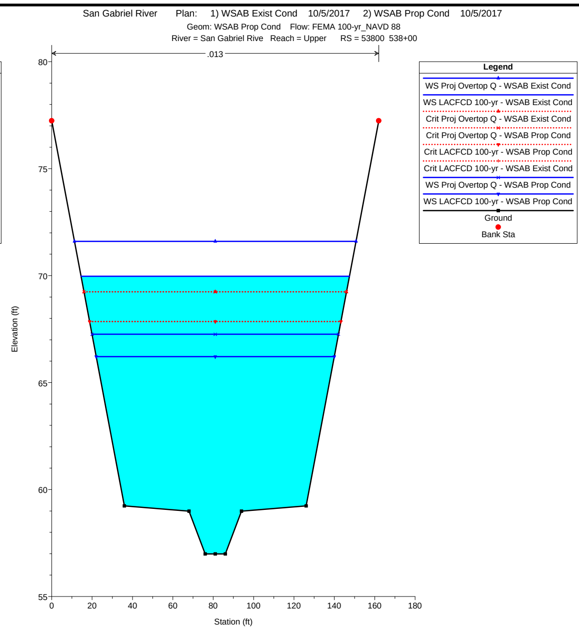
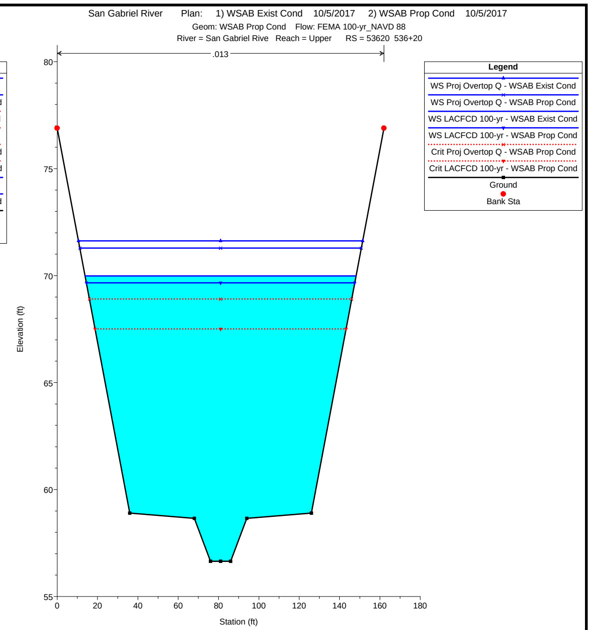
Geom: WSAB Prop Cond Flow: FEMA 100-yr_NAVD 88
River = San Gabriel Rive Reach = Upper RS = 54210.20 542+10.20
.013
Legend
Crit Proj Overtop Q - WSAB Exist Cond
Crit Proj Overtop Q - WSAB Prop Cond
Crit LACFCD 100-yr - WSAB Prop Cond
Crit LACFCD 100-yr - WSAB Exist Cond
WS Proj Overtop Q - WSAB Exist Cond
WS Proj Overtop Q - WSAB Prop Cond
WS LACFCD 100-yr - WSAB Prop Cond
WS LACFCD 100-yr - WSAB Exist Cond
Ground
Bank Sta
Elevation (ft)
Station (ft)


San Gabriel River Plan: 1) WSAB Exist Cond 10/5/2017 2) WSAB Prop Cond 10/5/2017
Geom: WSAB Prop Cond Flow: FEMA 100-yr_NAVD 88
River = San Gabriel Rive Reach = Upper RS = 54100 541+00
.013
Legend
Crit Proj Overtop Q - WSAB Exist Cond
Crit Proj Overtop Q - WSAB Prop Cond
Crit LACFCD 100-yr - WSAB Prop Cond
Crit LACFCD 100-yr - WSAB Exist Cond
WS Proj Overtop Q - WSAB Exist Cond
WS Proj Overtop Q - WSAB Prop Cond
WS LACFCD 100-yr - WSAB Prop Cond
WS LACFCD 100-yr - WSAB Exist Cond
Ground
Bank Sta
Elevation (ft)
Station (ft)


San Gabriel River Plan: 1) WSAB Exist Cond 10/5/2017 2) WSAB Prop Cond 10/5/2017
Geom: WSAB Prop Cond Flow: FEMA 100-yr_NAVD 88
River = San Gabriel Rive Reach = Upper RS = 54000 540+00
.013
Legend
Crit Proj Overtop Q - WSAB Exist Cond
Crit Proj Overtop Q - WSAB Prop Cond
Crit LACFCD 100-yr - WSAB Prop Cond
Crit LACFCD 100-yr - WSAB Exist Cond
WS Proj Overtop Q - WSAB Exist Cond
WS Proj Overtop Q - WSAB Prop Cond
WS LACFCD 100-yr - WSAB Prop Cond
WS LACFCD 100-yr - WSAB Exist Cond
Ground
Bank Sta
Elevation (ft)
Station (ft)


San Gabriel River Plan: 1) WSAB Exist Cond 10/5/2017 2) WSAB Prop Cond 10/5/2017
Geom: WSAB Prop Cond Flow: FEMA 100-yr_NAVD 88
River = San Gabriel Rive Reach = Upper RS = 53930 539+30
.013
Legend
Crit Proj Overtop Q - WSAB Exist Cond
Crit Proj Overtop Q - WSAB Prop Cond
Crit LACFCD 100-yr - WSAB Prop Cond
Crit LACFCD 100-yr - WSAB Exist Cond
WS Proj Overtop Q - WSAB Exist Cond
WS Proj Overtop Q - WSAB Prop Cond
WS LACFCD 100-yr - WSAB Prop Cond
WS LACFCD 100-yr - WSAB Exist Cond
Ground
Bank Sta
Elevation (ft)
Station (ft)


San Gabriel River Plan: 1) WSAB Exist Cond 10/5/2017 2) WSAB Prop Cond 10/5/2017
Geom: WSAB Prop Cond Flow: FEMA 100-yr_NAVD 88
River = San Gabriel Rive Reach = Upper RS = 53800 538+00
.013
Legend
WS Proj Overtop Q - WSAB Exist Cond
WS LACFCD 100-yr - WSAB Exist Cond
Crit Proj Overtop Q - WSAB Exist Cond
Crit Proj Overtop Q - WSAB Prop Cond
Crit LACFCD 100-yr - WSAB Prop Cond
Crit LACFCD 100-yr - WSAB Exist Cond
WS Proj Overtop Q - WSAB Prop Cond
WS LACFCD 100-yr - WSAB Prop Cond
Ground
Bank Sta
Elevation (ft)
Station (ft)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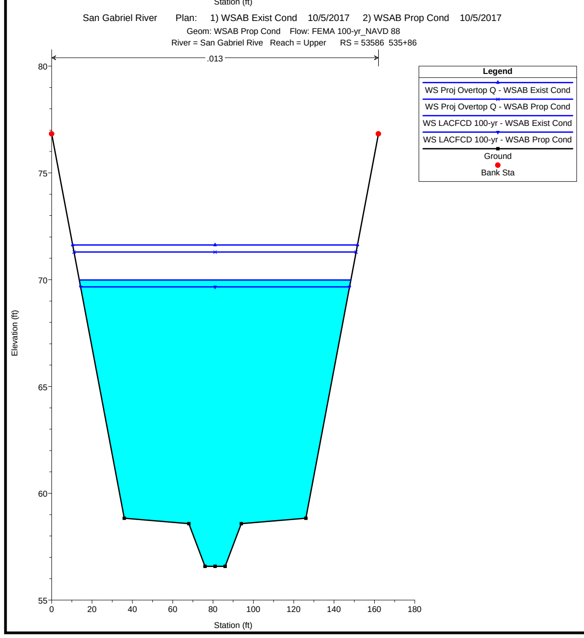
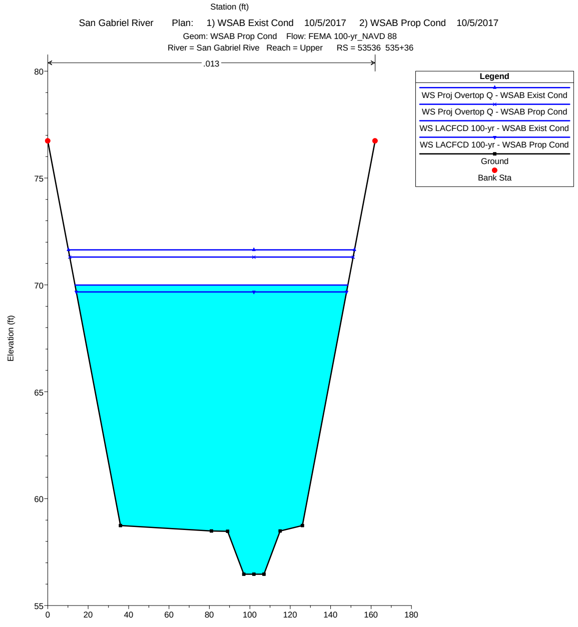
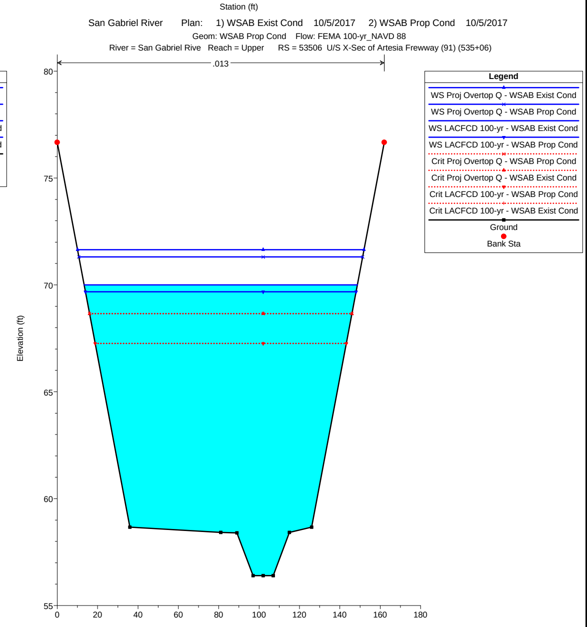
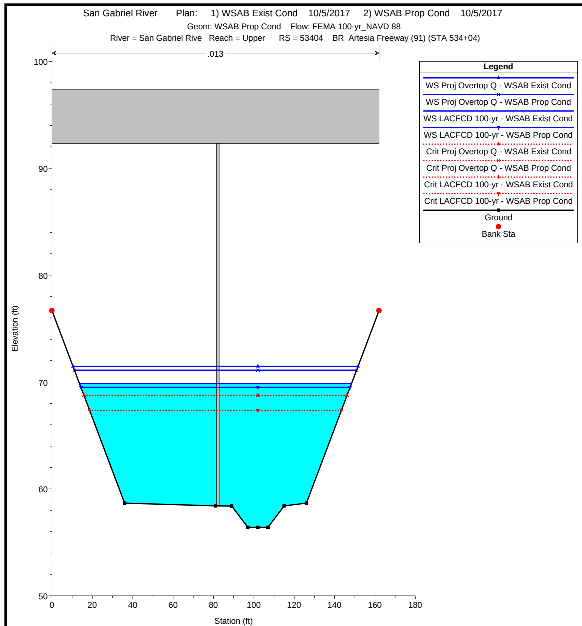
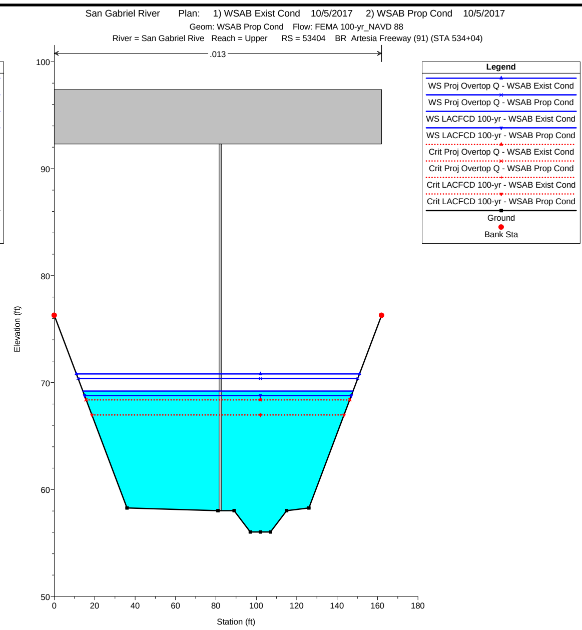
Geom: WSAB Prop Cond Flow: FEMA 100-yr_NAVD 88
River = San Gabriel Rive Reach = Upper RS = 53620 536+20
.013
Legend
WS Proj Overtop Q - WSAB Exist Cond
WS Proj Overtop Q - WSAB Prop Cond
WS LACFCD 100-yr - WSAB Exist Cond
WS LACFCD 100-yr - WSAB Prop Cond
Crit Proj Overtop Q - WSAB Prop Cond
Crit LACFCD 100-yr - WSAB Prop Cond
Ground
Bank Sta
Elevation (ft)
Station (ft)

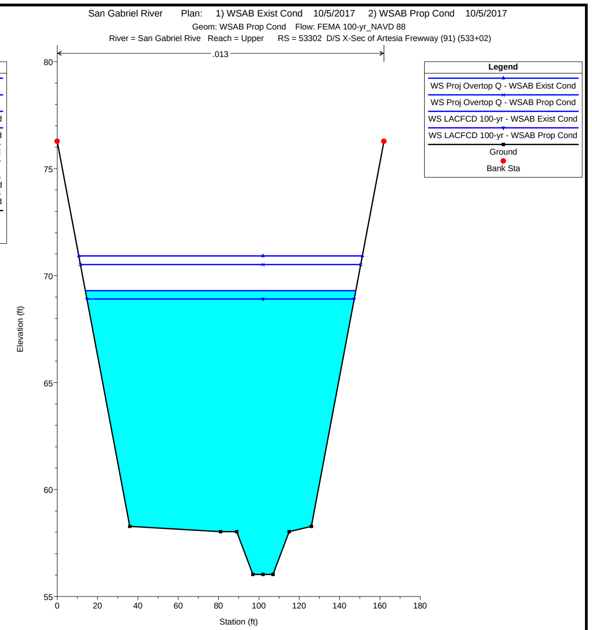

San Gabriel River Plan: 1) WSAB Exist Cond 10/5/2017 2) WSAB Prop Cond 10/5/2017
Geom: WSAB Prop Cond Flow: FEMA 100-yr_NAVD 88
River = San Gabriel Rive Reach = Upper RS = 53586 535+86
.013
Legend
WS Proj Overtop Q - WSAB Exist Cond
WS Proj Overtop Q - WSAB Prop Cond
WS LACFCD 100-yr - WSAB Exist Cond
WS LACFCD 100-yr - WSAB Prop Cond
Ground
Bank Sta
Elevation (ft)
Station (ft)

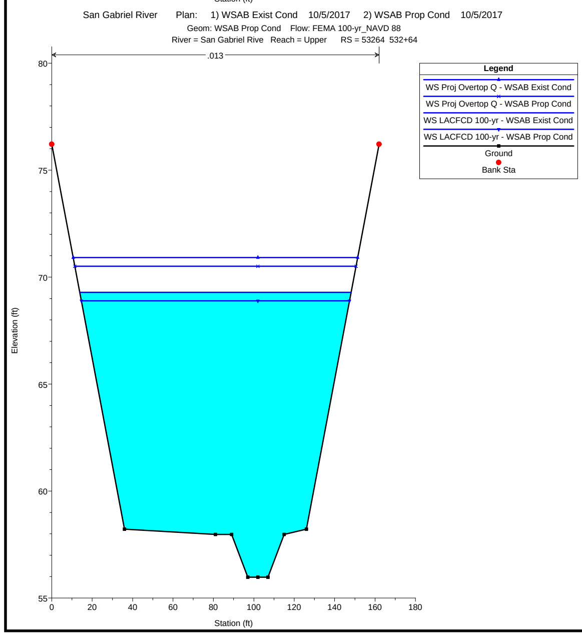

San Gabriel River Plan: 1) WSAB Exist Cond 10/5/2017 2) WSAB Prop Cond 10/5/2017
Geom: WSAB Prop Cond Flow: FEMA 100-yr_NAVD 88
River = San Gabriel Rive Reach = Upper RS = 53536 535+36
.013
Legend
WS Proj Overtop Q - WSAB Exist Cond
WS Proj Overtop Q - WSAB Prop Cond
WS LACFCD 100-yr - WSAB Exist Cond
WS LACFCD 100-yr - WSAB Prop Cond
Ground
Bank Sta
Elevation (ft)
Station (ft)

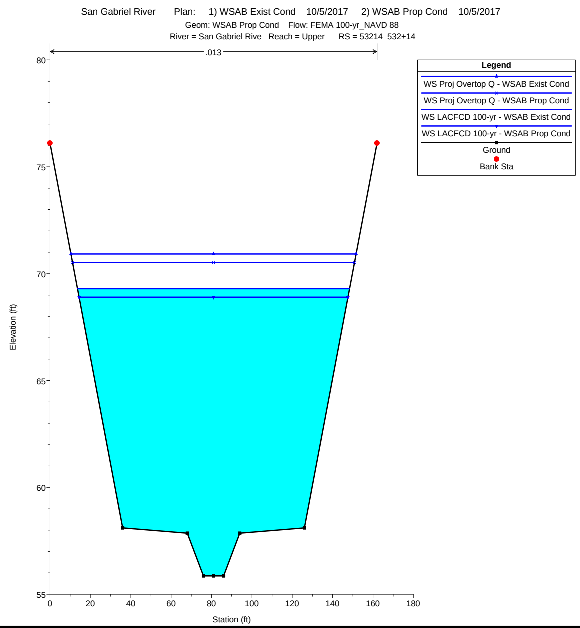

San Gabriel River Plan: 1) WSAB Exist Cond 10/5/2017 2) WSAB Prop Cond 10/5/2017
Geom: WSAB Prop Cond Flow: FEMA 100-yr_NAVD 88
River = San Gabriel Rive Reach = Upper RS = 53506 U/S X-Sec of Artesia Freeway (91) (535+06)
.013
Legend
WS Proj Overtop Q - WSAB Exist Cond
WS Proj Overtop Q - WSAB Prop Cond
WS LACFCD 100-yr - WSAB Exist Cond
WS LACFCD 100-yr - WSAB Prop Cond
Crit Proj Overtop Q - WSAB Prop Cond
Crit Proj Overtop Q - WSAB Exist Cond
Crit LACFCD 100-yr - WSAB Prop Cond
Crit LACFCD 100-yr - WSAB Exist Cond
Ground
Bank Sta
Elevation (ft)
Station (ft)

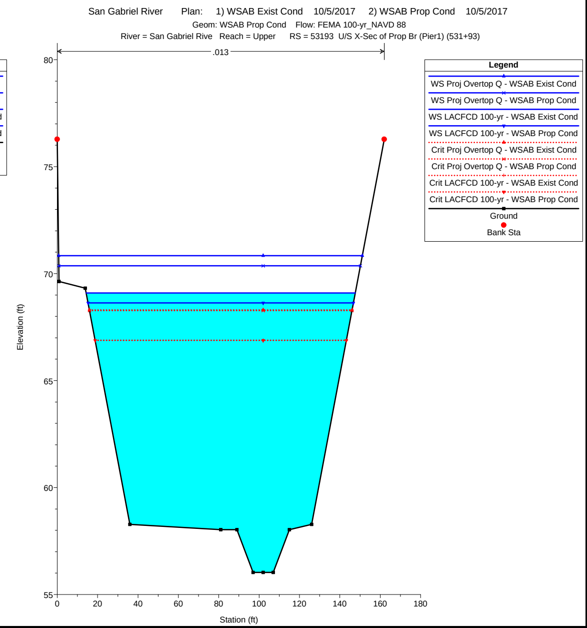

San Gabriel River Plan: 1) WSAB Exist Cond 10/5/2017 2) WSAB Prop Cond 10/5/2017
Geom: WSAB Prop Cond Flow: FEMA 100-yr_NAVD 88
River = San Gabriel Rive Reach = Upper RS = 53404 BR Artesia Freeway (91) (STA 534+04)
.013
Legend
WS Proj Overtop Q - WSAB Exist Cond
WS Proj Overtop Q - WSAB Prop Cond
WS LACFCD 100-yr - WSAB Exist Cond
WS LACFCD 100-yr - WSAB Prop Cond
Crit Proj Overtop Q - WSAB Exist Cond
Crit Proj Overtop Q - WSAB Prop Cond
Crit LACFCD 100-yr - WSAB Exist Cond
Crit LACFCD 100-yr - WSAB Prop Cond
Ground
Bank Sta
Elevation (ft)
Station (ft)

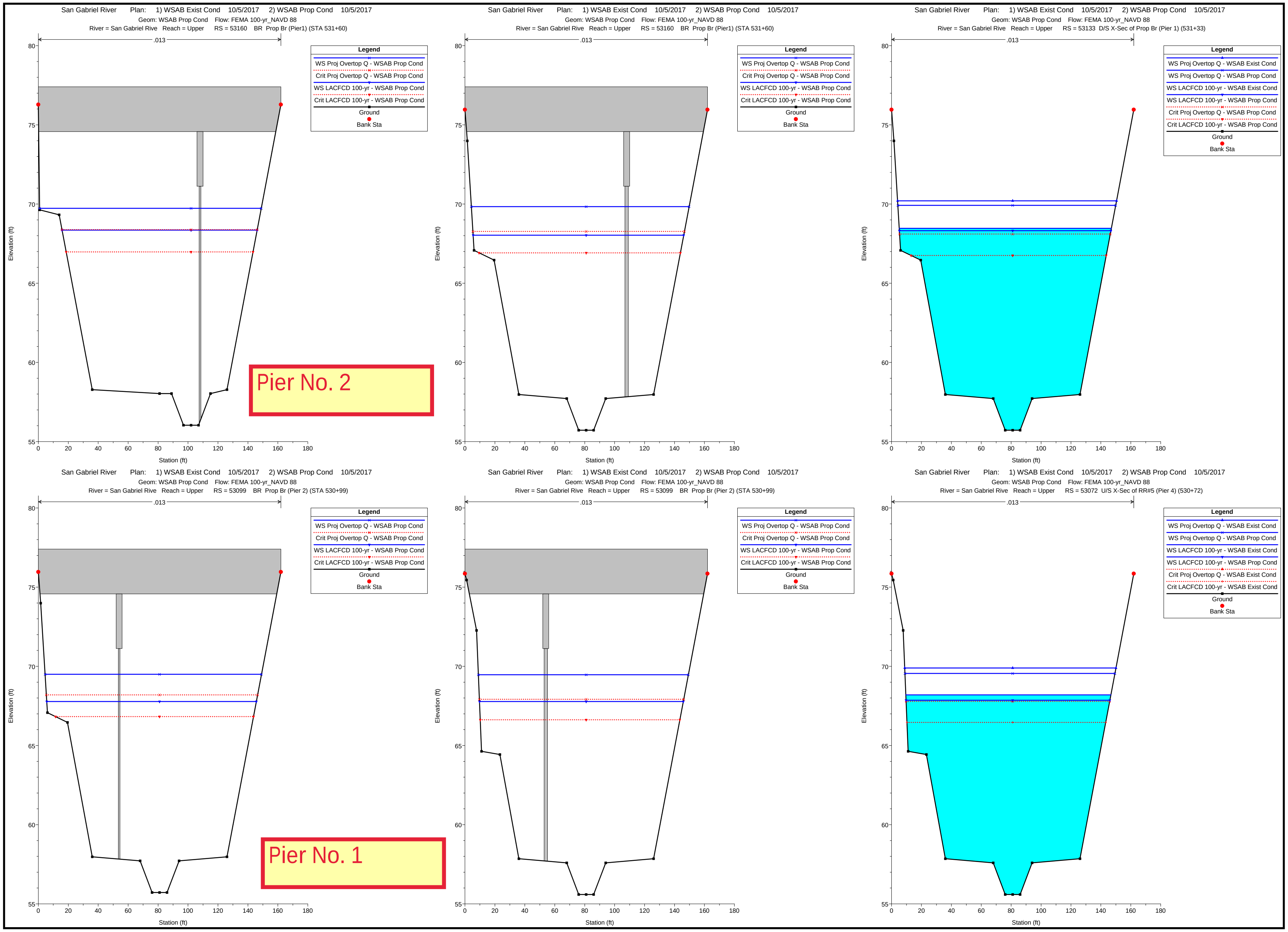

San Gabriel River Plan: 1) WSAB Exist Cond 10/5/2017 2) WSAB Prop Cond 10/5/2017
Geom: WSAB Prop Cond Flow: FEMA 100-yr_NAVD 88
River = San Gabriel Rive Reach = Upper RS = 53404 BR Artesia Freeway (91) (STA 534+04)
.013
Legend
WS Proj Overtop Q - WSAB Exist Cond
WS Proj Overtop Q - WSAB Prop Cond
WS LACFCD 100-yr - WSAB Exist Cond
WS LACFCD 100-yr - WSAB Prop Cond
Crit Proj Overtop Q - WSAB Exist Cond
Crit Proj Overtop Q - WSAB Prop Cond
Crit LACFCD 100-yr - WSAB Exist Cond
Crit LACFCD 100-yr - WSAB Prop Cond
Ground
Bank Sta
Elevation (ft)
Station (ft)

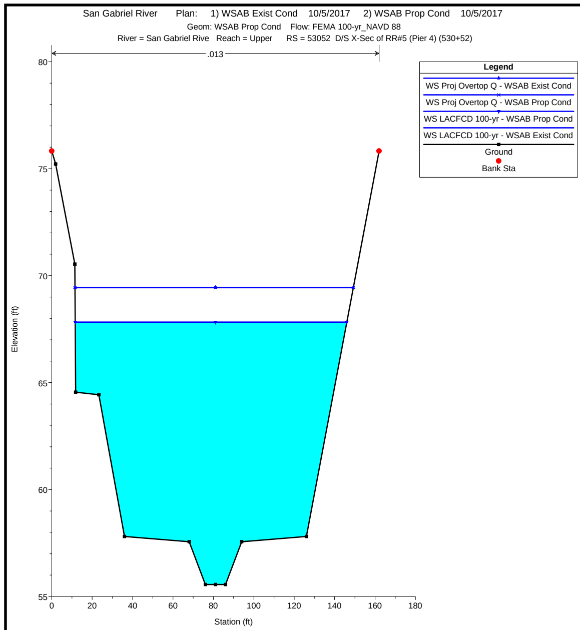

San Gabriel River Plan: 1) WSAB Exist Cond 10/5/2017 2) WSAB Prop Cond 10/5/2017
Geom: WSAB Prop Cond Flow: FEMA 100-yr_NAVD 88
River = San Gabriel Rive Reach = Upper RS = 53302 D/S X-Sec of Artesia Frewway (91) (533+02)
.013
Legend
WS Proj Overtop Q - WSAB Exist Cond
WS Proj Overtop Q - WSAB Prop Cond
WS LACFCD 100-yr - WSAB Exist Cond
WS LACFCD 100-yr - WSAB Prop Cond
Ground
Bank Sta
Elevation (ft)
Station (ft)

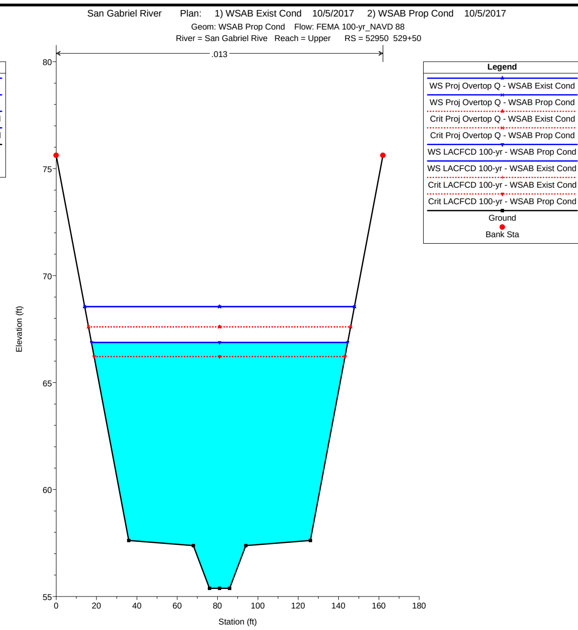

San Gabriel River Plan: 1) WSAB Exist Cond 10/5/2017 2) WSAB Prop Cond 10/5/2017
Geom: WSAB Prop Cond Flow: FEMA 100-yr_NAVD 88
River = San Gabriel Rive Reach = Upper RS = 53264 532+64
.013
Legend
WS Proj Overtop Q - WSAB Exist Cond
WS Proj Overtop Q - WSAB Prop Cond
WS LACFCD 100-yr - WSAB Exist Cond
WS LACFCD 100-yr - WSAB Prop Cond
Ground
Bank Sta
Elevation (ft)
Station (ft)

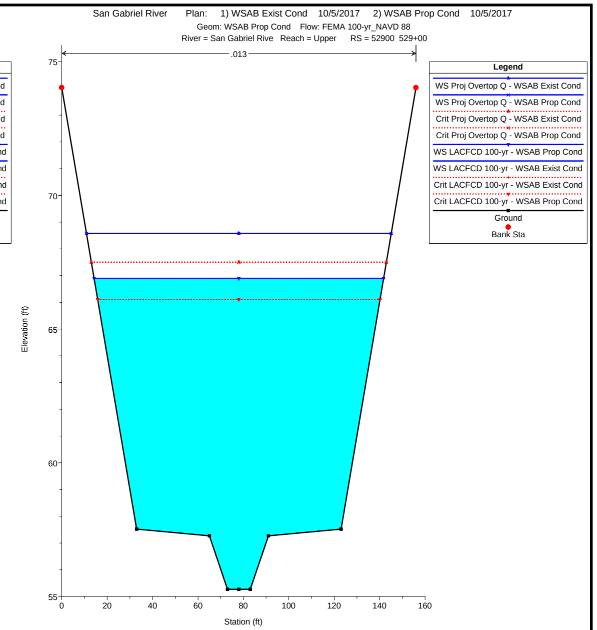

San Gabriel River Plan: 1) WSAB Exist Cond 10/5/2017 2) WSAB Prop Cond 10/5/2017
Geom: WSAB Prop Cond Flow: FEMA 100-yr_NAVD 88
River = San Gabriel Rive Reach = Upper RS = 53214 532+14
.013
Legend
WS Proj Overtop Q - WSAB Exist Cond
WS Proj Overtop Q - WSAB Prop Cond
WS LACFCD 100-yr - WSAB Exist Cond
WS LACFCD 100-yr - WSAB Prop Cond
Ground
Bank Sta
Elevation (ft)
Station (ft)


San Gabriel River Plan: 1) WSAB Exist Cond 10/5/2017 2) WSAB Prop Cond 10/5/2017
Geom: WSAB Prop Cond Flow: FEMA 100-yr_NAVD 88
River = San Gabriel Rive Reach = Upper RS = 53193 U/S X-Sec of Prop Br (Pier1) (531+93)
.013
Legend
WS Proj Overtop Q - WSAB Exist Cond
WS Proj Overtop Q - WSAB Prop Cond
WS LACFCD 100-yr - WSAB Exist Cond
WS LACFCD 100-yr - WSAB Prop Cond
Crit Proj Overtop Q - WSAB Exist Cond
Crit Proj Overtop Q - WSAB Prop Cond
Crit LACFCD 100-yr - WSAB Exist Cond
Crit LACFCD 100-yr - WSAB Prop Cond
Ground
Bank Sta
Elevation (ft)
Station (ft)


San Gabriel River Plan: 1) WSAB Exist Cond 10/5/2017 2) WSAB Prop Cond 10/5/2017
Geom: WSAB Prop Cond Flow: FEMA 100-yr_NAVD 88
River = San Gabriel Rive Reach = Upper RS = 53160 BR Prop Br (Pier1) (STA 531+60)
Legend
WS Proj Overtop Q - WSAB Prop Cond
Crit Proj Overtop Q - WSAB Prop Cond
WS LACFCD 100-yr - WSAB Prop Cond
Crit LACFCD 100-yr - WSAB Prop Cond
Ground
Bank Sta
Pier No. 2
San Gabriel River Plan: 1) WSAB Exist Cond 10/5/2017 2) WSAB Prop Cond 10/5/2017
Geom: WSAB Prop Cond Flow: FEMA 100-yr_NAVD 88
River = San Gabriel Rive Reach = Upper RS = 53160 BR Prop Br (Pier1) (STA 531+60)
San Gabriel River Plan: 1) WSAB Exist Cond 10/5/2017 2) WSAB Prop Cond 10/5/2017
Geom: WSAB Prop Cond Flow: FEMA 100-yr_NAVD 88
River = San Gabriel Rive Reach = Upper RS = 53133 D/S X-Sec of Prop Br (Pier 1) (531+33)
Legend
WS Proj Overtop Q - WSAB Exist Cond
WS Proj Overtop Q - WSAB Prop Cond
WS LACFCD 100-yr - WSAB Exist Cond
WS LACFCD 100-yr - WSAB Prop Cond
Crit Proj Overtop Q - WSAB Prop Cond
Crit LACFCD 100-yr - WSAB Prop Cond
Ground
Bank Sta
San Gabriel River Plan: 1) WSAB Exist Cond 10/5/2017 2) WSAB Prop Cond 10/5/2017
Geom: WSAB Prop Cond Flow: FEMA 100-yr_NAVD 88
River = San Gabriel Rive Reach = Upper RS = 53099 BR Prop Br (Pier 2) (STA 530+99)
Pier No. 1
San Gabriel River Plan: 1) WSAB Exist Cond 10/5/2017 2) WSAB Prop Cond 10/5/2017
Geom: WSAB Prop Cond Flow: FEMA 100-yr_NAVD 88
River = San Gabriel Rive Reach = Upper RS = 53099 BR Prop Br (Pier 2) (STA 530+99)
San Gabriel River Plan: 1) WSAB Exist Cond 10/5/2017 2) WSAB Prop Cond 10/5/2017
Geom: WSAB Prop Cond Flow: FEMA 100-yr_NAVD 88
River = San Gabriel Rive Reach = Upper RS = 53072 U/S X-Sec of RR#5 (Pier 4) (530+72)
Legend
WS Proj Overtop Q - WSAB Exist Cond
WS Proj Overtop Q - WSAB Prop Cond
WS LACFCD 100-yr - WSAB Exist Cond
WS LACFCD 100-yr - WSAB Prop Cond
Crit Proj Overtop Q - WSAB Exist Cond
Crit LACFCD 100-yr - WSAB Exist Cond
Ground
Bank Sta
.013
Elevation (ft)
Station (ft)


San Gabriel River Plan: 1) WSAB Exist Cond 10/5/2017 2) WSAB Prop Cond 10/5/2017
Geom: WSAB Prop Cond Flow: FEMA 100-yr_NAVD 88
River = San Gabriel Rive Reach = Upper RS = 53052 D/S X-Sec of RR#5 (Pier 4) (530+52)
.013
Legend
WS Proj Overtop Q - WSAB Exist Cond
WS Proj Overtop Q - WSAB Prop Cond
WS LACFCD 100-yr - WSAB Prop Cond
WS LACFCD 100-yr - WSAB Exist Cond
Ground
Bank Sta
Elevation (ft)
Station (ft)


San Gabriel River Plan: 1) WSAB Exist Cond 10/5/2017 2) WSAB Prop Cond 10/5/2017
Geom: WSAB Prop Cond Flow: FEMA 100-yr_NAVD 88
River = San Gabriel Rive Reach = Upper RS = 52950 529+50
.013
Legend
WS Proj Overtop Q - WSAB Exist Cond
WS Proj Overtop Q - WSAB Prop Cond
Crit Proj Overtop Q - WSAB Exist Cond
Crit Proj Overtop Q - WSAB Prop Cond
WS LACFCD 100-yr - WSAB Prop Cond
WS LACFCD 100-yr - WSAB Exist Cond
Crit LACFCD 100-yr - WSAB Exist Cond
Crit LACFCD 100-yr - WSAB Prop Cond
Ground
Bank Sta
Elevation (ft)
Station (ft)


San Gabriel River Plan: 1) WSAB Exist Cond 10/5/2017 2) WSAB Prop Cond 10/5/2017
Geom: WSAB Prop Cond Flow: FEMA 100-yr_NAVD 88
River = San Gabriel Rive Reach = Upper RS = 52900 529+00
.013
Legend
WS Proj Overtop Q - WSAB Exist Cond
WS Proj Overtop Q - WSAB Prop Cond
Crit Proj Overtop Q - WSAB Exist Cond
Crit Proj Overtop Q - WSAB Prop Cond
WS LACFCD 100-yr - WSAB Prop Cond
WS LACFCD 100-yr - WSAB Exist Cond
Crit LACFCD 100-yr - WSAB Exist Cond
Crit LACFCD 100-yr - WSAB Prop Cond
Ground
Bank Sta
Elevation (ft)
Station (ft)

HEC-RAS Output
Exist Condition vs. Proposed
(Some sections are omitted)

HEC-RAS River: San Gabriel Rive Reach: Upper

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Upper	54500	LACFCD 100-yr	WSAB Exist Cond	15500.00	58.50	68.56	69.94	74.44	0.002207	19.46	796.50	111.26	1.28
Upper	54500	LACFCD 100-yr	WSAB Prop Cond	15500.00	58.50	68.56	69.94	74.44	0.002207	19.46	796.50	111.26	1.28
Upper	54500	Proj Overtop Q	WSAB Exist Cond	19500.00	58.50	69.76	71.38	76.55	0.002192	20.91	932.71	116.05	1.30
Upper	54500	Proj Overtop Q	WSAB Prop Cond	19500.00	58.50	69.76	71.38	76.55	0.002192	20.91	932.71	116.05	1.30
Upper	54400	LACFCD 100-yr	WSAB Exist Cond	15500.00	58.28	68.34	69.72	74.22	0.002207	19.46	796.50	111.26	1.28
Upper	54400	LACFCD 100-yr	WSAB Prop Cond	15500.00	58.28	68.34	69.72	74.22	0.002207	19.46	796.50	111.26	1.28
Upper	54400	Proj Overtop Q	WSAB Exist Cond	19500.00	58.28	69.54	71.16	76.33	0.002191	20.90	932.88	116.06	1.30
Upper	54400	Proj Overtop Q	WSAB Prop Cond	19500.00	58.28	69.54	71.16	76.33	0.002191	20.90	932.88	116.06	1.30
Upper	54335.20	LACFCD 100-yr	WSAB Exist Cond	15500.00	58.15	68.23	69.59	74.08	0.002194	19.42	798.12	111.33	1.28
Upper	54335.20	LACFCD 100-yr	WSAB Prop Cond	15500.00	58.15	68.23	69.59	74.08	0.002194	19.42	798.12	111.33	1.28
Upper	54335.20	Proj Overtop Q	WSAB Exist Cond	19500.00	58.15	69.43	71.03	76.19	0.002181	20.87	934.34	116.12	1.30
Upper	54335.20	Proj Overtop Q	WSAB Prop Cond	19500.00	58.15	69.43	71.03	76.19	0.002181	20.87	934.34	116.12	1.30
Upper	54210.20	LACFCD 100-yr	WSAB Exist Cond	15500.00	57.86	67.91	69.30	73.81	0.002220	19.50	794.92	111.20	1.29
Upper	54210.20	LACFCD 100-yr	WSAB Prop Cond	15500.00	57.86	67.91	69.30	73.81	0.002220	19.50	794.92	111.20	1.29
Upper	54210.20	Proj Overtop Q	WSAB Exist Cond	19500.00	57.86	69.12	70.74	75.91	0.002196	20.92	932.22	116.03	1.30
Upper	54210.20	Proj Overtop Q	WSAB Prop Cond	19500.00	57.86	69.12	70.74	75.91	0.002196	20.92	932.22	116.03	1.30
Upper	54100	LACFCD 100-yr	WSAB Exist Cond	15500.00	57.61	67.67	69.05	73.56	0.002214	19.48	795.67	111.23	1.28
Upper	54100	LACFCD 100-yr	WSAB Prop Cond	15500.00	57.61	67.67	69.05	73.56	0.002214	19.48	795.67	111.23	1.28
Upper	54100	Proj Overtop Q	WSAB Exist Cond	19500.00	57.61	68.86	70.49	75.67	0.002201	20.94	931.38	116.00	1.30
Upper	54100	Proj Overtop Q	WSAB Prop Cond	19500.00	57.61	68.86	70.49	75.67	0.002201	20.94	931.38	116.00	1.30
Upper	54000	LACFCD 100-yr	WSAB Exist Cond	15500.00	57.40	66.27	68.27	73.19	0.003054	21.12	734.06	116.50	1.48
Upper	54000	LACFCD 100-yr	WSAB Prop Cond	15500.00	57.40	66.27	68.27	73.19	0.003054	21.12	734.06	116.50	1.48
Upper	54000	Proj Overtop Q	WSAB Exist Cond	19500.00	57.40	67.35	69.67	75.29	0.002982	22.62	862.04	120.81	1.49
Upper	54000	Proj Overtop Q	WSAB Prop Cond	19500.00	57.40	67.35	69.67	75.29	0.002982	22.62	862.04	120.81	1.49
Upper	53930	LACFCD 100-yr	WSAB Exist Cond	15500.00	57.24	66.21	68.10	72.92	0.002917	20.80	745.31	116.87	1.45
Upper	53930	LACFCD 100-yr	WSAB Prop Cond	15500.00	57.24	66.21	68.10	72.92	0.002917	20.80	745.31	116.87	1.45
Upper	53930	Proj Overtop Q	WSAB Exist Cond	19500.00	57.24	67.27	69.50	75.03	0.002878	22.35	872.29	121.14	1.47
Upper	53930	Proj Overtop Q	WSAB Prop Cond	19500.00	57.24	67.27	69.50	75.03	0.002878	22.35	872.29	121.14	1.47
Upper	53800	LACFCD 100-yr	WSAB Exist Cond	15500.00	56.99	69.97	67.85	72.37	0.000632	12.43	1246.71	132.93	0.72
Upper	53800	LACFCD 100-yr	WSAB Prop Cond	15500.00	56.99	66.22	67.85	72.42	0.002586	19.98	775.67	117.90	1.37
Upper	53800	Proj Overtop Q	WSAB Exist Cond	19500.00	56.99	71.60	69.25	74.34	0.000620	13.27	1469.10	139.46	0.72
Upper	53800	Proj Overtop Q	WSAB Prop Cond	19500.00	56.99	67.26	69.25	74.54	0.002616	21.65	900.62	122.07	1.40
Upper	53620	LACFCD 100-yr	WSAB Exist Cond	15500.00	56.65	69.98		72.21	0.000567	11.98	1293.81	134.36	0.68
Upper	53620	LACFCD 100-yr	WSAB Prop Cond	15500.00	56.65	69.66	67.51	72.05	0.000626	12.39	1250.54	133.06	0.71
Upper	53620	Proj Overtop Q	WSAB Exist Cond	19500.00	56.65	71.62		74.18	0.000562	12.83	1519.40	140.92	0.69
Upper	53620	Proj Overtop Q	WSAB Prop Cond	19500.00	56.65	71.29	68.91	74.01	0.000616	13.25	1472.15	139.57	0.72

HEC-RAS   River: San Gabriel Rive   Reach: Upper (Continued)

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Upper	53586	LACFCD 100-yr	WSAB Exist Cond	15500.00	56.58	69.99		72.18	0.000554	11.89	1303.70	134.63	0.67
Upper	53586	LACFCD 100-yr	WSAB Prop Cond	15500.00	56.58	69.66		72.01	0.000612	12.30	1260.40	133.34	0.70
Upper	53586	Proj Overtop Q	WSAB Exist Cond	19500.00	56.58	71.63		74.15	0.000551	12.75	1529.88	141.19	0.68
Upper	53586	Proj Overtop Q	WSAB Prop Cond	19500.00	56.58	71.29		73.98	0.000603	13.15	1482.62	139.85	0.71
Upper	53536	LACFCD 100-yr	WSAB Exist Cond	15500.00	56.47	69.99		72.14	0.000536	11.76	1318.30	135.02	0.66
Upper	53536	LACFCD 100-yr	WSAB Prop Cond	15500.00	56.47	69.67		71.97	0.000591	12.16	1275.00	133.73	0.69
Upper	53536	Proj Overtop Q	WSAB Exist Cond	19500.00	56.47	71.64		74.11	0.000535	12.62	1545.33	141.59	0.67
Upper	53536	Proj Overtop Q	WSAB Prop Cond	19500.00	56.47	71.30		73.93	0.000585	13.02	1498.09	140.24	0.70
Upper	53506	LACFCD 100-yr	WSAB Exist Cond	15500.00	56.40	70.00	67.26	72.12	0.000524	11.66	1328.81	135.33	0.66
Upper	53506	LACFCD 100-yr	WSAB Prop Cond	15500.00	56.40	69.68	67.26	71.94	0.000577	12.06	1285.52	134.04	0.69
Upper	53506	Proj Overtop Q	WSAB Exist Cond	19500.00	56.40	71.65	68.66	74.08	0.000524	12.53	1556.50	141.90	0.67
Upper	53506	Proj Overtop Q	WSAB Prop Cond	19500.00	56.40	71.31	68.66	73.90	0.000573	12.92	1509.30	140.56	0.69
Upper	53404			Bridge									
Upper	53302	LACFCD 100-yr	WSAB Exist Cond	15500.00	56.03	69.30		71.55	0.000577	12.05	1285.87	134.07	0.69
Upper	53302	LACFCD 100-yr	WSAB Prop Cond	15500.00	56.03	68.90		71.36	0.000652	12.57	1233.46	132.50	0.73
Upper	53302	Proj Overtop Q	WSAB Exist Cond	19500.00	56.03	70.92		73.51	0.000573	12.92	1508.81	140.57	0.70
Upper	53302	Proj Overtop Q	WSAB Prop Cond	19500.00	56.03	70.52		73.32	0.000640	13.42	1452.76	138.96	0.73
Upper	53264	LACFCD 100-yr	WSAB Exist Cond	15500.00	55.97	69.29		71.52	0.000568	11.99	1292.74	134.30	0.68
Upper	53264	LACFCD 100-yr	WSAB Prop Cond	15500.00	55.97	68.89		71.32	0.000642	12.50	1239.99	132.71	0.72
Upper	53264	Proj Overtop Q	WSAB Exist Cond	19500.00	55.97	70.91		73.48	0.000565	12.86	1516.15	140.80	0.69
Upper	53264	Proj Overtop Q	WSAB Prop Cond	19500.00	55.97	70.51		73.28	0.000631	13.36	1459.78	139.19	0.73
Upper	53214	LACFCD 100-yr	WSAB Exist Cond	15500.00	55.86	69.30		71.48	0.000550	11.86	1307.39	134.74	0.67
Upper	53214	LACFCD 100-yr	WSAB Prop Cond	15500.00	55.86	68.90		71.27	0.000620	12.35	1254.61	133.16	0.71
Upper	53214	Proj Overtop Q	WSAB Exist Cond	19500.00	55.86	70.92		73.44	0.000549	12.73	1531.77	141.25	0.68
Upper	53214	Proj Overtop Q	WSAB Prop Cond	19500.00	55.86	70.52		73.23	0.000612	13.22	1475.41	139.64	0.72
Upper	53193	LACFCD 100-yr	WSAB Exist Cond	15500.00	56.03	69.09	66.88	71.45	0.000615	12.32	1258.48	133.27	0.71
Upper	53193	LACFCD 100-yr	WSAB Prop Cond	15500.00	56.03	68.63	66.88	71.23	0.000711	12.95	1197.25	131.42	0.76
Upper	53193	Proj Overtop Q	WSAB Exist Cond	19500.00	56.03	70.84	68.30	73.42	0.000623	12.89	1513.15	150.39	0.72
Upper	53193	Proj Overtop Q	WSAB Prop Cond	19500.00	56.03	70.37	68.27	73.21	0.000721	13.52	1441.97	149.38	0.77
Upper	53183			Bridge									
Upper	53173	LACFCD 100-yr	WSAB Exist Cond	15500.00	55.78	68.84		71.20	0.000686	12.32	1257.79	145.03	0.74
Upper	53173	Proj Overtop Q	WSAB Exist Cond	19500.00	55.78	70.60		73.17	0.000612	12.85	1517.00	149.19	0.71
Upper	53152	LACFCD 100-yr	WSAB Exist Cond	15500.00	55.74	68.89	66.60	71.12	0.000631	12.00	1292.15	145.51	0.71

HEC-RAS River: San Gabriel Rive Reach: Upper (Continued)

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Upper	53152	Proj Overtop Q	WSAB Exist Cond	19500.00	55.74	70.65	68.17	73.10	0.000571	12.57	1551.55	149.60	0.69
Upper	53142.5			Bridge									
Upper	53133	LACFCD 100-yr	WSAB Exist Cond	15500.00	55.72	68.47		70.92	0.000716	12.58	1232.18	141.85	0.75
Upper	53133	LACFCD 100-yr	WSAB Prop Cond	15500.00	55.72	68.31	66.75	70.86	0.000756	12.80	1210.48	141.44	0.77
Upper	53133	Proj Overtop Q	WSAB Exist Cond	19500.00	55.72	70.20		72.89	0.000644	13.15	1482.58	146.44	0.73
Upper	53133	Proj Overtop Q	WSAB Prop Cond	19500.00	55.72	69.92	68.11	72.76	0.000703	13.54	1440.38	145.68	0.76
Upper	53113	LACFCD 100-yr	WSAB Exist Cond	15500.00	55.67	68.49	66.70	70.88	0.000680	12.41	1248.57	140.66	0.73
Upper	53113	Proj Overtop Q	WSAB Exist Cond	19500.00	55.67	70.22	67.95	72.85	0.000621	13.04	1495.79	145.14	0.72
Upper	53102.5			Bridge	←		Pier No. 2						
Upper	53092	LACFCD 100-yr	WSAB Exist Cond	15500.00	55.63	68.19		70.71	0.000725	12.73	1217.95	138.54	0.76
Upper	53092	Proj Overtop Q	WSAB Exist Cond	19500.00	55.63	69.90		72.68	0.000664	13.38	1457.65	142.85	0.74
Upper	53072	LACFCD 100-yr	WSAB Exist Cond	15500.00	55.59	68.20	66.46	70.68	0.000703	12.64	1226.47	137.16	0.74
Upper	53072	LACFCD 100-yr	WSAB Prop Cond	15500.00	55.59	67.86		70.54	0.000792	13.14	1179.92	136.33	0.79
Upper	53072	Proj Overtop Q	WSAB Exist Cond	19500.00	55.59	69.89	67.78	72.65	0.000651	13.33	1462.77	141.30	0.73
Upper	53072	Proj Overtop Q	WSAB Prop Cond	19500.00	55.59	69.55		72.50	0.000721	13.78	1414.59	140.47	0.77
Upper	53062			Bridge	←		Pier No. 1						
Upper	53052	LACFCD 100-yr	WSAB Exist Cond	15500.00	55.56	67.82		70.52	0.000795	13.19	1175.08	134.42	0.79
Upper	53052	LACFCD 100-yr	WSAB Prop Cond	15500.00	55.56	67.82		70.52	0.000795	13.19	1175.08	134.42	0.79
Upper	53052	Proj Overtop Q	WSAB Exist Cond	19500.00	55.56	69.44		72.47	0.000744	13.97	1395.82	137.77	0.77
Upper	53052	Proj Overtop Q	WSAB Prop Cond	19500.00	55.56	69.44		72.47	0.000744	13.97	1395.82	137.77	0.77
Upper	52950	LACFCD 100-yr	WSAB Exist Cond	15500.00	55.38	66.88	66.21	70.23	0.001035	14.70	1054.44	127.03	0.90
Upper	52950	LACFCD 100-yr	WSAB Prop Cond	15500.00	55.38	66.88	66.21	70.23	0.001035	14.70	1054.44	127.03	0.90
Upper	52950	Proj Overtop Q	WSAB Exist Cond	19500.00	55.38	68.55	67.61	72.20	0.000942	15.32	1272.69	133.72	0.88
Upper	52950	Proj Overtop Q	WSAB Prop Cond	19500.00	55.38	68.55	67.61	72.20	0.000942	15.32	1272.69	133.72	0.88
Upper	52900	LACFCD 100-yr	WSAB Exist Cond	15500.00	55.27	66.90	66.11	70.15	0.000990	14.48	1070.20	127.49	0.88
Upper	52900	LACFCD 100-yr	WSAB Prop Cond	15500.00	55.27	66.90	66.11	70.15	0.000990	14.48	1070.20	127.49	0.88
Upper	52900	Proj Overtop Q	WSAB Exist Cond	19500.00	55.27	68.57	67.50	72.12	0.000906	15.12	1289.38	134.18	0.86
Upper	52900	Proj Overtop Q	WSAB Prop Cond	19500.00	55.27	68.57	67.50	72.12	0.000906	15.12	1289.38	134.18	0.86

HEC-RAS Output
Bridge Six Sections

HEC-RAS River: San Gabriel Rive Reach: Upper

Reach	River Sta	Profile	Plan	E.G. Elev	W.S. Elev	Crit W.S.	Frctn Loss	C & E Loss	Top Width	Q Left	Q Channel	Q Right	Vel Chnl
				(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)
Upper	53133	LACFCD 100-yr	WSAB Exist Cond	70.92	68.47		0.01	0.03	141.85		15500.00		12.58
Upper	53133	LACFCD 100-yr	WSAB Prop Cond	70.86	68.31	66.75	0.01	0.12	141.44		15500.00		12.80
Upper	53133	Proj Overtop Q	WSAB Exist Cond	72.89	70.20		0.01	0.02	146.44		19500.00		13.15
Upper	53133	Proj Overtop Q	WSAB Prop Cond	72.76	69.92	68.11	0.01	0.10	145.68		19500.00		13.54
Upper	53113	LACFCD 100-yr	WSAB Exist Cond	70.88	68.49	66.70	0.00	0.06	140.66		15500.00		12.41
Upper	53113	Proj Overtop Q	WSAB Exist Cond	72.85	70.22	67.95	0.00	0.05	145.14		19500.00		13.04
Upper	53102.5 BR U	LACFCD 100-yr	WSAB Exist Cond	70.81	68.21	66.78	0.02	0.02	138.82		15500.00		12.93
Upper	53102.5 BR U	Proj Overtop Q	WSAB Exist Cond	72.80	69.98	68.06	0.02	0.03	143.39		19500.00		13.47
Upper	53102.5 BR D	LACFCD 100-yr	WSAB Exist Cond	70.78	68.12	66.72	0.00	0.07	136.08		15500.00		13.09
Upper	53102.5 BR D	Proj Overtop Q	WSAB Exist Cond	72.75	69.82	68.02	0.00	0.08	140.38		19500.00		13.74
Upper	53099 BR U	LACFCD 100-yr	WSAB Prop Cond	70.73	67.77	66.82	0.05	0.06	138.87		15500.00		13.80
Upper	53099 BR U	Proj Overtop Q	WSAB Prop Cond	72.66	69.50	68.20	0.05	0.02	143.43		19500.00		14.27
Upper	53099 BR D	LACFCD 100-yr	WSAB Prop Cond	70.62	67.78	66.62	0.00	0.08	133.87		15500.00		13.52
Upper	53099 BR D	Proj Overtop Q	WSAB Prop Cond	72.59	69.47	67.92	0.00	0.08	137.99		19500.00		14.17
Upper	53092	LACFCD 100-yr	WSAB Exist Cond	70.71	68.19		0.01	0.02	138.54		15500.00		12.73
Upper	53092	Proj Overtop Q	WSAB Exist Cond	72.68	69.90		0.01	0.01	142.85		19500.00		13.38
Upper	53072	LACFCD 100-yr	WSAB Exist Cond	70.68	68.20	66.46	0.00	0.03	137.16		15500.00		12.64
Upper	53072	LACFCD 100-yr	WSAB Prop Cond	70.54	67.86		0.02	0.01	136.33		15500.00		13.14
Upper	53072	Proj Overtop Q	WSAB Exist Cond	72.65	69.89	67.78	0.00	0.03	141.30		19500.00		13.33
Upper	53072	Proj Overtop Q	WSAB Prop Cond	72.50	69.55		0.01	0.02	140.47		19500.00		13.78
Upper	53062 BR U	LACFCD 100-yr	WSAB Exist Cond	70.65	68.06	66.53	0.02	0.06	135.68		15500.00		12.92
Upper	53062 BR U	Proj Overtop Q	WSAB Exist Cond	72.62	69.75	67.83	0.02	0.08	139.81		19500.00		13.61
Upper	53062 BR D	LACFCD 100-yr	WSAB Exist Cond	70.57	67.77	66.50	0.00	0.05	132.04		15500.00		13.43
Upper	53062 BR D	Proj Overtop Q	WSAB Exist Cond	72.53	69.38	67.81	0.00	0.06	135.38		19500.00		14.23
Upper	53052	LACFCD 100-yr	WSAB Exist Cond	70.52	67.82		0.09	0.20	134.42		15500.00		13.19
Upper	53052	LACFCD 100-yr	WSAB Prop Cond	70.52	67.82		0.09	0.20	134.42		15500.00		13.19
Upper	53052	Proj Overtop Q	WSAB Exist Cond	72.47	69.44		0.09	0.18	137.77		19500.00		13.97
Upper	53052	Proj Overtop Q	WSAB Prop Cond	72.47	69.44		0.09	0.18	137.77		19500.00		13.97
Upper	52950	LACFCD 100-yr	WSAB Exist Cond	70.23	66.88	66.21	0.05	0.03	127.03		15500.00		14.70
Upper	52950	LACFCD 100-yr	WSAB Prop Cond	70.23	66.88	66.21	0.05	0.03	127.03		15500.00		14.70
Upper	52950	Proj Overtop Q	WSAB Exist Cond	72.20	68.55	67.61	0.05	0.03	133.72		19500.00		15.32
Upper	52950	Proj Overtop Q	WSAB Prop Cond	72.20	68.55	67.61	0.05	0.03	133.72		19500.00		15.32

Plan: WSAB Prop Cond San Gabriel Rive Upper RS: 53099 Profile: LACFCD 100-yr

E.G. US. (ft)	70.86	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	68.31	E.G. Elev (ft)	70.73	70.62
Q Total (cfs)	15500.00	W.S. Elev (ft)	67.77	67.78
Q Bridge (cfs)	15500.00	Crit W.S. (ft)	66.82	66.62
Q Weir (cfs)		Max Chl Dpth (ft)	12.05	12.19
Weir Sta Lft (ft)		Vel Total (ft/s)	13.80	13.52
Weir Sta Rgt (ft)		Flow Area (sq ft)	1123.07	1146.50
Weir Submerg		Froude # Chl	0.86	0.81
Weir Max Depth (ft)		Specif Force (cu ft)	12074.27	12073.69
Min El Weir Flow (ft)	77.41	Hydr Depth (ft)	8.09	8.56
Min El Prs (ft)	74.57	W.P. Total (ft)	164.02	160.53
Delta EG (ft)	0.32	Conv. Total (cfs)	462869.9	486003.5
Delta WS (ft)	0.46	Top Width (ft)	138.87	133.87
BR Open Area (sq ft)	2110.06	Frctn Loss (ft)	0.05	0.00
BR Open Vel (ft/s)	13.80	C & E Loss (ft)	0.06	0.08
Coef of Q		Shear Total (lb/sq ft)	0.48	0.45
Br Sel Method	Energy only	Power Total (lb/ft s)	0.00	0.00

HEC-RAS Output
Pier No. 1 Detailed Output

Plan: WSAB Prop Cond San Gabriel Rive Upper RS: 53160 Profile: LACFCD 100-yr

E.G. US. (ft)	71.23	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	68.63	E.G. Elev (ft)	71.19	70.87
Q Total (cfs)	15500.00	W.S. Elev (ft)	68.35	68.03
Q Bridge (cfs)	15500.00	Crit W.S. (ft)	66.98	66.92
Q Weir (cfs)		Max Chl Dpth (ft)	12.32	12.31
Weir Sta Lft (ft)		Vel Total (ft/s)	13.51	13.51
Weir Sta Rgt (ft)		Flow Area (sq ft)	1147.40	1147.39
Weir Submerg		Froude # Chl	0.80	0.83
Weir Max Depth (ft)		Specif Force (cu ft)	12227.91	12168.77
Min El Weir Flow (ft)	77.41	Hydr Depth (ft)	8.88	8.29
Min El Prs (ft)	74.57	W.P. Total (ft)	158.53	164.28
Delta EG (ft)	0.37	Conv. Total (cfs)	490711.5	479184.0
Delta WS (ft)	0.31	Top Width (ft)	129.17	138.42
BR Open Area (sq ft)	2058.18	Frctn Loss (ft)		
BR Open Vel (ft/s)	13.51	C & E Loss (ft)		
Coef of Q		Shear Total (lb/sq ft)	0.45	0.46
Br Sel Method	Momentum	Power Total (lb/ft s)	0.00	0.00

HEC-RAS Output
Pier No. 2 Detailed Output

APPENDIX D CONSTRUCTION RISK LEVEL CALCULATIONS

R-Value Calculation

National Pollutant Discharge Elimination System (NPDES)

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Rainfall Erosivity Factor Calculator for Small Construction Sites

EPA's stormwater regulations allow NPDES permitting authorities to waive NPDES permitting requirements for stormwater discharges from small construction sites if:

- the construction site disturbs less than five acres, and
- the rainfall erosivity factor ("R" in the revised universal soil loss equation, or RUSLE) value is less than five during the period of construction activity.

If your small construction project is located in an area where EPA is the permitting authority and your R factor is less than five, you qualify for a low erosivity waiver (LEW) from NPDES stormwater permitting. If your small construction project does not qualify for a waiver, then NPDES stormwater permit coverage is required. Follow the steps below to calculate your R-Factor.

LEW certifications are submitted through the NPDES eReporting Tool or "CGP-NeT". Several states that are authorized to implement the NPDES permitting program also accept LEWs. Check with your state NPDES permitting authority for more information.

- Submit your LEW through EPA's eReporting Tool
- List of states, Indian country, and territories where EPA is the permitting authority
- Construction Rainfall Erosivity Waiver Fact Sheet
- Appendix C of the 2017 CGP – Small Construction Waivers and Instructions

The R-factor calculation can also be integrated directly into custom applications using the R-Factor web service.

For questions or comments, email EPA's CGP staff at cgp@epa.gov.

Select the estimated start and end dates of construction by clicking the boxes and using the dropdown calendar.

The period of construction activity begins at initial earth disturbance and ends with final stabilization.

Construction duration based on direction from WSP (2023-2028).

Start Date: 01/01/2023 **End Date:** 01/01/2028

Locate your small construction project using the search box below or by clicking on the map.

Location: 34.0586, -118.2337 **Search**

+
—

Click the "Calculate R Factor" button below to calculate an R Factor for your small construction project.

Calculate R Factor

Approx coordinates for northern end of project

Facility Information

Start Date: 01/01/2023	**Latitude:** 34.0586
End Date: 01/01/2028	**Longitude:** -118.2337

Calculation Results

Northern End R-Value

Rainfall erosivity factor (R Factor) = **244**

A rainfall erosivity factor of 5.0 or greater has been calculated for your site's period of construction.

You do NOT qualify for a waiver from NPDES permitting requirements and must seek Construction General Permit (CGP) coverage. If you are located in an area where EPA is the permitting authority, you must submit a Notice of Intent (NOI) through the NPDES eReporting Tool (NeT).Otherwise, you must seek coverage under your state’s CGP.

Click the "Calculate R Factor" button below to calculate an R Factor for your small construction project.

Calculate R Factor

Approx coordinates for middle of project

Facility Information

Start Date: 01/01/2023	**Latitude:** 33.9368
End Date: 01/01/2028	**Longitude:** -118.1723

Calculation Results

Mid Project R-Value

Rainfall erosivity factor (R Factor) = **197**

A rainfall erosivity factor of 5.0 or greater has been calculated for your site's period of construction.

You do NOT qualify for a waiver from NPDES permitting requirements and must seek Construction General Permit (CGP) coverage. If you are located in an area where EPA is the permitting authority, you must submit a Notice of Intent (NOI) through the NPDES eReporting Tool (NeT).Otherwise, you must seek coverage under your state's CGP.

Click the "Calculate R Factor" button below to calculate an R Factor for your small construction project.

Calculate R Factor

Approx coordinates for southern end of project

Facility Information

Start Date: 01/01/2023	**Latitude:** 33.8588
End Date: 01/01/2028	**Longitude:** -118.0795

Calculation Results

Southern End R-Value

Rainfall erosivity factor (R Factor) = **183**

A rainfall erosivity factor of 5.0 or greater has been calculated for your site's period of construction.

You do NOT qualify for a waiver from NPDES permitting requirements and must seek Construction General Permit (CGP) coverage. If you are located in an area where EPA is the permitting authority, you must submit a Notice of Intent (NOI) through the NPDES eReporting Tool (NeT).Otherwise, you must seek coverage under your state's CGP.

K Factor

Data Source: State Water Resources Control Board
https://ftp.waterboards.ca.gov/#/swrcb/dwq/cgp/Risk/

LS Factor

Data Source: State Water Resources Control Board
https://ftp.waterboards.ca.gov/#/swrcb/dwq/cgp/Risk/

Sediment Risk Factor Worksheet	Entry
A) R Factor	
Analyses of data indicated that when factors other than rainfall are held constant, soil loss is directly proportional to a rainfall factor composed of total storm kinetic energy (E) times the maximum 30-min intensity (I30) (Wischmeier and Smith, 1958). The numerical value of R is the average annual sum of EI30 for storm events during a rainfall record of at least 22 years. "Isoerodent" maps were developed based on R values calculated for more than 1000 locations in the Western U.S. Refer to the link below to determine the R factor for the project site. https://lew.epa.gov/	
R Factor Value	244
B) K Factor (weighted average, by area, for all site soils)	
The soil-erodibility factor K represents: (1) susceptibility of soil or surface material to erosion, (2) transportability of the sediment, and (3) the amount and rate of runoff given a particular rainfall input, as measured under a standard condition. Fine-textured soils that are high in clay have low K values (about 0.05 to 0.15) because the particles are resistant to detachment. Coarse-textured soils, such as sandy soils, also have low K values (about 0.05 to 0.2) because of high infiltration resulting in low runoff even though these particles are easily detached. Medium-textured soils, such as a silt loam, have moderate K values (about 0.25 to 0.45) because they are moderately susceptible to particle detachment and they produce runoff at moderate rates. Soils having a high silt content are especially susceptible to erosion and have high K values, which can exceed 0.45 and can be as large as 0.65. Silt-size particles are easily detached and tend to crust, producing high rates and large volumes of runoff. Use Site-specific data must be submitted. Site-specific K factor guidance	
K Factor Value	0.32
C) LS Factor (weighted average, by area, for all slopes)	
The effect of topography on erosion is accounted for by the LS factor, which combines the effects of a hillslope-length factor, L, and a hillslope-gradient factor, S. Generally speaking, as hillslope length and/or hillslope gradient increase, soil loss increases. As hillslope length increases, total soil loss and soil loss per unit area increase due to the progressive accumulation of runoff in the downslope direction. As the hillslope gradient increases, the velocity and erosivity of runoff increases. Use the LS table located in separate tab of this spreadsheet to determine LS factors. Estimate the weighted LS for the site prior to construction. LS Table	
LS Factor Value	1.4
Watershed Erosion Estimate (=RxKxLS) in tons/acre	109.312
Site Sediment Risk Factor Low Sediment Risk: < 15 tons/acre Medium Sediment Risk: >=15 and <75 tons/acre High Sediment Risk: >= 75 tons/acre	**High**

Note: Sediment Risk Factor calculation only shown for northern end of project.
Northern end has highest R, K, and LS values, resulting in highest sediment risk.

Receiving Water (RW) Risk Factor Worksheet	Entry	Score
A. Watershed Characteristics	**yes/no**	
A.1. Does the disturbed area discharge (either directly or indirectly) to a **303(d)-listed waterbody impaired by sediment** (For help with impaired waterbodies please visit the link below) or has a **USEPA approved TMDL implementation plan for sediment**?: http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml **OR** A.2. Does the disturbed area discharge to a waterbody with designated beneficial uses of SPAWN & COLD & MIGRATORY? (For help please review the appropriate Regional Board Basin Plan) http://www.waterboards.ca.gov/waterboards_map.shtml	**no**	**Low**

Combined Risk Level Matrix

<table>
<tr><td colspan="2"></td><td colspan="3">Sediment Risk</td></tr>
<tr><td colspan="2"></td><td>Low</td><td>Medium</td><td>High</td></tr>
<tr><td rowspan="2">Receiving Water Risk</td><td>Low</td><td>Level 1</td><td colspan="2">Level 2</td></tr>
<tr><td>High</td><td colspan="2">Level 2</td><td>Level 3</td></tr>
</table>

Project Sediment Risk:	**High**
Project RW Risk:	**Low**
Project Combined Risk:	**Level 2**