SR 710 North Study

Engineering Document

Preliminary Drainage Report

Prepared for

Caltrans
CALIFORNIA DEPARTMENT OF TRANSPORTATION

Metro
Los Angeles County
Metropolitan Transportation Authority

August 8, 2014

Signature Page

This Preliminary Drainage Report has been prepared by CH2M HILL Engineers 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 recommendations, conclusions, and decisions are based:

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Acronyms and Abbreviations

°F	degrees Fahrenheit
BMP	best management practice
BRT	Bus Rapid Transit
BSW	biofiltration swale
Caltrans	California Department of Transportation
cfs	cubic feet per second
CMP	corrugated metal pipe
CSP	corrugated steel pipe
FHWA	Federal Highway Administration
ft/s	feet per second
ft^2	square foot (feet)
GSRD	gross solid removal devices
HGL	hydraulic grade line
HSG	hydrologic soil group
I	Interstate
LACDPW	Los Angeles County Department of Public Works
LID	low-impact development
LRT	Light Rail Transit
Metro	Los Angeles Metropolitan Transportation Authority
MVP	maintenance vehicle pull-out
RCB	reinforce concrete box
RCC	reinforced concrete channel
RCP	reinforced concrete pipe
STA	Station
SR	State Route
TBF	tree box filters
TDH	total dynamic head
TDM	Transportation Demand Management
TSM	Transportation System Management
WSE	water surface elevation
WSPG	Water Surface and Pressure Gradient Hydraulic Analysis System

SECTION 1

1 Introduction

1.1 Project Description

The Los Angeles Metropolitan Transportation Authority (Metro), in cooperation with the California Department of Transportation (Caltrans), proposes transportation improvements to improve mobility and relieve congestion in the area between State Route (SR) 2 and Interstates (I) 5, 10, 210, and 605 in east/northeast Los Angeles and the San Gabriel Valley. The study area is centrally located within the extended urbanized area of Southern California.

The purpose of the project is to effectively accommodate regional and local north-south travel demands in the study area of the western San Gabriel Valley and east/northeast Los Angeles, including the following considerations: (1) improve efficiency of the existing regional freeway and transit networks; (2) reduce congestion on local arterials adversely affected due to accommodating regional traffic volumes; and (3) minimize environmental impacts related to mobile sources. Multiple alternatives are considered, including the No Build Alternative, the Transportation System Management/Transportation Demand Management (TSM/TDM) Alternative, the Bus Rapid Transit (BRT) Alternative, the Light Rail Transit (LRT) Alternative, and the Freeway Alternative.

1.2 Objective

The construction of the project has optional impact on existing drainage systems. Impacted systems are studied, and mitigations are proposed. The objective of this drainage report is to describe and document the hydrologic and hydraulic conditions of the project site using established procedures and methodologies. This report also addresses the installation of treatment best management practices (BMPs) to meet water quality requirement of the watershed. Detailed hydrologic and hydraulic analyses of the affected drainage systems are presented in the appendices.

1.3 Projection Location

The Project locations are shown in Figures 1-1 to 1-4 for TSM/TDM, BRT, LRT, and Freeway Alternatives, respectively.

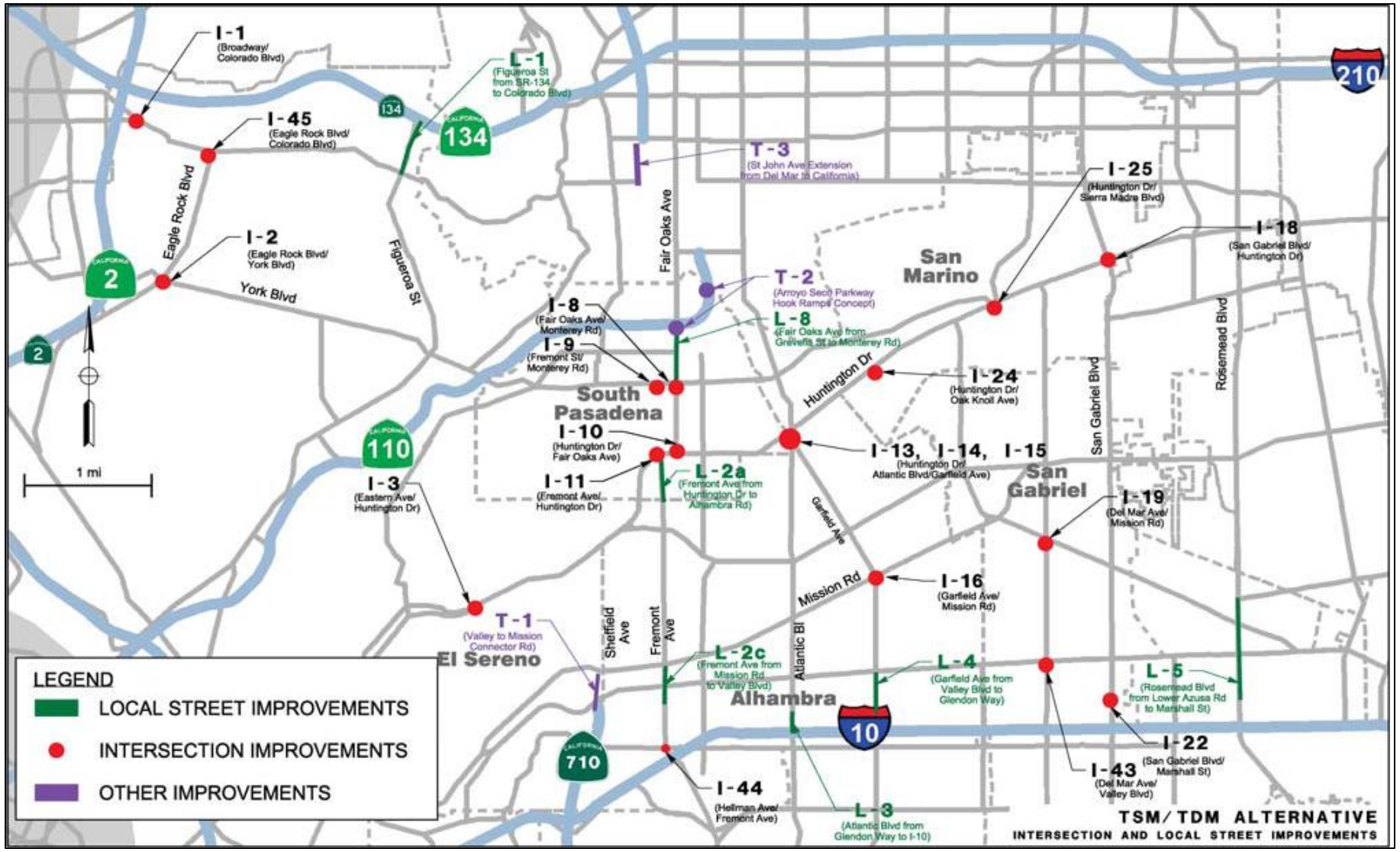

Figure 1-1 Location Map for TSM/TDM Alternative

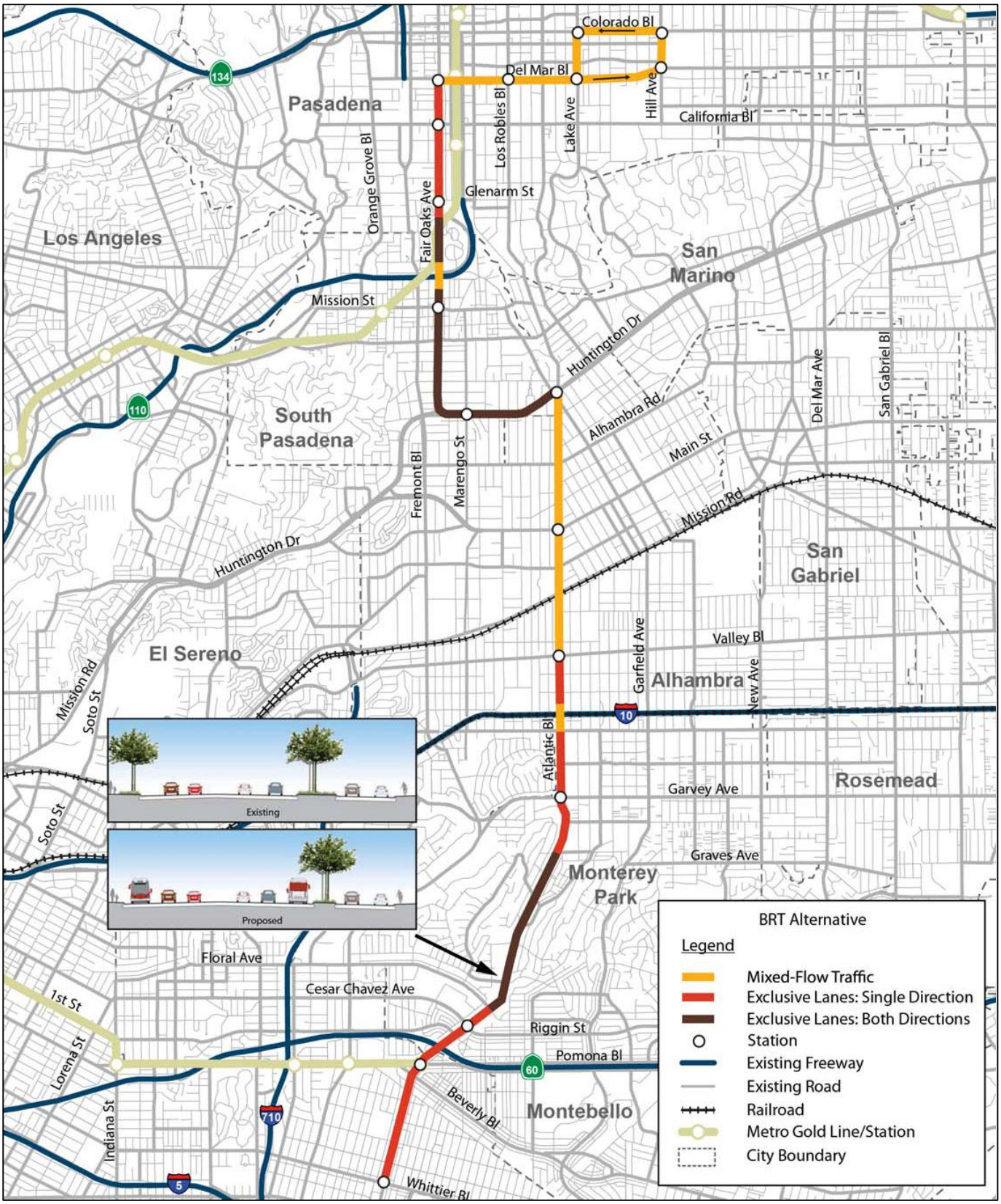

Figure 1-2 Location Map for BRT Alternative

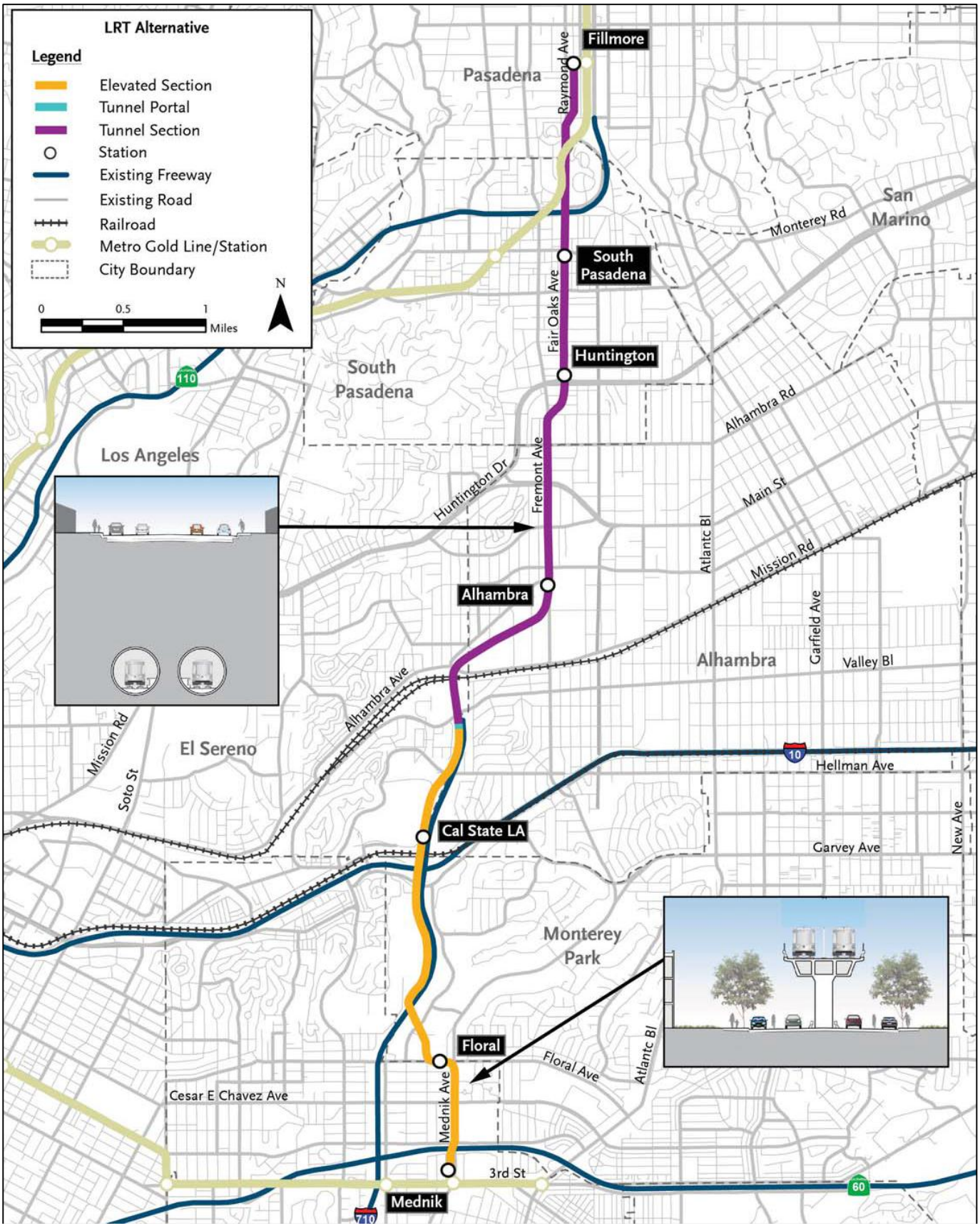

Figure 1-3 Location Map for LRT Alternative

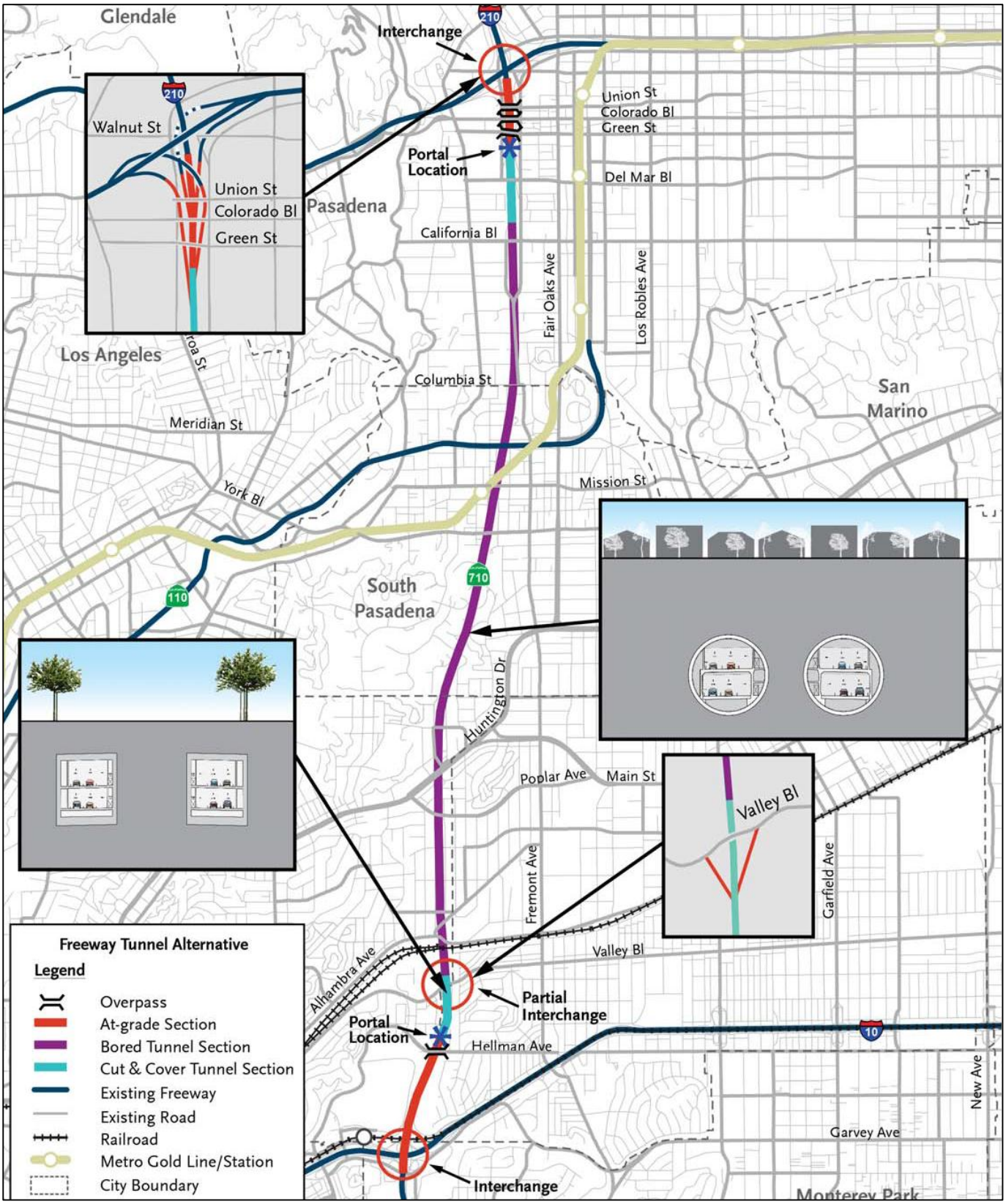

Figure 1-4 Location Map for Freeway Alternative

2 Existing Drainage Conditions and Facilities

2.1 TSM/TDM Alternative

TSM/TDM improvements spread at 35 local intersections, 7 local street segments, 2 street extensions, and 1 interchange improvement within the cities of Los Angeles, Pasadena, South Pasadena, Alhambra, San Gabriel, Rosemead, and San Marino.

Local intersections and local street segments are mainly located at local surface streets. Existing drainage systems include curb and gutters, curb opening inlets, laterals, and main trunk line pipes to County of Los Angeles storm drain systems.

The proposed T-1 Connector would begin at Valley Boulevard on the south and end at Mission Road on the north. It is located on a primarily vacant lot located within an urban and light industrial area of the City of Los Angeles. The main drainage system is Dorchester Avenue Storm Drain (Dorchester Channel), which consists of a double 9-foot (ft)-8-inch by 12-ft-9-inch reinforced concrete box (RCB) under cover section and 20-ft by 14-ft concrete channel. A 54-inch reinforced concrete pipe (RCP) and a 3-ft-6-inch by 3-ft semielliptical conduit are two major lateral of Dorchester Channel, primarily carrying street runoff from Mission Road. Other drainage systems are the existing natural swales on the western portion of the project site that direct runoff into storm drains in the low-lying areas.

The proposed T-2 Connector consists of two parts. At south part of the connector, a 63-inch RCP starts from Mound Avenue where it connects a 3-ft-3-inch by 4-ft RCB and a 36-inch vitrified brick storm drain, crosses I-110 eastbound off-ramp Grevelia Street, turns west to Fair Oaks Avenue, and runs southerly on Fair Oaks Avenue. Existing drainage systems also include curb & gutter, six curb opening inlets, two inlets, and varied sizes of laterals including 12-inch, 18-inch & 24-inch CMP and 21-inch RCP. At north site of the Connector, surface runoff from I-110 is collected by four inlets and 18-inch CMP laterals and drains to the existing Broadway Storm Drain.

The proposed T-3 Connector (St. John Avenue Extension) would begin at Del Mar Boulevard on the north and end at California Boulevard on the south. The alignment is located on a primarily vacant lot along the west of I-210 southbound. A sunken area and a pump station located at a parcel bounded by Del Mar Boulevard to the north, I-210 to the east and west, and California Boulevard to the south. A curb opening inlet located at each cul-de-sac of Palmetto Dr and Waverly Drive collects the street surface runoff and drains to the sunken area through existing 24-inch CSP laterals. Runoff from St. John Avenue and Del Mar Boulevard is collected into a 42-inch RCP then to an 84-inch RCP which drains to the sunken area as well.

2.2 BRT Alternative

Based on the topographic data provided by United States Geological Survey (USGS) quadrangles maps, the general terrain in the project vicinity slopes from north to south. Project alignment starts from Whittier Boulevard and ends at Del Mar Boulevard, crossing multiple city streets. Existing drainage systems include curbs, gutters, curb opening inlets, lateral pipes, and main trunk lines pipes to County storm drain systems.

2.3 LRT Alternative

The alignment of this alternative starts few hundred feet south of SR 60 on elevated deck, and ends in the tunnel near the California Boulevard. Existing drainage systems on the surface street include curbs, gutters, curb opening inlets, lateral pipes, main trunk lines pipes, and concrete channel to County storm drain systems.

2.4 Freeway Alternative

The existing SR 710 terminates at Valley Boulevard and started again near Del Mar Blvd. The proposed freeway alternative starts from the interchange of I-10 and SR 710, enters the tunnel at the south portal near Valley Blvd,

and exits the north portal near Del Mar Boulevard. From I-10 to Valley Boulevard, runoff from the freeway is carried by dikes and collected in inlets at shoulder. Several cross-culverts, ranging from 24 to 54 inches, carry runoff from east to west, to Dorchester Channel. This channel is a double 9-ft-8-inch-wide by 12-ft-9-inch-high RCB under cover section and 20-ft-wide by 14-ft-high concrete channel on open section. It runs parallel to the freeway and crosses the freeway from south of Hellman Avenue to Laguna Regulating Basin (the Basin). After the Basin, the water drains through several channel systems, mostly located within Caltrans right-of-way, and eventually the runoff drains to the Los Angeles River in the City of Vernon.

Between California Boulevard and Del Mar Boulevard, there is a sunken area and a pump station. Offsite runoff from the west drains to the sunken area through 24 to 30-inch downdrain pipe. As the terrain slopes from north to south, all runoff from north up to Mountain Street Bridge on I-210 drains to this sunken area. The portion of SR-134 near the I-210 interchange, I-210 to Fair Oaks Avenue Bridge, and surrounding residential/commercial areas drained to the sunken area as well. Two trunk line pipes ran parallel to SR 710. One 60-inch RCP is on the east and the other one is from 72- to 84-inch RCP on the west of SR 710. The pump station had an outlet 36-inch pipe connecting to 54-inch pipe draining to east on Del Mar Boulevard. An existing screen is at the pump station to remove trash in the runoff.

SECTION 3

3 Proposed Drainage Systems

3.1 Project Design Limits

The project limits vary based on different alternatives. Figures 1-1 to 1-4 present the design limits for each alternative. Proposed construction would include grading, paving, retaining walls, tunnels, bridges, drainage systems, pavement delineation, and traffic control devices.

3.2 Impacts on Existing Drainage Systems

Existing systems will either need to be extended and/or augmented in order to contain the required design flows within the project limits. These alternatives will impact several existing drainage systems and drainage features by removing, blocking, paving over, or interfering with these systems. These impacts may be minimized or avoided by the following:

- Relocation and extension of systems as necessary
- Additional catch basins, downdrains, or overside drains where required
- Abandonment of systems which are no longer serviceable

3.3 Proposed Drainage Systems

Major drainage design concepts in this project are described below. Where feasible, the drainage design would:

- Maintain existing offsite drainage flow patterns yet minimize the number of points at which cross-culverts must be constructed
- Contain, collect, and treat 100 percent of onsite water quality runoff using appropriately designed collection systems and BMPs
- Modify existing drainage facilities to be capable of handling any increased design flows as much as possible, given existing physical constraints
- Install pump stations to avoid flooding

Treatment BMPs would be provided to treat onsite runoff before discharging to corresponding receiving waters. Conceptual drainage and BMP plans are presented in Appendix F.

3.3.1 TSM/TDM Alternative

Most of local intersections and local street segments improvements would need signal control enhancement and restriping. There are no drainage impacts to this type of locations. About one dozen additional local intersections and local streets would be widened to provide more lanes. The widening will alter the existing flow line outside to the new proposed curb. The existing catch basins impacted by widening have to be relocated to the new curbs. Summary of TSM/TDM drainage impact and mitigation is presented in Appendix E.

The proposed T-1 Connector would increase the amount of impervious surfaces by approximately 2.25 acres. It is estimated that the increase of stormwater would be inconsequential. Runoff from the roadway would drain into gutters and be directed into curb opening catch basins. Laterals are proposed to collect runoff from the roadway, which would connect to the Dorchester Avenue storm drain. A 24-inch CSP is proposed to collect runoff from low point at east of connector and drain to existing swale which drains to Dorchester Channel. The connector road would travel beneath an underpass that would be constructed to carry the Union Pacific Railroad tracks on the north end of the project site. A portion of an existing 3-ft-6-inch by 3-ft elliptical conduit is in conflict with west side abutment of proposed underpass bridge and, thus, needs to be relocated. The realignment of SR 710 southbound makes a few inlets excessive and thus need to be abandoned. An existing 28-ft-wide curb opening catch basin at Alhambra Avenue needs to be relocated due to realignment of road curb line at proposed roundabout.

The proposed T-2 Connector would widen existing I-110 eastbound off-ramp and encroach into Grevelia Street. A retaining wall is proposed between existing I-110 eastbound off-ramp and Grevelia Street. The underneath 63-inch RCP underneath the proposed retaining wall is investigated, and it is estimated that the pipe has sufficient clearance under the wall foundation. A catch basin needs to be relocated due to I-110 eastbound off-ramp widening. North part of the T-2 improvements providing southbound hook on ramp on State Street would realign existing off-ramp and would impact an existing inlet which needs to be removed. An existing inlet on State Street would need to be relocated as well.

The proposed T-3 Connector (St. John Avenue Extension) would eliminate each cul-de-sac of Palmetto Drive and Waverly Drive, thus the curb opening catch basin at each location needs to be relocated to new curb lines. An existing inlet at St. John Avenue needs to be relocated to new curb line due to street widening. Future runoff would continue its existing flow patterns, thus the impacts would be less than significant.

3.3.2 BRT Alternative

The BRT Alternative would widen the existing street on both sides to add the bus lane in some locations. The maximum street widening is about 8 ft, except at some street intersection where extra right-turn lane is proposed. Most of the widening is to take some of sidewalk width. The widening will alter the existing flow line outside to the new proposed curb line. The existing catch basins impacted by widening will be relocated to the new curb line.

3.3.3 LRT Alternative

The LRT Alternative would have limited impact on the exiting drainage systems at the elevated segment and the underground tunnel. Deck drain will be installed on the elevated train deck near each column. A pipe inside the column drains water down to the street.

A pump will be installed at the low point of the tunnel near Station 181+45 to pump out any fire sprinkler or seepage water in the tunnel to the storage tank located under the parking lot in the train yard. In the train yard, underdrains are proposed under each track, and swales, catch basins, pipes are proposed to collect surface runoff within the train yard and drain to the Dorchester Channel on the west.

3.3.4 Freeway Alternative

3.3.4.1 Dual-Bore Tunnel Option

The regional Laguna Regulating Basin and Dorchester Channel are two major offsite drainage systems that will be impacted by the Project. The proposed I-710 widening would encroach horizontally into the west side of the Basin. The extent of the encroachment would be up to 20 ft wide and 700 ft long along the western boundary of the Basin. The encroachment would also affect the existing maintenance access road along the west side of the Basin.

The affected maintenance road for the Basin will be replaced by a new entrance and pull-out (maintenance vehicle pull-out [MVP]) area from the I-10/I-710 Connector. The encroaching portion of the roadway will be placed on a bridge structure to avoid reducing the storage volume of the Basin (see Appendix C). Furthermore, most of structure will be above the operation level of 381.00 ft. The construction and maintenance of the bridge need to cut some slope approximately to Elevations 375.8 to 380.7 ft. The excavation for the bridge structure would actually increase some basin storage volume.

Under the dual-bore Tunnel option, the proposed I-710 on-ramp would encroach into the Dorchester Channel. Including the new grading, it will affect about 728 ft at the southern end and about 267 ft at the northern end of the reinforced concrete channel (RCC). The affected RCC portion of Dorchester Channel will be changed into double 9.67- by 14-ft RCBs along the original channel alignment. The first box will start at about 59 ft north of Hellman Avenue and continue for 728 ft. The second box will begin 246 ft north of first box and continue for about 267 ft. The proposed channel layout is intended to minimize the hydraulic impact to the existing condition.

South Portal includes the surface portion and the cut and cover portion. Due to adding new lanes and the cut and cover construction, many inlets and pipes have to be removed to avoid the conflict. New inlets are proposed at the low points, before the super reversals and beginning of cut and cover locations. New crossing culverts are proposed to convey water from the east to the west. No new connection is proposed on the Dorchester Channel. The onsite systems convey all runoff from the high point near Hellman Avenue Bridge to the pump station near the Valley Boulevard. A pump station is proposed to pump water out to the Dorchester channel.

A sump pump is proposed at the low point of the tunnel (Station 1518+00) to collect fire sprinkler and seepage water inside the tunnel. A 16-inch discharge pipe is proposed between the wet well of the pump and a storage tank (60-ft length, 40-ft width, 26-ft depth) located under the parking lot of the Operation and Management Center, which is at the north of Valley Boulevard.

Due to the tunnel construction, the existing pump station and storage chamber at south of Del Mar Boulevard are relocated to the north side of Del Mar Boulevard. All offsite flow (west of I-710 and south of Del Mar Boulevard) that drains to this sump area is collected in a proposed swale and pipe, draining north to the trunk line (48-inch RCP) on Del Mar Boulevard. An 84-inch RCP on the west side of I-710 is rerouted to the east side, and joins a 60-inch RCP at Station 1743+00. From the confluence point, a 96-inch RCP runs south to the storage chamber of the relocated pump station. The pump station is designed to handle 50-year storm event for 324.8-acre drainage area. An outlet pipe connects to an existing 48-inch RCP on Del Mar Boulevard.

3.3.4.2 Single-Bore Tunnel Option

The Single-Bore Tunnel alternative has similar impact on existing drainage systems, but in lesser degree, because the project footprint is smaller than the dual-bore tunnel option. There will be no impact to Dorchester Channel. New inlets and pipes are proposed as needed, and the pump station and storage chamber at Del Mar Boulevard will be relocated. Same as in the dual-bore tunnel option, the sump pump in the tunnel has a 16-inch discharge pipe connecting to the storage tank under the parking area in the Operation and Management Center.

4 Hydrologic Analysis

4.1 Design Criteria

The hydrologic analysis is based on the design criteria outlined in the Caltrans Highway Design Manual (HDM) (Caltrans, 2000). The rainfall intensity in the Los Angeles County Hydrology Manual (2006) is used for onsite drainage areas. The most pertinent design criteria are summarized as follows:

- Drainage areas in the project vicinity are small (less than 640 acres). In accordance with the HDM, the Rational Method is used to determine all onsite design discharges. All hydrology calculations are performed using Los Angeles County's Tc Calculator.
- Project topographic maps are available for offsite hydrologic analysis. Adjacent offsite areas that would contribute runoff to proposed systems are included in the onsite hydrology.

4.2 Rainfall Characteristics

The project site has a Mediterranean-type climate 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, with summer daytime high temperatures averaging about 82 degrees Fahrenheit (°F), with overnight lows of 63 °F. Winter daytime high temperatures are up to around 63 °F on average, with overnight lows of 48 °F; during this season, rain is common. The average annual precipitation is approximately 15 inches.

Based on the Los Angeles County Hydrology Manual (2006), the 50-year 24-hour rainfall depth varies from 8.0 inches per year in the northern portion of the project (North portal of Freeway Tunnel) to 6.2 inches per year at the southern portion of the project.

4.3 Soil Types and Infiltration

The project area has a diverse geology. Quaternary-age alluvium occurs as narrow valley fill in the valleys of the Repetto Hills and over the entire San Gabriel Valley. Alluvium is present at the northern portion of the zone, where it is approximately 500 to 600 ft thick, and at the southern portion of the zone where it is much thinner (on the order of 0 to 50 ft). The central part of the project area is composed of the Puente and Topanga Formations separated by a fault on the north flank of the South Pasadena Anticline. The Topanga Formation occurs in the northern half of the project area. Information for the hydrologic soil group (HSG) is obtained from the Caltrans Soil Group Index Map. The soil is classified as HSG Type D soil throughout the project study area. Type D soils have low infiltration rates and poor-drained soils. These soils have a high runoff potential after saturation.

4.4 Land Use

Current land uses within the proposed project areas reflect a mixture of industrial, residential, open space, flood control, and urban use.

4.5 Runoff Coefficient

The pavements (including all of freeway main line, the ramps, and local streets within the project limits) are impervious pavements. Runoff coefficient is determined based on the land use. According to the Los Angeles County Hydrology Manual, runoff coefficient 0.91 is used for freeways and major roads. For residential area, runoff coefficient 0.55 is used for townhouses and 0.21 is used for low density single family community. For other vegetated area, runoff coefficient 0.02 is used. An effective C value is calculated based on the area-weighted method.

4.6 Summary of Results

Hydrology analysis is performed to properly size the pump stations for freeway alternative dual-bore option. It will be the worst case in a 50-year rain event. Tc Calculator is used to calculate Tc for each subarea and combined hydrograph is created. For other alternatives, no hydrology analysis is performed as the drainage impact is local and minimal.

4.3.1 South Portal Pump Station

The hydrology map for south portal pump station is presented in Exhibit A (Appendix B). TC calculation results are presented in Appendix B. The total drainage area for the pump station is 12.76 acres. The peak inflow Q_{50} is 28.7 cubic feet per second (cfs). Figure 4-1 is the 50-year, 24-hour hydrograph for the pump station at the South Portal.

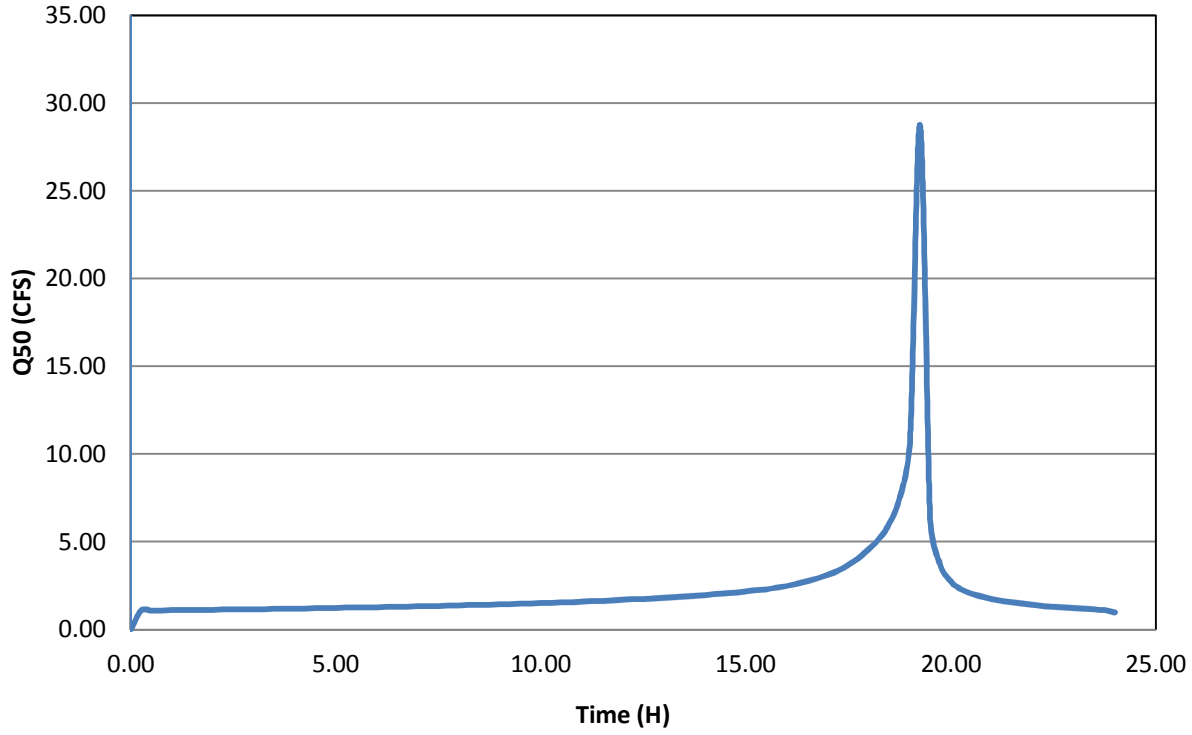

Figure 4-1 A 50-Year and 24-Hour Inflow Hydrograph for the South Portal Pump Station

4.3.2 North Portal Pump Station

The hydrology map for the north portal pump station is presented in Exhibit B (Appendix B). TC calculation results are presented in Appendix B. The total drainage area to the pump station is 324.8 acres. The peak inflow Q_{50} is 588.9 cfs. Figure 4-2 is the 50-year, 24-hour hydrograph for the pump station at the North Portal.

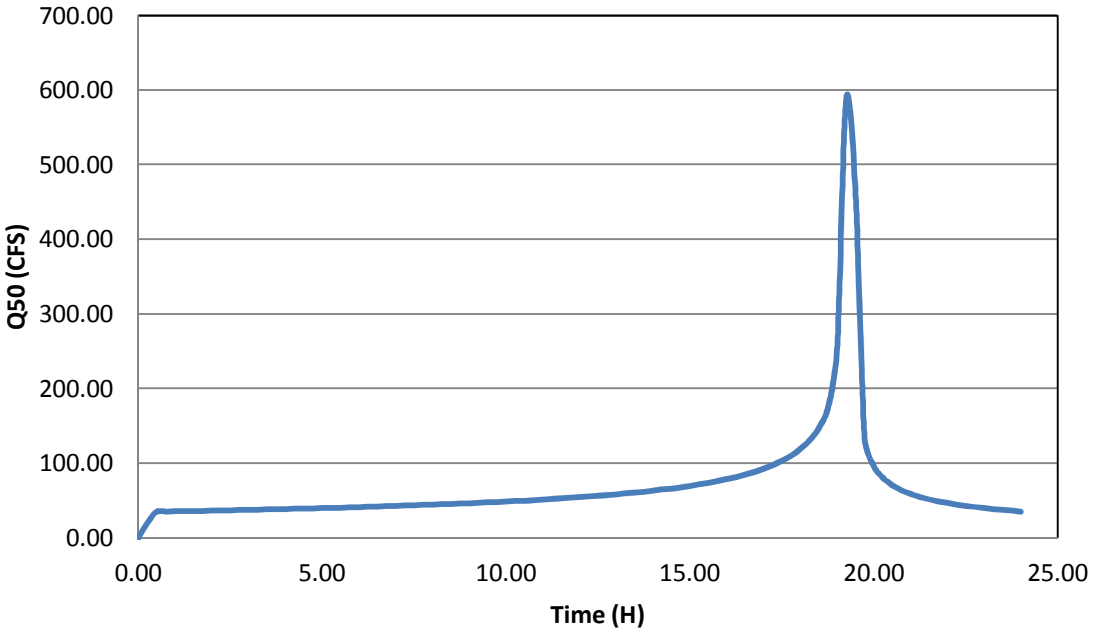

Figure 4-2 A 50-Year and 24-Hour Hydrograph for the North Portal Pump Station

4.3.3 Dorchester Channel and Laguna Regulating Basin

The size of Dorchester Channel varies from the beginning to the end (outlet to Laguna Regulating Basin). North of the Union Pacific Railroad, the channel splits into two parallel RCBs: Line A West and Line A East. Line A West is an 11- by 12.5-ft RCB, and Line A East is a 10.25- by 13.25-ft RCB. Available design documents indicate design flows of the channel main line (Line A) and Line A West at various locations. These design flows are summarized in Table 4-1. The system splits into Line A West and Line A East at the junction. Based on available hydrologic data, at the junction of Line A West and Line A East, a design flow of 2,813 (= 5,148-2,335) cfs is derived for Line A East. These data are used for the hydraulic analysis. The dominant inflow for this basin comes from the Dorchester Channel, with several other minor inflows from culverts draining the existing SR 710 and the surrounding neighborhoods.

TABLE 4-1
Dorchester Channel Design Flows (Capital Flood)

Channel Reach	Design Flow [cfs]
Main Line/Line A West	
@ Gravios (Hellman) Avenue	5,481
@ Bohlig Road	5,392
@ Valley Boulevard	5,339
@ Junction with Line A East (Upstream becomes Line A West)	5,148
@ Alhambra Avenue	2,335
Line A East	
Alhambra Avenue	2,813

Note:
Data extracted from microfilm design reports (LACDPW, 1955).
cfs = cubic feet per second

SECTION 5

5 Hydraulic Analysis

5.1 Design Criteria and Computation Procedures

Technical references include Urban Drainage Design Manual (HEC-22) (FHWA, 2009) and the Highway Design Manual (Caltrans, 2012). Storm drain systems are analyzed using the Los Angeles County Department of Public Works (LACDPW) software package, *Water Surface and Pressure Gradient Hydraulic Analysis System* (WSPG) (LACDPW, 2013). The program used for this project is the Windows version, modified by CivilDesign, Inc. (CivilDesign, 2000).

5.2 Summary of Results

No onsite inlet or storm drain hydraulic analyses are performed at the preliminary design phase. Inlets or pipes are relocated as needed for each alternative. Only major offsite drainage facilities are evaluated to address the impact and propose mitigation solutions. The hydraulic analysis for the basin and Dorchester Channel were presented in a technical memorandum and a Location Hydraulic Study (CH2M HILL, 2013 and 2014). Key discussions are summarized below.

5.3.1 Laguna Regulating Basin

5.3.1.1 Outlet Analysis

No stage-discharge curves are available from existing LACDPW data (CH2M HILL, 2013). The existing Basin outflow discharge is estimated based on as-built information and topographic elevation data. The maximum water surface elevation (WSE) is assumed to be the spillway crest at Elevation 381 ft (NAVD88). The Basin outlet is at Elevation 343.29 ft (NAVD88). Using the Basin contours, the Basin volume is estimated to be 290.6 acre-ft. At this WSE, the basin outlet would function under inlet-controlled conditions, with a peak flow capacity of about 3,500 cfs.

5.3.1.2 Drawdown Time

There are no published hydraulic data in the LACDPW records for the Dorchester Channel or Laguna Regulating Basin of flooding in the past. In the unlikely event that the Basin is full, it would take approximately 1.88 hours to drain the Basin empty or 0.66 hour to drain down to WSE 364.50 ft NAVD29 (or 366.92 ft NAVD88) when there is no major incoming flow to the Basin. This WSE is determined to be the maximum tail water elevation that would not cause hydraulic jump in Dorchester Channel or affect the flow capacity of the channel.

5.3.1.3 Flood Routing

Because drawdown occurs rapidly, the recurrence interval for this extreme peak-to-peak event is likely to be very high (greater than 100 years), which may explain why the Basin has no history of overflowing its spillway, and it has not caused an overflow in Dorchester Channel. In a normal hydrologic cycle, a peak-to-peak flood may come in a 24-hour interval. It will be a high probability that the channel peak flow would drain into a low WSE in the Basin. This preliminary study takes a decoupled approach, assuming the Basin has enough storage to attenuate the peak flood such that peak flow in Dorchester Channel will not arrive at the peak elevation at the Basin. Therefore, flood routing is irrelevant.

The available volume within the Laguna Regulating Basin for active flood storage is 290.6 acre-ft, between Elevation 343.3 ft and Elevation 381.0 ft. The encroaching portion of the roadway will be placed on a bridge structure to avoid reducing the storage volume of the Basin (see Figure 3 in Appendix C). This is not anticipated to affect the serviceability of this basin. Operation and maintenance of the Basin would be accomplished by providing a new MVP attached to the I-10/I-710 Connector, with a new access road into the Basin. An approximate method is applied to the 100-year floodplain for the purpose of addressing the project impacts. The Basin is estimated to have peak WSE of 381.0 ft without overtopping the spillway. In the proposed condition, the floodplain elevation in the Basin is not anticipated to change, although the floodplain limits may be modified

slightly due to additional excavation under the bridge structure. The floodplain impacts to the Basin are presented in Appendix C.

5.3.2 Dorchester Channel

5.3.2.1 Existing Conditions

The hydraulic models for the channel are created using As-Built drawings and the older NGVD29 datum. The models cover at least 2,700 ft upstream of the open channel and ended downstream at the Basin.

As discussed in the flood routing, it is reasonable to assume a tail water elevation within the Basin to be lower than Elevation 364.50 ft NGVD29 (or 366.92 ft NAVD88). Lower tail water is also technically necessary for the channel modeling because a higher WSE assumption would result in a hydraulic jump in the Dorchester Channel, causing the model to fail.

For the reach between the Hellman Avenue and Valley Boulevard crossings (Station 12+50 to Station 26+75), the water depths range from 9.95 to 10.92 ft, velocities from 24.63 to 27.12 ft per second (ft/s), and Froude Numbers from 1.51 to 1.30. Therefore, the existing channel maintains a supercritical flow to drain into the Basin when the WSE in the Basin WSE is not higher than Elevation 364.50 ft NGVD29 (or 366.92 ft NAVD88).

5.3.2.2 Proposed Conditions

As a result of widening of SR 710, multiple alternatives are considered that provided varying shapes of RCB sizes to cover the portion of the Dorchester Channel that would be impacted. Multiple alternatives are studied to minimize the hydraulic grade line (HGL) impacts. The result showed that a smaller RCB section (double 9.67 by 14 ft) with three openings would minimize adverse hydraulic impacts to the channel. This is because a larger section will cause more energy loss in the supercritical flow regime. The first box will start at about 59 ft north of the Hellman Avenue crossing and will extend upstream approximately 728 ft. The second box will begin 246 ft north of the first box and will extend approximately 267 ft. The proposed channel layout minimizes adverse hydraulic impacts. The maximum HGL impact of 2.11 ft would occur at Station 14+85.00, approximately 235 ft upstream of the Hellman Avenue crossing. Flow velocities decrease slightly due to extra energy loss within the RCB; however, the HGL would be contained with the channel. There would be no change in WSE in the upstream channel that is not altered, starting at Station 25+50, approximately 1,275 ft downstream of Valley Avenue crossing. Therefore, there would be no increase to flood risk to the upstream community. The hydraulic results are adjusted to the NAVD88 datum by adding 2.42 ft to the WSPG outputs and are summarized in Table 5-1.

TABLE 5-1
Summary of Hydraulics of the Dorchester Channel

	Proposed Condition		Existing Condition		
Cross Section	**WSE (ft)**	**Channel Velocity (ft/s)**	**WSE (ft)**	**Channel Velocity (ft/s)**	**WSE Difference (ft)**
At Laguna Regulating Basin					
491.00	366.27	23.57	366.18	23.75	0.09
517.00	366.48	23.57	366.37	23.79	0.11
544.03	366.71	23.57	366.59	23.80	0.12
916.00	369.94	23.22	369.35	24.34	0.56
1078.00	371.53	22.75	370.50	24.79	1.03
1088.00	371.08	23.61	370.25	25.38	0.83
1153.80	371.64	23.60	370.67	25.68	0.97
1173.80	371.80	23.59	370.79	25.78	1.01
1250.00	372.44	23.57	371.25	26.19	1.19
End Hellman Avenue RCB Crossing					
1250.00	371.34	25.09	370.52	27.14	0.82
1279.74	371.67	24.91	370.78	27.11	0.89
1309.00	371.99	24.78	371.03	27.07	0.96
1309.00	**373.07**	**23.29**	**371.03**	**27.07**	**2.04**
1398.74	**373.88**	**23.15**	**371.82**	**26.94**	**2.06**
1485.00	**374.69**	**22.95**	**372.58**	**26.80**	**2.12**
1505.00	**374.44**	**23.63**	**372.57**	**27.12**	**1.87**
1754.09	**376.42**	**23.74**	**374.75**	**26.75**	**1.68**
2013.40	**378.41**	**24.03**	**377.12**	**26.11**	**1.29**
2037.00	**378.58**	**24.06**	**377.35**	**25.52**	**1.24**
2037.00	377.59	25.42	377.35	25.52	0.25
2190.00	379.25	24.49	378.84	25.43	0.41
2220.00	379.25	24.90	378.86	25.85	0.40
2264.53	379.75	24.61	379.29	25.68	0.46
2283.00	379.96	24.47	379.50	24.78	0.46
2283.00	**381.10**	**22.95**	**379.50**	**24.78**	**1.60**
2333.00	**381.59**	**22.79**	**380.01**	**25.05**	**1.58**
2450.00	**382.98**	**22.02**	**381.24**	**24.68**	**1.75**
2482.31	**382.29**	**23.59**	**381.09**	**25.39**	**1.20**
2550.00	**382.83**	**23.61**	**381.79**	**25.05**	**1.04**
2550.00	381.79	25.05	381.79	25.05	0.00
2625.00	382.61	24.58	382.61	24.58	0.00
2675.00	382.88	24.63	382.88	24.63	0.00
Begin Valley Boulevard RCB Crossing					
2675.00	383.77	23.45	383.77	23.45	0.00
2780.00	384.15	24.12	384.15	24.12	0.00
2790.00	383.75	24.95	383.75	24.95	0.00

Notes: ft = foot/feet ft/s = feet per second
RCB = reinforced concrete box WSE = water surface elevation
Bold sections indicate where concrete channel sections are replaced by RCB

SECTION 6

6 Pump Stations

This section discusses the stormwater drain pumping system and facility design, including pumping system capacity, facility layout, and pump selection for Freeway and LRT Alternatives. For the single-bore tunnel option in the Freeway Alternative, we conservatively assume the pump station serves the same drainage area as the dual-bore tunnel option.

6.1 North Portal Pump Station

6.1.1 Outflow Capacity

The storm drain pump station design (capacity, number of pumps, chamber storage volume) will be primarily driven by the estimated design 50-year peak flow of 588.9 cfs. As in the existing condition, the stormwater will be discharged to a local 48-inch drainage system and the total dynamic head is estimated at about 80 ft. The pump outflow is limited by the capacity of the existing 48-inch stormwater line, which is estimated at maximum of 55.5 cfs. The pump station will be designed for the most economical combination of retention capacity, number of pumps, and pump capacity to meet the low-flow and peak-flow requirement.

6.1.2 Storage Chamber

For the north portal pump station, an underground storage chamber is proposed to store the excess flow so that the maximum outflow will match the existing outflow capacity. The maximum flow rate is determined to be 55.5 cfs. The proposed underground storage chamber is located at the north of Del Mar Boulevard and between the freeway and Pasadena Avenue. This storage chamber is to replace the existing sump basin between California Boulevard and Del Mar Boulevard. The storage chamber is designed to detent 50-year, 24-hour rainfall event with maximum outflow 55.5 cfs, which is controlled by the pump station. Basin Routing is performed by PCSWMM program (CHI, 2012). The result indicates that the chamber size is approximately 792 ft long X 110 ft wide X 30 ft high. The storage chamber routing is presented in Appendix D.

6.1.3 Station Layout

The pump station is located at Station 1740+00, between the freeway and the Pasadena Avenue. The pump station profile is shown in the Appendix D. A rectangular concrete chamber is proposed for the pump station. The pump cycling time is 15 minutes or longer (cycles 4 times or less). The chamber storage capacity, pump size, and pump cycling time will be optimized to minimize the construction cost.

The proposed preliminary storage chamber size is 792 ft long X 110 ft wide X 30 ft deep with a transition section, a trash bar screen, access stairs and platforms, and access hatches.

The pump station layout is to place the chamber, electrical transformer, metering pad, and backup generator along the freeway within the cut and cover area. The pump room will be constructed outside next to Pasadena Avenue for maintenance access to the pump station and appurtenance equipment. The chamber will include bar screens and a recessed area for a smaller sump pump to drain the chamber during periods of dry weather. Vertical turbine pumps will be used as the basis for the pump station design; however, other pump types may be feasible.

A utility water supply with back flow preventer will be provided for this pump station and a hose bib shall be installed near the sump next to the small submersible pumps for wash down, cleaning, and maintenance.

6.1.4 Pump Selection

Generally, the minimum number of pumps required (excluding the sump pump) is three. That will cover the total flow range up to the peak flow. It is desirable to have identical pumps so that maximum use of each pump can be obtained. Three vertical pumps and one small submersible pump are proposed for this pump station. The main vertical pumps are proposed for handling the normal and high flow conditions, and the one small submersible

pumps is used for draining of the wetwell. Each of the high flow pumps will be sized for 8,300 gpm (18.5 cfs). The pump total dynamic head (TDH) is estimated about 80 ft. The high flow pump discharges will be piped individually to the stormwater discharge box (in-line with the stormwater drain conduit) due to the short distance from the pump station to the stormwater conduit. The discharge pipes will be equipped with flap valves. The smaller submersible pump will convey the dry-weather flow or the water quality flow to a biofiltration swale for stormwater treatment. It is sized for approximately 2,765 gpm (6.16 cfs) total capacity. To cover all flow ranges, three small submersible pumps are selected for this application. Table 6-1 summaries the pump selection.

TABLE 6-1
Pump Selection of North Portal Pump Station

Description	Qty	Pump Type	Capacity Each (gpm)	TDH (ft)	HP
Main pump	3	Vertical, mixed flow	8,300	80	250
Sump pump	3	Submersible	925	85	40

6.2 South Portal Pump Station Design

6.2.1 Pump Capacity

The storm drain pump station design (capacity, number of pumps, wetwell storage volume) will be primarily driven by the estimated design 50-year peak flow of 28.7 cfs. It is assumed that the stormwater can be discharged to Dorchester Channel, and the total dynamic head is estimated at about 70 ft. The pump station will be designed for the most economical combination of retention capacity, number of pumps, and pump capacity to meet the low-flow and peak-flow requirement.

6.2.2 Pump Station Layout

The pump Station is located at Station1450+00, between the tunnel and the V-3 on-ramp. A rectangular concrete wetwell is proposed for the pump station. It provides the most favorable conditions for flow into and through the wetwell for pumps and meet the Hydraulic Institute Standard. The pump cycling time to be 15 minutes or longer (cycles 4 times or less). The wetwell storage capacity, pump size, and pump cycling time will be optimized to minimize the construction cost.

The proposed preliminary wetwell size is 20 ft wide by 40 ft long by 76 ft deep with a transition section, a trash bar screen, access stairs and platforms, and access hatches.

The pump station layout is to place the wetwell, electrical transformer, metering pad, and backup generator along the freeway within the cut and cover area, outside the tunnel boring. The pump room will be constructed outside of the southbound traffic lanes for maintenance access to the pump station and appurtenance equipment. The wetwell will include bar screens and a recessed area for a smaller sump pump to drain the wetwell during periods of dry weather. Vertical turbine pumps will be used as the basis for the pump station design; however, other pump types may be feasible.

A utility water supply with backflow preventer will be provided for this pump station, and a hose bib shall be installed near the sump next to the small submersible pumps for wash down, cleaning, and maintenance.

6.2.3 Pump Selection

Generally, the minimum number of pumps required (excluding the sump pump) is three. That will cover the total flow range up to the peak flow. Due to the pump station size, two main vertical pumps are selected instead of three. It is desirable to have identical pumps so that maximum use of each pump can be obtained. Two vertical pumps and one small submersible pump are proposed for this pump station. The main vertical pumps are proposed for handling the normal and high-flow conditions, and the one small submersible pumps is used for draining of the wetwell. Each of the high flow pumps will be sized for 7,100 gpm (14.5 cfs). The pump total TDH is estimated about 44 ft. The high-flow pump discharges will be piped individually to the stormwater discharge box

(in-line with the stormwater drain conduit) due to the short distance from the pump station to the stormwater conduit. The discharge pipes will be equipped with flap valves. The smaller submersible pump will convey the dry-weather flow or the water quality flow to a biofiltration swale for stormwater treatment. It is sized for approximately 900 gpm (2.01 cfs) total capacity. Table 6-2 summaries the pump selection.

TABLE 6-2
Pump Selection of South Portal Pump Station

Description	Qty	Pump Type	Capacity Each (gpm)	TDH (ft)	HP
Main pump	2	Vertical, mixed flow	7,100	70	200
Sump pump	1	Submersible	900	70	30

6.3 Freeway Tunnel Pump Station

6.3.1 Pump Capacity

Figure 6-1 presents the conceptual dual-bore tunnel drainage. This Tunnel Pump Station will be constructed at the tunnel low point. The pump station will pump water that collects in a wetwell to a local water storage system, and then the water will be treated offsite before being discharged. Inlets located along the lower side of both the northbound and the southbound tunnel roadways will collect road runoff and convey it into a steel pipe running beneath the lower roadway within the tunnel. Stormwater will be collected and conveyed to the stormwater pump stations. Therefore, the tunnel roadways will normally generate little or no runoff, except during periods of tunnel washing or tunnel fire. The tunnel drainpipe will also convey the minor amounts of tunnel seepage (generated on a continuous basis), draining it to the sump. Among the possible water sources, the design flow will be the fire sprinklers and fire hydrant. Based on Section 4 Fire Life Safety Systems of "Tunnel System Report for the Freeway Tunnel Alternative, SR 710 North Study", two fire-fighting water sources will be considered. One is Fixed Fire Fighting System (FFFS) which generates 2,000 gpm for 60 minutes; and the other is a standpipe and hose system which generates 500 gpm for 60 minutes. So the total flow is 2,500 gpm for 60 minutes.

6.3.2 Pump Station Layout

The Pump Station is located at Station 1518+00 between two tunnel structures. A pump station profile is shown in Appendix D. A storage tank (35 ft long X 35 ft wide W X 23 ft deep) is proposed underneath the parking lot of the OMC building. A 16-inch discharge pipe will connect the pump station and the storage tank. A rectangular concrete wetwell is proposed for the pump station. It will be designed with the most favorable conditions for flow into and through the wetwell for pumps and meet the Hydraulic Institute Standard. The wetwell is sized for maximum water elevation in the collection system to be 2 ft below the lowest surface of the collection system inlets and pump cycling time to be 15 minutes or longer (cycles 4 times or less). The wetwell storage capacity, pump size, and pump cycling time will be optimized to minimize the construction cost.

The proposed preliminary wetwell size is 20 ft long by 12 ft wide by 15 ft deep with a transition section, a trash bar screen, access stairs and platforms, and access hatches.

The pump station layout is to place the wetwell, electrical transformer, metering pad, and backup generator at the low point recessed area in the middle of south and north bound tunnels. The pump room will be constructed at the road surface elevation for maintenance access to the pump station and appurtenance equipment. The wetwell will include a recessed area for a smaller sump pump to drain the wetwell. Submersible pumps will be used as the basis for the pump station design; however, other pump types may be feasible.

A utility water supply with back flow preventer will be provided for this pump station, and a hose bib shall be installed near the sump next to the small submersible pumps for wash down, cleaning, and maintenance.

6.3.3 Pump Selection

Generally, the minimum number of pumps required (excluding the sump pump) is three, to cover the total flow range up to the peak flow. Due to the pump station size, two main pumps are selected instead of three. It is desirable to have identical pumps so that maximum use of each pump can be obtained. Two submersible pumps and one small submersible pump are proposed for this pump station. The main submersible pumps are proposed for handling the normal and high flow conditions, and the one small submersible pumps is used for draining of the wetwell. Each of the high-flow pumps will be sized for 1,500 gpm. The pump total TDH is estimated about 200 ft. The high flow pump discharges will be piped to 16-inch header pipe and convey the water along the bottom of the tunnel to the to a surface storage tank for future treatment. The smaller submersible pump will drain the pump station wetwell after the fire testing or fire event, also drain the tunnel seepage. They can also be used for very low-flow event with long lasting period, if it is desired. It is sized for approximately 300 gpm (0.61 cfs) Pump Selection table (Table 6-3).

TABLE 6-3
Pump Selection for Freeway Tunnel Pump Station

Description	Qty	Pump Type	Capacity Each (gpm)	TDH (ft)	HP
Main pump	2	Submersible	1,500	200	125
Sump pump	1	Submersible	300	200	25

6.4 LRT Tunnel Pump Station

6.4.1 Pump Capacity

This Low Point Pump Station will be constructed at the tunnel low point. The pump station will pump water that collects in a wetwell to a local water storage system, and then the water will treated for discharge. Inlets located along the lower side of both the northbound and the southbound tunnel will collect track runoff and convey it into a steel pipe within the tunnel. Stormwater will be collected a short distance inside the tunnel and conveyed to the stormwater pump stations. Therefore, the tunnel will normally generate little or no runoff, except during periods of tunnel washing or tunnel fire suppression system testing. The tunnel drainpipe will also convey the minor amounts of tunnel seepage (generated on a continuous basis), draining it to the sump. Among the possible water sources, the design flow will be the fire sprinklers and fire hydrant from the LRT station. Each station has approximately 400 ft long with 25 ft wide platform. It is assume that maximum fire sprinkler zone is half of the platform area or 200 ft X 25 ft. A fire zone of 5,000 ft^2 and density of 0.16 gpm/ft^2 for Ordinary Hazard Group 2 are used for calculating the fire water flow rate. The fire sprinkler water flow rate will be 800 gpm, plus another 250 gpm for standpipe. So the total maximum flow is estimated at 1,050 gpm. The duration of fire is assumed 60 minutes.

6.4.2 Pump Station Layout

The Pump Station is located at Station 181+40, outside the tunnel structure. A storage tank (24 ft long X 24 ft wide X 25 ft deep) is proposed underneath the parking lot of the train yard. 10-inch by 150-ft discharge pipe connected the pump station and the storage tank. A rectangular concrete wetwell is proposed for the pump station. It will be designed with the most favorable conditions for flow into and through the wetwell for pumps and meet the Hydraulic Institute Standard. The wetwell is sized for maximum water elevation in the collection system to be 2 ft below the lowest surface of the collection system inlets and pump cycling time to be 15 minutes or longer (cycles 4 times or less). The wetwell storage capacity, pump size, and pump cycling time will be optimized to minimize the construction cost.

The proposed preliminary wetwell size is 12 ft long by 8 ft wide by 15 ft deep with a transition section, access stairs and platforms, and access hatches.

The pump station layout is to place the wetwell, electrical transformer, metering pad, and backup generator at the low point recessed area in the middle of south and north bound tunnels. The pump room will be constructed at the track surface elevation for maintenance access to the pump station and appurtenance equipment. The wetwell will include a recessed area for a smaller sump pump to drain the wetwell. Submersible pumps will be used as the basis for the pump station design; however, other pump types may be feasible.

A utility water supply with back flow preventer will be provided for this pump station, and a hose bib shall be installed near the sump next to the small submersible pumps for wash down, cleaning, and maintenance.

6.4.3 Pump Selection

Due to the pump station size, two main pumps will be used. It is desirable to have identical pumps so that maximum use of each pump can be obtained. Two submersible pumps and one small submersible pump are proposed for this pump station. The main submersible pumps are proposed for handling the normal and high-flow conditions and the one small submersible pumps is used for draining of the wetwell. Each of the high-flow pumps will be sized for 600 gpm. The pump total TDH is estimated about 105 ft. The high-flow pump discharges will be piped to 10-inch header pipe and convey the water along the bottom of the tunnel to the to a surface storage tank for future treatment. The smaller submersible pump will drain the pump station wetwell after the fire testing or fire event, also drain the tunnel seepage. They can also be used for very low-flow events with long-lasting durations, if desired. It is sized for approximately 300 gpm (0.61 cfs) Pump Selection table (Table 6-4)

TABLE 6-4
Pump Selection for LRT Tunnel Pump Station

Description	Qty	Pump Type	Capacity Each (gpm)	TDH (ft/s)	HP
Main pump	2	Submersible	600	105	30
Sump pump	1	Submersible	300	105	15

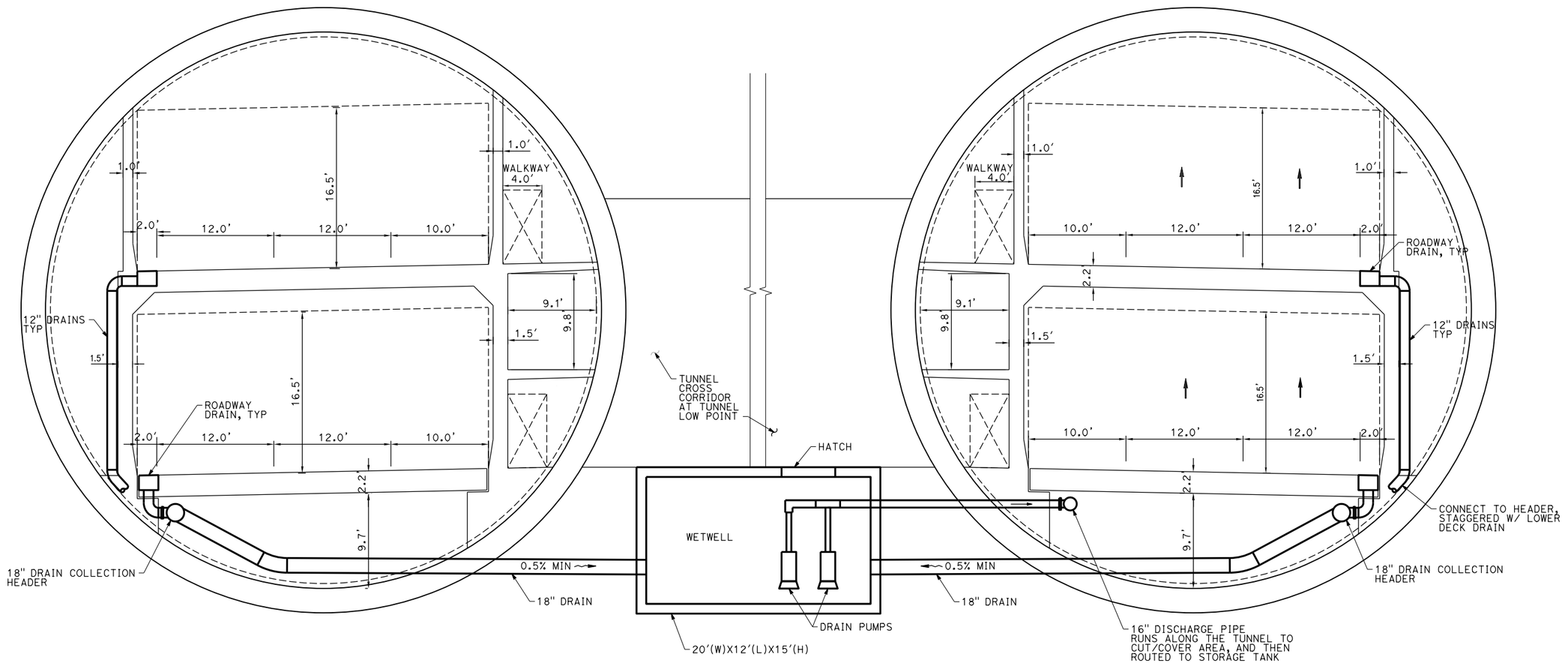

Figure 6-1

CONCEPTUAL DUAL BORE TUNNEL DRAINAGE

1"=20'

SR-710 NORTH STUDY

VERSION: 10-31-13
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SECTION 7

7 Water Quality Treatment BMP

Treatment BMPs are measures designed to remove pollutants from stormwater runoff prior to discharging (directly or indirectly) to receiving water bodies. The Treatment BMP strategy is to consider the existing site constraints and determine the feasibility of BMP implementation at the site-specific location. The goal is for the BMPs to retain and treat the paved area runoff to the maximum extent practicable.

7.1 Water Quality Design Storm

BMP design depends on the amount of runoff expected, which is affected by the location, land use, drainage area, storm intensity, topography, soil characteristics, and the extent of impervious areas. Both storm volume and peak flow conditions must be considered in the evaluation of runoff conditions. The *Design Storm* is the particular event that generates runoff rates or volumes that the drainage facilities are designed to handle. Treatment BMPs are designed to treat the flow of more frequent storm events.

The volume of flows associated with the frequent events is commonly referred to as the water quality volume for BMP designs based on volume, and the water quality flow for BMP designs based on flow. The water quality volume is calculated based on the water quality depth 0.75 inch, and water quality flow was determined according to the intensity 0.2 inch per hour predetermined by the Los Angeles Regional Water Quality Control Board.

7.2 Proposed BMPs

The treatment BMP strategy for each alternative is to consider the site constraints and determine the feasibility of BMP implementation at the site-specific location. The goal is for the BMPs to retain and treat the paved area runoff to the maximum extent practicable. Each BMP is evaluated individually in accordance with the guidelines provided in the Project Planning and Design Guide (PPDG) (Caltrans, 2010), and Water Quality Management Plan for Los Angeles River region. According to the current Caltrans National Pollutant Discharge Elimination System permit, the strategy is to first evaluate Treatment BMPs that infiltrate, harvest and reuse, and/or evapotranspire the stormwater runoff, followed by BMPs that capture and treat the runoff. Where the entire runoff volume from an 85th percentile 24-hour storm event cannot be infiltrated, harvested and reused, or evapotranspired, the excess volume may be treated by low-impact development (LID)-based flow-through treatment devices. Where LID-based flow-through treatment devices are not feasible, the excess volume may be treated through conventional volume-based or flow-based stormwater treatment devices.

For Freeway Alternatives, only Caltrans-approved BMPs are considered. For other alternatives, tree box filter (TBF) and the catch basin screen and curb inlet filter assembly (CB Screen & Insert) are considered where it's feasible. The flow-through modular treatment system, (i.e., TBF) has a demonstrated efficiency at least equivalent to a sand filter. The sizing of the flow-through devices is based on a rainfall intensity of 0.2 inch per hour. Tree box filters are proposed at new catch basins where the sidewalk width is at least 7 ft wide. This criterion is required to maintain enough clearance to meet American with Disability Act standards.

Locations with a new inlet where the sidewalk is less than 7 ft will have a CB Screen & Insert. The CB screen will be installed at the curb opening to screen for trash. The curb inlet filter assembly will have a filter liner and support basket for sediment removal and also an absorbent pouch to remove oil and grease. Areas tributary to the catch basin screens and filter inserts are not included in the treatment area calculation. The CB Screen & Insert does not have a demonstrated efficiency at least equivalent to a sand filter, and are proposed where other treatment devices are technically infeasible.

For TSM/TDM alternative, 1 Biofiltration Swale (BSW), and 18 TBFs are proposed at various locations (Table 7-1). For BRT alternative, 1 BSW, 28 CB Screens and Inserts, and 48 TBFs are proposed at various locations (Table 7-2). For LRT alternative, 4 BSW, 2 Media Filters, 10 TBFs, and 3 Bioretentions are proposed at various locations (Table 7-3). For Freeway Tunnel dual-bore alternative, 4 BSW, and 2 Gross Solid Removal Devices (GSRD) are proposed

at various locations. For Freeway Tunnel single-bore alternative, 3 BSWs, and 2 GSRDs are proposed at various locations (Table 7-4). Proposed BMPs for each alternative is presented on Conceptual Drainage Plans (Appendix F). BSW calculation is presented in Appendix E.

TABLE 7-1
Summary of TSM/TDM Proposed BMPs

ID	Location	TREATED AREA (AC)	BMP Type
TBF T1a	W OF T-1 CONNECTOR STA 36+90	0.16	TBF
TBF T1b	E OF T-1 CONNECTOR STA 36+90	0.10	TBF
TBF T1c	W OF T-1 CONNECTOR STA 43+40	0.65	TBF
TBF T1d	W OF T-1 CONNECTOR STA 43+60	0.47	TBF
TBF T1e	E OF T-1 CONNECTOR STA 43+40	0.59	TBF
TBF T1f	E OF T-1 CONNECTOR STA 43+60	0.87	TBF
TBF T1g	ALHAMBRA AVE STA 11+00	0.88	TBF
TBF I22a	SE OF SAN GABRIEL BLVD/MARSHALL ST	0.35	TBF
TBF I5a	SE OF VALLEY BLVD/SR-710 NB	0.25	TBF
TBF I10a	MEDIAN OF FAIR OAKS AVE/HUNTINGTON DR	0.17	TBF
TBF I19a	NW OF FREMONT AVE/MONTEREY RD	0.23	TBF
TBF I40a	NW OF ROSEMEAD BLVD/MARSHALL ST	0.84	TBF
TBF I40b	NE OF ROSEMEAD BLVD/MARSHALL ST	0.97	TBF
TBF L5a	NW OF ROSEMEAD BLVD/RALPH ST	0.36	TBF
TBF L5b	NE OF ROSEMEAD BLVD/RALPH ST	1.40	TBF
TBF L5c	NW OF ROSEMEAD BLVD/GUESS ST	0.39	TBF
TBF L5d	NW OF ROSEMEAD BLVD/NAVADA ST	0.57	TBF
TBF I20a	NW OF ROSEMEAD BLVD/MISSION DR	1.59	TBF
BSW 34	110 ON RAMP	0.99	BSW

TABLE 7-2
Summary of BRT Proposed BMPs

ID	Location	TREATED AREA (AC)	BMP type
N/A	ATLANTIC BLVD STA 10+97	0.82	SCREEN & INSERT
N/A	ATLANTIC BLVD STA 11+06	0.85	SCREEN & INSERT
N/A	ATLANTIC BLVD STA 18+78	0.89	SCREEN & INSERT
TBF 1891	ATLANTIC BLVD STA 18+91	0.93	TBF
N/A	ATLANTIC BLVD STA 27+30	0.89	SCREEN & INSERT
TBF 2743	ATLANTIC BLVD STA 27+43	0.95	TBF
N/A	ATLANTIC BLVD STA 35+86	0.87	SCREEN & INSERT
TBF 3598	ATLANTIC BLVD STA 35+98	0.63	TBF
TBF 4434	ATLANTIC BLVD STA 44+34	0.45	TBF
BSW 7309	ATLANTIC BLVD STA 73+09	1.97	BSW
N/A	ATLANTIC BLVD STA 81+24	0.43	SCREEN & INSERT
TBF 8129	ATLANTIC BLVD STA 81+29	0.41	TBF
N/A	ATLANTIC BLVD STA 84+35	0.08	SCREEN & INSERT
TBF 8504	ATLANTIC BLVD STA 85+04	0.52	TBF
N/A	ATLANTIC BLVD STA 84+43	0.55	SCREEN & INSERT
TBF 8950	ATLANTIC BLVD STA 89+50	0.37	TBF
TBF 9262	ATLANTIC BLVD STA 92+62	0.37	TBF
TBF 9549	ATLANTIC BLVD STA 95+49	0.10	TBF
TBF 8952	ATLANTIC BLVD STA 89+52	0.69	TBF
TBF 9643	ATLANTIC BLVD STA 96+43	0.82	TBF
TBF 9576	ATLANTIC BLVD STA 95+76	0.95	TBF
TBF 10360	ATLANTIC BLVD STA 103+60	0.63	TBF
TBF 10400	ATLANTIC BLVD STA 104+00	0.62	TBF
TBF 10886	ATLANTIC BLVD STA 108+86	2.78	TBF
TBF 13275	ATLANTIC BLVD STA 132+75	0.25	TBF
TBF 14298	ATLANTIC BLVD STA 142+98	0.90	TBF
TBF 14189	ATLANTIC BLVD STA 141+89	0.78	TBF
TBF 15296	ATLANTIC BLVD STA 152+96	1.18	TBF
TBF 15272	ATLANTIC BLVD STA 152+72	1.34	TBF
N/A	ATLANTIC BLVD STA 152+96	0.13	SCREEN & INSERT
TBF 15394	ATLANTIC BLVD STA 153+94	0.11	TBF
N/A	ATLANTIC BLVD STA 153+09	0.31	SCREEN & INSERT
TBF 15483	ATLANTIC BLVD STA 154+83 LT	1.01	TBF
TBF 16364	ATLANTIC BLVD STA 163+64	1.06	TBF
TBF 15453	ATLANTIC BLVD STA 154+53 RT	0.99	TBF
N/A	ATLANTIC BLVD STA 173+18	0.25	SCREEN & INSERT
TBF 17334	ATLANTIC BLVD STA 173+34	1.28	TBF
N/A	ATLANTIC BLVD STA 185+13	0.24	SCREEN & INSERT
N/A	ATLANTIC BLVD STA 185+03	0.28	SCREEN & INSERT
TBF 18704	ATLANTIC BLVD STA 187+04	1.46	TBF

TABLE 7-2
Summary of BRT Proposed BMPs

ID	Location	TREATED AREA (AC)	BMP type
N/A	ATLANTIC BLVD STA 186+79	1.29	SCREEN & INSERT
TBF 20030	ATLANTIC BLVD STA 200+30	0.07	TBF
TBF 20100	ATLANTIC BLVD STA 201+00	1.17	TBF
TBF 21106	ATLANTIC BLVD STA 211+06	0.18	TBF
N/A	ATLANTIC BLVD STA 243+16	1.82	SCREEN & INSERT
N/A	ATLANTIC BLVD STA 243+09	1.15	SCREEN & INSERT
TBF 61413	FAIROAKS STA 614+13	2.47	TBF
TBF 61381	FAIROAKS STA 613+81	1.74	TBF
TBF 63056	FAIROAKS STA 630+56	0.07	TBF
TBF 63121	FAIROAKS STA 631+21	0.43	TBF
TBF 63039	FAIROAKS STA 630+39	0.52	TBF
TBF 63566	FAIROAKS STA 635+66	0.32	TBF
N/A	FAIROAKS STA 638+52	0.61	SCREEN & INSERT
TBF 64331	FAIROAKS STA 643+31	0.42	TBF
TBF 64677	FAIROAKS STA 646+77	0.05	TBF
TBF 64718	FAIROAKS STA 647+18	0.75	TBF
TBF 64713	FAIROAKS STA 647+13	0.62	TBF
N/A	FAIROAKS STA 651+49	0.14	SCREEN & INSERT
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TBF 68278	FAIROAKS STA 682+78	0.33	TBF
N/A	FAIROAKS STA 685+57	0.34	SCREEN & INSERT
N/A	FAIROAKS STA 686+02	1.20	SCREEN & INSERT
N/A	FAIROAKS STA 689+14	0.48	SCREEN & INSERT
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N/A	FAIROAKS STA 698+74	1.55	SCREEN & INSERT
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N/A	FAIROAKS STA 721+36	0.36	SCREEN & INSERT
TBF 72503	FAIROAKS STA 725+03	0.44	TBF
TBF 71577	FAIROAKS STA 715+77	0.87	TBF
TBF 72500	FAIROAKS STA 725+00	0.39	TBF
N/A	FAIROAKS STA 729+35	0.27	SCREEN & INSERT
N/A	FAIROAKS STA 729+57	0.27	SCREEN & INSERT

TABLE 7-3
Summary of LRT Proposed BMPs

ID	Location	Treated Area (AC)	BMP type
TBF 3843	STA 38+43	0.79	TBF
TBF 3866	STA 38+66	1.43	TBF
TBF 4848	STA 48+48	1.44	TBF
BSW 123	STA 123+00	0.39	BSW
BSW 149	STA 148+70	0.56	BSW
BSW 151	STA 150+50	0.15	BSW
BSW 157	STA 156+50	0.61	BSW
MF 169	STA 168+74	1.30	MEDIA FITER
MF 176	STA 175+74	3.51	MEDIA FITER
BR 176	STA 176+71	0.60	BIORETENTION
BR 177	STA 177+00	0.30	BIORETENTION
BR 179	STA 185+13	0.61	BIORETENTION
TBF 22973	STA 229+73	0.37	TBF
TBF 23000	STA 230+00	0.86	TBF
TBF 23215	STA 232+15	0.73	TBF
TBF 34052	STA 340+52	0.39	TBF
TBF 40269	STA 402+69	0.55	TBF
TBF 40979	STA 409+79	0.40	TBF
TBF 41392	STA 413+92	0.92	TBF

TABLE 7-4
Summary of Freeway Tunnel Proposed BMPs

ID	Location	Treated Area (ac)	BMP type
Option: Dual-Bore			
BSW 403	Line-L STA402+72	1.64	BSW
BSW 1407	Line-B STA1405+80	0.91	BSW
GSRD 1149	Line-V3 STA449+70	12.76	GSRD
BSW 449	Line-V3 STA446+75	12.76	BSW
GSRD 1739	Line-NNBT STA1739+20	324.75	GSRD
BSW 1737	Line-NNBT STA1735+20	324.75	BSW
Option: Single-Bore			
BSW 1407	Line B STA405+70	0.62	BSW
GSRD 1149	Line V3 STA446+75	12.76	GSRD
BSW 449	Line V3 STA443+50	12.76	BSW
GSRD 1739	Line NNBT STA1739+00	324.75	GSRD
BSW 1737	Line NNBT STA1735+10	324.75	BSW

SECTION 8

8 Coordination and Cooperation with Local Agencies

The design team has worked closely with the cities and land owners to incorporate their requirements and concerns. All drainage work is within existing or future proposed right-of-way or temporary construction easement.

SECTION 9

9 References

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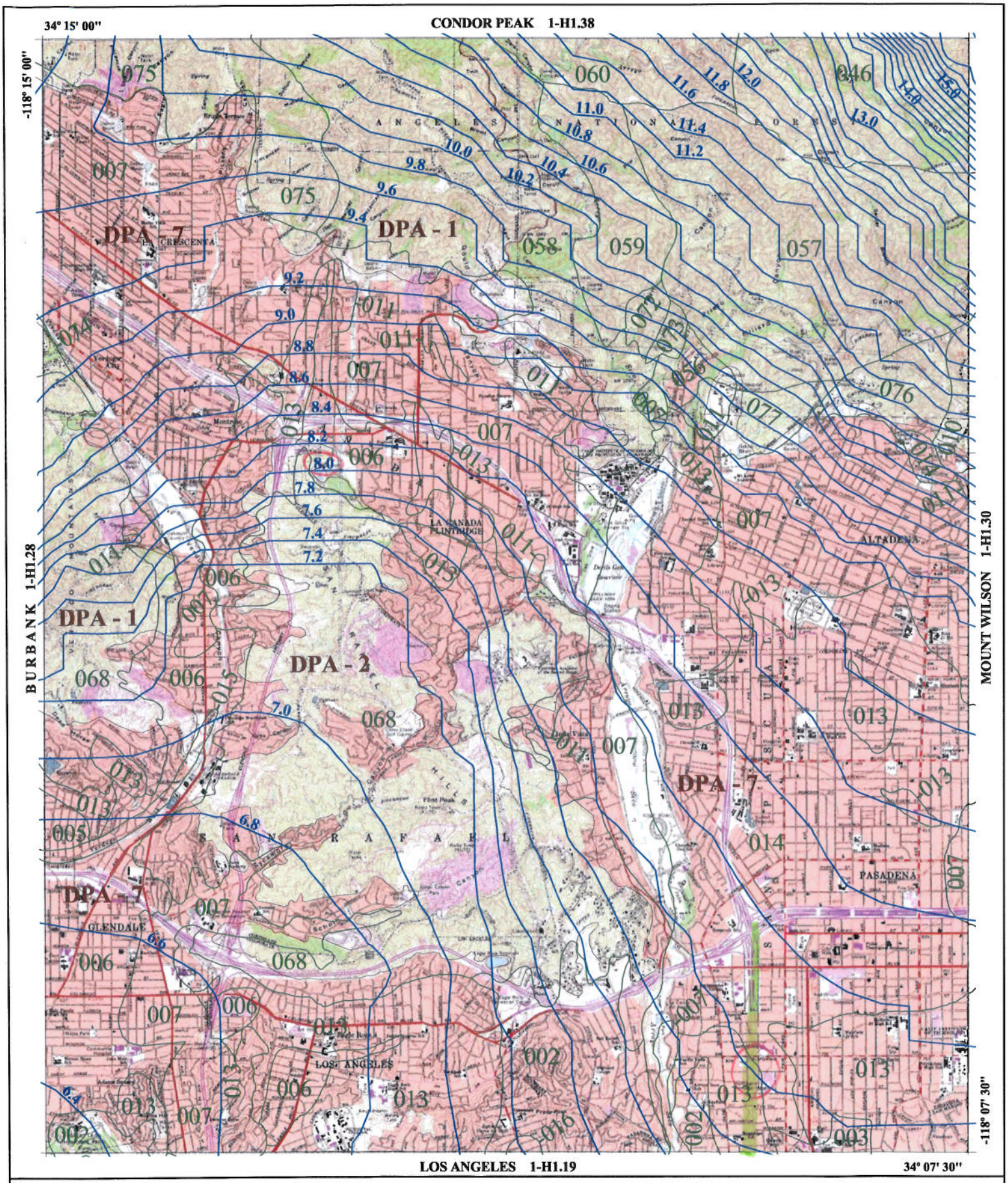
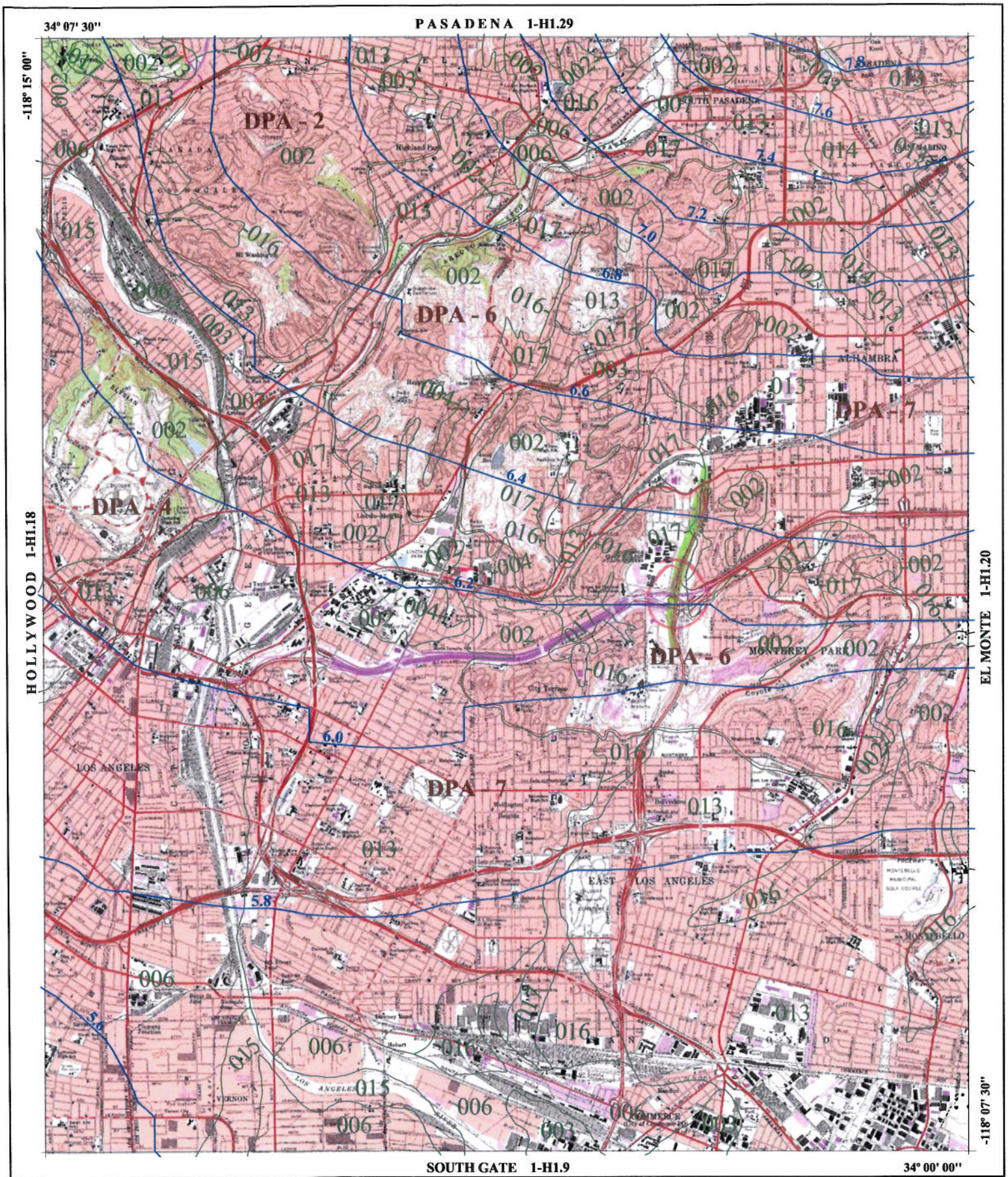
Appendix A
Pertinent Design Data

Project Site 50-Year 24-Hour Isohyets
Dorchester Channel Design Flow
Meeting Summary Notes


34° 15' 00"
CONDOR PEAK 1-H1.38
-118° 15' 00"
BURBANK 1-H1.28
MOUNT WILSON 1-H1.30
LOS ANGELES 1-H1.19
34° 07' 30"
-118° 07' 30"
DPA - 7
DPA - 1
DPA - 2
DPA - 6
LA CRESCENTA
LA CANADA FLINTRIDGE
ALTADENA
PASADENA
GLENDALE
LOS ANGELES
SAN RAFAEL HILLS
016
SOIL CLASSIFICATION AREA
7.2
INCHES OF RAINFALL
DPA - 6
DEBRIS POTENTIAL AREA
N
S
E
W
1 0 1 2 Miles
25-YEAR 24-HOUR ISOHYET REDUCTION FACTOR: 0.878
10-YEAR 24-HOUR ISOHYET REDUCTION FACTOR: 0.714
PASADENA
50-YEAR 24-HOUR ISOHYET
1-H1.29
LOS ANGELES COUNTY
PUBLIC WORKS
Public Service That Works



016 SOIL CLASSIFICATION AREA

7.2 INCHES OF RAINFALL

DPA - 6 DEBRIS POTENTIAL AREA

1 0 1 2 Miles

25-YEAR 24-HOUR ISOHYET REDUCTION FACTOR: 0.878
10-YEAR 24-HOUR ISOHYET REDUCTION FACTOR: 0.714

LOS ANGELES
50-YEAR 24-HOUR ISOHYET

1-H1.19

LOS ANGELES COUNTY PUBLIC WORKS
Public Service That Works

gmk
7-11-55

PROJECT NO. 65
HYDROLOGY REPORT

Intersection	City Q	L.A.C.F.C.D. Q	Adjusted Q	% Diff.
Stockbridge & Poplar "A"	1027	981	1125	9
Lathrop "C"	857	802	919	7
Junction "A" & "C"	2072	1675	1887	9
Allan St.	2155	1755	2013	6½
Alhambra	2335	1878	2153	8
Junction "A" & "B"	5148	4460	5114	0.7
Valley Blvd	5339	4638	5316	0.4
Bohlig Rd	5392	4712	5402	0.1
Travois Av	5481	4781	5481	0

Ratio of intensity to 50 yr. Q. (City Freq.)

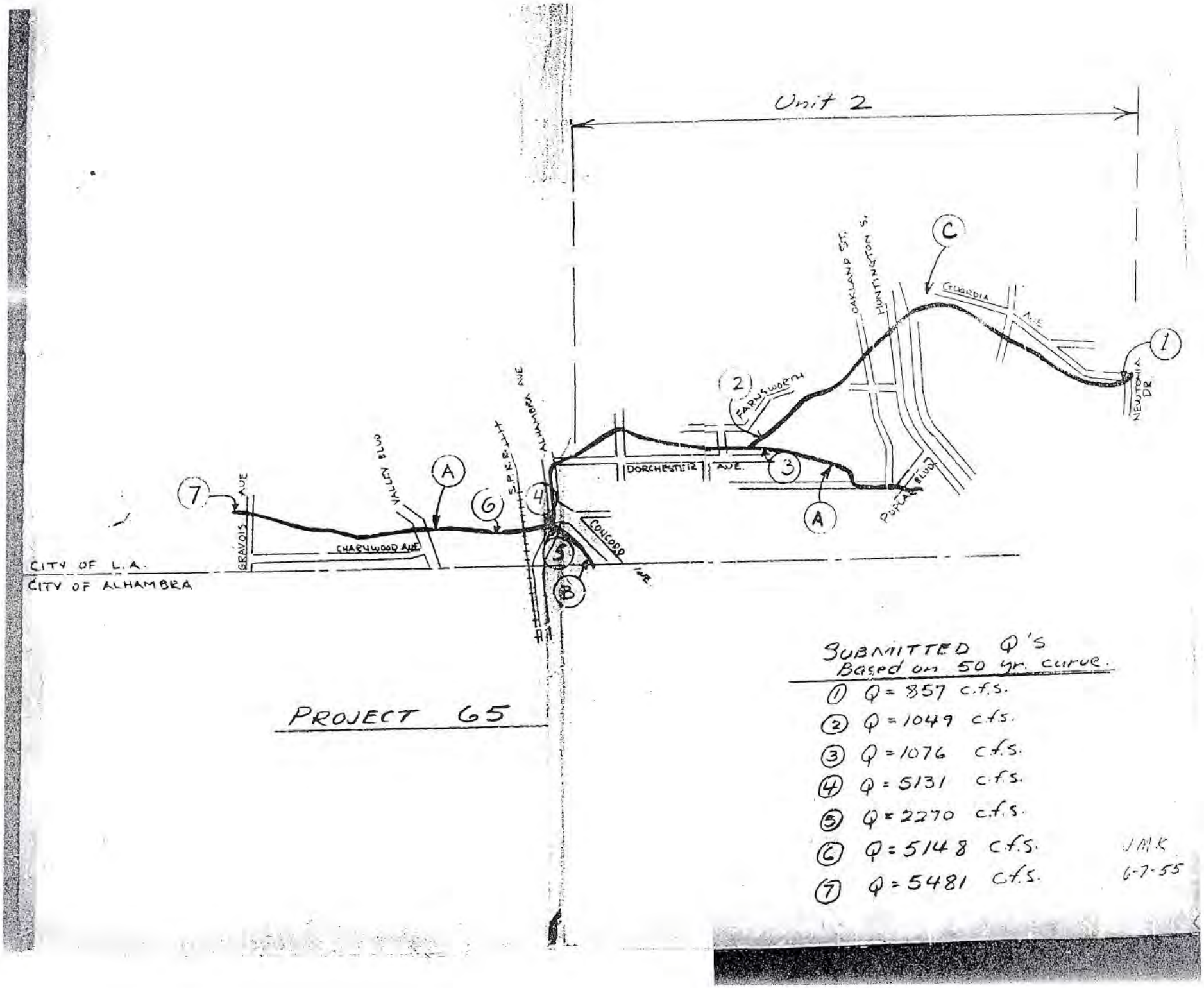
$$\frac{5481}{4781} \times 1.00 = 1.14$$

District frequency is 100 yrs. based on Alhambra Wash Curve.

Submitted T_c, Line A = 10.5 min.
Line C = 12.5 min.
County T_c, Line A = 10.0 min.
Line C = 12.1 min.

Note that B.I.P. originally called for a large portion of the project to be Open Channel.
By agreement, in which the City proposed to Design either Boron pipe, and approved by Mr. Hedger, the City is to pay the difference in cost between the Open Channel and Both.
See C.W.O. memo, no date

PROJECT



PROJECT 65

SUBMITTED Q's
Based on 50 yr. curve.

(1)	Q = 857	c.f.s.
(2)	Q = 1049	c.f.s.
(3)	Q = 1076	c.f.s.
(4)	Q = 5131	c.f.s.
(5)	Q = 2270	c.f.s.
(6)	Q = 5148	c.f.s.
(7)	Q = 5481	c.f.s.

JMK
6-7-55

Elevation	Outlet Elevatin	HW	HW/D	Area	Volume (ft^3)	Q (ft^3/s)	Average Q (ft^3/s)	Time(s)	Time(hr)	
381	343.29	37.71	3.1	539,305		3500				
380	343.29	36.71	3.1	529,757	534,531	3500	3500	152.72	0.04	
378	343.29	34.71	2.9	513,118	1,042,875	3300	3400	306.73	0.09	
376	343.29	32.71	2.7	496,686	1,009,804	3200	3250	310.71	0.09	
374	343.29	30.71	2.6	480,527	977,213	3100	3150	310.23	0.09	
372	343.29	28.71	2.4	465,357	945,884	3000	3050	310.13	0.09	
370	343.29	26.71	2.2	450,046	915,404	2700	2850	321.19	0.09	
368	343.29	24.71	2.1	435,194	885,240	2600	2650	334.05	0.09	Time Needed
366	343.29	22.71	1.9	420,228	855,422	2400	2500	342.17	0.10	0.66
364	343.29	20.71	1.7	405,492	825,720	2200	2300	359.01	0.10	
362	343.29	18.71	1.6	390,334	795,826	2100	2150	370.15	0.10	
360	343.29	16.71	1.4	374,141	764,475	1850	1975	387.08	0.11	
358	343.29	14.71	1.2	355,641	729,781	1600	1725	423.06	0.12	
356	343.29	12.71	1.1	330,590	686,231	1400	1500	457.49	0.13	
354	343.29	10.71	0.9	295,074	625,664	1000	1200	521.39	0.14	
352	343.29	8.71	0.7	241,980	537,054	690	845	635.57	0.18	
350	343.29	6.71	0.6	97,974	339,953	500	595	571.35	0.16	
348	343.29	4.71	0.4	34,334	132,307	260	380	348.18	0.10	
346	343.29	2.71	0.2	18,822	53,156	80	170	312.68	0.09	
				Total Volume	12,656,542			Total Time	1.88	

≈ 290.6 Ac-ft

SR 710 Study
Draft - Meeting Summary Notes
Los Angeles County Department of Public Works Coordination Meeting

PREPARED FOR: Michelle Smith/Metro

PREPARED BY: CH2M HILL

DATE: January 22, 2013

TIME: 3:00 p.m.

LOCATION: LACDPW Office, Alhambra, CA

ATTENDEES: See attached sign-in sheet.

OVERVIEW: The purpose of the meeting was to discuss the SR 710 Study alternatives and solicit feedback from LACFCD.

1. Yoga gave an introduction of the project, including the alternatives that are being considered and where we are currently in the schedule for the SR 710 Study.

2. Tom Ionta gave an overview of the Freeway tunnel alternative.

3. Ryan Mitry located the LACDPW facilities that would be impacted by the freeway tunnel alternative. The first impact is to the detention basin east of the SR 710 and north of the I-10, as the freeway is proposed to be widened in this area in order to accommodate the new improvements.

    a. The connector ramp from westbound I-10 to northbound SR 710 will need to be realigned to accommodate the widened freeway.
    b. The connector ramp and a portion of the SR 710 will encroach into the detention basin area.

    CH2M HILL provided LACDPW maps and cross sections showing the impacts to the detention basin area. Ryan informed LACDPW that the access road located on the west edge of the basin would be impacted and will need to be relocated or removed.

Metro

Caltrans

4. Amir Zandieh said CH2M HILL will need to evaluate the storage impacts to the detention basin and propose mitigating measures to ensure there is minimal impact to the capacity and the hydraulic grade line.

    a. LACDPW will provide CH2M HILL with the design storage volume and the design HGL of the basin.
    b. Amir also stated that the County maintenance staff will need to review the plans and they will inform CH2M HILL of the access requirements needed.

5. George Hsu noted that the houses on the east side of the basin appear to be lower in elevation than that of the access road on the west. With the design HGL lower than the houses the proposed impacts might not affect the design capacity of the basin. CH2M HILL will confirm once information is received from County.

6. The second impact is on Dorchester Storm Drain Channel south of Valley Blvd., along the southbound on ramp from Valley Blvd. CH2M HILL provided LACDPW with maps and cross sections showing the impacts to the channel and proposed converting the encroached open channel segment into a reinforced concrete box (RCB).

    a. Amir said LACDPW will provide CH2M HILL with the design flow rate and the design HGL of the channel. CH2M HILL will need to evaluate the hydraulic impacts to the channel and ensure the minimal HGL impact to the upstream reaches.
    b. LACDPW will review the analysis and provide comments.
    c. Amir noted that maintenance access to the RCB could be an issue with the channel.

7. Jamal Al-Mashat from AECOM described the light rail transit alternative and potential impacts on the basin, located on the east side of the I-710 south of I-10. The elevated LRT alignment passes near this basin.

    a. Jamal noted that there will not be any construction proposed in the basin but there are proposed bridge piers just north of this area.
    b. Amir said to evaluate the piers and see if they will have any effect on the basin.

Action Items:

1. Erik Bautista to send Tom Ionta design criteria for the Dorchester channel and the 2 basins.
2. CH2M HILL to determine impacts to the hydraulics of the facilities and propose mitigation solutions for LACDPW to review.
3. AECOM will evaluate the piers along the southerly basin to confirm there is no impact to the LACDPW basin.

SR 710 Study
LACDPW Coordination Meeting

Date: January 22, 2013
Location: LACDPW

Name	Role	Agency	Phone	E-mail	Initial
Smith, Michelle	Project Manager	Metro	213-922-3057	smithmi@metro.net	MES
Govan, Cleavon	Environmental Lead	Metro	213-922-3034	govanc@metro.net	CG
Higa, Derek	Design Manager	Calrans	213-897-0394	derek.higa@dot.ca.gov	DH
Saghafi, Abdi	Corridor Manager	Caltrans	213-897-9810	abdi.saghafi@dot.ca.gov	
Gaur, Jatinder		Caltrans		jatinder.gaur@dot.ca.gov	
Kung, Ainsley		Caltrans		ainsley.kung@dot.ca.gov	A.K.
Thurow, Jim		LACDPW	626 458-7844	jthurow@dpw.lacounty.cog	JT
Lasao, Manolito		LACDPW		mlasao@dpw.lacounty.gov	
Zandieh, Amir		LACDPW		azandieh@dpw.lacounty.gov	AZ
Chandran, Yoga	Project Manager	CH2M HILL	714-435-6111	Cyoga.Chandran@ch2m.com	CyC
Ionta, Tom	Engineering	CH2M HILL	714-435-6238	tionta@ch2m.com	TI
Mitry, Ryan	Engineering	CH2M HILL	714-435-6337	rmitry@ch2m.com	RoM
Hsu, George	Drainage	CH2M HILL	714-435-6205	melissa.delapena@ch2m.com	GH
Greene, Steve	AA/Transit	AECOM	213-330-7182	steve.greene@aecom.com	
Acuna, Lilly	Project Assisatant	CH2M HILL	213-228-8250	lacuna@ch2m.com	
JAMAL AL-MASHAT	PROJECT ENGINEER MANGR.	AECOM	213-330-7235	JAMAL.AL-MASHAT@AECOM.COM	J.A.
ERIK BAUTISTA		LADPW	6264587964	ebautista@dpw.lacounty.gov ↓ See card	

SR 710 North Study
Draft - Meeting Summary Notes
LACDPW Hydraulic Discussion Meeting

PREPARED FOR: Michelle Smith/Metro

PREPARED BY: CH2M HILL

DATE: April 03, 2013

TIME: 10:00 a.m.

LOCATION: LACDPW Office, Alhambra, CA

ATTENDEES: See attached sign-in sheet.

OVERVIEW: The purpose of the meeting was to discuss the alternatives for Dorchester Channel and Laguna Regulating Basin and solicit feedback from LACFCD.

1. George H. started with a summary of the data provided by LACDPW since the last meeting on 1/22/2013. CH2M HILL obtained the Dorchester channel design flows on 3/11/2013 from the original design report. The report was in microfilm format and the calculations were prepared by hand in 1995. George A. also provided some as-builts of the basin. The basin storage curve and FEMA floodplain map are still pending.

2. George H. gave an introduction of the channel layout, developed from the channel as-builts, and the two rectangular concrete channel (RCC) segments, impacted by the proposed roadway. The impacted segments of 20 ft channel width will be converted to double-barrel reinforced concrete boxes (RCBs). From upstream to downstream, there will be 3 openings – approximately 150 ft, 250 ft, and 50 ft long, respectively. The curvilinear channel alignment will remain unchanged because of housing on the west side of the channel. The channel design flows were based on the design report.

3. Amir said the LACDPW has switched from rainfall zoning to isohyets method a few years ago. CH2M HILL has the choice of re-investigating the whole watershed hydrology based on the new method, which could produce 30 to 40% less in the peak flows.

4. George H. presented the channel hydraulics of the existing and 4 proposed alternatives, assuming low tailwater condition. The analyses were mainly to address the mitigation

issues and would apply to most of flow conditions. With the channel slope steeper than 0.82%, the flow will be supercritical and the hydraulic grade line (HGL) is sensitive to channel size. The results showed that a smaller RCB width (9.67 ft each barrel) as that of under Hellman Avenue would provide the best results. The HGL in the proposed RCB will be unavoidably higher due to additional friction caused by the partition wall in the box. A wider RCB actually would cause a higher HGL and potential for a hydraulic jump. Under the best alternative, the maximum HGL impact is about 2.13 ft within the new RCB segment. The RCB will not be "sealed" or under pressure. There will be no hydraulic jump within the project reach and no impact to existing RCB upstream of the existing RCC.

5. Amir said higher HGLs occurring in the proposed RCB could be acceptable, as long as it does not cause flooding in the upstream reaches. He was concerned about the high tailwater condition in the basin to which the channel discharges. George H. said the 1955 design report started the calculations at Valley Blvd. assuming a HGL at the RCB soffit. The calculations did not include the downstream reaches or the basin. If a high tailwater was used in the model, the whole channel will be flooded, even under the existing condition. But the flooding will not reach the surrounding houses, at approximately Elev. 390 ft. The high tailwater condition will be assessed to conduct the floodplain mapping.

6. The discussion then moved to the basin. George A. said Water Resource Department (WRD) did not study the whole system north of the I-10 Freeway. It was unclear what the design basin elevation was or the chance of overflow from the crest onto the I-10 Freeway. There was no record of basin overflow in the past, even in the very wet years. George A. cannot find any hydrologic analysis to support why the spillway crest was raised in 1992 from Elev. 374.0 to 380.3 ft or would it adversely impact the upstream channel.

7. George H. stated that no record of flooding in this area seems to support the fact that the channel and basin were over-designed. George H. questioned where the water would go if it overflowed onto the I-10 and I-710 interchange, as the storage in the interchange area is very limited without flooding the I-10 Freeway. George H. then explained the potential impact to the basin from the roadway widening. There will be about 900 ft longitudinal encroachment into the basin storage volume with widths varying from zero to 20 ft. It will be difficult to restore the access road on the top of the basin, along the northbound side of the SR-710 freeway. Instead, CH2M HILL proposes to provide a pull-out and driveway from the I-10 connector to connect to the existing access road. To address the encroachment to the storage, CH2M HILL is proposing to calculate and compare the storage volumes between the existing and proposed conditions based on the 2012 project topo contours. Instead of a retaining wall, a bridge overhanging structure could be proposed for the roadway widening, which will minimize the volume reduction. If feasible, additional basin grading will be proposed to compensate any volume loss. Every effort will be taken to restore the original storage volume.

8. Amir asked George A. to contact WRD again about the hydrologic modeling of the basin. If such analysis was not conducted, the LACDPW will not impose extra requirements to ask CH2M HILL to conduct a further study. In this case, he would agree that the approaches proposed by CH2M HILL seem reasonable. He said the LACDPW could accept the mitigation for the basin access road.

9. George A. asked if CH2M HILL should study an alternative to divert some flow from the channel before entering the basin, as the downstream RCC may have extra capacity. The new storm drain could run along the west side of I-710 to connect the open channel south of I-10 Freeway. George H. said the idea seems to defeat the purpose of using the basin for the peak flow attenuation. He pointed out some hydraulic problems of this idea, such as adding more flow to the downstream RCC and potential hydraulic instability at the diverting junction structure. George H. said such idea could be explored by the LACDPW as part of the master drainage plan, and not for this roadway project. In addition, this alternative may extend the environmental footprint beyond the current project limit. The new storm drain will be about 5,500 ft long and very costly to go under I-10 Freeway and connectors.

10. George H. said that CH2M HILL will prepare a preliminary drainage report to document the hydraulic analyses on the channel and basin mitigations. The report will be ready for LACDPW's review in a few weeks. In the meantime, CH2M HILL provided a set of as-builts, WSPG runs, and summary of results to George A. and asked for feedback on the hydraulic analyses from LACDPW.

Action Items:

1. George A. to check WRD about the basin routing and storage curve.
2. CH2M HILL to prepare a preliminary drainage report to document the hydraulic analyses on the channel and basin mitigations for LACDPW to review.
3. George A. to provide FEMA floodplain map of the channel and basin, if available.

SR-710 North Study
LACDPW Hydraulic Discussion Meeting
4/03/13 @ 10:00 am

ATTENDANCE FORM

Name	Role	Agency	Phone	E-mail
Wai Chan	Drainage	CH2M HILL	714-435-6156	wai.chan@ch2m.com
George Hsu	"	"	714-435-6205	ghsu2@ch2m.com
George Aintablian	Design Division	LACDPW	626-458-7959	gaintabl
Amir Zandi	"	"	" - " 7894	azandieh@ladpw

Metro

Caltrans

Appendix B
Hydrologic Analysis

Hydrology Map for North Pump Station
Tc Calculation output for North Portal Areas
Hydrology Map for South Pump Station
Tc Calculation output for South Portal Areas

LEGEND:

- EXISTING STORM DRAIN
- PROPOSED STORM DRAIN
- DRAINAGE AREA BOUNDARY
- SUBAREA BOUNDARY
- FLOW DIRECTION ON SURFACE
- S-1 / 0.35 — SUBAREA ID / AREA (AC)

0' 200'

PASEO RANCHO CASTILLA
VANDALIA Ave
BOHLIG RD
LILLYVALE AVE
VALLEY Blvd
HIGHBURY Ave
DORCHESTER STORM DRAIN
PS
CHARNWOOD Ave
HELLMAN Ave
CABRILLO AVE
NORWOOD PL
WESTMONT Dr
MILTON Ave

S-0 0.97
S-1 0.35
S-2 0.33
S-3 0.21
S-4 0.21
S-5 0.29
S-6 0.34
S-7 0.67
S-8 0.25
S-9 0.38
S-10 0.89
S-11 0.33
S-12 2.53
S-13 4.53
S-14 0.48

SR-710 NORTH STUDY
FREEWAY TUNNEL ALTERNATIVE

HYDROLOGY MAP FOR SOUTH PUMP STATION
EXHIBIT A

CH2MHILL®

Tc Calculation for South Portal Pump Station (50-year, 24-hr rainfall event)

Subarea	Area (acres)	%imp	Frequency	Soil Type	Length (ft)	Slope (ft/ft)	Isohyet (in.)	Tc-calculated (min.)	Intensity (in./hr)	Cu	Cd	Flow rate (cfs)	Volume (acre-ft)
S-0	0.97	0.91	50	17	1940	0.028	6.2	13	2.36	0.86	0.9	2.06	0.42
S-1	0.35	0.91	50	17	1852	0.029	6.2	13	2.36	0.86	0.9	0.74	0.15
S-2	0.33	0.91	50	17	1935	0.028	6.2	13	2.36	0.86	0.9	0.7	0.14
S-3	0.21	0.91	50	17	1568	0.031	6.2	12	2.45	0.87	0.9	0.46	0.09
S-4	0.21	0.91	50	17	1516	0.032	6.2	11	2.55	0.88	0.9	0.48	0.09
S-5	0.29	0.91	50	17	1368	0.033	6.2	10	2.67	0.88	0.9	0.7	0.13
S-6	0.34	0.91	50	17	1335	0.034	6.2	10	2.67	0.88	0.9	0.82	0.15
S-7	0.67	0.91	50	17	1363	0.041	6.2	10	2.67	0.88	0.9	1.61	0.29
S-8	0.25	0.91	50	17	1082	0.035	6.2	9	2.81	0.89	0.9	0.63	0.11
S-9	0.38	0.91	50	17	1026	0.037	6.2	8	2.97	0.89	0.9	1.02	0.17
S-10	0.89	0.66	50	17	669	0.032	6.2	7	3.16	0.9	0.9	2.53	0.31
S-11	0.33	0.91	50	17	1884	0.030	6.2	13	2.36	0.86	0.9	0.7	0.14
S-12	2.53	0.67	50	17	875	0.027	6.2	8	2.97	0.89	0.9	6.76	0.9
S-13	4.53	0.42	50	17	1838	0.048	6.2	12	2.45	0.87	0.88	9.77	1.24
S-14	0.48	0.02	50	17	555	0.095	6.2	5	3.7	0.9	0.9	1.6	0.07

Hydrology Map for North Pump Station (in Back Pocket)

Tc Calculation for North Portal Pump Station (50-year, 24-hr rainfall event)

Subarea	Area (acres)	%imp	Frequency	Soil Type	Length (ft)	Slope (ft/ft)	Isohyet (in.)	Tc-calculated (min.)	Intensity (in./hr)	Cu	Cd	Flow rate (cfs)	Volume (acre-ft)
N-1	6.25	0.79	50	14	5812	0.013	8.2	26	2.25	0.66	0.85	11.95	3.18
N-2	7	0.64	50	14	6796	0.011	8.2	30	2.11	0.64	0.81	11.96	3.01
N-3	2.74	0.38	50	14	4237	0.021	8.2	21	2.49	0.7	0.78	5.32	0.82
N-31	0.63	0.91	50	14	4250	0.020	8.2	19	2.61	0.71	0.88	1.45	0.36
N-4	103.48	0.68	50	14	7875	0.020	8.2	30	2.11	0.64	0.82	179.04	46.33
N-21	11.56	0.44	50	14	6680	0.016	8.2	30	2.11	0.64	0.75	18.29	3.82
N-5	13.77	0.44	50	14	5766	0.020	8.2	26	2.25	0.66	0.77	23.86	4.64
N-22	6	0.19	50	14	5157	0.012	8.2	28	2.18	0.65	0.7	9.16	1.26
N-7	1.05	0.17	50	14	3776	0.023	8.2	20	2.55	0.7	0.73	1.95	0.21
N-8	1.7	0.56	50	14	3585	0.030	8.2	17	2.75	0.72	0.82	3.83	0.67
N-51	0.3	0.91	50	14	3703	0.027	8.2	17	2.75	0.72	0.88	0.73	0.17
N-9	3.18	0.40	50	14	3175	0.032	8.2	16	2.83	0.73	0.8	7.2	1
N-10	4.16	0.50	50	14	3719	0.021	8.2	19	2.61	0.71	0.8	8.69	1.51
N-11	2.53	0.61	50	14	3359	0.010	8.2	20	2.55	0.7	0.82	5.29	1.06
N-12	0.91	0.25	50	14	2545	0.026	8.2	14	3.02	0.74	0.78	2.14	0.22
N-13	1.38	0.42	50	14	2371	0.028	8.2	13	3.12	0.75	0.81	3.49	0.45
N-14	0.96	0.30	50	14	2055	0.030	8.2	12	3.24	0.76	0.8	2.49	0.26
N-15	1.11	0.85	50	14	2457	0.016	8.2	14	3.02	0.74	0.88	2.95	0.6
N-16	1.15	0.36	50	14	1558	0.020	8.2	11	3.38	0.77	0.82	3.19	0.34
N-17	1.25	0.38	50	14	1383	0.020	8.2	10	3.53	0.78	0.83	3.66	0.39
N-18	0.89	0.54	50	14	1039	0.021	8.2	8	3.92	0.8	0.85	2.97	0.34
N-19	1.07	0.47	50	14	768	0.018	8.2	7	4.18	0.82	0.86	3.85	0.37
N-20	1.73	0.77	50	14	1243	0.018	8.2	9	3.71	0.79	0.87	5.58	0.85
N2-1	17.17	0.74	50	14	8850	0.017	8.2	30	2.11	0.64	0.83	30.07	8.21
N2-2	22.25	0.59	50	14	7994	0.017	8.2	30	2.11	0.64	0.79	37.09	9
N2-3	3.68	0.63	50	14	6311	0.021	8.2	26	2.25	0.66	0.81	6.71	1.58
N2-4	3.35	0.78	50	14	5350	0.015	8.2	24	2.34	0.67	0.85	6.66	1.67
N2-5	30.97	0.53	50	14	6085	0.018	8.2	27	2.21	0.66	0.79	54.07	11.61
N2-6	4.05	0.58	50	14	4842	0.014	8.2	24	2.34	0.67	0.8	7.58	1.64
N2-7	7.1	0.59	50	14	5150	0.021	8.2	23	2.39	0.68	0.81	13.74	2.89
N2-8	27.6	0.79	50	14	5750	0.019	8.2	24	2.34	0.67	0.85	54.9	13.91
N2-9	12.68	0.68	50	14	5025	0.025	8.2	22	2.44	0.69	0.83	25.68	5.77
N2-10	5.08	0.67	50	14	4480	0.023	8.2	20	2.55	0.7	0.83	10.75	2.28
N2-11	3.01	0.23	50	14	3560	0.033	8.2	17	2.75	0.72	0.76	6.29	0.71
N2-12	1.72	0.58	50	14	3428	0.012	8.2	19	2.61	0.71	0.82	3.68	0.69
N2-13	0.75	0.91	50	14	3205	0.012	8.2	18	2.68	0.71	0.88	1.77	0.42
N2-14	0.89	0.52	50	14	2972	0.012	8.2	18	2.68	0.71	0.81	1.93	0.33
N2-15	0.63	0.68	50	14	2770	0.012	8.2	17	2.75	0.72	0.84	1.46	0.29
N2-16	0.42	0.57	50	14	2535	0.012	8.2	16	2.83	0.73	0.83	0.99	0.17
N2-17	0.28	0.91	50	14	2312	0.012	8.2	14	3.02	0.74	0.89	0.75	0.16
N2-18	1.47	0.91	50	14	3212	0.012	8.2	18	2.68	0.71	0.88	3.47	0.83
N2-19	2.9	0.44	50	14	2978	0.019	8.2	17	2.75	0.72	0.8	6.38	0.97
N2-20	2.71	0.35	50	14	2045	0.029	8.2	12	3.24	0.76	0.81	7.11	0.79
N2-21	0.57	0.91	50	14	2265	0.010	8.2	15	2.92	0.73	0.88	1.46	0.32
N2-22	0.67	0.91	50	14	1244	0.032	8.2	8	3.92	0.8	0.89	2.34	0.38

LEGEND:

- EXISTING STORM DRAIN
- PROPOSED STORM DRAIN
- DRAINAGE AREA BOUNDARY
- SUBAREA BOUNDARY
- FLOW DIRECTION ON SURFACE
- N-1 / 6.25 — SUBAREA ID / AREA (AC)

0' 400'

ORANGE GROVE Blvd
SAINT JOHN Ave
PASADENA Ave
SB SR-710
NB SR-710
WB SR-134
EB SR-134
SB I-210
NB I-210
CYPRESS Ave
SARTHE DR
W MOUNTAIN St
W WALNUT St
MAPLE St
DEL MAR Blvd
DAYTON St
GREEN St
COLORADO Blvd
UNION St
FAIR OAKS AVE
MARENGO Ave

N2-1 17.2
N2-2 22.3
N2-3 3.68
N2-4 3.35
N2-5 30.97
N2-6 4.06
N2-7 7.10
N2-8 27.6
N2-9 12.7
N2-10 5.08
N2-11 3.01
N2-12 1.72
N2-13 1.38
N2-14 0.89
N2-15 0.63
N2-16 0.42
N2-17 0.28
N2-18 1.47
N2-19 2.90
N2-20 2.71
N2-21 0.57
N-1 6.25
N-2 7.0
N-3 2.74
N-4 103.5
N-5 13.8
N-6 1.70
N-7 1.05
N-7 1.05
N-8 1.70
N-9 3.18
N-10 4.16
N-10 4.16
N-11 2.53
N-12 0.91
N-13 1.38
N-14 0.96
N-15 1.11
N-16 1.15
N-17 1.25
N-18 0.89
N-19 1.07
N-20 1.73
N-21 11.6
N-22 6.0
N-31 0.63
N-51 0.30

CH2MHILL®

SR-710 NORTH STUDY
FREEWAY TUNNEL ALTERNATIVE

HYDROLOGY MAP FOR NORTH PUMP STATION
EXHIBIT B

Appendix C
Hydraulic Calculations for Dorchester Channel

WSPG Modeling Output for Existing Condition
WSPG Modeling Output for Proposed Condition
Proposed Channel Layout
Dorchester Channel Floodplain
Laguna Regulating Basin Floodplain

SR-710 NORTH STUDY -- REGIONAL CHANNEL SUMMARY, EXISTING CONDITION
(Project 65 Line A and Line B)

8/23/2013

System No	Station Model	Station Design plan	Channel Type	Elevation (NGVD29) (ft)	Length (LF)	Slope (%)	Q50 (City) cfs	Q (Study) cfs	Note
Main Lines									
Dorchester Drain	4+91.00	4+13.00	SYSTEM OUTLET	351.820			5481	**5481**	
Line "A"	5+17.00	4+39.00	TRAN. STRUCTURE	352.033	26.00	0.821%	5481	**5481**	Δ =–5.959 ° , R = 250'
	5+44.03	4+66.03	DBL 9.67'x12.75' RCB	352.255	27.03	0.821%	5481	**5481**	Δ =–6.195 ° , R = 250'
	9+16.00	8+38.00	DBL 9.67'x12.75' RCB	355.310	371.97	0.821%	5481	**5481**	
	10+78.00	10+00.00	DBL 9.67'x12.75' RCB	356.640	162.00	0.821%	5481	**5481**	Δ=37.127 ° , R=250'
	10+88.00	+88.00	JUNCTION STRUCTURE	356.723	10.00	0.826%	5481	**5481**	10+00.00=0+78.00 JOIN 72" RCP (Q=30cfs) Δ =2.291 ° , R = 250'
	11+53.80	1+53.80	DBL 9.67'x12.75' RCB	357.266	65.80	0.826%	N/A	**5451**	Δ =15.080 ° , R = 250'
	11+73.80	1+73.80	DBL 9.67'x12.75' RCB	357.431	20.00	0.826%	N/A	**5451**	
	12+50.00	2+50.00	DBL 9.67'x12.75' RCB	358.060	76.20	0.826%	N/A	**5451**	Δ =17.464 ° , R = 250'
	12+79.74	2+79.74	20.00'X14.00' RCC	358.304	29.74	0.819%	N/A	**5451**	Δ =6.816 ° , R = 250'
	13+98.80	3+98.80	20.00'X14.00' RCC	359.279	119.06	0.819%	N/A	**5451**	Δ =–27.286 ° , R = 250'
	14+85.00	4+85.00	20.00'X14.00' RCC	359.985	86.20	0.819%	N/A	**5451**	Δ =–2.469 ° , R =2000'
	15+05.00	5+05.00	JUNCTION STRUCTURE	360.149	20.00	0.819%	N/A	**5451**	Δ =–0.573 ° , R =2000' Lateral 30"RCP (Q=29 cfs)
	17+54.09	7+54.09	20.00'X14.00' RCC	362.189	249.09	0.819%	N/A	**5422**	Δ =–7.136 ° , R =2000'
	20+13.40	10+13.40	20.00'X14.00' RCC	364.313	259.31	0.819%	N/A	**5422**	Δ =–34.960 ° , R = 425'
	21+90.00	11+90.00	20.00'X14.00' RCC	365.760	176.60	0.819%	N/A	**5422**	Δ =23.808 ° , R = 425'
	22+20.00	12+20.00	JUNCTION STRUCTURE	366.005	30.00	0.819%	N/A	**5422**	Δ =4.044 ° , R = 425' Lateral 30" RCP (Q=30cfs)
	22+64.53	12+64.53	20.00'X14.00' RCC	366.370	44.53	0.819%	5392	**5392**	Δ =6.003 ° , R = 425'
	24+50.00	14+50.00	20.00'X14.00' RCC	367.893	185.47	0.821%	5392	**5392**	Δ =–21.253 ° , R = 500'
	24+82.31	14+82.31	JUNCTION STRUCTURE	368.158	32.31	0.821%	5392	**5392**	Δ =–3.702 ° , R = 500' Lateral 45" RCP (Q=53cfs)
	26+25.00	16+25.00	20.00'X14.00' RCC	369.330	142.69	0.821%	5339	**5339**	
	26+75.00	16+75.00	TRAN. STRUCTURE	369.970	50.00	1.280%	5339	**5339**	
	27+80.00	17+80.00	DBL 10.00'x12.00' RCB	370.661	105.00	0.658%	5339	**5339**	
	27+90.00	17+90.00	JUNCTION STRUCTURE	370.727	10.00	0.658%	5339	**5339**	Lateral 30" RCP (Q=50cfs)
	29+57.51	19+57.51	DBL 10.00'x12.00' RCB	371.830	167.51	0.658%	N/A	**5289**	
	29+82.51	+25.21	TRAN. STRUCTURE	372.380	25.00	2.200%	N/A	**5289**	19+57.51=0+00.21
	31+89.30	2+32.00	DBL 10.00'x12.00' RCB	374.520	206.79	1.035%	N/A	**5289**	∠-5.027° MH 1
	31+99.30	2+42.00	JUNCTION STRUCTURE	374.623	10.00	1.035%	N/A	**5289**	Lateral 36" RCP(Q=45cfs)
	32+23.12	2+65.82	DBL 10.00'x12.00' RCB	374.870	23.82	1.035%	N/A	**5244**	MH 1
	33+03.90	3+46.60	DBL 10.00'x12.00' RCB	375.980	80.78	1.374%	N/A	**5244**	
	33+08.90	3+51.60	TRAN. STRUCTURE	376.015	5.00	0.703%	N/A	**5244**	
	33+29.44	3+72.14	TRAN. STRUCTURE	376.159	20.54	0.703%	N/A	**5244**	Δ =11.770 ° , R =100'
	33+45.18	3+87.88	TRAN. STRUCTURE	376.270	15.74	0.703%	N/A	**5244**	
	33+55.18	3+97.88	JUNCTION STRUCTURE	376.384	10.00	1.144%	N/A	**5244**	Lateral 24" RCP(Q=48cfs)
	35+99.63	6+42.33	DBL 10.00'x12.00' RCB	379.180	244.45	1.144%	N/A	**5196**	MH
	36+25.79	6+68.49	DBL 10.00'x12.00' RCB	379.479	26.16	1.144%	N/A	**5196**	Δ =–4.282 ° , R =350'
	38+87.30	9+30.00	TRAN. STRUCTURE	382.470	261.51	1.144%	N/A	**5196**	
	38+97.30	9+40.00	JUNCTION STRUCTURE	382.584	10.00	1.144%	N/A	**5196**	JOIN Line "A" West Lateral 24" RCP(Q=48cfs)
	40+89.30	11+32.00	DBL 10.00'x12.00' RCB	384.780	192.00	1.144%	5148	**5148**	
Line "A" East	41+35.72	11+78.42	JUNCTION STRUCTURE	385.310	46.42	1.142%	5148	**5148**	Lateral 10.00'x12.00' RCB (Q=2335cfs)
	41+41.60	11+84.30	DBL 10.00'x12.00' RCB	385.389	5.88	1.336%	5148	**2813**	
	42+11.51	12+54.21	DBL 10.00'x12.00' RCB	386.322	69.91	1.336%	5148	**2813**	Δ =10.54 ° , R =380' MH
	42+23.54	12+66.24	DBL 10.00'x12.00' RCB	386.483	12.03	1.336%	5148	**2813**	
	42+43.54	12+86.24	TRAN. STRUCTURE	386.750	20.00	1.336%	5148	**2813**	
	44+20.54	14+63.24	12.00'x12.00' Horseshoe Arch*	389.120	177.00	1.339%	5148	**2813**	
	44+40.54	14+83.24	TRAN. STRUCTURE	390.218	20.00	5.488%	5148	**2813**	
	44+53.21	14+95.91	TRAN. STRUCTURE	390.913	12.67	5.488%	N/A	**2813**	Δ=–3.156 ° , R=230'
	44+63.54	15+06.24	TRAN. STRUCTURE	391.480	10.33	5.488%	N/A	**2813**	Δ=–2.573 °, R=230'
	44+97.74	15+40.44	10.25'x13.25' RCB	391.638	34.20	0.462%	N/A	**2813**	Δ =–8.520 ° , R =230'
	45+79.22	16+21.92	10.25'x13.25' RCB	392.015	81.48	0.462%	N/A	**2813**	
	45+95.38	16+38.08	TRAN. STRUCTURE	392.089	16.16	0.462%	N/A	**2813**	
	46+23.64	16+66.34	10.25'x13.25' RCB	392.220	28.26	0.462%	N/A	**2813**	
Line "B"	47+03.02	7+03.62	10.25'x13.25' RCB	393.220	79.38	1.260%	N/A	**2813**	16+66.34=7+83.00 MH
	47+13.02	6+93.62	TRAN. STRUCTURE	393.340	10.00	1.200%	N/A	**2813**	
	47+39.96	6+66.68	10.00'x13.25' RCB	393.663	26.94	1.198%	N/A	**2813**	
	48+80.82	5+25.82	10.00'x13.25' RCB	395.350	140.86	1.198%	N/A	**2813**	Δ =51.785 ° , R =155.85'
	51+91.14	2+15.50	10.00'x13.25' RCB	397.650	310.32	0.741%	N/A	**2813**	
	53+83.64	+23.00	10.00'x13.25' RCB	399.749	192.50	1.090%	N/A	**2813**	Δ =46.177 ° , R =238.85' MH
	53+92.38	+14.26	TRAN. STRUCTURE	399.844	8.74	1.090%	N/A	**2813**	Δ =2.096 ° , R =238.85'
	54+06.64	+0.00	TRAN. STRUCTURE	400.000	14.26	1.090%	N/A	**2813**	Q=5148-2335 cfs

SR-710 NORTH STUDY -- REGIONAL CHANNEL SUMMARY, EXISTING CONDITION
(Project 65 Line A and Line B)

8/23/2013

System No	Station Model	Station Design plan	Channel Type	Elevation (NGVD29) (ft)	Length (LF)	Slope	Q50 (City) cfs	Q (Study) cfs	Note
Laterals									
Line "A" West	+35.72	11+78.04	JUNCTION STRUCTURE	385.310			2335	**2335**	Join Line "A" West
	1+18.58	12+60.90	10.00'x12.00' RCB	386.389	82.86	1.303%	2335	**2335**	
	1+38.58	12+80.90	TRAN. STRUCTURE	386.650	20.00	1.303%	2335	**2335**	
	3+23.58	14+65.90	12.00'x12.00' Horseshoe Arch*	389.650	185.00	1.622%	2335	**2335**	
	3+33.58	14+75.90	TRAN. STRUCTURE	390.180	10.00	5.299%	2335	**2335**	
	3+45.83	14+88.15	11.00'x12.50' RCB	390.829	12.25	5.299%	2335	**2335**	
	3+58.50	15+00.82	TRAN. STRUCTURE	391.501	12.67	5.299%	2335	**2335**	
	3+72.83	15+15.15	11.00'x12.50' RCB	392.260	14.33	5.299%	2335	**2335**	
	3+74.58	15+16.90	11.00'x12.50' RCB	392.274	1.75	0.805%	2335	**2335**	
	4+31.78	15+74.10	11.00'x12.50' RCB	392.735	57.20	0.805%	2335	**2335**	Δ =-14.250 ° , R =230'
	5+15.61	16+57.93	11.00'x12.50' RCB	393.410	83.83	0.805%	2335	**2335**	
	6+35.25	17+78.04	11.00'x12.50' RCB	394.374	119.64	0.805%	2335	**2335**	1657.93=1658.40 Δ=-68.547, R=100'
	7+05.01	18+47.80	11.00'x12.50' RCB	394.935	69.76	0.805%	2335	**2335**	Δ =-21.037 ° , R =190' MH
	11+42.21	22+85.00	11.00'x12.50' RCB	398.460	437.20	0.805%	2335	**2335**	MH
	11+58.13	23+00.92	11.00'x12.50' RCB	398.612	15.92	0.955%	2335	**2335**	
	11+96.76	23+39.55	11.00'x12.50' RCB	398.981	38.63	0.955%	2335	**2335**	Δ =34.05 ° , R =65'
	12+75.03	24+17.82	11.00'x12.50' RCB	399.729	78.27	0.955%	2335	**2335**	Δ =44.848 ° , R =100'
	15+22.21	26+65.00	11.00'x12.50' RCB	402.090	247.18	0.955%	2335	**2335**	

*For practical purpose, the Horse Shoe Arch was modeled as 9.73'x12.00' RCB.

WATER SURFACE PROFILE - CHANNEL DEFINITION LISTING

CARD CODE	SECT NO	CHN TYPE	NO OF PIER/PIP	AVE PIER WIDTH	HEIGHT 1 DIAMETER	BASE WIDTH	ZL	ZR	INV DROP	Y(1)	Y(2)	Y(3)	Y(4)	Y(5)	Y(6)	Y(7)	Y(8)	Y(9)	Y(10)
CD	1	3	1	.670	12.750	20.000	.000	.000	.00										
CD	2	2	0	.000	14.000	20.000			.00										
CD	3	4	1		6.000														
CD	4	3	1	.670	12.000	20.670	.000	.000	.00										
CD	5	3	1	.670	12.000	20.670	.000	.000	.00										
CD	6	3	0	.000	12.000	9.730	.000	.000	.00										
CD	7	3	0	.000	13.250	10.250	.000	.000	.00										
CD	8	3	0	.000	12.500	11.000	.000	.000	.00										
CD	9	4	1		3.750														
CD	10	4	1		3.000														
CD	11	4	1		2.000														
CD	12	4	1		2.500														
CD	13	2	0	.000	14.000	20.670			.00										
CD	14	3	0	.000	12.000	10.000	.000	.000	.00										

WATER SURFACE PROFILE - TITLE CARD LISTING

HEADING LINE NO 1 IS -

SR-710 NORTH STUDY

HEADING LINE NO 2 IS -

DORCHESTER DRAIN LINE-A EAST & LINE-B (Existing)(NGVD 29)

HEADING LINE NO 3 IS -

MODEL: W.CHEN REVIEW: G.HSU

WATER SURFACE PROFILE - ELEMENT CARD LISTING

ELEMENT NO 1 IS A SYSTEM OUTLET

U/S DATA	STATION	INVERT	SECT	W S ELEV
	491.000	351.820	1	364.500

ELEMENT NO 2 IS A TRANSITION

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE
	517.000	352.033	1	.013	249.990	-5.959

ELEMENT NO 3 IS A REACH

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	544.030	352.255	1	.013	249.993	-6.195	.000	0

ELEMENT NO 4 IS A REACH

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	916.000	355.310	1	.013	.000	.000	.000	0

ELEMENT NO 5 IS A REACH

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	1078.000	356.640	1	.013	250.004	37.127	.000	0

ELEMENT NO 6 IS A JUNCTION

U/S DATA	STATION	INVERT	SECT	LAT-1	LAT-2	N	Q3	Q4	INVERT-3	INVERT-4	PHI 3	PHI 4
	1088.000	356.723	1	3	0	.013	30.000	.000	361.000	.000	-76.000	.000

RADIUS	ANGLE
250.091	2.291

ELEMENT NO 7 IS A REACH

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	1153.800	357.266	1	.013	250.004	15.080	.000	0

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ELEMENT NO   8 IS A REACH                *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             1173.800  357.431    1              .013                           .000     .000      .000     0
ELEMENT NO   9 IS A REACH                *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             1250.000  358.060    1              .013                        249.996   17.464      .000     0
ELEMENT NO  10 IS A BRIDGE ENTRANCE                  *
                  U/S DATA   STATION    INVERT  SECT             FP
                             1250.000  358.060    2              .100
ELEMENT NO  11 IS A REACH                *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             1279.740  358.304    2              .014                        249.996    6.816      .000     0
ELEMENT NO  12 IS A REACH                *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             1309.000  358.543    2              .014                        249.996   -6.706      .000     0
                                                    W S P G W                                                    PAGE NO   3
                                WATER SURFACE PROFILE - ELEMENT CARD LISTING
ELEMENT NO  13 IS A REACH                *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             1398.800  359.279    2              .014                        250.008  -20.580      .000     0
ELEMENT NO  14 IS A REACH                *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             1485.000  359.985    2              .014                       2000.362   -2.469      .000     0
ELEMENT NO  15 IS A JUNCTION             *         *     *     *              *                    *                 *
                  U/S DATA   STATION    INVERT  SECT LAT-1 LAT-2   N      Q3        Q4     INVERT-3 INVERT-4  PHI 3  PHI 4
                             1505.000  360.149    2    12     0   .014    29.000      .000   361.500      .000  60.000     .000
                                                                                            RADIUS    ANGLE
                                                                                           1999.853   -.573
ELEMENT NO  16 IS A REACH                *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             1754.090  362.189    2              .014                       1999.972   -7.136      .000     0
ELEMENT NO  17 IS A REACH                *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             2013.400  364.313    2              .014                        424.982  -34.960      .000     0
ELEMENT NO  18 IS A REACH                *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             2190.000  365.760    2              .014                        425.001   23.808      .000     0
ELEMENT NO  19 IS A JUNCTION             *         *     *     *              *                    *                 *
                  U/S DATA   STATION    INVERT  SECT LAT-1 LAT-2   N      Q3        Q4     INVERT-3 INVERT-4  PHI 3  PHI 4
                             2220.000  366.005    2    12     0   .014    30.000      .000   367.000      .000  60.000     .000
                                                                                            RADIUS    ANGLE
                                                                                            425.043   4.044
ELEMENT NO  20 IS A REACH                *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             2264.530  366.370    2              .014                        425.018    6.003      .000     0
ELEMENT NO  21 IS A REACH                *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             2450.000  367.893    2              .014                        500.007  -21.253      .000     0
ELEMENT NO  22 IS A JUNCTION             *         *     *     *              *                    *                 *
                  U/S DATA   STATION    INVERT  SECT LAT-1 LAT-2   N      Q3        Q4     INVERT-3 INVERT-4  PHI 3  PHI 4
                             2482.310  368.158    2     9     0   .014    53.000      .000   370.000      .000  45.000     .000
                                                                                            RADIUS    ANGLE
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                                                                                                            500.062  -3.702
                                                        W S P G W                                                                       PAGE NO   4
                                   WATER SURFACE PROFILE - ELEMENT CARD LISTING
 ELEMENT NO  23 IS A REACH             *         *     *
                     U/S DATA   STATION    INVERT  SECT              N                                  RADIUS    ANGLE     ANG PT  MAN H
                                2550.000  368.714    2              .014                                 .000     .000      .000     0
 ELEMENT NO  24 IS A REACH             *         *     *
                     U/S DATA   STATION    INVERT  SECT              N                                  RADIUS    ANGLE     ANG PT  MAN H
                                2625.000  369.330    2              .014                                 .000     .000      .000     0
 ELEMENT NO  25 IS A TRANSITION        *         *     *
                     U/S DATA   STATION    INVERT  SECT              N                                  RADIUS   ANGLE
                                2675.000  369.970   13              .014                                 .000     .000
 ELEMENT NO  26 IS A BRIDGE EXIT                       *
                     U/S DATA   STATION    INVERT  SECT
                                2675.000  369.970    4
 ELEMENT NO  27 IS A REACH             *         *     *
                     U/S DATA   STATION    INVERT  SECT              N                                  RADIUS    ANGLE     ANG PT  MAN H
                                2780.000  370.661    4              .013                                 .000     .000      .000     0
 ELEMENT NO  28 IS A JUNCTION          *         *     *     *                  *                   *               *
                     U/S DATA   STATION    INVERT  SECT LAT-1 LAT-2   N      Q3        Q4     INVERT-3 INVERT-4  PHI 3  PHI 4
                                2790.000  370.727    4    12     0   .013    50.000      .000   371.500      .000  60.000     .000
                                                                                                    RADIUS    ANGLE
                                                                                                      .000     .000
 ELEMENT NO  29 IS A REACH             *         *     *
                     U/S DATA   STATION    INVERT  SECT              N                                  RADIUS    ANGLE     ANG PT  MAN H
                                2957.510  371.830    4              .013                                 .000     .000      .000     0
 ELEMENT NO  30 IS A TRANSITION        *         *     *
                     U/S DATA   STATION    INVERT  SECT              N                                  RADIUS   ANGLE
                                2982.510  372.380    5              .013                                 .000     .000
 ELEMENT NO  31 IS A REACH             *         *     *
                     U/S DATA   STATION    INVERT  SECT              N                                  RADIUS    ANGLE     ANG PT  MAN H
                                3189.300  374.520    5              .013                                 .000     .000    -5.027     1
 ELEMENT NO  32 IS A JUNCTION          *         *     *     *                  *                   *               *
                     U/S DATA   STATION    INVERT  SECT LAT-1 LAT-2   N      Q3        Q4     INVERT-3 INVERT-4  PHI 3  PHI 4
                                3199.300  374.623    5    10     0   .013    45.000      .000   374.623      .000 -90.000     .000
                                                                                                    RADIUS    ANGLE
                                                                                                      .000     .000
                                                        W S P G W                                                                       PAGE NO   5
                                   WATER SURFACE PROFILE - ELEMENT CARD LISTING
 ELEMENT NO  33 IS A REACH             *         *     *
                     U/S DATA   STATION    INVERT  SECT              N                                  RADIUS    ANGLE     ANG PT  MAN H
                                3223.120  374.870    5              .013                                 .000     .000      .000     1
 ELEMENT NO  34 IS A REACH             *         *     *
                     U/S DATA   STATION    INVERT  SECT              N                                  RADIUS    ANGLE     ANG PT  MAN H
                                3303.900  375.980    5              .013                                 .000     .000      .000     0
 ELEMENT NO  35 IS A TRANSITION        *         *     *
                     U/S DATA   STATION    INVERT  SECT              N                                  RADIUS   ANGLE
                                3308.900  376.015    4              .013                                 .000     .000
 ELEMENT NO  36 IS A TRANSITION        *         *     *
                     U/S DATA   STATION    INVERT  SECT              N                                  RADIUS   ANGLE
                                3329.440  376.159    4              .013                                 .000     .000
 ELEMENT NO  37 IS A TRANSITION        *         *     *
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                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS   ANGLE
                             3345.180  376.270    4              .013                           .000     .000
ELEMENT NO  38 IS A JUNCTION         *         *     *     *                    *                    *              *
                  U/S DATA   STATION    INVERT  SECT LAT-1 LAT-2   N      Q3         Q4     INVERT-3 INVERT-4  PHI 3  PHI 4
                             3355.180  376.384    4    11     0   .013    48.000      .000   376.384      .000 -90.000     .000
                                                                                             RADIUS    ANGLE
                                                                                               .000     .000
ELEMENT NO  39 IS A REACH            *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             3599.630  379.180    4              .013                           .000     .000      .000     1
ELEMENT NO  40 IS A REACH            *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             3625.790  379.479    4              .013                        350.039   -4.282      .000     0
ELEMENT NO  41 IS A REACH            *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             3887.300  382.470    4              .013                           .000     .000      .000     0
ELEMENT NO  42 IS A JUNCTION         *         *     *     *                    *                    *              *
                  U/S DATA   STATION    INVERT  SECT LAT-1 LAT-2   N      Q3         Q4     INVERT-3 INVERT-4  PHI 3  PHI 4
                             3897.300  382.584    4    11     0   .013    48.000      .000   382.584      .000 -90.000     .000
                                                                                             RADIUS    ANGLE
                                                                                               .000     .000
                                                        W S P G W                                                  PAGE NO   6
                                  WATER SURFACE PROFILE - ELEMENT CARD LISTING
ELEMENT NO  43 IS A REACH            *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             4089.300  384.780    4              .013                           .000     .000      .000     0
ELEMENT NO  44 IS A JUNCTION         *         *     *     *                    *                    *              *
                  U/S DATA   STATION    INVERT  SECT LAT-1 LAT-2   N      Q3         Q4     INVERT-3 INVERT-4  PHI 3  PHI 4
                             4135.720  385.310   14    14     0   .013  2335.000      .000   385.310      .000    .000     .000
                                                                                             RADIUS    ANGLE
                                                                                               .000     .000
ELEMENT NO  45 IS A REACH            *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             4141.600  385.389   14              .013                           .000     .000      .000     0
ELEMENT NO  46 IS A REACH            *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             4211.510  386.322   14              .013                        380.031   10.540      .000     1
ELEMENT NO  47 IS A REACH            *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             4223.540  386.483   14              .013                           .000     .000      .000     0
ELEMENT NO  48 IS A TRANSITION       *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS   ANGLE
                             4243.540  386.750    6              .013                           .000     .000
ELEMENT NO  49 IS A REACH            *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             4420.540  389.120    6              .013                           .000     .000      .000     0
ELEMENT NO  50 IS A TRANSITION       *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS   ANGLE
                             4440.540  390.218    7              .013                           .000     .000
ELEMENT NO  51 IS A TRANSITION       *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS   ANGLE
                             4453.210  390.913    7              .013                        230.017   -3.156
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ELEMENT NO  52 IS A TRANSITION          *          *      *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS   ANGLE
                             4463.540  391.480    7              .013                       230.031   -2.573
ELEMENT NO  53 IS A REACH               *          *      *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             4497.740  391.638    7              .013                       229.991   -8.520      .000     0
ELEMENT NO  54 IS A REACH               *          *      *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             4579.220  392.015    7              .013                        .000      .000      .000     0
                                                    W S P G W                                                            PAGE NO   7
                          WATER SURFACE PROFILE - ELEMENT CARD LISTING
ELEMENT NO  55 IS A TRANSITION          *          *      *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS   ANGLE
                             4595.380  392.089    7              .013                        .000     .000
ELEMENT NO  56 IS A REACH               *          *      *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             4623.640  392.220    7              .013                        .000      .000      .000     0
ELEMENT NO  57 IS A REACH               *          *      *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             4703.020  393.220    7              .013                        .000      .000      .000     1
ELEMENT NO  58 IS A TRANSITION          *          *      *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS   ANGLE
                             4713.020  393.340    7              .013                        .000     .000
ELEMENT NO  59 IS A REACH               *          *      *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             4739.960  393.663    7              .013                        .000      .000      .000     0
ELEMENT NO  60 IS A REACH               *          *      *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             4880.820  395.350    7              .013                       155.850   51.785      .000     0
ELEMENT NO  61 IS A REACH               *          *      *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             5191.140  397.650    7              .013                        .000      .000      .000     0
ELEMENT NO  62 IS A REACH               *          *      *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             5383.640  399.749    7              .013                       238.851   46.177      .000     1
ELEMENT NO  63 IS A TRANSITION          *          *      *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS   ANGLE
                             5392.380  399.844    7              .013                       238.908    2.096
ELEMENT NO  64 IS A TRANSITION          *          *      *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS   ANGLE
                             5406.640  400.000    7              .013                        .000     .000
ELEMENT NO  65 IS A SYSTEM HEADWORKS                   *                      *
                  U/S DATA   STATION    INVERT  SECT                                 W S ELEV
                             5406.640  400.000    7                                   400.000
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Program Package Serial Number: 1806

WATER SURFACE PROFILE LISTING Date: 8-23-2013 Time:10:47: 1

SR-710 NORTH STUDY
DORCHESTER DRAIN LINE-A EAST & LINE-B (Existing)(NGVD 29)
MODEL: W.CHEN REVIEW: G.HSU

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope				SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch	
491.000	351.820	11.941	363.761	5481.00	23.75	8.76	372.52	12.75	12.75	20.00	12.750	20.000	.00	1 .7
TRANS STR	.0082					.0083	.22	12.75	1.23		.013	.00	.00	BOX
				---------- WARNING - Flow depth near top of box conduit ----------										
517.000	352.033	11.920	363.953	5481.00	23.79	8.79	372.74	12.75	12.75	20.00	12.750	20.000	.00	1 .7
27.030	.0082					.0084	.23	12.75	1.24	12.00	.013	.00	.00	BOX
				---------- WARNING - Flow depth near top of box conduit ----------										
544.030	352.255	11.912	364.167	5481.00	23.80	8.80	372.97	.00	12.75	20.00	12.750	20.000	.00	1 .7
371.970	.0082					.0086	3.19	11.91	1.24	12.00	.013	.00	.00	BOX
				---------- WARNING - Flow depth near top of box conduit ----------										
916.000	355.310	11.648	366.958	5481.00	24.34	9.20	376.16	12.75	12.75	20.00	12.750	20.000	.00	1 .7
162.000	.0082					.0090	1.46	12.75	1.28	12.00	.013	.00	.00	BOX
				---------- WARNING - Flow depth near top of box conduit ----------										
1078.000	356.640	11.440	368.080	5481.00	24.79	9.54	377.62	12.75	12.75	20.00	12.750	20.000	.00	1 .7
JUNCT STR	.0083					.0095	.09	12.75	1.31		.013	.00	.00	BOX

Program Package Serial Number: 1806

WATER SURFACE PROFILE LISTING Date: 8-23-2013 Time:10:47: 1

SR-710 NORTH STUDY

DORCHESTER DRAIN LINE-A EAST & LINE-B (Existing)(NGVD 29)

MODEL: W.CHEN REVIEW: G.HSU

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS) / SF Ave	Vel Head / HF	Energy Grd.El. / SE Dpth	Super Elev / Froude N	Critical Depth / Norm Dp	Flow Top Width / "N"	Height/Dia.-FT / X-Fall	Base Wt or I.D. / ZR	ZL	No Wth Prs/Pip / Type Ch
1088.000	356.723	11.111	367.834	5451.00	25.38	10.00	377.84	1.55	12.75	20.00	12.750	20.000	.00	1 .7
65.800	.0083				.0099	.65	12.66	1.36	11.92	.013	.00	.00	BOX	
1153.800	357.266	10.980	368.246	5451.00	25.68	10.24	378.49	.00	12.75	20.00	12.750	20.000	.00	1 .7
20.000	.0083				.0101	.20	10.98	1.39	11.92	.013	.00	.00	BOX	
1173.800	357.431	10.937	368.368	5451.00	25.78	10.32	378.69	1.60	12.75	20.00	12.750	20.000	.00	1 .7
76.200	.0083				.0103	.79	12.53	1.40	11.92	.013	.00	.00	BOX	
1250.000	358.060	10.767	368.827	5451.00	26.19	10.65	379.48	1.65	12.75	20.00	12.750	20.000	.00	1 .7
BRIDGE ENTRANCE														
1250.000	358.060	10.041	368.101	5451.00	27.14	11.44	379.54	1.83	13.21	20.00	14.000	20.000	.00	0 .0
29.740	.0082				.0076	.23	11.87	1.51	9.77	.014	.00	.00	RECTANG	
1279.740	358.304	10.055	368.359	5451.00	27.11	11.41	379.77	1.83	13.21	20.00	14.000	20.000	.00	0 .0
29.260	.0082				.0076	.22	11.88	1.51	9.79	.014	.00	.00	RECTANG	
1309.000	358.543	10.068	368.611	5451.00	27.07	11.38	379.99	1.82	13.21	20.00	14.000	20.000	.00	0 .0
89.800	.0082				.0075	.68	11.89	1.50	9.77	.014	.00	.00	RECTANG	
1398.800	359.279	10.116	369.395	5451.00	26.94	11.27	380.67	.23	13.21	20.00	14.000	20.000	.00	0 .0
86.200	.0082				.0074	.64	10.34	1.49	9.78	.014	.00	.00	RECTANG	
1485.000	359.985	10.171	370.156	5451.00	26.80	11.15	381.31	.22	13.21	20.00	14.000	20.000	.00	0 .0
JUNCT STR	.0082				.0075	.15	10.39	1.48		.014	.00	.00	RECTANG	

Program Package Serial Number: 1806

WATER SURFACE PROFILE LISTING Date: 8-23-2013 Time:10:47: 1

SR-710 NORTH STUDY

DORCHESTER DRAIN LINE-A EAST & LINE-B (Existing)(NGVD 29)

MODEL: W.CHEN REVIEW: G.HSU

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
1505.000	360.149	9.997	370.146	5422.00	27.12	11.42	381.57	.23	13.17	20.00	14.000	20.000	.00	0 .0
249.090	.0082					.0075	1.87	10.23	1.51	9.74	.014	.00	.00	RECTANG
1754.090	362.189	10.136	372.325	5422.00	26.75	11.11	383.43	1.05	13.17	20.00	14.000	20.000	.00	0 .0
259.310	.0082					.0071	1.85	11.18	1.48	9.74	.014	.00	.00	RECTANG
2013.400	364.313	10.383	374.696	5422.00	26.11	10.59	385.28	1.00	13.17	20.00	14.000	20.000	.00	0 .0
176.600	.0082					.0067	1.18	11.38	1.43	9.74	.014	.00	.00	RECTANG
2190.000	365.760	10.662	376.422	5422.00	25.43	10.04	386.46	.94	13.17	20.00	14.000	20.000	.00	0 .0
JUNCT STR	.0082					.0066	.20	11.61	1.37		.014	.00	.00	RECTANG
2220.000	366.005	10.431	376.436	5392.00	25.85	10.37	386.81	.98	13.12	20.00	14.000	20.000	.00	0 .0
44.530	.0082					.0067	.30	11.41	1.41	9.70	.014	.00	.00	RECTANG
2264.530	366.370	10.500	376.870	5392.00	25.68	10.24	387.11	.82	13.12	20.00	14.000	20.000	.00	0 .0
185.470	.0082					.0063	1.17	11.32	1.40	9.69	.014	.00	.00	RECTANG
2450.000	367.893	10.923	378.816	5392.00	24.68	9.46	388.28	.76	13.12	20.00	14.000	20.000	.00	0 .0
JUNCT STR	.0082					.0062	.20	11.68	1.32		.014	.00	.00	RECTANG
2482.310	368.158	10.512	378.670	5339.00	25.39	10.01	388.68	.00	13.03	20.00	14.000	20.000	.00	0 .0
67.690	.0082					.0064	.43	10.51	1.38	9.62	.014	.00	.00	RECTANG
2550.000	368.714	10.657	379.371	5339.00	25.05	9.74	389.11	.00	13.03	20.00	14.000	20.000	.00	0 .0
75.000	.0082					.0061	.46	10.66	1.35	9.62	.014	.00	.00	RECTANG

Program Package Serial Number: 1806

WATER SURFACE PROFILE LISTING Date: 8-23-2013 Time:10:47: 1

SR-710 NORTH STUDY
DORCHESTER DRAIN LINE-A EAST & LINE-B (Existing)(NGVD 29)
MODEL: W.CHEN REVIEW: G.HSU

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope				SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch	
2625.000	369.330	10.861	380.191	5339.00	24.58	9.38	389.57	.00	13.03	20.00	14.000	20.000	.00	0 .0
TRANS STR	.0128					.0060	.30	10.86	1.31		.014	.00	.00	RECTANG
2675.000	369.970	10.485	380.455	5339.00	24.63	9.42	389.88	.00	12.75	20.67	14.000	20.670	.00	0 .0
BRIDGE EXIT														
2675.000	369.970	11.384	381.354	5339.00	23.45	8.54	389.89	.00	12.00	20.67	12.000	20.670	.00	1 .7
105.000	.0066					.0083	.87	11.38	1.25	12.00	.013	.00	.00	BOX
---------- WARNING - Flow depth near top of box conduit ----------														
2780.000	370.661	11.068	381.729	5339.00	24.12	9.03	390.76	.00	12.00	20.67	12.000	20.670	.00	1 .7
JUNCT STR	.0066					.0089	.09	11.07	1.30		.013	.00	.00	BOX
---------- WARNING - Flow depth near top of box conduit ----------														
2790.000	370.727	10.601	381.328	5289.00	24.95	9.66	390.99	.00	12.00	20.67	12.000	20.670	.00	1 .7
27.323	.0066					.0094	.26	10.60	1.37	12.00	.013	.00	.00	BOX
2817.323	370.907	10.509	381.416	5289.00	25.16	9.83	391.25	.00	12.00	20.67	12.000	20.670	.00	1 .7
140.187	.0066					.0101	1.42	10.51	1.39	12.00	.013	.00	.00	BOX
2957.510	371.830	10.020	381.850	5289.00	26.39	10.82	392.67	.00	12.00	20.67	12.000	20.670	.00	1 .7
TRANS STR	.0220					.0104	.26	10.02	1.49		.013	.00	.00	BOX

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WATER SURFACE PROFILE LISTING Date: 8-23-2013 Time:10:47: 1

SR-710 NORTH STUDY

DORCHESTER DRAIN LINE-A EAST & LINE-B (Existing)(NGVD 29)

MODEL: W.CHEN REVIEW: G.HSU

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS) / SF Ave	Vel Head / HF	Energy Grd.El. / SE Dpth	Super Elev / Froude N	Critical Depth / Norm Dp	Flow Top Width / "N"	Height/Dia.-FT / X-Fall	Base Wt or I.D. / ZR	ZL	No Wth Prs/Pip / Type Ch
2982.510	372.380	10.243	382.623	5289.00	25.82	10.35	392.97	.00	12.00	20.67	12.000	20.670	.00	1 .7
206.790	.0103					.0101	2.08	10.24	1.45	10.16	.013	.00	.00	BOX
3189.300	374.520	10.300	384.820	5289.00	25.68	10.24	395.06	.00	12.00	20.67	12.000	20.670	.00	1 .7
JUNCT STR	.0103					.0103	.10	10.30	1.43		.013	.00	.00	BOX
3199.300	374.623	9.965	384.588	5244.00	26.31	10.75	395.34	.00	12.00	20.67	12.000	20.670	.00	1 .7
23.820	.0104					.0107	.25	9.96	1.49	10.08	.013	.00	.00	BOX
3223.120	374.870	9.959	384.829	5244.00	26.33	10.76	395.59	.00	12.00	20.67	12.000	20.670	.00	1 .7
80.780	.0137					.0104	.84	9.96	1.49	8.99	.013	.00	.00	BOX
3303.900	375.980	10.211	386.191	5244.00	25.68	10.24	396.43	.00	12.00	20.67	12.000	20.670	.00	1 .7
TRANS STR	.0070					.0101	.05	10.21	1.44		.013	.00	.00	BOX
3308.900	376.015	10.185	386.200	5244.00	25.74	10.29	396.49	.00	12.00	20.67	12.000	20.670	.00	1 .7
TRANS STR	.0070					.0102	.21	10.19	1.45		.013	.00	.00	BOX
3329.440	376.159	10.081	386.240	5244.00	26.01	10.50	396.74	.00	12.00	20.67	12.000	20.670	.00	1 .7
TRANS STR	.0071					.0105	.16	10.08	1.47		.013	.00	.00	BOX
3345.180	376.270	10.002	386.272	5244.00	26.21	10.67	396.94	.00	12.00	20.67	12.000	20.670	.00	1 .7
JUNCT STR	.0114					.0109	.11	10.00	1.48		.013	.00	.00	BOX
3355.180	376.384	9.677	386.061	5196.00	26.85	11.19	397.25	.00	12.00	20.67	12.000	20.670	.00	1 .7
244.450	.0114					.0112	2.73	9.68	1.55	9.61	.013	.00	.00	BOX

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SR-710 NORTH STUDY

DORCHESTER DRAIN LINE-A EAST & LINE-B (Existing)(NGVD 29)

MODEL: W.CHEN REVIEW: G.HSU

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS) / SF Ave	Vel Head / HF	Energy Grd.El. / SE Dpth	Super Elev / Froude N	Critical Depth / Norm Dp	Flow Top Width / "N"	Height/Dia.-FT / X-Fall	Base Wt or I.D. / ZR	ZL	No Wth Prs/Pip / Type Ch
3599.630	379.180	9.727	388.907	5196.00	26.71	11.08	399.98	1.27	12.00	20.67	12.000	20.670	.00	1 .7
26.160	.0114				.0111	.29	10.99	1.53	9.61	.013	.00	.00	BOX	
3625.790	379.479	9.734	389.213	5196.00	26.69	11.06	400.27	.00	12.00	20.67	12.000	20.670	.00	1 .7
261.510	.0114				.0109	2.86	9.73	1.53	9.61	.013	.00	.00	BOX	
3887.300	382.470	9.840	392.310	5196.00	26.40	10.82	403.13	.00	12.00	20.67	12.000	20.670	.00	1 .7
JUNCT STR	.0114				.0111	.11	9.84	1.51		.013	.00	.00	BOX	
3897.300	382.584	9.523	392.107	5148.00	27.03	11.34	403.45	.00	12.00	20.67	12.000	20.670	.00	1 .7
192.000	.0114				.0115	2.21	9.52	1.57	9.54	.013	.00	.00	BOX	
4089.300	384.780	9.515	394.295	5148.00	27.05	11.36	405.66	.00	12.00	20.67	12.000	20.670	.00	1 .7
JUNCT STR	.0114				.0120	.56	9.52	1.57		.013	.00	.00	BOX	
4135.720	385.310	9.913	395.223	2813.00	28.38	12.50	407.73	.00	12.00	10.00	12.000	10.000	.00	0 .0
5.880	.0134				.0124	.07	9.91	1.59	9.60	.013	.00	.00	BOX	
4141.600	385.389	9.917	395.306	2813.00	28.37	12.49	407.80	.66	12.00	10.00	12.000	10.000	.00	0 .0
69.910	.0133				.0123	.86	10.57	1.59	9.63	.013	.00	.00	BOX	
4211.510	386.322	9.964	396.286	2813.00	28.23	12.38	408.66	.00	12.00	10.00	12.000	10.000	.00	0 .0
12.030	.0134				.0123	.15	9.96	1.58	9.62	.013	.00	.00	BOX	
4223.540	386.483	9.973	396.456	2813.00	28.21	12.36	408.81	.00	12.00	10.00	12.000	10.000	.00	0 .0
TRANS STR	.0133				.0121	.24	9.97	1.57		.013	.00	.00	BOX	

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SR-710 NORTH STUDY

DORCHESTER DRAIN LINE-A EAST & LINE-B (Existing)(NGVD 29)

MODEL: W.CHEN REVIEW: G.HSU

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope				SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch	
4243.540	386.750	10.440	397.190	2813.00	27.69	11.91	409.10	.00	12.00	9.73	12.000	9.730	.00	0 .0
177.000	.0134					.0115	2.03	10.44	1.51	9.93	.013	.00	.00	BOX
4420.540	389.120	10.722	399.842	2813.00	26.96	11.29	411.13	.00	12.00	9.73	12.000	9.730	.00	0 .0
TRANS STR	.0549					.0107	.21	10.72	1.45		.013	.00	.00	BOX
4440.540	390.218	10.429	400.647	2813.00	26.31	10.75	411.40	.96	13.25	10.25	13.250	10.250	.00	0 .0
TRANS STR	.0549					.0097	.12	11.39	1.44		.013	.00	.00	BOX
4453.210	390.913	10.944	401.857	2813.00	25.08	9.76	411.62	.87	13.25	10.25	13.250	10.250	.00	0 .0
TRANS STR	.0549					.0085	.09	11.81	1.34		.013	.00	.00	BOX
4463.540	391.480	11.531	403.011	2813.00	23.80	8.80	411.81	.39	13.25	10.25	13.250	10.250	.00	0 .0
34.200	.0046					.0082	.28	11.92	1.24	13.25	.013	.00	.00	BOX
4497.740	391.638	11.316	402.954	2813.00	24.25	9.13	412.09	.00	13.25	10.25	13.250	10.250	.00	0 .0
81.480	.0046					.0088	.72	11.32	1.27	13.25	.013	.00	.00	BOX
4579.220	392.015	10.840	402.855	2813.00	25.32	9.95	412.81	.00	13.25	10.25	13.250	10.250	.00	0 .0
TRANS STR	.0046					.0095	.15	10.84	1.36		.013	.00	.00	BOX
4595.380	392.089	10.682	402.771	2813.00	25.69	10.25	413.02	.00	13.25	10.25	13.250	10.250	.00	0 .0
28.260	.0046					.0098	.28	10.68	1.39	13.25	.013	.00	.00	BOX
4623.640	392.220	10.530	402.750	2813.00	26.06	10.55	413.30	.00	13.25	10.25	13.250	10.250	.00	0 .0
79.380	.0126					.0097	.77	10.53	1.42	9.58	.013	.00	.00	BOX

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SR-710 NORTH STUDY

DORCHESTER DRAIN LINE-A EAST & LINE-B (Existing)(NGVD 29)

MODEL: W.CHEN REVIEW: G.HSU

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS) / SF Ave	Vel Head / HF	Energy Grd.El. / SE Dpth	Super Elev / Froude N	Critical Depth / Norm Dp	Flow Top Width / "N"	Height/Dia.-FT / X-Fall	Base Wt or I.D. / ZR	ZL	No Wth Prs/Pip / Type Ch
4703.020	393.220	10.774	403.994	2813.00	25.47	10.07	414.07	.00	13.25	10.25	13.250	10.250	.00	0 .0
TRANS STR	.0120					.0094	.09	10.77	1.37		.013	.00	.00	BOX
4713.020	393.340	10.798	404.138	2813.00	25.42	10.03	414.17	.00	13.25	10.25	13.250	10.250	.00	0 .0
26.940	.0120					.0093	.25	10.80	1.36	9.77	.013	.00	.00	BOX
4739.960	393.663	10.885	404.548	2813.00	25.21	9.87	414.42	1.30	13.25	10.25	13.250	10.250	.00	0 .0
52.066	.0120					.0090	.47	12.18	1.35	9.78	.013	.00	.00	BOX
4792.026	394.287	11.087	405.373	2813.00	24.75	9.51	414.89	1.25	13.25	10.25	13.250	10.250	.00	0 .0
88.794	.0120					.0083	.74	12.34	1.31	9.78	.013	.00	.00	BOX
4880.820	395.350	11.628	406.978	2813.00	23.60	8.65	415.63	.00	13.25	10.25	13.250	10.250	.00	0 .0
310.320	.0074					.0082	2.56	11.63	1.22	11.91	.013	.00	.00	BOX
5191.141	397.650	11.184	408.833	2813.00	24.54	9.35	418.18	.80	13.25	10.25	13.250	10.250	.00	0 .0
47.437	.0109					.0085	.40	11.99	1.29	10.16	.013	.00	.00	BOX
5238.577	398.167	11.367	409.534	2813.00	24.14	9.05	418.59	.78	13.25	10.25	13.250	10.250	.00	0 .0
87.583	.0109					.0078	.69	12.14	1.26	10.16	.013	.00	.00	BOX
5326.160	399.122	11.922	411.044	2813.00	23.02	8.23	419.27	.71	13.25	10.25	13.250	10.250	.00	0 .0
42.513	.0109					.0070	.30	12.63	1.17	10.16	.013	.00	.00	BOX
5368.673	399.586	12.504	412.089	2813.00	21.95	7.48	419.57	.64	13.25	10.25	13.250	10.250	.00	0 .0
14.967	.0109					.0062	.09	13.15	1.09	10.16	.013	.00	.00	BOX

---------- WARNING - Flow depth near top of box conduit ----------

Program Package Serial Number: 1806

WATER SURFACE PROFILE LISTING Date: 8-23-2013 Time:10:47: 1

SR-710 NORTH STUDY

DORCHESTER DRAIN LINE-A EAST & LINE-B (Existing)(NGVD 29)

MODEL: W.CHEN REVIEW: G.HSU

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope				SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch	
5383.640	399.749	13.114	412.863	2813.00	20.93	6.80	419.66	13.25	13.25	10.25	13.250	10.250	.00	0 .0
TRANS STR	.0109					.0061	.05	13.25	1.02		.013	.00	.00	BOX
				WARNING - Flow depth near top of box conduit										
5392.380	399.844	12.816	412.660	2813.00	21.41	7.12	419.78	.00	13.25	10.25	13.250	10.250	.00	0 .0
TRANS STR	.0109					.0060	.09	12.82	1.05		.013	.00	.00	BOX
				WARNING - Flow depth near top of box conduit										
5406.640	400.000	13.250	413.250	2813.00	20.71	6.66	419.91	.00	13.25	10.25	13.250	10.250	.00	0 .0

SR-710 NORTH STUDY -- PROPOSED REGIONAL CHANNEL SUMMARY
(Project 65 Line A and Line B)

6/13/2013

System No	Station Model	Station Design plan	Channel Type	Elevation (NGVD29) (ft)	Length (LF)	Slope (%)	Q50 (City) cfs	Q (Study) cfs	Note
Main Lines									
Dorchester Drain	4+91.00	4+13.00	SYSTEM OUTLET	351.820			5481	**5481**	
Line "A"	5+17.00	4+39.00	TRAN. STRUCTURE	352.033	26.00	0.821%	5481	**5481**	Δ =-5.959 ° , R = 250'
	5+44.03	4+66.03	DBL 9.67'x12.75' RCB	352.255	27.03	0.821%	5481	**5481**	Δ =-6.195 ° , R = 250'
	9+16.00	8+38.00	DBL 9.67'x12.75' RCB	355.310	371.97	0.821%	5481	**5481**	
	10+78.00	10+00.00	DBL 9.67'x12.75' RCB	356.640	162.00	0.821%	5481	**5481**	Δ=37.127 ° , R=250'
	10+88.00	+88.00	JUNCTION STRUCTURE	356.723	10.00	0.826%	5481	**5481**	10+00.00=0+78.00 JOIN 72" RCP (Q=30cfs) Δ =2.291 ° , R = 250'
	11+53.80	1+53.80	DBL 9.67'x12.75' RCB	357.266	65.80	0.826%	N/A	**5451**	Δ =15.080 ° , R = 250'
	11+73.80	1+73.80	DBL 9.67'x12.75' RCB	357.431	20.00	0.826%	N/A	**5451**	
	12+50.00	2+50.00	DBL 9.67'x12.75' RCB	358.060	76.20	0.826%	N/A	**5451**	Δ =17.464 ° , R = 250'
	12+50.00	2+50.00	Bridge Entrance	358.060	0.00	0.826%	N/A	**5451**	
	12+79.74	2+79.74	20.00'X14.00' RCC	358.304	29.74	0.819%	N/A	**5451**	Δ =6.816 ° , R = 250'
	13+09.00	3+09.00	20.00'X14.00' RCC	358.543	29.26	0.819%	N/A	**5451**	Δ =-6.706 ° , R = 250'
	13+09.00	3+09.00	Bridge Exit	358.543	0.00	0.819%	N/A	**5451**	
	13+98.80	3+98.80	DBL 9.67'x14.00' RCB	359.279	89.80	0.819%	N/A	**5451**	Δ =-20.581 ° , R = 250'
	14+85.00	4+85.00	DBL 9.67'x14.00' RCB	359.985	86.20	0.819%	N/A	**5451**	Δ =-2.469 ° , R =2000'
	15+05.00	5+05.00	JUNCTION STRUCTURE	360.149	20.00	0.819%	N/A	**5451**	Δ =-0.573 ° , R =2000' Lateral 30"RCP (Q=29 cfs)
	17+54.09	7+54.09	DBL 9.67'x14.00' RCB	362.189	249.09	0.819%	N/A	**5422**	Δ =-7.136 ° , R =2000'
	20+13.40	10+13.40	DBL 9.67'x14.00' RCB	364.313	259.31	0.819%	N/A	**5422**	Δ =-34.960 ° , R = 425'
	20+37.00	10+37.00	DBL 9.67'x14.00' RCB	364.506	23.60	0.819%	N/A	**5422**	Δ =3.182° , R = 425'
	20+37.00	10+37.00	Bridge Entrance	364.506	0.00	0.819%	N/A	**5392**	
	21+90.00	11+90.00	20.00'X14.00' RCC	365.760	153.00	0.819%	N/A	**5422**	Δ =20.626° , R = 425'
	22+20.00	12+20.00	JUNCTION STRUCTURE	366.005	30.00	0.819%	N/A	**5422**	Δ =4.044 ° , R = 425' Lateral 30" RCP (Q=30cfs)
	22+64.53	12+64.53	20.00'X14.00' RCC	366.370	44.53	0.819%	5392	**5392**	Δ =6.003 ° , R = 425'
	22+83.00	12+83.00	Bridge Exit	366.521	18.47	0.819%	5392	**5392**	
	22+83.00	12+83.00	DBL 9.67'x14.00' RCB	366.521	0.00	0.819%	5392	**5392**	Δ =-2.117 ° , R = 500'
	24+50.00	14+50.00	DBL 9.67'x14.00' RCB	367.893	167.00	0.819%	5392	**5392**	Δ =-19.137 ° , R = 500'
	24+82.31	14+82.31	JUNCTION STRUCTURE	368.158	32.31	0.821%	5392	**5392**	Δ =-3.702 ° , R = 500' Lateral 45" RCP (Q=53cfs)
	25+50.00	15+50.00	DBL 9.67'x14.00' RCB	368.714	67.69	0.821%	5392	**5339**	
	25+50.00	15+50.00	Bridge Entrance	368.714	0.00	0.821%	5392	**5339**	
	26+25.00	16+25.00	20.00'X14.00' RCC	369.330	75.00	0.821%	5339	**5339**	
	26+75.00	16+75.00	TRAN. STRUCTURE	369.970	50.00	1.280%	5339	**5339**	
	27+80.00	17+80.00	DBL 10.00'x12.00' RCB	370.661	105.00	0.658%	5339	**5339**	
	27+90.00	17+90.00	JUNCTION STRUCTURE	370.727	10.00	0.658%	5339	**5339**	Lateral 30" RCP (Q=50cfs)
	29+57.51	19+57.51	DBL 10.00'x12.00' RCB	371.830	167.51	0.658%	N/A	**5289**	
	29+82.51	+25.21	TRAN. STRUCTURE	372.380	25.00	2.200%	N/A	**5289**	19+57.51=0+00.21
	31+89.30	2+32.00	DBL 10.00'x12.00' RCB	374.520	206.79	1.035%	N/A	**5289**	∠-5.027° MH 1
	31+99.30	2+42.00	JUNCTION STRUCTURE	374.623	10.00	1.035%	N/A	**5289**	Lateral 36" RCP(Q=45cfs)
	32+23.12	2+65.82	DBL 10.00'x12.00' RCB	374.870	23.82	1.035%	N/A	**5244**	MH 1
	33+03.90	3+46.60	DBL 10.00'x12.00' RCB	375.980	80.78	1.374%	N/A	**5244**	
	33+08.90	3+51.60	TRAN. STRUCTURE	376.015	5.00	0.703%	N/A	**5244**	
	33+29.44	3+72.14	TRAN. STRUCTURE	376.159	20.54	0.703%	N/A	**5244**	Δ =11.770 ° , R =100'
	33+45.18	3+87.88	TRAN. STRUCTURE	376.270	15.74	0.703%	N/A	**5244**	
	33+55.18	3+97.88	JUNCTION STRUCTURE	376.384	10.00	1.144%	N/A	**5244**	Lateral 24" RCP(Q=48cfs)
	35+99.63	6+42.33	DBL 10.00'x12.00' RCB	379.180	244.45	1.144%	N/A	**5196**	MH
	36+25.79	6+68.49	DBL 10.00'x12.00' RCB	379.479	26.16	1.144%	N/A	**5196**	Δ =-4.282 ° , R =350'
	38+87.30	9+30.00	TRAN. STRUCTURE	382.470	261.51	1.144%	N/A	**5196**	
	38+97.30	9+40.00	JUNCTION STRUCTURE	382.584	10.00	1.144%	N/A	**5196**	Lateral 24" RCP(Q=48cfs)
	40+89.30	11+32.00	DBL 10.00'x12.00' RCB	384.780	192.00	1.144%	5148	**5148**	
	41+35.72	11+78.42	TRAN. STRUCTURE	385.310	46.42	1.142%	5148	**5148**	
	41+41.60	11+84.30	DBL 10.00'x12.00' RCB	385.389	5.88	1.336%	5148	**5148**	
	42+11.51	12+54.21	DBL 10.00'x12.00' RCB	386.322	69.91	1.336%	5148	**5148**	Δ =10.54 ° , R =380' MH
	42+23.54	12+66.24	DBL 10.00'x12.00' RCB	386.483	12.03	1.336%	5148	**5148**	
	42+43.54	12+86.24	TRAN. STRUCTURE	386.750	20.00	1.336%	5148	**5148**	
	44+20.54	14+63.24	DBL 12.00'x12.00' Horseshoe Arch	389.120	177.00	1.339%	5148	**5148**	
	44+40.54	14+83.24	JUNCTION STRUCTURE	390.218	20.00	5.488%	5148	**5148**	JOIN LINE-A WEST (Q=2335cfs)
Line "A" East	44+53.21	14+95.91	TRAN. STRUCTURE	390.913	12.67	5.488%	N/A	**2813**	Δ=-3.156 ° , R=230'
	44+63.54	15+06.24	TRAN. STRUCTURE	391.480	10.33	5.488%	N/A	**2813**	Δ=-2.573 °, R=230'
	44+97.74	15+40.44	10.25'x13.25' RCB	391.638	34.20	0.462%	N/A	**2813**	Δ =-8.520 ° , R =230'
	45+79.22	16+21.92	10.25'x13.25' RCB	392.015	81.48	0.462%	N/A	**2813**	
	45+95.38	16+38.08	TRAN. STRUCTURE	392.089	16.16	0.462%	N/A	**2813**	
	46+23.64	16+66.34	10.25'x13.25' RCB	392.220	28.26	0.462%	N/A	**2813**	
Line "B"	47+03.02	7+03.62	10.25'x13.25' RCB	393.220	79.38	1.260%	N/A	**2813**	16+66.34=7+83.00 MH
	47+13.02	6+93.62	TRAN. STRUCTURE	393.340	10.00	1.200%	N/A	**2813**	
	47+39.96	6+66.68	10.00'x13.25' RCB	393.663	26.94	1.198%	N/A	**2813**	
	48+80.82	5+25.82	10.00'x13.25' RCB	395.350	140.86	1.198%	N/A	**2813**	Δ =51.785 ° , R =155.85'
	51+91.14	2+15.50	10.00'x13.25' RCB	397.650	310.32	0.741%	N/A	**2813**	
	53+83.64	+23.00	10.00'x13.25' RCB	399.749	192.50	1.090%	N/A	**2813**	Δ =46.177 ° , R =238.85' MH
	53+92.38	+14.26	TRAN. STRUCTURE	399.844	8.74	1.090%	N/A	**2813**	Δ =2.096 ° , R =238.85'
	54+06.64	+0.00	TRAN. STRUCTURE	400.000	14.26	1.090%	N/A	**2813**	Q=5148-2335 cfs

SR-710 NORTH STUDY -- PROPOSED REGIONAL CHANNEL SUMMARY
(Project 65 Line A and Line B)

6/13/2013

System No	Station Model	Station Design plan	Channel Type	Elevation (NGVD29) (ft)	Length (LF)	Slope	Q50 (City) cfs	Q (Study) cfs	Note
Laterals									
Line "A" West	+40.54	14+75.90	11.00'x12.50' RCB	390.180		5.299%	2335	**2335**	Join Line "B"
	+52.79	14+88.15	11.00'x12.50' RCB	390.829	12.25	5.299%	2335	**2335**	
	+65.46	15+00.82	TRAN. STRUCTURE	391.501	12.67	5.299%	2335	**2335**	
	+79.79	15+15.15	11.00'x12.50' RCB	392.260	14.33	5.299%	2335	**2335**	
	+81.54	15+16.90	11.00'x12.50' RCB	392.274	1.75	0.805%	2335	**2335**	
	1+38.74	15+74.10	11.00'x12.50' RCB	392.735	57.20	0.805%	2335	**2335**	$\Delta = -14.250°$, R =230'
	2+22.57	16+57.93	11.00'x12.50' RCB	393.410	83.83	0.805%	2335	**2335**	
	3+42.21	17+78.04	11.00'x12.50' RCB	394.374	119.64	0.805%	2335	**2335**	1657.93=1658.40 $\Delta = -68.547$, R=100'
	4+11.97	18+47.80	11.00'x12.50' RCB	394.935	69.76	0.805%	2335	**2335**	$\Delta = -21.037°$, R =190' MH
	8+49.17	22+85.00	11.00'x12.50' RCB	398.460	437.20	0.805%	2335	**2335**	MH
	8+65.09	23+00.92	11.00'x12.50' RCB	398.612	15.92	0.955%	2335	**2335**	
	9+03.72	23+39.55	11.00'x12.50' RCB	398.981	38.63	0.955%	2335	**2335**	$\Delta = 34.05°$, R =65'
	9+81.99	24+17.82	11.00'x12.50' RCB	399.729	78.27	0.955%	2335	**2335**	$\Delta = 44.848°$, R =100'
	12+29.17	26+65.00	11.00'x12.50' RCB	402.090	247.18	0.955%	2335	**2335**	

WATER SURFACE PROFILE - CHANNEL DEFINITION LISTING

CARD CODE	SECT NO	CHN TYPE	NO OF PIER/PIP	AVE PIER WIDTH	HEIGHT 1 DIAMETER	BASE WIDTH	ZL	ZR	INV DROP	Y(1)	Y(2)	Y(3)	Y(4)	Y(5)	Y(6)	Y(7)	Y(8)	Y(9)	Y(10)
CD	1	3	1	.670	12.750	20.000	.000	.000	.00										
CD	2	2	0	.000	14.000	20.000			.00										
CD	3	4	1		6.000														
CD	4	3	1	.670	12.000	20.670	.000	.000	.00										
CD	5	3	1	.670	12.000	20.670	.000	.000	.00										
CD	6	3	0	.000	12.000	9.730	.000	.000	.00										
CD	7	3	0	.000	13.250	10.250	.000	.000	.00										
CD	8	3	0	.000	12.500	11.000	.000	.000	.00										
CD	9	4	1		3.750														
CD	10	4	1		3.000														
CD	11	4	1		2.000														
CD	12	4	1		2.500														
CD	13	2	0	.000	14.000	20.670			.00										
CD	14	3	1	.670	14.000	20.000	.000	.000	.00										
CD	15	3	1	.670	14.000	20.000	.000	.000	.00										
CD	23	2	0	.000	14.000	20.200			.00										
CD	24	3	1	.670	14.000	20.200	.000	.000	.00										
CD	25	3	0	.000	12.000	10.000	.000	.000	.00										

WATER SURFACE PROFILE - TITLE CARD LISTING

HEADING LINE NO 1 IS -

SR-710 NORTH STUDY

HEADING LINE NO 2 IS -

DORCHESTER DRAIN LINE-A EAST & LINE-B (P20)(NGVD 29)

HEADING LINE NO 3 IS -

MODEL: W.CHEN REVIEW: G.HSU

WATER SURFACE PROFILE - ELEMENT CARD LISTING

ELEMENT NO 1 IS A SYSTEM OUTLET * * *

U/S DATA	STATION	INVERT	SECT	W S ELEV
	491.000	351.820	1	364.500

ELEMENT NO 2 IS A TRANSITION * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE
	517.000	352.033	1	.013	249.990	-5.959

ELEMENT NO 3 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	544.030	352.255	1	.013	249.993	-6.195	.000	0

ELEMENT NO 4 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	916.000	355.310	1	.013	.000	.000	.000	0

ELEMENT NO 5 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	1078.000	356.640	1	.013	250.004	37.127	.000	0

ELEMENT NO 6 IS A JUNCTION * * * * * * *

U/S DATA	STATION	INVERT	SECT	LAT-1	LAT-2	N	Q3	Q4	INVERT-3	INVERT-4	PHI 3	PHI 4
	1088.000	356.723	1	3	0	.013	30.000	.000	361.000	.000	-76.000	.000

RADIUS	ANGLE

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                                                                                                                250.091   2.291
ELEMENT NO   7 IS A REACH                *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             1153.800  357.266    1              .013                        250.004   15.080      .000     0
ELEMENT NO   8 IS A REACH                *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             1173.800  357.431    1              .013                          .000     .000      .000     0
ELEMENT NO   9 IS A REACH                *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             1250.000  358.060    1              .013                        249.996   17.464      .000     0
ELEMENT NO  10 IS A BRIDGE ENTRANCE                   *
                  U/S DATA   STATION    INVERT  SECT             FP
                             1250.000  358.060    2              .100
ELEMENT NO  11 IS A REACH                *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             1279.740  358.304    2              .014                        249.996    6.816      .000     0
ELEMENT NO  12 IS A REACH                *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             1309.000  358.543    2              .014                        249.996   -6.706      .000     0
                                                    W S P G W                                                     PAGE NO   3
                           WATER SURFACE PROFILE - ELEMENT CARD LISTING
ELEMENT NO  13 IS A BRIDGE EXIT                       *
                  U/S DATA   STATION    INVERT  SECT
                             1309.000  358.543   14
ELEMENT NO  14 IS A REACH                *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             1398.800  359.279   14              .013                        250.008  -20.580      .000     0
ELEMENT NO  15 IS A REACH                *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             1485.000  359.985   14              .013                       2000.362   -2.469      .000     0
ELEMENT NO  16 IS A JUNCTION             *         *     *     *              *                  *                 *
                  U/S DATA   STATION    INVERT  SECT LAT-1 LAT-2   N      Q3        Q4     INVERT-3 INVERT-4  PHI 3  PHI 4
                             1505.000  360.149   14    12     0   .013    29.000      .000   361.500      .000  60.000     .000
                                                                                            RADIUS    ANGLE
                                                                                           1999.853   -.573
ELEMENT NO  17 IS A REACH                *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             1754.090  362.189   14              .013                       1999.972   -7.136      .000     0
ELEMENT NO  18 IS A REACH                *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             2013.400  364.313   14              .013                        424.982  -34.960      .000     0
ELEMENT NO  19 IS A REACH                *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             2037.000  364.506   14              .013                        424.946    3.182      .000     0
ELEMENT NO  20 IS A BRIDGE ENTRANCE                   *
                  U/S DATA   STATION    INVERT  SECT             FP
                             2037.000  364.506    2              .100
ELEMENT NO  21 IS A REACH                *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             2190.000  365.760    2              .014                        425.010   20.626      .000     0
ELEMENT NO  22 IS A JUNCTION             *         *     *     *              *                  *                 *
                  U/S DATA   STATION    INVERT  SECT LAT-1 LAT-2   N      Q3        Q4     INVERT-3 INVERT-4  PHI 3  PHI 4
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                          2220.000  366.005    2    12     0   .014    30.000      .000   367.000      .000  60.000     .000
                                                                                           RADIUS    ANGLE
                                                                                          425.043   4.044
                                                W S P G W                                                          PAGE NO   4
                                WATER SURFACE PROFILE - ELEMENT CARD LISTING
ELEMENT NO  23 IS A REACH                *         *     *
                    U/S DATA   STATION    INVERT  SECT               N                        RADIUS    ANGLE     ANG PT  MAN H
                               2233.000  366.112    2               .014                      424.897    1.753      .000     0
ELEMENT NO  24 IS A REACH                *         *     *
                    U/S DATA   STATION    INVERT  SECT               N                        RADIUS    ANGLE     ANG PT  MAN H
                               2264.530  366.370    2               .014                      424.968    4.251      .000     0
ELEMENT NO  25 IS A REACH                *         *     *
                    U/S DATA   STATION    INVERT  SECT               N                        RADIUS    ANGLE     ANG PT  MAN H
                               2283.000  366.522    2               .014                      499.883   -2.117      .000     0
ELEMENT NO  26 IS A BRIDGE EXIT                        *
                    U/S DATA   STATION    INVERT  SECT
                               2283.000  366.522   14
ELEMENT NO  27 IS A REACH                *         *     *
                    U/S DATA   STATION    INVERT  SECT               N                        RADIUS    ANGLE     ANG PT  MAN H
                               2333.000  366.932   14               .013                      499.963   -5.730      .000     0
ELEMENT NO  28 IS A REACH                *         *     *
                    U/S DATA   STATION    INVERT  SECT               N                        RADIUS    ANGLE     ANG PT  MAN H
                               2450.000  367.893   14               .013                      500.008  -13.407      .000     0
ELEMENT NO  29 IS A JUNCTION             *         *     *     *               *                    *                 *
                    U/S DATA   STATION    INVERT  SECT LAT-1 LAT-2   N      Q3        Q4     INVERT-3 INVERT-4  PHI 3  PHI 4
                               2482.310  368.158   14     9     0   .013    53.000      .000   370.000      .000  45.000     .000
                                                                                           RADIUS    ANGLE
                                                                                          500.062  -3.702
ELEMENT NO  30 IS A REACH                *         *     *
                    U/S DATA   STATION    INVERT  SECT               N                        RADIUS    ANGLE     ANG PT  MAN H
                               2550.000  368.714   14               .013                        .000     .000      .000     0
ELEMENT NO  31 IS A BRIDGE ENTRANCE                    *
                    U/S DATA   STATION    INVERT  SECT              FP
                               2550.000  368.714    2               .100
ELEMENT NO  32 IS A REACH                *         *     *
                    U/S DATA   STATION    INVERT  SECT               N                        RADIUS    ANGLE     ANG PT  MAN H
                               2625.000  369.330    2               .014                        .000     .000      .000     0
ELEMENT NO  33 IS A TRANSITION           *         *     *
                    U/S DATA   STATION    INVERT  SECT               N                        RADIUS   ANGLE
                               2675.000  369.970   13               .014                        .000     .000
ELEMENT NO  34 IS A BRIDGE EXIT                        *
                    U/S DATA   STATION    INVERT  SECT
                               2675.000  369.970    4
                                                W S P G W                                                          PAGE NO   5
                                WATER SURFACE PROFILE - ELEMENT CARD LISTING
ELEMENT NO  35 IS A REACH                *         *     *
                    U/S DATA   STATION    INVERT  SECT               N                        RADIUS    ANGLE     ANG PT  MAN H
                               2780.000  370.661    4               .013                        .000     .000      .000     0
ELEMENT NO  36 IS A JUNCTION             *         *     *     *               *                    *                 *
                    U/S DATA   STATION    INVERT  SECT LAT-1 LAT-2   N      Q3        Q4     INVERT-3 INVERT-4  PHI 3  PHI 4
                               2790.000  370.727    4    12     0   .013    50.000      .000   371.500      .000  60.000     .000
                                                                                           RADIUS    ANGLE
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                                                                                                                .000    .000
ELEMENT NO  37 IS A REACH            *         *     *
                    U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                               2957.510  371.830    4              .013                           .000     .000      .000     0
ELEMENT NO  38 IS A TRANSITION       *         *     *
                    U/S DATA   STATION    INVERT  SECT              N                          RADIUS   ANGLE
                               2982.510  372.380    5              .013                           .000     .000
ELEMENT NO  39 IS A REACH            *         *     *
                    U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                               3189.300  374.520    5              .013                           .000     .000    -5.027     1
ELEMENT NO  40 IS A JUNCTION         *         *     *     *              *                        *                *
                    U/S DATA   STATION    INVERT  SECT LAT-1 LAT-2   N      Q3        Q4     INVERT-3 INVERT-4  PHI 3  PHI 4
                               3199.300  374.623    5    10     0   .013    45.000      .000   374.623      .000 -90.000     .000
                                                                                                RADIUS    ANGLE
                                                                                                  .000    .000
ELEMENT NO  41 IS A REACH            *         *     *
                    U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                               3223.120  374.870    5              .013                           .000     .000      .000     1
ELEMENT NO  42 IS A REACH            *         *     *
                    U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                               3303.900  375.980    5              .013                           .000     .000      .000     0
ELEMENT NO  43 IS A TRANSITION       *         *     *
                    U/S DATA   STATION    INVERT  SECT              N                          RADIUS   ANGLE
                               3308.900  376.015    4              .013                           .000     .000
ELEMENT NO  44 IS A TRANSITION       *         *     *
                    U/S DATA   STATION    INVERT  SECT              N                          RADIUS   ANGLE
                               3329.440  376.159    4              .013                           .000     .000
                                                    W S P G W                                                        PAGE NO   6
                                WATER SURFACE PROFILE - ELEMENT CARD LISTING
ELEMENT NO  45 IS A TRANSITION       *         *     *
                    U/S DATA   STATION    INVERT  SECT              N                          RADIUS   ANGLE
                               3345.180  376.270    4              .013                           .000     .000
ELEMENT NO  46 IS A JUNCTION         *         *     *     *              *                        *                *
                    U/S DATA   STATION    INVERT  SECT LAT-1 LAT-2   N      Q3        Q4     INVERT-3 INVERT-4  PHI 3  PHI 4
                               3355.180  376.384    4    11     0   .013    48.000      .000   376.384      .000 -90.000     .000
                                                                                                RADIUS    ANGLE
                                                                                                  .000    .000
ELEMENT NO  47 IS A REACH            *         *     *
                    U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                               3599.630  379.180    4              .013                           .000     .000      .000     1
ELEMENT NO  48 IS A REACH            *         *     *
                    U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                               3625.790  379.479    4              .013                        350.039   -4.282      .000     0
ELEMENT NO  49 IS A REACH            *         *     *
                    U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                               3887.300  382.470    4              .013                           .000     .000      .000     0
ELEMENT NO  50 IS A JUNCTION         *         *     *     *              *                        *                *
                    U/S DATA   STATION    INVERT  SECT LAT-1 LAT-2   N      Q3        Q4     INVERT-3 INVERT-4  PHI 3  PHI 4
                               3897.300  382.584    4    11     0   .013    48.000      .000   382.584      .000 -90.000     .000
                                                                                                RADIUS    ANGLE
                                                                                                  .000    .000
ELEMENT NO  51 IS A REACH            *         *     *
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                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             4089.300  384.780    4             .013                           .000     .000      .000     0
ELEMENT NO  52 IS A JUNCTION          *         *     *     *                 *                    *                *
                  U/S DATA   STATION    INVERT  SECT LAT-1 LAT-2   N      Q3        Q4     INVERT-3 INVERT-4  PHI 3  PHI 4
                             4135.720  385.310   25    25     0   .013  2335.000      .000   385.310      .000    .000     .000
                                                                                           RADIUS    ANGLE
                                                                                             .000     .000
                                                          W S P G W                                                PAGE NO   7
                                WATER SURFACE PROFILE - ELEMENT CARD LISTING
ELEMENT NO  53 IS A REACH             *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             4141.600  385.389   25             .013                           .000     .000      .000     0
ELEMENT NO  54 IS A REACH             *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             4211.510  386.322   25             .013                        380.031   10.540      .000     1
ELEMENT NO  55 IS A REACH             *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             4223.540  386.483   25             .013                           .000     .000      .000     0
ELEMENT NO  56 IS A TRANSITION        *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS   ANGLE
                             4243.540  386.750    6             .013                           .000     .000
ELEMENT NO  57 IS A REACH             *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             4420.540  389.120    6             .013                           .000     .000      .000     0
ELEMENT NO  58 IS A TRANSITION        *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS   ANGLE
                             4440.540  390.218    7             .013                           .000     .000
ELEMENT NO  59 IS A TRANSITION        *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS   ANGLE
                             4453.210  390.913    7             .013                        230.017   -3.156
ELEMENT NO  60 IS A TRANSITION        *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS   ANGLE
                             4463.540  391.480    7             .013                        230.031   -2.573
ELEMENT NO  61 IS A REACH             *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             4497.740  391.638    7             .013                        229.991   -8.520      .000     0
ELEMENT NO  62 IS A REACH             *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             4579.220  392.015    7             .013                           .000     .000      .000     0
ELEMENT NO  63 IS A TRANSITION        *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS   ANGLE
                             4595.380  392.089    7             .013                           .000     .000
ELEMENT NO  64 IS A REACH             *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             4623.640  392.220    7             .013                           .000     .000      .000     0
ELEMENT NO  65 IS A REACH             *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                             4703.020  393.220    7             .013                           .000     .000      .000     1
ELEMENT NO  66 IS A TRANSITION        *         *     *
                  U/S DATA   STATION    INVERT  SECT              N                          RADIUS   ANGLE
                             4713.020  393.340    7             .013                           .000     .000
                                                          W S P G W                                                PAGE NO   8
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WATER SURFACE PROFILE - ELEMENT CARD LISTING

ELEMENT NO 67 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	4739.960	393.663	7	.013	.000	.000	.000	0

ELEMENT NO 68 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	4880.820	395.350	7	.013	155.850	51.785	.000	0

ELEMENT NO 69 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	5191.140	397.650	7	.013	.000	.000	.000	0

ELEMENT NO 70 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	5383.640	399.749	7	.013	238.851	46.177	.000	1

ELEMENT NO 71 IS A TRANSITION * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE
	5392.380	399.844	7	.013	238.908	2.096

ELEMENT NO 72 IS A TRANSITION * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE
	5406.640	400.000	7	.013	.000	.000

ELEMENT NO 73 IS A SYSTEM HEADWORKS * *

U/S DATA	STATION	INVERT	SECT	W S ELEV
	5406.640	400.000	7	400.000

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WATER SURFACE PROFILE LISTING Date: 8-23-2013 Time:10:45: 9

SR-710 NORTH STUDY
DORCHESTER DRAIN LINE-A EAST & LINE-B (P20)(NGVD 29)
MODEL: W.CHEN REVIEW: G.HSU

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope				SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch	
491.000	351.820	12.029	363.849	5481.00	23.57	8.63	372.48	12.75	12.75	20.00	12.750	20.000	.00	1 .7
TRANS STR	.0082					.0082	.21	12.75	1.22		.013	.00	.00	BOX
				WARNING - Flow depth near top of box conduit										
517.000	352.033	12.029	364.062	5481.00	23.57	8.63	372.69	12.75	12.75	20.00	12.750	20.000	.00	1 .7
27.030	.0082					.0082	.22	12.75	1.22	12.00	.013	.00	.00	BOX
				WARNING - Flow depth near top of box conduit										
544.030	352.255	12.032	364.287	5481.00	23.57	8.62	372.91	.00	12.75	20.00	12.750	20.000	.00	1 .7
371.970	.0082					.0080	2.98	12.03	1.22	12.00	.013	.00	.00	BOX
				WARNING - Flow depth near top of box conduit										
916.000	355.310	12.210	367.521	5481.00	23.22	8.37	375.89	12.75	12.75	20.00	12.750	20.000	.00	1 .7
162.000	.0082					.0077	1.25	12.75	1.19	12.00	.013	.00	.00	BOX
				WARNING - Flow depth near top of box conduit										
1078.000	356.640	12.465	369.105	5481.00	22.75	8.04	377.14	12.75	12.75	20.00	12.750	20.000	.00	1 .7
JUNCT STR	.0083					.0079	.08	12.75	1.15		.013	.00	.00	BOX
				WARNING - Flow depth near top of box conduit										

Program Package Serial Number: 1806

WATER SURFACE PROFILE LISTING Date: 8-23-2013 Time:10:45: 9

SR-710 NORTH STUDY
DORCHESTER DRAIN LINE-A EAST & LINE-B (P20)(NGVD 29)
MODEL: W.CHEN REVIEW: G.HSU

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope				SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch	
1088.000	356.723	11.944	368.667	5451.00	23.61	8.66	377.32	12.75	12.75	20.00	12.750	20.000	.00	1 .7
65.800	.0083				.0082	.54	12.75	1.22	11.92	.013	.00	.00	BOX	

WARNING - Flow depth near top of box conduit

1153.800	357.266	11.950	369.216	5451.00	23.60	8.65	377.86	.00	12.75	20.00	12.750	20.000	.00	1 .7
20.000	.0083				.0082	.16	11.95	1.22	11.92	.013	.00	.00	BOX	

WARNING - Flow depth near top of box conduit

1173.800	357.431	11.952	369.383	5451.00	23.59	8.64	378.03	12.75	12.75	20.00	12.750	20.000	.00	1 .7
76.200	.0083				.0082	.62	12.75	1.22	11.92	.013	.00	.00	BOX	

WARNING - Flow depth near top of box conduit

1250.000	358.060	11.962	370.022	5451.00	23.57	8.63	378.65	12.75	12.75	20.00	12.750	20.000	.00	1 .7

BRIDGE ENTRANCE

WARNING - Flow depth near top of box conduit

Program Package Serial Number: 1806

WATER SURFACE PROFILE LISTING Date: 8-23-2013 Time:10:45: 9

SR-710 NORTH STUDY
DORCHESTER DRAIN LINE-A EAST & LINE-B (P20)(NGVD 29)
MODEL: W.CHEN REVIEW: G.HSU

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
1250.000	358.060	10.862	368.922	5451.00	25.09	9.78	378.70	1.56	13.21	20.00	14.000	20.000	.00	0 .0
29.740	.0082					.0061	.18	12.43	1.34	9.77	.014	.00	.00	RECTANG
1279.740	358.304	10.941	369.245	5451.00	24.91	9.64	378.88	1.54	13.21	20.00	14.000	20.000	.00	0 .0
29.260	.0082					.0060	.18	12.48	1.33	9.79	.014	.00	.00	RECTANG
1309.000	358.543	11.026	369.569	5451.00	24.72	9.49	379.06	1.52	13.21	20.00	14.000	20.000	.00	0 .0
BRIDGE EXIT														
1309.000	358.543	12.109	370.652	5451.00	23.29	8.42	379.07	1.30	13.52	20.00	14.000	20.000	.00	1 .7
89.800	.0082					.0079	.71	13.41	1.20	11.95	.013	.00	.00	BOX
1398.800	359.279	12.180	371.459	5451.00	23.15	8.32	379.78	.16	13.52	20.00	14.000	20.000	.00	1 .7
86.200	.0082					.0078	.67	12.34	1.19	11.96	.013	.00	.00	BOX
1485.000	359.985	12.286	372.271	5451.00	22.95	8.18	380.45	.16	13.52	20.00	14.000	20.000	.00	1 .7
JUNCT STR	.0082					.0080	.16	12.44	1.17		.013	.00	.00	BOX
1505.000	360.149	11.869	372.018	5422.00	23.63	8.67	380.69	.17	13.47	20.00	14.000	20.000	.00	1 .7
249.090	.0082					.0083	2.07	12.04	1.23	11.91	.013	.00	.00	BOX
1754.090	362.189	11.813	374.002	5422.00	23.74	8.75	382.76	.80	13.47	20.00	14.000	20.000	.00	1 .7
259.310	.0082					.0085	2.19	12.61	1.24	11.90	.013	.00	.00	BOX
2013.400	364.313	11.674	375.987	5422.00	24.03	8.96	384.95	.82	13.47	20.00	14.000	20.000	.00	1 .7
23.600	.0082					.0086	.20	12.49	1.26	11.91	.013	.00	.00	BOX

Program Package Serial Number: 1806

WATER SURFACE PROFILE LISTING Date: 8-23-2013 Time:10:45: 9

SR-710 NORTH STUDY
DORCHESTER DRAIN LINE-A EAST & LINE-B (P20)(NGVD 29)
MODEL: W.CHEN REVIEW: G.HSU

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
2037.000	364.506	11.656	376.162	5422.00	24.06	8.99	385.15	.82	13.47	20.00	14.000	20.000	.00	1 .7
BRIDGE ENTRANCE														
2037.000	364.506	10.665	375.171	5422.00	25.42	10.03	385.20	.94	13.17	20.00	14.000	20.000	.00	0 .0
153.000	.0082					.0061	.94	11.61	1.37	9.74	.014	.00	.00	RECTANG
2190.000	365.760	11.071	376.831	5422.00	24.49	9.31	386.14	.88	13.17	20.00	14.000	20.000	.00	0 .0
JUNCT STR	.0082					.0060	.18	11.95	1.30		.014	.00	.00	RECTANG
2220.000	366.005	10.827	376.832	5392.00	24.90	9.63	386.46	.91	13.12	20.00	14.000	20.000	.00	0 .0
13.000	.0082					.0061	.08	11.73	1.33	9.68	.014	.00	.00	RECTANG
2233.000	366.112	10.863	376.975	5392.00	24.82	9.56	386.54	.90	13.12	20.00	14.000	20.000	.00	0 .0
31.530	.0082					.0060	.19	11.76	1.33	9.70	.014	.00	.00	RECTANG
2264.530	366.370	10.956	377.326	5392.00	24.61	9.40	386.73	.75	13.12	20.00	14.000	20.000	.00	0 .0
18.470	.0082					.0059	.11	11.71	1.31	9.68	.014	.00	.00	RECTANG
2283.000	366.522	11.018	377.540	5392.00	24.47	9.30	386.84	.74	13.12	20.00	14.000	20.000	.00	0 .0
BRIDGE EXIT														
2283.000	366.522	12.156	378.678	5392.00	22.95	8.18	386.85	.63	13.42	20.00	14.000	20.000	.00	1 .7
50.000	.0082					.0076	.38	12.79	1.18	11.84	.013	.00	.00	BOX
2333.000	366.932	12.239	379.171	5392.00	22.79	8.07	387.24	.62	13.42	20.00	14.000	20.000	.00	1 .7
117.000	.0082					.0073	.85	12.86	1.17	11.84	.013	.00	.00	BOX

Program Package Serial Number: 1806

WATER SURFACE PROFILE LISTING Date: 8-23-2013 Time:10:45: 9

SR-710 NORTH STUDY
DORCHESTER DRAIN LINE-A EAST & LINE-B (P20)(NGVD 29)
MODEL: W.CHEN REVIEW: G.HSU

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/Dia.-FT / "N"	Base Wt or I.D. / X-Fall	ZL / ZR	No Wth Prs/Pip / Type Ch
2450.000	367.893	12.671	380.564	5392.00	22.02	7.53	388.09	.58	13.42	20.00	14.000	20.000	.00	1 .7
JUNCT STR	.0082					.0076	.25	13.25	1.11		.013	.00	.00	BOX
					WARNING - Flow depth near top of box conduit									
2482.310	368.158	11.709	379.867	5339.00	23.59	8.64	388.51	.00	13.33	20.00	14.000	20.000	.00	1 .7
67.690	.0082					.0083	.56	11.71	1.24	11.74	.013	.00	.00	BOX
2550.000	368.714	11.700	380.414	5339.00	23.61	8.65	389.07	.00	13.33	20.00	14.000	20.000	.00	1 .7
BRIDGE ENTRANCE														
2550.000	368.714	10.657	379.371	5339.00	25.05	9.74	389.11	.00	13.03	20.00	14.000	20.000	.00	0 .0
75.000	.0082					.0061	.46	10.66	1.35	9.62	.014	.00	.00	RECTANG
2625.000	369.330	10.861	380.191	5339.00	24.58	9.38	389.57	.00	13.03	20.00	14.000	20.000	.00	0 .0
TRANS STR	.0128					.0060	.30	10.86	1.31		.014	.00	.00	RECTANG
2675.000	369.970	10.485	380.455	5339.00	24.63	9.42	389.88	.00	12.75	20.67	14.000	20.670	.00	0 .0
BRIDGE EXIT														
2675.000	369.970	11.384	381.354	5339.00	23.45	8.54	389.89	.00	12.00	20.67	12.000	20.670	.00	1 .7
105.000	.0066					.0083	.87	11.38	1.25	12.00	.013	.00	.00	BOX
					WARNING - Flow depth near top of box conduit									

Program Package Serial Number: 1806

WATER SURFACE PROFILE LISTING Date: 8-23-2013 Time:10:45: 9

SR-710 NORTH STUDY
DORCHESTER DRAIN LINE-A EAST & LINE-B (P20)(NGVD 29)
MODEL: W.CHEN REVIEW: G.HSU

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS) / SF Ave	Vel Head / HF	Energy Grd.El. / SE Dpth	Super Elev / Froude N	Critical Depth / Norm Dp	Flow Top Width / "N"	Height/Dia.-FT / X-Fall	Base Wt or I.D. / ZR	ZL	No Wth Prs/Pip / Type Ch
2780.000	370.661	11.068	381.729	5339.00	24.12	9.03	390.76	.00	12.00	20.67	12.000	20.670	.00	1 .7
JUNCT STR	.0066				.0089	.09	11.07	1.30		.013		.00	.00	BOX
				WARNING - Flow depth near top of box conduit										
2790.000	370.727	10.601	381.328	5289.00	24.95	9.66	390.99	.00	12.00	20.67	12.000	20.670	.00	1 .7
27.323	.0066				.0094	.26	10.60	1.37	12.00	.013		.00	.00	BOX
2817.323	370.907	10.509	381.416	5289.00	25.16	9.83	391.25	.00	12.00	20.67	12.000	20.670	.00	1 .7
140.187	.0066				.0101	1.42	10.51	1.39	12.00	.013		.00	.00	BOX
2957.510	371.830	10.020	381.850	5289.00	26.39	10.82	392.67	.00	12.00	20.67	12.000	20.670	.00	1 .7
TRANS STR	.0220				.0104	.26	10.02	1.49		.013		.00	.00	BOX
2982.510	372.380	10.243	382.623	5289.00	25.82	10.35	392.97	.00	12.00	20.67	12.000	20.670	.00	1 .7
206.790	.0103				.0101	2.08	10.24	1.45	10.16	.013		.00	.00	BOX
3189.300	374.520	10.300	384.820	5289.00	25.68	10.24	395.06	.00	12.00	20.67	12.000	20.670	.00	1 .7
JUNCT STR	.0103				.0103	.10	10.30	1.43		.013		.00	.00	BOX
3199.300	374.623	9.965	384.588	5244.00	26.31	10.75	395.34	.00	12.00	20.67	12.000	20.670	.00	1 .7
23.820	.0104				.0107	.25	9.96	1.49	10.08	.013		.00	.00	BOX
3223.120	374.870	9.959	384.829	5244.00	26.33	10.76	395.59	.00	12.00	20.67	12.000	20.670	.00	1 .7
80.780	.0137				.0104	.84	9.96	1.49	8.99	.013		.00	.00	BOX

Program Package Serial Number: 1806

WATER SURFACE PROFILE LISTING Date: 8-23-2013 Time:10:45: 9

SR-710 NORTH STUDY
DORCHESTER DRAIN LINE-A EAST & LINE-B (P20)(NGVD 29)
MODEL: W.CHEN REVIEW: G.HSU

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS) / SF Ave	Vel Head / HF	Energy Grd.El. / SE Dpth	Super Elev / Froude N	Critical Depth / Norm Dp	Flow Top Width / "N"	Height/Dia.-FT / X-Fall	Base Wt or I.D. / ZR	ZL	No Wth Prs/Pip / Type Ch
3303.900	375.980	10.211	386.191	5244.00	25.68	10.24	396.43	.00	12.00	20.67	12.000	20.670	.00	1 .7
TRANS STR	.0070					.0101	.05	10.21	1.44		.013	.00	.00	BOX
3308.900	376.015	10.185	386.200	5244.00	25.74	10.29	396.49	.00	12.00	20.67	12.000	20.670	.00	1 .7
TRANS STR	.0070					.0102	.21	10.19	1.45		.013	.00	.00	BOX
3329.440	376.159	10.081	386.240	5244.00	26.01	10.50	396.74	.00	12.00	20.67	12.000	20.670	.00	1 .7
TRANS STR	.0071					.0105	.16	10.08	1.47		.013	.00	.00	BOX
3345.180	376.270	10.002	386.272	5244.00	26.21	10.67	396.94	.00	12.00	20.67	12.000	20.670	.00	1 .7
JUNCT STR	.0114					.0109	.11	10.00	1.48		.013	.00	.00	BOX
3355.180	376.384	9.677	386.061	5196.00	26.85	11.19	397.25	.00	12.00	20.67	12.000	20.670	.00	1 .7
244.450	.0114					.0112	2.73	9.68	1.55	9.61	.013	.00	.00	BOX
3599.630	379.180	9.727	388.907	5196.00	26.71	11.08	399.98	1.27	12.00	20.67	12.000	20.670	.00	1 .7
26.160	.0114					.0111	.29	10.99	1.53	9.61	.013	.00	.00	BOX
3625.790	379.479	9.734	389.213	5196.00	26.69	11.06	400.27	.00	12.00	20.67	12.000	20.670	.00	1 .7
261.510	.0114					.0109	2.86	9.73	1.53	9.61	.013	.00	.00	BOX
3887.300	382.470	9.840	392.310	5196.00	26.40	10.82	403.13	.00	12.00	20.67	12.000	20.670	.00	1 .7
JUNCT STR	.0114					.0111	.11	9.84	1.51		.013	.00	.00	BOX
3897.300	382.584	9.523	392.107	5148.00	27.03	11.34	403.45	.00	12.00	20.67	12.000	20.670	.00	1 .7
192.000	.0114					.0115	2.21	9.52	1.57	9.54	.013	.00	.00	BOX

Program Package Serial Number: 1806

WATER SURFACE PROFILE LISTING Date: 8-23-2013 Time:10:45: 9

SR-710 NORTH STUDY
DORCHESTER DRAIN LINE-A EAST & LINE-B (P20)(NGVD 29)
MODEL: W.CHEN REVIEW: G.HSU

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
4089.300	384.780	9.515	394.295	5148.00	27.05	11.36	405.66	.00	12.00	20.67	12.000	20.670	.00	1 .7
JUNCT STR	.0114					.0120	.56	9.52	1.57		.013	.00	.00	BOX
4135.720	385.310	9.913	395.223	2813.00	28.38	12.50	407.73	.00	12.00	10.00	12.000	10.000	.00	0 .0
5.880	.0134					.0124	.07	9.91	1.59	9.60	.013	.00	.00	BOX
4141.600	385.389	9.917	395.306	2813.00	28.37	12.49	407.80	.66	12.00	10.00	12.000	10.000	.00	0 .0
69.910	.0133					.0123	.86	10.57	1.59	9.63	.013	.00	.00	BOX
4211.510	386.322	9.964	396.286	2813.00	28.23	12.38	408.66	.00	12.00	10.00	12.000	10.000	.00	0 .0
12.030	.0134					.0123	.15	9.96	1.58	9.62	.013	.00	.00	BOX
4223.540	386.483	9.973	396.456	2813.00	28.21	12.36	408.81	.00	12.00	10.00	12.000	10.000	.00	0 .0
TRANS STR	.0133					.0121	.24	9.97	1.57		.013	.00	.00	BOX
4243.540	386.750	10.440	397.190	2813.00	27.69	11.91	409.10	.00	12.00	9.73	12.000	9.730	.00	0 .0
177.000	.0134					.0115	2.03	10.44	1.51	9.93	.013	.00	.00	BOX
4420.540	389.120	10.722	399.842	2813.00	26.96	11.29	411.13	.00	12.00	9.73	12.000	9.730	.00	0 .0
TRANS STR	.0549					.0107	.21	10.72	1.45		.013	.00	.00	BOX
4440.540	390.218	10.429	400.647	2813.00	26.31	10.75	411.40	.96	13.25	10.25	13.250	10.250	.00	0 .0
TRANS STR	.0549					.0097	.12	11.39	1.44		.013	.00	.00	BOX
4453.210	390.913	10.944	401.857	2813.00	25.08	9.76	411.62	.87	13.25	10.25	13.250	10.250	.00	0 .0
TRANS STR	.0549					.0085	.09	11.81	1.34		.013	.00	.00	BOX

Program Package Serial Number: 1806

WATER SURFACE PROFILE LISTING Date: 8-23-2013 Time:10:45: 9

SR-710 NORTH STUDY
DORCHESTER DRAIN LINE-A EAST & LINE-B (P20)(NGVD 29)
MODEL: W.CHEN REVIEW: G.HSU

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/Dia.-FT / "N"	Base Wt or I.D. / X-Fall	ZL / ZR	No Wth Prs/Pip / Type Ch
4463.540	391.480	11.531	403.011	2813.00	23.80	8.80	411.81	.39	13.25	10.25	13.250	10.250	.00	0 .0
34.200	.0046					.0082	.28	11.92	1.24	13.25	.013	.00	.00	BOX
4497.740	391.638	11.316	402.954	2813.00	24.25	9.13	412.09	.00	13.25	10.25	13.250	10.250	.00	0 .0
81.480	.0046					.0088	.72	11.32	1.27	13.25	.013	.00	.00	BOX
4579.220	392.015	10.840	402.855	2813.00	25.32	9.95	412.81	.00	13.25	10.25	13.250	10.250	.00	0 .0
TRANS STR	.0046					.0095	.15	10.84	1.36		.013	.00	.00	BOX
4595.380	392.089	10.682	402.771	2813.00	25.69	10.25	413.02	.00	13.25	10.25	13.250	10.250	.00	0 .0
28.260	.0046					.0098	.28	10.68	1.39	13.25	.013	.00	.00	BOX
4623.640	392.220	10.530	402.750	2813.00	26.06	10.55	413.30	.00	13.25	10.25	13.250	10.250	.00	0 .0
79.380	.0126					.0097	.77	10.53	1.42	9.58	.013	.00	.00	BOX
4703.020	393.220	10.774	403.994	2813.00	25.47	10.07	414.07	.00	13.25	10.25	13.250	10.250	.00	0 .0
TRANS STR	.0120					.0094	.09	10.77	1.37		.013	.00	.00	BOX
4713.020	393.340	10.798	404.138	2813.00	25.42	10.03	414.17	.00	13.25	10.25	13.250	10.250	.00	0 .0
26.940	.0120					.0093	.25	10.80	1.36	9.77	.013	.00	.00	BOX
4739.960	393.663	10.885	404.548	2813.00	25.21	9.87	414.42	1.30	13.25	10.25	13.250	10.250	.00	0 .0
52.066	.0120					.0090	.47	12.18	1.35	9.78	.013	.00	.00	BOX
4792.026	394.287	11.087	405.373	2813.00	24.75	9.51	414.89	1.25	13.25	10.25	13.250	10.250	.00	0 .0
88.794	.0120					.0083	.74	12.34	1.31	9.78	.013	.00	.00	BOX

Program Package Serial Number: 1806

WATER SURFACE PROFILE LISTING Date: 8-23-2013 Time:10:45: 9

SR-710 NORTH STUDY
DORCHESTER DRAIN LINE-A EAST & LINE-B (P20)(NGVD 29)
MODEL: W.CHEN REVIEW: G.HSU

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS) / SF Ave	Vel Head / HF	Energy Grd.El. / SE Dpth	Super Elev / Froude N	Critical Depth / Norm Dp	Flow Top Width / "N"	Height/Dia.-FT / X-Fall	Base Wt or I.D. / ZR	ZL	No Wth Prs/Pip / Type Ch
4880.820	395.350	11.628	406.978	2813.00	23.60	8.65	415.63	.00	13.25	10.25	13.250	10.250	.00	0 .0
310.320	.0074				.0082	2.56	11.63	1.22	11.91	.013	.00	.00	BOX	
5191.141	397.650	11.184	408.833	2813.00	24.54	9.35	418.18	.80	13.25	10.25	13.250	10.250	.00	0 .0
47.437	.0109				.0085	.40	11.99	1.29	10.16	.013	.00	.00	BOX	
5238.577	398.167	11.367	409.534	2813.00	24.14	9.05	418.59	.78	13.25	10.25	13.250	10.250	.00	0 .0
87.583	.0109				.0078	.69	12.14	1.26	10.16	.013	.00	.00	BOX	
5326.160	399.122	11.922	411.044	2813.00	23.02	8.23	419.27	.71	13.25	10.25	13.250	10.250	.00	0 .0
42.513	.0109				.0070	.30	12.63	1.17	10.16	.013	.00	.00	BOX	
5368.673	399.586	12.504	412.089	2813.00	21.95	7.48	419.57	.64	13.25	10.25	13.250	10.250	.00	0 .0
14.967	.0109				.0062	.09	13.15	1.09	10.16	.013	.00	.00	BOX	
---------- WARNING - Flow depth near top of box conduit ----------														
5383.640	399.749	13.114	412.863	2813.00	20.93	6.80	419.66	13.25	13.25	10.25	13.250	10.250	.00	0 .0
TRANS STR	.0109				.0061	.05	13.25	1.02		.013	.00	.00	BOX	
---------- WARNING - Flow depth near top of box conduit ----------														
5392.380	399.844	12.816	412.660	2813.00	21.41	7.12	419.78	.00	13.25	10.25	13.250	10.250	.00	0 .0
TRANS STR	.0109				.0060	.09	12.82	1.05		.013	.00	.00	BOX	
---------- WARNING - Flow depth near top of box conduit ----------														

Program Package Serial Number: 1806

WATER SURFACE PROFILE LISTING Date: 8-23-2013 Time:10:45: 9

SR-710 NORTH STUDY
DORCHESTER DRAIN LINE-A EAST & LINE-B (P20)(NGVD 29)
MODEL: W.CHEN REVIEW: G.HSU

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
5406.640	400.000	13.250	413.250	2813.00	20.71	6.66	419.91	.00	13.25	10.25	13.250	10.250	.00	0 .0

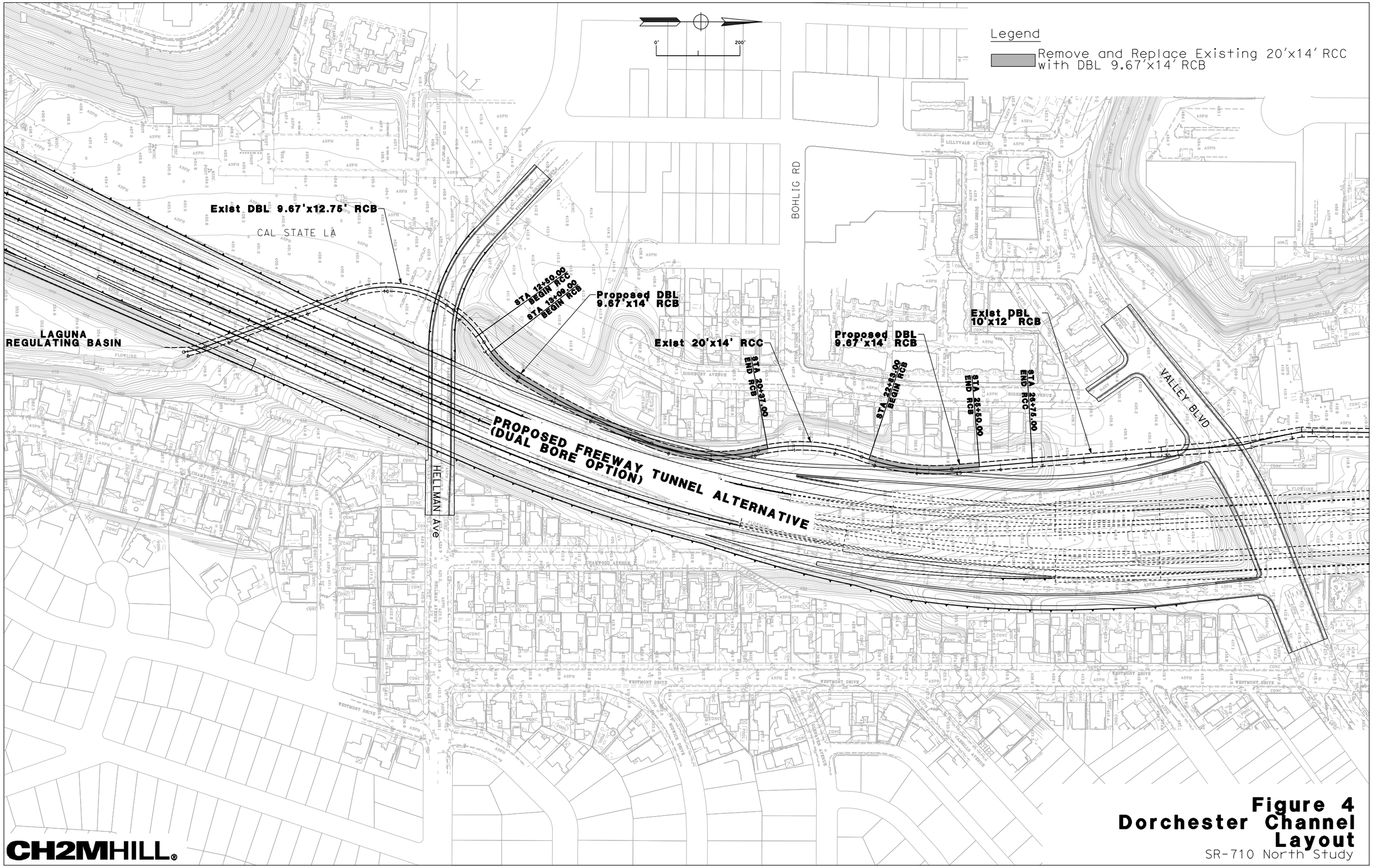

Figure 4
Dorchester Channel Layout
SR-710 North Study

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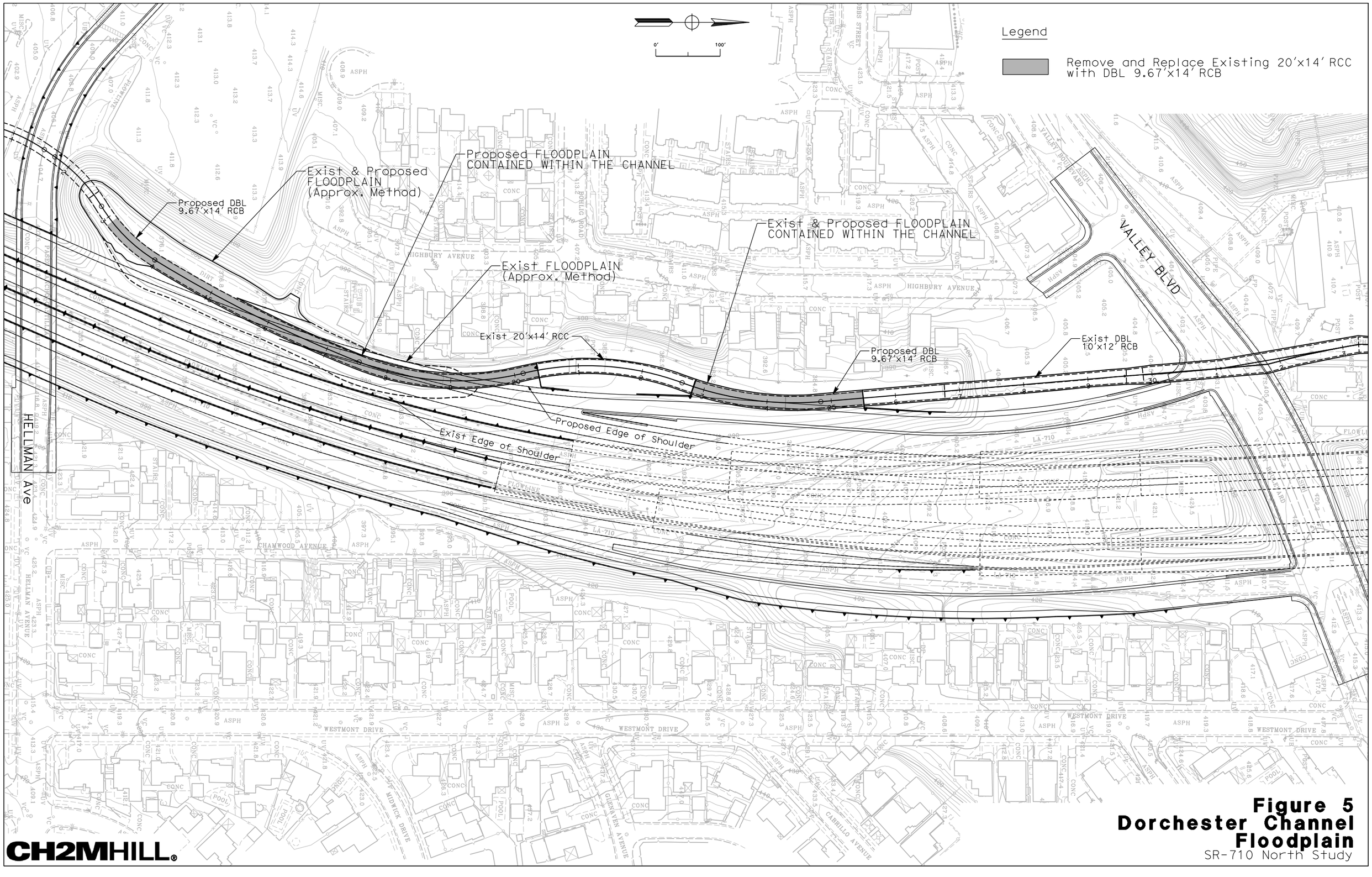

Figure 5
Dorchester Channel Floodplain
SR-710 North Study

CH2MHILL®

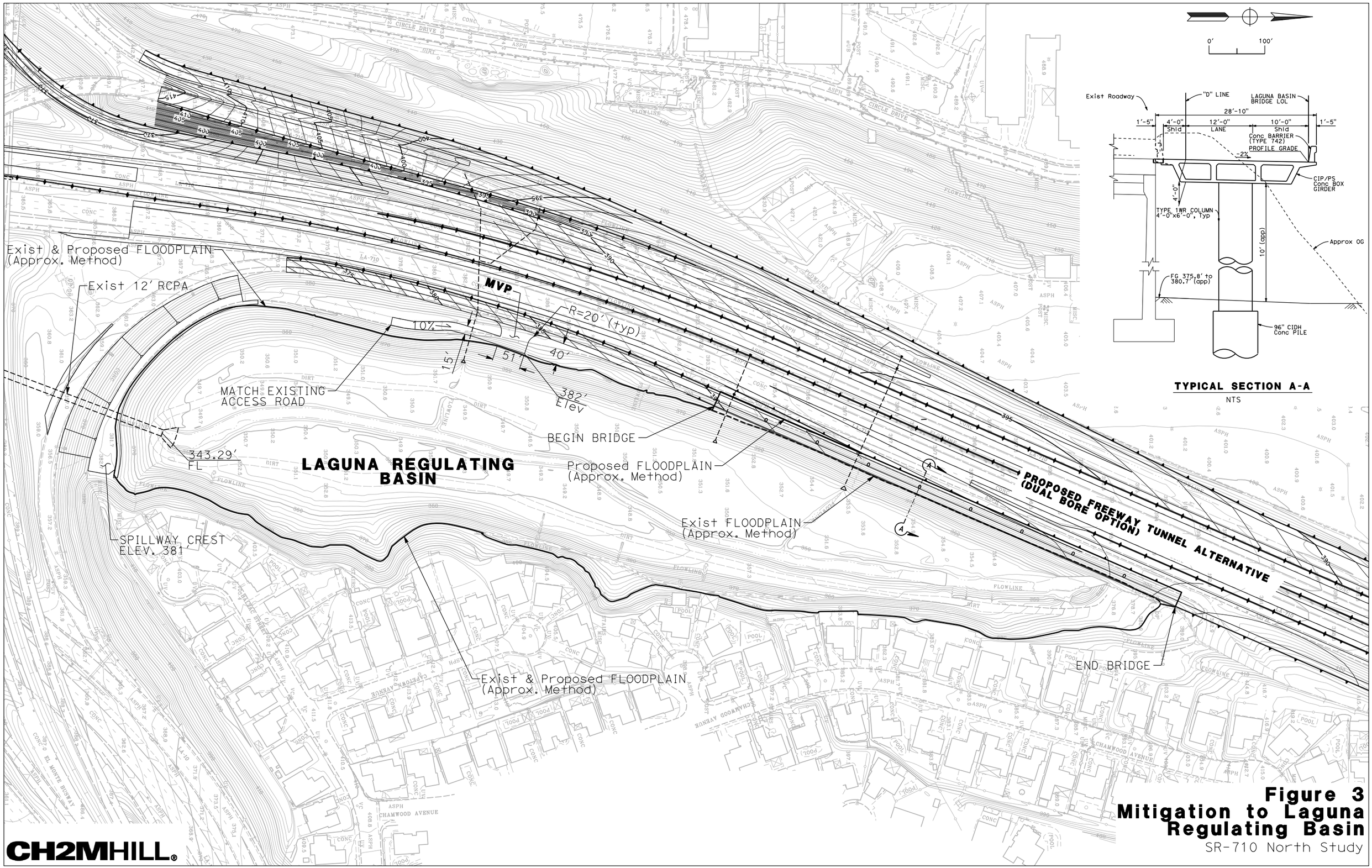

Figure 3
Mitigation to Laguna Regulating Basin
SR-710 North Study

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Appendix D
North Pump Storage Routing

Pump Station Profile
Storage Chamber Inflow and Outflow Hydrograph
Water Depth in the Chamber
Storage Volume in the Chamber
Pump Function Curves
Storage Chamber Routing Output

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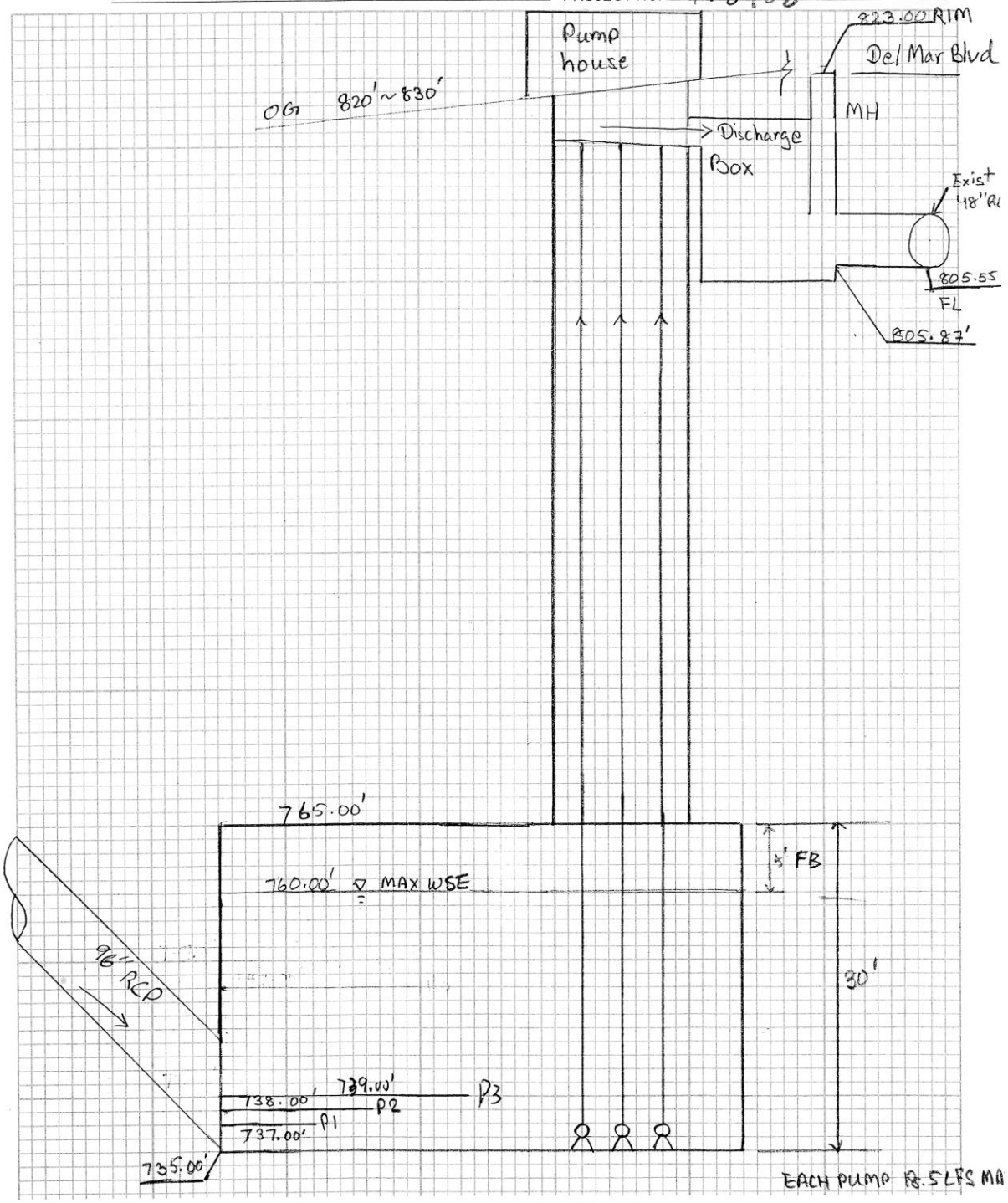
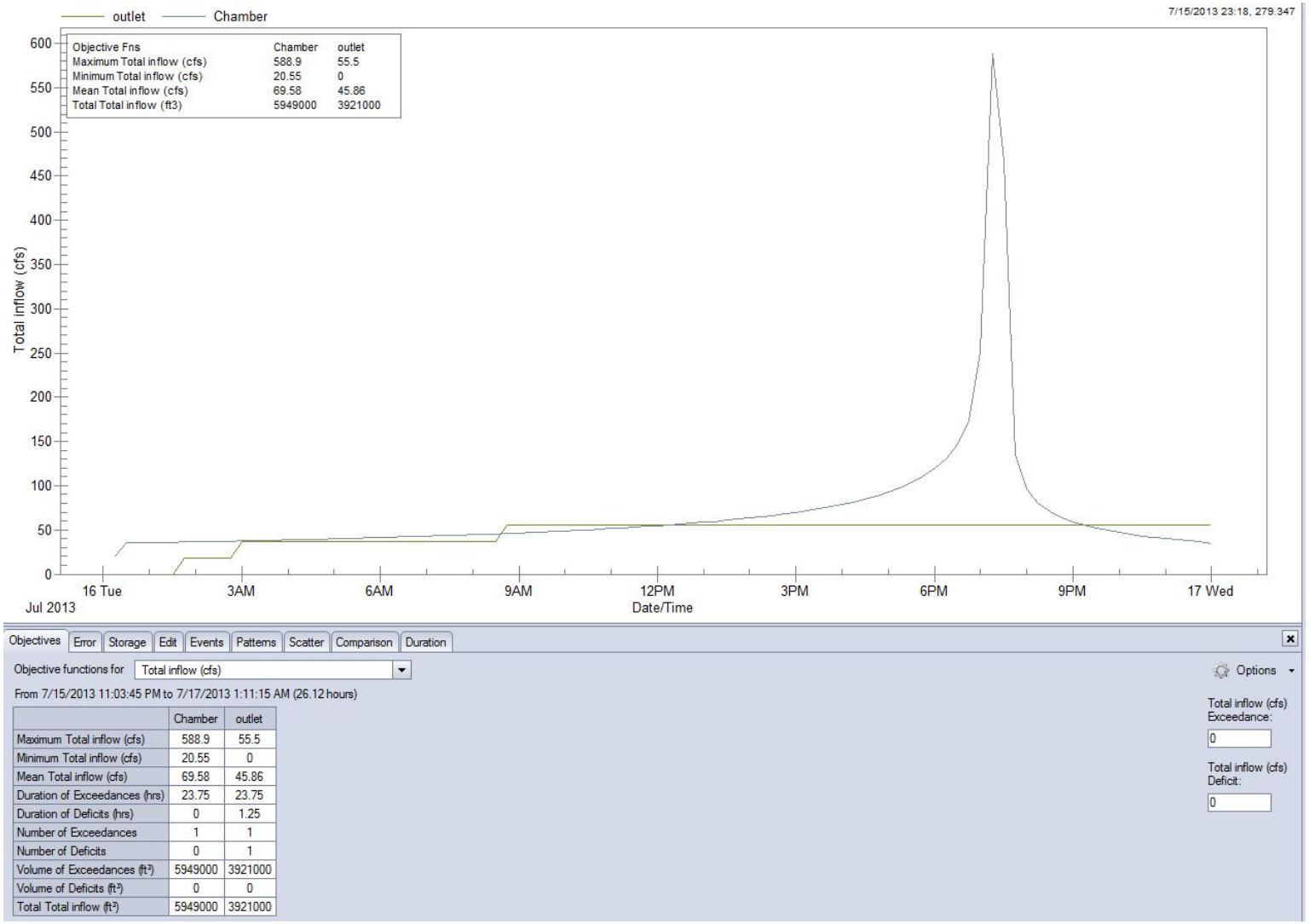
SUBJECT North portal pump station profile

BY TG

SHEET NO. 1 of 1 DATE 10/14/13

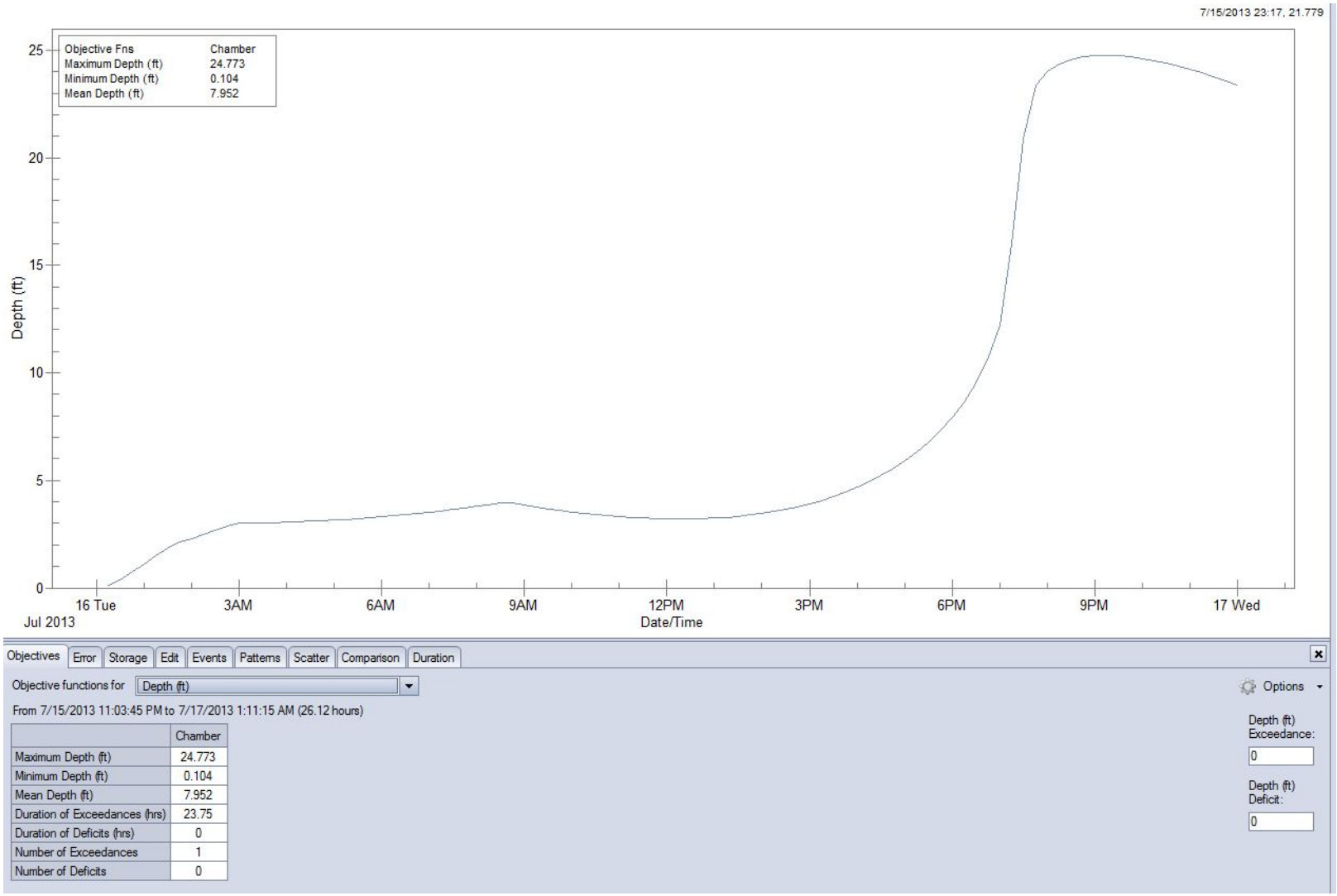
PROJECT NO. 428908





	Chamber	outlet
Maximum Total inflow (cfs)	588.9	55.5
Minimum Total inflow (cfs)	20.55	0
Mean Total inflow (cfs)	69.58	45.86
Duration of Exceedances (hrs)	23.75	23.75
Duration of Deficits (hrs)	0	1.25
Number of Exceedances	1	1
Number of Deficits	0	1
Volume of Exceedances (ft³)	5949000	3921000
Volume of Deficits (ft³)	0	0
Total Total inflow (ft³)	5949000	3921000

Figure 1 North Portal Storage Chamber Inflow and Outflow Hydrograph (50yr-24 hr)



	Chamber
Maximum Depth (ft)	24.773
Minimum Depth (ft)	0.104
Mean Depth (ft)	7.952
Duration of Exceedances (hrs)	23.75
Duration of Deficits (hrs)	0
Number of Exceedances	1
Number of Deficits	0

Figure 2 Water Depth in the Storage Chamber

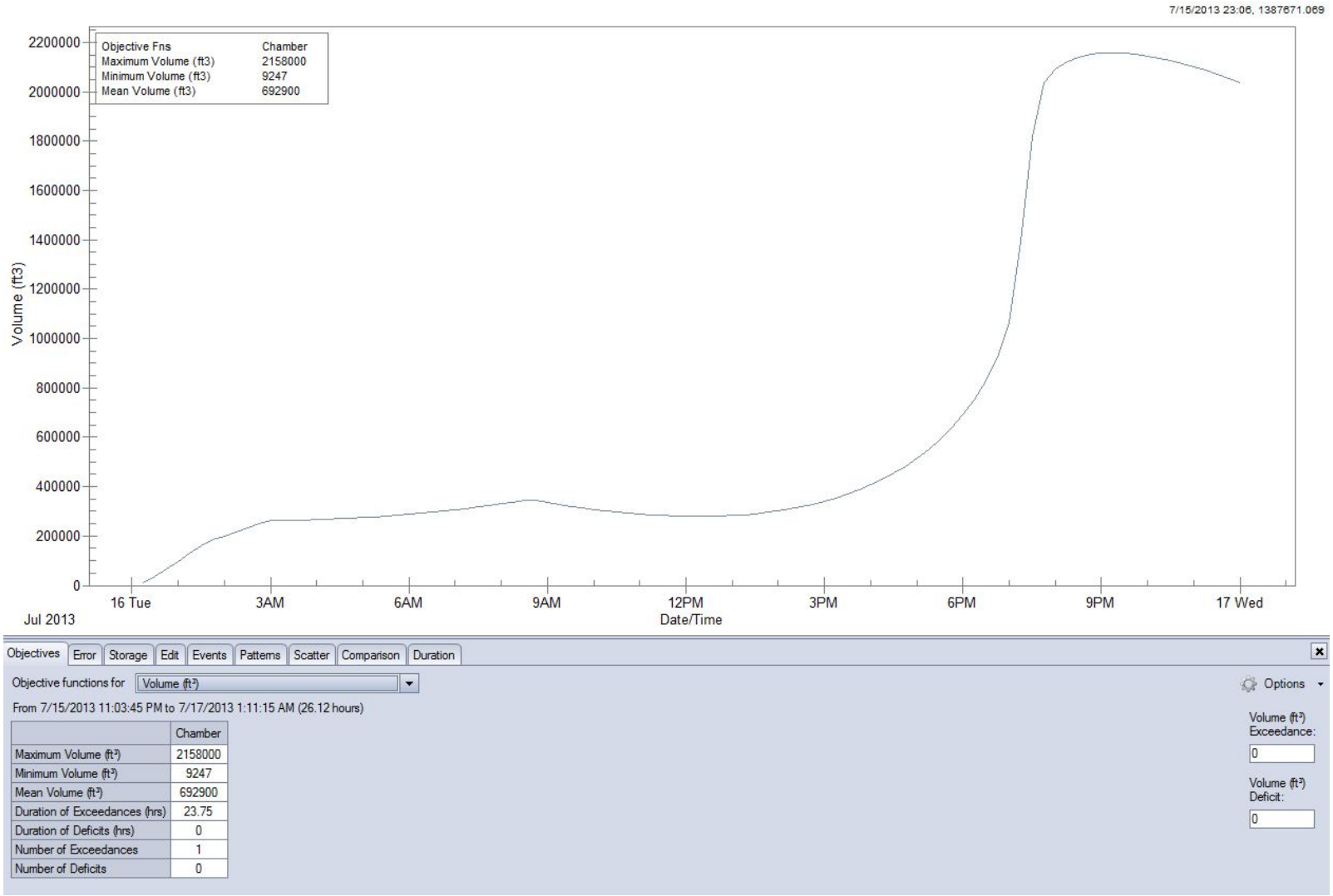
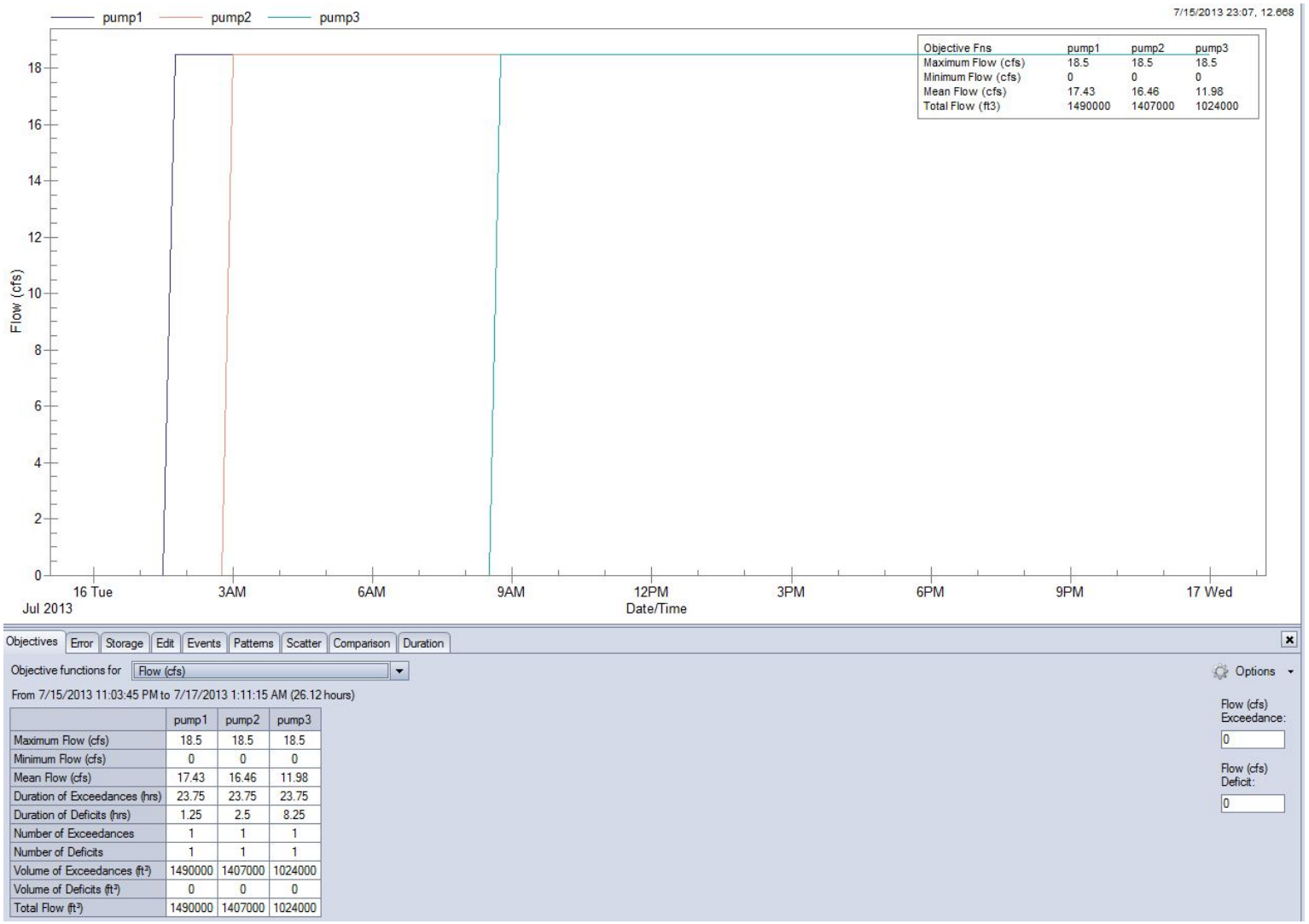


Figure 3 Storage Volume in the Chamber



	pump1	pump2	pump3
Maximum Flow (cfs)	18.5	18.5	18.5
Minimum Flow (cfs)	0	0	0
Mean Flow (cfs)	17.43	16.46	11.98
Duration of Exceedances (hrs)	23.75	23.75	23.75
Duration of Deficits (hrs)	1.25	2.5	8.25
Number of Exceedances	1	1	1
Number of Deficits	1	1	1
Volume of Exceedances (ft^3)	1490000	1407000	1024000
Volume of Deficits (ft^3)	0	0	0
Total Flow (ft^3)	1490000	1407000	1024000

Figure 4 Pump Function Curves

North Portal Pumps Station Storage Chamber Design Model Output

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.022)
--------------------------------------------------------------


***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

***************
Analysis Options
***************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Flow Routing Method ...... KINWAVE
Starting Date ............ JUL-16-2013 00:00:00
Ending Date .............. JUL-17-2013 00:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Routing Time Step ........ 30.00 sec


*************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
*************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.000         0.000
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........       136.794        44.576
External Outflow .........        90.057        29.346
Internal Outflow .........         0.000         0.000
Storage Losses ...........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......        46.737        15.230
Continuity Error (%) .....         0.000


*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.


************************
Routing Time Step Summary
************************
Minimum Time Step           :    30.00 sec
Average Time Step           :    30.00 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     1.00
```

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
outlet	OUTFALL	0.00	0.00	0.00	0 00:00
Chamber	STORAGE	7.88	24.77	24.77	0 21:14

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
Outlet	OUTFALL	0.00	55.50	0 08:37	0.000	29.344
Chamber	STORAGE	588.86	588.86	0 19:15	44.573	44.573

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
Chamber	STORAGE	24.01	24.773	5.227

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 ft3	Avg Pcnt Full	E&I Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CFS
Chamber	686.577	26	0	2158.241	83	0 21:13	55.50

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
outlet	93.37	48.62	55.50	29.344
System	93.37	48.62	55.50	29.344

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
pump1	PUMP	18.50	0 01:36		1.00	
pump2	PUMP	18.50	0 02:55		1.00	
pump3	PUMP	18.50	0 08:37		1.00	

****
Conduit Surcharge Summary
****

No conduits were surcharged.

****
Pumping Summary
****

Pump	Percent Utilized	Number of Start-Ups	Min Flow CFS	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal	Power Usage Kw-hr	% Time Off Pump Curve Low	% Time Off Pump Curve High
pump1	93.37	1	0.00	18.50	18.50	11.167	293.95	0.0	100.0
pump2	87.89	1	0.00	18.50	18.50	10.511	288.79	0.0	100.0
pump3	64.14	1	0.00	18.50	18.50	7.672	258.95	0.0	57.8

Analysis begun on: Tue Oct 29 15:17:29 2013
Analysis ended on: Tue Oct 29 15:17:29 2013
Total elapsed time: < 1 sec

Appendix E
Treatment BMP Calculations

Summary of TSM/TDM Drainage Impact and Mitigation
Biofiltration Swale Calculations

SUMMARY OF TSM/TDM DRAINAGE IMPACT & MITIGATION

#	EXH T-	TSM TDM	CITY	LOCATION/ DESCRIPTION	PROPOSED IMPROVEMENTS	DRAINAGE IMPACT	DRAINAGE MITIGATION	BMP DATA		
								Ex. Imp. AREA (AC)	Prop. Imp. AREA (AC)	Dis-turbed AREA (AC)
1	**1 & 2**	**T-1**	Alhambra	Valley to Mission Connector Rd	•Add 710 SB to where ex 710 NB locates; close ex 710 SB at Valley •Add connector road from Valley and northbound off-ramp to Mission Road. •Add roundabout at connector road and Mission/Alhambra •Add grade separation of connector road under RxR tracks.	•7 Inlets along west of ex 710 SB needs to be abandoned •One inlet at ex 710 SB entrance from Valley to be abandoned •Ex 48" RCP under proposed bridge needs to relocate •one ex CB at roundabout at Alhambra Ave needs to be relocated	•Install 8 inlets and one CB are proposed on new 710 SB •Install a 24" culvert to drain water to West into ex swale •Install 2 CBs at south end of connector before Valley Blvd •Install 2 CBs at low point of connector located at station 43+50 •Relocate one CB at new roundabout	9.58	11.16	10.510
2	**3 & 4**	**T-2**	South Pasadena	Arroyo Seco Parkway Hook Ramps Concept	•Widen to provide two left turn and two through lanes for eastbound off-ramp at Fair Oaks/Grevelia St. •Close Grevelia St. west of Fair Oaks off-ramp •Restripe to provide three northbound through lanes on Fair Oaks south of Grevelia •Remove raised median and restripe to provide two northbound through and one right turn lanes onto State Street and eliminate northbound left turn lanes on Fair Oaks to SB SR110. •Provide SB hook on-ramp on State St. (near Pasadena Water and Power Plant)	•Ex inlet located at eastbound off-ramp needs to relocate •Retailing wall above ex. 63" RCP needs to be clear with ex SD (8.5' Separation, OK) •Runoff from eastbound off-ramp widen area needs to mitigate •Inlet on State Street near 110 SB on-ramp needs to relocate •Runoff 110 SB hook on-ramp needs to mitigate	•Relocate one inlet at new eastbound off-ramp •Remove one inlet on State Street near 110 SB on -ramp; Construct one inlet further north and connector pipe •Construct a OSD at low point of 110 SB hook on-ramp at Sta 34+60 and a inlet	8.07	8.64	3.400
3	**5**	**T-3**	Pasadena	St John Ave Extension from Del Mar to California	•Extend St. John St from Del Mar to California	•One CB on Palemetto Dr cul de sac needs to relocate •One CB on Waverly Ave cul de sac needs to relocate •One inlet at SW of St John and Del Mar needs to relocate	•Remove ex 2 CBs and one inlet @ Sta 4+20, Sta 22+50 •Construct 2 new CBs and one inlet and connector pipes	3.34	4.42	2.230
4	**N/A**	**I-1**	Los Angeles	Broadway /Colorado Blvd	•Eliminate left turn pocket to Lockhaven Ave by extending the ex. Raised median	•Flow pattern stay unchanged. No blocked water.	NONE.	0.16	0.16	0.005
5	**6**	**I-2**	Los Angeles	Eagle Rock Blvd/York Blvd	•York Blvd: exclusive right turn from WB York to NB Eagle Rock •Closure of Alumni Ave	•NONE	•Water from cul de sec (cross slope to south) goes to ex CB at the south, no mitigation needed •2 CBs on the ex sidewalk to be protected in place.	3.54	3.58	0.370
6	**N/A**	**I-3**	Los Angeles	Eastern Ave/Huntington Dr	•Reduce raised median and restripe to make dual left turn from Huntington Dr •Widen to add RT lane on NB Eastern	•RT lane encroaching sidewalk of Eastern Ave, but no CBs/inlets at the area.	NONE	1.99	2.01	0.180
7	**7**	**I-4**	Los Angeles	710 SB On-Ramp/Valley Blvd	•Widen and increase right turn radius to add new lane	•CB on W of Valley Blvd needs to relocate.	•Relocate one CB on Valley Blvd and pipe connector	1.25	1.37	0.220
8	**7**	**I-5**	Los Angeles	710 NB Off-Ramp Valley Blvd	•Widen to add new RT lane which continues on EB Valley Blvd as combined through and RT lane (striping only) at the next cross street (Westmont Dr)	•CB on Valley Blvd. in conflicts with added lane	•Relocate one CB on Valley Blvd and pipe connector	1.16	1.21	0.190
9	**N/A**	**I-7**	South Pasadena	Fair Oaks Ave/Mission St	•Optimize signal timing and implement adaptive traffic signal control	NONE	NONE	0.48	0.48	0.000
10	**N/A**	**I-8**	South Pasadena	Fair Oaks Ave/Monterey St	•Reduce median to extend NB left turn pocket •Modify median at west of Fair Oaks to extend EB left turn pocket and close left turn access to shopping area at SW quadrant	NONE	NONE	1.45	1.46	0.031
11	**8**	**I-9**	South Pasadena	Fremont Ave/Monterey Rd	•Introduce protected left turns (signal) •Widen to add RT lanes on NB and SB Fremont	•2 CBs on West (NW) of Fremont need to relocate. No inlets/CBs on SE corner.	•Relocate 2 CBs and connector pipes.	1.24	1.27	0.287
12	**8**	**I-10**	South Pasadena	Huntington Dr/Fair Oaks Ave	•Reduce median to add third southbound left turn lane	•CB on Median needs to relocate	•Relocate one CB and connector pipe.	3.00	3.06	0.090
13	**N/A**	**I-11**	South Pasadena	Fremont Ave/Huntington Dr	•Restripe to convert northbound and southbound right turn lanes to through right lanes •Widen southbound departure lane	•No inlets at widening area.	NONE	3.26	3.26	0.055

SUMMARY OF TSM/TDM DRAINAGE IMPACT & MITIGATION

#	EXH T-	TSM TDM	CITY	LOCATION/ DESCRIPTION	PROPOSED IMPROVEMENTS	DRAINAGE IMPACT	DRAINAGE MITIGATION	BMP DATA		
								Ex. Imp. AREA (AC)	Prop. Imp. AREA (AC)	Dis-turbed AREA (AC)
14	**N/A**	**I-12**	Alhambra	Fremont Ave/Valley Blvd	•Part of L-2c •Adaptive signal control	NONE	NONE	0.69	0.69	0.000
15	**N/A**	**I-13**	Alhambra/S. Pasadena/San Marino	Huntington Dr/Garfield Ave	•Restripe to add eastbound right turn lane on Huntington at Garfield •Widen to add southbound right through lane on Garfield at Huntington •Widen to add southbound right turn lane on Garfield at Atlantic	•No CBs/inlets on west side of Garfield where will be widened.	NONE	2.56	2.57	0.190
16	**N/A**	**I-14**	Alhambra/S. Pasadena/San Marino	Huntington Dr/Atlantic Blvd	see above	see above	NONE			
17	**N/A**	**I-15**	Alhambra	Atlantic Blvd/Garfield Ave	see above	see above	NONE			
18	**9**	**I-16**	Alhambra	Garfield Ave/Mission Rd	•Widen to provide SB right through lane •Widen to provide NB right turn lane •Restripe to extend NB left turn pocket storage	•2 CBs on west of Garfield and north of Mission needs to relocate	•Relocate 2 CBs and connector pipes.	2.61	2.61	0.119
19	**N/A**	**I-17**	Alhambra	Garfield Ave/Valley Blvd	•Adaptive signal control •Part of L-4	NONE	NONE	1.11	1.11	0.000
20	**N/A**	**I-18**	Pasadena/San Marino	San Gabriel Blvd/Huntington Dr	•Remove median portion and add second eastbound left turn lane on Huntington •Stripe eastbound right turn lane on Huntington	•One CB on median to relocate	•Relocate one CB on median and connector pipe.	2.17	2.23	0.063
21	**9**	**I-19**	San Gabriel	Del Mar Ave/Mission Rd	•Widen to add additional through lane for southbound and northbound directions •Upgrade traffic signal heads to 12" heads •Restripe for dedicated left turn lane westbound on Mission Rd. •Restripe for dedicated left turn lane eastbound on Mission Rd. •Signal to have protected left turn lane southbound direction •Restripe to reconfigure (diag. parking) parking lot at SE quadrant	•One CB on NW side of Del Mar Ave to relocate	•Relocate one CB and connector pipe.	1.65	1.67	0.173
22	**10**	**I-20**	Rosemead	Rosemead Blvd/Mission Rd	•Part of L-5 •Widen to add dedicated RT pockets on all legs.	•2 CBS on NE and 2CBs on SE of Rosemead/Mission Dr needs to relocate	•Relocate one CBs and and connector pipes	1.28	1.28	0.193
23	**6**	**I-22**	San Gabriel	San Gabriel Blvd/Marshall St	• Restripe to provide dual turn for westbound •Widen to add a northbound through lane •Restripe SE corner parking lot	•2 CBs on East of San Gabriel Blvd and south of Marshall need to relocate	•Relocate 2 CBs and connector pipes	1.93	1.93	0.118
24	**N/A**	**I-24**	San Marino	Huntington Dr/Oak Knoll Ave	•Restripe/modify angled parking to parallel parking to add through lanes on Huntington Dr.	NONE	NONE	3.30	3.30	0.000
25	**N/A**	**I-25**	San Marino	Huntington Dr/Sierra Madre Blvd	• Restripe/modify angled parking to parallel parking to add through lanes on Huntington Dr.	NONE	NONE	5.21	5.21	0.000
26	**11**	**I-30**	Los Angeles	Colorado Blvd/N Figueroa St	•Part of L-1 •Signal for protected left turns	NONE	NONE	1.32	1.32	0.000
27	**11**	**I-31**	Los Angeles	Figueroa St/EB SR 134 Ramps	•Part of L-1 •Widen to add RT lane; restripe for dual LT; add ped crosswalk at the Figueroa St NB approach	•One Inlet at NE corner needs to relocate	•Relocate one inlet and connector pipes.	1.36	1.40	0.138
28	**11**	**I-32**	Los Angeles	Figueroa St/WB SR 134 Ramps	•Part of L-1 •Widen to add RT lane; restripe for dual LT	•NONE (no CBs/Inlets at widen area)	NONE	1.28	1.29	0.046
29	**N/A**	**I-33**	South Pasadena	Fremont Ave/Alhambra Rd	•Part of L-2a •Adaptive signal control	NONE	NONE	0.38	0.38	0.000
30	**N/A**	**I-34**	Alhambra	Fremont Ave/Commonwealth Ave	•Adaptive signal control	NONE	NONE	0.56	0.56	0.000
31	**N/A**	**I-35**	Alhambra	Fremont Ave /Poplar Blvd	•Adaptive signal control	NONE	NONE	0.55	0.55	0.000
32	**N/A**	**I-37**	Alhambra	Fremont Ave/Mission Rd	•Part of L-2c	NONE	NONE	1.80	1.80	0.000
33	**N/A**	**I-37A**	Alhambra	Atlantic Blvd /Glendon Way	• Widen to add southbound lane to on-ramp with restriping and pork chop island to Glendon Way approaches •Part of L-3	•No CBs/inlets at widening area	NONE	2.45	2.46	0.102

SUMMARY OF TSM/TDM DRAINAGE IMPACT & MITIGATION

#	EXH T-	TSM TDM	CITY	LOCATION/ DESCRIPTION	PROPOSED IMPROVEMENTS	DRAINAGE IMPACT	DRAINAGE MITIGATION	BMP DATA		
								Ex. Imp. AREA (AC)	Prop. Imp. AREA (AC)	Dis-turbed AREA (AC)
34	**N/A**	**I-38**	Alhambra	Garfield Ave/Glendon Way	•Widen to add southbound lane to on-ramp with restriping and pork chop island to Glendon Way approaches •Part of L-4	•No CBs/inlets at widening area	NONE	0.99	1.00	0.042
35	**N/A**	**I-39**	Alhambra	Garfield Ave/Norwood Pl Way	•Eliminate left turn traffic signal and pedestrian crossings •Restripe and signal to eliminate left turns •Part of L-4	NONE	NONE	0.50	0.50	0.000
36	**10**	**I-40**	Rosemead	Rosemead Blvd/Marshall St	•Part of L-5 •Widen NW, NE and SW corners.	•CB on NW of Rosemead needs to relocate •CB on NE of Rosemead needs to relocate •CB on SW of Rosemead needs to relocate	•Relocate 3 CBs and connector pipes	1.22	1.24	0.155
37	**10**	**I-41**	Rosemead	Rosemead Blvd/Valley Blvd	•Part of L-5 •Widen all four quadrant to add through lanes on Rosemead	•CB on NW of Rosemead needs to relocate •CB on NE of Rosemead needs to relocate	•Relocate 3 CBs and connector pipes	1.17	1.17	0.181
38	**10**	**I-42**	Rosemead	Rosemead Blvd/Lower Azusa Rd	•Part of L-5 •Widen NE and SE right turn lane by increasing turn radius	•No CBs along widen area	NONE	1.29	1.29	0.288
39	**N/A**	**I-43**	San Gabriel	Del Mar Ave/Valley Blvd	•Adaptive signal control •Widen to add southbound right turn lane to be added by Developer	•CB on NW side of Del Mar Ave/ to relocate	•Relocate one CB and connector pipe	1.21	1.22	0.055
40	**N/A**	**I-44**	Alhambra	Hellman Ave/Fremont Ave	•Remove median and restripe to add northbound right turn lane at southeast corner	•No CBs/inlets along along median	NONE	1.56	1.56	0.038
41	**N/A**	**I-45**	Los Angeles	Eagle Rock Blvd/Colorado Blvd	•Restripe to modify SB left turn pocket on Colorado	NONE	NONE	0.18	0.18	0.000
42	**N/A**	**L-1**	Los Angeles	Figueroa St from SR-134 to Colorado Blvd	•Use on-street parking lanes during peak hours only as a through lanes	NONE	NONE	2.55	2.55	0.000
43	**N/A**	**L-2a**	South Pasadena	Fremont Ave From Huntington Dr to Alhambra Rd	•Add pork chop islands to side streets •Add signal for reversible lane in median area	NONE	NONE	3.01	3.01	0.018
44	**N/A**	**L-2c**	Alhambra	Fremont Ave From Mission Rd to Valley Blvd	•Remove raised median •Restriping	•No CBs/inlets along along median	NONE	1.73	1.78	0.083
45	**N/A**	**L-3**	Alhambra	Atlantic Blvd from Glendon Way to 1-10	•Add reversible lane from Valley Blvd. to I-10 •Restripe to convert left turn lanes to thru lane •Add pork chop islands to side streets •Eliminate traffic signal and ped crossing (due to reversible lane) at side streets	NONE	NONE	3.03	3.03	0.008
46	**N/A**	**L-4**	Alhambra	Garfield Ave form Valley Blvd to Glyndon Way	•Add reversible lane from Valley Blvd. to I-10 •Restripe to convert left turn lanes to thru lane •Add pork chop islands to side streets •Eliminate traffic signal and ped crossing (due to reversible lane) at side streets	NONE	NONE	1.34	1.34	0.008
47	**10**	**L-5**	Rosemead	Rosemead Blvd from Lower Azusa Rd to Marshall St	•Widen to add a new through lane each way by remove on street parking	•2 CB near Ralph St needs to relocate •one CB near Guess st and one CB near Navada needs to relocate	•Relocate 4 CBs and connector pipes	8.25	8.25	1.752
48	**N/A**	**L-8**	South Pasadena	Fair Oaks from Grevelia St to Monterey St	•Add signal for reversible lane from I-110 to Monterey	NONE	NONE	4.71	4.71	0.000
							Total	103.47	107.27	21.338

LRT

BSW 123

Biofiltration Swale Calculations

Water Quality Flow		
Paved area treated	0.39	ac
Unpaved area treated	0.13	ac
Assumed freeboard	0.2	ft
WQ Rainfall Intesity	0.2	in/hr
WQF	**0.08**	cfs

Runoff Coefficients	WQF	Design Storm
C_{paved}	0.9	1.0
$C_{unpaved}$	0.5	0.9

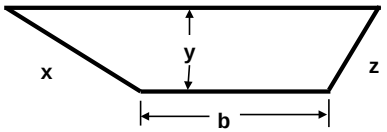
Design Storm, Q_{25}		
I_{25} (t_c = 5 min)	3.25	in/hr
I_{25} (t_c = 10 min)	2.34	in/hr
Q_{25}	**1.65**	cfs

WQF event - use n = 0.24

Manning's Equation : Q = (1.486*A*(R^0.67)*(S^0.5))/n (ENGLISH)

b (ft)	x (Lt side slope)	z (Rt side slope)	n	S (ft / ft)	Length (ft)
2.00	4.0	4.0	0.24	0.0300	130

Bioswale schematic



Input Site Data on this row

initial trial depth	0.050	ft
increment on depth	0.0500	ft

Solve by trial and error on the initial and increment depths, match required Q TDA

depth	y (=Depth)	A	P	R	Q	Velocity	HRT	HRT criteria met
inches	(feet)	(feet ^ 2)	(feet)	(feet)	(ft^3 / sec)	(ft/sec)	(minutes)	(sec^2/ft^2)
max = 6 inches						**max = 1.0 ft/s**	**min = 5 minutes**	**HRT*60/(y*V) >= 1300**
0.6	0.05	0.11	2.41	0.05	**0.02**	**0.14**	**15.8**	139,054
1.2	0.10	0.24	2.82	0.08	**0.05**	**0.21**	**10.5**	30,310
1.8	0.15	0.39	3.24	0.12	**0.10**	**0.26**	**8.3**	12,681
2.4	0.20	0.56	3.65	0.15	**0.17**	**0.31**	**7.1**	6,888
3.0	0.25	0.75	4.06	0.18	**0.26**	**0.35**	**6.2**	4,305
3.6	0.30	0.96	4.47	0.21	**0.37**	**0.38**	**5.6**	2,936
4.2	0.35	1.19	4.89	0.24	**0.50**	**0.42**	**5.2**	2,125
4.8	0.40	1.44	5.30	0.27	**0.65**	**0.45**	**< 5 minutes**	#VALUE!
5.4	0.45	1.71	5.71	0.30	**0.82**	**0.48**	**< 5 minutes**	#VALUE!

Criteria

1. **HRT*60/(y * V) >=1300**
2. **V max <= 1.0 fps**
3. **Depth <= 6 inches**
4. **HRT >= 5 minutes**

Criteria Checks			
HRT Criteria	**19009.0**	s2/ft2	ok
V_{WQF}	**0.2**	fps	ok
d_{WQF}	**1.6**	in	ok
HRT	**9.1**	min	ok

HDM event, Q25 - use n = 0.05

b (feet)	x (Lt side slope)	z (Rt side slope)	n	S (feet / feet)	Length (feet)
2.00	4.00	4.0	0.05	0.030	130

← Data copied from above

initial trial depth 0.100 ft

increment on depth 0.050 ft

Solve by trial and error on the initial and increment depths, match required Q

depth	y (=Depth)	A	P	R	Q	Velocity
inches	(feet)	(feet ^ 2)	(feet)	(feet)	(ft^3 / sec)	(ft/sec)
no max depth						max = 4.0 ft/s
1.2	0.10	0.24	2.82	0.08	**0.24**	**0.99**
1.8	0.15	0.39	3.24	0.12	**0.49**	**1.25**
2.4	0.20	0.56	3.65	0.15	**0.83**	**1.47**
3.0	0.25	0.75	4.06	0.18	**1.25**	**1.67**
3.6	0.30	0.96	4.47	0.21	**1.77**	**1.84**
4.2	0.35	1.19	4.89	0.24	**2.39**	**2.01**
4.8	0.40	1.44	5.30	0.27	**3.11**	**2.16**
5.4	0.45	1.71	5.71	0.30	**3.94**	**2.30**
6.0	0.50	2.00	6.12	0.33	**4.88**	**2.44**
6.6	0.55	2.31	6.54	0.35	**5.94**	**2.57**
7.2	0.60	2.64	6.95	0.38	**7.13**	**2.70**
7.8	0.65	2.99	7.36	0.41	**8.44**	**2.82**
8.4	0.70	3.36	7.77	0.43	**9.89**	**2.94**
9.0	0.75	3.75	8.18	0.46	**11.47**	**3.06**
9.6	0.80	4.16	8.60	0.48	**13.20**	**3.17**
10.2	0.85	4.59	9.01	0.51	**15.07**	**3.28**
10.8	0.90	5.04	9.42	0.53	**17.09**	**3.39**
11.4	0.95	5.51	9.83	0.56	**19.27**	**3.50**
12.0	1.00	6.00	10.25	0.59	**21.61**	**3.60**
12.6	1.05	6.51	10.66	0.61	**24.12**	**3.71**
13.2	1.10	7.04	11.07	0.64	**26.79**	**3.81**
13.8	1.15	7.59	11.48	0.66	**29.64**	**3.91**
14.4	1.20	8.16	11.90	0.69	**32.67**	**NO!, Vel >4.0 ft/s**
15.0	1.25	8.75	12.31	0.71	**35.87**	**NO!, Vel >4.0 ft/s**
15.6	1.30	9.36	12.72	0.74	**39.27**	**NO!, Vel >4.0 ft/s**
16.2	1.35	9.99	13.13	0.76	**42.85**	**NO!, Vel >4.0 ft/s**
16.8	1.40	10.64	13.54	0.79	**46.63**	**NO!, Vel >4.0 ft/s**
17.4	1.45	11.31	13.96	0.81	**50.60**	**NO!, Vel >4.0 ft/s**
18.0	1.50	12.00	14.37	0.84	**54.78**	**NO!, Vel >4.0 ft/s**
18.6	1.55	12.71	14.78	0.86	**59.16**	**NO!, Vel >4.0 ft/s**
19.2	1.60	13.44	15.19	0.88	**63.75**	**NO!, Vel >4.0 ft/s**
19.8	1.65	14.19	15.61	0.91	**68.55**	**NO!, Vel >4.0 ft/s**

Design Calculations

Interpolated Depth, d_{Q25}	3.5	in
Interpolated Velocity, V_{Q25}	1.80	fps
Froude #, Fr	0.22	subcritical
Freeboard Required	0.01	ft
Minimum Curve Radius, R	0	ft
Superelevation, E	0.00	ft
Min BSW depth, $h_{req'd}$	0.30	ft

Freeboard and Superelevation are based on HDM Topic 866

Criteria Checks

V_{Q25}	1.8	fps	ok

BSW Design Summary

Bottom Width, B	2.0	ft
Height, H	1.00	ft
Side Slope, Z	4.0	ft/ft
Long. Slope, S	0.0300	ft/ft

LRT

BSW 149

Biofiltration Swale Calculations

Water Quality Flow		
Paved area treated	0.56	ac
Unpaved area treated	0	ac
Assumed freeboard	0.2	ft
WQ Rainfall Intesity	0.2	in/hr
WQF	**0.10**	cfs

Runoff Coefficients	WQF	Design Storm
C_{paved}	0.9	1.0
$C_{unpaved}$	0.5	0.9

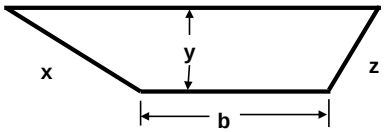
Design Storm, Q_{25}		
I_{25} (t_c = 5 min)	3.25	in/hr
I_{25} (t_c = 10 min)	2.34	in/hr
Q_{25}	**1.82**	cfs

WQF event - use n = 0.24

Manning's Equation : Q = (1.486*A*(R^0.67)*(S^0.5))/n (ENGLISH)

b (ft)	x (Lt side slope)	z (Rt side slope)	n	S (ft / ft)	Length (ft)
2.00	4.0	4.0	0.24	0.0130	97

Bioswale schematic



Input Site Data on this row

initial trial depth	0.050	ft
increment on depth	0.0500	ft

Solve by trial and error on the initial and increment depths, match required Q TDA

depth	y (=Depth)	A	P	R	Q	Velocity	HRT	HRT criteria met
inches	(feet)	(feet ^ 2)	(feet)	(feet)	(ft^3 / sec)	(ft/sec)	(minutes)	(sec^2/ft^2)
max = 6 inches						**max = 1.0 ft/s**	**min = 5 minutes**	**HRT*60/(y*V) >= 1300**
0.6	0.05	0.11	2.41	0.05	**0.01**	**0.09**	**18.0**	239,437
1.2	0.10	0.24	2.82	0.08	**0.03**	**0.14**	**11.9**	52,191
1.8	0.15	0.39	3.24	0.12	**0.07**	**0.17**	**9.4**	21,835
2.4	0.20	0.56	3.65	0.15	**0.11**	**0.20**	**8.0**	11,860
3.0	0.25	0.75	4.06	0.18	**0.17**	**0.23**	**7.1**	7,412
3.6	0.30	0.96	4.47	0.21	**0.24**	**0.25**	**6.4**	5,055
4.2	0.35	1.19	4.89	0.24	**0.33**	**0.28**	**5.9**	3,660
4.8	0.40	1.44	5.30	0.27	**0.43**	**0.30**	**5.5**	2,766
5.4	0.45	1.71	5.71	0.30	**0.54**	**0.32**	**5.1**	2,161

Criteria

1. HRT*60/(y * V) >=1300 **2. V max <= 1.0 fps** **3. Depth <= 6 inches** **4. HRT >= 5 minutes**

Criteria Checks			
HRT Criteria	**14551.1**	s2/ft2	ok
V_{WQF}	**0.2**	fps	ok
d_{WQF}	**2.2**	in	ok
HRT	**8.4**	min	ok

HDM event, Q25 - use n = 0.05

b (feet)	x (Lt side slope)	z (Rt side slope)	n	S (feet / feet)	Length (feet)
2.00	4.00	4.0	0.05	0.013	97

← Data copied from above

initial trial depth 0.100 ft

increment on depth 0.050 ft

Solve by trial and error on the initial and increment depths, match required Q

depth	y (=Depth)	A	P	R	Q	Velocity
inches	(feet)	(feet ^ 2)	(feet)	(feet)	(ft^3 / sec)	(ft/sec)
no max depth						max = 4.0 ft/s
1.2	0.10	0.24	2.82	0.08	**0.16**	**0.65**
1.8	0.15	0.39	3.24	0.12	**0.32**	**0.83**
2.4	0.20	0.56	3.65	0.15	**0.54**	**0.97**
3.0	0.25	0.75	4.06	0.18	**0.82**	**1.10**
3.6	0.30	0.96	4.47	0.21	**1.17**	**1.21**
4.2	0.35	1.19	4.89	0.24	**1.57**	**1.32**
4.8	0.40	1.44	5.30	0.27	**2.05**	**1.42**
5.4	0.45	1.71	5.71	0.30	**2.59**	**1.52**
6.0	0.50	2.00	6.12	0.33	**3.21**	**1.61**
6.6	0.55	2.31	6.54	0.35	**3.91**	**1.69**
7.2	0.60	2.64	6.95	0.38	**4.69**	**1.78**
7.8	0.65	2.99	7.36	0.41	**5.56**	**1.86**
8.4	0.70	3.36	7.77	0.43	**6.51**	**1.94**
9.0	0.75	3.75	8.18	0.46	**7.55**	**2.01**
9.6	0.80	4.16	8.60	0.48	**8.69**	**2.09**
10.2	0.85	4.59	9.01	0.51	**9.92**	**2.16**
10.8	0.90	5.04	9.42	0.53	**11.25**	**2.23**
11.4	0.95	5.51	9.83	0.56	**12.69**	**2.30**
12.0	1.00	6.00	10.25	0.59	**14.23**	**2.37**
12.6	1.05	6.51	10.66	0.61	**15.88**	**2.44**
13.2	1.10	7.04	11.07	0.64	**17.64**	**2.51**
13.8	1.15	7.59	11.48	0.66	**19.51**	**2.57**
14.4	1.20	8.16	11.90	0.69	**21.50**	**2.64**
15.0	1.25	8.75	12.31	0.71	**23.62**	**2.70**
15.6	1.30	9.36	12.72	0.74	**25.85**	**2.76**
16.2	1.35	9.99	13.13	0.76	**28.21**	**2.82**
16.8	1.40	10.64	13.54	0.79	**30.69**	**2.88**
17.4	1.45	11.31	13.96	0.81	**33.31**	**2.95**
18.0	1.50	12.00	14.37	0.84	**36.06**	**3.00**
18.6	1.55	12.71	14.78	0.86	**38.94**	**3.06**
19.2	1.60	13.44	15.19	0.88	**41.97**	**3.12**
19.8	1.65	14.19	15.61	0.91	**45.13**	**3.18**

Design Calculations

Interpolated Depth, d_{Q25}	4.5	in
Interpolated Velocity, V_{Q25}	1.37	fps
Froude #, Fr	0.17	subcritical
Freeboard Required	0.01	ft
Minimum Curve Radius, R	0	ft
Superelevation, E	0.00	ft
Min BSW depth, $h_{req'd}$	0.38	ft

Freeboard and Superelevation are based on HDM Topic 866

Criteria Checks

V_{Q25}	1.4	fps	ok

BSW Design Summary

Bottom Width, B	2.0	ft
Height, H	1.00	ft
Side Slope, Z	4.0	ft/ft
Long. Slope, S	0.0130	ft/ft

LRT

BSW 151

Biofiltration Swale Calculations

Water Quality Flow		
Paved area treated	0.15	ac
Unpaved area treated	0	ac
Assumed freeboard	0.2	ft
WQ Rainfall Intesity	0.2	in/hr
WQF	0.03	cfs

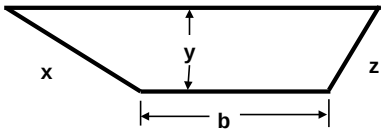
Runoff Coefficients	WQF	Design Storm
C_{paved}	0.9	1.0
$C_{unpaved}$	0.5	0.9

Design Storm, Q_{25}		
I_{25} (t_c = 5 min)	3.25	in/hr
I_{25} (t_c = 10 min)	2.34	in/hr
Q_{25}	0.49	cfs

WQF event - use n = 0.24

Manning's Equation : Q = (1.486*A*(R^0.67)*(S^0.5))/n (ENGLISH)

Bioswale schematic



b (ft)	x (Lt side slope)	z (Rt side slope)	n	S (ft / ft)	Length (ft)
2.00	4.0	4.0	0.24	0.0180	63

← Input Site Data on this row

initial trial depth 0.050 ft

increment on depth 0.0500 ft

Solve by trial and error on the initial and increment depths, match required Q TDA

depth	y (=Depth)	A	P	R	Q	Velocity	HRT	HRT criteria met
inches	(feet)	(feet ^ 2)	(feet)	(feet)	(ft^3 / sec)	(ft/sec)	(minutes)	(sec^2/ft^2)
max = 6 inches						**max = 1.0 ft/s**	**min = 5 minutes**	**HRT*60/(y*V) >= 1300**
0.6	0.05	0.11	2.41	0.05	**0.01**	**0.11**	**9.9**	112,313
1.2	0.10	0.24	2.82	0.08	**0.04**	**0.16**	**6.5**	24,481
1.8	0.15	0.39	3.24	0.12	**0.08**	**0.20**	**5.2**	10,242
2.4	0.20	0.56	3.65	0.15	**0.13**	**0.24**	**< 5 minutes**	#VALUE!
3.0	0.25	0.75	4.06	0.18	**0.20**	**0.27**	**< 5 minutes**	#VALUE!
3.6	0.30	0.96	4.47	0.21	**0.29**	**0.30**	**< 5 minutes**	#VALUE!
4.2	0.35	1.19	4.89	0.24	**0.39**	**0.32**	**< 5 minutes**	#VALUE!
4.8	0.40	1.44	5.30	0.27	**0.50**	**0.35**	**< 5 minutes**	#VALUE!
5.4	0.45	1.71	5.71	0.30	**0.64**	**0.37**	**< 5 minutes**	#VALUE!

Criteria

1. **HRT*60/(y * V) >=1300**
2. **V max <= 1.0 fps**
3. **Depth <= 6 inches**
4. **HRT >= 5 minutes**

Criteria Checks			
HRT Criteria	62102.3	s2/ft2	ok
V_{WQF}	0.1	fps	ok
d_{WQF}	0.9	in	ok
HRT	8.0	min	ok

HDM event, Q25 - use n = 0.05

b (feet)	x (Lt side slope)	z (Rt side slope)	n	S (feet / feet)	Length (feet)
2.00	4.00	4.0	0.05	0.018	63

← Data copied from above

initial trial depth 0.100 ft

increment on depth 0.050 ft

Solve by trial and error on the initial and increment depths, match required Q

depth	y (=Depth)	A	P	R	Q	Velocity
inches	(feet)	(feet ^ 2)	(feet)	(feet)	(ft^3 / sec)	(ft/sec)
no max depth						max = 4.0 ft/s
1.2	0.10	0.24	2.82	0.08	**0.18**	**0.77**
1.8	0.15	0.39	3.24	0.12	**0.38**	**0.97**
2.4	0.20	0.56	3.65	0.15	**0.64**	**1.14**
3.0	0.25	0.75	4.06	0.18	**0.97**	**1.29**
3.6	0.30	0.96	4.47	0.21	**1.37**	**1.43**
4.2	0.35	1.19	4.89	0.24	**1.85**	**1.55**
4.8	0.40	1.44	5.30	0.27	**2.41**	**1.67**
5.4	0.45	1.71	5.71	0.30	**3.05**	**1.78**
6.0	0.50	2.00	6.12	0.33	**3.78**	**1.89**
6.6	0.55	2.31	6.54	0.35	**4.60**	**1.99**
7.2	0.60	2.64	6.95	0.38	**5.52**	**2.09**
7.8	0.65	2.99	7.36	0.41	**6.54**	**2.19**
8.4	0.70	3.36	7.77	0.43	**7.66**	**2.28**
9.0	0.75	3.75	8.18	0.46	**8.88**	**2.37**
9.6	0.80	4.16	8.60	0.48	**10.22**	**2.46**
10.2	0.85	4.59	9.01	0.51	**11.67**	**2.54**
10.8	0.90	5.04	9.42	0.53	**13.24**	**2.63**
11.4	0.95	5.51	9.83	0.56	**14.93**	**2.71**
12.0	1.00	6.00	10.25	0.59	**16.74**	**2.79**
12.6	1.05	6.51	10.66	0.61	**18.68**	**2.87**
13.2	1.10	7.04	11.07	0.64	**20.75**	**2.95**
13.8	1.15	7.59	11.48	0.66	**22.96**	**3.03**
14.4	1.20	8.16	11.90	0.69	**25.30**	**3.10**
15.0	1.25	8.75	12.31	0.71	**27.79**	**3.18**
15.6	1.30	9.36	12.72	0.74	**30.42**	**3.25**
16.2	1.35	9.99	13.13	0.76	**33.19**	**3.32**
16.8	1.40	10.64	13.54	0.79	**36.12**	**3.39**
17.4	1.45	11.31	13.96	0.81	**39.20**	**3.47**
18.0	1.50	12.00	14.37	0.84	**42.43**	**3.54**
18.6	1.55	12.71	14.78	0.86	**45.82**	**3.61**
19.2	1.60	13.44	15.19	0.88	**49.38**	**3.67**
19.8	1.65	14.19	15.61	0.91	**53.10**	**3.74**

Design Calculations

Interpolated Depth, d_{Q25}	2.0	in
Interpolated Velocity, V_{Q25}	1.04	fps
Froude #, Fr	0.13	subcritical
Freeboard Required	0.00	ft
Minimum Curve Radius, R	0	ft
Superelevation, E	0.00	ft
Min BSW depth, $h_{req'd}$	0.17	ft

Freeboard and Superelevation are based on HDM Topic 866

Criteria Checks

V_{Q25}	1.0	fps	ok

BSW Design Summary

Bottom Width, B	2.0	ft
Height, H	1.00	ft
Side Slope, Z	4.0	ft/ft
Long. Slope, S	0.0180	ft/ft

LRT

BSW 157

Biofiltration Swale Calculations

Water Quality Flow		
Paved area treated	0.61	ac
Unpaved area treated	0	ac
Assumed freeboard	0.2	ft
WQ Rainfall Intesity	0.2	in/hr
WQF	**0.11**	cfs

Runoff Coefficients	WQF	Design Storm
C_{paved}	0.9	1.0
$C_{unpaved}$	0.5	0.9

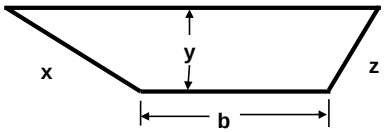
Design Storm, Q_{25}		
I_{25} (t_c = 5 min)	3.25	in/hr
I_{25} (t_c = 10 min)	2.34	in/hr
Q_{25}	**1.98**	cfs

WQF event - use n = 0.24

Manning's Equation : Q = (1.486*A*(R^0.67)*(S^0.5))/n (ENGLISH)

b (ft)	x (Lt side slope)	z (Rt side slope)	n	S (ft / ft)	Length (ft)
2.00	4.0	4.0	0.24	0.0100	96

Bioswale schematic



Input Site Data on this row

initial trial depth	0.050	ft
increment on depth	0.0500	ft

Solve by trial and error on the initial and increment depths, match required Q TDA

depth	y (=Depth)	A	P	R	Q	Velocity	HRT	HRT criteria met
inches	(feet)	(feet ^ 2)	(feet)	(feet)	(ft^3 / sec)	(ft/sec)	(minutes)	(sec^2/ft^2)
max = 6 inches						**max = 1.0 ft/s**	**min = 5 minutes**	**HRT*60/(y*V) >= 1300**
0.6	0.05	0.11	2.41	0.05	**0.01**	**0.08**	**20.3**	308,059
1.2	0.10	0.24	2.82	0.08	**0.03**	**0.12**	**13.4**	67,148
1.8	0.15	0.39	3.24	0.12	**0.06**	**0.15**	**10.6**	28,093
2.4	0.20	0.56	3.65	0.15	**0.10**	**0.18**	**9.0**	15,259
3.0	0.25	0.75	4.06	0.18	**0.15**	**0.20**	**8.0**	9,536
3.6	0.30	0.96	4.47	0.21	**0.21**	**0.22**	**7.2**	6,504
4.2	0.35	1.19	4.89	0.24	**0.29**	**0.24**	**6.6**	4,709
4.8	0.40	1.44	5.30	0.27	**0.37**	**0.26**	**6.2**	3,559
5.4	0.45	1.71	5.71	0.30	**0.47**	**0.28**	**5.8**	2,780

Criteria

1. HRT*60/(y * V) >=1300 **2. V max <= 1.0 fps** **3. Depth <= 6 inches** **4. HRT >= 5 minutes**

Criteria Checks			
HRT Criteria	**14087.3**	s2/ft2	ok
V_{WQF}	**0.2**	fps	ok
d_{WQF}	**2.5**	in	ok
HRT	**8.8**	min	ok

LRT

BSW 157

Biofiltration Swale Calculations

HDM event, Q25 - use n = 0.05

b (feet)	x (Lt side slope)	z (Rt side slope)	n	S (feet / feet)	Length (feet)
2.00	4.00	4.0	0.05	0.010	96

← Data copied from above

initial trial depth 0.100 ft

increment on depth 0.050 ft

Solve by trial and error on the initial and increment depths, match required Q

depth	y (=Depth)	A	P	R	Q	Velocity
inches	(feet)	(feet ^ 2)	(feet)	(feet)	(ft^3 / sec)	(ft/sec)
no max depth						max = 4.0 ft/s
1.2	0.10	0.24	2.82	0.08	**0.14**	**0.57**
1.8	0.15	0.39	3.24	0.12	**0.28**	**0.72**
2.4	0.20	0.56	3.65	0.15	**0.48**	**0.85**
3.0	0.25	0.75	4.06	0.18	**0.72**	**0.96**
3.6	0.30	0.96	4.47	0.21	**1.02**	**1.06**
4.2	0.35	1.19	4.89	0.24	**1.38**	**1.16**
4.8	0.40	1.44	5.30	0.27	**1.79**	**1.25**
5.4	0.45	1.71	5.71	0.30	**2.27**	**1.33**
6.0	0.50	2.00	6.12	0.33	**2.82**	**1.41**
6.6	0.55	2.31	6.54	0.35	**3.43**	**1.49**
7.2	0.60	2.64	6.95	0.38	**4.11**	**1.56**
7.8	0.65	2.99	7.36	0.41	**4.87**	**1.63**
8.4	0.70	3.36	7.77	0.43	**5.71**	**1.70**
9.0	0.75	3.75	8.18	0.46	**6.62**	**1.77**
9.6	0.80	4.16	8.60	0.48	**7.62**	**1.83**
10.2	0.85	4.59	9.01	0.51	**8.70**	**1.90**
10.8	0.90	5.04	9.42	0.53	**9.87**	**1.96**
11.4	0.95	5.51	9.83	0.56	**11.13**	**2.02**
12.0	1.00	6.00	10.25	0.59	**12.48**	**2.08**
12.6	1.05	6.51	10.66	0.61	**13.93**	**2.14**
13.2	1.10	7.04	11.07	0.64	**15.47**	**2.20**
13.8	1.15	7.59	11.48	0.66	**17.11**	**2.25**
14.4	1.20	8.16	11.90	0.69	**18.86**	**2.31**
15.0	1.25	8.75	12.31	0.71	**20.71**	**2.37**
15.6	1.30	9.36	12.72	0.74	**22.67**	**2.42**
16.2	1.35	9.99	13.13	0.76	**24.74**	**2.48**
16.8	1.40	10.64	13.54	0.79	**26.92**	**2.53**
17.4	1.45	11.31	13.96	0.81	**29.21**	**2.58**
18.0	1.50	12.00	14.37	0.84	**31.63**	**2.64**
18.6	1.55	12.71	14.78	0.86	**34.16**	**2.69**
19.2	1.60	13.44	15.19	0.88	**36.81**	**2.74**
19.8	1.65	14.19	15.61	0.91	**39.58**	**2.79**

Design Calculations

Interpolated Depth, d_{Q25}	5.0	in
Interpolated Velocity, V_{Q25}	1.28	fps
Froude #, Fr	0.16	subcritical
Freeboard Required	0.01	ft
Minimum Curve Radius, R	0	ft
Superelevation, E	0.00	ft
Min BSW depth, $h_{req'd}$	0.42	ft

Freeboard and Superelevation are based on HDM Topic 866

Criteria Checks

V_{Q25}	1.3	fps	ok

BSW Design Summary

Bottom Width, B	2.0	ft
Height, H	1.00	ft
Side Slope, Z	4.0	ft/ft
Long. Slope, S	0.0100	ft/ft

SR 710 North Study

BSW 403

Biofiltration Swale Calculations

Water Quality Flow		
Paved area treated	1.64	ac
Unpaved area treated	0	ac
Assumed freeboard	0.2	ft
WQ Rainfall Intesity	0.2	in/hr
WQF	**0.30**	cfs

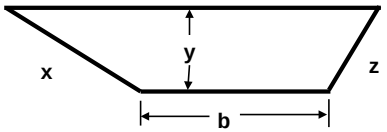
Runoff Coefficients	WQF	Design Storm
C_{paved}	0.9	1.0
$C_{unpaved}$	0.54	0.9

Design Storm, Q_{25}		
I_{25} (t_c = 5 min)	3.25	in/hr
I_{25} (t_c = 10 min)	2.34	in/hr
Q_{25}	**5.33**	cfs

WQF event - use n = 0.24

Manning's Equation : Q = (1.486*A*(R^0.67)*(S^0.5))/n (ENGLISH)

Bioswale schematic



b (ft)	x (Lt side slope)	z (Rt side slope)	n	S (ft / ft)	Length (ft)
2.00	4.0	4.0	0.24	0.0230	240

← **Input Site Data on this row**

initial trial depth 0.200 ft

increment on depth 0.0500 ft

Solve by trial and error on the initial and increment depths, match required Q TDA

depth	y (=Depth)	A	P	R	Q	Velocity	HRT	HRT criteria met
inches	(feet)	(feet ^ 2)	(feet)	(feet)	(ft^3 / sec)	(ft/sec)	(minutes)	(sec^2/ft^2)
max = 6 inches						**max = 1.0 ft/s**	**min = 5 minutes**	**HRT*60/(y*V) >= 1300**
2.4	0.20	0.56	3.65	0.15	**0.15**	**0.27**	**14.9**	16,586
3.0	0.25	0.75	4.06	0.18	**0.23**	**0.30**	**13.1**	10,366
3.6	0.30	0.96	4.47	0.21	**0.32**	**0.34**	**11.9**	7,070
4.2	0.35	1.19	4.89	0.24	**0.44**	**0.37**	**10.9**	5,118
4.8	0.40	1.44	5.30	0.27	**0.57**	**0.39**	**10.2**	3,869
5.4	0.45	1.71	5.71	0.30	**0.72**	**0.42**	**9.5**	3,022
6.0	0.50	2.00	6.12	0.33	**0.89**	**0.45**	**9.0**	2,422
6.6	0.55	2.31	6.54	0.35	**1.08**	**0.47**	**8.5**	1,982
7.2	0.60	2.64	6.95	0.38	**1.30**	**0.49**	**8.1**	1,649

Criteria

1. HRT*60/(y * V) >=1300 **2. V max <= 1.0 fps** **3. Depth <= 6 inches** **4. HRT >= 5 minutes**

Criteria Checks			
HRT Criteria	**8035.1**	s2/ft2	ok
V_{WQF}	**0.3**	fps	ok
d_{WQF}	**3.4**	in	ok
HRT	**12.3**	min	ok

HDM event, Q25 - use n = 0.05

b (feet)	x (Lt side slope)	z (Rt side slope)	n	S (feet / feet)	Length (feet)
2.00	4.00	4.0	0.05	0.023	240

← Data copied from above

initial trial depth 0.100 ft

increment on depth 0.050 ft

Solve by trial and error on the initial and increment depths, match required Q

depth	y (=Depth)	A	P	R	Q	Velocity
inches	(feet)	(feet ^ 2)	(feet)	(feet)	(ft^3 / sec)	(ft/sec)
no max depth						max = 4.0 ft/s
1.2	0.10	0.24	2.82	0.08	**0.21**	**0.87**
1.8	0.15	0.39	3.24	0.12	**0.43**	**1.10**
2.4	0.20	0.56	3.65	0.15	**0.72**	**1.29**
3.0	0.25	0.75	4.06	0.18	**1.10**	**1.46**
3.6	0.30	0.96	4.47	0.21	**1.55**	**1.61**
4.2	0.35	1.19	4.89	0.24	**2.09**	**1.76**
4.8	0.40	1.44	5.30	0.27	**2.72**	**1.89**
5.4	0.45	1.71	5.71	0.30	**3.45**	**2.02**
6.0	0.50	2.00	6.12	0.33	**4.27**	**2.14**
6.6	0.55	2.31	6.54	0.35	**5.20**	**2.25**
7.2	0.60	2.64	6.95	0.38	**6.24**	**2.36**
7.8	0.65	2.99	7.36	0.41	**7.39**	**2.47**
8.4	0.70	3.36	7.77	0.43	**8.66**	**2.58**
9.0	0.75	3.75	8.18	0.46	**10.04**	**2.68**
9.6	0.80	4.16	8.60	0.48	**11.55**	**2.78**
10.2	0.85	4.59	9.01	0.51	**13.19**	**2.87**
10.8	0.90	5.04	9.42	0.53	**14.97**	**2.97**
11.4	0.95	5.51	9.83	0.56	**16.88**	**3.06**
12.0	1.00	6.00	10.25	0.59	**18.93**	**3.15**
12.6	1.05	6.51	10.66	0.61	**21.12**	**3.24**
13.2	1.10	7.04	11.07	0.64	**23.46**	**3.33**
13.8	1.15	7.59	11.48	0.66	**25.95**	**3.42**
14.4	1.20	8.16	11.90	0.69	**28.60**	**3.51**
15.0	1.25	8.75	12.31	0.71	**31.41**	**3.59**
15.6	1.30	9.36	12.72	0.74	**34.38**	**3.67**
16.2	1.35	9.99	13.13	0.76	**37.52**	**3.76**
16.8	1.40	10.64	13.54	0.79	**40.83**	**3.84**
17.4	1.45	11.31	13.96	0.81	**44.31**	**3.92**
18.0	1.50	12.00	14.37	0.84	**47.96**	**4.00**
18.6	1.55	12.71	14.78	0.86	**51.80**	**NO!, Vel >4.0 ft/s**
19.2	1.60	13.44	15.19	0.88	**55.82**	**NO!, Vel >4.0 ft/s**
19.8	1.65	14.19	15.61	0.91	**60.03**	**NO!, Vel >4.0 ft/s**

Design Calculations

Interpolated Depth, d_{Q25}	6.7	in
Interpolated Velocity, V_{Q25}	2.27	fps
Froude #, Fr	0.28	subcritical
Freeboard Required	0.02	ft
Minimum Curve Radius, R	0	ft
Superelevation, E	0.00	ft
Min BSW depth, $h_{req'd}$	0.57	ft

Freeboard and Superelevation are based on HDM Topic 866

Criteria Checks

V_{Q25}	2.3	fps	ok

BSW Design Summary

Bottom Width, B	2.0	ft
Height, H	1.00	ft
Side Slope, Z	4.0	ft/ft
Long. Slope, S	0.0230	ft/ft

SR 710 North Study

BSW 1407

Biofiltration Swale Calculations

Water Quality Flow		
Paved area treated	0.91	ac
Unpaved area treated	0	ac
Assumed freeboard	0.2	ft
WQ Rainfall Intesity	0.16	in/hr
WQF	**0.13**	cfs

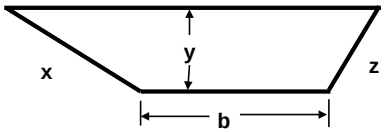
Runoff Coefficients	WQF	Design Storm
C_{paved}	0.9	1.0
$C_{unpaved}$	0.62	0.9

Design Storm, Q_{25}		
I_{25} (t_c = 5 min)	3.25	in/hr
I_{25} (t_c = 10 min)	2.34	in/hr
Q_{25}	**2.96**	cfs

WQF event - use n = 0.24

Manning's Equation : Q = (1.486*A*(R^0.67)*(S^0.5))/n (ENGLISH)

Bioswale schematic



b (ft)	x (Lt side slope)	z (Rt side slope)	n	S (ft / ft)	Length (ft)
2.00	4.0	4.0	0.24	0.0130	280

← **Input Site Data on this row**

initial trial depth 0.200 ft

increment on depth 0.0500 ft

Solve by trial and error on the initial and increment depths, match required Q TDA

depth	y (=Depth)	A	P	R	Q	Velocity	HRT	HRT criteria met
inches	(feet)	(feet ^ 2)	(feet)	(feet)	(ft^3 / sec)	(ft/sec)	(minutes)	(sec^2/ft^2)
max = 6 inches						**max = 1.0 ft/s**	**min = 5 minutes**	**HRT*60/(y*V) >= 1300**
2.4	0.20	0.56	3.65	0.15	**0.11**	**0.20**	**23.1**	34,235
3.0	0.25	0.75	4.06	0.18	**0.17**	**0.23**	**20.4**	21,396
3.6	0.30	0.96	4.47	0.21	**0.24**	**0.25**	**18.5**	14,593
4.2	0.35	1.19	4.89	0.24	**0.33**	**0.28**	**17.0**	10,564
4.8	0.40	1.44	5.30	0.27	**0.43**	**0.30**	**15.8**	7,986
5.4	0.45	1.71	5.71	0.30	**0.54**	**0.32**	**14.8**	6,237
6.0	0.50	2.00	6.12	0.33	**0.67**	**0.33**	**13.9**	4,999
6.6	0.55	2.31	6.54	0.35	**0.81**	**0.35**	**13.2**	4,090
7.2	0.60	2.64	6.95	0.38	**0.98**	**0.37**	**12.6**	3,404

Criteria

1. HRT*60/(y * V) >=1300 **2. V max <= 1.0 fps** **3. Depth <= 6 inches** **4. HRT >= 5 minutes**

Criteria Checks			
HRT Criteria	30319.2	s2/ft2	ok
V_{WQF}	0.2	fps	ok
d_{WQF}	2.6	in	ok
HRT	22.3	min	ok

HDM event, Q25 - use n = 0.05

b (feet)	x (Lt side slope)	z (Rt side slope)	n	S (feet / feet)	Length (feet)
2.00	4.00	4.0	0.05	0.013	280

← Data copied from above

initial trial depth 0.100 ft

increment on depth 0.050 ft

Solve by trial and error on the initial and increment depths, match required Q

depth	y (=Depth)	A	P	R	Q	Velocity
inches	(feet)	(feet ^ 2)	(feet)	(feet)	(ft^3 / sec)	(ft/sec)
no max depth						max = 4.0 ft/s
1.2	0.10	0.24	2.82	0.08	**0.16**	**0.65**
1.8	0.15	0.39	3.24	0.12	**0.32**	**0.83**
2.4	0.20	0.56	3.65	0.15	**0.54**	**0.97**
3.0	0.25	0.75	4.06	0.18	**0.82**	**1.10**
3.6	0.30	0.96	4.47	0.21	**1.17**	**1.21**
4.2	0.35	1.19	4.89	0.24	**1.57**	**1.32**
4.8	0.40	1.44	5.30	0.27	**2.05**	**1.42**
5.4	0.45	1.71	5.71	0.30	**2.59**	**1.52**
6.0	0.50	2.00	6.12	0.33	**3.21**	**1.61**
6.6	0.55	2.31	6.54	0.35	**3.91**	**1.69**
7.2	0.60	2.64	6.95	0.38	**4.69**	**1.78**
7.8	0.65	2.99	7.36	0.41	**5.56**	**1.86**
8.4	0.70	3.36	7.77	0.43	**6.51**	**1.94**
9.0	0.75	3.75	8.18	0.46	**7.55**	**2.01**
9.6	0.80	4.16	8.60	0.48	**8.69**	**2.09**
10.2	0.85	4.59	9.01	0.51	**9.92**	**2.16**
10.8	0.90	5.04	9.42	0.53	**11.25**	**2.23**
11.4	0.95	5.51	9.83	0.56	**12.69**	**2.30**
12.0	1.00	6.00	10.25	0.59	**14.23**	**2.37**
12.6	1.05	6.51	10.66	0.61	**15.88**	**2.44**
13.2	1.10	7.04	11.07	0.64	**17.64**	**2.51**
13.8	1.15	7.59	11.48	0.66	**19.51**	**2.57**
14.4	1.20	8.16	11.90	0.69	**21.50**	**2.64**
15.0	1.25	8.75	12.31	0.71	**23.62**	**2.70**
15.6	1.30	9.36	12.72	0.74	**25.85**	**2.76**
16.2	1.35	9.99	13.13	0.76	**28.21**	**2.82**
16.8	1.40	10.64	13.54	0.79	**30.69**	**2.88**
17.4	1.45	11.31	13.96	0.81	**33.31**	**2.95**
18.0	1.50	12.00	14.37	0.84	**36.06**	**3.00**
18.6	1.55	12.71	14.78	0.86	**38.94**	**3.06**
19.2	1.60	13.44	15.19	0.88	**41.97**	**3.12**
19.8	1.65	14.19	15.61	0.91	**45.13**	**3.18**

Design Calculations

Interpolated Depth, d_{Q25}	5.8	in
Interpolated Velocity, V_{Q25}	1.57	fps
Froude #, Fr	0.20	subcritical
Freeboard Required	0.01	ft
Minimum Curve Radius, R	0	ft
Superelevation, E	0.00	ft
Min BSW depth, $h_{req'd}$	0.49	ft

Freeboard and Superelevation are based on HDM Topic 866

Criteria Checks

V_{Q25}	1.6	fps	ok

BSW Design Summary

Bottom Width, B	2.0	ft
Height, H	1.00	ft
Side Slope, Z	4.0	ft/ft
Long. Slope, S	0.0130	ft/ft

SR 710 North Study
BSW 449
Biofiltration Swale Calculations

Water Quality Flow		
Paved area treated	8.75	ac
Unpaved area treated	4.01	ac
Assumed freeboard	0.2	ft
WQ Rainfall Intesity	0.2	in/hr
WQF	2.01	cfs

Runoff Coefficients	WQF	Design Storm
C_{paved}	0.9	1.0
$C_{unpaved}$	0.54	0.9

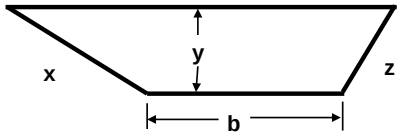
Design Storm, Q_{50}		
I_{50} (t_c = 5 min)	N/A	in/hr
I_{50} (t_c = 10 min)	N/A	in/hr
Q_{50}	N/A	cfs

Flows larger than WQF will be bypassed by pump

WQF event - use n = 0.24

Manning's Equation : Q = (1.486*A*(R^0.67)*(S^0.5))/n (ENGLISH)

Bioswale schematic



b (ft)	x (Lt side slope)	z (Rt side slope)	n	S (ft / ft)	Length (ft)
6.00	4.0	4.0	0.24	0.0269	250

← Input Site Data on this row

initial trial depth 0.200 ft

increment on depth 0.0500 ft

Solve by trial and error on the initial and increment depths, match required Q TDA

depth	y (=Depth)	A	P	R	Q	Velocity	HRT	HRT criteria met
inches	(feet)	(feet ^ 2)	(feet)	(feet)	(ft^3 / sec)	(ft/sec)	(minutes)	(sec^2/ft^2)
max = 6 inches						**max = 1.0 ft/s**	**min = 5 minutes**	**HRT*60/(y*V) >= 1300**
2.4	0.20	1.36	7.65	0.18	**0.44**	**0.32**	**13.0**	12,138
3.0	0.25	1.75	8.06	0.22	**0.64**	**0.37**	**11.4**	7,440
3.6	0.30	2.16	8.47	0.25	**0.88**	**0.41**	**10.2**	5,004
4.2	0.35	2.59	8.89	0.29	**1.16**	**0.45**	**9.3**	3,587
4.8	0.40	3.04	9.30	0.33	**1.46**	**0.48**	**8.6**	2,693
5.4	0.45	3.51	9.71	0.36	**1.81**	**0.52**	**8.1**	2,094
6.0	0.50	4.00	10.12	0.40	**2.19**	**0.55**	**7.6**	1,673
6.6	0.55	4.51	10.54	0.43	**2.60**	**0.58**	**7.2**	1,367
7.2	0.60	5.04	10.95	0.46	**3.05**	**0.61**	**6.9**	NO

Criteria

1. HRT*60/(y * V) >=1300 **2. V max <= 1.0 fps** **3. Depth <= 6 inches** **4. HRT >= 5 minutes**

Criteria Checks			
HRT Criteria	1871.5	s2/ft2	ok
V_{WQF}	0.5	fps	ok
d_{WQF}	5.7	in	ok
HRT	7.8	min	ok

SR 710 North Study

BSW 1737

Biofiltration Swale Calculations

Water Quality Flow		
Paved area treated	208.67	ac
Unpaved area treated	116.08	ac
Assumed freeboard	0.2	ft
WQ Rainfall Intesity	0.2	in/hr
WQF	48.70	cfs
WQF Max	6.16	cfs

Runoff Coefficients	WQF	Design Storm
C_{paved}	0.9	1.0
$C_{unpaved}$	0.48	0.9

Design Storm, Q_{50}		
I_{50} (t_c = 5 min)	N/A	in/hr
I_{50} (t_c = 10 min)	N/A	in/hr
Q_{50}	N/A	cfs

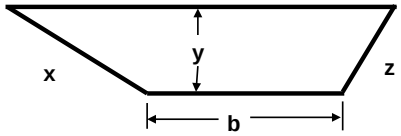
Flows larger than WQF_{Max} will be bypassed by pump

Pump outfow control

WQF event - use n = 0.24

Manning's Equation : Q = (1.486*A*(R^0.67)*(S^0.5))/n (ENGLISH)

Bioswale schematic



b (ft)	x (Lt side slope)	z (Rt side slope)	n	S (ft / ft)	Length (ft)
20.00	4.0	4.0	0.24	0.0250	210

← **Input Site Data on this row**

initial trial depth	0.450	ft
increment on depth	0.0100	ft

Solve by trial and error on the initial and increment depths, match required Q TDA

depth	y (=Depth)	A	P	R	Q	Velocity	HRT	HRT criteria met
inches	(feet)	(feet ^ 2)	(feet)	(feet)	(ft^3 / sec)	(ft/sec)	(minutes)	(sec^2/ft^2)
max = 6 inches						**max = 1.0 ft/s**	**min = 5 minutes**	**HRT*60/(y*V) >= 1300**
5.4	0.45	9.81	23.71	0.41	**5.33**	**0.54**	**6.4**	1,580
5.5	0.46	10.05	23.79	0.42	**5.53**	**0.55**	**6.4**	1,505
5.6	0.47	10.28	23.88	0.43	**5.74**	**0.56**	**6.3**	1,434
5.8	0.48	10.52	23.96	0.44	**5.95**	**0.57**	**6.2**	1,368
5.9	0.49	10.76	24.04	0.45	**6.16**	**0.57**	**6.1**	1,307
6.0	0.50	11.00	24.12	0.46	**6.38**	**0.58**	**6.0**	NO
6.1	0.51	11.24	24.21	0.46	**6.60**	**0.59**	**6.0**	NO
6.2	0.52	11.48	24.29	0.47	**6.82**	**0.59**	**5.9**	NO
6.4	0.53	11.72	24.37	0.48	**7.04**	**0.60**	**5.8**	NO

Criteria

1. HRT*60/(y * V) >=1300 **2. V max <= 1.0 fps** **3. Depth <= 6 inches** **4. HRT >= 5 minutes**

Criteria Checks			
HRT Criteria	1306.7	s2/ft2	ok
V_{WQF}	0.6	fps	ok
d_{WQF}	5.9	in	ok
HRT	6.1	min	ok

SR 710 North Study
BSW 34
Biofiltration Swale Calculations

Water Quality Flow		
Paved area treated	0.99	ac
Unpaved area treated	0.09	ac
Assumed freeboard	0.2	ft
WQ Rainfall Intesity	0.2	in/hr
WQF	**0.19**	cfs

Runoff Coefficients	WQF	Design Storm
C_{paved}	0.9	1.0
$C_{unpaved}$	0.48	0.9

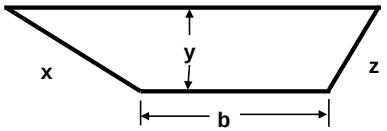
Design Storm, Q_{25}		
I_{25} (t_c = 5 min)	4.08	in/hr
I_{25} (t_c = 10 min)	2.95	in/hr
Q_{25}	**4.37**	cfs

WQF event - use n = 0.24

Manning's Equation : Q = (1.486*A*(R^0.67)*(S^0.5))/n (ENGLISH)

b (ft)	x (Lt side slope)	z (Rt side slope)	n	S (ft / ft)	Length (ft)
2.00	3.0	3.0	0.24	0.0100	80

Bioswale schematic



Input Site Data on this row

initial trial depth	0.050	ft
increment on depth	0.0500	ft

Solve by trial and error on the initial and increment depths, match required Q TDA

depth	y (=Depth)	A	P	R	Q	Velocity	HRT	HRT criteria met
inches	(feet)	(feet ^ 2)	(feet)	(feet)	(ft^3 / sec)	(ft/sec)	(minutes)	(sec^2/ft^2)
max = 6 inches						**max = 1.0 ft/s**	**min = 5 minutes**	**HRT*60/(y*V) >= 1300**
0.6	0.05	0.11	2.32	0.05	**0.01**	**0.08**	**16.7**	250,740
1.2	0.10	0.23	2.63	0.09	**0.03**	**0.12**	**10.9**	53,913
1.8	0.15	0.37	2.95	0.12	**0.06**	**0.15**	**8.6**	22,378
2.4	0.20	0.52	3.26	0.16	**0.09**	**0.18**	**7.3**	12,100
3.0	0.25	0.69	3.58	0.19	**0.14**	**0.21**	**6.5**	7,545
3.6	0.30	0.87	3.90	0.22	**0.20**	**0.23**	**5.9**	5,142
4.2	0.35	1.07	4.21	0.25	**0.26**	**0.25**	**5.4**	3,723
4.8	0.40	1.28	4.53	0.28	**0.34**	**0.27**	**5.0**	2,816
5.4	0.45	1.51	4.85	0.31	**0.43**	**0.28**	**< 5 minutes**	#VALUE!

Criteria

1. HRT*60/(y * V) >=1300	2. V max <= 1.0 fps	3. Depth <= 6 inches	4. HRT >= 5 minutes

Criteria Checks			
HRT Criteria	**5626.1**	s2/ft2	ok
V_{WQF}	**0.2**	fps	ok
d_{WQF}	**3.5**	in	ok
HRT	**6.0**	min	ok

HDM event, Q25 - use n = 0.05

b (feet)	x (Lt side slope)	z (Rt side slope)	n	S (feet / feet)	Length (feet)
2.00	3.00	3.0	0.05	0.010	80

← Data copied from above

initial trial depth 0.100 ft

increment on depth 0.050 ft

Solve by trial and error on the initial and increment depths, match required Q

depth	y (=Depth)	A	P	R	Q	Velocity
inches	(feet)	(feet ^ 2)	(feet)	(feet)	(ft^3 / sec)	(ft/sec)
no max depth						max = 4.0 ft/s
1.2	0.10	0.23	2.63	0.09	**0.13**	**0.58**
1.8	0.15	0.37	2.95	0.12	**0.27**	**0.74**
2.4	0.20	0.52	3.26	0.16	**0.45**	**0.87**
3.0	0.25	0.69	3.58	0.19	**0.68**	**0.99**
3.6	0.30	0.87	3.90	0.22	**0.95**	**1.09**
4.2	0.35	1.07	4.21	0.25	**1.27**	**1.19**
4.8	0.40	1.28	4.53	0.28	**1.64**	**1.28**
5.4	0.45	1.51	4.85	0.31	**2.06**	**1.36**
6.0	0.50	1.75	5.16	0.34	**2.53**	**1.44**
6.6	0.55	2.01	5.48	0.37	**3.05**	**1.52**
7.2	0.60	2.28	5.79	0.39	**3.64**	**1.60**
7.8	0.65	2.57	6.11	0.42	**4.28**	**1.67**
8.4	0.70	2.87	6.43	0.45	**4.98**	**1.74**
9.0	0.75	3.19	6.74	0.47	**5.75**	**1.80**
9.6	0.80	3.52	7.06	0.50	**6.58**	**1.87**
10.2	0.85	3.87	7.38	0.52	**7.47**	**1.93**
10.8	0.90	4.23	7.69	0.55	**8.44**	**1.99**
11.4	0.95	4.61	8.01	0.58	**9.47**	**2.06**
12.0	1.00	5.00	8.32	0.60	**10.58**	**2.12**
12.6	1.05	5.41	8.64	0.63	**11.76**	**2.17**
13.2	1.10	5.83	8.96	0.65	**13.01**	**2.23**
13.8	1.15	6.27	9.27	0.68	**14.34**	**2.29**
14.4	1.20	6.72	9.59	0.70	**15.75**	**2.34**
15.0	1.25	7.19	9.91	0.73	**17.25**	**2.40**
15.6	1.30	7.67	10.22	0.75	**18.82**	**2.45**
16.2	1.35	8.17	10.54	0.78	**20.48**	**2.51**
16.8	1.40	8.68	10.85	0.80	**22.22**	**2.56**
17.4	1.45	9.21	11.17	0.82	**24.06**	**2.61**
18.0	1.50	9.75	11.49	0.85	**25.98**	**2.66**
18.6	1.55	10.31	11.80	0.87	**27.99**	**2.72**
19.2	1.60	10.88	12.12	0.90	**30.09**	**2.77**
19.8	1.65	11.47	12.44	0.92	**32.29**	**2.82**

Design Calculations

Interpolated Depth, d_{Q25}	7.9	in
Interpolated Velocity, V_{Q25}	1.68	fps
Froude #, Fr	0.21	subcritical
Freeboard Required	0.01	ft
Minimum Curve Radius, R	0	ft
Superelevation, E	0.00	ft
Min BSW depth, $h_{req'd}$	0.66	ft

Freeboard and Superelevation are based on HDM Topic 866

Criteria Checks

V_{Q25}	1.7	fps	ok

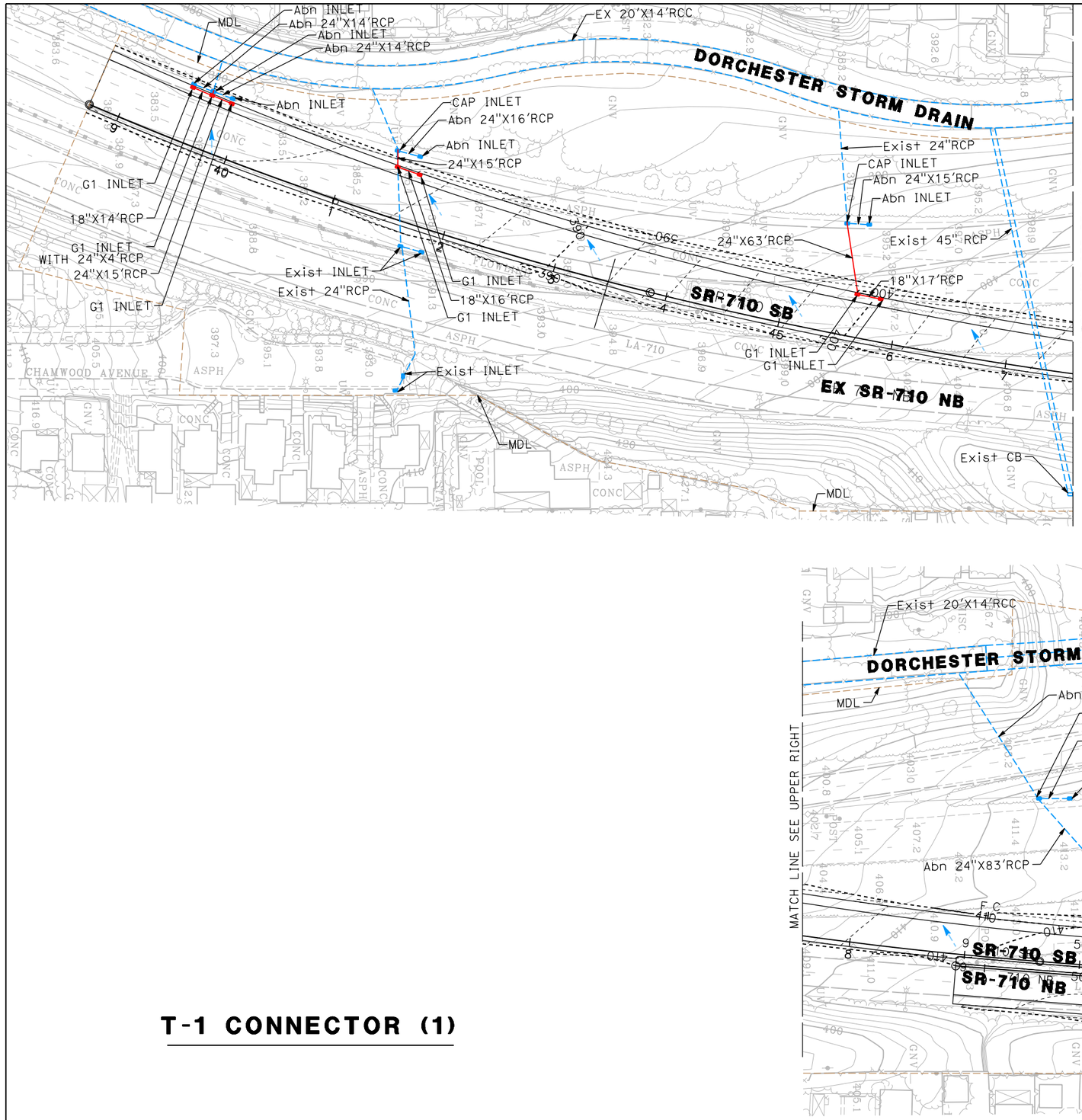
BSW Design Summary

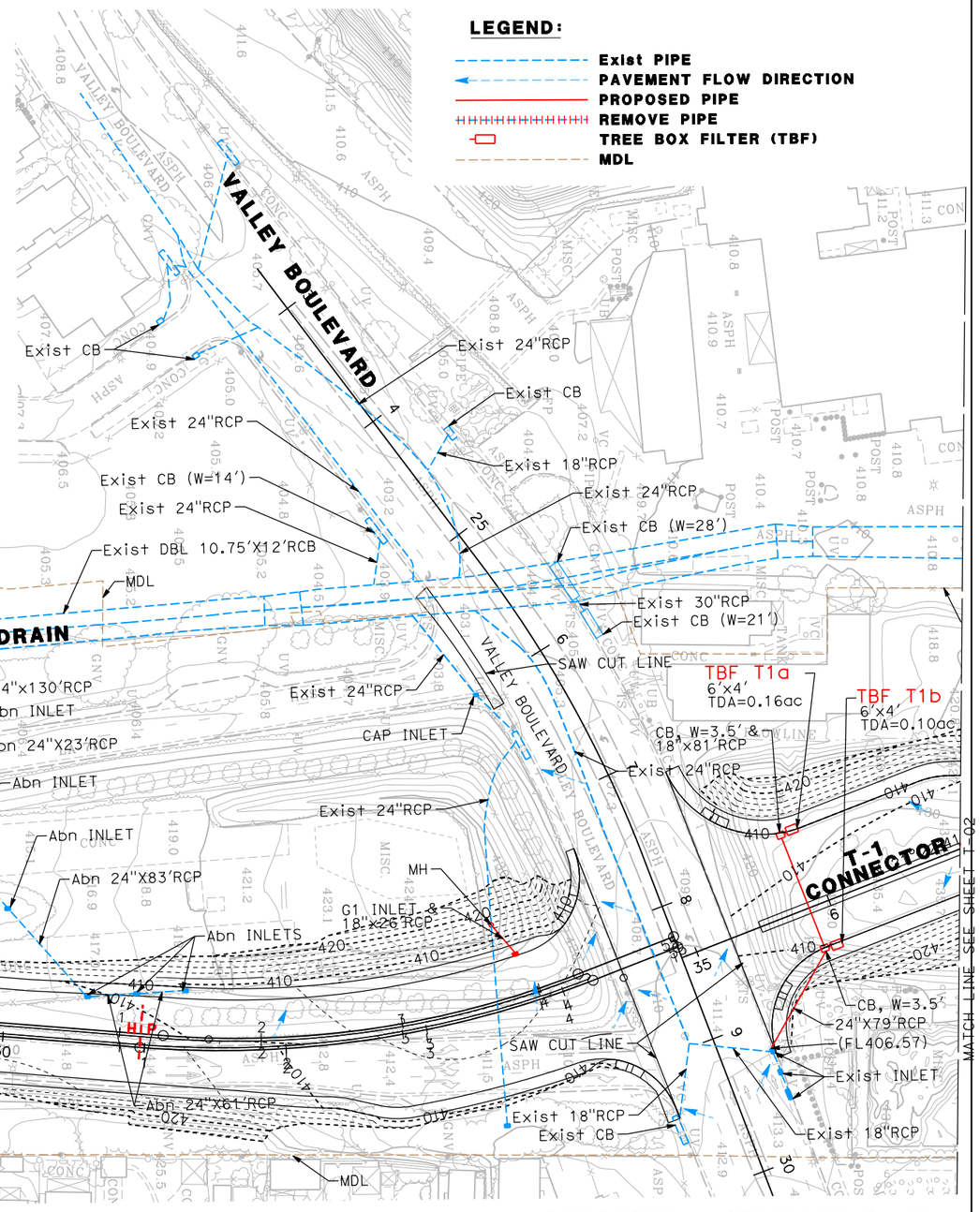
Bottom Width, B	2.0	ft
Height, H	1.00	ft
Side Slope, Z	3.0	ft/ft
Long. Slope, S	0.0100	ft/ft

Appendix F
Conceptual Drainage Plans

TSM/TDM Alternative
BRT Alternative
LRT Alternative
Freeway Alternative (Dual- and Single-Bore Options)

T-1 CONNECTOR (1)





CONCEPTUAL DRAINAGE PLAN

TSM/TDM

0 100'

EXHIBIT T-01

VERSION: 10-31-13

T-1 CONNECTOR (2)

DORCHESTER STORM DRAIN

T-1 CONNECTOR

ALHAMBRA AVENUE

MISSION ROAD

STOCKINGBRIDGE AVENUE

LOWELL AVENUE

Exist DBL 10'X12'RCB

MDL

Exist SWALE

TBF T1c
6'x10'
TDA=0.65ac

CB, W=14'

TBF T1d
6'x8'
TDA=0.47ac

24"X343'RCP

24" FES

18"X56'RCP

24"X105'RCP

24" FES

TBF T1e
6'x8'
TDA=0.59ac

CB, W=14'

TBF T1f
6'x12'
TDA=0.87ac

Exist 12'X12'
REINFORCED CONCRETE
HORSE SHOE ARCH

REMOVE
48"X74'RCP

MH
(FL406.50)

36"X150'RCP

Exist 3'-6"X3'
SEMI ELLIPTICAL CONDUIT

MH
(FL400.45)

Abn 18"x64'RCP

Exist 11'X12'-6"RCB

Exist 15"PIPE

Exist 21"RCP

SAW CUT LINE

Exist 24"RCP

REMOVE CB
& 27"x15'RCP

Exist 15" PIPE

Exist CB

Exist 12"PIPE

Exist CB

Exist 12"PIPE

EX CB

Exist 10'X13'-3"RCB

CB, W=28'
WITH 30"X5'RCP

TBF T1g
MDL 6'x12'
TDA=0.88ac

Exist 54"RCP

REMOVE CB

REMOVE CB

SAW CUT LINE

MATCH LINE SEE SHEET T-01

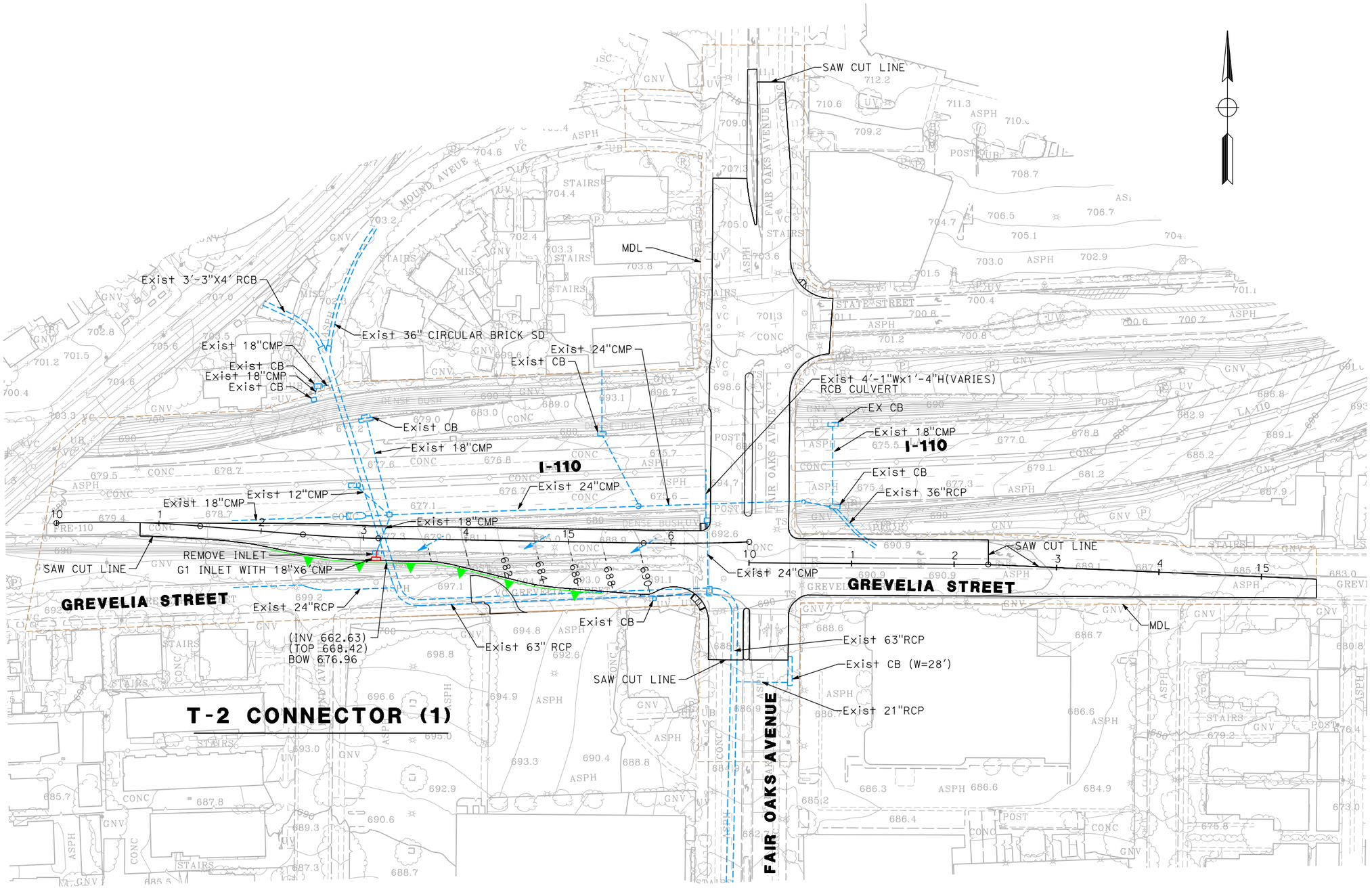
CONCEPTUAL DRAINAGE PLAN

TSM/TDM

EXHIBIT T-02

0 100'

VERSION: 10-15-13



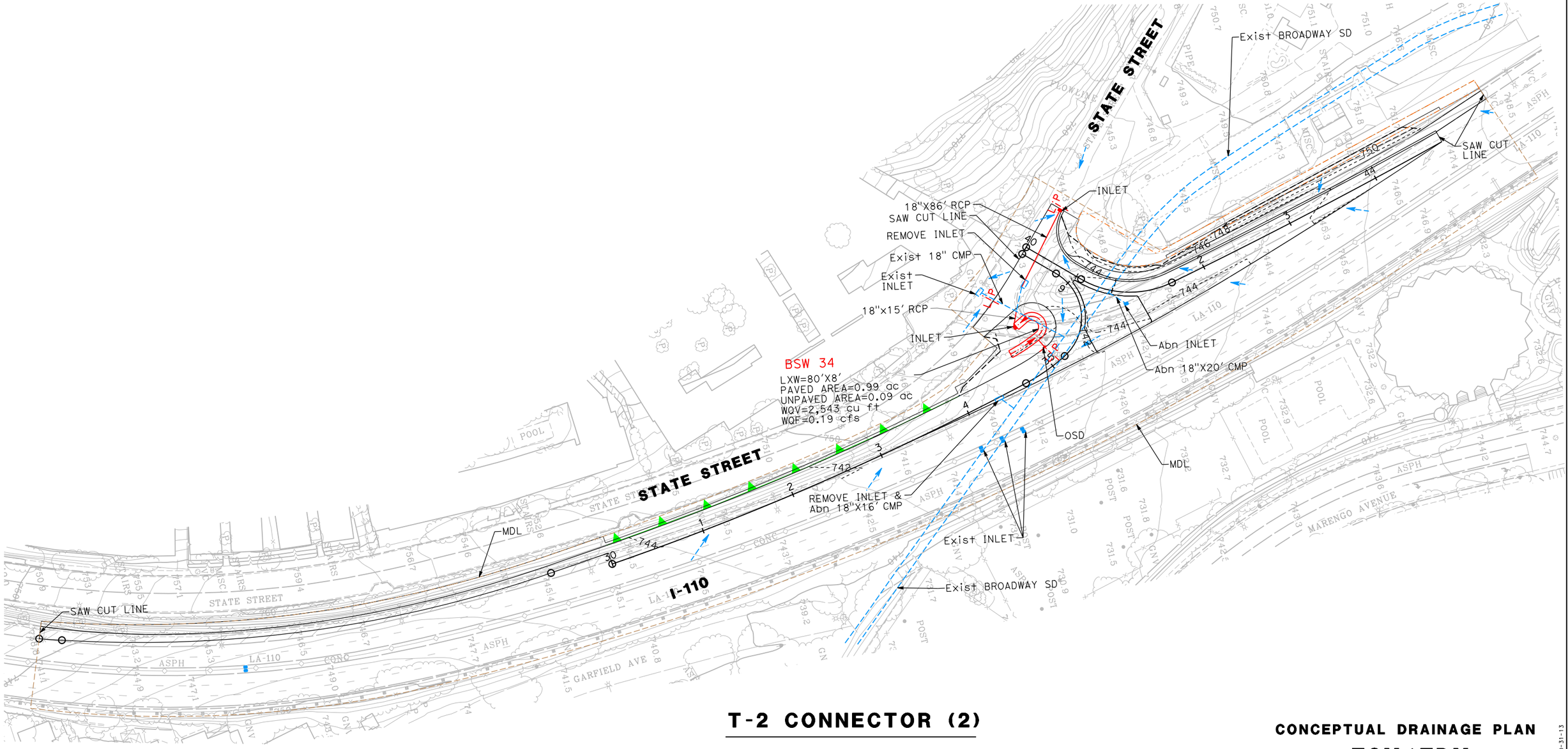
CONCEPTUAL DRAINAGE PLAN

TSM/TDM

0 100'

EXHIBIT T-03

VERSION: 10-31-13



T-2 CONNECTOR (2)

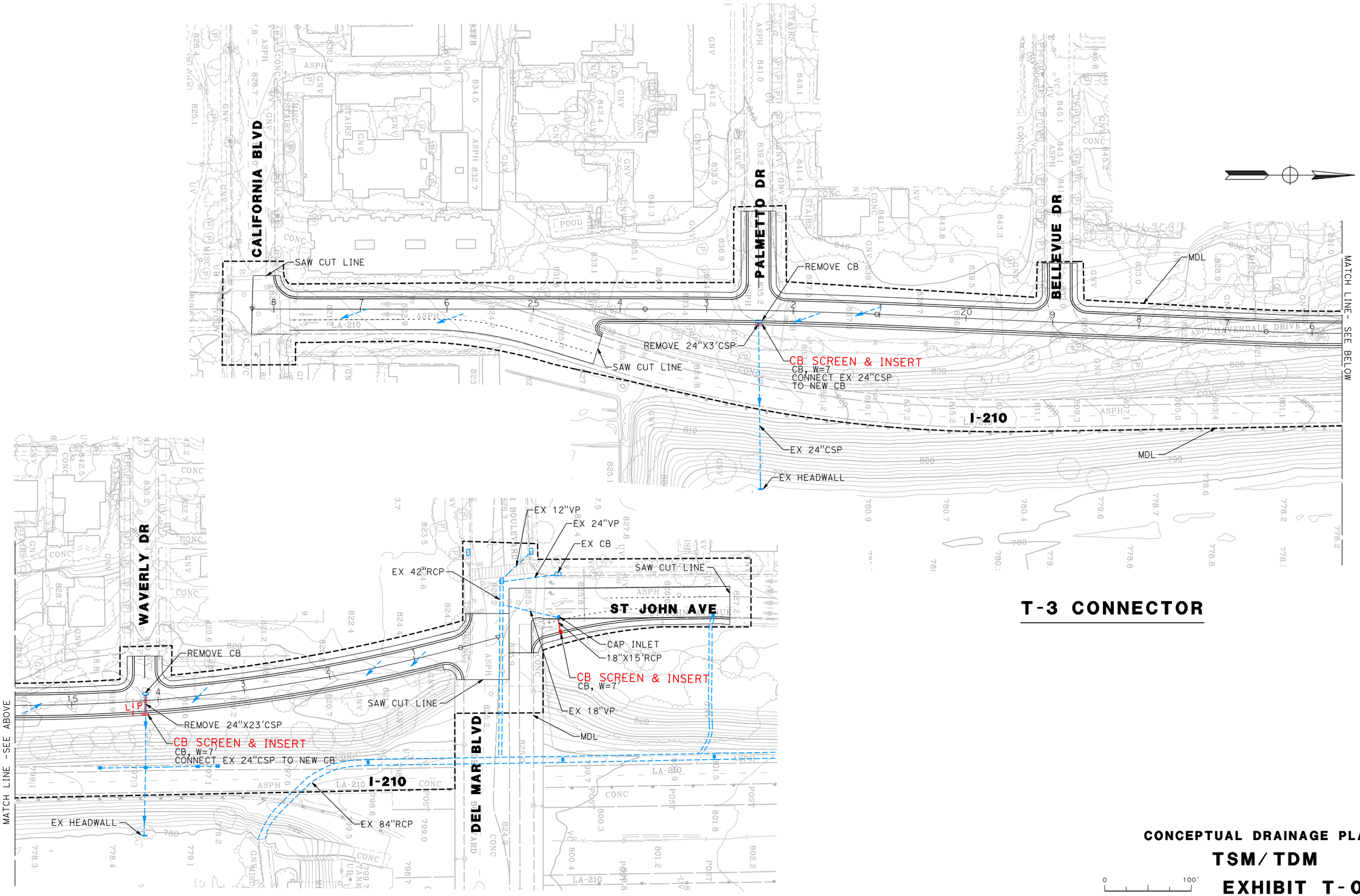
CONCEPTUAL DRAINAGE PLAN

TSM/TDM

0 100'

EXHIBIT T-04

VERSION: 10-31-13



T-3 CONNECTOR

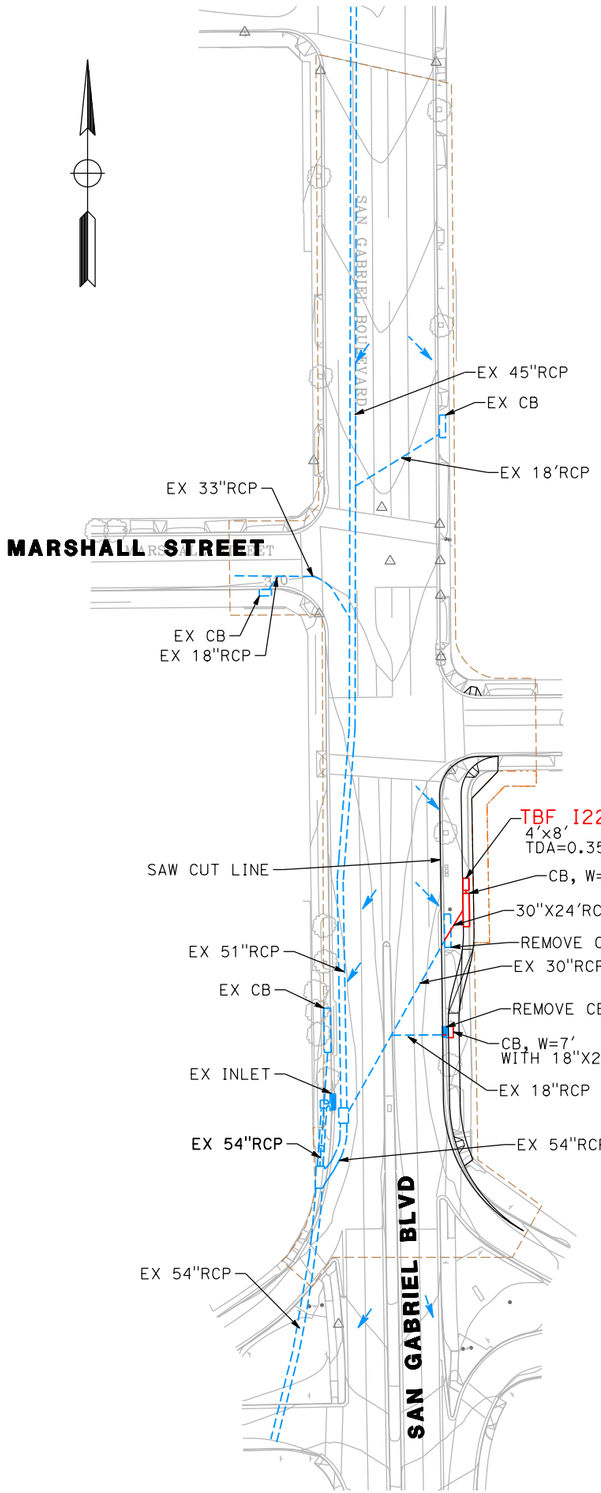
CONCEPTUAL DRAINAGE PLAN

TSM/TDM

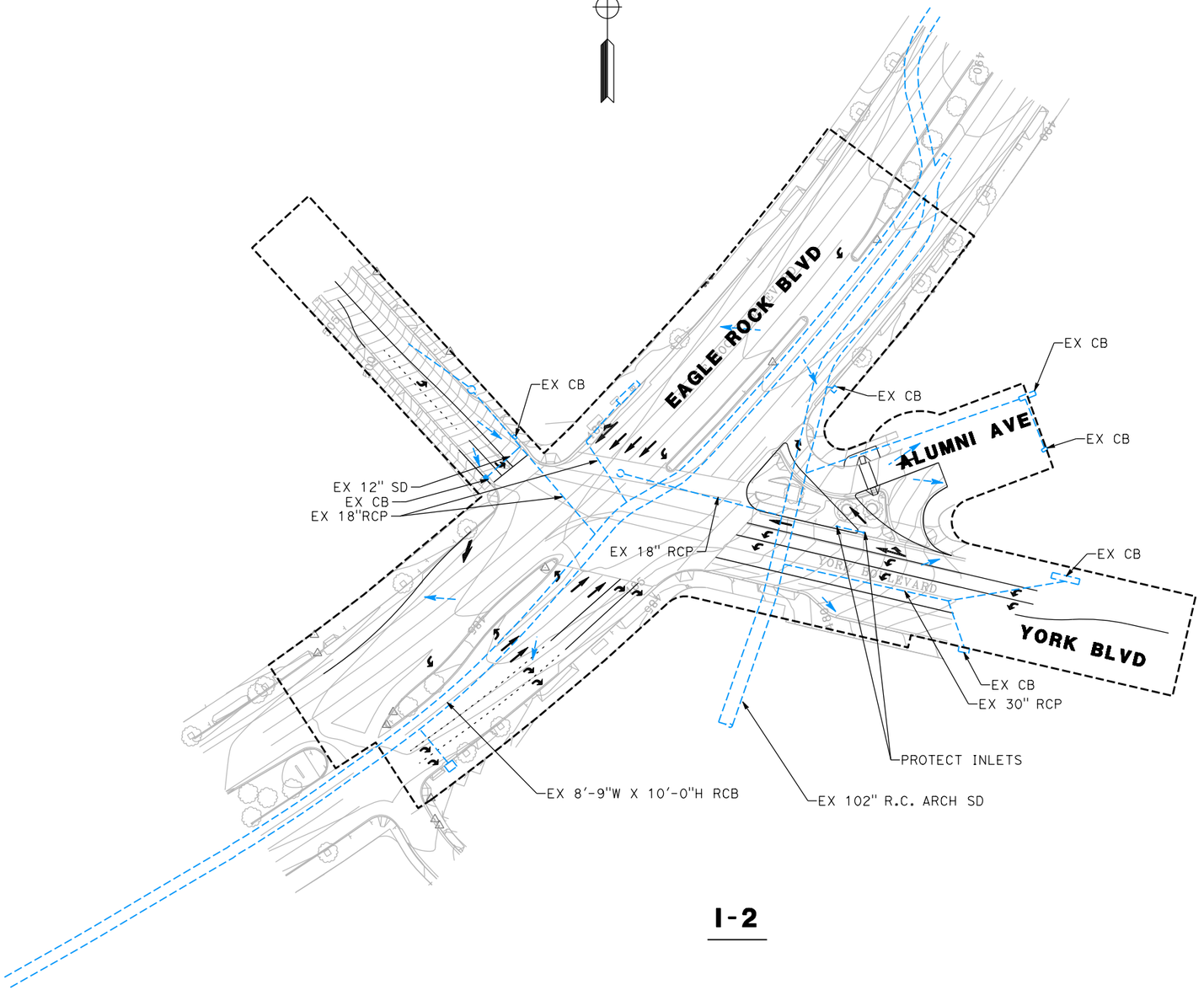
0 100'

EXHIBIT T-05

VERSION: 10-31-13



I-22



I-2

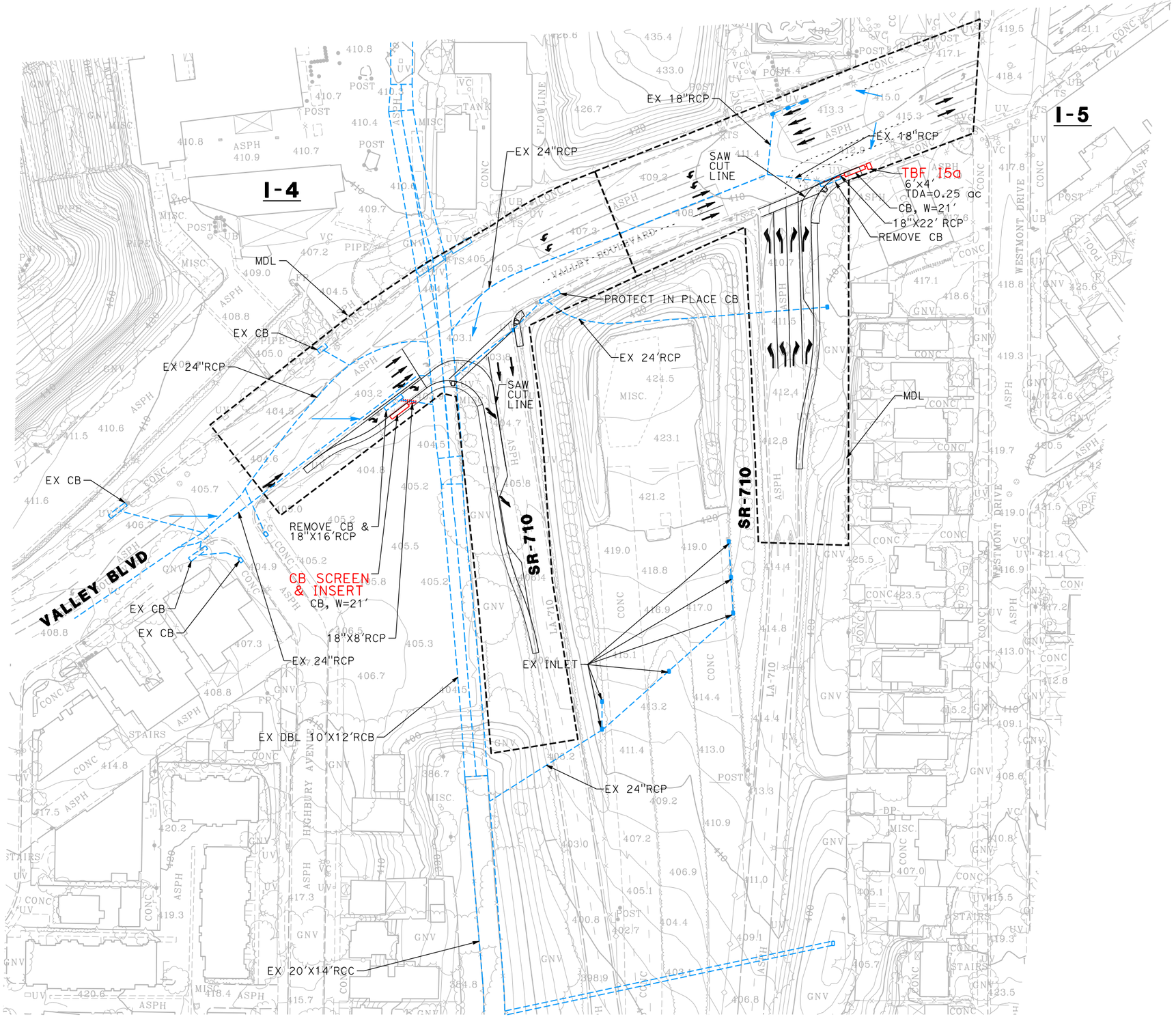
CONCEPTUAL DRAINAGE PLAN

TSM/TDM

0 100'

EXHIBIT T-06

VERSION: 10-31-13



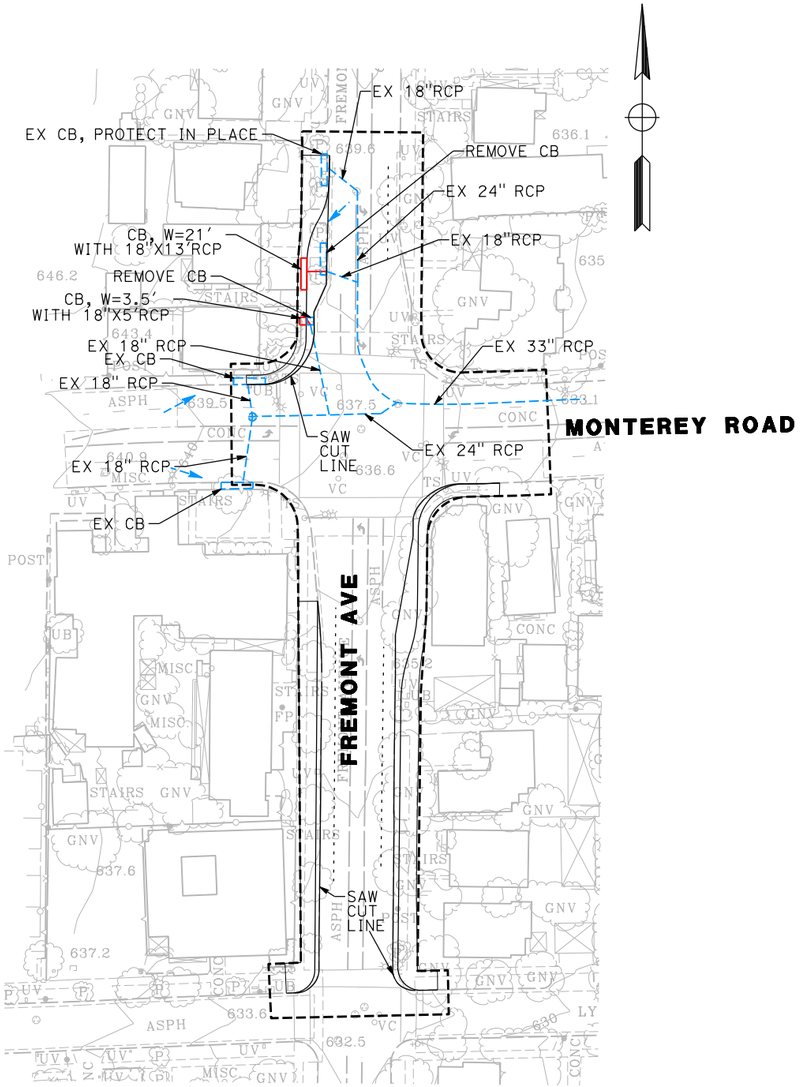
CONCEPTUAL DRAINAGE PLAN

TSM/TDM

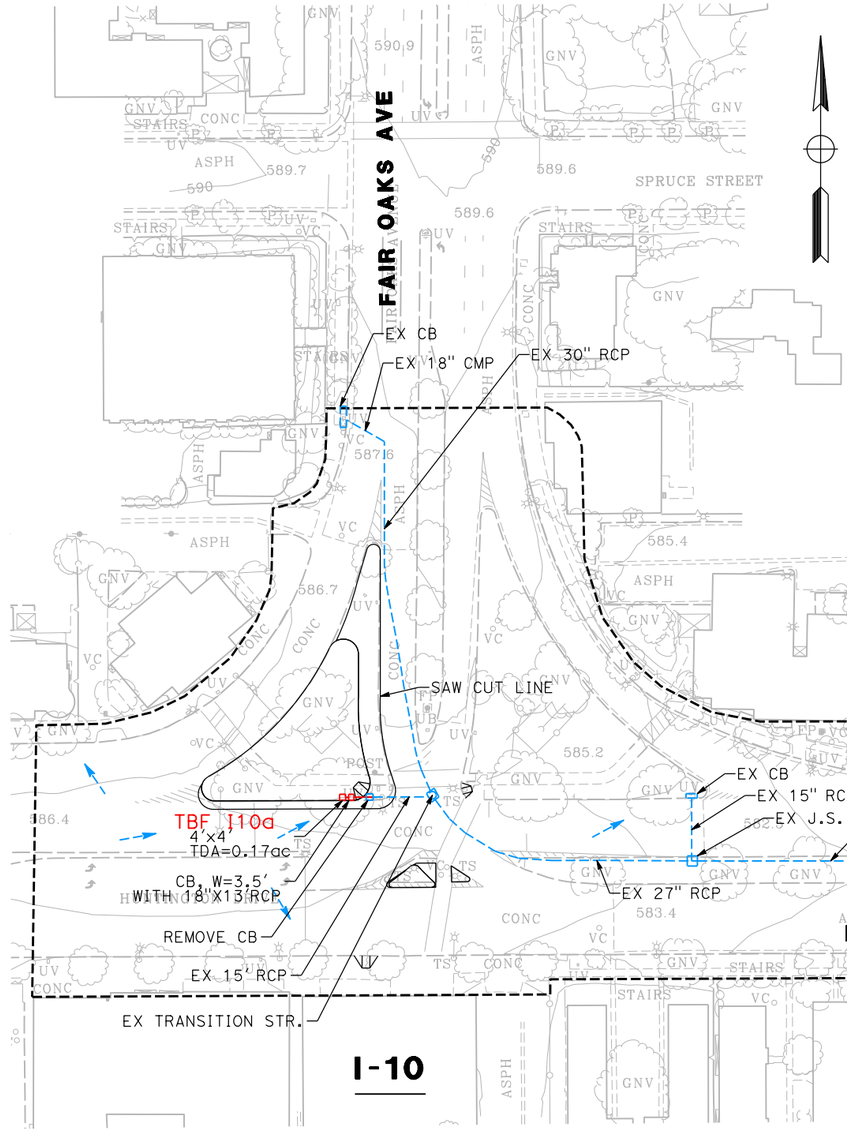
0 100'

EXHIBIT T-07

VERSION: 10-31-13



I-9



I-10

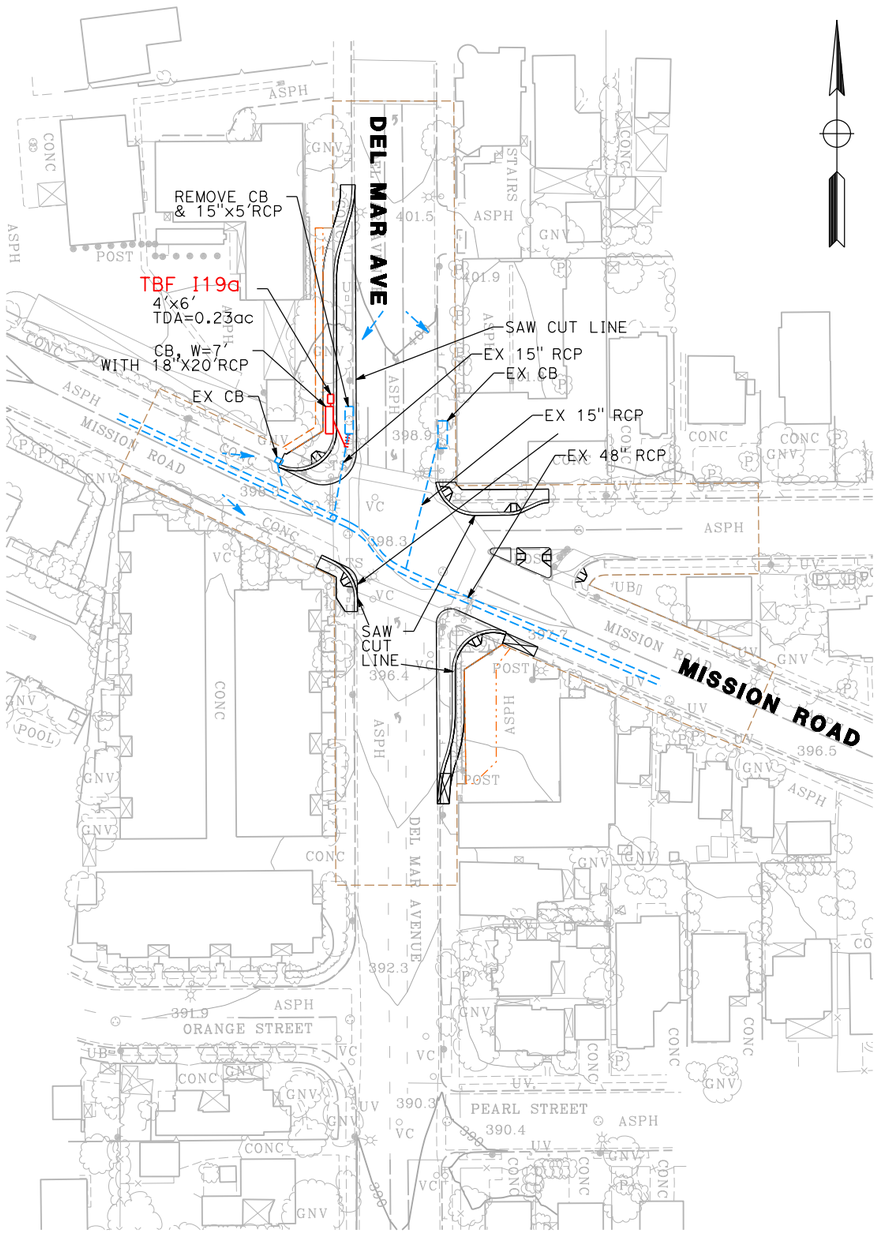
CONCEPTUAL DRAINAGE PLAN

TSM/TDM

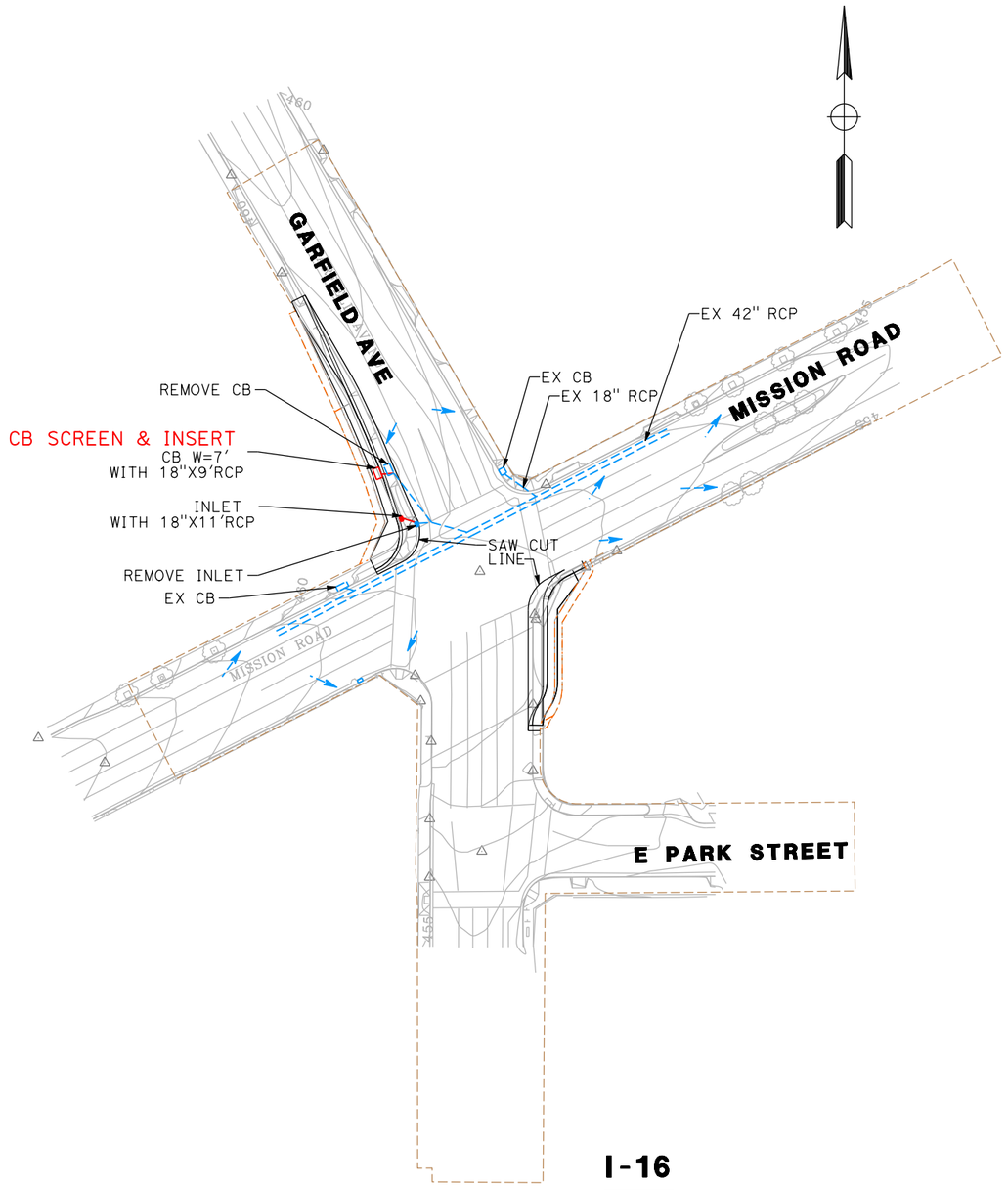
0 100'

EXHIBIT T-08

VERSION: 10-31-13



I-19



I-16

CONCEPTUAL DRAINAGE PLAN

TSM/TDM

0 100'

EXHIBIT T-09

VERSION: 10-31-13

EX CB
EX 24"RCP
CB SCREEN & INSERT
CB, W=14' & 24"X13'RCP
EX 42" RCP
REMOVE CB
EX 18"RCP
CB, W=7' WITH 18"X2'RCP
CONNECT EX 30"RCP TO CB
TBF I40a
4'x18'
TDA = 0.84ac
EX 30"RCP
REMOVE CB
SAW CUT LINE
ROSEMEAD BLVD
MARSHALL ST
EX 18"RCP
TBF I40b
6'x14'
TDA = 0.97ac
REMOVE CB
CB, W=7' & 18"X8'RCP
DE ADELENA ST
SAW CUT LINE
MDL
EX 30"RCP
SAW CUT LINE
EX CB
EX 18"RCP
EX CB
CB, W=10' WITH 18"X2'RCP
TBF L5a
4'x10'
TDA=0.36ac
REMOVE CB
EX 27"RCP
EX 18"RCP
RALPH ST
EX 18"RCP
REMOVE CB
TBF L5b
6'x18'
TDA=1.40ac
CB, W=3.5' WITH 18"X2'RCP
GUESS ST
EX CB
EX 18"RCP
EX CB
CB, W=7' WITH 18"X2'RCP
TBF L5c
6'x6'
TDA = 0.39ac
REMOVE CB
EX 18"RCP
EX 27"RCP
TBF L5d
4'x12'
TDA=0.57ac
CB, W=14' WITH 18'X8'RCP
EX CB
EX 18"RCP
REMOVE CB
NAVADA ST
MATCH LINE -BELOW LEFT

L-5

CB SCREEN & INSERT
CB, W=7' WITH 18"X10'RCP INLET
18"X7'RCP OUTLET
REMOVE CB & 18"X10'RCP
CB SCREEN & INSERT
CB, W=7' WITH 18"X12'RCP
VALLEY BLVD
REMOVE CB & INLET & 18"X18'RCP
ROSEMEAD BLVD
SAW CUT LINE
MDL
SAW CUT LINE
SAW CUT LINE
MDL
REMOVE CB & INLET
CB SCREEN & INSERT
CB, W=14'
CONNECT EX 18"RCP TO NEW CB
EX 18"RCP
EX CB
EX 18"RCP
MATCH LINE-UP RIGHT
MATCH LINE-BELOW LEFT

L-5

I-20
I-42
MISSION DR
EX 60"RCP
EX 18"RCP
EX CB
EX CB
EX 18"RCP
CB, W=14' WITH 18"X45'RCP
TBF I20a
6'x18' & 6'x4'
TDA = 1.59ac
INLET
MDL
REMOVE CB & 18"X48'RCP
REMOVE INLET
EX 18"RCP
REMOVE CB
CB, W=14'
CONNECT EX 18"RCP TO NEW CB
CB, W=21'
CONNECT EX 18"RCP TO NEW CB
EX 60"RCP
MDL
SAW CUT LINE
LOWER AZUSA R
ROSEMEAD BLVD
MATCH LINE-UP RIGHT

CONCEPTUAL DRAINAGE PLAN
TSM/TDM
EXHIBIT T-10

0 100'

VERSION: 10-31-13

MATCH LINE A-A

L-1

FIGUEROA ST

I-30

COLORADO BLVD

EX CB

EX 18'RCP

EX MH

EX 6'WX5'H RCB

EX CB

EX 6'WX4'H RCB

MATCH LINE A-A

L-1

FIGUEROA ST

MATCH LINE B-B

EX 18"RCP

EX 18"RCP

EX 18"CMP

EX CB

EX 24"RCP

EX CB

EX 102"RCP

EX CB (W=28')

EX 24"RCP

EX 90"RCP

INLET G2 & 18"X7'RCP IN 24"X12'RCP OUT

REMOVE INLET & 24"X16'RCP

SAW CUT LINE

EX 18"RCP

EX 7'WX7'H RCB

SR134 EB OFF RAMP

SR134 EB ON RAMP

EX INLET G2

EX 18"RCP

MATCH LINE B-B

I-32

FIGUEROA ST

EX 102"RCP

EX 18"RCP

EX CB

EX 21"RCP

EX CB

EX 18"RCP

EX 33"RCP

SAW CUT LINE

EX 24"RCP

EX CB (W=21')

EX 18"RCP

EX 24"RCP

EX CB

EX CB

EX 42"RCP

SR134 WB OFF RAMP

SR134 WB ON RAMP

EX INLET G2

EX 21"RCP

EX G2 INLET

EX G2 INLET

EX 36"RCP

EX 18"RCP

EX 18"RCP

EX G2 INLET

EX 18"RCP

EX INLET G2

EX 18"RCP

MATCH LINE A-A

CONCEPTUAL DRAINAGE PLAN

TSM/TDM

0 100'

EXHIBIT T-11

VERSION: 10-31-13

LEGEND:

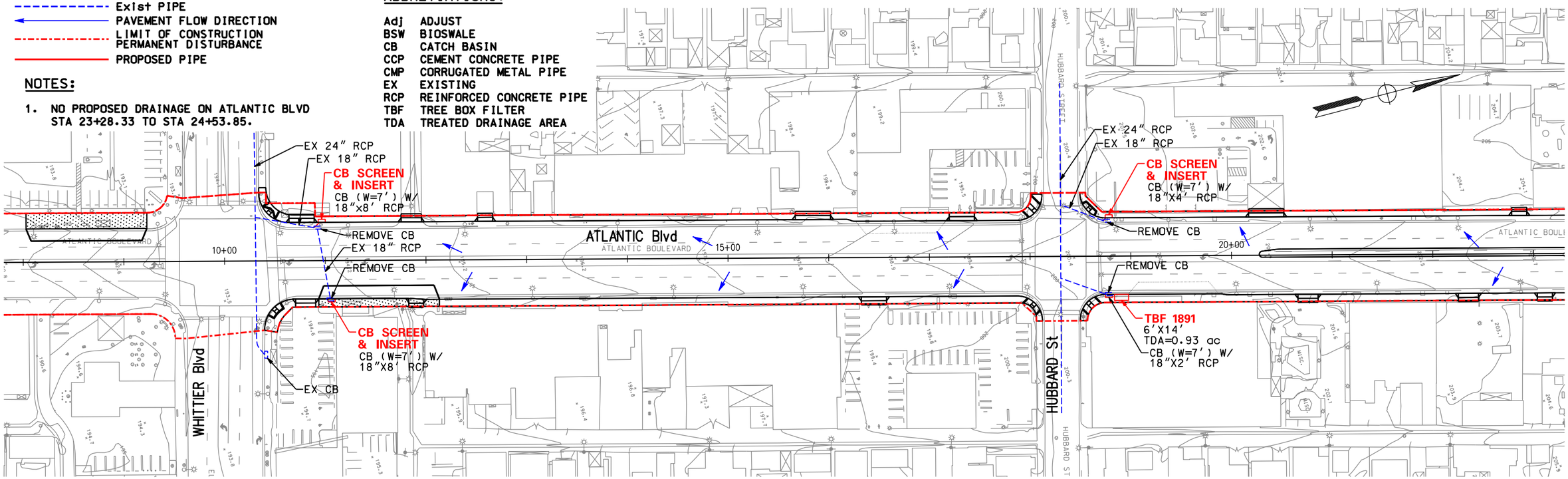
- Exist PIPE
- PAVEMENT FLOW DIRECTION
- LIMIT OF CONSTRUCTION PERMANENT DISTURBANCE
- PROPOSED PIPE

NOTES:

1. NO PROPOSED DRAINAGE ON ATLANTIC BLVD STA 23+28.33 TO STA 24+53.85.

ABBREVIATIONS:

Adj	ADJUST
BSW	BIOSWALE
CB	CATCH BASIN
CCP	CEMENT CONCRETE PIPE
CMP	CORRUGATED METAL PIPE
EX	EXISTING
RCP	REINFORCED CONCRETE PIPE
TBF	TREE BOX FILTER
TDA	TREATED DRAINAGE AREA



CONCEPTUAL DRAINAGE PLAN

BUS RAPID TRANSIT

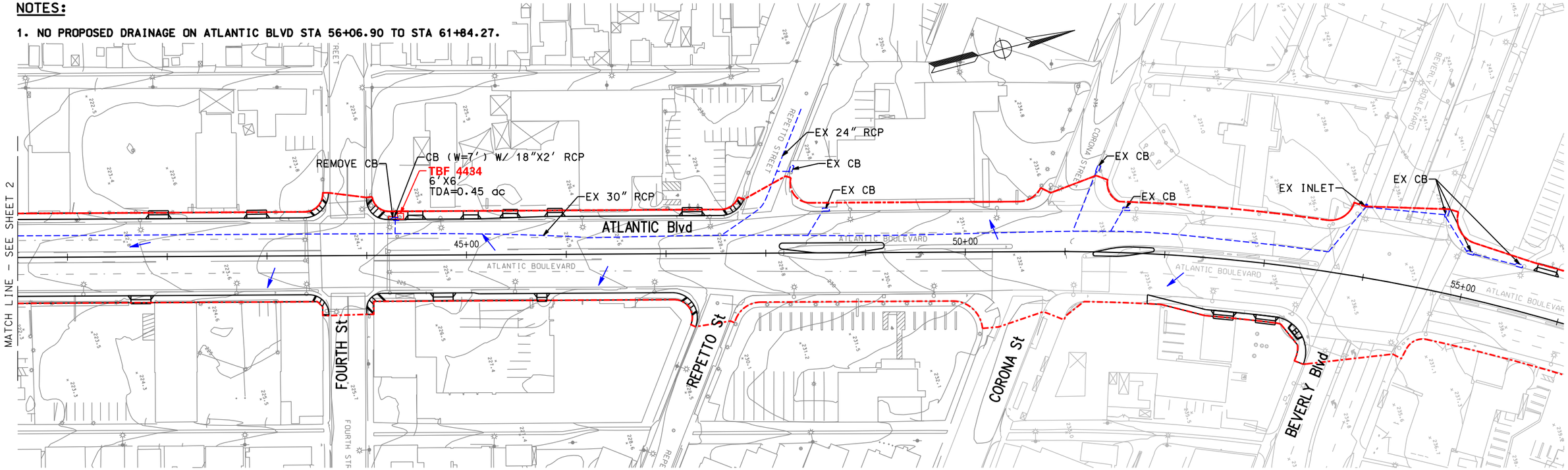
0 100'

EXHIBIT B – 01

VERSION: 10-31-13

NOTES:

1. NO PROPOSED DRAINAGE ON ATLANTIC BLVD STA 56+06.90 TO STA 61+84.27.



CONCEPTUAL DRAINAGE PLAN

BUS RAPID TRANSIT

EXHIBIT B – 02

VERSION: 10-31-13

MATCH LINE - SEE SHEET 2

AVENIDA CESAR CHAVEZ

EX 81" RCP

CB SCREEN & INSERT
CB (W=7') W/ 18"X3' RCP

CAP INLET

EX 24" RCP

EX 81" RCP

80+00

ATLANTIC BOULEVARD

EX 24" RCP

CAP INLET

TBF 8129
6'X6'
TDA=0.41 ac

CB (W=7') W/ 18"X9' RCP

REMOVE CB

CB SCREEN & INSERT
CB (W=7') W/ 18"X2' RCP

CB (W=7') W/ 18"X1' RCP

TBF 8504
6'X8'
TDA=0.52 ac

REMOVE CB

85+00

ATLANTIC Blvd

REMOVE CB

CB SCREEN & INSERT
CB (W=7') W/ 18"X4' RCP

CB (W=7') W/ 18"X1' RCP

TBF 8950
6'X6'
TDA=0.37 ac

REMOVE CB

90+00

ATLANTIC BOULEVARD

REMOVE CB

TBF 8952
6'X10'
TDA=0.69 ac

CB (W=7') W/ 18"X5' RCP

TBF 9262
6'X6'
TDA=0.37 ac

CB (W=7') W/ 18"X4' RCP

REMOVE CB

MATCH LINE - SEE BELOW

MATCH LINE - SEE SHEET 4

TBF 10360
6'X10'
TDA=0.63 ac

CB (W=7') W/ 18"X8' RCP

REMOVE CB

105+00

TBF 10400
6'X8'
TDA=0.62 ac

REMOVE CB

CB (W=7') W/ 18"X2'RCP
EX 87" RCP

ATLANTIC Blvd

100+00

BRADSHAW AVENUE

FLORAL DRIVE

FLORAL Dr

CB (W=7') W/ 18"X3' RCP

TBF 9549
6'X4'
TDA=0.10 ac

CB (W=7') W/ 18"X3' RCP

TBF 9643
6'X12'
TDA=0.82 ac

REMOVE CB

REMOVE CB

95+00

ATLANTIC BOULEVARD

REMOVE CB

ATLANTIC BOULEVARD

TBF 9576
6'X14'
TDA=0.95 ac

CB (W=7') W/ 18"X2' RCP

EX 87" RCP

MATCH LINE - ABOVE

CONCEPTUAL DRAINAGE PLAN

BUS RAPID TRANSIT

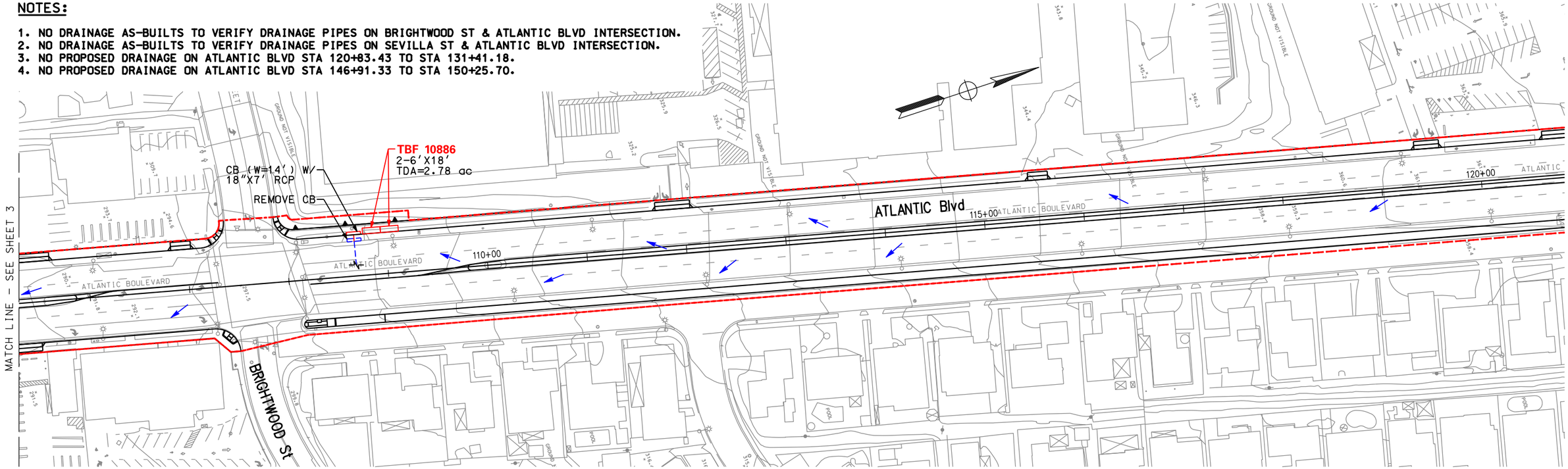
EXHIBIT B – 03

0 100'

VERSION: 10-31-13

NOTES:

1. NO DRAINAGE AS-BUILTS TO VERIFY DRAINAGE PIPES ON BRIGHTWOOD ST & ATLANTIC BLVD INTERSECTION.
2. NO DRAINAGE AS-BUILTS TO VERIFY DRAINAGE PIPES ON SEVILLA ST & ATLANTIC BLVD INTERSECTION.
3. NO PROPOSED DRAINAGE ON ATLANTIC BLVD STA 120+83.43 TO STA 131+41.18.
4. NO PROPOSED DRAINAGE ON ATLANTIC BLVD STA 146+91.33 TO STA 150+25.70.



CONCEPTUAL DRAINAGE PLAN

BUS RAPID TRANSIT

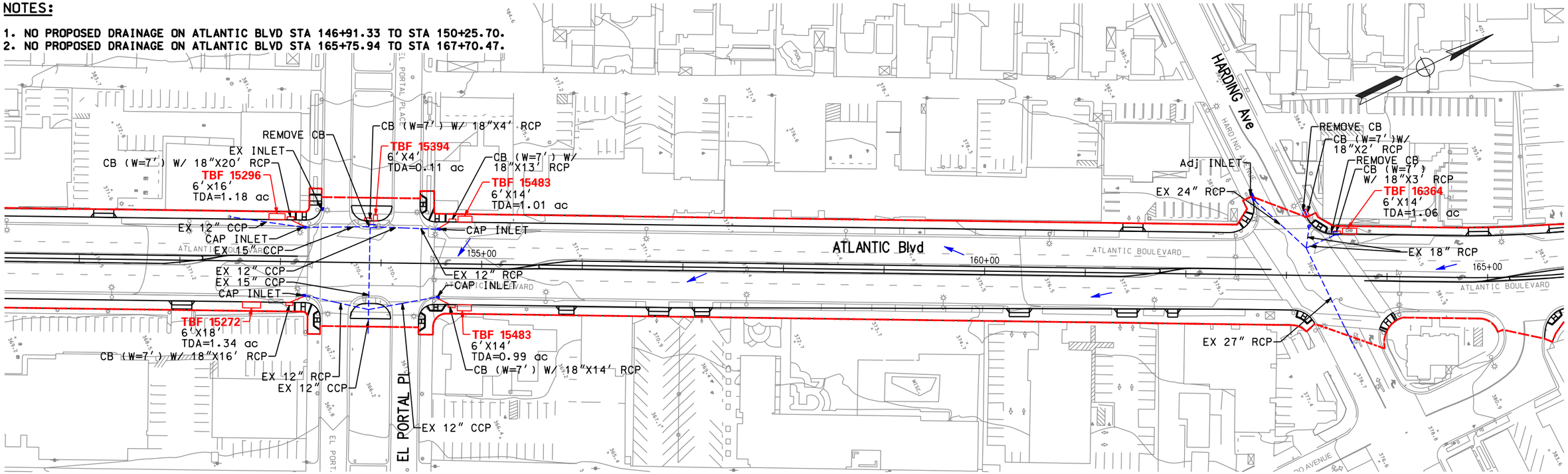
EXHIBIT B – 04

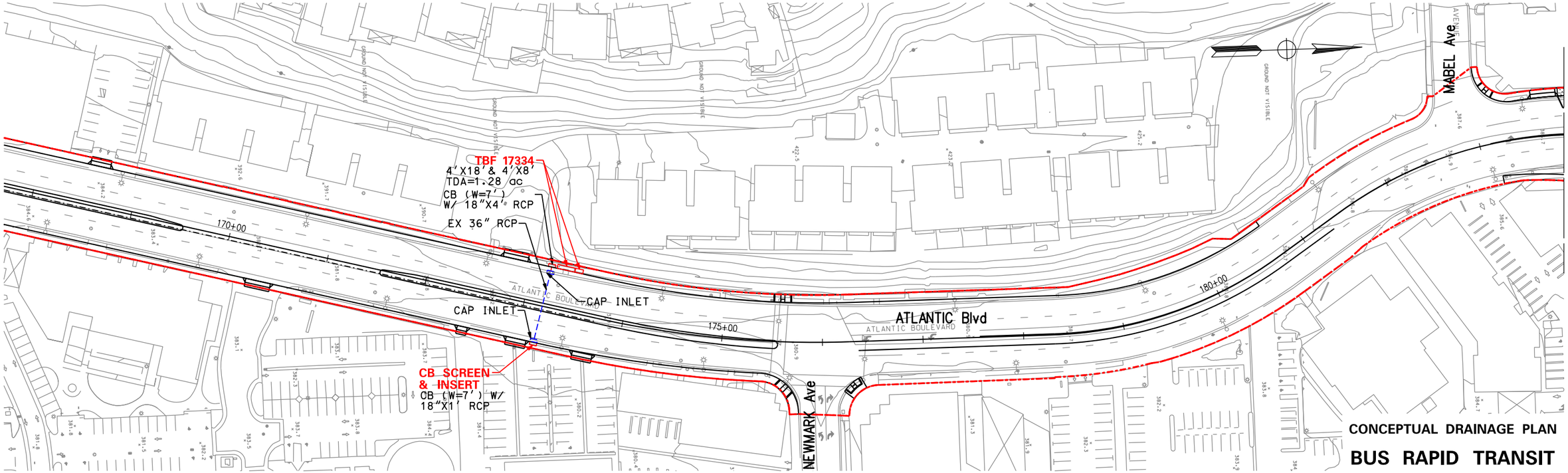
0 100'

VERSION: 10-31-13

NOTES:

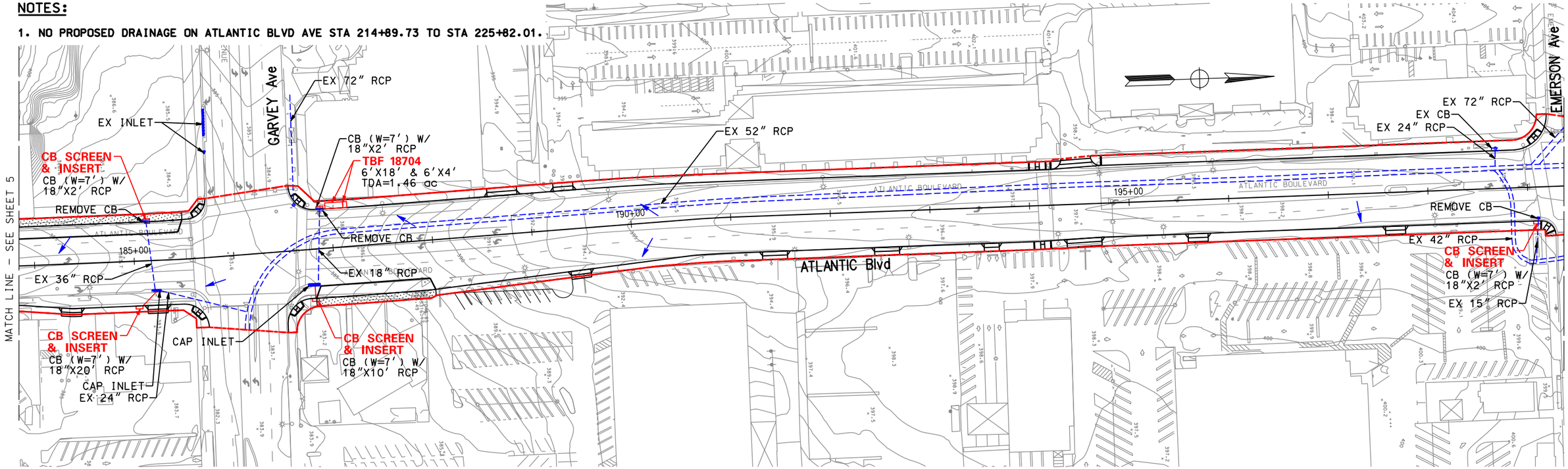
1. NO PROPOSED DRAINAGE ON ATLANTIC BLVD STA 146+91.33 TO STA 150+25.70.
2. NO PROPOSED DRAINAGE ON ATLANTIC BLVD STA 165+75.94 TO STA 167+70.47.

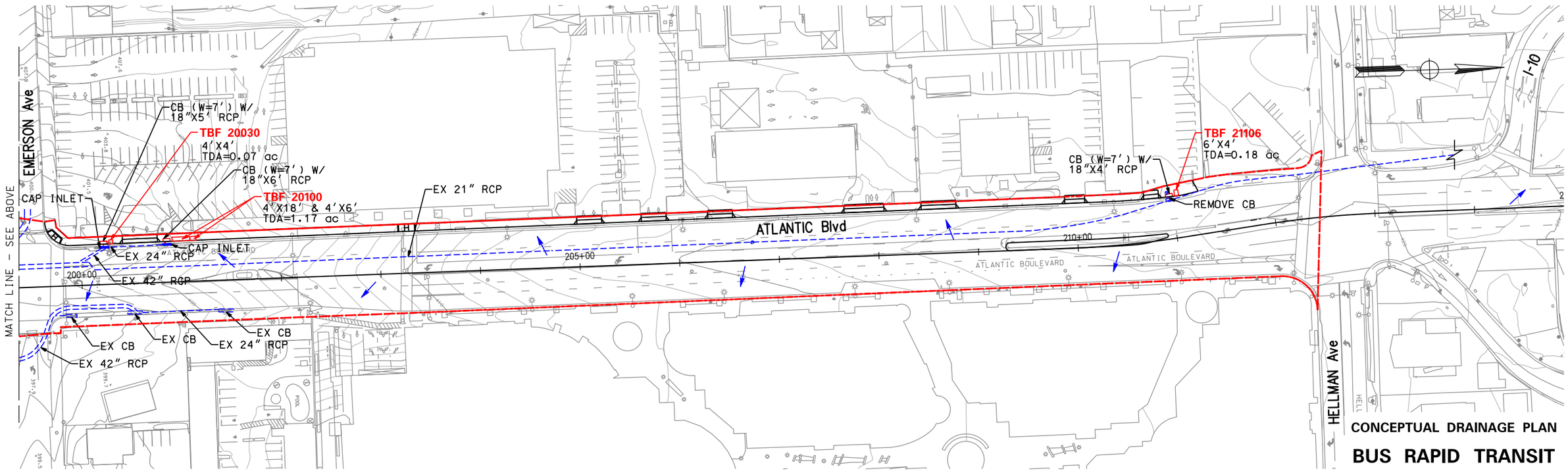




NOTES:

1. NO PROPOSED DRAINAGE ON ATLANTIC BLVD AVE STA 214+89.73 TO STA 225+82.01.





CONCEPTUAL DRAINAGE PLAN

BUS RAPID TRANSIT

0 100'

EXHIBIT B – 06

VERSION: 10-31-13

NOTES:

1. NO PROPOSED DRAINAGE ON ATLANTIC BLVD STA 214+89.73 TO STA 225+82.01.
2. NO PROPOSED DRAINAGE ON ATLANTIC BLVD STA 256+82.03 TO STA 343+62.65.

GLENDON WAY

NORWOON PL

ATLANTIC Blvd

ATLANTIC BOULEVARD

230+00

235+00

240+00

EX CB

MATCH LINE - SEE BELOW

MATCH LINE - SEE ABOVE

SHORB St

CB SCREEN & INSERT
CB (W=7') W/ 18"X2' RCP

REMOVE CB

EX 18" RCP

245+00

250+00

255+00

CAP INLET

CB SCREEN & INSERT
CB (W=7') W/ 18"X12' RCP

VALLEY Blvd

POOL

GROUND NOT VISIBLE

CONCEPTUAL DRAINAGE PLAN

BUS RAPID TRANSIT

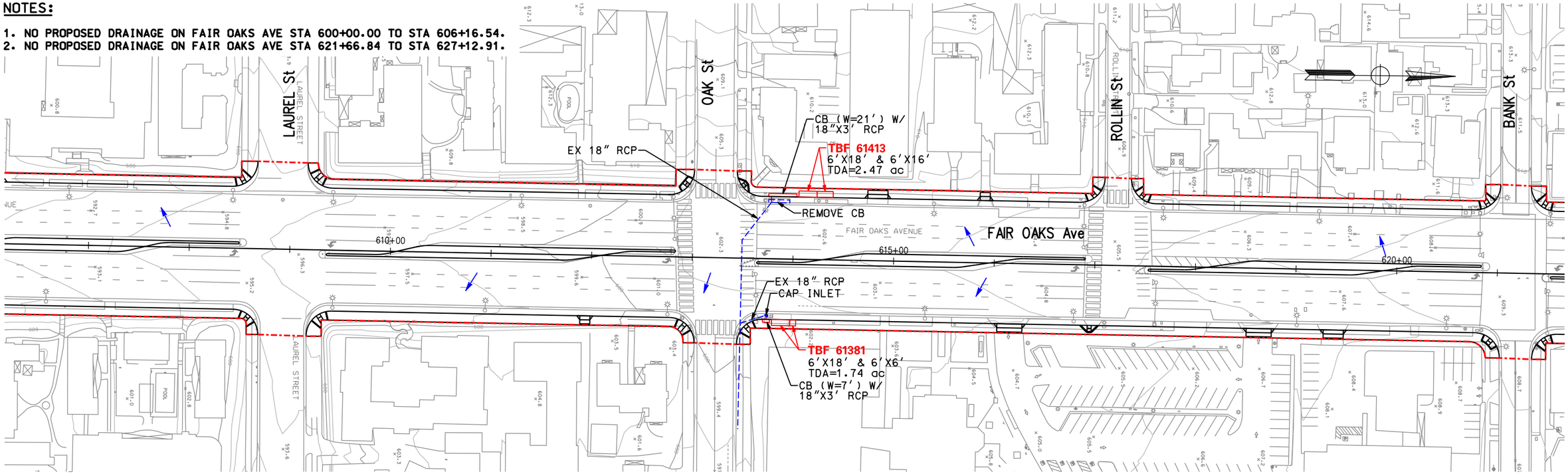
EXHIBIT B – 07

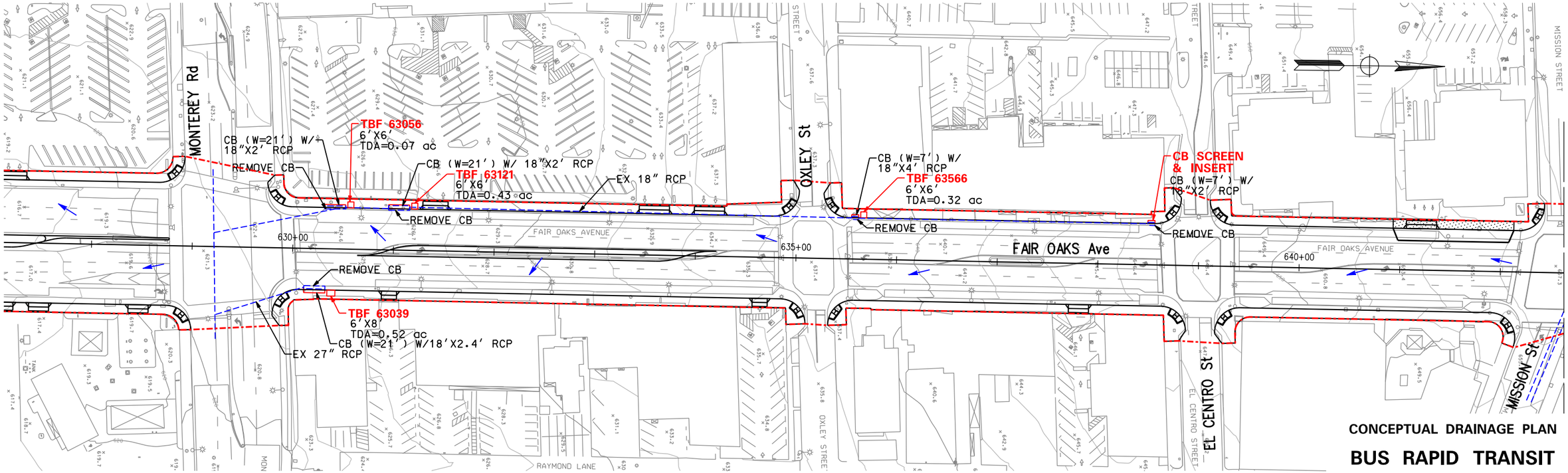
0 100'

VERSION: 10-31-13

NOTES:

1. NO PROPOSED DRAINAGE ON FAIR OAKS AVE STA 600+00.00 TO STA 606+16.54.
2. NO PROPOSED DRAINAGE ON FAIR OAKS AVE STA 621+66.84 TO STA 627+12.91.





CONCEPTUAL DRAINAGE PLAN

BUS RAPID TRANSIT

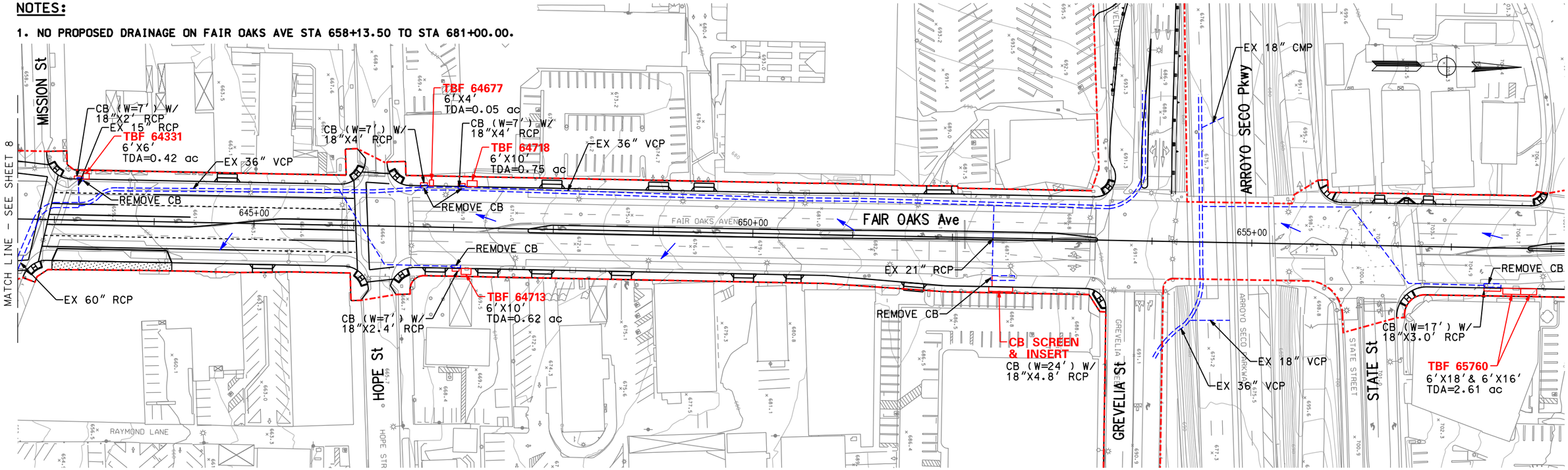
0 100'

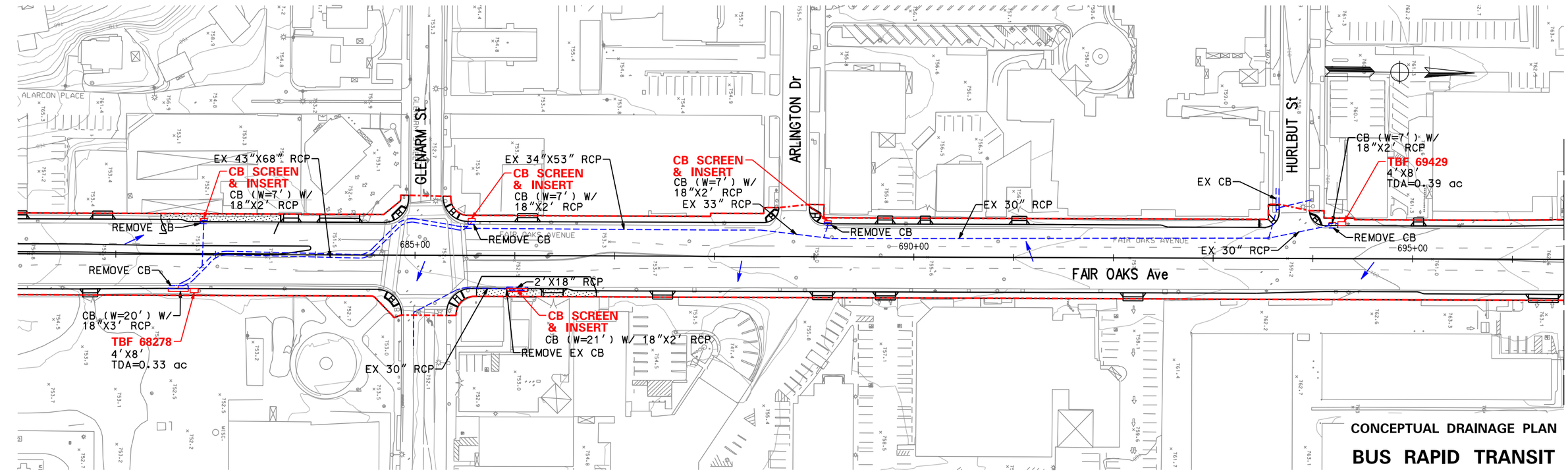
EXHIBIT B – 08

VERSION: 10-31-13

NOTES:

1. NO PROPOSED DRAINAGE ON FAIR OAKS AVE STA 658+13.50 TO STA 681+00.00.





CONCEPTUAL DRAINAGE PLAN

BUS RAPID TRANSIT

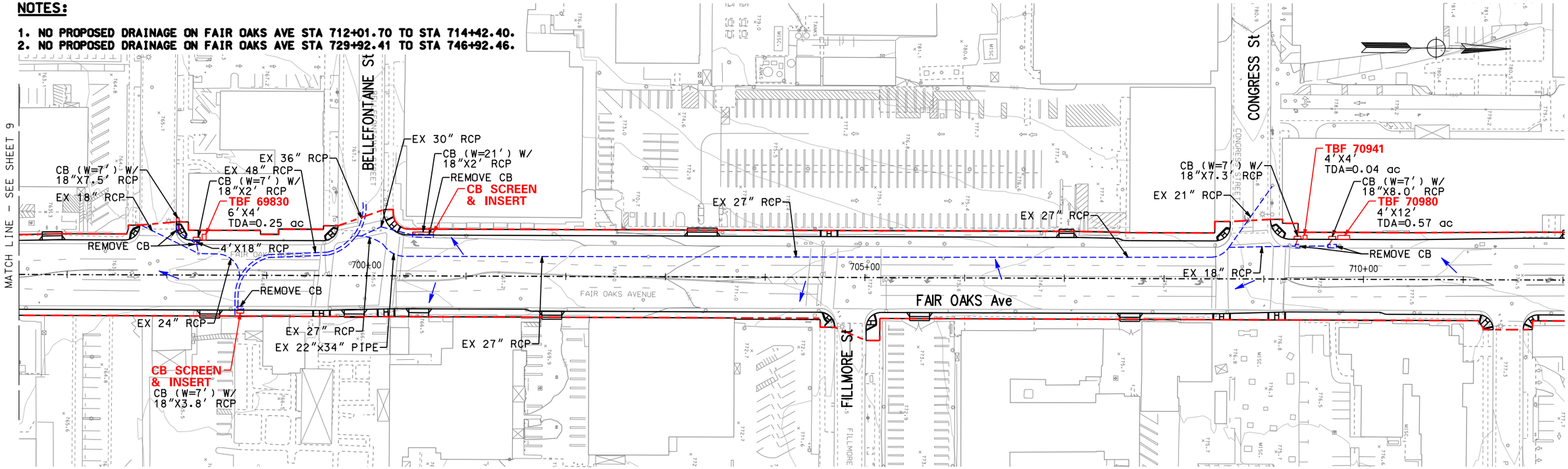
EXHIBIT B – 09

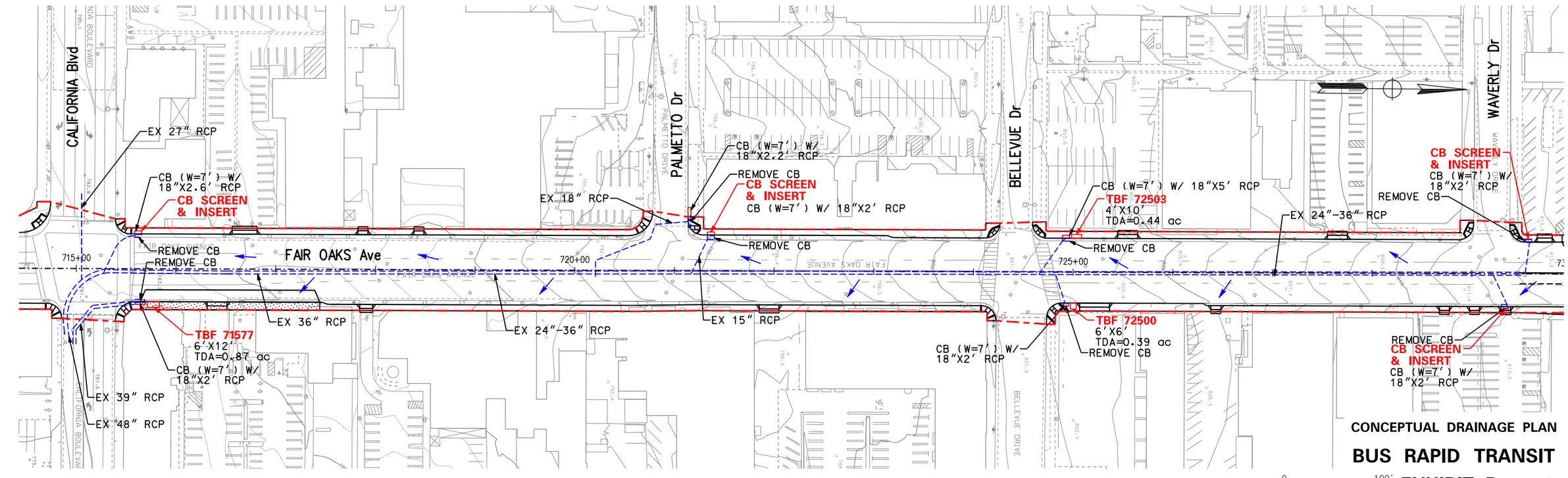
0 100'

VERSION: 10-31-13

NOTES:

1. **NO PROPOSED DRAINAGE ON FAIR OAKS AVE STA 712+01.70 TO STA 714+42.40.**
2. **NO PROPOSED DRAINAGE ON FAIR OAKS AVE STA 729+92.41 TO STA 746+92.46.**





CONCEPTUAL DRAINAGE PLAN

BUS RAPID TRANSIT

EXHIBIT B – 10

0 100'

VERSION: 10-31-13

LEGEND:

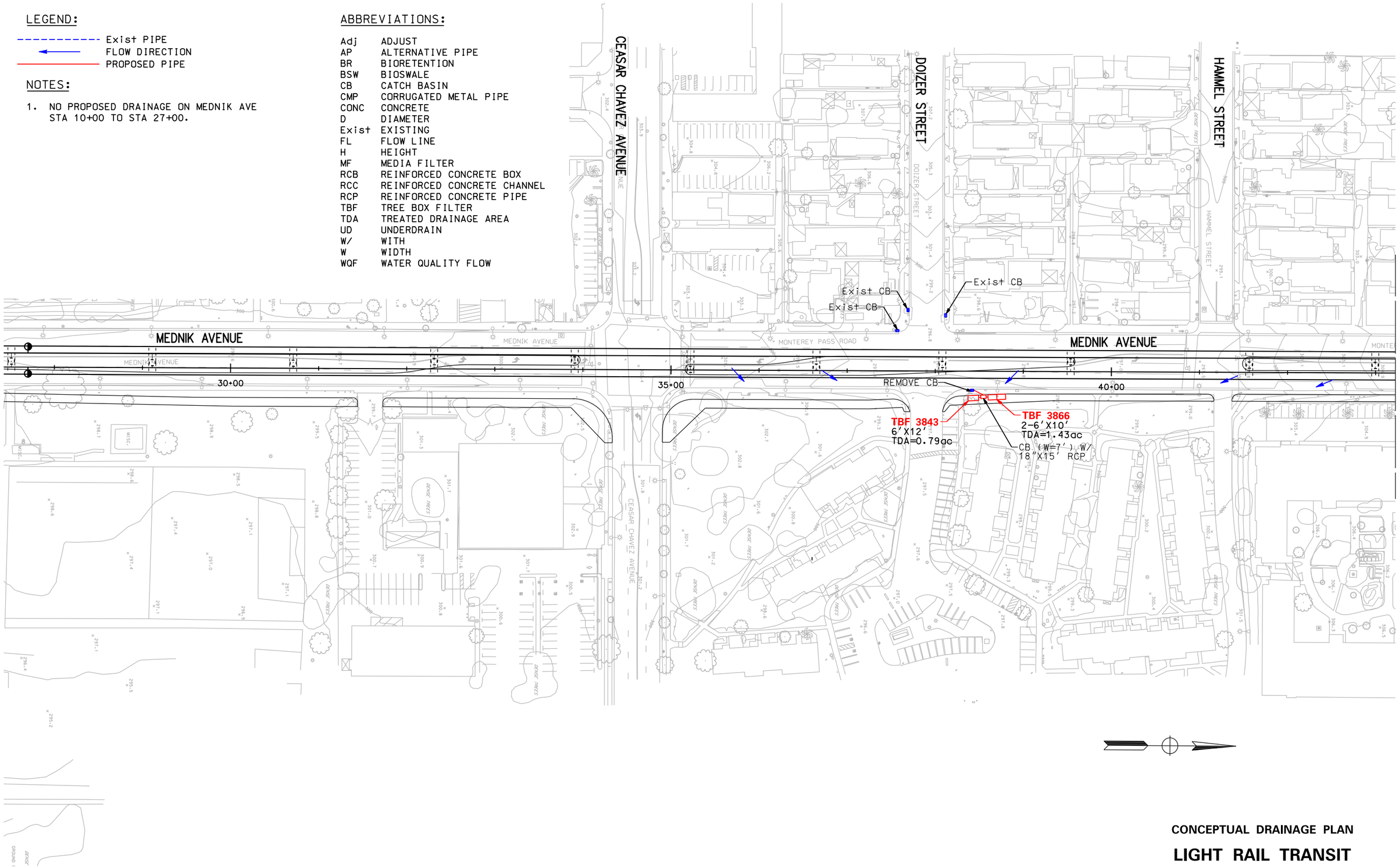
- Exist PIPE
- FLOW DIRECTION
- PROPOSED PIPE

NOTES:

1. NO PROPOSED DRAINAGE ON MEDNIK AVE STA 10+00 TO STA 27+00.

ABBREVIATIONS:

Adj	ADJUST
AP	ALTERNATIVE PIPE
BR	BIORETENTION
BSW	BIOSWALE
CB	CATCH BASIN
CMP	CORRUGATED METAL PIPE
CONC	CONCRETE
D	DIAMETER
Exist	EXISTING
FL	FLOW LINE
H	HEIGHT
MF	MEDIA FILTER
RCB	REINFORCED CONCRETE BOX
RCC	REINFORCED CONCRETE CHANNEL
RCP	REINFORCED CONCRETE PIPE
TBF	TREE BOX FILTER
TDA	TREATED DRAINAGE AREA
UD	UNDERDRAIN
W/	WITH
W	WIDTH
WQF	WATER QUALITY FLOW



CONCEPTUAL DRAINAGE PLAN

LIGHT RAIL TRANSIT

EXHIBIT L – 01

VERSION: 10-31-13

EXIST 42" CMP

EXIST 84" RCP

EXIST 18" RCP

EXIST 42" RCP

MONTERAY PASS ROAD

Exist CB

CB (W=7') W/ 18"X37' RCP

TBF 4848
2-6'X10'
TDA=1.44ac

KERN AVENUE

55+00

EXIST 18" CMP

50+00

FLORAL STATION

EXIST 24" RCP

FLORAL DRIVE

EXIST 54" RCP

EXIST RCB

DANGER AVENUE

45+00

FISHER STREET

0 100' MATCH LINE – SEE SHEET 1

CONCEPTUAL DRAINAGE PLAN

LIGHT RAIL TRANSIT

EXHIBIT L – 02

VERSION: 10-31-13

NOTES:

1. NO PROPOSED DRAINAGE STA 50+00 TO 115+00

Exist INLET
Exist INLET
Exist INLET
Exist INLET
Exist 24" RCP
Exist 24" RCP
Exist INLET
Exist 24" RCP
Exist 24" RCP
Exist INLET
Exist INLET
Exist INLET

BSW 123
131'X10'
TDA=0.39 ac
WQF=0.08 cfs

TDA Site BSW123

FRANKLIN BLUE VARD

CENTRE PLACE DRIVE

CIRCLE DRIVE

EL MONTE BUSWAY

LA-710

21+61.70 POE

21+62

115+00

120+00

125+00

0 100'

CONCEPTUAL DRAINAGE PLAN

LIGHT RAIL TRANSIT

EXHIBIT L – 03

VERSION: 10-31-13

MATCH LINE – SEE SHEET 5

Exist 20'x14' RCC

Exist PIPE
Exist INLET
Exist INLET

Exist DBL 9.67'x12.75' RCB

BSW 149
97'X10'
TDA=0.56 ac
WQF=0.10 cfs

INLET

Exist 8"
PERFORATED CMP
Exist 24" RCP
Exist UD RISER

REMOVE UD RISER

BSW 157
96'X10'
TDA=0.61 ac
WQF=0.11 cfs

145+00

150+00

BSW 151
63'X10'
TDA=0.15 ac
WQF=0.03 cfs

Exist INLET

Exist 24" RCP

155+00

Exist UD RISER
Exist PIPE

Exist INLET

PASEO RANCHO CASTILLA

CHAMWOOD AVENUE

POOL

LA-710

0 100'

CONCEPTUAL DRAINAGE PLAN

LIGHT RAIL TRANSIT

EXHIBIT L – 04

VERSION: 10-31-13

MATCH LINE - SEE SHEET 4

HIGHBURY AVENUE

HILLCREST ROAD

HIGHBURY AVE

Exist 20'x14' RCC

Exist 24" RCP

Exist INLET

Exist 24" RCP

Exist INLET

Exist 24" RCP

Exist INLET

Exist 24" RCP

Exist INLET

Exist INLET

Exist INLET

160+00

387.18'FL

15+00

EXIST INLET

G1 INLET

24"X40' RCP

REMOVE PIPE

Exist INLET

Exist INLET

387.39'FL

G1 INLET

24"X30' RCP

387.80'FL

Exist 24" RCP

AMWOOD AVENUE

165+00

Exist 24" RCP

Exist INLET

375.33'FL

Exist 24" RCP

376.34'FL

EXIST 45" RCP

G2 INLET

G2 INLET

24"X12'RCP

24"X10'RCP

INLET W/WALL DRAIN

20+00

Exist DBL 10'X12' RCB

DORCHESTER STORM DRAIN

386.40'FL

CONC COLLAR

24"X93'RCP

387.30'FL

REMOVE PIPE

REMOVE INLET

G2 INLET

MF 169

6'X8'

TDA=1.30ac

24"X39'RCP

24"X746 RCP

G1 INLET

24"X55' RCP

G1 INLET

24"X58'RCP

G1 INLET

24"X21'RCP

G1 INLET

389.30'FL

24"X55'RCP

G1 INLET

24"X59'RCP

170+00

Exist 24" RCP

Exist DBL-10'-9"x12' RCB

Exist INLET

Exist 24" RCP

CB (W=28')
CB (W=21')
W/ 18"X3'RCP
CAP INLET

Exist 24" RCP

VALLEY BLVD

Adj INLET
390.81'FL

REMOVE PIPE
REMOVE INLET

Exist 24" RCP

380.00'FL

24"X50'RCP

G1 INLET

REMOVE INLET

UD

UD

UD

UD

25+00

435.00'FL

G1 INLET

24"X61'RCP

G1 INLET

24"X60'RCP

G1 INLET

REMOVE INLET

24"X57'RCP

REMOVE PIPE

REMOVE INLET

G1 INLET

G1 INLET

REMOVE INLET

Exist 24" RCP

Exist INLET

MATCH LINE - SEE SHEET 6

0 100'

CONCEPTUAL DRAINAGE PLAN

LIGHT RAIL TRANSIT

EXHIBIT L – 05

VERSION: 10-31-13

MATCH LINE - SEE SHEET 5

DORCHESTER STORM DRAIN

Exist 11'X12'-6" RCB

Exist 12'x12' Horseshoe Arch

Exist 10'X13'-3" RCB

Exist 18" PIPE

Exist INLET

Exist 12" PIPE

Exist 48" RCP

Exist INLET

Exist 45" RCP

MISSION ROAD

U.P.R.R.

18"x100' RCP
435.00'FL
381.00'FL

INLET

18"X45' RCP

MF 176
8'X11'
TDA=1.30ac
INLET (6)

BR 177
AREA=0.02 ac
TDA=0.30 ac

18"X385' RCP

18"X93' RCP

18"X34' RCP

18"X35' RCP

INLET W/
18"X54' RCP

UD

30+00

35+00

36+50

HEAVY/HOIST

HEAVY/HOIST

PARTS/MATERIALS BLOWDOWN

PARTS/MATERIALS

WHEEL TRUING

PAINT SHOP

BODY REPAIR

SHOP AREA
265'x 75'

TUNNEL DRAINAGE
STORAGE TANK
(24'X24'X25'D)

BR 185
AREA=0.02 ac
TDA=1.09 ac

18"X65'RCP

BR 176
AREA=0.06 ac
TDA=0.60 ac

18"X
200'
RCP

Exist 24"

CAP INLET (3)

18"X330'

10"X150'
STEEL PIPE

18"X335'RCP

18"X75'RCP

CAR WASH

CAR CLEANING PLATFORM

175+00

180+00

185+00

190+00

YARD ENTRANCE

TUNNEL
SUMP PUMP

18"X100' RCP
INLET (3)

ABN PIPE
ABN INLET (3)

408.76'FL

Exist INLET

0 100'

CONCEPTUAL DRAINAGE PLAN

LIGHT RAIL TRANSIT

EXHIBIT L – 06

VERSION: 10-31-13

EXIST TRANSITION STRUCTURE

EXIST 10'W X 8' H RCB

EXIST 42" RCP

EXIST 10' W CULVERT

ALHAMBRA STATION

FREMONT AVENUE

225+00

230+00

REMOVE CB

CB (W=14')

TBF 23000
6'X12'
TDA=0.86 ac

TBF 22973
6'X6'
TDA=0.37 ac

LA PALOMA STREET

CONCORD AVENUE

Exist CB

Exist CB

Exist 18" RCP

EXIST 12' X 8' RCB

REMOVE CB

CB (W=7')

TBF 23215
6'X10'
TDA=0.73 ac

235+00

FREMONT AVENUE

COMMONWEALTH AVENUE

Exist CB

EXIST 24" RCP

Exist CB

EXIST 27" RCP

Exist CB

EXIST 27" RCP

COMMONWEALTH AVENUE

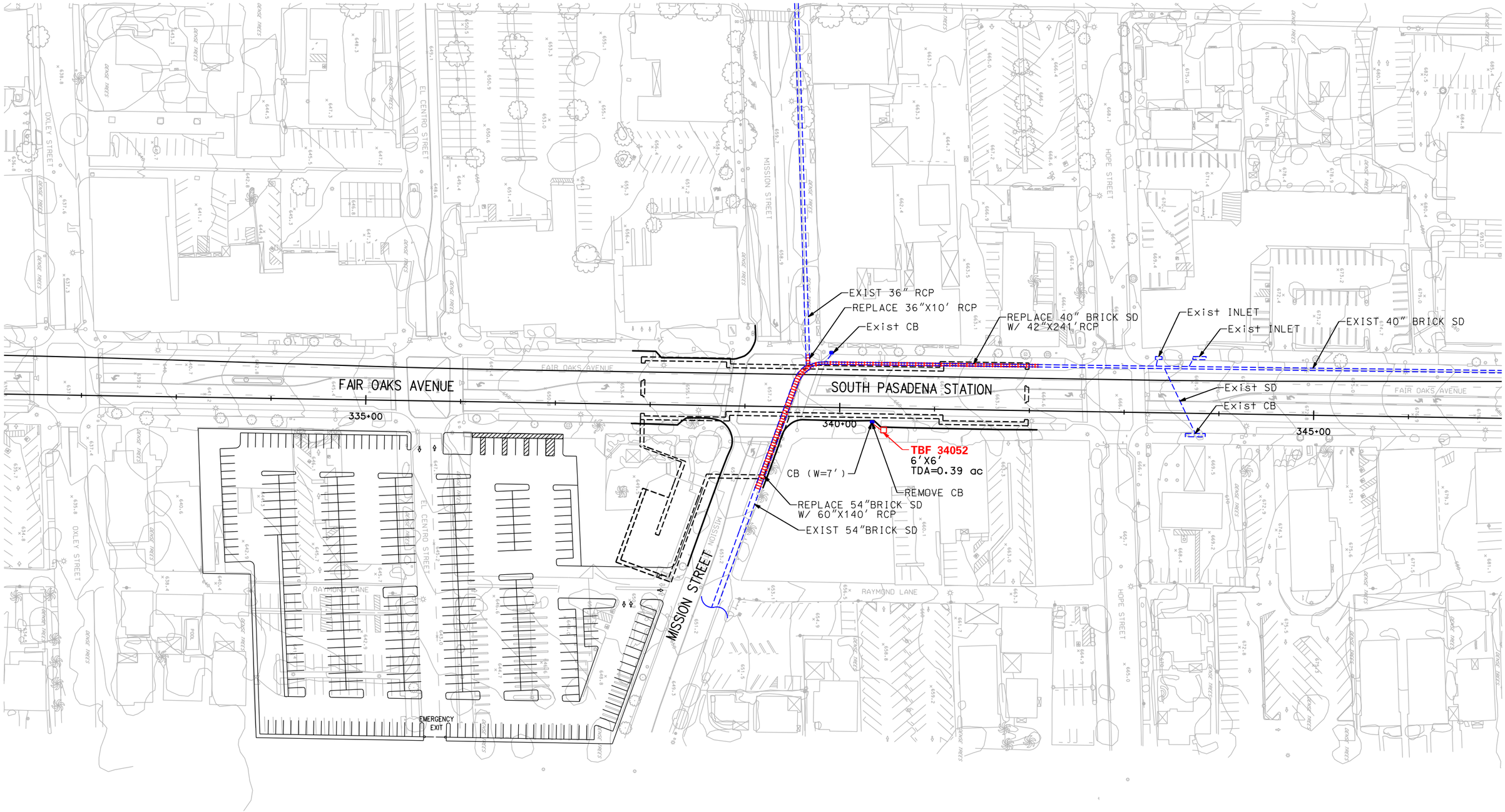
0 100'

CONCEPTUAL DRAINAGE PLAN

LIGHT RAIL TRANSIT

EXHIBIT L – 07

VERSION: 10-31-13



CONCEPTUAL DRAINAGE PLAN

LIGHT RAIL TRANSIT

EXHIBIT L – 08

VERSION: 10-31-13

OAKS AVENUE

FAIR OAKS AVENUE

FILLMORE STREET

PICO STREET

CALIFORNIA BOULEVARD

RAYMOND AVENUE

ARROYO PARKWAY

Exist CB

REPLACE 18"X37' RCP

REMOVE CB

CB (W=7')

EXIST 24" RCP

EXIST 18" RCP

REPLACE 18"X10' RCP

TBF 40269
6'X8'
TDA=0.56 ac

REPLACE 24"X87' RCP

REMOVE PIPE

REMOVE CB

FILLMORE STATION

405+00

CB SCREEN & INSERT
CB (W=7') W/
18"X38' RCP

EXIST 24" RCP

REPLACE 18"X27' RCP

Exist CB

Exist CB

REPLACE 18"X20' RCP

REPLACE 24"X62' RCP

REMOVE CB

410+00

TBF 40979
6'X6'
TDA=0.40 ac

CB (W=7')
18"X15' RCP

EXIST 24" RCP

Exist CB

EXIST 18" RCP

REPLACE 39" SD
W/ 42"X80' RCP

EXIST 39" SD

EXIST 45" RCP

EXIST 3'X10' CULVERT

Exist CB

Exist CB

REPLACE 18"X90' RCP

REMOVE CB

415+00

TBF 41392
6'X14'
TDA=0.92 ac

CB (W=21')

Exist CB

0 100'

CONCEPTUAL DRAINAGE PLAN

LIGHT RAIL TRANSIT

EXHIBIT L – 09

VERSION: 10-31-13

LEGEND:

REMOVE PIPE OR DITCH
Exist PIPE
PAVEMENT FLOW DIRECTION
PROPOSED PIPE

Exist OSD
Exist 24" RCP
Exist 24" RCP
Exist INLET
Exist INLET
Exist INLET
Exist 18" CMP
Adj INLET
24"X105' RCP
G2 INLET
SR 710
G1 INLET
G1 INLET
Exist INLET
Exist INLET
G1 INLET
Exist INLET
Exist INLET
G1 INLET
Exist 36" RCP
"M" LINE
Exist INLET
Exist 24" RCP
G1 INLET
REMOVE INLET
Exist INLET
G1 INLET
Exist INLET
Exist 24" RCP
Exist INLET
Exist DBL 10'x11' RCB
CORPORATE CENTER Dr
MATCH LINE - SEE SHEET 2
1380
1385
1390
R/W
FLOWLINE
ASPH
CONC
LA-710

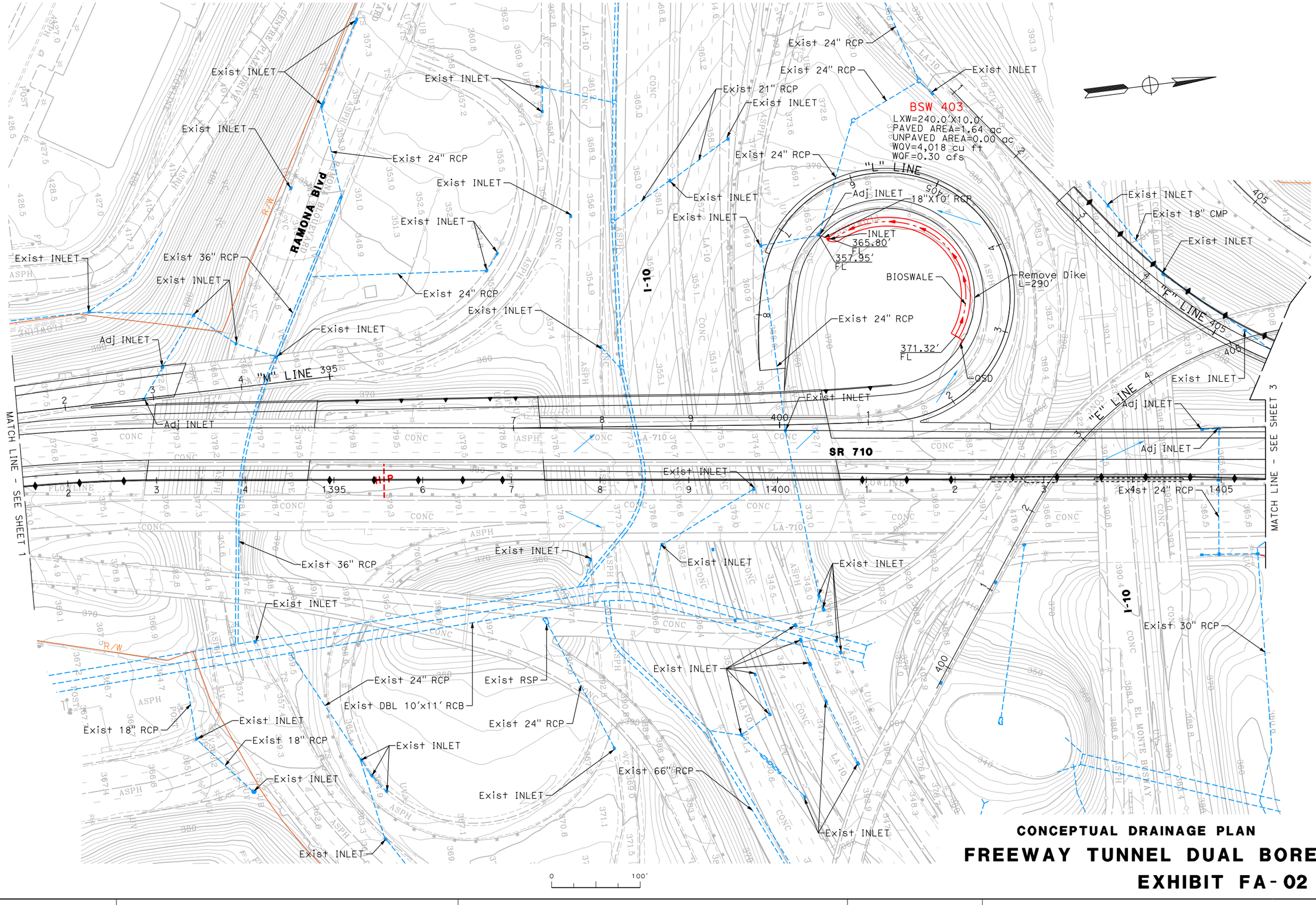
0 100'

CONCEPTUAL DRAINAGE PLAN

FREEWAY TUNNEL DUAL BORE

EXHIBIT FA-01

VERSION: 10-31-13
LAST REVISION | DATE PLOTTED => 21-JUL-2014
00-00-00 | TIME PLOTTED => 14:15



CONCEPTUAL DRAINAGE PLAN

FREEWAY TUNNEL DUAL BORE

EXHIBIT FA-02

VERSION: 10-31-13	DATE PLOTTED => 21-JUL-2014
LAST REVISION	TIME PLOTTED => 14:15
00-00-00	

MATCH LINE - SEE SHEET 4

24"X60' RCP
G2 INLET
24"X110' RCP
G2 INLET
398.50' FL
Adj INLET
G1 INLET
18"X90' RCP
406.00' FL
"G" LINE
"E" S/R LINE
"E" LINE
G1 INLET
18"X60' RCP
CAP INLET
Exist 24" RCP
G1 INLET
Adj INLET
341.85' FL
Exist 24" RCP
SSBL 2 LINE
SR 710
Exist INLET
Exist 24" RCP
Exist INLET
Exist 24" RCP
368.40' FL
BIOSWALE
"D" LINE
Adj INLET
Adj INLET
18"X20" RCP
G1 INLET
CAP INLET
Exist 24" RCP
Exist 24" RCP
364.76' FL
G1 INLET
18"X33' RCP
R/W
CIRCLE DRIVE
CONC
DIRT
ASPH
FLOWLINE
POOL
STAIRS
BALZAC STREET
WAVENUE
LAGUNA REGULATING BASIN

BSW 1407
LXW=280.0'X10.0'
PAVED AREA=0.91 ac
UNPAVED AREA=0.00 ac
WQV=2,230 cu ft
WQF=0.13 cfs

Exist 12' Arch
Exist INLET

MATCH LINE - SEE SHEET 2

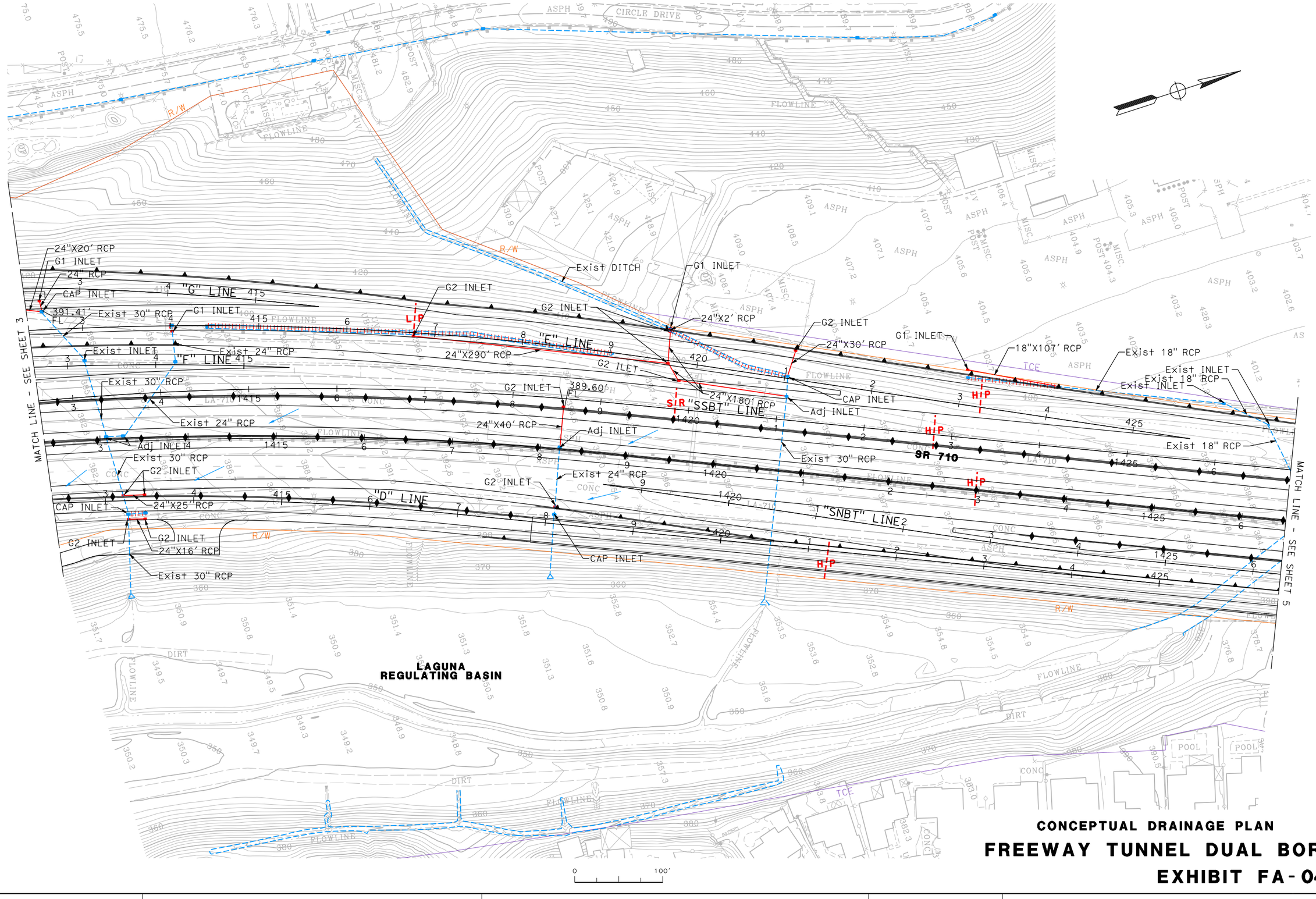
0 100'

CONCEPTUAL DRAINAGE PLAN

FREEWAY TUNNEL DUAL BORE

EXHIBIT FA-03

VERSION: 10-31-13
LAST REVISION | DATE PLOTTED => 21-JUL-2014
00-00-00 | TIME PLOTTED => 14:15

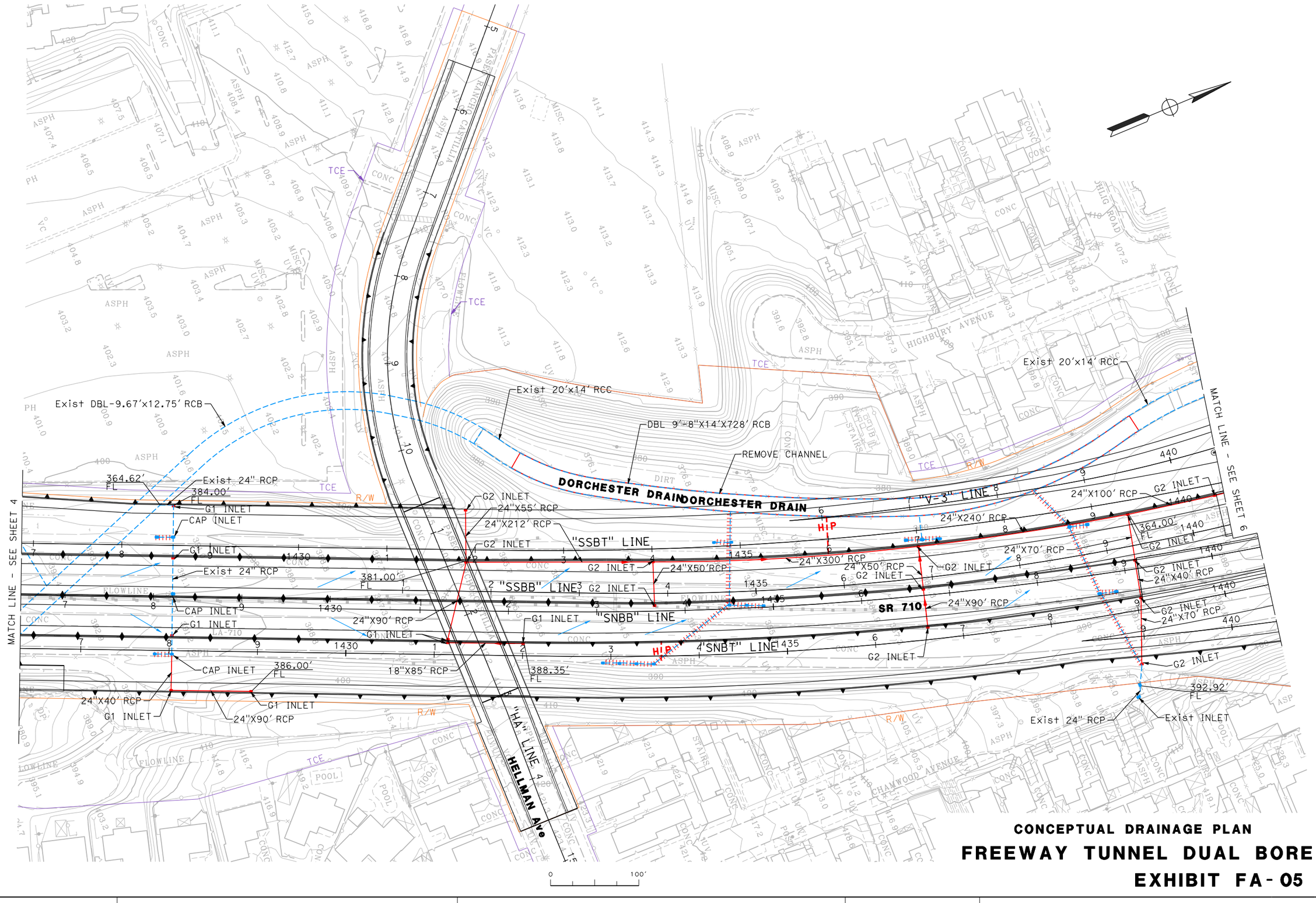


CONCEPTUAL DRAINAGE PLAN

FREEWAY TUNNEL DUAL BORE

EXHIBIT FA-04

VERSION: 10-31-13
LAST REVISION
DATE PLOTTED => 21-JUL-2014
TIME PLOTTED => 14:15
00-00-00



CONCEPTUAL DRAINAGE PLAN

FREEWAY TUNNEL DUAL BORE

EXHIBIT FA-05

VERSION: 10-31-13
LAST REVISION | DATE PLOTTED => 21-JUL-2014
00-00-00 | TIME PLOTTED => 14:17

MATCH LINE - SEE SHEET 5

VALLEY Blvd

(3) GSRD 1149
LXW=44.3'X11.5'
PAVED AREA=8.75 ac
UNPAVED AREA=4.01 ac
WQV=27,335cu ft
WQF=2.01 cfs

BSW 449
LXW=250.0'X16.0"
PAVED AREA=8.75 ac
UNPAVED AREA=4.01 ac
WQV=27,335 cu ft
WQF=2.01 cfs

Exist 24" RCP
CB. (W=14')
REMOVE INLET
Exist 24" RCP
Exist DBL-10.75'x12' RCB
Exist 24" RCP
Exist INLET
Exist INLET
"V" LINE
CB (W=24')
CONC. COLLAR
403.15' FL
GSRD
GSRD
GSRD
SOUTH PS 40'X20'
341.00' FL
402.15' FL
SR 710
Exist 20'x14' RCC
Exist 20'x14' RCC
G2 INLET
REMOVE CHANNEL
DBL 9'-8"X14'X267' RCB
DORCHESTER DRAIN
G2 INLET
384.78' FL
24"X97' RCP
G2 INLET
24"X300' RCP
"V-3" LINE 8
BIO SWALE
24"X325' RCP
24"X380' RCP
G2 INLET
395.39' FL
24" RCP
18"X70' RCP
18"X150' RCP
G2 INLET
G2 INLET
G2 INLET
374.00' FL
G1 INLET
24"X35' RCP
LIP
24"X270' RCP
G2 INLET
342.25' FL
24"X165' RCP
24" RCP
24"X180' RCP
G2 INLET
G2 INLET
2"SSBB" LINE 3
24"X130' RCP
G2 INLET
342.55' FL
G1 INLET
24"X80' RCP
24"X145' RCP
2"SNBB" LINE 3
G2 INLET
374.00' FL
2"SNBT" LINE 3
24"X40' RCP
SWALE
SWALE
G1 INLET
G1 INLET
24"X90' RCP
388.00' FL
CB (W=24')
WESTMONT Dr
R/W
TCE
TCE
TCE
TCE
TCE
R/W
R/W
R/W
LA-710
LA-710
FLOWLINE
FLOWLINE
VALLEY BOULEVARD
WESTMONT DRIVE
WESTMONT DRIVE
1445
1450
1455
445
450

0 100'

CONCEPTUAL DRAINAGE PLAN

FREEWAY TUNNEL DUAL BORE

EXHIBIT FA-06

VERSION: 10-31-13
LAST REVISION | DATE PLOTTED => 21-JUL-2014
00-00-00 | TIME PLOTTED => 14:15

DORCHESTER DRAIN

R/W

Exist 12'x12' Horseshoe Arch

Exist 12'x12' Horseshoe Arch
Exist 11'X12'-6" RCB

Exist 10'X13'-3" RCB
Exist 18" PIPE
Exist INLET
Exist 12" PIPE
Exist 48" RCP
Exist INLET

Exist 10.0'X13.0'-3" RCB

EXIST CB

Exist 45" RCP

MATCH LINE - SEE SHEET 6

MATCH LINE - SEE SHEET 8

7"SSBT" LINE

SB SR 710

416.00'
FL

16"X1973' STEEL PIPE

7"SNBB" LINE
7"SNBT" LINE

NB SR 710

STORAGE TANK
(35'X35'X23'D)

TCE

R/W

WESTMONT Dr

MILTON Ave

FRONT ST

U.P.R.R

MISSION Rd

LOWELL AVENUE

CONCORD AVENUE

MILTON AVENUE

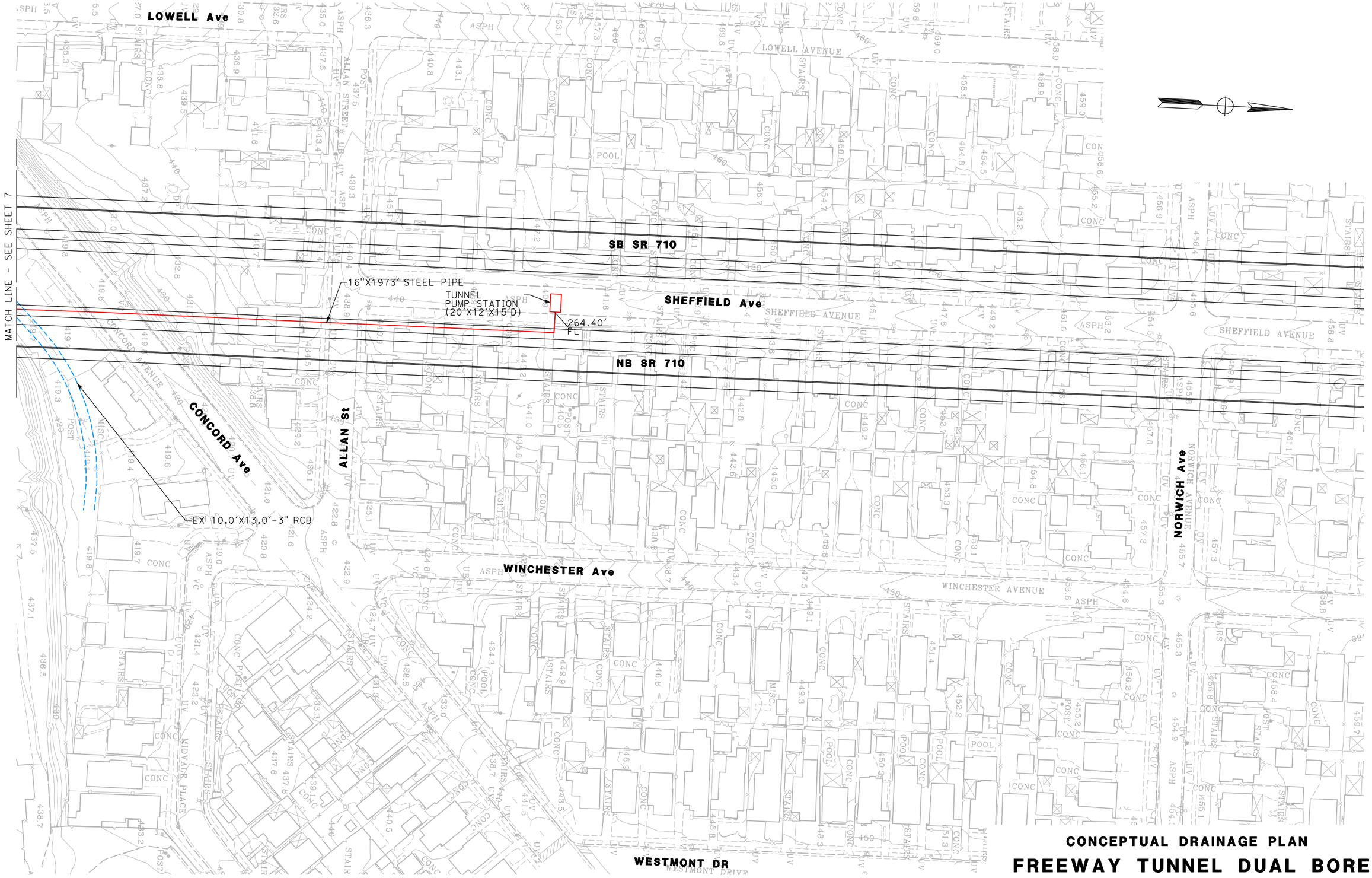
0 100'

CONCEPTUAL DRAINAGE PLAN

FREEWAY TUNNEL DUAL BORE

EXHIBIT FA-07

VERSION: 10-31-13
LAST REVISION



CONCEPTUAL DRAINAGE PLAN

FREEWAY TUNNEL DUAL BORE

EXHIBIT FA-08

VERSION: 10-31-13
LAST REVISION:

PALMETTO DR

BELLEVUE DRIVE

GORDON TERRACE

WAVERLY DRIVE

HAVENDALE DRIVE

PASADENA AVEUE

PASADENA Ave

IMPERIAL ELEMENTARY SCHOOL

DEL MAR Blvd

SB SR 710

NB SR 710

TCE

R/W

SW CULVERT

REMOVE INLET
831.00'
FL

Exist 24" CSP

830.52'
FL

813.00 TG
810.00 FL
36"X25' RCP

CMP INLET

18"X20' RCP

18"X20' RCP

G1 INLET

36"X212' RCP

Exist INLET

INLET W/ 18"X12'RCP
814.00'
FL

RSP

FES

"NSBB" LINE

"NSBT" LINE

REMOVE PUMP STATION

"NNBB" LINE

"NNBT" LINE

Exist 12" VP

Exist INLET

Exist 24" VP

Exist 42" RCP
36"X55' RCP

FES
820.00'
FL

Exist 18" VP

G2 INLET

24"X47' RCP

G2 INLET

24"X110' RCP

"NSBT" LIN

"NSBB"

"NNBB"

"NNBT"

BIOSWALE

Exist INLET

Exist
12" VP

823.00' TG
805.87' FL

805.55'
FL

36"X588' RCP

48"X140' RCP

CMP INLET

48"X65' RCP

Exist 48" RCP

Exist 22" VP

Exist INLET

MATCH LINE - SEE SHEET 10

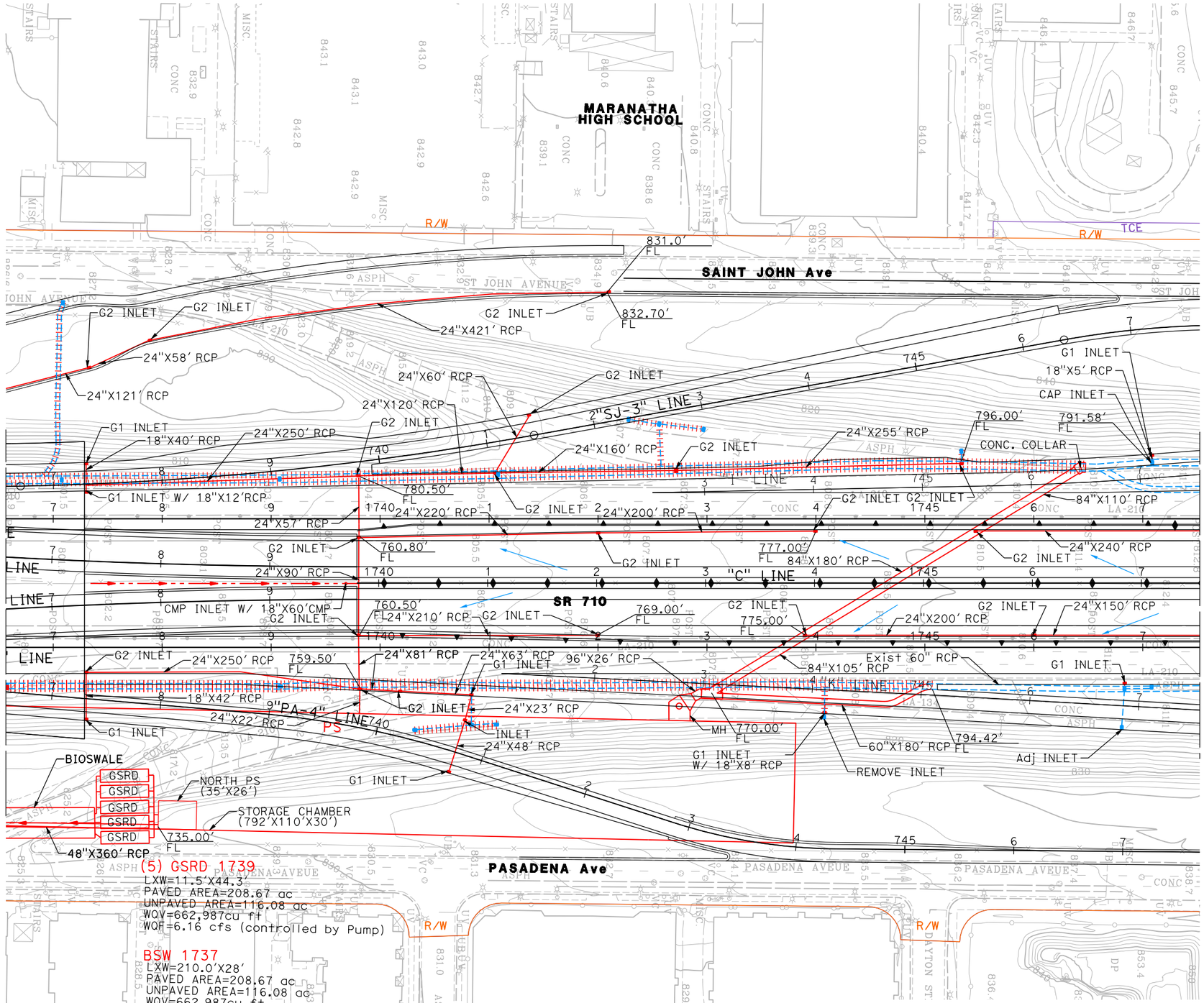
0 100'

CONCEPTUAL DRAINAGE PLAN

FREEWAY TUNNEL DUAL BORE

EXHIBIT FA-09

VERSION: 10-31-13
LAST REVISION | DATE PLOTTED => 21-JUL-2014
00-00-00 | TIME PLOTTED => 14:15

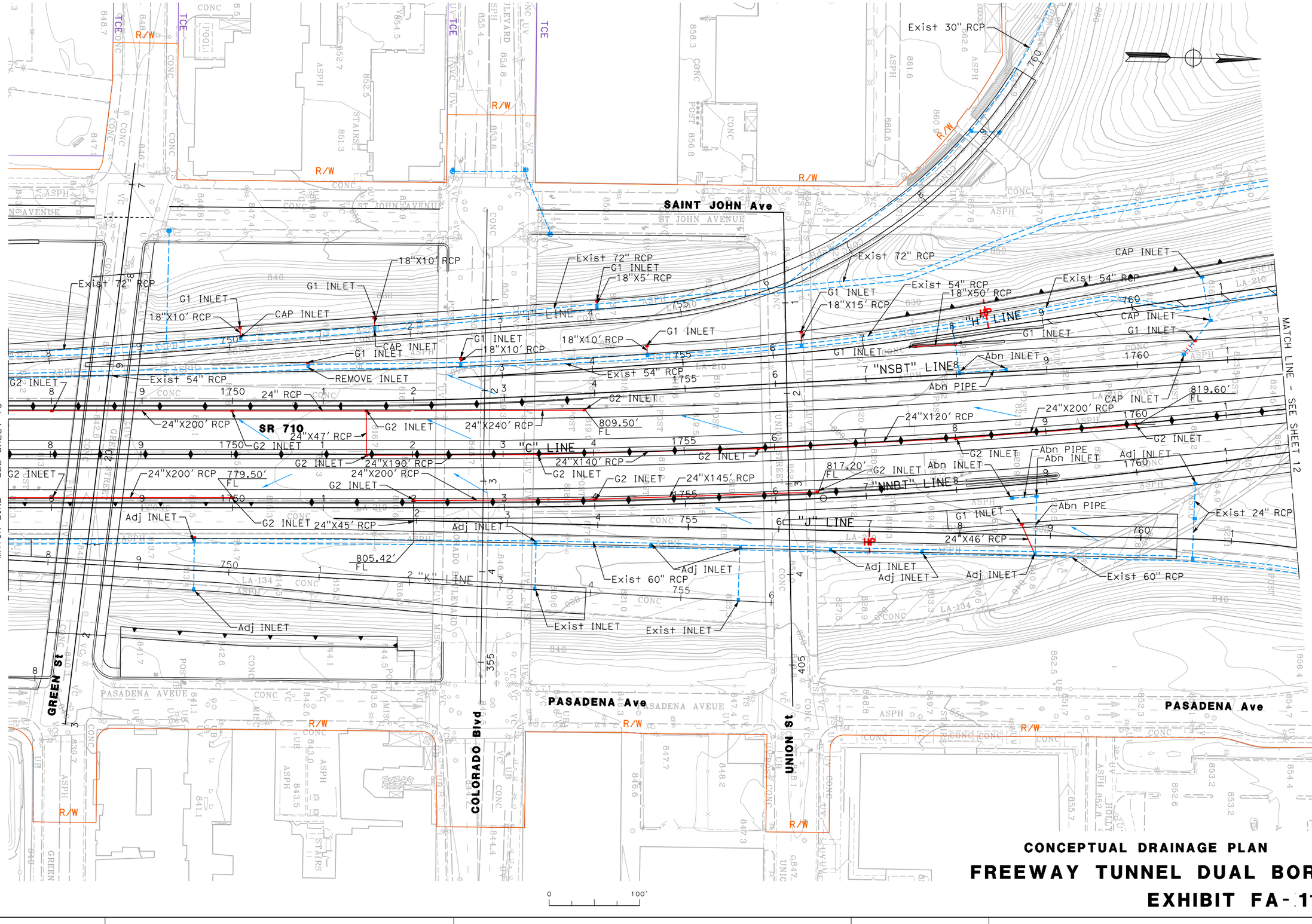


CONCEPTUAL DRAINAGE PLAN

FREEWAY TUNNEL DUAL BORE

EXHIBIT FA-10

VERSION: 10-31-13
LAST REVISION
DATE PLOTTED => 21-JUL-2014
TIME PLOTTED => 14:15
00-00-00



CONCEPTUAL DRAINAGE PLAN

FREEWAY TUNNEL DUAL BORE

EXHIBIT FA-.11

VERSION: 10-31-13	
LAST REVISION	DATE PLOTTED => 21-JUL-2014
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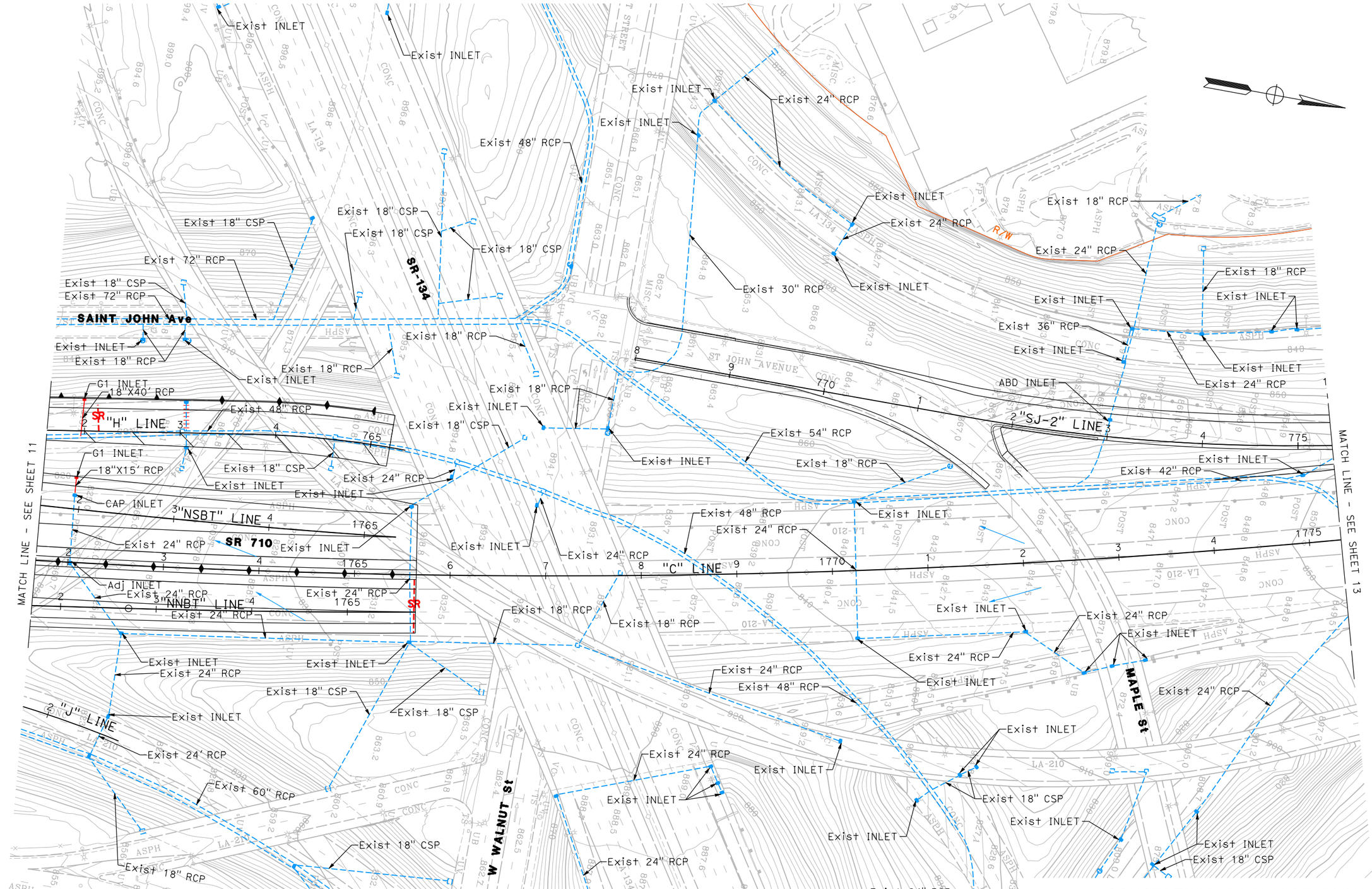
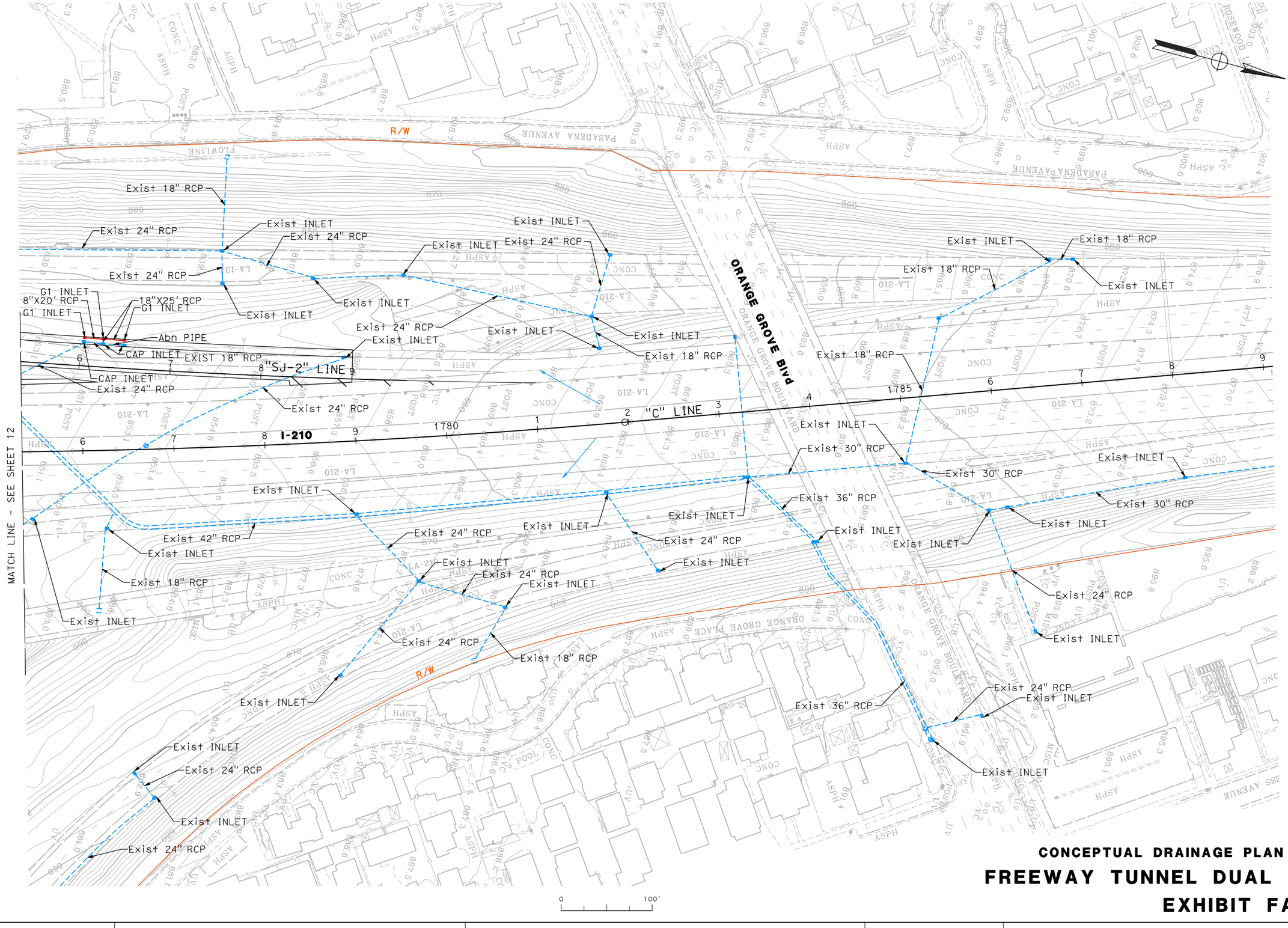


CONCEPTUAL DRAINAGE PLAN

FREEWAY TUNNEL DUAL BORE

EXHIBIT FA-12

VERSION: 10-31-13
LAST REVISION | DATE PLOTTED => 21-JUL-2014
00-00-00 | TIME PLOTTED => 14:15



CONCEPTUAL DRAINAGE PLAN

FREEWAY TUNNEL DUAL BORE

EXHIBIT FA-13

VERSION: 10-31-13
LAST REVISION
00-00-00
DATE PLOTTED => 21-JUL-2014
TIME PLOTTED => 14:15

LEGEND:

- REMOVE PIPE OR DITCH
- Exist PIPE
- PAVEMENT FLOW DIRECTION
- PROPOSED PIPE

Exist INLET
Exist 18" RCP
Exist INLET
Exist INLET
Exist INLET
Exist INLET
Exist 24" RCP
Exist 24" RCP
Exist INLET
Exist INLET
Exist 24" RCP
Exist 24" RCP
Exist INLET
Exist INLET
Exist 24" RCP
Exist INLET
Exist 30" RCP
Exist 12' Arch
REMOVE INLET
GD-2 INLET
Exist 24" RCP
8"F" LINE
1410 "SSB" LINE
"SNB" LINE
Exist 24" RCP
Exist 24" RCP
Exist 24" RCP
Adj INLET
Adj INLET
Exist 24" RCP
BIOSWALE
INLET
18"x39' AP
BSW 1407
LXW=280.0'X10.0'
PAVED AREA=0.62 ac
UNPAVED AREA=0.00 ac
WQV=1,519 cu ft
WQF=0.09 cfs
Exist INLET
Exist 30" RCP
Exist INLET
Exist DITCH
Exist 24" RCP
Exist INLET
Exist 24" RCP
Exist INLET
Exist 30" RCP
ABN PIPE
ABN INLET
CAP INLET
18"X20' RCP
"D" LINE
G1 INLET
Exist 30" RCP
R/W
R/W
TCE
CIRCLE DRIVE
SR 710
I-10
LAGUNA
REGULATING BASIN
MATCH LINE - SEE SHEET 2

CONCEPTUAL DRAINAGE PLAN

FREEWAY TUNNEL SINGLE BORE

EXHIBIT FB- 01

0 100'

VERSION: 10-31-13
LAST REVISION | DATE PLOTTED => 21-JUL-2014
00-00-00 | TIME PLOTTED => 14:17

CIRCLE DRIVE

R/W

Exist DITCH

REMOVE TYPE A DRAIN

G2 INLET

Exist INLET

Exist INLET

Exist INLET

Exist 18" RCP

Exist DBL-9.67'x12.75' RCB

Exist INLET

Exist 18" RCP

Exist 21" RCP

364.62'
FL

CAP INLET

Exist 24" RCP

G1 INLET

CAP INLET

"E" LINE

"SNB" LINE

"SSB" LINE

Exist INLET

Exist 30" RCP

Exist 24" RCP

7 CAP INLET

G2 INLET

G1 INLET

"SSB" LINE

CAP INLET

24"X130' RCP

24"X90' RCP

G2 INLET

G2 INLET

G2 INLET

24"X45' RCP

SR 710

LAGUNA
REGULATING BASIN

TCE

MATCH LINE - SEE SHEET 1

MATCH LINE - SEE SHEET 3

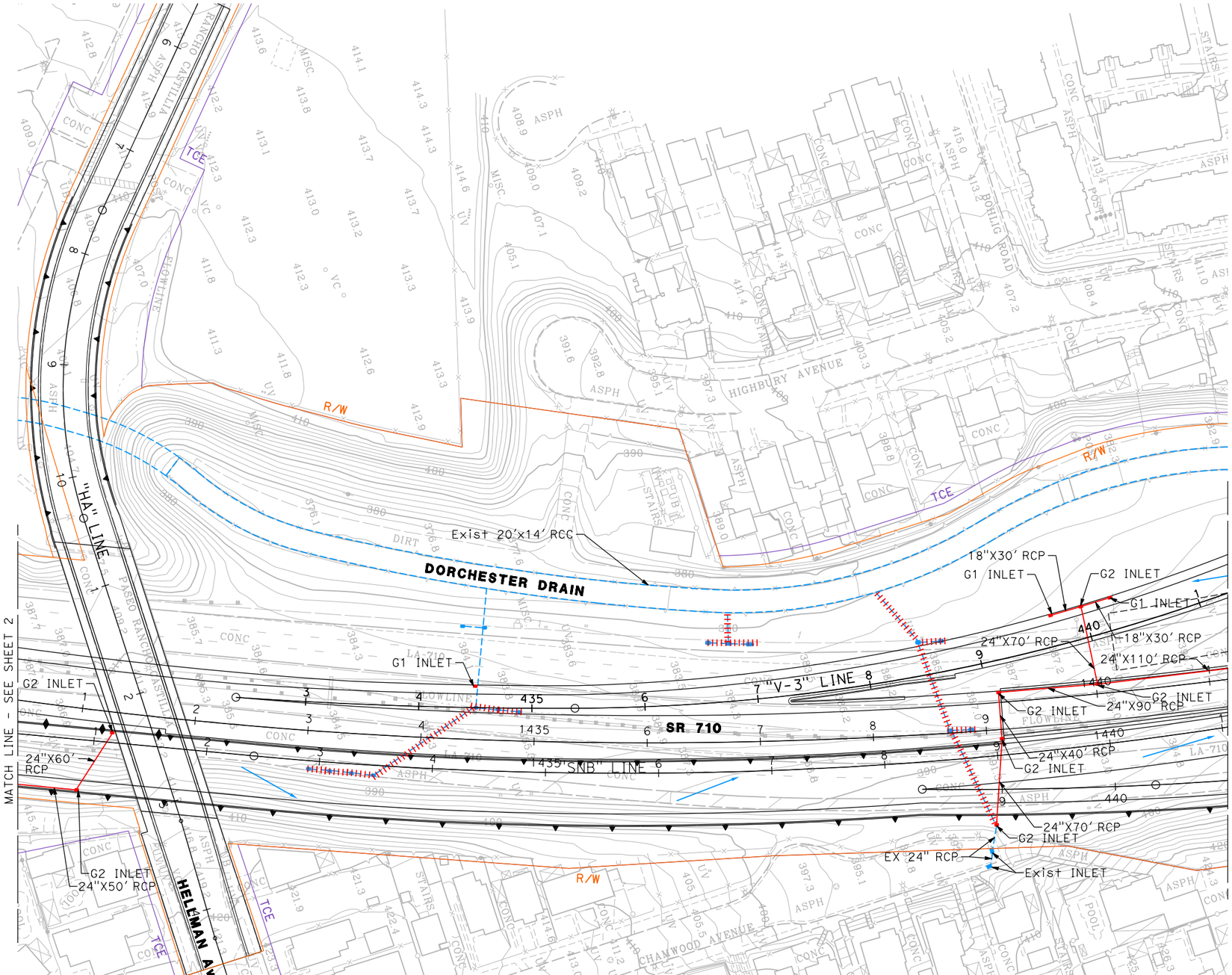
CONCEPTUAL DRAINAGE PLAN

FREEWAY TUNNEL SINGLE BORE

0 100'

EXHIBIT FB-02

VERSION: 10-31-13
LAST REVISION
DATE PLOTTED => 21-JUL-2014
00-00-00
TIME PLOTTED => 14:16



CONCEPTUAL DRAINAGE PLAN

FREEWAY TUNNEL SINGLE BORE

EXHIBIT FB-03

0 100'

VERSION: 10-31-13
LAST REVISION | DATE PLOTTED => 21-JUL-2014
00-00-00 | TIME PLOTTED => 14:17

(3) GSRD 1149
LXW=11.5'X44.3'
PAVED AREA=7.55 ac
UNPAVED AREA=5.21 ac
WQV=26,159cu ft
WQF=1.54 cfs

BSW 449
LXW=250.0'X16.0'
PAVED AREA=7.55 ac
UNPAVED AREA=5.21 ac
WQV=26,159 cu ft
WQF=1.54 cfs

VALLEY Blvd
Exist 24" RCP
CB (W=14')
Exist 24" RCP
Exist DBL-10.75'x12' RCB
Exist 24" RCP
Exist INLET
Exist INLET
384.94 FL
CB (W=24')
W/ 24"X20' RCP
24"X310' RCP
"V" LINE
SR 710
Exist 20'x14' RCC
TCE
R/W
DORCHESTER DRAIN
G2 INLET
7 "V-3" LINE 8
Exist 48" RCP 445
411.00 FL
SOUTH PS (40'X20')
INLET
BIOSWALE
409.00' FL
24"X241' RCP
GSRD
399.00' TG
374.90' FL
24"X80' RCP
330.00' FL
328.00' FL
336.00' FL
G2 INLET
24"X40' RCP
356.00' FL
24"X395' RCP
3 "SNBB" LINE 4
24"X147' RCP
G2 INLET
G2 INLET
374.00' FL
24"X40' RCP
"SNB" LINE
SWALE
SWALE
G1 INLET
"V-4" LINE
18"X95' RCP
392.00' FL
G1 INLET
TCE
R/W
WESTMONT Dr
1450
G1 INLET
416.00' FL
24"X80' RCP
418.00' FL
24"X70' RCP
CB (W=24')
TCE
R/W
20'
MATCH LINE - SEE SHEET 3
MATCH LINE - SEE SHEET 5

CONCEPTUAL DRAINAGE PLAN
FREEWAY TUNNEL SINGLE BORE
EXHIBIT FB-04

0 100'

VERSION: 10-31-13
LAST REVISION: - - - - - -

TCE
R/W
DORCHESTER DRAIN
R/W
STORAGE TANK (35'X35'X23'D)
16"X1973' STEEL PIPE
1500
"SNBB" LINE
"SNB" LINE
MATCH LINE - SEE SHEET 4
NB SR 710
SB SR 710
"A" LINE
1505
1510
MATCH LINE - SEE SHEET 4
R/W
TCE
TCE
WESTMONT Dr
MILTON Ave
FRONT ST
U.P.R.R
MISSION Rd
LOWELL AVENUE
CONCORD AVENUE

CONCEPTUAL DRAINAGE PLAN

FREEWAY TUNNEL SINGLE BORE

EXHIBIT FB- 05

0 100'

VERSION: 10-31-13
LAST REVISION

MATCH LINE - SEE SHEET 5

LOWELL Ave

LOWELL AVENUE

TUNNEL
PUMP STATION
(20'X12'X15'D)

SB SR 710

"A" LINE

16" STEEL PIPE

SHEFFIELD Ave

SHEFFIELD AVENUE

NB SR 710

CONCORD Ave

ALLAN St

WINCHESTER Ave

WINCHESTER AVENUE

NORWICH Ave

NORWICH AVENUE

POOL

0 100'

CONCEPTUAL DRAINAGE PLAN

FREEWAY TUNNEL SINGLE BORE

EXHIBIT FB-06

VERSION: 10-31-13
LAST REVISION:

PALMETTO DR

IMPERIAL ELEMENTARY SCHOOL

GORDON TERRACE

HAVENDALE DRIVE

"SJ" LINE

"DM" LINE

"A" LINE

"NNBB" LINE

"NNB" LINE

SB SR 710

NB SR 710

DEL MAR Blvd

PASADENA Ave

PASADENA AVEUE

TCE

R/W

Exist INLET

24"x51' RCP

FES

RSP

SW CULVERT

REMOVE INLET

G1 INLET

18"X57' RCP

18"X17' RCP

24"X35' RCP

Exist 42" RCP

24"X29' RCP

G2 INLET

36"X54' RCP

7 RSP

FES

24"X200' RCP

24"X56' RCP

24"X60' RCP

CMP INLET

INLET

Exist 12" VP

REMOVE PUMP STATION

36"X240' RCP

36"X588' RCP

BIOSWALE

48"X100' RCP

Exist 48" RCP

823.00' TG

805.87' FL

48"X65' RCP

Exist 22" VP

MATCH LINE - SEE SHEET 8

CONCEPTUAL DRAINAGE PLAN

FREEWAY TUNNEL SINGLE BORE

EXHIBIT FB- 07

0 100'

VERSION: 10-31-13
LAST REVISION: DATE PLOTTED => 21-JUL-2014
00-00-00 TIME PLOTTED => 14:16

MARANATHA HIGH SCHOOL

SAINT JOHN Ave

"SJ" LINE

ST JOHN AVENUE

G2 INLET

24"X303' RCP

G2 INLET

"N" LINE

791.58' FL

24"X40' RCP

G2 INLET

G1 INLET 18"X10' RCP

84"X395' RCP

G1 INLET

"NNBB" LINE

SR 710

"NSB" LINE

"NNB" LINE

780.50' FL

24"X50' RCP

G2 INLET

768.50' FL

24"X35' RCP

G1 INLET (2)

96"X26' RCP

744.42' FL

18"X40' RCP

CAP INLET

G2 INLET

18"X42' RCP

G2 INLET

24"X250' RCP

G2 INLET

24"X19' RCP

770.00' FL

MH

"K" LINE

G1 INLET

60"X190' RCP

18"X8' RCP

Exist INLET

Exist 60" RCP

Adj INLET

Adj INLET

G1 INLET

24"X48' RCP

"PA" LINE

24"X20' RCP

BIOSWALE

GSRD

GSRD

GSRD

GSRD

GSRD

NORTH PS (35'X26')

STORAGE CHAMBER (792'x110'x30')

735.00' FL

48"X360' RCP

PASADENA Ave

PASADENA AVEUE

R/W

DAYTON ST

MATCH LINE - SEE SHEET 7

MATCH LINE - SEE SHEET 9

GSRD 1739
LXW=11.5'X44.3'
PAVED AREA=206.24 ac
UNPAVED AREA=118.51 ac
WQV=660,209 cu ft
WQF=6.16 cfs

BSW 1737
LXW=210.0'X28'
PAVED AREA=206.24 ac
UNPAVED AREA=118.51 ac
WQV=660,209 cu ft
WQF=6.16 cfs

0 100'

CONCEPTUAL DRAINAGE PLAN

FREEWAY TUNNEL SINGLE BORE

EXHIBIT FB- 08

VERSION: 10-31-13
LAST REVISION | DATE PLOTTED => 21-JUL-2014
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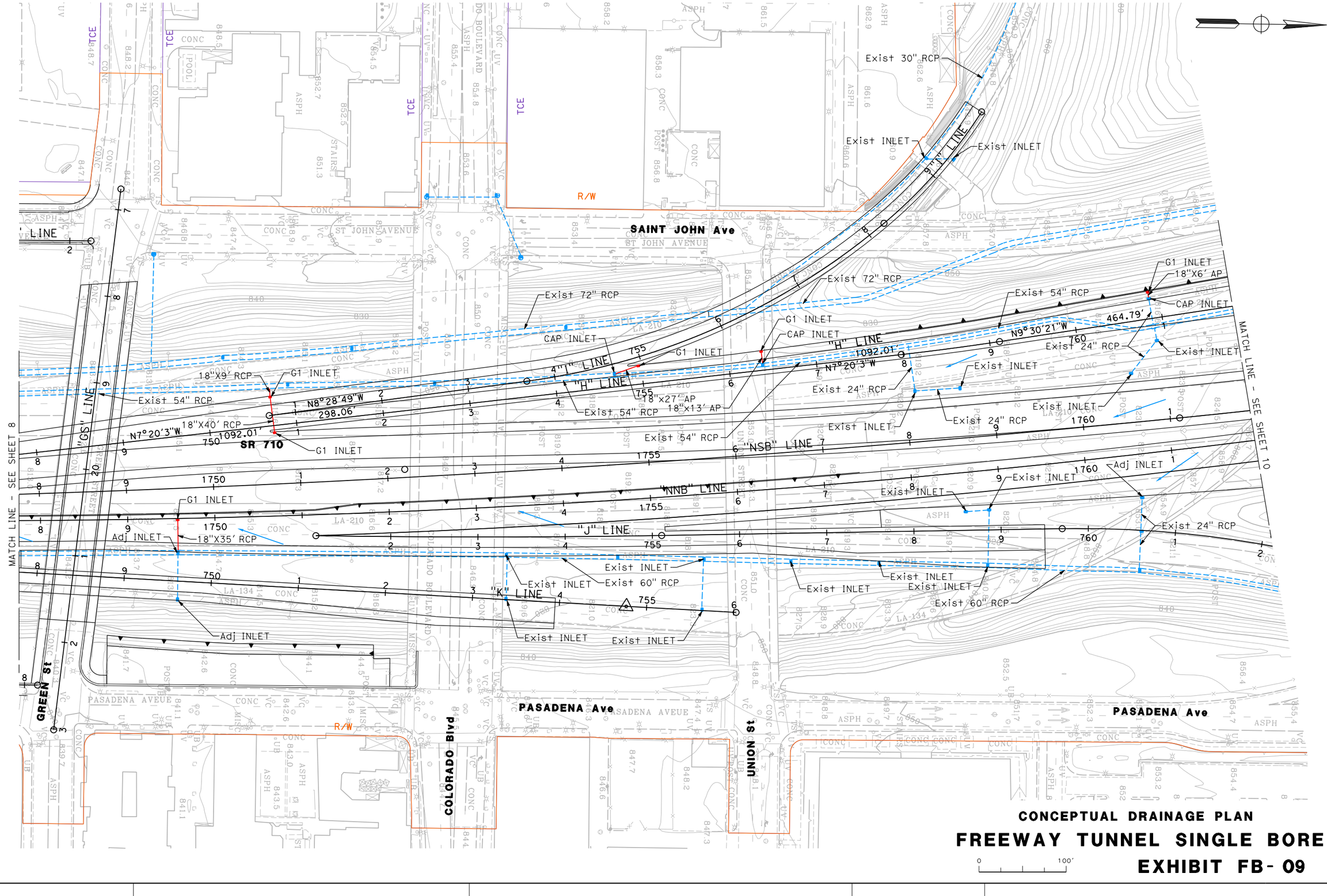


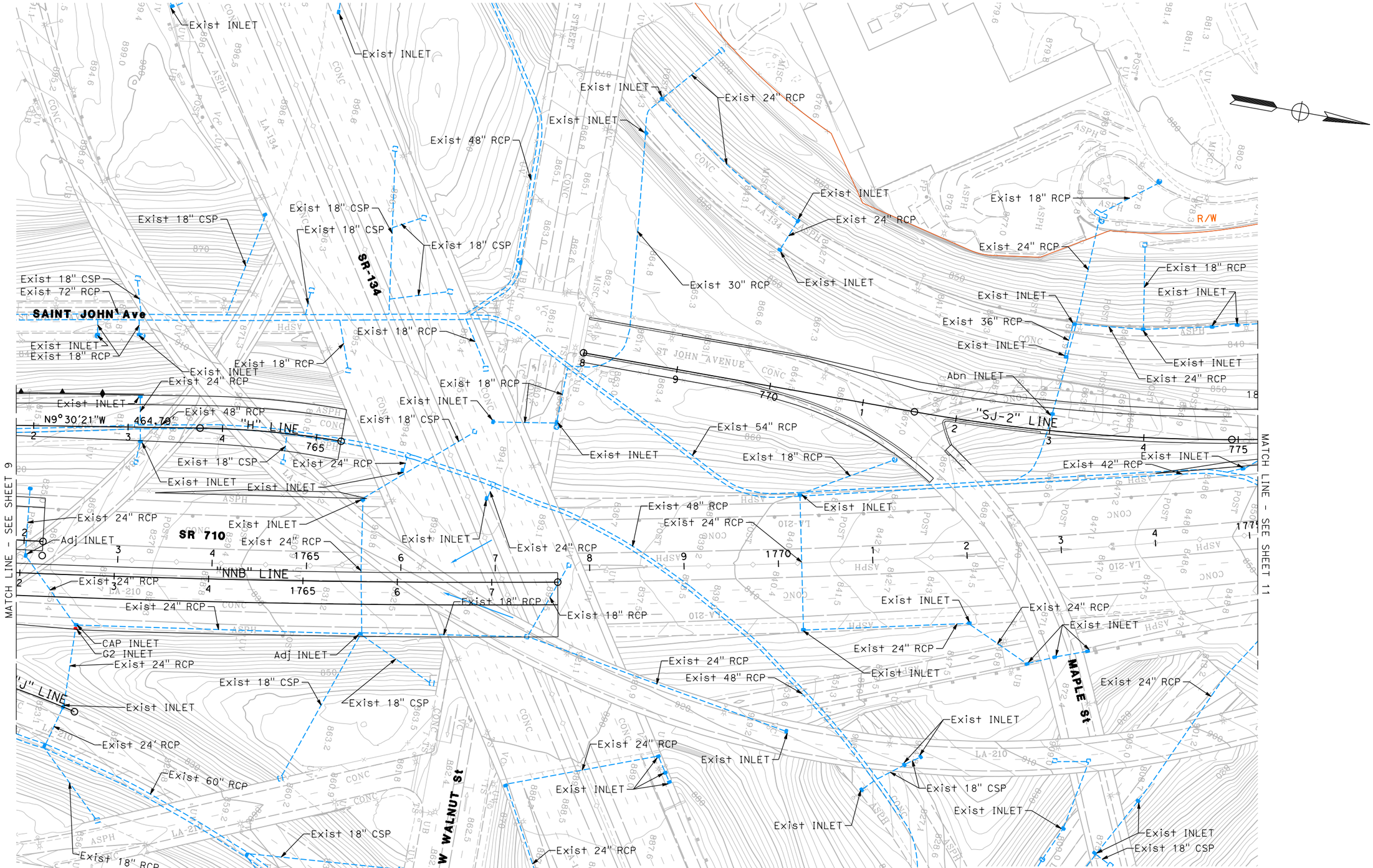
CONCEPTUAL DRAINAGE PLAN

FREEWAY TUNNEL SINGLE BORE

0 100'

EXHIBIT FB- 09

VERSION: 10-31-13	
LAST REVISION	DATE PLOTTED => 21-JUL-2014
00-00-00	TIME PLOTTED => 14:17



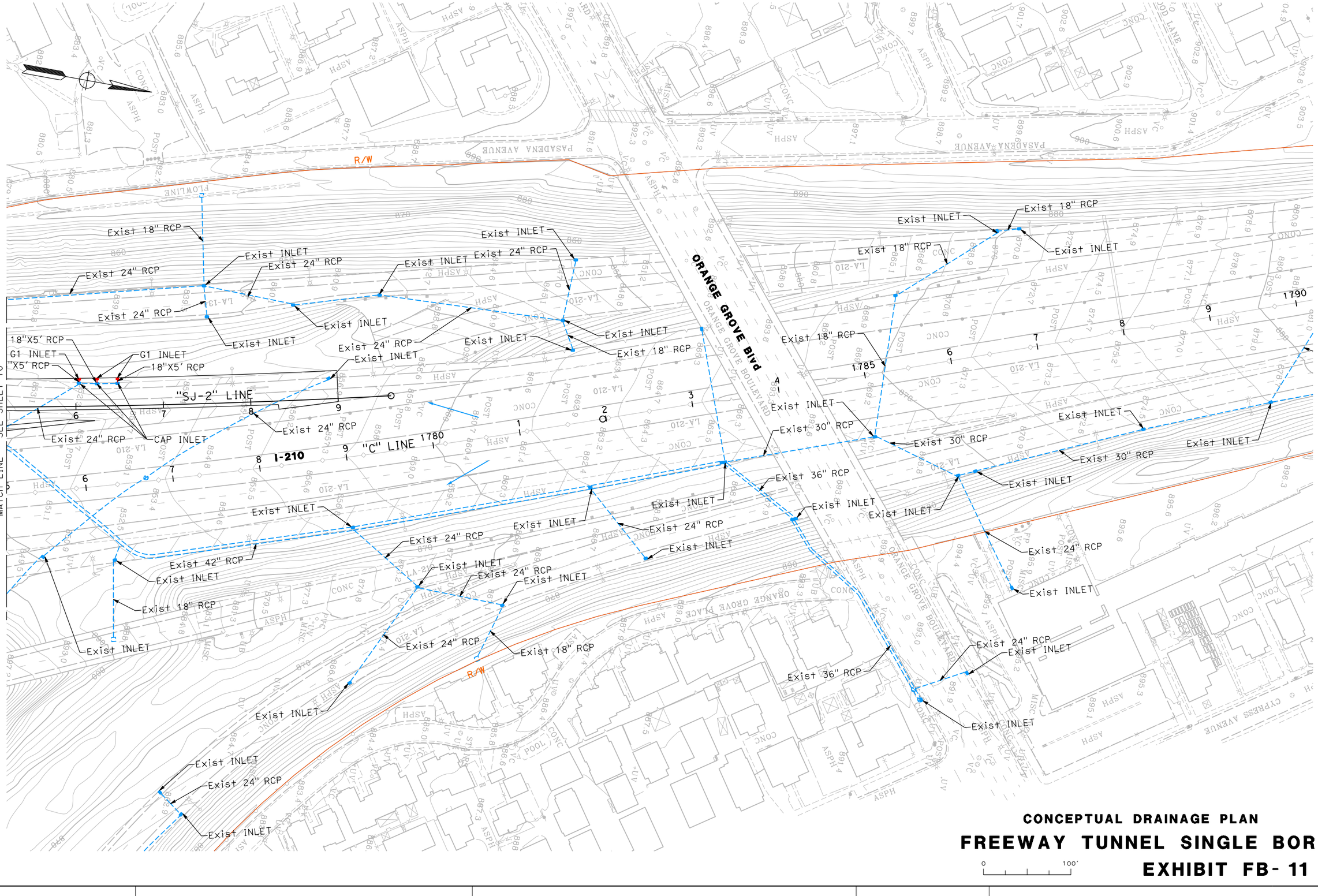
CONCEPTUAL DRAINAGE PLAN

FREEWAY TUNNEL SINGLE BORE

EXHIBIT FB-10

0 100'

VERSION: 10-31-13
LAST REVISION | DATE PLOTTED => 21-JUL-2014
00-00-00 | TIME PLOTTED => 14:17



CONCEPTUAL DRAINAGE PLAN

FREEWAY TUNNEL SINGLE BORE

0 100'

EXHIBIT FB- 11

VERSION: 10-31-13
LAST REVISION
DATE PLOTTED => 21-JUL-2014
TIME PLOTTED => 14:16
00-00-00
00-00-00