DELIVERING THE STATE'S FIRST DIVERGING DIAMOND INTERCHANGE

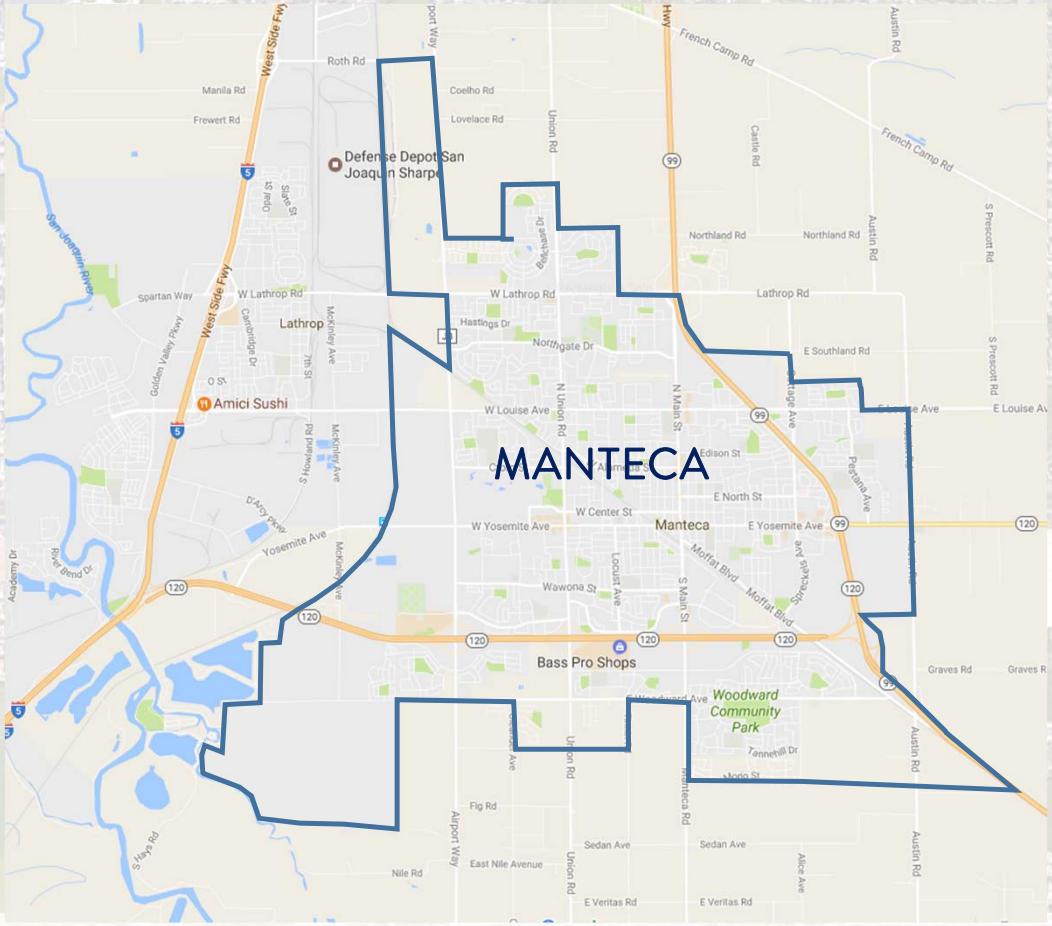
State Route 120/Union Road Diverging Diamond Retrofit

Presented by:
Aaron Silva
Mark Thomas

PRESENTATION FOCUS

- Project History
- Interchange Innovation
- Existing Conditions
- Proposed Design
- Approval Process
- Final Details

PROJECT HISTORY



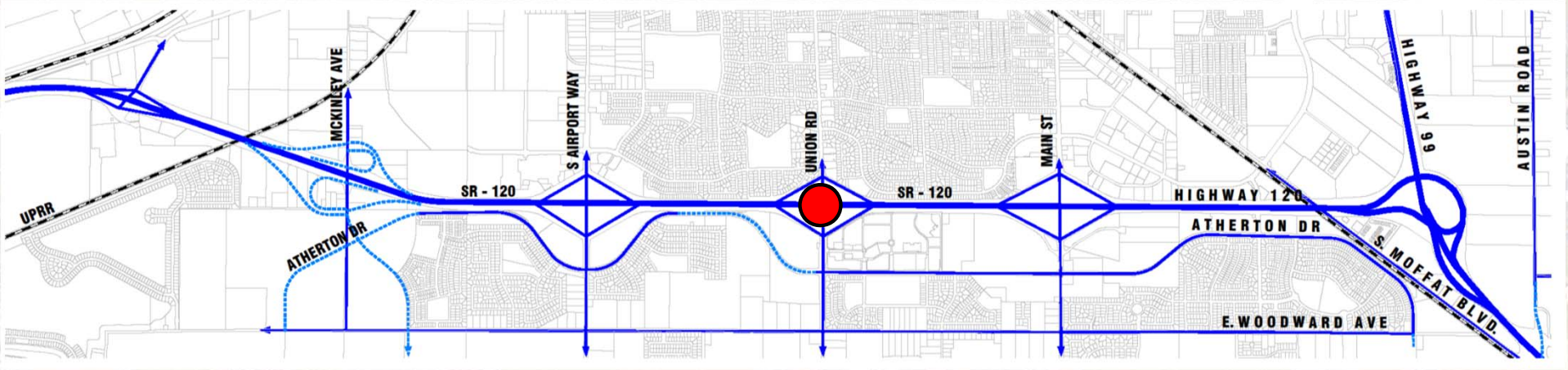
SR120/Union Road Interchange

PROJECT HISTORY

PROJECT HISTORY

- Existing Interchange Configuration
- Growth in Manteca
- Congestion along SR 120

EXISTING CONDITIONS



SR120/Union Road Interchange



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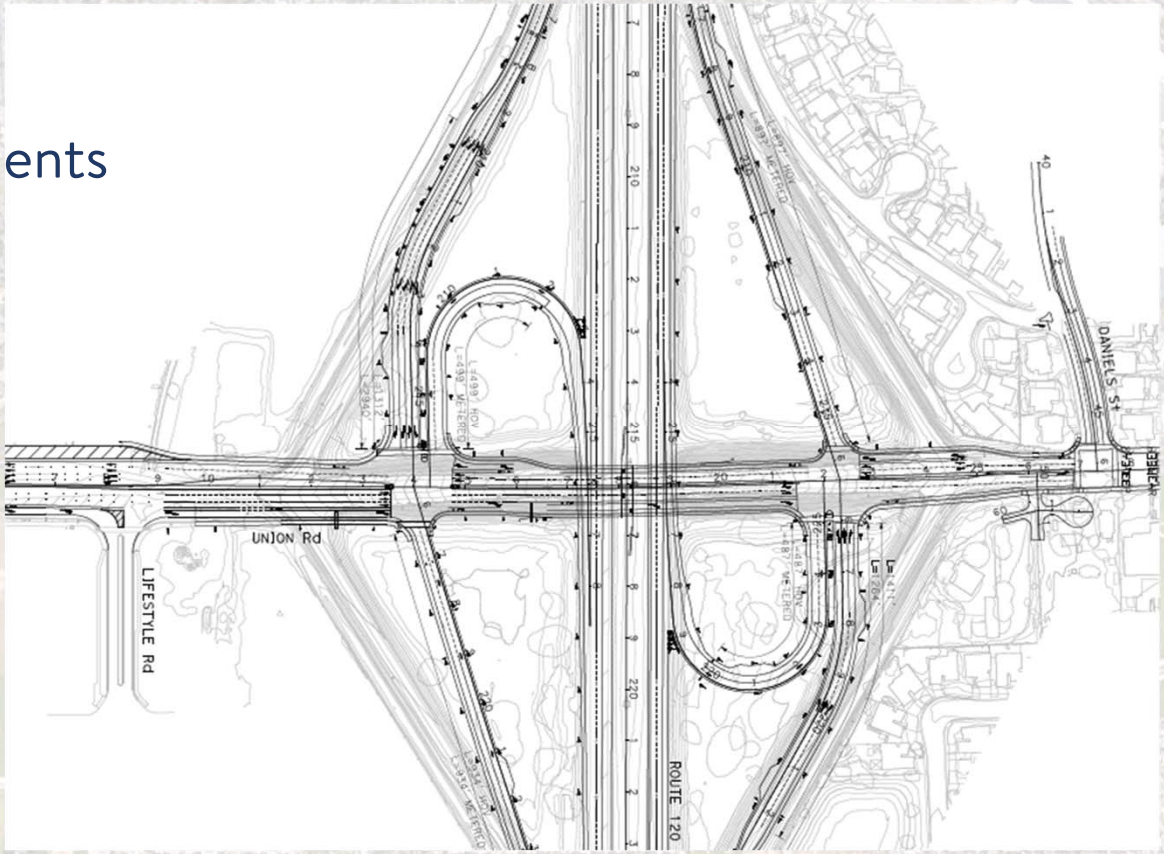
PREVIOUS DESIGN

Partial Cloverleaf (Type L-9)

- Provided Operational Improvements
- Required Bridge Replacement
- Non-Standard Design Features
- High Construction Costs



PREVIOUS DESIGN

- Project Study Report/Project Report – Approved 2010
- Initial Study/Mitigated Negative Declaration – Approved 2010
- 65% Design Plan Development

Results:

- High Construction Costs
- Adjacent Development Influence

ADJACENT DEVELOPMENT

- Existing & Planned Development
- Access Needs
- Timing Concerns
- Bicycles & Pedestrians

ADJACENT DEVELOPMENT

- Access Needs

INTERCHANGE INNOVATION

INTERCHANGE INNOVATION

INTERCHANGE INNOVATION

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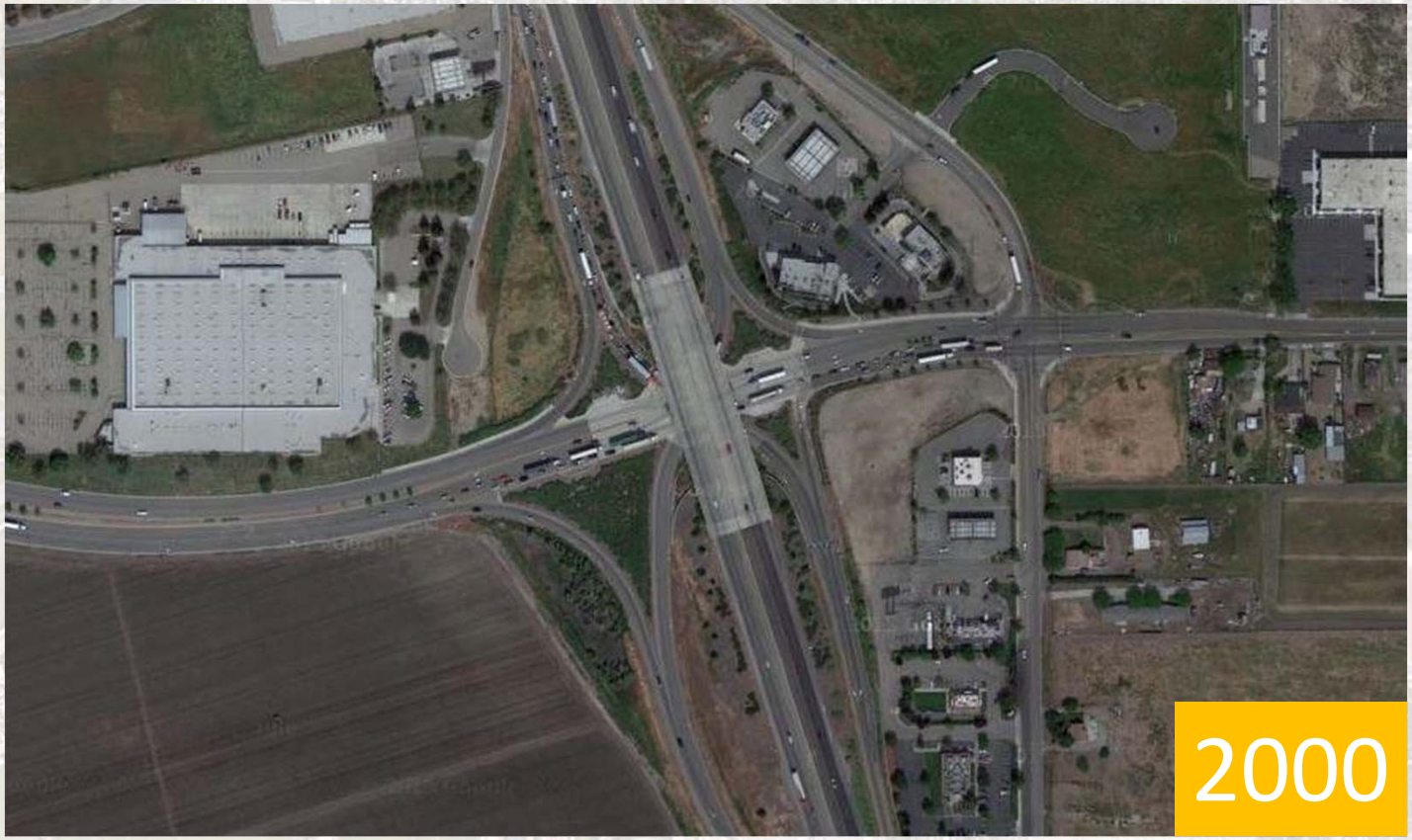
INTERCHANGE INNOVATION

INTERCHANGE INNOVATION



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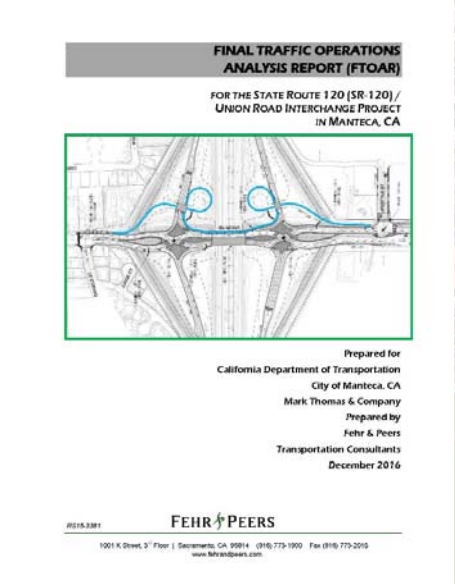
INTERCHANGE INNOVATION

INTERCHANGE INNOVATION

REVISED APPROACH

- Traffic Conditions & Forecasts
- Cost Savings through Design
- Improved Development Access
- Long Term Operational Efficiency

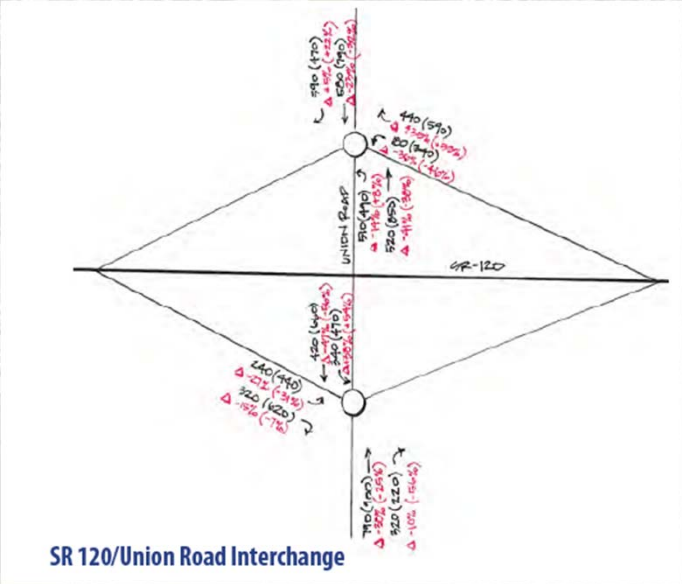


FINAL TRAFFIC OPERATIONS ANALYSIS REPORT (FTOAR)

FOR THE STATE ROUTE 120 (SR-120) / UNION ROAD INTERCHANGE PROJECT IN MANTECA, CA

Prepared for
California Department of Transportation
City of Manteca, CA
Mark Thomas & Company
Prepared by
Fehr & Peers
Transportation Consultants
December 2016

FEHR & PEERS



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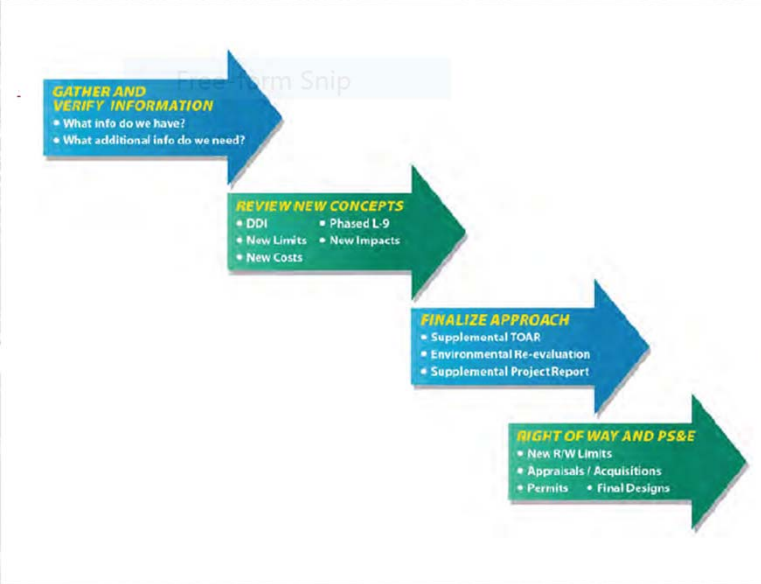

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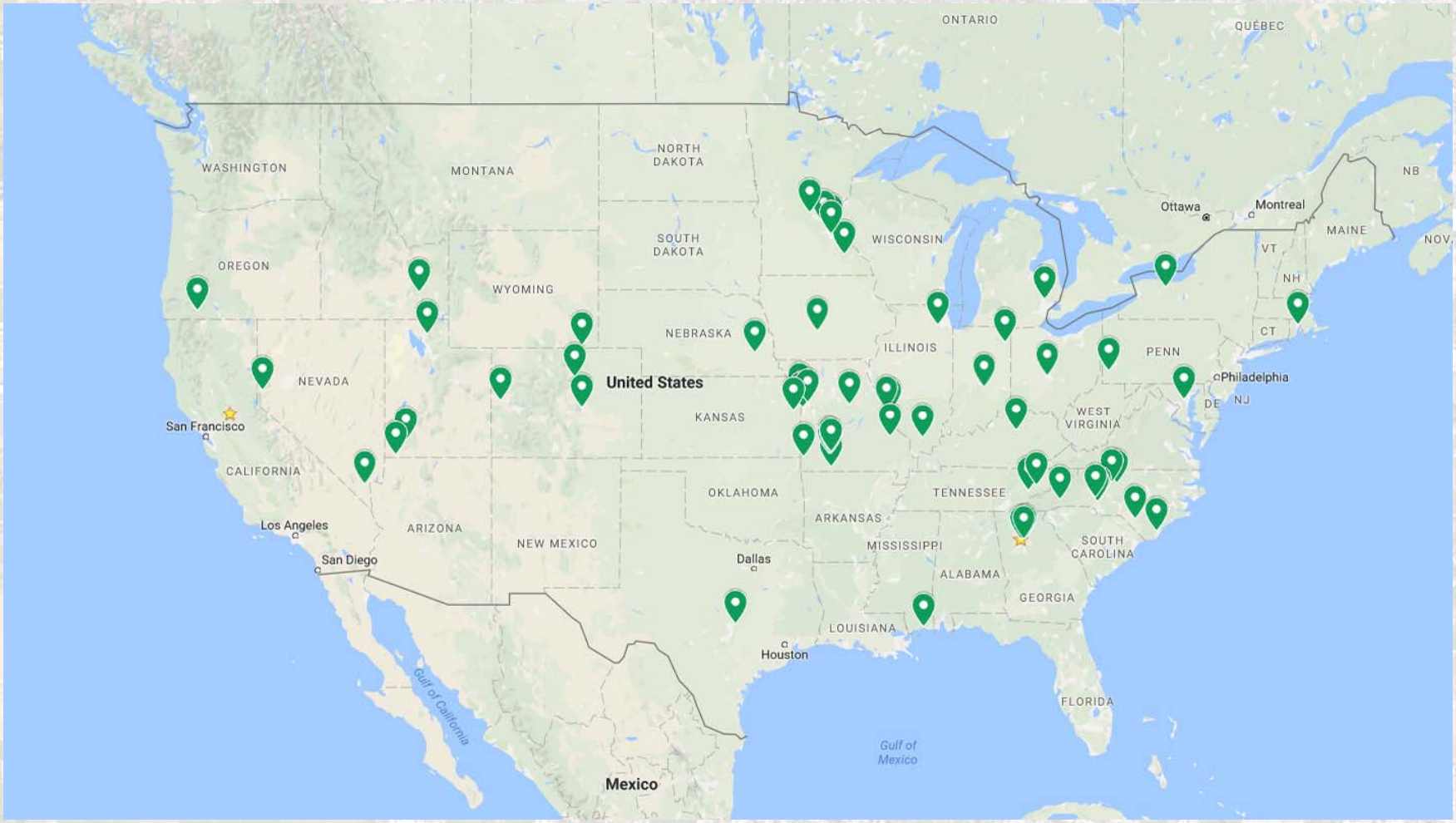

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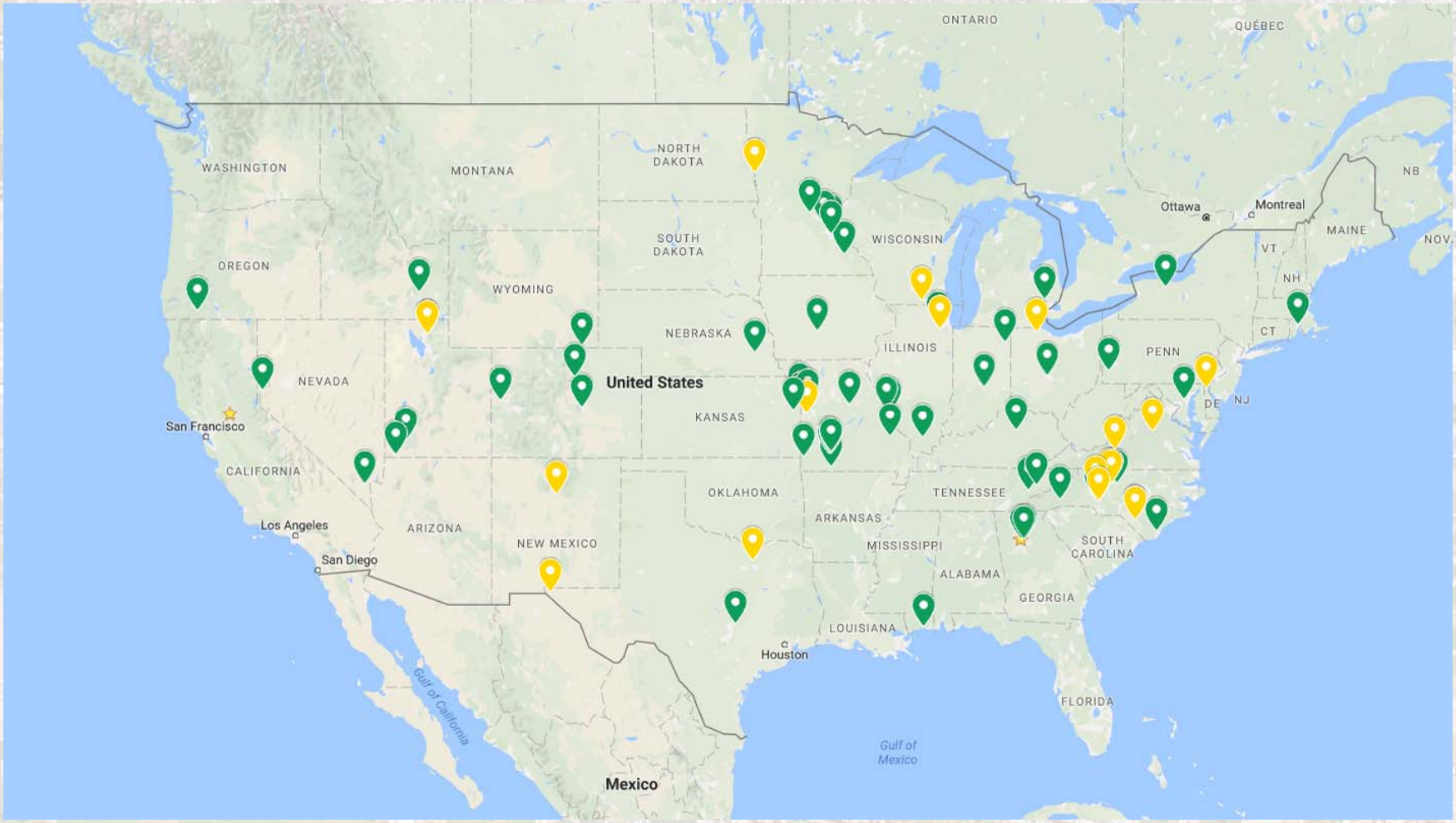

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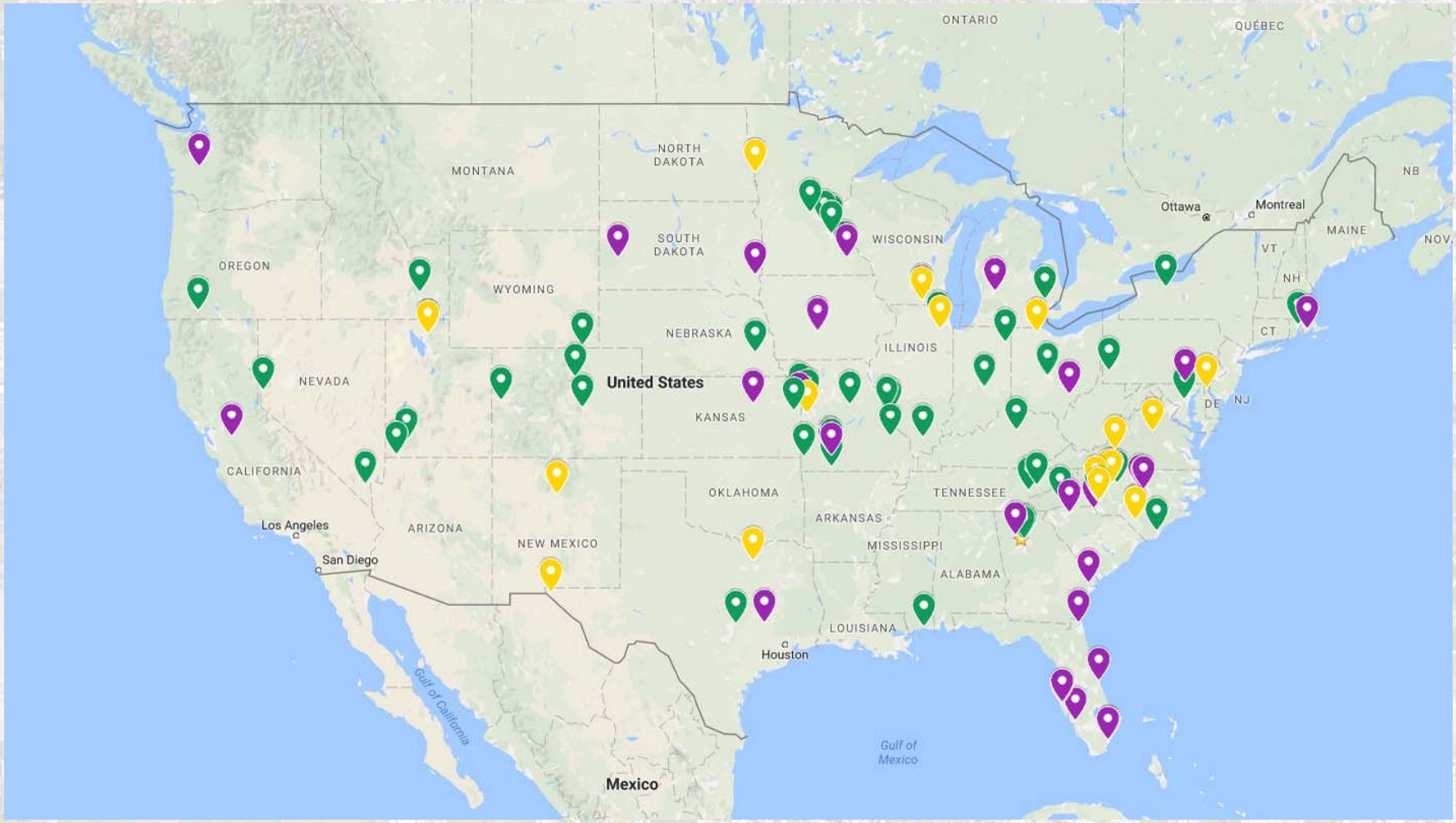

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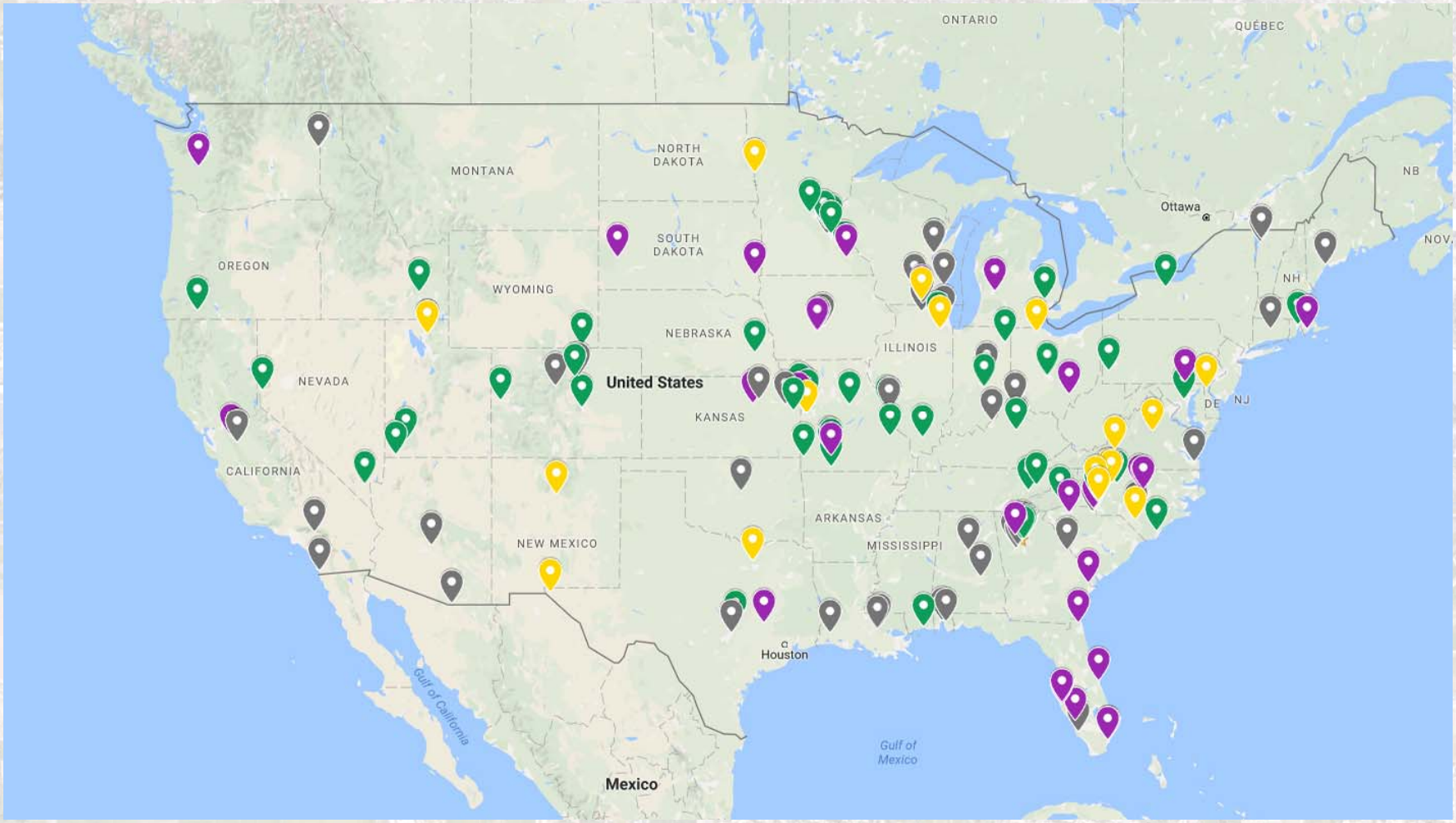

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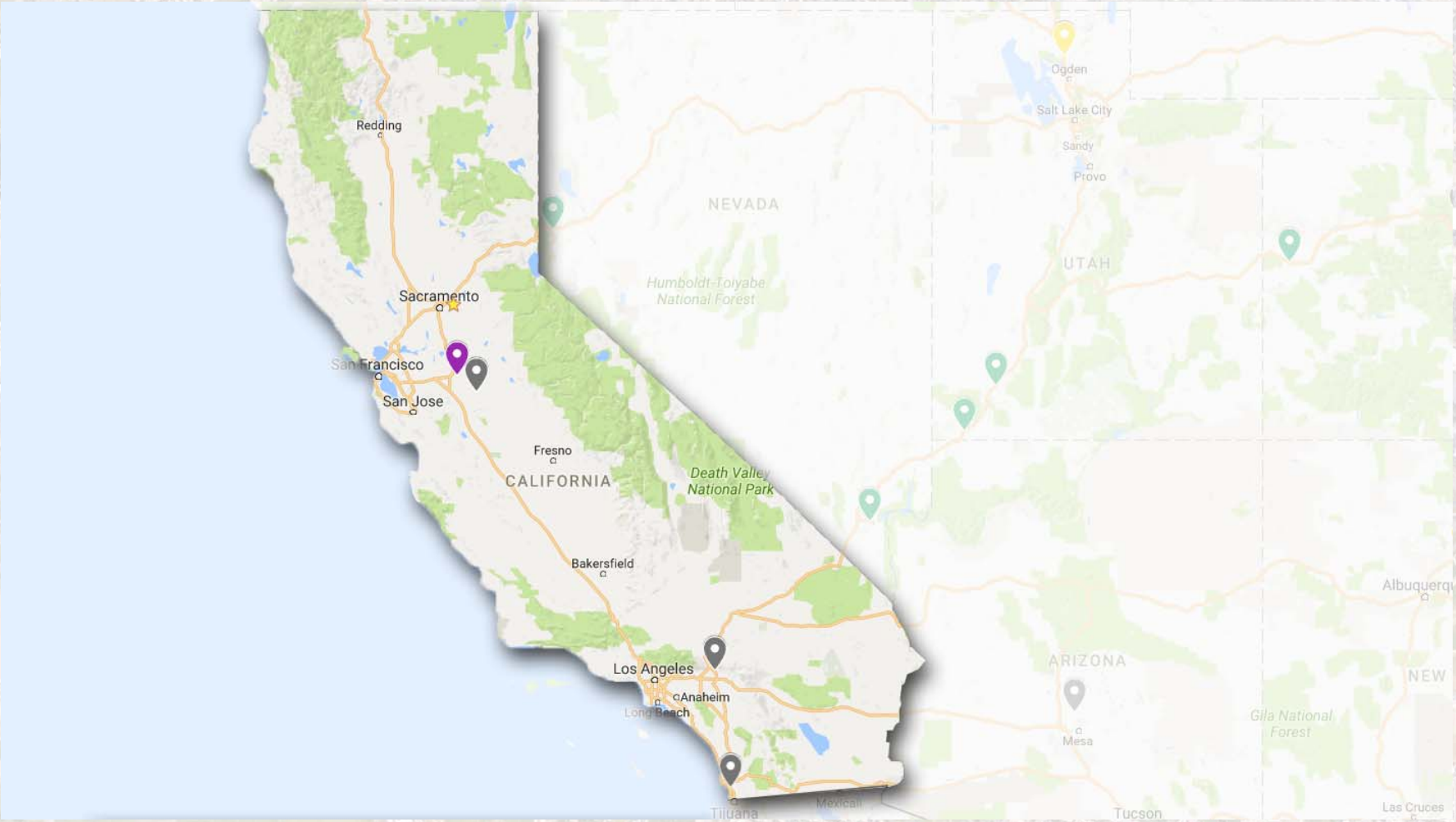

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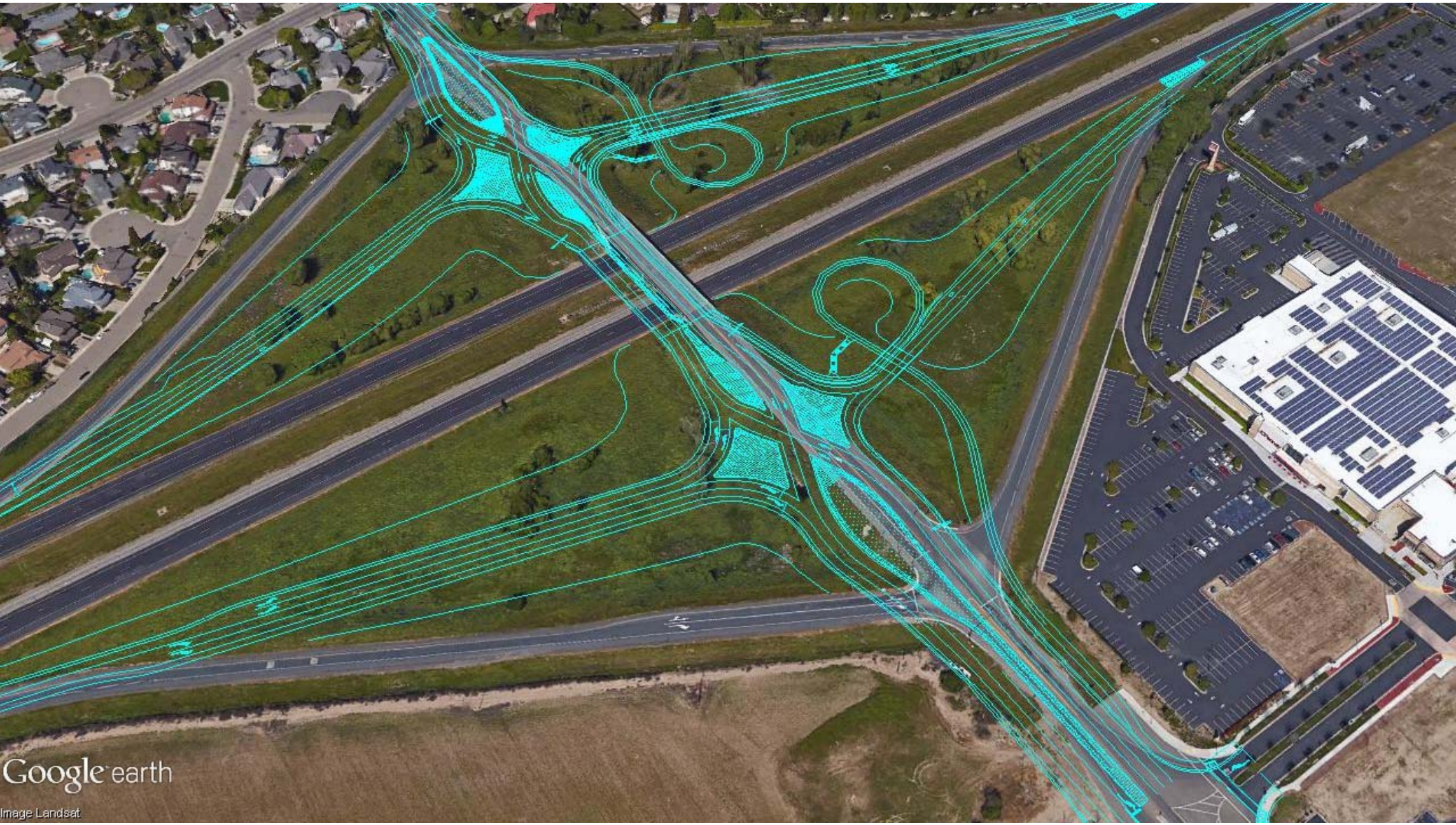
AIRPORT WAY
UNION ROAD
MAIN STREET
CALIFORNIA
120
Google earth
Image Landsat


Image Landsat
Google earth


Google earth
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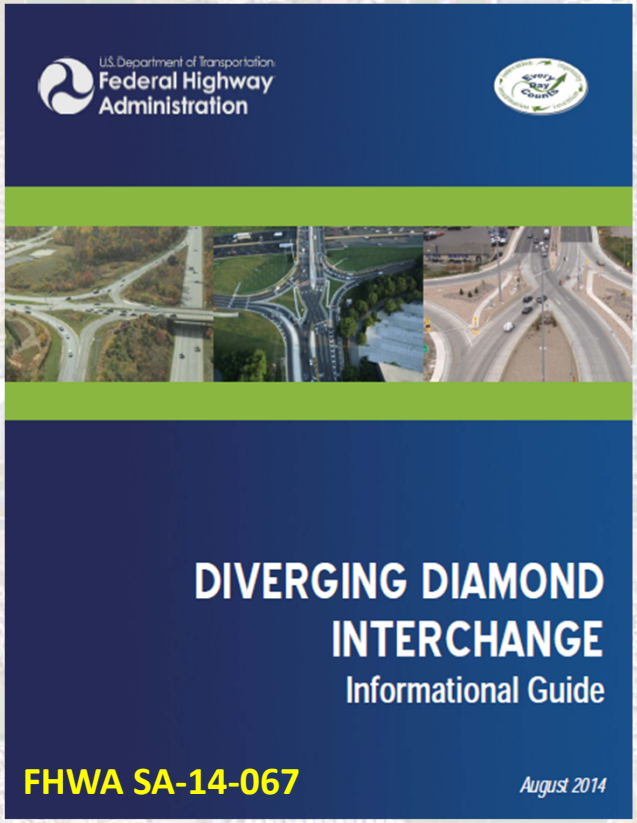
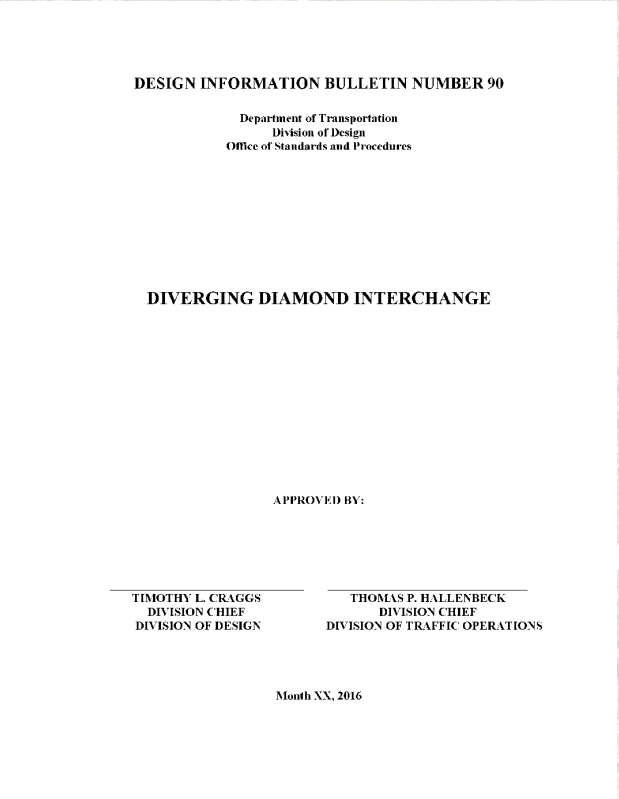




DESIGN INFORMATION BULLETIN NUMBER 90

Department of Transportation
Division of Design
Office of Standards and Procedures

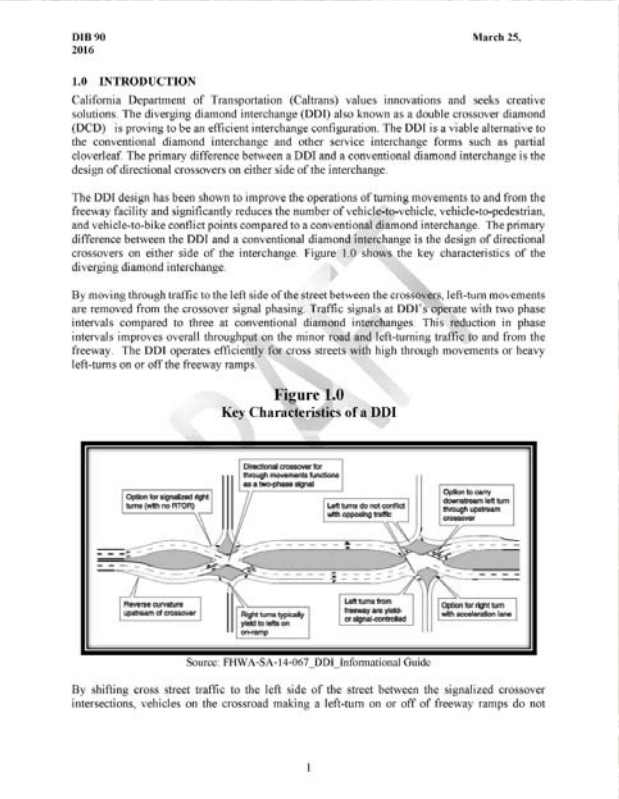
DIVERGING DIAMOND INTERCHANGE

APPROVED BY:

TIMOTHY L. CRAGGS
DIVISION CHIEF
DIVISION OF DESIGN

THOMAS P. HALLENBECK
DIVISION CHIEF
DIVISION OF TRAFFIC OPERATIONS

Month XX, 2016



DIB 90 **March 25, 2016**

1.0 INTRODUCTION

California Department of Transportation (Caltrans) values innovations and seeks creative solutions. The diverging diamond interchange (DDI) also known as a double crossover diamond (DCD) is proving to be an efficient interchange configuration. The DDI is a viable alternative to the conventional diamond interchange and other service interchange forms such as partial cloverleaf. The primary difference between a DDI and a conventional diamond interchange is the design of directional crossovers on either side of the interchange.

The DDI design has been shown to improve the operations of turning movements to and from the freeway facility and significantly reduces the number of vehicle-to-vehicle, vehicle-to-pedestrian, and vehicle-to-bike conflict points compared to a conventional diamond interchange. The primary difference between the DDI and a conventional diamond interchange is the design of directional crossovers on either side of the interchange. Figure 1.0 shows the key characteristics of the diverging diamond interchange.

By moving through traffic to the left side of the street between the crossovers, left-turn movements are removed from the crossover signal phasing. Traffic signals at DDI's operate with two phase intervals compared to three at conventional diamond interchanges. This reduction in phase intervals improves overall throughput on the minor road and left-turning traffic to and from the freeway. The DDI operates efficiently for cross streets with high through movements or heavy left-turns on or off the freeway ramps.

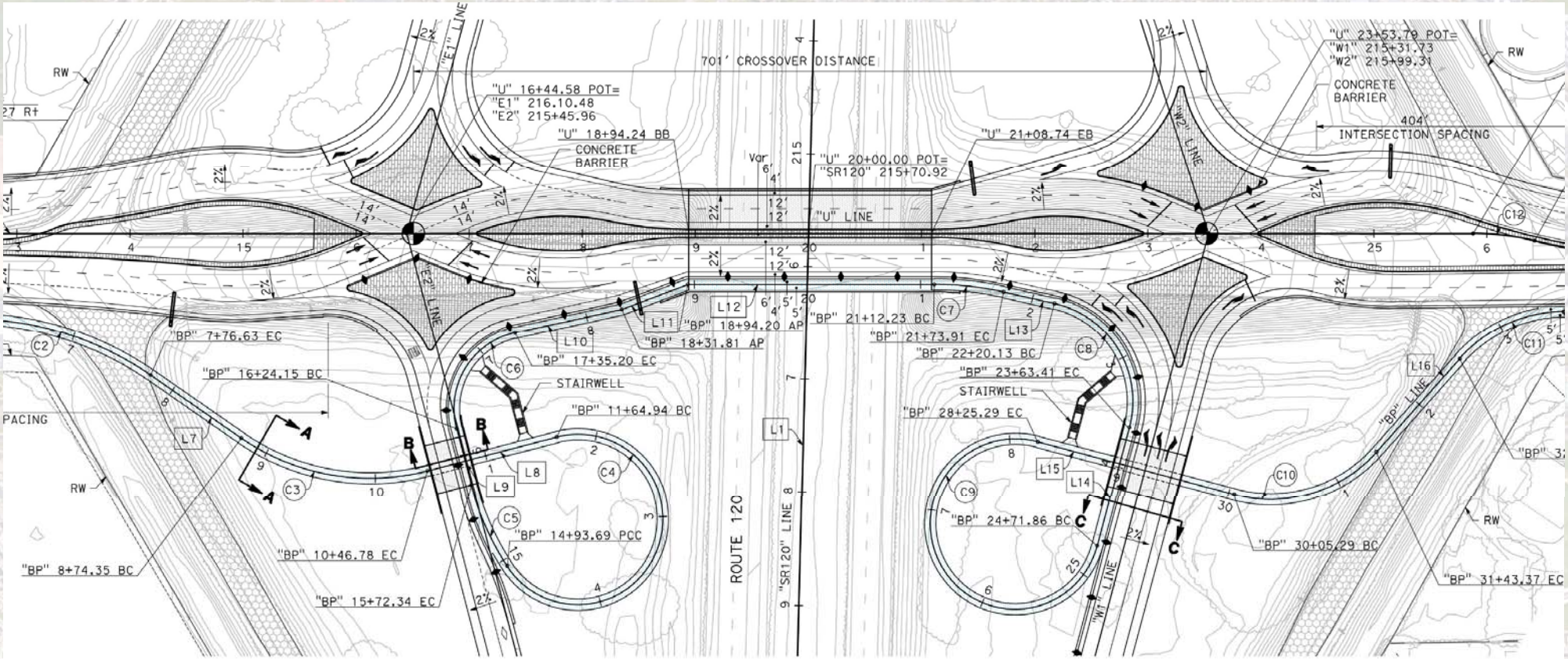
Figure 1.0
Key Characteristics of a DDI

Source: FHWA-SA-14-067_DDI_Informational Guide

By shifting cross street traffic to the left side of the street between the signalized crossover intersections, vehicles on the crossroad making a left-turn on or off of freeway ramps do not

1

TRAFFIC OPERATIONS



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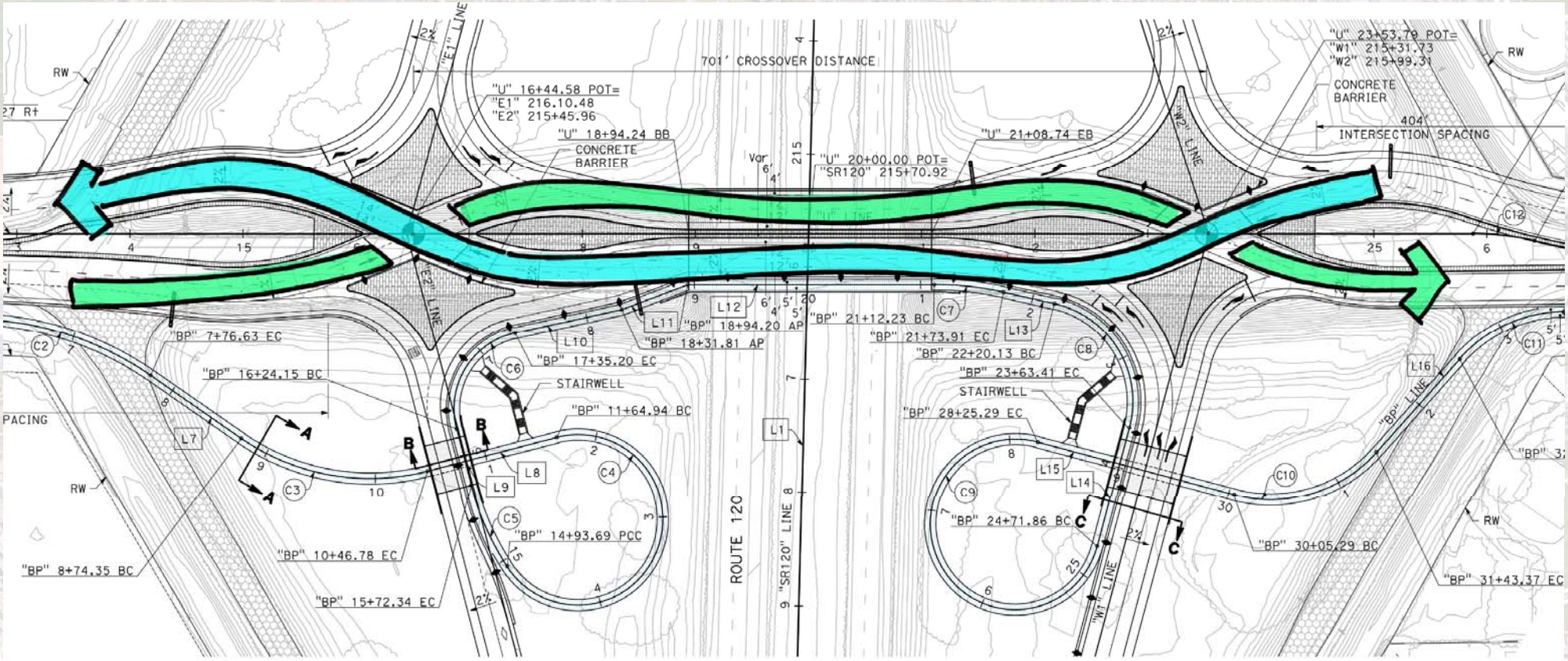
TRAFFIC OPERATIONS



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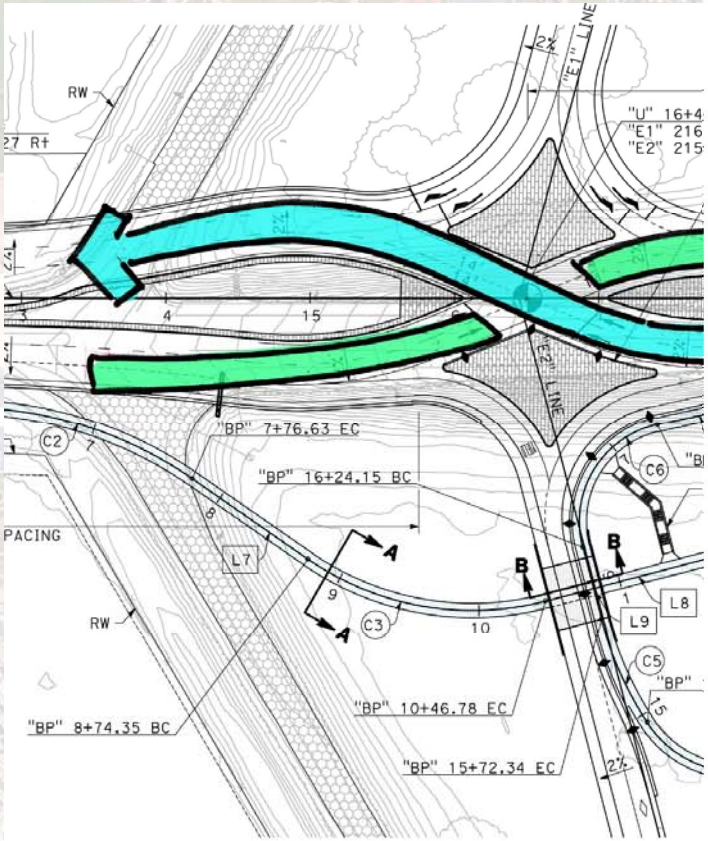
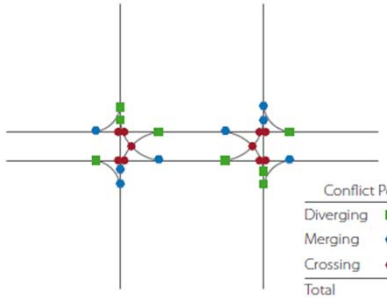
TRAFFIC OPERATIONS

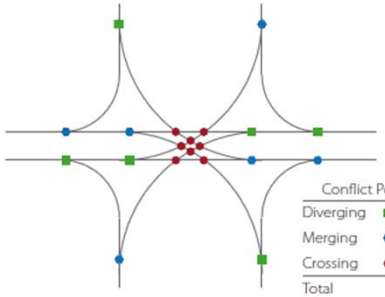


Diamond interchange



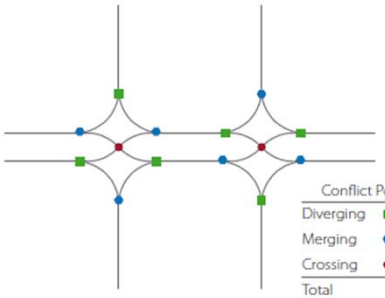
Conflict Points	
Diverging	8
Merging	8
Crossing	10
Total	26

SPUI interchange

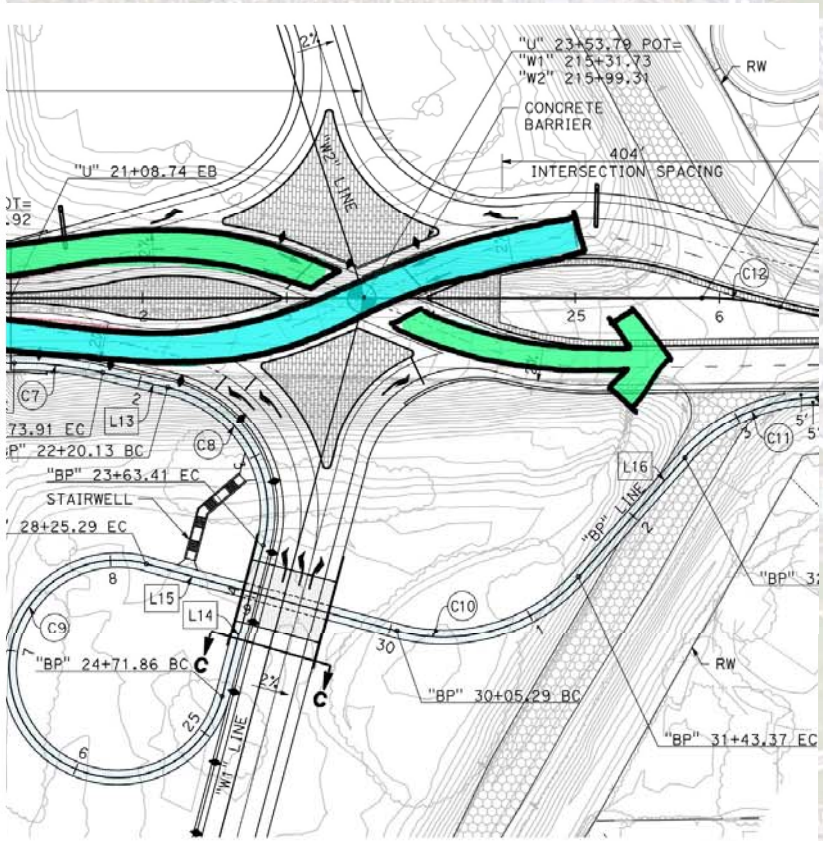


Conflict Points	
Diverging	6
Merging	6
Crossing	8
Total	20

DDI interchange



Conflict Points	
Diverging	6
Merging	6
Crossing	2
Total	14



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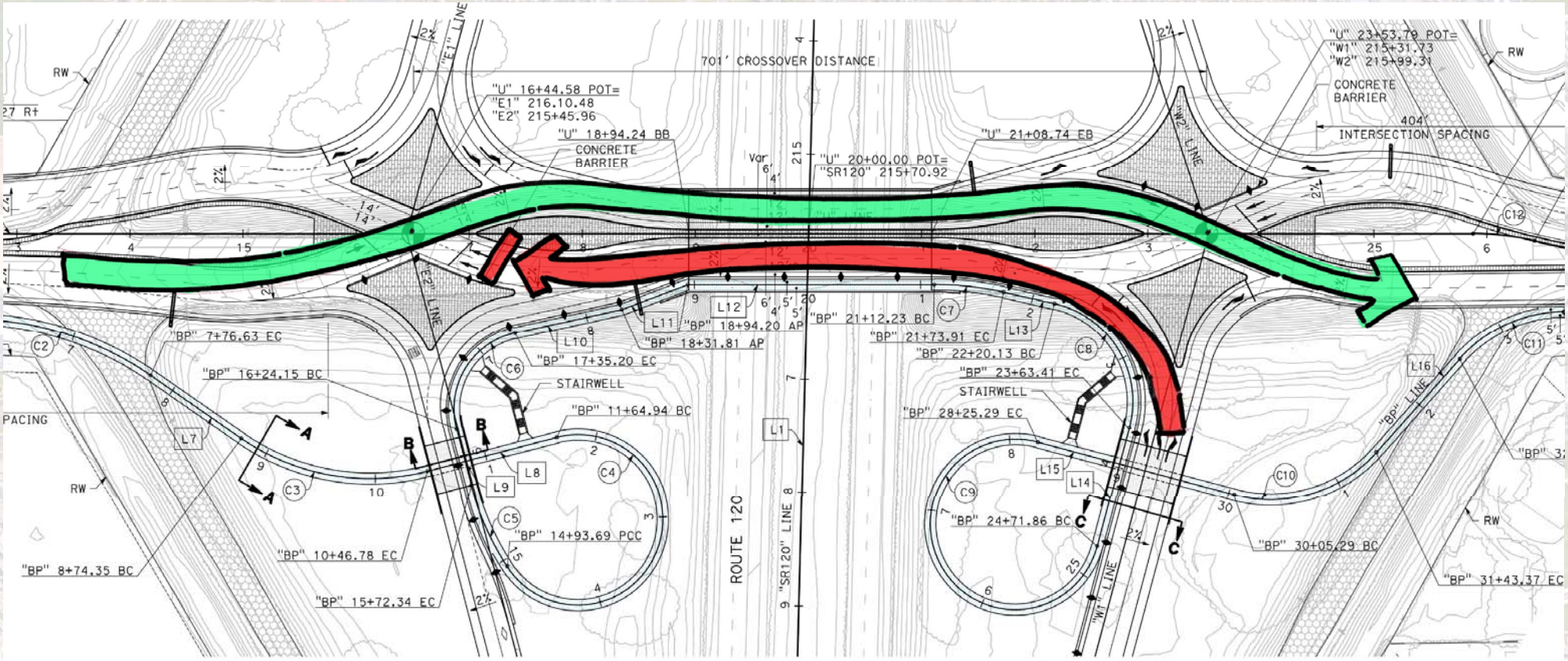
CROSS STREET PRIORITY



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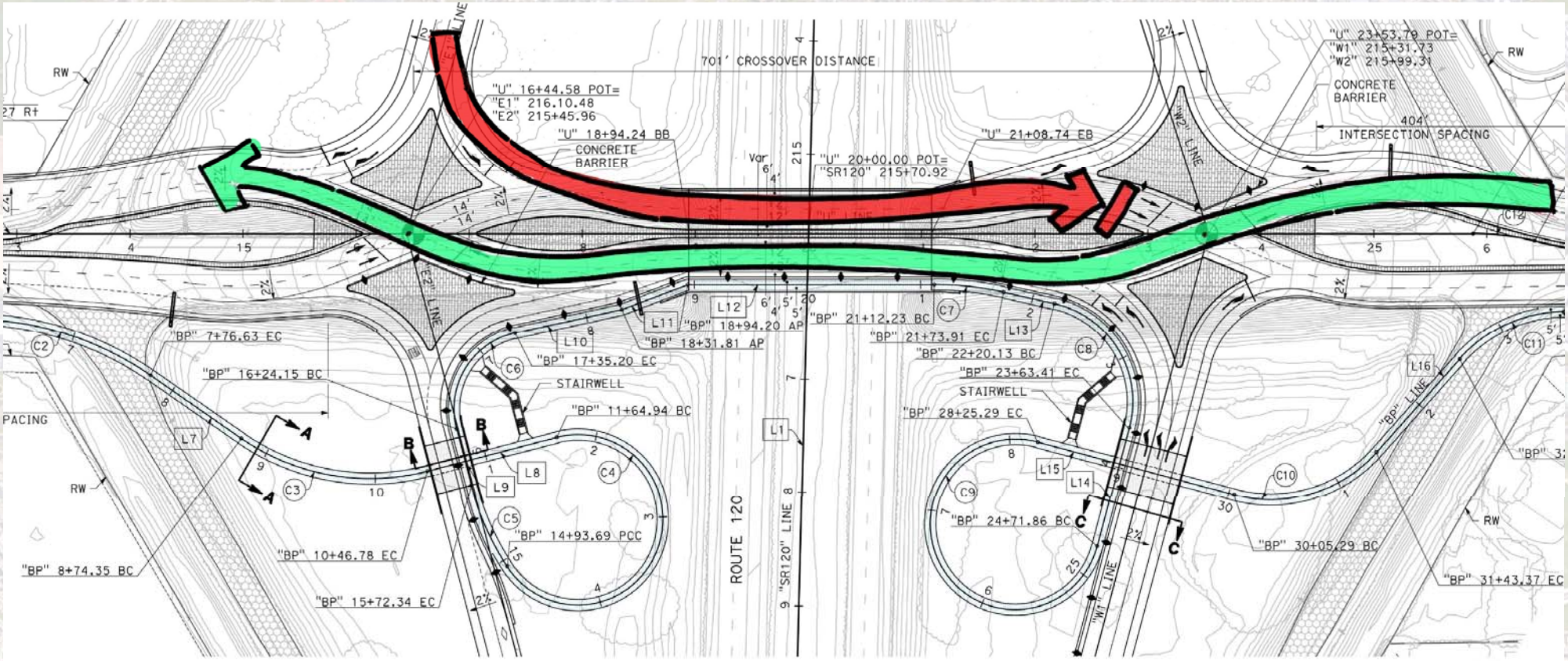

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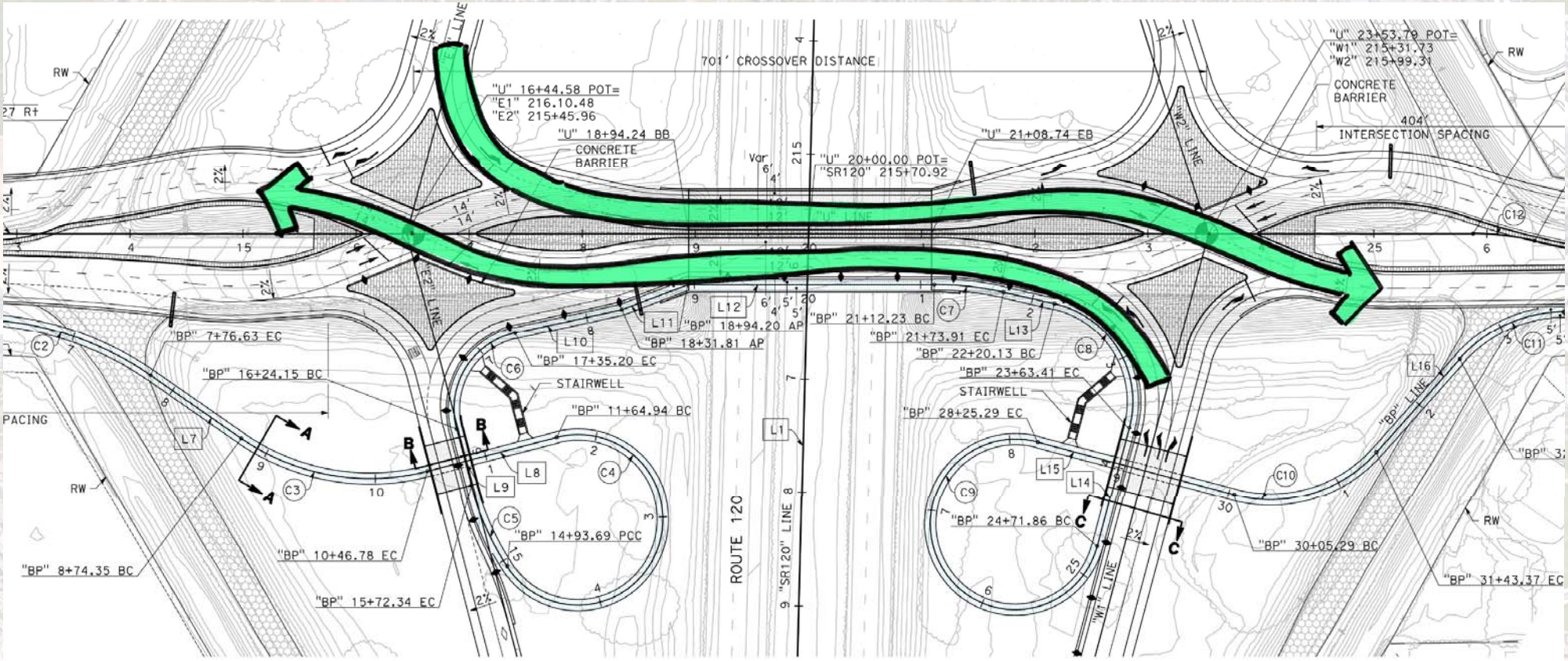
RAMP PRIORITY



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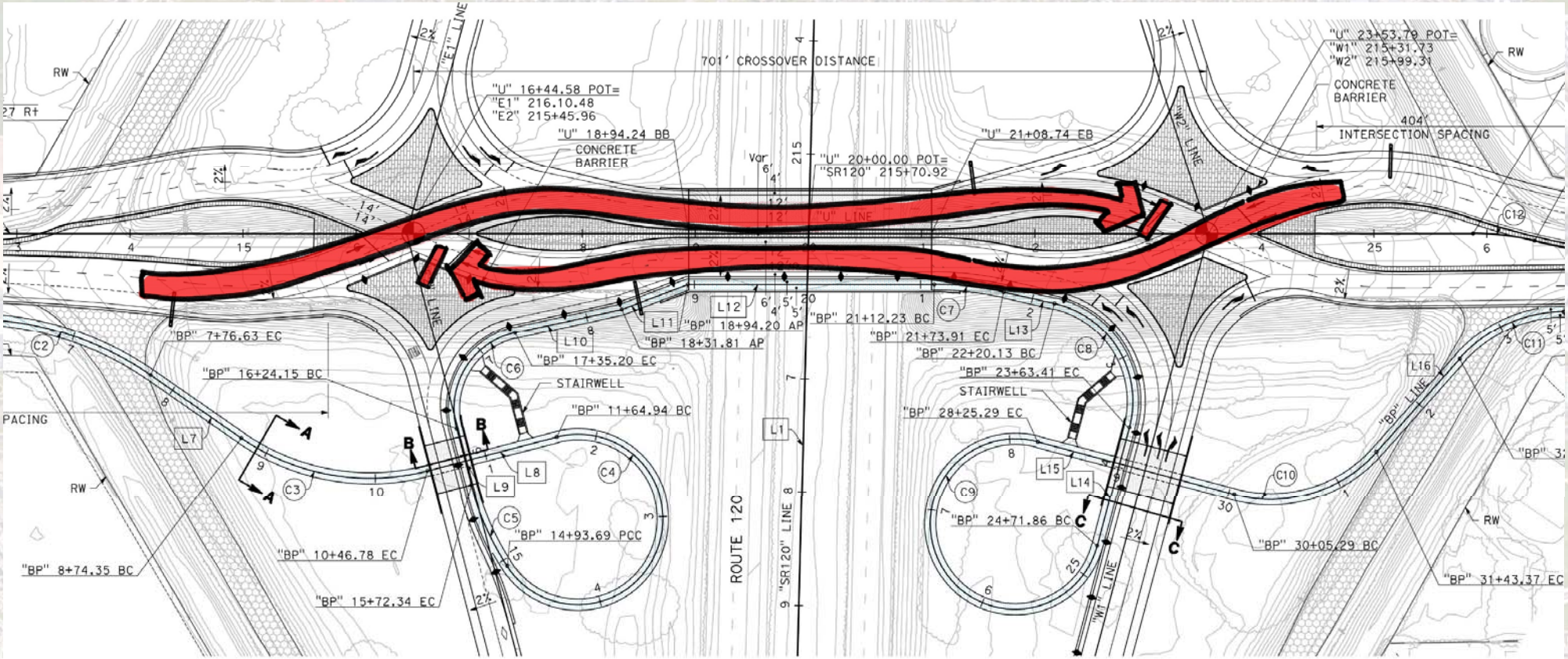
RAMP PRIORITY



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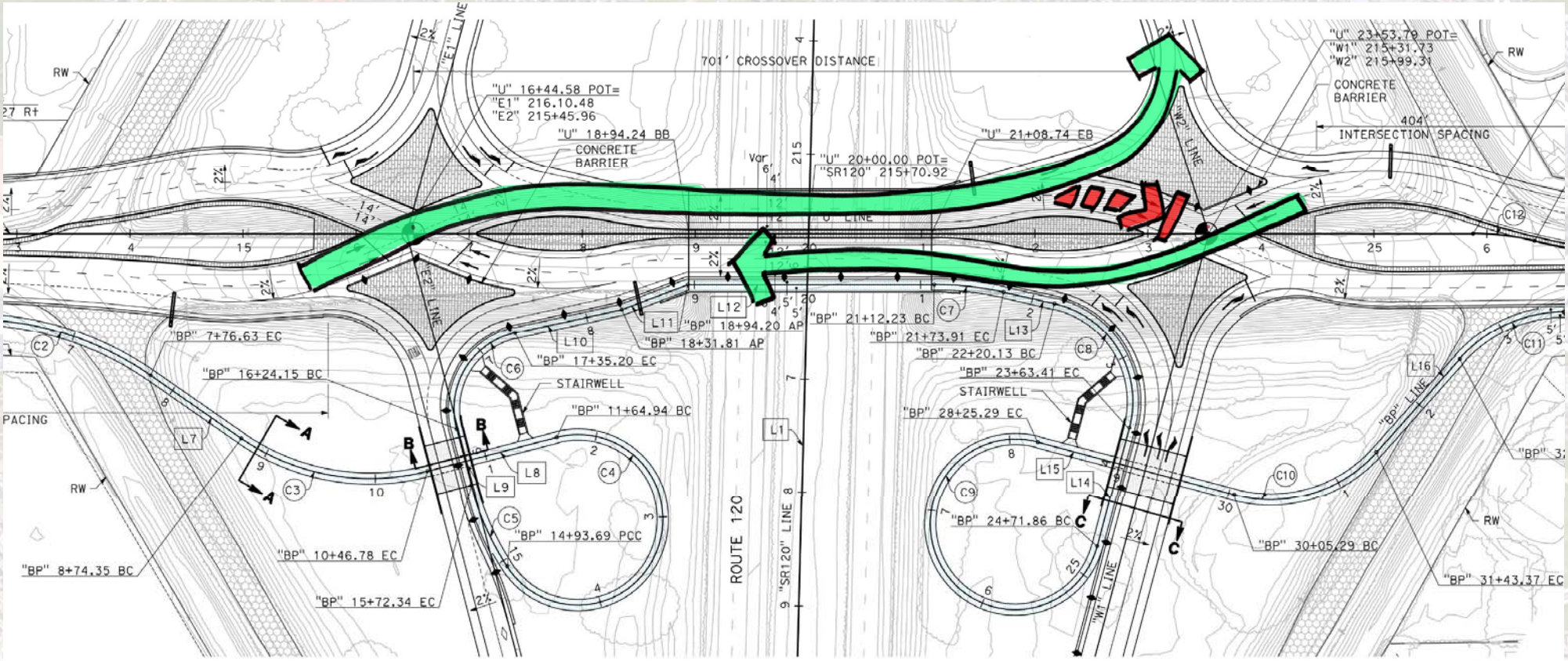
PEAK HOUR TRAFFIC



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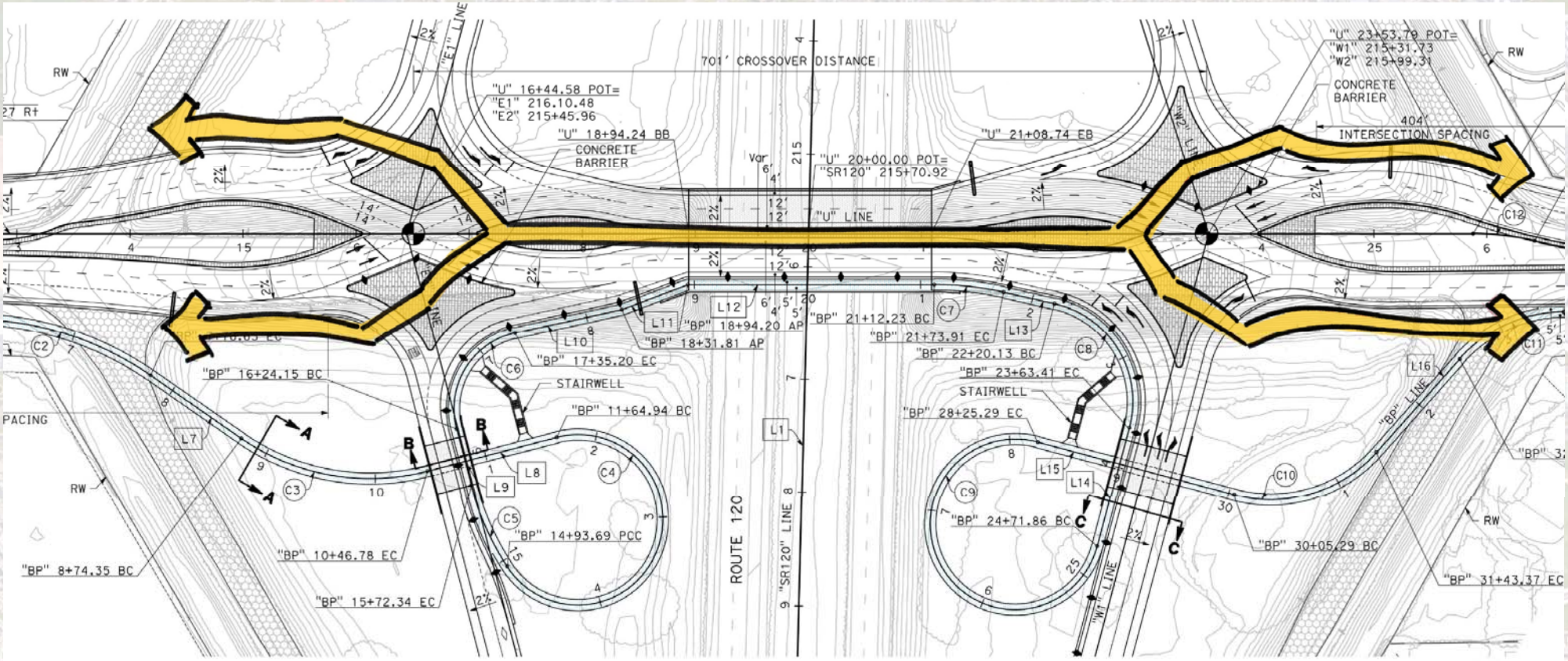
PEDESTRIAN CIRCULATION



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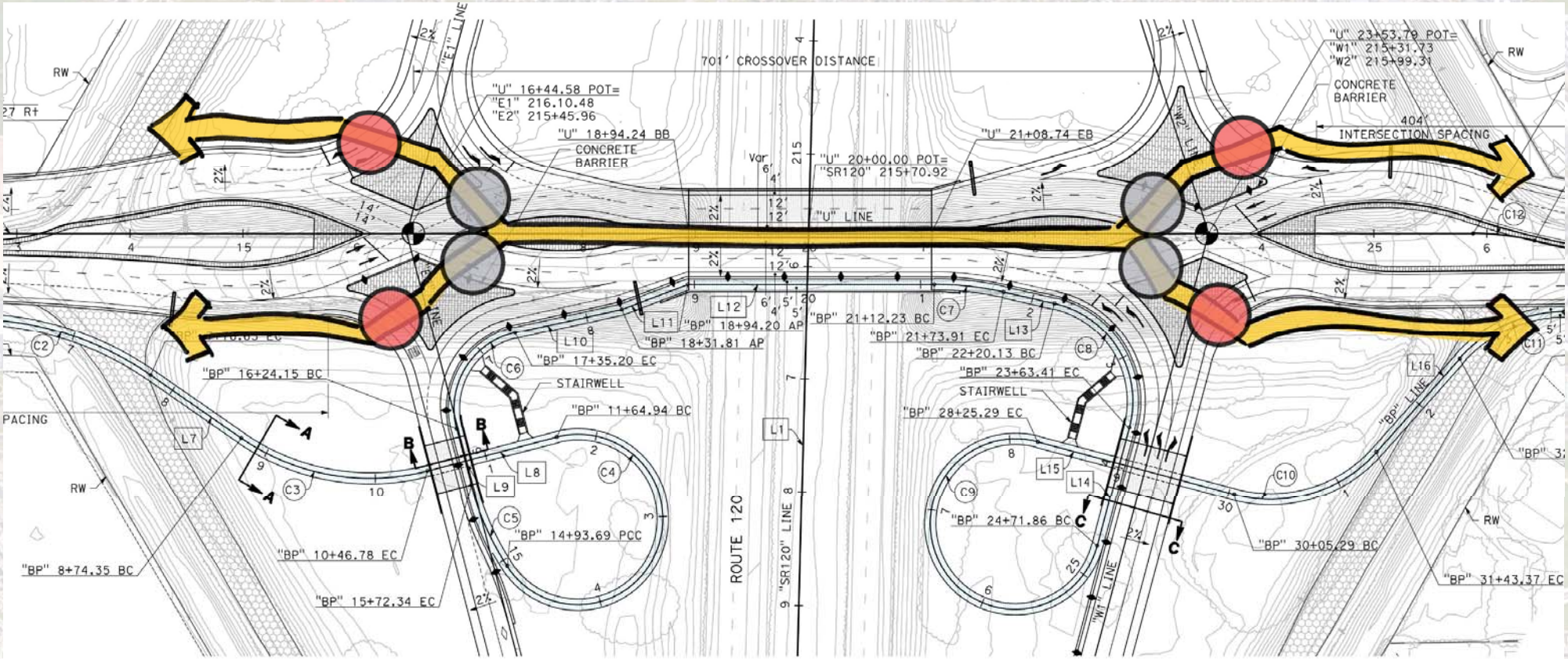
PEDESTRIAN CIRCULATION



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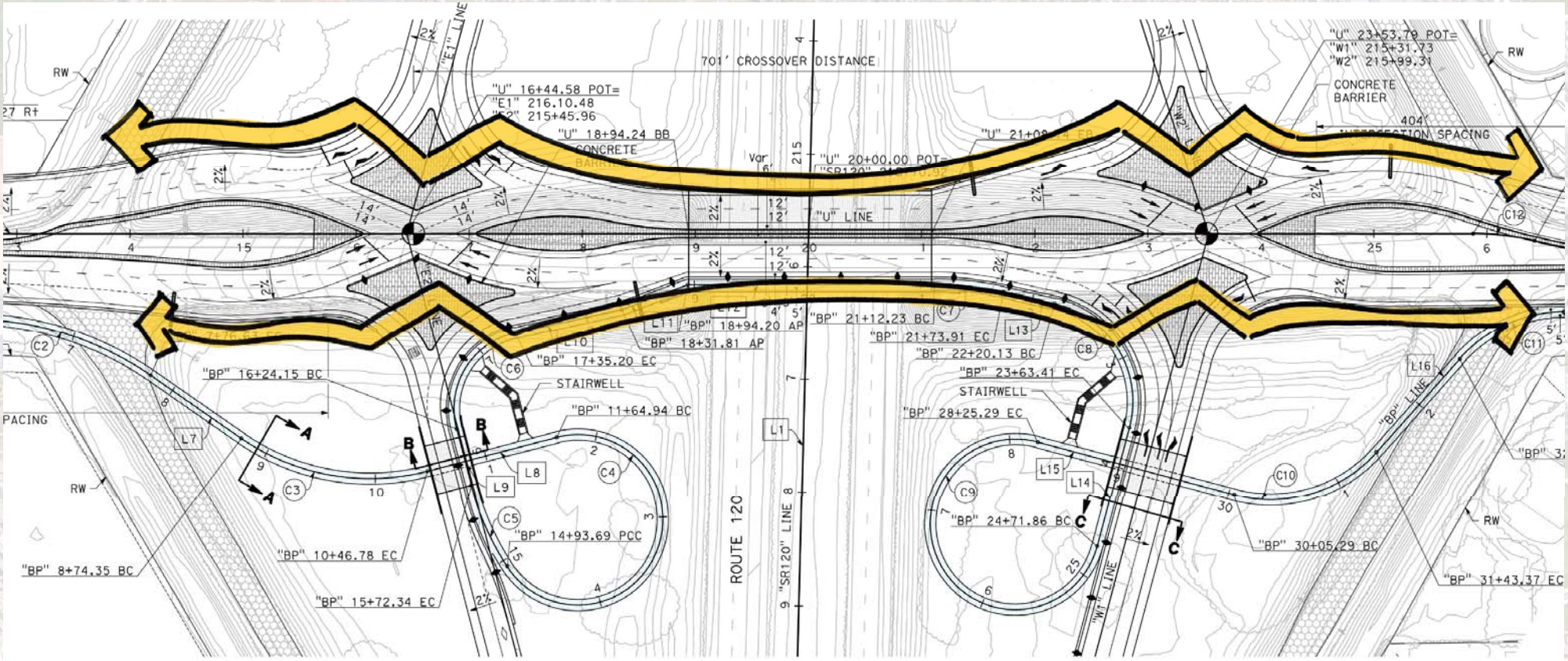
PEDESTRIAN CIRCULATION



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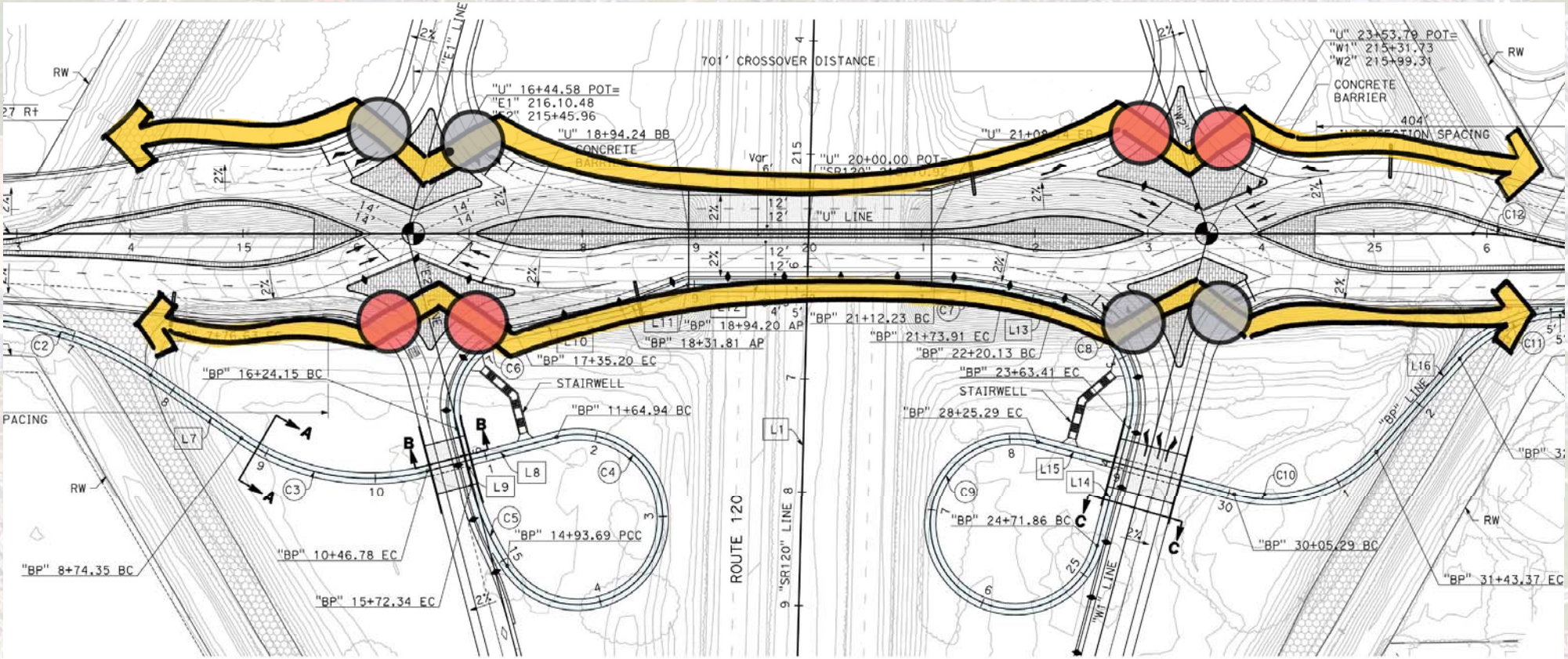
PEDESTRIAN CIRCULATION



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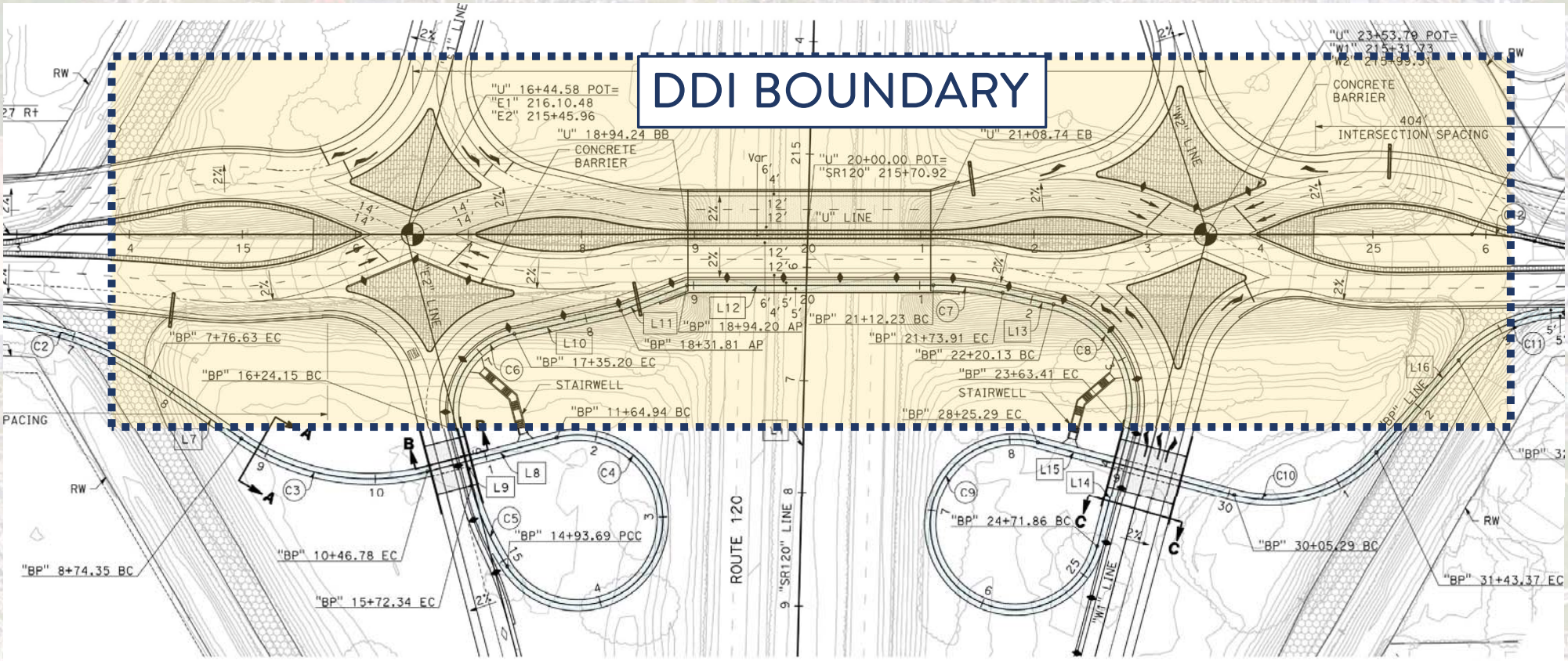
GEOMETRIC DESIGN CRITERIA



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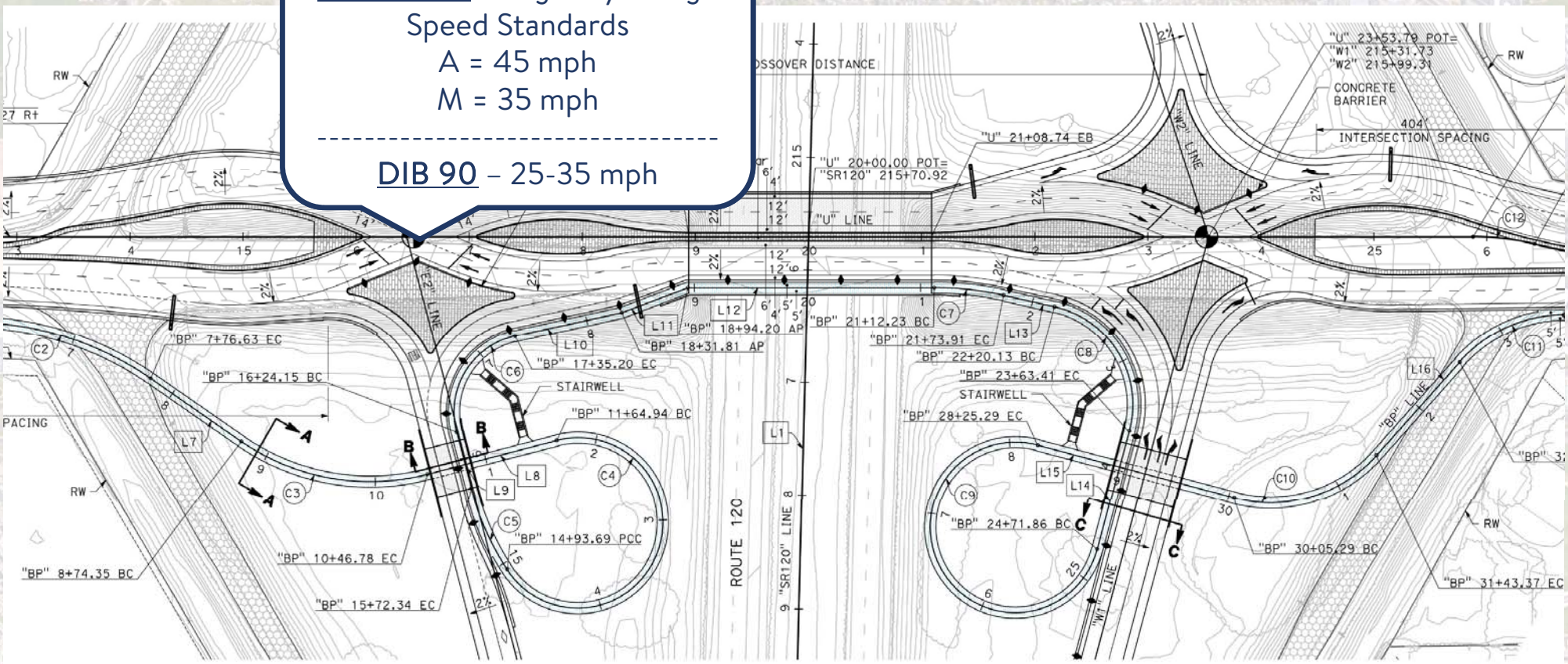
GEOMETRIC DESIGN CRITERIA

HDM 101.2 – Highway Design Speed Standards
A = 45 mph
M = 35 mph

DIB 90 – 25-35 mph



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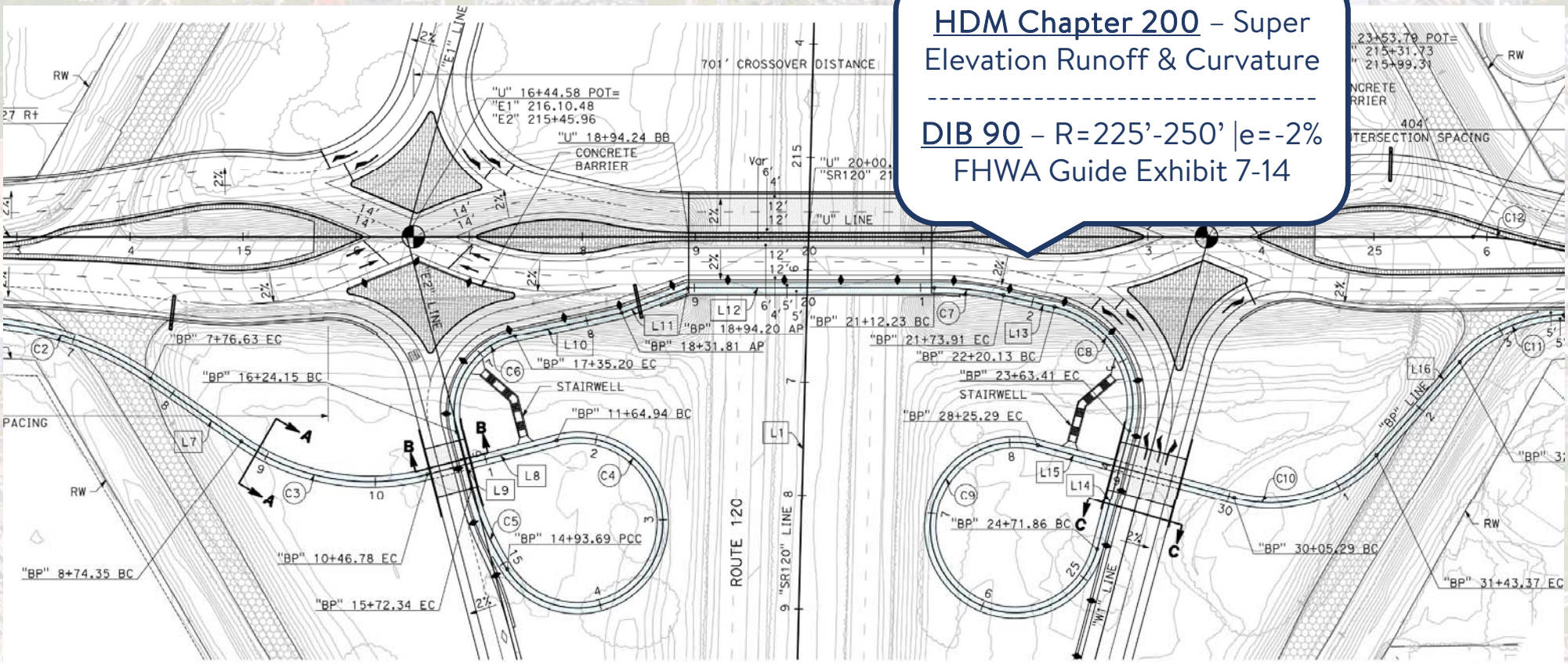

HDM Chapter 200 – Super Elevation Runoff & Curvature

DIB 90 – R=225'-250' |e=-2%
FHWA Guide Exhibit 7-14

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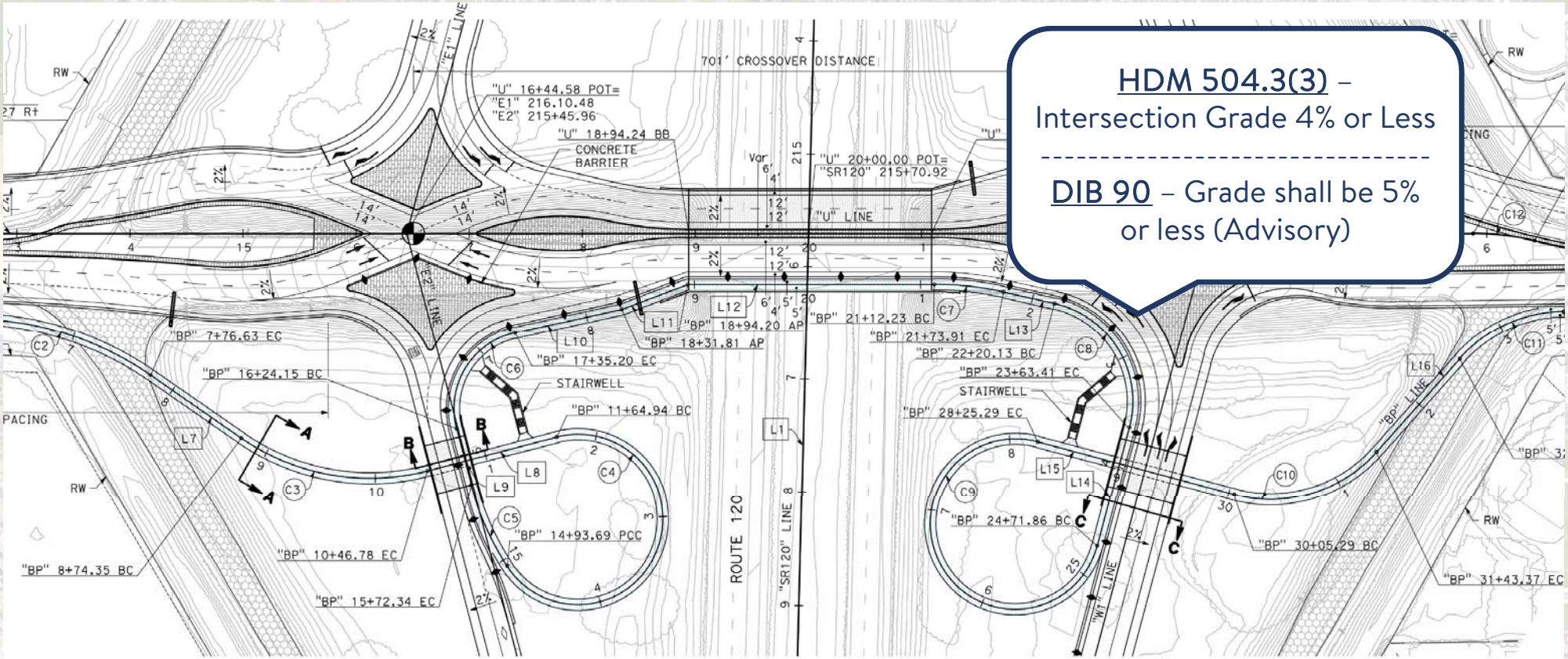
GEOMETRIC DESIGN CRITERIA



HDM 504.3(3) – Intersection Grade 4% or Less

DIB 90 – Grade shall be 5% or less (Advisory)

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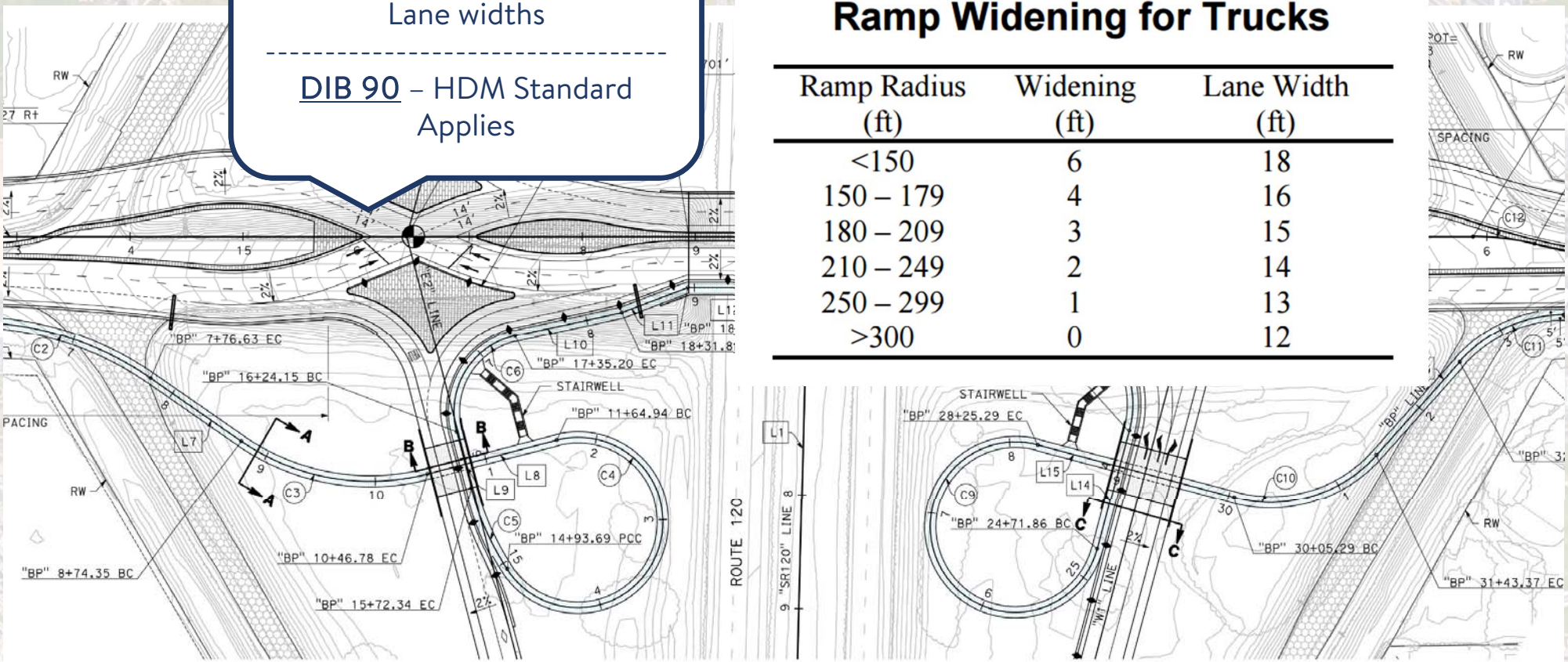
GEOMETRIC DESIGN CRITERIA

HDM 301.1 and Table 504.3 – Lane widths

DIB 90 – HDM Standard Applies

Table 504.3
Ramp Widening for Trucks

Ramp Radius (ft)	Widening (ft)	Lane Width (ft)
<150	6	18
150 – 179	4	16
180 – 209	3	15
210 – 249	2	14
250 – 299	1	13
>300	0	12



GEOMETRIC DESIGN CRITERIA

HDM 1003.1 (8A) – Bike Paths shall not be placed in median of a Local Roadway

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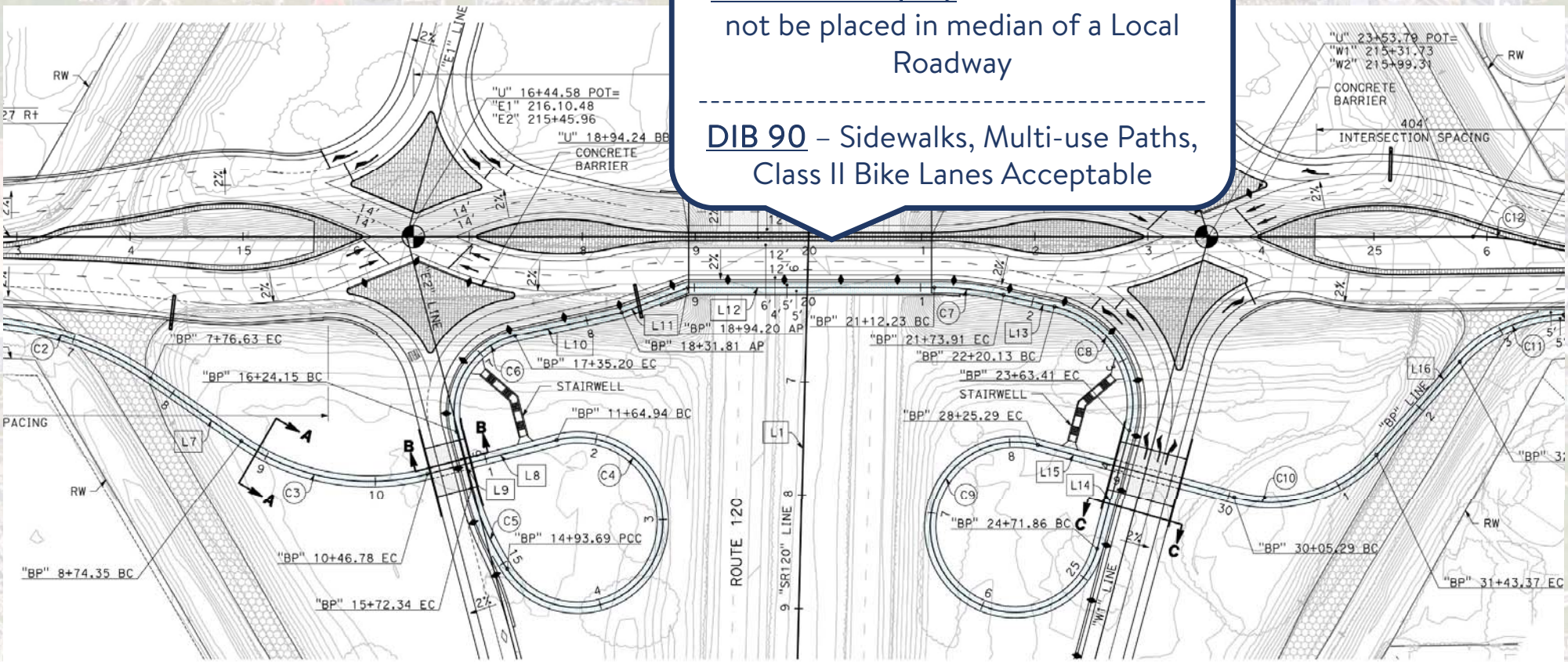
DIB 90 – Sidewalks, Multi-use Paths, Class II Bike Lanes Acceptable



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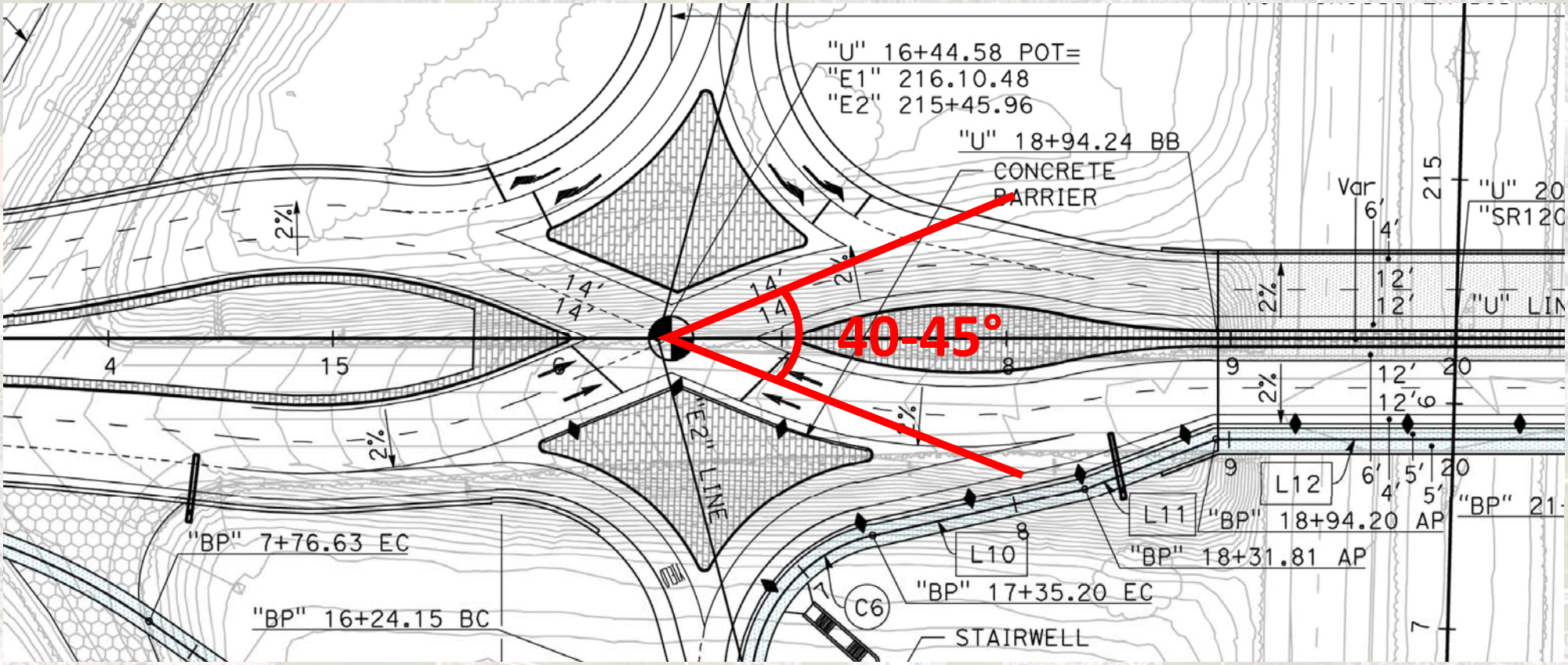

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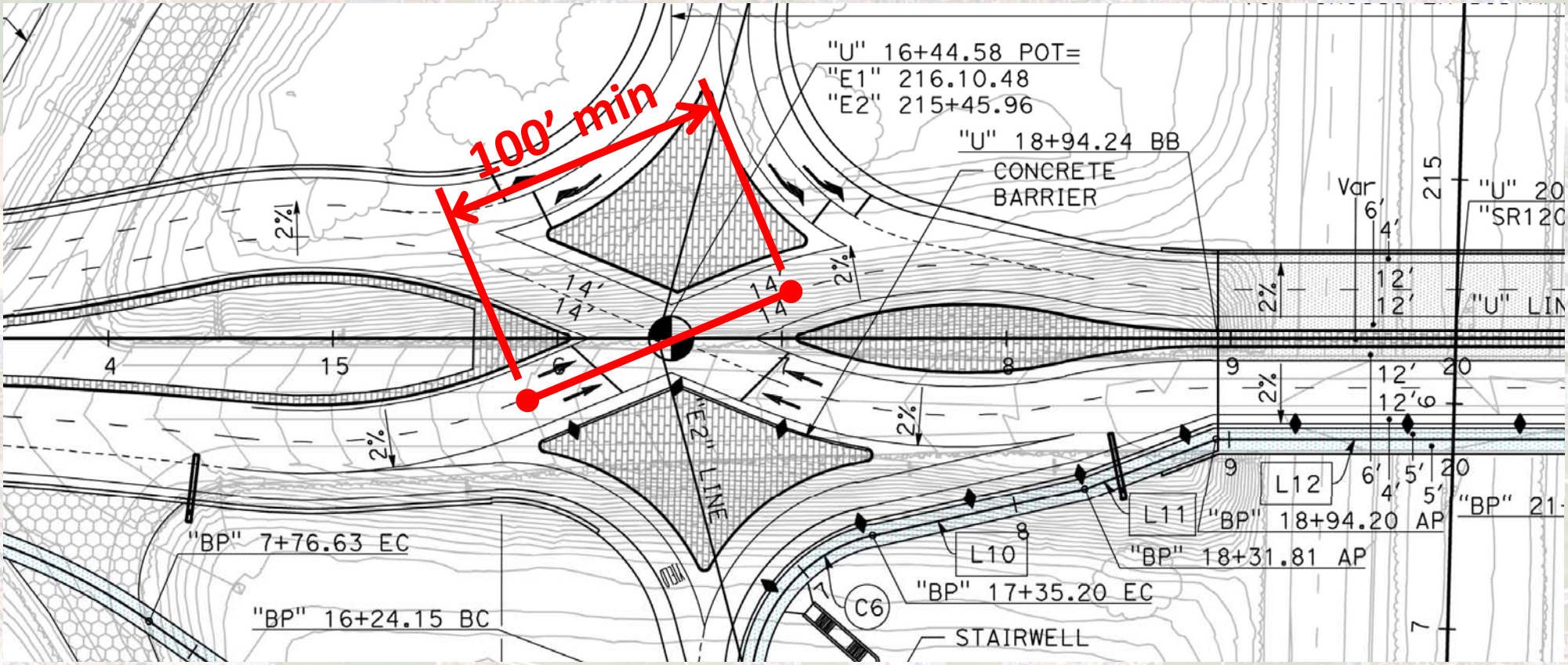


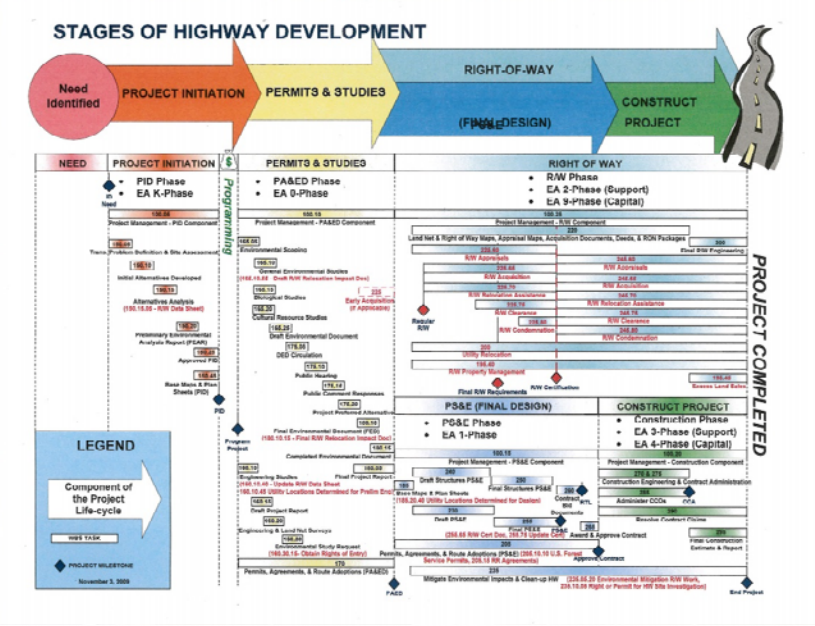
SR120/Union Road Interchange

LESSONS LEARNED

		Strength	Weakness	
Safety	1	●		Fewer collisions than traditional interchanges
	2	●		Reduced collision severity versus traditional interchanges
	3	●		Reduced numbed of conflict points, especially crossing conflicts
	4	●		Medians and curves provide traffic calming
	5	●		Highly functional during power outage
	6	●		Limits wrong way movement potential for highway ramps
	7		●	Wrong way potential exists for crossover movement
	8		●	Potential headlight glare from opposing traffic
Traffic Operations	9	●		Increase in turn movement capacities, decreases congestion
	10	●		Serves high volume facilities, favors high volume turn movements
	11	●		2-phase signal operation can favor peak period movements
	12	●		Possibility of shortened cycle lengths
	13	●		Increased green time
	14	●		Accomodates u-turns from highway
	15		●	Higher failure potential, especially with short crossover distance & high crossroad through traffic
	16		●	Not suitable for high ramp traffic with high crossroad traffic
	17		●	Locking crossover progression potential
	18		●	Difficult crossroad progression
	19		●	Through movements required to use crossover lanes
	20		●	Spacing to adjacent intersection with more complex signal phasing
Cost & Impact	21	●		High delay savings per dollar expended, exceeds cost in few years
	22	●		Context sensitive (retrofit interchanges)
	23	●		Reduced cost versus bridge widening, low cost compared to SPUI
	24	●		Shorter bridge spans (pillars in middle), narrower structures
	25	●		Reduced construction time
	26	●		Free or simplified left turn movements (not out-of-direction)
	27		●	Retrofits often require auxiliary lanes
Public Perception	28	●		Drivers adapt quickly to the concept, acceptance is high
	29		●	Public confusion with new concept
	30		●	Driving on opposite side of roadway
	31		●	Free right and left movements complicate ped crossing
	32		●	Flexibility of design variations, inconsistent signing potential
Design	33	●		Short at grade pedestrian crossing
	34	●		Bikes & Pedestrians can be accommodated at grade
	35	●	●	Peds may require 2-stage crossings, refuges, structures
	36		●	Medians and vertical separators required
Bike & Ped	37	●		Relatively simple pedestrian crossing when crossing in the middle
	38		●	Complicated pedestrian crossing when crossing on the outside
Maintenance	39		●	Little space for snow storage, snow removal routes complicated

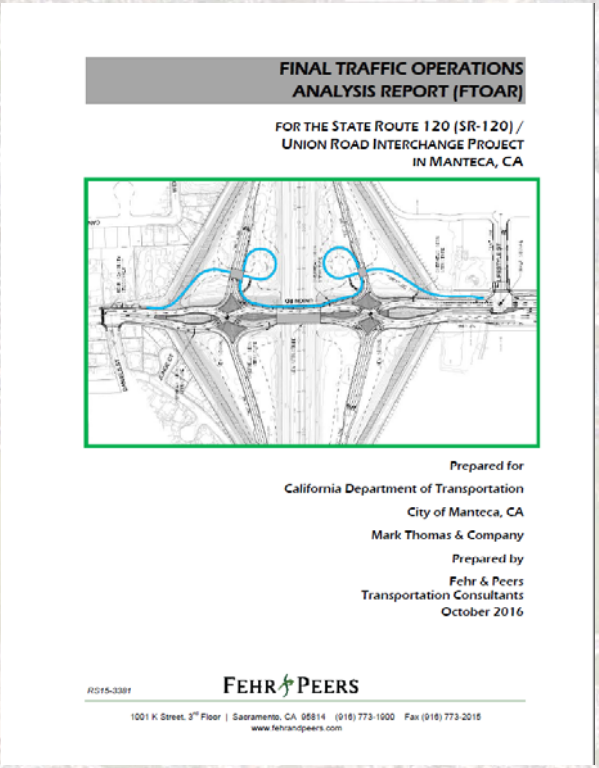
APPROVALS PROCESS WITH CALTRANS

- Caltrans is CEQA lead – Revalidation
- Caltrans will own and operate the results
- Draft DIB 90-DDI Guidelines (FHWA based)
- Caltrans wants to set the proper precedence for future DDI



PROCESS STICKING POINTS

- Traffic Operations Analysis (new counts, calibration, analysis)
- Concern over non-typical DDI pedestrian crossing
- Advisory and Mandatory Design Exceptions
- Request to install ramp metering, although not likely to be used
- Air Quality - RTP consistency (SJCOG effort to update RTP)
- Structure Type Selection
- Public Acceptance



FINAL TRAFFIC OPERATIONS ANALYSIS REPORT (FTOAR)

FOR THE STATE ROUTE 120 (SR-120) / UNION ROAD INTERCHANGE PROJECT IN MANTECA, CA

Prepared for

California Department of Transportation

City of Manteca, CA

Mark Thomas & Company

Prepared by

Fehr & Peers Transportation Consultants

October 2016

RS15-3381

FEHR & PEERS

1001 K Street, 3rd Floor | Sacramento, CA 95814 (916) 773-1000 Fax (916) 773-2015

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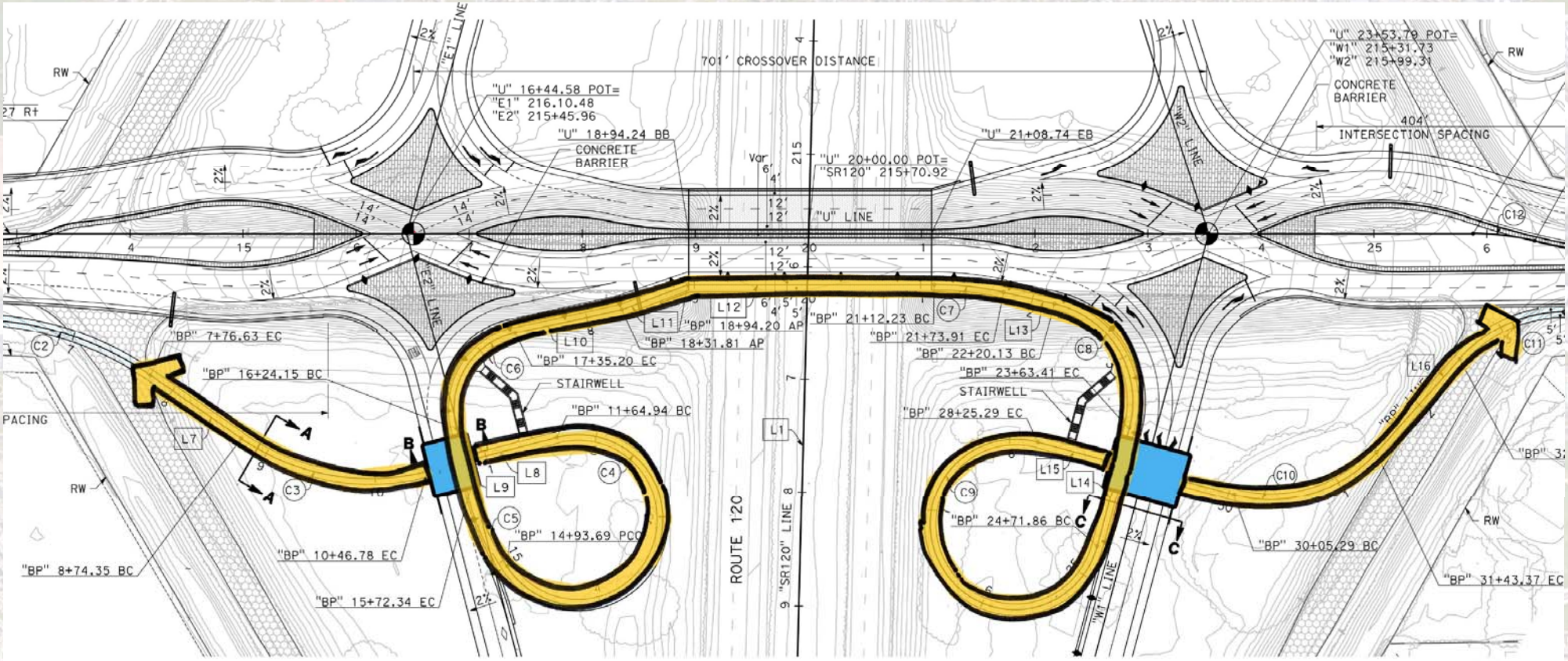
FINAL DETAILS

- Class I Bike Path/Pedestrians
- Ramp Metering
- Single Lane On-Ramp
- Stopping Sight Distance

PEDESTRIAN CIRCULATION

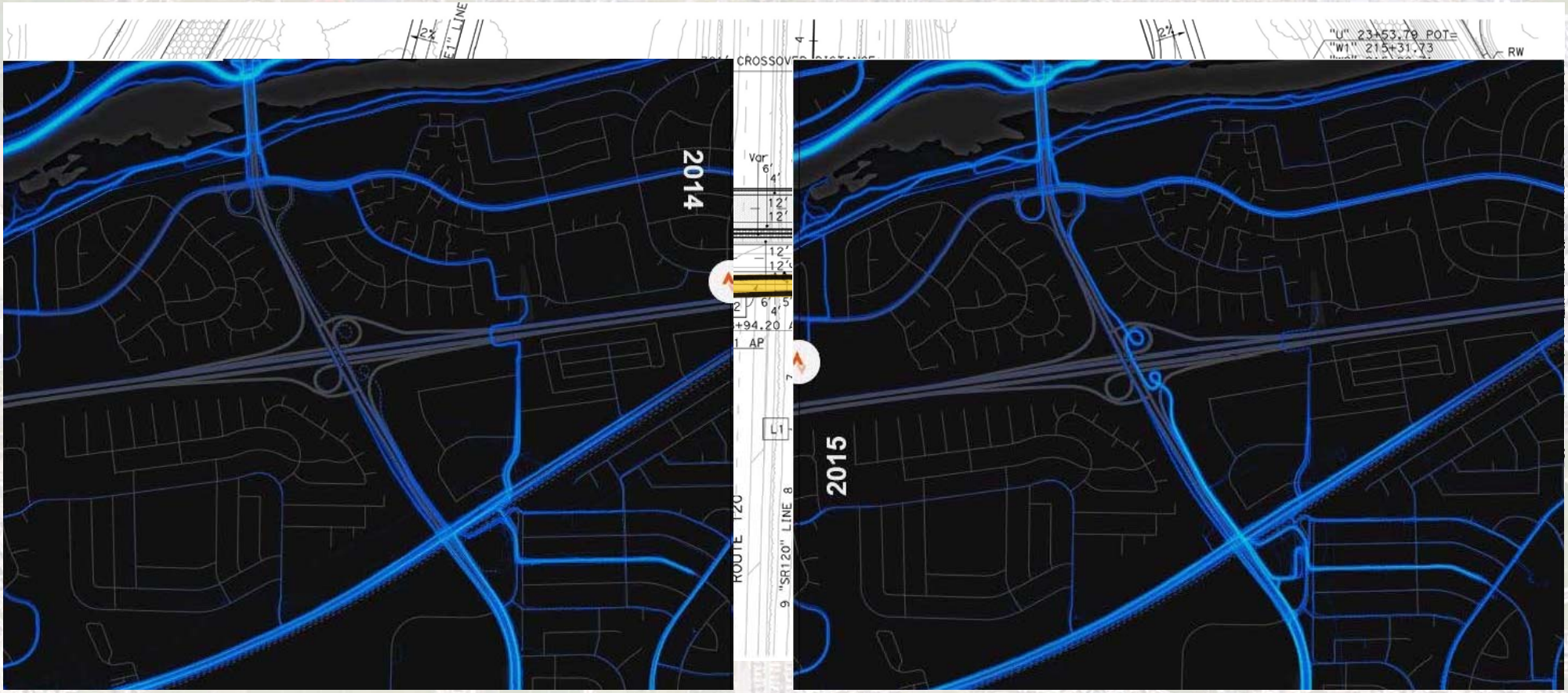


SR120/Union Road Interchange

PEDESTRIAN CIRCULATION

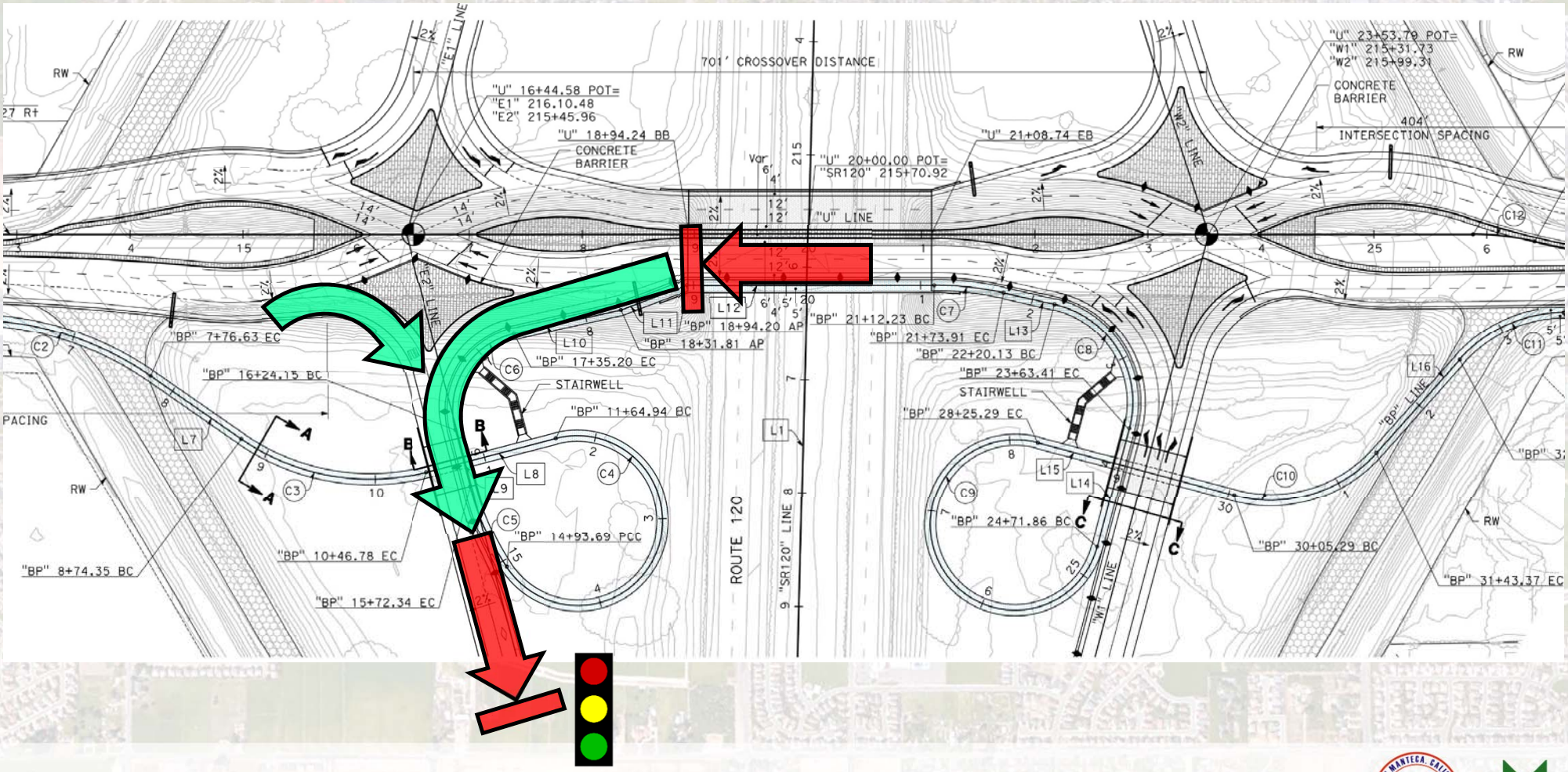
SR120/Union Road Interchange

PEDESTRIAN CIRCULATION



SR120/Union Road Interchange

RAMP METER QUEUES



SR120/Union Road Interchange

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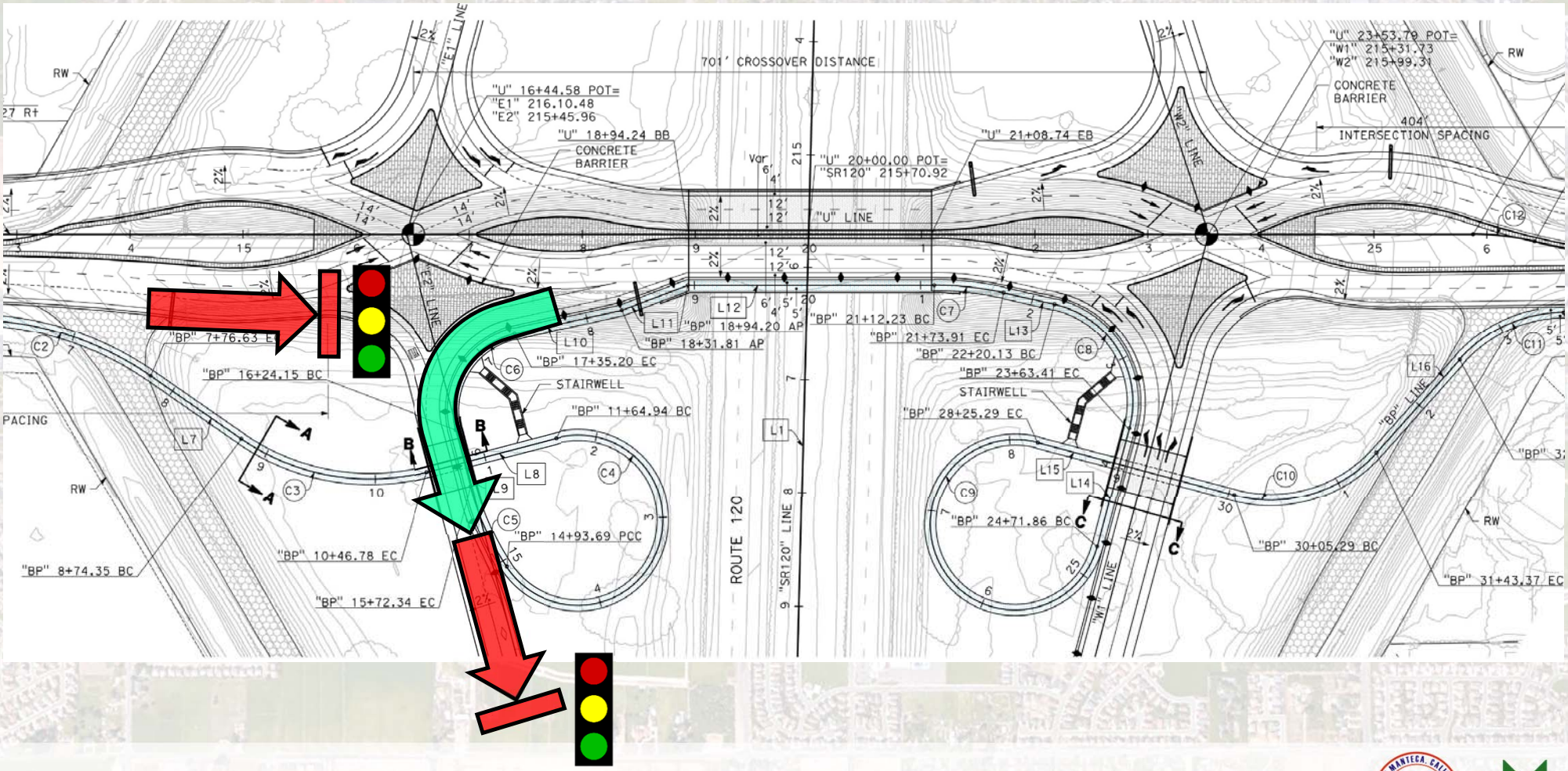
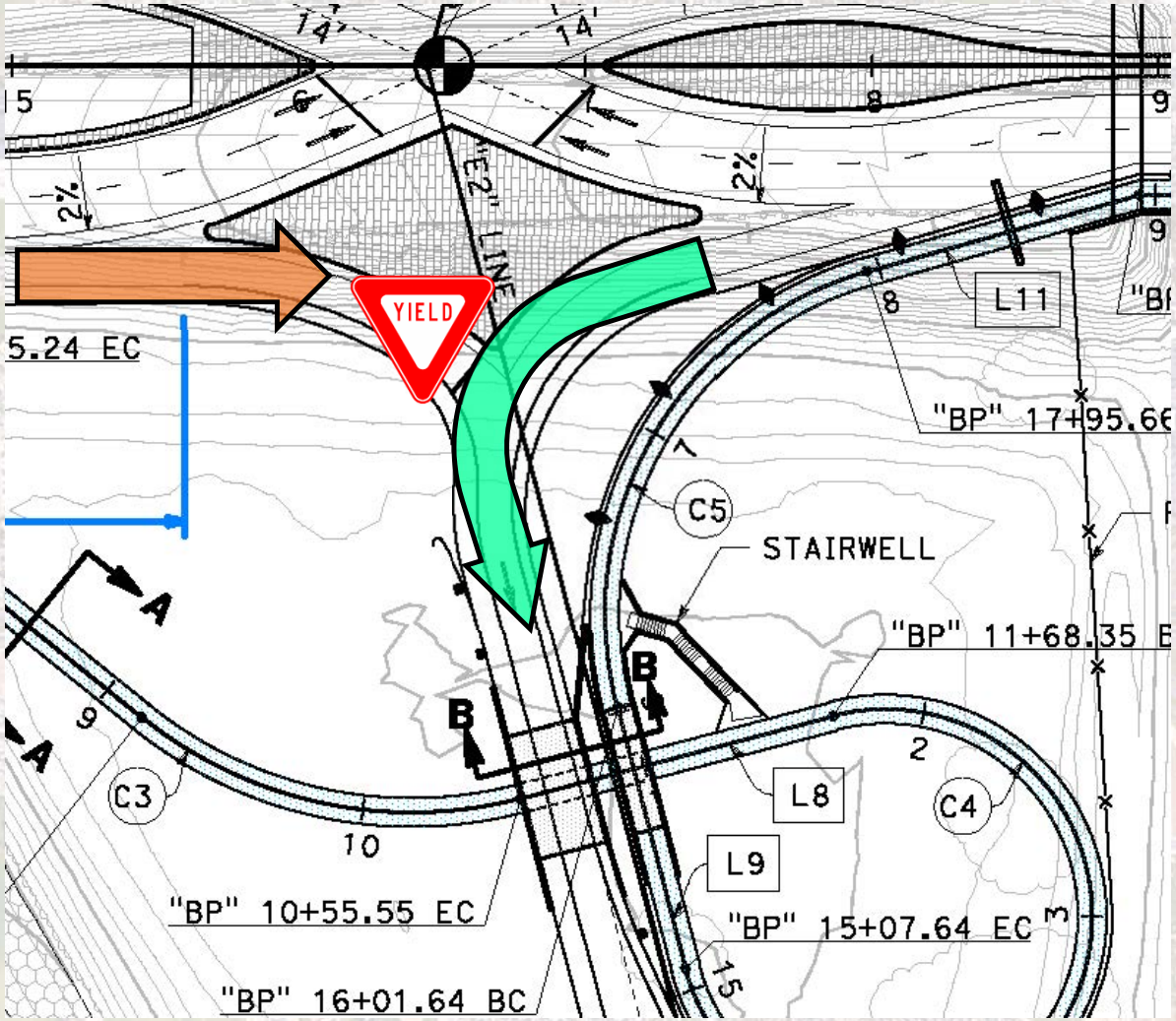
RAMP METER QUEUES



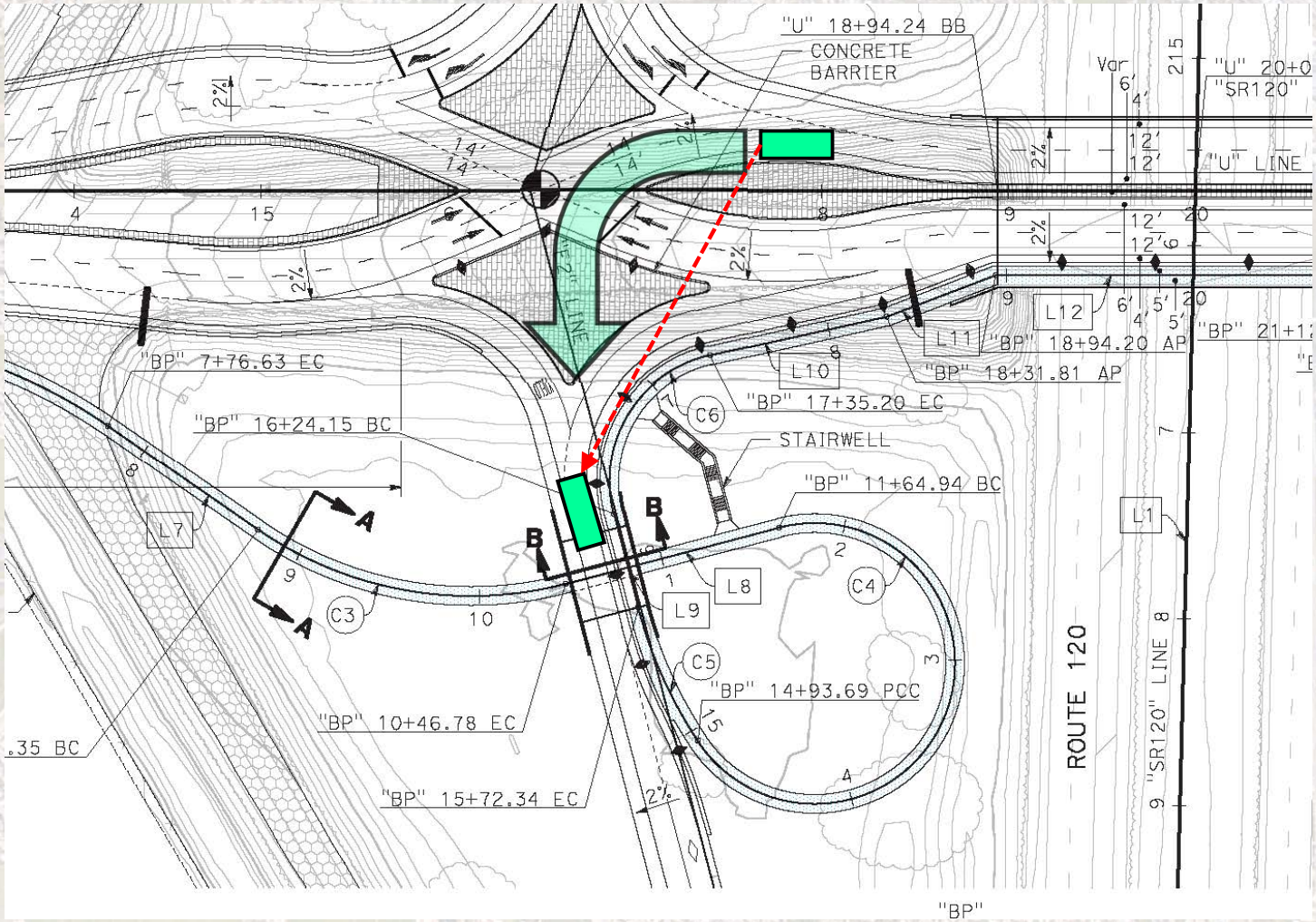
SR120/Union Road Interchange

SINGLE LANE ON-RAMP



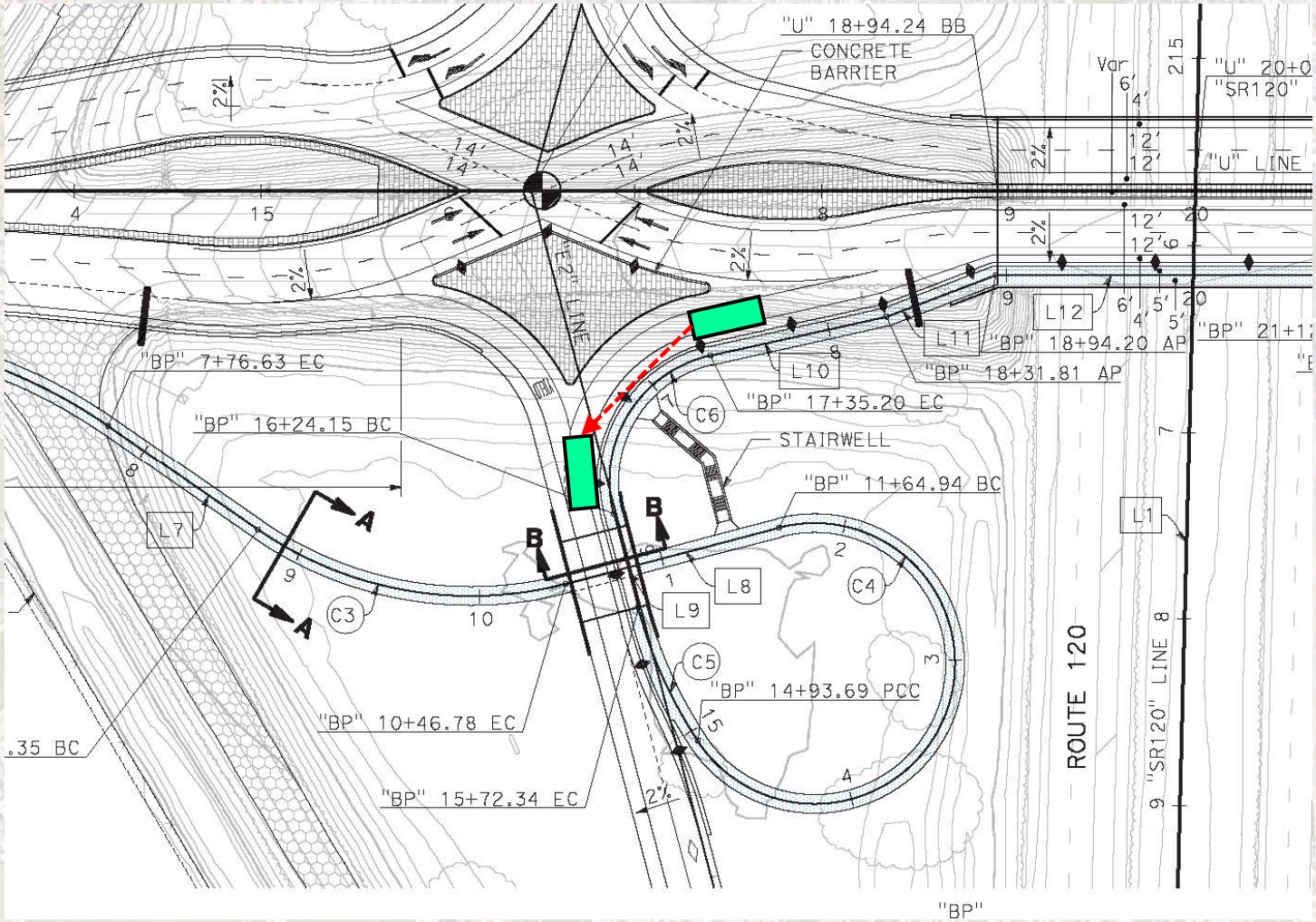
SR120/Union Road Interchange

STOPPING SIGHT DISTANCE



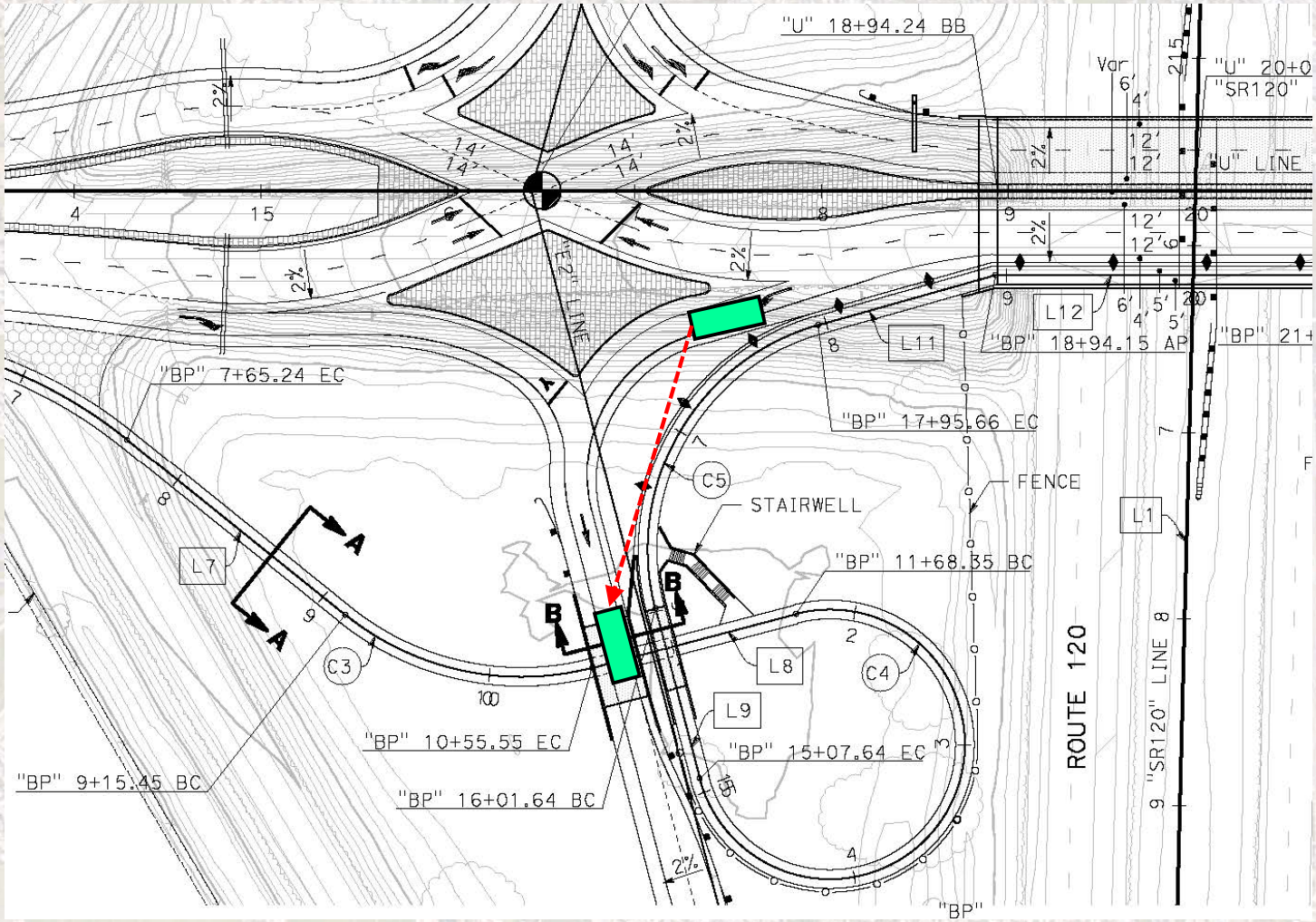
SR120/Union Road Interchange

STOPPING SIGHT DISTANCE



SR120/Union Road Interchange

STOPPING SIGHT DISTANCE



SR120/Union Road Interchange

SCHEDULE

SPRING 2017

APPROVED TRAFFIC ANALYSIS

SUMMER 2017

ENVIRONMENTAL REVALIDATION

WINTER 2017

FINAL CONSTRUCTION DOCUMENTS

SPRING 2018

AWARD/CONSTRUCTION

QUESTIONS?