FEHR PEERS

Memorandum

Date: June 5, 2024

To: City of Palo Alto - Philip Kamhi, Chief Transportation Official; Sylvia Star-Lack, Transportation Planning Manager; and Charlie Coles, Senior Transportation Planner

From: Fehr & Peers - Steve Davis, PE and Meghan Mitman, AICP, RSP_{2I}

Subject: **Review of El Camino Real Proposed Striping in Palo Alto, California**

SJ21-2081.12

We have performed a review of the proposed striping plans dated May 20, 2024, from Caltrans for the El Camino Real (State Route 82) Corridor in the City of Palo Alto. We previously reviewed draft Caltrans striping plans dated January 22, 2024, in a memorandum dated March 11, 2024. That review considered the consistency of the proposed design with Caltrans' complete streets and safety policies and national complete streets design best practices, as well as the City's ongoing Bicycle Pedestrian Transportation Plan (BPTP) update and safety action plan efforts. It also considered the role of the El Camino Real Corridor in the City's land use plans, in particular planned high-density housing along the corridor, and the compatibility of the proposed design with the land use context and mode shift goals to meet the City's sustainability, affordable housing, and climate goals.

Our review of the May 20, 2024, striping plans was similarly rooted in the Safe System Approach, which recognizes the role of kinetic energy (speed and vehicle mass) and exposure as the root causes of severe injuries and fatalities, and requires a redundant, holistic, and proactive approach to address systemic issues and opportunities. As such, we completed a detailed evaluation of the proposed design treatments to identify how they best serve the core principles of this approach. This included specifically reviewing:

- Lane widths, alignments, and intersection treatments that affect overall travel speeds, including speeds of turning vehicles
- Bikeway separation, bike lane provision, bicycle turn accommodation, and pedestrian enhancements that help to reduce exposure and points of conflict for people walking, biking, and rolling by separating them from moving vehicles
- Bus stop treatments that address interactions between bicyclists and buses as well as between bicyclists and pedestrians/transit riders
- Operational enhancements such as turn restrictions and traffic signal operations adjustments that separate users temporally

A redline markup with review comments for consideration is attached. These comments represent suggestions based on a review of the proposed design plans and existing conditions, but require further engineering evaluation to verify feasibility.

Note that the Caltrans design reflects improvements are being delivered as part of the State Highway Operation and Protection Program (SHOPP), which has limitations on the types of modifications that can be constructed. As such, our review comments note both suggested enhancements to the proposed Caltrans design and additional modifications which could be pursued as part of separate planning and design efforts in the future. Overall, we observe the following:

- The proposed design has been refined to include reduced vehicle lane widths and expand the availability of Class IV bikeways. Additional refinements are suggested to increase separation for bicyclists and reduce turning speeds for vehicles.
- Though many portions of El Camino Real will receive noticeable enhancement to bicycle facilities through the Caltrans SHOPP design, limitations of SHOPP may result in "weak links" (higher level of traffic stress situations) being maintained at a few major intersections where the cross-section is limited. We have suggested enhancements which provide additional separation for bicyclists near intersections, improve pedestrian and transit accommodation, and address conflicts between vehicles and vulnerable users as a next step to build upon the proposed Caltrans design.
- Revisions to the plans have resulted in anticipated improvements to interactions between bicyclists and buses at some locations, but additional enhancements are suggested to establish a desired standard for marking shared bus/bike spaces including "BUS BIKE ONLY" pavement legends and yield markings for bicyclists where feasible. Further collaboration with transit providers, Caltrans, and City is suggested to identify short-term pilot treatments that could address interactions between buses and bicyclists.

In summary, with additional refinements noted below, the improvements proposed as part of the Caltrans SHOPP project serve as a helpful first step toward improved multimodal comfort, access, and mobility along El Camino Real. We suggest the SHOPP project ideally be accompanied by cooperation with transit providers to address interactions between modes at bus stops and a commitment to undertake a more comprehensive planning and design process to address the needs of all users on the corridor.

In our review of the Caltrans striping plans dated January 22, 2024, we described how the typical candidate bicycling populations were likely to be affected by the proposed design. With the refined Caltrans plans dated May 20, 2024, it is anticipated that bicyclists would be affected in the following positive (+) or negative (-) ways:

TYPE OF BICYCLIST	EXISTING CONDITIONS	PROPOSED CALTRANS CONFIGURATION	POTENTIAL LOWER STRESS DESIGN
STRONG AND FEARLESS	Currently riding on the street	+ Will continue riding on the street and benefit from new separated (Class IV) facilities in some stretches	+ Will continue riding on the street and benefit from new separated facilities as well as easy access to turns off and on El Camino Real
ENTHUSED AND CONFIDENT (OR BICYCLE DEPENDENT)	Currently riding on the sidewalk, at times contra-flow	+/- Will likely use enhanced on-street bicycle facilities in many areas but are likely to divert to the sidewalk to avoid weak links at major intersections or busy bus stops; contra-flow riding may occur in the bikeway where high-quality crossings of El Camino Real are infrequent and/or side street crossings of/access to El Camino Real are not enhanced for bicyclists.	+ Will likely shift to on-street riding, removing the challenges associated with contra-flow sidewalk or bikeway riding; additional refinements to the Caltrans design to add separation and reduce turning speeds, as well as treatments to enhance crossings and crossing opportunities, could shift the design plans closer to this category for confident bicyclists
INTERESTED BUT CONCERNED	Not currently riding on El Camino Real	+/- Some may use El Camino Real, particularly on segments providing a high proportion of separated bikeways; some are likely to continue to avoid El Camino Real or choose to drive instead because of weakest links	+ May be open to riding on El Camino Real, including a wider range of ages and abilities (i.e., 8-80 year olds)

We suggest the following to support higher comfort, access, and mode shift potential for walking and bicycling along and across El Camino Real (moving to the right-most column in the table above). These suggestions specifically focus on opportunities to proactively and redundantly reduce exposure for vulnerable road users to high-speed traffic and/or heavy vehicles, in line with the Safe System Approach:

- As part of the Caltrans SHOPP project, potentially including City coordination in parallel:
    - Provide additional segments of Class IV bikeway with physical separation, including elimination of conflict markings downstream from most intersections.
    - Add separation in locations that will reduce the total length of conflict marking zones that serve as de facto right-turn lanes approaching intersections.
    - Convert some sections of Class II bike lane to Class IV bikeway by utilizing reduced bikeway and/or buffer widths (on a roadway such as El Camino Real, a somewhat narrower separated bikeway is likely to provide a more comfortable riding experience than a wider standard bike lane for many bicyclists)
    - Provide quick-build curb extensions at many intersections to address turning speeds on and off El Camino Real while reducing crossing distances.
    - Provide "paint and plastic" protected intersections, dedicated intersections, and two-stage turn opportunities where geometry allows, including elimination of right-turn channelization where feasible.
    - Provide additional temporal separation of modes at key intersections using signal timing strategies and/or right turn on red restrictions to reduce bicyclist and pedestrian exposure.
    - Where Class II bike lanes are provided, continue the bike lane with solid striping across minor driveways rather than providing conflict markings.
    - Provide additional striping to narrow lane widths and clarify desired travel paths for drivers.
    - Provide wayfinding to direct people walking, biking, or rolling to desirable travel routes such as the Stanford Perimeter Trail where facilities on El Camino Real are not suited to accommodating all modes.

- In the short term, as enhancements to the Caltrans SHOPP project presumed to be completed separately:
    - Address bus/bicycle conflicts by piloting stop-in-lane bus stops and bus boarding islands, including shared bike lane/boarding islands, in collaboration with transit providers.
    - Evaluate left-turn restrictions to limit/remove situations with permissive or unsignalized left turns to or from side streets, which require drivers to evaluate gaps in multiple lanes of traffic while monitoring the location of bicyclists and pedestrians.
    - After evaluating additional refinements to the Caltrans SHOPP project based upon the suggestions above, pursue a comprehensive planning and design

process to determine a vision for El Camino Real in collaboration with stakeholders and the community. Potential for more comprehensive intersection and traffic signal modifications, vehicle lane reductions, or other reallocation of space in the public realm should be studied, potentially allowing:

- More substantial separation for bicyclists,
- Protected corners that increase the overall separation of the bikeway,
- Enhanced bus stops with separation between bicyclists, pedestrians, and transit vehicles,
- Restoration of parking, loading, and other existing curbside uses, and
- An overall El Camino Real corridor compatible with the mode shift goals, context, and community needs of the corridor.

- In the medium term:
  - Convert all quick-build enhancements to permanent treatments, including reviewing all signalized intersection geometry and controls, especially those with skewed/high speed angles and/or missing crosswalk legs.
  - Determine additional midblock crossings that may be needed to serve desire lines for pedestrians and bicyclists traveling to key destinations in the corridor, including bus stops.
  - As development occurs along El Camino Real, prioritize access and curbside management strategies that promote greater bicycle/pedestrian activity and reduce the number of driveways which access El Camino Real directly.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	SCl	82	18.2/26.4	232	466

AS-AWARDED CONTRACT PLANS
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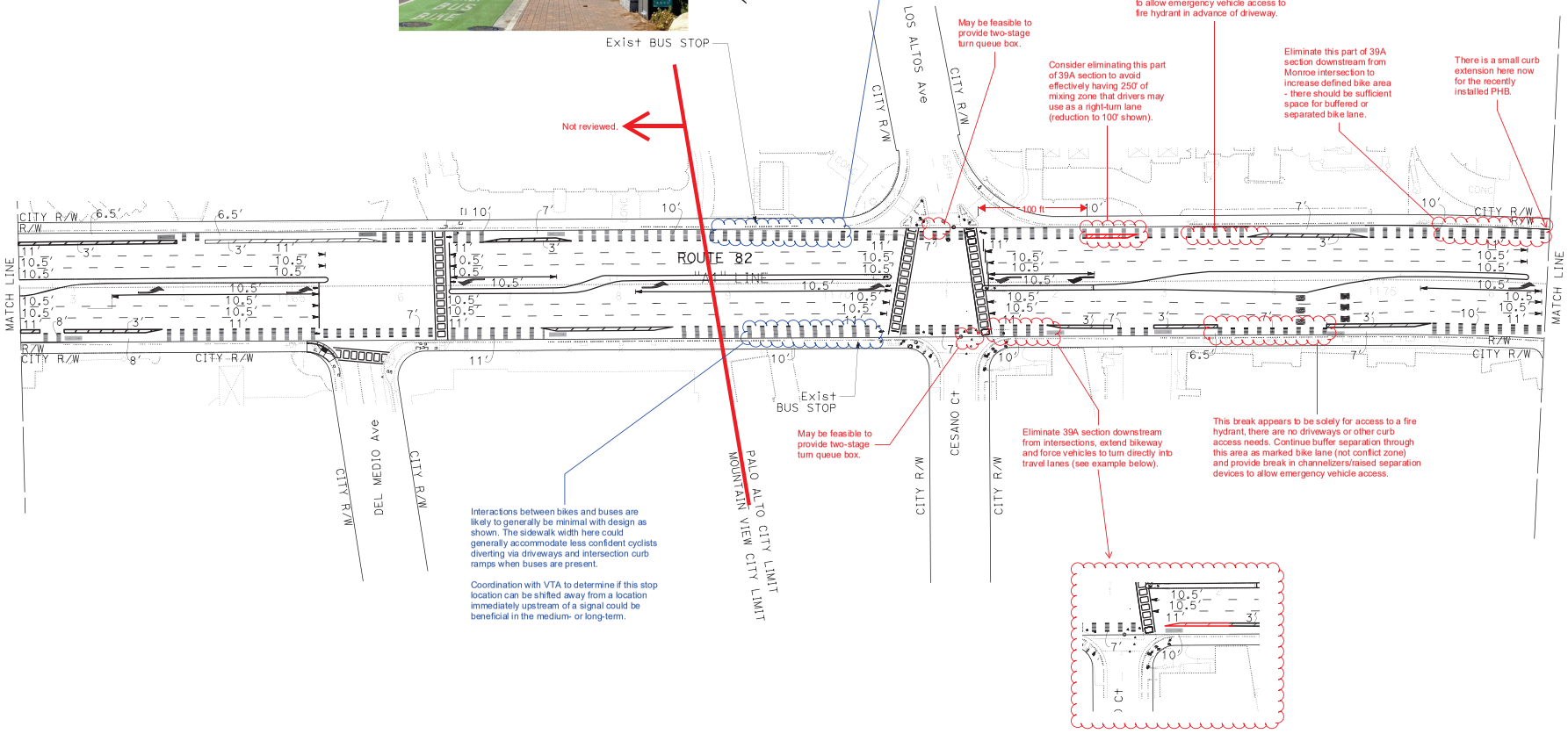
Universal comments:
- Verify drainage and other infrastructure in bikeway has bicycle-friendly lids
- Verify placement of bike detection symbols is centered in bikeway/bike lane
- Consider including limit lines across bike lanes where appropriate
- Where feasible, consider quick-build curb extensions to narrow side streets, helping to reduce vehicle turning speeds
- Consider establishing a desired standard for marking shared bus/bike spaces such as the example at right (from Caltrans DIB 94) to make clear which modes are allowed and which interactions bicyclists and bus drivers should be prepared to navigate - this may include yield markings in the bikeway where suitable space is available for bicyclists to yield to buses
  - Opportunities for potential additional enhancements or pilot projects to consider at specific locations are indicated in these markups
- Consider additional temporal separation of modes at key intersections using signal timing strategies and/or right turn on red restrictions to reduce bicyclist/pedestrian exposure
- Permissive/unsignalized left turns will require drivers to evaluate gaps in multiple lanes of traffic while monitoring the location of bicyclists, consider left-turn restrictions where feasible



These comments represent suggestions based on a review of the proposed design plans and existing conditions, but require further engineering evaluation to verify feasibility.

APPROVED FOR PAVEMENT DELINEATION WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET PD-1

PAVEMENT DELINEATION PLAN

SCALE: 1" = 50'

PD-15

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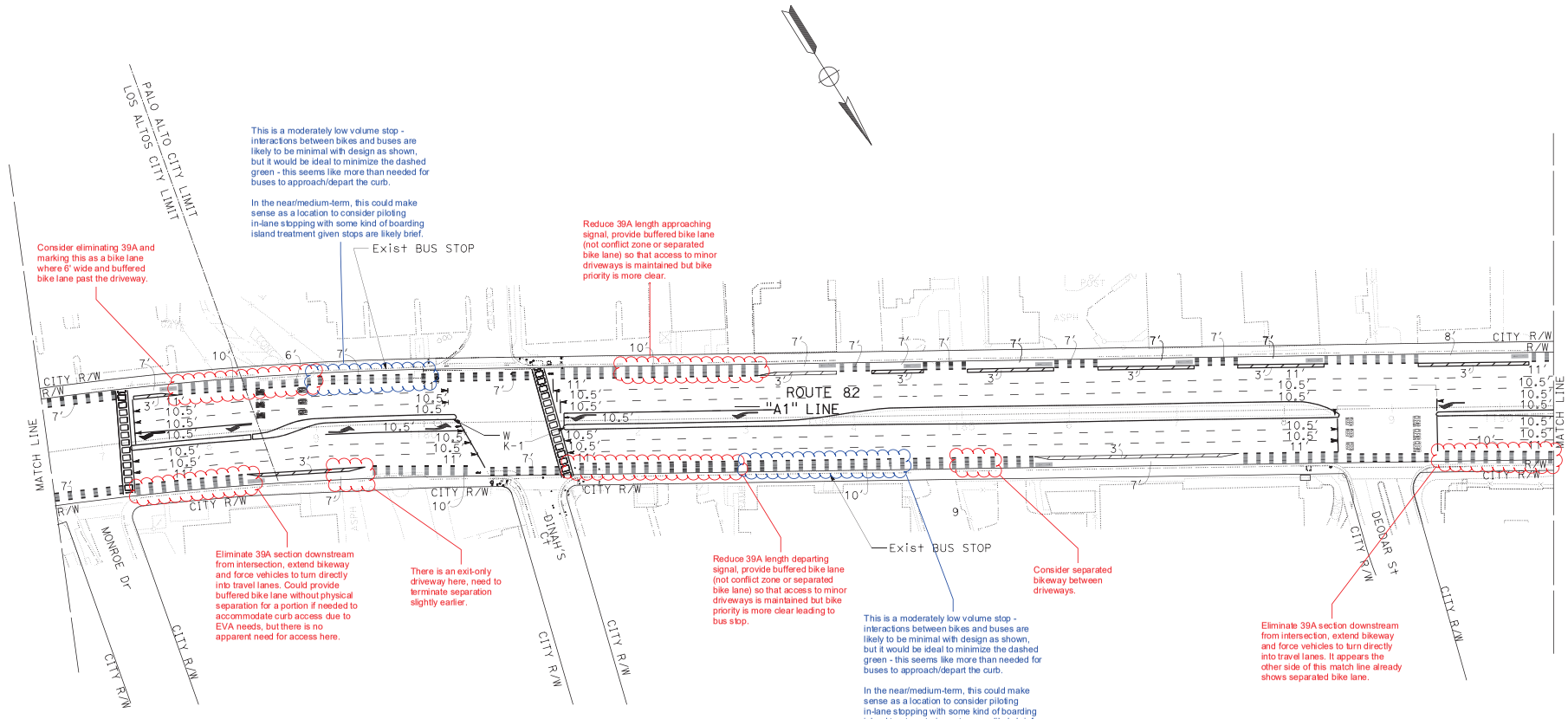

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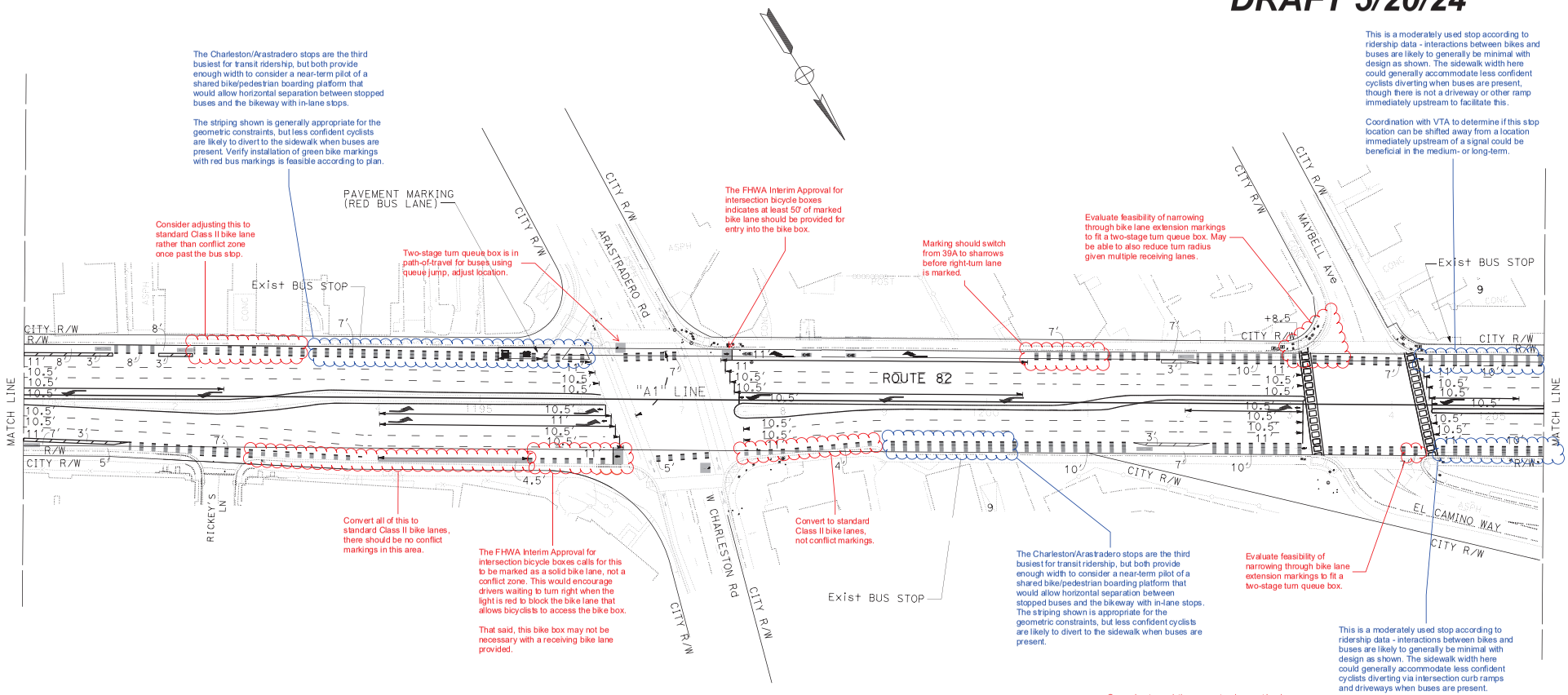

General note - existing geometry does not lend itself to provision of bike boxes, two-stage turn queue boxes, or bike lane extensions across ECR at the Maybell Avenue / El Camino Way intersection. Future efforts could evaluate whether reallocation of space in the ECR right-of-way (potentially including lane reductions) could provide space to enhance multimodal facilities.

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SCALE: 1" = 50'

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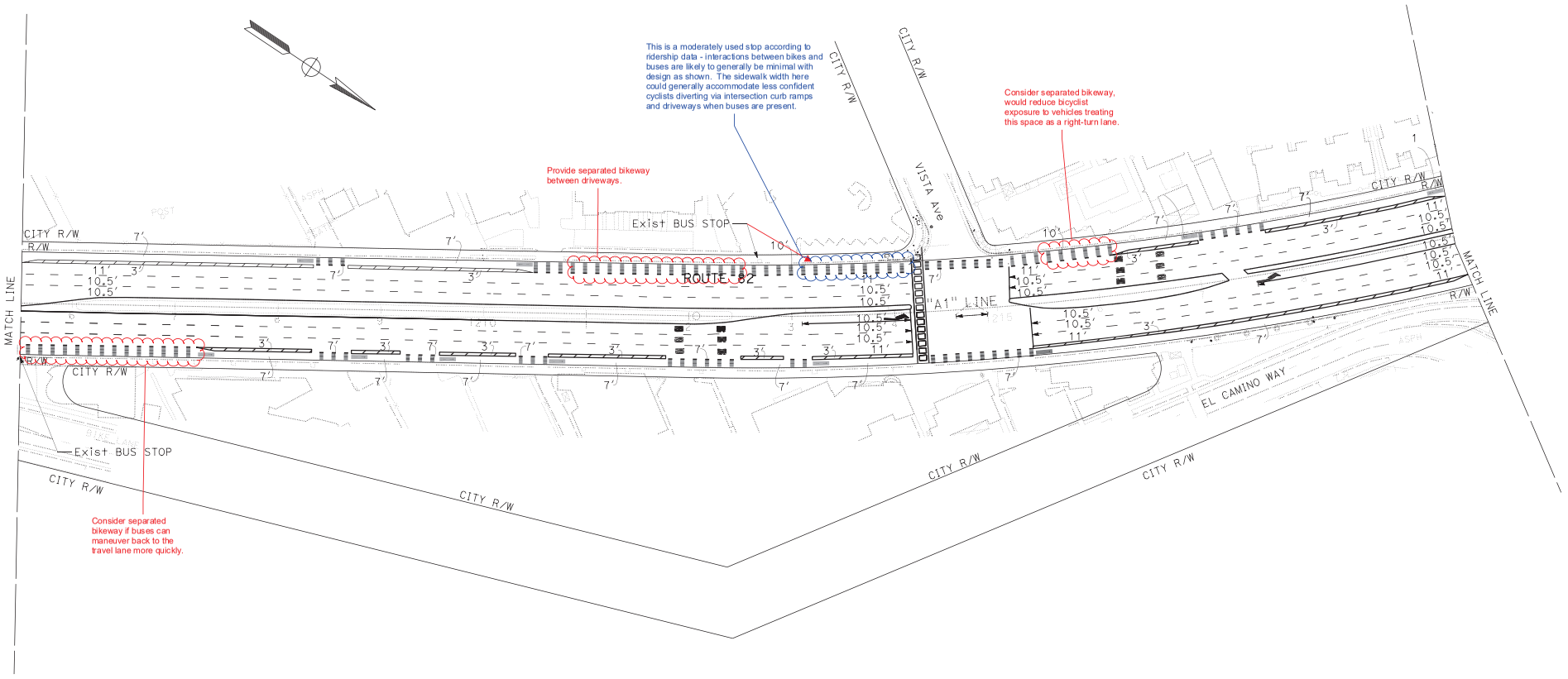

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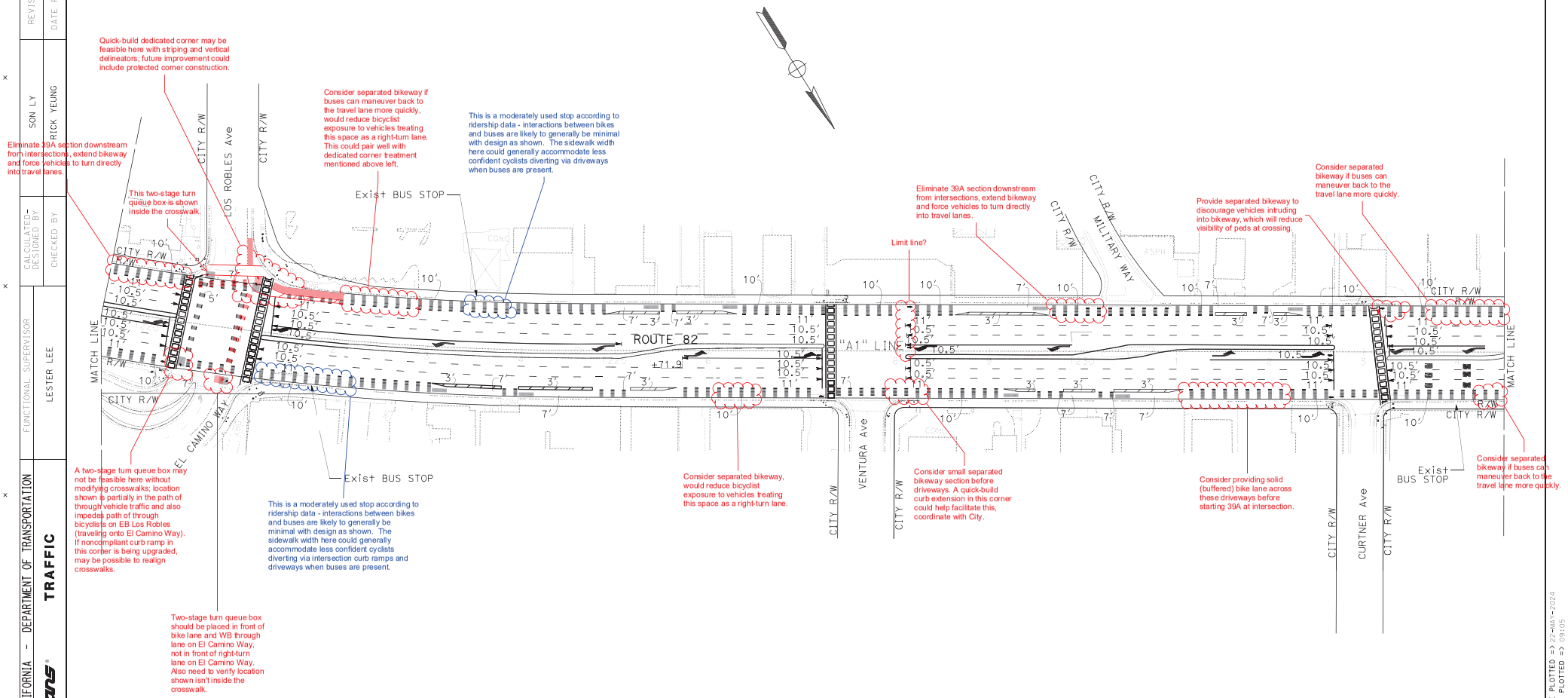

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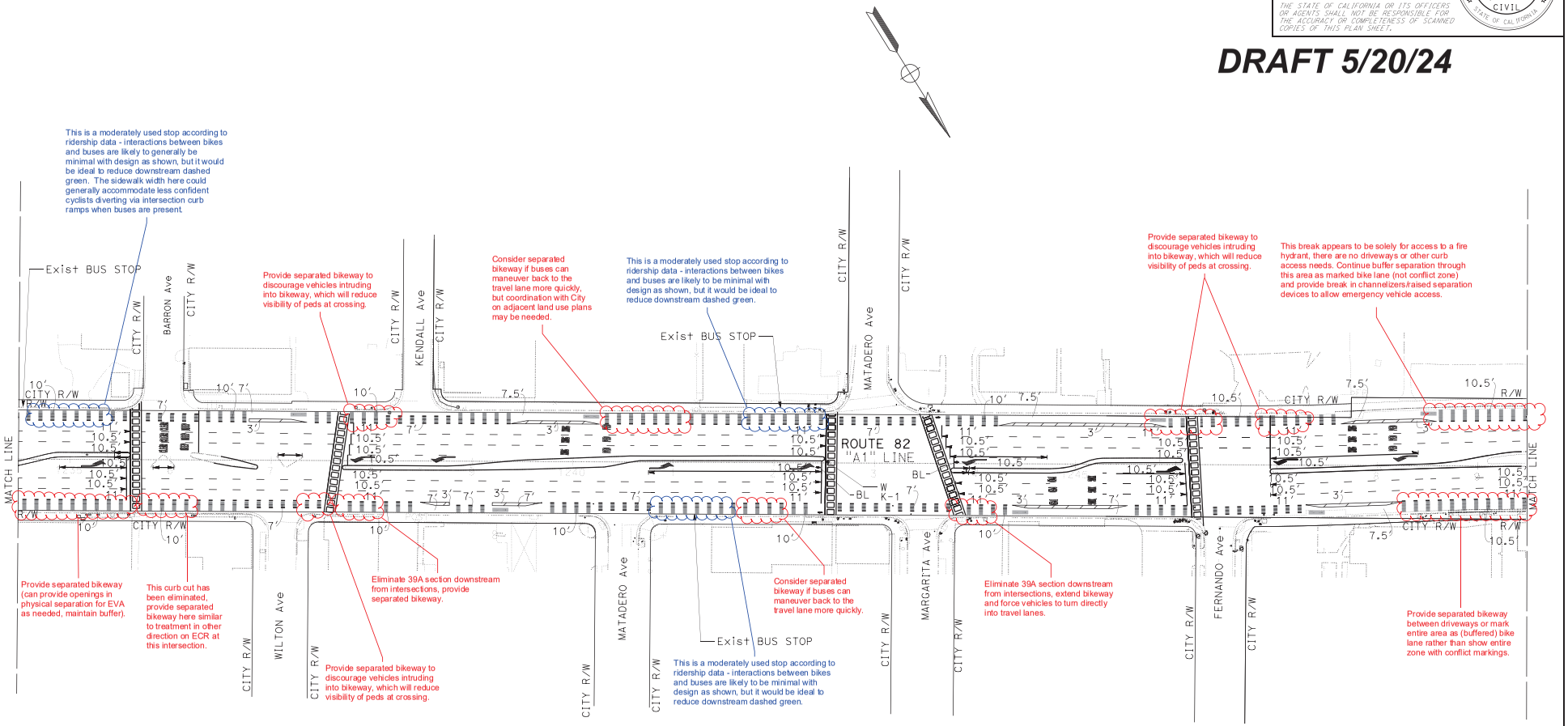

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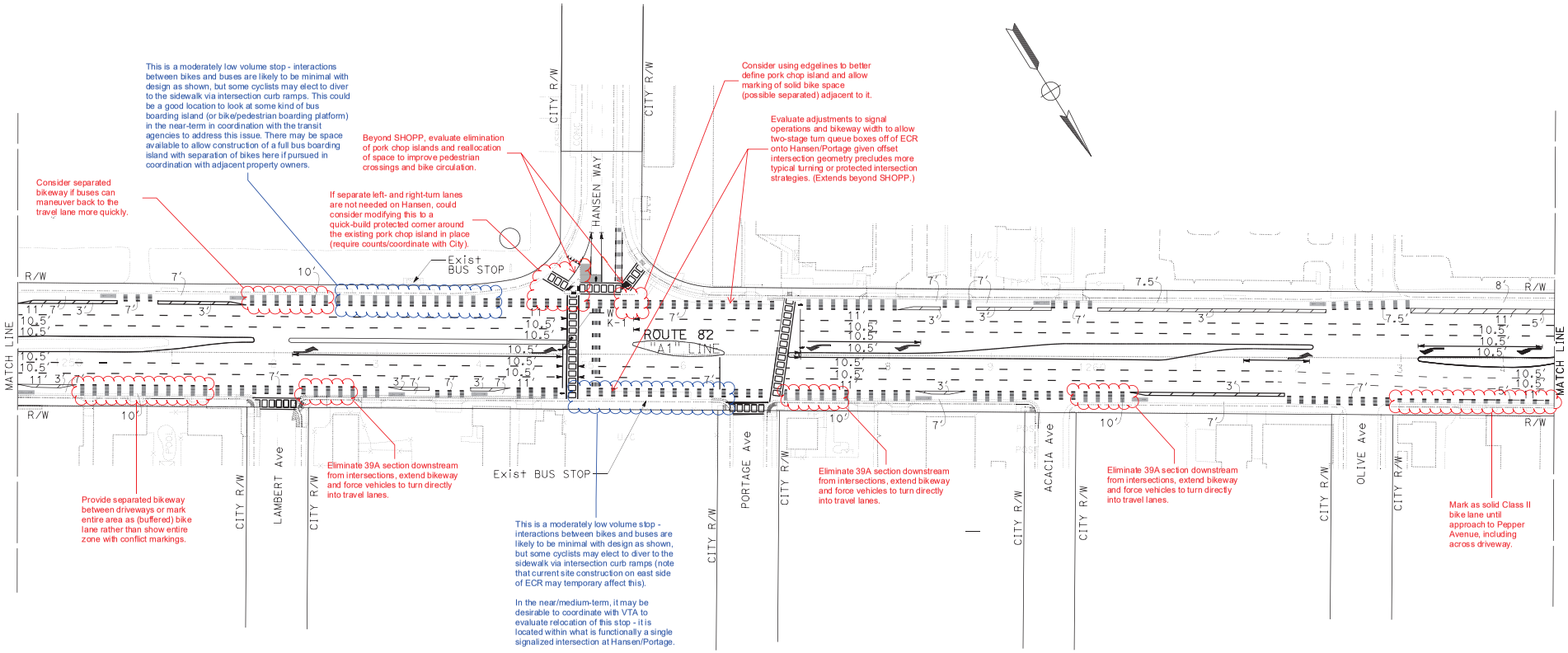

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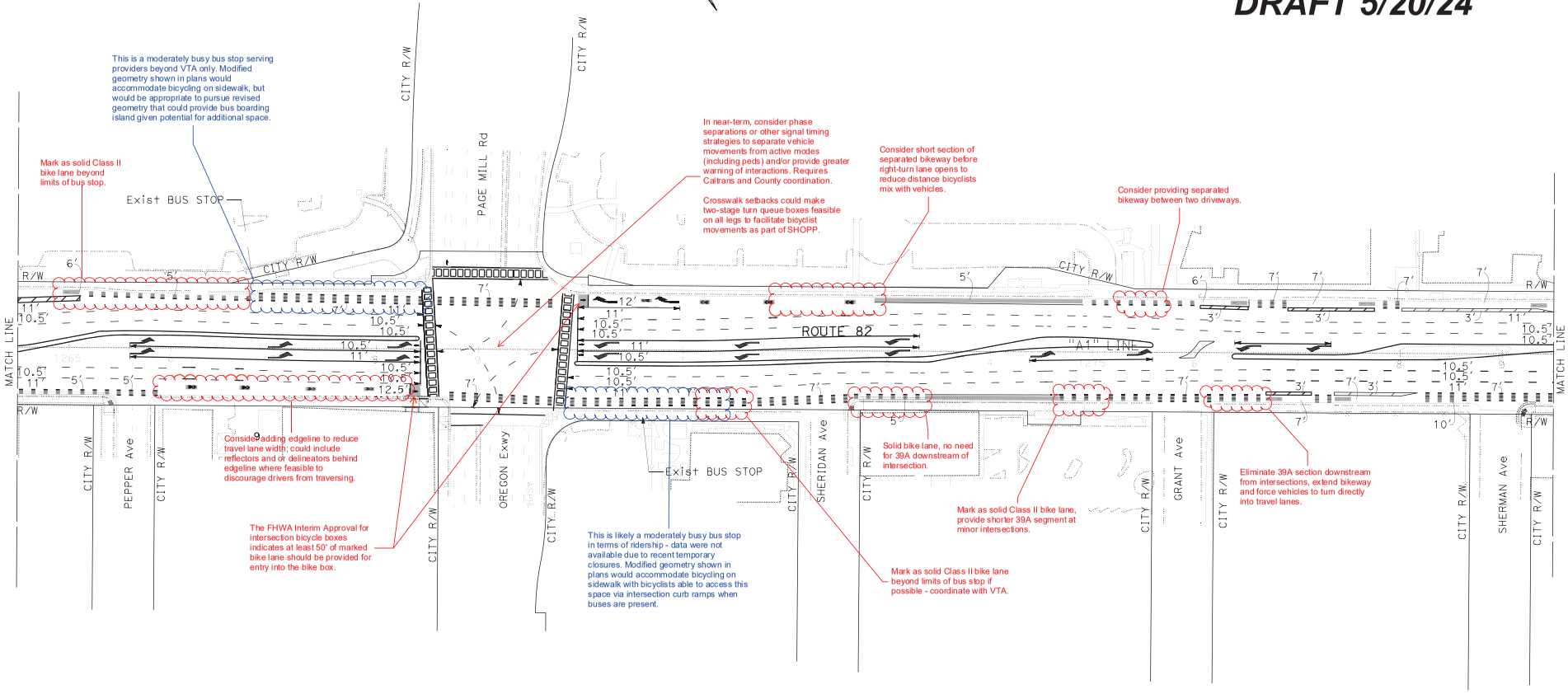

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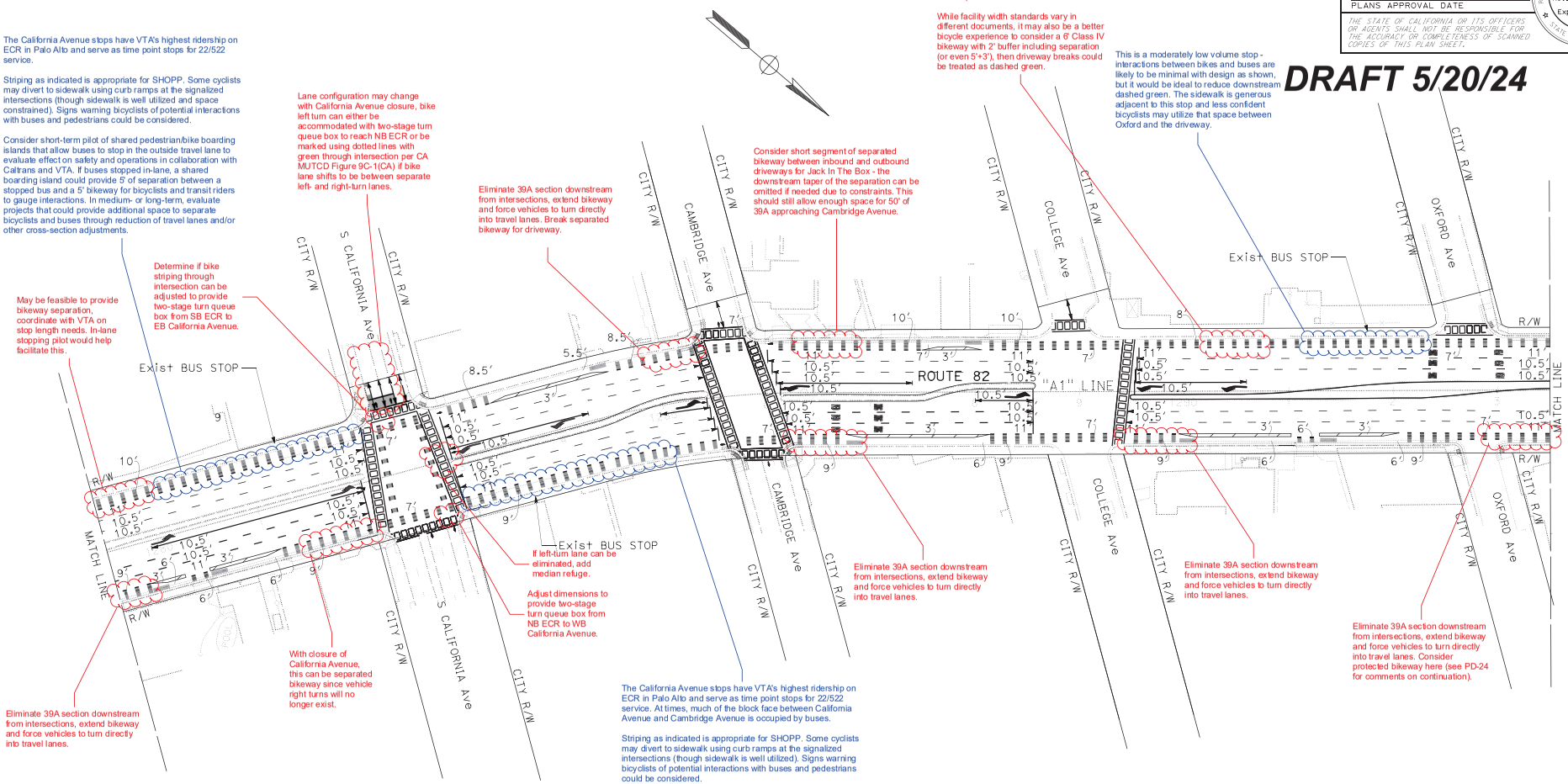

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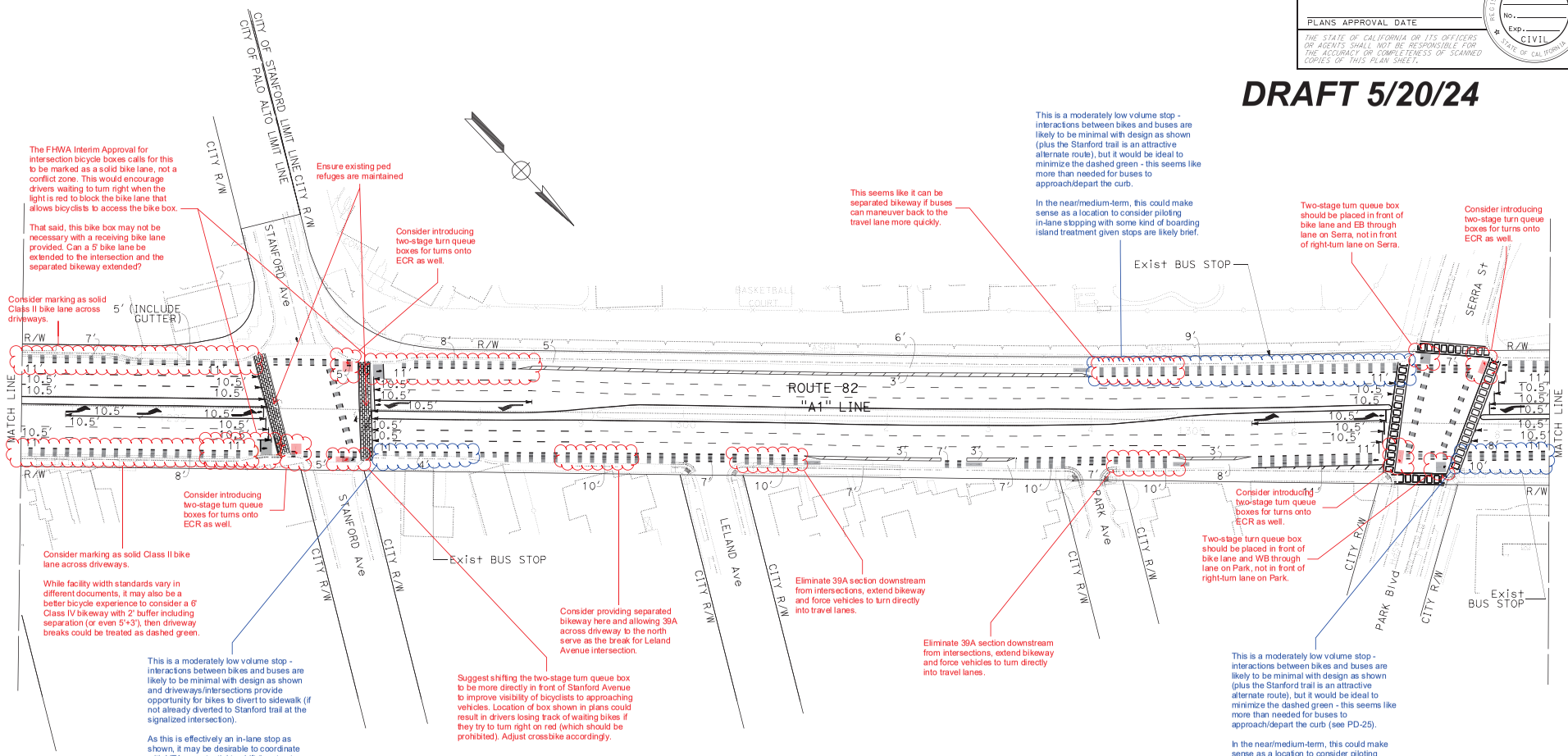

These comments represent suggestions based on a review of the proposed design plans and existing conditions, but require further engineering evaluation to verify feasibility.

APPROVED FOR PAVEMENT DELINEATION WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET PD-1

PAVEMENT DELINEATION PLAN

SCALE: 1" = 50'

PD-24

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans® TRAFFIC

FUNCTIONAL SUPERVISOR: LESTER LEE
CALCULATED-DESIGNED BY: SON LY
CHECKED BY: RICK YEUNG
REVISED BY: SL
DATE REVISED: 11-18-22

DATE PLOTTED => 22-MAY-2024
TIME PLOTTED => 09:05

BORDER LAST REVISED 7/2/2010

USERNAME => s135226
DGN FILE => 0419000140na024.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0712

PROJECT NUMBER & PHASE 04190001401

NOTE:

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	SCl	82	18.2/26.4	242	466

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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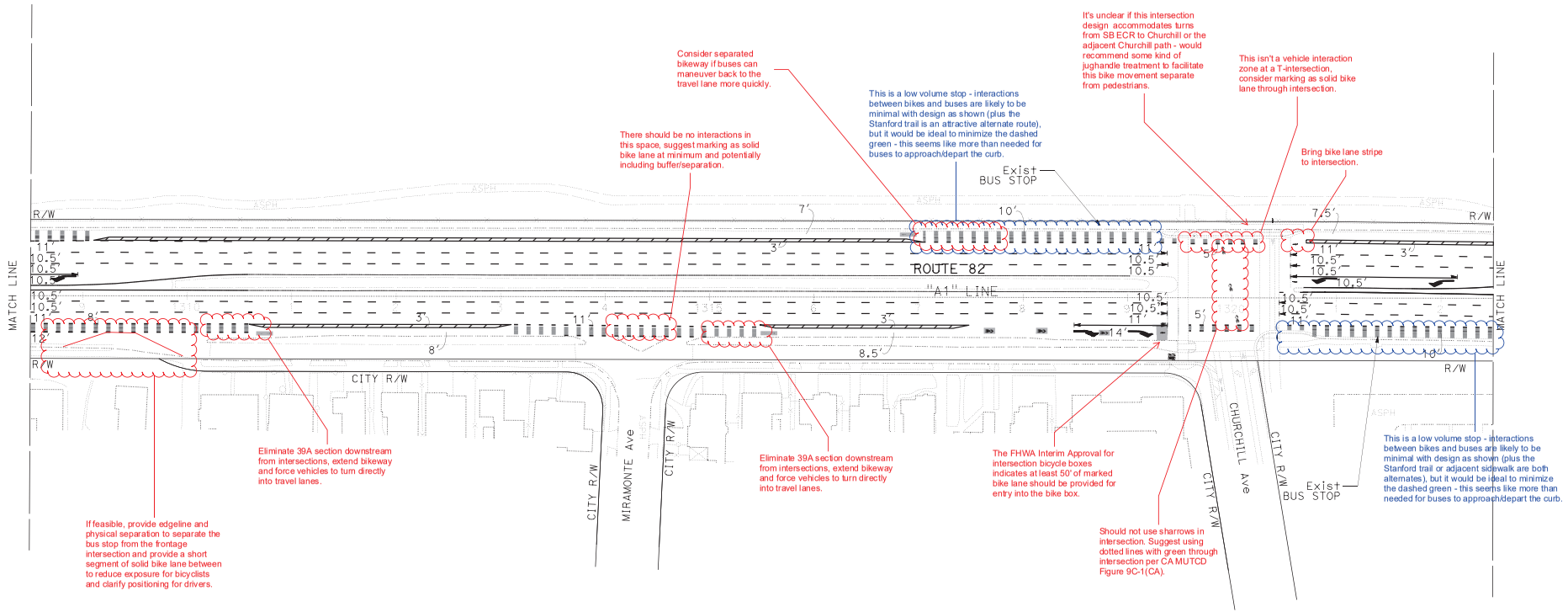
DRAFT 5/20/24



These comments represent suggestions based on a review of the proposed design plans and existing conditions, but require further engineering evaluation to verify feasibility.

APPROVED FOR PAVEMENT DELINEATION WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET PD-1

PAVEMENT DELINEATION PLAN

SCALE: 1" = 50'

PD-25

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans
TRAFFIC

FUNCTIONAL SUPERVISOR: LESTER LEE
CALCULATED-DESIGNED BY: SON LY
CHECKED BY: RICK YEUNG
REVISED BY: SL
DATE REVISED: 11-18-22

DATE PLOTTED => 22-MAY-2024
TIME PLOTTED => 09:06

BORDER LAST REVISED 7/2/2010

USERNAME => s135226
DGN FILE => 0419000140na025.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0712

PROJECT NUMBER & PHASE 04190001401

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	SCl	82	18.2/26.4	243	466

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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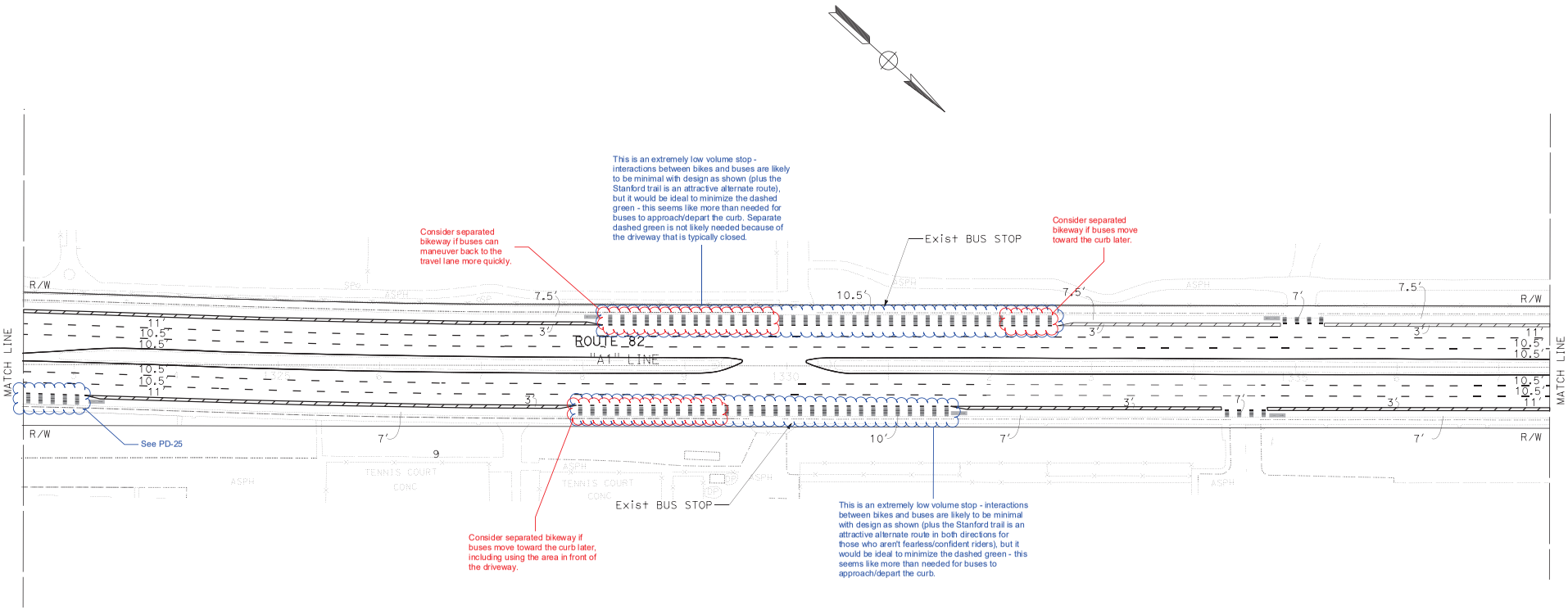
NOTE:

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.



These comments represent suggestions based on a review of the proposed design plans and existing conditions, but require further engineering evaluation to verify feasibility.

APPROVED FOR PAVEMENT DELINEATION WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET PD-1

PAVEMENT DELINEATION PLAN

SCALE: 1" = 50'

PD-26

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans® TRAFFIC

FUNCTIONAL SUPERVISOR: LESTER LEE

CALCULATED-DESIGNED BY: SON LY
CHECKED BY: RICK YEUNG

REVISED BY: SL
DATE REVISED: 11-18-22

DATE PLOTTED => 22-MAY-2024
TIME PLOTTED => 09:06

BORDER LAST REVISED 7/2/2010

USERNAME => s135226
DGN FILE => 0419000140na026.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0712

PROJECT NUMBER & PHASE 04190001401

NOTE:

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	SCl	82	18.2/26.4	244	466

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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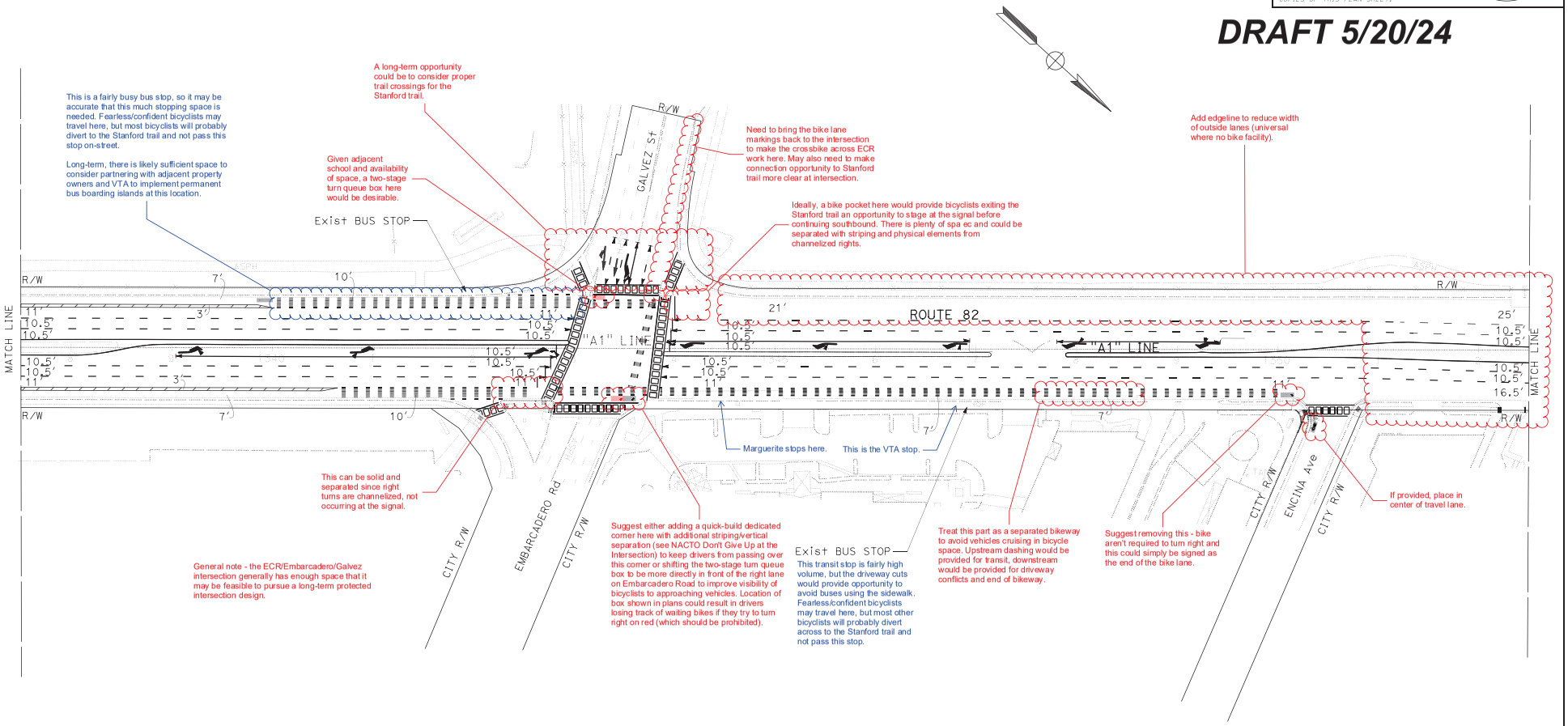
DRAFT 5/20/24



These comments represent suggestions based on a review of the proposed design plans and existing conditions, but require further engineering evaluation to verify feasibility.

APPROVED FOR PAVEMENT DELINEATION WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET PD-1

PAVEMENT DELINEATION PLAN

SCALE: 1" = 50'

PD-27

DATE REVISED 09-19-22
DATE PLOTTED => 22-MAY-2024
TIME PLOTTED => 09:06

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans
TRAFFIC
FUNCTIONAL SUPERVISOR: LESTER LEE
CALCULATED-DESIGNED BY: SON LY
CHECKED BY: RICK YEUNG
REVISED BY: SL
DATE REVISED: 11-18-22

BORDER LAST REVISED 7/2/2010
USERNAME => s135226
DGN FILE => 0419000140na027.dgn
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 0712
PROJECT NUMBER & PHASE 04190001401

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	SCI	82	18.2/26.4	245	466

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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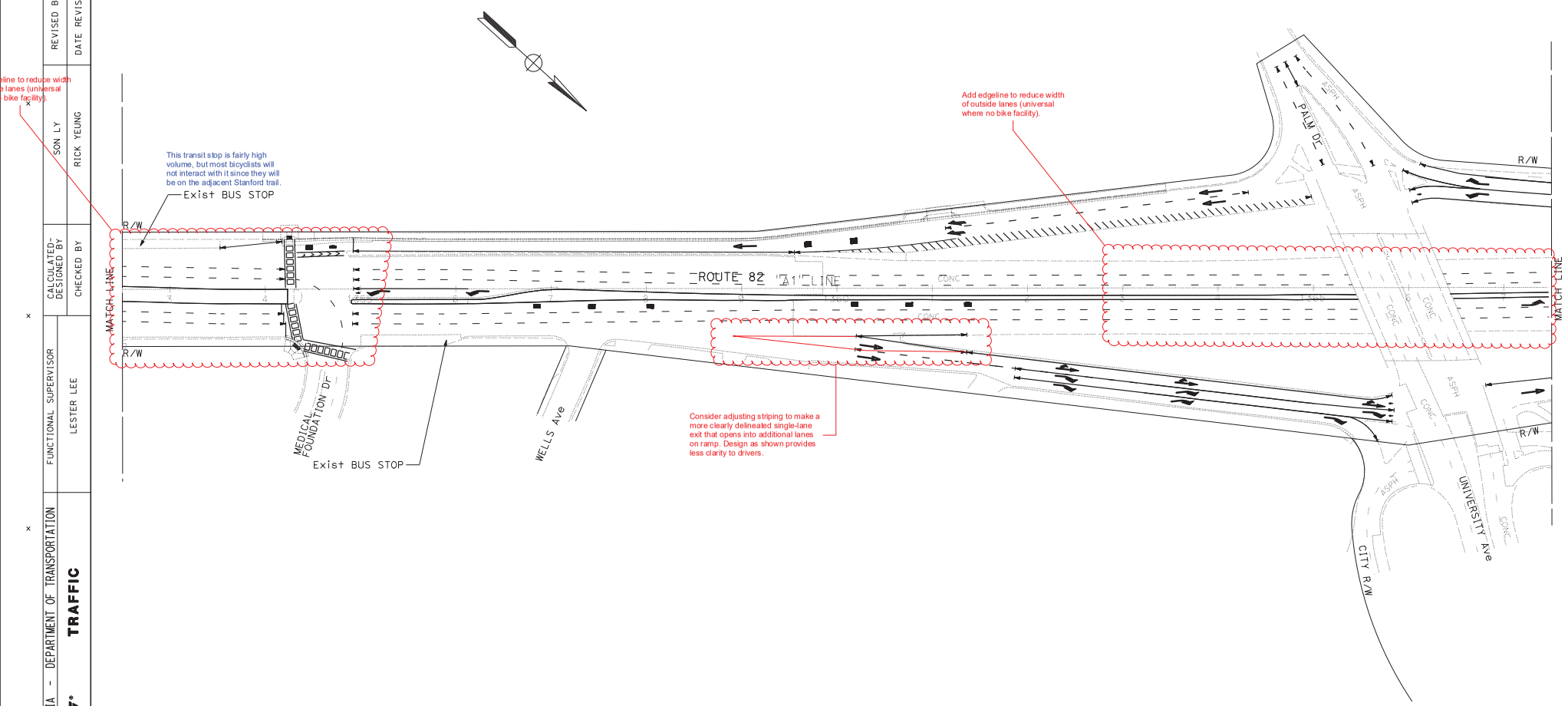
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.



These comments represent suggestions based on a review of the proposed design plans and existing conditions, but require further engineering evaluation to verify feasibility.

28

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
Caltrans TRAFFIC	LESTER LEE	SON LY	RICK YEUNG	SL	11-18-22

LAST REVISION 09-19-22 | DATE PLOTTED => 22-MAY-2024 TIME PLOTTED => 09:06

BORDER LAST REVISED 7/2/2010 | USERNAME => s135226 DGN FILE => 0419000140na028.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0712 | PROJECT NUMBER & PHASE 04190001401

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	SCl	82	18.2/26.4	246	466

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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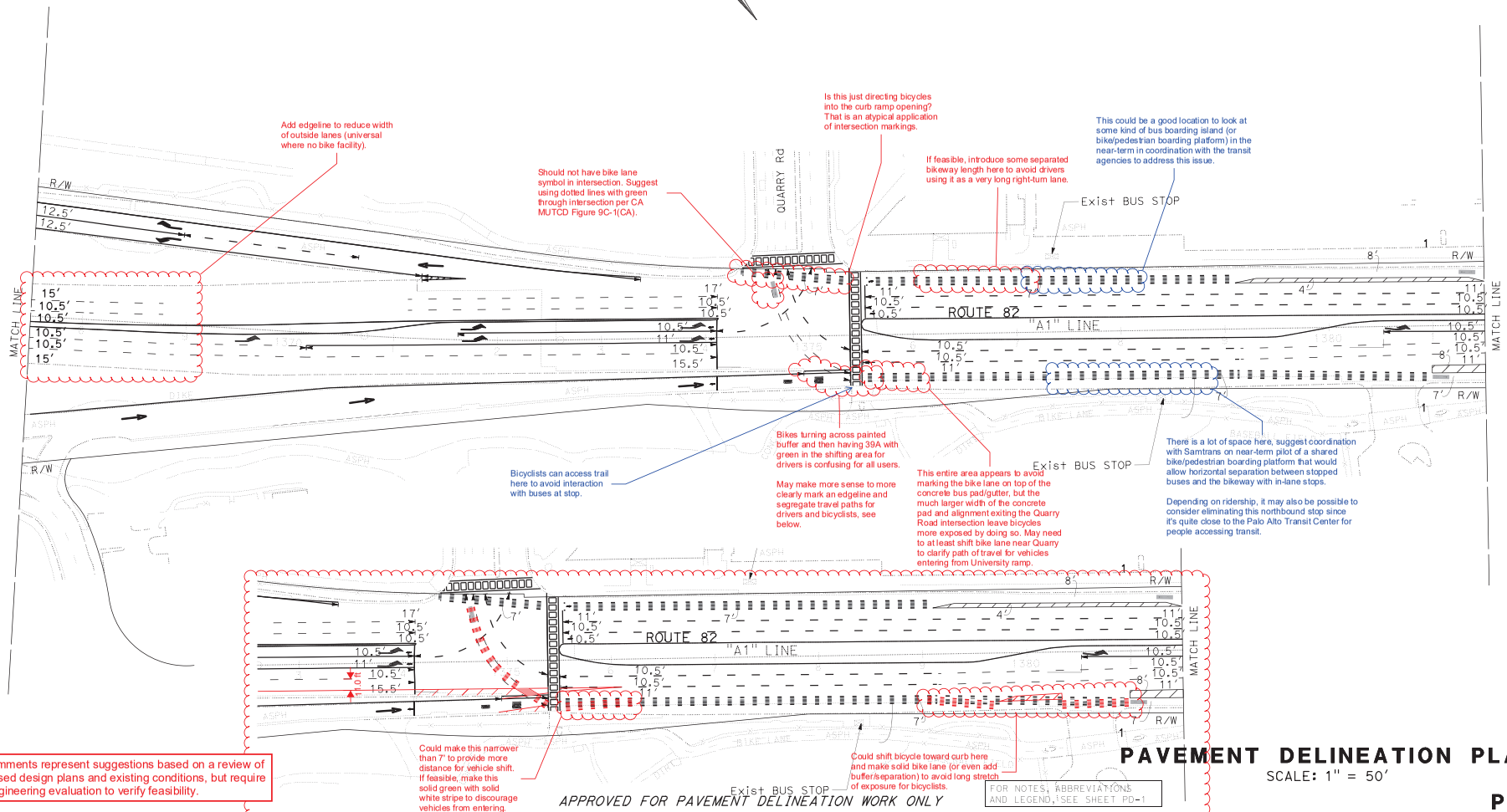
NOTE:

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.



These comments represent suggestions based on a review of the proposed design plans and existing conditions, but require further engineering evaluation to verify feasibility.

APPROVED FOR PAVEMENT DELINEATION WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET PD-1

PAVEMENT DELINEATION PLAN

SCALE: 1" = 50'

PD-29

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION — Caltrans® TRAFFIC

FUNCTIONAL SUPERVISOR: LESTER LEE

CALCULATED-DESIGNED BY: SON LY

CHECKED BY: RICK YEUNG

REVISED BY: SL

DATE REVISED: 11-18-22

DATE PLOTTED => 22-MAY-2024
TIME PLOTTED => 09:06

BORDER LAST REVISED 7/2/2010

USERNAME => s135226
DGN FILE => 0419000140na029.dgn

RELATIVE BORDER SCALE IS IN INCHES

UNIT 0712

PROJECT NUMBER & PHASE 04190001401

NOTE:

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	SCl	82	18.2/26.4	247	466

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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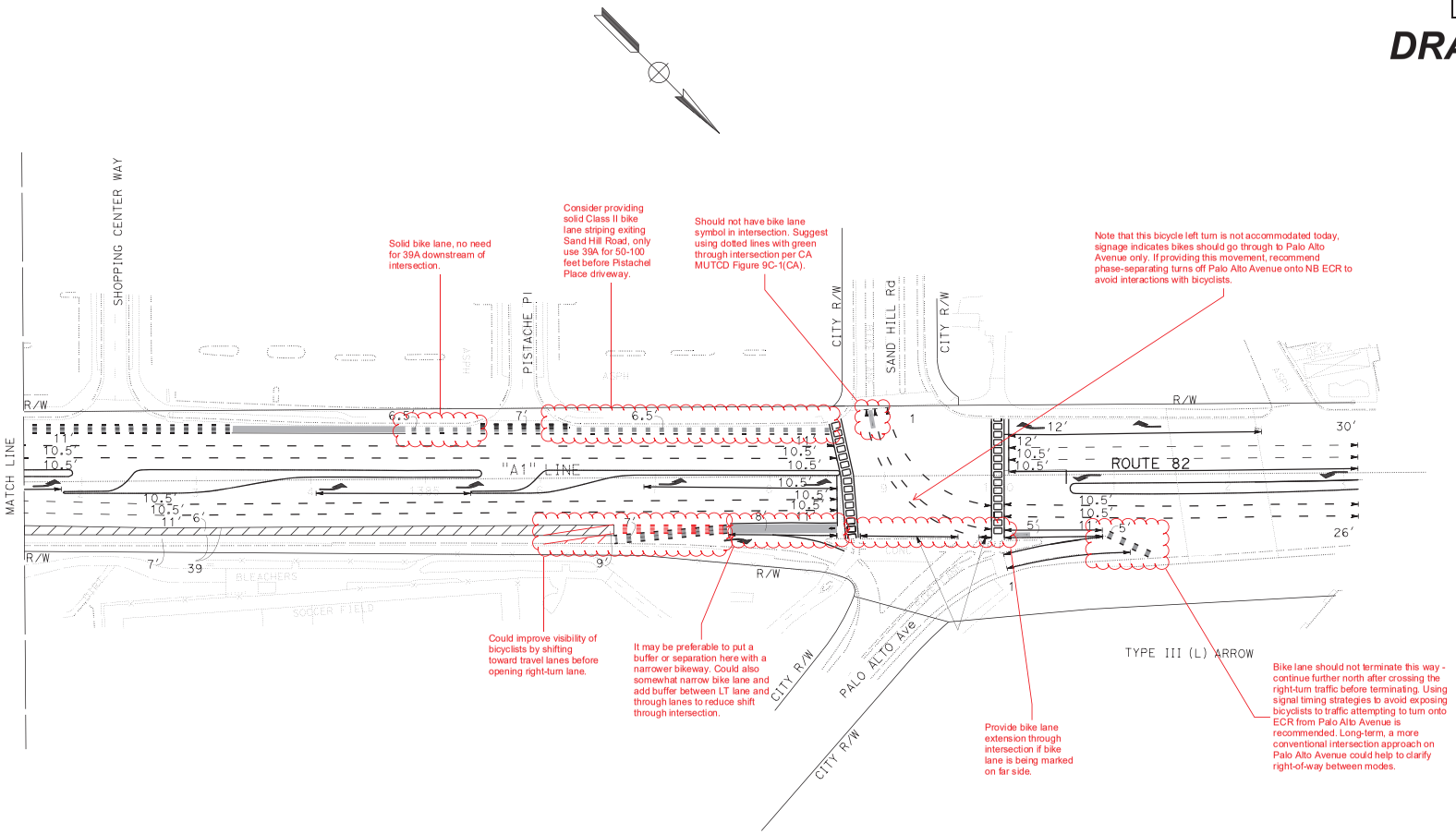
DRAFT 5/20/24



These comments represent suggestions based on a review of the proposed design plans and existing conditions, but require further engineering evaluation to verify feasibility.

APPROVED FOR PAVEMENT DELINEATION WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET PD-1

PAVEMENT DELINEATION PLAN

SCALE: 1" = 50'

PD-30

REVISION DATE PLOTTED => 22-MAY-2024
TIME PLOTTED => 09:06

01-12-23

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans® TRAFFIC
FUNCTIONAL SUPERVISOR: LESTER LEE
CALCULATED-DESIGNED BY: SON LY
CHECKED BY: RICK YEUNG
REVISED BY: SL
DATE REVISED: 11-18-22

BORDER LAST REVISED 7/2/2010

USERNAME => s135226
DGN FILE => 0419000140na030.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0712

PROJECT NUMBER & PHASE 04190001401

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	SCI	82	18.2/26.4	248	466

12-5-22
REGISTERED CIVIL ENGINEER DATE

January 20, 2023
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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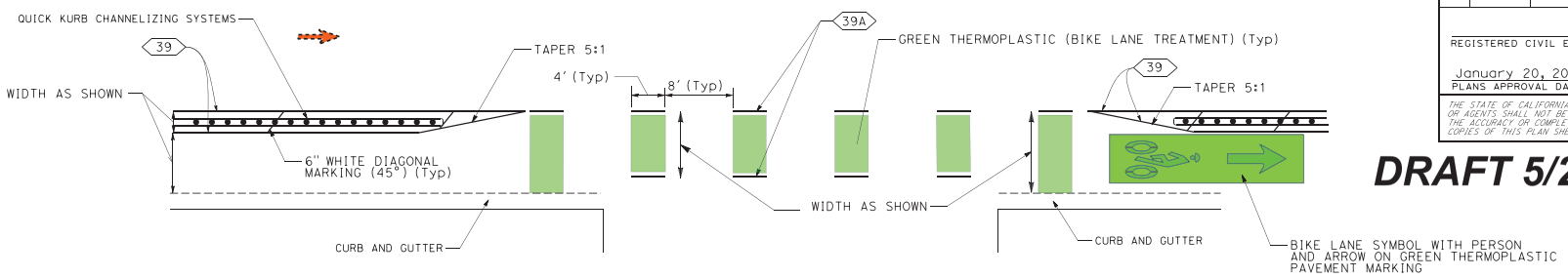
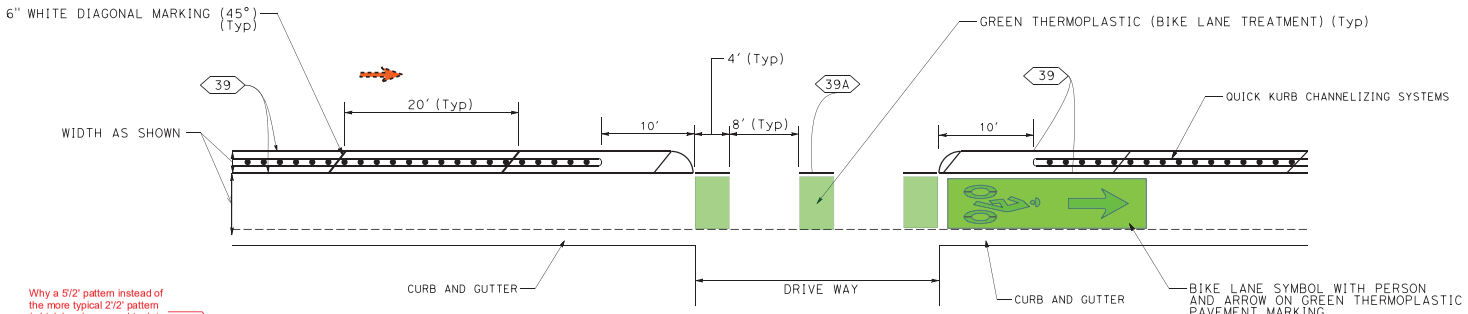
DRAFT 5/20/24



DETAIL A

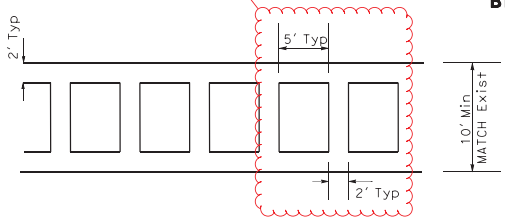
BIKE LANE MARKINGS THROUGH CONFLICT ZONES/INTERSECTION



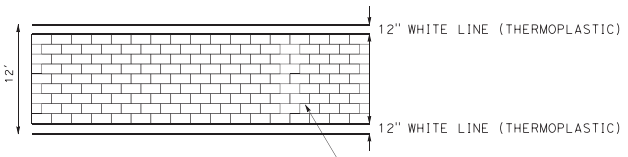
DETAIL B

BIKE LANE MARKINGS THROUGH DRIVEWAY

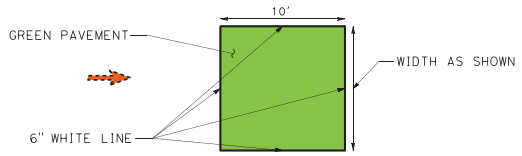
Why a 5'/2' pattern instead of the more typical 2'/2' pattern (which has been used to date on El Camino Real)?



CROSSWALK MARKINGS (LADDER)



STAMPED ASPHALT CROSSWALK
(AT STANFORD Ave AND ROUTE 82)



BOX DETAILS

These comments represent suggestions based on a review of the proposed design plans and existing conditions, but require further engineering evaluation to verify feasibility.

PAVEMENT DELINEATION DETAILS

NO SCALE

PDD-1

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	REVISED BY	DATE REVISED	
TRAFFIC	LESTER LEE	SON LY	RICK YEUNG	11-18-22	

DATE PLOTTED => 5/15/2024
TIME PLOTTED => 10:01:45 AM
LAST REVISION 11-28-22

BORDER LAST REVISED 7/2/2010 | USERNAME => | DGN FILE => ...\04190000140nb001-QUICKKURB.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0712 | PROJECT NUMBER & PHASE 04190001401