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## DRAFT TECHNICAL LETTER

Moraga Avenue S-Curve Improvements in Piedmont, California

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Date: January 9, 2015 Project #: 18507  
To: John Wanger, PE  
From: Jorge A. Barrios, PE; Erin Ferguson, PE  
cc: Mark Bowman, PE

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Kittelison & Associates, Inc. (KAI) reviewed speed data, crash data, and existing field conditions at the Moraga Avenue S-Curve near Ramona Avenue in Piedmont, California. This letter presents findings from the review and improvements for the City's consideration. Figure 1 summarizes the potential improvements for the City's consideration.

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Figure 1: Potential Improvements for City of Piedmont's Consideration

Applying High Friction Surface Treatment to the roadway surface will increase friction for vehicles driving through the S-curve, helping to keep vehicles within the travel lane. Flattening the cross-slope on the southern shoulder may help motorists that drift onto the shoulder maintain control of their vehicle.

Providing yellow centerline pavement markings helps provide positive guidance to motorists through horizontal curves; additional information is available from the Federal Highway Administration<sup>1</sup>.

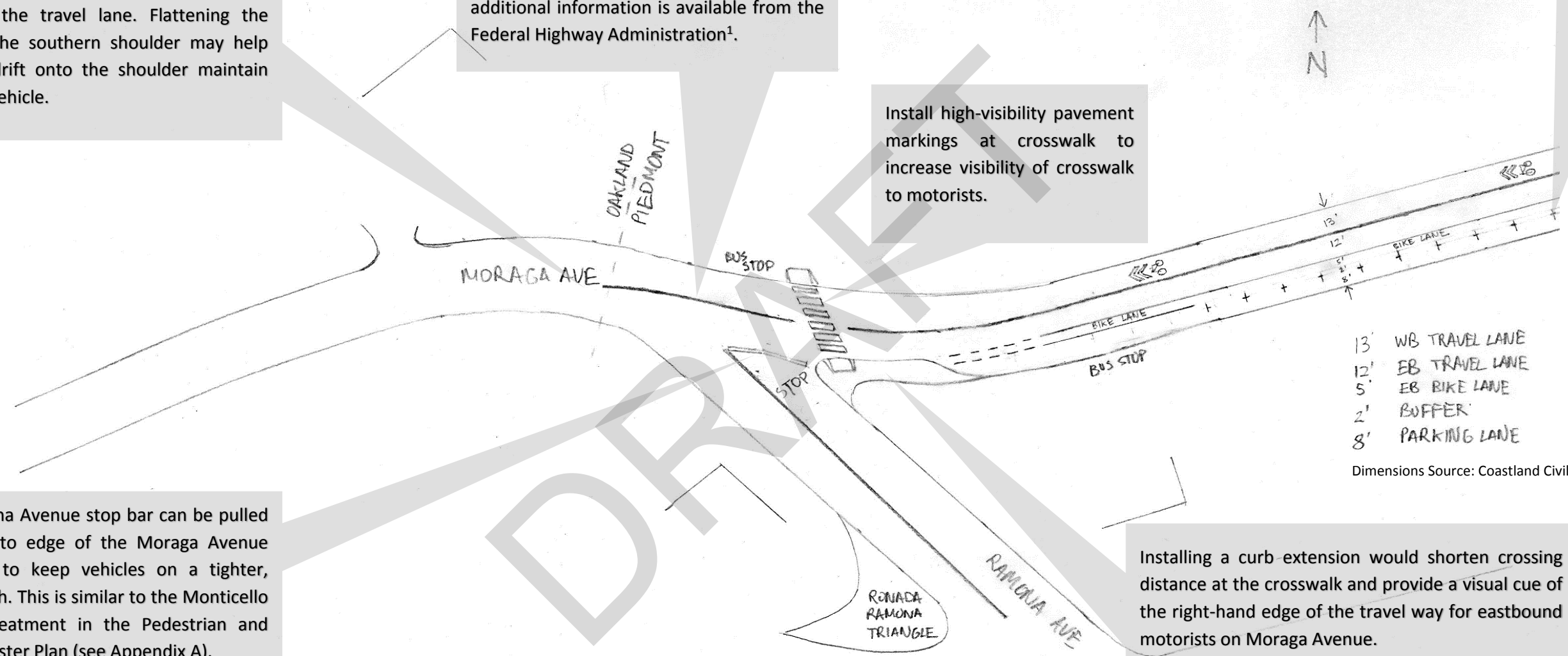
Install high-visibility pavement markings at crosswalk to increase visibility of crosswalk to motorists.

The 2' buffer between the bicycle lane and parking lane can be provided through parking "T's"

The Ramona Avenue stop bar can be pulled up closer to edge of the Moraga Avenue travelway to keep vehicles on a tighter, slower path. This is similar to the Monticello Avenue treatment in the Pedestrian and Bicycle Master Plan (see Appendix A).

Installing a curb extension would shorten crossing distance at the crosswalk and provide a visual cue of the right-hand edge of the travel way for eastbound motorists on Moraga Avenue.

Note: Corners with curb extensions can be difficult to navigate by large trucks. The City may evaluate the amount of truck traffic using Ramona Avenue prior to implementing the curb extension.



Dimensions Source: Coastland Civil Engineering

<sup>1</sup>Low Cost Treatments for Horizontal Curve Safety, Federal Highway Administration. [http://safety.fhwa.dot.gov/roadway\\_dept/horcurves/fhwas07002/ch2.cfm](http://safety.fhwa.dot.gov/roadway_dept/horcurves/fhwas07002/ch2.cfm)



## EXISTING CONDITIONS

Moraga Avenue is a two-lane undivided east-west arterial on the northern border of the City of Piedmont. It is one of four streets that form the backbone of Piedmont's circulation system, according to the City of Piedmont Pedestrian and Bicycle Master Plan (the other three streets are Grand Avenue, Highland Avenue, and Oakland Avenue). Ramona Avenue is a two-way residential street. Both roadways have parallel on-street parking on both sides.

**Figure 2: Project Location**



At the study intersection, Ramona Avenue traffic must stop before turning right or left onto Moraga Avenue. Moraga Avenue traffic does not have to stop. An uncontrolled crosswalk is located on the east leg of the intersection, connecting a transit stop on the north side of Moraga Avenue to Ramona Avenue south of Moraga Avenue.

The KAI team performed field reviews at the study intersection on Monday, December 15, 2014 and Wednesday, December 17, 2014. The rainy weather on December 15<sup>th</sup> highlighted the differences in existing pavement condition between the City of Oakland and City of Piedmont sections of Moraga Avenue, as shown in Figure 2.

During the field visit, the KAI team also noted a relatively steep cross-slope on the south side of Moraga Avenue, dropping from the edge of the eastbound travel lane to the face of curb, as shown in Figure 3.



**Figure 3: Moraga Avenue, near Ramona Avenue. Facing eastbound.**



Source: Aaron Elias, Kittelson & Associates, Inc. (2014)

## PEDESTRIAN AND BICYCLE MASTER PLAN IMPROVEMENTS

The City of Piedmont Pedestrian and Bicycle Master Plan identifies both Moraga Avenue, from Ramona Avenue to the eastern City of Piedmont border, and Ramona Avenue, from Moraga Avenue to Ronada Avenue, as part of its recommended bikeway network. The Moraga Avenue segment would have bicycle lanes up to Estrella Avenue, and then transition to a bicycle route to Mesa Avenue and as an “enhanced bicycle route” from Mesa Avenue to the City of Piedmont border.

The Pedestrian and Bicycle Master Plan defines an “enhanced bike route” as one which includes sharrow stencils on the pavement as well as “Bikes may use full lane” signs. A regular bike route is defined in the Master Plan as one without the sharrow pavement markings but with the roadside signs noted above.

Because Moraga Avenue is a relatively steep grade for bicyclists, the Pedestrian and Bicycle Master Plan included a concept drawing for bikeway improvements on Moraga Avenue near Monticello Avenue. This drawing, as well as a more detailed drawing by Coastland Civil Engineering focused on the study intersection, is included as Appendix A.

## SPOT-SPEED ANALYSIS

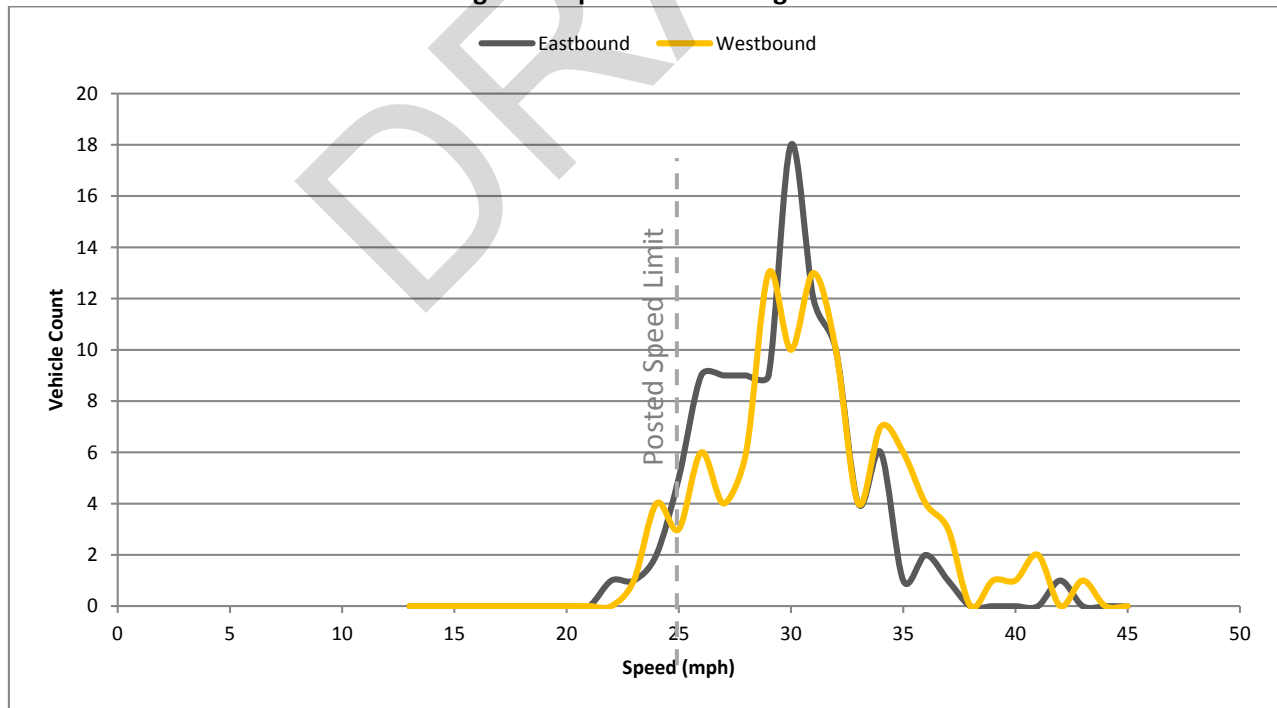
The KAI team obtained speed data through a data collection vendor. The speed data were collected on the off-peak (i.e., free-flow) hours of Monday, December 22, 2014 using a calibrated radar gun mounted on an inconspicuous vehicle as to not affect drivers' behavior. The data includes one hundred vehicles in each direction of travel on Moraga Avenue. Appendix B contains the speed data for individual vehicles.

In the vicinity of the study intersection, the observations indicate that 84 percent of the surveyed motorists travelled in the range of 25 to 34 mph. Table 1 and Figure 4 summarize the speed data.

**Table 1: Speed Data Summary**

Speed Study Metrics	Moraga Avenue, at Ramona Avenue
Speed Limit	25 mph
Median (50th Percentile) Speed	30 mph
85th Percentile Speed	34 mph
10 mph Pace, (% of daily traffic in pace)	25-34 mph, (83.9%)

**Figure 4: Speed Data Histogram**



## HISTORICAL CRASH ANALYSIS

KAI reviewed crash data for the intersection and adjacent roadway segments (within 200 feet of the intersection). KAI used data from the California Highway Patrol Statewide Integrated Traffic Records System (SWITRS) for the crash data review. The crash data covered the period from 2009 through November 2013.

Table 2 summarizes the crashes recorded at each study intersection during the January 1, 2009- November 30, 2013 study period.

The KAI team also received information of recent unreported crashes and spin-outs on Moraga Avenue, just east of the study intersection. The information was supplied by Coastland Civil Engineering on behalf of City of Piedmont staff and residents. It appears that the unreported crashes and community-observed spin-outs are due to vehicles losing control at the S-curve. Incidents of lost control that do not result in an injury or property damage are likely not captured in the crash data.

**Table 2. Historical Crash Data Summary January 1, 2009- November 30, 2013**

Year	Kingston Avenue/Linda Avenue/Rose Avenue Intersection
2009	No collisions recorded.
2010	<ul style="list-style-type: none"> <li>On <b>August 14, 2010</b>, a Property Damage Only (PDO) crash occurred approximately 150 feet east of the study intersection. A vehicle struck a fixed object. Crash data indicates the weather was clear and pavement dry. The crash occurred during day time.</li> </ul>
2011	No collisions recorded.
2012	<ul style="list-style-type: none"> <li>On <b>May 30, 2012</b>, a PDO crash occurred between two vehicles. One vehicle was reported as traveling at unsafe speeds. The crash occurred immediately east of the intersection. Crash data indicates clear weather, dry pavement, and daylight at the time of the crash.</li> <li>On <b>December 9, 2012</b>, a PDO crash occurred approximately 200 feet east of the study intersection. A motorist turned and sideswiped a parked car under clear weather and dry pavement. The crash occurred during day time.</li> </ul>
2013	<ul style="list-style-type: none"> <li>On <b>July 3, 2013</b>, a PDO crash occurred between a vehicle backing out of a parked position and another parked vehicle. The crash occurred under clear weather, dry pavement, and daylight.</li> <li>On <b>October 5, 2013</b>, a PDO crash occurred at the study intersection. A vehicle struck a fixed object; the crash occurred at daytime and with dry pavement.</li> <li>On <b>October 12, 2013</b>, a PDO crash occurred at the study intersection between a turning vehicle and a vehicle traveling on Moraga Avenue. The crash occurred under clear weather, dry pavement, and daylight.</li> <li>On <b>October 27, 2013</b>, a nighttime DUI-related crash occurred at the study intersection. A vehicle hit a fixed object under foggy weather and dry pavement. The crash was a PDO crash.</li> </ul>

Source: California Highway Patrol Statewide Integrated Traffic Records System (SWITRS)

## CONCLUSION

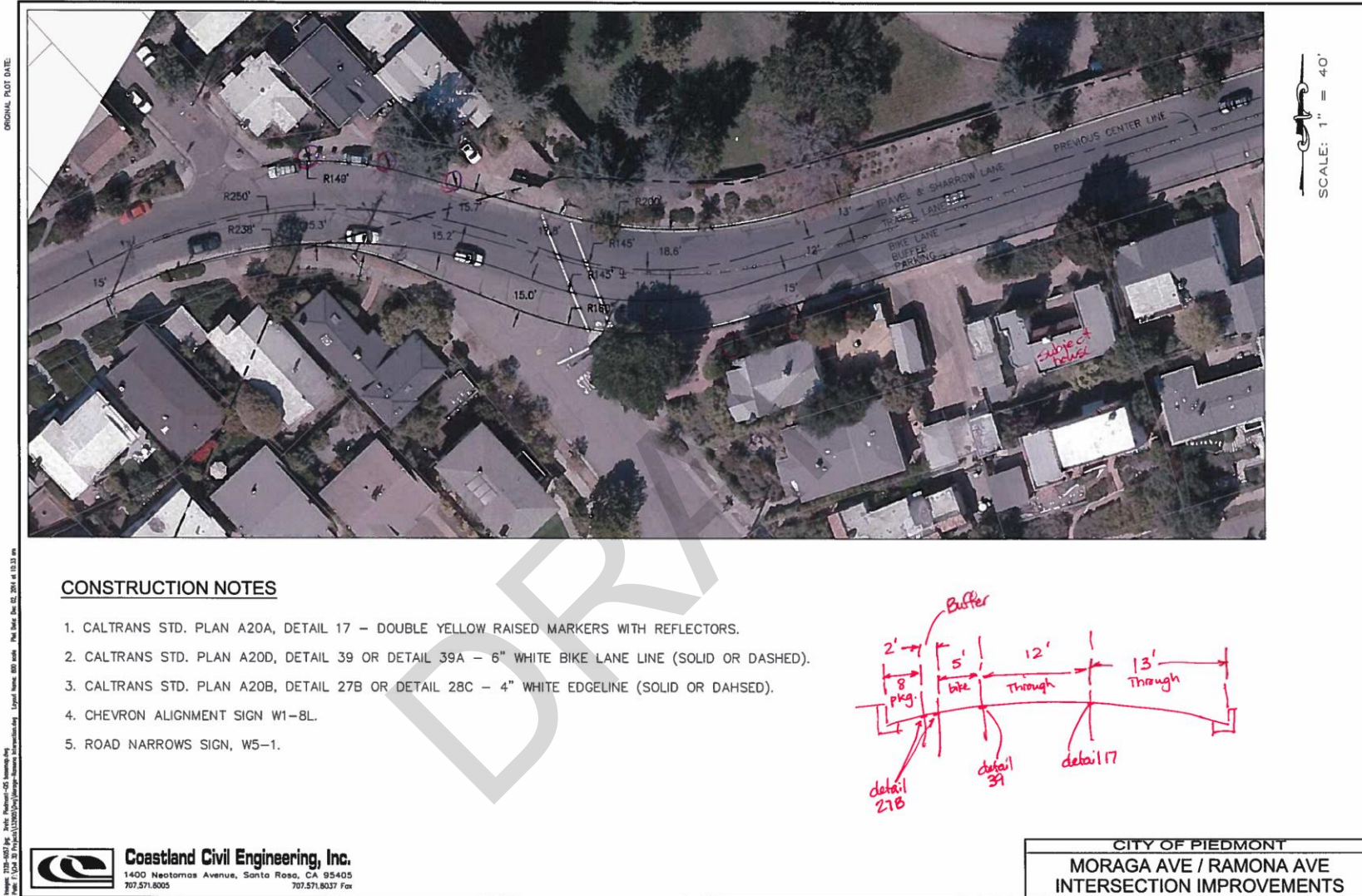
The KAI team reviewed speed data and historical crash data, as well as potential improvements already identified in the City of Piedmont Pedestrian and Bicycle Master Plan and documented by Coastland Civil Engineering. KAI used this information to develop a list of potential improvements to the Moraga Avenue S-curve for the City of Piedmont to consider. Figure 1 at the beginning of this document summarizes the potential improvements identified by the KAI team.

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## APPENDIX A: PEDESTRIAN AND BICYCLE MASTER PLAN IMPROVEMENTS

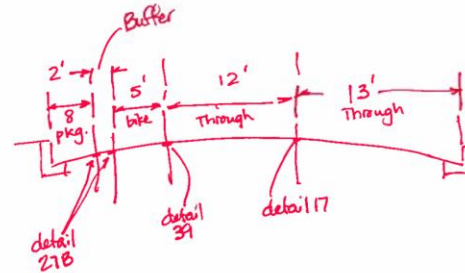
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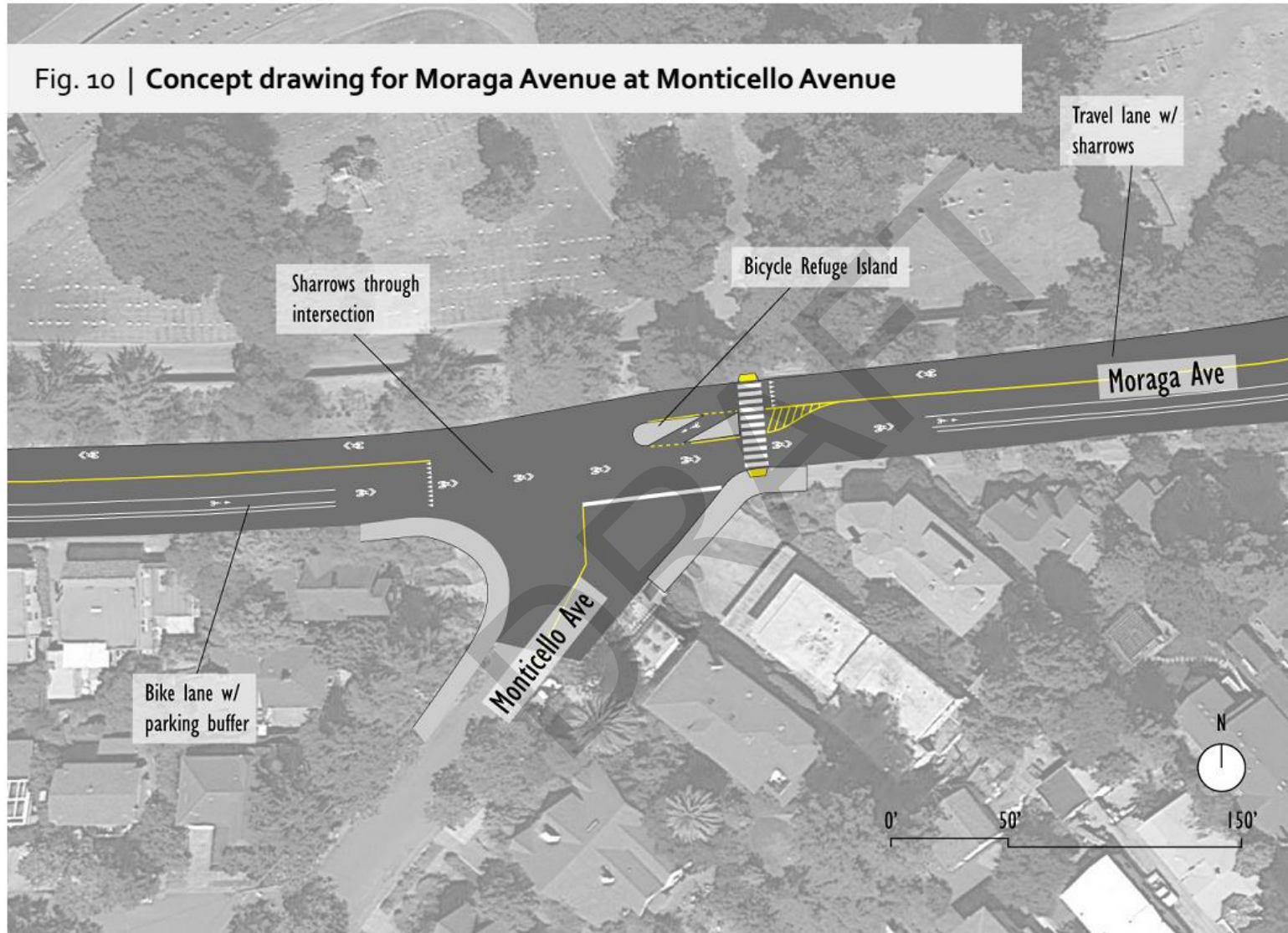
**CONSTRUCTION NOTES**

1. CALTRANS STD. PLAN A20A, DETAIL 17 – DOUBLE YELLOW RAISED MARKERS WITH REFLECTORS.
2. CALTRANS STD. PLAN A20D, DETAIL 39 OR DETAIL 39A – 6" WHITE BIKE LANE LINE (SOLID OR DASHED).
3. CALTRANS STD. PLAN A20B, DETAIL 27B OR DETAIL 28C – 4" WHITE EDGELINE (SOLID OR DAHSED).
4. CHEVRON ALIGNMENT SIGN W1-BL.
5. ROAD NARROWS SIGN, W5-1.



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**CITY OF PIEDMONT**  
**MORAGA AVE / RAMONA AVE**  
**INTERSECTION IMPROVEMENTS**



Source: City of Piedmont Pedestrian and Bicycle Master Plan (2014)

## APPENDIX B: SPEED DATA

Location: Moraga Avenue at Ramona Avenue  
Date: 12/22/2014  
Surveyor: CA

EB			WB	
Time	Speed	Vehicle Count	Time	Speed
1:00 PM	31	1	1:00 PM	29
1:00 PM	34	2	1:00 PM	31
1:01 PM	28	3	1:00 PM	24
1:01 PM	26	4	1:01 PM	32
1:02 PM	33	5	1:02 PM	30
1:02 PM	35	6	1:02 PM	27
1:02 PM	28	7	1:03 PM	28
1:03 PM	30	8	1:04 PM	31
1:03 PM	30	9	1:04 PM	26
1:04 PM	27	10	1:04 PM	29
1:04 PM	32	11	1:05 PM	25
1:04 PM	26	12	1:05 PM	23
1:05 PM	34	13	1:06 PM	32
1:05 PM	31	14	1:06 PM	30
1:05 PM	25	15	1:06 PM	29
1:06 PM	28	16	1:07 PM	26
1:06 PM	29	17	1:07 PM	29
1:07 PM	31	18	1:07 PM	36
1:07 PM	30	19	1:08 PM	25
1:07 PM	31	20	1:08 PM	26
1:08 PM	26	21	1:09 PM	30
1:08 PM	34	22	1:09 PM	32
1:09 PM	30	23	1:09 PM	28
1:09 PM	25	24	1:10 PM	24
1:09 PM	29	25	1:11 PM	31
1:10 PM	32	26	1:11 PM	30
1:10 PM	30	27	1:11 PM	28
1:10 PM	27	28	1:12 PM	26
1:11 PM	29	29	1:12 PM	35
1:12 PM	32	30	1:12 PM	31
1:12 PM	30	31	1:13 PM	29
1:13 PM	26	32	1:13 PM	30
1:13 PM	25	33	1:13 PM	27
1:13 PM	34	34	1:14 PM	24
1:14 PM	30	35	1:14 PM	31
1:14 PM	29	36	1:14 PM	26
1:15 PM	24	37	1:15 PM	32
1:16 PM	33	38	1:15 PM	31
1:16 PM	28	39	1:15 PM	29
1:17 PM	25	40	1:16 PM	34
1:18 PM	37	41	1:17 PM	27
1:18 PM	31	42	1:17 PM	25
1:19 PM	42	43	1:18 PM	32
1:19 PM	30	44	1:18 PM	30
1:20 PM	28	45	1:18 PM	37
1:20 PM	26	46	1:19 PM	24
1:20 PM	28	47	1:19 PM	29
1:21 PM	31	48	1:20 PM	31
1:21 PM	36	49	1:20 PM	28
1:22 PM	30	50	1:21 PM	33
1:22 PM	31	51	1:21 PM	30
1:23 PM	27	52	1:22 PM	26
1:23 PM	36	53	1:22 PM	29
1:23 PM	29	54	1:23 PM	33
1:24 PM	28	55	1:23 PM	30



(cont'd)

Location: Moraga Avenue at Ramona Avenue  
Date: 12/22/2014  
Surveyor: CA

EB			WB	
Time	Speed	Vehicle Count	Time	Speed
1:24 PM	30	56	1:23 PM	43
1:24 PM	34	57	1:23 PM	32
1:25 PM	32	58	1:23 PM	32
1:25 PM	29	59	1:24 PM	31
1:25 PM	27	60	1:25 PM	30
1:25 PM	23	61	1:26 PM	31
1:26 PM	33	62	1:26 PM	34
1:26 PM	30	63	1:26 PM	29
1:27 PM	31	64	1:27 PM	30
1:27 PM	22	65	1:27 PM	34
1:28 PM	30	66	1:28 PM	36
1:29 PM	29	67	1:28 PM	28
1:29 PM	27	68	1:29 PM	29
1:30 PM	31	69	1:29 PM	35
1:30 PM	28	70	1:29 PM	31
1:31 PM	26	71	1:30 PM	32
1:31 PM	30	72	1:30 PM	34
1:32 PM	34	73	1:31 PM	41
1:32 PM	26	74	1:31 PM	35
1:32 PM	32	75	1:31 PM	32
1:32 PM	28	76	1:32 PM	39
1:33 PM	32	77	1:33 PM	6
1:33 PM	30	78	1:33 PM	27
1:33 PM	31	79	1:34 PM	28
1:33 PM	33	80	1:35 PM	34
1:34 PM	27	81	1:35 PM	33
1:34 PM	29	82	1:36 PM	41
1:35 PM	27	83	1:36 PM	36
1:35 PM	31	84	1:36 PM	29
1:35 PM	26	85	1:37 PM	29
1:36 PM	27	86	1:37 PM	37
1:37 PM	30	87	1:37 PM	35
1:37 PM	24	88	1:38 PM	35
1:37 PM	32	89	1:38 PM	32
1:38 PM	32	90	1:39 PM	31
1:39 PM	25	91	1:39 PM	36
1:39 PM	32	92	1:40 PM	31
1:39 PM	26	93	1:40 PM	40
1:40 PM	30	94	1:41 PM	34
1:40 PM	30	95	1:42 PM	34
1:40 PM	27	96	1:42 PM	29
1:41 PM	30	97	1:42 PM	35
1:41 PM	32	98	1:42 PM	37
1:41 PM	29	99	1:43 PM	31
1:41 PM	31	100	1:43 PM	33

EB Average	29.62
EB Mode	30

EB Average	30.71
EB Mode	29