1st Street Corridor Roundabout Feasibility Study

Working Paper #1

Prepared For
City of Napa

Prepared By:

omni · means
ENGINEERS · PLANNERS

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March 2013

25-1753-01
(R1480RPT003.DOCX)

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INTRODUCTION

Due to the tight intersection spacing and the constrained overcrossing on 1st Street with SR 29, the 1st Street corridor between Freeway Drive and California Boulevard in the City of Napa currently experiences congested conditions during the peak commute periods. With the buildout of General Plan uses and land uses as identified in the Downtown Specific Plan, traffic volumes on the corridor are expected to increase by approximately twenty-five (25) percent from the current conditions. As such, the existing lane geometrics will not be able to accommodate the future traffic volumes along the corridor and the congested conditions will be further exacerbated with the forecasted increase in traffic volumes.

In order for the 1st Street corridor between Freeway Drive and California Boulevard (hereafter referred to as the 1st Street Corridor) to operate at an acceptable level of service (LOS) with improved safety, improvements are needed at the critical intersections on the corridor. Since our initial review of the 1st Street and California Avenue as a potential roundabout intersection, we have expanded the roundabout solution to include the 2nd Street and California intersection as a part of the "Streets West of Downtown" project. The compatibility presented by these two roundabouts leads directly to the idea of extending this approach across State Route 29 encompassing the two SR 29 ramp intersections, as well as potentially the Freeway Drive/1st Street intersection. Furthermore, this approach has the potential to save millions of dollars by eliminating the need to replace the 1st Street overcrossing with SR 29 as would be required with a conventional interchange reconstruction project.

This study provides:

- A description of the existing conditions along the 1st Street Corridor,
- Identifies intersection improvements (roundabouts),
- Determine the feasibility of adding an additional southbound off-ramp to accommodate the southbound SR 29 to westbound First Street movement, and
- Proposes roundabout design features and geometric design standards to be considered in the preparation of roundabout concepts.

This Draft Working Paper #1 (WP#1) has been prepared in order to primarily document OMNI-MEANS' compilation and understanding of available background data and information pertinent to the feasibility study. The WP#1 also provides an outline for the tasks that will be included in the feasibility study. The data and understandings presented herein will be used as inputs towards the preparation of the roundabout concepts and the feasibility study. The technical analysis for the various alternatives will be discussed in subsequent Working Papers, as those tasks get completed. Finally, the data, information and results presented in the Working Papers will be compiled, edited/revised and presented in a Final Report that will serve as technical documentation in support of the feasibility study.

EXISTING CONDITIONS

The City of Napa is the principal community and county seat of Napa County. Napa is roughly 18 square miles in size. In 2009, the Department of Finance estimated the City's population to be 72,000.

EXISTING TRANSPORTATION SYSTEM

The following roadways provide primary circulation within the City of Napa in the vicinity of the proposed study area.

> ***State Route 29 (SR 29)*** is a key facility that travels in the north-south direction between I-80 in Vallejo and CA 20 in Upper Lake. Within Napa, SR 29 bisects the City as a four-lane highway with connecting interchanges at major cross streets. It serves as a primary route for commuter and industrial truck traffic traveling between Napa County and the

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San Francisco-Oakland Bay Area.

1st Street is a major two-lane east west arterial that traverses between SR 121, from within the City, to SR 29, where it forms a grade-separated interchange. In the downtown area between Main Street and California Boulevard, 1st Street is a one-way Street in the westbound direction. West of California Boulevard, 1st Street is a two way street and is called as Browns Valley Road. In the vicinity of the study area,

Existing average daily traffic volume on the 1st Street corridor is approximately 25,700. The current AM and PM peak hour volume on the 1st Street corridor is 2,241 and 2,395 vehicles, respectively. The anticipated General Plan build-out plus downtown specific plan volume is 2,880 and 3,005 vehicles in the AM and PM peak hour, respectively. This represents a 25%-28% increase from the current levels. With these volumes, and the existing intersection lane geometry and control, the corridor is expected to experience congested conditions.

2nd Street is an east-west road that extends between California Blvd and Main Street. The roadway operates as a one-way street heading eastbound and provides access to residential and commercial areas in Napa.

California Boulevard is a two-lane north-south collector that runs parallel to SR 29 extends between Trancas Street and Laurel Street.

EXISTING TRAFFIC VOLUMES

The following locations have been identified as the critical study intersections in this analysis:

Intersections:

1. 1st Street / Freeway Drive
2. 1st Street / SR 29 SB Ramps
3. 1st Street / SR 29 NB Ramps
4. California Boulevard / 1st Street
5. California Boulevard / 2nd Street

Weekday peak-hour intersection traffic counts were conducted at the above locations in November 2010. Since the peak hour intersection data was more than fifteen months old, traffic counts were conducted on 30th and 31st of May 2012 on the 1st Street overcrossing with SR 29 to verify if any adjustments will be required for the 2010 data. As indicated below, the November 2010 counts (bold and shaded) are greater than the May 2012 counts. Therefore, adjustments to November 2010 counts are not required.

Count	AM Peak Hour	PM Peak Hour
Nov-10	**2241**	**2395**
30-May-12	1617	1904
31-May-12	1675	2130

The AM peak-hour is defined as the one continuous hour of peak traffic flow counted between 7:00 AM and 9:00 AM, and the PM peak-hour is defined as the one continuous hour of peak traffic flow counted between 4:00 PM and 6:00 PM under typical weekday conditions when schools are in session.

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EXISTING PEDESTRIAN FACILITIES

In the project study area, pedestrian facilities are well established throughout the residential community east of California Boulevard. Specifically along the 1st Street corridor, sidewalk exists on the southside of 1st Street. Sidewalks are present with appropriate pedestrian ramps, signs, and crosswalks at the SR 29 NB ramps stop controlled intersection and at the signalized intersections at California Boulevard, SR 29 SB ramps and Freeway Drive, sidewalks, crosswalk markings, pedestrian warning signs, and crossing signals are present and operating along each intersection approach.

EXISTING BICYCLE FACILITIES

The City of Napa General Plan, *Envision Napa 2020*, plans to develop and maintain a safe and efficient bike route network connecting key destinations for residents and visitors. Chapter 3 of the General Plan identifies existing bike facilities with classifications from the Department of Transportation.

> *"Class I Bike Paths are completely separated right-of-ways designated for the exclusive use of bicycles. Cross-flows by pedestrians and motorized vehicles are minimized."*
> *"Class II Bike Lanes are restricted right-of-ways designated for the exclusive or semi-exclusive use of bicycles. Travel by motor vehicles or pedestrians are not allowed; except for vehicle parking and cross flows. In most cases, Class II Bikeways require a lane of at least four feet of well-maintained pavement for the cyclist to ride on."*
> *"Class III Bike Routes are shared right-of-ways either on the street or on the sidewalk, and are designated by signs placed on vertical posts or markings stenciled on the pavement. Any bikeway which shares a through-traffic right-of-way with motor vehicles and pedestrians is considered a Class III bikeway."*

The General Plan notes that bicycle use in the City is expected to increase and intends to improve the existing bike network for safe and efficient travel. In the project study area, clearly marked Class II bike lanes currently exist along 1st Street west of the SR 29 interchange. Additional Class II and Class III bicycle facilities along California, 1st, and 2nd Street are planned in the future bikeway system.

EXISTING TRANSIT SERVICES

Several transit systems within the City provide service for local residents and visitors.

> ***Valley Intracity Neighborhood Express (VINE)*** is the primary transit service for the City of Napa. A total of five VINE routes provide access to various destinations in the City, and each route stops at the Napa downtown transit terminal allowing for a convenient transfer between bus lines. Several bus stops are also located on 1st, 2nd, and 3rd Street.
>
> ***Napa Valley Transit (NVT)*** is a county operated transit service that provides regional connections between Napa and its neighboring communities. The main transfer terminal in downtown Napa allows passengers to utilize other transit systems in the City.
>
> ***FlexRide*** is a curb-to-curb service that provides affordable one-way trips during weeknights and Sunday. The FlexRide option requires advanced reservation to travel to any designation within Napa.

Detailed information regarding the routes, bus-stops, and schedules are available at the Napa County Transportation & Planning Agency website (http://www.ncpta.net).

LARGE TRUCK TRAFFIC

The 1st Street corridor also experiences a regular volume of trucks as it provides access to various

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commercial centers along the corridor and businesses in the downtown. Provided below is a breakdown of vehicle classification on 1st Street overcrossing with SR 29.

	MOTOR-CYCLE	AUTO	2-AXLE	3-AXLE	4-AXLE	5-AXLE	>5-AXLE	VOLUME
Daily	133	23,559	1,083	72	4	781	81	25,713
	0.52%	91.62%	4.21%	0.28%	0.02%	3.04%	0.32%	100%
AM Peak Hour	8	1,434	139	3	0	85	6	1,675
	0.48%	85.61%	8.30%	0.18%	0.00%	5.07%	0.36%	100.00%
PM Peak Hour	7	1,917	105	6	0	79	16	2,130
	0.33%	90.00%	4.93%	0.28%	0.00%	3.71%	0.75%	100.00%

The truck percentage for trucks with more than 2-axles during the AM peak hour is 5.61% and 4.74% during the PM peak hour. These truck percentages will be used in the operations analysis.

EXISTING TRANSPORTATION POLICIES

The following section describes governing circulation policies established in the City of Napa.

APPLICABLE LOS POLICIES

The Napa General Plan, *Envision Napa 2020*, specifies minimum level-of-service standards for all streets and intersections within the City's jurisdiction. In chapter 3, policy T-2.1 establishes the following performance standards for acceptable LOS:

> *"The City shall ensure that traffic levels of service (LOS) will not exceed midrange LOS D at all signalized intersections on arterial and collector streets with the following exceptions where midrange LOS E will be permitted:*
>
> *a. Downtown Napa within the area bounded by Soscol Avenue, First Street, California Boulevard and Third Street;*
> *b. Jefferson Street between Third Street and Old Sonoma Road; and*
> *c. Silverado Trail between Soscol Avenue and First Street*
>
> *"In addition, until funding is available to improve the intersection of Trancas/Redwood and SR 29, LOS F shall be permitted."*

Criteria for unsignalized or stop-controlled intersections:

- For unsignalized intersections, the minimum acceptable level of service recommended by the Draft Policy Document is midrange LOS 'E'.[7]

- For unsignalized intersections, a low-volume movement may have delays that yield LOS 'E' or 'F' but may still be considered as having "acceptable operation" by considering both total delay and LOS (defined in terms of average control delay). An intersection traffic movement at a stop-controlled approach can be deemed to have acceptable operation under the following conditions
  - Total delay less than 4.0 vehicle-hours for single lane movement with low volume
  - Total delay less than 5.0 vehicle-hours for multilane movement with low volume

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APPLICABLE ROADWAY PROVISIONS

The Napa General Plan also identifies "crucial corridors" which serve a vital role in communitywide circulation and providing accessibility to key community facilities. Several policies have been established to maintain acceptable traffic flow along Napa's crucial corridors.

CALTRANS LEVEL OF SERVICE STANDARDS

Per the City of Napa Traffic Impact Analysis Guidelines, for traffic signals on State highway facilities, the following criteria shall be used in a collaborative effort between the City of Napa and Caltrans.

- The City of Napa shall use as a reference the threshold level LOS 'E', consistent with the criteria used by the former Napa County Congestion Management Agency (CMA) for freeway mainline sections and freeway ramps. Facilities previously under the jurisdiction of the CMA in the City of Napa are the State Highways (SR-12, SR-29, SR-121, and SR-221).
- Caltrans has indicated that "Caltrans endeavors to maintain a target LOS at the transition between LOS 'C' and LOS 'D' … on State highway facilities; however, Caltrans acknowledges that this may not always be feasible and recommends that the lead agency consult with Caltrans to determine the appropriate target LOS. If an existing State highway facility is operating at less than the appropriate target LOS, the existing MOE (measure of effectiveness) should be maintained." Through the use of the Napa TMP Traffic Model, which was co-sponsored by the City of Napa, Caltrans, NCTPA, and NCFCWCD, the State highway intersections operating at less than appropriate target LOS per Caltrans criteria have been identified.

TRAFFIC ANALYSIS PARAMETERS

The following section outlines the methodology and analysis parameters used to quantify existing and projected operations at critical study locations.

INTERSECTION LOS METHODOLOGIES

Intersection level-of-service (LOS) has been calculated for all control types using the methods documented in the Transportation Research Board publications *Highway Capacity Manual, Fourth Edition, 2000*. Traffic operations have been quantified through the determination of LOS. LOS determinations are presented on a letter grade scale from "A" to "F", whereby LOS "A" represents free-flow operating conditions and LOS "F" represents over-capacity conditions. For a signalized or all-way stop-controlled (AWSC) intersection, an LOS determination is based on the calculated average delay for all approaches and movements. For a two-way stop-controlled (TWSC) intersection, an LOS determination is based upon the calculated average delay for all movements of the worst-performing approach. LOS definitions for different types of intersection controls are presented in Table 1.

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TABLE 1
LOS CRITERIA AND DEFINITIONS FOR INTERSECTIONS

Level of Service	Type of Flow	Delay	Maneuverability	Stopped Delay/Vehicle		
				Signalized And Roundabout	Un signalized	All-Way Stop
A	Stable Flow	Very slight delay. Progression is very favorable, with most vehicles arriving during the green phase not stopping at all.	Turning movements are easily made, and nearly all drivers find freedom of operation.	< 10.0	< 10.0	< 10.0
B	Stable Flow	Good progression and/or short cycle lengths. More vehicles stop than for LOS A, causing higher levels of average delay.	Vehicle platoons are formed. Many drivers begin to feel some what restricted within groups of vehicles.	>10.0 and < 20.0	>10.0 and < 15.0	>10.0 and < 15.0
C	Stable Flow	Higher delays resulting from fair progression and/or longer cycle lengths. Individual cycle failures may begin to appear at this level. The number of vehicles stopping is significant, although many still pass through the intersection without stopping.	Back-ups may develop behind turning vehicles. Most drivers feel somewhat restricted	>20.0 and < 35.0	>15.0 and < 25.0	>15.0 and < 25.0
D	Approaching Unstable Flow	The influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavorable progression, long cycle lengths, or high volume-to-capacity ratios. Many vehicles stop, and the proportion of vehicles not stopping declines. Individual cycle failures are noticeable.	Maneuverability is severely limited during short periods due to temporary back-ups.	>35.0 and < 55.0	>25.0 and < 35.0	>25.0 and < 35.0
E	Unstable Flow	Generally considered to be the limit of acceptable delay. Indicative of poor progression, long cycle lengths, and high volume-to-capacity ratios. Individual cycle failures are frequent occurrences.	There are typically long queues of vehicles waiting upstream of the intersection.	>55.0 and < 80.0	>35.0 and < 50.0	>35.0 and < 50.0
F	Forced Flow	Generally considered to be unacceptable to most drivers. Often occurs with over saturation. May also occur at high volume-to-capacity ratios. There are many individual cycle failures. Poor progression and long cycle lengths may also be major contributing factors.	Jammed conditions. Back-ups from other locations restrict or prevent move-ment. Volumes may vary widely, depending prin-cipally on the downstream back-up conditions.	> 80.0	> 50.0	> 50.0

References: 2010 Highway Capacity Manual

TECHNICAL ANALYSIS PARAMETERS

This study provides an evaluation of traffic conditions which incorporates appropriate heavy vehicle adjustment factors, peak-hour factors, and signal lost-time factors. LOS operations will be determined using HCM-2000 methodologies for determining intersection delay, incorporating the aforementioned factors. For Existing conditions, PHF observed from the counts was used within the analysis. For future conditions, a PHF of 0.95 has been used within the analysis. In addition, a minimum traffic signal cycle length of 80 seconds has been used at signalized intersection locations, with 4 seconds of "lost time" per critical signal phase. Study intersections were analyzed with a truck percentage estimate of 6% during the AM peak period and 5% during the PM peak period based on the data obtained from counts. The *Synchro Version 7* software suite by Trafficware has been used to implement the HCM-2000 analysis methodologies.

ANALYSIS SOFTWARE

Operational performance of the roundabout was evaluated using two computer simulation/modeling

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programs which are discussed below. The operational performance outputs from the software are coupled with sound engineering principles and judgment was used in the preparation of the roundabout concepts within this study. Synchro, the computer simulation tool used for evaluating the performance of traffic signals) is also discussed within this section.

Synchro
Synchro7 is an integrated computer software program that was used to evaluate the operational characteristics of traffic signal and stop controlled intersections using the HCM-2000 analysis methodologies.

SIDRA
The SIDRA model is a "gap acceptance" model that uses the design parameters input, and predicts operations based on theoretical gap characteristics. SIDRA uses a bunched exponential model for emulating gap acceptance.

EXISTING CONDITIONS INTERSECTION LEVELS OF SERVICE

Results of the existing conditions level of service analysis at all 5 study intersections during the AM and PM peak hours are summarized in Table 2.

TABLE 2
EXISTING CONDITIONS INTERSECTION LOS

#	Intersection	Control Type[1,2]	Target LOS	AM Peak Hour		PM Peak Hour	
				Delay	LOS	Delay	LOS
1	1st Street / Freeway Drive	Signal	D	44.1	D	30.3	C
2	1st Street / SR 29 SB Ramps	Signal	E	13.6	B	12.6	B
3	1st Street / SR 29 NB Ramps	TWSC	E	36.7	E	20.6	C
4	California Boulevard / 1st Street	Signal	E	20.8	C	27.3	C
5	**California Boulevard / 2nd Street**	**TWSC**	**E**	**OVR**	**F**	**OVR**	**F**

Notes:
1. TWSC = Two Way Stop Control
2. LOS and Delay based on worst minor street approach for TWSC intersections
3. Warrant = Based on California MUTCD Warrant 3

As shown in Table 2, the study intersections operate at acceptable levels of service, with the exception of the California Boulevard 2nd Street intersection.

The analysis indicates that the 95th percent queues exceed the available storage for majority of the intersection during the AM and PM peak periods. This results in congested conditions along the corridor.

FUTURE FORECASTS

The Napa Travel Demand Model is based on the existing regional travel demand model maintained by the Napa County Transportation Planning Agency (NCTPA) and the Solano Transportation Authority (STA). This model covers the entire Napa County and has the ability to forecast future traffic volumes within the City of Napa. The traffic forecasting model is a land use (households) and socio economic data (employment) driven model which uses the trip generation characteristics of various land uses to predict

the travel interaction associated with each land use, and therefore the anticipated level of traffic flow on the street network. The model outputs Year 2030 forecasts in the form of directional AM and PM peak hour link volumes.

The traffic model available for forecasts is a regional model and the forecasts are based on assumptions in land use and socio economic development and circulation improvements over the next 20 years. Before using the forecasts, due to the regional nature of the model it is important to verify the accuracy of these assumptions to ascertain if they are applicable for the smaller area that is included within the study.

LAND USE

The first activity was for OMNI-MEANS to verify that the land use data base within the model as it relates to the City of Napa is consistent with the General Plan, and other factors used to generate the traffic volume forecasts in the immediate area of the intersections under study. This model review is not intended to be an exhaustive critique of the validity of the model.

Traffic volume forecasts are derived by loading the calibrated base year model with new trips generated by future development in areas currently vacant or underdeveloped. The future development land uses are generally taken from the City's General Plan. Areas in the model are aggregated into Traffic Analysis Zones (TAZs). Similar to Census Blocks, TAZs are designed to reflect areas with homogeneous land use (e.g. residential and non-residential) and logical traffic access points.

The travel demand model summarizes the land use into seven categories. Residential development is divided by single-family and multi-family development, and summarized by the number of dwelling units. Non-residential development is split between retail, service, other, Agriculture, Manufacturing and Wholesale uses, and summarized by number of employees. The model land uses for the City are presented in Table 3. The Year 2030 model land uses were compared to the Year 2030 City of Napa population, employment and housing projections provided by City staff (ABAG projections). The ABAG projections do not have individual breakdowns within the residential and non-residential uses but rather provides total which are sufficient for comparison purposes.

TABLE 3
SUMMARY OF CITY'S LAND USE INFORMATION

Jurisdiction	Land Use Category	2030 Model	ABAG (2030)
	Housing		
City of Napa	Total Housing Units	35,444	35,770
	Population	92,951	91,600
Napa County	Total Housing Units	58,902	58,500
	Population	154,091	153,400
	Employment		
City of Napa	Total Employment	33,176	46,760
Napa County	Total Employment	92,147	91,500

As shown in Table 3, the residential land uses and the associated population and employment estimates from the model for Year 2030 conditions compare very well against the ABAG projections. Since the travel demand model inputs are reasonably consistent with the ABAG assumptions, the forecasts from the travel demand model for the City of Napa have been utilized within this study, with modifications.

For the purposes of this analysis, Year 2035 forecasts were derived by adding a 1.2% growth per year to the Year 2030 forecasts. Based on the comparison of existing and Year 2030 forecasts, it was observed that traffic on the corridor increased by approximately 1.2% per year.

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YEAR 2035 ALTERNATIVES ANALYSES

The traffic flow conditions for forecast year 2035 were developed with through the use of the NCTPA model and assistance of the city staff. These traffic operational demands have formed the common traffic conditions for all Year 2035 alternatives traffic operations analysis.

ALTERNATIVES

The following four alternatives will be evaluated within this study:

- No Build – Existing Intersection Lane geometry and control
- Roundabout Intersection
- Roundabout Intersection – with new SB off-ramp

NO BUILD ALTERNATIVE

For the no build traffic operation evaluation, no study area improvements over what currently exists have been assumed. Table 4 presents Year 2035 No Build Condition AM and PM peak hour intersection LOS.

TABLE 4
YEAR 2035 CONDITIONS INTERSECTION LOS – NO BUILD

#	Intersection	Control Type[1,2]	Target LOS	AM Peak Hour		PM Peak Hour	
				Delay	LOS	Delay	LOS
1	1st Street / Freeway Drive	Signal	D	43.0	D	30.4	C
2	**1st Street / SR 29 SB Ramps**	**Signal**	**E**	**81.0**	**F**	23.3	C
3	**1st Street / SR 29 NB Ramps**	**TWSC**	**E**	**51.7**	**F**	29.2	D
4	California Boulevard / 1st Street	Signal	E	60.8	E	72.5	E
5	**California Boulevard / 2nd Street**	**TWSC**	**E**	**OVR**	**F**	**OVR**	**F**

Notes:
1. TWSC = Two Way Stop Control
2. LOS and Delay based on worst minor street approach for TWSC intersections
3. Warrant = Based on California MUTCD Warrant 3

As shown in Table 4, majority of the study intersections operate at unacceptable levels of service, under Year 2035 conditions with the existing lane geometrics and control.

The analysis also indicates that the 95th percent queues exceed the available storage for majority of the intersection during the AM and PM peak periods for Year 2035 No Build conditions. This results in congested conditions along the corridor.

ROUNDABOUT INTERSECTION ALTERNATIVE

For the roundabout alternative, the roundabout lane geometrics that would provide acceptable LOS and accommodate the 95th % have been assumed. .

These improvements are based on LOS and queues from SIDRA software and are therefore, based on stand-alone intersection operations. However, due to the close spacing between intersections, it is expected that operations from one intersection influence operations at the adjacent intersection(s). This interaction between intersections cannot be evaluated within the aaSDRA software. To accurately assess the interaction between intersections and the associated operations, a VISSIM simulation model has been

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created. As noted before, this model is based on car following theory and is capable of addressing intersection impacts between closely based intersections.

Table 6A presents Year 2035 roundabout intersection alternative AM and PM peak hour intersection LOS based on SIDRA software.

TABLE 6A
YEAR 2035 CONDITIONS INTERSECTION LOS – ROUNDABOUT INTERSECTION ALTERNATIVE (SIDRA)

#	Intersection	Control Type[1,2]	Target LOS	AM Peak Hour		PM Peak Hour	
				Delay	LOS	Delay	LOS
1	1st Street / Freeway Drive	RNDBT	D	14.8	B	10.9	B
2	1st Street / SR 29 SB Ramps	RNDBT	E	16.1	B	29.7	C
3	1st Street / SR 29 NB Ramps	RNDBT	E	9.0	A	11.5	B
4	California Boulevard / 1st Street	RNDBT	E	20.7	C	33.9	C
5	California Boulevard / 2nd Street	RNDBT	E	5.4	A	12.7	B

Notes:
1. RNDBT = Roundabout
2. LOS and Delay based on average for all approaches for roundabouts

As indicated in Table 6A all of the study locations are projected to operate at acceptable LOS.

ROUNDABOUT INTERSECTION ALTERNATIVE - WITH A DIRECT SB OFF RAMP TO WB 1ST STREET

Under this alternative, a direct SB on ramp to WB 1st Street with the necessary roundabout lane geometrics that would provide acceptable LOS and accommodate the 95th % will be assumed. As with the "roundabout alternative", traffic operations have been evaluated with both SIDRA and VISSIM software.

Table 6B presents Year 2035 roundabout intersection alternative with direct SB off-ramp to WB 1st Street for AM and PM peak hours. The intersection LOS is based on SIDRA software.

TABLE 6B
YEAR 2035 CONDITIONS INTERSECTION LOS – NEW DIRECT SB OFF-RAMP ALTERNATIVE (SIDRA)

#	Intersection	Control Type[1,2]	Target LOS	AM Peak Hour		PM Peak Hour	
				Delay	LOS	Delay	LOS
2	1st Street / SR 29 SB Ramps - New Direct Off-Ramp	RNDBT	E	12.3	B	9.7	A

Notes:
1. RNDBT = Roundabout
2. LOS and Delay based on average for all approaches for roundabouts

As indicated in Table 6B, the operations at the 1st Street/SR 29 SB Ramps with the direct off-ramp plus a roundabout are better when compared to a roundabout alternative. All of the other study locations are projected to operate at acceptable LOS consistent with the results identified in Table 6A.

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ROUNDABOUT DESIGN

As demonstrated above, design of a roundabout intersection begins with an evaluation of the traffic volumes and required turning movements to achieve acceptable operations (both Level of Service (LOS) and 95th percentile queues) assuming generic roundabout parameters. Next, a preliminary layout is developed taking into consideration the various right-of-way constraints, truck-turning requirements, deflection (fast-path) and sight and view angle requirements. These revised roundabout geometrics are then re-input in to the various analysis software programs and the process repeated until an acceptable balance of traffic operations, safety and right-of-way impacts is achieved.

For purposes of this study, OMNI-MEANS subcontracted with Bartelt Engineering, who prepared the digital base mapping for the study area. Mapping included contour elevations and most visible physical features. This mapping was supplemented with readily available aerial photography as a basis for the various roundabout concepts.

Other factors that will be considered in the design of the roundabout concepts include:

- Access for adjacent properties
- Pedestrians
- Good for all modes of traffic (bicyclists, transit, trucks and motorists)
- Grade
- Utilities

DESIGN STANDARDS

The design of a roundabout is unique to its location. Primary in the development of roundabout and roadway design is the determination of the appropriate design guidelines and standards, as once established they will be used through the development of the plans and contract documents.

General Intersection Design Standards – All details, such as curb, gutter, sidewalk, ramps, and any other detail that will apply shall abide by the City of Napa Public Work Department, Engineering Division Standard Details and Caltrans Standard Plans (as applicable) with the notion that all standards abide by the American with Disabilities Act (ADA). If any standard conflicts with ADA requirements, then ADA requirements will govern.

Roundabout Design Standards – The roundabout intersection was designed per The National Cooperative Highway Research Program (NCHRP) Report 672, *Roundabouts and Informational Guide*, Second Edition, developed in cooperation with the U.S. Department of Transportation, Federal Highway Administration.

TRUCK/BUS TURN TEMPLATES

Truck/bus movements will be analyzed using *AutoTURN 6* for *AutoCAD* software. The roundabout concepts at this location will be designed to accommodate the following 2 design vehicles, specifically the STAA truck and semi trailer and a 45 foot bus/motorcoach. The STAA truck and semi trailer must be able to navigate all turning movements within the roundabout with the tractor portion remaining in roadway portion; the trailer wheels may mount the center island truck apron or other truck aprons as required. The 45 foot bus/motorcoach must be able to navigate all turning movements within the roundabout without mounting the truck apron(s).

Furthermore, on multilane approaches, the design vehicle may use its lane and adjoining shared areas provided it does not unduly encroach into the adjacent lane. Where a single lane approach flares to 2

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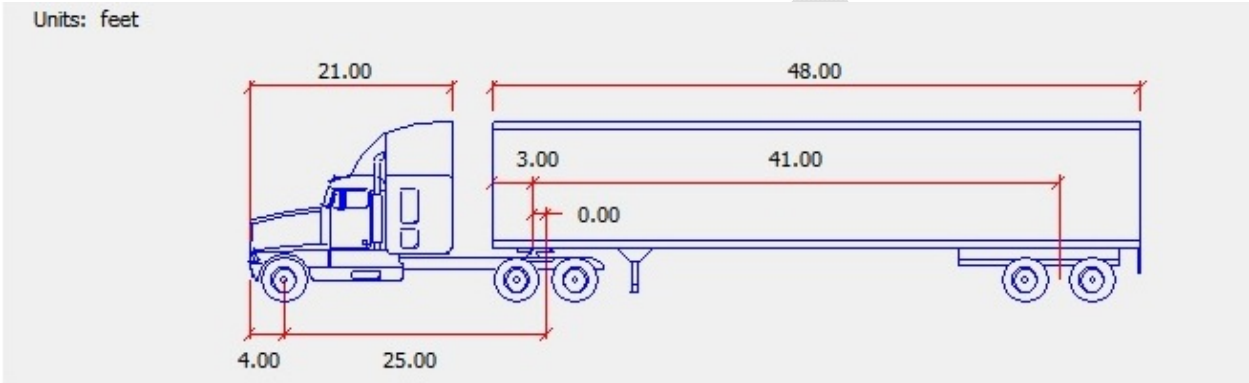
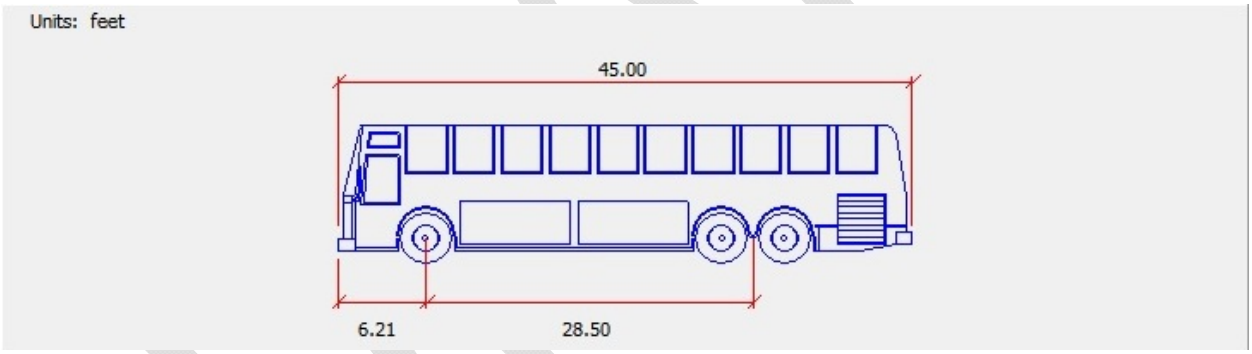
lanes, it is assumed the design vehicle may encroach into the adjacent lane.

Vehicles that are larger in size than the above two design vehicles (over-sized or permit vehicles) will be able to negotiate the roundabout, but will not necessarily meet the criteria described above. For instance, on multilane approaches, an over-sized vehicle may need to encroach into the adjacent lane to navigate the roundabout and/or the tractor portion of the vehicle may have to use the truck apron to maneuver through the roundabout. This is also applicable for single lane approaches where a single lane approach flares to 2 lanes.

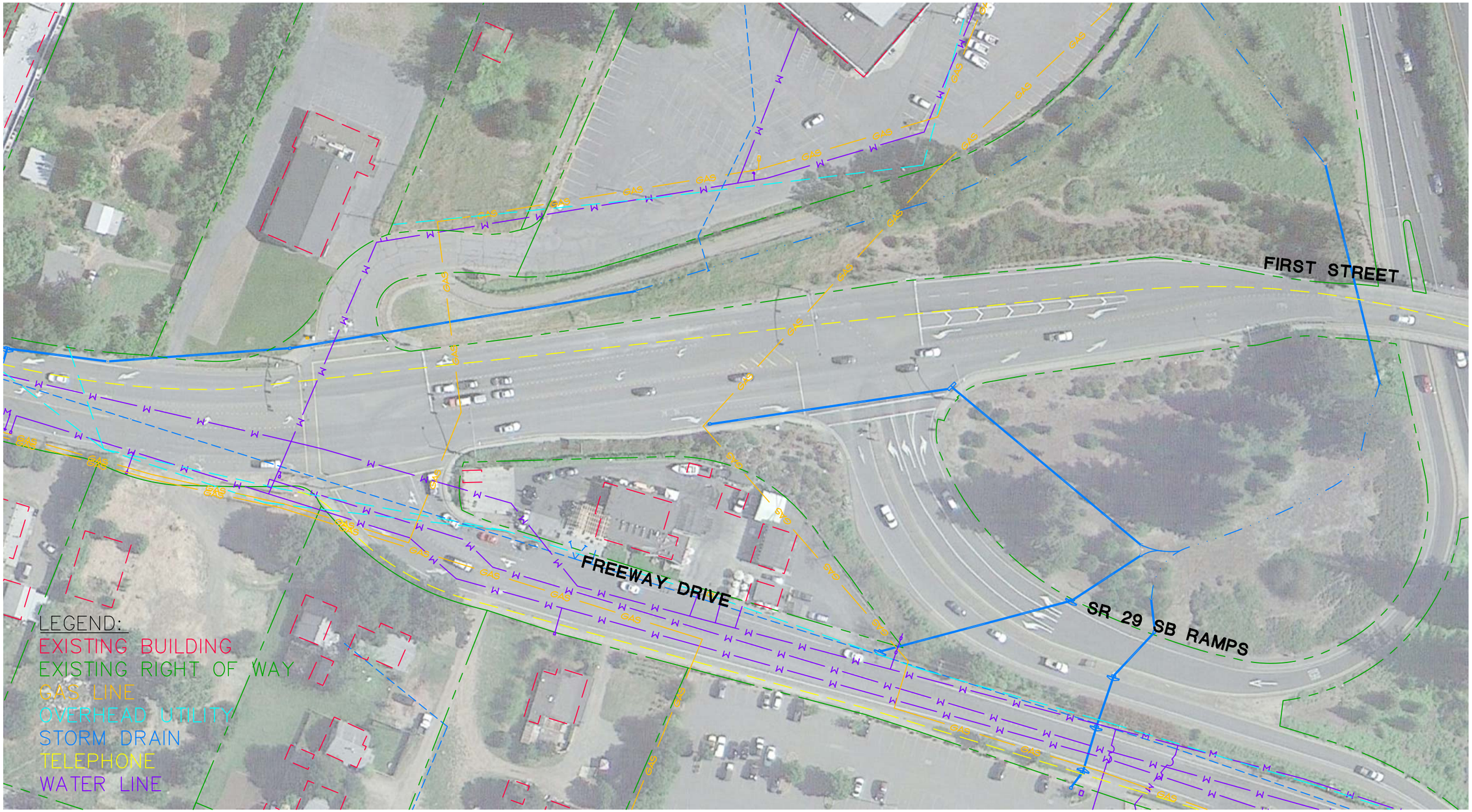
The 2 design vehicles are shown below:



STAA-Long Design Vehicle



Bus-Motorcoach 45 Design Vehicle



CITY OF NAPA ROUNDABOUT FEASIBILITY STUDY

SCALE: 1" = 80'

EXISTING UTILITIES WEST OF SR 29

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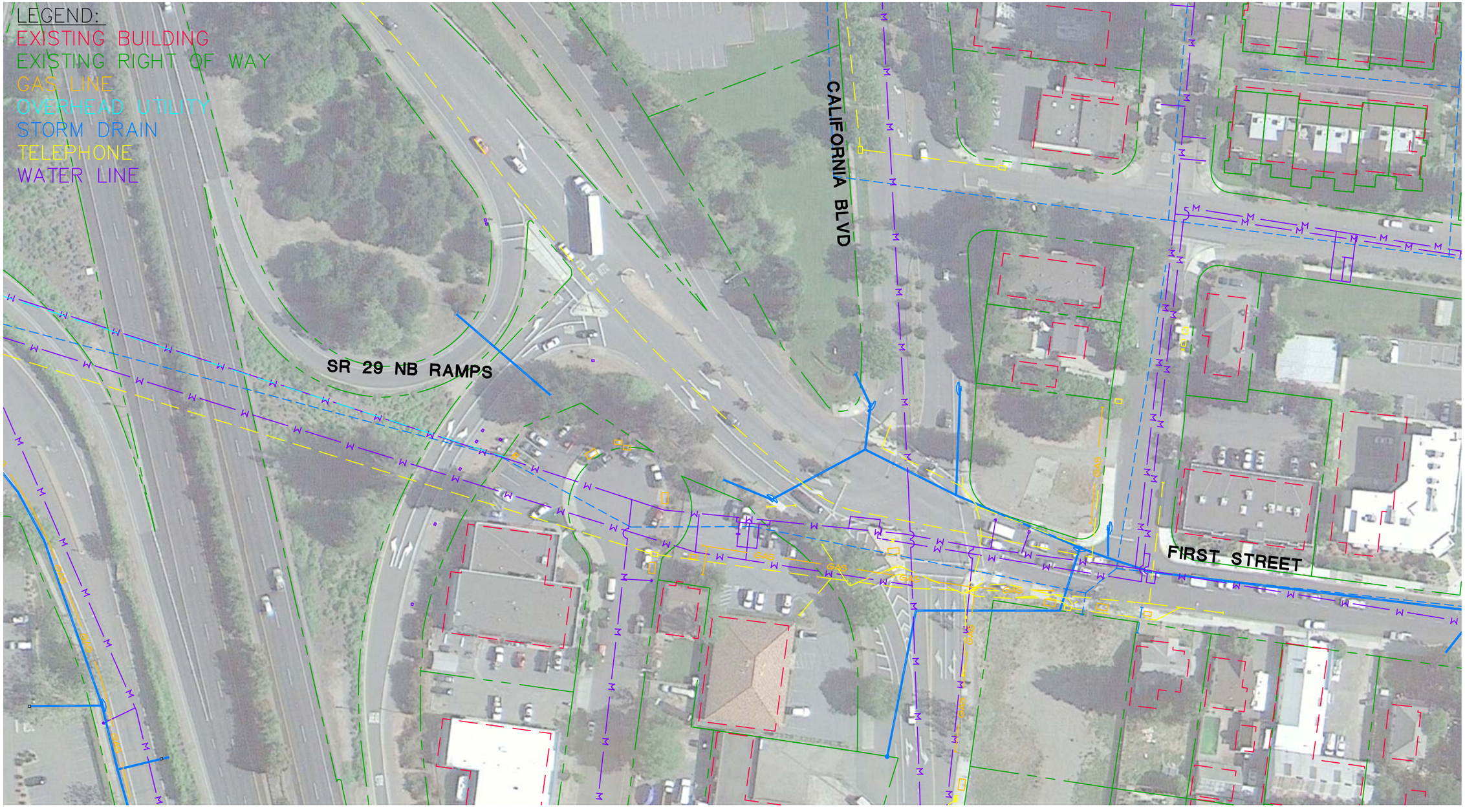
Job No:



CITY OF NAPA ROUNDABOUT FEASIBILITY STUDY

SCALE: 1" = 80'

EXISTING UTILITIES EAST OF SR 29

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Job No:

CITY OF NAPA ROUNDABOUT FEASIBILITY STUDY

SCALE: 1" = 50'

EXISTING UTILITIES EAST OF SR 29

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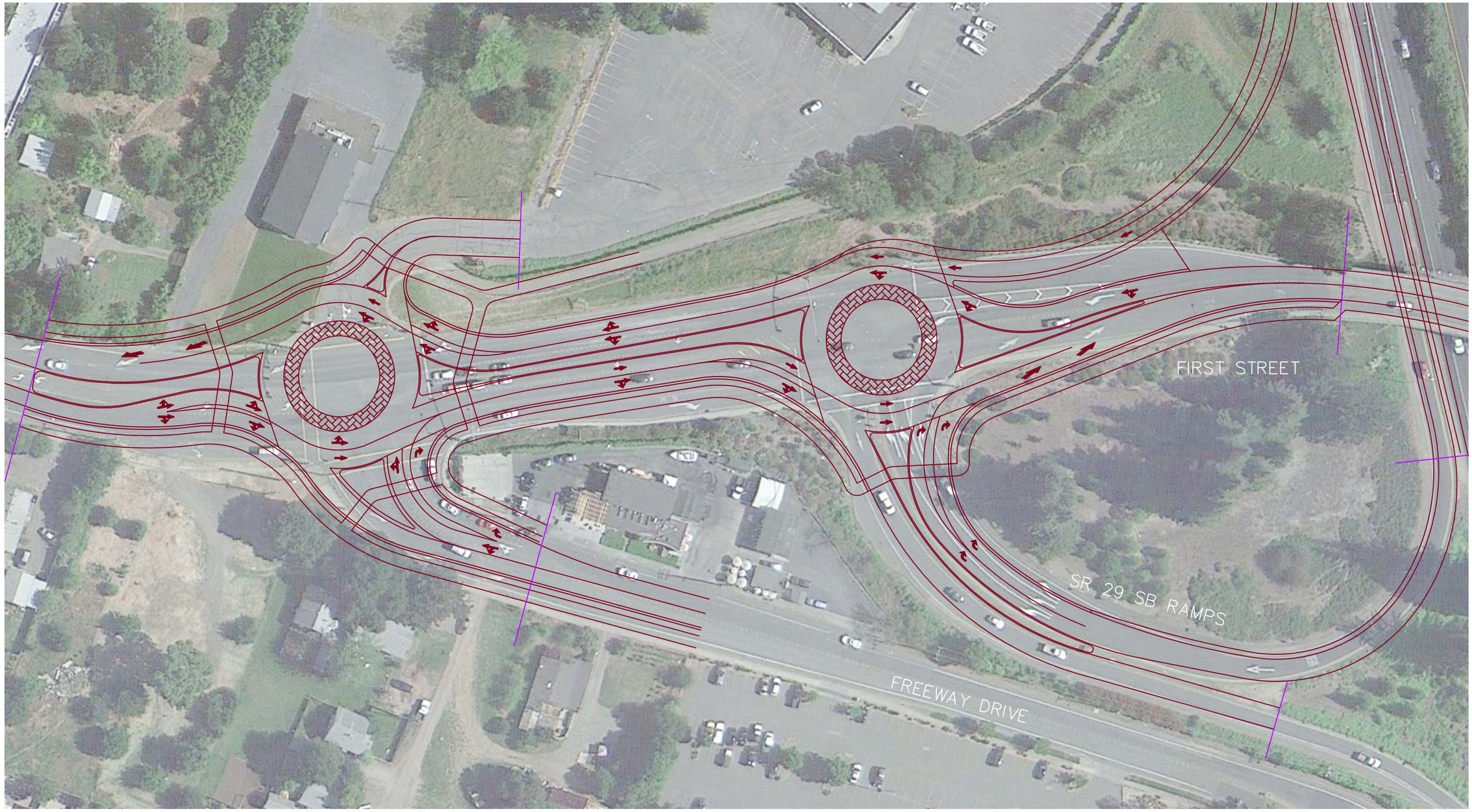
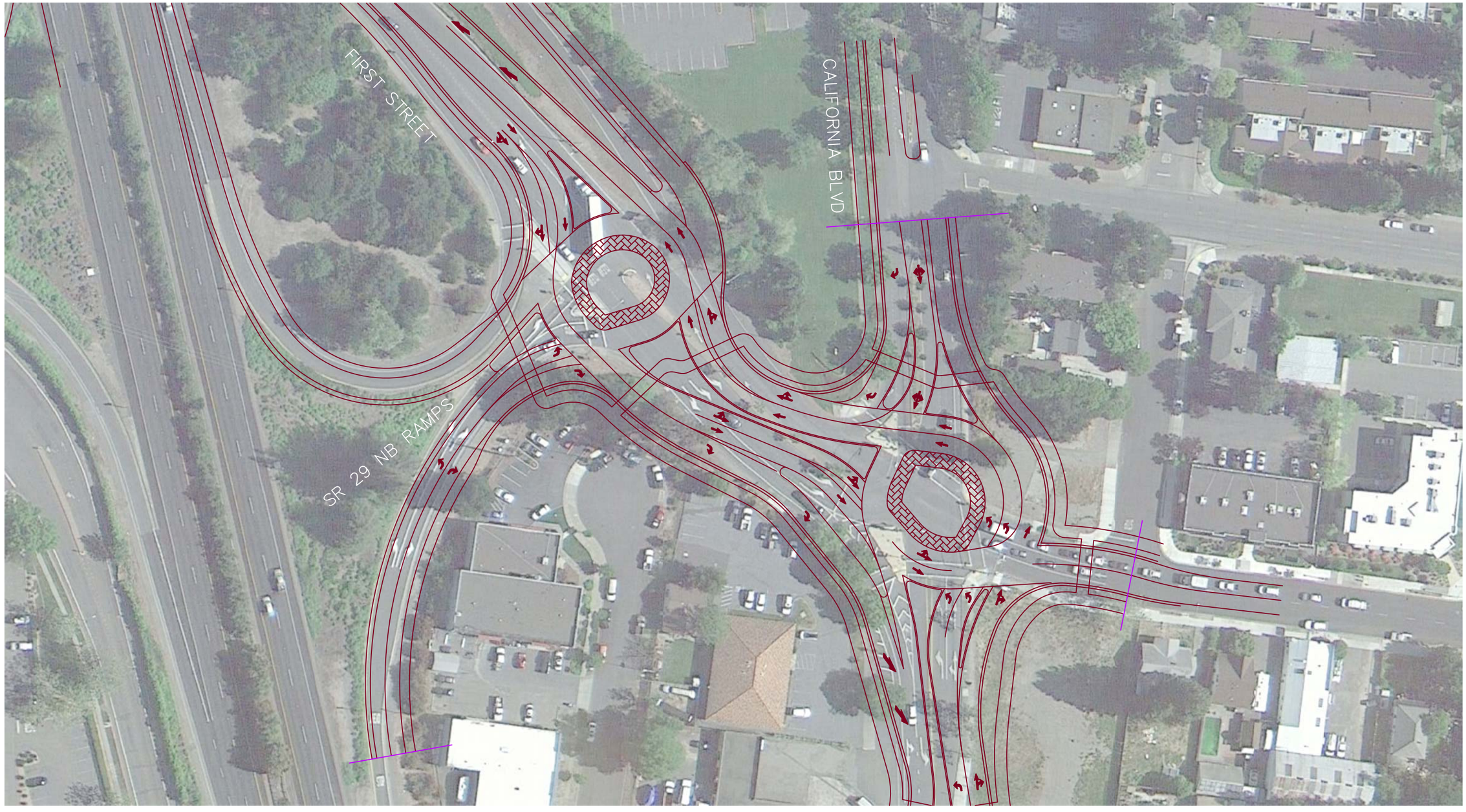


CITY OF NAPA ROUNDABOUT FEASIBILITY STUDY

SCALE: 1" = 80'

CONCEPT 4 - 2030 FIRST STREET ROUNDABOUT CORRIDOR



CITY OF NAPA ROUNDABOUT FEASIBILITY STUDY

SCALE: 1" = 80'

CONCEPT 4 - 2030 FIRST STREET ROUNDABOUT CORRIDOR

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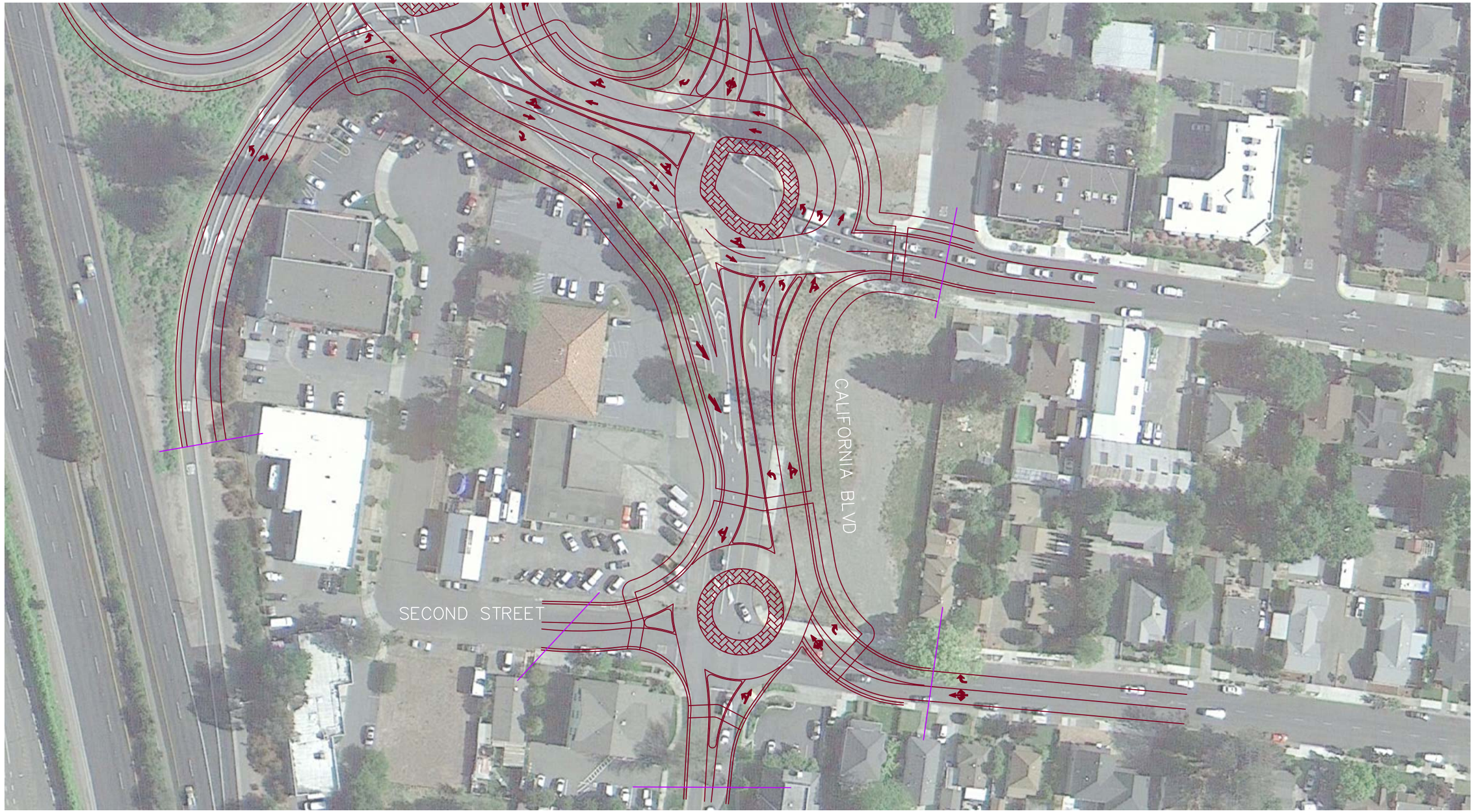
Job No:



CITY OF NAPA ROUNDABOUT FEASIBILITY STUDY

SCALE: 1" = 80'

CONCEPT 4 - 2030 FIRST STREET ROUNDABOUT CORRIDOR

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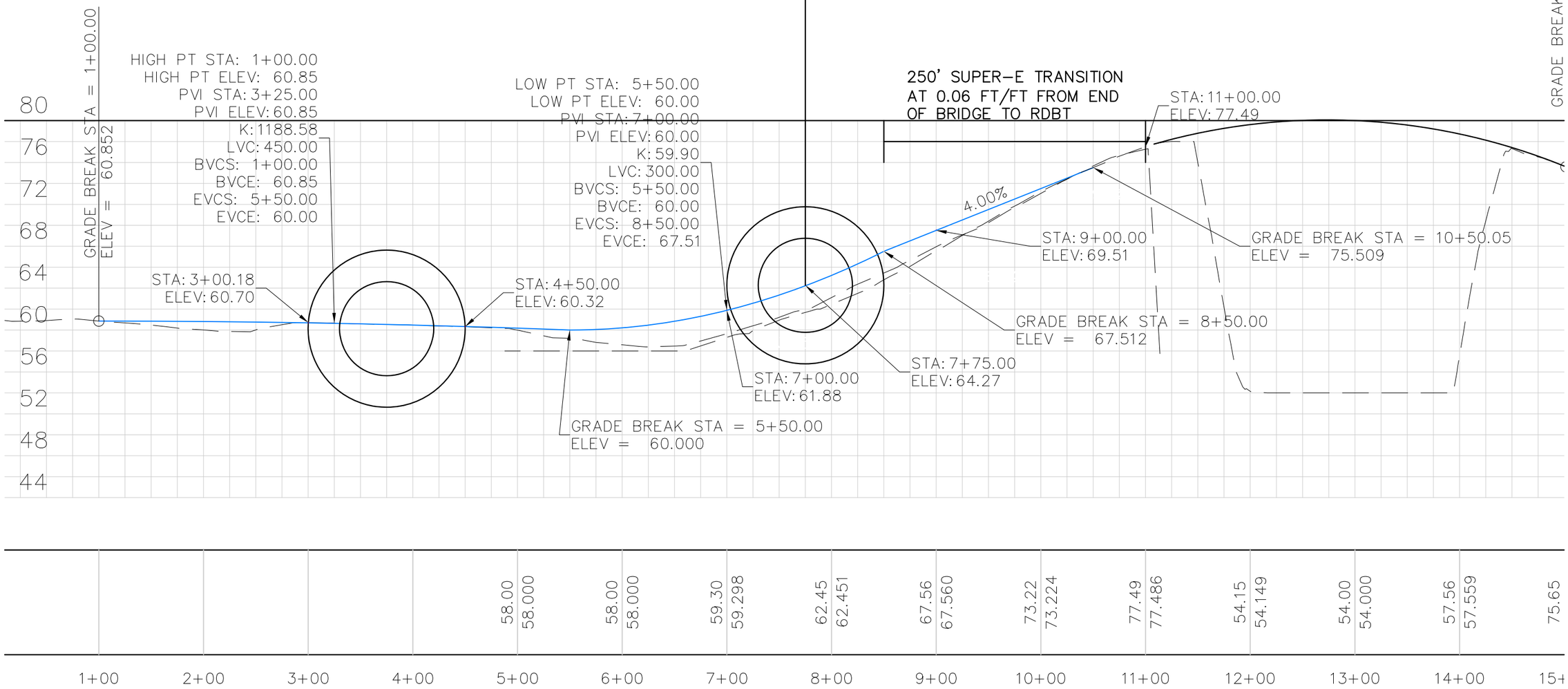
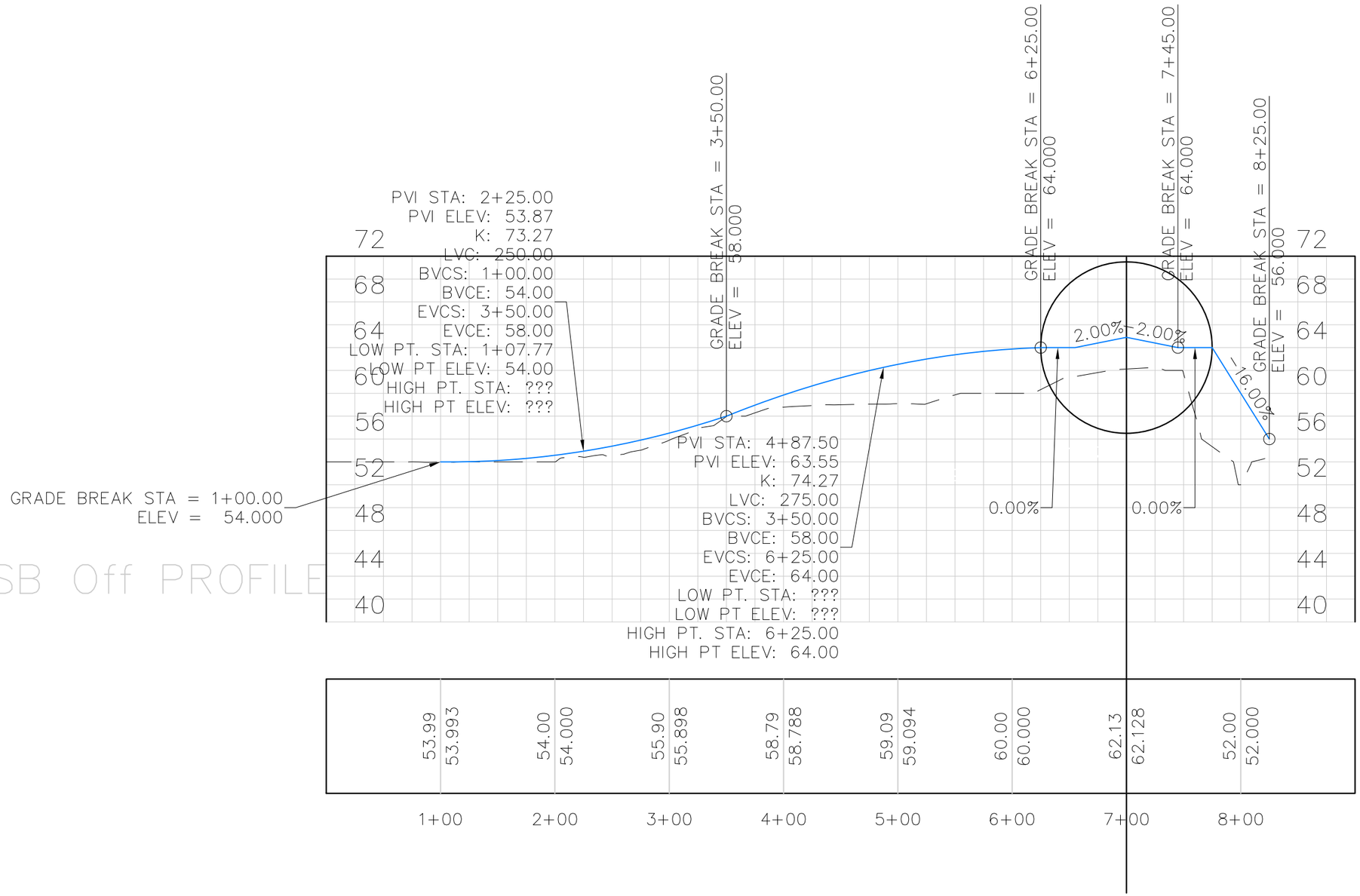
Job No:



CITY OF NAPA ROUNDABOUT FEASIBILITY STUDY

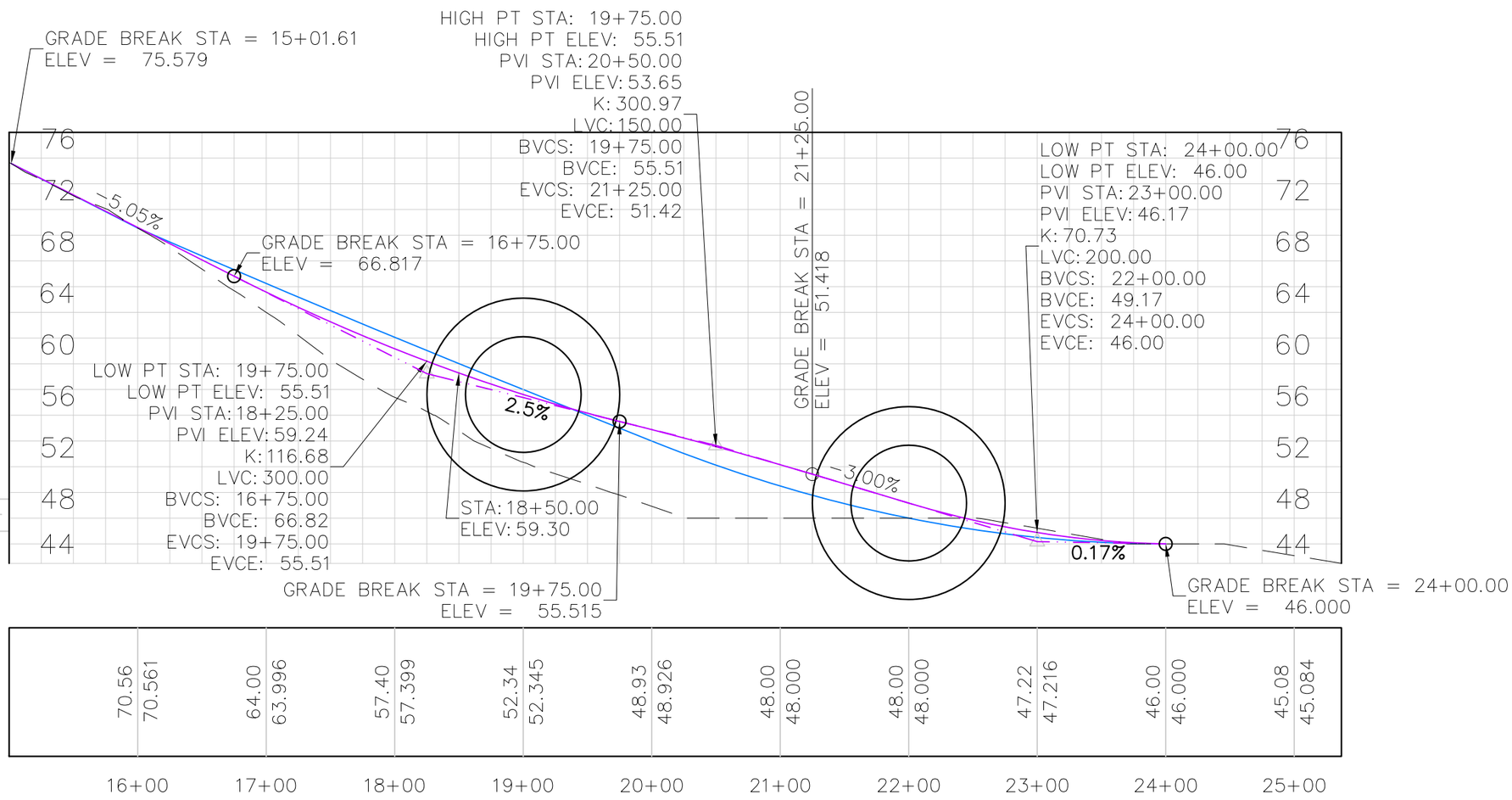
FIRST STREET ROUNDABOUT CORRIDOR - WEST OF SR 29



CITY OF NAPA ROUNDABOUT FEASIBILITY STUDY

FIRST STREET ROUNDABOUT CORRIDOR - WEST OF SRR 29

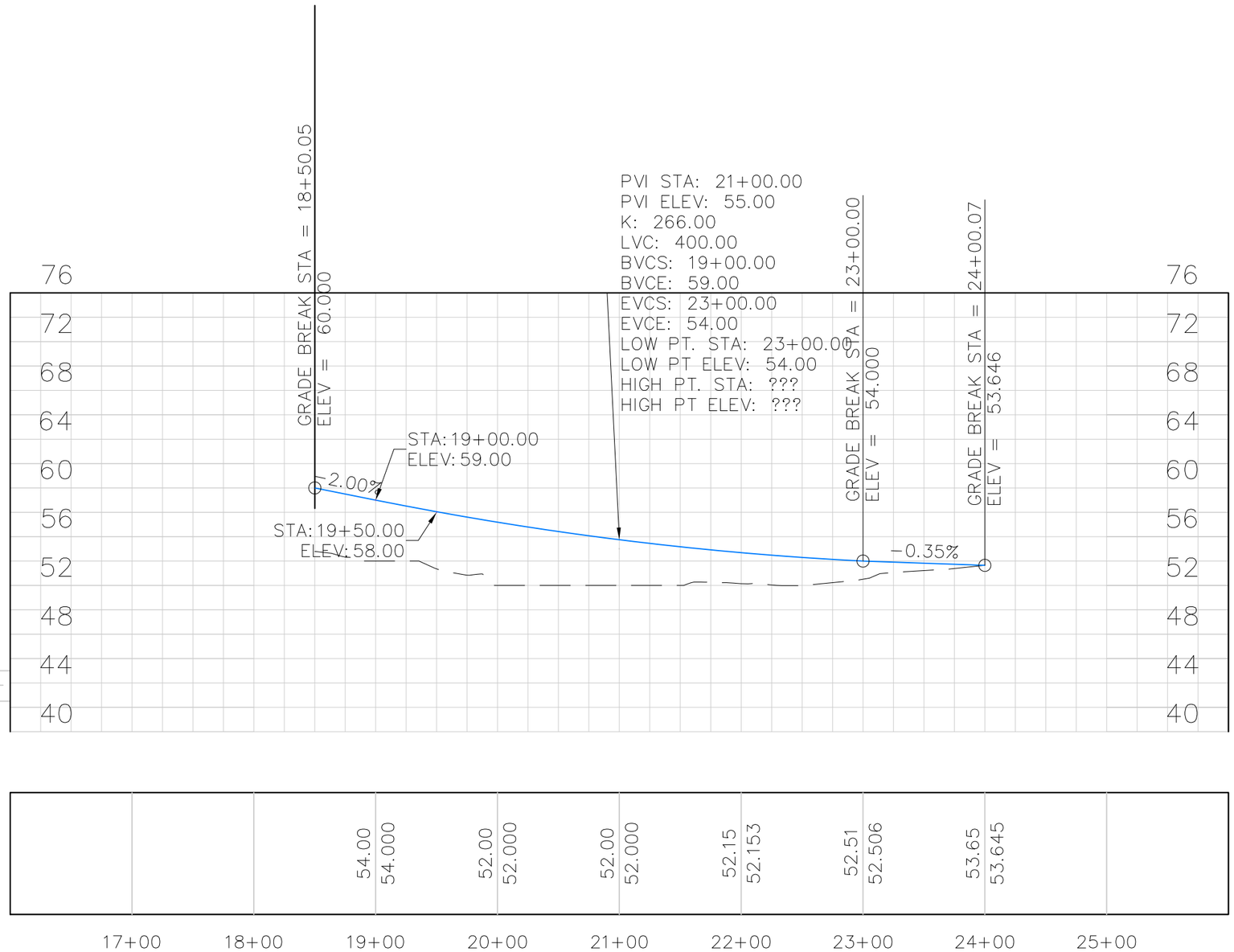
: PROFILE



CITY OF NAPA ROUNDABOUT FEASIBILITY STUDY

FIRST STREET ROUNDABOUT CORRIDOR - EAST OF SR 29

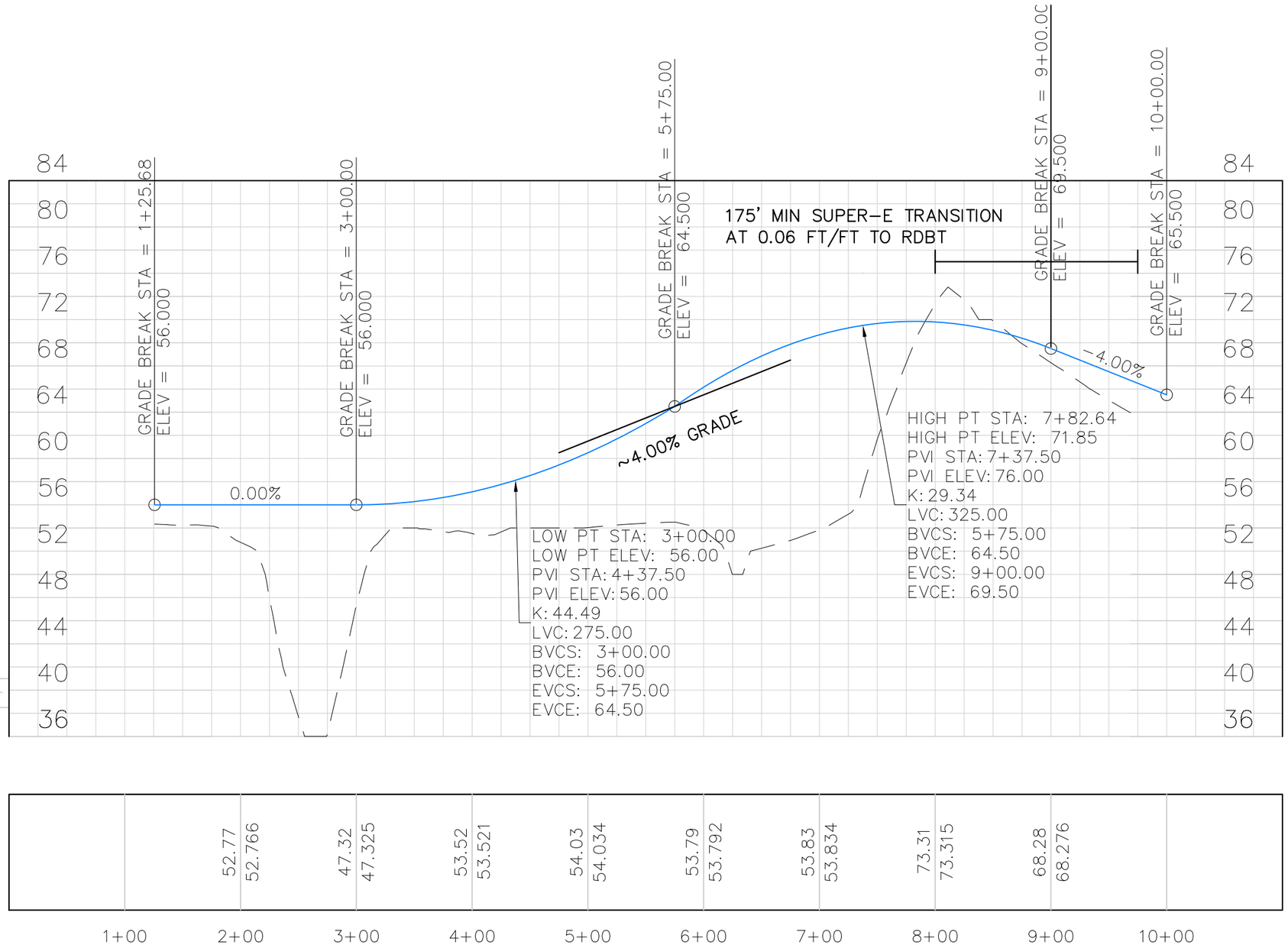
SR29 NB On PROFILE



CITY OF NAPA ROUNDABOUT FEASIBILITY STUDY

FIRST STREET ROUNDABOUT CORRIDOR - EAST OF SR 29

Off Aux PROFILE



CITY OF NAPA ROUNDABOUT FEASIBILITY STUDY

FIRST STREET ROUNDABOUT CORRIDOR - SB AUX RAMP WEST OF SR 29

FREEWAY DRIVE / FIRST STREET

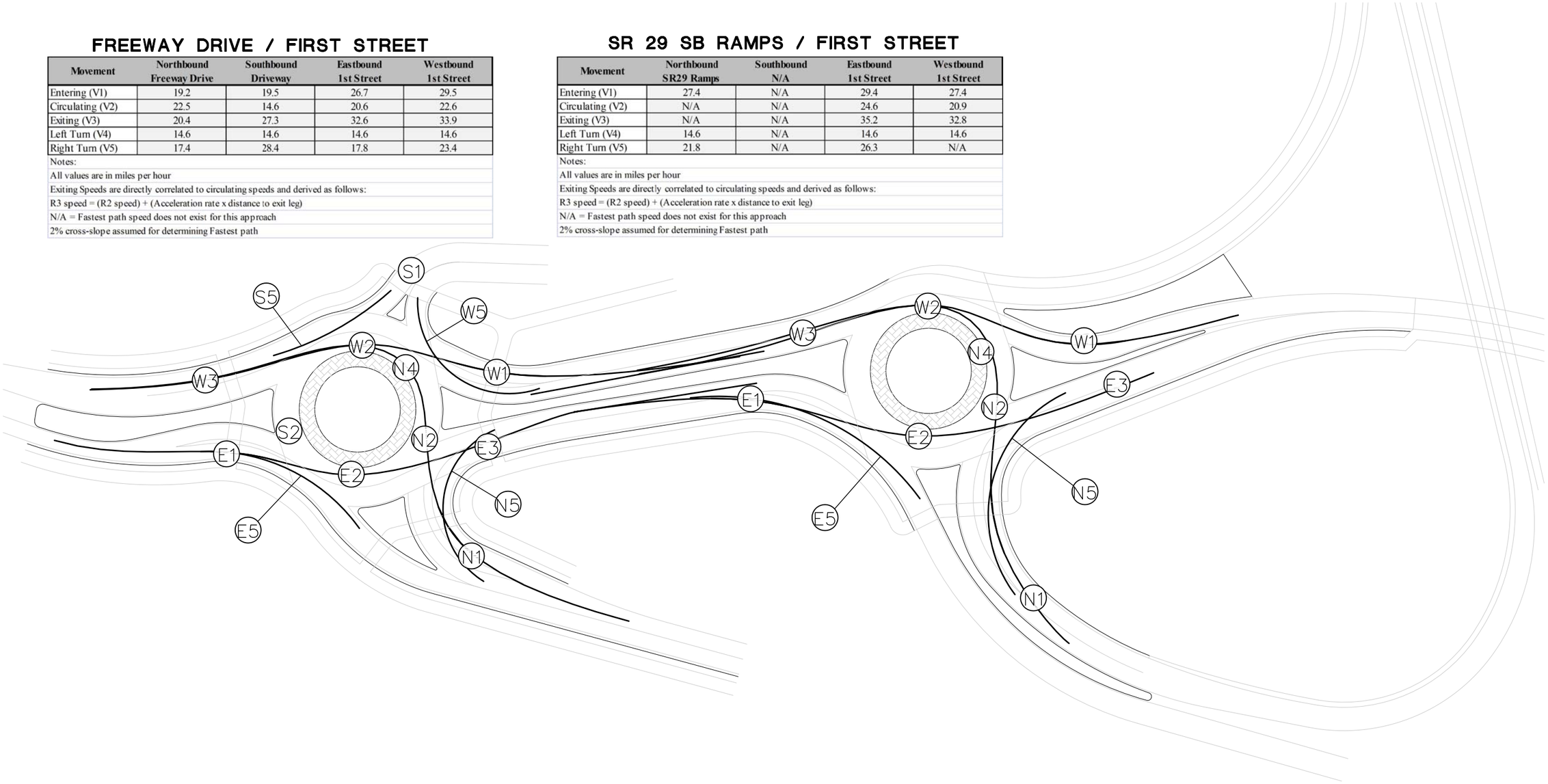
Movement	Northbound Freeway Drive	Southbound Driveway	Eastbound 1st Street	Westbound 1st Street
Entering (V1)	19.2	19.5	26.7	29.5
Circulating (V2)	22.5	14.6	20.6	22.6
Exiting (V3)	20.4	27.3	32.6	33.9
Left Turn (V4)	14.6	14.6	14.6	14.6
Right Turn (V5)	17.4	28.4	17.8	23.4

Notes:
All values are in miles per hour
Exiting Speeds are directly correlated to circulating speeds and derived as follows:
R3 speed = (R2 speed) + (Acceleration rate x distance to exit leg)
N/A = Fastest path speed does not exist for this approach
2% cross-slope assumed for determining Fastest path

SR 29 SB RAMPS / FIRST STREET

Movement	Northbound SR29 Ramps	Southbound N/A	Eastbound 1st Street	Westbound 1st Street
Entering (V1)	27.4	N/A	29.4	27.4
Circulating (V2)	N/A	N/A	24.6	20.9
Exiting (V3)	N/A	N/A	35.2	32.8
Left Turn (V4)	14.6	N/A	14.6	14.6
Right Turn (V5)	21.8	N/A	26.3	N/A

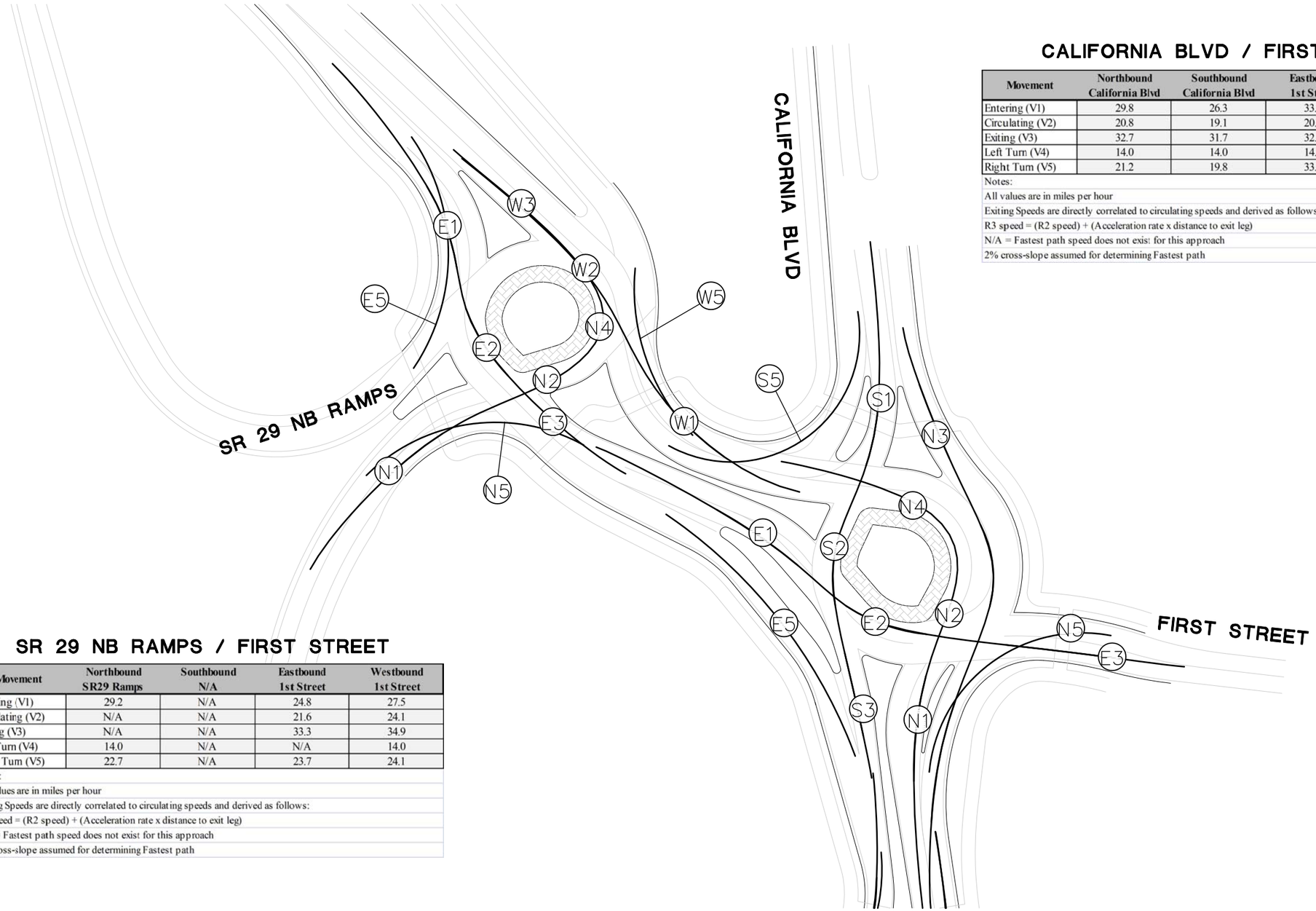
Notes:
All values are in miles per hour
Exiting Speeds are directly correlated to circulating speeds and derived as follows:
R3 speed = (R2 speed) + (Acceleration rate x distance to exit leg)
N/A = Fastest path speed does not exist for this approach
2% cross-slope assumed for determining Fastest path



CITY OF NAPA ROUNDABOUT FEASIBILITY STUDY

SCALE: 1" = 80'

CONCEPT 3 & 4 - FASTEST PATH SPEEDS WEST OF SR 29



CALIFORNIA BLVD / FIRST STREET

Movement	Northbound California Blvd	Southbound California Blvd	Eastbound 1st Street	Westbound 1st Street
Entering (V1)	29.8	26.3	33.9	N/A
Circulating (V2)	20.8	19.1	20.7	N/A
Exiting (V3)	32.7	31.7	32.7	N/A
Left Turn (V4)	14.0	14.0	14.0	N/A
Right Turn (V5)	21.2	19.8	33.6	N/A

Notes:
All values are in miles per hour
Exiting Speeds are directly correlated to circulating speeds and derived as follows:
R3 speed = (R2 speed) + (Acceleration rate x distance to exit leg)
N/A = Fastest path speed does not exis: for this approach
2% cross-slope assumed for determining Fastest path

SR 29 NB RAMPS / FIRST STREET

Movement	Northbound SR29 Ramps	Southbound N/A	Eastbound 1st Street	Westbound 1st Street
Entering (V1)	29.2	N/A	24.8	27.5
Circulating (V2)	N/A	N/A	21.6	24.1
Exiting (V3)	N/A	N/A	33.3	34.9
Left Turn (V4)	14.0	N/A	N/A	14.0
Right Turn (V5)	22.7	N/A	23.7	24.1

Notes:
All values are in miles per hour
Exiting Speeds are directly correlated to circulating speeds and derived as follows:
R3 speed = (R2 speed) + (Acceleration rate x distance to exit leg)
N/A = Fastest path speed does not exist for this approach
2% cross-slope assumed for determining Fastest path

CITY OF NAPA ROUNDABOUT FEASIBILITY STUDY

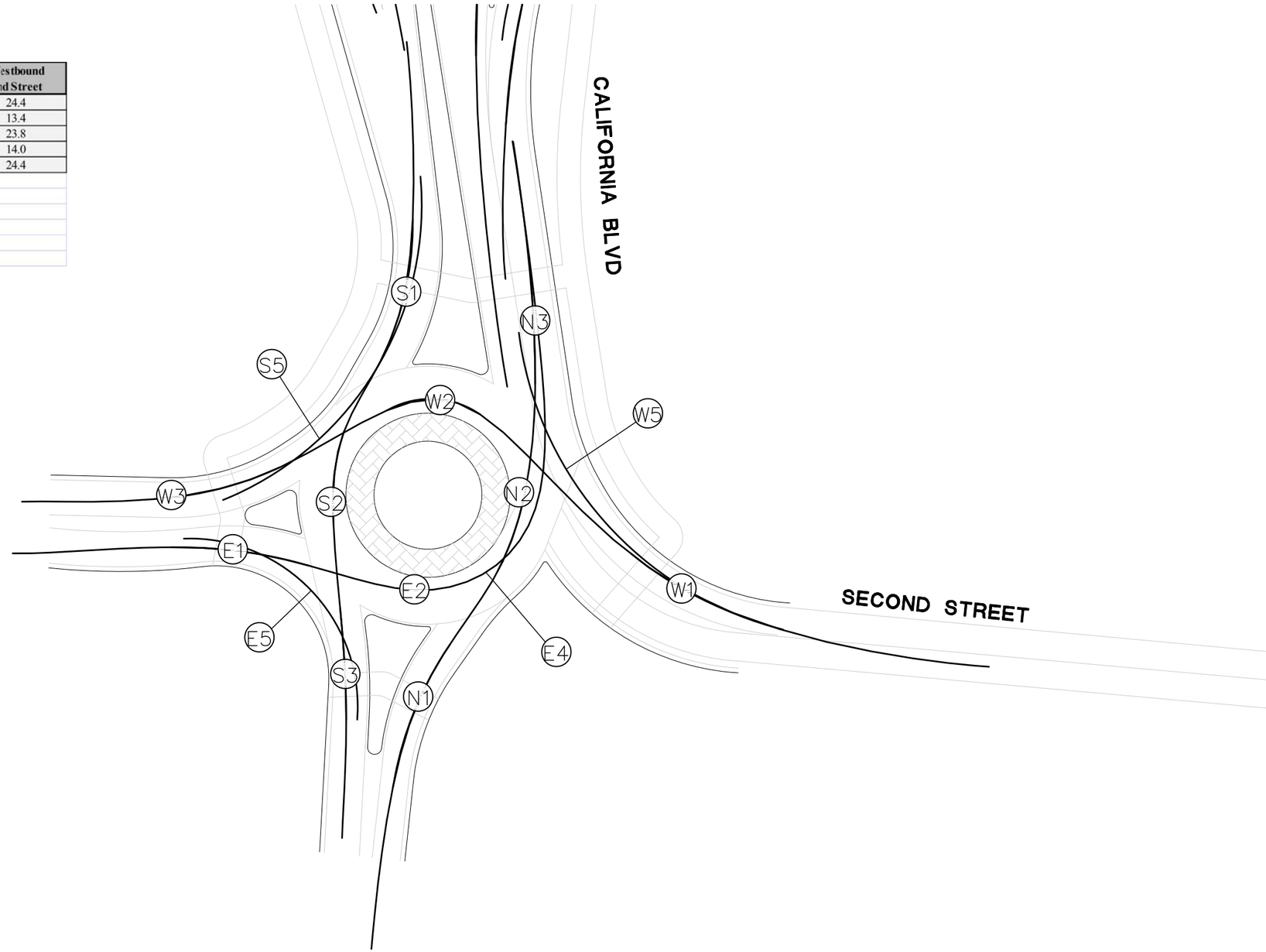
SCALE: 1" = 80'

CONCEPT 2 & 4 - FASTEST PATH SPEEDS EAST OF SR 29

CALIFORNIA BLVD / SECOND ST

Movement	Northbound California Blvd	Southbound California Blvd	Eastbound 2nd Street	Westbound 2nd Street
Entering (V1)	23.9	22.6	26.6	24.4
Circulating (V2)	20.6	18.7	N/A	13.4
Exiting (V3)	32.6	31.4	N/A	23.8
Left Turn (V4)	14.0	14.0	14.0	14.0
Right Turn (V5)	N/A	22.9	17.9	24.4

Notes:
All values are in miles per hour
Exiting Speeds are directly correlated to circulating speeds and derived as follows:
R3 speed = (R2 speed) + (Acceleration rate x distance to exit leg)
N/A = Fastest path speed does not exist for this approach
2% cross-slope assumed for determining Fastest path



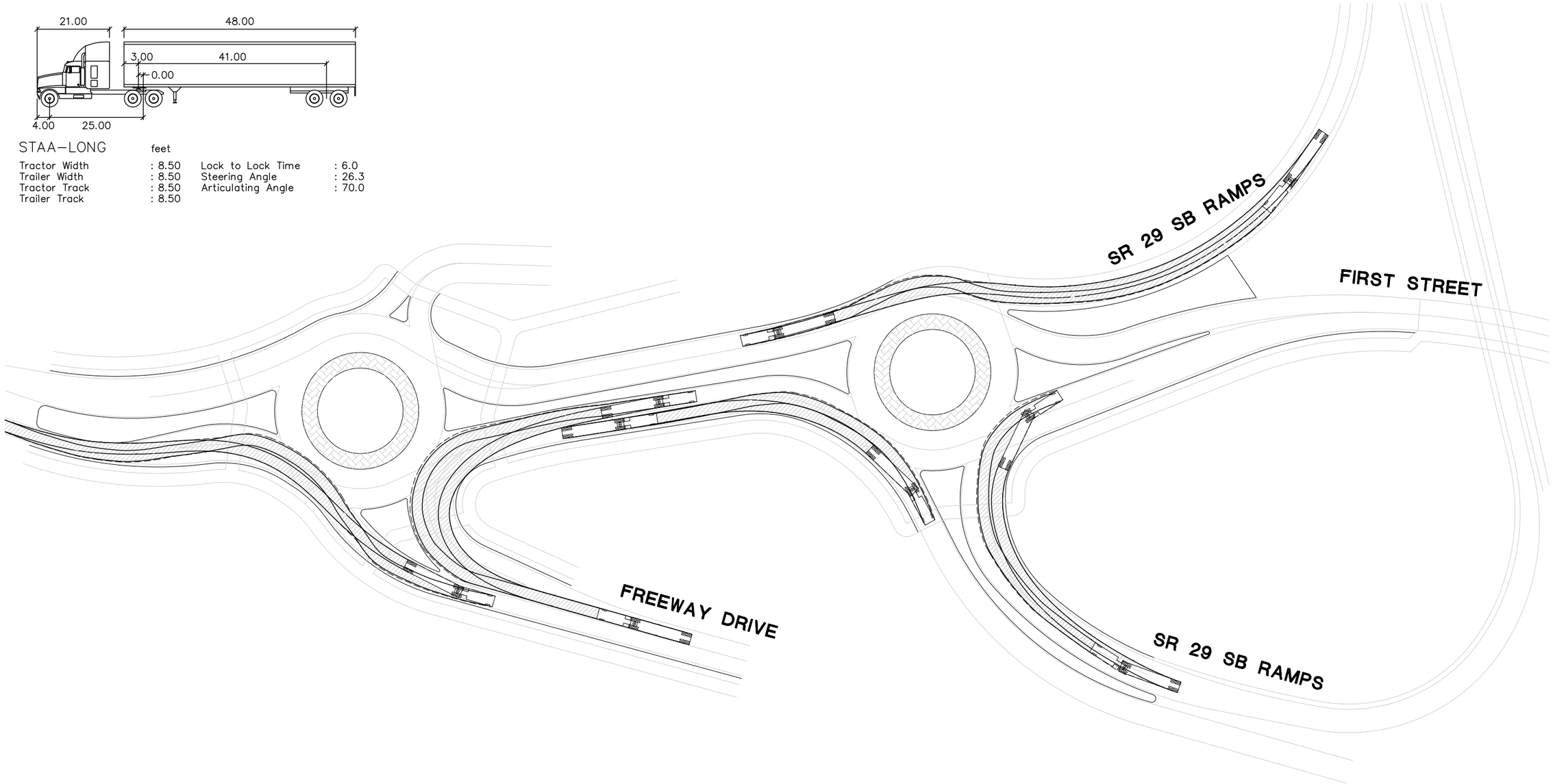
CITY OF NAPA ROUNDABOUT FEASIBILITY STUDY

SCALE: 1" = 50'

CONCEPT 2 & 4 - FASTEST PATH SPEEDS EAST OF SR 29

STAA–LONG feet

Tractor Width	: 8.50	Lock to Lock Time	: 6.0
Trailer Width	: 8.50	Steering Angle	: 26.3
Tractor Track	: 8.50	Articulating Angle	: 70.0
Trailer Track	: 8.50		



CITY OF NAPA ROUNDABOUT FEASIBILITY STUDY

SCALE: 1" = 80'

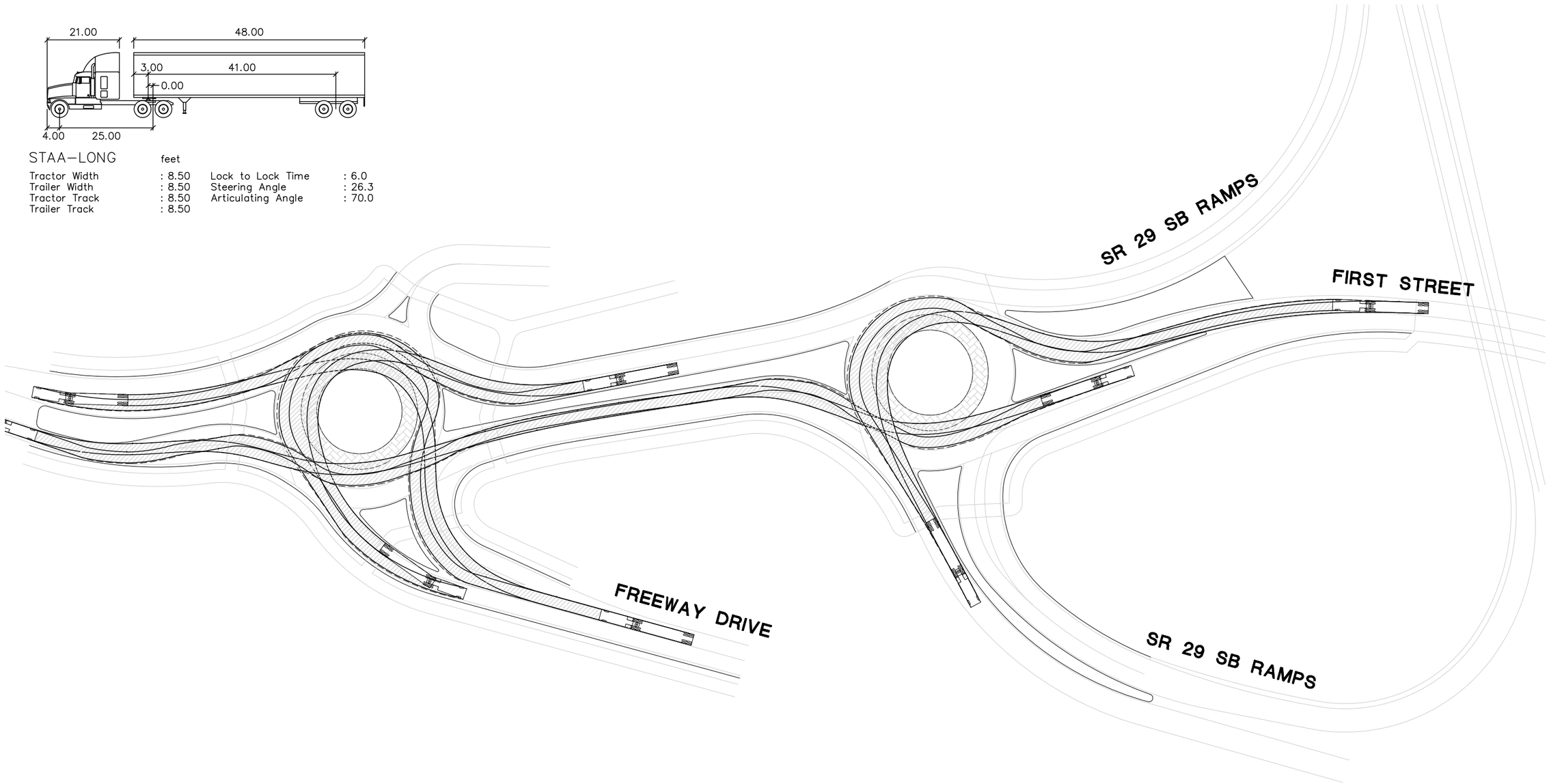
CONCEPT 3 & 4 - STAA LONG TRUCK TURNS (LEFT) WEST OF SR 29

8/27/2012 9:24 AM \\10.3.250.25\DATA\COMMON\PRJ\1480\1480EX008.DWG

Job No:

STAA–LONG feet

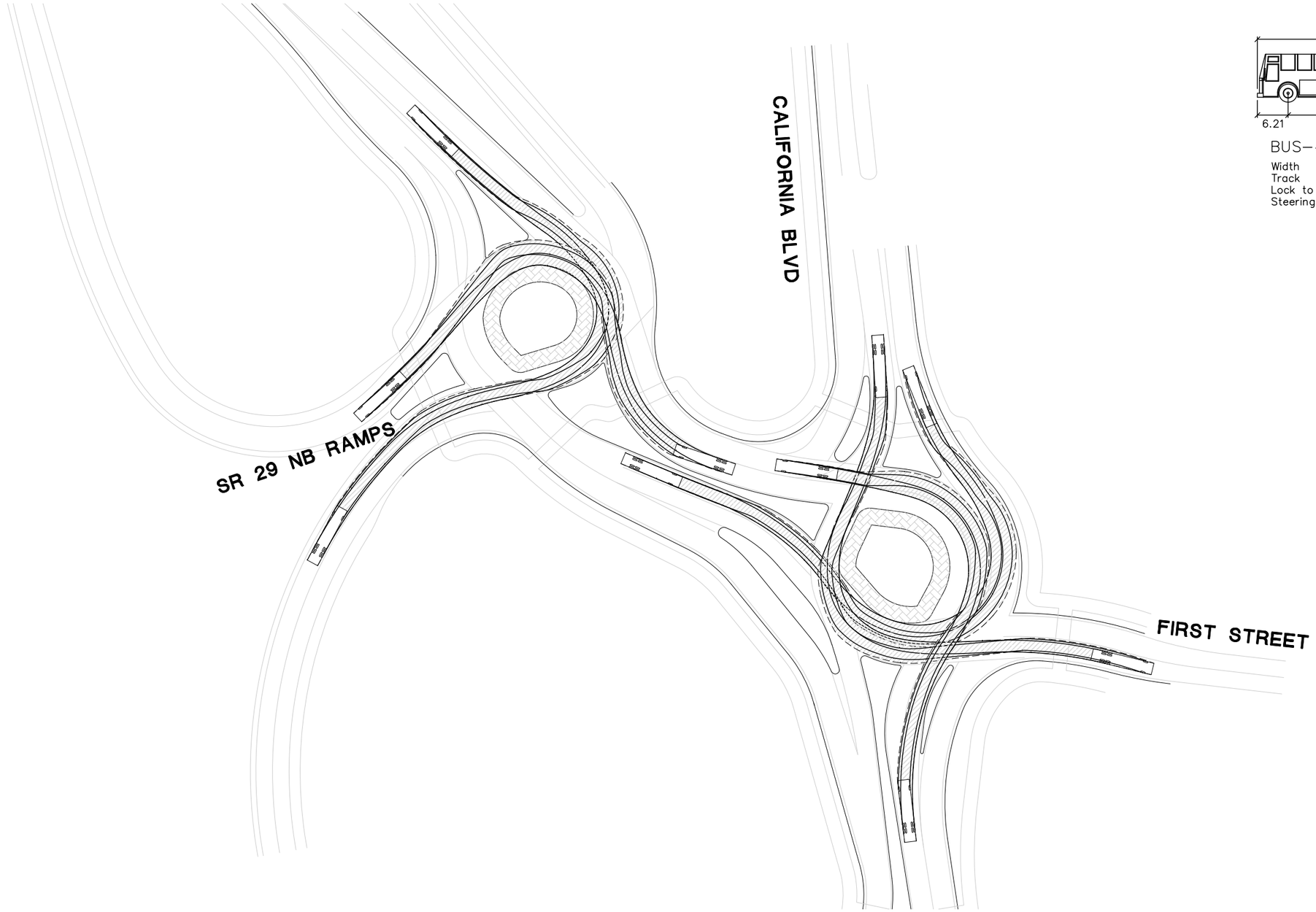
Tractor Width	: 8.50	Lock to Lock Time	: 6.0
Trailer Width	: 8.50	Steering Angle	: 26.3
Tractor Track	: 8.50	Articulating Angle	: 70.0
Trailer Track	: 8.50		

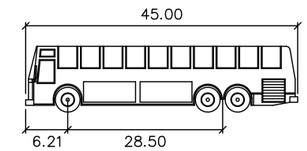


CITY OF NAPA ROUNDABOUT FEASIBILITY STUDY

SCALE: 1" = 80'

CONCEPT 3 & 4 - STAA LONG TRUCK TURNS (RIGHT) WEST OF SR 29





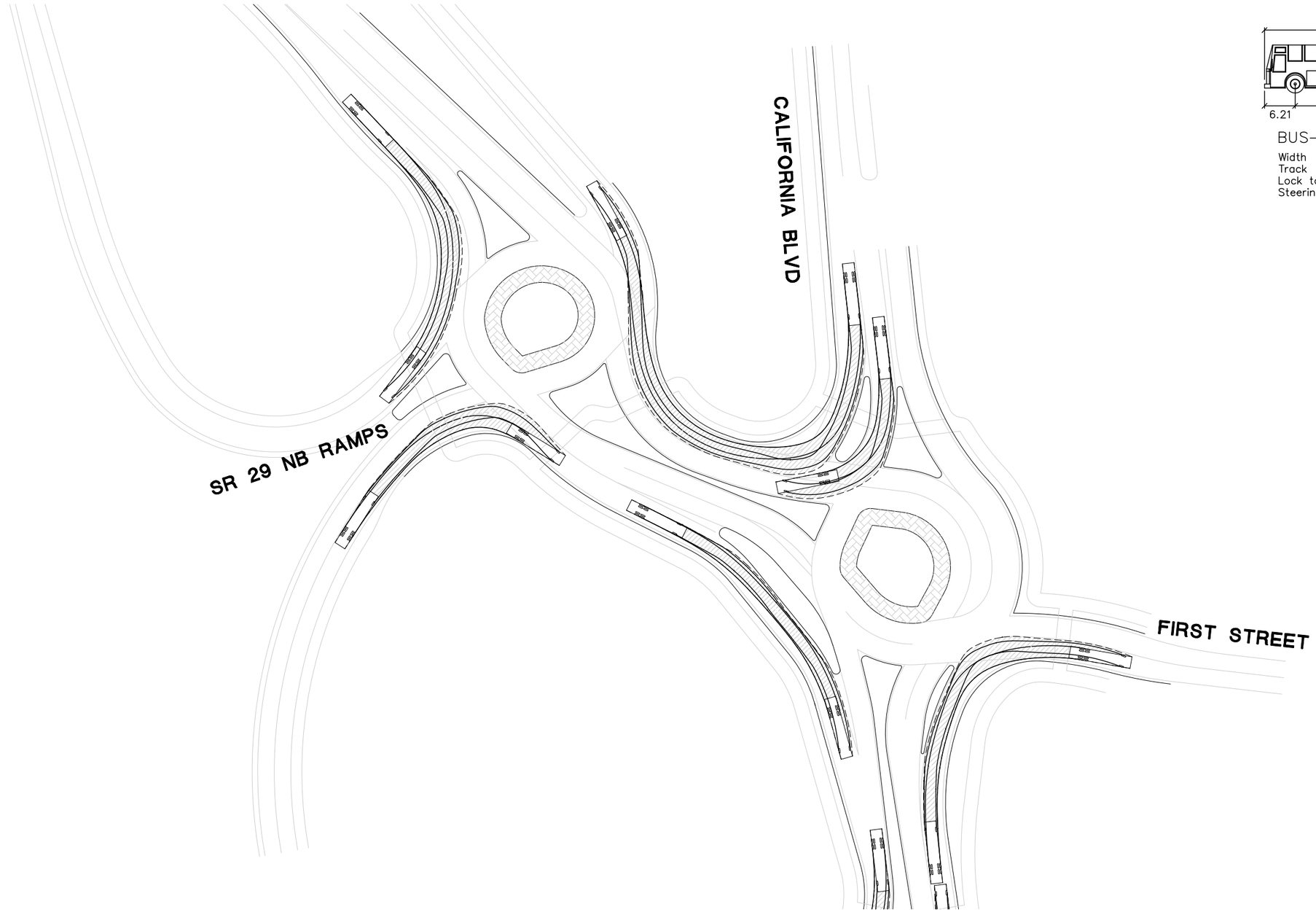
BUS-45 feet

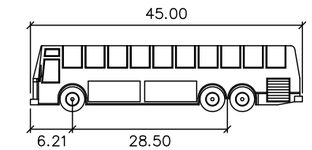
Width	: 8.50
Track	: 8.50
Lock to Lock Time	: 6.0
Steering Angle	: 44.3

CITY OF NAPA ROUNDABOUT FEASIBILITY STUDY

SCALE: 1" = 80'

CONCEPT 2 & 4 - BUS 45 TURNS (LEFT) EAST OF SR 29





BUS-45 feet

Width	: 8.50
Track	: 8.50
Lock to Lock Time	: 6.0
Steering Angle	: 44.3

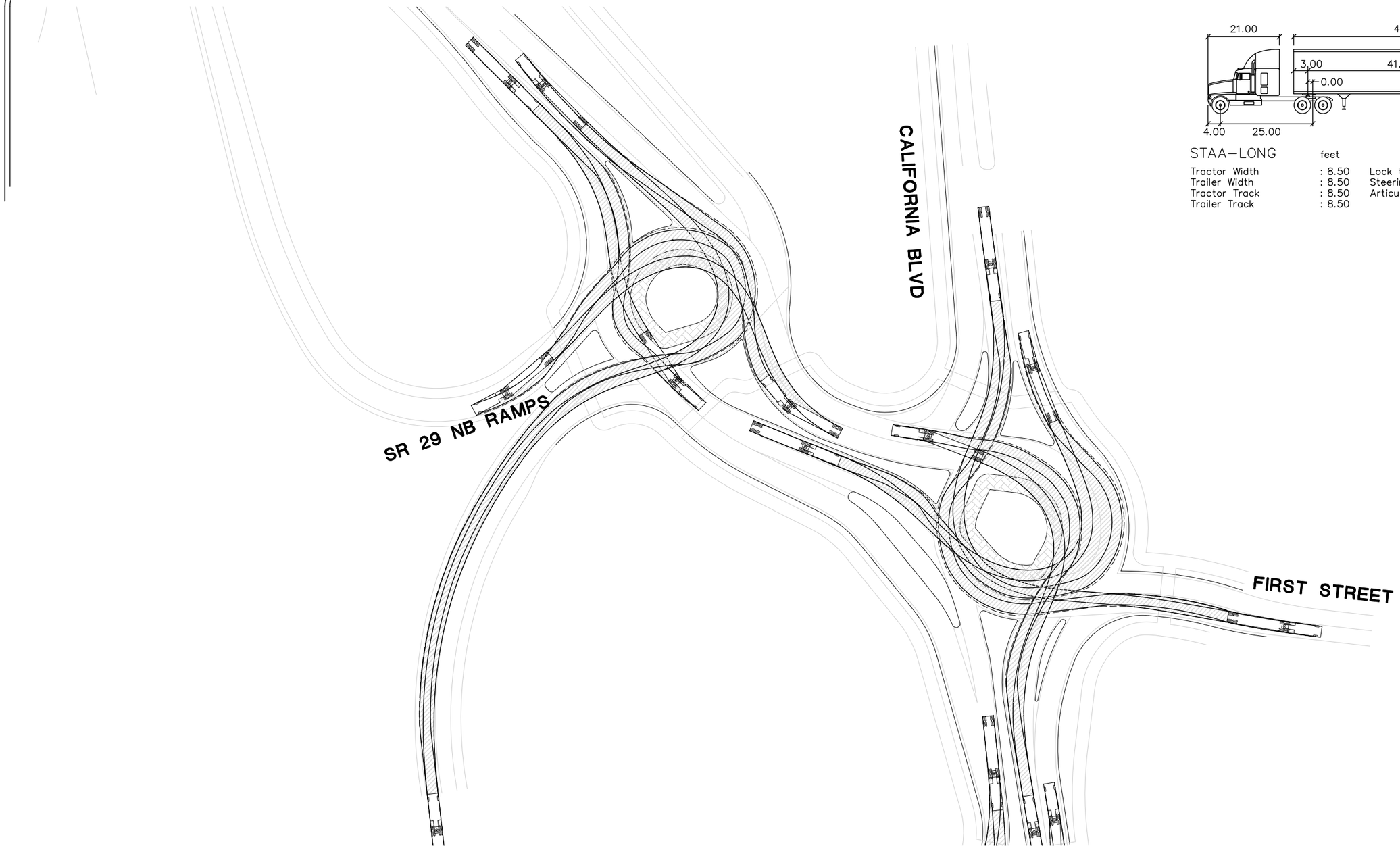
CITY OF NAPA ROUNDABOUT FEASIBILITY STUDY

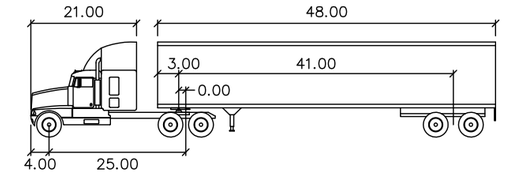
SCALE: 1" = 80'

CONCEPT 2 & 4 - BUS 45 TURNS (RIGHT) EAST OF SR 29

8/27/2012 9:26 AM \\10.3.250.25\DATA\COMMON\PRJ\1480\1480EX008.DWG

Job No:





STAA–LONG feet

Tractor Width	: 8.50	Lock to Lock Time	: 6.0
Trailer Width	: 8.50	Steering Angle	: 26.3
Tractor Track	: 8.50	Articulating Angle	: 70.0
Trailer Track	: 8.50		

CITY OF NAPA ROUNDABOUT FEASIBILITY STUDY

SCALE: 1" = 80'

CONCEPT 2 & 4 - STAA LONG TRUCK TURNS (LEFT) EAST OF SR 29

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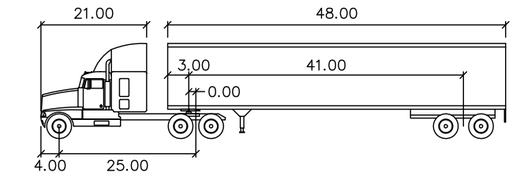
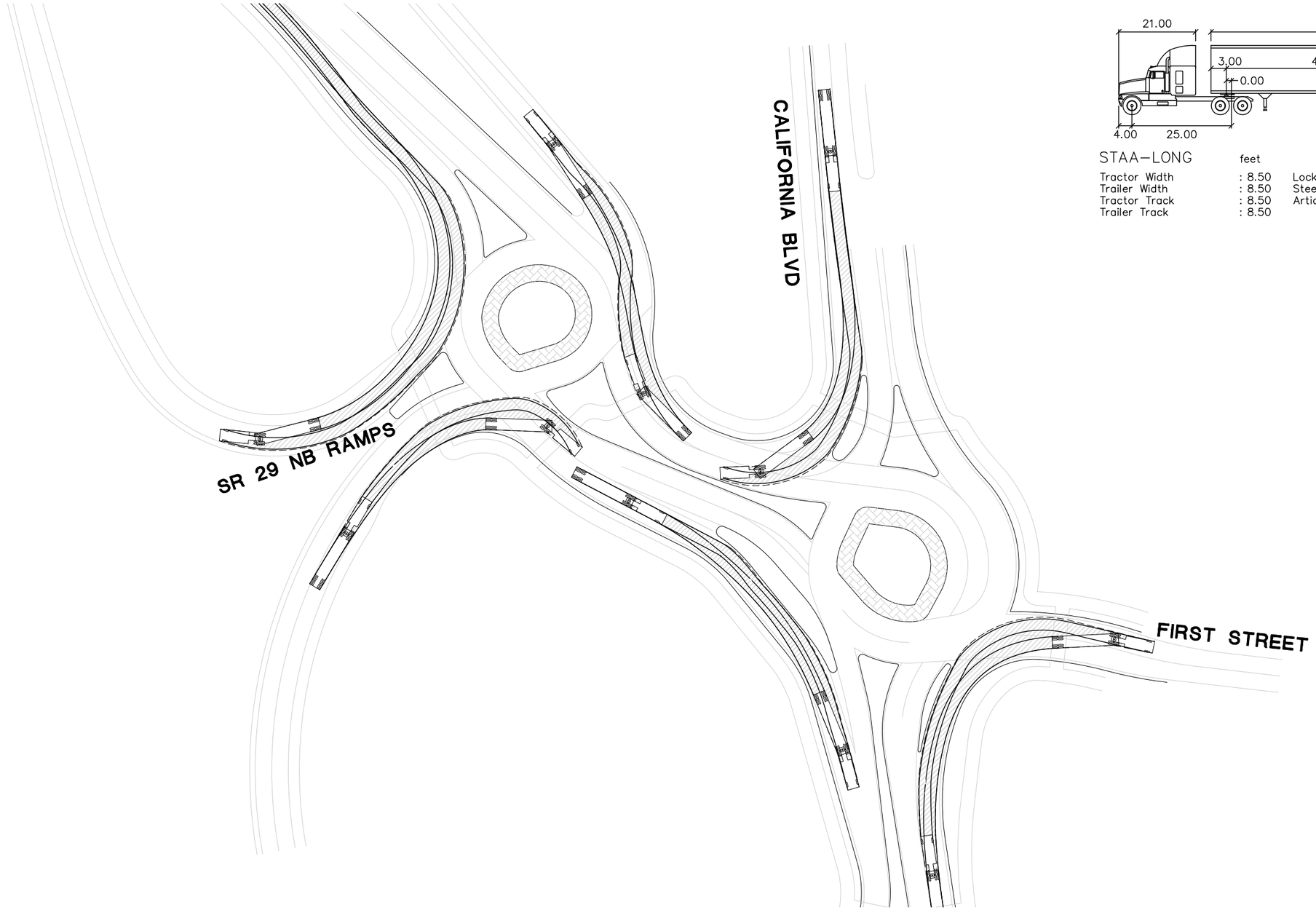


STAA–LONG feet

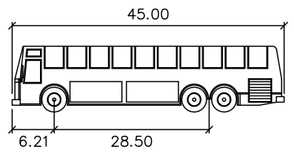
Tractor Width	: 8.50	Lock to Lock Time	: 6.0
Trailer Width	: 8.50	Steering Angle	: 26.3
Tractor Track	: 8.50	Articulating Angle	: 70.0
Trailer Track	: 8.50		



CITY OF NAPA ROUNDABOUT FEASIBILITY STUDY

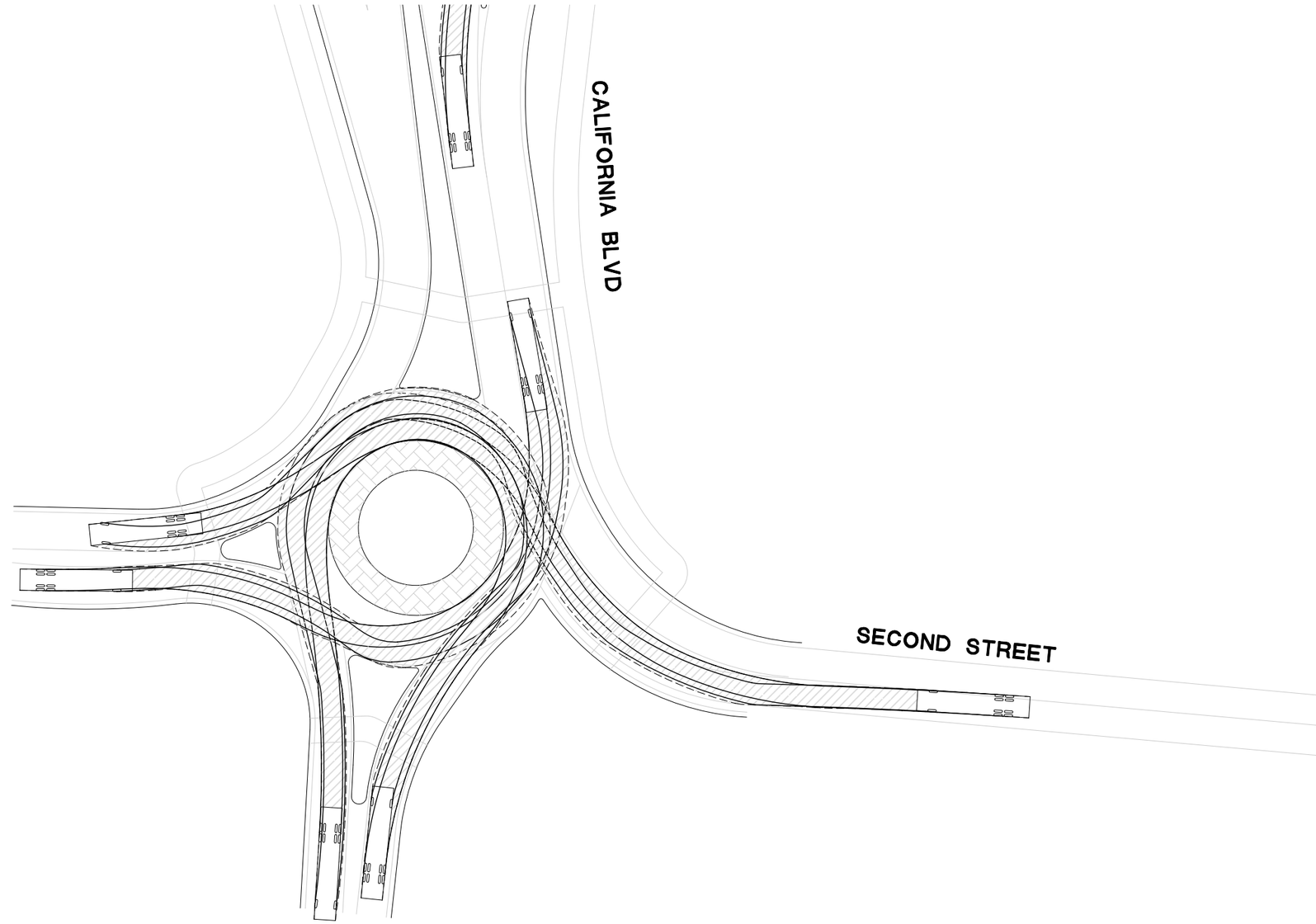
SCALE: 1" = 80'

CONCEPT 2 & 4 - STAA LONG TRUCK TURNS (RIGHT) EAST OF SR 29



BUS-45 feet

Width	: 8.50
Track	: 8.50
Lock to Lock Time	: 6.0
Steering Angle	: 44.3



CITY OF NAPA ROUNDABOUT FEASIBILITY STUDY

SCALE: 1" = 50'

CONCEPT 2 & 4 - BUS 45 TURNS (LEFT) EAST OF SR 29

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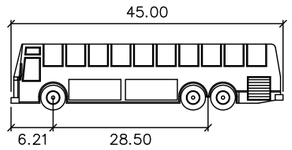
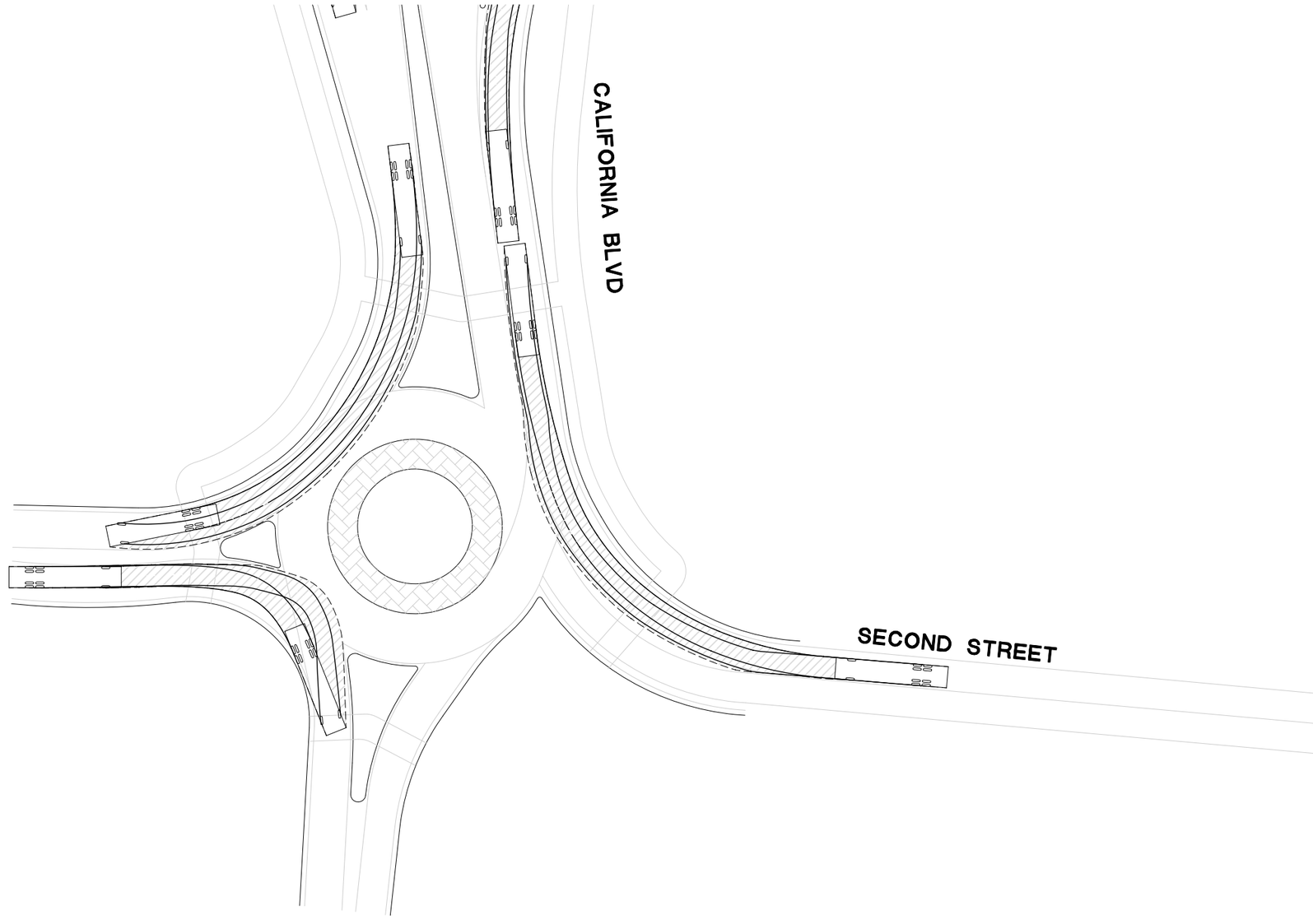
Job No:



BUS-45 feet

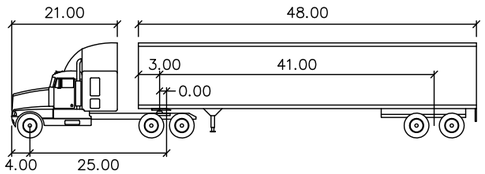
Width	: 8.50
Track	: 8.50
Lock to Lock Time	: 6.0
Steering Angle	: 44.3



CITY OF NAPA ROUNDABOUT FEASIBILITY STUDY

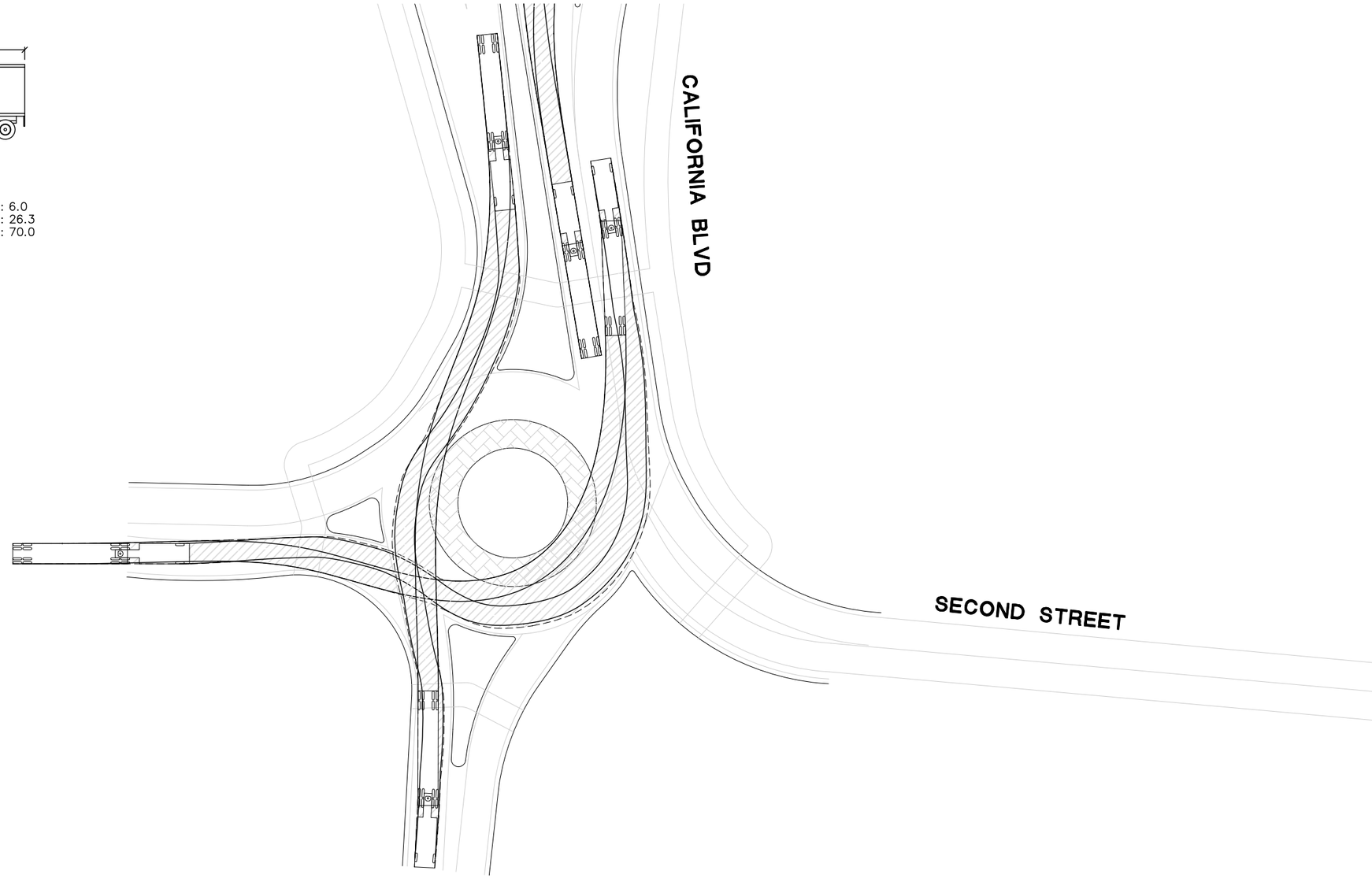
SCALE: 1" = 50'

CONCEPT 2 & 4 - BUS 45 TURNS (RIGHT) EAST OF SR 29



STAA–LONG feet

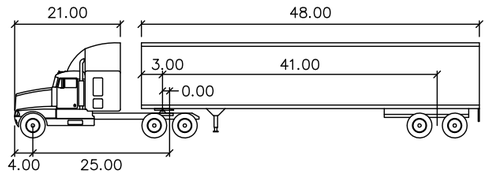
Tractor Width	: 8.50	Lock to Lock Time	: 6.0
Trailer Width	: 8.50	Steering Angle	: 26.3
Tractor Track	: 8.50	Articulating Angle	: 70.0
Trailer Track	: 8.50		



CITY OF NAPA ROUNDABOUT FEASIBILITY STUDY

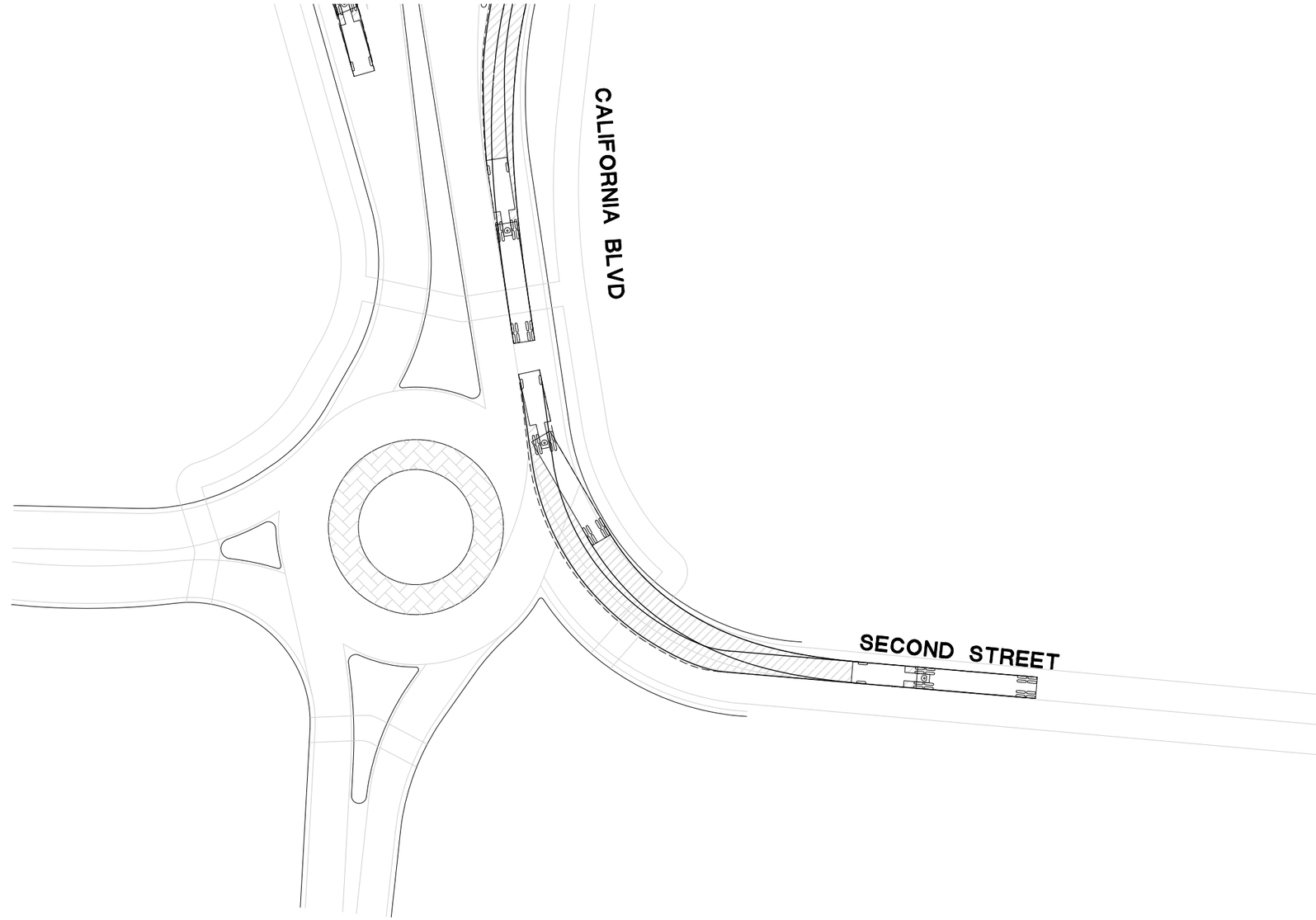
SCALE: 1" = 50'

CONCEPT 2 & 4 - STAA LONG TRUCK TURNS (LEFT) EAST OF SR 29



STAA–LONG feet

Tractor Width	: 8.50	Lock to Lock Time	: 6.0
Trailer Width	: 8.50	Steering Angle	: 26.3
Tractor Track	: 8.50	Articulating Angle	: 70.0
Trailer Track	: 8.50		



CITY OF NAPA ROUNDABOUT FEASIBILITY STUDY

SCALE: 1" = 50'

CONCEPT 2 & 4 - STAA LONG TRUCK TURNS (RIGHT) EAST OF SR 29