State Route 29 Comprehensive Multimodal Corridor Plan

Final Plan

May 2020

Acknowledgments

This plan was prepared for

Napa Valley Transportation Authority

Napa County

City of Napa

City of American Canyon

Caltrans District 4

This plan was prepared by

GHD

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Regional Government Services

Elite Transportation Group

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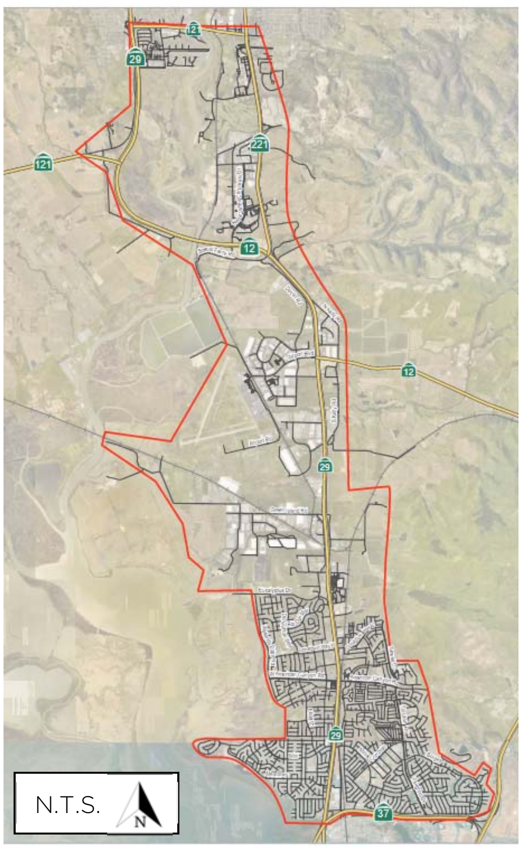
Executive Summary

This Executive Summary provides a brief overview of the following *State Route 29 Comprehensive Multimodal Corridor Plan (SR 29 CMCP)* report and highlights the resulting Preferred Corridor Plan. While this Executive Summary was prepared to convey an overall summary of the report and resulting Corridor Plan, the study and its appendices should be referenced for additional detail on methodology and findings.

The SR 29 Comprehensive Multimodal Corridor Plan (SR 29 CMCP) evaluates the most constrained portion of SR 29 – an 11.5-mile portion that stretches from Imola Avenue (designated SR 121 east of SR 29) in the City of Napa to SR 37 in the City of Vallejo. The study corridor is shown below.



Study Objective

The objective of the SR 29 CMCP is to develop a comprehensive multimodal package of prioritized improvements that address the corridor's pre-eminent issues, including:

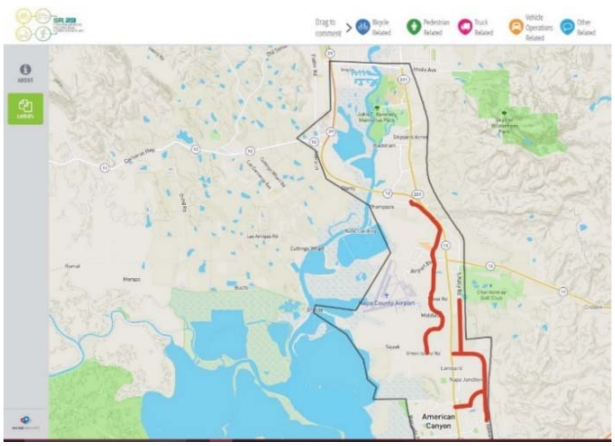
- Traffic congestion and delay;
- Increased crash risks for all users;
- Lack of low-stress multimodal connectivity;
- Reduced travel time and transit reliability;

The preferred package of multimodal improvements must be feasible, equitable, cost-effective, and have community support. The preferred multimodal improvement package will serve to guide future SR 29 corridor programming decisions over a 20-year timeframe based on available funding. Enhancements for multimodal travel, parallel capacity, operational, and telecommunication strategies were a key focus of the SR 29 CMCP. Requisite technical information consistent with State and Federal grant program guidelines and implementation phasing of the multimodal improvement package were also key elements of the Plan.

Study Approach

The SR 29 CMCP examines the existing and future operational and safety performance of SR 29 using the Caltrans Smart Mobility Framework approach, a performance-based analysis performed to develop and evaluate alternative corridor improvement concepts. The results of the performance analysis were combined with substantial input from the public to inform the ultimate selection of the SR 29 preferred corridor concept recommendation. The SR 29 preferred corridor concept with associated multimodal improvements establishes the funding priorities for the corridor that best meet both the local and regional goals while providing the highest return on investment (benefit-cost) of limited regional transportation funding over the next 20 years.

The SR 29 CMCP builds on a solid foundation of plans, policy documents, and community outreach efforts already completed along the SR 29 corridor. In particular, the SR 29 CMCP is a continuation of the outreach, analysis, and findings from the SR 29 Gateway Corridor Improvement Plan (NVTA, 2014).



Public Outreach Overview

The SR 29 CMCP outreach effort was robust in its focus on reaching the diverse communities. This outreach effort included two community workshops, a Staff Working Group comprising of all the partner agencies, and a robust online public engagement campaign including an interactive mapping tool. The mapping tool was made available on the project website beginning in early November 2019 and remained "live" through March 2020.

Corridor Solutions

Upon review of past planning and other corridor-related documents and establishment of evaluation performance metrics (Chapter 2 of the report), the public was engaged for their input (Chapter 3) and a thorough assessment of existing conditions was conducted (Chapter 4). These combined efforts led to the identification and evaluation of a focused group of Corridor Solutions (Chapter 5). These corridor solutions were identified based on prior efforts from the SR 29 Gateway Corridor Improvement Plan and from the needs analysis prepared as part of this study.

Seven categories of potential corridor improvements were identified. Within each of these categories, 24 separate and distinct improvements and/or services were described. Each of the improvements within these seven categories were costed and prioritized for future grant funding and implementation. The categories are outlined below.

- Parallel Capacity Improvements
- SR 29 Multimodal Improvements
- Intersection Improvements
- Shared Use Paths
- SMART Train Extensions
- Bus Improvements
- Integrated Corridor Management

Performance Assessment

The performance metrics selected for the SR 29 CMCP informed each of the six Smart Mobility Framework objectives to ensure that the resulting improvement recommendations provide a balanced, sustainable, and multimodal assessment of current and forecasted corridor conditions. Requisite rubrics include:

- Planning level cost opinions;
- Mode shift and vehicle miles travelled;
- Level of traffic stress scores;
- Vehicular delay and buffer time reductions;
- Collision reduction benefit;
- Health and air quality benefit;
- Societal cost and benefit monetization factors (per Caltrans 2018 Economic Parameters); and,
- Return on investment (i.e. benefit-cost).

Equal attention was given to document the beneficial outcomes of measures not directly reflected in the benefit-cost assessment. These include: Plan Consistency (with existing plans); Policy Consistency (NVTA, the City and County of Napa, City of American Canyon and Caltrans); Environmental/Institutional Sensitivity; Adaptation; Economic Development and, Community Acceptance.

Benefit Monetization Assessment

The societal costs and benefits were monetized based on the societal cost information from the Caltrans 2016 and 2018 Economic Parameters, using the Caltrans Cal-B/C analysis tool. All quantified benefits were annualized and projected to reflect a 20-year design year condition (i.e., life-cycle costs). These monetized benefits were then combined with currently available planning level improvement cost opinions (described below) to yield a holistic benefit-cost estimate for each project alternative. The total estimated benefit for the proposed corridor improvements was $699,589,714 over 20 years.

Cot estimates were sourced from previous planning documents, reviewed and adjusted to be consistent with existing costs, where possible. Where not available, preliminary planning-level costs were developed by project team planning and engineering staff. The individual corridor improvement cost estimates are presented in the report. The total estimated life-cycle costs for the proposed corridor improvements is $404,515,000.

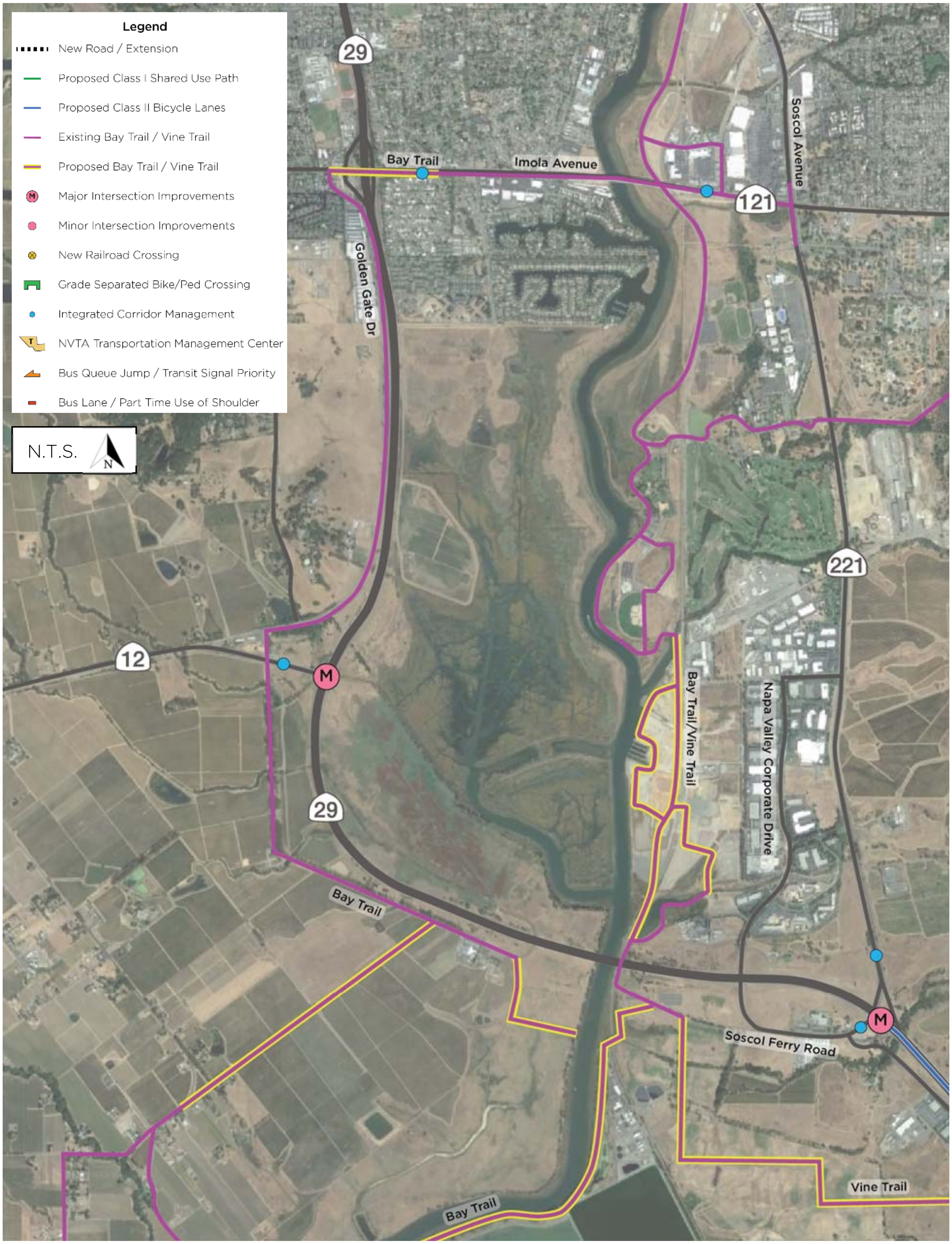
The comprehensive benefit cost for all improvements proposed within the study corridor. When monetized to a 20-Year life cycle, the benefit-cost equates to 1.73. This means that the overall benefit over 20-years is nearly 75% over the actual capital and maintenance costs expended over that same period of time.

Total Project Life-Cycle Cost	Life Cycle Benefit (20 Yrs.)
$404,515,000	$699,589,714
Total B/C	1.73

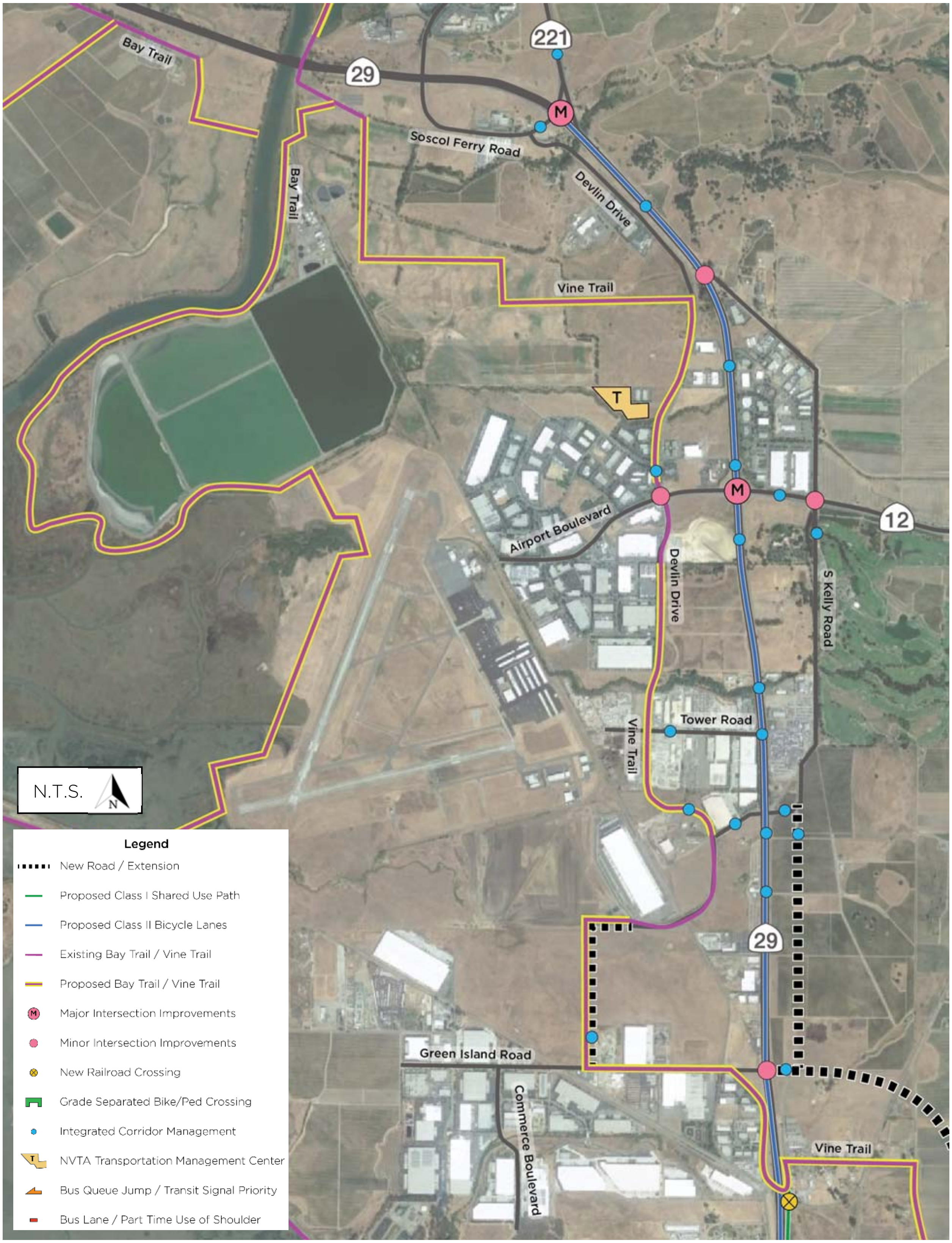
Preferred Corridor Plan

The following Preferred Corridor Plan, which represents implementation of the prioritized multimodal improvement package, is the achieved outcome of this study. The Preferred Corridor Plan consider public input and the application of the Smart Mobility Framework to assess holistic performance measures that align with State and Federal grant application requirements, yielding a competitive result.

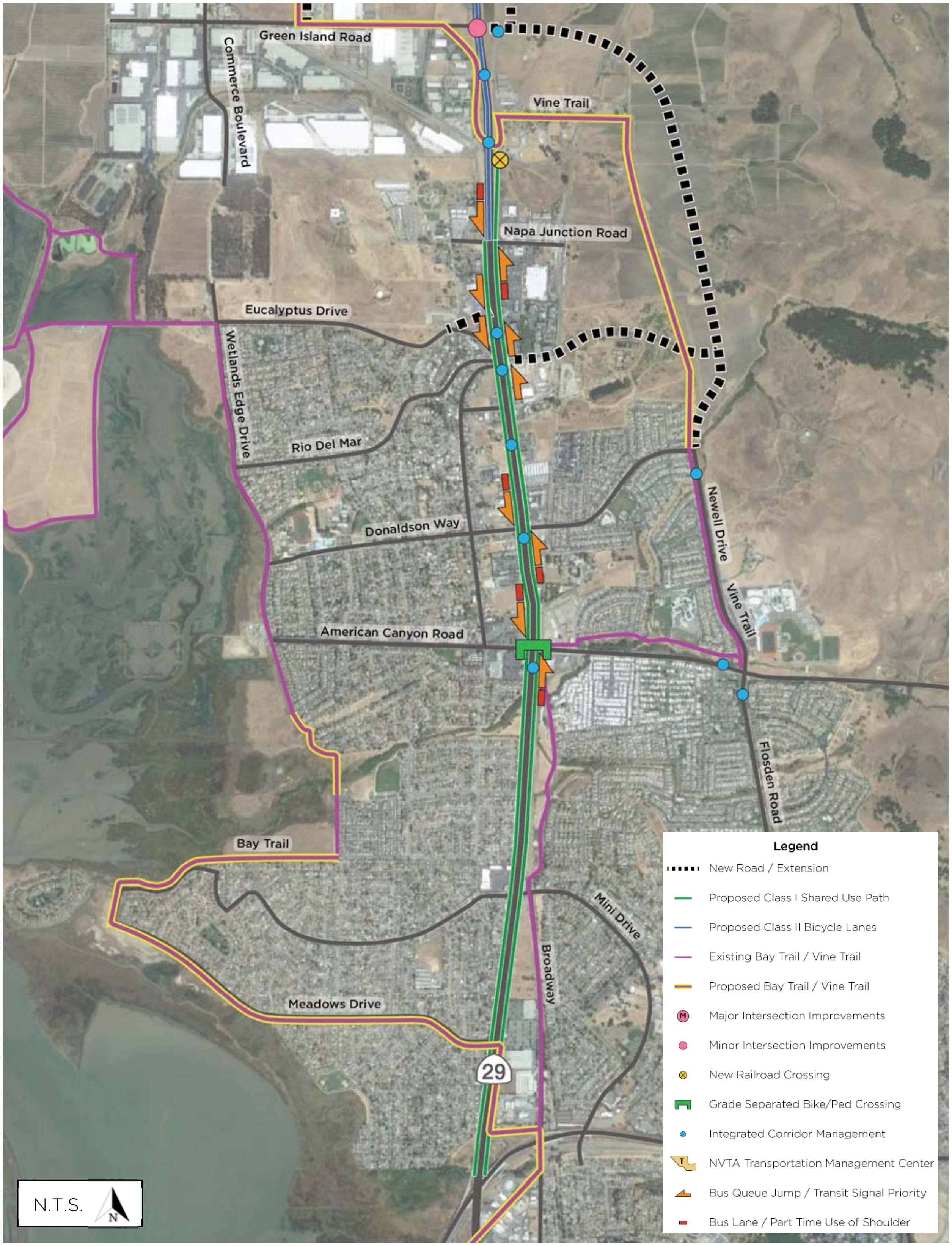
Preferred Corridor Plan: Imola Avenue to Soscol Junction (Figure 1 of 3)



Preferred Corridor Plan: Soscol Junction to Green Island Road (Figure 2 of 3)



Preferred Corridor Plan: Green Island Road to State Route 37 (Figure 3 of 3)



1 - Introduction

State Route (SR) 29 is part of the California Freeway and Expressway System within Caltrans District 4. It serves as the gateway to the world-renowned Napa Valley, extending from SR 20 in Lake County to Interstate 80 (I-80) in Solano County, as shown in Figure 1. The highway connects the Napa County cities of Calistoga, St. Helena, Yountville, Napa, and American Canyon. Immediately south of American Canyon, the highway connects the City of Vallejo in Solano County where it ultimately terminates at I-80. As the prime freight and agricultural access route for residents and wine industry businesses, SR 29 provides a vital regional connection to both the San Francisco Bay Area and the Sacramento Valley. Daily travel within Napa County ranges from 40,000 to 70,000 vehicles per day, including people commuting to work, tourists visiting the legendary wine region, and special event traffic.

Portions of SR 29 are eligible for inclusion into the State Scenic Highway System, although they are not currently designated as such. The historic alignment of SR 29 began as Old Bull Trail Road in the 1850s, which included steep grades up to 35 percent. That road was replaced by the St Helena Toll Road in 1868, which reduced inclines to 12 percent. During World War II, the highway was widened again to support military operations at the US Naval Base on Mare Island in Vallejo, leading to the current four-lane configuration. SR 29 is classified as a conventional highway throughout the study area. A portion of SR 29 is classified as a freeway between postmile 8.66 and 13.01, from the Imola Avenue (SR 121) interchange to the Trancas Street / Redwood Road interchange.

The SR 29 Comprehensive Multimodal Corridor Plan (SR 29 CMCP) evaluates the most constrained portion of SR 29 – an 11.5-mile portion that stretches from Imola Avenue (designated SR 121 east of SR 29) in the City of Napa to SR 37 in the City of Vallejo. The study corridor is shown in Figure 2. There are several discontinuous parallel roadways in the study corridor including SR 221, SR 12, South and North Kelly Road, Devlin Road, Soscol Ferry Road, Soscol Creek Road, Newell Drive, Flosden Road, and Fairgrounds Drive. This lack of continuous alternative routes contributes to the congestion problems on SR 29 and has elevated the importance of this state route as a lifeline for many of the communities it serves.

The SR 29 study corridor experiences significant safety and operational issues during weekday and weekend peak hour conditions. The most pronounced issues in the corridor include:

- Lack of multimodal connectivity particularly for bicycle and pedestrian access along and across SR 29;
- Lack of low-stress routing options for bicyclists;
- Lack of continuous parallel routes to support local and regional travel demand;
- Capacity constraints at key SR 29 intersections that cause extensive queuing and delays, extensive bottleneck durations, and unreliable travel times for both motorists and transit;
- Compromised feasibility to provide enhanced transit service due to travel time unreliability
- Increased safety risk and conflicts between motorists and active transportation users

- Compromised emergency response times, evacuation routes and incident clearance capabilities.

Napa County residents have long expressed concerns about congestion and safety on SR 29. Area residents, commuters and others who regularly drive the corridor have noted the 11.5-mile segment between SR 121 and SR 37 is particularly challenging. In recognition of the regional importance of SR 29, its diminishing quality of service, and its priority need for improvement by the jurisdictions it serves, the Napa Valley Transportation Authority (NVTA) in partnership with Caltrans District 4, the County of Napa, and the Cities of Napa and American Canyon commissioned the 2014 SR 29 Gateway Corridor Improvement Plan, and subsequently, this SR 29 CMCP.

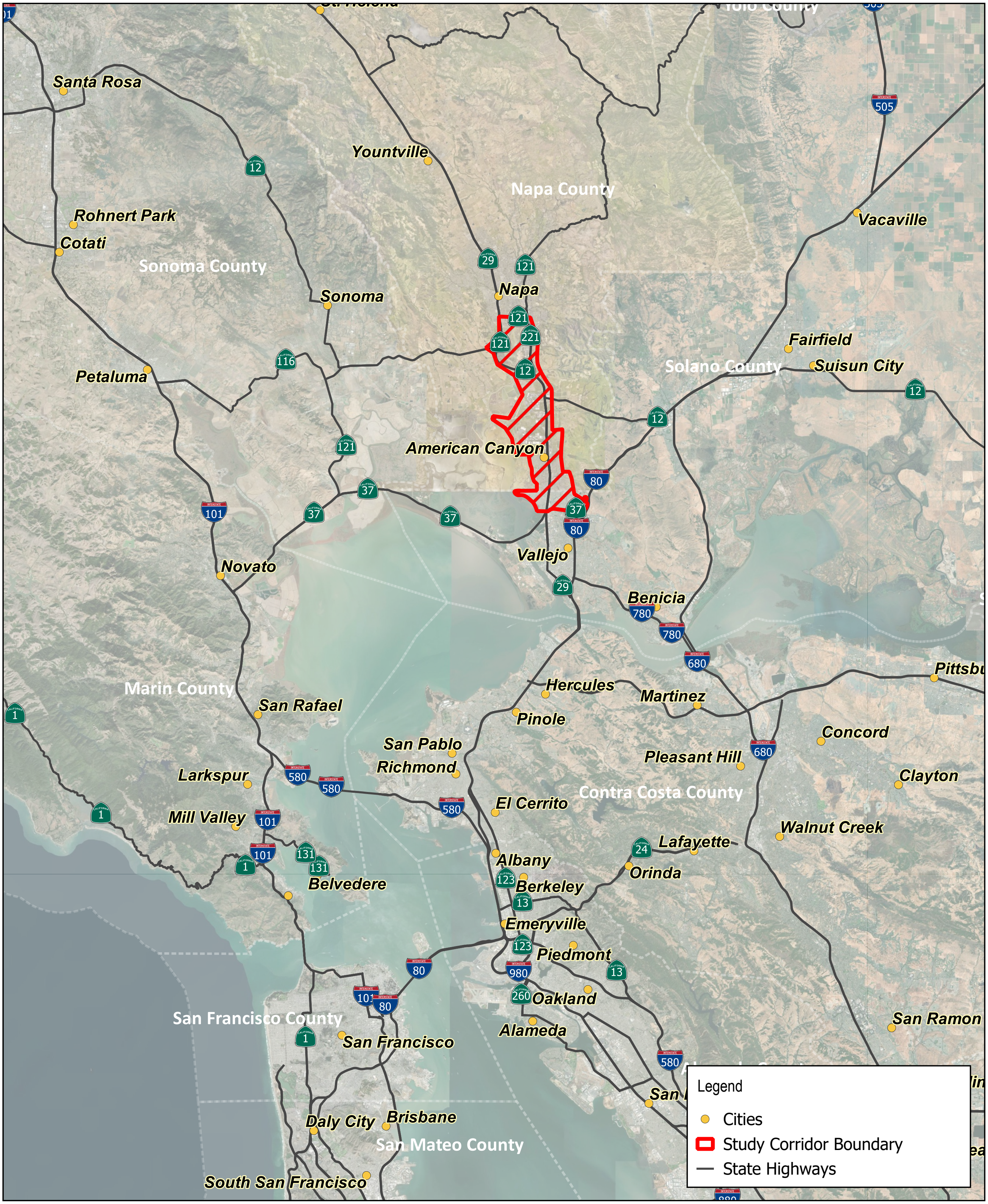
The SR 29 CMCP builds on the efforts and recommendations of the 2014 SR 29 Gateway Corridor Improvement Plan, expanding the study area to include parallel facilities and updating the analysis to assist in the prioritization of projects using the requisite performance measures necessary to move priority projects into implementation through competitive Statewide and Federal grant programs.

Study Purpose

The purpose of The SR 29 CMCP is to inventory known planned and programmed corridor improvements identified in prior corridor planning efforts to form a comprehensive multimodal package of prioritized improvements. The preferred package of multimodal improvements should improve the quality of and access to active transportation, thus encouraging travel mode shift from single occupant vehicles to bicycle, pedestrian, and transit travel, consistent with Caltrans Deputy Directive DD-64-R2 and the Metropolitan Transportation Commission (MTC) policies for implementation of “Complete Streets”.

The preferred package of multimodal improvements must be feasible, equitable, cost-effective, and have community support. The preferred multimodal package of improvements will serve to systematically guide future SR 29 corridor programming decisions over a 20-year timeframe based on available funding. Multimodal improvements, parallel capacity, operational, and telecommunication strategies were a key focus of the SR 29 CMCP.

Requisite technical information consistent with State and Federal grant program guidelines and implementation phasing of the multimodal improvement package were also key elements of the SR 29 CMCP. In order to ensure that the SR 29 CMCP successfully serves to inform future Solutions for Congested Corridors Program (SCCP) grant applications, the SR 29 CMCP was prepared following Caltrans’ *Comprehensive Multimodal Corridor Plan Guidelines* (December 2018) and *Corridor Planning Process Guide* (February 2020). The SCCP is a funding program created by Senate Bill 1 (Beal, 2017), also known as the Road Repair and Accountability Act of 2017.



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Not To Scale

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Horizontal Datum: WGS 1984
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NAPA VALLEY TRANSPORTATION AUTHORITY
SR 29 COMPREHENSIVE MULTIMODAL
CORRIDOR PLAN

REGIONAL CONTEXT

Project No. 1187559
Revision No. -
Date. 03/26/2020

FIGURE 1

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\Fig 2 - Vicinity Map.qgs

Data Source:

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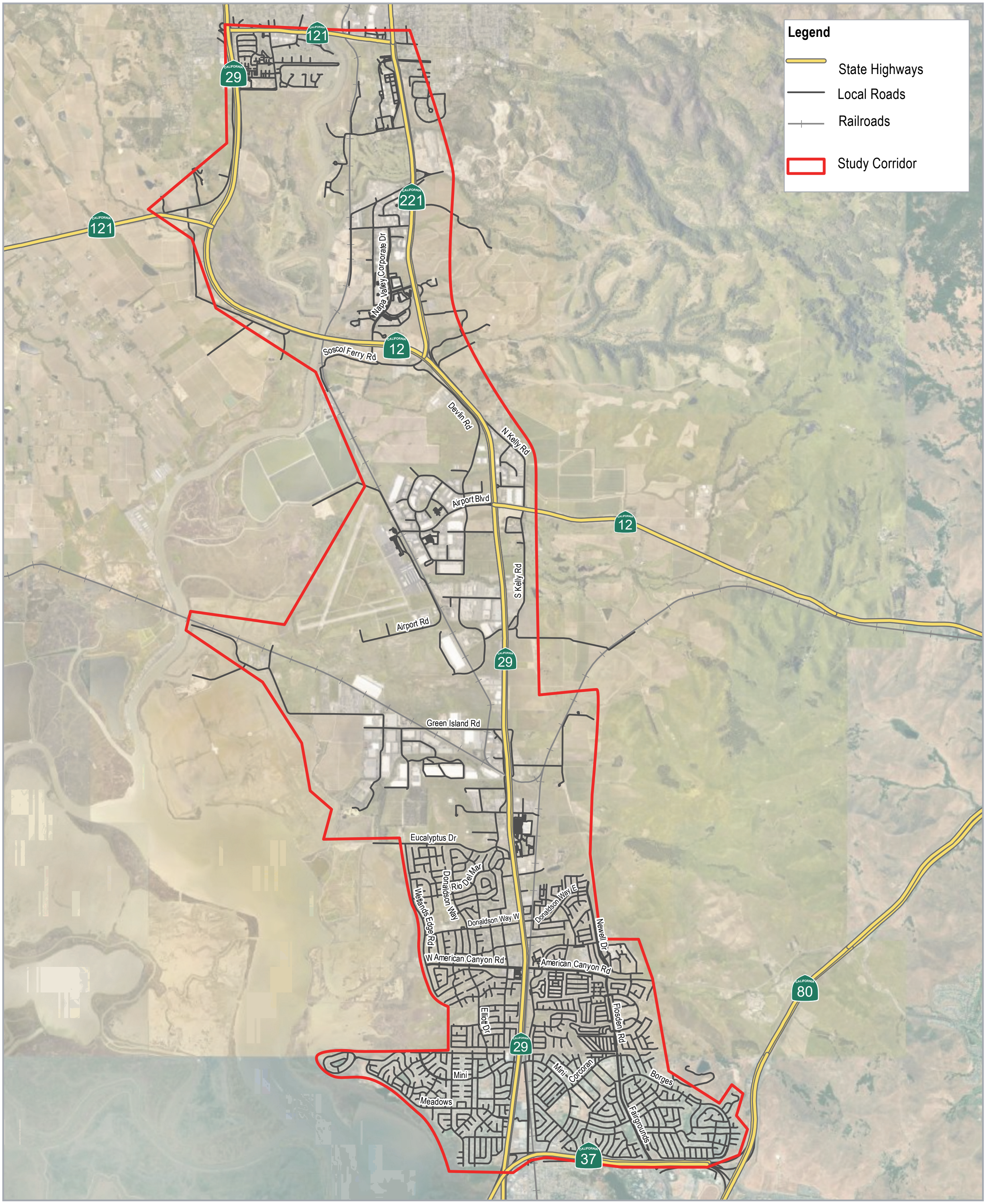

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NAPA VALLEY TRANSPORTATION AUTHORITY
SR 29 COMPREHENSIVE MULTIMODAL
CORRIDOR PLAN

SR 29 CMCP
STUDY CORRIDOR

Project No. 11187559
Revision No. -
Date 3/27/2020

FIGURE 2

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Data source: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community. Created by: rsouthern

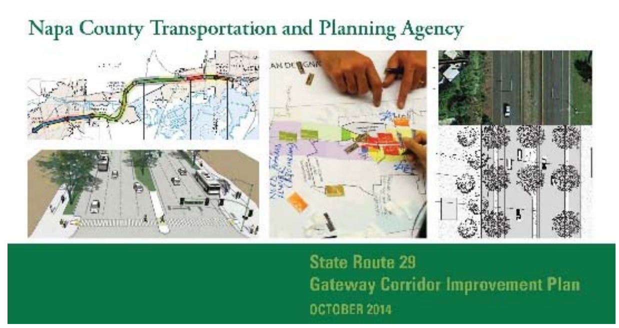
Study Approach

To determine the most cost-effective solution for resolving the various operational and safety needs on the SR 29 corridor, the SR 29 CMCP holistically examines the existing and future operational and safety performance of SR 29 from its juncture with SR 37 to Imola Avenue (approximately 11.5 miles). Using the Smart Mobility Framework approach, a performance-based analysis was performed to develop and evaluate alternative corridor improvement concepts. The results of the performance analysis were combined with substantial input from the public to inform the ultimate selection of the SR 29 preferred corridor concept recommendation. The SR 29 preferred corridor concept with associated multimodal improvements establishes the funding priorities for the corridor that best meet both the local and regional goals while providing the highest return on investment (benefit-cost) of limited regional transportation funding over the next 20 years.

The SR 29 CMCP includes the following primary objectives:

- Draw from existing data sources and apply advanced data collection technology and resources such as multiple "Big Data" sources and video to establish travel characteristics, traffic counts, vehicle speeds, and travel time variation trends to establish an accurate baseline;
- With direct input from the public, develop a preferred corridor concept that: 1) maximizes efficiency and safety; 2) achieves acceptable operating conditions relative to projected future demand; 3) improves air quality, economic development, and social equity; 4) is context sensitive in accord with SR 29's rural and scenic character; and, 5) minimizes potential impacts to the natural environment;
- Consistent with Caltrans' *Smart Mobility Framework 2010* and the *2018 Comprehensive Multimodal Corridor Plan Guidelines* and *SB 1 Solutions for Congested Corridors Program Guidelines* from the California Transportation Commission (CTC), perform a transparent and objective performance-based analysis to identify a preferred corridor concept to calculate life-cycle benefit-costs that support infrastructure investment decisions made by NVTA, MTC, Caltrans District 4, and other stakeholders including the County of Napa and the cities of Napa and American Canyon.

The SR 29 CMCP builds on a solid foundation of plans, policy documents, and community outreach efforts already completed along the SR 29 corridor. In particular, the SR 29 CMCP is a continuation of the outreach, analysis, and findings from the SR 29 Gateway Corridor Improvement Plan (NVTA, 2014).



The SR 29 Gateway Corridor Improvement Plan was a community driven vision and improvement strategy for the southern portion of SR 29 from the Vallejo Ferry Terminal to the Trancas Park & Ride lot (near Redwood Road in the City of Napa). It included extensive public outreach, engaging the community in conversations about transportation challenges on the corridor and identifying possible solutions. The Gateway Plan evaluated current and future travel conditions guided by community input to develop a corridor vision and identified multimodal safety and operation improvements to roadway sections and intersections. Given this prior planning groundwork, the SR 29 CMCP carries forward several projects identified in the Gateway Plan alongside new improvement concepts and strategies for evaluation and community feedback.

The SR 29 CMCP expands the breadth of analysis beyond what was addressed in the SR 29 Gateway Corridor Improvement Plan. The CMCP broadens the planning area by including parallel facilities east and west of the highway and expands the technical analysis and performance assessment of the identified improvements consistent with State guidance. However, the SR 29 CMCP study area ends south of Imola Avenue, rather than the Trancas Park & Ride lot.

Public Outreach Overview

An effective community engagement program creates confidence in the planning process, promotes broad-based understanding, and reflects the interests and needs of the community. Successful implementation of the improvements recommended in this plan will require cooperation between NVTA, Napa County, the cities of Napa and American Canyon, and the community as a whole.

The SR 29 CMCP pivots off the prior Gateway Plan community engagement efforts. Gateway Plan input primarily focused on the identification of problem areas and needs which helped inform improvement recommendations. The SR 29 CMCP community engagement was strategically targeted to gauge the public's support for the SR 29 CMCP candidate improvement concepts.

The SR 29 CMCP outreach effort is robust in its focus on reaching diverse communities. This outreach effort includes the following:

- Community Workshops
  - November 19, 2019
  - April 23, 2020
- Staff Working Group, including:
  - Napa Valley Transportation Authority (NVTA)
  - City of Napa
  - City of American Canyon
  - Napa County
  - Caltrans District 4
- Stakeholder Committee
- Media
- Project Logo Branding and Project Information Cards
- Online Engagement
- Interactive Mapping Tool

The input received through these various channels helped inform the SR 29 preferred improvement concept and associated multimodal improvements. The community workshops, their participation and insights as well as each of the other outreach efforts are more fully described in the Public Outreach section of this report.

Organization of this Plan

This plan is organized into seven chapters. These chapters include:

- Chapter 1 – Introduction: includes a brief study background, study objective, approach/purpose and need, public outreach overview and organization of this SR 29 CMCP document
- Chapter 2 - Planning Guidance and Metrics: examines past planning documents for planning context and the Caltrans Smart Mobility Framework for performance criteria for selection of priority of improvements
- Chapter 3 - Public Outreach: summarizes outreach process conducted to gather feedback on potential solutions and preferred concepts
- Chapter 4 - Existing Conditions: documents findings from field observations, technical analyses, and models
- Chapter 5 - Corridor Solutions: outlines the potential improvements identified for the corridor based on the existing conditions analysis and prior outreach conducted during the SR 29 Gateway Corridor Improvement Plan
- Chapter 6 - Performance Assessment: evaluates the preferred concept under current and future conditions based on performance metrics described in the Introduction
- Chapter 7 - Preferred Corridor Plan: describes the Preferred Corridor Plan that evolved from the Public Outreach and Performance Assessment efforts

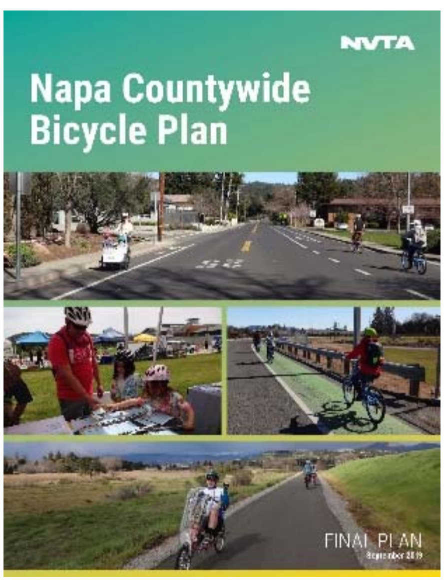
In addition, appendices provided under separate cover have more detail on analysis methodology, data, and findings as well as community feedback.

2 - Planning Guidance and Metrics

In providing an overall framework and planning guidance for the preparation of this SR 29 CMCP, an understanding of all past transportation related planning studies was needed as well as the performance criteria for establishing a Comprehensive Multimodal Corridor Plan that meets mobility needs, is fundable and implementable. For this planning effort, the Caltrans *Smart Mobility Framework 2010,* as described in the following pages was utilized. It is consistent with both the *2018 Comprehensive Multimodal Corridor Plan Guidelines* and the *SB 1 Solutions for Congested Corridors Program Guidelines* from the California Transportation Commission (CTC).

Planning Context

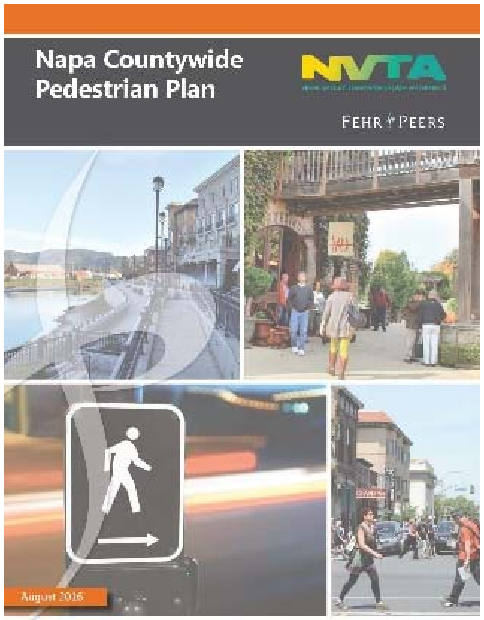
In addition to the SR 29 Gateway Corridor Improvement Plan, several other related planning documents were used to help inform the SR 29 CMCP. These are described below. It should be noted that the Caltrans District 4 System Planning division is currently developing the SR 29 Transportation Concept Report (TCR). As a key partner in the development of the SR 29 CMCP, Caltrans District 4 opted to delay completion of the SR 29 TCR until after adoption of the SR 29 CMCP to ensure the latest planning concepts for the corridor are considered for inclusion.



Countywide Bicycle Plan (2019)

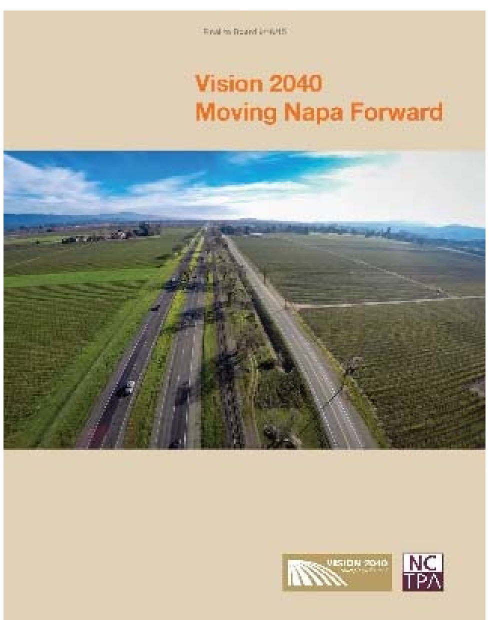
The 2019 Napa Countywide Bicycle Plan outlines a strategy to make bicycling accessible and appealing to the broader county community, beyond those who have traditionally identified themselves as bicyclists. The plan focuses on developing low-stress bicycle routes, improving safety, and improving access for disadvantaged communities.

Identified improvements in the SR 29 CMCP study area include closing gaps in the San Francisco Bay Trail and the Napa Valley Vine Trail. A shared use path is also recommended on SR 221 from SR 29 to Imola Avenue, and bicycle lanes are recommended on SR 29. In American Canyon, shared use paths are proposed for both sides of SR 29 in addition to parallel off-street bicycle routes along Devlin Road and South Kelly Road.



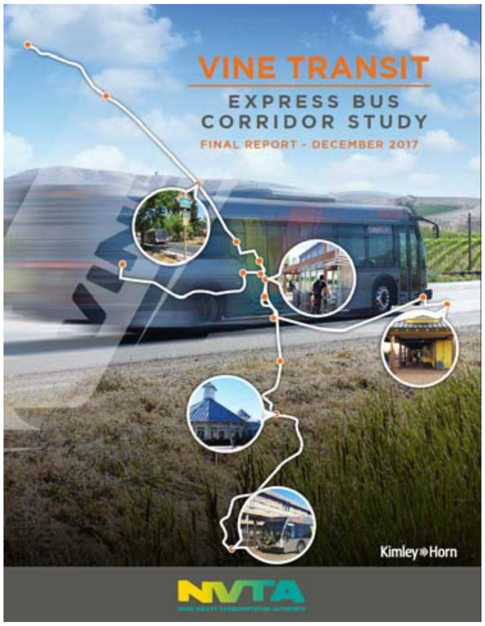
Countywide Pedestrian Plan (2016)

The 2016 Countywide Pedestrian Plan aims to improve safety, convenience, and accessibility for people walking in Napa County. In addition to recommending new sidewalks and accessibility features, the Pedestrian Plan carries forward recommendations for larger-scale improvements that would positively impact the experience for pedestrians, including roundabouts at First Street at SR 29.



Countywide Transportation Plan – Vision 2040: Moving Napa Forward (2014)

The Vision 2040 plan sets long-range goals and investment strategies for all modes of transportation in Napa County over the next 25 years. In addition to identifying multimodal improvements, it highlights the nexus between multimodal transportation and economic development, public health, and place-making.



Vine Transit Express Bus Corridor Study (2017)

The Vine Transit Express Bus Corridor Study identified and recommended operational and capital improvements for the express bus system in the Napa Valley. Many of these solutions are evaluated in this CMCP, including queue jumping, use of shoulders, and station improvements.

Caltrans District 4 Bike Plan (2018)

The Caltrans District 4 Bike Plan is the first of its kind in the State, evaluating bicycle needs across the Bay Area's State transportation network. The plan identifies infrastructure improvements to enhance bicycle safety and mobility and remove barriers to bicycling in the region. The plan identifies SR 29 as a highway opportunity to implement parallel trail or on-highway separated bikeways, with the SR 29 alignment through American Canyon in particular noted as a high-priority project..

Smart Mobility Framework

Caltrans' *Smart Mobility Framework 2010: A Call to Action for the New Decade* provides a broad planning framework to guide multimodal and sustainable transportation planning and project development. It also provides tools to assess how plans, programs, and projects meet Smart Mobility goals throughout the State.

Smart Mobility moves people and freight while enhancing California's economic, environmental, and human resources by emphasizing convenient and safe multimodal travel, speed suitability, accessibility, management of the circulation network, and efficient use of land.

The Smart Mobility Framework is premised on six key objectives: Location Efficiency; Reliable Mobility; Health and Safety; Environmental Stewardship; Social Equity; and, Robust Economy. These six objectives are informed through the application of seventeen candidate performance measures. The Smart Mobility Framework process is consistent with both the 2018 Comprehensive Multimodal Corridor Plan Guidelines and the SB 1 Solutions for Congested Corridors Program Guidelines from the California Transportation Commission (CTC).

Source: Caltrans' Smart Mobility Framework 2010: A Call to Action for the New Decade

The fundamental premise of the Smart Mobility Framework is to ensure that planning or programming decisions for transportation improvements are performance based, transparent, and address sustainable outcomes and objectives. The performance metrics selected for the SR 29 CMCP informed each of the six Smart Mobility Framework objectives to ensure that the resulting improvement recommendations provide a balanced, sustainable, and multimodal assessment of current and forecast corridor conditions. Requisite rubrics include: planning level cost opinions; vehicular delay and buffer time reduction; level of traffic stress scores; mode shift and vehicle miles traveled (VMT) reduction; collision reduction benefit; health and air quality benefit; societal cost and benefit monetization factors (per Caltrans 2018 Economic Parameters); and return on investment (i.e., benefit-cost). Equal attention will be given to documenting the beneficial outcomes of measures not directly reflected in the benefit-cost assessment. These include: Plan Consistency (with existing plans); Policy Consistency (NVTA, the City and County of Napa, City of American Canyon and Caltrans); Environmental/Institutional Sensitivity; Adaptation; Economic Development and, Community Acceptance. Metrics selected for this SR 29 Plan are described on the following section. Results from this analysis were combined with substantial input from the public to inform the selection of the preferred multimodal corridor improvement package.

Performance Metrics

The performance metrics selected to evaluate this Plan are coordinated with the six objectives outlined in the Smart Mobility Framework to ensure the resulting improvement recommendations provide a balanced, sustainable, and multimodal assessment of current and future corridor conditions.

Many of these performance measures do not have established standards but were analyzed to better understand the existing and future operational characteristics of SR 29 and inform a comparative analysis of improvement concept alternatives. Use of additional metrics other than vehicular Level of Service (LOS) is consistent with the Smart Mobility Framework and with the recent Senate Bill (SB) 743 intended to streamline the California Environmental Quality Act (CEQA) process. Some metrics such as delay, collision reduction, mode shift, and vehicle miles of travel reduction can be monetized and were incorporated into a benefit-cost analysis. Other quantifiable indices, such as suitability scores (i.e. level of traffic stress analysis), adaptation assessments, economic development assessments, and environmental justice impacts, etc. are not conducive to being monetized. Although some of the presented performance metrics cannot be monetized, assessment of the results of these analyses provide value to informing improvement recommendations.

The measures of effectiveness for the SR 29 CMCP performance metrics and analysis tools used to generate each measure of effectiveness is mapped in matrix form in Table 1. Also shown is whether the measure can be monetized for inclusion in a benefit-cost assessment. The performance measures by Smart Mobility Framework objective are described on the following pages.

Table 1: Performance Measures of Effectiveness and Analysis Tools

Analysis Purpose	Measure of Effectiveness	Model or Analysis Tool											Monetized Benefit?
		Solano-Napa ABM	Microsimulation	Level of Traffic Stress	NCHRP 552 Method	TCRP 118 Elasticity	HSM Part C CMFs	SB1 Emissions Calc.	GIS Analysis	Online Mapping Tools	Literature Review	NPMRDS/INRIX	
Baseline Travel Demand	Trips, Ridership, VMT	X											Y
Future Travel Demand	Trips, Ridership, VMT	X											Y
Roadway Operations	Delay, Buffer Time, Throughput		X									X	Y
Transit Ridership	Ridership, VMT					X					X		Y
Pedestrian/Bike Connectivity	Access Indices			X					X				N
Pedestrian/Bike Mode Shift	Trips, VMT				X				X				Y
Safety	Collision Reduction, Rate	X				X	X		X				Y
Air Quality	Emissions (criteria, GHG)	X	X		X	X		X					Y
Social Equity	Access, Benefit/Burden	X		X					X	X			N
Economic Development	GRP, Jobs, Income		X						X		X	X	N
Health	VMT	X			X					X			Y
Adaptation	Network Vulnerability								X	X	X		N

Location Efficiency

Accessibility and Connectivity

Bicycle Level of Traffic Stress (Bicycle LTS) measures a bicyclist's perceived sense of risk associated with riding in or adjacent to vehicle traffic. Roadways are assigned an LTS score based on posted speed limit, number of travel lanes, the type of bikeway provided, and other factors. Low-stress facilities would be considered by up to 60% of the general population a viable option for biking. Bicycle LTS in the study corridor was evaluated using methodology developed by the Mineta Transportation Institute. The objective is to provide a connected network of low-stress bicycle facilities within the study corridor.

Transit Mode Share

Transit mode share measures the degree that system and service improvements in transit service induce more ridership. The methodologies described in TCRP-118 the Bus Rapid Transit Practitioner's Guide were used to determine the degree of mode shift to transit resulting from proposed service and system transit improvements.

Vehicle Miles Traveled VMT

Vehicle Miles Traveled (VMT) is calculated by multiplying the number of trips and the average segment lengths of a given trip. California's Senate Bill (SB) 743 declares VMT the operative metric used to assess transportation impacts under the California Environmental Quality Act (CEQA). Statewide mandatory implementation of SB 743's provisions will occur on July 1, 2020. VMT is a measure of both transportation and land use efficiency given that shorter trips or trips not requiring an automobile will result is less VMT.

Reliable Mobility

Multimodal Service Quality

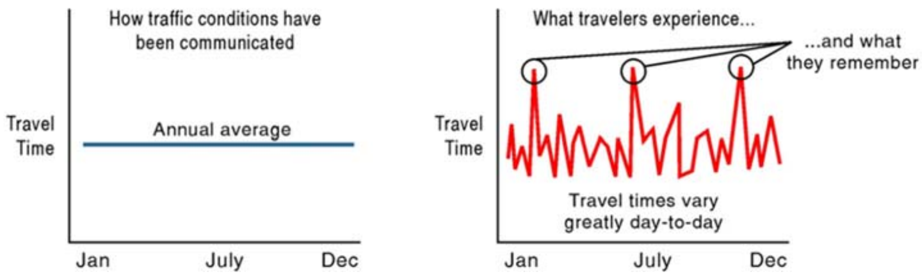
Baseline service quality in the SR 29 corridor was empirically based using travel time data sets from INRIX and the National Performance Monitoring Research Data Set (NPMRDS). The Federal National Performance Rule Congestion Threshold performance measure was used to determine the performance of roadway segments within the study corridor: Uncongested (>= 60 % of free-flow) vs. Congested (< 60% of free-flow).

To forecast corridor performance a VISSIM micro-simulation model was developed to determine corridor-wide person throughput, vehicle throughput, vehicle miles of travel and travel time, travel time index (TTI), and delay.

Intersection operations were also quantified using the SR 29 micro-simulation model through the determination of Level of Service (LOS) at key intersections. LOS is a qualitative metric that describes the experience of motorists. Intersections and approaches are assigned scores from "A" through "F" with A being free-flowing traffic with little to no congestion and F being highly congested. LOS criteria are established to determine whether a given roadway facility is providing the desired quality of service. The methodologies used to determine LOS (i.e. delay, speed, density) were based on the Highway Capacity Manual (HCM) 6th Edition. Caltrans operating standards have been applied that identify the cusp between LOS C and D as the acceptable threshold for SR 29.

Multimodal Service Reliability

Travel time reliability is defined as the variation in travel time for the same trip from day to day ("same trip" implies a trip made with the same purpose, from the same origin, to the same destination, at the same time of the day, using the same mode, and by the same route). If variability is large, the travel time is considered to be unreliable, because it is difficult to generate consistent and accurate estimates for it. If there is little or no variation in the travel time for the same trip, the travel time is considered to be reliable.



Two sources of the travel time data were used for the SR 29 CMCP, a combination of INRIX data (for passenger vehicles and trucks combined) and NPMRDS data. These data were used to establish baseline passenger car and freight travel time reliability for the SR 29 CMCP. The following performance metrics for passenger vehicles were generated:

- Buffer time
- Buffer time index

Both the national rule's definition of reliability (based on 80th percentile speed) and the HCM definition of reliability (based on 95th percentile speed) were applied.

To estimate the change in reliability (buffer time only) as a result of the SR 29 CMCP improvement concepts, the change of travel time reliability was holistically projected for each SR 29 CMCP alternative under future year conditions. The relative change in the Travel Time Index (TTI) between baseline and future was applied to adjust the empirically based NPMRDS baseline estimate of buffer time. This assumes that the effect of construction, weather, and incidents reflected in the most recent 12 months of NPMRDS data is reasonably reflective of the frequency of like events in the future.

Health and Safety

Pedestrian and Bicycle Mode Share

To estimate the induced demand associated with the bicycle improvements proposed in the study corridor, the National Cooperative Highway Research Program (NCHRP) 552 methodology provided in the Guidelines for Analysis of Investment in Bicycle Facilities was utilized. The analysis quantifies the induced demand mode shift (induced demand) associated with the proposed improvements, and monetizes the annualized mobility, health, recreation and decreased auto use benefits provided by the projected mode shift at high, moderate and low estimates. The estimated mode shift is then converted to VMT reduction by applying an average trip length estimate.

Design and Speed Suitability (i.e., Collision Reduction Potential of Infrastructure Improvements)

Based on the contributing factors from the baseline collision hot-spot assessment, Parts B and D of the Highway Safety Manual (HSM) 2010 were applied to identify location-specific and corridor-wide countermeasures. At intersections, Part C of the HSM was applied to estimate the potential safety performance and crash reduction potential of identified infrastructure design treatments. Estimated collision reductions are then monetized using societal cost estimates from the Caltrans 2018 Economic Parameters.

Environmental Stewardship

Vehicle Emissions (Criteria Health-Based Pollutants and Climate Change Pollutants)

Corridor and intersection-specific on-road mobile sources of health-based criteria pollutants (including VOC, NOx, and PM_{10}) and climate change pollutants (greenhouse gases) were estimated using the California Transportation Commission (CTC) Emissions Analyzer which is based on modified base emission rates consistent with the California Air Resources Board (CARB) emissions model EMFAC.

Adaptation

A qualitative assessment of the degree of vulnerability and sustainability of future transportation investments in the SR 29 corridor as well as potential benefits associated with evacuation responses to climate change related events such as flood and wildfire was determined using the Caltrans Vulnerability Mapping web-based resources.

Social Equity

Equitable Distribution of Benefits and Impacts

A qualitative assessment of the distribution of benefits (i.e., access to and utilization of) and impacts (construction, environmental, and right-of-way impacts) of the proposed future transportation investments in the SR 29 corridor relative to advantaged and disadvantaged communities was determined through application of Cal-environ web-based mapping resources.

Robust Economy

Return on Investment

To provide an indication of the projected return on investment of the proposed investment in the SR 29 corridor, a holistic 20-year life cycle benefit-cost (B/C) metric is computed based on the net present value (i.e. life cycle duration using a discount rate of four percent) incorporating the following five measures of effectiveness:

- Safety Benefit (predicted collision reduction)
- Health Benefit (mode shift to active transportation)
- Reduced Vehicle Operating Cost Benefit (VMT reductions)
- Delay and Buffer Time Reduction Benefit (delay and buffer time savings)
- Vehicle Emission Reduction Benefit (VMT and vehicular operations i.e., delay reductions)
- Operations and Maintenance Costs
- Initial Capital Costs

Monetized benefits were based on 2016 / 2018 societal cost parameters developed by Caltrans. Improvement costs (capital and operations and maintenance) used a format based on Caltrans preparation guidelines for developing project planning cost options.

The following assessments, though qualitative, relate to the robust economy objective given the importance of ensuring and protecting the integrity and sustainability of the proposed SR 29 corridor investment.

Economic Development

An economic assessment using IMPLAN economic multipliers of the short- and long-term economic impacts of the proposed investments in the SR 29 corridor on Gross Regional Product, job creation and income.

Plan/Policy Consistency

A qualitative assessment of the degree that the proposed investments in the SR 29 corridor are politically and institutionally feasible and implementable.

Emerging Technologies

A qualitative assessment of the degree that the proposed investments in the SR 29 corridor are compatible with emerging transportation technologies and service trends.

Data Collection/Retrieval

Performance measures require data. The following data sources were tapped to collect/retrieve data needed to operationalize the performance measures used for the SR 29 CMCP.

Longitudinal Employment-Housing Dynamic (LEHD) Origin-Destination Data

Longitudinal Employer–Household Dynamics (LEHD) data is primarily based on Unemployment Insurance (UI) earnings data and the Quarterly Census of Employment and Wages (QCEW), and censuses and surveys. Firm and worker information are combined to create job level quarterly earnings history data, data on where workers live and work, and data on firm characteristics, such as industry. The most recent available LEHD data (2017) was utilized.

Streetlight Data Origin-Destination Data

Streetlight Data is cell data including navigation-GPS and other location-based data from connected cars, trucks, and location apps collected on an “opt-in” basis. Streetlight also uses publicly available Census, traffic counts, and points of interest data. This sample-based data is expanded, tracked and mapped using proprietary algorithms to determine travel characteristics including origins-destinations by trip purpose. A full year of Streetlight data for calendar year 2018 was acquired by NVTA for regional planning purposes.

National Performance Monitoring Research Data Set (Speed Data)

Per the National Performance Management Measures Final Rule, the preferred data for complying with the National Highway Performance Program is NPMRDS from FHWA. The NPMRDS provides average speed data (five-minute averaging time) for federally defined roadway segments designated as part of the National Highway System (NHS) including SR 29.

Two and half years of NPMRDS speed data was retrieved (1/1/2017 to 7/31/2019). Data was filtered to isolate average weekday conditions (Tuesday-Thursday AM/PM peak periods) for passenger vehicles and heavy-duty truck vehicles separately. To identify the AM/PM peak hour, the peak periods between

6:00 AM to 9:00 PM and 4:00 PM and 7:00 PM were analyzed to identify the most congested continuous 60-minute span for both passenger vehicles and trucks.

After filtering the data to isolate average peak hour conditions, a total of 1,048,575 individual data records were processed to yield 1,195 averaged observations for 278 segments (reflecting both directions of travel) for both passenger vehicles and heavy-duty trucks respectively. The only data cleansing applied was to remove extreme high-speed outliers (e.g., 90+ mph) from the free flow speed, congestion and reliability calculations. All data was processed and summarized based on the NPMRDS segmentation.

INRIX Data (Speed Data)

Through the Metropolitan Transportation Commission (MTC), NVTA accessed one-year of INRIX speed data (7/1/2018 to 6/30/2019). This data was processed similarly to the NPMRDS data. INRIX collects data streams from local transport authorities, sensors on road networks, fleet vehicles such as delivery vans, long haul trucks and taxis. It includes data for additional roadways other than the NHS. This allowed local parallel facilities to SR 29 to be analyzed.

Traffic Counts

AM/PM peak hour intersection turn movement counts utilized in SR 29 CMCP were a combination of existing counts sourced from recent planning studies including: SR 29 Gateway Corridor Plan (1 intersection); Imola Avenue Complete Streets (9 intersections); Soscol Junction PA-ED Traffic Analysis (7 intersections); and Watson Ranch Specific Plan Traffic Impact Analysis (21 intersections). New traffic counts were performed in November 2019 specifically to update or augment the existing traffic count data. These include:

- SR 221 -- Napa Valley Corporate Way, Napa, CA
- SR 29-- N Kelly Rd, Napa, CA Syar Way -- Kaiser Rd, Napa, CA
- Napa Valley Corporate Dr -- Kaiser Rd, Napa, CA
- Enterprise Way -- Kaiser Rd, Napa, CA
- SR 221 -- Kaiser Rd, Napa, CA
- Napa Valley Corporate Dr -- Napa Valley Corporate Way, Napa, CA
- Napa Valley Corporate Dr -- Bordeaux Way, Napa, CA
- Devlin Rd -- Soscol Ferry Rd, Napa, CA
- Stanly Ln -- SR 12, Napa, CA
- Stanly Ln -- Golden Gate Dr, Napa, CA
- Kelly Rd -- SR 12, Napa, CA
- Devlin Rd -- S Kelly Rd, Napa, CA
- Devlin Rd -- Tower Rd, Napa, CA
- Airport Blvd -- Devlin Rd, Napa, CA

The source of the SR 29 daily segment counts was the NVTA 2018 Travel Behavior Study. These counts were collected in November/December 2018.

Transit Ridership Data

Transit ridership data for 2019 was provided by NVTA.

SWITRS and TIMS Collision Data

Collision data was obtained from the Statewide Integrated Traffic Records System (SWITRS) for the years between 2014 and 2018. Transportation Injury Mapping System (TIMS) data was also accessed for the same period to cross reference the injury and fatality collision data in SWITRS.

Infrastructure Costs

Planning-level costs for infrastructure recommendations were obtained from existing planning studies and regional transportation planning documents. Where costs were unavailable through these sources, costs were estimated based on industry standard planning level procedures.

Societal Costs

Societal cost data were sourced from the 2018 Economic Parameters published by Caltrans. These societal costs are consistent with parameters resident in the Caltrans benefit-cost analysis tool Cal-BC.

On-line Mapping Resources

On-line mapping tools such as Climate Change Vulnerability (Caltrans District 4), LEHD, and CalEnviroScreen 3.0 were utilized to inform examinations for adaptation, travel pattern and environmental justice respectively.

Analysis Tool Development

Solano Napa Activity Based Model

The Solano-Napa Activity-Based Model (SNABM) is an analysis tool that gives NVTA the capability to generate technical information pertinent to the understanding of travel behavior and transportation network performance within the SR 29 study corridor boundary. This information is critical to the development, updating and monitoring of the NVTA's transportation capital improvement program, analysis of specific transportation projects and programs, as well as the General Plan land use and transportation strategies and policies of its member agencies including the cities of American Canyon and Napa and the County of Napa. The SNABM model yields the future volume sets (i.e., roadway segment volumes and intersection turn movements) to inform operational analyses that determine whether a given road segment or intersection will operate acceptably in the future.

The most recent version of the SNABM model including a 2015 Baseline and 2040 out-year was utilized for the SR 29 CMCP. Though the SNABM model has been regionally validated/calibrated, a sub-area validation analysis was performed to better ensure that the SNABM model would generate reasonable forecasts within the study corridor sub-area. The following tasks were performed as part of the sub-area validation:

- Approximately 40 intersection turn movement counts within the SR 29 study corridor boundary were summed to generate AM and PM peak hour segment volume sets for validation purposes;
- For segments not emulating observed counts, select link was performed to identify the TAZs that contribute trips on the link; the peak hour origin-destination pairs were then incrementally adjusted in relative proportion to the link error and the assignment step re-run. This procedure modifies the AM/PM peak hour factors to allow the daily origin-destination table to better emulate peak hour conditions.
- % Root Mean Square Error (%RMSE) was performed for the AM and PM peak hour assignments respectively. Validation criteria was %RMSE of 40% or less overall.

Based on the sub-area validation results in Table 2, the SNABM model was determined to be suitable for generating reasonable travel forecasts within the SR 29 study corridor. A detailed description of the SNABM sub-area validation analysis is provided in Appendix A.

Table 2: SNABM Sub-Area Validation Results

%RMSE	AM PH	PM PH
Original SNABM Subarea	57.3%	49.2%
After Subarea Validation	41.5%	34.9%

A 2015 baseline model run and two travel forecast scenarios were developed: 1) a 2040 Programmed Forecast that reflected all currently programmed projects (i.e., considered the future baseline); and, 2) SR 29 CMCP Planned Forecast which included all applicable SR 29 CMCP roadway improvements. Coding of network attributes (lane capacity, free flow speed, etc.) for new roadways was based on accepted network coding conventions used by NVTA.

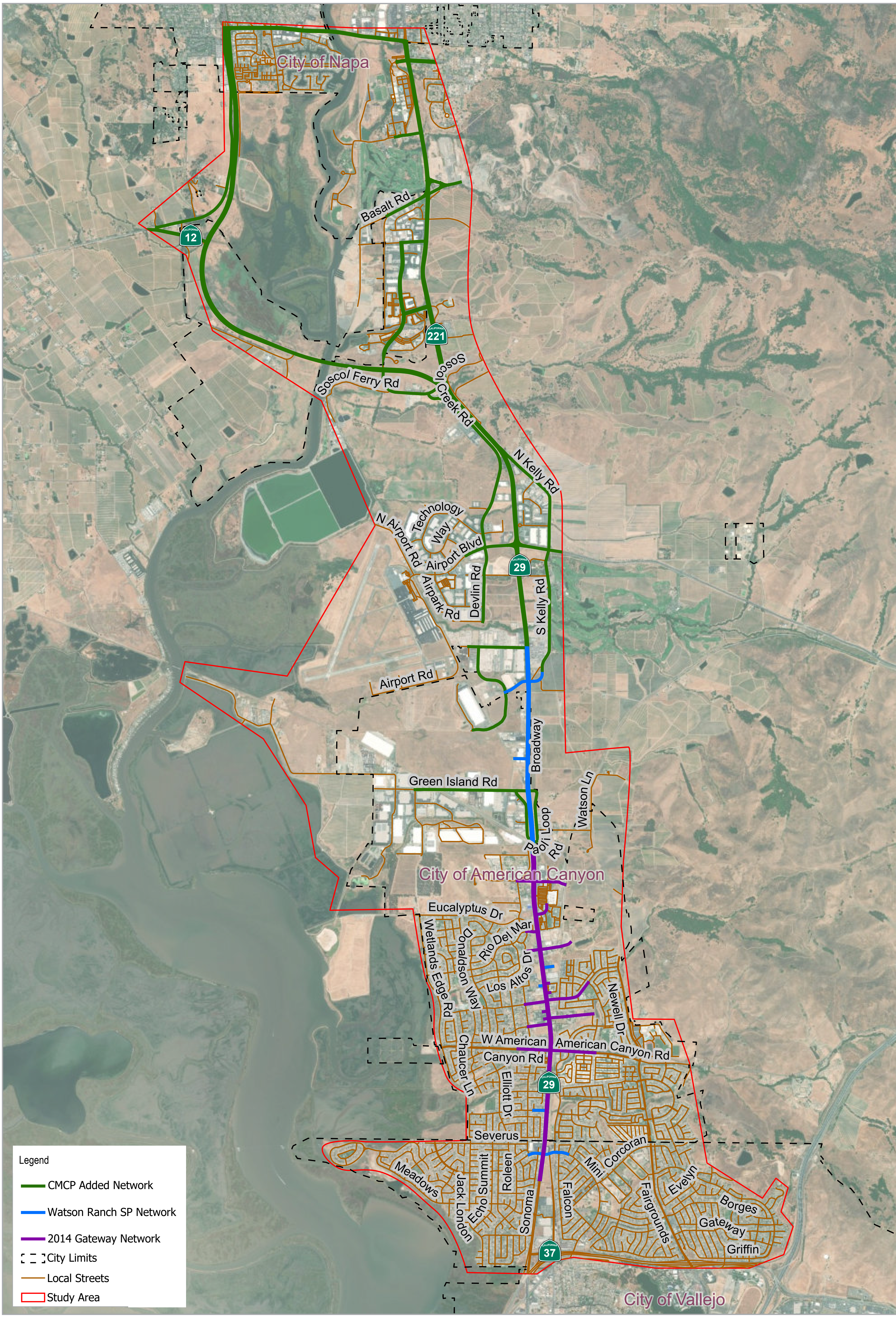
The SNABM model projects approximately 20% growth in AM/PM peak hour traffic levels by 2040. This equates to slightly less than a one percent annual average growth rate over the planning horizon of the plan.

All raw model volumes were processed by applying the AM and PM peak hour model growth to ground counts to essentially "grow" the counts to reflect future year conditions and circulation changes.

SR 29 VISSIM Micro-simulation Model

VISSIM microsimulation software was developed to simulate SR 29 corridor operations under both baseline and future year conditions. The model network was built by amalgamating VISSIM networks completed for other planning studies (SR 29 Gateway Plan and Watson Ranch Specific Plan Traffic Impact Analysis) and new coding to complete the remaining applicable SR 29 CMCP study corridor network. Figure 3 displays the sources by location used to develop the corridor network.

The SR 29 micro-simulation model was validated to applicable criteria established by the Federal Highway Administration (FHWA) *Guidelines for Applying Traffic Microsimulation Software* using INRIX and NPMRDS travel time data. The SR 29 microsimulation model was used to analyze the operational performance using volume sets generated from the 2040 Programmed and SR 29 CMCP travel forecasts. All VISSIM microsimulation runs were based on a minimum 10-minute seeding time, 60-minute analysis time (divided into four 15-minue intervals), and reflect an average of 5 multiple runs. The development of the SR 29 microsimulation model is described in greater detail in Appendix B.



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NAPA VALLEY TRANSPORTATION AUTHORITY
SR 29 COMPREHENSIVE MULTIMODAL
CORRIDOR PLAN

MICROSIMULATION MODEL
NETWORK DEVELOPMENT

Project No. 11187559
Revision No. -
Date 7/11/2019

FIGURE 3

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Data source: World Imagery: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community. Created by: bnamsaly

3 - Public Outreach

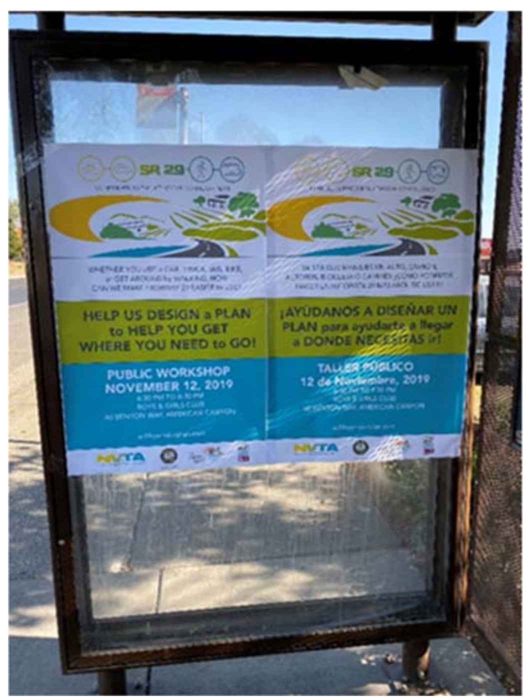
A robust and targeted public outreach program was created to augment the prior Gateway Plan outreach effort and to gauge public acceptance of specific improvement options.

Outreach efforts included both traditional and non-traditional venues for gathering community input.

These outreach efforts, starting with the Community Workshops, are more fully described in the following sections. Clearly, as will be evident through the process, the input received through these various channels helped inform and guide the analysis and the SR 29 corridor solutions that ultimately lead to the creation of the SR 29 CMCP, itself.

Community Workshops

Two public workshops were held during the course of the plan's development on November 12, 2019 and on April 23, 2020. Both were supplemented with on-line virtual workshops which emulated all materials presented at the traditional workshops. This allowed the results of both workshops to be appropriately merged and summarized together. Presentation materials including all input/responses from the public workshops are provided in Appendix C.



Workshop #1

A public workshop was held on November 12, 2019 to introduce the project to the public, inform the public how to stay actively engaged during its development; and gather feedback from the community on the potential solutions under consideration. Of the 31 attendees, seven were City of American Canyon staff and elected officials and Caltrans staff.

Building on prior community outreach conducted for the SR 29 Gateway Plan, this workshop presented potential improvement concepts for the corridor and asked attendees to share their thoughts and preferences.

Attendees were also asked a series of polling questions about their current experiences on the corridor and their priorities for improvements.

Most respondents reported that driving was their most frequent mode traveled on the SR 29 corridor. Few people said they walk or bicycle on the corridor currently, citing concerns about safety and a lack of dedicated paths. Transit on the corridor is not commonly used by attendees, due to concerns about travel time.

Workshop attendees rated improving safety for people walking and driving as their highest priority for the corridor, followed by improving safety for transit and then people bicycling. Most that choose not to walk cited safety concerns or lack of designated paths. Similarly, the reason most often cited for not biking was fear for safety at 52.38%, followed by lack of paths/connections at 28.57%.

Reducing vehicle congestion and improving signal timing were also identified as top priorities, in addition to improved connectivity for bicyclists.

Potential solutions rated as top priorities by attendees include:

- Increase parallel roadway capacity
- Multimodal improvements on SR 29 between SR 37 and Soscol Junction
- Intersection improvements on SR 29 at Airport Drive and at Carneros Highway
- Transit frequency improvements on SR 29 including queue jumps or part-time use of shoulder for transit vehicles

A complete summary of Workshop #1 is provided in Appendix D.

Workshop #2

The second public workshop was held on April 23, 2020 to present the draft SR 29 CMCP including the proposed multimodal improvements to the community for comment. In recognition of the COVID-19 Pandemic and the Shelter-at-Home order for the Napa County, and the rest of the Bay Area, this workshop was held entirely virtually. The April workshop was performed remotely via webinar to the public. The workshop was attended by members of the general public as well as City of American Canyon staff and elected officials and Caltrans staff. A complete summary of Workshop #2 is provided in Appendix D.

Staff Working Group

A staff working group was convened to guide development of this Plan and ensure consistency with the goals and complementary planning efforts of partner agencies in the region. Members included representatives from the following agencies:

- Napa Valley Transportation Authority (NVTA)
- City of Napa
- City of American Canyon
- Napa County
- Caltrans District 4

Each of these agencies were a key partner in implementing the recommendations in this Plan. The group met a total of nine times throughout the plan's development (monthly) to provide guidance and oversight on the process and review draft deliverables and documents at key milestones.

Media

Various forms of social media were used for posting announcements of outreach events including Facebook, Twitter and Next Door. Public announcements of outreach events were also made on various news and radio media outlets including the American Canyon Eagle, the Napa Valley Register and KVON Wine Country Radio station.

A mailing list of interested community members was also developed to share project updates and information about outreach opportunities. More than 160 people provided their email address for this list.

Project partners and stakeholders were also encouraged to use their existing social media platforms to share information about the project and outreach opportunities.

Project Logo Branding and Project Information Cards

To distinguish the SR 29 CMCP planning effort from other on-going planning activities by NVTA and partnering agencies a Project Logo was developed. This branding was placed on all project deliverables and products.

In addition, a Project Information Card was also developed to encourage the use of online engagement by the public particularly the use of the interactive mapping tool on the project website (see below). The Project Information Card was printed in both English and Spanish (back-to-back) and provided te SR 29 project website URL.

Online Engagement

To support and supplement public engagement activities, a project website was developed, available at www.sr29corridorplan.com.

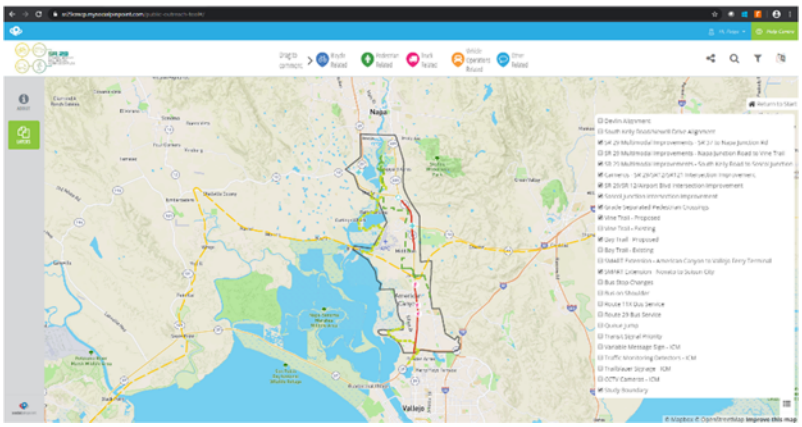
The website was used to share information about outreach events, host online versions of the community workshops, and gather feedback on draft project deliverables.

Over the course of the project study period, the website was visited 259 times by 198 unique website visitors. One survey was completed through the virtual workshop, and ten comments were left through the comment form available on the site. Most input was received through the interactive mapping tool described below.

Interactive Mapping Tool

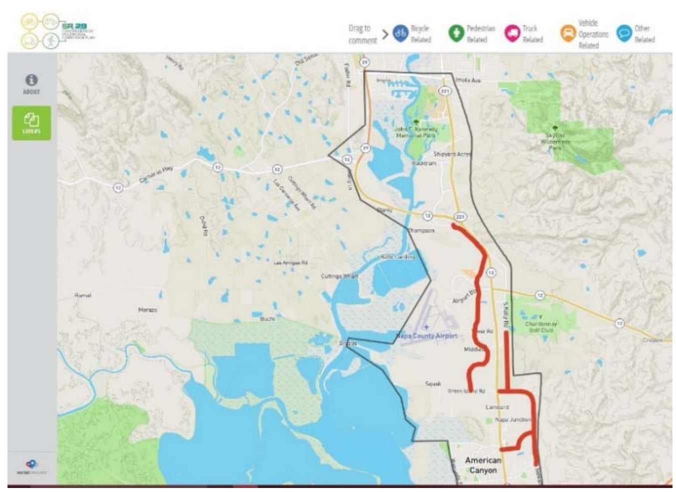
To supplement in-person engagement and gather additional feedback, an online interactive mapping tool was developed through the engagement platform Social Pinpoint. The mapping tool was made available on the project website beginning in early November 2019 and remained “live” through March 2020.

Typically, on-line mapping tools are used to solicit public input on where issues and needs are located by allowing geo-referenced pin-drops and comments to be placed on a map. However, given that extensive outreach to identify existing needs and issues had already been accomplished as part of previous planning efforts, the SR 29 CMCP outreach effort pivoted from earlier efforts to solicit more specific public input on candidate improvement concepts identified by these efforts. This entailed specifically tailoring the on-line mapping tool to show candidate improvement concepts (shown as separate map layers the user could toggle on or off) and provide input on whether they could support the improvement concept and why via a dialogue comment box. This approach allowed the SR 29 CMCP to leverage the previously gathered input on existing conditions and present potential corridor improvement concepts to the public.



The mapping tool, offered in over 70 languages including English and Spanish, presented graphical renditions of candidate corridor improvements and allowed the community to comment on the various options. Users were also able to leave location-specific comments on needs and issues.

Between November 2019 and March 2020, the website was visited 1,451 times by 550 unique users. Seventeen general comments were left and 186 targeted survey responses on the various improvement concepts were provided by the public.



Public input on the various improvement concepts examined as part of the SR 29 CMCP are summarized in the Corridor Solutions section of the plan. This input served to facilitate along with the technical analyses the ultimate selection of improvements to include in the SR 29 preferred multimodal package of improvements.

4 - Baseline Conditions

Regional Context

As described in the Gateway Plan and Vision 2040, SR 29 is an essential north-south connection within the North Bay's transportation network, providing connections to significant east-west routes, including SR 12 and secondary roadways, and SR 121 and SR 221 to the north. Many commuters travel on SR 29 from affordable housing in Solano County to jobs in Napa or Sonoma Counties, or from the Napa Valley to jobs in the greater Bay Area. On weekends and during summer and harvest months, the corridor also plays a significant role in bringing tourists to the Napa Valley wine region.

By 2040, the nine-county Bay Area region is projected to have a total of approximately 4.5 million jobs and 3.4 million housing units, or an additional 1.1 million jobs and 660,000 housing units from 2010 levels. The region's population is expected to grow to 9.3 million in 2040, as indicated by economic and demographic trends, housing production, and the Bay Area's unique role in the national and state economies. Within the study area, an additional 30,000 jobs and 10,000 housing units are projected.

As shown in Figure 4 (heat map of existing employment concentrations), SR 29 is also an important corridor for commercial activity and residential access, drawing in commuters from the rest of the region.

Figure 4: Employment Concentrations Served by the SR 29 Corridor

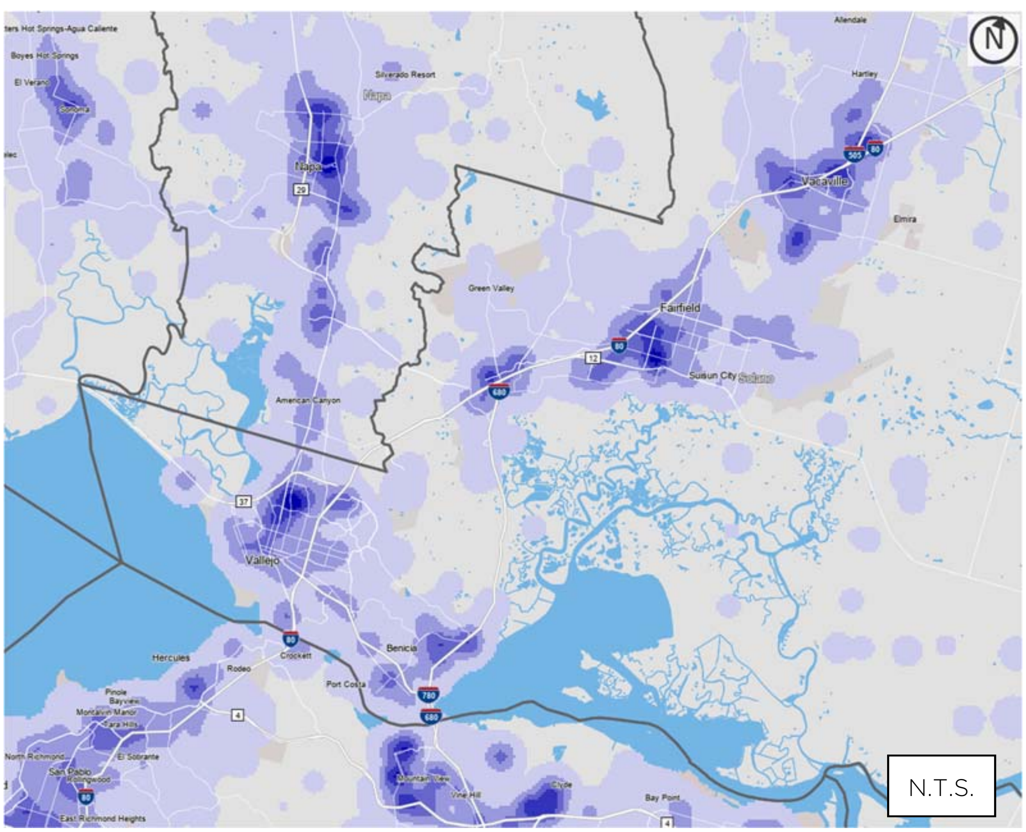


Figure 5 shows the concentration of residents in the study area. Figure 6 shows the concentration of total job locations in the study area. As shown in these figures, significant residential concentrations are found along the study corridor, with equally significant job opportunities. However, as shown in later figures, significant imbalance exists between residential areas and local job opportunities, most significantly in the City of American Canyon, generating a large amount of intercity commute travel along this lifeline corridor between Napa and Solano counties. Within the City of American Canyon itself, job opportunities are concentrated at the northern end of the City, with residential concentrations at the southern end. Lacking parallel facilities to accommodate local commutes within the City, local traffic shares SR 29 with regional traffic even for short trips.

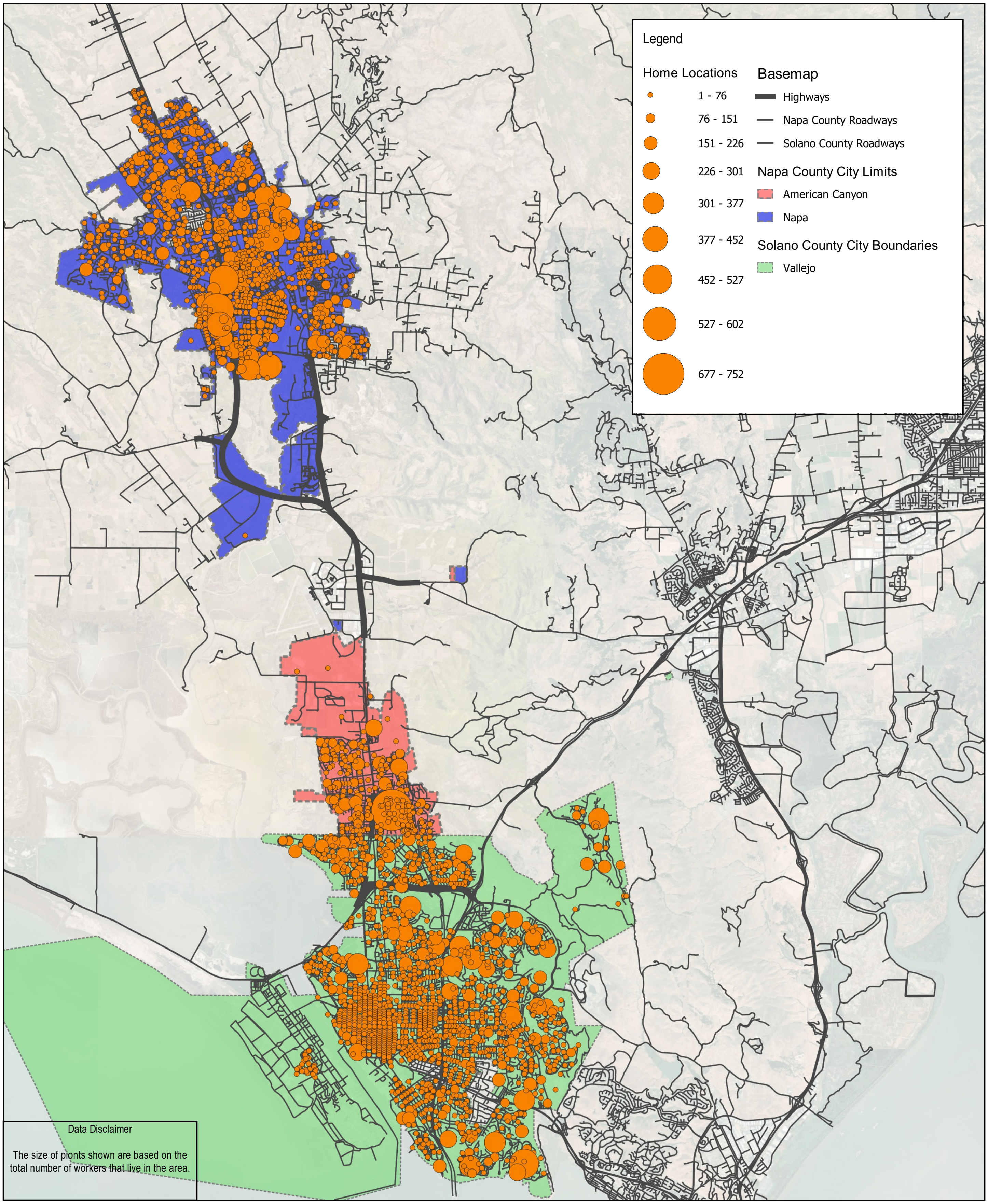
Plan Bay Area and Priority Development Areas

Senate Bill 375 (Steinberg, 2008), also known as the Sustainable Communities and Climate Protection Act of 2008, seeks to implement the statewide greenhouse gas reduction targets set forth by the Global Warming Solutions Act of 2006 (AB 32) by reducing emissions from passenger vehicle. SB 375 added a new element to each Metropolitan Planning Organization (MPO) Regional Transportation Plan (RTP), the Sustainable Communities Strategy (SCS). The Association of Bay Area Governments (ABAG) and the Metropolitan Transportation Commission (MTC), the regional planning agencies for this MPO region, recently prepared Plan Bay Area 2040, which includes the SCS required per SB 375. The SR 29 CMCP is consistent with NVTA's Countywide Transportation Plan, which is consistent Plan Bay Area 2040.

The current Plan Bay Area 2040[1] projects growth in households and jobs through year 2040 and identifies strategies for reducing greenhouse gas emissions from cars and light trucks through land use and transportation planning efforts. These strategies plan for future growth in a way that encourages compact development with a broad array of housing types and transportation choices. To accommodate the Bay Area's projected growth while meeting environmental sustainability goals, Plan Bay Area focuses on directing development into Priority Development Areas (PDAs). PDAs are locally identified nodes of development (such as a corridor, a downtown, or an area around a transit station) that have substantial opportunity for infill housing that supports increased walkability and transit usage.

Region-wide, PDAs are proposed to absorb about 80 percent of new housing and 66 percent of new jobs on about five percent of the total regional land area. This pattern holds true for the one PDA identified in the SR 29 Corridor Planning Area, in American Canyon. In this city, approximately 81 percent of new housing and 67 percent of new jobs are projected to be located in the PDA. In Napa County, another PDA has been identified in Downtown Napa/Soscol Corridor, north and east of the SR 29 study corridor. In Vallejo, the Waterfront and Downtown PDA is located southwest of the SR 29 study corridor.

[1] The preparation of the successor to Plan Bay Area 2040, Plan Bay Area 2050, is currently underway.



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NAPA VALLEY TRANSPORTATION AUTHORITY
SR 29 COMPREHENSIVE MULTIMODAL CORRIDOR PLAN

RESIDENT LOCATIONS AND CONCENTRATION (LEHD)

Project No. **11187559**
Revision No. **-**
Date. **03/13/2020**

FIGURE 5

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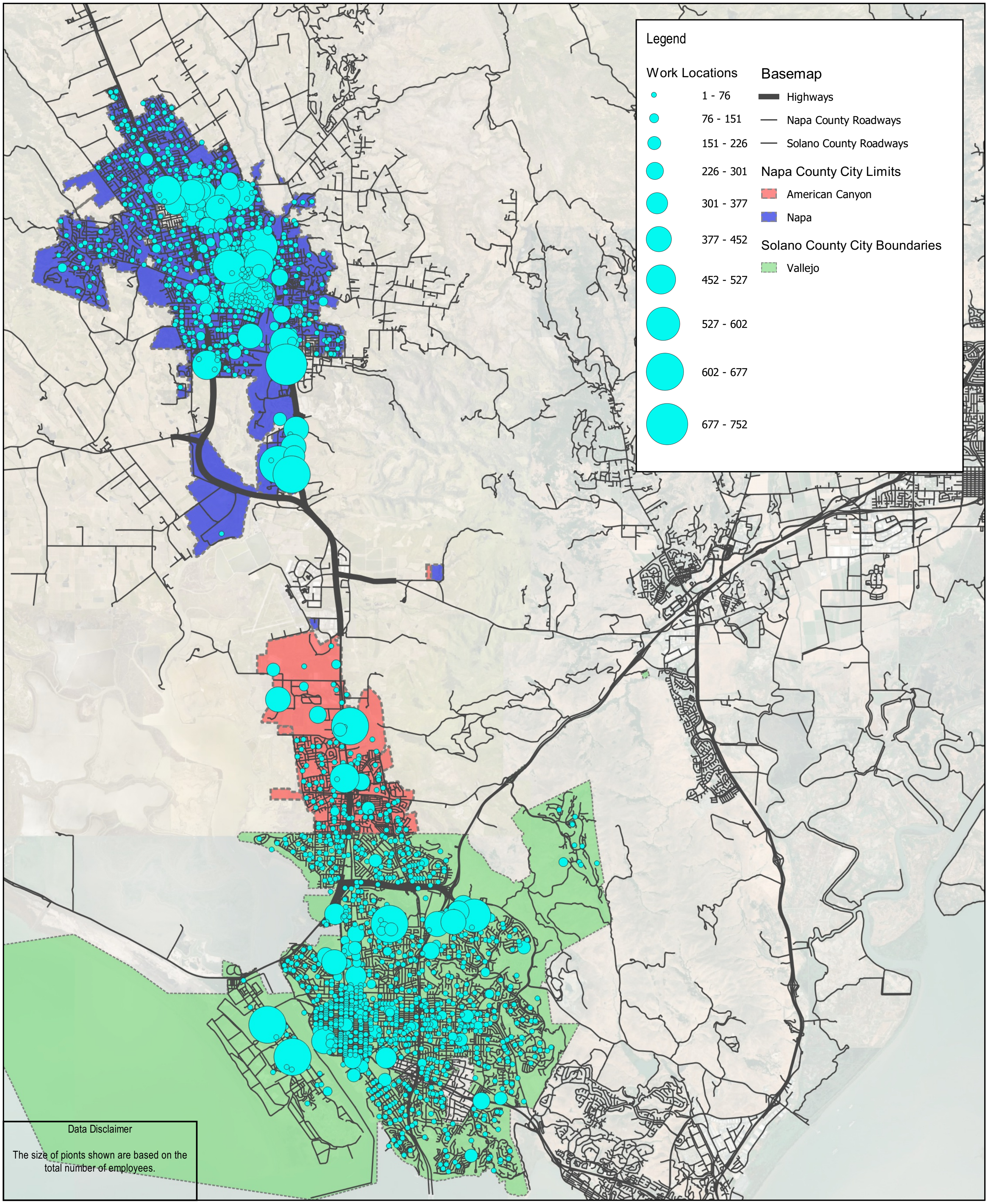

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NAPA VALLEY TRANSPORTATION AUTHORITY
SR 29 COMPREHENSIVE MULTIMODAL CORRIDOR PLAN

RESIDENT LOCATIONS AND CONCENTRATION (LEHD)

Project No. 11187559
Revision No. -
Date. 03/13/2020

FIGURE 6

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City of American Canyon

SR 29 is the only continuous north-south roadway through the City of American Canyon, both providing access to homes and local businesses but also acting as a substantial barrier to east-west local travel through the city. In American Canyon, SR 29 is lined with retail commercial uses and other destinations that serve residents and visitors. Local connections to these businesses are limited, and SR 29 often provides the only access. Surrounding urban areas have few north-south routes, so SR 29 serves many local trips. Residential development abuts the roadway on both sides at the southern end of the city, though it is buffered by landscaping. On the east side, the railroad also separates adjacent development from the highway.

Local- and community-serving commercial uses start just south of the intersection of SR 29 and American Canyon Road, and are the predominant land use between there and Napa Junction Road. Uses are auto-oriented, typically single story, and set back from the highway with surface parking and some landscaping. North of Napa Junction Road, land uses transition to light industrial on larger parcels, interspersed with vacant and agricultural land.

Nearly the entire SR 29 corridor that runs through American Canyon has been designated as a PDA by ABAG and MTC. ABAG/MTC give priority to PDAs when issuing technical assistance and capital grants, in exchange for a community's commitment to compact growth and alternative modes within PDAs. The City intends to complete a Specific Plan for the PDA within the next several years.

Most of the PDA has a Community Commercial and Commercial Neighborhood designation under American Canyon's General Plan. These designations allow for a range of retail, office, personal services, and other commercial uses; these designations also allow 50 percent of a site to be used for multi-family residential development.

Unincorporated County of Napa

Immediately north of the American Canyon city limits (and within American Canyon just north of Napa Junction Road), land uses adjacent to SR 29 consist primarily of business and light industrial parks. Many are to the west, clustered near the Napa County Airport, and support the wine industry. Most industrial parcels south of South Kelly Road connect directly to the highway, with intermittent access to roads shared among multiple parcels. This is not the case north of South Kelly Road. Business parks along this corridor typically exhibit a high level of design—buildings are separated from the highway with landscaping, and properties within the Business/Industrial Park portion of the Airport Area Specific Plan are subject to design review with regards to site planning, landscaping, signage, off-street parking, noise control, and outdoor storage facilities.

North of the industrial area, land uses adjacent to the highway are almost entirely rural, comprised of open space (wetlands surrounding the Napa River) and agricultural uses.

Within unincorporated Napa County, parcels abutting SR 29 are generally designated either as Agriculture, Watershed and Open Space or Industrial by the County's General Plan. Urban uses are not permitted on land designated as Agriculture, Watershed and Open Space; however County Policy AG/LU-40 says that "Hess Vineyard area" (just north of American Canyon and east of SR 29) is to be "considered for re-designation to an Industrial designation if [the] Newell [Drive extension] is ever extended north of Green Island Road." However, this is unlikely to occur, as a 2008 voter initiative by the City of American Canyon rerouted Newell [Drive] to connect to SR 29 at Green Island Road specifically in order to preserve the Hess Vineyard.

While most of the corridor is designed for agricultural or industrial uses, exceptions exist: just north and east of the Napa River crossing where the "Napa Pipe" site is re-designated for multi-family with some retail/commercial uses, and annexed to the City of Napa; and south of SR 29 and just east of the Napa River, where land designated as Public-Institutional includes the Napa County Airport and allows for public and quasi-public uses, but also limited commercial uses.

Another asset of this area is the Grape Crusher statue, located just west of the SR 29/Highway 221 intersection. A tourist attraction and significant landmark, the statue helps to signify entrance to the Napa Valley.

City of Napa

While SR 29 is a major route through the city, its design as a grade-separated freeway means that it does not interface directly with adjacent land uses, which are a mix of residential, commercial, office, and institutional developments, and are separated from the highway by landscaping and sound walls. Landscape improvements remain possible, along with gateway identity features at interchanges.

Where SR 29 passes alongside urban uses in the City of Napa, a freeway configuration limits access and land use designations vary. Parcels with commercial designations tend to surround freeway interchanges, while other frontages along the freeway include parcels with Corporate Park, multi-family residential, single-family residential and other designations.

Observed Travel Patterns

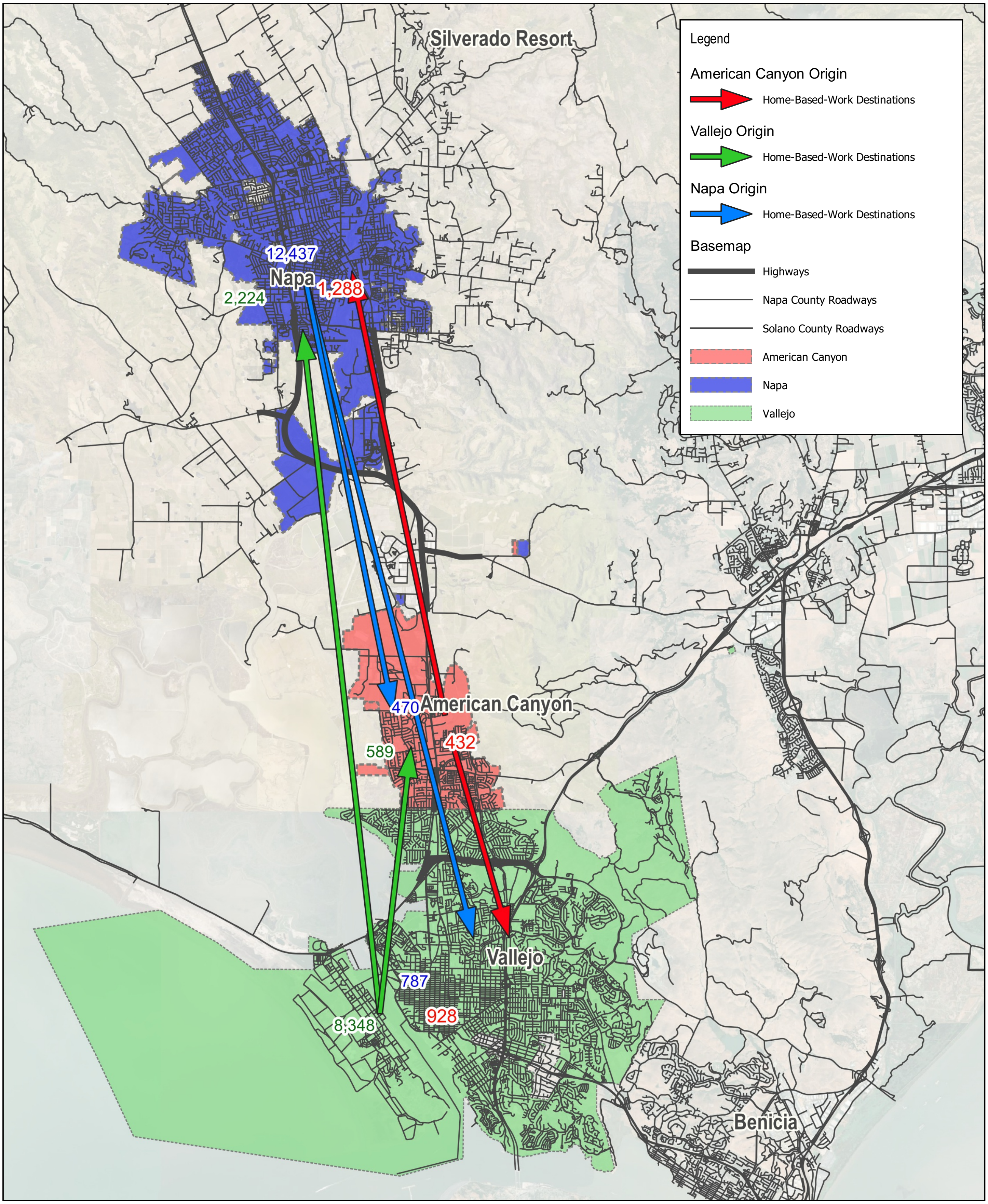
Longitudinal Employer-Household Dynamics Database (LEHD) Data

As shown in Table 3 based on the LEHD journey to work data shows over 6,000 residents of the Cities of Napa, American Canyon and Vallejo commute to their jobs outside their home-city to one of the other two neighboring cities. The vast majority of these trips must traverse SR 29 within the study corridor. Approximately 25,000 residents live and work in their respective jurisdictions. This journey to work origin-destination information is also graphically shown in Figure 7.

Table 3: LEHD Journey to Work Origin-Destination Pairs

Home Location	Work Destination				
	Napa	American Canyon	Vallejo	Other	Total
Napa	12,437	470	787	20,063	39,757
American Canyon	1,288	432	928	7,251	9,899
Vallejo	2,224	589	8,348	45,308	56,469

Looking beyond the three cities, Figure 8 shows the total number of in-coming, intra-, and out-going commuters for the cities of Napa, American Canyon and Vallejo. This data indicates that over 11,000 additional commuters either commute to or from the City of American Canyon to/from places other than the City of Napa or Vallejo. Many of these commuters must traverse a portion of SR 29. Nearly 50,000 commuters do the same from the City of Napa. Over 70,000 commuters either commute to or from the City of Vallejo – many of which are either coming or going to the Bay Area or Sacramento Valley.



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GHD

NAPA VALLEY TRANSPORTATION AUTHORITY
SR 29 COMPREHENSIVE MULTIMODAL CORRIDOR PLAN

EMPLOYMENT ORIGINS-DESTINATIONS (LEHD)

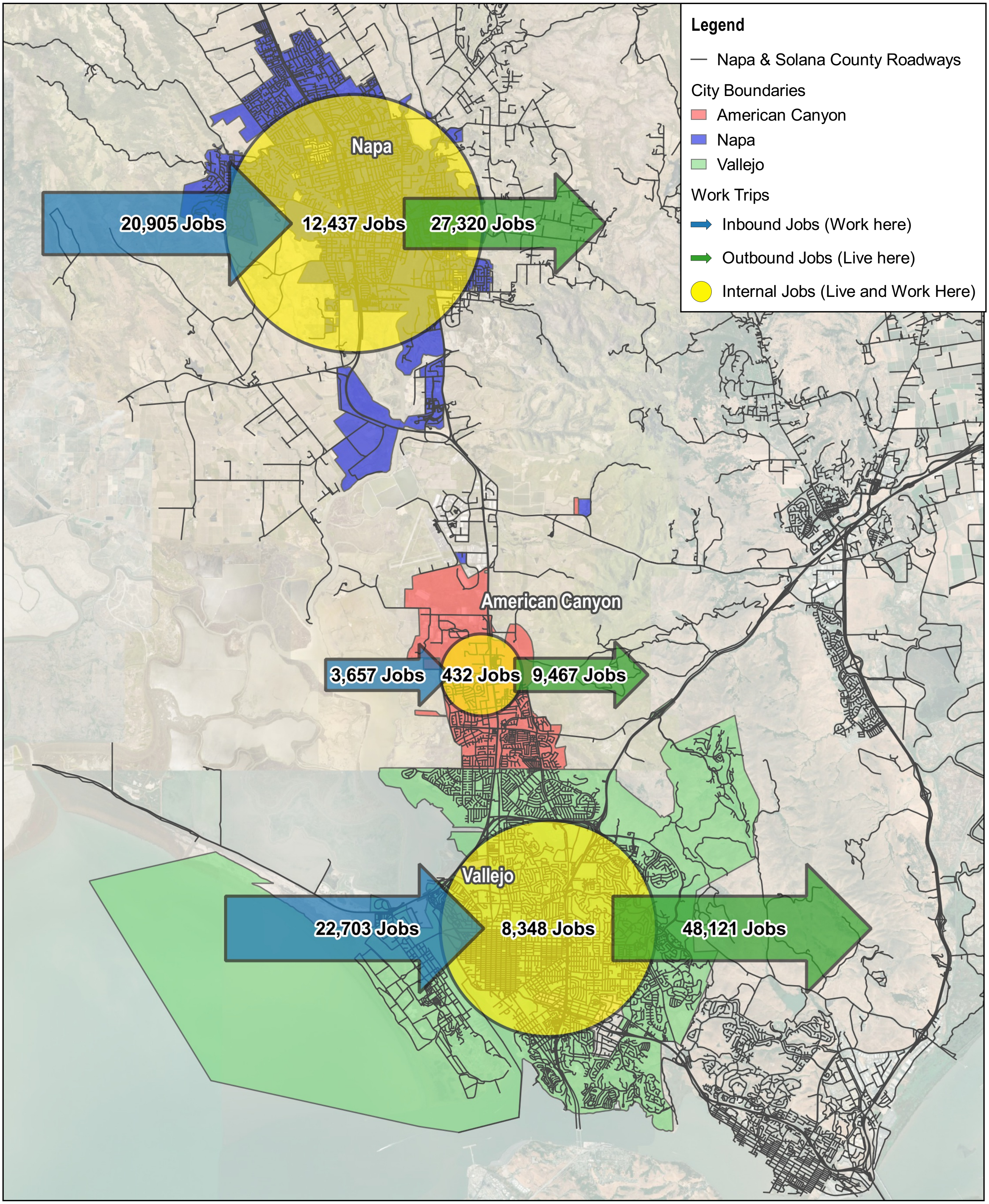
Project No. 11187559
Revision No. -
Date. 05/12/2020

FIGURE 7

Document Path: N:\US\Roseville\Projects\561\11187559\GIS\Maps\Working\LEHD-OTM Flows.qgs

Data Source: U.S. Census Bureau. 2020. LEHD Origin-Destination Employment Statistics Data (2017). Washington, DC. Longitudinal-Employer Household Dynamics Program, accessed on 03/13/2020 at https://lehd.ces.census.gov/data/#lodes. LODES 7.4.

Created By: Rosanna Southern



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Map Projection: Mercator Auxillary Sphere
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NAPA VALLEY TRANSPORTATION AUTHORITY
SR 29 COMPREHENSIVE MULTIMODAL CORRIDOR PLAN

WORKER INFLOW / OUTFLOW (LEHD)

Project No. 11187559
Revision No. 2
Date. 05/12/2020

FIGURE 8

Document Path: N:\US\Roseville\Projects\561\11187559\GIS\Maps\Working\Inflow-Outflow LEHD.qgz

Data Source: U.S. Census Bureau. 2020. LEHD Origin-Destination Employment Statistics Data (2017). Washington, DC: U.S. Census Bureau, Longitudinal-Employer Household Dynamics Program, accessed on 03/13/2020 at https://lehd.ces.census.gov/data/#lodes. LODES 7.4

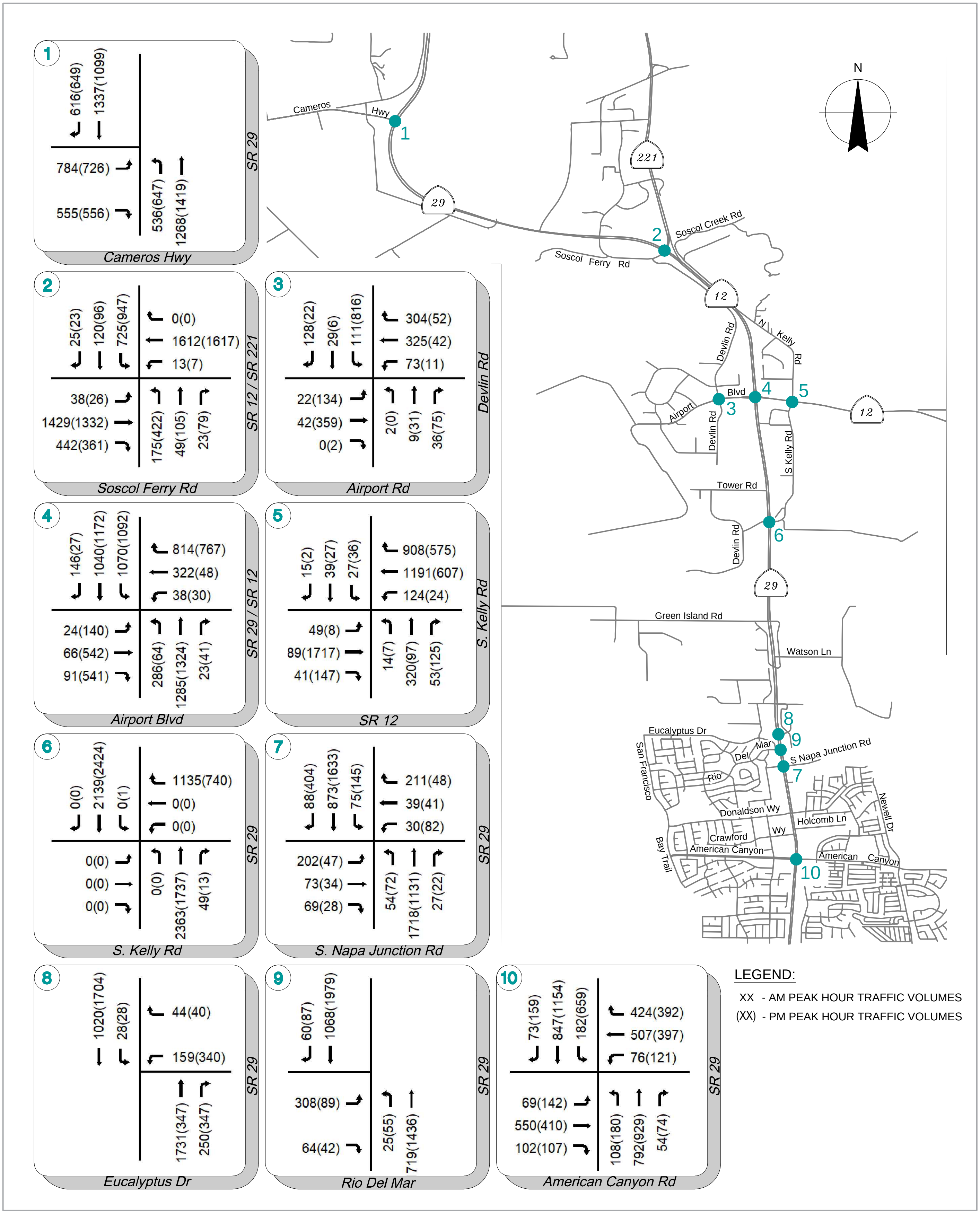
Created By: rsouthern

Streetlight Data

LEHD data only provided journey to work origin-destination pairs. Based on Streetlight Data which captures all trip types (versus just journey to work trips), annually, an average of 64% of the traffic that use SR 29 is traveling between destinations located in the cities of Napa and American Canyon. During weekdays this percentage is 66% while on weekends it drops to 61% due to the influx of regional traffic. Countywide, 70% of trips stay within Napa County while 30% travel from or to areas outside Napa County. Countywide, 40% of total trips are intra-city trips in the City of Napa. Further, 63% of trips are less the 5 miles in length. These are trips that are most conducive for non-motorized travel such biking or walking.

Traffic Counts

On a typical weekday, SR 29, north of American Canyon Road, carries 24,000 vehicles travel northbound and 25,000 vehicles travel southbound daily. On SR 29 at the Napa/Solano County Line 19,000 vehicles travel both northbound and southbound daily. At the Napa/Lake County Line 4,500 vehicles travel northbound and 4,000 vehicles southbound on SR 29. These daily volumes do not significantly change during weekends. Existing turn movement counts by source are shown in Figure 9.



SR 29 COMPREHENSIVE MULTIMODAL CORRIDOR PLAN

NAPA VALLEY TRANSPORTATION AUTHORITY
SR 29 COMPREHENSIVE MULTIMODAL CORRIDOR PLAN

EXISTING TURNING MOVEMENTS

Project No. **11187559**
Report No. **001**
Date **March 2020**

FIGURE 9

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Roadway Operations

Key Intersections

Turn movement counts for approximately 40 intersections were input into the SR 29 microsimulation model for baseline validation purposes. Of the 40 intersections, ten key intersections were selected for detailed operational analysis using microsimulation. As shown in Table 4 and Table 5 below, the following five intersections currently operate below established standards during either the AM or PM peak hours:

1) SR 29/Carneros Hwy (SR 121/12 West)
2) SR 29/SR 221/Soscol Ferry Rd
3) SR 29/Airport/SR 12
4) SR 12/Kelly Road
5) SR 29/American Canyon Road

Each of these intersections experience excessive delays which propagate congestion upstream of these critical nodes.

Table 4: Existing Conditions Level of Service (AM Peak Hour)

Intersection	Control Type[1,2]	AM Peak Hour					
		Intersection Delay (sec)	LOS	Vehicle Throughput	Veh Hrs of Delay (hrs)	Person Throughput	Person Hrs of Delay (hrs)
SR 29 & Carneros Hwy	Signal	37.5	D	4,928	51.3	6,406	66.7
SR 29 & SR 221/Soscol Ferry Rd	Signal	215.7	F	4,881	292.4	6,345	380.2
Airport Blvd/Devlin Rd	Signal	19.2	B	1,329	7.1	1,728	9.2
SR 29 & Airport Blvd/SR 12	Signal	51.7	D	5,120	73.5	6,656	95.5
SR 12 & Kelly Rd	Signal	130.1	F	3,374	121.9	4,386	158.5
SR 29 & S. Kelly Rd	Signal	41.7	D	4,198	48.7	5,457	63.2
SR 29 & Eucalyptus Drive	Signal	8.3	A	3,492	8.0	4,540	10.5
SR 29 & Rio Del Mar	Signal	17.7	B	3,517	17.3	4,572	22.5
SR 29 & S. Napa Junction Rd	Signal	41.8	D	3,663	42.6	4,762	55.3
SR 29 & American Canyon Rd	Signal	45.3	D	4,019	50.5	5,225	65.7

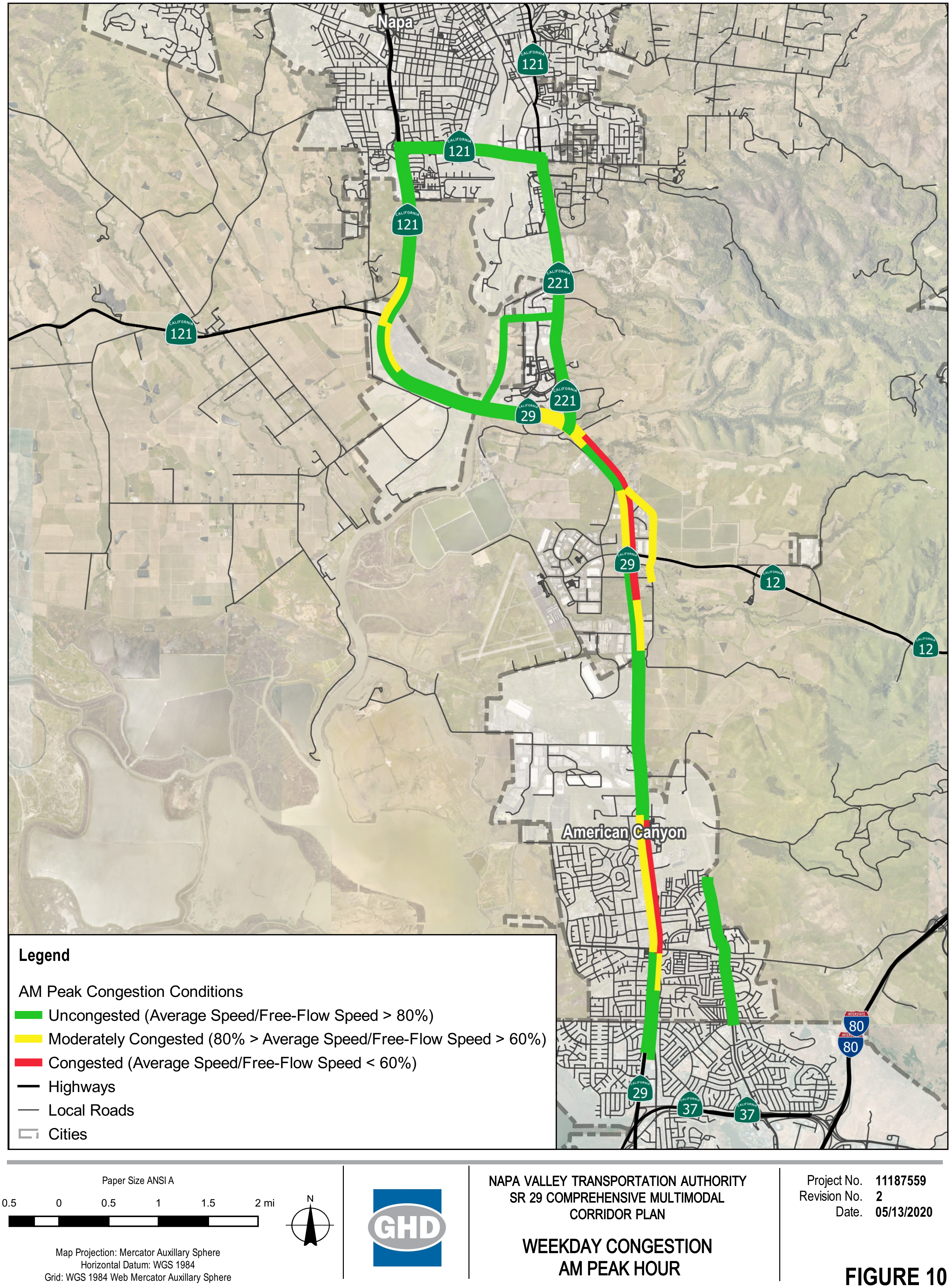
Table 5: Existing Conditions Level of Service (PM Peak Hour)

Intersection	Control Type[1,2]	PM Peak Hour					
		Intersection Delay (sec)	LOS	Vehicle Throughput	Veh Hrs of Delay (hrs)	Person Throughput	Person Hrs of Delay (hrs)
SR 29 & Carneros Hwy	Signal	105.1	F	5,389	157.4	7,006	204.6
SR 29 & SR 221/Soscol Ferry Rd	Signal	129.8	F	5,171	186.4	6,722	242.3
Airport Blvd/Devlin Rd	Signal	18.8	B	1,736	9.1	2,257	11.8
SR 29 & Airport Blvd/SR 12	Signal	114.6	F	5,718	182.0	7,433	236.6
SR 12 & Kelly Rd	Signal	21.2	C	3,317	19.5	4,312	25.3
SR 29 & S. Kelly Rd	Signal	20.5	C	3,564	20.3	4,633	26.3
SR 29 & Eucalyptus Drive	Signal	13.0	B	3,715	13.5	4,830	17.5
SR 29 & Rio Del Mar	Signal	19.1	B	3,768	20.0	4,898	26.0
SR 29 & S. Napa Junction Rd	Signal	51.2	D	4,028	57.3	5,236	74.5
SR 29 & American Canyon Rd	Signal	63.1	E	4,584	80.3	5,959	104.4

Roadway Congestion (Speed-Based Analysis)

The Federal National Performance Rule Congestion Threshold performance measure was used to determine the performance of roadway segment operating conditions within the study corridor. Under the federal definition, a roadway is considered congested if peak period travel speeds fall below 60% of free flow speeds. This includes delays experienced at intersections. The analysis is based on NPMRDS and INRIX speed data collected over a two-year period and reflects the AM/PM peak hours. Given that free flow speed is a key variable for calculating this performance measure, free flow speed was empirically estimated for each roadway segment using NPMRDS data between the hours of midnight and 3 AM.

Congestion Threshold results are graphically presented in Figure 10, Figure 11, and Figure 12 respectively. As shown, during the AM peak hour recurrent congestion occurs on SR 29 in the northbound direction between the junctures with SR 12 and Soscol Junction and between American Canyon Road and Napa Junction Road. During the PM peak hour, the majority of southbound SR 29 operates at less than 60% of free flow speed – from Soscol Ferry Road to American Canyon Road. During the Weekend peak hour, frequent congested conditions occur on SR 29 within the City of American Canyon as well as on SR 29 north of Airport Road/SR 12 through Soscol Junction.



NAPA VALLEY TRANSPORTATION AUTHORITY
SR 29 COMPREHENSIVE MULTIMODAL CORRIDOR PLAN

WEEKDAY CONGESTION AM PEAK HOUR

Project No. 11187559
Revision No. 2
Date. 05/13/2020

FIGURE 10

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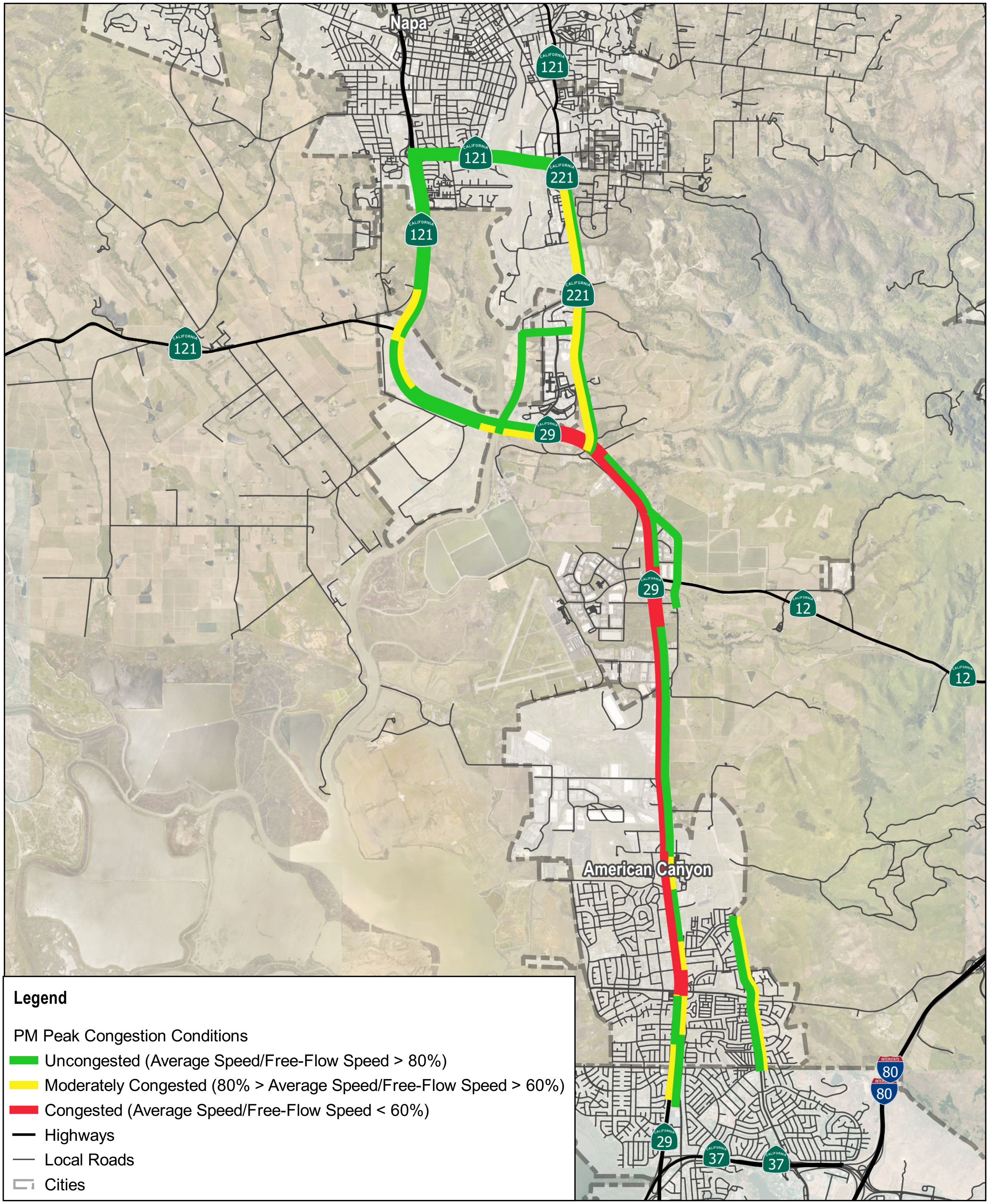
Data Source: INRIX Analytics
Created By: rsouthern



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Map Projection: Mercator Auxillary Sphere
Horizontal Datum: WGS 1984
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NAPA VALLEY TRANSPORTATION AUTHORITY
SR 29 COMPREHENSIVE MULTIMODAL CORRIDOR PLAN

WEEKDAY CONGESTION PM PEAK HOUR

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Date. 05/13/2020

FIGURE 11

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Data Source: INRIX Analytics
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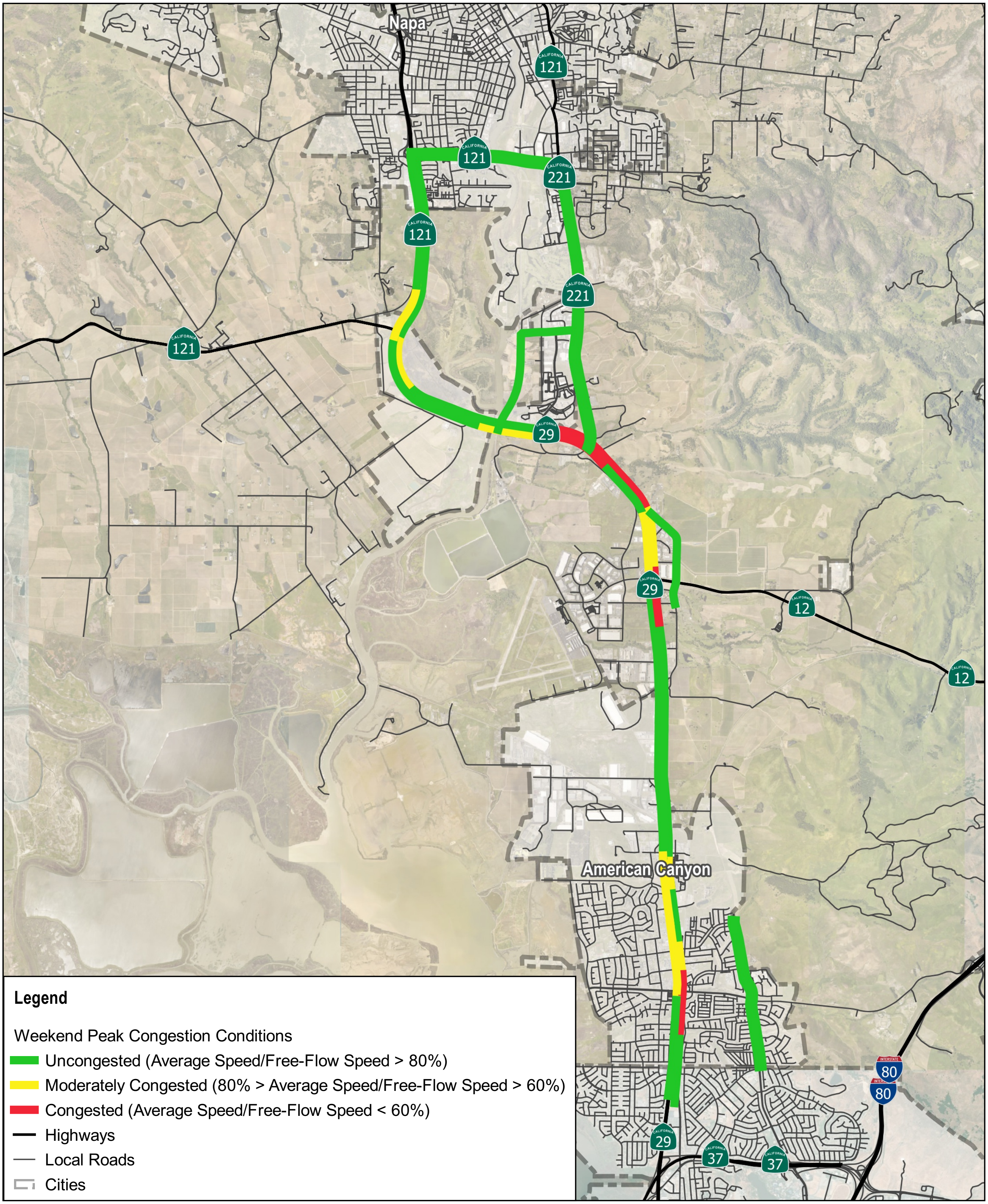

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Map Projection: Mercator Auxillary Sphere
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NAPA VALLEY TRANSPORTATION AUTHORITY
SR 29 COMPREHENSIVE MULTIMODAL
CORRIDOR PLAN

WEEKEND CONGESTION
PM PEAK HOUR

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Date. **05/13/2020**

FIGURE 12

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Data Source: INRIX Analytics
Created By: rsouthern

Travel Time Reliability Analysis

NPMRDS speed data was used for baseline travel time reliability analysis. The following performance metrics for passenger vehicles were generated:

- Buffer time
- Buffer time index

Federal definitions from the National Performance Management Measures Rule were used to define reliability. Both the national rule's definition of reliability (based on 80th percentile speed) and the HCM definition of reliability (based on 95th percentile speed) were applied. Buffer Time represents the additional time a motorist needs to budget for to ensure they arrive at their destination at the expected time 95% of the time. Buffer Time Index (BTI) simply normalizes Buffer Time for distance and is expressed as a ratio or percentage (added percent of time required). A higher BTI indicates more time drivers need to budget for to drive the corridor as a typical drive time becomes less reliable. BTI equal to or greater than 0.5 indicates that a motorist will need to budget 50+ percent more time over the normal travel window (i.e., departing earlier) to ensure an on-time arrival 95 percent of the time (i.e., equates to allowing for one late arrival for every 30 trips). Table 6 displays the Buffer Time Index thresholds as they relate to reliability.

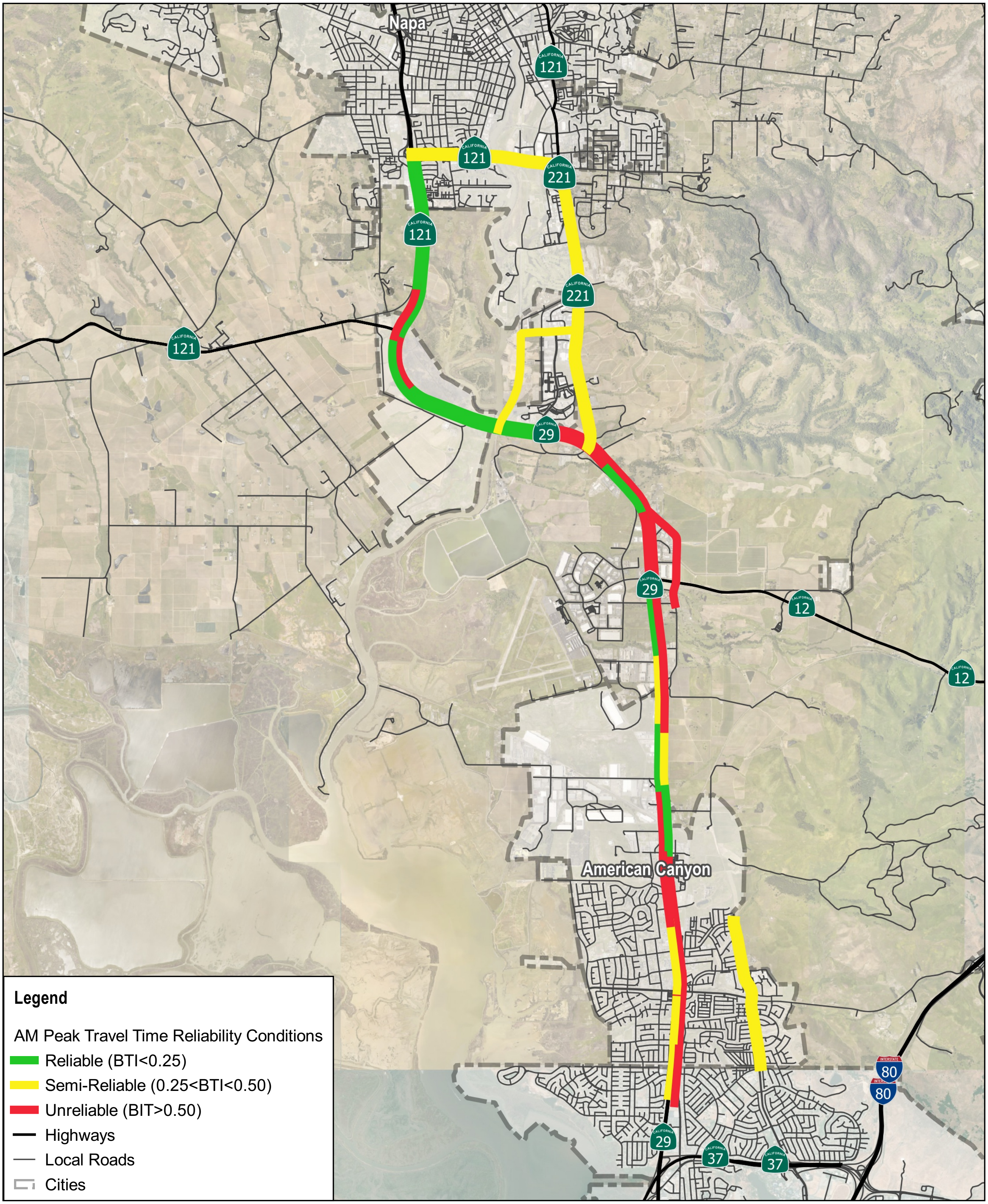
Table 6: Buffer Time Index Thresholds

Reliable	Moderately Reliable	Unreliable
BTI[A] < 0.25	BTI[A] 0.25 – < 0.5	BTI[A] > = 0.5

[A] Buffer Time Index – A measure of reliability, measures percentage of travel time devoted to being on time above average travel time.

Buffer time indices for weekday AM peak hour, weekday PM peak hour, and weekend PM peak hour are shown in Figure 13, Figure 14, and Figure 15 respectively. As shown, frequent service reliability issues occur predominantly during the weekday AM and PM peak commute hours and do not particularly mirror where congestion typically occurs. Although reliability issues are present during weekends – they are much more specific at the SR 29 junctures with American Canyon Road, Airport/SR 12 and Soscol Junction.

Figure 16 and Figure 17 show how motorists who use SR 29 in either direction respectively must compensate for both travel delay and buffer time. As shown, instead of a 13-minute drive to traverse 11.5 miles under non-congested conditions within the study corridor motorist must typically commit to over 30 minutes to reliably travel on SR 29 during peak hours. This also presents issues for on-time performance of transit service in the SR 29 corridor.



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Map Projection: Mercator Auxillary Sphere
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NAPA VALLEY TRANSPORTATION AUTHORITY
SR 29 COMPREHENSIVE MULTIMODAL CORRIDOR PLAN

BUFFER TIME INDEX
WEEKDAY AM PEAK HOUR

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FIGURE 13

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Data Source: INRIX Analytics
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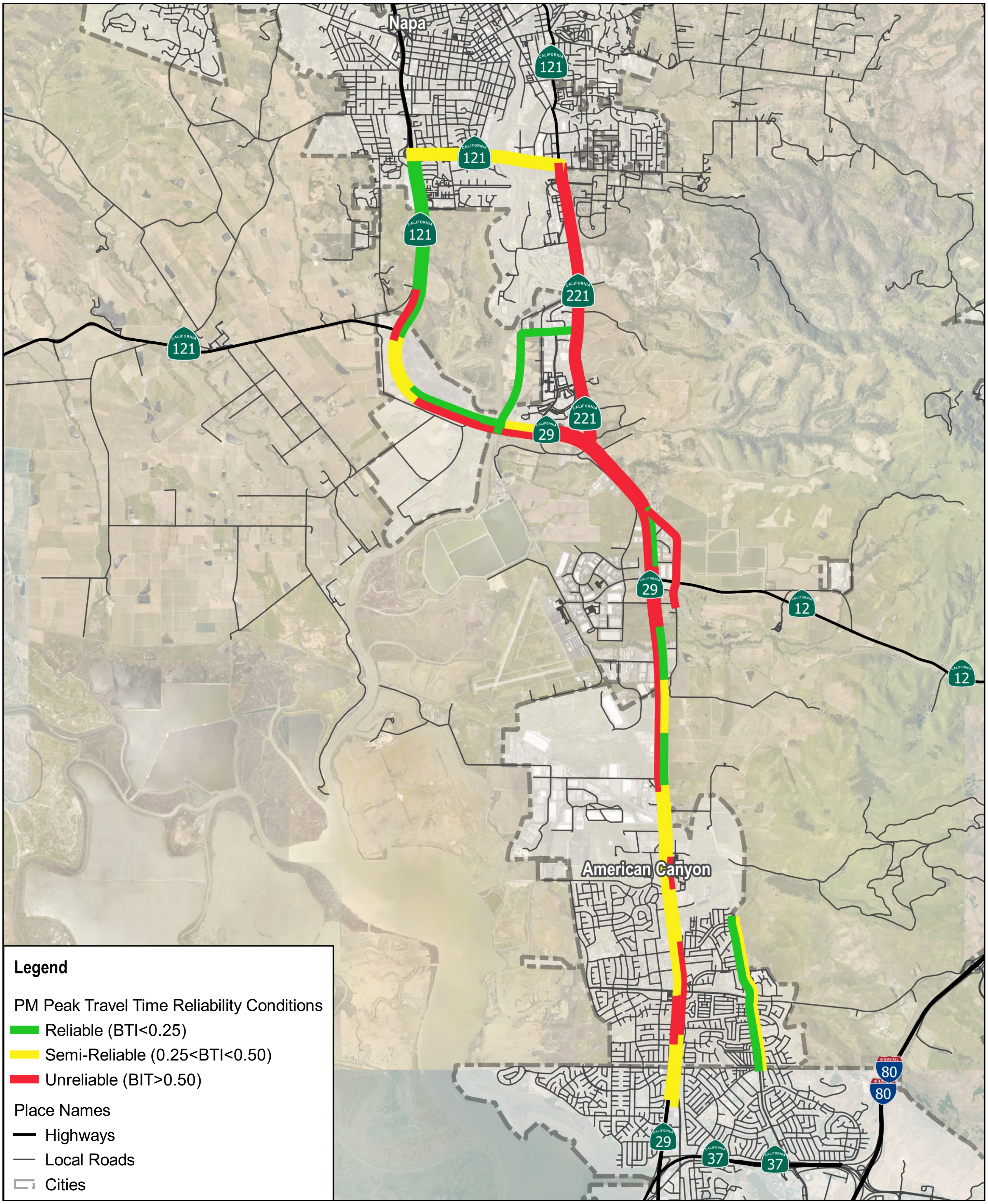

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NAPA VALLEY TRANSPORTATION AUTHORITY
SR 29 COMPREHENSIVE MULTIMODAL
CORRIDOR PLAN

BUFFER TIME INDEX
WEEKDAY PM PEAK HOUR

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FIGURE 14

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Data Source: INRIX Analytics
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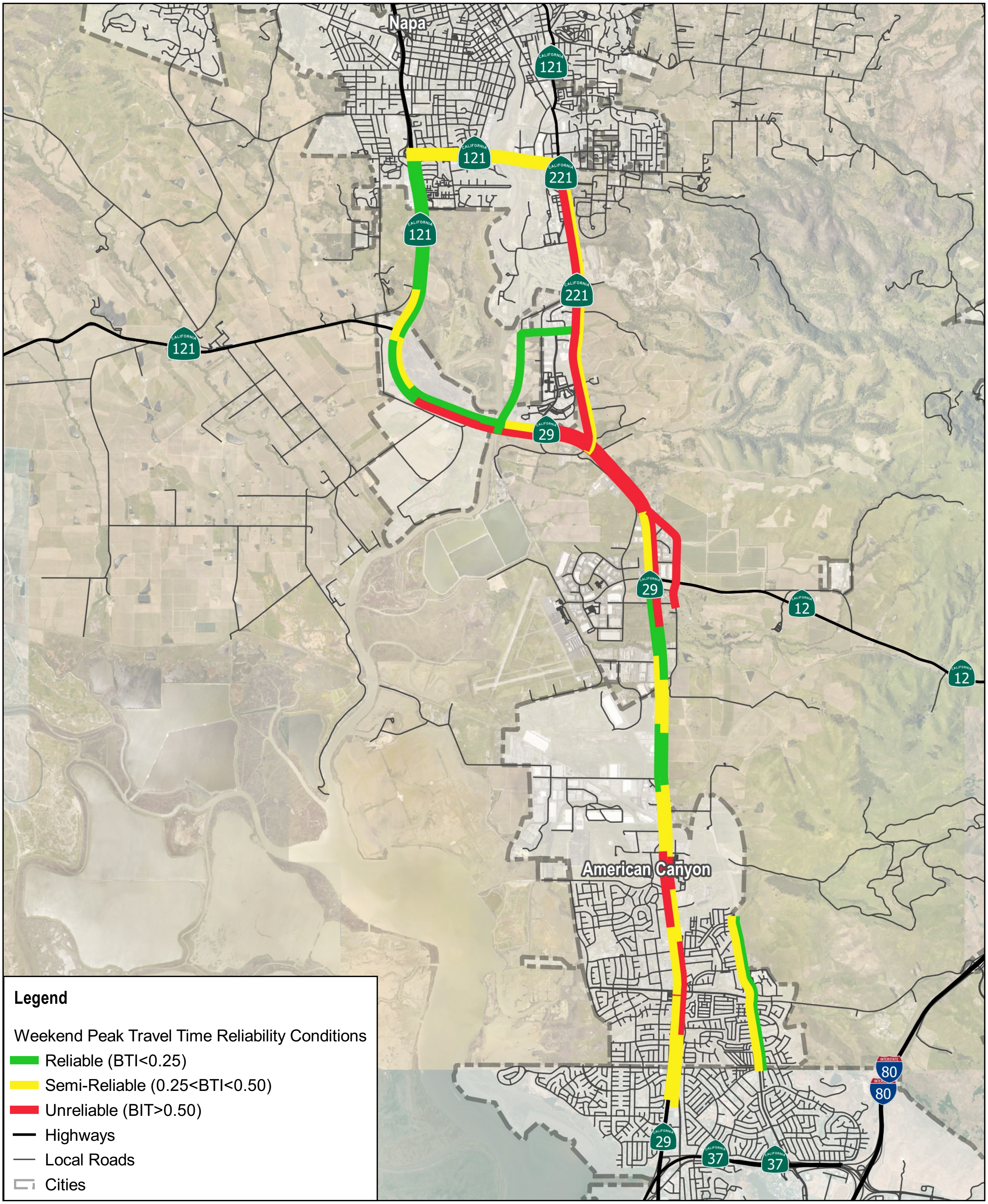

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NAPA VALLEY TRANSPORTATION AUTHORITY
SR 29 COMPREHENSIVE MULTIMODAL CORRIDOR PLAN

BUFFER TIME INDEX WEEKEND PM PEAK HOUR

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Date. **05/13/2020**

FIGURE 15

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Data Source: INRIX Analytics
Created By: rsouthern

Figure 16: Total Time Required for Reliably Traveling Northbound on SR 29

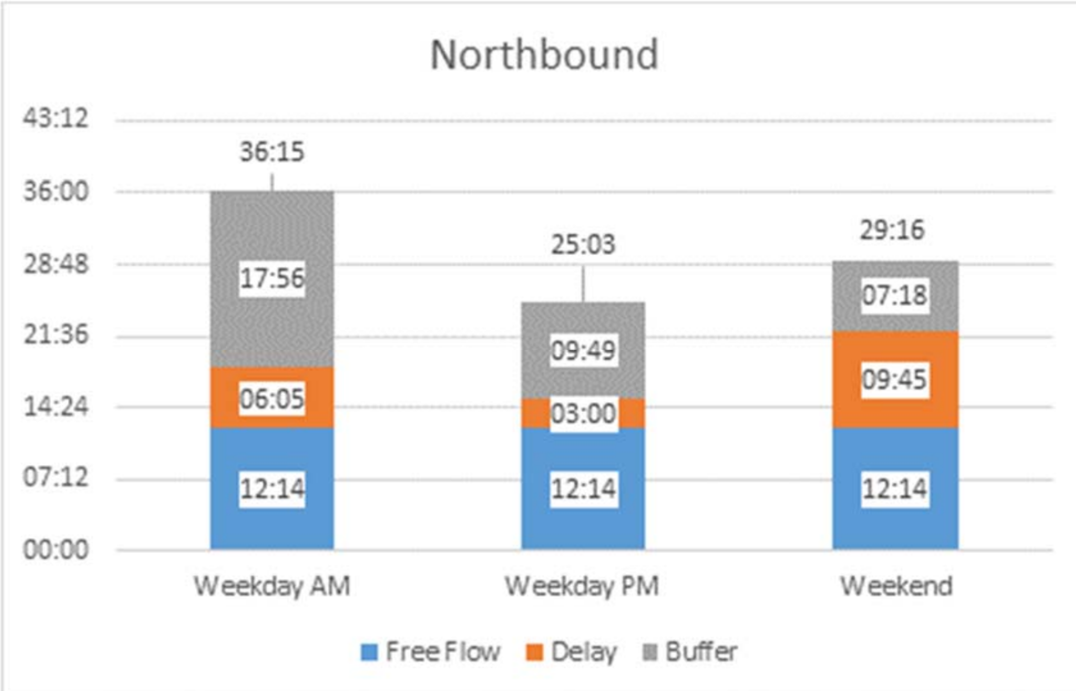
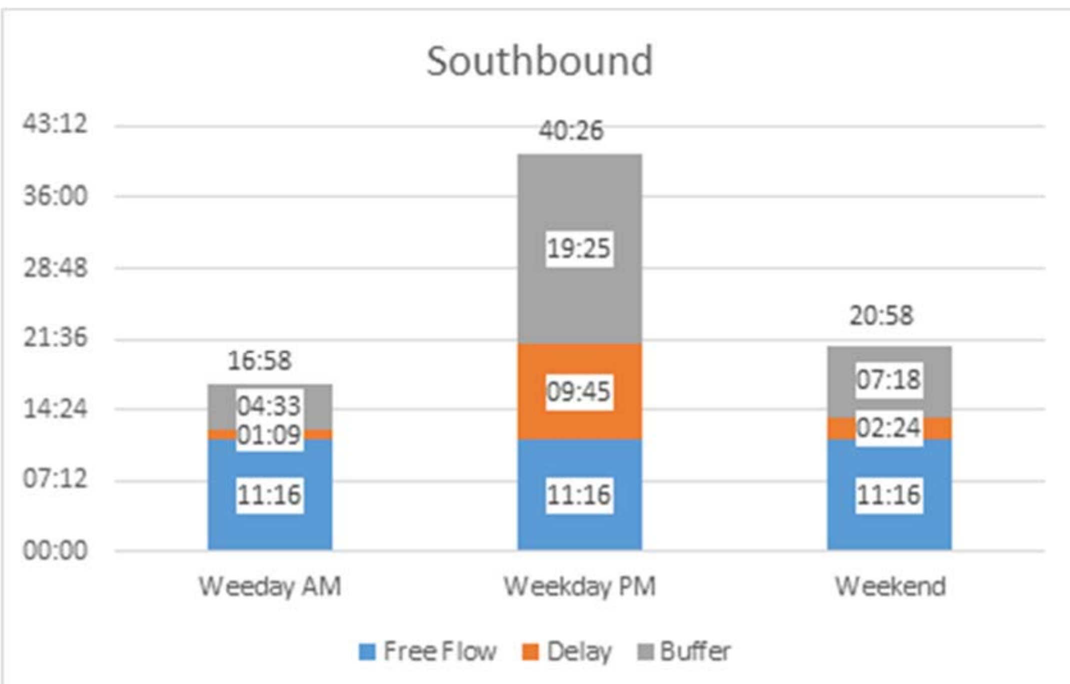


Figure 17: Total Time Required for Reliably Traveling Southbound on SR 29

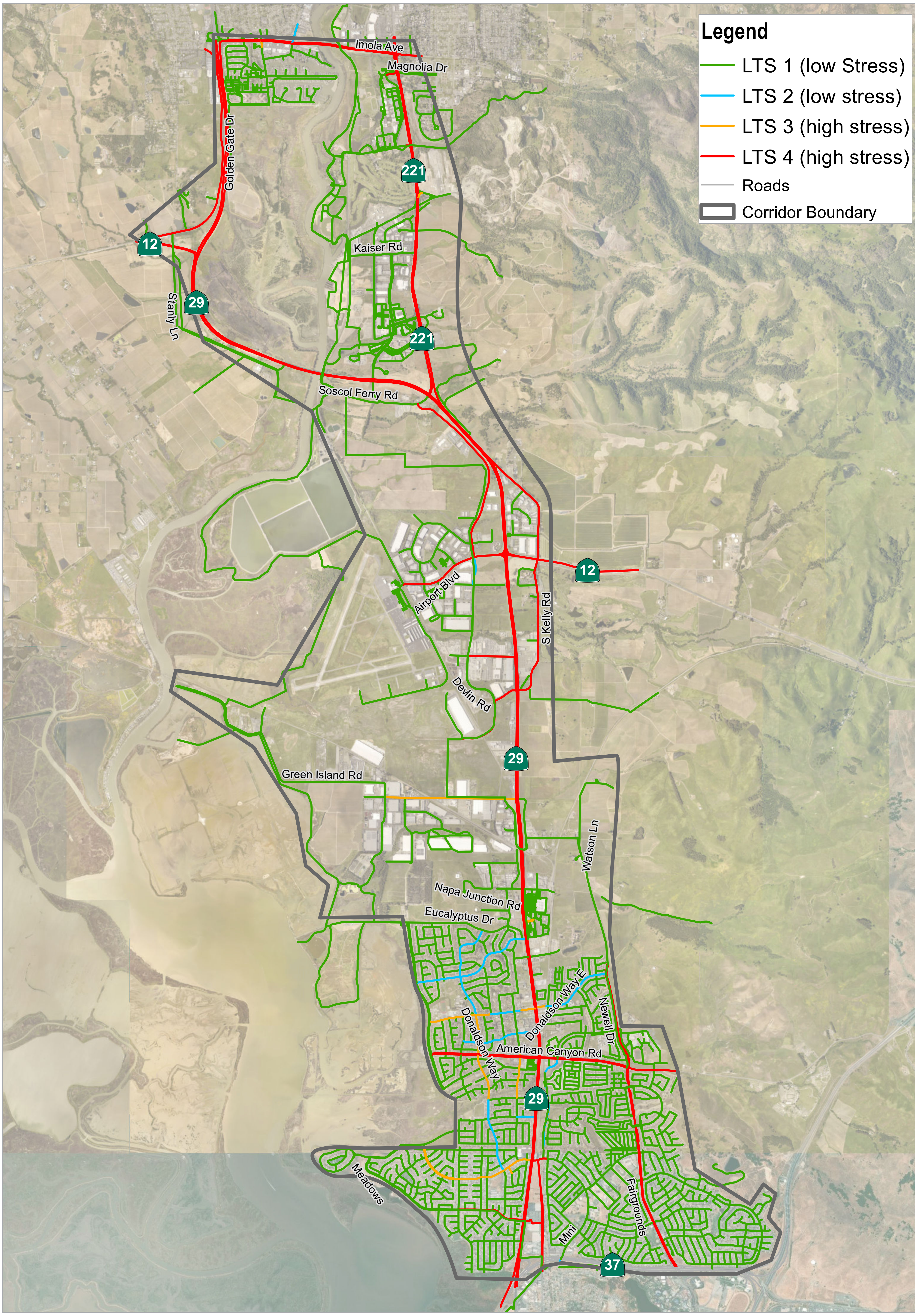


Bicycle Level of Traffic Stress

Bicycle Level of Traffic Stress (Bicycle LTS) is an objective, data-driven evaluation of the bicycling experience on various types of streets. The analysis uses roadway characteristics like posted speed limit, street width, number of travel lanes, intersection conditions, traffic controls, and the presence and character of bikeways to determine bicyclist comfort level. The results assign a score between 1 and 4, with Bicycle LTS 1 being most comfortable and least stressful. Bicycle LTS 4 is least comfortable and most stressful. Additional detail on Bicycle LTS methodology is provided in Appendix E.

Corridor segments and intersection approaches in the study area were both evaluated for LTS. An overall LTS score was determined by applying the worst score between adjacent street segments and intersection approaches. Figure 18 displays the overall existing condition LTS for the study corridor. LTS for crossings were not evaluated; however, all crossings of SR 29 are assumed to be high-stress due to the traffic volume and speed of the roadway. Most local streets provide low stress connectivity within neighborhoods; however, higher stress roadways bisect these areas throughout the study area to create pockets of low stress connectivity with high stress barriers at streets with higher functional classifications, street widths, speeds and volumes.

The main barriers to low-stress connectivity for bicyclists within the SR 29 study corridor are the high stress State Routes, including SR 29, SR 221, SR 121, and SR 12. These high-stress facilities serve to discourage access to and bicycling on SR 29 itself (north-south bicycle travel). SR 29 also bifurcates the study corridor, posing as a barrier to east-west bicycle travel. Although crossing scores were not generated as part of the SR 29 CMCP, the Caltrans District 4 Bike Plan Web Map presents Bicycle LTS crossing scores along SR 29, showing seven “LTS 4” and four “LTS 3” out of a total 13 crossings between SR 37 and Imola Avenue (SR 121). American Canyon Road, Newell Drive, Flosden Road, Fairgrounds Drive, and S. Kelly Road are additional high-stress roadways that limits local low-stress bicycling community access and limit viable on-street low-stress alternatives to SR 29.



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NAPA VALLEY TRANSPORTATION AUTHORITY
SR 29 COMPREHENSIVE MULTIMODAL
CORRIDOR PLAN

EXISTING BICYCLE
LEVEL OF TRAFFIC STRESS

Project No. 11187559
Revision No. -
Date 02/27/2020

FIGURE 18

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Data source: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community. Created by: pthornton

Transit

Existing Service

Transit service in the Napa Valley is provided by Napa Valley Transportation Authority (NVTA)'s Vine Transit. Of the eight local routes, several serve the Imola corridor, which is at the northern end of the project study area. Several regional routes serve the study corridor directly, including Route 29, Route 21, Route 11 and Route 11X. Routes 29, 21, and 11X operate Monday through Friday, and Route 11 operates Monday through Sunday. Figure 19[2] displays the main transit lines serving the study corridor—Routes 29, 21, 11, and 11x.

Figure 19: Regional Vine Transit Routes Serving Corridor[1]

Routes 11X, 21 and 29 are express buses, serving a limited number of stops and providing access to regional destinations, and connection to the regional transit network, including Bay Area Rapid Transit (BART), San Francisco Bay Ferry, Fairfield-Suisun Transit, Rio Vista Delta Breeze, Solano County Transit, Lake Transit, Greyhound, and Amtrak/Capital Corridor.

In addition to the previously described routes operating in the study area, Vine Transit also provides American Canyon Transit service offering fixed route and on-demand, door-to-door, transit service within the City of American Canyon.

Existing Performance

Based on an analysis of existing ridership data of the express routes serving the study area, Route 29 experiences the highest ridership demand. However, traffic congestion on SR 29 causes significant service delays, varied travel times and diminished reliability. While Route 21 sees lower ridership demand than Route 29, Route 21 also experiences significant congestion on some segments of the route. Based on data presented in the *Vine Transit Express Bus Corridor Study* (2017), Routes 21 and 29 perform below Vine transit performance standards and typical express bus service standards across several performance metrics. Moreover, on-time performance and service reliability were highlighted as issues for both routes. The #1 need identified in the *Express Bus Corridor Study* was to reduce the impact of congestion on trip time and variability on Route 29.

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[2] *Figure 19 Source: vinetransit.com*

Ridership Levels

65% of surveyed respondents said they very rarely or never used transit.[3] Existing Vine Transit ridership data was obtained from NVTA. Existing ridership for Routes serving the study area is summarized in Table 7. As shown, Route 29 experiences the highest ridership demand of the express buses serving the study area.

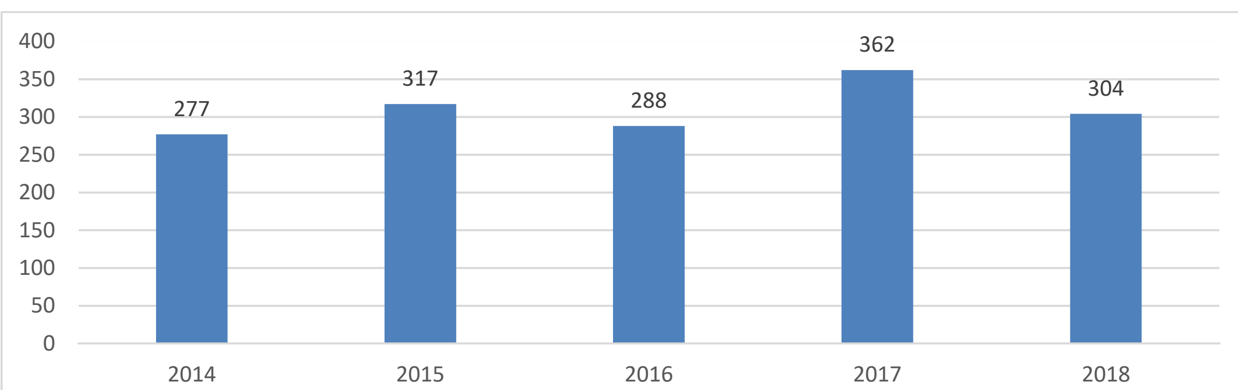
Table 7: Existing VINE Transit Ridership - Routes 29 and 11X

Existing Ridership			
	Peak Period		
Route	AM	PM	Daily
Route 11 Northbound	95	47	345
Route 11 Southbound	51	86	365
Route 11X Northbound	42	22	64
Route 11X Southbound	11	17	28
Route 29 Northbound	58	77	135
Route 29 Southbound	88	35	123
Route 21 Northbound	16	30	77
Route 21 Southbound	27	12	65

Collision Data

The primary data source for collisions was the Transportation Injury Mapping System (TIMS), which uses data from the Statewide Integrated Traffic Records System (SWITRS). TIMS records include all injury collisions, excluding property damage only (PDO) collisions. Non-PDO collisions occurring within the study area was analyzed over a five-year period for the years between 2014 and 2018. The number of non-PDO collisions occurring within the study area during this time frame is displayed in Figure 20. Table 8 displays this data by collision severity and type.

Figure 20: Non-PDO Study Area Collisions, 2014-2018



[3] *NVTA. VINE Transit Express Bus Corridor Study, 2017.*

The most common crash type among all collisions within the study area was rear end type collisions, at 55% of the total. Eight percent of all fatal and injury collisions resulted in fatal or severe injury. Fifty percent of all collisions were reported as unsafe speed being the primary violation category.

Table 8: Study Area Non-PDO Collisions, 2014-2018

Collision Category		Number of Collisions	
		Count	Percent
Collisions By Severity	Total Collisions	1548	100%
	Injury (Complaint of Pain)	1102	71%
	Injury (Other Visible)	323	21%
	Injury (Severe)	109	7%
	Fatality	14	1%
	Total Fatal/Severe Injuries(FSI)	123	8%
Collisions By Type	Broadside	252	16%
	Head-On	48	3%
	Hit Object	187	12%
	Not Stated	4	0%
	Other	23	1%
	Overturned	49	3%
	Rear End	846	55%
	Sideswipe	93	6%
	Vehicle/Pedestrian	46	3%

Table 9 displays collisions by severity and type that occurred on state routes within the study area. Because the majority, or 75 %, of the total collisions occurred on state routes, the results are similar to the total study area collision counts reported in Table 8.

Table 9: Study Area Non-PDO Collisions on State Routes, 2014-2018

Collision Category		Number of Collisions	
		Count	Percent
Collisions By Severity	Total Collisions	1173	100%
	Injury (Complaint of Pain)	856	71%
	Injury (Other Visible)	222	21%
	Injury (Severe)	82	7%
	Fatality	13	1%
	Total Fatal/Severe Injuries(FSI)	95	8%
Collisions By Type	Broadside	115	16%
	Head-On	23	3%
	Hit Object	141	12%
	Not Stated	4	0%
	Other	13	1%
	Overturned	36	3%
	Rear End	758	55%
	Sideswipe	67	6%
	Vehicle/Pedestrian	16	3%

Bicycle and Pedestrian Collisions

Table 10 displays the bicycle collisions and Table 11 displays the pedestrian collisions that occurred within the corridor between 2014 and 2018. Figure 21 presents a map of pedestrian collisions and Figure 22 presents a map of bicycle collisions during this five-year time period.

Bicycle Collisions

The most common crash type among bicycle-related collisions were broadside collisions with 41% percent of bicycle collisions reported as this type. Thirty-five percent were reported as "Other."

Table 10: Bicycle Collisions, 2014-2018

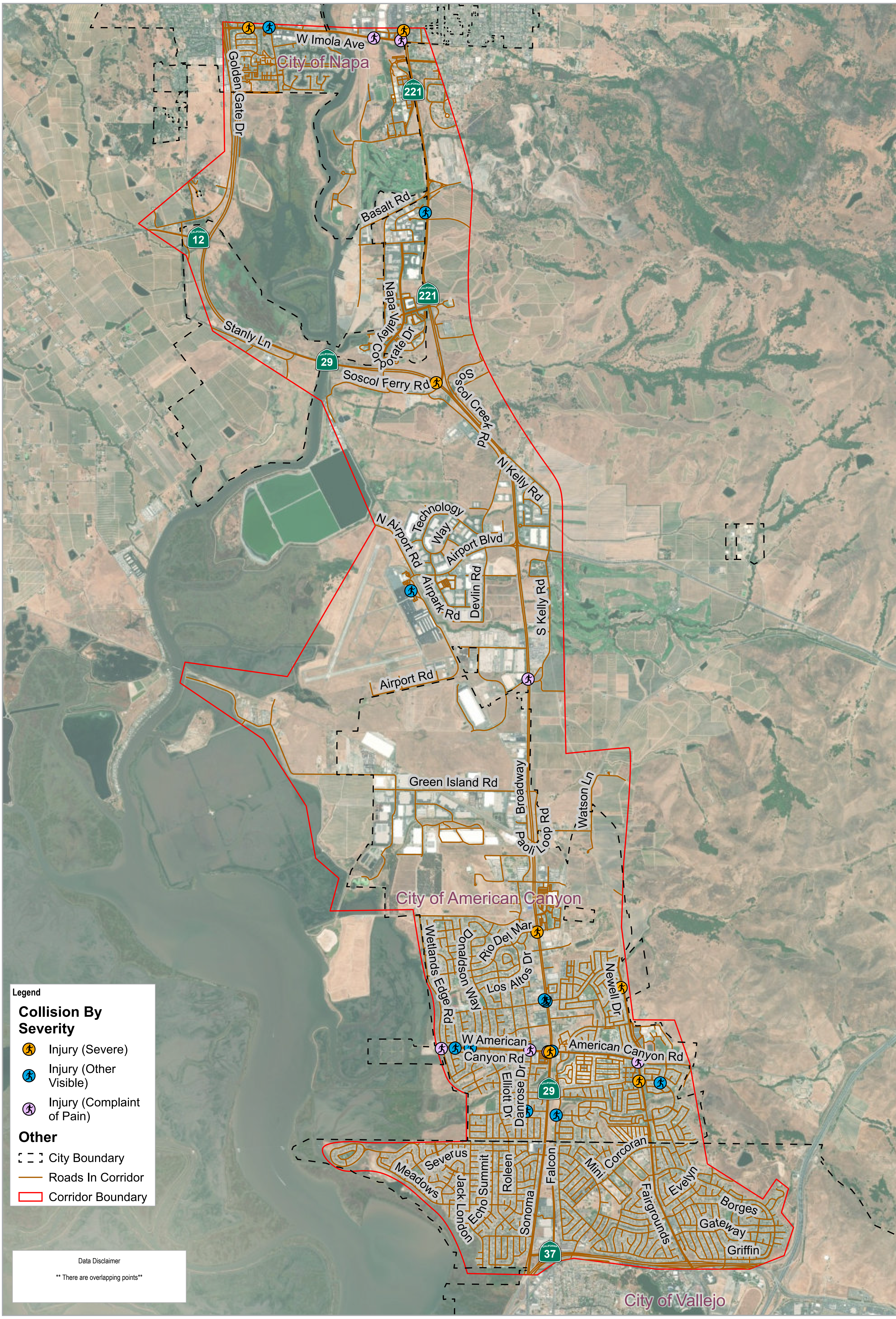
Collision Category		Number of Collisions	
		Count	Percent
Collisions By Severity	Total Collisions	34	100%
	Injury (Complaint of Pain)	17	50%
	Injury (Other Visible)	14	41%
	Injury (Severe)	1	3%
	Fatality	2	6%
	Total Fatal/Severe Injuries (FSI)	3	9%
Collisions By Type	Broadside	14	41%
	Head-On	1	3%
	Hit Object	0	0%
	Not Stated	0	0%
	Other	12	35%
	Overturned	2	6%
	Rear End	2	6%
	Sideswipe	2	6%
	Vehicle/Pedestrian	1	3%

Pedestrian Collisions

Twenty-seven percent of pedestrian collisions resulted in fatal and severe injury. Forty-three percent of pedestrian-related collisions occurred when the pedestrian was crossing in a crosswalk at an intersection.

Table 11: Pedestrian Collisions, 2014-2018

Collision Category		Number of Collisions	
		Count	Percent
Collision by Severity	Total Collisions	51	100%
	Injury (Complaint of Pain)	20	39%
	Injury (Other Visible)	17	33%
	Injury (Severe)	11	22%
	Fatality	3	6%
	Total Fatal/Severe Injuries(FSI)	14	27%
Pedestrian Action	Crossing in Crosswalk at Intersection	22	43%
	Crossing in Crosswalk Not at Intersection	1	2%
	Crossing Not in Crosswalk	12	24%
	In Road, Including Shoulder	12	24%
	Not in Road	2	4%
	Not Stated	2	4%



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Map Projection: Lambert Conformal Conic
Horizontal Datum: NAD 1983 2011
Grid: NAD 1983 2011 StatePlane California II FIPS 0402 Ft US

GHD

NAPA VALLEY TRANSPORTATION AUTHORITY
SR 29 COMPREHENSIVE MULTIMODAL
CORRIDOR PLAN

**PEDESTRIAN COLLISIONS
2014 to 2018 (SWITRS / TIMS)**

Project No. **11187559**
Revision No. **-**
Date **7/11/2019**

FIGURE 21

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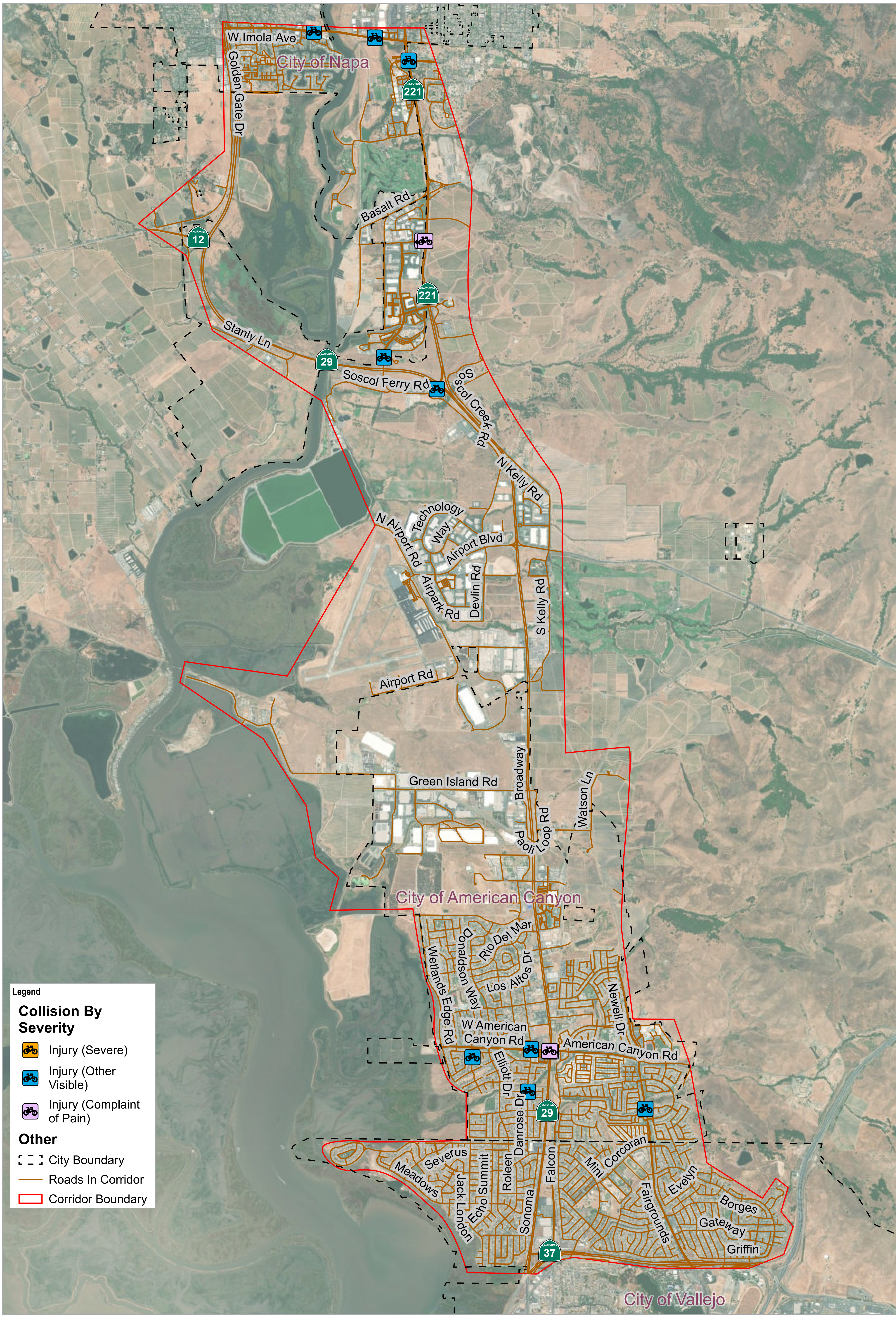
Print date: 11 Jul 2019 - 08:35

Data source: TIMS 14-18, SWITRS 14-18 World Imagery: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community. Created by: bnamsaly



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Map Projection: Lambert Conformal Conic
Horizontal Datum: NAD 1983 2011
Grid: NAD 1983 2011 StatePlane California II FIPS 0402 Ft US

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GHD

NAPA VALLEY TRANSPORTATION AUTHORITY
SR 29 COMPREHENSIVE MULTIMODAL CORRIDOR PLAN

BICYCLE COLLISIONS
2014 to 2018 (SWITRS / TIMS)

Project No. 11187559
Revision No. -
Date 7/11/2019

FIGURE 22

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Print date: 11 Jul 2019 - 08:52

Data source: World Imagery: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community. Created by: bnamsaly

5 - Corridor Solutions

This chapter presents potential solutions examined for the SR 29 corridor. These solutions were identified in the preceding 2014 SR 29 Gateway Corridor Improvement Plan, other relevant programming and planning documents, and during the course of preparing the SR 29 CMCP, including the public outreach process and the needs analysis documented in the Existing Conditions chapter of this report.

As outlined below, seven (7) categories of potential improvements have been identified. Within each of these categories, 24 separate and distinct improvements and/or services are described. Each of these improvements within these 7 categories were individually costed and prioritized for future grant funding and implementation. The categories and improvements are outlined below:

Parallel Capacity Improvements

- Devlin Road
- South Kelly Road/Newell Drive

SR 29 Multimodal Improvements

- SR 37 to Napa Junction Road
- Napa Junction Road to Paoli Loop Road
- South Kelly Road to Soscol Junction

Intersection Improvements

- Carneros Junction
- Airport Boulevard/SR 12/SR 29
- Soscol Junction
- Grade-Separated Pedestrian Crossings

Shared Use Paths

- Napa Valley Vine Trail
- San Francisco Bay Trail

SMART Train Extensions

- American Canyon to Vallejo Ferry Terminal
- Novato to Suisun City

Bus Improvements

- Bus Stop Changes
- Part Time Use of Shoulder
- 11X Bus Service
- New Route 29 Bus Service
- Queue Jump
- Transit Signal Priority
- NVTA Maintenance Facility/ Transportation Management Center

Integrated Corridor Management

- Variable Message Signs
- Traffic Monitoring Detectors
- Adaptive Signal Control
- Trailblazer Signs
- CCTV Cameras

Online Response Summary

These potential solutions were presented to the community at outreach events and on-line mapping tool. The mapping tool presented graphical renditions of each of the candidate corridor improvements and allowed the community to comment on the various options. A summary of this targeted outreach is provided below in Table 12

Table 12: Public Outreach Concept Preference Polling Results

Concept	Yes Support	Don't Support	Not Sure
Parallel Capacity: Devlin	7	-	-
Parallel Capacity: South Kelly/Newell Drive	7	-	1
Multimodal Improvements: SR 37 to Napa Junction	2	-	1
Multimodal Improvements: Napa Junction to Paoli Loop Road	3	-	-
Multimodal Improvements: South Kelly Road to Soscol Junction	3	-	1
Intersection Improvements: Carneros – SR 29/SR 12/SR 121	2	1	-
Intersection Improvements: SR 29/SR 12/Airport Boulevard	2	1	1
Intersection Improvements : Soscol Junction	4	1	-
Grade-Separated Pedestrian Crossings	17	1	1
Vine Trail Alignment Improvement	6	-	-
Bay Trail Alignment	6	1	-
SMART Extension: American Canyon to Vallejo Ferry Terminal	5	-	1
SMART Extension: Novato to Suisun City	4	-	2
Bus Stop Changes	6	-	-
Bus on Shoulder	1	1	1
Route 11 Express Bus Service	4	-	-
New Route 29 Bus Service	6	1	-
Bus Queue Jump	4	3	2
Bus Transit Signal Priority	4	2	5
NVTA Maintenance Facility / Transportation Management Center	3	-	1
Integrated Corridor Management: Variable Message Sign	9	3	2
Integrated Corridor Management: Traffic Monitoring Detectors	7	1	2
Integrated Corridor Management: Trailblazer Signage	6	1	1
Integrated Corridor Management: CCTV Cameras	7	1	1

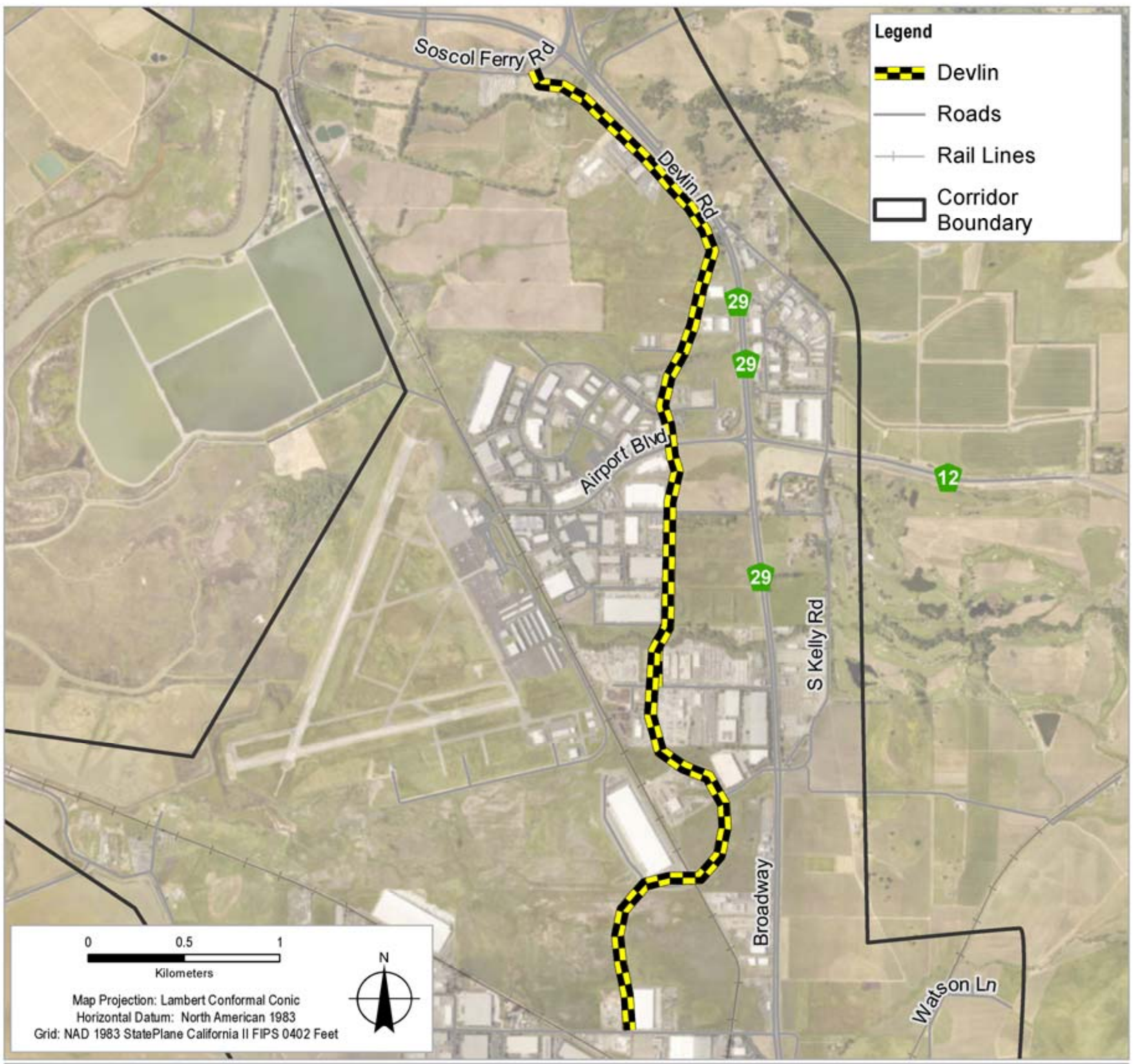
Parallel Capacity Improvements

Devlin Road Extension

The Devlin Road alignment will provide parallel road capacity to SR 29, and connectivity within the employment and industrial areas of unincorporated Napa County, in the vicinity of the airport. Most segments of this ultimate alignment have been constructed. Segment E, between Tower Road and south of Airpark Road, opened in March 2020.

Segment H, between Green Island Road and Devlin Road's current southern terminus has secured funding. Once constructed, this will complete the full Devlin Road extension alignment shown below in Figure 23.

Figure 23 Devlin Road Parallel Capacity



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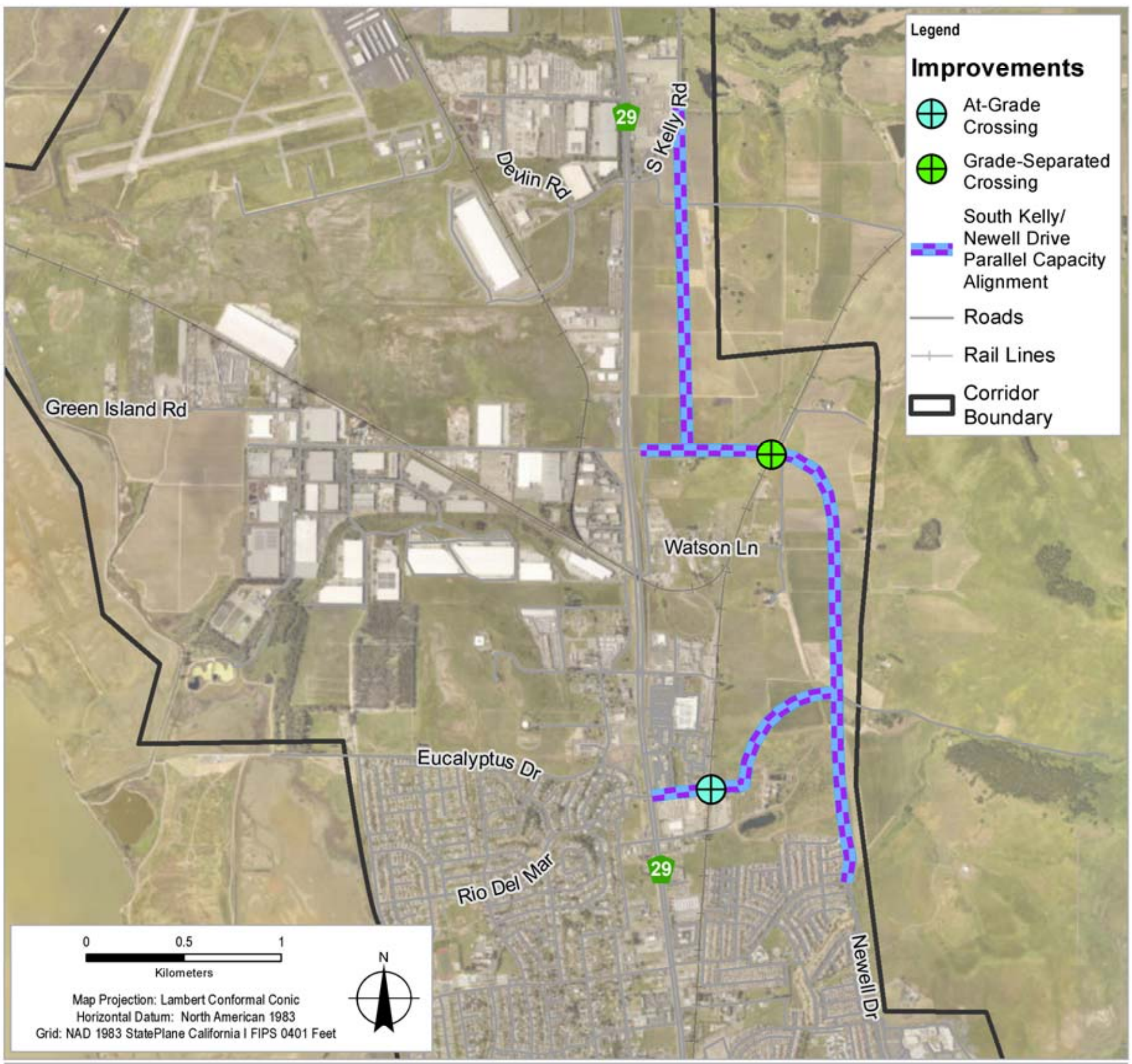
Data source: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community Created by:pthornton

South Kelly Road/Newell Drive Extension

The South Kelly Road/Newell Drive alignment would provide parallel roadway capacity to SR 29. This improvement would include roadway extensions of Newell Drive, Rio Del Mar, and South Kelly Road. Newell Drive would be extended as a four-lane roadway from Donaldson Way to Rio Del Mar, and a two-lane roadway from Rio Del Mar to Green Island Road.

Additionally, Rio Del Mar and South Kelly Road would each be extended as two-lane roadways to connect with the Newell Drive extension at the southern and northern ends, respectively. Portions of these extensions are anticipated to be constructed as part of the Watson Ranch Specific Plan, specifically the Rio Del Mar extension and a portion of the Newell Drive extension. The complimentary roadway extensions are shown below in Figure 24.

Figure 24 South Kelly Road/Newell Drive Parallel Capacity



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Data source: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community Created by:pthornton

SR 29 Multimodal Improvements

Recognizing the character of the SR 29 corridor changes as the adjacent land uses and access needs change, three (3) distinct segments of SR 29 became apparent for which different cross-sections of improvements were developed. An overview of this segmentation is presented in Figure 25. The segmentation of SR 29 is as follows:

- SR 37 to Napa Junction Road
- Napa Junction Road to Paoli Loop Road
- South Kelly Road to Soscol Junction

For each of these segments, the key elements of the proposed improvements to meet the multimodal needs of the segment are highlighted in the following sections.

SR 37 to Napa Junction Road

This solution would provide multimodal improvements on SR 29 between SR 37 and Napa Junction Road. Improvements would maintain the existing four-lane roadway and add off-corridor Class I shared use paths on both sides of the roadway, 8 foot shoulders, pedestrian refuge islands at intersections, and landscaped planting strips to separate the Class I paths from vehicle traffic. A path exists from Eucalyptus Road to Napa Junction Road. The proposed improvements along SR 29 would connect to this path. Segment One improvements are depicted in Figure 26.

Napa Junction Road to Paoli Loop Road

This solution would provide multimodal improvements from Napa Junction Road to the proposed Napa Valley Vine Trail and Paoli Loop Road. Improvements would maintain the existing four-lane roadway and include new and existing Class I shared use paths for bicycling and walking completely separated from and parallel to SR 29.

There is an existing Class I shared use path east of SR 29 from Eucalyptus Drive to Napa Junction Road, which would be extended to Paoli Loop Road. This path would connect to the proposed Napa Valley Vine Trail alignment at Paoli Loop Road with an at-grade bicycle and pedestrian railroad crossing south of Paoli Loop Road. This would provide access to the proposed Napa Valley Vine Trail alignment along Paoli Loop Road and Green Island Road, which extends north to the west of SR 29.[4] Segment Two improvements are depicted in Figure 27.

Napa Junction Road to Soscol Junction

This solution would provide multimodal improvements from Napa Junction Road to Soscol Junction (SR 221). Improvements would provide buffered bike lanes on SR 29 from Napa Junction Road to Soscol Junction, and improve intersections like South Kelly Road, Green Island Road, and North Kelly Road to provide safer bicycle and pedestrian crossing. These facilities would provide a bicycle connection to existing Napa Valley Vine Trail and San Francisco Bay Trail segments east of Soscol Junction via SR 29. If feasible, additional bikeway separation from SR 29 (Class I or IV) may be pursued to enhance bicyclist comfort and safety. Segment three improvements are depicted in Figure 28.

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[4] The Vine Trail Coalition is studying trail alignments options along Paoli Loop. A preferred route is not yet identified.

Figure 25: SR 29 Multimodal Improvements Segment Overview

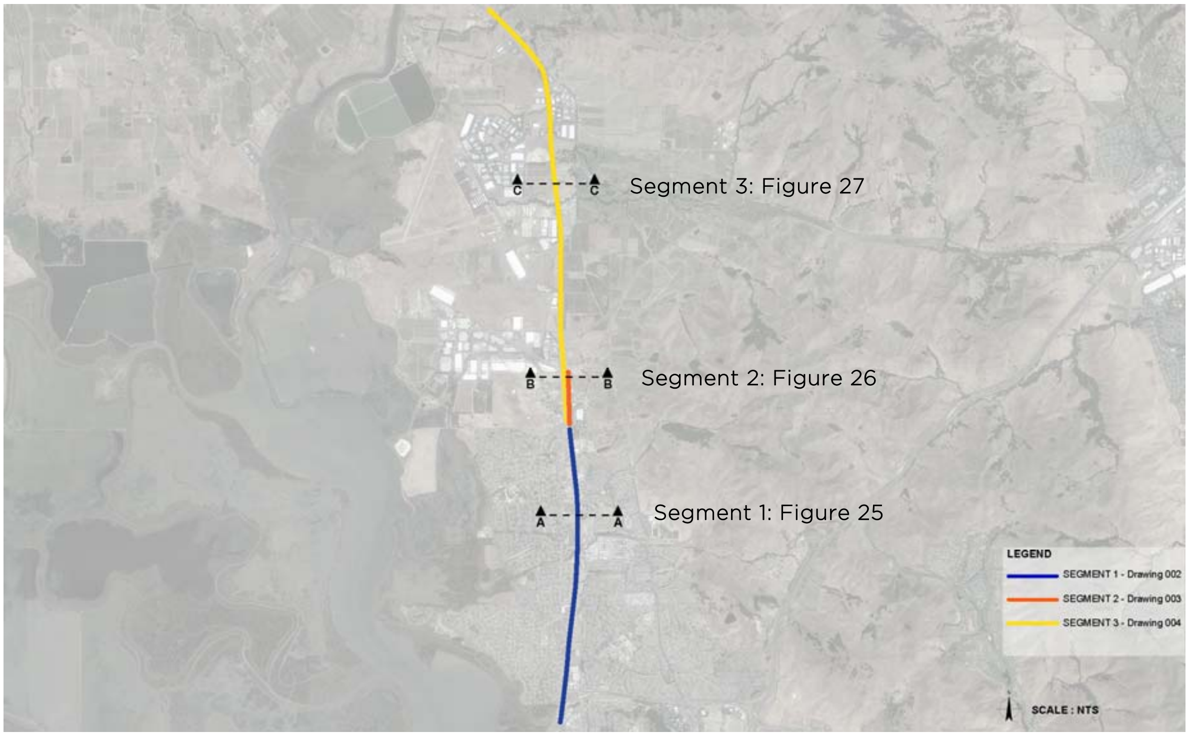


Figure 26: SR 29 Multimodal Improvements Segment One

Figure 27: SR 29 Multimodal Improvements Segment Two

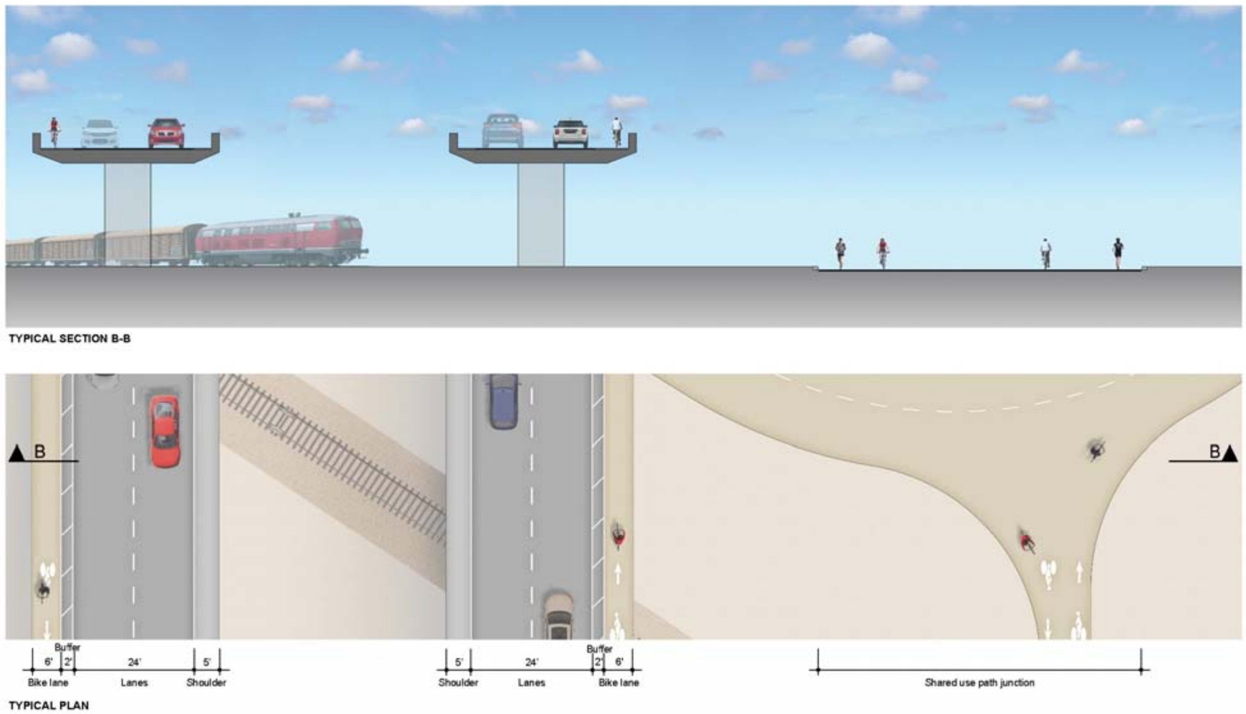
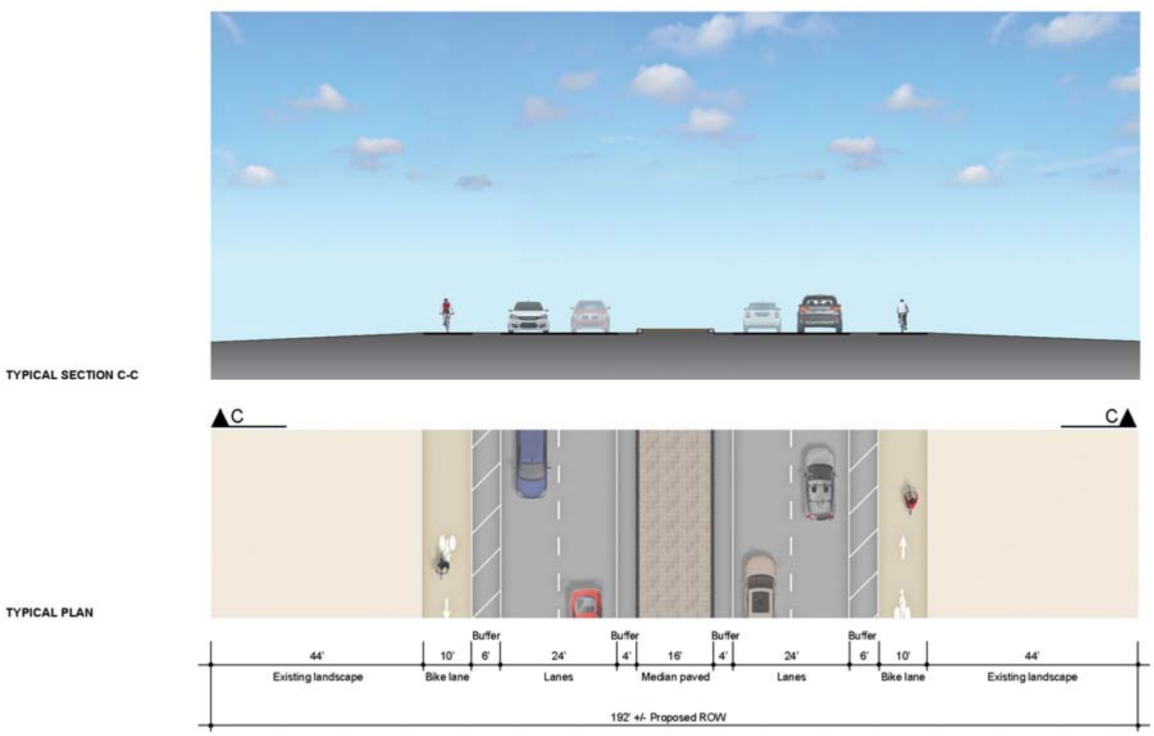


Figure 28: SR 29 Multimodal Improvements Segment Three

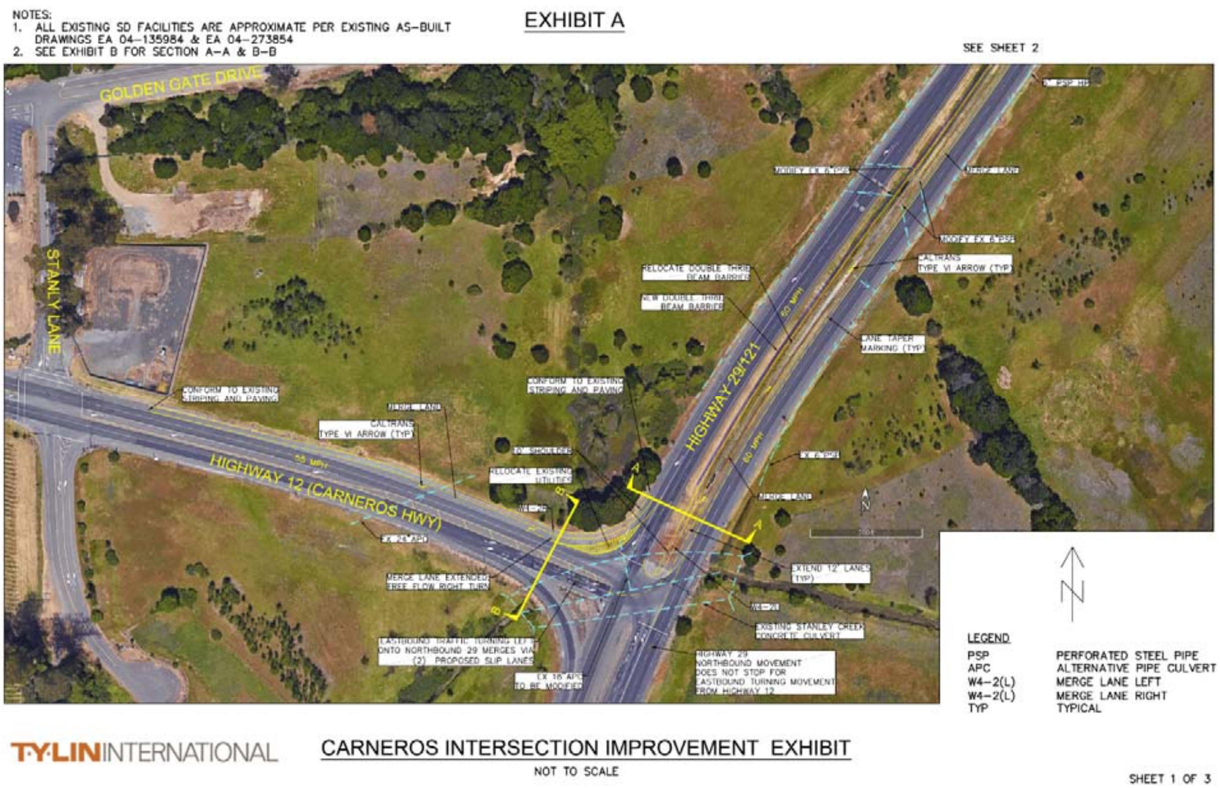


Intersection Improvements

Carneros Junction

This solution would improve the existing signalized intersection at Carneros Junction, where SR 29 intersects with SR 12/SR 121. Carneros Junction intersection Improvements are depicted in Figure 29.

Figure 29: Carneros Junction Intersection Improvements



Improvements would include:

- Converting the signal-controlled northbound through movement on SR 29 to a free no-stop through movement
- Constructing a dedicated unsignalized right turn lane from southbound SR 29 to westbound SR 12, including a merge lane on SR 12 that extends approximately 1,000 feet
- Constructing two receiving slip lanes in the existing SR 29 median for left turns from westbound SR 12 to northbound SR 29, extending approximately 3,100 feet

Airport Boulevard/SR 12/SR 29

Two alternatives were proposed for improvements at the intersection of SR 29 and SR 12/Airport Boulevard. The current configurations at the three study intersections (Airport Blvd & Devlin Road, SR 29 & Airport Blvd/SR 12, SR 12 & N/S Kelly Rd) are all signal configuration.

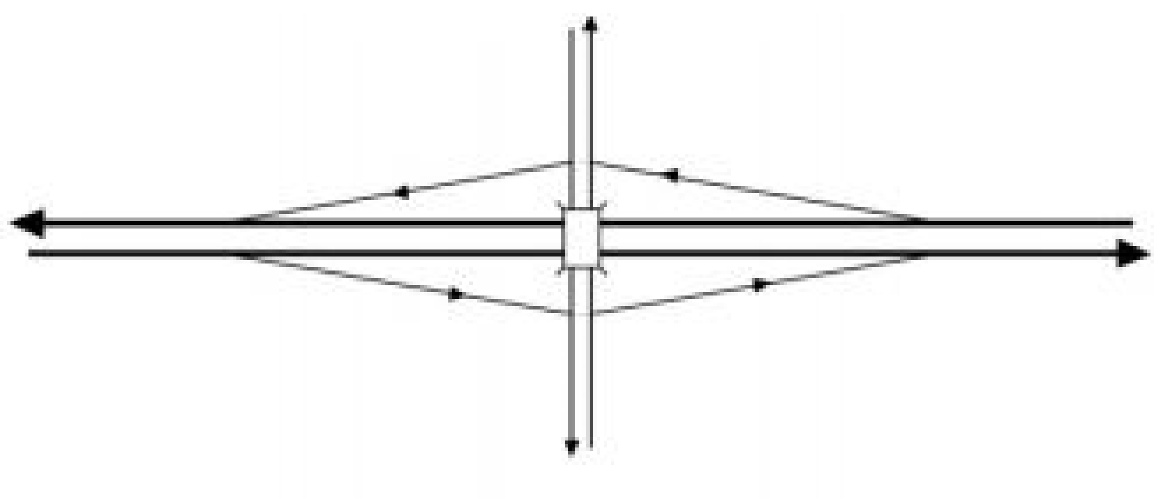
Alternative 1 would be a tight diamond interchange. With this alternative, SR 29 would be on a grade-separated overcrossing structure, and SR 12/Airport Boulevard would cross underneath it. This is depicted in Figure 30. Alternative 1 is proposed to include signalized ramp termini.

Alternative 2 would include an interchange, with SR 12/Airport Boulevard crossing either over or under SR 29 with roundabouts also proposed at Airport Boulevard & Devlin Road, and SR 29 & North/South Kelly Road. These improvements are depicted in Figure 31. Relative to Alternative 1, Alternative 2 provides improved operational benefit at a lower construction cost.

Alternative 2 proposes a single lane roundabout at Airport Boulevard & Devlin road with an adjacent reduction in approach lanes from each direction. The intersection of SR 12 & North/South Kelly Road would become a hybrid roundabout (4 lane roadway east/west and 2 lane roadway north/south).

The intersection of SR 29 & Airport Blvd/SR 12 would be transformed from an at-grade signalized intersection into a grade-separate roundabout interchange. It is still to be determined if SR 29 would be improved to either an overcrossing structure or depressed (sunk into the ground) design. The Airport Boulevard / SR 12 roadway would become a double roundabout “dogbone” with a single westbound lane and two eastbound lanes.

Figure 30: Airport Boulevard/SR 12/SR 29 Alternative 1



Source: Caltrans Highway Design Manual

Figure 31: Airport Boulevard/SR 12/ SR 29 Alternative 2

Soscol Junction

The proposed improvement at Soscol Junction (SR 29/SR 221/Soscol Ferry Road) includes construction of two roundabouts and a grade-separated overcrossing structure for SR 29. Soscol Ferry Road would cross beneath SR 29, and shared use paths would be provided to connect to future alignments in the vicinity. The improvement is displayed in Figure 32 and Figure 33.

Figure 32: Soscol Junction Intersection Improvement – Overhead View

Figure 33: Soscol Junction Intersection Improvement – Perspective View

Shared Use Paths

Napa Valley Vine Trail

This proposed path would offer a dedicated space for people walking and bicycling parallel to SR 29 and completely separated from vehicle traffic. The overall Vine Trail project envisions 47 miles of trail system connecting the entire Napa Valley, from the City of Vallejo in Solano County to the City of Calistoga in Napa County. The current Vine Trail stretches about 12.5 miles, from Kennedy Park, along SR 221 at the northern end of the SR 29 CMCP study area, to the Town of Yountville. Several segments of the trail are in various stages of design or construction. Some segments of the trail system currently fall short of Class I standards, for example the current Class II bike lanes on Devlin Road in American Canyon.

The proposed improvements included in the SR 29 CMCP include gap closures between discontinuous segments of the Vine Trail, in particular, from Kennedy Park in the City of Napa, through Soscol Junction, to Newell Drive in the City of American Canyon. From Newell Drive, the trail would rejoin existing portions of the Vine Trail to American Canyon Road and SR 29 (Broadway). Through the City of Vallejo, a portion of the Vine Trail along Broadway, east of SR 29, to SR 37, has received funding through the Active Transportation Program (ATP) and is in final design. Figure 34 depicts the proposed Vine Trail alignments in the northern study area. Figure 35 depicts the proposed Vine Trail alignment in the southern study area.

San Francisco Bay Trail

This proposed path would offer a dedicated space for people walking and bicycling parallel to SR 29, closer to the bay. The overall Bay Trail project envisions 500 miles of trail system throughout the San Francisco and San Pablo Bays, and throughout the member agencies of the Association of Bay Area Governments (ABAG) and Metropolitan Transportation Commission (MTC). The Bay Trail shares alignments with other trail systems, including the Napa Valley Vine Trail, in several segments. Other "sister trails" include the Bay Area Ridge Trail, Bay Area Water Trail, and the Great Delta Trail.

As with the Vine Trail, the proposed improvements included in the SR 29 CMCP include gap closures between discontinuous segments of the Bay Trail, on the western edge of the study area. In particular, alignments are proposed along the Napa River connecting the Cities of Napa and American Canyon, west of the Napa Airport to Green Island Road. Further south, the proposed alignment would connect the trail terminus along Wetlands Edge Road in the City of American Canyon, through the City of Vallejo, and to SR 37. Figure 36 depicts the proposed Bay Trail alignments in the northern study area. Figure 37 depicts the proposed Bay Trail alignment in the southern study area.

Figure 34: Proposed Vine Trail Alignment (Northern Corridor)

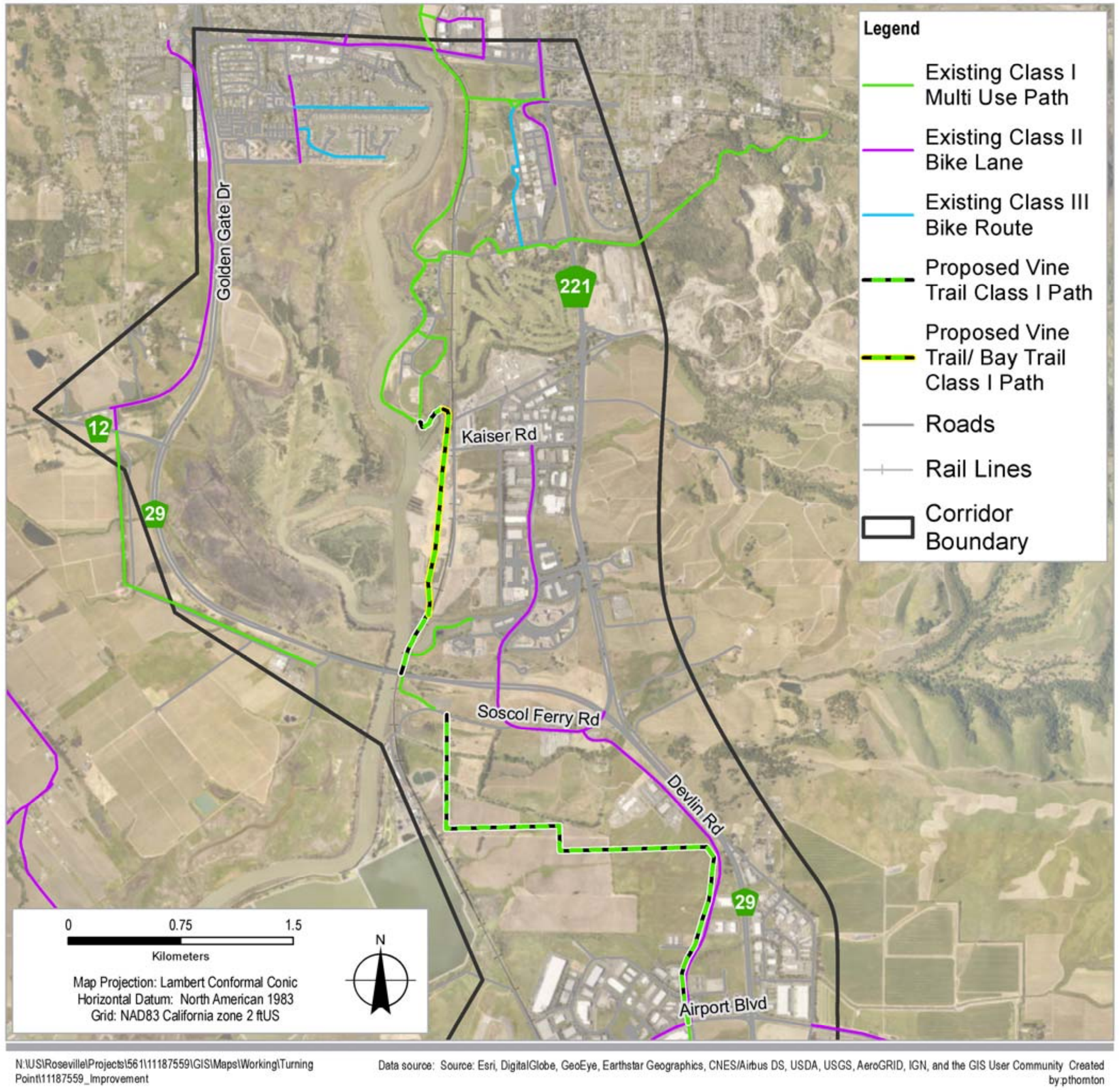


Figure 35: Proposed Vine Trail Alignment (Southern Corridor)

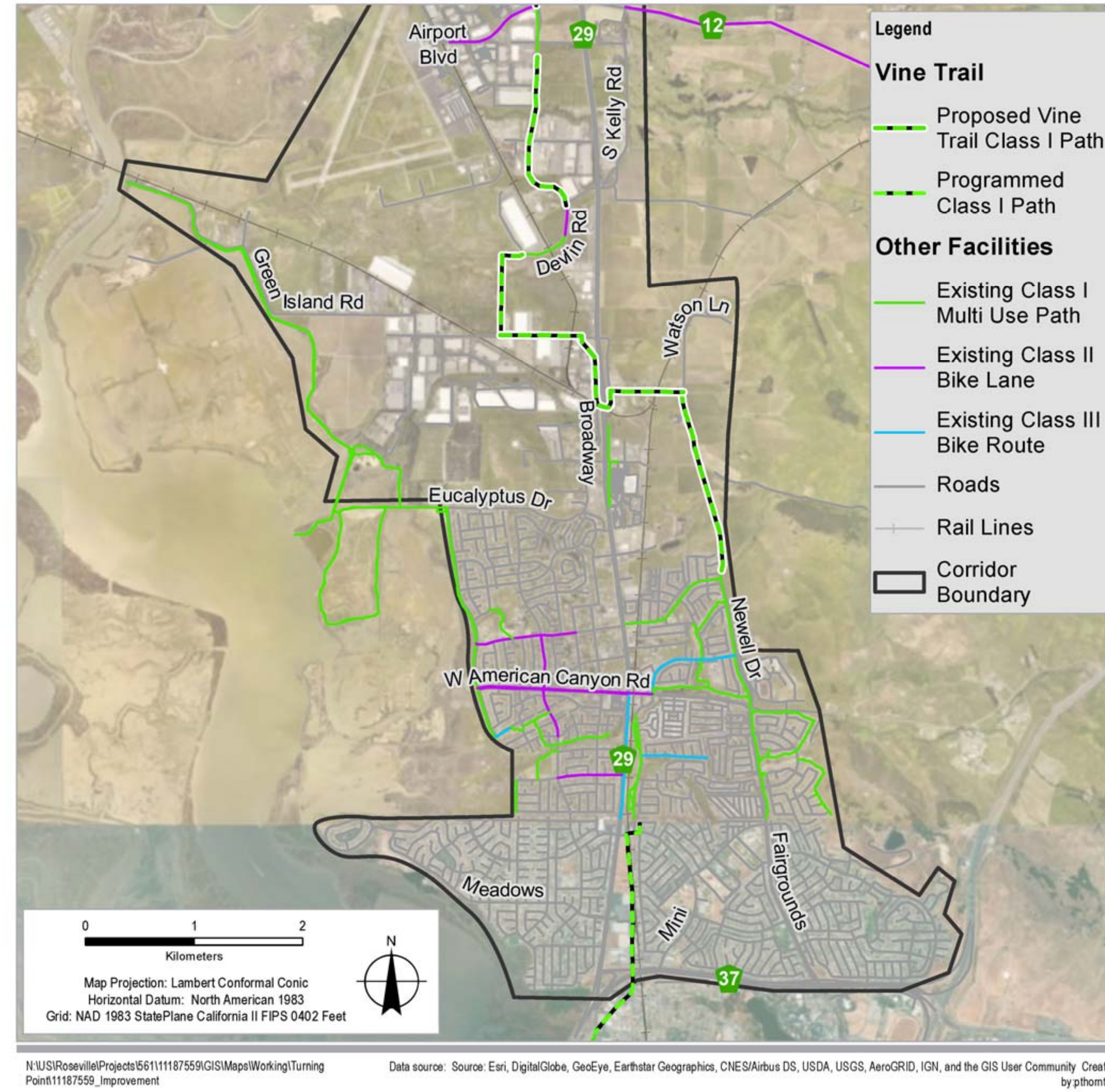
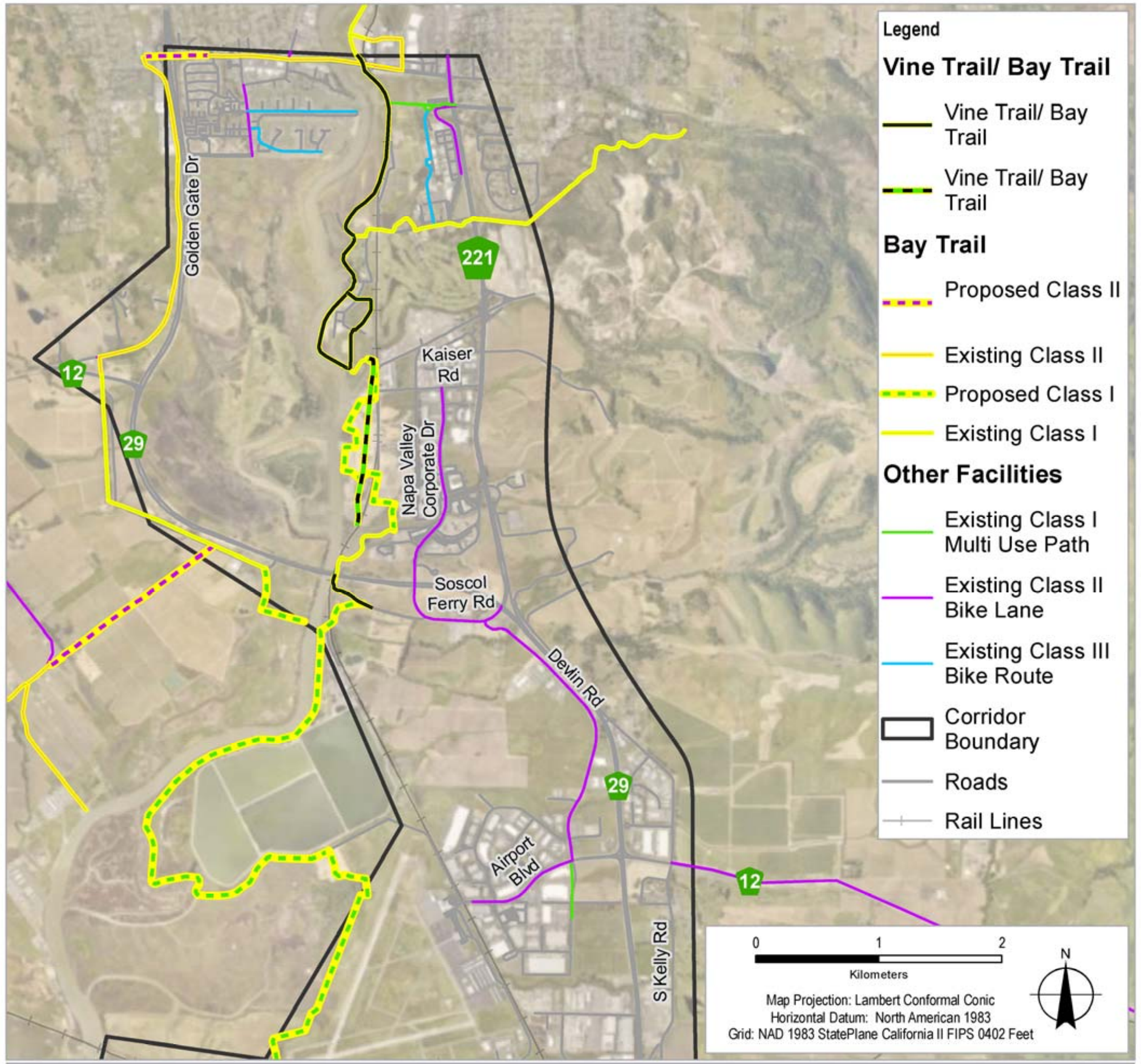


Figure 36: Proposed Bay Trail Alignment (Northern Corridor)



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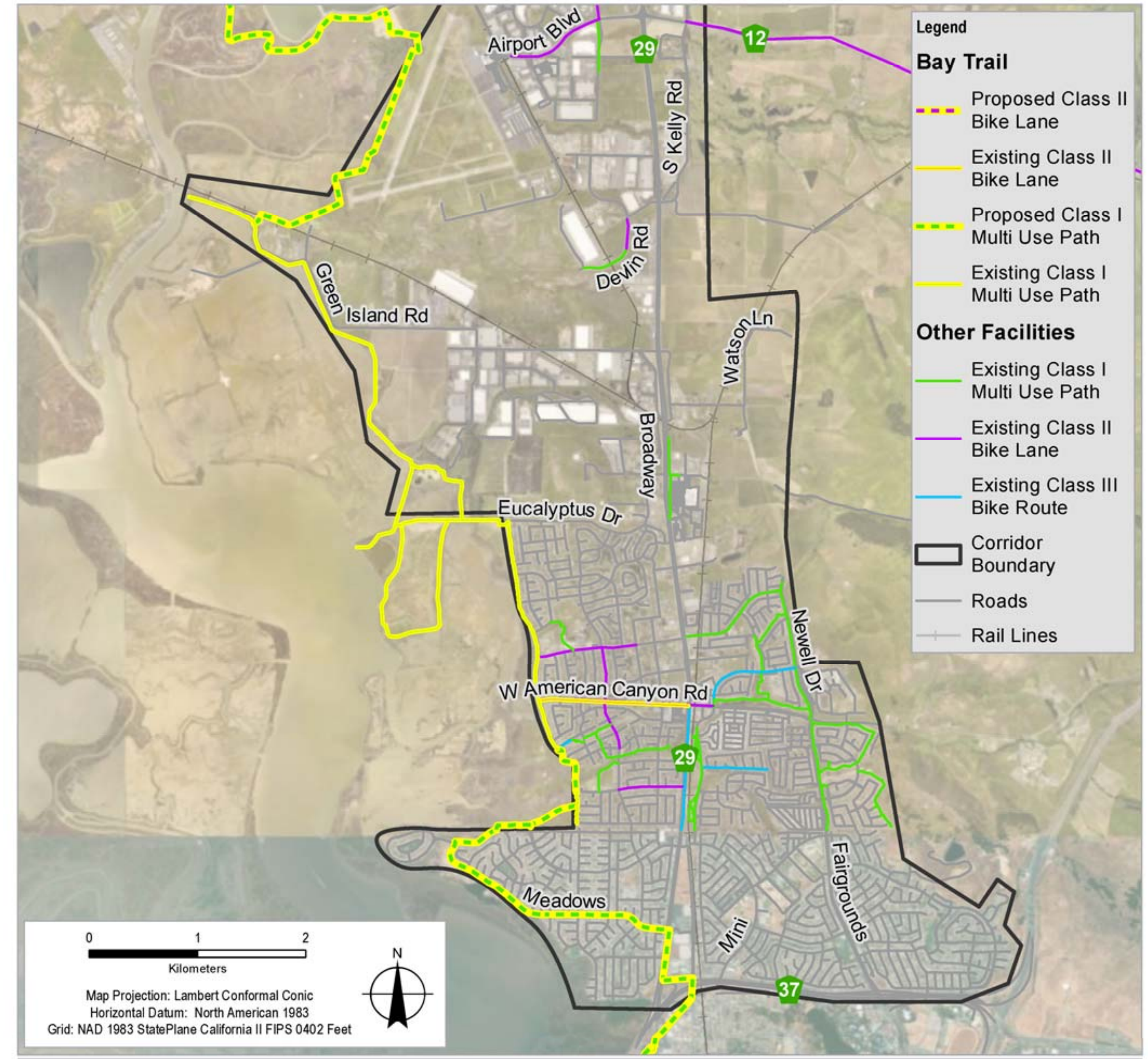
Data source: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community Created by:pthornton

Figure 37: Proposed Bay Trail Alignment (Southern Corridor)



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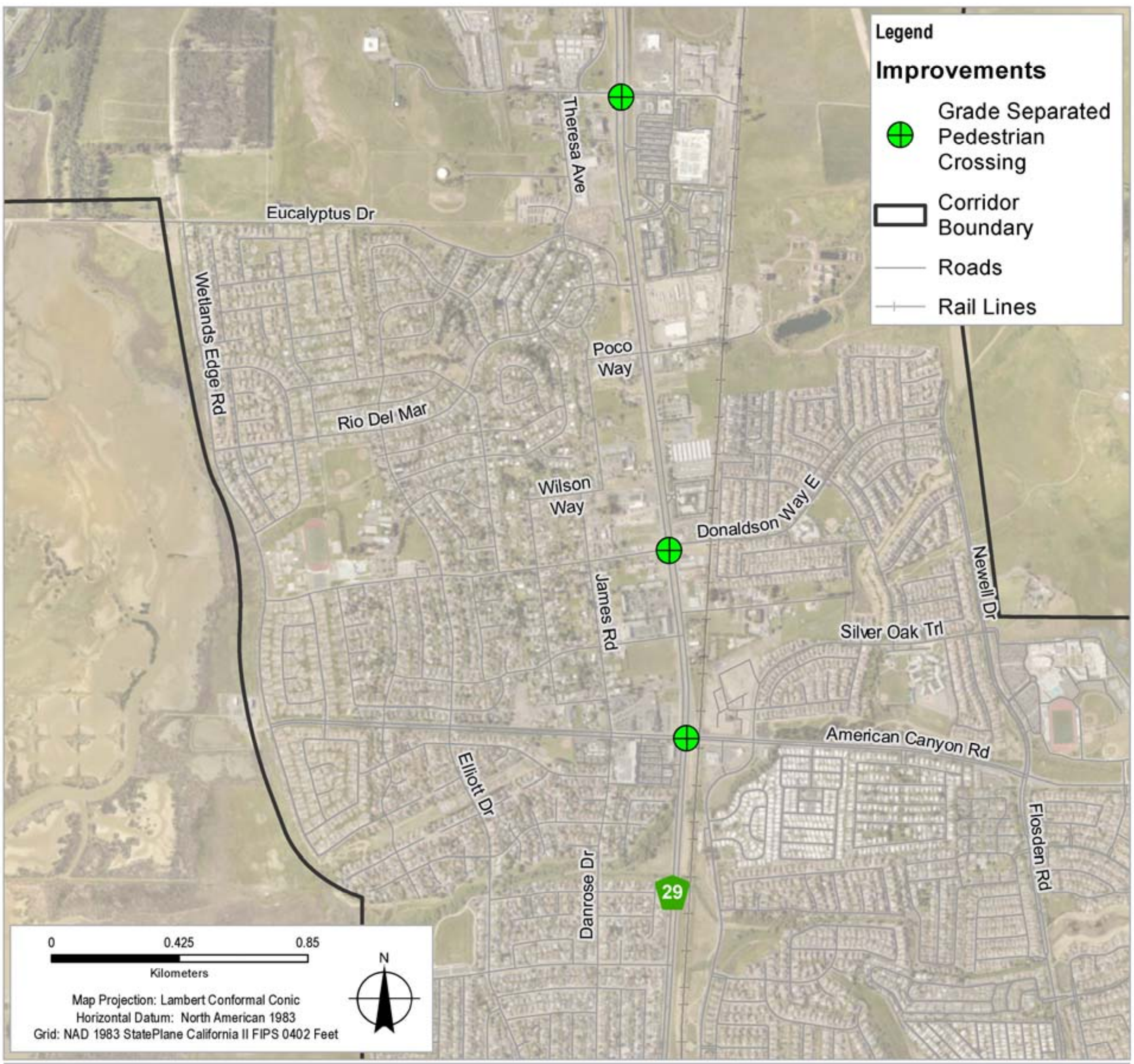
Data source: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community Created by:pthornton

Grade-Separated Pedestrian Crossings

Grade-separated pedestrian crossings would provide safe access across major intersections for pedestrians. Proposed locations, consistent with the City of American Canyon's General Plan Circulation Element, are along SR 29 at the intersections of Donaldson Drive, American Canyon Road, and Napa Junction Road. Figure 38 depicts the location of the proposed grade-separated pedestrian crossings.

Grade-separated pedestrian crossings provide a low-stress crossing option, provided they are designed according to be accessible and safe, and can provide some operation improvements to intersections that are able to eliminate at-grade pedestrian traffic signal cycles. However, these improvements can be expensive and can result in more circuitous pedestrian circulation than direct at-grade crossings.

Figure 38: Grade-Separated Pedestrian Crossings



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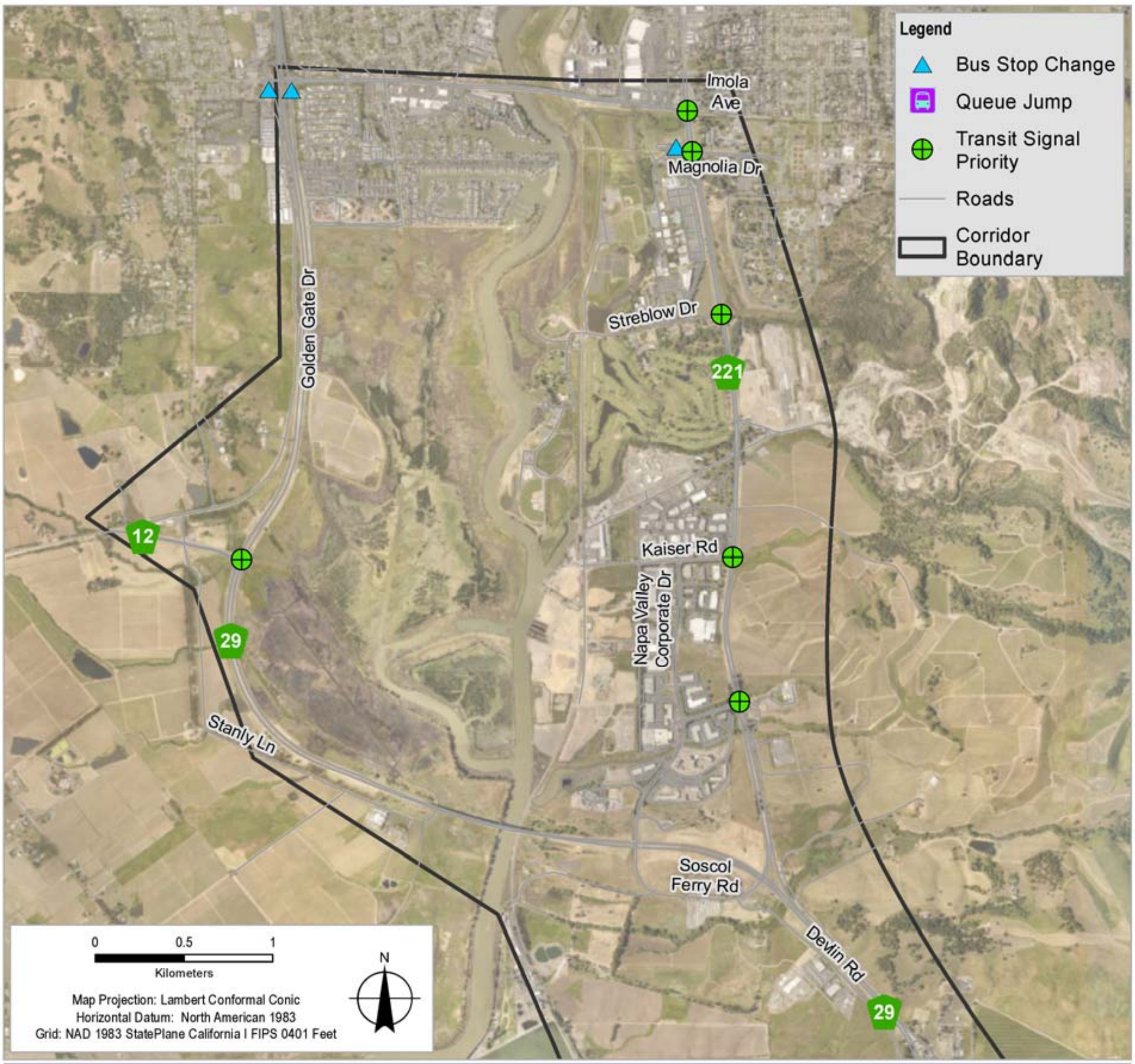
Data source: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community Created by pthornton

Transit

A variety of proposed transit improvements are included in the SR 29 CMCP. These improvement categories are described below in more detail. Proposed improvement locations in the northern study area are presented in Figure 39. Figure 40 presents proposed transit improvement locations in the central study area. Proposed improvement locations in the southern study area are shown in Figure 41

Figure 39: Transit Improvements - Northern Study Area



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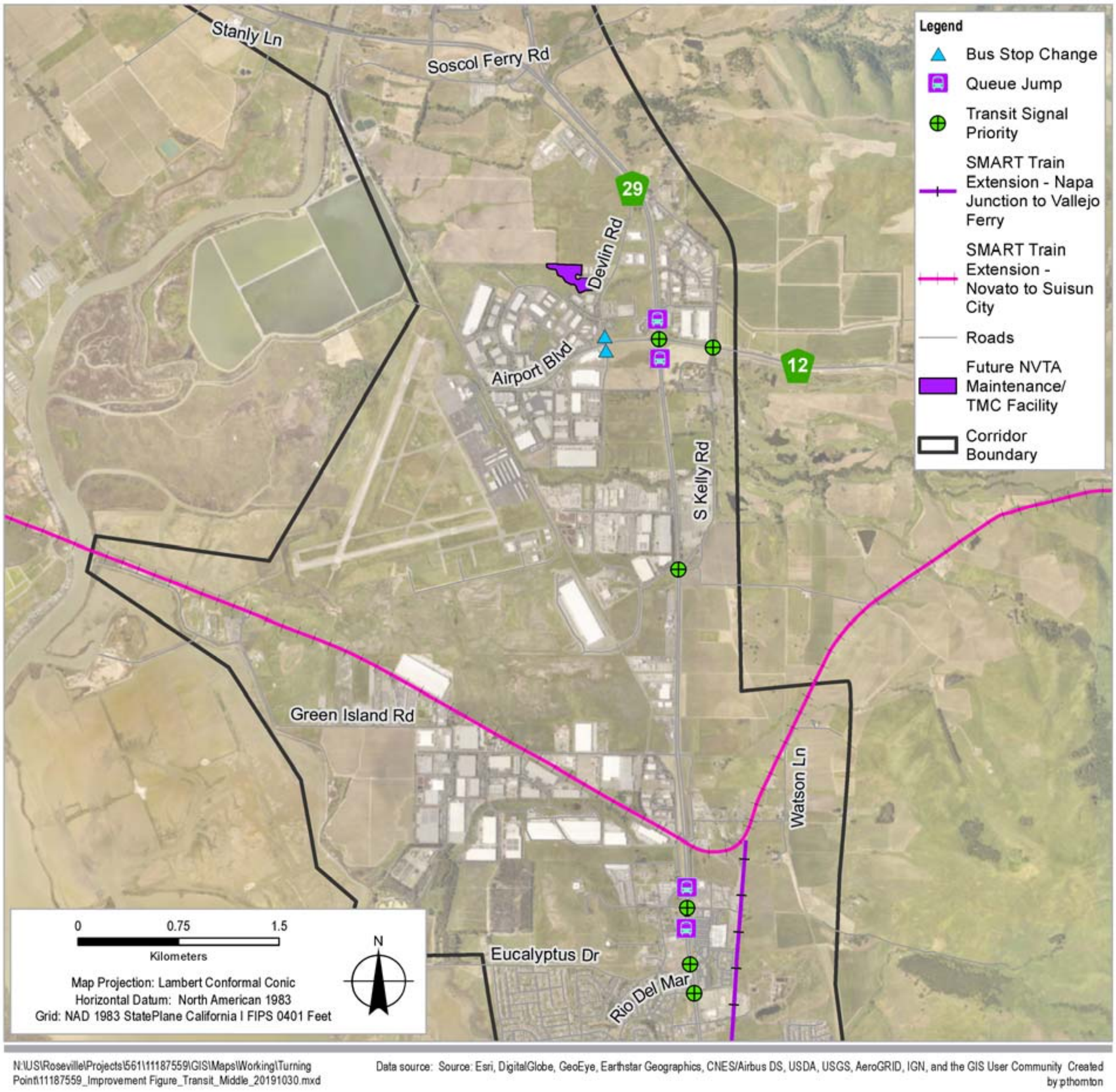
Data source: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community Created by pthornton

Bus Stop Changes

Proposed bus stop changes and/or upgrades would include benches, new or improved bus shelters, real-time travel information, wayfinding, and transit route information. Some locations would include Wi-Fi, bicycle storage, lighting, and improved pedestrian facilities.

Figure 40: Transit Improvements – Central Study Area



Queue Jump

Queue jump locations would provide dedicated lane space for buses to travel around queued vehicles at particular locations. Queue jumps reduce delay for buses caused by intersections and reduce travel time and variability. Proposed locations along SR 29 include Napa Junction Road, Donaldson Way, and American Canyon Road. The graphic below depicts an example of a queue jump intersection location.

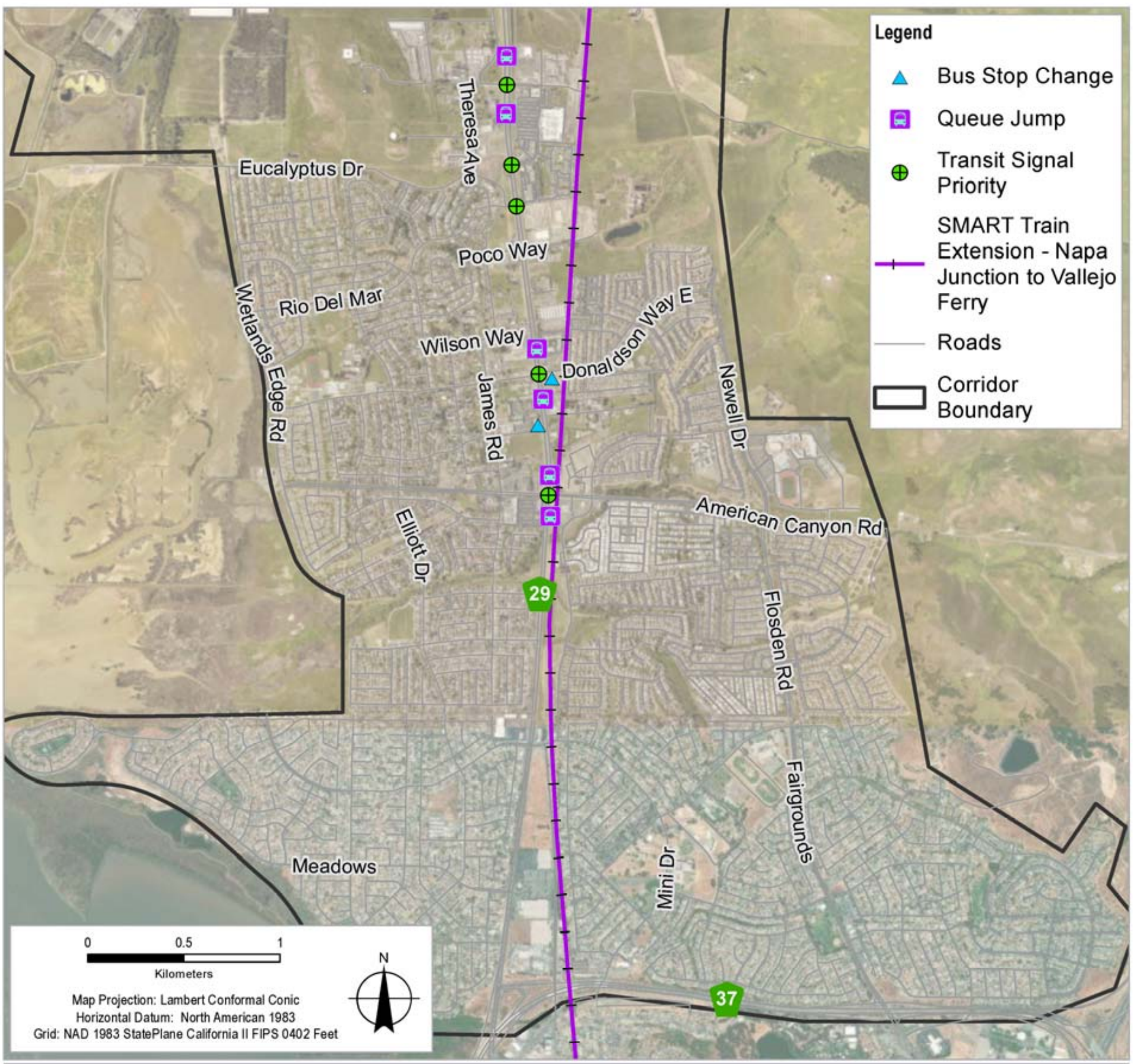
Part Time Use of Shoulder

This improvement allows buses to use existing shoulder width to increase efficiency and improve transit service. Bus use of shoulder space is becoming a more common means to increase highway capacity and transit service reliability. Caltrans has the authority to redesignate shoulders as a part-time use lanes. Caltrans is currently developing guidance for the implementation of part time lanes for shoulder use.

Part time bus use of the current shoulder space could present a potential conflict between bicyclists and buses. This conflict would be limited to the peak hours during which buses were allowed to operate in the shoulder. With current 30-minute bus headways, this potential conflict between users would be limited to twice in one hour. Proposed parallel Class I bikeways would remain a low-stress option.

Use of existing shoulders by buses would be implemented in conjunction with queue jump locations with between 1,000 and 1,500 feet depending on location constraints. Part time use of shoulder by buses would require upgrades to existing shoulders in order to ensure geometric design and pavement index requirements are met.

Figure 41: Transit Improvements - Southern Study Area



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Data source: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community Created by pthornton

Transit Signal Priority

Transit signal priority can reduce travel time and improve reliability by giving priority to buses at intersections. Installation of equipment is needed on buses to activate the signal priority.

Increased Service Frequency

The Route 11X and Route 29 would be served by two new, electric, 40-foot buses, and increased service frequency to 30 minute headways.

SMART Train Extensions

Extensions of SMART train service into the study area are currently in early planning stages and lack funding source(s). SMART feasibility studies estimate a roughly $1B to achieve the planned extensions.

American Canyon to Vallejo Ferry Terminal

This north-south extension of the Sonoma-Marin Area Rail Transit (SMART) train would extend from Napa Junction in American Canyon to the Vallejo Ferry Terminal.

Novato to Suisun City

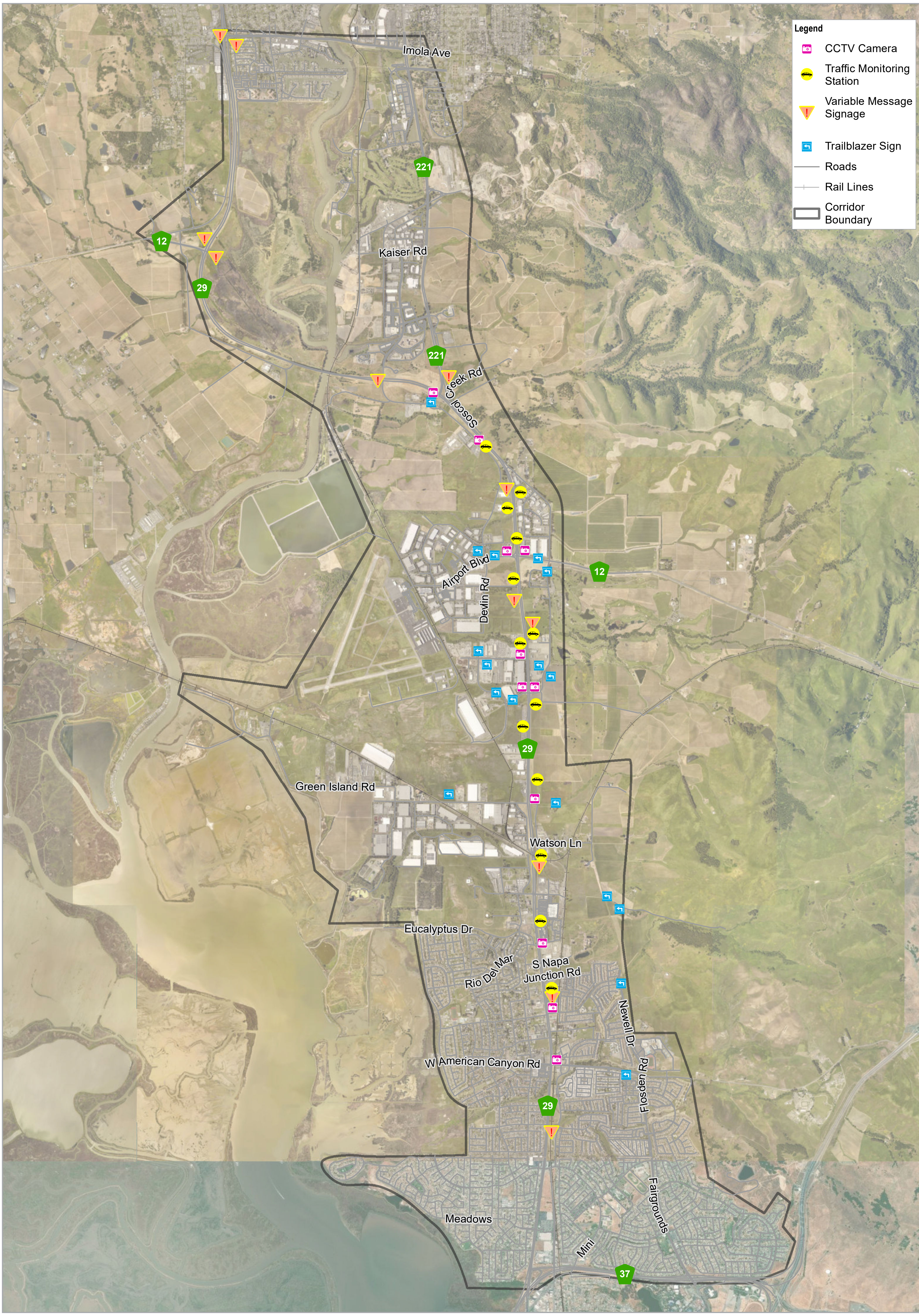
This extension of the SMART train would extend from Novato to Suisun City, passing through Napa County and providing east-west rail connectivity as an alternative to the SR 12, SR 37, and SR 29 corridors.

The extension would include upgrades to existing tracks, several bridges, and at-grade crossings. Station improvements would include upgrades to existing facilities at Novato-Hamilton and Suisun-Fairfield, and construction of new stations between these existing facilities. A passenger rail communication system would also need to be implemented.

Integrated Corridor Management

The Integrated Corridor Management (ICM) improvements considered in this Plan include: traffic monitoring detectors, Trailblazer Signs, CCTV Cameras, Variable Message Signs, and a Transportation Management Center to facilitate the deployment of the communications systems needed to facilitate the various intelligent transportation systems (ITS) within the ICM package. It is assumed that all field devices deployed would use wireless communications and that data is transferred to the Traffic Management Center through an internet network over 4G cellular system.

All current and future signalized intersections would be upgraded with traffic sensors/traffic detection; traffic signal controllers; and fiber optic or wireless communication systems at key corridor intersections. These communication devices would allow signalized intersections to be adaptive and allow them to react to changing traffic conditions; monitor traffic conditions in real time, and continuously distribute green time equitably for all traffic movements. Proposed locations of the ICM components discussed below are shown in Figure 42.



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NAPA VALLEY TRANSPORTATION AUTHORITY
SR 29 COMPREHENSIVE MULTIMODAL CORRIDOR PLAN

INTEGRATED CORRIDOR MANAGEMENT IMPROVEMENTS

Project No. 11187559
Revision No. -
Date 05/12/2020

FIGURE 42

Data source: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.
Created by: pthornton

NVTA Maintenance Facility/ Transportation Management Center

The new NVTA Vine Transit Maintenance facility is proposed to replace the existing facility at 720 Jackson Street. The new facility would be constructed on undeveloped land at the terminus of Sheehy Court, approximately 900 feet west of its intersection with Devlin Road in unincorporated Napa County. The eight-acre site would provide for maintenance for six bays, an administrative building, parking for 74 transit vehicles up to 45 feet long, 75 visitor and employee parking spaces, and the opportunity to host a Transportation Management Center (TMC). The TMC would be a multiagency project to coordinate transportation communication within the corridor. Further discussion to coordinate logistics of the TMC are required with Caltrans District 4 to prevent regional traffic management friction.

Traffic Monitoring Detectors

Field deployment of traffic monitoring detectors include underground loop and radar detectors. The detectors would monitor traffic conditions and communicate with the TMC for incident management. Proposed locations along SR 29 include:

- Near 231 Devlin Road
- 0.37 miles north of Airport Boulevard
- 850 feet south of Airport Boulevard
- 350 feet north of Tower Road
- 1,200 feet south of Kelly Road
- 830 feet north of Donaldson Way
- 200 feet north of Eucalyptus Drive
- Overpass near Paoli Loop Road
- 1,000 feet north of Paoli Loop Road
- 430 feet south of S Kelly Road
- 1,100 feet north of Tower Road
- 250 feet north of Airport Boulevard
- 0.27 miles south of Kelly Road

Trailblazer Signs

Trailblazer signs provide wayfinding information on roadways, guiding road users to routes, connections, and destinations. Signs at the proposed locations below would provide detour and route information to manage circulation and direct traffic in the corridor. This could alleviate congestion on SR 29 by diverting some drivers to parallel routes. Proposed locations include:

- Soscol Ferry Road/Devlin Drive: 250 ft east
- Devlin Road/Airport Boulevard: 300 ft north
- Airport Boulevard/Devlin Road: 300 ft east
- Tower Road/Devlin Road: 300 ft east
- Devlin Road/S Kelly Road: 650 ft north
- S Kelly Road/Devlin Road: 300 ft east
- Devlin Road/Green Island Road: 300 ft north

- American Canyon Road/Newell Drive: 500 ft west
- Newell Drive/Donaldson Way: 300 ft south
- S Kelly Road/Rio Del Mar: 300 ft south
- Rio Del Mar/S Kelly Road: 300 ft east
- Paoli Loop Road/S Kelly Road: 300 ft south
- S Kelly Road Extension/S Kelly Road: 300 ft south
- S Kelly Road/S Kelly Road Extension: 300 ft west
- S Kelly Road/Lincoln Avenue: 300 ft south
- Lincoln Avenue/S Kelly Road: 500 ft west

CCTV Cameras

Closed-circuit television (CCTV) cameras would be used in conjunction with variable message signs and traffic monitoring detectors to monitor and manage traffic conditions throughout the corridor.

Proposed locations along the west side of SR 29 include:

- Soscol Ferry Road
- 231 Devlin Road
- Airport Boulevard
- Tower Road
- South Kelly Road

Proposed locations along the east side of SR 29 include:

- American Canyon Road
- Donaldson Way
- Rio Del Mar
- Paoli loop Road
- South Kelly Road
- Lincoln Avenue

Variable Message Sign

Variable message signs are traffic control devices capable of displaying one or more alternative messages. As one component of the Integrated Corridor Management improvement package, variable message signs would be used for incident management and route diversion to divert and control traffic throughout the corridor. This may result in lowered congestion and delay on more commonly traversed routes. Proposed locations along SR 29 include one half-mile north of the following intersections:

- Soscol Ferry Road
- Airport Boulevard
- Tower Road
- Donaldson Way

Proposed locations also include one half-mile south of the following intersections:

- American Canyon Road
- Paoli Loop Road
- Lincoln Avenue

Proposed locations off the SR 29 mainline:

- SR 221 east of SR 29 (Soscol Junction)
- SR 12 west of SR 29 (Carneros Junction)
- SR 121 (Imola Avenue) east of SR 29 and west of SR 221

6-Performance Assessment

The performance metrics selected for the SR 29 CMCP informed each of the six Smart Mobility Framework objectives to ensure that the resulting improvement recommendations provide a balanced, sustainable, and multimodal assessment of current and forecasted corridor conditions. Requisite rubrics include:

- Planning level cost opinions
- Mode shift and vehicle miles travelled
- Level of traffic stress scores
- Collision reduction benefit
- Health and air quality benefit
- Vehicular delay and buffer time reductions
- Societal cost and benefit monetization factors
- Return on investment (i.e. benefit-cost)

Equal attention was given to document the beneficial outcomes of measures not directly reflected in the benefit-cost assessment. These include:

- Plan and Policy Consistency (with existing NVTA, City and County of Napa, City of American Canyon and Caltrans plans and policies)
- Environmental/Institutional Sensitivity
- Adaptation
- Economic Development
- Community Acceptance

Using these tools to measure effectiveness, the following benefit quantitative and qualitative analyses are summarized below and presented in the following sections:

- Induced Demand/Bicycle Mode Shift Benefits
- Multimodal Connectivity/Level of Traffic Stress
- Transit Ridership
- Vehicle Operations
- Safety
- Interconnected Streets and Integrated Corridor Management
- Air Quality
- Environmental Justice and Social Equity
- Economic Development
- Adaptation Assessment
  - Climate Change Vulnerability
- Plan and Policy Consistency
  - Plan Consistency
  - Policy Consistency
  - Community Support
- Emerging Technologies Assessment

Induced Demand/Bicycle Mode Shift Benefits

To estimate the induced demand associated with the bicycle improvements proposed in the State Route 29 Comprehensive Multimodal Corridor Plan, the project team utilized the National Cooperative Highway Research Program (NCHRP) 552 methodology provided in the *Guidelines for Analysis of Investment in Bicycle Facilities*.

The facilities included in the benefit analysis presented herein include the Class I path gap closures along the Bay Trail and Vine Trail alignments and the provision of bike paths adjacent to SR 29 from SR 37 to Napa Junction Road, Napa Junction Road to Napa Valley Vine Trail, and South Kelly Road to Soscol Junction. The employed methodology, estimated benefits and associated benefit-cost ratio is described in the following sections.

Methodology

The analysis quantifies the induced demand mode shift (induced demand) associated with the proposed improvements, and monetizes the annualized mobility, health, recreation and decreased auto use benefits provided by the projected mode shift at high, moderate and low estimates. Bicyclists are more likely to use a facility if they live within a 1.5 mile buffer than if they live outside of this distance. Moreover, the highest likelihood of a member of the population to use the facility exists if they live within a 0.5 mile buffer around the facility. The NCHRP 552 methodology suggests that bicycle commute mode share can be utilized to estimate the number of existing and future bicycle ridership based on the population, and low, moderate, and high likelihood multipliers at 1.5 mile, 1 mile, and 0.5 mile buffers that surround a facility. Each buffer area—at 0.5, 1 and 1.5 mile buffers from the proposed improvements was created using a network-based analysis in a GIS environment. Benefit values are based on the following assumptions:

- Existing cyclists near a new facility will shift from a nearby facility to a new facility
- The new facility will induce new cyclists as a function of the number of existing cyclists relative to the attractiveness of the proposed facilities

To estimate future bicycle ridership, the population near the improvements was calculated using block level population data from the 2010 Decennial U.S. Census, Solano-Napa Activity Based Model (SNABM), and distance buffers of 0.5 miles, 1 mile and 1.5 miles based on the NCHRP Report 552 methodology. 2010 population estimates were utilized as baseline population estimates. Population growth rates were calculated using the land use data by TAZ found in the 2015 and 2040 SNAB Models and applied to the baseline to estimate future population. The total population within each buffer distance range near the proposed improvements was estimated by multiplying the proportion of area of each buffer to the area of the whole block by the estimated block population.

Using the estimated population and the sketch planning method presented in Appendix A of NCHRP Report 552, existing bicycle rates and the mobility, health, recreation, and decreased auto use benefits at high, moderate and low levels were estimated.

Induced Demand

Induced demand takes into account percentage of child and adult population, bicycle commute mode share, percentage of children who bicycle, and the population within three buffer distances, 0.5 miles, 1.0 miles, and 1.5 miles, of the proposed facility. These variables are incorporated into the equations provided in the NCHRP methodology.

The result of the estimated induced demand analysis is reported below. Appendix F provides a detailed explanation of the analysis procedures and results. Table 13 presents the new adult, children commuter and total bicyclists estimated to induce with implementation of the proposed improvements.

These results are used to calculate the measures of effectiveness associated with bicycle mode shift (reduction in trips and VMT), and the mobility, health, recreation, and decreased auto use benefits discussed in the following sections.

Table 13: Study Area Induced Demand Results

Study Area Induced Demand Results	
Total New Commuters, 2400m	67
Total New Commuters, 1600m	186
Total New Commuters, 800m	142
Total New Adult Cyclists, High 2400m	205
Total New Adult Cyclists, High 1600m	571
Total New Adult Cyclists, High 800m	437
Total New Adult Cyclists, Moderate 2400m	95
Total New Adult Cyclists, Moderate 1600m	263
Total New Adult Cyclists, Moderate 800m	202
Total New Adult Cyclists, Low 2400m	53
Total New Adult Cyclists, Low 1600m	147
Total New Adult Cyclists, Low 800m	111
Total New Child Cyclists, 2400m	106
Total New Child Cyclists, 1600m	296
Total New Child Cyclists, 800m	232
Total New Cyclists, High	2243
Total New Cyclists, Moderate	1590
Total New Cyclists, Low	1340

Measures of Effectiveness

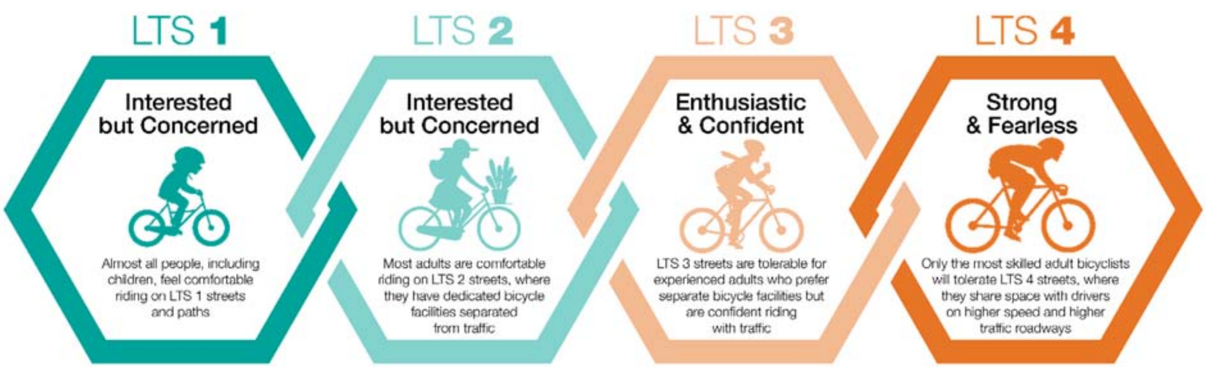
Induced demand/bicycle mode shift can be measured by the reduction in vehicle trips and vehicle miles traveled (VMT) associated with the proposed bicycle improvements using the methodology described above. The number of trips and VMT reduced was calculated using the number of new commuters estimated using the NCHRP methodology and the average person trip length (9.34 miles) reported by the 2017 National Household Transportation Survey (NHTS). Because the NCHRP 552 methodology uses new commuters to estimate decreased auto trips, trip reductions and VMT are annualized under the assumption that a working year is comprised of 47 weeks and 5 days per week to account for the typical work week and vacations. These measures are reported in Table 14.

Table 14: Reduction in Trips and VMT Associated with Induced Demand

Induced Demand Measures of Effectiveness (MOE)	
MOE	Count
Daily New Commuters	396
Daily Reduction in Trips	792
Daily Reduction in VMT	7,397
Annualized Reduction in Trips	186,120
Annualized Reduction in VMT	1,738,361

Multimodal Connectivity/ Level of Traffic Stress

While the quantitative benefits associated with bicycle and pedestrian improvements are assessed using induced demand and bicycle mode shift, qualitative benefits of these improvements can be analyzed by examining improvements to multimodal connectivity throughout the corridor. Connectivity benefits associated with the improvements recommended in this plan are analyzed through the lens of Level of Traffic Stress (LTS). The LTS analysis presented herein incorporates Bicycle Level of Traffic Stress methodologies as a proxy for analyzing traffic stress for all active transportation network users. The recommended improvements provide low stress connectivity throughout the study area with off-street bicycle and pedestrian facilities and improved crossings along and adjacent to SR 29.



These improvements include the SR 29 Multimodal Improvements, the San Francisco Bay Trail and Napa Valley Vine Trail, a grade-separated pedestrian crossing at American Canyon Road/SR 29, and intersection improvements at Soscol Junction and Airport Boulevard/SR12/SR 29—both of which feature bicycle and pedestrian facilities planned to safely integrate with the proposed network improvements. The LTS with the recommended improvements are displayed in Figure 43.

The active transportation improvements along SR 29 allow for low stress travel options for bicyclists and pedestrians through Vallejo, American Canyon and unincorporated Napa County, and provide connectivity to other low-stress facilities proposed within the corridor study area.

Segment One, between SR 37 and Napa Junction Road, includes Class I Paths, landscaping, and median improvements. Landscaping improvements and an eight foot shoulder serve as a barrier between the separated path and vehicular traffic, providing low stress connectivity through the entirety of this roadway segment. Additionally, the landscaping and median improvements could contribute to traffic calming and lowered traffic stress by transforming the look and feel of the corridor segment from both the driver and active user's perspective. Vehicles tend to slow in areas that look like pedestrian and bike-friendly corridors, and active users are more likely to utilize the facility when the environment encourages them to travel there.

Segment Two improvements are proposed to extend the existing Class I facility between Napa Junction Road and the Paoli Loop Road segment of the proposed Napa Valley Vine Trail. Together, Segment One and Two improvements provide continuous low stress transportation options along SR 29 from the Southern ingress of the corridor study area. Additionally, the proposed improvements connect to the proposed Napa Valley Vine Trail alignment to provide comprehensive low stress connectivity across the study area.

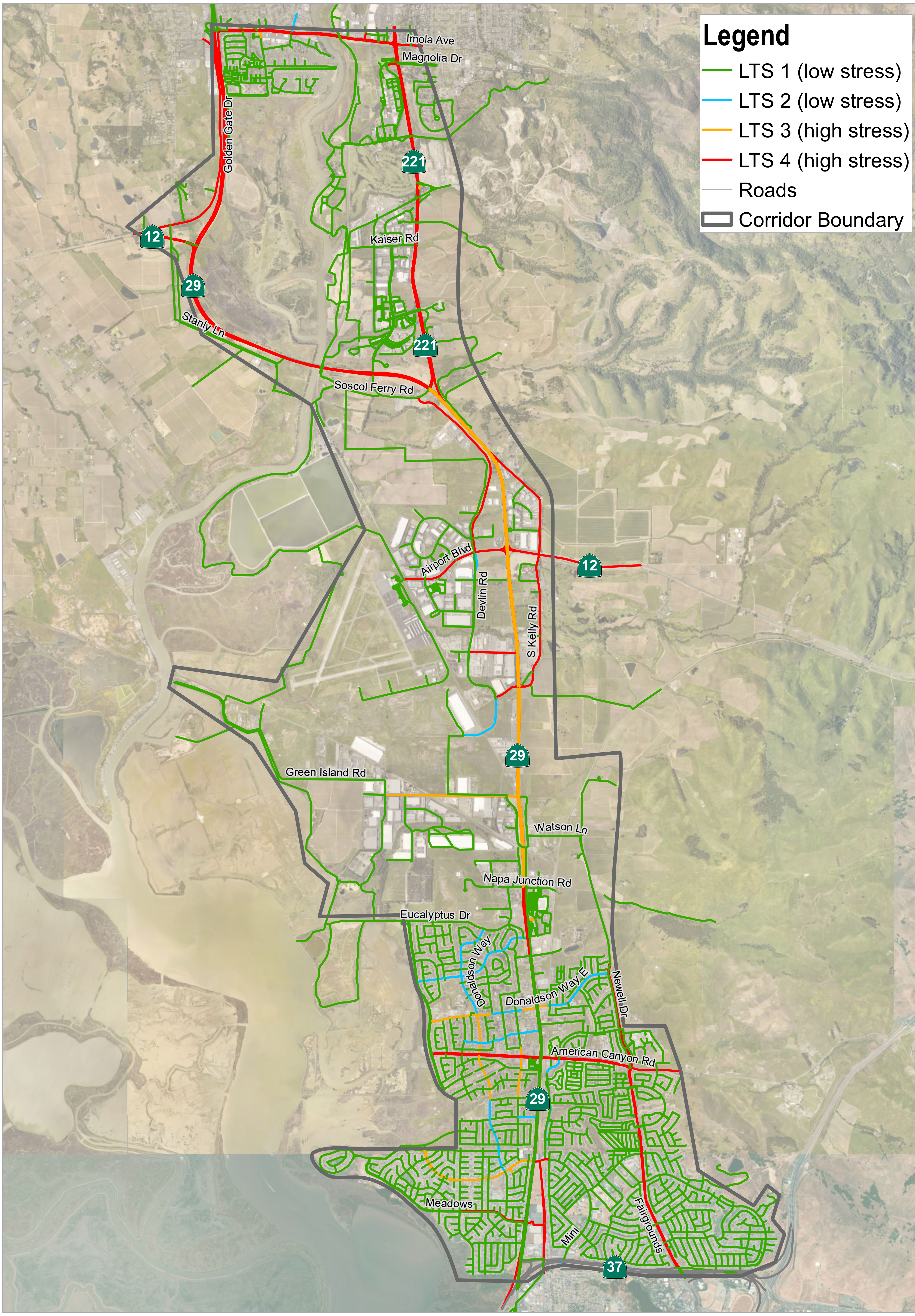
Finally, Segment Three improvements include Buffered Class II facilities along SR 29 between South Kelly Road and Soscol Junction. While this facility is higher stress due to high speeds and volumes, the facility results in reduced traffic stress compared against the existing condition due to the 10 foot Class II bike lane with a 6 foot buffer. There are a variety of buffering materials that could further reduce traffic stress by increasing driver awareness. This includes but is not limited to rumble strips; high visibility, hatched pavement markings; and painted bike lanes.

While SR 29 remains a high stress barrier north of Napa Junction Road, the San Francisco Bay Trail and Napa Valley Vine Trail Class I Paths offer low stress travel options as an alternative to SR 29. These facilities connect to low stress, local streets and other low stress recommended facilities to enable multimodal connectivity across the study area.

Additionally, the intersection improvements at Soscol Junction and Airport/SR 12/SR 29 improve high stress bicycle and pedestrian crossing conditions at these locations by incorporating multi-stage crossings, bicycle ramps, and shared-use bicycle and pedestrian facilities connecting to existing and proposed facilities.

All of the Class I Path and intersection improvements discussed above provide low stress connectivity for both bicyclists and pedestrians. In addition, the proposed pedestrian overcrossing at American Canyon Road provides low stress crossing opportunity for pedestrians crossing at American Canyon Road and SR 29. Three pedestrian crossing locations were considered, as described previously. The American Canyon Road location was chosen based on the proximity to key origins and destinations, including schools, parks, commercial, and residential land uses.

Collectively, the proposed active transportation, transit and operational improvements coalesce to provide a comprehensively connected, safe and multimodal corridor.



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NAPA VALLEY TRANSPORTATION AUTHORITY
SR 29 COMPREHENSIVE MULTIMODAL
CORRIDOR PLAN

Bicycle Level of Traffic Stress with Proposed Improvements

Project No. 11187559
Revision No. -
Date 05/12/2020

FIGURE 43

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Data source: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community. Created by: pthornton

Transit Ridership

Overview

To assess the benefits associated with the transit improvements proposed in the SR 29 CMCP, the methodologies presented in Transit Cooperative Research Program (TCRP) Report 118: *Bus Rapid Transit Practitioner's Guide* was employed to project transit ridership. Transit improvements include a 30 minute increase in service frequency for Route 11X and Route 29, as well as Transit Queue Jumps, Transit Signal Priority, and Part-Time Use of Shoulder at select intersection locations. Route 11X and Route 29 are both proposed to transition from 60 minute to 30 minute headways and add two 40' electric busses to NVTA's fleet. Although a dedicated BRT line is not proposed (i.e., dedicated travel lane and 15 minute headways), the above improvements all serve to prioritize transit vehicle operations and travel times to improve on-time performance and reliability in ways that emulate BRT operations. These improvements justify the conservative application of the BRT Practitioners Guide Elasticity Methodology for estimating the mode shift analysis for improving the service frequency of Routes 11X and 29.

Ridership Projections and VMT Reduction Benefit

Available ridership data from the Vine Transit System was analyzed in addition to ridership projections associated with proposed service expansions for Route 11X and Route 29. These routes will be servicing their existing routes so any change in ridership will be solely attributable to the increase in frequency (not capturing new markets via route diversions). Annualized projections of ridership changes, and average vehicle trip length reported by the 2017 National Household Transportation Survey (NHTS) were utilized to estimate a reduction in Vehicle Miles Traveled (VMT) associated with the proposed improvements. The annualized increase in ridership projected to occur as a result of the proposed service frequency improvements is presented in Table 15 and the annualized VMT reduction associated with these projected changes in ridership are summarized in Table 16.

Table 15: Annualized Transit Ridership Increases

Annualized Transit Ridership Increase		
Route	Service Period	
	AM	PM
29-N	43,732	58,058
29-S	66,352	26,390
11X-N	31,668	16,588
11X-S	8,294	12,818

Table 16: Annualized VMT Reduction Associated with Transit Ridership

Annualized VMT Reduction		
Route	Service Period	
	AM	PM
29-N	408,457	542,262
29-S	246,483	619,728
11X-N	295,779	154,932
11X-S	77,466	119,720

Vehicle Operations

Unique 2040 Programmed (Baseline) and 2040 SR 29 CMCP (Planned) future year volume sets that reflect the traffic diversion and AM/PM peak hour circulation characteristics were developed to quantify the diversion of traffic onto parallel routes created by potential roadway capacity improvements and other operational improvements. These future-year volume sets served as inputs to the VISSIM microsimulation model.

Roadway Operations Performance Summary

Operational benefits associated with the planned roadway network were quantified by changes to delay and travel time reliability. Performance measures were generated from the VISSIM microsimulation for existing, future baseline, and future with project conditions. These performance measures included:

- Person throughput
- Person hours of delay (PHD)
- Travel time reliability – travel time index/buffer time index
- Vehicle hours of delay (VHD)
- Vehicle miles traveled (VMT)

Performance measure results are provided in Table 17.

Table 17: Roadway Operations Measures of Effectiveness

Simulation Scenario	Vehicle Miles Traveled (miles)	Total Delay (Hrs)	Person Delay (Hrs)	Vehicle Throughput	Person Throughput
Existing AM	249,031	1,297	1,686	20,824	27,071
Existing PM	297,697	1,296	1,685	23,083	30,008
Baseline 2040 AM	295,589	1,642	2,134	21,964	28,553
Baseline 2040 PM	328,934	2,778	3,612	26,006	33,808
Planned 2040 AM	283,004	1,087	1,414	22,328	29,026
Planned 2040 PM	399,604	2,147	2,791	26,924	35,001

Travel Time Reliability

Table 18 shows the travel time and buffer time as well as indices for each of these metrics for each scenario (passenger vehicle and trucks combined). INRIX Analytics data in conjunction with data produced by Vissim simulation network model was used to estimate future buffer time for the baseline and planned condition. Future buffer times are proportional to correlation between Travel Time Index (TTI) between existing condition and future conditions. Average travel time in calculation of TTI (which is a ratio of average travel time and free flow travel time) was generated by the VIssim Simulation model while the free flow travel time was calculated based on INRIX Analytics data.

Table 18: Travel Time Results by Scenario – All Vehicle Types

	Travel Time (Minutes)		Travel Time Index (TTI)		Growth in TTI		Buffer Time	
Direction	AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour
Northbound								
Existing	18:19	14:31	1.6	1.3	-	-	17:56	06:13
Baseline	24:00	26:23	2.1	2.3	1.2	1.6	20:57	10:11
Planned	23:14	22:41	2.1	2.0	1.1	1.4	20:17	08:45
Southbound								
Existing	12:25	21:01	1.0	1.7	-	-	04:33	19:25
Baseline	20:38	27:34	1.7	2.3	1.4	1.3	06:20	24:35
Planned	17:24	21:52	1.4	1.8	1.2	1.0	05:21	19:29

Vehicular Level of Service

Table 19 shows the LOS of the study intersections for the Planned Network scenario within the AM peak hour, and Table 20 displays this for the PM peak hour. As shown – all intersections identified for improvements operate at LOS D or better except SR 29/Carneros Highway. One intersection that was not identified for capacity improvements, SR 29/American Canyon Road is shown to operate at LOS F in both peak hours. This intersection will be improved to include channelization for bus queue jumps and part-time use of shoulder for transit which will provide operational benefits (these infrastructure improvements are not reflected in the microsimulation model). Additionally, a grade separated pedestrian bridge is identified near the intersection of SR 29/American Canyon Road which will preclude the need for a pedestrian crossing cycle. This will allow more green time to the through movements on SR 29 which will also improve operations at this intersection.

Table 19: Level of Service – SR 29 CMCP (Planned) Improvements 2040 Network (AM Peak Hour)

Intersection	Control Type	Intersection Delay (sec)	LOS	Vehicle Through-put	Veh Hrs of Delay	Person Through-put	Person Hrs of Delay
SR 29 & Carneros Hwy	Signal	81.1	F	5,014	113.0	6,518	146.9
SR 29 & SR 221/Soscol Ferry Rd	Interchange	8.0	A	5,917	13.2	7,692	17.2
Airport Blvd/Devlin Rd	Roundabout	10.7	B	1,352	4.0	1,758	5.2
SR 29 & Airport Blvd/SR 12	Interchange	8.9	A	5,460	13.5	7,098	17.6
SR 12 & Kelly Rd	Roundabout	6.7	A	2,750	5.1	3,575	6.6
SR 29 & S. Kelly Rd	Signal	22.7	C	3,805	24.0	4,947	31.2
SR 29 & Eucalyptus Drive	Signal	18.3	B	3,581	18.2	4,655	23.6
SR 29 & Rio Del Mar	Signal	34.5	C	3,611	34.6	4,694	45.0
SR 29 & S. Napa Junction Rd	Signal	53.9	D	3,703	55.4	4,814	72.0
SR 29 & American Canyon Rd	Signal	187.1	F	4,481	232.9	5,825	302.7

Table 20: Level of Service SR 29 CMCP (Planned) Improvements 2040 Network (PM Peak Hour)

Intersection	Control Type	Intersection Delay (sec)	LOS	Vehicle Through-put	Veh Hrs of Delay	Person Through-put	Person Hrs of Delay
SR 29 & Carneros Hwy	Signal	57.0	E	5,714	90.5	7,428	117.7
SR 29 & SR 221/Soscol Ferry Rd	Interchange	6.6	A	6,903	12.6	8,974	16.4
Airport Blvd/Devlin Rd	Roundabout	5.3	A	1,368	2.0	1,778	2.6
SR 29 & Airport Blvd/SR 12	Interchange	30.4	C	7,034	59.5	9,144	77.3
SR 12 & Kelly Rd	Roundabout	35.4	D	4,153	40.9	5,399	53.1
SR 29 & S. Kelly Rd	Signal	22.9	C	3,573	22.8	4,645	29.6
SR 29 & Eucalyptus Drive	Signal	22.0	C	4,039	24.6	5,251	32.0
SR 29 & Rio Del Mar	Signal	32.9	C	3,756	34.3	4,883	44.6
SR 29 & S. Napa Junction Rd	Signal	42.2	D	3,867	45.3	5,027	58.9
SR 29 & American Canyon Rd	Signal	112.9	F	5,097	159.9	6,626	207.9

Safety

Overview

Based on contributing factors identified in the collision assessment, Part C of the Highway Safety Manual (HSM) was applied to estimate the potential safety performance of the CMCP improvement package. Crash Modification Factors (CMF) were applied to estimate the reduction in collisions. These reduced collisions were then distributed by severity—property damage only (PDO), injury, severe injury, or fatality—based on historical data of bicycle and pedestrian collisions experienced in the study corridor.

Bicycle and pedestrian related collisions and associated reductions were isolated to assess safety for active transportation users. The estimated reduction in collisions was distributed by severity—property damage only (PDO), injury, severe injury, or fatality—based on historical data of bicycle and pedestrian collisions experienced in the study corridor.

Safety Crash Modification Results

Vehicular and bicycle/pedestrian related collisions and improvements identified to improve safety were summarized for input into the HSIP analyzer to compute anticipated crash reduction. The safety benefit calculation worksheets that informs this analysis are provided in Appendix H. The anticipated collision reductions are presented in Table 21 alongside existing crash totals at these locations.

Table 21: Crash Reduction Summary

Countermeasure & Project Location	Total Crashes (2014 to 2018)	Collision Reduction Factor (CRF)	Anticipated Crash Reduction
R37 - Install Shared-Use Path – SR 29: SR 37 to Napa Junction Road	6	80%	5
R37 - Install Shared-Use Path – SR 29: Napa Junction Road to Paoli Loop Vine Trail	0	80%	0
R36 - Install Bike Lanes – SR 29:South Kelly Road to SR 12/Airport	2	35%	1
IC - Convert Signalized Intersection at SR 29/SR 221 (Soscol Junction) to Grade-Separated Interchange with Roundabouts	75	50%	38
S18 - Convert Signalized Intersection to Roundabout Devlin Rd at Airport Blvd	8	50%	4
IC - Convert Signalized Intersection at SR 29/Airport Blvd to Grade-Separated Interchange with Roundabouts	75	50%	38
S18 - Convert Signalized Intersection to Roundabout at S Kelly Rd/SR 12	38	50%	19
Total Project Area Expected Benefit	204	49.5%	101

**No benefit reported because no pedestrian and bicycle collisions reported near countermeasure area.*

Interconnected Streets and Integrated Corridor Management

According to FHWA, over 60% of delay experienced on United States roadways is caused by traffic incidents. Integrated Corridor Management (ICM) improvements provide benefit by directing traffic through the network by utilizing a series of interconnected, intelligent transportation communication devices. The ICM improvements recommended in this Plan include:

- Traffic monitoring detectors, such as underground loop and radar detectors;
- Trailblazer signage, providing wayfinding and route guidance to vehicles;
- Variable message signage, providing information through changeable messages to vehicles;
- CCTV cameras, used in conjunction with variable message signs and traffic monitoring detectors to monitor and manage traffic conditions; and
- Transportation Management Center, serving as the ICM hub to facilitate intelligent communications between the components listed above.

Additionally, these improvements are recommended to coincide with the parallel capacity improvements along Devlin Road and South Kelly/Newell Drive.

Some components can be useful during expected periods of congestion. However, the system can be particularly useful during unexpected incidences that cause high amounts of congestion such as special events or emergency incidences to manage and divert traffic quickly and safely through the corridor.

ICM Scenario Development

On June 14, 2019 in the city of American Canyon, commuters into Napa experienced a significant collision related incident as a utility pole was struck overnight between Green Island Rd and S. Kelly Road. This collision caused one northbound lane of SR 29 to be blocked during commute time while the utility pole was being replaced. Traffic was backed up for five miles during this incident and normal traffic operations were not seen until hours after all lanes were opened. This incident occurred and drivers were not alerted or aware as they attempted to travel northbound on SR 29.

With an Integrated Corridor Management (ICM) system, local agencies would be able to inform drivers of quick and easily accessible parallel routes along Devlin Road and S. Kelly Road. With these two parallel roadways providing much needed additional capacity, and with interconnected signals allocating significantly more green time to the through movements, the delay and backup from an incident similar to the one described above could drastically diminish queues, delays, and reduce GHG emissions.

An ITS benefit assessment was conducted to validate the operational impacts of implementing Integrated Corridor Management (ICM) throughout the study area through active freeway management, active Transportation Demand Management strategies, active transit management, active arterial management, and traveler information systems in the corridor. To assess the benefit associated with the proposed ICM improvements, corridor network operations were modeled using the VISSIM Planned networks with incidents and without incidents.

Scenario # 1 – Baseline

A VISSIM micro-simulation was completed to simulate the conditions if one lane of northbound traffic was closed during the AM and PM peak hour commutes. With no ICM system in place, drivers would not be immediately aware of the parallel capacity that Devlin Road and S. Kelly Road could provide to alleviate congestion along SR 29 during an event. Table 22 shows the potential travel time runs that may be experienced if only one northbound lane was open during the AM and PM peak hours.

Table 22: Scenario # 1 (No Diversion) Northbound Travel Time

Travel Time (Minutes)	
AM Peak Hour	PM Peak Hour
46.7	48.4

Scenario # 2 – Planed Network with ICM Improvements

A second VISSIM micro-simulation model was built to simulate the conditions if one lane of northbound traffic was closed during the AM and PM peak hour commutes but with an ICM system operating. Under this scenarios, drivers would see signs indicating the travel time benefits of using parallel roadways such as Devlin Road and Kelly Road. ICM provides safety benefits to the corridor in terms of improving possible evacuation scenarios when throughput demand may be increased beyond capacity.

Table 23 shows the projected travel time with an ICM system in operation.

Table 23: Scenario # 2 (With Diversion) Northbound Travel Time

Travel Time (Minutes)	
AM Peak Hour	PM Peak Hour
37.6	36.6

Adjacent intersection will experience higher delays as a result of traffic diverting from SR 29. The travel time presented above accounts for the additional delays that drivers would experience at adjacent intersections. With the parallel roadways, drivers can expect to save approximately 9.1 minutes in the AM peak hour and 11.8 minutes in the PM peak hour if an incident were to occur and one lane northbound was required to be closed during the entire commute time.

Air Quality

Air quality benefits were estimated using the Emissions Calculator or Cal-B/C. All requisite on-road activity inputs (i.e. study corridor VMT and vehicle speeds) for this analysis were generated by the VISSIM microsimulation model, the NCHRP 552 bicycle mode shift analysis, and TCRP-118 transit mode shift analysis.

Health-based criteria pollutants and climate change greenhouse gases (CO_2 and CO_2 equivalents) were quantified. Based on the on-road vehicle activity changes quantified, the SB 1 Emissions Calculator tool developed by the California Transportation Commission (CTC) was used to calculate the change in these emissions as a result of the SR 29 CMCP improvements. The emissions analysis was informed by the VMT and average vehicle speed characteristics of each of the CMCP improvements.

Air Quality benefits associated with the operational, bike-related and Transit improvements, reflected in Table 24, Table 25, and Table 26, respectively.

Table 24: Air Quality Benefits - Operational Improvements

Emissions Reduction	Reduction in Short Tons	
	Total Over 20 Years	Average Annual
CO Emissions Saved	288.79632	14.43982
CO2 Emissions Saved	140,694.75042	7,034.73752
NOX Emissions Saved	64.51040	3.22552
PM10 + PM2.5 Emissions Saved	2.76002	0.13800
SOX Emissions Saved	1.45560	0.07278
VOC Emissions Saved	26.61383	1.33069

Table 25: Air Quality Benefits - Bike Related Improvements

Emissions Reduction	Reduction in Short Tons	
	Total Over 20 Years	Average Annual
CO Emissions Saved	10.84134	0.54207
CO2 Emissions Saved	3,468.84983	173.44249
NOX Emissions Saved	0.82878	0.04144
PM10 + PM2.5 Emissions Saved	0.03232	0.00162
SOX Emissions Saved	0.03424	0.00171
VOC Emissions Saved	0.41034	0.02052

Table 26: Air Quality Benefits - Transit Improvements

Emissions Reduction	Reduction in Short Tons	
	Total Over 20 Years	Average Annual
CO Emissions Saved	27.83587	1.39179
CO2 Emissions Saved	8,906.50632	445.32532
NOX Emissions Saved	2.12795	0.10640
PM10 + PM2.5 Emissions Saved	0.08298	0.00415
SOX Emissions Saved	0.08792	0.00440
VOC Emissions Saved	1.05358	0.05268

Environmental Justice and Social Equity

Impacts of construction and benefit of use should be shared across the community regardless of ethnicity, economic situation or physical ability because improvements developed with public funds are for everyone[5]. Projects that could potentially impact minority or low-income communities, or that will provide benefits that favor wealthier communities, need to be off-set by mitigating activities, or another less impactful solution should be pursued.

Figure 44 presents CalEnviroScreen 3.0 results within the direct SR 29 CMCP study area. As shown, none of the study area covers any census tracks with a CalEnviroScreen 3.0 result worse than 80%, which is typically used to designated disadvantaged communities.

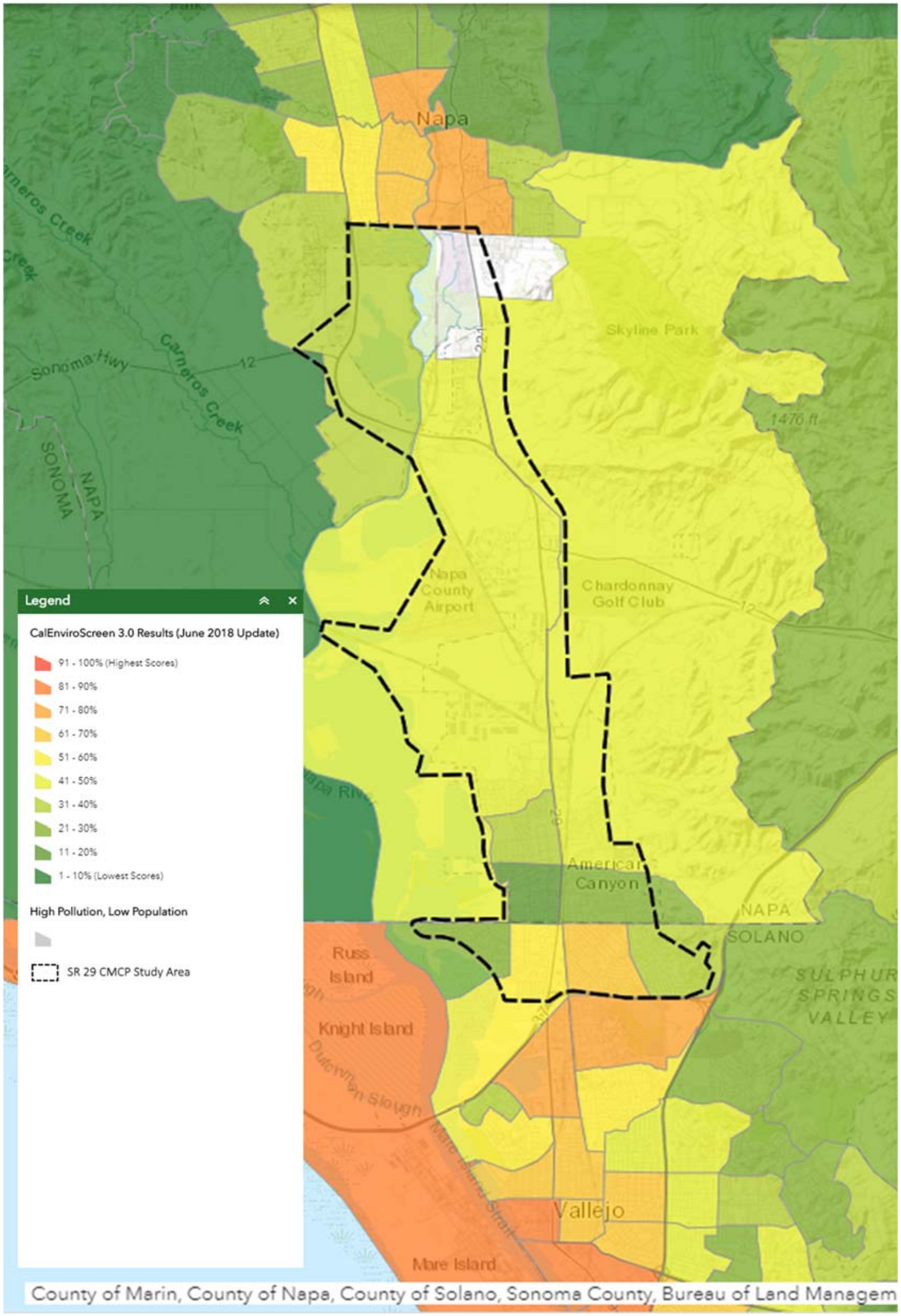
Figure 45 presents low income communities (per AB 1550) and disadvantaged communities (per SB 535). As shown, the SR 29 corridor connects several disadvantaged and low-income communities. Improvements identified in the SR 29 will benefit all users equally, including any disadvantaged and low-income communities that commute along the corridor.

All the improvements identified in the SR 29 CMCP preferred package address regional corridor-wide needs. Given that the SR 29 corridor itself serves a significant number of low income and minority populations, particularly those who work in service and agriculture-based industries, all improvements promote a social equity perspective. NVTA and MTC definitions for disadvantaged communities were used to differentiate the degree of improved accessibility between advantaged and disadvantaged communities resulting from the SR 29 CMCP improvement package.

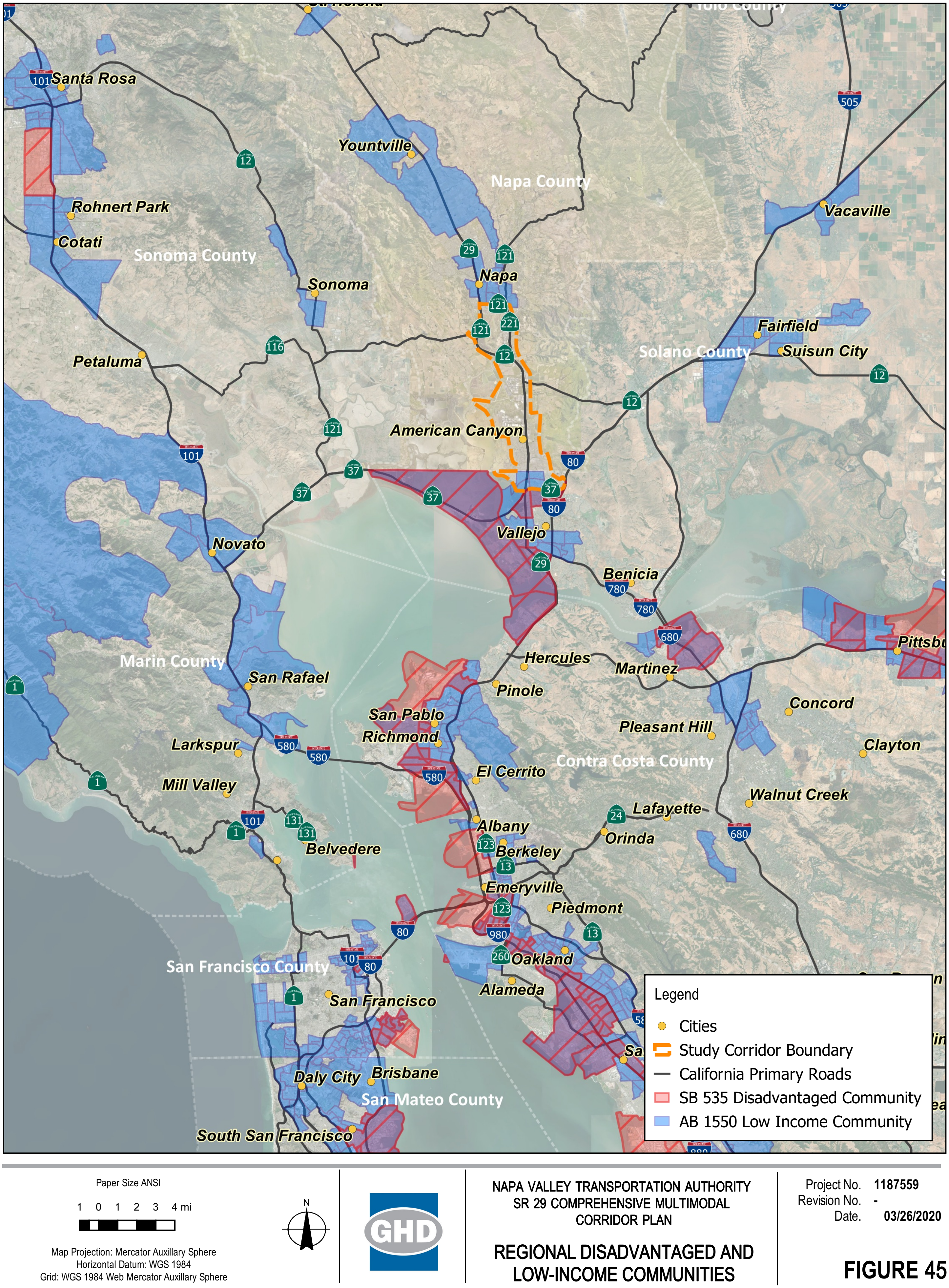
As described under the Active Transportation Accessibility and Mode Shift Analysis, LTS connectivity assessments were also conducted to identify the degree of access to active transportation and transit improvements by disadvantaged communities versus non-disadvantaged communities. Disproportionately high adverse effects resulting from the implementation of the SR 29 CMCP improvements on minority and low-income populations were also examined and found not to exist.

[5] The consideration of environmental justice is consistent with Title VI of the Civil Rights Act of 1964 and subsequent Executive Orders 12898 and 13166, that prohibit discriminatory based on a variety of factors.

Figure 44: Study Area CalEnviroScreen 3.0 Results



Source: CalEnviroScreen 3.0 Results (June 2018 Update), California Office of Environmental Health Hazard Assessment



GHD

NAPA VALLEY TRANSPORTATION AUTHORITY
SR 29 COMPREHENSIVE MULTIMODAL CORRIDOR PLAN

REGIONAL DISADVANTAGED AND LOW-INCOME COMMUNITIES

Project No. 1187559
Revision No. -
Date. 03/26/2020

FIGURE 45

Document Path: \\ghdnet\ghd\US\Roseville\Projects\561\11187559\GIS\Maps\Deliverables\Fig 2 - Vicinity Map.qgs

Data Source:

Created By: Rosanna Southern

Economic Development

The economic analysis of the mobility improvements along the study corridor within the Corridor Plan consist of two parts:

- Benefit-cost analysis comparing the user benefits of the improvement plan with the costs of implementation
- Economic impact analysis showing the regional impacts/benefits of the Corridor Plan to help achieve the economic forecasts of increased jobs, housing and people

Benefit-Cost Analysis - The quantification of the benefit-cost of the proposed improvements are contained in this Performance Assessment chapter of this SR 29 CMCP document. To receive Federal or State grant funding, clear benefit to cost need to be calculated for each of the corridor solutions, which are contained herein.

Freight Movement –Table 27 shows the travel time and buffer time as well as indices for each of these metrics for trucks only. NPMRDS was used to calculate existing truck delay and build correlation between existing truck delay and regular vehicle delay. Truck delay was then estimated under baseline and future year conditions both with and without the project.

Table 27: Travel Time Results by Scenario – Trucks Only

	Truck Average Travel Time (Minutes)		Truck Travel Time Index (TTI)		Growth in TTI		Truck Buffer Time	
Direction	AM Peak Hour	PM Peak Hour	AM Peak Hour	AM Peak Hour	PM Peak Hour	PM Peak Hour	PM Peak Hour	PM Peak Hour
Northbound								
Existing	28:11	21:20	1.2	0.9	-	-	1:03:22	34:23
Baseline	36:56	38:47	1.5	1.7	1.3	1.8	1:23:02	1:02:32
Planned	35:46	33:20	1.5	1.4	1.3	1.6	1:20:24	53:45
Southbound								
Existing	20:08	36:56	0.8	1.3	-	-	23:05	56:08
Baseline	33:28	48:26	1.3	1.8	1.7	1.3	38:22	1:13:37
Planned	28:13	38:25	1.1	1.4	1.4	1.0	32:20	58:23

Economic Development - The IMPLAN 2018 Multiplier for Gross Regional Product for Napa County is 1.29. This indicates that every dollar expended in NICS Code 54, Highway Construction Streets and Roads, will generate a total (direct, indirect and induced) return of an additional 29 cents in GRP countywide. Of the $553 million funding necessary to implement the SR 29 CMCP, this equates to $160 million of additional GRP through 2040.

The IMPLAN 2018 Multiplier for Job Creation is 1.407. This indicates that for every job added to NICS Code 54, a total (direct, indirect and induced) of .407 full-time equivalent jobs should be generated. The direct job creation of the proposed SR 29 CMCP investment is projected to be 1,711 added FTEs that will generate the indirect effect of creating an additional 696 FTEs over the same time frame.

Economic Impact Analysis - The nine-county Bay Area region has continued growth and development plans, anticipating to have more than 4.5 million jobs and a population of upwards to 9.3 million people by 2040. To house this growing population, upwards of 450,000 to 500,000 more housing units will be needed by 2040. Within the study area, designated PDAs have the potential to absorb a significant share of this growth potential.

Currently as identified in this document, the existing SR 29 corridor is already impacted with congestion, limiting not only automobile travel for work commuting and recreation, but also limiting substantial truck travel for goods movement and agriculture. In addition, without a current connected multimodal system, multimodal corridor options are very limited, leaving only the state route and local roadways available to move people and goods.

The SR 29 CMCP is a comprehensive multimodal corridor plan that has identified high benefit-cost improvements and prioritized them to systematically meet the growing capacity and multimodal needs as they arise through 2040. Without the improvements contained in this Corridor Plan, travel, particularly during peak periods and peak seasons, would come to a standstill for extended periods of time. The balanced approach to not only provide additional street capacity, but also modal options for public transit and paths for both cycling and walking, greatly enhances the ability to move both people and goods in the future to at least, 2040. The implementation of the SR 29 CMCP will be essential to provide the increased capacity and modal options to support the planned economic growthe and development of the Napa Valley region.

Adaptation Assessment

A qualitative assessment of climate preparedness and infrastructure asset production/resilience was developed, taking full advantage of online mapping tools including the Caltrans Vulnerability Interactive Mapping Tool (District 4) and CalEnviroScreen 3.0, developed by the Office of Environmental Health Hazard Assessment. Flood and wildfire events were evaluated.

This assessment evaluated the enhanced risk associated with not implementing the SR 29 CMCP improvements as well as the corridor's overall use and functionality on:

- Multimodal transportation infrastructure assessment
- Network connectivity assessment
- Goods movement assessment
- Emergency response assessment
- Evacuation response assessment

State Route 29 – Climate Change Vulnerability Assessment

As a part of this comprehensive assessment for the SR 29 CMCP, a climate change vulnerability assessment has been prepared for each of the primary improvement categories. This assessment follows the guidance recently provided in the Caltrans Climate Change Vulnerability Assessment 2018 Summary Report, prepared by Caltrans District 4. In the 2018 Summary Report, Caltrans identifies in their assessment approach, three action items that must be considered in evaluating the potential climate change impacts on the assets of the State's transportation infrastructure, both existing and planned. Action items of the assessment included the following:

- Exposure – Will the asset be exposed to climate change?

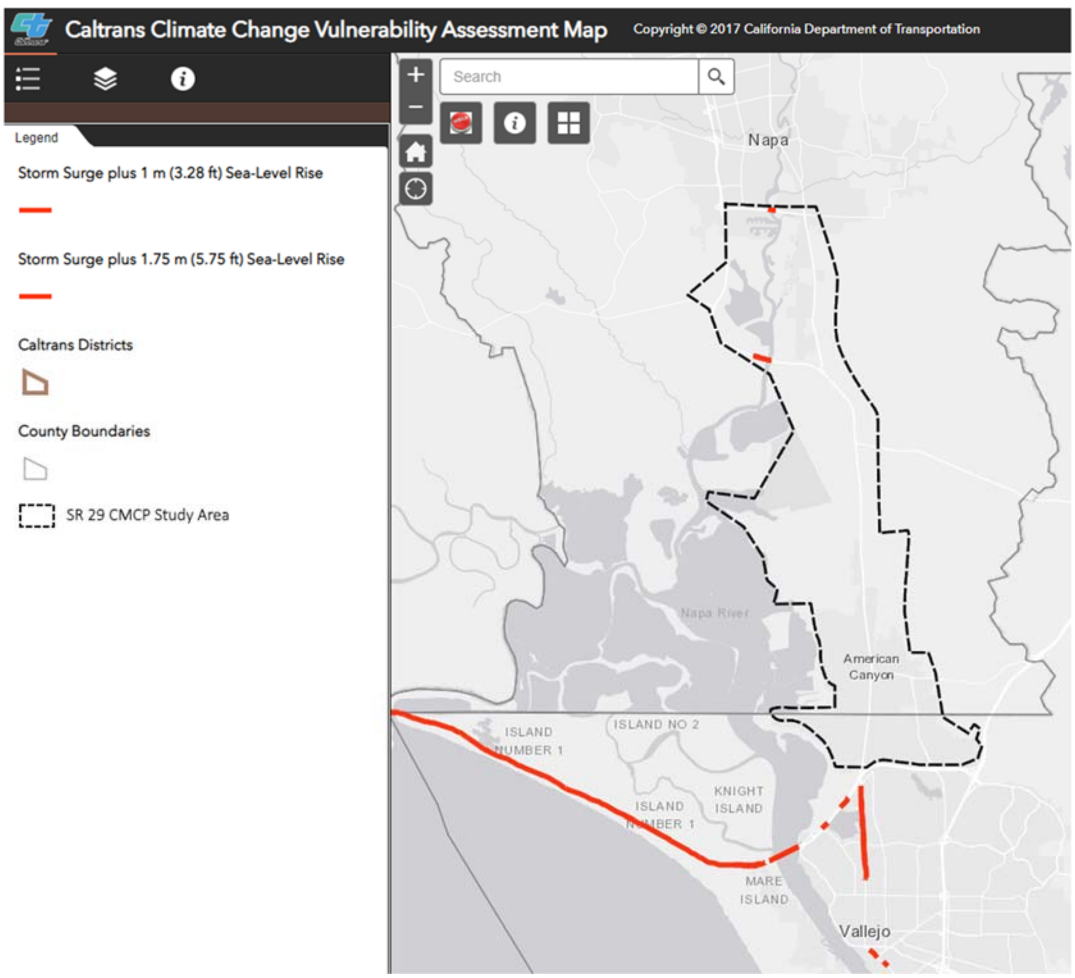
- Consequence – If it is, how will the asset deteriorate or otherwise be impacted and how quickly will such impact occur?
- Prioritizations – Presuming the asset is impacted, how frequent, at what cost and what risk needs to be considered prior to making the investment for improving or replacing the asset?

With acknowledgement that climate change is occurring and significant adverse events will continue to increase, the Caltrans report identifies the four primary climate change impacts for which the above action items need to be considered and the risks assessed. They are as follows:

- Temperature
- Precipitation
- Sea Level Rise
- Wildfires

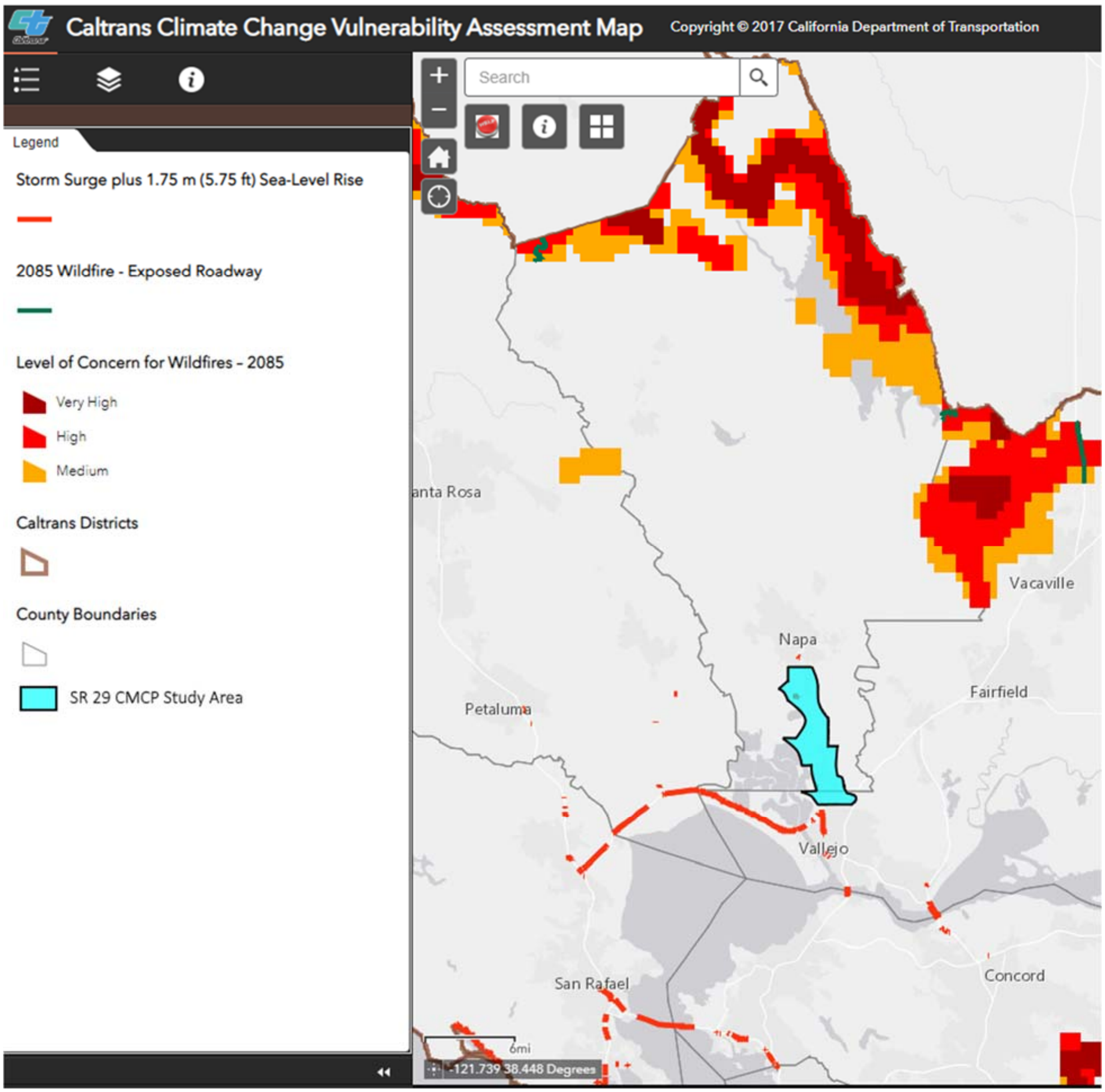
For each of these above potential climate change impacts, an assessment has been conducted regarding the proposed mobility improvements recommended in the SR 29 CMCP as to their potential impact, benefit and risk. The following is a brief summary of each assessment for each proposed improvement category of the SR 29 CMCP improvement package. Additionally, Figure 46 shows 1 meter (3.28 feet), and 1.75 meter (5.75 feet) Sea-Level Rise vulnerability maps developed using Caltrans District 4 Climate Change Vulnerability web-based mapping tool.

Figure 46: Storm Surge (Sea-Level Rise) Vulnerability Map



As shown in Figure 46, a short segment of SR 29 across the Napa River, as well as a short segment of SR 121 (Imola Avenue) across the Napa River, are vulnerable to 1 meter (3.28 feet) sea-level rise. Risks include increased lateral forces on the bridge structure and erosion due to increased sea levels. The mapping tool was also used to review flooding and wildfire vulnerability, but no results were found in the immediate SR 29 corridor study area. However, north of and south of the SR 29 corridor study area, wildfire and flooding risks, associated with climate change, demonstrate the importance of SR 29 as an evacuation route for a large geographic area. SR 29, between Napa and Vallejo, is a lifeline corridor providing direct connectivity between major east-west corridors like Interstate 80 and State Route 12. This connection is significant especially considering the climate vulnerability or State Route 37. Figure 47 below shows these risk areas in relation to the study corridor.

Figure 47: Wildfire and Flood Risk Vulnerability Map



Climate Change Assessment by Improvement Category Proposed in the Mobility Plan

Parallel Capacity Improvements

Temperature – In order to minimize potential increases in ambient temperatures, street trees should be planted as part of these alignments to provide shade, reduce heat island effect, and reduce rate of pavement deterioration caused by increased heat.

Precipitation – Bioswales and water-efficient plantings should be implemented along new streets in order to minimize irrigation needs and offset potential increase in runoff as a result of increased impervious surfaces.

Sea Level Rise – The construction of parallel facilities, particularly on the east side of SR 29, would provide local street connections in the event roadways closer to the Napa River were to become compromised during a flood event.

Wildfires –New parallel roadways should be considered for inclusion in local and regional emergency plans in case of a regional evacuation event and aid local and regional emergency response.

State Route 29 Multimodal Improvements

Temperature – With increases in temperatures, and due to the multimodal facilities' proximity to urban elements like SR 29, parking lots, and buildings, shade trees, water fountains, and shaded rest areas should be considered along the proposed bikeways to minimize heat island effects.

Precipitation – Impervious materials, bioswales and water-efficient plantings should be implemented along new facilities in order to minimize irrigation needs and offset potential increase in runoff as a result of increased paved surfaces.

Sea-Level Rise - The construction of multimodal options along the SR 29 corridor would provide other modes of travel in the event roadways closer to the Napa River were to become compromised during a flood event.

Wildfires –The proposed on-street bikeways should be designed to remain useable as shoulders in case of a regional evacuation event and aid local and regional emergency response.

Intersection Improvements

Temperature –In order to minimize potential increases to ambient temperatures, street trees should be planted as part of these facilities to provide shade, reduce heat island effect, and reduce rate of pavement deterioration caused by increased heat.

Precipitation – Bioswales and water-efficient plantings should be implemented around new intersections in order to minimize irrigation needs and offset potential increase in runoff as a result of increased impervious surfaces.

Sea Level Rise – The intersection improvements, particularly the grade-separated intersections, will need to consider potential future flooding events from sea-level rise. However, these are not anticipated to be at risk themselves for flooding.

Wildfires –Roundabout intersection control should be considered the more resilient option in case of a power-loss event as roundabouts remain able to serve traffic at full capacity without power, aiding potential regional evacuation events and reducing local and regional emergency response times.

Shared Use Paths

Temperature – With increases in temperatures, and due to the multimodal facilities' proximity to urban elements like SR 29, parking lots, and buildings, shade trees, water fountains, and shaded rest areas should be considered along the proposed bikeways to minimize heat island effects.

Precipitation – Impervious materials, bioswales and water-efficient plantings should be implemented along new facilities in order to minimize irrigation needs and offset potential increase in runoff as a result of increased paved surfaces.

Sea-Level Rise – Redundancy in the shared use path / trail network should be developed in case of flooding from the Napa River as a result of sea-level rise. Implementing parallel facilities will ensure continued connectivity in the case a portion of a route is compromised.

Wildfires – New trails should be constructed at sufficient width that they may be utilized by emergency personnel if needed to respond to a wildfire event.

Bus Improvements

Temperature – New bus stops should be designed to include shade whenever possible, and where feasible, include a bus shelter. In the vicinity of bus stops, shade trees should be considered to lower ambient temperatures exacerbated by urban heat island effects.

Precipitation – Impervious materials, bioswales and water-efficient plantings should be implemented as reasonable to minimize irrigation needs and rapture runoff.

Sea-Level Rise – Not applicable

Wildfires – Not applicable

Integrated Corridor Management

Temperature – ICM can be utilized to communicate heat wave events to travelers along the corridor and provide information directing vulnerable users to nearby cooling centers.

Precipitation – ICM can be utilized to issue public service announcements related to inclement weather, drought, or flood events.

Sea-Level Rise - ICM can be utilized to issue public service announcements related to any area roadway closures or other flood-related emergencies and redirect traffic to alternate routes.

Wildfires – ICM can be utilized to issue public service announcements related to any area roadway closures or other fire-related emergencies and redirect traffic to alternate routes.

Plan/Policy Consistency

In sorting and selecting a preferred corridor concept for the SR 29 CMCP, both a quantitative and qualitative measures were considered and used. The Benefit/Cost Analysis quantified and compared metrics associated with traffic operations, safety, emissions and cost characteristics to help narrow and focus the selection to the most beneficial improvements to corridor circulation and safety. In addition to these quantitative metrics, qualitative measures, although often less objective, can provide further insights into the desirability and functionality of proposed improvements. Per the Smart Mobility Framework process, the following qualitative factors were also considered when evaluating and selecting the preferred alternative. These factors included:

- Plan Consistency (namely, SR 29 Gateway Plan, Regional Transportation Plan and local agencies' General Plan Circulation Elements)

- Policy Consistency (NVTA, Caltrans and local agencies)
- Environmental/Institutional Sensitivity (per the environmental screen analysis)
- Community Acceptance (based on the community engagement process)
- Social Equity (consideration of low income and minority population concentrations relative to the location of anticipated improvement impacts and benefits)

Plan Consistency

An assessment was performed as to the general consistency of the corridor alternatives relative to the following plan documents emanating from the involved agencies; Caltrans SR 29 Route Concept Report, NVTA Regional Transportation Plan and the Napa County, City of American Canyon and City of Napa General Plan Circulation Elements.

With the exception of one improvement concept, the proposed SR 29 CMCP was found consistent with the plan documents from the involved agencies. The City of American Canyon is supportive of SR 29 multimodal improvements of the SR 29 CMCP which maintains SR 29 as a four-lane arterial through the City of American Canyon. These multimodal improvements are consistent with the City's General Plan Circulation Element. The City's General Plan envisions SR 29 ultimately widened to six lanes.

Policy Consistency

Recognizing the importance of SR 29 to both regional and local circulation, the involved agencies have been and are aligned in establishing policies that further the improvement of the corridor to enhance traffic operations, capacity, safety and multimodal opportunities and reduce environmental impacts.

Similar to the assessment made regarding Plan Consistency, with the exception of the SR 29 Multimodal Improvements, the SR 29 CMCP was found consistent with all policies established by the involved agencies. In the case of the SR 29 Multimodal Improvements, the concept is not in opposition to adopted City of American Canyon policies. The trail improvements along SR 29 remain consistent with City of American Canyon policy.

Community Support

The process of involving and gaining community support began long before the initiation of this SR 29 CMCP. Through local planning efforts to address circulation in the cities' and County's General Plan Circulation Elements and through previous studies, like the SR 29 Gateway Plan, the communities have been invited and encouraged to participate in identifying corridor solutions for State Route 29. Based on feedback received, some in the community support vehicular capacity enhancements in addition to enhanced and expanded multimodal opportunities. Communities of the partner agencies are supportive of the proposed improvements and understand that additional improvement needs beyond those identified in the SR 29 CMCP will remain, subject to funding availability, prioritization, and successful competitive grant pursuits over the next 20 years and beyond.

Emerging Technologies Assessment

Innovation is a touchstone of our advancing lifestyles to live more efficient and connected lives. New technologies continue to emerge, narrowing the privacy line in the name of "big data". As a part of this Corridor Plan, Integrated Corridor Management or ICM is proposed for implementation to achieve "inter-connected streets" through:

- Active freeway management
- Active Transportation Demand Management Strategies
- Active Transit Management
- Active Arterial Management
- Traveler information Systems in the Corridor

As technologies continue to advance for autonomous vehicles, the need to obtain a centralized Traffic Management Center (TMC), which is proposed in the Corridor Plan, becomes critical to actively manage in "real-time" all multimodal travel within the corridor. With a TMC planned in the future, as technologies advance, when a TMC is available, such a facility in this key regional travel corridor can actively manage in "real-time" the following:

- Facilitate Multimodal Operations, including:
    - Real-time bus arrival information
    - Improve bus on-time performance through signal pre-emption
- Facilitate Real-time Incident Management
- Facilitate VTI (vehicle to infrastructure communications as autonomous vehicles advance) to actively manage corridor travel flow
- Collect travel data to create a historical database to actively manage hourly, daily, weekly and seasonal corridor travel fluctuations.

As new technologies continue to emerge at an astonishing pace, it is difficult to forecast the advanced mobility options and opportunities that will emerge for transportation users on the SR 29 corridor. The SR 29 CMCP acknowledges that such new technologies will come and anticipates, with a planned TMC, to evaluate their value, utility, application and timing for appropriate integration. With this forward thinking, travel demand/ridership can be better managed, congestion and air quality impacts minimized and economic benefits maximized.

7-Benefit Monetization Assessment

Benefits were monetized based on the societal cost information from a either the Caltrans 2018 Economic Parameters or the Caltrans 2016 Economic Parameters if updated 2018 values were not available. The latter information informs the Caltrans Cal-B/C analysis tool. All quantified benefits were annualized and projected to reflect a 20-year design year condition (i.e., life-cycle costs). These monetized benefits are then combined with currently available planning level improvement cost opinions (described below) to yield a holistic benefit-cost estimate for each project alternative.

The Caltrans 2018 Economic Parameters societal cost of time is provided below. The weighted average is based on the 7% truck percentage assumption used as part of this study. The weighted average of societal cost will be applied to both the reduction in delay and buffer time as follows:

- Automobile: $14.20 per hour /person
- Truck: $32.25 per hour /vehicle
- Weighted Average: $15.46 per hour / vehicle

The Caltrans 2016 Economic Parameters societal costs by collision severity is as follows:

- Fatal Accident: $10,800,000 per accident
- Injury Accident: $148,800 per accident
- PDO Accident: $9,700 per accident

Improvement Costs

Costs associated with service frequency improvement, shown in Table 28, include:

- 40' Electric Bus = $1.1 Million per bus
- Operational costs: $48 per service hour
    - Peak Period Operation Only (6 hrs. during weekdays)

Table 28: Transit Service Frequency Improvements Costs

Improvement	Cost
Operational Costs (Annual)	$374,400
Additional Bus Fleet	$2,200,000

Table 29 displays the planning-level cost estimates of improvements recommended in the plan. Cost estimates were sourced from previous planning documents, reviewed and adjusted to be consistent with existing costs, where possible. Where not possible, preliminary planning-level costs were estimated by project team planning and engineering staff.

Table 29: Total Rounded Improvement Costs

Improvement	Total Cost	Life-Cycle Cost
Parallel Capacity Improvements		
South Kelly Road/Newell	$68,680,000	$75,000,000
Devlin Road	Programmed	-
Intersection Improvements		
Soscol Junction	$60,000,000	$65,000,000
Carneros Junction	$2,700,000	$3,000,000
SR 12/Airport/SR 29	$144,400,000	$152,000,000
American Canyon Road/SR 29 Pedestrian Crossing	$22,500,000	$24,000,000
SR 29 Multimodal Improvements		
Segment 1	$16,300,000	$17,600,000
Segment 2	$1,000,000	$1,100,000
Segment 3	$15,300,000	$15,300,000
Bus Improvements		
Queue Jumps/Part-Time Use of Shoulder	$3,200,000	$3,400,000
Transit Signal Priority	$537,000	$565,000
Service Frequency Increase (Annual)	$374,000	$7,500,000
Additional Bus Fleet	$2,200,000	$2,400,000
Integrated Corridor Management Improvements		
Transportation Management Center	$25,000	$30,000
Variable Message Signage	$840,000	$880,000
Traffic Monitoring Detectors	$427,000	$450,000
Trailblazer Signage	$663,000	$700,000
CCTVs	$183,000	$190,000
Communications equipment	$2,400,000	$2,500,000
Shared-Use Paths		
San Francisco Bay Trail gap closure	$18,700,000	$23,400,000
Napa Valley Vine Trail gap closure	$7,400,000	$9,300,000
Total Rounded Improvement Costs	$367,829,000	$404,515,000

Note: Life-cycle costs based on 5% maintenance estimate over 20 years for all projects except transit service increase and Class I trails. Class I trails assume $12,000 / miles maintenance cost.

Comprehensive Benefit-Cost Assessment

Monetized Bicycle Mode Shift Benefits

The SR 29 study area encompasses portions of both Napa and Solano Counties. Because the NCHRP 552 methodology takes into account bicycle commute mode share and the percentage of adult versus children comprising the population, the analysis presented herein was completed separately for the two portions of the study area. Table 30 provides the total estimated benefit associated with the bicycle improvements proposed throughout the entire study area, which range from approximately $7 million at the low end and $10.4 million at the high end. Appendix F presents the induced bicycle demand benefit by Napa County and Solano County portions of the study area.

Table 30: Bicycle Mode Shift Benefits – Total Study Area

Bicycle Facility Benefits	
Annual Mobility Benefit	
Class I Shared Use Path	$3,364,579
Annual Health Benefit	
High Estimate	$286,976
Moderate Estimate	$203,520
Low Estimate	$171,520
Annual Recreation Benefit	
High Estimate	$6,741,550
Moderate Estimate	$4,361,750
Low Estimate	$3,449,250
Annual Decreased Auto Use Benefit	$17,384
Total Annual Benefit	
High Estimate	$10,410,489
Moderate Estimate	$7,947,233
Low Estimate	$7,002,733

Annualized benefits were adjusted to account for a 20-year life cycle. Assuming a 20-year life span, and incorporating a four percent discount rate or P/A Factor to reflect the present worth of future dollars, the 20 year adjusted benefit for the study area is estimated to total $145.2 million, shown in Table 31.

Table 31: Bicycle Mode Shift Life-Cycle Benefits

Total Annualized Benefit	2020 Benefit	Expected Life (yr)	20 Year Adjusted Benefit
Bicycle Mode Shift	$10,410,489	20	$145,225,683

Notes:

20 year life cycle cost estimated using planning-level cost estimates include 20 year operations and maintenance costs associated with Class I shared use paths

20 year benefit estimated by multiplying the annualized benefit by a factor of 20 and applying a 4% year over year discount rate to account for the present worth of future dollars

Air quality benefits associated with bicycle mode shift were also quantified, shown in Table 34 below, based on an annualized reduction in VMT. The estimated reduction in VMT associated with projected bicycle mode shift was utilized as an input in the air quality analysis, where the reduction in emissions and pollutants correlated with the reduction in VMT was monetized.

Table 32: Air Quality Benefits – Bicycle Mode Shift

	Short Tons		Value (mil. $)	
Emissions Reduction	Total Over 20 Years	Average Annual	Total Over 20 Years	Average Annual
CO Emissions Saved	10.84134	0.54207	$506	$25
CO2 Emissions Saved	3,468.84983	173.44249	$98,170	$4,908
NOX Emissions Saved	0.82878	0.04144	$9,326	$466
PM10 + PM2.5 Emissions Saved	0.03232	0.00162	$1,450	$72
SOX Emissions Saved	0.03424	0.00171	$1,441	$72
VOC Emissions Saved	0.41034	0.02052	$314	$16
Total Monetized Reduction Benefit			$111,207	$5,560

Monetized Transit Ridership Benefits

The recommended service frequency improvements and increases in transit ridership are associated with an annualized reduction in VMT. The estimated reduction in VMT associated with projected transit ridership increases was utilized as an input in the air quality analysis, where the reduction in emissions and pollutants correlated with the reduction in VMT was monetized. The result of this analysis is presented in Table 33.

Table 33: Air Quality Benefits - Transit Improvements

	Short Tons		Value (mil. $)	
Emissions Reduction	Total Over 20 Years	Average Annual	Total Over 20 Years	Average Annual
CO Emissions Saved	27.83587	1.39179	$1,299	$65
CO2 Emissions Saved	8,906.50632	445.32532	$252,059	$12,603
NOX Emissions Saved	2.12795	0.10640	$23,944	$1,197
PM10 + PM2.5 Emissions Saved	0.08298	0.00415	$3,723	$186
SOX Emissions Saved	0.08792	0.00440	$3,699	$185
VOC Emissions Saved	1.05358	0.05268	$806	$40
Total Monetized Reduction Benefit			$285,530	$14,276

Monetized Vehicle Operations Benefits

Monetization expresses the amount of savings society directly and indirectly experiences. This monetization has been annualized and is based on 208 weekdays over one year. Table 34 shows the monetized delay per year and annualized for a 20-year life cycle.

Table 34: Delay and Buffer Time Index Benefit

Scenario	Monetized Annual Delay Reduction	Monetized Life-Cycle Delay Reduction
AM Peak Period	$7,447,186	$103,887,803
PM Peak Period	$18,688,562	$260,704,304
Combined	$26,135,748	$364,592,107

The results presented above reflect delay reduction for a five-hour peak period (two hour AM peak period and three hour PM peak period). However, congestion on SR 29 often extends even beyond the peak periods monetized above. Therefore, this delay reduction benefit is conservative since it does not account for delay benefits that occur outside the single-hour peak commute times. Additionally, it does not account for delay benefits during weekends.

The recommended vehicle operations improvements are associated air quality benefits, where the reduction in emissions and pollutants was monetized. The result of this analysis is presented in Table 33.

Table 35: Air Quality Benefits – Vehicle Operations Improvements

Emissions Reduction	Short Tons		Value (mil. $)	
	Total Over 20 Years	Average Annual	Total Over 20 Years	Average Annual
CO Emissions Saved	288.79632	14.43982	$14,539	$727
CO2 Emissions Saved	140,694.75042	7,034.73752	$4,107,647	$205,382
NOX Emissions Saved	64.51040	3.22552	$590,092	$29,505
PM10 + PM2.5 Emissions Saved	2.76002	0.13800	$128,196	$6,410
SOX Emissions Saved	1.45560	0.07278	$66,396	$3,320
VOC Emissions Saved	26.61383	1.33069	$21,551	$1,078
Total Monetized Reduction Benefit			$4,928,421	$246,422

Monetized Safety Benefits

Vehicular and bicycle/pedestrian related collisions and improvements identified to improve safety were summarized for input into the HSIP analyzer to compute monetized benefits. The safety benefit calculation worksheets that informs this analysis are provided in Appendix H. The basis for this analysis is the Caltrans 2016 Economic Parameters. Once monetized, the estimate was expanded to reflect the design life horizon year. As shown in Table 36, the expected benefit of the identified countermeasures is $109,422,454.

Table 36: Safety Benefit Summary

Countermeasure	Benefit
R37 - Install Shared-Use Path – SR 29: SR 37 to Napa Junction Road	$13,895,040
R37 - Install Shared-Use Path– SR 29: Napa Junction Road to Paoli Loop Vine Trail*	N/A*
R36 - Install Bike Lanes SR 29:South Kelly Road to SR 12/Airport	$2,900,661
IC - Convert Signalized Intersection at SR 29/SR 221 (Soscol Junction) to Grade-Separated Interchange with Roundabouts	$32,873,551
S18 - Convert Signalized Intersection to Roundabout Devlin Rd at Airport Blvd	$4,519,821
IC - Convert Signalized Intersection at SR 29/Airport Blvd to Grade-Separated Interchange with Roundabouts	$34,348,581
S18 - Convert Signalized Intersection to Roundabout at S Kelly Rd/SR 12	$20,884,800
Total Project Area Expected Benefit	$109,422,454

**No benefit reported because no pedestrian and bicycle collisions reported near countermeasure area.*

Monetized ICM Benefits

The ICM system provides information to drivers to change travel patterns providing additional parallel capacity to SR 29. This benefits the drivers by reducing the amount of queues, delay, and emissions. The decrease in delay is an attribute that can be monetized to show how drivers not only benefit from a time perspective but also monetarily. The monetary benefit comes from less time spent driving which reduces fuel consumption, greenhouse gas emissions, and loss time. The monetized benefits are presented in Table 37.

Table 37: ICM Benefits Summary

Scenario	Monetized Annual Delay Reduction	Monetized Life-Cycle Delay Reduction
AM Peak Period	$1,228,894	$24,577,890
PM Peak Period	$2,522,322	$50,446,422
Combined	$3,751,216	$75,024,312

Notes: 1. Calculation based on two incidents per year.

As presented in Table 37, the total life cycle benefit if two incidents occurred during the two hour AM peak period is approximately $24.6 million and approximately $50.5 million during the three hour PM peak period over 20 years. Combined, over the five hour peak period, $75 million in life-cycle benefits are anticipated.

If the northbound direction of SR 29 experience a reduction in capacity from two lanes to one lane between Green Island Road and Airport Boulevard/SR twice a year, the ICM would reduce travel times in the AM peak hour by approximately 9.1 minutes per incident and save drivers approximately $12.3 million in delay costs. If the incident occurred in the PM peak hour, the travel time savings would be 11.8 minutes per incident and approximately $16.8 million in delay costs over 20 years.

Monetized Air Quality Benefits

Table 38 displays the monetized air quality benefits related to operational, bicycle and transit improvements, as well as the total air quality benefit resulting from all emissions and pollutant reduction.

Table 38: Air Quality Benefits Summary

Emissions Reduction	Total Over 20 Years	Average Annual
Total Monetized Emissions Reduction – Operational Benefits	$4,928,421	$246,422
Total Monetized Emissions Reduction – Bike-Related Benefits	$111,207	$5,560
Total Monetized Emissions Reduction Benefit – Transit Benefits	$285,530	$14,276
Total Monetized Air Quality Benefits	$5,325,158	$266,258

Overall Benefit-Cost Summary

Project Benefits

A summary of the quantitative benefits that could be monetized are presented in Table 39.

Table 39: Monetized Benefits Summary

Benefit Type	Annual Benefit	Life Cycle Benefit (20 Yrs.)
Bicycle Mode Shift Benefit *(Except Air Quality)*	$10,410,489	$145,225,683
Transit Ridership Benefit	Included in Air Quality Benefit	Included in Air Quality Benefit
Operational Delay Benefit *(Except Air Quality)*	$26,135,748	$364,592,107
Safety Benefit	$5,471,123	$109,422,454
ICM Delay Benefit	$3,751,216	$75,024,312
Air Quality/ Emissions Benefit	$266,258	$5,325,158
Total Benefit	$46,034,834	$699,589,714

Total Benefit-Cost

Table 40 displays the comprehensive benefit cost for all improvements proposed within the study corridor. When monetized to a 20-Year life cycle, the benefit-cost of the proposed SR 29 CMCP multimodal improvement package is 1.73.

Table 40: Comprehensive Benefit-Cost Summary

Total Project Life-Cycle Cost	Life Cycle Benefit (20 Yrs.)
$404,515,000	$699,589,714
Total B/C	1.73

8 - Preferred Corridor Plan

The culmination of the process for the SR 29 CMCP is to identify a comprehensive and systemic Corridor Plan that achieves the corridor objective to:

"…….form a comprehensive multimodal package of prioritized improvements that will serve to systematically guide future SR 29 corridor programming decisions over a 20-year timeframe based on available funding."

To achieve this objective, consistent with the chapters of this Plan:

- A performance-based analysis based on the Smart Mobility Framework was applied,
- The Public was engaged for their input throughout the process,
- Existing Conditions to establish a baseline were evaluated,
- Corridor Solutions from prior planning efforts identified, and
- Performance Assessments of those corridor solutions conducted.

Following the collation of the high performing corridor solutions, the next challenge was to systemically integrate these corridor solutions into a priority schedule based on anticipated need and funding through the plan year 2040.

The following Preferred Corridor Plan, which includes the implementation phasing of the prioritized multimodal improvement package and funding, is the outcome achieved from the input from the Public and output from the technical information that has been performed consistent with the Smart Mobility Framework and applicable State and Federal grant program guidelines.

The Preferred Plan

Based on the input from the extensive public outreach and the comprehensive performance assessments conducted, the proposed Corridor Solutions identified were reduced in number and prioritized to correspond with a phased implementation plan, so systemically, the most critical multimodal improvements are met over time and as likely funding becomes available. The overall Corridor Plan improvements and services are identified as follows with the physical corridor improvements shown in Figure 48, Figure 49, and Figure 50.

Figure 48: Preferred Plan: Imola Avenue to Soscol Junction

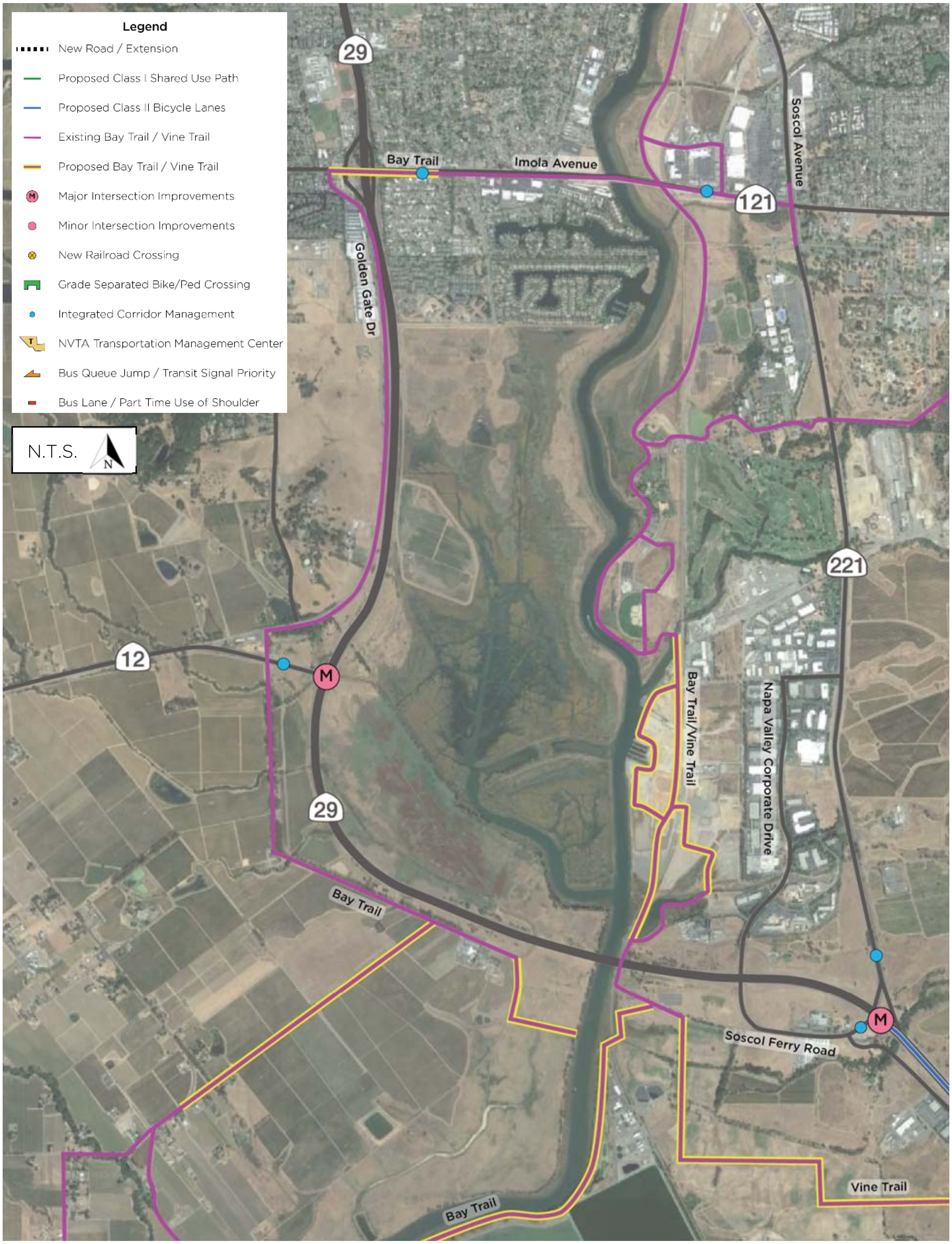


Figure 49: Preferred Plan: Soscol Junction to Green Island Road

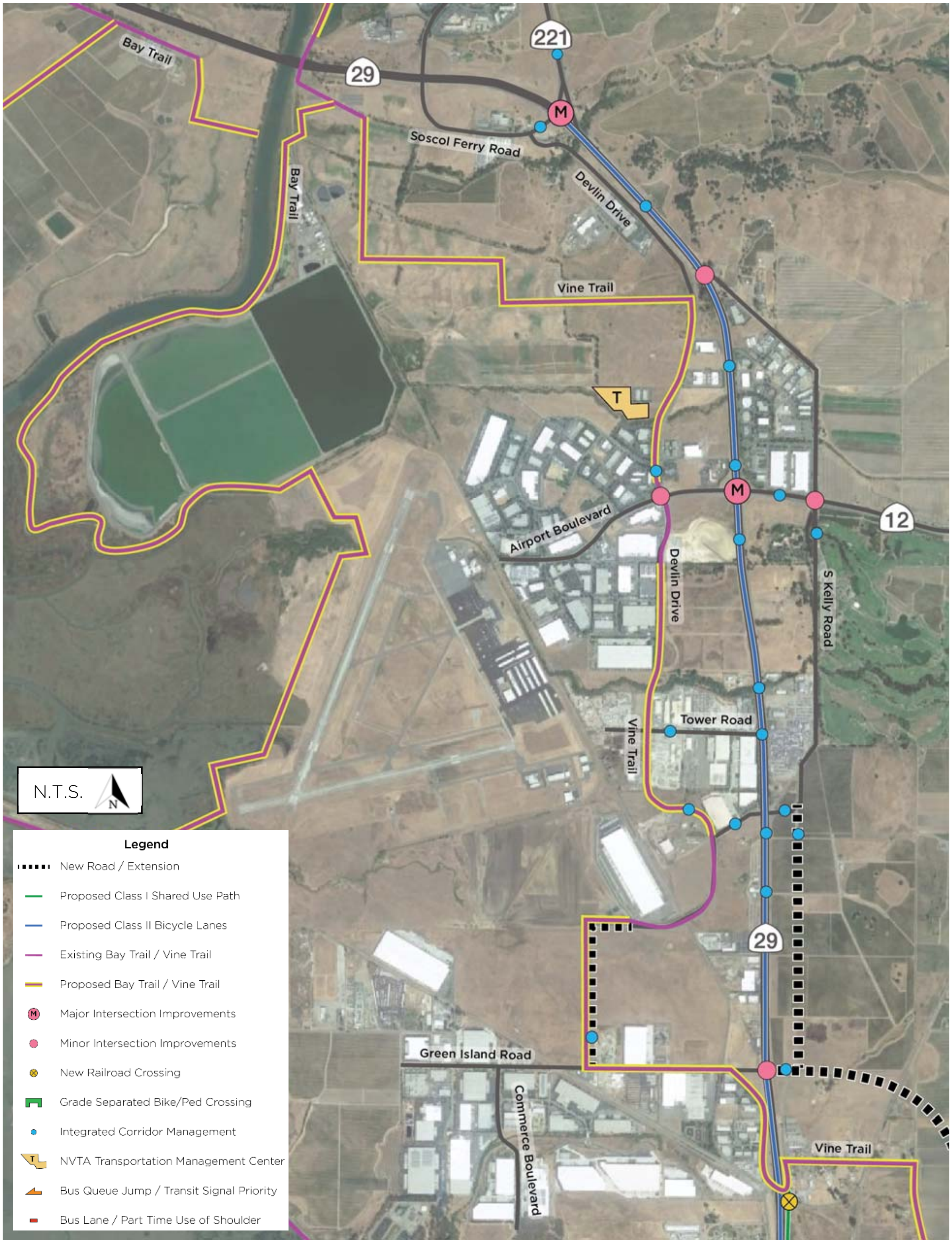
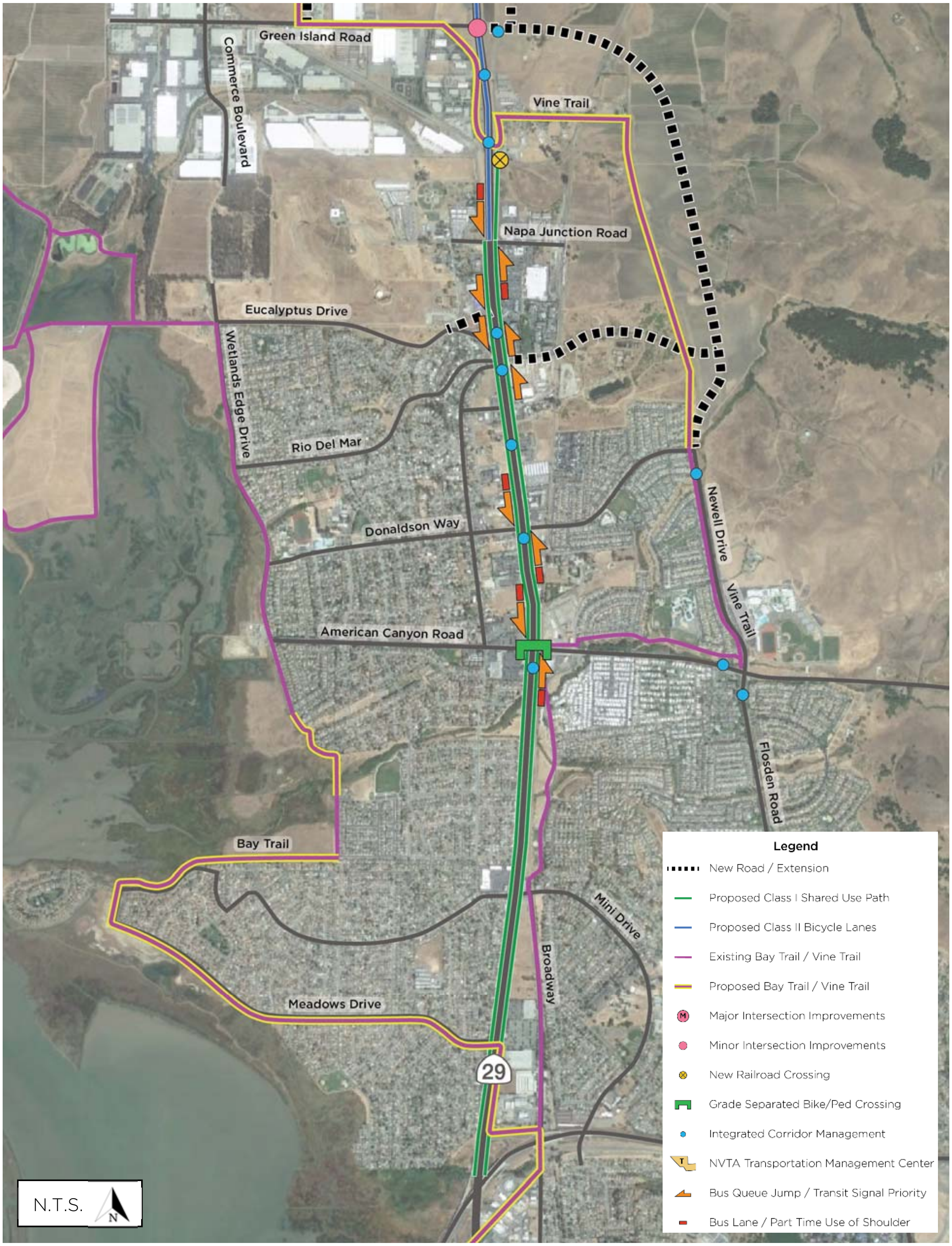


Figure 50: Preferred Plan: Green Island Road to State Route 37



Parallel Capacity Improvements

- Devlin Road
- South Kelly Road/Newell Drive

SR 29 Multimodal Improvements

- SR 37 to Napa Junction Road
- Napa Junction Road to Napa Valley Vine Trail
- South Kelly Road to Soscol Junction

Intersection Improvements

- Carneros Junction
- Airport Boulevard/SR 12/SR 29
- Soscol Junction
- American Canyon Road Grade-Separated Pedestrian Crossing

Shared Use Paths

- Napa Valley Vine Trail
- San Francisco Bay Trail

Bus Improvements

- Bus Stop Changes
- Part Time Use of Shoulder
- 11X Bus Service
- New Route 29 Bus Service
- Queue Jump
- Transit Signal Priority
- NVTA Maintenance Facility/ Transportation Management Center

Integrated Corridor Management

- Variable Message Signs
- Traffic Monitoring Detectors
- Trailblazer Signs
- CCTV Cameras

Of these above Corridor Plan improvements, several improvements, including the final extension of Devlin Road to Paoli Loop and the NVTA Maintenance Facility have already received funding and are in the process of being designed and/or constructed. Although these projects are both part of the comprehensive and systematic Corridor Plan, no further programming is necessary for future funding and construction, which is the focus of the following section – Implementation Plan.

Implementation Plan

In order to facilitate implementation of the SR 29 CMCP preferred package of multimodal improvements, an implementation opportunity matrix was developed based on the SCCP grant application primary, secondary, and deliverability criteria. The performance the SR 29 CMCP preferred plan has been quantified in the preceding sections of this report. In this section, the relative performance of the individual improvements within the preferred package are presented in order to differentiate the relative competitiveness of component projects.

The scoring was prepared on a scale of 0 to 2, where 0 presents the lowest opportunity to score well against a given criteria and 2 presents the highest opportunity. Projects scored with a 1 may require additional analysis, but demonstrate potential to score well against a given criteria.

Table 41 displays the results of the implementation prioritization assessment. As shown, the highest scoring project is the Soscol Junction improvement, due to strong performance against several criteria, and top performance against deliverability criteria. The next two top candidate projects are the bus transit improvements along SR 29 and the Airport Boulevard / SR 12 / SR 29 intersection. However, this prioritization matrix does not consider the compounding benefit of implementing several projects at once, such as the SR 29 multimodal improvements and integrated corridor management strategies.

Further detailed analysis into the combined benefits of combined projects should be prepared in order to maximize the possible score of an upcoming SCCP grant application by combining components of the preferred SR 29 CMCP package, as the deliverability criteria of component projects are increased through further planning and design phases.

Table 41: SR 29 CMCP Implementation & Prioritization Matrix

	Parallel Capacity Improvements	Devlin Road	South Kelly Road / Newell Drive	SR 29 Multimodal Improvements	SR 37 to Napa Junction Road	Napa Junction Road to Paoli Loop	Napa Junction Road to Soscol Junction	Intersection Improvements	Carneros Junction	Airport Boulevard / SR 12 / SR 29	Soscol Junction	American Canyon Pedestrian Bridge	Shared Use Paths	Napa Valley Vine Trail	San Francisco Bay Trail	Bus Transit Improvements	Integrated Corridor Management
Congestion Reduction	6	3	3	6	2	2	2	14	2	4	4	4	4	2	2	4	2
VMT Reduction	2	1	1	3	1	1	1	1	0	0	0	1	2	1	1	1	0
Travel Time Reduction	2	1	1	0	0	0	0	6	1	2	2	1	0	0	0	1	1
Delay Reduction	2	1	1	0	0	0	0	6	1	2	2	1	0	0	0	1	1
Reduced SOV Mode Share	0	0	0	3	1	1	1	1	0	0	0	1	2	1	1	1	0
Throughput	2	1	1	9	3	3	3	9	1	3	4	1	6	3	3	3	1
Throughput for Multiple Modes	2	1	1	3	1	1	1	5	1	2	2	0	2	1	1	1	1
Vehicle Occupancy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Bicycle/Pedestrian Mode Share	0	0	0	6	2	2	2	4	0	1	2	1	4	2	2	1	0
System Reliability	4	2	2	0	0	0	0	9	2	3	3	1	0	0	0	3	3
Travel Time Reliability	2	1	1	0	0	0	0	5	1	2	2	0	0	0	0	1	2
Transit Service Performance	2	1	1	0	0	0	0	4	1	1	1	1	0	0	0	2	1
Safety	0	0	0	8	3	2	3	9	1	3	3	2	2	1	1	0	0
FSI Reduction	0	0	0	3	1	1	1	6	1	2	2	1	0	0	0	0	0
Non-Motorized Collision Reduction	0	0	0	5	2	1	2	3	0	1	1	1	2	1	1	0	0
Accessibility	4	2	2	12	4	4	4	4	0	0	2	2	4	2	2	3	0
Job Accessibility by Mode	2	1	1	6	2	2	2	2	0	0	1	1	2	1	1	1	0
Key Destination Accessibility by Mode	2	1	1	6	2	2	2	2	0	0	1	1	2	1	1	1	0
Disadvantaged Accessibility to Transit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Economic Development	4	2	2	6	2	2	2	12	2	4	4	2	4	2	2	2	2
Direct Jobs Created	2	1	1	3	1	1	1	6	1	2	2	1	2	1	1	1	1
Indirect Jobs Created	2	1	1	3	1	1	1	6	1	2	2	1	2	1	1	1	1
Air Quality & Greenhouse Gases	2	1	1	3	1	1	1	4	1	1	1	1	2	1	1	1	0
Criteria Pollutant Reduction	2	1	1	3	1	1	1	4	1	1	1	1	2	1	1	1	0
Efficient Land Use	3	1	2	7	3	3	1	2	0	0	0	2	3	2	1	2	0
Multimodal Mixed Use & Infill	2	1	1	5	2	2	1	1	0	0	0	1	2	1	1	1	0
Supports Efficient Land Development	1	0	1	2	1	1	0	1	0	0	0	1	1	1	0	1	0
Deliverability	9	5	4	9	3	3	3	19	6	4	8	1	6	3	3	5	3
Matching Funds	2	1	1	0	0	0	0	3	1	0	2	0	2	1	1	1	0
Deliverable Readiness	3	2	1	3	1	1	1	3	1	0	2	0	2	1	1	1	0
Potential for Collaboration	2	1	1	3	1	1	1	7	2	2	2	1	2	1	1	2	2
Cost Effectiveness	2	1	1	3	1	1	1	6	2	2	2	0	0	0	0	1	1
Community Impact	4	2	2	3	1	1	1	5	1	1	1	2	3	2	1	1	1
Community Support	4	2	2	3	1	1	1	5	1	1	1	2	3	2	1	1	1
Disadvantaged Community Impacts	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Overall Score	38	19	19	63	22	21	20	87	16	23	30	18	34	18	16	24	12
Overall Rank	-	7	7	-	4	5	6	-	9	**3**	**1**	8	-	8	9	**2**	10