INTERSTATE 515

Moving forward together 93 95

I-515 Alternatives Development Study

JUNE 2017

CONCEPT REPORT

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List of Acronyms and Abbreviations

AADT	Annual Average Daily Traffic
AASHTO	American Association of State Highway Transportation Officials
AGC	Associated General Contractors
AM	Ante Meridiem
ASTM	American Society for Testing and Materials
ATDM	Active Traffic and Demand Management
ATM	Active Traffic Management
CAAA	Clean Air Act and Amendments
CC-215	Clark County 215
CE	Categorical Exclusion
CFR	Code of Federal Regulations
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CORSIM	CORSIM microsimulation software
DDI	Diverging Diamond Interchange
DEIS	Draft Environmental Impact Statement
DMS	Dynamic Message Sign
EA	Environmental Assessment
EJ	Environmental Justice
EMS	Emergency Medical Services
EO	Executive Order
EPA	Environmental Protection Agency
ESA	Environmental Site Assessment
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
HCM	Highway Capacity Manual
HCS	Highway Capacity Software
HOV	High Occupancy Vehicle
HSM	Highway Safety Manual
I-515	Interstate 515

ISATe	Enhanced Interchange Safety Analysis Tool
ITS	Intelligent Transportation Systems
LED	Light-Emitting Diode
LOS	Level of Service
LPA	Locally Preferred Alternative
LVCVA	Las Vegas Convention and Visitors Authority
LVVWD	Las Vegas Valley Water District
MOE	Measures of Effectiveness
mph	Miles Per Hour
MSAT	Mobile Source Air Toxics
MUTCD	Manual on Uniform Traffic Control Devices
NAC	Nevada Administrative Code
NBIS	National Bridge Inspection Standards
NDEP	Nevada Department of Environmental Protection
NDOT	Nevada Department of Transportation
NEPA	National Environmental Policy Act
NHP	Nevada Highway Patrol
NHPA	National Historic Preservation Act
NO_X	Nitrogen Oxides
NRA	National Recreation Area
NRHP	National Register of Historic Places
NRS	Nevada Revised Statute
NVCRIS	Nevada Cultural Resources Information System
PCCP	Portland Cement Concrete Pavement
PDO	Property Damage Only
PEL	Planning and Environmental Linkages
PHT	Person Hours Travelled
PI	Public Information
PM	Post Meridiem
PM10	Particulate matter less than 10 microns
RCRA	Resource Conservation and Recovery Act
REC	Recognized Environmental Condition
ROW	Right-of-way

RSA	Road Safety Assessment
RTC	Regional Transportation Commission of Southern Nevada
RTP	Regional Transportation Plan
SHPO	State Historic Preservation Office
SNRPC	Southern Nevada Regional Planning Coalition
SNV	Southern Nevada
SNWA	Southern Nevada Water Authority
SO_2	Sulfur Dioxide
SPF	Safety Performance Functions
STIP	Statewide Transportation Improvement Program
Synchro	Synchro software
TIBP	Transportation Investment Business Plan
TSM	Transportation System Management
TUDI	Tight Urban Diamond Interchange
TV	Television
U.S. or US	United States
UNLV	University of Nevada/Las Vegas
UPRR	Union Pacific Railroad
USC	United States Code
USDOT	United States Department of Transportation
VHT	Vehicle Hours Traveled
VMT	Vehicle Miles Traveled
VOCs	Volatile organic compounds

I-515 ALTERNATIVES DEVELOPMENT STUDY
Concept Report

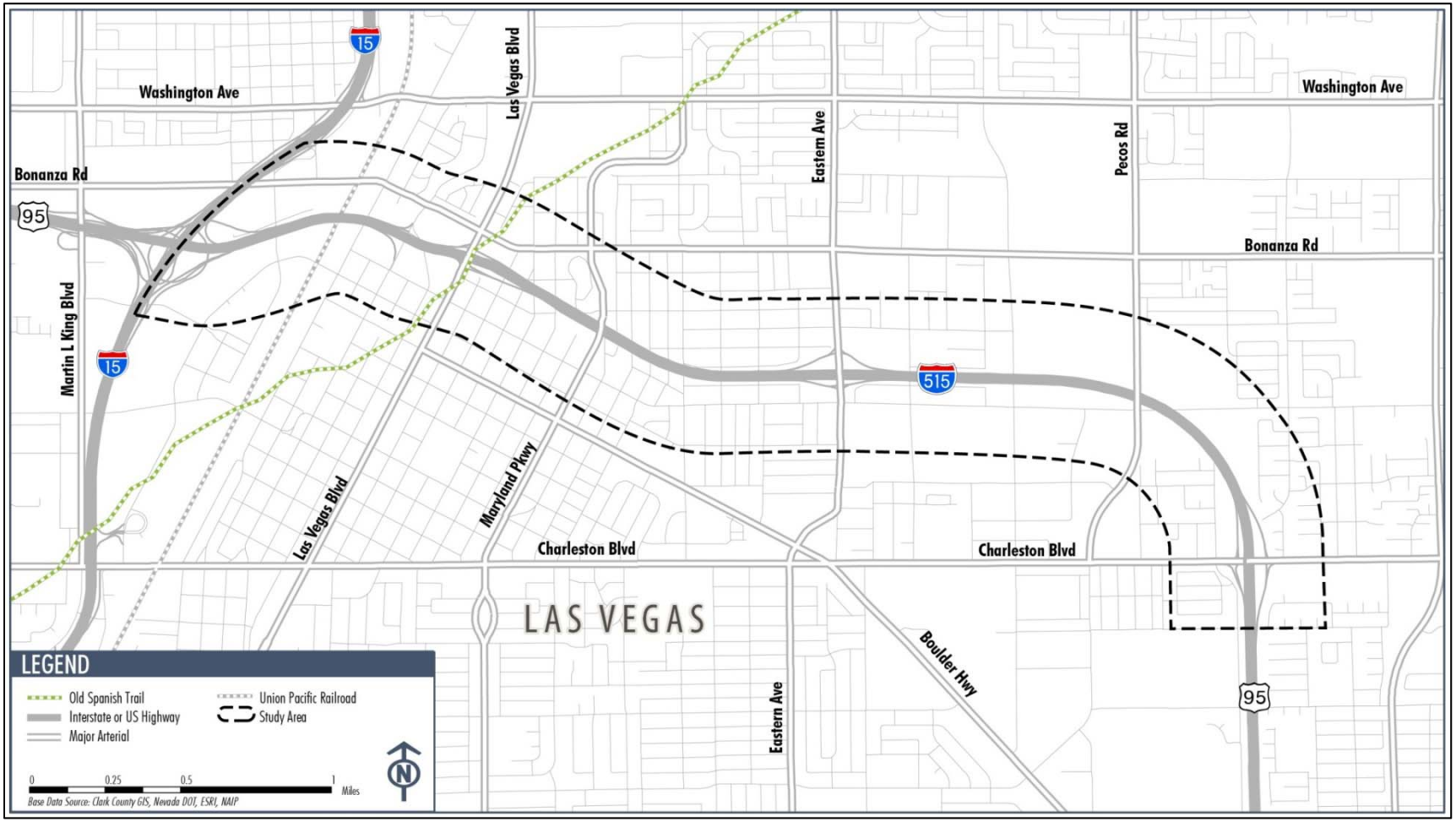
Executive Summary

ES.1 Introduction and Study Background

U.S. Interstate 515 (I-515) is a 20-mile spur between the junction of I-15 and US 95 (known as the Las Vegas Spaghetti Bowl interchange) and Railroad Pass in southeastern Henderson, Nevada. This I-515 Alternatives Development Study was initiated by the Nevada Department of Transportation (NDOT) to identify and evaluate near-term operational and safety improvements along I-515 from the Spaghetti Bowl to Charleston Boulevard in Las Vegas (study area), as shown on Figure ES-1. This study is intended to be a precursor to future NDOT environmental studies to comply with the National Environmental Policy Act (NEPA).

Key stakeholders provided study oversight. They included the City of Las Vegas, Clark County, the Regional Transportation Commission of Southern Nevada, and Federal Highway Administration (FHWA). The study team, which included NDOT and the consultant team of Jacobs, Atkins, and Louis Berger Group, used the Planning and Environmental Linkages (PEL) approach to guide this study. As part of this PEL approach, the study team developed a Purpose and Need statement, evaluated improvements, and recommended potential projects for NDOT to evaluate further. The team also solicited public and agency input on the process and study findings.

Figure ES-1: Study Area



Purpose and Need

The purpose of this study is to improve traffic operations and safety on the I-515 corridor, including ramp terminal intersections, between I-15 (at the Spaghetti Bowl interchange) and Charleston Boulevard by implementing near-term and cost-effective transportation improvements that are compatible with other future improvements.

The needs to be addressed in the study include:

- Mobility Problem: Impaired traffic flow resulting from high traffic volumes, substandard geometry, and incidents.
- Safety Problem: Higher than expected crashes due to traffic congestion and substandard geometry.

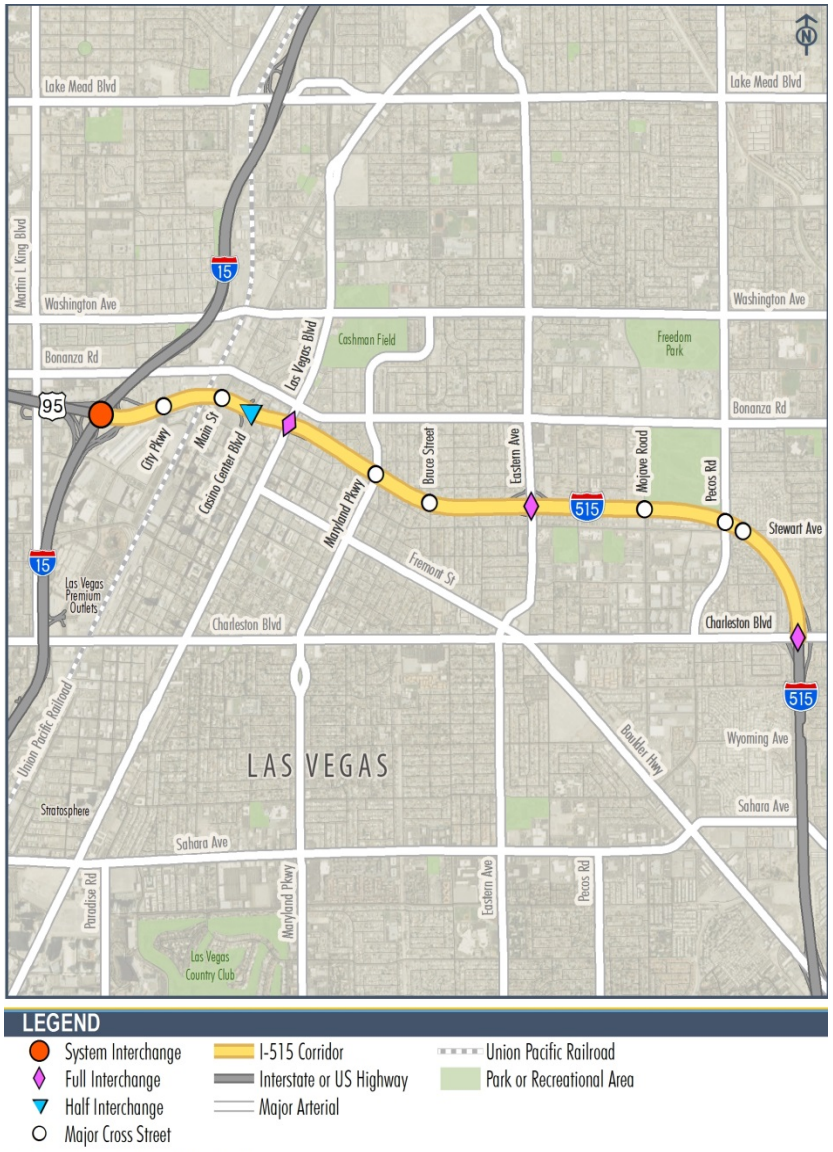
ES.2 Existing Corridor Conditions

The study evaluated and documented the existing corridor conditions, including the roadway network, land use and demographic characteristics, traffic conditions, traffic volumes, traffic operations, utilities, safety performance, transit options, bicycle and pedestrian facilities, major structures, and environmental conditions.

Roadway Network

I-515 extends between the City of Las Vegas and the City of Henderson, with interchanges serving both cities and unincorporated areas of Clark County. Eleven major streets cross beneath I-515 within the study area, providing a network of roads that complement I-515. One system interchange (with I-15) and four service interchanges are located within the study area. Figure ES-2 depicts the road network within the study area.

Figure ES-2: Study Area Road Network



Data Source: Clark County GIS, Nevada DOT, ESRI, NAIP

Land Use and Demographic Characteristics

Between 1990 and 2015, the Las Vegas Valley urban area experienced an average population growth rate of 4.1 percent per year. Demographic information on occupied housing unit density, major trip generators, average population growth (1990 to 2015), population density, employment density, percent of households below the poverty level, and percent of zero-vehicle households is presented in the study. The study area has a mix of land uses that includes residential, commercial, public, parks and recreation, mixed-use, and industrial.

Traffic Conditions

The study team conducted an existing conditions traffic operations analysis using CORSIM microsimulation software and SYNCHRO intersection analysis. Levels of Service (LOS)[1] were calculated in accordance with the *Highway Capacity Manual 2010* (Transportation Research Board, 2010). The operational performance results from CORSIM included:

- Five northbound road segments with LOS E and F in the AM period
- Ten northbound road segments with LOS E and F in the PM period
- Six southbound road segments with LOS E and F in the AM period,
- Six southbound road segments with LOS E and F in the PM period

[1] LOS is a qualitative measure of the quality of traffic service using letters A through F, with A being the best and F being the worst.

The Synchro existing intersection analysis showed the Eastern Avenue and Stewart Avenue intersection operating at LOS F in the PM peak hour, and the southbound ramp intersection at Charleston Boulevard and the southbound ramp intersection at Las Vegas Boulevard operating at LOS E in the AM peak hour.

Utilities

Utility relocations can greatly add to construction costs for highway improvements. This study identified nine specific utility owners with facilities in the study area.

Safety Performance

From July 1, 2011, to July 1, 2014, a total of 1,377 crashes occurred in the 5.5 miles of I-515 evaluated in the *Road Safety Assessment Report for I-515/US 93/US 95 from Rancho Drive to Wyoming Avenue Grade Separation* (NDOT, 2015a). This section of the I-515 corridor experienced higher overall crashes, injury crashes, and property damage crashes than the state average. The study summarized corridor crash severity by roadway segment and crashes at the I-515 interchanges.

Transit Options

Transit routes on the freeways within the study area are primarily express services. The arterials serve as the main transit routes, with several stops strategically placed to provide connectivity. The study shows the average monthly ridership for each route servicing the study area for the three-year period between July 1, 2011, and July 1, 2014. The express routes (SDX and BHX) and Route 206 experience the highest ridership.

Bicycle and Pedestrian Facilities

The study area has a network of bicycle routes/lanes and multi-use paths. A shared-use path runs along I-515. However, the existing trail is discontinuous; missing trail segments are planned to be built in the future.

Major Structures

The Downtown Las Vegas Viaduct consists of two multi-span bridges that carry northbound and southbound I-515 over multiple roads and the Union Pacific Railroad tracks.

The first bridge segment (G-947) between 4th Street and Mesquite Avenue was built in the 1960s, and the second bridge segment (I-947) between 21st Street and 4th Street was built in the early- to mid-1980s. The G-947 structure has reached 50 years of service life; it is in poor overall condition and is functionally obsolete. The I-947 structure and two associated ramp bridges are considered to be in generally good condition. However, as expected for a 35-year-old structure, various elements are reaching the point where either major maintenance or minor rehabilitation are needed to repair existing deficiencies and ensure structure longevity. Additionally, an assessment of the structure's seismic performance identified the need for retrofitting several columns and in-span hinges. The I-947 structure is also functionally obsolete.

Environmental Conditions

The environmental conditions section in the study summarizes existing data collected for the environmental resources identified within the study area. Data is presented for land use and zoning, parks, recreation, bicycle/pedestrian facilities, community facilities, environmental justice (EJ) populations, air quality, traffic noise, cultural resources, hazardous materials, floodplains, and visual conditions. This information helped inform the evaluation of the alternatives as discussed below. Environmental resources most prevalent in the study area include EJ populations, community facilities, historic properties, and hazardous material sites.

ES.3 Alternatives Development and Screening Process

To identify and evaluate near-term operational and safety improvements within the study area, the study team considered a range of reasonable improvements to meet this study's Purpose and Need. The improvements that were carried forward through the screening process generally fell into the following categories:

- Interchange and ramp improvements, including new interchanges
- Collector-distributor roads
- Auxiliary lanes
- Congestion management improvements
- Travel Demand Management (e.g. high-occupancy vehicle lane) improvements
- Transportation System Management improvements, including:
  - Traffic signal optimization
  - Ramp metering

- Active Transportation and Demand Management strategies, such as variable speed control
- Additional turn bays

Thirty-five Conceptual Build Alternatives were developed and evaluated in this study. The screening process was designed to:

- Assess potential improvements along I-515 within the study area, in relation to the study's Purpose and Need.
- Group improvements based on compatibility, proximity, and logical termini into consolidated project alternatives where appropriate.
- Evaluate the benefits and costs of selected project alternatives.

Figure ES-3 illustrates the multilevel screening and prioritization process.

No-Action Alternative

The No-Action Alternative was fully evaluated and serves as a baseline comparison for operational, safety, benefit to cost, and environmental analysis purposes. It assumes completion of ongoing or reasonably foreseeable transportation, development, and infrastructure projects. Figure ES-4shows the locations of these planned improvements.

Fatal Flaw Screening Process and Results

The first level of screening was the most basic, and evaluated whether the proposed improvements met the following criteria:

- Does the improvement meet this study's Purpose and Need?
- Does the improvement serve a study goal?
- Does the improvement have irresolvable environmental impacts?
- Is the improvement widely opposed by stakeholders and/or the public?

All improvements were evaluated against the No-Action Alternative. If an improvement did not meet the criteria listed above, it was screened out and did not continue in the evaluation process. Of the 35 preliminary improvements evaluated in this study, eight were deemed fatally flawed and eliminated.

Figure ES-3: Alternatives Screening Process

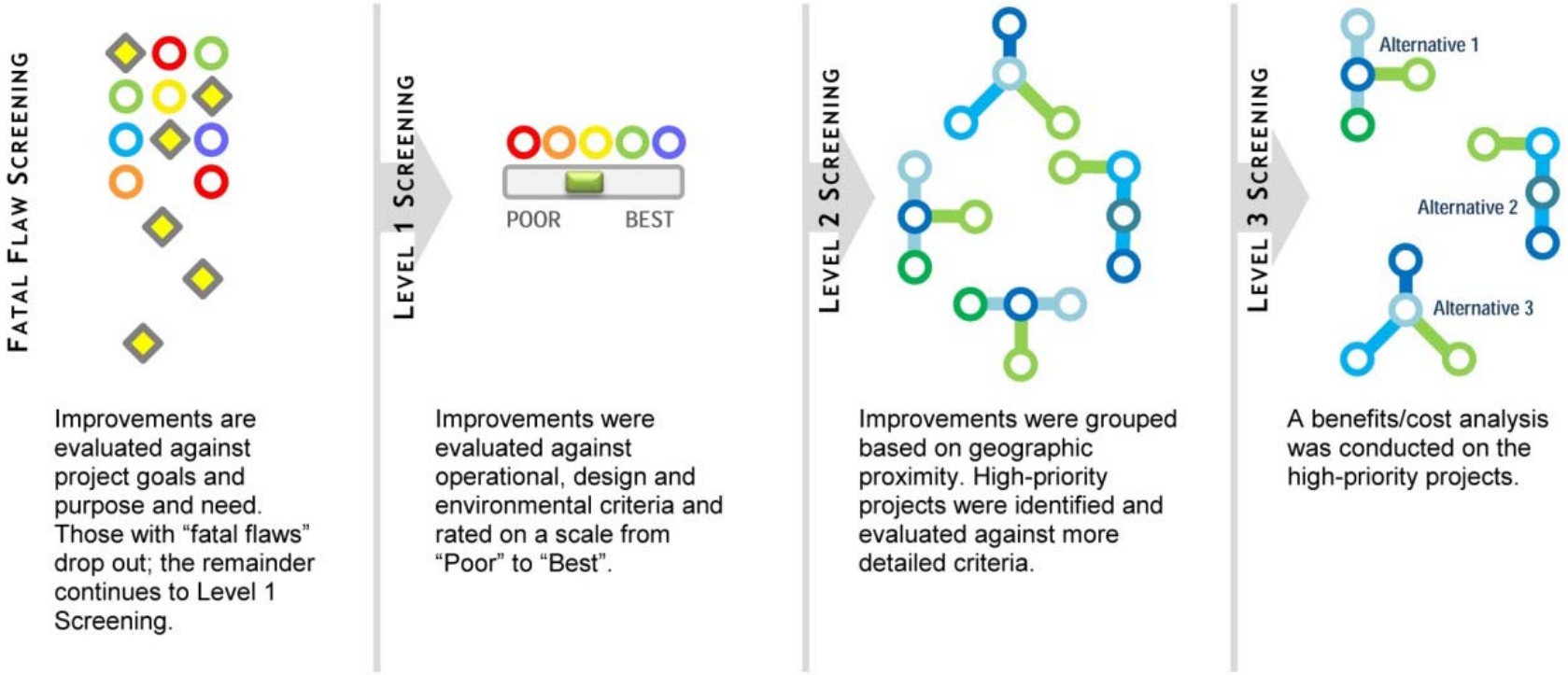


Figure ES-4: Planned Projects Included in the No-Action Alternative

Level 1 Screening – Comparative Screening Process

The Level 1 screening process provided a qualitative evaluation of the individual concepts. More thorough than the preceding fatal flaw screening, this step rated each improvement based on design, operations and safety, and environmental evaluation criteria. The evaluation criteria were developed for this study's Purpose and Need and pre-established goals.

Based on the results of the Level 1 Screening, the improvements were then divided into three tiers:

- Tier 1 – concepts with the highest potential for meeting the Purpose and Need and project goals
- Tier 2 – concepts with a medium potential for meeting the Purpose and Need and project goals
- Tier 3 – concepts with a low potential for meeting the Purpose and Need and project goals

Tier 1 and Tier 2 concepts were advanced to Level 2 Screening. Tier 3 concepts were not carried forward to Level 2 Screening but were held in reserve for consideration if the more detailed analysis in Level 2 screening indicates a Tier 1 or a Tier 2 concept performed poorer than expected.

Level 2 Screening – Quantitative Screening Process

The Level 2 Screening included grouping Tier 1 and Tier 2 concepts from Level 1 into projects based on compatibility and proximity. Six projects were identified for further evaluation and refinement. The six projects identified for further advancement in this study are listed in Table ES-1and shown in Figure ES-5.

The six projects identified for further advancement were subjected to a quantitative screening process. Similar to the qualitative Level 1 screening, this process assessed the six selected projects in three categories — design, operations and safety, and environmental. These categories included evaluation of the following criteria: cost, right-of-way, traffic operations, safety, and environmental impacts. Level 2 findings are summarized below.

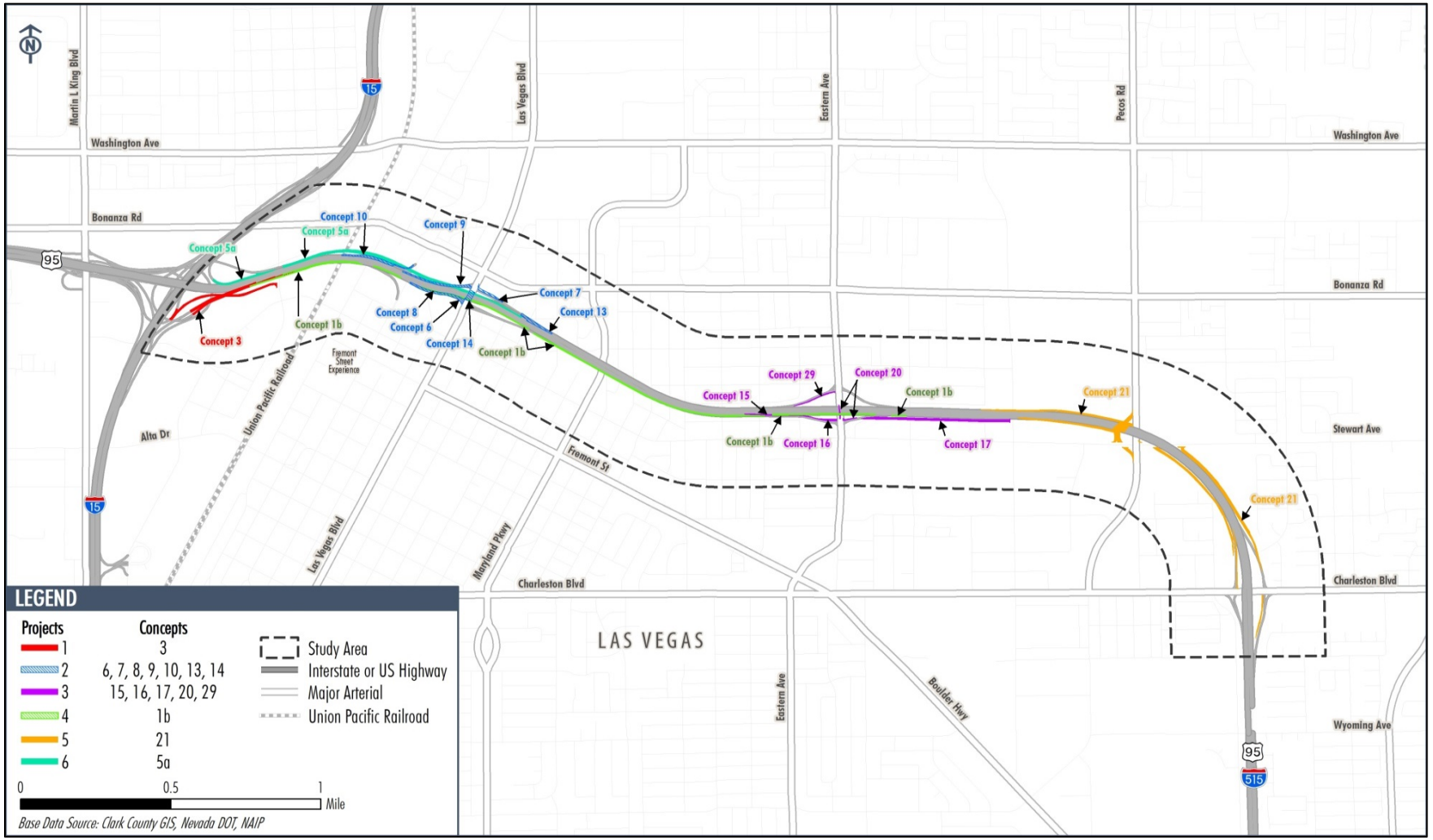
COST

Cost estimates for the projects identified for further advancement included two cost components: 1) capital costs and 2) operating, maintenance, and rehabilitation costs. All cost estimates were developed from preliminary conceptual drawings and are considered appropriate for planning level project programming purposes.

Table ES-1: Level 2 Screening – Projects Identified for Further Advancement in this Study

Project	Description of Project Elements	Benefits to Cost
Project 1: City Parkway Southbound Ramp	Construct a southbound directional ramp to City Parkway from the US 95/northbound I-15 ramp.	Project 1 Benefit/Cost Ratio 2.9
Project 2: Las Vegas Boulevard and Casino Center Boulevard Interchange Improvements	Add two right-turn lanes and two left-turn lanes on the southbound I-515 Las Vegas Boulevard off-ramp.	Project 2 Benefit/Cost Ratio 0.4
	Widen the I-515 northbound Las Vegas Boulevard off-ramp to provide two right-turn lanes.	
	Restripe the I-515 southbound Las Vegas Boulevard off-ramp to add one lane.	
	Widen the I-515 northbound Las Vegas Boulevard metered on-ramp to add one lane.	
	Widen the I-515 northbound Casino Center Boulevard on-ramp to three lanes.	
	Restripe the I-515 northbound Las Vegas Boulevard off-ramp to add a choice exit lane to the off-ramp.	
	Add one left-turn lane to the I-515 northbound Las Vegas Boulevard on-ramp interchange.	
Project 3: Eastern Avenue Interchange Improvements	Add one lane to the I-515 southbound Eastern Avenue off-ramp.	Project 3 Benefit/Cost Ratio 2.8
	Add one right-turn lane at the I-515 southbound Eastern Avenue off-ramp.	
	Construct a one-way frontage road between the I-515 southbound Eastern Avenue on-ramp and Mojave Road.	
	Add one left-turn lane on Eastern Avenue at the I-515 southbound Eastern Avenue Interchange.	
	Add one lane to the I-515 northbound Eastern Avenue on-ramp.	
Project 4: Southbound Auxiliary Lane from I-15 Underpass to Charleston Boulevard	Eliminate the southbound lane reduction at the I-15 underpass, and construct a full southbound auxiliary lane connecting to the proposed auxiliary lane between Eastern Avenue and Charleston Boulevard exit (partial widening of I-515 to the south).	Project 4 Benefit/Cost Ratio 6.8. Expected to have the greatest benefit/cost ratio because of the expected significant corridor-wide benefits.
Project 5: Pecos Road Interchange	Construct a split diamond interchange at I-515 and Pecos Road.	Project 5 Benefit/Cost Ratio 0.3. If completed together with other capacity improvement projects, it is likely that greater benefits would be realized.
Project 6: Collector-Distributor Road from Las Vegas Boulevard to I-15	Construct a collector-distributor road to allow ramp braiding on northbound I-515 between I-15 and Las Vegas Boulevard.	Project 6 Benefit/Cost Ratio 1.2. Expected to produce significant corridor-wide benefits greater than reflected in ratio. See Report.

Figure ES-5: Level 2 Screening – Projects Identified for Further Advancement in this Study



TRAFFIC OPERATIONS

Traffic operation analyses showed that each of the six projects identified for further advancement in this study would result in higher speeds and lower delays compared to the No-Action Alternative. Traffic operation results are summarized below.

- Project 1 is expected to impact traffic operations in three key segments of the I-515 study area. Both positive and negative impacts are expected if Project 1 is implemented as a stand-alone project.
- For Projects 2 and 3, operational impacts would be mostly localized.
- Project 4, which includes a third southbound lane under the Spaghetti Bowl, would eliminate a severe bottleneck, resulting in significant congestion reduction and improvements in corridor-wide operations.
- Minimal changes in operations are expected under Project 5 within the study area due to congestion and bottlenecks upstream and downstream along the I-515 corridor.
- Project 6 would result in significant congestion reduction and improvement in corridor-wide operations. Project 6 would also result in fewer vehicles entering I-515 because traffic from Las Vegas Boulevard and Casino Center Boulevard could access I-15 directly.

SAFETY

The study presents the safety performance of the six projects when compared to the No-Action Alternative. Project 6 provided the greatest improvement regarding crash frequency, with a reduction of 60 crashes per year per lane mile.

ENVIRONMENTAL

The Level 2 environmental screening refined the Level 1 environmental resource evaluations for each project, which included EJ populations, community facilities, recreational, cultural, and Section 4(f) resources, and hazardous material sites. The results of the environmental screening analysis are summarized in Table ES-2.

Table ES-2: Level 2 Environmental Screening Results

Project Number	EJ & Community Impacts Rating	Recreation Impacts Rating	Cultural Impacts Rating	Hazardous Materials Impacts Rating	Overall Rating
Project 1					
Project 2					
Project 3					
Project 4					
Project 5					
Project 6					

Level 3 Screening – Benefit/Cost Analysis

Level 3 involved benefit/cost analyses to evaluate the six projects identified for further advancement in this study. Benefits quantified in the analysis corresponded to:

- Reduced Travel Time
- Reduced Vehicle Operations Costs
- Reduced Crashes (Improved Safety)
- Reduced Emissions

Costs quantified in the analysis included:

- Capital Costs
- Operation, Maintenance, and Rehabilitation Costs

Results

Benefits and costs calculated for each project were discounted to determine common equivalent year 2016 benefits and costs. These discounted benefits and costs were used to determine the final benefit/cost ratios. The study presents the total cumulative benefits, costs, and benefit/cost ratios for all six projects. Some key observations from the benefit/cost analyses were:

- Project 1, Project 3, Project 4, and Project 6 are expected to provide benefit/cost ratios greater than 1.0. This implies that the total cumulative benefits produced would be greater than the total cumulative implementation costs for these projects.
- Project 4 is expected to have the greatest benefit/cost ratio (greater than 6.0) because of the significant corridor-wide benefits expected.
- Project 2 and Project 5 are expected to have a benefit/cost ratio below 1.0. This implies that the total cumulative benefits produced would be lower than the total cumulative cost of implementation.
- The true benefits of Project 6 will likely be greater than those represented by the benefit/cost ratio presented in the report. Reasons for this conclusion are explained in the Key Observations Regarding the Estimated Benefits section of the report.

ES.4 Outreach Conducted

NDOT conducted an extensive agency, stakeholder, and public outreach program throughout this study. A Public Information Plan was established at the onset of the study, with the goal to engage agencies, stakeholders, and members of the public in a meaningful way while reestablishing connections with stakeholders that were involved in the *I-515 Preliminary Draft Environmental Impact Statement* process.

Stakeholder Outreach

NDOT solicited stakeholder involvement throughout this study to achieve the following objectives:

- Proactively identify project and corridor issues, concerns, and needs
- Build valuable relationships

- Establish and strengthen public trust and support

NDOT involved stakeholders throughout the course of this study through the following:

- Project Kick-off Meeting and Site Visit
- Individual Stakeholder Interviews/Meetings
- Stakeholder Workshops and Field Trips

Public Outreach

Members of the public were provided the following opportunities to offer comments about this study:

- Send comments directly by email or U.S. mail
- Call NDOT project manager by telephone
- Send email using email link on project website
- Submit contact request form provided on project website
- Complete comment form provided at public meeting
- Provide verbal comments to stenographer at public meeting

A public meeting was held on March 31, 2016, at the East Las Vegas Community Center, which provided an opportunity for members of the public to express their concerns and have their questions answered. The meeting was conducted in an open house format with exhibit reviews from 4:00 PM to 7:00 PM, and a short presentation at 5:30 PM, followed by a question-and-answer session.

A project website (http://nevadadot.com/i-515study/) was established early and regularly updated to keep agencies and members of the public informed and up-to-date.

Over the course of the study, study team members were available for interaction with the public via phone, fax, email, and in person. The study team reached out to minority and low-income groups and organizations in the study area before and after the public meeting to advertise the meeting, provide general project information, and answer questions.

Significant public comments received are summarized below:

- Funding: Questions raised about how much the projects will cost and how they will be funded.
- Purpose and Need: Support voiced for improving the I–515 corridor.
- Alternatives/Design: Suggestions received about various design elements, such as bridge construction, ramp configurations, and additional lanes. Both support and opposition were voiced for the improvements, as recorded in letters and comments from the various meetings.

Agency coordination included meetings between FHWA and NDOT to discuss project status, public and agency involvement activities, work products, and improvement concepts.

In February and March 2016, NDOT sent 47 Intent to Study letters to local, state, and federal agencies; government bodies; companies; and organizations to identify concerns and potential issues related to the project. Comments received were considered during execution of the study.

ES.5 Implementation

This study identified six projects for further advancement, designed to address the traffic operational and safety needs along the I-515 corridor. These projects must compete for limited funding resources in order to be implemented. NDOT project priorities are reflected in its long-range transportation plan, *Connecting Nevada* (NDOT 2013), and its near-term Statewide Transportation Improvement Program (STIP) (NDOT 2016b). NDOT intends to evaluate, compare, and prioritize the projects from this study in relation to other transportation needs in the state to determine which projects will be added to the STIP and eventually constructed.

In cooperation with the City of Las Vegas, NDOT plans to advance Project 1 (City Parkway Southbound Ramp) and begin the environmental analysis in early 2017. Project 1 has received extensive support from stakeholders since its inception.

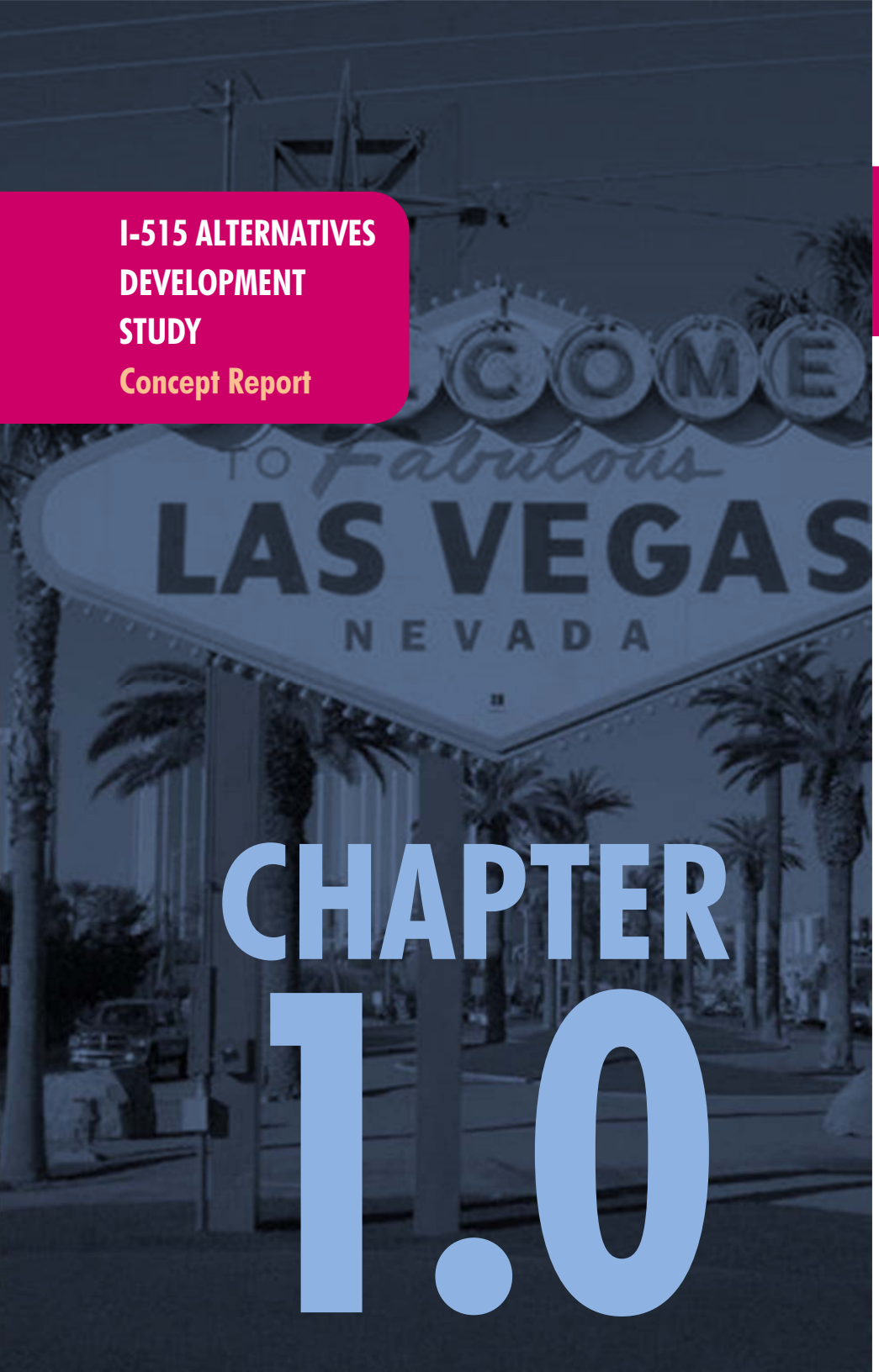
NDOT plans to seek funding for other high-value projects from this study. As funding is identified, projects will advance through project development, including the environmental, design, right-of-way, and construction phases.

Viaduct Structures: Project 7 and Project 8

Assessment of the two structures that comprise the Downtown Las Vegas Viaduct (G-947 and I-947) concluded that each structure would need to be replaced or rehabilitated, and this work would be best achieved in coordination with the implementation of adjacent projects. The G-947 viaduct structure (referred to as Project 7 in this study) is not a candidate for major rehabilitation investment and should be programmed for replacement. The I-947 viaduct structure (referred to as Project 8) could potentially be rehabilitated and widened; determination of a final replacement vs. rehabilitation course of action would require more detailed study.

National Environmental Policy Act Process

As NDOT identifies projects for implementation, it will coordinate with FHWA to outline environmental clearance requirements under NEPA. Because this study adopted a PEL approach, an environmental analysis was conducted at the planning level based on existing mapping and environmental resource data. Future NEPA studies will require more detailed analyses of the environmental resources that could be impacted by the projects as they are implemented.



I-515 ALTERNATIVES DEVELOPMENT STUDY
Concept Report

CHAPTER 1.0

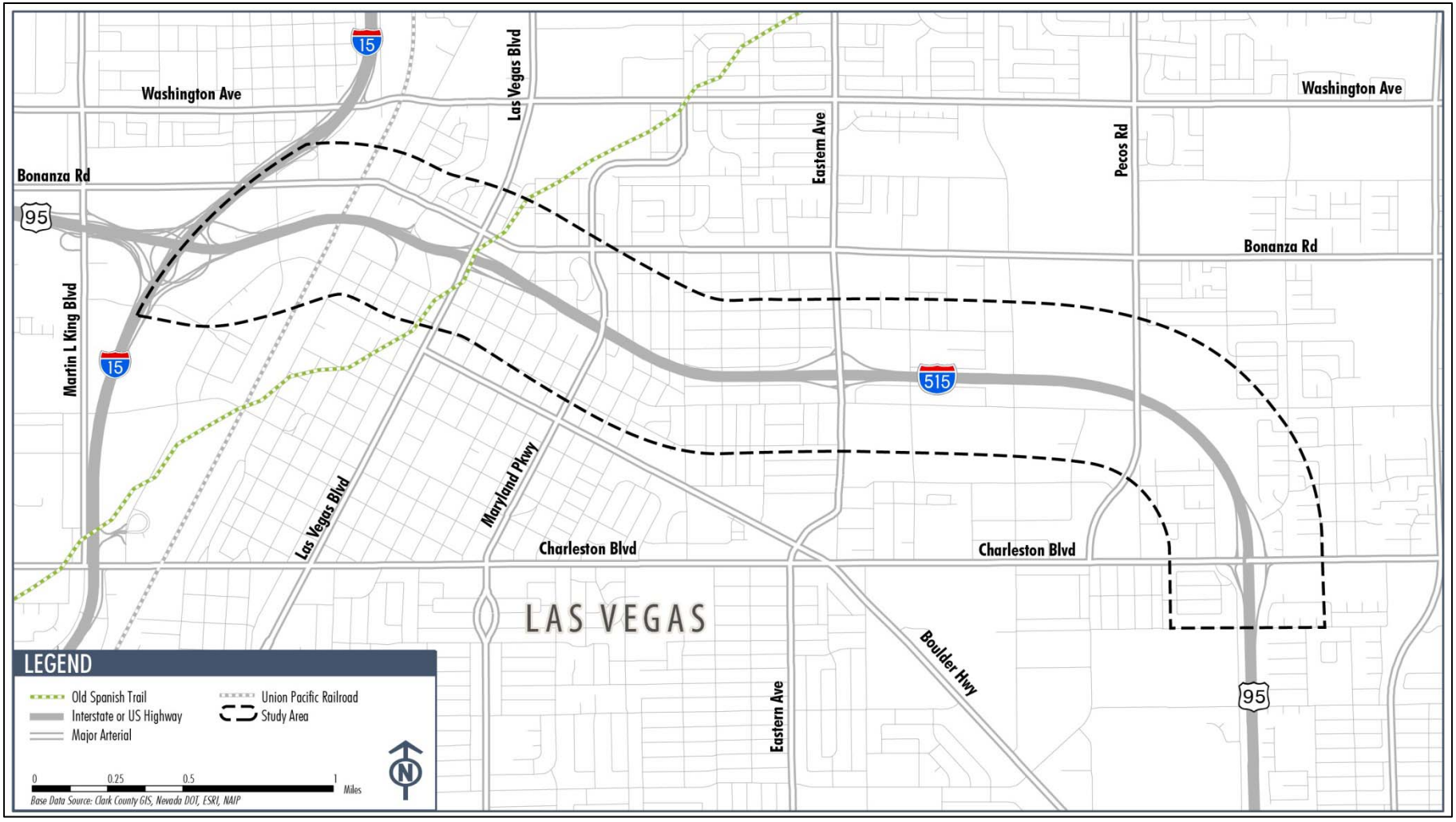
Chapter 1.0 Introduction and Study Background

1.1 Study Location and Description

The U.S. Interstate 515 (I-515) is a 20-mile spur of I-15 between the junction of I-15 and US 95 (known as the Las Vegas Spaghetti Bowl interchange) and Railroad Pass in southeastern Henderson, Nevada. This I-515 Alternatives Development Study was initiated by the Nevada Department of Transportation (NDOT) to identify and evaluate near-term operational and safety improvements along I-515 from the Spaghetti Bowl to Charleston Boulevard in Las Vegas (study area), as shown on Figure 1-1. This study is intended to be a precursor to future NDOT environmental studies to comply with the National Environmental Policy Act (NEPA). Specifically, this study:

- Identifies near-term transportation needs in the study area.
- Identifies and evaluates improvements to address those needs.
- Groups the improvements into alternatives based on geographic proximity and compatibility.
- Further refines and prioritizes alternatives to meet the study purpose, needs, and goals.

Figure 1-1: Study Area



The study area can be characterized as urban. Land uses within the study area vary from developed industrial and commercial uses in the west to civic, recreational, and residential uses in the center and east.

The study team, which included NDOT and the consultant team of Jacobs, Atkins, and Louis Berger Group, used the Planning and Environmental Linkages (PEL) approach. PEL represents a collaborative and integrated approach to transportation decision-making that 1) considers environmental, community, and economic goals early in the transportation planning process, and 2) uses the information, analysis, and products developed during planning to inform the environmental review process. A PEL approach seeks to minimize duplication of effort, promote environmental stewardship, and reduce delays. As part of this PEL approach, the study team developed a Purpose and Need statement, evaluated improvements, and recommended potential projects for NDOT to evaluate further. The team also solicited public and agency input on the process and study findings.

1.2 Study Background and Context

Over the past decade, the study area has been included in numerous transportation-related studies and plans. These documents provide a broader context for the transportation issues and potential solutions within the study area. This section briefly describes the previous studies and plans, and how they inform or impact this study.

I-515 Preliminary Draft Environmental Impact Statement (DEIS), 2009, NDOT

Purpose: Assessed impacts of several transportation alternatives to reduce congestion, enhance safety, and improve the performance of the entire I-515 corridor. The preliminary DEIS was never finalized.

Relation to I-515 Alternatives Development Study: The DEIS included construction of additional lanes and interchanges, local street improvements, reconstruction of the Downtown Las Vegas Viaduct (between N. Eastern Avenue and W. Mesquite Avenue), installation of a Freeway Management System and express lanes, and reconstruction and extension of pedestrian and bicycle facilities along I-515. The study team collected and used the environmental data in the DEIS in the preliminary data collection and analysis for this study.

Statewide Transportation Improvement Program, 2016 – 2019, NDOT

Purpose: NDOT administers and implements programs for the planning, development, construction, and operation of the state's transportation system. NDOT develops an annual Statewide Transportation Improvement Program (STIP) covering all areas of the state (NDOT 2016). The STIP is used to implement the plans resulting from the statewide transportation planning process.

Relation to I-515 Alternatives Development Study: I-515 Downtown Viaduct Rehabilitation, I-515/Charleston Boulevard Interchange and Auxiliary Lane Improvements, and I-515 NEPA projects are listed in the STIP.

2035 Regional Transportation Plan (RTP), 2013, Regional Transportation Commission (RTC)

Purpose: Identified the transportation investments needed within the region through 2035. A 20-year long-range plan for the transportation system in Southern Nevada, the current RTP was approved in 2013 and is currently being updated to reflect revenue changes and revised transportation priorities.

Relation to I-515 Alternatives Development Study: The RTP lists the following I-515 projects within the study area:

- I-515 between Charleston Boulevard and I-15/US 95 Interchange (Spaghetti Bowl): Widen to 10 lanes to include high occupancy vehicle (HOV) lanes; add new interchanges at Pecos Road and F Street. Anticipated completion 2031.
- I-515 at Charleston Boulevard Interchange improvements. Anticipated completion 2018.

Casino Center Boulevard/Stewart Avenue to I-515 (US 95) Improvements Plan, City of Las Vegas

Purpose: Proposed converting Casino Center Boulevard between Stewart Avenue and US 95 (I-515) into a two-way street with the addition of one northbound lane, and keeping the southbound lane configuration. The plan also proposed altering the intersection of Casino Center Boulevard and Stewart Avenue to provide vehicular access to northbound US 95 (I-515) via Casino Center Boulevard, and reconstructing curbs and sidewalks to accommodate pedestrians on the west side of Casino Center Boulevard.

Relation to I-515 Alternatives Development Study: When constructed, this project would impact the surface street system below I-515, and access to northbound I-515. Because construction of these proposed improvements is imminent, they were included in this study's future conditions.

Road Safety Assessment Report (RSA) for I-515/US 93/US 95 from Rancho Drive to Wyoming Avenue Grade Separation, 2015, NDOT

Purpose: Conducted field review and evaluated existing conditions to identify areas to improve safety.

Relation to I-515 Alternatives Development Study: The report provided several recommendations for safety improvements, which are incorporated into this study.

City of Las Vegas, I-515 and Charleston Boulevard Interchange Alternatives Feasibility Study, 2015, City of Las Vegas

Purpose: Evaluated potential alternatives and provided recommendations for interchange improvements for the I-515 and Charleston Boulevard interchange and 0.75 mile along Charleston Boulevard from Honolulu Street to Lamb Boulevard. An environmental assessment (EA) is in progress that will identify the preferred interchange selection, along with other improvements within and near the study area.

Relation to I-515 Alternatives Development Study: Two interchange improvement options were recommended:

- Tight Urban Diamond Interchange (TUDI)
- Diverging Diamond Interchange (DDI)

These interchange and other associated improvements are included in the base future conditions for this study.

SOUTHERN NEVADA HOV PLAN, 2007 (REV. 2015), NDOT	CITY OF LAS VEGAS MOBILITY MASTER PLAN, 2016, CITY OF LAS VEGAS
Purpose: Assessed the effectiveness of constructing HOV lanes in the Las Vegas metropolitan area to alleviate future traffic congestion. The plan was updated in 2015 to include changes in the RTC's Regional Travel Demand Model, updates to NDOT's *Managed Lanes and Ramp Metering Manual*, short- and long-term HOV recommendations, and an HOV system operational plan.	**Purpose:** Functions as the transportation component of the City of Las Vegas's citywide *Strategic Plan*. The *Mobility Master Plan* provides a 20-year vision for transportation in Las Vegas and presents transportation recommendations for each of the six City Wards.
Relation to I-515 Alternatives Development Study: The plan recommends one HOV lane in each direction along the I-515 corridor for the long term (i.e., beyond 2025). Additionally, the plan proposes HOV direct access drop ramps on I-515 at Maryland Parkway to and from both the north and south.	**Relation to I-515 Alternatives Development Study:** Recommends two projects within the study area to improve vehicular access: o Maryland Parkway and I-515 Interchange o City Parkway/I-515 Interchange
PROJECT NEON FINAL ENVIRONMENTAL IMPACT STATEMENT (FEIS), 2010 (REV. 2012), NDOT	**LAS VEGAS DOWNTOWN TRAFFIC CAPACITY, TRANSIT, AND PARKING NEEDS STUDY, 2007, RTC**
Purpose: Assessed alternatives to improve safety and travel efficiency in the I-15 corridor from the Sahara Avenue interchange to the Las Vegas Spaghetti Bowl. The FEIS proposed reconstructing I-15 to provide four to five through-lanes in each direction, auxiliary lanes, collector-distributor roads, local street improvements, two HOV lanes in each direction, and a direct HOV connector from the I-15 HOV lanes to the US 95 HOV lanes.	**Purpose:** Commissioned by the RTC to identify traffic conditions, document parking supply, evaluate future network operations, and recommend improvements for the downtown area. The study primarily focuses on improvements related to pedestrians and alternative transportation modes.
Relation to I-515 Alternatives Development Study: The first phase of work is under construction. Improvements or alternatives assessed in this study must be compatible with the proposed improvements near the Spaghetti Bowl.	**Relation to I-515 Alternatives Development Study:** The report noted that the worst traffic congestion occurs on two primary arterials within the study area: Charleston Boulevard and Las Vegas Boulevard.

Vision 2045 Downtown Las Vegas Master plan, 2016, City of Las Vegas	Southern Nevada Strong Regional Plan, 2015, RTC
Purpose: Provided an overall vision, policy direction, and implementation strategy that support the ongoing recovery and revitalization of downtown Las Vegas. The *Masterplan* is one of several products of the City by Design initiative – a citywide planning effort focused on the revival of downtown Las Vegas. The *Masterplan* focuses on three areas: Land Use and Community Development, Mobility and Sustainability, and Economic Development and Strategic Planning. The planning process included six planning stages: 1) Inventory and Analysis, 2) Vision Plan, 3) Alternative Master Plan Concepts, 4) Preferred Master Plan Scenario, 5) Draft Implementation Strategy, and 6) Final Master Plan Documentation. The Masterplan was adopted by the City Council (Resolution R-25-2016) in June 2016.	**Purpose:** Developed regional support under this regional planning and visioning effort for long-term economic success and stronger communities by integrating reliable transportation, quality housing for all income levels, and job opportunities throughout Southern Nevada. The plan outlines valley-wide goals grouped under three focus areas: 1) improving economic competitiveness and education, 2) investing in complete communities, and 3) increasing transportation choice. The plan presents a "Vision Map" that conceptually illustrates how the regional vision can be implemented through coordinated land use and transportation planning.
Relation to I-515 Alternatives Development Study: o The plan identifies the I-515 corridor as a barrier that contributes to the marginalization of "North Downtown" by isolating the Cultural Corridor located north of I-515 along Las Vegas Boulevard and dividing the Helen J. Steward neighborhood (north of this study area). o The plan mentions several areas within this study area that will likely experience growth in the near future, including the Cashman Center, Symphony Park, and the Medical District. o The plan notes heavy traffic and congestion occurring along the I-515 corridor near downtown, as well as along Charleston Boulevard and Las Vegas Boulevard, as issues facing downtown revitalization.	**Relation to I-515 Alternatives Development Study:** The plan recommends several opportunity sites, including the Maryland Parkway (between McCarran International Airport and Charleston Boulevard), which is closest to the I-515 corridor. The plan does not have a direct impact on this study, but its general recommendations and vision are noted.

PECOS ROAD CORRIDOR STUDY, 2009, RTC	MARYLAND PARKWAY ALTERNATIVES ANALYSIS, 2014, RTC
Purpose: Commissioned by RTC to develop alternative short-term and long-term solutions to traffic congestion, increasing travel demand, and projected continued growth along Pecos Road between Clark County Road 215 on the north to Fremont Street/Boulder Highway on the south.	**Purpose:** Conducted by the RTC of Southern Nevada to study potential transit improvements between downtown Las Vegas and McCarran International Airport. The Locally Preferred Alternative (LPA) included center-running transit (bus rapid transit or rail) along Maryland Parkway. An EA and preliminary engineering are ongoing.
Relation to I-515 Alternatives Development Study: The study recommends short-term and long-term improvements along Pecos Road at the intersection of Charleston Boulevard, which is located within the study area.	**Relation to I-515 Alternatives Development Study:** Maryland Parkway crosses the study area, and improvements there could affect this study. Recent indications are that a side-running transit option is possible and the proposed route will not extend to I-515.
TRANSPORTATION INVESTMENT BUSINESS PLAN (TIBP), 2016, RTC	**SOUTHERN NEVADA REGIONAL GOODS MOVEMENT MASTER PLAN, 2015, RTC**
Purpose: Focused on developing framework and strategies for economic and transportation infrastructure development in the core area of Las Vegas, encompassing the Las Vegas Strip and downtown Las Vegas, the Convention Center, the Global Business District, other major convention facilities, McCarran International Airport, and the University of Nevada/Las Vegas (UNLV). TIBP is a comprehensive plan for roadway, transit, and pedestrian-related transportation investments, including potential funding mechanisms and a phased implementation program.	**Purpose:** Provided a snapshot of the region's freight transportation system, a forecast of future freight demand, and recommendations to address regional freight deficiencies.
Relation to I-515 Alternatives Development Study: The plan recommends several improvements within the study area, including high-capacity transit improvements along Charleston Boulevard and South Las Vegas Boulevard, and interchange improvements at I-515 at City Parkway and I-515 at Maryland Parkway.	**Relation to I-515 Alternatives Development Study:** The plan mentions northbound I-515 at the Charleston Curve as experiencing recurring congestion, and mentions the study area as a location with average peak-hour travel speeds more than 20 miles per hour (mph) below the posted speed. Identifies "last-mile" connection/delivery issues for freight.

Corridor Concept Report, I-11 and Intermountain West Corridor Study , 2014, NDOT and Arizona Department of Transportation (ADOT)

Purpose: Established a vision statement, provided justification, and developed concepts for a new high-capacity, multimodal transportation corridor through Arizona and Nevada. The study used the PEL approach to identify design concepts, and recommended three alternatives for a new corridor within the Las Vegas area for further study, including (1) a new corridor on the east side of the valley in combination with Clark County 215 (CC-215) Northern Beltway, (2) a new corridor along I-515/US 95 through the center of the valley, and (3) co-location with I-215/CC-215 Southern and Western Beltway.

Relation to I-515 Alternatives Development Study: All alternatives would enter Las Vegas from the south using the Boulder City Bypass. However, none of the alternatives from this study have considered future I-11 through traffic on the I-515 corridor, since the actual alignment through the Las Vegas Valley has not been determined.

Cashman Center Redevelopment, City of Las Vegas

Purpose: Proposed adaptive reuse of the Cashman Center, a multi-use facility encompassing 483,000 square feet on a 50.25-acre site within downtown Las Vegas, currently owned and operated by the Las Vegas Convention and Visitors Authority (LVCVA). The Cashman Center is one of the potential development hubs in the *Downtown Master Plan*, envisioned as a significant sports venue with mixed-use development, including residential. On May 21, 2014, the City of Las Vegas and the LVCVA entered into a two-year Memorandum of Understanding that authorized the City to enter into an Exclusive Negotiation Agreement for the adaptive reuse of the site.

Relation to I-515 Alternatives Development Study: The Cashman Center is located approximately 1.0 mile north of the study area, off North Las Vegas Boulevard. If the site is redeveloped, it could impact traffic movements and traffic congestion along I-515.

1.3 Study Limits/Logical Termini

Logical termini represent rational starting and stopping points for evaluating transportation improvements. The logical termini, or study limits, for this study extend from the Spaghetti Bowl to Charleston Boulevard. The northern terminus at I-15 ties to Project Neon, another major project. The southern terminus is located at the existing Charleston Boulevard interchange, where improvements are being evaluated as part of an ongoing EA. The traffic analysis limits for this study are broader, extending west of the Spaghetti Bowl to Rancho Drive and south of Charleston Boulevard to the Wyoming Avenue overpass.

1.4 Purpose and Need

Purpose and Need statements describe the transportation needs that exist and the problems to be addressed within the study area.

1.4.1 Purpose

The purpose of this study is to improve traffic operations and safety on the I-515 corridor, including ramp terminal intersections, between I-15 (at the Spaghetti Bowl interchange) and Charleston Boulevard by implementing near-term and cost-effective transportation improvements that are compatible with other future improvements.

1.4.2 Needs for the Study

MOBILITY PROBLEM: IMPAIRED TRAFFIC FLOW RESULTING FROM HIGH TRAFFIC VOLUMES, SUBSTANDARD GEOMETRY, AND INCIDENTS.

Traffic jams repeatedly occur during peak travel periods at predictable locations as a result of high traffic volumes, bottlenecks, substandard road design, and vehicle incidents (e.g., crashes and breakdowns) that reduce the travel speeds along the corridor. During peak hours, average speeds within the study area drop to as low as 15 mph between the Spaghetti Bowl and the downtown interchanges in the southbound direction, and 10 mph along the entire study area limits in the northbound direction. Special events within the vicinity of the study area also cause congestion along the corridor.

Figure 1-2: Traffic Congestion within the Study Area

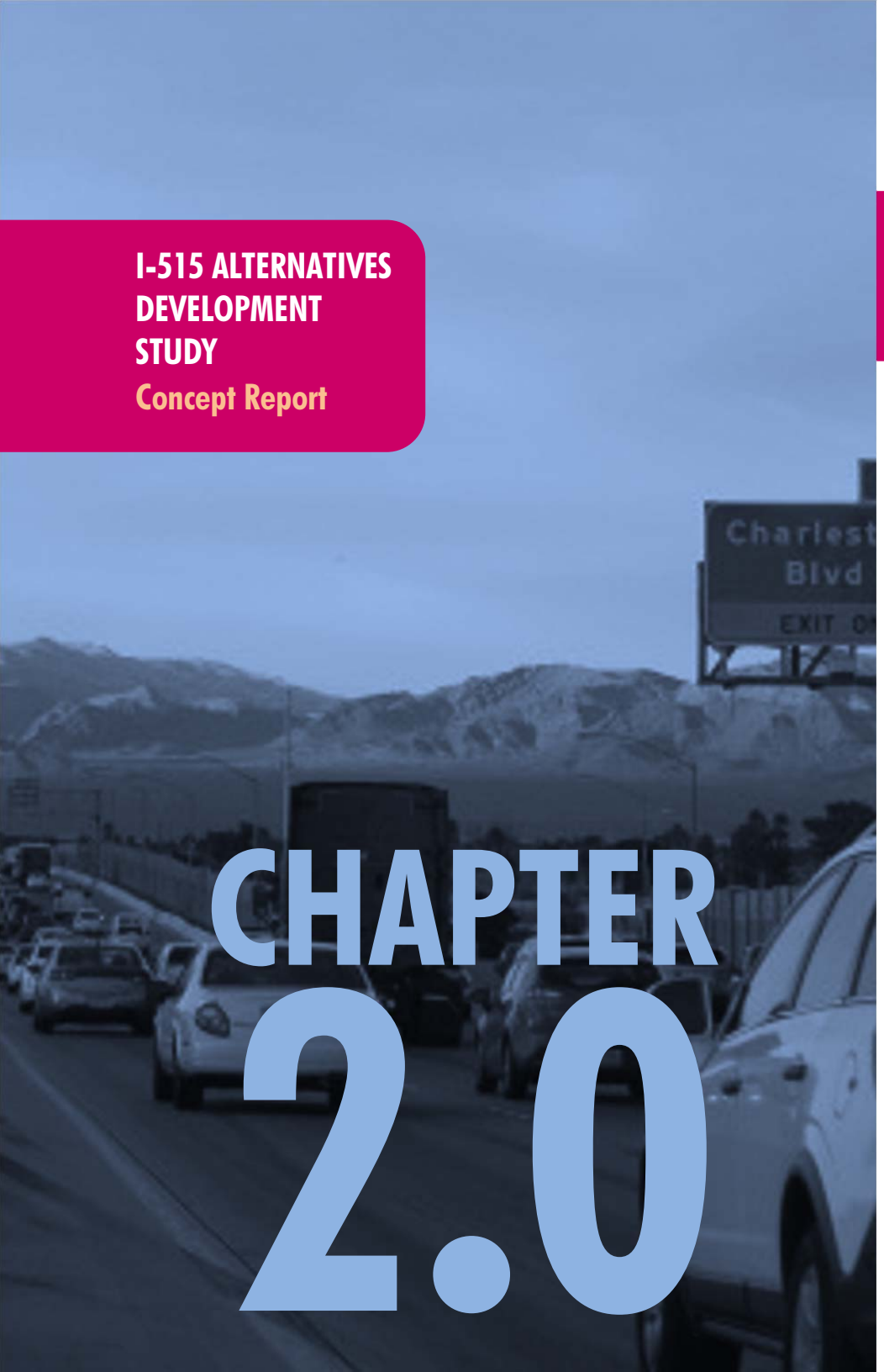
SAFETY PROBLEM: HIGHER THAN EXPECTED CRASHES DUE TO TRAFFIC CONGESTION AND SUBSTANDARD GEOMETRY.

I-515 within the study area has higher than average crash rates compared to statewide average crash rates for similar facilities, with most crashes occurring between the Spaghetti Bowl and the Las Vegas Boulevard interchanges.

1.5 Study Goals

Study goals supplement the Purpose and Need and help guide the alternatives screening process. These goals help differentiate between transportation improvements identified to meet the transportation needs. The goals of this study are to develop project alternatives that:

- Improve mobility within the I-515 corridor
- Improve safety within the I-515 corridor
- Do not preclude long-term improvements in the I-515 corridor
- Minimize right-of-way acquisition
- Have limited environmental impacts
- Improve access to downtown Las Vegas
- Have independent utility and logical termini
- Enhance mobility during special events
- Maintain and/or improve multimodal connections for buses, pedestrians, and bicyclists
- Are compatible with adopted plan



I-515 ALTERNATIVES DEVELOPMENT STUDY
Concept Report

CHAPTER 2.0

Chapter 2.0 Existing Corridor Conditions

2.1 Roadway Network

The Interstate 515 (I-515) freeway extends between the City of Las Vegas and City of Henderson, with interchanges serving both cities and unincorporated areas of Clark County. In the north, I-515 provides access to downtown Las Vegas and the I-15 and US 95 freeways, which in turn provide access to the north, west, south, and central portions of the Las Vegas Valley. In the south, I-515 connects to the Las Vegas Beltway (I-215) freeway and US 93 highway toward Boulder City. The study area, as described in Chapter 1, consists of the I-515 corridor, from I-15 to Charleston Boulevard. The study area is located fully within the jurisdictional boundaries of the City of Las Vegas. The area considered in the traffic analysis (referred to as the traffic study area) extends slightly beyond the study area boundary to the west of I-15 and south of Charleston Boulevard.

The following major streets cross beneath I-515 within the study area: City Parkway, Main Street, Casino Center Boulevard, Las Vegas Boulevard, Maryland Parkway, Bruce Street, Eastern Avenue, Mojave Road, Pecos Road, Stewart Avenue, and Charleston Boulevard. These streets provide a network of roads that complement I-515.

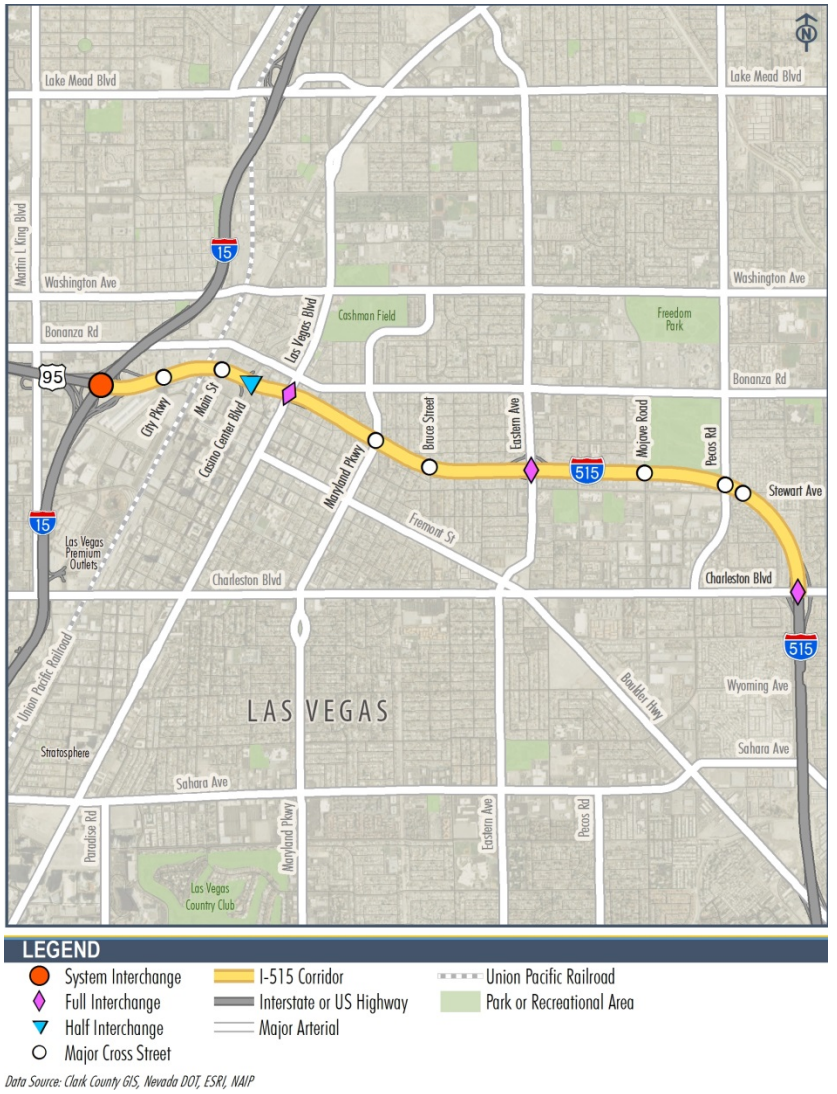
One system interchange (with I-15) and four service interchanges are located within the study area. These include:

- A system interchange at I-15 (the "Spaghetti Bowl"), with directional ramps in all directions
- Full diamond configuration service interchanges at Las Vegas Boulevard, Eastern Avenue, and Charleston Boulevard
- A half interchange providing a southbound exit to Casino Center Boulevard and a northbound entrance from 4th Street

Casino Center Boulevard and Las Vegas Boulevard provide direct access to downtown Las Vegas. Figure 2-1 depicts the road network within the study area.

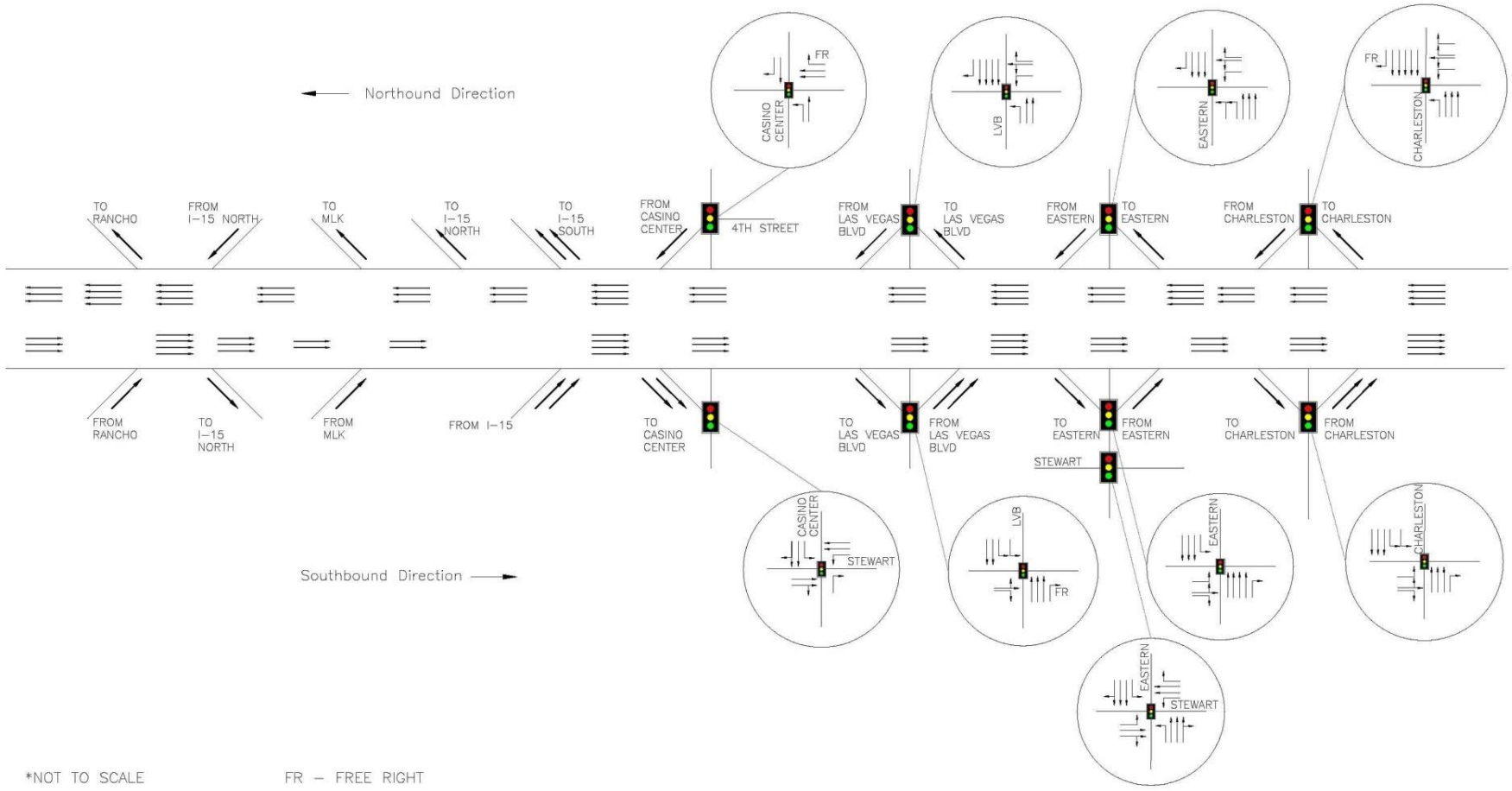
At the Spaghetti Bowl interchange, I-515 crosses at-grade under an elevated I-15. I-515 consists of five lanes under I-15: two eastbound lanes and three westbound lanes. Immediately east of I-15, I-515 transitions to a fully-elevated six-lane freeway (the Downtown Las Vegas Viaduct) to Eastern Avenue. From the Spaghetti Bowl to Charleston Boulevard, I-515 consists of three through-lanes in each direction. Auxiliary lanes provide a fourth lane in each direction between the I-15 ramps and the Casino Center/4th Street interchanges, and between the Las Vegas Boulevard and the Eastern Avenue interchanges. Figure 2-2 shows the existing lane configurations along the I-515 corridor. The limits on this figure extend beyond the study area limits (to Rancho Drive) because this figure represents the traffic modeling limits. The signalized ramp terminal intersections shown on the figure are the study intersections that were included in the traffic modeling and analysis.

Figure 2-1: Study Area Road Network



Data Source: Clark County GIS, Nevada DOT, ESRI, NAIP

Figure 2-2: Existing Lane Configurations



2.2 Land Use and Demographic Characteristics

The traffic study area has a mix of land uses that includes residential, commercial, public, parks and recreation, mixed-use, and industrial. Figure 2-3 shows the land use within the traffic study area. As indicated on Figure 2-3, land uses within the traffic study area are divided into four areas, summarized below:

- **Area 1**: This area, located on the west end of the I-515 study area, is bounded to the east by the I-15 freeway and to the west by Rancho Drive. The predominant land use types are industrial, mixed-use, and residential. Public facilities and commercial uses are also present. This area generates high traffic volumes, resulting in peak period congestion on Martin Luther King Boulevard and Rancho Drive arterials.
- **Area 2**: Downtown Las Vegas lies within this area, which is bounded to the north by the Cashman Center and to the south by Bridger Avenue. The east and west boundaries are Bruce Street and the I-15 freeway, respectively. To the south of I-515, land use is commercial and mixed-use. To the north of I-515, public facilities and industrial uses are included, with areas of commercial and mixed-use. I-515 within this area experiences AM and PM peak period congestion. Additionally, the roadways in Area 2 experience congestion during events in the downtown area.
- **Area 3**: This area is bounded on the east by Pecos Road and on the west by Bruce Street. This segment of the I-515 corridor has the highest mix of land uses within the study area. Land uses in the eastern portion of this segment are predominantly industrial and public facilities, including one park. Land uses in the middle portion consist of residential, public facilities, and commercial, while land uses in the western portion predominantly consist of residential with some commercial and mixed-use.
- **Area 4**: This area occupies the east end of the traffic study area and is bounded to the west by Pecos Road. Except for small pockets of land allocated to public facilities, commercial, and industrial uses, land use in Area 4 is almost entirely residential.

Figure 2-4 shows the occupied housing unit density per square mile within the traffic study area, which influences trip generation. Figure 2-5 shows the major trip generators. As seen on Figure 2-5, most of the major employers in the traffic study area are located close to I-515 or other major arterials.

2.2.1 I-515 Corridor Demographics

Between 1990 and 2015, the Las Vegas Valley urban area experienced an average population growth rate of about 4.12 percent per year. All years since 1990 recorded positive growth, except when the population declined between 2008 and 2011. The Las Vegas Valley urban area population represents over 95 percent of Clark County's overall population. Figure 2-6 shows Las Vegas urban area average population growth between 1990 and 2015.

Figure 2-3: Land Use within Traffic Study Area

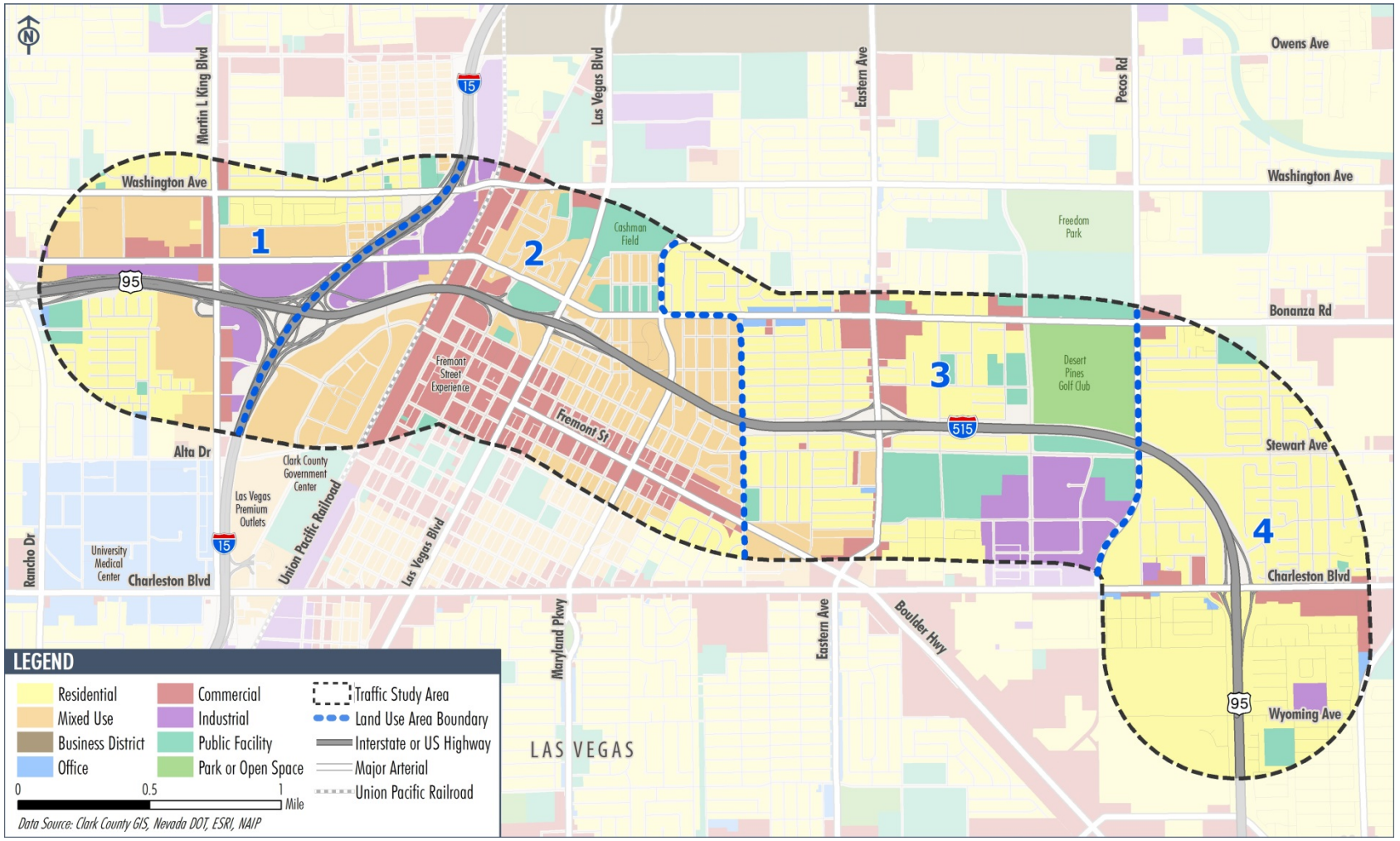


Figure 2-4: Occupied Housing Unit Density (Units per Square Mile) within Traffic Study Area

Figure 2-5: Major Trip Generators

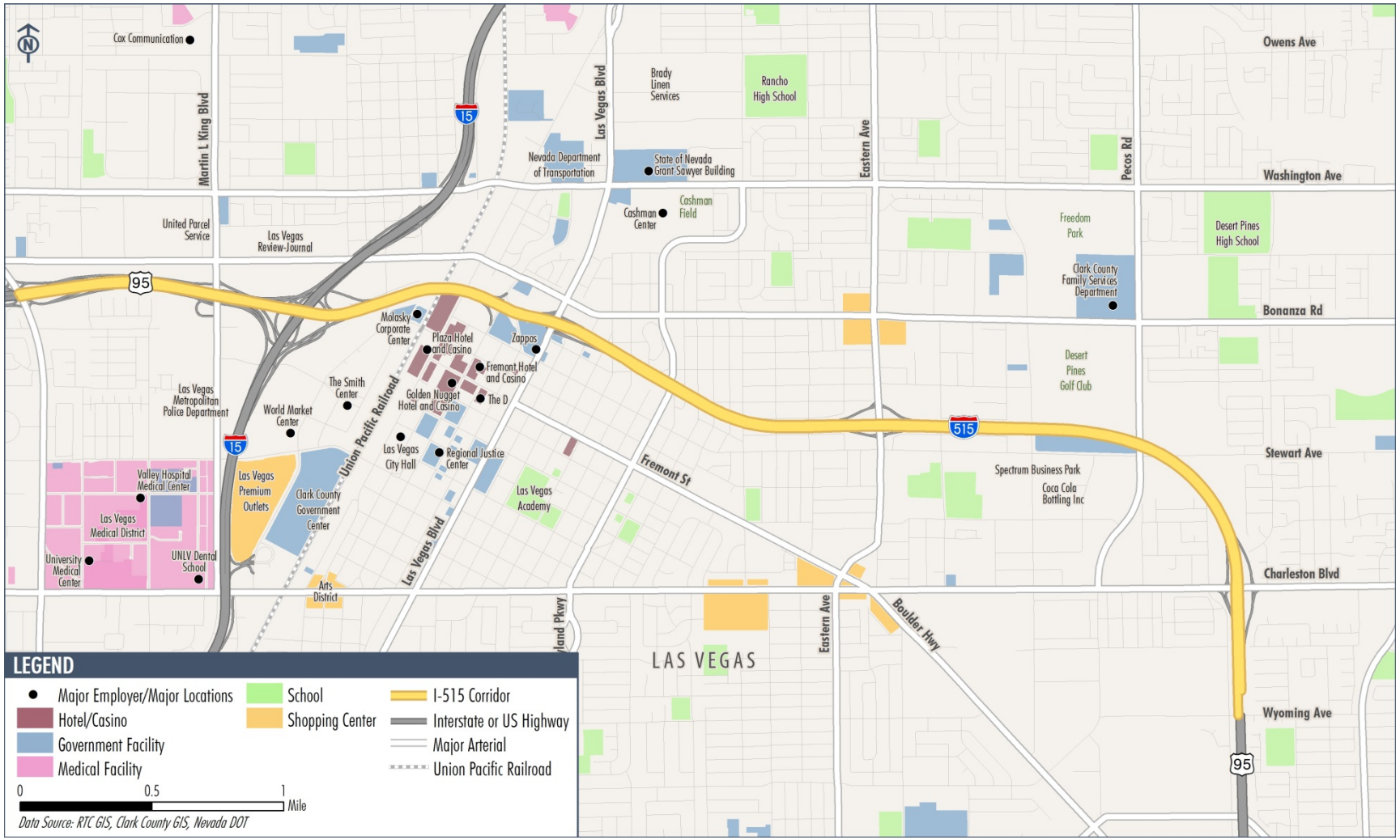
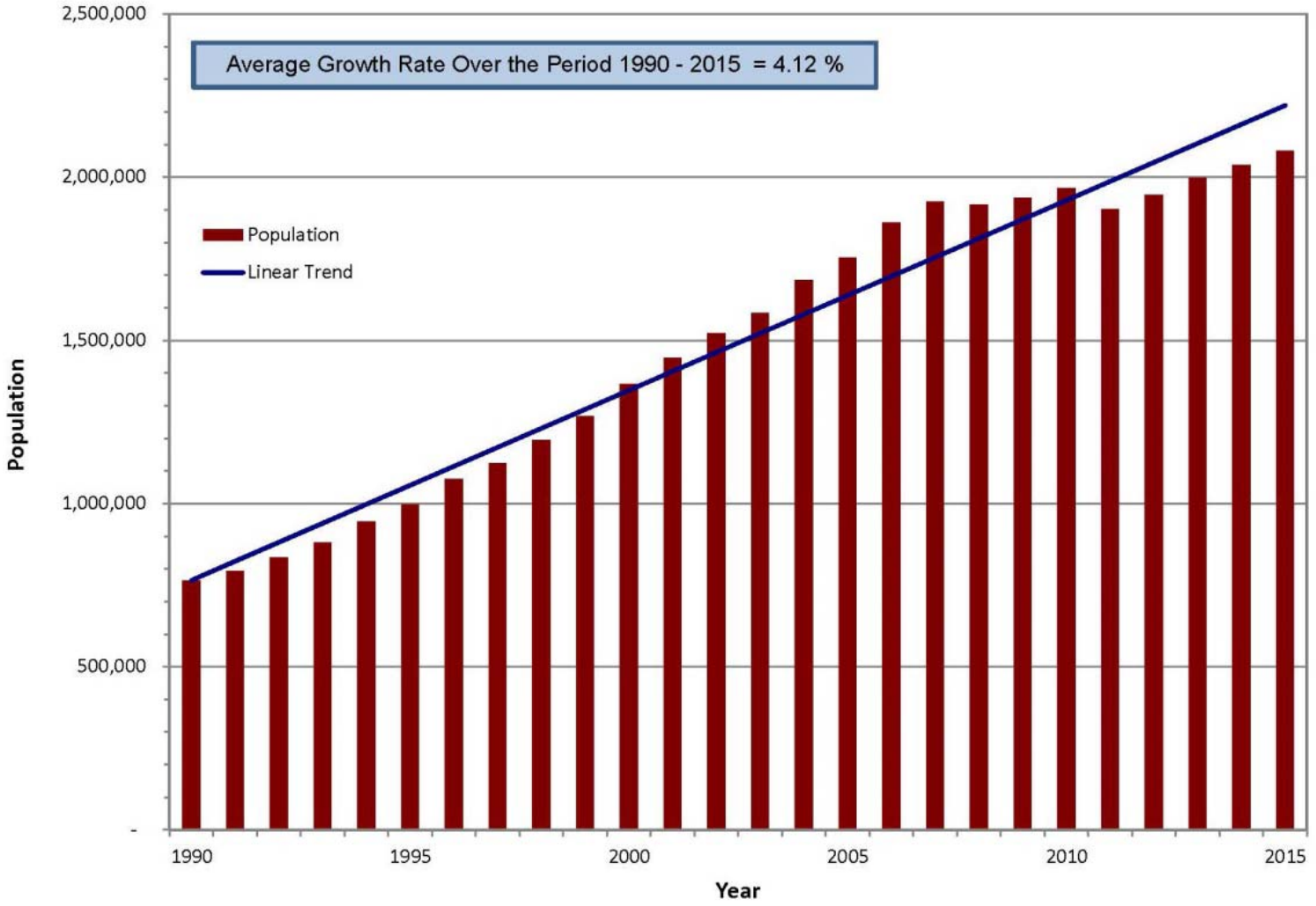


Figure 2-6: Las Vegas Urban Area Average Population Growth: 1990 to 2015



Source: Clark County Department of Comprehensive Planning, Southern Nevada Regional Planning Coalition (SNRPC) Consensus Population Estimate.
Note: Local annual estimates as of July 1 resident population based on housing methods.

I-515 runs through the center of the Las Vegas Valley and provides direct access to downtown Las Vegas and its immediate environs. Figure 2-7 shows the population density per square mile within the traffic study area. The eastern half of the traffic study area is largely residential, and therefore, is more densely populated than the western half. Figure 2-8 shows the employment density per square mile within the traffic study area. As shown, areas with the highest employment densities are located along Fremont Street and Las Vegas Boulevard. Also, areas south of I-515 have higher employment densities than areas to the north.

Figure 2-9 shows the percentage of households living below the poverty level within the traffic study area. This figure shows that areas located between Las Vegas Boulevard and Pecos Road, and areas near the Spaghetti Bowl have higher percentages of people living below poverty level. For more discussion on low-income populations, please refer to Section 2.9.

Figure 2-10 shows the percentage of households within the traffic study area that do not own a vehicle. The number of households with no vehicle is highest near the downtown areas and around the Spaghetti Bowl, indicating that these residents highly depend on transit, walking, bicycle, or other transportation alternatives. The eastern and western portions of the traffic study area have higher percentages of households with vehicle ownership.

2.3 Traffic Conditions

Peak congestion on I-515 within the traffic study area occurs in the morning from 6:30 AM to 9:00 AM, and in the afternoon/evening from 3:00 PM to 6:00 PM. Multiple field inspections were performed during the AM and PM peak congested periods to assess traffic conditions within the traffic study area limits. Notable observations are shown on Figure 2-11.

2.3.1 Traffic Volumes

The Nevada Department of Transportation (NDOT) operates traffic count stations along the I-515 corridor on each mainline segment and ramp. The traffic analysis conducted for this study used the 2015 NDOT traffic count station volumes (the most recent data available at the time of the existing conditions analysis), as well as field counts collected in January and February 2016 for each turning movement at study intersections (shown on Figure 2-2).

The existing conditions traffic operations analysis is based on year 2016. The 2015 NDOT traffic count station volumes were converted to 2016 volumes by applying the necessary seasonal adjustment factors. The adjusted year 2016 peak period volumes along the I-515 corridor are shown on Figure 2-12. Year 2016 peak period turning movement counts at the study intersections are provided in Appendix A.

Figure 2-13 shows the traffic volume-to-capacity ratio of the major roadways within the traffic study area generated from the Regional Transportation Commission's (RTC's) travel demand model. It provides a general understanding of the high-volume segments in the study area and areas with issues.

Figure 2-7: Population Density (Per Square Mile) within Traffic Study Area

Figure 2-8: Employment Density (Per Square Mile) within Traffic Study Area

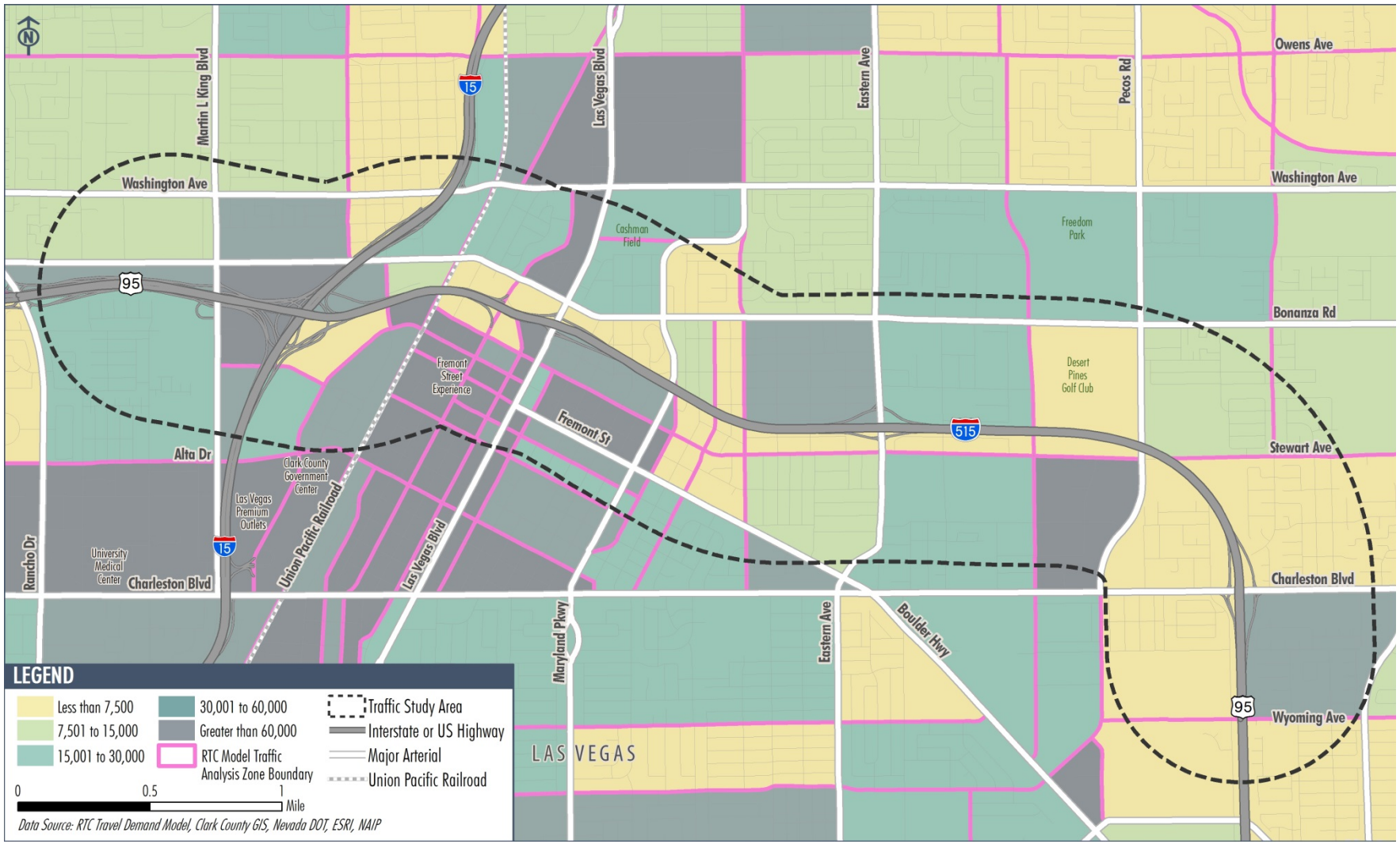


Figure 2-9: Percent of Households Below Poverty Level within Traffic Study Area

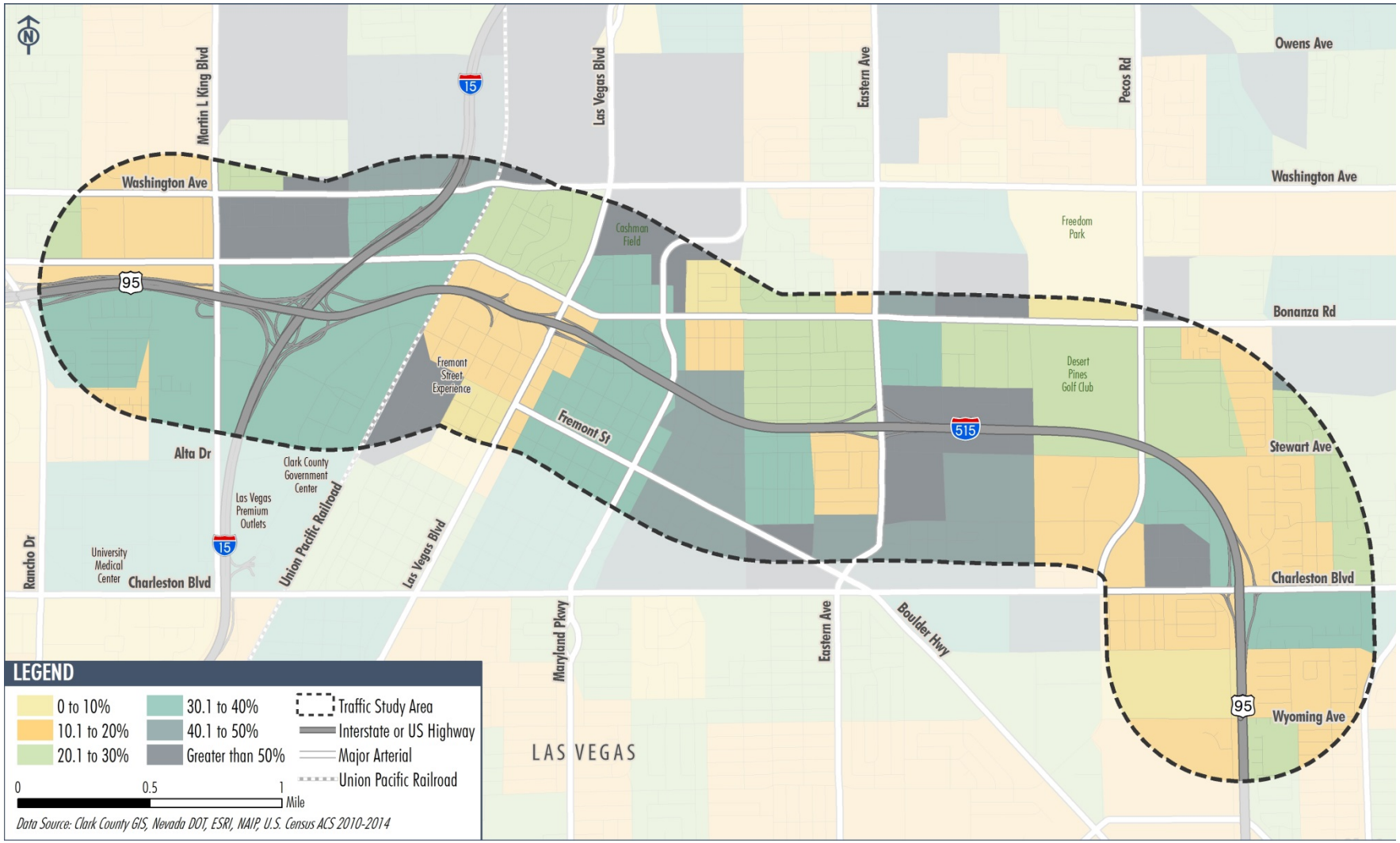


Figure 2-10: Percent of Zero Vehicle Households within Traffic Study Area

Figure 2-11: Existing Traffic Conditions

1. Southbound I-515 mainline through the Spaghetti Bowl is a major bottleneck in both the AM and PM peak periods because the number of lanes is reduced from three to two lanes past the northbound I-15 exit.

2. Major southbound congestion in both the AM and PM peak periods between the Spaghetti Bowl and Casino Center Boulevard, which is caused by traffic entering I-515 from I-15 and weaving with mainline traffic to exit to Casino Center Boulevard and Las Vegas Boulevard.

3. Northbound I-515 experiences major congestion in the PM peak period between Las Vegas Boulevard and the Spaghetti Bowl, caused by weaving between I-515 mainline traffic and traffic entering I-515 from Las Vegas Boulevard and Casino Center Boulevard to use the I-15 exits. The congestion propogates (backs up) to Charleston Boulevard and beyond.

4. During the PM peak period, spillback occurs on the arterial at the northbound on-ramp at Casino Center Boulevard. The ramp meter does not flush (stay on) when this happens. 4th Street has adequate storage to accommodate the traffic queues.

5. During the PM peak period, spillback occurs on the arterial at the northbound on-ramp at Las Vegas Boulevard. The ramp meter flushes (turns off) when spillback occurs.

6. Las Vegas Boulevard is congested during the PM peak period within the I-515 interchange area. The Las Vegas Boulevard northbound movement to I-515 northbound movement operates particularly poor, resulting in queue spillback.

7. During both the AM and PM peak periods, no congestion was observed on southbound I-515 past Casino Center Boulevard, except for some localized congestion near Eastern Avenue exit in the PM peak period.

8. Queues on the Eastern Avenue southbound off-ramp sometimes spillback onto the I-515 mainline during the PM peak period. Queues also are long during the AM peak, but only occasionally spillback onto the I-515 mainline.

9. During the AM and PM peak periods, spillback occurs on the arterial at the northbound on-ramp at Eastern Avenue. The ramp meter flushes (turns off) when spillback occurs.

10. Eastern Avenue is very congested during the PM peak period. The proximity of Stewart Avenue contributes to the congestion because vehicles have difficulty weaving on Eastern Avenue to turn left onto Stewart Avenue.

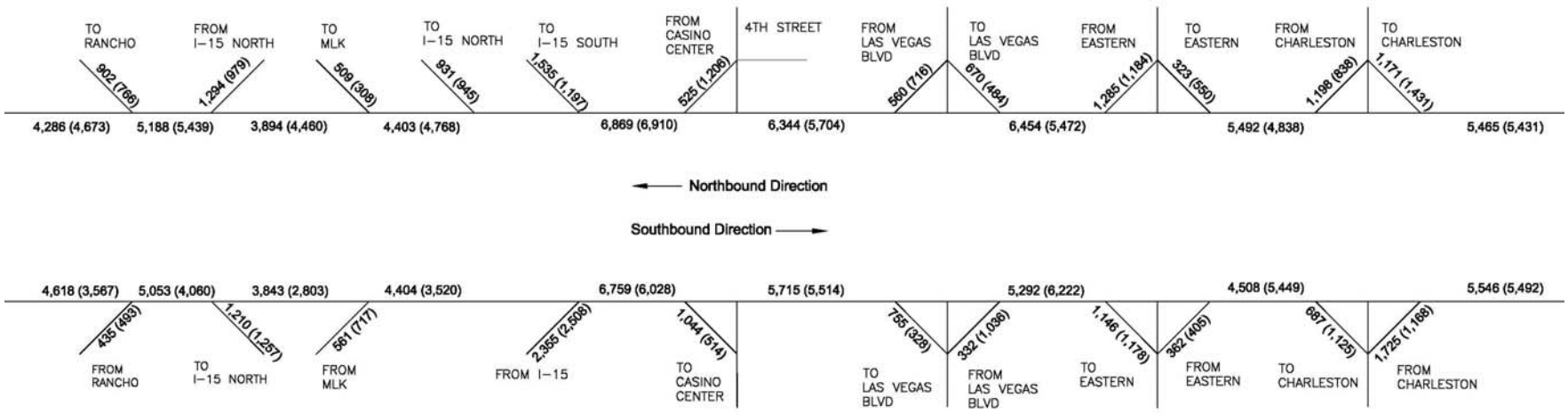
11. Northbound I-515 mainline is congested in the AM peak period between Charleston Boulevard and Casino Center Boulevard. Northbound congestion is generally worse than southbound congestion during the PM peak period, except under the Spaghetti Bowl, where southbound congestion is worse because of the lane drop.

12. The southbound I-515 exit at Charleston Boulevard experiences long queues during the PM peak period.

13. Queues spillback on the arterial at the northbound on-ramp from Charleston Boulevard, in both the AM and PM peak periods. The ramp meter flushes (turns off) when spillback occurs. The northbound congestion along the Charleston Curve contributes to this spillback; there is no auxiliary lane along this location.

14. The Charleston Boulevard interchange is congested, particularly during the PM peak period.

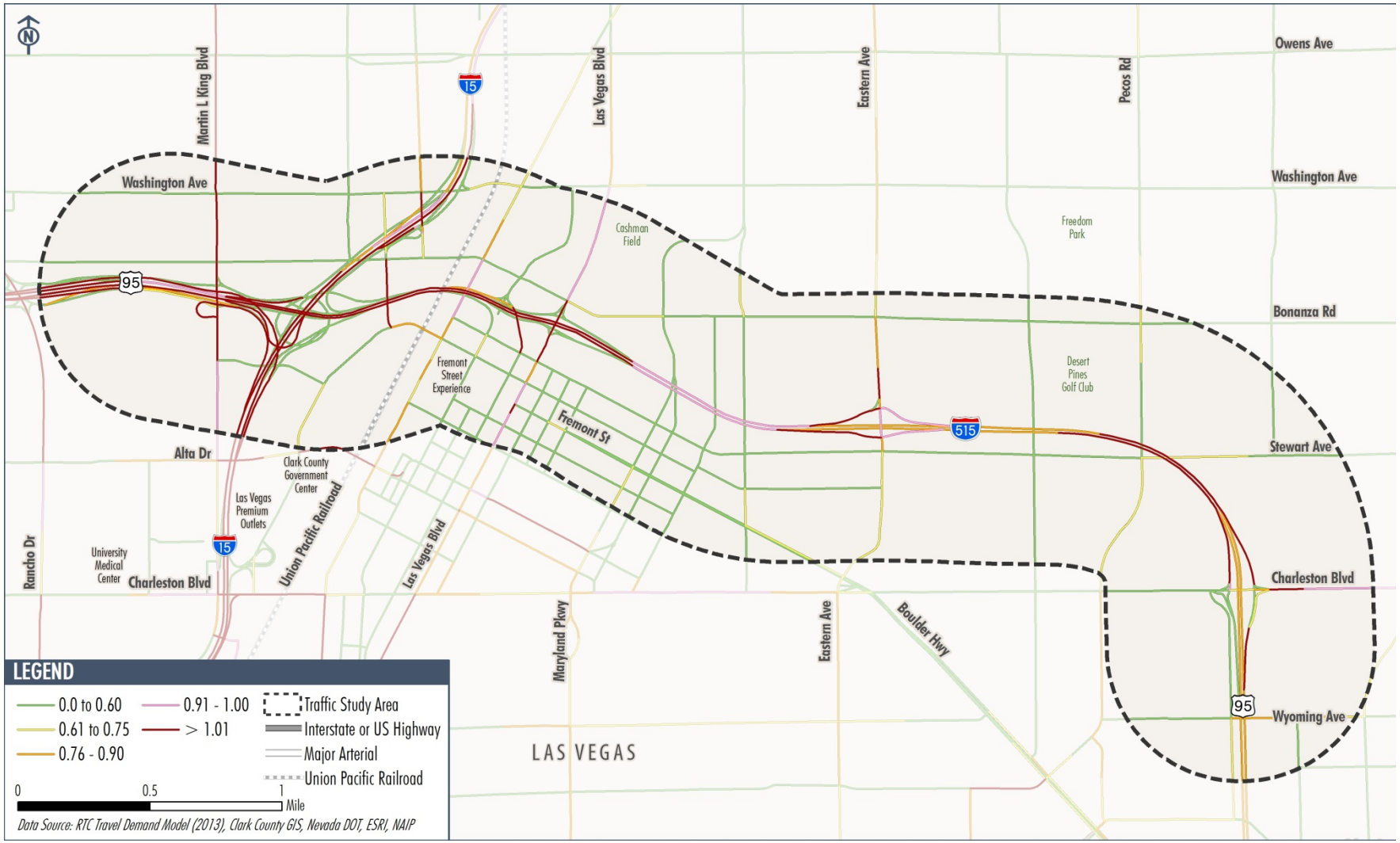
Figure 2-12: 2016 Peak Hour Volumes along I-515



XX (XX): AM (PM)

*Not to scale

Figure 2-13: Existing Volume-to-Capacity Ratios from Travel Demand Model



2.3.2 Traffic Operations Analysis

The study team first completed a planning level traffic operations analysis using Highway Capacity Software (HCS) and Synchro software to identify issues and establish the overall traffic operation of the I-515 corridor. This initial analysis is documented in the *Existing Conditions Initial Traffic Analysis* memoranda (Jacobs, February 10, 2016, and update).[1] The study team then conducted a more definitive and comprehensive existing conditions traffic operations analysis using CORSIM microsimulation software (CORSIM). Additionally, Synchro intersection analysis conducted in the initial evaluation was updated with 2016 volumes specifically collected for this study.

This section presents the existing traffic operations conditions from CORSIM and the updated year 2016 Synchro analysis. A summary of the CORSIM modeling and calibration approach is provided first.

CORSIM Modeling and Calibration Approach

An *Operational Analysis and CORSIM Modeling Methodology Memorandum* (Jacobs, December 31, 2015) was prepared and approved by NDOT. After the CORSIM models were calibrated, a *CORSIM Calibration Memorandum* (Jacobs, May 27, 2016) documenting the calibration process and operational performance results, was prepared and approved by NDOT. These memoranda, included in Appendix B, provide additional details for the CORSIM modeling and calibration approach as well as operational performance results.[2]

CORSIM modeling was performed in version 6.3 of CORSIM. Synchro version 8.0 was used as a supporting traffic analysis tool for coding intersection signal timings in CORSIM. The following technical documents and guidelines were key references used for the CORSIM modeling conducted for this study:

- Primary Reference: *CORSIM Modeling Guidelines* (NDOT 2012)
- *Traffic Analysis Toolbox Volume IV: Guidelines for Applying CORSIM Microsimulation Modeling Software* (Federal Highway Administration [FHWA] 2007)
- *Guidance on the Level of Effort Required to Conduct Traffic Analysis Using Microsimulation* (FHWA 2014)

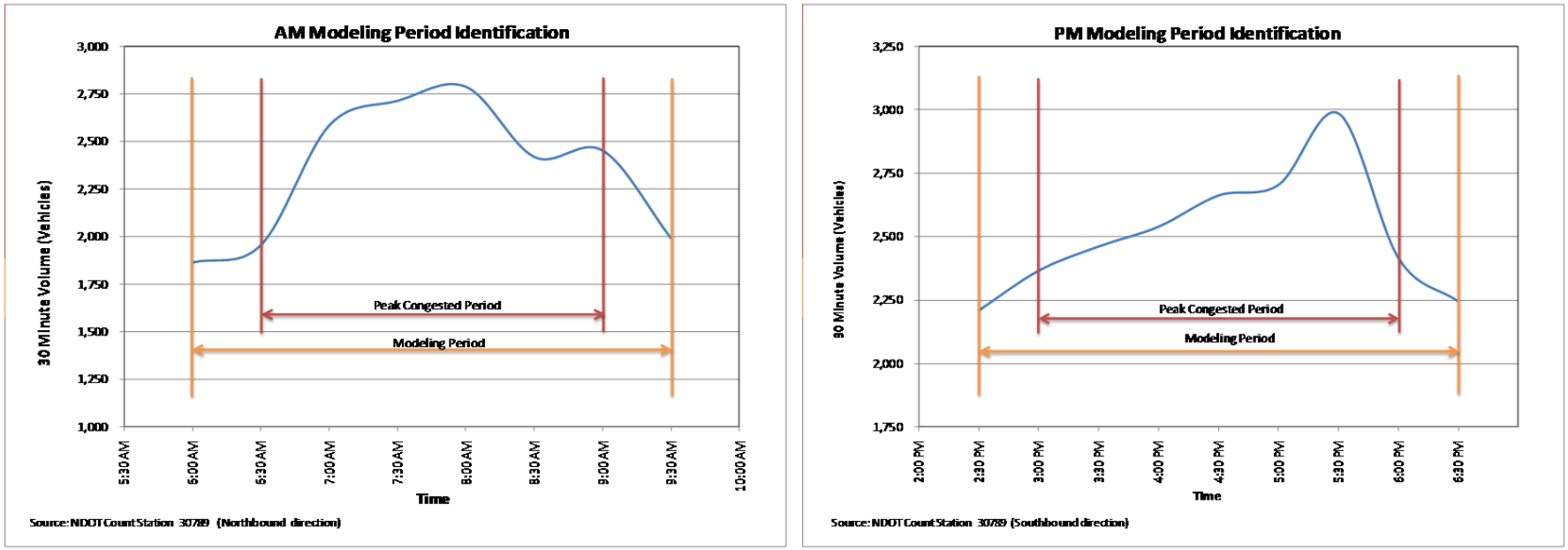
The CORSIM analysis followed a systematic process to develop, calibrate, and document the 2016 base models, consistent with NDOT's *CORSIM Modeling Guidelines* (NDOT 2012).

As discussed in Section 1.3, the limits for the traffic analysis extend beyond the study area, and ramp terminal intersections are included in the analysis (see Figure 2-2). Figure 2-14 illustrates the duration of modeling periods and the individual 30-minute time periods for the 2016 base models. The blue lines shown on Figure 2-2 represent the volume of traffic during the peak hours of traffic activity at a representative NDOT traffic count station in the study corridor.

[1] The HCS analysis in the February 10, 2016, draft memorandum was later updated with HCS' "Facilities" module per NDOT's request. The updated memorandum is provided in Appendix B.

[2] The Synchro analysis in the initial traffic operations analysis (documented in the February 10, 2016 memorandum) was based on previously available year 2014/2015 volumes.

Figure 2-14: Year 2016 AM and PM Modeling Periods for Calibration



- The AM peak congested period extends from 6:30 AM to 9:00 AM. The selected AM modeling period is an hour longer than this peak period to capture the build-up and dissipation of the peak period.
- The PM peak congested period extends from 3:00 PM to 6:00 PM. The PM modeling period is an hour longer, extending from 2:30 PM to 6:30 PM.

The minimum number of required CORSIM runs was calculated per NDOT and FHWA microsimulation modeling guidelines. The calculated minimum required number of runs was 10 and 15 for the AM and PM models, respectively. Also, per NDOT's *CORSIM Modeling Guidelines*, a minimum of two measures of effectiveness (MOEs) are required to be calibrated in addition to traffic volumes. Speeds and queues were selected as the two additional calibration MOEs. Traffic volume calibration was performed on all segments and for all time periods. Speed calibration was performed for the stretch between the I-15 on-ramp and the Charleston Boulevard off-ramp in the southbound direction. In the northbound direction, the segment between the Charleston Boulevard on-ramp and the I-15 northbound off-ramp was the key stretch that was calibrated.

Queue calibration was performed for the entire modeling period at the following off-ramp locations:

- Southbound off-ramp at Eastern Avenue (AM and PM), calibrated for the right-turn lane
- Southbound off-ramp at Las Vegas Boulevard (AM), calibrated for the left-turn lane
- Southbound off-ramp at Charleston Boulevard (PM), calibrated for the middle left-turn lane
- Northbound off-ramp at Las Vegas Boulevard (AM), calibrated for the middle left-turn lane

The following on-ramp locations where queues often spill onto connection arterials were also calibrated.

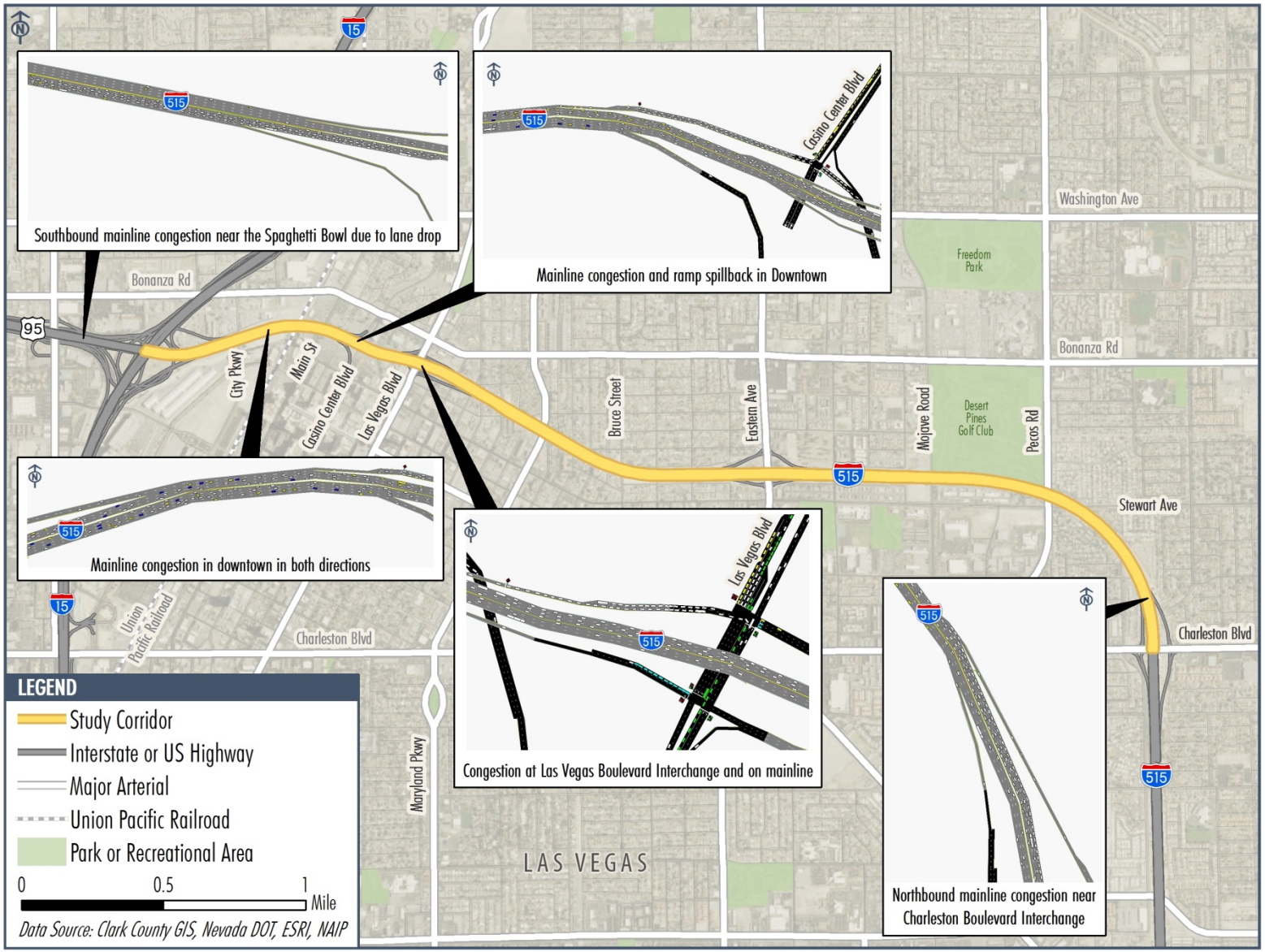
- Eastern Avenue on-ramp (AM and PM)
- Casino Center Boulevard on-ramp (PM)
- Las Vegas Boulevard on-ramp (PM)
- Charleston Boulevard on-ramp (AM)

The calibration process involved comparing model output with the field MOEs, and then iteratively adjusting calibration parameters until an acceptable match was achieved. Several CORSIM parameters were adjusted to meet the calibration targets for the three selected MOEs (volumes, speeds, and queues), and to match the observed field conditions. Refer to Appendix B for information on calibration results, targets, acceptable matches, and adjustments made to the model. A summary of results is provided below:

- Volume Calibration: For the AM model, all of the calibration targets were met. For the PM model, certain segments did not meet the volume targets for every time period. In evaluating the volume calibration results for each time period, the CORSIM volumes on the mainline are lower than the field volumes in the initial time periods and higher than the field volumes in the later time periods. This is explained by the build-up of congestion (in the initial time periods) in the system, resulting in queues at the ramp meters and the ramp terminal intersections. As congestion dissipates (in the later time periods), vehicles are able to travel through the system, resulting in the volumes being processed, including those that were previously queued at the ramps. Therefore, the build-up and the eventual dissipation of congestion impact the volume calibration results.
- Queue Calibration: For the PM model, the percent difference between the field-observed queue length and the CORSIM-simulated queue length met the calibration target (20 percent). For the AM model, the percent difference between the field-observed queue length and the CORSIM-simulated queue length met the calibration target (20 percent), except at one location where the percent difference was slightly higher (21 percent).
- Speed Calibration: The targets were not met for certain time periods, even with the most aggressive application of relevant calibration parameters. After several iterations, tests, and considerations, it was decided to leave the target unmet for these time periods.

With the application of several adjustments, the models generally reflect the observed field conditions. Figure 2-15 illustrates the AM model at sample locations with operational issues.

Figure 2-15: Sample CORSIM Screenshots Illustrating the AM Model



Year 2016 Traffic Operations Analysis Results

The Level of Service (LOS) was calculated in accordance with the *Highway Capacity Manual [HCM] 2010* (Transportation Research Board 2010). LOS is a term used to describe the operating performance of an intersection or roadway. The operation is described by a letter designation from "A" to "F," with LOS A representing essentially uninterrupted flow with minimal delays, and LOS F representing a breakdown of traffic flow with excessive congestion and delay. Table 2-1 and Table 2-2 define LOS criteria evaluated and discussed below.

Table 2-1: HCM 2010 LOS Criteria for Freeway Facilities

LOS	Basic Freeway Segment Density (pc/mi/ln)*	Freeway Weaving Segments Densities (pc/mi/ln)	Freeway Merge and Diverge Density (pc/mi/ln)*
A	≤11	0-10	≤10
B	>11-18	>10-20	>10-20
C	>18-26	>20-28	>20-28
D	>26-35	>28-35	>28-35
E	>35-45	>35	>35
F	Demand exceeds capacity >45	Demand exceeds capacity	Demand exceeds capacity

Source: *Highway Capacity Manual 2010*, Transportation Research Board

* Passenger cars per mile per lane

Table 2-2: HCM 2010 LOS Criteria for Intersections

LOS	Control Delay per Vehicle (in seconds)	
	Signalized Intersections	Unsignalized Intersections
A	0-10	0-10
B	>10-20	>10-15
C	>20-35	>15-25
D	>35-55	>25-35
E	>55-80	>35-50
F	>80	>50

Source: *Highway Capacity Manual 2010*, Transportation Research Board

The following performance measures from CORSIM and Synchro were used to assess existing traffic conditions along the I-515 corridor:

- CORSIM freeway mainline densities: Densities that correspond to HCM LOS D or better based on the HCM 2010 density thresholds are considered satisfactory.
- CORSIM freeway mainline speeds: Speeds greater than 50 miles per hour (mph) are considered satisfactory.
- Synchro intersection LOS: Overall intersection LOS D or better with no individual movement or approach worse than LOS E based on the HCM thresholds are considered satisfactory.

CORSIM results for densities and speeds along the I-515 mainline for northbound and southbound directions are provided in Table 2-3 and Table 2-4, respectively. Results show only the most congested 30-minute time period (see Appendix B for all time periods). Table 2-5 shows the delay and LOS results from Synchro. Values shown in red indicate unsatisfactory traffic conditions; several locations within the corridor operate poorly.

Table 2-3: Operational Performance Results from CORSIM – Northbound

Road Segment	Road Segment	AM Period			PM Period		
		Speed (mph)	Density (vphpln)	LOS	Speed (mph)	Density (vphpln)	LOS
South end of model :: Charleston off-ramp	Basic	67.5	16.1	B	66.1	20.5	C
Charleston off-ramp :: Charleston on-ramp	Basic	64.5	18.0	B	45.4	44.8	F
Charleston on-ramp :: Eastern off-ramp	Merge	43.3	39.1	E	25.5	58.7	F
	Basic	58.3	26.2	C	26.0	62.3	F
	Diverge	60.5	23.5	C	25.2	74.1	F
Eastern off-ramp :: Eastern on-ramp	Basic	60.4	23.1	C	15.4	97.8	F
Eastern on-ramp :: Las Vegas off-ramp	Weave	38.3	43.3	F	12.4	102.3	F
Las Vegas off-ramp :: Las Vegas on-ramp	Basic	27.9	61.9	F	18.5	80.3	F
Las Vegas on-ramp :: 4th St on-ramp	Merge	25.5	72.5	F	21.9	81.4	F
4th St on-ramp :: I-15SB off-ramp	Weave	34.4	43.8	F	30.7	49.8	F
I-15SB off-ramp :: I-15NB off-ramp	Diverge	42.7	34.8	D	39.8	42.5	E
I-15NB off-ramp :: MLK off-ramp	Diverge	53.6	19.6	B	53.2	24.6	C
MLK off-ramp :: I-15SB on-ramp	Basic	64.0	16.6	B	63.8	21.0	C
I-15SB on-ramp :: Rancho off-ramp	Weave	67.0	15.4	B	66.4	18.9	B
Rancho off-ramp :: North end of model	Basic	67.1	15.9	B	65.9	20.8	C

Table 2-4: Operational Performance Results from CORSIM – Southbound

Road Segment	Road Segment	AM Period			PM Period		
		Speed (mph)	Density (vphpln)	LOS	Speed (mph)	Density (vphpln)	LOS
North end of model :: Rancho on-ramp	Basic	18.2	81.7	F	61.7	18.3	B
Rancho on-ramp :: I-15NB off-ramp	Weave	8.3	125.2	F	59.5	17.4	B
I-15NB off-ramp :: MLK on-ramp	Basic	16.1	94.5	F	42.9	35.6	E
MLK on-ramp :: I-15NB on-ramp	Merge	29.9	64.2	F	30.6	56.7	F
I-15NB on-ramp :: Casino off-ramp	Weave	39.4	36.9	E	30.7	51.5	F
Casino off-ramp :: Las Vegas off-ramp	Diverge	45.6	35.3	E	47.5	38.1	E
Las Vegas off-ramp :: Las Vegas on-ramp	Basic	59.4	23.1	C	53.7	32.2	D
Las Vegas on-ramp :: Eastern off-ramp	Weave	65.9	15.7	B	59.3	25.2	C
Eastern off-ramp :: Eastern on-ramp	Basic	61.7	18.4	B	53.5	32.1	D
Eastern on-ramp :: Charleston off-ramp	Merge	61.6	19.7	B	50.1	36.5	E
	Basic	65.9	18.6	B	52.8	35.0	D
	Diverge	62.8	21.7	C	44.2	43.7	F
Charleston off-ramp :: Charleston on-ramp	Basic	67.5	14.7	B	65.8	21.7	C
Charleston on-ramp :: South end of model	Basic	65.8	15.3	B	64.5	20.1	C

Table 2-5: Year 2016 Intersection Analysis Results from Synchro

Intersection	Approach	Movement	AM						PM					
			Movement		Approach		Intersection		Movement		Approach		Intersection	
			Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
Northbound ramps and Charleston Boulevard	EB	EBL	80.4	F	19.6	B	32.4	C	71.5	E	18.8	B	50.8	D
		EBT	9.3	A					16.1	B				
	WB	WBT	22.2	C	22.2	C			26.0	C	26.0	C		
		WBR	0	A					0	A				
	NB	NBL	48.8	D	58.5	E			46.1	D	116.4	F		
		NBR	66.0	E					142.9	F				
Southbound ramps and Charleston Boulevard	EB	EBLT	47.6	D	153.9	F	60.8	E	54.0	D	70.7	E	48.9	D
		EBR	254.2	F					106.2	F				
	WB	WBL	48.1	D	30.6	C			65.8	E	39.6	D		
		WBT	8.7	A					21.8	C				
	SB	SBL	51.8	D	50.6	D			40.5	D	39.3	D		
		SBR	46.3	D					34.3	C				
Eastern Avenue and Stewart Avenue	EB	EBL	39.0	D	41.9	D	43.7	D	38.7	D	43.5	D	84.0	F
		EBT	43.7	D					45.4	D				
		EBR	43.8	D					45.4	D				
	WB	WBL	39.1	D	65.4	E			38.9	D	85.8	F		
		WBT	45.1	D					44.5	D				
		WBR	86.5	F					121.6	F				
	NB	NBL	96.3	F	27.1	C			87.7	F	33.9	C		
		NBT	23.7	C					31.8	C				
		NBR	24.1	C					33.7	C				
	SB	SBL	246.7	F	42.7	D			519.0	F	149.6	F		
		SBT	0.6	A					39.8	D				
		SBR	1.1	A					40.4	D				
Northbound ramps and Eastern Avenue	WB	WBLT	49.0	D	67.3	E	25.9	C	36.4	D	70.4	E	42.9	D
		WBR	71.8	E					79.3	E				
	NB	NBL	57.1	E	19.4	B			69.2	E	38.2	D		
		NBT	0.2	A					26.2	C				
	SB	SBT	19.0	B	24.8	C			37.3	D	41.1	D		
		SBR	34.4	C					50.5	D				

Table 2-5: Year 2016 Intersection Analysis Results from Synchro

Intersection	Approach	Movement	AM						PM					
			Movement		Approach		Intersection		Movement		Approach		Intersection	
			Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
Southbound ramps and Eastern Avenue	EB	EBLT	57.0	E	138.0	F	53.1	D	45.6	D	57.3	E	35.8	D
		EBR	242.4	F					75.8	E				
	NB	NBT	0.6	A	0.6	A			31.4	C	31.1	C		
		NBR	0.6	A					23.2	C				
	SB	SBL	73.2	E	21.2	C			98.3	F	24.8	C		
		SBT	0.1	A					0.2	A				
Casino Center Boulevard and 4th Street	WB	WBT	16.4	B	16.4	B	11.3	B	15.5	B	15.5	B	14.3	B
		WBR	0.0	A					0	A				
	NB	NBL	0.0	A	3.6	A			9.5	A	9.3	A		
		NBT	3.6	A					8.7	A				
	SB	SBT	3.6	A	4.6	A			8.7	A	10.8	B		
		SBR	4.6	A					10.9	B				
Casino Center Boulevard and Stewart Avenue*	EB	EBTR	33.8	C	33.8	C	17.5	B	31.0	C	31.0	C	21.3	C
	WB	WBL	40.4	D	31.3	C			33.9	C	21.6	C		
		WBT	22.3	C					17.9	B				
	NB	NBR	16.8	B	16.8	B			18.8	B	18.8	B		
	SB	SBL	31.0	C	12.5	B			39.5	D	16.2	B		
		SBTR	9.0	A					10.7	B				
Northbound ramps and Las Vegas Boulevard *	WB	WBL	48.9	D	46.7	D	31.6	C	45.9	D	44.4	D	35.5	D
		WBR	41.7	D					42.8	D				
	NB	NBL	81.3	F	31.4	C			104.5	F	37.3	D		
		NBT	9.5	A					5.7	A				
	SB	SBT	20.1	C	20.7	C			29.1	C	29.1	C		
		SBR	21.6	C					29.1	C				
Southbound ramps and Las Vegas Boulevard*	EB	EBL	46.9	D	143.7	F	58.1	E	47.4	D	45.0	D	31.0	C
		EBR	177.2	F					43.1	D				
	NB	NBT	16.6	B	16.5	B			25.3	C	27.8	C		
		NBR	16.4	B					31.1	C				
	SB	SBL	59.1	E	21.4	C			71.9	E	32.2	C		
		SBT	15.0	B					9.7	A				

* Geometric or controller configuration is not supported by Highway Capacity Manual (HCM) 2010 Edition. Therefore, HCM 2000 Edition results are reported.

2.3.3 Corridor Travel Time

To further analyze existing traffic conditions along the I-515 corridor and assist with CORSIM calibration, a three-day travel time study was conducted along the I-515 mainline in January 2016. Northbound travel time runs were conducted between the Charleston Boulevard on-ramp and Rancho Drive off-ramp, in both the AM and PM peak periods. Southbound travel time runs were conducted between the Rancho Drive on-ramp and Charleston Boulevard off-ramp, in both the AM and PM peak periods. A summary of the travel time statistics is provided in Table 2-6, which shows that peak period travel speeds are below the posted speed limit, resulting in delays. The lowest average speed (28 mph) is for the I-515 northbound during the PM peak period.

Table 2-6: Corridor Travel Time Statistics

Travel Time Statistics	Northbound		Southbound	
	AM	PM	AM	PM
Length of Segment	23,562 ft. (4.46 mi.)		23,906 ft. (4.53 mi.)	
Number of Travel Time Runs	23	22	21	20
Travel Time (minutes)	5.8	9.4	7.2	7.8
Average Speed (mph)	45.9	28.4	38.1	35.4
Total Delay (minutes)	**0.9**	**3.2**	**2.4**	**2.5**

2.4 Utilities

Utility relocations can greatly add to construction costs for highway improvements. Several utilities are located within the study area, including:

- NV Energy Transmission overhead power lines
- NV Energy Distribution overhead power lines
- Southwest Gas underground natural gas pipelines
- Las Vegas Valley Water District underground water distribution pipelines
- Southern Nevada Water Authority underground water transmission pipelines
- Clark County Water Reclamation District underground sewer pipelines
- City of Las Vegas underground water and sewer pipelines
- Cox Communications underground cable television lines
- CenturyLink underground telephone lines

2.5 Safety Performance

This section summarizes traffic crashes recorded in the traffic study area for the three-year period from July 1, 2011, to July 1, 2014, which was the most recent available data at the time of this study. The crash summary data was obtained from the *Road Safety Assessment [RSA] Report for I-515/US 93/US 95 from Rancho Drive to Wyoming Avenue Grade Separation* (NDOT 2015a) discussed in Chapter 1. A summary of the RSA recommendations is provided in Chapter 5.

For the three-year period, a total of 1,377 crashes occurred in the 5.5 miles of I-515 evaluated in the RSA (i.e., from the Wyoming Avenue grade separation to the Rancho Drive interchange). Out of the 1,377 total crashes, 947 were property damage only (PDO) crashes, and 430 were injury crashes, resulting in 660 injuries. No fatal crashes were recorded. Table 2-7 compares the I-515 corridor crash rates with the NDOT statewide crash rates for roadways of similar classification. This comparison shows that the I-515 corridor experiences higher overall crashes, injury crashes, and PDO crashes than the state average. Table 2-8 provides a crash summary by type along the I-515 corridor for the three-year period.

Table 2-7: I-515 Corridor Crash Comparison with Statewide Average

Location	Classification	Overall Crash Rate	Fatal Crash Rate	Injury Crash Rate	PDO Crash Rate
I-515/US 93/US 95 Study Segment July 2011-July 2014	Urban Principal Arterial Interstate	1.30	0.00	0.41	0.90
2011 Functional Classification Crash Rate for Nevada	Urban Principal Arterial Interstate	1.00	0.00	0.29	0.71

Rates per million vehicle miles traveled

Table 2-8: I-515 Mainline Traffic Crash Summary

Crash Type	Number of Crashes by Crash Type	Number of Injury Crashes by Crash Type	Number of Injuries by Crash Type
Rear-End	714	266	425
Non-Collision	328	81	102
Angle	194	55	97
Sideswipe, Overtaking	106	23	30
Sideswipe, Meeting	22	4	4
Unknown	5	0	0
Head-On	4	0	0
Rear-to-Rear	3	1	2
Backing	1	0	0
Total	**1,377**	**430**	**660**

Rear-end crashes are the predominant crash type within the corridor, accounting for 52 percent of total crashes. This is a common crash type on congested roadways where vehicles repeatedly accelerate and decelerate over short distances. Table 2-9 summarizes the number of crashes by severity within the corridor for the three-year period, divided into eight roadway segments along the corridor.

Table 2-9: I-515 Corridor Crash Severity by Roadway Segment

Road Segment	Length (mile)	Crash Severity				No. of Injuries	Overall Crash Rate (MVM)*	Injury Crash Rate (MVM)*
		Total	Injury	PDO	Fatal			
Wyoming Ave to Charleston Blvd	0.51	139	44	95	0	67	1.61	0.51
Charleston Blvd to Eastern Avenue	1.70	246	86	160	0	127	0.84	0.55
Eastern Avenue to Las Vegas Blvd	1.33	267	84	183	0	134	1.17	0.37
Las Vegas Blvd to Casino Center Blvd	0.21	98	18	70	0	32	2.83	0.52
Casino Center Blvd to I-15 off–ramps	0.77	211	68	143	0	103	1.60	0.52
I-15 off – ramps to Martin Luther King Blvd	0.33	140	43	84	0	56	2.53	0.78
Martin Luther King Blvd to Rancho Dr	0.76	172	56	116	0	92	1.31	0.43
Rancho Dr and End of Segment	0.50	104	31	73	0	49	1.20	0.36
Total	**6.11**	**1377**	**430**	**924**	**0**	**660**		

*MVM = Million Vehicle Miles Traveled

Figure 2-16 illustrates the number of crashes along the I-515 corridor by time of day crash type. The figure shows an increase in all crash types from 7:00 AM to 9:00 AM, and from 2:00 PM to 7:00 PM. These time periods coincide with the I-515 corridor AM and PM peak periods.

Crashes at I-515 interchanges within the traffic study area for the same three-year period are summarized below.

I-515/Charleston Boulevard Interchange: A total of 147 crashes occurred at the interchange on- and off-ramps, including 97 PDO crashes and 50 injury crashes, resulting in 62 injuries. Rear-end crashes accounted for 67 percent of the total crashes.

Figure 2-16: Crashes by Time of Day

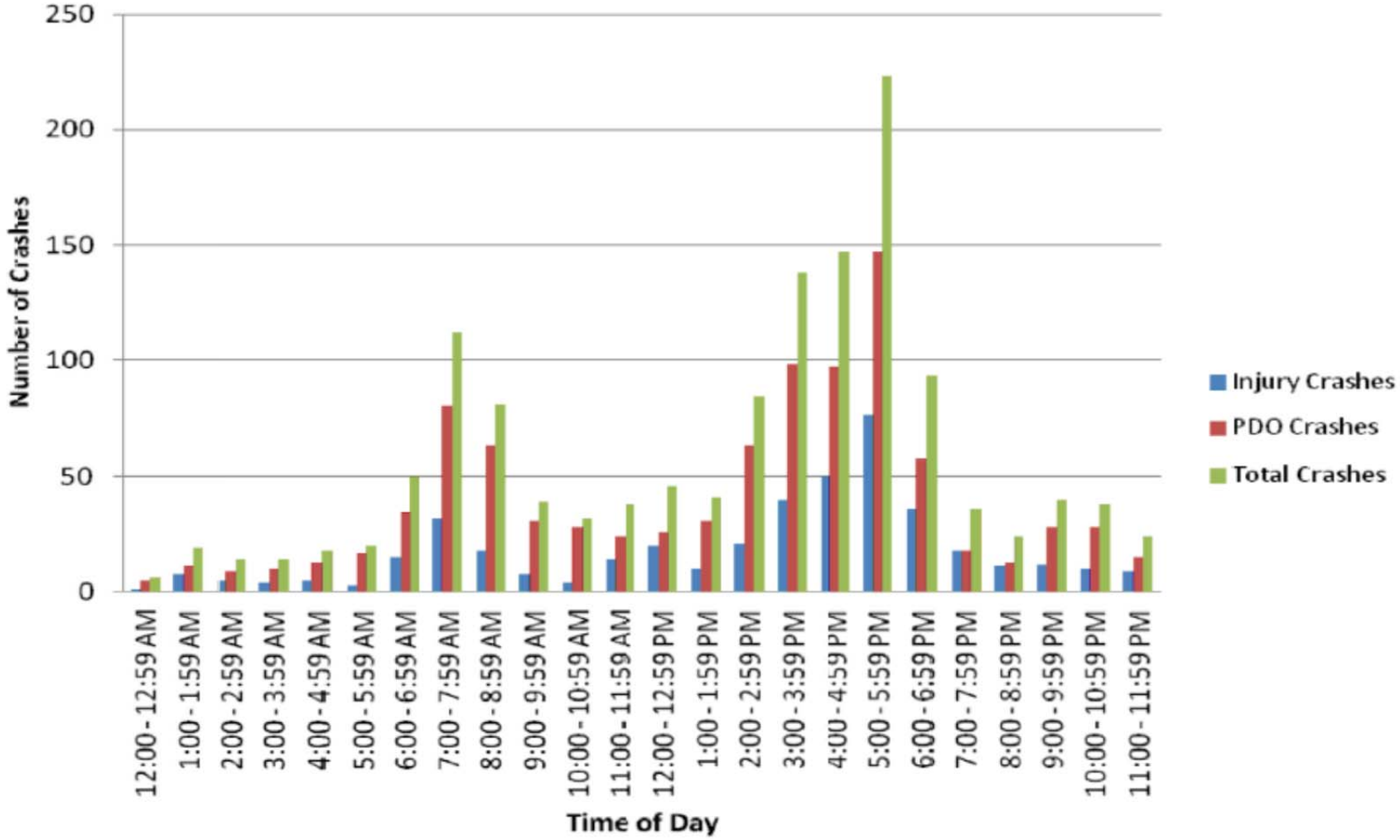


Table 2-10: Crash Summary by Severity at I-515/Charleston Boulevard Interchange

Charleston Boulevard Interchange	Crash Severity		Total Crashes
	Injury Crashes	PDO Crashes	
Northbound Off-Ramp	10	7	17
Northbound On-Ramp	7	22	29
Southbound Off-Ramp	12	37	49
Southbound On-Ramp	21	31	52
Total	50	97	147

Table 2-11: Crash Summary by Crash Type at I-515/Charleston Boulevard Interchange

Crash Type	Charleston Boulevard Interchange				Total Crashes
	Northbound Off-Ramp	Northbound On-Ramp	Southbound Off-Ramp	Southbound On-Ramp	
Rear-End	10	15	37	37	99
Non-Collision	3	12	1	6	22
Angle	2	1	10	5	18
Sideswipe, Overtaking	2	1	0	1	4
Sideswipe, Meeting	0	0	1	1	2
Head-On	0	0	0	1	1
Rear-to-Rear	0	0	0	1	1
Total	17	29	49	52	147

I-515/Eastern Avenue Interchange: A total of 94 crashes occurred at the interchange on- and off-ramps, including 62 PDO crashes and 32 injury crashes, resulting in 42 injuries. Rear-end crashes accounted for 67 percent of the total crashes.

Table 2-12: Crash Summary by Severity at I-515/Eastern Avenue Interchange

Eastern Avenue Interchange	Crash Severity		Total Crashes
	Injury Crashes	PDO Crashes	
Northbound Off-Ramp	10	15	25
Northbound On-Ramp	9	13	22
Southbound Off-Ramp	10	30	40
Southbound On-Ramp	3	4	7
Total	32	62	94

Table 2-13: Crash Summary by Crash Type at I-515/Eastern Avenue Interchange

Crash Type	Eastern Avenue Interchange				Total Crashes
	Northbound Off-Ramp	Northbound On-Ramp	Southbound Off-Ramp	Southbound On-Ramp	
Rear-End	21	10	27	5	63
Angle	3	4	7	2	16
Non-Collision	0	4	5	0	9
Rear-to-Rear	1	1	0	0	2
Sideswipe, Overtaking	0	3	1	0	4
Total	25	22	40	7	94

I-515/Las Vegas Boulevard Interchange: A total of 71 crashes occurred at the interchange on- and off-ramps, including 50 PDO crashes and 21 injury crashes, resulting in 30 injuries. Rear-end crashes accounted for 77 percent of the total crashes.

Table 2-14: Crash Summary by Severity at I-515/Las Vegas Boulevard Interchange

Las Vegas Boulevard Interchange	Crash Severity		Total Crashes
	Injury Crashes	PDO Crashes	
Northbound Off-Ramp	6	14	20
Northbound On-Ramp	5	13	18
Southbound Off-Ramp	10	21	31
Southbound On-Ramp	0	2	2
Total	21	50	71

Table 2-15: Crash Summary by Crash Type at I-515/Las Vegas Boulevard Interchange

Crash Type	Las Vegas Boulevard Interchange				Total Crashes
	Northbound Off-Ramp	Northbound On-Ramp	Southbound Off-Ramp	Southbound On-Ramp	
Rear-End	13	14	28	0	55
Angle	4	0	3	0	7
Non-Collision	2	3	0	2	7
Sideswipe, Overtaking	1	1	0	0	2
Total	20	18	31	2	71

I-515/Casino Center Boulevard Interchange: A total of 15 crashes occurred at the interchange on- and off-ramps, including 13 PDO crashes and 2 injury crashes, resulting in 2 injuries. Rear-end crashes accounted for 40 percent of the total crashes.

Table 2-16: Crash Summary by Severity at I-515/Casino Center Boulevard Interchange

Casino Center Boulevard Interchange	Crash Severity		Total Crashes
	Injury Crashes	PDO Crashes	
Northbound On-Ramp	1	7	8
Southbound Off-Ramp	1	6	7
Total	2	13	15

Table 2-17: Crash Summary by Crash Type at I-515/Casino Center Boulevard Interchange

Crash Type	Casino Center Boulevard Interchange		Total Crashes
	Northbound On-Ramp	Southbound Off-Ramp	
Rear-End	4	2	6
Non-Collision	2	2	4
Angle	1	2	3
Sideswipe, Overtaking	1	1	2
Total	8	7	15

Appendix A provides a figure that summarizes crash data from the RSA.

2.6 Transit Options

Figure 2-17 shows the RTC transit routes that serve the traffic study area. The routes on freeways are mainly express services. The arterials serve as the main transit routes, with several stops strategically placed to provide interconnectivity. Operating hours and headways for each route are provided in Appendix A.

Figure 2-18 shows the average monthly ridership for each transit route for the three-year period between July 1, 2011, and July 1, 2014. As shown, the express routes SDX and BHX, and Route 206 experience the most ridership.

Figure 2-17: Existing Transit Services

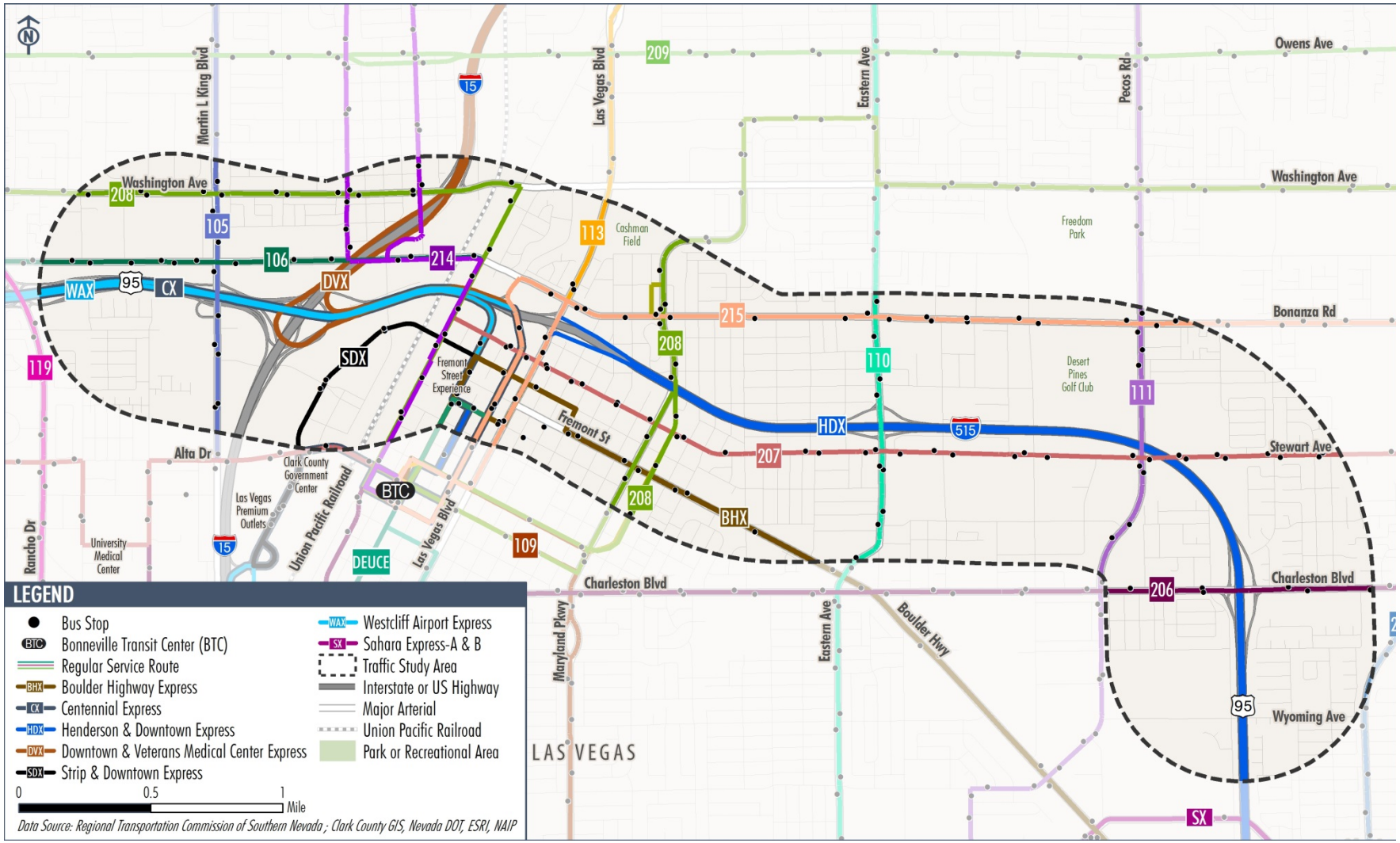
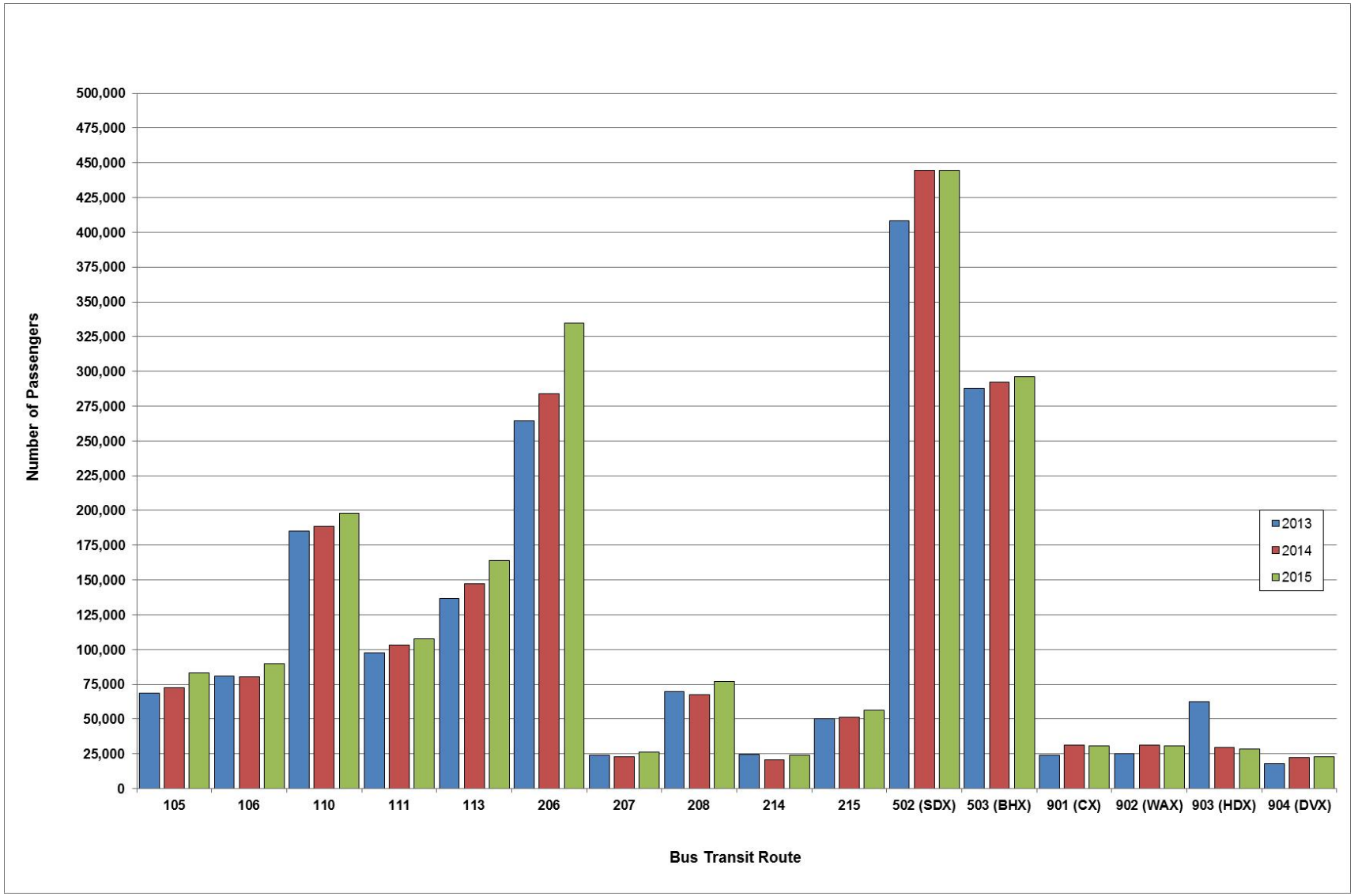


Figure 2-18: Average Monthly Ridership for Each Transit Route



Source: RTC

2.7 Bicycle and Pedestrian Facilities

The traffic study area has a network of bicycle routes/lanes and multi-use paths. Figure 2-19 shows the existing and planned bicycle and pedestrian facilities within the traffic study area based on the bicycle facilities data in the RTC's *Regional Bicycle & Pedestrian Plan for Southern Nevada* (Public Draft March 2017). As shown, a shared-use path runs along I-515 that starts in the downtown area and continues south along and beneath the freeway. However, the existing trail is discontinuous, and missing trail segments are planned to be built in the future.

2.8 Major Structures

The Downtown Las Vegas Viaduct consists of two multi-span bridges that carry northbound and southbound I-515 over multiple roads and the Union Pacific Railroad (UPRR) tracks. The viaduct extends approximately 8,300 feet (1.6 miles), beginning at 21st Street (west of the Eastern Avenue interchange) and terminating at Mesquite Avenue west of the UPRR tracks. The viaduct consists of two bridge segments (or structures) connecting just east of the 4th Street crossing. The first bridge segment (G-947) between 4th Street and Mesquite Avenue was built in the 1960s, and the second bridge segment (I-947) between 21st Street and 4th Street was built in the early- to mid-1980s. The viaduct includes a full interchange with four ramp structures at Las Vegas Boulevard, a northbound on-ramp structure from 4th Street, and a southbound off-ramp structure to Casino Center Boulevard (see Figure 2-20).

The viaduct accommodates three 12-foot-wide through-lanes and shoulders in each direction, plus additional ramp lanes. The structure width varies to accommodate the ramp lanes. Northbound and southbound traffic movements are separated by a concrete barrier.

The general superstructure construction type for both bridge segments is cast-in-place, conventionally reinforced concrete box girder. Although this superstructure type was quite common when the viaduct bridges were built, it is no longer typically used in Nevada because of the limiting span lengths and additional drawbacks compared to other structure types commonly used today.

G-947 Bridge Segment

This bridge segment was built in the 1960s and extends approximately 1,920 feet between 4th Street and Mesquite Avenue. This segment crosses Casino Center Boulevard, Main Street, UPRR, and Mesquite Avenue. About 60 percent of the viaduct length is located over areas such as governmental facilities and land, parking, and other non-traffic areas.

The G-947 structure has reached 50 years of service life and is in poor overall condition. NDOT surveyed some elements of the G-947 structure in 2016, as documented in the *Bridge Inspection Report for Bridge G-947* (November 3, 2016) (NDOT 2016). The survey identified several areas that are experiencing extensive concrete cracking, spalling (e.g., breaking, flaking, or pitting), joint failure, water intrusion, and rebar exposure and corrosion. Additionally, structural elements, such as columns, hinges, and connections, are seismically deficient because the structure was not designed to meet current seismic performance requirements. The report also indicates that the vehicle load level that can be safely carried is below an established threshold, and the bridge structure exhibits a reduced ability to carry oversized loads.

Figure 2-19: Existing and Planned Bicycle and Pedestrian Facilities within Traffic Study Area

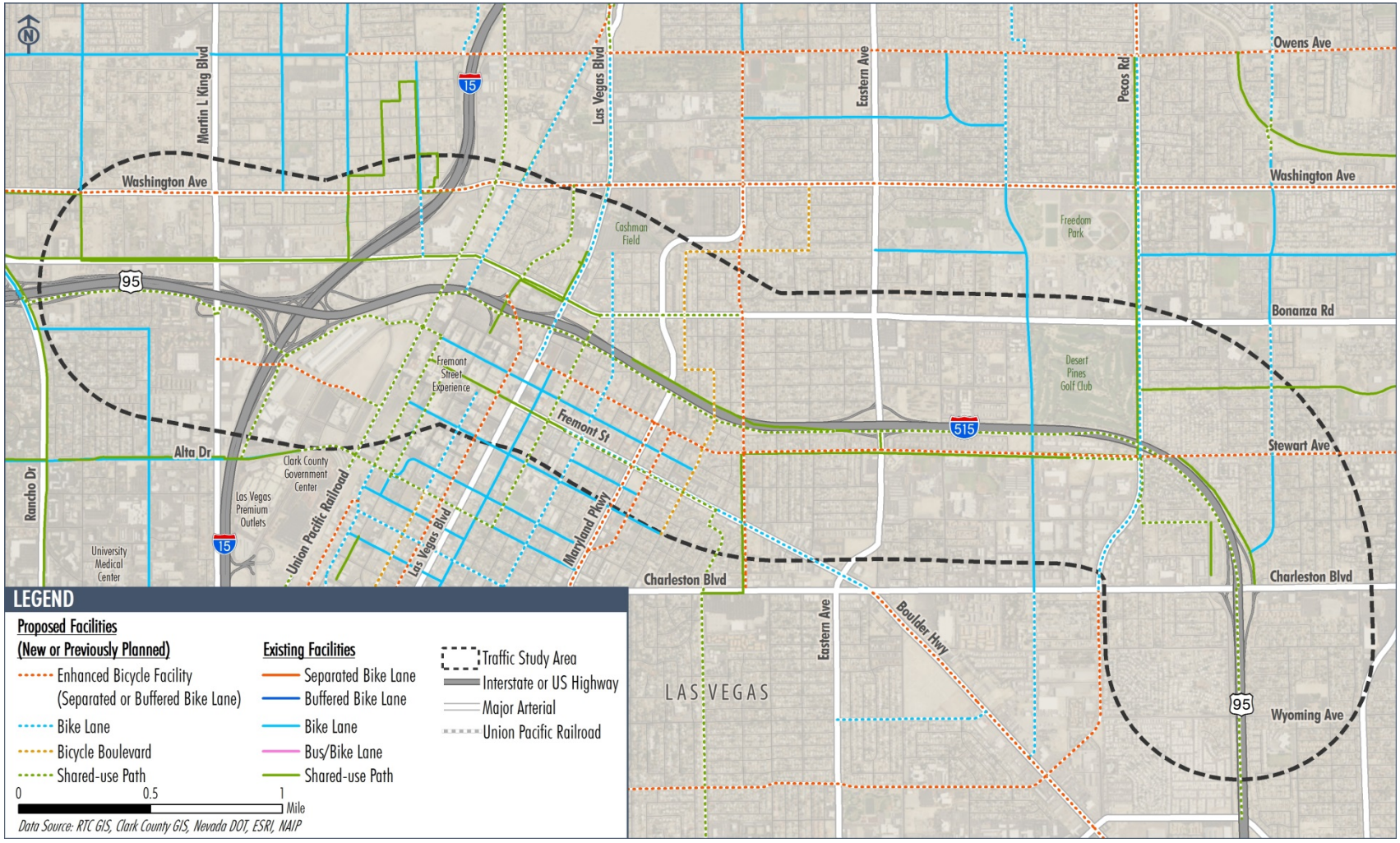


Figure 2-20: Downtown Las Vegas Viaduct

The structure's current National Bridge Inspection Standards (NBIS) sufficiency rating is 64.6[3]. The G-947 structure and the ancillary ramp structures are not classified as Structurally Deficient but are Functionally Obsolete. The seismic risk rating is 314, which is well above the action threshold value of 140. This indicates that the structure requires retrofitting measures to best comply with current seismic design and detailing standards. Replacement of the G-947 structure with ancillary ramp structures, in association with other improvements, is recommended.

I-947 Bridge Segment

This bridge segment was built in the early to mid-1980s and extends approximately 6,380 feet between 21st Street and 4th Street. This segment was constructed in three phases, as described below:

- Construction of the structure from the west side of Maryland Parkway to the east side of Las Vegas Boulevard, including ramp structures I-947E and I-947W. Structure type consists of multi-frame, multi-span, conventionally-reinforced concrete box girders. Typical span lengths range from 115 to 125 feet.
- Construction of the structure from 21st Street to Maryland Parkway. Structure types consist of conventionally-reinforced concrete box girders and precast prestressed closed-cell tub girders (over several city streets). Typical span lengths range from 105 to 125 feet. Due to concerns with potential differential settlement between adjacent pier supports, simple-span construction was employed for this portion of the viaduct.
- Construction of the structure from the east side of Las Vegas Boulevard to the connection with the existing G-947 bridge. Structure type consists of multi-frame, multi-span, conventionally-reinforced concrete box girders with precast prestressed closed cell tub girders over Las Vegas Boulevard. Span lengths of 95 feet and 125 feet were used.

The I-947 structure and the I-947E and I-947W ramp structures are generally considered to be in a good state of repair based on their respective NBIS sufficiency ratings of 90.5, 92.5, and 96.5. The latest NDOT *Bridge Inspection Report* (November 3, 2015) (NDOT 2015b) documents minor repairs needed within the next two years, with more significant repairs recommended based on available funding. The I-947 structure and the I-515 northbound off-ramp to Las Vegas Boulevard are not classified as Structurally Deficient but are Functionally Obsolete.

As expected for a 35-year-old structure, various elements are reaching the point where major maintenance/minor rehabilitation is needed to repair existing deficiencies and ensure structure longevity. In addition, an assessment of the structure's seismic performance identified the need for retrofitting a portion of the structure columns and in-span hinges.

The simple-span support configuration and superstructure type used for the 0.56-mile viaduct section between 21st Street and Maryland Parkway has created a series of peaks and valleys on the structure surface, resulting in a poor "roller coaster" ride

[3] The sufficiency rating is a measure of a bridge's structural adequacy and level of service provided to the public. The rating varies from 0 percent (poor) to 100 percent (very good).

quality for travelers. Rehabilitation measures are recommended to alleviate this issue. Other portions of the structure may have similar issues with ride quality. Determining all rehabilitation measures necessary to address these issues would require additional investigation.

2.9 Environmental Conditions

Identifying potentially affected environmental resources early in the process helps avoid and minimize impacts when developing improvement concepts, and informs the alternatives evaluation. This section summarizes existing data collected for environmental resources within the study area. This data will be supplemented by additional data collected during the National Environmental Policy Act (NEPA) phase for each project.

Land Use and Zoning

The study area has a mix of land uses that includes residential, commercial, parks and recreation, and industrial. Refer to Section 2.2 and Figure 2-3 for more information.

Parks, Recreation, and Bicycle/Pedestrian Facilities

The study area contains several park, recreation, and bicycle/pedestrian facilities, including the following.

- City of Las Vegas Municipal Pool
- Senior Citizens Center
- East Las Vegas Community and Senior Citizen Center
- Robert Dula Gymnasium
- Chuck Minker Sports Complex
- Hadland Park
- Rafael Rivera Community Center and Park
- Desert Pines Golf Course
- Bike routes, bike lanes, multi-use paths, and designated urban trails
- Various sidewalks

Park and recreation facilities are shown on Figure 2-21; existing and planned bicycle and pedestrian facilities are shown on Figure 2-19. Section 4(f) of the U.S. Department of Transportation Act requires consideration of publicly-owned parks and recreation areas in transportation project development. Use of a 4(f) property cannot be approved unless the use is *de minimis* or there is no feasible and prudent alternative that completely avoids the property, and the project includes all possible planning to minimize harm to the property. The parks and several recreational facilities listed above, including resources such as the municipal pool, Dula Gymnasium, and Desert Pines Golf Course, would be properties considered under Section 4(f).

According to the Nevada Division of State Parks, no resources within the study area have been developed with Land and Water Conservation Fund monies.

Community Facilities

The following community facilities and schools are located within the study area (see Figure 2-22):

- Fire Station #1
- Law enforcement facilities
- Howard E. Hollingsworth Elementary School
- Sunrise Acres Elementary School
- Roy W. Martin Middle School
- Variety School
- Miley Achievement Center

Figure 2-21: Parks/Recreation Facilities within Study Area

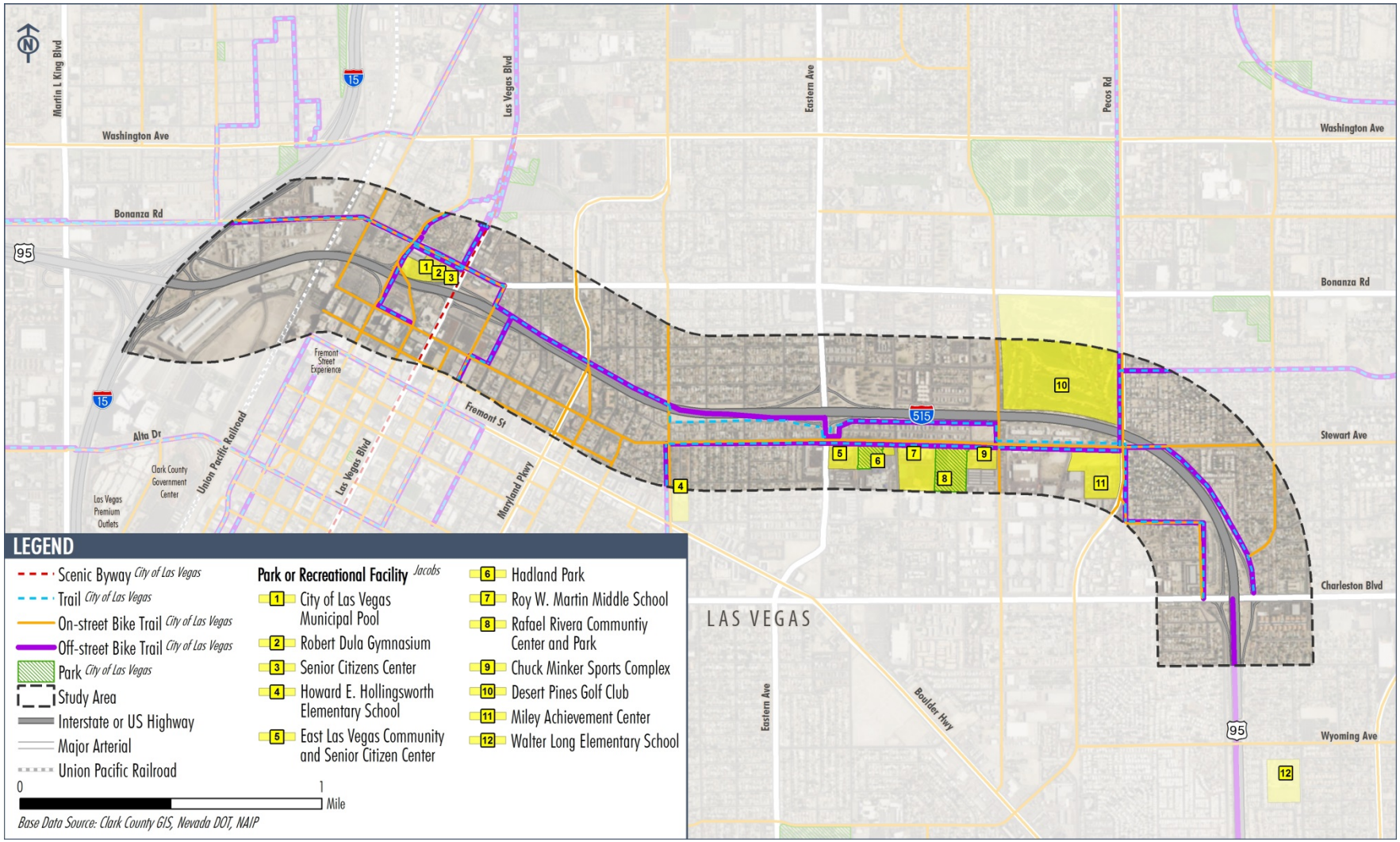


Figure 2-22: Community Facilities within Study Area

Environmental Justice

Environmental Justice (EJ) was first identified as a national policy in 1994 when President Clinton issued Executive Order (EO) 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, which required federal agencies to develop a strategy for incorporating EJ into the NEPA evaluation process. The EO directs federal agencies to identify and address disproportionately high and adverse human health or environmental effects of their actions on minority and low-income populations, to the greatest extent practicable and permitted by law.

The study team collected income and minority data for the study area from the U.S. Census American Community Survey (2010-2014) (U.S. Census 2010-2014), Clark County, and NDOT. In Clark County, 16 percent of households fall below the poverty threshold. Most Census block groups located either partially or wholly within the study area have low-income population percentages greater than the county, as shown on Figure 2-23. Clark County has a minority population of 53 percent. Within the study area, most Census blocks have higher minority percentages than Clark County. These populations are shown on Figure 2-24. These figures show that most of the study area contains low-income populations, minority populations, or both.

Air Quality

The study area is located within portions of Clark County hydrographic area 212, which is designated by the Environmental Protection Agency (EPA) as a maintenance area under the Clean Air Act for carbon monoxide (CO) and particulate matter less than 10 microns (PM_{10}), and an attainment area for all other criteria pollutants. Future NEPA studies will include air quality analysis to evaluate compliance and conformity with the federal Clean Air Act and Amendments (CAAA) of 1990, Nevada State Implementation Plans, and applicable state and local regulations. However, improvements evaluated in this study generally would ease congestion, and, therefore, improve air quality.

Traffic Noise

Noise-sensitive receptors are those locations or areas with dwelling units or other fixed, developed sites of frequent human use, such as homes, recreation areas, and schools. Noise-sensitive receptors within the study area include residences, schools, playgrounds, park and recreation facilities (including trails), offices, and historic resources. Under future NEPA studies, a traffic noise analysis will be conducted to identify specific noise-sensitive resources within each project's study area, establish existing traffic noise levels, evaluate traffic noise impacts from the project, and assess traffic noise abatement measures for all impacted noise receptors.

Cultural Resources

Historic properties are protected under Section 106 of the National Historic Preservation Act (NHPA) of 1966 (as amended) and other statutes, as well as Section 4(f) as amended and codified in the U.S. Department of Transportation Act of 1966, 49 U.S. Code (USC) 303 (c).

Figure 2-23: Environmental Justice Populations (Households Below Poverty Threshold) within Study Area

Figure 2-24: Environmental Justice Populations (Minority) within Study Area

Section 106 of the NHPA requires federal agencies to take into account the effects that their undertakings have on historic properties, which are those properties that are included in, or eligible for, the National Register of Historic Places (NRHP). This review process ensures that federal agencies identify any potential conflicts between their undertakings and historic preservation, and resolve any conflicts in the public interest.

I-515 in the study area travels through older parts of Las Vegas that contain many historic properties relative to other parts of the city. NRHP-eligible or potentially eligible resources within the study area were identified through review of surveys conducted under the *I-515 Preliminary Draft Environmental Impact Statement* (DEIS) (that was withdrawn and is described in Chapter 1).

Additionally, a search of the Nevada Cultural Resources Information System (NVCRIS) was conducted in November 2016 to identify any cultural resources studies, historic resources, and archaeological resources that have been recorded within the study area since 2005. NVCRIS is a digital database of cultural resources studies and cultural resources maintained by the Nevada State Historic Preservation Office (SHPO). The November 2016 research only included a desktop search of the NVCRIS database; a field visit was not conducted.

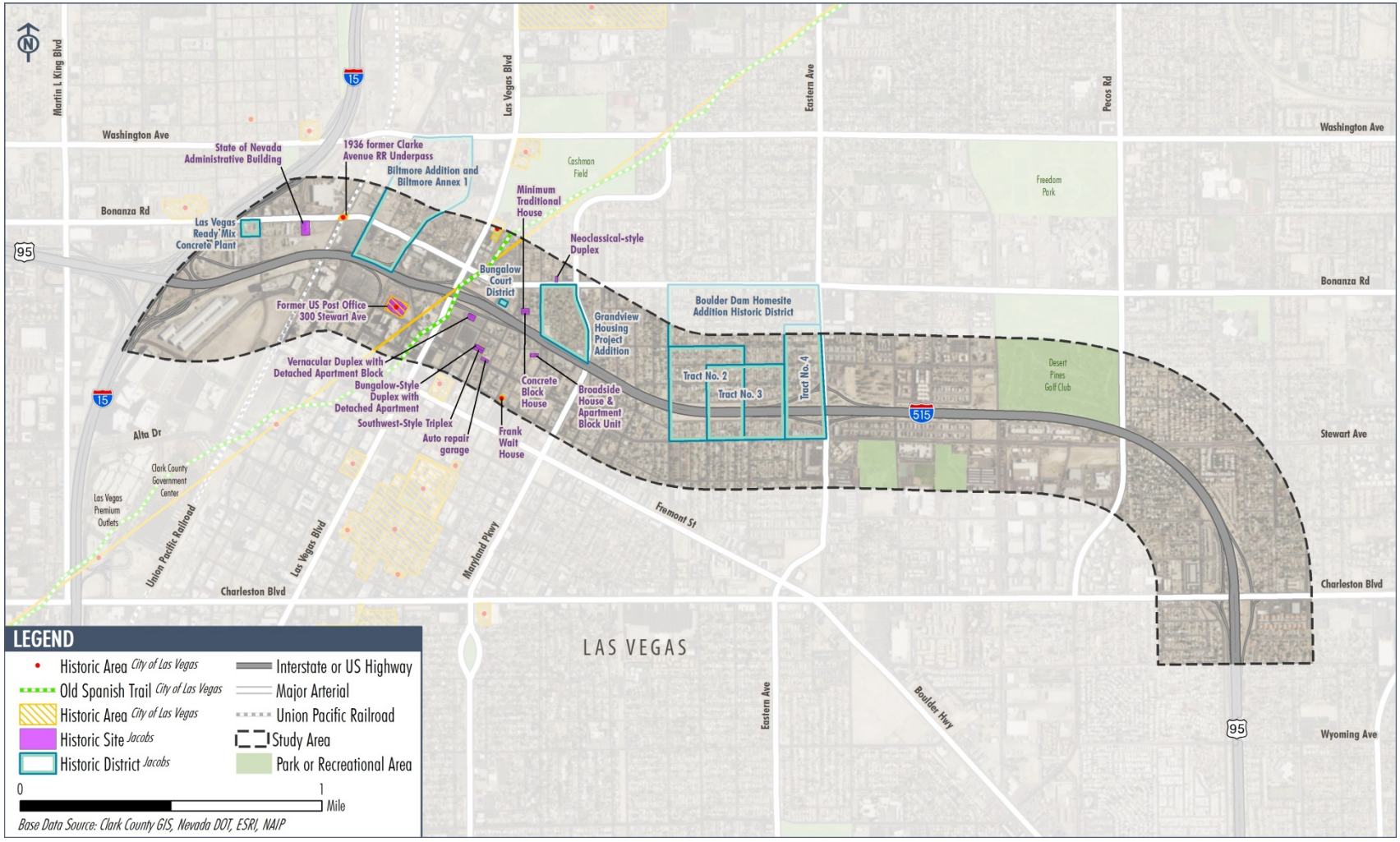
Several NRHP-eligible or potentially eligible resources were identified within the study area under the *I-515 Preliminary DEIS*, which included surveys conducted through 2005. These resources included such properties as the former US Post Office, several residences, railroad facilities, historic trail, and potential historic districts. All of these resources are located within the central and western portion of the study area (see Figure 2-25).

The NVCRIS record search conducted in November 2016 revealed that eight cultural resources studies had been performed within the study area since 2005. Those surveys recorded a total of 602 cultural resources within the study area, of which 600 are historic sites and two are archaeological sites. Two historic sites are listed on the NRHP, 348 are not eligible for the NRHP, 158 sites are potentially eligible for the NRHP, and the remaining are unevaluated. The historic sites include resources such as residences, buildings, railroad facility, and a trail. Both of the archaeological sites are linear above-ground resources that are potentially eligible for the NRHP. Although located throughout the study area, most of these resources are concentrated in the central and western portions.

A supplemental records search was conducted in February 2017 to clarify the NRHP eligibility of 29 residences within the study area that were identified in a 2009 cultural resources study. This involved a request to the SHPO for all records concerning SHPO correspondence with the lead agency, NDOT, regarding the 29 properties and documentation concerning their NRHP eligibility status. The records obtained indicated that in March 2011, the SHPO concurred that the 29 resources are eligible for the NRHP.

For more detail and locations of resources identified in the November 2016 data search, refer to Appendix C – I-515 Cultural Resources Supplementary Records Search.

Figure 2-25: Historic Resources Identified under I-515 Preliminary DEIS within Study Area



Hazardous Materials

Hazardous waste may be encountered during the construction of a project. Therefore, it is important to identify properties that may contain contamination prior to right-of-way acquisition and construction.

An agency regulatory records search was conducted in November 2016 to determine the presence of potential recognized environmental conditions (RECs) within the study area. RECs are defined as the presence or likely presence of hazardous materials or petroleum products on a property under conditions that indicate an existing or past release, or a material threat of a release.

Information about toxic releases, hazardous waste, and brownfields was obtained from EPA's online mapping database, EnviroMapper for EnviroFacts. Additional information was obtained from the Nevada Department of Environmental Protection (NDEP) eMap database about regulated and corrective action petroleum sites. This data was used to identify all listed sites with known or suspected RECs within approximately 0.5 mile of proposed improvements. A distance of 0.5 mile is the standard American Society for Testing and Materials (ASTM) search distance for sites with leaking storage tanks and sites that generally could be associated with remedial activities. However, only hazardous waste sites within 0.25 mile of the proposed improvements were further researched to determine their status and if a violation has occurred and/or remedial activities are on-going because these sites are generally associated with Resource Conservation and Recovery Act (RCRA) generator sites that have a standard ASTM search distance of 0.25 mile.

Figure 2-26 shows all listed sites from EPA and NDEP that could pose a risk to the proposed projects. As shown, most of the sites are located in the western portion of the study area. See Appendix C – Hazardous Materials Research for Task Order 2 for more information.

Floodplains

The study area is located within a Federal Emergency Management Agency (FEMA) designated Unshaded Flood Zone X. An Unshaded Flood Zone X indicates areas located outside the 500-year floodplain. Several flood conveyances, existing and planned, traverse the study area (see Figure 2-27).

Figure 2-26: Hazardous Materials Sites

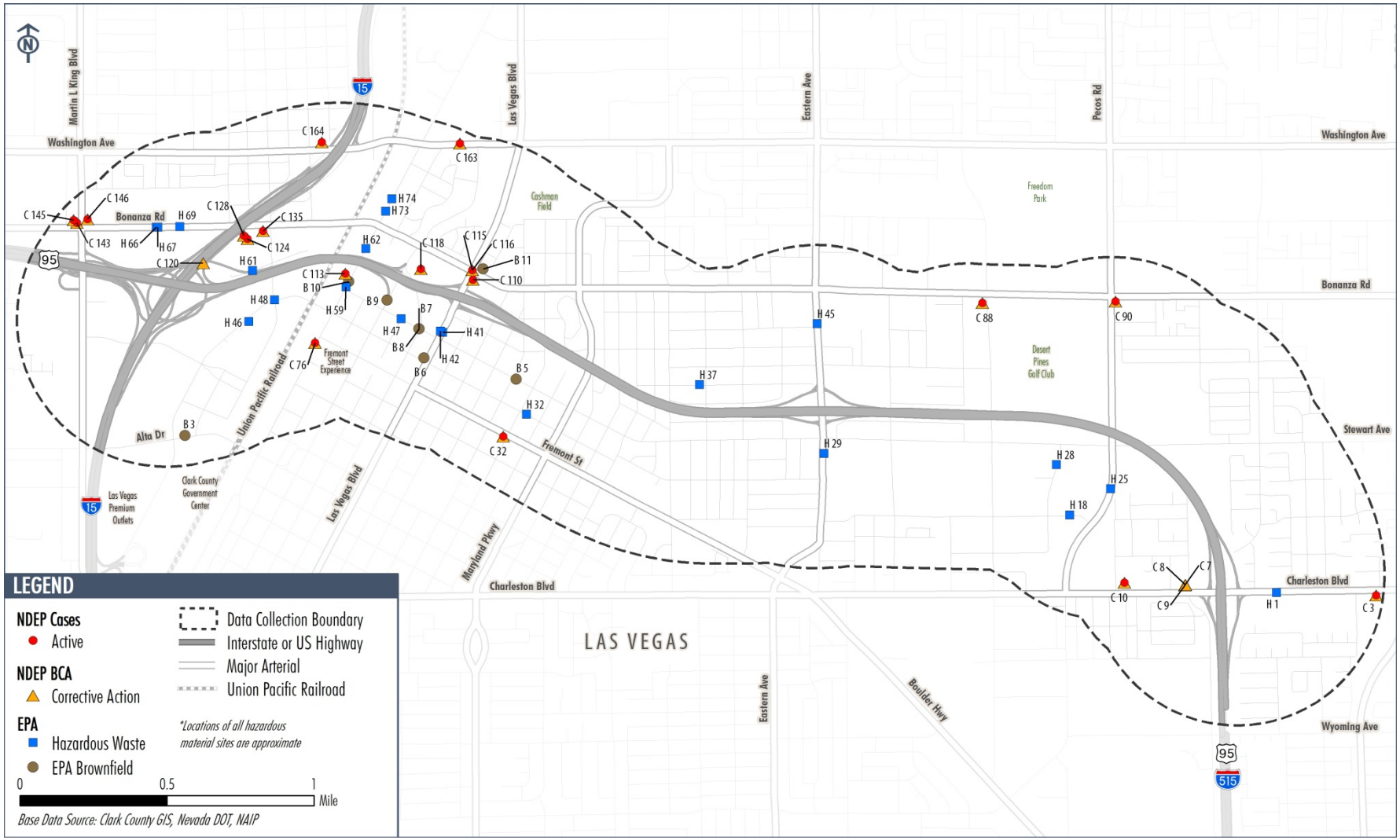
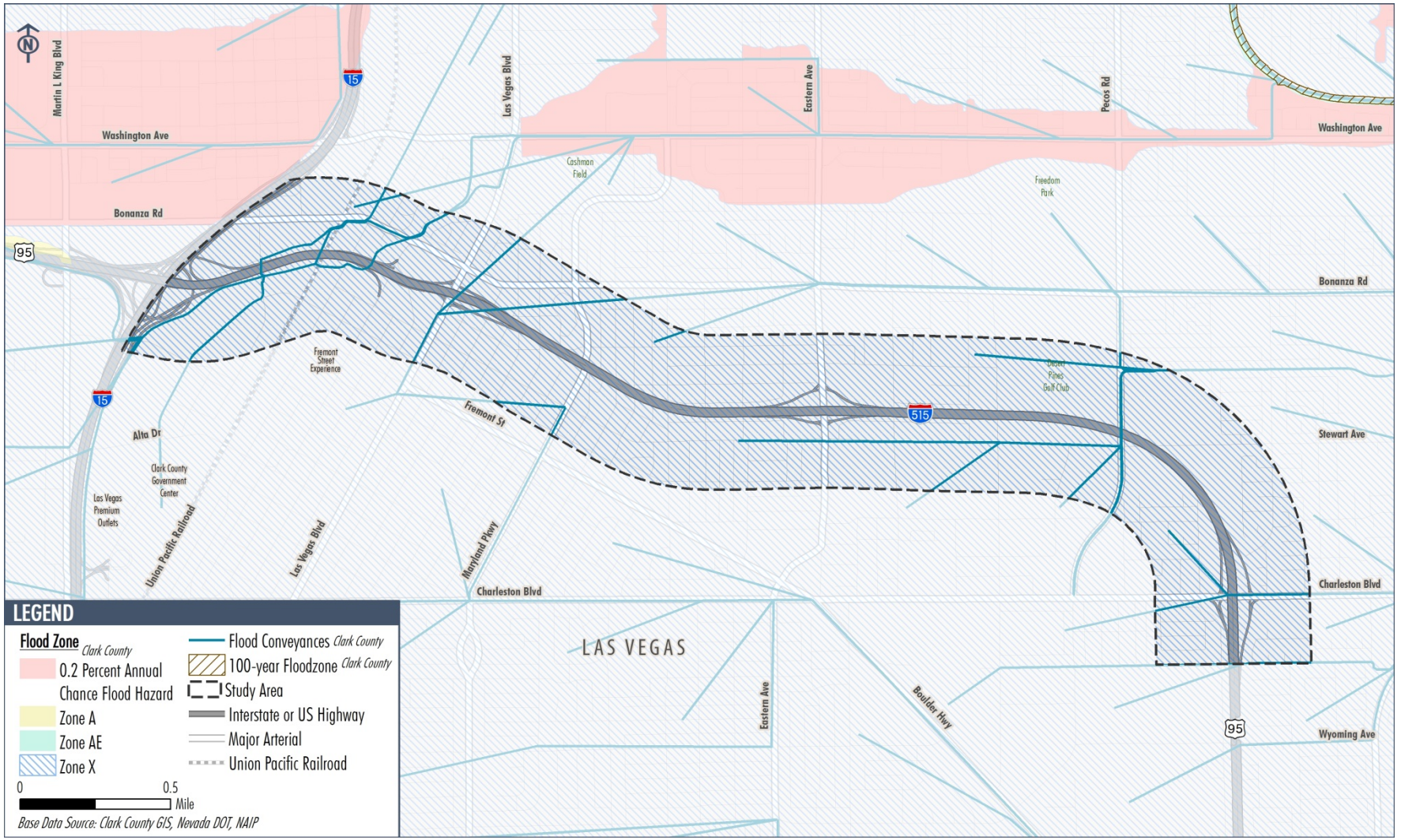


Figure 2-27: Floodplains within Study Area



Visual Conditions

The study area is located within a highly developed urban area within 0.5 mile of I-515 in the City of Las Vegas. The visual setting consists of views of residential and commercial buildings, commercial roadside landscaping, industrial areas, and roadways and related infrastructure, such as bridges, ramps, and retaining walls. Elevated I-515 and associated retaining walls can be viewed from study area roadways, residences, and commercial buildings in proximity to the highway. Beyond that area, views of elevated I-515 within the study area are intermittently blocked by adjacent residential and commercial buildings. Views to the north and south for travelers along I-515 are constrained by the existing noise wall along both sides of the highway, although some taller buildings can be seen. However, to the east and west, I-515 travelers are provided longer distant views of high-rise buildings and mountains.

Other Resources Not Present or Minimally Present within the Study Area

Wetlands/Waters of the U.S.

Based on existing data mapping, the study area has no waters of the U.S. as defined by the Clean Water Act (CWA), including wetlands, immediately near I-515. During future NEPA phases, NDOT will review any undisturbed areas to confirm whether impacts to resources protected by Section 404 of the CWA would occur.

Biological Resources

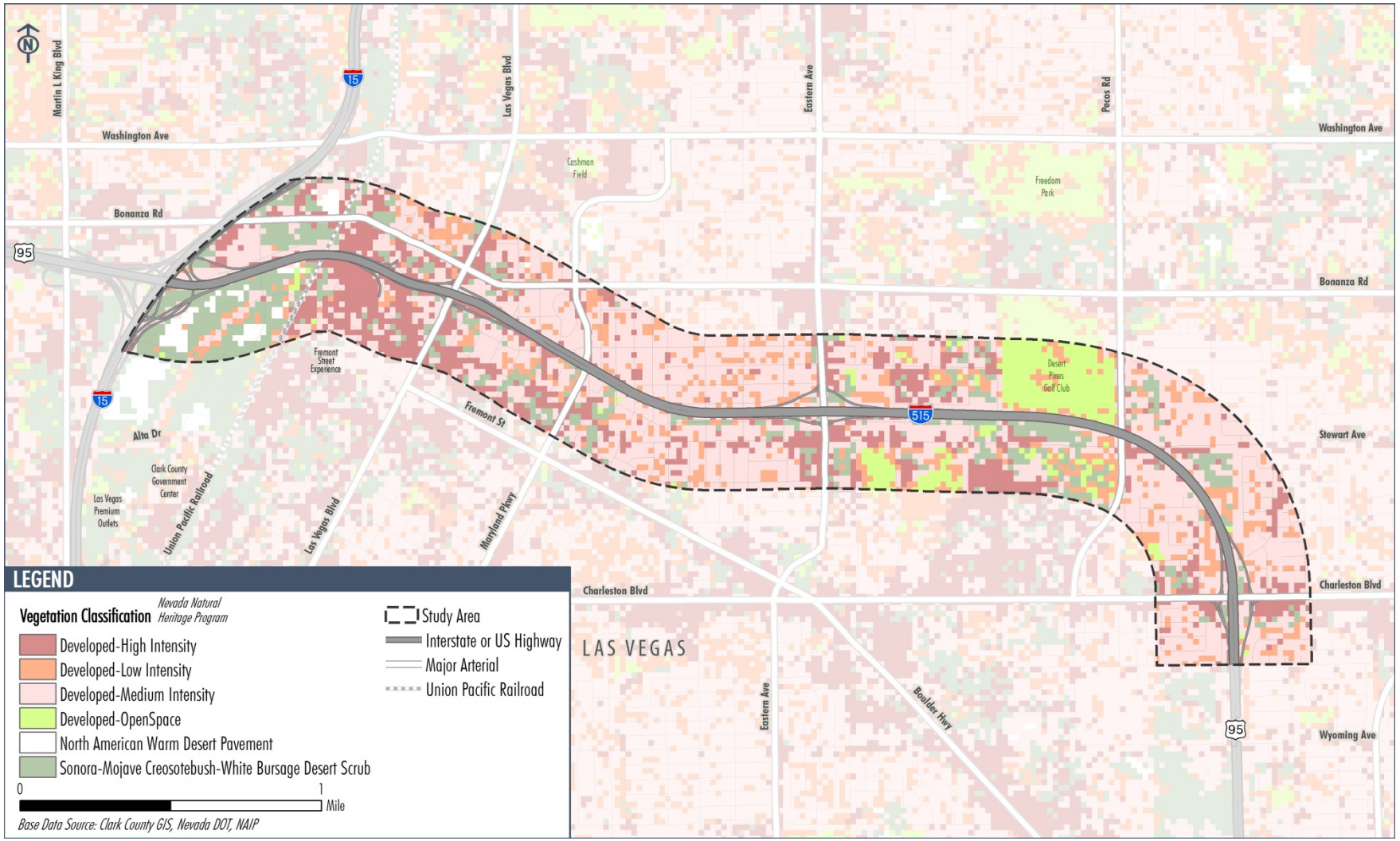
The study area is highly disturbed due to existing urban development. As such, federal- or state-protected species effects are not expected to occur. However, studies will be conducted during future NEPA phases for proposed improvements to verify the expected occurrence of such species within the study area, as well as migratory birds protected under the Migratory Bird Treaty Act.

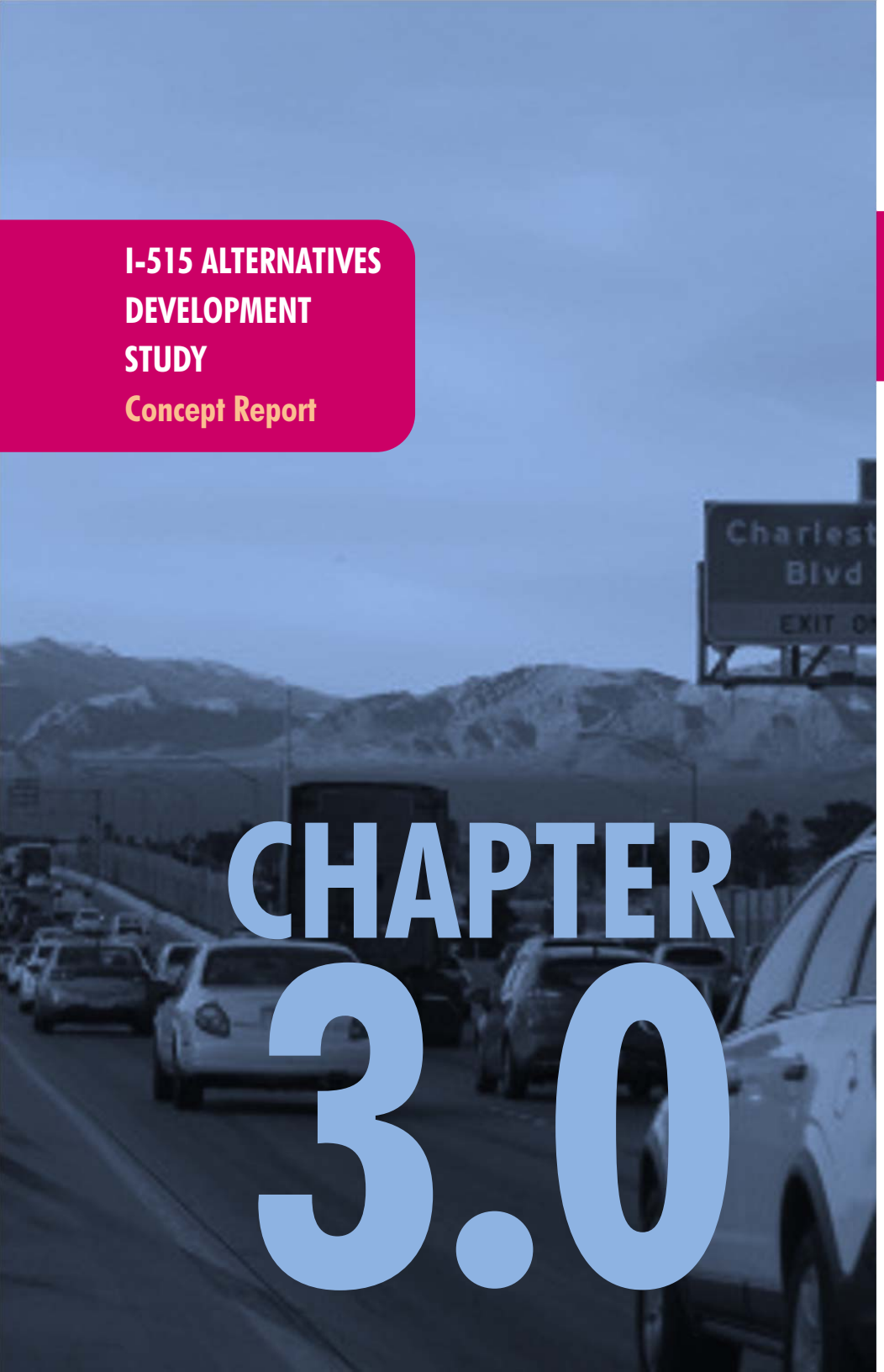
Due to the high level of urban development within the study area, little natural vegetation is present. According to the Nevada Natural Heritage Program data, most of the vegetation within the study area is classified as "developed-medium intensity," with scattered areas classified as "developed-high intensity," "developed-low intensity," "developed-open space," "North American Warm Desert Pavement," and "Sonoma-Mojave Creosotebush-White Bursage Desert Scrub" (see Figure 2-28).

Water Resources/Quality

According to Clark County and NDOT, six drinking water wells are located within the study area, but none are located adjacent to I-515. No significant water resources are located within the study area.

Figure 2-28: Vegetation Classifications within Study Area





Chapter 3.0 Alternatives Development and Screening Process

Chapter 3 provides information about the alternatives development and screening process used to identify and recommend projects for the Nevada Department of Transportation (NDOT) to implement.

3.1 Range of Improvements

To identify and evaluate near-term operational and safety improvements within the study area, the study team considered a range of reasonable improvements to meet this study's Purpose and Need, discussed in Section 1.4. Improvements were identified through a series of stakeholder meetings and workshops (see Chapter 4 for more information). Problems and issues in the corridor were identified and documented, and conceptual improvements to solve these problems and issues were developed. The conceptual improvements were presented to stakeholders and the public, and then refined based on their feedback. The improvements carried forward through the screening process generally fell into the following categories:

- Interchange and ramp improvements, including new interchanges
- Collector-distributor roads
- Auxiliary lanes
- Congestion management improvements
- Travel Demand Management (e.g., high-occupancy vehicle [HOV] lane) improvements.
- Transportation System Management (TSM) improvements, including:
  - Traffic signal optimization
  - Ramp metering
  - Active Transportation and Demand Management (ATDM) strategies, such as variable speed control
  - Additional turn bays

3.1.1 No-Action Alternative

The No-Action Alternative was fully evaluated and serves as a baseline comparison for operational, safety, benefit-to-cost, and environmental analysis purposes. It assumes completion of ongoing or reasonably foreseeable transportation, development, and infrastructure projects. These projects include:

- Projects programmed by NDOT, Clark County, the City of Las Vegas, or the Southern Nevada Regional Transportation Commission (RTC).
- Projects included in the fiscally-constrained *2035 Regional Transportation Plan* (RTP), except for programmed improvements that would meet the Purpose and Need for this study.

Projects programmed in the vicinity of the study area that are included in the No-Action Alternative include the following:

- Project Neon: Improvements include construction of an HOV direct connection between US 95 and I-15, conversion of express lanes to HOV on I-15 with access ramps at Wall Street, realignment of Martin Luther King Boulevard with a flyover at Charleston Boulevard, extension of Grand Central Parkway over the Union Pacific Railroad to Industrial Road, and reconstruction of the I-15 and Charleston Boulevard interchange. Construction activities started in spring 2016, and are anticipated to be completed in 2019.
- I-515 Northbound Viaduct Overlay: Improvements include a polymer concrete overlay on the viaduct along northbound I-515 between Las Vegas Boulevard and the Union Pacific Railroad (UPRR). This improvement was recently completed.
- I-515/Charleston Boulevard Interchange and Auxiliary Lane Improvements: Improvements include reconstructing and widening Charleston Boulevard through the I-515 interchange, and widening all four ramps to increase capacity and improve operations. The improvement limits along Charleston Boulevard are Honolulu Street and Lamb Boulevard. Improvements include adding a northbound full auxiliary lane from Charleston Boulevard to Eastern Avenue with a dual lane exit at Eastern Avenue, and adding a southbound full auxiliary lane from Eastern Avenue to Charleston Boulevard with a dual lane exit at Charleston Boulevard.The anticipated project completion date is 2021. The next section of this report (Section 3.1.2) provides additional information regarding the

relationship, history, and programming status of this project.

- Casino Center Boulevard, Stewart Avenue to US 95 Improvements: This project planned by the City of Las Vegas seeks to convert Casino Center Boulevard between Stewart Avenue and US 95 into a two-way street with the addition of one continuous northbound lane while keeping the southbound lane configuration. The intersection of Casino Center and Stewart Avenue will be restriped to allow vehicular movements that were previously prohibited, providing access to northbound US 95 via Casino Center Boulevard, which is not currently available.

Figure 3-1 shows the locations of these planned improvements.

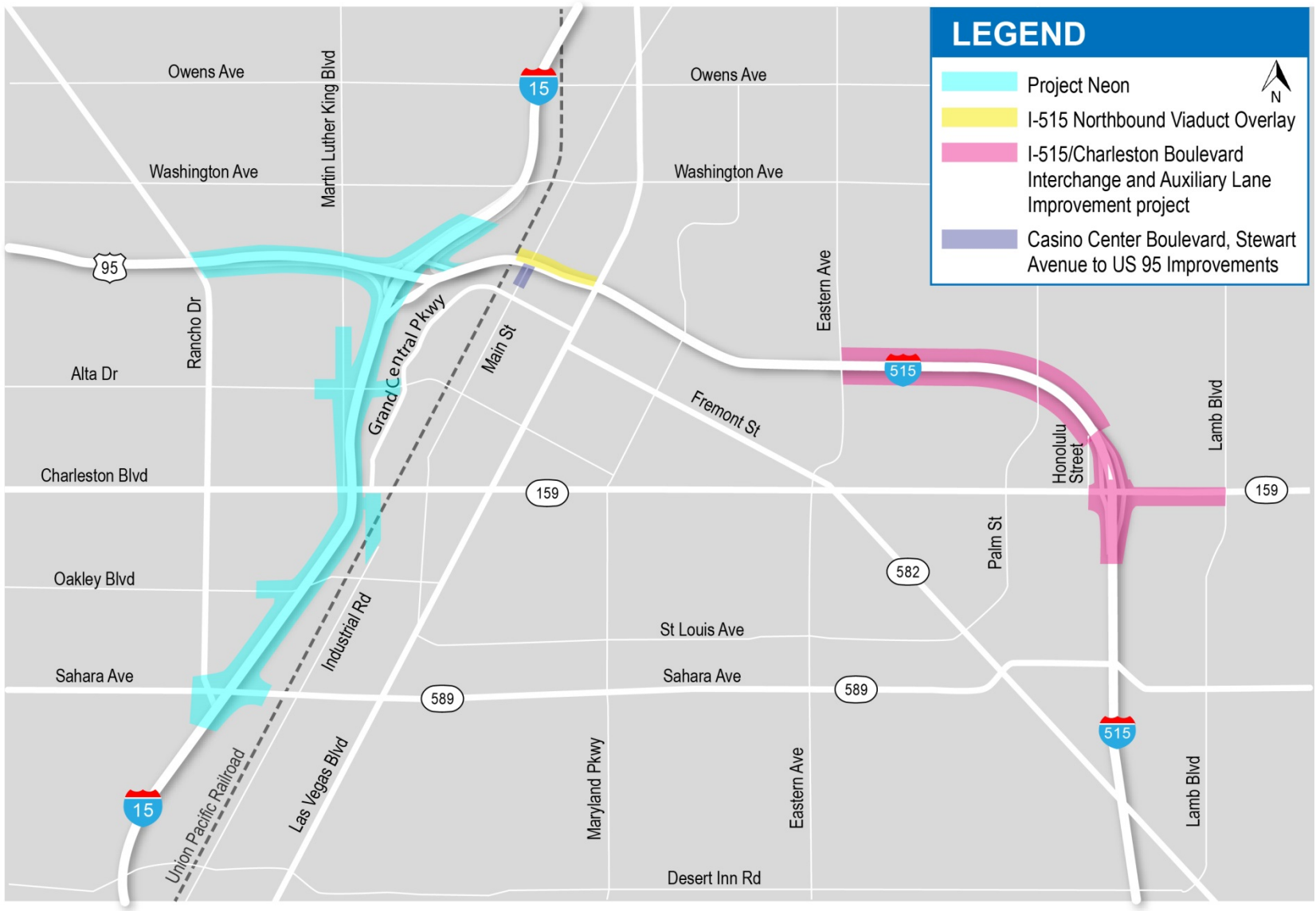
One programmed project in the RTP is not included in the No-Action Alternative because it would help meet this study's Purpose and Need. This project includes widening I-515 to 10 lanes between Charleston Boulevard and the Spaghetti Bowl, and adding new interchanges at F Street (City Parkway) and Pecos Road.

3.1.2 I-515/Charleston Boulevard Interchange and Auxiliary Lane Improvements

Although the I-515/ Charleston Boulevard Interchange and Auxiliary Lane Improvement Project has been included in the No-Action Alternative as an ongoing project programmed by NDOT, the history and programming status of this project is described in more detail in this section because significant components of the project originated as a result of this I-515 Alternatives Development Study.

Recognizing the high congestion and above-average crash rates at the I-515/ Charleston Boulevard interchange, in 2013 the City of Las Vegas Department of Public Works commissioned the *I-515 and Charleston Boulevard Interchange Alternatives Feasibility Study* to provide recommendations to improve operations, reduce congestion, and enhance safety on Charleston Boulevard at the I-515 interchange. The City's study, completed in 2015, focused primarily on Charleston Boulevard at the I-515 interchange. The feasibility study identified multiple interchange concepts that could improve operations through this segment of the Charleston Boulevard arterial corridor. However, the City's analysis showed that, while the concepts would relieve congestion and improve operations somewhat, the capacity of the I-515 interstate and ramp facilities would also need to be increased to realize the full potential of any improvements made to Charleston Boulevard.

Figure 3-1: Planned Projects Included in the No-Action Alternative



In coordination with the City of Las Vegas and in recognition of the need for compatible and complementary improvements to both Charleston Boulevard and I-515, NDOT commissioned an Environmental Assessment (EA) in 2016 in accordance with the National Environmental Policy Act (NEPA) for the I-515/ Charleston Boulevard Interchange Improvement Project. The scope of the EA was a combination of improvements to Charleston Boulevard identified in the *City of Las Vegas I-515 and Charleston Boulevard Interchange Alternatives Feasibility Study*, and complementary improvements to I-515 between Eastern Avenue and Charleston Boulevard (identified as Concepts 23 through 28 and 32) generated as part of this I-515 Alternatives Development Study.

The project study area reflecting the combined improvements to Charleston Boulevard and Interstate 515 is shown on Figure 3-2 below.

Figure 3-2: NEPA Environmental Assessment Study Area

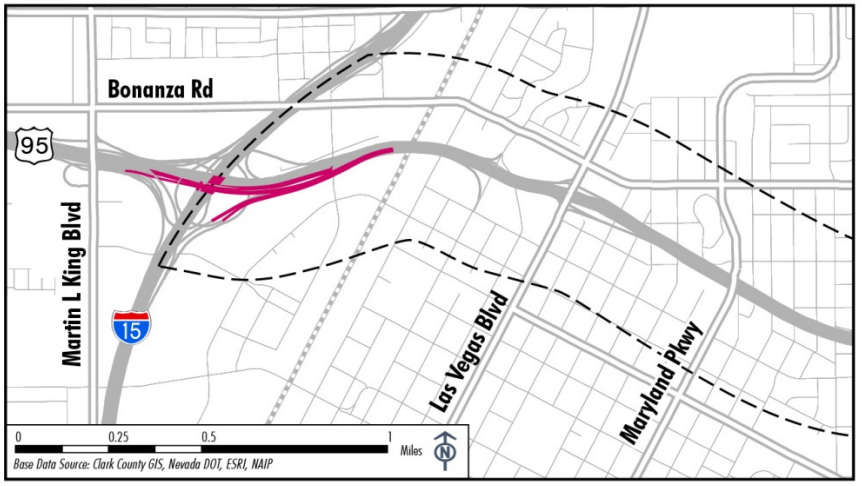
NDOT has committed to serving as the lead agency through the implementation of the proposed improvements. The EA is scheduled to be submitted for approval by the Federal Highway Administration (FHWA) in late 2017, with a determination regarding the need for preparation of an Environmental Impact Statement or finding of no significant impact (FONSI) expected in early 2018. Under a FONSI outcome, NDOT intends to advance implementation of the project through the preliminary engineering, right-of-way (ROW), and construction phases as soon as possible, subject to funding availability.

3.1.3 Conceptual Build Alternatives

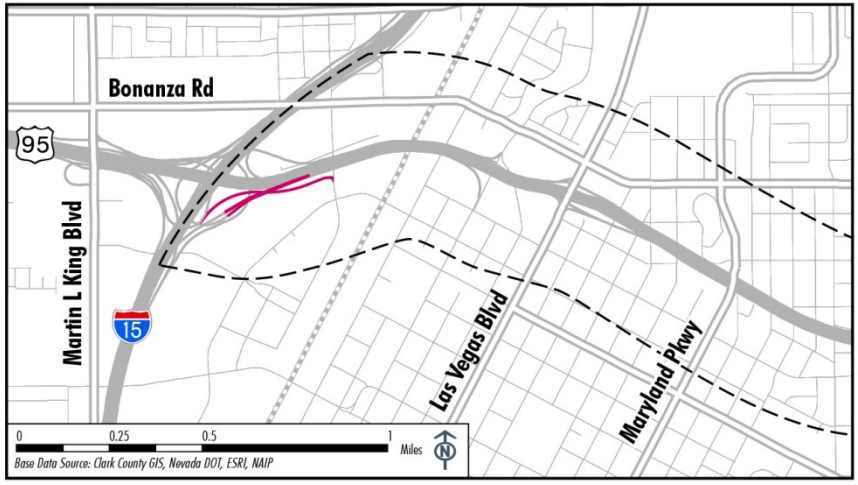
Figure 3-3 summarizes all of the concepts considered in this study. For more information on these concepts, see Appendix C – Improvements Evaluated in Task Order 1.

Figure 3-3: Conceptual Build Alternatives

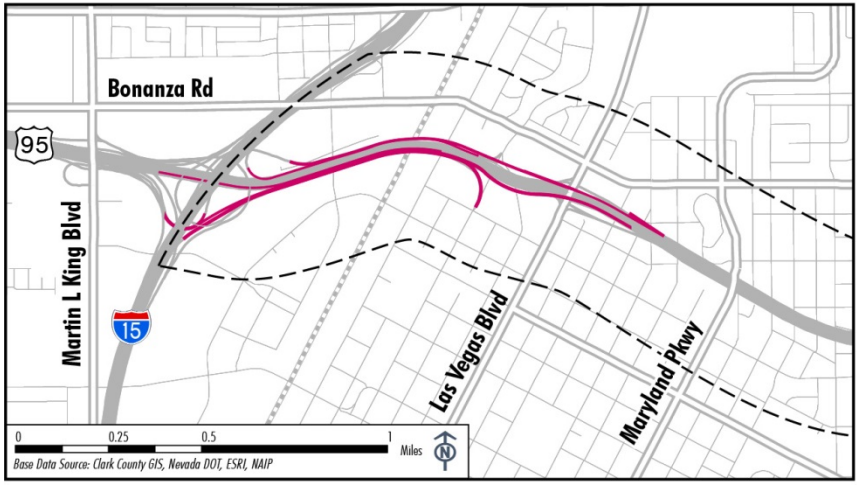
1a: Eliminate the southbound lane reduction at the I-15 underpass, and construct a full southbound auxiliary lane to the Charleston Boulevard exit (full widening of I-515 to the south).
1b: Eliminate the southbound lane reduction at the I-15 underpass, and construct a full southbound auxiliary lane connecting to the proposed auxiliary lane between Eastern Avenue and Charleston Boulevard exit (partial widening of I-515 to the south).
1c: Eliminate the southbound lane reduction at the I-15 underpass, and provide a full southbound auxiliary lane to the Charleston Boulevard exit (re-striping I-515 to the south).



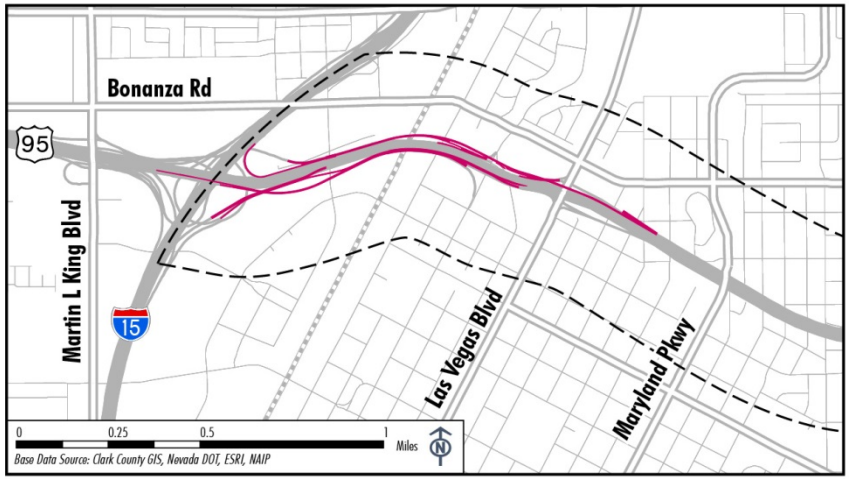
2: Construct a left exit/entry half interchange at City Parkway. Reconfigure the southbound general purpose lanes and the I-15 to southbound I-515 system ramp to accomplish the left exit/entry at City Parkway.



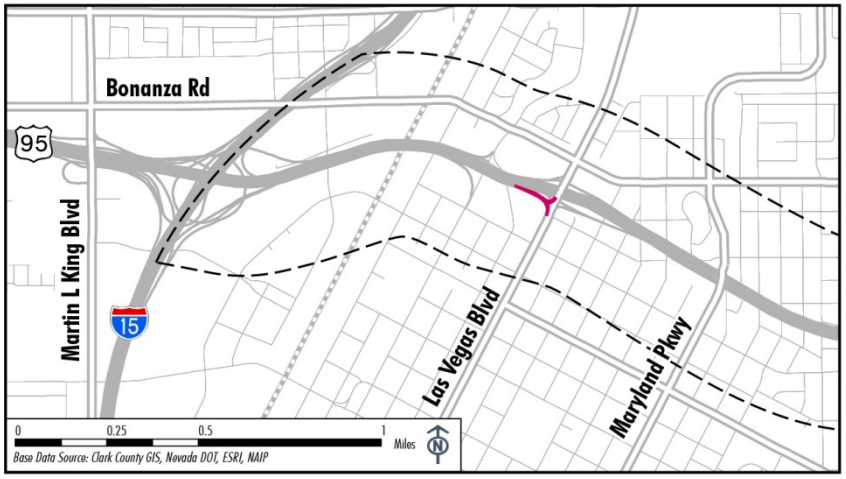
3: Construct a southbound directional ramp to City Parkway from the US 95/northbound I-15 ramp.



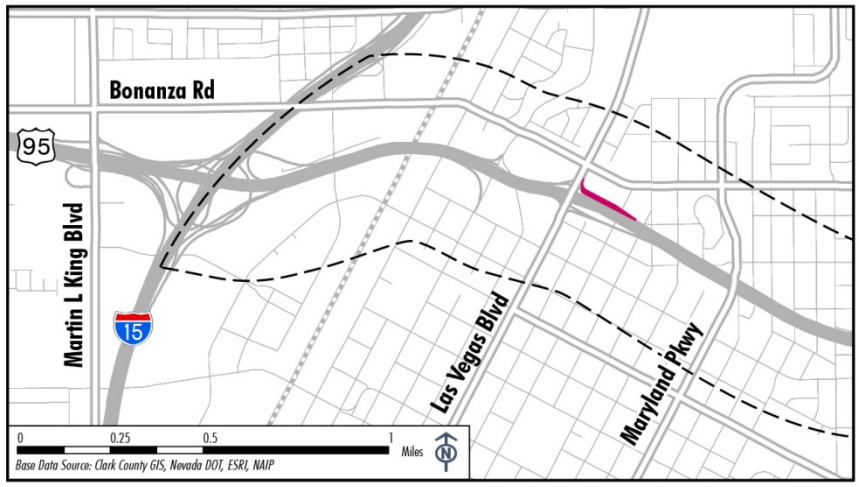
4: Braid ramps between I-15 and Las Vegas Boulevard, and reconfigure I-515 southbound Casino Center Boulevard off-ramps.



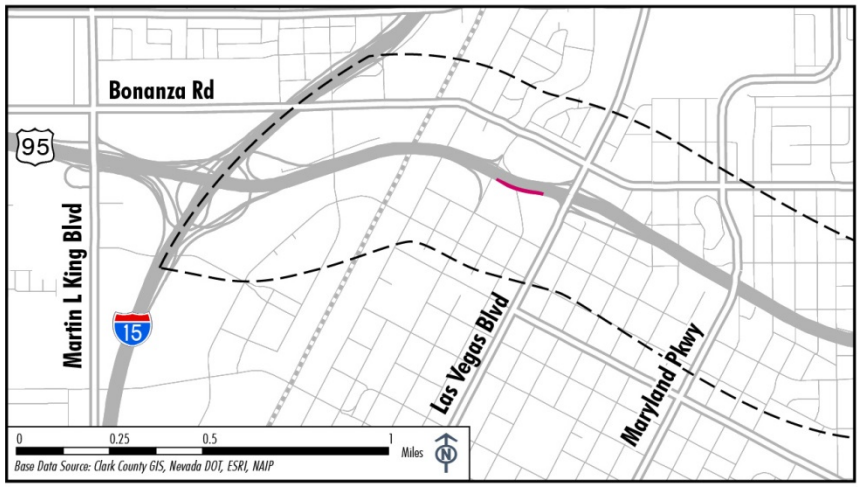
5a: Construct a collector-distributor road to allow ramp braiding on northbound I-515 between I-15 and Las Vegas Boulevard.
5b: Construct a collector-distributor road to allow ramp braiding on southbound I-515 between I-15 and Las Vegas Boulevard.



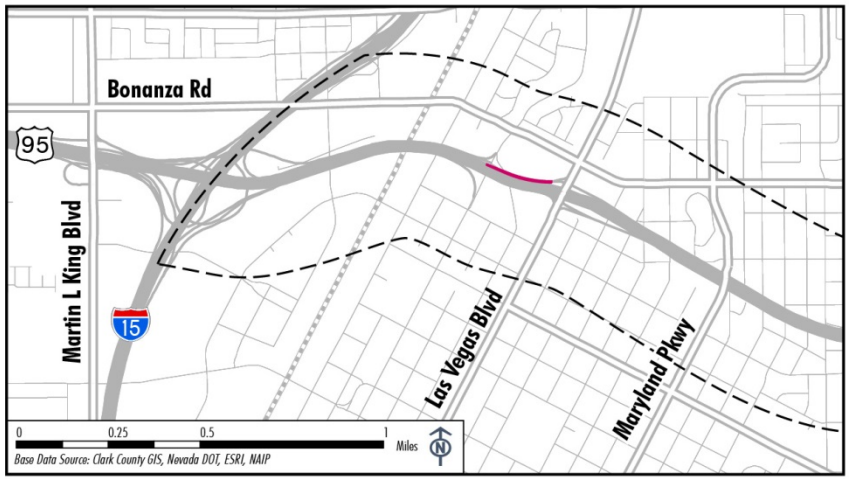
6: Add two right-turn lanes and two left-turn lanes on the southbound I-515 Las Vegas Boulevard off-ramp.



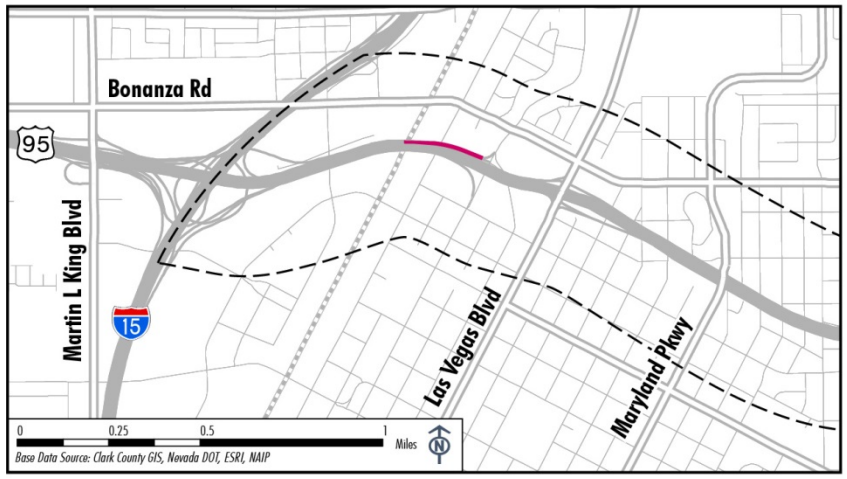
7: Widen the I-515 northbound Las Vegas Boulevard off-ramp to provide two right-turn lanes.



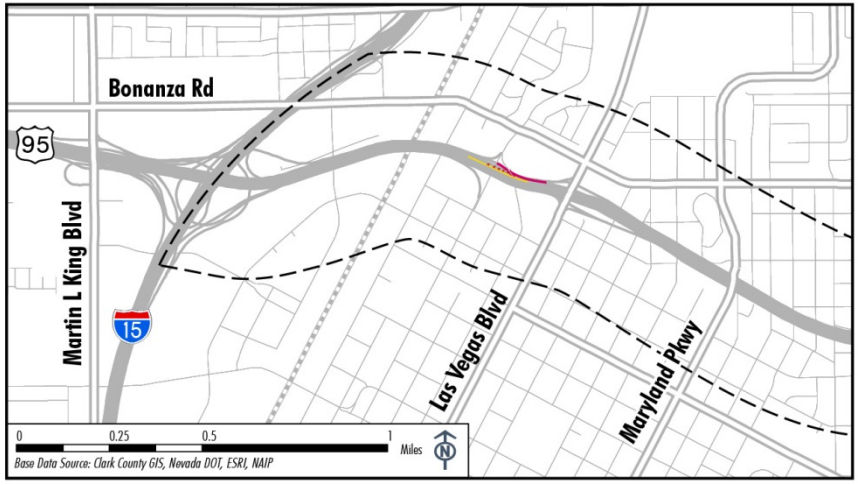
8: Restripe the I-515 southbound Las Vegas Boulevard off-ramp to add one lane.



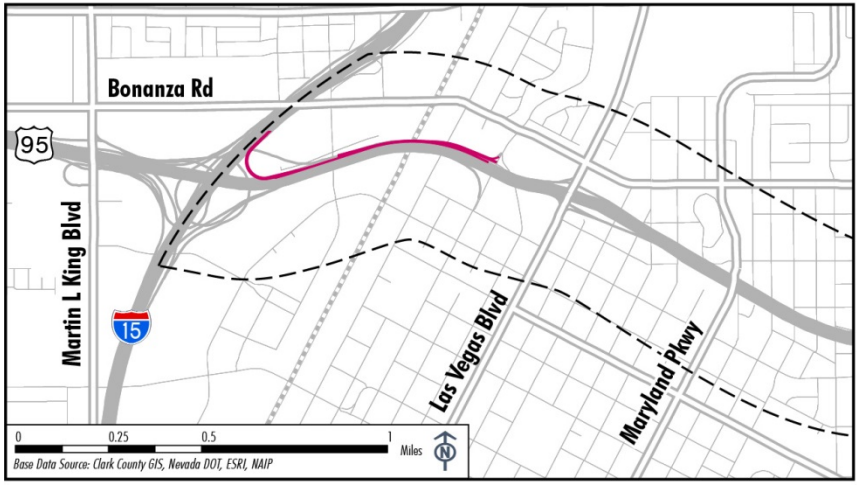
9: Widen the I-515 northbound Las Vegas Boulevard metered on-ramp to add one lane.



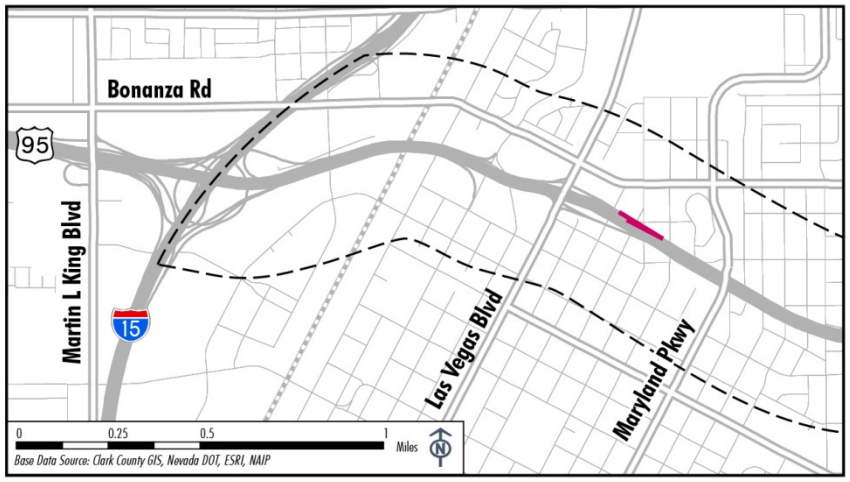
10: Widen the I-515 northbound Casino Center Boulevard on-ramp to three lanes.



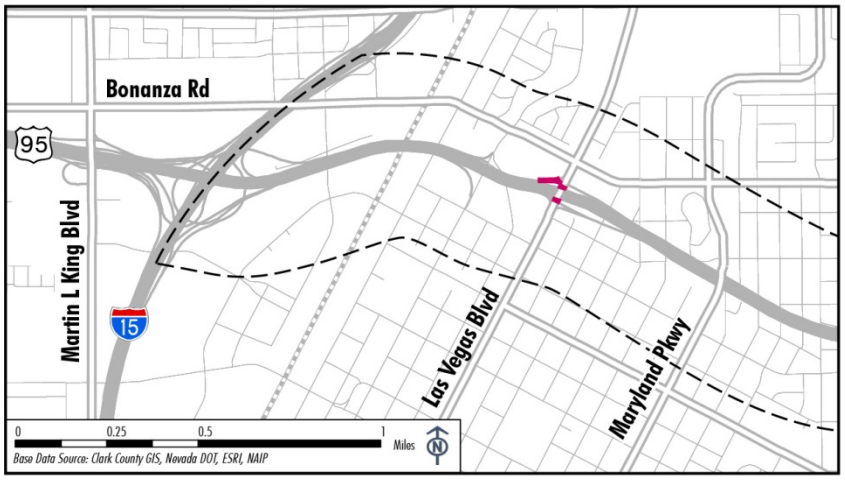
11: Reconstruct the I-515 northbound Las Vegas Boulevard on-ramp to merge with the Casino Center Boulevard on-ramp. Close the existing I-515 northbound Las Vegas Boulevard on-ramp.



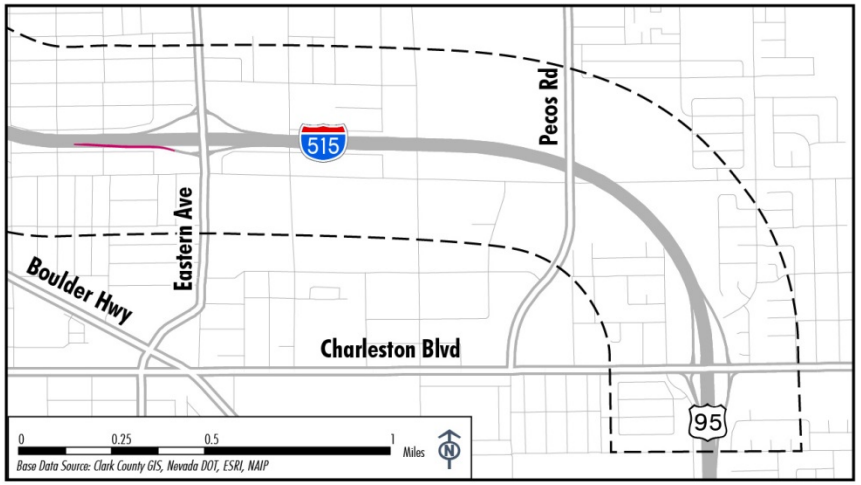
12: Add a full northbound auxiliary lane between the Las Vegas Boulevard on-ramp and the northbound I-15 exit, including an auxiliary lane from the Casino Center Boulevard on-ramp to the I-15 southbound exit.



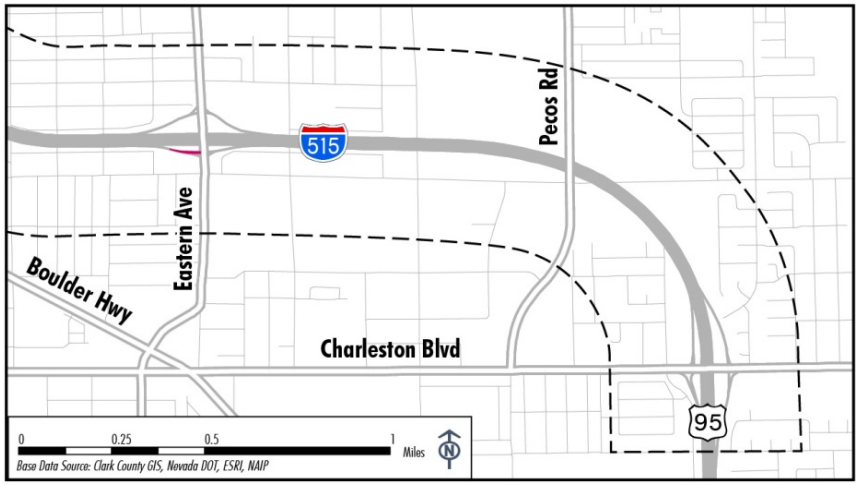
13: Restripe the I-515 northbound Las Vegas Boulevard off-ramp to add a choice exit lane to the off-ramp.



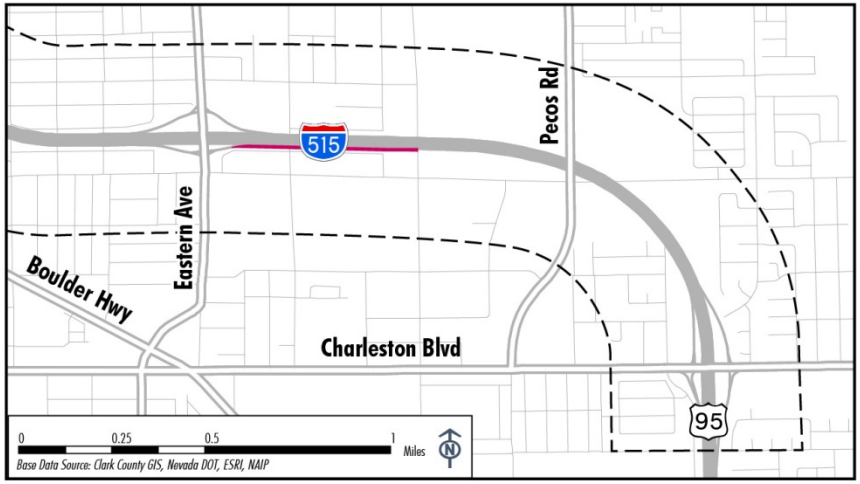
14: Add one left-turn lane to the I-515 northbound Las Vegas Boulevard on-ramp interchange.



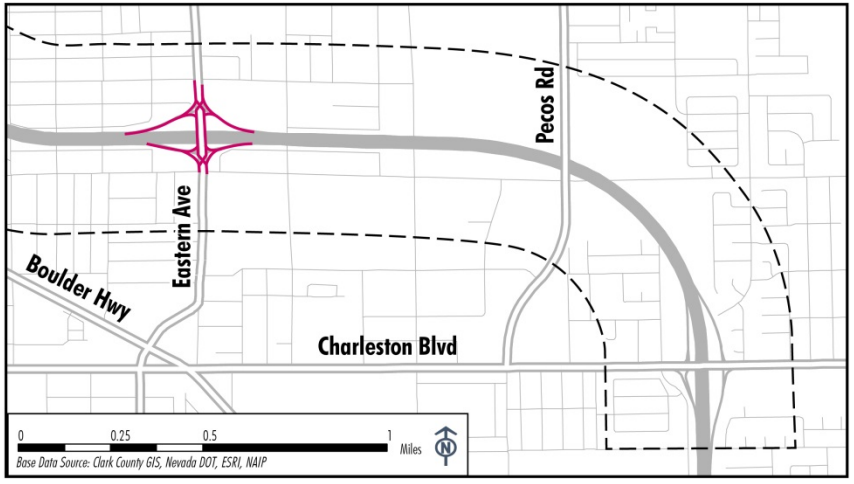
15: Add one lane to the I-515 southbound Eastern Avenue off-ramp.



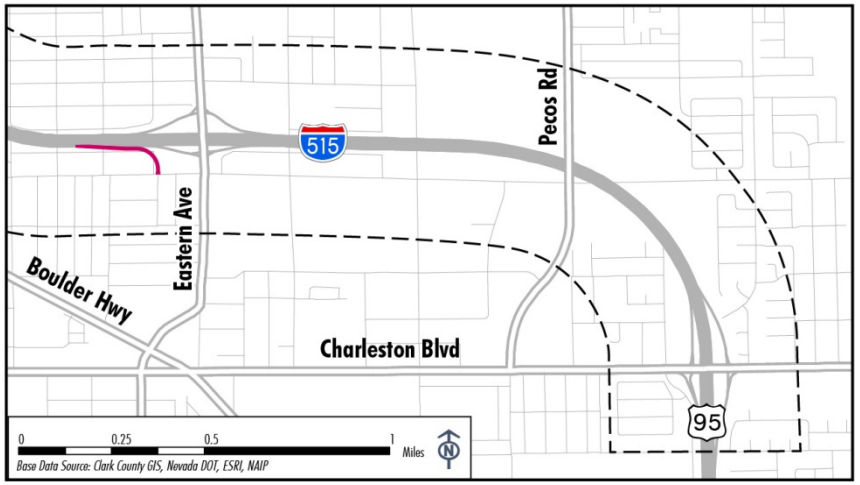
16: Add one right-turn lane at the I-515 southbound Eastern Avenue off-ramp.



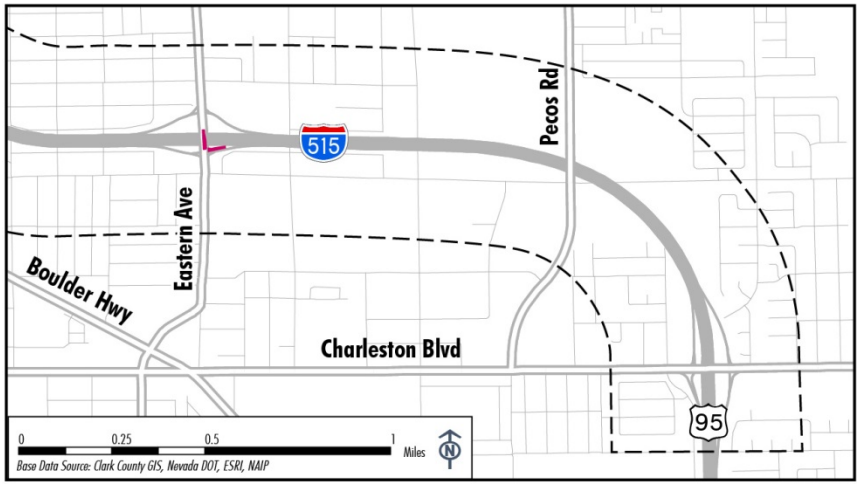
17: Construct a one-way frontage road between the I-515 southbound Eastern Avenue on-ramp and Mojave Road.



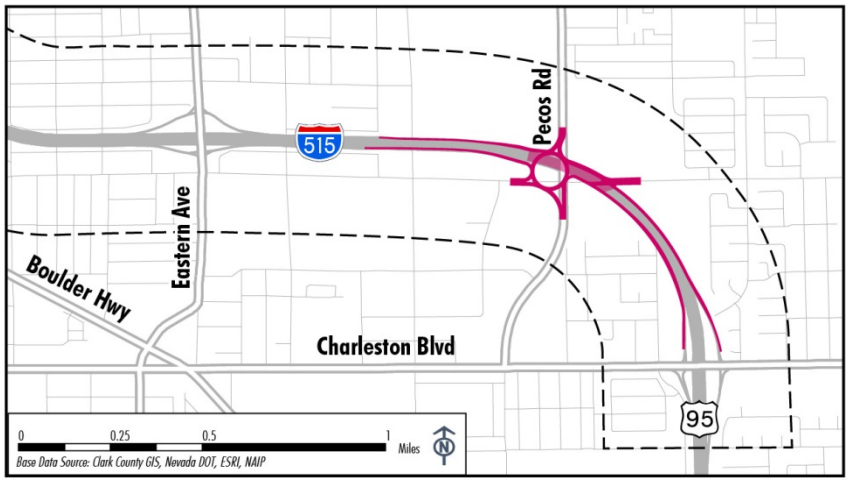
18: Reconstruct the Eastern Avenue interchange to a diverging diamond Interchange.



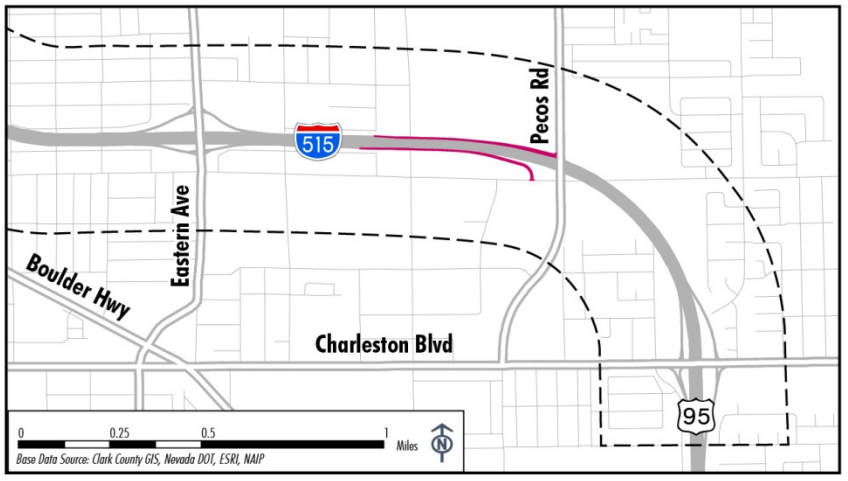
19: Add a slip ramp that connects the southbound I-515 freeway to Stewart Avenue near Eastern Avenue.



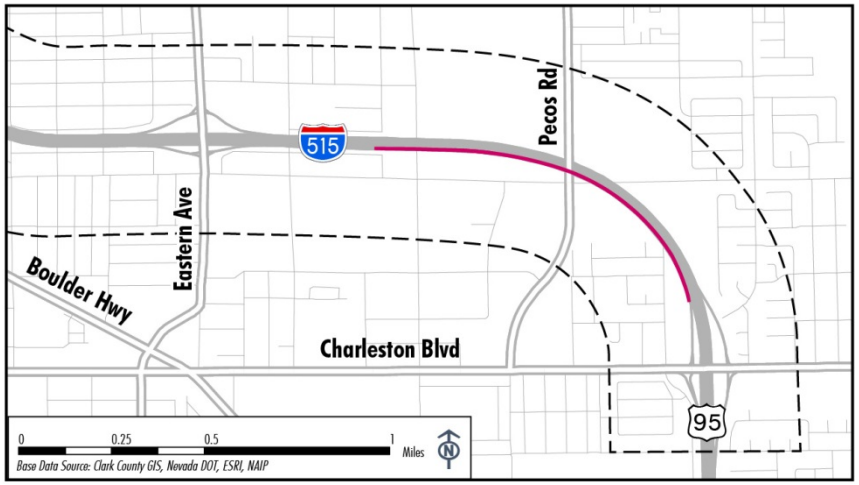
20: Add one left-turn lane on Eastern Avenue at the I-515 southbound Eastern Avenue Interchange.



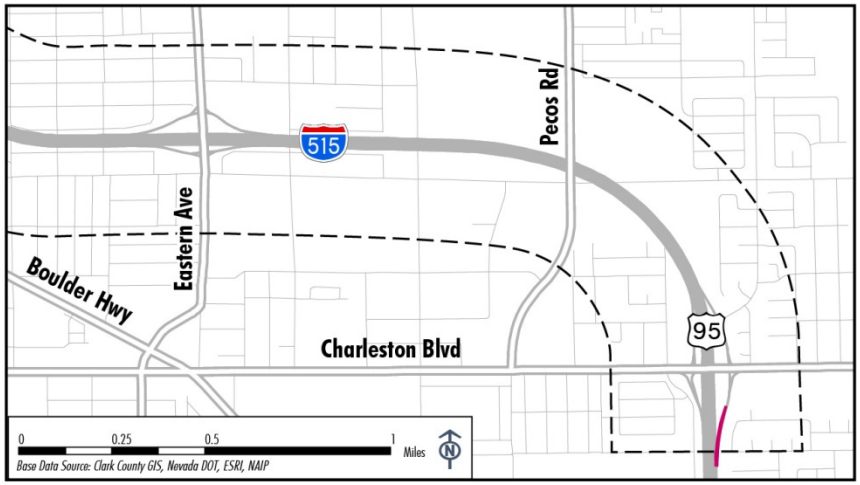
21: Construct an interchange at I-515 and Pecos Road.



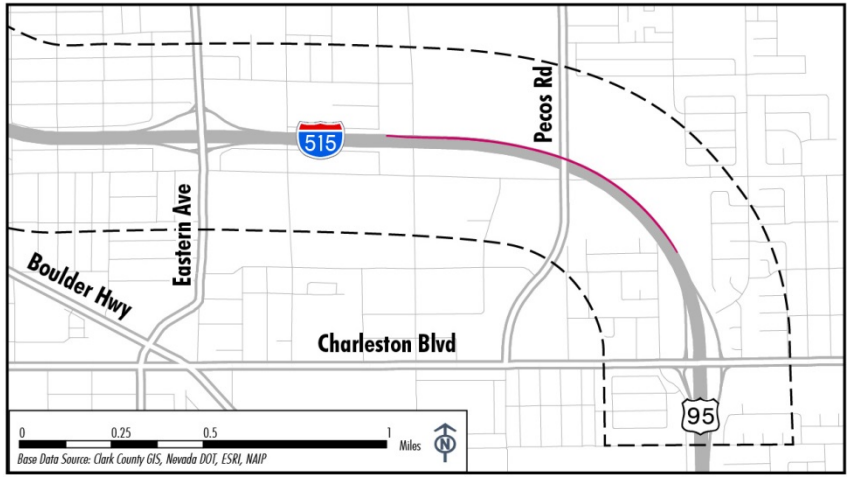
22: Construct a partial interchange at I-515 and Pecos Road.



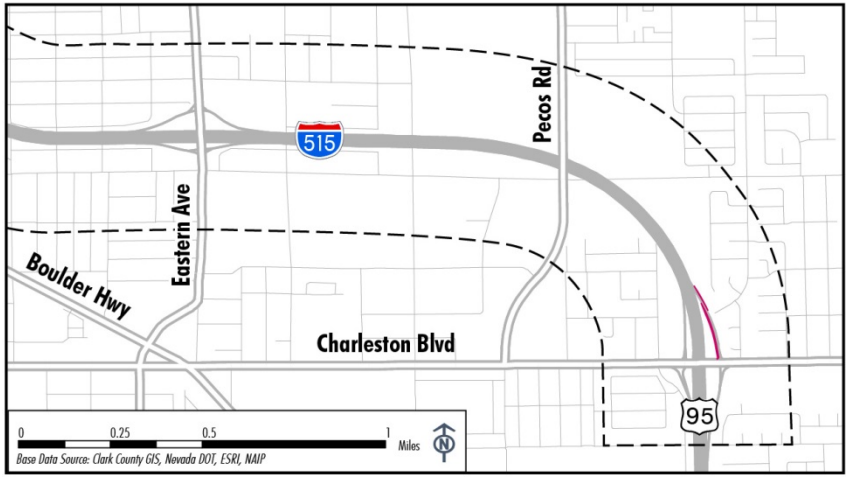
23*: Add one 1-515 southbound auxiliary lane from Eastern Avenue to Charleston Boulevard, and add one lane to the Charleston Boulevard off-ramp.



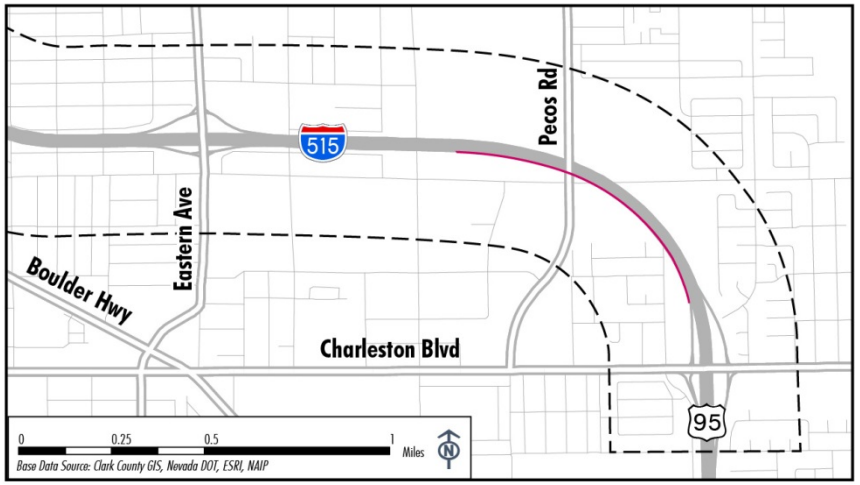
24*: Add one lane to the I-515 northbound Charleston Boulevard off-ramp.



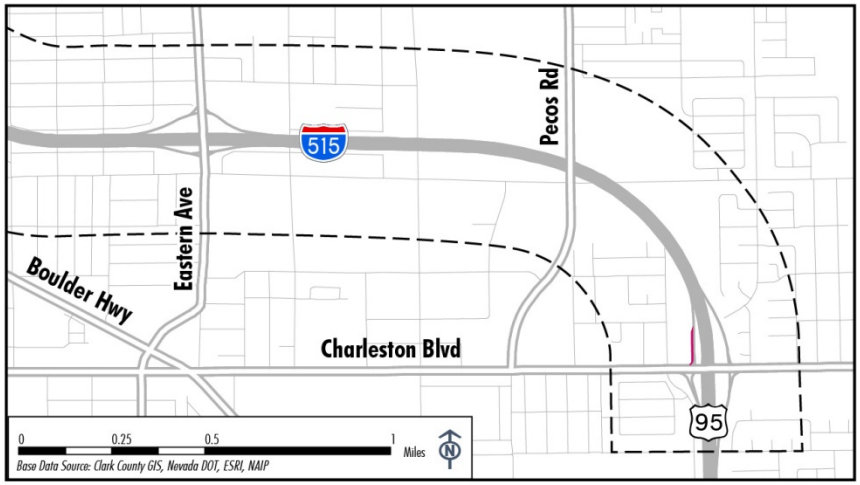
25*: Add one I-515 northbound auxiliary lane from Charleston Boulevard to Eastern Avenue.



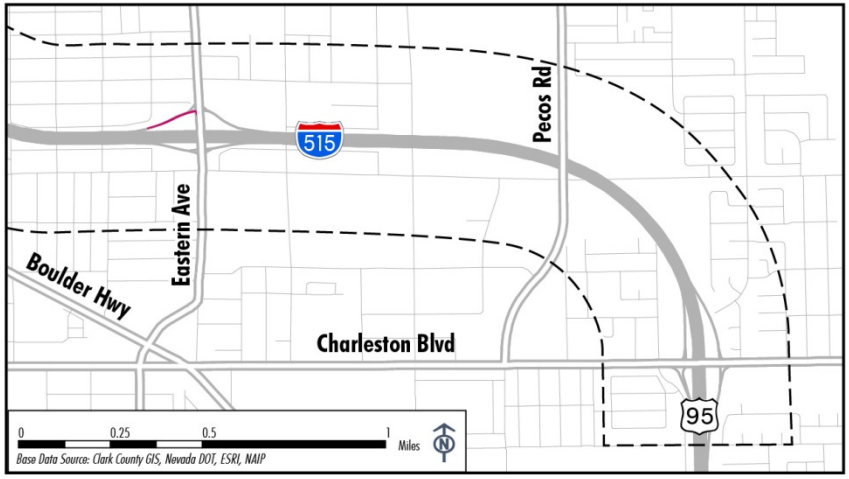
26*: Add one lane to the I-515 northbound Charleston Boulevard on-ramp.



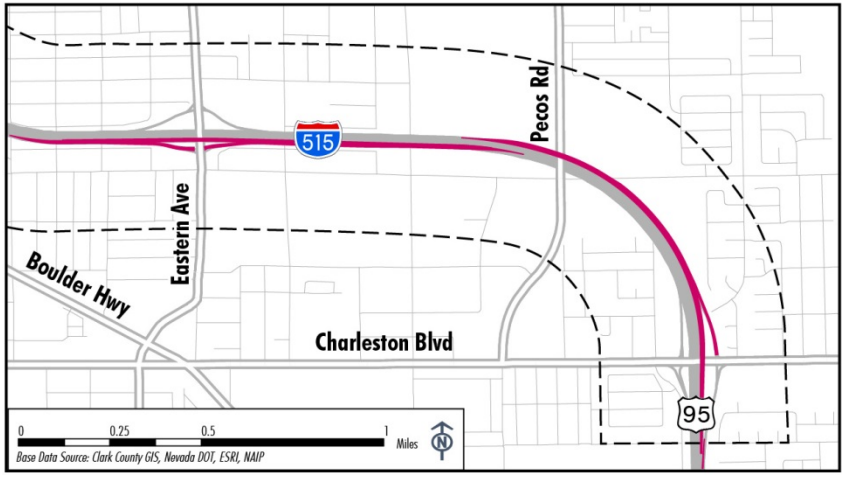
27*: Add one deceleration lane and off-ramp lane for the I-515 southbound Charleston Boulevard off-ramp.



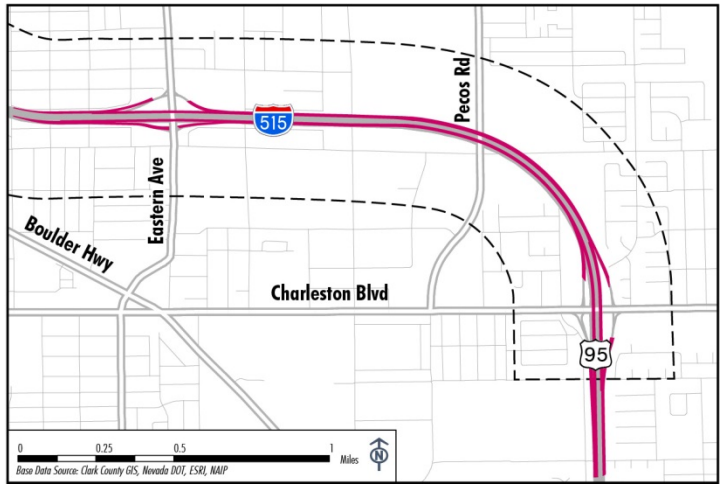
28*: Add a lane to the I-515 southbound Charleston Boulevard off-ramp.



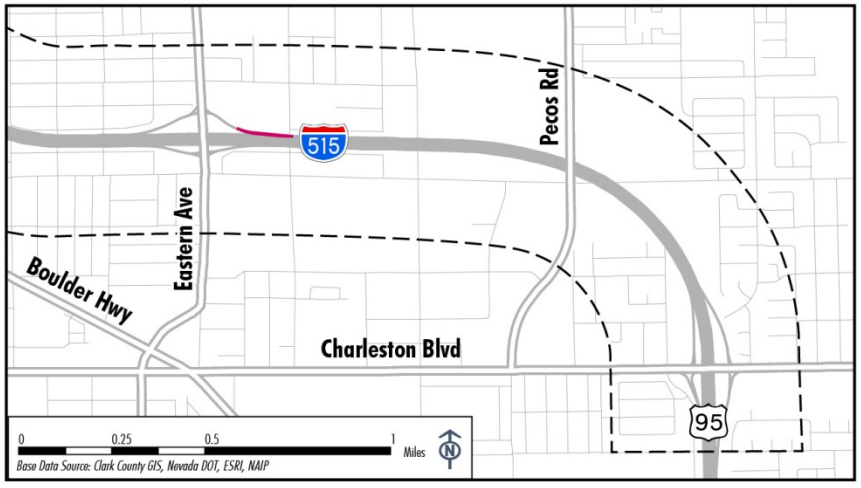
29*: Add one lane to the I-515 northbound Eastern Avenue on-ramp.



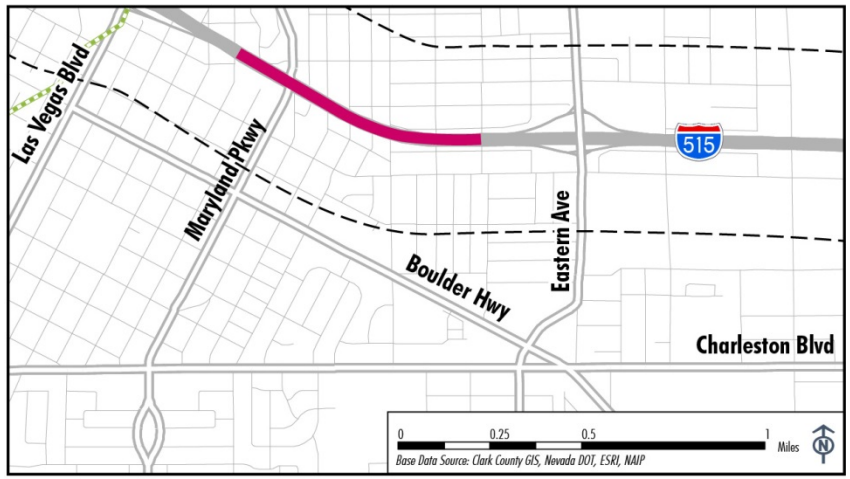
30: Add a collector-distributor road along I-515 between Eastern Avenue and Charleston Boulevard in either the northbound or southbound direction.



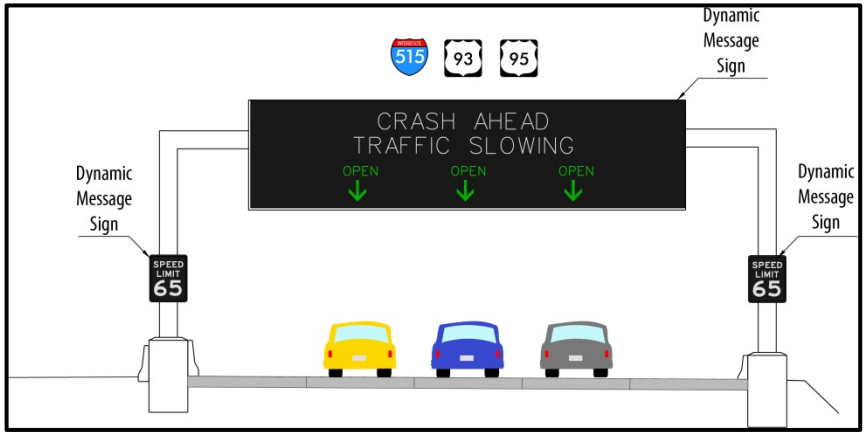
31: Add a collector-distributor road along I-515 between Eastern Avenue and Charleston Boulevard in the northbound and southbound direction.



32*: Add one lane to the I-515 northbound Eastern Avenue off-ramp.



33: Resurface the I-515 road surface along the Las Vegas viaduct between 21st Street and Mesquite Avenue.



34: Install Intelligent Transportation Systems (ITS)/ ATDM improvements throughout the corridor.

35a: Widen I-515 to add HOV lanes along the I-515 corridor in both directions (full widening).
35b: Widen I-515 to add HOV lanes along the I-515 corridor in both directions (partial widening).
35c: Add an HOV lane along the I-515 corridor in both directions (re-striping only).

* Concepts 23 through 29 and 32 were moved to a separate NDOT planned project (see Section 3.1.2), and were made part of the No-Action Alternative of this study. Therefore, these improvements are not evaluated.

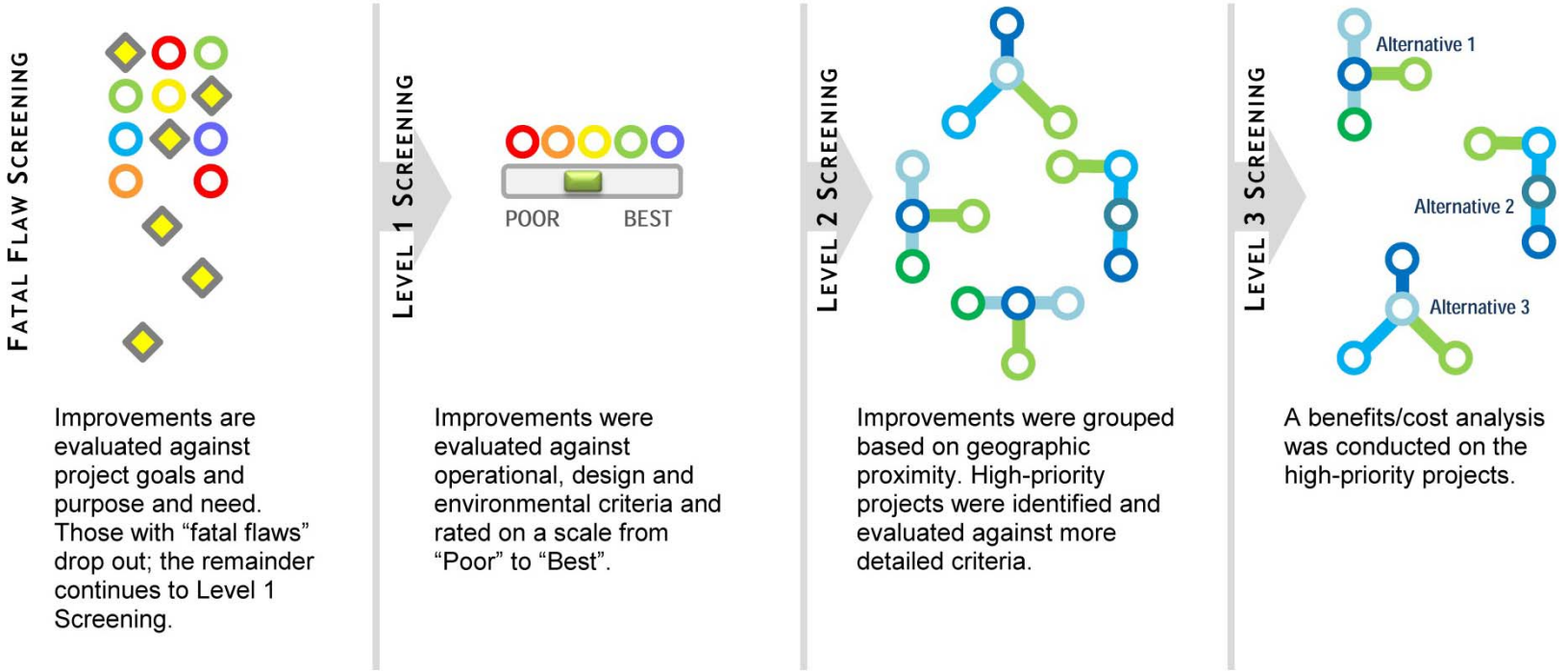
3.2 Alternatives Screening Process and Results

This section summarizes the alternatives screening process and results for this study. This process was designed to:

- Objectively assess potential improvements along I-515 within the study area, consistent with this study's purpose.
- Group improvements based on compatibility, proximity, and logical termini into consolidated alternatives where appropriate.
- Evaluate alternatives.

Figure 3-4 illustrates the multilevel screening and prioritization process, which is described below.

Figure 3-4: Alternatives Screening Process



3.2.1 Fatal Flaw Screening Process and Results

The first level of screening was the most basic, and evaluated whether the proposed improvements met the following criteria:

- Does the improvement meet this study's Purpose and Need?
- Does the improvement serve a study goal?
- Does the improvement have irresolvable environmental impacts?
- Is the improvement widely opposed by stakeholders and/or the public?

All improvements were evaluated against the No-Action Alternative. If an improvement did not meet the criteria listed above, it was screened out and did not continue in the evaluation process. Of the 35 preliminary improvements evaluated in this study, eight were deemed fatally flawed and eliminated. Table 3-1 lists the improvements that were fatally flawed.

Table 3-1: Fatally Flawed Concepts

Concept Number	Concept Description	Reason for Elimination
1c	Eliminate the southbound lane reduction at the I-15 underpass, and provide a full southbound auxiliary lane to the Charleston Boulevard exit (re-striping I-515 to the south).	Would require substandard 11-foot lanes with minimal shoulders, and 10.5-foot lanes with less than 1.0-foot shoulders in certain locations. This design would not meet this study's safety need.
4	Braid ramps between I-15 and Las Vegas Boulevard, and reconfigure I-515 southbound Casino Center Boulevard off-ramps.	Stakeholder opposition and considerable ROW impacts would conflict with this study's goal to minimize ROW impacts.
5b	Construct a collector-distributor road to allow ramp braiding on southbound I-515 between I-15 and Las Vegas Boulevard.	Considerable ROW impacts would conflict with this study's goal to minimize ROW impacts.
11	Reconstruct the I-515 northbound Las Vegas Boulevard on-ramp to merge with the Casino Center Boulevard on-ramp. Close the existing I-515 northbound Las Vegas Boulevard on-ramp.	Stakeholder opposition. Also, would not significantly improve traffic operations, and therefore does not meet this study's Purpose and Need.
12	Add a full northbound auxiliary lane between the Las Vegas Boulevard on-ramp and the northbound I-15 exit, including an auxiliary lane from the Casino Center Boulevard on-ramp to the I-15 southbound exit.	
18	Reconstruct the Eastern Avenue interchange to a diverging diamond Interchange.	Would require considerable ROW acquisition, and therefore would conflict with this study's goal to minimize ROW impacts.
19	Add a slip ramp that connects the southbound I-515 freeway to Stewart Avenue near Eastern Avenue.	Stakeholder opposition. Considerable ROW acquisition would require relocating impacted residents, which would conflict with this study's goal to minimize ROW impacts.
35c	Add an HOV lane along the I-515 corridor in both directions (re-striping only).	Would require substandard 11-foot lanes with minimal shoulders, and 10.5-foot lanes with less than 1.0-foot shoulders in certain locations. This design would not meet this study's safety need.

3.2.2 Level 1 Screening – Comparative Screening

The Level 1 screening process was a qualitative evaluation of the individual concepts. More thorough than the preceding fatal flaw screening, this step rated each improvement based on several evaluation criteria, illustrated on Figure 3-5. The evaluation criteria were developed from this study's Purpose and Need, and goals described previously.

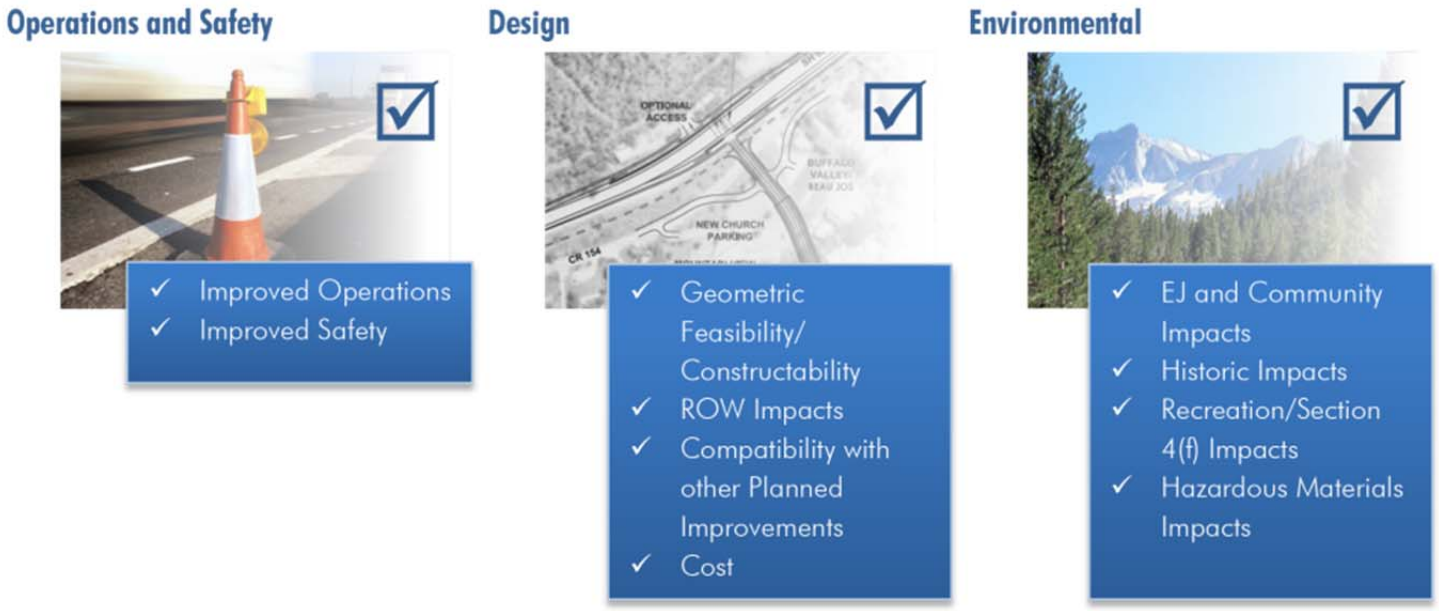
Concepts were assessed based on three criteria – Operations and Safety, Design, and Environmental. Each criterion included several topics and corresponding topic questions. The proposed concepts were rated on a scale from "poor" (score of 1) to "best" (score of 5). Level 1 screening questions for each topic follow.

Operations and Safety

Does the concept:

- Reduce congestion?
- Provide better connectivity?
- Improve travel time and reliability?
- Reduce the potential for crashes and provide a safe roadway environment for travelers?
- Have the potential to incorporate NDOT road safety audit recommendations?

Figure 3-5: Level 1 Screening Evaluation Criteria



Design (Geometric Feasibility/Constructability)

Does the concept:

- Pose considerable construction difficulties?
- Fit within the existing I-515 footprint?
- Involve major reconstruction of I-515?
- Require grade separations?
- Require NDOT design exceptions?
- Have major utility conflicts?
- Require major activities to maintain traffic during construction?

ROW Impacts

- Does the concept require any ROW acquisition?

Concepts with no property acquisitions were scored 5 (best), and those with minimal acquisition (a sliver of land) were scored 4. Those with more than minimal acquisition were scored from 3 to 1 relative to each other and in decreasing order of value.

Compatibility with Other Planned Improvements

Is the concept:

- Compatible with other studies and plans?
- Compatible with and does it maintain flexibility for implementing other agency plans and longer term plans?

Those concepts that are fully compatible with other planned improvements and would not require subsequent modification if constructed in separate projects or phases were scored 5.

Cost

Concepts were assessed based on a preliminary order of magnitude cost estimates. Any concept that had exorbitant costs scored a 1. Professional judgment was used to define "exorbitant" because costs are relative based on the magnitude of the improvement. In general, any concept that did not extend the length of the entire study area and cost greater than $60 million scored a 1.

Environmental

The Level 1 screening evaluated environmental resources having the potential to influence the concepts. The resources included environmental justice (EJ) and community impacts, historic resources, recreation resources, and hazardous materials.

Environmental Justice and Community Impacts

- Does the concept have negative environmental justice or community impacts?

Negative impacts included commercial and residential acquisitions or relocations, and increased traffic noise[1]. Air quality as it relates to EJ was not evaluated at this stage.[2] EJ and community impacts were scored as follows in descending order of value:

No foreseen impacts 5
Slight property-only impacts or minor proximity impacts 4

[1] Potential noise impacts were identified if the proposed improvement included the addition of a traffic lane.
[2] Air quality assessment includes conformity determinations, hot-spot analyses, and mobile source air toxic evaluations requiring greater design detail and project definition.

Greater property-only impacts or impacts with greater nuisance effects 3
Several relocations or substantial nuisance impacts 2
Multiple relocations and substantial nuisance impacts 1

Other environmental resources, including cultural[3], Department of Transportation Act Section 4(f) resources[4], recreational, and hazardous materials sites, were scored similarly, based on the following scale:

No impacts 5
Proximity impacts 4
Directly impacting one parcel 3
Directly impacting several parcels 2
Directly impacting multiple parcels 1

The results of the Level 1 Screening are shown in Appendix C – I-515 Initial Improvements Evaluation Matrix.

Based on the results of Level 1 Screening, the improvements were then divided into three tiers:

- Tier 1 – concepts with the highest potential for meeting the Purpose and Need and project goals
- Tier 2 - concepts with a medium potential for meeting the Purpose and Need and project goals
- Tier 3 - concepts with a low potential for meeting the Purpose and Need and project goals

Table 3-2 lists the concepts identified for each tier. Tier 1 and Tier 2 concepts were advanced to Level 2 Screening. Tier 3 concepts were not carried forward to Level 2 Screening, but were held in reserve for consideration if more detailed analysis in Level 2 screening indicates a Tier 1 or a Tier 2 concept performed poorer than expected. Appendix C - Alternatives Screening Process and Screening Completed in Task Order 1, provides details on the Level 1 screening.

[3] Cultural sites include archaeological, historic architectural, or other historic properties (those addressed under Section 106 of the National Historic Preservation Act).
[4] Bike/pedestrian facilities within this study's limits are generally on-street and/or within existing transportation ROW, and therefore were not assumed to be Section 4(f) properties.

Table 3-2: Level 1 Screening Tiers

Concept Tier	Concept Number and Description
Tier 1 Concepts (Best)	3: Construct a southbound directional ramp to City Parkway from the US 95/northbound I-15 ramp.
	6: Add two right-turn lanes and two left-turn lanes on the southbound I-515 Las Vegas Boulevard off-ramp.
	7: Widen the I-515 northbound Las Vegas Boulevard off-ramp to provide two right-turn lanes.
	8: Restripe the I-515 southbound Las Vegas Boulevard off-ramp to add one lane.
	9: Widen the I-515 northbound Las Vegas Boulevard metered on-ramp to add one lane.
	13: Restripe the I-515 northbound Las Vegas Boulevard off-ramp to add a choice exit lane to the off-ramp.
	14: Add one left-turn lane to the I-515 northbound Las Vegas Boulevard on-ramp interchange.
	15: Add one lane to the I-515 southbound Eastern Avenue off-ramp.
	16: Add one right-turn lane at the I-515 southbound Eastern Avenue off-ramp.
	17: Construct a one-way frontage road between the I-515 southbound Eastern Avenue on-ramp and Mojave Road.
	20: Add one left-turn lane on Eastern Avenue at the I-515 southbound Eastern Avenue Interchange.
	29: Add one lane to the I-515 northbound Eastern Avenue on-ramp.
	33: Resurface the I-515 road surface along the Las Vegas viaduct between 21st Street and Mesquite Avenue.
	34: Install ITS/ATDM improvements throughout the corridor.
Tier 2 Concepts (Medium)	1b: Eliminate southbound lane reduction at I-15 underpass, and construct a full southbound auxiliary lane to the Charleston Boulevard exit (partial widening of I-515 to the south).
	2: Construct a left exit/entry half interchange at City Parkway. Reconfigure the southbound general purpose lanes and the I-15 to southbound I-515 system ramp to accomplish the left exit/entry at City Parkway.
	5a: Construct a collector-distributor road to allow ramp braiding on northbound I-515 between I-15 and Las Vegas Boulevard.
	10: Widen the I-515 northbound Casino Center Boulevard on-ramp to three lanes.
	21: Construct an interchange at I-515 and Pecos Road.
	22: Construct a partial interchange at I-515 and Pecos Road.
Tier 3 Concepts (Poor) - not carried forward to Level 2 Screening	1a: Eliminate the southbound lane reduction at the I-15 underpass, and construct a full southbound auxiliary lane to the Charleston Boulevard exit (full widening of I-515 to the south).
	30: Add a collector-distributor road along I-515 between Eastern Avenue and Charleston Boulevard in either the northbound or southbound direction.
	31: Add a collector-distributor road along I-515 between Eastern Avenue and Charleston Boulevard in the northbound and southbound direction.
	35 a, b: Widen I-515 to add HOV lanes along the I-515 corridor in both directions (full widening and partial widening).

Note: Tier 3 concepts were not carried forward to Level 2 Screening. However, these concepts are not fatally flawed or otherwise infeasible or undesirable. Tier 3 concepts were held as reserve concepts that could be evaluated if a higher ranked concept was eliminated from consideration.

3.2.3 Level 2 Screening – Quantitative Screening Process and Results

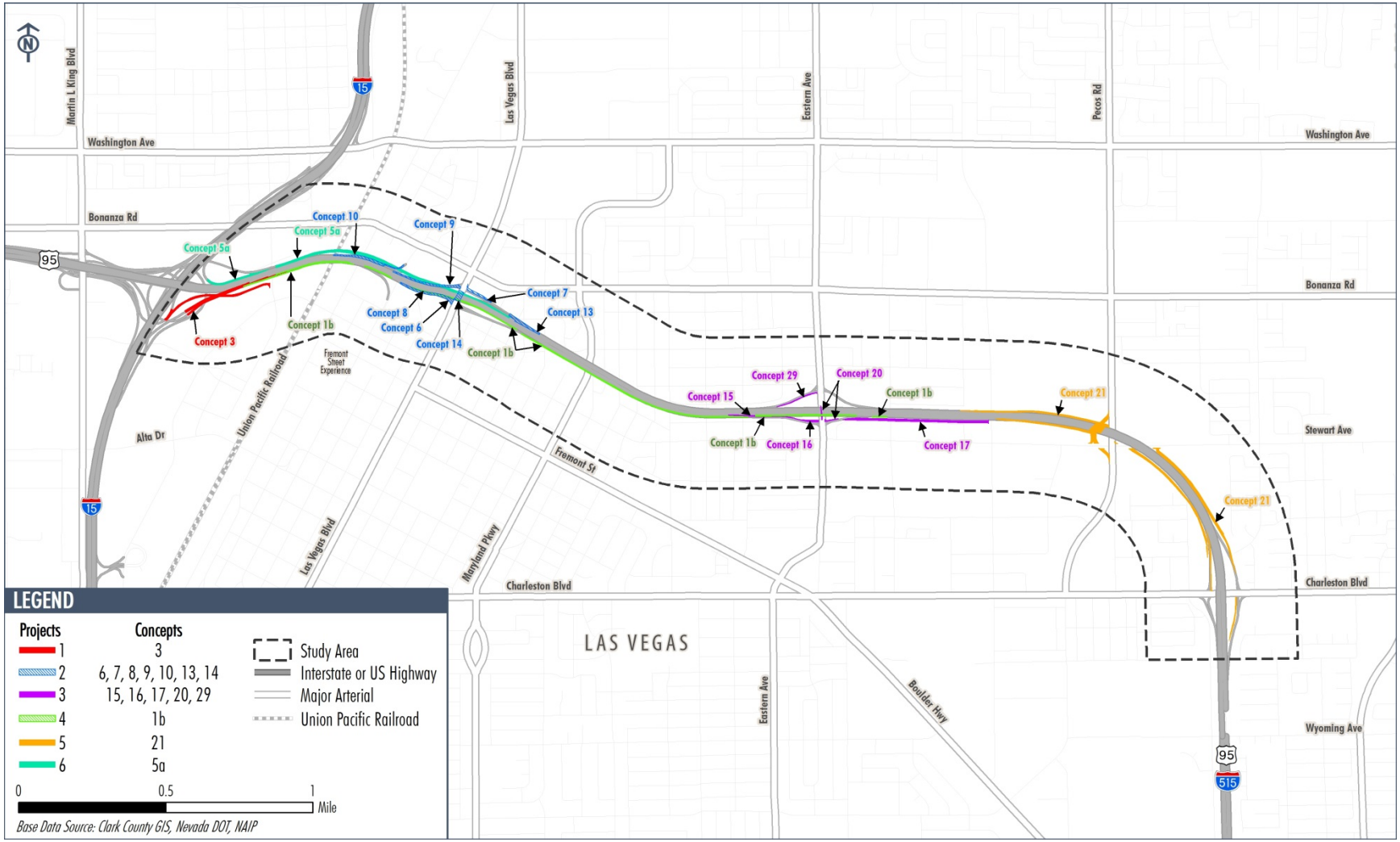
Level 2 Screening included a more quantitative evaluation of the concepts. First, Tier 1 and Tier 2 concepts from Level 1 were grouped into projects based on compatibility and proximity. For example, concepts might be grouped if they complement each other to address a study need or goal, or if grouping would provide efficiency or cost savings during construction. Six projects were then identified and advanced to the next level of analysis in Level 2 screening. The six projects identified for further advancement are listed in Table 3-3 and shown in Figure 3-6. Conceptual drawings for these six projects are provided in Appendix C – Conceptual Drawings of the Six Projects.

Table 3-3: Level 2 Screening – Projects Identified for Further Advancement in this Study

PROJECT	CONCEPTS
Project 1: City Parkway Southbound Ramp*	3 - Construct a southbound directional ramp to City Parkway from the US 95/northbound I-15 ramp.
Project 2: Las Vegas Boulevard and Casino Center Boulevard Interchange Improvements	6 - Add two right-turn lanes and two left-turn lanes on the southbound I-515 Las Vegas Boulevard off-ramp.
	7 - Widen the I-515 northbound Las Vegas Boulevard off-ramp to provide two right-turn lanes.
	8 - Restripe the I-515 southbound Las Vegas Boulevard off-ramp to add one lane.
	9 - Widen the I-515 northbound Las Vegas Boulevard metered on-ramp to add one lane.
	10 - Widen the I-515 northbound Casino Center Boulevard on-ramp to three lanes.
	13 - Restripe the I-515 northbound Las Vegas Boulevard off-ramp to add a choice exit lane to the off-ramp.
	14 - Add one left-turn lane to the I-515 northbound Las Vegas Boulevard on-ramp interchange.
Project 3: Eastern Avenue Interchange Improvements	15 - Add one lane to the I-515 southbound Eastern Avenue off-ramp.
	16 - Add one right-turn lane at the I-515 southbound Eastern Avenue off-ramp.
	17 - Construct a one-way frontage road between the I-515 southbound Eastern Avenue on-ramp and Mojave Road.
	20 - Add one left-turn lane on Eastern Avenue at the I-515 southbound Eastern Avenue Interchange.
	29 - Add one lane to the I-515 northbound Eastern Avenue on-ramp.
Project 4: Southbound Auxiliary Lane from I-15 Underpass to Charleston Boulevard	1b - Eliminate the southbound lane reduction at the I-15 underpass, and construct a full southbound auxiliary lane connecting to the proposed auxiliary lane between Eastern Avenue and Charleston Boulevard exit (partial widening of I-515 to the south).
Project 5: Pecos Road Interchange	21** - Construct a split diamond interchange at I-515 and Pecos Road.
Project 6: Collector-Distributor Road from Las Vegas Boulevard to I-15	5a - Construct a collector-distributor road to allow ramp braiding on northbound I-515 between I-15 and Las Vegas Boulevard.

* Wayfinding to access US 95 and I-15 to be incorporated as the project progresses to design stages that include signing.
** Concept 21 was changed from a roundabout to a split diamond interchange to use the existing bridges in the vicinity, and to reduce the need for new bridges. Two Concept 21 options were developed — a split diamond interchange and a braided interchange. However, no Level 2 or Level 3 screening was completed for the braided option.

Figure 3-6: Level 2 Screening – Projects Identified for Further Advancement in this Study



The six projects identified for further advancement were evaluated for independent utility and logical termini. All six projects were deemed to have independent utility and logical termini.

The six projects were then carried through a more quantitative screening process. Similar to the qualitative Level 1 screening, this process assessed the projects based on three criteria — Design, Operations and Safety, and Environmental. The following discussion summarizes the Level 2 screening methodology and results.

3.2.4 Design

Cost and ROW Estimates Process and Results

Cost estimates for the projects identified for further advancement included two types of costs: 1) capital costs and 2) operating, maintenance, and rehabilitation costs. The results of the cost estimates are provided below in 2016 dollars.

For the projects identified for further advancement, capital costs include construction, ROW, preliminary and final engineering, environmental, administration and legal, and construction engineering and inspection costs. Capital costs were estimated in accordance with the NDOT's "Risk Management and Risk Based Cost Estimation Guidelines," using the department's Project Estimating Tool: Project Estimation Wizard.

Conceptual construction cost estimates, capital cost ranges (from low to high), and maintenance and rehabilitation cost estimates for each project follow. All cost estimates were developed from preliminary conceptual drawings and are only appropriate for planning level project programming purposes.

Project 1: City Parkway Southbound Ramp

Construction Costs

Conceptual construction costs were developed for the following improvements:

- Construct and pave a new off-ramp from US 95 southbound to the I-15 northbound connector ramp to City Parkway, and construct a barrier rail.
- Re-profile the I-15 to US 95 southbound connector ramp.
- Construct a new bridge over the new City Parkway off-ramp.
- Construct a retaining wall.
- Tie the I-15 to US 95 southbound connector ramp to US 95.
- Widen the I-515 bridge over City Parkway.

Conceptual construction costs for Project 1 are summarized in Table 3-4.

Table 3-4: Conceptual Construction Costs (Millions) for Project 1

Improvements	Conceptual Construction Costs
City Parkway off-ramp / Re-profile I-15 to US 95 Southbound Connector Ramp	$10.6
Total Construction Costs	$10.6

Capital Costs

Conceptual capital costs for Project 1 are summarized in Table 3-5.

Table 3-5: Conceptual Capital Costs (Millions) for Project 1

Construction	ROW	Other	Total		
			Low	Median	High
$10.6	—	$1.7	**$11.2**	$12.3	**$13.8**

Maintenance and Rehabilitation Costs

Conceptual maintenance and rehabilitation costs for Project 1 are summarized in Table 3-6 and Table 3-7.

Table 3-6: Conceptual Maintenance Costs for Project 1

Annual Roadway Maintenance	Annual Bridge Maintenance	Biennial Bridge Inspection
$9,200	$4,500	$3,400

Table 3-7: Conceptual Rehabilitation Costs for Project 1

Asphalt Pavement (every 8 years)	Concrete Pavement (after 30 years)	Bridge (after 40 years)
$460,000	$340,000	$450,000

Project 2: Las Vegas Boulevard and Casino Center Boulevard Interchange Improvements

Construction Costs

Conceptual construction costs were developed for the following improvements:

- Las Vegas Boulevard Improvements
  - Widen both sides of Las Vegas Boulevard.
  - Modify the traffic signal at the Las Vegas Boulevard and I-515 northbound intersection.
- Las Vegas Boulevard Northbound Off-Ramp Improvements
  - Widen the Las Vegas Boulevard northbound off-ramp from I-515.
  - Construct a concrete barrier rail.
- Las Vegas Boulevard Northbound On-Ramp Improvements
  - Widen the Las Vegas Boulevard northbound on-ramp to I-515.
  - Construct retaining walls and sound walls.
  - Widen the viaduct.
  - Install an on-ramp meter signal.
- Casino Center Boulevard Northbound On-Ramp Improvements
  - Widen and pave the Casino Center Boulevard northbound on-ramp to I-515.
  - Widen the viaduct.
  - Install an on-ramp meter signal.
- Las Vegas Boulevard Southbound Off-Ramp Improvements
  - Widen the Las Vegas Boulevard southbound off-ramp from I-515.
  - Construct retaining walls.
  - Widen the viaduct.
  - Modify the traffic signal at the Las Vegas Boulevard and I-515 southbound intersection.

Conceptual construction costs for Project 2 are summarized in Table 3-8.

Table 3-8: Conceptual Construction Costs (Millions) for Project 2

Improvements	Conceptual Construction Costs
Las Vegas Boulevard Improvements	$1.2
Las Vegas Boulevard Northbound Off-Ramp Improvements	$0.5
Las Vegas Boulevard Northbound On-Ramp Improvements	$6.9
Casino Center Boulevard Northbound On-Ramp Improvements	$2.9
Las Vegas Boulevard Southbound Off-Ramp Improvements	$1.7
Total Construction Costs	$13.2

Capital Costs

Conceptual capital costs for Project 2 are summarized in Table 3-9.

Table 3-9: Conceptual Capital Costs (Millions) for Project 2

Construction	ROW	Other	Total		
			Low	Median	High
$13.2	$0.4	$2.2	$14.0	$15.9	$17.4

Maintenance and Rehabilitation Costs

Conceptual maintenance and rehabilitation costs for Project 2 are summarized in Table 3-10 and Table 3-11.

Table 3-10: Conceptual Maintenance Costs for Project 2

Annual Roadway Maintenance	Annual Bridge Maintenance	Biennial Bridge Inspection
$4,600	$11,000	$8,300

Table 3-11: Conceptual Rehabilitation Costs for Project 2

Asphalt Pavement (every 8 years)	Concrete Pavement (after 30 years)	Bridge (after 40 years)
$240,000	—	$1,100,000

Project 3: Eastern Avenue Interchange Improvements

Construction Costs

Conceptual construction costs were developed for the following improvements:

- Eastern Avenue Northbound On-ramp Improvements
  - Widen the Eastern Avenue northbound on-ramp to I-515.
  - Modify the traffic signal at the Eastern Avenue and I-515 northbound on-ramp intersection.
- Eastern Avenue Southbound Off-ramp Improvements
  - Widen the Eastern Avenue southbound off-ramp from I-515.
  - Construct retaining walls.
  - Modify traffic signal.
- New Frontage Road between Eastern Avenue and Mojave Road Improvements
  - Widen Eastern Avenue to provide dual southbound left-turn lanes to the southbound on-ramp.
  - Construct a new frontage road (with asphalt pavement) between the Eastern Avenue southbound on-ramp and Mojave Road.
  - Construct retaining walls.
  - Construct a new bridge over 28th Street.
  - Widen the Eastern Avenue southbound on-ramp.

- Modify traffic signals at the Eastern Avenue and I-515 southbound ramp intersection.
- Install a new signal at Mojave Road.

Conceptual construction costs for Project 3 are summarized in Table 3-12.

Table 3-12: Conceptual Construction Costs (Millions) for Project 3

Improvements	Conceptual Construction Costs
Eastern Avenue Northbound On-Ramp Improvements	$0.7
Eastern Avenue Southbound Off-Ramp Improvements	$0.8
New Frontage Road between Eastern Avenue and Mojave Road Improvements	$9.8
Total Construction Costs	$11.3

Capital Costs

Conceptual capital costs for Project 3 are summarized in Table 3-13.

Table 3-13: Conceptual Capital Costs (Millions) for Project 3

Construction	ROW	Other	Total		
			Low	Median	High
$11.3	—	$3.3	$13.8	$14.6	$16.3

Maintenance and Rehabilitation Costs

Conceptual maintenance and rehabilitation costs for Project 3 are summarized in Table 3-14 and Table 3-15.

Table 3-14: Conceptual Maintenance Costs for Project 3

Annual Roadway Maintenance	Annual Bridge Maintenance	Biennial Bridge Inspection
$9,300	$1,500	$1,200

Table 3-15: Conceptual Rehabilitation Costs for Project 3

Asphalt Pavement (every 8 years)	Concrete Pavement (after 30 years)	Bridge (after 40 years)
$300,000	—	$150,000

Project 4: Southbound Auxiliary Lane from I-15 Underpass to Charleston Boulevard

Construction Costs

Conceptual construction costs were developed for the following improvements:

- Widen the I-515 mainline along the outside shoulder from the I-15 underpass to the UPRR bridge.
- Construct a retaining wall.
- Widen the bridge over City Parkway.
- Widen the viaduct from the UPRR overpass to Main Street.
- Widen the I-515 viaduct along the Casino Center Boulevard off-ramp.
- Widen the I-515 viaduct from the Las Vegas Boulevard off-ramp to the Las Vegas Boulevard on-ramp gore, and construct a sound wall.
- Widen and pave the Eastern Avenue southbound off-ramp from I-515.
- Construct a retaining wall to accommodate the Eastern Avenue southbound off-ramp widening.

Conceptual construction costs for Project 4 are summarized in Table 3-16.

Table 3-16: Conceptual Construction Costs (Millions) for Project 4

Improvements	Conceptual Construction Costs
I-515 Southbound Auxiliary Lane Improvements	$21.1
Total Construction Costs	$21.1

Capital Costs

Conceptual capital costs for Project 4 are summarized in Table 3-17.

Table 3-17: Conceptual Capital Costs (Millions) for Project 4

Construction	ROW	Other	Total		
			Low	Median	High
$21.1	$0.9	$3.5	$22.1	$25.5	$27.9

Maintenance and Rehabilitation Costs

Conceptual maintenance and rehabilitation costs for Project 4 are summarized in Table 3-18 and Table 3-19.

Table 3-18: Conceptual Maintenance Costs for Project 4

Annual Roadway Maintenance	Annual Bridge Maintenance	Biennial Bridge Inspection
$700	$21,000	$16,000

Table 3-19: Conceptual Rehabilitation Costs for Project 4

Asphalt Pavement (every 8 years)	Concrete Pavement (after 30 years)	Bridge (after 40 years)
$58,000	$670,000	$2,100,000

An option to substantially reduce structure costs associated with Project 4 is to provide the southbound auxiliary lane from the I-15 underpass to Las Vegas Boulevard (instead of Charleston Boulevard). Additionally, the auxiliary lane could be provided with no (or little) widening if lane widths less than 12 feet are provided. Additional design exceptions (such as for shoulders) would also be necessary. These options have not been examined in Level 2 or Level 3 screening and should be considered and evaluated if this project is advanced. Such options may be particularly valuable if the viaducts (G-947 and I-947) are programmed for reconstruction.

Project 5: Pecos Road Interchange

Construction Costs

Conceptual construction costs were developed for the following improvements:

- Pecos Road Improvements
  - Realign and pave southbound Pecos Road.
  - Construct a new I-515 bridge over the realigned southbound Pecos Road.
  - Construct traffic signals along the realigned southbound Pecos Road.
- Stewart Avenue Modifications
  - Overlay the existing asphalt pavement along Stewart Avenue.
  - Modify traffic signals along Stewart Avenue.
- Pecos Road Northbound On-ramp Improvements
  - Construct a new on-ramp with asphalt pavement.
  - Widen the existing I-515 northbound mainline.

    - Widen the existing I-515 northbound bridge over Mojave Road.
    - Construct retaining walls.
- Pecos Road Southbound Off-ramp Improvements
    - Construct a new off-ramp with asphalt pavement.
    - Widen the existing I-515 southbound mainline.
    - Construct retaining walls.
- Charleston Boulevard Northbound Off-Ramp Improvements
    - Widen the Charleston Boulevard off-ramp from I-515.
    - Modify traffic signals at the Charleston Boulevard and I-515 northbound off-ramp intersection.
- Northbound Frontage Road (Charleston Boulevard to Stewart Avenue) Improvements
    - Construct and pave a new connector.
    - Construct retaining walls.
- Southbound Frontage Road (Stewart Avenue to Charleston Boulevard) Improvements
    - Construct and pave a new connector.
    - Construct sound wall.
    - Construct a retaining wall.

Conceptual construction costs for Project 5 are summarized in Table 3-20.

Table 3-20: Conceptual Construction Costs (Millions) for Project 5

Improvements	Conceptual Construction Costs
Pecos Road Improvements	$11.9
Stewart Avenue Modifications	$1.2
Pecos Road Northbound On-Ramp Improvements	$6.4
Pecos Road Southbound Off-Ramp Improvements	$3.3
Charleston Boulevard Northbound Off-Ramp Improvements	$0.4
Northbound Frontage Road (Charleston Boulevard to Stewart Avenue) Improvements	$2.8
Southbound Frontage Road (Stewart Avenue to Charleston Boulevard) Improvements	$4.6
Total Construction Costs	**$30.6**

An additional option was investigated for the Pecos Road Interchange Project, which provided a braided interchange south of Pecos Road so that Pecos Road interchange traffic would not have to use the Charleston Boulevard interchange ramps. Level 2 and level 3 screening were not completed for this braided interchange option. However, general construction costs for this option are estimated to be $62.8 million.

Capital Costs

Conceptual capital costs for Project 5 are summarized in Table 3-21.

Table 3-21: Conceptual Capital Costs (Millions) for Project 5

Construction	ROW	Other	Total		
			Low	Median	High
$30.6	$2.2	$9.0	**$38.7**	$41.8	**$46.8**

Maintenance and Rehabilitation Costs

Conceptual maintenance and rehabilitation costs for Project 5 are summarized in Table 3-22 and Table 3-23.

Table 3-22: Conceptual Maintenance Costs for Project 5

Annual Roadway Maintenance	Annual Bridge Maintenance	Biennial Bridge Inspection
$25,000	$10,000	$7,200

Table 3-23: Conceptual Rehabilitation Costs for Project 5

Asphalt Pavement (every 8 years)	Concrete Pavement (after 30 years)	Bridge (after 40 years)
$2,300,000	$860,000	$960,000

Project 6: Collector-Distributor Road from Las Vegas Boulevard to I-15

Construction Costs

Conceptual construction costs were developed for the following improvements:

- Downtown Connector Ramp from Northbound I-515 to I-15 Improvements
  - Construct a new northbound I-515 viaduct along a new alignment from south of Las Vegas Boulevard to north of the UPRR tracks.
  - Construct asphalt pavement from north of the UPRR tracks to south of City Parkway.
  - Construct a new bridge over City Parkway.
  - Construct asphalt pavement from north of City Parkway to the I-15 ramps.
  - Construct retaining walls.
- Las Vegas Boulevard Ramp Improvements
  - Realign the Las Vegas Boulevard on-ramp to I-515 northbound, and provide connection to the Downtown Connector ramp.
  - Construct retaining walls.
- Casino Center Boulevard Ramp Improvements
  - Realign Casino Center Boulevard on-ramp to I-515 northbound.
  - Construct retaining walls along the Casino Center Boulevard on-ramp to I-515 northbound, and provide connection to the Downtown Connector ramp.
  - Construct retaining walls.

Conceptual construction costs for Project 6 are summarized in Table 3-24.

Table 3-24: Conceptual Construction Costs (Millions) for Project 6

Improvements	Conceptual Construction Costs
Downtown Connector Ramp from Northbound I-515 to I-15 Improvements	$84.2
Las Vegas Boulevard Ramp Improvements	$2.9
Casino Center Boulevard Ramp Improvements	$4.2
Total Construction Costs	**$91.3**

Capital Costs

Conceptual capital costs for Project 6 are summarized in Table 3-25.

Table 3-25: Conceptual Capital Costs (Millions) for Project 6

Construction	ROW	Other	Total		
			Low	Median	High
$91.3	$4.1	$26.6	**$107.2**	$122.0	**$134.1**

Maintenance and Rehabilitation Costs

Conceptual maintenance and rehabilitation costs for Project 6 are summarized in Table 3-26 and Table 3-27.

Table 3-26: Conceptual Maintenance Costs for Project 6

Annual Roadway Maintenance	Annual Bridge Maintenance	Biennial Bridge Inspection
$9,000	$85,500	$64,000

Table 3-27: Conceptual Rehabilitation Costs for Project 6

Asphalt Pavement (every 8 years)	Concrete Pavement (after 30 years)	Bridge (after 40 years)
$355,000	$1,000,000	$8,500,000

Right-of-Way Process and Results

Project 1

All of the proposed improvements can be constructed within the existing public ROW.

Project 2

Approximately 0.94 acre of ROW would be required for a temporary easement, of which 0.42 acre would be from four private parcels and 0.52 acre would be from one public parcel. In addition, 0.05 acre of permanent ROW would be required from one public parcel.

Project 3

All of the proposed improvements can be constructed within the existing public ROW.

Project 4

Approximately 2.5 acres of ROW would be required for a temporary easement, of which 0.37 acre would be from one UPRR parcel, 0.18 acre would be from one private parcel, and 1.93 acres would be from one public parcel. Also, 0.08 acre would be required for permanent easement, of which .05 acre would be from one UPRR parcel and 0.3 acre would be from one private parcel. Additionally, 0.04 acre of permanent ROW would be required from one private parcel.

Project 5

Approximately 1.2 acres of ROW would be required from four public parcels, and approximately 2.8 acres of ROW would be required from three private parcels.

Project 6

Approximately 1.3 acres of ROW would be required from two public parcels, and approximately 1.3 acres of ROW would be required from three private parcels.

3.2.5 Operations and Safety

Transportation Analysis Process and Results

Travel Demand Forecasts

Travel demand forecasts were developed for use in the operational analysis of each project identified for further advancement. All traffic forecasts were developed per the guidance provided in NDOT's *Traffic Forecasting Guidelines*.

Year 2025 Forecasts for the Projects Identified for Further Advancement

The interim year 2025 traffic forecasts were developed for the six projects (see Appendix C – Traffic Forecasting Methodology Memorandum for a summary of how the forecasts were developed and approved). The study team developed the year 2025 AM and PM peak hour volumes and intersection turning movement volume forecasts for each project (see Figure 1 through Figure 12 in Appendix C - Traffic Demand Forecasts Figures). These forecasts provide traffic volumes for comparative analyses of the projects.

Year 2025 and 2040 No-Action Forecasts

The study team developed No-Action traffic forecasts for the interim year 2025 and design year 2040 (see Figure 13 through Figure 16 in Appendix C - Traffic Demand Forecasts Figures). The year 2025 No-Action forecasts were used as a baseline for comparison with the six projects. The year 2040 forecast was developed from the year 2035 travel demand model from the adopted RTP for southern Nevada. The year 2040 No-Action forecasts will be used to analyze design year conditions for the project(s) that are advanced to the NEPA process.

Traffic Operations Analysis Process and Results

Year 2025 CORSIM Analysis for the Projects Identified for Further Advancement

The No-Action Alternative and each of the six projects were modeled separately in CORSIM for the interim year 2025. Each model used a two-hour modeling period, and traffic signal timings were optimized in Synchro. CORSIM analysis results correspond to the PM peak hour, shown in Table 3-28, which compares each project's operational performance to the others.

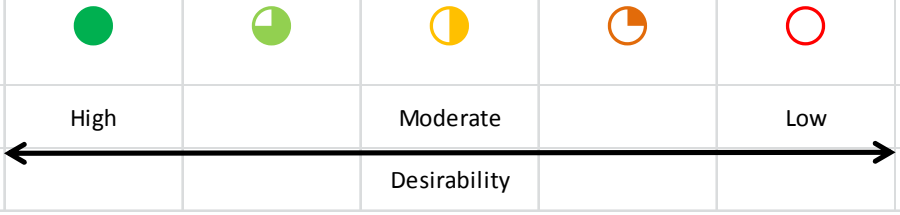
Table 3-28 shows the following Measures of Effectiveness (MOEs) for the No-Action Alternative and each of the six projects:

- Vehicle Miles Traveled (VMT): Total distance traveled by all vehicles within the traffic study area.
- Vehicle Hours Traveled (VHT): Total travel time for all vehicles traveling within the traffic study area.
- Speed Average (miles/hour): Average speed of all vehicles traveling within the traffic study area.
- Vehicle Hours of Delay Inside the Modeled Network (hours): Total time that all vehicles were delayed traveling within the traffic study area.
- Vehicle Hours of Delay Behind Entry Nodes (hours): Total delay experienced by all vehicles waiting to enter the traffic study area.
- Total Vehicle Hours of Delay (hours): Total of "Vehicle Hours of Delay Inside the Modeled Network" and "Vehicle Hours of Delay Behind Entry Nodes." This is a measure of the total delay experienced by all vehicles traveling within the traffic study area and waiting to enter it.
- Delayed Vehicles Behind Entry Nodes (vehicles): Total number of vehicles that were unable to enter the network at the drivers' desired time.

Table 3-28: CORSIM Operations Results from Year 2025 PM Models

Column	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Project	Vehicle Miles Traveled (VMT) (miles)	Vehicle Hours Traveled (VHT) (hours)	Speed Average (Miles/Hour)	Vehicle Hours of Delay Inside the Modeled Network (hours)	Vehicle Hours of Delay Behind Entry Nodes (hours)	Total Vehicle Hours of Delay (hours) (4) + (5)	Delayed Vehicles Behind Entry Nodes (Vehicles)	Performance
No-Action Alternative	65,670	4,183	15.8	3,105	2,486	5,591	16,471	
Project 1	65,977	4,042	16.4	2,955	2,067	5,022	15,464	
Project 2	64,151	3,985	16.2	2,925	2,304	5,229	15,000	
Project 3	64,585	3,880	16.7	2,814	2,232	5,046	14,461	
Project 4	73,286	4,022	18.3	2,819	1,535	4,354	16,818	
Project 5	63,619	3,595	17.8	2,545	2,378	4,923	14,791	
Project 6	75,332	2,442	30.9	1,202	1,767	2,969	10,588	

Notes:
All results above are for Time Periods 2 and 3 from the year 2025 CORSIM PM period models (Time period 1 is the anticipation of peak and Time period 4 is the dissipation of peak and results from these periods are therefore not shown; each time period is 30 minutes long).
Column (4) "Vehicle Hours of Delay Inside the Modeled Network (hours)" is the total time that all vehicles were delayed inside the network, while traveling in the network.
Column (5) "Vehicle Hours of Delay Behind Entry Nodes (hours)" is the total delay experienced by all vehicles waiting to enter the network (backed up behind the entry nodes).
Column (6) "Total Vehicle Hours of Delay (hours) (4) + (5)" represents the total delay encountered by all vehicles (waiting to enter the network and while traveling in the network).



As shown in Table 3-28, each of the six projects identified for further advancement resulted in higher speeds and lower delays compared to the No-Action Alternative. Table 3-28 also summarizes the relative performance of the six projects based on an evaluation of the MOEs. Project 4 and Project 6 are expected to provide significant, corridor-wide safety and operational benefits, and are therefore the most desirable. The operational impacts of the other four projects are expected to be mostly localized. After Project 4 and Project 6, Project 5 is expected to be the next most desirable, followed by Project 1 and Project 3, and finally, Project 2.

In addition to the CORSIM analysis completed for project operational performance, Synchro and highway capacity software (HCS) analyses were completed to determine intersection operations and local (freeway link/segment level) operations compared to the No-Action Alternative summarized below.

Project 1

Project 1 is expected to impact three key segments:

- I-515 southbound between the I-15 on-ramp and Casino Center Boulevard off-ramp: This weaving segment is expected to operate at Level of Service (LOS)[5] F in 2025 under the No-Action conditions. The number of vehicles weaving in this segment would be reduced compared to the No-Action Alternative, improving operations of this segment. However, LOS is expected to remain F under Project 1.
- I-515 southbound between the Rancho Drive on-ramp and I-15 northbound off-ramp: This weaving segment is expected to operate at LOS E in 2025 under No-Action conditions. Under Project 1, the number of vehicles weaving in this segment would increase compared to the No-Action Alternative because vehicles destined to City Parkway would now use the I-15 northbound off-ramp. These additional vehicles would negatively impact operations of this segment. LOS is expected to remain E under Project 1. Traffic destined for City Parkway could use the outside lane rather than queue behind the bottleneck area (resulting from the reduction in the mainline from three to two lanes), thereby improving lane utilization in this section.
- I-15 northbound off-ramp between the Martin Luther King Boulevard on-ramp and the City Parkway off-ramp: LOS D is expected under the No-Action Alternative. LOS is expected to worsen to E under Project 1 due to the additional traffic using this ramp destined for City Parkway.

Project 2

The operational impacts of Project 2 would be mostly localized, impacting specific movements. These include:

- Adding dual right and dual left turns on the southbound Las Vegas Boulevard off-ramp would improve LOS and reduce queues that form to make these turns. The intersection LOS is expected to improve from LOS C under the No-Action Alternative to LOS B under Project 2 by 2025.

[5] LOS is a qualitative measure of the quality of traffic service using letters A through F, with A being the best and F being the worst.

- Similarly, providing dual right turns on the northbound Las Vegas Boulevard off-ramp would improve the 2025 LOS for this movement from LOS D under the No-Action Alternative to LOS B under Project 2.
- The additional left-turn lane from Las Vegas Boulevard to the northbound on-ramp would improve the 2025 LOS for this movement from LOS D under the No-Action Alternative to LOS C under Project 2, and reduce the length of queues and the probability of them extending beyond the storage bay.
- Providing a two-lane northbound off-ramp at Las Vegas Boulevard by making the outside through-lane an optional through/exit lane would improve the LOS of the weaving segment between Eastern Avenue and Las Vegas Boulevard. The year 2025 LOS would be F under the No-Action Alternative, but would improve to LOS E under Project 2.

Project 3

Similar to Project 2, the operational impacts of Project 3 would be mostly localized, impacting the following traffic movements:

- Providing a two-lane southbound off-ramp at Eastern Avenue by converting the outside through-lane to an optional through/exit lane would improve the LOS of the weaving segment between Las Vegas Boulevard and Eastern Avenue. LOS would be F for 2025 under the No-Action Alternative, which is expected to improve to LOS E under Project 3.
- Providing dual right turns from the southbound Eastern Avenue off-ramp to Eastern Avenue would improve this movement from LOS F under the No-Action Alternative to LOS D under Project 3. The queue lengths would also shorten, reducing the probability of queues extending to the freeway.
- Providing dual left turn lanes to the southbound on-ramp from Eastern Avenue would improve this turning movement from LOS F under the 2025 No-Action Alternative to LOS D under Project 3.
- Constructing a one-way frontage road on the south side of I-515 from Eastern Avenue to Mojave Road would improve the southbound left-turn movement at the Eastern Avenue and Stewart Avenue intersection from LOS F under the No-Action Alternative to LOS E under Project 3. Additional safety benefits from reducing traffic on Stewart Avenue are expected in this segment that is actively used by pedestrains and school children.

Project 4

Project 4, which includes a third southbound lane under the Spaghetti Bowl, would eliminate a severe bottleneck, resulting in significant congestion reduction and improvements in corridor-wide operations. The maps shown in Appendix C – Heat Maps for Projects 4 and 6, compare the southbound corridor speeds and volumes processed between the No-Action Alternative and Project 4. The heat maps show a significant improvement in travel speeds while processing significantly more vehicles under Project 4.

Project 5

Minimal changes in operations are expected within the study area under Project 5. Operations at both the northbound and

southbound Charleston Boulevard ramp terminal intersections are expected to improve, but LOS C is expected to remain unchanged under Project 5. Provision of the new access (Pecos Road interchange) is expected to improve operations (reduced net travel time) on arterial streets adjacent to the study area due to the reduction in out-of-direction travel required to access I-515.

Project 6

Congestion along northbound I-515 is primarily due to:

1. Northbound I-515 traffic destined for I-15 weaving with traffic entering from Las Vegas Boulevard and Casino center Boulevard.
2. Traffic merging from the Las Vegas Boulevard on-ramp and weaving across I-515 to continue northbound on I-515 or to exit at the I-15 off-ramps.
3. Traffic weaving between Casino Center Boulevard and the I-15 off-ramps. Traffic from Casino Center Boulevard destined for northbound I-515 must weave across I-515 traffic to exit to I-15.

Project 6 includes braiding these ramps, resulting in significant congestion reduction and significant improvement in corridor-wide operations. Project 6 would also result in fewer vehicles entering I-515 because vehicles from Vegas Boulevard and Casino Center Boulevard accessing I-15 could use the proposed collector-distributer road along I-515. The maps shown in Appendix C – Heat Maps for Projects 4 and 6, compare the No-Action Alternative and Project 6 northbound corridor speeds and volumes processed. The heat maps show a significant improvement in travel speeds while processing significantly more vehicles.

Safety Process and Results

Safety analyses of the six projects identified for further advancement were conducted using the American Association of State Highway and Transportation Officials' (AASHTO) Highway Safety Manual (HSM) predictive method to estimate the expected average crash frequency (AASHTO 2014a; AASHTO 2014b).

Methodology and Assumptions

The Enhanced Interchange Safety Analysis Tool (ISATe) was used to estimate the safety impacts of design decisions related to freeways and interchanges. Table 3-29 identifies the parameters used in the safety analysis of the six projects.

Table 3-29: Parameters Used in the Safety Analysis

Design Speed	Enter/Exit Ramp Presence
Lane Width	Number of Through-Travel Lanes
Shoulder Width	Horizontal Curve Data
Segment Length	Weaving Presence
Barrier Presence	Presence of Lane Drops/Additions
Speed-Change Lane Presence	Annual Average Daily Traffic (AADT) for the Study Period

Each of the six projects was analyzed to predict the average annual crash frequency (crashes per year) compared with the No-Action Alternative. Crash frequency was calculated using the Safety Performance Functions (SPFs) in the ISATe model that were established from roadway geometry and AADT characteristics of each alternative. Changes to crash frequency would only occur

within segments of the study area where changes to roadway geometry or traffic volumes would occur. Therefore, only those segments were analyzed, and the results are representative of crash frequency for the entire study area corridor.

The impact limits for each of the six projects were measured in lane miles. Some projects would result in a substantial increase in lane miles, while others would result in a minimal change in lane miles. Therefore, to properly rate the performance of each project, the change in crash frequency was normalized using the total lane miles impacted by the proposed project. The resulting final change in crash frequency per lane mile was used to rate the effectiveness of each project identified for further advancement in this study.

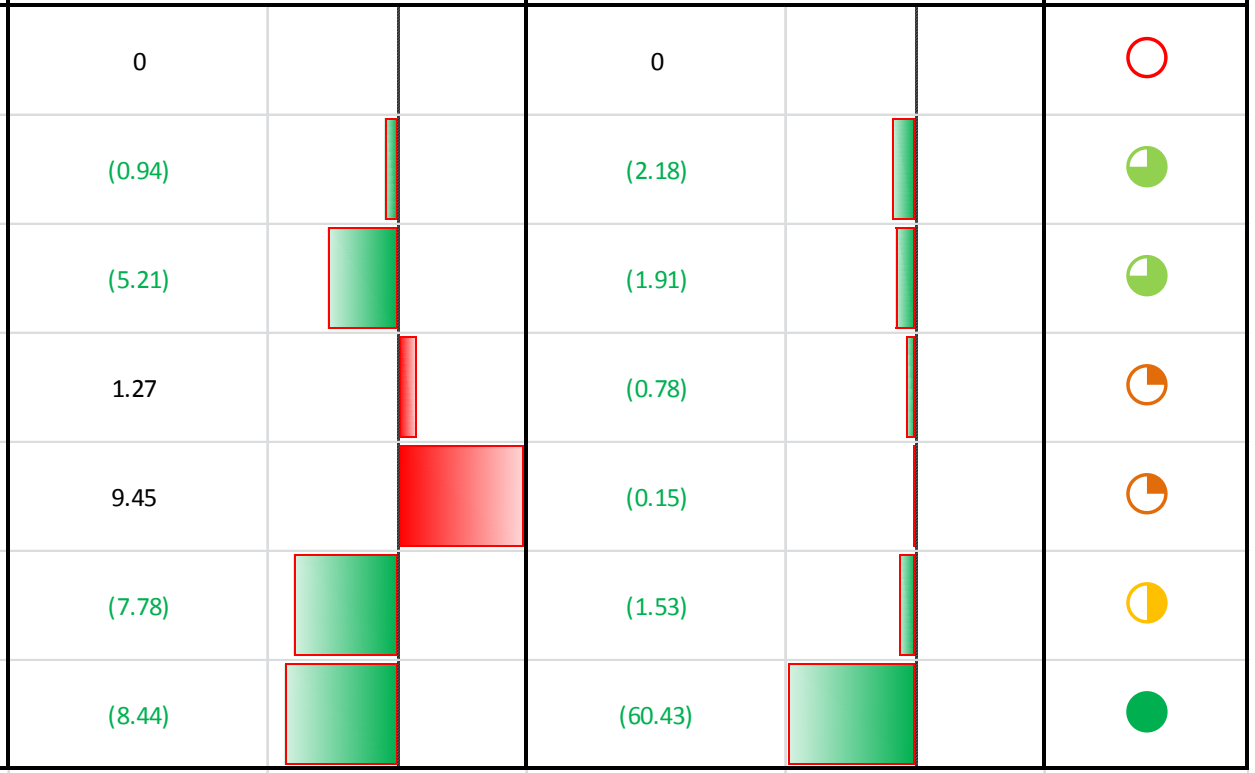
The following assumptions were made to simplify procedures and eliminate duplication:

1. Typical project life is 20 years; however, many of the projects require improvements to existing structural components or propose new structural components, requiring a design life of 40 years. Therefore, a 40-year study period was used to maintain consistency for comparison purposes.
2. The proposed projects were assumed to be operational in 2021; thus, the 40-year study period encompasses the years 2021 to 2060.
3. A change in crash frequency for the area of impact would represent the change in crash frequency for the entire I-515 study area corridor.
4. A compound annual growth rate of 1 percent was applied to calculate the year 2030 traffic volumes. The 1 percent growth rate was estimated based on the year 2025 and year 2035 AADT forecasts.
5. No local calibration factors were necessary.

The ISATe model requires a minimum of two years of traffic volume data. Additional travel forecasts for 2030 were developed for each of the six projects to provide the second year of required traffic volumes. Year 2025 traffic volumes were derived from the travel demand forecasts (see page 3-34). The model only accommodates analysis for a study period of 24 consecutive years. Therefore, the analysis was performed twice for each project in order to complete the full 40-year study period: once for years 2021 to 2040, and again for years 2041 to 2060. The total predicted crashes from each model was summed to provide the total crashes for the 40-year study period.

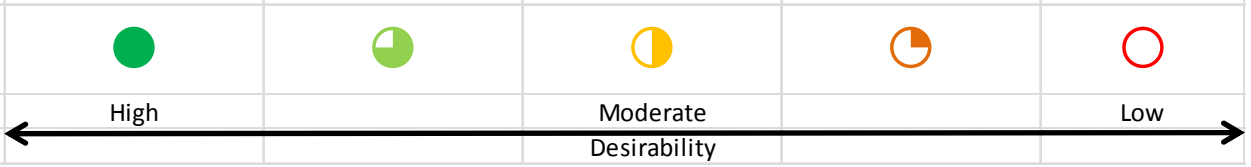
Table 3-30: Safety Performance Rating for the Six Projects Identified for Further Advancement in this Study

Summary			
Project	Change in Annual Crash Frequency	Change in Annual Crash Frequency/Ln Mile	Performance
No Action	0	0	
Project 1	(0.94)	(2.18)	
Project 2	(5.21)	(1.91)	
*Project 3	1.27	(0.78)	
**Project 4	9.45	(0.15)	
Project 5	(7.78)	(1.53)	
Project 6	(8.44)	(60.43)	



* Additional safety analysis is required as the ISATe model only captures safety improvments to the freeway system and does not capture reductions along Stewart Avenue to Mojave Road.

** The extra lane permits substantial additional volume to access the system.



Summary Results

Both the individual and combined output data generated by the ISATe model is provided in Appendix C — ISATe Model, and Appendix C — Results of the HSM Analysis, of this report.

Table 3-30 shows the performance rating for each of the six projects when compared to the No-Action Alternative. The change in crash frequency for each project was compared to the No-Action alternative to determine a performance rating. As shown in Table 3-30, before normalization, Project 4 provides the greatest change in annual crash frequency, with an increase of 9.45 crashes annually. However, as noted previously, each alternative was normalized due to their limited geometric and traffic volume impacts within the project corridor. This normalization provides a comparative analysis based on Change in Annual Crash Frequency per Lane Mile, and is also presented in Table 3-30. As can be seen after normalization, Project 6 provides the greatest change in crash frequency, with a reduction of 60.43 crashes per year per lane mile.

Project 1

Although the ISATe model analyzed multiple SPFs, the safety analysis for Project 1 showed that the following safety SPFs were of particular significance.

1. Weaving
2. Intersections

The weaving along the mainline of I-515 southbound between the I-15 northbound on-ramp and the Casino Center off-ramp showed a reduction in crashes due to lower traffic volumes. However, the off-ramp from I-515 southbound to I-15 northbound showed an increase in crashes due to the introduction of an additional lane, producing weaving from the Martin Luther King slip ramp to the City Parkway exit ramp.

The addition of a three-leg intersection at the City Parkway ramp terminal also resulted in an increase in crashes; however, the reduction in crashes on the mainline was significant enough that an overall reduction in crashes would result from the proposed improvements. See Table 3-30 and Appendix C — Results of the HSM Analysis for more information.

Project 2

The following SPFs identified in the safety analysis for Project 2 were of particular significance:

1. Number of storage lanes
2. Speed change lanes
3. Lane width
4. Shoulder width

The increased shoulder width and additional storage lanes on the Las Vegas Boulevard and Casino Center ramps would decrease crashes. These improvements, together with the additional length in speed change lanes, would result in fewer crashes on the freeway. Lane widths would be reduced at the ramp terminal intersections, resulting in additional crashes at these locations. However, based on the results of ISATe model and as shown in Table 3-30, an overall reduction in crashes is expected. See Appendix C — Results of the HSM Analysis for more information.

An important feature of this alternative is the multiple pedestrian safety improvements on the ramp terminal intersections, which

would result in fewer pedestrian and vehicle crashes (pedestrian and vehicle crashes are not captured in the ISATe model).

Project 3

The following SPFs identified in the safety analysis for Project 3 were of particular significance:

1. Weaving
2. Number of through-travel lanes
3. Lane width
4. Shoulder width
5. Intersections

The widened shoulders and increased number of travel lanes on the Eastern Avenue ramp segments would reduce crashes, while the increased traffic volumes and decreased lane width at the ramp terminal intersections would increase predicted crashes. The connector road to Mojave Road would be a new roadway segment, and thereby would have the potential for crashes. To access the connector road from I-515, traffic would exit the improved southbound Eastern Avenue exit ramp, continue through the intersection at the green traffic signal indication, and weave through traffic, making a right turn from Eastern Avenue (yield-controlled) onto the southbound on-ramp.

As shown in Table 3-30, safety analyses revealed an increase in the crash frequency for these improvements. However, when normalized, a reduction in crashes per year, per lane mile resulted. Additionally, this alternative would also provide multiple safety benefits to Stewart Avenue between Eastern Avenue and Mojave Road due to the reduction in traffic volumes. However, these crash reductions on Stewart Avenue (and at the Eastern Avenue intersection at Stewart Avenue) are not captured in the ISATe model. See Appendix C — Results of the HSM Analysis for more information.

Project 4

The following SPFs identified in the safety analysis for Project 4 were of particular significance:

1. Weaving
2. Speed change lanes
3. Lane width

The additional southbound auxiliary lane (speed change lane) to the Charleston interchange would eliminate the lane drop on the far north end of the project corridor (within the Spaghetti Bowl). Although the elimination of the lane drop would result in fewer crashes, most of these crash reductions would occur outside the northern project limits and were not captured in the model. A broader study area would be necessary to capture the complete safety effectiveness of this alternative. The provision of this auxiliary lane would be achieved through decreased lane widths. Furthermore, the increased capacity provided by the additional auxiliary lane would increase volumes on the freeway, ramp, terminal segments, and weaving areas throughout the I-515 corridor. The impacts of this increased capacity were not limited to one section of the I-515 corridor, but apply to the entire study area corridor in the southbound direction. As shown in Table 3-30, an increase in the predicted crash frequency would occur within the project limits due to the substantial additional traffic

volumes. However, when normalized, a reduction in crashes per year per lane mile is expected.

Project 5

The following SPFs identified in the safety analysis for Project 5 were of particular significance:

1. Weaving
2. Intersections

The access ramps to northbound and southbound I-515 at Pecos Road would relieve the northbound on-ramp and southbound off-ramp at the Charleston Interchange. This reduction in traffic volume would decrease crashes on I-515 between Eastern Avenue and Charleston Boulevard, as well as the Charleston Boulevard ramps. Traffic accessing Stewart Avenue via the northbound Pecos ramp would be required to exit at the northbound I-515 exit ramp to Charleston Boulevard, and continue straight through the intersection at the green signal indication. As a result, crashes would increase on this segment of the ramp. Similarly, traffic from Pecos Road and Stewart Avenue to southbound I-515 would be required to merge with the southbound exit ramp to Charleston Boulevard, weave across traffic destined for west Charleston Avenue, continue straight through the intersection, and use the southbound on-ramp to I-515 from Charleston Boulevard. As a result, crashes are expected to increase on this segment of the ramp as well. However, the proposed improvements would provide an overall decrease in crash frequency. See Table 3-30 and Appendix C — Results of the HSM Analysis, for more information.

Project 6

The following SPF identified in the safety analysis for Project 4 was of particular significance:

1. Weaving

The weaving movements between the on-ramps from Las Vegas Boulevard and Casino Center Boulevard, and the I-15 southbound and northbound off-ramps, would be removed and placed on the collector-distributor road. The elimination of this weaving section on the I-515 mainline would result in a reduction in crash frequency. See Table 3-30 and Appendix C — Results of the HSM Analysis, for more information.

3.2.6 Environmental

Environmental Screening Methods and Results

Methods

The Level 2 environmental screening evaluated the same environmental resources as the Level 1 screening, which included EJ and community, recreation, cultural, Department of Transportation Act Section 4(f) resources, and hazardous materials.

To ensure a more accurate evaluation of the environmental resources, a supplementary records search for cultural resources and hazardous materials sites was conducted. For cultural resources, an archaeologist conducted a record search of the Nevada Cultural Resources Information System to identify past cultural resources studies, and recorded historic and archaeological resources within a 0.25-mile radius of the study area (see Appendix C – I-515 Cultural Resources Supplementary

Records Search for more information). For hazardous materials, an assessment was performed to identify recognized environmental conditions (RECs) (see Appendix C – Hazardous Materials Research for Task Order 2 for more information). The geospatial information collected for the existing conditions analysis (see Section 2.9 for more information) was determined to be sufficient for the Level 2 screening of EJ and community and recreational resources.

The study team then assessed the impacts of each of the six projects identified for further advancement, to each resource based on the criteria and methods described below. After each of the six projects was assessed, desirability ratings were assigned. For each resource, projects with no impacts received a score of 5 (highest desirability). Projects that impacted a parcel/site, and/or had low nuisance impacts (noise) received a score of 4. Projects that impacted more than one parcel/site, and/or had greater nuisance impacts, received a score of 3 (moderate desirability). Projects that impacted three or more parcels/or sites received a score of 2, and projects that had more than three parcel or site impacts, or considerable nuisance impacts, received a score of 1 (low desirability).

Environmental Justice / Community

Impacts to EJ neighborhoods and community resources were quantified by identifying the number of ROW acquisitions from parcels located within an EJ neighborhood, or parcels with community resources (such as schools) and community centers. Indirect impacts were also considered in the final rating of EJ community impacts. These indirect impacts included the potential for nuisance impacts, such as noise, on EJ communities and community facilities.

Recreation, Cultural and Section 4(f)

Impacts to recreational and cultural resources, including Section 4(f) resources, were quantified by counting the number of parcels with recreational and cultural resources that likely would require ROW acquisition. Indirect impacts, such as the potential for nuisance impacts, were also considered in the final ratings for each project.

Hazardous Materials

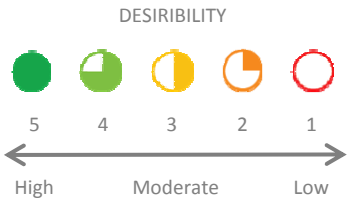
Impacts to hazardous materials sites were quantified by counting the number of active RECs within 0.5 mile, and hazardous waste sites within 0.25 mile of the study area (see Appendix C – Hazardous Materials Research for Task Order 2 for more information). The potential for ground disturbance and the proximity of the project to an REC or hazardous waste site were also considered in the final ratings for each project.

Results

The results of the environmental screening analysis are summarized in Table 3-31.

Table 3-31: Level 2 Environmental Screening Results

Project Number	EJ & Community Impacts Rating	Recreation Impacts Rating	Cultural Impacts Rating	Hazardous Materials Impacts Rating	Overall Rating
Project 1					
Project 2					
Project 3					
Project 4					
Project 5					
Project 6					



Environmental Justice / Community Rating

The location of the six projects relative to EJ communities is shown in Figure 3-7 and Figure 3-8. Figure 3-9 shows the location of these projects and the study area's community facilities. As shown in Table 3-31, Project 5 scored the lowest rating for EJ/ community impacts due to the high number of relocations and potential noise impacts in EJ neighborhoods. Project 3 and Project 6 both received a moderate rating with a score of 3. Under Project 3, constructing a one-way frontage road, widening Eastern Avenue, and constructing I-515 northbound on-ramps and southbound off-ramps would result in potential noise and other nuisance impacts to nearby EJ communities. Project 6 would result in removal of parking spaces from the community center/ public pool parcel located on the southwest corner of Las Vegas Boulevard and Bonanza Road. Projects 2 and 4 scored a 4 for the potential for noise impacts to nearby EJ communities. Project 1 would not have EJ/community impacts and received the highest desirability rating.

Figure 3-7: Level 2 Projects and Environmental Justice Populations (Minority) within the Study Area

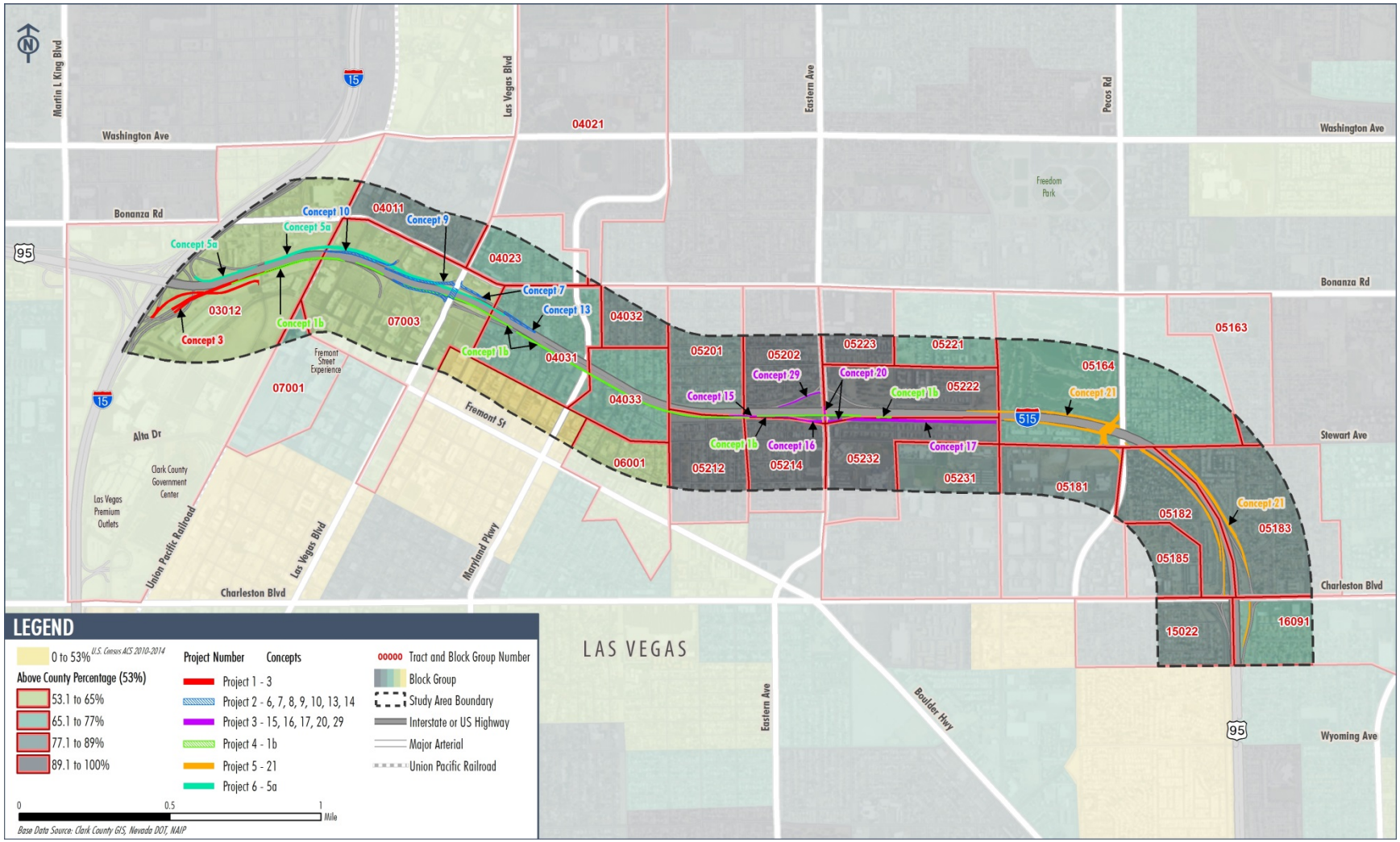


Figure 3-8: Level 2 Projects and Environmental Justice Populations (Low Income) within the Study Area

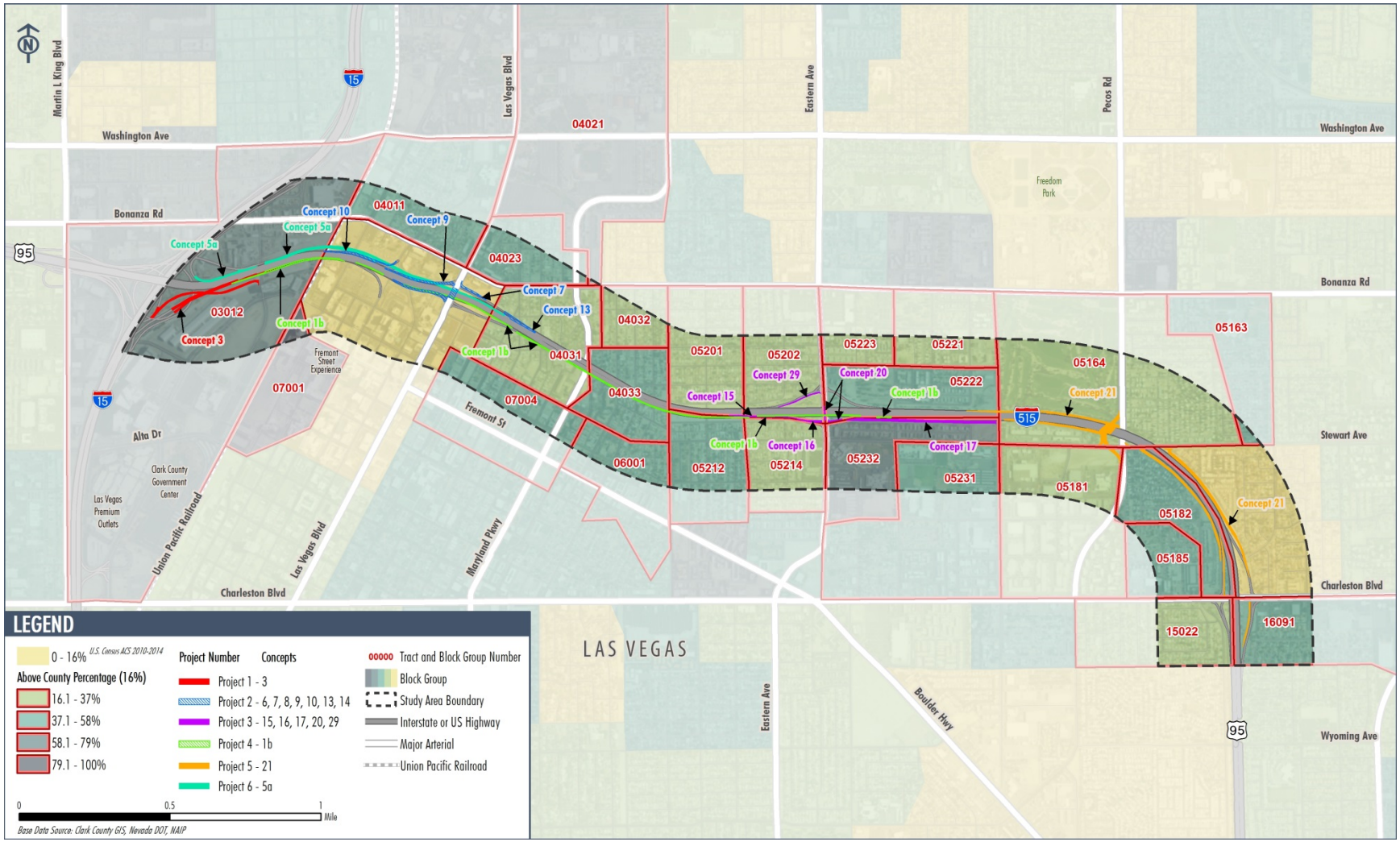


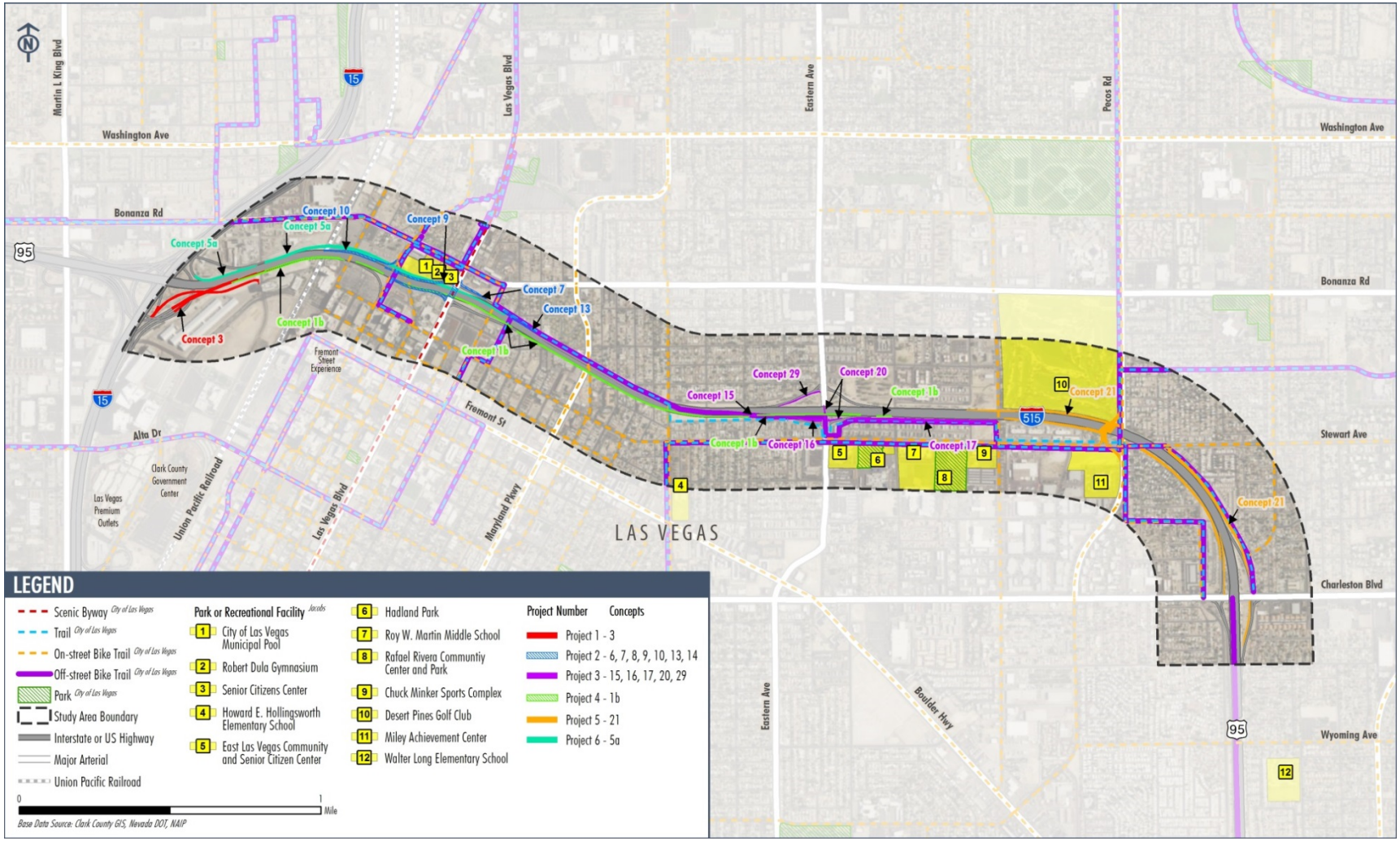
Figure 3-9: Level 2 Projects and Community Facilities within the Study Area

Recreation Resources Rating

The Level 2 projects and the location of recreational facilities, including parks, recreation areas, and bicycle and pedestrian facilities, are shown in Figure 3-10. Project 5 received the lowest rating compared to all projects, with a score of 3 due to potential ROW

impacts to the Desert Pines Golf Club and the Miley Achievement Center. Project 2 and Project 6 each scored a 4 due to potential construction-related impacts to Las Vegas Boulevard, a City of Las Vegas Scenic Byway. Project 1, Project 3, and Project 4 each scored a 5 and had no impacts to recreational resources, including Section 4(f) properties.

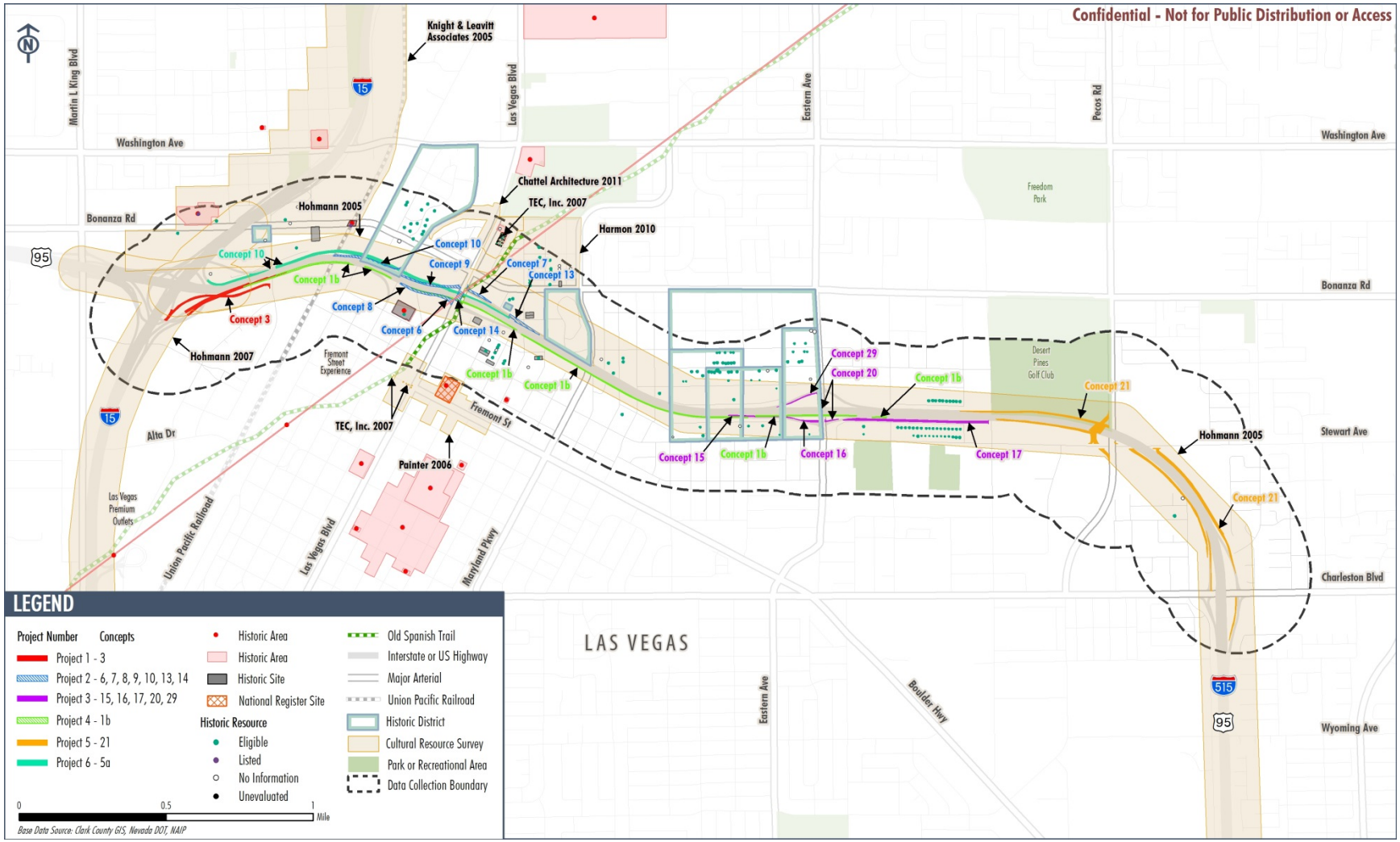
Figure 3-10: Level 2 Projects and Parks/Recreation and Bicycle/Pedestrian Facilities within the Study Area



Cultural Resources Rating

For cultural resource effects, Project 3 and Project 6 received the lowest desirability rating, with a score of 3. Project 3 received a score of 3 due to the proximity of the proposed frontage road to residential properties east of 28th Street and south of Marlin Avenue that are eligible for listing on the National Register of Historic Places. The proposed frontage road may result in audible and visual impacts to the eligible properties. Project 6 scored a 3 due to potential direct impacts to a potential historic district, and proximity to two potentially historic sites located west of the UPRR. Project 1, Project 2, Project 4, and Project 5 each received the highest desirability rating, with a score of 5, for having no impacts to cultural resources. The Level 2 projects and the locations of the cultural sites are included in Figure 3-11.

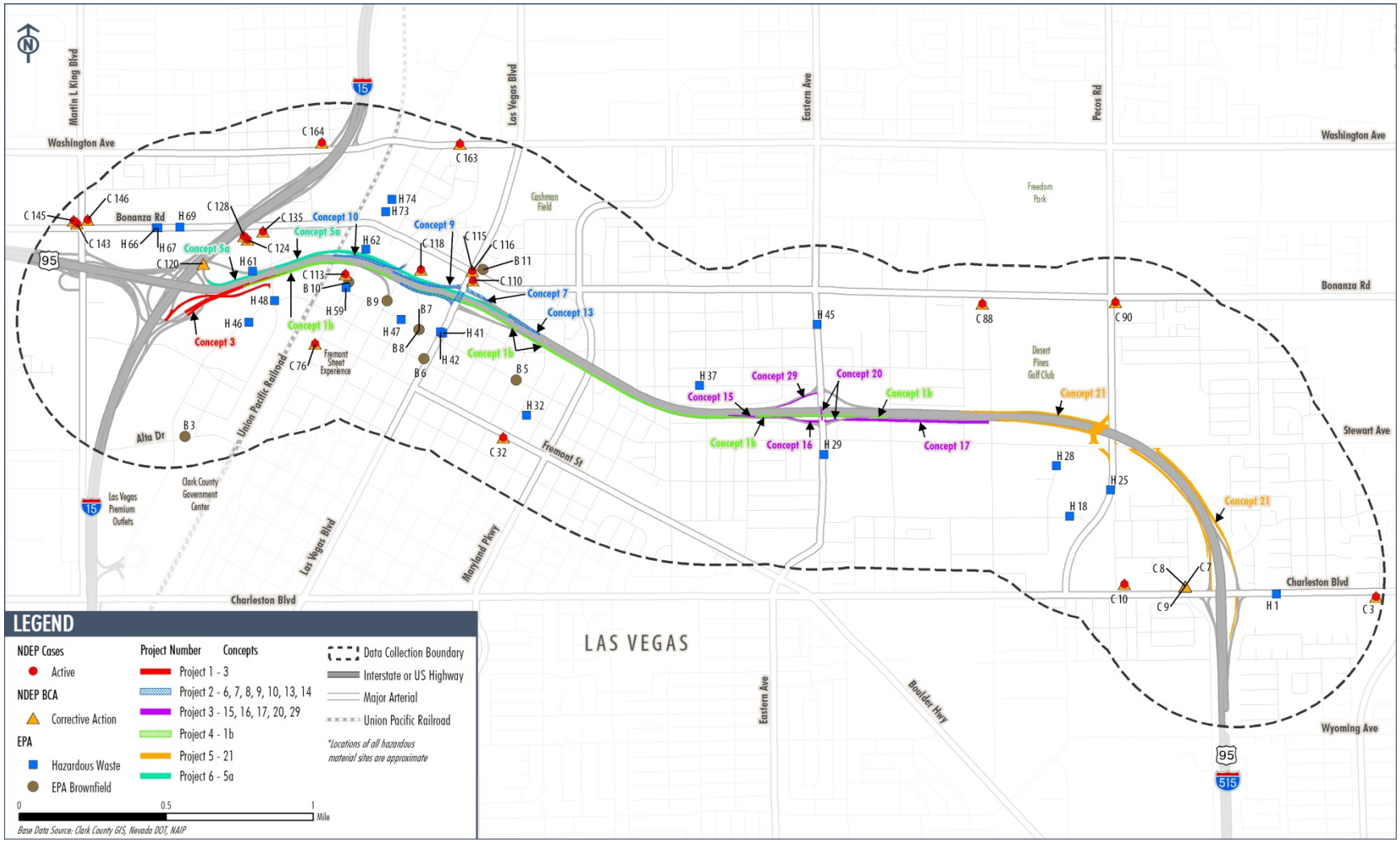
Figure 3-11: Level 2 Projects and Cultural Resources Identified within the Study Area



Hazardous Materials Rating

The Level 2 projects and the location of hazardous materials sites within the study area are shown in Figure 3-12. Projects 4 and 6 received the lowest desirability rating, each with a score of 3, due to the proximity of a high number of RECs, brownfield, and hazardous materials sites, and the potential for ROW acquisition and ground disturbance. Project 1 and Project 2 each scored a 4 due to the proximity of potential RECs, brownfield and hazardous materials sites, and the potential for ground disturbance, but should not require ROW acquisition. Therefore the probability of project impacts from nearby hazardous material sites is low. Project 3 and Project 5 each scored a 5 due to the lack of hazardous material sites near the proposed improvements, and no potential impacts to hazardous materials sites.

Figure 3-12: Level 2 Projects and Hazardous Materials Sites within the Study Area



Overall Ratings

Overall, Projects 5 and 6 scored the lowest, with an overall score of 3. Projects 1, 2, 3, and 4 each scored a 4 overall. Project 1 received the highest ratings (score of 5) in the most categories – EJ/ community, recreation, and cultural impacts.

3.2.7 Level 3 Screening – Benefit/Cost Analysis

A benefit/cost analysis was completed in support of Level 3 Screening. This section briefly explains the methodology, assumptions, and results of the benefit/cost analyses completed to evaluate the six projects identified for further advancement in this study. See Appendix C – I-515 Benefit-Cost Analysis Memorandum for more information on the benefit/cost analysis.

Benefit/Cost Analysis Methodology

The benefit/cost analysis was conducted using the California Department of Transportation's (CalTrans) life-cycle benefit/cost analysis model Cal-B/C Corridor spreadsheet analysis tool. The Cal-B/C Corridor uses the travel demand model outputs from two horizon years (the year 2025 and year 2035 were selected for this study) for each project to estimate the benefit components for the other years of the project's life. RTC's travel demand models were used to evaluate each of the six projects and generate outputs needed for use in the Cal-B/C Corridor tool. Conceptual project cost estimates were developed in accordance with NDOT's *Risk Management and Risk Based Cost Estimation Guidelines*, and NDOT's Project Estimating Tool: Project Estimation Wizard (NDOT 2012).

Benefit/Cost Analysis Assumptions and Parameters

Most of the parameters involved in the benefit/cost analysis were obtained from NDOT's *2016 Discussion of the Calculations of Costs and Benefits* document and coordination with NDOT (NDOT 2016). Key parameter values and assumptions are listed below:

- The base year for the benefit/cost analysis is the year 2016. All benefits and costs were quantified in year 2016 dollars, and benefits and costs accrued in future years were discounted to the year 2016 using the assumed discount rate.
- Construction was assumed to occur in years 2019 and 2020, and projects were assumed to open to traffic in the year 2021. Capital costs for the projects were assumed to be incurred during years 2017 through 2020.
- The typical project life was assumed to be 20 years, i.e., benefits and costs accrued during a period of 20 years after the opening of the project are accounted for in the benefit/cost analysis. However, when the cost of the structural components of a project was a significant portion (greater than 25 percent) of the total project costs, a 40-year project life was assumed. Based on this approach, Project 1, Project 3, and Project 5 were analyzed with a 20-year project life, and Project 2, Project 4, and Project 6 were analyzed with a 40-year project life. A discount rate of seven percent was used as a default in the analysis. Sensitivity analyses were completed with three percent and five percent discount rates.

Benefits Included in the Analysis

Reduced Travel Time

The daily change in VHT as a result of each of the six projects compared to the No-Action Alternative for both 2025 and 2035 was obtained from the travel demand models. The change in VHT was converted to a change in Person Hours Travelled (PHT) based on average vehicle occupancy. The change in PHT was monetized based on the "value of time" for different modes of travel (automobile vs. truck).

Reduced Vehicle Operations Costs

Reduction in vehicle operations costs due to reduced fuel consumption and non-fuel operations costs (tires, depreciation, and maintenance) was considered in the analysis. These costs were estimated based on the changes in VMT between each of the six projects and the No-Action Alternative. Benefits were monetized separately for different modes of travel.

Reduced Crashes (Improved Safety)

Changes in VMT due to each of the six projects compared to the No-Action Alternative resulted in changes in the likelihood of crashes. Crash rates for Clark County (obtained from NDOT) were used to estimate the number of crashes for the No-Action Alternative and the six projects. Changes in the number of crashes were monetized using the crash cost assumptions.

Reduced Emissions

The analysis estimated vehicle emissions cost savings based on changes in VMT between each of the six projects and the No-Action Alternative. Benefits were monetized separately for different modes of travel. Emission reductions for the following pollutants were included in the analyses:

- Carbon dioxide (CO_2)
- Particulate matter (PM)
- Nitrogen oxides (NO_X)
- Sulfur dioxide (SO_2)
- Volatile organic compounds (VOCs)

Reduction in CO_2 emissions was monetized using the guidance provided in the *TIGER Benefit-Cost Analysis (BCA) Resource Guide* (USDOT 2016).

Key Observations Regarding Estimated Benefits

- Project 2 includes improvements at the Las Vegas Boulevard and the I-515/Casino Center Boulevard interchanges. The improvements mainly include providing additional turn lanes and additional on-ramp storage behind the ramp meter.The total benefits expected due to this project are lower than the benefits from the other projects.
- Projects 4 and 6 are expected to produce significant corridor-wide benefits. As shown in Figure 3-13, these projects are expected to each produce more than 100 million dollars (discounted to the year 2016) of benefits over their project lives.
- Project 5 includes the construction of an interchange at Pecos Road and I-515. The main benefits of the Pecos Road interchange come from improving the regional distribution of traffic accessing the I-515 corridor. If this project is completed together with other capacity improvement projects, it is likely that greater benefits

would be realized with this project, compared to the other projects.

- Project 6 includes the construction of a new northbound I-515 exit ramp to I-15, braided over the northbound I-515 entrance ramps from Las Vegas Boulevard and Casino Center Boulevard. The benefits identified in this analysis would result from eliminating the existing weave, which causes congestion on northbound I-515 between Las Vegas Boulevard and I-15. The new, proposed I-515 exit ramp would include a collector-distributor road along the north side of I-515, providing a 70 mile-per-hour design speed with three travel lanes. Such a design would allow the new ramp to serve as a detour road during the planned reconstruction of the downtown I-515 viaduct (Structure G-947). However, the benefits of the new collector-distributor road serving as a detour during the reconstruction of the Downtown Viaduct are not included in this benefit/cost analysis.

Costs Included in the Analysis

Capital Costs

Capital costs include the initial investments made for the project, which are the project costs incurred before the project opens. Conceptual project construction cost estimates were developed in accordance with NDOT"s *Risk Management and Risk Based Cost Estimation Guidelines*, using the department's Project Estimating Tool: Project Estimation Wizard (NDOT 2012). The following components of capital costs were also estimated for the six projects:

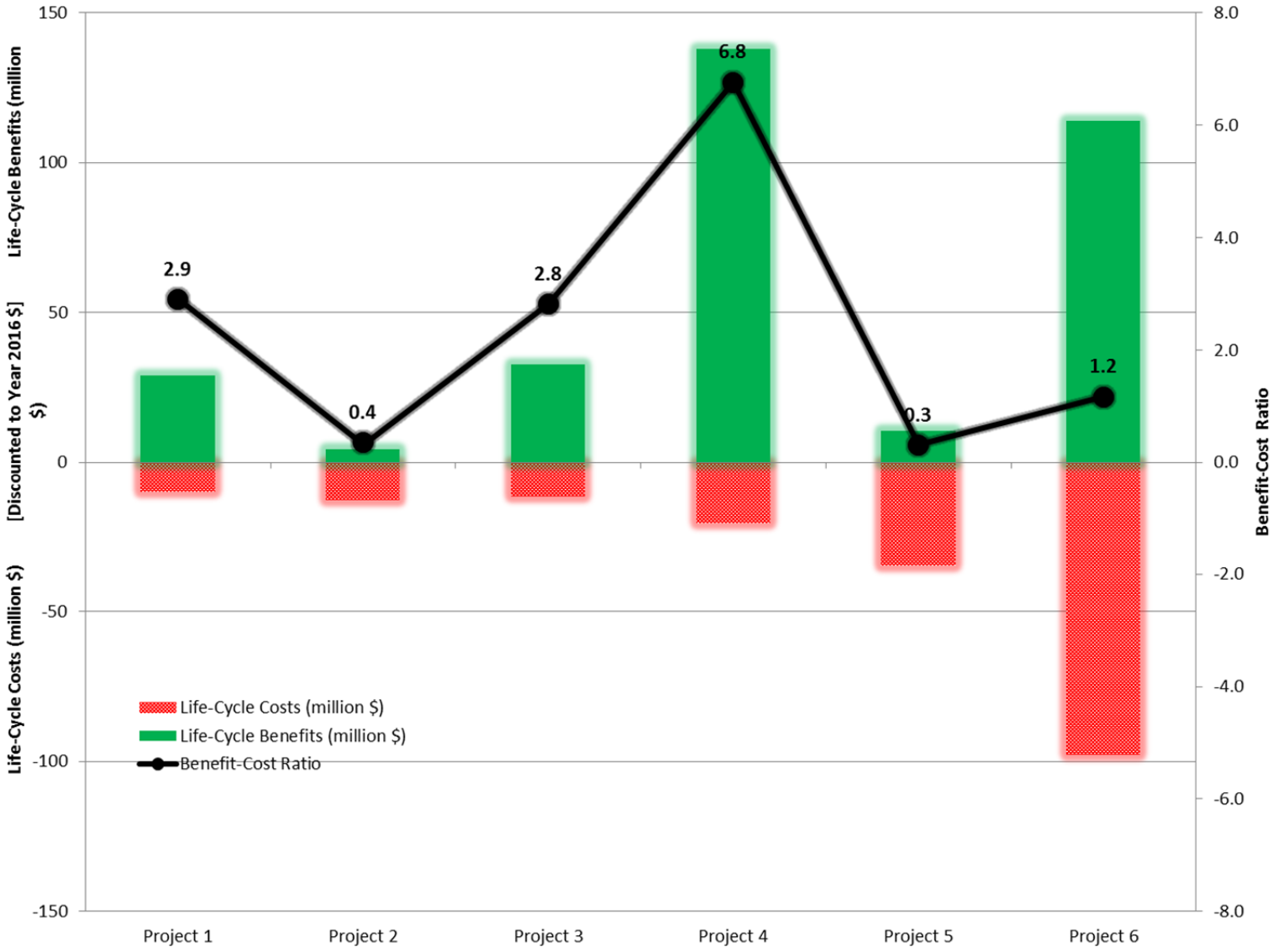
- ROW costs
- Preliminary engineering
- Final engineering
- Environmental
- Administration and legal
- Construction engineering and inspection

Operating, Maintenance, and Rehabilitation Costs

Operating, maintenance, and rehabilitation costs are incurred after the project is open to traffic. As appropriate for each project, operating, maintenance, and rehabilitation costs were estimated, and include:

- Annual asphalt pavement maintenance costs
- Concrete pavement rehabilitation costs
- Conceptual annual bridge/structure maintenance costs
- Conceptual biennial bridge inspection costs
- Bridge rehabilitation costs

Figure 3-13: Comparison of Project Life-Cycle Costs, Benefits, and Benefit/Cost Ratio



Key Observations Regarding Project Costs

- Project 4 provides a full auxiliary lane in the southbound direction between I-15 and Eastern Avenue, and connects to the proposed auxiliary lane between the Eastern Avenue and Charleston Avenue interchanges. This project can be completed either through a full widening of the roadway to accommodate the auxiliary lane or through a partial widening with reduced shoulders. The cost estimates and the benefit/cost analysis correspond to the preferred option — the partial widening option. The full widening option would be more expensive than the partial widening option.
- The split diamond option for Project 5 was evaluated in this benefit/cost analysis.
- Project 6 includes construction of a new northbound braided I-515 exit ramp, which could also be used as a detour road during the planned reconstruction of the Downtown Viaduct (Structure G-947). Although the cost estimates for Project 6 are high, they do not account for a substantially reduced cost to reconstruct the I-515 viaduct by using the potential detour. Accordingly, cost savings during construction of the Downtown Viaduct could reduce the cost for Project 6, which are not included in this analysis.

Results

Benefit/Cost Analysis

Benefits and costs were estimated for each project, for each year of the analysis period. These benefits and costs were discounted to determine the equivalent year 2016 benefits and costs. The discounted benefits and costs accrued in each year of the projects' life are shown in Table 3-32. These discounted benefits and costs were used to determine the final benefit/cost ratio. Figure 3-14 shows the total cumulative benefits, costs, and the benefit/cost ratio for all six projects. Some key observations from the results of the benefit/cost analysis follow:

- Project 1, Project 3, Project 4, and Project 6 are expected to have a benefit/cost ratio greater than 1.0. This implies that the total cumulative benefits are greater than the total cumulative costs for these projects.
- Project 4 is expected to have the greatest benefit/cost ratio (6.8) because of the expected significant corridor-wide benefits.
- Project 2 and Project 5 are expected to have a benefit/cost ratio below 1.0. This implies that the total cumulative benefits are lower than the total cumulative costs.
- The benefit/cost ratio for Project 6 will likely be greater than the benefit/cost ratio shown in Figure 3-14, below, for reasons explained in the Key Observations Regarding Estimated Benefits and the Key Observations Regarding Project Costs section.

Sensitivity Analysis

A sensitivity analysis was completed to determine the impact of changes in the discount rate on the benefit/cost ratio. The parameter values listed in Appendix C — Benefit Cost Analysis Memo Appendices, were used as the baseline values, and the sensitivity analysis was performed by changing the discount rate to determine the impact of the discount rate on the benefit/cost

ratios. The results of the sensitivity analysis are shown in Figure 3-14. The baseline discount rate is seven percent. A three percent and five percent discount rate, both of which are less conservative than the seven percent value, result in greater benefit/cost ratio for all projects compared to the baseline benefit/cost ratios. The three percent discount rate results in the greatest benefit/cost ratio for all projects.

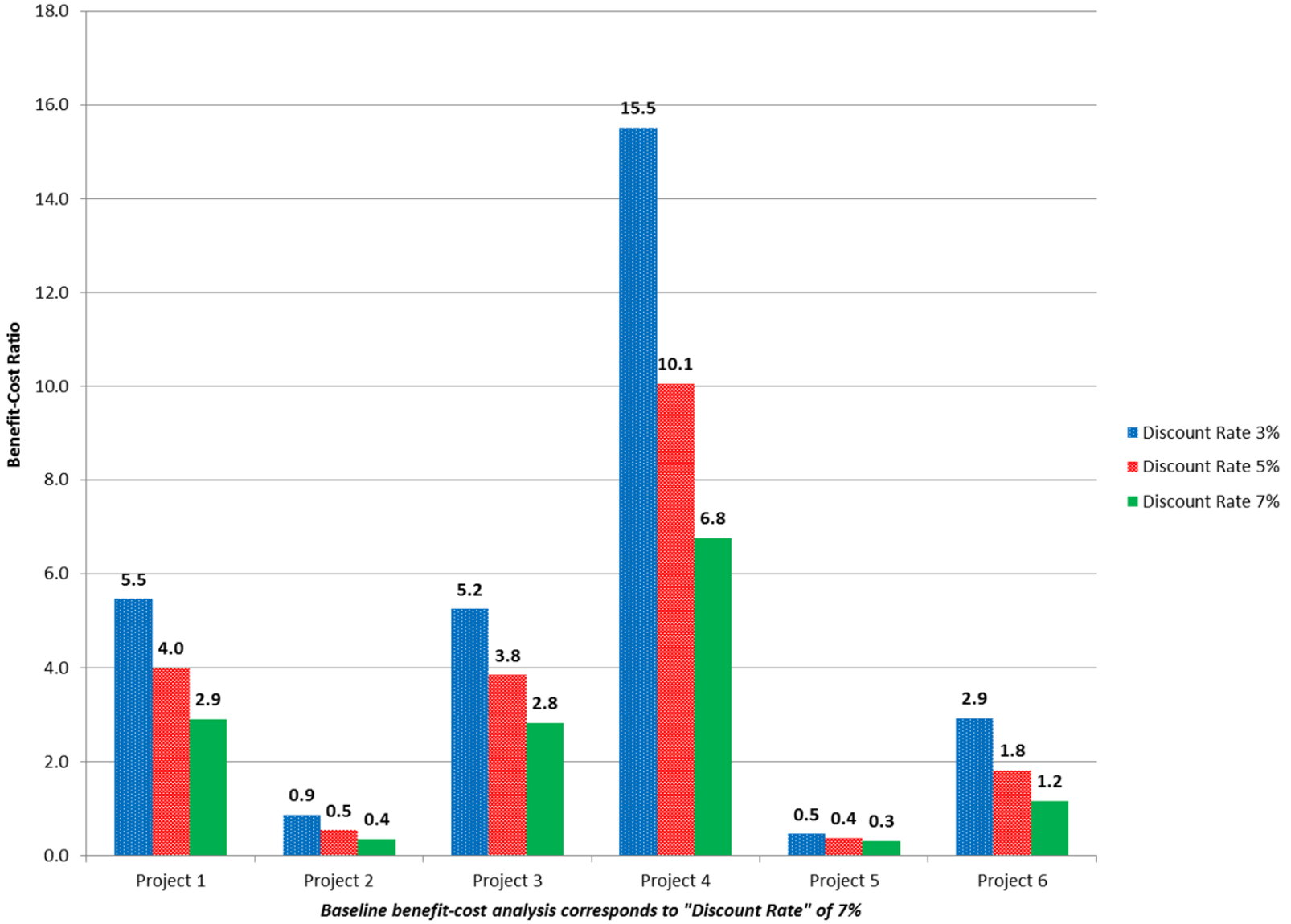
Table 3-32: Annual Costs and Benefits (Discounted Year 2016 Dollars)

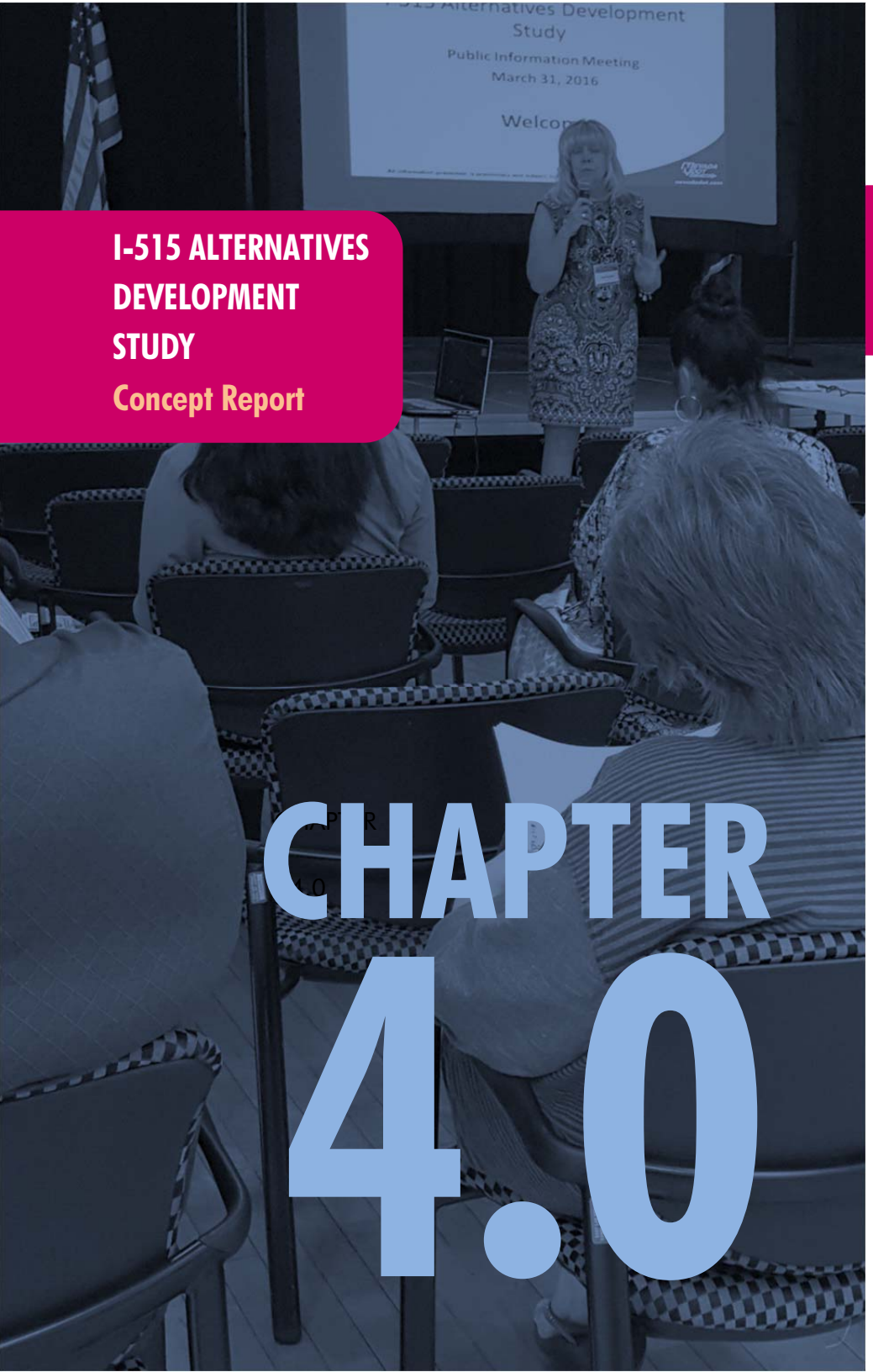
Year	Project 1		Project 2		Project 3		Project 4		Project 5		Project 6	
	Costs	Benefits	Costs	Benefits	Costs	Benefits	Costs	Benefits	Costs	Benefits	Costs	Benefits
2017	$163,407	-	$204,243	-	$307,824	-	$326,210	-	$836,948	-	$2,482,806	-
2018	$305,433	-	$504,043	-	$575,372	-	$871,770	-	$3,416,387	-	$8,219,278	-
2019	$1,290,707	-	$1,881,094	-	$1,728,289	-	$3,102,322	-	$4,698,732	-	$13,954,684	-
2020	$7,788,480	-	$9,740,053	-	$8,757,664	-	$15,568,948	-	$23,808,464	-	$70,761,545	-
2021	$9,768	-$3,359,922	$11,123	-$131,599	$7,631	-$3,216,096	$15,472	-$1,106,134	$24,644	$359,315	$65,911	-$3,283,419
2022	$11,378	-$2,397,815	$15,892	-$88,957	$7,880	-$2,237,177	$25,121	-$211,658	$27,828	$406,313	$103,787	-$2,195,701
2023	$8,532	-$1,544,229	$9,715	-$51,172	$6,665	-$1,369,667	$13,514	$573,537	$21,525	$445,690	$57,569	-$1,232,873
2024	$9,938	-$790,453	$13,881	-$17,886	$6,883	-$604,431	$21,942	$1,258,571	$24,306	$478,334	$90,652	-$384,927
2025	$7,452	-$112,206	$8,485	$25,016	$5,822	$72,225	$11,803	$2,041,968	$18,801	$530,862	$50,283	$509,192
2026	$8,680	$475,431	$12,124	$50,253	$6,012	$669,182	$19,165	$2,680,836	$21,230	$552,141	$79,179	$1,165,262
2027	$6,509	$988,436	$7,411	$72,163	$5,085	$1,189,560	$10,310	$3,114,401	$16,422	$568,559	$43,919	$1,735,356
2028	$205,966	$1,414,283	$112,002	$90,134	$135,510	$1,617,906	$42,181	$3,440,443	$1,023,346	$573,039	$226,415	$2,200,635
2029	$5,685	$1,791,960	$6,473	$106,021	$4,441	$1,999,446	$9,005	$3,740,780	$14,343	$580,654	$38,361	$2,615,119
2030	$6,622	$2,115,925	$9,249	$119,534	$4,586	$2,326,019	$14,621	$3,989,796	$16,196	$585,169	$60,405	$2,968,196
2031	$4,966	$2,391,068	$5,654	$130,881	$3,879	$2,602,585	$7,865	$4,191,668	$12,528	$586,744	$33,506	$3,265,331
2032	$5,784	$2,622,400	$8,079	$140,291	$4,006	$2,834,301	$12,770	$4,351,510	$14,146	$585,747	$52,760	$3,512,346
2033	$4,337	$2,814,484	$4,939	$147,966	$3,388	$3,025,860	$6,870	$4,473,964	$10,942	$582,506	$29,265	$3,714,538
2034	$5,052	$2,971,473	$7,056	$154,096	$3,499	$3,181,533	$11,154	$4,563,245	$12,356	$577,320	$46,083	$3,876,726
2035	$3,788	$3,097,143	$4,314	$158,849	$2,959	$3,305,202	$6,000	$4,623,176	$9,558	$570,459	$25,562	$4,003,287
2036	$119,874	$3,194,924	$65,186	$162,380	$78,868	$3,400,393	$24,550	$4,657,218	$595,597	$562,163	$131,775	$4,098,194
2037	$3,309	$3,267,932	$3,768	$164,828	$2,585	$3,470,308	$5,241	$4,668,506	$8,348	$552,650	$22,326	$4,165,054
2038	$3,854	$3,321,056	$5,383	$166,421	$2,669	$3,520,035	$8,509	$4,662,717	$9,426	$542,447	$35,156	$4,209,716
2039	$2,890	$3,352,827	$3,291	$167,076	$2,258	$3,547,931	$4,578	$4,636,811	$7,291	$531,068	$19,501	$4,230,084
2040	$3,366	$3,367,524	$4,702	$166,993	$2,331	$3,558,458	$7,432	$4,595,843	$8,233	$518,997	$30,707	$4,231,300
2041	-	-	$2,874	$166,265	-	-	$3,998	$4,541,895	-	-	$17,033	$4,215,783
2042	-	-	$4,107	$164,863	-	-	$6,492	$4,473,685	-	-	$26,821	$4,182,755
2043	-	-	$2,511	$162,971	-	-	$3,492	$4,395,927	-	-	$14,877	$4,136,996
2044	-	-	$37,939	$160,781	-	-	$14,288	$4,313,416	-	-	$76,694	$4,083,405
2045	-	-	$2,193	$158,239	-	-	$3,050	$4,224,349	-	-	$12,994	$4,020,614

Year	Project 1		Project 2		Project 3		Project 4		Project 5		Project 6	
	Costs	Benefits	Costs	Benefits	Costs	Benefits	Costs	Benefits	Costs	Benefits	Costs	Benefits
2046	-	-	$3,133	$155,399	-	-	$4,953	$4,129,931	-	-	$20,461	$3,950,052
2047	-	-	$1,915	$152,440	-	-	$2,664	$4,034,632	-	-	$11,350	$3,876,275
2048	-	-	$2,737	$149,151	-	-	$4,326	$3,932,654	-	-	$17,872	$3,793,924
2049	-	-	$1,673	$145,699	-	-	$2,327	$3,828,205	-	-	$9,913	$3,707,248
2050	-	-	$2,390	$142,118	-	-	$70,224	$3,722,037	-	-	$111,688	$3,617,158
2051	-	-	$1,461	$138,439	-	-	$2,032	$3,614,813	-	-	$8,659	$3,524,466
2052	-	-	$22,081	$134,692	-	-	$8,316	$3,507,119	-	-	$44,637	$3,429,890
2053	-	-	$1,276	$130,899	-	-	$1,775	$3,399,465	-	-	$7,563	$3,334,065
2054	-	-	$1,823	$127,083	-	-	$2,882	$3,292,299	-	-	$11,909	$3,237,551
2055	-	-	$1,115	$123,126	-	-	$1,551	$3,182,480	-	-	$6,606	$3,137,349
2056	-	-	$1,593	$119,317	-	-	$2,518	$3,077,397	-	-	$10,402	$3,040,860
2057	-	-	$974	$115,535	-	-	$1,354	$2,973,813	-	-	$5,770	$2,944,980
2058	-	-	$1,391	$111,791	-	-	$2,199	$2,871,971	-	-	$9,085	$2,850,033
2059	-	-	$850	$108,098	-	-	$1,183	$2,772,075	-	-	$5,039	$2,756,295
2060	-	-	$68,892	$104,463	-	-	$111,827	$2,674,295	-	-	$456,054	$2,664,004
Total	**$9,985,774**	**$28,982,240**	**$12,811,089**	**$4,504,654**	**$11,666,108**	**$32,893,573**	**$20,398,803**	**$137,909,655**	**$34,657,599**	**$10,690,176**	**$97,546,863**	**$113,907,120**
Benefit/ Cost Ratio	**2.9**		**0.4**		**2.8**		**6.8**		**0.3**		**1.2**	

Note: Numbers may not total precisely due to rounding.

Figure 3-14: Sensitivity Analysis – Impact of Discount Rate on Benefit/Cost Ratio





I-515 ALTERNATIVES DEVELOPMENT STUDY

Concept Report

CHAPTER 4.0

Chapter 4.0 Outreach Conducted for this Study

The Nevada Department of Transportation (NDOT) conducted an extensive agency, stakeholder, and public outreach program throughout this study. A Public Information (PI) Plan was established at the onset of this study with the goal to engage agencies, stakeholders, and members of the public in a meaningful way while reestablishing connections with stakeholders that were previously involved in the *I-515 Preliminary Environmental Impact Statement* (DEIS) process. This chapter summarizes outreach activities undertaken for this study as outlined in the PI plan, which describes outreach activities conducted through May 2016, correspondence, meeting announcements, meeting minutes, presentations, and documentation of other activities. See Appendix D, *Public Information Summary Memorandum—Task Order 1* (May 2016) for more details.

4.1 Stakeholder Outreach

NDOT solicited stakeholder involvement throughout this study to achieve the following project objectives:

- Proactively identify issues, concerns, and needs
- Build valuable relationships
- Establish and strengthen public trust and support

The following sections summarize stakeholder involvement conducted for this study.

4.1.1 Stakeholders

The study team, which included NDOT and the consultant team of Jacobs, Atkins, and Louis Berger Group, developed an initial list of potential project stakeholders at the onset of this study. The stakeholders included those previously engaged in the *I-515 Preliminary DEIS* process, adjacent residents and business owners, local agencies, government and community representatives, neighborhood associations, multicultural groups, and I-515 corridor users. The stakeholder list was refined and augmented during the course of this study. Project stakeholders are listed alphabetically below.

- Adjacent government facilities
- Cashman Center
- City of Las Vegas (Public Works, Engineering, and Planning)
- Clark County Public Works
- Clark County School District
- Federal Highway Administration (FHWA)
- Fremont Street Experience
- Housing and Urban Development
- Local chambers of commerce
- Local homeowners associations
- Local residents and *I-515 Preliminary DEIS* participants
- Major commercial interests
- Multicultural groups
- Nevada Highway Patrol (NHP)
- NV Energy
- Resort Gaming Group
- Downtown Project
- Regional Transportation Commission of Southern Nevada (RTC)
- RTC Freeway and Arterial System of Transportation
- Southern Nevada Health District (Emergency Medical Services)
- Southern Nevada Regional Housing Authority

NDOT involved stakeholders throughout the course of this study in the following ways:

- Kick-off meeting
- Interviews/one-on-one meetings
- Two stakeholder group workshops

- Two field trips (during kick-off meeting and stakeholder workshop #1)
- Public meeting
- Correspondence (letters, email)

4.1.2 Kick-Off Meeting and Field Trip

A project kick-off meeting was held on October 12, 2015. The purpose of the meeting was to introduce the project; provide project background; present the project objectives; outline the lines of communication between NDOT, consultants, and stakeholders; review the project scope and schedule milestones; describe the Planning and Environmental Linkages (PEL) process that would be followed for this study; describe the project development and scoping processes; describe the results and end products of this study; and describe how the decisions made under the PEL will be useful for future environmental studies required for individual projects along the corridor. The meeting format included a presentation and discussion held at NDOT's offices from 8:30 AM to 9:30 AM, with a field visit through the study area from 9:30 AM to 11:30 AM. Eighteen people participated in the meeting either in person, video call, or on-line via WebEx, including representatives from NDOT, RTC, and the City of Las Vegas, as well as representatives from the consultant team.

General discussion covered the project timeline, traffic data, relationship to other projects in the vicinity, the relationship between this PEL study and the *I-515 Preliminary DEIS* that was withdrawn, and whether this study will include short-term and long-term improvements. Refer to meeting minutes in Appendix D for more detail.

Most meeting attendees then participated in the field visit that immediately followed the in-office meeting. Participants drove along a highlighted route depicted in the "field visit route map" prepared for the trip. The field visit involved brief stops at key locations to observe and discuss the important features along the corridor. The study team explained the geometric constraints, environmental issues, and the environmental justice concerns along the corridor that should be considered during the development of corridor improvements. No additional comments or action items were noted during the field visit.

Figure 4-1: Field Visit Participants Observing Corridor Features

4.1.3 Stakeholder Interviews/Meetings

Study team members held several one-on-one interviews with stakeholders to present preliminary improvement concepts and obtain their input on issues or concerns within the project corridor and the preliminary concepts. This information was used to help guide the development and screening of concepts and projects. Stakeholder interview discussion points are summarized in Table 4-1. Refer to the meeting minutes in Appendix D for details.

Table 4-1: Stakeholder One-on-One Interviews

Stakeholder	Meeting Date	Input Received
City of Las Vegas Public Works	**October 26, 2015**	• The City voiced concerns about operational issues at several locations along the project corridor; those concerns and possible improvement options were discussed. • The City has programmed $25 million in "FRI-2" funds to contribute toward improvements for either split diamond ramps or high-occupancy vehicle (HOV) direct-connect ramps at City Parkway/I-515. The City noted that the availability of these funds will be known in November 2016. • The City can provide information on recent traffic studies along the corridor. • The City provided information on planned redevelopments and road and pedestrian facility improvements within the study area.
Clark County Public Works	**December 7, 2015**	• Clark County voiced concerns about operational issues at certain locations within the project corridor. • Clark County asked about the compatibility of this study with the future vision for the corridor. • Clark County asked whether this project includes improvements on surface streets.
RTC	**December 7, 2015**	• The RTC voiced concerns about operational issues at certain locations within the project corridor, and possible improvement options were discussed. • The RTC noted that even though this study's focus is on the freeway, the study team should also consider intersecting surface streets and ramp intersections. • The RTC thinks Active Traffic Management (ATM) implementation along the corridor would be beneficial. • The RTC noted that this study needs to consider improvements included in Project Neon.
RTC Fast and CLV Engineering	**December 9, 2015**	• Several issues in the Eastern/Stewart Area were presented and possible solutions discussed. • In the downtown area, bumpy "roller coaster" ride is an issue. • This project is geared toward cost-effective near- to mid-term solutions; it does not include full viaduct reconstruction as proposed in the *I-515 Preliminary DEIS*. • Ramp braiding in downtown area makes sense. • I-15 traffic should be taken directly to I-15 without weaving with traffic bound for US 95. • F Street (City Parkway) interchange idea was not well received; concerns were with space constraints. • Signal changes have reduced crashes on Las Vegas Boulevard, but there are long queues at the southbound off-ramp in the AM peak, and no spillback to the mainline. There is mainline spillback at this southbound off-ramp during Cashman Field special events. There are no queuing issues at the northbound off-ramp. • The Active Traffic and Demand Management (ATDM) concept was well received.

STAKEHOLDER	MEETING DATE	INPUT RECEIVED
City of Las Vegas Planning and Engineering	**December 10, 2015**	• Will projects developed in this study require right-of-way? • Will the study include non-vehicular (pedestrian) improvements? • Consider improvements in the *City Mobility Plan*, e.g., City Parkway concept. • The City sees the freeway as a gateway opportunity. • The City views the Cashman redevelopment as a significant sports venue with mixed use development including heavy residential. Special events will still attract regional traffic. • The City will have land use information for input to the RTC model by March 2016. • The City's *Final Downtown Master Plan* is anticipated in May 2016. • The City supports HOV lanes. • The CLV Mobility Plan, *Downtown Master Plan*, and *Transportation Investment Business Plan* are separate projects, but all work synergistically and are being coordinated for consistency/compatibility.
Boyd Gaming	**March 21, 2016**	• Boyd Gaming strongly supports the City Parkway concept. • How do some of the concepts tie into Project Neon? • Boyd Gaming is primarily interested in additional access to downtown. • Since the *I-515 Preliminary DEIS*, Boyd Gaming has been waiting for NDOT to decide what to do before making any improvements on Main Street. What is the long-term vision for I-515? • Can NDOT build a noise wall along Main Street Station? Noise is a big issue.
Resort Gaming Group and Downtown Project	**March 23, 2016**	• The Resort Gaming Group and Downtown Project support the project concepts presented, and look forward to something being implemented as soon as possible. • The Resort Gaming Group and Downtown Project are very interested and supportive of access to and at Maryland Parkway.
Las Vegas City Councilman Bob Coffin	**March 29, 2016**	• Will there be any road closures? • Will any right-of-way acquisitions be required? • Is high-level transit being considered? Be sure that transit access is maintained for residents near the Pecos roundabout interchange. • Pecos Road has been designated as "Camino Cesar Chavez" and should be labeled as such in study exhibits. • Expansion of the detention facility could impact this study. • Will the project include sound walls? Voiced concern about noise impacts to nearby residences. • Will the trail near the Mojave extension concept remain usable? • Requested scheduling a meeting with the Mayor to provide a briefing about the project. • Expressed support for this study and its improvements concepts.
D Hotel, Golden Gate Hotel, Arc Consulting, and Terry Murphy	**March 29, 2016**	• The group was specifically interested in concepts that provide additional access to City Parkway, and asked questions about specific details on the concepts addressing that. • Concerned about event attendees having difficulty accessing downtown. Long queues are currently experienced. • Las Vegas Club Hotel is being redeveloped and planned to reopen in 2018. This study and proposed connections to the site impacts their redevelopment plan. • The Tamares Group and Molasky Group would be very happy about the City Parkway connection project. • Project funding and other project concepts were also discussed. • A presentation to the Downtown Alliance would be helpful.

STAKEHOLDER	MEETING DATE	INPUT RECEIVED
Sunrise Manor Town Advisory Board	**April 14, 2016**	• Mike Dias (Board Chair) is concerned that there is not enough time to review and comment on the concepts by the April 22nd deadline and requested another meeting where more time can be allocated to present and discuss the concepts. • Interchanges at Sahara and Pecos are needed; Charleston is the only current exit for Sunrise Manor. • Primary concern and the problem for Sunrise Township is the Charleston interchange. • Cashman Field could be redeveloped into a significant trip attractor, which should be considered in this study. • A Maryland Parkway interchange is desired to serve Cashman Field.
City of Las Vegas Mayor Goodman	**April 25, 2016**	• Who will fund the projects that result from this study? • Requested that a dual left turn is provided at the southbound off-ramp to Las Vegas Boulevard (concept #6) to accommodate Cashman Field event traffic. • What are next steps in this study?
Sunrise Manor Town Advisory Board	**May 4, 2016**	• Board members asked questions and provided comments on the project concepts. • Support was voiced for the Pecos Interchange Concept (concept #21). • The Charleston northbound exit backs up; need an alternate way to access I-515. • Is closure of the Casino Center ramp being considered? • The board is more concerned with additional access to Sunrise Manor than about the mainline itself. • A Sahara and Pecos interchange is desired, and it may be unnecessary to improve Charleston Boulevard with these new interchanges. • The board does not support the Pecos half interchange (concept #22) and prefers the full interchange instead. • The board feels their community has been ignored; they have not received improvements that serve their needs for a long time. • NDOT should take a holistic approach in developing improvements; look regionally. • Board member consensus was that the Pecos interchange concept #21 is the best concept for their community and they strongly support it.
Downtown Alliance	**May 9, 2016**	• Support was voiced for the City Parkway Connection Concept #3. • What are the potential improvement concepts planned in the northbound direction to improve downtown access? • The group supports this study and hopes that improvements can be built within two years.

4.1.4 Stakeholder Workshop #1 and Field Trip

The study team conducted a two-day stakeholder workshop February 16 and 17, 2016, in which stakeholders participated in the refinement, evaluation, and screening of improvement concepts (refer to the workshop meeting minutes in Appendix D for details). Workshop activities included the following:

- Present the improvement concepts developed by the study team and discuss the strengths, weaknesses, opportunities, and drawbacks of each.
- Review the project's draft Purpose and Need statement.
- Review the improvement screening and prioritization process, and begin screening the improvements.

The following stakeholder representatives participated in the workshop:

- NDOT
- RTC
- NHP
- City of Las Vegas Public Works
- City of Las Vegas Planning
- Clark County Public Works

Representatives from the consulting team also participated.

On Day 1, the following information was presented and discussed:

- Public outreach/involvement that occurred under the *I-515 Preliminary DEIS* process, issues with the outreach expressed by the public, and goals of public outreach for this study
- Overview of the corridor issues and needs
- Summary of one-on-one stakeholder meetings held to date
- Questions and discussions regarding input obtained from the one-on-one stakeholder meetings
- PEL study approach
- Purpose and Need for the project
- Study goals
- Screening process
- Range of alternatives
- Evaluation criteria
- Improvement concepts

Following the presentation and discussion, attendees participated in a field trip to observe some of the corridor issues and potential improvements discussed in the meeting.

On Day 2, attendees divided into two groups to discuss the improvements presented on Day 1, evaluate each improvement against the established fatal flaw and Level 1 screening criteria, propose modifications to the improvements, and develop additional improvements. In the afternoon, both groups reconvened and discussed the results of their analysis. Based on analysis results and group discussion, three concepts were eliminated from further consideration (refer to Chapter 3 for details on alternatives screening).

Based on the results of the stakeholder analysis and input obtained during the workshop, the study team completed the following steps:

- Refined improvements based on workshop participant feedback.
- Summarized each improvement based on anticipated impacts and assessed the strengths, weaknesses, opportunities, and drawbacks of each improvement.
- Completed an evaluation matrix using the evaluation criteria used in the workshop.
- Produced a refined list of improvements to be evaluated in more detail.

4.1.5 Stakeholder Workshop #2

NDOT held a second stakeholder workshop on January 5, 2017, that focused on the six projects identified for further advancement and the two structures projects identified since the first stakeholder workshop was held. The workshop is summarized below (refer to meeting minutes in Appendix D for details).

The purpose of the workshop was to:

- Present and discuss the projects identified for further advancement based on the analysis and screening completed to date.
- Discuss and confirm the selection of the projects identified for further advancement.
- Review and finalize the project's Purpose and Need statement.

Workshop attendees included representatives from the following stakeholders:

- NDOT
- RTC
- City of Las Vegas Public Works
- City of Las Vegas Planning
- CA Group (to represent Charleston Interchange EA project)

Consultant team members also participated in the workshop.

The following information was presented and discussed:

- A recap of work completed to date, including:
  - Outreach activities
  - Screening process
  - The 35 individual improvement concepts
  - Fatal flaw screening and results
  - Level 1 screening and results
  - Identification of the six projects for further advancement and the two structures projects
  - Cost estimates
- Final Purpose and Need statement

- Presentation of the six projects identified for further advancement
- Level 2 screening results (comparative analysis of the six projects for operations performance, safety performance, and environmental impacts)
- Level 3 screening results (benefit/cost analysis)
- Presentation of the two structures projects
- Next steps

Each of the six projects identified for further advancement in this study was presented and discussed. Information presented included project design elements, operations performance, environmental issues, cost estimates, and benefit/cost analysis results. Stakeholders provided input for each of the projects and posed questions about the project design, project costs, traffic operations, school children and other pedestrian safety and facilities, transit, multi-modal options, right-of-way requirements, historic sites, public comments received to date, planned development/redevelopment in the area, and area plans.

The study team then presented results of the comparative analysis conducted for the six projects. The comparative analysis considered operations, safety, environmental impacts, and benefits/costs. Information about the two structure projects (I-515 Downtown Las Vegas Viaduct) was also presented and discussed.

The study team will use the stakeholder input obtained at the workshop to refine the projects identified for further advancement, as well as the two structure projects, in future phases of this study.

4.2 Public Outreach

This section summarizes the public involvement activities undertaken for this study.

4.2.1 Public Input Methods

Members of the public were provided the following opportunities to offer comments about this study:

- Send written comments to NDOT project manager by email or U.S. mail
- Call NDOT project manager on telephone
- Send email using email link on project website
- Submit contact form on project website
- Complete comment form provided at meeting and submit at meeting or mail later
- Provide verbal comments to the stenographer at the public meeting

4.2.2 Public Open House Meeting

Public meetings provide an opportunity for members of the public who are interested in the project to express their concerns and have their questions answered. Public meeting attendees had one-on-one interaction with planners, engineers from the consultant team, and agencies to obtain information about the project. One public meeting was held during this

study, as summarized below. Additional information is provided in Appendix D.

Public Meeting, March 31, 2016

A public meeting was held at the East Las Vegas Community Center on March 31, 2016, from 4:00 PM to 7:00 PM, with a short presentation at 5:30 PM followed by a question and answer session. Twenty-five people signed in at the meeting. The purpose of the meeting was to re-engage nearby residents and business owners and the traveling public in the project, provide information about this study, and gather public input on proposed concepts to improve operations and safety on I-515. Project information was displayed around the meeting room and included a study area map; exhibits for each improvement concept; exhibits illustrating the range of alternatives, local community facilities, historic resources, screening process, and study area crashes; and a list of other planned or current projects in the area.

Figure 4-2: March 31, 2016, Public Meeting

Study team members were available throughout the meeting to discuss the project with attendees one-on-one and answer questions. Handouts provided to attendees included a welcome letter, fact sheets, study area map, and comment form. A stenographer was present throughout the meeting to directly record questions and comments during the open house, short presentation, and question-and-answer session. The transcript of the public meeting is provided as an appendix to the *Public Information Summary Memorandum, Task Order 1*, May 2016 (see Appendix D).

Written or emailed public comments from the public meeting were accepted through 5:00 PM on April 15, 2016. Refer to Section 4.2.6 for a summary of public comments received at the public meetings and throughout this study.

Several means of announcing the public meeting and encouraging attendance were used, as summarized below (refer to the *Public Information Summary Memorandum*, May 2016 in Appendix D for details).

- Newspaper advertisements in the Las Vegas Review-Journal on the following dates:
  - March 17, 2016 (15 days before the meeting)
  - March 30, 2016 (one day before the meeting)
  - March 31, 2016 (day of the public meeting)
- Spanish language newspaper advertisement in the weekly El Mundo Newspaper on March 25, 2016
- Two-sided, bilingual door hangers delivered to approximately 12,000 residences and businesses within the project area

- A bilingual flyer distributed in bulk to 15 local community facilities, including libraries, police departments, city hall, chamber of commerce, and community and recreation centers
- Press release distributed on March 28, 2016, to the following:
  - Over 100 officials and public information officers for local and regional governments and agencies, including the following:
    - City of Las Vegas
    - Clark County
    - Boulder City
    - City of Mesquite
    - City of North Las Vegas
    - City of Henderson
    - Boulder City
    - Arizona Department of Transportation
    - NDOT
    - Las Vegas Convention and Visitors Authority
    - Metro police
    - RTC
    - Yucca Mountain
    - Bureau of Reclamation
    - Las Vegas Valley Water District
    - McCarran Airport
    - Nevada Highway Patrol
    - Nevada Department of Conservation and Natural Resources
    - Nevada Department of Public Safety
    - Nevada Department of Motor Vehicles
    - Nevada Department of Education
    - Nevada Resort Association
  - Over 25 radio stations
  - Over 10 television stations
  - Almost 40 newspapers

  In addition to the above contacts, the press release was also posted on the project website, Twitter, and Facebook. It was also emailed for inclusion in community newsletters for the following organizations:
  - City Council Wards
  - County Commission Districts
  - Adjacent homeowner associations and neighborhood associations
  - West Las Vegas Church
  - Local chambers of commerce
  - Local nonprofit organizations
- The meeting notice was published on the NDOT website's "Meetings" page.
- The meeting notice was distributed to public information officers for the following agencies:

- RTC
- State Transportation Board
- FHWA

In addition to the public meeting held for this study, study team members also hosted a table for this study at a March 30, 2016, public meeting held for the Eastern Avenue Safety Improvements project, which is a separate project adjacent to the study area. Additionally, study team members hosted a table for this study at a September 22, 2016, public meeting held for the I-515/Charleston Boulevard Interchange and Auxiliary Lanes project, which is another separate project adjacent to the study area. Information provided at both these meetings included bilingual fact sheets, study area map, and comment form. No public comments regarding this study were received.

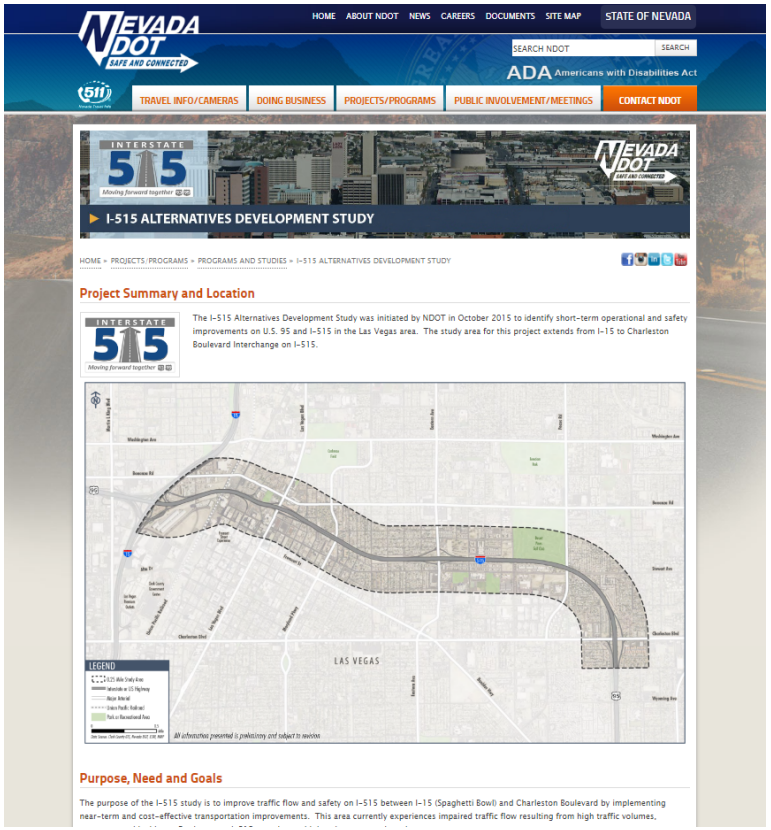
4.2.3 Project Website

A project website (http://nevadadot.com/i-515study/) was established early in this study's process and was regularly updated to keep agencies and members of the public up-to-date. The website provided the following information:

- Project summary, including purpose and need and project goals
- Study location map
- Project timeline
- Bilingual project information
- Public meeting announcements and meeting materials
- Project news
- Photo gallery

The website also provided an email link to the NDOT Project Manager, so people could ask questions or provide input. The website also included a contact form allowing people to submit comments, request presentations, or sign up for project e-news and updates.

Figure 4-3: Project Website



4.2.4 Study Contacts

Study team members were available to answer questions from the public via phone, fax, email, and in person. The main project contact is the NDOT Project Manager for this study:

Richard Splawinski
Highway Project Manager, RPE
Nevada Department of Transportation
1263 S. Carson Street
Carson City, Nevada 89712
(775) 888-7317
rsplawinski@dot.state.nv.us

4.2.5 Specialized Environmental Justice (EJ) Outreach

The study team reached out to minority and low-income groups and organizations near the study area prior to and following the public meeting to announce the meeting, provide general project information, and answer questions. The study team also offered to provide project briefings; however, no briefing requests were received. Spanish versions of the project flyer and fact sheet (refer to the *Public Information Summary Memorandum, Task Order 1*, May 2016, Appendix D) were provided to the following entities:

- Las Vegas Academy of Arts
- Legal Aid Center of Southern Nevada
- Garcia Mendoza & Snavely, Chtd.
- 18b Arts District Association
- City of Las Vegas
- Zappos
- United Way
- BLVD Magazine
- Outside Las Vegas Foundation
- Las Vegas Academy
- Selah Art Salon
- Univeristy of Nevada/Las Vegas

Additionally, public meeting handout materials and website information were provided in Spanish and English. A Spanish translator was present at the public meeting to translate discussions with study team members and provide live translation during the presentation and question-and-answer session.

4.2.6 Summary of Comments Received

Despite the various methods provided for members of the public to submit comments, as listed in Section 4.2.1, and good attendance at the March 31, 2016 public meeting, minimal written public comments were received. Public comments received are summarized below; refer to Appendix D for more detail.

- Funding: Questions about how much the project will cost and how it will be funded.
- Purpose and Need: Support voiced for improving the I-515 corridor.
- Alternatives/Design: Questions and suggestions about various design elements, such as the possibility of another bridge being built, ramp configurations, and laneage. Support and opposition was voiced for various improvements, as indicated in written letters or recorded at various meetings (see Table 4-1, Table 4-2,and Appendix D for details).

Chapter 3 illustrates how public, stakeholder, and agency input was incorporated into the development and screening of improvement concepts.

4.3 Agency Outreach

Agency coordination included meetings between representatives from FHWA and NDOT to discuss the project status, public and agency involvement activities, deliverables, and improvement concepts.

Monthly progress meetings were also held throughout the course of this study (from November 2015 to January 2017), which were attended by representatives from FHWA, NDOT, Clark County, City of Las Vegas, RTC, NHP, and the consultant team. The purpose of these meetings was to keep participants apprised of the status of study activities, schedule, key dates, deliverables, project SharePoint site, and budget; and obtain feedback, answer questions, and identify action items. Project activities discussed included public and agency involvement, traffic modeling, and potential improvement concepts, projects, and screening.

4.4 Study Scoping/Intent to Study Notices

The purpose of conducting scoping is to identify concerns and potential issues related to the project. In February and March 2016, NDOT sent Intent to Study letters to the following local, state, and federal agencies; governments; companies; and organizations (listed alphabetically). Copies of these letters are provided in Appendix D.

- AT&T Nevada
- Bureau of Indian Affairs
- Bureau of Land Management
- Bureau of Reclamation
- Centurylink
- City of Las Vegas Councilpersons
- City of Las Vegas Historic Preservation Officer
- City of Las Vegas Mayor
- City of Las Vegas Planning Department
- City of Las Vegas Public Works
- City of North Las Vegas
- Clark County Commissioners
- Clark County Public Works
- Department of Conservation and Natural Resources, Natural Heritage Program
- Department of Energy
- Department of Housing and Urban Development
- Department of Public Safety
- Eleventh Coast Guard District
- Federal Emergency Management Agency
- Federal Highway Administration
- Las Vegas Paiute Tribe
- National Park Service
- Nevada Chapter Associated General Contractors
- Nevada Department of Wildlife
- Nevada Division of Water Resources
- Nevada Environmental Coalition, Inc.

- Nevada Preservation Foundation
- Nevada State Assemblypersons
- Nevada State Senators
- NV Energy
- Preservation Association of Clark County
- Regional Transportation Commission of Southern Nevada
- Sierra Club
- Southern Nevada Water Authority
- Southwest Gas
- State Historic Preservation Officer
- U.S. Army Corps of Engineers
- U.S. Department of Agriculture, Natural Resources Conservation Service, and Regional Forester
- U.S. Department of the Interior, United States Forest Service
- U.S. Department of Transportation, Federal Aviation Administration
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service
- U.S. Forest Service, Spring Mountains National Recreation Area
- U.S. Geological Survey, Water Resources Division
- U.S. Representatives
- U.S. Senators
- USGS Western Ecological Research Center

Comments received in response to the Intent to Study letters are summarized in Table 4-2 and provided in Appendix D.

Table 4-2: Study Scoping Comments

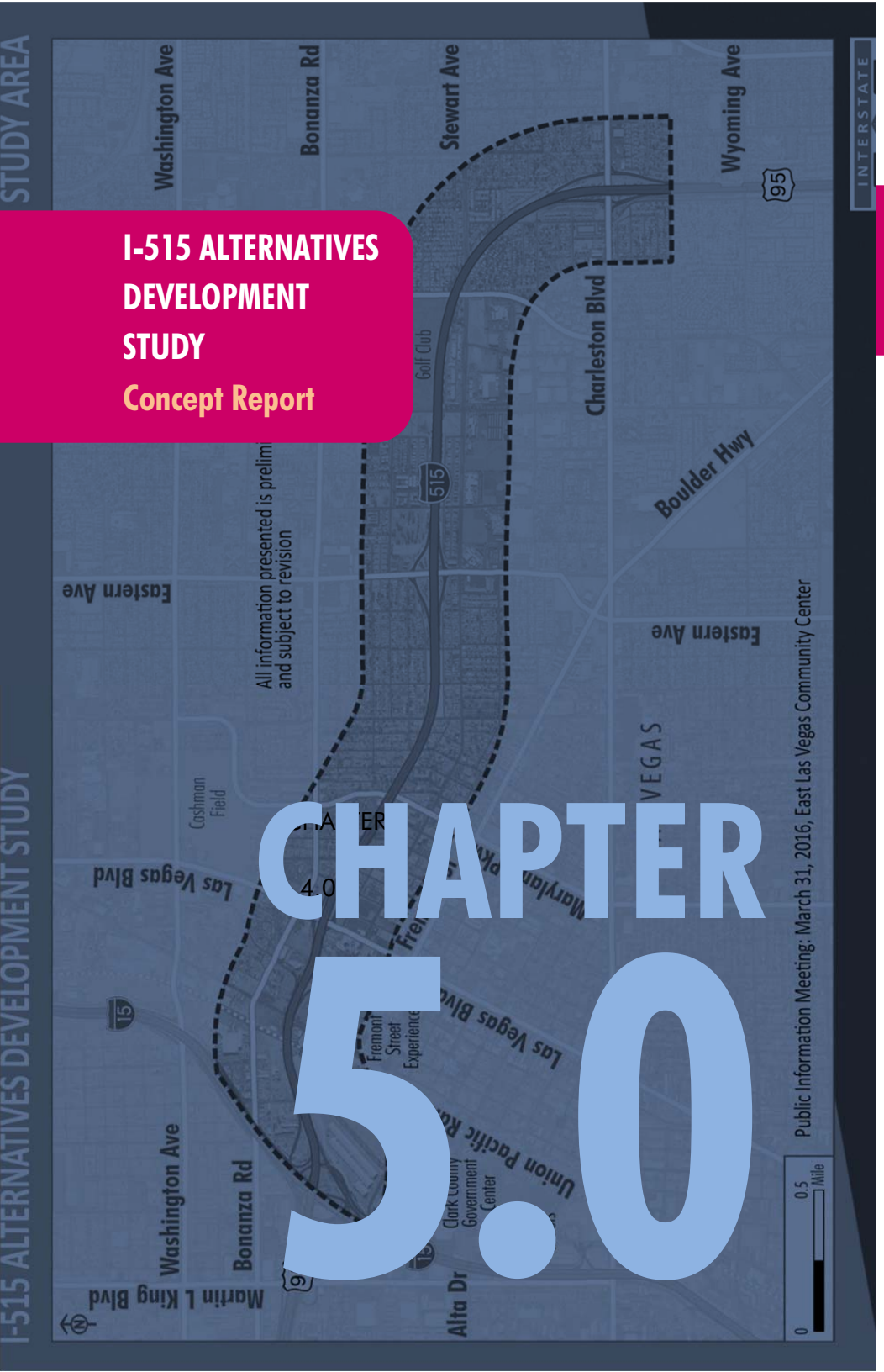
AGENCY	COMMENT
City of Las Vegas, City Councilman Bob Beers, Ward 2	February 17, 2016, letter: Do not include HOV lanes. The purpose of HAW [HOV] lanes is to promote carpooling, but the legal users of the current HAW [HOV] lanes on Summerlin Parkway and US 95 are families and couples, not carpoolers. As such, current HAW [HOV] lanes are a waste of public assets and create additional pollution by increasing congestion in non-HAW [HOV] lanes.
Eleventh Coast Guard District, David Sulouff	February 18, 2016, email: There appear to be no bridges under U.S. Coast Guard jurisdiction included with the subject project.
Nevada State Parks, Jennifer Scanlan	February 26, 2016, email: None of the parks within the study area were developed with Land and Water Conservation Funds [Section 6(f)].
Commissioner Chris Giunchigliani	February 29, 2016, email: Consider using more braided ramps and roundabouts.

AGENCY	COMMENT

Nevada State Clearinghouse	April 1, 2016, email: Nevada State Clearinghouse received the following comments and forwarded them to the study team:
	• Nevada Land Use Planning Agency:
	  • Consider cumulative visual impacts from development activities (temporary and permanent), including the proliferation of improper lighting.
	  • Use appropriate lighting. Use consistent lighting mitigation measures that follow "dark sky" lighting practices.
	  • Effective lighting should have screens that prevent light from shining up or out. Locate lighting to avoid light pollution onto adjacent lands as viewed from a distance. All lighting fixtures should be hooded and shielded, face downward, be located within soffits, and be directed to the pertinent site only and away from adjacent parcels or areas.
	  • A lighting plan should be submitted indicating types of lighting and fixtures, fixture locations, lumens, and areas illuminated by lighting plan.
	• State Historic Preservation Officer:
	  • Recommends that NDOT also consult with City of Las Vegas Historic Preservation Officer, Nevada Preservation Foundation, and Preservation Association of Clark County.
	• Nevada Division of Water Resources:
	  • All waters of the State belong to the public and may be appropriated for beneficial use pursuant to the provisions of Nevada Revised Statutes (NRS) Chapters 533 and 534 and not otherwise.
	  • All water used on a project must be permitted by the State Engineer's Office.
	  • Ensure that any water used on a project for any use shall be provided by an established utility or under permit or temporary change application or waiver issued by the State Engineer's Office with a manner of use acceptable for suggested projects' water needs.
	  • Any water used on the described project for construction, dust control, or maintenance should be provided by an established utility or under permit or waiver issued by the State Engineer's Office.
	  • Water diversions from any underground source must comply with the permitting provisions of NRS 533 and 534.
	  • Treated effluent is considered water as referred to in NRS Chapter 533, and is subjected to appropriation for beneficial use under procedures described in NRS Chapter 533, and specifically NRS § 533.440.
	  • Any water or monitor wells or boreholes located on the project lands are the responsibility of the owner of the property and must be plugged and abandoned as required in Chapter 534 of the Nevada Administrative Code [NAC].
	  • Water wells must be permitted; monitor wells require a waiver from the State Engineer's Office; boreholes are not regulated but must be plugged within 60 days after being drilled as required by NAC 534.4371.
	  • If artesian water is located in any well or borehole, it shall be controlled as required in NRS 534.060(3).
	  • Dewatering for the alleviation of hazards caused by the rise of ground water from secondary recharge is provided by the provisions of NRS 534.025 and NRS 534.050(2).

AGENCY	COMMENT
State Historic Preservation Officer	March 7, 2016, email: Recommends that NDOT also consult with City of Las Vegas Historic Preservation Officer, Nevada Preservation Foundation, and Preservation Association of Clark County.
Freemont Street Experience	April 12, 2016, letter: Fully supports including the southbound directional ramp to City Parkway from US 95/northbound I-15 system ramp. As time is of the essence, request that this project be added to Project Neon.
Boyd Gaming	April 14, 2016, letter: Strongly supports the inclusion of a US 95/I-515 directional lane and drop ramp to City Parkway. Requests and strongly supports the inclusion of this project with Project Neon to help mitigate impacts from the execution of Project Neon.
Downtown Las Vegas Alliance	April 17, 2016, letter: Enthusiastically supports including the southbound directional ramp to City Parkway from US 95/northbound I-15 system ramp. As time is of the essence, request that this project is added to Project Neon. Requested to be engaged and informed as progress is made.
The Molasky Group of Companies	April 20, 2016, letter: Urges NDOT to expedite construction of the proposed City Parkway ramp from US 95. Requests including the ramp in Project Neon to help facilitate vehicular circulation in this critical downtown area.
City of Las Vegas Department of Public Works	May 10, 2016, letter: • Supports concept to widen freeway along the southern edge to eliminate current three- to two-lane drop on southbound US 95 at the Spaghetti Bowl, which would carry four lanes all the way to the southbound exit at Charleston. • Supports concept to provide auxiliary lanes on northbound and southbound I-515 between the Eastern Avenue and Charleston Boulevard exits. • Supports concept that improves the Eastern Avenue/I-515 interchange, including a southbound one-way frontage road to Mojave Road to address challenges at Stewart/Eastern intersection. • Supports new interchange at I-515/Stewart/Pecos that uses a circular, signalized intersection. Also likes Phase 1 concept of this improvement, which would provide southbound off-ramp to Stewart/northbound on-ramp from Pecos. The City owns land in the northwest corner of the Pecos/Stewart intersection and wants to discuss the feasibility of this improvement as soon as possible, as the City has some preliminary plans to use the excess land for a jail expansion. • Supports a half interchange concept at City Parkway/I-515 that provides ramps to/from northbound US 95 with one caveat –doesn't want these ramps to be limited to HOV lanes. The NDOT *HOV Master Plan* shows a future HOV-only interchange that would begin/end the HOV lanes on US 95/I-515 at Maryland Parkway. However, this improvement is many years away because it would likely require major reconstruction of the viaduct. • Supports the alternative for a new southbound US 95 access ramp to City Parkway. This would be small enough to be added to Project Neon before that project is completed. The City is interested in seeing how a future northbound US 95 on-ramp could be added to complement this off-ramp. • Supports a concept that improves Las Vegas Boulevard and Casino Center interchanges at I-515. In particular, supports adding more storage on the ramps to better enable ramp metering to work without backing up traffic on surface streets, and the addition of dual left turns on northbound Las Vegas Boulevard to northbound US 95. Also, adding dual right turns on the Las Vegas Boulevard off-ramps would improve pedestrian safety. • Does not support the concept that braids US 95 northbound traffic over Las Vegas Boulevard, which requires Las Vegas Boulevard northbound on-ramp traffic to proceed at-grade to the Casino Center/4th/Veterans Memorial intersection, as this would create major congestion at this intersection. • Does not see the benefit of the concept (in light of expense) that would create collector/distributor roads between Eastern Avenue and Charleston Boulevard interchanges.

AGENCY	COMMENT
City of Las Vegas City Manager	May 17, 2016, letter: Supports providing a new access from I-515 to City Parkway. One of the proposed concepts using the existing US 95 to I-15 ramp seems simple enough to incorporate into the current Project Neon improvements to provide immediate relief to I-515 through the Spaghetti Bowl.
International Market Centers	May 18, 2016, letter: • Wants the City Parkway ramps to/from US 95/I-15 to be designed, funded, and constructed as soon as possible as part of the I-515 Corridor Improvement Project. • International Market Centers has recently launched a new business initiative to attract additional trade shows and special events to The Pavilions, with three event structures totaling 345,000 square feet in the northwest quadrant of Grand Central Parkway and Symphony Park, which will attract dozens of events annually and create a corresponding increase in traffic to the campus. Additional vehicle traffic on Grand Central Parkway as a result of Project Neon extending that artery to the Western/Highland/Industrial corridor will only exacerbate the gridlock already experienced during two Las Vegas Market events each year, inconveniencing customers and losing attendance and events to other facilities/cities/states.



Chapter 5.0 Next Steps and Implementation

This chapter discusses next steps to implementing future Interstate 515 (I-515) projects in the study area.

5.1 Project Implementation and Priorities

This study identifies six projects to address the traffic operational and safety needs along the I-515 corridor. These projects must compete for limited funding resources. The Nevada Department of Transportation's (NDOT's) project priorities are reflected in its long-range transportation plan, *Connecting Nevada* (NDOT 2013), and its three-year Statewide Transportation Improvement Program (STIP) (NDOT 2016b). NDOT intends to evaluate, compare, and prioritize the projects identified for further advancement in this study to others in the state to determine which will be added to the STIP, and eventually constructed.

NDOT has identified construction funding for Project 1 (City Parkway Southbound Ramp). In cooperation with the City of Las Vegas, NDOT plans to advance this project and begin the environmental analysis in 2017. Project 1 has received extensive support from stakeholders since its inception as a concept (see Tables 4-1 and 4-2 in Chapter 4). The City of Las Vegas has also submitted an application to the Federal Highway

Administration (FHWA) for a FASTLANE grant (which provides funding for projects that address critical freight issues facing the country's highways and bridges) and is committed to implementing Project 1.

NDOT plans to seek future funding for other projects identified for further advancement in this study. As funding is identified, projects will advance through project development, which includes environmental, design, right-of-way, and construction activities.

5.2 Road Safety Assessment Implementation

NDOT prepared a *Road Safety Assessment Report* (RSA) (NDOT 2015) for the I-515 corridor (see Section 1.2), which divides the recommendations into two categories:

- Priority 1 – those improvements that can be completed in the immediate future by NDOT District 1 staff
- Priority 2 – those improvements that can be included in this study

Table 5-1 provides a summary of the recommendations for both categories listed above and identifies which apply to the six projects identified for further advancement in this study. The project numbering in Table 5-1 is consistent with the numbering in the summary of improvements at the end of the RSA Report.

5.3 Structures Recommendations: Project 7 and Project 8

Based on an assessment of the two structures that comprise the Downtown Las Vegas Viaduct (G-947 and I-947, described in Section 2.8 and shown on Figure 2-20), each would need to be replaced or rehabilitated, which would be best achieved in coordination with the implementation of adjacent projects identified for further advancement in this study. The G-947 structure (referred to as Project 7) would need to be entirely replaced; the I-947 structure (referred to as Project 8) would require rehabilitation, as described below (see Appendix E for technical details).

5.3.1 Project 7: G-947 Structure Replacement

- Several structure types may be considered for replacement: cast-in-place post-tensioned concrete box girder, pre-cast pre-stressed concrete girder, and composite steel girder. The cast-in-place structure type is the least expensive; the other two structure types have comparable costs.
- The northbound and southbound structures are completely independent of each other, and therefore, can be removed separately without compromising the structural integrity of the adjacent bridge.
- An alternate detour route for staged demolition and reconstruction is recommended to reduce cost and construction-related traffic impacts.
- Project 6 (Collector-Distributor Road from Las Vegas Boulevard to I-15) may provide the needed detour for the replacement. Project 6 would be used for northbound movements during the demolition and reconstruction of the northbound and southbound structures.

Table 5-1: NDOT Road Safety Assessment Recommendations

NDOT Road Safety Assessment		Applicable Project
Priority 1 Recommendations:		
1.	Throughout the I-515 corridor, refresh striping on the freeway and ramps, and increase maintenance of markings.	Projects 1, 2, 3, 4 See Note 1 below
2.	Improve pavement markings for auxiliary lanes and add "EXIT ONLY" legend for northbound auxiliary lanes for Charleston Boulevard and Eastern Avenue exits.	See Note 2 below
3.	Replace the existing ceramic buttons and consider substituting additional reflective marker for a ceramic marker throughout the corridor. Conduct an Engineering Study to determine the effectiveness of increasing the number of reflective buttons per skip. Instead of 1 reflector and 3 ceramic buttons, replace one of the ceramic buttons with a reflective one.	See Note 1 below
4.	Prohibit pedestrians/bikes from freeways. Consider signage prohibiting pedestrians/bikes throughout the study corridor.	Projects 2, 3, 5, 6 See Note 1 below
5.	Throughout the study corridor, install lane assignment signs on either side of the off-ramps near the beginning of the pavement markings.	Projects 2, 3, 5 See Note 1 below
6.	Replace missing and maintain existing barrier tabs to improve the visibility of the wall on either side of the freeway throughout the corridor.	See Note 1 below
7.	Refresh striping on crosswalks, lane markings, and stop bars for the southbound Charleston Boulevard off-ramp.	See Note 2 below
8.	Based on Table 2C-4 (Use Condition B: Decel to Advisory Speed) of FHWA's *Manual on Uniform Traffic Control Devices* (MUTCD), 2009 Edition (FHWA 2009), locate the 45 mph Exit Sign for the northbound Eastern Avenue off-ramp at a distance of ~250 feet. Evaluate and adjust the sign's location as needed at the Eastern Avenue off-ramp from I-515 northbound.	See Note 2 below
9.	Add a warning sign for the lane merge along the Eastern Avenue southbound on-ramp and evaluate other options for advance signing at the Eastern Avenue southbound on-ramp.	See Note 2 below
10.	Install in-lane pavement markings along the ramp at the Eastern Avenue southbound off-ramp, Casino Center northbound on-ramp, and Martin Luther King northbound off-ramp.	Projects 2 and 3 Also applicable to Project Neon
11.	Add "No Pedestrian Signs" to the Las Vegas Boulevard southbound on-ramp.	Project 2
Priority 2 Recommendations		
12.	Consider improving striping visibility in rain events by increasing the thickness of the retro-reflective material. Suggest using 90 mil thickness of thermoplastic material throughout the corridor.	Projects 1, 2, 3, 4, 5, 6 See Note 1 below
13.	Consider replacing existing ceramic markers with conventional striping materials, using contrast materials on Portland Cement Concrete Pavement (PCCP) throughout the corridor.	Projects 4 and 6 See Note 1 below
14.	Evaluate all signage in the corridor to comply with the MUTCD. Evaluate existing guide sign placement and messages for consistency throughout the corridor.	Projects 1, 2, 3, 4, 5, 6 See Note 1 below

	NDOT Road Safety Assessment	Applicable Project
15.	Consider replacing sign sheeting with premium prismatic sheeting, and remove up lights from signs throughout the corridor.	Projects 1, 2, 3, 4, 6 See Note 1 below
16.	Consider installing larger exit signs behind gores throughout the corridor.	Projects 1, 2, 3, 4, 6 See Note 1 below
17.	Consider pulling lane assignment markings and lane lines back to guide drivers to the correct lane at the Charleston Boulevard southbound off-ramp and Eastern Avenue northbound off-ramp.	See Note 2 below
18.	Consider adding overhead signs at the top of off-ramps indicating lane configurations throughout the corridor. Extend pockets to increase weaving distance. Perform weave analysis to determine required minimum weaving distance throughout the corridor.	Projects 2, 3, 5 See Note 1 below
19.	Consider replacing the existing light fixtures with a high lumen light-emitting diode (LED) light fixture for the corridor.	See Note 1 below
20.	Consider adding "Exit Only" signs at the beginning of auxiliary lane off-ramps, with an overhead cantilever sign where appropriate throughout the corridor.	Project 4 See Note 1 below
21.	Consider adding advance signs to help make drivers aware of where they need to be in advance of an upcoming exit, upstream of the Martin Luther King Boulevard exit from US 95 southbound.	Not within the limits of this study; possibly applicable to Project Neon
22.	Consider installing mile marker posts with route and location information every 0.2 mile (per Section 2H.06 of the MUTCD, Enhanced Reference Location Signs [D10-5]) to more easily and accurately identify and report crash locations and to help drivers orient to their locations along the corridor. Consider installing milepost markers on the concrete median barrier throughout the corridor.	See Note 1 below
23.	Evaluate installing barrier tabs at a tighter spacing to better delineate the barrier wall throughout the corridor; 20-foot spacing has been effective in construction zones in some states.	Project 4 See Note 1 below
24.	Evaluate the corridor drainage; coordinate with NDOT Hydraulics.	Contractor to obtain applicable drainage reports and applicable plans as needed by using their own staff as part of their scope of work deliverables See Note 1 below
25.	Consider adding rumble strips to shoulders throughout the corridor. However, consider noise impacts and proximity to existing sound walls.	Project 4 See Note 1 below
26.	Consider installing a friction material to decrease stopping distance, thereby addressing wet roadway conditions throughout the corridor. Published FHWA research illustrates decreased crashes with the installation of a friction course.	Project 4 See Note 1 below
27.	Consider using wider striping and/or in-lane markings to improve striping along auxiliary lanes throughout the corridor.	Project 4 See Note 1 below
28.	Consider installing glare screens on the lower barrier wall to reduce glare from oncoming headlights of traffic traveling in the opposite direction throughout the corridor.	See Note 1 below

	NDOT Road Safety Assessment	Applicable Project
29.	Throughout the corridor, evaluate modeling traffic flows and determine where widening would achieve the greatest benefit from restriping the existing freeway.	Achieved through this Alternatives Development Study
30.	Consider conducting a transit study for the corridor to determine the feasibility for park-and-ride or other transit facilities.	To be addressed in the future with the Regional Transportation Commission of Southern Nevada
31.	Consider conducting a noise study to determine if the existing sound wall along the right side of the Charleston Boulevard northbound on-ramp would allow removal of a portion of the wall along the mainline to improve sight distance.	See Note 2 below
32.	Consider creating an additional off-ramp lane for the outside through-freeway lane in addition to the auxiliary must-exit lane for the northbound Charleston Boulevard exit.	See Note 2 below
33.	Where the northbound Charleston on-ramp merges onto US 95, consider extending the on-ramp with an auxiliary lane by using some of the shoulder width, allowing for a longer and safer entrance onto the freeway. Coordinate any narrowing of shoulders with NDOT, FHWA, law enforcement, and any other necessary stakeholders.	See Note 2 below
34.	Consider moving the dynamic message sign farther from the Charleston Boulevard northbound on-ramp if determined to be a distraction to drivers.	See Note 2 below
35.	Consider adding an oversized 45 mph exit warning sign (W13-2) for the southbound Charleston Boulevard off-ramp. According to Table 2C-2 of the MUTCD, the standard size for an exit advisory speed sign on a freeway is 36" x 48"; however, an oversized W13-2 sign should be 48" x 60".	See Note 2 below
36.	Consider using part of the shoulder to create an additional exit lane for the southbound Charleston Boulevard off-ramp.	See Note 2 below
37.	Consider adding an auxiliary lane, lengthening or widening the southbound Charleston Boulevard off-ramp to ensure ramp traffic does not back onto the mainline.	See Note 2 below
38.	Coordinate with Freeway and Arterial System of Transportation (FAST) to determine if adjustments can be made to the southbound Charleston Boulevard off-ramp traffic signal timing to prevent queues from backing onto the mainline.	See Note 2 below
39.	Consider increasing sign size to make the signs more prominent along the corridor between Eastern Avenue and Las Vegas Boulevard.	Project 4
40.	Consider improving the signage for the southbound Charleston exit due to the off-ramp being hidden behind a curve and sight distance being obstructed by a sound wall. Suggest installing cantilever sign(s) in advance of the exit.	See Note 2 below
41.	Evaluate increasing storage lanes as much as possible on the northbound Charleston Boulevard off-ramp.	See Note 2 below
42.	Evaluate taper distance and the need for additional signing for the northbound Charleston Boulevard on-ramp.	See Note 2 below
43.	Evaluate increasing the available storage of the auxiliary lanes at the Eastern Avenue southbound off-ramp.	Project 3

	NDOT Road Safety Assessment	Applicable Project
44.	For the Eastern Avenue northbound on-ramp, consider requiring the left lane to merge onto the freeway and make the right lane an auxiliary lane, such that the left and right on-ramp lanes do not have to merge with each other.	Considered in Project 3: Eastern Avenue Interchange Improvements, and not recommended due to safety and driver expectation concerns
45.	For the Eastern Avenue northbound on-ramp, consider shifting the merge point of the two on-ramp lanes farther up the ramp, prior to having to merge onto the freeway.	Project 3
46.	Evaluate the undulating section of US 95 that is elevated between Eastern Avenue and Casino Center Boulevard to determine if the roadway can be smoothed and drainage can be improved to address reports of water ponding during rain events.	I-947 Structure Rehabilitation
47.	Evaluate advance guide signing for Martin Luther King Boulevard for US 95 southbound to allow more time for drivers to merge into the correct lane.	Not within the limits of this study; possibly applicable to Project Neon
48.	Consider providing diagrammatic signs in advance of the I-15 system-to-system traffic interchange in the northbound direction. Provide pavement markings in the lanes providing route information.	Project 6
49.	Consider installing larger signs that can be seen from a farther distance near the I-15/US 95 system interchange in the northbound direction to provide better motorist guidance than pavement markings alone.	Project 6
50.	Consider using in-lane markings with route numbers in advance of exit gores near the system interchange with I-15 and US 95 in the southbound direction.	Project 1 Also applicable to Project Neon
51.	Consider adding or modifying advance guide signing to show I-15 southbound and Martin Luther King Boulevard on the same signs so drivers are aware that the same exit is used to reach both roadways.	Not within the limits of this study; possibly applicable to Project Neon
52.	Evaluate options to reposition the ramp meter and improve the striping on the northbound Casino Center Boulevard on-ramp. Consider options to merge the northbound Las Vegas Boulevard on-ramp onto the freeway sooner while allowing for a longer merging area.	Project 2
53.	Consider merging the northbound Casino Center Boulevard on-ramp and northbound Las Vegas Boulevard on-ramp so there is only one merging point onto US 95/US 93.	Considered and not recommended. Better alternatives included in Project 6
54.	Consider widening the southbound Casino Center Boulevard off-ramp and southbound Las Vegas Boulevard off-ramp or lengthening the auxiliary turn lanes on the ramps to provide more storage.	Project 2
55.	Consider replacing the signs under the Casino Center Boulevard Bridge.	Casino Center Boulevard, Stewart Avenue to US 95 Improvements Project by City of Las Vegas is making modifications to this location
56.	The Eastern Avenue southbound off-ramp has a signal pole in the center of the ramp where it splits. Consider reconfiguring the traffic signal to eliminate the pole in the center of the ramp.	Project 3
57.	Consider reconstructing the median barrier with a taller 42-inch concrete barrier, and include median lighting to eliminate the need for outside lighting improvements along the side of the freeway throughout the corridor.	See Note 1 below
58.	To reduce congestion and improve safety, consider widening the corridor south of I-15 by one lane in each direction using some of the shoulder under the I-15 Interchange.	Project 4

	NDOT Road Safety Assessment	Applicable Project
59.	Consider reducing conflicts and short weave sections near the system interchange of I-15 and US 95. Duplicate ramps could be closed. The use of braided ramps could shift some of the movements to a point where multiple conflicts are eliminated.	Project 6
60.	Consider reconfiguring the system interchange with I-15 to add more distance between the system-to-system and Martin Luther King Boulevard interchanges in the southbound direction.	Possibly applicable to Project Neon
61.	Consider a sign rehabilitation project to relocate signs and make them visible to all lanes of traffic along southbound US 95 near the I-15 system interchange.	Project 1 Also applicable to Project Neon
62.	Consider providing additional travel lanes along the Martin Luther King Boulevard northbound off-ramp to increase safety and smooth traffic flow.	Not within the scope of this study; possibly applicable to Project Neon
63.	At Martin Luther King Boulevard, the northbound off-ramp ends at the intersection with a right turn lane and a left turn lane. Consider adding a second right turn lane to alleviate some of the congestion on the ramp and enhance safety in that area.	Not within the scope of this study; possibly applicable to Project Neon
64.	Consider re-designing the Martin Luther King Boulevard northbound off-ramp to improve sight distance.	Not within the scope of this study; possibly applicable to Project Neon
65.	Evaluate tying in the ramp meters throughout the corridor to the actual traffic on the mainline and modifying the timing based on current traffic volumes along the corridor.	Operational improvement by RTC-FAST
66.	Evaluate variable speed limits for the corridor to notify drivers of current traffic flow conditions.	ATDM improvement recommended for the corridor as an independent project
67.	Consider operational improvements for the US 95/Charleston Boulevard interchange. The City of Las Vegas and NDOT are evaluating alternatives, such as a diverging diamond interchange and triple-lefts, at this location.	See Note 2 below
68.	Traffic queues at the Rancho Drive southbound off-ramp back onto the freeway. NDOT is pursuing a project that will improve the capacity of the interchange by constructing an additional exit lane from US 95 and signalizing dual right turn lanes onto Rancho Drive. NDOT hopes to complete this project before Project Neon begins.	Not within the scope of this study
69.	Consider modifying the overhead sign along the Rancho Drive northbound and southbound off-ramps to include a shield for US 95 Business South.	Not within the scope of this study

Notes:

1. These improvements apply to the entire corridor. NDOT can implement them as standalone corridor-wide maintenance projects, as appropriate. Portions of these recommended corridor-wide improvements can also be implemented as part of the individual projects identified in this I-515 Alternatives Development Study, within that individual project limits. The applicable projects are indicated in the table.
2. These improvements should be incorporated in the I-515/Charleston Boulevard and Auxiliary Lanes project between Eastern and Charleston exits, as appropriate.

- Extending the replacement limit to the hinge located to the east of Las Vegas Boulevard (Hinge 9) would allow for correction of deficiencies, such as vertical clearances and roadway geometrics. This extension would benefit Project 2 (Las Vegas Boulevard and Casino Center Boulevard Interchange Improvements), Project 4 (Southbound

Auxiliary Lane from I-15 Underpass to Charleston Boulevard), and Project 6 (Collector-Distributor Road from Las Vegas Boulevard to I-15) by achieving a better configuration for Las Vegas Boulevard.

- A portion of the segment between 4th Street and Las Vegas Boulevard could be built on embankment instead of structure to reduce costs.

G-947 Replacement Cost Estimate

The preliminary cost estimate to replace the G-947 component of the I-515 Viaduct ranges from $66,800,000 to $106,600,000, with a median value of about $88,800,000 based on a fixed dollar cost estimate per square foot of deck area. The replacement limits assumed for this estimate include complete replacement of G-947 and ancillary ramp structures, as well as portions of I-947 to Hinge 9 located on the east side of Las Vegas Boulevard. This cost estimate is for the structure only, and does not include traffic maintenance, benefits of other future projects, and other factors. Furthermore, this simplified planning level estimate was not obtained from detailed engineering analysis and shall not be construed or interpreted to be based on actual engineering estimates. See Appendix E for cost estimate details.

5.3.2 Project 8: I-947 Structure Rehabilitation

Structure I-947 of the Downtown Las Vegas Viaduct would be rehabilitated to remediate current issues and significantly extend the structure's service life. The bridge inspection report and preliminary drawings prepared by NDOT were used to scope an all-inclusive rehabilitation project (refer to Appendix E for technical details). Preliminary G/I-947 rehabilitation drawings and the current National Bridge Inventory inspection report were used to identify the improvements needed, as follows:

- Replace expansion joints at 60 locations
- Replace 21 elastomeric bearings at Pier 13
- Install steel jackets on columns at 52 locations
- Retrofit in-span hinges at 2 locations
- Repair damage to the bridge deck and place a protective overlay

Additionally, the segment from 21st Street to Maryland Parkway is the most problematic area because it was constructed with a series of simple spans, where long-term deformation has resulted in poor ride quality. The profile could be corrected using supplemental post-tensioning and a variable thickness deck overlay.

I-947 Rehabilitation Cost Estimate

I-947 rehabilitation limits for cost estimate purposes extend from the eastern end of the viaduct to the proposed G-947 replacement limits at Hinge 9. Ramp structures I-947E and I-947W are included in the rehabilitation cost. Two cost options were developed to reflect the difference between the protective deck overlay materials. Option 1, based on using a polymer overlay, is estimated to range between $19,900,000 and $42,400,000, with a median value of about $27,500,000. Option 2, based on using a multilayer overlay, is estimated to range between $18,800,000 and $38,600,000, with a median value of about $25,000,000. These simplified planning level

estimates were not obtained from detailed engineering analysis and shall not be construed or interpreted to be based on actual engineering estimates. See Appendix E for cost estimate derivation.

5.4 Anticipated National Environmental Policy Act Process and Considerations

As NDOT identifies projects to advance to development, it will work with FHWA to outline environmental clearance requirements under the National Environmental Policy Act (NEPA). Because this study took a Planning and Environmental Linkages (PEL) approach, an environmental analysis was conducted at a planning level based on existing mapping and data resources. Future NEPA studies will involve more detailed analyses for environmental resources that could be impacted by the projects. This section highlights future resource analyses expected, and discusses future NEPA classes of action (described below).

5.4.1 Future Resources Analysis

Land Use

The proposed projects are focused on improving safety and mobility on I-515, mostly within the existing I-515 right-of-way (ROW). Therefore, changes in land use are not expected. However, future NEPA processes should continue to include coordination with city, county, and Regional Transportation Commission (RTC) planners to identify plans, planned projects, and any future land use changes. This information will help ensure consistency with local land use and transportation decision-making.

Parks and Recreation, Community Facilities, Bicycle/Pedestrian Facilities

Plans for future community, park, and bicycle and pedestrian facilities should be reviewed for updated information. This includes the city's plans to continue improving the bicycle and pedestrian connections underneath and around I-515. Although the projects identified for further advancement in this study are focused on freeway segments, improvements to ramps and ancillary facilities should include improving bicycle and pedestrian connections affected by the projects. Improvements to bicycle and pedestrian facilities would help accommodate the many households without vehicles within the study area (see Figure 2-10) that are transit- and/or bike- and pedestrian-dependent.

Right-of-Way/Relocations

Future NEPA studies should identify existing ROW and future ROW needs through more detailed design and property mapping. Where projects require additional ROW, designers should work to avoid and minimize effects to private landowners as much as possible. Any residential and/or business relocations resulting from implementation of federal aid projects require compliance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Uniform Act), as well as NDOT's *Right-of-Way Manual* (NDOT 2016a).

Environmental Justice

Each project must be assessed to determine if it will result in disproportionate effects to low-income or minority populations. If

such impacts are expected, the analysis should assess whether they are high and adverse, as defined by FHWA guidance (https://www.environment.fhwa.dot.gov/projdev/guidance_ej_nepa.asp). For any adverse effects, NDOT should evaluate measures to avoid and minimize impacts to disadvantaged communities. If impacts cannot be avoided, NDOT should work with the affected community to develop mitigation measures to offset the impacts. This will require outreach to these communities to determine their needs and concerns.

Air Quality

The study area is located within portions of Clark County Hydrographic Area 212, which is designated as a maintenance area for carbon monoxide (CO) and particulate matter less than 10 microns (PM_{10}). The study area is in attainment for all other criteria pollutants. Future NEPA studies should include air quality analyses to evaluate compliance and conformity with the federal Clean Air Act and Amendments of 1990, Nevada State implementation plans, and applicable state and local regulations. The project assessment should consist of an analysis of traffic data, emissions calculations, evaluation of potential project air quality impacts, and preparation of technical reports. Depending on the project, coordination with agencies such as the Environmental Protection Agency (EPA) and Nevada Department of Environmental Protection Bureau of Air Quality may be required.

Projects will likely require quantitative (hot spot) CO analysis using the EPA's approved CAL3QHC model for assessing potential CO impacts. These hot-spot analyses would be conducted at the intersections or interchanges within the study area with the worst traffic operations. EPA's most current and approved MOtor Vehicle Emission Simulator Model (MOVES) should be used to estimate CO emission factors.

Either a quantitative or qualitative analysis of Mobile Source Air Toxics (MSATs) would be required using FHWA's current guidance on assessing MSATs. The type of analysis will depend on whether the project meets the criteria requiring a quantitative analysis. Additionally, temporary construction impacts on local air quality should be assessed qualitatively.

Traffic Noise

Future studies will need to identify noise-sensitive resources for potential traffic noise analysis. FHWA regulation 23 Code of Federal Regulations (CFR) 772 requires investigation of traffic noise impacts in areas adjacent to federally-aided highways for proposed construction of a highway on a new location, or the reconstruction of an existing highway to either significantly change the horizontal or vertical alignment, or increase the number of through-traffic lanes. If NDOT identifies traffic noise impacts, the agency should consider and incorporate all feasible and reasonable traffic noise abatement into project design.

Cultural Resources

Figure 2-25 shows historic properties within the study area identified under the *I-515 Preliminary Draft Environmental Impact Statement*. Properties currently considered as "unevaluated" or "potentially eligible" require additional analysis to determine their eligibility for listing on the National Register of Historic Places (NRHP). Further, a comprehensive review will be required to identify whether other historic properties may exist that were

not identified as part of previous studies. Consultation with the State Historic Preservation Officer (SHPO) should occur for concurrence with NRHP eligibility determinations for those properties. During the NEPA process, a determination of no effect, no adverse effect, or adverse effect should be made for properties that have been determined to be eligible for the NRHP, followed by consultation with the SHPO and other parties consulting in the NRHP Section 106 process to identify any necessary mitigation for adversely affected properties.

Hazardous Materials

Future projects should consider the locations of recognized environmental conditions relative to future improvements to determine the need for future hazardous materials analysis. This effort should start with updated database searches, followed by an Initial Site Assessment or, if greater potential exists for contamination, a Phase I Environmental Site Assessment (ESA). Results of these assessments will determine the need for sampling and testing as part of a larger Phase II ESA. The need for future study and/or remediation efforts will be determined based on the results.

Visual

Future NEPA processes should evaluate the need to conduct a visual impact assessment in accordance with FHWA's *Guidelines for the Visual Impact Assessment of Highway Projects* (FHWA 2015). An example of a visual impact that might require assessment would be moving a frontage road or noise barriers closer to an environmental justice (EJ) neighborhood.

The need for and nature of these assessments will vary depending on the projects advanced. The assessment could include a description of the existing visual quality, important visual resource issues, viewer characteristics, and the visual environment. Based on these elements, key observation points should be determined that represent important views. If necessary, photo simulations may be developed to assist in determining impacts to visual quality and identifying appropriate mitigation measures.

Floodplains

No Federal Emergency Management Agency (FEMA)-regulated 100-year floodplains are located in the study area. However, as project designs are refined, hydrologic and hydraulic analyses should be conducted to confirm compliance with the City of Las Vegas and NDOT drainage criteria. Consistency with these requirements should be coordinated with NDOT, the City of Las Vegas, and FEMA. Additionally, the number and type of permits should be identified, including National Pollution Discharge Elimination System permits.

Wetlands/Waters of the U.S.

Based on the existing mapping, no waters of the U.S., including wetlands, are immediately adjacent to I-515 within the study area. During the NEPA process, NDOT will confirm that no impacts to resources protected by Section 404 of the Clean Water Act would occur.

Biological Resources

Because of the study area's highly disturbed nature, impacts to federal- or state-protected species are not expected. However,

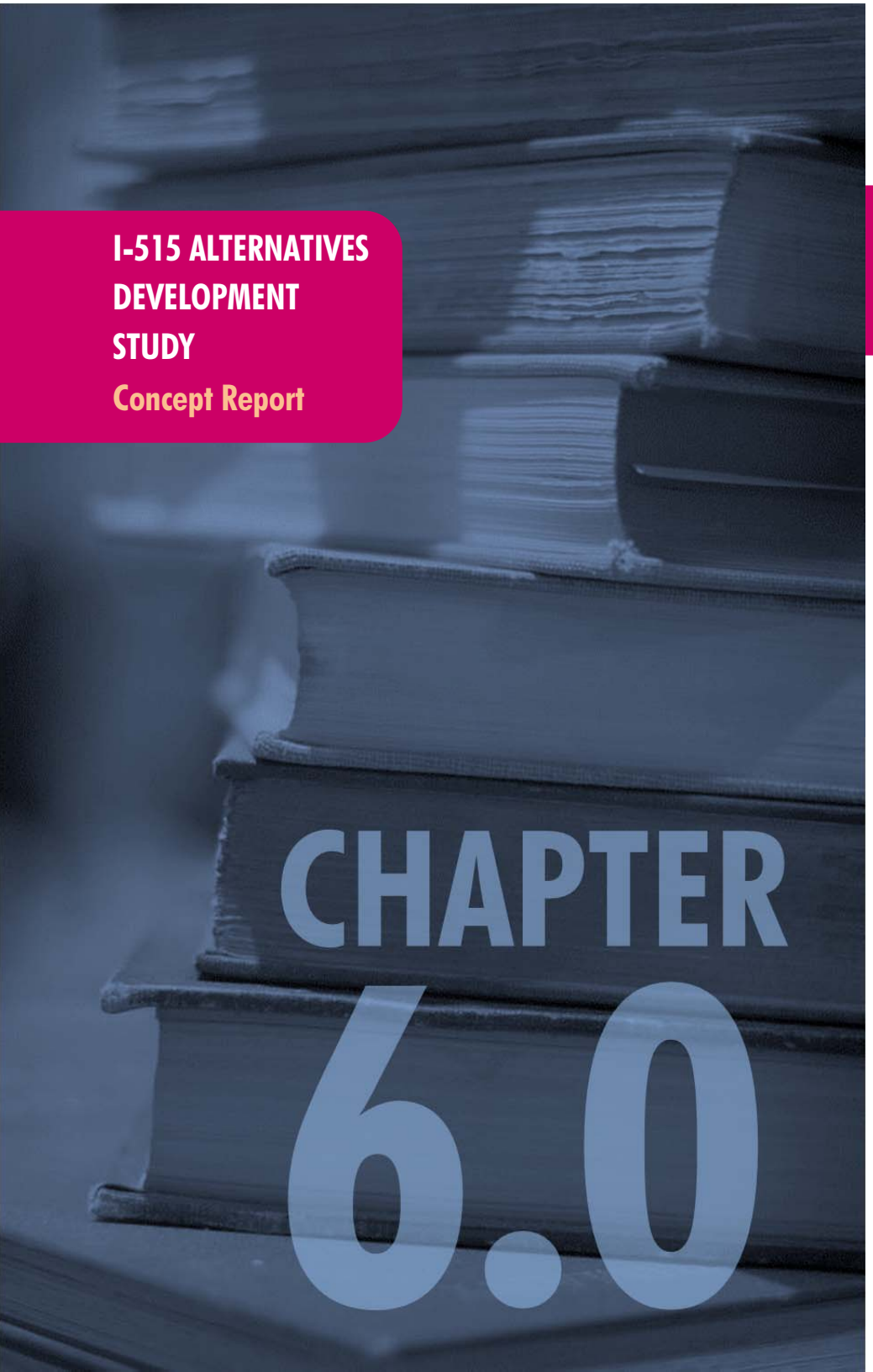
future studies should verify that no effects would occur, and evaluate effects to migratory birds under the Migratory Bird Treaty Act, which may include migratory birds nesting under bridge structures. Wildlife and vegetation impacts are expected to be minimal.

NEPA Classes of Action

FHWA regulations (23 CFR § 771.115) define three classes of actions that prescribe the level of documentation required in a NEPA process:

- Class I (environmental impact statement [EIS]). Actions that significantly affect the environment require an EIS; for example, building a new controlled access freeway or a highway project with four or more lanes at a new location.
- Class II (categorical exclusion [CE]). Actions that do not individually or cumulatively have a significant environmental effect are excluded from the requirement to prepare an environmental assessment (EA) (defined below) or EIS. A specific list of CEs normally not requiring NEPA documentation for FHWA actions is described in 23 CFR § 771.117(c) or, when appropriately documented, additional projects may also qualify as CEs under 23 CFR § 771.117(d).
- Class III (environmental assessment). Actions in which the significance of the environmental impact is not clearly established. All actions that are not Class I or II are Class III. All Class III actions require preparation of an EA to determine the appropriate environmental document required.

For future projects stemming from this study, NDOT will consult with FHWA on appropriate classes of action, and FHWA will make final determinations. Based on the information provided in this study, it appears that Projects 1, 2, and 4 could qualify as Class II actions and cleared with CEs. Other projects identified for further advancement in this study could potentially impact resources such as EJ neighborhoods, historic properties, and public recreational facilities to varying degrees. It appears that Projects 5 and 6 might require EAs to determine the significance of these types of impacts. Project 3 might qualify for a CE if indirect EJ and historic impacts along Marlin Avenue can be minimized and mitigated.



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Concept Report

CHAPTER 6.0

Chapter 6.0 References

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