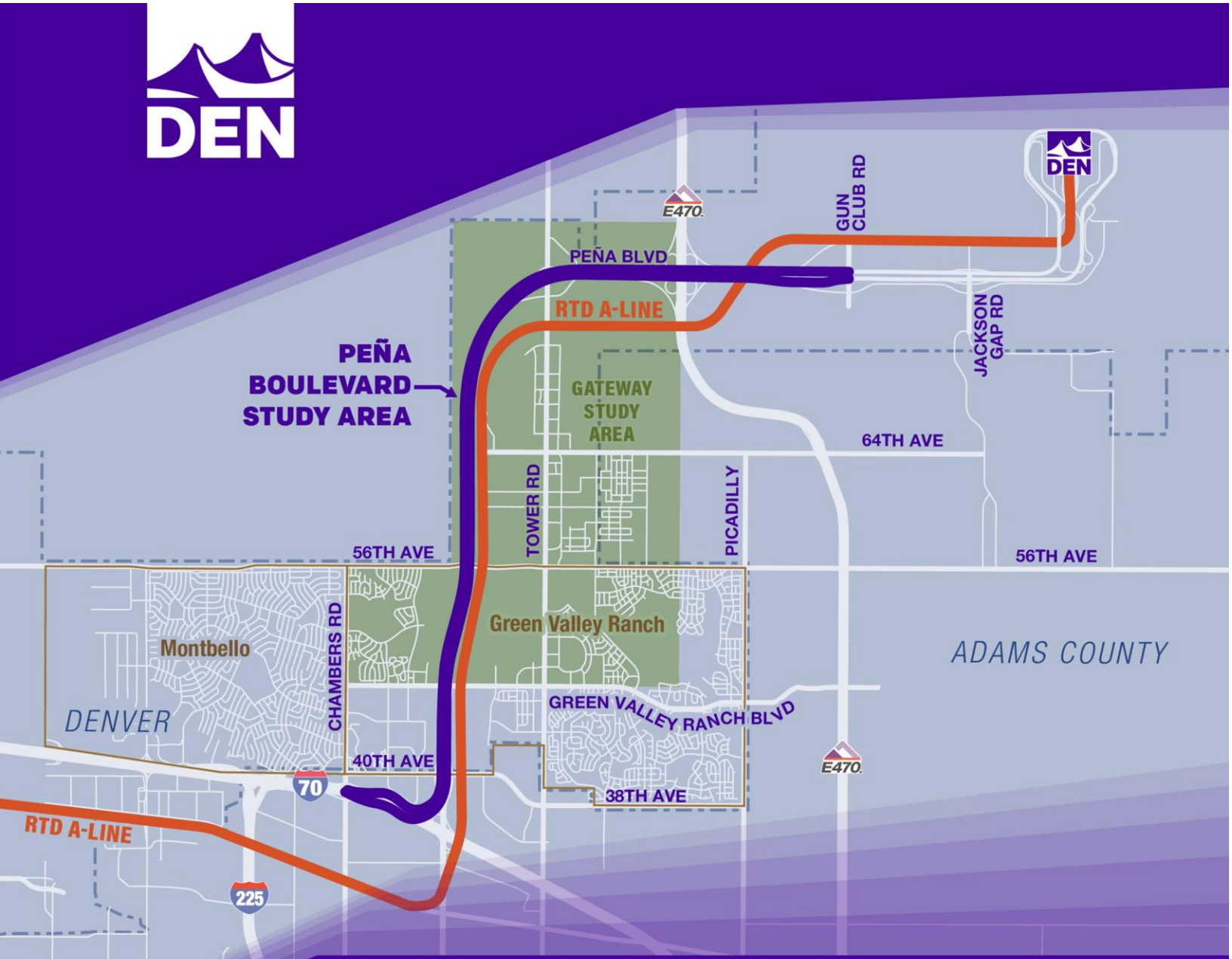


PEÑA BOULEVARD TRANSPORTATION AND MOBILITY MASTER PLAN

Attachment D

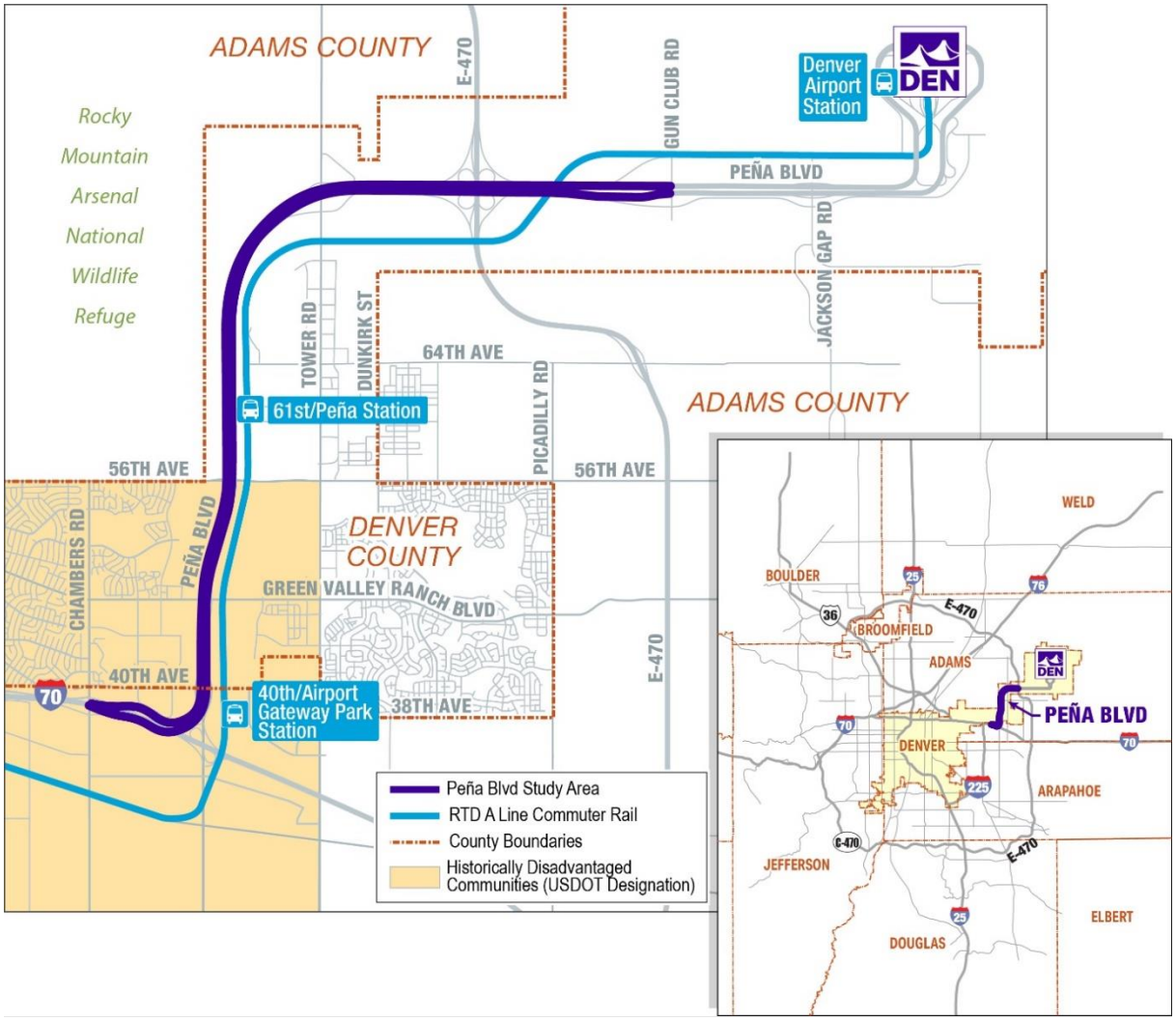
Alternatives Evaluation Report

1. Alternatives Evaluation Process

The Peña Boulevard Transportation and Mobility Master Plan Study (the Study) sets out to provide a blueprint for infrastructure improvements for the Peña Boulevard corridor and to develop a Travel Demand Management (TDM) Plan with strategies aimed to incentivize sustainable transportation to the airport. In particular, the purpose of the transportation portion of the Study is to recommended improvements to the Peña Boulevard Corridor between I-70 and Gun Club Road to increase mobility options, enhance safety, and manage travel demand for the airport and the surrounding community while addressing congestion. To achieve this, DEN evaluated a range of concepts and alternatives for the Peña Boulevard corridor.

Peña Boulevard is an 11.1-mile-long roadway that extends from Interstate 70 (I-70) to the Jeppesen Terminal at DEN and provides the only roadway access to DEN while also offering connectivity to numerous off-airport developments and communities. The Study is focused on an 8-mile section of Peña Boulevard from I-70 and Chambers Road to Gun Club Road, shown in purple in Figure 1.

Figure 1 – Peña Boulevard Transportation and Mobility Master Plan Study Area



The alternatives development and evaluation process is outlined in Figure 2 and discussed in detail later in the following sections of this report. The planning started with the development of a range of

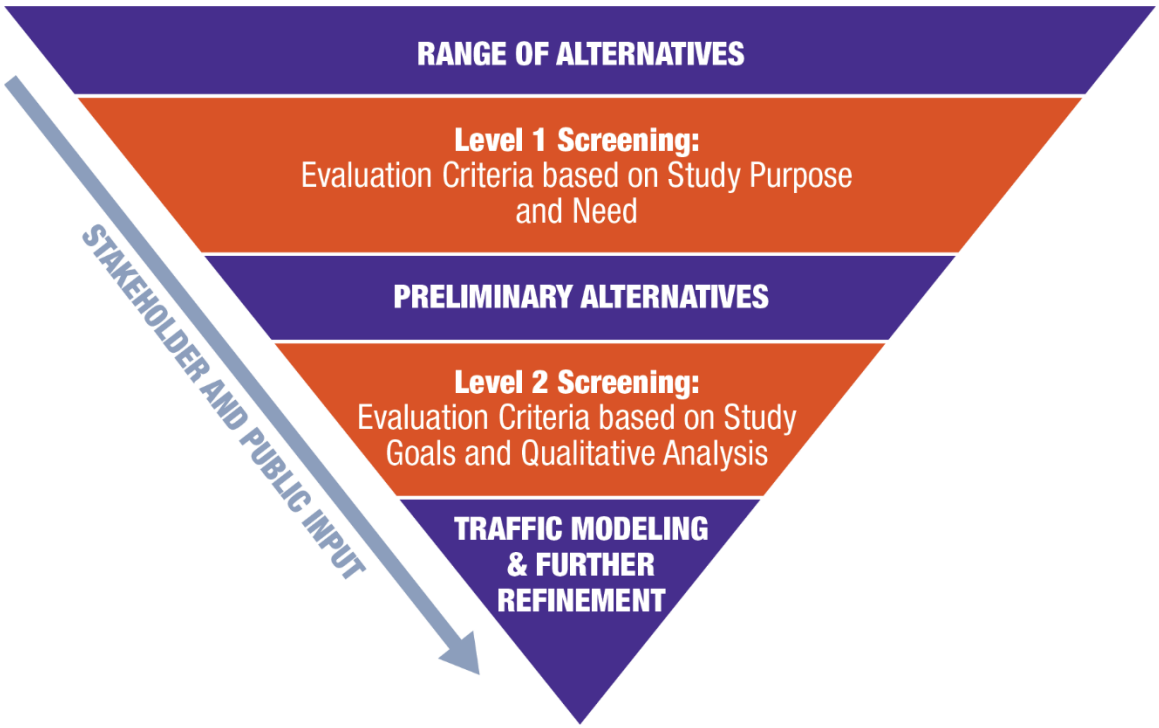
alternative concepts that were screened using criteria to support the Purpose and Need for the project. The next step was to develop a list of preliminary alternatives that met the Purpose and Need. The preliminary alternatives were then screened using criteria that were based on the Goals and Objectives. As Figure 2 shows, this process ended with recommended alternatives that will advance in the study process. Each recommended alternative will be included in the final Master Plan.

Although this is not a traditional Planning and Environmental Linkage (PEL) study process, the alternatives development, evaluation and screening was conducted using a robust alternatives evaluation that will be valuable for the next step in the project development process when alternatives are further defined and optimized with conceptual engineering design and a formal environmental review under the National Environmental Policy Act, known as NEPA, is conducted.

During the alternatives analysis, the surrounding environment was considered and documented in an Existing Conditions Assessment Report included as Attachment A of the Peña Master Plan. The natural environment, cultural resources, socio/economic resources, and the physical environment were inventoried throughout the project study area. Since all alternatives studied were located in the Peña Boulevard right of way, they are all located within the same study area. This means that differentiating environmental evaluation criteria did not show a difference between alternatives or options and were therefore not used in evaluation of alternatives during the Master Plan phase. They will be fully evaluated during NEPA.

As shown in Figure 2, obtaining stakeholder and public input was key to every step in the alternatives development and evaluation process. A detailed description of the list of stakeholders, the participation methods, and the results of outreach have been described in the Public & Stakeholder Engagement Summary included as Attachment B of the Peña Master Plan.

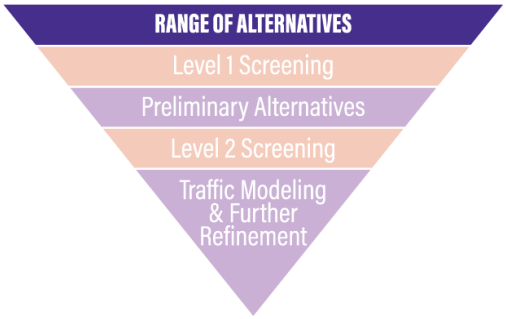
Figure 2 – Peña Alternatives Development and Screening Process



2. Range of Alternative Concepts

A range of alternative concepts were identified through brainstorming discussions with the Study Technical Advisory Committee (TAC), through public and stakeholder input, and from recommendations from previous studies. Below is a description of how alternative concepts were developed and how they were evaluated.

Figure 3 – Range of Alternative Concepts



2.1. Public and Stakeholder Input – Round #1

DEN hosted its first round of public and stakeholder engagement in early 2023 which included in-person public open houses in the Montbello and Green Valley Ranch neighborhoods of Denver and a virtual open house hosted on the https://www.flydenver.com/about-den/projects-and-infrastructure/pena-master-plan/ webpage from February 23 – March 9, 2023. Almost 120 unique responses were received during the virtual and in-person open houses. Comments and feedback captured from these sources which were categorized into 30 Community Input Themes. The Table 1 outlines the top 13 themes communicated throughout the engagement period.

Table 1 – Community Input Themes

Community Input Theme	Number	Percentage
Concerned with delays and congestion on Peña	39	33%
Desire for more investment in transit to increase the number of routes and/or increase the frequency/capacity of existing services	28	24%
The two lanes on Peña do not adequately serve the demand	26	22%
Desire to make transit free/cheaper for employees and/or passengers accessing the airport and/or within the airport pricing zone	24	20%
Miscellaneous/Opinion	16	13%
Safety and congestion concerns on Peña ramps and/or merge/diverge locations	15	13%
Does not support adding lanes to Peña	14	12%
Desire for more multi-modal access to the airport	11	9%
Environmental/pollution concerns with proposed solutions and/or concerns that adding lanes will increase GHG emissions	10	8%
Desire to add managed lanes to Peña	10	8%

Community Input Theme	Number	Percentage
Concerned with safety	9	8%
Concerned with local/city/airport growth and the surrounding traffic growth	9	8%
Concerned with volume and congestion associated with heavy vehicles on Peña and/or desire for separate freight lane	6	5%

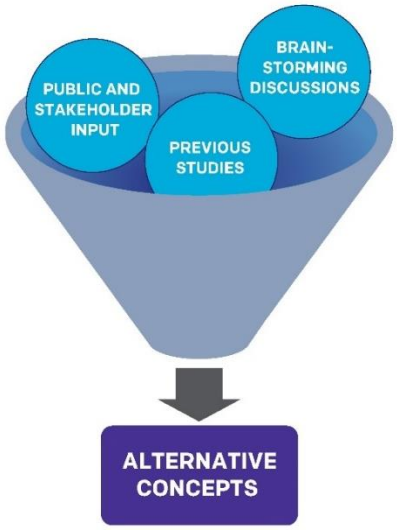
The community input themes influenced the alternative concepts outlined in Section 2.2 below. For additional information on the public and stakeholder feedback, see the Stakeholder and Public Engagement Meeting Memo.

2.2. Alternative Concept Development

DEN held an alternatives development workshop on April 25, 2023, to brainstorm potential cross-sectional upgrades to Peña Boulevard between I-70 and Gun Club Road. All members of the Peña Master Plan's Technical Advisory Committee (TAC) were invited to attend the 3-hour in-person workshop. The TAC oversees the overall management, coordination, and approach, and deliverables of the Study and is composed of managers from DEN Planning, DOTI Design and Plan staff, and task leads from Peña PMT.

The TAC used the feedback received from the first round of public and stakeholder engagement in February and March 2023, and recommendations from previous studies, to develop a range of alternative concepts for Peña Boulevard described below, see Figure 4.

Figure 4 – Alternative Concept Development



2.3. Public and Stakeholder Input – Round #2

DEN hosted a second round of public and stakeholder engagement in late summer 2023 to solicit feedback on the following potential alternatives for the Peña Boulevard (developed using feedback from round #1 engagement and through internal brainstorming discussions):

- No Build

- Intelligent Transportation Systems (ITS) and Operational Improvements
- Multimodal and Equity Improvements
- Safety Improvements
- General Purpose (GP) Lane(s)
- Separate Lane(s) for airport and local traffic
- Managed Lane(s) (non-tolling)
- Managed Lane(s) (tolling)

Both the public and stakeholder were asked "*Do you have any comments or concerns regarding alternatives being considered for Peña Boulevard*? Table 2 outlines the top public responses.

Table 2 – Community Input Themes

Do you have any comments or concerns regarding the below alternatives being considered for Peña Boulevard?	Alternative Feedback Responses
Do something (see breakdown in Table 3)	484
Enhanced transit and TDM strategies	137
Do nothing	115
Opposed to tolling	40
Opposed to adding lanes for cars or SOVs	29

Table 3 – Breakdown of "Do-somethings"

Do-something	Response
Peña: Separating local and airport traffic	89
Peña: General purpose lanes	77
Peña: Separating local and airport traffic, specifically frontage road	65
Peña: Managed Lanes	53
Peña: Opposed to tolling	40
Peña: Managed lanes (bus only lanes)	30

2.3.1. Range of Alternative Concepts

As shown in Table 4 there was strong public support for enhanced transit and transportation demand management (TDM) strategies. DEN heard similar sentiment from the stakeholder working group (SWG). In response to this public and stakeholder feedback, DEN expanded the list of alternative concepts being considered for Peña Boulevard:

- No Build
- Do-Minimum (added in response to engagement feedback)
- Alternative Concept 1: Intelligent Transportation Systems (ITS) and Operational Improvements
- Alternative Concept 2: Multimodal and Equity Improvements
- Alternative Concept 3: Safety Improvements
- Alternative Concept 4: Transportation Demand Management Improvements (added in response to engagement feedback)
- Alternative Concept 5: Bus Only Lane(s) (added in response to engagement feedback)
- Alternative Concept 6: General Purpose (GP) Lane(s)
- Alternative Concept 7: Separate Lane(s) for airport and local traffic
- Alternative Concept 8: Managed Lane(s) (non-tolling)
- Alternative Concept 9: Managed Lane(s) (tolling)

The various alternatives within each of these concepts are described in the following sections:

Table 4 – Range of Alternative Concepts

Alternative Concept	Description	Potential Alternatives/Variations
No Build	The No Build alternative is defined as the alternative in which the proposed project would not take place and is included as a baseline for comparison to the action alternatives. No Build would retain the existing cross-section for Peña Boulevard and could include upgrades to the pavement and existing infrastructure such as crash barriers, signage, and lighting.	This alternative includes planned mobility improvements in the region within the 2050 regional planning horizon as identified in the Denver Regional Council of Governments (DRCOG) 2050 Fiscally Constrained Metro Vision Regional Transportation Plan.
Do-Minimum	Do-minimum would not make changes to the current cross-section but would include upgrades to the interchanges, acceleration/deceleration lanes and on/off ramps, in addition to pavement upgrades and safety improvements	• Add lanes to ramps • Increase acceleration/deceleration lane lengths

Alternative Concept 1: ITS and Operational Improvements	Implement strategies designed to make travel smarter, faster, safer and more convenient by improving the use of the current transportation system and reducing travel demand on Peña, rather than making large investments and major capital improvements.	• Operational, and Intelligent Transportation Systems (ITS)
		  ○ Ramp metering
		  ○ Dynamic speed limits

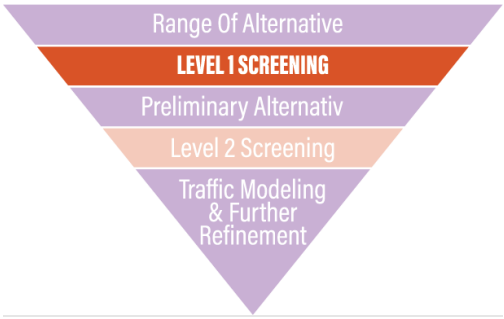
Alternative Concept 2: Multimodal and Equity Improvements	Implement strategies to improve multimodal transportation opportunities and connections along Peña. This option would seek to reduce travel demand on Peña by reducing single occupant vehicle (SOV) usage.	• Increase Transit Services and Ridership of Existing Transit • Multiuse Trail Facilities
Alternative Concept 3: Safety Improvements	Safety improvements to reduce collisions and near misses on Peña Boulevard.	• Geometric Improvements • Improved acceleration and deceleration lanes at ramps
Alternative Concept 4: Transportation Demand Management	Transportation Demand Management (TDM) plan, with recommendations and specific policies to improve transportation infrastructure and increase mobility choices for DEN passengers and employees.	• Increase ridership of existing transit facilities • Additional transit services: On-demand micro transit, employee shuttles, increased connections to the A-Line

Alternative Concept	Description	Potential Alternatives/Variations
Alternative Concept 5: Bus Only Lane(s)	Add a bus-only lane exclusively for RTD, mountain shuttles, and other transit services on Peña Blvd.	• Add one bus-only lane in each direction
Alternative Concept 6: Add General Purpose Lane(s)	Add a new general-purpose lane or lanes in each direction and widened inside shoulder. General purpose lanes are traffic lanes available for use by the general public without any restrictions or tolls.	• Add one general purpose lane in each direction • Add two general purpose lanes in each direction
Alternative Concept 7: Add Lane(s) to Separate Airport and Non-Airport Traffic	Add separate lanes or parallel facilities for non-airport trips to reduce congestion and weaving associated with local traffic on the southern extents of Peña Boulevard. Between 40th Ave and Green Valley Ranch, up to 46% of vehicle traffic on Peña Boulevard are non-airport trips, east of Tower Road this is reduced to 16% of trips.	• Add Buffer Separated Express Lane for airport-only traffic • Add Barrier Separated Collector-Distributor Road for local traffic • Add Continuous Frontage Road for local traffic
Alternative Concept 8: Add Managed Lane(s) (non-tolling)	Add a new managed lane or lanes (non-tolled) in each direction and widened inside shoulder. Managed lanes are a set of lanes where operational strategies are proactively implemented and managed in response to changing conditions.	• High occupancy vehicle (HOV) lanes – Access restricted to HOVs with 3+ occupants, carpools, vanpools etc. • Bus only lanes – Dedicated lanes and rights of way for public transit vehicles and commercial shuttles • Peak period shoulder lanes – Where a shoulder becomes a driving lane to provide operational improvements during peak periods
Alternative Concept 9: Add Managed Lane(s) (Tolling)	Add a new managed lane or lanes (tolled express lanes) in each direction and widened inside shoulder. Users must pay a toll to gain access to the new capacity, but preference (e.g., free or reduced-toll access) may be provided for high-occupancy vehicles.	• Dynamic pricing – The fee adjusts in real-time to mitigate congestion in the lane • High occupancy toll lanes – High occupancy vehicles travel free or at discounted rates depending on demand, other vehicles pay a fee • Bus Only Lane - Dedicated lanes and rights of way for public transit vehicles or shuttles

3. Level 1 Screening

The first level of screening consisted of a high-level review to see if the alternative concepts met the project's Purpose and Need. The alternative concepts developed were evaluated against the Level 1 screening criteria to determine if the concept meets the project purpose and need. Alternative concepts not meeting the purpose and need were set aside or eliminated as standalone concept alternatives and were not bought forward to the Level 2 screening process.

Figure 5 – Level 1 Screening



Based on a qualitative evaluation, each alternative concept received one of three responses to each of the metrics: yes, neutral, or no. A "yes" response indicates that the concept would meet or has the potential to meet the criterion in question. A "neutral" response indicates the concept likely would not affect the criterion in question. A "no" response indicates that the concept likely would negatively affect the criterion in question.

Alternative concepts were either retained, set aside, eliminated as a standalone alternative, or eliminated as follows:

- **Retained for additional analysis –** the alternative concept meets the purpose and need and will progress to Level 2 screening.
- **Eliminated as a standalone alternative –** the alternative concept satisfies some but not all the purpose & need and will not be considered as a standalone alternative but elements of it could be incorporated into the retained alternatives.
- **Set aside/Eliminated from further consideration –** the alternative concept does not meet the purpose & need and will not be carried forward to Level 2 screening.

The Study Purpose and Need which formed the basis of the Level 1 screening criteria is described in the following subsection.

3.1. Purpose & Need

The purpose of the recommended improvements to the Peña Boulevard Corridor between I-70 and Gun Club Road is to increase mobility options, enhance safety, and manage travel demand for the airport and the surrounding community while addressing congestion.

Transportation improvements are required to address the project needs identified in the study area and described in Table 5.

Table 5 – Project Needs

	Need	Description of Need
	Safety	There were 860 crashes on Peña Boulevard between 2016 through 2021. With 181 crashes in 2016 and 224 crashes in 2019 this represents a 24% increase or a 7% average annual increase in crashes on Peña Boulevard. Of the 860 collisions almost 50% were front to rear (rear-end collision) and four incidents involved fatalities.
	Lack of Multimodal Connectivity	Bicycle and pedestrian facilities in and around the Peña Boulevard corridor remain unconnected, with a lack of connectivity to transit stations, and regional trails. There are currently no bicycle facilities connecting the 40th Ave & Airport Blvd - Gateway Park or 61st & Pena rail transit stations with the surrounding neighborhoods or the First Creek Trail.
	Regional Growth	Passenger growth at DEN, developments along the corridor, and increased freight trips have all added significant demands to the corridor and all are expected to increase due to anticipated regional growth projections. Peña Boulevard was originally constructed almost 30 years ago, serving 31 million DEN air passengers in 1995 when the airport opened. By 2022, DEN served 69 million passengers, a 123% increase since opening in 1995. Within the next 8-10 years, DEN is expected to serve 100-million annual passengers. Based on current aviation forecast, the estimated total of 121.9 million annual passengers in 2040, is made up of 63% of whom will begin or end their trips at DEN (the remaining 37% will arrive at DEN to catch connecting flights). This means that 76.3 million passengers begin and end their trip in the Denver metro area and will, therefore, use ground transportation such as public transit, private automobiles, rental cars, taxis, rideshare or vanpools. Using DRCOG 2050 projections for household and employment numbers within 5 miles of Peña Boulevard, households are expected to increase from approximately 127,000 to 250,000, and the number of jobs inside and outside of DEN are projected to increase from 238,000 to 400,000 jobs in the 30-year period. This represents an increase of 97% in number of households and 68% in the number of jobs when compared with 2020.
	Congestion	Average daily traffic (ADT) volume on Peña Boulevard has increased from 75,000 vehicles in 1995 to more than 135,000 ADT in 2019 (an increase of 80%). If this congestion and demand are not managed, vehicles will continue to divert to local streets.
	Travel Time Reliability	Travel time has become increasingly unreliable on Peña Boulevard. When Peña Boulevard is free flowing it takes 8 minutes to travel westbound from Gun Club Road to I-70 (an 8-mile segment), during congested periods it can take up to 24 minutes assuming no road incidents.
	Aging Infrastructure	DEN is committed to maintaining transportation facilities under its jurisdiction in a state of good repair. Because Peña Boulevard is more than 30 years old, required annual maintenance work is necessary, and the cost to maintain the aging facility is substantial. Since 2017, DEN has invested almost $17 million in pavement maintenance and improvement for Peña Boulevard. An update of the facility at current design standards would provide new pavement with a 30-year or greater design life, reducing the cost of the annual maintenance work.

3.2. Level 1 Screening Evaluation

The Study Purpose and Need was used to develop criteria for Level 1 screening through which the 11 alternative concepts were evaluated. The results of Level 1 screening are detailed in Table 6.

Table 6 – Level 1 Screening Matrix of Alternative Concepts

	Increase mobility options?	Manage Demand?	Enhance Safety?	
Alternative	- Benefits multiple modes - Promotes shift to HOV / more sustainable modes	- Reduces congestion on Peña - Improves travel time reliability - Addresses Regional Growth	- Reduces crash rates - Improve merge/diverge safety - Addresses aging infrastructure	**Recommendation (Retained, set aside, eliminated)**
No Build	No	No	No	Retained for comparison purposes
Do Minimum	Neutral	No / Neutral	Yes	Retained for additional analysis
Alternative Concept 1: – ITS and Operational Improvements	No	Yes	No	Set aside as standalone alternative concept
Alternative Concept 2: – Multimodal and Equity Improvements	Yes	Neutral	No	Set aside as standalone alternative concept
Alternative Concept 3: – Safety Improvements	No	No	Yes	Set aside as standalone alternative concept
Alternative Concept 4: Transportation Demand Management	Yes	Yes	No	Set aside as standalone alternative concept
Alternative Concept 5: - Transit/Bus Only Lane	Yes	Yes	Neutral	Retained for additional analysis
Alternative Concept 6: – General Purpose (GP) Lane(s)	No	Neutral	Yes	Eliminated from further consideration

Alternative	Increase mobility options? - Benefits multiple modes - Promotes shift to HOV / more sustainable modes	Manage Demand? - Reduces congestion on Peña - Improves travel time reliability - Addresses Regional Growth	Enhance Safety? - Reduces crash rates - Improve merge/diverge safety - Addresses aging infrastructure	Recommendation (Retained, set aside, eliminated)
Alternative Concept 7: –Separate Lane(s) for Airport & Local Traffic	Neutral	Yes	Yes	Retained for additional analysis
Alternative Concept 8: – Managed Lane(s) (non-tolling)	Yes	Yes	Yes	Retained for additional analysis
Alternative Concept 9: – Managed Lane(s) (tolling)	Yes	Yes	Yes	Retained for additional analysis

3.3. Alternatives Eliminated Following the Level 1 Evaluation

After Level 1 screening, one alternative was eliminated and will not be evaluated as part of Level 2 screening. Four alternatives were eliminated as standalone alternatives but will be incorporated into the remaining alternatives carried forward to Level 2.

Table 7 – Alternative Concepts Set Aside/Eliminated as Standalone Following the Level 1 Evaluation

Alternative Concept	Recommendation	Summary of Analysis	Elements carried forward
Alternative Concept 1, ITS and Operational Improvements	**Set aside as standalone alternative concept** as it would not increase mobility options or enhance safety; however, elements of this alternative concept could be incorporated into alternative concepts 5 through 7.	Operational improvements alone would not increase mobility options or manage demand on Peña. Over its history, Peña Boulevard traffic has increased from an average daily traffic (ADT) volume of 75,000 vehicles in 1995 to more than 135,000 ADT in 2019 (an increase of 80%). In 2019, DEN served 69 million passengers; within the next 8-10 years, DEN is expected to serve 100-million annual passengers. To manage projected regional growth, maintain the reliability of the supply-chain and continue to boost the local and regional economy, DEN must address infrastructure and capacity deficiencies on Peña Boulevard.	All of the retained concept alternatives have specific alternatives that will include innovative technologies to manage demand. Opportunities include ramp metering, peak period shoulders, and real-time traffic and road condition information to reduce overall congestion by managing demand.
Alternative Concept 2, Multimodal Improvements	**Set aside as standalone alternative concept** as it would not measurably manage demand or enhance safety; however, elements of this alternative concept could be incorporated into alternative concepts 5 through 7.	Located near the geographic center of the United States, DEN is the only major hub airport within a 500-mile radius and offers nonstop flights to more than 200 destinations. Because of its location, DEN attracts passengers from all over Colorado as well as significant passenger numbers from the Mountain States and Midwest. DEN also has service to approximately 20 Federal Essential Air Service (EAS) routes across the western and midwestern U.S. making DEN the only air service option for these rural markets. Transit or other multimodal options (walking, biking, and rolling) are viable options, however, currently they are not a preferred mode of transport to the airport for a significant number of travelers. As a result, these modes do little to reduce vehicle trips on Pena Blvd, which is a key element of the project purpose and need. Vehicle reduction and mode share increases will be evaluated/considered under each alternative.	Regardless of cross-sectional improvements to Peña Boulevard, DEN is developing a Transportation Demand Management (TDM) Plan, with recommendations and specific policies to improve transportation infrastructure and increase mobility choices for airport passengers and employees. This TDM Plan will establish target mode splits that aim to decrease vehicle trips on Peña Boulevard and encourage more sustainable transportation options to passengers, visitors, and employees at DEN. The TDM Plan will provide implementable strategies and plans on how DEN can increase its share of public transit ridership (including RTD A-Line and bus services), support employee vanpools/carpools, incentivize sustainable transportation, and encourage HOVs. Proposed solutions from the TDM program could include employee incentive programs to promote transit ridership, innovative parking solutions to encourage carpools and vanpools, and improved facilities to make sustainable transportation more enticing.
Alternative Concept 3, Safety Improvements	**Set aside as standalone alternative concept** as it would not increase mobility options or manage demand: however, elements of this alternative concept could be incorporated into alternative 5 through 7.	Safety improvements alone would not increase mobility options or manage demand on Peña Boulevard. Over its history, Peña Boulevard traffic has increased from an average daily traffic (ADT) volume of 75,000 vehicles in 1995 to more than 135,000 ADT in 2019 (an increase of 80%). In 2019, DEN served 69 million passengers; within the next 8-10 years, DEN is expected to serve 100-million annual passengers. Based on current aviation forecast, the estimated total of 121.9 million annual passengers in 2040, is made up of 63% of whom will begin or end their trips at DEN (the remaining 37% will arrive at DEN to catch connecting flights). This means that 76.3 million passengers begin and end their trip in the Denver metro area and will, therefore, use ground transportation such as public transit, private automobiles, rental cars, taxis, rideshare or vanpools. To manage airport and regional growth, maintain the reliability of the supply-chain and continue to boost the local and regional economy, DEN must address infrastructure and capacity deficiencies on Peña Boulevard.	All of the retained concept alternatives have specific alternatives that will include safety improvements that bring Peña Boulevard up to current design standards including improved shoulder widths, acceleration/deceleration lengths, and merge/diverge locations. The current shoulder widths vary between 6 ft to 8 ft., increasing the shoulder widths to 12 ft. would reduce accidents and improve infrastructure resiliency. Increased acceleration and deceleration lane lengths on Peña Boulevard would enhance safety and improve access for vehicles/freight movements.
Alternative Concept 4: Transportation Demand Management	**Set aside as standalone alternative concept** as it would not enhance safety.	The Peña Master Plan will include a Transportation Demand Management (TDM) plan, with recommendations and specific policies to improve transportation infrastructure and increase mobility choices for DEN passengers and employees. This TDM plan will aim to decrease vehicle trips on Peña Boulevard and encourage more sustainable transportation options for passengers, visitors and employees at DEN.	The TDM plan will provide implementable strategies and plans on how DEN can increase its share of public transit ridership (including RTD A-Line and bus services), support employee vanpools/carpools, incentivize sustainable transportation and encourage HOVs. Proposed solutions from the TDM plan could include employee incentive programs to promote transit ridership, innovative parking solutions to encourage carpools and vanpools and improved facilities to make sustainable transportation more enticing, such as bike lockers, assembly and repair stations, and bike tools.

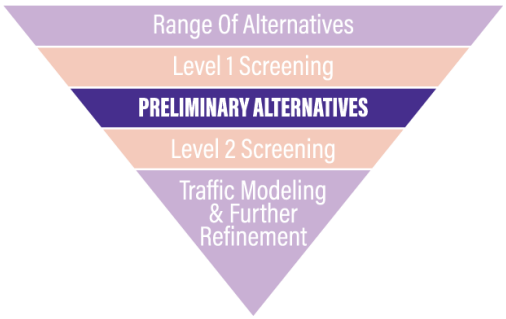
Alternative Concept	Recommendation	Summary of Analysis	Elements carried forward
Alternative Concept 6, General Purpose Lanes	**Eliminated from further consideration** as it would not increase mobility options and while it would reduce congestion and improve travel time reliability, in the short-term it would not measurably manage demand.	DEN collaborated with DRCOG to change the Peña Boulevard improvements in the 2050 Metro Vision Plan from additional general capacity lanes to additional proposed managed lanes.	Not carried forward.

4. Preliminary Alternatives

The conceptual alternatives remaining after Level 1 were further refined and carried forward into Level 2 screening. The remaining alternative concepts, listed below, are described in the following sections.

- No Build
- Do-Minimum
- Alternative Concept 6: Bus-only Lane(s)
- Alternative Concept 7: Separate Lane(s) for airport and local traffic
- Alternative Concept 8: Managed Lane(s) (non-tolling)
- Alternative Concept 9: Managed Lane(s) (tolling)

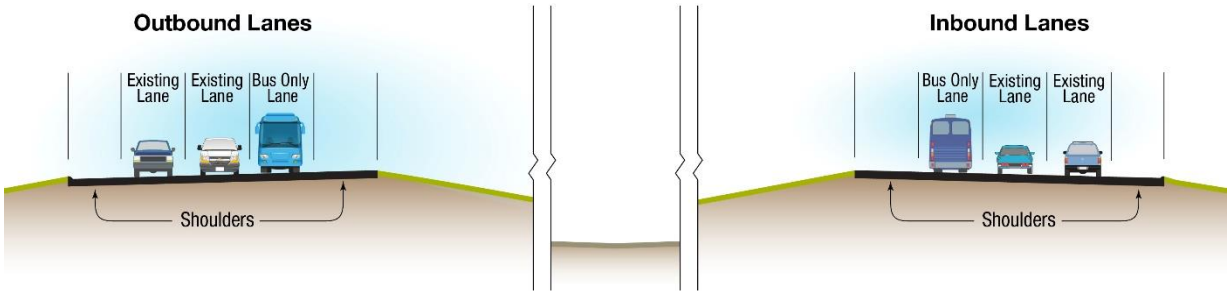
Figure 6 – Preliminary Alternatives Concept



4.1. Alternative Concept 6: Add Bus-only Lane(s)

Alternative concept 6 involves adding bus-only lanes to Peña Boulevard, see Figure 7. This concept seeks to provide dedicated lanes for transit on Peña Boulevard to improve travel time reliability and encourage more bus ridership along the corridor. A bus-only lane could also encourage transit operators to add new bus services along Peña Boulevard.

Figure 7 – Alternative 6: Bus-Only Lanes



4.2. Alternative Concept 7: Add Separate Lane(s) for airport and local traffic

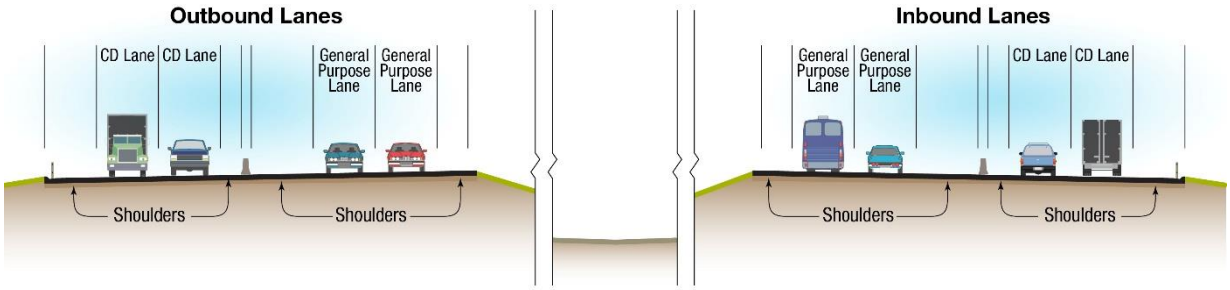
Alternative concept 7 involves adding a separate lane(s) or constructing a parallel road for non-airport trips that currently use Peña Boulevard. Local, or non-airport, trips make up 46% of the vehicles on

Peña Boulevard between 40th Avenue and Green Valley Ranch Boulevard and 32% between Green Valley Ranch Boulevard and 56th Avenue. This concept seeks alternatives to reduce congestion and weaving associated with local traffic on the southern extents of the Peña Boulevard. Three alternatives were considered under this concept:

4.2.1. Add Barrier Separated Collector-Distributor Road for local traffic

As shown in Figure 8, this alternative would involve construction of a new barrier-separated collector-distributor road in each direction on the outside of the existing Peña Boulevard. The collector/distributor would separate freeway through-traffic from other vehicles that are exiting or entering the freeway. This alternative would provide dedicated lanes for local traffic, reduce congestion and weaving associated with local traffic on the southern extents of the Peña Boulevard.

Figure 8 – Alternative 7A: Add Barrier Separated Collector-Distributor (CD) Road



4.2.2. Add Striped Buffer Separated Express Lane for airport traffic

As shown in Figure 9, this alternative would involve adding a new buffer separated express lane in each direction and widening the inside shoulder from 6 ft to 12 ft. The express lane would be a dedicated lane for through traffic, with few exits (i.e., airport bound vehicles). This alternative would allow airport bound vehicles to avoid congestion and weaving associated with local traffic on the southern extents of Peña Boulevard. A striped buffer would provide a soft measure separation from the existing lanes and would disincentivize weaving vehicular movements.

Figure 9 – Alternative 7B: Add Buffer Separated Express Lane

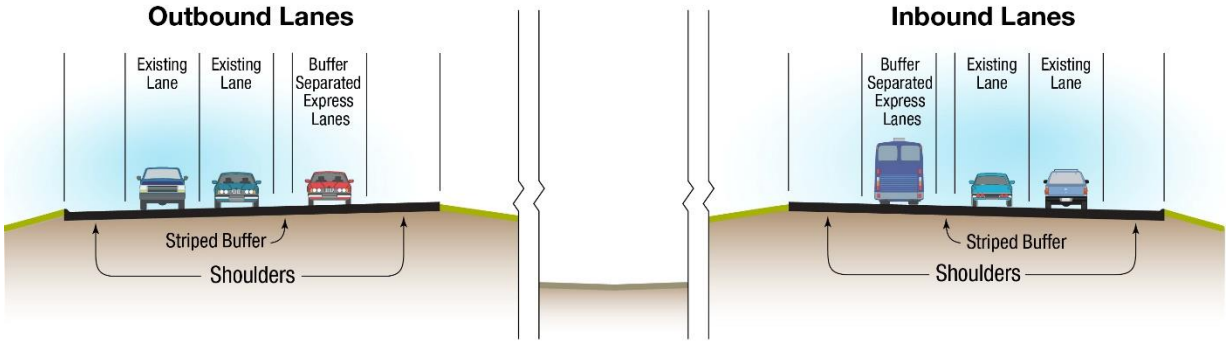


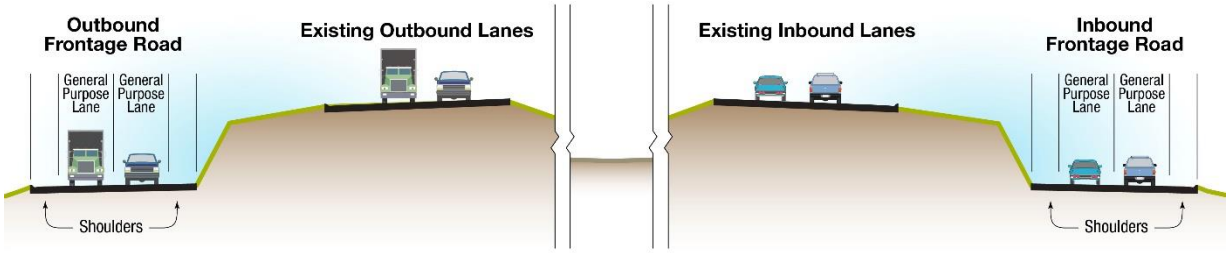
Figure 10 – Example of Striped Buffer Separated Express or Managed Lane

Source: The Denver Post

4.2.3. Alternative 7C: Add Continuous Frontage Road

As shown in Figure 11, this alternative would include a new continuous parallel frontage road(s) in each direction. A frontage road is a subsidiary road running parallel to a highway and giving local access to neighborhoods and businesses. Frontage Roads could include interchange and access modifications to Peña Boulevard including split diamond interchanges, Texas U-turns, etc.

Figure 11 – Alternative 7C: Add Continuous Frontage Road



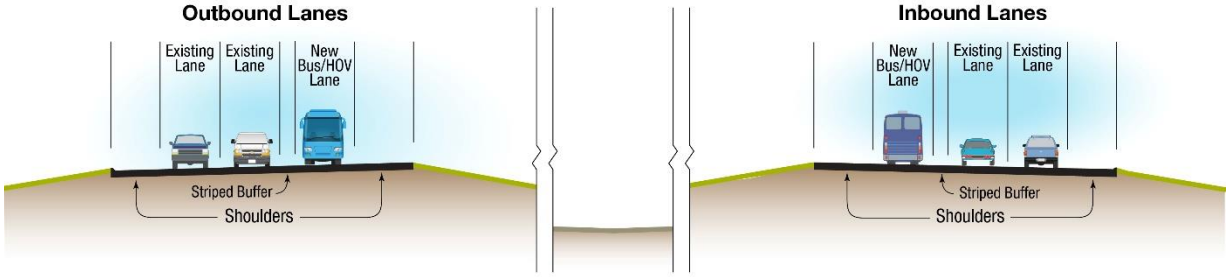
4.3. Alternative Concept 8: Managed Lane(s) (non-tolling)

Alternative concept 8 proposes adding a new managed lane or lanes (non-tolled) in each direction and includes a widened inside shoulder on Peña Boulevard. Managed lanes are a set of lanes where operational strategies are proactively implemented and managed in response to changing conditions. The operations of these managed lanes could include high occupancy vehicle lanes. Two alternatives were considered under this concept:

4.3.1. Alternative 8A: Add One Managed Lane in Each Direction

As shown in Figure 12, this alternative would include a new inside managed lane and a widened inside shoulder from 6 ft to 12 ft. in each direction. The additional managed lane would provide trip reliability and reduce congestion.

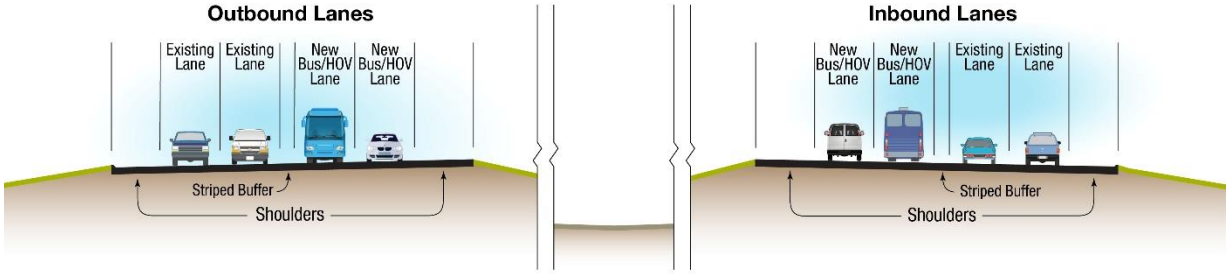
Figure 12 – Alternative 8A: Add One Managed Lane in Each Direction



4.3.2. Alternative 8B: Add Two Managed Lanes in Each Direction

As shown in Figure 13, this alternative would include two new inside managed lanes and a widened inside shoulder from 6 ft. to 12 ft. in each direction. The additional managed lanes would provide trip reliability and reduce congestion.

Figure 13 – Alternative 8B: Add Two Managed Lanes in Each Direction



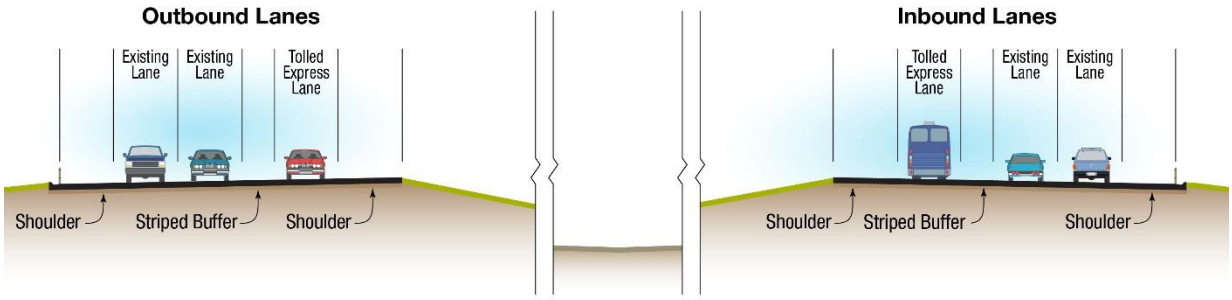
4.4. Alternative Concept 9: Managed Lane(s) (tolling)

Alternative Concept 9 proposes adding a new managed lane or lanes (tolled) in each direction and includes a widened inside shoulder on Peña Boulevard. Users pay a toll to gain access to the new capacity, but preference (e.g., free or reduced-toll access) may be provided for high-occupancy vehicles. The operations of these tolled lanes would be decided at a later point in the Study but could include dynamic pricing lanes or high occupancy toll lanes. Two alternatives were considered under this concept:

4.4.1. Alternative 9A: Add One Tolled Express Lane in Each Direction

As shown in Figure 14, this alternative would include a new tolled lane and widened inside shoulder from 6 ft to 12 ft in each direction. The striped buffer would provide a soft measure separation from the existing lanes and would disincentivize weaving vehicular movements.

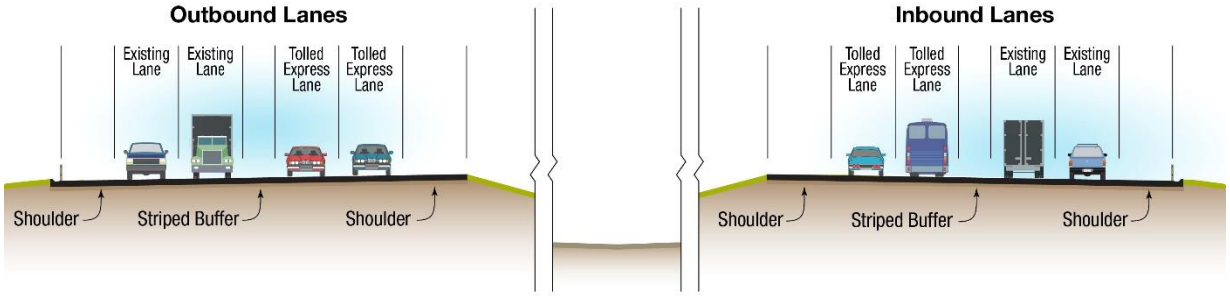
Figure 14 – Alternative 9A: Add One Tolled Lane in Each Direction



4.4.2. Alternative 9B: Add Two Tolled Express Lanes in Each Direction

As shown in Figure 15, this alternative would include adding two new tolled lanes in each direction and widening the inside shoulder from 6 ft to 12 ft. The striped buffer would provide a soft measure separation from the existing lanes and would disincentivize weaving vehicular movements.

Figure 15 – Alternative 9B: Add Two Tolled Lanes in Each Direction



4.5. Elements Incorporated into Retained Alternatives

Although eliminated as standalone alternatives during Level 1 screening; ITS/operational, multimodal, and safety improvements all satisfy elements of the purpose and need and therefore will be incorporated into the remaining alternatives for Level 2 screening. The elements of the eliminated alternatives incorporated into the retained alternatives are described below.

4.5.1. Alternative Concept 1: ITS and Operational Improvements

All of the retained alternatives will incorporate innovative technologies to manage demand. Opportunities include ramp metering, peak period shoulders, and real-time traffic and road condition information to reduce overall congestion by managing demand. Additional ITS improvements may include active traffic management, variable message signs, and variable speed limits to help improve traffic flow on the existing and proposed transportation system.

4.5.2. Alternative Concept 2 – Multimodal Improvements

Regardless of cross-sectional improvements to Peña Boulevard, the Study will identify adjacent multi-use trails, outside of the Peña Boulevard roadway, to improve comfort for pedestrians and cyclists in the Study area. The trails would increase regional connectivity for active transportation by connecting to DEN, the First Creek Trail and RTD A-Line Stations along Peña Boulevard. Identified trails will be further refined during the environmental review phase due to begin in 2024.

4.5.3. Alternative Concept 3 – Safety Improvements

All of the retained alternatives will include safety improvements that aim to reduce the number and severity of collisions and near misses on Peña Boulevard. This includes geometric improvements to bring Peña Boulevard up to current design standards including improved shoulder widths, acceleration/deceleration lengths, and merge/diverge locations. The current shoulder widths vary between 6 ft to 8 ft., increasing the shoulder widths uniformly to 12 ft. would reduce accidents and enhance infrastructure resiliency. Increased acceleration and deceleration lane lengths on Peña Boulevard would enhance safety and improve access for vehicles/freight movements.

4.5.4. Alternative Concept 4 – Transportation Demand Management (TDM) Improvements

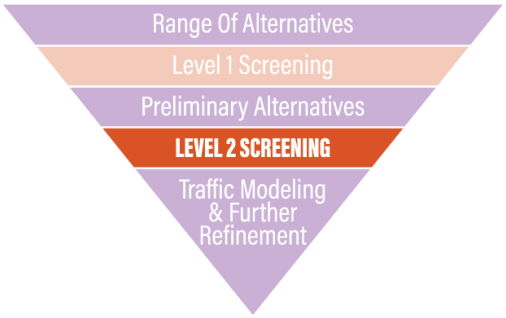
Regardless of cross-sectional improvements to Peña Boulevard, the Study includes the development of a Transportation Demand Management (TDM) Plan, with recommendations and specific policies to improve transportation infrastructure and increase mobility choices for DEN passengers and employees. This TDM Plan will establish target mode splits that aim to decrease vehicle trips on Peña Boulevard and encourage more sustainable transportation options to passengers, visitors, and employees at DEN.

The TDM solutions would include implementable strategies and plans on how DEN can increase its share of public transit ridership (including RTD A-Line and bus services), support employee vanpools/carpools, incentivize sustainable transportation, and encourage HOVs. Proposed solutions could include employee incentive programs to promote transit ridership, innovative parking solutions to encourage carpools and vanpools, and improved facilities to make sustainable transportation more enticing, such as bike lockers, assembly and repair stations, and bike tools.

5. Level 2 Screening

The Level 2 screening involved a more detailed evaluation of the preliminary alternatives that were developed after the Level 1 screening. The Level 2 screening of preliminary alternatives is evaluated using the project's goals and objectives. These goals and objectives were organized into eleven categories that included Mobility, Safety, Manage Demand and Congestion, Economic Growth, Equity and Access to Jobs, Resilience, Sustainability, Environment, Partnership, Innovative Technologies, and Inclusivity and Accessibility. These categories reflect themes and topics important to the study's stakeholders and the general public, as well as issues important to DEN.

Figure 16 – Level 2 Screening Concept



Alternatives were either retained, set aside, eliminated as a standalone alternative, or eliminated as follows:

- **Retained for additional analysis –** the alternative satisfies the Study Goals and Objectives and will be progress to traffic modeling where it will be analyzed and further refined.
- **Eliminated as a standalone alternative –** the alternative satisfies some but not all the goals and objectives and therefore will no longer be considered as a standalone alternative but elements of it could be incorporated into the retained alternatives.
- **Set aside/Eliminated from further consideration –** the alternative does not meet the goals and objectives and will not progress to traffic modeling or analyzed further.

5.1. Study Goals & Objectives and Level 2 Criteria

Goals and Objectives were created at the beginning of the Study to guide the development of infrastructure improvements for the Peña Boulevard corridor and a Travel Demand Management (TDM) Plan for the airport. From these goals and objectives evaluation metrics were developed for Level 2 screening.

Based on a qualitative evaluation, each alternative will receive one of three responses to each of the evaluation criteria: fully satisfies criteria, somewhat satisfies criteria, or does not satisfy criteria. A "fully satisfies criteria" response indicated the concept would meet or has the potential to meet the criterion in question. A "somewhat satisfies criteria" response indicated the concept likely would not affect the criterion in question. A "does not satisfy criteria" response indicated that the concept likely would negatively affect the criterion in question.

The Study Goals and Transportation Objectives and the Level 2 screening criteria are outlined in Table 8.

Table 8 – Study Goals & Objectives and Level 2 Evaluation

Goal		Transportation Objectives	Fully Satisfies (Level 2)	Somewhat Satisfies (Level 2)	Does Not Satisfy (Level 2)
Mobility	Improve mobility for all ground transportation modes accessing the airport: vehicles; freight; transit; and first mile/last mile bicycle and pedestrian connections to transit.	• To expand travel options to the airport, prioritize mobility improvements that improve access to transit for vehicles, bicycles and pedestrians. • Identify opportunities to accommodate cyclists on facilities off Peña Boulevard	• Improves access to the airport for all ground transportation modes Provides dedicated facilities for HOV and transit • Accommodates cyclists on facilities off Peña Boulevard	• Improves access to the airport for some ground transportation modes. Improvements provide indirect benefits for HOVs and transit • Some accommodation for cyclists on facilities off Peña Boulevard	• Would not improve access to the airport • No improvement for HOVs or transit • No accommodation for cyclists on facilities off Peña Boulevard
Safety	Eliminate traffic related crashes, fatalities and serious injuries on Peña Boulevard and enhance safety of all users along the Corridor.	• Bring Peña Boulevard up to current geometric standards including improved shoulder widths, acceleration/ deceleration lane lengths, and merge/ diverge locations • Evaluate all alternatives on their ability to reduce crash rates on Peña Boulevard • Incorporate strategies from Denver's Vision Zero Action Plan	• Proactively improves safety and brings Peña Boulevard up to current geometric standards - Increased shoulder width - Acceleration/deceleration lane improvements - Improve merge/diverge safety • Addresses aging infrastructure • Incorporates most strategies from Denver's Vision Zero Action Plan	• Brings Peña Boulevard up to current geometric standards • Addresses aging infrastructure • Incorporate only a few strategies from Denver's Vision Zero Action Plan	• Would not bring Peña Boulevard up to current geometric standards • Would not address aging infrastructure • Would not incorporate any strategies from Denver's Vision Zero Action Plan
Manage Demand and Congestion	Ensure Peña Boulevard continues to facilitate the growth of DEN while reasonably accommodating surrounding non-airport developments.	• Identify a preferred alternative that proactively addresses capacity and congestion issues on Peña Boulevard	• Proactively manages travel demand on Peña • Improves travel time reliability	• Adds additional capacity but does not manage travel demand • Improves travel time reliability in the short term	• Would not manage travel demand on Pena Blvd • Would not improve travel time reliability
Economic Growth	Support the DEN's Vision 100 strategic plan to prepare for 100 million annual passengers within 10 years.	• Address infrastructure and capacity deficiencies in the Peña Boulevard Corridor to enable DEN to serve 100 million passengers in the next 8-10 years and continue to boost the local and regional economy • Accommodate the projected growth of freight and ensure efficient supply chain movements on Peña Boulevard	• Enables continued growth of DEN and surrounding local and regional growth • Accommodates the projected growth of freight	• Enables some additional growth of DEN and surrounding local and regional growth • Accommodates some of the projected growth of freight	• Would not enable the growth of DEN and surrounding local and regional growth • Would not accommodate the projected growth of freight

Goal		Transportation Objectives	Fully Satisfies (Level 2)	Somewhat Satisfies (Level 2)	Does Not Satisfy (Level 2)
Equity and Access to Jobs	Increase transportation choices along the corridor to reduce barriers to economic opportunity, ensure all residents have equitable access to employment at the airport.	• Engage with communities affected by the Study and integrate their considerations into the proposed solutions	• Improves transit access to DEN by providing dedicated lanes for transit and HOV • Increases transportation choices along the corridor • Increases access from historically disadvantaged communities along Peña Boulevard to DEN	• Improves transit access to DEN but does not provide dedicated lanes for transit and HOV • Increases transportation choices along the corridor but does not explicitly consider historically disadvantaged communities along Peña Boulevard	• Would not improve transit access to DEN or provide dedicated lanes for transit and HOV • Would not increase transportation choices along the corridor • Would not increase access from historically disadvantaged communities along Peña Boulevard to DEN
Resilience	Increase the resilience and reduce the total lifecycle cost of existing transportation facilities and systems on Peña Boulevard.	• Identify geometric and other improvements that reduce the disruption to air passengers, employees and freight during accidents, extreme weather events and routine maintenance • Improve the condition of Peña Boulevard and contribute to an ongoing state of good repair	• Address current and projected system vulnerabilities	• Address current but not future projected system vulnerabilities	• Would not address measurable system vulnerabilities
Sustainability	Reduce single occupancy vehicles (SOVs) on Peña Boulevard and shift existing travel to more sustainable modes of transportation.	• Follow the Envision® Framework to promote more cost effective, resource-efficient and adaptable long-term infrastructure solutions • Align with DEN's Sustainability Policy to consider the long-term economic, social, and environmental impacts of improvements to Peña Boulevard	• Alternative prioritizes more sustainable modes of transportation and results in a reduction of SOVs on Peña Boulevard.	• Alternative promotes more sustainable modes of transportation and encourages a reduction of SOVs on Peña Boulevard.	• Alternative does not encourage a reduction of SOVs on Peña Boulevard or a shift to more sustainable modes of transportation.
Environment	Improve air quality and enhance quality of life in the communities surrounding Peña Boulevard.	• Reduce impacts to local communities by addressing capacity issues along Peña Boulevard to mitigate vehicles diverting to the local road network • Avoid, minimize, and mitigate impacts to the natural and human environment • Prioritize improvements that promote environmental and ecological restoration	• Provides adequate capacity on Peña Boulevard so that traffic does not divert onto local street network • Manages demand on Peña Boulevard to reduce idling vehicles	• Provide some additional capacity on Peña Boulevard but traffic still diverts onto local street network • Manages demand on Peña Boulevard to reduce idling vehicles	• Capacity concerns on Peña Boulevard are not addressed and traffic diverts onto local street network • Would not manage demand on Peña Boulevard to reduce idling vehicles

Goal		Transportation Objectives	Fully Satisfies (Level 2)	Somewhat Satisfies (Level 2)	Does Not Satisfy (Level 2)
Partnership	Keep surrounding agencies informed of the proposed solutions for the Peña Boulevard Corridor and the associated benefits to the region.	• Engage with surrounding agencies to keep them informed of the strategic plan for Peña Boulevard • Work with the City of Denver to develop an overall strategic plan for the Gateway Area • Identify opportunities to incorporate transportation and mobility improvements outlined in the Far Northeast Area Plan	• Surrounding agencies are engaged and their feedback is considered as part of the alternatives evaluation	• Surrounding agencies are informed of the recommended alternatives but there is limited feedback	• Surrounding agencies are not engaged as part of the alternative evaluation process
Innovative Technologies	Use technology to improve operations and accommodate the projected growth on Peña Boulevard.	• Deploy intelligent transportation systems (ITS) and communication technology to improve operations and manage congestion on Peña Boulevard • Identify technology solutions to support more efficient travel on Peña Boulevard such as electric vehicle infrastructure and connected vehicle technology • Identify solutions that reduce embodied carbon during construction	• Deploys ITS technology to manage demand on Peña Boulevard	• Deploys some ITS technology on Peña Boulevard, somewhat helps manage demand	• Would not use innovative technology to manage demand on Pena Blvd
Inclusivity and Accessibility	Promote inclusive, accessible, and safe modes of transportation removing unnecessary barriers for people with disabilities and access needs.	• Identify transportation solutions that reduce barriers for people with disabilities accessing the airport • Identify transportation solutions that prioritize buses and shuttles	• Improves access to DEN for people with disabilities by providing dedicated lanes for transit and HOV •	• Somewhat improves access to DEN for people with disabilities by providing dedicated lanes for transit and HOV	• Does not improve access to DEN for people with disabilities by providing dedicated lanes for transit and HOV

What is ENVISION?

Envision® is a holistic sustainability framework and rating system that enables a thorough examination of the sustainability and resiliency of all types of civil infrastructure. It is the only comprehensive tool in North America that can assist public and private agencies in delivering civil infrastructure that tackles climate change, addresses public health needs, cultivates environmental justice, creates jobs, and spurs economic recovery. Now explain how DEN uses this.

Sustainability at DEN

DEN is committed to strategically considering the long-term economic, social, and environmental impacts of all airport activities in order to maximize long-term benefits and ensure that DEN's success strengthens our community and stakeholders. DEN will utilize the Envision® framework to find ways to incorporate sustainable infrastructure strategies.

5.2. Level 2 Screening

The results of Level 2 Screening are outlined in Table 9.

Table 9 - Level 2 Screening Matrix with Goals

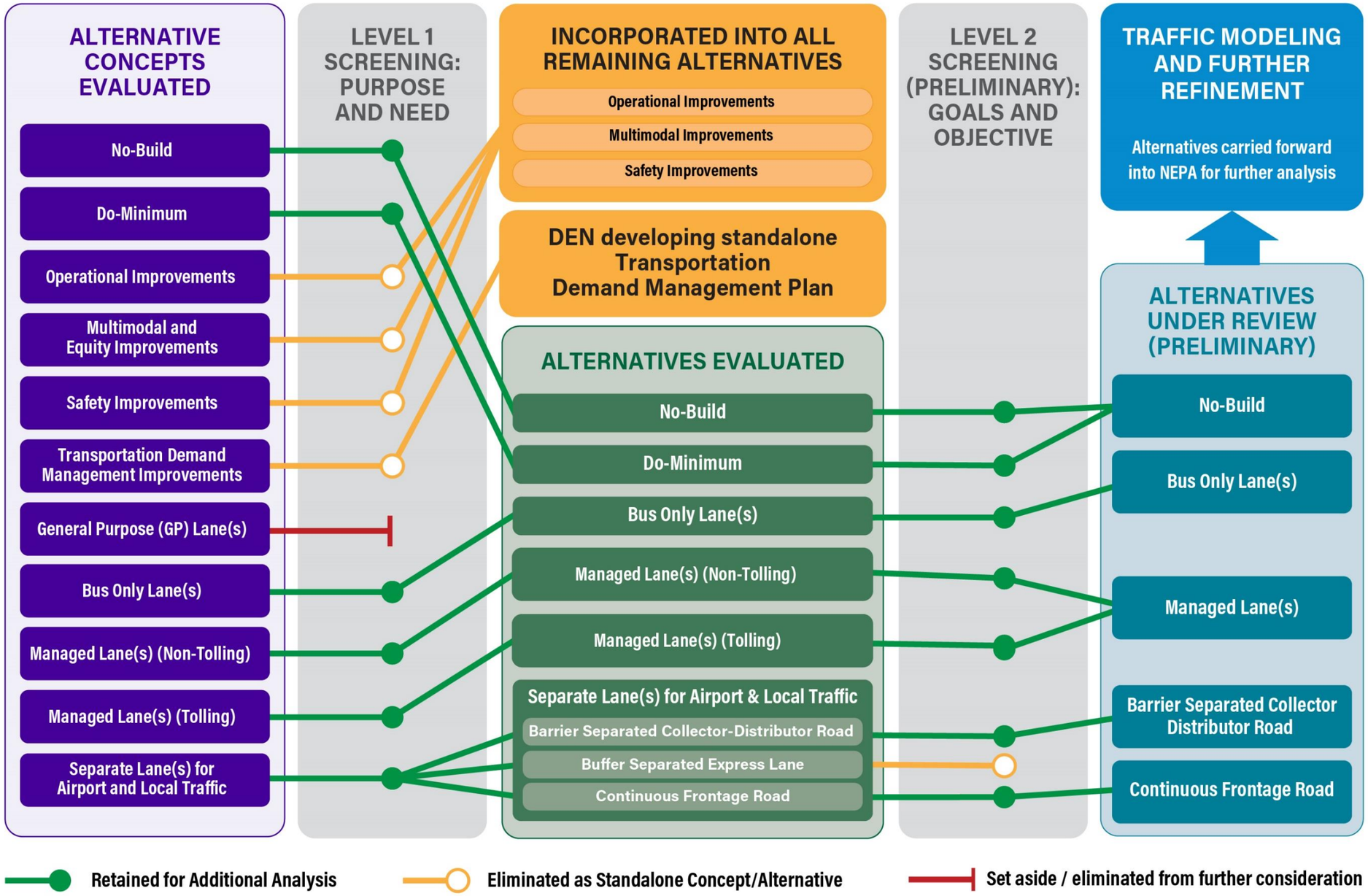
Satisfies criteria – 1 point	Somewhat satisfies criteria – 0.5 points	Does not satisfy criteria – 0 points

Concept	Alternative	Mobility	Safety	Manage Demand and Congestion	Economic Growth	Equity and Access to Jobs	Resilience	Sustainability	Environment	Partnership	Innovative Technologies	Inclusivity and Accessibility	Score out of 11	Recommendation (Retained, set aside, eliminated)
	Existing (No Build)	0	0	0	0	0	0	0	0	0	.5	0	0.5	Retained for comparison purposes
	Do- Minimum	0	.5	.5	0	0	.5	0	0	0	.5	0	2.0	Retained for traffic modeling and further refinement
Transit	**Bus-Only Lane**	.5	.5	1	.5	1	.5	1	1	1	1	1	8.5	Retained for traffic modeling and further refinement
Separate Lane(s) for airport and local traffic	**Alternative 2A: Add Barrier Separated Express Lane**	.5	1	1	1	.5	.5	0	.5	1	.5	.5	7.0	Retained for traffic modeling and further refinement
Separate Lane(s) for airport and local traffic	**Alternative 2B: Add Buffer Separated Express Lane**	.5	1	1	1	.5	.5	0	.5	1	.5	.5	7.0	Retained for traffic modeling and further refinement
Separate Lane(s) for airport and local traffic	**Alternative 2C: Add Continuous Frontage Road**	.5	1	1	1	.5	.5	0	.5	1	.5	.5	7.0	Retained for traffic modeling and further refinement
Managed Lane(s) (non-tolling)	**Alternative 3A: Add Managed Lane(s) in Each Direction**	1	1	1	1	1	1	1	1	1	1	1	11.0	Retained for traffic modeling and further refinement
Managed Lane(s) (tolling)	**Alternative 4A: Add Tolled Lane(s) in Each Direction**	1	1	1	1	.5	1	1	1	1	1	1	10.5	Retained for traffic modeling and further refinement

5.3. Level 2 and Level Screening Summary

The results of Level 2 Screening Figure 17 provides a graphical summary of level 1 and level 2 screening.

Figure 17 – Alternatives Screening Summary



6. Traffic Modeling and Further Refinement

Following Level 2 screening and evaluation, there were five preliminary alternatives concept that were recommended for more detailed analysis, see Figure 18. The purpose of this additional analysis was to understand how the remaining concepts could be applied in different ways along Peña Boulevard and to understand how these different implementation variations would affect the corridor. This additional refinement and evaluation process was completed in two steps. First, a range of implementation configurations were identified based on the alternative concepts carried forward from the Level 2 Screening. Then, each of these configurations were evaluated using DRCOG's regional travel demand model to understand how they may impact travel and congestion along Peña Boulevard and the surrounding neighborhoods.

Figure 18 – Traffic Modeling and Further Refinement Concept

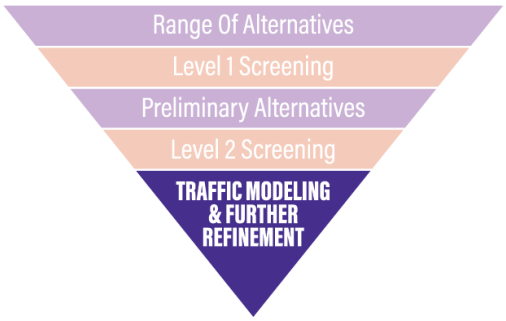
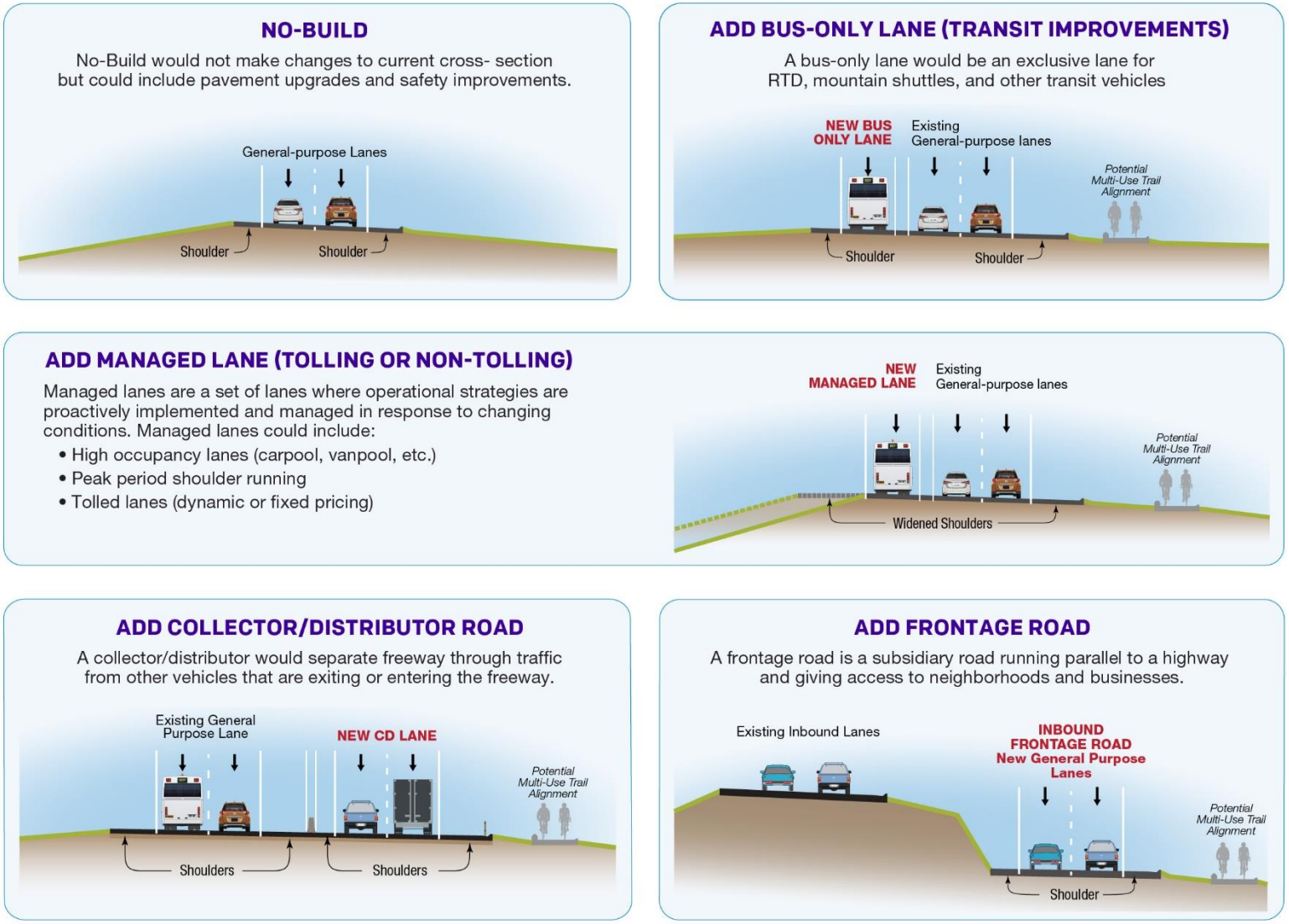


Figure 19 – Remaining Alternative Concepts After Level 1 & 2 Screening



6.1. Refined Alternatives Evaluated

Using the five alternative concepts carried forward from the Level 2 screening, a series of different potential implementation configurations were identified to be further evaluated. These implementation configurations represent a range of ways in which the five alternative concepts could be constructed. This includes variations in the extents of potential improvements, different combinations of improvements, different operational strategies, etc. The range of implementation configurations is based on:

1. feasible ways in which improvements may be constructed,
2. likelihood to result in distinct operational impacts as compared to each other, and
3. inclusivity of all five alternative concepts carried forward from the Level 2 Screening.

A description of the different configurations and refinement evaluated for each of the alternative concepts is provided below. Additional details about the individual implementation configurations modeled, traffic analysis methodology, assumptions used, and detailed traffic modeling results can be found in the *Peña Boulevard Transportation and Mobility master Plan Alternative Analysis Traffic Technical Report*.

6.1.1. No-Build Alternative

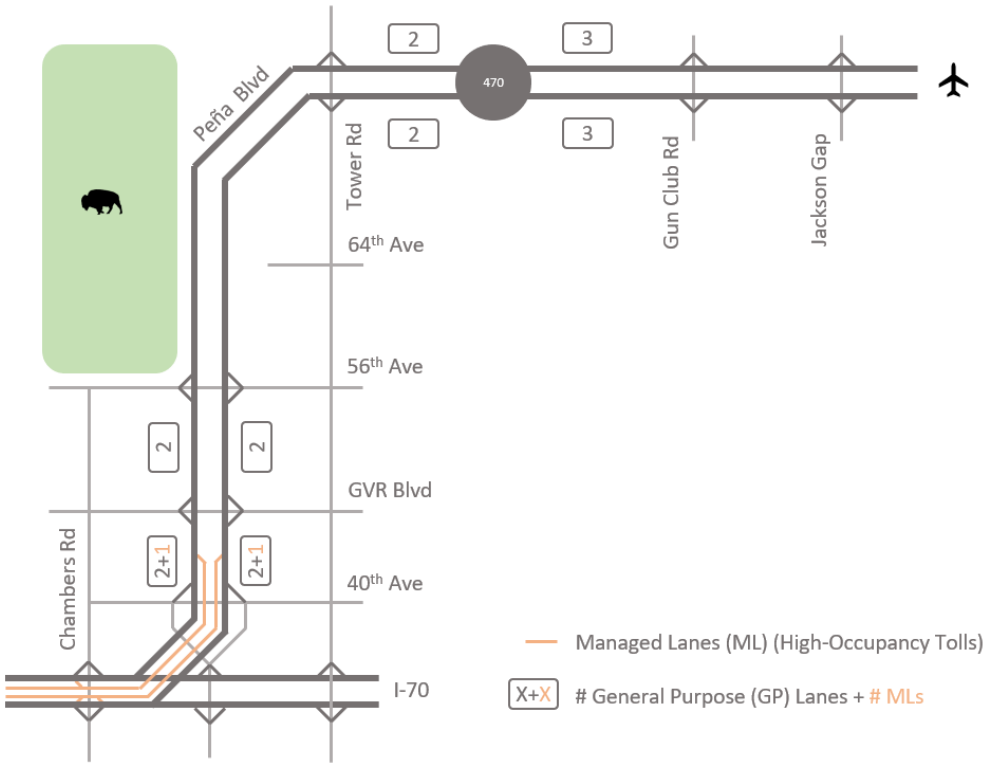
The No-Build Alternative would not make any changes to the current cross-section of Peña Boulevard. However, it is not the same as existing conditions, as improvements to other adjacent facilities still may occur as part of other projects and result in changes to operations or conditions along Peña Boulevard. DRCOG maintains and regularly updates a list of regionally significant projects within the *2050 Metro Vision Regional Transportation Plan*. At the time the Peña Master Plan was developed, one project was identified within the *2050 Metro Vision Regional Transportation Plan* that could impact the No-Build Alternative of Peña Boulevard: the construction of managed lane direct connect ramps between existing managed lanes along I-70 and Peña Boulevard.

Direct connect ramps between I-70 and Peña Boulevard are envisioned to start/end between 40th Avenue and GVR Boulevard. North of GVR Boulevard, Peña Boulevard would continue to have two general purpose lanes in each direction (the same as existing conditions). Figure 20 shows the layout considered for the No Build Alternative.

What are managed lane direct connect ramps?

Managed lane direct connect ramps are freeway ramps that connect from a managed lane facility to another facility, such as a managed lane on a crossing freeway or to a local roadway. The purpose of such ramps is to allow vehicles to enter or exit a managed lane facility, which are typically located on the inside-most lane of a freeway without needing to merge across multiple lanes of traffic. Eliminating these lane changes improves traffic flow and reduces crashes.

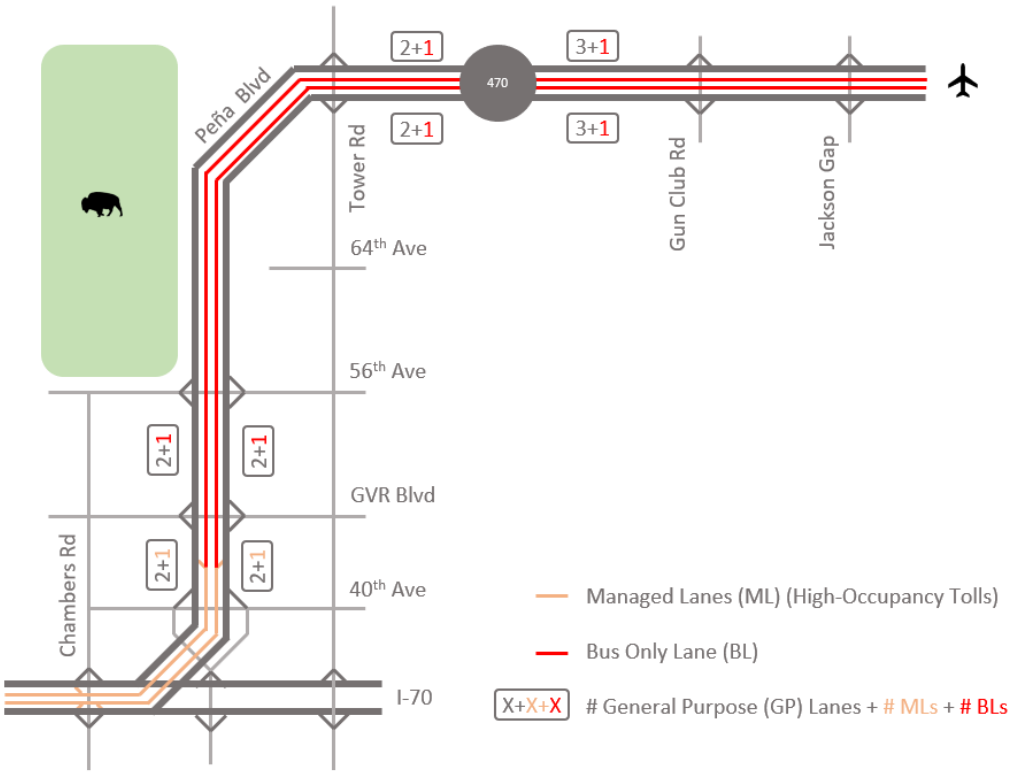
Figure 20 – No Build Alternative with Direct Connect Ramps Between I-70 and Peña Boulevard



6.1.2. Add Bus-Only Lane Alternative

The Add Bus-Only Lane Alternative proposes to construct an additional lane in each direction along Peña Boulevard that would be reserved for use by transit buses, including RTD buses, airport shuttles, etc. It is envisioned that on the southern end of Peña Boulevard (near I-70), the bus only lanes would connect directly to the managed lane direct connect ramps to/from I-70 by providing buses a seamless connection to the regional express lanes network. Figure 21 shows the implementation configuration evaluated as part of this study.

Figure 21 – Bus-Only Lane Alternative



6.1.3. Add a Facility to Accommodate Local Traffic Alternative

Growth both at DEN and within the northeast Denver Metropolitan Region will continue to exert dual pressures on Peña Boulevard and to serve both airport and non-airport traffic. This alternative proposes constructing new facilities to best manage the needs of both user groups. Within this master plan study, two types of facilities were considered to manage local traffic, including collector-distributor (C-D) roads and a frontage road. Although each facility type is slightly different, the intention of both is to separate local traffic from DEN traffic and create appropriate infrastructure tailored to the needs of these two different user groups.

6.1.3.1. Add Frontage Road

Frontage roads are adjacent local roadways that are not grade-separated, running parallel to Peña Boulevard. The purpose of a frontage road is to provide better access and local connectivity to the local street network than can be provided by a freeway facility. Frontage roads also provide an alternative route for local traffic trips that do not require them to utilize the freeway facility. Three different implementation options were evaluated for this alternative including:

- Two-Lane Frontage Road from 40th Avenue to Tower Road with HOT Lanes from I-70 to Jackson Gap Road
- Two-Lane Frontage Road from 40th Avenue to Tower Road
- Four-Lane Frontage Road from 40th Avenue to Tower Road

These different options varied things such as the number of lanes along the frontage and the potential combination of frontage with additional managed lanes on Peña Boulevard. Figure 22 through Figure 24 show the layouts considered for the Add a Facility to Accommodate Local Traffic Alternative.

Figure 22 – Two Lane Frontage Road from 40th Avenue to Tower Road with HOT Lanes from I-70 to Jackson Gap Road

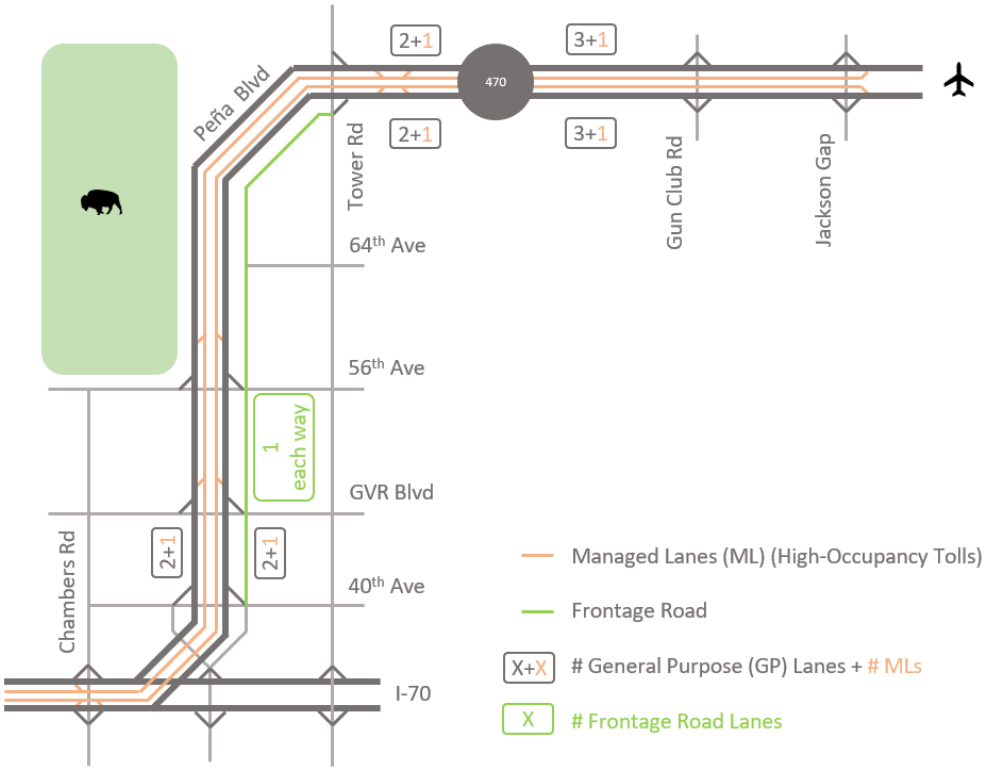


Figure 23 – Two Lane Frontage Road from 40th Avenue to Tower Road

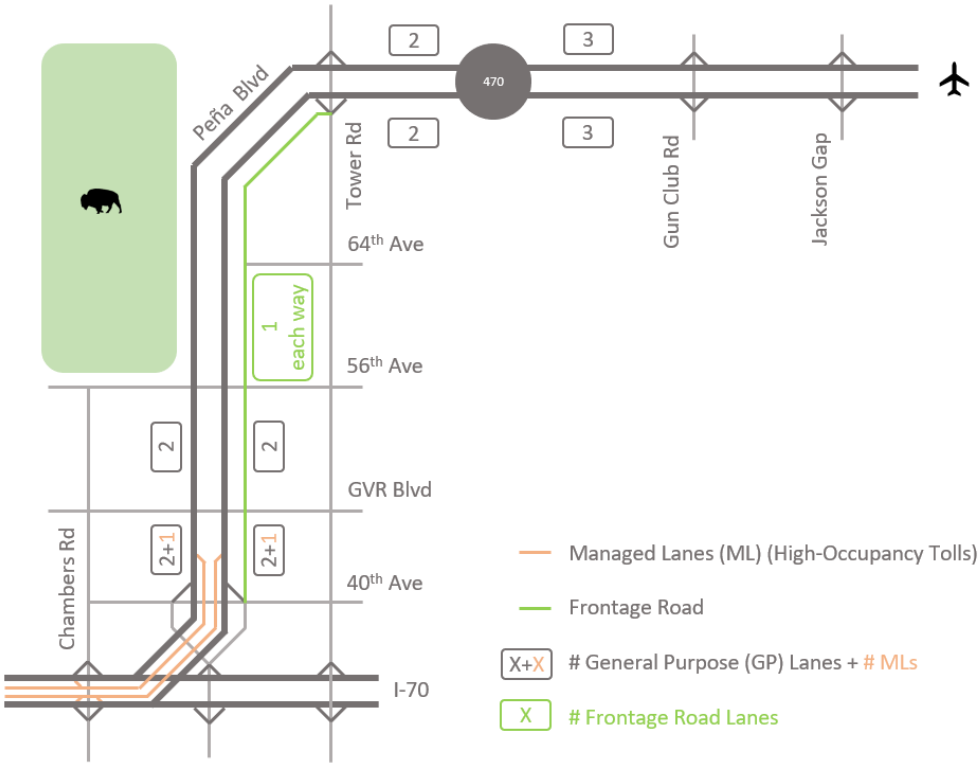
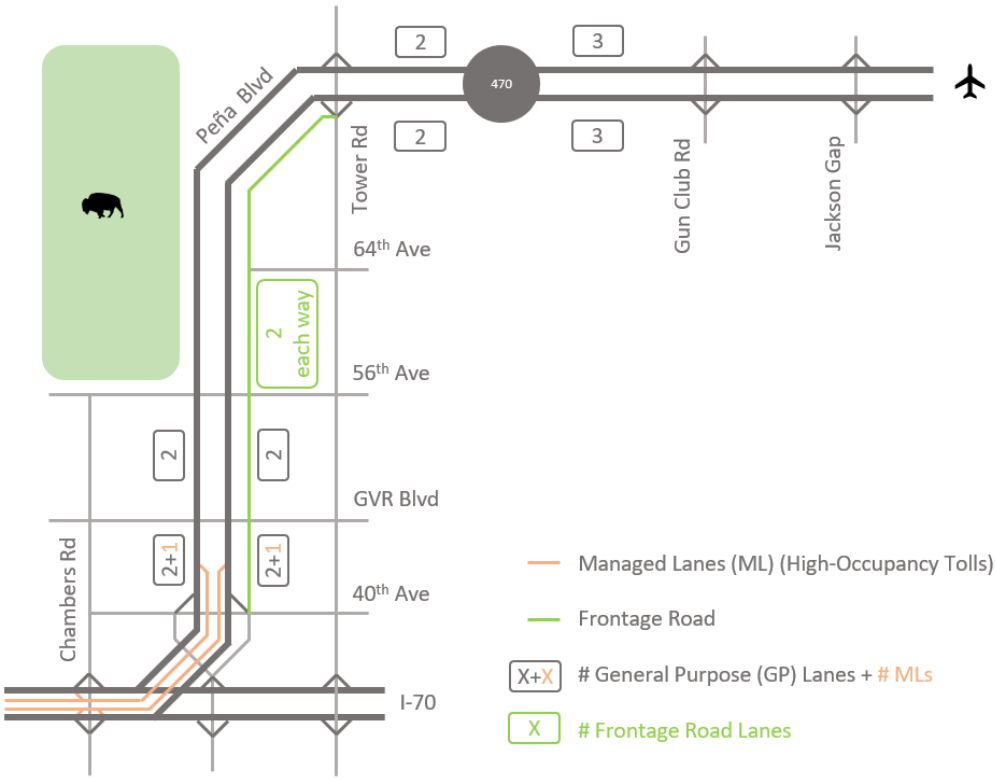


Figure 24 – Four Lane Frontage Road from 40th Avenue to Tower Road



6.1.3.2. Add Collector Distributor Roads

C-D roads are fully grade-separated, freeway-type facilities which run parallel to the mainline freeway and connect to on-ramps and off-ramps. The purpose of C-D roads is to separate traffic getting onto or off the freeway from traffic that is continuing through. This alternative provides an "airport express-lane" for through traffic to proceed without interruption from on-ramp and off-ramp local traffic usage. The lane changing associated with on-ramps and off-ramps happen on a dedicated facility, which may have a lower speed limit than the mainline freeway making it safer and easier to change lanes, especially when on-ramps and off-ramps are closely spaced.

Four different implementation options were evaluated for this alternative including:

- One-Lane C-D Roads from 40th Avenue to 56th Avenue with HOT Lanes from I-70 to Jackson Gap Road
- One-Lane C-D Roads from 40th Avenue to Tower Road with HOT Lanes from I-70 to Jackson Gap Road
- One-Lane C-D Roads from 40th Avenue to Tower Road
- Two-Lane C-D Roads from 40th Avenue to Tower Road

These different options varied things such as the number of lanes along the C-D roads, the extents of the C-D roads, and the potential combination of C-D roads with additional managed lanes on Peña Boulevard. Figure 25 through Figure 28 show the layouts considered for the Add a Facility to Accommodate Local Traffic Alternative.

Figure 25 – One Lane C-D Roads Between 40th Avenue and 56th Avenue with HOT Lanes Between I-70 and Jackson Gap Road

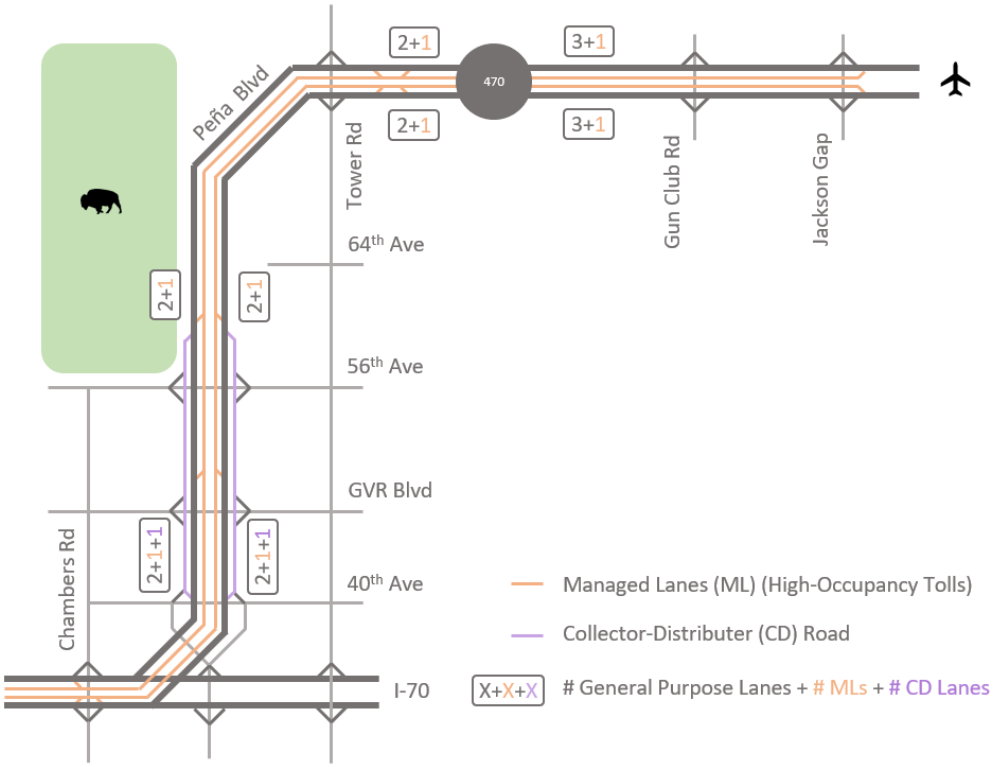


Figure 26 – One Lane C-D Roads Between 40th Avenue and Tower Road with HOT Lanes Between I-70 and Jackson Gap Road

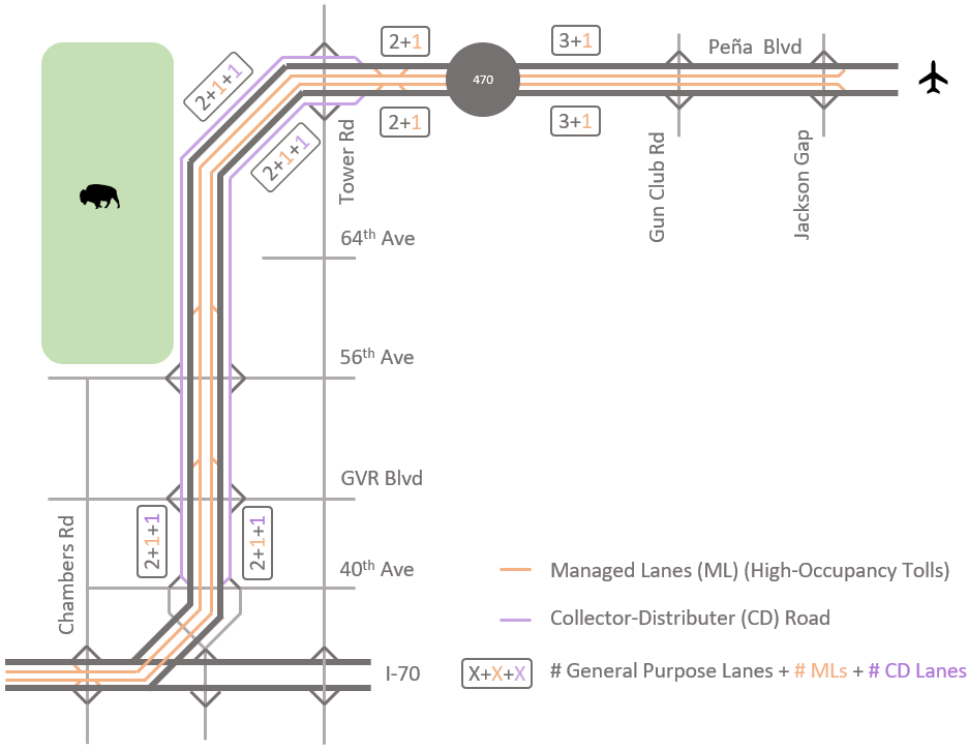


Figure 27 – One Lane C-D Roads Between 40th Avenue and Tower Road

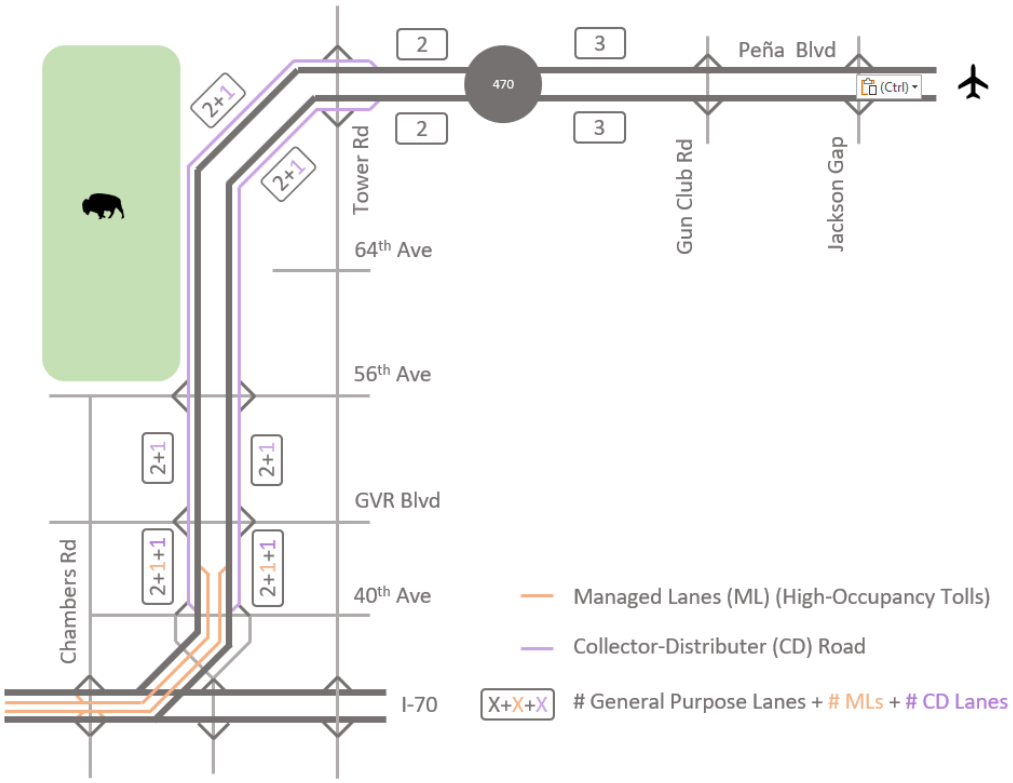
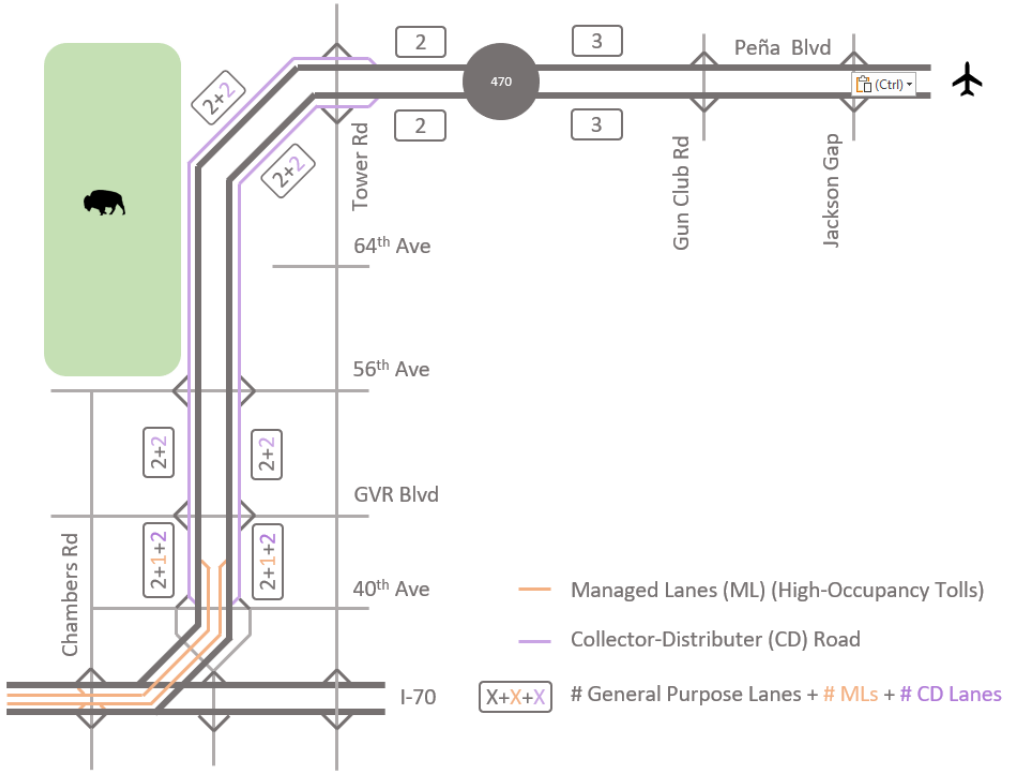


Figure 28 – Two Lane C-D Roads Between 40th Avenue and Tower Road



6.1.4. Add Managed Lanes Alternative

This alternative proposes constructing new lanes along Peña Boulevard that would have a specific usage strategy to help achieve specific mobility objectives. This master plan study considered several management strategies, including high-occupancy toll (HOT) lanes and high-occupancy vehicle (HOV) lane configurations with different extents, including:

- One HOT lane in each direction between I-70 and Jackson Gap Street
- One HOV2+ lane in each direction between I-70 and E-470
- One HOV2+ lane in each direction between I-70 and Jackson Gap Street

Figure 29 through Figure 31 show the configurations considered for the Add Managed Lanes Alternative.

Figure 29 – HOT Lanes from I-70 to Jackson Gap Road

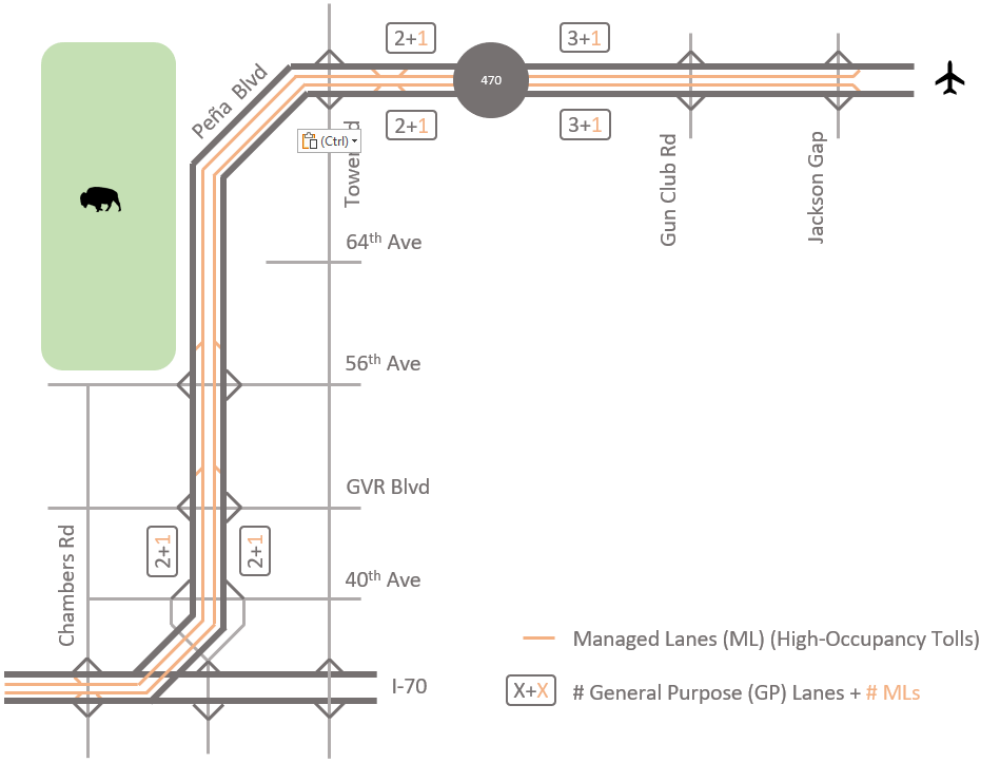


Figure 30 – HOV2+ Lanes from I-70 to E-470

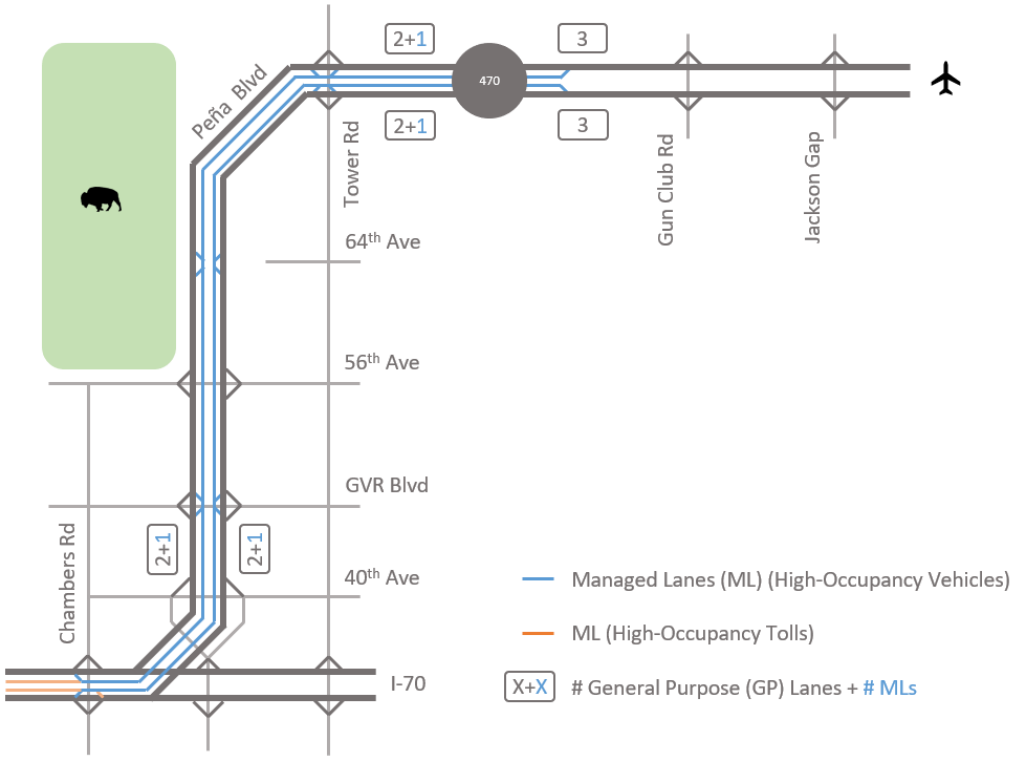
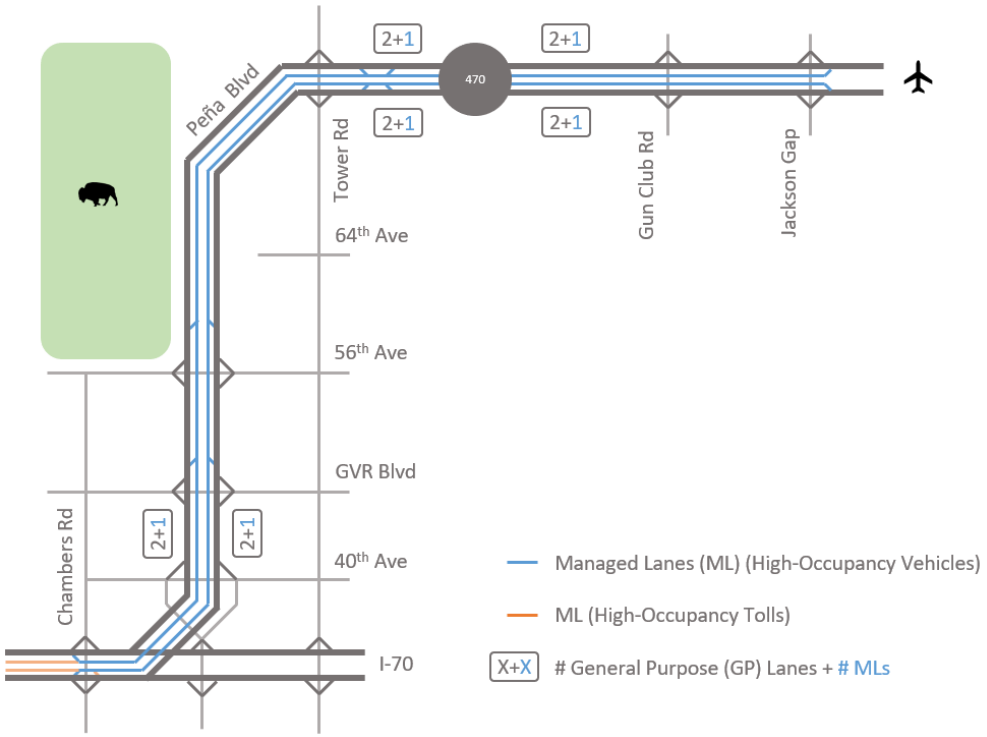


Figure 31 – HOV2+ Lanes from I-70 to Jackson Gap Road



6.2. Traffic Modeling Findings

The various refined alternatives were evaluated using DRCOG's regional travel demand model (TDM). Technical details about the TDM, including information about refinements made to the model to make it applicable to this project, are provided in the *Peña Boulevard Transportation and Mobility Master Plan Existing Traffic Conditions and Needs Technical Report*.

Several measures of effectiveness (MOEs) were considered to evaluate the concepts, including:

- Travel Times – for the purpose of summarization, PM peak travel times have been reported here because they represent the longest travel times as compared to the AM peak period. A shorter travel time reflects a quicker trip for people heading to or from DEN.
- Daily Vehicle Miles Travelled (VMT) – VMT is a measure of how many vehicles are traveling multiplied by the distance they travel. A higher VMT represents more vehicles traveling a further distance.
- Daily Vehicle Hours Travelled (VHT) – VHT is a measure of how many vehicles are traveling multiplied by the time it takes them to travel. A higher VHT reflects greater congestion in an area.
- Percent Single Occupancy Vehicles (SOVs) – The percentage of SOVs reflects how many people are choosing to drive alone in their vehicles. Increasing vehicle occupancy (i.e., reducing the percentage of SOVs) is a way of moving more people without needing to accommodate more vehicles on the road.
- Daily Vehicle Demand – the total number of vehicles wanting to use Peña Boulevard each day.

It should be noted that the Bus Only Lanes Alternative was not modeled in the TDM as the impact of bus only lanes is not derived from their physical presence, but rather by the associated transit services that are able to take advantage of the provided infrastructure. Details about how modified existing transit services or potentially new transit services would use bus only lanes on Peña Boulevard or the impact that could have on transit ridership were not developed as part of this study. From a roadway operations perspective, the Bus Only Lanes Alternative will operate similarly to the No Build Alternative. Therefore, vehicle operation results for the Bus Only Lanes Alternative were taken from the No Build Alternative and additional qualitative discussion has been included to consider the specific impacts bus only lanes could have on those operational results.

A summary of the MOEs for each alternative considered is provided in Table 10. More detailed discussion and results are provided in the following sections with a focus on the differentiating factors along Peña Boulevard. Complete documentation of the results and further discussion is provided in the *Peña Boulevard Transportation and Mobility master Plan Alternative Analysis Traffic Technical Report*.

Table 10 – Summary of 2050 Measure of Effectiveness

Alternative	Daily Vehicle Demand Along Peña Boulevard	AM Peak Period Travel Time in Minutes (Round trip from I-70 to Jackson Gap St and back to I-70)	AM Peak Period Travel Time in Minutes (Round trip from I-70 to Jackson Gap St and back to I-70)	PM Peak Period Travel Time in Minutes (Round trip from I-70 to Jackson Gap St and back to I-70)	PM Peak Period Travel Time in Minutes (Round trip from I-70 to Jackson Gap St and back to I-70)	Daily Study Area Vehicle Miles Traveled (VMT)	Daily Study Area Vehicle Miles Traveled (VMT)	Percent Single Occupancy Vehicles[1]
		GP Lanes	ML / Bus Lanes	GP Lanes	ML / Bus Lanes			
No-Build	165,000	27.8 minutes	n/a	56.4 minutes	n/a	2,520,600 miles	65,000 hours	77% SOV
Bus-Only	0% increase	0% increase	39% decrease	0% increase	n/a	0% increase	0% increase	0% increase
Managed Lanes (Bus + HOV2+)	10% to 11% increase	5% decrease	35% decrease	6% decrease	37% decrease	2% increase	3% decrease	5% decrease
Managed Lanes (Bus + HOT)	9% increase	7% decrease	26% decrease	8% decrease	30% decrease	1% increase	2% decrease	1% decrease
Frontage Road	12% to 17% decrease	24% decrease	29% decrease	9% to 20% decrease	36% decrease	0% to 2% increase	2% decrease to 1% increase	1% to 2% decrease
Collector-Distributor	11% to 20% increase	22% decrease	29% decrease	13% to 20% decrease	33% decrease	2% to 4% increase	3% to 5% decrease	1% to 0% decrease

[1]SOV percentages are for Pena Boulevard between 40th Avenue and GVR Boulevard.

Note: all increase and decreases are calculated relative to the No-Build Alternative

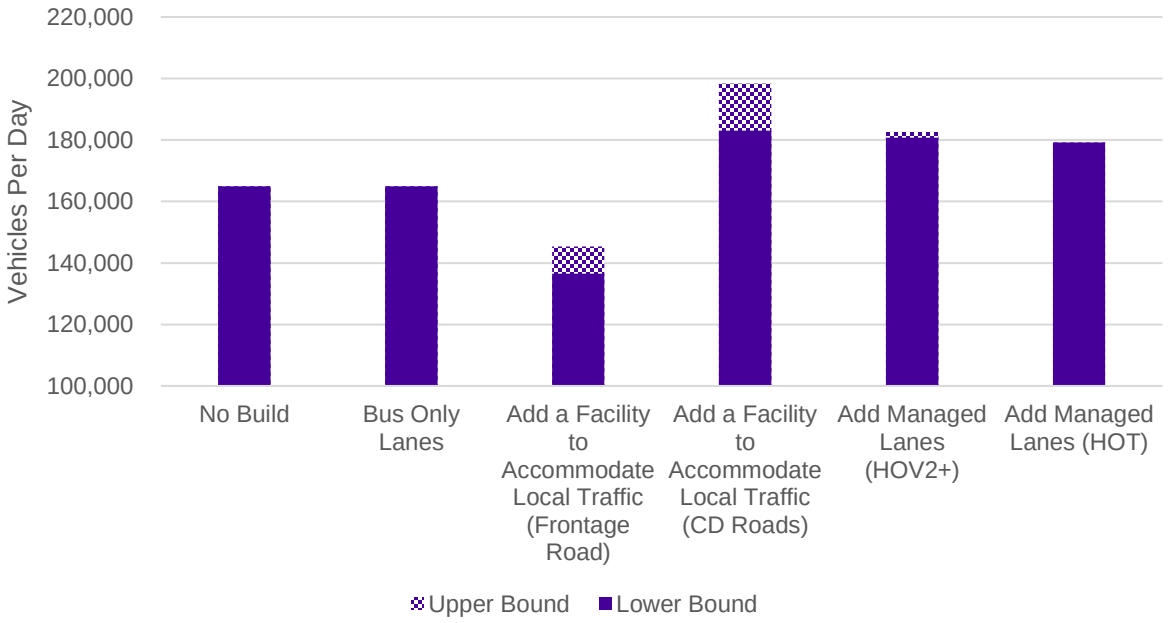
6.2.1. Volumes Along Peña Boulevard

Figure 32 shows the projected 2050 daily demand volumes on Peña Boulevard between GVR Boulevard and 56th Avenue for the various alternatives. The minimum and maximum values shown for each alternative reflect the different projected demand volumes given different implementation configurations.

The Add a Facility to Accommodate Local Traffic Alternative is expected to have the highest variation in demand for Peña Boulevard. In general, adding C-D roads to Peña Boulevard is expected to result in an increase in volumes as compared to the No Build Alternative because C-D roads create additional capacity and allow for people to travel to local interchanges more easily. Adding a frontage road to Peña Boulevard is expected to reduce vehicle volumes on Peña Boulevard as compared to the No Build Alternative because trips going to local interchanges, such as GVR Boulevard and 56th Avenue, will instead use the new frontage road. The exact reduction or addition in volumes is influenced by the extent and capacity of the facilities provided.

Variation in vehicle demand for the Add Managed Lanes Alternative is primarily the result of different ML strategies (HOT and HOV2+). Modeling results show the greatest demand volumes are observed with HOV2+ lanes on Peña Boulevard as compared to HOT lanes.

Figure 32 – 2050 Volumes on Peña Boulevard between GVR Boulevard and 56th Avenue



Volumes shown are inclusive of all GP, ML and C-D road volumes. However, they exclude volumes in frontage roads if present.

6.2.2. Travel Times Along Peña Boulevard

Figure 33 shows the projected 2050 travel times volumes on Peña Boulevard from I-70 to Jackson Gap Road for the various alternatives. The minimum and maximum values shown reflect the different projected travel times given different implementation configurations for each alternative.

The Add a Facility to Accommodate Local Traffic Alternatives (both adding CD roads and adding a frontage road) are the only alternatives modeled which show the potential to have notably shorter travel times as compared to other alternatives considered. This reduction in travel times is obtained through a combination of additional capacity through the construction of C-D roads or a frontage road

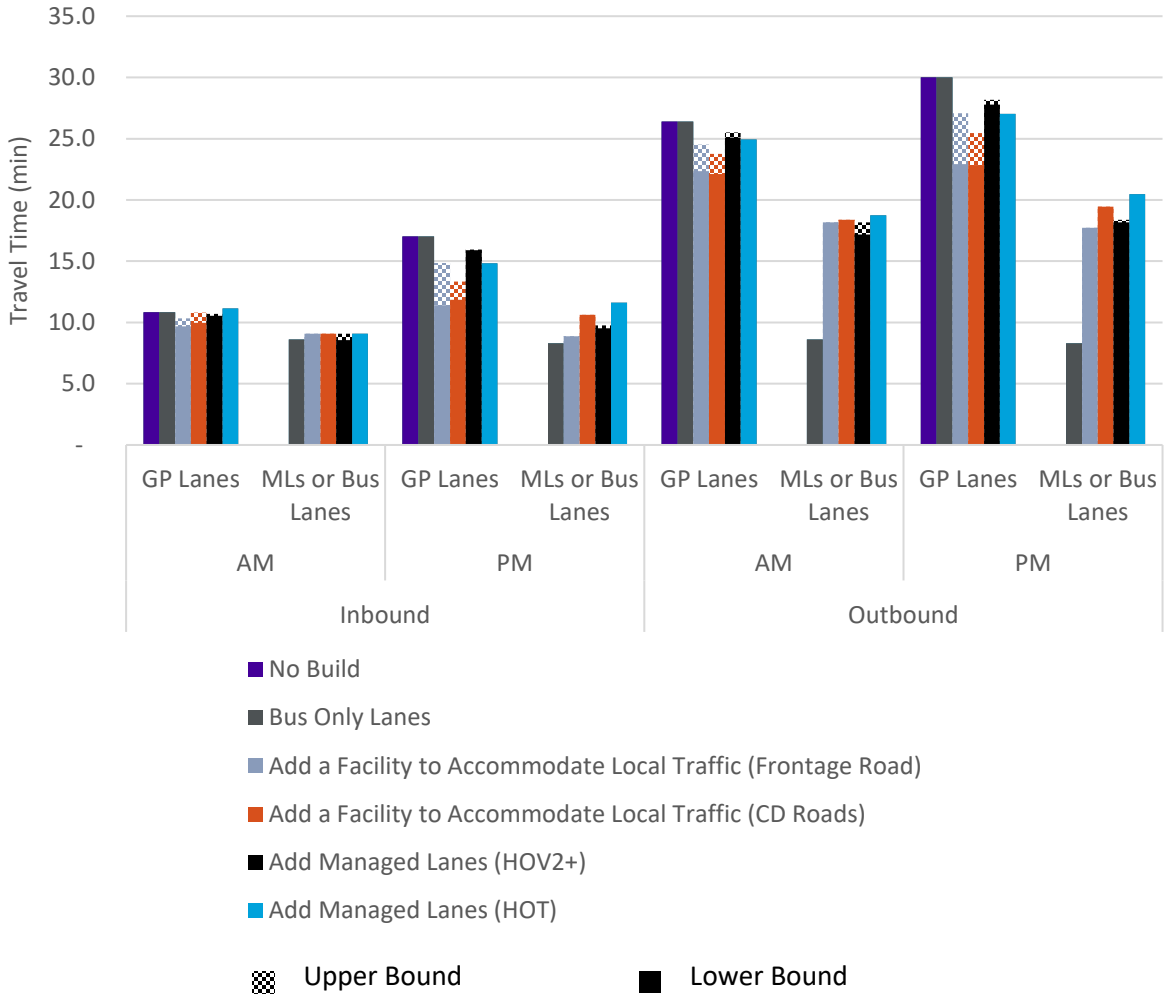
as well as the benefits gained from improving access management to/from Peña Boulevard. The maximum travel time savings is expected to be received by combining the construction of C-D roads or a frontage road with the construction of an HOT lane.

The Add Managed Lanes Alternatives (both HOV2+ and HOT) are expected to provide travel times savings to the GP lanes as compared to the No Build Alternative by providing additional capacity along Peña Boulevard. However, modeling results indicate that the largest benefit of these alternatives is the provision of a faster travel time within the managed lanes. Even during the peak periods, the managed lanes are expected to provide up to a 30 percent faster travel time as compared to the GP lanes.

The No Build Alternative is expected to have the longest travel times as compared to other alternatives considered.

The Bus Only Lanes Alternative was not modeled in the TDM as the impact of bus only lanes is not derived from their physical presence, but rather by the associated transit services that are able to take advantage of the provided infrastructure. From a vehicle travel time perspective, the Bus Only Lanes alternative is expected to be similar to the No Build Alternative because they both provide similar vehicle capacities along Peña Boulevard. However, the Bus Only Lanes Alternative is expected to provide travel times savings for transit vehicles utilizing the bus only lanes. Although not explicitly modeled, the bus only lanes are assumed to operate congestion free and at free-flow conditions regardless of congestion in the GP lanes. Therefore, a free-flow travel time of approximately 8.5 minutes can be reasonably assumed given the distance traveled and the posted speed limit.

Figure 33 – 2050 Travel Times on Peña Boulevard from I-70 to Jackson Gap Road



6.2.3. Vehicle Occupancy Rates

Vehicle occupancy is the number of people traveling in a single vehicle. Along Peña Boulevard, and across the Denver Metropolitan Region in general, most vehicles are single occupancy meaning they only have one person, the driver, inside of them. Increasing vehicle occupancy is one way in which more people can be moved along Peña Boulevard using the same number of vehicles.

Based on the modeling completed for this study, only the HOV2+ Managed Lanes Alternative is anticipated to have any meaningful impact on vehicle occupancy. Results show that adding an HOV2+ lane could increase HOV2+ vehicles by up to 4 percent as compared to alternatives without and HOV2+ lane. Similar increases in vehicle occupancy are not observed in any other alternative, including for Managed Lanes Alternatives where an HOT lane is implemented.

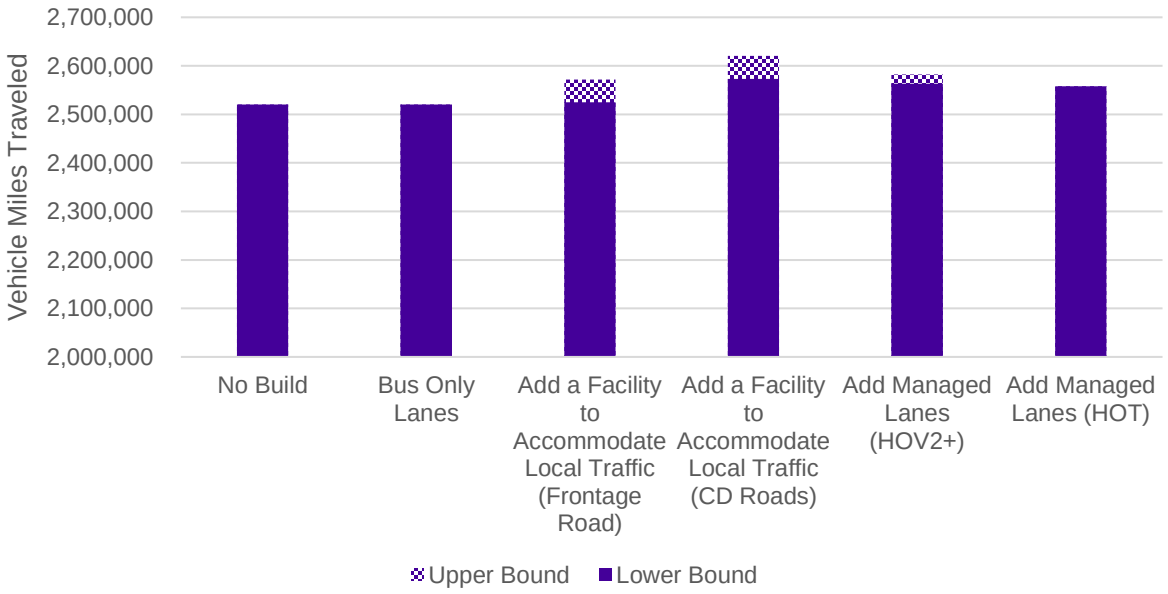
6.2.4. Vehicle Miles Traveled

Vehicle miles traveled (VMT) is a measure of the distance traveled by all vehicles in a given area over a given time period. For this study, daily VMT within the traffic analysis area was considered. The overall highest expected VMT is associated with the Add a Facility to Accommodate Local Traffic Alternative (CD Roads). This alternative has the highest VMT because it has the potential to add the most lanes of

capacity to Peña Boulevard (in the form of C-D roads) and includes the direct connect between I-70 and Peña Boulevard.

The lowest overall VMT is associated with the No Build, and Bus Only Lane alternatives. Note that the Bus Only Lanes Alternative was not explicitly modeled in the TDM. However, it is expected to provide similar vehicle capacity as the No Build Alternative and are therefore expected to have similar overall VMT. Additionally, the Bus Only Lanes Alternative has the potential to reduce VMT depending on the transit ridership gains. At this time, specific details about the potential transit operations using the bus only lanes has not been determined and therefore it is not known what quantitative impact, if any, the Bus Only Lanes Alternative could have on VMT. Figure 34 shows the project 2050 VMT within the study area for all alternatives considered.

Figure 34 – 2050 Study Area Daily VMT

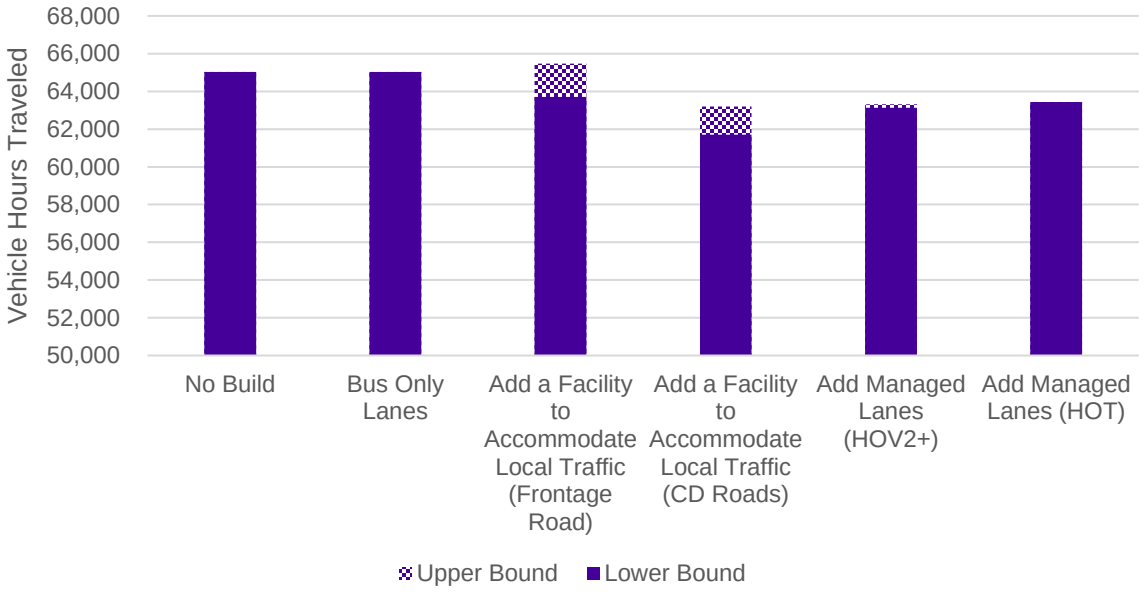


6.2.5. Vehicle Hours Traveled

Vehicle hours traveled (VHT) is a measure of the time traveled by all vehicles in a given area over a given time period. For this study, daily VHT within the traffic analysis area was considered. The highest VHT is expected in the No Build, Bus Only Lanes, and Frontage Road Alternatives. This is because these alternatives do not add capacity to Peña Boulevard and are therefore expected to result in greater congestion within the study area as compared to other alternatives.

The lowest VHT is expected with the addition of CD roads along Peña Boulevard. These CD roads separate out local traffic along Pena Boulevard and provide dedicated capacity to accommodate these trips. Figure 35 shows the expected daily VHT for all alternatives.

Figure 35 – 2050 Study Area Daily VHT



Appendices

Appendix A. Alternatives Analysis Traffic Technical Report