Memorandum

Subject:	Castle Creek Bridge Operational Traffic Analysis
Project Name:	New Castle Creek Bridge Investigative Study with Revised Scope (the Project)
Attention:	City of Aspen (the City)
From:	Jacobs
Date:	July 31, 2024
Copies to:	Project File

1. Introduction

This memorandum evaluates traffic impacts of the roadway improvement alternatives under consideration, which generally improve traffic and transit operations. The study area is depicted on **Figure 1**, primarily following Colorado State Highway (SH) 82 on the west side of Aspen, Colorado. The study area is subject to recurring congestion throughout the week, particularly heavy during weekday peaks (morning and afternoon), which the Project aims to improve for general traffic and transit.

A traffic model was prepared for this study using PTV Vissim software (Version 2024), a traffic microsimulation software that produces realistic visual demonstrations and performance measures of varying traffic operational scenarios.

The eastbound travel direction on Castle Creek Bridge will be referred to as “inbound” (into Aspen), and the westbound travel direction on Castle Creek Bridge will be referred to as “outbound” (out of Aspen). Similarly, the southbound SH 82 travel direction (that is, up-valley) will be referred to as “inbound,” and northbound SH 82 (that is, down-valley) will be referred to as “outbound.”

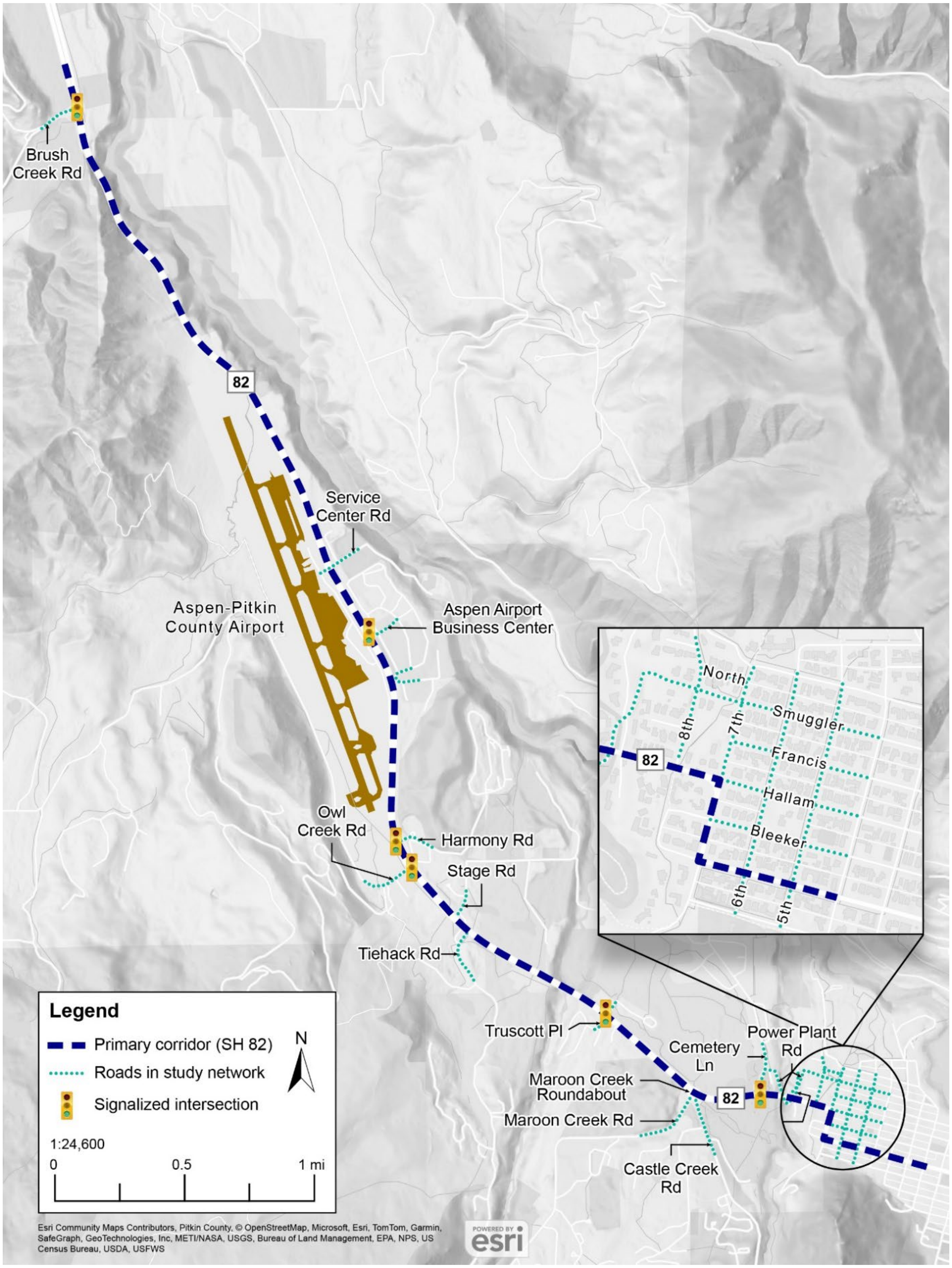
2. Methodology

The analysis focuses on two peak hours for traffic demand – one for inbound traffic and one for outbound traffic.

2.1 Traffic Count Data

Traffic data were collected on Tuesday, May 21, 2024. Automatic traffic recorder counts were collected on Castle Creek Bridge for 24 hours, and turning movement counts (TMCs) were collected using video cameras at 21 study intersections during known traffic peak periods of 7:30 to 9:30 a.m. and 4:00 to 6:00 p.m. on weekdays. The 21 study intersections are shown on **Figure 1**.

Figure 1: Study Area



All data were provided in 15-minute increments. TMC data were provided with three vehicle classifications: (1) light vehicles, (2) medium vehicles, and (3) articulated trucks.

2.2 Peak-hour Identification

Traffic peak hours were determined using the directional bridge volumes and peak period TMCs. The inbound peak hour on Castle Creek Bridge was found to be 8:15 to 9:15 a.m., and the outbound peak hour was identified as 4:30 to 5:30 p.m. These peak hours matched the majority of peak hours at the 21 study intersections.

2.3 Traffic Volume Adjustment (May to July)

Monthly traffic data on Castle Creek Bridge from1999 to 2023 (McGowan, pers. comm. 2024) indicate that July typically has the highest traffic volumes of any month. To represent the true traffic peak in Aspen, traffic volumes were adjusted from May to July. In 2023, July daily traffic was 37% higher than May. However, peak-hour traffic in July is not expected to be 37% higher than peak-hour traffic in May because of limited roadway capacity during the peak-hour. This phenomenon is known as "peak spreading," which features longer traffic peak durations in July compared to May.

Hourly traffic data were obtained from Colorado Department of Transportation's (CDOT's) Online Transportation Information System (OTIS) (CDOT n.d.) at the nearest location of continuous daily traffic counter (Station 000236) located SH 82 near Snowmass Creek Road. At this location, peak-hour traffic in July was found to be 8.3% higher during the morning peak and 17.3% higher during the evening peak when compared to May. These factors were applied to the traffic data collected in May to estimate traffic data in July, with one exception on Maroon Creek Road due to the presence of schools, which are out of session in July. Using StreetLight data (StreetLight n.d.), it was determined that peak-hour traffic should be decreased by 20% on Maroon Creek Road to adjust from May to July.

2.4 Traffic Signals

The study area includes six signalized intersections, all located along SH 82 at the following cross streets:

1) Brush Creek Road
2) Aspen Airport Business Center
3) Harmony Road
4) Owl Creek Road
5) Truscott Place
6) Cemetery Lane

All traffic signals are owned and maintained by CDOT, who provided signal timing information for this study (Staley, pers. comm. 2024).

2.5 Traffic Growth

Jacobs reviewed the Entrance to Aspen Record of Decision (ROD) (FHWA 1998) and bridge traffic data between 1993 and 2023. The highest average daily traffic (ADT) was measured in July 1993, which was the community goal to maintain in the ROD. Assuming that July 1993 is the highest feasible ADT for Castle Creek Bridge in 2050, a growth rate of 1.09% (from 2023 to 2050) was back calculated to reach 1993 ADT levels in the analysis year (2050).

Jacobs reviewed CDOT's OTIS (CDOT n.d.) at traffic count stations surrounding Castle Creek Bridge (Stations 103524 and 103528). Both stations were found to have an annual growth rate of 0.45%.

Considering annual growth rates obtained from OTIS and 1993 bridge ADT, a recommended growth rate should be between these values. To be conservative, leaning toward the higher growth, an annual growth rate of 1.00% for ADT is recommended for this study.

Because of peak-hour roadway capacity constraints, peak hours cannot accommodate as much traffic as off-peak hours (that is, peak spreading), so a reduced growth rate is recommended for peak hour analysis. A 25% reduction was selected based on engineering judgement, and an annual growth rate of 0.75% for peak hours is recommended for this study.

Traffic growth is applied linearly in this study and is not compounded annually.

2.6 Analysis Scenarios

This study analyzed the scenarios listed below. Option 2 includes an additional outbound transit lane, which has been discussed in association with three-lane options to replace the existing Castle Creek bridge. Options 3 and 4 were alternatives studied in the Entrance to Aspen EIS. Different options include varied improvements to improve SH 82 traffic flow.

- Option 0: No Build
- Option 1: S-curve Improvements
- Option 2: Outbound Transit Improvements
- Option 3: Phased Preferred Alternative (PA)
- Option 4: Splitshot
- Option 5: Down-valley Improvements

The following scenarios were evaluated as described:

1) Existing (2024) for purposes of calibration

2) Operational (2050)

   a) **Option 0: No Build**

      - Applies 0.75% annual growth to traffic demand into the study network

   b) **Option 1: S-curve Improvements**

      - Adds bus lane in each travel direction through the SH 82 S-curves
      - Eliminates the southbound approach of North 7th Street onto SH 82
      - Eliminates the wastbound left turn from SH 82 to 7th Street
      - Eliminates the eastbound left turn from SH 82 to North 8th Street
      - Eliminates the westbound right turn from SH 82 to North 8th Street
      - Eliminates the movements from SH 82 to West Main Street and South 7th Street
      - <u>Option 1A</u>: Maintains the southbound approach of North 8th Street onto SH 82
      - <u>Option 1B</u>: Eliminates the southbound approach of 8th Street onto SH 82

   c) **Option 2: S-curve Improvements with Outbound Bus Improvements**

      - Includes all features described in Option 1
      - Introduces one additional lane on Castle Creek Bridge as an outbound bus lane
      - <u>Option 2A</u>: Introduces an outbound bus queue jump for the SH 82 signal at Cemetery Lane
      - <u>Option 2B</u>: Introduces an outbound bus bypass at the SH 82 roundabout

   d) **Option 3: Phased PA (Bus Transit)**

      - Modifies the SH 82 alignment to cross the Marolt-Thomas property parallel to Hallam Street, including one general purpose lane and one bus lane in each direction
      - Removes the existing SH 82 roadway section between Maroon Creek Road and Cemetery Lane
      - Removes the existing signal at Cemetery Lane and converts the intersection into a free-flow section
      - Adds a signalized intersection at West Main Street and North 7th Street

   e) **Option 4: Splitshot**

      - Modifies the SH 82 inbound alignment to cross the Marolt-Thomas property parallel to Hallam Street, including one general purpose lane and one bus lane

- Converts the existing SH 82 alignment to one-way between Maroon Creek Road and 7th Street, which includes one general purpose lane for the outbound direction and one bus lane
- Removes the existing signal at Cemetery Lane and converts the intersection into a right-in/right-out roadway
- Adds a signalized intersection at West Main Street and North 7th Street

f) Option 5: Down-valley Improvements

- Includes all features described in Option 1A (S-curve widening and intersection access restrictions)
- Channelizes the outside lane of the westbound (outbound) movement at the Maroon Creek roundabout by adding a barrier between lanes
- Removes 0.38 mile of the dedicated northbound (outbound) bus lane on SH 82 between Truscott Lane and Maroon Creek roundabout
- Introduces 0.38 mile of the dedicated southbound (inbound) bus lane on SH 82 between the Airport Business Center and Service Center Road
- Increases the maximum green time for the left turn from Brush Creek Road to outbound SH 82 from 15 seconds to 20 seconds

Construction analysis year 2028 was selected for the construction year traffic analysis. Design year 2050 was selected as the planning horizon year, slightly more than 20 years after Project completion.

2.7 Measures of Effectiveness

This study uses the following measures of effectiveness to evaluate traffic impacts:

- Vehicular travel time (in minutes or hours) along SH 82, which was measured between the study area extents of Brush Creek Road and 5th Street, a roughly 5.5-mile section (Figure 1)
- Transit travel time (in minutes) along SH 82 across the same 5.5-mile section
- Total roadway network delay, that is congestion (in vehicle-hours of delay) within the study area
- Throughput (in vehicles) across SH 82 on Castle Creek Bridge

3. Traffic Modeling Results

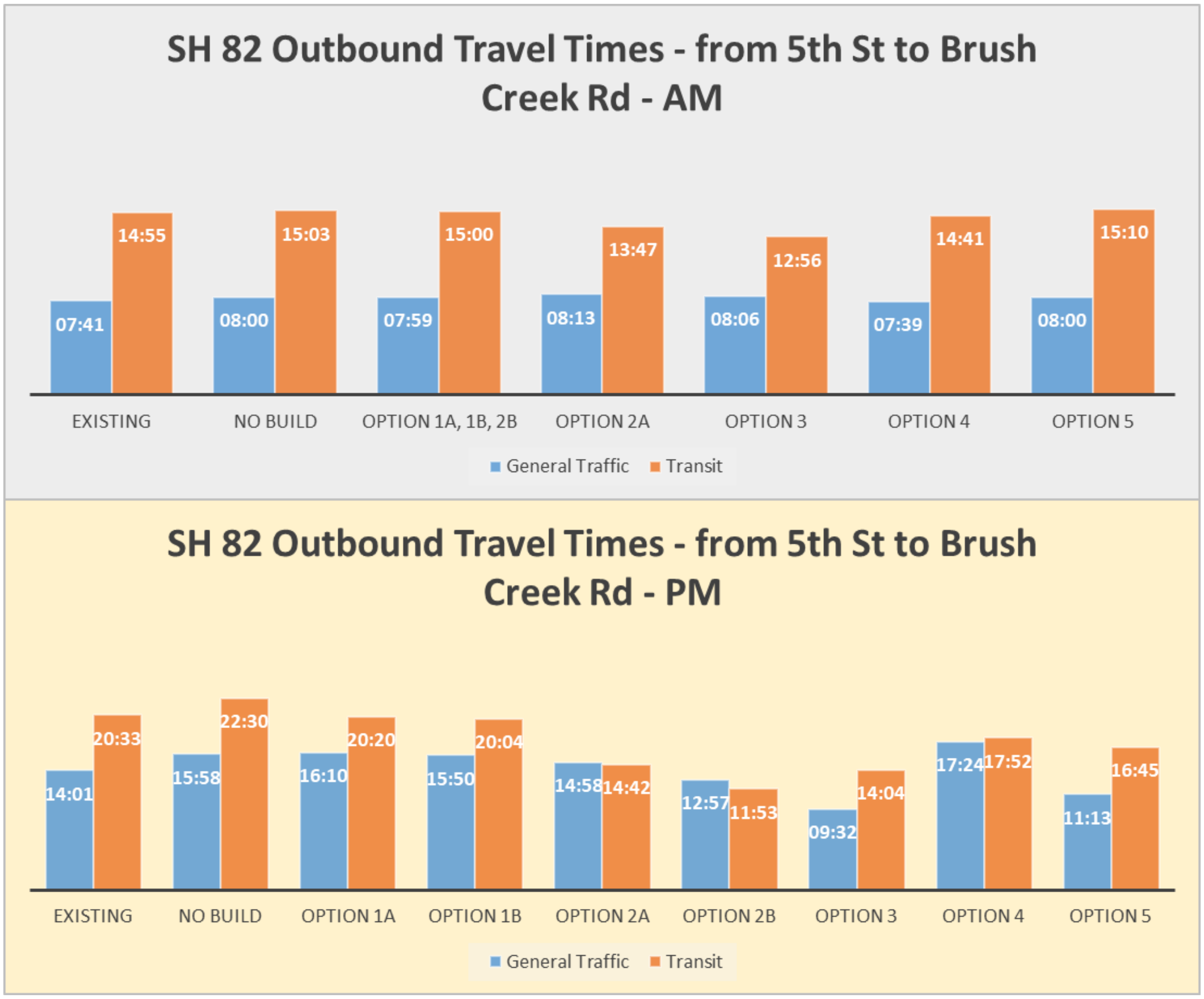
This section describes operations under each analysis scenario. The discussion is based on the travel time results and overall roadway delay results provided on **Figures 2 through 5**.

General traffic and transit travel times are different due to dwell time at bus stops and exclusive bus-only lanes to bypass peak-hour queues.

Bridge throughput is represented as SH 82 bridge throughput. For Option 3, the Phased PA, this means only traffic crossing the new Castle Creek Bridge. For Option 4, Splitshot, this would be traffic that crosses the new Castle Creek Bridge and the bridge on existing SH 82.

Options 1A, 1B, and 2A contain similar operations during the AM peak, as explained later in this section.

Figure 2: Outbound Travel Times



- Option 0: No Build
- Option 1: S-curve Improvements
- Option 2: Outbound Transit Improvements
- Option 3: Phased Preferred Alternative (PA)
- Option 4: Splitshot
- Option 5: Down-valley Improvements

Figure 3: Inbound Travel Times

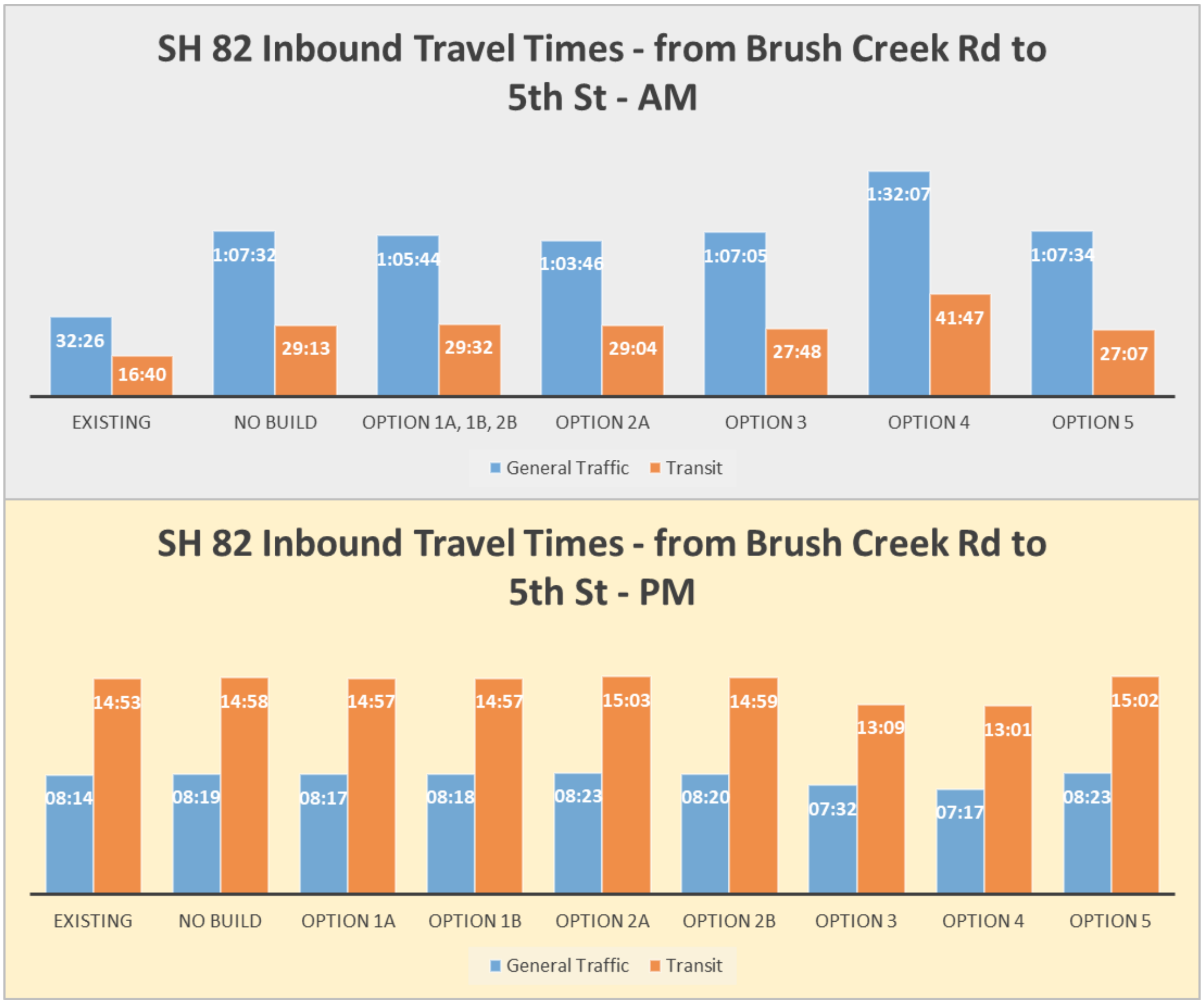


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Figure 4: Total Roadway Network Delay

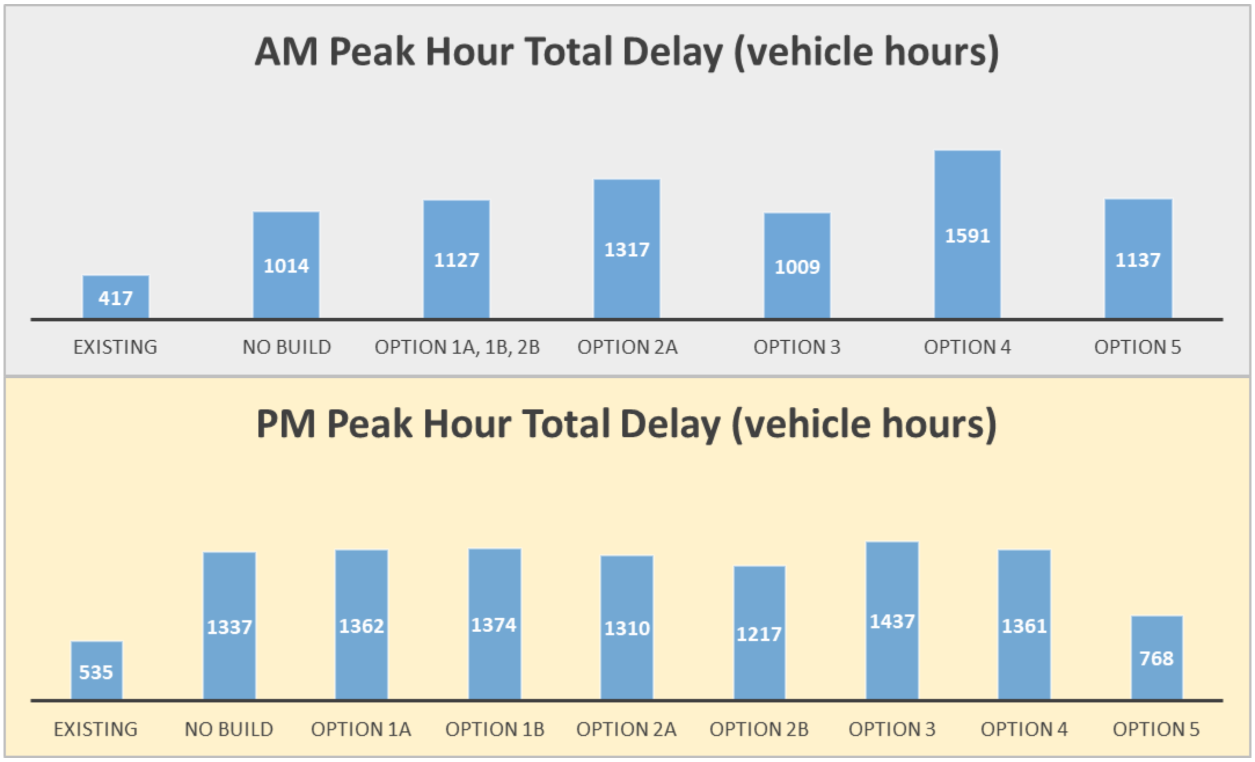

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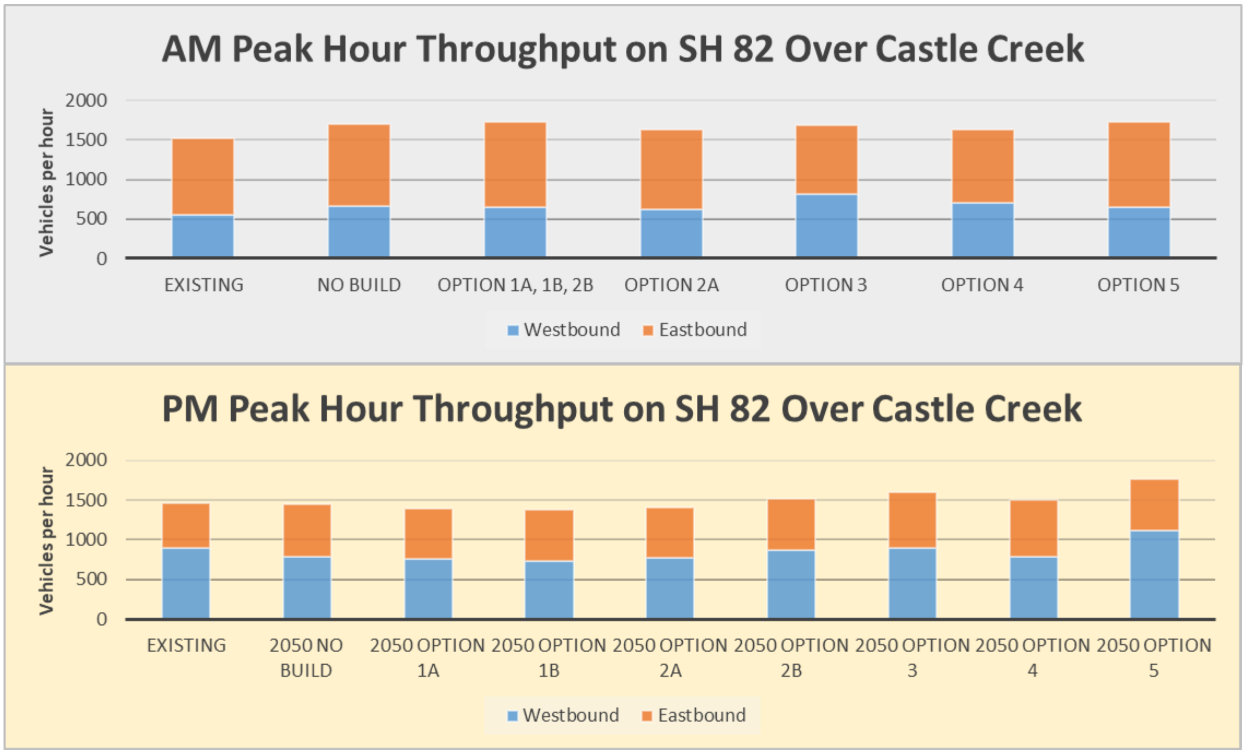
Figure 5: SH 82 Bridge Throughput



- Option 0: No Build
- Option 1: S-curve Improvements
- Option 2: Outbound Transit Improvements
- Option 3: Phased Preferred Alternative (PA)
- Option 4: Splitshot
- Option 5: Down-valley Improvements

3.1 Existing Conditions

The following is an overview of how existing conditions in the peak hours operate today.

3.1.1 Morning Peak Hour

The inbound direction’s peak hour contains several bottlenecks along SH 82 within the study network. The first bottleneck is located 0.2 mile north of the SH 82 intersection at Harmony Road, where there is a reduction from two general traffic lanes to one lane. This bottleneck generates the longest and slowest-moving queue along the inbound route. The next bottlenecks along SH 82 are less severe and include the roundabout at Maroon Creek Road, the signal at Cemetery Lane, and the free right turn from Hallam Street to 7th Street. Further upstream of the free right turn, the model shows that traffic flows relatively uninterrupted into Downtown Aspen.

The inbound peak-hour queue on SH 82 extends from 7th St to the north side of the Aspen-Pitkin County Airport.

On average during the morning peak hour, it takes 32 minutes for general traffic to travel 5.5 miles on SH 82 from Brush Creek Road to 5th Street.

3.1.2 Evening Peak Hour

The outbound direction's peak hour also contains several bottlenecks along SH 82 within the study network. The first bottleneck is located between 5th Street and 6th Street, where there is a reduction from two general traffic lanes to one lane. The next bottlenecks along SH 82 include the free right turn from Main Street to 7th Street, the free left turn from 7th Street to Hallam Street, the signal at Cemetery Lane, the roundabout at Maroon Creek Road, and the reduction from two general traffic lanes to one located 0.1 mile north of the roundabout at Maroon Creek Road. Further downstream, traffic congestion is limited to typical traffic signal delay.

All bottlenecks mentioned previously contribute to the slow travel speeds experienced throughout Downtown Aspen during the evening peak hour. On average during the evening peak hour, it takes 14 minutes for general traffic to travel 5.5 miles on SH 82 from 5th Street to Brush Creek Road.

3.2 No Build (2050) Conditions

The following is an overview of how a future condition with no improvements and traffic growth in the year 2050 will operate in the peak hours.

3.2.1 Morning Peak Hour

Under No Build conditions, the inbound peak-hour queue on SH 82 extends roughly 2 miles further north, beyond Brush Creek Road and the edge of the study network. At the beginning of the peak hour, approximately 20% more vehicles travel through this very long queue. In 2050, travel times roughly double from Existing to No Build.

3.2.2 Evening Peak Hour

Under No Build conditions, the outbound peak queue on SH 82 extends east beyond 5th Street into Downtown Aspen. This delay (backup into downtown and throughout the west end neighborhoods) is captured as overall network delay but is not captured in travel times from 5th Street to Brush Creek Road. This means that, in 2050, more vehicles wait to access the highway system on the neighborhood streets and on SH 82 beyond 5th Street, but once they reach 5th Street or enter the highway at another location, the travel time between 5th Street and Brush Creek Road remains comparable to the morning peak hour.

3.3 Option 1A: S-curve Improvements with 8th Street Access to SH 82

The following is an overview of how the S-curve improvements with 8th Street outbound access and a future traffic year of 2050 will operate in the peak hours.

3.3.1 Morning Peak Hour

In Option 1A, inbound peak-hour traffic and transit operations remain relatively the same. Although inbound general traffic travel times decrease by 2 minutes, overall traffic congestion increases by 11% compared to the No Build.

3.3.2 Evening Peak Hour

In Option 1A, outbound peak-hour travel times for general traffic remain similar to the No Build. Outbound bus delay is reduced by 2 minutes due to the new bus lane through the S-curve. Overall network congestion increases by 2% compared to the No Build.

3.4 Option 1B: S-curve Improvements with no 8th Street Access to SH 82

The following is an overview of how the S-curve improvements with no 8th Street outbound access and a future traffic year of 2050 will operate in the peak hours.

3.4.1 Morning Peak Hour

The removal of 8th Street access is not anticipated to impact morning peak-hour operations. Result from Option 1A apply to Option 1B.

3.4.2 Evening Peak Hour

The removal of 8th Street access increases overall network congestion by 1% compared to maintaining 8th Street access. This finding suggests that 8th Street access should be maintained.

3.5 Option 2A: S-curve Improvements with Outbound Bus Lane with Bus Queue Jump for the SH 82 Signal at Cemetery Lane

The following is an overview of how the S-curve improvements with a transit priority queue jump at the Cemetery Lane signal will operate in the peak hours in the year 2050.

3.5.1 Morning Peak Hour

In Option 2A, inbound peak-hour traffic and transit operations remain relatively the same. Although general traffic travel times decrease by 4 minutes, overall network congestion increases by 30% compared to the No Build.

3.5.2 Evening Peak Hour

In Option 2A, outbound peak-hour traffic travel time decreases by 1 minute compared to the No Build, whereas outbound transit travel times decrease by 8 minutes compared to the No Build. Overall network congestion decreases by 2% compared to the No Build.

3.6 Option 2B: S-curve Improvements with Outbound Bus Lane Addition and an Outbound Bus Bypass lane around the SH 82 Roundabout

The following is an overview of how the S-curve improvements with an outbound bus lane feeding into a bus bypass lane from Cemetery Lane to west of the roundabout will operate in the peak hours in the year 2050.

3.6.1 Morning Peak Hour

The addition of a bus bypass at Maroon Creek roundabout is not anticipated to impact morning peak-hour operations. Results from Option 1A are assumed to represent Option 2B since the geometry is the same

3.6.2 Evening Peak Hour

The addition of a roundabout bypass decreases outbound peak-hour transit travel times by 3 minutes compared to Option 2A. Overall network congestion decreases by 7% compared to Option 2A.

3.7 Option 3: Phased PA

The following is an overview of how the Phased Preferred Alternative (with bus transit) with a new signal at 7th Street and Main Street will operate in the 2050 peak hours.

3.7.1 Morning Peak Hour

In Option 3, inbound peak-hour traffic operations remains relatively the same compared to the No Build. Transit travel times decrease by 2 minutes compared to the No Build. Overall network congestion decreases by 1% compared to the No Build. This indicates that the signal at Cemetery Lane and right turn from Hallam Street to 7th Street are not critical bottlenecks in the model, as removing them does not noticeably improve morning peak hour traffic conditions.

3.7.2 Evening Peak Hour

In Option 3, outbound peak-hour traffic travel time decreases by 7 minutes. Transit travel times decrease by 8 minutes compared to the No Build. Overall network congestion increases by 7% compared to the No Build. This increase is primarily due to the new traffic signal at the intersection of Main Street and 7th Street, which constrains outbound flow from Downtown Aspen.

3.8 Option 4: Splitshot

The following is an overview of how the Splitshot (also known as the Couplet) with new signal at 7th Street and Main Street will operate in the 2050 peak hours.

3.8.1 Morning Peak Hour

In Option 4, inbound peak-hour traffic travel time increases by about 24 minutes compared to the No Build scenario. Transit travel times increase by 13 minutes. This increase is primarily due to newly introduced U-turns (195 vehicles in the 2050 morning peak hour) at the Maroon Creek roundabout, which currently execute a southbound left turn from Cemetery Lane to inbound SH 82. These U-turns force the critical heavy inbound flow to yield (both lanes) at the roundabout. Overall network congestion increases by 57%, as indicated by the travel time increase.

3.8.2 Evening Peak Hour

In Option 4, outbound peak-hour traffic travel time increases by 1 minute due to the U-turns mentioned previously (50 vehicles in the 2050 evening peak hour). Transit travel times decrease by 5 minutes compared to the No Build. Overall network congestion increases by 2% compared to the No Build.

3.9 Option 5: Down-valley Improvements

This an overview of how select down-valley improvements will operate in the 2050 peak hours. These include modifications that are less costly than other options considering, such as Options 2, 3, and 4. Improvements modeled include:

- Includes all features described in Option 1A (S-curve widening and associated intersection access)
- Channelizes the outside lane of the westbound (outbound) movement at the Maroon Creek roundabout by adding a barrier between lanes – that is, continuos westbound lane through the roundabout
- Removes 0.38 mile of the dedicated northbound (outbound) bus lane on SH 82 between Truscott Lane and Maroon Creek roundabout
- Introduces 0.38 mile of the dedicated southbound (inbound) bus lane on SH 82 between the Airport Business Center and Service Center Road (alongside two southbound general traffic lanes)
- Increases the maximum green time for the left turn from Brush Creek Road to outbound SH 82 from 15 seconds to 20 seconds

3.9.1 Morning Peak Hour

In Option 5, inbound peak-hour traffic travel time remains relatively the same compared to the No Build, whereas transit travel times decrease by 2 minutes. Overall network congestion increases by 12% compared to the No Build.

3.9.2 Evening Peak Hour

In Option 5, outbound peak-hour traffic travel time decreases by 5 minutes compared to the No Build, whereas transit travel times decrease by 6 minutes. Overall network congestion decreases by 43% compared to the No Build. This improvement is due to continuation of two general purpose travel lanes immediately north of the Truscott Place intersection, which increases the capacity of northbound flow through the Maroon Creek roundabout and thus improves throughput across Castle Creek Bridge.

3.10 Summary of Findings

Based on the results discussed in the previous sections, each option was scored for its operational performance, as summarized in **Table 1**. A score of 3 indicates an option performs similarly overall to the No Build. A score of 1 to 2 means the option performs worse than the No Build, and a score higher than 3 means the option performs better.

Table 1: Options Scoring Table

Criteria	Weight	Option 1A/B: S-curve Improvements	Option 2A: S-curve Plus Outbound Transit Improvements	Option 2B: 2A Plus Bus Bypass	Option 3: Phased Preferred Alternative	Option 4: Splitshot	Option 5: Down-Valley Improvements
Benefit to corridor travel times	25%	3	3	4	5	1	4
Benefit to overall network congestion	25%	2	2	3	3	1	5
Benefit to transit	50%	3.5	4	4.5	5	3.5	4
Overall score	100%	**3.0**	**3.3**	**4.0**	**4.5**	**2.3**	**4.3**

4. References

Carly McGowan, City of Aspen. 2024. Personal communication (email) with Doug Stremel, Jacobs; and Pete Rice, City of Aspen. June 13.

Colorado Department of Transportation (CDOT). n.d. Online Transportation Information System. Accessed July 2024. https://dtdapps.coloradodot.info/otis.

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Andi Staley, Traffic Operations Engineer, Colorado Department of Transportation (CDOT). 2024. Personal communication (email) with Carly McGowan, City of Aspen; Terri Partch, Jacobs; Tyler Pottorff, CDOT; and Zane Znamenacek, State of Colorado. June 18.

StreetLight Data, Inc. (StreetLight). n.d. StreetLight metrics. Accessed July 2024. https://www.streetlightdata.com/.