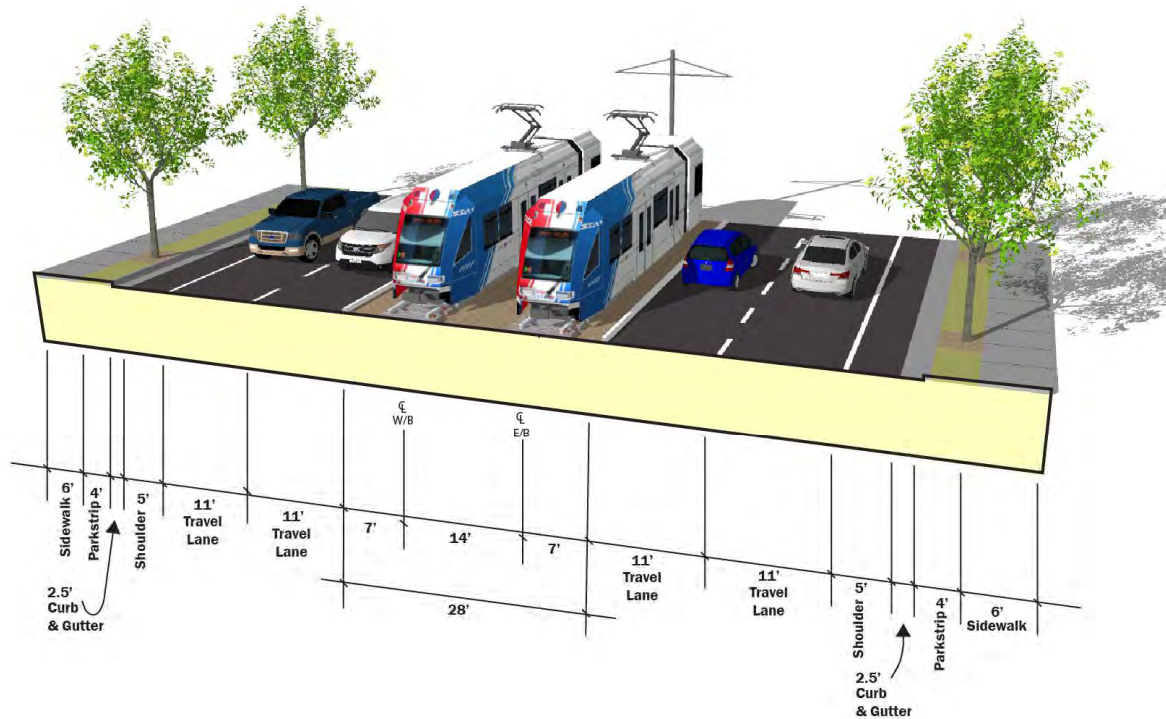
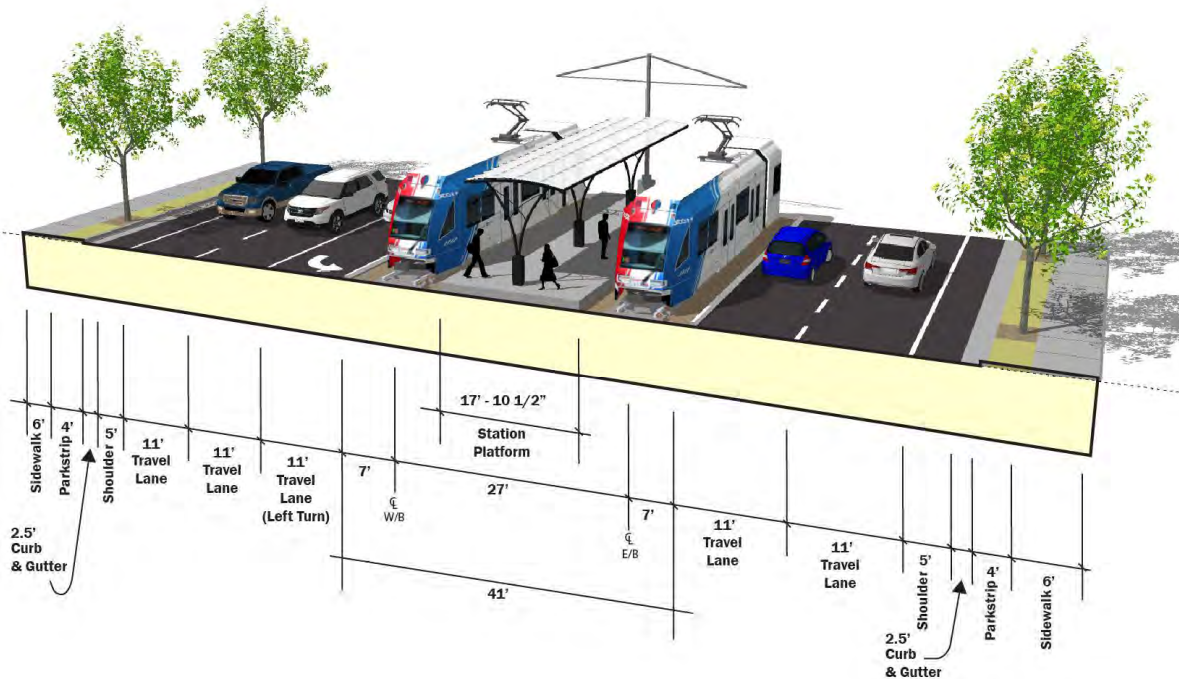


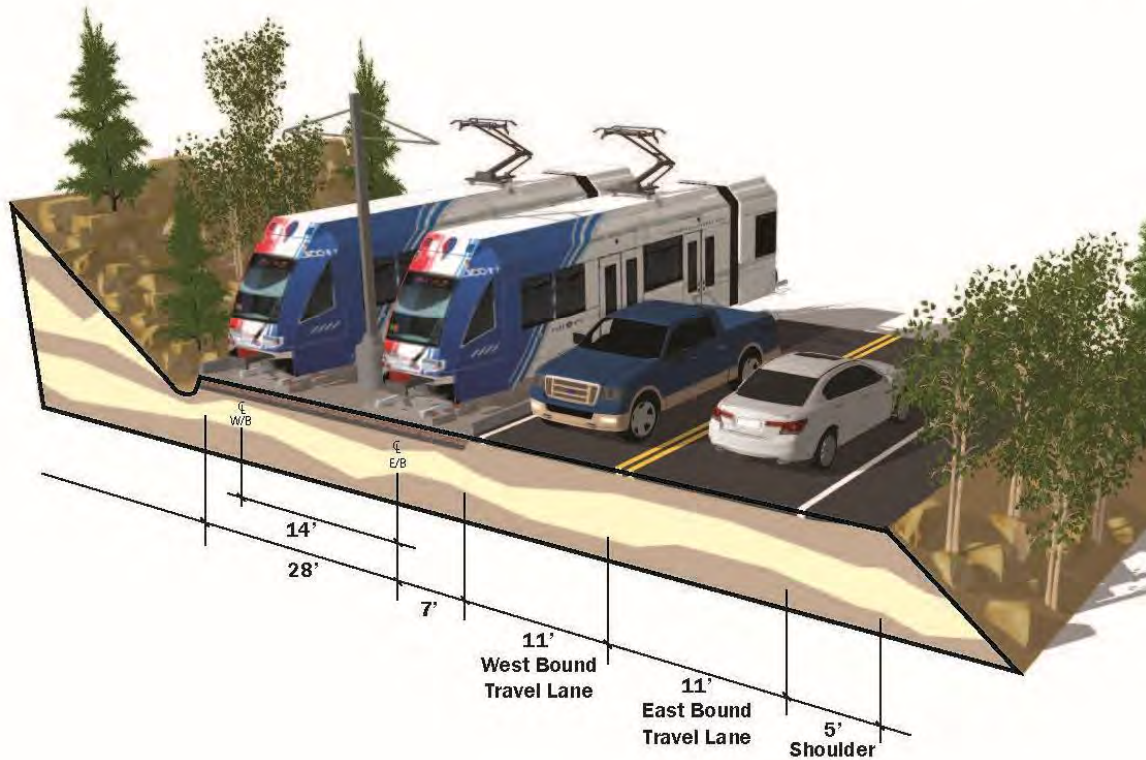
Light Rail Transit Section 3 9400 South With Two Travel Lanes



Light Rail Transit Section 4 9400 South at Intersection With Platform



Light Rail Transit Section 1 Little Cottonwood Canyon



To: File

From: WSP Parsons Brinckerhoff

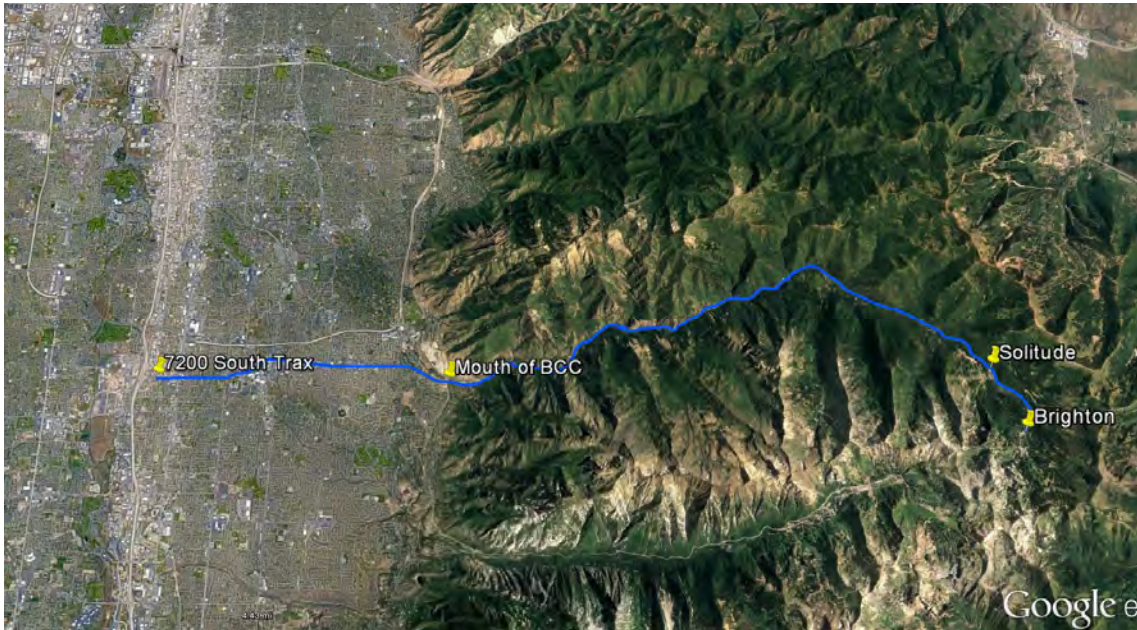
Date: October 7, 2016

Subject: Mountain Accord – BCC vs LCC Corridor

Route Description

Big Cottonwood Canyon Route

The Big Cottonwood Canyon route would begin at the 7200 South TRAX station and head east on 7200 South. It would continue east for about six miles to the mouth of Big Cottonwood Canyon. The route would continue east up Big Cottonwood Canyon and pass Solitude Ski Area and continue on to Brighton. The alignment in Big Cottonwood Canyon would be about 14.6 miles long for a total of about 20.6 miles. This route is shown in the Figure below.



Little Cottonwood Canyon Route

The Option 1 route would begin at the 9400 South Trax Station and run east on 9400 South for about 6.3 miles to the mouth of Little Cottonwood Canyon. Another option, option 2, from the existing north-south line is to head east on 7200 South from the 7200 South TRAX station for about

six miles to the mouth of Big Cottonwood Canyon. There it would head south along Wasatch Boulevard for about four miles to the mouth of Little Cottonwood Canyon. The route would continue east up Little Cottonwood Canyon and pass Snowbird and continue on to Alta. The rail alignment in Little Cottonwood Canyon would be about 8.6 miles and would be either adjacent to the existing roadway or on a separate alignment from the road. Option 1 would be about 14.9 miles total while option 2 would be about 18.6 miles total. The routes are shown in the figure below.



Engineering and Construction

Big Cottonwood Canyon Route

The western 8.5 miles of the Big Cottonwood Canyon Route is characterized by very steep canyon walls with several very constricted sections with steep grades including the Storm Mountain area and the S-Turns area. These topographic characteristics would require a significant amount of surface excavation and additional tunneling to allow the passage of a rail alignment.

The construction of a rail line in these highly constricted areas would be very difficult due to the constrained access, multiple tunnels, tight working space, and the difficulty of establishing construction staging areas.

There are sections of this route where the grades would exceed 6-8% which is the limitation of traditional light rail systems. In these locations the rail line would have to be a “cog” rail where the rail vehicle has a cog that engages a fixed rack between the rails. There are numerous avalanche paths in Big Cottonwood Canyon that affect the highway. Depending on the alignment of the rail, a series of avalanche sheds would be required to protect the rail line from avalanches.

Little Cottonwood Canyon Route

The existing highway up Little Cottonwood Canyon is constructed on an historic rail line. Consequently the geometry of the rail line would be relatively straightforward. In many locations the grades exceed 6-8%. These sections would also require cog rail. Because the Little Cottonwood Canyon route is within the canyon for about 8.6 miles and climbs about the same amount of elevation as the Big Cottonwood Canyon route, the average grade is steeper and would require much longer sections of cog compared to Big Cottonwood Canyon.

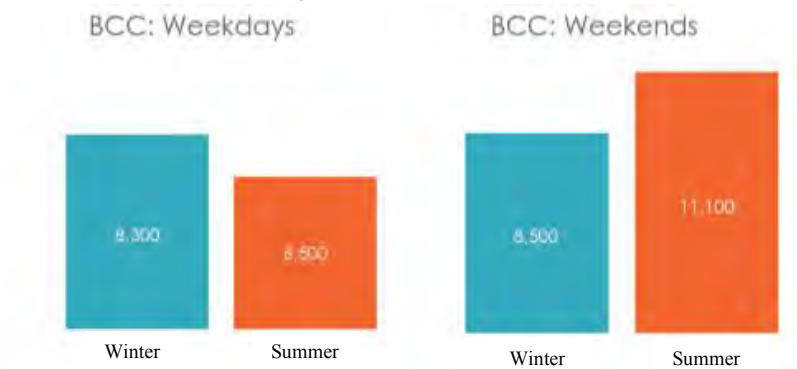
This alignment crosses numerous avalanche paths high enough in the track of the avalanche that the return interval of those avalanches is relatively frequent. As a result, this highway is considered to have the highest avalanche hazard index (a risk rating of avalanche exposure to the highway users if no avalanche safety activities were implemented) of any highway in North America. If the Little Cottonwood Canyon route were to run adjacent to the highway, a series of avalanche sheds would be required to protect the rail line from avalanches.

Alternatively the LCC route could follow an alignment independent of the highway avoiding some of the avalanche paths.

Winter/Summer and Weekday/Weekend Trips

Big Cottonwood Canyon Route

The graph below shows the current approximate number of person trips made to Big Cottonwood Canyon on high volume traffic days.



Little Cottonwood Canyon Route

The graph below shows the current approximate number of person trips made to Little Cottonwood Canyon on high volume traffic days.



During all time frames, except summer weekdays, Little Cottonwood Canyon generates more person trips than Big Cottonwood Canyon. Little Cottonwood Canyon also has more days of the year characterized by low speeds initiated by high volumes and/or inclement weather (See *Mountain Accord: Cottonwood Canyons Transportation Framework*). Due to the fact that the Canyons would be the primary generator of riders along the routes a rail line in Little Cottonwood Canyon would likely generate more ridership than a rail line in Big Cottonwood Canyon.

Conclusion

The Little Cottonwood Canyon route has less side slope impacts due to a wider and flatter canyon bottom providing better construction conditions and requiring less excavation when compared to Big Cottonwood Canyon. The Little Cottonwood Canyon route is shorter in length, provides better construction conditions compared to the Big Cottonwood Canyon route. Based on the length of route, with an approximate cost of over \$65M/mile for a rail line, the Little Cottonwood Canyon route will be hundreds of millions of dollars less expensive than a Big Cottonwood Canyon route. Little Cottonwood would require more avalanche sheds than Big Cottonwood but these costs would be offset by tunneling required in Big Cottonwood. Furthermore, Little Cottonwood Canyon attracts more people and would likely have higher transit ridership numbers than a route up Big Cottonwood Canyon.

To: File

From: WSP Parsons Brinckerhoff

Date: October 10, 2016

Subject: Mountain Accord – 7200 South vs 9400 South Corridor for Little Cottonwood Canyon

Route Length

7200 South Little Cottonwood Canyon Route

The route would begin at the 7200 South TRAX station and head east for six miles on 7200 South to the mouth of Big Cottonwood Canyon. Based on the conclusions from the "BCC vs LCC corridor" memo dated October 7, 2016 the route would terminate in Little Cottonwood Canyon at Alta; therefore, the route from the mouth of Big Cottonwood Canyon would head south along Wasatch Blvd. for about four miles to the mouth of Little Cottonwood Canyon. Lastly, the route would continue east up Little Cottonwood Canyon and pass Snowbird and continue on to Alta. The alignment in Little Cottonwood Canyon would be about 8.6 miles. The length of this option would be 18.6 miles. This route is shown in the Figure below.



9400 South Route

The route would begin at the 9400 South Trax Station and run east on 9400 South for about 6.3 miles to the mouth of Little Cottonwood Canyon. The alignment in Little Cottonwood Canyon would be about 8.6 miles. This route would be 14.9 miles. This route is shown in the figure below.



Travel Times

The *Mountain Transportation Study final report* dated May 2012 documents travel times along the 7200 South and 9400 South Routes. The times are shown in tables 1 and 2.

Table 1 "7200 South Route Travel Times"

Route Segment	Description	Length (miles)	Auto	Enhanced Bus	BRT	Rail
1	7200 South Trax to mouth of Big Cottonwood Canyon	6	10-19	21-31	18-23	11-15
2	Mouth of Big Cottonwood Canyon to mouth of Little Cottonwood Canyon	4	7-12	10-14	10-14	6-9
3	Mouth of Little Cottonwood Canyon to Alta	8.6	14-24	36-63	20-28	13-25
Total		18.6	31-55	67-108	48-65	30-49

9400 South Route

Table 2 "9400 South Route Travel Times"

No.	Description	Length (miles)	Auto	Enhanced Bus	BRT	Rail
1	9400 South Trax to mouth of Little Cottonwood Canyon	6.3	10-19	20-30	18-23	11-15
2	Mouth of Little Cottonwood Canyon to Alta	8.6	14-24	36-63	20-28	13-25
Total		14.9	24-43	56-93	38-51	24-40

Travel Patterns

Based on the memo by WSP/Parsons Brinckerhoff titled "Potential Ridership to LCC" dated August 23, 2016 the origin and destination of summer and winter trips to Little Cottonwood Canyon was determined from collected data. Assumptions of the origin-destination data can be found in the aforementioned memo. The memo findings are shown in tables 3 and 4.

Table 3 Little Cottonwood Canyon Summer Origin of Trips

Summer Weekday		Summer Weekend	
Zone classes	Origin/Destination (O/D) %	Zone classes	O/D%
North of 7200 South	38%	North of 7200 South	42%
Between 7200 South and 9400 South	31%	Between 7200 South and 9400 South	29%
South of 9400 South	31%	South of 9400 South	29%

Data source: AirSage

Table 4 Little Cottonwood Canyon Winter Origin of Trips

Winter Weekday		Winter Weekend	
Zone classes	Origin/Destination (O/D) %	Zone classes	O/D%
North of 7200 South	44%	North of 7200 South	47%
Between 7200 South and 9400 South	37%	Between 7200 South and 9400 South	33%
South of 9400 South	19%	South of 9400 South	20%

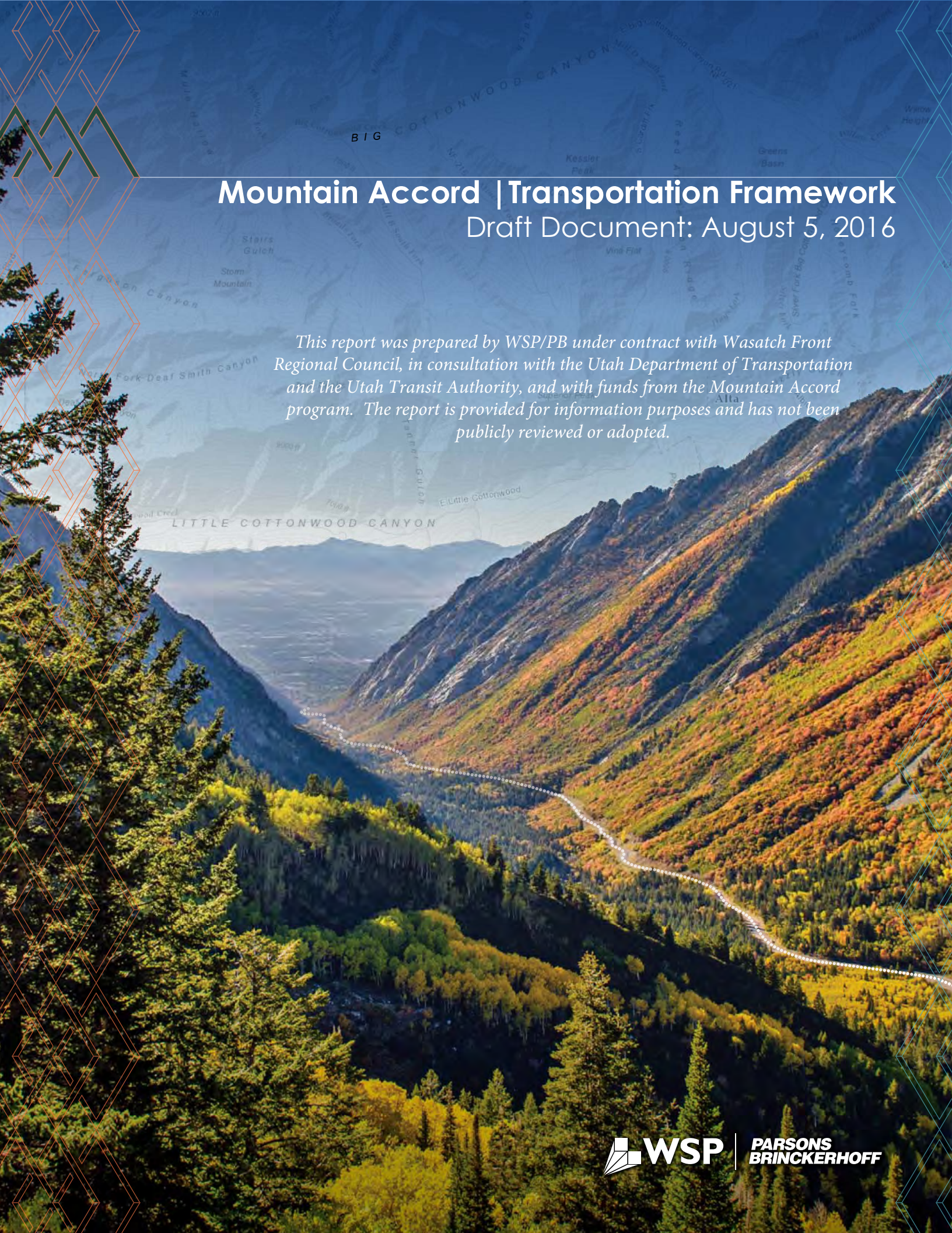
Data source: AirSage

Nearly all trips originating between 7200 South to 9400 South can be expected to choose 9400 South as it is irrational to go north to the 7200 South Trax station and then come south again from a travel behavior perspective. All trips south of 9400 South can also be expected to choose 9400 South as their route to get to Little Cottonwood Canyon. Based on the travel pattern data we can conclude that less than half of the trips to Little Cottonwood Canyon originate north of 7200 South for all summer, winter, weekday, and weekend scenarios.

Conclusion

Based on the current data that Little Cottonwood Canyon is a better choice than Big Cottonwood Canyon for a fixed guideway improvement it is possible to reach conclusions about the best corridor for fixed guideway, 7200 South or 9400 South. The corridor length from the 9400 South Trax to Alta is shorter than the 7200 South Corridor to Alta by about 3.7 miles. This shorter distance will result in lower costs for a fixed guideway along 9400 South. Travel times from the 9400 South Trax station to Alta will be lower compared to 7200 S as presented in tables 1 and 2 giving a better user experience along a 9400 South guideway. Based on travel patterns presented in tables 3 and 4 over half of the people travelling to Little Cottonwood Canyon during any time of the week or year are coming from south of 7200 South; therefore, it is reasonable that more people travelling to Little Cottonwood Canyon will use the 9400 South corridor than the 7200 South corridor.

The 9400 South corridor will be less costly, have lower travel times, and deliver more riders to Little Cottonwood Canyon than the 7200 South corridor.



Mountain Accord | Transportation Framework

Draft Document: August 5, 2016

This report was prepared by WSP/PB under contract with Wasatch Front Regional Council, in consultation with the Utah Department of Transportation and the Utah Transit Authority, and with funds from the Mountain Accord program. The report is provided for information purposes and has not been publicly reviewed or adopted.



Contents

(Will be included in final draft once all revisions have been made)



INTRODUCTION

Transportation is an essential component of the Mountain Accord's vision for the Central Wasatch Mountains. As such, the intended transportation outcomes outlined in the Mountain Accord Agreement (Accord) include

- to provide a sustainable, safe, efficient, and multi-modal transportation system that:
 - provides year-round choices to residents, visitors and employees
 - connects to the overall regional network
 - serves a diversity of commercial and dispersed recreation uses
 - is integrated within the fabric of community values and lifestyle choices
 - is compatible with the unique environmental characteristics
- to increase transit use, walking, and biking and decrease single-occupancy vehicle use
- to design a balanced recreation system ... that will reduce the degradation of natural resources caused by [recreation] uses
 - to focus recreation infrastructure at strategically located and designed nodes
 - to provide convenient access at these nodes
 - to accommodate and manage growth in recreation uses
 - to integrate trail access with transit solutions
- to reduce risks associated with avalanches, winter weather, rockslides, incidents, and other hazards
- to improve emergency response capabilities and evacuation routes
- to encourage development patterns that reduce sprawl and preserve open space
- to focus future development in urban areas.....and at the bases of the ski areas
- to address road cycling needs in Big Cottonwood Canyon, Little Cottonwood Canyon, Millcreek Canyon, and Parley's Canyon (including the approaches to each canyon)]

This framework document focuses specifically on the transportation issues in Big and Little Cottonwood Canyons, served by SR 190 and SR 210, respectively. The purpose of this document is to frame the transportation context for the Cottonwood Canyons by addressing the following questions: What is the transportation problem? What are we trying to accomplish? What solutions have been identified?

Consequently, the framework document has been organized to first summarize the transportation conditions and problems for the Cottonwood Canyons in the Problem Framework section. Second, the Evaluation Framework section of the document defines the evaluation methodology and general performance criteria to meet the objectives of the Mountain Accord. These performance criteria will be used to evaluate proposed solutions in follow-on project work. Finally, the Solutions Inventory section of this document summarizes transportation solutions identified for the Cottonwood Canyons. Evaluation of these solutions, including forecasts of existing and future transportation conditions, will be presented in documents to follow.

FRAMEWORK

What is the Transportation Problem ?



Problem Framework

What are we Trying to Accomplish ?



Evaluation Framework

What Solutions Have Been Identified ?



Solutions Framework





PROBLEM FRAMEWORK

The major transportation problems currently observed for the Cottonwood Canyons can be summarized as significant travel time delays and parking shortages during heavily congested periods. As such, the problem framework defines the conditions that contribute to these congested periods. It provides “a closer look” at the conditions that drive congestion in and near the Cottonwood Canyons.

However, the transportation problems for the Cottonwood Canyons are multi-faceted and impact many users, modes of transportation, travel destinations, seasons, and time periods. As a result, the discussion of congested conditions for the canyons is preceded by an introduction to the general context for the canyons, including canyon roadway background information, travel patterns, and environmental considerations. The problem framework also includes a discussion of existing conditions for transit service in the canyons. A “closer look” at the existing transit service conditions sets up the context for transit solutions in the canyons.

GENERAL CONTEXT

CANYON ROADWAY BACKGROUND

Roadway Description

Big and Little Cottonwood Canyon roads (SR 190 and SR 210, respectively) are characterized by steep grades, sharp bends, and few passing zones. Both SR 190 and SR 210 are dead-end roads (except during the warm summer months, when Guardsman Pass opens to connect SR 190 to Park City). Within the Cottonwood Canyons, both canyon roadways are located in Salt Lake County and are managed and maintained by the Utah Department of Transportation (UDOT). Both canyon roads serve resort and dispersed recreation areas as well as residential areas. In the absence of accidents, at non-peak hours and during dry optimal roadway conditions, travelers can traverse the canyons in under 20 minutes¹¹. While automobile drivers are the primary users of the roadways, cyclists and pedestrians (especially those moving between parking and destinations) are also present on the

canyon roads, primarily in summer months. Although there are many similarities between the Cottonwood Canyons, there are also significant differences in the setting and conditions for Big and Little Cottonwood Canyons and their corresponding access roadways. Whenever possible and practical, these differences are highlighted in follow-on sections of the problem framework document. Where needed for simplicity and clarity, conditions for both canyons are combined. However, the supporting information is generally available for separately for each of the canyons.

Roadway User Information

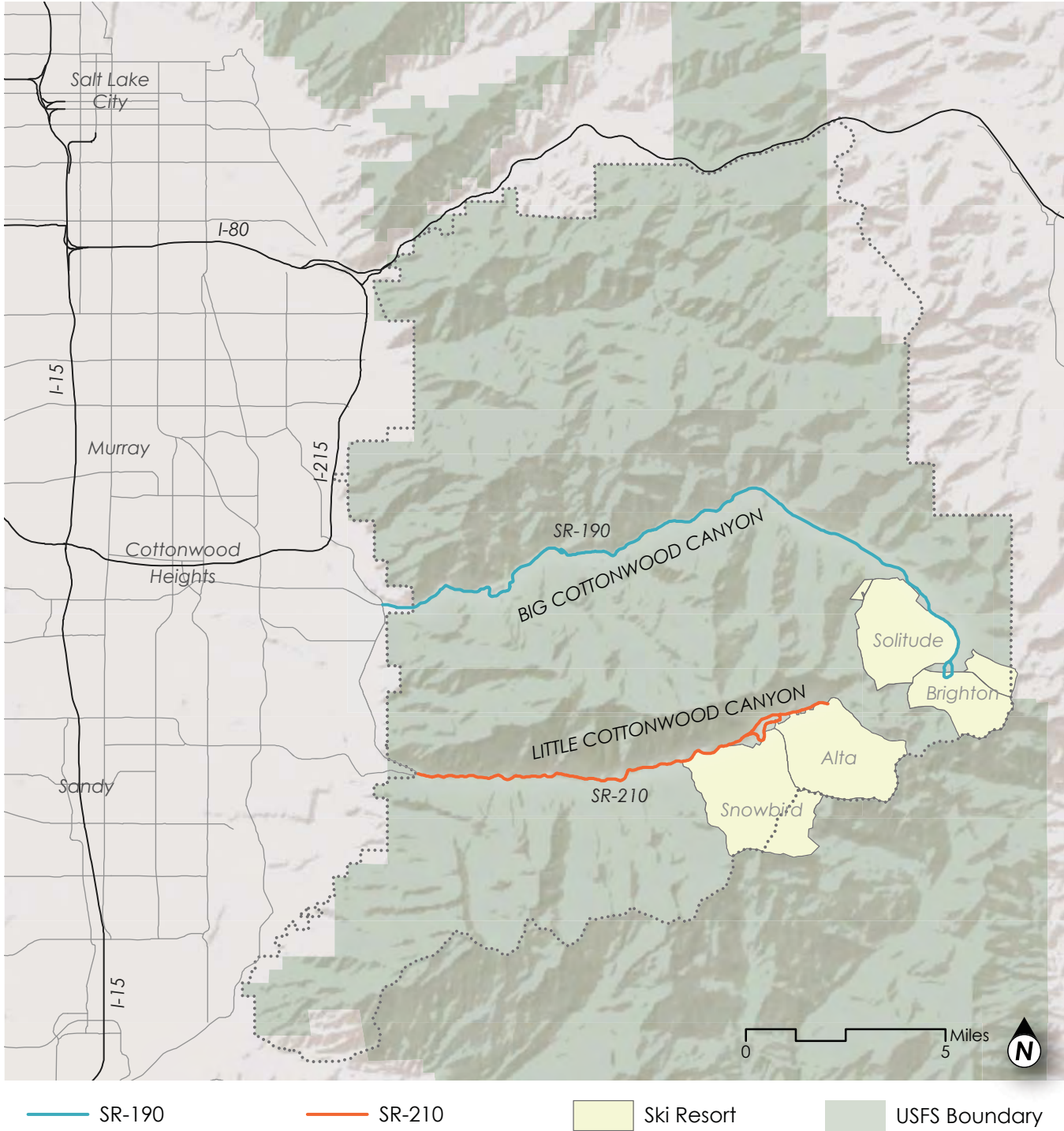
Advanced Traffic Management System (ATMS) technologies provide real-time data that are used by UDOT to improve operational

Exhibit 1 Variable Message Signs

Signs on SR 190 at 6200 South (top) and on SR 209 at Old Wasatch Blvd. (bottom) (Google Street View, retrieved July 2016)



Exhibit 2 Context Map





efficiencies. Data gathered by ATMS technologies can also be shared with the public to inform travel-related decision making. Understanding the existing ATMS infrastructure is important because it sets the context for potential technology and communications-driven solutions. There are currently a total of 22 existing ATMS devices in Big and Little Cottonwood Canyons. These devices include four highway advisory radio (HAR) transmitters, 14 closed-circuit television cameras (CCTVs), and four variable message signs (VMS). The VMS devices are located at or near the base of Big and Little Cottonwood Canyons. In 2014, UDOT installed fiber optic infrastructure in Big and Little Cottonwood Canyons, along SR 190 and SR 210, respectively. This is important because it facilitates future installation of additional ATMS devices and other communications technologies in the Cottonwood Canyons.

In addition to ATMS devices, a UDOT 511 road conditions number, ski area websites, automated phones lines, and a UDOT traffic application for smartphones also provide travel information for canyon visitors²⁰. However, canyon users currently face a lack of real-time canyon information about traffic, weather conditions, and parking

availability that is accessible before making travel decisions and while traveling to and in the canyons.

Roadway Safety

Safety for all users is a concern for all transportation facilities, including the canyon roadways. Potential hazards for SR 190 and SR 210 include avalanches, adverse weather, and collisions between cars and also cyclists and pedestrians.

The canyon roadways (and especially SR 210) are particularly susceptible to avalanches, and avalanche mitigation is a constant concern during the winter season. As documented in the 2006 SR 210 Transportation Study, Little Cottonwood Canyon road is one of the highest avalanche-related risk roads in North America and the Mid-Canyon section of Little Cottonwood Canyon surrounding White Pine and Little Pine slide areas is the most risky⁷. The avalanche hazard index (AHI) takes into account slide frequency, quantity of slide paths, volume of vehicles, and speed of traffic to assess the risk of avalanches to the traveling public. Traffic congestion increases the AHI because of slow movement and reduced spacing between

In addition to newly updated and gathered data, this framework draws heavily upon the findings of previous plans and studies. These include:

- Mountain Accord Agreement (2015)
- Mountain Accord Phase I: Existing Conditions and Future Trend lines (Transportation) (2015)
- Mountain Accord Phase I: Existing Conditions and Future Trend lines (Environment) (2014)
- Mountain Accord Phase I: Existing Conditions and Future Trend lines (Recreation) (2014)
- Salt Lake County Watershed Management Plan (1999)
- Wasatch-Cache National Forest Plan (2003)
- SR 210 Transportation Study (2006)
- Scenic Byway Corridors – Corridor Management Plan (2008)
- Albion Basin Visitors Survey (2009)
- Wasatch Canyons Tomorrow (2010)
- Mountain Transportation Study (2012)
- Cottonwood Canyons Parking Study (2012)
- Mountain Accord Phase I Draft and Working Documents (2015)
- Big Cottonwood Canyon General Plan – Salt Lake County, UT (2013)
- Envision Utah Wasatch Front 2050 Market-Driven Growth Scenario (2014)
- Backcountry Winter Use Assessment of Central Wasatch Mountains (2014)
- Salt Lake County Bicycle Best Practices (2014)
- Central Wasatch Visitor Use Survey (2014-2015)
- Paths More Traveled, Forests on the Edge (2015)

These plans and studies, along with other data sources, are listed at the end of this document. Citations are noted throughout this document with a superscript number that corresponds to the source list.



cars⁷. Avalanche control for the Cottonwood Canyons typically occurs in the morning, often affecting busy traffic times and causing delays. Staged avalanche control progresses up the Canyon, starting in the lower sections and moving farther into the canyon. Time required for avalanche mitigation varies. If snow from the controlled avalanches doesn't reach the roadway, the canyon can be opened to traffic in less than an hour. If snow removal is required, it might take closer to two hours before the road can be reopened²⁰.

The geometry of the canyon roadways contributes to safety concerns. Narrow shoulders and common roadside parking means that cyclists are often required to share the narrow, winding roadway with cars and forced to move closer to opposing traffic. Other safety concerns include pedestrians crossing or walking along the road to get from informal roadside parking to access trailheads or other dispersed recreational areas.

Adverse weather conditions can easily make travel through the canyons hazardous. In addition to snow, black ice can form on the roadway. As described in the Scenic Byway Corridors Management Plan (2008), "The shadows cast by the mountains cause a difference of temperature on the road surface, leading to icy conditions. It misleads drivers particularly on sunny, warming days when snow is melting elsewhere but forming ice on

the roadway at lower elevations, sometimes due to an inversion of colder air in the lower reaches of the canyons. Unsuspecting drivers traveling down-canyon at high speeds are most vulnerable and most dangerous⁸." Crashes occur more often on SR 210 and SR 190 than on similar peer facilities, with a majority of incidents occurring in the winter months, between November and March².

TRAVEL PATTERNS

Temporal Variations

Traffic conditions in the Cottonwood Canyons are highly dependent on season, day of the week, time of day, and weather factors. The canyons experience the highest use during the winter season (December-March) and the summer season (June-September). Weekends and holidays are the busiest times for traffic in the canyons, both in summer and winter. For example, of the 15 highest entering vehicle volume days during the winter of 2016 (January-March) in Little Cottonwood Canyon, 14 occurred on a weekend.

Winter traffic typically follows a "rush-hour" pattern that responds to the opening and closing of ski resorts. Traffic is heavy inbound to the canyons during winter mornings, peaking at approximately 9 am. In the afternoon, traffic is heavier exiting the canyons, peaking at approximately 4 pm. Morning traffic is somewhat more spread out as skiers start their day at

Exhibit 3

**Weekend BCC Total Traffic by Time of Day
February 2016 & July 2015**

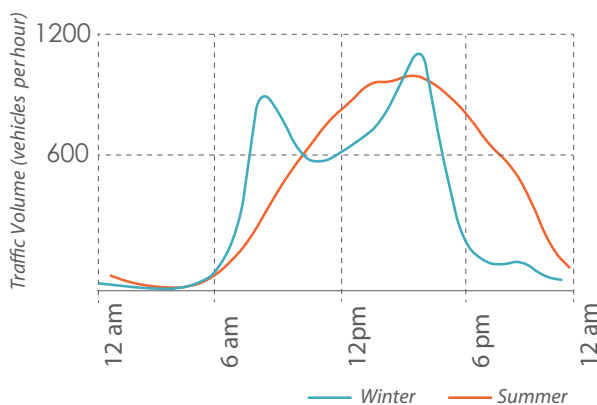
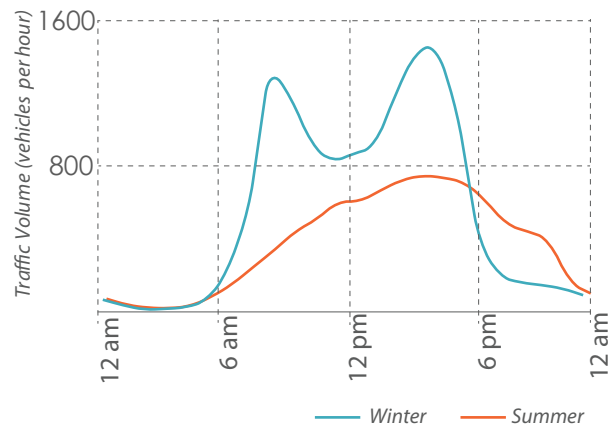


Exhibit 4

**Weekend LCC Total Traffic by Time of Day
February 2016 & July 2015**





different times, but afternoon traffic exiting the canyons is more concentrated.

Compared to winter travel patterns, summer recreation activities in the canyons tend to be more spread out throughout the day and occur at many points, trailheads, and destinations along SR 190 and SR 210. These travel patterns are affected by more hours of sunlight for summer canyon activities. As a result, summer traffic does not display the typical “rush hour” patterns observed in winter for inbound and outbound canyon trips. Summer traffic gradually increases throughout the day until it reaches highest levels of traffic between 1 and 6 pm. This single two-directional peak reflects the combination of multiple waves of inbound and outbound peaks for the morning, mid-day, and evening periods.

Follow-on discussions of the problem framework present additional data that demonstrate the significant differences between summer and winter seasons, weekdays and weekends, and peak and non-peak periods. These temporal variations set a critical component of the context for transportation needs and corresponding potential transportation solutions for the Cottonwood Canyons.

Canyon Visitors

As discussed above, traffic in the canyons is generally higher on weekends than on weekdays in both winter and summer. Visitation estimates

were made by aggregating transit ridership and traffic estimates based on counts and occupancy assumptions (see Exhibit 6). These visitation estimates represent external two-way person trips accessing the canyons from Salt Lake Valley (each two-way person trip represents one visitor). The visitation estimates also represent conditions for some of the busiest visitation days for Big and Little Cottonwood Canyons for both winter and summer.

For the busiest weekdays, canyon visits are notably lower in the summer than in the winter, while visits for the busiest summer and winter weekends are similar. However, the number of busy summer weekend days is lower than busy winter weekend days. Also of note, transit ridership (primarily available in the winter) shows very little difference between the weekdays and weekend, and is in fact a bit higher on the weekday than the weekend. As shown, transit currently accounts for a small share of external winter canyon visitation – approximately 4 to 5 percent of external daily visits. As previously mentioned, these total visit estimates account only for one-directional trips entering the canyons on a busy day, and do not include intra-canyon trips. However, transit-based visits are consistent for weekdays and weekends throughout the winter season.

Car occupancy measurements collected in late March and early April 2016, combined with average daily transit ridership information, were used to estimate the number of external person visits for the Cottonwood Canyons. Although the March/April occupancy counts captured winter ski season trends, they represent late season conditions which may differ for the peak winter season (January-March). Carpooling patterns may also differ in summer. However, as the best available data, these occupancy counts were used to estimate winter and summer vehicle occupancy trends. Additional occupancy counts in January/February 2017 should be collected to help refine winter occupancy and canyon visitor estimates. Additional occupancy counts were collected in July 2016 to better represent summer patterns, but the data were not analyzed in time for inclusion in the draft version of this framework document.



Exhibit 5

Heavy southbound traffic on Wasatch Blvd/SR 210



Occupancy counts analyzed for this framework document showed that approximately half of the trips made to Little Cottonwood Canyon on a weekday (52 percent) are cars with a single occupant. In Big Cottonwood Canyon, 57 percent of cars were observed to have a single occupant. Based on occupancy counts, car occupancy for Little Cottonwood Canyon was estimated at 184 percent for weekends and 158 percent for weekdays. Occupancy rates were estimated to be higher in Big Cottonwood Canyon, estimated at 177 percent for weekends and 190 percent for weekdays.

Both canyons see more carpooling on weekends than on weekdays, which can be attributed to a higher percentage of recreation-bound travelers entering the canyons on weekends. Occupancy data collected also shows a positive relationship between higher traffic and higher vehicle occupancy, meaning that there is more carpooling on busier traffic days. Occupancy data also shows more carpooling during busier times of the day. The data shows less carpooling in the early morning hours (before 8:30 am) and more carpooling in the later morning hours (after 8:30 am). This suggests that fixed daily trips, such as canyon-bound employees and canyon-based commuters, generally have lower tendency to carpool than flexible recreation-bound travelers.

Trip Origin-Destination Data

Trip origin-destination patterns for the Big and Little Cottonwood Canyons were estimated using cell phone data collected by Aisrage for average weekdays and weekends for the months of July 2015 and February 2016. The Aisrage origin-destination data was obtained for 43 zones in Utah, including 30 zones to cover the urbanized areas of Salt Lake County and four zones to cover the Cottonwood Canyons. This data is significantly more granular and winter and summer season specific than similar Aisrage data collected by the Wasatch Front Regional Council (WFRC) in the past. The Aisrage data represents a sample of travelers in the Cottonwood Canyon who use Verizon cellular service. However, this sample is much more inclusive than traditional origin-destination surveys that capture only a small portion of travelers.

The following heat diagrams show where trips to/from the Cottonwood Canyons are originating or ending. The information is available separately for residents of Utah and out-of-state visitors and for weekdays and weekends. However to keep this document brief, the origin-destinations heat diagrams are presented here only for all captured trips (resident and visitor trips) for weekdays only. This origin destination data is important because it establishes travel markets that could be served through park and ride lots, transit service, and other transportation solutions.

EXHIBIT 6: Canyon Visitation by Season

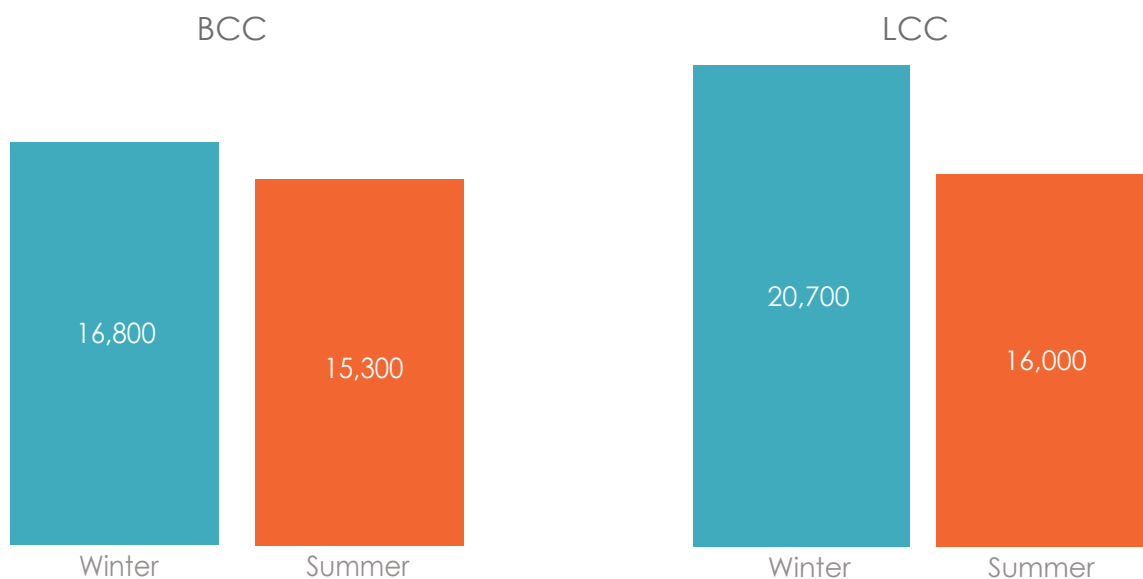
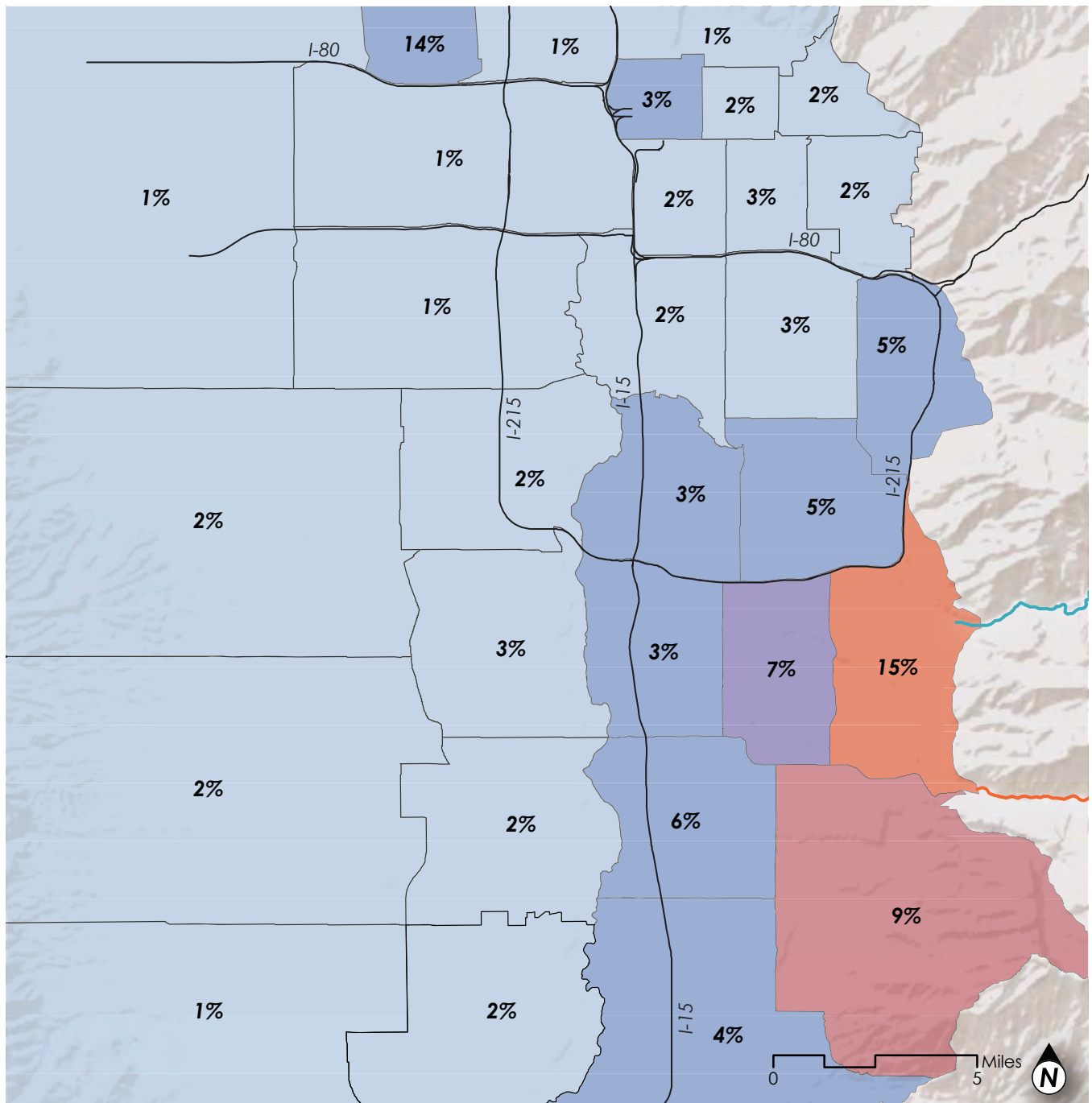




EXHIBIT 7: Summer Weekday Trip Origins



LEGEND

Interstate

SR-210

SR-190

Ski Resort

% of Trip Origin to Canyons

+0% - 3%

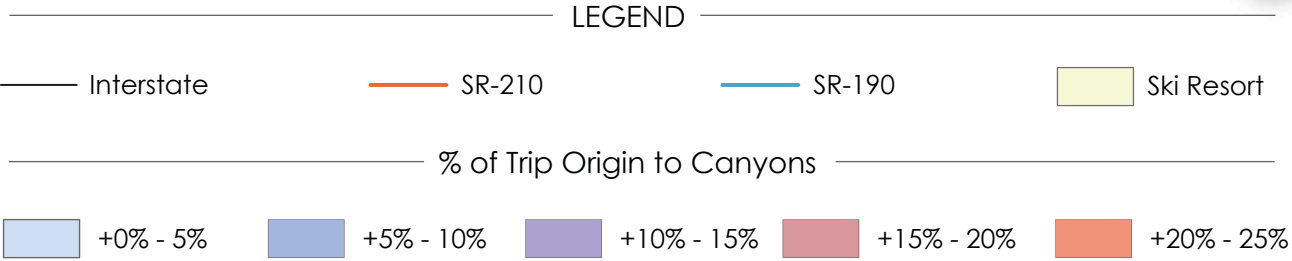
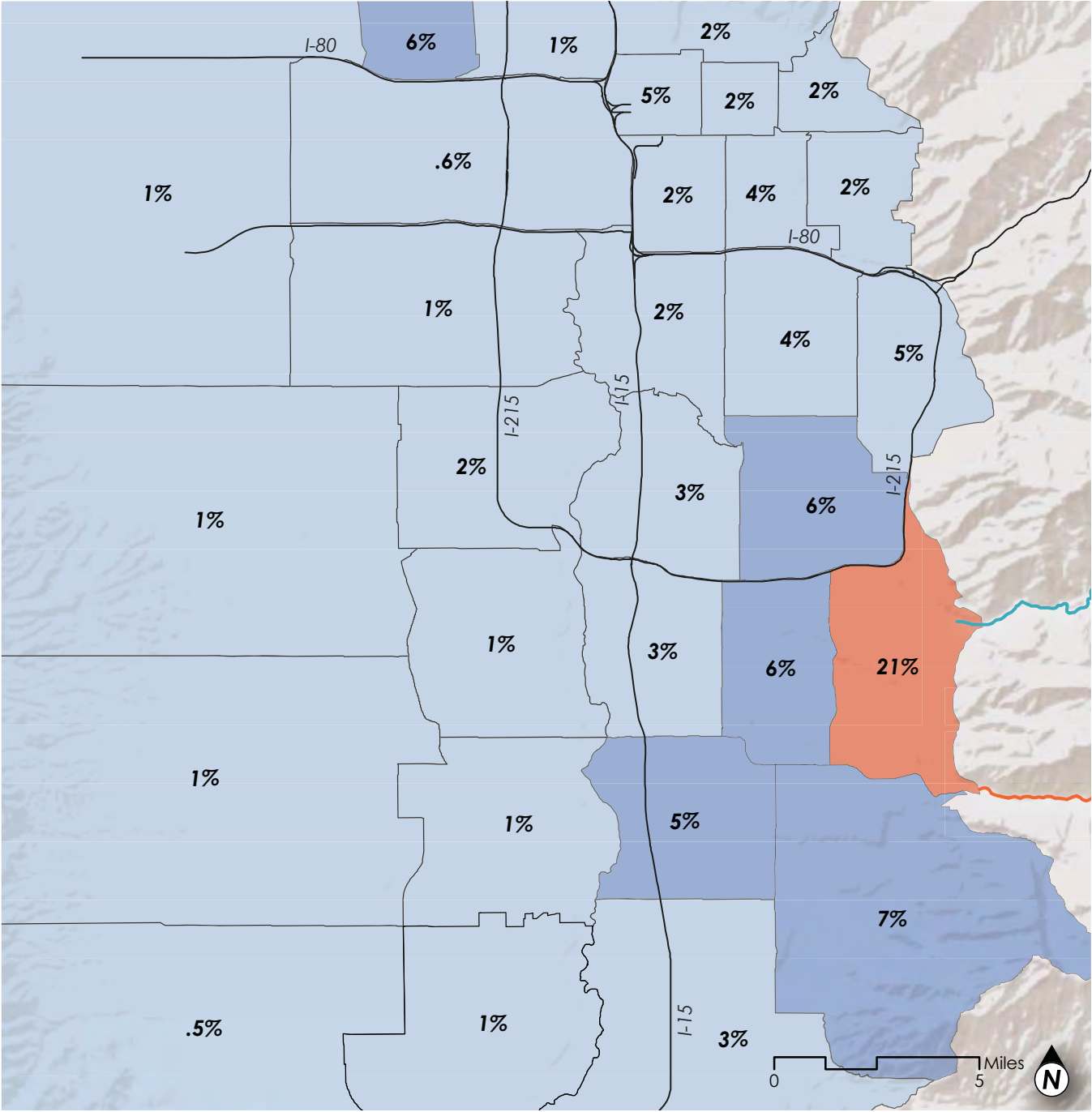
+3% - 6%

+6% - 9%

+9% - 12%

+12% - 15%

EXHIBIT 8: Winter Weekday Trip Origins





Developed and Dispersed Recreation

Recreation in the Cottonwood Canyons can be generally divided into two categories: developed and dispersed. Developed recreation occurs at resorts and on managed areas and includes activities such as resort skiing, hiking on maintained trails, and camping at campsites. Dispersed recreation happens outside of formal areas and includes activities such as rock climbing, primitive camping, backcountry skiing, and bushwhacking. Developed recreation accounts for a large proportion of recreation in the canyons; in the winter, developed recreation represents 87 percent and 96 percent of recreation in Big Cottonwood Canyon and Little Cottonwood Canyon, respectively. Most of this can be attributed to skiing at the four ski resorts. As such, this framework document generally refers to developed recreation as “resort” recreation.

In Little Cottonwood Canyon, resort recreation is still more common in the summer; 82 percent of summer recreation happens in resort areas, likely because of the summer activities offered at Snowbird and Alta resorts^{18, 23, 25}. On the other hand, Big Cottonwood Canyon sees a large jump in dispersed recreation in the summer, from 13 percent in the winter to 59 percent in the summer¹⁸.

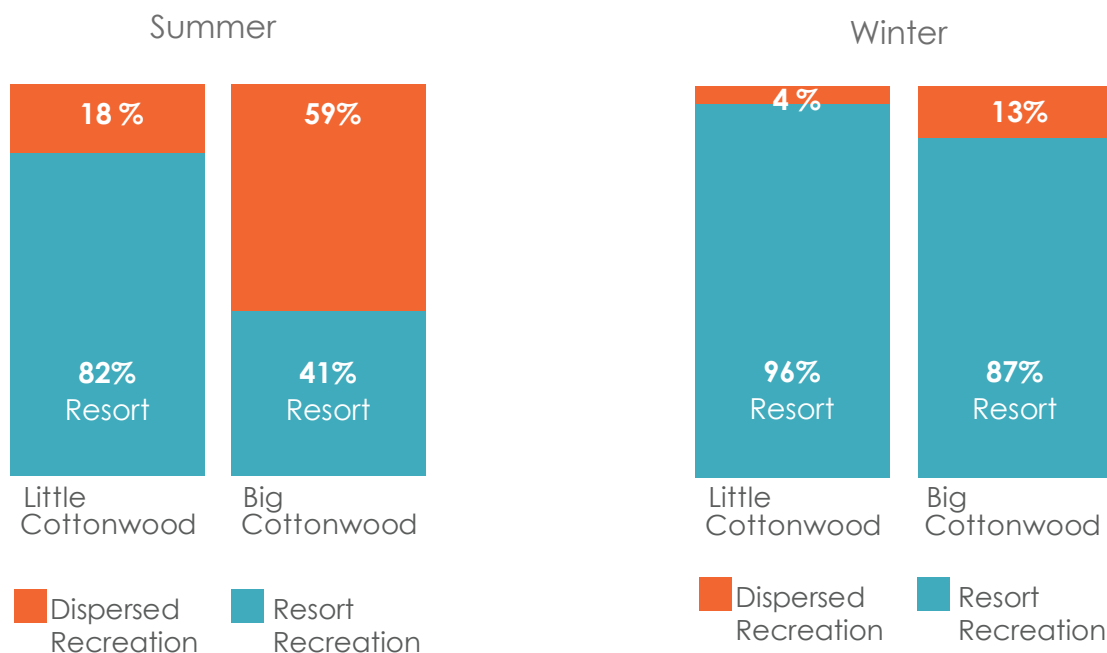
The Central Wasatch Visitor Use Survey found that local dispersed users are more likely to be local to the area, while resort visitors are more likely to be non-local. Nearly half of the survey respondents reported recreating in both developed and undeveloped areas¹⁸.

The relationship between resort and dispersed canyon recreation activities is important because it defines summer and winter conditions for each of the Cottonwood Canyons. It sets the context for transportation solutions for all canyon users and seasons.

Canyon Employment

Transportation planning efforts completed for Mountain Accord Phase I included the development of travel demand model for the Cottonwood Canyons. This model included estimates of socioeconomic data for the Cottonwood Canyons, including the households, population, and employment (Exhibit 11). A caveat to this employment data is that seasonal employment variations are not accounted for. Information provided by the individual ski resorts allows a perspective on these seasonal employment variations (Exhibit 10). The primary employers in the Cottonwood Canyons are the ski resorts: Alta and Snowbird

EXHIBIT 9: Recreation Destinations by Season



in Little Cottonwood Canyon, and Brighton and Solitude in Big Cottonwood Canyon. Other (non-resort) employment in the canyons generally consists of businesses that support tourism, including shops, restaurants, spas, etc.

Employment at the ski resorts is highly seasonal because most of the employment is tied to the winter ski season. However, resort personnel are also employed during the summer. Little Cottonwood Canyon resorts employ a combined 2,360 employees in the winter, more than double the combined 1,050 winter employees of Big Cottonwood Canyon resorts. In the summer, Snowbird has over 1,100 employees to support summer resort activities, while Alta and Solitude employee numbers drop to 85 and 125, respectively. Summer employment data for Brighton resort was not available for inclusion in the draft version of this framework document. As such, Brighton employment was assumed to be proportional to Solitude and estimated at 165 summer employees.

Canyon Housing and Lodging

Big Cottonwood Canyon houses approximately 800 residential units across 11 neighborhood communities, and is home to an estimated year-round population of 215 people²¹. Little

EXHIBIT 10: Ski Area Employment

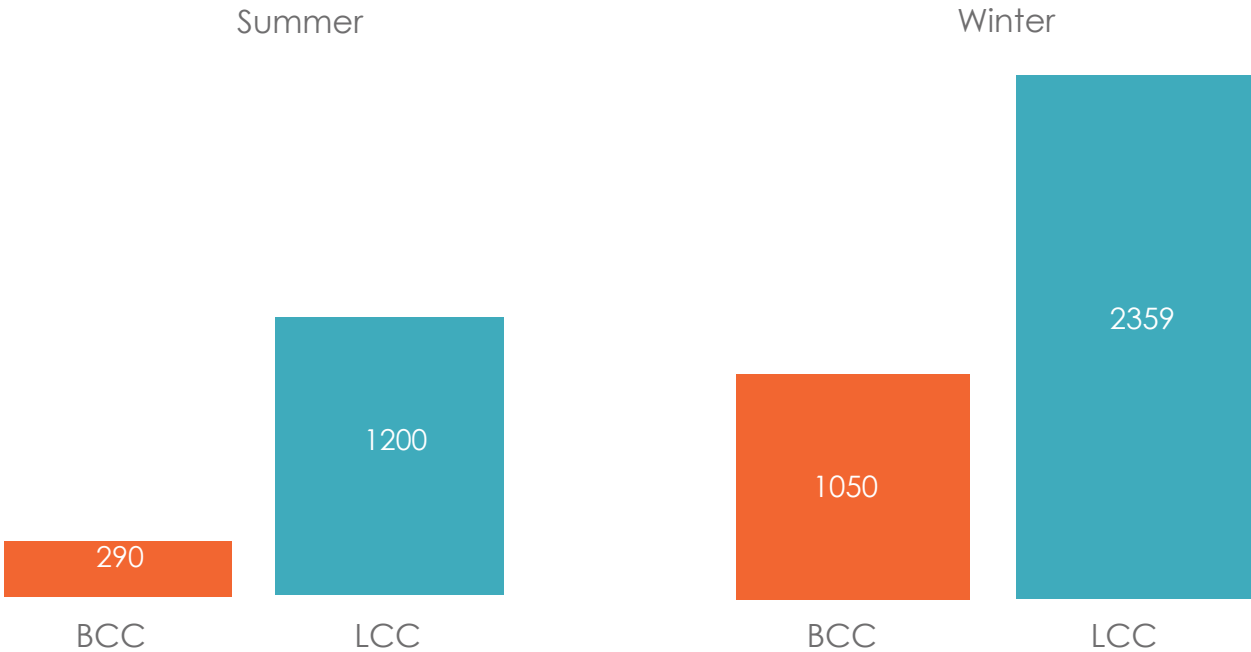


EXHIBIT 11: Hourly Traffic Conditions

	Total Households	Total Population	Total Employment
BCC	607	1,613	876
LCC	449	1,227	2,001

Cottonwood Canyon's Town of Alta houses approximately 330 residential units. Town of Alta officials, however, suggest that the number of year-round residents is likely as low as 100, and is subject to a wide range of seasonal fluctuation. The discrepancy between households and year-round residents in both canyons is indicative of a large amount of rental properties and second homes in the canyons. Additional housing and population estimates are summarized in Exhibit 11.

Three of the four canyon ski resorts have hotels on-premises: Solitude has 66 hotel rooms, Alta has 250 hotel rooms, and Snowbird has 883 hotel rooms³⁰. Alta also reports having on-site lodging for 96 employees³¹.



ENVIRONMENT

The Cottonwood Canyons are home to protected species, migratory birds, and rare plant species⁸. Growth in use of the Cottonwood Canyons has led to concerns about habitat fragmentation, water quality, and air quality. Development and increased traffic contribute to habitat degradation and habitat fragmentation³. The canyons are an important watershed for the Salt Lake Valley, including valued water-related features, such as wetlands and Little Cottonwood Creek. Big and Little Cottonwood Canyons are drinking water source areas protected under special ordinances of Salt Lake City, Sandy City, and the Town of Alta³. Increased use of the canyons and development in the canyons have raised the alarm about potential degradation of water quality. As documented in the Mountain Accord's Existing Conditions & Future Trendlines report, roadway runoff typically contains relatively high concentrations of heavy metals, hydrocarbons, and salt or de-icing chemicals. Increasing traffic could adversely affect water quality in the project area watersheds. Also, cars informally parked on the roadside can lead to increased contaminant runoff entering the watershed³.

The increase in cars and congestion through the canyons has also led to concerns about air quality impacts. Salt Lake County is a nonattainment areas for PM10 (particulate matter smaller than 10 microns) and for PM2.5

(particulate matter smaller than 2.5 microns). While improvements in vehicle mileage efficiency, fuel mixtures, and emission controls are expected to induce reductions in emissions over the coming years, stakeholders of the Central Wasatch Mountains are concerned about the air quality impacts of single-occupancy vehicles traveling in the canyons³.

A CLOSER LOOK: CONGESTION

TRAFFIC CONGESTION

Canyons and Access Roads

Congestion of the roadways in the Cottonwood Canyons is a common theme in recent studies that have looked at transportation in the area. Traffic congestion in the canyons is a problem on peak days and peak times during the winter and summer. Traffic volumes on the canyon roads often exceed capacity during the ski season, and the steep grades and winter driving conditions can cause heavy traffic -sometimes referred to as the "red snake"- that requires several hours to clear. Additionally, road closures because of weather conditions and avalanche danger cause significant congestion on the roads approaching the canyons. During non-peak and dry roadway conditions, vehicles can travel the speed limit for most of the corridor.

Road closures are primarily issued in the event of an avalanche hazard or avalanche clearing activity that could present a hazard to travelers in the canyons. Information was collected from data derived by Alta Dispatch, which provides drivers with advanced notice of traffic conditions in Little Cottonwood Canyon. In the winter months of 2016, Alta Dispatch advised of daytime avalanche closures a total of seven days, three of which occurred on a weekday, and four of which occurred on the weekend or a Friday. Given the nature of traffic during an avalanche hazard closure and the duration of the closure, impacts on traffic and canyon visitors on these days can be burdensome.

Given normal travel and roadway winter conditions, traffic is heaviest in the eastbound direction during the morning hours as people

Traffic Congestion

The "Red Snake"

- Increased Demand
- Limited Capacity
- Weather Events





arrive at the ski resorts, and is mirrored in the westbound direction during the late afternoon. Poor road surface conditions cause congestion. When the chain law is in effect, each car must be checked by a police officer to verify compliance with traction laws in effect, including four-wheel drive and snow tires or chains. Traction laws require chains to be in the car, but not necessarily mounted on the tires. This can cause problems when vehicles encounter slippery conditions up the canyon and have to stop to mount chains without the benefit of a dedicated chain-up area. The current chain up area is inconvenient or poorly signed. In addition to a lack of convenient chain-up areas, the base of the Cottonwood Canyons roads lack areas for vehicles to turn around when they do not meet the chain law requirements. Generally, there is a lack of public understanding of the traction chain laws²⁰.

Bad Days

Congestion the Cottonwood Canyons can be described by the number of “bad days” that affect travelers accessing the canyons and surrounding neighborhoods and corridors impacted. Volume and speed data continuously collected by UDOT Automatic Traffic Recorders (ATR) at the mouth of the canyons was used to analyze when and how often canyon users are impacted by this congestion. Congestion is triggered by the following:

- Conditions that increase demand for canyon travel use, including weekends, holidays, and storm events

- Reductions in roadway capacity caused by poor roadway conditions, including snow covered and icy roads
- Road closures required for avalanche control and incident management

To measure bad days, roadway capacity was estimated for both Big and Little Cottonwood Canyons by comparing traffic counts and speed data. Estimates considered the number of cars that moved through SR 190 and SR 210 and how fast their speed. From this analysis, the overall traffic capacity for the canyon roads was estimated to be approximately 1,100 to 1,300 vehicles per hour per direction during favorable operating conditions. Depending on the roadway conditions, inclement weather was observed to reduce this capacity to approximately 900 to 1,100 vehicles per hour per direction. Days when one hour or more of traffic exceeded the performance threshold noted above were considered “bad days”.

Exhibit 12 shows the estimated number of bad days that occurred during the summer and winter, based on traffic data for the past year²⁹. The data show that Big Cottonwood Canyon has more bad days in the summer than Little Cottonwood Canyon, attributable to the higher proportional access to dispersed summer activities than Little Cottonwood Canyon.

In winter, Little Cottonwood Canyon sees a notably higher number of bad days. In the winter of 2016 (January-March), Little Cottonwood Canyon users experienced congestion while

EXHIBIT 12: Days with Over Capacity Traffic

Summer					Winter				
Road Condition	BCC		LCC		Road Condition	BCC		LCC	
	Inbound/Outbound		Inbound/Outbound			Inbound/Outbound		Inbound/Outbound	
Poor	0 (Days)	0	0	0	Poor	5 (Days)	2	11	11
Good	14	8	3	14	Good	3	2	11	25
Total	14/122 (Days)	8/122	3/122	14/122	Total	8/91 (Days)	4/91	22/91	36/91

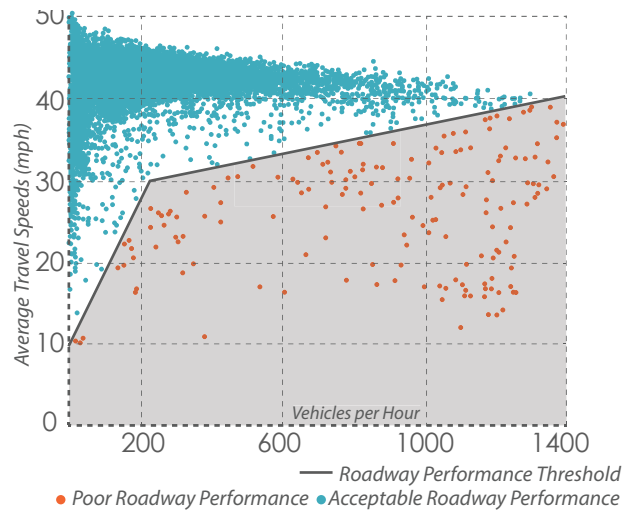


entering the canyon on 22 of 91 days (24 percent), and while exiting the canyon, on 36 of 91 days, or 40 percent of the time (See Exhibit 12). Lower winter congestion levels match reports and anecdotal information that winter congestion is worse in Little Cottonwood Canyon than in Big Cottonwood Canyon.

In Little Cottonwood Canyon, congestion is higher for travelers on their way out the canyon, but in Big Cottonwood Canyon, congestion rates are higher on the way into the canyons. This may be due to the higher rates of dispersed recreation in Big Cottonwood Canyon (meaning not all users are held to the same opening and closing times of the resorts). It is also possible that the low number of congested days exiting the canyon may be attributed to the location of the UDOT traffic count recorders. Particularly for Big Cottonwood Canyon, the counters located at the mouth of the canyon likely miss the bottlenecks occurring in the canyon. The position of the traffic counters may underestimate the number of bad days for one or both canyon roads.

Efforts to estimate the number of bad days for this framework document included attempts to use the UDOT signal detector information and real time signal metrics for traffic signals located

EXHIBIT13: Hourly Traffic Conditions

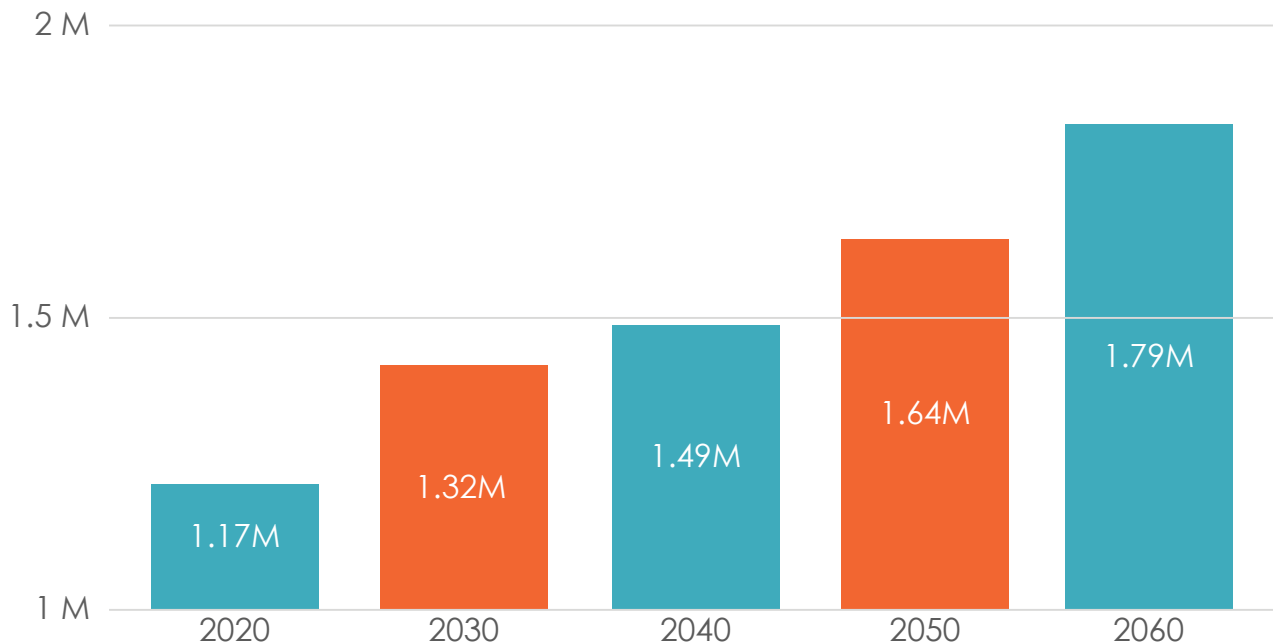


at the approaches to the Cottonwood Canyons. However, the utility of traffic signal data was limited because the current signal detection records filter out low speed data and to do not include stop bar detection needed to identify periods of congestion.

Growth

Big and Little Cottonwood Canyons are experiencing pressure to accommodate the recreational needs of a rapidly growing

EXHIBIT14: SLC Projected Growth





population in nearby urban areas, including Salt Lake Valley. As shown in Exhibit 14, Salt Lake County is expected to experience significant growth into the future.

Utahans are enthusiastic about outdoor recreation and participate at a rate much higher than nationwide averages (82 percent vs. 50 percent)²⁶. The US Department of Agriculture identified the Uinta-Wasatch-Cache National Forest as the forest with the greatest expected increase in visitor use, with more than one million additional visits expected from the local area annually between 2010 and 2020¹⁹. The report also notes the high level of local visitation to the forest, cited at about 2.1 visits per capita for the local area (residents living within 50 miles of the forest). The plentiful and unique recreational opportunities afforded to residents in the Salt Lake City area is often listed as a major influence on the choice to live in the area.

The anticipated growth in the region is expected to put a major strain on the transportation system if modal options and choices follow existing patterns.

Traffic in the Cottonwood Canyons itself has also grown over the past few years. The latest data

from automatic UDOT traffic counters indicate that over a three year period (2014-16), winter traffic increased by about 13 percent, and during a similar three year period (2013-15), summer traffic increased by approximately 24 percent (Exhibit 15).

PARKING

Valley and Canyon Parking Capacity

The capacity of parking facilities in the Cottonwood Canyons and its base are important because they set the context for transportation solutions. They also set the context for current incentives for travel to and within the Cottonwood Canyons.

In 2012, a parking study was completed to inventory and analyze the parking for the Cottonwood Canyons. Based on that study, parking facilities for the Cottonwood Canyons ski resorts were estimate to include approximately 7,000 parking spaces within their parking lots.

This resort parking capacity contrasts with approximately 300 parking spaces for the combined Big and Little Cottonwood Canyon park and ride lots located at the mouth of each canyon. The park and ride capacity for the base of the Cottonwood canyons increases

EXHIBIT 15: Daily Canyon Traffic Growth

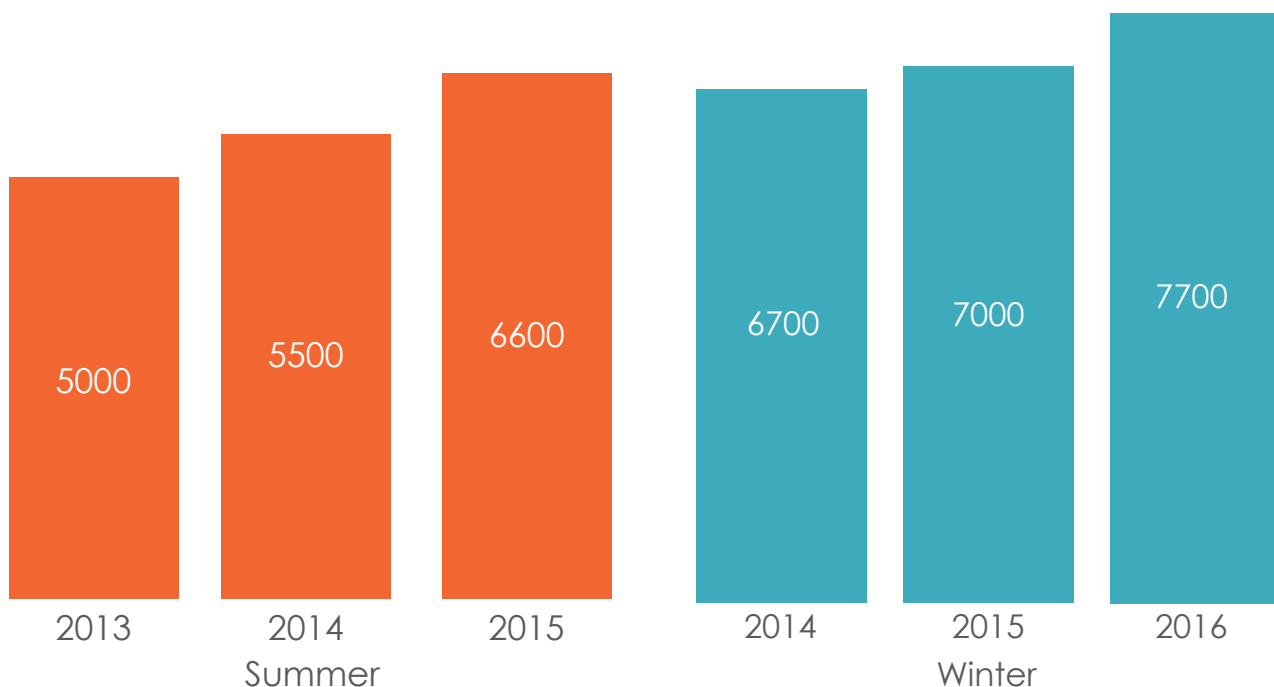




EXHIBIT 16 & 17: Roadside Parking



Summer Roadside Parking



Winter Roadside Parking

to approximately 700 parking spaces for the combined Cottonwood Canyons park and ride lots and the nearby 6200 South and 3500 East park and ride lots¹². Additional parking capacity is available in the canyons and the base of the canyons if formal and informal roadside parking is considered.

Parking Lot Overflow and Informal Roadside Parking

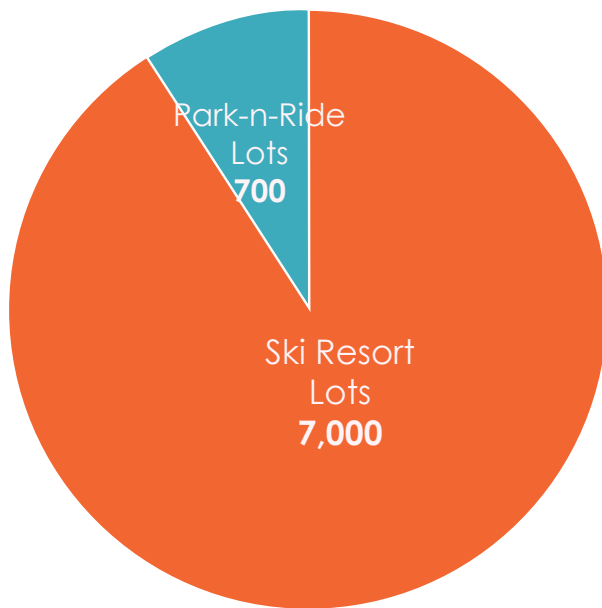
During peak periods, parking in the canyons reaches and often exceeds capacity, leading to overflow. Informal parking is common on roadway shoulders at and near dispersed recreational access points. Currently, informal shoulder parking is generally allowed¹¹. Peak

summer use leads to overflow of trailhead parking facilities and an increase in roadside parking on shoulders¹².

Roadside parking reduces the availability of shoulder space for cyclists, pedestrians, and emergency vehicles¹². Shoulder parking also has negative environmental consequences, such as disturbance of contaminated soils within the roadbed that could result in the conveyance of hazardous materials into the water supply³. Informal roadside parking in the summer also contributes to the formation of “spider web” trails (discussed further in the Pedestrians and Cyclists section).



EXHIBIT18: Parking Lot Spaces



In the winter, ski resort parking lots often fill up and overflow parking happens on the shoulders, park and ride lots, located at the mouth of the canyons and in the valley, also exhibit parking issues: some fill up and overflow at peak times, while at the same time, some are underutilized. Parking overflow results in street parking in and near neighborhoods near the canyon mouths¹².

While this parking overflow issue suggests that there is a parking shortage in the canyons, expansion of parking areas is not desired because of the environmental impacts that would cause. The Wasatch-Cache National Forest Plan (2003) does not allow for parking expansion except if needed for watershed protection or to facilitate mass transit⁶.

PEDESTRIANS AND CYCLISTS

Pedestrian and Cyclist Access

Biking and pedestrian activity in Big and Little Cottonwood Canyons is primarily for recreational purposes. Bicyclists and pedestrians most often reach the canyons via personal vehicles, commercial vehicles, or public transit. Some users access the canyons without cars by riding, walking, or running on canyons roads. During the summer, fishing, cycling, hiking, and climbing are popular activities in the canyons. In winter, popular non-resort based activities include

According to the Backcountry Winter Use Assessment of the Central Wasatch Mountains report:

“A majority of the WBA (Wasatch Backcountry Alliance) members and UMA (Utah Mountain Adventures) clientele reported that the CWM (Central Wasatch Mountains) backcountry is an essential part of living in Utah. Respondents indicated that the CWM positively contributes to quality of life, quality of outdoor recreation, social atmosphere, a strong economy, and cultural awareness.” (Executive summary)

Additionally, the report states that members of these organizations specifically located to the Salt Lake City Area because of the recreational amenities of the central Wasatch. It goes on to state that if access to these unique amenities is restricted or if they are impacted by overuse they would consider moving away from the Salt Lake City area. Demographically, these individuals tend to be in high-earning professions, with the vast majority having attained at least a 4 year degree.

alpine touring and alpine skiing. The myriad of recreational opportunities found in the canyons are an integral part of the Utah lifestyle; many residents indicate recreational opportunities as a primary reason for living in the area¹⁶.

Shoulders and Safe Movement

Bike and Pedestrian use within the canyons contribute to a number of transportation issues. With no dedicated paths or sidewalks along the roadways, bikes and pedestrians must share the roadway and shoulders with cars moving through the canyons. This can lead to conflicts on the narrow canyon roads. Shoulders, where present and available, are often littered with road debris, which can be dangerous for bikes²⁷. In other places, shoulders are narrow or are obstructed by cars informally parked on the roadside. When sharing the roadway on inclines, cyclists can slow car travel significantly where passing is difficult, or may lead to cars attempting unsafe passes. Pedestrian and cyclist facilities for access roads to Big and Little Cottonwood Canyon, including



SR 210, exist, but are not complete or connected. For summer of 2016, UDOT plans to stripe and, where necessary, widen the SR 210 to provide bike lanes in each direction between the mouth of Big Cottonwood Canyon and the mouth of Little Cottonwood Canyon.

Most cyclists using the canyon roadways could be considered expert riders who are comfortable with mixed-traffic riding. No separated bike facilities currently exist in the canyons. The infographics below show shoulder facilities available to accommodate pedestrians and cyclists for each canyon in for the uphill (eastbound) and downhill (westbound) directions.

Going downhill, cyclists can travel closer to the speed of cars, so the lack of shoulders is not as much of an issue for expert level cyclists⁷. In some cases, cyclists adjust their riding patterns to assert themselves on the road; riding two abreast (side by side in the road, rather than single file). This is seen by some cyclists as a way make their presence more visible and to discourage cars from passing in narrow areas. These behaviors are sometimes seen as frustrating to drivers, who feel slowed by side-by-side cyclists that won't allow them to pass¹¹.

Cyclists traveling through the canyons must compete with parked cars for space in the shoulder. More pedestrians are likely to be crossing and/or walking alongside the road during the summer, as they move between

parking spots and trailheads. Anecdotally, new trends in the Cottonwood Canyons include an estimated increase use by runners, including running in winter and poor roadway conditions. However, data for cyclists, runners, and other pedestrian users were not available for this framework document.

Facilities

Visitors to non-resort areas of the canyons have limited facilities available for use. Restroom facilities owned and operated by the US Forest Service and concessionaires are available at 15 locations in Big Cottonwood Canyon and six locations in Little Cottonwood Canyon. Out of these 21 total restroom facilities, only three are open year round. This means that in many cases, locations used heavily in the winter are left with no restroom services²². Stakeholders have also expressed concerns about facilities that are accessible long after "shoulder" season users access the canyons.

The absence of service at trailheads leads to the degradation of the watershed from improper human waste disposal. Because of the potential negative consequences to water quality, the Salt Lake County Watershed Management Plan (1999) stipulates that disposal of human waste must be at least 200 feet from waterways and at least 6 inches deep⁵. Users do not always comply with these rules²⁸.

Limitations on bathroom facilities are primarily caused by funding scarcity. According to the US





Limited Facilities October-May

Summer-only Facilities: 16

Winter-only Facilities: 2

Year-round Facilities: 3



In 2016, the US Forest Service proposed a fee structure to help mitigate use impacts and pay for enhanced services at formal trailheads, which are expected to worsen with time as user volumes increase. Six locations in Big Cottonwood Canyon and four locations in Little Cottonwood Canyon would require a pass, offered at \$6 for 3 days or \$45 annually.

Forest Service, the lack of fees to use trailhead parking and facilities means that dispersed canyon activities provide no revenue stream to help the US Forest Service operate and maintain facilities. In the winter, the potential for additional maintenance concerns, such as freezing pipes, also contributes to the decision not to open facilities²².

Unofficial Trails and Parking

Unofficial trails are forged by hikers, rock climbers, and other dispersed recreationists in the summer. These trails form “spider web” patterns

between roadside parking locations and routes or destinations. These trails have negative environmental consequences for watershed health and can fragment wildlife habitat¹¹.

A CLOSER LOOK: TRANSIT

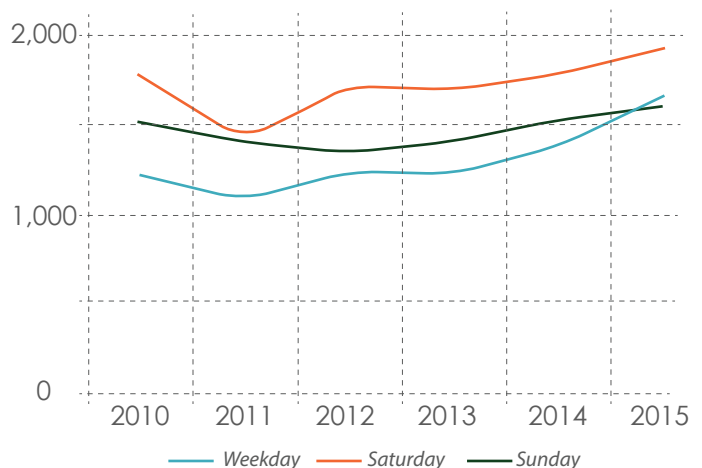
Transit Service Overview

Service Background

The concentration of people traveling into the Cottonwood Canyons and on to a few unique destinations is an ideal environment for transit service. Seizing this opportunity, UTA has provided public transit service to and from the Canyons since 1976. While this problem framework covers publically funded transit services only, there are currently a number of privately owned shuttle and bus providers that serve the Cottonwood Canyons as well. These providers have fleets of vehicles that consist of vans, buses with amenities such as restrooms, Wi-Fi, and beverages, and/or taxis for individual users/groups. The transit components of the problem framework presents transit services (this section) and transit facilities and users (subsequent sections) for fixed routes and vanpools.

As previously noted, summer recreation activities in the canyons tend to be more spread out throughout the day and occur at many points, trailheads, and destinations along SR 190 and SR 210. The dispersed nature of summer canyon trips are more costly and less efficient to serve with

EXHIBIT19: Yearly Transit Ridership Trends





a fixed-route transit system. As a result, there is a significant drop between winter and summer transit service levels. Over 96% of the transit service provided annually into the Canyons occurs between December and April as part of UTA's ski bus service. A small number of ski service trips begin in mid-November. These trips are intended to serve pre-season training and orientation for resort employees and other pre-season canyon users. The balance of annual service consists of one daily round-trip between the Midvale Fort Union TRAX station and Little Cottonwood Canyon. Thus, this section of the framework document focuses on winter ski bus service.

Service Characteristics

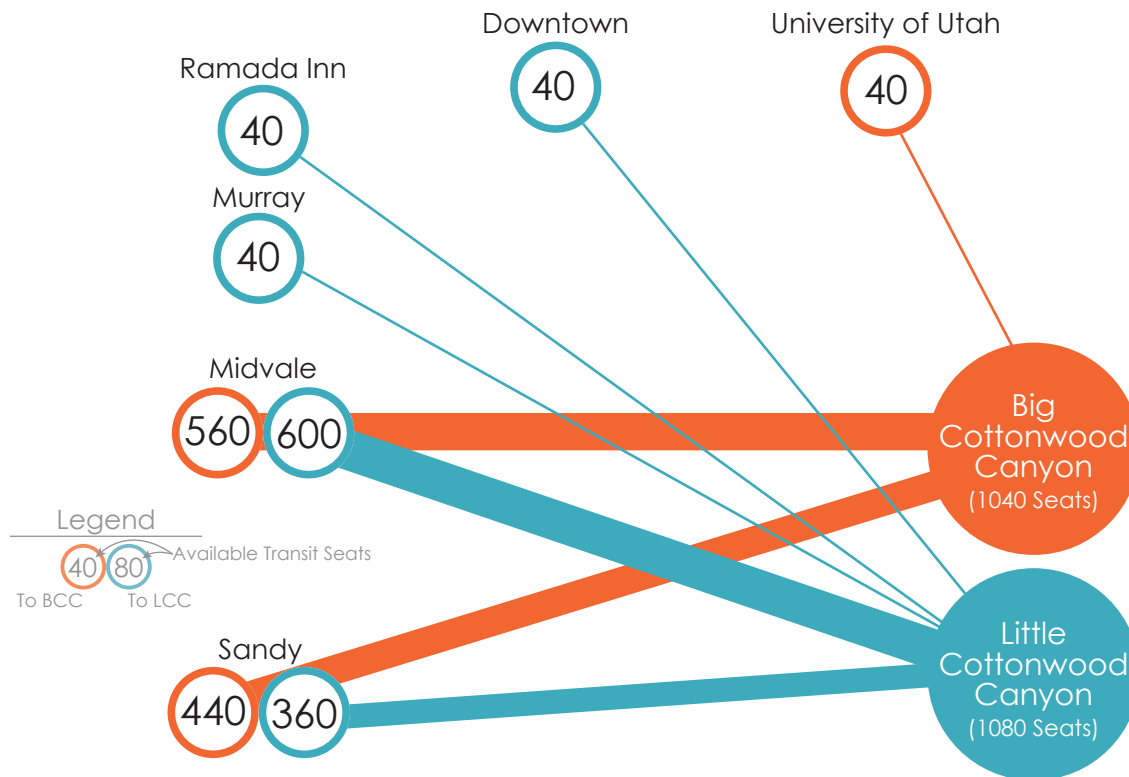
UTA provides approximately 110 transit trips daily into and out of the Cottonwood Canyons, using 32 buses specially equipped to accommodate ski and snowboard gear, and also mechanically adapted to drive in winter conditions. Exhibit 20 below shows the amount of daily service capacity between major destinations in the Salt Lake Valley and the Cottonwood Canyons.

Each ski bus can seat approximately 35 to 40 passengers. This analysis assumed a capacity of 40 passengers per ski bus.

UTA ski bus service operates a relatively consistent schedule on weekdays, Saturdays, and Sundays throughout the duration of the ski season. Exhibit 22 below indicates the number of transit trips that occur into each canyon, by day of the week. In addition to the 32 buses that are used to accommodate the regularly scheduled ski bus service, UTA has up to six additional buses that may be put into service on busy days as needed. Demand is assessed each morning, and the determination of whether or not to use these buses is made in a responsive and dynamic manner.

There are 8 transit routes that serve Big and Little Cottonwood Canyon. A description of each follows:

EXHIBIT 20: Average Daily Transit Seats to Resorts





Routes serving Big Cottonwood Canyon:

1. Route 954: operates one trip each way Friday – Sunday, from the University of Utah to Brighton and Solitude. There are 10 stops and the trip from the University to Brighton takes 1 hour and 22 minutes.
2. Route 960: operates 13 trips inbound every day from the Midvale Fort Union TRAX station to Brighton and Solitude. There are 16 stops and the total route time is one hour.
3. Route 962: operates 11 trips inbound every day from the Sandy Civic Center TRAX station to Brighton and Solitude. There are 12 stops and the total route time is one hour.

Routes serving Little Cottonwood Canyon:

1. Route 951: operates one trip each way every day, from Downtown Salt Lake City to Snowbird and Alta. There are 23 stops, and the total trip takes 1 hour and 26 minutes
2. Route 952: operates one trip each way every day, from the Ramada Inn south of Salt Lake City to Snowbird and Alta. There are 18 stops, and the total trip takes 1 hour and 13 minutes
3. Route 953: operates one trip each way every day, from the Murray Central TRAX station to Snowbird and Alta. There are 19 stops, and the total trip takes 1 hour and 11 minutes
4. Route 990: operates 14 trips each way every

day, from the Midvale Fort Union station to Snowbird and Alta. There are 27 stops, and the total trip takes 1 hour and 3 minutes

5. Route 992: operates 9 trips each way every day, from the Sandy Civic TRAX station to Snowbird and Alta. There are 17 stops, and the total trip takes 52 minutes

VANPOOL SERVICE

In addition to transit service provided via fixed routes, UTA also provides vanpool vehicles – these vehicles are 12-15 seat vans used for carpools by resort employees. Vanpools are fully paid for by individual resorts. Because of the higher number of winter resort employees, there is a greater demand for vanpool vehicles in the winter than the summer. However, resorts that stay open in the summer utilize these vanpool vehicles year-round for their employees. Employees of Snowbird and Alta are the most significant users of UTA's vanpool services in the Cottonwood Canyon. Exhibit 21 shows the number of vans and participants by month for 2015. Van pool details were not available for any of the other Cottonwood Canyon ski resorts. While data reveals the utilization of vanpools throughout the year, it is not clear where resort employees access vanpools.

EXHIBIT 22: UTA Buses Serving Canyons

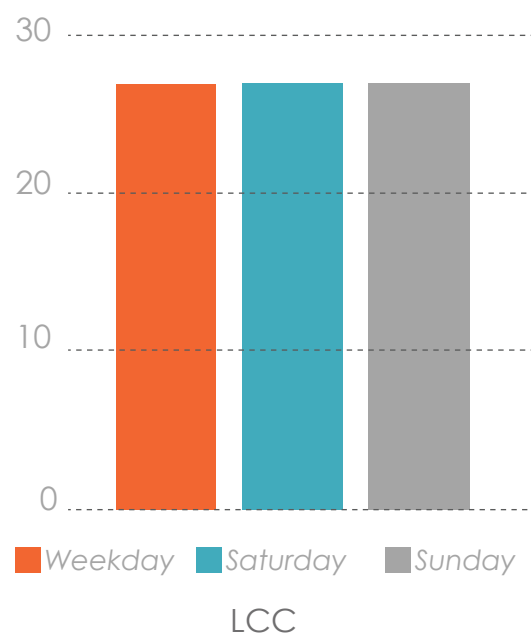
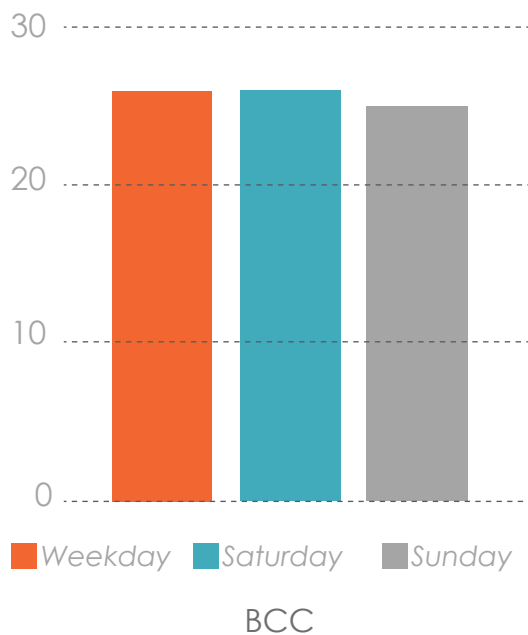




EXHIBIT 21: Vanpool Numbers

Month	Vans	Participants
June, 2015	8	104
July, 2015	8	102
August, 2015	8	104
September, 2015	8	104
October, 2015	8	103
November, 2015	11	141
December, 2015	16	196
January, 2016	16	200
February, 2016	17	202
March, 2016	16	198
April, 2016	16	187
May, 2015	10	122

Using UTA owned park and ride lots for vanpools may decrease parking spaces available to ski bus service users.

TRANSIT PARK AND RIDE FACILITIES

Ski bus Service routes are supported by seven UTA-owned park and ride lots. These parking facilities include hundreds of parking spaces and provide connection to UTA's TRAX light rail lines and a number of additional local and regional bus routes. As will be shown in a subsequent section, a number of users board the ski buses at these lots. However, some users may also use "informal" park and ride lots located adjacent to the ski bus routes. These parking spots may be located at large shopping centers, schools, or churches. Exhibit XX below indicates the location of UTA-owned park and ride lots as well as the location and relative number of spaces in other public or private parking lots located along the major ski bus routes.

EXHIBIT 23: Parking Facilities

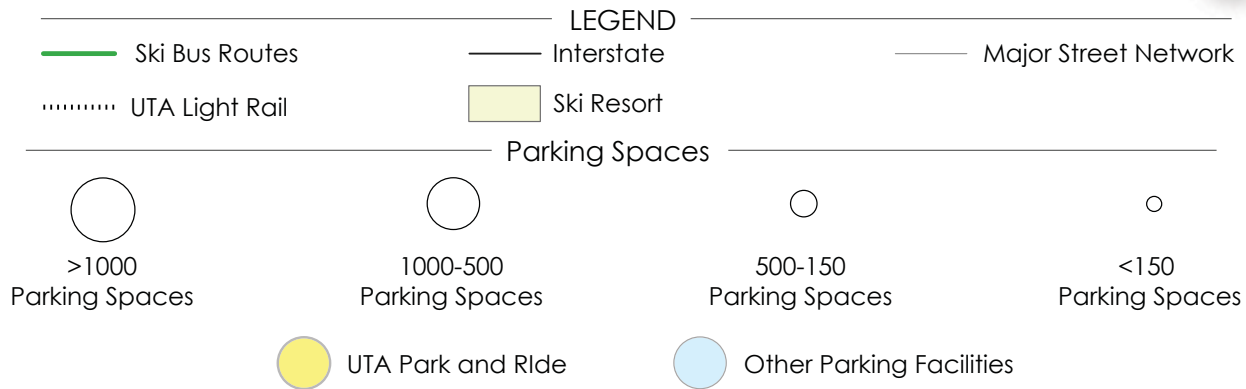
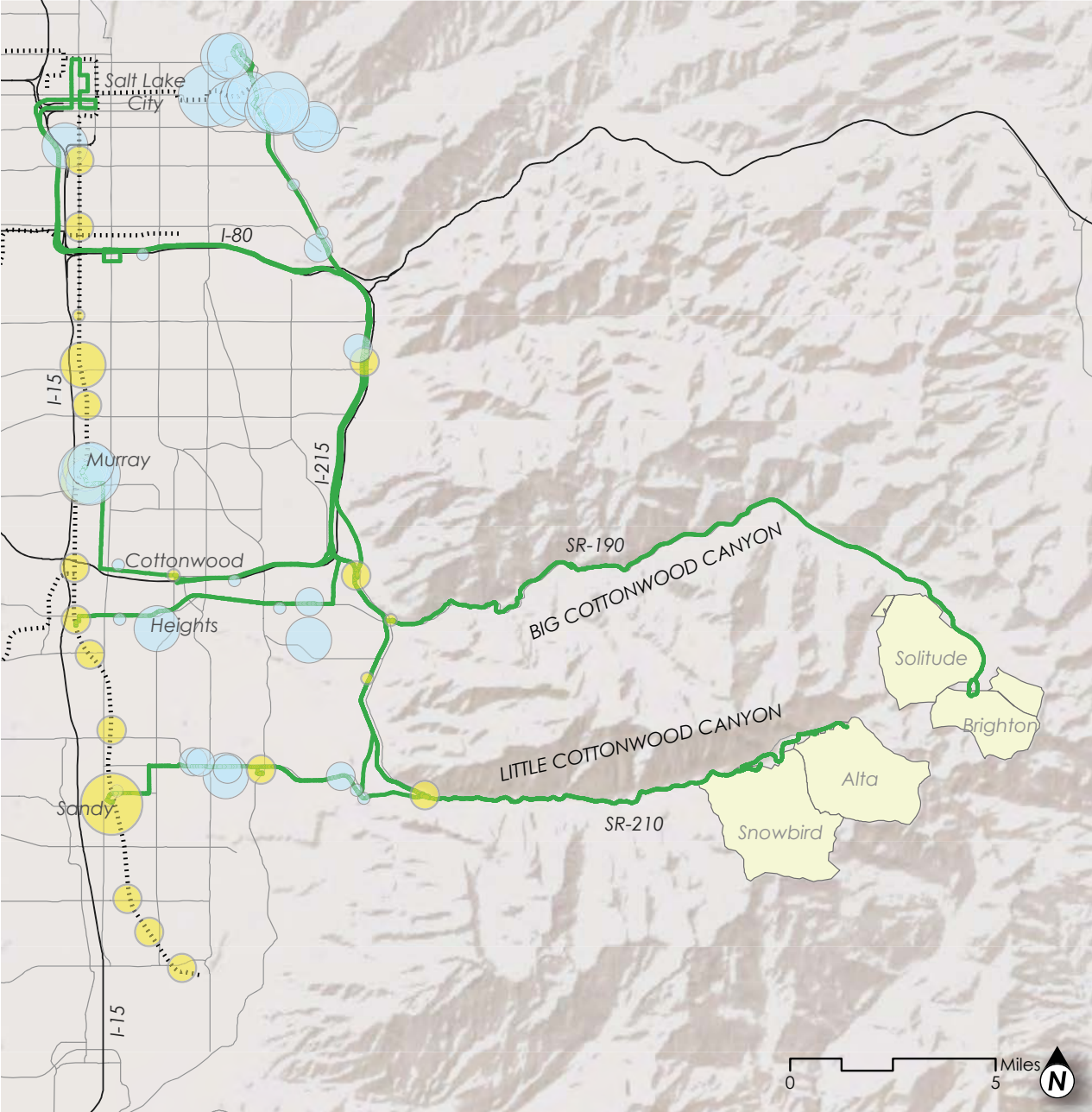
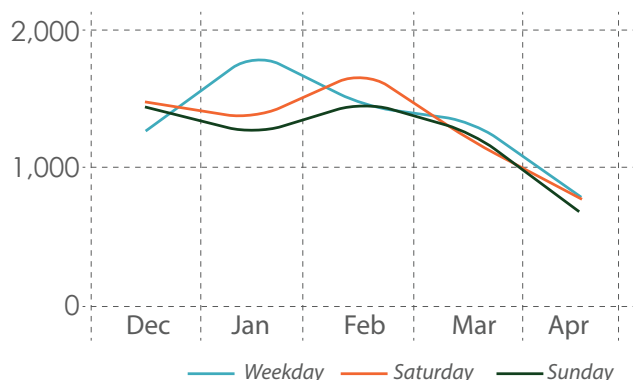




EXHIBIT 24: Average Daily Transit Boardings
(December 2015 - April 2016)



RIDERSHIP CHARACTERISTICS

The ski bus is a unique regional transit service. Operating over the course of four months each year, the service averages about 1,500 boardings each day. Generally, boardings are more heavily concentrated in the morning hours for those buses arriving as resorts open for business. Similarly, there is a high concentration of boardings that occur on buses returning from the resorts at the end of the day. This pattern holds for ski bus routes into both Big and Little Cottonwood Canyons. However, in addition to these concentrated boarding times, a number of additional characteristics of the ski bus and its users may be gleaned from data taken from the 2015-16 service season. The following will be discussed below: observations such as differences in the number of boardings between routes that serve Big Cottonwood Canyon and Little Cottonwood Canyon; how the day of the week may affect boardings; and the locations where users access the ski bus.

Big and Little Cottonwood Canyon Service, User Characteristics

Overall, ski bus between both Canyons maintains a similar number of boardings throughout the week. That is, there is a nearly equivalent number of trips and seats available daily into each Canyon (Exhibit X). However, there exists a significant difference in the number of transit users on buses that enter each Canyon. There are nearly double the number of transit riders that utilize a bus to access Little Cottonwood Canyon as those that use transit to access Big Cottonwood Canyon. Exhibit XX below displays the differences between transit boardings into Big and Little Cottonwood Canyons, as well as the small differences in the number of buses serving each canyon, and the number of boardings that occur on weekdays versus weekends.

Boarding Locations

The following exhibits provide the actual inbound ski bus boarding locations for those with a destination at a resort in Big Cottonwood Canyon or Little Cottonwood Canyon. That is, the boardings are for. As may be seen in the exhibits, there are a few boarding locations that seem to capture a large number of riders consistently throughout the week. The majority of boardings occur at a UTA-owned park and ride lot. However, the next largest number of boardings seems to occur along Fort Union Boulevard, possibly due to the high number of hotels and available parking lots. Interestingly, another seemingly attractive location for boardings is at Snowbird resort. This may be due to transit users looking to access more than one resort in a day and the relative ease to catch a bus from Snowbird to Alta, as well as the frequency of service.

EXHIBIT 25: Weekday Inbound Transit Boardings

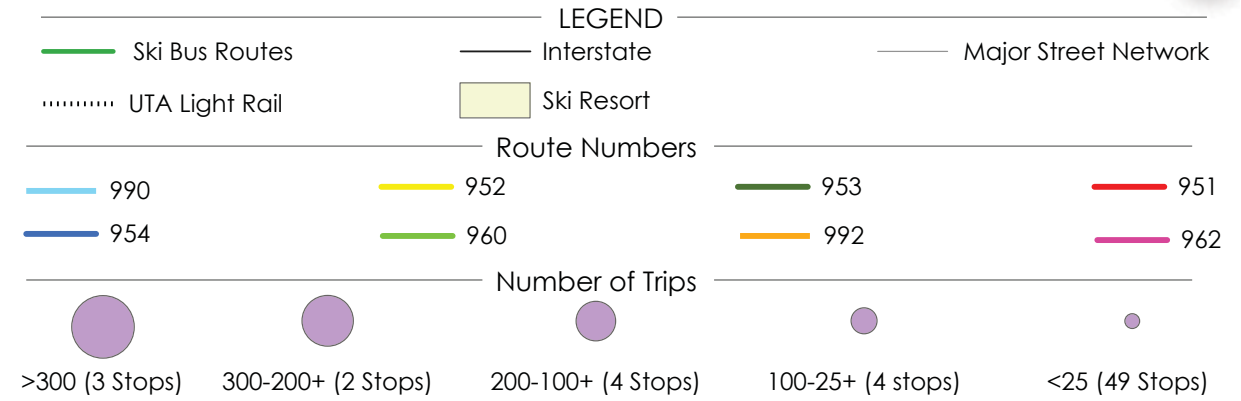
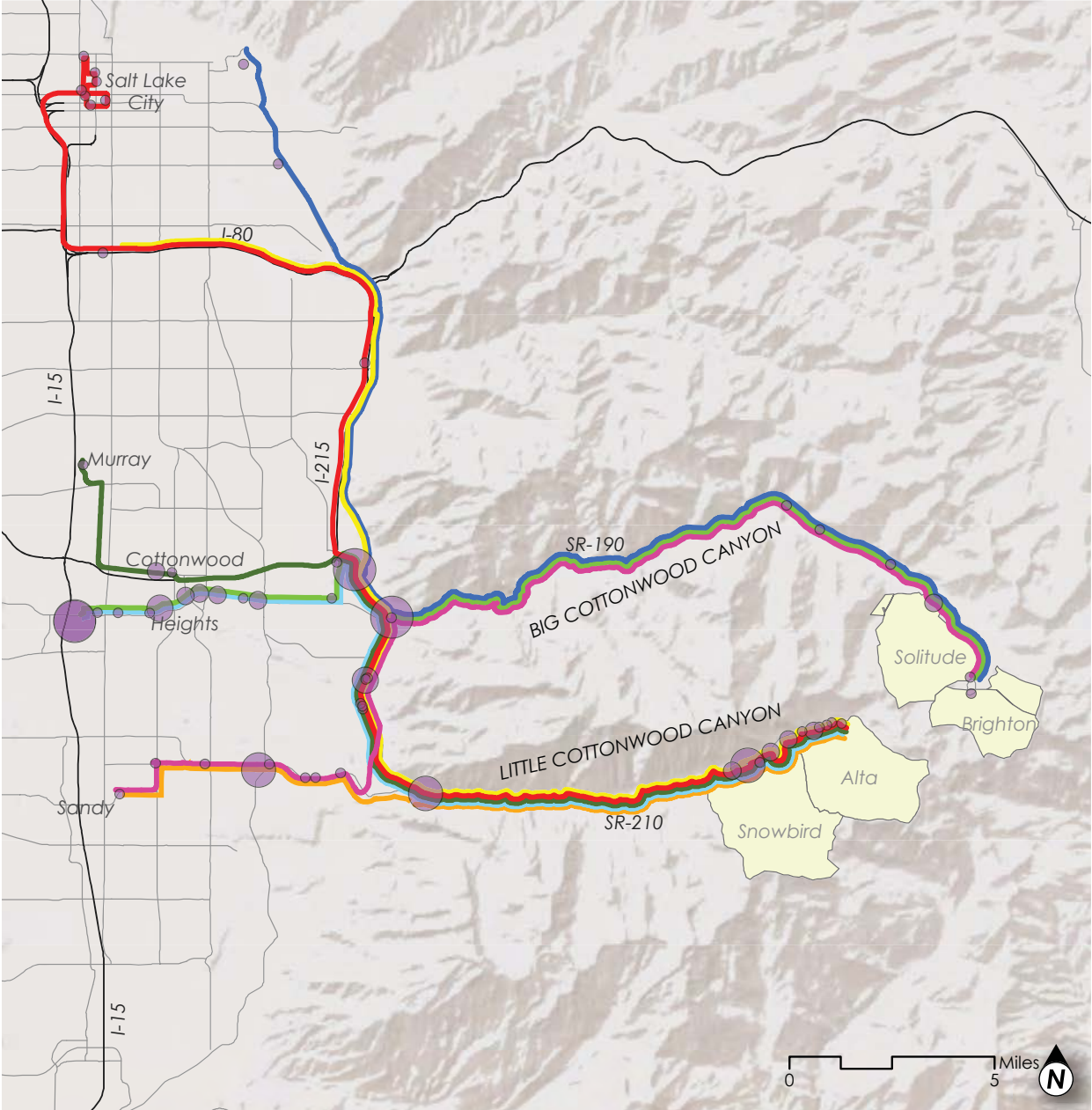
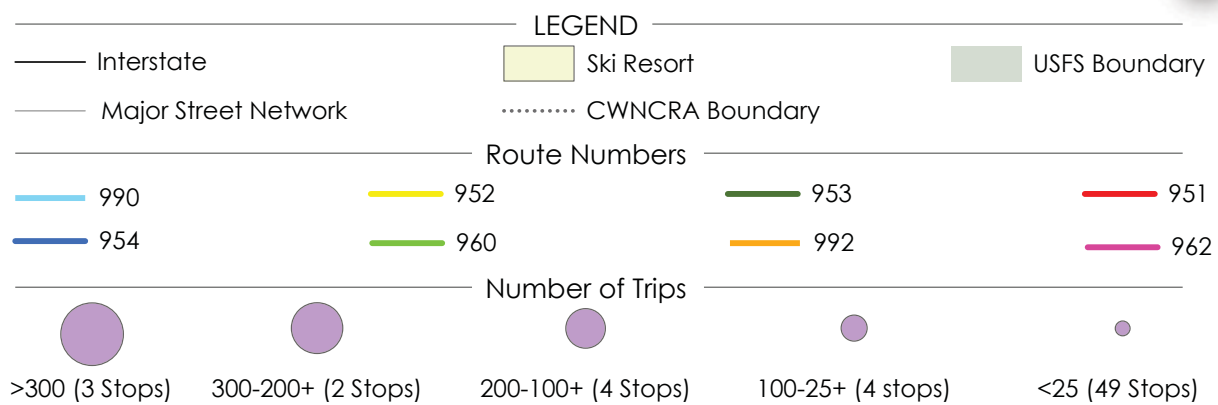
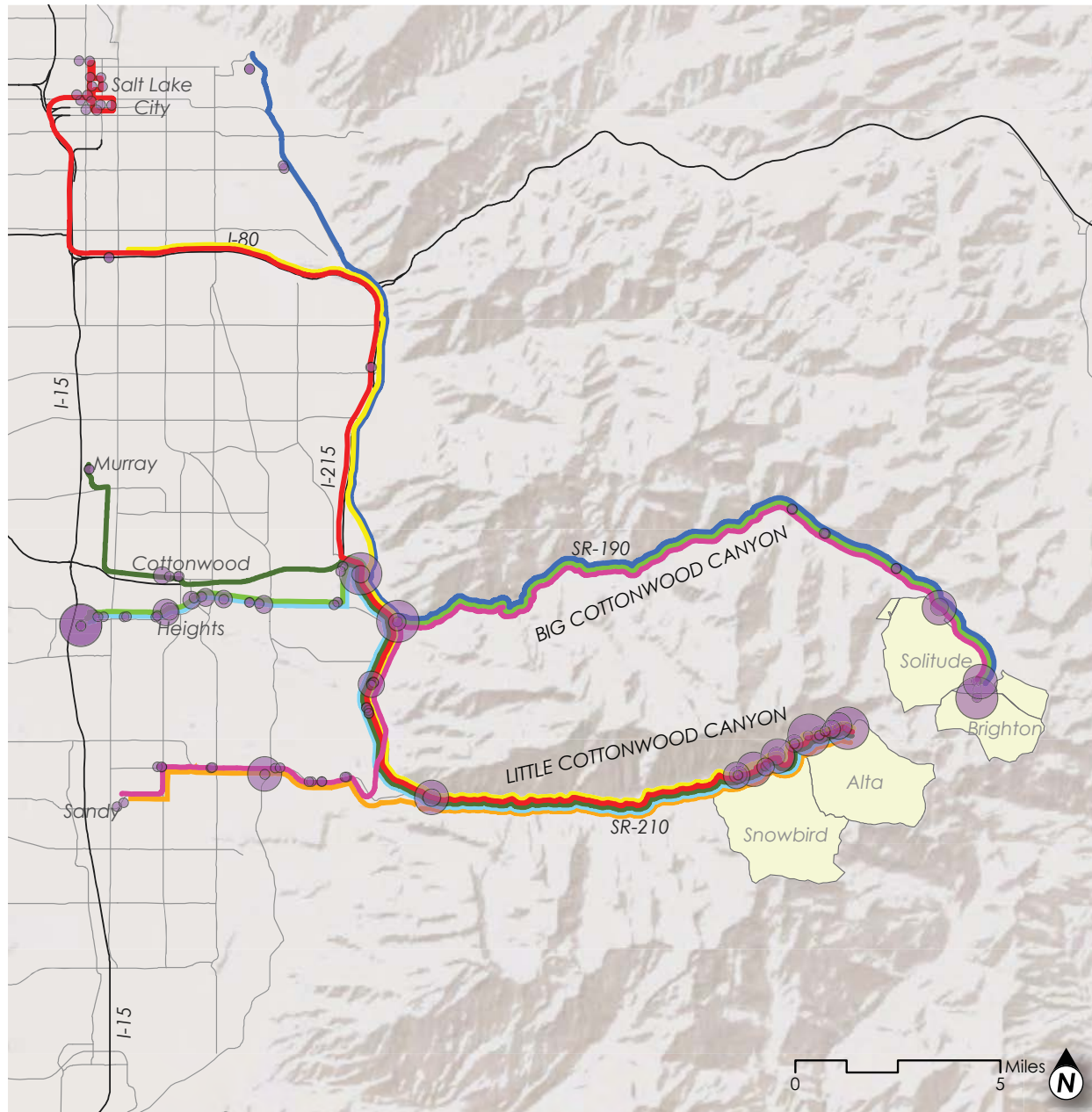




EXHIBIT 26: Saturday Inbound Transit Boardings





Day of Week Travel Patterns

As noted above, transit service levels remain relatively consistent on weekdays, Saturdays, and Sundays. That is, there are a similar number of trips that access each canyon every day of the week. There also appears to be a relatively consistent level of boardings that occur throughout the week. Weekday boardings are only slightly higher than weekend boardings and the routes chosen to access the canyons appear to remain the same throughout the week. This could suggest users are familiar with the ski bus routes and use one or more frequently; in fact, most canyon transit riders are season pass holders and resort employees. There is a slight increase in Saturday boardings on buses into Little Cottonwood Canyon that originate in Sandy, and a slight decrease on Little Cottonwood Canyon buses that originate in Midvale. The following exhibits illustrate average daily boardings, by day of week and route end points, on ski bus routes into Big Cottonwood Canyon and Little Cottonwood Canyon.

EXHIBIT 27: Weekday (Average Daily) Transit Ridership to Canyons

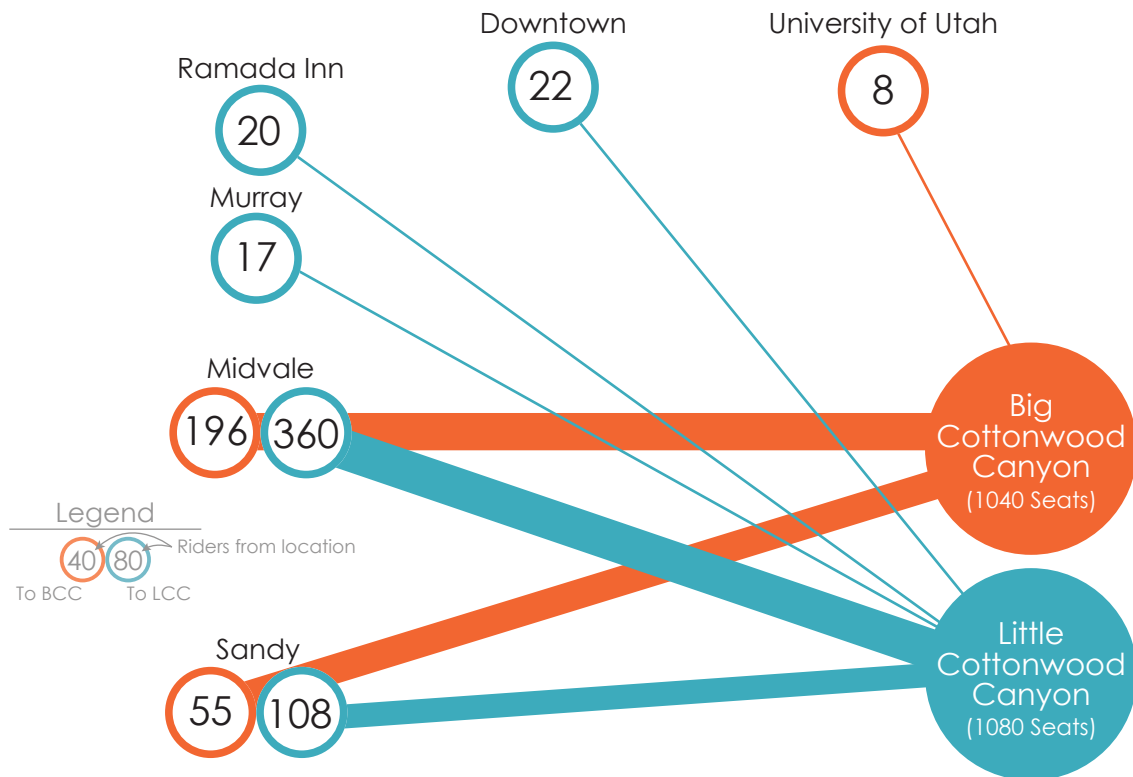




EXHIBIT 28: Saturday (Average Daily) Transit Ridership to Canyons

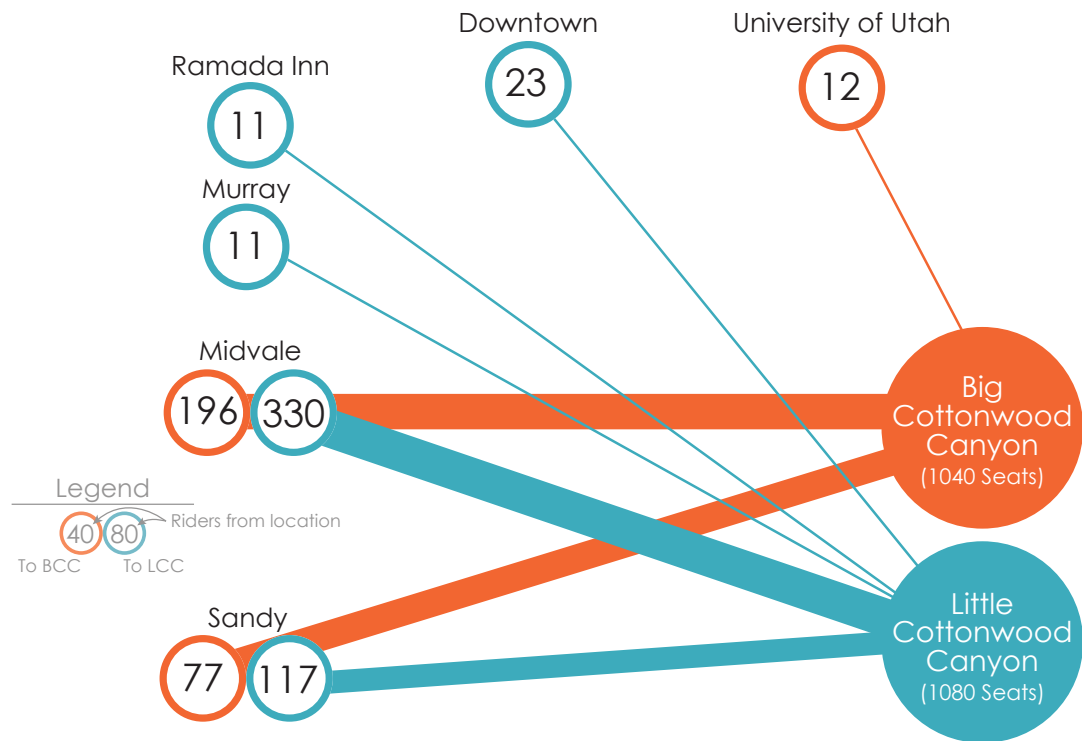
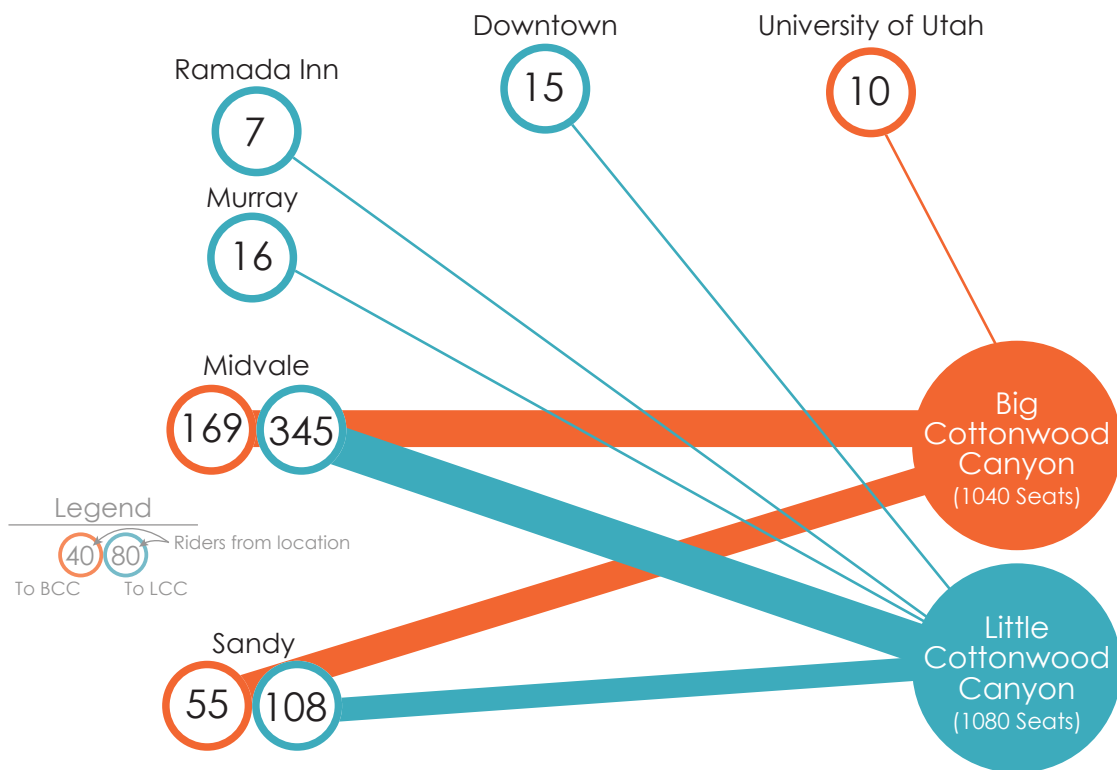


EXHIBIT 29: Sunday (Average Daily) Transit Ridership to Canyons





EVALUATION FRAMEWORK

The Evaluation Framework defines our plan to study and measure the effectiveness of transportation solutions identified for the Cottonwood Canyons. While more extensive analysis is needed to implement long-term solutions that require major capital investment, some short-term incremental steps could be taken now without major study and analysis. Incremental solutions and pilot programs intended to test the effectiveness of transportation solutions can be evaluated at a lower level of rigor than major long-term

solutions. As such, the evaluation framework is organized with separate sections for evaluation metrics for long-term solutions requiring major capital improvements and for short-term solutions and pilot programs requiring minor or no capital improvements. The evaluation framework is organized to first present high level evaluation criteria followed by more specific metrics presented separately for long-term and short-term solutions. To distinguish analysis and measurement efforts, the evaluation framework also presents our performance tracking plan in a separate section.



GOALS, OBJECTIVES, AND EVALUATION CRITERIA

The evaluation criteria presented in Exhibit 30 were compiled from the objectives of the Mountain Accord Agreement and System Group goals and metrics out of Phase I. These

criteria define the objectives and performance requirements that we will use to evaluate transportation solutions. The criteria guide the metrics and performance measures that we will use to determine the efficiency of transportation solutions.

EXHIBIT 30: Evaluation Criteria Table

Evaluation Category	Evaluation Criteria
Transit	Increase transit use for canyon access
	Reduce transit travel time for canyon access
	Increase transit use for designated nodes (strategically located high use or high demand destinations)
Bike/Walk	Improve bicycle and pedestrian use for canyon access
Cars	Reduce single-occupancy vehicle (SOV) for canyon access
Access	Reduce VMT for canyon access trips
Parking	Maintain or reduce surface parking in sensitive natural areas
Seasonal Flexibility	Accommodate daily and seasonal fluctuations in demand (year-round service)
Environment	Protect water, lands, and the environment and preserve natural and scenic resources
Safety	Reduce susceptibility associated with avalanches, winter weather, rockslides, and incidents
Efficiency	Reduce overall cost per person for canyon access
Emergency Response	Improve emergency response capabilities and evacuation routes
Canyon Community Character	Protect community character and quality of life in the canyon.
	Limit future canyon development to bases of the ski areas.
Valley Development	Encourage future valley development in urban areas near transit corridors



MAJOR IMPROVEMENTS EVALUATION METRICS

It is anticipated that the metrics shown in Exhibit 31 will be applied to evaluate major capital improvement solutions considered for the Cottonwood Canyons. The intent of these metrics is to facilitate the evaluation of mid- to long-term transportation solutions for the Cottonwoods. Using these metrics, the evaluation

of transportation solutions will compare proposed solutions to a baseline (such as a no-build scenario) and to each other. It is important to note that the intent of this document is not to define a rigid set of metrics, but rather define the overarching framework for evaluation, including metrics that could fit within the evaluation criteria defined above. The metrics defined as part of this framework document will be refined in follow-on evaluation efforts and deliverables for this project.

**EXHIBIT 31: Evalaution Criteria Table**

Evaluation Category	Long-term Evaluation Metrics
Transit	Total transit ridership for canyon access in relation to the total number of canyon visitors Transit utilization for canyon access (riders per bus) Transit capacity for canyon access (ridership capacity)
	Transit travel time for canyon access
Bike/Walk	Number of canyon visitors covered by transit in relation to the total number of canyon visitors Percentage of high use canyon destinations accessible by transit Number of total riders relative to number of stops Distance between transit stop and destination
	Number of bicyclists and pedestrians using canyon roads [Qualitative] Condition and amount of road cycling amenities in the canyons roads and approaches (bike lanes, etc.)
Cars	Vehicle occupancy (Number of people per car) Number of SOVs in relation to total canyon visitors Number of total cars in relation to total canyon visitors
Access	Reduce VMT for canyon access trips
Parking	Number of informal roadside parking spaces Number of cars parked roadside
Seasonal Flexibility	Number of transit/shuttle service days in relation to total days for the year
Environment	[Qualitative] Impacts to water, lands, and the environment.
Safety	Avalanche Index (Analysis by UDOT) Vehicle crash type, location, frequency, and severity [Qualitative] Susceptibility associated with avalanches, winter weather, rockslides, and incidents
Efficiency	Overall cost and revenue per person accessing canyons Capitol cost per user Operating cost and revenue per user
Emergency Response	Travel time for emergency response
Canyon Community Character	[Qualitative] Impacts to community character and quality of life in the canyons
	[Qualitative] Canyon land use and development impacts of transportation solutions.
Valley Development	[Qualitative] Salt Lake County land use and development impacts of transportation solutions.



PILOT PROGRAM EVALUATION METRICS

Short-term solutions are intended to address immediate transportation needs, including solutions that can be implemented in the immediate future without major capital construction and without the need for major studies or analysis, such as National Environmental Policy Act (NEPA) required studies. It is anticipated that the metrics shown in Exhibit 32 will be applied to evaluate short term solutions considered for the Cottonwood Canyons, including solutions for the upcoming winter 2016/2017 and summer 2017 seasons. Although smaller in magnitude and rigor, these metrics mirror those of the long-term metrics. However, short-term metrics will be primarily compared to existing conditions. Like the long-term metrics, it is expected that these short-term metrics will be refined to evaluate specific solutions defined for the upcoming winter 2016/2017 and summer 2017 seasons.

EXHIBIT 32: Evaluation Criteria Table

Evaluation Category	Short-term Evaluation Metrics
Transit	Total transit ridership for canyon access in relation to the total number of canyon visitors Transit utilization for canyon access (riders per bus) Transit capacity for canyon access (ridership capacity)
	Ski bus travel time for canyon access
	Number of canyon visitors covered by transit in relation to the total number of canyon visitors Percentage of high use canyon destinations accessible by transit Number of total riders relative to number of stops Distance between transit stop and destination
Bike/Walk	[Qualitative] Condition and amount of road cycling amenities in the canyons roads and approaches (bike lanes, etc.)
Cars	Vehicle occupancy (Number of people per car) Number of SOVs in relation to total canyon visitors Number of total cars in relation to total canyon visitors
Parking	Number of cars parked roadside
Efficiency	Capitol cost per user Operating cost and revenue per user



PERFORMANCE TRACKING PLAN

The Mountain Accord will monitor and report transportation performance for the Cottonwood Canyons through an on-going performance tracking plan. This performance tracking plan is intended to provide a real-time data feedback loop to measure the actual impacts of implemented solutions. This plan will also provide data to facilitate future evaluation and analysis efforts for the Cottonwood Canyons. Exhibit 33

presents an initial working list of data needed to gauge the performance of implemented solutions. This list focuses on the priority data collection efforts which will be expanded and/or refined in subsequent project efforts. Data highlighted in orange is not currently being collected by any agencies and will therefore need to be collected in the future by the Mountain Accord or agency partners.

EXHIBIT 33: Performance Criteria Table

Data Category	Data Needed	Source(s)	Data Frequency	Notes
Transit	Ridership data and transit capacity	UTA	On-going	Transit utilization
	Bus headways and travel times	UTA	On-going	Transit frequency
Bike/Walk	Bike/pedestrian counts	Field data	Winter Summer	Collected in field with vehicle occupancy
	Destination (trail, resort) use	Field data Surveys	Winter Summer	
Cars	Enhanced vehicle data collection (volumes, delays, speeds, travel time, classification)	UDOT ATR UDOT signal detection Big data source	On-going	Data collected at mouth of canyons Data collected farther up canyons
	Vehicle occupancy	Field data	Winter Summer	Collected in field with bike/ped counts
Parking	Parking utilization	Field data	Winter Summer	Roadside parking Parking lots
Safety	Crash data	UDOT	On-going	Crash type, location, frequency, and severity
	Avalanche Index	UDOT	As needed	Protect exposure to avalanches
NOTE: Data highlighted in <u>GREEN</u> are not currently being collected by agencies.				



SOLUTIONS INVENTORY

A summary of the working inventory of proposed solutions suggested in plans, reports, and efforts completed for Mountain Accord Phase I and other preceding efforts. This working list of solutions will be modified to include additional solutions identified through transportation work for the Cottonwood Canyons. The list will also be consolidated and screened using the evaluation framework described in the preceding section. Outcomes of this screening process will identify *short* and *long* term solutions and estimate their relative effectiveness.

The following solutions are organized into separate categories. Refinement and consolidation of solutions will occur through the evaluation process.

Bus Solutions

Bus Rapid Transit
Bus Tunnel between BCC and LCC
Transit hub
Express bus routes
Bus priority during peak travel times

Special bus services on big event days or highest Traffic days
Year-round bus service
Expanded current bus service
Add transit stops

Rail Solutions

Cog Rail
Maglev
Heavy Rail

Commuter Rail
Monorail
Funicular

Aerial

Gondola between valley and ski resorts

Parking

Additional valley parking areas
Ban roadside parking in the canyons
Paid parking at resorts
Paid parking at base of canyons
USFS recreation fees at dispersed lots
Smaller, free lots in the valley
Parking lot driveway metering
Improve parking turnout signage

Provide trail and parking info at park and ride lots
Remote vehicular detection – smart parking lots
Open and plow lots now closed in winter
Pave/stripe parallel parking
One-way parking circulation to provide more spaces
Provide parking that accommodates trailers
ITS at park and ride lots



Shuttles and Carpooling

Shuttles from visitor center
Provide designated carpool areas at base of canyons
Priority parking for carpoolers at ski resort parking lots

Road and Auto

Keep Guardsman Pass open year round At-grade road re-alignments to create space for parking Use structures to facilitate safe connections and movement	Improve pullouts and shoulders Install traffic signals at resort entrances Tunnel between Big and Little Cottonwood Canyons
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SOV and Auto Disincentives

Implement summer gate closures
Increase fines and enforcement for speeding
Bus only in the canyons

Information

Expand wayfinding and signage Expand interpretive/destination signage Mobile apps	Next-bus information More variable message signs Improve road weather updates
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Bike and Pedestrians

Provide uphill bike lanes Grade-separated crossings Consolidate pedestrian crossings Provide pedestrian connections between dispersed parking locations Provide short trail connections to existing trail systems from new parking	Shoulder widening Flashing warning signs when bikes present Promote "Single File is Safer" ethic Cyclist expectation signage to remind drivers and cyclists to "share the road"
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Transportation Demand Management

Employee incentives
Smart, high density land use near transit

Safety and Incident Management

Provide turnaround areas in lots for transit/fire/ patrons Realign the roadways in mid-canyon to avoid the most dangerous avalanche paths Convert both lanes to one direction when avalanche risk is high	Mid-canyon snowsheds Construct berms to prevent avalanche debris from reaching the road Snowfencing
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11. Mountain Transportation Study (2012)
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