

## **APPENDIX D**

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### Draft Enhanced Bus Concepts

## **Draft Enhanced Bus Concepts**

**Little Cottonwood Canyon  
Environmental Impact Statement  
S.R. 210 - Wasatch Boulevard to  
Alta**

Utah Transit Authority  
Utah Department of Transportation

**April 3, 2020**

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## 1.0 Introduction

The purpose of this technical report is to analyze enhanced bus service for Little Cottonwood Canyon to support enhanced winter transit service. This report also provides information that the Utah Department of Transportation (UDOT) will use during the alternatives development and screening process for the Little Cottonwood Canyon Environmental Impact Statement (EIS), which will evaluate how well the bus concepts described in this report would satisfy the purpose of and need for the Little Cottonwood Canyon Project.

During the winter, Little Cottonwood Canyon experience increase travel for winter recreation to two resorts. By 2050, winter recreation and overall travel demand is expected to increase on State Route (S.R.) 210, which will result in reduced mobility. By 2050, the population in Salt Lake County is expected to increase by 36% and Utah County by 108%.

The purpose of the winter transit concepts presented in this report is to reduce personal vehicle use on S.R. 210 by having people going to the resorts use bus service instead of personal vehicles to improve overall mobility. See Sections 4.0 for more information about the transit service being proposed. For Little Cottonwood Canyon, this report looks at providing a peak-hour bus capacity that can accommodate up to 1,008 people per hour. The capacity of 1,008 people per hour is the maximum capacity of bus service assuming 5-minute headways to each resort. Headways less than 5 minutes would be difficult when considering the time to load and unload buses with the equipment required for skiing.

For each concept, direct service to each resort is assumed. For example, a bus leaving a transit hub would go directly to the Alta resort without stopping at Snowbird. The purpose of the direct service is to make the bus service more attractive to all users. Currently, when a bus stops at the Snowbird resort first, this adds about 15 minutes to the travel time to the Alta resort. In addition, at the end of the day, buses fill up with passengers at the Snowbird resort first, making it difficult for Alta users to find space on the bus. A survey conducted by the Utah Transit Authority (UTA) in March 2019 of 333 bus users in Little Cottonwood Canyon found that 16.5% of those using the bus service were going to Alta resort and 45.6% were going to Snowbird resort (UTA 2019). The purpose of the point-to-point service is to make bus service more attractive to users of each resort.

Summer transit is not be considered in this report. UTA can implement summer transit if a need is identified in the future.

## 2.0 Existing Bus Service

### 2.1 Little Cottonwood Canyon

Existing transit service in Little Cottonwood Canyon includes two UTA bus routes (953 and 994) that provide ski bus service during the winter season. UTA ski bus service to Alta and Snowbird resorts typically begins on or around December 1 and operates until early April. The service runs all day from two routes with 15-minute frequency during peak hours, or a capacity of about 336 riders per hour (see Section 3.1 for passenger-carrying assumptions). UTA’s bus service provides connections to TRAX, FrontRunner, and Route 220 (a UTA route that serves the University of Utah and downtown Salt Lake City), offering frequent all-day access to people from downtown Salt Lake City and throughout the region.

At the resorts, the number of stops (three at Snowbird and two at Alta) and circulation in resort lots accounts for 15 minutes of scheduled travel time along a route with no congestion. In addition, buses are subject to the same roadway congestion as other vehicles, which does not provide an incentive for using transit. The slower time for transit travel makes it unattractive to many users.

The cash fare for the ski bus is \$4.50 each way. The cost of any bus, TRAX, or FrontRunner ticket counts for partial credit toward a ski bus fare, so riders pay only once, even if they transfer. The cost of the ski bus service is free to resort season pass holders (the cost of the bus ride is subsidized by the resort).

The Route 953 ski bus operates between Midvale Fort Union TRAX Station and Snowbird/Alta with 15 to 30-minute service during peak hours along with several midday trips. The Route 994 ski bus operates between Historic Sandy TRAX Station and Snowbird/Alta with 15-minute service during the peak hours and 30-minute service during the midday. The Route 953 ski bus also operates one daily trip during the summer to serve employees at Snowbird. The existing transit service is shown in Table 1 and Figure 1.

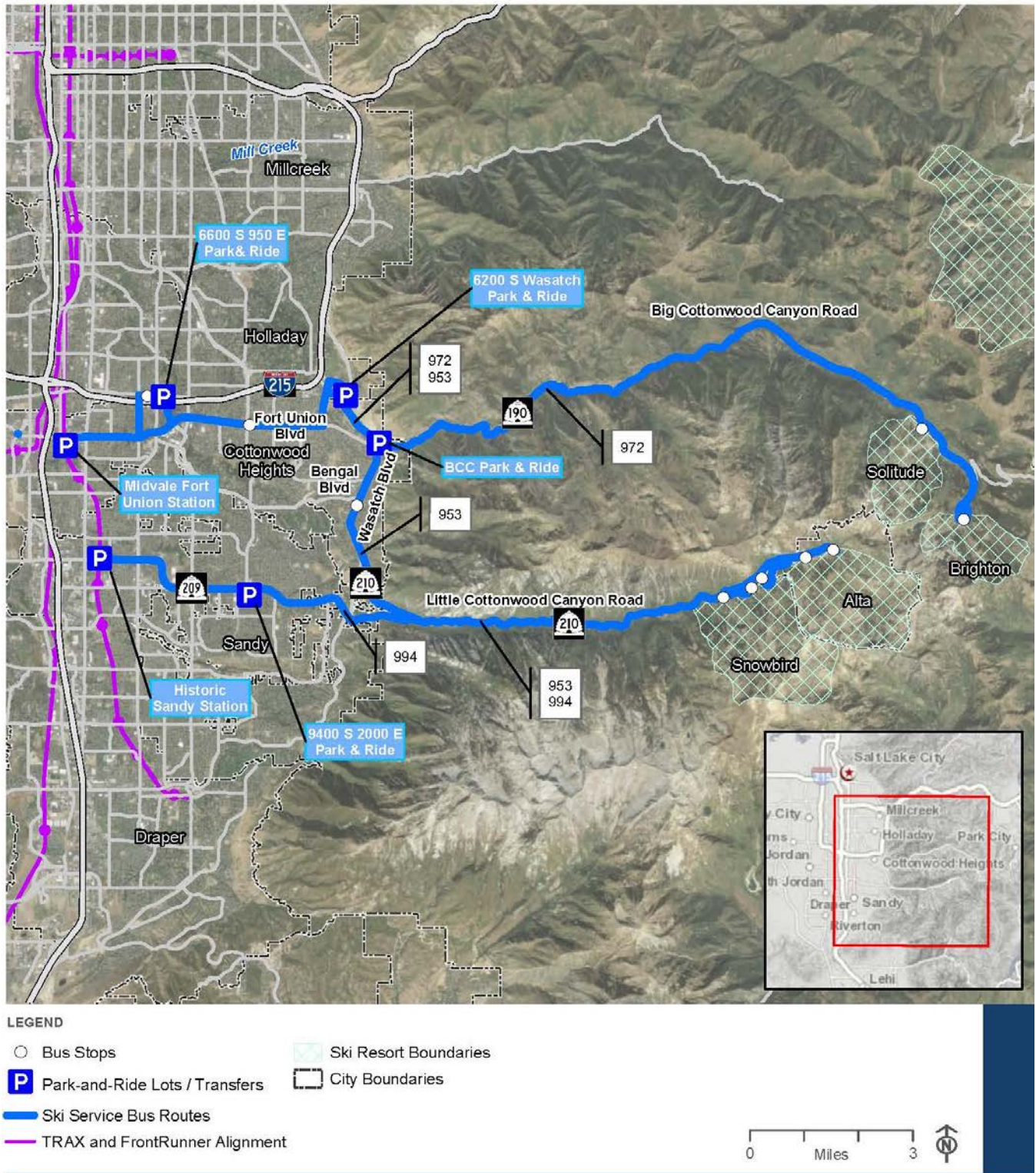
**Table 1. Existing Bus Service in Little Cottonwood Canyon**

Route	Description	Winter	Summer
953	Midvale Fort Union Station to Snowbird/Alta	15–30 minute service during peak hours, with additional midday trips	1 trip in each direction (up and down canyon) per day
994	Historic Sandy Station to Snowbird/Alta	15–30 minute service	None

Source: UTA 2018a

A survey conducted by UTA in March 2019 of 333 bus users in Little Cottonwood Canyon found that about 60% of ski bus passengers were season pass holders or employees, 18% paid as they boarded (cash, mobile application, or FAREPAY cards), and 5% paid by SuperPass. This indicates that the average ski bus rider is either a resort employee or a dedicated resident skier (UTA 2019). Data from the Ski Utah survey (presented in Mountain Accord 2015) show that about 7% of the visitors to the ski areas in Big and Little Cottonwood Canyons use public transit, whereas 78% use a private or rental vehicle.

Figure 1. Existing Transit Service in Little Cottonwood Canyon



## 3.0 Assumptions Made for the Enhanced Bus Service Concepts

The project team made the following assumptions when developing the enhanced bus service concepts that are analyzed in this report.

### 3.1 Bus Capacity and Technology Type

**Size.** UTA's current ski buses have special power, transmission, and automatic chain deployment systems designed to operate in a winter canyon environment. The engine and transmission requirements are necessary to handle the steep grades in Little Cottonwood Canyon (up to 11%), and the automatic chains are for the frequent snowfalls. The current buses provide seating for 23 riders and standing room for an additional 19 riders, for a total capacity of 42 riders. For the analysis of enhanced bus service concepts, the total bus capacity of 42 riders was used.

Transit buses are typically 35 feet long. Replacing the 35-foot buses currently used in the canyons with 60-foot articulated buses (see Figure 2) would allow UTA to carry more riders without hiring more operators. Larger buses such as articulated buses have a capacity of about 80 riders. However, studies have found that articulated buses are prone to jackknifing when operating in snow and ice on steep grades (Nelson/Nygaard Consulting Associates, Inc. 2017). Even with tire chains, articulated buses might not be able to operate on steep grades in snow and ice as easily as nonarticulated buses can.

Therefore, articulated buses were eliminated from consideration in this concepts analysis.

**Technology.** UTA's current ski buses are diesel powered. For this concepts analysis, the project team considered diesel buses, electric buses, and hybrid buses.

Although electric bus technology is rapidly advancing, electric bus batteries currently have both limited range and performance issues on steep grades. Further, when primary electric heaters are used in cold weather, the heaters drain the batteries, limiting the range the bus can travel before needing to charge. (Currently, most transit authorities heat any electric buses in their fleet using a diesel fuel heating system.)

Because electric bus technology is still evolving, electric buses were eliminated from consideration when this report was written. This concepts analysis assumes the use of diesel buses with a total capacity of 42 riders, the same as UTA's current ski buses. If electric bus technology improves in the future, UTA might add electric buses to its ski bus fleet.

Hybrid buses could be considered by UTA as a bus option if they can be designed to meet the requirements of the steep mountain grades, maneuverability at the resorts, and chains.

Figure 2. Articulated Bus





## 3.2 Bus Routes

To optimize bus travel time to be competitive with personal vehicles, the project team assumed point-to-point service from an origin point to the resorts with no intermediate stops along the way. The reason for point-to-point service is that the loading and unloading time in the parking lot of the first resort in the canyon can add up to 15 minutes to the travel time to get to the second resort, thereby making bus service to the second resort less desirable. In addition, at the end of the day, buses sometimes fill up with passengers at the first resort and bypass the second resort, causing users at the second resort to wait for a later bus.

For Little Cottonwood Canyon, bus service would be provided from the existing park-and-ride lot at 9400 South and Highland Drive and from another proposed park-and-ride lot at the gravel pit located on the east side of Wasatch Boulevard between 6200 South and Fort Union Boulevard. See the technical memorandum *Evaluation of Transit Hub Locations in Big and Little Cottonwood Canyons* (UDOT 2019) for more information regarding the proposed park-and-ride lots and Section 4.2, Valley Transit Hubs, below for a summary of the results of an analysis of a proposed transit hub. The enhanced ski bus service would run between each of the proposed park-and-ride lots directly to one transit stop each at either Snowbird or Alta. Riders on the bus to Alta would not need to stop at Snowbird first, since separate buses would run directly to each resort.

## 4.0 Enhanced Bus Service Concepts for Little Cottonwood Canyon

For Little Cottonwood Canyon, the following four enhanced bus service concepts are being considered. The four concepts described in this report will provide data to support the bus transit alternatives being considered in the Little Cottonwood Canyon Environmental Impact Statement. Note that the ridership for each concept in the year 2050 is the bus capacity per hour, not the predicted number of riders. For each concept, the buses would be staged to go directly to Snowbird or Alta from either the gravel pit or the existing UTA park-and-ride at 9400 South and Highland Drive. Bus service for the mobility concepts described in this report would be provided from 7 AM to 7 PM. UTA would also extend a less-frequent service outside these hours for night skiing and resort employees.

### What is mixed-flow traffic?

In mixed-flow traffic, automobiles and buses operate in the same travel lanes.

- **Concept A1:**
  - **Roadway** – Mixed flow (No new roadway capacity in Little Cottonwood Canyon. Bus in same traffic flow as personal vehicles). Transit priority from Fort Union Boulevard to the S.R. 209/S.R. 210 intersection.
  - **Number of transit hubs** – 2 (gravel pit, 9400 South and Highland Drive).
  - **Peak-travel bus headway/route:**
    - Gravel pit to Alta – 4 buses per hour (1 bus every 15 minutes)
    - Gravel pit to Snowbird – 4 buses per hour (1 bus every 15 minutes)
    - 9400 South/Highland Drive to Alta – 4 buses per hour (1 bus every 15 minutes)
    - 9400 South/Highland Drive to Snowbird – 4 buses per hour (1 bus every 15 minutes)
  - **Total bus peak-hour resort capacity** – 8 buses per resort × 42 riders for an hourly capacity of 336 per resort.
  - **Total concept peak-hour bus capacity** – Capacity of 672 riders per hour.
- **Concept A2:**
  - **Roadway** – Bus lane (new bus lane capacity added starting at Wasatch Boulevard and North Little Cottonwood Road; bus operates in its own lane separate from personal vehicles or shared with high-occupancy vehicles). Bus might operate in a striped peak-hour shoulder lane. Transit priority from Fort Union Boulevard to the S.R. 209/S.R. 210 intersection.
  - **Number of transit hubs** – 2 (gravel pit, 9400 South and Highland Drive).
  - **Peak-travel bus headway/route:**
    - Gravel pit to Alta – 4 buses per hour (1 bus every 15 minutes)
    - Gravel pit to Snowbird – 4 buses per hour (1 bus every 15 minutes)
    - 9400 South/Highland Drive to Alta – 4 buses per hour (1 bus every 15 minutes)
    - 9400 South/Highland Drive to Snowbird – 4 buses per hour (1 bus every 15 minutes)
  - **Total bus peak-hour resort capacity** – 8 buses per resort × 42 riders for an hourly capacity of 336 per resort.
  - **Total concept peak-hour bus capacity** – Capacity of 672 riders per hour.

- **Concept B1:**
  - **Roadway** – Mixed flow (no new roadway capacity in Little Cottonwood Canyon; bus in same traffic flow as personal vehicles). Transit priority from Fort Union Boulevard to the S.R. 209/S.R. 210 intersection.
  - **Number of transit hubs** – 2 (gravel pit, 9400 South and Highland Drive).
  - **Peak-travel bus headway/route:**
    - Gravel pit to Alta – 6 buses per hour (1 bus every 10 minutes)
    - Gravel pit to Snowbird – 6 buses per hour (1 bus every 10 minutes)
    - 9400 South/Highland Drive to Alta – 6 buses per hour (1 bus every 10 minutes)
    - 9400 South/Highland Drive to Snowbird – 6 buses per hour (1 bus every 10 minutes)
  - **Total bus peak-hour resort capacity** – 12 buses per resort × 42 riders for an hourly capacity of 504 per resort.
  - **Total concept peak-hour bus capacity** – Capacity of 1,008 riders per hour.
- **Concept B2:**
  - **Roadway** – Bus lane (new bus lane capacity added starting at Wasatch Boulevard and North Little Cottonwood Road; bus operates in its own lane separate from personal vehicles or shared with high-occupancy vehicles). Bus lane might operate in a striped peak-hour shoulder lane instead of a dedicated separate traffic lane. Transit priority from Fort Union Boulevard to the S.R. 209/S.R. 210 intersection.
  - **Number of transit hubs** – 2 (gravel pit, 9400 South and Highland Drive).
  - **Peak-travel bus headway/route:**
    - Gravel pit to Alta – 6 buses per hour (1 bus every 10 minutes)
    - Gravel pit to Snowbird – 6 buses per hour (1 bus every 10 minutes)
    - 9400 South/Highland Drive to Alta – 6 buses per hour (1 bus every 10 minutes)
    - 9400 South/Highland Drive to Snowbird – 6 buses per hour (1 bus every 10 minutes)
  - **Total bus peak-hour resort capacity** – 12 buses per resort × 42 riders for an hourly capacity of 504 per resort.
  - **Total concept peak-hour bus capacity** – Capacity of 1,008 riders per hour.

The bus technology, transit hub locations and amenities, transit priority, and resort transit stops would be common to all four concepts. The alignment configuration would be common to the A1 and B1 (mixed-flow) concepts and common to the A2 and B2 (bus lane) concepts. The headways, and consequently the operating and capital costs, would be different, as discussed in Section 4.4.1, Operating Cost, and Section 4.4.2, Capital Cost.

## 4.1 Hours of Operation and Headways

The enhanced bus service would operate 7 days per week between 7 AM and 7 PM. As shown in Table 3, during the morning (7 AM to 10 AM) and afternoon (2 PM to 5 PM) peak hours, a bus would leave from each transit hub to Snowbird or Alta every 10 minutes. A bus would leave every 20 minutes during off-peak hours.

For each concept, a travel demand model was used to determine travel times assuming a reduced number of personal vehicles as more recreationists use buses. With more recreationists using buses, the analysis of the enhanced bus concepts showed that bus service during the peak hours would reduce per-person travel time and meet the ridership capacity for the concepts developed. Headways less than 5 minutes were considered infeasible because there would not be enough time for all riders to exit or board the bus and retrieve or stow their gear.

The travel time in 2050 with enhanced bus service is projected to be 24 to 64 minutes under dry road conditions, depending on the concept, from the valley transit hub to the resort stop. Travel time for each bus was assumed to be the speed limit in the valley and 30 miles per hour in Little Cottonwood Canyon where steep grades slow bus speeds.

Concepts A2 and B2 (with the dedicated bus lane) would have the fastest travel time: 24 minutes from the gravel pit transit hub to Alta. Travel time was calculated to Alta, so the travel time to Snowbird would be slightly less. The Alta stop would be about 1.5 miles past the Snowbird stop. Assuming a bus speed average of around 20 miles per hour (mph), it would be about 4 minutes faster to travel to Snowbird on the road. So, the fastest trip to Snowbird would be about 20 minutes. Note that a direct route to each resort was assumed to reduce travel time to the second resort. Although there would be only a 4-minute road travel time difference between Snowbird and Alta if the same bus were to stop at Snowbird first, it would add 15 minutes to the Alta travel time because the Alta passengers would have to wait for the bus to travel through the Snowbird area and unload or load passengers first.

Table 3 shows the enhanced bus travel times for Little Cottonwood Canyon in 2050 for each concept. For reference, in 2050 under no-build conditions (no increase in bus service and no change in roadway capacity), the travel time for the ski bus without the enhanced bus service would be 80 to 85 minutes between Fort Union Boulevard and Alta and 105 to 110 minutes from 9400 South to Alta.

The reason for the different travel times between concepts with the same road configuration (for example, A1 and B1) is that the greater number of buses with the B1 concept would result in fewer personal vehicles on the road and thus less roadway congestion and faster travel times.

**Table 2. Operating Details for Little Cottonwood Canyon Concepts in 2050**

Concept	Description	Transit Hub/Route	Days	Frequency to Each Ski Resort Peak/Off Peak (minutes)	Travel Time (minutes)
A1	Buses operating in mixed-flow traffic. (No capacity added to S.R. 210 from North Little Cottonwood Road through the town of Alta.). Total concept capacity of 672 in peak hour.	Gravel pit/ Wasatch Blvd	Mon–Sun	15/30	52
		9400 South	Mon–Sun	15/30	64
A2	Buses operating in a bus lane. (Additional capacity added to S.R. 210 from North Little Cottonwood Road through the town of Alta.). Total concept capacity of 672 in peak hour.	Gravel pit/ Wasatch Blvd	Mon–Sun	15/30	24
		9400 South	Mon–Sun	15/30	36
B1	Buses operating in mixed-flow traffic. (No capacity added to S.R. 210 from North Little Cottonwood Road through the town of Alta.). Total concept capacity of 1,008 in peak hour.	Gravel pit/ Wasatch Blvd	Mon–Sun	10/20	42
		9400 South	Mon–Sun	10/20	52
B2	Buses operating in a bus lane. (Additional capacity added to S.R. 210 from North Little Cottonwood Road through the town of Alta.). Total concept capacity of 1,008 in peak hour.	Gravel pit/ Wasatch Blvd	Mon–Sun	10/20	24
		9400 South	Mon–Sun	10/20	34

The analysis in this table is based on the following assumptions:

- Ski bus capacity: 42 passengers.
- Operating plan: Mon–Sun, 12 hours/day, 6-hour peak (7:00–10:00 AM and 2:00–5:00 PM).
- Travel time was calculated from Fort Union Blvd./Wasatch Blvd. to Alta Ski Resort. The roadway travel time to Snowbird was assumed to be about 4 minutes shorter (does not account for buses stopping at Snowbird first).
- Travel times for B1 and B2 are faster than for A1 and A2 because more users would be using bus service and there would be fewer personal vehicle on the road and thus overall less congestion and faster travel times.

## 4.2 Valley Transit Hubs

As described in the technical report *Evaluation of Transit Hub Locations in Big and Little Cottonwood Canyons* (UDOT 2019), the project team determined that two valley transit hubs would be required to meet the bus ridership demand for both concepts. The proposed transit hubs would be located at the Wasatch Boulevard gravel pit and the current UTA park-and-ride lot at 9400 South and Highland Drive. The transit hubs would include amenities including shelters, lighting and seating at passenger waiting areas, enhanced fare collection (such as prepaid or smart card technologies), real-time service information, and security features.

## 4.3 Transit Priority

Transit signal priority (TSP) treatment of transit vehicles (such as buses) gives them priority when they approach a traffic signal. With TSP, sensors on traffic signals detect approaching buses and extend the duration of a green signal or shorten the duration of a red signal as the bus approaches the intersection. All four enhanced bus concepts assume transit priority at all traffic signals between the transit hubs and base of Little Cottonwood Canyon. There would be three traffic signals with transit priority along 9400 South and four traffic signals with transit priority along Wasatch Boulevard.

The project team assumed that any travel time benefit from TSP would be greatest at traffic signals with bus-only travel lanes (that is, along Wasatch Boulevard where buses could operate in the shoulder during peak hours). In areas where the buses would travel in mixed-flow traffic (along 9400 South or along Wasatch Boulevard when the buses are not operating in the shoulders), there would be little travel time savings for the buses because the bus would be moving with the rest of traffic.

## 4.4 Ski Resort Transit Stops

Buses would travel directly between the two valley transit hubs to either Snowbird or Alta. The locations of the ski resort transit stops have not been determined, but there would be one transit stop at each resort. The transit stops would be designed to handle peak-hour arrivals and departures. The stops would be developed to minimize conflicts with vehicle traffic and parking at the resorts to improve safety and to help buses stay on schedule.

### 4.4.1 Operating Cost

Table 4 lists the operating cost per revenue hour for Little Cottonwood Canyon concepts. Concepts A1 and A2 have lower operating cost because the bus service is less frequent compared to B1 and B2. Appendix A, Operation and Capital Cost, provides more information about the cost assumptions.

**Table 3. Winter Operating Cost per Revenue-Hour for Little Cottonwood Canyon Concepts**

Concept	Route	Bus Travel Time (minutes)	Cost per Revenue-Hour (\$)	Days	Frequency Peak/Off-Peak (minutes)	Trips both Directions	Days	Operating Cost (\$)
<b>A1:</b> Two lanes, bus and vehicle, and 7.5-minute headways	S.R. 210 Fort Union – Snowbird	48	112.63	Mon–Sun	15 30	72	140	1,563,073
	S.R. 210 Fort Union – Alta	52	112.63	Mon–Sun	15 30	72	140	1,652,726
	S.R. 209 Highland – Snowbird	60	112.63	Mon–Sun	15 30	72	140	2,026,927
	S.R. 209 Highland – Alta	64	112.63	Mon–Sun	15 30	72	140	2,116,579
	<b>Total winter operating cost</b>							
<b>B1:</b> Two lanes, bus and vehicle, and 5-minute headways	S.R. 210 Fort Union – Snowbird	38	112.63	Mon–Sun	10 20	108	140	1,886,602
	S.R. 210 Fort Union – Alta	42	112.63	Mon–Sun	10 20	108	140	2,069,805
	S.R. 209 Highland – Snowbird	48	112.63	Mon–Sun	10 20	108	140	2,490,782
	S.R. 209 Highland – Alta	52	112.63	Mon–Sun	10 20	108	140	2,625,260
	<b>Total winter operating cost</b>							
<b>A2:</b> Three lanes, with bus-only lane, and 7.5-minute headways	S.R. 210 Fort Union – Snowbird	20	112.63	Mon–Sun	15 30	72	140	789,332
	S.R. 210 Fort Union – Alta	24	112.63	Mon–Sun	15 30	72	140	878,985
	S.R. 209 Highland – Snowbird	32	112.63	Mon–Sun	15 30	72	140	1,139,497
	S.R. 209 Highland – Alta	36	112.63	Mon–Sun	15 30	72	140	1,294,116
	<b>Total winter operating cost</b>							
<b>B2:</b> Three lanes, with bus-only lane, and 5-minute headways	S.R. 210 Fort Union – Snowbird	20	112.63	Mon–Sun	10 20	108	140	1,135,274
	S.R. 210 Fort Union – Alta	24	112.63	Mon–Sun	10 20	108	140	1,318,477
	S.R. 209 Highland – Snowbird	30	112.63	Mon–Sun	10 20	108	140	1,625,764
	S.R. 209 Highland – Alta	34	112.63	Mon–Sun	10 20	108	140	1,825,209
	<b>Total winter operating cost</b>							

## 4.4.2 Capital Cost

Table 5 lists the capital cost per concept for Little Cottonwood Canyon. Capital costs are fixed, one-time expenses incurred for the purchase of land, buildings, roadway improvements, and equipment used for a project. The capital costs for each concept include bus stops, parking lots, TSP equipment, bus maintenance and storage facilities, fare collection and communications equipment, buses, snow sheds, and road widening (Concepts A2 and B2).

The capital cost was determined for each bus route for each concept—Snowbird and Alta from the gravel pit transit hub and Snowbird and Alta from the 9400 South transit hub, since the routes have a different number of signalized intersections and maintenance and storage facility needs and locations. The capital cost for each of the four routes under each concept was then combined to produce the total capital cost for each concept (A1, A2, B1, and B2). As shown, the concepts that include the addition of a bus lane on S.R. 210 in Little Cottonwood Canyon (Concepts A2 and B2) have the highest capital cost. These concepts also have the fastest bus travel times. Appendix A, Operation and Capital Cost, provides more information about the cost assumptions.



**Table 4. Winter Capital Cost for Little Cottonwood Canyon Concepts**

Item	2019 Unit Cost	Unit	A1							
			Quantity				Amount			
<b>Roadway</b>										
Bus lane	\$211,000,000	Lump Sum	0				\$0			
<b>Stops</b>										
Stops at terminal	\$500,000	Per stop	4				\$2,000,000			
<b>Park-and-Rides</b>										
Parking (Gravel Pit and 9400 S)	\$36,000,000	Lump Sum	1				\$36,000,000			
Parking (Gravel Pit and 9400 S)	\$52,000,000	Lump Sum	0				\$0			
<b>Transit Speed and Reliability</b>										
Queue jumps	\$250,000	Per intersection	6				\$1,500,000			
Transit signal priority (Intersection)	\$75,000	Per intersection	6				\$450,000			
<b>Systems</b>										
Fare collection (Ticket vending machine)	\$50,000	Per TVM	8				\$400,000			
Fare collection (Tap machine)	\$5,000	Per tap	8				\$40,000			
Communications	\$100,000	Lump Sum	1				\$100,000			
<b>Other</b>										
Snow Sheds	\$72,000,000	Lump Sum	1				\$72,000,000			
<b>Subtotal</b>							<b>\$112,490,000</b>			
			<b>Gravel Pit - Snowbird</b>		<b>Gravel Pit - Alta</b>		<b>9400 South - Snowbird</b>		<b>9400 South - Alta</b>	
			<b>Quantity</b>	<b>Amount</b>	<b>Quantity</b>	<b>Amount</b>	<b>Quantity</b>	<b>Amount</b>	<b>Quantity</b>	<b>Amount</b>
<b>Support Facilities</b>										
Light maintenance and storage facility	\$850,000	Per vehicle	10	\$8,500,000	10	\$8,500,000	12	\$10,200,000	12	\$10,200,000
<b>Subtotal</b>			<b>\$37,400,000</b>							
<b>Vehicles</b>										
Ski bus	\$530,000	Per vehicle	10	\$5,300,000	10	\$5,300,000	12	\$6,360,000	12	\$6,360,000
Transit signal priority (Bus)	\$25,000	Per bus	10	\$250,000	10	\$250,000	12	\$300,000	12	\$300,000
<b>Subtotal</b>			<b>\$24,420,000</b>							
<b>Total</b>			<b>\$174,310,000</b>							

(continued on next page)

**Table 5. Winter Capital Cost for Little Cottonwood Canyon Concepts (continued)**

Item	2019 Unit Cost	Unit	A2							
			Quantity				Amount			
<b>Roadway</b>										
Bus lane	\$211,000,000	Lump Sum	1				\$211,000,000			
<b>Stops</b>										
Stops at terminal	\$500,000	Per stop	4				\$2,000,000			
<b>Park-and-Rides</b>										
Parking (Gravel Pit and 9400 S)	\$36,000,000	Lump Sum	1				\$36,000,000			
Parking (Gravel Pit and 9400 S)	\$52,000,000	Lump Sum	0				\$0			
<b>Transit Speed and Reliability</b>										
Queue jumps	\$250,000	Per intersection	6				\$1,500,000			
Transit signal priority (Intersection)	\$75,000	Per intersection	6				\$450,000			
<b>Systems</b>										
Fare collection (Ticket vending machine)	\$50,000	Per TVM	8				\$400,000			
Fare collection (Tap machine)	\$5,000	Per tap	8				\$40,000			
Communications	\$100,000	Lump Sum	1				\$100,000			
<b>Other</b>										
Snow Sheds	\$72,000,000	Lump Sum	1				\$72,000,000			
<b>Subtotal</b>										\$323,490,000
			Gravel Pit - Snowbird		Gravel Pit - Alta		9400 South - Snowbird		9400 South - Alta	
			Quantity	Amount	Quantity	Amount	Quantity	Amount	Quantity	Amount
<b>Support Facilities</b>										
Light maintenance and storage facility	\$850,000	Per vehicle	5	\$4,250,000	5	\$4,250,000	6	\$5,100,000	8	\$6,800,000
<b>Subtotal</b>							\$20,400,000			
<b>Vehicles</b>										
Ski bus	\$530,000	Per vehicle	5	\$2,650,000	5	\$2,650,000	6	\$3,180,000	8	\$4,240,000
Transit signal priority (Bus)	\$25,000	Per bus	5	\$125,000	5	\$125,000	6	\$150,000	8	\$200,000
<b>Subtotal</b>							\$13,320,000			
<b>Total</b>										\$357,210,000

(continued on next page)

**Table 5. Winter Capital Cost for Little Cottonwood Canyon Concepts (continued)**

Item	2019 Unit Cost	Unit	B1							
			Quantity				Amount			
<b>Roadway</b>										
Bus lane	\$211,000,000	Lump Sum	0				\$0			
<b>Stops</b>										
Stops at terminal	\$500,000	Per stop	4				\$2,000,000			
<b>Park-and-Rides</b>										
Parking (Gravel Pit and 9400 S)	\$36,000,000	Lump Sum	0				\$0			
Parking (Gravel Pit and 9400 S)	\$52,000,000	Lump Sum	1				\$52,000,000			
<b>Transit Speed and Reliability</b>										
Queue jumps	\$250,000	Per intersection	6				\$1,500,000			
Transit signal priority (Intersection)	\$75,000	Per intersection	6				\$450,000			
<b>Systems</b>										
Fare collection (Ticket vending machine)	\$50,000	Per TVM	8				\$400,000			
Fare collection (Tap machine)	\$5,000	Per tap	8				\$40,000			
Communications	\$100,000	Lump Sum	1				\$100,000			
<b>Other</b>										
Snow Sheds	\$72,000,000	Lump Sum	1				\$72,000,000			
<b>Subtotal</b>							<b>\$128,490,000</b>			
			<b>Gravel Pit - Snowbird</b>		<b>Gravel Pit - Alta</b>		<b>9400 South - Snowbird</b>		<b>9400 South - Alta</b>	
			<b>Quantity</b>	<b>Amount</b>	<b>Quantity</b>	<b>Amount</b>	<b>Quantity</b>	<b>Amount</b>	<b>Quantity</b>	<b>Amount</b>
<b>Support Facilities</b>										
Light maintenance and storage facility	\$850,000	Per vehicle	11	\$9,350,000	12	\$10,200,000	15	\$12,750,000	15	\$12,750,000
<b>Subtotal</b>			<b>\$45,050,000</b>							
<b>Vehicles</b>										
Ski bus	\$530,000	Per vehicle	11	\$5,830,000	12	\$6,360,000	15	\$7,950,000	15	\$7,950,000
Transit signal priority (Bus)	\$25,000	Per bus	11	\$275,000	12	\$300,000	15	\$375,000	15	\$375,000
<b>Subtotal</b>			<b>\$29,415,000</b>							
<b>Total</b>			<b>\$202,955,000</b>							

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**Table 5. Winter Capital Cost for Little Cottonwood Canyon Concepts (continued)**

Item	2019 Unit Cost	Unit	B2							
			Quantity				Amount			
<b>Roadway</b>										
Bus lane	\$211,000,000	Lump Sum	1				\$211,000,000			
<b>Stops</b>										
Stops at terminal	\$500,000	Per stop	4				\$2,000,000			
<b>Park-and-Rides</b>										
Parking (Gravel Pit and 9400 S)	\$36,000,000	Lump Sum	0				\$0			
Parking (Gravel Pit and 9400 S)	\$52,000,000	Lump Sum	1				\$52,000,000			
<b>Transit Speed and Reliability</b>										
Queue jumps	\$250,000	Per intersection	6				\$1,500,000			
Transit signal priority (Intersection)	\$75,000	Per intersection	6				\$450,000			
<b>Systems</b>										
Fare collection (Ticket vending machine)	\$50,000	Per TVM	8				\$400,000			
Fare collection (Tap machine)	\$5,000	Per tap	8				\$40,000			
Communications	\$100,000	Lump Sum	1				\$100,000			
<b>Other</b>										
Snow Sheds	\$72,000,000	Lump Sum	1				\$72,000,000			
<b>Subtotal</b>							<b>\$339,490,000</b>			
			Gravel Pit - Snowbird		Gravel Pit - Alta		9400 South - Snowbird		9400 South - Alta	
			Quantity	Amount	Quantity	Amount	Quantity	Amount	Quantity	Amount
<b>Support Facilities</b>										
Light maintenance and storage facility	\$850,000	Per vehicle	6	\$5,100,000	8	\$6,800,000	9	\$7,650,000	10	\$8,500,000
<b>Subtotal</b>			<b>\$28,050,000</b>							
<b>Vehicles</b>										
Ski bus	\$530,000	Per vehicle	6	\$3,180,000	8	\$4,240,000	9	\$4,770,000	10	\$5,300,000
Transit signal priority (Bus)	\$25,000	Per bus	6	\$150,000	8	\$200,000	9	\$225,000	10	\$250,000
<b>Subtotal</b>			<b>\$18,315,000</b>							
<b>Total</b>			<b>\$385,855,000</b>							

## 5.0 References

### Mountain Accord

- 2015 Big Cottonwood Canyon and Little Cottonwood Canyon Visitation (2015) Based on UDOT Vehicle Counts and Assumed Occupancy.

### Nelson/Nygaard Consulting Associates, Inc.

- 2017 Whatcom Transit Authority 2017 Strategic Plan. April 1.

### [UDOT] Utah Department of Transportation

- 2019 Evaluation of Transit Hub Locations in Big and Little Cottonwood Canyons. October 17.

### [UTA] Utah Transit Authority

- 2018a Ski Bus Service. April.
- 2018b Email communication between Mary DeLoretto, UTA, and Vince Izzo, HDR, regarding transit payment type for the 2017–2018 ski season. May 9.
- 2019 Salt Lake Ski Service Survey Based on 333 Samples. March.



## **Appendix A. Operation and Capital Cost**

LCC Operating Cost

Little Cottonwood Canyon - Transit Alternatives  
Draft Operating Cost

Cost per Mile Methodology

Alternative	Route	Miles	Cost per Rev Mile	Days	Peak Frequency	Off-Peak Frequency	Trips	Days	Revenue Operating Cost	Deadhead Operating Cost	Total Operating Cost
A1	Gravel Pit - Snowbird	11.0	\$8.56	Mon-Sun	15	30	72	140	\$949,133	\$373,901	\$1,323,034
	Gravel Pit - Alta	13.0	\$8.56	Mon-Sun	15	30	72	140	\$1,121,702	\$373,901	\$1,495,603
	9400 South - Snowbird	10.0	\$8.56	Mon-Sun	15	30	72	140	\$862,848	\$539,280	\$1,402,128
	9400 South - Alta	12.0	\$8.56	Mon-Sun	15	30	72	140	\$1,035,418	\$539,280	\$1,574,698
								<b>\$3,969,101</b>	<b>\$1,826,362</b>	<b>\$5,795,463</b>	
A2	Gravel Pit - Snowbird	11.0	\$8.56	Mon-Sun	15	30	72	140	\$949,133	\$186,951	\$1,136,084
	Gravel Pit - Alta	13.0	\$8.56	Mon-Sun	15	30	72	140	\$1,121,702	\$186,951	\$1,308,653
	9400 South - Snowbird	10.0	\$8.56	Mon-Sun	15	30	72	140	\$862,848	\$251,664	\$1,114,512
	9400 South - Alta	12.0	\$8.56	Mon-Sun	15	30	72	140	\$1,035,418	\$323,568	\$1,358,986
								<b>\$3,969,101</b>	<b>\$949,134</b>	<b>\$4,918,235</b>	
B1	Gravel Pit - Snowbird	11.0	\$8.56	Mon-Sun	10	20	108	140	\$1,423,699	\$405,060	\$1,828,759
	Gravel Pit - Alta	13.0	\$8.56	Mon-Sun	10	20	108	140	\$1,682,554	\$467,376	\$2,149,930
	9400 South - Snowbird	10.0	\$8.56	Mon-Sun	10	20	108	140	\$1,294,272	\$647,136	\$1,941,408
	9400 South - Alta	12.0	\$8.56	Mon-Sun	10	20	108	140	\$1,553,126	\$647,136	\$2,200,262
								<b>\$5,953,651</b>	<b>\$2,166,708</b>	<b>\$8,120,359</b>	
B2	Gravel Pit - Snowbird	11.0	\$8.56	Mon-Sun	10	20	108	140	\$1,423,699	\$218,109	\$1,641,808
	Gravel Pit - Alta	13.0	\$8.56	Mon-Sun	10	20	108	140	\$1,682,554	\$280,426	\$1,962,980
	9400 South - Snowbird	10.0	\$8.56	Mon-Sun	10	20	108	140	\$1,294,272	\$359,520	\$1,653,792
	9400 South - Alta	12.0	\$8.56	Mon-Sun	10	20	108	140	\$1,553,126	\$431,424	\$1,984,550
								<b>\$4,400,525</b>	<b>\$1,289,479</b>	<b>\$5,690,004</b>	

Cost per Revenue Hour Methodology

Alternative	Route	Travel Time	Cost per Rev Hour	Days	Peak Frequency	Off-Peak Frequency	Trips	Days	Revenue Operating Cost	Load/Unload Operating Cost	Layover Operating Cost	Deadhead Operating Cost	Total Operating Cost
A1	Gravel Pit - Snowbird	48	\$116.01	Mon-Sun	15	30	72	140	\$935,505	\$194,897	\$140,326	\$292,346	\$1,563,073
	Gravel Pit - Alta	52	\$116.01	Mon-Sun	15	30	72	140	\$1,013,463	\$194,897	\$152,020	\$292,346	\$1,652,726
	9400 South - Snowbird	60	\$116.01	Mon-Sun	15	30	72	140	\$1,169,381	\$194,897	\$175,407	\$487,242	\$2,026,927
	9400 South - Alta	64	\$116.01	Mon-Sun	15	30	72	140	\$1,247,340	\$194,897	\$187,101	\$487,242	\$2,116,579
								<b>\$4,365,688</b>	<b>\$779,587</b>	<b>\$654,853</b>	<b>\$1,559,176</b>	<b>\$7,359,305</b>	
A2	Gravel Pit - Snowbird	20	\$116.01	Mon-Sun	15	30	72	140	\$389,794	\$194,897	\$58,469	\$146,173	\$789,332
	Gravel Pit - Alta	24	\$116.01	Mon-Sun	15	30	72	140	\$467,752	\$194,897	\$70,163	\$146,173	\$878,985
	9400 South - Snowbird	32	\$116.01	Mon-Sun	15	30	72	140	\$623,670	\$194,897	\$93,550	\$227,380	\$1,139,497
	9400 South - Alta	36	\$116.01	Mon-Sun	15	30	72	140	\$701,628	\$194,897	\$105,244	\$292,346	\$1,294,116
								<b>\$2,182,844</b>	<b>\$779,587</b>	<b>\$327,427</b>	<b>\$812,072</b>	<b>\$4,101,930</b>	
B1	Gravel Pit - Snowbird	38	\$116.01	Mon-Sun	10	20	108	140	\$1,110,912	\$292,345	\$166,637	\$316,708	\$1,886,602
	Gravel Pit - Alta	42	\$116.01	Mon-Sun	10	20	108	140	\$1,227,850	\$292,345	\$184,177	\$365,432	\$2,069,805
	9400 South - Snowbird	48	\$116.01	Mon-Sun	10	20	108	140	\$1,403,257	\$292,345	\$210,489	\$584,691	\$2,490,782
	9400 South - Alta	52	\$116.01	Mon-Sun	10	20	108	140	\$1,520,195	\$292,345	\$228,029	\$584,691	\$2,625,260
								<b>\$5,262,214</b>	<b>\$1,169,381</b>	<b>\$789,332</b>	<b>\$1,851,522</b>	<b>\$9,072,448</b>	
B2	Gravel Pit - Snowbird	20	\$116.01	Mon-Sun	10	20	108	140	\$584,690	\$292,345	\$87,704	\$170,535	\$1,135,274
	Gravel Pit - Alta	24	\$116.01	Mon-Sun	10	20	108	140	\$701,628	\$292,345	\$105,244	\$219,259	\$1,318,477
	9400 South - Snowbird	30	\$116.01	Mon-Sun	10	20	108	140	\$877,036	\$292,345	\$131,555	\$324,828	\$1,625,764
	9400 South - Alta	34	\$116.01	Mon-Sun	10	20	108	140	\$993,974	\$292,345	\$149,096	\$389,794	\$1,825,209
								<b>\$3,157,328</b>	<b>\$1,169,381</b>	<b>\$473,599</b>	<b>\$1,104,416</b>	<b>\$5,904,724</b>	

Assumptions

Operating Plan  
 Seasonal: 140 days (20 weeks)  
 Mon-Sun: 12 hours (7am-7pm), 6 hour peak (7am-10am, 2pm-5pm)  
 Loading/Unloading: Assumes 5 minutes each for total of 10 minutes  
 Layover: Assumes 15% of revenue operating cost

Source	2018	3%	2019
Cost per Revenue Mile is from NTD 2018, then inflated by 3% for 2019	\$8.31	\$0.25	\$8.56
Cost per Revenue Hour is from NTD 2018, then inflated by 3% for 2019	\$112.63	\$3.38	\$116.01



LCC Operating Cost

Little Cottonwood Canyon - Transit Alternatives  
Draft Operating Cost

Cost per Mile Methodology

Trip Table

Alternative	Route	Miles	Cost per Rev Mile	Days	Peak			Off-Peak			Total Trips			
					Peak Frequency	Hours	Trips per Hour	Trips	Off-Peak Frequency	Hours	Trips per Hour	Trips	One-Way	Both Directions
A1	Gravel Pit - Snowbird	11.0	\$8.56	Mon-Sun	15	6	4	24	30	6	2	12	36	72
	Gravel Pit - Alta	13.0	\$8.56	Mon-Sun	15	6	4	24	30	6	2	12	36	72
	9400 South - Snowbird	10.0	\$8.56	Mon-Sun	15	6	4	24	30	6	2	12	36	72
	9400 South - Alta	12.0	\$8.56	Mon-Sun	15	6	4	24	30	6	2	12	36	72
A2	Gravel Pit - Snowbird	11.0	\$8.56	Mon-Sun	15	6	4	24	30	6	2	12	36	72
	Gravel Pit - Alta	13.0	\$8.56	Mon-Sun	15	6	4	24	30	6	2	12	36	72
	9400 South - Snowbird	10.0	\$8.56	Mon-Sun	15	6	4	24	30	6	2	12	36	72
	9400 South - Alta	12.0	\$8.56	Mon-Sun	15	6	4	24	30	6	2	12	36	72
B1	Gravel Pit - Snowbird	11.0	\$8.56	Mon-Sun	10	6	6	36	20	6	3	18	54	108
	Gravel Pit - Alta	13.0	\$8.56	Mon-Sun	10	6	6	36	20	6	3	18	54	108
	9400 South - Snowbird	10.0	\$8.56	Mon-Sun	10	6	6	36	20	6	3	18	54	108
	9400 South - Alta	12.0	\$8.56	Mon-Sun	10	6	6	36	20	6	3	18	54	108
B2	Gravel Pit - Snowbird	11.0	\$8.56	Mon-Sun	10	6	6	36	20	6	3	18	54	108
	Gravel Pit - Alta	13.0	\$8.56	Mon-Sun	10	6	6	36	20	6	3	18	54	108
	9400 South - Snowbird	10.0	\$8.56	Mon-Sun	10	6	6	36	20	6	3	18	54	108
	9400 South - Alta	12.0	\$8.56	Mon-Sun	10	6	6	36	20	6	3	18	54	108

Cost per Revenue Hour Methodology

Trip Table

Alternative	Route	Travel Time	Cost per Rev Hour	Days	Peak			Off-Peak			Total Trips			
					Peak Frequency	Hours	Trips per Hour	Trips	Off-Peak Frequency	Hours	Trips per Hour	Trips	One-Way	Both Directions
A1	Gravel Pit - Snowbird	48	\$116.01	Mon-Sun	15	6	4	24	30	6	2	12	36	72
	Gravel Pit - Alta	52	\$116.01	Mon-Sun	15	6	4	24	30	6	2	12	36	72
	9400 South - Snowbird	60	\$116.01	Mon-Sun	15	6	4	24	30	6	2	12	36	72
	9400 South - Alta	64	\$116.01	Mon-Sun	15	6	4	24	30	6	2	12	36	72
A2	Gravel Pit - Snowbird	20	\$116.01	Mon-Sun	15	6	4	24	30	6	2	12	36	72
	Gravel Pit - Alta	24	\$116.01	Mon-Sun	15	6	4	24	30	6	2	12	36	72
	9400 South - Snowbird	32	\$116.01	Mon-Sun	15	6	4	24	30	6	2	12	36	72
	9400 South - Alta	36	\$116.01	Mon-Sun	15	6	4	24	30	6	2	12	36	72
B1	Gravel Pit - Snowbird	38	\$116.01	Mon-Sun	10	6	6	36	20	6	3	18	54	108
	Gravel Pit - Alta	42	\$116.01	Mon-Sun	10	6	6	36	20	6	3	18	54	108
	9400 South - Snowbird	48	\$116.01	Mon-Sun	10	6	6	36	20	6	3	18	54	108
	9400 South - Alta	52	\$116.01	Mon-Sun	10	6	6	36	20	6	3	18	54	108
B2	Gravel Pit - Snowbird	20	\$116.01	Mon-Sun	10	6	6	36	20	6	3	18	54	108
	Gravel Pit - Alta	24	\$116.01	Mon-Sun	10	6	6	36	20	6	3	18	54	108
	9400 South - Snowbird	30	\$116.01	Mon-Sun	10	6	6	36	20	6	3	18	54	108
	9400 South - Alta	34	\$116.01	Mon-Sun	10	6	6	36	20	6	3	18	54	108

Assumptions

Operating Plan  
 Seasonal: 140 days (20 weeks)  
 Mon-Sun: 12 hours (7am-7pm), 6 hour peak (7am-10am, 2pm-5pm)  
 Loading/Unloading: Assumes 5 minutes each for total of 10 minutes  
 Layover: Assumes 15% of revenue operating cost

Source

Cost per Revenue Mile is from NTD 2018, then inflated by 3% for 2019  
 Cost per Revenue Hour is from NTD 2018, then inflated by 3% for 2019

Little Cottonwood Canyon - Transit Alternatives  
Draft Operating Cost

Cost per Mile Methodology

Deadhead Calculation

Alternative	Route	Miles	Cost per Rev Mile	Days	Total Minutes	Peak Frequency	Peak Pullout	Off-Peak Return	Deadhead Trips/Day	Deadhead Miles/Trip	Deadhead Miles/Day	Deadhead Cost
A1	Gravel Pit - Snowbird	11.0	\$8.56	Mon-Sun	120	15	8	4	24	13	312	\$373,901
	Gravel Pit - Alta	13.0	\$8.56	Mon-Sun	120	15	8	4	24	13	312	\$373,901
	9400 South - Snowbird	10.0	\$8.56	Mon-Sun	150	15	10	5	30	15	450	\$539,280
	9400 South - Alta	12.0	\$8.56	Mon-Sun	150	15	10	5	30	15	450	\$539,280
A2	Gravel Pit - Snowbird	11.0	\$8.56	Mon-Sun	60	15	4	2	12	13	156	\$186,951
	Gravel Pit - Alta	13.0	\$8.56	Mon-Sun	60	15	4	2	12	13	156	\$186,951
	9400 South - Snowbird	10.0	\$8.56	Mon-Sun	75	15	5	2	14	15	210	\$251,664
	9400 South - Alta	12.0	\$8.56	Mon-Sun	90	15	6	3	18	15	270	\$323,568
B1	Gravel Pit - Snowbird	11.0	\$8.56	Mon-Sun	90	10	9	4	26	13	338	\$405,060
	Gravel Pit - Alta	13.0	\$8.56	Mon-Sun	100	10	10	5	30	13	390	\$467,376
	9400 South - Snowbird	10.0	\$8.56	Mon-Sun	120	10	12	6	36	15	540	\$647,136
	9400 South - Alta	12.0	\$8.56	Mon-Sun	120	10	12	6	36	15	540	\$647,136
B2	Gravel Pit - Snowbird	11.0	\$8.56	Mon-Sun	50	10	5	2	14	13	182	\$218,109
	Gravel Pit - Alta	13.0	\$8.56	Mon-Sun	60	10	6	3	18	13	234	\$280,426
	9400 South - Snowbird	10.0	\$8.56	Mon-Sun	70	10	7	3	20	15	300	\$359,520
	9400 South - Alta	12.0	\$8.56	Mon-Sun	80	10	8	4	24	15	360	\$431,424

Cost per Revenue Hour Methodology

Deadhead Calculation

Alternative	Route	Travel Time	Cost per Rev Hour	Days	Total Minutes	Peak Frequency	Peak Pullout	Off-Peak Return	Deadhead Trips/Day	Deadhead Hour/Trip	Deadhead Hour/Day	Deadhead Cost
A1	Gravel Pit - Snowbird	48	\$116.01	Mon-Sun	120	15	8	4	24	0.75	18	\$292,346
	Gravel Pit - Alta	52	\$116.01	Mon-Sun	120	15	8	4	24	0.75	18	\$292,346
	9400 South - Snowbird	60	\$116.01	Mon-Sun	150	15	10	5	30	1	30	\$487,242
	9400 South - Alta	64	\$116.01	Mon-Sun	150	15	10	5	30	1	30	\$487,242
A2	Gravel Pit - Snowbird	20	\$116.01	Mon-Sun	60	15	4	2	12	0.75	9	\$146,173
	Gravel Pit - Alta	24	\$116.01	Mon-Sun	60	15	4	2	12	0.75	9	\$146,173
	9400 South - Snowbird	32	\$116.01	Mon-Sun	75	15	5	2	14	1	14	\$227,380
	9400 South - Alta	36	\$116.01	Mon-Sun	90	15	6	3	18	1	18	\$292,346
B1	Gravel Pit - Snowbird	38	\$116.01	Mon-Sun	90	10	9	4	26	0.75	20	\$316,708
	Gravel Pit - Alta	42	\$116.01	Mon-Sun	100	10	10	5	30	0.75	23	\$365,432
	9400 South - Snowbird	48	\$116.01	Mon-Sun	120	10	12	6	36	1	36	\$584,691
	9400 South - Alta	52	\$116.01	Mon-Sun	120	10	12	6	36	1	36	\$584,691
B2	Gravel Pit - Snowbird	20	\$116.01	Mon-Sun	50	10	5	2	14	0.75	11	\$170,535
	Gravel Pit - Alta	24	\$116.01	Mon-Sun	60	10	6	3	18	0.75	14	\$219,259
	9400 South - Snowbird	30	\$116.01	Mon-Sun	70	10	7	3	20	1	20	\$324,828
	9400 South - Alta	34	\$116.01	Mon-Sun	80	10	8	4	24	1	24	\$389,794

Deadhead calculation provided by UTA

Assumptions

Assumptions

Operating Plan  
Seasonal: 140 days (20 weeks)  
Mon-Sun: 12 hours (7am-7pm), 6 hour peak (7am-10am, 2pm-5pm)  
Loading/Unloading: Assumes 5 minutes each for total of 10 minutes  
Layover: Assumes 15% of revenue operating cost

Deadhead Miles Hours  
SR-201 Fort Union 13 0.75  
SR-209 Highland 15 1

Deadhead Costs Calculation, based on miles

Deadhead Trips/Day = [(Peak Pullout)\*2 + (Off-Peak Return)\*2]  
Deadhead Miles/Day = (Deadhead Trips/Day) \* (Deadhead Mile/Trip)

Deadhead Costs Calculation, based on hours

Deadhead Trips/Day = [(Peak Pullout)\*2 + (Off-Peak Return)\*2]  
Deadhead Hours/Day = (Deadhead Trips/Day) \* (Deadhead Hour/Trip)  
Deadhead Costs = (Deadhead Hour/Day) \* (Costs/Hour) \* (Days/Year)

LCC Fleet

Little Cottonwood Canyon - Transit Alternatives  
Draft Fleet Estimate

Alternative	Route	Peak Frequency	One-way (minutes)	Roundtrip (minutes)	Layover (minutes)	Total (minutes)	Fleet	Spare	Total
A1	Gravel Pit - Snowbird	15	48	96	14	120	8	2	10
	Gravel Pit - Alta	15	52	104	16	120	8	2	10
	9400 South - Snowbird	15	60	120	18	150	10	2	12
	9400 South - Alta	15	64	128	19	150	10	2	12
	<b>Subtotal</b>								<b>44</b>
A2	Gravel Pit - Snowbird	15	20	40	6	60	4	1	5
	Gravel Pit - Alta	15	24	48	7	60	4	1	5
	9400 South - Snowbird	15	32	64	10	75	5	1	6
	9400 South - Alta	15	36	72	11	90	6	2	8
	<b>Subtotal</b>								<b>24</b>
B1	Gravel Pit - Snowbird	10	38	76	11	90	9	2	11
	Gravel Pit - Alta	10	42	84	13	100	10	2	12
	9400 South - Snowbird	10	48	96	14	120	12	3	15
	9400 South - Alta	10	52	104	16	120	12	3	15
	<b>Subtotal</b>								<b>53</b>
B2	Gravel Pit - Snowbird	10	20	40	6	50	5	1	6
	Gravel Pit - Alta	10	24	48	7	60	6	2	8
	9400 South - Snowbird	10	30	60	9	70	7	2	9
	9400 South - Alta	10	34	68	10	80	8	2	10
	<b>Subtotal</b>								<b>33</b>

**Assumptions**

Layover 15%  
Spare Ratio 20%  
Fleet estimate based on peak vehicle requirement