Chapter 5: Comparison of Alternatives

This chapter compares the No-Action Alternative, the Enhanced Bus Alternative, and the Preferred Alternative based on their abilities to meet the project's purpose and need, their transportation benefits, and their environmental impacts.

5.1 HOW THE ALTERNATIVES MEET PURPOSE AND NEED

This section discusses how the No-Action Alternative, Enhanced Bus Alternative, and Preferred Alternative meet the purpose and need of the project. The Enhanced Bus Alternative is improved bus service without capital improvements, as described in Chapter 2: Alternatives. The purpose of the project is to do the following:

- Increase transportation capacity to accommodate growing population, employment, student enrollment, and travel demand.
- Improve transit competitiveness with the automobile by improving transit reliability and reducing transit travel time.
- Improve transit connections to and from FrontRunner commuter rail.
- Improve multi-modal connectivity across Interstate 15 (I-15) and from I-15 to Orem and Provo (Phase II).

No-Action Alternative

The No-Action Alternative would make no contribution toward meeting the purpose and need of the project.

Enhanced Bus Alternative

The objective of the Enhanced Bus Alternative is to determine how much of the benefit of the Preferred Alternative could be attained without building additional facilities. The Enhanced Bus Alternative assumes improved transit service characteristics and Transportation Systems Management (TSM) strategies, such as signal timing improvements, traffic engineering actions, and bus route restructuring. Additional details on the Enhanced Bus Alternative can be found in Section 2.2.2.

The Enhanced Bus Alternative would provide an opportunity for a small increase in transit ridership over the No-Action Alternative due to increased service frequency and improved stations. The increased frequency would provide a small increase in person-throughput over the No-Action Alternative. The Enhanced Bus Alternative would increase the peak-hour capacity of the system from approximately 164 to 220 riders (No-Action Alternative) to 250 to 330 riders in each direction, assuming each bus can carry an average of 41 seated passengers and up to 55 passengers with standing capacity. The 2030 demand is more than 550 riders in the peak direction in the peak hour.

The Enhanced Bus Alternative would serve major trip generators; however, it would not adequately increase transit and roadway capacity to meet growing population and travel demand, nor would it improve transit reliability or reduce transit travel time. Furthermore, the

Enhanced Bus Alternative would not improve multi-modal connectivity across I-15 or from I-15 to Orem and Provo.

Preferred Alternative

The Preferred Alternative meets the purpose and need of the project and demonstrates the ability to solve the transportation needs listed above and detailed in Chapter 1: Purpose and Need. The Phase II project would address needs in the year 2030, which is the planning horizon year consistent with the Mountainland Association of Governments (MAG) Regional Transportation Plan and associated 2030 Regional Travel Demand Model. The Phase I project would likely be opened in the year 2014, assuming funds become available. Additional information on opening year conditions is provided in the Provo-Orem Rapid Transit Alternatives Analysis (AA) report to be consistent with FTA Small Starts requirements. The Preferred Alternative would do the following:

- Increase transportation capacity to accommodate growing population, employment, student enrollment, and travel demand.
- Improve transit competitiveness with the automobile by improving transit reliability and reducing transit travel time.
- Improve transit connections to and from FrontRunner commuter rail.
- Improve multi-modal connectivity across I-15 and from I-15 to Orem and Provo (Phase II).

5.2 COMPARISON OF TRANSPORTATION BENEFITS

A comparison of how the No-Action Alternative, Enhanced Bus Alternative, and Preferred Alternative meet the transportation needs of the project is presented in Table 5-1: Comparison of Alternatives on the following page. The No-Action Alternative and the Enhanced Bus Alternative perform similarly in terms of ridership. Although there would be a slight increase in ridership with the Enhanced Bus Alternative, the regional travel demand model does not capture an increase that small. The Preferred Alternative (Phase II) would improve transit reliability by avoiding the congested University Parkway interchange and would provide increased access to Utah Valley University (UVU). The reduction in car trips converted to transit between the Preferred Alternative Phase I and Phase II is due to an increase in the overall number of car trips associated with construction of a new interchange at 800 South.

Transit ridership is typically quantified in two ways. First, transit boardings occur whenever a passenger boards a transit vehicle in the course of making a trip. Linked trips, the other common measure of ridership, includes all segments that a passenger travels from a trip origin to a trip destination. These measures of ridership are explained in more detail in the Ridership discussion on page 5-5.

The Preferred Alternative would increase transit ridership to both UVU and Brigham Young University (BYU). For UVU, the Preferred Alternative would eliminate more than 500 auto trips to campus per day, which would reduce the need for parking on campus by 2 acres. Likewise, it would eliminate 1,000 auto trips to the BYU campus per day, which would reduce the need for parking on campus by 5 acres.

Table 5- 1: Comparison of Alternatives

	No-Action/ Enhanced Bus	Preferred Alternative (Phase I)	Preferred Alternative (Phase II)
2030 Linked Transit Trips on Wasatch Front (riders/day)	225,900	232,400	232,000
2030 Route Ridership (riders/day)	8,400	16,100	16,400
2014 Route Ridership (riders/day)	6,800	12,900	N/A
Corridor Travel Time (minutes, 2014)	45 minutes	34 minutes	36 minutes, 30 seconds
Travel Time from SLC to BYU (minutes, 2014)	1 hour 20 minutes	1 hour 7 minutes	1 hour 9 minutes
Peak Hour Transit Capacity (transit plus auto, persons/hour, one-direction)	164–330	720–960	720–960
Peak Hour Person-Throughput (persons/hour, two-directions)[1]	3,262	3,628	3,628
Transit Capture[2]	2.2%	2.9%	2.9%
Corridor Mode Split, Peak Hour (persons on transit/persons in autos)[1]	10% / 90%	19% / 81%	19% / 81%
Reliability	84%	Estimated at 95%	Estimated at higher than 95%
2030 Auto Trips Eliminated Over the No-Action Alternative (trips/day)[3]	0	4,200	3,600
Parking Saved at Universities (acres)	0	7 acres	7 acres

1. *Peak Hour Person-Throughput is an average of persons in transit and persons in autos taken at select intersections on University Parkway and University Avenue. (Source: Fehr & Peers, Traffic Analysis Memorandums, November 2010)*
2. *Transit Capture is the percentage of all trips that involve transit in the study area. The study area encompasses approximately one-half to 1 mile on either side of the Preferred Alternative.*
3. *Auto Trips Eliminated is presented for the study area.*

Sources: MAG Travel Demand Model, Version 6.1; WCEC Engineers 2010

Transportation Capacity

The Preferred Alternative would increase transportation capacity to accommodate growing population, employment, student enrollment, and travel demand. The Preferred Alternative would increase person-throughput (people in cars and people on transit) in the p.m. peak hour on the Preferred Alternative corridor by up to 25 percent in some locations (see Table 5-2: Person-Throughput in the PM Peak Hour, and Figure 5-1: Person-Throughput in the PM Peak Hour). The increase in travel capacity calculated at the four locations shown on Table 5-2 is due entirely to the transit improvements.

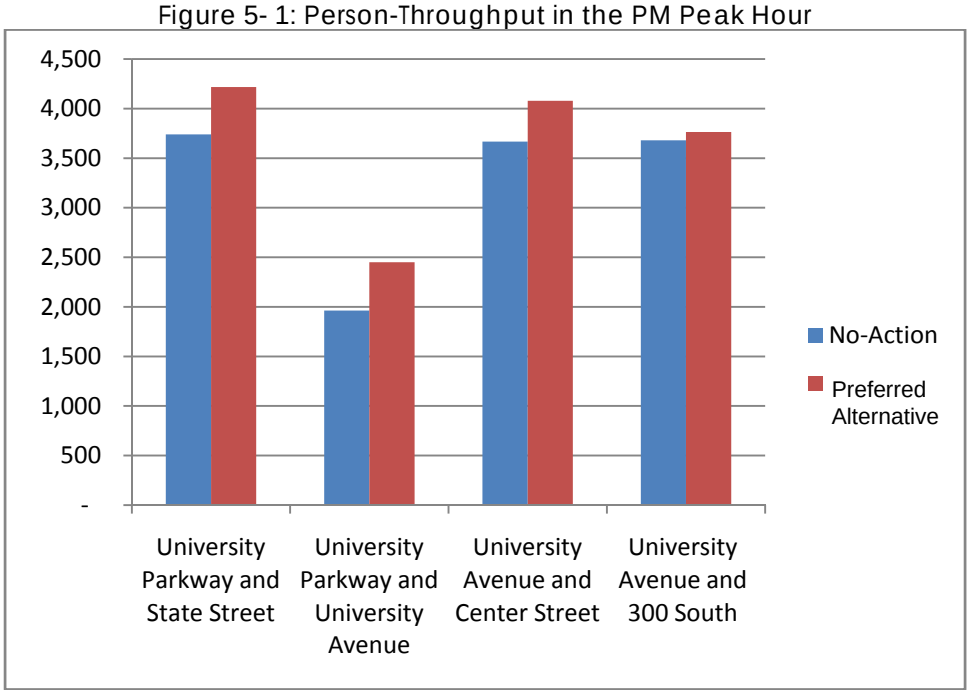
Table 5- 2: Person-Throughput in the PM Peak Hour (Persons/Hour)

Intersection	No-Action (persons/hour)	Preferred Alternative (persons/hour)	% Increase
University Parkway and State Street	3,739	4,218	13%
University Parkway and University Avenue	1,962	2,450	25%
University Avenue and Center Street	3,668	4,078	11%
University Avenue and 300 South	3,681	3,765	2%
Average	3,263	3,628	11%

Notes:
1. *Person-throughput is for the p.m. peak hour, and summed for both directions in the through-direction only.*
2. *Transit ridership in the p.m. peak hour is assumed to be 10% of the 2030 transit ridership demand.*
3. *Autos Served is based on VISSIM modeling.*

Source: Fehr & Peers, Traffic Analysis Memorandums, November 2010

Figure 5- 1: Person-Throughput in the PM Peak Hour



The general purpose lanes on the segment of University Parkway would increase travel capacity for autos for a discrete segment of the corridor also. The Preferred Alternative includes expanding University Parkway from two lanes in each direction to three lanes in each direction from State Street to University Avenue. This would give University Parkway a consistent eight-lane cross-section (three general purpose lanes and one bus rapid transit (BRT) lane in each direction) from I-15 in Orem to University Avenue in Provo.

Transit capacity is estimated to increase from 164 (seated capacity) to 220 persons (assuming standing capacity) per hour (one direction) for the current Bus Route 830 (or 250 to 330 persons per hour for the Enhanced Bus Alternative) to 720 to 960 persons per hour. Transit demand in the peak hour is estimated at more than 550 persons per hour.

Transit Mode Share and Transit Competitiveness with the Automobile

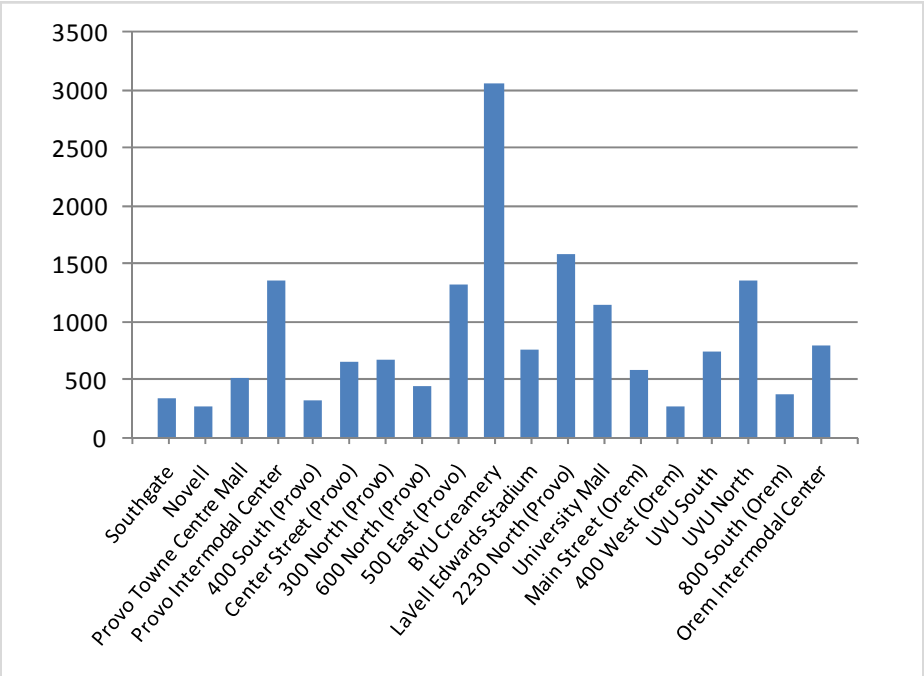
The Preferred Alternative would increase transit competitiveness with the automobile and increase overall transit mode share (the percentage of overall trips taken by transit) by improving transit reliability and reducing transit travel time. Opening day (2014) transit ridership is estimated to increase from 3,700 riders on the current Bus Route 830 to 12,900 for the Preferred Alternative (Phase I). The Preferred Alternative would increase transit capture in the study area from 2.2 percent to 2.9 percent. The ratio of transit riders to persons in autos would increase from 10 percent to 19 percent, on average, at congested locations during the peak hour (congested locations are shown on Table 5-2).The Preferred Alternative (Phase I) would eliminate 4,200 auto trips per day in the study area in 2030.

Ridership

Transit ridership is typically quantified in two ways. Transit boardings, referred to as route ridership, is the most common measure. A transit boarding occurs whenever a passenger boards a transit vehicle in the course of making a trip. A linked trip is the other common measure of ridership. A linked trip includes all segments that a passenger travels from a trip origin to a trip destination. For example, one linked trip could include a walk from home to a transit station, a bus ride with a transfer to a rail route, and a walk to the final destination. A single linked trip could require more than one transit boarding, especially if transfers are required.

Table 5-1 shows both daily boardings and total linked trips for the Enhanced Bus Alternative and the Preferred Alternative. Figure 5-2: Station-Level Daily Boardings for the Preferred Alternative shows estimated daily boardings by station for 2030. Daily ridership is expected to be approximately 16,400 for Phase II of the Preferred Alternative in 2030, with opening day ridership for Phase I estimated at 12,900. Although some increase in ridership is expected for the Enhanced Bus Alternative over the No-Action Alternative due to increased service frequency and improved stations, the travel demand model is not sensitive enough to quantify this increase.

Figure 5- 2: Station-Level Daily Boardings for the Preferred Alternative (Phase II, 2030)



Reliability

The Preferred Alternative would improve transit reliability from 84 percent to 95 percent through exclusive lanes, transit signal priority, and high-capacity boarding (buses with multiple doors, level-boarding at stations, and off-board fare collection). The reliability of buses operating in mixed-flow traffic conditions is expected to worsen in 2030 under No-Action conditions. Without the exclusive lanes and other improvements, the bus would be subject to the delay and unpredictability associated with increasing congestion. In 2030 delay at intersections across the corridor (using all Orem intersections as a test case) will increase by more than 45 percent.

Travel Time

The Preferred Alternative would decrease transit travel time from an average of 45 minutes for the current Bus Route 830 or Enhanced Bus Alternative to 34 minutes (Phase I) in the opening year, as shown in Table 5-3: Peak-Hour Travel Times. Auto travel times are estimated to be 37 minutes in the opening year. Traffic analysis results show that exclusive lanes allow the bus to travel the corridor faster than automobiles or buses operating in mixed-flow traffic lanes. Transit travel time benefits result from exclusive lanes in congested segments of the corridor.

While Phase II of the Preferred Alternative would result in an increase in travel time over Phase I, the Phase II station locations provide better access to transit riders on the UVU campus.

Auto travel times would improve from 40 minutes, 30 seconds to approximately 39 minutes in 2030. This auto time improvement is a result of general purpose lanes on University Parkway and the transit signal priority for BRT. Transit signal priority results in more green time for autos and transit in the through-direction.

Table 5- 3: Peak-Hour Travel Times

	Existing[1]	No-Action (2030)	Preferred Alternative Phase I (2014)	Preferred Alternative Phase II[2] (2030)
Automobile (minutes)	35:00	40:30	37:00	39:00
Bus/BRT[3] (minutes)	45:00	56:42	34:00	36:30

1. Travel time measured using GPS technology and field review.
2. Travel time for auto and bus is the same as for Phase 1 (2030), based on drivers continuing to use the shorter travel path to the Provo Intermodal Center via University Parkway.
3. Travel time for bus in future years (2014 and 2030) is assumed to be 40% higher than automobile travel time. (Source: Fehr & Peers 2010b)

Source: Estimates created from the MAG Travel Demand Model Version 6.1 unless otherwise noted

Transit Connections To and From FrontRunner Commuter Rail

The Preferred Alternative would improve transit connections to and from FrontRunner commuter rail. The reliability of the local bus service is 84 percent, while FrontRunner commuter rail reliability is estimated to be more than 98 percent. If the local bus arrives at the FrontRunner station after the FrontRunner leaves, the delay will be almost 30 minutes until the next train is scheduled to depart. The Preferred Alternative is estimated to improve reliability to 95 percent, which would reduce the likelihood of missing a transit connection and incurring a 30-minute trip delay.

The Preferred Alternative would also improve travel time for trips involving FrontRunner commuter rail. For a typical transit trip from downtown Salt Lake City to BYU, the Preferred Alternative would reduce the travel time by 16 percent, from 1 hour and 20 minutes to 1 hour and 7 minutes (Phase I). The travel time on FrontRunner from Salt Lake City to the Orem Intermodal Center, a distance of 40 miles, is estimated to be 47 minutes. The time to travel the remaining 5 miles from the Orem Intermodal Center to BYU on the current bus route would be more than 33 minutes (assuming average connection time is half of headway time). The Preferred Alternative would reduce the travel time from the Orem Intermodal Center to BYU to 20 minutes. The total Preferred Alternative trip time from Salt Lake City to BYU would be 1 hour and 7 minutes, compared to 56 minutes by car.

Multi-Modal Connectivity Across I-15 and from I-15 to Orem and Provo

The Preferred Alternative would provide a much needed multi-modal connection across I-15 and a connection from I-15 to Orem and Provo. The proposed high-occupancy/toll (HOT) interchange at 800 South would provide a critical link across I-15 for autos, transit, cyclists, and pedestrians. It would also serve as an alternative to the congested University Parkway Single Point Urban Interchange. The University Parkway Single Point Urban Interchange is approximately one-half mile south of the proposed interchange and is projected to be 50 percent over capacity in 2030. It is used to access UVU and the commercial corridor of Orem. It is also a major corridor to Provo and BYU. The Preferred Alternative would reduce volumes on the University Parkway interchange southbound off-ramp, one of the more critical movements, by approximately 12 percent during the peak hour. The proposed interchange would reduce congestion directly east and west of I-15 along University Parkway.

The new interchange would connect existing residential and commercial uses to a regional transit system at the Orem Intermodal Center, improving accessibility region-wide. The addition of the exclusive BRT bus lanes on 800 South and the direct connection to the Orem Intermodal Center would also improve transit reliability for the Preferred Alternative. Buses would no longer have to wait in traffic on University Parkway.

The Preferred Alternative would also improve bicycle and pedestrian connections to the Orem Intermodal Center, avoiding the University Parkway interchange and other circuitous routes. For example, a typical bicycle or pedestrian trip from the Orem Intermodal Center to the UVU campus on the east side of I-15 is over 2 miles and involves a circuitous route, navigating the University Parkway interchange and multiple road crossings. The new interchange would reduce that distance to approximately one-half mile.

Cost

The total project capital cost, including Phase I and Phase II, is approximately $297 million (Lochner 2010b). The capital cost for the Phase I project is approximately $177 million, and the capital cost for the Phase II project is approximately $120 million. Costs for the Enhanced Bus Alternative and the Preferred Alternative (Phase I) are shown in Table 5-4: Cost Comparison. There are no new costs for the No-Action Alternative.

Table 5- 4: Cost Comparison*

	Enhanced Bus Alternative	Preferred Alternative (Phase I)
Roadway Capital Cost	$0	$21 million
Transit Capital Cost	$17 million	$156 million
Total Phase I Capital Cost	**$17 million**	**$177 million**
Annualized Capital Cost	$1,6 million	$10.9 million
Annual Operating Cost	$4.2 million	$8.5 million
Total Annualized Costs	$5.8 million	$19.4 million
**Capital costs are presented in Year of Expenditure dollars, assumed to be 2013.*		
Source: Lochner, Provo-Orem Bus Rapid Transit Compiled Cost Estimates, 2010		

5.3 ENVIRONMENTAL IMPACTS

The environmental impacts of the Preferred Alternative are summarized in Table 5-5: Environmental Impacts of the Preferred Alternative. The No-Action Alternative and Enhanced Bus Alternative would have little to no environmental impacts.

Table 5- 5: Environmental Impacts of the Preferred Alternative

Resource	Impact
Economic	The Preferred Alternative would attract TOD investment.
Community Character and Cohesion	The Preferred Alternative would result in improved transportation accessibility and pedestrian connections, and increased traffic volumes on some local roads near the 800 South interchange.
Environmental Justice	No impact because minority and low-income populations are distributed throughout the study area and are not concentrated in certain neighborhoods.
Land Use and Zoning	The Preferred Alternative would attract redevelopment and TOD investment near stations. The new interchange could change land use from residential to commercial near 800 South.
Land Acquisition, Displacements, and Relocations	The Preferred Alternative would result in 126 partial acquisitions and 16 full acquisitions (10 residential relocations, three industrial relocations, one UVU structure relocation, one agricultural relocation, and one vacant lot).
Historic Properties	The Preferred Alternative would result in no *adverse effects* to 22 historic properties, one historic district, and four archaeological and linear historic resources.
Paleontological Resources	No impact
Visual Quality	Improvements are consistent with the urban landscape, so overall impacts would be minor. Viewshed for residences near the 800 South interchange would be affected, and mature trees and landscaping would be impacted in some locations.

Table 5-5: Environmental Impacts of the Preferred Alternative (cont'd)

Resource	Impact
Parks and Recreation Resources	The Preferred Alternative would result in minor impacts to two existing parks, one planned park, and two existing separated trails (College Connector Trail and Provo River Trail).
Air Quality	The project would not create or contribute to any new or existing carbon monoxide (CO) or PM_{10} violations of the National Ambient Air Quality Standards (NAAQS) and conforms to the purpose of the regional State Implementation Plan.
Noise and Vibration	The Preferred Alternative would result in 121 moderate noise impacts and 10 severe noise impacts (FTA Category 2) and six moderate impacts (FTA Category 3) (assuming the construction of three noise barriers), based on FTA noise criteria. There would be no vibration impacts.
Biological Resources	The Preferred Alternative would impact 3.7 acres of wetlands. Of those, 0.23 acres would be impacted near the Provo River in Phase I. The remaining wetland impacts would occur as part of Phase II. Minimal impacts to wildlife and aquatic habitat are expected.
Water Resources	There are potential minor impacts to the Provo River, canals, and water quality.
Hazardous Materials	Four UST sites are located directly adjacent to the proposed corridor, and therefore could pose a contamination risk during construction.
Utilities	Approximately 65 utility lines would require relocation outside of the project corridor, and 19 utility lines would require protection during construction.
Energy and Mineral Resources	No impact
Public Safety and Security	No impact
Travel Patterns, Accessibility, and Parking	Accessibility for autos, transit, pedestrians, and cyclists would be improved across I-15; one at-grade railroad crossing would be eliminated at 800 South in Orem; pedestrian accessibility at stations would be improved; some on-street parking would be eliminated on University Avenue; left turn movements would be prohibited along 900 East, 700 North, and University Avenue in Provo; and 1370 West in Orem would be a dead-end at 800 South.
Construction Impacts	Construction of the Preferred Alternative may cause temporary minor impacts to air quality, noise levels, water, hazardous materials, business access, and traffic.
Cumulative Impacts	No impact
Section 4(f)	Hillcrest Park, four archaeological sites, 22 historic buildings, and the Provo Downtown Historic District would be subject to a *de minimis* use by the Preferred Alternative. Temporary occupancy of Carterville Park and the Provo River Trail will occur during construction.

5.4 FTA SMALL STARTS CRITERIA

The Provo-Orem Bus Rapid Transit Project is a multi-modal project that addresses transit and roadway infrastructure needs. UTA intends to request funding for the Phase I transit improvements under FTA's Section 5309 Small Starts program. Qualifying requirements for the Small Starts program are shown in Table 5-6: Small Starts Project Qualifications. A more detailed description of the Small Starts program is given in Chapter 1: Purpose and Need.

Table 5-6: Small Starts Project Qualifications

Small Starts Requirement	Provo-Orem Bus Rapid Project, Phase I Transit
The total project cost must be less than $250 million with no greater than $75 million requested in Section 5309 grant funding	✓ Total transit cost is an estimated $156 million (year of expenditure) ✓ Section 5309 funding request will be $75 million
The project must be a fixed guideway for at least 50% of the project length, and/or	✓ Exclusive lanes are proposed for 53% of the alignment
Be a corridor-based bus project with the following minimum elements:	
Substantial transit stations	✓
Signal priority for bus	✓
Low floor/level boarding vehicles	✓
Special branding of service	✓
Service offered at least 14 hours per day	✓

FTA rates projects applying for Small Starts annually. Evaluation criteria include local financial commitment and FTA's project justification criteria. The project justification criteria include cost-effectiveness, land use, and other factors. FTA proposed new funding guidelines in January 2010; the guidelines state that criteria will also include livability issues such as economic development opportunities and environmental benefits.

Based on a preliminary evaluation of the project according to FTA's Updated Interim Guidance and Instructions for Small Starts (dated June 2007), the ratings shown in Table 5-7 could be expected for the Provo-Orem Bus Rapid Transit Project.

Table 5-7: Preliminary Small Starts Ratings

Criteria	Provo-Orem Bus Rapid Project, Phase I Transit
Local Financial Commitment FTA will assign a rating of *High* if:	High
1. Small Starts share is no greater than 50%	✓ Federal Small Starts share is proposed at 48%; see Chapter 6: Financial Plan
2. Project has a reasonable plan to secure funding for the local share of capital costs	✓ Refer to Chapter 6
3. The additional operating and maintenance cost to the agency is less than 5% of the agency's operating budget;	✓ Refer to Chapter 6
4. The agency is in reasonably good financial condition.	✓ Refer to Chapter 6

Table 5-7: Preliminary Small Starts Ratings (cont'd)

Criteria	Provo-Orem Bus Rapid Project, Phase I Transit
Land Use	Not Rated
Cost-Effectiveness	$7,22
Other Factors	Not Rated

Based on the above preliminary evaluation, it is expected that the project will attain at least a "medium" rating. A medium rating or higher is required to proceed to the next phase of the Small Starts process (Project Development).