APPENDIX I:

[FIXED-GUIDEWAY TRANSIT FEASIBILITY]
Appendix I. Fixed-Guideway Transit Feasibility
Jackson/Teton County Integrated Transportation Plan

Introduction
This appendix provides a description and brief evaluation of the potential feasibility of various high-capacity, fixed-guideway transit modes for service in Teton County. The current transit mode operating in the region (Bus in Mixed Traffic) is compared with seven high-capacity transit modes that are common to North America public transit systems.

A brief description of each of these transit modes follows.

High Capacity Transit Modes

Bus in Mixed Traffic. This includes urban buses, commuter buses and shuttles. Buses operate in the general traffic stream, stopping at curb-side bus stops and at transit centers. Operations are significantly affected by roadway congestion. This is the transit mode in use in Jackson and Teton County today, operated by START. A wide range of power options are available, but most bus fleets in rural North America operate with either diesel or CNG internal combustion engines. This mode reaches its peak capability where there is a combination of commuter, corridor and circulator routes operating at the highest frequencies feasible on congested streets. Examples: in service everywhere except small rural places.

Enhanced Bus. This term is used to describe measures implemented to improve bus travel times and ridership. These measures may include dedicated bus (“queue-jumper”) lanes at congested intersections, bus priority signal timing at intersections, improved bus pullout bays, and bus passenger transfer facilities. Power options are the same as for the Bus in Mixed Traffic mode. Examples: most major urban transit agencies have implemented at least some Enhanced Bus route improvements. Examples in the West include Seattle, Portland, San Francisco, Boulder and Denver.

Bus Rapid Transit (BRT). Although there is variability in the types of BRT systems operating in North America, common elements include provision of exclusive lanes for buses for some or all of the routes, higher capacity bus vehicles, a range of intersection prioritization measures, stations that resemble rail stations in design, and external fare collection systems to speed boarding. At the higher end of this mode, buses operate on exclusive lanes that are either grade separated or barrier-protected from the general traffic stream. The same power options are available as for the other bus modes. Examples include Eugene (Oregon), Roaring Fork Transit Authority (Aspen – Glenwood Springs, Colorado), and Flagstaff (Arizona).
Streetcars. Also referred to as trolleys or trams, streetcars are equipped with steel wheels that roll on steel rails (“steel-on-steel”) and are powered by overhead electric lines feeding electric motors. Most streetcars operate independently rather than in train sets, although there are exceptions. This is the oldest mode described here and was in service before development of the internal combustion engine. Some systems use modern vehicles while others have traditionally-themed cars. Most streetcar lines in North America operate on streets in mixed traffic and run at relatively low speeds (10 to 20 mph). Both low- and high-floor vehicles are currently in use, but most modern streetcars have low floors that eliminate the need for elevated platforms. Examples include Portland, San Francisco, Seattle, Tucson, and Houston.

Light Rail Transit (LRT). LRT systems were uncommon in the U.S. as recently as 1980. Now there are dozens of new and upgraded systems operating in cities across the country. LRT is a modern version of streetcar lines, but light rail vehicles (LRVs) are larger and capable of higher speeds. Most versions of this technology allow for entraining multiple vehicles to allow increases in capacity as needed. LRT systems are powered by overhead electric wires feeding electric motors. Most LRT lines are grade-separated at street crossings and corridors are reserved exclusively for LRV use, although in downtown settings there may be at-grade crossings. Line speeds can range up to 55 mph. Examples include: Portland, Seattle, San Francisco, Denver, and Salt Lake City.

Commuter Rail. Commuter rail systems are found in major urban regions, where they carry commuters from distant suburban areas into dense downtowns. These are heavy rail systems and often operate in mixed traffic with freight and intercity passenger rail. Rail cars are entrained in multiple sets and are much larger than most LRVs. Powering systems include overhead electric wires feeding electric motors and diesel-powered locomotives. With only rare exceptions, commuter rail lines operate in exclusive corridors and are not mixed with motor vehicle traffic. At-grade motor vehicle crossings are more common in the U.S. than grade separations. Most commuter rail lines in the U.S. use high-floor vehicles that are boarded via steps, with lifts for disabled persons access. Line speeds can range up to 90 mph, but most operate at 35 to 55 mph. Examples include: all of the major coastal California cities, Denver, Chicago and Miami.
Metro Rail. The term “Metro Rail” is used to describe a broad category of high-speed, high-capacity, steel-on-steel rail systems, including subways. Most heavy rail systems are powered by alternating current electricity through “third rail” connections that must be isolated to protect passengers from electrocution. Metro rail vehicles are large and their corridors are reserved exclusively for their use. Metro rail lines are either elevated or buried below grade, or both, and do not allow at-grade motor vehicle crossings. Line speeds can range up to 75 mph, but most operate at 25 to 55 mph. Vehicles are high-floor and require boarding platforms. Examples include: BART in the Bay Area, MARTA in Atlanta, Metra in Chicago, and Metro in Washington, D.C.

Aerial Tramway. These systems are well-known in the West because they are used by ski resorts. Urban or public transit examples, however, are uncommon in the U.S. There are two basic technologies: trams, which have two vehicles affixed to a cable that alternate back and forth like elevators, and gondolas, which rotate multiple vehicles in a one-directional loop. Jackson Hole Mountain Resort has both a tram and a gondola. Aerial trams can operate at up to 25 mph, but gondolas are slower, with detachable gondolas reaching 15 mph. Public transit examples in North America include the Portland (Oregon) aerial tram and the Mont-Tremblant Cabriolet gondola (Quebec).

Feasibility
The feasibility of successfully implementing high-capacity transit modes is determined by a combination of many factors, the most important of which are: capital cost, ridership capacity, terrain (grade), and context. Table I.1 on the next provides summary information for each of the eight transit modes described above.

The Bus in Mixed Traffic mode reaches peak capacity in heavily-traveled corridors at about 500 passengers per hour in the peak direction. Achieving this level requires larger, articulated vehicles (90 passengers) operating at 10 minute frequencies. There are double-decker and bi-articulated buses in some European cities with capacities up to 200 passengers, but such vehicles are not generally available and present significant feasibility issues in the U.S.

Bus in Mixed Traffic service frequencies ("headways") below 10 minutes are difficult to achieve in mixed traffic. Mountain Express, which operates between Crested Butte and Mt. Crested Butte (Colorado) has surmounted this barrier by “platooning” two buses on each run during peak season/peak hour in the peak direction. Peak ridership on START service today between Jackson and Teton Village reaches about 450 passengers during ski season, so this service is operating at close to feasible capacity for this mode.
Table I.1 High-Capacity Transit Mode Comparison

<table>
<thead>
<tr>
<th>MODE</th>
<th>CAPACITY (passengers per hour per direction)</th>
<th>CAPITAL COST ($millions per route mile)</th>
<th>TERRAIN (maximum grade)</th>
<th>CONTEXT</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUS IN MIXED TRAFFIC</td>
<td>Up to 500</td>
<td>$0.5 - $1.5</td>
<td>15%</td>
<td>All</td>
</tr>
<tr>
<td>ENHANCED BUS</td>
<td>Up to 750</td>
<td>$1 - $5</td>
<td>15%</td>
<td>Busy arterial corridors</td>
</tr>
<tr>
<td>BRT</td>
<td>Up to 2,500</td>
<td>$10 - $30</td>
<td>15%</td>
<td>Heavily-traveled arterial corridors</td>
</tr>
<tr>
<td>STREETCAR</td>
<td>Up to 1,500</td>
<td>$30 - $80</td>
<td>5%</td>
<td>Urban streets</td>
</tr>
<tr>
<td>LRT</td>
<td>Up to 3,600</td>
<td>$50 - $150</td>
<td>8%</td>
<td>Metro areas over 1 million population</td>
</tr>
<tr>
<td>COMMUTER RAIL</td>
<td>Up to 20,000</td>
<td>$15 - $100</td>
<td>1.5%</td>
<td>Major metro regions (&gt; 5 million) with large, dense downtowns</td>
</tr>
<tr>
<td>HEAVY RAIL</td>
<td>Up to 25,000</td>
<td>$100 - $600</td>
<td>5%</td>
<td>Metro regions (&gt;2.5 million population)</td>
</tr>
<tr>
<td>AERIAL TRAMWAY</td>
<td>Up to 4,000</td>
<td>$5 - $50</td>
<td>Almost vertical</td>
<td>Steep grade settings</td>
</tr>
</tbody>
</table>

Figure I.1 below shows general ranges of transit mode feasibility based on transit ridership. This is measured in terms of the peak hour, peak direction highest expected ridership. Methodologies for this vary, but FTA recommends calculating it for the average annual weekday unless there are significant seasonal peaks (which there are in Jackson).
In Figure 1.1, the lower end of the indicator for each mode is minimum ridership required for cost feasibility and the upper end is maximum capacity. The line in between indicates the range of feasibility for that mode. These are generalized estimates. More precise estimates would use passengers per route mile, but the relationships would be the same.

**Figure I.1. Transit Mode Feasibility Based on Ridership**

This Integrated Transportation Plan calls for development of BRT service between Jackson and Teton Village, if possible before 2024 and definitely by 2035. An Enhanced Bus intermediate step would be feasible but care must be taken to avoid losing access to the WY-22 lanes needed for BRT. Streetcar makes no sense, given the specific needs in Jackson Hole. LRT, Commuter Rail, and Metro Rail are clearly infeasible. An Aerial Tramway between the airport and Teton Village might be technically feasible, but would face daunting environmental barriers, private property owner opposition, and funding challenges.