





PEORIA MULTI-MODAL TRANSPORTATION PLAN

High Capacity Transit Alternatives

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HIGH CAPACITY TRANSIT ALTERNATIVES

INTRODUCTION

This document presents an overview of the six HCT alternatives that have been developed to potentially extend HCT service to Peoria. These six alternatives are:

- L1 LRT from downtown Glendale via Grand Avenue
- L2 LRT from Westgate Center via 91st Avenue
- B1 BRT from 19th Street at Montebello Avenue via Grand Avenue
- B2 BRT from Westgate Center via 91st Avenue
- B3 BRT from Northwest Extension via Dunlap Avenue
- B4 BRT from Northwest Extension via Peoria Avenue

All six alternatives would operate to Old Town Peoria from either a currently planned or potential LRT extension (the Northwest Extension or one of the potential Glendale extensions). From Old Town, all six alternatives would follow a common alignment to the planned Arrowhead Transit Center via 83rd Avenue and the Peoria Sports Complex.

DEFINITION OF HCT/MODES EXAMINED

High capacity transit is defined by its function: to carry high volumes of passengers quickly and efficiently from one place to another. Other defining characteristics of HCT include the ability to bypass traffic and avoid delays by operating in exclusive or semi-exclusive rights of way, faster overall travel speeds due to wide station spacing, frequent service, transit priority street and signal treatments, and premium station and passenger amenities.

Transit modes that are most frequently associated with HCT are light rail, urban streetcar, bus rapid transit (BRT), and commuter rail. MAG's Transit Framework Study further categorizes HCT as "HCT Peak Period," which focuses primarily on providing peak period commuter service, and "HCT All Day," which provides all day, seven day a week service that serves a wide variety of trip purposes in high volume corridors.

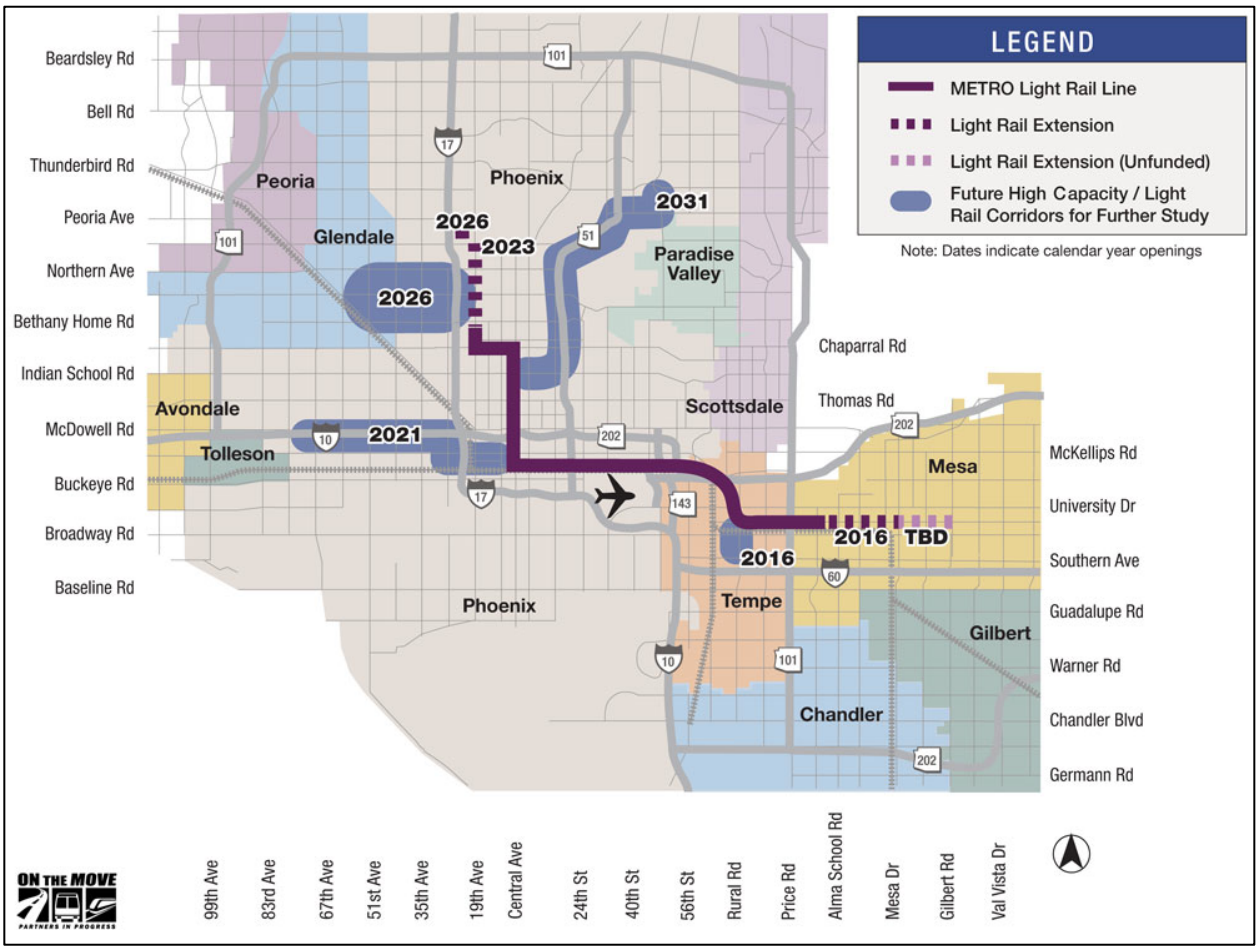
Of the four modes most commonly defined as HCT, urban streetcar is designed to serve medium to large densely developed downtown areas, which for the foreseeable future, Peoria will not have. A second mode, commuter rail, is being examined in MAG's Commuter Rail System Study. One of the most promising lines being examined in that study is along Grand Avenue between Wickenburg and downtown Phoenix via Peoria. This document examines the remaining two modes, which are light rail and BRT.

LIGHT RAIL ALTERNATIVES

To be most effective, light rail would need to be developed as part of the METRO system. At present, this system operates between Mesa and Phoenix via downtown and midtown Phoenix. A number of extensions to the line are planned, but due to recession-related declines in Prop 400 revenues, have been delayed a number of times (see Figure 1). The most relevant of these for Peoria are the:

- The Northwest Extension, which would extend the northern end of the existing line northward to the vicinity of Peoria Avenue at I-17. This extension would be constructed in two phases. The first would be along 19th Avenue to Dunlop Avenue, which is now scheduled for completion in 2023. The second phase to Peoria Avenue is now scheduled for completion in 2025.
- The currently programmed Glendale extension, which would branch off of the Northwest extension along or near Glendale Avenue to downtown Glendale. This extension is now scheduled for completion in 2026.

Figure 1: METRO Light Rail: Existing Service and Planned Extensions

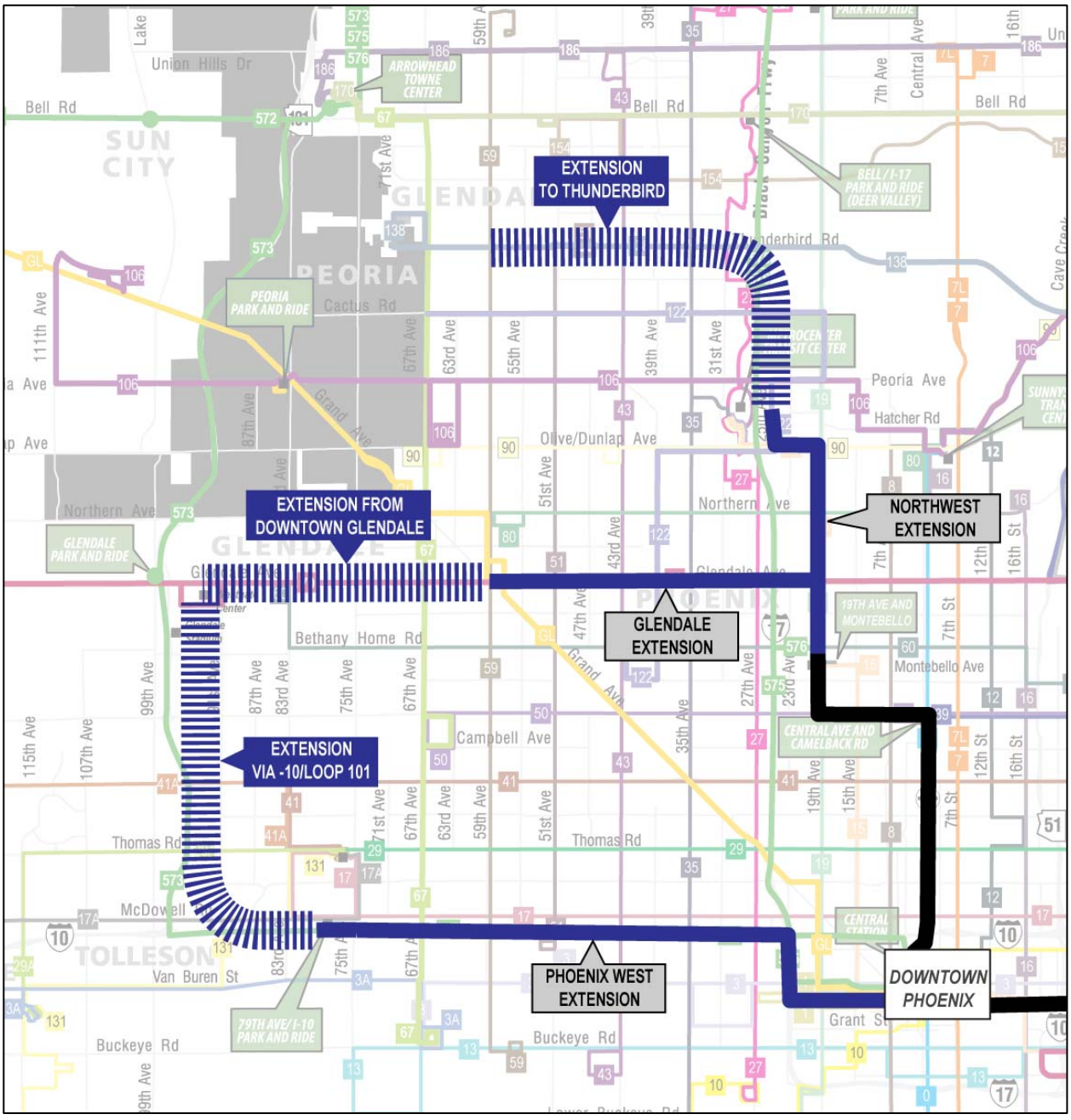


However, due to the construction of the Westgate Center and sports areas in that area, development along Loop 101, and development opportunities in downtown Glendale, Glendale

has begun to reassess its light rail options. Initially it considered three alternative services (see Figure 2):

1. An extension from the end of the Northwest extension to Thunderbird Road, and then along Thunderbird Road into Glendale.
2. A longer extension of the currently programmed Glendale extension along Glendale Avenue to the Westgate Center.
3. An extension of the Phoenix West extension to Westgate Center via I-10 or Thomas Road and 91st Avenue or Loop 101.

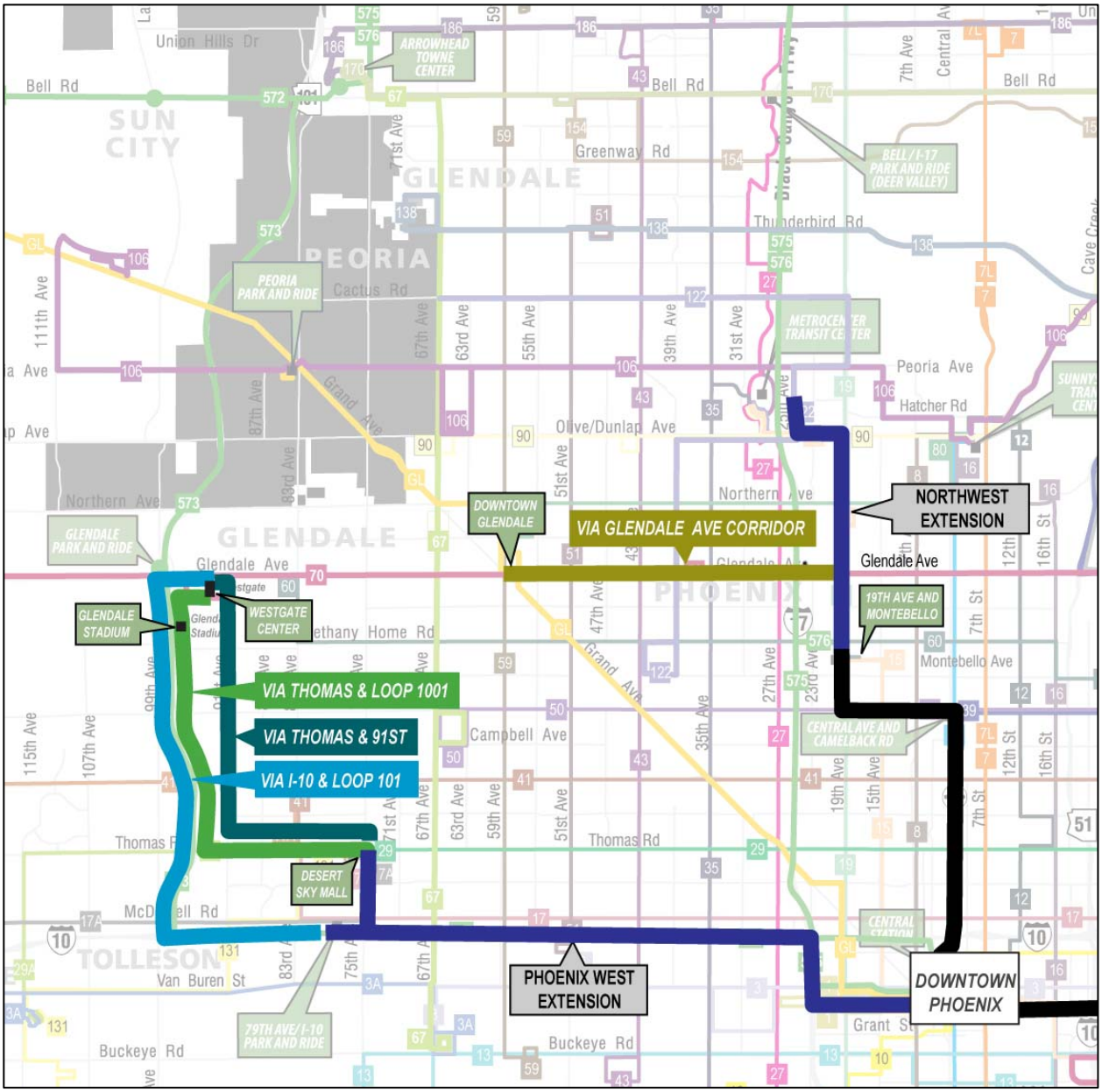
Figure 2: Glendale Extension Initial Options



Of these initial options, the first two, which were the options that would bring service closest to Peoria, were eliminated because they would not perform well. Now, with the first two options eliminated, the focus of the Glendale extension study is now to compare the relative merits of the currently programmed Glendale extension to those for the "I-10/Loop 101" corridor that would extend service to Westgate Center via the end of the Phoenix West extension. To date, three different alternative alignments have been developed for the I-10/Loop 101 corridor (see Figure 3), which are:

- Via I-10 and Loop 101.
- Via Thomas Road and Loop 101.
- Via Thomas Road and 91st Avenue.

Figure 3: Glendale Extension Short-List Options



In addition, alternative alignments will be examined for the Glendale Avenue corridor extension. These could be as far north as Northern Ave or as far south as Bethany Home Road, but would still run east-west between the Northwest Extension and downtown Glendale.

For the purposes of light rail service to Peoria, the decisions that have been made to date help to narrow options. The decisions made by Glendale not to pursue service to Thunderbird Road or west of downtown in the Glendale Avenue corridor indicate that it is unlikely that Glendale would partner with Peoria for service through those areas. In a similar manner, the decision to further examine options to downtown Glendale and Westgate indicate that those two locations would be logical starting points for light rail service to Peoria.[1]

In terms of potential alignments through Peoria, the most densely developed areas of Peoria are projected to be in selected areas generally along 83rd Avenue and Loop 101. As described in previous work, Peoria will need to take steps to concentrate development to make HCT feasible, but if this is done, the 83rd Avenue and Loop 101 corridors would be logical corridors. Also, in the same manner as for local service options, connections to the rest of the Phoenix metro area will be important, and the best places to make those connections will be at the planned Old Town Transit Center and Arrowhead. Arrowhead would also be a logical northern terminal, at least until development intensifies further north. In this respect, potential options would be:

- L1 LRT from downtown Glendale via Grand Avenue
- L2 LRT from Westgate Center via 91st Avenue

In general terms, these potential options would be as described in the following sections. More detailed information on specific alignment options would be developed subsequently.

L1 LRT FROM DOWNTOWN GLENDALE VIA GRAND AVENUE AND 83RD AVENUE

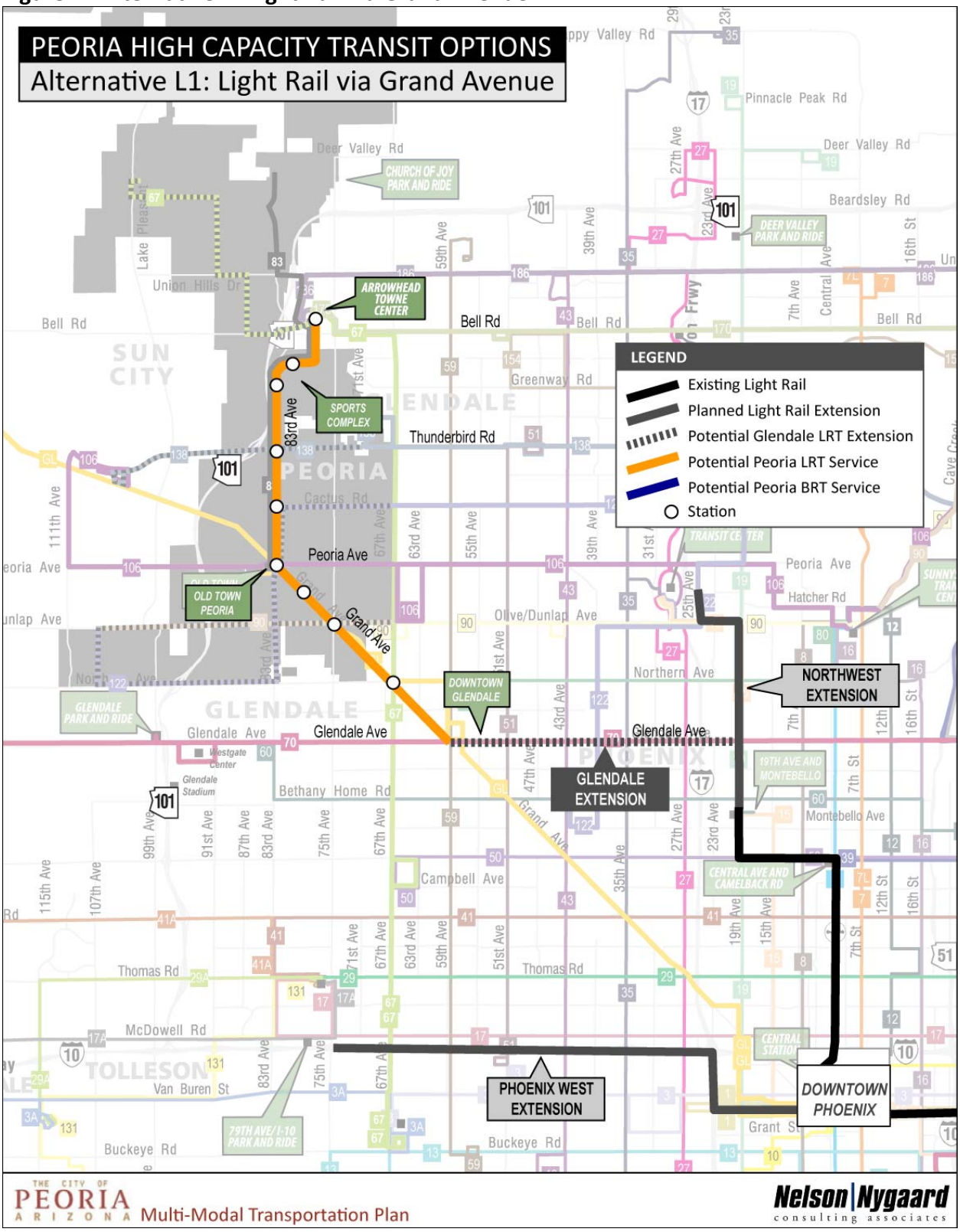
This light rail alternative, which would be dependent upon the development of the Glendale Extension to downtown Glendale, would run from downtown Glendale to Arrowhead Town Center via Grand Avenue, Old Town, 83rd Avenue, and the Peoria Sports Complex (see Figure 4).

Alignment

Alternative L1's alignment, and key characteristics of the alignment would be as follows:

[1] A third conceivable starting point for light rail to Peoria could be the northern terminus of the Northwest Extension, near Peoria Avenue at I-17. However, prior work has indicated that the crossing of I-17 would be prohibitively expensive, and thus a light rail extension from the Northwest Extension was dropped from consideration.

Figure 4: Alternative L1 Light Rail via Grand Avenue



Downtown Glendale – Old Town Peoria

From Downtown Glendale, LRT would use local streets (which would need to be identified based on the location of the downtown Glendale LRT station), to the northern side of Grand Avenue. It would then run in an exclusive right-of-way parallel to the north side of Grand Avenue through to Old Town Peoria.[2]

This alignment would likely require land acquisition along most of its length. However, most of this land is currently undeveloped, or underutilized, and so impacts on existing uses could be relatively minor.

Old Town Peoria

In Old Town, service would operate consistent with the plans previously developed for an Old Town Transit Center to Peoria Avenue/83rd Avenue.

LRT would operate in the center of Peoria Avenue in front of the Zocalo Mall. This section of Peoria Avenue has a six-lane cross section that currently consists of four through lanes and up to two left-turn lanes. However, the roads in this area will be reconfigured, and could presumably be reconfigured in a manner that would accommodate light rail.

Old Town to Peoria Sports Complex

The primary alignment between Old Town and the Peoria Sports Complex would be along 83rd Avenue. Most of this roadway has two through travel lanes in each direction and a center left-turn lane. The operation of LRT on this roadway would require that the number of through travel lanes be reduced to one in each direction, or that the roadway be widened. It would also impact left-hand turns at many locations. The Skunk Creek Bridge would also need to be assessed to determine whether it could accommodate light rail.

If a commuter rail station and/or park and ride lot is developed near Loop 101, then an alternative alignment that would serve that location would be for LRT to continue from Old Town in an exclusive right-of-way to the vicinity of 91st Avenue and then north to Cactus Road. It would then operate east along Cactus Road to rejoin the 83rd Avenue alignment. This alignment would be more circuitous than the 83rd Avenue alignment. However, the impacts of developing an exclusive right-of-way north of Old Town would be similar to those south of Old Town, and the impacts of operating on Cactus Avenue would be similar to those on 83rd Avenue.

Peoria Sports Complex – Arrowhead Transit Center

Between the Peoria Sports Complex and the Arrowhead Transit Center, service would operate along 83rd Avenue, Paradise Lane, and 77th Avenue. Approaching the Sports Complex, 83rd Avenue widens to three travel lanes in each direction, with a center left-turn lane. Paradise Lane and 77th Avenue are both two lanes in each direction, with only a limited number of additional lanes at some intersections.

[2] Initial options for extending LRT from downtown Glendale included of one that would operate west on Glendale Avenue to 83rd Avenue. However, crossing Grand Avenue and the BNSF rail line would be difficult and expensive, and thus was dropped from consideration.

In this area, it is likely that widening would be needed on some or all of each of the three roadways. However, this area will be reconfigured as part of the city's Sports Complex development plans, and most roads are fronted on at least one side by parking lots. As a result, the widening of these roadways should not present major obstacles.

Station Locations

In the Phoenix area, outside of downtown Phoenix, light rail stations are generally spaced approximately one mile apart. Using this general spacing, potential station locations, from south to north, would be:

Downtown Glendale – Old Town Peoria

- 67th Avenue, with parking (near Grand Avenue and Northern Avenue, and primarily as a park and ride location).
- Olive Avenue, with parking (near Grand Avenue and 75th Avenue, and primarily as a park and ride location).

Old Town Peoria

- Old Town Peoria Transit Center at or near 83rd Avenue and Peoria Avenue.

Old Town to Peoria Sports Complex

- 83rd Avenue at Cactus Road.
- 83rd Avenue at Thunderbird Road.

Peoria Sports Complex – Arrowhead Transit Center

- 83rd Avenue at Stadium Way.
- Paradise Lane near 77th Avenue.
- Arrowhead Transit Center

Service Levels

Peoria light rail service would operate in the same manner as existing Valley METRO service, with spans of service and service frequencies as shown in Table 1.[3]

Travel Times

Alternative L1 light rail service would average approximately 35 mph in an exclusive right-of-way along Grand Avenue and 17 mph in other areas. With these speeds, travel times would be 17 minutes between Arrowhead and Old Town, and 25 minutes along the entire length between downtown Glendale and Arrowhead.

[3] These service levels are those that were in effect before the July 26, 2010 service reductions. It is assumed that these service levels will be restored once economic conditions improve.

Table 1: Alternative L1 Spans of Service and Headways

	Begin	End	Headway
Weekdays			
Monday - Thursday			
Early AM	4:40	6:00	20
Day	6:00	19:00	10
Evening/Night	19:00	23:00	20
Friday			
Early AM	4:40	6:00	20
Day	6:00	19:00	10
Evening/Night	19:00	26:00	20
Saturday			
Early AM	5:00	6:00	20
Day	6:00	19:00	15
Evening/Night	19:00	26:00	20
All Day			
Sundays			
All Day	5:00	23:00	20

This alternative would provide the fastest travel times to and from downtown Phoenix, at 44 minutes from Old Town, and 69 minutes from Arrowhead.

TOD Opportunities

As described in the "High Capacity Transit Development Issues" document, higher density development will be needed to produce the travel volumes that would be needed to make HCT feasible. A number of undeveloped "islands" exist along this alignment that could be developed in a transit-oriented manner to support HCT. These include:

Downtown Glendale – Old Town Peoria
A large number of undeveloped parcels exist along Grand Avenue. However, the high-speed nature of Grand Avenue, the presence of the BNSF tracks, and many industrial uses, indicates that there would not be any significant opportunities for TOD along this segment.

Old Town Peoria
The Old Town Revitalization Plan envisions the types of TOD that would support HCT.

Old Town to Peoria Sports Complex
There are a number of undeveloped parcels in the vicinity of the intersection of 83rd Avenue and Thunderbird Road. In addition, there may be opportunities to redevelop some of the already developed parcel in a more transit-oriented manner.

Peoria Sports Complex – Arrowhead Transit Center
The planned development of the Sports Complex district provides very strong opportunities for TOD that would support HCT.

L2 LRT FROM WESTGATE CENTER VIA 91ST AVENUE AND 83RD AVENUE

If LRT is extended into Glendale via I-10 to the Westgate Center, then LRT to Peoria would be extended from that location, along 91st Avenue and 83rd Avenue (see Figure 5).

Alignment

L2's alignment, and key characteristics of the alignment, would be as follows:

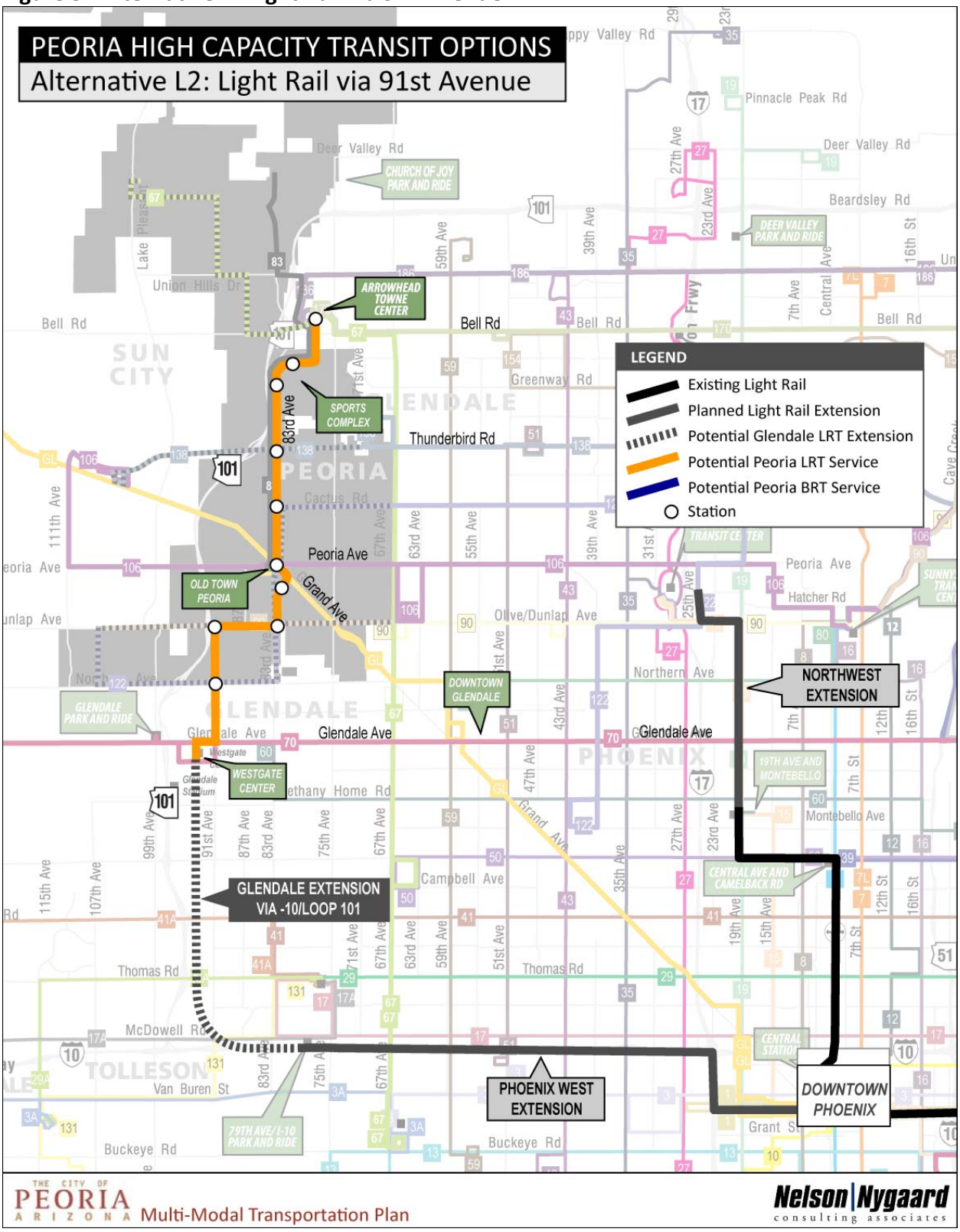
Westgate Center – Old Town Peoria
From the Westgate Center, LRT would operate to Old Town north on 91st Avenue, east on Olive Avenue, north on 83rd Avenue, in an exclusive right-of-way parallel to Cotton Crossing, and then via an aerial (or underground) crossing of Grand Avenue and the BNSF tracks. Key considerations include:

- Between Glendale Avenue and Olive Avenue, 91st Avenue has a cross section that varies from two to four lanes, with some wider intersections. Thus, 91st Avenue would need to be widened to accommodate light rail.
- Olive Avenue currently has two travel lanes in each direction plus a center left-turn lane. However, setbacks along Olive Avenue indicate that the additional right-of-way would be available to widen the road to accommodate light rail.
- Between Olive Avenue and Cotton Crossing, 83rd Avenue is generally two lanes, but with some much wider sections (that are still striped to two lanes). As with Olive Avenue, setbacks indicate that additional right-of-way would be available to widen the road to accommodate light rail.
- Along Cotton Crossing, light rail would operate in an exclusive right-of-way parallel to Cotton Crossing, and the land adjacent to Cotton Crossing is currently vacant.
- Between Cotton Crossing and the Old Town Transit Center, light rail would need to travel over or under Grand Avenue and the BNSF tracks. An overcrossing with sufficient vertical clearance (23' 4") would need to be over 1,000 feet long. A tunnel would reduce visual impacts, but with the planned depression of Grand Avenue, would need to be below that and even longer.

Old Town Peoria
In Old Town, service would operate consistent with the plans previously developed for an Old Town Transit Center to Peoria Avenue/83rd Avenue. The roads in this area will be reconfigured, and could presumably be reconfigured in a manner that would provide the needed space to accommodate light rail.

Old Town to Arrowhead Transit Center
Alternative L2 would operate between Old Town and the Arrowhead Transit Center in the same manner as Alternative L1, and impacts and implications would be the same as for that alternative.

Figure 5: Alternative L2 Light Rail via 91st Avenue



Station Locations

Potential station locations, from south to north, would be:

Peoria/Glendale Line – Old Town Peoria

- 91st Avenue at Northern Avenue.
- 91st Avenue at Olive Avenue
- 83rd Avenue at Olive Avenue
- Cotton Crossing at 83rd Avenue.

Old Town Peoria, and Old Town Peoria to Arrowhead Transit Center.

- Same as Alternative L1.

Service Levels

Service levels would be the same as presented above for Alternative L1.

Travel Times

Alternative L2 light rail service would average approximately 17 mph along the entire alignment. At this speed, travel times would be 17 minutes between Arrowhead and Old Town, and 32 minutes along the entire length between Westgate Center and Arrowhead.

Travel times to downtown Phoenix would be significantly longer than with Alternative L1, at 68 minutes from Old Town, and 85 minutes from Arrowhead. These longer travel times would be due to the more circuitous north-south to east-west alignment.

TOD Opportunities

As described in previous work, higher density development will be needed to produce the travel volumes that would be needed to make HCT feasible. A number of undeveloped "islands" exist along this alignment that be developed in a manner that could support HCT. TOD opportunities along the corridor include:

Westgate Center – Old Town Peoria

Alternative L2 would operate via the intersections of 91st Avenue and Olive Avenue (near Loop 101) and Olive Avenue and 83rd Avenue. There are a large number of undeveloped, or underdeveloped parcels, in the vicinity of both intersections that would provide the potential for TOD.

Old Town Peoria, and Old Town to Arrowhead Transit Center

Alternative L2 would operate between Old Town and the Arrowhead Transit Center in the same manner as Alternative L1, and TOD opportunities would be the same as for that alternative.

BRT OPTIONS

In the Phoenix area, arterial BRT service, called Valley Metro LINK, is provided in Mesa between Sycamore Station at the eastern end of the light rail line and Superstition Springs Center, largely along Main Street. (A more detailed description of BRT is provided in Attachment A.) A second line is currently under construction that will operate between Sycamore Station and Chandler, largely along Arizona Avenue. Both of these services are designed to act as an extension of the light rail system.

In a similar manner, arterial BRT could be developed between Peoria and a western light rail station. This type of service could be provided as an alternative or as a precursor to extending light rail to Peoria. Furthermore, in the shorter-term, BRT could be developed between Peoria and an existing light rail station. Then, if light rail is extended northward and/or into Glendale, the BRT service could be shortened to provide connections to a closer station.

Through 2023, when Phase 1 of the Northwest Extension will be constructed, the closest light rail station to Peoria will be the northern terminus at 19th Avenue and Montebello Avenue. The development of BRT between this station and Peoria would be similar to the light rail alignments between downtown Glendale and Peoria, except that they would also include service between 19th Avenue and Montebello Avenue and downtown Glendale.

Over the longer-term, once light rail has been extended closer to Peoria, BRT service could be revised to operate to and from a closer station. BRT alignments would be dependent upon how LRT is extended, especially into Glendale. However, for each potential LRT extension, potential BRT alignments would be essentially the same as the alignments described above for LRT extensions to Peoria. In addition, BRT service could also be developed from the end of the Northwest Extension. For both the short and long-term, potential options would include:

- B1 BRT from 19th Street at Montebello Avenue via Grand Avenue
- B2 BRT from Westgate Center via 91st Avenue
- B3 BRT from Northwest Extension via Dunlap Avenue
- B4 BRT from Northwest Extension via Peoria Avenue

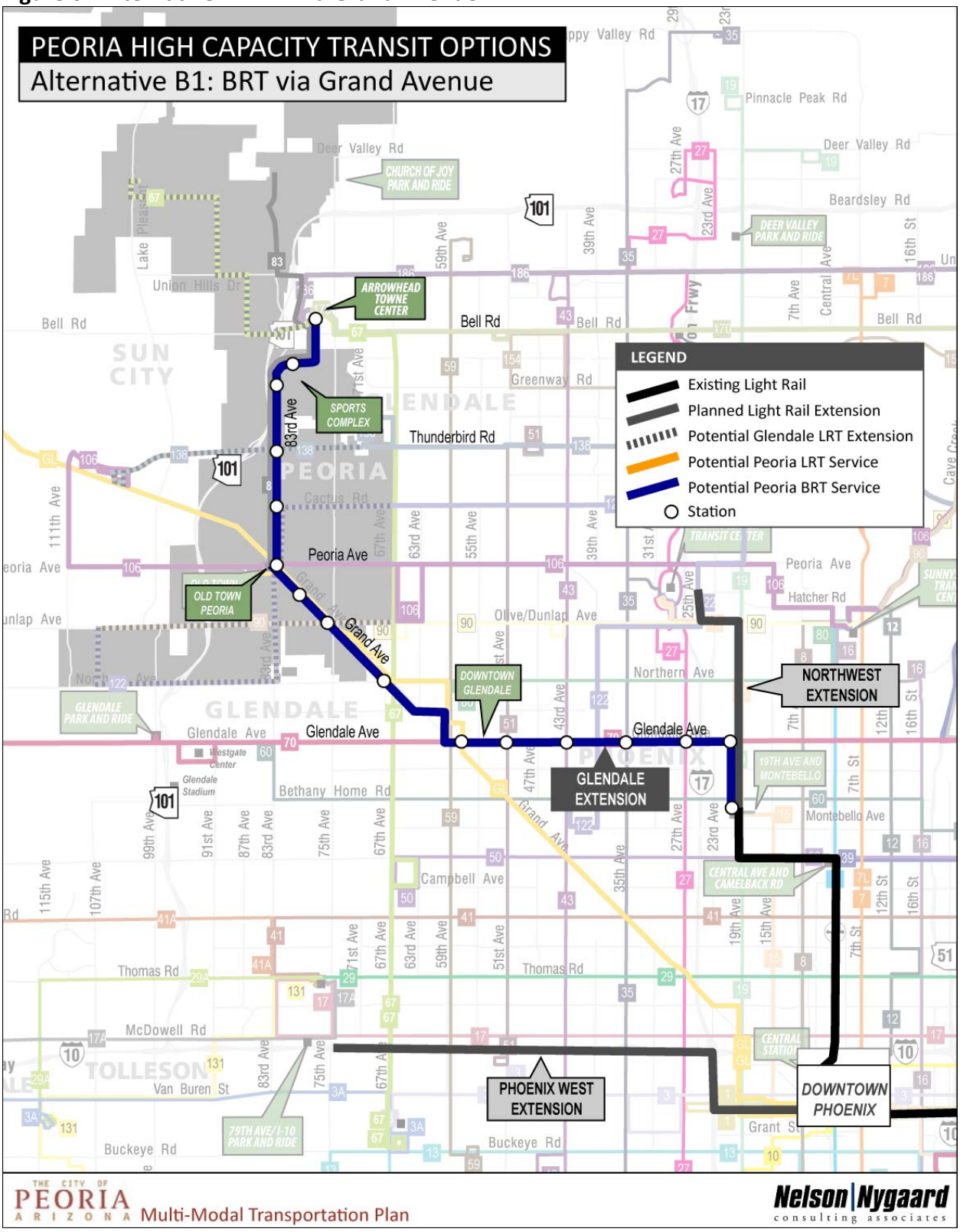
B1 BRT FROM METRO LIGHT RAIL AT 19TH AND MONTEBELLO VIA GRAND AVE AND 83RD AVE

In a similar manner as with Mesa's Valley Metro LINK service, arterial BRT could be developed between Peoria and the current end of the light rail system at 19th Avenue and Montebello Avenue (see Figure 6). This type of service could be provided as an alternative or as a precursor to extending light rail to Peoria.

Alignment

BRT service would operate largely on existing roadways. Depending upon the area, it would operate in exclusive bus lanes, with queue jump lanes, and in mixed traffic. Also, whereas

Figure 6: Alternative B1 BRT via Grand Avenue



Alternatives L1 and L2 would add service in Glendale and Peoria, Alternative B1 would also add service in Phoenix. Key characteristics of the alignment would be as follows:

METRO Light Rail – Downtown Glendale
To be most effective, the B1 BRT line would provide service between the end of the METRO Rail line at 19th Avenue and Montebello Avenue and downtown Glendale, and the most logical alignment would probably be along Glendale Avenue.

Downtown Glendale – Old Town Peoria
From Downtown Glendale, BRT would operate along 59th Avenue to Myrtle Avenue to Grand Avenue. Along Grand Avenue, traffic conditions would probably allow BRT to operate in mixed traffic. However, there would need to be pullouts for stations located along Grand Avenue, as well as pedestrian overcrossings to connect the inbound and outbound platforms.

Old Town Peoria
In Old Town, service would operate consistent with the plans previously developed for an Old Town Transit Center to Peoria Avenue/83rd Avenue. The roads in this area will be reconfigured, and could presumably be reconfigured in a manner that would provide the needed space for the exclusive lanes or queue jump lanes.

Old Town to Arrowhead Transit Center
Between Old Town and the Arrowhead Transit Center, BRT would operate along the same alignment as the two light rail alternatives. Since traffic flows well along most of the alignment, it would likely be possible to provide transit priority through queue jump lanes and transit signal priority at intersections.

Station Locations

In Peoria, station locations for BRT would be the same as for LRT Alternative L1. In addition, there would be opportunities for BRT stations in Glendale between the end of the METRO Rail line and Peoria.

Service Levels

BRT could operate with the same or different span of service and frequencies as light rail. For the purposes of these alternatives, it is assumed that Alternative B1 would operate with the same levels of service as Mesa's LINK BRT service, which would be as presented in Table 2.[4] This would be less service than for the LRT alternatives. On weekdays, BRT service would operate every 15 minutes during the day compared to 10 minutes for LRT, and every 30

[4] As with the LRT alternatives, these spans of service and headways are those that were in effect before the July 26, 2010 service reductions and it is assumed that original service levels will be restored once economic conditions improve.

minutes in the early morning and at night, versus every 20 minutes for LRT. On weekends, service would only operate every 60 minutes, versus every 15 to 20 minutes for LRT.

Table 2: Alternative B1 Spans of Service and Headways

	Begin	End	Headway
Weekdays			
Early AM	4:15	5:15	30
Day	5:15	18:00	15
Evening/Night	18:00	22:00	30
Saturday			
All Day	5:00	22:00	60
Sunday			
All Day	5:00	22:00	60

Travel Times

Alternative B1 BRT service would average approximately 35 mph along Grand Avenue and 15 mph in other areas. With these speeds, travel times would be 20 minutes between Arrowhead and Old Town (about 3 minutes slower than light rail), and 53 minutes along the entire length between Montebello/19th Avenue Station at the current end of the METRO light rail line and Arrowhead.

Travel times to downtown Phoenix would be the second lowest of all alternatives (after Alternative L1), at 60 minutes from Old Town and 80 minutes from Arrowhead. Travel times would be longer for BRT than for light rail due to BRT's slight lower average operating speeds and the need to transfer between BRT and light rail at Montebello/19th Avenue Station.

TOD Opportunities

BRT would likely encourage and stimulate TOD to a lesser extent than LRT, but opportunities would still exist, and at the same locations as for LRT Alternative L1.

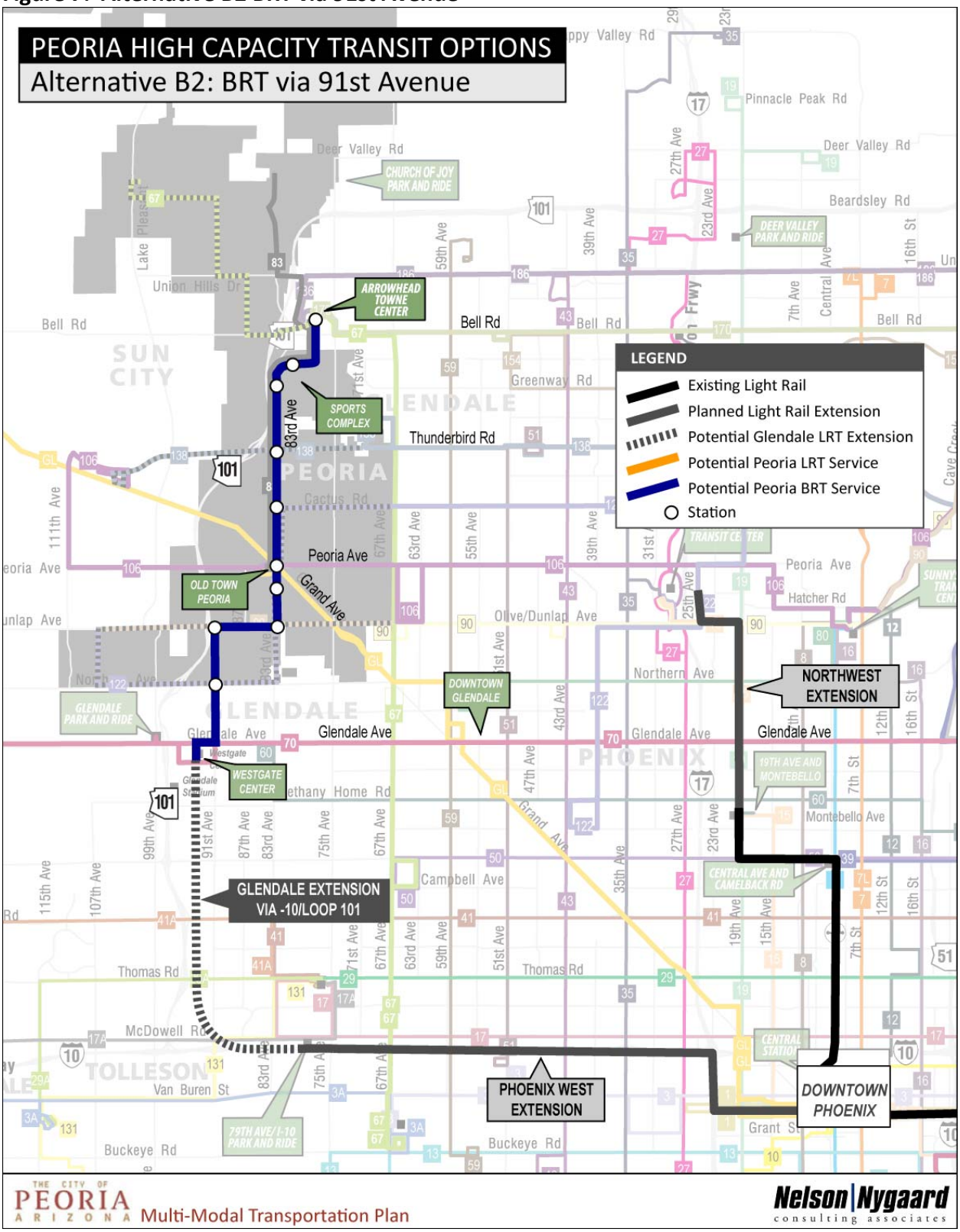
B2 BRT FROM METRO LIGHT RAIL AT WESTGATE CENTER VIA 91ST AVENUE AND 83RD AVENUE

If LRT is extended into Glendale via I-10 to the Westgate Center, then BRT service to Peoria could be provided from that location, with the most likely alignment along 91st Avenue and 83rd Avenue (see Figure 7).

Alignment

BRT service would operate largely on existing roadways. Depending upon the area, it would operate in exclusive bus lanes, with queue jump lanes, and in mixed traffic. In most areas, the alignment would be the same as for an LRT extension from Westgate Center. However, one major exception would be in Old Town Peoria, where BRT would cross the BNSF tracks at-grade

Figure 7: Alternative B2 BRT via 91st Avenue



at 83rd Avenue rather than via an aerial structure or tunnel. Key characteristics of the alignment would be as follows:

Westgate Center – Old Town Peoria

From the Westgate Center, LRT would operate to Old Town north on 91st Avenue, east on Olive Avenue, and north on 83rd Avenue:

- Between Glendale Avenue and Olive Avenue, 91st Avenue has a cross section that varies from two to four lanes, with some wider intersections. Traffic conditions would probably allow BRT to operate in mixed traffic. However, there would need to be pullouts for stations, as well as pedestrian overcrossings to connect the inbound and outbound platforms at some locations.
- Olive Avenue currently has two travel lanes in each direction plus a center left-turn lane. As on 91st Avenue, traffic conditions would probably allow BRT to operate in mixed traffic, but bus pullouts pedestrian crossings would be needed at stations.
- Between Olive Avenue and Cotton Crossing, 83rd Avenue is generally two lanes, but with some much wider sections (that are still striped to two lanes). As on 91st and 83rd Avenues, traffic conditions would probably allow BRT to operate in mixed traffic, but bus pullouts pedestrian crossings would be needed at stations.
- Between Cotton Crossing and Grand Avenue, 83rd Avenue is two lanes. One station would be constructed opposite City Hall, and there appears to be sufficient right-of-way at that location. For the rest of this segment, BRT would operate in mixed traffic without and stations.

Old Town Peoria

In Old Town, service would operate consistent with the plans previously developed for an Old Town Transit Center to Peoria Avenue/83rd Avenue. The roads in this area will be reconfigured, and could presumably be reconfigured in a manner that would provide the needed space for the exclusive lanes or queue jump lanes.

Old Town to Arrowhead Transit Center

Between Old Town and the Arrowhead Transit Center, BRT would operate along the same alignment as the two light rail alternatives. Since traffic flows well along most of the alignment, it would likely be possible to provide transit priority through queue jump lanes and transit signal priority at intersections.

Station Locations

Potential station locations, with one exception, would be the same as for LRT Alternative L2. The one exception would be that the station located in the vicinity of Peoria City Hall would be located on 83rd Avenue instead of Cotton Crossing.

Service Levels

Service levels would be the same as presented above for Alternative B1.

Travel Times

Alternative B2 BRT service would average approximately 15 mph along the entire alignment. At this speed, travel times would be 20 minutes between Arrowhead and Old Town, and 36 minutes along the entire length between Westgate Center and Arrowhead.

Travel times to downtown Phoenix would be significantly longer than with Alternatives L1 and B1, at 74 minutes from Old Town, and 94 minutes from Arrowhead. These longer travel times would be due largely to the more circuitous north-south to east-west alignment.

TOD Opportunities

BRT would likely encourage and stimulate TOD to a lesser extent that LRT, but opportunities would still exist, and at the same locations as for LRT Alternative L2.

B3 BRT FROM METRO RAIL NORTHWEST EXTENSION VIA DUNLAP/OLIVE AVENUES

Phase 1 of light rail's Northwest Extension will extend light rail service to the vicinity of Dunlap Avenue at 19th Avenue in Phoenix. This extension is currently planned for 2023. At that time, BRT could also extended along Dunlap Avenue, which becomes Olive Avenue, to 83rd Avenue then through Old Town Peoria, and then to the Arrowhead Transit Center along the same alignment as BRT Alternative B2 (see Figure 8).

Alignment

BRT service would operate largely on existing roadways and would operate in exclusive bus lanes, with queue jump lanes, and in mixed traffic. Similar to Alternative B1 BRT via Grand Avenue, Alternative B3 would add service in in Phoenix, Glendale and Peoria:

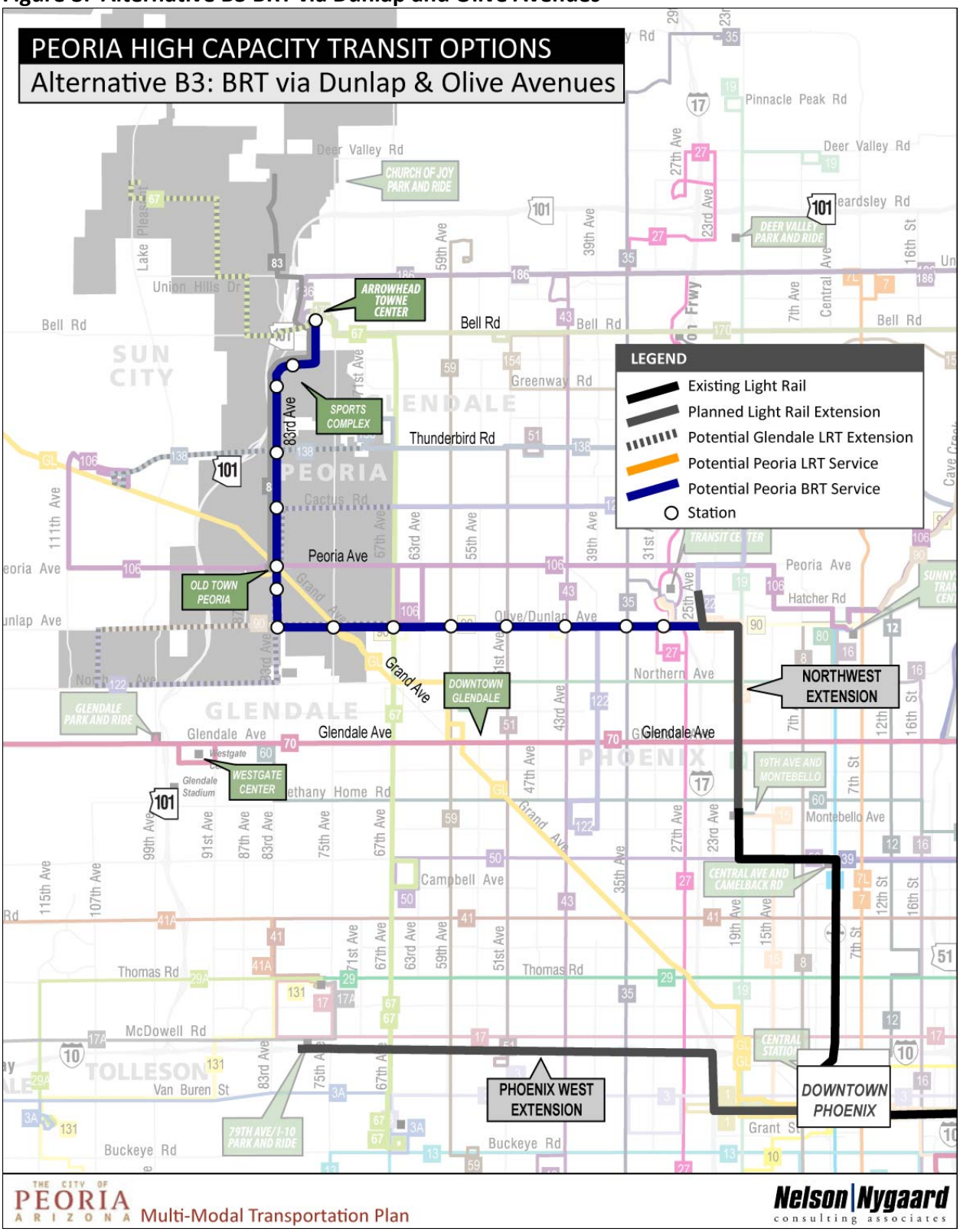
Northwest Extension – 83rd Avenue

From the terminus of the Northwest extension near Dunlap and 19th Avenues, BRT would operate west along Dunlap Avenue/Olive Avenue. Along this segment, it would be desirable to develop bus lanes or queue jump lanes and transit signal priority. Key considerations include:

Dunlap Avenue/Olive Avenue

- Between 19th Avenue and I-17, Dunlap Avenue generally has two lanes westbound and three lanes westbound, with left-turn lanes at major intersections. It appears that there is right-of-way available on both sides of the road to develop bus lanes, queue jump lanes, and stations.
- Between I-17 and 35th Avenue, Dunlap Avenue has three lanes in each direction, with left-turn lanes at major intersections. The right-of-way is generally more constrained along this segment, which may present some constraints in placing queue jump lanes and stations.

Figure 8: Alternative B3 BRT via Dunlap and Olive Avenues



- Between 35th Avenue and 42nd Avenue, Dunlap Avenue has three lanes westbound and two lanes eastbound, with left-turn lanes at major intersections. In addition,

most of this segment has a parallel westbound service road that serves the houses that front Dunlap Avenue. There is also a short section of eastbound service road near 42nd Avenue. The service roads may present some constraints in placing queue jump lanes and stations, but overall there is a lot of width to work within (more than 130 feet in many locations).

- Between 42th Avenue and 67nd Avenue, Dunlap Avenue/Olive has three lanes westbound and two lanes eastbound, with left-turn lanes at major intersections. Throughout most of this segment, it appears that there is right-of-way available on both sides of the road to develop bus lanes, queue jump lanes, and stations.
- Between 67th Avenue and 83rd Avenue, Olive Avenue currently has two travel lanes in each direction plus a center left-turn lane. It appears that there is right-of-way available on both sides of the road to develop bus lanes, queue jump lanes, and stations.

83rd Avenue/Old Town

Between Olive Avenue and the Old Town Transit Center, BRT would operate along 83rd Avenue in the same manner as BRT Alternative B2. Key considerations include:

- Between Olive Avenue and Cotton Crossing, 83rd Avenue is generally two lanes, but with some much wider sections (that are still striped to two lanes). Traffic conditions would probably allow BRT to operate in mixed traffic, but bus pullouts pedestrian crossings would be needed at stations.
- Between Cotton Crossing and Grand Avenue, 83rd Avenue is one lane in each direction. One station would be constructed opposite City Hall, and there appears to be sufficient right-of-way at that location. For the rest of this segment, BRT would operate in mixed traffic without and stations.

Old Town Peoria

In Old Town, service would operate consistent with the plans previously developed for an Old Town Transit Center to Peoria Avenue/83rd Avenue. The roads in this area will be reconfigured, and could presumably be reconfigured in a manner that would provide the needed space for the exclusive lanes or queue jump lanes.

Old Town to Arrowhead Transit Center

Between Old Town and the Arrowhead Transit Center, BRT would operate along the same alignment as the two light rail alternatives BRT Alternative B1. Since traffic flows well along most of the alignment, it would likely be possible to provide transit priority through queue jump lanes and transit signal priority at intersections.

Station Locations

As with the other BRT alternatives, stations would be located approximately every mile, at the one-mile arterials plus other key locations. In Peoria, these locations would include:

67th Avenue – 83rd Avenue

- Olive Avenue @ 67th Avenue
- Olive Avenue at Grand Avenue (with parking)
- 83rd Avenue at Olive Avenue

Old Town Peoria

- 83rd Avenue at Cotton Crossing
- Old Town Peoria Transit Center at or near 83rd Avenue and Peoria Avenue.

Old Town to Peoria Sports Complex

- 83rd Avenue at Cactus Road.
- 83rd Avenue at Thunderbird Road.

Peoria Sports Complex – Arrowhead Transit Center

- 83rd Avenue at Stadium Way.
- Paradise Lane near 77th Avenue.

Service Levels

Service levels would be the same as presented above for Alternative B1.

Travel Times

Alternative B3 BRT service would average approximately 15 mph along the entire alignment. Travel times would be 20 minutes between Arrowhead and Old Town, and 55 minutes along the entire length between 19th Avenue at Dunlap Avenue and Arrowhead.

Travel times to downtown Phoenix would be the same as those for Alternative B2 BRT via 91st Avenue, at 74 minutes from Old Town, and 94 minutes from Arrowhead. These long travel times would be due largely to the circuitous east-west to north-south alignment.

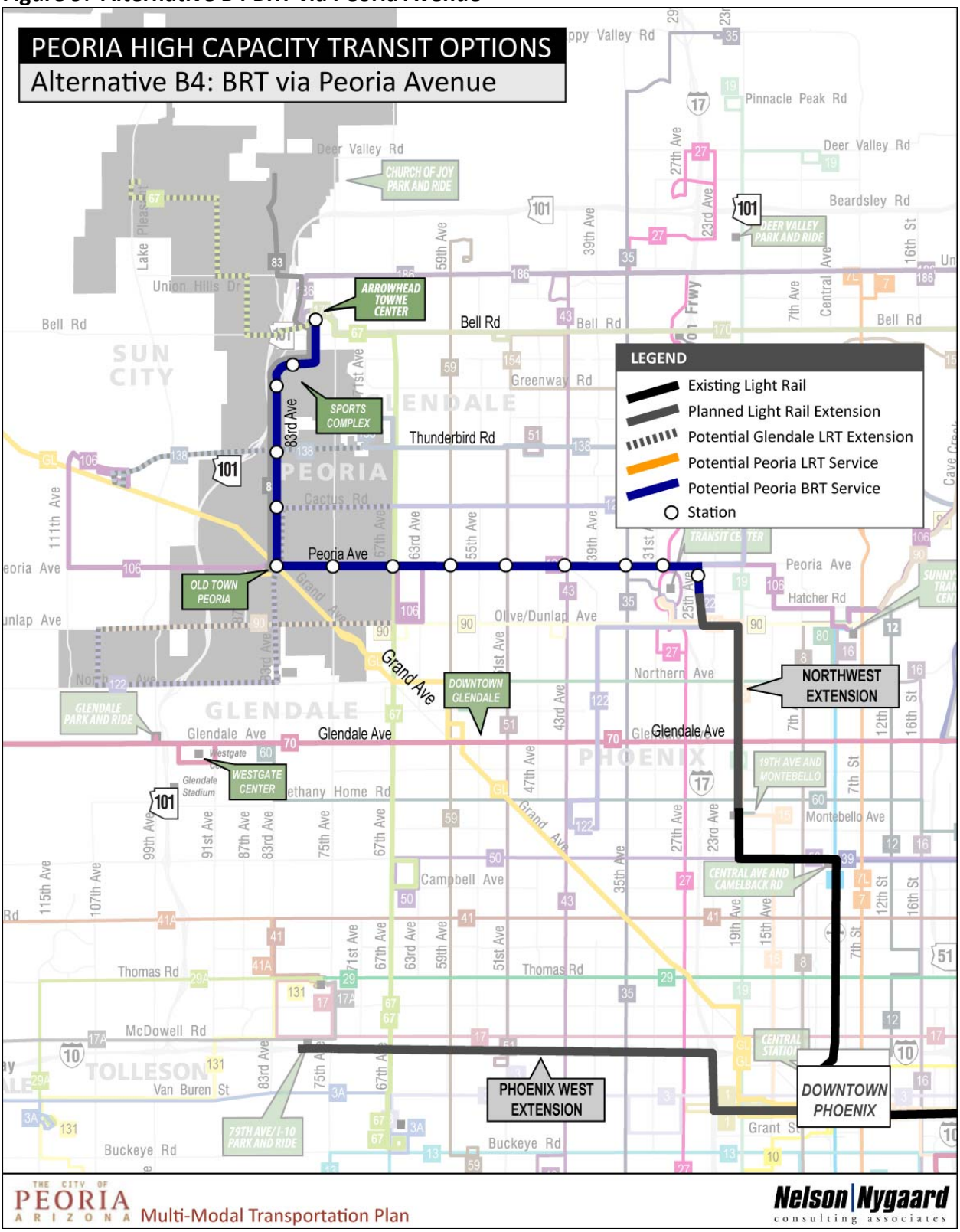
TOD Opportunities

BRT would likely encourage and stimulate TOD to a lesser extent that LRT, but opportunities would still exist. In Peoria, these opportunities would be the same as for LRT Alternative L2 and BRT Alternative B2 for all locations from Olive Avenue northward.

B4 BRT FROM METRO RAIL NORTHWEST EXTENSION VIA PEORIA AVENUE

MAG's Regional Transit Framework Study identified Peoria Avenue as a major east-west travel corridor that will likely warrant BRT service. In addition, Phase 2 of light rail's Northwest Extension will extend light rail service to 25th Avenue and Mountain View Road, which is just south of Peoria Avenue. This extension is currently planned for 2026. At that time, BRT could also extended along Peoria Avenue to 83rd Avenue then through Old Town Peoria, and then to the Arrowhead Transit Center along the same alignment as BRT Alternative B2 (see Figure 9).

Figure 9: Alternative B4 BRT via Peoria Avenue



Alignment

BRT service would operate largely on existing roadways and would operate in exclusive bus lanes, with queue jump lanes, and in mixed traffic. As would be the case with Alternatives B1 and B3, this alternative would also add service in Phoenix, Glendale and Peoria:

Northwest Extension – 83rd Avenue

From the terminus of the Northwest extension near Dunlap and 19th Avenues, BRT would operate west along Dunlap Avenue/Olive Avenue. Along this segment, it would be desirable to develop bus lanes or queue jump lanes and transit signal priority. Key considerations include:

Peoria Avenue

- Between 25th Avenue and I-17, the major feature is the I-17 intersection, which has three to four lanes in each direction and is often congested. There would not be any significant opportunities for BRT treatments at this intersection without major construction.
- Between I-17 and 35th Avenue, Peoria Avenue has three lanes in each direction, a center median, left-turn lanes at major intersections, and fairly frequent right-turn lanes that could be used as queue jump lanes.
- Between 35th Avenue and 53rd Avenue, Peoria Avenue generally has three lanes westbound and two lanes eastbound, with a center two-way left-turn lane, and dedicated left-turn lanes at major intersections. Throughout most of this segment, there appears to be sufficient right-of-way to develop queue jump lanes and stations.
- Between 53rd Avenue and 63rd Avenue, Peoria Avenue generally has three lanes, a center median, and left-turn lanes at major intersections and many locations in between. Throughout most of this segment, there appears to be sufficient right-of-way to develop queue jump lanes and stations.
- Between 63rd Avenue and 67th Avenue, Peoria Avenue generally has three lanes westbound and two lanes eastbound, with a center two-way left-turn lane, and dedicated left-turn lanes at major intersections. Throughout most of this segment, there appears to be sufficient right-of-way to develop queue jump lanes and stations.
- Between 67th Avenue and 83rd Avenue, Peoria Avenue currently has two travel lanes in each direction plus a center left-turn lane. It appears that there is right-of-way available on both sides of the road to develop queue jump lanes and stations.

Old Town Peoria

In Old Town, service would operate consistent with the plans previously developed for an Old Town Transit Center to Peoria Avenue/83rd Avenue. The roads in this area will be reconfigured, and could presumably be reconfigured in a manner that would provide the needed space for the exclusive lanes or queue jump lanes.

Old Town to Arrowhead Transit Center

Between Old Town and the Arrowhead Transit Center, BRT would operate along the same alignment as the two light rail alternatives BRT Alternative B1. Since traffic flows well along

most of the alignment, it would likely be possible to provide transit priority through queue jump lanes and transit signal priority at intersections.

Station Locations

As with the other BRT alternatives, stations would be located approximately every mile, at the one-mile arterials plus other key locations. In Peoria, these locations would include:

67th Avenue – 83rd Avenue
- Peoria Avenue @ 67th Avenue
- Peoria Avenue @ 75th Avenue

Old Town Peoria
- Old Town Peoria Transit Center at or near 83rd Avenue and Peoria Avenue.

Old Town to Peoria Sports Complex
- 83rd Avenue at Cactus Road.
- 83rd Avenue at Thunderbird Road.

Peoria Sports Complex – Arrowhead Transit Center
- 83rd Avenue at Stadium Way.
- Paradise Lane near 77th Avenue.

Service Levels

Service levels would be the same as presented above for Alternative B1.

Travel Times

Alternative B4 BRT service would average approximately 15 mph along the entire alignment. At this speed, travel times would be 20 minutes between Arrowhead and Old Town, and 48 minutes along the entire length between 25th Avenue at Mountain View Drive and Arrowhead.

Travel times to downtown Phoenix would be similar to Alternative B3 BRT via Dunlap and Olive Avenue, at 72 minutes from Old Town, and 92 minutes from Arrowhead.

TOD Opportunities

BRT would likely encourage and stimulate TOD to a lesser extent that LRT, but opportunities would still exist. In Peoria, these opportunities would be the same as for LRT Alternative L2 and BRT Alternative B2 for all locations from Old Town northward.

COMPLEMENTARY LOCAL SERVICE

With all of the HCT alternatives, there would also need to be complementary local service, to provide local service in the HCT corridor, to provide connections to and from HCT service, and to provide local service within, to, and from Peoria. For all of the HCT alternatives, it is assumed that complementary local service would be provided by extending Valley Metro's grid into Peoria as described in the "Extend Valley Metro Grid" local service alternative.

Local Service Alignments

New and extended local services would operate as follows: (see also Figure 10):

- **Route 67 67th Avenue:** Route 67 would be extended from the Arrowhead Transit Center to Walmart on Lake Pleasant Pkwy via west on Campo Bello Drive, south on 83rd Avenue, west on Bell Road, north on 87th Avenue, west on Union Hills Driver, north on 91st Avenue, west on Lake Pleasant Parkway to Walmart.
- **Route 83 83rd Avenue:** A new Route 83 would be developed that would operate north-south route generally along 83rd Ave between Old Town and just south of Deer Valley Road via the planned Arrowhead Transit Center. From the Old Town Transit Center, service would operate north on 83rd Avenue to east on Paradise Lane to north on 71st Avenue to the Arrowhead Transit Center. From there, Route 83 would operate west on Union Hills Drive to back to north on 83rd Avenue.
- **Route 90 Dunlap/Cave Creek:** Route 90 would e extended from 67th Avenue 107th Avenue along Olive Avenue.
- **Route 122 Cactus/39th Avenue:** Route 122 would be extended from 67th Avenue to 107th Avenue at Olive Avenue via west on Cactus Road, south on 83rd Avenue through Old Town, west on Northern Avenue, and north on 107th Avenue.
- **Route 138 Thunderbird:** Route 138 would be extended from 67th Avenue to the Peoria/Sun City line along Thunderbird Road.

Service Levels

Improved local services would operate generally with existing weekday spans of service, but more frequently, and with weekend service on all routes (see Table 3). On weekdays, service would operate every 30 minutes on all routes. On weekends, service would operate either every 30 or 60 minutes.

Figure 7: Complementary Local Service

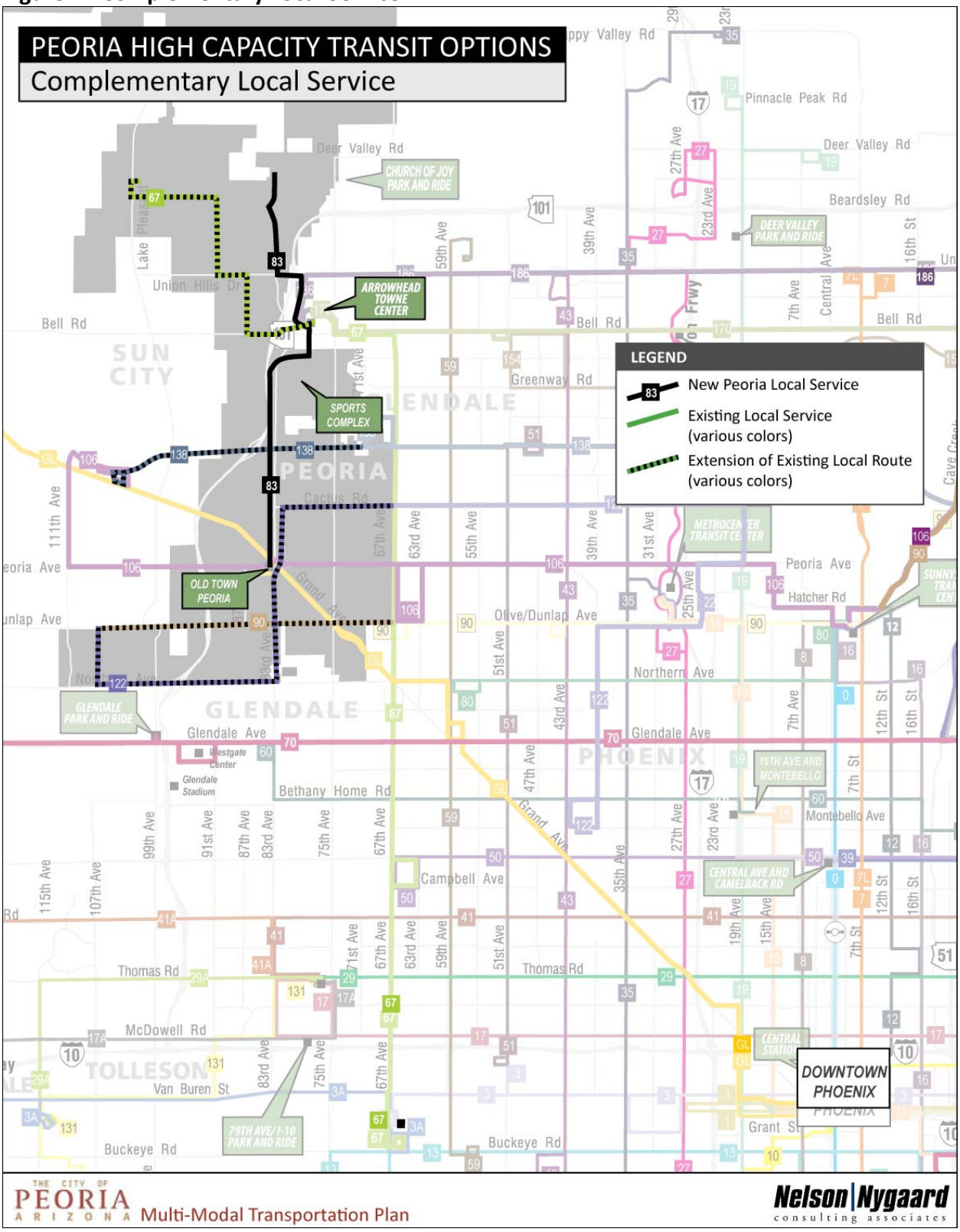


Table 3: Local Service Spans of Service and Headways

	Begin	End	Headway
Weekdays			
67 67th Avenue	5:45	22:16	30
83 83rd Street	6:00	22:00	30
90 Dunlap/Cave Creek	5:12	22:15	30
106 Peoria/Shea	5:12	21:37	30
122 Cactus/39th Avenue	4:25	21:33	30
138 Thunderbird	5:00	21:55	30
Saturdays			
67 67th Avenue	5:50	20:51	30
83 83rd Street	6:00	21:00	60
90 Dunlap/Cave Creek	5:51	21:28	60
106 Peoria/Shea	5:39	22:03	30
122 Cactus/39th Avenue	6:18	20:15	60
138 Thunderbird	6:00	20:54	60
Sundays			
67 67th Avenue	5:50	20:51	30
83 83rd Street	6:00	21:00	60
90 Dunlap/Cave Creek	5:51	21:28	60
106 Peoria/Shea	6:00	21:23	60
122 Cactus/39th Avenue	6:18	20:15	60
138 Thunderbird	6:00	20:54	60

ATTACHMENT 1
BRT OVERVIEW

WHAT IS BRT?

Bus Rapid Transit (BRT) is an integrated system of transit measures that work together to make bus service similar to rail. These measures include:

- **Exclusive Bus Lanes**—either dedicated rights-of-ways, or reserved lanes on existing roads—allow buses to avoid the delays experienced in mixed-traffic operations.
- **Transit Priority Measures** such as signal priority and queue jump lanes speed buses through congested areas.
- **Special Vehicles** provide BRT service with a unique image that differentiates it from "regular" bus service.
- **BRT Stations and Shelters** provide similar features, amenities, and levels of passenger comfort as rail stations.
- **Pre-Paid Fare Collection** via either pre-paid passes or the sale of tickets from ticket vending machines at stations and stops reduces delays associated with on-board fare collection.
- **Real Time Passenger Information** informs passengers when buses will actually arrive or depart from stations, which reduces some of the uncertainty that is often associated with bus service.
- **Intelligent Transportation System Technologies** such as Automatic Vehicle Location, which can be used to maintain consistent spacings between buses and to keep them on schedule.

These measures work together to make service fast and reliable, to make it convenient and comfortable service, and to establish a strong image and identity for service—characteristics that are all associated with rail service.

BRT BENEFITS

BRT is extremely flexible and can be implemented in a wide variety of environments. As such, it can both take advantage of existing facilities, as well as work around existing constraints. BRT can provide better service at lower cost, and with fewer environmental and community impacts than other modes

BRT OPERATIONS

Because of its flexibility, BRT can operate in a number of ways:

Bus Running Ways

BRT systems can operate in exclusive busways (for example, in the rail right-of-way), freeway bus and HOV lanes, bus lanes on regular roadways, in mixed traffic, and even in fixed guideways. These options can be "mixed and matched" along the length of a BRT system.

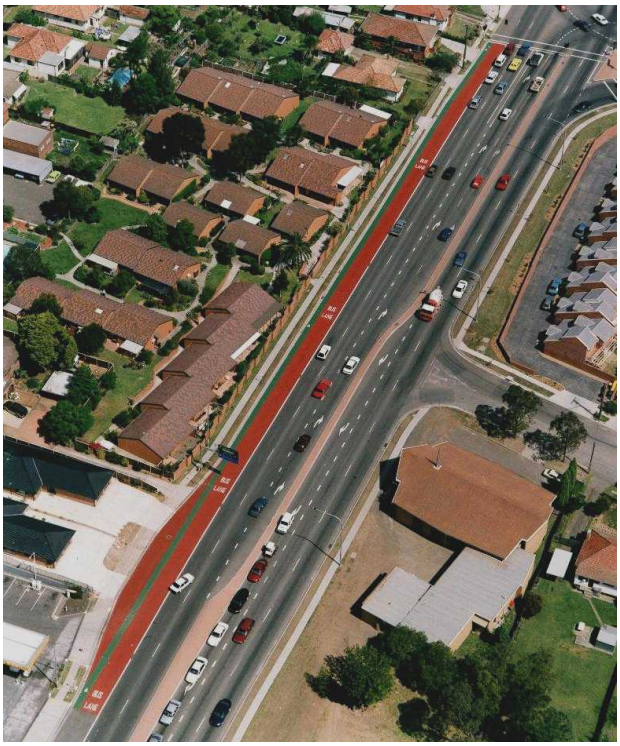
South Miami Dade Busway

Busways can also be shared with other uses. For example, in some areas, carpools are allowed to use bus lanes.

Bus Lane on Regular Road

Queue Jump Lanes

Queue jump lanes are short stretches of bus lane that enable buses to by-pass waiting queues of traffic at traffic signals. Queue jump lanes are often combined with signal priority, where the queue jump lane is provided a green signal before the general traffic lanes.



Sydney Queue Jump Lane

Signal Priority

Signal priority modifies normal traffic signal operation to facilitate the movement of transit vehicles. Signal priority is typically implemented in conjunction with exclusive bus lanes or queue jump lanes.

BRT Stations and Stops

BRT systems typically have stations that are similar to equivalent rail stations, with specific design features varying depending upon passenger volumes, location, type of facility, and available space. These frequently include parking and local transit connections.

Brisbane BRT Station

Mesa, AZ BRT Station

Higher volume stops typically have large stations similar to larger commuter rail, LRT, or inter-city bus stations. Smaller volume stations are more similar to on-street LRT stations or

park and ride lots. Passenger amenities provided at BRT stations typically include:

- Enclosed or sheltered waiting areas.
- Seating
- Lighting.
- Telephones and waste receptacles.
- Passenger information, ranging from basic signs, maps, and schedules to electronic passenger information system that provide real-time information on arrival and departure times.
- Concessions and retail.
- Joint use.

BRT Vehicles

Virtually any type of vehicle can be used for BRT service, ranging from standard transit buses to specially designed vehicles. Features commonly found on BRT vehicles include low floor boarding and/or raised platforms to allow for level boarding, and wide doors, both of which allow for faster boarding and alighting. Seating is often provided that would be comparable to that provided for rail service.

Valley Metro BRT Vehicle (Mesa, AZ)

Los Angeles LA Metro Rapid BRT Bus

Service Design

A large number of different types of BRT services can be provided. Typically the focus is on reducing travel times, which means that most BRT services are express or limited stop services.

Service need not be limited to within the BRT "line," and most BRT services extend beyond the limits of the BRT system or facilities.

Fare Collection

Off board fare collection can significantly reduce dwell times at stations by eliminating the time involved for passengers to pay fares as they board vehicles. Ticket vending machines at stops and stations allow passengers to purchase a ticket before boarding the bus. This eliminates time involved in collecting fares as part of the boarding process.

Ticket Vending Machine

Further time savings can be achieved through the use of a "proof-of-payment" enforcement system. Unlike traditional systems, which require all riders to board through the front door to either by pay a fare or display a pass, proof-of-payment systems require riders to purchase a ticket or pass and then retain the ticket or pass as the proof of payment. Enforcement is then made via spot checks of passengers on board vehicles. With proof-of-payment systems, passengers can board through all doors, rather than only the front door, which further reduces dwell times.

System Identity and Image

Rail lines usually have a very strong identity that helps to increase ridership. BRT systems can create a similarly strong identity though the use of a unified system design, with colors and images coordinated between stops, vehicles, and print materials.

LA Metro Rapid System Identify

Intelligent Transportation Systems

Reductions in waiting time and more reliable service can make service much more attractive. Automatic vehicle location (AVL) systems can be used to manage bus service to regularize the intervals between buses, thereby minimizing passenger waiting time. AVL can also be used to provide real-time bus status information, which can reduce customer anxiety while waiting.