Project Schedule and Public Involvement Plan M1

Needs and Opportunities M2

Identification of Alternatives M3

Evaluation of Alternatives M4

Regional Commuter Rail/High-Capacity Transit Plan M5

Final Report M6

October 2002

MILESTONE 4
EVALUATION OF ALTERNATIVES

HIGH-CAPACITY TRANSIT PLAN

Maricopa Association of Governments

4.0 Executive Summary 1
4.0.1 Estimate Ridership, Revenues, and Costs 3
4.0.2 Refine Threshold and Performance Measures 20
4.0.3 Evaluate Alternatives 24
4.1 System Ridership and Revenues 1
4.1.1 Commuter Rail Ridership 6
4.1.2 Commuter Rail Capital and Operating Costs 14
4.1.3 Light Rail and Bus Rapid Transit Ridership 21
4.1.4 Light Rail Capital and Operating Costs 28
4.1.5 Bus Rapid Transit Operating and Capital Costs 37
4.2 Refine Threshold and Performance Measures 44
4.2.1 Refined Revenue Forecasts 44
4.2.2 Evaluation Screening Criteria 58
4.2.3 Feeder Network Role 59
4.3 Evaluate Alternatives 64
4.3.1 Population and Employment Data 64
4.3.2 Ridership and Cost Effectiveness 66
4.3.3 Existing Service Impact 68
4.3.4 Land Use, Redevelopment, and Transit Oriented Development Potential 72
4.3.5 Feeder Network Contribution 78
4.3.6 Recommended High Capacity Transit Options 79

4.0 Executive Summary

This Milestone Report is the fourth of six milestones that will be prepared for Maricopa Association of Governments' (MAG) High Capacity Transit Plan. The Milestone 4 document is comprised of three tasks:

- Task 9: Estimate Commuter Rail System Ridership and Potential Revenues; Estimate Operating and Capital Costs
- Task 11: Refine Threshold and Performance Measures
- Task 12: Evaluate Alternatives

Task 10: Alternative High Capacity Transit Service Concepts was provided in Milestone 3.

Task Nine involves the development of ridership and cost estimates for the commuter rail corridors. These are planning-level estimates applied to each of the four possible commuter corridors. Ridership has been estimated using a direct demand model based upon the ridership patterns of commuter service in Toronto, Canada. This model has been successfully used to estimate ridership for several other West Coast commuter rail systems. Capital costs have been estimated using average unit costs for rail infrastructure, signals, rail vehicles, and maintenance facilities. Operating costs were developed using the three levels of service developed in Milestone 3.

Task Eleven includes the development of estimates for ridership and costs for the light rail (LRT) and bus rapid transit (BRT) corridors. The ridership estimates have been developed using the MAG sketch planning model, which was based upon ridership patterns on three West Coast LRT systems in San Diego, Portland, and Sacramento. Dedicated BRT services are assumed to be capable of providing a level of service which is comparable to LRT. Capital and operating costs were estimated using accepted average unit costs and/or models of costs from other transit systems.

Task Twelve represents the culmination of all the data collection and analysis performed in Milestones 2 and 3. This objective of this task is to evaluate the potential high capacity transit corridors and recommended a network of high capacity transit alternatives. The evaluation has been performed using socio-economic data, ridership and cost estimated, and an assessment of land use opportunities and impacts. The evaluation process has resulted in a set of corridors which will be carried forward for further refinement in Milestone 5.

Cost estimates, ridership estimates, and the evaluation results are provided for 28 potential high capacity transit corridors in the MAG region. These corridors, including the corridor limits and proposed transit technology are summarized in Table 4.0-1. Each alignment identified in the table represents a single centerline street or freeway selected for ridership, cost and socio-economic data estimates.

The actual corridors are approximately five miles in width and a final alignment could include other streets parallel to the alignments identified in the table.

Table 4.0-1 **Potential High Capacity Transit Corridors & Technologies**

Corridor	Limits	Technology
59th Avenue	51st Avenue/Baseline Road to 59th Avenue/Bell Road	LRT/BRT
Baseline Road	51st Avenue to Tempe Industrial Branch	LRT/BRT
Bell Road	Loop 303 to Scottsdale Road	LRT/BRT
Burlington Northern Santa Fe (BNSF)	Downtown Phoenix to Loop 303 *(potential extension to Wickenburg)*	Commuter Rail
Camelback Road	Loop 101 West Valley to Scottsdale Road	LRT/BRT
Chandler Boulevard	Ray Road to Power Road	LRT/BRT
Union Pacific Chandler Branch	Union Pacific Mainline to Queen Creek Road and Price Road	LRT/BRT
Glendale Avenue/Cactus Avenue (to Paradise Valley)	Glendale/19th Avenue to Bell Road/Scottsdale via SR-51, Cactus, Tatum	LRT/BRT
Interstate 10 West	Central Avenue/Van Buren to Loop 101	LRT
Interstate 10 Far West	Loop 101 to Loop 303	Express BRT
I-17	Loop 101 to Anthem Way	Express BRT
Loop 101 East	I-17 to Queen Creek Rd/Price Road	Express BRT
Loop 101 West	I-17 to Baseline Road/91st Avenue	Express BRT
Loop 202	I-10/SR-51/Loop 202 interchange to I-10/Loop 202 south interchange	Express BRT
Loop 303	Baseline Road to Grand Avenue	Express BRT
Main Street (Option 1)	Alma School Road to Loop 202	LRT/BRT
Main Street (Option 2)	Alma School Road to Power Road	LRT/BRT
Metrocenter Extension	19th Avenue/Bethany Home to I-17/Peoria	LRT
Northern Avenue (east of Grand Avenue)	19th Avenue to Grand Avenue	LRT
Northern Avenue (west of Grand Avenue)	Grand Avenue to Loop 303	LRT/BRT
Power Road	Williams Field to Higley Road/McDowell Road	LRT/BRT
Scottsdale Road	Queen Creek Road/Price Road to Scottsdale/Bell	LRT/BRT
SR-51	Glendale Avenue/19th Avenue to Tatum Blvd./Loop 101 via Tatum north of Cactus	LRT/BRT

Corridor	Limits	Technology
Union Pacific Tempe Branch	UP Mainline to 56th Street/I-10	LRT/BRT
Union Pacific Mainline/Chandler	Downtown Phoenix to Chandler Heights Road	Commuter Rail
Union Pacific Southeast	Downtown Phoenix to Ellsworth Avenue	Commuter Rail
Union Pacific Yuma	Downtown Phoenix to Buckeye *(potential extension to Palo Verde Nuclear Generating Station)*	Commuter Rail
US-60	I-10 to Idaho Road	Express BRT

4.0.1 Estimate Ridership, Revenues, and Costs

Ridership and cost estimates have been developed on four potential commuter rail corridors. The corridors and limits assumed in the ridership and cost estimates are summarized in Table 4.0-2.

Table 4.0-2 **Potential Commuter Rail Corridors**

Corridor	Limits
Burlington Northern Santa Fe (BNSF)	Downtown Phoenix to Loop 303 *(potential extension to Wickenburg)*
Union Pacific Mainline/Chandler	Downtown Phoenix to Queen Creek Road
Union Pacific Southeast	Downtown Phoenix to Ellsworth Avenue
Union Pacific Yuma	Downtown Phoenix to Buckeye *(potential extension to Palo Verde Nuclear Generating Station)*

Commuter Rail Ridership

Commuter rail ridership was forecast using a direct demand model (DDM). The more traditional four stage modeling approach was considered less suitable at this stage due to the absence of commuter rail as a mode in the MAG model, and its much slower application than the quick sketch planning forecasts that the DDM can produce. This DDM estimates weekday boarding passengers per station based on the catchment population and level of service factors such as train frequency and journey time savings.

Catchment areas were developed for each proposed station to represent the major source of all trip origins. Catchments were developed with three mile radii for the primary catchment area and an additional two to four miles for the secondary catchment area, resulting in a catchment area with a five to seven mile radius overall. Manual adjustments were made to reflect observed catchment shape characteristics and to ensure no overlaps between station catchments. Catchments of alternative locations for the same station could overlap. Catchment population

was determined and this was applied to a trip rate to determine the total number of weekday trip boardings at each station. Stations designated as 'destination' stations were not included as they would primarily represent trip attractions rather than trip productions.

The trip rate factors were originally calibrated from the GO Rail system in Toronto with subsequent adjustments, and include factors to allow for:

- Number of peak period trains;
- Presence/absence of an off-peak service; and
- Time/distance factors

Weekday corridor ridership was determined by summing all the respective stations. Where more than one option for a station location existed, the location producing the most boardings was selected. Since daily ridership also includes the return leg of the daily round trip the sum of station boardings were also doubled.

Ridership was estimated using the service plan implementation process developed in Milestone 3. There are assumed to be three phases of commuter rail implementation with the following levels of service:

- Phase 1: Start-Up/Introductory Services. Examination of the impact of limited peak hour, peak direction service composed of three trains inbound in the a.m. peak and outbound in the p.m. peak on each of the networks.
- Phase 2: Intermediate Services. Headways of 20 minutes during the peak hour will be examined together with limited counter-flow service. Midday service would consist of hourly trains in each direction.
- Phase 3: Full Commuter Train Operation. In this phase, trains would operate on 15-minute headways during the peak hours and at 30-minute headways during the off-peak. During the peak periods there would be a 30-minute interval counter-flow services.

Table 4.0-3 below displays the average weekday ridership forecast for each of the four corridors.

Table 4.0-3 **Forecast Weekday Commuter Rail Ridership**

Corridor	Length (Miles)	Phase 1	Phase 2	Phase 3
BNSF	27.73	2,854	7,166	8,026
UP Mainline/Chandler	25.95	1,190	2,988	3,347
UP Southeast	36.18	2,430	6,100	6,832
UP Yuma	32.5	2,312	5,802	6,499

Note: The boarding figures contained within this table have been obtained from a sketch planning model.

The Burlington North Santa Fe (BNSF) corridor was found to perform particularly strongly, with the Union Pacific Mainline/Chandler performing least strongly. The difference is believed to be due to the significant length of the BNSF running through relatively dense residential and employment development, while serving a travel corridor with only one other parallel route (Grand Avenue). The UP Mainline/Chandler corridor by contrast is paralleled by several alternative routes capable of providing competitive travel times.

Commuter Rail Capital and Operating Costs

Capital and operating costs have been developed for the four alternative commuter rail corridors. The costs are presented individually for each corridor; therefore, selected infrastructure costs including a central terminal station are included in each corridor cost estimate. Assuming a network implementation of two or more corridors, these costs would be distributed evenly between the corridors since each of these facilities are capable of serving more than one corridor. Costs have been estimated so that the maintenance and storage facility is scaled to the number of vehicles required to run service in an individual corridor.

Capital costs were developed using standard unit cost rates obtained from the Southern California Regional Rail Authority (Metrolink), and unit costs obtained from several other rail infrastructure cost estimates prepared for West Coast rail properties during the previous five years. The capital and infrastructure needs described in Milestone 3 have been used as the basis for developing costs in each corridor. Costs have also been broken down for each of the three phases of service identified in Milestone 3: Phase 1 (Start-up), Phase 2 (Intermediate), and Phase 3 (Full Service).

A major component of the cost of new start commuter rail systems is track ownership or the lease rights to use freight rail corridors. Various corridor ownership models were discussed in Milestone 2. The purchase or lease of rights to utilize the MAG region freight railroad corridors varies between each phase and each corridor. Phase 1 services assume the lease of track rights from the freight railroad services, with trains providing service during operating windows provided by the freight railroad companies, Burlington Northern Santa Fe (BNSF) and Union Pacific (UP). These lease rates are an estimate based upon the number of annual train miles and are incorporated into the annual operating and maintenance costs. The rates represent an average cost paid by other West Coast commuter rail systems operating in freight corridors owned by BNSF and UP. In corridors where second main tracks are constructed, right-of-way purchase is assumed in the capital cost for Phase 2 and 3 services where increased frequency of service would likely preclude the use of operating windows between freight services. Due to the limited amount of freight operations occurring in the corridor, the Union Pacific Yuma corridor does not require a second main track, allowing for the lease of track rights through all three phases of service implementation.

Table 4.0-4 summarizes the capital costs for each commuter rail corridor by major category. All costs are in 2001 dollars. Detailed unit costs can be found in Appendix A.

Table 4.0-4 Revised Commuter Rail Capital Cost Summary

Item		BNSF Phase 1	BNSF Phase 2	BNSF Phase 3	UP Mainline/Chandler Phase 1	UP Mainline/Chandler Phase 2	UP Mainline/Chandler Phase 3	UP Southeast Phase 1	UP Southeast Phase 2	UP Southeast Phase 3	UP Yuma Phase 1	UP Yuma Phase 2	UP Yuma Phase 3
Corridor Length (miles)		27.73	27.73	27.73	27.95	27.95	27.95	36.18	36.18	36.18	32.5	32.5	32.5
Subtotal-Civil		$16,414,844	$40,000	$158,400	$23,106,160	$20,000	$168,890	$24,692,082	$160,000	$174,500	$3,058,400	$105,600	$0
Subtotal-Utilities		$24,488,376	$660,000	$427,680	$13,024,440	$330,000	$456,003	$13,024,440	$2,640,000	$471,150	$0	$1,742,400	$0
Subtotal-Track		$34,697,676	$1,867,000	$5,691,195	$28,200,799	$633,500	$4,032,866	$19,695,628	$3,268,000	$4,243,088	$0	$2,062,880	$0
Subtotal-Stations		$29,120,000	$6,216,000	$1,190,000	$31,700,000	$2,660,000	$490,000	$33,520,000	$5,250,000	$1,050,000	$24,350,000	$4,900,000	$910,000
Subtotal-Controls & Signals		$0	$25,688,016	$965,840	$15,785,584	$480,000	$11,456,460	$15,585,584	$15,963,216	$3,593,000	$0	$0	$26,976,496
Subtotal Facilities		$2,500,000	$17,000,000	$0	$2,500,000	$17,000,000	$0	$2,500,000	$21,000,000	$0	$2,500,000	$21,000,000	$0
A. Construction Subtotal		**$107,220,896**	**$51,471,016**	**$8,433,115**	**$114,316,983**	**$21,123,500**	**$16,604,219**	**$109,017,734**	**$48,281,216**	**$9,531,738**	**$29,908,400**	**$29,810,880**	**$27,886,496**
Environmental Mitigation	Percent of A 3%	$3,216,627	$1,544,130	$252,993	$3,429,509	$633,705	$498,127	$3,270,532	$1,448,436	$285,952	$897,252	$894,326	$836,595
B. Construction Cost Subtotal		**$110,437,523**	**$53,015,146**	**$8,686,108**	**$117,746,492**	**$21,757,205**	**$17,102,345**	**$112,288,266**	**$49,729,652**	**$9,817,690**	**$30,805,652**	**$30,705,206**	**$28,723,091**
C. Right of Way Subtotal		**$13,503,600**	**$104,674,900**	**$3,702,600**	**$8,276,400**	**$71,872,900**	**$1,524,600**	**$13,939,200**	**$82,654,000**	**$3,267,000**	**$11,107,800**	**$42,471,000**	**$2,831,400**
D. Vehicles Subtotal		**$61,932,500**	**$30,800,000**	**$33,750,000**	**$46,350,000**	**$19,800,000**	**$44,750,000**	**$64,000,000**	**$47,300,000**	**$39,205,019**	**$56,125,000**	**$32,400,000**	**$41,800,000**
Cost Contingencies (Uncertainties, Changes)													
Design&Construction	Percent of B 25%	$27,609,381	$13,253,787	$2,171,527	$29,436,623	$5,439,301	$4,275,586	$28,072,066	$12,432,413	$2,454,422	$7,701,413	$7,676,302	$7,180,773
Right of Way	Percent of C 30%	$4,051,080	$31,402,470	$1,110,780	$2,482,920	$21,561,870	$457,380	$4,181,760	$24,796,200	$980,100	$3,332,340	$12,741,300	$849,420
Vehicle Cost	Percent of D 10%	$6,193,250	$3,080,000	$3,375,000	$4,635,000	$1,980,000	$4,475,000	$6,400,000	$4,730,000	$3,920,502	$5,612,500	$3,240,000	$4,180,000
Program Implementation (Agency Costs and Fees)													
Design&Construction	Percent of B 31%	$34,235,632	$16,434,695	$2,692,694	$36,501,413	$6,744,734	$5,301,727	$34,809,362	$15,416,192	$3,043,484	$9,549,752	$9,518,614	$8,904,158
Right of Way Purchase	Percent of C 15%	$2,025,540	$15,701,235	$555,390	$1,241,460	$10,780,935	$228,690	$2,090,880	$12,398,100	$490,050	$1,666,170	$6,370,650	$424,710
Vehicle Procurement	Percent of D 5%	$3,096,625	$1,540,000	$1,687,500	$2,317,500	$990,000	$2,237,500	$3,200,000	$2,365,000	$1,960,251	$2,806,250	$1,620,000	$2,090,000
E. Capital Cost Subtotal		**$263,085,131**	**$269,902,234**	**$57,731,599**	**$248,987,808**	**$160,926,945**	**$80,352,829**	**$268,981,534**	**$251,821,558**	**$65,138,518**	**$128,706,877**	**$146,743,072**	**$96,983,552**
Project Reserve	Percent of E 10%	$26,308,513	$26,990,223	$5,773,160	$24,898,781	$16,092,694	$8,035,283	$26,898,153	$25,182,156	$6,513,852	$12,870,688	$14,674,307	$9,698,355
F. Total Capital Cost		**$289,393,644**	**$296,892,457**	**$63,504,759**	**$273,886,589**	**$177,019,639**	**$88,388,112**	**$295,879,688**	**$277,003,714**	**$71,652,369**	**$141,577,565**	**$161,417,379**	**$106,681,907**
			Total all 3 Phases	**$649,790,860**		**Total all 3 Phases**	**$539,294,340**		**Total all 3 Phases**	**$644,535,771**		**Total all 3 Phases**	**$409,676,851**

Note: All costs are in 2001 dollars. More detailed information on costs can be found in Appendix A

Commuter Rail operating costs were developed using the three phases of service implementation noted above in the ridership estimates.

Operating costs have been estimated using the comparison of Year 2001 bus and commuter rail operating and maintenance costs from four commuter rail service providers in the Western United States:

- Dallas Area Rapid Transit Authority (DART) – Dallas Trinity Railway Express
- North County Transit District (NCTD) – San Diego Coaster
- Sound Transit – Seattle Sounder
- Altamont Commuter Express (ACE)/Valley Transit Authority (VTA) – San Jose Altamont Commuter Express

To obtain an estimated cost per vehicle revenue mile and revenue hour in the MAG region operating costs from the National Transit Database for bus service provided in each of the four metropolitan regions noted above were first compared to 2001 bus operating cost figures for Valley Metro/RPTA ($96.52 per vehicle hour and $6.26 per vehicle mile in 2001). The percentage difference in bus operating costs between each of the outside agencies and Valley Metro/RPTA was then applied to the commuter rail operating costs from each region to estimate a comparable difference in cost for a proposed MAG region commuter rail system. The four estimated operating costs were then averaged to obtain a single estimated cost per revenue service hour and revenue service mile for commuter rail in the MAG region. Table 4.0-5 summarizes the cost differences between each commuter rail provider.

Table 4.0-5 **Commuter Rail Operating Cost Comparison**

Metropolitan Area	Bus Revenue Hour Cost	Bus Revenue Mile Cost	Commuter Rail Revenue Hour Cost	Commuter Rail Revenue Mile Cost	Valley Metro/RPTA Average Difference (Bus)
Dallas	$99.84	$7.50	$545.51	$28.65	-9.9%
San Diego	$74.37	$4.33	$460.08	$11.05	37.2%
Seattle	$102.64	$7.66	$1,535.02	$39.14	-12.1%
San Jose	$130.93	$10.22	$504.48	$14.00	-32.5%
Valley Metro	$96.52	$6.26			
MAG Average			$487.64	$16.81	

Table 4.0-6 summarizes the estimated operating costs for the four commuter rail corridors. All figures are in Year 2001 dollars.

Table 4.0-6 **Commuter Rail Operating Cost Summary**

Annual O&M Cost (millions $)			
Corridor	**Phase 1**	**Phase 2**	**Phase 3**
BNSF	$3.45	$14.60	$18.25
UP Mainline/Chandler	$2.00	$8.50	$14.05
UP Southeast	$4.65	$17.30	$21.60
UP Yuma	$2.80	$12.30	$19.95

Note: All costs are in Year 2001 dollars.

Light Rail/Bus Rapid Transit Ridership

A total of 24 other corridors have been identified for potential high capacity transit service in addition to the four commuter rail corridors noted above. These corridors would likely contain a light rail transit (LRT) or bus rapid transit (BRT) system. Ridership estimates have been determined using a single centerline alignment chosen as a representative for each corridor. These representative alignments will be use to identify each corridor in this report. Parallel alignments within each corridor could be considered as a final alignment for high capacity transit service.

Similarly to the commuter rail forecasts, a direct demand modeling approach was used, in this case the MAG Sketch Plan Model. The four stage modeling technique was deferred since LRT and BRT are new modes to the MAG region, and require calibration. The MAG Sketch Plan Model is particularly suited to the level of detail required at this stage and was selected as a tool for the rapid development of corridor forecasts. It was developed from trip rates on existing LRT systems in San Diego, Sacramento and Portland. These are believed to be representative of Phoenix being of similar size with comparable development patterns and densities. Forecasts are average daily ridership based on the number of catchment households and distribution of employment.

The existing LRT systems were used to determine trip rate factors based on access and egress distance. To apply the trip rate factors it is necessary to determine the number of households and jobs within the four distance bands of the LRT stations, namely 0-0.25 miles, 0.25-0.5 miles, 0-2 miles and 2-5 miles. Trips within 0.5 miles are assumed to represent the walk access/egress catchment, with those up to 5 miles representing motorized access.

The number of households and jobs were determined within the required distance bands of each of the corridors. The proportion of regional jobs within each distance band was calculated, and these values were then applied to the Sketch Plan Model trip rate factors. The same methodology was used in the forecasting of both proposed LRT and BRT corridors, since the level of service between the two modes is fairly similar.

Table 4.0-7 below summarizes the LRT/BRT corridors and shows the ridership forecasts for each corridor examined in the MAG region.

Table 4.0-7 **Ridership Forecasts for LRT/BRT Corridors**

Corridor	Limits	Technology	Approximate Length (miles)	Estimated Average daily boardings	Boardings per mile
59th Avenue	51st Avenue/Baseline Road to 59th/Bell Road	LRT/Dedicated BRT	19	19,594	1,059
Baseline Road	51st Avenue to UP Tempe Branch	LRT/Dedicated BRT	13	8,199	631
Bell Road	Loop 303 to Scottsdale Road	LRT/Dedicated BRT	28	28,661	1,024
Camelback Road	Loop 101 West Valley to Scottsdale Road	LRT/Dedicated BRT	20	24,020	1,201
Chandler Boulevard	Ray Road to Power Road	LRT/Dedicated BRT	16	12,507	760
Union Pacific Chandler Branch	Union Pacific Mainline to Queen Creek Road/Price Road	LRT/Dedicated BRT	12	19,490	1,751
Glendale Avenue/Cactus Avenue	Glendale/19th Ave to Bell Road/Scottsdale Road	LRT/Dedicated BRT	19	14,295	752
I-10 West	Central Avenue/Van Buren to Loop 101	Express BRT	12	11,386	1,035
I-10 Far West	Loop 101 to Loop 303	Express BRT	9	510	54
I-17	Loop 101 to Anthem Way	Express BRT	17	377	22
Loop 101 East	I-17 to Queen Creek Road/Price Road	Express BRT	35	1,108	32
Loop 101 West	I-17 to Baseline Road/91st Avenue	Express BRT	34	1,163	34
Loop 202	I-10/SR-51/Loop 202 Interchange to I-10/Loop 202 south Interchange	Express BRT	55	1,788	33
Loop 303	Baseline Road to Grand Avenue	Express BRT	19	485	26
Mesa Rd (Option 1)	Alma School Road to Loop 202	LRT/Dedicated BRT	12	12,090	1,051
Mesa Rd (Option 2)	Alma School Road to Power Road	LRT/Dedicated BRT	9	9,674	1,075
Metrocenter Extension	19th Ave/Bethany Home to I-17/Peoria	LRT	5	5,062	1,012
Northern (east of Grand Ave)	19th Avenue to Grand Avenue	LRT	6	7,266	1,275
Northern (west of Grand Ave)	Grand Avenue to Loop 303	LRT/Dedicated BRT	13	4,700	261

Corridor	Limits	Technology	Approximate Length (miles)	Estimated Average daily boardings	Boardings per mile
Northern (Total)	19th Avenue to Loop 303	LRT/Dedicated BRT	19	11,966	647
Power Road	Williams Field Road to McDowell/Higley	LRT/Dedicated BRT	13	10,496	807
Scottsdale Road	Queen Creek Rd/Price Rd to Scottsdale Rd/Bell Rd	LRT/Dedicated BRT	28	27,182	967
SR-51	Glendale Ave/19th Ave to Tatum Blvd/Loop 101	LRT	17	9,988	584
Union Pacific Tempe Branch	UP Mainline to 56th Street/I-10	LRT/Dedicated BRT	10	8,010	801
US-60	I-10 to Idaho Road	Express BRT	18	1,362	76

Note: The boarding figures contained within this table have been obtained from a sketch planning model.

Many of the corridors perform well in comparison with the existing systems in San Diego, Portland and Sacramento, including parts of the Scottsdale Road and Northern Avenue corridors, the Union Pacific Chandler Branch, and the Central Phoenix/East Valley LRT extension to the Metrocenter. Some of the freeway-based systems appear to perform less well, such as the Loop 303 corridor. This is believed to reflect the different development densities between the corridors and the different operating characteristics of express bus.

Light Rail/Bus Rapid Transit Capital and Operating Costs

Two sets of capital costs have been developed for the LRT corridors. The first set assumes ballasted track along the at-grade alignments except at cross streets. Intersections require embedded track to allow for crossing by automobiles. Embedded track is assumed along the entire corridor in the second set of estimates. The main feature of embedded track is that it is a relatively flat, smooth surface, which would allow for the operation of automobiles above. This configuration is substantially more expensive than ballasted track, with differences of approximately $5 million per mile for each corridor. These two costs are presented for comparison purposes. Specific selection of a single track configuration would be performed on a corridor specific basis utilizing several criteria including cost, community input, and street configuration. All costs are based upon average unit rates for various light rail and BRT projects designed in the Western United States. These cost estimates are planning level estimates that have been produced without the benefit of detailed plans. More precise costs would be produced in the latter stages of project design and development.

Tables 4.0-8 and 4.0-9 summarize the LRT capital costs for each of the potential corridors. Detailed LRT capital cost estimate information is provided in Appendix B.

Table 4.0-8 Light Rail Capital Cost Summary (Ballasted Track)

Item	Bell Road	Camelback Road	Chandler Boulevard	Power Road	Scottsdale Road	Glendale Ave/Cactus Ave	SR-51	59th Avenue	I-10 West
Corridor Length (miles)	28.55	20.88	16.45	13.04	28.10	19.77	17.12	18.99	11.05
Subtotal-Civil Site Mods	$42,052,000	$31,888,250	$24,825,000	$19,646,000	$42,570,000	$19,155,750	$17,622,500	$28,004,250	$15,181,000
Subtotal-Guideway	$50,834,544	$45,681,888	$32,199,388	$19,428,172	$82,121,724	$167,127,224	$134,687,792	$54,647,512	$12,999,292
Subtotal-Utilities	$135,691,200	$99,216,900	$78,188,400	$61,977,600	$133,531,200	$93,944,700	$81,354,600	$90,260,100	$52,509,600
Subtotal-Track	$54,558,880	$42,311,510	$32,645,760	$24,876,440	$56,079,480	$35,912,730	$31,813,340	$39,357,990	$21,185,840
Subtotal-Stations	$54,275,000	$51,240,000	$37,527,500	$28,660,000	$65,565,000	$37,592,500	$35,815,000	$41,472,500	$21,647,500
Subtotal-Systems & Electrical	$99,290,384	$74,625,433	$59,437,188	$46,509,432	$104,734,184	$56,624,379	$53,768,322	$67,195,457	$37,741,672
Subtotal - Facilities	$12,500,000	$10,000,000	$7,500,000	$5,500,000	$13,500,000	$7,500,000	$8,500,000	$7,500,000	$5,500,000
A. Construction Subtotal	**$449,202,008**	**$354,963,981**	**$272,323,236**	**$206,597,644**	**$498,101,588**	**$417,857,283**	**$363,561,554**	**$328,437,809**	**$166,764,904**
Environmental Mitigation	$13,476,060	$10,648,919	$8,169,697	$6,197,929	$14,943,048	$12,535,718	$10,906,847	$9,853,134	$5,002,947
B. Construction Cost Subtotal	**$462,678,068**	**$365,612,900**	**$280,492,933**	**$212,795,573**	**$513,044,636**	**$430,393,001**	**$374,468,401**	**$338,290,943**	**$171,767,851**
C. Right of Way Subtotal	**$102,523,600**	**$73,763,375**	**$59,273,000**	**$49,430,500**	**$101,442,900**	**$55,600,825**	**$50,887,350**	**$63,794,375**	**$25,237,200**
D. Vehicles Subtotal	**$142,425,000**	**$107,500,000**	**$60,100,000**	**$42,850,000**	**$159,550,000**	**$67,450,000**	**$90,050,000**	**$67,450,000**	**$42,350,000**
Cost Contingencies (Uncertainties, Changes)									
Design&Construction	$115,669,517	$91,403,225	$70,123,233	$53,198,893	$128,261,159	$107,598,250	$93,617,100	$84,572,736	$42,941,963
Right of Way	$30,757,080	$22,129,013	$17,781,900	$14,829,150	$30,432,870	$16,680,248	$15,266,205	$19,138,313	$7,571,160
Vehicle Cost	$14,242,500	$10,750,000	$6,010,000	$4,285,000	$15,955,000	$6,745,000	$9,005,000	$6,745,000	$4,235,000
Program Implementation (Agency Costs and Fees)									
Design&Construction	$143,430,201	$113,339,999	$86,952,809	$65,966,628	$159,043,837	$133,421,830	$116,085,204	$104,870,192	$53,248,034
Right of Way Purchase	$15,378,540	$11,064,506	$8,890,950	$7,414,575	$15,216,435	$8,340,124	$7,633,103	$9,569,156	$3,785,580
Vehicle Procurement	$7,121,250	$5,375,000	$3,005,000	$2,142,500	$7,977,500	$3,372,500	$4,502,500	$3,372,500	$2,117,500
E. Capital Cost Subtotal	**$1,034,225,756**	**$800,938,018**	**$592,629,826**	**$452,912,819**	**$1,130,924,337**	**$829,601,779**	**$761,514,862**	**$697,803,215**	**$353,254,288**
Project Reserve	$103,422,576	$80,093,802	$59,262,983	$45,291,282	$113,092,434	$82,960,178	$76,151,486	$69,780,322	$35,325,429
F. Total Capital Cost	**$1,137,648,332**	**$881,031,820**	**$651,892,808**	**$498,204,101**	**$1,244,016,770**	**$912,561,956**	**$837,666,349**	**$767,583,537**	**$388,579,717**

Note: All costs are in 2001 Dollars.
Detailed cost information can be found in Appendix B

Table 4.0-8 Light Rail Capital Cost Summary (Ballasted Track)

Item	Union Pacific Chandler Branch	Union Pacific Tempe Branch	Main (Option 1)	Main (Option 2)	Northern Avenue east of Grand	Northern Avenue west of Grand	Baseline Road	Metrocenter
Corridor Length (miles)	11.13	10.00	12.64	9.64	5.70	12.89	12.95	5.07
Subtotal-Civil Site Mods	$6,102,000	$1,716,000	$18,459,000	$13,853,000	$8,247,750	$17,002,750	$18,592,000	$6,433,000
Subtotal-Guideway	$9,108,928	$6,880,200	$8,355,104	$6,214,484	$24,607,988	$29,318,456	$29,622,588	$13,712,868
Subtotal-Utilities	$52,889,400	$47,520,000	$55,321,200	$41,065,200	$27,135,900	$61,296,300	$61,538,400	$24,116,400
Subtotal-Track	$32,627,060	$17,474,000	$23,479,080	$17,541,680	$12,059,010	$22,482,370	$25,014,760	$8,833,360
Subtotal-Stations	$28,582,500	$16,125,000	$19,170,000	$16,125,000	$7,612,500	$18,625,000	$18,625,000	$11,012,500
Subtotal-Systems & Electrical	$45,403,758	$33,196,400	$40,599,484	$31,156,564	$18,062,263	$40,417,491	$41,426,688	$16,462,148
Subtotal - Facilities	$8,000,000	$5,500,000	$7,500,000	$7,000,000	$3,500,000	$4,500,000	$6,000,000	$3,500,000
A. Construction Subtotal	**$182,713,646**	**$128,411,600**	**$172,883,868**	**$132,955,928**	**$101,225,411**	**$193,642,367**	**$200,819,436**	**$84,070,276**
Environmental Mitigation	$5,481,409	$3,852,348	$5,186,516	$3,988,678	$3,036,762	$5,809,271	$6,024,583	$2,522,108
B. Construction Cost Subtotal	**$188,195,055**	**$132,263,948**	**$178,070,384**	**$136,944,606**	**$104,262,173**	**$199,451,638**	**$206,844,019**	**$86,592,384**
C. Right of Way Subtotal	**$48,198,350**	**$38,267,000**	**$42,578,500**	**$32,475,600**	**$16,644,325**	**$43,802,525**	**$42,174,700**	**$17,632,000**
D. Vehicles Subtotal	**$76,007,500**	**$42,100,000**	**$65,700,000**	**$58,260,000**	**$34,312,500**	**$49,425,000**	**$49,450,000**	**$34,250,000**
Cost Contingencies (Uncertainties, Changes)								
Design&Construction	$47,048,764	$33,065,987	$44,517,596	$34,236,151	$26,065,543	$49,862,910	$51,711,005	$21,648,096
Right of Way	$14,459,505	$11,480,100	$12,773,550	$9,742,680	$4,993,298	$13,140,758	$12,652,410	$5,289,600
Vehicle Cost	$7,600,750	$4,210,000	$6,570,000	$5,826,000	$3,431,250	$4,942,500	$4,945,000	$3,425,000
Program Implementation (Agency Costs and Fees)								
Design&Construction	$58,340,467	$41,001,824	$55,201,819	$42,452,828	$32,321,274	$61,830,008	$64,121,646	$26,843,639
Right of Way Purchase	$7,229,753	$5,740,050	$6,386,775	$4,871,340	$2,496,649	$6,570,379	$6,326,205	$2,644,800
Vehicle Procurement	$3,800,375	$2,105,000	$3,285,000	$2,913,000	$1,715,625	$2,471,250	$2,472,500	$1,712,500
E. Capital Cost Subtotal	**$450,880,519**	**$310,233,909**	**$415,083,624**	**$327,722,205**	**$226,242,637**	**$431,496,967**	**$440,697,485**	**$200,038,019**
Project Reserve	$45,088,052	$31,023,391	$41,508,362	$32,772,221	$22,624,264	$43,149,697	$44,069,748	$20,003,802
F. Total Capital Cost	**$495,968,571**	**$341,257,300**	**$456,591,987**	**$360,494,426**	**$248,866,900**	**$474,646,663**	**$484,767,233**	**$220,041,821**

Note: All costs are in 2001 Dollars.
Detailed cost information can be found in Appendix B

Table 4.0-9 Light Rail Capital Cost Summary (Embedded Track)

Item	Bell Road	Camelback Road	Chandler Boulevard	Power Road	Scottsdale Road	Glendale Ave/Cactus Ave	SR-51	59th Avenue	I-10 West
Corridor Length (miles)	28.55	20.88	16.45	13.04	28.10	19.77	17.12	18.99	11.05
Subtotal-Civil Site Mods	$42,052,000	$31,888,250	$24,825,000	$19,526,000	$42,570,000	$19,155,750	$17,622,500	$28,004,250	$15,181,000
Subtotal-Guideway	$62,392,320	$53,679,015	$38,663,140	$24,798,160	$92,988,720	$172,328,345	$139,343,510	$61,531,735	$12,999,292
Subtotal-Utilities	$135,691,200	$99,216,900	$78,188,400	$61,977,600	$133,531,200	$93,944,700	$81,354,600	$90,260,100	$52,509,600
Subtotal-Track	$159,508,800	$114,929,100	$91,339,600	$73,638,400	$154,756,800	$83,141,300	$74,089,400	$101,869,900	$21,185,840
Subtotal-Stations	$54,275,000	$51,240,000	$37,527,500	$28,660,000	$65,565,000	$37,592,500	$35,815,000	$41,472,500	$21,647,500
Subtotal-Systems & Electrical	$99,290,384	$74,625,433	$59,437,188	$46,509,432	$104,734,184	$56,624,379	$53,768,322	$67,195,457	$37,741,672
Subtotal - Facilities	$12,500,000	$10,000,000	$7,500,000	$5,500,000	$13,500,000	$7,500,000	$8,500,000	$7,500,000	$5,500,000
A. Construction Subtotal	**$565,709,704**	**$435,578,698**	**$337,480,828**	**$260,609,592**	**$607,645,904**	**$470,286,974**	**$410,493,332**	**$397,833,942**	**$166,764,904**
Environmental Mitigation	$16,971,291	$13,067,361	$10,124,425	$7,818,288	$18,229,377	$14,108,609	$12,314,800	$11,935,018	$5,002,947
B. Construction Cost Subtotal	**$582,680,995**	**$448,646,059**	**$347,605,253**	**$268,427,880**	**$625,875,281**	**$484,395,583**	**$422,808,132**	**$409,768,960**	**$171,767,851**
C. Right of Way Subtotal	**$102,523,600**	**$73,763,375**	**$59,273,000**	**$49,430,500**	**$101,442,900**	**$55,600,825**	**$50,887,350**	**$63,794,375**	**$25,237,200**
D. Vehicles Subtotal	**$143,050,000**	**$107,050,000**	**$60,850,000**	**$42,600,000**	**$159,550,000**	**$67,450,000**	**$90,050,000**	**$67,450,000**	**$42,350,000**
Cost Contingencies (Uncertainties, Changes)									
Design&Construction	$145,670,249	$112,161,515	$86,901,313	$67,106,970	$156,468,820	$121,098,896	$105,702,033	$102,442,240	$42,941,963
Right of Way	$30,757,080	$22,129,013	$17,781,900	$14,829,150	$30,432,870	$16,680,248	$15,266,205	$19,138,313	$7,571,160
Vehicle Cost	$14,305,000	$10,705,000	$6,085,000	$4,260,000	$15,955,000	$6,745,000	$9,005,000	$6,745,000	$4,235,000
Program Implementation (Agency Costs and Fees)									
Design&Construction	$180,631,108	$139,080,278	$107,757,628	$83,212,643	$194,021,337	$150,162,631	$131,070,521	$127,028,378	$53,248,034
Right of Way Purchase	$15,378,540	$11,064,506	$8,890,950	$7,414,575	$15,216,435	$8,340,124	$7,633,103	$9,569,156	$3,785,580
Vehicle Procurement	$7,152,500	$5,352,500	$3,042,500	$2,130,000	$7,977,500	$3,372,500	$4,502,500	$3,372,500	$2,117,500
E. Capital Cost Subtotal	**$1,222,149,072**	**$929,952,246**	**$698,187,544**	**$539,411,717**	**$1,306,940,144**	**$913,845,806**	**$836,924,843**	**$809,308,922**	**$353,254,288**
Project Reserve	$122,214,907	$92,995,225	$69,818,754	$53,941,172	$130,694,014	$91,384,581	$83,692,484	$80,930,892	$35,325,429
F. Total Capital Cost	**$1,344,363,980**	**$1,022,947,470**	**$768,006,299**	**$593,352,889**	**$1,437,634,158**	**$1,005,230,387**	**$920,617,328**	**$890,239,814**	**$388,579,717**

Note: All costs are in 2001 Dollars. Detailed cost information can be found in Appendix B

Table 4.0-9 Light Rail Capital Cost Summary (Embedded Track)

Item	Union Pacific Chandler Branch	Union Pacific Tempe Branch	Main (Option 1)	Main (Option 2)	Northern Avenue east of Grand	Northern Avenue west of Grand	Baseline Road	Metrocenter
Corridor Length (miles)	11.13	10.00	12.64	9.64	5.70	12.89	12.95	5.07
Subtotal-Civil Site Mods	$6,102,000	$1,716,000	$19,779,000	$15,173,000	$7,640,000	$17,002,750	$18,592,000	$6,433,000
Subtotal-Guideway	$9,108,928	$6,880,200	$14,350,820	$10,945,220	$25,944,600	$34,627,805	$34,685,640	$15,753,540
Subtotal-Utilities	$52,889,400	$47,520,000	$60,073,200	$45,817,200	$24,948,000	$61,296,300	$61,538,400	$24,116,400
Subtotal-Track	$32,627,060	$17,474,000	$73,422,800	$55,998,800	$26,268,000	$70,693,700	$70,989,600	$27,363,600
Subtotal-Stations	$28,582,500	$16,125,000	$19,170,000	$16,125,000	$9,612,500	$17,702,500	$18,625,000	$11,012,500
Subtotal-Systems & Electrical	$45,403,758	$33,196,400	$42,252,124	$32,809,204	$17,301,360	$40,754,991	$41,426,688	$16,462,148
Subtotal - Facilities	$8,000,000	$5,500,000	$7,500,000	$7,000,000	$3,500,000	$4,500,000	$6,000,000	$3,500,000
A. Construction Subtotal	**$182,713,646**	**$128,411,600**	**$236,547,944**	**$183,868,424**	**$115,214,460**	**$246,578,046**	**$251,857,328**	**$104,641,188**
Environmental Mitigation	$5,481,409	$3,852,348	$7,096,438	$5,516,053	$3,456,434	$7,397,341	$7,555,720	$3,139,236
B. Construction Cost Subtotal	**$188,195,055**	**$132,263,948**	**$243,644,382**	**$189,384,477**	**$118,670,894**	**$253,975,387**	**$259,413,048**	**$107,780,424**
C. Right of Way Subtotal	**$48,198,350**	**$38,267,000**	**$45,614,500**	**$35,511,600**	**$15,246,500**	**$43,802,525**	**$42,174,700**	**$17,632,000**
D. Vehicles Subtotal	**$75,600,000**	**$42,100,000**	**$65,950,000**	**$58,600,000**	**$34,250,000**	**$49,425,000**	**$49,450,000**	**$34,250,000**
Cost Contingencies (Uncertainties, Changes)								
Design&Construction	$47,048,764	$33,065,987	$60,911,096	$47,346,119	$29,667,723	$63,493,847	$64,853,262	$26,945,106
Right of Way	$14,459,505	$11,480,100	$13,684,350	$10,653,480	$4,573,950	$13,140,758	$12,652,410	$5,289,600
Vehicle Cost	$7,560,000	$4,210,000	$6,595,000	$5,860,000	$3,425,000	$4,942,500	$4,945,000	$3,425,000
Program Implementation (Agency Costs and Fees)								
Design&Construction	$58,340,467	$41,001,824	$75,529,759	$58,709,188	$36,787,977	$78,732,370	$80,418,045	$33,411,931
Right of Way Purchase	$7,229,753	$5,740,050	$6,842,175	$5,326,740	$2,286,975	$6,570,379	$6,326,205	$2,644,800
Vehicle Procurement	$3,780,000	$2,105,000	$3,297,500	$2,930,000	$1,712,500	$2,471,250	$2,472,500	$1,712,500
E. Capital Cost Subtotal	**$450,411,894**	**$310,233,909**	**$522,068,761**	**$414,321,604**	**$246,621,519**	**$516,554,016**	**$522,705,170**	**$233,091,361**
Project Reserve	$45,041,189	$31,023,391	$52,206,876	$41,432,160	$24,662,152	$51,655,402	$52,270,517	$23,309,136
F. Total Capital Cost	**$495,453,083**	**$341,257,300**	**$574,275,638**	**$455,753,764**	**$271,283,671**	**$568,209,417**	**$574,975,687**	**$256,400,497**

Note: All costs are in 2001 Dollars. Detailed cost information can be found in Appendix B

Light rail operating costs have estimated using a parametric model developed for the Tri-Met LRT system in Portland, Oregon. The model includes the number of stations, length of the alignment, number of vehicles in the fleet, vehicle service hours, and vehicle service miles. Model inputs have been adjusted by comparing bus operating costs for Valley Metro/RPTA with Tri-Met bus service. The use of these model inputs eliminates the need for comparisons between multiple light rail systems as was the case in developing commuter rail operating costs. Instead, the parametric model is designed to produce consistent results even when applied to different light rail systems in different metropolitan areas because the model is based upon the bus service costs within the metropolitan region. Operating costs are the same whether the light rail system is run on ballasted or embedded track. Table 4.0-10 summarizes the operating costs for 17 LRT corridors. Costs are in Year 2001 dollars. Detailed LRT operating costs are provided in Appendix B.

Table 4.0-10 **LRT Operating Cost Summary**

Corridor	Annual O&M Cost ($ millions)
59th Avenue	$11.35
Baseline Road	$8.16
Bell Road	$22.58
Camelback Road	$17.12
Chandler Boulevard	$9.79
Union Pacific Chandler Branch	$10.44
Glendale Avenue/Cactus Avenue	$11.14
I-10 West	$6.79
Main (Option 1)	$10.41
Main (Option 2)	$8.96
Metrocenter	$4.93
Northern (east of Grand Avenue)	$6.13
Northern (west of Grand Avenue)	$8.16
Power Road	$7.22
Scottsdale Road	$22.58
SR-51	$14.16
Union Pacific Tempe Branch	$6.66

Note: All figures in 2001 dollars

Bus Rapid Transit Operating and Capital Costs

BRT capital and operating costs have been developed for 20 corridors located across the MAG region. Two forms of BRT service are assumed. All services will operate at-grade along any type of alignment. Dedicated BRT with buses operating at-grade in an exclusive lane separate from automobile travel lanes has been assumed for arterial street and rail right-of-way corridors. The BRT service would be similar to light rail in terms of type of service and system cross-section, but with

smaller vehicles requiring higher frequencies to provide a comparable level of service. Consistent with the LRT capital cost estimates, a 27-foot wide cross-section is assumed to accommodate the new exclusive BRT lanes on arterial streets. The cost estimates for Dedicated BRT assume the replacement of any mixed-flow automobile lanes that are removed to accommodate the new BRT lanes. Express BRT is assumed in all freeway corridors, utilizing existing or proposed high occupancy vehicle (HOV) lanes to serve each corridor. No freeway lane widening or lane replacement is required to implement Express BRT service.

Dedicated BRT assumes stations approximately ¼ mile to one mile apart, while Express BRT serves park-and-ride lots three to five miles apart. Capital costs for the Dedicated and Express BRT corridors are summarized in Table 4.0-11. Detailed capital costs are available in Appendix C.

Table 4.0-11 Bus Rapid Transit Capital Cost Summary

Item	Bell Road	Camelback Road	Chandler Boulevard	Scottsdale Road	Power Road	Glendale Ave/Cactus Ave	Union Pacific Chandler Branch	Union Pacific Tempe Branch	Northern Avenue west of Grand	Main (Option 1)
Corridor Length (miles)	28.55	20.88	16.45	28.10	13.04	19.77	11.13	10.00	12.89	12.64
Subtotal-Civil/Roadway	$49,919,272	$37,100,214	$28,704,994	$54,296,955	$22,834,447	$21,114,350	$23,463,286	$17,208,800	$21,796,052	$21,754,791
Subtotal-Utilities	$22,615,350	$16,536,150	$13,031,400	$24,450,600	$10,329,600	$9,717,450	$10,798,500	$7,920,000	$9,851,700	$10,012,200
Subtotal-Stations	$38,880,000	$32,805,000	$26,730,000	$44,955,000	$20,655,000	$17,010,000	$20,655,000	$15,795,000	$13,365,000	$18,225,000
Subtotal-Systems & Electrical	$13,151,663	$10,894,057	$8,422,530	$15,164,076	$6,385,939	$5,800,731	$6,393,826	$4,724,000	$4,659,462	$6,114,833
Subtotal Facilities	$1,050,000	$1,050,000	$1,050,000	$1,050,000	$1,050,000	$1,050,000	$1,050,000	$1,050,000	$1,050,000	$1,050,000
A. Construction Subtotal	**$125,616,285**	**$98,385,421**	**$77,938,925**	**$139,916,631**	**$61,254,986**	**$54,692,531**	**$62,360,612**	**$46,697,800**	**$50,722,215**	**$57,156,825**
Environmental Mitigation	$3,768,489	$2,951,563	$2,338,168	$4,197,499	$1,837,650	$1,640,776	$1,870,818	$1,400,934	$1,521,666	$1,714,705
B. Construction Cost Subtotal	**$129,384,774**	**$101,336,984**	**$80,277,093**	**$144,114,130**	**$63,092,636**	**$56,333,307**	**$64,231,430**	**$48,098,734**	**$52,243,881**	**$58,871,529**
C. Right of Way Subtotal	**$99,527,725**	**$73,090,175**	**$58,533,800**	**$107,799,400**	**$46,882,900**	**$42,506,425**	**$50,865,350**	**$37,105,400**	**$43,118,650**	**$43,872,100**
D. Vehicles Subtotal	**$22,264,000**	**$16,456,000**	**$9,196,000**	**$23,716,000**	**$5,324,000**	**$15,004,000**	**$10,648,000**	**$8,228,000**	**$5,324,000**	**$9,680,000**
Cost Contingencies (Uncertainties, Changes)										
Design&Construction	$32,346,193	$25,334,246	$20,069,273	$36,028,532	$15,773,159	$14,083,327	$16,057,858	$12,024,684	$13,060,970	$14,717,882
Right of Way	$29,858,318	$21,927,053	$17,560,140	$32,339,820	$14,064,870	$12,751,928	$15,259,605	$11,131,620	$12,935,595	$13,161,630
Vehicle Cost	$2,226,400	$1,645,600	$919,600	$2,371,600	$532,400	$1,500,400	$1,064,800	$822,800	$532,400	$968,000
Program Implementation (Agency Costs and Fees)										
Design&Construction	$40,109,280	$31,414,465	$24,885,899	$44,675,380	$19,558,717	$17,463,325	$19,911,743	$14,910,608	$16,195,603	$18,250,174
Right of Way Purchase	$14,929,159	$10,963,526	$8,780,070	$16,169,910	$7,032,435	$6,375,964	$7,629,803	$5,565,810	$6,467,798	$6,580,815
Vehicle Procurement	$1,113,200	$822,800	$459,800	$1,185,800	$266,200	$750,200	$532,400	$411,400	$266,200	$484,000
E. Capital Cost Subtotal	**$371,759,048**	**$282,990,849**	**$220,681,674**	**$408,400,573**	**$172,527,317**	**$166,768,875**	**$186,200,989**	**$138,299,055**	**$150,145,097**	**$166,586,131**
Project Reserve	$37,175,905	$28,299,085	$22,068,167	$40,840,057	$17,252,732	$16,676,888	$18,620,099	$13,829,906	$15,014,510	$16,658,613
F. Total Capital Cost	**$408,934,953**	**$311,289,933**	**$242,749,842**	**$449,240,630**	**$189,780,049**	**$183,445,763**	**$204,821,088**	**$152,128,961**	**$165,159,606**	**$183,244,744**

Note: All costs are in 2001 Dollars.
Detailed cost information can be found in Appendix B

Table 4.0-11 Bus Rapid Transit Capital Cost Summary

Item	Main (Option 2)	Baseline Road	59th Avenue	US-60	Loop 101 West	Loop 101 East	Loop 202	Loop 303	I-17	I-10 Far West
Corridor Length (miles)	9.64	12.95	18.99	18.96	34.10	34.33	54.64	19.44	17.00	9.42
Subtotal-Civil/Roadway	$16,592,151	$22,675,396	$33,076,616	$0	$0	$0	$0	$0	$0	$0
Subtotal-Utilities	$7,636,200	$10,256,400	$15,043,350	$0	$0	$0	$0	$0	$0	$0
Subtotal-Stations	$14,580,000	$19,440,000	$32,805,000	$7,680,000	$11,520,000	$15,360,000	$21,120,000	$9,600,000	$3,840,000	$3,840,000
Subtotal-Systems & Electrical	$4,829,833	$6,241,000	$10,258,178	$520,000	$780,000	$1,040,000	$1,430,000	$650,000	$260,000	$260,000
Subtotal Facilities	$1,050,000	$1,050,000	$1,050,000	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000
A. Construction Subtotal	**$44,688,185**	**$59,662,796**	**$92,233,144**	**$8,450,000**	**$12,550,000**	**$16,650,000**	**$22,800,000**	**$10,500,000**	**$4,350,000**	**$4,350,000**
Environmental Mitigation	$1,340,646	$1,789,884	$2,766,994	$253,500	$376,500	$499,500	$684,000	$315,000	$130,500	$130,500
B. Construction Cost Subtotal	**$46,028,830**	**$61,452,680**	**$95,000,139**	**$8,703,500**	**$12,926,500**	**$17,149,500**	**$23,484,000**	**$10,815,000**	**$4,480,500**	**$4,480,500**
C. Right of Way Subtotal	**$33,769,200**	**$45,791,500**	**$67,252,775**	**$6,969,600**	**$10,454,400**	**$13,939,200**	**$19,166,400**	**$8,712,000**	**$3,484,800**	**$3,484,800**
D. Vehicles Subtotal	**$7,744,000**	**$7,744,000**	**$14,520,000**	**$2,376,000**	**$3,960,000**	**$4,356,000**	**$6,732,000**	**$1,980,000**	**$1,980,000**	**$1,584,000**
Cost Contingencies (Uncertainties, Changes)										
Design&Construction	$11,507,208	$15,363,170	$23,750,035	$2,175,875	$3,231,625	$4,287,375	$5,871,000	$2,703,750	$1,120,125	$1,120,125
Right of Way	$10,130,760	$13,737,450	$20,175,833	$2,090,880	$3,136,320	$4,181,760	$5,749,920	$2,613,600	$1,045,440	$1,045,440
Vehicle Cost	$774,400	$774,400	$1,452,000	$237,600	$396,000	$435,600	$673,200	$198,000	$198,000	$158,400
Program Implementation (Agency Costs and Fees)										
Design&Construction	$14,268,937	$19,050,331	$29,450,043	$2,698,085	$4,007,215	$5,316,345	$7,280,040	$3,352,650	$1,388,955	$1,388,955
Right of Way Purchase	$5,065,380	$6,868,725	$10,087,916	$1,045,440	$1,568,160	$2,090,880	$2,874,960	$1,306,800	$522,720	$522,720
Vehicle Procurement	$387,200	$387,200	$726,000	$118,800	$198,000	$217,800	$336,600	$99,000	$99,000	$79,200
E. Capital Cost Subtotal	**$129,675,915**	**$171,169,456**	**$262,414,740**	**$26,415,780**	**$39,878,220**	**$51,974,460**	**$72,168,120**	**$31,780,800**	**$14,319,540**	**$13,864,140**
Project Reserve	$12,967,592	$17,116,946	$26,241,474	$2,641,578	$3,987,822	$5,197,446	$7,216,812	$3,178,080	$1,431,954	$1,386,414
F. Total Capital Cost	**$142,643,507**	**$188,286,401**	**$288,656,214**	**$29,057,358**	**$43,866,042**	**$57,171,906**	**$79,384,932**	**$34,958,880**	**$15,751,494**	**$15,250,554**

Note: All costs are in 2001 Dollars.
Detailed cost information can be found in Appendix B

Operating costs for the BRT corridors were estimated using the Year 2001 National Transit Database data for Valley Metro/RPTA bus service. The costs for vehicle revenue hour and vehicle revenue mile were used as a base for estimating BRT service costs. As mentioned above, Dedicated BRT service is capable of providing a level of service that is comparable to LRT service, but additional vehicles and increased frequencies are usually required to serve the same number of passengers. A summary of the BRT operating costs is presented in Table 4.0-12.

Table 4.0-12 **BRT Operating Cost Summary**

Corridor	Annual O&M (millions $)
59th Avenue	$10.29
Baseline Road	$5.35
Bell Road	$15.64
Camelback Road	$11.53
Chandler Boulevard	$6.59
Union Pacific Chandler Branch	$7.41
Glendale Avenue/Cactus Avenue	$10.71
I-10 Far West	$1.52
I-17	$2.27
Loop 101 East	$5.21
Loop 101 West	$4.63
Loop 202	$8.11
Loop 303	$2.31
Main (Option 1)	$7.00
Main (Option 2)	$5.35
Northern (west of Grand Avenue)	$3.71
Power Road	$3.71
Scottsdale Road	$15.23
Union Pacific Tempe Branch	$5.77
US-60	$2.88

Note: All figures in 2001 dollars

4.0.2 Refine Threshold and Performance Measures

Minimum thresholds for the operation of high capacity transit systems were identified in Milestone 2 following the review of several peer group transit systems located throughout North America. These measures have been used to identify a set of criteria that will be used to evaluate the 28 potential high capacity transit corridors. These criteria are:

- Population Density
- Employment Density
- Environmental Justice Population Density

- Boardings per Mile
- Capital Cost per Mile
- Land Use Opportunities
- Right-of-Way Impacts
- Natural Resources Impacts
- Cost Effectiveness

The results of this evaluation are presented in Section 4.3.

Included in this section is a forecast of the potential revenues and farebox recovery rates for each of the transit corridors and a discussion of the role that bus feeder networks will play in a high capacity transit network. These discussions are designed to present a fuller picture of all the elements and operating characteristics of a high capacity transit system.

Revenue Forecasts

The fare structure and fare levels for high capacity BRT, LRT and express bus services will need to be pegged to the existing Valley Metro/RPTA system, since these high capacity modes are similar or identical to Valley Metro/RPTA services. Public discussion has focused on the desirability of maintaining a seamless fare structure for all services operating under the Valley Metro/RPTA umbrella, extending as well to the Central Phoenix/East Valley LRT service. Commuter rail fare policies and fare levels can and should be different from the other transit modes. A more complex fare structure encompassing zone-based and off-peak fares is desirable. Fare levels for commuter rail should reflect a comparison to other peer systems, but also take into considerations such as the cost of living and propensity to use transit in the MAG region.

The average fare per passenger for the Valley Metro/RPTA system for the year ended June 30, 2001 was $0.66. This fare was used to develop revenue projections for the BRT, LRT, and express bus corridors shown in Table 4.0-13.

Table 4.0-13 **Farebox Revenue Forecast: BRT, LRT and Express Bus Corridors**

Corridor	Length (Miles)	Estimated Daily Boardings	Mode	Annual Passengers	Annual Revenue at FY 2000 Valley Metro/RPTA Average Fare
59th Avenue	19	19,594	BRT/LRT	7,151,976	$4,720,304
Baseline Road	13	8,199	BRT/LRT	2,992,469	$1,975,029
Bell Road	28	28,661	BRT/LRT	10,461,159	$6,904,365

Corridor	Length (Miles)	Estimated Daily Boardings	Mode	Annual Passengers	Annual Revenue at FY 2000 Valley Metro/RPTA Average Fare
Camelback Road	20	24,020	BRT/LRT	8,767,384	$5,786,473
Chandler Boulevard	17	12,507	BRT/LRT	4,565,153	$3,013,001
Union Pacific Chandler Branch	12	19,490	BRT/LRT	7,113,668	$4,695,021
Glendale Avenue/Cactus Avenue	19	14,295	BRT/LRT	5,217,605	$3,443,619
I-10 West	12	11,386	BRT/LRT	4,155,709	$2,742,768
I-10 Far West	9	510	Express BRT	186,298	$122,956
I-17	9	377	Express BRT	137,528	$90,768
Loop 101 East	36	1,108	Express BRT	404,558	$267,008
Loop 101 West	28	1,163	Express BRT	424,560	$280,210
Loop 202	56	1,788	Express Bus	652,467	$430,628
Loop 303	22	485	Express BRT	177,035	$116,843
Main Street (Option 1)	12	12,090	BRT/LRT	4,412,766	$2,912,426
Main Street (Option 2)	9	9,674	BRT/LRT	3,530,842	$2,330,356
Metrocenter	3	5,062	LRT	1,847,570	$1,219,396
Northern (East of Grand Ave)	6	7,266	LRT	2,652,219	$1,750,464
Northern (West of Grand Ave)	13	4,700	BRT/LRT	1,715,507	$1,132,235
Northern (Total)	19	11,966	BRT/LRT	4,367,726	$2,882,699
Power Road	11	10,496	BRT/LRT	3,831,214	$2,528,601
Scottsdale Road	29	27,182	BRT/LRT	9,921,518	$6,548,202
SR-51	16	9,988	LRT	3,645,505	$2,406,033
Union Pacific Tempe Branch	10	8,010	BRT/LRT	2,923,540	$1,929,537
US-60	18	1,362	Express BRT	497,173	$328,134

The proposed commuter rail fare structure is presented in Table 4.0-14. It represents a balance between a reasonable full fare and appropriate levels of discounts for monthly pass users and off peak riders. Seniors, disabled, and youth are eligible for the discount fare. All passengers are eligible for the discount fare during off-peak hours.

Table 4.0-14 **Proposed Commuter Rail Fare Structure**

Mileage	Zone	Full Fare	Discount Fare At 55%	Monthly Pass At 30 Times Full Fare	Fare Per Mile (At Highest Mileage in Zone)		
					Full Fare	Discount	Monthly/40
0-10	1	$2.75	$1.50	$82.50	$0.28	$0.15	$0.21
10-15	2	$3.25	$1.75	$97.50	$0.22	$0.12	$0.16

Mileage	Zone	Full Fare	Discount Fare At 55%	Monthly Pass At 30 Times Full Fare	Fare Per Mile (At Highest Mileage in Zone)		
					Full Fare	Discount	Monthly/40
15-20	3	$4.00	$2.25	$120.00	$0.20	$0.11	$0.15
20-30	4	$5.00	$2.75	$150.00	$0.17	$0.09	$0.13
30-40	5	$6.25	$3.50	$187.50	$0.16	$0.09	$0.12
40-50	6	$7.00	$3.75	$210.00	$0.14	$0.08	$0.11
Over 50	7	$7.50	$4.00	$225.00	$0.14	$0.08	$0.11

Table 4.0-15 provides the resulting annual revenue forecast.

Table 4.0-15 **Annual Farebox Revenue by Corridor**

Corridor	Phase 1	Phase 2	Phase 3
BNSF	$2,479,511	$5,956,898	$6,673,695
UP Mainline/Chandler	$1,244,244	$2,989,451	$3,348,523
UP Southeast	$3,002,693	$7,219,965	$8,088,197
UP Yuma	$1,959,941	$4,709,528	$5,273,338

Feeder Networks Role

Even though the majority of feeder networks are expected to be provided by the existing transit network, there will be at least one alternative and select stations where feeder services may be warranted. While there are no quantitative criteria for determining when a feeder service is desirable or has a high likelihood for success, there are several qualitative criteria that are appropriate to consider when planning for feeder services. The five planning criteria presented in this report are listed below and further discussed in Section 4.2.4.

- Proximity to employment sites and limited or no existing transit service
- Capacity constraints as defined by parking availability and affordability
- Direct transit service connections to nearby activity centers
- Community support
- Private sector funding

As with any new service, it is important to evaluate whether it is successful. The key question is, "What defines success?" While there are many factors that contribute to the success of a service, there are a small number of performance measures that are standard in the transit industry. For a feeder network, performance expectations address passenger productivity, cost effectiveness and the

level of financial support. These are discussed in further detail including specific performance targets in the following sections.

4.0.3 Evaluate Alternatives

Using the criteria set out in Section 4.2 each of the 28 potential high capacity transit corridors was subjected to a screening and evaluation process in order to determine a priority corridor selection list. The corridors have been placed into three tiers based upon the results of the evaluation. The first two tiers of corridors will be recommended to continue on to Milestone 5 for further refinement and evaluation for the final recommended High Capacity Transit network. In Milestone 5 a further review of the corridor characteristics and specific transit technologies will take place to finalize the recommended network.

Population and Employment Data

The population, employment, and environmental justice data collected for each of the corridors is presented in Table 4.0-16. Population and employment data has been collected using future projections for the MAG region. The ethnicity data used in the environmental justice category is 2002 data since future projections of this information are not available. All data presented has been collected from a one-mile wide (½ mile each side) area around each corridor. This collection area represents a more refined level of data than that collected in Milestone 2. The ½ mile distance is accepted as the most common maximum distance a prospective transit rider will walk to access transit station. While some riders would access the corridor from beyond the ½ mile boundary, it is assumed that a substantial majority of system riders would originate from within the ½ mile boundary.

Table 4.0-16 **Population and Employment Corridor Data**

Corridor	Length (miles)	Population Density (per mile)	Total Population	Employment Density (per mile)	Total Employment	Environmental Justice Density (per mile)	Environmental Justice Population
59th Avenue	18.99	13,533	257,125	6,042	114,802	2,856	54,257
Baseline Road	12.95	17,522	227,792	4,323	56,204	2,558	33,257
Bell Road	28.55	10,527	300,019	4,644	132,356	904	25,757
BNSF	27.73	8,941	247,665	5,651	156,521	2,262	62,665
Camelback Road	20.88	13,107	273,678	7,918	165,323	3,696	77,166
Chandler Boulevard	16.45	10,503	172,773	5,954	97,946	1,731	28,467
Union Pacific Chandler Branch	11.13	10,138	112,841	9,732	108,313	1,957	21,782
Glendale Avenue/Cactus Aven	19.77	10,378	205,180	7,049	139,356	1,613	31,897
I-10 Express Bus	9.4	13,125	123,639	3,945	37,163	589	5,546
I-10 West	11.05	14,611	160,723	10,726	117,985	4,730	52,029
I-17	17	5,537	94,131	3,637	61,834	110	1,864
Loop 101 East	34.33	6,983	239,533	5,682	194,893	760	26,063
Loop 101 West	34.1	8,303	283,134	2,872	97,922	735	25,079
Loop 202	54.6	7,354	401,505	5,564	303,790	982	53,613
Loop 303	19.44	6,403	124,476	1,514	29,441	82	1,588
Main (Option 1)	12.64	14,284	180,552	4,976	62,897	1,762	22,275
Main (Option 2)	9.64	15,120	145,752	5,553	53,529	2,144	20,670
Metrocenter	5.07	18,197	90,985	14,751	73,754	4,763	23,814
Northern east of Grand Avenue	5.7	19,380	110,465	8,863	50,520	3,713	21,164
Northern west of Grand Avenue	12.89	4,357	56,162	1,704	21,970	334	4,306
Power Road	13	8,396	109,149	4,661	60,597	386	5,015
Scottsdale Road	28.1	8,881	249,548	8,170	229,569	1,097	30,826
SR-51	17.12	10,814	184,918	6,146	105,099	1,807	30,901
Union Pacific Tempe Branch	10	8,450	84,498	11,699	116,994	1,683	16,827
Union Pacific Mainline/Chandle	25.95	12,397	321,693	13,811	358,405	2,960	76,809
Union Pacific Southeast	36.18	9,860	356,735	8,819	319,072	1,876	67,868
Union Pacific Yuma	30.9	7,661	236,721	5,568	172,055	1,287	39,756
US-60	18	12,884	231,918	9,267	166,807	2,122	38,193

Ridership and Cost Effectiveness

The daily ridership and capital cost figures presented in Table 4.0-17 were obtained from the planning level estimates of ridership and capital costs developed in Section 4.1. The capital cost data summarized for the potential LRT corridors represents the estimated cost of a system running on ballasted track. This cost estimate is the lower of the two alternative cost estimates provided in Section 4.1. Dedicated BRT costs assume exclusive lanes for the BRT vehicles, while Express BRT services are assumed to operating within the existing for future high occupancy vehicle (HOV) network on the MAG region freeways. Express BRT costs include costs for new or additional park-and-ride lots throughout the corridor.

Included in the final column of Table 4.0-17 is a category for "cost-effectiveness". Cost effectiveness is a measure used by the Federal Transit Administration (FTA) as part of the Section 5309 "New Starts" program. This program allocates federal capital funding for major transit investment projects. For the purposes of the New Starts evaluation process the cost effectiveness of the project is measured using the following calculation:

(Project annualized capital cost + Project annual operating cost) – (Baseline annualized capital cost + Baseline annual operating cost) / (Total Project Annual Riders – Total Baseline Annual Riders) = Cost Effectiveness

This calculation relies upon a baseline of future transit assumptions and difference between the proposed project and this baseline set of improvements. The corridors and high capacity transit systems here have not been matched to a specific baseline level of transit investment, making it impossible to exactly match the calculation above. Instead, a modified calculation of cost effectiveness has been selected for this portion of the evaluation. This calculation is illustrated below:

(Project Annualized Capital Cost + Project Annual Operating Cost) / Project Annual Boardings = Cost Effectiveness

The annualized figure for capital cost is obtained by multiplying the total project capital cost by 0.08 to annualize the figure over the expected useful life of the improvements. Boardings are annualized by multiplying the weekday boarding figure by an annualization factor of 300. In the case of corridors identified as possibly LRT or Dedicated BRT, the LRT cost-effectiveness figure has been presented.

Table 4.0-17 **Ridership and Capital Cost Corridor Data**

Corridor	Length (miles)	Boardings per Mile	Boardings	Capital Cost per Mile (Rail)	Total Cost Rail	Capital Cost per Mile (BRT)	Total Cost BRT	Cost Effectiveness*
59th Avenue	18.99	1,031	19,594	$40.42	$767,583,537	$15.20	$288,656,214	$12.38
Baseline Road	12.95	633	8,199	$37.43	$484,767,233	$14.54	$188,286,401	$19.08
Bell Road	28.55	1,006	28,661	$39.85	$1,137,648,332	$14.32	$408,934,953	$13.21
BNSF	27.73	289	8,026	$23.43	$649,790,860			$29.17
Camelback Road	20.88	1,150	24,020	$42.20	$881,031,820	$14.91	$311,289,933	$12.16
Chandler Boulevard	16.45	760	12,507	$39.63	$651,892,808	$14.76	$242,749,842	$16.51
Union Pacific Chandler Branch	11.13	1,751	19,490	$44.56	$495,968,571	$18.40	$204,821,088	$8.57
Glendale Avenue/Cactus Aven	19.77	723	14,295	$46.16	$912,561,956	$9.28	$183,445,763	$19.62
I-10 Express Bus	9.4	54	510			$1.62	$15,250,554	$17.91
I-10 West	11.05	1,035	11,386	$35.17	$388,579,717			$11.09
I-17	17	22	377			$0.93	$15,751,494	$31.21
Loop 101 East	34.33	32	1,108			$1.67	$57,171,906	$29.43
Loop 101 West	34.1	34	1,163			$1.29	$43,866,042	$23.33
Loop 202	54.6	33	1,788			$1.45	$79,384,932	$26.96
Loop 303	19.44	25	485			$1.80	$34,958,880	$35.10
Main (Option 1)	12.64	956	12,090	$36.12	$456,591,987	$14.50	$183,244,744	$12.94
Main (Option 2)	9.64	1,004	9,674	$37.40	$360,494,426	$14.80	$142,643,507	$13.02
Metrocenter	5.07	1,012	5,062	$43.40	$220,041,821			$14.84
Northern east of Grand Avenue	5.7	1,275	7,266	$43.66	$248,866,900			$11.95
Northern west of Grand Avenue	12.89	365	4,700	$36.82	$474,646,663	$12.81	$165,159,606	$32.72
Power Road	13	807	10,496	$38.32	$498,204,101	$14.60	$189,780,049	$14.95
Scottsdale Road	28.1	967	27,180	$44.27	$1,244,016,770	$15.99	$449,240,630	$14.97
SR-51	17.12	584	9,988	$48.93	$837,666,349			$27.09
Union Pacific Tempe Branch	10	801	8,010	$34.13	$341,257,300	$15.21	$152,128,961	$14.13
Union Pacific Mainline/Chandle	25.95	129	3,346	$20.78	$539,294,340			$56.96
Union Pacific Southeast	36.18	189	6,832	$17.81	$644,535,771			$35.70
Union Pacific Yuma	30.9	210	6,499	$13.26	$409,676,851			$27.04
US-60	18	76	1,362			$1.61	$29,057,358	$12.74

** Cost effectiveness is calculated using the annualized capital cost plus the annual operating cost divided by the annual boardings*

Land Use, Right-of-Way, Natural Resources Opportunities and Impacts

A review of the existing and future land use characteristics in each corridor was preformed to rate the corridors in three categories:

- Opportunities for redevelopment and transit oriented development
- Right-of-Way Impacts
- Impacts to Natural Resources

Table 4.0-18 summarizes the results from each of these reviews.

Table 4.0-18 **Summary of Land Use, Right-of-Way, Natural Resources Opportunities and Impacts**

Corridor	Land Use Opportunities	Right-of-Way Impacts	Natural Resources Impacts
59th Avenue	High	Low	Medium
Baseline Road	Medium	Low	Low
Bell Road	Medium	Medium	Medium
BNSF	High	Low	Low
Camelback Road	High	High	Low
Chandler Boulevard	Medium	Low	Medium
Union Pacific Chandler Branch	High	Low	Medium
Glendale Avenue/Cactus Avenue	Low	Low	Medium
Interstate 10 West	Medium	Low	Low
Interstate 10 Far West	Low	Low	Low
I-17	Low	Low	Low
Loop 101 East	Low	Low	Low
Loop 101 West	Low	Low	Low
Loop 202	Low	Low	Low
Loop 303	Low	Low	Low
Main Street (Option 1)	High	Low	Low
Main Street (Option 2)	High	Low	Low
Metrocenter	Medium	High	Low
Northern Avenue (east of Grand Avenue)	High	Medium	Low
Northern Avenue (west of Grand Avenue)	Low	Low	Medium
Power Road	High	Low	Low
Scottsdale Road	High	Medium	Medium
SR-51	Medium	Medium	Medium

Corridor	Land Use Opportunities	Right-of-Way Impacts	Natural Resources Impacts
Union Pacific Tempe Branch	Medium	Low	Low
Union Pacific Mainline/Chandler	High	Low	Medium
Union Pacific Southeast	High	Low	Low
Union Pacific Yuma	High	Low	Low
US-60	Medium	Low	Low

Recommended High Capacity Transit Options

This evaluation process has resulted in the identification of a set of high capacity transit corridors which will be carried forward into Milestone 5 for further refinement during the development of a recommended high capacity transit network.

Table 4.0-20 summarizes the results of the corridor evaluation process that has been undertaken for the 28 high capacity transit corridors. This evaluation includes the data collected for population, employment, and environmental justice, as well as the results of the estimates of ridership and capital costs, observations on land use, and possible impacts to the corridor.

Each corridor has received a rating in each of the evaluation categories in order to allow for a comparison between the corridors in each category. This rating represents how positive the evaluation result is in comparison to the capability of the corridor to support high capacity transit service. The ratings and their general meanings are presented below:

- = Very Supportive
- = Supportive
- = Neutral
- = Not Supportive
- = Significant Constraint

Ratings were assigned for each corridor in the various categories using an equal interval method. Table 4.0-19 presents the rating applied to a range of values under each evaluation criteria.

Table 4.0-19 **Evaluation Criteria Rating Assignments**

Criteria	Significant Constraint	Not Supportive	Neutral	Supportive	Very Supportive
Population Density (sqmi)	0 – 4,000	4,001 – 8,000	8001 – 12,000	12,001- 16,000	16,001 – 20,000
Employment Density (sqmi)	0 – 3,000	3,001 – 6,000	6,001 – 9,000	9,001 – 12,000	12,001 – 15,000
Environmental Justice Density	0 – 1,000	1,001 -2,000	2,001 – 3,000	3,001 – 4,000	4,001 – 5,000
Boardings per Mile	0 – 350	351 – 700	701 – 1,050	1,051 – 1,400	1,401 – 1,750
Capital Cost per Mile ($ millions)	$50 - $40	$40 - $30	$30 - $20	$20 - $10	$10 - $0
Land Use Opportunities	n/a	Low	Medium	High	n/a
Right-of-Way Impacts	n/a	High	Medium	Low	n/a
Natural Resources Impacts	n/a	High	Medium	Low	n/a
Cost Effectiveness	$60.00 – $48.01	$48.00 – $36.01	$36.00 - $24.01	$24.00 - $12.01	$12.00 - $0.00

Table 4.0-20 **Evaluation Results**

Corridor	Length (miles)	Population Density (per mile)	Employment Density (per mile)	Envir. Justice Density (per mile)	Boardings per Mile	Capital Cost per Mile	Land Use	Right-of-Way	Natural Resources	Cost Effectiveness*
59th Avenue	18.99	13,533	6,042	2,856	1,031	$40.42				$12.38
										
Baseline Road	12.95	17,522	4,323	2,558	633	$37.43				$19.08
										
Bell Road	28.55	10,527	4,644	904	1,006	$39.85				$13.21
										
BNSF	27.73	8,941	5,651	2,262	289	$23.43				$29.17
										
Camelback Road	20.88	13,107	7,918	3,696	1,150	$42.20				$12.16
										
Chandler Boulevard	16.45	10,503	5,954	1,731	760	$39.63				$16.51
Union Pacific Chandler Branch	11.13	10,138	9,732	1,957	1,751	$44.56				$8.57
Glendale Avenue/Cactus Avenue	19.77	10,378	7,049	1,613	723	$46.16				$19.62
I-10 Express Bus	9.4	13,125	3,945	589	54	$1.62				$17.91
I-10 West	11.05	14,611	10,726	4,730	1,035	$35.17				$11.09
I-17	17	5,537	3,637	110	22	$0.93				$31.21
Loop 101 East	34.33	6,983	5,682	760	32	$1.67				$29.43
Loop 101 West	34.1	8,303	2,872	735	34	$1.29				$23.33
Loop 202	54.6	7,354	5,564	982	33	$1.45				$26.96
Loop 303	19.44	6,403	1,514	82	25	$1.80				$35.10
Main (Option 1)	12.64	14,284	4,976	1,762	956	$36.12				$12.94
Main (Option 2)	9.64	15,120	5,553	2,144	1,004	$37.40				$13.02
Metrocenter	5.07	18,197	14,751	4,763	1,012	$43.40				$14.84
Northern east of Grand Avenue	5.7	19,380	8,863	3,713	1,275	$43.66				$11.95
Northern west of Grand Avenue	12.89	4,357	1,704	334	365	$36.82				$32.72
Power Road	13	8,396	4,661	386	807	$38.32				$14.95
Scottsdale Road	28.1	8,881	8,170	1,097	967	$44.27				$14.97
SR-51	17.12	10,814	6,146	1,807	584	$48.93				$27.09
Union Pacific Tempe Branch	10	8,450	11,699	1,683	801	$34.13				$14.13
Union Pacific Mainline/Chandler	25.95	12,397	13,811	2,960	129	$20.78				$56.96
Union Pacific Southeast	36.18	9,860	8,819	1,876	189	$17.81				$35.70
Union Pacific Yuma	30.9	7,661	5,568	1,287	210	$13.26				$27.04
US-60	18	12,884	9,267	2,122	76	$1.61				$12.74

During the evaluation process, it was determined that rating the various forms of high capacity transit technologies was difficult using the same scale and measures. Each technology has very different characteristics in terms of costs, ridership, and the type of service provided. Some qualifications to the evaluation results for Express BRT and Commuter Rail were made to reflect the differing characteristics of these transit technologies.

Express BRT Corridors

The Express BRT corridors have been separated out from the evaluation for several reasons. Express BRT has dramatically different operating characteristics when compared to other forms of high capacity transit such as LRT and Dedicated BRT. Many Express BRT systems in North America operate only during peak commute times. Systems with service during off-peak periods operate a minimal amount of service, approximately every hour. These service levels are limited compared to projections of LRT and Dedicated BRT service in the MAG region with 5 to 10 minute headways in the peak periods and 15 to 20 minute service during off-peak times. Even the Phase 3 commuter rail service would provide more frequent service during both peak and off-peak times, while carrying more passengers per mile. The boarding figures projected for the Express BRT corridors achieve a maximum of 76 passengers per mile even with an assumed minimal off-peak service. This figure is noticeably less than the lowest boarding figure for a LRT/Dedicated BRT corridor of 584 passengers per mile.

The capital costs of these corridors are also not comparable to the other technologies since Express BRT requires a substantially lower amount of capital investment when compared to other forms of transit. The High Capacity Transit plan is designed to evaluate transit systems capable of being classified as Major Investment Studies (MIS). This type of study is undertaken by public agencies to analyze the benefits and costs of major transportation infrastructure projects such as an LRT system or a new freeway. The construction of an LRT or Dedicated BRT project studied as part of an MIS has a distinctly different set of benefits and trade-offs in terms of costs, riders, and corridor impacts when compared to implementing Express BRT service in an existing freeway corridor, requiring minimal capital improvements. These distinctive differences limit the ability of Express BRT to be compared to LRT and Dedicated BRT systems on an equal footing.

As a result of these distinctions in the ridership and cost characteristics of this technology, the Express BRT corridors will not be included in further evaluation processes. However, the benefits of Express BRT including low capital cost and simple implementation are recognized in this study. Therefore, the seven Express BRT corridors are recommended for incorporation into the base transit network. Further evaluation and refinement of these corridors could occur as part of Valley Metro/RPTA's Regional Transit System Study. Additional coordination and consultation will occur with Valley Metro/RPTA to evaluate these corridors. The seven Express BRT corridors are:

- I-10 Far West – Loop 101 to Loop 303
- I-17 – Loop 101 to Anthem Way
- Loop 101 East – I-17 to Queen Creek Road
- Loop 101 West – I-17 to Baseline Road (via 91st Avenue)
- Loop 202 – I-10/SR-51/Loop 202 Interchange to I-10 South Interchange
- Loop 303 – I-10 to Grand Avenue
- US-60 – I-10 to Idaho Road

Commuter Rail Corridors

As shown in Table 4.0-20, as a group the commuter rail corridors do not perform as well as the LRT/Dedicated BRT corridors. This is not to suggest that commuter rail in its entirety is infeasible. However, several basic factors underlie the unfavorable comparison of commuter rail with other corridors:

- High capital costs per mile for the implementation of full service operation
- Poor level of infrastructure investment and need for second main track in several corridors

The assessment of commuter rail in the MAG region performed as part of this Milestone indicates that, in terms of ridership, the lines would perform on par with recent commuter rail systems in the West. However, there are significant challenges to implementing commuter rail in the MAG region in terms of cost. The rail corridors in the MAG region have been optimized over the years for the service they provide today – a local-serving freight operation. As a result, projections twenty or more years into the future looking at a fully mature commuter rail service would require significant upgrades with a second track, centralized traffic control and other necessities for a safe and reliable mature system. This requires a significant investment in rail infrastructure, on par with projected costs for the BRT and LRT systems also under evaluation.

Nevertheless, Milestone 4 recognizes two factors. First, while cost-effectiveness is extremely important from both a "good planning" perspective and its match with Federal funding criteria, other factors must also be considered, such as the need for good regional connectivity. Second, it is possible that a more modest "start-up" operation featuring a more focused peak-only service and/or smaller, more maneuverable diesel multiple unit (DMU) trains could be implemented with fewer capital investments, thus improving short-term cost-effectiveness. While this does not change conclusions about investments that would be required in the long-term for an "ultimate" commuter rail system, a start-up service can nevertheless provide significant benefits in the short-term. Milestone 5 will look at the cost-effectiveness and mobility benefits of the start-up (Phase 1) and intermediate (Phase 2) level of service in more detail.

The study, in moving to refining the preferred network in Milestone 5, will continue to consider commuter rail. Several scenarios will be evaluated in the next Milestone. Alternatives will include reverse commute service in the Union Pacific Yuma and Union Pacific Southeast corridors to the Palo Verde and Williams Gateway employment centers, alternative or additional station locations to identify possible new ridership opportunities, availability of operating windows during start-up phases of service to reduce capital investment requirements, and an assessment of the DMU technology within each corridor. Although untried technology does not form part of the scope of work, there are new low-cost alternatives to the traditional heavy locomotive-hauled service which are coming onto the market, although are not yet Federal Railroad Administration (FRA) certified for use on mixed passenger-freight rail corridors.

Some of DMU products are understood to be close to being certified for the kind of application envisaged on the MAG rail corridors, and would merit consideration in Milestone 5 for several reasons including the long term horizon date for implementing study recommendations, evidence of lower capital costs, and the improved efficiency and quality of service offered by DMU technology.

LRT/Dedicated BRT Corridors

The 17 LRT/Dedicated BRT corridors have been placed into three groups: A, B, and C. The corridors contained in Groups A and B are recommended to be carried forward into Milestone 5 where they will be further refined in terms of cost, ridership, and appropriate technology. Group C corridors will not be evaluated further in Milestone 5.

Group A corridors have received this designation as a result of receiving an above average rating in the cost-effectiveness category, as well as performing well in the other evaluation criteria. These corridors represent the "best of best" with reasonable costs, minimal impacts to surrounding land uses, and high population and employment figures. Ridership in these corridors also compares well to ridership figures on several of the peer group high capacity transit services examined in Milestone 2. The six Group A corridors are:

- 59th Avenue
- Camelback Road
- Union Pacific Chandler Branch
- Metrocenter
- Northern Avenue (to Loop 101)
- I-10 West

Group B corridors did not score as well the six Group A corridors in the cost effectiveness category. These corridors have some constraints or characteristics

which have resulted in higher costs than the corridors presented in Group A. However, the Group B corridors also have high ridership figures that are comparable to those generated by the Group A corridors and also serve dense corridors capable of supporting high capacity transit. The cost estimates of these corridors will be refined further in Milestone 5, allowing for some opportunity to reduce the overall cost of these corridors and improve cost effectiveness ratings. The seven corridors included in Group B are listed below:

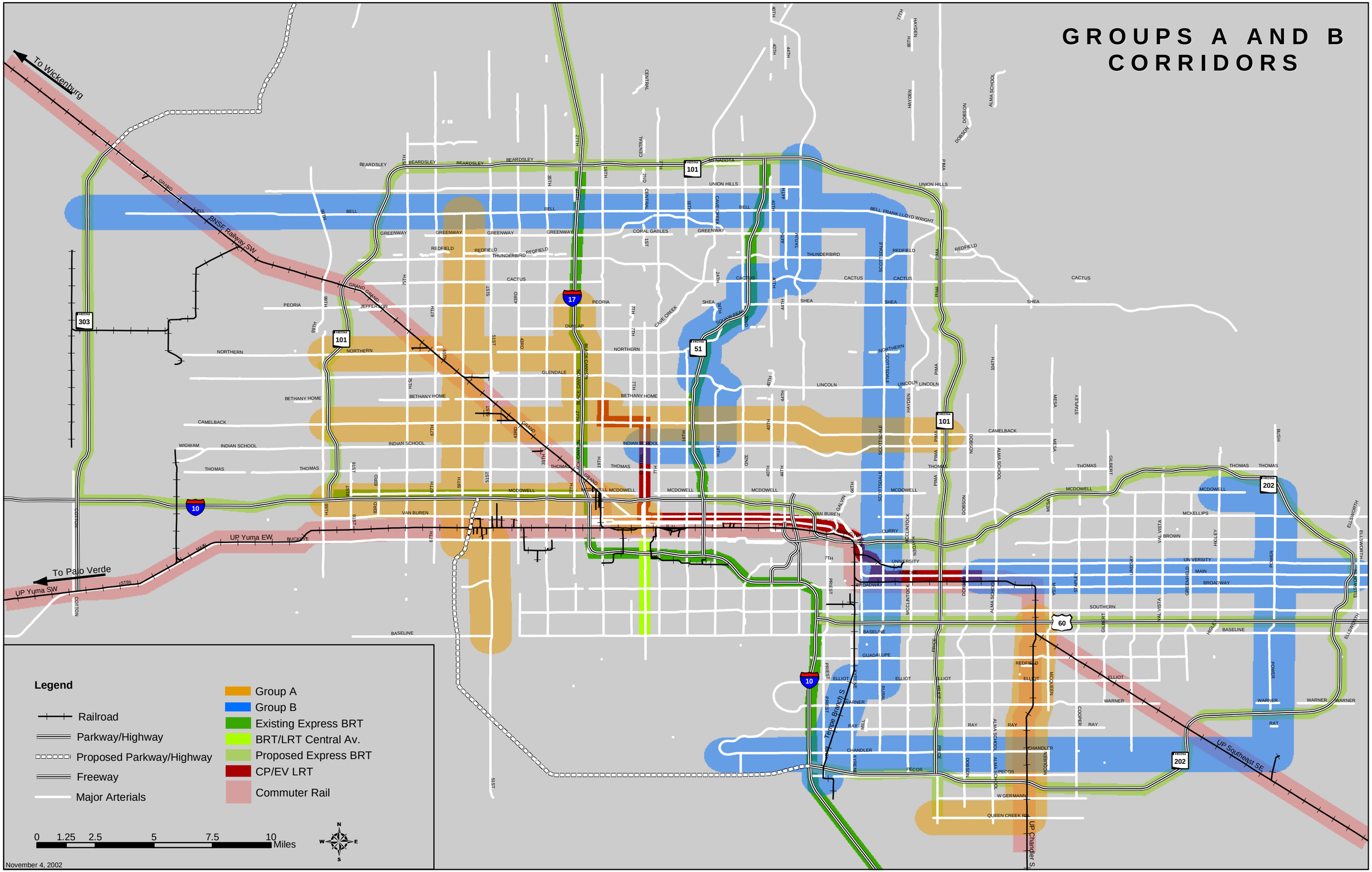
- Bell Road
- Chandler Boulevard
- Main Street (Option 2)
- Power Road
- Scottsdale Road
- SR-51
- UP Tempe Branch

Group C corridors will not be carried forward for further evaluation. Corridors in this group have not deemed to serve a high number of riders or in the case of Main Street (Option 1) overlap another corridor selected for inclusion in Group A and B. The Group C corridors are:

- Baseline Road – although the corridor traverses an area of high population density, this corridor did not generate a high number of riders due to limit employment centers in the corridor
- Main Street (Option 1) – this corridor is duplicative of Main Street (Option 2), but does not perform as well.
- Glendale Avenue/Cactus Avenue – This is very similar to the SR-51 corridor; SR-51 was selected since it is more consistent with the current MAG Long Range Transportation Plan.

Based upon discussions with several local agencies in the MAG region, some modifications to the Group A and B LRT/Dedicated BRT corridors will likely be made in Milestone 5. These adjustments include extensions of the Northern Avenue corridor from Grand Avenue to Loop 101 and the Metrocenter Corridor from Peoria Avenue to Loop 101. In addition, portions of some corridors may be consolidated to reduce overlaps and resolve possible right-of-way impacts. Opportunities for consolidation include combining the Rural Road portion of the Scottsdale Road/Rural corridor with the UP Tempe Branch and combining the Northern Avenue and Camelback Road corridors west of 19th Avenue. Alternative alignments for these combined corridors will be examined in Milestone 5. Exhibit 4.0-1 illustrates the 13 LRT/Dedicated BRT corridors included in Groups A and B and the four commuter rail corridors selected for further refinement in Milestone 5.

GROUPS A AND B CORRIDORS



4.1 System Ridership and Revenues

Capital and operating cost estimates have been developed for 28 distinct high capacity transit corridors. These corridors include the alignments identified in Networks 1 and 2 developed in Milestone 3. Three technologies, commuter rail, light rail transit (LRT), and bus rapid transit (BRT), have been assumed in various corridors. Table 4.1-1 summarizes the corridors, technologies, and limits assumed in the ridership and cost estimates. The MAG transportation network is illustrated in Exhibit 4.1-1, while Exhibits 4.1-2 and 4.1-3 illustrate the corridor locations.

The specific corridor alignments listed below have been selected as a designated centerline for a five-mile wide potential high capacity transit corridor. All parallel alignments, including streets, freeways, and non-traditional transportation corridors, within the five mile wide area could be considered as a final alignment for high capacity transit service. Individual alignments presented below were selected to simplify data collection and the presentation of results. The objective in selecting these corridors was to develop a network of corridors operating together as an integrated system serving demand for high capacity transit in the MAG region.

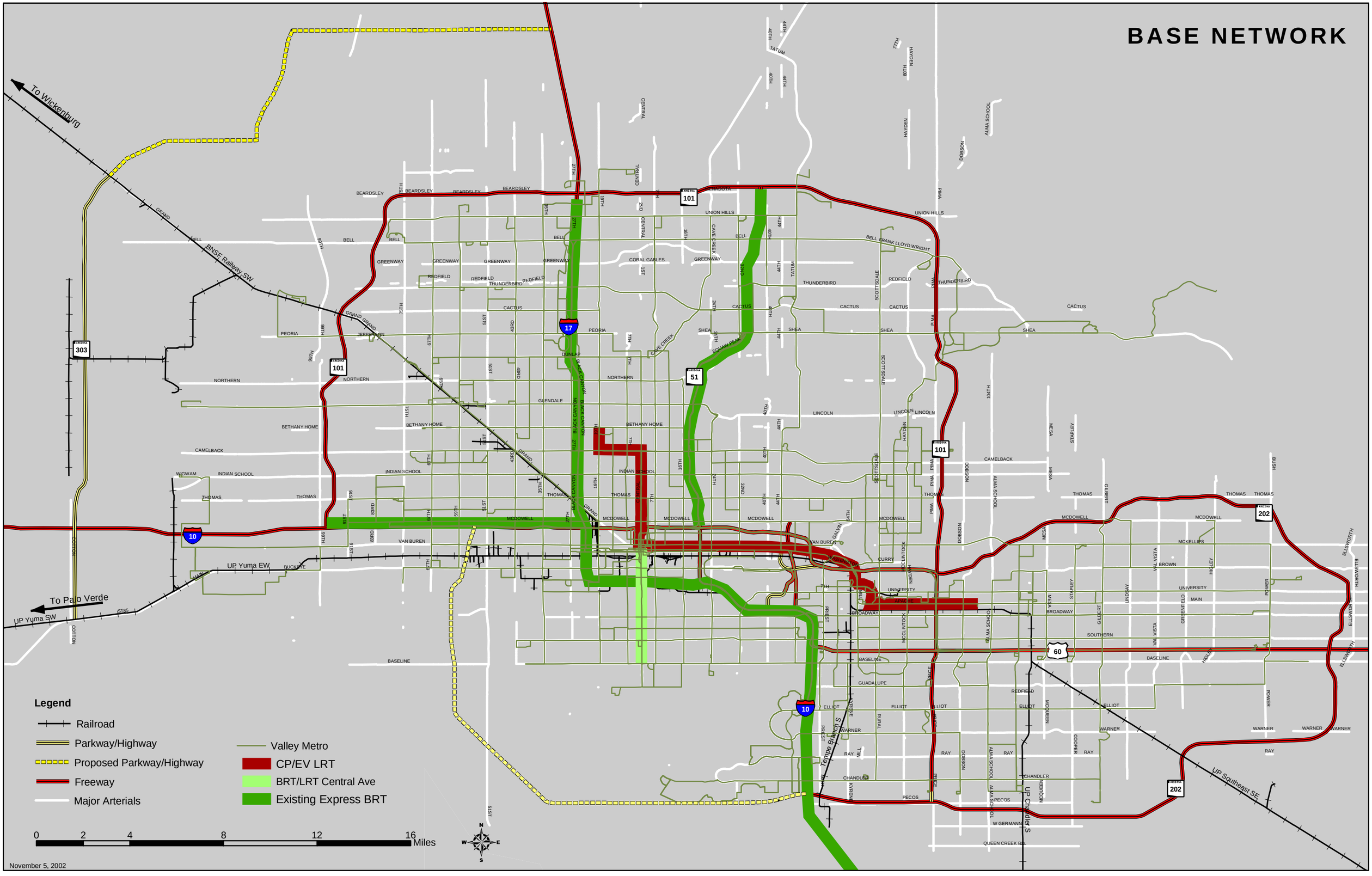
The cost estimates have been used in conjunction with population and other socio-economic data to perform a preliminary screening of corridors to identify a single network of high capacity transit corridors. The results of this preliminary analysis are presented in Section 4.3.

Table 4.1-1 **Potential High Capacity Transit Corridors & Technologies**

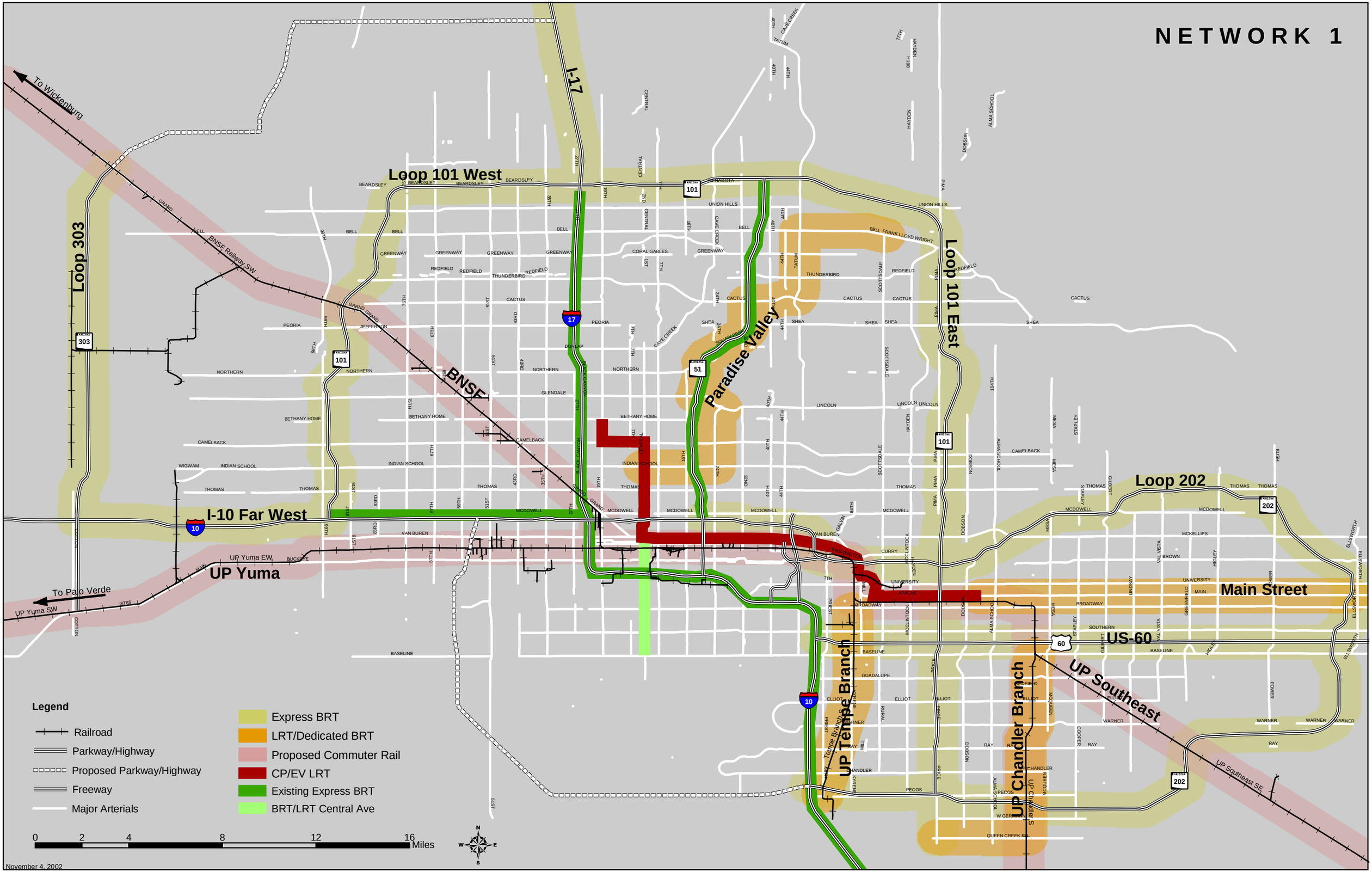
Corridor	Limits	Technology
59th Avenue	51st Avenue/Baseline Road to 59th Avenue/Bell Road	LRT/BRT
Baseline Road	51st Avenue to Tempe Industrial Branch	LRT/BRT
Bell Road	Loop 303 to Scottsdale Road	LRT/BRT
Burlington Northern Santa Fe (BNSF)	Downtown Phoenix to Loop 303 *(potential extension to Wickenburg)*	Commuter Rail
Camelback Road	Loop 101 West Valley to Scottsdale Road	LRT/BRT
Chandler Boulevard	Ray Road to Power Road	LRT/BRT
Union Pacific Chandler Branch	Union Pacific Mainline to Queen Creek Road and Price Road	LRT/BRT
Glendale Avenue/Cactus Avenue (to Paradise Valley)	Glendale/19th Avenue to Bell Road/Scottsdale via SR-51, Cactus, Tatum	LRT/BRT
Interstate 10 West	Central Avenue/Van Buren to Loop 101	LRT

Corridor	Limits	Technology
Interstate 10 Far West	Loop 101 to Loop 303	Express BRT
I-17	Loop 101 to Anthem Way	Express BRT
Loop 101 East	I-17 to Queen Creek Rd/Price Road	Express BRT
Loop 101 West	I-17 to Baseline Road/91st Avenue	Express BRT
Loop 202	I-10/SR-51/Loop 202 interchange to I-10/Loop 202 south interchange	Express BRT
Loop 303	Baseline Road to Grand Avenue	Express BRT
Main Street (Option 1)	Alma School Road to Loop 202	LRT/BRT
Main Street (Option 2)	Alma School Road to Power Road	LRT/BRT
Metrocenter Extension	19th Avenue/Bethany Home to I-17/Peoria	LRT
Northern Avenue (east of Grand Avenue)	19th Avenue to Grand Avenue	LRT
Northern Avenue (west of Grand Avenue)	Grand Avenue to Loop 303	LRT/BRT
Power Road	Williams Field to Higley Road/McDowell Road	LRT/BRT
Scottsdale Road	Queen Creek Road/Price Road to Scottsdale/Bell	LRT/BRT
SR-51	Glendale Avenue/19th Avenue to Tatum Blvd./Loop 101 via Tatum north of Cactus	LRT/BRT
Union Pacific Mainline/Chandler	Downtown Phoenix to Chandler Heights Road	Commuter Rail
Union Pacific Southeast	Downtown Phoenix to Ellsworth Avenue	Commuter Rail
Union Pacific Yuma	Downtown Phoenix to Buckeye *(potential extension to Palo Verde Nuclear Generating Station)*	Commuter Rail
Union Pacific Tempe Branch	UP Mainline to 56th Street/I-10	LRT/BRT
US-60	I-10 to Idaho Road	Express BRT

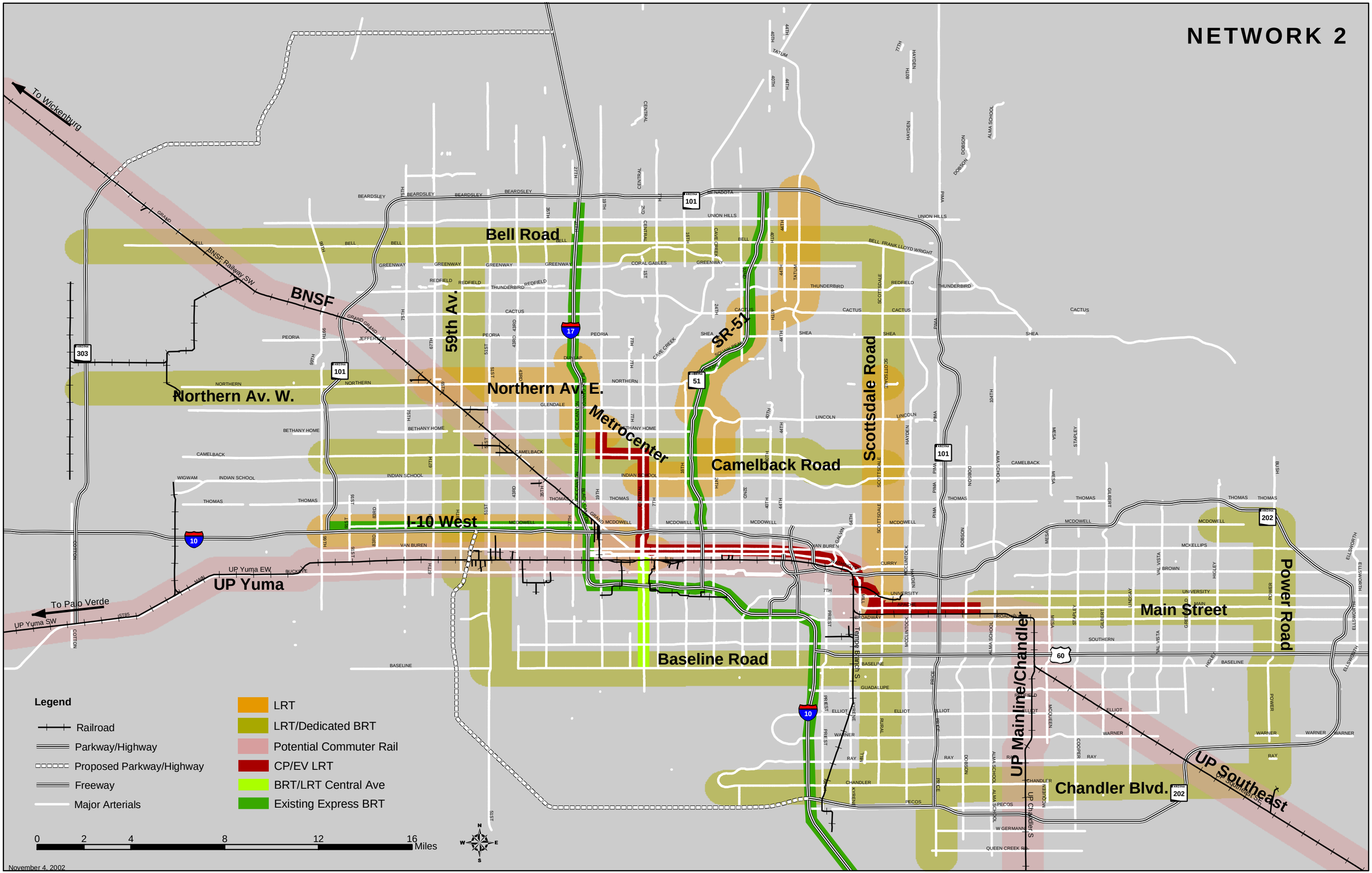
BASE NETWORK



NETWORK 1


To Wickenburg
Loop 303
BNSF Railway SW
BNSF
I-17
Loop 101 West
Loop 101 East
Paradise Valley
I-10 Far West
UP Yuma
To Palo Verde
UP Yuma SW
UP Yuma EW
Loop 202
Main Street
US-60
UP Southeast
UP Southeast SE
UP Tempe Branch
UP Chandler Branch
UP Chandler S
Legend
Railroad
Parkway/Highway
Proposed Parkway/Highway
Freeway
Major Arterials
Express BRT
LRT/Dedicated BRT
Proposed Commuter Rail
CP/EV LRT
Existing Express BRT
BRT/LRT Central Ave
0 2 4 8 12 16 Miles
N
W
E
S
November 4, 2002

NETWORK 2


To Wickenburg
BNSF Railway SW
BNSF
Bell Road
Northern Av. W.
Northern Av. E.
59th Av.
Metrocenter
Camelback Road
Scottsdale Road
I-10 West
UP Yuma
To Paio Verde
UP Yuma SW
UP Yuma EW
Baseline Road
Tempe Branch S.
UP Mainline/Chandler
Main Street
Power Road
Chandler Blvd.
UP Southeast
SR-51
Legend
Railroad
Parkway/Highway
Proposed Parkway/Highway
Freeway
Major Arterials
LRT
LRT/Dedicated BRT
Potential Commuter Rail
CP/EV LRT
BRT/LRT Central Ave
Existing Express BRT
0 2 4 8 12 16 Miles
N
W
E
S
November 4, 2002

4.1.1 Commuter Rail Ridership

Two approaches were considered for the development of commuter rail forecasts:

- The use of a four stage planning model
- Direct demand estimation

Four stage models are the most common approach, and involve trip generation, distribution, modal split and assignment. This model enables all elements of rail service to be modeled and may include network components such as feeder buses and ability to interchange onto other services. However, it requires a detailed multi-modal planning model, which in particular requires a fully calibrated modal split submodel. This calibration can be particularly difficult where the mode being estimated has particularly low portion of total demand. The Maricopa Association of Governments (MAG) model does not include commuter rail as a mode. It is sometimes possible to use a manual (subjective or judgmental) approach to forecast demand, where modal shares for origins/destination pairs within station catchment areas are estimated from an existing service. For the MAG region, however, it was considered that no suitable service was currently available on which to easily base these mode shares.

The direct demand approach develops forecasts for passenger boardings directly from basic land use data, effectively combining the trip generation and modal split components of a traditional four-stage model. Trip rates are developed for simple variables such as aggregated population or employment using catchment areas of stations. These trip rates are calibrated to boarding figures observed on existing commuter rail systems with further adjustment factors to include a representation of the level of service. This method is highly suited to sketch planning forecasting prior to full four-stage model development. The aggregate nature of the model means that the required data is readily available, and the factors are often likely to be transferable. It is particularly appropriate when the mode being estimated represents a small share of the total demand, such as commuter rail.

At this stage it was considered that the direct demand model was the most appropriate tool to forecast demand for the commuter rail corridors. Its weakness is that it forecasts each corridor in isolation and so is insensitive to other changes in the transportation network. However, more detailed forecasts could be developed at a later stage using the MAG model, providing the commuter rail mode share could be successfully modeled.

The Direct Demand Model

The direct demand model (DDM) used to forecast commuter rail ridership was developed from the model used by GO Transit[1] in the Greater Toronto Area, and has now been successfully applied to several proposed new services throughout North America and abroad. Some of these services have been implemented and the resulting ridership compares well with the DDM forecasts. Ridership is estimated as weekday boarding passengers per station, which is based on the catchment population and level of service factors such as train frequency and journey time savings.

As this DDM is essentially an origin end model it assumes that the rail service also serves trip attractions, particularly employment areas. It would clearly be unsuitable for a route serving purely dormitory areas. However, as the rail lines under investigation in the MAG region serve major employment centers this is not believed to be an issue in this case.

Development of Catchment Areas

The initial stage when applying the DDM is the definition of station catchment areas. This is the location around stations that is responsible for rail trip production, with trips accessing the stations by walking, kiss & ride and park & ride.

Catchment areas in the GO DDM were developed from rail survey data, to give areas providing most of the station boardings. Catchment areas for the MAG region were developed using aggregations of MAG traffic zones around proposed station locations. An initial primary catchment radius of three miles was used to select traffic zones, based on observations of the Toronto GO system catchments. Secondary catchment areas were also included. These catchment areas extended two to four miles beyond the primary catchment area boundary, bring the total catchment area size to five to seven miles. While it was recognized that a number of trips would originate from outside this area, it was considered the bulk of boarding trips would be captured. These approximate catchment areas were then adjusted based on judgment to include all zones considered relevant for each station location. For instance, some of the catchment areas in more outer areas were slightly expanded. Only complete zones were selected as there was considered insufficient evidence to warrant the inclusion of portions of zones.

Overlap between catchment areas was removed with each traffic zone assigned to a single catchment area. Traffic zones within three miles of two stations and equidistant between the stations were allocated to the

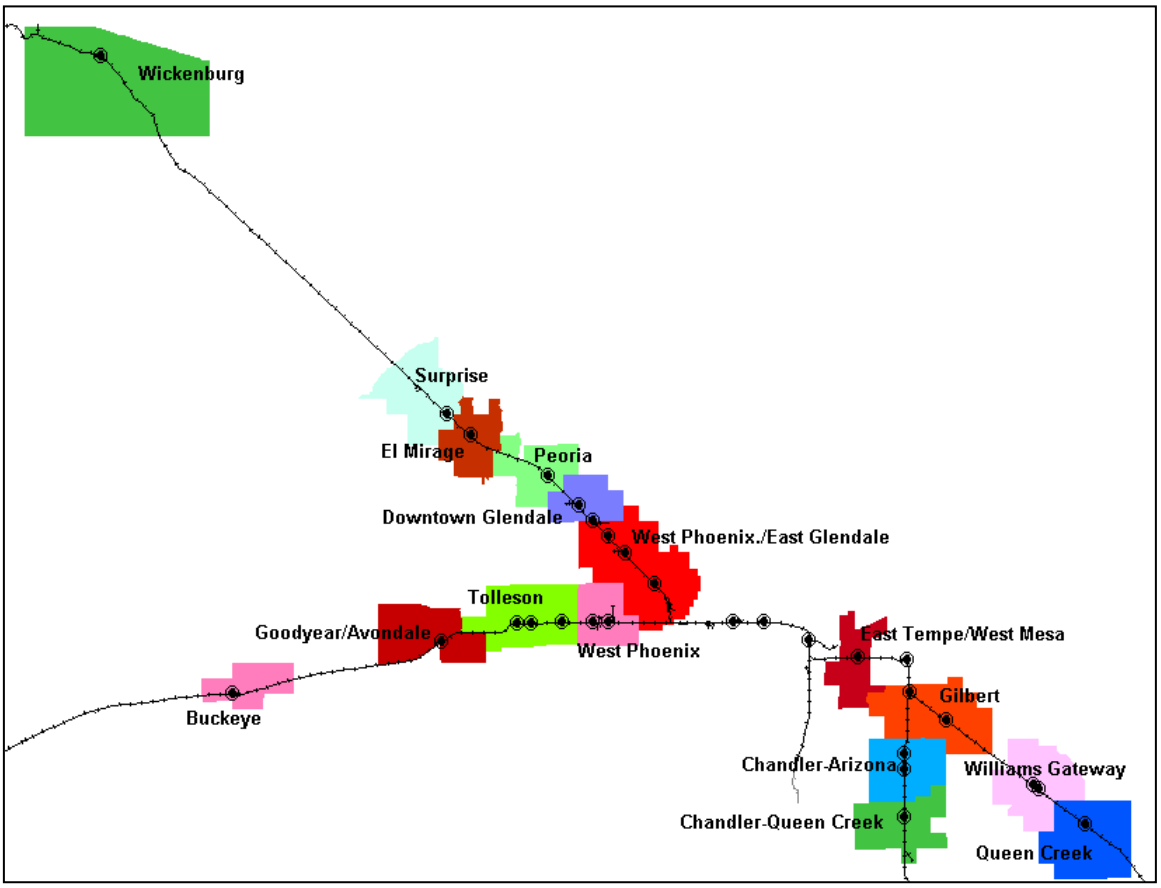
[1] GO Rail Forecasting Procedures, Transportation Demand and Forecasting Office, Ministry of Transportation, Ontario, Peter Dalton Consulting, Tranplan Associates and SPK Consulting, September 1994

station nearer to a downtown or destination station. This reflects observed behavior that drivers tend to drive to the station in the direction of their final destination, and leads to station catchment areas extending further 'upstream' from a station than 'downstream'.

In some instances, alternative station sites have been proposed. One catchment per zone was enforced for individual stations, but not for sites where individual station locations are mutually exclusive. Consequently a traffic zone could be in two or three catchments of proposed locations, each representing alternatives for the same station area.

Catchments areas were defined in this way for all station locations proposed along the three major corridors. This also included 'destination stations' although they are not used to directly forecast demand (see below). Traffic zones located within the catchment of both an inner 'origin station' and a 'destination station' are generally allocated to the destination station catchment. Exhibit 4.1-4 shows the stations and their respective catchments.

Exhibit 4.1-4 **Potential Station Locations and Catchment Areas for Origin Stations**



Catchment Population

Target year population forecasts as used in the MAG model were input into the DDM. With catchment areas defined, populations for each of the component zones were summed to determine the total catchment population. Populations were not determined for destination stations however, which include the following:

- Downtown Phoenix;
- Downtown Tempe;
- Downtown Mesa;
- Sky Harbor Airport

These station catchments are believed to primarily serve trip attractions rather than the trip productions the model forecasts. These stations will of course have large numbers of boarding passengers but these will primarily represent the return leg of the trip rather than the outward leg.

Train Frequency

Train frequency is represented in the DDM as two factors:

- The number of trains in the morning peak period; and
- The presence or absence of an off-peak service.

The most significant service parameter in the DDM is the number of peak period trains. It is assumed that the majority of trips on commuter rail occur in the peak, primarily to and from work, and hence it is the peak service that determines the initial trip rate. This trip rate is subsequently factored according to other service parameters. The trip rates below in Table 4.1-2 were developed by GO Rail in Toronto and have been refined following a series of IBI studies. They indicate the number of weekday boardings expected per 1000 population in the catchment area.

Table 4.1-2 **Peak Period Train Service**

Peak period trains	Boardings/1000 population
1	9
2	14
3	17
4	19.5
5	22.5
6	25

Peak period trains	Boardings/1000 population
7	27
8	28
9	28
10	28
11	28
12	28

As might be expected, the trip rates increase with improving level of service. However, incremental effect of service improvement declines as the service improves. With a single peak period train the implied elasticity of demand to train frequency is 0.6 (a doubling of frequency increases demand by 60%). However, this declines to around 0.3 with 7 trains and increasing train service above 8 trains attracts no additional ridership. This approaches a 'turn up and go' service with average wait times around 10 minutes or less. Further improvements are less perceptible to passengers.

A factor is then applied to these trip rates representing whether or not the station has an off-peak service. As noted above, peak trips are the most significant element of commuter rail ridership and thus off-peak service is included with the simple factors shown below in Table 4.1-3:

Table 4.1-3 **Off peak Service Factors**

Off peak train	Factor
No	0.82
Yes	1.4

Without off-peak provision the trip rates above are reduced by about 18%, while the presence of an off-peak service increases the trip rate by 40%.

Three scenarios have been developed for the commuter rail ridership:

- Phase 1 - Introductory services;
- Phase 2 - Intermediate services; and
- Phase 3 - Full commuter train operation

The corresponding levels of service used in the DDM are shown below in Table 4.1-4:

Table 4.1-4 **Train Frequency assumed in DDM**

Development Phase	Peak Period Trains	Off Peak Service
1: Introductory Service	3	No
2: Intermediate Service	6	Yes
3: Full commuter rail operation	12	Yes

Distance and Time Factors

The second set of factors relate to the relative strengths of commuter rail over existing alternatives. Commuter rail ridership rates will be highest from stations with the poorest alternatives. In the DDM, a factor is included for the travel time savings compared to existing transit services, with a general distance factor to include non-modeled factors such as availability of alternatives, journey reliability, comfort, etc. which increase in significance with distance.

The magnitude of travel time savings over existing transit is expected to be significant in affecting the trip rate. Table 4.1-5 lists the factors used in the DDM.

Table 4.1-5 **Timesaving factors**

Timesaving (minutes)	Factor
0-15	0.3
15-30	0.44
30-45	0.9
45-60	0.95
> 60	1.15

As might be expected, the factors imply that increased timesaving leads to increased trip rates, although above a 30-minute savings incremental improvements have less impact. The effect of applying the timesaving factors is, however, generally to reduce the initial trip rates – Table 4.1-5 suggests that the initial trip rates shown in Table 4.1-2 assume an implicit timesaving of between 45 and 60 minutes.

The final factor to be applied represents general effects of distance from the downtown, including the availability of alternatives, reliability improvements and significance of comfort. Table 4.1-6 below lists the factors used.

Table 4.1-6 **Distance factors**

Distance from downtown (miles)	Factor
0-5	0.3
5-8	0.5
8-15	0.8
> 15	1

Factors are only applied to trips less than 15 miles long. The effect is to reduce trip rates in the more central areas where the availability of transit is greater and since trips are shorter, journey time reliability is higher for all modes. Comfort is also less important for short trips.

In order to apply these factors it was necessary to determine the road network distance. This was calculated using the MAG model network and identifying the shortest path through the network between each station location and the nearest major downtown – the following 'destination' stations:

- Phoenix;
- Tempe; or
- Mesa

Travel time savings are estimated assuming using simple average operating speeds for bus and commuter rail.

- Bus: 25mph
- Commuter Rail: 40mph

At the aggregate scale of the model exact journey times based on the complete origin-destination patterns are not necessary. The actual origin-destination pattern is significantly more complex than the DDM assumes. The use of average speeds also implicitly includes auto trips as a competing mode where transit is not presently an option.

Station Boarding Passengers

The final rate for each station catchment in trips/1000 population is developed as the product of the peak train trip rate and all other relevant factors. This trip rate is then applied to the catchment population/1000 to give average weekday boardings from that station.

Table 4.1-7 lists the resulting estimates for passengers boarding in an average weekday for all proposed station locations, for each of the three scenarios. Note that this includes all the alternative locations for each station, which are assumed to be mutually exclusive.

Table 4.1-7 **Average Weekday Boardings from Proposed Station Locations**

Station	Location	Distance to nearest destination station (miles)	Average Weekday Boardings		
			Initial	Intermediate	Full
BNSF					
West Phoenix/East Glendale	Thomas/27th	4	164	412	462
	Camelback/43rd	6.5	256	642	719
	Bethany/51st	8	173	436	488
Glendale	Glendale/59th	9.5	192	483	541
	Northern/67th	11	220	553	619
Peoria	83rd Avenue	13.5	287	721	808
El Mirage	Grand/Santa/Fe	19	214	537	602
Surprise	Grand/Bell	21	450	1,130	1,266
Wickenburg	Wickenburg	56	327	820	919
UP Mainline/Chandler					
East Tempe	Loop 101	4	89	223	250
Gilbert	Baseline	3	83	208	233
Chandler North	Arizona/Ray	6	200	501	562
	Arizona/Chandler	7	235	590	661
Chandler South	Queen Creek	10	188	473	529
UP Southeast					
East Tempe	Loop 101	4	89	223	250
Gilbert	Baseline	3	83	208	233
	Gilbert	7	199	499	559
Williams Gateway	Williams Field/Power	16	382	959	1,075
Queen Creek	Ellsworth	20	545	1,369	1,533
UP Yuma					
West Phoenix	51st Avenue	6	161	404	452
	59th Avenue	7	147	369	413
Tolleson	75th Avenue	9	154	386	432
	91st Avenue	11	305	766	858
	99th Avenue	12.5	350	879	984
Goodyear/Avondale	Main/Litchfield	17.5	579	1,453	1,627
Buckeye	Baseline/Miller	30.9	66	165	185

The largest boardings occur from stations on the edge of the MAG region area, such as Surprise, Goodyear and Queen Creek, which are around 20 miles from the nearest major downtown. With shorter distances boardings are lower as commuter rail becomes less competitive, but weekday boardings are still significant even from the very central stations of West Phoenix, simply due to the higher population densities in these areas.

Corridor Forecasts

Corridor boarding forecasts are developed by summing all stations along the corridor. Where two or more alternative sites are available for a station, at this stage it is assumed that the location producing the highest demand is selected. Total weekday ridership also includes the return trip; hence the boarding figures are doubled. Weekday ridership by corridor is shown in Table 4.1-8 below. These ridership figures do not include potential extensions to Wickenburg on BNSF line and to the Palo Verde Nuclear Generating station on the UP Yuma line. Ridership and cost estimates for these potential extensions will be examined in more detail in Milestone 5.

Table 4.1-8 **Weekday Ridership**

Corridor	Phase 1	Phase 2	Phase 3
BNSF	2,854	7,166	8,026
UP Mainline/Chandler	1,190	2,988	3,347
UP Southeast	2,430	6,100	6,832
UP Yuma	2,311	5,802	6,499

BNSF is clearly the strongest corridor in terms of ridership, with more than double the number of passengers forecast for the UP Mainline/Chandler. Passing through a long corridor of relatively high population density this is intuitive. The UP Mainline/Chandler line has the weakest ridership, due to the presence of additional parallel transportation facilities with competitive travel times and proximity of it stations to the destination station in Mesa. However, ridership is still significant on all three major corridors; four-stage modeling to develop more detailed forecasts would now be warranted to combine commuter rail with other transit improvements.

4.1.2 Commuter Rail Capital and Operating Costs

Capital and operating costs have been developed for the four alternative commuter rail corridors:

- Burlington Northern Santa Fe – Surprise to downtown Phoenix
- Union Pacific Mainline/Chandler – Chandler to downtown Phoenix

- Union Pacific Southeast – Queen Creek to downtown Phoenix
- Union Pacific Yuma – Buckeye to downtown Phoenix

The costs are presented for each corridor operating independently of the other, therefore, selected infrastructure costs including maintenance and storage facilities and a central terminal station are included in each corridor cost estimate. Assuming a network implementation of two or more corridors, these costs would be distributed evenly between the corridors since each of these facilities are capable of serving more than one corridor.

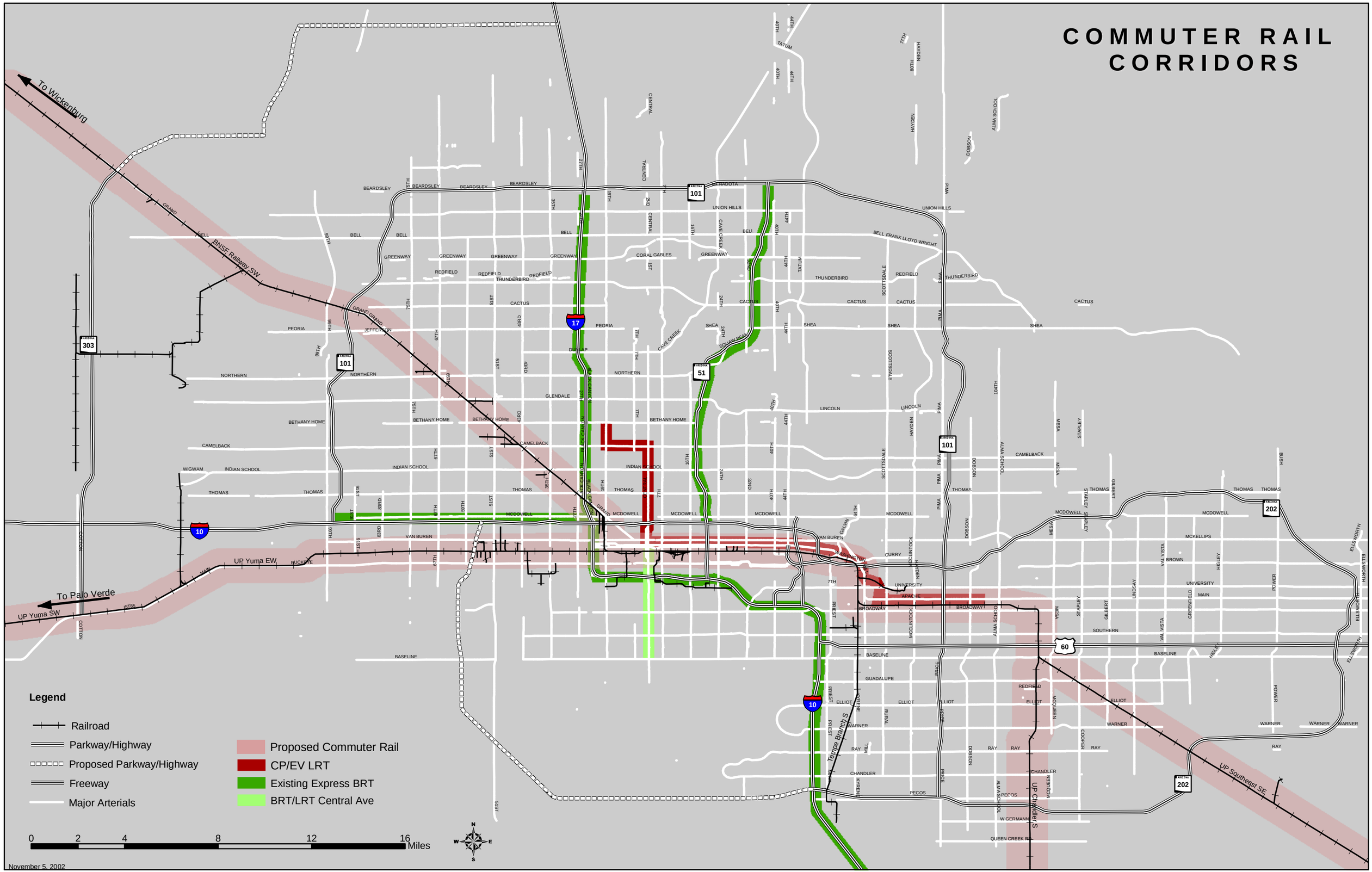
Capital Costs

Capital costs were developed using standard unit cost rates obtained from the Southern California Regional Rail Authority (Metrolink), and unit costs obtained from several other rail infrastructure cost estimates prepared for West Coast rail properties during the previous five years. The capital and infrastructure needs described in Milestone 3 have been used as the basis for developing costs in each corridor. Costs have also been broken down for each of the three phases of service identified in Milestone 3, Phase 1 (Start-up), Phase 2 (Intermediate), and Phase 3 (Full Service).

A major component of the cost of new start commuter rail systems is track ownership or the lease rights to use freight rail corridors. Various corridor ownership models were discussed in Milestone 2. The purchase or lease of rights to utilize the MAG region freight railroad corridors varies between each phase and each corridor. Phase 1 services assume the lease of track rights from the freight railroad services, Burlington Northern Santa Fe (BNSF) and Union Pacific (UP). These lease rates are an estimate based upon the number of annual train miles and are incorporated into the annual operating and maintenance costs. The rates represent an average cost paid by other West Coast commuter rail systems operating in freight corridors owned by BNSF and UP. In corridors where second main tracks are constructed, right-of-way purchase is assumed in the capital cost for Phase 2 and 3 services where increased frequency of service would preclude the use of operating windows between freight services. The unit cost for this purchase was estimated using an average of per mile costs paid for right-of-way by four present or planned commuter rail providers. The Union Pacific Yuma corridor does not require a second main track, allowing for the lease of track rights through all three phases of service implementation.

Exhibit 4.1-5 illustrates the commuter rail corridors included in the cost estimates. Table 4.1-9 summarizes the capital costs for each commuter rail corridor by major category. Detailed unit costs can be found in Appendix A.

COMMUTER RAIL CORRIDORS



November 5, 2002

Table 4.1-9 Revised Commuter Rail Capital Cost Summary

Item		BNSF Phase 1	BNSF Phase 2	BNSF Phase 3	UP Mainline/Chandler Phase 1	UP Mainline/Chandler Phase 2	UP Mainline/Chandler Phase 3	UP Southeast Phase 1	UP Southeast Phase 2	UP Southeast Phase 3	UP Yuma Phase 1	UP Yuma Phase 2	UP Yuma Phase 3
Corridor Length (miles)		27.73	27.73	27.73	27.95	27.95	27.95	36.18	36.18	36.18	32.5	32.5	32.5
Subtotal-Civil		$16,414,844	$40,000	$158,400	$23,106,160	$20,000	$168,890	$24,692,082	$160,000	$174,500	$3,058,400	$105,600	$0
Subtotal-Utilities		$24,488,376	$660,000	$427,680	$13,024,440	$330,000	$456,003	$13,024,440	$2,640,000	$471,150	$0	$1,742,400	$0
Subtotal-Track		$34,697,676	$1,867,000	$5,691,195	$28,200,799	$633,500	$4,032,866	$19,695,628	$3,268,000	$4,243,088	$0	$2,062,880	$0
Subtotal-Stations		$29,120,000	$6,216,000	$1,190,000	$31,700,000	$2,660,000	$490,000	$33,520,000	$5,250,000	$1,050,000	$24,350,000	$4,900,000	$910,000
Subtotal-Controls & Signals		$0	$25,688,016	$965,840	$15,785,584	$480,000	$11,456,460	$15,585,584	$15,963,216	$3,593,000	$0	$0	$26,976,496
Subtotal Facilities		$2,500,000	$17,000,000	$0	$2,500,000	$17,000,000	$0	$2,500,000	$21,000,000	$0	$2,500,000	$21,000,000	$0
A. Construction Subtotal		**$107,220,896**	**$51,471,016**	**$8,433,115**	**$114,316,983**	**$21,123,500**	**$16,604,219**	**$109,017,734**	**$48,281,216**	**$9,531,738**	**$29,908,400**	**$29,810,880**	**$27,886,496**
Environmental Mitigation	Percent of A 3%	$3,216,627	$1,544,130	$252,993	$3,429,509	$633,705	$498,127	$3,270,532	$1,448,436	$285,952	$897,252	$894,326	$836,595
B. Construction Cost Subtotal		**$110,437,523**	**$53,015,146**	**$8,686,108**	**$117,746,492**	**$21,757,205**	**$17,102,345**	**$112,288,266**	**$49,729,652**	**$9,817,690**	**$30,805,652**	**$30,705,206**	**$28,723,091**
C. Right of Way Subtotal		**$13,503,600**	**$104,674,900**	**$3,702,600**	**$8,276,400**	**$71,872,900**	**$1,524,600**	**$13,939,200**	**$82,654,000**	**$3,267,000**	**$11,107,800**	**$42,471,000**	**$2,831,400**
D. Vehicles Subtotal		**$61,932,500**	**$30,800,000**	**$33,750,000**	**$46,350,000**	**$19,800,000**	**$44,750,000**	**$64,000,000**	**$47,300,000**	**$39,205,019**	**$56,125,000**	**$32,400,000**	**$41,800,000**
Cost Contingencies (Uncertainties, Changes)													
Design&Construction	Percent of B 25%	$27,609,381	$13,253,787	$2,171,527	$29,436,623	$5,439,301	$4,275,586	$28,072,066	$12,432,413	$2,454,422	$7,701,413	$7,676,302	$7,180,773
Right of Way	Percent of C 30%	$4,051,080	$31,402,470	$1,110,780	$2,482,920	$21,561,870	$457,380	$4,181,760	$24,796,200	$980,100	$3,332,340	$12,741,300	$849,420
Vehicle Cost	Percent of D 10%	$6,193,250	$3,080,000	$3,375,000	$4,635,000	$1,980,000	$4,475,000	$6,400,000	$4,730,000	$3,920,502	$5,612,500	$3,240,000	$4,180,000
Program Implementation (Agency Costs and Fees)													
Design&Construction	Percent of B 31%	$34,235,632	$16,434,695	$2,692,694	$36,501,413	$6,744,734	$5,301,727	$34,809,362	$15,416,192	$3,043,484	$9,549,752	$9,518,614	$8,904,158
Right of Way Purchase	Percent of C 15%	$2,025,540	$15,701,235	$555,390	$1,241,460	$10,780,935	$228,690	$2,090,880	$12,398,100	$490,050	$1,666,170	$6,370,650	$424,710
Vehicle Procurement	Percent of D 5%	$3,096,625	$1,540,000	$1,687,500	$2,317,500	$990,000	$2,237,500	$3,200,000	$2,365,000	$1,960,251	$2,806,250	$1,620,000	$2,090,000
E. Capital Cost Subtotal		**$263,085,131**	**$269,902,234**	**$57,731,599**	**$248,987,808**	**$160,926,945**	**$80,352,829**	**$268,981,534**	**$251,821,558**	**$65,138,518**	**$128,706,877**	**$146,743,072**	**$96,983,552**
Project Reserve	Percent of E 10%	$26,308,513	$26,990,223	$5,773,160	$24,898,781	$16,092,694	$8,035,283	$26,898,153	$25,182,156	$6,513,852	$12,870,688	$14,674,307	$9,698,355
F. Total Capital Cost		**$289,393,644**	**$296,892,457**	**$63,504,759**	**$273,886,589**	**$177,019,639**	**$88,388,112**	**$295,879,688**	**$277,003,714**	**$71,652,369**	**$141,577,565**	**$161,417,379**	**$106,681,907**
			Total all 3 Phases	**$649,790,860**		**Total all 3 Phases**	**$539,294,340**		**Total all 3 Phases**	**$644,535,771**		**Total all 3 Phases**	**$409,676,851**

Note: All costs are in 2001 dollars. More detailed information on costs can be found in Appendix A

Cost categories in Table 4.1-9 include:

- **Civil** – This category includes sound walls, grade separations, grade crossings, bridges, and earthwork (grading, etc).
- **Utilities** – This is an estimate for relocating utilities both overhead and underground along the alignment. Utilities can include power lines, underground pipes and fuel lines, sewer lines, etc.
- **Track** – This category presents the costs for installing new trackwork in the corridor.
- **Stations** – The cost of implementing the commuter rail stations, including associated parking, is included here. For the purposes of this cost estimate parking was distributed as 80 percent surface parking and 20 percent structured parking.
- **Controls and Signals** – The category identifies the costs for installing Centralized Traffic Control signals in the corridor to manage train operations.
- **Facilities** – The cost of the maintenance and storage facility and an operations control and dispatching center are estimated here. The maintenance and storage facility has been scaled to accommodate only the number of vehicles required to provide service in each corridor, allowing for an equal analysis of each corridor based upon its individual needs.
- **Environmental Mitigation** – This is a cost allowance added to the construction costs identified above which would be used to provide spot mitigation measures such as landscaping that could be identified later in the implementation process.
- **Construction Add-ons** – A cost contingency of 25 percent is added to the construction cost estimate to allow for variations in unit costs and unforeseen design issues that may arise during the development of the project. A program implementation cost of 31 percent is also added to account for the cost of designing and constructing the system.
- **Right-of-Way** – This category includes the land required to accommodate the system. Right-of-way costs assume the cost of purchasing a large enough portion of the railroad right-of-way to accommodate the implementation of a new main track for commuter rail operations on the BNSF and UP Southeast corridors. The rate applied for this cost represents an average of right-of-way costs paid by four public agencies during the past decade (Los Angeles - Metrolink, San Diego - North County Transit District, Miami - Tri-Rail, and Salt Lake City - Utah Transit Authority) for freight rail rights of way. Specific right-of-way costs would be determined through negotiations

with the freight railroad operators and could vary dramatically from the experience of other public agencies in the United States. The cost estimate also includes the cost of right-of-way for stations and parking lots.

- **Right-of-Way Add-ons** – A cost contingency of 30 percent has been added to right-of-way, similar to the contingency for construction. This contingency accounts for increased land costs and possible increases in land purchases. The right-of-way procurement process is accounted for in the 15 percent contingency.
- **Vehicles/Maintenance of Way** – This category includes the commuter rail passenger cars and locomotives, spare parts, and maintenance of way equipment.
- **Vehicle Add-ons** – These include contingencies for the price of the commuter rail vehicles, and the cost of the procurement, testing, and commissioning of the vehicles.

Operating Costs

Commuter Rail operating costs were developed using the service plans developed in Milestone 3. There are assumed to be three phases of commuter rail implementation with the following levels of service:

- Phase 1: Start-Up/Introductory Services. Examination of the impact of limited peak hour, peak direction service composed of three trains inbound in the a.m. peak and outbound in the p.m. peak on each corridor.
- Phase 2: Intermediate Services. Headways of 20 minutes during the peak hour will be examined together with limited counter-flow service. Midday service would consist of hourly trains in each direction.
- Phase 3: Full Commuter Train Operation. In this phase, trains would operate on 15-minute headways during the peak hours and at 30-minute headways during the off-peak. During the peak periods there would be a 30-minute interval counter-flow services.

Operating costs have been estimated using the comparison of Year 2001 bus and commuter rail operating and maintenance costs from four commuter rail service providers in the Western United States:

- Dallas Area Rapid Transit Authority (DART) – Dallas Trinity Railway Express
- North County Transit District (NCTD) – San Diego Coaster
- Sound Transit – Seattle Sounder

- Altamont Commuter Express (ACE)/Valley Transit Authority (VTA) – San Jose Altamont Commuter Express

To obtain an estimated cost per vehicle revenue mile and revenue hour in the MAG region operating costs from the National Transit Database for bus service provided in each of the four metropolitan regions noted above were first compared to 2001 bus operating cost figures for Valley Metro/RPTA. The percentage difference in bus operating costs between the two agencies was then applied to the commuter rail operating costs from each region to estimate a comparable difference in cost for a proposed MAG region commuter rail system. The four estimated operating costs were then averaged to obtain a single estimated cost per revenue service hour and revenue service mile for commuter rail in the MAG region.

To obtain an estimated cost per vehicle revenue mile and revenue hour in the MAG region operating costs from the National Transit Database for bus service provided in each of the four metropolitan regions noted above were first compared to 2001 bus operating cost figures for Valley Metro/RPTA. The percentage difference in bus operating costs between each of the outside agencies and Valley Metro/RPTA was then applied to the commuter rail operating costs from each region to estimate a comparable difference in cost for a proposed MAG region commuter rail system. The four estimated operating costs were then averaged to obtain a single estimated cost per revenue service hour and revenue service mile for commuter rail in the MAG region. Table 4.1-10 summarizes the cost differences between each commuter rail provider.

Table 4.1-10 **Commuter Rail Operating Cost Comparison**

Metropolitan Area	Bus Revenue Hour Cost	Bus Revenue Mile Cost	Commuter Rail Revenue Hour Cost	Commuter Rail Revenue Mile Cost	Valley Metro/RPTA Average Difference (Bus)
Dallas	$99.84	$7.50	$545.51	$28.65	-9.9%
San Diego	$74.37	$4.33	$460.08	$11.05	37.2%
Seattle	$102.64	$7.66	$1,535.02	$39.14	-12.1%
San Jose	$130.93	$10.22	$504.48	$14.00	-32.5%
Phoenix	$96.52	$6.26			
Phoenix Average			$487.64	$16.81	

Table 4.1-11 summarizes the estimated operating costs for the four commuter rail corridors. All figures are in Year 2001 dollars.

Table 4.1-11 **Commuter Rail Operating Cost Summary**

Annual O&M Cost (millions $)			
Corridor	**Phase 1**	**Phase 2**	**Phase 3**
BNSF	$3.45	$14.60	$18.25
UP Mainline/Chandler	$2.00	$8.50	$14.05
UP Southeast	$4.65	$17.30	$21.60
UP Yuma	$2.80	$12.30	$19.95

4.1.3 Light Rail and Bus Rapid Transit Ridership

The direct demand modeling approach was chosen for the LRT/BRT forecasts, rather than the more traditional four-stage modeling. LRT and Dedicated BRT operating on arterial streets are new modes to the MAG region and mode splits would prove difficult to estimate. It was also intended to develop sketch planning forecasts rapidly for a large number of potential corridors, and the four stage modeling approach would preclude forecasting for more than a few corridors. A direct demand-style sketch planning model has already been developed by MAG, and this was chosen to develop forecasts for the potential LRT corridors.

The MAG Sketch Planning Model

As part of an update of its regional travel demand forecasting model, MAG have developed a sketch planning model which forecasts LRT ridership based on trip rates of catchment area households for the proposed facility. Similar to the commuter rail direct demand model, the sketch-planning model combines the trip production and modal split components of a standard four-stage model in a trip rate factor. These factors are based on the relationship between distance from an LRT station and LRT trip productions.

For these trip rates to be valid it is important that the demographic and mobility characteristics of any proposed route are fairly similar to those from which they are calibrated. In the case of the MAG sketch-planning model, trip rates were calibrated using boardings on existing LRT systems in the Western United States that are believed to exhibit similar characteristics to the MAG region.

The Sketch Plan Model was developed based on data from western communities with urban rail systems similar to those proposed for the MAG region area. These cities were considered 'peer' to the MAG region in terms of patterns of development and transportation infrastructure, and included the cities of San Diego, Portland and Sacramento. The three regions compared similarly with the MAG region for several reasons:

- All are western metropolitan areas with similar numbers of households and jobs and have experienced substantial growth in population and employment in the last half-century.
- Development patterns are predominantly suburban, low to medium density and strongly favor the use of private cars.
- Daily peak period congestion is a problem associated with home-based work trips.
- Each has an identifiable downtown or central business district with a concentration of office employment, but with other employment centers distributed throughout the metropolitan area.
- There is a viable bus system on which the LRT system has been built.

The aim of the sketch plan model development was to identify the size of LRT station catchments, and the relationship between LRT trip productions and distance from LRT stations. Consequently on board travel surveys were undertaken on each of the cities' LRT systems between 1990 and 1994, allowing the identification of the final origin and destination of the trips to be identified. From this home to station and station to destination distances were calculated for both walk and motorized access/egress.

Two key catchments areas were determined –

- Walk-in access or egress, within 0.5 miles of stations, and
- Motorized access or egress, within 5 miles of an origin station, or 2 miles of a destination station

Each of these catchments was disaggregated into two sub-catchments:

- 0-0.25 miles and 0.25-0.5 miles for walk access or egress
- 0-2 miles and 2-5 miles for motorized access or egress.

The number of trips within each of the sub-catchments was deduced from the survey data, and matrices of numbers of trips by distance cell were developed, combining the origin and destination sub-catchments. The table for San Diego is shown in Table 4.1-12 as an example.

Table 4.1-12 **Daily boardings by access and egress distance cells for San Diego**

Home to Station Travel Distance	0-1/4 MILES	1/4-1/2 MILES	0-2 MILES	Sum
0-1/4 MILE	4,400	1,140	1,024	6,564
1/4-1/2 MILE	2,214	522	482	3,218
0-2 MILES	9,843	1,400	1,490	12,734
2-5 MILES	3,915	258	372	4,544

Home to Station Travel Distance	0-1/4 MILES	1/4-1/2 MILES	0-2 MILES	Sum
Sum	20,372	3,321	3,368	27,060

These matrices describe trips for given access and egress distances. Table 4.1-12 for San Diego for example shows that the most significant access sub-catchment is motorized within 2 miles of the access station (12,734 or just under half of all trips). The most significant egress sub-catchment is walk within 0.25 miles of the destination station (20,372 or around three-quarters of all trips).

To develop rates rather than absolute numbers, total numbers of households and jobs corresponding to each of the sub-catchments were required. The calculation of trip rates is described in the Sketch Planning Analysis Report[2] as "the number of LRT trips in each distance cell, divided by the product of number of households occurring in the corresponding home to station cell and the proportion of regional jobs located in the corresponding travel distance to destination cell. This can be expressed as:

$$TripRateFactor_{OD} = \frac{Trips}{Households_O * JobFraction_D}$$

Where $Households_O$ is number of households within distance O of a station (origins), and $JobFraction_D$ is proportion of regional jobs within distance D of a station (destinations)"

By combining all three LRT systems the following average trip rate factors were developed, shown in Table 4.1-13. The trip rate model could then be transferred to a comparable proposed LRT system, such as in Phoenix.

Table 4.1-13 **Average Trip Rate Factors**

	Station to Destination Travel Distance			
Home to Station Travel Distance	0-1/4 MILES	1/4-1/2 MILES	0-2 MILES	Sum
0-1/4 MILE	3.32	0.88	0.36	4.56
1/4-1/2 MILE	0.74	0.21	0.03	0.98
0- 2 miles	0.40	0.09	0.04	0.53
2-5 MILES	0.23	0.03	0.02	0.28
Sum	4.69	1.21	0.45	6.35

[2] Phoenix Model Development Project, Sketch Planning Analysis Report, Parsons Brinckerhoff Quade & Douglas Inc, November 1999

As one might expect, the largest trip rate factor occurs for trips where both the origin and destination occur within 0.25 miles of a station. However, travel distance to access the rail seems to be less distance sensitive than the egress end, and no LRT trips are assumed where the destination is greater than 2 miles from the final station. This illustrates commuters' reticence to rely on connections to complete their journey, preferring to walk to their destination while they may access the system using their car.

Essentially, these factors are a similar concept to the origin catchment trip rates used in the commuter rail DDM. However, for the LRT sketch planning model the trip rates are disaggregated by access and egress distance giving explicit catchment sizes. Similarly to the commuter rail DDM, the availability of sufficient trip attractions is also implied, but in this case their distribution is explicit. Unlike the commuter rail DDM, the sketch planning model does not include any service parameters. Instead we must imply a level of service of a similar nature to the three systems used in the calibration e.g. headway of around 10 minutes, similar time savings compared to other modes etc.

This methodology was used in the forecasting of potential BRT as well as LRT corridors. While the model was originally developed for the forecasting of LRT systems, BRT is now recognized as approaching the level of service of LRT with only the vehicle differing. More significantly, the choice of mode for each corridor has yet to be made. A more accurate comparison of corridors could be made if all are forecast using the same technique and level of service assumptions.

Application of the Model

The model requires two basic inputs for each proposed corridor:

- Distribution of households; and
- Distribution of employment

As stated above, the model is not sensitive to service parameters, the assumption being a high quality LRT/BRT style of service with consequent frequencies, time savings and reliability. This level of service has also been assumed in the cost estimates.

The number and distribution of households and employment was determined using a GIS technique. Corridors described in Networks 1 and 2 of Milestone 3 were identified, and bands were developed for particular distance ranges from the proposed corridor; the center line of the corridor was used as the proposed LRT alignment. 'Horizon' year population projections used in the MAG model were used in the forecasts as with the commuter rail model, and the number of households and jobs determined for the required distance bands. For walk access and egress this includes:

- 0-0.25 miles of centerline and
- 0.25-0.5 miles of centerline

For motorized access and egress this includes:

- 0-2 miles of centerline; and
- 2-5 miles of centerline

Thus total number of households and jobs for the four distance bands were determined for each corridor, and for each distance band the total number of jobs as a proportion of total employment within 5 miles of the centerline was deduced. A slight adjustment was then made to convert the distance bands from the centerline to distance bands from stations.

Assuming stations every 0.5 miles along an LRT route, certain points that are within 0.25 miles from the alignment are not within 0.25 miles of a station. Assuming a station catchment is circular, the area within 0.25 miles of a station was calculated as 79% of the area within 0.25 miles of the centerline. This factor was applied to the demographic data and the remaining 21% was added to the 0.25-0.5 mile band. This was considered necessary due to the much higher trip rate factors that occur in the 0-0.25 mile cells, but other distance categories did not require adjustment.

Ridership Calculation

With total number of households and proportion of area employment for each corridor, the inputs could be entered into the model. Average daily boardings were determined as the product of the number of households, the proportion of employment for each cell in Exhibit 1.4, and the respective trip factor, i.e.

$$Trips = Households_O * JobFraction_D * TripRateFactor_{OD}$$

Where a corridor represented a minor extension of an existing or committed scheme, forecasts were developed for both the current and extended corridor. The model is not suitable for very short corridors since the representation of attractions may be unreasonable.

Table 4.14 lists the ridership forecasts for all the corridors described in Milestone 3. While the result of number of boarding trips appears to be origin-based, unlike the commuter rail forecasts, these results are total average daily ridership, including both portions of the daily round trip. Approximate boardings per mile have also been included to allow comparison of the corridors.

Table 4.1-14 **Average Daily Ridership Forecasts for LRT/BRT Corridors**

Corridor	Limits	Approximate Length (miles)	Estimated Average daily boardings	Boardings per mile
59th Avenue	51st Avenue/Baseline Road to 59th/Bell Road	19	19,594	1,059
Baseline Avenue	51st Avenue to UP Tempe Branch	13	8,199	631
Bell Road	Loop 303 to Scottsdale Road	28	28,661	1,024
Camelback Road	Loop 101 West Valley to Scottsdale Road	20	24,020	1,201
Chandler Boulevard	Ray Road to Power Road	16	12,507	760
Union Pacific Chandler Branch	Union Pacific Mainline to Queen Creek Road/Price Road	12	19,490	1,751
Glendale Avenue/Cactus Avenue	Glendale/19th Ave to Bell Road/Scottsdale Road	19	14,295	752
I-10 West	Central Avenue/Van Buren to Loop 101	12	11,386	1,035
I-10 Far West	Loop 101 to Loop 303	9	510	54
I-17	Loop 101 to Anthem Way	17	377	22
Loop 101 East	I-17 to Queen Creek Road/Price Road	35	1,108	32
Loop 101 West	I-17 to Baseline Road/91st Avenue	34	1,163	34
Loop 202	I-10/SR-51/Loop 202 Interchange to I-10/Loop 202 south Interchange	55	1,788	33
Loop 303	Baseline Road to Grand Avenue	19	485	26
Mesa Rd (Option 1)	Alma School Road to Loop 202	12	12,090	1,051
Mesa Rd (Option 2)	Alma School Road to Power Road	9	9,674	1,075
Metrocenter	19th Ave/Bethany Home to I-17/Peoria	5	5,062	1,012
Northern (east of Grand Ave)	19th Avenue to Grand Avenue	6	7,266	1,275
Northern (west of Grand Ave)	Grand Avenue to Loop 303	13	4,700	261
Northern (Total)	19th Avenue to Loop 303	19	11,966	647
Power Road	Williams Field Road to McDowell/Higley	13	10,496	807
Scottsdale Road	Queen Creek Rd/Price Rd to	28	27,182	967

Corridor	Limits	Approximate Length (miles)	Estimated Average daily boardings	Boardings per mile
	Scottsdale Rd/Bell Rd			
SR-51	Glendale Ave/19th Ave to Tatum Blvd/Loop 101	17	9,988	584
Union Pacific Tempe Branch	UP Mainline to 56th Street/I-10	10	8,010	801
US-60	I-10 to Idaho Road	18	1,362	76

Average daily boardings per mile compare with existing levels of 795, 1382 and 1283 for San Diego, Portland and Sacramento respectively. Particularly strong corridors include:

- Union Pacific Chandler Branch
- Camelback Road
- Bell Road
- 59th Avenue
- Main Street
- I-10 West
- Metrocenter

Other sections of corridors attract strong demand, such as Northern Avenue east of Grand Ave, and Scottsdale Road between Apache Boulevard and Camelback Road. This reinforces their identification as LRT extensions of the proposed Central Phoenix/East Valley (CP/EV) Light Rail project in Network 2 of Milestone 3.

Other corridors perform less well, particularly some of the freeway corridors such as Loop 303. Each of the Express BRT corridors was assessed with a lower level of service including fewer stations and reduced headways to more accurately depict the Express BRT service planned for these corridors. Additionally, these forecasts investigate each corridor in isolation, and it might be expected that some of these corridors may perform better within a complete network. It is also important to recognize that since many of the corridor catchment areas overlap, ridership for each corridor is likely to be lower should they all be implemented.

An estimate of total ridership for Networks 1 and 2 (as shown in Milestone 3) is presently best determined as the sum of all applicable corridors. However, as noted above, both the commuter rail DDM and the LRT/BRT sketch planning model develop forecasts for individual corridors one at a

time, and are not sensitive to other changes in the transportation network. Milestone 5 will address this issue using a more complex four-stage modeling approach, and will thus produce forecasts for complete Networks 1 and 2.

4.1.4 Light Rail Capital and Operating Costs

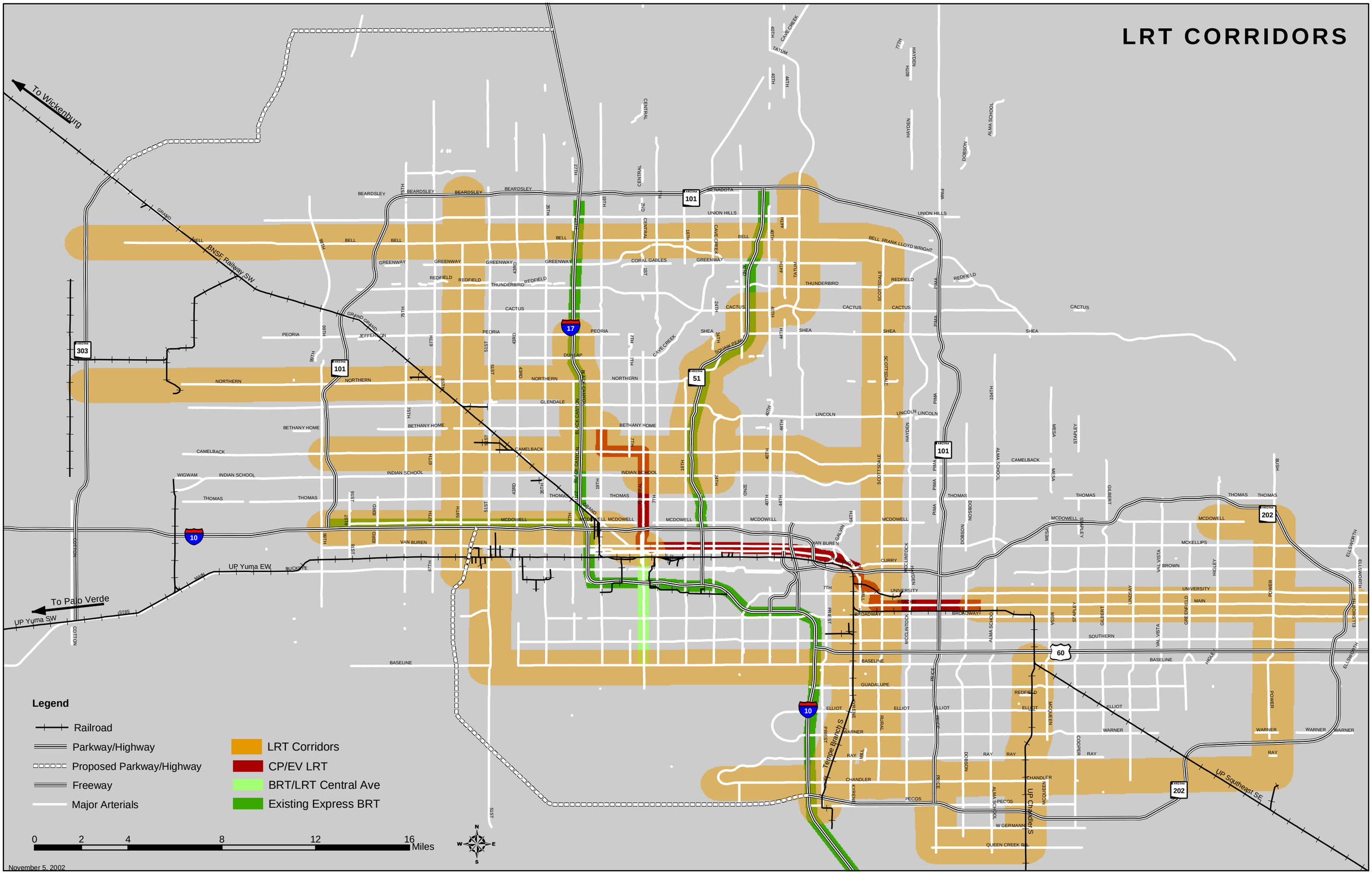
Capital and operating costs have been estimated for 17 different corridors located throughout the MAG region. These corridors have been derived from the Network 1 and 2 alternatives developed in Milestone 3 as well as additional suggestions by local agencies. Corridor lengths and distances used in the cost estimates are estimates obtained from a Geographic Information Systems (GIS) database of arterial street corridors in the MAG region. All street-running corridors have been assumed to operate at-grade in the street median. Full replacement of vehicle travel lanes has also been assumed. Freeway running portions of the corridors assume an elevated system running in the median of the freeway, except in the case of the Metrocenter LRT extension along I-17, which has been assumed at-grade consistent with the City of Phoenix's assumptions for this corridor.

Capital Costs

Two sets of capital costs have been developed for the LRT corridors. The first set assumes ballasted track along the at-grade alignments except at cross streets. Intersections require embedded track to allow for crossing by automobiles. Embedded track is assumed along the entire corridor in the second set of estimates. The main feature of embedded track is that it is a relatively flat, smooth surface, which would allow for the operation of automobiles above. This configuration is substantially more expensive than ballasted track, with differences of approximately $5 million per mile for each corridor. These two costs are presented for comparison purposes. Specific selection of a single track configuration would be performed on a corridor specific basis utilizing several criteria including cost, community input, and street configuration. All costs are based upon average unit rates for various light rail projects designed in the Western United States. These cost estimates are planning level estimates that have been produced without the benefit of detail plans. More precise costs could be produced in the latter stages of project design and development.

Exhibit 4.1-6 illustrates the LRT corridors considered in the cost estimates. Tables 4.1-15 and 4.1-16 summarize the LRT capital costs for each of the potential corridors.

LRT CORRIDORS



November 5, 2002

Table 4.1-15 Light Rail Capital Cost Summary (Ballasted Track)

Item	Bell Road	Camelback Road	Chandler Boulevard	Power Road	Scottsdale Road	Glendale Ave/Cactus Ave	SR-51	59th Avenue	I-10 West
Corridor Length (miles)	28.55	20.88	16.45	13.04	28.10	19.77	17.12	18.99	11.05
Subtotal-Civil Site Mods	$42,052,000	$31,888,250	$24,825,000	$19,646,000	$42,570,000	$19,155,750	$17,622,500	$28,004,250	$15,181,000
Subtotal-Guideway	$50,834,544	$45,681,888	$32,199,388	$19,428,172	$82,121,724	$167,127,224	$134,687,792	$54,647,512	$12,999,292
Subtotal-Utilities	$135,691,200	$99,216,900	$78,188,400	$61,977,600	$133,531,200	$93,944,700	$81,354,600	$90,260,100	$52,509,600
Subtotal-Track	$54,558,880	$42,311,510	$32,645,760	$24,876,440	$56,079,480	$35,912,730	$31,813,340	$39,357,990	$21,185,840
Subtotal-Stations	$54,275,000	$51,240,000	$37,527,500	$28,660,000	$65,565,000	$37,592,500	$35,815,000	$41,472,500	$21,647,500
Subtotal-Systems & Electrical	$99,290,384	$74,625,433	$59,437,188	$46,509,432	$104,734,184	$56,624,379	$53,768,322	$67,195,457	$37,741,672
Subtotal - Facilities	$12,500,000	$10,000,000	$7,500,000	$5,500,000	$13,500,000	$7,500,000	$8,500,000	$7,500,000	$5,500,000
A. Construction Subtotal	**$449,202,008**	**$354,963,981**	**$272,323,236**	**$206,597,644**	**$498,101,588**	**$417,857,283**	**$363,561,554**	**$328,437,809**	**$166,764,904**
Environmental Mitigation	$13,476,060	$10,648,919	$8,169,697	$6,197,929	$14,943,048	$12,535,718	$10,906,847	$9,853,134	$5,002,947
B. Construction Cost Subtotal	**$462,678,068**	**$365,612,900**	**$280,492,933**	**$212,795,573**	**$513,044,636**	**$430,393,001**	**$374,468,401**	**$338,290,943**	**$171,767,851**
C. Right of Way Subtotal	**$102,523,600**	**$73,763,375**	**$59,273,000**	**$49,430,500**	**$101,442,900**	**$55,600,825**	**$50,887,350**	**$63,794,375**	**$25,237,200**
D. Vehicles Subtotal	**$142,425,000**	**$107,500,000**	**$60,100,000**	**$42,850,000**	**$159,550,000**	**$67,450,000**	**$90,050,000**	**$67,450,000**	**$42,350,000**
Cost Contingencies (Uncertainties, Changes)									
Design&Construction	$115,669,517	$91,403,225	$70,123,233	$53,198,893	$128,261,159	$107,598,250	$93,617,100	$84,572,736	$42,941,963
Right of Way	$30,757,080	$22,129,013	$17,781,900	$14,829,150	$30,432,870	$16,680,248	$15,266,205	$19,138,313	$7,571,160
Vehicle Cost	$14,242,500	$10,750,000	$6,010,000	$4,285,000	$15,955,000	$6,745,000	$9,005,000	$6,745,000	$4,235,000
Program Implementation (Agency Costs and Fees)									
Design&Construction	$143,430,201	$113,339,999	$86,952,809	$65,966,628	$159,043,837	$133,421,830	$116,085,204	$104,870,192	$53,248,034
Right of Way Purchase	$15,378,540	$11,064,506	$8,890,950	$7,414,575	$15,216,435	$8,340,124	$7,633,103	$9,569,156	$3,785,580
Vehicle Procurement	$7,121,250	$5,375,000	$3,005,000	$2,142,500	$7,977,500	$3,372,500	$4,502,500	$3,372,500	$2,117,500
E. Capital Cost Subtotal	**$1,034,225,756**	**$800,938,018**	**$592,629,826**	**$452,912,819**	**$1,130,924,337**	**$829,601,779**	**$761,514,862**	**$697,803,215**	**$353,254,288**
Project Reserve	$103,422,576	$80,093,802	$59,262,983	$45,291,282	$113,092,434	$82,960,178	$76,151,486	$69,780,322	$35,325,429
F. Total Capital Cost	**$1,137,648,332**	**$881,031,820**	**$651,892,808**	**$498,204,101**	**$1,244,016,770**	**$912,561,956**	**$837,666,349**	**$767,583,537**	**$388,579,717**

Note: All costs are in 2001 Dollars.
Detailed cost information can be found in Appendix B

Table 4.1-15 Light Rail Capital Cost Summary (Ballasted Track)

Item	Union Pacific Chandler Branch	Union Pacific Tempe Branch	Main (Option 1)	Main (Option 2)	Northern Avenue east of Grand	Northern Avenue west of Grand	Baseline Road	Metrocenter
Corridor Length (miles)	11.13	10.00	12.64	9.64	5.70	12.89	12.95	5.07
Subtotal-Civil Site Mods	$6,102,000	$1,716,000	$18,459,000	$13,853,000	$8,247,750	$17,002,750	$18,592,000	$6,433,000
Subtotal-Guideway	$9,108,928	$6,880,200	$8,355,104	$6,214,484	$24,607,988	$29,318,456	$29,622,588	$13,712,868
Subtotal-Utilities	$52,889,400	$47,520,000	$55,321,200	$41,065,200	$27,135,900	$61,296,300	$61,538,400	$24,116,400
Subtotal-Track	$32,627,060	$17,474,000	$23,479,080	$17,541,680	$12,059,010	$22,482,370	$25,014,760	$8,833,360
Subtotal-Stations	$28,582,500	$16,125,000	$19,170,000	$16,125,000	$7,612,500	$18,625,000	$18,625,000	$11,012,500
Subtotal-Systems & Electrical	$45,403,758	$33,196,400	$40,599,484	$31,156,564	$18,062,263	$40,417,491	$41,426,688	$16,462,148
Subtotal - Facilities	$8,000,000	$5,500,000	$7,500,000	$7,000,000	$3,500,000	$4,500,000	$6,000,000	$3,500,000
A. Construction Subtotal	**$182,713,646**	**$128,411,600**	**$172,883,868**	**$132,955,928**	**$101,225,411**	**$193,642,367**	**$200,819,436**	**$84,070,276**
Environmental Mitigation	$5,481,409	$3,852,348	$5,186,516	$3,988,678	$3,036,762	$5,809,271	$6,024,583	$2,522,108
B. Construction Cost Subtotal	**$188,195,055**	**$132,263,948**	**$178,070,384**	**$136,944,606**	**$104,262,173**	**$199,451,638**	**$206,844,019**	**$86,592,384**
C. Right of Way Subtotal	**$48,198,350**	**$38,267,000**	**$42,578,500**	**$32,475,600**	**$16,644,325**	**$43,802,525**	**$42,174,700**	**$17,632,000**
D. Vehicles Subtotal	**$76,007,500**	**$42,100,000**	**$65,700,000**	**$58,260,000**	**$34,312,500**	**$49,425,000**	**$49,450,000**	**$34,250,000**
Cost Contingencies (Uncertainties, Changes)								
Design&Construction	$47,048,764	$33,065,987	$44,517,596	$34,236,151	$26,065,543	$49,862,910	$51,711,005	$21,648,096
Right of Way	$14,459,505	$11,480,100	$12,773,550	$9,742,680	$4,993,298	$13,140,758	$12,652,410	$5,289,600
Vehicle Cost	$7,600,750	$4,210,000	$6,570,000	$5,826,000	$3,431,250	$4,942,500	$4,945,000	$3,425,000
Program Implementation (Agency Costs and Fees)								
Design&Construction	$58,340,467	$41,001,824	$55,201,819	$42,452,828	$32,321,274	$61,830,008	$64,121,646	$26,843,639
Right of Way Purchase	$7,229,753	$5,740,050	$6,386,775	$4,871,340	$2,496,649	$6,570,379	$6,326,205	$2,644,800
Vehicle Procurement	$3,800,375	$2,105,000	$3,285,000	$2,913,000	$1,715,625	$2,471,250	$2,472,500	$1,712,500
E. Capital Cost Subtotal	**$450,880,519**	**$310,233,909**	**$415,083,624**	**$327,722,205**	**$226,242,637**	**$431,496,967**	**$440,697,485**	**$200,038,019**
Project Reserve	$45,088,052	$31,023,391	$41,508,362	$32,772,221	$22,624,264	$43,149,697	$44,069,748	$20,003,802
F. Total Capital Cost	**$495,968,571**	**$341,257,300**	**$456,591,987**	**$360,494,426**	**$248,866,900**	**$474,646,663**	**$484,767,233**	**$220,041,821**

Note: All costs are in 2001 Dollars.
Detailed cost information can be found in Appendix B

Table 4.1-16 Light Rail Capital Cost Summary (Embedded Track)

Item	Bell Road	Camelback Road	Chandler Boulevard	Power Road	Scottsdale Road	Glendale Ave/Cactus Ave	SR-51	59th Avenue	I-10 West
Corridor Length (miles)	28.55	20.88	16.45	13.04	28.10	19.77	17.12	18.99	11.05
Subtotal-Civil Site Mods	$42,052,000	$31,888,250	$24,825,000	$19,526,000	$42,570,000	$19,155,750	$17,622,500	$28,004,250	$15,181,000
Subtotal-Guideway	$62,392,320	$53,679,015	$38,663,140	$24,798,160	$92,988,720	$172,328,345	$139,343,510	$61,531,735	$12,999,292
Subtotal-Utilities	$135,691,200	$99,216,900	$78,188,400	$61,977,600	$133,531,200	$93,944,700	$81,354,600	$90,260,100	$52,509,600
Subtotal-Track	$159,508,800	$114,929,100	$91,339,600	$73,638,400	$154,756,800	$83,141,300	$74,089,400	$101,869,900	$21,185,840
Subtotal-Stations	$54,275,000	$51,240,000	$37,527,500	$28,660,000	$65,565,000	$37,592,500	$35,815,000	$41,472,500	$21,647,500
Subtotal-Systems & Electrical	$99,290,384	$74,625,433	$59,437,188	$46,509,432	$104,734,184	$56,624,379	$53,768,322	$67,195,457	$37,741,672
Subtotal - Facilities	$12,500,000	$10,000,000	$7,500,000	$5,500,000	$13,500,000	$7,500,000	$8,500,000	$7,500,000	$5,500,000
A. Construction Subtotal	**$565,709,704**	**$435,578,698**	**$337,480,828**	**$260,609,592**	**$607,645,904**	**$470,286,974**	**$410,493,332**	**$397,833,942**	**$166,764,904**
Environmental Mitigation	$16,971,291	$13,067,361	$10,124,425	$7,818,288	$18,229,377	$14,108,609	$12,314,800	$11,935,018	$5,002,947
B. Construction Cost Subtotal	**$582,680,995**	**$448,646,059**	**$347,605,253**	**$268,427,880**	**$625,875,281**	**$484,395,583**	**$422,808,132**	**$409,768,960**	**$171,767,851**
C. Right of Way Subtotal	**$102,523,600**	**$73,763,375**	**$59,273,000**	**$49,430,500**	**$101,442,900**	**$55,600,825**	**$50,887,350**	**$63,794,375**	**$25,237,200**
D. Vehicles Subtotal	**$143,050,000**	**$107,050,000**	**$60,850,000**	**$42,600,000**	**$159,550,000**	**$67,450,000**	**$90,050,000**	**$67,450,000**	**$42,350,000**
Cost Contingencies (Uncertainties, Changes)									
Design&Construction	$145,670,249	$112,161,515	$86,901,313	$67,106,970	$156,468,820	$121,098,896	$105,702,033	$102,442,240	$42,941,963
Right of Way	$30,757,080	$22,129,013	$17,781,900	$14,829,150	$30,432,870	$16,680,248	$15,266,205	$19,138,313	$7,571,160
Vehicle Cost	$14,305,000	$10,705,000	$6,085,000	$4,260,000	$15,955,000	$6,745,000	$9,005,000	$6,745,000	$4,235,000
Program Implementation (Agency Costs and Fees)									
Design&Construction	$180,631,108	$139,080,278	$107,757,628	$83,212,643	$194,021,337	$150,162,631	$131,070,521	$127,028,378	$53,248,034
Right of Way Purchase	$15,378,540	$11,064,506	$8,890,950	$7,414,575	$15,216,435	$8,340,124	$7,633,103	$9,569,156	$3,785,580
Vehicle Procurement	$7,152,500	$5,352,500	$3,042,500	$2,130,000	$7,977,500	$3,372,500	$4,502,500	$3,372,500	$2,117,500
E. Capital Cost Subtotal	**$1,222,149,072**	**$929,952,246**	**$698,187,544**	**$539,411,717**	**$1,306,940,144**	**$913,845,806**	**$836,924,843**	**$809,308,922**	**$353,254,288**
Project Reserve	$122,214,907	$92,995,225	$69,818,754	$53,941,172	$130,694,014	$91,384,581	$83,692,484	$80,930,892	$35,325,429
F. Total Capital Cost	**$1,344,363,980**	**$1,022,947,470**	**$768,006,299**	**$593,352,889**	**$1,437,634,158**	**$1,005,230,387**	**$920,617,328**	**$890,239,814**	**$388,579,717**

Note: All costs are in 2001 Dollars. Detailed cost information can be found in Appendix B

Table 4.1-16 Light Rail Capital Cost Summary (Embedded Track)

Item	Union Pacific Chandler Branch	Union Pacific Tempe Branch	Main (Option 1)	Main (Option 2)	Northern Avenue east of Grand	Northern Avenue west of Grand	Baseline Road	Metrocenter
Corridor Length (miles)	11.13	10.00	12.64	9.64	5.70	12.89	12.95	5.07
Subtotal-Civil Site Mods	$6,102,000	$1,716,000	$19,779,000	$15,173,000	$7,640,000	$17,002,750	$18,592,000	$6,433,000
Subtotal-Guideway	$9,108,928	$6,880,200	$14,350,820	$10,945,220	$25,944,600	$34,627,805	$34,685,640	$15,753,540
Subtotal-Utilities	$52,889,400	$47,520,000	$60,073,200	$45,817,200	$24,948,000	$61,296,300	$61,538,400	$24,116,400
Subtotal-Track	$32,627,060	$17,474,000	$73,422,800	$55,998,800	$26,268,000	$70,693,700	$70,989,600	$27,363,600
Subtotal-Stations	$28,582,500	$16,125,000	$19,170,000	$16,125,000	$9,612,500	$17,702,500	$18,625,000	$11,012,500
Subtotal-Systems & Electrical	$45,403,758	$33,196,400	$42,252,124	$32,809,204	$17,301,360	$40,754,991	$41,426,688	$16,462,148
Subtotal - Facilities	$8,000,000	$5,500,000	$7,500,000	$7,000,000	$3,500,000	$4,500,000	$6,000,000	$3,500,000
A. Construction Subtotal	**$182,713,646**	**$128,411,600**	**$236,547,944**	**$183,868,424**	**$115,214,460**	**$246,578,046**	**$251,857,328**	**$104,641,188**
Environmental Mitigation	$5,481,409	$3,852,348	$7,096,438	$5,516,053	$3,456,434	$7,397,341	$7,555,720	$3,139,236
B. Construction Cost Subtotal	**$188,195,055**	**$132,263,948**	**$243,644,382**	**$189,384,477**	**$118,670,894**	**$253,975,387**	**$259,413,048**	**$107,780,424**
C. Right of Way Subtotal	**$48,198,350**	**$38,267,000**	**$45,614,500**	**$35,511,600**	**$15,246,500**	**$43,802,525**	**$42,174,700**	**$17,632,000**
D. Vehicles Subtotal	**$75,600,000**	**$42,100,000**	**$65,950,000**	**$58,600,000**	**$34,250,000**	**$49,425,000**	**$49,450,000**	**$34,250,000**
Cost Contingencies (Uncertainties, Changes)								
Design&Construction	$47,048,764	$33,065,987	$60,911,096	$47,346,119	$29,667,723	$63,493,847	$64,853,262	$26,945,106
Right of Way	$14,459,505	$11,480,100	$13,684,350	$10,653,480	$4,573,950	$13,140,758	$12,652,410	$5,289,600
Vehicle Cost	$7,560,000	$4,210,000	$6,595,000	$5,860,000	$3,425,000	$4,942,500	$4,945,000	$3,425,000
Program Implementation (Agency Costs and Fees)								
Design&Construction	$58,340,467	$41,001,824	$75,529,759	$58,709,188	$36,787,977	$78,732,370	$80,418,045	$33,411,931
Right of Way Purchase	$7,229,753	$5,740,050	$6,842,175	$5,326,740	$2,286,975	$6,570,379	$6,326,205	$2,644,800
Vehicle Procurement	$3,780,000	$2,105,000	$3,297,500	$2,930,000	$1,712,500	$2,471,250	$2,472,500	$1,712,500
E. Capital Cost Subtotal	**$450,411,894**	**$310,233,909**	**$522,068,761**	**$414,321,604**	**$246,621,519**	**$516,554,016**	**$522,705,170**	**$233,091,361**
Project Reserve	$45,041,189	$31,023,391	$52,206,876	$41,432,160	$24,662,152	$51,655,402	$52,270,517	$23,309,136
F. Total Capital Cost	**$495,453,083**	**$341,257,300**	**$574,275,638**	**$455,753,764**	**$271,283,671**	**$568,209,417**	**$574,975,687**	**$256,400,497**

Note: All costs are in 2001 Dollars. Detailed cost information can be found in Appendix B

Cost categories in LRT cost tables include:

- **Civil Site Modifications** – This category includes widening streets and intersections to accommodate the rail guideway, and modifications to traffic signals to match the new traffic lane alignment.
- **Guideway** – The cost of the guideway structure or base is estimated in this category.
- **Utilities** – same as commuter rail.
- **Track** – This category presents the costs for installing new trackwork in the corridor.
- **Stations** – The cost of implementing light rail stations, including associated parking is included here. For the purposes of this cost estimate parking was assumed to be distributed evenly between surface lots and parking structures. An average of 150 parking spaces is estimated at each station.
- **Systems & Electrical** – The cost of installing the electric power distribution systems, ticket vending machines, and corridor lighting are included here.
- **Facilities** – The cost of an operations control and dispatching center is estimated here along with the cost of a maintenance and storage facility.
- **Environmental Mitigation** – This is a cost allowance added to the construction costs identified above which would be used to provide spot mitigation measures such as landscaping that could be identified later in the implementation process.
- **Construction Add-ons** – Same as commuter rail.
- **Right-of-Way** – This category includes the land required to accommodate the system. Right-of-way costs assume the costs of purchasing 23 feet of right-of-way in each arterial street corridor where the system is assumed to run at-grade. Aerial portions of the alignment are assumed to not require additional right-of-way since the Guideway support structures would be located entirely in the existing median. The cost estimate also includes the cost of right-of-way for stations and parking lots.
- **Right-of-Way Add-ons** – Same as commuter rail.
- **Vehicles/Maintenance of Way** – This category includes the light rail vehicles, spare parts, and maintenance of way equipment.
- **Vehicle Add-ons** – These include contingencies for the price of the light rail vehicles, and the cost of the procurement, testing, and commissioning of the vehicles.

Detailed LRT capital cost estimate information is provided in Appendix B

Operating Costs

Light rail operating costs have estimated using a parametric model developed for the Tri-Met LRT system in Portland, Oregon. The model includes the number of stations, length of the alignment, number of vehicles in the fleet, vehicle service hours, and vehicle service miles. Model inputs have been adjusted by comparing bus operating costs for Valley Metro/RPTA with Tri-Met bus service. The use of these model inputs allows for comparisons between light rail systems. The parametric model is designed to produce consistent results even when applied to different light rail systems in different metropolitan areas because the model is calibrated using the bus cost per revenue vehicle mile and vehicle hour for a specific metropolitan area. Operating costs are the same whether the system is run on ballasted or embedded track. Table 4.1-17 summarizes the peak period headways assumed for each corridor. These headways are based upon exitsing Valley Metro bus headways and proposed headways identified in Milestone 3. Off-peak headways are assumed to be half that of peak headways. For example, off-peak headways on Bell Road would be 20 minutes.

Table 4.1-17 **LRT Headways**

Corridor	Assumed Peak Headway (minutes)
59th Avenue	15
Baseline Road	15
Bell Road	10
Camelback Road	10
Chandler Boulevard	15
Union Pacific Chandler Branch	10
Glendale Avenue/Cactus Avenue	15
Interstate 10 West	15
Main Street (Option 1)	10
Main Street (Option 2)	10
Metrocenter	10
Northern Avenue (east of Grand Avenue)	10
Northern Avenue (west of Grand Avenue)	15
Power Road	20
Scottsdale Road	10
SR-51	10
Union Pacific Tempe Branch	15

Table 4.1-18 summarizes the operating costs for the 17 LRT corridors. Costs are in Year 2001 dollars. Detailed LRT operating costs are provided in Appendix B.

Table 4.1-18 Light Rail Operating Cost Summary

Corridor	Annual O&M Cost ($ millions)
59th Avenue	$11.35
Baseline Road	$8.16
Bell Road	$22.58
Camelback Road	$17.12
Chandler Boulevard	$9.79
Union Pacific Chandler Branch	$10.44
Glendale Avenue/Cactus Avenue	$11.14
I-10 West	$6.79
Main (Option 1)	$10.41
Main (Option 2)	$8.96
Metrocenter	$4.93
Northern (east of Grand Avenue)	$6.13
Northern (west of Grand Avenue)	$8.16
Power Road	$7.22
Scottsdale Road	$22.58
SR-51	$14.16
Union Pacific Tempe Branch	$6.66

Note: All figures in 2001 dollars

4.1.5 Bus Rapid Transit Operating and Capital Costs

Bus Rapid Transit capital and operating costs have been developed for 20 corridors located across the MAG region. As was the case with the LRT corridors, these alignments are based upon the Network 1 and Network 2 alternatives identified in Milestone 3. Two forms of BRT service are assumed depending upon the characteristics of each corridor. Dedicated BRT has been assumed for arterial street and rail right-of-way corridors. This form of BRT involves buses operating at-grade in an exclusive lane separate from automobile travel lanes. The width of this lane is assumed to be 27 feet, consistent with the light rail systems. The cost estimates for Dedicated BRT assume the replacement of any mixed-flow automobile lanes that are removed to accommodate the new BRT lanes.

The BRT service would also be similar to light rail in terms of type of service. However, Dedicated BRT uses smaller vehicles, which would require higher frequencies to provide a comparable level of service. Express BRT is assumed in all freeway corridors. These BRT services would utilize existing or proposed high occupancy vehicle (HOV) lanes to serve each corridor. No freeway lane widening or lane replacement is required to implement Express BRT service.

As was the case with the LRT corridors, specific lengths and distances were obtained from a Geographic Information Systems (GIS) database of arterial street corridors in the MAG region. All services will operate at-grade along any type of alignment. Dedicated BRT assumes stations approximately ¼ mile to one mile apart, while Express BRT serves park-and-ride lots three to five miles apart. Exhibit 4.1-5 illustrates the Dedicated and Express BRT corridors considered in the cost estimates. Capital costs for the Dedicated and Express BRT corridors are summarized in Table 4.1-19.

DEDICATED & EXPRESS BRT CORRIDORS

Legend

- Railroad
- Parkway/Highway
- Proposed Parkway/Highway
- Freeway
- Major Arterials
- Dedicated BRT
- Express BRT
- CP/EV LRT
- BRT/LRT Central Ave
- Existing Express BRT

0 2 4 8 12 16 Miles

N W E S

November 5, 2002

Table 4.1-19 Bus Rapid Transit Capital Cost Summary

Item	Bell Road	Camelback Road	Chandler Boulevard	Scottsdale Road	Power Road	Glendale Ave/Cactus Ave	Union Pacific Chandler Branch	Union Pacific Tempe Branch	Northern Avenue west of Grand	Main (Option 1)
Corridor Length (miles)	28.55	20.88	16.45	28.10	13.04	19.77	11.13	10.00	12.89	12.64
Subtotal-Civil/Roadway	$49,919,272	$37,100,214	$28,704,994	$54,296,955	$22,834,447	$21,114,350	$23,463,286	$17,208,800	$21,796,052	$21,754,791
Subtotal-Utilities	$22,615,350	$16,536,150	$13,031,400	$24,450,600	$10,329,600	$9,717,450	$10,798,500	$7,920,000	$9,851,700	$10,012,200
Subtotal-Stations	$38,880,000	$32,805,000	$26,730,000	$44,955,000	$20,655,000	$17,010,000	$20,655,000	$15,795,000	$13,365,000	$18,225,000
Subtotal-Systems & Electrical	$13,151,663	$10,894,057	$8,422,530	$15,164,076	$6,385,939	$5,800,731	$6,393,826	$4,724,000	$4,659,462	$6,114,833
Subtotal Facilities	$1,050,000	$1,050,000	$1,050,000	$1,050,000	$1,050,000	$1,050,000	$1,050,000	$1,050,000	$1,050,000	$1,050,000
A. Construction Subtotal	**$125,616,285**	**$98,385,421**	**$77,938,925**	**$139,916,631**	**$61,254,986**	**$54,692,531**	**$62,360,612**	**$46,697,800**	**$50,722,215**	**$57,156,825**
Environmental Mitigation	$3,768,489	$2,951,563	$2,338,168	$4,197,499	$1,837,650	$1,640,776	$1,870,818	$1,400,934	$1,521,666	$1,714,705
B. Construction Cost Subtotal	**$129,384,774**	**$101,336,984**	**$80,277,093**	**$144,114,130**	**$63,092,636**	**$56,333,307**	**$64,231,430**	**$48,098,734**	**$52,243,881**	**$58,871,529**
C. Right of Way Subtotal	**$99,527,725**	**$73,090,175**	**$58,533,800**	**$107,799,400**	**$46,882,900**	**$42,506,425**	**$50,865,350**	**$37,105,400**	**$43,118,650**	**$43,872,100**
D. Vehicles Subtotal	**$22,264,000**	**$16,456,000**	**$9,196,000**	**$23,716,000**	**$5,324,000**	**$15,004,000**	**$10,648,000**	**$8,228,000**	**$5,324,000**	**$9,680,000**
Cost Contingencies (Uncertainties, Changes)										
Design&Construction	$32,346,193	$25,334,246	$20,069,273	$36,028,532	$15,773,159	$14,083,327	$16,057,858	$12,024,684	$13,060,970	$14,717,882
Right of Way	$29,858,318	$21,927,053	$17,560,140	$32,339,820	$14,064,870	$12,751,928	$15,259,605	$11,131,620	$12,935,595	$13,161,630
Vehicle Cost	$2,226,400	$1,645,600	$919,600	$2,371,600	$532,400	$1,500,400	$1,064,800	$822,800	$532,400	$968,000
Program Implementation (Agency Costs and Fees)										
Design&Construction	$40,109,280	$31,414,465	$24,885,899	$44,675,380	$19,558,717	$17,463,325	$19,911,743	$14,910,608	$16,195,603	$18,250,174
Right of Way Purchase	$14,929,159	$10,963,526	$8,780,070	$16,169,910	$7,032,435	$6,375,964	$7,629,803	$5,565,810	$6,467,798	$6,580,815
Vehicle Procurement	$1,113,200	$822,800	$459,800	$1,185,800	$266,200	$750,200	$532,400	$411,400	$266,200	$484,000
E. Capital Cost Subtotal	**$371,759,048**	**$282,990,849**	**$220,681,674**	**$408,400,573**	**$172,527,317**	**$166,768,875**	**$186,200,989**	**$138,299,055**	**$150,145,097**	**$166,586,131**
Project Reserve	$37,175,905	$28,299,085	$22,068,167	$40,840,057	$17,252,732	$16,676,888	$18,620,099	$13,829,906	$15,014,510	$16,658,613
F. Total Capital Cost	**$408,934,953**	**$311,289,933**	**$242,749,842**	**$449,240,630**	**$189,780,049**	**$183,445,763**	**$204,821,088**	**$152,128,961**	**$165,159,606**	**$183,244,744**

Note: All costs are in 2001 Dollars.
Detailed cost information can be found in Appendix B

Table 4.1-19 Bus Rapid Transit Capital Cost Summary

Item	Main (Option 2)	Baseline Road	59th Avenue	US-60	Loop 101 West	Loop 101 East	Loop 202	Loop 303	I-17	I-10 Far West
Corridor Length (miles)	9.64	12.95	18.99	18.96	34.10	34.33	54.64	19.44	17.00	9.42
Subtotal-Civil/Roadway	$16,592,151	$22,675,396	$33,076,616	$0	$0	$0	$0	$0	$0	$0
Subtotal-Utilities	$7,636,200	$10,256,400	$15,043,350	$0	$0	$0	$0	$0	$0	$0
Subtotal-Stations	$14,580,000	$19,440,000	$32,805,000	$7,680,000	$11,520,000	$15,360,000	$21,120,000	$9,600,000	$3,840,000	$3,840,000
Subtotal-Systems & Electrical	$4,829,833	$6,241,000	$10,258,178	$520,000	$780,000	$1,040,000	$1,430,000	$650,000	$260,000	$260,000
Subtotal Facilities	$1,050,000	$1,050,000	$1,050,000	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000
A. Construction Subtotal	**$44,688,185**	**$59,662,796**	**$92,233,144**	**$8,450,000**	**$12,550,000**	**$16,650,000**	**$22,800,000**	**$10,500,000**	**$4,350,000**	**$4,350,000**
Environmental Mitigation	$1,340,646	$1,789,884	$2,766,994	$253,500	$376,500	$499,500	$684,000	$315,000	$130,500	$130,500
B. Construction Cost Subtotal	**$46,028,830**	**$61,452,680**	**$95,000,139**	**$8,703,500**	**$12,926,500**	**$17,149,500**	**$23,484,000**	**$10,815,000**	**$4,480,500**	**$4,480,500**
C. Right of Way Subtotal	**$33,769,200**	**$45,791,500**	**$67,252,775**	**$6,969,600**	**$10,454,400**	**$13,939,200**	**$19,166,400**	**$8,712,000**	**$3,484,800**	**$3,484,800**
D. Vehicles Subtotal	**$7,744,000**	**$7,744,000**	**$14,520,000**	**$2,376,000**	**$3,960,000**	**$4,356,000**	**$6,732,000**	**$1,980,000**	**$1,980,000**	**$1,584,000**
Cost Contingencies (Uncertainties, Changes)										
Design&Construction	$11,507,208	$15,363,170	$23,750,035	$2,175,875	$3,231,625	$4,287,375	$5,871,000	$2,703,750	$1,120,125	$1,120,125
Right of Way	$10,130,760	$13,737,450	$20,175,833	$2,090,880	$3,136,320	$4,181,760	$5,749,920	$2,613,600	$1,045,440	$1,045,440
Vehicle Cost	$774,400	$774,400	$1,452,000	$237,600	$396,000	$435,600	$673,200	$198,000	$198,000	$158,400
Program Implementation (Agency Costs and Fees)										
Design&Construction	$14,268,937	$19,050,331	$29,450,043	$2,698,085	$4,007,215	$5,316,345	$7,280,040	$3,352,650	$1,388,955	$1,388,955
Right of Way Purchase	$5,065,380	$6,868,725	$10,087,916	$1,045,440	$1,568,160	$2,090,880	$2,874,960	$1,306,800	$522,720	$522,720
Vehicle Procurement	$387,200	$387,200	$726,000	$118,800	$198,000	$217,800	$336,600	$99,000	$99,000	$79,200
E. Capital Cost Subtotal	**$129,675,915**	**$171,169,456**	**$262,414,740**	**$26,415,780**	**$39,878,220**	**$51,974,460**	**$72,168,120**	**$31,780,800**	**$14,319,540**	**$13,864,140**
Project Reserve	$12,967,592	$17,116,946	$26,241,474	$2,641,578	$3,987,822	$5,197,446	$7,216,812	$3,178,080	$1,431,954	$1,386,414
F. Total Capital Cost	**$142,643,507**	**$188,286,401**	**$288,656,214**	**$29,057,358**	**$43,866,042**	**$57,171,906**	**$79,384,932**	**$34,958,880**	**$15,751,494**	**$15,250,554**

Note: All costs are in 2001 Dollars.
Detailed cost information can be found in Appendix B

Cost categories for BRT include:

- **Civil Site Modifications** – This category includes widening streets and intersections to accommodate the Dedicated BRT lanes and modifications to traffic signals to match the new traffic lane alignment.
- **Utilities** – same as above.
- **Stations** – The cost of implementing BRT stations, including associated parking is included here. Express bus stations were assumed to provide an average of 300 spaces, while Dedicated BRT stations provided an average of 100 spaces. For the purposes of this cost estimate parking was assumed to be distributed evenly between surface lots and parking structures.
- **Systems & Electrical** – The cost of installing signal priority systems at major intersections and on-board the BRT vehicles are assumed here. This category also includes the cost of ticket vending machines, corridor lighting, and automated vehicle location (AVL) systems on the buses.
- **Facilities** – The cost of an operations control and dispatching center is estimated here. No estimate for a maintenance and storage facility has been provided. It is assumed that the BRT vehicles could be accommodated in the existing Valley Metro/RPTA facilities. The cost of AVL hardware at the operations and control center and at stations is also included here.
- **Environmental Mitigation** – This is a cost allowance added to the construction costs identified above which would be used to provide spot mitigation measures such as landscaping that could be identified later in the implementation process.
- **Construction Add-ons** – Same as commuter and light rail.
- **Right-of-Way** – This category includes the land required to accommodate the system. Right-of-way costs assume the costs of purchasing 23 feet of right-of-way in each arterial street corridor where the system is assumed to run at-grade. Freeway portions of the alignment are assumed to not require additional right-of-way since the vehicles will operate in existing or planned HOV lanes. The cost estimate also includes the cost of right-of-way for stations and parking lots.
- **Right-of-Way Add-ons** – Same as commuter and light rail.
- **Vehicles/Maintenance of Way** – This category includes the buses, spare parts, and maintenance of way equipment. Express BRT service operates using 40-foot compressed natural gas (CNG) vehicles. Dedicated BRT service is provided by 60-foot articulated buses.

- **Vehicle Add-ons** – These include contingencies for the price of the buses, and the cost of the procurement, testing, and commissioning of the vehicles.

Detailed capital costs are available in Appendix C.

Operating Costs

Operating costs for the BRT corridors were estimated using the Year 2001 NTD data for Valley Metro/RPTA bus service. The costs for vehicle revenue hour and vehicle revenue mile were used as a base for estimating BRT service costs. As mentioned above, Dedicated BRT service is capable of providing a level of service that is comparable to LRT service, but additional vehicles and increased frequencies are usually required to serve the same number of passengers. The peak headways for BRT service are shown in Table 4.1-20. Ridership and cost estimates have been prepared assuming Dedicated BRT and Express BRT operating in the peak and off-peak periods. Off-peak headways were assumed to be twice that of peak headways for both Dedicated and Express BRT. For example, BRT service on 59th Avenue would operate at 10 minute headways during off-peak times.

Table 4.1-20 **BRT Headways**

Corridor	Assumed Peak Headway (minutes)
59th Avenue	5
Baseline Road	7
Bell Road	5
Camelback	5
Chandler Boulevard	7
Union Pacific Chandler Branch	5
Glendale Ave/Cactus Rd	5
Interstate 10 Far West	15
Interstate 17	20
Loop 101 East	15
Loop 101 West	15
Loop 202	15
Loop 303	20
Main Street (Option 1)	5
Main Street (Option 2)	5
Northern Avenue (west of Grand Ave)	10
Power Road	10
Scottsdale Road	5
Union Pacific Tempe Branch	5
US-60	15

Table 4.1-21 summarizes the Dedicated and Express BRT operating costs. Detailed BRT operating costs are available in Appendix C.

Table 4.1-21 BRT Operating Cost Summary

Corridor	Annual O&M (millions $)
59th Avenue	$10.29
Baseline Road	$5.35
Bell Road	$15.64
Camelback Road	$11.53
Chandler Boulevard	$6.59
Union Pacific Chandler Branch	$7.41
Glendale Avenue/Cactus Avenue	$10.71
I-10 Far West	$1.52
I-17	$2.27
Loop 101 East	$5.21
Loop 101 West	$4.63
Loop 202	$8.11
Loop 303	$2.31
Main (Option 1)	$7.00
Main (Option 2)	$5.35
Northern (west of Grand Avenue)	$3.71
Power Road	$3.71
Scottsdale Road	$15.23
Union Pacific Tempe Branch	$5.77
US-60	$2.88

Note: All figures in 2001 dollars

4.2 Refine Threshold and Performance Measures

Peer group transit systems and technologies were reviewed in Milestone 2 with the purpose of identifying a set of thresholds in the areas of socio-economic indicators, ridership, and system costs which could be applied to corridors selected for evaluation as possible high capacity transit corridors in the MAG region. The data collected for these peer transit systems was refined to create a series of criteria to evaluate the corridors identified in Milestone 3. Table 4.2-1 illustrates the first and second level of screening that will occur for each of the 28 corridors identified in Section 4.1.

Table 4.2-1 **Corridor Screening Criteria**

Category	Criteria	Key Indicator
Mobility & Demand	**Population**	population density within 1/2 mi.
	Employment	employment density within 1/2 mi.
	Existing Service Impact	complementary or competitive impact on ridership
	Equity/Env. Justice	employment accessible by ethnic groups
Policy & Land Use	**Redevelopment Areas**	'blight' reduction / links redevelopment areas
	Station Area Cohesion	TOD development potential
Cost and Cost Effectiveness	**Capital Cost**	capital cost per mile ($M)
	Cost Effectiveness	per new rider cost using annual capital and operating costs ($)
Environmental Impacts and Benefits	**Displacement**	through ROW expansion
	Natural Resources	identified key resources on ROW
Community Input	**Public Input**	from public involvement plan work to date

This section first provides an overview of the revenue forecasts for each corridor based upon the ridership estimates developed in Section 4.1 and an analytical review of the current Valley Metro/RPTA fare structure compared to the fare structure of similar transit systems around the country.

Following the fare structure review, each of the criteria used in the two levels of screening is identified an explained. This section closes with a detailed assessment of the role that a potential feeder bus network would play in a high capacity transit network.

4.2.1 Refined Revenue Forecasts

This section first presents general criteria for developing a fare structure for new high capacity services. As mentioned in Milestone 3, commuter rail fare

policies and structures are typically more sophisticated than those instituted for conventional public transportation systems. On the other hand, the fare structure for LRT, and Dedicated and Express BRT services will closely resemble the existing Valley Metro/RPTA scheme. For this reason, fare structure and revenue forecasts are treated separately by mode: first the BRT and LRT services, followed by commuter rail.

Fare Structure Principles

The fare structure for proposed new high capacity services should:

- Be consistent with the existing Valley Metro/RPTA bus fare structure.
- Reflect the thinking of local transit operators, planning agencies and policy makers with respect to future directions in transit fare structure, especially as additional modes are introduced.
- Incorporate the experience of similar transit agencies.
- Produce a reasonable and sustainable farebox recovery.

Some discussion and planning has already taken place in the MAG Region with respect to fares for LRT and BRT services. Phoenix's new Express BRT service that begins in mid-2003 will use the current express fare structure. The online fact sheet for the Central Phoenix/East Valley LRT starter line[3] specifies that the fare structure for the line will be similar to the current bus fare structure. It is generally preferred that no changes be made in fares or fare policies until the opening of the light rail system. The goal is to insure the continuation of the seamless fare structure and policies for all cities providing service under the Valley Metro/RPTA umbrella.

The City of Phoenix has commissioned a study to look at fare policies that began in early September 2002. The study will take a strategic, long-range look at fare structures, not just for the existing bus services but look toward introduction of LRT services. Participation in the study includes Valley Metro/RPTA and other cities operating transit services in the region. As this study progresses toward its completion at the end of 2002, its findings will have a significant effect on fare policies for all future transit services.

Public policy discussion is less developed with respect to a commuter rail fare structure and its relationship to fares for other transit services. Since commuter rail forms a significant part of the High Capacity Transit Plan, a key benefit of this study is the stimulus and framework it can provide for public discussion on the issue.

[3] http://www.valleyconnections.com/content_08/index.cfm

Existing Valley Metro/RPTA Fare Structure

The current Valley Metro/RPTA fare structure is shown in Table 4.2-2.

Table 4.2-2 **Valley Metro/RPTA Fare Structure**

BUS FARES	Local Service	Discount Local Service	Express Service
Bus Fare	$1.25	$0.60	$1.75
Tokens (20 for $12.00)	2 tokens	1 token	3 tokens
Ten-Ride Ticket Book	$12.00	$6.00	$18.00
All Day Pass	$3.60	$1.80	N/A
Monthly Pass	$34.00	$17.00	$51.00
Semester Pass: Fall (8/15 to 12/31) Spring (1/1 to 5/15)	$120.00	N/A	N/A
Summer Semester Pass (valid 5/16 to 8/14)	$80.00	N/A	N/A
Summer Youth Passport (valid 6/1 to 8/31)	$46.00	N/A	N/A
Transfers	Free		

Source: http://www.valleymetro.org/transit/fare_structure.htm

Fare Structures of Other Transit Agencies

For purposes of general comparison and to provide some context, following are examples of fare structures from other transit operators selected from the peer systems analyzed in Milestone 2. The cities compared are:

- San Diego
- Miami
- Denver
- Dallas
- San Jose
- Pittsburgh

Agencies in all of these cities provide rail service in addition to bus operations. Two operate BRT services.

San Diego Transit Corporation and San Diego Trolley

San Diego Transit Corporation operates about 268 peak buses. The San Diego Trolley provides service on two light rail lines.

Table 4.2-3 **San Diego Transit Corporation/San Diego Trolley Fare Structure**

Fare Category	Fare
Bus	
Cash Full Fare	$2.00
Cash Express Routes	$2.25 - $2.50
Transfers	Free (Pay Fare Difference, If Any)
Rail	
Cash Full Fare (Depends on Number of Stations Traveled)	$1.25-$2.50
Transfers	Free
Rail or Bus	
Cash Senior/Disabled	$1.00
Transfers: Rail to Bus	Free (Pay Fare Difference, If Any)
Transfers: Bus to Rail	Free (Pay Fare Difference, If Any)
One-Day Pass	$5.00
Two-Day Pass (Consecutive Days)	$8.00
Three-Day Pass (Consecutive Days)	$10.00
Four-Day Pass (Consecutive Days)	$12.00
Monthly Pass – Full Fare (Incl. Express $2.25 Fare)	$54.00
Monthly Pass – Full Fare (All Express Routes)	$60.00
Monthly Pass - Youth	$26.00
Monthly Pass – Senior/Disabled	$13.50
Tokens (11) – Valid for $2.00 Fare	$20.00
Tokens (44) – Valid for $2.00 Fare	$80.00

Miami-Dade Transit

Miami-Dade Transit operates about 530 peak buses, including BRT. The agency also provides heavy rail and Metromover (automated guideway) services.

Table 4.2-4 **Miami-Dade Transit Fare Structure**

Fare Category	Fare	
	Full	Reduced[1]
Cash Fare	$1.25	$0.60
Cash Fare Express Bus	$1.50	$0.75
Cash Fare Metromover	$0.25	$0.10

Fare Category		Fare	
		Full	Reduced[1]
Transfers	Bus/Rail[2]	$0.25	$0.10
	Metromover to Bus/Rail	$1.00	$0.50
	Bus/Rail to Metromover	Free	Free
	Local Bus to Express Bus	$0.25	$0.10
Monthly Pass		$60.00	$30.00
Monthly Pass – College Students		$45.00	-
Golden Passport (Senior - Low Income)		-	Free
10 Tokens – Bus/Rail (Express Premium - $0.25)		$10.00	-

1. Student/Senior/Disabled
2. Free Transfer From BRT Lines to Rail at Dadeland South Station.

Denver Rapid Transit District

The Denver Rapid Transit District (RTD) operates about 639 peak buses and two light rail lines.

Table 4.2-5 **Denver RTD Fare Structure**

Fare Category	Bus and Rail		Regional Bus
	Local	Express[1]	
Cash Full Fare	$1.10	$2.50	$3.50
Cash Senior/Disabled/Medicare	$0.55	$1.25	$1.75
Cash Youth (Off-peak)	-	$1.25	$1.75
Cash Round Trip (Rail Only)	$2.20	$5.00	-
Transfer	Free (Pay Fare Difference, If Any)		
10-Ride Ticketbook	$8.25	$19.00	$26.00
Monthly Pass - Full Fare	$31.00	$70.00	$98.00
Monthly Pass - Student	$19.00	$42.00	$59.00
Monthly Pass – Senior/Disabled/Medicare	$19.00	$42.00	$59.00

1. Express Rail Fares Apply to Trips Crossing Hampden Avenue.

Dallas Area Rapid Transit

Dallas Area Rapid Transit (DART) system operates about 441 peak buses and two light rail lines.

Table 4.2-6 **Dallas DART Fare Structure**

Fare Category	Fare			
	Local	Premium (Express Bus)	Reduced[1]	Downtown Reduced[2]
Cash Fare (Bus only)	$1.00	$2.00	$0.50	-

Fare Category	Fare			
	Local	Premium (Express Bus)	Reduced[1]	Downtown Reduced[2]
Single-Trip Ticket (Rail only)	$1.00	-	$0.50	$0.50
Transfers	None (Purchase One-day Pass)			
One-day Pass	$2.00	$4.00	$1.00	-
Monthly Pass	$30.00	$60.00	$10.00	-

1. Seniors, Disabled, Students
2. Light Rail Trips Between Downtown Stations

San Jose (Santa Clara Valley Transit Authority)

The Santa Clara Valley Transit Authority (VTA) operates about 427 peak buses and two light rail lines.

Table 4.2-7 **San Jose/Santa Clara VTA Fare Structure**

Fare Category	Fare		
	Adult	Youth	Senior/Disabled
Cash - Single Ride	$1.40	$0.85	$0.45
Cash - Express Single Ride	$2.25	$0.85	$0.45
Day Pass	$4.00	$2.50	$1.25
Day Pass - Express Bus	$6.00	N/A[1]	N/A[1]
Transfers	None[2]		
Monthly Pass	$45.00	$27.00	$11.00
Monthly Pass - Express Bus	$72.00	N/A[1]	N/A[1]
Annual Pass	$495.00	$297.00	$121.00
Annual Pass - Express Bus	$792.00	N/A[1]	N/A[1]
Day Pass Tokens (5)	$18.00[3]	$11.25	-

1. Youths/Senior/Disabled Day, Monthly, or Annual Pass Holders May Use Express Bus Service Without Additional Charge.
2. Light Rail Single Ride Tickets May Be Used to Transfer Between Light Rail Lines Within the Two-Hour Time Limit.
3. Additional Charge for Express Service.

Pittsburgh (Allegheny County) Port Authority

The Pittsburgh Port Authority operates 848 peak buses, including BRT services, as well as a light rail transit system and an incline.

Table 4.2-8 **Pittsburgh Port Authority Fare Structure**

Fare Category	Fare	
	Adult	Child/ Disabled[1]
Free Zone	Free	Free
Cash Fare City Center Downtowner Zone	$1.25	$0.60
Cash Fare One Zone	$1.75	$0.85

Fare Category	Fare	
	Adult	Child/ Disabled[1]
Cash Fare Two Zone	$2.25	$1.10
Cash Fare Three Zone	$2.75	$1.35
Peak Period/Peak Direction Surcharge for LRT:		
Downtowner Zone	$0.25	$0.10
One Zone	$0.50	$0.25
Two Zone	$0.50	$0.25
Transfers (One Zone)	$0.50	$0.25
Merchant Program Tokens (with $20 store purchase)	$1.00 Toward Any Fare	
Ten Trip Tickets		
Downtowner Zone	$12.50	$6.00
One Zone	$17.50	$8.50
Two Zone	$22.50	$11.00
Three Zone	$27.50	$13.50
Weekly Pass - One to Three Zone	$16.75 - $25.75	N/A
Monthly Pass - One to Three Zone	$60.00 - $93.00	N/A
Annual Pass - One to Three Zone	$660.00 - $1023.00	N/A
Seniors	Free Off Peak	

1. Discount Fares for Disabled May Be Used at Off-Peak Hours Only.

The six systems illustrate a wide variety of fare policies and structures. Generally as technology improves the number of fare alternatives increases. Agencies that have fareboxes capable of reading and writing magnetic media have a richer variety of fare options including stored value tickets, multi-ride tickets, daily, weekly, monthly, quarterly and annual passes. Authorities using less sophisticated farebox equipment are more limited in the number of fare products they offer, as drivers are simply not able to check the validity of many different types of media with varied expiration dates.

The complexity of the fare structures in the six peer cities seven varies widely. Some have simple tariffs with base fares and premiums for express service, while other have complex tariffs with multiple zones and peak/off peak pricing. Specially discounted services for special markets such as universities or geographic areas like downtown are offered in some cities. Two of the systems offer free transfers although the rules for number of transfers or length of validity vary widely. Some of the systems have consolidated all reduced fare options into a single generic category identified as discount fares, while the majority of systems continue to have multiple fare categories including adult, student, youth, seniors and disabled.

MAG Region BRT, LRT, and Express Bus Fare Structure

With the introduction of high capacity transit services, the average passenger trip length will no doubt increase over today's level. While the City of Phoenix fare study may evaluate distance-based fares, it is considered unlikely that a comprehensive BRT/LRT network will move to a zone-based fare structure, even as service expands to outlying areas. Of the six peer light rail systems profiled in the Milestone 2 report, four employ a completely flat fare structure without respect to distance traveled. (St. Louis Metrolink charges a higher fare for trips from Lambert Airport station only.) Denver RTD's Central and Southwest lines charge an express fare for trips crossing a certain street on the southern portion of the line. Fares for the San Diego Trolley depend on the number of stations traveled, which equates roughly to distance, but the fare range, $1.25 to $2.50, is fairly compressed.

On the other hand, the practice of charging a premium for express bus service is well established. All the systems described in the previous section charge a higher fare for designated express bus routes with the exception of Pittsburgh. The Pittsburgh Port Authority employs a true zone-based fare structure that includes the additional complexity of a peak period/peak direction surcharge for LRT routes. These systems are generally in older eastern cites with long-established transit service and ingrained usage patterns. Implementation of even a portion of the BRT and LRT services developed in this report would constitute a major expansion of service in a region where transit usage patterns are not well developed. Even when assisted by technologies such as smart cards, zone-based fares add complexity for the rider. One of the goals of the City of Phoenix fare study is to make fares as understandable as possible.

Based on the general direction of public discussion to date, and the desire to continue the seamless regional fare framework, the existing Valley Metro/RPTA fare structure is adopted as the basis for revenue forecasts for LRT, BRT and express bus services. Again, this decision is subject to any major changes resulting from the strategic fare structure study now underway under the auspices of the City of Phoenix Public Transit Department.

The fare structure shown in Table 4.2-2 yields an average fare per passenger as shown in Table 4.2-10.

Table 4.2-10 **Valley Metro/RPTA: Passenger Boardings, Farebox Revenue and Average Fare**

	Twelve Months Ended:	
	June 30, 2000	**June 30, 2001**
Passenger Boardings	37,367,584	40,194,801
Farebox Revenue	$23,031,477	$26,650,087

	Twelve Months Ended:	
	June 30, 2000	June 30, 2001
Average Fare[4]	$0.62	$0.66

The average fare for the fiscal year ended June 30, 2001 of $0.66 is used in the revenue forecasts in the following section. In practice, it is possible that some express bus, BRT and even LRT services may justify an average fare more heavily weighted toward the Valley Metro/RPTA express fare level than the systemwide average fare presented above. Moreover, about 90 percent of riders on current Valley Metro/RPTA express bus routes use a monthly pass and this pattern might characterize future high capacity services. However, sketch-planning ridership forecasts were developed at the corridor level, not at the origin and destination level. Service patterns and stop locations have not yet been determined. There is no basis then at this time for determining the ability to charge higher express fares or alter the mix of fare payment methods to reflect higher monthly pass usage.

Bus and Light Rail Revenue Forecasts

Table 4.2-11 below shows the corridor length in miles, passenger forecast, and a farebox revenue forecast for the BRT and LRT corridors.

Table 4.2-11 **Farebox Revenue Forecast: BRT, LRT and Express Bus Corridors**

Corridor	Length (Miles)	Estimated Daily Boardings	Mode	Annual Passengers	Annual Revenue at FY 2000 Valley Metro/RPTA Average Fare
59th Avenue	19	19,594	BRT/LRT	7,151,976	$4,720,304
Baseline Road	13	8,199	BRT/LRT	2,992,469	$1,975,029
Bell Road	28	28,661	BRT/LRT	10,461,159	$6,904,365
Camelback Road	20	24,020	BRT/LRT	8,767,384	$5,786,473
Chandler Boulevard	17	12,507	BRT/LRT	4,565,153	$3,013,001
Union Pacific Chandler Branch	12	19,490	BRT/LRT	7,113,668	$4,695,021
Glendale Avenue/Cactus Avenue	19	14,295	BRT/LRT	5,217,605	$3,443,619
I-10 West	12	11,386	BRT/LRT	4,155,709	$2,742,768
I-10 Far West	9	510	Express BRT	186,298	$122,956
I-17	9	377	Express BRT	137,528	$90,768
Loop 101 East	36	1,108	Express BRT	404,558	$267,008

[4] This compares to $0.63 for FY 2000, Phoenix services only, National Transit Database ("NTDB"), Federal Transit Administration.

Corridor	Length (Miles)	Estimated Daily Boardings	Mode	Annual Passengers	Annual Revenue at FY 2000 Valley Metro/RPTA Average Fare
Loop 101 West	28	1,163	Express BRT	424,560	$280,210
Loop 202	56	1,788	Express Bus	652,467	$430,628
Loop 303	22	485	Express BRT	177,035	$116,843
Main Street (Option 1)	12	12,090	BRT/LRT	4,412,766	$2,912,426
Main Street (Option 2)	9	9,674	BRT/LRT	3,530,842	$2,330,356
Metrocenter	3	5,062	LRT	1,847,570	$1,219,396
Northern (east of Grand Ave)	6	7,266	LRT	2,652,219	$1,750,464
Northern (west of Grand Ave)	13	4,700	BRT/LRT	1,715,507	$1,132,235
Northern (Total)	19	11,966	BRT/LRT	4,367,726	$2,882,699
Power Road	11	10,496	BRT/LRT	3,831,214	$2,528,601
Scottsdale Road	29	27,182	BRT/LRT	9,921,518	$6,548,202
SR-51	16	9,988	LRT	3,645,505	$2,406,033
Union Pacific Tempe Branch	10	8,010	BRT/LRT	2,923,540	$1,929,537
US-60	18	1,362	Express BRT	497,173	$328,134

Note: The revenue in the table above represents farebox revenue only. Additional revenue sources could exist including advertising.

Commuter Rail Fare Structure

As indicated in the Milestone 3 report, commuter rail typically has a more sophisticated fare structure compared to bus or other rail transit modes. This is a result of several factors which distinguish commuter rail service:

- Very defined, more sheltered and relatively few station locations compared to other transit services. The stations can be equipped with sophisticated ticket vending machines at a reasonable cost.
- Faster point to point travel times for a given journey, enabling commuter rail to be considered a "premium" service, and command higher fares.
- Due to the faster service and longer typical corridor lengths, riders take longer trips, on average, than on other transit services.
- A very high percentage of home to work trips compared to other modes, especially at Phase 1 service levels with will accommodate peak hour home to work trips almost exclusively.

It is expected that these factors will all come into play in the introduction of commuter rail service to the MAG region.

Like all of the commuter rail systems initiating service in recent years, it is assumed that new Phoenix commuter rail service will use a Proof-of-Payment

(POP) fare payment system with tickets issued by vending machines. This payment system would easily allow the implementation of a zone-based fare structure, the norm for commuter rail service in North America.

POP fare payment and machine-issued tickets would also allow a peak/off peak pricing structure, which is highly recommended. Patronage on commuter rail lines in general tends to be heavily concentrated at peak hours. Phase 1 level of commuter rail service is peak hour and direction only. Peak/off-peak pricing is not meaningful until the Phase 2 level of service is reached. The fare structure described below incorporates off peak fares at Phase 2 and 3 service levels.

The fare structures and fare levels of the peer commuter rail systems profiled in the Milestone 2 were analyzed to determine their suitability to serve as a model for the MAG region. In particular, the San Jose Altamont Commuter Express and Los Angeles Metrolink Inland Empire to Orange County line were considered especially relevant because of the decentralized areas they serve and both are relatively new services introduced in the western United States. However, both the Los Angeles Basin and San Francisco Bay Area are high cost of living areas, and the full fare levels were considered too high for the MAG region. So some adjustment was made to bring the basic full fares down and allow less of a discount for monthly pass users. Table 4.2-12 shows the recommended fare structure.

Table 4.2-12 **Proposed Commuter Rail Fare Structure**

Mileage	Zone	Full Fare	Discount Fare At 55%	Monthly Pass At 30 Times Full Fare	Fare Per Mile (At Highest Mileage in Zone)		
					Full Fare	Discount	Monthly/40
0-10	1	$2.75	$1.50	$82.50	$0.28	$0.15	$0.21
10-15	2	$3.25	$1.75	$97.50	$0.22	$0.12	$0.16
15-20	3	$4.00	$2.25	$120.00	$0.20	$0.11	$0.15
20-30	4	$5.00	$2.75	$150.00	$0.17	$0.09	$0.13
30-40	5	$6.25	$3.50	$187.50	$0.16	$0.09	$0.12
40-50	6	$7.00	$3.75	$210.00	$0.14	$0.08	$0.11
Over 50	7	$7.50	$4.00	$225.00	$0.14	$0.08	$0.11

Fare Usage by Type of Fare

Discount Fare - Seniors, disabled and youth would be eligible for the discount fare. About 30% of existing Valley Metro/RPTA systemwide passengers fell into these discount categories in June 2002. Commuter rail service will

attract a much higher percentage of home-to-work trips than Valley Metro/RPTA local bus service, so the 30% was reduced to 15%.

Peak/Off-Peak Fares - The initial level of commuter rail service will consist of peak trips only. As service is added, off peak trips will be integrated into the schedule. Since commuter rail ridership tends to be highly concentrated in peak periods even with a full day pattern of service, it is desirable to have an off peak fare to stimulate demand at off-peak times. It is proposed that all riders on off peak service would be eligible to use the discount fare described above. Subsequent analysis may examine the concept of an off-peak fare that is not pegged to the level of the discounted senior, disabled, and youth fare.

Monthly Passes

Over 90% of passengers on current Valley Metro/RPTA express bus service use a monthly pass. While the percentage of monthly pass usage on commuter rail will be high, it will serve more varied destinations than the current express bus service. Estimates are that 65-70% of riders will use monthly passes.

Table 4.2-13 represents estimated fare usage obtained by adjusting the Valley Metro/RPTA figures for the different characteristics of commuter rail riders.

Table 4.2-13 **Distribution of Fare Usage**

Service Level	Fare Usage (Percent of Total)		
	Full Fare	Discount Fare	Monthly Pass
Phase 1	15%	15%	70%
Phase 2 and 3	10%	25%	65%

Using the proposed fare structure from Table 4.2-12 and the distribution of fare usage from Table 4.2-13, Table 4.2-14 presents the commuter rail corridors, mileages, and average fares under the three phases of service.

Table 4.2-14 **Commuter Rail Corridors: Stations and Average Fares**

Corridor, Station	Location	Approximate Mileage From Central Phoenix	Average Fare	
			Phase 1	Phases 2 and 3
BNSF				
West Phoenix/East Glendale	Camelback/43rd	7	$2.08	$1.99
Glendale	Northern/67th	10	$2.46	$2.35
Peoria	83rd	14	$2.46	$2.35

Corridor, Station	Location	Approximate Mileage From Central Phoenix	Average Fare	
			Phase 1	Phases 2 and 3
El Mirage	Grand/Santa Fe	18	$3.04	$2.91
Surprise	Grand/Bell	22	$3.79	$3.63
UP Yuma				
West Phoenix	51st Ave	6	$2.08	$1.99
Tolleson	99th Ave	11	$2.46	$2.35
Goodyear	Main/Litchfield	17	$3.04	$2.91
Buckeye	Baseline/Miller	31	$4.74	$4.55
UP Southeast				
East Tempe	Loop 101	12	$2.46	$2.35
Gilbert	Gilbert	21	$3.79	$3.63
Williams Gateway	Williams Field/Power	27	$3.79	$3.63
Queen Creek	Ellsworth Ave	32	$4.74	$4.55
UP Mainline/Chandler				
East Tempe	Loop 101	12	$2.46	$2.35
Gilbert	Baseline	18	$3.04	$2.91
North Chandler	Arizona/Chandler	23	$3.79	$3.63
South Chandler	Queen Creek	26	$3.79	$3.63

It is instructive to look at the average fare per passenger mile and average passenger trip length to test the reasonableness of the proposed fare structure. Table 4.2-15 compares both of these averages for each corridor to the U.S. national average of 19 commuter rail systems. The average fares per passenger mile for the BNSF (excluding Wickenburg) and UP Yuma corridors are considerably higher than the national average due to their shorter passenger trip length. In general, the other corridors are consistent with the national average, with UP Chandler coming in a bit higher.

Table 4.2-15 **Average Commuter Rail Fare by Corridor**

Corridor	Average Passenger Trip Length (Miles)	Average Fare Per Passenger Mile		
		Phase 1	Phase 2	Phase 3
BNSF	15.3	$0.190	$0.182	$0.182
UP Mainline/Chandler	21.6	$0.161	$0.154	$0.154
UP Southeast	27.2	$0.152	$0.145	$0.145
UP Yuma	14.5	$0.196	$0.187	$0.187
U.S. National Average	22.8	$0.146		

U.S. national average is for Fiscal Year 2000.
Source: American Public Transportation Association, Public Transportation Fact Book

Commuter Rail Revenue Forecasts

Table 4.2-16 shows the revenue forecast for each station and the totals for each corridor.

Table 4.2-16 **Annual Revenue by Station and Corridor**

Station	Location	Annual Revenue		
		Phase 1	Phase 2	Phase 3
BNSF				
West Phoenix/East Glendale	Camelback/43rd	$319,680	$766,789	$858,756
Glendale	Northern/67th	$324,225	$778,693	$871,629
Peoria	83rd	$422,966	$1,015,258	$1,137,765
El Mirage	Grand/Santa/Fe	$390,015	$938,408	$1,051,995
Surprise	Grand/Bell	$1,022,625	$2,457,750	$2,753,550
Total		**$2,479,511**	**$5,956,898**	**$6,673,695**
UP Yuma				
West Phoenix	51st Ave	$201,049	$482,528	$539,858
Tolleson	99th Ave	$515,813	$1,237,742	$1,385,595
Goodyear	Main/Litchfield	$1,055,228	$2,539,118	$2,843,183
Buckeye	Baseline/Miller	$187,853	$450,141	$504,703
Total		**$1,959,941**	**$4,709,528**	**$5,273,338**
UP Southeast				
East Tempe	Loop 101	$131,164	$314,012	$352,031
Gilbert	Gilbert	$452,228	$1,085,325	$1,215,825
Williams Gateway	Williams Field/Power	$868,095	$2,085,825	$2,338,125
Queen Creek	Ellsworth Ave	$1,551,206	$3,734,803	$4,182,216
Total		**$3,002,693**	**$7,219,965**	**$8,088,197**
UP Mainline/Chandler				
East Tempe	Loop 101	$131,164	$314,012	$352,031
Gilbert	Baseline	$151,012	$363,553	$407,179
North Chandler	Arizona/Chandler	$534,330	$1,284,016	$1,438,097
South Chandler	Queen Creek	$427,738	$1,027,870	$1,151,215
Total		**$1,244,244**	**$2,989,451**	**$3,348,523**

Comparing forecast revenues to operating and maintenance costs for the commuter rail service yields the farebox recovery figures shown in Table 4.2-17. The high farebox recovery under the Phase 1 service level indicates a high degree of cost effectiveness for all but the UP Chandler corridor, at least from an operating cost perspective.

Table 4.2-17 **Farebox Recovery**

Corridor	Farebox Recovery		
	Phase 1	Phase 2	Phase 3
BNSF	80.0%	34.5%	28.0%
UP Mainline/Chandler	49.8%	20.7%	14.0%
Up Southeast	80.1%	39.7%	26.3%
UP Yuma	68.8%	32.3%	21.5%

4.2.2 Evaluation Screening Criteria

Each of the corridors identified in Milestone 3 as being part of Networks 1 & 2 has been subjected to an evaluation analyzing several criteria in the areas of land use, socio-economic data, capital costs, ridership, and right-of-way impacts. The data collected from the peer group transit systems in Milestone 2 served as the basis for identifying the evaluation criteria. Rating thresholds used in the evaluation in Section 4.3 are reflective of the analysis performed on the peer group data collected in Milestone 2. The criteria selected for inclusion in this evaluation include:

- Population Density
- Employment Density
- Transit Dependency
- Equity/Environmental Justice
- Daily Boardings per Mile
- Capital Cost per Mile
- Land Use Opportunities
- Right-of-Way Impacts
- Natural Resource Impacts
- Overall Cost Effectiveness

In a process similar to that conducted in Milestone 2, data regarding population and employment levels and densities for each corridor was collected for a one-mile wide area (1/2 mile each side) around each corridor. Environmental justice populations were defined as all non-white residents living within the corridor. For the purposes of this evaluation population and employment figures are future horizon year projections. Future projections of ethnicity were not available, so the current year (2002) figures were used.

The project cost and boardings per day evaluation criteria were applied using the data gathered for daily ridership and project costs in Section 4.1. Corridor

land use characteristics selected for this level of screening are more qualitative in nature and come from observations and field reviews of each corridor and the surrounding development.

The information noted above was used to categorize each corridor's ability to support high capacity transit. The results of this screening and evaluation process are presented in Section 4.3.

4.2.3 Feeder Network Role

Even though the majority of feeder networks are expected to be provided by the existing transit network, there will be at least one alternative and select stations where feeder services may be warranted. While there are no quantitative criteria for determining when a feeder service is desirable or has a high likelihood for success, there are several qualitative criteria that are appropriate to consider when planning for feeder services. These are described in Table 4.2-18 below with a definition of each criteria followed by a discussion of how they apply to the proposed three levels of high capacity transit service. The five planning criteria presented in the figure are summarized below:

Proximity to employment sites and limited or no existing transit service

When planning for feeder service, the proximity of the station to nearby employment sites and other major activity centers is critical. If existing local service is available to connect the stations to these sites, then feeder service would not be needed or desirable. In cases where there is *no* existing bus service and employment sites are within close proximity, then feeder services can play an important role linking the station to a passenger's final destination.

Capacity constraints as defined by parking availability and affordability

Parking is an important factor in whether a feeder service is warranted. Where parking is relatively convenient and affordable at high capacity transit stations, the desirability and need for feeder service is minimal.

Direct transit service connections to nearby activity centers

A key to success for any feeder service is to provide direct and fast connections from the high capacity transit station to major activity centers. While there may be existing local bus service at some locations, it may *not* directly serve the activity centers, reducing the desirability of local service. At some stations where there is one large attractor within a three miles radius of the station, a feeder service may be warranted, particularly if there is private sector support.

Community support

Securing support from the local community for feeder services can be invaluable in getting a service underway and influencing its ultimate success. Support can come from local employers and businesses or schools and community organizations that directly benefit from the service. Support can be measured in a variety of ways.

Private sector funding

Any new service requires funds for capital investments and ongoing operating support. While feeder services may not require a significant level of funds they require ongoing operating subsidies. Feeder services in other communities often rely on public/private partnerships with the private sector covering as much as 50% of the cost of the service, especially if they directly benefit from it.

Table 4.2-18 **When is Feeder Service Warranted?**

	Three Levels of Service		
Planning Criteria	**Phase 1: Start Up Introductory Service**	**Phase II: Intermediate Services**	**Phase III: Full Commuter Train Operation**
Proximity to employment sites and limited or no existing transit service. If no existing transit service is provided from high capacity transit stations and employment sites are located within three miles from station, then feeder service may be warranted.	For start-up commute high capacity transit service, limited feeder service would be recommended to meet trains and to serve large employment sites or centers.	As with introductory high capacity transit service, it is recommended that feeder services would be limited and only meet commute trains. Feeder services would not be warranted for midday high capacity transit service.	With 15-minute headways during peak periods, feeder services would operate more frequently to meet every train and provide direct service to employment centers.
Capacity constraints as defined by parking availability and affordability. If there is a parking shortage or parking costs are "high", then feeder service may be warranted.	With only three daily peak hour trains, there should be ample parking availability, reducing demand for feeder services, particularly at originating stations.	Twenty minute peak hour high capacity transit service and hourly midday service will increase parking demand and parking may become constrained. Feeder service may be warranted during peak hours only.	Parking capacity may be severely constrained under a full commuter operation, justifying a fee for parking. Under these circumstances, a feeder bus service has high probability for success.

	Three Levels of Service		
Planning Criteria	**Phase 1: Start Up Introductory Service**	**Phase II: Intermediate Services**	**Phase III: Full Commuter Train Operation**
Direct transit service connections to nearby activity centers. If local transit service exists, but it is not direct or express service, feeder service to a "major attractor" may be warranted.	Feeder service to nearby activity centers would not be warranted given the limited hours of high capacity transit operation.	Limited feeder service may be warranted at select destination stations where a major activity center is within three miles and there is no existing transit service.	As with intermediate services, feeder service may be warranted at select stations to directly serve a major activity center. Caution should be taken to ensure there is no duplication of existing transit services.
Community support. Obtain business and community support to provide amenities for feeder service implementation.	Securing support from would likely be limited under peak only service to employers. They could support the service by offering incentives to their employees and in marketing the service.	A broader level of support can be expected for all day service – from employers to local businesses who might be directly served by the feeder network.	A full commuter train operation might enjoy the benefits of local community support through a wide variety of in-kind contributions, giving the service a high profile.
Private Sector Funding. Securing operating subsidies to support feeder services can be difficult. To the extent that the public and private sector cooperatively fund feeder services encourages implementation.	Experience in other communities suggests that employers and developers may be willing to "jump start" a feeder service with private funds with commitment to evaluate success of service after given timeframe.	Long-term private funding commitments are realistic as long as service is cooperatively funded and it meets pre-determined performance measures.	As service matures and feeder service proves successful, there will opportunities to increase private sector funding through enhanced feeder network.

Performance Expectations

As with any new service, it is important to evaluate whether it is successful. The key question is, "What defines success?" While there are many factors that contribute to the success of a service, there are a small number of

performance measures that are standard in the transit industry. For a feeder network, performance expectations address passenger productivity, cost effectiveness and the level of financial support. Table 4.2-19 below presents these measures and proposes performance targets for the three levels of high capacity transit service.

Table 4.2-19 **Performance Expectations**

	Three Levels of Service		
Performance Expectations	**Phase 1: Start Up Introductory Service**	**Phase II: Intermediate Services**	**Phase III: Full Commuter Train Operation**
Passenger Productivity Passengers per hour	Passengers carried per hour of service would range between ten and 20 passengers per hour.	With a higher frequency of service, a feeder network is expected to carry a higher number of passengers per hour, ranging between 20 and 30 hourly passengers.	Under a full commuter train operation, a feeder network should carry a minimum of between 25 and 35 passengers per hour.
Cost Effectiveness Cost per hour	Cost per hour of service would range between $40 and $85, depending on service contractor.	Cost per hour of service would range between $40 and $85, depending on service contractor.	Cost per hour of service would range between $40 and $85, depending on service contractor
Financial Support Farebox recovery ratio	Free fares are desirable for new start-up service	If feeder service continues with free fares, then private sector support is encouraged.	If feeder service continues with free fares, then private sector support is encouraged.
Level of private sector support	Private support is desirable to "jump start" service – either one-time capital contribution or ongoing operating support.	Private sector support should cover a minimum of between 10% and 50% of costs.	Private sector support should cover a minimum of between 10% and 50% of costs

Passenger Productivity

This measure is typically defined as the number of passengers carried for each hour of service. Performance would be expected to increase with each increasing level of high capacity transit service. Under a start-up service, a minimum of ten passengers per hour would be considered acceptable performance. Passenger productivity would be expected to gradually

increase up to approximately 25 hourly passengers under a full commuter operation.

Cost Effectiveness

The primary cost effectiveness measure is the cost to operate one hour of service. There is a wide range of hourly costs presented in the above figure. Hourly costs range from a low of $40 per hour to a high of $85 for all three levels of high capacity transit service. The primary reason for this wide variation is because of the many uncertainties in how the service would operate. For example, would the vehicles be purchased and publicly owned and operated or would a private contractor operate the service with their own vehicles? In many communities a private contractor is used to provide day-to-day operations, particularly for a new demonstration type service. Private vendors tend to have lower unit costs than a public operation. It is not known whether Valley Metro/RPTA would be interested in operating a feeder service and if yes, whether their current cost structure would apply. Their hourly cost of Valley Metro/RPTA service is approximately $85, the basis for the upper end of the proposed performance measure.

Financial Support

Feeder services require ongoing financial support. While there are many different funding sources that could be used to support a feeder network, system generated revenues and private sector support should be considered. Since passenger fares traditionally do not account for a high percentage of the overall revenue of any bus service, feeder service, which tends to be more limited in scope than general public service, is often free of charge. In return for this "forgone" revenue, it is very common for feeder services that connect with a regional rail carrier to solicit funds from the private sector. Major employers and retail business that directly benefit from feeder services typically contribute funds. A successful feeder network should expect between 10% and 50% of its revenue to come from the private sector. A public/private partnership helps to ensure local support and responsiveness to the service.

4.3 Evaluate Alternatives

Using the criteria set out in Section 4.2 each of the 28 potential high capacity transit corridors was subjected to a screening and evaluation process in order to determine a priority corridor selection list. The corridors have been placed into three tiers based upon the results of the evaluation. The first two tiers of corridors will be recommended to continue on to Milestone 5 for further refinement and evaluation for the final recommended High Capacity Transit network. In addition, the four commuter rail corridors will also be carried forward for further evaluation in Milestone 5. This evaluation will include refinements to the cost-estimates, a reassessment of coordinating operations with freight rail traffic, and an analysis of other lower-cost technologies including diesel multiple units (DMU). A further review of the corridor characteristics and specific transit technologies will take place in Milestone 5 to finalize the recommended network.

4.3.1 Population and Employment Data

The population, employment, and environmental justice data collected for each of the corridors is presented in Table 4.3-1. Population and employment data has been collected using future projections for the MAG region. The ethnicity data used in the environmental justice category is 2002 data since future projections of this information are not available. All data presented has been collected from a one-mile wide (½ mile each side) area around each corridor. This collection area represents a more refined level of data than that collected in Milestone 2. The ½ mile distance is accepted as the most common maximum distance a prospective transit rider will walk to access transit station. While some riders would access the corridor from beyond the ½ mile boundary, it is assumed that a substantial majority of system riders would originate from within the ½ mile boundary.

Table 4.3-1 **Population and Employment Corridor Data**

Corridor	Length (miles)	Population Density (per mile)	Total Population	Employment Density (per mile)	Total Employment	Environmental Justice Density (per mile)	Environmental Justice Population
59th Avenue	18.99	13,533	257,125	6,042	114,802	2,856	54,257
Baseline Road	12.95	17,522	227,792	4,323	56,204	2,558	33,257
Bell Road	28.55	10,527	300,019	4,644	132,356	904	25,757
BNSF	27.73	8,941	247,665	5,651	156,521	2,262	62,665
Camelback Road	20.88	13,107	273,678	7,918	165,323	3,696	77,166
Chandler Boulevard	16.45	10,503	172,773	5,954	97,946	1,731	28,467
Union Pacific Chandler Branch	11.13	10,138	112,841	9,732	108,313	1,957	21,782
Glendale Avenue/Cactus Aven	19.77	10,378	205,180	7,049	139,356	1,613	31,897
I-10 Express Bus	9.4	13,125	123,639	3,945	37,163	589	5,546
I-10 West	11.05	14,611	160,723	10,726	117,985	4,730	52,029
I-17	17	5,537	94,131	3,637	61,834	110	1,864
Loop 101 East	34.33	6,983	239,533	5,682	194,893	760	26,063
Loop 101 West	34.1	8,303	283,134	2,872	97,922	735	25,079
Loop 202	54.6	7,354	401,505	5,564	303,790	982	53,613
Loop 303	19.44	6,403	124,476	1,514	29,441	82	1,588
Main (Option 1)	12.64	14,284	180,552	4,976	62,897	1,762	22,275
Main (Option 2)	9.64	15,120	145,752	5,553	53,529	2,144	20,670
Metrocenter	5.07	18,197	90,985	14,751	73,754	4,763	23,814
Northern east of Grand Avenue	5.7	19,380	110,465	8,863	50,520	3,713	21,164
Northern west of Grand Avenue	12.89	4,357	56,162	1,704	21,970	334	4,306
Power Road	13	8,396	109,149	4,661	60,597	386	5,015
Scottsdale Road	28.1	8,881	249,548	8,170	229,569	1,097	30,826
SR-51	17.12	10,814	184,918	6,146	105,099	1,807	30,901
Union Pacific Tempe Branch	10	8,450	84,498	11,699	116,994	1,683	16,827
Union Pacific Mainline/Chandle	25.95	12,397	321,693	13,811	358,405	2,960	76,809
Union Pacific Southeast	36.18	9,860	356,735	8,819	319,072	1,876	67,868
Union Pacific Yuma	30.9	7,661	236,721	5,568	172,055	1,287	39,756
US-60	18	12,884	231,918	9,267	166,807	2,122	38,193

4.3.2 Ridership and Cost Effectiveness

The daily ridership and capital cost figures presented in Table 4.3-2 were obtained from the planning level estimates of ridership and capital costs development in Section 4.1. The capital cost data summarized for the potential LRT corridors represents the estimated cost of a system running on ballasted track. This cost estimated is the lower of the two alternative cost estimates provided in Section 4.1. Dedicated BRT costs assume exclusive lanes for the BRT vehicles, while Express BRT services are assumed to operating within the existing for future high occupancy vehicle (HOV) network on the MAG region freeways. Express BRT costs include costs for new or additional park-and-ride lots throughout the corridor.

Cost Effectiveness

Included in the final column of Table 4.3-2 is a category for "cost-effectiveness". Cost effectiveness is a measure used by the Federal Transit Administration (FTA) as part of the Section 5309 "New Starts" program. This program allocates federal capital funding for major transit investment projects. For the purposes of the New Starts evaluation process the cost effectiveness of the project is measured using the following calculation:

(Project annualized capital cost + Project annual operating cost) – (Baseline annualized capital cost + Baseline annual operating cost) / (Total Project Annual Riders – Total Baseline Annual Riders) = Cost Effectiveness

This calculation relies upon a baseline of future transit assumptions and difference between the proposed project and this baseline set of improvements. The corridors and high capacity transit systems here have not been matched to a specific baseline level of transit investment, making it impossible to exactly match the calculation above. Instead, a modified calculation of cost effectiveness has been selected for this portion of the evaluation. This calculation is illustrated below:

(Project Annualized Capital Cost + Project Annual Operating Cost) / Project Annual Boardings = Cost Effectiveness

The annualized figure for capital cost is obtained by multiplying the total project capital cost by 0.08 to annualize the figure over the expected useful life of the improvements. Boardings are annualized by multiplying the weekday boarding figure by an annualization factor of 300. In the case of corridors identified as possibly LRT or Dedicated BRT, the LRT cost-effectiveness figure has been presented.

Table 4.3-2 **Ridership and Capital Cost Corridor Data**

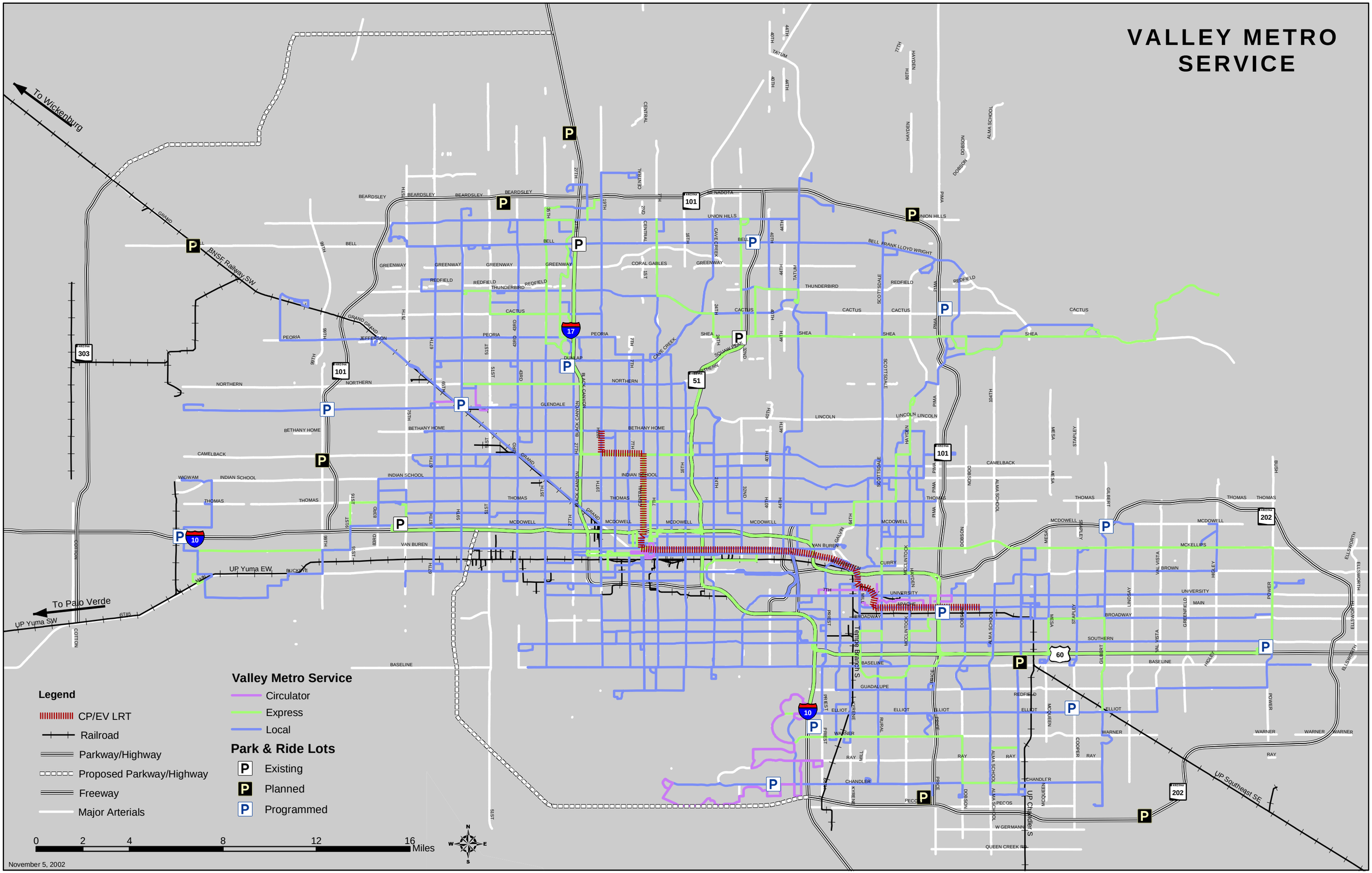
Corridor	Length (miles)	Boardings per Mile	Boardings	Capital Cost per Mile (Rail)	Total Cost Rail	Capital Cost per Mile (BRT)	Total Cost BRT	Cost Effectiveness*
59th Avenue	18.99	1,031	19,594	$40.42	$767,583,537	$15.20	$288,656,214	$12.38
Baseline Road	12.95	633	8,199	$37.43	$484,767,233	$14.54	$188,286,401	$19.08
Bell Road	28.55	1,006	28,661	$39.85	$1,137,648,332	$14.32	$408,934,953	$13.21
BNSF	27.73	289	8,026	$23.43	$649,790,860			$29.17
Camelback Road	20.88	1,150	24,020	$42.20	$881,031,820	$14.91	$311,289,933	$12.16
Chandler Boulevard	16.45	760	12,507	$39.63	$651,892,808	$14.76	$242,749,842	$16.51
Union Pacific Chandler Branch	11.13	1,751	19,490	$44.56	$495,968,571	$18.40	$204,821,088	$8.57
Glendale Avenue/Cactus Aven	19.77	723	14,295	$46.16	$912,561,956	$9.28	$183,445,763	$19.62
I-10 Express Bus	9.4	54	510			$1.62	$15,250,554	$17.91
I-10 West	11.05	1,035	11,386	$35.17	$388,579,717			$11.09
I-17	17	22	377			$0.93	$15,751,494	$31.21
Loop 101 East	34.33	32	1,108			$1.67	$57,171,906	$29.43
Loop 101 West	34.1	34	1,163			$1.29	$43,866,042	$23.33
Loop 202	54.6	33	1,788			$1.45	$79,384,932	$26.96
Loop 303	19.44	25	485			$1.80	$34,958,880	$35.10
Main (Option 1)	12.64	956	12,090	$36.12	$456,591,987	$14.50	$183,244,744	$12.94
Main (Option 2)	9.64	1,004	9,674	$37.40	$360,494,426	$14.80	$142,643,507	$13.02
Metrocenter	5.07	1,012	5,062	$43.40	$220,041,821			$14.84
Northern east of Grand Avenue	5.7	1,275	7,266	$43.66	$248,866,900			$11.95
Northern west of Grand Avenue	12.89	365	4,700	$36.82	$474,646,663	$12.81	$165,159,606	$32.72
Power Road	13	807	10,496	$38.32	$498,204,101	$14.60	$189,780,049	$14.95
Scottsdale Road	28.1	967	27,180	$44.27	$1,244,016,770	$15.99	$449,240,630	$14.97
SR-51	17.12	584	9,988	$48.93	$837,666,349			$27.09
Union Pacific Tempe Branch	10	801	8,010	$34.13	$341,257,300	$15.21	$152,128,961	$14.13
Union Pacific Mainline/Chandle	25.95	129	3,346	$20.78	$539,294,340			$56.96
Union Pacific Southeast	36.18	189	6,832	$17.81	$644,535,771			$35.70
Union Pacific Yuma	30.9	210	6,499	$13.26	$409,676,851			$27.04
US-60	18	76	1,362			$1.61	$29,057,358	$12.74

** Cost effectiveness is calculated using the annualized capital cost plus the annual operating cost divided by the annual boardings*

4.3.3 Existing Service Impact

Long-range bus services have been defined by each of the cities within the MAG region. These services may change or be adjusted depending upon findings resulting form the work being done for the Valley Metro/RPTA Regional Transit Plan and the various Regional Transportation Plan Area Studies. Until the findings from these studies are finalized, some assumptions can be made about the potential future impacts of the high capacity transit alternatives on the larger bus network by referencing the existing and currently planned future Valley Metro/RPTA Transit system. Exhibit 4.3-1 illustrates the existing Valley Metro/RPTA bus network.

VALLEY METRO SERVICE



Once high capacity transit services are implemented, the bus transit network will serve two key purposes: It will operate both as a traditional bus transit system — as it currently does — and a comprehensive feeder system for the new high capacity transit services. High capacity transit services will displace — and replace — some of the existing bus lines. The following summaries provide an overview of how high capacity services in selected corridors would operate in tandem with existing local transit services:

- **Metrocenter**. Serving one of the transit hubs of the existing Valley Metro/RPTA system, the Metrocenter LRT connection serves Metrocenter - a transfer point for riders using east-west and north-south services. The mall area is served by seven local bus routes and three express services. Several routes are currently diverted off the grid to Metrocenter from nearby arterials. Thus, under the current configuration, although the proposed Metrocenter LRT line would require some services to be shifted, the existing grid network also acts as a special feeder network at this location. The alignment of the line, paralleling I-17, may eliminate the need for a number of Valley Metro/RPTA's express routes to serve downtown Phoenix, allowing them to instead begin northbound service at Metrocenter. Nevertheless, current route configurations for some of Valley Metro/RPTA's more productive routes would necessitate only minor modifications.

- **Camelback**. The existing Camelback local service operates at higher frequencies than many of Valley Metro/RPTA's current local routes (15-minute headways at peak periods), providing a trunkline service for the system. The line operates from approximately 4:30 am to midnight. Route 50 provides service between 57th Avenue at the west end to Granite Reef at the east end along Camelback Road. As a major local east-west corridor, 36 Valley Metro/RPTA Routes intersect or provide connections to this route. This includes nine limited-service Express Routes. Any new BRT or LRT line would effectively replace the local bus service along Camelback, and depending on service frequency, could be implemented to produce a minimal impact on the north-south bus lines serving it.

- **59th Avenue**. Nineteen routes intersect the current Valley Metro/RPTA Route 59 operating along 59th Avenue. All except two of the routes provide primarily east-west service, and the routes are evenly distributed over the grid from the southern terminal point at Buckeye Road to the northern terminus at Utopia Road. The route operates at 30-minute headways from 5:15 am to 10:30 pm. A new BRT/LRT line could replace the existing bus service along 59th Avenue, as long as stations are programmed for each of the major arterial crossings served by bus lines. Depending on the service frequency, a new BRT/LRT line along 59th Avenue would have a minor impact on the existing east-west bus lines that would serve it.

- **Main**. LRT/BRT service along Main Street would effectively replace the eastern end of Valley Metro/RPTA Red Line Service (to become LRT), one of the system's trunkline services, operating at 15-minute headways for much of the day. Existing Route 30 service along University and Route 45 along Broadway might also compete with high capacity transit in this corridor, particularly for local trips in Tempe and Mesa. For the services currently provided along this corridor, more than 15 routes — primarily north-south services — intersect it, providing many alternatives for connections at all major arterials.

- **Northern Corridor**. The proposed Northern Corridor, operating west of 19th Avenue to Grand Avenue (as LRT), and then further west as LRT or Dedicated BRT, runs along a corridor that is currently served by Valley Metro/RPTA's Route 80 and express Route 570. The corridor currently offers good east-west local bus service, as well as north-south local service, as far west as 67th Avenue. This route would also parallel the Route 24/70 service that operates east-west along Glendale Avenue, as far west as Litchfield. Under the existing transit network, of all of the preliminary high capacity transit alternatives, this is the only one that would require substantial additional feeder bus services. Currently there are no transit connections to or from the western portion of Northern Avenue. North-south transit connections are not currently available that would allow Surprise, Goodyear, or the west side of Glendale to transfer to a BRT service on this corridor.

- **UP Southeast Corridor.** For the UP Southeast Corridor, no comparable direct service is currently provided along or parallel to this line. The rail line intersects the existing grid arterial network in this area, and thus is served by both north-south and east-west local bus lines. A commuter rail line here would provide a new service to a market not currently served, because there are limited commuter-oriented bus lines in this area.

- **Tempe Industrial Branch**. The Tempe Industrial Branch of the UP mainline provides a central southern spur of the high capacity transit network. Tempe is one of the most transit-supportive jurisdictions in the MAG region and provides a dense network of local services, including local shuttle circulation in the central area. This line would complement the existing bus network in Tempe. Nevertheless, it would likely require the reconfiguration of some of the north-south routes in the southwest portion of the city where the LRT/BRT service would parallel existing bus services (Route 62, 65, and 72) on Mill Avenue, Kyrene Road, Hardy Drive, and Rural Road.

- **Baseline Road**. The Baseline LRT/BRT corridor is currently served by express route service along the Superstition Freeway (Route 533, which operates only two AM and PM peak period runs), as well as Route 77 local bus service along Baseline Road. Twenty-one local routes

intersect the existing Route 77, with an additional 11 routes crossing Baseline Rd. from the east end of Route 77's terminal point to Power Road. While the majority of the intersecting routes provide north-south connectivity for Baseline Road, a few of the current routes intersect Baseline and then operate parallel to the corridor on arterials to the north or south. The Route 77 service currently operates at 30-minute headways. A Baseline Road LRT or BRT would eliminate the need for this type of local bus operation.

Overall, the strong grid system of Valley Metro/RPTA's current services makes it more adaptable to implementation of the various high capacity transit technologies, because neither timed transfers at major hubs will be significantly disrupted nor do major transit centers need not be shifted to new locations. Although some routes are diverted off arterials to serve major transit hubs, timed connections at these hubs do not have a dramatic effect on operations systemwide. It will, however, be appropriate for the high capacity services to address the major transfer hubs that are currently located along the various corridors. This may result in some locational shifts at the most time-sensitive of existing transit hubs.

4.3.4 Land Use, Redevelopment, and Transit Oriented Development Potential

As part of the second level of the corridor evaluation process, the land use characteristics of each corridor were analyzed to determine what impacts a high capacity transit system might have upon the land uses present. Included in this analysis are observations about the potential for redevelopment and transit-oriented development within each corridor. These development opportunities can have a positive impact upon the projected ridership for a high capacity transit corridor and in some cases can create opportunities for public-private partnerships to assist in funding stations or transfer hubs that are integrated into new development along the corridor. Other criteria in this analysis include right-of-way impacts and impacts upon natural resources.

Redevelopment Opportunities

A large proportion of the MAG region has developed recently during a period of high population and employment growth. The recent nature of most development in the region means that there is less likelihood of major land uses in need of redevelopment or rehabilitation. However, there will some opportunities, particularly in more established corridors near the downtowns of Phoenix, Mesa, and Glendale. These areas were developed prior to the remainder of the region and do contain some areas which could be considered prime redevelopment candidates. In addition, each of these cities, along with a few others in the MAG region has designated specific portions of their cities "redevelopment areas". The advantage of redevelopment areas along a proposed high capacity transit corridor is the opportunity for new development which could enhance the performance of

the system and create an opportunity to enhance sales tax revenue and amenities in a particular city.

Each of the 28 proposed high capacity transit corridors has been evaluated for redevelopment opportunities. The evaluation process included the review of city general plans and an assessment of the age and probable condition of development within the corridor. Corridors passing through predominantly commercial and industrial areas were also considered to have a greater potential for redevelopment than those bordering residential areas.

Transit Oriented Development Opportunities

Milestone 3 included a short discussion about the definition of Transit Oriented Development (TOD). This definition of TOD has been applied to each of the corridors identified for evaluation in this Milestone. Specific areas along each corridor have been identified for their potential in accommodating new transit oriented development. Many of these areas are located near existing activity and centers, with the objective of enhancing existing destination points and creating nodes where two or more corridors could intersection for transfers.

An important part of the success of TOD is access to various forms of transit. Part of the review process has studied the existing transit service in each of these corridors along with existing development patterns to determine if the beginning stages of transit-oriented growth are occurring. Corridors characterized by low density, auto-oriented development have not been rated as high as corridors which have begun to transform into more pedestrian friendly areas where residents and commuters have ample access to transit and several types of land uses are located within a walkable distance to each other.

The results of the redevelopment and transit oriented development reviews have been combined into the results summarized in Table 4.3-3.

Table 4.3-3 **Corridor Land Use Opportunities**

Corridor	Overall Land Use Opportunities
59th Avenue	High
Baseline Road	Medium
Bell Road	Medium
Burlington Northern Santa Fe	High
Camelback Road	High
Chandler Boulevard	Medium
Union Pacific Chandler Branch	High
Glendale Avenue/Cactus Avenue	Low

Corridor	Overall Land Use Opportunities
Interstate 10 West	Medium
Interstate 10 Far West	Low
I-17	Low
Loop 101 East	Low
Loop 101 West	Low
Loop 202	Low
Loop 303	Low
Main Street (Option 1)	High
Main Street (Option 2)	High
Metrocenter Extension	Medium
Northern Avenue (east of Grand Ave)	High
Northern Avenue (west of Grand Ave)	Low
Power Road	High
Scottsdale Road	High
SR-51	Medium
Tempe Branch	Medium
Union Pacific Chandler	High
Union Pacific Southeast	High
Union Pacific Yuma	High
US-60	Medium

Displacement Issues

Right-of-way impacts can have major implications upon several aspects of a high capacity transit system including capital cost, community opinion, and political support. The loss of major established land uses is usually opposed by nearby residents and businesses, and in some cases, these land takes can eliminated ridership generator which originally contributed to the viability of the transit service. Both LRT and Dedicated BRT systems were assumed to require 23 feet of additional right of way along arterial streets.

Table 4.3-4 summarizes the potential right-of-way impacts in each corridor. Right-of-way impacts were estimated using aerial photography of each corridor and assessor's parcel maps to determine property lines and street right-of-way widths. The condition of the existing right-of-way in each corridor has been categorized into three groups. Examples of the characteristics of these three groups are described below:

- Narrow – The existing street is built close to the maximum width of existing public right-of-way. Buildings may be located close the existing street.

- Medium – Combines the characteristics of both narrow and wide classifications. Possible right-of-way takes would likely not impact buildings. Development density ranges from low to medium density.
- Wide – Development adjacent to the street is usually low-density in nature and setback far from the street. Streets may not be built to their fullest extent, meaning future improvements could occur in the public right-of-way. Built improvements adjacent to the street are usually parking or landscaping.

The linear distance of each corridor contained within each of the three groupings in reported below. These three distances were then multiplied by a coefficient for each right-of-way classification.

- Narrow = 3
- Medium = 2
- Wide = 1

The three ROW values used in the evaluation were then calculated by multiplying the narrow, medium and wide lengths by their respective coefficients. The total value is calculated by totalling the three ROW values and dividing by the overall corridor length. Corridors with ratings below 2.00 are considered to have a lower level of impact, while those above 2.00 would have greater potential for impacts.

Table 4.3-4 **Corridor Right-of-Way Impacts**

	ROW Distance (linear feet)			Narrow $$$	Medium $$	Wide $	Total
	Narrow	Medium	Wide	Dist x 3	Dist x 2	Dist x 1	Value
59th Avenue	20,389	46,590	32,021	61,167	93,180	32,021	**1.88**
Baseline Road	1,319	23,791	44,951	3,957	47,582	44,951	**1.38**
Bell Road	33,265	106,118	22,864	99,795	212,236	22,864	**2.06**
BNSF	Rail						**0.00**
Camelback	35,985	47,129	17,263	107,955	94,258	17,263	**2.19**
Chandler Boulevard	2,489	55,013	42,667	7,467	110,026	42,667	**1.60**
Union Pacific Chandler Branch	Rail	-	-				**0.00**
Glendale Ave/Cactus Ave	50,585	36,872	16,926	151,755	73,744	16,926	**2.32**
I-10 West	5,482	-	52,862	16,446		52,862	**1.19**
I-10 Far West	Express BRT	-	-				**0.00**

	ROW Distance (linear feet)			Narrow $$$	Medium $$	Wide $	Total
	Narrow	Medium	Wide	Dist x 3	Dist x 2	Dist x 1	Value
I-17	Express BRT	-	-				**0.00**
Loop 101 East	Express BRT	-	-				**0.00**
Loop 101 West	Express BRT	-	-				**0.00**
Loop 202	Express BRT	-	-				**0.00**
Loop 303	Express BRT	-	-			-	**0.00**
Main Street	13,076	25,902	13,559	39,228	51,804	13,559	**1.99**
Metrocenter	21,337	5,459	-	64,011	10,918		**2.80**
Northern Avenue	4,964	23,102	68,524	14,892	46,204	68,524	**1.34**
Power Road	3,459	36,315	28,813	10,377	72,630	28,813	**1.63**
Scottsdale Road	55,803	76,146	15,520	167,409	152,292	15,520	**2.27**
SR-51	28,520	34,361	13,062	85,560	68,722	13,062	**2.20**
Union Pacific Tempe Branch	Rail	-	-				**0.00**
UP Mainline/ Chandler	Rail						**0.00**
UP Southeast	Rail						**0.00**
UP Yuma	Rail						**0.00**
US-60	Express BRT	-	-				**0.00**

No right-of-way impacts were identified in the freight corridors, since it was assumed that all improvements would occur within the rail right-of-way. Express bus corridors also do not have any identified impacts since the buses would operate in the existing freeway right-of-way. The cost coefficients have been assigned so that lower scores equate to lower right-of-way impacts within the corridor. The observations were made using aerial photography and assessor's parcel information in each corridor. Specific right-of-way takes have not been identified, and would not be until precise alignments and system configurations have been identified.

Natural Resources Impacts

As the MAG region continues to develop and possibly expand into sensitive environmental areas, increased steps will need to be taken to minimize the impact of new development upon natural resources and the environment. Transportation projects, including high capacity transit systems, also have the potential for impacting the environment. However,

transit does have a positive influence on the environment in terms of air quality since it removes automobile trips.

A review of the MAG region has been conducted to determine the potential level of impact each corridor may have upon natural resources and the environment in the MAG region. This review and evaluation was conducted in a format similar to the review performed for identifying redevelopment and transit oriented development opportunities in each corridor. Impacts were considered in the areas of possible habitat loss, water quality impacts, noise impacts to sensitive land uses, and impacts to recreational facilities. The results of this review are presented in Table 4.3-5.

Table 4.3-5 **Corridor Natural Resources Impacts**

Corridor	Potential Impact Areas	Overall Rating
59th Avenue	Salt River	Medium
Baseline Road	South Mountain Park	Low
Bell Road	Cave Creek, Paradise Valley Hospital	Medium
Burlington Northern Santa Fe	Del E. Webb Hospital, Walter Boswell Hospital,	Low
Camelback Road	None	Low
Chandler Boulevard	San Marcos Country Club, Eastern Canal	Medium
Union Pacific Chandler Branch	Gazelle Meadows Park, Armstrong Park, Kokopelli Golf Resort	Medium
Glendale Avenue/Cactus Avenue	Phoenix Mountains Preserve	Medium
Interstate 10 West	None	Low
Interstate 10 Far West	None	Low
I-17	None	Low
Loop 101 East	None	Low
Loop 101 West	None	Low
Loop 202	None	Low
Loop 303	None	Low
Main Street (Option 1)	Pioneer Park	Low
Main Street (Option 2)	Pioneer Park	Low
Metrocenter Extension	None	Low
Northern Avenue (east of Grand Avenue)	None	Low
Northern Avenue (west of Grand Avenue)	Luke AFB	Medium
Power Road	None	Low

Corridor	Potential Impact Areas	Overall Rating
Scottsdale Road	Salt River, Camelback Golf Club, Cactus Park	Medium
SR-51	Phoenix Mountains Preserve	Medium
Union Pacific Tempe Branch	Kiwanis Community Park	Low
Union Pacific Mainline/Chandler	Gazelle Meadows Park, Armstrong Park, Kokopelli Golf Resort	Medium
Union Pacific Southeast	Crossroads Park, Western Skies Golf Club	Low
Union Pacific Yuma	None	Low
US-60	None	Low

4.3.5 Feeder Network Contribution

As noted in Section 4.3.2, the majority of feeder services are expected to be provided by the existing transit network, although there may be occasion for special dedicated feeder (and distributor) services at specific locations. Because many of the alternatives serve transit nodes, such as central Tempe or Metrocenter, they would essentially be making use of these "feeder hubs" that are part of the existing transit network. Much of Maricopa County is middle to low density, with large tracts of industrial and commercial uses, and vast residential expanses. The downtown areas are exceptions to the lower density, as are certain arterials and communities which feature higher density development. The ideal markets for dedicated feeder routes are high-rise employment centers in suburban areas (or major transit-oriented developments that are built up around high capacity transit hubs), as well as downtowns of Maricopa County's larger cities.

Dedicated feeders will serve a different type of transit user in Maricopa County — not only the current transit markets. Often referred to as "choice" riders, these are usually persons who have other travel alternatives (such as their own car), but choose to ride high capacity transit for its convenience, efficiency and general appeal. These "choice" riders are often good candidates for feeder bus use because a feeder shuttle offers a unique bus experience, with timed connections and a special purpose routing that most of Valley Metro/RPTA's existing lines would not provide. In the absence of high capacity transit services in Maricopa County, transit users are more often transit-dependent, familiar and comfortable with Valley Metro/RPTA's services. With the objective of not competing with existing transit services, a feeder bus cannot be successful unless it has a unique market to support it.

To evaluate each corridor alternative for feeder service, it is important to determine several factors:

- **The degree to which the corridor serves potential "choice" riders.** Choice riders are top feeder users because feeder routes essentially "plug a hole" in the existing transit network. An analysis of where effective feeder routes might be developed can be done by reviewing income and automobile ownership data for various points along the corridor.
- **The lack of existing transit connections to high capacity transit lines.** The specific routing of most of the high capacity transit alternatives has not been precisely defined. However, high capacity transit stations that are not well served by Valley Metro/RPTA local routes are more apt to support dedicated feeder services.
- **High population densities within three miles of the high capacity transit station.** High population densities, either employment or residential, that are not served by high-frequency existing transit lines from the nearest high capacity transit station are top candidates for dedicated feeder services.
- **Location of large, private employment centers.** Concentrations of large, private employers may provide a source for funding or operating support for dedicated feeder services.
- **Availability, cost and access to parking.** Although availability of parking is a determinant in overall ridership projections for the various high capacity transit alternatives, it also plays a role in whether or not a passenger will use a feeder service. Plentiful and affordable parking will discourage the use of dedicated feeders at both of the high capacity transit trip ends. This is true particularly in lower density areas where one is more likely to find free parking.
- **Improved pedestrian environment.** When transportation options are available, dedicated feeder service is most effective when high capacity transit station areas are very pedestrian friendly (and therefore, are oriented less toward cars).

Dedicated feeders should be developed to complement the high capacity transit network. From a corridor evaluation perspective, the need for new local feeders should not affect the design of a high capacity transit line, but should be considered when planning for station locations and transfer points.

4.3.6 Recommended High Capacity Transit Options

The data presented in the proceeding sections has been evaluated using the criteria outlined in Section 4.2.2. This evaluation process has resulted in the identification of a set of high capacity transit corridors which will be carried forward into Milestone 5 for further refinement during the development of a recommended high capacity transit network.

Table 4.3-7 summarizes the results of the corridor evaluation process that has been undertaken for the 28 high capacity transit corridors. This evaluation includes the data collected for population, employment, and environmental justice, as well as the results of the estimates of ridership and capital costs, observations on land use, and possible impacts of the corridors on the built and natural environments.

Each corridor has received a rating in each of the evaluation categories in order to allow for a comparison between the corridors in each category. This rating represents how positive the evaluation result is in comparison to the capability of the corridor to support high capacity transit service. The ratings and their general meanings are presented below:

- = Very Supportive
- = Supportive
- = Neutral
- = Not Supportive
- = Significant Constraint

Ratings were assigned for each corridor in the various categories using an equal interval method. Table 4.3-6 presents the rating applied to a range of values under each evaluation criteria.

Table 4.3-6 **Evaluation Criteria Rating Assignments**

Criteria	Significant Constraint	Not Supportive	Neutral	Supportive	Very Supportive
Population Density (sqmi)	0 – 4,000	4,001 – 8,000	8001 – 12,000	12,001- 16,000	16,001 – 20,000
Employment Density (sqmi)	0 – 3,000	3,001 – 6,000	6,001 – 9,000	9,001 – 12,000	12,001 – 15,000
Environmental Justice Density	0 – 1,000	1,001 -2,000	2,001 – 3,000	3,001 – 4,000	4,001 – 5,000
Boardings per Mile	0 – 350	351 – 700	701 – 1,050	1,051 – 1,400	1,401 – 1,750
Capital Cost per Mile ($ millions)	$50 - $40	$40 - $30	$30 - $20	$20 - $10	$10 - $0
Land Use Opportunities	n/a	Low	Medium	High	n/a
Right-of-Way Impacts	n/a	High	Medium	Low	n/a

Criteria	Significant Constraint	Not Supportive	Neutral	Supportive	Very Supportive
Natural Resources Impacts	n/a	High	Medium	Low	n/a
Cost Effectiveness	$60.00 - $48.01	$48.00 - $36.01	$36.00 - $24.01	$24.00 - $12.01	$12.00 - $0.00

Table 4.3-7 **Evaluation Results**

Corridor	Length (miles)	Population Density (per mile)	Employment Density (per mile)	Envir. Justice Density (per mile)	Boardings per Mile	Capital Cost per Mile	Land Use	Right-of-Way	Natural Resources	Cost Effectiveness*
59th Avenue	18.99	13,533	6,042	2,856	1,031	$40.42				$12.38
Baseline Road	12.95	17,522	4,323	2,558	633	$37.43				$19.08
Bell Road	28.55	10,527	4,644	904	1,006	$39.85				$13.21
BNSF	27.73	8,941	5,651	2,262	289	$23.43				$29.17
Camelback Road	20.88	13,107	7,918	3,696	1,150	$42.20				$12.16
Chandler Boulevard	16.45	10,503	5,954	1,731	760	$39.63				$16.51
Union Pacific Chandler Branch	11.13	10,138	9,732	1,957	1,751	$44.56				$8.57
Glendale Avenue/Cactus Avenue	19.77	10,378	7,049	1,613	723	$46.16				$19.62
I-10 Express Bus	9.4	13,125	3,945	589	54	$1.62				$17.91
I-10 West	11.05	14,611	10,726	4,730	1,035	$35.17				$11.09
I-17	17	5,537	3,637	110	22	$0.93				$31.21
Loop 101 East	34.33	6,983	5,682	760	32	$1.67				$29.43
Loop 101 West	34.1	8,303	2,872	735	34	$1.29				$23.33
Loop 202	54.6	7,354	5,564	982	33	$1.45				$26.96
Loop 303	19.44	6,403	1,514	82	25	$1.80				$35.10
Main (Option 1)	12.64	14,284	4,976	1,762	956	$36.12				$12.94
Main (Option 2)	9.64	15,120	5,553	2,144	1,004	$37.40				$13.02
Metrocenter	5.07	18,197	14,751	4,763	1,012	$43.40				$14.84
Northern east of Grand Avenue	5.7	19,380	8,863	3,713	1,275	$43.66				$11.95
Northern west of Grand Avenue	12.89	4,357	1,704	334	365	$36.82				$32.72
Power Road	13	8,396	4,661	386	807	$38.32				$14.95
Scottsdale Road	28.1	8,881	8,170	1,097	967	$44.27				$14.97
SR-51	17.12	10,814	6,146	1,807	584	$48.93				$27.09
Union Pacific Tempe Branch	10	8,450	11,699	1,683	801	$34.13				$14.13
Union Pacific Mainline/Chandler	25.95	12,397	13,811	2,960	129	$20.78				$56.96
Union Pacific Southeast	36.18	9,860	8,819	1,876	189	$17.81				$35.70
Union Pacific Yuma	30.9	7,661	5,568	1,287	210	$13.26				$27.04
US-60	18	12,884	9,267	2,122	76	$1.61				$12.74

During the evaluation process, it was determined that rating the various forms of high capacity transit technologies was difficult using the same scale and measures. Each technology has very different characteristics in terms of costs, ridership, and the type of service provided. Some qualifications to the evaluation results for Express BRT and Commuter Rail were made to reflect the differing characteristics of these transit technologies.

Express BRT Corridors

The Express BRT corridors have been separated out from the evaluation for several reasons. Although this mode is an essential component of an overall transit strategy for the region, it is not truly a form of high capacity transit when compared to the other technologies included in this study. Ridership projections developed by the sketch planning model report boardings per mile figures that are substantially less that of any other technology evaluated in this report.

Express BRT has dramatically different operating characteristics when compared to other forms of high capacity transit such as LRT and Dedicated BRT. Many Express BRT systems in North America operate only during peak commute times. Systems with service during off-peak periods operate a minimal amount of service, approximately every hour. These service levels are limited compared to projections of LRT and Dedicated BRT service in the MAG region with 5 to 10 minute headways in the peak periods and 15 to 20 minute service during off-peak times. Even the Phase 3 commuter rail service would provide more frequent service during both peak and off-peak times, while carrying more passengers per mile. The boarding figures projected for the Express BRT corridors achieve a maximum of 76 passengers per mile even with an assumed minimal off-peak service. This figure is noticeably less than the lowest boarding figure for a LRT/Dedicated BRT corridor of 584 passengers per mile.

The capital costs of these corridors are also not comparable to the other technologies since Express BRT requires a substantially lower amount of capital investment when compared to other forms of transit. The High Capacity Transit plan is designed to evaluate transit systems capable of being classified as Major Investment Studies (MIS). This type of study is undertaken by public agencies to analyze the benefits and costs of major transportation infrastructure projects such as an LRT system or a new freeway. The construction of an LRT or Dedicated BRT project studied as part of an MIS has a distinctly different set of benefits and trade-offs in terms of costs, riders, and corridor impacts when compared to implementing Express BRT service in an existing freeway corridor, requiring minimal capital improvements. These distinctive differences

limit the ability of Express BRT to be compared to LRT and Dedicated BRT systems on an equal footing.

As a result of these distinctions in the characteristics of this technology, the Express BRT corridors will not be included in further evaluation processes. However, the benefits of Express BRT including low capital cost and simple implementation are recognized in this study. Therefore, the seven Express BRT corridors are recommended for incorporation into the base transit network. Further evaluation and refinement of these corridors could occur as part of Valley Metro/RPTA's Regional Transit System Study. Additional coordination and consultation will occur with Valley Metro/RPTA to evaluate these corridors. The seven Express BRT corridors are:

- I-10 Far West – Loop 101 to Loop 303
- I-17 – Loop 101 to Anthem Way
- Loop 101 E – I-17 to Queen Creek Road
- Loop 101 W – I-17 to Baseline Road (via 91st Avenue)
- Loop 202 – I-10/SR-51/Loop 202 Interchange to I-10 South Interchange
- Loop 303 – I-10 to Grand Avenue
- US-60 – I-10 to Idaho Road

Exhibit 4.3-2 illustrates the Express BRT corridors.

EXPRESS BRT CORRIDORS

To Wickenburg

BNSF Railway SW

To Palo Verde

UP Yuma SW

UP Yuma EW

UP Southeast SE

UP Chandler S

Tempe Branch S

Legend

- Railroad
- Parkway/Highway
- Proposed Parkway/Highway
- Freeway
- Major Arterials
- Express BRT
- CP/EV LRT
- Existing Express BRT
- BRT/LRT Central Ave

0 2 4 8 12 16 Miles

N W E S

November 5, 2002

Commuter Rail Corridors

The assessment of commuter rail in the MAG region performed as part of this Milestone indicates that, in terms of ridership, the lines would perform on par with recent commuter rail systems in the Western Unites States. However, there are significant challenges to implementing commuter rail in the MAG region in terms of cost. The rail corridors in the MAG region have been optimized over the years for the service they provide today – a local-serving freight operation. As a result, projections twenty or more years into the future looking at a fully mature commuter rail service would require significant upgrades with a second track, centralized traffic control and other necessities for a safe and reliable mature system. This requires a significant investment in rail infrastructure, on par with projected costs for the BRT and LRT systems also under evaluation.

This is not to suggest that commuter rail in its entirety is infeasible. However several basic factors underlie the unfavorable comparison of commuter rail with other corridors:

- **Capital costs per mile**: these are very significant, even for commuter rail startup, even with the first level of service assumption of peak-commute only service. The rail corridors, especially the BNSF, are all very active freight routes at or close to existing capacity. Using assumptions of U.S. experience in new startups, a conventional locomotive-hauled service would require significant new trackage within existing rights of way, if freight operations for BNSF and UP customers on these corridors are to continue unhindered.
- **No 'legacy investment' foundation:** unlike commuter rail systems elsewhere, commuter rail in the MAG region would be built almost entirely as a new system. The existing routes have in most cases ceased to be passenger routes for many decades, and the current infrastructure has since evolved to suit a low-speed freight-only local operation. There is no 'legacy investment' of track or signalization which in many other startups has reduced the level of initial capital cost for an incoming passenger operation. In the same period that rail investment in the MAG area has pushed its suitability further away from passenger use, other modes with better rankings reflect the ongoing investment in road infrastructure, for example, - widening of arterials so that costs are not for a build-from-scratch system in most cases.
- **Ridership limitations**: the service and operational characteristics of commuter rail – station spacing two or three times less dense than other modes considered in the study, limited headways in the startup phase resulting from limited track capacity and equipment availability – all contribute to poorer comparative results in the evaluation. Moving away from the key strengths of commuter rail in order to overcome this 'handicap' – by introducing more frequent than desirable station stops,

for example – in the long term can undermine the effectiveness of passenger rail. As such these pressures are usually resisted by the operators of new startups in the Western U.S., where local jurisdictions often lobby for many more new stations than were originally designated, once the service has become established.

Nevertheless, Milestone 4 recognizes two factors. First, while cost-effectiveness is extremely important from both a "good planning" perspective and its match with Federal funding criteria, other factors must also be considered, such as the need for good regional connectivity. Second, it is possible that a more modest "start-up" operation featuring a more focused peak-only service or smaller, more maneuverable diesel multiple unit (DMU) trains could be implemented with fewer capital investments, thus improving short-term cost-effectiveness. While this does not change conclusions about investments that would be required in the long-term for an "ultimate" commuter rail system, a start-up service can nevertheless provide significant benefits in the short-term. Milestone 5 will look at the cost-effectiveness and mobility benefits of the start-up (Phase 1) and intermediate (Phase 2) levels of service in more detail.

The study, in moving to refining the preferred network in Milestone 5, will continue to consider commuter rail. Several scenarios will be evaluated in the next Milestone. Alternatives will include reverse commute service in the Union Pacific Yuma and Union Pacific Southeast corridors, alternative or additional station locations to identify possible new ridership opportunities, the availability of operating windows during start-up phases of service to reduce capital investment requirements, and an assessment of the DMU technology within each corridor. Although untried technology does not form part of the scope of work, there are new low-cost alternatives to the traditional heavy locomotive-hauled service which are coming onto the market, although are not yet Federal Railroad Administration (FRA) certified for use on mixed passenger-freight rail corridors.

Some DMU products are understood to be close to being certified for the kind of application envisaged on the MAG rail corridors, and would merit consideration in Milestone 5 for several reasons:

- Even if not currently available, they are likely to be in use within the timeframe of the study, and therefore are a valid technology consideration for the rail corridors.
- Evidence from use of DMU technology in Canada and Europe suggests that capital costs are lower for the vehicles themselves, as are O&M costs, including less substantial maintenance facility requirements.
- Quality of service offered by the newest generation of DMU trains – in passenger environment, overcoming the negative impacts of under floor

engines – has improved so significantly that many new operators prefer DMU over traditional train operation on this count alone.

- Introduction of DMUs in these other locations, with its improved acceleration and deceleration, reduced station dwell times, has in some cases reduced the need for costly double tracking and enabled more flexible (and cost effective) use of shared freight routes.

LRT/Dedicated BRT Corridors

The 17 LRT/Dedicated BRT corridors have been placed into three groups: A, B, and C. The corridors contained in Groups A and B are recommended to be carried forward into Milestone 5 where they will be further refined in terms of cost, ridership, and appropriate technology. Group C corridors will not be evaluated further in Milestone 5.

Group A corridors have received this designation as a result of receiving an above average rating in the cost-effectiveness category, as well as performing well in boardings per mile, and cost per mile. These corridors represent the "best of best" with reasonable costs, minimal impacts to surrounding land uses, and high population and employment figures. Ridership in these corridors also compares well to ridership figures on several of the peer group high capacity transit services examined in Milestone 2. The six Group A corridors are:

- 59th Avenue
- Camelback Road
- Union Pacific Chandler Branch
- Metrocenter
- Northern Avenue (to Loop 101)
- I-10 West

Group B corridors did not score as well the six Group A corridors in the cost effectiveness category. These corridors have some constraints or characteristics which have resulted in higher costs than the corridors presented in Group A. However, the Group B corridors also have high ridership figures that are comparable to those generated by the Group A corridors and also serve dense corridors capable of supporting high capacity transit. The cost estimates of these corridors will be refined further in Milestone 5, allowing for some opportunity to reduce the overall cost of these corridors and improve cost effectiveness ratings. The seven corridors included in Group B are listed below:

- Bell Road

- Chandler Boulevard
- Main Street (Option 2)
- Power Road
- Scottsdale Road
- SR-51
- Union Pacific Tempe Branch

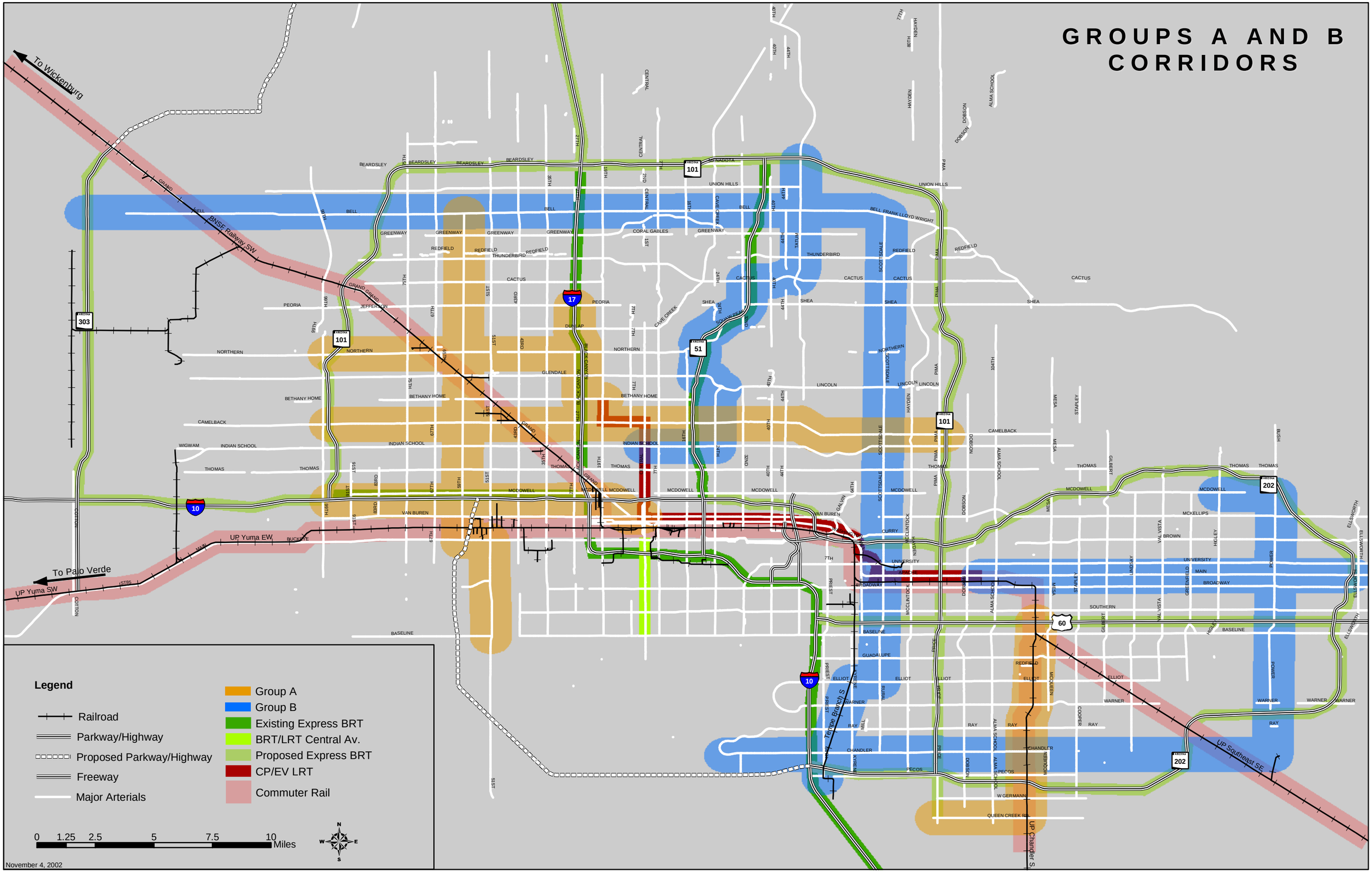
Group C corridors will not be carried forward for further evaluation. Corridors in this group have not deemed to serve a high number of riders or in the case of Main Street (Option 1) overlap another corridor selected for inclusion in Group A and B. The Group C corridors are:

- Baseline Road – although the corridor traverses an area of high population density, this corridor did not generate a high number of riders due to …
- Main Street (Option 1) – this corridor is duplicative of Main Street (Option 2), but does not perform as well.
- Glendale Avenue/Cactus Avenue – This is very similar to the SR-51 corridor; SR-51 was selected since it is more consistent with the current MAG Long Range Transportation Plan.

Based upon discussions with several local agencies in the MAG region, some modifications to the Group A and B LRT/Dedicated BRT corridors will likely be made in Milestone 5. These adjustments include extensions of the Northern Avenue corridor from Grand Avenue to Loop 101 and the Metrocenter Corridor from Peoria Avenue to Loop 101. In addition, portions of some corridors may be consolidated to reduce overlaps and resolve possible right-of-way impacts. Opportunities for consolidation include combining the Rural Road portion of the Scottsdale Road/Rural corridor with the UP Tempe Branch and combining the Northern Avenue and Camelback Road corridors west of 19th Avenue. Alternative alignments for these combined corridors will be examined in Milestone 5.

Exhibit 4.3-3 illustrates the 13 corridors included in Groups A and B and selected for further refinement in Milestone 5, along with the four commuter rail corridors. This map also illustrates how the corridors integrate with each other, and with the Central Phoenix/East Valley LRT, the Central Avenue BRT, and City of Phoenix Express BRT program to form a cohesive network of high capacity transit services. This network will be further refined based on technical analysis and public input in Milestone 5.

GROUPS A AND B CORRIDORS



Commuter Rail Capital Costs
BNSF Corridor

			Phase 1	*Phase 2*	*Phase 3*
Alignment Breakdown					
Surface (main track)	linear foot		146,414	0	15,840
Surface (sidings)	linear foot		2,000	4,000	0
Bridges	each		2		
Street Crossings	each		51	0	15
Item	**Units**	**Avg. Unit Cost**	*Phase 1*	*Phase 2*	*Phase 3*
Sound Wall	linear foot	$137	$4,260,700	$0	$0
Grade Separations (undercrossing)	Each	$15,000,000	$0	$0	$0
Grade Separations (overcrossing)	Each	$12,000,000	$0	$0	$0
Earthwork	linear foot	$2	$1,484,144	$40,000	$158,400
New At-grade crossing	Each	$250,000	$4,250,000	$0	$0
Close existing crossing	Each	$140,000	$420,000	$0	$0
Waterway Crossing	linear foot	$10,000	$5,000,000	$0	$0
Flood Control Crossing	linear foot	$10,000	$1,000,000	$0	$0
Subtotal-Civil			**$16,414,844**	**$40,000**	**$158,400**
Utility Relocation	Linear ft	$165	$24,488,376	$660,000	$427,680
Subtotal-Utilities			**$24,488,376**	**$660,000**	**$427,680**
Track (ballasted)	linear foot	$145	$20,780,588	$580,000	$2,079,300
Street Crossing	linear foot	$2,000	$10,200,000	$0	$3,000,000
Special Trackwork	%	15%	$3,117,088	$87,000	$311,895
Crossover - Single	Each	$150,000	$600,000	$1,200,000	$300,000
Subtotal-Track			**$34,697,676**	**$1,867,000**	**$5,691,195**
Mid-Line Stations	Each	$2,000,000	$6,000,000	$0	$0
Transit Hub Station	Each	$4,000,000	$8,000,000	$0	$0
Central Terminal	Each	$10,000,000	$10,000,000	$0	$0
Surface Parking	Space	$2,800	$4,340,000	$6,216,000	$1,190,000
Parking Structures	Space	$9,500	$0	$0	$0
Elevated Ped Xings	Each	$1,000,000	$0	$0	$0
Ticket Vending Machines	Each	$65,000	$780,000	$0	$0
Subtotal-Stations			**$29,120,000**	**$6,216,000**	**$1,190,000**
Centralized Traffic Control	linear foot	$140	$0	$21,338,016	$15,840
CTC Control Point	each	$750,000	$0	$3,750,000	$750,000
Signal Control and Switch points	each	$100,000	$0	$600,000	$200,000
Subtotal-C&S			**$0**	**$25,688,016**	**$965,840**
Maintenance/Storage	Each	$40,000,000	$0	$17,000,000	$0
Operations Control	Each	$5,000,000	$2,500,000	$0	$0
Subtotal Facilities			**$2,500,000**	**$17,000,000**	**$0**
A. Construction Subtotal			**$107,220,896**	**$51,471,016**	**$8,433,115**
Environmental Mitigation	Percent of A	3%	$3,216,627	$1,544,130	$252,993
B. Construction Cost Subtotal			**$110,437,523**	**$53,015,146**	**$8,686,108**
Maintenance/Storage Yard	square foot	$25	$0	$24,502,500	$0
System Envelope	mile	$2,200,000	$0	$61,006,000	$0
New Parking Spaces	square foot	$25	$13,503,600	$19,166,400	$3,702,600
C. Right of Way Subtotal			**$13,503,600**	**$104,674,900**	**$3,702,600**
Revenue Vehicles (cab car, bi-level, 135 pass)	Each	$3,000,000	$12,000,000	$6,000,000	$12,000,000
Revenue Vehicles (non cab, bi-level, 135 pass.)	Each	$2,000,000	$22,000,000	$14,000,000	$2,000,000
Revenue Vehicles (loco)	Each	$4,000,000	$16,000,000	$8,000,000	$16,000,000
Spare Parts	Percent	10%	$5,000,000	$2,800,000	$3,000,000
MOW Equipment	Rt Mile	$250,000	$6,932,500	$0	$750,000
D. Vehicles Subtotal			**$61,932,500**	**$30,800,000**	**$33,750,000**
Cost Contingencies (Uncertainties, Changes)					
Design&Construction	Percent of B	25%	$27,609,381	$13,253,787	$2,171,527
Right of Way	Percent of C	30%	$4,051,080	$31,402,470	$1,110,780
Vehicle Cost	Percent of D	10%	$6,193,250	$3,080,000	$3,375,000
Program Implementation (Agency Costs and Fees)					
Design&Construction	Percent of B	31%	$34,235,632	$16,434,695	$2,692,694
Right of Way Purchase	Percent of C	15%	$2,025,540	$15,701,235	$555,390
Vehicle Procurement	Percent of D	5%	$3,096,625	$1,540,000	$1,687,500
E. Capital Cost Subtotal			**$263,085,131**	**$269,902,234**	**$57,731,599**
Project Reserve	Percent of E	10%	$26,308,513	$26,990,223	$5,773,160
F. Total Capital Cost			**$289,393,644**	**$296,892,457**	**$63,504,759**

Note: All costs are in Year 2001 Dollars

Commuter Rail Capital Costs
Union Pacific Mainline/Chandler Corridor

			Phase 1	*Phase 2*	*Phase 3*
Alignment Breakdown					
Surface (main track)	linear foot		78,936	0	14,889
Upgraded Track			45,461		
Surface (siding)	linear foot		0	2,000	2,000
Bridges	each				
Street Crossings	each		49	0	5
Item	**Units**	**Avg. Unit Cost**	*Phase 1*	*Phase 2*	*Phase 3*
Sound Wall	linear foot	$137	$3,616,800	$0	$0
Grade Separations (undercrossing)	Each	$15,000,000	$0	$0	$0
Grade Separations (overcrossing)	Each	$12,000,000	$0	$0	$0
Earthwork	linear foot	$2	$789,360	$20,000	$168,890
New At-grade crossing	Each	$250,000	$2,500,000	$0	$0
Close existing crossing	Each	$140,000	$0	$0	$0
Waterway Crossing	linear foot	$10,000	$13,200,000	$0	$0
Flood Control Crossing	linear foot	$10,000	$3,000,000	$0	$0
Subtotal-Civil			**$23,106,160**	**$20,000**	**$168,890**
Utility Relocation	linear foot	$165	$13,024,440	$330,000	$456,003
Subtotal-Utilities			**$13,024,440**	**$330,000**	**$456,003**
Track	linear foot	$145	$10,735,220	$290,000	$2,376,405
Upgrade Track	linear foot	$120	$5,455,296	$0	$0
Street Crossing	linear foot	$2,000	$9,800,000	$0	$1,000,000
Special Trackwork	%	15%	$1,610,283	$43,500	$356,461
Crossover - Single	Each	$150,000	$600,000	$300,000	$300,000
Subtotal-Track			**$28,200,799**	**$633,500**	**$4,032,866**
Mid-Line Stations	Each	$2,000,000	$10,000,000	$0	$0
Transit Hub Station	Each	$4,000,000	$8,000,000	$0	$0
Central Terminal	Each	$10,000,000	$10,000,000	$0	$0
Surface Parking	Space	$2,800	$2,660,000	$2,660,000	$490,000
Parking Structures	Space	$9,500	$0	$0	$0
Elevated Ped Xings	Each	$1,000,000	$0	$0	$0
Ticket Vending Machines	Each	$65,000	$1,040,000	$0	$0
Subtotal-Stations			**$31,700,000**	**$2,660,000**	**$490,000**
Centralized Traffic Control	linear foot	$140	$13,135,584	$280,000	$9,756,460
CTC Control Point	each	$750,000	$2,250,000	$0	$1,500,000
Signal Control and Switch points	each	$100,000	$400,000	$200,000	$200,000
Subtotal-C&S			**$15,785,584**	**$480,000**	**$11,456,460**
Maintenance/Storage	Each	$40,000,000	$0	$17,000,000	$0
Operations Control	Each	$5,000,000	$2,500,000	$0	$0
Subtotal Facilities			**$2,500,000**	**$17,000,000**	**$0**
A. Construction Subtotal			**$114,316,983**	**$21,123,500**	**$16,604,219**
Environmental Mitigation	Percent of A	3%	$3,429,509	$633,705	$498,127
B. Construction Cost Subtotal			**$117,746,492**	**$21,757,205**	**$17,102,345**
Maintenance/Storage Yard	Lump	$25	$0	$24,502,500	$0
System Envelope	mile	$2,200,000	$0	$39,094,000	$0
New Parking Spaces	square foot	$25	$8,276,400	$8,276,400	$1,524,600
C. Right of Way Subtotal			**$8,276,400**	**$71,872,900**	**$1,524,600**
Revenue Vehicles (cab car, bi-level, 135 pass)	Each	$3,000,000	$12,000,000	$6,000,000	$12,000,000
Revenue Vehicles (non cab, bi-level, 135 pass.)	Each	$2,000,000	$8,000,000	$4,000,000	$12,000,000
Revenue Vehicles (loco)	Each	$4,000,000	$16,000,000	$8,000,000	$16,000,000
Spare Parts	Percent	10%	$3,600,000	$1,800,000	$4,000,000
MOW Equipment	Rt Mile	$250,000	$6,750,000	$0	$750,000
D. Vehicles Subtotal			**$46,350,000**	**$19,800,000**	**$44,750,000**
Cost Contingencies (Uncertainties, Changes)					
Design&Construction	Percent of B	25%	$29,436,623	$5,439,301	$4,275,586
Right of Way	Percent of C	30%	$2,482,920	$21,561,870	$457,380
Vehicle Cost	Percent of D	10%	$4,635,000	$1,980,000	$4,475,000
Program Implementation (Agency Costs and Fees)					
Design&Construction	Percent of B	31%	$36,501,413	$6,744,734	$5,301,727
Right of Way Purchase	Percent of C	15%	$1,241,460	$10,780,935	$228,690
Vehicle Procurement	Percent of D	5%	$2,317,500	$990,000	$2,237,500
E. Capital Cost Subtotal			**$248,987,808**	**$160,926,945**	**$80,352,829**
Project Reserve	Percent of E	10%	$24,898,781	$16,092,694	$8,035,283
F. Total Capital Cost			**$273,886,589**	**$177,019,639**	**$88,388,112**

Note: All costs are in Year 2001 Dollars

Commuter Rail Capital Costs
Union Pacific Southeast

			Phase 1	*Phase 2*	*Phase 3*
Alignment Breakdown					
Surface (main track)	linear foot		78,936		14,890
Surface (siding)	linear foot			16,000	2,560
Bridges	each		1		
Street Crossings	each		34	0	4
Item	**Units**	**Avg. Unit Cost**	***Phase 1***	***Phase 2***	***Phase 3***
Sound Wall	linear foot	$137	$4,202,722	$0	$0
Grade Separations (undercrossing)	Each	$15,000,000	$0	$0	$0
Grade Separations (overcrossing)	Each	$12,000,000	$0	$0	$0
New At-grade crossing	Each	$250,000	$3,500,000	$0	$0
Close existing crossing	Each	$140,000	$0	$0	$0
Earthwork	linear foot	$2	$789,360	$160,000	$174,500
Waterway Crossing	linear foot	$10,000	$13,200,000	$0	$0
Flood Control Crossing	linear foot	$10,000	$3,000,000	$0	$0
Subtotal-Civil			**$24,692,082**	**$160,000**	**$174,500**
Utility Relocation	linear ft	$165	$13,024,440	$2,640,000	$471,150
Subtotal-Utilities			**$13,024,440**	**$2,640,000**	**$471,150**
Track	linear foot	$145	$10,952,720	$2,320,000	$2,472,250
Street Crossing	linear foot	$2,000	$6,800,000	$0	$800,000
Special Trackwork	%	15%	$1,642,908	$348,000	$370,838
Crossover - Single	Each	$150,000	$300,000	$600,000	$600,000
Subtotal-Track			**$19,695,628**	**$3,268,000**	**$4,243,088**
Mid-Line Stations	Each	$2,000,000	$10,000,000	$0	$0
Transit Hub Station	Each	$4,000,000	$8,000,000	$0	$0
Central Terminal	Each	$10,000,000	$10,000,000	$0	$0
Surface Parking	Space	$2,800	$4,480,000	$5,250,000	$1,050,000
Parking Structures	Space	$9,500	$0	$0	$0
Elevated Ped Xings	Each	$1,000,000	$0	$0	$0
Ticket Vending Machines	Each	$65,000	$1,040,000	$0	$0
Subtotal-Stations			**$33,520,000**	**$5,250,000**	**$1,050,000**
Centralized Traffic Control	linear foot	$140	$13,135,584	$13,313,216	$2,443,000
CTC Control Point	each	$750,000	$2,250,000	$2,250,000	$750,000
Signal Control and Switch points	each	$100,000	$200,000	$400,000	$400,000
Subtotal-C&S			**$15,585,584**	**$15,963,216**	**$3,593,000**
Maintenance/Storage	Each	$40,000,000	$0	$21,000,000	$0
Operations Control	Each	$5,000,000	$2,500,000	$0	$0
Subtotal Facilities			**$2,500,000**	**$21,000,000**	**$0**
A. Construction Subtotal			**$109,017,734**	**$48,281,216**	**$9,531,738**
Environmental Mitigation	Percent of A	3%	$3,270,532	$1,448,436	$285,952
B. Construction Cost Subtotal			**$112,288,266**	**$49,729,652**	**$9,817,690**
Maintenance/Storage Yard	square foot	$25	$0	$27,225,000	$0
System Envelope	mile	$2,200,000	$0	$39,094,000	$0
New Parking Spaces	square foot	$25	$13,939,200	$16,335,000	$3,267,000
C. Right of Way Subtotal			**$13,939,200**	**$82,654,000**	**$3,267,000**
Revenue Vehicles (cab car, bi-level, 135 pass)	Each	$3,000,000	$12,000,000	$9,000,000	$15,000,000
Revenue Vehicles (non cab, bi-level, 135 pass.)	Each	$2,000,000	$22,000,000	$22,000,000	$0
Revenue Vehicles (loco)	Each	$4,000,000	$16,000,000	$12,000,000	$20,000,000
Spare Parts	Percent	10%	$5,000,000	$4,300,000	$3,500,000
MOW Equipment	Rt Mile	$250,000	$9,000,000	$0	$705,019
D. Vehicles Subtotal			**$64,000,000**	**$47,300,000**	**$39,205,019**
Cost Contingencies (Uncertainties, Changes)					
Design&Construction	Percent of B	25%	$28,072,066	$12,432,413	$2,454,422
Right of Way	Percent of C	30%	$4,181,760	$24,796,200	$980,100
Vehicle Cost	Percent of D	10%	$6,400,000	$4,730,000	$3,920,502
Program Implementation (Agency Costs and Fees)					
Design&Construction	Percent of B	31%	$34,809,362	$15,416,192	$3,043,484
Right of Way Purchase	Percent of C	15%	$2,090,880	$12,398,100	$490,050
Vehicle Procurement	Percent of D	5%	$3,200,000	$2,365,000	$1,960,251
E. Capital Cost Subtotal			**$268,981,534**	**$251,821,558**	**$65,138,518**
Project Reserve	Percent of E	10%	$26,898,153	$25,182,156	$6,513,852
F. Total Capital Cost			**$295,879,688**	**$277,003,714**	**$71,652,369**

Note: All costs are in Year 2001 Dollars

Commuter Rail Capital Costs
Union Pacific Yuma Corridor

			Phase 1	*Phase 2*	*Phase 3*
Alignment Breakdown					
Surface (main track)	linear foot		-	0	0
Surface (sidings)	linear foot		0	10,560	0
Street Crossings	each		0	0	0
Total Ft					
Item	**Units**	**Avg. Unit Cost**	*Phase 1*	*Phase 2*	*Phase 3*
Sound Wall	linear foot	$137	$1,808,400	$0	$0
Grade Separations (undercrossing)	Each	$15,000,000	$0	$0	$0
Grade Separations (overcrossing)	Each	$12,000,000	$0	$0	$0
Earthwork	linear foot	$2	$0	$105,600	$0
New At-grade crossing	Each	$250,000	$1,250,000	$0	$0
Close existing crossing	Each	$140,000	$0	$0	$0
Waterway Crossing	linear foot	$10,000	$0	$0	$0
Flood Control Crossing	linear foot	$10,000	$0	$0	$0
Subtotal-Civil			**$3,058,400**	**$105,600**	**$0**
Utility Relocation	Linear ft	$165	$0	$1,742,400	$0
Subtotal-Utilities			**$0**	**$1,742,400**	**$0**
Track (ballasted)	linear foot	$145	$0	$1,531,200	$0
Street Crossing	linear foot	$2,000	$0	$2,000	$0
Special Trackwork	%	15%	$0	$229,680	$0
Crossover - Single	Each	$150,000	$0	$300,000	$0
Subtotal-Track			**$0**	**$2,062,880**	**$0**
Mid-Line Stations	Each	$2,000,000	$6,000,000	$0	$0
Transit Hub Station	Each	$4,000,000	$4,000,000	$0	$0
Central Terminal	Each	$10,000,000	$10,000,000	$0	$0
Surface Parking	Space	$2,800	$3,570,000	$4,900,000	$910,000
Parking Structures	Space	$9,500	$0	$0	$0
Elevated Ped Xings	Each	$1,000,000	$0	$0	$0
Ticket Vending Machines	Each	$65,000	$780,000	$0	$0
Subtotal-Stations			**$24,350,000**	**$4,900,000**	**$910,000**
Centralized Traffic Control	linear foot	$140	$0	$0	$22,826,496
CTC Control Point	each	$750,000	$0	$0	$3,750,000
Signal Control and Switch points	each	$100,000	$0	$0	$400,000
Subtotal-C&S			**$0**	**$0**	**$26,976,496**
Maintenance/Storage Yard	Each	$40,000,000	$0	$21,000,000	$0
Operations Control	Each	$5,000,000	$2,500,000	$0	$0
Subtotal Facilities			**$2,500,000**	**$21,000,000**	**$0**
A. Construction Subtotal			**$29,908,400**	**$29,810,880**	**$27,886,496**
Environmental Mitigation	Percent of A	3%	$897,252	$894,326	$836,595
B. Construction Cost Subtotal			**$30,805,652**	**$30,705,206**	**$28,723,091**
Right-of-way for Maintenance/Storage Yard	square foot	$25	$0	$27,225,000	$0
System Envelope	square foot	$20	$0	$0	$0
Right-of-way for Parking Spaces	square foot	$25	$11,107,800	$15,246,000	$2,831,400
C. Right of Way Subtotal			**$11,107,800**	**$42,471,000**	**$2,831,400**
Revenue Vehicles (cab car, bi-level, 135 pass)	Each	$3,000,000	$12,000,000	$9,000,000	$12,000,000
Revenue Vehicles (non cab, bi-level, 135 pass.)	Each	$2,000,000	$16,000,000	$8,000,000	$10,000,000
Revenue Vehicles (loco)	Each	$4,000,000	$16,000,000	$12,000,000	$16,000,000
Spare Parts	Percent	10%	$4,400,000	$2,900,000	$3,800,000
MOW Equipment	Mile	$250,000	$7,725,000	$500,000	$0
D. Vehicles Subtotal			**$56,125,000**	**$32,400,000**	**$41,800,000**
Cost Contingencies (Uncertainties, Changes)					
Design&Construction	Percent of B	25%	$7,701,413	$7,676,302	$7,180,773
Right of Way	Percent of C	30%	$3,332,340	$12,741,300	$849,420
Vehicle Cost	Percent of D	10%	$5,612,500	$3,240,000	$4,180,000
Program Implementation (Agency Costs and Fees)					
Design&Construction	Percent of B	31%	$9,549,752	$9,518,614	$8,904,158
Right of Way Purchase	Percent of C	15%	$1,666,170	$6,370,650	$424,710
Vehicle Procurement	Percent of D	5%	$2,806,250	$1,620,000	$2,090,000
E. Capital Cost Subtotal			**$128,706,877**	**$146,743,072**	**$96,983,552**
Project Reserve	Percent of E	10%	$12,870,688	$14,674,307	$9,698,355
F. Total Capital Cost			**$141,577,565**	**$161,417,379**	**$106,681,907**

Note: All costs are in Year 2001 Dollars

BNSF Corridor Phase 1

CR - Fleet Sizing and O&M Estimate

Item			Comments
			peak
Travel/Track Miles of Line	27.73	27.73	headway
Stations:			60
* Surface	see total ----------	6	on each line
Operating Times:			
* 1-way run, minutes	*45.3*		
* 2-way cycle, minutes	**91**		average cycle
Vehicle Fleet:			
* Trains in service (peak)	3	3	combined - 60' peak headways (H)
Pass Cars (4-car consist)	12	12	
* Cars in service (peak)	12	12	
* Fleet		14	In service + 20% spares
Train & Car Hrs & Miles:			
* Train Hours:			
- Daily	5	5	
* Car Hrs per day:			
- Base	5	5	
- Total	20	20	
* Car miles per day	666	666	
* Train miles per day	166		
* Annualization:			300 equivalent weekdays/year
- Car Hours	6,000	6,000	
- Car Miles	199,656	199,656	
O&M Cost Estimates:			
* Rev. Veh Hrs @ $487.64		$ 2.9	$ millions
* Rev Veh Mi @ $16.81		$ 3.4	$ millions
* ROW Lease @ $6.00/train mile		$ 0.3	$ millions
*** Total Annual O&M**		**$ 3.5**	$ millions

* Total Annual O&M Cost is computed using an average of the model inputs for revenue hours and revenue miles, plus the cost of lease track rights for Phase 1.

BNSF Corridor Phase 2

CR - Fleet Sizing and O&M Estimate

Item			Comments
			peak
Travel/Track Miles of Line	27.73	27.73	headway
Stations:			20
* Surface	see total ----------	6	on each line
Operating Times:			
* 1-way run, minutes	*45.3*		
* 2-way cycle, minutes	**91**		average cycle
Vehicle Fleet:			
* Trains in service (peak)	5	5	combined - 20' peak headways (H)
Pass Cars (4-car consist)	20	20	
* Cars in service (peak)	20	20	
* Fleet		24	In service + 20% spares
Train & Car Hrs & Miles:			
* Train Hours:			
- Peak	14		
- Off-Peak	10		
- Total	24	24	
* Car Hrs per day:			
- Peak	42	42	Single cars, 9 hrs/day
- Off-Peak	20	20	
- Crush	0	-	
- Total	62	62	
* Car miles per day	3,990	3,990	
* Peak Train miles per day	998		
* Off-Peak Train miles per day	499		
* Total Train miles per day	1,619		
* Annualization:			300 equivalent weekdays/year
- Car Hours	18,600	18,600	
- Car Miles	1,197,007	1,197,007	
O&M Cost Estimates:			
* Rev. Veh Hrs @ $487.64		$ 9.1	$ millions
* Rev Veh Mi @ $16.81		$ 20.1	$ millions
*** Total Annual O&M**		**$ 14.6**	$ millions

* Total Annual O&M Cost is computed using an average of the model inputs for revenue hours and revenue miles.

BNSF Corridor Phase 3

CR - Fleet Sizing and O&M Estimate

Item			Comments
			peak
Travel/Track Miles of Line	27.73	27.73	headway
Stations:			15
* Surface	see total ----------	6	on each line
Operating Times:			
* 1-way run, minutes	*45.3*		
* 2-way cycle, minutes	**91**		average cycle
Vehicle Fleet:			
* Trains in service (peak)	8	8	combined - 15' peak headways (H)
Pass Cars (3-car consist)	24	24	
* Cars in service (peak)	24	24	
* Fleet		29	In service + 20% spares
Train & Car Hrs & Miles:			
* Train Hours:			
- Peak	28		
- Off-Peak	14		
- Total	42	42	
* Car Hrs per day:			
- Peak	84	84	
- Off-Peak	28	28	
- Crush	0	-	
- Total	112	112	
* Car miles per day	3,990	3,990	
* Peak Train miles per day	998		
* Off-Peak Train miles per day	499		
* Total Train miles per day	1,619		
* Annualization:			300 equivalent weekdays/year
- Car Hours	33,600	33,600	
- Car Miles	1,197,007	1,197,007	
O&M Cost Estimates:			
* Rev. Veh Hrs @ $487.64		$ 16.4	$ millions
* Rev Veh Mi @ $16.81		$ 20.1	$ millions
*** Total Annual O&M**		**$ 18.3**	$ millions

* Total Annual O&M Cost is computed using an average of the model inputs for revenue hours and revenue miles.

UP Mainline/Chandler Corridor Phase 1
CR - Fleet Sizing and O&M Estimate

Item			Comments
			peak
Travel/Track Miles of Line	25.95	25.95	headway
Stations:			60
* Surface	see total ----------	8	on each line
Operating Times:			
* 1-way run, minutes	*52.1*		
* 2-way cycle, minutes	**104**		average cycle
Vehicle Fleet:			
* Trains in service (peak)	3	3	combined - 60' peak headways (H)
Pass Cars (2-car consist)	6	6	
* Cars in service (peak)	6	6	
* Fleet		7	In service + 20% spares
Train & Car Hrs & Miles:			
* Train Hours:			
- Daily	6	6	
* Car Hrs per day:			
- Base	6	6	
- Total	12	12	
* Car miles per day	311	311	
* Train miles per day	156		
* Annualization:			300 equivalent weekdays/year
- Car Hours	3,600	3,600	
- Car Miles	93,420	93,420	
O&M Cost Estimates:			
* Rev. Veh Hrs @ $487.64		$ 1.8	$ millions
* Rev Veh Mi @ $16.81		$ 1.6	$ millions
* ROW Lease @ $6.00/train mile		$ 0.3	$ millions
*** Total Annual O&M**		**$ 2.0**	$ millions

* Total Annual O&M Cost is computed using an average of the model inputs for revenue hours and revenue miles, plus the cost of lease track rights for Phase 1.

UP Mainline/Chandler Corridor Phase 2
CR - Fleet Sizing and O&M Estimate

Item			Comments
			peak
Travel/Track Miles of Line	25.95	25.95	headway
Stations:			20
* Surface	see total ----------	8	on each line
Operating Times:			
* 1-way run, minutes	*52.1*		
* 2-way cycle, minutes	**104**		average cycle
Vehicle Fleet:			
* Trains in service (peak)	5	5	combined - 20' peak headways (H)
Pass Cars (2-car consist)	10	10	
* Cars in service (peak)	10	10	
* Fleet		12	In service + 20% spares
Train & Car Hrs & Miles:			
* Train Hours:			
- Peak	16		
- Off-Peak	11		
- Total	27	27	
* Car Hrs per day:			
- Peak	32	32	
- Off-Peak	22	22	
- Crush	0	-	
- Total	54	54	
* Car miles per day	1,558	1,558	
* Peak Train miles per day	467		
* Off-Peak Train miles per day	312		
* Total Train miles per day	779		
* Annualization:			300 equivalent weekdays/year
- Car Hours	16,200	16,200	
- Car Miles	467,337	467,337	
O&M Cost Estimates:			
* Rev. Veh Hrs @ $487.64		$ 7.9	$ millions
* Rev Veh Mi @ $16.81		$ 7.9	$ millions
* ROW Lease @ $6.00/train mile		$ 0.6	$ millions
*** Total Annual O&M**		**$ 8.5**	$ millions

* Total Annual O&M Cost is computed using an average of the model inputs for revenue hours and revenue miles, plus the cost of leasing track rights along the Chandler Industrial Branch.

Up Mainline/Chandler Corridor Phase 3
CR - Fleet Sizing and O&M Estimate

Item			Comments
			peak
Travel/Track Miles of Line	25.95	25.95	headway
Stations:			15
* Surface	see total ----------	8	on each line
Operating Times:			
* 1-way run, minutes	*52.1*		
* 2-way cycle, minutes	**104**		average cycle
Vehicle Fleet:			
* Trains in service (peak)	9	9	combined - 15' peak headways (H)
Pass Cars (2-car consist)	18	18	
* Cars in service (peak)	18	18	
* Fleet		22	In service + 20% spares
Train & Car Hrs & Miles:			
* Train Hours:			
- Peak	32		
- Off-Peak	16		
- Total	48	48	
* Car Hrs per day:			
- Peak	64	64	
- Off-Peak	32	32	
- Crush	0	-	
- Total	96	96	
* Car miles per day	2,804	2,804	
* Peak Train miles per day	935		
* Off-Peak Train miles per day	467		
* Total Train miles per day	1,402		
* Annualization:			300 equivalent weekdays/year
- Car Hours	28,800	28,800	
- Car Miles	841,207	841,207	
O&M Cost Estimates:			
* Rev. Veh Hrs @ $487.64		$ 14.0	$ millions
* Rev Veh Mi @ $16.81		$ 14.1	$ millions
* ROW Lease @ $6.00/train mile		$ 1.0	$ millions
*** Total Annual O&M**		**$ 14.1**	$ millions

* Total Annual O&M Cost is computed using an average of the model inputs for revenue hours and revenue miles, plus the cost of leasing track rights along the Chandler Industrial Branch.

UP Southeast Corridor Phase 1
CR - Fleet Sizing and O&M Estimate

Item			Comments
			peak
Travel/Track Miles of Line	36.18	36.18	headway
Stations:			60
* Surface	see total ----------	8	on each line
Operating Times:			
* 1-way run, minutes	*64.4*		
* 2-way cycle, minutes	**129**		average cycle
Vehicle Fleet:			
* Trains in service (peak)	3	3	combined - 60' peak headways (H)
Pass Cars (4-car consist)	12	12	
* Cars in service (peak)	12	12	
* Fleet		14	In service + 20% spares
Train & Car Hrs & Miles:			
* Train Hours:			
- Daily	7	7	
* Car Hrs per day:			
- Base	7	7	
- Total	28	28	
* Car miles per day	868	868	
* Train miles per day	217		
* Annualization:			300 equivalent weekdays/year
- Car Hours	8,400	8,400	
- Car Miles	260,496	260,496	
O&M Cost Estimates:			
* Rev. Veh Hrs @ $487.64		$ 4.1	$ millions
* Rev Veh Mi @ $16.81		$ 4.4	$ millions
* ROW Lease @ $6.00/train mile		$ 0.4	$ millions
*** Total Annual O&M**		**$ 4.7**	$ millions

* Total Annual O&M Cost is computed using an average of the model inputs for revenue hours and revenue miles, plus the cost of lease track rights for Phase 1.

UP Southeast Corridor Phase 2

CR - Fleet Sizing and O&M Estimate

Item			Comments
			peak
Travel/Track Miles of Line	36.18	36.18	headway
Stations:			20
* Surface	see total ----------	8	on each line
Operating Times:			
* 1-way run, minutes	*64.4*		
* 2-way cycle, minutes	**129**		average cycle
Vehicle Fleet:			
* Trains in service (peak)	6	6	combined - 20' peak headways (H)
Pass Cars (4-car consist)	24	24	
* Cars in service (peak)	24	24	
* Fleet		29	In service + 20% spares
Train & Car Hrs & Miles:			
* Train Hours:			
- Peak	20		
- Off-Peak	13		
- Total	33	33	
* Car Hrs per day:			
- Peak	80	80	
- Off-Peak	26	26	
- Crush	0	-	
- Total	106	106	
* Car miles per day	3,472	3,472	
* Peak Train miles per day	651		
* Off-Peak Train miles per day	434		
* Total Train miles per day	1,085		
* Annualization:			300 equivalent weekdays/year
- Car Hours	31,800	31,800	
- Car Miles	1,041,734	1,041,734	
O&M Cost Estimates:			
* Rev. Veh Hrs @ $487.64		$ 15.5	$ millions
* Rev Veh Mi @ $16.81		$ 17.5	$ millions
* ROW Lease @ $6.00/train mile		$ 0.8	$ millions
*** Total Annual O&M**		**$ 17.3**	$ millions

* Total Annual O&M Cost is computed using an average of the model inputs for revenue hours and revenue miles, plus the cost of lease track rights between Baseline Road and Ellsworth Avenue.

UP Southeast Corridor Phase 3

CR - Fleet Sizing and O&M Estimate

Item			Comments
			peak
Travel/Track Miles of Line	36.18	36.18	headway
Stations:			15
* Surface	see total ----------	8	on each line
Operating Times:			
* 1-way run, minutes	*64.4*		
* 2-way cycle, minutes	**129**		average cycle
Vehicle Fleet:			
* Trains in service (peak)	10	10	combined - 15' peak headways (H)
Pass Cars (3-car consist)	25	25	
* Cars in service (peak)	25	25	
* Fleet		30	In service + 20% spares
Train & Car Hrs & Miles:			
* Train Hours:			
- Peak	39		
- Off-Peak	20		
- Total	59	59	
* Car Hrs per day:			
- Peak	98	98	
- Off-Peak	40	40	
- Crush	0	-	
- Total	138	138	
* Car miles per day	4,558	4,558	
* Peak Train miles per day	1,302		
* Off-Peak Train miles per day	651		
* Total Train miles per day	1,953		
* Annualization:			300 equivalent weekdays/year
- Car Hours	41,400	41,400	
- Car Miles	1,367,276	1,367,276	
O&M Cost Estimates:			
* Rev. Veh Hrs @ $487.64		$ 20.2	$ millions
* Rev Veh Mi @ $16.81		$ 23.0	$ millions
* ROW Lease @ $6.00/train mile		$ 1.5	$ millions
*** Total Annual O&M**		**$ 21.6**	$ millions

* Total Annual O&M Cost is computed using an average of the model inputs for revenue hours and revenue miles, plus the cost of lease track rights between Baseline Road and Ellsworth Avenue.

Up Yuma Corridor Phase 1
CR - Fleet Sizing and O&M Estimate

Item			Comments
			peak
Travel/Track Miles of Line	30.90	30.90	headway
Stations:			60
* Surface	see total ----------	5	on each line
Operating Times:			
* 1-way run, minutes	*46.1*		
* 2-way cycle, minutes	**92**		average cycle
Vehicle Fleet:			
* Trains in service (peak)	3	3	combined - 60' peak headways (H)
Pass Cars (3-car consist)	9	9	
* Cars in service (peak)	9	9	
* Fleet		11	In service + 20% spares
Train & Car Hrs & Miles:			
* Train Hours:			
- Daily	5	5	
* Car Hrs per day:			
- Base	5	5	
- Total	15	15	
* Car miles per day	556	556	
* Train miles per day	185		
* Annualization:			300 equivalent weekdays/year
- Car Hours	4,500	4,500	
- Car Miles	166,860	166,860	
O&M Cost Estimates:			
* Rev. Veh Hrs @ $487.64		$ 2.2	$ millions
* Rev Veh Mi @ $16.81		$ 2.8	$ millions
* ROW Lease @ $6.00/train mile		$ 0.3	$ millions
*** Total Annual O&M**		**$ 2.8**	$ millions

* Total Annual O&M Cost is computed using an average of the model inputs for revenue hours and revenue miles, plus the cost of lease track rights for Phase 1.

UP Yuma Corridor Phase 2

CR - Fleet Sizing and O&M Estimate

Item			Comments
			peak
Travel/Track Miles of Line	30.90	30.90	headway
Stations:			20
* Surface	see total ----------	5	on each line
Operating Times:			
* 1-way run, minutes	*46.1*		
* 2-way cycle, minutes	**92**		average cycle
Vehicle Fleet:			
* Trains in service (peak)	5	5	combined - 20' peak headways (H)
Pass Cars (3-car consist)	15	15	
* Cars in service (peak)	15	15	
* Fleet		18	In service + 20% spares
Train & Car Hrs & Miles:			
* Train Hours:			
- Peak	14		
- Off-Peak	10		
- Total	24	24	
* Car Hrs per day:			
- Peak	42	42	
- Off-Peak	20	20	
- Crush	0	-	
- Total	62	62	
* Car miles per day	2,409	2,409	
* Peak Train miles per day	556		
* Off-Peak Train miles per day	371		
* Total Train miles per day	927		
* Annualization:			300 equivalent weekdays/year
- Car Hours	18,600	18,600	
- Car Miles	722,756	722,756	
O&M Cost Estimates:			
* Rev. Veh Hrs @ $487.64		$ 9.1	$ millions
* Rev Veh Mi @ $16.81		$ 12.1	$ millions
* ROW Lease @ $6.00/train mile		$ 1.7	$ millions
*** Total Annual O&M**		**$ 12.3**	$ millions

* Total Annual O&M Cost is computed using an average of the model inputs for revenue hours and revenue miles, plus the cost of lease track rights.

UP Yuma Corridor Phase 3

CR - Fleet Sizing and O&M Estimate

Item			Comments
			peak
Travel/Track Miles of Line	30.90	30.90	headway
Stations:			15
* Surface	see total ----------	5	on each line
Operating Times:			
* 1-way run, minutes	*46.1*		
* 2-way cycle, minutes	**92**		average cycle
Vehicle Fleet:			
* Trains in service (peak)	9	9	combined - 15' peak headways (H)
Pass Cars (2 or 3-car consist)	23	23	
* Cars in service (peak)	23	23	
* Fleet		28	In service + 20% spares
Train & Car Hrs & Miles:			
* Train Hours:			
- Peak	28		
- Off-Peak	14		
- Total	42	42	
* Car Hrs per day:			
- Peak	70	70	
- Off-Peak	28	28	
- Crush	0	-	
- Total	98	98	
* Car miles per day	3,892	3,892	
* Peak Train miles per day	1,112		
* Off-Peak Train miles per day	556		
* Total Train miles per day	1,668		
* Annualization:			300 equivalent weekdays/year
- Car Hours	29,400	29,400	
- Car Miles	1,167,529	1,167,529	
O&M Cost Estimates:			
* Rev. Veh Hrs @ $487.64		$ 14.3	$ millions
* Rev Veh Mi @ $16.81		$ 19.6	$ millions
* ROW Lease @ $6.00/train mile		$ 3.0	$ millions
*** Total Annual O&M**		**$ 20.0**	$ millions

* Total Annual O&M Cost is computed using an average of the model inputs for revenue hours and revenue miles, plus the cost of lease track rights.

Light Rail Transit Estimated Costs
(Ballasted Track)

Item	Units	Avg. Unit Cost	Amount	*Bell Road*	*Amount*	*Camelback Road*	*Amount*	*Chandler Boulevard*
Alignment Breakdown								
Surface (Median)	linear ft			142,848		102,321		81,596
Surface (Rail ROW, Freeway)	linear ft							
Freeway/Bridge Crossings (Locations)	linear ft			7,920		7,920		5,280
Elevated (Aerial Locations)	linear ft							
Elevated/Special (Aerial Locations)	linear ft							
Street Crossings	each							
Intersections	each			100		104		73
Signal Intersections	each			69		67		47
Basic intersection traffic mitigation	Each	$50,000				$0		$0
Intersection Modifications (Spot widening)	Each	$300,000				$0		$0
Modify/Move Traffic Signals	Sig. Intrsctn	$60,000	69	$4,140,000	67	$4,020,000	47	$2,820,000
Roadway Widening	linear ft	$250	142,848	$35,712,000	102,321	$25,580,250	81,596	$20,399,000
New at-grade crossing (in freight railway)	Each	$250,000						
Civil/Roadway Modifications (at intersections)	linear ft	$220	10,000	$2,200,000	10,400	$2,288,000	7,300	$1,606,000
Subtotal-Civil Site Mods				**$42,052,000**		**$31,888,250**		**$24,825,000**
Surface Track Embedded in Street	linear ft	$215	10,000	$2,150,000	10,400	$2,236,000	7,300	$1,569,500
Surface Track Ballast	linear ft	$128	132,848	$17,004,544	91,921	$11,765,888	74,296	$9,509,888
Dual Track Aerial	Aerial Rt Ft	$4,000	7,920	$31,680,000	7,920	$31,680,000	5,280	$21,120,000
Long Span Aerial Structures	Aerial Rt Ft	$8,000						
Subtotal-Guideway				**$50,834,544**		**$45,681,888**		**$32,199,388**
Rail Service Utilities (Elect.)	Aerial Rt Ft							
Utility Relocation	Linear ft	$900	150,768	$135,691,200	110,241	$99,216,900	86,876	$78,188,400
Subtotal-Utilities				**$135,691,200**		**$99,216,900**		**$78,188,400**
Direct Fixation Track (on structure)	linear ft	$300	7,920	$2,376,000	7,920	$2,376,000	5,280	$1,584,000
Ballast Track (at-grade)	linear ft	$310	132,848	$41,182,880	91,921	$28,495,510	74,296	$23,031,760
Embedded Track (in pavement)	linear ft	$1,100	10,000	$11,000,000	10,400	$11,440,000	7,300	$8,030,000
Subtotal-Track				**$54,558,880**		**$42,311,510**		**$32,645,760**
Surface Stations	Each	$600,000	26	$15,600,000	16	$9,600,000	15	$9,000,000
Aerial Stations	Each	$3,000,000	2	$6,000,000	3	$9,000,000	2	$6,000,000
Hub Station (surface)	Each	$1,500,000	2	$3,000,000	5	$7,500,000	2	$3,000,000
Surface Parking	Space	$2,800	2,250	$6,300,000	1,800	$5,040,000	1,425	$3,990,000
Parking Structures	Space	$9,500	2,250	$21,375,000	1,800	$17,100,000	1,425	$13,537,500
Elevated Ped Xings	Each	$1,000,000	2	$2,000,000	3	$3,000,000	2	$2,000,000
Subtotal-Stations				**$54,275,000**		**$51,240,000**		**$37,527,500**
Ticket Vending Machines	Station	$130,000	30	$3,900,000	24	$3,120,000	19	$2,470,000
Substations	Each	$1,000,000	30	$30,000,000	24	$24,000,000	19	$19,000,000
Overhead Catenary	linear ft	$140	150,768	$21,107,520	110,241	$15,433,740	86,876	$12,162,640
Catenary Foundations	linear ft	$40	142,848	$5,713,920	102,321	$4,092,840	81,596	$3,263,840
Communications/Signals	linear ft	$100	150,768	$15,076,800	110,241	$11,024,100	86,876	$8,687,600
Crossover Interlockings	Each	$550,000	14	$7,700,000	10	$5,500,000	8	$4,400,000
Duct Bank - Aerial	Aerial Rt Ft	$73	7,920	$578,160	7,920	$578,160	5,280	$385,440
Duct Bank - At Grade	linear ft	$33	142,848	$4,713,984	102,321	$3,376,593	81,596	$2,692,668
Lighting At Grade	Surfc Rt Mile	$375,000	28	$10,500,000	20	$7,500,000	17	$6,375,000
Subtotal-Sys Electrical				**$99,290,384**		**$74,625,433**		**$59,437,188**
Maintenance/Storage	Each			$10,000,000		$7,500,000		$5,000,000
Operations Control	Each			$2,500,000		$2,500,000		$2,500,000
Subtotal - Facilities				**$12,500,000**		**$10,000,000**		**$7,500,000**
A. Construction Subtotal				**$449,202,008**		**$354,963,981**		**$272,323,236**
Environmental Mitigation	Percent of A	3%		$13,476,060		$10,648,919		$8,169,697
B. Construction Cost Subtotal				**$462,678,068**		**$365,612,900**		**$280,492,933**
System Envelope	square foot	$25	3,055,504	$76,387,600	2,114,183	$52,854,575	1,708,808	$42,720,200
New Parking Spaces	square foot	$25	1,045,440	$26,136,000	836,352	$20,908,800	662,112	$16,552,800
C. Right of Way Subtotal				**$102,523,600**		**$73,763,375**		**$59,273,000**
Revenue Vehicles	Each	$3,000,000	41	$123,000,000	31	$93,000,000	17	$51,000,000
Spare Parts	Percent	10%		$12,300,000		$9,300,000		$5,100,000
MOW Equipment	Rt Mile	$250,000	29	$7,125,000	21	$5,200,000	16	$4,000,000
D. Vehicles Subtotal				**$142,425,000**		**$107,500,000**		**$60,100,000**
Cost Contingencies (Uncertainties, Changes)								
Design&Construction	Percent of B	25%		$115,669,517		$91,403,225		$70,123,233
Right of Way	Percent of C	30%		$30,757,080		$22,129,013		$17,781,900
Vehicle Cost	Percent of D	10%		$14,242,500		$10,750,000		$6,010,000
Program Implementation (Agency Costs and Fees)								
Design&Construction	Percent of B	31%		$143,430,201		$113,339,999		$86,952,809
Right of Way Purchase	Percent of C	15%		$15,378,540		$11,064,506		$8,890,950
Vehicle Procurement	Percent of D	5%		$7,121,250		$5,375,000		$3,005,000
E. Capital Cost Subtotal				**$1,034,225,756**		**$800,938,018**		**$592,629,826**
Project Reserve	Percent of E	10%		$103,422,576		$80,093,801.84		$59,262,983
F. Total Capital Cost				**$1,137,648,332**		**$881,031,820**		**$651,892,808**

Note: All costs are in Year 2001 Dollars

Light Rail Transit Estimated Costs
(Ballasted Track)

Item	Units	Avg. Unit Cost	*Amount*	*Power Road*	*Amount*	*Scottsdale Road*	*Amount*	*Glendale Ave/Cactus Ave*
Alignment Breakdown								
Surface (Median)	linear ft			66,224		137,808		64,783
Surface (Rail ROW, Freeway)	linear ft							
Freeway/Bridge Crossings (Locations)	linear ft			2,640		5,280		
Elevated (Aerial Locations)	linear ft							39,600
Elevated/Special (Aerial Locations)	linear ft					5,280		
Street Crossings	each							
Intersections	each			45		129		50
Signal Intersections	each			35		88		31
Basic intersection traffic mitigation	Each	$50,000		$0		$0		$0
Intersection Modifications (Spot widening)	Each	$300,000		$0		$0		$0
Modify/Move Traffic Signals	Sig. Intrsctn	$60,000	35	$2,100,000	88	$5,280,000	31	$1,860,000
Roadway Widening	linear ft	$250	66,224	$16,556,000	137,808	$34,452,000	64,783	$16,195,750
New at-grade crossing (in freight railway)	Each	$250,000						$0
Civil/Roadway Modifications (at intersections)	linear ft	$220	4,500	$990,000	12,900	$2,838,000	5,000	$1,100,000
Subtotal-Civil Site Mods				**$19,646,000**		**$42,570,000**		**$19,155,750**
Surface Track Embedded in Street	linear ft	$215	4,500	$967,500	12,900	$2,773,500	5,000	$1,075,000
Surface Track Ballast	linear ft	$128	61,724	$7,900,672	124,908	$15,988,224	59,783	$7,652,224
Dual Track Aerial	Aerial Rt Ft	$4,000	2,640	$10,560,000	5,280	$21,120,000	39,600	$158,400,000
Long Span Aerial Structures	Aerial Rt Ft	$8,000			5,280	$42,240,000		
Subtotal-Guideway				**$19,428,172**		**$82,121,724**		**$167,127,224**
Rail Service Utilities (Elect.)	Aerial Rt Ft							
Utility Relocation	Linear ft	$900	68,864	$61,977,600	148,368	$133,531,200	104,383	$93,944,700
Subtotal-Utilities				**$61,977,600**		**$133,531,200**		**$93,944,700**
Direct Fixation Track (on structure)	linear ft	$300	2,640	$792,000	10,560	$3,168,000	39,600	$11,880,000
Ballast Track (at-grade)	linear ft	$310	61,724	$19,134,440	124,908	$38,721,480	59,783	$18,532,730
Embedded Track (in pavement)	linear ft	$1,100	4,500	$4,950,000	12,900	$14,190,000	5,000	$5,500,000
Subtotal-Track				**$24,876,440**		**$56,079,480**		**$35,912,730**
Surface Stations	Each	$600,000	14	$8,400,000	27	$16,200,000	6	$3,600,000
Aerial Stations	Each	$3,000,000	1	$3,000,000	3	$9,000,000	5	$15,000,000
Hub Station (surface)	Each	$1,500,000	1	$1,500,000	4	$6,000,000	2	$3,000,000
Surface Parking	Space	$2,800	1,200	$3,360,000	2,550	$7,140,000	975	$2,730,000
Parking Structures	Space	$9,500	1,200	$11,400,000	2,550	$24,225,000	975	$9,262,500
Elevated Ped Xings	Each	$1,000,000	1	$1,000,000	3	$3,000,000	4	$4,000,000
Subtotal-Stations				**$28,660,000**		**$65,565,000**		**$37,592,500**
Ticket Vending Machines	Station	$130,000	16	$2,080,000	34	$4,420,000	13	$1,690,000
Substations	Each	$1,000,000	16	$16,000,000	34	$34,000,000	13	$13,000,000
Overhead Catenary	linear ft	$140	68,864	$9,640,960	148,368	$20,771,520	104,383	$14,613,620
Catenary Foundations	linear ft	$40	66,224	$2,648,960	137,808	$5,512,320	64,783	$2,591,320
Communications/Signals	linear ft	$100	68,864	$6,886,400	148,368	$14,836,800	104,383	$10,438,300
Crossover Interlockings	Each	$550,000	5	$2,750,000	15	$8,250,000	9	$4,950,000
Duct Bank - Aerial	Aerial Rt Ft	$73	2,640	$192,720	10,560	$770,880	39,600	$2,890,800
Duct Bank - At Grade	linear ft	$33	66,224	$2,185,392	137,808	$4,547,664	64,783	$2,137,839
Lighting At Grade	Surfc Rt Mile	$375,000	11	$4,125,000	31	$11,625,000	12	$4,312,500
Subtotal-Sys Electrical				**$46,509,432**		**$104,734,184**		**$56,624,379**
Maintenance/Storage	Each			$3,000,000		$11,000,000		$5,000,000
Operations Control	Each			$2,500,000		$2,500,000		$2,500,000
Subtotal - Facilities				**$5,500,000**		**$13,500,000**		**$7,500,000**
A. Construction Subtotal				**$206,597,644**		**$498,101,588**		**$417,857,283**
Environmental Mitigation	Percent of A	3%		$6,197,929		$14,943,048		$12,535,718
B. Construction Cost Subtotal				**$212,795,573**		**$513,044,636**		**$430,393,001**
System Envelope	square foot	$25	1,419,652	$35,491,300	2,872,884	$71,822,100	1,771,009	$44,275,225
New Parking Spaces	square foot	$25	557,568	$13,939,200	1,184,832	$29,620,800	453,024	$11,325,600
C. Right of Way Subtotal				**$49,430,500**		**$101,442,900**		**$55,600,825**
Revenue Vehicles	Each	$3,000,000	12	$36,000,000	46	$138,000,000	19	$57,000,000
Spare Parts	Percent	10%		$3,600,000		$13,800,000		$5,700,000
MOW Equipment	Rt Mile	$250,000	13	$3,250,000	31	$7,750,000	19	$4,750,000
D. Vehicles Subtotal				**$42,850,000**		**$159,550,000**		**$67,450,000**
Cost Contingencies (Uncertainties, Changes)								
Design&Construction	Percent of B	25%		$53,198,893		$128,261,159		$107,598,250
Right of Way	Percent of C	30%		$14,829,150		$30,432,870		$16,680,248
Vehicle Cost	Percent of D	10%		$4,285,000		$15,955,000		$6,745,000
Program Implementation (Agency Costs and Fees)								
Design&Construction	Percent of B	31%		$65,966,628		$159,043,837		$133,421,830
Right of Way Purchase	Percent of C	15%		$7,414,575		$15,216,435		$8,340,124
Vehicle Procurement	Percent of D	5%		$2,142,500		$7,977,500		$3,372,500
E. Capital Cost Subtotal				**$452,912,819**		**$1,130,924,337**		**$829,601,779**
Project Reserve	Percent of E	10%		$45,291,281.94		$113,092,434		$82,960,177.86
F. Total Capital Cost				**$498,204,101**		**$1,244,016,770**		**$912,561,956**

Note: All costs are in Year 2001 Dollars

Light Rail Transit Estimated Costs
(Ballasted Track)

Item	Units	Avg. Unit Cost	*Amount*	*SR-51*	*Amount*	*59th Avenue*	*Amount*	*I-10 West*
Alignment Breakdown								
Surface (Median)	linear ft			58,714		89,729		57,004
Surface (Rail ROW, Freeway)	linear ft							
Freeway/Bridge Crossings (Locations)	linear ft					5,280		
Elevated (Aerial Locations)	linear ft			31,680				1,340
Elevated/Special (Aerial Locations)	linear ft					5,280		
Street Crossings	each							
Intersections	each			52		106		15
Signal Intersections	each			30		54		10
Basic intersection traffic mitigation	Each	$50,000		$0		$0		$0
Intersection Modifications (Spot widening)	Each	$300,000		$0		$0		$0
Modify/Move Traffic Signals	Sig. Intrsctn	$60,000	30	$1,800,000	54	$3,240,000	10	$600,000
Roadway Widening	linear ft	$250	58,714	$14,678,500	89,729	$22,432,250	57,004	$14,251,000
New at-grade crossing (in freight railway)	Each	$250,000		$0		$0		$0
Civil/Roadway Modifications (at intersections)	linear ft	$220	5,200	$1,144,000	10,600	$2,332,000	1,500	$330,000
Subtotal-Civil Site Mods				**$17,622,500**		**$28,004,250**		**$15,181,000**
Surface Track Embedded in Street	linear ft	$215	5,200	$1,118,000	10,600	$2,279,000	3,940	$847,100
Surface Track Ballast	linear ft	$128	53,514	$6,849,792	79,129	$10,128,512	53,064	$6,792,192
Dual Track Aerial	Aerial Rt Ft	$4,000	31,680	$126,720,000	10,560	$42,240,000	1,340	$5,360,000
Long Span Aerial Structures	Aerial Rt Ft	$8,000						
Subtotal-Guideway				**$134,687,792**		**$54,647,512**		**$12,999,292**
Rail Service Utilities (Elect.)	Aerial Rt Ft							
Utility Relocation	Linear ft	$900	90,394	$81,354,600	100,289	$90,260,100	58,344	$52,509,600
Subtotal-Utilities				**$81,354,600**		**$90,260,100**		**$52,509,600**
Direct Fixation Track (on structure)	linear ft	$300	31,680	$9,504,000	10,560	$3,168,000	1,340	$402,000
Ballast Track (at-grade)	linear ft	$310	53,514	$16,589,340	79,129	$24,529,990	53,064	$16,449,840
Embedded Track (in pavement)	linear ft	$1,100	5,200	$5,720,000	10,600	$11,660,000	3,940	$4,334,000
Subtotal-Track				**$31,813,340**		**$39,357,990**		**$21,185,840**
Surface Stations	Each	$600,000	9	$5,400,000	16	$9,600,000	10	$6,000,000
Aerial Stations	Each	$3,000,000	4	$12,000,000	2	$6,000,000	0	$0
Hub Station (surface)	Each	$1,500,000	1	$1,500,000	3	$4,500,000	1	$1,500,000
Surface Parking	Space	$2,800	1,050	$2,940,000	1,575	$4,410,000	825	$2,310,000
Parking Structures	Space	$9,500	1,050	$9,975,000	1,575	$14,962,500	825	$7,837,500
Elevated Ped Xings	Each	$1,000,000	4	$4,000,000	2	$2,000,000	4	$4,000,000
Subtotal-Stations				**$35,815,000**		**$41,472,500**		**$21,647,500**
Ticket Vending Machines	Station	$130,000	15	$1,950,000	21	$2,730,000	11	$1,430,000
Substations	Each	$1,000,000	15	$15,000,000	21	$21,000,000	11	$11,000,000
Overhead Catenary	linear ft	$140	90,394	$12,655,160	100,289	$14,040,460	58,344	$8,168,160
Catenary Foundations	linear ft	$40	58,714	$2,348,560	89,729	$3,589,160	57,004	$2,280,160
Communications/Signals	linear ft	$100	90,394	$9,039,400	100,289	$10,028,900	58,344	$5,834,400
Crossover Interlockings	Each	$550,000	8	$4,400,000	9	$4,950,000	6	$3,300,000
Duct Bank - Aerial	Aerial Rt Ft	$73	31,680	$2,312,640	10,560	$770,880	1,340	$97,820
Duct Bank - At Grade	linear ft	$33	58,714	$1,937,562	89,729	$2,961,057	57,004	$1,881,132
Lighting At Grade	Surfc Rt Mile	$375,000	11	$4,125,000	19	$7,125,000	10	$3,750,000
Subtotal-Sys Electrical				**$53,768,322**		**$67,195,457**		**$37,741,672**
Maintenance/Storage	Each			$6,000,000		$5,000,000		$3,000,000
Operations Control	Each			$2,500,000		$2,500,000		$2,500,000
Subtotal - Facilities				**$8,500,000**		**$7,500,000**		**$5,500,000**
A. Construction Subtotal				**$363,561,554**		**$328,437,809**		**$166,764,904**
Environmental Mitigation	Percent of A	3%		$10,906,847		$9,853,134		$5,002,947
B. Construction Cost Subtotal				**$374,468,401**		**$338,290,943**		**$171,767,851**
System Envelope	square foot	$25	1,547,622	$38,690,550	1,819,967	$45,499,175	626,160	$15,654,000
New Parking Spaces	square foot	$25	487,872	$12,196,800	731,808	$18,295,200	383,328	$9,583,200
C. Right of Way Subtotal				**$50,887,350**		**$63,794,375**		**$25,237,200**
Revenue Vehicles	Each	$3,000,000	26	$78,000,000	19	$57,000,000	12	$36,000,000
Spare Parts	Percent	10%		$7,800,000		$5,700,000		$3,600,000
MOW Equipment	Rt Mile	$250,000	17	$4,250,000	19	$4,750,000	11	$2,750,000
D. Vehicles Subtotal				**$90,050,000**		**$67,450,000**		**$42,350,000**
Cost Contingencies (Uncertainties, Changes)								
Design&Construction	Percent of B	25%		$93,617,100		$84,572,736		$42,941,963
Right of Way	Percent of C	30%		$15,266,205		$19,138,313		$7,571,160
Vehicle Cost	Percent of D	10%		$9,005,000		$6,745,000		$4,235,000
Program Implementation (Agency Costs and Fees)								
Design&Construction	Percent of B	31%		$116,085,204		$104,870,192		$53,248,034
Right of Way Purchase	Percent of C	15%		$7,633,103		$9,569,156		$3,785,580
Vehicle Procurement	Percent of D	5%		$4,502,500		$3,372,500		$2,117,500
E. Capital Cost Subtotal				**$761,514,862**		**$697,803,215**		**$353,254,288**
Project Reserve	Percent of E	10%		$76,151,486.25		$69,780,322		$35,325,428.77
F. Total Capital Cost				**$837,666,349**		**$767,583,537**		**$388,579,717**

Note: All costs are in Year 2001 Dollars

Light Rail Transit Estimated Costs
(Ballasted Track)

Item	Units	Avg. Unit Cost	*Amount*	*Union Pacific Chandler Branch*	*Amount*	*Union Pacific Tempe Branch*	*Amount*	*Main (Option 1)*
Alignment Breakdown								
Surface (Median)	linear ft			18,240		1,400		61,468
Surface (Rail ROW, Freeway)	linear ft			40,526		51,400		-
Freeway/Bridge Crossings (Locations)	linear ft							
Elevated (Aerial Locations)	linear ft							
Elevated/Special (Aerial Locations)	linear ft							
Street Crossings	each			24		14		-
Intersections	each			7		14		56
Signal Intersections	each			6		-		31
Basic intersection traffic mitigation	Each	$50,000		$0		$0		$0
Intersection Modifications (Spot widening)	Each	$300,000		$0		$0		$0
Modify/Move Traffic Signals	Sig. Intrsctn	$60,000	6	$360,000	0	$0	31	$1,860,000
Roadway Widening	linear ft	$250	18,240	$4,560,000	1,400	$350,000	61,468	$15,367,000
New at-grade crossing (in freight railway)	Each	$250,000	2	$500,000	3	$750,000	0	$0
Civil/Roadway Modifications (at intersections)	linear ft	$220	3,100	$682,000	2,800	$616,000	5,600	$1,232,000
Subtotal-Civil Site Mods				**$6,102,000**		**$1,716,000**		**$18,459,000**
Surface Track Embedded in Street	linear ft	$215	18,240	$3,921,600	1,400	$301,000	5,600	$1,204,000
Surface Track Ballast	linear ft	$128	40,526	$5,187,328	51,400	$6,579,200	55,868	$7,151,104
Dual Track Aerial	Aerial Rt Ft	$4,000	0	$0	0	$0	0	$0
Long Span Aerial Structures	Aerial Rt Ft	$8,000		$0		$0		$0
Subtotal-Guideway				**$9,108,928**		**$6,880,200**		**$8,355,104**
Rail Service Utilities (Elect.)	Aerial Rt Ft							
Utility Relocation	Linear ft	$900	58,766	$52,889,400	52,800	$47,520,000	61,468	$55,321,200
Subtotal-Utilities				**$52,889,400**		**$47,520,000**		**$55,321,200**
Direct Fixation Track (on structure)	linear ft	$300	0	$0	0	$0	0	$0
Ballast Track (at-grade)	linear ft	$310	40,526	$12,563,060	51,400	$15,934,000	55,868	$17,319,080
Embedded Track (in pavement)	linear ft	$1,100	18,240	$20,064,000	1,400	$1,540,000	5,600	$6,160,000
Subtotal-Track				**$32,627,060**		**$17,474,000**		**$23,479,080**
Surface Stations	Each	$600,000	14	$8,400,000	9	$5,400,000	11	$6,600,000
Aerial Stations	Each	$3,000,000	0	$0	0	$0	0	$0
Hub Station (surface)	Each	$1,500,000	3	$4,500,000	1	$1,500,000	1	$1,500,000
Surface Parking	Space	$2,800	1,275	$3,570,000	750	$2,100,000	900	$2,520,000
Parking Structures	Space	$9,500	1,275	$12,112,500	750	$7,125,000	900	$8,550,000
Elevated Ped Xings	Each	$1,000,000	0	$0	0	$0	0	$0
Subtotal-Stations				**$28,582,500**		**$16,125,000**		**$19,170,000**
Ticket Vending Machines	Station	$130,000	17	$2,210,000	9	$1,170,000	12	$1,560,000
Substations	Each	$1,000,000	17	$17,000,000	9	$9,000,000	12	$12,000,000
Overhead Catenary	linear ft	$140	58,766	$8,227,240	52,800	$7,392,000	61,468	$8,605,520
Catenary Foundations	linear ft	$40	58,766	$2,350,640	52,800	$2,112,000	61,468	$2,458,720
Communications/Signals	linear ft	$100	58,766	$5,876,600	52,800	$5,280,000	61,468	$6,146,800
Crossover Interlockings	Each	$550,000	6	$3,300,000	5	$2,750,000	6	$3,300,000
Duct Bank - Aerial	Aerial Rt Ft	$73	0	$0	0	$0	0	$0
Duct Bank - At Grade	linear ft	$33	58,766	$1,939,278	52,800	$1,742,400	61,468	$2,028,444
Lighting At Grade	Surfc Rt Mile	$375,000	12	$4,500,000	10	$3,750,000	12	$4,500,000
Subtotal-Sys Electrical				**$45,403,758**		**$33,196,400**		**$40,599,484**
Maintenance/Storage	Each			$5,500,000		$3,000,000		$5,000,000
Operations Control	Each			$2,500,000		$2,500,000		$2,500,000
Subtotal - Facilities				**$8,000,000**		**$5,500,000**		**$7,500,000**
A. Construction Subtotal				**$182,713,646**		**$128,411,600**		**$172,883,868**
Environmental Mitigation	Percent of A	3%		$5,481,409		$3,852,348		$5,186,516
B. Construction Cost Subtotal				**$188,195,055**		**$132,263,948**		**$178,070,384**
System Envelope	square foot	$25	1,335,518	$33,387,950	1,182,200	$29,555,000	1,284,964	$32,124,100
New Parking Spaces	square foot	$25	592,416	$14,810,400	348,480	$8,712,000	418,176	$10,454,400
C. Right of Way Subtotal				**$48,198,350**		**$38,267,000**		**$42,578,500**
Revenue Vehicles	Each	$3,000,000	22	$66,000,000	12	$36,000,000	19	$57,000,000
Spare Parts	Percent	10%		$6,600,000		$3,600,000		$5,700,000
MOW Equipment	Rt Mile	$250,000	14	$3,407,500	10	$2,500,000	12	$3,000,000
D. Vehicles Subtotal				**$76,007,500**		**$42,100,000**		**$65,700,000**
Cost Contingencies (Uncertainties, Changes)								
Design&Construction	Percent of B	25%		$47,048,764		$33,065,987		$44,517,596
Right of Way	Percent of C	30%		$14,459,505		$11,480,100		$12,773,550
Vehicle Cost	Percent of D	10%		$7,600,750		$4,210,000		$6,570,000
Program Implementation (Agency Costs and Fees)								
Design&Construction	Percent of B	31%		$58,340,467		$41,001,824		$55,201,819
Right of Way Purchase	Percent of C	15%		$7,229,753		$5,740,050		$6,386,775
Vehicle Procurement	Percent of D	5%		$3,800,375		$2,105,000		$3,285,000
E. Capital Cost Subtotal				**$450,880,519**		**$310,233,909**		**$415,083,624**
Project Reserve	Percent of E	10%		$45,088,052		$31,023,390.89		$41,508,362
F. Total Capital Cost				**$495,968,571**		**$341,257,300**		**$456,591,987**

Note: All costs are in Year 2001 Dollars

Light Rail Transit Estimated Costs
(Ballasted Track)

Item	Units	Avg. Unit Cost	*Amount*	*Main (Option 2)*	*Amount*	*Northern Avenue east of Grand*	*Amount*	*Northern Avenue west of Grand*
Alignment Breakdown								
Surface (Median)	linear ft			45,628		24,871		62,827
Surface (Rail ROW, Freeway)	linear ft			-		-		-
Freeway/Bridge Crossings (Locations)	linear ft					5,280		5,280
Elevated (Aerial Locations)	linear ft							
Elevated/Special (Aerial Locations)	linear ft							
Street Crossings	each			-		-		-
Intersections	each			43		35		18
Signal Intersections	each			25		21		15
Basic intersection traffic mitigation	Each	$50,000		$0		$0		$0
Intersection Modifications (Spot widening)	Each	$300,000		$0		$0		$0
Modify/Move Traffic Signals	Sig. Intrsctn	$60,000	25	$1,500,000	21	$1,260,000	15	$900,000
Roadway Widening	linear ft	$250	45,628	$11,407,000	24,871	$6,217,750	62,827	$15,706,750
New at-grade crossing (in freight railway)	Each	$250,000	0	$0	0	$0	0	$0
Civil/Roadway Modifications (at intersections)	linear ft	$220	4,300	$946,000	3,500	$770,000	1,800	$396,000
Subtotal-Civil Site Mods				**$13,853,000**		**$8,247,750**		**$17,002,750**
Surface Track Embedded in Street	linear ft	$215	4,300	$924,500	3,500	$752,500	1,800	$387,000
Surface Track Ballast	linear ft	$128	41,328	$5,289,984	21,371	$2,735,488	61,027	$7,811,456
Dual Track Aerial	Aerial Rt Ft	$4,000	0	$0	5,280	$21,120,000	5,280	$21,120,000
Long Span Aerial Structures	Aerial Rt Ft	$8,000		$0		$0		$0
Subtotal-Guideway				**$6,214,484**		**$24,607,988**		**$29,318,456**
Rail Service Utilities (Elect.)	Aerial Rt Ft							
Utility Relocation	Linear ft	$900	45,628	$41,065,200	30,151	$27,135,900	68,107	$61,296,300
Subtotal-Utilities				**$41,065,200**		**$27,135,900**		**$61,296,300**
Direct Fixation Track (on structure)	linear ft	$300	0	$0	5,280	$1,584,000	5,280	$1,584,000
Ballast Track (at-grade)	linear ft	$310	41,328	$12,811,680	21,371	$6,625,010	61,027	$18,918,370
Embedded Track (in pavement)	linear ft	$1,100	4,300	$4,730,000	3,500	$3,850,000	1,800	$1,980,000
Subtotal-Track				**$17,541,680**		**$12,059,010**		**$22,482,370**
Surface Stations	Each	$600,000	9	$5,400,000	5	$3,000,000	9	$5,400,000
Aerial Stations	Each	$3,000,000	0	$0	0	$0	1	$3,000,000
Hub Station (surface)	Each	$1,500,000	1	$1,500,000	0	$0	0	$0
Surface Parking	Space	$2,800	750	$2,100,000	375	$1,050,000	750	$2,100,000
Parking Structures	Space	$9,500	750	$7,125,000	375	$3,562,500	750	$7,125,000
Elevated Ped Xings	Each	$1,000,000	0	$0	0	$0	1	$1,000,000
Subtotal-Stations				**$16,125,000**		**$7,612,500**		**$18,625,000**
Ticket Vending Machines	Station	$130,000	10	$1,300,000	5	$650,000	10	$1,300,000
Substations	Each	$1,000,000	10	$10,000,000	5	$5,000,000	10	$10,000,000
Overhead Catenary	linear ft	$140	45,628	$6,387,920	30,151	$4,221,140	68,107	$9,534,980
Catenary Foundations	linear ft	$40	45,628	$1,825,120	24,871	$994,840	62,827	$2,513,080
Communications/Signals	linear ft	$100	45,628	$4,562,800	30,151	$3,015,100	68,107	$6,810,700
Crossover Interlockings	Each	$550,000	4	$2,200,000	2	$1,100,000	6	$3,300,000
Duct Bank - Aerial	Aerial Rt Ft	$73	0	$0	5,280	$385,440	5,280	$385,440
Duct Bank - At Grade	linear ft	$33	45,628	$1,505,724	24,871	$820,743	62,827	$2,073,291
Lighting At Grade	Surfc Rt Mile	$375,000	9	$3,375,000	5	$1,875,000	12	$4,500,000
Subtotal-Sys Electrical				**$31,156,564**		**$18,062,263**		**$40,417,491**
Maintenance/Storage	Each			$4,500,000		$2,500,000		$3,500,000
Operations Control	Each			$2,500,000		$1,000,000		$1,000,000
Subtotal - Facilities				**$7,000,000**		**$3,500,000**		**$4,500,000**
A. Construction Subtotal				**$132,955,928**		**$101,225,411**		**$193,642,367**
Environmental Mitigation	Percent of A	3%		$3,988,678		$3,036,762		$5,809,271
B. Construction Cost Subtotal				**$136,944,606**		**$104,262,173**		**$199,451,638**
System Envelope	square foot	$25	950,544	$23,763,600	491,533	$12,288,325	1,403,621	$35,090,525
New Parking Spaces	square foot	$25	348,480	$8,712,000	174,240	$4,356,000	348,480	$8,712,000
C. Right of Way Subtotal				**$32,475,600**		**$16,644,325**		**$43,802,525**
Revenue Vehicles	Each	$3,000,000	17	$51,000,000	10	$30,000,000	14	$42,000,000
Spare Parts	Percent	10%		$5,100,000		$3,000,000		$4,200,000
MOW Equipment	Rt Mile	$250,000	9	$2,160,000	5	$1,312,500	13	$3,225,000
D. Vehicles Subtotal				**$58,260,000**		**$34,312,500**		**$49,425,000**
Cost Contingencies (Uncertainties, Changes)								
Design&Construction	Percent of B	25%		$34,236,151		$26,065,543		$49,862,910
Right of Way	Percent of C	30%		$9,742,680		$4,993,298		$13,140,758
Vehicle Cost	Percent of D	10%		$5,826,000		$3,431,250		$4,942,500
Program Implementation (Agency Costs and Fees)								
Design&Construction	Percent of B	31%		$42,452,828		$32,321,274		$61,830,008
Right of Way Purchase	Percent of C	15%		$4,871,340		$2,496,649		$6,570,379
Vehicle Procurement	Percent of D	5%		$2,913,000		$1,715,625		$2,471,250
E. Capital Cost Subtotal				**$327,722,205**		**$226,242,637**		**$431,496,967**
Project Reserve	Percent of E	10%		$32,772,221		$22,624,263.66		$43,149,696.65
F. Total Capital Cost				**$360,494,426**		**$248,866,900**		**$474,646,663**

Note: All costs are in Year 2001 Dollars

Light Rail Transit Estimated Costs
(Ballasted Track)

Item	Units	Avg. Unit Cost	*Amount*	*Baseline Road*	*Amount*	*Metrocenter*
Alignment Breakdown						
Surface (Median)	linear ft			63,096		24,156
Surface (Rail ROW, Freeway)	linear ft			-		-
Freeway/Bridge Crossings (Locations)	linear ft			5,280		-
Elevated (Aerial Locations)	linear ft					2,640
Elevated/Special (Aerial Locations)	linear ft					
Street Crossings	each			-		-
Intersections	each			49		7
Signal Intersections	each			29		4
Basic intersection traffic mitigation	Each	$50,000		$0		$0
Intersection Modifications (Spot widening)	Each	$300,000		$0		$0
Modify/Move Traffic Signals	Sig. Intrsctn	$60,000	29	$1,740,000	4	$240,000
Roadway Widening	linear ft	$250	63,096	$15,774,000	24,156	$6,039,000
New at-grade crossing (in freight railway)	Each	$250,000	0	$0	0	$0
Civil/Roadway Modifications (at intersections)	linear ft	$220	4,900	$1,078,000	700	$154,000
Subtotal-Civil Site Mods				**$18,592,000**		**$6,433,000**
Surface Track Embedded in Street	linear ft	$215	4,900	$1,053,500	700	$150,500
Surface Track Ballast	linear ft	$128	58,196	$7,449,088	23,456	$3,002,368
Dual Track Aerial	Aerial Rt Ft	$4,000	5,280	$21,120,000	2,640	$10,560,000
Long Span Aerial Structures	Aerial Rt Ft	$8,000		$0		$0
Subtotal-Guideway				**$29,622,588**		**$13,712,868**
Rail Service Utilities (Elect.)	Aerial Rt Ft					
Utility Relocation	Linear ft	$900	68,376	$61,538,400	26,796	$24,116,400
Subtotal-Utilities				**$61,538,400**		**$24,116,400**
Direct Fixation Track (on structure)	linear ft	$300	5,280	$1,584,000	2,640	$792,000
Ballast Track (at-grade)	linear ft	$310	58,196	$18,040,760	23,456	$7,271,360
Embedded Track (in pavement)	linear ft	$1,100	4,900	$5,390,000	700	$770,000
Subtotal-Track				**$25,014,760**		**$8,833,360**
Surface Stations	Each	$600,000	9	$5,400,000	4	$2,400,000
Aerial Stations	Each	$3,000,000	1	$3,000,000	1	$3,000,000
Hub Station (surface)	Each	$1,500,000	0	$0	0	$0
Surface Parking	Space	$2,800	750	$2,100,000	375	$1,050,000
Parking Structures	Space	$9,500	750	$7,125,000	375	$3,562,500
Elevated Ped Xings	Each	$1,000,000	1	$1,000,000	1	$1,000,000
Subtotal-Stations				**$18,625,000**		**$11,012,500**
Ticket Vending Machines	Station	$130,000	10	$1,300,000	5	$650,000
Substations	Each	$1,000,000	10	$10,000,000	5	$5,000,000
Overhead Catenary	linear ft	$140	68,376	$9,572,640	26,796	$3,751,440
Catenary Foundations	linear ft	$40	63,096	$2,523,840	24,156	$966,240
Communications/Signals	linear ft	$100	68,376	$6,837,600	26,796	$2,679,600
Crossover Interlockings	Each	$550,000	7	$3,850,000	1	$550,000
Duct Bank - Aerial	Aerial Rt Ft	$73	5,280	$385,440	2,640	$192,720
Duct Bank - At Grade	linear ft	$33	63,096	$2,082,168	24,156	$797,148
Lighting At Grade	Surfc Rt Mile	$375,000	13	$4,875,000	5	$1,875,000
Subtotal-Sys Electrical				**$41,426,688**		**$16,462,148**
Maintenance/Storage	Each			$3,500,000		$2,500,000
Operations Control	Each			$2,500,000		$1,000,000
Subtotal - Facilities				**$6,000,000**		**$3,500,000**
A. Construction Subtotal				**$200,819,436**		**$84,070,276**
Environmental Mitigation	Percent of A	3%		$6,024,583		$2,522,108
B. Construction Cost Subtotal				**$206,844,019**		**$86,592,384**
System Envelope	square foot	$25	1,338,508	$33,462,700	565,888	$14,147,200
New Parking Spaces	square foot	$25	348,480	$8,712,000	139,392	$3,484,800
C. Right of Way Subtotal				**$42,174,700**		**$17,632,000**
Revenue Vehicles	Each	$3,000,000	14	$42,000,000	10	$30,000,000
Spare Parts	Percent	10%		$4,200,000		$3,000,000
MOW Equipment	Rt Mile	$250,000	13	$3,250,000	5	$1,250,000
D. Vehicles Subtotal				**$49,450,000**		**$34,250,000**
Cost Contingencies (Uncertainties, Changes)						
Design&Construction	Percent of B	25%		$51,711,005		$21,648,096
Right of Way	Percent of C	30%		$12,652,410		$5,289,600
Vehicle Cost	Percent of D	10%		$4,945,000		$3,425,000
Program Implementation (Agency Costs and Fees)						
Design&Construction	Percent of B	31%		$64,121,646		$26,843,639
Right of Way Purchase	Percent of C	15%		$6,326,205		$2,644,800
Vehicle Procurement	Percent of D	5%		$2,472,500		$1,712,500
E. Capital Cost Subtotal				**$440,697,485**		**$200,038,019**
Project Reserve	Percent of E	10%		$44,069,748.48		$20,003,801.95
F. Total Capital Cost				**$484,767,233**		**$220,041,821**

Note: All costs are in Year 2001 Dollars

Light Rail Transit Estimated Costs
(Embedded Track)

Item	Units	Avg. Unit Cost	*Amount*	*Bell Road*	*Amount*	*Camelback Road*	*Amount*	*Chandler Boulevard*
Alignment Breakdown								
Surface (Median)	linear ft			142,848		102,321		81,596
Surface (Rail ROW, Freeway)	linear ft							
Freeway/Bridge Crossings (Locations)	linear ft			7,920		7,920		5,280
Elevated (Aerial Locations)	linear ft							
Elevated/Special (Aerial Locations)	linear ft							
Street Crossings	each							
Intersections	each			100		104		73
Signal Intersections	each			69		67		47
Basic intersection traffic mitigation	Each	$50,000				$0		$0
Intersection Modifications (Spot widening)	Each	$300,000				$0		$0
Modify/Move Traffic Signals	Sig. Intrsctn	$60,000	69	$4,140,000	67	$4,020,000	47	$2,820,000
Roadway Widening	linear ft	$250	142,848	$35,712,000	102,321	$25,580,250	81,596	$20,399,000
New at-grade crossing (in freight railway)	Each	$250,000						
Civil/Roadway Modifications (at intersections)	linear ft	$220	10,000	$2,200,000	10,400	$2,288,000	7,300	$1,606,000
Subtotal-Civil Site Mods				**$42,052,000**		**$31,888,250**		**$24,825,000**
Surface Track Embedded in Street	linear ft	$215	142,848	$30,712,320	102,321	$21,999,015	81,596	$17,543,140
Surface Track Ballast	linear ft	$128	0	$0	0	$0	0	$0
Dual Track Aerial	Aerial Rt Ft	$4,000	7,920	$31,680,000	7,920	$31,680,000	5,280	$21,120,000
Long Span Aerial Structures	Aerial Rt Ft	$8,000						
Subtotal-Guideway				**$62,392,320**		**$53,679,015**		**$38,663,140**
Rail Service Utilities (Elect.)	Aerial Rt Ft							
Utility Relocation	Linear ft	$900	150,768	$135,691,200	110,241	$99,216,900	86,876	$78,188,400
Subtotal-Utilities				**$135,691,200**		**$99,216,900**		**$78,188,400**
Direct Fixation Track (on structure)	linear ft	$300	7,920	$2,376,000	7,920	$2,376,000	5,280	$1,584,000
Ballast Track (at-grade)	linear ft	$310	0	$0	0	$0	0	$0
Embedded Track (in pavement)	linear ft	$1,100	142,848	$157,132,800	102,321	$112,553,100	81,596	$89,755,600
Subtotal-Track				**$159,508,800**		**$114,929,100**		**$91,339,600**
Surface Stations	Each	$600,000	26	$15,600,000	16	$9,600,000	15	$9,000,000
Aerial Stations	Each	$3,000,000	2	$6,000,000	3	$9,000,000	2	$6,000,000
Hub Station (surface)	Each	$1,500,000	2	$3,000,000	5	$7,500,000	2	$3,000,000
Surface Parking	Space	$2,800	2,250	$6,300,000	1,800	$5,040,000	1,425	$3,990,000
Parking Structures	Space	$9,500	2,250	$21,375,000	1,800	$17,100,000	1,425	$13,537,500
Elevated Ped Xings	Each	$1,000,000	2	$2,000,000	3	$3,000,000	2	$2,000,000
Subtotal-Stations				**$54,275,000**		**$51,240,000**		**$37,527,500**
Ticket Vending Machines	Station	$130,000	30	$3,900,000	24	$3,120,000	19	$2,470,000
Substations	Each	$1,000,000	30	$30,000,000	24	$24,000,000	19	$19,000,000
Overhead Catenary	linear ft	$140	150,768	$21,107,520	110,241	$15,433,740	86,876	$12,162,640
Catenary Foundations	linear ft	$40	142,848	$5,713,920	102,321	$4,092,840	81,596	$3,263,840
Communications/Signals	linear ft	$100	150,768	$15,076,800	110,241	$11,024,100	86,876	$8,687,600
Crossover Interlockings	Each	$550,000	14	$7,700,000	10	$5,500,000	8	$4,400,000
Duct Bank - Aerial	Aerial Rt Ft	$73	7,920	$578,160	7,920	$578,160	5,280	$385,440
Duct Bank - At Grade	linear ft	$33	142,848	$4,713,984	102,321	$3,376,593	81,596	$2,692,668
Lighting At Grade	Surfc Rt Mile	$375,000	28	$10,500,000	20	$7,500,000	17	$6,375,000
Subtotal-Sys Electrical				**$99,290,384**		**$74,625,433**		**$59,437,188**
Maintenance/Storage	Each			$10,000,000		$7,500,000		$5,000,000
Operations Control	Each			$2,500,000		$2,500,000		$2,500,000
Subtotal - Facilities				**$12,500,000**		**$10,000,000**		**$7,500,000**
A. Construction Subtotal				**$565,709,704**		**$435,578,698**		**$337,480,828**
Environmental Mitigation	Percent of A	3%		$16,971,291		$13,067,361		$10,124,425
B. Construction Cost Subtotal				**$582,680,995**		**$448,646,059**		**$347,605,253**
System Envelope	square foot	$25	3,055,504	$76,387,600	2,114,183	$52,854,575	1,708,808	$42,720,200
New Parking Spaces	square foot	$25	1,045,440	$26,136,000	836,352	$20,908,800	662,112	$16,552,800
C. Right of Way Subtotal				**$102,523,600**		**$73,763,375**		**$59,273,000**
Revenue Vehicles	Each	$3,000,000	41	$123,000,000	31	$93,000,000	17	$51,000,000
Spare Parts	Percent	10%		$12,300,000		$9,300,000		$5,100,000
MOW Equipment	Rt Mile	$250,000	31	$7,750,000	19	$4,750,000	19	$4,750,000
D. Vehicles Subtotal				**$143,050,000**		**$107,050,000**		**$60,850,000**
Cost Contingencies (Uncertainties, Changes)								
Design&Construction	Percent of B	25%		$145,670,249		$112,161,515		$86,901,313
Right of Way	Percent of C	30%		$30,757,080		$22,129,013		$17,781,900
Vehicle Cost	Percent of D	10%		$14,305,000		$10,705,000		$6,085,000
Program Implementation (Agency Costs and Fees)								
Design&Construction	Percent of B	31%		$180,631,108		$139,080,278		$107,757,628
Right of Way Purchase	Percent of C	15%		$15,378,540		$11,064,506		$8,890,950
Vehicle Procurement	Percent of D	5%		$7,152,500		$5,352,500		$3,042,500
E. Capital Cost Subtotal				**$1,222,149,072**		**$929,952,246**		**$698,187,544**
Project Reserve	Percent of E	10%		$122,214,907		$92,995,224.57		$69,818,754
F. Total Capital Cost				**$1,344,363,980**		**$1,022,947,470**		**$768,006,299**

Note: All costs are in Year 2001 Dollars

Light Rail Transit Estimated Costs
(Embedded Track)

Item	Units	*Amount*	*Power Road*	*Amount*	*Scottsdale Road*	*Amount*	*Glendale Ave/Cactus Ave*
Alignment Breakdown							
Surface (Median)	linear ft		66,224		137,808		64,783
Surface (Rail ROW, Freeway)	linear ft						
Freeway/Bridge Crossings (Locations)	linear ft		2,640		5,280		
Elevated (Aerial Locations)	linear ft						39,600
Elevated/Special (Aerial Locations)	linear ft				5,280		
Street Crossings	each						
Intersections	each		45		129		50
Signal Intersections	each		33		88		31
Basic intersection traffic mitigation	Each		$0		$0		$0
Intersection Modifications (Spot widening)	Each		$0		$0		$0
Modify/Move Traffic Signals	Sig. Intrsctn	33	$1,980,000	88	$5,280,000	31	$1,860,000
Roadway Widening	linear ft	66,224	$16,556,000	137,808	$34,452,000	64,783	$16,195,750
New at-grade crossing (in freight railway)	Each						$0
Civil/Roadway Modifications (at intersections)	linear ft	4,500	$990,000	12,900	$2,838,000	5,000	$1,100,000
Subtotal-Civil Site Mods			**$19,526,000**		**$42,570,000**		**$19,155,750**
Surface Track Embedded in Street	linear ft	66,224	$14,238,160	137,808	$29,628,720	64,783	$13,928,345
Surface Track Ballast	linear ft	0	$0	0	$0	0	$0
Dual Track Aerial	Aerial Rt Ft	2,640	$10,560,000	5,280	$21,120,000	39,600	$158,400,000
Long Span Aerial Structures	Aerial Rt Ft			5,280	$42,240,000		
Subtotal-Guideway			**$24,798,160**		**$92,988,720**		**$172,328,345**
Rail Service Utilities (Elect.)	Aerial Rt Ft						
Utility Relocation	Linear ft	68,864	$61,977,600	148,368	$133,531,200	104,383	$93,944,700
Subtotal-Utilities			**$61,977,600**		**$133,531,200**		**$93,944,700**
Direct Fixation Track (on structure)	linear ft	2,640	$792,000	10,560	$3,168,000	39,600	$11,880,000
Ballast Track (at-grade)	linear ft	0	$0	0	$0	0	$0
Embedded Track (in pavement)	linear ft	66,224	$72,846,400	137,808	$151,588,800	64,783	$71,261,300
Subtotal-Track			**$73,638,400**		**$154,756,800**		**$83,141,300**
Surface Stations	Each	14	$8,400,000	27	$16,200,000	6	$3,600,000
Aerial Stations	Each	1	$3,000,000	3	$9,000,000	5	$15,000,000
Hub Station (surface)	Each	1	$1,500,000	4	$6,000,000	2	$3,000,000
Surface Parking	Space	1,200	$3,360,000	2,550	$7,140,000	975	$2,730,000
Parking Structures	Space	1,200	$11,400,000	2,550	$24,225,000	975	$9,262,500
Elevated Ped Xings	Each	1	$1,000,000	3	$3,000,000	4	$4,000,000
Subtotal-Stations			**$28,660,000**		**$65,565,000**		**$37,592,500**
Ticket Vending Machines	Station	16	$2,080,000	34	$4,420,000	13	$1,690,000
Substations	Each	16	$16,000,000	34	$34,000,000	13	$13,000,000
Overhead Catenary	linear ft	68,864	$9,640,960	148,368	$20,771,520	104,383	$14,613,620
Catenary Foundations	linear ft	66,224	$2,648,960	137,808	$5,512,320	64,783	$2,591,320
Communications/Signals	linear ft	68,864	$6,886,400	148,368	$14,836,800	104,383	$10,438,300
Crossover Interlockings	Each	5	$2,750,000	15	$8,250,000	9	$4,950,000
Duct Bank - Aerial	Aerial Rt Ft	2,640	$192,720	10,560	$770,880	39,600	$2,890,800
Duct Bank - At Grade	linear ft	66,224	$2,185,392	137,808	$4,547,664	64,783	$2,137,839
Lighting At Grade	Surfc Rt Mile	11	$4,125,000	31	$11,625,000	12	$4,312,500
Subtotal-Sys Electrical			**$46,509,432**		**$104,734,184**		**$56,624,379**
Maintenance/Storage	Each		$3,000,000		$11,000,000		$5,000,000
Operations Control	Each		$2,500,000		$2,500,000		$2,500,000
Subtotal - Facilities			**$5,500,000**		**$13,500,000**		**$7,500,000**
A. Construction Subtotal			**$260,609,592**		**$607,645,904**		**$470,286,974**
Environmental Mitigation	Percent of A		$7,818,288		$18,229,377		$14,108,609
B. Construction Cost Subtotal			**$268,427,880**		**$625,875,281**		**$484,395,583**
System Envelope	square foot	1,419,652	$35,491,300	2,872,884	$71,822,100	1,771,009	$44,275,225
New Parking Spaces	square foot	557,568	$13,939,200	1,184,832	$29,620,800	453,024	$11,325,600
C. Right of Way Subtotal			**$49,430,500**		**$101,442,900**		**$55,600,825**
Revenue Vehicles	Each	12	$36,000,000	46	$138,000,000	19	$57,000,000
Spare Parts	Percent		$3,600,000		$13,800,000		$5,700,000
MOW Equipment	Rt Mile	12	$3,000,000	31	$7,750,000	19	$4,750,000
D. Vehicles Subtotal			**$42,600,000**		**$159,550,000**		**$67,450,000**
Cost Contingencies (Uncertainties, Changes)							
Design&Construction	Percent of B		$67,106,970		$156,468,820		$121,098,896
Right of Way	Percent of C		$14,829,150		$30,432,870		$16,680,248
Vehicle Cost	Percent of D		$4,260,000		$15,955,000		$6,745,000
Program Implementation (Agency Costs and Fees)							
Design&Construction	Percent of B		$83,212,643		$194,021,337		$150,162,631
Right of Way Purchase	Percent of C		$7,414,575		$15,216,435		$8,340,124
Vehicle Procurement	Percent of D		$2,130,000		$7,977,500		$3,372,500
E. Capital Cost Subtotal			**$539,411,717**		**$1,306,940,144**		**$913,845,806**
Project Reserve	Percent of E		$53,941,171.74		$130,694,014		$91,384,580.61
F. Total Capital Cost			**$593,352,889**		**$1,437,634,158**		**$1,005,230,387**

Note: All costs are in Year 2001 Dollars

Light Rail Transit Estimated Costs
(Embedded Track)

Item	Units	*Amount*	*SR-51*	*Amount*	*59th Avenue*	*Amount*	*I-10 West*
Alignment Breakdown							
Surface (Median)	linear ft		58,714		89,729		57,004
Surface (Rail ROW, Freeway)	linear ft						
Freeway/Bridge Crossings (Locations)	linear ft				5,280		
Elevated (Aerial Locations)	linear ft		31,680				1,340
Elevated/Special (Aerial Locations)	linear ft				5,280		
Street Crossings	each						
Intersections	each		52		106		15
Signal Intersections	each		30		54		10
Basic intersection traffic mitigation	Each		$0		$0		$0
Intersection Modifications (Spot widening)	Each		$0		$0		$0
Modify/Move Traffic Signals	Sig. Intrsctn	30	$1,800,000	54	$3,240,000	10	$600,000
Roadway Widening	linear ft	58,714	$14,678,500	89,729	$22,432,250	57,004	$14,251,000
New at-grade crossing (in freight railway)	Each		$0		$0		$0
Civil/Roadway Modifications (at intersections)	linear ft	5,200	$1,144,000	10,600	$2,332,000	1,500	$330,000
Subtotal-Civil Site Mods			**$17,622,500**		**$28,004,250**		**$15,181,000**
Surface Track Embedded in Street	linear ft	58,714	$12,623,510	89,729	$19,291,735	3,940	$847,100
Surface Track Ballast	linear ft	0	$0	0	$0	53,064	$6,792,192
Dual Track Aerial	Aerial Rt Ft	31,680	$126,720,000	10,560	$42,240,000	1,340	$5,360,000
Long Span Aerial Structures	Aerial Rt Ft						
Subtotal-Guideway			**$139,343,510**		**$61,531,735**		**$12,999,292**
Rail Service Utilities (Elect.)	Aerial Rt Ft						
Utility Relocation	Linear ft	90,394	$81,354,600	100,289	$90,260,100	58,344	$52,509,600
Subtotal-Utilities			**$81,354,600**		**$90,260,100**		**$52,509,600**
Direct Fixation Track (on structure)	linear ft	31,680	$9,504,000	10,560	$3,168,000	1,340	$402,000
Ballast Track (at-grade)	linear ft	0	$0	0	$0	53,064	$16,449,840
Embedded Track (in pavement)	linear ft	58,714	$64,585,400	89,729	$98,701,900	3,940	$4,334,000
Subtotal-Track			**$74,089,400**		**$101,869,900**		**$21,185,840**
Surface Stations	Each	9	$5,400,000	16	$9,600,000	10	$6,000,000
Aerial Stations	Each	4	$12,000,000	2	$6,000,000	0	$0
Hub Station (surface)	Each	1	$1,500,000	3	$4,500,000	1	$1,500,000
Surface Parking	Space	1,050	$2,940,000	1,575	$4,410,000	825	$2,310,000
Parking Structures	Space	1,050	$9,975,000	1,575	$14,962,500	825	$7,837,500
Elevated Ped Xings	Each	4	$4,000,000	2	$2,000,000	4	$4,000,000
Subtotal-Stations			**$35,815,000**		**$41,472,500**		**$21,647,500**
Ticket Vending Machines	Station	15	$1,950,000	21	$2,730,000	11	$1,430,000
Substations	Each	15	$15,000,000	21	$21,000,000	11	$11,000,000
Overhead Catenary	linear ft	90,394	$12,655,160	100,289	$14,040,460	58,344	$8,168,160
Catenary Foundations	linear ft	58,714	$2,348,560	89,729	$3,589,160	57,004	$2,280,160
Communications/Signals	linear ft	90,394	$9,039,400	100,289	$10,028,900	58,344	$5,834,400
Crossover Interlockings	Each	8	$4,400,000	9	$4,950,000	6	$3,300,000
Duct Bank - Aerial	Aerial Rt Ft	31,680	$2,312,640	10,560	$770,880	1,340	$97,820
Duct Bank - At Grade	linear ft	58,714	$1,937,562	89,729	$2,961,057	57,004	$1,881,132
Lighting At Grade	Surfc Rt Mile	11	$4,125,000	19	$7,125,000	10	$3,750,000
Subtotal-Sys Electrical			**$53,768,322**		**$67,195,457**		**$37,741,672**
Maintenance/Storage	Each		$6,000,000		$5,000,000		$3,000,000
Operations Control	Each		$2,500,000		$2,500,000		$2,500,000
Subtotal - Facilities			**$8,500,000**		**$7,500,000**		**$5,500,000**
A. Construction Subtotal			**$410,493,332**		**$397,833,942**		**$166,764,904**
Environmental Mitigation	Percent of A		$12,314,800		$11,935,018		$5,002,947
B. Construction Cost Subtotal			**$422,808,132**		**$409,768,960**		**$171,767,851**
System Envelope	square foot	1,547,622	$38,690,550	1,819,967	$45,499,175	626,160	$15,654,000
New Parking Spaces	square foot	487,872	$12,196,800	731,808	$18,295,200	383,328	$9,583,200
C. Right of Way Subtotal			**$50,887,350**		**$63,794,375**		**$25,237,200**
Revenue Vehicles	Each	26	$78,000,000	19	$57,000,000	12	$36,000,000
Spare Parts	Percent		$7,800,000		$5,700,000		$3,600,000
MOW Equipment	Rt Mile	17	$4,250,000	19	$4,750,000	11	$2,750,000
D. Vehicles Subtotal			**$90,050,000**		**$67,450,000**		**$42,350,000**
Cost Contingencies (Uncertainties, Changes)							
Design&Construction	Percent of B		$105,702,033		$102,442,240		$42,941,963
Right of Way	Percent of C		$15,266,205		$19,138,313		$7,571,160
Vehicle Cost	Percent of D		$9,005,000		$6,745,000		$4,235,000
Program Implementation (Agency Costs and Fees)							
Design&Construction	Percent of B		$131,070,521		$127,028,378		$53,248,034
Right of Way Purchase	Percent of C		$7,633,103		$9,569,156		$3,785,580
Vehicle Procurement	Percent of D		$4,502,500		$3,372,500		$2,117,500
E. Capital Cost Subtotal			**$836,924,843**		**$809,308,922**		**$353,254,288**
Project Reserve	Percent of E		$83,692,484.34		$80,930,892		$35,325,428.77
F. Total Capital Cost			**$920,617,328**		**$890,239,814**		**$388,579,717**

Note: All costs are in Year 2001 Dollars

Light Rail Transit Estimated Costs
(Embedded Track)

Item	Units	*Amount*	*Union Pacific Chandler Branch*	*Amount*	*Union Pacific Tempe Branch*	*Amount*	*Main (Option 1)*
Alignment Breakdown							
Surface (Median)	linear ft		18,240		1,400		66,748
Surface (Rail ROW, Freeway)	linear ft		40,526		51,400		-
Freeway/Bridge Crossings (Locations)	linear ft						
Elevated (Aerial Locations)	linear ft						
Elevated/Special (Aerial Locations)	linear ft						
Street Crossings	each		24		14		-
Intersections	each		7		14		56
Signal Intersections	each		6		-		31
Basic intersection traffic mitigation	Each		$0		$0		$0
Intersection Modifications (Spot widening)	Each		$0		$0		$0
Modify/Move Traffic Signals	Sig. Intrsctn	6	$360,000	0	$0	31	$1,860,000
Roadway Widening	linear ft	18,240	$4,560,000	1,400	$350,000	66,748	$16,687,000
New at-grade crossing (in freight railway)	Each	2	$500,000	3	$750,000	0	$0
Civil/Roadway Modifications (at intersections)	linear ft	3,100	$682,000	2,800	$616,000	5,600	$1,232,000
Subtotal-Civil Site Mods			**$6,102,000**		**$1,716,000**		**$19,779,000**
Surface Track Embedded in Street	linear ft	18,240	$3,921,600	1,400	$301,000	66,748	$14,350,820
Surface Track Ballast	linear ft	40,526	$5,187,328	51,400	$6,579,200	0	$0
Dual Track Aerial	Aerial Rt Ft	0	$0	0	$0	0	$0
Long Span Aerial Structures	Aerial Rt Ft		$0		$0		$0
Subtotal-Guideway			**$9,108,928**		**$6,880,200**		**$14,350,820**
Rail Service Utilities (Elect.)	Aerial Rt Ft						
Utility Relocation	Linear ft	58,766	$52,889,400	52,800	$47,520,000	66,748	$60,073,200
Subtotal-Utilities			**$52,889,400**		**$47,520,000**		**$60,073,200**
Direct Fixation Track (on structure)	linear ft	0	$0	0	$0	0	$0
Ballast Track (at-grade)	linear ft	40,526	$12,563,060	51,400	$15,934,000	0	$0
Embedded Track (in pavement)	linear ft	18,240	$20,064,000	1,400	$1,540,000	66,748	$73,422,800
Subtotal-Track			**$32,627,060**		**$17,474,000**		**$73,422,800**
Surface Stations	Each	14	$8,400,000	9	$5,400,000	11	$6,600,000
Aerial Stations	Each	0	$0	0	$0	0	$0
Hub Station (surface)	Each	3	$4,500,000	1	$1,500,000	1	$1,500,000
Surface Parking	Space	1,275	$3,570,000	750	$2,100,000	900	$2,520,000
Parking Structures	Space	1,275	$12,112,500	750	$7,125,000	900	$8,550,000
Elevated Ped Xings	Each	0	$0	0	$0	0	$0
Subtotal-Stations			**$28,582,500**		**$16,125,000**		**$19,170,000**
Ticket Vending Machines	Station	17	$2,210,000	9	$1,170,000	12	$1,560,000
Substations	Each	17	$17,000,000	9	$9,000,000	12	$12,000,000
Overhead Catenary	linear ft	58,766	$8,227,240	52,800	$7,392,000	66,748	$9,344,720
Catenary Foundations	linear ft	58,766	$2,350,640	52,800	$2,112,000	66,748	$2,669,920
Communications/Signals	linear ft	58,766	$5,876,600	52,800	$5,280,000	66,748	$6,674,800
Crossover Interlockings	Each	6	$3,300,000	5	$2,750,000	6	$3,300,000
Duct Bank - Aerial	Aerial Rt Ft	0	$0	0	$0	0	$0
Duct Bank - At Grade	linear ft	58,766	$1,939,278	52,800	$1,742,400	66,748	$2,202,684
Lighting At Grade	Surfc Rt Mile	12	$4,500,000	10	$3,750,000	12	$4,500,000
Subtotal-Sys Electrical			**$45,403,758**		**$33,196,400**		**$42,252,124**
Maintenance/Storage	Each		$5,500,000		$3,000,000		$5,000,000
Operations Control	Each		$2,500,000		$2,500,000		$2,500,000
Subtotal - Facilities			**$8,000,000**		**$5,500,000**		**$7,500,000**
A. Construction Subtotal			**$182,713,646**		**$128,411,600**		**$236,547,944**
Environmental Mitigation	Percent of A		$5,481,409		$3,852,348		$7,096,438
B. Construction Cost Subtotal			**$188,195,055**		**$132,263,948**		**$243,644,382**
System Envelope	square foot	1,335,518	$33,387,950	1,182,200	$29,555,000	1,406,404	$35,160,100
New Parking Spaces	square foot	592,416	$14,810,400	348,480	$8,712,000	418,176	$10,454,400
C. Right of Way Subtotal			**$48,198,350**		**$38,267,000**		**$45,614,500**
Revenue Vehicles	Each	22	$66,000,000	12	$36,000,000	19	$57,000,000
Spare Parts	Percent		$6,600,000		$3,600,000		$5,700,000
MOW Equipment	Rt Mile	12	$3,000,000	10	$2,500,000	13	$3,250,000
D. Vehicles Subtotal			**$75,600,000**		**$42,100,000**		**$65,950,000**
Cost Contingencies (Uncertainties, Changes)							
Design&Construction	Percent of B		$47,048,764		$33,065,987		$60,911,096
Right of Way	Percent of C		$14,459,505		$11,480,100		$13,684,350
Vehicle Cost	Percent of D		$7,560,000		$4,210,000		$6,595,000
Program Implementation (Agency Costs and Fees)							
Design&Construction	Percent of B		$58,340,467		$41,001,824		$75,529,759
Right of Way Purchase	Percent of C		$7,229,753		$5,740,050		$6,842,175
Vehicle Procurement	Percent of D		$3,780,000		$2,105,000		$3,297,500
E. Capital Cost Subtotal			**$450,411,894**		**$310,233,909**		**$522,068,761**
Project Reserve	Percent of E		$45,041,189		$31,023,390.89		$52,206,876
F. Total Capital Cost			**$495,453,083**		**$341,257,300**		**$574,275,638**

Note: All costs are in Year 2001 Dollars

Light Rail Transit Estimated Costs
(Embedded Track)

Item	Units	*Amount*	*Main (Option 2)*	*Amount*	*Northern Avenue east of Grand*	*Amount*	*Northern Avenue west of Grand*
Alignment Breakdown							
Surface (Median)	linear ft		50,908		22,440		62,827
Surface (Rail ROW, Freeway)	linear ft		-		-		-
Freeway/Bridge Crossings (Locations)	linear ft				5,280		5,280
Elevated (Aerial Locations)	linear ft						
Elevated/Special (Aerial Locations)	linear ft						
Street Crossings	each		-		-		-
Intersections	each		43		35		18
Signal Intersections	each		25		21		15
Basic intersection traffic mitigation	Each		$0		$0		$0
Intersection Modifications (Spot widening)	Each		$0		$0		$0
Modify/Move Traffic Signals	Sig. Intrsctn	25	$1,500,000	21	$1,260,000	15	$900,000
Roadway Widening	linear ft	50,908	$12,727,000	22,440	$5,610,000	62,827	$15,706,750
New at-grade crossing (in freight railway)	Each	0	$0	0	$0	0	$0
Civil/Roadway Modifications (at intersections)	linear ft	4,300	$946,000	3,500	$770,000	1,800	$396,000
Subtotal-Civil Site Mods			**$15,173,000**		**$7,640,000**		**$17,002,750**
Surface Track Embedded in Street	linear ft	50,908	$10,945,220	22,440	$4,824,600	62,827	$13,507,805
Surface Track Ballast	linear ft	0	$0	0	$0	0	$0
Dual Track Aerial	Aerial Rt Ft	0	$0	5,280	$21,120,000	5,280	$21,120,000
Long Span Aerial Structures	Aerial Rt Ft		$0		$0		$0
Subtotal-Guideway			**$10,945,220**		**$25,944,600**		**$34,627,805**
Rail Service Utilities (Elect.)	Aerial Rt Ft						
Utility Relocation	Linear ft	50,908	$45,817,200	27,720	$24,948,000	68,107	$61,296,300
Subtotal-Utilities			**$45,817,200**		**$24,948,000**		**$61,296,300**
Direct Fixation Track (on structure)	linear ft	0	$0	5,280	$1,584,000	5,280	$1,584,000
Ballast Track (at-grade)	linear ft	0	$0	0	$0	0	$0
Embedded Track (in pavement)	linear ft	50,908	$55,998,800	22,440	$24,684,000	62,827	$69,109,700
Subtotal-Track			**$55,998,800**		**$26,268,000**		**$70,693,700**
Surface Stations	Each	9	$5,400,000	5	$3,000,000	9	$5,400,000
Aerial Stations	Each	0	$0	0	$0	1	$3,000,000
Hub Station (surface)	Each	1	$1,500,000	0	$0	0	$0
Surface Parking	Space	750	$2,100,000	375	$1,050,000	675	$1,890,000
Parking Structures	Space	750	$7,125,000	375	$3,562,500	675	$6,412,500
Elevated Ped Xings	Each	0	$0	2	$2,000,000	1	$1,000,000
Subtotal-Stations			**$16,125,000**		**$9,612,500**		**$17,702,500**
Ticket Vending Machines	Station	10	$1,300,000	5	$650,000	10	$1,300,000
Substations	Each	10	$10,000,000	5	$5,000,000	10	$10,000,000
Overhead Catenary	linear ft	50,908	$7,127,120	27,720	$3,880,800	68,107	$9,534,980
Catenary Foundations	linear ft	50,908	$2,036,320	22,440	$897,600	62,827	$2,513,080
Communications/Signals	linear ft	50,908	$5,090,800	27,720	$2,772,000	68,107	$6,810,700
Crossover Interlockings	Each	4	$2,200,000	2	$1,100,000	6	$3,300,000
Duct Bank - Aerial	Aerial Rt Ft	0	$0	5,280	$385,440	5,280	$385,440
Duct Bank - At Grade	linear ft	50,908	$1,679,964	22,440	$740,520	62,827	$2,073,291
Lighting At Grade	Surfc Rt Mile	9	$3,375,000	5	$1,875,000	13	$4,837,500
Subtotal-Sys Electrical			**$32,809,204**		**$17,301,360**		**$40,754,991**
Maintenance/Storage	Each		$4,500,000		$2,500,000		$3,500,000
Operations Control	Each		$2,500,000		$1,000,000		$1,000,000
Subtotal - Facilities			**$7,000,000**		**$3,500,000**		**$4,500,000**
A. Construction Subtotal			**$183,868,424**		**$115,214,460**		**$246,578,046**
Environmental Mitigation	Percent of A		$5,516,053		$3,456,434		$7,397,341
B. Construction Cost Subtotal			**$189,384,477**		**$118,670,894**		**$253,975,387**
System Envelope	square foot	1,071,984	$26,799,600	435,620	$10,890,500	1,403,621	$35,090,525
New Parking Spaces	square foot	348,480	$8,712,000	174,240	$4,356,000	348,480	$8,712,000
C. Right of Way Subtotal			**$35,511,600**		**$15,246,500**		**$43,802,525**
Revenue Vehicles	Each	17	$51,000,000	10	$30,000,000	14	$42,000,000
Spare Parts	Percent		$5,100,000		$3,000,000		$4,200,000
MOW Equipment	Rt Mile	10	$2,500,000	5	$1,250,000	13	$3,225,000
D. Vehicles Subtotal			**$58,600,000**		**$34,250,000**		**$49,425,000**
Cost Contingencies (Uncertainties, Changes)							
Design&Construction	Percent of B		$47,346,119		$29,667,723		$63,493,847
Right of Way	Percent of C		$10,653,480		$4,573,950		$13,140,758
Vehicle Cost	Percent of D		$5,860,000		$3,425,000		$4,942,500
Program Implementation (Agency Costs and Fees)							
Design&Construction	Percent of B		$58,709,188		$36,787,977		$78,732,370
Right of Way Purchase	Percent of C		$5,326,740		$2,286,975		$6,570,379
Vehicle Procurement	Percent of D		$2,930,000		$1,712,500		$2,471,250
E. Capital Cost Subtotal			**$414,321,604**		**$246,621,519**		**$516,554,016**
Project Reserve	Percent of E		$41,432,160		$24,662,151.93		$51,655,401.56
F. Total Capital Cost			**$455,753,764**		**$271,283,671**		**$568,209,417**

Note: All costs are in Year 2001 Dollars

Light Rail Transit Estimated Costs
(Embedded Track)

Item	Units	*Amount*	*Baseline Road*	*Amount*	*Metrocenter*
Alignment Breakdown					
Surface (Median)	linear ft		63,096		24,156
Surface (Rail ROW, Freeway)	linear ft		-		-
Freeway/Bridge Crossings (Locations)	linear ft		5,280		-
Elevated (Aerial Locations)	linear ft				2,640
Elevated/Special (Aerial Locations)	linear ft				
Street Crossings	each		-		-
Intersections	each		49		7
Signal Intersections	each		29		4
Basic intersection traffic mitigation	Each		$0		$0
Intersection Modifications (Spot widening)	Each		$0		$0
Modify/Move Traffic Signals	Sig. Intrsctn	29	$1,740,000	4	$240,000
Roadway Widening	linear ft	63,096	$15,774,000	24,156	$6,039,000
New at-grade crossing (in freight railway)	Each	0	$0	0	$0
Civil/Roadway Modifications (at intersections)	linear ft	4,900	$1,078,000	700	$154,000
Subtotal-Civil Site Mods			**$18,592,000**		**$6,433,000**
Surface Track Embedded in Street	linear ft	63,096	$13,565,640	24,156	$5,193,540
Surface Track Ballast	linear ft	0	$0	0	$0
Dual Track Aerial	Aerial Rt Ft	5,280	$21,120,000	2,640	$10,560,000
Long Span Aerial Structures	Aerial Rt Ft		$0		$0
Subtotal-Guideway			**$34,685,640**		**$15,753,540**
Rail Service Utilities (Elect.)	Aerial Rt Ft				
Utility Relocation	Linear ft	68,376	$61,538,400	26,796	$24,116,400
Subtotal-Utilities			**$61,538,400**		**$24,116,400**
Direct Fixation Track (on structure)	linear ft	5,280	$1,584,000	2,640	$792,000
Ballast Track (at-grade)	linear ft	0	$0	0	$0
Embedded Track (in pavement)	linear ft	63,096	$69,405,600	24,156	$26,571,600
Subtotal-Track			**$70,989,600**		**$27,363,600**
Surface Stations	Each	9	$5,400,000	4	$2,400,000
Aerial Stations	Each	1	$3,000,000	1	$3,000,000
Hub Station (surface)	Each	0	$0	0	$0
Surface Parking	Space	750	$2,100,000	375	$1,050,000
Parking Structures	Space	750	$7,125,000	375	$3,562,500
Elevated Ped Xings	Each	1	$1,000,000	1	$1,000,000
Subtotal-Stations			**$18,625,000**		**$11,012,500**
Ticket Vending Machines	Station	10	$1,300,000	5	$650,000
Substations	Each	10	$10,000,000	5	$5,000,000
Overhead Catenary	linear ft	68,376	$9,572,640	26,796	$3,751,440
Catenary Foundations	linear ft	63,096	$2,523,840	24,156	$966,240
Communications/Signals	linear ft	68,376	$6,837,600	26,796	$2,679,600
Crossover Interlockings	Each	7	$3,850,000	1	$550,000
Duct Bank - Aerial	Aerial Rt Ft	5,280	$385,440	2,640	$192,720
Duct Bank - At Grade	linear ft	63,096	$2,082,168	24,156	$797,148
Lighting At Grade	Surfc Rt Mile	13	$4,875,000	5	$1,875,000
Subtotal-Sys Electrical			**$41,426,688**		**$16,462,148**
Maintenance/Storage	Each		$3,500,000		$2,500,000
Operations Control	Each		$2,500,000		$1,000,000
Subtotal - Facilities			**$6,000,000**		**$3,500,000**
A. Construction Subtotal			**$251,857,328**		**$104,641,188**
Environmental Mitigation	Percent of A		$7,555,720		$3,139,236
B. Construction Cost Subtotal			**$259,413,048**		**$107,780,424**
System Envelope	square foot	1,338,508	$33,462,700	565,888	$14,147,200
New Parking Spaces	square foot	348,480	$8,712,000	139,392	$3,484,800
C. Right of Way Subtotal			**$42,174,700**		**$17,632,000**
Revenue Vehicles	Each	14	$42,000,000	10	$30,000,000
Spare Parts	Percent		$4,200,000		$3,000,000
MOW Equipment	Rt Mile	13	$3,250,000	5	$1,250,000
D. Vehicles Subtotal			**$49,450,000**		**$34,250,000**
Cost Contingencies (Uncertainties, Changes)					
Design&Construction	Percent of B		$64,853,262		$26,945,106
Right of Way	Percent of C		$12,652,410		$5,289,600
Vehicle Cost	Percent of D		$4,945,000		$3,425,000
Program Implementation (Agency Costs and Fees)					
Design&Construction	Percent of B		$80,418,045		$33,411,931
Right of Way Purchase	Percent of C		$6,326,205		$2,644,800
Vehicle Procurement	Percent of D		$2,472,500		$1,712,500
E. Capital Cost Subtotal			**$522,705,170**		**$233,091,361**
Project Reserve	Percent of E		$52,270,516.96		$23,309,136.09
F. Total Capital Cost			**$574,975,687**		**$256,400,497**

Note: All costs are in Year 2001 Dollars

59th Avenue

LRT - Fleet Sizing and O&M Estimate

Item			Comments	peak headway
Travel/Track Miles of Line	18.99	18.99	For branches, miles = travel	
Stations:			distance; not additive	15
* Surface	see total ----------	19		on each line
* Aerial	see total ----------	2		
Operating Times:				
* 1-way run, minutes	*51.8*		Baseline to Bell, average NB/SB	
Round trip w/o recovery (min)	104		excluding turn-around time at ends of line	
* 2-way cycle, minutes	**115**		average cycle	
Vehicle Fleet:				
* Trains in service (peak)	8	8	combined - 15' peak headways (H)	
LRTs (Basic 2-car consist)	16	16		
* Cars in service (peak)	16	16		
* Fleet		19	In service + 20% spares	
Train & Car Hrs & Miles:				
* Train Hours:				
- Daily	104	104	7 hr @ 15' H, 12 hr @ 30' H	
* Car Hrs per day:				
- Base	104	104	Single cars, 19 hrs/day	
- Peak	104	104	*2nd car, 19 hrs/day*	
- Total	208	208		
* *Schedule* speed, mph	19.8		Includes dwell and recovery times	
* Car miles per day	4,118	4,118		
* Annualization:			300 equivalent weekdays/year	
- Car Hours	62,400	62,400		
- Car Miles	1,235,400	1,235,400		
O&M Cost Estimates:				
* Rev. Veh Hrs @ $67		$ 4.2	$ millions	
* Rev Veh Mi @ $2.09		$ 2.6	$ millions	
* Peak Veh @ $147000		$ 2.4	$ millions	
* Line Mi @ $82000		$ 1.6	$ millions	
* Pass Stations @ $26000		$ 0.55	$ millions	
*** Total Annual O&M**		**$ 11.3**	$ millions	

Baseline Road
LRT - Fleet Sizing and O&M Estimate

Item			Comments
			peak
Travel/Track Miles of Line	12.95	12.95	For branches, miles = travel distance; not additive — headway 15
Stations:			
* Surface	see total ----------	9	on each line
* Aerial	see total ----------	1	
Operating Times:			
* 1-way run, minutes	*35.3*		51st Ave to Tempe Lead, average WB/EB
Round trip w/o recovery (min)	71		excluding turn-around time at ends of line
* 2-way cycle, minutes	**81**		average cycle
Vehicle Fleet:			
* Trains in service (peak)	6	6	combined - 15' peak headways (H)
LRTs (Basic 2-car consist)	12	12	
* Cars in service (peak)	12	12	
* Fleet		14	In service + 20% spares
Train & Car Hrs & Miles:			
* Train Hours:			
- Daily	78	78	7 hr @ 15' H, 12 hr @ 30' H
* Car Hrs per day:			
- Base	78	78	Single cars, 19 hrs/day
- Peak	78	78	*2nd car, 19 hrs/day*
- Total	156	156	
* *Schedule* speed, mph	19.3		Includes dwell and recovery times
* Car miles per day	3,011	3,011	
* Annualization:			300 equivalent weekdays/year
- Car Hours	46,800	46,800	
- Car Miles	903,300	903,300	
O&M Cost Estimates:			
* Rev. Veh Hrs @ $67		$ 3.1	$ millions
* Rev Veh Mi @ $2.09		$ 1.9	$ millions
* Peak Veh @ $147000		$ 1.8	$ millions
* Line Mi @ $82000		$ 1.1	$ millions
* Pass Stations @ $26000		$ 0.26	$ millions
* **Total Annual O&M**		**$ 8.2**	$ millions

Bell Road

LRT - Fleet Sizing and O&M Estimate

Item			Comments
			peak
Travel/Track Miles of Line	28.55	28.55	headway
Stations:			10
* Surface	see total ----------	28	on each line
* Aerial	see total ----------	2	
Operating Times:			
* 1-way run, minutes	*77.9*		Scottsdale to Loop 303, average WB/EB
Round trip w/o recovery (min)	156		excluding turn-around time at ends of line
* 2-way cycle, minutes	**170**		average cycle
Vehicle Fleet:			
* Trains in service (peak)	17	17	combined - 10' peak headways (H)
LRTs (Basic 2-car consist)	34	34	
* Cars in service (peak)	34	34	
* Fleet		41	In service + 20% spares
Train & Car Hrs & Miles:			
* Train Hours:			
- Daily	221	221	7 hr @ 10' H, 12 hr @ 20' H
* Car Hrs per day:			
- Base	221	221	Single cars, 19 hrs/day
- Peak	221	221	*2nd car, 19 hrs/day*
- Total	442	442	
* *Schedule* speed, mph	20.2		Includes dwell and recovery times
* Car miles per day	8,928	8,928	
* Annualization:			300 equivalent weekdays/year
- Car Hours	132,600	132,600	
- Car Miles	2,678,400	2,678,400	
O&M Cost Estimates:			
* Rev. Veh Hrs @ $67		$ 8.9	$ millions
* Rev Veh Mi @ $2.09		$ 5.6	$ millions
* Peak Veh @ $147000		$ 5.0	$ millions
* Line Mi @ $82000		$ 2.3	$ millions
* Pass Stations @ $26000		$ 0.78	$ millions
*** Total Annual O&M**		**$ 22.6**	$ millions

Camelback Road
LRT - Fleet Sizing and O&M Estimate

Item			Comments
Travel/Track Miles of Line	20.88	20.88	For branches, miles = travel distance; not additive
Stations:			
* Surface	see total ----------	21	
* Aerial	see total ----------	3	
Operating Times:			
* 1-way run, minutes	*56.9*		Scottsdale to Loop 101, average WB/EB
Round trip w/o recovery (min)	114		excluding turn-around time at ends of line
* 2-way cycle, minutes	**125**		average cycle
Vehicle Fleet:			
* Trains in service (peak)	13	13	combined - 10' peak headways (H)
LRTs (Basic 2-car consist)	26	26	
* Cars in service (peak)	26	26	
* Fleet		31	In service + 20% spares
Train & Car Hrs & Miles:			
* Train Hours:			
- Daily	169	169	7 hr @ 10' H, 12 hr @ 20' H
* Car Hrs per day:			
- Base	169	169	Single cars, 19 hrs/day
- Peak	169	169	*2nd car, 19 hrs/day*
- Total	338	338	
* *Schedule* speed, mph	20		Includes dwell and recovery times
* Car miles per day	6,760	6,760	
* Annualization:			300 equivalent weekdays/year
- Car Hours	101,400	101,400	
- Car Miles	2,028,000	2,028,000	
O&M Cost Estimates:			
* Rev. Veh Hrs @ $67		$ 6.8	$ millions
* Rev Veh Mi @ $2.09		$ 4.2	$ millions
* Peak Veh @ $147000		$ 3.8	$ millions
* Line Mi @ $82000		$ 1.7	$ millions
* Pass Stations @ $26000		$ 0.62	$ millions
* **Total Annual O&M**		**$ 17.1**	$ millions

peak headway **10** on each line

Chandler Boulevard

LRT - Fleet Sizing and O&M Estimate

Item			Comments	
				peak
Travel/Track Miles of Line	16.45	16.45	For branches, miles = travel	headway
Stations:			distance; not additive	**15**
* Surface	see total ----------	17		on each line
* Aerial	see total ----------	2		
Operating Times:				
* 1-way run, minutes	*44.9*		Ray Road to Power Road, average WB/EB	
Round trip w/o recovery (min)	90		excluding turn-around time at ends of line	
* 2-way cycle, minutes	**100**		average cycle	
Vehicle Fleet:				
* Trains in service (peak)	7	7	combined - 15' peak headways (H)	
LRTs (Basic 2-car consist)	14	14		
* Cars in service (peak)	14	14		
* Fleet		17	In service + 20% spares	
Train & Car Hrs & Miles:				
* Train Hours:				
- Daily	91	91	7 hr @ 15' H, 12 hr @ 30' H	
* Car Hrs per day:				
- Base	91	91	Single cars, 19 hrs/day	
- Peak	91	91	*2nd car, 19 hrs/day*	
- Total	182	182		
* *Schedule* speed, mph	19.7		Includes dwell and recovery times	
* Car miles per day	3,585	3,585		
* Annualization:			300 equivalent weekdays/year	
- Car Hours	54,600	54,600		
- Car Miles	1,075,500	1,075,500		
O&M Cost Estimates:				
* Rev. Veh Hrs @ $67		$ 3.7	$ millions	
* Rev Veh Mi @ $2.09		$ 2.2	$ millions	
* Peak Veh @ $147000		$ 2.1	$ millions	
* Line Mi @ $82000		$ 1.3	$ millions	
* Pass Stations @ $26000		$ 0.49	$ millions	
*** Total Annual O&M**		**$ 9.8**	$ millions	

Union Pacific Chandler Branch
LRT - Fleet Sizing and O&M Estimate

Item			Comments	
				peak
Travel/Track Miles of Line	11.13	11.13	For branches, miles = travel	headway
Stations:			distance; not additive	10
* Surface	see total ----------	17		on each line
* Aerial	see total ----------	-		
Operating Times:				
* 1-way run, minutes	*30.4*		Price to Baseline, average NB/SB	
Round trip w/o recovery (min)	61		excluding turn-around time at ends of line	
* 2-way cycle, minutes	**71**		average cycle	
Vehicle Fleet:				
* Trains in service (peak)	8	8	combined - 10' peak headways (H)	
LRTs (Basic 2-car consist)	16	16		
* Cars in service (peak)	16	16		
* Fleet		19	In service + 20% spares	
Train & Car Hrs & Miles:				
* Train Hours:				
- Daily	104	104	7 hr @ 10' H, 12 hr @ 20' H	
* Car Hrs per day:				
- Base	104	104	Single cars, 19 hrs/day	
- Peak	104	104	*2nd car, 19 hrs/day*	
- Total	208	208		
* *Schedule* speed, mph	18.9		Includes dwell and recovery times	
* Car miles per day	3,931	3,931		
* Annualization:			300 equivalent weekdays/year	
- Car Hours	62,400	62,400		
- Car Miles	1,179,300	1,179,300		
O&M Cost Estimates:				
* Rev. Veh Hrs @ $67		$ 4.2	$ millions	
* Rev Veh Mi @ $2.09		$ 2.5	$ millions	
* Peak Veh @ $147000		$ 2.4	$ millions	
* Line Mi @ $82000		$ 0.9	$ millions	
* Pass Stations @ $26000		$ 0.44	$ millions	
*** Total Annual O&M**		**$ 10.4**	$ millions	

Glendale Avenue/Cactus Avenue
LRT - Fleet Sizing and O&M Estimate

Item			Comments
			peak headway
Travel/Track Miles of Line	19.77	19.77	For branches, miles = travel distance; not additive — 15
Stations:			on each line
* Surface	see total ----------	8	
* Aerial	see total ----------	5	
Operating Times:			
* 1-way run, minutes	*53.9*		Glendale/19th to Bell/Scottsdale, average WB/EB
Round trip w/o recovery (min)	108		excluding turn-around time at ends of line
* 2-way cycle, minutes	**120**		average cycle
Vehicle Fleet:			
* Trains in service (peak)	8	8	combined - 15' peak headways (H)
LRTs (Basic 2-car consist)	16	16	
* Cars in service (peak)	16	16	
* Fleet		19	In service + 20% spares
Train & Car Hrs & Miles:			
* Train Hours:			
- Daily	104	104	7 hr @ 15' H, 12 hr @ 30' H
* Car Hrs per day:			
- Base	104	104	Single cars, 19 hrs/day
- Peak	104	104	*2nd car, 19 hrs/day*
- Total	208	208	
* *Schedule* speed, mph	19.8		Includes dwell and recovery times
* Car miles per day	4,118	4,118	
* Annualization:			300 equivalent weekdays/year
- Car Hours	62,400	62,400	
- Car Miles	1,235,400	1,235,400	
O&M Cost Estimates:			
* Rev. Veh Hrs @ $67		$ 4.2	$ millions
* Rev Veh Mi @ $2.09		$ 2.6	$ millions
* Peak Veh @ $147000		$ 2.4	$ millions
* Line Mi @ $82000		$ 1.6	$ millions
* Pass Stations @ $26000		$ 0.34	$ millions
* **Total Annual O&M**		**$ 11.1**	$ millions

I-10 West

LRT - Fleet Sizing and O&M Estimate

Item			Comments	
				peak
Travel/Track Miles of Line	11.05	11.05	For branches, miles = travel	headway
Stations:			distance; not additive	15
* Surface	see total ----------	2		on each line
* Aerial	see total ----------	9		
Operating Times:				
* 1-way run, minutes	*30.1*		Central to Loop 101 W, average WB/EB	
Round trip w/o recovery (min)	60		excluding turn-around time at ends of line	
* 2-way cycle, minutes	**70**		average cycle	
Vehicle Fleet:				
* Trains in service (peak)	5	5	combined - 15' peak headways (H)	
LRTs (Basic 2-car consist)	10	10		
* Cars in service (peak)	10	10		
* Fleet		12	In service + 20% spares	
Train & Car Hrs & Miles:				
* Train Hours:				
- Daily	65	65	7 hr @ 15' H, 12 hr @ 30' H	
* Car Hrs per day:				
- Base	65	65	Single cars, 19 hrs/day	
- Peak	65	65	*2nd car, 19 hrs/day*	
- Total	130	130		
* *Schedule* speed, mph	18.9		Includes dwell and recovery times	
* Car miles per day	2,457	2,457		
* Annualization:			300 equivalent weekdays/year	
- Car Hours	39,000	39,000		
- Car Miles	737,100	737,100		
O&M Cost Estimates:				
* Rev. Veh Hrs @ $67		$ 2.6	$ millions	
* Rev Veh Mi @ $2.09		$ 1.5	$ millions	
* Peak Veh @ $147000		$ 1.5	$ millions	
* Line Mi @ $82000		$ 0.9	$ millions	
* Pass Stations @ $26000		$ 0.29	$ millions	
*** Total Annual O&M**		**$ 6.8**	$ millions	

Main Street (Option 1)
LRT - Fleet Sizing and O&M Estimate

Item			Comments
			peak
Travel/Track Miles of Line	12.64	12.64	For branches, miles = travel headway
Stations:			distance; not additive 10
* Surface	see total ----------	12	on each line
* Aerial	see total ----------	-	
Operating Times:			
* 1-way run, minutes	*34.5*		Alma School TO Ellsworth/Loop 202, average WB/EB
Round trip w/o recovery (min)	69		excluding turn-around time at ends of line
* 2-way cycle, minutes	**79**		average cycle
Vehicle Fleet:			
* Trains in service (peak)	8	8	combined - 10' peak headways (H)
LRTs (Basic 2-car consist)	16	16	
* Cars in service (peak)	16	16	
* Fleet		19	In service + 20% spares
Train & Car Hrs & Miles:			
* Train Hours:			
- Daily	104	104	7 hr @ 10' H, 12 hr @ 20' H
* Car Hrs per day:			
- Base	104	104	Single cars, 19 hrs/day
- Peak	104	104	*2nd car, 19 hrs/day*
- Total	208	208	
* *Schedule* speed, mph	19.2		Includes dwell and recovery times
* Car miles per day	3,994	3,994	
* Annualization:			300 equivalent weekdays/year
- Car Hours	62,400	62,400	
- Car Miles	1,198,200	1,198,200	
O&M Cost Estimates:			
* Rev. Veh Hrs @ $67		$ 4.2	$ millions
* Rev Veh Mi @ $2.09		$ 2.5	$ millions
* Peak Veh @ $147000		$ 2.4	$ millions
* Line Mi @ $82000		$ 1.0	$ millions
* Pass Stations @ $26000		$ 0.31	$ millions
* **Total Annual O&M**		**$ 10.4**	$ millions

Main Street (Option 2)
LRT - Fleet Sizing and O&M Estimate

Item			Comments
			peak headway
Travel/Track Miles of Line	9.64	9.64	For branches, miles = travel distance; not additive
Stations:			10
* Surface	see total ----------	10	on each line
* Aerial	see total ----------	-	
Operating Times:			
* 1-way run, minutes	*26.3*		Alma School to Power, average WB/EB
Round trip w/o recovery (min)	53		excluding turn-around time at ends of line
* 2-way cycle, minutes	**63**		average cycle
Vehicle Fleet:			
* Trains in service (peak)	7	7	combined - 10' peak headways (H)
LRTs (Basic 2-car consist)	14	14	
* Cars in service (peak)	14	14	
* Fleet		17	In service + 20% spares
Train & Car Hrs & Miles:			
* Train Hours:			
- Daily	91	91	7 hr @ 10' H, 12 hr @ 20' H
* Car Hrs per day:			
- Base	91	91	Single cars, 19 hrs/day
- Peak	91	91	*2nd car, 19 hrs/day*
- Total	182	182	
* *Schedule* speed, mph	18.5		Includes dwell and recovery times
* Car miles per day	3,367	3,367	
* Annualization:			300 equivalent weekdays/year
- Car Hours	54,600	54,600	
- Car Miles	1,010,100	1,010,100	
O&M Cost Estimates:			
* Rev. Veh Hrs @ $67		$ 3.7	$ millions
* Rev Veh Mi @ $2.09		$ 2.1	$ millions
* Peak Veh @ $147000		$ 2.1	$ millions
* Line Mi @ $82000		$ 0.8	$ millions
* Pass Stas @ $26000		$ 0.26	$ millions
*** Total Annual O&M**		**$ 9.0**	$ millions

Metrocenter

LRT - Fleet Sizing and O&M Estimate

Item			Comments
			peak
Travel/Track Miles of Line	5.07	5.07	For branches, miles = travel distance; not additive — headway 10
Stations:			
* Surface	see total ----------	4	on each line
* Aerial	see total ----------	1	
Operating Times:			
* 1-way run, minutes	*13.8*		19th/Bethany Home to MetroCenter, average NB/SB
Round trip w/o recovery (min)	28		excluding turn-around time at ends of line
* 2-way cycle, minutes	**38**		average cycle
Vehicle Fleet:			
* Trains in service (peak)	4	4	combined - 10' peak headways (H)
LRTs (Basic 2-car consist)	8	8	
* Cars in service (peak)	8	8	
* Fleet		10	In service + 20% spares
Train & Car Hrs & Miles:			
* Train Hours:			
- Daily	52	52	7 hr @ 10' H, 12 hr @ 20' H
* Car Hrs per day:			
- Base	52	52	Single cars, 19 hrs/day
- Peak	52	52	*2nd car, 19 hrs/day*
- Total	104	104	
* *Schedule* speed, mph	16.2		Includes dwell and recovery times
* Car miles per day	1,685	1,685	
* Annualization:			300 equivalent weekdays/year
- Car Hours	31,200	31,200	
- Car Miles	505,500	505,500	
O&M Cost Estimates:			
* Rev. Veh Hrs @ $67		$ 2.1	$ millions
* Rev Veh Mi @ $2.09		$ 1.1	$ millions
* Peak Veh @ $147000		$ 1.2	$ millions
* Line Mi @ $82000		$ 0.4	$ millions
* Pass Stations @ $26000		$ 0.13	$ millions
* **Total Annual O&M**		**$ 4.9**	$ millions

Northern east of Grand Avenue

LRT - Fleet Sizing and O&M Estimate

Item			Comments	
				peak
Travel/Track Miles of Line	5.70	5.70	For branches, miles = travel	headway
Stations:			distance; not additive	10
* Surface	see total ----------	5		on each line
* Aerial	see total ----------	-		
Operating Times:				
* 1-way run, minutes	*15.5*		19th to Grand School, average WB/EB	
Round trip w/o recovery (min)	31		excluding turn-around time at ends of line	
* 2-way cycle, minutes	**41**		average cycle	
Vehicle Fleet:				
* Trains in service (peak)	5	5	combined - 10' peak headways (H)	
LRTs (Basic 2-car consist)	10	10		
* Cars in service (peak)	10	10		
* Fleet		12	In service + 20% spares	
Train & Car Hrs & Miles:				
* Train Hours:				
- Daily	65	65	7 hr @ 10' H, 12 hr @ 20' H	
* Car Hrs per day:				
- Base	65	65	Single cars, 19 hrs/day	
- Peak	65	65	*2nd car, 19 hrs/day*	
- Total	130	130		
* *Schedule* speed, mph	16.6		Includes dwell and recovery times	
* Car miles per day	2,158	2,158		
* Annualization:			300 equivalent weekdays/year	
- Car Hours	39,000	39,000		
- Car Miles	647,400	647,400		
O&M Cost Estimates:				
* Rev. Veh Hrs @ $67		$ 2.6	$ millions	
* Rev Veh Mi @ $2.09		$ 1.4	$ millions	
* Peak Veh @ $147000		$ 1.5	$ millions	
* Line Mi @ $82000		$ 0.5	$ millions	
* Pass Stations @ $26000		$ 0.13	$ millions	
*** Total Annual O&M**		**$ 6.1**	$ millions	

Northern west of Grand Avenue

LRT - Fleet Sizing and O&M Estimate

Item			Comments	
				peak
Travel/Track Miles of Line	12.89	12.89	For branches, miles = travel	headway
Stations:			distance; not additive	**15**
* Surface	see total ----------	9		on each line
* Aerial	see total ----------	1		
Operating Times:				
* 1-way run, minutes	*35.2*		19th to Grand School, average WB/EB	
Round trip w/o recovery (min)	70		excluding turn-around time at ends of line	
* 2-way cycle, minutes	**80**		average cycle	
Vehicle Fleet:				
* Trains in service (peak)	6	6	combined - 15' peak headways (H)	
LRTs (Basic 2-car consist)	12	12		
* Cars in service (peak)	12	12		
* Fleet		14	In service + 20% spares	
Train & Car Hrs & Miles:				
* Train Hours:				
- Daily	78	78	7 hr @ 15' H, 12 hr @ 30' H	
* Car Hrs per day:				
- Base	78	78	Single cars, 19 hrs/day	
- Peak	78	78	*2nd car, 19 hrs/day*	
- Total	156	156		
* *Schedule* speed, mph	19.3		Includes dwell and recovery times	
* Car miles per day	3,011	3,011		
* Annualization:			300 equivalent weekdays/year	
- Car Hours	46,800	46,800		
- Car Miles	903,300	903,300		
O&M Cost Estimates:				
* Rev. Veh Hrs @ $67		$ 3.1	$ millions	
* Rev Veh Mi @ $2.09		$ 1.9	$ millions	
* Peak Veh @ $147000		$ 1.8	$ millions	
* Line Mi @ $82000		$ 1.1	$ millions	
* Pass Stations @ $26000		$ 0.26	$ millions	
*** Total Annual O&M**		**$ 8.2**	$ millions	

Power Road

LRT - Fleet Sizing and O&M Estimate

Item			Comments	peak headway
Travel/Track Miles of Line	13.04	13.04	For branches, miles = travel	
Stations:			distance; not additive	20
* Surface	see total ----------	15		on each line
* Aerial	see total ----------	1		
Operating Times:				
* 1-way run, minutes	*35.6*		Williams Field to McDowell/Higley, average NB/SB	
Round trip w/o recovery (min)	71		excluding turn-around time at ends of line	
* 2-way cycle, minutes	**81**		average cycle	
Vehicle Fleet:				
* Trains in service (peak)	5	5	combined - 20' peak headways (H)	
LRTs (Basic 2-car consist)	10	10		
* Cars in service (peak)	10	10		
* Fleet		12	In service + 20% spares	
Train & Car Hrs & Miles:				
* Train Hours:				
- Daily	65	65	7 hr @ 20' H, 12 hr @ 40' H	
* Car Hrs per day:				
- Base	65	65	Single cars, 19 hrs/day	
- Peak	65	65	*2nd car, 19 hrs/day*	
- Total	130	130		
* *Schedule* speed, mph	19.3		Includes dwell and recovery times	
* Car miles per day	2,509	2,509		
* Annualization:			300 equivalent weekdays/year	
- Car Hours	39,000	39,000		
- Car Miles	752,700	752,700		
O&M Cost Estimates:				
* Rev. Veh Hrs @ $67		$ 2.6	$ millions	
* Rev Veh Mi @ $2.09		$ 1.6	$ millions	
* Peak Veh @ $147000		$ 1.5	$ millions	
* Line Mi @ $82000		$ 1.1	$ millions	
* Pass Stations @ $26000		$ 0.42	$ millions	
*** Total Annual O&M**		**$ 7.2**	$ millions	

Scottsdale Road

LRT - Fleet Sizing and O&M Estimate

Item			Comments	
				peak
Travel/Track Miles of Line	28.10	28.10	For branches, miles = travel	headway
Stations:			distance; not additive	10
* Surface	see total ----------	31		on each line
* Aerial	see total ----------	3		
Operating Times:				
* 1-way run, minutes	*76.6*		Price/Queen Creek to Bell, average NB/SB	
Round trip w/o recovery (min)	153		excluding turn-around time at ends of line	
* 2-way cycle, minutes	**170**		average cycle	
Vehicle Fleet:				
* Trains in service (peak)	17	17	combined - 10' peak headways (H)	
LRTs (Basic 2-car consist)	34	34		
* Cars in service (peak)	34	34		
* Fleet		41	In service + 20% spares	
Train & Car Hrs & Miles:				
* Train Hours:				
- Daily	221	221	7 hr @ 10' H, 12 hr @ 20' H	
* Car Hrs per day:				
- Base	221	221	Single cars, 19 hrs/day	
- Peak	221	221	*2nd car, 19 hrs/day*	
- Total	442	442		
* *Schedule* speed, mph	19.8		Includes dwell and recovery times	
* Car miles per day	8,752	8,752		
* Annualization:			300 equivalent weekdays/year	
- Car Hours	132,600	132,600		
- Car Miles	2,625,600	2,625,600		
O&M Cost Estimates:				
* Rev. Veh Hrs @ $67		$ 8.9	$ millions	
* Rev Veh Mi @ $2.09		$ 5.5	$ millions	
* Peak Veh @ $147000		$ 5.0	$ millions	
* Line Mi @ $82000		$ 2.3	$ millions	
* Pass Stations @ $26000		$ 0.88	$ millions	
*** Total Annual O&M**		**$ 22.6**	$ millions	

SR-51

LRT - Fleet Sizing and O&M Estimate

Item			Comments	
				peak
Travel/Track Miles of Line	17.12	17.12	For branches, miles = travel	headway
Stations:			distance; not additive	**10**
* Surface	see total ----------	10		on each line
* Aerial	see total ----------	4		
Operating Times:				
* 1-way run, minutes	*46.7*		Glendale 19th to Mayo Clinic, average NB/SB	
Round trip w/o recovery (min)	93		excluding turn-around time at ends of line	
* 2-way cycle, minutes	**105**		average cycle	
Vehicle Fleet:				
* Trains in service (peak)	11	11	combined - 10' peak headways (H)	
LRTs (Basic 2-car consist)	22	22		
* Cars in service (peak)	22	22		
* Fleet		26	In service + 20% spares	
Train & Car Hrs & Miles:				
* Train Hours:				
- Daily	143	143	7 hr @ 10' H, 12 hr @ 20' H	
* Car Hrs per day:				
- Base	143	143	Single cars, 19 hrs/day	
- Peak	143	143	*2nd car, 19 hrs/day*	
- Total	286	286		
* *Schedule* speed, mph	19.6		Includes dwell and recovery times	
* Car miles per day	5,606	5,606		
* Annualization:			300 equivalent weekdays/year	
- Car Hours	85,800	85,800		
- Car Miles	1,681,800	1,681,800		
O&M Cost Estimates:				
* Rev. Veh Hrs @ $67		$ 5.7	$ millions	
* Rev Veh Mi @ $2.09		$ 3.5	$ millions	
* Peak Veh @ $147000		$ 3.2	$ millions	
* Line Mi @ $82000		$ 1.4	$ millions	
* Pass Stations @ $26000		$ 0.36	$ millions	
*** Total Annual O&M**		**$ 14.2**	$ millions	

Union Pacific Tempe Branch
LRT - Fleet Sizing and O&M Estimate

Item			Comments	
				peak
Travel/Track Miles of Line	10.00	10.00	For branches, miles = travel	headway
Stations:			distance; not additive	**15**
* Surface	see total ----------	10		on each line
* Aerial	see total ----------	-		
Operating Times:				
* 1-way run, minutes	*27.3*		UP Mainline to Terminus, average NB/SB	
Round trip w/o recovery (min)	55		excluding turn-around time at ends of line	
* 2-way cycle, minutes	**65**		average cycle	
Vehicle Fleet:				
* Trains in service (peak)	5	5	combined - 15' peak headways (H)	
LRTs (Basic 2-car consist)	10	10		
* Cars in service (peak)	10	10		
* Fleet		12	In service + 20% spares	
Train & Car Hrs & Miles:				
* Train Hours:				
- Daily	65	65	7 hr @ 15' H, 12 hr @ 30' H	
* Car Hrs per day:				
- Base	65	65	Single cars, 19 hrs/day	
- Peak	65	65	*2nd car, 19 hrs/day*	
- Total	130	130		
* *Schedule* speed, mph	18.6		Includes dwell and recovery times	
* Car miles per day	2,418	2,418		
* Annualization:			300 equivalent weekdays/year	
- Car Hours	39,000	39,000		
- Car Miles	725,400	725,400		
O&M Cost Estimates:				
* Rev. Veh Hrs @ $67		$ 2.6	$ millions	
* Rev Veh Mi @ $2.09		$ 1.5	$ millions	
* Peak Veh @ $147000		$ 1.5	$ millions	
* Line Mi @ $82000		$ 0.8	$ millions	
* Pass Stations @ $26000		$ 0.26	$ millions	
*** Total Annual O&M**		**$ 6.7**	$ millions	

Dedicated BRT Estimated Capital Costs

Item	Units	Avg. Unit Cost	Amount	Bell Road	Amount	Camelback Road
Alignment Breakdown						
Surface (Median)	linear ft			150,769		110,241
Intersections	each			100		104
Signal Intersections	each			75		73
In Freeway						
Freeway Crossings						
Elevated	Aerial Rt Ft					
Earthwork	linear ft	$90	150,769	$13,569,210	110,241	$9,921,690
Drainage	linear ft	$60	150,769	$9,046,140	110,241	$6,614,460
Pavement	linear ft	$56	150,769	$8,443,064	110,241	$6,173,496
Road Modifications	linear ft	$40	150,769	$6,030,760	110,241	$4,409,640
Adjust Traffic Signals Light Poles	mile	$362,000	29	$10,336,814	21	$7,558,190
Signing/Striping	mile	$60,000	29	$1,713,284	21	$1,252,739
Modif. Grade Sep Crossings	each	$390,000	2	$780,000	3	$1,170,000
Subtotal-Civil/Roadway				**$49,919,272**		**$37,100,214**
Utility Relocation	linear ft	$150	150,769	$22,615,350	110,241	$16,536,150
Subtotal-Utilities				**$22,615,350**		**$16,536,150**
Surface Stations	Each	$600,000	32	$19,200,000	27	$16,200,000
Surface Parking	Space	$2,800	1,600	$4,480,000	1,350	$3,780,000
Parking Structures	Space	$9,500	1,600	$15,200,000	1,350	$12,825,000
Elevated Ped Xings	Each	$1,000,000		$0		$0
Subtotal-Stations				**$38,880,000**		**$32,805,000**
Ticket Vending Machines	Station	$130,000	32	$4,160,000	27	$3,510,000
On-Board AVL Equipment	Each Vehicle	$22,000	28	$616,000	28	$616,000
On-Board Signal Priority System	Each Vehicle	$9,000	46	$414,000	34	$306,000
Traffic Signal Priority and Intersections	Each	$20,000	75	$1,500,000	73	$1,460,000
Signals and Communication	Station	$77,000	32	$2,464,000	27	$2,079,000
Lighting At Grade	mile	$140,000	29	$3,997,663	21	$2,923,057
Subtotal-Sys El				**$13,151,663**		**$10,894,057**
Maintenance/Storage	Each			$0		$0
AVL Equipment	Lump			$800,000		$800,000
Operations Control	Each			$250,000		$250,000
Subtotal Facilities				**$1,050,000**		**$1,050,000**
A. Construction Subtotal				**$125,616,285**		**$98,385,421**
Environmental Mitigation	Percent of A	3%		$3,768,489		$2,951,563
B. Construction Cost Subtotal				**$129,384,774**		**$101,336,984**
System Envelope	square foot	$25	3,237,687	$80,942,175	2,296,343	$57,408,575
New Parking Spaces	square foot	$25	743,422	$18,585,550	627,264	$15,681,600
C. Right of Way Subtotal				**$99,527,725**		**$73,090,175**
Revenue Vehicles (40' Diesel Bus)	Each	$275,000	0	$0		$0
Revenue Vehicles (40' CNG Bus)	Each	$360,000	0	$0	0	$0
Revenue Vehicles (60' Articulated Bus)	Each	$440,000	46	$20,240,000	34	$14,960,000
Spare Parts	Percent	10%		$2,024,000		$1,496,000
D. Vehicles Subtotal				**$22,264,000**		**$16,456,000**
Cost Contingencies (Uncertainties, Changes)						
Design&Construction	Percent of B	25%		$32,346,193		$25,334,246
Right of Way	Percent of C	30%		$29,858,318		$21,927,053
Vehicle Cost	Percent of D	10%		$2,226,400		$1,645,600
Program Implementation (Agency Costs and Fees)						
Design&Construction	Percent of B	31%		$40,109,280		$31,414,465
Right of Way Purchase	Percent of C	15%		$14,929,159		$10,963,526
Vehicle Procurement	Percent of D	5%		$1,113,200		$822,800
E. Capital Cost Subtotal				**$371,759,048**		**$282,990,849**
Project Reserve	Percent of E	10%		$37,175,905		$28,299,085
F. Total Capital Cost				**$408,934,953**		**$311,289,933**

Note: All costs are in Year 2001 Dollars

Dedicated BRT Estimated Capital Costs

Item	Units	Avg. Unit Cost	Amount	Chandler Boulevard	Amount	Scottsdale Road
Alignment Breakdown						
Surface (Median)	linear ft			86,876		163,004
Intersections	each			73		129
Signal Intersections	each			51		92
In Freeway						
Freeway Crossings						
Elevated	Aerial Rt Ft					
Earthwork	linear ft	$90	86,876	$7,818,840	163,004	$14,670,360
Drainage	linear ft	$60	86,876	$5,212,560	163,004	$9,780,240
Pavement	linear ft	$56	86,876	$4,865,056	163,004	$9,128,224
Road Modifications	linear ft	$40	86,876	$3,475,040	163,004	$6,520,160
Adjust Traffic Signals Light Poles	mile	$362,000	16	$5,956,271	31	$11,175,653
Signing/Striping	mile	$60,000	16	$987,227	31	$1,852,318
Modif. Grade Sep Crossings	each	$390,000	1	$390,000	3	$1,170,000
Subtotal-Civil/Roadway				**$28,704,994**		**$54,296,955**
Utility Relocation	linear ft	$150	86,876	$13,031,400	163,004	$24,450,600
Subtotal-Utilities				**$13,031,400**		**$24,450,600**
Surface Stations	Each	$600,000	22	$13,200,000	37	$22,200,000
Surface Parking	Space	$2,800	1,100	$3,080,000	1,850	$5,180,000
Parking Structures	Space	$9,500	1,100	$10,450,000	1,850	$17,575,000
Elevated Ped Xings	Each	$1,000,000		$0		$0
Subtotal-Stations				**$26,730,000**		**$44,955,000**
Ticket Vending Machines	Station	$130,000	22	$2,860,000	37	$4,810,000
On-Board AVL Equipment	Each Vehicle	$22,000	17	$374,000	41	$902,000
On-Board Signal Priority System	Each Vehicle	$9,000	19	$171,000	49	$441,000
Traffic Signal Priority and Intersections	Each	$20,000	51	$1,020,000	92	$1,840,000
Signals and Communication	Station	$77,000	22	$1,694,000	37	$2,849,000
Lighting At Grade	mile	$140,000	16	$2,303,530	31	$4,322,076
Subtotal-Sys El				**$8,422,530**		**$15,164,076**
Maintenance/Storage	Each			$0		$0
AVL Equipment	Lump			$800,000		$800,000
Operations Control	Each			$250,000		$250,000
Subtotal Facilities				**$1,050,000**		**$1,050,000**
A. Construction Subtotal				**$77,938,925**		**$139,916,631**
Environmental Mitigation	Percent of A	3%		$2,338,168		$4,197,499
B. Construction Cost Subtotal				**$80,277,093**		**$144,114,130**
System Envelope	square foot	$25	1,830,248	$45,756,200	3,452,392	$86,309,800
New Parking Spaces	square foot	$25	511,104	$12,777,600	859,584	$21,489,600
C. Right of Way Subtotal				**$58,533,800**		**$107,799,400**
Revenue Vehicles (40' Diesel Bus)	Each	$275,000		$0		$0
Revenue Vehicles (40' CNG Bus)	Each	$360,000	0	$0	0	$0
Revenue Vehicles (60' Articulated Bus)	Each	$440,000	19	$8,360,000	49	$21,560,000
Spare Parts	Percent	10%		$836,000		$2,156,000
D. Vehicles Subtotal				**$9,196,000**		**$23,716,000**
Cost Contingencies (Uncertainties, Changes)						
Design&Construction	Percent of B	25%		$20,069,273		$36,028,532
Right of Way	Percent of C	30%		$17,560,140		$32,339,820
Vehicle Cost	Percent of D	10%		$919,600		$2,371,600
Program Implementation (Agency Costs and Fees)						
Design&Construction	Percent of B	31%		$24,885,899		$44,675,380
Right of Way Purchase	Percent of C	15%		$8,780,070		$16,169,910
Vehicle Procurement	Percent of D	5%		$459,800		$1,185,800
E. Capital Cost Subtotal				**$220,681,674**		**$408,400,573**
Project Reserve	Percent of E	10%		$22,068,167		$40,840,057
F. Total Capital Cost				**$242,749,842**		**$449,240,630**

Note: All costs are in Year 2001 Dollars

Dedicated BRT Estimated Capital Costs

Item	Units	Avg. Unit Cost	Amount	Power Road	Amount	Glendale Ave/Cactus Ave
Alignment Breakdown						
Surface (Median)	linear ft			68,864		64,783
Intersections	each			45		50
Signal Intersections	each			35		31
In Freeway						39,600
Freeway Crossings						
Elevated	Aerial Rt Ft					
Earthwork	linear ft	$90	68,864	$6,197,760	64,783	$5,830,470
Drainage	linear ft	$60	68,864	$4,131,840	64,783	$3,886,980
Pavement	linear ft	$56	68,864	$3,856,384	64,783	$3,627,848
Road Modifications	linear ft	$40	68,864	$2,754,560	64,783	$2,591,320
Adjust Traffic Signals Light Poles	mile	$362,000	13	$4,721,358	12	$4,441,562
Signing/Striping	mile	$60,000	13	$782,545	12	$736,170
Modif. Grade Sep Crossings	each	$390,000	1	$390,000	0	$0
Subtotal-Civil/Roadway				**$22,834,447**		**$21,114,350**
Utility Relocation	linear ft	$150	68,864	$10,329,600	64,783	$9,717,450
Subtotal-Utilities				**$10,329,600**		**$9,717,450**
Surface Stations	Each	$600,000	17	$10,200,000	14	$8,400,000
Surface Parking	Space	$2,800	850	$2,380,000	700	$1,960,000
Parking Structures	Space	$9,500	850	$8,075,000	700	$6,650,000
Elevated Ped Xings	Each	$1,000,000		$0		$0
Subtotal-Stations				**$20,655,000**		**$17,010,000**
Ticket Vending Machines	Station	$130,000	17	$2,210,000	14	$1,820,000
On-Board AVL Equipment	Each Vehicle	$22,000	11	$242,000	13	$286,000
On-Board Signal Priority System	Each Vehicle	$9,000	11	$99,000	31	$279,000
Traffic Signal Priority and Intersections	Each	$20,000	35	$700,000	31	$620,000
Signals and Communication	Station	$77,000	17	$1,309,000	14	$1,078,000
Lighting At Grade	mile	$140,000	13	$1,825,939	12	$1,717,731
Subtotal-Sys El				**$6,385,939**		**$5,800,731**
Maintenance/Storage	Each			$0		$0
AVL Equipment	Lump			$800,000		$800,000
Operations Control	Each			$250,000		$250,000
Subtotal Facilities				**$1,050,000**		**$1,050,000**
A. Construction Subtotal				**$61,254,986**		**$54,692,531**
Environmental Mitigation	Percent of A	3%		$1,837,650		$1,640,776
B. Construction Cost Subtotal				**$63,092,636**		**$56,333,307**
System Envelope	square foot	$25	1,480,372	$37,009,300	1,375,009	$34,375,225
New Parking Spaces	square foot	$25	394,944	$9,873,600	325,248	$8,131,200
C. Right of Way Subtotal				**$46,882,900**		**$42,506,425**
Revenue Vehicles (40' Diesel Bus)	Each	$275,000		$0		$0
Revenue Vehicles (40' CNG Bus)	Each	$360,000	0	$0	0	$0
Revenue Vehicles (60' Articulated Bus)	Each	$440,000	11	$4,840,000	31	$13,640,000
Spare Parts	Percent	10%		$484,000		$1,364,000
D. Vehicles Subtotal				**$5,324,000**		**$15,004,000**
Cost Contingencies (Uncertainties, Changes)						
Design&Construction	Percent of B	25%		$15,773,159		$14,083,327
Right of Way	Percent of C	30%		$14,064,870		$12,751,928
Vehicle Cost	Percent of D	10%		$532,400		$1,500,400
Program Implementation (Agency Costs and Fees)						
Design&Construction	Percent of B	31%		$19,558,717		$17,463,325
Right of Way Purchase	Percent of C	15%		$7,032,435		$6,375,964
Vehicle Procurement	Percent of D	5%		$266,200		$750,200
E. Capital Cost Subtotal				**$172,527,317**		**$166,768,875**
Project Reserve	Percent of E	10%		$17,252,732		$16,676,888
F. Total Capital Cost				**$189,780,049**		**$183,445,763**

Note: All costs are in Year 2001 Dollars

Dedicated BRT Estimated Capital Costs

Item	Units	Avg. Unit Cost	Amount	Union Pacific Chandler Branch	Amount	Union Pacific Tempe Branch
Alignment Breakdown						
Surface (Median)	linear ft			71,990		52,800
Intersections	each			7		14
Signal Intersections	each			23		13
In Freeway						
Freeway Crossings						
Elevated	Aerial Rt Ft					
Earthwork	linear ft	$90	71,990	$6,479,100	52,800	$4,752,000
Drainage	linear ft	$60	71,990	$4,319,400	52,800	$3,168,000
Pavement	linear ft	$56	71,990	$4,031,440	52,800	$2,956,800
Road Modifications	linear ft	$40	71,990	$2,879,600	52,800	$2,112,000
Adjust Traffic Signals Light Poles	mile	$362,000	14	$4,935,678	10	$3,620,000
Signing/Striping	mile	$60,000	14	$818,068	10	$600,000
Modif. Grade Sep Crossings	each	$390,000	0	$0	0	$0
Subtotal-Civil/Roadway				**$23,463,286**		**$17,208,800**
Utility Relocation	linear ft	$150	71,990	$10,798,500	52,800	$7,920,000
Subtotal-Utilities				**$10,798,500**		**$7,920,000**
Surface Stations	Each	$600,000	17	$10,200,000	13	$7,800,000
Surface Parking	Space	$2,800	850	$2,380,000	650	$1,820,000
Parking Structures	Space	$9,500	850	$8,075,000	650	$6,175,000
Elevated Ped Xings	Each	$1,000,000		$0		$0
Subtotal-Stations				**$20,655,000**		**$15,795,000**
Ticket Vending Machines	Station	$130,000	17	$2,210,000	13	$1,690,000
On-Board AVL Equipment	Each Vehicle	$22,000	14	$308,000	10	$220,000
On-Board Signal Priority System	Each Vehicle	$9,000	22	$198,000	17	$153,000
Traffic Signal Priority and Intersections	Each	$20,000	23	$460,000	13	$260,000
Signals and Communication	Station	$77,000	17	$1,309,000	13	$1,001,000
Lighting At Grade	mile	$140,000	14	$1,908,826	10	$1,400,000
Subtotal-Sys El				**$6,393,826**		**$4,724,000**
Maintenance/Storage	Each			$0		$0
AVL Equipment	Lump			$800,000		$800,000
Operations Control	Each			$250,000		$250,000
Subtotal Facilities				**$1,050,000**		**$1,050,000**
A. Construction Subtotal				**$62,360,612**		**$46,697,800**
Environmental Mitigation	Percent of A	3%		$1,870,818		$1,400,934
B. Construction Cost Subtotal				**$64,231,430**		**$48,098,734**
System Envelope	square foot	$25	1,639,670	$40,991,750	1,182,200	$29,555,000
New Parking Spaces	square foot	$25	394,944	$9,873,600	302,016	$7,550,400
C. Right of Way Subtotal				**$50,865,350**		**$37,105,400**
Revenue Vehicles (40' Diesel Bus)	Each	$275,000		$0		$0
Revenue Vehicles (40' CNG Bus)	Each	$360,000	0	$0	0	$0
Revenue Vehicles (60' Articulated Bus)	Each	$440,000	22	$9,680,000	17	$7,480,000
Spare Parts	Percent	10%		$968,000		$748,000
D. Vehicles Subtotal				**$10,648,000**		**$8,228,000**
Cost Contingencies (Uncertainties, Changes)						
Design&Construction	Percent of B	25%		$16,057,858		$12,024,684
Right of Way	Percent of C	30%		$15,259,605		$11,131,620
Vehicle Cost	Percent of D	10%		$1,064,800		$822,800
Program Implementation (Agency Costs and Fees)						
Design&Construction	Percent of B	31%		$19,911,743		$14,910,608
Right of Way Purchase	Percent of C	15%		$7,629,803		$5,565,810
Vehicle Procurement	Percent of D	5%		$532,400		$411,400
E. Capital Cost Subtotal				**$186,200,989**		**$138,299,055**
Project Reserve	Percent of E	10%		$18,620,099		$13,829,906
F. Total Capital Cost				**$204,821,088**		**$152,128,961**

Note: All costs are in Year 2001 Dollars

Dedicated BRT Estimated Capital Costs

Item	Units	Avg. Unit Cost	Amount	Northern west of Grand	Amount	Main (Option 1)
Alignment Breakdown						
Surface (Median)	linear ft			65,678		66,748
Intersections	each			18		56
Signal Intersections	each			15		31
In Freeway						
Freeway Crossings						
Elevated	Aerial Rt Ft					
Earthwork	linear ft	$90	65,678	$5,911,020	66,748	$6,007,320
Drainage	linear ft	$60	65,678	$3,940,680	66,748	$4,004,880
Pavement	linear ft	$56	65,678	$3,677,968	66,748	$3,737,888
Road Modifications	linear ft	$40	65,678	$2,627,120	66,748	$2,669,920
Adjust Traffic Signals Light Poles	mile	$362,000	12	$4,502,923	13	$4,576,283
Signing/Striping	mile	$60,000	12	$746,341	13	$758,500
Modif. Grade Sep Crossings	each	$390,000	1	$390,000	0	$0
Subtotal-Civil/Roadway				**$21,796,052**		**$21,754,791**
Utility Relocation	linear ft	$150	65,678	$9,851,700	66,748	$10,012,200
Subtotal-Utilities				**$9,851,700**		**$10,012,200**
Surface Stations	Each	$600,000	11	$6,600,000	15	$9,000,000
Surface Parking	Space	$2,800	550	$1,540,000	750	$2,100,000
Parking Structures	Space	$9,500	550	$5,225,000	750	$7,125,000
Elevated Ped Xings	Each	$1,000,000		$0		$0
Subtotal-Stations				**$13,365,000**		**$18,225,000**
Ticket Vending Machines	Station	$130,000	11	$1,430,000	15	$1,950,000
On-Board AVL Equipment	Each Vehicle	$22,000	11	$242,000	20	$440,000
On-Board Signal Priority System	Each Vehicle	$9,000	11	$99,000	20	$180,000
Traffic Signal Priority and Intersections	Each	$20,000	15	$300,000	31	$620,000
Signals and Communication	Station	$77,000	11	$847,000	15	$1,155,000
Lighting At Grade	mile	$140,000	12	$1,741,462	13	$1,769,833
Subtotal-Sys El				**$4,659,462**		**$6,114,833**
Maintenance/Storage	Each			$0		$0
AVL Equipment	Lump			$800,000		$800,000
Operations Control	Each			$250,000		$250,000
Subtotal Facilities				**$1,050,000**		**$1,050,000**
A. Construction Subtotal				**$50,722,215**		**$57,156,825**
Environmental Mitigation	Percent of A	3%		$1,521,666		$1,714,705
B. Construction Cost Subtotal				**$52,243,881**		**$58,871,529**
System Envelope	square foot	$25	1,469,194	$36,729,850	1,406,404	$35,160,100
New Parking Spaces	square foot	$25	255,552	$6,388,800	348,480	$8,712,000
C. Right of Way Subtotal				**$43,118,650**		**$43,872,100**
Revenue Vehicles (40' Diesel Bus)	Each	$275,000		$0		$0
Revenue Vehicles (40' CNG Bus)	Each	$360,000	0	$0	0	$0
Revenue Vehicles (60' Articulated Bus)	Each	$440,000	11	$4,840,000	20	$8,800,000
Spare Parts	Percent	10%		$484,000		$880,000
D. Vehicles Subtotal				**$5,324,000**		**$9,680,000**
Cost Contingencies (Uncertainties, Changes)						
Design&Construction	Percent of B	25%		$13,060,970		$14,717,882
Right of Way	Percent of C	30%		$12,935,595		$13,161,630
Vehicle Cost	Percent of D	10%		$532,400		$968,000
Program Implementation (Agency Costs and Fees)						
Design&Construction	Percent of B	31%		$16,195,603		$18,250,174
Right of Way Purchase	Percent of C	15%		$6,467,798		$6,580,815
Vehicle Procurement	Percent of D	5%		$266,200		$484,000
E. Capital Cost Subtotal				**$150,145,097**		**$166,586,131**
Project Reserve	Percent of E	10%		$15,014,510		$16,658,613
F. Total Capital Cost				**$165,159,606**		**$183,244,744**

Note: All costs are in Year 2001 Dollars

Dedicated BRT Estimated Capital Costs

Item	Units	Avg. Unit Cost	Amount	Main (Option 2)	Amount	Baseline Road
Alignment Breakdown						
Surface (Median)	linear ft			50,908		68,376
Intersections	each			43		49
Signal Intersections	each			25		31
In Freeway						
Freeway Crossings						
Elevated	Aerial Rt Ft					
Earthwork	linear ft	$90	50,908	$4,581,720	68,376	$6,153,840
Drainage	linear ft	$60	50,908	$3,054,480	68,376	$4,102,560
Pavement	linear ft	$56	50,908	$2,850,848	68,376	$3,829,056
Road Modifications	linear ft	$40	50,908	$2,036,320	68,376	$2,735,040
Adjust Traffic Signals Light Poles	mile	$362,000	10	$3,490,283	13	$4,687,900
Signing/Striping	mile	$60,000	10	$578,500	13	$777,000
Modif. Grade Sep Crossings	each	$390,000	0	$0	1	$390,000
Subtotal-Civil/Roadway				**$16,592,151**		**$22,675,396**
Utility Relocation	linear ft	$150	50,908	$7,636,200	68,376	$10,256,400
Subtotal-Utilities				**$7,636,200**		**$10,256,400**
Surface Stations	Each	$600,000	12	$7,200,000	16	$9,600,000
Surface Parking	Space	$2,800	600	$1,680,000	800	$2,240,000
Parking Structures	Space	$9,500	600	$5,700,000	800	$7,600,000
Elevated Ped Xings	Each	$1,000,000		$0		$0
Subtotal-Stations				**$14,580,000**		**$19,440,000**
Ticket Vending Machines	Station	$130,000	12	$1,560,000	16	$2,080,000
On-Board AVL Equipment	Each Vehicle	$22,000	16	$352,000	16	$352,000
On-Board Signal Priority System	Each Vehicle	$9,000	16	$144,000	16	$144,000
Traffic Signal Priority and Intersections	Each	$20,000	25	$500,000	31	$620,000
Signals and Communication	Station	$77,000	12	$924,000	16	$1,232,000
Lighting At Grade	mile	$140,000	10	$1,349,833	13	$1,813,000
Subtotal-Sys El				**$4,829,833**		**$6,241,000**
Maintenance/Storage	Each			$0		$0
AVL Equipment	Lump			$800,000		$800,000
Operations Control	Each			$250,000		$250,000
Subtotal Facilities				**$1,050,000**		**$1,050,000**
A. Construction Subtotal				**$44,688,185**		**$59,662,796**
Environmental Mitigation	Percent of A	3%		$1,340,646		$1,789,884
B. Construction Cost Subtotal				**$46,028,830**		**$61,452,680**
System Envelope	square foot	$25	1,071,984	$26,799,600	1,459,948	$36,498,700
New Parking Spaces	square foot	$25	278,784	$6,969,600	371,712	$9,292,800
C. Right of Way Subtotal				**$33,769,200**		**$45,791,500**
Revenue Vehicles (40' Diesel Bus)	Each	$275,000		$0		$0
Revenue Vehicles (40' CNG Bus)	Each	$360,000	0	$0	0	$0
Revenue Vehicles (60' Articulated Bus)	Each	$440,000	16	$7,040,000	16	$7,040,000
Spare Parts	Percent	10%		$704,000		$704,000
D. Vehicles Subtotal				**$7,744,000**		**$7,744,000**
Cost Contingencies (Uncertainties, Changes)						
Design&Construction	Percent of B	25%		$11,507,208		$15,363,170
Right of Way	Percent of C	30%		$10,130,760		$13,737,450
Vehicle Cost	Percent of D	10%		$774,400		$774,400
Program Implementation (Agency Costs and Fees)						
Design&Construction	Percent of B	31%		$14,268,937		$19,050,331
Right of Way Purchase	Percent of C	15%		$5,065,380		$6,868,725
Vehicle Procurement	Percent of D	5%		$387,200		$387,200
E. Capital Cost Subtotal				**$129,675,915**		**$171,169,456**
Project Reserve	Percent of E	10%		$12,967,592		$17,116,946
F. Total Capital Cost				**$142,643,507**		**$188,286,401**

Note: All costs are in Year 2001 Dollars

Dedicated BRT Estimated Capital Costs

Item	Units	Avg. Unit Cost	Amount	59th Avenue
Alignment Breakdown				
Surface (Median)	linear ft			100,289
Intersections	each			106
Signal Intersections	each			54
In Freeway				
Freeway Crossings				
Elevated	Aerial Rt Ft			
Earthwork	linear ft	$90	100,289	$9,026,010
Drainage	linear ft	$60	100,289	$6,017,340
Pavement	linear ft	$56	100,289	$5,616,184
Road Modifications	linear ft	$40	100,289	$4,011,560
Adjust Traffic Signals Light Poles	mile	$362,000	19	$6,875,875
Signing/Striping	mile	$60,000	19	$1,139,648
Modif. Grade Sep Crossings	each	$390,000	1	$390,000
Subtotal-Civil/Roadway				**$33,076,616**
Utility Relocation	linear ft	$150	100,289	$15,043,350
Subtotal-Utilities				**$15,043,350**
Surface Stations	Each	$600,000	27	$16,200,000
Surface Parking	Space	$2,800	1,350	$3,780,000
Parking Structures	Space	$9,500	1,350	$12,825,000
Elevated Ped Xings	Each	$1,000,000		$0
Subtotal-Stations				**$32,805,000**
Ticket Vending Machines	Station	$130,000	27	$3,510,000
On-Board AVL Equipment	Each Vehicle	$22,000	30	$660,000
On-Board Signal Priority System	Each Vehicle	$9,000	30	$270,000
Traffic Signal Priority and Intersections	Each	$20,000	54	$1,080,000
Signals and Communication	Station	$77,000	27	$2,079,000
Lighting At Grade	mile	$140,000	19	$2,659,178
Subtotal-Sys El				**$10,258,178**
Maintenance/Storage	Each			$0
AVL Equipment	Lump			$800,000
Operations Control	Each			$250,000
Subtotal Facilities				**$1,050,000**
A. Construction Subtotal				**$92,233,144**
Environmental Mitigation	Percent of A	3%		$2,766,994
B. Construction Cost Subtotal				**$95,000,139**
System Envelope	square foot	$25	2,062,847	$51,571,175
New Parking Spaces	square foot	$25	627,264	$15,681,600
C. Right of Way Subtotal				**$67,252,775**
Revenue Vehicles (40' Diesel Bus)	Each	$275,000		$0
Revenue Vehicles (40' CNG Bus)	Each	$360,000	0	$0
Revenue Vehicles (60' Articulated Bus)	Each	$440,000	30	$13,200,000
Spare Parts	Percent	10%		$1,320,000
D. Vehicles Subtotal				**$14,520,000**
Cost Contingencies (Uncertainties, Changes)				
Design&Construction	Percent of B	25%		$23,750,035
Right of Way	Percent of C	30%		$20,175,833
Vehicle Cost	Percent of D	10%		$1,452,000
Program Implementation (Agency Costs and Fees)				
Design&Construction	Percent of B	31%		$29,450,043
Right of Way Purchase	Percent of C	15%		$10,087,916
Vehicle Procurement	Percent of D	5%		$726,000
E. Capital Cost Subtotal				**$262,414,740**
Project Reserve	Percent of E	10%		$26,241,474
F. Total Capital Cost				**$288,656,214**

Note: All costs are in Year 2001 Dollars

Express BRT Estimated Capital Costs

Item	Amount	US-60	Amount	Loop 101 West	Amount	Loop 101 East
Alignment Breakdown						
Surface (Median)						
Signal Intersections		0		0		0
Surface Stations	4	$300,000	6	$450,000	8	$600,000
Surface Parking	600	$1,680,000	900	$2,520,000	1,200	$3,360,000
Parking Structures	600	$5,700,000	900	$8,550,000	1,200	$11,400,000
Subtotal-Stations		**$7,680,000**		**$11,520,000**		**$15,360,000**
Ticket Vending Machines	4	$520,000	6	$780,000	8	$1,040,000
On-Board AVL Equipment	0	$0	0	$0	0	$0
On-Board Signal Priority System	0	$0	0	$0	0	$0
Traffic Signal Priority and Intersections	0	$0	0	$0	0	$0
Subtotal-Sys El		**$520,000**		**$780,000**		**$1,040,000**
AVL Equipment						
Operations Control		$250,000		$250,000		$250,000
Subtotal Facilities	**$0**	**$250,000**	**$0**	**$250,000**	**$0**	**$250,000**
A. Construction Subtotal		**$8,450,000**		**$12,550,000**		**$16,650,000**
Environmental Mitigation		$253,500		$376,500		$499,500
B. Construction Cost Subtotal		**$8,703,500**		**$12,926,500**		**$17,149,500**
System Envelope						
New Parking Spaces	278,784	$6,969,600	418,176	$10,454,400	557,568	$13,939,200
C. Right of Way Subtotal		**$6,969,600**		**$10,454,400**		**$13,939,200**
Revenue Vehicles (40' Diesel Bus)		$0		$0		$0
Revenue Vehicles (40' CNG Bus)	6	$2,160,000	10	$3,600,000	11	$3,960,000
Revenue Vehicles (60' Articulated Bus)		$0		$0		$0
Spare Parts		$216,000		$360,000		$396,000
D. Vehicles Subtotal		**$2,376,000**		**$3,960,000**		**$4,356,000**
Cost Contingencies (Uncertainties, Changes)						
Design&Construction		$2,175,875		$3,231,625		$4,287,375
Right of Way		$2,090,880		$3,136,320		$4,181,760
Vehicle Cost		$237,600		$396,000		$435,600
Program Implementation (Agency Costs and Fees)						
Design&Construction		$2,698,085		$4,007,215		$5,316,345
Right of Way Purchase		$1,045,440		$1,568,160		$2,090,880
Vehicle Procurement		$118,800		$198,000		$217,800
E. Capital Cost Subtotal		**$26,415,780**		**$39,878,220**		**$51,974,460**
Project Reserve		$2,641,578		$3,987,822		$5,197,446
F. Total Capital Cost		**$29,057,358**		**$43,866,042**		**$57,171,906**
Cost per Mile		$1,614,298		$1,592,812		$1,358,003

Note: All costs are in Year 2001 Dollars

Express BRT Estimated Capital Costs

Item	Amount	Loop 202	Amount	Loop 303	Amount	I-17
Alignment Breakdown						
Surface (Median) Signal Intersections		0		0		0
Surface Stations	11	$825,000	5	$375,000	2	$150,000
Surface Parking	1,650	$4,620,000	750	$2,100,000	300	$840,000
Parking Structures	1,650	$15,675,000	750	$7,125,000	300	$2,850,000
Subtotal-Stations		**$21,120,000**		**$9,600,000**		**$3,840,000**
Ticket Vending Machines	11	$1,430,000	5	$650,000	2	$260,000
On-Board AVL Equipment	0	$0	0	$0	0	$0
On-Board Signal Priority System	0	$0	0	$0	0	$0
Traffic Signal Priority and Intersections	0	$0	0	$0	0	$0
Subtotal-Sys El		**$1,430,000**		**$650,000**		**$260,000**
AVL Equipment Operations Control		$250,000		$250,000		$250,000
Subtotal Facilities	**$0**	**$250,000**	**$0**	**$250,000**	**$0**	**$250,000**
A. Construction Subtotal		**$22,800,000**		**$10,500,000**		**$4,350,000**
Environmental Mitigation		$684,000		$315,000		$130,500
B. Construction Cost Subtotal		**$23,484,000**		**$10,815,000**		**$4,480,500**
System Envelope New Parking Spaces	766,656	$19,166,400	348,480	$8,712,000	139,392	$3,484,800
C. Right of Way Subtotal		**$19,166,400**		**$8,712,000**		**$3,484,800**
Revenue Vehicles (40' Diesel Bus)		$0		$0		$0
Revenue Vehicles (40' CNG Bus)	17	$6,120,000	5	$1,800,000	5	$1,800,000
Revenue Vehicles (60' Articulated Bus)		$0		$0		$0
Spare Parts		$612,000		$180,000		$180,000
D. Vehicles Subtotal		**$6,732,000**		**$1,980,000**		**$1,980,000**
Cost Contingencies (Uncertainties, Changes)						
Design&Construction		$5,871,000		$2,703,750		$1,120,125
Right of Way		$5,749,920		$2,613,600		$1,045,440
Vehicle Cost		$673,200		$198,000		$198,000
Program Implementation (Agency Costs and Fees)						
Design&Construction		$7,280,040		$3,352,650		$1,388,955
Right of Way Purchase		$2,874,960		$1,306,800		$522,720
Vehicle Procurement		$336,600		$99,000		$99,000
E. Capital Cost Subtotal		**$72,168,120**		**$31,780,800**		**$14,319,540**
Project Reserve		$7,216,812		$3,178,080		$1,431,954
F. Total Capital Cost		**$79,384,932**		**$34,958,880**		**$15,751,494**
Cost per Mile		$1,421,141		$1,782,707		$1,115,545

Note: All costs are in Year 2001 Dollars

Express BRT Estimated Capital Costs

Item	Amount	I-10 Far West
Alignment Breakdown		
Surface (Median)		
Signal Intersections		0
Surface Stations	2	$150,000
Surface Parking	300	$840,000
Parking Structures	300	$2,850,000
Subtotal-Stations		**$3,840,000**
Ticket Vending Machines	2	$260,000
On-Board AVL Equipment	0	$0
On-Board Signal Priority System	0	$0
Traffic Signal Priority and Intersections	0	$0
Subtotal-Sys El		**$260,000**
AVL Equipment		
Operations Control		$250,000
Subtotal Facilities	**$0**	**$250,000**
A. Construction Subtotal		**$4,350,000**
Environmental Mitigation		$130,500
B. Construction Cost Subtotal		**$4,480,500**
System Envelope		
New Parking Spaces	139,392	$3,484,800
C. Right of Way Subtotal		**$3,484,800**
Revenue Vehicles (40' Diesel Bus)		$0
Revenue Vehicles (40' CNG Bus)	4	$1,440,000
Revenue Vehicles (60' Articulated Bus)		$0
Spare Parts		$144,000
D. Vehicles Subtotal		**$1,584,000**
Cost Contingencies (Uncertainties, Changes)		
Design&Construction		$1,120,125
Right of Way		$1,045,440
Vehicle Cost		$158,400
Program Implementation (Agency Costs and Fees)		
Design&Construction		$1,388,955
Right of Way Purchase		$522,720
Vehicle Procurement		$79,200
E. Capital Cost Subtotal		**$13,864,140**
Project Reserve		$1,386,414
F. Total Capital Cost		**$15,250,554**
Cost per Mile		$1,663,092

Note: All costs are in Year 2001 Dollars

59th Avenue
BRT - Fleet Sizing and O&M Estimate

Item			Comments
			peak
Travel/Miles of Line	18.99	18.99	headway
Stations:			5
* Surface	see total ----------	27	on each line
* Aerial	see total ----------	-	
Operating Times:			
* 1-way run, minutes	*51.8*		51st Ave/Baseline to Bell, average NB/SB
Round trip w/o recovery (min)	104		excluding turn-around time at ends of line
* 2-way cycle, minutes	**124**		average cycle
Vehicle Fleet:			
* Buses in service (peak)	25	25	combined - 5' peak headways (H)
* Buses in service (off-peak)			
* Fleet		30	In service + 20% spares
Bus Hrs & Miles:			
* Bus Hours:			
- Daily	325	325	7 hr @ 5' H, 12 hr @ 10' H
* Bus Hrs per day:			
- Base	325	325	Single vehicle, 19 hrs/day
- Peak	0	-	
- Crush	-	-	
- Total	325	325	
* *Schedule* speed, mph	18.3		Includes dwell and recovery times
* Bus miles per day	5,948	5,948	
* Annualization:			300 equivalent weekdays/year
- Bus Hours	97,500	97,500	
- Bus Miles	1,784,400	1,784,400	
O&M Cost Estimates (current 2001 Valley Metro):			
* Rev. Veh Hrs @ $96.52		9.41	$ millions
* Rev Veh Mi @ $6.26		11.17	$ millions
*** Total Annual O&M**		**10.29**	$ millions

All costs in Year 2001 Dollars

Baseline Road
BRT - Fleet Sizing and O&M Estimate

Item			Comments
			peak headway
Travel/Miles of Line	12.95	12.95	7
Stations:			
* Surface	see total ----------	16	on each line
* Aerial	see total ----------	-	
Operating Times:			
* 1-way run, minutes	*35.3*		Tempe Lead to 51st Ave, average WB/EB
Round trip w/o recovery (min)	71		excluding turn-around time at ends of line
* 2-way cycle, minutes	**85**		average cycle
Vehicle Fleet:			
* Buses in service (peak)	13	13	combined - 7' peak headways (H)
* Buses in service (off-peak)			
* Fleet		16	In service + 20% spares
Bus Hrs & Miles:			
* Bus Hours:			
- Daily	169	169	7 hr @ 7' H, 12 hr @ 14' H
* Bus Hrs per day:			
- Base	169	169	Single vehicle, 19 hrs/day
- Peak	0	-	
- Crush	-	-	
- Total	169	169	
* *Schedule* speed, mph	18.3		Includes dwell and recovery times
* Bus miles per day	3,093	3,093	
* Annualization:			300 equivalent weekdays/year
- Bus Hours	50,700	50,700	
- Bus Miles	927,900	927,900	
O&M Cost Estimates (current 2001 Valley Metro):			
* Rev. Veh Hrs @ $96.52		4.89	$ millions
* Rev Veh Mi @ $6.26		5.81	$ millions
*** Total Annual O&M**		**5.35**	$ millions

All costs in Year 2001 Dollars

Bell Road

BRT - Fleet Sizing and O&M Estimate

Item			Comments
			peak
Travel/Miles of Line	28.55	28.55	headway
Stations:			5
* Surface	see total ----------	32	on each line
* Aerial	see total ----------		
Operating Times:			
* 1-way run, minutes	*77.9*		Scottsdale to Loop 303, average WB/EB
Round trip w/o recovery (min)	156		excluding turn-around time at ends of line
* 2-way cycle, minutes	**187**		average cycle
Vehicle Fleet:			
* Buses in service (peak)	38	38	combined - 5' peak headways (H)
* Fleet		46	In service + 20% spares
Bus Hrs & Miles:			
* Bus Hours:			
- Daily	494	494	7 hr @ 5' H, 12 hr @ 10' H
* Bus Hrs per day:			
- Base	494	494	Single vehicle, 19 hrs/day
- Total	494	494	
* *Schedule* speed, mph	18.3		Includes dwell and recovery times
* Bus miles per day	9,040	9,040	
* Annualization:			300 equivalent weekdays/year
- Bus Hours	148,200	148,200	
- Bus Miles	2,712,000	2,712,000	
O&M Cost Estimates (current 2001 Valley Metro):			
* Rev. Veh Hrs @ $96.52		14.30	$ millions
* Rev Veh Mi @ $6.26		16.98	$ millions
* **Total Annual O&M**		**15.64**	$ millions

All costs in Year 2001 Dollars

Camelback Road
BRT - Fleet Sizing and O&M Estimate

Item			Comments
			peak headway
Travel/Miles of Line	20.88	20.88	5
Stations:			
* Surface	see total ----------	27	on each line
* Aerial	see total ----------	-	
Operating Times:			
* 1-way run, minutes	*56.9*		Scottsdale to Loop 101, average WB/EB
Round trip w/o recovery (min)	114		excluding turn-around time at ends of line
* 2-way cycle, minutes	**137**		average cycle
Vehicle Fleet:			
* Buses in service (peak)	28	28	combined - 5' peak headways (H)
* Fleet		34	In service + 20% spares
Bus Hrs & Miles:			
* Bus Hours:			
- Daily	364	364	7 hr @ 5' H, 12 hr @ 10' H
* Bus Hrs per day:			
- Base	364	364	Single vehicle, 19 hrs/day
- Peak	0	-	
- Crush	-	-	
* *Schedule* speed, mph	18.3		Includes dwell and recovery times
* Bus miles per day	6,661	6,661	
* Annualization:			300 equivalent weekdays/year
- Bus Hours	109,200	109,200	
- Bus Miles	1,998,300	1,998,300	
O&M Cost Estimates (current 2001 Valley Metro):			
* Rev. Veh Hrs @ $96.52		10.54	$ millions
* Rev Veh Mi @ $6.26		12.51	$ millions
* **Total Annual O&M**		**11.53**	$ millions

All costs in Year 2001 Dollars

Chandler Boulevard

BRT - Fleet Sizing and O&M Estimate

Item			Comments
			peak
Travel/Miles of Line	16.45	16.45	headway
Stations:			7
* Surface	see total ----------	22	on each line
* Aerial	see total ----------	-	
Operating Times:			
* 1-way run, minutes	*44.9*		Ray to Power, average WB/EB
Round trip w/o recovery (min)	90		excluding turn-around time at ends of line
* 2-way cycle, minutes	**108**		average cycle
Vehicle Fleet:			
* Buses in service (peak)	16	16	combined - 7' peak headways (H)
* Buses in service (off-peak)			
* Fleet		19	In service + 20% spares
Bus Hrs & Miles:			
* Bus Hours:			
- Daily	208	208	7 hr @ 7' H, 12 hr @ 14' H
* Bus Hrs per day:			
- Base	208	208	Single vehicle, 19 hrs/day
- Peak	0	-	
- Crush	-	-	
- Total	208	208	
* *Schedule* speed, mph	18.3		Includes dwell and recovery times
* Bus miles per day	3,806	3,806	
* Annualization:			300 equivalent weekdays/year
- Bus Hours	62,400	62,400	
- Bus Miles	1,141,800	1,141,800	
O&M Cost Estimates (current 2001 Valley Metro):			
* Rev. Veh Hrs @ $96.52		6.02	$ millions
* Rev Veh Mi @ $6.26		7.15	$ millions
*** Total Annual O&M**		**6.59**	$ millions

All costs in Year 2001 Dollars

Glendale Avenue/Cactus Avenue
BRT - Fleet Sizing and O&M Estimate

Item			Comments
			peak
Travel/Miles of Line	19.77	19.77	headway
Stations:			5
* Surface	see total ----------	14	on each line
* Aerial	see total ----------	-	
Operating Times:			
* 1-way run, minutes	*53.9*		Camelback/Central to Bell/Scottsdale, average WB/EB
Round trip w/o recovery (min)	108		excluding turn-around time at ends of line
* 2-way cycle, minutes	**129**		average cycle
Vehicle Fleet:			
* Buses in service (peak)	26	26	combined - 5' peak headways (H)
* Buses in service (off-peak)			
* Fleet		31	In service + 20% spares
Bus Hrs & Miles:			
* Bus Hours:			
- Daily	338	338	7 hr @ 5' H, 12 hr @ 10' H
* Bus Hrs per day:			
- Base	338	338	Single vehicle, 19 hrs/day
- Peak	0	-	
- Crush	-	-	
- Total	338	338	
* *Schedule* speed, mph	18.3		Includes dwell and recovery times
* Bus miles per day	6,185	6,185	
* Annualization:			300 equivalent weekdays/year
- Bus Hours	101,400	101,400	
- Bus Miles	1,855,500	1,855,500	
O&M Cost Estimates (current 2001 Valley Metro):			
* Rev. Veh Hrs @ $96.52		9.79	$ millions
* Rev Veh Mi @ $6.26		11.62	$ millions
* **Total Annual O&M**		**10.71**	$ millions

All costs in Year 2001 Dollars

Main Street (Option 1)
BRT - Fleet Sizing and O&M Estimate

Item			Comments
			peak
Travel/Miles of Line	12.64	12.64	headway
Stations:			5
* Surface	see total ----------	15	on each line
* Aerial	see total ----------	-	
Operating Times:			
* 1-way run, minutes	*34.5*		Alma School to Ellsworth, average WB/EB
Round trip w/o recovery (min)	69		excluding turn-around time at ends of line
* 2-way cycle, minutes	**83**		average cycle
Vehicle Fleet:			
* Buses in service (peak)	17	17	combined - 5' peak headways (H)
* Buses in service (off-peak)			
* Fleet		20	In service + 20% spares
Bus Hrs & Miles:			
* Bus Hours:			
- Daily	221	221	7 hr @ 5' H, 12 hr @ 10' H
* Bus Hrs per day:			
- Base	221	221	Single vehicle, 19 hrs/day
- Peak	0	-	
- Crush	-	-	
- Total	221	221	
* *Schedule* speed, mph	18.3		Includes dwell and recovery times
* Bus miles per day	4,044	4,044	
* Annualization:			300 equivalent weekdays/year
- Bus Hours	66,300	66,300	
- Bus Miles	1,213,200	1,213,200	
O&M Cost Estimates (current 2001 Valley Metro):			
* Rev. Veh Hrs @ $96.52		6.40	$ millions
* Rev Veh Mi @ $6.26		7.59	$ millions
* **Total Annual O&M**		**7.00**	$ millions

All costs in Year 2001 Dollars

Main Street (Option 2)
BRT - Fleet Sizing and O&M Estimate

Item			Comments
			peak
Travel/Miles of Line	9.64	9.64	headway
Stations:			5
* Surface	see total ----------	12	on each line
* Aerial	see total ----------	-	
Operating Times:			
* 1-way run, minutes	*26.3*		Alma School to Power, average WB/EB
Round trip w/o recovery (min)	53		excluding turn-around time at ends of line
* 2-way cycle, minutes	**63**		average cycle
Vehicle Fleet:			
* Buses in service (peak)	13	13	combined - 5' peak headways (H)
* Buses in service (off-peak)			
* Fleet		16	In service + 20% spares
Bus Hrs & Miles:			
* Bus Hours:			
- Daily	169	169	7 hr @ 5' H, 12 hr @ 10' H
* Bus Hrs per day:			
- Base	169	169	Single vehicle, 19 hrs/day
- Peak	0	-	
- Crush	-	-	
- Total	169	169	
* *Schedule* speed, mph	18.3		Includes dwell and recovery times
* Bus miles per day	3,093	3,093	
* Annualization:			300 equivalent weekdays/year
- Bus Hours	50,700	50,700	
- Bus Miles	927,900	927,900	
O&M Cost Estimates (current 2001 Valley Metro):			
* Rev. Veh Hrs @ $96.52		4.89	$ millions
* Rev Veh Mi @ $6.26		5.81	$ millions
*** Total Annual O&M**		**5.35**	$ millions

All costs in Year 2001 Dollars

Northern west of Grand Avenue
BRT - Fleet Sizing and O&M Estimate

Item			Comments
			peak
Travel/Miles of Line	12.44	12.44	headway
Stations:			10
* Surface	see total ----------	11	on each line
* Aerial	see total ----------	-	
Operating Times:			
* 1-way run, minutes	*33.9*		Grand to Loop 303, average WB/EB
Round trip w/o recovery (min)	68		excluding turn-around time at ends of line
* 2-way cycle, minutes	**81**		average cycle
Vehicle Fleet:			
* Buses in service (peak)	9	9	combined - 10' peak headways (H)
* Buses in service (off-peak)			
* Fleet		11	In service + 20% spares
Bus Hrs & Miles:			
* Bus Hours:			
- Daily	117	117	7 hr @ 10' H, 12 hr @ 20' H
* Bus Hrs per day:			
- Base	117	117	Single vehicle, 19 hrs/day
- Peak	0	-	
- Crush	-	-	
- Total	117	117	
* *Schedule* speed, mph	18.3		Includes dwell and recovery times
* Bus miles per day	2,141	2,141	
* Annualization:			300 equivalent weekdays/year
- Bus Hours	35,100	35,100	
- Bus Miles	642,300	642,300	
O&M Cost Estimates (current 2001 Valley Metro):			
* Rev. Veh Hrs @ $96.52		3.39	$ millions
* Rev Veh Mi @ $6.26		4.02	$ millions
*** Total Annual O&M**		**3.71**	$ millions

All costs in Year 2001 Dollars

Power Road

BRT - Fleet Sizing and O&M Estimate

Item			Comments
			peak
Travel/Miles of Line	13.04	13.04	headway
Stations:			10
* Surface	see total ----------	17	on each line
* Aerial	see total ----------	-	
Operating Times:			
* 1-way run, minutes	*35.6*		McDowell/Higley to Williams Field, average NB/SB
Round trip w/o recovery (min)	71		excluding turn-around time at ends of line
* 2-way cycle, minutes	**85**		average cycle
Vehicle Fleet:			
* Buses in service (peak)	9	9	combined - 10' peak headways (H)
* Buses in service (off-peak)			
* Fleet		11	In service + 20% spares
Bus Hrs & Miles:			
* Bus Hours:			
- Daily	117	117	7 hr @ 10' H, 12 hr @ 20' H
* Bus Hrs per day:			
- Base	117	117	Single vehicle, 19 hrs/day
- Peak	0	-	
- Crush	-	-	
- Total	117	117	
* *Schedule* speed, mph	18.3		Includes dwell and recovery times
* Bus miles per day	2,141	2,141	
* Annualization:			300 equivalent weekdays/year
- Bus Hours	35,100	35,100	
- Bus Miles	642,300	642,300	
O&M Cost Estimates (current 2001 Valley Metro):			
* Rev. Veh Hrs @ $96.52		3.39	$ millions
* Rev Veh Mi @ $6.26		4.02	$ millions
*** Total Annual O&M**		**3.71**	$ millions

All costs in Year 2001 Dollars

Scottsdale Road

BRT - Fleet Sizing and O&M Estimate

Item			Comments
			peak
Travel/Miles of Line	28.10	28.10	headway
Stations:			5
* Surface	see total ----------	37	on each line
* Aerial	see total ----------	-	
Operating Times:			
* 1-way run, minutes	*76.6*		Price/Queen Creek to Bell, average NB/SB
Round trip w/o recovery (min)	153		excluding turn-around time at ends of line
* 2-way cycle, minutes	**184**		average cycle
Vehicle Fleet:			
* Buses in service (peak)	37	37	combined - 5' peak headways (H)
* Buses in service (off-peak)			
* Fleet		44	In service + 20% spares
Bus Hrs & Miles:			
* Bus Hours:			
- Daily	481	481	7 hr @ 5' H, 12 hr @ 10' H
* Bus Hrs per day:			
- Base	481	481	Single vehicle, 19 hrs/day
- Peak	0	-	
- Crush	-	-	
- Total	481	481	
* *Schedule* speed, mph	18.3		Includes dwell and recovery times
* Bus miles per day	8,802	8,802	
* Annualization:			300 equivalent weekdays/year
- Bus Hours	144,300	144,300	
- Bus Miles	2,640,600	2,640,600	
O&M Cost Estimates (current 2001 Valley Metro):			
* Rev. Veh Hrs @ $96.52		13.93	$ millions
* Rev Veh Mi @ $6.26		16.53	$ millions
*** Total Annual O&M**		**15.23**	$ millions

All costs in Year 2001 Dollars

Union Pacific Tempe Branch
BRT - Fleet Sizing and O&M Estimate

Item			Comments
			peak
Travel/Miles of Line	10.00	10.00	headway
Stations:			5
* Surface	see total ----------	13	on each line
* Aerial	see total ----------	-	
Operating Times:			
* 1-way run, minutes	*27.3*		UP Mainline to 56th/I-10, average WB/EB
Round trip w/o recovery (min)	55		excluding turn-around time at ends of line
* 2-way cycle, minutes	**65**		average cycle
Vehicle Fleet:			
* Buses in service (peak)	14	14	combined - 5' peak headways (H)
* Buses in service (off-peak)			
* Fleet		17	In service + 20% spares
Bus Hrs & Miles:			
* Bus Hours:			
- Daily	182	182	7 hr @ 5' H, 12 hr @ 10' H
* Bus Hrs per day:			
- Base	182	182	Single vehicle, 19 hrs/day
- Peak	0	-	
- Crush	-	-	
- Total	182	182	
* *Schedule* speed, mph	18.3		Includes dwell and recovery times
* Bus miles per day	3,331	3,331	
* Annualization:			300 equivalent weekdays/year
- Bus Hours	54,600	54,600	
- Bus Miles	999,300	999,300	
O&M Cost Estimates (current 2001 Valley Metro):			
* Rev. Veh Hrs @ $96.52		5.27	$ millions
* Rev Veh Mi @ $6.26		6.26	$ millions
*** Total Annual O&M**		**5.77**	$ millions

All costs in Year 2001 Dollars

I-10 Far West

BRT - Fleet Sizing and O&M Estimate

Item			Comments
			peak
Travel/Miles of Line	9.42	9.42	headway
Stations:			15
* Surface	see total ----------	2	on each line
* Aerial	see total ----------	-	
Operating Times:			
* 1-way run, minutes	*14.1*		Loop 101 W to Loop 303, average WB/EB
Round trip w/o recovery (min)	28		excluding turn-around time at ends of line
* 2-way cycle, minutes	**43**		average cycle
Vehicle Fleet:			
* Buses in service (peak)	3	3	combined - 15' peak headways (H)
* Buses in service (off-peak)			
* Fleet		4	In service + 20% spares
Bus Hrs & Miles:			
* Bus Hours:			
- Daily	39	39	7 hr @ 15' H, 12 hr @ 30' H
* Bus Hrs per day:			
- Base	39	39	Single vehicle, 19 hrs/day
- Peak	0	-	
- Crush	-	-	
- Total	39	39	
* *Schedule* speed, mph	26.1		Includes dwell and recovery times
* Bus miles per day	1,018	1,018	
* Annualization:			300 equivalent weekdays/year
- Bus Hours	11,700	11,700	
- Bus Miles	305,400	305,400	
O&M Cost Estimates (current 2001 Valley Metro):			
* Rev. Veh Hrs @ $96.52		1.13	$ millions
* Rev Veh Mi @ $6.26		1.91	$ millions
*** Total Annual O&M**		**1.52**	$ millions

All costs in Year 2001 Dollars

I-17

BRT - Fleet Sizing and O&M Estimate

Item			Comments
			peak
Travel/Miles of Line	17.00	17.00	headway
Stations:			20
* Surface	see total ----------	2	on each line
* Aerial	see total ----------	-	
Operating Times:			
* 1-way run, minutes	*25.5*		Loop 101 to Anthem, average NB/SB
Round trip w/o recovery (min)	51		excluding turn-around time at ends of line
* 2-way cycle, minutes	**66**		average cycle
Vehicle Fleet:			
* Buses in service (peak)	4	4	combined - 20' peak headways (H)
* Buses in service (off-peak)			
* Fleet		5	In service + 20% spares
Bus Hrs & Miles:			
* Bus Hours:			
- Daily	52	52	7 hr @ 20' H, 12 hr @ 40' H
* Bus Hrs per day:			
- Base	52	52	Single vehicle, 19 hrs/day
- Peak	0	-	
- Crush	-	-	
- Total	52	52	
* *Schedule* speed, mph	30.9		Includes dwell and recovery times
* Bus miles per day	1,607	1,607	
* Annualization:			300 equivalent weekdays/year
- Bus Hours	15,600	15,600	
- Bus Miles	482,100	482,100	
O&M Cost Estimates (current 2001 Valley Metro):			
* Rev. Veh Hrs @ $96.52		1.51	$ millions
* Rev Veh Mi @ $6.26		3.02	$ millions
* **Total Annual O&M**		**2.27**	$ millions

All costs in Year 2001 Dollars

Loop 101 East

BRT - Fleet Sizing and O&M Estimate

Item			Comments
			peak
Travel/Miles of Line	34.33	34.33	headway
Stations:			15
* Surface	see total ----------	8	on each line
* Aerial	see total ----------	-	
Operating Times:			
* 1-way run, minutes	*51.5*		Price/Queen Creek to I-17, average NB/SB
Round trip w/o recovery (min)	103		excluding turn-around time at ends of line
* 2-way cycle, minutes	**129**		average cycle
Vehicle Fleet:			
* Buses in service (peak)	9	9	combined - 15' peak headways (H)
* Buses in service (off-peak)			
* Fleet		11	In service + 20% spares
Bus Hrs & Miles:			
* Bus Hours:			
- Daily	117	117	7 hr @ 15' H, 12 hr @ 30' H
* Bus Hrs per day:			
- Base	117	117	Single vehicle, 19 hrs/day
- Peak	0	-	
- Crush	-	-	
- Total	117	117	
* *Schedule* speed, mph	32		Includes dwell and recovery times
* Bus miles per day	3,744	3,744	
* Annualization:			300 equivalent weekdays/year
- Bus Hours	35,100	35,100	
- Bus Miles	1,123,200	1,123,200	
O&M Cost Estimates (current 2001 Valley Metro):			
* Rev. Veh Hrs @ $96.52		3.39	$ millions
* Rev Veh Mi @ $6.26		7.03	$ millions
*** Total Annual O&M**		**5.21**	$ millions

All costs in Year 2001 Dollars

Loop 101 West
BRT - Fleet Sizing and O&M Estimate

Item			Comments
			peak
Travel/Miles of Line	28.30	28.30	headway
Stations:			15
* Surface	see total ----------	6	on each line
* Aerial	see total ----------	-	
Operating Times:			
* 1-way run, minutes	*42.5*		I-10 to I-17, average NB/SB
Round trip w/o recovery (min)	85		excluding turn-around time at ends of line
* 2-way cycle, minutes	**106**		average cycle
Vehicle Fleet:			
* Buses in service (peak)	8	8	combined - 15' peak headways (H)
* Buses in service (off-peak)			
* Fleet		10	In service + 20% spares
Bus Hrs & Miles:			
* Bus Hours:			
- Daily	104	104	7 hr @ 15' H, 12 hr @ 30' H
* Bus Hrs per day:			
- Base	104	104	Single vehicle, 19 hrs/day
- Peak	0	-	
- Crush	-	-	
- Total	104	104	
* *Schedule* speed, mph	32		Includes dwell and recovery times
* Bus miles per day	3,328	3,328	
* Annualization:			300 equivalent weekdays/year
- Bus Hours	31,200	31,200	
- Bus Miles	998,400	998,400	
O&M Cost Estimates (current 2001 Valley Metro):			
* Rev. Veh Hrs @ $96.52		3.01	$ millions
* Rev Veh Mi @ $6.26		6.25	$ millions
*** Total Annual O&M**		**4.63**	$ millions

All costs in Year 2001 Dollars

Loop 202

BRT - Fleet Sizing and O&M Estimate

Item			Comments
			peak
Travel/Miles of Line	54.64	54.64	headway
Stations:			15
* Surface	see total ----------	11	on each line
* Aerial	see total ----------	-	
Operating Times:			
* 1-way run, minutes	*82.0*		SR-51 to I-10, average WB/EB
Round trip w/o recovery (min)	164		excluding turn-around time at ends of line
* 2-way cycle, minutes	**205**		average cycle
Vehicle Fleet:			
* Buses in service (peak)	14	14	combined - 15' peak headways (H)
* Buses in service (off-peak)			
* Fleet		17	In service + 20% spares
Bus Hrs & Miles:			
* Bus Hours:			
- Daily	182	182	7 hr @ 15' H, 12 hr @ 30' H
* Bus Hrs per day:			
- Base	182	182	Single vehicle, 19 hrs/day
- Peak	0	-	
- Crush	-	-	
- Total	182	182	
* *Schedule* speed, mph	32		Includes dwell and recovery times
* Bus miles per day	5,824	5,824	
* Annualization:			300 equivalent weekdays/year
- Bus Hours	54,600	54,600	
- Bus Miles	1,747,200	1,747,200	
O&M Cost Estimates (current 2001 Valley Metro):			
* Rev. Veh Hrs @ $96.52		5.27	$ millions
* Rev Veh Mi @ $6.26		10.94	$ millions
*** Total Annual O&M**		**8.11**	$ millions

All costs in Year 2001 Dollars

Loop 303

BRT - Fleet Sizing and O&M Estimate

Item			Comments
			peak
Travel/Miles of Line	19.45	19.45	headway
Stations:			20
* Surface	see total ----------	5	on each line
* Aerial	see total ----------	-	
Operating Times:			
* 1-way run, minutes	*29.2*		I-10 to Grand, average NB/SB
Round trip w/o recovery (min)	58		excluding turn-around time at ends of line
* 2-way cycle, minutes	**73**		average cycle
Vehicle Fleet:			
* Buses in service (peak)	4	4	combined - 20' peak headways (H)
* Buses in service (off-peak)			
* Fleet		5	In service + 20% spares
Bus Hrs & Miles:			
* Bus Hours:			
- Daily	52	52	7 hr @ 20' H, 12 hr @ 40' H
* Bus Hrs per day:			
- Base	52	52	Single vehicle, 19 hrs/day
- Peak	0	-	
- Crush	-	-	
- Total	52	52	
* *Schedule* speed, mph	31.8		Includes dwell and recovery times
* Bus miles per day	1,654	1,654	
* Annualization:			300 equivalent weekdays/year
- Bus Hours	15,600	15,600	
- Bus Miles	496,200	496,200	
O&M Cost Estimates (current 2001 Valley Metro):			
* Rev. Veh Hrs @ $96.52		1.51	$ millions
* Rev Veh Mi @ $6.26		3.11	$ millions
*** Total Annual O&M**		**2.31**	$ millions

All costs in Year 2001 Dollars

US-60

BRT - Fleet Sizing and O&M Estimate

Item			Comments
			peak
Travel/Miles of Line	18.96	18.96	headway
Stations:			15
* Surface	see total ----------	4	on each line
* Aerial	see total ----------	-	
Operating Times:			
* 1-way run, minutes	*28.4*		I-10 to SR-88, average WB/EB
Round trip w/o recovery (min)	57		excluding turn-around time at ends of line
* 2-way cycle, minutes	**72**		average cycle
Vehicle Fleet:			
* Buses in service (peak)	5	5	combined - 15' peak headways (H)
* Buses in service (off-peak)			
* Fleet		6	In service + 20% spares
Bus Hrs & Miles:			
* Bus Hours:			
- Daily	65	65	7 hr @ 15' H, 12 hr @ 30' H
* Bus Hrs per day:			
- Base	65	65	Single vehicle, 19 hrs/day
- Peak	0	-	
- Crush	-	-	
- Total	65	65	
* *Schedule* speed, mph	31.7		Includes dwell and recovery times
* Bus miles per day	2,061	2,061	
* Annualization:			300 equivalent weekdays/year
- Bus Hours	19,500	19,500	
- Bus Miles	618,300	618,300	
O&M Cost Estimates (current 2001 Valley Metro):			
* Rev. Veh Hrs @ $96.52		1.88	$ millions
* Rev Veh Mi @ $6.26		3.87	$ millions
*** Total Annual O&M**		**2.88**	$ millions

All costs in Year 2001 Dollars