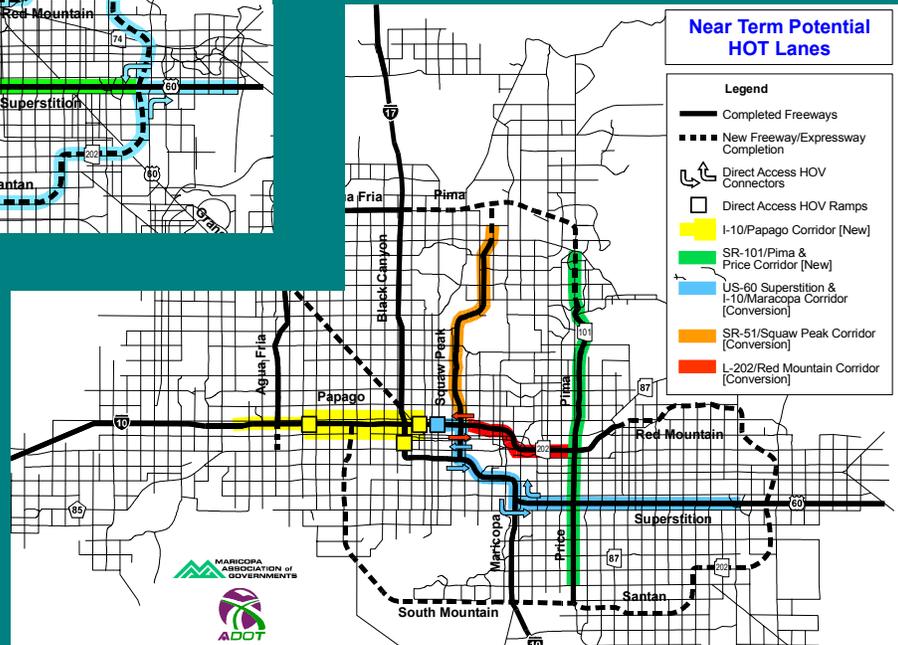
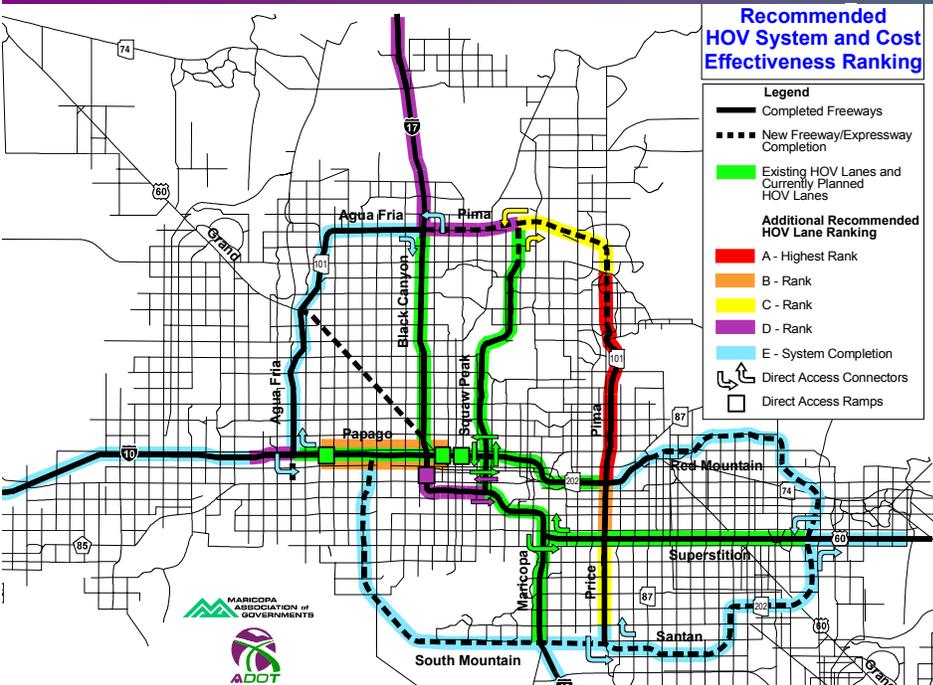


VALUE LANES STUDY HOV LANES EXECUTIVE SUMMARY

June 2002



Prepared by
PARSONS TRANSPORTATION GROUP INC.

for



**ARIZONA
DEPARTMENT OF
TRANSPORTATION**

in partnership with



HOV Executive Summary
HOV Plan Update

HIGH OCCUPANCY VEHICLE FACILITIES
POLICY GUIDELINES AND PLAN
FOR THE MAG FREEWAY SYSTEM

Prepared for:

Arizona Department of Transportation
Maricopa Association of Governments
Regional Public Transportation Authority

Prepared by:

Parsons Transportation Group Inc.

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1.0 INTRODUCTION

The purpose of this study was to update the 1994 MAG Freeway System Policies and System Plan for implementation of High Occupancy Vehicle (HOV) facilities. HOV facilities are an integral component of the MAG Congestion Management Strategy designed to maximize the people-carrying capacity of the MAG Freeway System. These facilities provide incentives for people to ride buses, carpool and vanpool.

HOV facilities components include:

- 1) HOV lanes;
- 2) exclusive HOV ramps;
- 3) HOV bypass lanes;
- 4) park-and-ride lots; and
- 5) bus stations.

HOV, or carpool lanes, are dedicated exclusively to high occupant vehicles. Exclusive HOV ramps provide direct connections of HOV lanes to streets, park-and-ride lots, or from one freeway to another. HOV bypass lanes are dedicated to HOVs at metered ramps to permit the vehicles to bypass the general-purpose lane on the ramps. Park-and-ride lots are mode transfer facilities for carpoolers and transit users. As addressed in this study, park-and-ride lots include lots either adjacent to or within freeway right of way. Bus stations are mode transfer stations for express bus service.

A partnering process was implemented by the MAG HOV Working Group to update both the HOV policies and the proposed HOV System Plan. The Working Group consists of representatives of ADOT, MAG, and the RPTA. The recommended HOV policies were adopted and subsequently became the HOV System plan, jointly updated by the study consultant and the MAG HOV Working Group, and represent a consensus among its members.

The HOV Study reviewed the policies that guided the development of HOV facilities including HOV lanes, exclusive freeway-to-freeway ramps, exclusive freeway-to-arterial ramps, park-and-ride lots, and bus stations. The policies presented herein will be recommended for adoption by the MAG Regional Council, State Transportation Board, and Regional Public Transportation Authority (RPTA).

The HOV Study also updated a system-wide HOV plan building on the foundation of the adopted HOV policies contained in the initial 1994 System Plan. The major findings of a comprehensive evaluation of proposed HOV facilities on the MAG Freeway System are presented in this document. A recommended HOV system was then developed based upon the evaluation of these findings. The recommended HOV system plan update will be recommended for approval by the MAG Regional Council and will be included in the long-range plan for Air Quality Conformity Analysis.

2.0 KEY FINDINGS

HOV POLICIES

The key findings in the development of the HOV policies were:

- Federal and state laws do not mandate specific HOV facilities. However, HOV facilities are strongly encouraged by federal agencies to relieve traffic congestion and provide air quality mitigation strategy.
- HOV facilities have been committed by MAG through adapted air quality control measures since 1987 and have been annually reaffirmed as valid control measures by MAG and ADOT.
- MAG has taken the lead role in coordinating the planning of HOV facilities. An HOV working group has been formed consisting of ADOT, MAG, and the RPTA to coordinate the development of HOV facilities.
- A systemic approach to decision making for HOV facilities on the MAG Freeway System has been established and is used to update the HOV System Plan.
- The mission statement and the commitment statement are used to set the overall direction and tone of decision making for HOV facilities.
- HOV policies define agency roles and responsibilities for planning, constructing and funding HOV facilities.
- The initial 1994 HOV policies did not need major revisions, with the exception of including HOV bypass lanes on ramps.

HOV MISSION STATEMENT

The MAG Regional Council, State Transportation Board and RPTA Board adopted the following mission statement in 1994:

To enhance personal mobility through actions which encourage trip makers to share rides. Fewer cars on the road can reduce capital costs for new facilities, save energy, minimize congestion, speed traffic flow, improve air quality, and reduce vehicle noise.

HOV COMMITMENT STATEMENT

The following commitment statement was adopted by the MAG Regional Council, State Transportation Board and RPTA Board in 1994:

High Occupancy Vehicle (HOV) facilities are an integral component of the MAG Freeway System. Such facilities include HOV lanes, exclusive HOV ramps, HOV bypass lanes, park-and-ride lots, and freeway bus stations. ADOT, MAG, and RPTA will take an active role in the development of a regionally integrated system of HOV facilities, and support programs to move people. These facilities and programs shall be coordinated with other regional activities such as freeway management, freeway construction, transit service, trip reduction, congestion management, air quality management, and land use policy. The support programs will include enforcement, HOV incentives and SOV disincentives, marketing, promotion and coordination with public and private sector organizations.

DECISION MAKING AND COORDINATION PROCESS

- ADOT, in coordination with MAG and RPTA, will fully assess the need for high occupancy facilities in a regional HOV system plan and in all high demand freeway corridors that are programmed for new construction and widening.
- MAG, in coordination with RPTA and ADOT, will maintain the lead role in coordinating HOV plans.
- The MAG HOV Working Group with staff from MAG, RPTA, and ADOT will continue to address HOV issues and projects.
- Periodic reports on HOV plans, programs, policies, issues, funding, and performance will be made to the following groups for action as needed: 1) MAG Transportation Review Committee; 2) MAG Regional Council and the Regional Council Transportation Subcommittee; 3) ADOT Priority Planning Committee; 4) State Transportation Board; 5) RPTA Planning Team; and 6) RPTA Board.
- All obligations for HOV facilities on the MAG Freeway System must be included in the MAG, ADOT and RPTA five-year programs.

PLANNING AND PROGRAMMING PROCESS

- MAG, in coordination with ADOT and RPTA, will prepare and adopt a long-range system plan for HOV facilities. HOV facility projects will be included in the MAG, ADOT, and RPTA five-year programs.
- For each freeway project with HOV facilities, ADOT, in coordination with RPTA and MAG, will plan and design HOV lanes, exclusive ramps and bypass lanes. RPTA, in coordination with ADOT and MAG, will plan and design park-and-ride lots and bus stations.
- ADOT, in coordination with RPTA and MAG, will adopt design guidelines and standards for HOV lanes, exclusive HOV ramps, HOV bypass lanes, and for access from park-and-ride lots where they are adjacent to freeways. RPTA, in coordination with ADOT and MAG, will adopt design standards for park-and-ride lots and bus stations.

IMPLEMENTATION AND FUNDING

HOV Lanes and HOV Freeway to Freeway Ramps

ADOT is responsible for the design, construction, and operation of freeway lanes and freeway ramps. HOV lanes, exclusive HOV ramps, and HOV bypass lanes are an integral component of the MAG Freeway System and will be funded as part of the freeway system.

The principal sources of funding for HOV lanes, exclusive HOV ramps and HOV bypass lanes are anticipated to be the possible extension of the current half-cent Regional Area Road Fund (RARF) tax, Congestion Mitigation Air Quality (CMAQ), Surface Transportation Program (STP), National Highway System (NHS) and Federal Transit Administration (FTA) funds, and from the ADOT Discretionary program.

Park-and-Ride Lots

The specific location and design of park-and-ride lots adjacent to freeways and within freeway right-of-way will be joint RPTA and ADOT responsibility. ADOT is responsible for the construction of park-and-ride lots while operation and maintenance of park and ride lots will be a RPTA responsibility.

Funding for park-and-ride lots could include CMAQ, STP, local RARF, FTA funds, and potential new regional transit funds.

Bus Stations

Design of bus stations within freeway right-of-way will be a joint RPTA and ADOT responsibility. Construction of these bus stations will be an ADOT responsibility, while RPTA will be responsible for operating and maintaining the stations.

Funding will be an RPTA responsibility with FTA funds, CMAQ, and potential new regional transportation revenues anticipated as the principal funding sources.

MONITORING AND EVALUATION PROCESS

- MAG, in coordination with ADOT and RPTA, will take the lead role in evaluating all HOV facilities
- ADOT will collect traffic counts on HOV lanes and ramps.
- RPTA will collect bus ridership, carpooling information and utilization rates of park-and-ride lots, and information on modal shift changes.
- The monitoring of the HOV lanes, HOV ramps and bypass lanes will be accomplished with the Freeway Management System (FMS) where feasible. The design of the FMS will incorporate capabilities for monitoring and evaluating HOV lanes, HOV ramps, and HOV bypass lanes.

HOV ENFORCEMENT

HOV facility operational concepts must be enforceable and must include provisions for enforcement. Various enforcement techniques and apprehension strategies are available for implementation. A general compliance goal of the operator and enforcement agencies is to meet a 95 percent compliance rate (i.e., five percent violation fee). For on-site enforcement strategies, HOV facility design provisions should include accommodations for the specific recommended enforcement strategy (e.g., continuous shoulders suitable for enforcement or designated enforcement areas at high visibility locations). However, the single-most effective compliance strategy for enforcement is to prescribe violation fines at a sufficiently high level. HOV fines in Arizona have recently been raised significantly to a maximum of \$200 plus court costs. It is recommended that this fine be broadly shown in the freeway HOV signage as a means to deter potential violators to facilitate compliance.

Therefore, a recommended implementation approach to maximize HOV compliance is a combination of multiple strategies:

- Incorporate adequate HOV enforcement facilities and provisions into the facility planning and design process.
- Increase the DPS budget for additional enforcement staff.
- Implement highly visible violation fine signage throughout HOV facility service areas.

MARKETING

- RPTA, in coordination with MAG and ADOT, is responsible for marketing all HOV facilities. Funding for marketing activities will be provided through CMAQ and State Air Quality funds.

PRESERVATION OF CAPACITY FOR HOV FACILITIES

- Capacity for future HOV facilities will be reserved on all new freeways.

3.0 HOV SYSTEM PLAN

The 1994 HOV system plan included HOV lanes on the radial freeways serving the major activity centers such as downtown Phoenix and the Camelback Urban Village core. In this 2002 update, HOV lanes are proposed for all MAG Freeway System corridors. Implementation is recommended based upon ranking using a cost benefit measure. Park-and-ride lots are located along the freeways to collect carpoolers and transit riders and to feed the carpools and express buses to the HOV lanes. Bus stations are proposed along HOV lanes to serve high transit demand in major activity centers.

EXISTING AND PROGRAMMED HOV FACILITIES

The following facilities on the proposed HOV system are either in operation (50 miles) or planned (35 more miles):

Existing:

- 25 centerline miles of HOV lanes are currently in operation on I-10 from 91st Avenue to Ray Road.
- Nine (9) centerline miles of HOV lanes are currently in operation on the Red Mountain Freeway from I-10 to the Pima/Price Freeway interchange.
- Fourteen (14) centerline miles of HOV lanes are currently on I-17 from Beardsley Road to Thomas Road.
- Exclusive freeway-to-freeway HOV ramps provide exclusive connections from the Red Mountain Freeway to I-10
- Exclusive HOV ramps are located on I-10 at 3rd Street, 3rd Avenue, and 79th Avenue.
- Three (3) park-and-ride lots are currently in operation adjacent to a freeway: one at I-10 and 79th Avenue, one at SR-51 and Shea Boulevard, and one at I-17 and Bell Road.

Under Construction:

- Twelve (12) centerline miles of HOV lanes are currently under construction on US 60/Superstition between I-10/Maricopa and Val Vista Road.

Programmed:

- Four (4) centerline miles are (programmed) on US 60/Superstition between Val Vista and Power Roads.
- Nine (9) centerline miles of HOV lanes are programmed for the SR-51/Squaw Peak Freeway between I-10/Red Mountain and Shea Boulevard.
- Twelve (12) Park and Ride lots.

Planned:

- An additional seven (7) centerline miles of HOV lanes planned (but not programmed) on SR-51 between Shea Boulevard and the Pima Freeway.
- Freeway to freeway HOV ramp connectors (Table 3).
- Eight (8) additional Park and Ride lots.

PROPOSED ADDITIONAL HOV FACILITIES

The proposed HOV system plan includes the following additional facilities:

- Sixty-eight (68) centerline miles of new HOV lanes to be located on the MAG Freeway System through 2020.
- Forty-six (46) centerline miles of additional HOV lanes in the post 2020 era.
- Six (6) pairs of new freeway-to-freeway connectors, with two pair to be constructed prior to 2020.
- One pair of new exclusive freeway-to-arterial interchange.

The total estimated cost of the additional, not programmed HOV facilities is \$635 million. The additional costs of the HOV facilities include:

- \$90 million for the 13 centerline miles of currently planned, but not programmed HOV lanes.
- \$321 million for the 68 additional centerline miles of new HOV lanes (through 2020).
- \$70 million for the two added freeway-to-freeway ramps (through 2020).
- \$50 million for the added pair of freeway-to-arterial interchanges.
- \$90 million for the 20 new park-and-ride lots.

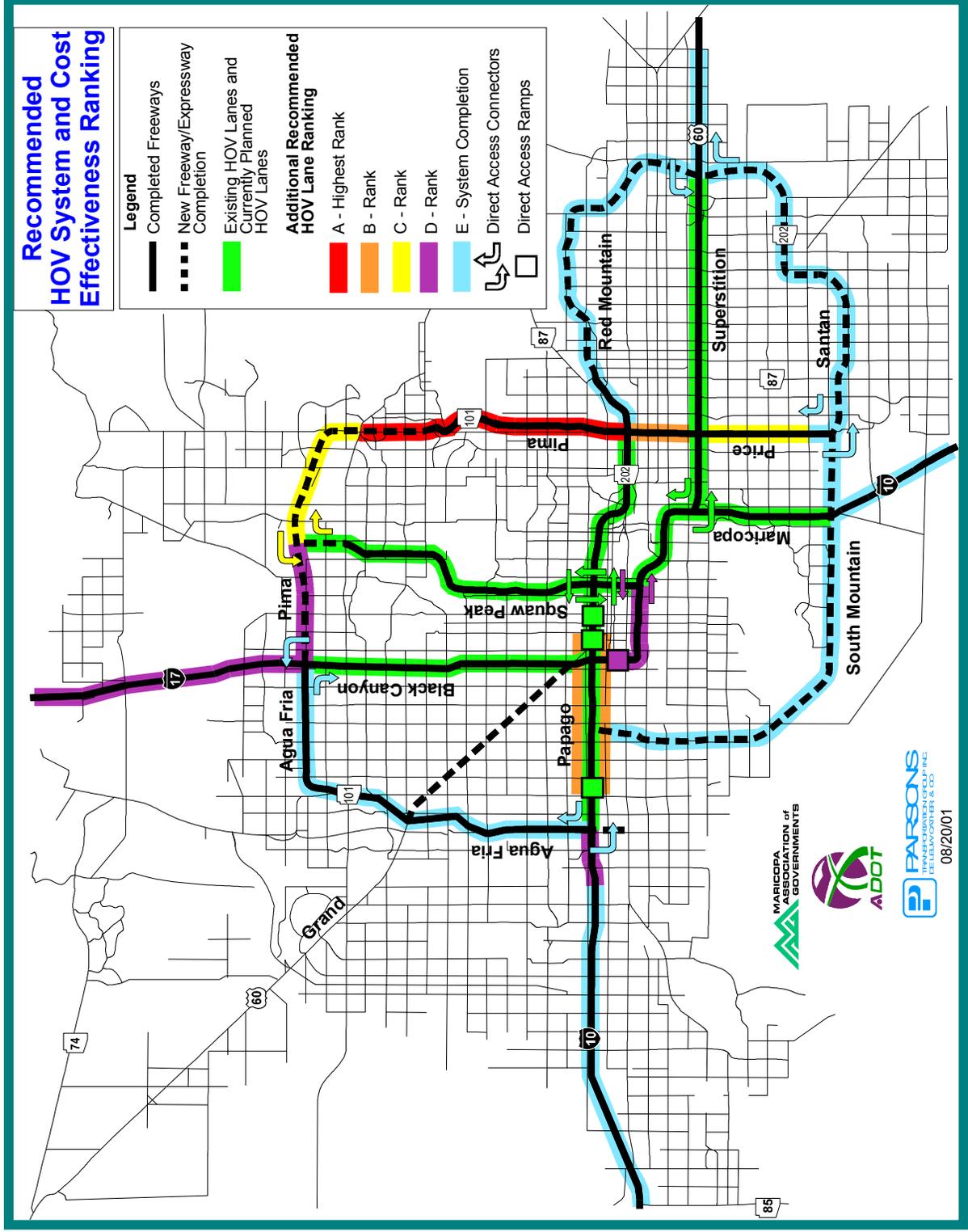
PROPOSED HOV SYSTEM PLAN

Figure 1 illustrates the HOV facilities in the proposed HOV system including both existing, programmed and proposed additional facilities. The characteristics of the HOV facilities in the proposed plan are shown in Table 1. The following proposed additional facilities are discussed in more detail: HOV lanes, exclusive HOV ramps, HOV bypass ramps, park-and-ride lots, and bus stations. This discussion presents both estimated costs and recommended ranking. The estimated costs are planning costs and are subject to further engineering evaluation.

Table 1
Summary of Additional HOV Facility
Characteristics of Proposed MAG HOV System through 2020

HOV Facility	Number	Cost (\$Millions)
Planned but not Funded HOV Lanes	13 miles	\$90
Additional HOV Lanes through 2020	68 miles	\$321
Freeway-to-Freeway Ramps through 2020	2 pairs	\$70
Freeway-to-Arterial Ramps	1 interchange	\$50
Park-and-Ride Lots	20 additional lots	\$90
	TOTAL NOT PROGRAMMED	\$621

Figure 1
Recommended HOV System and Cost Effectiveness Ranking



HOV LANES

The proposed HOV lanes in the HOV system are located on all MAG freeways. The locations, mileage, cost and ranking of the additional HOV lanes in the proposed plan are illustrated in Table 2. The 2020 ranking of new lanes is indicated in Figure 1 and Table 2. A total of 68 miles of additional new HOV lanes are proposed for the MAG freeway system prior to 2020 at an estimated cost of \$321 million. The freeways with the highest cost benefit ranking for new HOV lanes are:

1. I-10/Papago (second pair)
2. Pima Freeway
3. Price Freeway
4. I-17 (Papago to Maricopa)

In the future, there may be other opportunities for additional HOV lanes to those currently identified on the HOV System Plan. The adopted MAG HOV policies reserve the additional seventh and eighth lanes in the median of all existing and future freeways. The major investment analysis required for transportation improvements must examine a broad array of modal alternatives including HOV facilities. This analysis could recommend HOV facilities that are not on the current System Plan. The basic assumption for the HOV lanes in the proposed HOV System Plan is that the HOV lanes could be added as the seventh and eighth or ninth and tenth lanes of the freeway based upon sufficient roadway capacity.

**Table 2
Summary of Additional HOV Lanes
Characteristics of Proposed MAG HOV Systems**

Corridor	Segment	Segment Length (miles)	Cost Effectiveness		Benefit Ranking
			Total Cost (millions)	Value \$/hr saved	
SR-101 Pima	Frank Lloyd Wright to SR-202	14.2	\$50.6	\$1.82	A
I-10 Papago	79th Ave to 3rd Ave	8.4	\$64.9	\$3.25	B
SR-101 Pima	SR-202 (Red Mountain) to US-60	3.5	\$12.5	\$4.76	B
SR-101 Pima	US-60 to Chandler Blvd	5.7	\$20.3	\$8.97	C
SR-101 Pima	SR-51 to Frank Lloyd Wright	6.7	\$23.8	\$9.73	C
I-10 Papago	Agua Fria River to SR-101	3.6	\$13.4	\$10.45	D
I-17 Black Canyon	I-10 (Papago) to I-10 (Maricopa)	6.5	\$64.6	\$12.21	D
SR-101 Pima	I-17 to SR-51	6.8	\$24.4	\$12.48	D
I-17 Black Canyon	SR-74 (Carefree Highway) to SR-101	9.0	\$32.2	\$14.08	D
I-17 Black Canyon	Desert Hills to SR-74 (Carefree Hwy)	4.0	\$14.3	\$14.26	D
Subtotal [A - D Ranked Lanes]			\$321.0		
SR-101 Pima	Chandler to SR-202 (Santan)	1.1	\$3.8	\$20.97	E
SR-101 Agua Fria	I-17 to 67th Ave	5.4	\$19.2	\$24.32	E
SR-202 Red Mountain	SR-101 to SR-87 (Country Club)	3.6	\$12.8	\$24.66	E
I-10 Papago	SR-85 to Agua Fria River	16.0	\$59.5	\$27.04	E
SR-101 Agua Fria	US-60 (Grand) to I-10	9.7	\$34.5	\$31.42	E
SR-101 Agua Fria	67th Ave to US-60 (Grand)	10.4	\$37.1	\$76.05	E
Total [All New Recommended Lanes]			\$487.9		
I-10 - Maricopa	Ray to Chandler Blvd	0.5	N/A	N/A	FY 2001
SR-51 - Squaw Peak	I-10 to Shea Blvd	9.4	\$42.6	N/A	FY 2003
US-60 - Superstition	I-10 to Val Vista	12.0	\$127.3	N/A	FY 2001
Total [Funded Lanes]			\$169.9		
SR-51 - Squaw Peak	Shea Blvd to SR-101	6.7	\$23.8	N/A	Planned
US-60 - Superstition	Val Vista to Power Road	4.1	\$43.5	N/A	Planned
US-60 - Superstition	Power Road to SR-202	2.1	\$22.3	N/A	Planned
Total [Unfunded Lanes]			\$89.6		
Grand Total			\$747.4		

HOV BYPASS RAMPS

HOV Bypass Ramp Policy Revision ? The 1994 HOV policy manual included a strategy of HOV priority entrances to the freeway system in the form of HOV bypass lanes at ramp metering locations. Although initially this strategy worked reasonably well, its effectiveness has decreased significantly over time due to the increased number of turn lanes accessing the on-ramp, high violation rates, and safety concerns due to the above issues. For the above reasons, a new on-ramp metering and HOV bypass ramp is strategy is recommended as noted below.

STRATEGY	RECOMMENDATION
On-Ramp Metering	Provide two metered general-purpose lanes at on-ramps for both new designs and as a retrofit strategy where operational problems exist
HOV Bypass Lanes	Consider HOV bypass lanes or exclusive bus-only lanes that are in close proximity to park-and-ride lots, express bus routes, or transit oriented activity centers.

When considering implementation of HOV bypass lanes, the design configuration of the on-ramp will need to be assessed on a case-by-case basis. If on-ramp general-purpose volumes are low and not forecasted to increase significantly, a two-lane on-ramp configuration can be used where one lane is reserved for general-purpose traffic and the other as an HOV bypass lane. If general-purpose volumes are high, or are expected to increase significantly, a three-lane configuration should be considered where two lanes are reserved for general-purpose traffic and the third lane is reserved as an HOV bypass lane. However, the three-lane configuration would need to be carefully analyzed with regard to design standards, triple lane merging/weaving operations and right-of-way impacts.

Given the current planning for the park-and-ride lot system and express bus system, it is recommended that on-ramp HOV bypass lanes or exclusive bus ramps be considered at locations adjacent to park-and-ride lots and transit-oriented activity centers or along express bus routes. There are some excellent examples of the HOV/bus priority entrances at:

- I-17 southbound exclusive HOV entrance ramp south of Bell Road
- Deer Valley Road park-and-ride lot
- SR-51/Shea Boulevard park-and-ride lot express bus pullout and re-entry on the southbound on-ramp
- SR-51/Bell Road - another exclusive express bus entrance ramp is planned at the park-and-ride lot adjacent to the southbound Bell Road on-ramp.

Other exclusive HOV/bus only ramps are also being considered adjacent to other park-and-ride lots, including I-17 at Metro Center.

HOV FREEWAY-TO-FREEWAY CONNECTIONS

The proposed plan includes exclusive freeway-to-freeway ramps at some major system interchanges. The purpose of these connections is to provide continuity for HOVs for the high traffic movements from one freeway to another freeway. Table 3 identifies the freeway-to-freeway ramp connections provided in the proposed plan. The adopted plan has five such connectors with programmed funding that totals \$154 million. The total cost of the six new recommended freeway-to-freeway connections is \$210 million with the additional two connectors recommended for construction through 2020 totaling \$70 million.

All of the proposed exclusive HOV ramps must be analyzed with respect to the ability to construct the ramps. Detailed analysis of each specific site of the HOV ramps must be undertaken to determine the feasibility of implementing the connection.

Table 3
Summary of HOV Freeway-to-Freeway Connectors
Characteristics of Proposed MAG HOV System

	Freeways Connected	Proposed Connections		Total Cost (millions)	Cost-Benefit Ranking	
		From	To			
Recommended HOV Connectors (Post 2007)	I-10 - Maricopa	East	West	\$50	C	
	And I-17	West	East			
	SR-101 - Pima	East	South	\$20	C	
	And SR-51	South	East			
	Total [A-D Ranked Connectors]				\$70	
	SR-101 - Agua Fria	North	East	\$50	E	
	And I-10 - Papago	East	North			
	SR-101 - Agua Fria	West	South	\$50	E	
	And I-17- Black Canyon	South	West			
	SR-101 - Price	North	East	\$20	E	
And SR-202 - Santan	East	North				
SR-202 - Santan	South	East	\$20	E		
And US-60 - Superstition	East	South				
Total [All Planned Connectors]				\$210		
Connectors Funded in Current Program	I-10 – Maricopa/ US-60	North	East	\$33	FY 2001	
	And US-60 – Superstition/I-10	East	North			
	I-10/SR-51	South	North	\$26	FY 2004	
	And SR-51/I-10	North	South			
Total [Funded Connectors]				\$59		
Recommended HOV Access Ramp		Washington & Jefferson	I-17	\$50		
Grand Total {All Connectors/ Ramps}				\$319		

PARK-AND-RIDE LOTS

Three existing and twenty-one proposed park-and-ride lots are located primarily along the radial freeways. The park-and-ride lots are designated at the locations listed in Table 4 and shown on the area-wide map in Figure 2. The total estimated cost of the park-and-ride lots is \$90 million, an average of \$3 million per lot. Ideally, a park-and-ride lot should include exclusive ramps from the lot to the HOV to minimize travel time. The exclusive ramps should be considered in the site evaluation and design of each park-and-ride lot and the design of the HOV lanes in the vicinity. Depending upon the right-of-way cost for a specific park-and-ride site, exclusive ramps to the HOV lane should be included as part of the construction cost allocated for the park-and-ride lot. The park-and-ride lots with the highest ranking are those lots along the freeways with the highest ranking for HOV lanes.

If the development of exclusive ramps at a park-and-ride site cannot be warranted, sponsoring agencies will coordinate with the ADOT to develop sites that are “freeway close” and have reasonable access to/from regular freeway ramps. For park-and-ride sites that are more remote from the freeway system, a specific bus routing plan will be developed that minimizes the vehicle travel time to and from the nearest freeway ramps.

Table 4
Park-and-Ride Lots
Proposed MAG HOV System

FREEWAY	PARK-AND-RIDES
I-10	Litchfield Road 79 th Avenue (Existing) Warner Road* Pecos Road
I-17	Happy Valley Road Bell Road (Existing) Metro Center
Loop SR-101 (Agua Fria)	51 st Avenue Glendale Avenue Camelback Road
Loop SR-101 (Pima)	Scottsdale Road Cactus Road
Loop SR-101 (Price)	Apache/Broadway
Loop SR-202 (Red Mountain)	Gilbert Road
Loop 202 (Santan)	Price Road Val Vista Drive
Loop SR-202 (South/Mountain)	40 th Street/Pecos Road
SR-51 (Squaw Peak)	Shea Boulevard (Existing) Bell Road
US 60	Mesa Drive Gilbert Road (Page/Ash) Power Road (Superstition Springs Mall)
Other Locations	Grand Avenue/Bell Road (Sun City) Grand Avenue/59 th Avenue

* Expected to change to nearby location

Figure 2
Planned Park-and-Ride Lot Locations

