

## **Regional Transportation Profile Guidelines**

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# **Regional Transportation Profile Guidelines**



Arizona Department of Transportation Transportation Planning Division

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### 1.0 Introduction

The Arizona Department of Transportation (ADOT) will be conducting 12 regional transportation profiles (Profiles) across the State over the next several years (Figure 1.1). ADOT will use the Profiles to identify expected future transportation system needs and deficiencies and the potential capital projects designed to mitigate those deficiencies.

This document provides a common evaluation framework or guidelines to support all 12 Profiles. The Profile guidelines provide a foundation for needs and deficiency analyses and project evaluations that will be consistent with the performance-based planning concepts developed for the Arizona Long-Range Transportation Plan (MoveAZ).

The Profile guidelines will help ensure that each region of the State is treated equally in the analysis of needs and deficiencies and the identification and evaluation of projects. The Profile consultants must adapt these guidelines to the particular circumstances of the region being studied. The Profile guidelines provide explicit direction for certain Profile elements (e.g., performance measures), as well as decision rules that require judgment and application by ADOT and the consultant team hired to prepare a particular Profile (e.g., travel demand modeling).

ADOT has identified eight key elements to be used to guide the development of each Profile:

- 1. Issues for consideration;
- 2. Policies and context;
- 3. Data and data formatting;
- 4. Highway Economic Requirements System State (HERS-ST) and Profile tools;
- 5. Travel demand forecasting;
- 6. Performance factors and measures;
- 7. Performance thresholds; and
- 8. Project identification.

Each element presents a description of the supporting resources, data, information, documentation, and guidance steps to follow as each is developed. The tables provided in these Guidelines present the primary technical areas of the Profile development process. Additional background information is presented for Profile elements to provide additional context and understanding of the guidance steps, recommendations, and planning process.

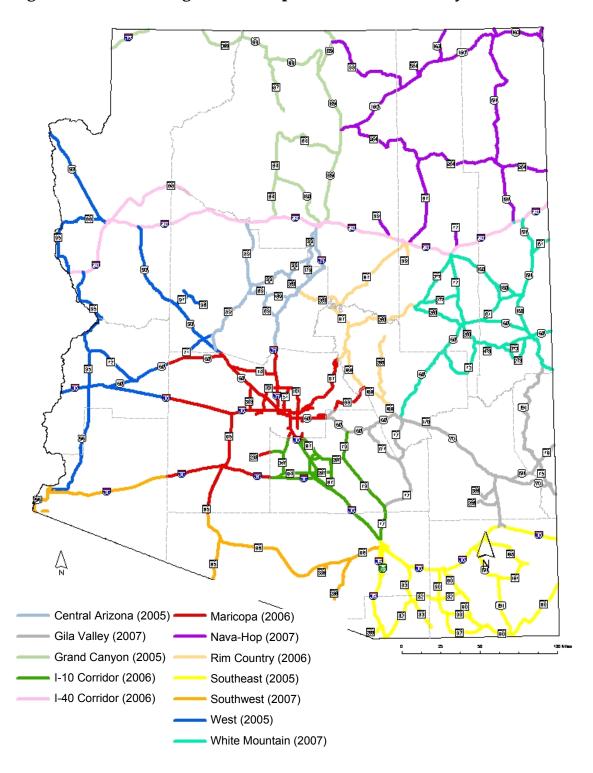


Figure 1.1 ADOT Regional Transportation Profile Study Areas

### 2.0 Issues for Consideration

Each Profile will address issues that are common across the State. In addition, all Profiles will address issues that are of particular relevance and importance to a given region. The purpose of this section is to outline both the key issues that must be addressed across the State, and additional issues for consideration that may be appropriate for only some of the Profiles. Figure 2.1 provides an overall diagram linking the Profile tasks to the guideline elements.

**Profile Tasks** Resources **Inventory Existing HPMS Data** and Future Conditions **HERS-ST AZ** Forecast **Future Conditions** Travel **Demand Model ADOT Planning Identify Needs** and Deficiencies **ADOT Districts** Performance Measures **Identify Elements** and Projects **Public Input** Recommended Other Tools **Improvements** 

Figure 2.1 Major Profile Tasks and Guideline Resources

Previous studies and plans will be the primary source of information to identify major transportation and related infrastructure issues that need to be addressed in the Profiles. The resources required to complete this element of the guidelines include existing state and regional plans and studies prepared by ADOT; Metropolitan Planning Organizations; Councils of Government; and local city, town, and transit agencies. To the extent possible, the Profiles will address a consistent set of transportation issues. Table 2.1 provides a summary of issues that all Profiles must address and methods that are required to support each Profile. Table 2.2 provides a list of additional issues that will need to be addressed, based on the characteristics of the Profile, as well as guidance and resources.

Table 2.1 Major Issues Addressed in the Profile Guidelines by Task

<b>Guidelines Section</b>	Task 2 – Existing and Future Conditions	Task 3 – Needs and Deficiencies	Task 5 - Project Improvements
2.0 Issues for consideration	Determine data needed to support Profile	Determine needs and deficiencies to be examined	
3.0 Policies and context	Data required to support evaluation of ADOT goals	Guidance on selection of performance measures	
4.0 Data and data formatting	Data collection and formatting guidance		
5.0 Profile tools and methods		Tools and methods to support performance analysis	
6.0 Travel demand forecasting	Data required to support modeling	Model Decision Rules; Modeling Methods; Connection of model to performance analysis	
7.0 Performance factors and measures		Performance factors and measures required for analysis	
8.0 Performance thresholds		Identify thresholds for HERS-ST and performance measures	
9.0 Project improvements			Project definition guidelines; Cost estimation procedures
Result of Task	Complete review of existing and future conditions in the study area	Needs and deficiencies identified relative to performance standards and thresholds	Performance-based evaluation of capital transportation projects

**Table 2.2** Additional Issues for Consideration

Issue	When to Address	Resources
Freight	Major through freight facilities, including interstates, national highway system routes, and railroads	Arizona Department of Commerce county-level freight data; national Freight Analysis Framework (FAF)
	Major border crossings	BTS TransBorder Surface Freight data
	Major freight facilities – national highway system, airports, intermodal terminals, railroads	State databases for national highway system, airports, intermodal facilities, railroads; Regional plans and studies
Border	Border crossing	BTS Border Crossing data; Regional and local plans and studies
Tourism	Near major tourist attractions, either regional or national	Alternate transportation modes; Seasonal, weekend traffic volumes
Transit	Urban areas (50,000 +)	Mode choice modeling; National Personal Transportation Survey
	Rural areas	ADOT rural transit programs; National Transit Database
Safety	Systemwide safety investments on rural routes	ADOT Safety Management System
	Major rail crossings (mainline and state highway)	Railroad Accident/Incident Reporting System
Access management	In growing towns, state routes that lack access control	ADOT Access management policies; access management performance measure

### 3.0 Policies and Context

This section presents the policy and context which the Profiles must follow. Adherence to the MoveAZ Plan goals, objectives, performance factors, and the updated MoveAZ's horizon year will be required to ensure consistency with the Profile development process. Refer to Section 3.0, Policy Directions of the Final MoveAZ Plan, for detailed information about policy and context.

#### ■ 3.1 Goals, Objectives, and Factors

The Profiles will be developed to identify system needs, deficiencies, and potential project solutions for each region. The needs and potential project solutions defined in each Profile will be the basis for updating the MoveAZ Plan. Therefore, the Profile evaluations need to be consistent with these MoveAZ Plan elements and will be used to help guide all subsequent steps. Table 3.1 presents the MoveAZ Plan goals and associated performance factors.

The performance factors shown in Table 3.1 consider multiple goals and objectives. At a minimum, the factors, as well as supporting performance measures, used in the Profiles need to adhere to the following factors:

- Mobility and economic competitiveness;
- Reliability;
- Accessibility;
- Connectivity;
- Safety;
- Preservation; and
- Resource conservation.

Additional information regarding the application of specific performance factors and measures is provided in Section 7.0, <u>including the use of cost effectiveness</u> as a factor in the Profile planning process.

Table 3.1 MoveAZ Long-Range Goals and Factors

Long-Range Goal	Description	Performance Factors
Access and Mobility	A reliable and accessible multimodal transportation system that provides for the efficient mobility of people and goods throughout the State	Mobility Reliability Accessibility Connectivity
Economic Vitality	A multimodal transportation system that improves Arizona's economic competitiveness and provides access to economic opportunities for all Arizonans	Economic Competitiveness Accessibility
Safety	A safe transportation system for the movement of people and goods	Safety
Stewardship	A balanced, cost-effective approach that combines preservation with necessary expansions and coordinates with local and regional transportation and land use planning	Preservation Mobility
Environmental Sensitivity	A transportation system that enhances Arizona's natural and cultural environment	Resource Conservation

Source: MoveAZ Plan, December 2004.

#### ■ 3.2 Develop Base and Future Horizon Years

Based on Federal transportation planning regulations and ADOT's long-range planning process, the adopted MoveAZ Plan considered a 20-year planning horizon to the future year of 2025. A 20-year planning horizon from the Plan's date of approval will be used to implement the updated MoveAZ Plan.

Each Profile should use the same base and future horizon years to ensure that consistency and common years will be used in the needs, deficiencies, and project solution evaluations. This consistency will provide ADOT with a common set of file evaluations that provide easy input into the MoveAZ Plan update. The establishment of these years will guide subsequent elements of the guidelines. The base and future horizon years used to support the analysis in each Profile will be:

- 2005 representing base year conditions (next MoveAZ Plan approval expected at the end of 2010); and
- 2030 representing future year conditions.

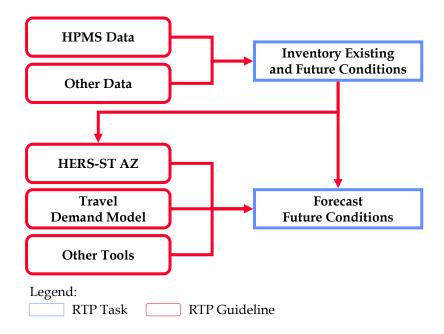
The supporting data, analysis tools, and performance evaluations used to conduct the Profile tasks will be formatted to 2005 and 2030 conditions.

# 4.0 Data and Data Formatting

This section presents the data and data formatting requirements that each Profile must follow, primarily focused on Highway Performance Monitoring System (HPMS) data and formatting. The most recent version of ADOT's HPMS will be the primary data source used to support the development of each Profile. Supplementary data from national, state, and regional sources have been identified that may be appropriate to supplement the HPMS data for transportation systems evaluation. These data sources will be integrated with the Profile tools and analytical procedures presented in Section 5.0 and used to support the evaluation procedures presented later in this document.

The following three sections (4.0, 5.0, and 6.0) describe data and tools that, combined, provide the foundation for each of the major RTP tasks. Figure 4.1 presents the link between these three sections and the identification of existing and future conditions – the first major task of the RTP. The links between these data and tools and the needs and deficiency and project improvements tasks are described in more detail in Sections 7.0, 8.0, and 9.0 of the guidelines.

Figure 4.1 Links Between Existing and Future Conditions Analysis and Profile Guidelines



# ■ 4.1 Obtain Highway Performance Monitoring System (HPMS) Data

The HPMS is a national highway data system of the extent, condition, performance, use, and operating characteristics of the nation's highways. HPMS contains administrative and system extent information for all public roads. State DOTs are required to assemble these data for both state and local roads, and submit them to the Federal Highway Administration (FHWA) for analysis of national needs. For the purposes of the Profile process, this document will focus exclusively on the Arizona state highway system, which this process is designed to address.

The HPMS data submitted to FHWA contains both universe and sample items. Universe items are collected for every road. Sample items include a much larger number of data fields and are collected for a sample of roads. Sample sections are chosen statistically and expansion factors are generated for these segments to allow for an evaluation of system performance. FHWA uses sample data in the analysis of highway system condition, performance, and investment needs that make up the biennial Condition and Performance Reports to Congress. Although the sample data are acceptable for these purposes, many of the sample items in the HPMS, which include detailed infrastructure and operations data, are vital for the identification of needs and deficiencies and evaluation of projects.

ADOT, like several other states, has implemented a process to generate a database that includes complete data for all highway segments. This is referred to as a **100 percent sample**. Although ADOT is required to submit the sampled records to FHWA, the 100 percent sample provides substantial additional data and the ability to examine conditions for every segment of the state highway system in addition to overall system performance. **The 100 percent sample must be used to support each Profile**.

At the beginning of the Fiscal Year (June 1), ADOT prepares and submits its annual HPMS database to FHWA. As of this writing, ADOT's current HPMS submittal represents 2003 conditions. In order to maintain consistency, Profile consultants must obtain and use the following HPMS datasets:

- Southeast Arizona Profile ADOT's most recent Federal HPMS submittal (representing 2004 conditions);
- Grand Canyon, Central, and West Arizona Profiles (studies to begin later in 2005) ADOT's 2004 HPMS submittal;
- I-40 Corridor, Maricopa, I-10 Corridor, and Rim Country Arizona Profiles (studies to begin in 2006) ADOT's 2004 HPMS submittal, transitioning to the 2005 submittal if it becomes available before the start of data collection for each study; and
- Southwest, Nava-Hopi, White Mountains, and Gila Valley Arizona Profiles (studies to begin in 2007) ADOT's 2005 HPMS submittal.

#### ■ 4.2 Refine and Format HPMS Data

As described above, ADOT's latest 100 percent sample HPMS database must be used to represent baseline transportation conditions for both the base (2005) and future (2030) years. This section identifies the HPMS refinements and formatting needed to support the Profile process. Specific database revisions will likely include:

- Integrating regional-specific VMT or travel model-based forecasts to represent both base and future regional AADT;
- Checking and updating base year (2005) HPMS data items to reflect recently completed transportation projects that may not be captured in the existing data;
- Updating future year (2030) HPMS data items to reflect expected future transportation projects, based on the current ADOT Five-Year Transportation Facilities Construction Program; and
- Other updates to be determined through consultation with ADOT and other regional agency staff.

Table 4.1 shows the process steps required to format the full 100 percent sample HPMS database for use in each Profile. The HPMS processing steps require knowledge of the specific region's transportation system characteristics and general knowledge of HPMS, and do not require advanced programming capabilities.

Table 4.1 Process Steps to Format a Full 100 Percent Sample HPMS

Process Step	Requirements	
Obtain data	Obtain current year 100 percent sample HPMS data from ADOT Data Section. The ADOT Data Section will provide each PROFILE consultant with a subset of the 100 percent sample HPMS records that represent the state highways covered by the PROFILE.	
Update AADT	Update projected vehicle trips (FUTAADT) using recommended travel demand modeling approach (described in Section 6.0).	
Update HPMS for HERS-ST	Edit variables for HERS-ST to understand full sample records. Two HPMS variables need to be edited so that HERS-ST can read all of the records as sample records:	
	1. ISSAMPLE records whether or not the record is a sample record. This should be set to 1 for all records.	
	2. SAMPLEID records the unique sample identifier for each of the sample records. This should be set to a unique identifier for all records, such as the SECTIONID record.	
Update base year data	Base year data should be checked against recently completed projects using the prior years' Transportation Facilities Construction Program. As appropriate, data items to update likely will include geometrics (number lanes, median type and width, shoulder type and width, etc.); capacity; a others.	
Develop future base data (existing plus committed projects)	Future base data should be developed to represent conditions on the state highway system as they would be if all committed projects in the current Five Year Transportation Facilities Construction Program were built. This existing plus committed database should be used for 2015 and 2030 (representing the ADOT Program of projects forecasted for construction by 2015 and 2030) analyses. ADOT has specified that an interim forecast year of 2015 be evaluated for each Profile in addition to the 2030 analysis. As above, all appropriate HPMS data items should be updated to reflect committed projects. (For example, widening a road from 2 to 4 lanes, will include changing the through lanes and peak lanes variables at a minimum. It will likely also require an evaluation of median type and width, shoulder type and width, surface type, PSR, and other variables that would be impacted by such a project.) Consultants on the Profile will be required to develop this information and conduct any GIS or other programming required to analyze these data for the Profile.	

ADOT has developed a comprehensive HPMS database that covers all state highway segments. Profile consultants need to be aware that data are absent for two areas – curves and grades. These data items are not crucial to the Profile analysis (e.g., it is unlikely that a Profile would suggest major changes to highway grades). However, when identifying the need for projects such as climbing lanes, as well as developing cost estimates, it will be

important to take into account curve and grade information as best as possible in the analysis. Section 9.0 provides additional information on how these data should be integrated. Profile consultants are not expected to collect these data for highway segments in the region under study.

#### ■ 4.3 Obtain Supplementary Data

Some Profiles may require additional data beyond the HPMS full sample attributes or may need to supplement default "lookup" tables with specific state and regional information. An understanding of the weakness of the "full sample" HPMS data will guide this effort. Profile consultants will likely need to integrate any new data developed for the Profile into ADOT's "full sample" HPMS database file or any related road inventory file. New data potentially includes updated roadway curve and grade data, access control, and geometrics, among others specific to the transportation system characteristics of a given Profile.

On its own, HPMS and its associated analysis tools will not support the analysis of all transportation system needs, deficiencies, and projects. For example, bridge, bicycle, and transit needs will need to be derived using other data and analysis methods outside of HPMS. Performance measures computations for safety using HERS are based on national rates that may not reflect regional conditions. Therefore, state and regional crash databases maintained by ADOT need to be obtained and formatted in the application tools to address regional and local characteristics. Those preparing Profiles need to identify other ADOT databases, GIS layers, and standards to integrate with the analytical tools (Section 5.0) and databases to best represent regional conditions of a given Profile. This includes the measured highway shapefile (highway network representation in GIS format) that will be used to merge the data in different ADOT databases. Table 4.2 shows the types of data and data sources that can be used in conjunction with HPMS data.

 Table 4.2
 Potential Supplementary Data Sources

Data	Source	Format
Highway physical condition, operations, performance	HPMS	Database
Highway accidents	ADOT Safety MS	Database
Highway network	ATIS	GIS
Truck-hauled commodities	BTS, FAF, ADOC	Database
Transit vehicle data, system ridership, system expenses	NTD	Database
Transit systems by service area	APTA	Database
Routes, service type, frequency, other operational data	City and transit agencies	Database
Amtrak station locations	BTS	GIS
Amtrak ridership	ADOT	Table
Amtrak route information	Amtrak web site	Text
Rail line locations	BTS, Census	GIS
Rail-highway intersections and rail accidents	FRA	Table
Rail ownership, rail-hauled commodities	AAR	Table
High-speed rail proposal characteristics	ADOT HSR Study	Text
Airport (and runway) locations and characteristics	BTS	GIS
Airport operations and performance	FAA, BTS	Database
Statewide bicycle suitability network	ADOT	GIS
Tucson bicycle network	PAG	GIS
Phoenix, Flagstaff, and Tucson regional bicycle and pedestrian system characteristics	Local off-street system plans	Text
Pedestrian border movements	BTS	Database
Intermodal facility locations and characteristics	BTS	GIS
Phoenix area and some statewide ITS systems	MAG ITS Strategic Plan	Text
Tucson area ITS systems	PAG web site	Text
Arizona ITS Plan	ADOT	Text
Federal land and tribal land ownership	ALRIS	GIS

### 5.0 Profile Tools and Methods

This section presents the analytical tools that will be used to support the development of each Profile with a primary focus on the Highway Economic Requirements System – State (HERS-ST). A detailed description of HERS-ST, as well as Arizona-specific refinements, is presented below. This section also presents information about additional tools that can be used to assess multimodal and intelligent transportation system/operational needs, deficiencies, and projects.

#### ■ 5.1 HERS, HERS-ST, and HERS-ST AZ

The Highway Economic Requirements System (HERS) was developed by the FHWA to analyze the performance and condition of the U.S. highway system, and to identify the cost of maintaining and expanding that system, given future demand. HERS uses engineering standards to identify highway system deficiencies and applies economic criteria to identify the costs and benefits of improving these deficiencies. HERS uses HPMS data submitted by the state DOTs to provide a summary of the condition and performance of U.S. roads.

The state version of HERS (HERS-ST) was developed by several states to expand HERS for additional analysis at the state level. It also included the development of a graphical user interface (GUI) that made the HERS-ST application more user friendly. HERS-ST is based on the analytic procedures of HERS, but also allows for the analysis of specific highway segments. (Where HERS provides a summary of deficiencies and project needs on the highway system, HERS-ST identifies deficiencies and projects on specific segments in addition to summarizing this information for the entire system. HERS-ST is designed to evaluate the impacts of alternative programs and policies on the conditions, performance, and user costs associated with highway projects. It estimates the cost of investments and predicts system conditions and user costs associated with a given project or projects.)

HERS-ST will be the basic analytical package used to identify needs and deficiencies and evaluate potential project improvements for each Profile. During the development of the Southeast Arizona Profile, HERS-ST will be refined and tailored to fit the needs of Arizona and for each specific Profile to be conducted (see Section 5.2). The tailored version of HERS-ST AZ developed as part of the Southeast Arizona Profile will be delivered to and then distributed by ADOT to the consultants responsible for the development of each Profile. No HERS-ST programming will be required of ADOT or the Profile consultants in this planning process.

#### **HERS-ST AZ**

The engineering models in HERS-ST are based on national averages. For example, pavement deterioration, value of time, and other variables are based on Federal research. As part of the Profile guidelines, these values will be refined to reflect Arizona specific data. In addition, several parameters will need to be refined to reflect regional conditions for each Profile. Table 5.1 presents the parameters that have been refined at the state level and information about further refinements that may be required at the regional level.

As stated previously, an Arizona specific version of HERS-ST AZ has been developed for the Profiles and will be made available on a CD-ROM for consultants preparing Profiles.

#### ■ 5.2 ITS and Operational Analysis Tools

The assessment of ITS and operational improvements within the PROFILE planning process requires specialized analysis capabilities. Conventional tools such as travel demand models and HERS-ST have various limitations that prohibit their use in adequately evaluating these dynamic strategies. Several tools provide these analysis capabilities that could be integrated into the Profile planning process. While no specific analytical tool or model is suggested for use, Profile developers must adhere to the following guidance in selecting an ITS and operational analysis tool for application:

- Tools must be approved for use by ADOT;
- Tools must support some or all of the performance factors identified in these Profile guidelines (see Section 7.0);
- Tools must support cost effectiveness criteria (user benefits and costs) for the measures used to support the performance factors;
- Tools must be able to use local, regional, and state parameters, rather than just depending on national defaults;
- Tools must address full range of ITS and operational strategies, including freeway management, arterial management, and incident management systems; and
- Tools must be fully documented and submitted to ADOT for their review and approval for potential use in a given Profile analysis.

**Table 5.1** State and Regional Refinements to HERS-ST Parameters

Variable/Parameter	State Refinement	Potential Regional Refinement
Deficiency Tables (DLTbls)	Base deficiency tables adjusted to reflect Arizona specific conditions. Discussed in thresholds (see Section 8.0)	No regional adjustments required
Maximum pavement deterioration rate (MaxPD)	HERS default value not adjusted	Value should be adjusted regionally based on weather conditions
Rural intersection and driveway densities (DDRML, MaxIML, DD, MaxIR2)	HERS default values adjusted to reflect Arizona specific conditions	Profiles that have substantial overlap between the state and local systems and the associated parameters of this overlap should be reviewed by consultants
Truck growth factors by functional class (TrkFac)	Adjusted to reflect estimated growth in truck travel relative to total travel from existing studies.	No regional adjustment required
Pavement after reconstruction or resurfacing (PavmTh, PSRRec, PSRInc, PSRRMx)	Adjusted to reflect Arizona specific conditions.	No regional adjustment required
Crash Costs (InjCost, PropDM)	Adjusted to reflect Arizona specific conditions	No regional adjustment required
Fatality and injury ratios (FatR, InjR)	Adjusted to reflect Arizona specific conditions	No regional adjustment required
Operating costs, price indices, value of travel time (UPrice, PrIndx, VTTCC)	Adjusted to reflect Arizona specific conditions	No regional adjustment required
Improvement costs	Improvement cost tables adjusted to reflect Arizona specific conditions. Discussed in projects (see Section 9.0)	No regional adjustment required.
HERS national models	HERS-ST AZ will include recently approved national models	No regional adjustments required

The operations analysis tool selected must be consistent with standard practice and must consider sensitivity tests to gauge the impact of the results. Profile consultants will need to satisfy ADOT that the selected tool provides reasonable results similar to those generated by standardized and approved tools. Once the tool has been reviewed and approved by ADOT, the Profile consultant will be required to submit the tool to ADOT for their continued use.

The FHWA's ITS Deployment Analysis System (IDAS) is one example of an available tool for evaluating ITS and operational strategies. IDAS is designed to operate as a post-processor to regional travel demand models, providing the ability to test the impacts of ITS and operational strategies on a wide range of performance factors and measures. The default impacts and analysis parameters in IDAS are based on national averages but can be refined to reflect state and regional conditions.

Adjusting the nationally based defaults within IDAS can be accomplished to better reflect Arizona conditions. For regions not supported by regional travel models, or for evaluating smaller scale ITS and operational improvements, techniques derived from the IDAS software or other similar tools can be used in conjunction with HERS-ST to provide these capabilities.

#### ■ 5.3 ADOT Management Systems

HERS-ST can be used to support some safety and pavement analysis. However, the integration of available ADOT management systems must be considered in the preparation of each Profile. Table 5.2 presents a summary of the information provided by ADOT Management Systems and their use in the Profile planning process.

Table 5.2 ADOT Management Systems Use in the PROFILE Process

System	Description	Use in Profile Process
Pavement	Identifies current pavement conditions, and short-term (3-year) resurfacing projects, and long-term analysis of pavement needs	Identify short-term pavement projects and long-term pavement needs
Bridge	Inventory of current bridges	Analyze long-term needs using National Bridge Inventory Analysis System (NBIAS)
Safety	Cost-benefit analysis of system and project safety improvements	Needs identified for region

Source: Cambridge Systematics, Inc., 2005.

#### ■ 5.4 Multimodal Analysis Tools

In addition to addressing highway related needs, deficiencies, and projects, each of the Profiles must also address multimodal considerations, including transit, bicycle/pedestrian, and others. Table 5.3 provides guidance on the types of tools and methods that should be used to assess multimodal considerations. As with the ITS and operational tools described in Section 5.2, no specific analytical tool or method is required. However, Profile consultants must adhere to the following guidance in selecting multimodal analysis tools for application:

- Tools and methods must be approved by ADOT;
- Tools must support some or all of the performance factors identified in these Profile guidelines (see Section 7.0);
- Tools must be based on state, local, and regional parameters; and
- Tools must address transit, pedestrian, and bicycle impacts on the state transportation system, and tools must be fully documented and submitted to ADOT at the completion of a given Profile.

Table 5.3 Multimodal Tools and Methods

Issue	Tools and Resources
Urban Transit Systems	Urban travel demand must be identified for those Profiles with established transit operations and regional travel demand models with transit networks and mode split components. This data will be the basis for forecasting urban transit demand within the context of any given Profile.
	For smaller urban areas, data from the national transit database (NTD) can support analysis of the extent and use of existing systems.
Rural Transit Systems	Rural areas primarily use private on-demand or flex route services as part of the Federal 5310 and 5311 programs. Using standards similar to those developed for MoveAZ, the extent of these systems, demand for their use, and need for new systems should be identified.
	Data from FTA and the ADOT Public Transportation Division will be useful to assess the extent and use of these systems, as well as the demand for new systems.
Bicycle/ Pedestrian	MoveAZ provides methods to assess the bicycle and pedestrian demand and utilization, primarily in urban areas.
	Additional resources include the Census Journey-to-Work file and the National Personal Transportation Survey (NPTS).
	In small urban areas, where state highways serve as local roads, visual inspection of bicycle and pedestrian facilities will be required.

Arizona Department of Transportation

Cambridge Systematics, Inc., 2005.

Source:

# 6.0 Travel Demand Forecasting

This section presents detailed information about the approaches to conducting travel demand forecasting for the Profiles. Criteria for selecting the appropriate approach for a given Profile also are described in this section along with guidance on travel modeling applications and procedures.

#### ■ 6.1 Determine Travel Modeling Approach

Methods for estimating travel demand will be determined by taking into account the availability of regional travel demand models, urban and rural travel conditions, and transportation system characteristics of a given Profile. For each Profile, an assessment will be made as to whether a travel demand model is necessary to identify needs and evaluate projects as part of the planning process. Three potential approaches have been identified to estimate travel demand:

- **Link factoring**. Link factoring applies growth factors to existing counts to estimate future traffic volumes. This approach is generally appropriate in rural areas or areas of steady or uniform growth. It is less appropriate in areas that are rapidly developing, urban, facing changing growth patterns, or with major new facilities.
- Travel demand modeling. A travel demand model uses a rigorous process to estimate trip generation, trip distribution, mode choice, and trip assignment. This approach is appropriate in urban areas that have an existing travel demand model covering most or all of the planning area. It is not appropriate for rural areas or areas of steady growth. The Profile process should not include development of a new 4-step travel demand model.
- Simplified network modeling. A simplified network modeling approach does many of the same things as a 4-step model, but with less rigor and at lower cost. This approach considers the estimation of travel demand using regional transportation network and travel behavior characteristics, much of which can be obtained with available modeling and traffic count data. This approach is generally appropriate in areas that have some existing modeling system that does not cover the entire study area, as well as rapidly growing areas with changing patterns of development. It is less appropriate for rural areas and areas of steady growth.

The appropriate modeling approach should be determined early in the Profile planning process, based on the characteristics of a given Profile. Figure 6.1 provides a flow chart to assist in determining the appropriate approach to demand estimation. In all cases, approval must be received by ADOT prior to implementing a modeling approach.

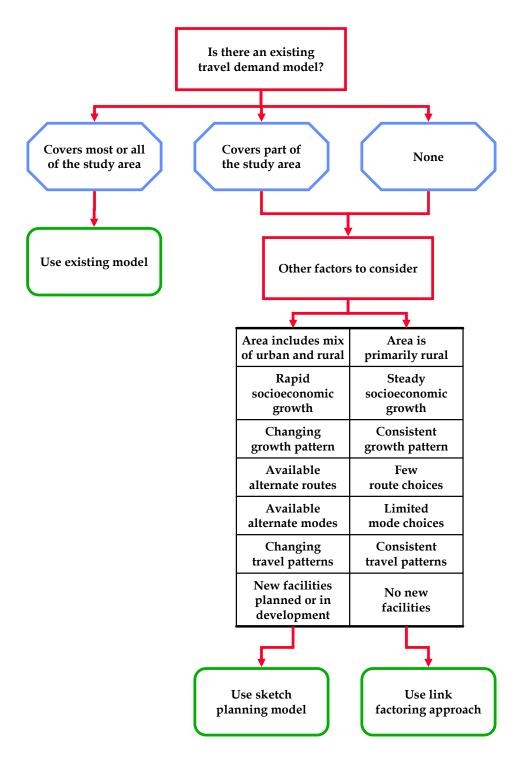


Figure 6.1 Demand Estimation Flow Chart

Additional information about the three approaches is provided below.

#### **Link Factoring Approach**

Link factoring methods were used in MoveAZ to update future HPMS travel forecasts. Factoring traffic volumes is less resource intensive than other approaches, but assumes that the underlying travel behavior in a region will not change. This approach is valid if the underlying trip distribution pattern is unlikely to change, if minimal changes in auto occupancy or mode split are expected, and if congestion on existing roads or the opening of new roads is not likely to result in a change in route choice/assignment.

Similar to the method used to support the MoveAZ plan, developing a VMT forecast and factoring the existing AADT fields in the "full sample" HPMS database could be accomplished using this factoring method. If this approach is used, factors must be developed and applied using the VMT methods described in MoveAZ Task 9 Report Appendix E, Section 2.6. The VMT forecast is based on population and employment forecasts as well as historical traffic counts. Appendix E of the MoveAZ Plan includes the regression equations by county and functional class that were used to estimate VMT and a complete description of the methods applied.

#### Regional Travel Demand Modeling Approach

Several regional agencies in Arizona have developed and maintain 4-step travel demand models, including:

- Maricopa Association of Governments (MAG);
- Pima Association of Governments (PAG);
- Flagstaff Metropolitan Planning Organization (FMPO);
- Yuma Metropolitan Planning Organization (YMPO); and
- Central Yavapai Metropolitan Planning Organization (CYMPO).

Regional travel demand models would add rigor to the Profile evaluations and provide ADOT with the opportunity to assess the travel diversion, congestion relief, and other impacts of a project solution on the transportation system. These methods primarily include the development and use of the traditional four-step travel demand modeling process (trip generation, distribution, mode choice, and assignment).

#### Simplified Network Modeling Approach

For most Profiles, a travel demand model will not be appropriate. A simplified network modeling approach provides a means to achieve many of the benefits of a 4-step model at a much lower cost. The approach recommended for the Profiles considers the use of the

TransCAD Origin Destination Matrix Estimation (ODME) module. This ODME process, in conjunction with regional travel demand model and GIS-based network and behavioral data, can be used to replicate base and future year travel on the regional transportation system.

Modeling results generated by TransCAD can be easily formatted for use in HPMS and HERS-ST AZ for needs, deficiencies, and project evaluations. In addition, the development of highway networks to support an ODME modeling process is consistent with the traditional 4-step approach.

#### ■ 6.2 Data Required for Travel Forecasting

Regardless of approach selected, several data items will need to be collected to support the modeling process. In most cases, available data will be collected and used to support this process, including:

- Classification traffic counts from ADOT and various regional agencies;
- Socioeconomic (population and employment) data from ADOT, Arizona Department of Economic Security, regional agencies, or others;
- Freight (truck) flow information from Arizona Department of Commerce (ADOC), FHWA, ADOT, and various regional agencies;
- GIS-based transportation network characteristics and parameters from ADOT; and
- Transit ridership and demand from ADOT and regional agencies.

Classification counts. Historical classification counts will be required to support the link factoring, regional travel demand modeling, and simplified network modeling approaches. In Profiles where simplified network models are developed, counts will be used to estimate travel demand. In cases where regional models are updated, counts will be used to validate volumes generated in the modeling process. Counts will be used in the link factoring approach to update VMT forecasting methods similar to the method used to support the MoveAZ plan. ADOT will provide its HPMS database for use by all Profile consultants.

**Socioeconomic data.** Socioeconomic data will be a primary input in the modeling process. If a link factoring approach is selected, socioeconomic data will be used to factor the observed traffic volumes according to methods described in MoveAZ Task 9 Report Appendix E, Section 2.6. The VMT forecasts developed for MoveAZ can be refined to represent both base and future travel demand for a given Profile. If a regional travel modeling approach is selected, socioeconomic data will be used to drive the travel modeling process, especially related to travel demand growth to 2030. In the simplified network modeling approach, socioeconomic growth will be used to generate future travel

demand. Profile consultants must identify the appropriate socioeconomic data, which will include state sources (such as Arizona Department of Security (ADES) projections), regional sources (such as data used to support travel demand models), and national sources (such as the Census or Woods & Poole). Although consultants are not required to use ADES projections for the Profiles, they must evaluate the usefulness of these data for a particular region and work with ADOT to define final data used in the Profile planning process. Final base and future year socioeconomic data estimates must be approved by ADOT.

Freight data. For many Profiles, freight travel demand data will be an important element to consider in the travel modeling process. Several available datasets can be used to support freight demand modeling in Arizona including commodity flow datasets recently obtained and used by the Arizona Department of Commerce in a Freight Logistics Study, classification counts collected by ADOT, and the FHWA Freight Analysis Framework (FAF) flows. The ADOC commodity flow information (Reebie TRANSEARCH Database) considers commodity flows for all Arizona counties and transportation modes (truck, rail, air), including internal and external movements to all states across the United States. This freight data can be used to update truck travel in the link factoring approach, and to represent regional truck travel in support of both the regional travel and simplified network modeling approaches.

Network data. ADOT maintains a road inventory file (ATIS) in GIS format that represents the entire state transportation system. This roadway inventory file was used to support the project prioritization process used in MoveAZ. ADOT maintains a linear referencing system that links these data to the HPMS roadway segments for all functional classifications. This dataset will be required regardless of approach used for a given Profile. If the link factoring approach is used, this file will be integrated with HPMS to provide updated link volumes by roadway segment and integrated directly with HERS-ST AZ to assess transportation system needs and deficiencies. If the regional modeling approach is used, this file will be used to develop the transportation network characteristics. This data can also be integrated with the TransCAD software to fully implement the ODME modeling process. It also will be linked to the HPMS and HERS-ST AZ tools for systems evaluation.

**Transit data**. Understanding the impacts of transit on the transportation system will be useful for each Profile. Collecting relevant transit usage information will be important to understand the performance of multimodal projects in both needs and project improvements analysis. Regardless of modeling approach, this information could be used to assess multimodal impacts and be obtained primarily from regional and local agencies.

# 7.0 Performance Factors and Measures

This section presents information about the performance factors and measures that will be used to support each of the Profiles. The MoveAZ plan set a clear direction for the use of performance-based planning in Arizona by identifying goals, objectives, and performance factors for the State. For the Profiles, performance measures will be identified to capture needs and deficiencies across a wide variety of conditions. HERS-ST AZ will be applied to generate most of the measures, although additional measures will be required.

The performance-based planning techniques outlined here form the foundation of the technical tasks to be conducted in each Profile – the analysis of needs and deficiencies and the identification of project improvements. This section describes the performance factors and measures to be used in the Profiles. Section 8.0 provides additional information needed to support a performance-based analysis of needs and deficiencies. Section 9.0 provides additional information needed to support a performance-based project definition and evaluation process. Figure 7.1 provides a summary of the links between the performance factors and measures and these two analyses.

**HERS-ST** and Other Tools **Performance Factors** and Measures Section 9.0 Section 8.0 Identify **Project Elements** Apply Define Performance **Projects Thresholds Identify Needs Identify Project** and Deficiencies **Improvements** Legend: RTP Task RTP Guideline

Figure 7.1 Link Between Performance Planning and Technical Tasks

#### 7.1 Performance Factors

Performance factors are a means to organize the analysis of transportation systems. Developed for the MoveAZ plan, ADOT has identified several broad factors that represent the major goals that ADOT would like to achieve from its transportation system investments (see Section 3.0). Each performance factor will be evaluated using one or more performance measures (see Section 7.2).

Each Profile will use a common set of performance factors. By and large, these will be consistent with the performance factors identified in the MoveAZ plan. Not all factors are to be considered equally in the Profile planning process. MoveAZ identified weights for factors that will be used to set relative priorities. Though all factors must be addressed in each Profile, more attention should be paid to the priority factors. Table 7.1 provides a list of the factors to be addressed in each Profile, as well as the priority of each factor. Through the MoveAZ planning process, descriptive weights (representing factor priorities) were established based on a comprehensive public and stakeholder involvement program. As shown in Table 7.1, three descriptive weights were selected to describe the relative priorities of the factors:

**Table 7.1** Profile Planning Factors and Priorities

Factor	Priority	Weights
Mobility	Enhance	1.4
Safety	Enhance	1.4
Cost Effectiveness	Enhance	1.4
Accessibility	Sustain	1.2
Preservation	Sustain	1.2
Connectivity	Neutral	1.0
Reliability	Neutral	1.0
<b>Economic Competitiveness</b>	Neutral	1.0
Resource Conservation	Neutral	1.0

Source: MoveAZ Plan, December 2004.

Enhance was used for factors with the highest priority for ADOT. These are factors
that ADOT should focus on to improve roadway performance, possibly at the expense
of other factors. These factors must be assigned a higher weight in the Profiles
performance-based planning process based on stakeholder and public input gathered
and used in the MoveAZ Plan.

- 2. **Sustain** was used for factors for which ADOT should try to maintain current performance levels. These factors must be assigned a weight in the Profiles consistent with maintaining system performance levels as defined in the MoveAZ Plan.
- 3. **Neutral** was used for all other factors. These factors represent issues that are important, but somewhat less so than other factors. As with the previous weight categories, these factors must be consistent with maintaining the definitions identified in the MoveAZ Plan.

#### ■ 7.2 Performance Measures

Each performance factor will be assessed using one or more performance measures. These measures will be used for both the needs and deficiency analysis and the evaluation of projects. Not all measures are appropriate for both of these tasks and not all evaluations can be assessed neatly with a single measure. ADOT has identified three basic performance measure categories:

- **Primary measures.** Most of the performance measures are designed to address both the needs and deficiency analysis and the evaluation of projects. The majority of these measures are calculated using HERS-ST AZ, though a few measures also use other tools. These measures are presented in Table 7.2.
- Project evaluation measures. Several performance measures have been identified
  exclusively to evaluate projects and not to address deficiencies. Most of these measures address benefits that result from operational and ITS type improvements. Typically, these types of improvements are alternate, cost-effective means to address a
  deficiency, such as congestion, that might otherwise be addressed by a major capital
  project. For example, ramp metering addresses a congestion deficiency, not a ramp
  metering deficiency. Table 7.3 provides a list of measures that should be used for
  project evaluation only.
- Additional considerations. In addition to the explicit performance measures identified, there are several issues noted in the Profile guidelines that cannot be addressed simply with performance measures. These items include access management, some multimodal considerations, and others. Although there are no explicit performance measures, it is imperative that each Profile address these issues using the best data and methods available (see Section 4.0). Table 7.4 provides a list of these considerations and the methods and tools that should be used to evaluate them.

**Table 7.2** Primary Performance Measures by Factor

Factor	Measure	Description	Source
Mobility	TDEL	Total delay (hours per 1,000 VMT)	HERS-ST AZ
	%VC	% VMT below thresholds for volume/capacity ratio	HERS-ST AZ
Reliability	IDEL	Incident delay (hours per 1,000 VMT)	HERS-ST AZ
Preservation	APSR	Average Pavement Serviceability Rating (PSR)	HERS-ST AZ, ADOT PMS
	%PSR	% VMT below thresholds for PSR	HERS-ST AZ
	BSR	Percent of bridges below sufficiency rating	NBIAS
Economic	TUC	Total user costs (\$ per 1,000 VMT)	HERS-ST AZ
Competitiveness	TTC	Travel time costs (\$ per 1,000 VMT)	HERS-ST AZ
	TKOC	Truck operating costs (\$ per 1,000 VMT)	HERS-ST AZ
Safety	CRAR	Crash rate (per 100 million VMT)	HERS-ST AZ
	ICR	Injury rate (per 100 million VMT)	HERS-ST AZ
	FCR	Fatality rate (per 100 million VMT)	HERS-ST AZ
Resource Conservation	EMIC	Average pollution damage cost (\$ per 1,000 VMT)	HERS-ST AZ
Accessibility	JOBS	Percent of employment with 45- minute drive time of average resident	Travel demand model trip tables
Connectivity	PASS	Travel times between city/town pairs	MoveAZ

Table 7.3 Additional Project Evaluation Performance Measures by Factor

Factor	Measure	Description	Source
Cost Effectiveness	CBR	Cost-benefit ratio for project investments	HERS-ST AZ
Mobility	PMI	Personal mobility (Index)	Operations tool
Reliability	DEL	Hours of unexpected delay	Operations tool
Accessibility	MODE	HOV and transit mode share	Operations tool
Safety	CRSH	Number of accidents per 100 million VMT	Operations tool
Resource Conservation	EMIS	Tons of emissions (HC, NO <sub>x</sub> , CO)	Operations tool
	GAS	Gallons of fuel used	Operations tool
Cost Effectiveness	NET	Net benefit	Operations tool
Accessibility	ACCESS	Number of jobs within 30 minutes of average resident	Travel model; GIS

Note: These measures will be used to address the performance of project improvements and will not be used to identify needs and deficiencies.

 Table 7.4
 Additional Performance Evaluations, by Factor

Factor	Issue	Method of Assessment
Accessibility	Interchange coverage	Using socioeconomic data and planning data from jurisdictions, identify accessibility of residents to state facilities (i.e., are new interchanges needed)
Mobility	Access management	For state routes that act as local facilities, consider number of access points along the route and traffic volumes. Can be calculated using HPMS data.
Accessibility	Rural Transit coverage	ADOT Transit Database, city population, etc. used to assess the availability of existing systems.

## 8.0 Performance Thresholds

The previous section identified performance measures that need to be used to address deficiencies on the transportation system and to evaluate potential transportation projects. This section addresses the link between the performance measures and the needs and deficiency analysis that must be conducted as part of every Profile. The key element of this linkage is in the area of thresholds. Figure 8.1 presents the process that should be used to implement the basic deficiency analysis for the Profiles.

**HPMS** and **Existing and Future** Conditions Identified Other Data HERS-ST Other AZ**Tools Performance Measures** Needs and Deficiency Analysis Performance Thresholds Needs and **Deficiencies Identified** 

Figure 8.1 Needs and Deficiency Analysis Process

The needs and deficiency analysis will be based on the tools and methods discussed in the previous sections of the guidelines. The results of this analysis should be presented in a format that is accessible to a broad range of potential users, including decision-makers and the public, as well as planners and engineers.

The performance measures allow for comparisons between the impact of potential projects, the seriousness of deficiencies on various segments, and the impact of deficiencies or projects over time. These comparisons are possible in the abstract (e.g., one segment can be determined to be some percentage more deficient than another without specific information about the scale). The purpose of this section is to identify the conditions under

which a segment can be determined as deficient and/or improved for each performance measure. This consideration primarily impacts the deficiency analysis, but is also relevant to the evaluation of projects.

- **Deficiency analysis.** Multiple threshold values for each measure will be used to determine the seriousness of the deficiency. The most basic level indicates that a deficiency exists. Additional levels indicate a serious deficiency or a critical (i.e., must be fixed) deficiency.
- **Project evaluations.** A single threshold is required for the project evaluation process. The purpose of these thresholds is to ensure that projects can be implemented to mitigate deficiencies, rather than improving upon already good performance for a given situation. Because each project will be evaluated using multiple performance measures, it is important to ensure that a given project does not receive credit for improving a segment that is already in good condition. For example, ADOT sets a V/C ratio of 0.8 for urban areas and 0.71 for rural areas. Projects that improve highway segments past these levels should receive credit only for the portion up to the threshold level (see MoveAZ Plan Appendix F for a detailed description of the application of these thresholds).

Descriptions of the HERS-ST AZ and non-HERS-ST AZ deficiency tables and analysis are presented below.

#### 8.1 HERS-ST AZ Deficiency Tables

HERS-ST AZ has built-in deficiency tables that allow the program to identify specific deficiencies on the state highway system, as well as summary information about those deficiencies. This section provides an overview of the deficiencies identified in HERS-ST AZ, as well as information about the deficiencies identified for Arizona. Actual deficiency tables developed for the Profile planning process are included in the HERS-ST AZ installation CD.

HERS-ST AZ identifies deficiencies on eight primary characteristics from HPMS data that address three types of deficiencies – pavement conditions, congestion, and geometrics. Table 8.1 presents the eight characteristics used by HERS-ST AZ to identify deficiencies. Detailed tables with recommended thresholds will be included in the HERS-ST AZ CD-ROM for distribution to all Profile consultants.

Table 8.1 HERS-ST AZ Deficiency Tables

Variable	Deficiencies Measured	
PSR	Pavement Serviceability Rating	
SfType	Surface type	
VC	Volume/capacity ratio	
LnWidth	n Lane width	
RSWidth	Right shoulder width	
ShType	Shoulder type	
Halign	Horizontal alignment	
Valign	Vertical alignment	
	PSR SfType VC LnWidth RSWidth ShType Halign	

The eight variables shown in Table 8.1 impact all of the deficiencies identified by HERS-ST AZ, including mobility (congestion or delay), safety (crash rates), and the others shown in Section 7.0.

Although three basic deficiency levels were discussed above, the deficiency tables built into HERS-ST AZ contain five values. These values reflect both maximum (i.e., design standards) and minimum (i.e., deficiencies) thresholds. Table 8.2 presents the five types of thresholds used by HERS-ST AZ, as well as how they are going to be used in the Profile planning process.

HERS-ST AZ allows for substantial detail in the identification of deficiency thresholds. Most deficiency levels are defined by some combination of functional class, traffic volume, and other factors. As a result, there is more detail than can be presented here, and the draft tables that contain this detail are included on the HERS-ST AZ installation CD. These files will automatically be loaded into HERS-ST AZ for the Profiles.

Table 8.2 HERS-ST AZ Thresholds and the Profile Planning Process

Threshold	Description	Profile Guidelines
Design Standard (DS)	HERS-ST AZ refers to this parameter to set the upper limit when designing and implementing improvements. Helps to determine the cost of the improvements selected.	Used as upper bounds for defining improvements.
Deficiency Level (DL)	HERS-ST AZ utilizes this parameter to identify deficiencies that warrant analysis, but do not necessarily require improvement. DLs limit the number of potential improvements by HERS-ST AZ, and hence limit the computation time.	Set to Arizona-specific levels for analysis.
Serious Deficiency Level (SDL)	Describe more severe levels of inadequacy than the DLs. If a section has a SDL condition, HERS-ST AZ will design all candidate improvements that correct the underlying SDL.	Set to Arizona-specific values, where appropriate.
Unacceptable Level (UL)	This parameter is used to identify sections that qualify for improvements and to correct for unacceptable conditions.	Set to Arizona-specific values, where appropriate.
Reconstruction Level (RL)	This parameter represents the level at which pavement reconstruction is required (resurfacing is insufficient).	Set to Arizona-specific values, where appropriate.

#### ■ 8.2 Non-HERS Deficiency Thresholds

Measures calculated outside of HERS-ST AZ also require thresholds to help understand deficiency levels. For these measures, two thresholds have been identified:

- 1. **Deficiency threshold captures needs -** At what level does a particular deficiency need to be addressed; and
- 2. **Upper bound captures maximum performance –** At what level does a project stop scoring (i.e., how good is good enough).

These thresholds are shown in Table 8.3. This table does not include the other evaluation considerations (the measures shown in Table 7.4), which do not use thresholds.

**Table 8.3 Non-HERS Deficiency Thresholds** 

Measure	Deficiency Threshold	Upper Bound		
Bridge sufficiency rating	Set to Arizona specific levels	None		
Passing lanes	Set to Arizona specific levels	AADT is equal to passing-lane weighted service volume		
Bike suitability	Not used independently to measure deficiencies	Arizona Bicycle-Pedestrian Plan uses an 18-point scale, broken into three tiers (Low: 0-6; Medium: 7-12; High: 13- 18); upper bound threshold is High (13 or higher)		

# 9.0 Project Improvements

One of the primary goals of the Profile process is to identify potential project improvements that address the needs and deficiencies identified in each region. This section provides guidance on how these project improvements should be identified and defined. As with any planning process, consultants will need to supplement the technical procedures outlined in these guidelines with appropriate engineering judgment and consultation with ADOT staff. The guidelines in this section are intended to provide a consistent definition of project improvements that will support ADOT's ability to conduct long-range transportation planning.

The purpose of the Profile process is not to conduct a final evaluation of potential project improvements. That task is intended to be conducted during the update of the MoveAZ Plan, and will include an analysis of projects across the entire State. The performance measures identified in Section 7.0 were structured to allow for a regional evaluation of projects for each Profile.

Figure 9.1 presents a flow of this process and how it is intended to work once needs and deficiencies are identified in previous Profile tasks. The Profile consultants will use available Profile tools; apply appropriate engineering judgment through an in-depth understanding of the regional transportation system and its characteristics; and work directly with ADOT, ADOT District, and regional agency staff to define the project elements that best meet the identified needs and deficiencies. This project element identification process is presented in Section 9.1. As described in Section 9.2, the Profile consultants will then define projects, consisting of appropriate project elements generated earlier, using specific ADOT requirements for corridor, major spot, and program projects. The end product of the Profile planning process will be a set of projects that best meet the needs and deficiencies of a region. Once the 12 Profiles are completed, ADOT will input the total set of projects into the MoveAZ project evaluation process to understand the performance of the projects at the statewide level, and to then prioritize these projects for long-range transportation planning and programming.

Sections 9.3 and 9.4 present the cost estimation methods that must be applied by the consultants in the Profile planning process. These methods will already be designed, developed, and distributed by ADOT to the consultants for application in the Profile planning process. For example, Profile consultants must apply the cost estimation methods defined by ADOT as part of the Profile planning process.

**Needs and Deficiencies Identified Other Sources:** • ITS & operations Project • Multimodal Element **HERS-ST AZ** • Access management Identification • Passing lanes Process • Others **Engineering Judgment** Corridor Spot Subprograms **Projects Projects Projects Reviewed by ADOT TPD Staff Project** Definition Process **Projects Reviewed by District Engineers Final Projects** Identified **Performance Measures HERS-ST AZ** Other Tools **Project Evaluation Process Projects Evaluated** 

Figure 9.1 Project Definition and Evaluation Process

#### ■ 9.1 Identify Project Elements

Many of the projects identified as part of each Profile will consist of individual project elements that comprise the larger project. These elements will include the specific segments of highway to be widened, the actual locations of passing lanes, the bridges requiring widening, and so forth. The larger projects will be a widening solution, passing lane solution, or other improvements.

These individual project elements will be identified through the Profile process using available tools (HERS-ST AZ), as well as engineering judgment and consultant with ADOT staff. Table 9.1 provides guidance on some of the sources that will be useful to help identify project elements.

**Table 9.1** Sources of Project Elements

Project Type	HERS-ST AZ	Other Sources
Highway widening	Use specific segments identified by HERS-ST AZ	
Shoulder widening	Use specific segments identified by HERS-ST AZ	
Passing lanes/climbing lanes		Passing lane performance measure
Pavement resurfacing	Long-term needs for pavement resurfacing over 25 years (not project specific)	Short-term pavement resurfacing projects
Pavement reconstruction	Long-term needs for pavement reconstruction over 25 years (not project specific)	Short-term pavement reconstruction projects
Bridge maintenance and replacement		National Bridge Inventory Analysis System (NBIAS) for overall long-term needs (does not need to be project specific)
Interchange rehabilitation or construction		Interchange assessment
Safety improvements (system and project)	HERS-ST AZ crash rates by functional class	ADOT Safety Management System
Access management		Existing access management studies

The result of this process will be a list of project elements that directly mitigate or satisfy the specific needs and deficiencies identified in earlier steps. As shown in Section 9.2, once these project elements are identified, the Profile consultants must then define overall projects that in some case may consist of multiple project elements.

#### ■ 9.2 Project Definition

Project definition is intended to insure that the projects identified in each of the Profiles follow consistent guidelines. ADOT requirements must be followed by the Profile consultants in order to generate consistent projects for input in the MoveAZ Plan update. For Profile planning purposes, ADOT has defined the following types of projects:

- Corridor Major corridor upgrades include widening, realignment, shoulder improvements, and others. These projects are defined at the corridor level; not segment by segment. A corridor is a logical length of a roadway that, over 20 to 30 years, would be considered for improvement. An example of a corridor is I-10 from Phoenix to Tucson. Corridors will need to be defined relative to the region, but often can be thought of as connecting city/town pairs or providing major access from a city to another area. Corridor-level projects must include all the individual elements that comprise that project. For example, a widening project will include the widening, any shoulder improvements in the corridor, bridges that must be replaced, and other related projects.
- Major Spot These projects include system-to-system interchanges, new interchanges (not connected to other corridor projects), and others. These projects are defined individually and likely will not have elements.
- **Subprogram -** These projects include pavement and bridge preservation, safety investments, and others. They are supported by ADOT management systems that are used to define specific projects. For the Profiles, subprograms will primarily be addressed at the regional level, providing an evaluation of the investment level needed to maintain pavement or bridge quality at a particular standard, or complete a system-level safety improvement (e.g., blunt end guardrail treatments).

As presented in Section 9.1, HERS-ST AZ will be used by the Profile consultants to identify the potential projects and associated project elements that will potentially mitigate the identified system deficiencies. Within HERTS-ST AZ, Profile consultants will need to tailor the specific project definitions to meet the criteria shown in Table 9.2. This table also provides additional guidance in the definition of project improvements.

**Table 9.2 Defining Projects** 

<b>Project Type</b>	Definition and Guidance			
Corridor	Corridor projects address needs in a clearly defined corridor. Should include all elements of a major project. Items to be included in the project definition:			
	Widening segments in the same corridor;			
	• Small cost items within a widening project that are not part of a sub-program;			
	<ul> <li>Bridges or interchanges that must be replaced or rehabilitated as a result of a road widening;</li> </ul>			
	<ul> <li>Projects off the primary route that are designed to support the improvements to the primary route (e.g., access lanes from another road); and</li> </ul>			
	• Sets of passing or climbing lanes that fit together in a corridor concept.			
Locational	Major system-to-system interchanges, interchange rehabilitations not associated with a corridor project, stoplight warrants, and other similar projects.			
Regional	Most management systems should be addressed at the regional level. These management systems typically provide an assessment of the total investment needed to maintain a system (e.g., pavement) at a given standard (e.g., PSR of 3.2).			

#### ■ 9.3 Cost Estimation in HERS-ST AZ

The Profile guidelines also provide information to use in developing cost estimates for projects. This subsection identifies cost estimation procedures used within HERS-ST AZ. These procedures will be conducted separately from the overall process for developing cost estimates for all projects presented in Section 9.4. These costs will be defined by ADOT and integrated into the HERS-ST AZ software and distributed to each of the Profile consultants.

HERS-ST AZ builds costs using three considerations:

- 1. The base cost of improvements;
- 2. Additional costs for potential alignment modifications; and
- 3. Optional urban improvement costs.

Each of these improvement costs are described below.

**Base Improvement Costs.** HERS-ST AZ calculates the capital improvement cost based on the roadway functional class and grade for rural areas and functional class alone for urban

areas. Capital costs are specified in thousands of 1997 dollars per lane-mile. Table 9.3 identifies the categories used by HERS-ST AZ to estimate base improvement costs.

Alignment Modification Costs. These are based upon estimated amounts of clearing and grubbing; earthwork; drainage and culverts; structures; additional right of way; miscellaneous costs (including curbs and guard rails at shoulder or median, fencing, painting, and lighting); and the requirements for base and surface pavements. Additional entries affecting the cost of improving alignment include box culverts per mile, clearing and grubbing parameter, earthwork parameters, generic drainage parameter, and pipe culverts per mile.

**Optional Urban Improvement Costs.** These are used to compute the extra cost of addressing four substandard conditions on urban freeways: 1) unsurfaced shoulders, 2) lack of full access control, 3) lack of a positive-barrier median, and 4) a median width that is below the design standard. To support the Profile process, the base cost parameters in HERS-ST AZ have been adjusted to reflect Arizona-specific circumstances. A summary of the cost assumptions used in HERS-ST AZ will be loaded automatically from the HERS-ST AZ installation CD for all Profile consultants.

Table 9.3 HERS-ST AZ Cost Items

Cost Item	Description
RCHC	Reconstruction with lanes added at high cost
RCNC	Reconstruction with lanes added at normal cost
RCWL	Reconstruction with wider lanes
RC	Pavement reconstruction (including improvements to shoulders)
MWHC	Major widening (resurfacing and adding lanes) with lanes added at high cost
MWNC	Major widening (resurfacing and adding lanes) with lanes added at normal cost
MinW	Minor widening (resurfacing and widening lanes)
RsSSh	Resurfacing with shoulder improvements
Rs	Resurfacing

Source: Cambridge Systematics, Inc., 2005.

#### ■ 9.4 Final Project Cost Estimation

The Profile planning process also includes a method to estimate total costs for all projects. This process uses similar information developed above for HERS-ST AZ to develop and

apply a consistent "planning level" cost estimation method across all Profiles. These cost estimates will take into account all aspects of project costs, including project construction, right of way, and similar costs. A spreadsheet tool will be included on the HERS-ST AZ install CD for making cost estimates using ADOT guidelines and methodologies to ensure consistency across each of the Profiles.

#### ■ 9.5 Project Evaluation

The final step for each of the Profiles will be the evaluation of project improvements, as defined using the process described here. This evaluation will use the performance factors and measures identified in Section 7.0 of the guidelines. The end result of this process will be a table of project improvements, evaluated by performance measure and factor and with the appropriate identification and cost information. Consistent with MoveAZ, project improvements for the Profile should be developed by primary functional system:

- Interstate routes;
- National Highway System routes; and
- Other routes.

These categories represent clear classifications that the FHWA and ADOT apply to project funding and should be reflected in the organization of project improvements for each Profile.

Table 9.4 provides a template that should be used to develop the project evaluation tables.

Table 9.4 Project Evaluation Table Template

	Begin	End	Performance Fact		actor Scor	ctor Scores		
Road	Mile Post	Mile Post	Project Description	Mobility	Safety	Others	Total	Cost
Intersta	te Routes							
National Highway System Routes  Other Routes								
Otner R	outes							