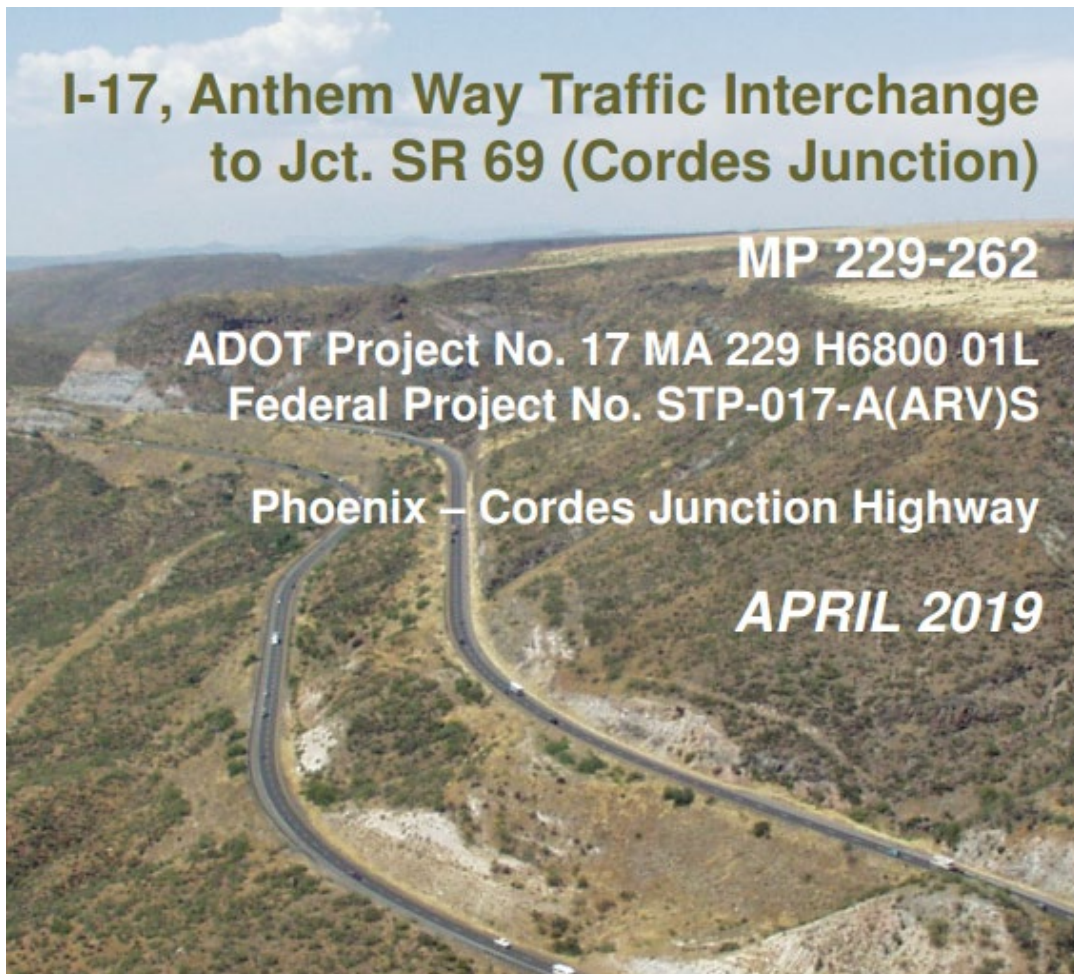




INVEST Memorandum
I-17, Anthem Way to Jct. SR 69
Arizona Department of Transportation





September 2019

INVEST Score: Gold (88 points)

Background

The Arizona Department of Transportation (ADOT) has completed a study to prepare a design concept report and environmental documentation for improvements to the segment of Interstate 17 (I-17) between the Anthem Way Traffic Interchange (TI) (MP 229) and the State Route 69 TI near Cordes Junction (MP 262+). This section of I-17, designated the "Arizona Veteran's Highway" in 2004, currently consists of two lanes in each direction, traversing rolling terrain in the southern and northern segments and mountainous terrain in the middle segment. I-17 is part of the National Highway System and connects I-10 with I-40, two of the nation's principal east-west interstate highways. I-17 also provides the major connection between Phoenix and communities in northern Arizona. This project is exploring various means of adding capacity and improving operational safety to I-17. In recent years, the study has focused on long-term solutions between Black Canyon City (MP 245) and Cordes Junction (MP 262+). However, the current effort focuses on adding capacity in the near-term between Anthem Way (MP 229) and Sunset Point (MP 252). **Construction estimate – \$320,000,000.**



Figure 1. Project Map

Recommended Build Alternative

Anthem Way TI to Black Canyon City TI: The Recommended Build Alternative includes adding a lane in both directions, widening the northbound roadway toward the median side and widening the southbound roadway toward the median in some segments and toward the outside in other segments.

Black Canyon City TI to Sunset Point TI: The Recommended Build Alternative includes constructing two flex lanes next to but separated from the southbound roadway by a concrete barrier. The flex lanes would be open to either northbound or southbound traffic depending on the peak traffic direction. Access to the flex lanes would be controlled by gates or a similar mechanism.

What is INVEST?

INVEST (Infrastructure Voluntary Evaluation Sustainability Tool) was developed by the Federal Highway



Administration (FHWA) as a practical, web-based, collection of voluntary best practices, called criteria, designed to help transportation agencies integrate sustainability into their programs (policies, processes, procedures, and practices) and projects.

INVEST considers the full lifecycle of projects and has four modules to self-evaluate the entire lifecycle of transportation services, including System Planning for States or Regions (SPS or SPR), Project Development (PD), and Operations and Maintenance (OM). Each of these modules is based on a separate collection of criteria and can be evaluated separately.

Purpose of the Memorandum

The ADOT, in partnership with the FHWA has utilized the latest version of INVEST (1.3) on numerous agency projects and programs in varying stages of development to document, explore, and identify sustainability elements of projects for incorporation, as well as provide feedback on the current INVEST 1.3 version of the tool. The goal of this INVEST memorandum is to document the use of INVEST scoring on the I-17, Anthem Way to Jct. SR 69 project using the Project Development (PD) and the Urban Extended Scorecard.

INVEST Scoring

INVEST may be used to score a project based on total points achieved. In the INVEST tool, FHWA does not recognize a project as having met the achievement level of sustainability based on scores; but rather recognizes that the user has self-evaluated their project and met the indicated achievement level.

The total points a project earns can be compared to several “achievement levels” that serve as relative benchmarks for sustainability accomplishments. Table 1 shows the minimum number of points necessary to meet each achievement level for the PD module.

I-17 INVEST PD Module Criteria Scoring Results and Basis for Scores

According to the INVEST User Guide;

The Project Development module spans the entire project development process. It includes early project planning, alternatives analysis, environmental documentation, preliminary and final design, and construction. Although the criteria span all phases of project development, including construction activities, the project owner typically has control over the decisions and actions necessary to meet all of the criteria. Scoring The Project Development Module of INVEST has seven (7) project scorecards available for the evaluation of projects. This approach allows for flexibility, since not all of the criteria will apply to every project. Six of the scorecards are based on both the type of project (paving, basic, extended, or scenic/recreational) and the location (rural or urban) and include a defined subset of the



thirty-three (33) total criteria relevant to the type and location of the project. There is also a custom scorecard that includes eleven (11) core criteria plus user-selected criteria to make a custom self-evaluation for projects that don't fit well into the five verified scorecards. The Project Development module contains the thirty-three (33) criteria listed below, used in various combinations to create the seven (7) different scorecards.

Table 1. INVEST User Guide P.4



Project Development by Criteria Scorecard

	Paving	Urban Basic	Urban Extended	Rural Basic	Rural Extended	Scenic and Recreational	Custom Core Criteria ⁽¹⁾
PD-1 Economic Analyses			●		●		
PD-2 Life-Cycle Cost Analyses	●	●	●	●	●		●
PD-3 Context Sensitive Project Development		●	●	●	●	●	
PD-4 Highway and Traffic Safety	●	●	●	●	●	●	●
PD-5 Educational Outreach		●	●	●	●	●	
PD-6 Tracking Environmental Commitments	●	●	●	●	●	●	●
PD-7 Habitat Restoration		●	●	●	●	●	
PD-8 Stormwater Quality and Flow Control		●	●	●	●	●	
PD-9 Ecological Connectivity			●	●	●	●	
PD-10 Pedestrian Facilities		●	●			●	
PD-11 Bicycle Facilities		●	●			●	
PD-12 Transit & HOV Facilities		●	●			●	
PD-13 Freight Mobility			●		●		
PD-14 ITS for System Operations		●	●		●		
PD-15 Historical, Archaeological, and Cultural Preservation		●	●	●	●	●	
PD-16 Scenic, Natural, or Recreational Qualities			●	●	●	●	
PD-17 Energy Efficiency		●	●	●	●		
PD-18 Site Vegetation, Maintenance, and Irrigation		●	●	●	●	●	
PD-19 Reduce, Reuse, and Repurpose Materials	●	●	●	●	●	●	●
PD-20 Recycle Materials	●	●	●	●	●	●	●
PD-21 Earthwork Balance			●		●	●	
PD-22 Long-Life Pavement	●	●	●	●	●	●	●
PD-23 Reduced Energy and Emissions in Pavement Materials	●	●	●	●	●	●	●
PD-24 Permeable Pavement	●	●	●	●	●	●	●
PD-25 Construction Environmental Training		●	●	●	●	●	
PD-26 Construction Equipment Emission Reduction	●	●	●	●	●	●	●
PD-27 Construction Noise Mitigation		●	●			●	
PD-28 Construction Quality Control Plan	●	●	●	●	●	●	●
PD-29 Construction Waste Management	●	●	●	●	●	●	●
PD-30 Low Impact Development		●	●	●	●	●	
PD-31 Infrastructure Resiliency Planning and Design			●		●	●	
PD-32 Light Pollution		●	●	●	●		
PD-33 Noise Abatement		●	●				
Total Number of Criteria in Scorecard	11	27	34	23	29	27	11

(¹) Indicates the core criteria that must be included in the custom scorecard. The user may choose as many additional criteria as desired.



The Project Development – Urban Extended Scorecard was used for the INVEST scoring of this project. Project Development (PD) is traditionally the second step in the lifecycle of a transportation project, where specific projects are planned, designed, and constructed. The PD module in the current INVEST tool includes a total of thirty-three criteria that are generally organized from planning to design to construction. The PD criteria are further organized into seven (7) scorecards for the evaluation of projects. The scorecards are designed to identify applicable criteria based on the project type (paving, small/spot improvements, new facility/corridor project) and location (urban/rural). Six (6) of these scorecards pre-identify criteria that are most likely to be applicable for the project type and location.

The Urban Extended scorecard is for urban projects for a new roadway facility; structure projects where nothing of its type currently exists; and major reconstruction projects that add travel lanes to an existing roadway or bridge. As this project is a project that will add capacity of I-17 and include some new right-of-way, temporary construction easements, or major construction work needed, ADOT evaluated this based off the 33 criteria available for the scorecard.

Based on the assessment completed for the INVEST scoring, the project received a score of 88 points, which identifies the project as a gold rating. Attached to this memorandum is the “Project Scorecard,” which shows all points and information related to the scoring of the project. Of the almost seventy-five INVEST scoring efforts less than 3% have achieved gold rating. These have become candidates for ADOT’s Excellence in Sustainable Design Award Program.

Several notable points were documented for the following categories:

- **Economic Analysis:** Conducting economic analyses supports all of the triple bottom line sustainability principles by ensuring that agencies consider improvements where benefits exceed the investment costs for the project through analysis of impacts to local businesses, emissions, safety, and others. With planned Interstate 17 flex lanes between Black Canyon City and Sunset Point set for construction starting by 2021, the state budget approved by state lawmakers and signed by Governor Doug Ducey provides the additional funding needed to also complete widening I-17 south of where the flex system will be built. This \$130 million investment to complete new third lanes in both directions of I-17 between Anthem and Black Canyon City is one of many in the budget that will expand and preserve transportation infrastructure across Arizona. More than \$190 million was already committed to building flex lanes north of Black Canyon City as well as adding 7 miles of a third southbound lane directly south of that project. Investing an additional \$130 million over three years will allow ADOT to complete all sections of new third lanes between Anthem and Black Canyon City. Combined with the flex lanes, this increased capacity will enhance safety and help address traffic flow challenges and backups that occur due to crashes and when many drivers are traveling to or from Arizona’s high country on summer weekends. In order to facilitate the projected \$330 million cost extensive cost benefit and due diligence was completed. The Maricopa Association of Governments is providing \$50 million in regional funds to help fund the widening of I-17 between Black Canyon City and Anthem. To round out the funding needs



and reflect just how critical this corridor is to Arizona and the nation; Arizona has won a highly competitive \$90 million federal highway grant, the Infrastructure for Rebuilding America (INFRA) grant, was awarded to the ADOT by the FHWA in July of 2019.

- **Context Sensitive Project Development:** Due to the fact that the project occurs on Bureau Land Management (BLM) land, context sensitive project development was needed to ensure the quality, cohesion, and character remained. The project required the ADOT and the BLM participation and partnering. The study segment is located in a rural area of Maricopa and Yavapai counties. The Agua Fria National Monument, administered by the BLM, is located immediately east of the I-17 right-of-way from approximately MP 245 to MP 260. In addition, the Upper Agua Fria Watershed Partnership (UAFWP) grew out of the Water Study Committee of the Big Bug Economic Development Alliance in early 2000. During the same period the Arizona Department of Water Resources (ADWR) began encouraging rural areas to form grassroots regional watershed groups to function as water study and management units outside the Active Management Areas (which are mostly urban). Coordination with this group is also ongoing as it relates to future construction phase water use.
- **Highway and Traffic Safety:** The I-17 horizontal and vertical alignments in this mountainous terrain present challenges related to steep grades and horizontal curves with limited sight distance. In addition, crashes can result in closures of I-17 that cause lengthy travel delays along the route. I-17 experiences heavy volumes during weekends and holidays as the main route for traffic between the Phoenix metropolitan area, Flagstaff, and recreational destinations to the north. The combination of large volumes of passenger cars, trucks, and recreational vehicles results in a substantial speed differential condition on the steep grades of the Black Canyon Hill. This condition affects the operational capacity of the interstate and results in congestion and long traffic back-ups. There are distant detour options for long-term closures; however, there are no alternate routes in the area for short-term closures.

A Preliminary Traffic Report (March 2007), a traffic Technical Memorandum (November 2014), and an updated Preliminary Traffic Report (October 2017) were prepared in support of the development of the Design Concept Report for this project. The traffic analyses present traffic volume projections and roadway capacity analyses for mainline I-17 beginning at the I-17/Anthem Way TI and extending north to approximately MP 262, south of the Cordes Junction TI. The Highway Capacity Manual (HCM) was used to evaluate freeway capacity and level of service. The measure used to provide an estimate of freeway LOS is density expressed in terms of the number of equivalent passenger cars per mile per lane (pc/mi/ln).

Two-Lane and Three-Lane Failure Year Sensitivity Analyses - As part of the capacity analysis, the last year during which each segment of the study area exhibits LOS D (the minimum acceptable design level of service) with two lanes and three lanes was determined. Utilizing the HCS, the maximum DDHV that corresponds with a density of 34.9 pc/mi/ln was calculated for each portion of the study area. Once the DDHV was calculated, the K and D factors were used to determine the AADT associated with the “failure

year.” Failure year is defined as the last year in which forecasted traffic volumes result in the segment operating at an acceptable LOS D; the following year, operations deteriorate to LOS E. Upon determining the failure year AADT values, linear relationships between the 2016 and 2040 Saturday AADTs were used to estimate the failure year for peak weekend traffic conditions. The crash data was also sorted and grouped by MP location to identify potential high crash locations within the study area.

- **Site Vegetation, Maintenance and Irrigation:** The native plants surrounding the I-17 corridor are a significant resource that provide soil stabilization and wildlife habitat, and act as visual interest. During final design, efforts should be made in areas of disturbance to salvage and replant suitable species: young and healthy *Carnegie gigantea* (Saguaro 12-20 feet in height), *Ferocactus fishhook* (Barrel Cactus), and *Olneya tesota* (Ironwood), etc. Revegetation efforts should and the elevation of salvaged material should be considered when identifying disposition of replanted salvaged material.

Native Plant Inventory: Prepare a native plant inventory of all saguaros, barrel cactus, ocotillos, and all healthy native trees within the disturbance areas meeting the requirements of the ADOT Native Plant Salvage and Replanting Guidelines. A Salvage Operations Plan should detail all used processes, methods, equipment, and materials for plant salvage, nursery set-up and operation, and replanting of salvaged plants. **Native Seeding:** All disturbed soils not paved, otherwise landscaped, or permanently stabilized by construction should be seeded using native species to the project vicinity. The various elevations, soil conditions, and drainage considerations may require that several seed mixes to be developed. Examples of project specific seed mixes include Low Grass & Forbs, Tall Background, and Wash Seed Mixes. Additionally, clear zone and background seed mixes may be needed.

A Noxious and Invasive Species Control Plan (NISCP) will be required to assist with controlling noxious and invasive plant species within the project area. The work under the NISCP shall consist of the detection and eradication of noxious and invasive plants. Proposed method(s) of noxious plant control include either manual eradication or herbicide application by recommended methods for each plant species identified in the NISCP and will be in accordance with NEPA and state statutes. The project area will be surveyed following rain events and during plant germination and growth periods prior to and during construction, as well as post-construction activities. Construction best management practices will include items of operation that may minimize the spread of noxious species. The NISCP shall also include post-construction measures to prevent invasive species seeds from leaving the site.

Permanent irrigation should be considered in urbanized areas planted with nursery and salvaged plants where potable water exists in adjacent municipal rights-of-way. Use of a temporary irrigation system should be considered for rural areas with salvaged and replanted landscaping and areas where no potable water exists. The final designer should coordinate with ADOT to develop performance criteria of temporary irrigation systems in the special provisions. No irrigation would be required for native seeding.



Landscaping costs at \$390,000 per mile are based on the following assumptions:

- 50' average disturbance both sides of I-17
 - Permanent irrigation may be used in urbanized areas with available water. Temporary irrigation used for revegetation areas.
 - Total disturbance of 315 acres.
 - \$200,000 per mile for native plant salvage, nursery storage, and replanting
 - One to 1.5 percent of structures costs assumed for aesthetics and rustication.
 - Salvage, store, and replace top 4-6" surface soil.
 - 10% of rock cuts could be stained. • Includes herbicide and manual or mechanical weed removal of non-rock roadside areas. Herbicide has been applied to 55% of non-rock areas and manual or mechanical weed removal to 45% of non-rock areas.
- **Energy Efficiency:** Light Emitting Diode (LED) luminaires with a correlated color temperature of 3,000k and zero uplight should be used on this project to be in accordance with the Dark Skies recommendations. As part of the ADOT Sustainable Transportation Program Life Cycle Assessment (LCA) and Life Cycle Cost Analysis (LCCA) and the recent INVEST grant an LED LCA LCCA was executed to form the basis of all future LCA LCCA lightning.

LCA is a technique that can be used for analyzing and quantifying the environmental impacts of a product, system, or process. LCA provides a comprehensive approach to evaluating the total environmental burden of a product or process by examining all of the inputs and outputs over the life cycle, from raw material production to end of life. This systematic approach identifies where the most relevant impacts occur and where the most significant improvements can be made while identifying potential trade-offs. LCA is a field of science that is still evolving, yet it has demonstrated real-world value over the last two decades by helping manufacturers, companies, governments and other groups identify what is environmentally important to them and then to define needed actions to improve their environmental impacts. The processes and rules for conducting an LCA are generally defined by the International Organization for Standardization (ISO) in its 14040 family of standards (ISO 2006). These standards are quite broad; thus, more precise guidance is needed for their application to a specific material or process. Such guidance is usually developed by the relevant industries and other stakeholders.

LCCA is an analysis technique that uses economic analysis to evaluate the total cost of an investment option in constant dollars over an analysis period. As such, it is principally used to address the economic component of sustainability. LCCA does not directly address societal or environmental issues (e.g., clean air and water, habitat impacts, establishment of livable community conditions) unless such issues can be monetized. ADOT is developing sustainable pavement systems LCCA guidance and assisting FHWA in updating LCCA methodology as it relates to sustainable transportation activities.



- **ITS for System Operations:** ADOT's Intelligent Transportation Systems (ITS) requirements include, ITS Concepts for Rural Corridor Management, September 2007, and are now incorporated in the Statewide ITS Architecture. Section 3.1.5 of the design concept report outlines the Prescott District's main traffic management concerns. These include interagency communications, real-time traffic monitoring for the I-17 corridor, traveler information systems, and weather forecasting to give the driver real-time accurate information. Section 3.2, Table 4, "Districts Needs Matrix," details what ITS components are identified as significant or minor needs. Mentioned, but not covered under the types of devices, was the District's desired installation of wildlife detection and monitoring systems. The specific needs identified by the Northwest District that relate to the I-17 corridor are:

- Real Time Traffic Monitoring of I-17
- CCTV Monitoring
- Budgetary Funding for ITS Maintenance
- Wildlife Presence Detection
- Additional Roadway Weather Information Sites
- Flood Detection Sensors
- Bridge Deck Icing Monitors
- Additional Dynamic Message Sign Locations
- Portable DMS
- Improved Traveler Information
- Comprehensive AZ 511 System
- Portable Speed Display Trailers and Photo Enforcement Programs
- Highway Advisory Radio for Work Zones
- Motorist Assist Patrols for Major Construction Projects

While many of these ITS needs are beyond the scope of initial design, it is important to include a description or vision of the fully evolved ITS system so that ITS infrastructure elements can be included in future projects that will contribute to the long-term traffic management goals of the Department.

I-17 INVEST Lesson Learned and Next Steps

The evaluation of this project introduced opportunities for improvements in sustainability elements for future projects within this area. Some opportunities that could be considered but will be considered in final design stage include items such as light pollution minimization, low impact development for storm water management, earthwork balance, and recycling of materials. Additionally, an ADOT agency goal in future projects would be to introduce sustainability earlier into the early design concept and NEPA stage, with an emphasis on education to the public. The challenge will be to carry forward this effort as completed during the design concept report and environmental phases to final design and the anticipated general engineering contractor for construction.



Appendix: I-17 PD Module Scorecards