

Pima County Economic Analysis Section 10 Permit



May 2003



Pima County Economic Analysis Section 10 Permit

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PIMA COUNTY

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List of Acronyms

ADES	Arizona Department of Economic Security
AGFD	Arizona Game and Fish Department
ASDM	Arizona-Sonoran Desert Museum
BE	Biological Evaluation
BLM	Bureau of Land Management
BRRC	Biology Resources Research Center
CAB	Conservation Acquisition Board
CES	Current Employment Statistics
CEW	Covered Employment and Wages
CFPO	Cactus Ferruginous Pygmy-owl
CLS	Conservation Lands System
ESA	Endangered Species Act
FY	Fiscal Year
GIS	Geographic Information Systems
HCP	Habitat Conservation Plan
HDR	High Density Residential
LDR	Low Density Residential
MHCP	Multi-species Habitat Conservation Plan
MSCP	Multiple Species Conservation Program
MSHCP	Multi-Species Habitat Conservation Plan
MTLUS	Metropolitan Tucson Land Use Study
NAV	Net Assessed Value
NPPO	Native Plant Preservation Ordinance
NPS	National Park Service
ODC	Other Direct Costs
PAD	Planned Area Development
PAG	Pima Association of Governments
PLMA	Public Land Management Act
PVS	Priority Vulnerable Species
RAC	Residences per Acre
RIM	Research, Inventory, and Monitoring
ROD	Record of Decision
SDCP	Sonoran Desert Conservation Plan
STAT	Scientific and Technical Advisory Team
TAMA	Tucson Active Management Area
UAEEB	University of Arizona Department of Ecology and Evolutionary Biology and Vertebrate Collections
UDWR	Utah Department of Wildlife Resources
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

Executive Summary

In October 1998 the Sonoran Desert Conservation Plan (SDCP) was initiated by Pima County Government. One goal of this plan was to obtain a permit from the U.S. Fish and Wildlife Service (USFWS) under Section 10 of the Endangered Species Act (ESA) to enable incidental take of species protected by the ESA in the course of development in Pima County. The County Government contracted with the ESI Corp Study Team to conduct an economic analysis of potential costs and benefits of obtaining the permit. The scope of this study, as defined by the County, specified the range of alternatives to be studied in three scenarios:

- ✧ **Scenario 1** – This measured the impact of Pima County *not acquiring* the Permit, while *not allowing* zoning to change over time.
- ✧ **Scenario 2** – This measured the impact of Pima County’s *acquisition* of the Permit, while *not allowing* zoning to change over time.
- ✧ **Scenario 3** – This measured the impact of Pima County’s *acquisition* of the Permit, while *allowing* zoning to change over time.

In evaluating the various alternative scenarios, the ESI Study Team utilized a methodology that included the following four key tasks:

1. Project the pattern of development expected in Pima County over the various time horizons
2. Identify the Research, Inventory, and Monitoring (RIM) and land acquisition costs to protect species habitat and mitigate for take of habitat
3. Assess the costs and benefits of the development pattern; and
4. Identify funding options to pay for the RIM and land acquisition costs.

Growth Model

The potential future patterns of development in Eastern Pima County (the area east of the Tohono O’odham Nation), were modeled by projecting and mapping them over three time horizons that included 10 years, 20 years, and buildout¹. Growth projections included population and employment (Table 1). Economic theory and empirical evidence show that obtaining a comprehensive Section 10 Permit facilitates development in the regional market by making the development process more straightforward and costs more tightly defined. This manifests itself in the growth model through more development occurring in the earlier timeframes in Scenarios 2 and 3 (with the Permit) than Scenario 1 (without the Permit). Water available for municipal use is slightly higher in Scenario 1 due to lower projected Mining employment, thus at buildout the total population is slightly higher.

¹ For purposes of this analysis, the term “buildout” is applied to mean the maximum theoretical population and municipal development possible given existing water rights.

Table 1 – Summary of Economic Model Results by Scenario

	Baseline	End 10 Year	End 20 Year	Buildout
Scenario 1				
Total Population	889,011	1,068,457	1,272,220	1,944,480
Total Wage and Salary Emp.	348,415	459,425	610,918	976,112
Scenario 2				
Total Population	889,011	1,107,453	1,339,575	1,933,723
Total Wage and Salary Emp.	348,415	491,801	654,034	970,729
Scenario 3				
Total Population	889,011	1,107,453	1,339,575	1,933,723
Total Wage and Salary Emp.	348,415	491,801	654,034	970,729

Source: ESI Corporation, Eller College of Business and Economic Research

Scenarios 2 and 3 are constructed under identical economic assumptions, but were allowed to vary spatially; thus some analyses are the same in Scenarios 2 and 3, while others, such as the number of Listed Species Habitat acres projected to be developed by the growth model, are different.

The spatial allocation of this growth is based on a geographic information systems (GIS) computer model that considered critical topographic, administrative, and public works infrastructure conditions. Table 2 presents the total acres of land developed and the impacts of this development on species habitat² outside the “built environment.”³ As these two tables show, the economic factors driving Scenarios 2 and 3 are identical, however the spatial allocation of this growth is different between Scenarios 2 and 3. This is due to zoning not being used as a constraint in Scenario 3.

As the amount of vacant land inside the built environment is absorbed, more land outside the build environment will be demanded. Over time this is expected to escalate the impacts on the species habitat.

² Acreage of habitat in Pima County used in this document is based specifically on the document *Listed Species Reserve Analysis*, which is one of many reports in the Sonoran Desert Conservation Plan series prepared for or by Pima County.

³ The built environment includes all parcels within the current sewer service area, as well as all other parcels that are either occupied or have improvements with values of more than \$10,000.

Table 2 –Acres of Species Habitat Impacted Outside the Built Environment and Total Acres of Development by Scenario and Timeframe

	End 10 Year	End 20 Year	Buildout	
Scenario 1	Total Acres Developed ¹	47,856	100,158	261,455
	Listed Species Habitat ²	6,505	23,668	153,150
	Biologically Preferred Alt. Habitat ³	5,796	22,111	105,461
Scenario 2	Total Acres Developed ¹	58,195	117,494	259,992
	Listed Species Habitat ²	7,938	37,391	148,856
	Biologically Preferred Alt. Habitat ³	7,045	34,931	102,288
Scenario 3	Total Acres Developed ¹	58,195	117,494	259,992
	Listed Species Habitat ²	8,195	37,458	153,515
	Biologically Preferred Alt. Habitat ³	7,193	34,181	109,784

Note: 1. “Total development” in this table represents activity in all of Eastern Pima County. The habitat land types listed represent only those outside the “built environment.” These habitat land types overlap in some places.

2. Listed Species habitat defined as “High Potential Habitat” for one or more Listed Species, “Recovery Area,” and “High Potential Habitat and Recovery Area” from the document *Listed Species Reserve Analysis*

3. Biologically Preferred Alternative defined as “Biological Core,” “Important Riparian Areas,” and “Recovery Management Areas” from the document *Listed Species Reserve Analysis*

Research, Inventory, and Monitoring, and Land Acquisition Costs

If a Section 10 permit is obtained, a program of research, inventory, and monitoring (RIM) will be an essential component. Also, under the current concept of the SDCP even without a Section 10 permit, Pima County’s goal is to provide a scientific basis for natural resource protection and maintenance of biodiversity in the County, and a RIM program is a necessary component of attaining that goal. Acquisition of conservation lands is another major cost of any potential program consistent with a Section 10 permit and the SDCP. Estimating costs of a RIM and land acquisition program is within the scope of this economic study. The parameters of a RIM study specific to the Section 10 permit will be developed by the County and USFWS, but currently (May 2003) are not defined. The general concepts of RIM are currently being discussed by the Scientific and Technical Advisory Team (STAT) serving the County, but are several months from resolution into a program for which costs can be estimated. Therefore, this study brings together information from Pima County and the nation on various RIM programs that have some comparable components to what may eventually be the costs experienced in Pima County.

Costs of acquisition of land for the purpose of mitigation for take of species habitat were estimated based on the value of land today in the Altar Valley, Cienega-Rincon, and the Tortolita Fan areas, as defined in previous SDCP documents. The values per acre vary within and between each of these areas, with the relatively high value of land in the Tortolita Fan greatly increasing land acquisition cost (Table 3). For the purposes of initial analysis, it was assumed that land would be preserved in equal amounts from only the Altar Valley and Cienega-Rincon areas, due to the County’s estimation that only a limited amount of Tortolita Fan land would be needed for mitigation of development in the *unincorporated* areas of the county.⁴ However, to present an alternative, an additional analysis was run showing costs if land acquisition was from all three areas.

Table 3 – Land Value Per Acre in Three Geographic Areas Identified for Preserve Lands (\$ 2002)

	Altar Valley	Cienega-Rincon	Tortolita Fan	Mean (AV & C-R only)	Mean (AV, C-R &TF)
Land Value Per Acre ¹					
Low	\$ 736	\$ 791	\$ 240	\$ 763	\$ 589
Middle (Median)	\$ 894	\$ 2,180	\$16,614	\$ 1,537	\$ 6,563
High	\$ 1,202	\$ 4,505	\$46,507	\$ 2,853	\$ 17,405

Note: 1. Low and high represent the first and third quartiles of the data

When Alter Valley and Cienega-Rincon “Mean” is multiplied by the amount of land needed to accommodate the expected development pattern in Scenarios 1, 2, and 3, the total cost for mitigation can be determined. This study estimated mitigation costs at four different mitigation ratios denoted as X acres of mitigation to Y acres of development (1:1, 2:1, 3:1 and 4:1).

The following summarizes the estimated low and high costs of land to be acquired to accommodate ten years of development at a 1:1 mitigation ratio applied to all development intersecting with the Listed Species Habitat and Biologically Preferred Alternative Habitat (as presented in Table 2 previously).

- ✧ Scenario 1 – expected land acquisition costs range from a low of \$5.0 million to a high of \$18.6 million for the Listed Species Alternative, and from \$4.4 million to \$16.5 million for the Biologically Preferred Alternative
- ✧ Scenario 2 – expected land acquisition costs range from a low of \$6.1 million to a high of \$22.6 million for the Listed Species Alternative, and from \$5.4 million to \$20.1 million for the Biologically Preferred Alternative

⁴ It should be noted that development in the towns of Marana and Oro Valley are expected to put more pressure on the Tortolita Fan area than development in the unincorporated county.

- ✧ Scenario 3 – expected land acquisition costs range from a low of \$6.3 million to a high of \$23.4 million for the Listed Species Alternative, and from \$5.5 million to \$20.5 million for the Biologically Preferred Alternative

To calculate comparable costs at higher mitigation ratios, simply multiply by the mitigation factor (i.e. mitigation costs at 2:1 are twice the comparable value listed). It should be noted that though total costs are projected to be somewhat higher for Scenarios 2 and 3, these scenarios also represent a larger economic base over which to spread the costs.

Costs and Benefits

Costs and benefits are likely to accrue to various entities across the county as a result of Pima County obtaining a Section 10 Permit. The acquisition of a Permit is not expected to have any impact on Pima County’s cost to provide infrastructure and services on a per unit basis for wastewater, sheriff, and other services provided by Pima County. However, since the level of development is expected to be higher at buildout without a Permit, the aggregate tax revenues and costs would be higher. The following lists some potential impacts to other entities.

Group	Potential Positive Impacts	Potential Negative Impacts
Environmentally Based Economy	<ul style="list-style-type: none"> ✧ Tourism, 6 percent more tourism jobs in Scenarios 2 and 3 than Scenario 1 after ten years ✧ Economic Development 	<ul style="list-style-type: none"> ✧ Access to some open space could be restricted
Private Property Interests	<ul style="list-style-type: none"> ✧ Land values are 2.8 percent higher after ten years with the Section 10 Permit than without the Permit ✧ New/enhanced markets for land (preserves / mitigation) 	<ul style="list-style-type: none"> ✧ Restrictions on future upzoning ✧ Possibility of eminent domain ✧ Unequal distribution of benefits (renters and new residents do not benefit equally) ✧ Loss of speculative land value (future upzoning potential)
Ranching and Agricultural Interests	<ul style="list-style-type: none"> ✧ Enhanced ability to sell development rights 	<ul style="list-style-type: none"> ✧ Possible loss of value of development rights in some cases
Real Estate / Business / Development Community	<ul style="list-style-type: none"> ✧ Certainty in regulatory regime 	<ul style="list-style-type: none"> ✧ Costs of plan implementation

Group	Potential Positive Impacts	Potential Negative Impacts
Other Jurisdictions (Cities)	<ul style="list-style-type: none"> ✧ If the cost of the permit to the developer is prohibitively high, new development may locate in other jurisdictions ✧ Ease of pursuing own Section 10 Permit under SDCP umbrella 	<ul style="list-style-type: none"> ✧ If the permit facilitates development at a reasonable cost, then future development will be inclined to go to the unincorporated area
Other Jurisdictions (State Land)	<ul style="list-style-type: none"> ✧ Revenue from purchased development rights 	<ul style="list-style-type: none"> ✧ Loss of speculative land value (future upzoning potential)

Funding Options

Various funding options are available to pay for the RIM and land acquisition costs associated with a Section 10 Permit. The following are four potential options, however in all likelihood a variety of funding options will be employed in combination.

Grants from outside sources – There are a number of state and federal grant programs that address the need for habitat and open space conservation. Many of these require a local match to receive the grant funds, and are subject to political and budgetary changes.

Property taxes – Property taxes can be used to fund the RIM program and land acquisition. Bond issues, special districts and other voter approved expenditures can all be financed from a secondary property tax assessment. There is no state statutory limit on the amount of secondary taxes that can be levied.

Sales taxes – In Arizona, sales taxes imposed by counties generally apply to all taxable sales that occur within the county, including those in incorporated cities and towns. For most activities the County could impose a tax of up to 0.5 percent. These revenues could be spent on RIM and land acquisition costs.

Mitigation fee – Mitigation fees are a tool used in many areas to fund both RIM and land acquisition costs. This type of revenue source would apply only to new development within a designated area. It is unclear whether fees of this nature could be imposed at this time under state statutes. However, the flexibility in their implementation in other communities around the country make them an appealing funding option.

In addition to these major categories of funding there are also many other smaller sources and alternative funding mechanisms that can be employed to help finance the costs.

Recommendations

This study provides the county with the framework to go forward and further its analysis of the final funding costs for a Section 10 Permit. As the County begins to select the mix of funds that will be used for RIM and land acquisition the following should be considered:

Adaptive Management Plan – The RIM costs and funding options should be reevaluated when the Adaptive Management Plan is completed as part of the development of the permit application and HCP.

Exclude Western Pima County – To the extent that the Section 10 Permit is only applicable to Eastern Pima County, then the final funding option should exclude the property and residents in Western Pima County. However, modifications may be needed to some state statutes to allow for the imposition of taxes in targeted areas.

Build an “endowment” – This would help facilitate the long-term stability of the plan. Ideally expenditures would only be made based on the interest earned, but the endowment funds would be available in case an extreme situation arose requiring significant immediate funds.

Build a mitigation land bank – This type of surplus would work as a cushion in times of high development activity and/or spikes in the value of land. This type of bank would give the County time to readjust the overall revenue structure to accommodate market changes, while minimizing financial impact.

Build in regular revenue adjustments – Adjustments should be built into all of the revenue sources to account for such factors as inflation, land appreciation, increases in labor and materials costs, etc.

Build flexibility into the funding options available to developers – Private developers may have the resources to do the work of the public sector at a lower cost per unit than the public sector. Building in flexibility will help prevent additional market distortions caused by the funding plan, and may provide indications of how the funding plan can be restructured in response to innovative ideas from the private sector.

Account for potential conservation land already owned by the County – It is possible that at the time the Section 10 Permit is issued the County will already own tracts of land appropriate for conservation management. These should be fully accounted for when developing a funding option to ensure that the community is not overcharged for conservation land acquisition.

Develop a balance between fees and taxes – Since fees impact developers and taxes impact everyone, a balance needs to be struck between who benefits and who is harmed by the Section 10 Permit.

Ensure that the adopted financing plan is legal – It is important to consider the legal requirements of state and federal law, such as how fees and taxes can be structured.

I. Introduction

Background

In 1997, the U.S. Fish and Wildlife Service (USFWS) listed the Cactus Ferruginous Pygmy-owl (CFPO) as an endangered species in Arizona. This small (less than 6 inches tall) owl set off a storm of controversy because a few individuals were known to be residents in an area of Pima County that had a rapidly expanding human population. “Take”⁵ of an Endangered Species (without a permit) is a federal offense, punishable by fines and imprisonment. Destruction of habitat by the process of development of human infrastructure has been interpreted in federal courts as “take.” The potential threat of liability extends to local government officials who permit development that results in the “take” of an endangered species, or whose government projects result in “take” of an endangered species. Although the CFPO is not the first species listed as endangered in Pima County, it is the first to seriously get in the way of development and land management on a major scale.

The Sonoran Desert Conservation Plan (SDCP) had its official origin in 1998, when the Pima County Board of Supervisors directed County staff to develop a plan to help the County comply with the federal Endangered Species Act (ESA) and protect the CFPO (and other species) from “take” and the County from liability. At the time, the SDCP was seen as containing several essential components, one the most important of which was to be a Multi-species Habitat Conservation Plan (MSHCP) which would satisfy federal requirements and provide for issuance of an incidental take permit under Section 10 of the ESA. Section 10 allows for the issuance of permits for the “incidental take”⁶ of endangered species, but requires development of a Habitat Conservation Plan (HCP) for the conservation of the species named in the permit. Multi-species HCPs are considered a potentially efficient cost-effective approach toward resolving development-endangered species issues. This began a major endeavor of gathering information, compiling reports, forming and convening technical advisory teams and a steering committee, holding public meetings, hiring consultants, and exploring a wide range of issues. Approximately 150 reports have been prepared, each dealing with one or more specific aspects of the process. The process has often been contentious, especially where inadequate information was used to support contradictory multiple positions deeply held by entrenched interests. Parts of the planning process have been widely praised by experts and members of the stakeholders and public. Other parts remain unresolved. As of this writing (April 2003), the SDCP is not yet in its final stage, and has not

⁵ “Take” is defined in the ESA as: “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.”

⁶ “Incidental take” is defined as “any taking otherwise prohibited. . .if such taking is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity.”

been developed to the point of deciding with certainty whether to pursue the Section 10 Permit, and which species to include.

One of the most contentious issues has concerned the potential costs of the process of obtaining a Section 10 Permit. These costs range from the basic costs of developing a HCP to the long-term annual costs of maintaining the plan and supporting a research, inventory, and monitoring (RIM) program that is acceptable to USFWS and all participants. Among the major cost considerations are land acquisition costs for preserves, management costs, and (certainly not the least contentious) opportunity costs.

Study Objectives and Scope of Analysis

This document represents the economic analysis of Pima County obtaining a Section 10 Permit in accordance with the guidelines developed in the Sonoran Desert Conservation Plan as it relates to species protection.⁷

There were two key questions to be addressed by the ESI study team in our analysis. The first was what the likely economic effects of obtaining a Section 10 Permit would be, including changes in employment mix, spatial location of development, and impacts to various constituent groups. The second relates to the expected cost of implementing the plan associated with obtaining the permit; including the costs of Research, Inventory, and Monitoring (RIM) and land acquisition for mitigation.

The study area included Eastern Pima County, generally all the land in Pima County east of the Tohono O’odham Nation as shown on Map 1.

Study Partners

The study team included ESI Corporation, a real estate and economic development consulting company based in Phoenix, Arizona and SWCA, an environmental consulting company with offices in Tucson, Arizona. The ESI study team was asked to develop this work product under an extremely short (approximately two month) timeframe, a feat which would not have been possible without substantial assistance from a variety of people and organizations.

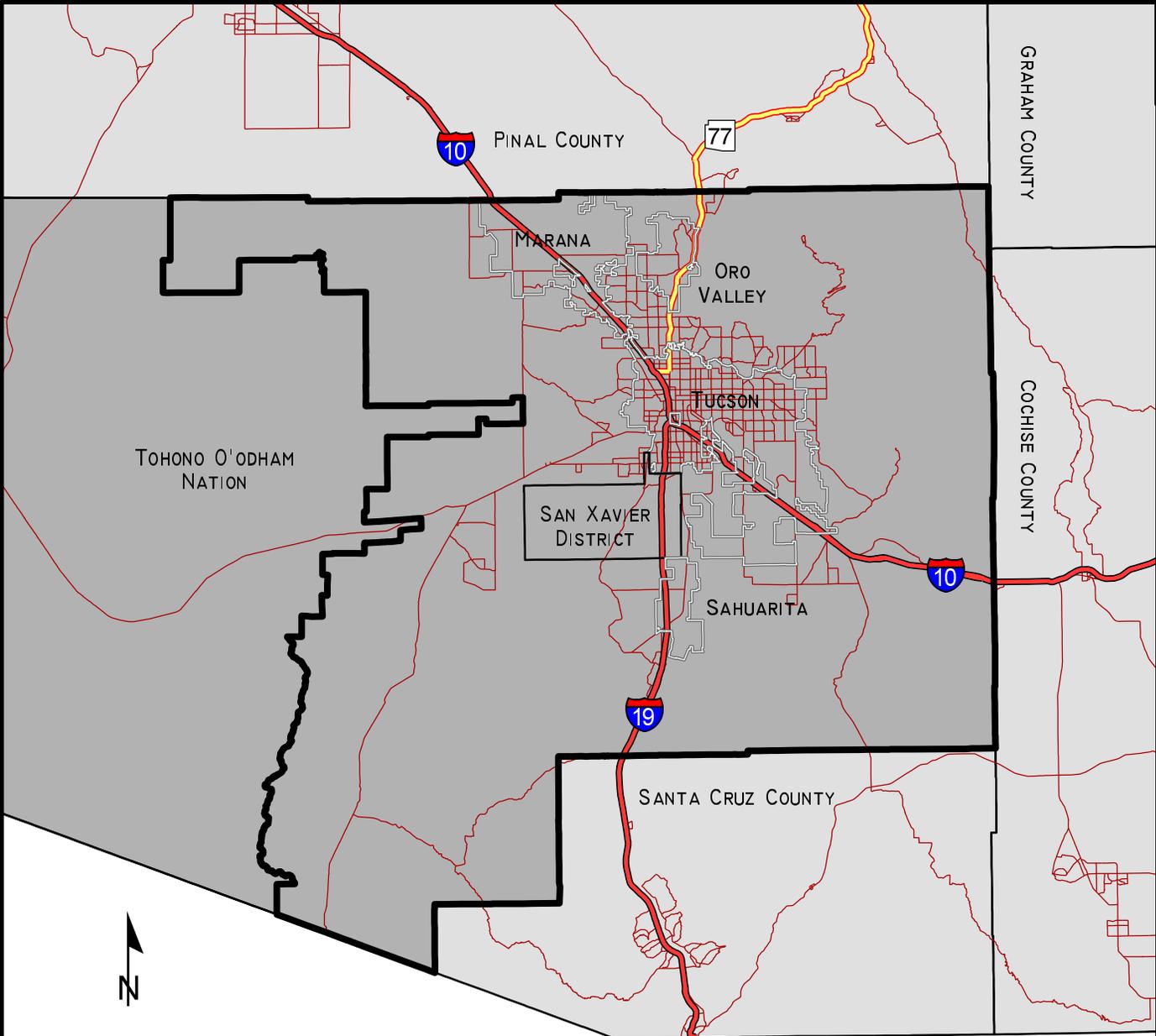
County staff were immeasurably helpful in assisting the ESI study team through providing data and insight throughout the study process. The Sonoran Desert Conservation Plan (SDCP) Steering Committee also provided valuable comments and insight throughout the process.

⁷ Though being used in this document to refer to a comprehensive permit that is granted in acceptance of Pima County’s conservation planning efforts, a Section 10 Permit can be obtained by individuals for specific projects if desired. Also, the SDCP provides a framework for other preservation efforts (such as archeological and cultural resources) that are not specifically considered in this analysis.

**Pima County Economic Analysis
Section 10 Permit**

KEY

-  Municipal Boundary
-  Pima County
-  Eastern Pima County



1:975,000

MAY 2003

MEXICO

**Map 1. Eastern Pima County
and Vicinity.**

Methodology and Approach

The ESI study team approached this process in a number of steps. The first part of the process involved developing a spatial suitability model (using geographic information systems (GIS) software) in order to identify the likely growth patterns of new development in Eastern Pima County in the future. This suitability model was used in conjunction with an economic growth model adapted for Eastern Pima County to create three scenarios of expected land absorption at three timeframes.

- ✧ **Scenario 1** – This measured the impact of Pima County *not acquiring* the Permit, while *not allowing* zoning to change over time.
- ✧ **Scenario 2** – This measured the impact of Pima County’s *acquisition* of the Permit, while *not allowing* zoning to change over time.
- ✧ **Scenario 3** – This measured the impact of Pima County’s acquisition of the Permit, while *allowing* zoning to change over time.

The land absorption analysis was conducted to understand the impact to species habitat in the following two alternatives:

- ✧ Listed Species Alternative – Species currently listed under the ESA as threatened or endangered, and those that are proposed or candidates for such listing
- ✧ Biologically Preferred Alternative – All the species in the Listed Species Alternative, along with species currently listed as Priority Vulnerable Species as designated in the draft SDCP.

In this document, the term “habitat” refers specifically to modeled potential habitat for species of concern, as described in several documents and GIS layers prepared by RECON, biological consultants to Pima County. Acreage of habitat in Pima County used in this document is based specifically on the document *Listed Species Reserve Analysis*, which is one of many reports in the Sonoran Desert Conservation Plan series prepared for or by Pima County. This modeled habitat may or may not be consistent with the biological concept of habitat as the actual environment of a species, and the modeled habitat of any individual species may or may not actually be occupied by, or suitable for, that species. These habitat layers were used to measure the *results* of the land absorption model, and therefore were *not an input* to that model.

Projected land costs and the likely costs of a Research, Inventory, and Monitoring (RIM) program were developed for the study area for each scenario.⁸

Lastly, alternative funding mechanisms for paying for this program were examined, with attention to the impacts to constituent groups (such as the development community, agricultural and ranching interests, and Pima

⁸ It is important to note that the cost results were not reiterated through the economic assumptions and growth model.

County government). Options evaluated included general sales tax, general property tax, and fees or assessments associated with new development.

Any analysis of the future is inherently speculative and subject to the variation based on the assumptions used and availability of data. In addition to the assumptions that are always necessary in order to construct a manageable model approximation of reality, there are some key variables involved in this analysis which we fully expect to be more substantively defined in the future. Most notably:

- ✧ The exact geographic area that will be covered by Pima County's application to USFWS. As conceptualized today the area will most likely include the unincorporated areas of Eastern Pima County.
- ✧ What the Adaptive Management Program will entail. Until the activities that will be performed are defined it is not possible to approach making a hard estimate about the likely costs.

For this reason, this study forms a framework for understanding, but the final answer should be developed following decisions on these key factors using the best available information as of that future time.

II. Growth Model

In preparation for the county to obtain a Section 10 Permit, in support of the MHCP developed as part of the SDCP, the ESI study team developed a growth model to examine likely development patterns spatially and to understand how changes to spatial and economic assumptions would change the level, character, and location of development in Eastern Pima County; particularly outside of the built environment⁹ where the impacts to Pima County Government would be most substantial.

This chapter is designed to be a broad overview of the process which was undertaken in the development of the growth model. An Appendix is included for each section (Suitability Analysis, Economic Projections, and Land Absorption) which contain more detailed methodology and documentation for selected topics pertaining to that analysis.

The ESI study team compared three possible development scenarios:

- ✧ **Scenario 1** – This measured the impact of Pima County *not acquiring* the Permit, while *not allowing* zoning to change over time.
- ✧ **Scenario 2** – This measured the impact of Pima County’s *acquisition* of the Permit, while *not allowing* zoning to change over time.
- ✧ **Scenario 3** – This measured the impact of Pima County’s acquisition of the Permit, while *allowing* zoning to change over time.

There were three interlocking components to this analysis.

- ✧ Suitability Analysis, which utilized a GIS model to weight the importance of various development factors (such as proximity to existing and planned infrastructure, access to the road network, and slope) for different development types.
- ✧ Economic Growth Projections, which were developed to quantify future land demand in Eastern Pima County in 10 years, 20 years, and at buildout.
- ✧ Land Absorption, which combined economic projections of land demand by type with suitability factors to map likely future development patterns.

Each is discussed individually in the following sections.

⁹ The built environment includes all parcels within the current sewer service area, as well as all other parcels that are either occupied or have improvements with values of more than \$10,000. The choices of these and other GIS model constraints and factors are detailed in the suitability analysis appendix.

Suitability Analysis

A standard and often-used GIS approach known as a weighted linear combination was used to evaluate the landscape east of the Tohono O'odham Nation in terms of its suitability for development. The goal of the suitability analysis was to rank vacant and underutilized parcels within a common scheme upon which land demand could be cast. A weighted linear combination treats digital maps layers as variables in an algebraic equation. Pima County provided a list of 604 available map layers. From this list, the team chose numerous map layers representing critical topographic, administrative, and public works infrastructure conditions. As our intent was to model the impact of development on species habitat, the location of species habitat was not used for the spatial allocation of development. The breadth of Pima County's GIS database provided the team with great flexibility.

Map layers were divided into three types of variables: Influences, Constraints, and Impediments. "Influences" affect development suitability along a scale. Examples include slope gradient and straight-line distance to existing infrastructure. The model also includes a novel use of street functional classification information to assess frictions of movement. "Constraints" act as barriers to development, or otherwise represent areas out of the model's consideration. Examples include existing mountain parks, tribal lands, and the channels of rivers and major washes. "Impediments" have a solely negative effect upon development suitability. However, they do not absolutely restrict development like Constraints. Examples include archaeological sites and areas prone to 100-year flood events.

By definition, the practicality of the weighted linear approach is that it allows some Influences to have a greater effect on suitability rankings than others. This level of effect is expressed as a numeric weight. Weights are justified for at least two reasons. First, they allow the model to reflect the real world dynamics particular to land development in southern Arizona. Second, they allow the model to incorporate the fact that some map layers are more reliable or useful than others. Influence weights were determined through a system of pairwise comparisons using the consultant team's professional discretion.

It should be noted that the GIS suitability analysis evaluated development suitability with regard to the five consolidated land use classes described in the land absorption section. Thus, the result is forty-five suitability maps, one for each combination of land use, timeframe, and scenario. The need to reconstruct the suitability maps for each timeframe arises from the fact that the model incorporates a previous timeframe's land absorption into the subsequent timeframe's definition of the built environment. This, in turn, requires the updating of two variables.

The result of the suitability analysis is a defensible classification of the lands in Eastern Pima County via well-established methods and the best

available data. The “time stamp” of the map layers provided by Pima County Technical Services is January 23, 2003. A detailed explanation of these methods and data appears in Appendix A.

Economic Projections

Economic projections were developed for three scenarios in order to project the amount and type of new development expected in Eastern Pima County over three timeframes: ten years, twenty years, and at buildout.¹⁰ It should be noted that from an economic perspective the key differential between these scenarios is whether the county obtains a Section 10 Permit or not. Thus projections for Scenarios 2 and 3 are identical in terms of the level of growth projected, but vary by the projected footprint of development (discussed in the Land Absorption section).

The base data used in developing these projections was the Eller College of Business and Public Administration Forecasting Project’s Long Range Projections for Pima County (third quarter 2002). These projections of employment by industry and new single family and multifamily housing permits were translated into demand for land using assumptions concerning square feet per employee for different industries, average residential densities and household sizes, and assumptions concerning “other land uses” such as acres of parks and golf courses per capita. The projections provide annual totals through 2027, after which the relationship of employment to population and ratio relationships across industries were held constant through buildout.

Not considered in the economic projections were the value of land, the location of habitat and associated potential mitigation ratios and mitigation fees, and redevelopment within the built environment where a change of use occurs.¹¹

Adopting a comprehensive multi-species conservation plan and obtaining a comprehensive Section 10 Permit in support of that plan (the premise behind the differences between Scenario 1 and Scenarios 2 and 3) was assumed to have a positive impact on employment generation and therefore new housing demand. The theoretical basis of this assumption stems from two factors. The first is the commonly held belief, substantiated by evidence from other plans, that obtaining a Section 10 Permit will transform the costs faced by developers today into ones that are predictable. This greater certainty in the process mitigates one of the many risk factors considered in deciding to pursue development projects. Second, modern economic development theory holds that attracting an educated workforce (the so called knowledge workers) is the key to regional economic development success. Essentially, these workers have

¹⁰ Buildout was defined as the point when water availability would cease to support additional population. See Appendix B for details.

¹¹ The methodology of using net changes in employment by industry implicitly accounts for redevelopment where the use of the land does not change.

become so valuable through changes in technology and increased international competition in product markets that companies today seek to locate where these workers prefer to live. Further, preservation of open space and natural amenities is relatively highly valued by these workers.¹² The quantitative basis of the adjustment to the economic projections was developed through examination of other counties that have recently (in the 1990s) developed multi-species conservation plans. While all plans are different in their implementation and the scope of the change they impart on their respective regional economies, this analysis did show increased share of national economic activity (employment) across jurisdictions and industries in comparison with the years preceding the adoption of the plan. This change in employment activity derived from the experience of other counties was used to adjust the baseline projections and develop Scenarios 2 and 3, holding other factors such as the ratio of employment to population and ratio of single family to multifamily permits constant.

Other differences between the scenarios include the buildout population (which is a function of available water after mining and agricultural use is subtracted), average residential density due to timing of higher or lower demand relative to projected permits by type, and the location of different development types. Table 4 is a summary of projected population and employment under the three scenarios.

Table 4 – Summary of Economic Model Results by Scenario				
	Baseline	End 10 Year	End 20 Year	Buildout
Scenario 1				
Total Population	889,011	1,068,457	1,272,220	1,944,480
Average Density ¹	3.787	3.781	3.799	3.919
Total Wage and Salary Employment	348,415	459,425	610,918	976,112
Scenario 2				
Total Population	889,011	1,107,453	1,339,575	1,933,723
Average Density ¹	3.787	3.781	3.803	3.909
Total Wage and Salary Employment	348,415	491,801	654,034	970,729
Scenario 3				
Total Population	889,011	1,107,453	1,339,575	1,933,723
Average Density ¹	3.787	3.781	3.803	3.909
Total Wage and Salary Employment	348,415	491,801	654,034	970,729

Note: 1. Population per built acre

Source: ESI Corporation, Eller College of Business and Economic Research

Generally, growth is projected to be higher in Scenarios 2 and 3 in the earlier years. This results in slightly higher average density under

¹² Florida, 2002.

Scenario 1 due to a declining ratio of single family to multifamily permits in later years (and proportionately more activity added later in this scenario). No explicit changes in density (i.e. higher average densities for a given type of development) are assumed across scenarios. It should also be noted that the above represent activity all over Eastern Pima County, with the issue of the proportion of that activity inside and outside of the built environment addressed separately (discussed in the Land Absorption section).

Land Absorption

The interaction of suitability factors, constraints, and weights and projected new employment and residential development is shown in the land absorption analysis. A more detailed methodology discussion of the land absorption analysis is included in Appendix C.

Industries and projected residential development were classified into a consolidated set of land use categories:

1. Two residential categories, low density and high density
2. Commercial category which included office and retail activity
3. Industrial
4. Urban park and open space.

The zoning of communities within the part of Eastern Pima County outside of GIS model constraints was also classified into the same categories (with two additional model categories created to accommodate zoning categories would allow multiple classifications of development, such as Planned Area Development (PAD) and non-residential classifications). Thus our GIS model was able to allocate development across space into areas with appropriate zoning starting with the most suitable for that type of development. By definition, Scenario 3 did not consider zoning as a factor in identifying the most suitable location for land demand by type.

It should be noted that not all development is projected to take place outside of the built environment,¹³ since there are more than 100 square miles of vacant land still available within the built environment. The allocation of development in and outside of the built environment was done through an analysis of recent construction trends by type through the use of Pima County Assessor data, so that a percentage of total development of each type could be allocated inside the built environment. Table 5 shows total projected new development acres and Table 6 shows only projected new development acreage to take place outside of the built environment. Thus the data on Table 6 coincides with the visual presentation on the maps which follow.

¹³ The built environment was one of the GIS model constraints and was defined by the existing sewer service area boundaries and non-vacant land (defined as having improvements of more than \$10,000). Discussed further in Appendix A.

Table 5 – Total New Development Acreage Projected in Eastern Pima County by Type, Scenario, and Timeframe

		First 10 Years	Second 10 Years	21 Years Through Buildout	Cumulative Total
Scenario 1	LDR	30,540	31,703	97,478	159,722
	HDR	11,563	13,109	43,385	68,057
	Urban Park / Golf Course	2,879	3,269	10,786	16,934
	Commercial	2,507	3,657	8,084	14,248
	Industrial	367	564	1,563	2,493
	Total	47,856	52,302	161,296	261,455
	Scenario 2¹	LDR	37,015	36,177	86,232
HDR		14,015	14,881	38,464	67,360
Urban Park / Golf Course		3,505	3,724	9,533	16,762
Commercial		3,078	3,893	6,904	13,875
Industrial		582	624	1,365	2,570
Total		58,195	59,300	142,497	259,992
Scenario 3¹		LDR	37,015	36,177	86,232
	HDR	14,015	14,881	38,464	67,360
	Urban Park / Golf Course	3,505	3,724	9,533	16,762
	Commercial	3,078	3,893	6,904	13,875
	Industrial	582	624	1,365	2,570
	Total	58,195	59,300	142,497	259,992

Note: 1. Scenarios 2 and 3 use the same economic assumptions, but vary spatially. This manifests itself in identical levels of absorption but different spatial allocation.

Source: ESI Corporation

Table 6 – Total New Development Acreage Projected to Take Place Outside the Built Environment in Eastern Pima County by Type, Scenario, and Timeframe

		First 10 Years	Second 10 Years	21 Years Through Buildout	Cumulative Total
Scenario 1	LDR	7,788	16,920	97,075	121,783
	HDR	1,156	2,743	43,206	47,106
	Urban Park / Golf Course	734	1,745	10,741	13,220
	Commercial	1,447	3,035	8,051	12,532
	Industrial	34	110	1,556	1,700
	Total	11,159	24,553	160,630	196,341
	Scenario 2 ¹	LDR	9,439	30,027	84,709
HDR		1,402	5,242	37,784	44,428
Urban Park / Golf Course		894	3,091	9,364	13,349
Commercial		1,776	3,231	6,782	11,789
Industrial		54	204	1,341	1,599
Total		13,564	41,796	139,980	195,341
Scenario 3 ¹		LDR	9,439	30,027	84,709
	HDR	1,402	5,242	37,784	44,428
	Urban Park / Golf Course	894	3,091	9,364	13,349
	Commercial	1,776	3,231	6,782	11,789
	Industrial	54	204	1,341	1,599
	Total	13,564	41,796	139,980	195,341

Note: 1. Scenarios 2 and 3 use the same economic assumptions, but vary spatially. This manifests itself in identical levels of absorption but different spatial allocation.

Source: ESI Corporation

Maps 2, 3, and 4 show land absorption under the three scenarios. These maps by no means should be interpreted as recommendations for future development policies nor official policy documents of any political jurisdictions located in the study area. Rather, they present a prediction of the likely path of development given assumptions and conditions as they are understood today.

The key purpose of this analysis was to understand if the aggregate supply of land is sufficient to meet the future development needs of Pima County and to identify a likely footprint of development in order to more accurately analyze the costs of implementing the plan.

Pima County Economic Analysis Section 10 Permit

KEY

-  2003 Built Environment
-  Conservation Lands System
-  Municipal Boundary
-  Constraint to Development or Outside of Consideration

LAND DEMAND

-  10-Year Absorption
-  20-Year Absorption
-  Build-Out Absorption

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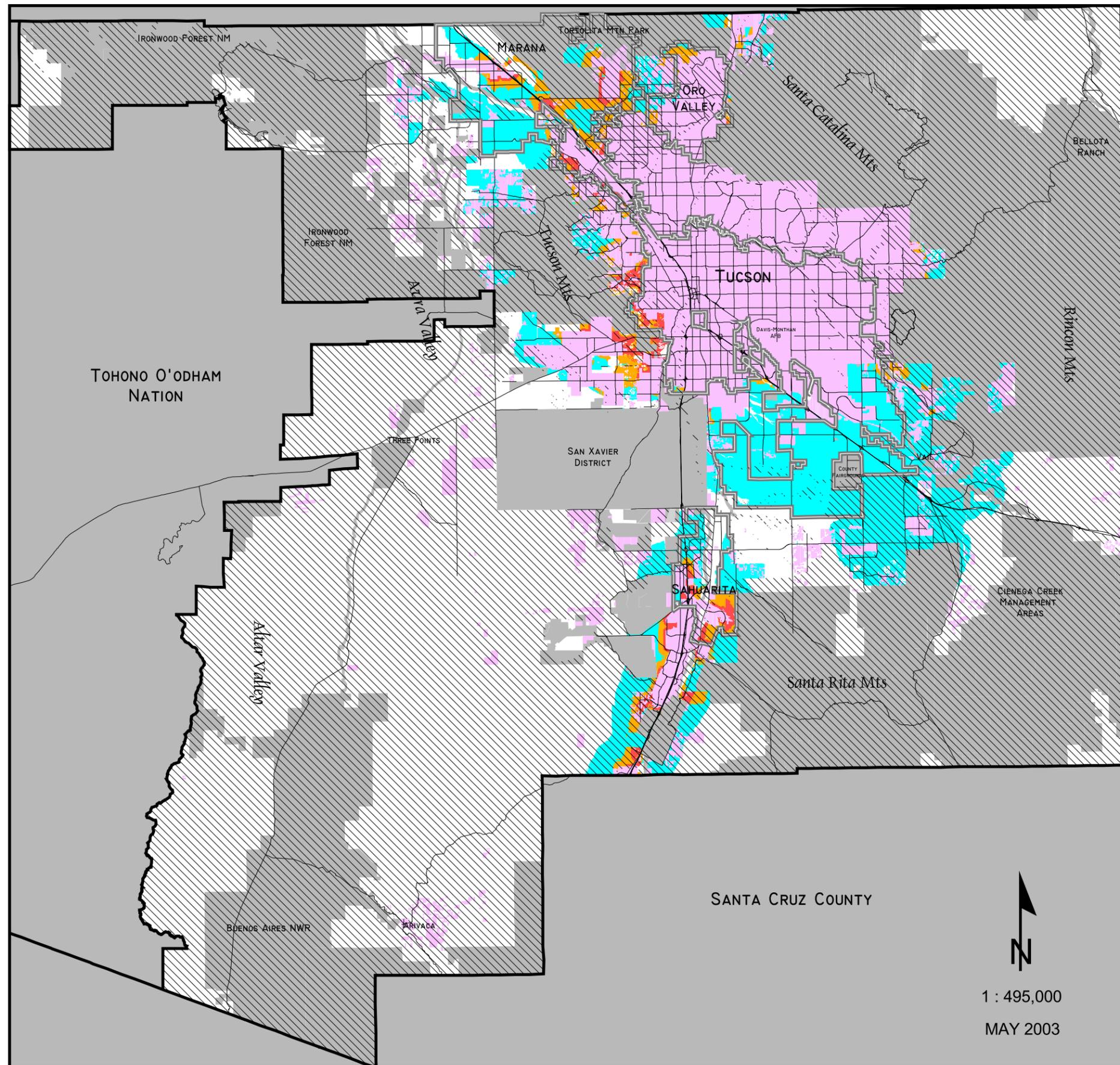


DISCLAIMER

Readers of this map are strongly advised to consider its constituent assumptions and intended use. This map shows modeled (potential) development footprints that are based upon population projections, employment forecasts, and manipulations of other maps portraying regional topographic and public works infrastructure conditions. This collection of data was supplied by various agencies and bureaus. The accuracy of the information presented on this map is limited to the date of origin and third-party quality assurance controls of the model inputs described above. Pima County, SWCA Environmental Consultants Inc., and ESI Corporation make no claims regarding the accuracy of the information depicted herein.

This map results from one of many models that form a comprehensive cost analysis of the economic impacts of Pima County obtaining a Section 10 Permit. This map is intended solely to serve as an explanatory illustration for the cost analysis document. Pima County, SWCA Environmental Consultants Inc., and ESI Corporation shall not be responsible to any person for any loss or damage suffered or incurred as a consequence of any other use of this map.

Map 2. Land Demand for Scenario 1.



Pima County Economic Analysis Section 10 Permit

KEY

-  2003 Built Environment
-  Conservation Lands System
-  Municipal Boundary
-  Constraint to Development or Outside of Consideration

LAND DEMAND

-  10-Year Absorption
-  20-Year Absorption
-  Build-Out Absorption

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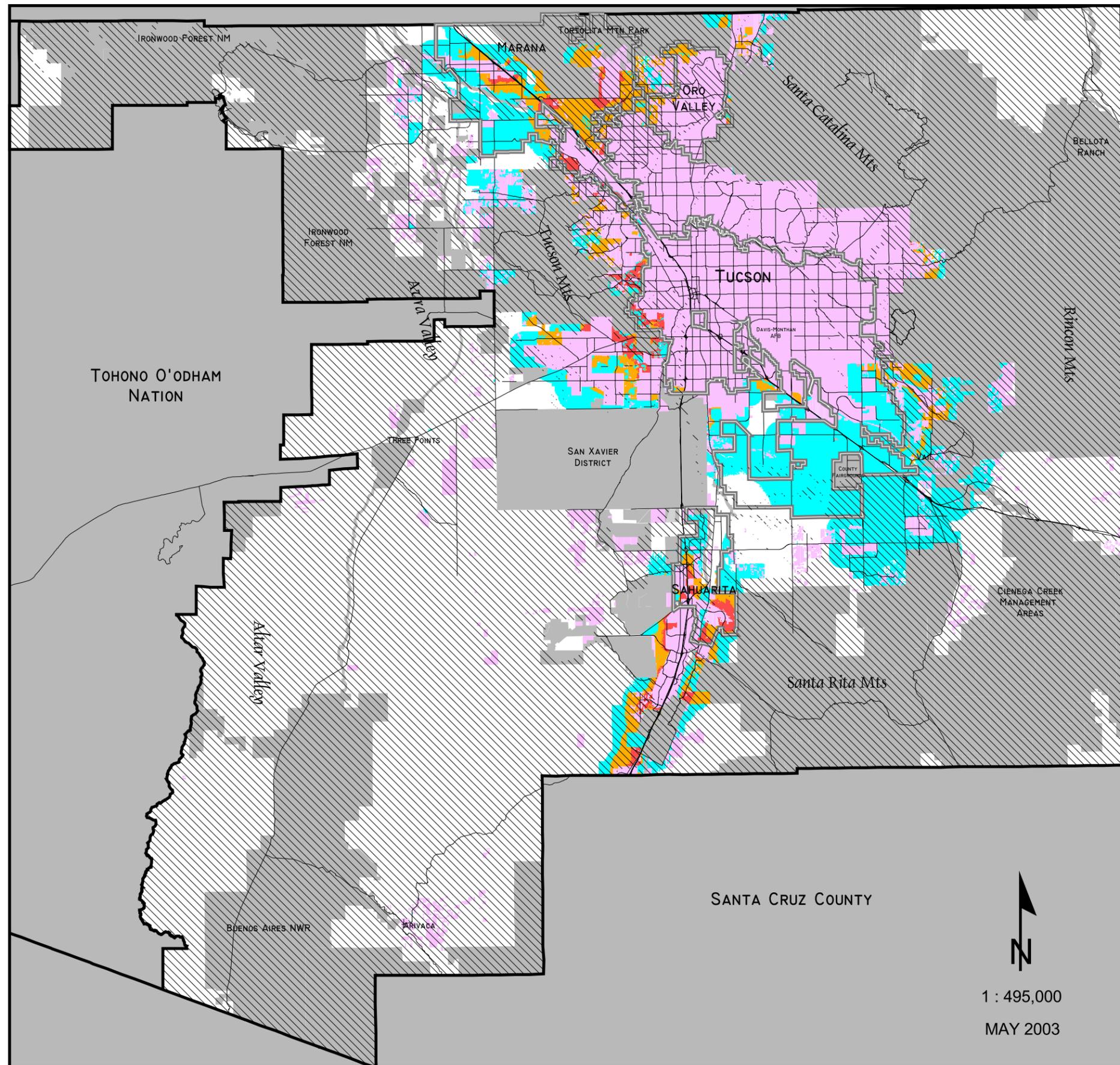


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Map 3. Land Demand for Scenario 2.



Pima County Economic Analysis Section 10 Permit

KEY

-  2003 Built Environment
-  Conservation Lands System
-  Municipal Boundary
-  Constraint to Development or Outside of Consideration

LAND DEMAND

-  10-Year Absorption
-  20-Year Absorption
-  Build-Out Absorption

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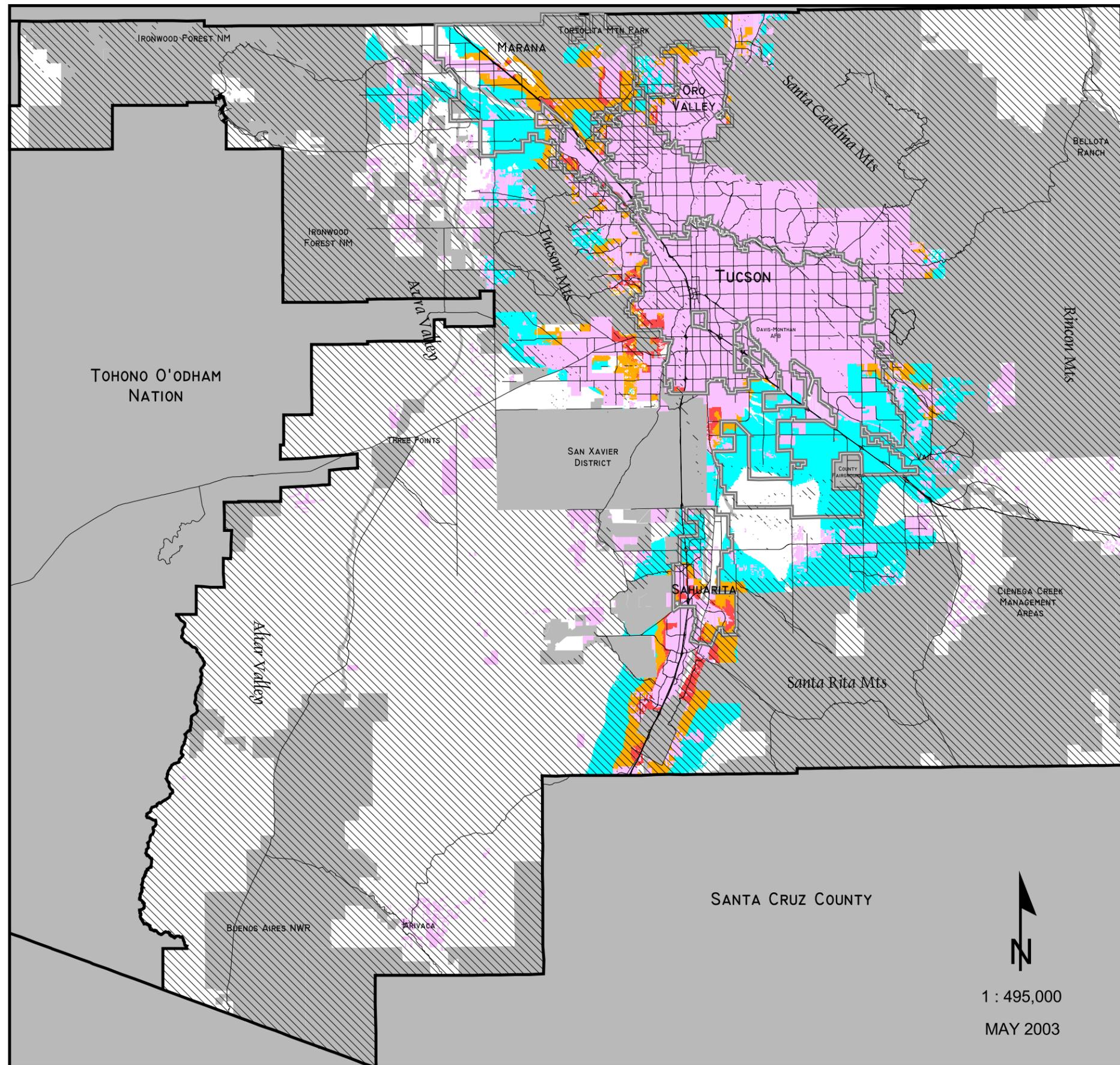


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Map 4. Land Demand for Scenario 3.



1 : 495,000
MAY 2003

III. Costs and Benefits

Obtaining a Section 10 Permit will entail substantive changes in policies and the regulatory regime that affect the regional economy. The effects of policy changes are not likely to be felt equally among all interested parties in Pima County. This chapter examines the likely impacts of the change to some specific constituent groups.

Many costs have offsetting benefits.¹⁴ For example, if land values were caused to increase as a result of obtaining a Section 10 Permit (whether due to constraining the supply of land or simply due to the value of the associated amenity) current landholders receive a windfall gain. That gain is offset by the higher price that will be faced by buyers in the market.

This chapter is organized into three sections:

1. Land impacts, which details the results of the land absorption model with respect to specific types of land (including species habitat and some constituent land holdings),
2. Cost and benefit components, which include objectively analyzing data that have implications for many groups, and
3. Constituent impacts which contains discussions of the impacts to specific constituent groups.

As discussed in the Growth Model Chapter, economic theory and empirical evidence from other counties that have adopted multi-species habitat conservation plans show that obtaining a comprehensive Section 10 Permit facilitates development in the regional market, by making the development process more straightforward and costs more tightly defined. This is the difference between Scenario 1 (without the Permit) and Scenarios 2 and 3 (with the permit).¹⁵ Scenarios 2 and 3 are constructed under identical economic assumptions, but were allowed to vary spatially; thus some analyses (such as aggregate income) are the same in Scenarios 2 and 3, while others, such as the number of ranching acres projected to be developed by the growth model, are different.

¹⁴ The concept in evaluation of proposed changes, called Pareto optimality, evaluates if there is a new situation where those who benefit **could** fully compensate those who are harmed by the change. It does not necessarily require those who benefit to actually reimburse those who are harmed, but is merely the criteria with which to analyze economic efficiency. Political considerations of the extent to which those who benefit **do** compensate (directly or indirectly) those who are harmed is an important but separate issue.

¹⁵ Water available for municipal use is slightly higher in Scenario 1 due to lower projected Mining employment, thus at buildout the total population is slightly higher.

Land Impacts

The maps shown in the Growth Model Chapter show the projected path and level of development in Eastern Pima County for the three scenarios. Table 7 shows how modeled development results intersect¹⁶ with select land categories.

Constituent impact sections which follow at the end of this chapter refer back to this summary of ranching, agricultural, and State Land. The remainder of this section discusses the total land that will need to be acquired to mitigate for development and the likely cost of that land.

¹⁶ The intersections are places where two geographically defined areas occupy the same location. It should be noted that the categories listed are not mutually exclusive. For example, much of State Land is also ranch land.

Table 7 – Intersection of Growth Model Results with Selected Land Types by Scenario and Timeframe (acres)

	Baseline	End 10 Year	End 20 Year	Buildout	
Scenario 1	Total Acres Outside Model Constraints ¹				
	Listed Species ²	883,075	876,569	859,407	729,925
	Biologically Preferred Alternative ³	902,544	896,748	880,434	797,083
	Ranch Land	177,117	175,916	170,460	144,495
	Agricultural Land	22,291	21,491	19,529	14,953
	State Land	608,281	607,175	601,598	513,993
	Intersected With Modeled Development Outside Built Environment				
	Listed Species	N/A	6,505	23,668	153,150
	Biologically Preferred Alternative	N/A	5,796	22,111	105,461
	Ranch Land	N/A	1,200	6,657	32,621
	Agricultural Land	N/A	800	2,762	7,338
	State Land	N/A	1,106	6,683	94,288
	Scenario 2	Total Acres Outside Model Constraints			
		Listed Species	883,075	875,137	845,684
Biologically Preferred Alternative		902,544	895,499	867,613	800,256
Ranch Land		177,117	175,663	164,357	145,214
Agricultural Land		22,291	21,296	17,839	10,960
State Land		608,281	606,558	597,589	522,955
Intersected With Modeled Development Outside Built Environment					
Listed Species		N/A	7,938	37,391	148,856
Biologically Preferred Alternative		N/A	7,045	34,931	102,288
Ranch Land		N/A	1,454	12,760	31,903
Agricultural Land		N/A	995	4,451	11,331
State Land		N/A	1,723	10,692	85,326
Scenario 3		Total Acres Outside Model Constraints			
		Listed Species	883,075	874,880	845,617
	Biologically Preferred Alternative	902,544	895,352	868,363	792,760
	Ranch Land	177,117	175,778	166,041	140,954
	Agricultural Land	22,291	21,748	18,601	14,955
	State Land	608,281	606,386	594,587	518,491
	Intersected With Modeled Development Outside Built Environment				
	Listed Species	N/A	8,195	37,458	153,515
	Biologically Preferred Alternative	N/A	7,193	34,181	109,784
	Ranch Land	N/A	1,338	11,076	36,162
	Agricultural Land	N/A	543	3,690	7,336
	State Land	N/A	1,895	13,694	89,790

Note: 1. Shows acres remaining vacant and not intersecting with any modeled development. It should be noted that intersection with modeled development does not necessarily equate with a "loss" of the land. For example, guidelines for development within the CLS are less restricting than existing zoning.

2. Listed Species defined as High Potential Habitat for One or More Listed Species, Recovery Area, and High Potential Habitat and Recovery Area

3. Biologically Preferred Alternative defined as Biological Core, Important Riparian Areas, and Recovery Management Areas.

Land Acquisition

One key cost component of obtaining or not obtaining a Section 10 Permit will be the costs to acquire land needed for preservation and (potentially) to serve as a mitigation bank for development elsewhere in the county. It must be clearly stated that the calculations of total acreage necessary and the current value of land identified for preservation represent **total** needs to accommodate a given amount of development activity and level of mitigation and do not represent costs that must be paid by Pima County or any other individual entity. It is important note, that even if Pima County does not have a Section 10 Permit (Scenario 1), consideration will have to be given to the protection of the Listed Species and their habitat. Both the Listed Species and Biologically Preferred alternatives are presented for Scenario 1 in this section for comparative purposes. Furthermore, depending on the specific details of the permit obtained there could be greater certainty in terms of the amount of land necessary to offset incidental take on a given site.¹⁷

The total land value will vary based on the amount of land to be acquired and where the land is located. The rationale behind each of these variables and the development of the total cost estimate are discussed below.

Amount of Land to Be Acquired

The amount of land to be acquired is related to the amount of habitat to be developed, but not simply as a one-to-one relationship. It is possible that some future development activity could have **no** land mitigation requirements external to the site where it occurs. This possibility differs per site, but is related to the suitability of the habitat, the site plan, intensity of development, and type of development.¹⁸ Where land mitigation external to the site is required, it can range anywhere from one acre preserved per acre developed to four acres preserved per one acre developed (referred to as 1:1 to 4:1 from this point forward). These calculations are conservative (actual costs will likely be lower) as all assume that at least some off-site mitigation must be done each time likely habitat is developed.

Likely habitat is defined as follows using GIS coverages developed as part of the SDCP.¹⁹

¹⁷ A question which requires site specific analysis without the Section 10 Permit.

¹⁸ When the plan is developed it will likely define mitigation ratios for different land areas.

¹⁹ Note that the development impacts of this analysis are further constrained to include only areas outside of the model constraints (as described in the Land Absorption Model Appendix).

- ⌘ Listed Species Alternative – Includes High Potential Habitat for One or More Listed Species, Recovery Area, and High Potential Habitat and Recovery Area
- ⌘ Biologically Preferred Alternative – Includes Important Riparian Areas, the Biological Core, and Multi-Recovery Areas from the Conservation Lands System

The amount of habitat developed is also a variable, depending on whether the Listed Species or Biologically Preferred Alternative definition of habitat is used. As lands encompassed in the Biologically Preferred Alternative are generally more concentrated away from likely urban expansion, the acres of land impacted by projected future development is lower for all scenarios and timeframes in the case of the Biologically Preferred Alternative relative to the Listed Species only analysis.²⁰ Maps 5, 6, and 7 show the intersection of projected future development (from the land absorption model) with both definitions of habitat. A substantial proportion of all of the designated habitat areas projected for development are common to both definitions (areas shown in purple on the maps).

To set aside the necessary amount of land to balance ten years of development would require anywhere from 6,000 to nearly 33,000 acres, depending on the scenario and **especially** on the level of mitigation required. Land acquisition to fully mitigate for twenty years worth of growth at a 2:1 mitigation could require 40,000 to 75,000 acres depending on the scenario. See Table 8 for the land needs of accommodating projected future development for the Listed Species Alternative and for the Biologically Preferred Alternative.

²⁰ The locations of Listed Species Alternative land and Biologically Preferred Alternative land used in this study come directly from the study *Listed Species Reserve Analysis*.

**Pima County Economic Analysis
Section 10 Permit**

KEY

10 Year Development Timeframe

- Listed Species
- Biologically Preferred Alternative
- Listed Species and Biologically Preferred Alternative

10 - 20 Year Development Timeframe

- Listed Species
- Biologically Preferred Alternative
- Listed Species and Biologically Preferred Alternative

Buildout Development Timeframe

- Listed Species
- Biologically Preferred Alternative
- Listed Species and Biologically Preferred Alternative

- Constraint to Development or Outside Consideration
- Not Developed or Not Habitat
- Municipal Boundary

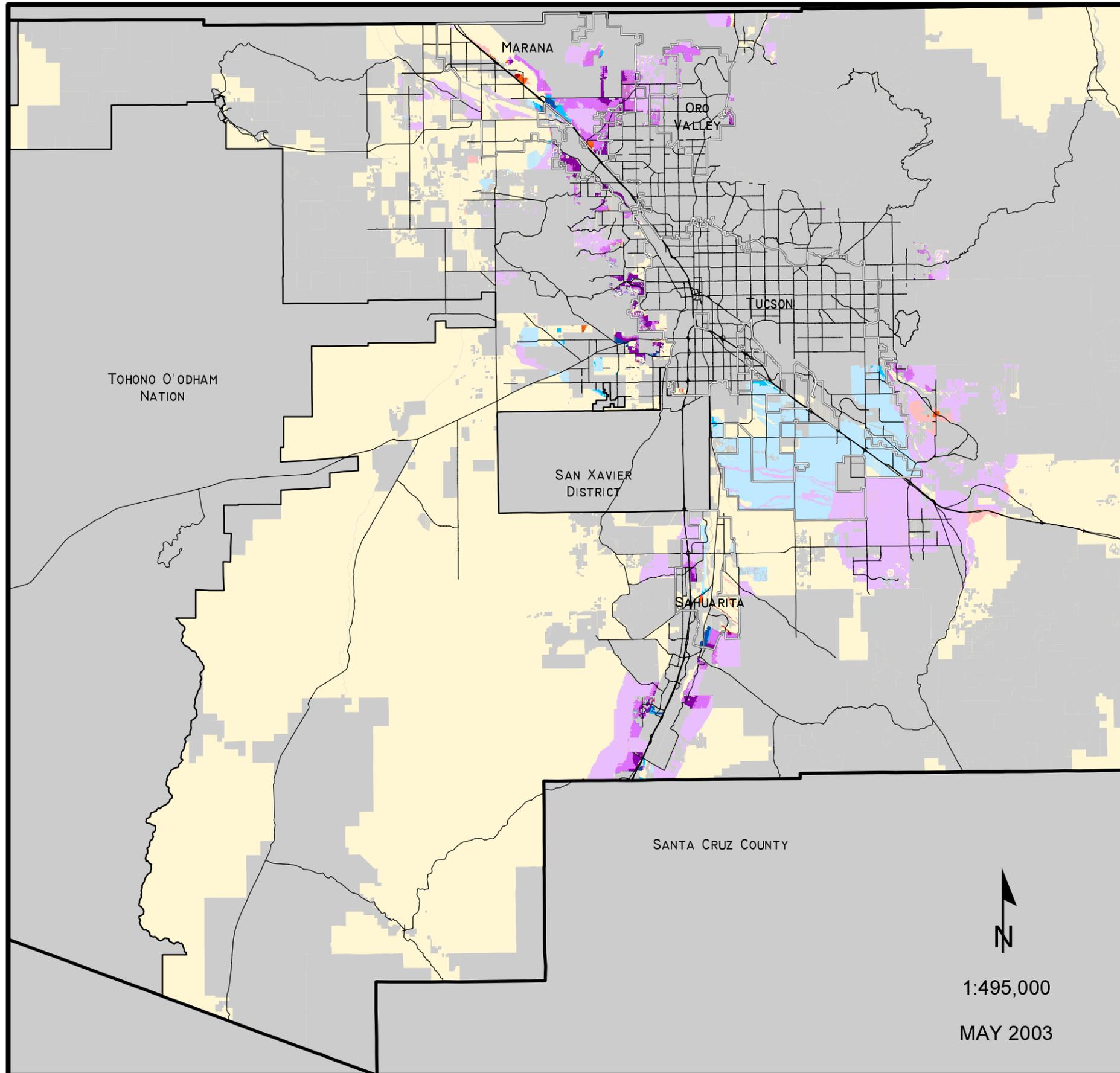


DISCLAIMER

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Map 5. Intersection of Growth Model Results with Species Habitat, Scenario 1.



**Pima County Economic Analysis
Section 10 Permit**

KEY

10 Year Development Timeframe

- Listed Species
- Biologically Preferred Alternative
- Listed Species and Biologically Preferred Alternative

10 - 20 Year Development Timeframe

- Listed Species
- Biologically Preferred Alternative
- Listed Species and Biologically Preferred Alternative

Buildout Development Timeframe

- Listed Species
- Biologically Preferred Alternative
- Listed Species and Biologically Preferred Alternative

- Constraint to Development or Outside Consideration
- Not Developed or Not Habitat
- Municipal Boundary

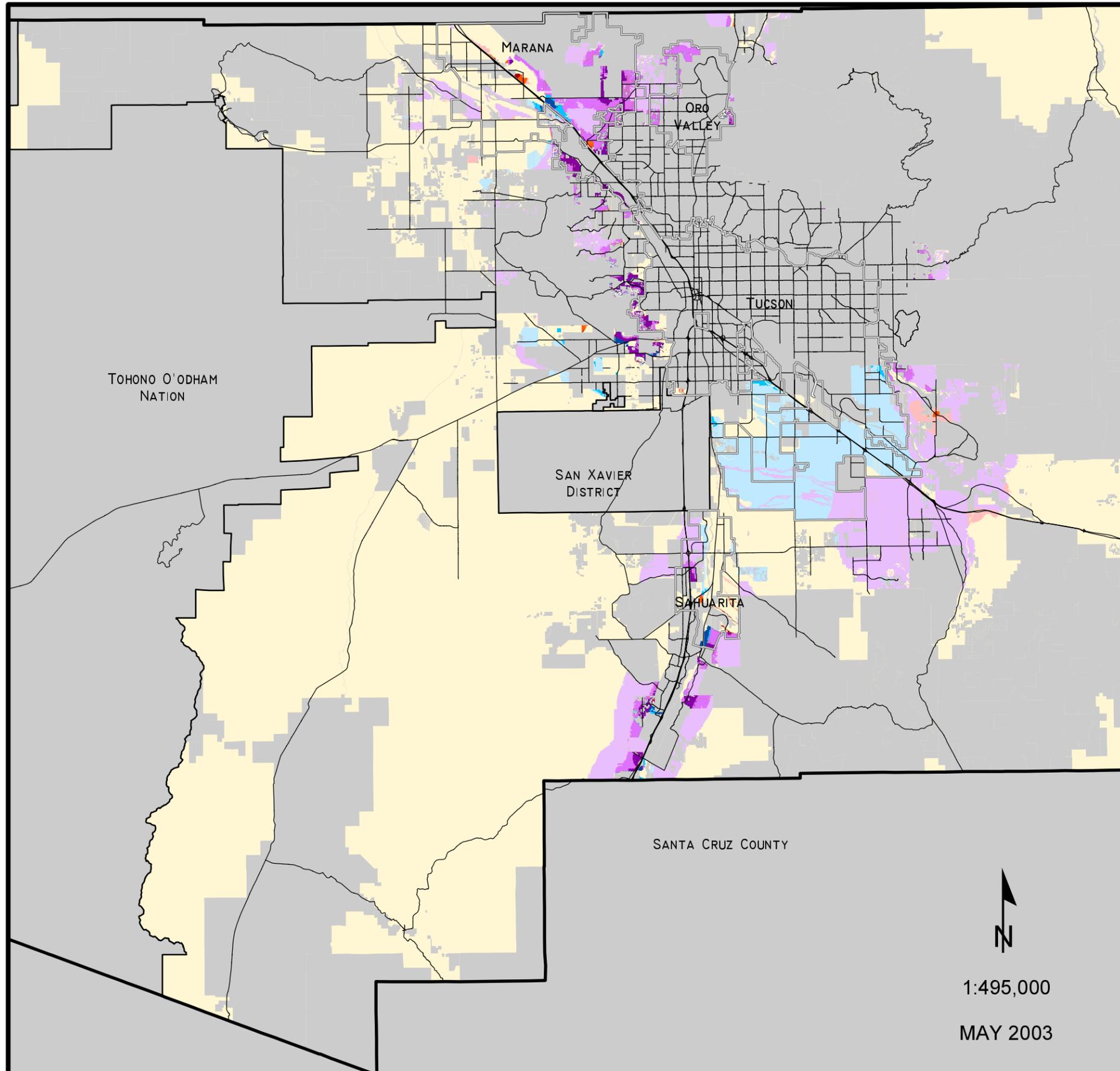


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Map 6. Intersection of Growth Model Results with Species Habitat, Scenario 2.



1:495,000
MAY 2003

**Pima County Economic Analysis
Section 10 Permit**

KEY

10 Year Development Timeframe

- Listed Species
- Biologically Preferred Alternative
- Listed Species and Biologically Preferred Alternative

10 - 20 Year Development Timeframe

- Listed Species
- Biologically Preferred Alternative
- Listed Species and Biologically Preferred Alternative

Buildout Development Timeframe

- Listed Species
- Biologically Preferred Alternative
- Listed Species and Biologically Preferred Alternative

- Constraint to Development or Outside Consideration
- Not Developed or Not Habitat
- Municipal Boundary



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Map 7. Intersection of Growth Model Results with Species Habitat, Scenario 3.

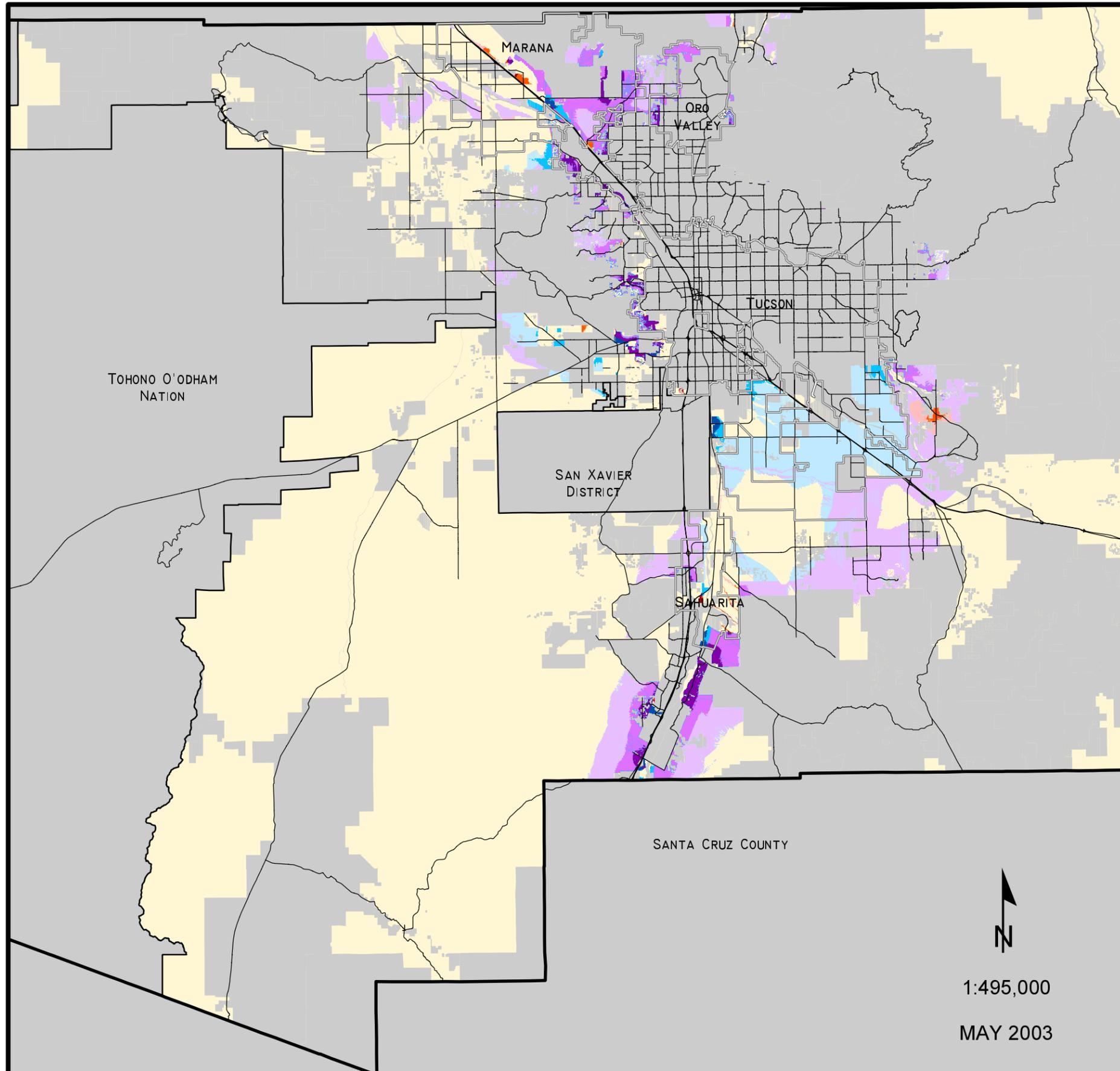


Table 8 – Land Acquisition Needs to Accommodate Listed Timeframe of Future Development, by Scenario and Mitigation Rate, Cumulative Acres

		10 Years Development	20 Years Development	Through Buildout
Scenario 1	Listed Species Only			
	1:1 Mitigation	6,505	23,668	153,150
	2:1 Mitigation	13,011	47,336	306,300
	3:1 Mitigation	19,516	71,003	459,449
	4:1 Mitigation	26,021	94,671	612,599
	Biologically Preferred			
	1:1 Mitigation	5,796	22,111	105,461
	2:1 Mitigation	11,591	44,221	210,922
	3:1 Mitigation	17,387	66,332	316,383
	4:1 Mitigation	23,183	88,442	421,844
Scenario 2	Listed Species Only			
	1:1 Mitigation	7,938	37,391	148,856
	2:1 Mitigation	15,875	74,783	297,713
	3:1 Mitigation	23,813	112,174	446,569
	4:1 Mitigation	31,750	149,565	595,426
	Biologically Preferred			
	1:1 Mitigation	7,045	34,931	102,288
	2:1 Mitigation	14,090	69,863	204,575
	3:1 Mitigation	21,135	104,794	306,863
	4:1 Mitigation	28,180	139,725	409,151
Scenario 3	Listed Species Only			
	1:1 Mitigation	8,195	37,458	153,515
	2:1 Mitigation	16,390	74,916	307,030
	3:1 Mitigation	24,585	112,374	460,545
	4:1 Mitigation	32,781	149,832	614,060
	Biologically Preferred			
	1:1 Mitigation	7,193	34,181	109,784
	2:1 Mitigation	14,385	68,363	219,568
	3:1 Mitigation	21,578	102,544	329,352
	4:1 Mitigation	28,770	136,726	439,137

Note: 1. The 1:1 mitigation ratio is equivalent to the amount of development expected to occur on the listed habitat.

Location of Land to Be Acquired

There are two key considerations in identifying appropriate land for acquisition for mitigation purposes.

1. The necessary consideration of the appropriateness of the habitat set aside relative to that which has been subject to the incidental take.

The habitat protected should be habitat for the same species that had habitat displaced and of similar or better habitat quality.

2. The strategic consideration relates to evaluating which land among all of that which is suitable is most appropriate to acquire, given costs and development pressures. Purchasing land before it is highly coveted for development will tend to be less expensive. Setting land aside contiguously will likely reduce the costs of monitoring the land and provide ecological benefits.

At the time of this writing, critical habitat for the CFPO had been proposed but not finalized by USFWS, and for the Pineapple Cactus had not yet been proposed. Because of this assumptions had to be made as to the location for mitigation land acquisition. Based on conversations with Pima County staff, three general areas were identified for mitigation:

- ✧ Altar Valley
- ✧ Cienega-Rincon
- ✧ Tortolita Fan

County staff also indicated that mitigation for development in unincorporated areas would likely occur primarily in Alter Valley and Cienega-Rincon, with mitigation in the Tortolita Fan resulting primarily from development in the towns of Marana and Oro Valley. The three mitigation areas are shown on Map 8.

For the purposes of this analysis, land needed to mitigate for development on species habitat would be acquired in equal amounts from the two key areas of Altar Valley and Cienega-Rincon. An alternate methodology that divides land acquisition equally between the three areas is presented in Appendix D.

These three areas were used to query the Assessor database and assemble a database of parcels meeting three criteria; 1) parcels which intersect one of the key areas and have relatively high habitat value, 2) parcels one acre or larger, and 3) parcels with \$10,000 or less in improvements on them (recall this is the working GIS definition of “vacant.”)

Pima County Economic Analysis Section 10 Permit

KEY

- Altar Valley
- Cienega-Rincon
- Tortolita Fan



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Map 8. Preservation Land Acquisition Areas.

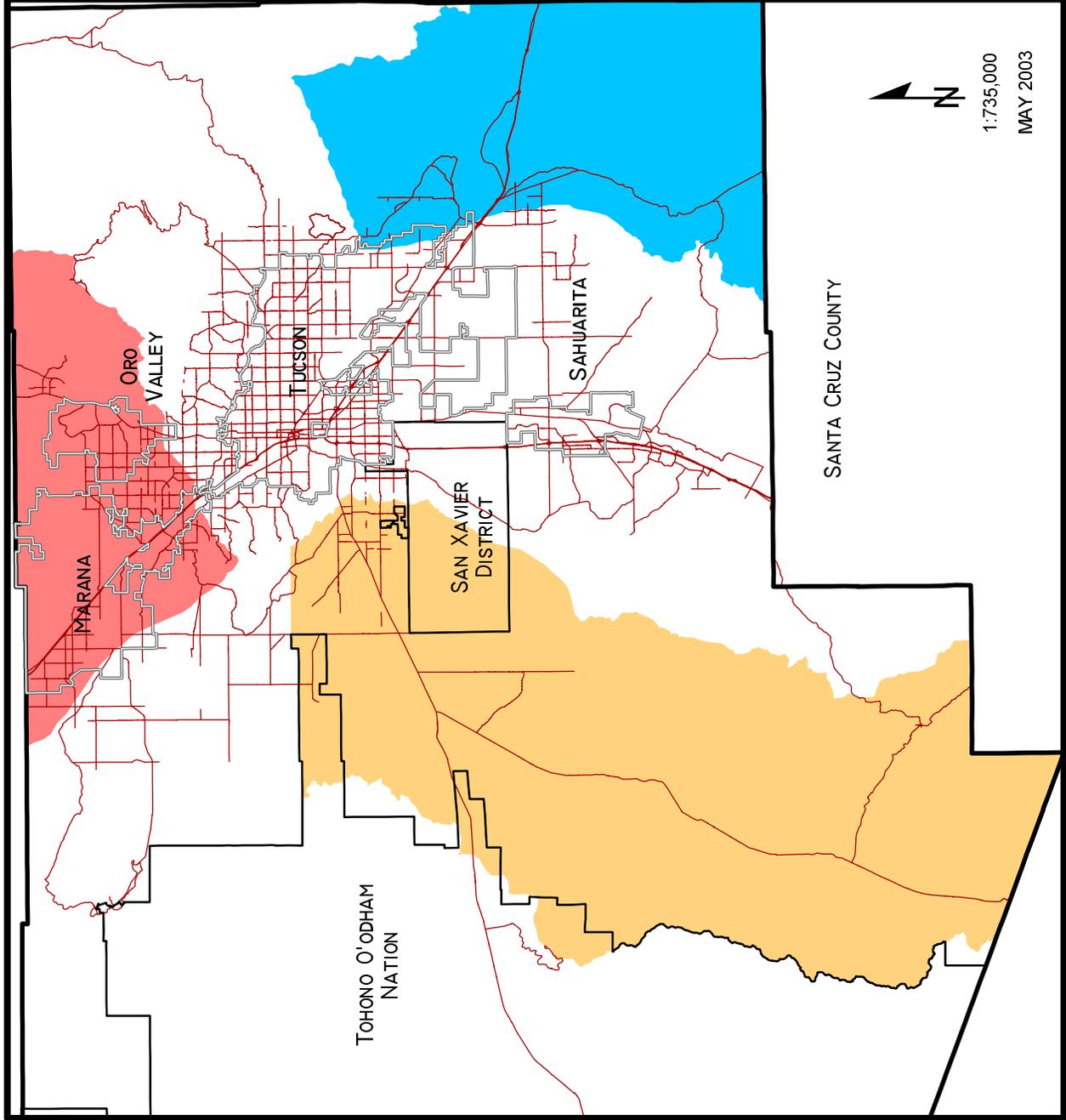


Table 9 presents values for each of the areas. The median represents the middle value of all full cash value of land per acre calculations. This measure is similar to a mean, but less sensitive to extreme values. The other land value points (low and high) represents the first and third quartiles of the data set.²¹ The range of land values varies greatly in the Tortolita Fan area, which is also the most expensive of the three areas identified in the middle and high values. This difference manifests itself especially in the middle and high mean values of the Alter Valley and Cienega-Rincon only, compared to the three areas combined.²²

Table 9 – Land Value Per Acre in Three Geographic Areas Identified for Preserve Lands (\$ 2002)

	Alter Valley	Cienega-Rincon	Tortolita Fan	Mean (AV & C-R only)	Mean (AV, C-R & TF)
Land Value Per Acre ¹					
Low	\$ 736	\$ 791	\$ 240	\$ 763	\$ 589
Middle (Median)	\$ 894	\$ 2,180	\$16,614	\$ 1,537	\$ 6,563
High	\$ 1,202	\$ 4,505	\$46,507	\$ 2,853	\$ 17,405

Note: 1. Low and high represent the first and third quartiles of the data

Table 10 presents the value of Alter Valley and Cienega-Rincon land to be acquired under a number of different conditions.²³ The figures in this table are the result of multiplying the acres of land presented in Table 8 by the “Mean” land values from Table 9. Due to the slightly lower land needs, the value of land to be acquired for the Biologically Preferred Alternative is slightly less than the value of land to be acquired for Listed Species only.

²¹ The median is actually the second quartile. Quartiles sort a data set and separate it into four equal parts. The distance (number of records) is equal between quartiles, so the first quartile (our low estimate) is halfway between the lowest value and the median and the third quartile (our high estimate) is halfway between the highest value and the median.

²² As a point of comparison, a 2000 study showed that generally land values for unplatted land for all of Eastern Pima County average \$3,560 as contrasted with land in the urbanizing areas of Pima County with an average unplatted value of \$14,839 per acre. Pima County Sonoran Desert Conservation Plan (Eds.). (2000, February). *Impact of Unregulated Development on the Pima County Tax Base, Service Demand and Future Infrastructure Liability* (SDCP CD Reports Disk 3, Report 31).

²³ Similar analysis of Alter Valley, Cienega-Rincon, and Tortolita Fan is contained in Appendix D.

Table 10 – Cumulative Value of Land to Be Acquired to Accommodate Development at Each by Scenario (\$ millions 2002) ¹

	<u>10 Years Development</u>			<u>20 Years Development</u>			<u>Through Buildout</u>			
	<u>Low</u>	<u>Mid</u>	<u>High</u>	<u>Low</u>	<u>Mid</u>	<u>High</u>	<u>Low</u>	<u>Mid</u>	<u>High</u>	
Scenario 1	Listed Species Only									
	1:1 Mitigation	\$ 5.0	\$ 10.0	\$ 18.6	\$ 18.1	\$ 36.4	\$ 67.5	\$ 116.9	\$ 235.4	\$ 437.0
	2:1 Mitigation	\$ 9.9	\$ 20.0	\$ 37.1	\$ 36.1	\$ 72.8	\$ 135.1	\$ 233.8	\$ 470.8	\$ 874.0
	3:1 Mitigation	\$ 14.9	\$ 30.0	\$ 55.7	\$ 54.2	\$ 109.1	\$ 202.6	\$ 350.7	\$ 706.2	\$ 1,311.0
	4:1 Mitigation	\$ 19.9	\$ 40.0	\$ 74.2	\$ 72.3	\$ 145.5	\$ 270.1	\$ 467.6	\$ 941.6	\$ 1,748.0
	Biologically Preferred									
	1:1 Mitigation	\$ 4.4	\$ 8.9	\$ 16.5	\$ 16.9	\$ 34.0	\$ 63.1	\$ 80.5	\$ 162.1	\$ 300.9
	2:1 Mitigation	\$ 8.8	\$ 17.8	\$ 33.1	\$ 33.8	\$ 68.0	\$ 126.2	\$ 161.0	\$ 324.2	\$ 601.8
	3:1 Mitigation	\$ 13.3	\$ 26.7	\$ 49.6	\$ 50.6	\$ 102.0	\$ 189.3	\$ 241.5	\$ 486.3	\$ 902.8
	4:1 Mitigation	\$ 17.7	\$ 35.6	\$ 66.1	\$ 67.5	\$ 135.9	\$ 252.4	\$ 322.0	\$ 648.4	\$ 1,203.7
Scenario 2	Listed Species Only									
	1:1 Mitigation	\$ 6.1	\$ 12.2	\$ 22.6	\$ 28.5	\$ 57.5	\$ 106.7	\$ 113.6	\$ 228.8	\$ 424.7
	2:1 Mitigation	\$ 12.1	\$ 24.4	\$ 45.3	\$ 57.1	\$ 114.9	\$ 213.4	\$ 227.2	\$ 457.6	\$ 849.5
	3:1 Mitigation	\$ 18.2	\$ 36.6	\$ 67.9	\$ 85.6	\$ 172.4	\$ 320.1	\$ 340.9	\$ 686.4	\$ 1,274.2
	4:1 Mitigation	\$ 24.2	\$ 48.8	\$ 90.6	\$ 114.2	\$ 229.9	\$ 426.8	\$ 454.5	\$ 915.2	\$ 1,699.0
	Biologically Preferred									
	1:1 Mitigation	\$ 5.4	\$ 10.8	\$ 20.1	\$ 26.7	\$ 53.7	\$ 99.7	\$ 78.1	\$ 157.2	\$ 291.9
	2:1 Mitigation	\$ 10.8	\$ 21.7	\$ 40.2	\$ 53.3	\$ 107.4	\$ 199.3	\$ 156.2	\$ 314.4	\$ 583.7
	3:1 Mitigation	\$ 16.1	\$ 32.5	\$ 60.3	\$ 80.0	\$ 161.1	\$ 299.0	\$ 234.2	\$ 471.7	\$ 875.6
	4:1 Mitigation	\$ 21.5	\$ 43.3	\$ 80.4	\$ 106.7	\$ 214.8	\$ 398.7	\$ 312.3	\$ 628.9	\$ 1,167.5
Scenario 3	Listed Species Only									
	1:1 Mitigation	\$ 6.3	\$ 12.6	\$ 23.4	\$ 28.6	\$ 57.6	\$ 106.9	\$ 117.2	\$ 236.0	\$ 438.0
	2:1 Mitigation	\$ 12.5	\$ 25.2	\$ 46.8	\$ 57.2	\$ 115.1	\$ 213.8	\$ 234.4	\$ 471.9	\$ 876.1
	3:1 Mitigation	\$ 18.8	\$ 37.8	\$ 70.2	\$ 85.8	\$ 172.7	\$ 320.6	\$ 351.5	\$ 707.9	\$ 1,314.1
	4:1 Mitigation	\$ 25.0	\$ 50.4	\$ 93.5	\$ 114.4	\$ 230.3	\$ 427.5	\$ 468.7	\$ 943.8	\$ 1,752.1
	Biologically Preferred									
	1:1 Mitigation	\$ 5.5	\$ 11.1	\$ 20.5	\$ 26.1	\$ 52.5	\$ 97.5	\$ 83.8	\$ 168.7	\$ 313.3
	2:1 Mitigation	\$ 11.0	\$ 22.1	\$ 41.0	\$ 52.2	\$ 105.1	\$ 195.1	\$ 167.6	\$ 337.5	\$ 626.5
	3:1 Mitigation	\$ 16.5	\$ 33.2	\$ 61.6	\$ 78.3	\$ 157.6	\$ 292.6	\$ 251.4	\$ 506.2	\$ 939.8
	4:1 Mitigation	\$ 22.0	\$ 44.2	\$ 82.1	\$ 104.4	\$ 210.2	\$ 390.1	\$ 335.2	\$ 675.0	\$ 1,253.0

Note: 1. Low, middle, and high values presented in this table reflect a range of land acquisition costs per acre for Alter Valley and Cienega-Rincon as presented in Table 9.

Cost and Benefit Components

The data not related to land development which was analyzed in compiling cost and benefit components is gathered in this section, particularly where the components impact multiple constituencies.

Employment Mix and Personal Income

The economic impacts of obtaining a comprehensive Section 10 Permit are substantially rooted in how the regional economy could be expected to

change in response to the action. One of the key differences is in the expected employment mix and level of growth developed in projections for Scenarios 2 and 3. The development of adjustments to the employment mix and the overall regional growth rate is described in Appendix B.

Projections of wage rates were held constant across scenarios, but as the mix of jobs changes, and as employment growth is more rapid, total personal income in the region (which in turn drives factors such as property values) increases in earlier years. Other income, such as from dividends, interest and rent is also projected to be higher in Scenarios 2 and 3 due to higher population growth. The calculations of income levels are contained in Appendix E.

Property Values and Property Tax

Property taxes are imposed on nearly all privately owned real estate property in the county, and also many forms of personal property. The property tax structure in Arizona is divided into the following two categories:

- ✧ Primary – “Primary property tax revenues help to fund the maintenance and operation budgets of state and local governments.”²⁴ Growth in the primary assessed values are limited, as is the growth in the total amount that can be collected.
- ✧ Secondary – “Secondary values fund such things as bond issues, budget overrides and special districts. There is no limit on either the amount of taxes that may be assessed or the growth rate of assessed values.”²⁵

The analysis of property taxes began by calculating the value of real property in the county, and then applying appropriate tax rates to arrive at the final result.

²⁴ Arizona Tax Research Foundation, *2002 Property Tax Rates & Assessed Values* (Page II)

²⁵ Ibid. (Page I)

Property Value

The purpose of this analysis was to project the future value of taxable property in Pima County for the three Scenarios. A model was built based on the correlation between historic socioeconomic factors and historic property values. Using statistical tools, high levels of correlation were found between the six property classifications studied and their associated socioeconomic factors.²⁶ Based on the strong linkages between the historic data, the changes in the projected socioeconomic data were used to project property values. See Appendix F for a full discussion of the methodology used.

For the purposes of the analysis of the Section 10 Permit, personal property and all “centrally valued” real property except mines were excluded from the analysis. Centrally valued property is appraised by the State and then allocated back to the counties and includes such categories as railroads and airlines. In the 2002/2003 tax year the excluded factors totaled 13.7 percent of the total net assessed value in the county.

The results of the property value analysis are presented in Table 12. The data presented here reflect the change in the inventory of a particular land use type and the appreciation or depreciation in the property. For example, the amount of vacant land is decreasing, and the number of homes is increasing, while on average property generally appreciates. All of the data points are in constant 2002 dollars, so the effects of inflation have been removed.

A comparison of the total property value in Scenario 1 to Scenarios 2 and 3 shows the trend of more development occurring in the first 20 years in Scenarios 2 and 3 than Scenario 1, with more total development occurring by buildout in Scenario 1. With the exception of mines and vacant land, the value of property in all the categories is increasing over time.

²⁶ In all cases, the correlation coefficients were above +0.9 or -0.9 (maximum of +1.0 or -1.0) indicating that changes in the socioeconomic factors were good indicators of changes in the property valuations.

Table 11 – Property Value, by Type, Timeframe and Scenario (\$millions 2002)

	Baseline	End of First 10 Years	End of Second 10 Years	Buildout	
Scenario 1	Property Value¹				
	Mines	\$ 138.0	\$ 52.5	\$ 36.5	\$ 17.9
	Commercial Real Property	\$ 4,338.9	\$ 4,968.8	\$ 5,013.7	\$ 5,735.2
	Vacant Land	\$ 1,994.8	\$ 1,203.0	\$ 693.0	\$ 178.8
	Residential - Owner Occupied	\$23,172.8	\$31,442.0	\$43,244.5	\$104,525.7
	Residential - Rental Occupied	\$ 4,034.8	\$ 4,620.6	\$ 4,662.3	\$ 5,333.2
	Other Real Property	\$ 210.1	\$ 507.3	\$ 1,351.6	\$ 17,587.1
	Total	\$33,889.5	\$42,794.3	\$55,001.6	\$133,377.9
	Annual Percent Change				
	Mines		-9.2%	-3.6%	-2.9%
	Commercial Real Property		1.4%	0.1%	0.6%
	Vacant Land		-4.9%	-5.4%	-5.5%
	Residential - Owner Occupied		3.1%	3.2%	3.7%
	Residential - Rental Occupied		1.4%	0.1%	0.6%
	Other Real Property		9.2%	10.3%	11.3%
Total		2.4%	2.5%	3.8%	
Scenarios 2 & 3	Property Value¹				
	Mines	\$ 138.0	\$ 57.4	\$ 41.7	\$ 23.2
	Commercial Real Property	\$ 4,338.9	\$ 5,143.9	\$ 5,550.3	\$ 6,405.0
	Vacant Land	\$ 1,994.8	\$ 1,007.4	\$ 580.3	\$ 202.8
	Residential - Owner Occupied	\$23,172.8	\$32,475.3	\$46,070.2	\$ 99,911.2
	Residential - Rental Occupied	\$ 4,034.8	\$ 4,783.4	\$ 5,161.3	\$ 5,956.1
	Other Real Property	\$ 210.1	\$ 541.2	\$ 1,534.0	\$ 14,229.4
	Total	\$33,889.5	\$44,008.6	\$58,938.0	\$126,727.7
	Annual Percent Change				
	Mines		-8.4%	-3.1%	-2.4%
	Commercial Real Property		1.7%	0.8%	0.6%
	Vacant Land		-6.6%	-5.4%	-4.3%
	Residential - Owner Occupied		3.4%	3.6%	3.3%
	Residential - Rental Occupied		1.7%	0.8%	0.6%
	Other Real Property		9.9%	11.0%	9.7%
Total		2.6%	3.0%	3.2%	

Note: 1. Data represent Net Assessed Value of selected property classifications for all of Pima County.

Property Taxes

Once future property values were understood, the assessment ratios were applied to each property classification. For example, commercial property is taxed at 25 percent of its value and residential at 10 percent. The various assessed values were summed, and the 2002 property tax rates

were applied to this total. The assessment ratios and property tax rates were also held constant throughout the analysis.

Table 12 presents the cumulative combined primary and secondary property tax collections during the three timeframes measured in constant 2002 dollars. The results show that during the first 10 years of development \$8.45 billion will be collected under Scenario 1, and \$8.50 billion under Scenarios 2 and 3. This is divided between a number of taxing entities including school districts, the county and others. See Appendix F for detailed year-to-year data, and the breakdown between primary and secondary collections.

Table 12 – Cumulative Property Tax Collections by Type, Timeframe and Scenario (\$millions 2002)

		First 10 Years	Second 10 Years	Year 21 to Buildout
Scenario 1	Property Tax Collections¹			
	County	\$ 2,846.4	\$ 6,008.4	\$ 19,826.8
	Cities and Towns	\$ 267.0	\$ 563.1	\$ 1,856.9
	Community Colleges	\$ 774.8	\$ 1,635.5	\$ 5,396.4
	Schools	\$ 4,088.0	\$ 8,628.4	\$ 28,469.9
	All Other	\$ 474.7	\$ 1,001.0	\$ 3,299.8
	Total	\$ 8,451.0	\$17,836.4	\$ 58,849.8
Scenarios 2 & 3	Property Tax Collections¹			
	County	\$ 2,862.7	\$ 6,236.6	\$ 17,447.2
	Cities and Towns	\$ 268.5	\$ 584.6	\$ 1,634.4
	Community Colleges	\$ 779.3	\$ 1,697.6	\$ 4,748.8
	Schools	\$ 4,111.3	\$ 8,956.2	\$ 25,053.6
	All Other	\$ 477.4	\$ 1,039.1	\$ 2,904.7
	Total	\$ 8,499.2	\$18,514.1	\$ 51,788.8

Note: 1. Includes Primary and Secondary collections.

Hotel Taxable Sales and Tax

The only sales tax currently imposed by Pima County is on hotel/motel activity, and this tax only applies to the unincorporated areas of the county. Similar to the property value methodology presented earlier, a model was built based on the correlation of a historic socioeconomic factor, in this case total employment, to historic taxable sales in the unincorporated county. Based on the strong linkage between the historic data, the changes in the projected total employment were used to project taxable sales. See Appendix G for a full discussion of the methodology used.

The current sales tax rate is two percent, however per state statute this rate will drop to one percent in 2012. These rates were applied to the

inflation adjusted projections of taxable sales to arrive at the projected tax collections at various timeframes. Table 13 shows that taxable sales and tax collections are higher in Scenarios 2 and 3 than Scenario 1 during the first 20 years, but is higher in Scenario 1 at buildout due to the additional years of development and resultant tax collections.

Table 13 – Cumulative Projected Hotel Sales Taxable Activity and Tax Collections by Scenario and Timeframe (\$millions 2002)

	First 10 Years	Second 10 Years	Year 21 to Buildout
Scenario 1			
Taxable Activity	\$1,487.0	\$1,908.1	\$6,224.0
Tax Collections ²	\$29.7	\$19.1	\$62.2
Scenarios 2 & 3			
Taxable Activity	\$1,548.3	\$2,186.8	\$5,999.0
Tax Collections ²	\$31.0	\$21.9	\$60.0

Note: 1. Assumes no change in tax base.

2. Per state statute, 2 percent tax rate through 2011, and 1 percent thereafter.

Constituent Impacts

Costs and benefits described accrue to various different constituent groups in Eastern Pima County. The effects on six major groups are discussed individually:

- ✧ Pima County government
- ✧ Environmental based economy
- ✧ Private property interests
- ✧ Ranch community
- ✧ Real estate, business and development communities
- ✧ Other jurisdictions

Pima County Government

As new homes, businesses and other projects are built in unincorporated Pima County, one-time expenditures on public infrastructure and facilities must be made to serve them. This new development also results in additional ongoing operation and maintenance costs to the Pima County government. While costs in these areas will unquestionably rise due to increased demand and inflation, the Section 10 Permit itself is expected to have no net effect on the Pima County government's cost to serve new development on a *per unit* basis. For example, the cost to provide wastewater services per gallon of water treated is not expected to be impacted by the permit. Since no net impact is expected, detailed costs were not calculated for the various county services studied. A brief discussion of each service reviewed follows.

County Services

Construction and Development Permits – The Pima County Development Services Department operates as an Enterprise Fund, so it is required to be self financing and also have a balanced budget. Discussions with county staff knowledgeable about both the Section 10 Permit process and the Department's processes resulted in a determination that there will be no increased or decreased time or cost impact to construction or development permits as a result of the Section 10 Permit.

Wastewater Services – The Pima County Wastewater Management Department operates as an Enterprise Fund, so it is required to be self financing and also have a balanced budget. Under the Department's current policy, a developer must connect at his own expense to the existing wastewater collection network. Developers also pay a fee for the cost of expansion of the treatment facility in proportion to their demand. Department staff does not see the Section 10 Permit placing any increased or decreased burden on the Department, the development community or ratepayers beyond those already imposed through existing policy.

Transportation (Roads) – On April 8, 2003 the Pima County Board of Supervisors approved an expansion of the previously existing transportation development fee. The new fee includes additional areas of unincorporated Pima County, and is imposed on most development classes. Discussions with staff from the Department of Transportation indicated that costs for roads are impacted by topography, drainage and amenities, but that these higher cost roads are spread throughout the county. The cost differential from the Section 10 Permit does not have any measurable impacts.

Sheriff's Department – As demand for police services grows, so to does the Sheriff's Department's need for buildings, vehicles, communication equipment, deputies, etc. Discussions with department staff and a review of the costs to increase the services they offer did not uncover any increased or reduced costs for the Department from the Section 10 Permit.

Parks and Community Facilities – This discussion relates only to active participation parks, such as those with baseball fields, and associated community centers; not open space parks and preserves that are available for public recreation. A thorough review of the parks development process and its related costs was conducted. No impact could be uncovered in the cost to build future facilities to serve new development from the Section 10 Permit.

County Revenues

County revenues, similar to county services, are not expected to be impacted on a *per unit* basis by the Section 10 Permit. However, the

differences in timing and magnitude of development between Scenario 1 and Scenarios 2 and 3 are expected to result in slight differences in the revenues collected. Table 12 showed that during the first ten years of development property taxes to Pima County are expected to be \$2.8 billion under Scenarios 2 and 3, which is \$16.3 million higher than Scenario 1. Table 13 showed that during the first ten years of development hotel/motel sales taxes collected in unincorporated Pima County are expected to be \$31.0 million under Scenarios 2 and 3, which is \$1.3 million higher than Scenario 1.

Environmental Based Economy

Metropolitan Tucson has long been a tourist destination; attracting visitors from across the state, nationally, and internationally. Two recent studies performed by Dr. Alberta Charney at the University of Arizona allow us to begin to quantify the amount of tourism activity that is a result of ecotourism, broadly defined as visitation of natural areas. Nearly half (44 percent) of visitors visited parks, zoos, and/or natural areas according to the 1997 study.

While it is by no means accurate to say that ecotourism would cease in its entirety without the implementation of the Section 10 Permit, it is reasonable to assume that some visitors who are particularly attracted to natural attractions will visit other regions. It has also been theorized that resort and golf course activities, which would seem particularly well positioned to take advantage of the amenity value where mitigation and or less intense development is called for, could be benefited by obtaining a comprehensive Section 10 Permit.

It is possible that identified preserve land could be closed to the public, in order to protect species' habitat. To the extent that this occurs an extreme situation could exist where the total amount of open space is large, the accessible share is small. This could have negative effects on the desirability of Metro Tucson as an *ecotourism* destination.

As discussed as a component of the growth model, examination of other counties that have recently adopted multi-species habitat conservation plans was used to make some inferences about changes to the employment mix and level of growth that could happen in the future in Pima County. From these estimates of higher employment (assumed to be servicing proportionate increases in activity) in tourism related industries as compared to our baseline projection, an estimate of the direct tourism jobs supported by obtaining the permit can be made. The overall difference in tourism jobs²⁷ was calculated by adjusting overall employment in

²⁷ Subtracting the activity that would have been present without the permit (Scenario 1) from the total projected in Scenarios 2 and 3.

appropriate industries by the share of the activity in that industry attributed to tourism.

According to the Hospitality Research Center at Northern Arizona University, the percentage of gross tax receipts attributed to tourist expenditures for several different categories of goods and services ranges from negligible to nearly 100 percent.²⁸ Of expenditures on amusements and entertainment, 6.1 percent were determined to be the result of tourism. Retail expenditures were similarly represented, with 11.2 percent of county taxable sales of retail goods allocated to tourists. Spending in restaurants and bars and in hotels and motels was more highly correlated with tourism. Tourist expenditures were estimated at 23.4 percent and 95.0 percent of all taxable expenditures in these respective categories.

Table 14 – Incremental Impacts to Tourism with the Section 10 Permit, Year 10

Category	Difference in Total Direct Jobs	Tourism Attribution	Difference in Tourism Direct Jobs
Amusement ¹	645	6.1%	39
Restaurant & Bar	1,978	23.4%	463
Retail ²	2,754	11.2%	308
Hotel & Hotel	846	95.0%	804
Total			1,614

Note: 1. Amusement calculated as county activity in amusements as a percentage of non-hotel services

Note: 2. Excluding eating and drinking places (accounted for by the restaurant and bar category)

Source: County Business Patterns, NAU Hospitality Research Center, ESI Corporation

Another factor important to consider in terms of the environmentally based economy is the possible development of a biology “cluster” with a concentration of employment in biology related activities. The cluster concept in economic development revolves around the idea that firms in the same and supporting industries often locate in the same geographic area due to any combination of desire for access to one another, use of a common labor pool, concentration of resources used in the industry, and regulatory environment / market conditions. A recent analysis of Arizona’s universities indicated that ecological sciences is one of the core competencies to be leveraged.²⁹ Thus current efforts in Arizona to develop a Biotechnology cluster will have some transferable skills crossover with the environmentally based economy in Pima County.

²⁸ Their calculations refer to tax collections, but are assumed to be a reasonable proxy for employment per industry in relative terms.

²⁹ Battelle Memorial Institute, 2003

Pima County is an attractive location for firms employed in environmental services, and it could be argued that **not** adopting a Section 10 Permit would actually be more likely to attract more of these firms in the future. If the key effects of obtaining the comprehensive permit are to make necessary monitoring and inventory more efficient, they could serve to lower total employment in related industries. It is equally likely that total employment could be the same, but that biological *research* activities (which presumably attract a higher share of PhD level Biologists as compared to inventory) would be enabled to a greater extent through better use of resources.

Private Property Interests

Private property interests are important to consider on a number of levels in relation to obtaining a Section 10 Permit.

Factors Indicating an Increase in Land Value

Changes in land value are an important consideration in any large scale policy change.³⁰ The question of whether these changes will be on net positive or negative is an ambiguous one. There are a number of reasons to expect land values to increase upon implementation of the plan:

- ✧ Increase in land value in proximity to preserves
- ✧ Decrease in the aggregate supply of land remaining for development
- ✧ Creation of new markets
- ✧ Changes in employment mix and personal income

A literature review shows that the value of residential land in proximity to preserves typically increases in response to the amenity values of preserved land and open space. There is also a component of regional value of proximity to the amenity. Also, the laws of supply and demand predict that decreasing the supply of any good causes its price to rise at least somewhat, even without any increase in demand.

The need for land for mitigation purposes to offset development activity creates a “new” market for land. Anecdotally, existing mitigation banks are selling land far in excess of its market value as current (or even future) developable land. Considerations which positively impact the value of land for development, such as proximity to water, sewer, and transportation infrastructure, and important residential factors such as school district and distance to employment opportunities and urban amenities (such as shopping) are joined by habitat value. Having this high habitat value, the low development value land increases aggregate land value (and hence the tax base) in Pima County in three ways: 1) its own

³⁰ Discussions in this section largely derived from: Muro, 2002. *The Economics of Large-Scale Conservation: A Framework for Assessment in Pima County*, (SDCP CD Reports Disk 13, Report 118).

increment, 2) amenity value to nearby development (discussed previously), and 3) enhancing the utility of land that is to be developed by allowing lower priced offsets of mitigation needs.³¹

The causes of changes in employment mix and income are discussed previously and in the Growth Model Chapter, but the reason they impact land values is fairly straightforward. Land values (particularly residential, and even more particularly owner occupied residential) show a direct relationship to income. Higher aggregate incomes in the economy yield more dollars in competition for residential land and homes.

Combining these factors, it is reasonable to say that dedicating preserves likely increases **both** demand for and price of adjacent land. In the context of a geographic area as large as Eastern Pima County, and given that the majority of proposed preserve lands are fairly isolated from projected development patterns, it is difficult to make the case that preservation of land equal to 1.5 percent of remaining vacant land³² in Eastern Pima County would solely cause an increase in property values.³³

Factors Indicating a Decrease in Land Values

Conversely, obtaining a Section 10 Permit will also likely have some negative impacts on private property values, and perhaps even rights. To the extent that the guidelines prescribed with the permit result in lower densities than otherwise would have occurred, there is a loss of *perceived* economic value to landholders.³⁴ The present value of a piece of land is determined in part by the expected future cash flows that could be derived from it (whether for development or resale).³⁵ Land entitled for higher densities and more intense (commercial/industrial) uses typically has higher values on a per acre basis. Downzoning is typically a much easier process than upzoning, and allows easier response to preferences of the local real estate market; thus higher density zoning allows the most flexibility in response to market realities.

Another key potential impact of adopting the plan would occur if eminent domain were exercised in order to acquire preserve land.³⁶ Though the law requires that property owners be granted fair market compensation for

³¹ Where allowed, on-site mitigation would be the preferred choice where it is determined to be less costly than purchasing land off-site.

³² Ten year land demand is projected to be at most 32,781 acres (a mitigation ratio of 4:1 times 8,195 acres of land to be developed) as compared to more than 2.4 million acres of vacant land in Eastern Pima County.

³³ It should be noted that this statement is made with the caveat that State Land, which makes up 38 percent of all the remaining vacant land in Eastern Pima County, would clearly impact land prices if it were not released for development in a timely fashion (as is their policy today).

³⁴ To what extent land speculators who have purchased low density zoned land in the hopes that it will be upzoned in the future would be legally harmed by a change in policy is a legal question beyond the scope of this analysis.

³⁵ Cash flows can be positive or negative. If the plan were paid for by a property tax then the cost of that tax would be a consideration in the value of property as well.

³⁶ See ARS 12-1111 for permitted uses of eminent domain authority.

their land, where eminent domain is exercised by definition the market exchange would not have otherwise occurred. Thus exercising this power will impact property holder preferences.

Ranch Community

The impacts to ranching are largely dependant on one key assumption: to what extent will ranching activity be preserved on existing ranchlands.³⁷ There are 1.5 million acres of ranch and agricultural land in Eastern Pima County; the majority of which are under ASLD jurisdiction. The market value of ranch/agriculture land has increased 111 percent from 1992 to 1997 (countywide) versus 21 percent increase in agriculture product sales. It is further believed that the 111 percent is even higher for the land near urban Tucson. Ranch land defines much of the urban boundary today.

The Land Absorption analysis (discussed in the Growth Model Chapter) indicated that between 1,200 and 1,454 acres of ranch land and another 500 to 1,000 acres of agricultural land are in the path of likely development outside the built environment in the next ten years (as shown on Table 7 at the beginning of this chapter).

Well managed grazing may be compatible with the protection of species habitat. One approach that has been advanced to address conservation needs in a method compatible with existing ranch and agricultural activity is the purchase of development rights and/or conservation easements.³⁸ This approach calls for some entity (most likely Pima County government in this case, regardless of how the transaction is paid for) to pay holders of ranch or agricultural land the difference between the land's value for development purchases and the ranching/agricultural value of the land in exchange for the land holder not developing the land or selling the land for development. Lands could be purchased outright and leased back to ranchers or only the development rights could be purchased. The latter approach would have the potential complication of being temporary, though it could be coterminous with the duration of the permit obtained. As being discussed today such a program would be entirely voluntary, and thus would represent a net gain of expanded choices to holders of ranch land.

The value of the development rights themselves, however, might be reduced, to the extent that some part of the development value is expected

³⁷ Background on Ranching and the Proposed Development Rights Purchase Program from: Pima County Sonoran Desert Conservation Plan (Eds.). (1999, November). Ranching in Pima County, (SDCP CD Reports Ranch Element, Report 1), (2002, February). Adaptive Management Workshop (SDCP CD Reports Disk 11, Report 107), [Speakers' Notes], and (2001, May). Purchase of Development Rights Program Discussion Paper, (SDCP CD Reports Ranch Element, Report 4) respectively.

³⁸ While these terms are often used interchangeably the latter is typically understood to contain a more detailed set of rules and guidelines for the activities that will occur on the land so designated.

future upzoning (discussed in more detail in the private property interests section).³⁹

Real Estate, Business, and Development Communities

A number of impacts to the real estate, business, and development communities are expected as a result of obtaining or not obtaining a Section 10 Permit.

Changes in the Regulatory Environment

It has been theorized that removing the uncertainty inherent in the current habitat study process will provide a benefit to the development community in general. In defense of this theory, the study *Economic Activity Following Critical Habitat Designation for the Cactus Ferruginous Pygmy-Owl* examined whether the critical habitat designation affected construction activity and/or land values.⁴⁰ This study showed higher levels of high density development activity and vacant land values and a similar number of vacant land transactions following the designation of the critical habitat. Overall, the results of this study showed no negative impact to construction activity, up-zoning, nor land values. From an economic perspective these findings are logical in that the designation of critical habitat decreased uncertainty by more precisely defining areas where USFWS consultations would be necessary.⁴¹

The further effect of Pima County obtaining a comprehensive Section 10 Permit is likely to be minimal, provided that a similar permit is in place in incorporated cities with similar land. If the costs of participation to developers are different for incorporated as compared to like unincorporated land, the permit could have the effect of incenting development in one jurisdiction over another. If fees were higher in unincorporated areas this could cause any combination of desire to incorporate land before development and/or create a preference for land in incorporated areas. Thus if it is true that having a comprehensive permit facilitates development, then it **could** cause greater development in the unincorporated part of the county if the cities do not also pursue similar permits under the SDCP umbrella.

³⁹ Some empirical studies completed in the late 1980s in other markets found decreases in value between 15 and 33 percent of land designated with different (restrictive) zoning categories. As reviewed in Muro, Economics of Large Scale Conservation.

⁴⁰ As documented in: McKenney, B. (2000, October). Economic Activity Following Critical Habitat Designation for the Cactus Ferruginous Pygmy-Owl (Critical Habitat Units 3 and 4): A Review of Key Economic Indicators. The discussion here relates to critical habitat units 3 and 4 in the south and northwest only and uses the definitions of high and low density development and data available as of the development of that document (building permits from July 1998 to February 1999 as compared to July 1999 to February 2000).

⁴¹ It would be reasonable to assert that reducing uncertainty itself had some negative impacts on landholders where their land was believed to *possibly* be outside of the affected area, but the change in activity overall seems to indicate that the net effect of this change was positive.

As discussed in the Program Costs Chapter, there are substantial economies of scale to be gained through concurrent study of large land tracts. These scale economies would likely apply to an even greater extent if they can be combined with aggregated purchasing, for example if the County took on the role of contracting for all RIM even if the final costs were borne in part by developers in the form of a fee per acre of development dedicated to this activity.

Impact to Construction Market Competition and Affordable Housing⁴²

To the extent that the plan developed might limit the aggregate supply of developable land, an examination of the effects of growth management policies is appropriate. Growth management controls have been shown to favor well established, larger developers and builders. Instituting such controls or otherwise constraining the amount of developable land can enable established interests to have a monopoly in dealing in the future land development market. Higher costs of operation act as barriers to entry and can also lead to decreased competition in the long run. This decreased competition may lead to higher prices and higher profits for developers and builders, though it is not clear if this study⁴³ controlled for the effect of higher land value on higher prices.⁴⁴

As mentioned previously, it is generally accepted that land values will increase after obtaining the Section 10 Permit, but the benefits do not accrue equally to all residents. The groups that are expected to benefit are land owners (as opposed to renters), higher income residents, and suburban households. Renters and new residents face a higher cost structure not offset by any windfall gain.

Attraction of Knowledge Workers and Businesses

Modern economic development recognizes the value of workers, particularly the “creative class”.⁴⁵ These workers are driving company location decisions in that companies are locating where there is a concentration of the “creative class.” Under the assumption that obtaining a Section 10 Permit is a further signal to these workers that the

⁴² Discussion largely adapted from: Muro, 2002. *The Economics of Large Scale Conservation*.

⁴³ Landis, 1986 as reviewed in: Muro, 2002. *The Economics of Large Scale Conservation*.

⁴⁴ The typical single family home (value of the improvement) makes up approximately 74 percent of the selling price. Thus as land values increase, if home values remain proportionate the value of homes constructed on that land also increase. Having a greater amount of capital invested in the development (at risk) justifies a higher return (profit).

⁴⁵ Florida, 2002. These so called knowledge workers, who are employed in many computer occupations, high level management, and engineering, are so vital to the success of many companies that their preferences drive company location decisions. One further finding is that these workers particularly value outdoor recreation, preservation, and natural settings. The Tucson metropolitan area received a ranking of third among the 32 metropolitan areas with populations between 500,000 and 1,000,000 on Dr. Florida’s Creativity Index, which combines indices of high technology, innovation, diversity, and creativity.

community is interested in preserving its high quality natural environment, it could be assumed that the permit would attract more of these workers. This increase could reasonably be expected to benefit economic development.

Somewhat ironically, though the attraction of high wage jobs and workers is one key piece of economic development efforts, studies have shown that individuals are willing to take wage concessions to live in places with good quality of life. Specifically, environmental quality was cited as the number one factor in high technology firm site selection decisions.⁴⁶

Other Jurisdictions in the Region

Other jurisdictions are impacted in two key ways by Pima County obtaining a Section 10 Permit. First, there are tax impacts resulting from changes in economic activity. To the extent that the Section 10 Permit allows for a higher overall level of employment and/or an increase in incomes of residents, greater retail spending and increased retail sales tax revenues will result.

The second impact to other jurisdictions is the relative ease of obtaining their own Section 10 Permit under the SDCP umbrella. Conversations with persons familiar with the process in other areas have indicated that the process has often been contentious between different levels of government. In concept it would be possible for any and all jurisdictions to participate together in obtaining one Section 10 Permit, with each developing its own list of permitted activities and rules and procedures that will be applied when those activities are undertaken. The proposed approach as of the writing of this document will be for the SDCP to serve as an umbrella supporting plan that jurisdictions can tie their own specific permit requests to, independent of one another. The regulatory environment section discusses some of the possible effects on incentives of some jurisdictions having a permit, and others not.

State Land is another jurisdiction that is important to consider. State Land makes up approximately 38 percent of all of the vacant land in Eastern Pima County. The growth model was constructed to consider development suitability, but for the most part ignore ownership. Thus projected development to occur on State Land is a result of market demand rather than a prediction of when State Land might be sold for development. It should be noted that our growth model abstracts from reality on this point, in that State Land disposition is usually transacted in large tracts. If for some reason this land was not made available as market demand increased, it could have an impact on the prices of remaining comparable private land. The Land Absorption model indicates between 1,100 and 1,900 acres of State Land is in the path of development

⁴⁶ Gottlieb, 1994 as reviewed in: Muro, 2002. *The Economics of Large Scale Conservation*.

in the next ten years depending on the scenario (as shown on Table 7 at the beginning of this chapter). In any short timeframe the impact of State Land not being brought to market was assumed to be minimal (growth patterns of “past” State Land holdings seem to indicate that it is brought to market at least somewhat “late” today); but could be substantial if for some reason State Land were permanently removed from the land supply.

The way in which the disposition of State Land will interact with future development needs in Pima County is not clear due to conflicting pressures. The mission of the Arizona State Land Department is:

To manage State Trust lands and resources to enhance value and optimize economic return for the Trust beneficiaries, consistent with sound stewardship, conservation, and business management principles supporting socioeconomic goals for citizens here today and generations to come. To manage and provide support for resource conservation programs for the well-being of the public and the State's natural environment.⁴⁷

Thus the need to sell its holdings to enhance value for trust beneficiaries and support of resource conservation can reasonably be seen to be somewhat in conflict. Beyond the scope of this analysis, but also important to consider is the fact that the Arizona State Land Department (ASLD) has land holdings throughout the state and the possibility exists that in an overall sense these conflicting goals could be met by selling land in one area and conserving it in another. This could even be true of different areas within Eastern Pima County, with State Land holdings inside the sewer service area (more than 7,000 acres) being sold in the near term for development. Additionally, the State Land Department has put special land use permits (which allow for a relatively rapid transition from current uses to selling the land for development) on more than 50,000 acres on the edge of urbanizing Tucson.⁴⁸

Another wrinkle to the State Land question relates to grazing. There are more than 800,000 acres of State Land among the 1.5 million acres of ranching and agricultural land in the county. The tradeoffs inherent in the decision to continue to lease the land for grazing as compared to selling the land for development or conservation are a function of the time horizon under which the transaction is viewed. To the extent that ASLD is the land holder receiving payments under a purchase of development rights agreement, the calculation becomes even more subjective.

⁴⁷ http://www.land.state.az.us/support/mission_goals.htm

⁴⁸ Pima County Sonoran Desert Conservation Plan (Eds.). (1999, November). *Ranching in Pima County*, (SDCP CD Reports Ranch Element, Report 1).

IV. Program Costs

Introduction

The purpose of this chapter is to describe and assess the range of costs and options for implementing and funding an effective research, inventory, and monitoring (RIM) program under a Section 10 Permit associated with the Sonoran Desert Conservation Plan (SDCP). An Adaptive Management Program (AMP) and some form of inventory and monitoring are required components of a Habitat Conservation Plan (HCP), which is necessary to obtain a Section 10 Permit from the U.S. Fish and Wildlife Service (USFWS). A RIM program is often a component of an AMP. Specifics of the AMP for the proposed Pima County HCP have not yet been developed. Several general ideas have been advanced, but there is no written draft AMP and no written plan for inventory or monitoring at this time to use as a basis for cost analysis. The Scientific and Technical Advisory Team (STAT) began collectively discussing some of the range of options for RIM and AMP at their meeting on March 27, 2003. They intend to develop a recommended approach and program in collaboration with their consultants over the next several months.

A range of options, including those that are currently being used by some existing HCPs and those that have been considered in the development of the SDCP, are considered in this chapter. However, this chapter does not specifically recommend RIM procedures or needs for the HCP. That task belongs to the STAT and Pima County's SDCP biological consultants. Some of the possible options discussed here are likely to become part of the requirements of final Section 10 Permit. This chapter will review and provide cost estimates for some of the potential RIM approaches that might be included in the AMP. Costs are based on specific techniques currently used to conduct basic studies of some of the species included as Priority Vulnerable Species (PVS) in the currently available SDCP documents, and the experience of environmental consultants and agencies in applying these techniques on a wide range of projects. In this chapter, a range of potential levels of effort that impact the costs of a RIM program are also considered.

Background Information

Definitions

Precise definitions of research, inventory, and monitoring, specifically as these concepts apply in the context of a HCP, are not available and do not appear to be consistent between existing HCPs and, furthermore, between professionals engaged in such work. General definitions of these terms and the concepts that underlie them are:

⌘ “Research: scholarly or scientific investigation or inquiry.”⁴⁹

⁴⁹ *The American Heritage Dictionary of the English Language*

- ⌘ “Wildlife habitat inventory consists of measuring selected habitat variables [including wildlife populations] on a piece of land to infer presence or abundance of wildlife species. The purpose is to determine the wildlife resources currently supported by the area.
- ⌘ Wildlife habitat monitoring consists of repeatedly measuring habitat or population variables to infer changes in the capability of the land to support wildlife. The purpose is usually issue-oriented, i.e., it determines how some activity such as mining, livestock grazing, or recreational activity is affecting wildlife habitat and ultimately wildlife populations. Monitoring is also used to determine the effectiveness of habitat management practices. . . the purpose of monitoring is not only to measure change but also to determine the cause(s) of change.
- ⌘ Habitat monitoring, like inventory, may be accompanied by population measurements to confirm the habitat relationships. If the purpose is to measure the effectiveness of a habitat management practice, then species or population measurements must be taken.”⁵⁰

The Habitat Conservation Planning Handbook⁵¹ does not include definitions of these terms in the chapter on definitions, but the Handbook and the Addendum provide some insights to the Handbook (Appendix H).

Many techniques and approaches are available for conducting inventory and monitoring. Essentially, most can be divided into two major categories, based primarily on intensity of effort (and cost):

1. Census: the systematic observation of variables (usually individuals of a target population) throughout the entire area being studied, with effort directed at detecting and identifying every occurrence of the important variables. Examples include: bird surveys of clearly defined habitat blocks with the intention of recording data on every individual bird present in the block; searches for plants of special interest, such as Pima pineapple cactus, that involve 100% pedestrian survey of the study area, sometimes with more than one pass over every square foot; seining or electrofishing small bodies of water or defined reaches of streams so as to observe every fish present. Census is rarely complete and often requires several repetitions, each with diminishing returns, to assure sufficiency. Census is significantly more costly than sampling, but the cost may be justified if the target is rare, hard to find, or potentially problematic if undetected.

⁵⁰ Cooperrider, A.Y., 1986. Introduction. p. xvii. . In: Cooperrider, A.Y, R.J. Boyd, and H.R. Stuart. 1986. *Inventory and Monitoring of Wildlife Habitat*. U.S. Department of the Interior, Bureau of Land Management, Service Center. Denver, CO. xviii, 858 pp.

⁵¹ U.S. Department of the Interior. Fish and Wildlife Service. U.S. Department of Commerce. National Oceanic and Atmospheric Administration. National Marine Fisheries Service. 1996. Habitat Conservation Planning And Incidental Take Permit Processing Handbook, November 4, 1996. <http://endangered.fws.gov/hcp/hcpbook.html>

2. **Sampling:** the systematic observation of variables at selected points within the area being studied, so as to obtain an indication of conditions that may then be extrapolated across the defined area. Examples include: call playback surveys for cactus ferruginous pygmy-owl, southwestern willow flycatcher, and yellow-billed cuckoo; use of mist nets over water for catching bats; small mammal trapping. In each example, the size of the area actually effectively sampled is not clearly known, but it is expected to be indicative of a larger area. Sampling is generally much more efficient and less costly than census, but it has greater potential for error.

There are many published protocols for collecting data by census and sampling. Several species listed (including proposed or candidate) under the ESA have designated protocols that are accepted by USFWS. Where accepted protocols are not available, development of a RIM protocol for any species requires repeated sampling to determine variance of the populations and techniques and the most cost-effective methods to study the variables of concern. Most accepted protocols are generally developed as reasonable expedients and lack scientific rigor in testing to determine what they are actually sampling and the effective area they are sampling.

RIM techniques are continually undergoing development and improvement, especially in terms of the use of technological advances. Therefore it becomes extremely difficult to project costs of a RIM program over more than a couple of years, especially with regard to the broad category of “research.”

Monitoring, as used in the HCP context, may be divided into two major categories:

1. **Implementation Monitoring.** This includes assuring that the terms of the HCP are adhered to by all signatories, that everything that has been agreed to is being implemented, and that everyone is playing by the rules.
2. **Effects Monitoring.** This includes monitoring the effects of the HCP on the species covered by the permit. Efforts may include the types of inventory and monitoring described above, or some other measures of changes in the environment and species populations within the defined area of concern

Requirements of an HCP RIM Program

The HCP process was developed in accordance with Section 10 of the Endangered Species Act (ESA) in order to resolve issues between economic development of private lands and species conservation. Although an incidental take permit is required only for Federally Listed Species, many HCPs provide conservation measures for proposed and candidate species

under the ESA, as well as other species of concern or interest that may occur in the plan area. To receive a permit, the applicant submits an HCP that meets the criteria included in the ESA and its implementing regulations. Under section 10(a)(1)(B) of the ESA, the conservation plan must ensure that the permittee will minimize and mitigate the effects of the authorized incidental take to the maximum extent practicable, while also ensuring long-term survival of covered species. Creativity, collaboration, and flexibility are required of all involved parties during the negotiations and development of HCPs.

The HCP Handbook⁵² includes requirements for a monitoring program. These requirements were further developed and codified in an addendum. Appendix H includes the specific sections of these documents that deal with RIM issues. The major conclusion to be drawn from these documents is that the RIM program must be specifically tailored to the individual HCP. At the time of this writing, no RIM program has been developed for the SDCP.

Several pieces of information that have been developed by the USFWS and RECON (Pima County's biological consultant for the development of the SDCP and RIM programs) may shed some light on where the process is headed with regard to RIM requirements. These are quoted below:

“The monitoring requirements of a multi-species HCP may be reduced within a robust reserve area that maintains a functioning ecosystem. For example, the monitoring for many species may be accomplished by monitoring the health of the vegetation community/ecosystem/watershed. If the natural system is intact and functioning properly, and it is adequately connected to other such areas to allow for species’ dispersal and other life history functions, the species is likely to also be thriving. Certain rare species will continue to require species-specific monitoring, and certain vegetation communities may require more intensive monitoring to ensure that the species are benefiting from the conservation measures.

The need for parcel-level surveys will be based on a number of considerations, including the implementation mechanisms (how will avoidance, minimization, mitigation be accomplished), the location of the project (e.g., is it in areas proposed for development or in the proposed reserve area), and the species that may occur there (certain rare species may continue to require parcel-level surveys to avoid/minimize effects).”⁵³

⁵² *Op. cit.*

⁵³ Email memo dated February 7, 2003 from Sherry Barrett (USFWS) to Maeveen Behan (Pima County) and others.

“There are 6 general reasons for surveys as part of an HCP; however whether or not surveys are necessary is dependent upon how the MSHCP will be implemented (e.g., how are we going to put the reserve together). The reasons to survey are:

- 1. To ensure avoidance or minimization of impacts to particularly rare species (e.g., pygmy-owls, flycatchers), or special resource elements (e.g., riparian areas).*
- 2. To allow salvage of species, if those species are necessary for augmentation of key areas that have been degraded.*
- 3. To determine a mitigation obligation (e.g., define what kind/number of species or type/acres of vegetation communities will be affected by a project).*
- 4. To track the amount of take that has occurred (e.g., by species or by vegetation community).*
- 5. To evaluate the mitigation benefits of land to be conserved (e.g., to ensure that the resources that are being lost are also being conserved).*
- 6. To determine appropriate management and monitoring of land to be conserved (e.g., to ensure that the management and monitoring plans for that land address the resources on it).*

Regardless of the reason for surveys, it is unlikely that all 55 species will need surveys. The presence of many of them would be determined based on the presence of appropriate habitat features (e.g., topography, soils, vegetation).

In looking closely at the list of Priority Vulnerable Species (PVS), it may be helpful to clarify first that 5 of the 7 plant species on the PVS already have survey requirements under the Native Plant Preservation Ordinance (NPPO), even on hard-zoned property. This means that prior to grading, they are included in the plant survey that identifies plants for preservation, salvage & transplant. The NPPO requirement kicks in whenever a grading permit is required (e.g., whenever an area of 14,000 sq. ft. is going to be graded, whether for a single-family residence or other development/improvement. That is a very small area, <120' square). The 2 PVS plants that aren't on the NPP list are Gentry Indigo Bush (grows with oak woodlands and sycamore) and Tumamoc globeberry (along desert washes).

For wildlife surveys, consideration will be given to the following:

- No invertebrates (talus snails and pseudoscorpion) will be present on the vast majority of project areas.*
- No Arizona shrew will be present on the vast majority of project areas. (It is associated with higher elevation mountainous terrain.)*

- *Very few projects requiring County permits will have the year-round stream flow or open water to support the 6 fish, Mexican garter snake, and 2 frogs on the list, since most properties don't have perennial water.*
- *Very few projects will have the riparian and marsh habitat to support the SW Willow Flycatcher or the Yellow-billed Cuckoo.*
- *That leaves 20 species: 8 mammals (the 7 bats, the Merriam's mouse), 6 birds, and 6 reptiles (3 snakes, 2 whiptail lizards and desert box turtle).*

As mentioned above, the potential likelihood for these species can be initially predicted by checking the PVS maps and further determined based on the presence of habitat features. The extent to which surveys are required for particular species may be an appropriate topic for the Science Technical Advisory Team and/or the Science Commission to weigh in on. Certainly the most rare species should be given higher priority, but it may be that a habitat type (e.g., riparian woodland, or open grasslands) can be used as a proxy for potential occurrence, as it was in the reserve design process, and that requirements for mitigation would be established accordingly.”⁵⁴

Methods

Based on the above information, it is clear that the specific components of the AMP and RIM programs have not yet been defined, and that a detailed, specific economic analysis of these components cannot be developed at this time. Nonetheless, there is still valuable information that can be considered at this time, and we have developed this chapter in accordance with a line of reasoning that will contribute to the process. Our steps toward analyzing the potential costs of the RIM program are outlined below.

First, we acknowledge and briefly review the range of expenses that might be included in a RIM program. The ultimate costs for addressing biological resources covered by the SDCP will necessitate many expenses including staff and direct costs to:

1. Administer the plan
2. Facilitate public interface
3. Handle logistics such as project compliance reviews, land exchange, and easement agreements
4. Manage habitat acquisitions (as different from property acquisitions)
5. Manage reserves

⁵⁴ Sonoran Desert Conservation Plan. Responses to Recent Questions from Steering Committee Member Larry Berlin and Others. Handout distributed at the Scientific Technical Advisory Team meeting, 27 March 2003. Prepared by FWS and Recon for Steering Committee.

6. Manage and execute protective and restorative measures such as installation of plantings, fencing and signage
7. Manage and pay for potential purchases of grazing permits and/or water rights
8. Conduct law enforcement
9. Provide education and public outreach efforts
10. Acquire and maintain equipment
11. Compile and manage data
12. Purchase lands for preservation (discussed in detail in the Costs and Benefits Chapter)
13. Conduct research, inventory, and monitoring.

Second, we have specifically limited the scope of the chapter. It is not appropriate at this time or within the scope to examine all of the components listed above. This chapter will not address items 1 through 11 of the list above. This analysis addresses only potential costs associated with a RIM program consisting of biological inventory, monitoring, and research efforts. It does not specifically address keeping the data and ongoing data management, which are extremely important components of a RIM program. Ultimately, this would be the County's responsibility, and might be absorbed by the existing GIS staff of Pima County with no costs beyond those to support the existing staff. It is also possible, and might be appropriate, that the data repository might be the Heritage Data Management System of the Arizona Game and Fish Department or even the USFWS. In any case, a permanent data repository is essential for a successful RIM program and should be defined in the Implementation Agreement (IA) of the HCP.

Third, we have compiled and reviewed available information on a range of options for conducting a RIM program. In the absence of an AMP or any specific guidance from the STAT, the County, or the County's biological consultants, and in order to comply with the basic terms of the contract for Economic Consulting Services, it becomes necessary to specify exactly what we are able to accomplish within the deadline requirements. We have tentatively decided to base this chapter on a review of current and recent project costs that fit within the general concept of Research, Inventory, and Monitoring activities potentially appropriate for the SDCP. Included in this review is information summarizing:

1. Recent experience of consultants conducting biological evaluations and assessments for specific projects;
2. Monitoring requirements for the two existing HCPs in Pima County;
3. Current RIM projects being conducted by AGFD in Pima County;
4. Current inventory projects being conducted by the U.S. Geological Survey (USGS) Sonoran Desert Field Station at National Parks and Monuments in southern Arizona;
5. Information from other large-scale HCPs in various parts of the country; and

6. Knowledge of the species being considered for inclusion in the SDCP, and existing or potential protocols and methods for conducting inventory and monitoring studies.

Fourth, we present several potential approaches, with cost estimates for operation of a RIM program developed from currently existing or recently past projects and other information. Potential efforts explored are:

1. The RIM program is entirely managed and staffed by County employees.
2. The program is contracted to private consultants.
3. The program is contracted to the Arizona Game and Fish Department.
4. The program is contracted to the U.S. Geological Survey, Sonoran Desert Field Station in cooperation with the University of Arizona.

As a standard of comparison, an attempt has been made to provide data for equivalent personnel and hours. Regrettably, this comparison can only be a rough approximation and cannot include all overhead, administrative costs, and other hidden costs for some approaches, which may cause highly significant variations in overall costs. Therefore, these approximations are only for the direct expenses of getting the job done, based on the assumption that a crew consisting of a Ph.D. level biologist, one M.S. level biologist, two B.S. level biologists, and an administrative support specialist working $\frac{1}{4}$ time is charged with the task of conducting the program. It is likely that a Geographic Information Systems (GIS) specialist would also be a valuable addition to the team, but that position is not factored in here because of the variety of ways in which GIS services might be included by any given agency.

Additional approaches are possible, such as the HCP requiring the establishment of a dependent entity (a Habitat Conservation Plan Administration Organization) that might have costs similar or identical to having the program staffed by County employees, or by a non-profit organization, whose costs might be even lower than those of the Arizona Game and Fish Department. These are not considered here.

The estimates to be included are for one possible effort, which may be an acceptable minimum effort under the terms of the final HCP. There are, of course, no assurances that the general scheme used here would be sufficient to conduct the RIM program for the HCP. Without information on the final program that would be included in the HCP, it is impossible to accurately predict the level of effort the program would require. We used this approach in order to develop a funding scenario, which was a requirement of the contract. The approach assumes utilizing the maximum possible economy of scale, conducting the RIM project on more than 5,000 acres, which reduces cost per acre. It also assumes that the program is continuing indefinitely, rather than a one-time cost.

Results and Discussion

Current Situation

This section reviews current and recent project costs that fit within the general concept of Research, Inventory, and Monitoring. Included here is information summarizing:

1. Recent experience of consultants conducting biological evaluations and assessments for specific projects
2. Monitoring requirements for the two existing HCPs in Pima County
3. Current RIM projects being conducted by AGFD in Pima County
4. Current inventory projects being conducted by the U.S. Geological Survey (USGS) Sonoran Desert Field Station at national parks and monuments in southern Arizona
5. Current monitoring program and Organ Pipe Cactus National Monument
6. Current projects of the Arizona-Sonora Desert Museum; and
7. Information from other large-scale HCPs in various parts of the country.

Detailed information on each of these is compiled in the Appendices.

Consulting Projects

This section provides information gathered from recent consulting projects. Specific project details such as name of project, project proponents, and specific locations were excluded in order to protect the interests of private entities. The intent here is to demonstrate a reasonable range of projects and costs entailed that are similar to some of the techniques likely to be included in a RIM program.

Four potential levels of effort were examined for the purposes of this analysis. Each is based on a common first step, preparing a Biological Evaluation (BE) which is essentially a report on an inventory of a specific project site and a conclusion as to the potential of a specific project to have an effect on species of special concern. The first two consider only species that are currently listed, proposed, or candidate species under the ESA. The second two represent the “Biologically Preferred Alternative” which consider the species covered by the ESA plus the other 55 PVS.

☒ Currently Listed, Proposed, and Candidate Species Alternative

1. Species currently listed under the ESA as threatened or endangered, and those that are proposed or candidates for such listing are considered in a BE of each proposed project area. Designated or proposed Critical Habitat is also considered. The outcome of the Biological Evaluation in this situation is No Effect.
2. Same as above, except the outcome of the Biological Evaluation in this situation is that either the project may affect a species but the effect is unlikely to be adverse, or the project may affect a species and the effect is likely to be adverse. Surveys for the species are required, depending on the location of the proposed project; the surveys may include 100% pedestrian surveys as for Pima pineapple cactus (PPC) or point calling stations as for cactus ferruginous pygmy-owl (CFPO).

☒ Biologically Preferred Alternative

3. Species currently listed under the ESA as threatened or endangered, and those that are proposed or candidates for such listing are considered in a BE of each proposed project area. Additionally, species currently listed as PVS as designated in the draft SDCP are considered. Designated or proposed Critical Habitat is also considered. The outcome of the Biological Evaluation in this situation is No Effect.
4. Same as above, except the outcome of the Biological Evaluation in this situation is that either the project may affect a species but the effect is unlikely to be adverse, or the project may affect a species and the effect is likely to be adverse. Surveys are required.

The cost of completing a BE varies considerably from project to project and is related to a host of factors including the following:

- ☒ The size and configuration of the proposed project area;
- ☒ The condition including topography and vegetation characteristics and other habitat features such as water features and rock outcrops within the proposed project area and adjacent lands;
- ☒ The accessibility and distance of the proposed project area from the greater Tucson area;
- ☒ Ecoregional characteristics;
- ☒ Economy of scale in completing surveys;
- ☒ Surrounding land uses; and,
- ☒ The presence of easements or other ownership issues that could make access difficult.

Costs for BEs of individual properties vary depending on whether or not one or more species-specific surveys must be conducted and the protocol required for the species addressed by surveys. For example, under the current methodology recommended by USFWS and AGFD for cactus ferruginous pygmy-owl (CFPO), surveys are conducted from one hour before official sunrise to two hours after official sunrise, and from one hour before official sunset until one hour after official sunset. The cost for an individual parcel would depend on the number of survey points that could be accomplished during this survey window, and how many trips to the area would be needed to complete the survey. In addition, required documentation of the BE could range from a simple summary of the site conditions to detailed vegetation mapping and individual species accounts. We assume that certain quality control standards and quality assurance methods would be specified in the SDCP, but the specifics of these are unknown at present. For these reasons, the projected costs estimates provided herein are highly speculative.

Situations 2 and 4 assume that any given proposed project will affect a special-interest species addressed by the BE. If the project is determined to be likely to adversely affect a species, formal consultation with USFWS is required under most circumstances. The cost of formal consultation with USFWS is not included in these estimates as these costs can only be addressed on a case-by-case basis. One of the purposes of the HCP is to relieve the project proponent (e.g., Pima County) from the requirement to do a formal consultation because, in effect, that process has already been completed programmatically in the HCP process. However, because the HCP has not yet been fully developed, it is possible that some kind of specific process will be required in the event a proposed project may adversely affect a Listed Species. It is not possible at this time to estimate the cost of this undefined process.

Table 15 provides a very rough estimate of projected costs for completion of a BE at differently sized project areas throughout Eastern Pima County. The estimates were compiled using an average billing rate for consulting biologists that are currently utilized on these types of projects.

Table 15 – Estimated Costs for Completing a Biological Evaluation Under Four Potential Situations (\$ 2003)

Situation Addressed	1-30 acres	30-60 acres	Parcels greater than 60 acres
Listed, Proposed, and Candidate Species Only			
1: No Effect (assumes no surveys required)	\$1,500-\$2,700 (\$90/acre)	\$2,700-\$3,300 (\$55/acre)	≥\$5,000 for every 1,000 acres as a very rough estimate (\$5/acre)
2: May Affect (assumes surveys required)	Cost of above PLUS: \$1,300-\$4,300 (\$143/acre)	Cost of above PLUS: \$2,100-\$6,300 (\$105/acre)	Cost of above PLUS: ≥\$4,000 for every 1,000 acres as a very rough estimate (\$9/acre)
Biologically Preferred Alternative			
3: No Effect (assumes no surveys required)	\$2,500-\$5,300 (\$176/acre)	\$3,700-\$5,300 (\$88/acre)	≥\$7,500 for every 1,000 acres as a very rough estimate (\$7.50/acre)
4: May Affect (assumes surveys required)	Cost of above PLUS: \$1,100-\$8,300 (\$453/acre)	Cost of above PLUS: \$1,900-\$16,300 (\$360/acre)	Cost of above PLUS: ≥\$6,000 for every 1,000 acres as a very rough estimate (\$13.50/acre)

Note: This is a one-time expense

Existing HCPs In Pima County

There are two currently approved HCPs in Pima County. Both are for developments that may affect CFPO. Costs for the monitoring programs associated with these two HCPs are not available (they are proprietary information) except as specifically described as ceilings in these HCPs. Detailed excerpts from the monitoring components of these two HCPs are included in Appendix J to provide to the reader information on typical levels of effort and types of monitoring currently under way for existing HCPs in Pima County.

Current Rim Projects Being Conducted by AGFD

The Arizona Game and Fish Department has several ongoing RIM projects in Pima County (Appendix K). Dr. Michael Ingraldi of AGFD supplied information about these projects via email. The total cost of these projects is \$651,509. Cost per acre for CFPO surveys that are part of this program varies from \$4 to \$5 per acre.

Current USGS Sonoran Desert Field Station Projects

The USGS Sonoran Desert Field Station is currently conducting an inventory program for several national parks and monuments in southern Arizona. Table 16 lists the surveys that were conducted in 2000 and 2001:

Table 16 – Summary of Field Inventories in Southwestern Desert Parks ¹

Park	Taxonomy					
	Plants	Amphibians	Reptiles	Birds	Fishes	Mammals
Casa Grande National Monument	X	X	X	X		
Gila Cliff Dwellings National Monument	X	X	X	X		X
Saguaro National Park	X	X	X	X		X
Tonto National Monument	X	X	X	X		X
Tumacacori National Historical Park	X	X	X	X	X	X

Note: 1. Powell, B.F., K. Docherty, and W.L. Halvorson. 2002. Biological inventory report for the Sonoran Desert Network. 2000 and 2001 field seasons. Annual Report No. 1. Sonoran Desert Network Inventory Program. USGS Sonoran Desert Field Station and School of Renewable Natural Resources, University of Arizona, Tucson. p. 1.

Each project is budgeted separately, and an example of one project budget is included in Appendix L. The total budget for the ongoing inventory project is \$670,000 for four years. In addition, the program has a budget of \$175,000 per year for administrative costs. The program is a cooperative program with the University of Arizona, which absorbs certain costs that would otherwise be associated with the program. The single greatest cost saving measure is the use of students to conduct most of the fieldwork. This benefits the students by providing them valuable experience, and allows the program to pay very small salaries and minimal benefits. Bill Halvorson and Brian Powell, in several emails and telephone conversations and in reports and budgets, provided information about this program. Dr. Halvorson offered the following comment: “The NPS determined that \$670,000 would be given each year for monitoring in the small southern Arizona Park Units. And the NPS knew that this would be much less than required for a full ecosystem monitoring program.”⁵⁵ The program is based on selective sampling rather than 100% pedestrian survey or census. The total acreage of the five parks is 104,223. The annual budget for the inventory project is \$342,000, of which more than half is administrative costs (W.L. Halvorson, pers. comm. to K.J. Kingsley). For this program, the cost per acre is \$3.29.

⁵⁵ Halvorson, W. L., 2003. email to K.J. Kingsley, 21 March.

A monitoring program for eleven southwestern parks and monuments is currently being started. That program will have an annual budget of approximately \$700,000. The breakdown of that budget is not available at this time.

Current Organ Pipe Cactus National Monument Monitoring Program

An ongoing program of biological monitoring at Organ Pipe Cactus National Monument follows protocols developed in the late 1980s and early 1990s.⁵⁶ The program involves intensive sampling at selected sites representing different ecological conditions. The current cost for this program is approximately \$700,000 per year.⁵⁷ The total acreage of Organ Pipe Cactus National Monument is 330,689. The cost per acre of the monitoring program is \$2.12 per year. This represents a cost savings developed by sampling at selected sites that have been intensively studied for more than a decade.

Current Arizona-Sonora Desert Museum Projects

Dr. Rick Brusca, Director of Conservation and Science of the Arizona-Sonora Desert Museum (ASDM), supplied the following information based on their current and recent projects:

1. ASDM is currently surveying the vegetation and some animals for BLM in the entire Ironwood Forest National Monument, 129,000 acres, for about \$150,000 per year, about \$1.16 per acre.
2. ASDM is surveying the Lesser Long-nosed Bats under flyways associated with Luke Air Force Base for \$20,000 per year. This is a sampling survey.
3. ASDM is surveying for Pima Pineapple Cactus in the Altar Valley for \$30,000 per year. This is a sampling survey.
4. ASDM is surveying for mountain lions in Saguaro National Park, West, at a cost of \$12,000 per year. This is a sampling survey.

⁵⁶ Organ Pipe Cactus National Monument Ecological Monitoring Program Monitoring Protocol Manual. Special Report No. 11. National Biological Service Cooperative Park Studies Unit, School of Renewable natural Resources, the University of Arizona. September 1995.

⁵⁷ Telephone conversation with Bill Halvorson, USGS and Kenneth Kingsley, SWCA.

Other HCP Programs

Several regional HCPs have been developed over the past few years and some are in operation at this time. Information from these may be helpful in understanding the potential range of RIM programs and their associated costs. We gathered information on several approved HCPs from several regions and from a variety of sources, including email exchange and website searches, as well as personal professional involvement in several of them. This is not an exhaustive compilation of RIM projects and costs for all existing HCPs, but rather only those about which specific information was readily available from the sources consulted. The one HCP that is most directly comparable to the SDCP is the Clark County, Nevada Multi-species Habitat Conservation Plan. In each case, a brief summary of specific information about RIM costs is presented below. Much more detail about these programs is included in Appendix M.

Clark County, Nevada MSHCP

The Desert Conservation Program (DCP), a division of Clark County government, is responsible for the implementation of the Clark County HCP. Clark County administers the plan by assuming responsibility for the collection of mitigation fees and ensuring adherence to all compliance measures associated with the Permit, as well as overseeing implementation of the Plan. The permit area includes all private land within Clark County and all land that becomes private through any means. The Plan initially provides coverage for approximately 79 species and will expand to include over 200 species. The Clark County HCP includes a biennial planning process during which the Implementation and Monitoring Committee (I&M Committee), consisting of stakeholder and agency representatives, calls for and reviews proposals for its RIM program, and votes on whether or not to fund proposals and how much to fund them.

Funding comes from a \$550 per acre mitigation fee on development within the plan area, which is anticipated to provide up to \$1.625 million annually for the first 10 years, and up to \$1.3 million annually for the remaining 20 years of the permit; and from the Southern Nevada Public Lands Management Act (PLMA) which will generate approximately \$60 million per year from sale of the approximately 27,000 acres of Federal lands scattered within the urban areas within the Las Vegas Valley.

At the present time, funds granted to the Clark County MSHCP are subject to the I&M Committee budgetary process. The RIM program consists of a large and growing number of projects that are developed and executed as contracts within the context of the I&M Committee meetings and the actions of many Federal and local agencies that are parties to the MSHCP. A formal proposal process is followed biennially, and the I&M

Committee makes funding recommendations to the BLM and Board of Commissioners. The BLM and Board usually follow the recommendations of the Committee.

Much of the money is currently used to fund projects that come generally under the heading Research, Inventory, and Monitoring. Also, a large portion of the money is used for HCP development and administration. The Biological Resources Research Center of the University of Nevada, Reno, serves as the primary AMP program contractor and science advisor to the I & M Committee. Appendix M includes a description of projects funded in the 2001 biennium (\$6,133,484), brief information on proposals submitted and recommended for the 2003 biennium (\$13,515,823), and a brief discussion of one of the projects. From this information, it is evident that a great deal of money is being spent on a wide variety of projects, and that amount of money is growing from one biennium to the next. It is possible to derive limited but potentially useful information on per acre costs for the RIM program from the available information on Clark County's program.

For an ecological assessment of the Blue Diamond Recreation Area, which encompasses 50 square miles (32,000 acres), Clark County submitted a proposal for \$125,000 for a one-time survey to be conducted by a consultant. The cost per acre is \$3.90. This project was proposed to accomplish the following objectives:

- ✧ Create an inventory of species found within the Blue Diamond Recreation Area;
- ✧ Suggest management actions to protect species listed within the MSHCP;
- ✧ Allow for responsible public access and use of public lands;
- ✧ Provide data with which to make responsible decisions regarding the location of recreational amenities; and
- ✧ Preserve and promote stewardship of Southern Nevada's natural resources.

For a Baseline Field Inventory and Integrated Management Plan and Environmental Assessment for the Logandale Management Area, which covers approximately 12,000 acres, the BLM submitted a proposal for a total of \$155,800, which included a matching contribution. That results in a cost per acre of \$12.92.

The objectives of this project are to:

- ✧ Inventory and delineate on maps sensitive sandy habitat;
- ✧ Inventory the current network of roads and compare the current network with 1998 aerial photographs to determine which trails have been created since the Record of Decision (ROD) for the BLM Resource Management Plan became final;
- ✧ Determine new disturbances since the ROD;

- ⌘ Develop an integrated management plan for this area, which will address resource and recreational issues, including law enforcement, restoration, managed use of the network of roads, future developments in sensitive areas, and public information; and
- ⌘ Develop a schedule to implement management actions, including rare habitat protection, restoration of disturbances, visitor use control, and effectiveness monitoring;

None of the other project proposals or available reports provide sufficient information to approximate cost per acre. Both of the above projects are based on sampling rather than census levels of effort and entail work well beyond that which can be defined as inventory and/or monitoring. The costs are not broken down in a manner that allows separation of I&M costs, so the cost per acre is probably lower than that stated above.

Washington County, Utah HCP

Washington County, Utah, and the USFWS signed the Washington County HCP for the endangered Mohave population of desert tortoise in March 1996, prior to the institution of AMP and RIM programs for HCPs. The time period for the permit is 20 years and includes development on up to 12,264 acres of private lands within potential desert tortoise habitat. The HCP details the County's proposed measures to minimize, monitor, and mitigate impacts of the proposed take of desert tortoise. The County is responsible for conducting desert tortoise surveys in take areas prior to development. A number of desert tortoises found in these areas are to be translocated by the USFWS, and follow-up monitoring is to occur. The estimated total cost of implementation of the HCP was \$11,555,000.

Lori Rose, HCP Biologist and Resource Specialist for Washington County, provided the following update information on 13 March 2003. The research that has been conducted to date includes a translocation study completed by Dr. Richard Tracy and University of Nevada Reno Biological Resources Research Center (BRRC). So far, \$150,000 a year for 5 years (\$750,000) was budgeted for this study. Utah Department of Wildlife Resources (UDWR) conducts population monitoring for the County. UDWR initially received \$50,000 in HCP funds for this work, plus an additional (unavailable) sum they secured through USFWS Section 6 funds. In 1998 they began to receive \$115,000 a year in HCP funds. In 2002, UDWR received \$50,000 in HCP funds though they did not monitor. Beginning in 2003, annual HCP funding has been increased to \$65,000, though monitoring of transects occurs every other year. It is not possible to calculate cost per acre from the available information, because there have been no consistent patterns from year to year.

San Diego, California Multiple Species HCP

The City of San Diego's Multiple Species Conservation Program (MSCP) is currently under development and has not yet received final approval by USFWS. The plan covers approximately 900 square miles (582,243 acres) in southwestern San Diego County and includes the City of San Diego, portions of the unincorporated County of San Diego, ten additional city jurisdictions, and several independent special districts. The MSCP preserve was designed based on an evaluation of 93 species as indicators of the range of habitats and biological diversity in the study area. Included within the 93 species were 41 species that are federally or state listed, candidates for listing, or proposed for listing. The plan attempts to maximize the presence of these species and their habitats in the designated reserve. Sixteen core biological resource areas and associated habitat linkages, totaling approximately 202,757 acres of habitat, were identified to assist local jurisdictions and special districts as one element to be considered in identifying their portion of the MSCP preserve and/or preserve design criteria. The study area contains 315,940 acres of habitat with almost two-thirds (about 194,563 acres) being privately owned. Over one-third of the habitat is in military (20,082 acres) or other public ownership (101,295 acres).

Wildlife agencies, as partners in MSCP implementation, will coordinate the biological monitoring program.

Monitoring MSCP implementation involves two independent processes:

- ✧ annual accounting of the acreage, type, and location of habitat conserved and destroyed (taken) by permitted land uses and other activities; and,
- ✧ biological monitoring to determine if the preserve system is meeting conservation goals for covered species.

If the MSCP is implemented using a 30-year benefit assessment program, the total cost to the local jurisdictions, residents, and businesses to implement the MSCP is estimated to range from \$339 to \$411 million (1996 dollars), based on a range in estimated value of habitat lands to be acquired. Most of this cost is for land acquisition. The total costs to the local jurisdictions for preserve management, biological monitoring, and program administration over the first 30 years is estimated to be approximately \$120 million, with an annual projected cost beyond that time of \$4.6 million per year (\$3.4 million more than current funding). Preserve management costs are estimated to range from \$37 per acre per year for areas isolated from urban development to \$47 per acre per year for areas near urban development. Biological monitoring costs will vary each year as a result of the type and frequency of monitoring required, with the average annual costs over a 10-year cycle estimated being \$230,400, roughly \$2.53 per acre per year. Annual administration costs

(e.g., land acquisition activities, subarea plan implementation, legal support, financial management, reporting and database management, and facilities and equipment) will also vary, reaching a peak of \$1.3 million in 2004 during the period of land acquisition, and declining to \$255,000 per year at preserve build-out.

State of Wisconsin HCP

This statewide HCP for the endangered Karner Blue Butterfly (*Lycaeides melissa samuelis*) in Wisconsin, developed in 1999, involves a large group of partners with the Wisconsin Department of Natural Resources (DNR) as the lead. The DNR and USFWS conduct implementation monitoring. Costs associated with the RIM program total \$285,275 per year for the 10-year permit period. The plan relies on in-kind monitoring, as most partners will choose to provide monitoring on their lands. Each partner will support pre-management surveying (pre-management and reconnaissance) and monitoring (self-monitoring for validation) of lands entered into the management strategies under the conservation agreement as related to normal management activities. Partners are obligated to perform this monitoring. Verification that this obligation has been met is part of implementation monitoring.

Potentially Appropriate Techniques for Inventory of SDCP PVS

In the absence of a developed inventory and monitoring program as part of the existing body of information being considered in the SDCP process, it is necessary to provide a measure of reference for the potential scope of inventory and monitoring of the species considered for inclusion in the plan. Specific protocols have been developed and/or approved by USFWS and AGFD for conducting inventory and monitoring for some of the species. Appendix N includes basic information on the currently included PVS, brief summaries of currently accepted protocols, and suggested methods that may be appropriate to use in a RIM program. Many of these techniques are currently used, and costs for them are available from several sectors, including Federal and State agencies and consultants. These have been included in other sections of this chapter.

Cost Estimates for a RIM Program Based on Various Strategies

In this section, several potential strategies are discussed, with cost estimates for operation of a RIM program developed from currently existing or recently completed projects and other information. Strategies explored are:

1. The RIM program is entirely managed and staffed by County employees;
2. The program is contracted to private consultants;

3. The program is contracted to the Arizona Game and Fish Department;
4. The program is contracted to the U.S. Geological Survey, Sonoran Desert Field Station in cooperation with the University of Arizona;
5. The program is contracted to the University of Arizona Department of Ecology and Evolutionary Biology and Vertebrate Collections; and
6. The program is contracted to the Arizona-Sonora Desert Museum.

Of course, other alternatives are possible, including arrangements with other University of Arizona departments and use of graduate students. As a standard of comparison, an attempt was made to provide data for equivalent personnel and hours on the tables that follow, based on the assumption that a crew consisting of a full-time staff of one Ph.D.-level biologist, one M.S.-level biologist, two B.S.-level biologists, and a 1/4 -time administrative support specialist has the task of implementing the program. As a starting place, the personnel of this hypothetical team makes sense, would have a high level of scientific credibility, and could conduct a reasonable (though as yet undefined) RIM program on reserve lands within the Conservation Lands System as currently defined. The first basis for comparison is that of a full-time staff dedicated to the RIM program, as would be the case if Pima County were to conduct the program with its own staff. A second basis for comparison (Alternative B in the table below) reflects the most likely approach that consultants or another agency might take, with higher-level staff working only part time on the RIM program, and lower-level staff conducting the majority of the work. Included are continuing costs only, not one-time costs. One-time costs might include vehicle purchase, office and field equipment purchase, software purchase, etc. Regrettably, this comparison is only a rough approximation and does not include all overhead, administrative costs, and other hidden costs for some strategies that may cause highly significant additions. It is likely that a GIS specialist would also be a valuable addition to the team, but that position is not factored in here because of the variety of ways in which GIS services might be included under any given strategy.

Additional strategies are possible, such as the HCP requiring the establishment of a new entity (a HCP Administration Organization) that might have costs similar or identical to having the program staffed by County employees, or by a non-profit organization, whose costs might be even less than those of the AGFD. In the following discussion, bits and pieces of information from a wide variety of sources are spliced together to develop a standard whereby costs might be compared.

Not considered here is the strategy presently employed in Clark County, where various agencies submit proposals for biennial funding. That program grows each biennium, is in part driven by the amount of money available and the range of active players competing for funding, and is funded by a source of money that is not likely to be available to the SDCP.

The estimates included herein are for one possible effort, which may be an acceptable minimum effort under the terms of the final HCP. There are, of course, no assurances that the general scheme used here would be sufficient to conduct the RIM program for the HCP. Without information on the final program that would be included in the HCP, it is impossible to accurately predict the level of effort the program would require. We used this approach in order to develop a conceptual funding scenario. However, it is possible that this level of effort may not be adequate to meet the needs of the program.⁵⁸

County Staff

One potentially suitable approach for the SDCP is for the County to create a bureau or office to be staffed by County employees who would administer and implement the RIM program. A potentially suitable staff might consist of four full-time staff: a PhD-level biologist, a M.S.-level biologist, and two B.S.-level biologists, and an administrative support person working 1/4 time. Included in costs would necessarily be salaries, benefits, office space, vehicles, equipment, supplies, and other necessary expenses. George Kuck of Pima County staff prepared cost estimates for this strategy. These estimates assume all personnel (with the exception of the 1/4 time administrative support person) are assigned full-time to this effort, which is an ongoing expense. One-time only expenses (not included here) assume that an office must be set up for this purpose, and new computers, software, vehicles, telephones, and other equipment are purchased in the first year. Mr. Kuck's detailed spreadsheet was condensed to a greatly simplified version for comparative purposes (see Table 17).

⁵⁸ Dr. Bill Halvorson, University of Arizona and US Geological Survey, reviewed this section and had the following comments in an email to K.J. Kingsley: "You say at one point that a vehicle would be a one time purchase like the office. In fact this job will take multiple vehicles which will need to be replaced every five years in order to maintain them in reasonably good working order. That is, vehicles are an on-going expense."

Since you are not able to include in the discussion, exactly what it is that the RIM crew would be doing, it is hard to figure what personnel are needed. However, I do believe that you have left a short-handed crew for any meaningful RIM program.

First the program will need two categories of folks that have been left out: a data manager and temporary field crews. The job, it seems to me, can be summarized as: Planning and management; field data collection; data summarization and analysis; information reporting through reports, meetings, websites, publications, etc; discovery of research projects that are needed; adaptation to the plan for the following year... In addition the program will have to be integrated into overall County Government activities, therefore lots of meetings. It is my opinion that to do all this and have a meaningful RIM program, it will take a full time program director (PhD), full time data manager/GIS specialist, full time field crew manager, and full time administrative assistant. There will then need to be temporary field crews (with crew leaders) to collect and input field data. The number of crews will be dependent upon what is being monitored or what inventories are being conducted in a particular year. There will also be the need for part-time help of a writer-editor, web-master, GIS technician, and administrative technician. These are all the kinds of jobs that we have discovered are needed through 20 years of developing these kinds of programs. I have usually learned the hard way - underestimating the job in the first place and having to live with the consequences. I am most certain that if you stick with your 'how it would most likely be done scenario' the program will not be able to function and will either have to pull back to monitoring only a very few species or will be quickly overwhelmed with data that no one is there to deal with."

Table 17 – Annual Cost Comparison of Strategies for Conducting RIM Program, Pima County Personnel, Dedicated Office (\$ 2003)

Classifications	Salary	Benefits	Total Cost
Ph.D. Biologist	\$50,000	\$15,000	\$65,000
MS Biologist	\$35,000	\$10,500	\$45,500
BS Biologist	\$32,000	\$9,600	\$41,600
BS Biologist	\$35,000	\$9,600	\$41,600
Administrative Support Specialist	\$7,638	\$2,291	\$9,929
Total Labor Costs			\$203,629
Direct Expenses			
Services and office costs			\$8,400
Mileage= .54/mile	50,000		\$27,000
Supplies			\$4,300
ODCs at 1% of labor			\$2,374
Total Direct Expenses			\$42,074
Total Estimated Program Costs			\$245,365

Private Consultants

Another approach would be to hire a consulting firm to conduct the program. The data in Table 18 are based on current average billing rates for consultants that are on the current list of firms qualified to provide biological services to Pima County. Alternative A shows the same staffing levels used for the estimate for County staff are used, strictly to facilitate comparison. It is very important to note that this does not actually illustrate the approach a consulting firm would likely use for this type of program. Instead, the Ph.D. and M.S. biologists would only be assigned on a part-time, as needed basis, directing the efforts of the B.S. biologists who might number as many as four. Alternative B illustrates the costs that would result from this more likely approach.

This estimate does not include the costs of creating an office, but assumes that all such costs are included within the hourly billing rates. Only direct labor and costs would be billed to this program. It is important to acknowledge that these rates include the hourly wages paid to the consulting employees, and overhead expenses borne by the consultants which include such things as rent, vehicle and other equipment costs and maintenance, and employee benefits such as sick leave, workers compensation insurance, and health insurance benefits, as well as company profit. The hours billed do not include holidays and vacation time, but only actual hours to be billed to the project, therefore the work year is not 2,080 hours, but 1,920 hours.

Table 18 – Annual Cost Comparison of Strategies for Conducting RIM Program, Consultant (\$ 2003)

CONSULTANT—Alternative A (for direct comparison)			
Classifications	Billed Hours	Rate	Total Cost
Ph.D. Biologist	1,920	\$95	\$182,400
MS Biologist	1,920	\$75	\$144,000
BS Biologist	1,920	\$45	\$86,400
BS Biologist	1,920	\$45	\$86,400
Administrative Support Specialist	520	\$40	\$20,800
Labor Costs			\$520,000
Direct Expenses			
Office costs: included in hourly rates			
Mileage= .36/mile	50,000		\$18,000
Supplies			\$4,300
ODCs at 1% of labor			\$5,200
Total Direct Expenses			\$27,500
Total Estimated Program Costs			\$547,500

CONSULTANT—Alternative B (how it would most likely be done)_			
Classifications	Billed Hours	Rate	Total Cost
Ph.D. Biologist ¼ time	520	\$95	\$49,400
MS Biologist ¼ time	520	\$75	\$39,000
BS Biologist 4 full-time	7680	\$45	\$345,600
Administrative Support Specialist	260	\$40	\$10,400
Labor Costs			\$444,400
Direct Expenses			
Office costs: included in hourly rates			
Mileage= .36/mile	50,000		\$18,000
Supplies			\$4,300
ODCs at 1%			\$4,444
Total Direct Expenses			\$26,744
Total Estimated Program Costs			\$471,144

Arizona Game and Fish Department

The Research Branch of the Arizona Game and Fish Department (AGFD) contracts for RIM projects, and currently has several ongoing projects in Pima County. Cost estimates for the same staffing and general expense levels discussed above are included in Table 19. Dr. Michael Ingraldi, AGFD, provided the data used in this table. It is likely that costs would be lower, because the Department would take the same approach as consultants, dedicating the higher-level staff on a part-time basis and using more effort by lower level staff, as is shown in Alternative B.

Table 19 – Annual Cost Comparison of Strategies for Conducting RIM Program, Arizona Game and Fish Department (\$ 2003)

AGFD —Alternative A (for direct comparison)			
Classifications	Salary	Benefits	Total Cost
Ph.D. Biologist	\$47,000	\$14,100	\$61,100
MS Biologist	\$35,000	\$10,500	\$45,500
BS Biologist	\$32,000	\$9,600	\$41,600
BS Biologist	\$32,000	\$9,600	\$41,600
Administrative Support Specialist	\$5,250	\$1,575	\$6,825
Labor Costs			\$196,625
Direct Expenses			
Office costs			\$13,500
Mileage= .50/mile	50,000		\$25,000
Supplies			\$500
ODCs at 1%			\$1,966
Total Direct Expenses			\$40,966
Total Estimated Program Costs			\$237,591

AGFD—Alternative B (how it would most likely be done)			
Classifications	Salary	Benefits	Total Cost
Ph.D. Biologist ¼ time	\$11,750	\$3,525	\$15,275
MS Biologist ¼ time	\$8,750	\$2,625	\$11,375
BS Biologist 4 full-time	\$128,000	\$38,400	\$166,400
Administrative Support Specialist	\$5,250	\$1,575	\$6,825
Labor Costs			\$199,875
Direct Expenses			
Office costs			\$13,500
Mileage= .50/mile	50,000		\$25,000
Supplies			\$500
ODCs at 1%			\$1,966
Total Direct Expenses			\$40,966
Total Estimated Program Costs			\$240,874

University of Arizona/US Geological Survey, Biological Resources Division

Costs that would be incurred by the program if it were done by the USGS-BRD (or USFWS or other Federal agency) in cooperation with the University of Arizona are shown in Table 20. Again, this assumes the same personnel and program. Salaries are based on the University of Arizona Classified Staff Pay Schedule, Fiscal Year 2002-2003. Mr. Brian Powell, University of Arizona School of Renewable Natural Resources, provided the additional data used in this table. These figures assume that the personnel are full-time University of Arizona employees at the lowest pay grades for their classifications, dedicated exclusively to this program, and the University charges the program the same rate for administrative fees that they currently use for the cooperative program. Not included are possible administrative fees charged by the USGS. In the current

inventory program, cited above, administrative costs are \$175,000 per year for a program that costs \$167,500 per year for direct costs, or 104% of direct costs. It is likely that the BRD would take the approach of dedicating the higher-level staff on a part-time basis and using more effort by lower-level staff, which would result in cost savings illustrated in Alternative B.

Table 20 – Annual Cost Comparison of Strategies for Conducting RIM Program, United States Geological Survey (\$ 2003)

USGS /UA—Alternative A (for direct comparison)			
Classifications	Salary	Benefits	Total Cost
Ph.D. Biologist	\$45,270	\$11,861	\$57,131
MS Biologist	\$33,107	\$8,674	\$41,781
BS Biologist	\$22,295	\$5,841	\$28,136
BS Biologist	\$22,295	\$5,841	\$28,136
Administrative Support Specialist	\$5,250	\$1,376	\$6,626
Labor Costs			\$161,810
Direct Expenses			
Office costs			
Mileage= .345 mile	50,000		\$17,250
Supplies			\$500
ODCs at 1% of labor			\$1,618
Total Direct Expenses			\$19,368
Total Direct Expenses + Labor Costs			\$181,178
Administrative Overhead 15% of project costs			\$27,177
Total Estimated Program Costs			\$208,355
USGS—Alternative B (how it would most likely be done)			
Classifications	Salary	Benefits	Total Cost
Ph.D. Biologist ¼ time	\$11,318	\$2,965	\$14,283
MS Biologist ¼ time	\$8,276	\$2,168	\$10,444
BS Biologist 4 full-time	\$89,180	\$23,365	\$112,545
Administrative Support Specialist	\$5,250	\$1,376	\$6,626
Labor Costs			\$143,898
Direct Expenses			
Office costs			
Mileage= .345/mile			\$17,250
Supplies			\$500
ODCs at 1% of labor			\$1,375
Total Direct Expenses			\$19,189
Total Direct Expenses + Labor Costs			\$163,087
Administrative Overhead 15% of project costs			\$24,463
Total Estimated Program Costs			\$187,550

University of Arizona Department of Ecology and Evolutionary Biology
and Vertebrate Collections

This department could conduct the RIM program, especially for fish, reptiles, birds, and mammals. Plant RIM could be conducted in association with the University Herbarium. The Vertebrate Collections represent the most significant collections of vertebrate organisms in the State of Arizona. Part-time collection managers and curators are associated with each respective collection. All of these individuals have extensive experience in faunal surveys and biodiversity database management. Table 21 includes the cost projections for this strategy. A potential option would be to have each of the Curators and Collections Managers assume a supervisory role, with Dr. Peter Reinthal, Director of the Vertebrate Collections and Curator of Fishes, serving as project supervisor. This would provide individual expertise in each of the taxonomic groups and Biodiversity Database Management (Dr. Yar Petryszyn, Mammals; Tom Huels, Birds; George Bradley, Herps; Dr. Peter Reinthal, Fish and Project Supervision) with a BS-level person under the direct supervision of each. Each of these individuals is currently .5 to .75 FTE depending on external funding. The curators of the Mammal and Bird Collections would also be available for consultation. This option is slightly more expensive but would provide a great deal of experience and expertise in surveys and database management. Direct expenses would remain the same. The 15% overhead cost is potentially negotiable. Dr. Peter Reinthal provided the information used in this table.

Table 21 – Annual Cost Comparison of Strategies for Conducting RIM Program, University of Arizona Department of Ecology and Evolutionary Biology and Vertebrate Collections (\$ 2003)

UA Department of Ecology and Evolutionary Biology and Vertebrate Collections (UAEEB) —Alternative A (for direct comparison)			
Classifications	Salary	Benefits	Total Cost
Ph.D. Biologist	\$40,000	\$10,480	\$50,480
MS Biologist	\$30,000	\$7,860	\$37,860
BS Biologist	\$22,000	\$5,764	\$27,764
BS Biologist	\$22,000	\$5,764	\$27,764
Administrative Support Specialist	\$5,250	\$1,376	\$6,626
Labor Costs			\$150,494
Direct Expenses			
Office costs			
Mileage= .345 mile	50,000		\$17,250
Supplies			\$500
ODCs at 1% of labor			\$1,505
Total Direct Expenses			\$19,255
Total Direct Expenses + Labor Costs			\$169,749
Administrative Overhead 15% of project costs			\$25,462
Total Estimated Program Costs			\$195,211

UAEEB—Alternative B (how it might best be done)			
Classifications	Salary	Benefits	Total Cost
Ph.D., Reinthal (Fish and Director) at ¼ time	\$13,113	\$3,436	\$16,549
Ph.D., Petryszyn at ¼ time	\$10,239	\$2,683	\$12,922
M.S., Bradley at ¼ time	\$6,899	\$1,808	\$8,707
M.S. Huels at ¼ time	\$10,100	\$2,646	\$12,746
BS Biologist 4 full-time	\$88,000	\$23,056	\$111,056
Administrative Support Specialist	\$5,250	\$1,376	\$6,626
Labor Costs			\$168,604
Direct Expenses			
Office costs			
Mileage= .345/mile			\$17,250
Supplies			\$500
ODCs at 1% of labor			\$16,865
Total Direct Expenses			\$19,436
Total Direct Expenses + Labor Costs			\$188,041
Administrative Overhead 15% of project costs			\$28,206
Total Estimated Program Costs			\$216,247

Arizona-Sonora Desert Museum

The Arizona-Sonora Desert Museum (ASDM) currently has several projects involving aspects of a potential RIM program, discussed in a

previous section of this chapter. ASDM could potentially conduct the entire RIM program for the SDCP. The senior staff biologists at ASDM would supervise specific aspects of the program, and would provide their expertise as needed. ASDM would provide facilities for the program. Table 22 includes the cost projections for this strategy. Dr. Richard C. Brusca, ASDM Executive Director of Programs provided the figures used here. Hours billed are similar to those for private consultants, for a 1,920-hour work year.

Table 22 – Annual Cost Comparison of Strategies for Conducting RIM Program, Arizona-Sonora Desert Museum (\$ 2003)

Arizona-Sonora Desert Museum (ASDM) —Alternative A (for direct comparison)			
Classifications	Billed Hours	Rate	Total Cost
Ph.D. Biologist	1,920	\$25	\$48,000
MS Biologist	1,920	\$23	\$44,160
BS Biologist	1,920	\$20	\$38,400
BS Biologist	1,920	\$20	\$38,400
Administrative Support Specialist	260	\$20	\$5,200
Labor Costs			\$174,160
Direct Expenses			
Office costs			
Mileage= .32 mile	50,000	0.32	\$16,000
Supplies			\$4,300
ODCs at 1% of labor			\$1,742
Total Direct Expenses			\$22,042
Total Direct Expenses + Labor Costs			\$196,202
Administrative Overhead 38% of project costs			\$74,557
Total Estimated Program Costs			\$270,758
ASDM—Alternative B (how it might best be done)			
Classifications	Billed Hours	Rate	Total Cost
Ph.D., Biologist, ¼ time	520	\$25	\$13,000
MS Biologist, ¼ time	520	\$23	\$11,960
BS Biologist 4 full-time	7,680	\$20	\$153,600
Administrative Support Specialist	260	\$20	\$5,200
Labor Costs			\$183,760
Direct Expenses			
Office costs			
Mileage= .32/mile	50,000	0.32	\$16,000
Supplies			\$4,300
ODCs at 1% of labor			\$1,838
Total Direct Expenses			\$22,138
Total Direct Expenses + Labor Costs			\$205,898
Administrative Overhead 38% of project costs			\$78,241
Total Estimated Program Costs			\$284,139

Conclusions and Recommendations

Available information from a variety of sources was compiled, analyzed, and presented. To the degree that these components can be applied to the yet-to-be developed SDCP RIM program, they provide some understanding of the range of possible costs that should be considered in the ongoing planning process of the SDCP. Ultimately the potential costs of a RIM program depend upon the following factors:

- ✧ Relative amounts and types of research, inventory, and monitoring in the program as specifically defined in the final approved HCP;
- ✧ Input from the STAT and USFWS on protocols and areas requiring inventory and monitoring, and the specific research questions and methods to be included;
- ✧ Final scope of the HCP, including area and species covered or included;
- ✧ Final decisions on funding mechanisms, dispersal methods, and administration of the HCP; and
- ✧ Amount of money available.

Because none of these factors have yet been determined, it is impossible to make an accurate estimate, or even a wild guess, as to what all of the costs will be. While this 'truism' may seem obvious, this analysis can provide some guidelines and general conclusions for anticipating the relative costs of components of a RIM program for the SDCP.

- ✧ Costs for inventory, monitoring, and research are species-dependent, as different protocols and techniques are required for different species/genera determine the level of effort or intensity that must be made;
- ✧ Costs for inventory and monitoring efforts are generally more easily defined than costs for research because species-specific and/or family-level survey/sampling methods exist that can answer questions about the presence and size of species or populations (which is the goal of inventory and monitoring);
- ✧ Based on the range of per acre costs for inventory and monitoring, these components of the SDCP RIM program could range from \$2.12 per acre to \$30.63⁵⁹ per acre or more.
- ✧ Monitoring costs are entirely dependent upon information that is not currently available, including:
 - What will be monitored?
 - How will it be monitored?
 - How will data be handled?
 - Who will conduct the monitoring program?

The answers to these questions will ultimately be provided by the STAT, the USFWS, and Pima County as the RIM program for the HCP is developed.

⁵⁹ This assumes a 100% pedestrian survey (\$26.50 per acre), as for PPC plus a point sampling as for CFPO (\$4.13 per acre) for over 1000 acres= \$30.63.

- ⌘ Research costs will depend upon the research question(s) to be answered, the methods to be used to collect and analyze the data, and to some degree, the entity conducting the research (e.g., consultants vs. County staff);
- ⌘ In general, labor costs may be higher when using a consultant (private and/or state or federal agencies) as compared to using county staff to implement a RIM program. One of the principle differences is that the consultant fees include all administrative costs, whereas the other alternatives, including the use of county staff, may include direct and indirect administrative costs that may equal or exceed the direct costs, but are not included in these calculations. In all cases, direct and indirect administrative costs must be factored into an implementation scenario, including but not limited to, the hiring and training of staff, benefits, office space, field equipment, vehicles, and management of employees. Consideration should also be given to benefits and challenges of the County managing the RIM program as a contractual agreement versus an in-house program or project.
- ⌘ RIM costs for the SDCP would likely be less than those currently estimated for the Clark County, Nevada HCP because fewer species are involved in the SDCP, there are fewer players at the table, and there is less money available (Pima County does not have the benefit of the Public Lands Management Act funding).
- ⌘ RIM costs may hold steady or diminish over time (accounting for inflation) as the program becomes established, basic inventory is completed, and specific monitoring tasks become routine.

In summary, one of the many contributors of information for this report, Dr. Phil Rosen, reinforced the idea that RIM costs are ultimately a negotiation: "... the only answer is going to come from knowledge of how much money you have to do the monitoring [and research]. That will define what you do."⁶⁰

⁶⁰ Rosen, P.C., 2003. Email response to query for input by P. Titus, 3 March 2003.

V. Funding Options

Various funding options are available to pay for the costs associated with a Section 10 Permit. In general there are a range of costs that include staff time and direct costs to:

1. Administer the plan
2. Facilitate public interface
3. Handle logistics such as project compliance reviews, land exchange, and easement agreements
4. Manage habitat acquisitions (as different from property acquisitions)
5. Manage reserves
6. Manage and execute protective and restorative measures such as installation of plantings, fencing and signage
7. Manage and pay for potential purchases of grazing permits and/or water rights
8. Conduct law enforcement
9. Provide education and public outreach efforts
10. Acquire and maintain equipment
11. Compile and manage data
12. Purchase lands for preservation (discussed in detail in the Costs and Benefits Chapter)
13. Conduct research, inventory, and monitoring (discussed in detail in the Program Costs Chapter)

The methods for paying for these costs can be divided into three general categories, and are described further in this chapter:

- ☒ Grants from outside sources
- ☒ Taxes on the entire community
- ☒ Fees on those entities that clearly benefit from or impede conservation

Primary Funding Mechanisms

Grants from Outside Sources

There are various forms of outside funding, however most come in the form of a “matching grant.” These grants require that the local community share the costs with the outside agency, and are subject to the budgetary issues in the state and federal political systems. This section lists a number of state and federal programs that could likely be tapped to help defray to the local burden for the cost related to the Section 10 Permit.

Heritage Fund

Heritage Initiative sets aside \$20 million in Arizona Lottery revenues each year for parks, trails, and natural areas, historic preservation, and a full range of wildlife conservation activities. Eligible applicants include the federal government, Indian tribes, the State of Arizona, counties, school districts, cities, towns, and any other political subdivisions of the state. The following programs are included in the Heritage Fund:

- ✧ Identification, Inventory, Acquisition, Protection and Management of Sensitive Habitats (IIAPM) – Grants are available for projects that will preserve and enhance Arizona’s natural biological diversity. The funding focus is directed annually toward species and habitat objectives that will give the greatest return for the Heritage funds invested.
- ✧ Environmental Education – The Environmental Education grant fund is for projects that develop awareness, appreciation and understanding of Arizona's wildlife and its environment and to increase responsible actions toward wildlife and their habitat. Project proposals are expected to be between \$1,000 and \$10,000.
- ✧ Urban Wildlife and Urban Habitat – Funds will be available under the Urban Wildlife/Urban Wildlife Habitat grant-funding source for projects that conserve, enhance and establish wildlife habitats and populations in harmony with urban environments, and that increase public awareness of and support for urban wildlife resources.
- ✧ Public Access – Funds will be available under the Heritage Public Access grant fund to increase, maintain or reduce public access as needed, for recreational use in cooperation with Federal land managers, local and state governments, private landowners and public users.

Arizona Preserve Initiative/Growing Smarter Grants

The Growing Smarter Grants programs is administered by the Arizona State Parks Board with monies from the state Land Conservation Fund. These grants provide \$20 million per year for eleven years, beginning in state fiscal year 2001, to award grants for the acquisition of State Trust Lands. The goal of these grants is “to conserve open spaces in or near urban areas and other areas experiencing high growth pressures.”

Conservation may occur through permanent or temporary acquisitions, such as leases of up to 50 years in length, purchases of a parcel’s development rights, or “fee simple” purchase of a parcel. Grants may be made by the Arizona State Parks Board for up to 50 percent of the appraised value of a land parcel. The Growing Smarter Act also authorizes the Parks Board to award grants, that do not require matching funds, “to individual landowners or grazing or agricultural lessees of state or federal land who contract with the Parks Board to implement

conservation-based management alternatives using livestock or crop production practices, or reduce livestock or crop production, to provide wildlife habitat or other public benefits that preserve open space.” The amount of grants for this purpose may not exceed 10 percent of the monies in the Public Conservation Account in any fiscal year.

The Growing Smarter Act established the Conservation Acquisition Board (CAB) to oversee these grant programs by soliciting donations, consulting with entities such as private land trusts, state land lessees, the Arizona State Land Department, the Arizona State Parks Board and others to identify conservation areas and to recommend to the Arizona State Parks Board appropriate grants from the land conservation fund. Lands eligible for acquisition through this program are defined in statute and this process is handled by the Arizona State Land Department (ASLD), as authorized by the Arizona Preserve Initiative. On petition, the State Land Commissioner may reclassify lands as suitable for conservation. Once reclassified, the lands may be acquired from the ASLD at public auction.

Arizona Water Protection Fund

The fund and its administrative body, the Arizona Water Protection Fund Commission, were established by the Arizona State Legislature to provide monies for the development and implementation of measures to protect water of sufficient quality and quantity to maintain, enhance, and restore rivers and streams and associated riparian habitats. This also includes fish and wildlife resources that are dependent on these important habitats. Funds come from the State Legislature (\$5 million per year), certain Central Arizona Project revenues and donations. Grants can be used to fund the following:

- ✧ The development and implementation of capital projects to maintain, enhance, and restore rivers and streams and associated riparian resources
- ✧ The acquisition of water resources or effluent for the purpose of protecting or restoring rivers and streams
- ✧ The development, promotion and implantation of water conservation programs outside of the five active management areas
- ✧ Support for research and data collection, compilation and analysis.

For the years 1995 to 2000, 142 projects were funded and awarded a total of \$26 million. The amount of funding awarded in each of these years ranged from \$2.5 million to \$6.9 million, with the average being \$4.5 million. However the next two fiscal years’ funds have been reduced to a total of \$2.5 million. Individual grants for 2000 ranged from \$34,416 to \$267,511. Since the program’s inception, Pima County’s Flood Control District applied four times, and was approved three times, totaling approximately \$760,000.

North American Wetlands Conservation Fund

This federal program, administered by the Fish and Wildlife Service, provides grants for the acquisition of land and water areas for conservation and for restoration, management and enhancement of wetland ecosystems and other habitat for migratory birds, fish and other wildlife. Standard grants range from \$50,000 to \$1 million, and require equal matching funds. Title VIII funding for the North American Conservation Fund was \$43.5 million for FY 2002.⁶¹

The Cooperative Endangered Species Conservation Fund

This federal program, which is authorized under Section 6 of the Endangered Species Act and administered by the Fish and Wildlife Service, provides money for land acquisition, habitat conservation planning, landowner assistance for habitat improvements, and candidate conservation plans for species at risk or becoming endangered or threatened. The grants are limited at 75 percent of program costs, therefore requiring at least 25 percent in matching funds. The fund was allocated \$96.2 million for FY 2002, and \$150 million for FY 2001. Funding is received under program title "Habitat Conservation Plan (HCP) Land Acquisition Program".⁶²

Land and Water Conservation Fund Grants

This fund was established in 1964 to fund the creation of parks and open space, protect wilderness wetlands and refuges, to preserve wildlife and enhance recreational opportunities. The federal program provides funds for the acquisition of land and water areas through the Forest Service, the Fish and Wildlife Service, the National Park Service, and the Bureau of Land Management. The state matching grants program provides funds to states to plan, develop and acquire land and water for state and local parks and recreation areas. No more than 50 percent of program costs can be paid for through federal funds. The fund's appropriation history has been uneven. Appropriations for the state grants program decreased from \$370 million in 1979 to nothing by the mid-1990s. In 2000 the state grants program was revived. Congress appropriated \$573 million for the Land and Water Conservation Fund for FY 2002; \$144 million of this is for the state grants program. Arizona's estimated apportionment of the state funding for FY 2002 is shown as \$2,591,241. Fifty million dollars for landowner incentive and stewardship grants were also included under the Land and Water Conservation Fund for FY 2002.⁶³

⁶¹ Americans for Our Heritage and Recreation

⁶² Ibid.

⁶³ Ibid.

Property Tax

Property taxes can be used to fund the RIM program and land acquisition. Bond issues, special districts and other voter approved expenditures can all be financed from a secondary property tax assessment. There is no state statutory limit on the amount of secondary taxes that can be levied.

Sales Tax

In Arizona, sales taxes imposed by counties generally apply to all taxable sales that occur within the county, including those in incorporated cities and towns. An exception to this rule is hotel/motel sales taxes in Pima County, where state statute requires that this tax be rebated to businesses in incorporated communities that impose a similar tax.⁶⁴ This is the only sales tax currently levied by the County. For most activities the County could impose a tax of up to 0.5 percent.⁶⁵ These revenues could be spent on RIM and land acquisition costs.

Mitigation Fee

Mitigation fees are a tool used in many areas to fund both RIM and land acquisition costs. This type of revenue source would apply only to new development within a designated area. It is unclear whether fees of this nature could be imposed at this time under state statutes. However, the flexibility in their implementation in other communities around the country make them an appealing funding option.

Other Funding Mechanisms

Other financing mechanisms have been identified from various sources. Primary among these were various materials initially gathered by Gayle Hartmann and Debbie Hecht and presented to the SDCP Steering Committee. Many of the ideas found there have been incorporated into the following section:

- ⊘ General Fund Line Item – Pima County has a \$2.25 million line item designated for open space purchases. While this comes from the general fund, some of the funding sources that likely help pay for this have been discussed previously.
- ⊘ Flood Prone Land Acquisition Program – Flood prone lands are purchased with money from two sources: 1) general obligation bonds designated especially for this purpose, and 2) a flood control line item that is part of the existing county property tax formula.
- ⊘ Conservation Easements Program – The Pima County Assessor could issue guidelines recognizing that the voluntary placement of a conservation easement reduces the value of the property, and thus the

⁶⁴ Arizona Revised Statute §42-6108

⁶⁵ Arizona Revised Statute §42-6103

taxes that should be collected. It will likely require a change in state statutes to implement this program.

- ✧ Purchase of Development Rights Program – The purchase of development rights entails paying a land owner the difference between the market value of the land for development purposes and its ranching value in exchange for the land not being developed or sold to be developed. This program will be especially important for the ranching community. Some funding for this program is available through the heritage fund. Additional funding can come from the mitigation fees as noted above.
- ✧ Transfer of Development Rights Program – This market driven program would allow private property owners in the “sending” area, lands targeted for conservation, to sell their development rights to property owners in the “receiving” area, lands with existing infrastructure that could accommodate higher zoning than is currently allowed. Currently, municipalities are expressly allowed by state statute to facilitate this type of activity,⁶⁶ but counties are not.
- ✧ Creation of Special Taxing Districts – State law allows for the creation of special taxing districts. Essentially, such districts generate funds from property taxes; with exceptions of some special taxing districts that can levy a sales tax or some combinations of the two methods. The restrictions on the shape of the district are specific to each type of district allowed under state statute. Currently there are 31 types of district. While the wording in statutes authorizing the following two districts does not clearly define land conservation as an option, they may still have some applicability to the costs associated with the Section 10 Permit.
 - Community Maintenance Districts: Maintenance and related operating costs incurred by each district are paid from revenues derived from an annual tax levy on the real property located within the district. The districts are formed only for the purpose of facilitating and encouraging the use and enjoyment of recreational land within the district and must contain land in at least two counties.⁶⁷
 - Agricultural Preservation Districts: Property taxes are levied based on acreage owned within the special districts. An agriculture preservation district can be formed for the purpose of maintaining and encouraging existing agricultural uses and maintaining and encouraging open space uses for the land included in the district without impairment of private rights of ownership.⁶⁸
- ✧ Impose a Development Fee: Development fees are a tool used by many local governments in Arizona to pay for the costs of adding new facilities and infrastructure to meet the demands imposed on the local jurisdictions by development. In general these pay for new roads,

⁶⁶ Arizona Revised Statute §9-462.01

⁶⁷ Arizona Revised Statute §48-1202

⁶⁸ Arizona Revised Statute §48-5702

water system expansions and new fire stations. This tool is also used by some jurisdictions around the country to help pay for conservation and open space lands.

- Per Arizona state statute, development fees can only be used for capacity expanding projects, and cannot be used for operation and maintenance. In the context of the costs related to the Section 10 Permit, land acquisition would likely be eligible for payment through development fees. However it is unclear if RIM costs could be paid for with this funding source as these may be more comparable to operation and maintenance which is expressly not allowed.
- Currently, counties in Arizona are only allowed to impose development fees for water, wastewater, transportation, public safety and parks.⁶⁹ It could be argued that a parks development fee could be used to acquire and improve open space lands for public recreation and at the same time used for conservation. However, as of this writing a development fee imposed by a county exclusively for the purpose of conservation does not appear to be legal. It should be noted that cities in Arizona have much more flexibility than counties regarding the types of development fees that can be charged, and would likely be able to impose a conservation fee today.⁷⁰

Funding Option Considerations

As the final funding option is developed the following considerations should be made:

Exclude Western Pima County – To the extent that the Section 10 Permit is only applicable to Eastern Pima County, then the final funding option should exclude the property and residents in Western Pima County. Since the development pressures and land ownership patterns are different in the western county, a separate and distinct approach to addressing endangered species issues there may be justified. However, modifications may be needed to some state statutes to allow for the imposition of taxes in targeted areas.

Build an “endowment” – This would help facilitate the long term stability of the plan. Ideally expenditures would only be made based on the interest earned, but the endowment funds would be available in case an extreme situation arose requiring significant immediate funds.

Build a mitigation land bank – This type of surplus would work as a cushion in times of high development activity and/or spikes in the value of land. In an average year approximately 800 acres of Listed Species habitat and 700 acres of Biologically Preferred habitat is developed on during the first ten years. With these figures rising to 3.5 times this level

⁶⁹ Arizona Revised Statute §11-1102

⁷⁰ Arizona Revised Statute §9-463.05

during the second 10 years. This type of bank would give the County the time to readjust the overall revenue structure to accommodate market changes, while minimizing the financial impact.

Build in regular revenue adjustments – Adjustments should be built into all of the revenue sources to account for such factors as inflation, land appreciation, increases in labor and materials costs, etc.

Build flexibility into the funding options available to developers – Large developers often have the resources to do the work of the public sector at a lower cost per unit than the public sector itself. For these situations, developers should be allowed to provide alternate funding solutions that meet the goals of the plan, while simultaneously lowering their overall cost. In contrast, small developers will likely need an inclusive funding option that allows them to pay a single fee and be released from their conservation responsibility. Building in flexibility will help prevent additional market distortions from the financing plan, and may provide indications of how the funding plan can be restructured in response to innovative ideas from the private sector.

Account for potential conservation land already owned by the County – It is possible that at the time the Section 10 Permit is issued the County will already own tracts of land appropriate for conservation management. These should be fully accounted for when developing a funding option to ensure that the community is not overcharged for conservation land acquisition.

Develop a balance between fees and taxes – From a technical perspective fees and taxes are not synonymous, although they are often used interchangeably in conversation and practice. *Fees* are imposed for a particular service being demanded by the fee payer, such as a building permit or renting a ramada at the park. In contrast, *taxes* are levied to pay for services that the tax payer may or may not use. Sales and income taxes that go into the general fund are examples.

Ensure that fees are rational and proportional – Supreme Court rulings⁷¹ have outlined some basic tests for fees that are contingent on development. These require that 1) there must be a clear and rational “nexus” between the fee charged and the development’s impact, and 2) the amount of the fee must be “roughly proportional” to the magnitude of impact the development is causing.

⁷¹ Nollan v. California Coastal Comm'n, 483 U.S. 825 (1987) and Dolan v. City of Tigard, 512 U.S. 374 (1994)

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⁷² Note that this report is labeled in documentation as Report 31 "Desert Ironwood Primer, 2/00."

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Appendix A Suitability Model

Approach and Data Format

The use of GIS technology in this study was methodical and threefold. The first goal was to evaluate, using the best available information, the suitability for development of lands in Eastern Pima County. Having accomplished this analysis, the consultant team utilized population projections and employment forecasts to map land demand outcomes for forty-five combinations of five land uses, three timeframes, and three regulatory scenarios. Finally, the results of the land demand modeling were overlain with maps of the Conservation Lands System and other administrative considerations to provide baseline area counts to help assess costs. This appendix details the methods and assumptions related to the first two of these tasks. These two tasks comprise a model, or predictive framework. The results of the third task are explained in the Costs and Benefits Chapter of the main document.

To facilitate computation, the development suitability analysis relied upon the raster data format. This contrasts with the more familiar vector data format. In the vector data format, map features are represented as point locations, closed shapes, and linework. Think of any map, paper or digital, used for road navigation or recreation. The raster data format, instead, applies a grid to the map realm so that geographic features are expressed as cells (rectangles, usually squares, of uniform size). In terms of this modeling exercise, the reader should visualize an array of squares of 0.2011 acres in size cast upon the expanse of Eastern Pima County. This approximate one-fifth acre resolution of the modeling grid was determined by the only source GIS data stored in a raster format, a set of digital elevation data provided by the United States Geological Survey via Pima County. This elevation information determined slope gradients. The role of slope in the model is described in the next section.

Because the raster data format defines a uniform mapping unit, many statistical and contextual analyses are accomplished that are not available with the vector data format. Note, the SDCP habitat modeling also used a raster data format. Furthermore, the raster data format provides an efficient approach to dealing with large spaces like Eastern Pima County.

An important first step was to delineate the year 2003 built environment. The consultant team investigated several techniques for the delineation (including the use of satellite imagery) and settled upon a map that has three components:

1. Current Sewer Service Area: All land within this area – whether built or not, whether on the sewer system or using a septic tank – is deemed built in terms of the GIS model. Nevertheless, the amount of vacant land within this area was quantified to temper the land

demand values described in the main document. In other words, in-fill opportunities were accounted for but not explicitly mapped.

2. Occupied Parcels outside the Current Sewer Service Area
3. Unoccupied Parcels outside the Current Sewer Service Area with Improvements > \$10,000: This dollar amount reflects that the parcel's hardscape might show more than a fence or some other minor structure. This approach stems from a previous GIS analysis performed by Pima County.

Figure A-1 included at the end of this appendix presents a schematic of the flow of operations described in this appendix. The "time stamp" of the GIS data used in this study is January 24, 2003.

Software

This study made use of state-of-the-art GIS software: Arc/Info, ArcView, and Idrisi. Manipulation and examination of vector data was accomplished with Arc/Info and ArcView. Modeling of raster data was accomplished with Idrisi. In particular, Idrisi provides a "Decision Support" suite of program modules that enable suitability analysis and land allocation mapping. The users' guide for Idrisi¹ provides illustrations of these procedures as well as a useful bibliography.

Suitability Analysis Variables

The land development suitability analysis employed a common GIS technique called a weighted linear combination. In this approach, digital map layers are treated as variables in an algebraic equation. The values at each grid cell for each of the variables are summed and/or multiplied to yield a single map. This suitability analysis recognized three types of variables – Influences, Constraints, and Impediments. Influences affect development suitability along a scale. Constraints act as barriers to development, or otherwise represent areas out of the model's consideration. Impediments have a solely negative effect upon development suitability. However, they do not absolutely restrict development like Constraints.

Following is the list of Influences and Constraints; Impediments are described later. The Pima County GIS coverages used to create the variables are named in parentheses.

Influences

Transportation Cost Surface (stfclass, stnetall)

Distance to Existing Sewer Line (wwm_sn)

Slope Gradient (dem30m)

Distance to Programmed Five-Year Transportation Improvement (cipdot, cipmar, ciporo)

Distance to Programmed Five-Year Sewer Improvement (cipwwm)

Distance to Existing Water Service Area (watercos)

¹ J. Ronald Eastman, *Idrisi32r2: Guide to GIS and Image Processing*

Distance to Built Environment (landavail, ssa)
Distance to Existing and Proposed Preserve² (preserve, parkprop)

Constraints

Existing Preserve (preserve)
Proposed Preserve (parkprop)
County and Municipal Parks (parkall)
Mines (mines)
Federal, State, County, and Municipal Landfills (lfiltspc, lfildaz)
Channels of Rivers and Major Washes (channel)
Tribal Lands (limjuris)
Built Environment (landavail, ssa)
Extra-territorial City of Tucson Holdings in Avra Valley (ownership)

The built environment plays a dual role in the model. Land demand cannot be sited within the built environment (a Constraint), and land closer to the built environment is deemed more suitable (an Influence). As the modeling progressed through the timeframes, the year 2003 built environment expanded with mapped land demand, and both of these variables were updated to account.

Among Influences, the “Transportation Cost Surface” requires special explanation. Those Influences named by “Distance to. . .” refer simply to Euclidean, or crow-flies, distance. Slope gradient is equally self-explanatory. The transportation cost surface, however, represents a model in itself. Descending numeric values were assigned to the road functional classification map such that interstate highways were assigned a value of “1” and rural collectors assigned a value of “7” – this range representing the full spectrum of the classification scheme. Yet, the road functional classification map (developed by the United States Census Bureau) represents only a part of Pima County’s complete road inventory. An overlay to identify those elements of the inventory not included was performed and the results were assigned a value of “8”. Finally, cells of the modeling grid that did not contain any road were assigned the arbitrarily high value of “16” to represent a diminished level of access and infrastructure service. The GIS software was then used to apply an algorithm that measured the least cost path (cost measured as the sum of grid cell road functional classification values) from the nearest edge of the current sewer service area to a vacant cell. The resulting values can be thought of as frictions of movement to a potentially-developable parcel. The cost surface for the 20 year and buildout timeframes incorporates elements of the Pima Association of Governments Long Range Transportation Plan.

² Used for Low Density Residential category only

Consequently, this stage in the suitability analysis yielded Influence maps dependent upon three different scales of measurement: distance as feet, slope gradient as a percentage, and modeled transportation friction values. To enable the weighted overlay, these scales had to be standardized. This was accomplished by using a linear transformation to yield integer values ranging between 0 and 255. This process is called “byte-scaling”, byte meaning the primary representation of digital computation as dictated by the permutations of eight sets of yes-no (binary) options – the result being 256 possible outcomes. In such a scale of measurement, values closer to 255 are deemed more suitable for development. (Byte-scaling is a common way of dealing with satellite imagery.) Constraint features were assigned a value of 0 and multiplied against the Influences to act as masks.

Pima County’s extensive spatial database provided the consultant team with great flexibility regarding inputs for the development suitability model. Such opportunity would not necessarily exist in other jurisdictions.

Influence Weights

Weights (multipliers) were assigned to each of the Influence maps per consolidated land use classification (Low Density Residential, High Density Residential, Commercial, Industrial, and Urban Open Space). The suitability values of each Influence map were then multiplied by the weights. Because each of the five sets of weights were designed to sum to one, the resulting suitability overlays retained the original, byte-scaled range of values (0 to 255) of the non-weighted influence maps. The weights reflect not only the relative importance of the influences with regard to land development dynamics, but also the relative usefulness of the source maps. The determination of weights relied upon the professional discretion of the consultant team, specifically two economists and a geographer knowledgeable with both land development practices in southern Arizona and the constitution of Pima County’s GIS database.

To establish the weights, the geographer provided the economists with five pairwise comparison matrices, one for each consolidated land use classification. The matrices evaluated the role of the influence maps with regard to one another. Consider the following abstracted example:

X
 Y
 Z
 1
 0.5 1
 0.25 0.5 1

This notation represents shorthand for the following matrix:

	X	Y	Z
X	1		
Y	0.5	1	
Z	0.25	0.5	1

The pairwise comparisons for this matrix are read: “Variable Y is one half as important as Variable X”; “Variable Z is one quarter as important as Variable X”; and “Variable Z is one half as important as Variable Y”. Note, only half of the matrix must be completed as the other values are inverses.

The following unformatted tables record the pairwise comparisons for the suitability model, with the order of Influences the same as which they were listed in the previous section.

Low Density Residential

1
 4 1
 1.5 0.66 1
 1 0.25 0.4 1
 0.66 0.25 1 1 1
 0.5 0.5 0.5 0.66 0.66 1
 3 1 0.4 1.5 1 1.5 1
 3 2 1 2 2 0.33 1 1

High Density Residential

1
 1 1
 1 1 1
 0.63 0.25 1 1
 0.25 0.25 1 1 1
 0.5 0.5 0.66 0.66 0.66 1
 0.63 0.63 1 0.75 0.75 1.5 1

Commercial

1
 0.63 1
 1 1 1
 0.57 0.67 1 1
 0.17 0.57 1 1 1
 0.5 0.5 0.67 0.67 0.67 1
 1 1.5 1 1.5 3 1.5 1

Industrial

1
 0.75 1
 1 1 1
 0.25 0.33 1 1
 0.17 0.14 1 1 1
 0.5 0.5 0.67 0.67 0.67 1
 1 1.5 1 1.5 3 1.5 1

Urban Open Space
 1
 1 1
 5 4 1
 0.67 2 0.33 1
 0.67 0.4 0.33 1 1
 0.5 0.5 0.67 0.67 0.67 1
 4 3 1.5 3 4.5 1.5 1

The weights were then solved by finding the algebraic solutions to the matrices. The results are shown in Figure A-2 at the end of this appendix. These procedures are part of the Analytical Hierarchy Process.³

Suitability and Land Demand Mapping

The weight-adjusted Influence maps were added together and then multiplied by the Constraint maps to yield preliminary versions for each of the forty-five model permutations. These maps were then multiplied by the Impediments: 100-Year Flood Plains (fp_dfirm), BLM Lands (ownership), and Priority Archaeological Sites (pcr_poly). The effect of the Impediments was to make the affected areas one-fifth less suitable for development. Next, for Scenarios 1 and 2, maps showing non-conforming zoning were applied in the same manner as the Constraints. The cross-jurisdictional zoning map was developed as described in Appendix C. Finally, the suitability values for each map were ranked, with ties being resolved by measuring the distance of tied cells to the geographic center of the current sewer service area.

Having ranked each grid cell in each of the suitability maps, land absorption was mapped with a “multi-objective land allocation” routine. This technique accepts that competing objectives (in this case, consolidated land uses) might compete for the same grid cells when seeking the most suitable areas to absorb as predicted land demand. The algorithm uses a linear, nearest-distance-to-ideal logic to resolve conflicts. In this model, the “ANY” and “NR” classes were always open to such competition, and the entire landscape was open to competition in Scenario 3.

³ Saaty, T.L., 1977, “A Scaling Method for Priorities in Hierarchical Structures”, *Journal of Mathematical Psychology*

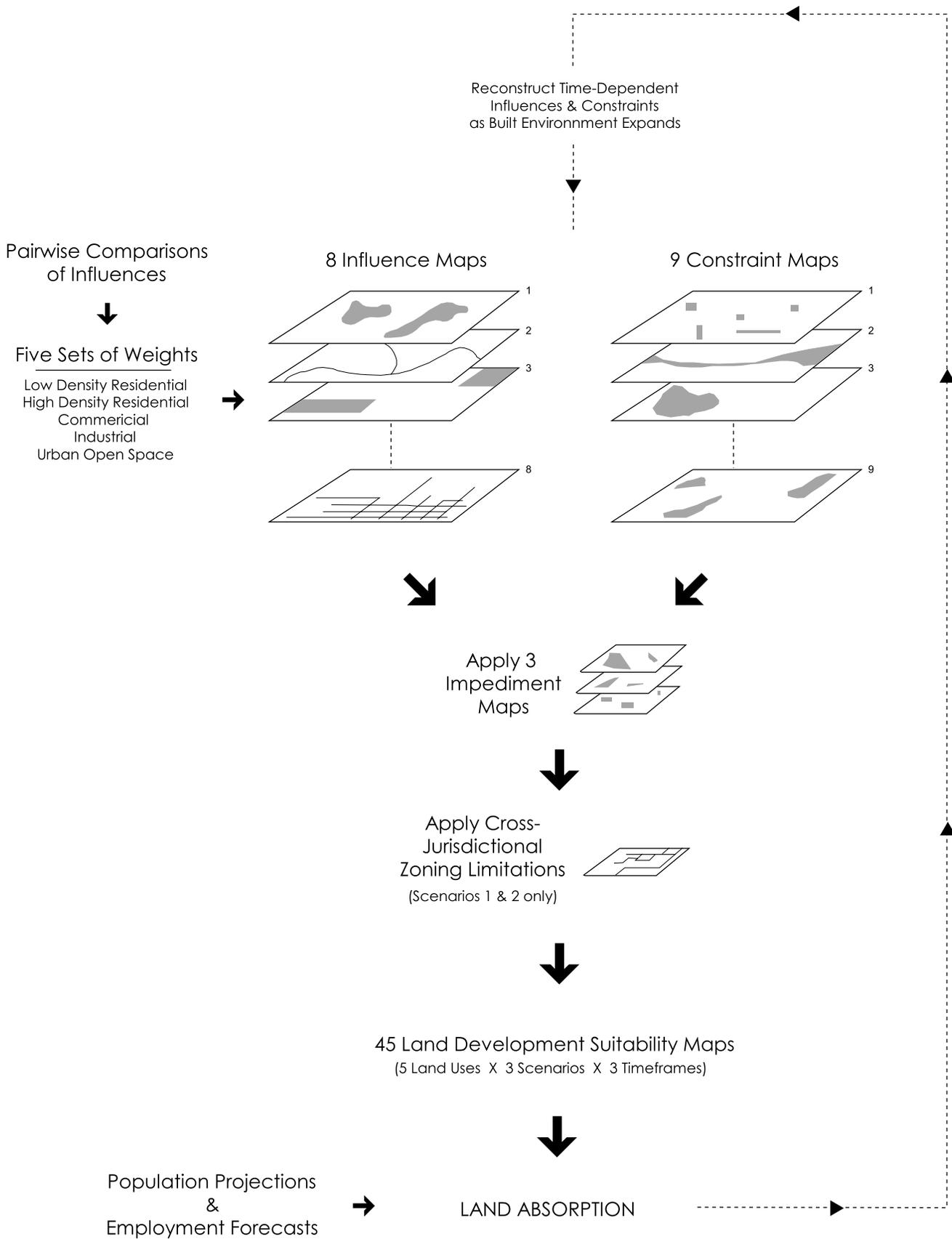


Figure A-1. Flow of GIS Operations.

	Low Density Residential	High Density Residential	Commercial	Industrial	Urban Open Space
Transportation Cost Surface	0.08	0.21	0.23	0.23	0.10
Distance to Existing Sewer Line	0.20	0.24	0.15	0.21	0.10
Slope Gradient	0.15	0.14	0.14	0.14	0.26
Distance to Programmed 5-Year Trans. Improvement	0.08	0.11	0.11	0.09	0.10
Distance to Programmed 5-Year Sewer Improvement	0.09	0.10	0.09	0.07	0.07
Distance to Existing Water Service Area	0.11	0.09	0.09	0.08	0.09
Distance to Built Environment	0.13	0.11	0.19	0.18	0.28
Distance to Existing and Proposed Preserve	0.16	n/a	n/a	n/a	n/a

Figure A-2. Influence weights.

Appendix B Economic Projection Scenarios

Three scenarios were developed to examine the likely pattern of future development in Pima County. This Appendix provides further detail and technical methodology on the steps taken to develop the economic projections scenarios. The three scenarios examined were:

- ✧ **Scenario 1** – This measured the impact of Pima County *not acquiring* the Permit, while *not allowing* zoning to change over time.
- ✧ **Scenario 2** – This measured the impact of Pima County’s *acquisition* of the Permit, while *not allowing* zoning to change over time.
- ✧ **Scenario 3** – This measured the impact of Pima County’s acquisition of the Permit, while *allowing* zoning to change over time.

Two different economic projection scenarios were created to serve as inputs to the land absorption model. These projections incorporate data concerning population growth and employment mix in order to project land absorption in Eastern Pima County for each of the three scenarios. Scenarios 2 and 3 entail identical economic assumptions, with the differences being in the spatial arrangement of projected development.

Baseline Data, Modifications and Limitations

The most recent (3rd quarter 2002) long range projection developed by the Eller College of Business and Public Administration (the Forecasting Project) was used as the baseline (Scenario 1). Documentation provided by the University of Arizona related to the development of these projections is included at the end of this appendix along with spreadsheets showing year to year detail of each scenario. This projection was modified through examination of changes in the employment mix in other counties that have recently adopted Multi-species Habitat Conservation Plans to create Scenarios 2 and 3.

Population Growth

Forecasting Project data models population growth in part using historic Arizona Department of Economic Security (ADES) estimates and ADES projections. It should be noted that population growth in our model is calculated as a function of new single family and multifamily residential permits which are projected by the Forecasting Project combined with household size data from the 2000 Census for Pima County by type (2.76 persons per single family household and 2.12 persons per multifamily household). Thus our analysis excludes the group quarters population (though their land demand is incorporated in changes in employment in group quarters serving industries such as prisons, assisted living facilities, and higher education) and new population living in mobile homes. The latter exclusion is due largely to a lack of reliable data. The Metropolitan Tucson Land Use Study (MTLUS) does track mobile home permits in the Tucson Metropolitan Area, but no projections are made in conjunction with

this study. The study area of MTLUS includes all of Eastern Pima County, but also spans across county lines.

Population and Employment Outside of Eastern Pima County

Population and employment projections represent all of Pima County, though our analysis includes only Eastern Pima County. An examination of recent Census data shows that the share of population and (especially) employment¹ outside of Eastern Pima County is minor; particularly relative to the scope of our analysis. It should be further noted that for all topics, with the exception of the buildout population, it is only the net change in population and employment by industry that impacts our analysis which implicitly assumes that all projected future growth occurs within the study area.

Employment Types Not Measured

It should be noted that Current Employment Statistics (CES) data are the basis for the Forecasting Project's projections, and in turn our application of them to future employment growth in Pima County. These data represent a sample of the universe included in Covered Employment and Wages (CEW, formerly ES 202) data; which includes all businesses subject to unemployment insurance reporting. These series include wage and salary employment only (excluding sole proprietors, agricultural and farm employment, and the federal military). Our analysis implicitly assumes a constant level of military land use (through the use of Davis-Monthan Air Force Base as an existing use constraint and by not including any projection of military employment and attempting to model additional land demand it would generate.) Agricultural and farm employment is allowed to fluctuate within the model as a result of land demand and is not separately identified. Non-profit organizations, such as churches, are allowed to self classify for participation in the unemployment insurance program, and thus are partially included in the data.²

Assumptions Common to All Scenarios and Overarching Concepts

Certain assumptions which were common to all scenarios were necessary to transform projections of employment and population into land absorption. These include some measure of land demand per employee by different industries, land demand of different housing types, and parks and golf courses per capita. Many assumptions, such as the relationship between employment and square footage by industry, the translation of the zoning codes of each jurisdiction into our consolidated land use

¹ Sub county employment data from the Census (County Business Patterns and Zip Code Business Patterns) is not comparable to other employment measures due to different reporting universes, however a comparison of total Pima County employment to employment in Western Pima County zip codes was done and Western Pima County accounts for less than one half of one percent of overall county employment.

² A phone conversation with Micki Gomez at DES indicated that the majority of non-profit organizations do participate, though a specific percentage was not available.

categories, and acres of parks and golf courses are held constant for all three scenarios.

Square Feet Per Employee

The ESI Corp Study Team utilized common assumptions of square feet per employee in different industries derived from a variety of sources in order to develop the assumptions shown on the following Table. Most categories will be apparent as within a fairly narrow range of assumptions used in planning exercises. One however, deserves further explanation. Construction demand for office space was calculated using the proportional share of employment in occupations which would likely drive the demand for office space (including administrative and support occupations, business and financial occupations, and computer and mathematical occupations) to calculate a ratio of total construction employment demand for office space. Each class of projected employment was also categorized into one or more of the consolidated land use categories, discussed further in the land absorption section.

Square Feet per Employee by Industry	
	SF per Employee
Construction ¹	112
Federal Government	400
Finance, Insurance and Real Estate	350
Manufacturing	448
Retail other than SIC 5356,54,55,58	478
Retail Trade: Automotive and Service Stations	699
Retail Trade: Eating and Drinking Places	538
Retail Trade: Food Stores	543
Retail Trade: General Merchandise and Apparel	442
Services other than SIC 70,73,80	350
Services: Business Services	350
Services: Health Services	358
Services: Hotel and other Lodging Places	1,100
State and Local Education	969
State and Local Non Education	400
Transportation, Communications and Public Utilities	201
Wholesale Trade	784

Note: 1. Share of construction employment that is admin/office (32%) derived from BLS industry occupation data. SF per employee is office rate based on that percentage.

Note that an average FAR of .35 were assumed for all land use types.

Sources: Institute of Transportation Engineers, Urban Land Institute, Office Space Use Review (Office of Governmentwide Policy; Office of Real Property) GIS Analysis and Data Enhancement Study (Maricopa Assn. of Gov.), BLS, ESI Corp

Classification of Employment Demand Drivers to Consolidated Land Use Categories

The following Table shows the classification of the different employment types into consolidated land use categories. These classifications were made in order to simulate actual land use patterns. For example, elementary schools are typically located in neighborhoods (conceptually following the location factors of the LDR category) and high schools are typically located on mile streets (more along the lines of the HDR category). Allocations of Federal Government and State and Local Government (non-education) were made under the judgment that these users behave in part as members of each class. For example, a wastewater treatment plant would typically locate under similar criteria to industrial development, but administrative offices are similar to private office (and indeed the county and federal government do actually lease some private office space) in terms of location factors.

Classification of Employment Types into Consolidated Land Use Model Categories

Non-Residential (Employment Driven)	Consolidated Land Use Class
Construction	Com
Federal Government	80% Com, 20% Ind
Finance, Insurance and Real Estate	Com
Manufacturing – Durable	Ind
Manufacturing – Non Durable	Ind
Retail other than SIC 5356,54,55,58	Com
Retail Trade: Automotive and Service Stations	Com
Retail Trade: Eating and Drinking Places	Com
Retail Trade: Food Stores	Com
Retail Trade: General Merchandise and Apparel	Com
Services other than SIC 70,73,80	Com
Services: Business Services	Com
Services: Health Services	Com
Services: Hotel and other Lodging Places	Com
State and Local Education	80% HDR, 20% LDR
State and Local Non Education	80% Com, 20% Ind
Transportation, Communication and Public Utilities	Ind
Wholesale Trade	Ind

Source: ESI Corporation

A number of other economic model assumptions that were held constant across scenarios are summarized on the following Table and are discussed individually in the following sections.

Summary of Select Economic Model Assumptions Applied to All Scenarios

Data	Value	Source
SF HH Size	2.12	2000 Census
MF HH Size	2.76	2000 Census
Acres of Parks and Golf Courses Per Capita	0.016	Analysis of Current GIS Coverages ¹
LDR Density	0.5	Weighted Average of zoning classifications used in each definition
HDR Density	5.8	
Percentage of single family homes in LDR category	23.28%	Parcel Base Analysis of SF Homes Built 1998-2001 Average (02 roll)
Water Constraint (Maximum Possible Population Supportable with no ag nor mining)	2,247,690	Waterwords, Southern Arizona Water Resources Association Autumn 2000 ²

Note: 1. Excludes river parks, Bellota Ranch, Bingham-Cienega Natural Preserve, Cienega Creek Natural Preserve, Colossal Cave Mountain Park, Tortolita Mountain Park, and Tucson Mountain Park

2. Modified by the percentage of the population in Pima County as of the 2000 Census

Source: As listed, ESI Corporation

Average Residential Density

Developing the Consolidated Land Use categories necessitated some abstraction from reality in terms of average activity as compared to actual activity. Where zoning is a constraint (Scenarios 1 and 2) the actual maximum allowable residential density is typically defined in the applicable zoning ordinances.³ Zoning categories were classified as LDR or HDR using a natural break of maximum allowable density of 3 residences per acre (RAC) (with figures less than this being classified as LDR and those of 3 RAC or above being classified as HDR).⁴ After this classification a weighted average of acreage by zoning in the study area (outside of the built environment) was calculated for each classification to derive average densities of 0.5 RAC for LDR and 5.8 RAC for HDR which were used to calculate land absorption as a function of projected new housing activity. All multifamily permits were assumed to be incorporated in the HDR category, and an analysis of recent (1998 to 2001 construction year) activity from the 2002 tax year Pima County Assessor's database indicated

³ Within the study area, there is land subject to the zoning ordinances of five different jurisdictions (Pima County, and the cities of Marana, Oro Valley, Sahuarita, and Tucson).

⁴ Calculation performed for all categories where maximum lot size information was available.

that 23.28 percent of single family home construction took place with densities less than 3 RAC. This allocation was used to classify single family homes within both residential categories.

Acres of Parks and Golf Courses Per Capita

A current GIS coverage of parks in Eastern Pima County and a 2002 population estimate from the Arizona Department of Economic Security were used to calculate the average acres of parks per capita. This calculation excluded river parks, Bellota Ranch, Bingham-Cienega Natural Preserve, Cienega Creek Natural Preserve, Colossal Cave Mountain Park, Tortolita Mountain Park, and Tucson Mountain Park which were assumed not to vary on a per population basis. A golf course GIS coverage was used to identify acres of golf course in Eastern Pima County.

Water Availability

The aggregate amount of water available for municipal⁵ and mining and agricultural uses serves as a constraint of our economic model. The Southern Arizona Water Resources Association (SAWARA) performed a series of calculations⁶ that were adapted for our analysis, beginning with the assumption that each acre foot of water supports eight persons and associated municipal activity. Mining and agricultural water uses are typically considered separately from other municipal uses. The SAWARA analysis indicated that the 200,000 acre feet of CAP supply and net recharge factors show that if there were no agricultural or mining uses in Pima County, a population of 2,282,209 would be supportable in the Tucson Active Management Area (TAMA). The TAMA however, services more than just Pima County. Utilizing the percentage of population in the Pima County portion of the TAMA in 2000 (from the Census), this maximum supportable population total was adjusted downward to 2,247,690. This maximum supportable population was further adjusted downward to reflect projected mining and agricultural activity.

The relationship between mining employment and water use was assumed to remain constant over time. The following Table shows these relationships as derived from SAWARA calculations and Bureau of Economic Analysis data concerning mining employment.

⁵ The term municipal is used here to indicate residential, commercial, and industrial; all CAP water uses with the exception of mining and agriculture.

⁶ Waterwords, Autumn 2000 publication of the Southern Arizona Water Resources Association; "How Much Population Growth Can Be Supported By Our Water Supply?"

Water Demand Adjustment per Mining Employment

Mining

Employment	2,680 jobs
Water Demand	43,000 acre feet
Recharge Factor	12%
Incidental Recharge	5,160 acre feet
Net Water Use	37,840 acre feet
Per Job	14.12 per job

Source: Southern Arizona Water Resources Association; Water Words, Volume 18, # 2, Autumn 2000, Pima County GIS Layer, Bureau of Economic Analysis

SAWARA analysis showed 93,000 acre feet of agricultural water demand, which with a 20 percent recharge factor indicated net water demand of 74,400 acre feet. Conversations with a representative of TAMA indicated that current TAMA projections (which extend through 2025) assume approximately 50 percent of current agricultural activity and associated water use will remain. It was further indicated that the factors driving the retirement of agricultural land are expected to continue in the years following the projection period. Another issue advanced in these conversations was *acceleration* in the retirement of agricultural land. It is postulated that some of the value of the agricultural land in Pima County is viewed as a **result** of other agricultural activity taking place today. Support services (such as farm equipment rental, repair, etc. and wholesale distribution networks) are economical specifically because there is a certain critical mass of agricultural activity in the region. Though this specific tipping point is not known, and reasonably varies for different crops, it is possible that as agricultural land is retired from production remaining land may become **more** likely to be retired as well. In the interest of a conservative assumption, it was assumed that 25 percent of agricultural water demand remains at buildout in each scenario.

Projected mining employment in 2027 (the last year of the projection data) was assumed to remain constant through buildout and that level of employment was subtracted from the maximum potential population at buildout at a rate of 14.12 acre feet per job and a reduction of eight persons per acre foot of water supply. While mining water demand is not necessarily equal to employment in any given year, due to high sunk costs and shut down and restart costs, the goal of our analysis is to develop a reasonable assumption of a sustained level of activity in mining as one factor limiting the maximum population at buildout. The Table which follows shows the reduction to the potential buildout population from these adjustments.

Calculation of Reduction of Buildout Population Due to Agricultural and Mining Water Use by Scenario

	Scenario 1	Scenario 2	Scenario 3
TAMA Adjusted for Eastern Pima County	2,247,690	2,247,690	2,247,690
Total Ag Water Demand (acre feet) ¹	18,600	18,600	18,600
Reduction of Buildout Population (000's)	148.800	148.800	148.800
Total Mining Employment (000's)	1.37	1.46	1.46
Reduction of Buildout Population (000's)	154.410	165.167	165.167
Adjusted Population	1,944,480	1,933,723	1,933,723

Note: 1. Agriculture analysis assumes 25 percent of all agricultural land remains in ag production through buildout.

Source: SAWARA, TAMA, Previous Table, ESI Corporation

Other County Conservation Plans and Employment Impacts

Employment data from five counties that have adopted conservation plans since 1990 were gathered and analyzed in order to develop employment growth projections for Scenarios 2 and 3. The counties analyzed were Clark County, NV, Orange County, CA, San Diego County, CA, Travis County, TX, and Volusia County, FL. The ESI Corp Study Team compared the share of national employment by major industry⁷ in each county in an equivalent number of years before and after adopting their conservation plans in each of the counties using employment data from the Bureau of Economic Analysis. The overall average difference by industry was used to adjust values from baseline (Scenario 1) projections of employment.⁸ Using this average percentage of national employment methodology was necessary to control for business cycle differences in the comparison of different timeframes. For example, Clark County's plan has been active throughout the 1990's, whereas the other plans have all had shorter timeframes (been implemented during the 1990's). The 1990's have been among the best years of economic growth in recorded history and a simple average level of employment measure (without the national benchmark) would have actually been capturing that business cycle effect instead of any real change in relative regional economic conditions. By incorporating the national economy (as the denominator) this calculation represents the increased or decreased activity before and after the adoption of the plan that is caused by changes in the regional economy that coincided with that change. While correlation is not causation, the uniformity of the results of relative increases in employment levels is reasonably associated with prevailing theories of regional economic growth, particularly as they relate to enhancing the attractiveness of the region and streamlining development processes.

⁷ With the exception of Agricultural employment, which is not part of the "790" projection series and was not specifically addressed in our projections.

⁸ With one exception; non-military government employment was assumed to be a proportionate share of population at buildout though fluctuating in the same manner as other categories on a year to year basis.

As shown on the following Table, on average all major industries showed a higher capture rate of national employment in the years following the adoption of their plans. The largest increases were in construction, transportation and public utilities, and finance, insurance and real estate. Total government showed virtually no change.

Change in Employment Relative to the United States Before and After Adoption of Conservation Plans

Major Industry	Pre-Plan	Post Plan	Ratio Post / Pre Plan
Ag. services, forestry, fishing, & other	0.59%	0.62%	1.06
Mining	0.21%	0.23%	1.07
Construction	0.54%	0.65%	1.22
Manufacturing	0.45%	0.49%	1.10
Transportation and public utilities	0.38%	0.44%	1.17
Wholesale trade	0.53%	0.60%	1.12
Retail trade	0.55%	0.58%	1.06
Finance, insurance, and real estate	0.66%	0.72%	1.10
Services	0.65%	0.69%	1.07
Total Government	0.58%	0.58%	1.01

Note: Average of five plans (Clark County, NV, Orange County, CA, San Diego, CA, Travis County, TX, and Volusia County, FL). Duration of comparison: SD 4yrs, Clark 10yrs, Travis, Orange and Volusia each 5 yrs.

Source: Bureau of Economic Analysis, ESI Corporation

The ratio of pre plan to post plan adjustment factor was applied to the baseline projection for Pima County phased in (ten percent after the first year and increased linearly thereafter) over a ten year time horizon.

Clark County, Nevada was the fastest growing county in the nation from 1990 to 2000 (a period largely congruent with the time after the adoption of their conservation plan).⁹ The possibility of removing Clark County from the analysis entirely as an outlier¹⁰ was considered. The effect of removing Clark County from the dataset is shown on the following Table. In all cases (except total government) the ratio of post-plan to pre-plan employment share was lower when Clark County was excluded. The percentage difference in these measures was largest in construction and mining.

⁹ While the working hypothesis was that adopting a multi-species conservation plan was a **cause** of a change in development activity this analysis was performed to understand the sensitivity of the assumption to the specific set of counties analyzed.

¹⁰ A value far from most others in a set of data not necessarily reflective of the overall relationship.

Effects of Removing Clark County from Change in Employment Analysis

Major Industry	All 5 ¹	Excluding Clark ²	% Dif
Ag. services, forestry, fishing, & other	1.06	1.00	5.7%
Mining	1.07	0.98	9.7%
Construction	1.22	1.10	11.2%
Manufacturing	1.10	1.08	1.8%
Transportation and public utilities	1.17	1.10	5.8%
Wholesale trade	1.12	1.08	3.8%
Retail trade	1.06	1.00	5.4%
Finance, insurance, and real estate	1.10	1.04	5.9%
Services	1.07	1.02	4.8%
Total Government	1.01	1.01	-0.3%

Note: 1. Ratios calculated from the previous table.

2. Ratios as calculated from the previous table with Clark County excluded.

Source: Previous Table, Bureau of Economic Analysis, ESI Corporation

It was decided to keep Clark County in the average calculation, in part due to the similarity of the actual performance of their plan with the likely effects of Pima County's plan. The Clark County plan collects fees for development throughout the county and uses the proceeds to preserve land outside of the Las Vegas urbanized area, with minor infringement¹¹ on development activity in the urbanized area. An examination of the Conservation Lands System reveals that the vast majority of the lands designated for preserve and/or relatively less intense development are well removed from the path of development (with the exception of parts of Marana that have been impacted by the presence of Cactus Ferruginous Pygmy Owl habitat and some Pima Pineapple Cactus habitat recently annexed by the city of Tucson). Part of the compromise involved in the development of the Biologically Preferred Alternative¹² included less land to be conserved in and around the urbanized area.

A higher level of population growth in Scenarios 2 and 3 was assumed, through the use of the higher level of job creation to calculate population growth (holding the ratio of wage and salary employment to population in each year of the projection equal to the same year of the Scenario 1 projection).

¹¹ The development impact fee can clearly be seen as an infringement to development, but beyond that the rules detailed in Clark County's incidental take permit provide for a total set number of acres for development without any specific need to perform inventory. The fee paid by new development and sales of federal lands provide the funding for the program to acquire land outside of the Las Vegas Valley.

¹² As shown in the Sonoran Desert Conservation Plan document "Listed Species Reserve Analysis," April 1, 2002 draft Figure 10b.

The proportion of growth in population inhabiting single family homes as opposed to multifamily homes (rental or ownership in either case) was assumed to be equivalent to the relationship calculated from household size data from the 2000 Census applied to Eller College of Business and Public Administration long term projections of single family and multifamily permits at each year. An interesting outcome of this methodology is that LDR development overall is somewhat higher (total acreage at buildout) and total HDR development is projected to be lower (total acreage at buildout) in Scenarios 2 and 3 due to the ratio of single family permits to multifamily permits decreasing over time.¹³ This relationship is clearly congruent with the conceptual “limit” on desirable land (proximity to existing urban area and the like) such that as the total supply of vacant land decreases the “need” to develop it more intensely increases. The declining ratio also represents expected changes resulting from national trends in terms of changing demographics, with the baby boom population nearing retirement and seeking to downsize homes and residential maintenance requirements. Younger age cohorts are smaller, and thus future demand for multifamily housing is projected to be higher than current demand. Places such as Pima County (and Arizona in general) by virtue of their attractiveness to retirees could be expected to exhibit this shift in a more pronounced fashion than the national average. It should be noted that the aggregate population of Eastern Pima County is projected to be slightly lower in Scenarios 2 and 3 due to a higher level of mining activity (which reduces the total water available to serve municipal growth).

The following Table shows projected land demand throughout Eastern Pima County at three timeframes, 10 years, 20 years, and buildout for each scenario and cumulative totals by land use type and timeframe. The detailed spreadsheets showing how each land demand factor was attributed to these categories are included at the end of Appendix C.

¹³ In 2002 there were approximately five single family units permitted per multifamily unit permitted. This ratio is projected to decrease over time to approximately three to one in 2018, and down to 2.5 to 1 in 2026.

Total New Development Acreage Projected in Eastern Pima County by Type, Scenario, and Timeframe

		First 10 Years	Second 10 Years	21 Years Through Buildout	Cumulative Total
Scenario 1	LDR	30,540	31,703	97,478	159,722
	HDR	11,563	13,109	43,385	68,057
	Urban Park / Golf Course	2,879	3,269	10,786	16,934
	Commercial	2,507	3,657	8,084	14,248
	Industrial	367	564	1,563	2,493
	Total	47,856	52,302	161,296	261,455
Scenario 2¹	LDR	37,015	36,177	86,232	159,425
	HDR	14,015	14,881	38,464	67,360
	Urban Park / Golf Course	3,505	3,724	9,533	16,762
	Commercial	3,078	3,893	6,904	13,875
	Industrial	582	624	1,365	2,570
	Total	58,195	59,300	142,497	259,992
Scenario 3¹	LDR	37,015	36,177	86,232	159,425
	HDR	14,015	14,881	38,464	67,360
	Urban Park / Golf Course	3,505	3,724	9,533	16,762
	Commercial	3,078	3,893	6,904	13,875
	Industrial	582	624	1,365	2,570
	Total	58,195	59,300	142,497	259,992

Note: 1. Scenarios 2 and 3 use the same economic assumptions, but vary spatially.
Source: Previous Tables, ESI Corporation

Appendix C discusses the spatial allocation of this projected land demand within the study area under the different scenarios.

Adjusted Projections Scenario 1

	1/1/01	1/1/02	1/1/03	1/1/04	1/1/05	1/1/06	1/1/07	1/1/08	1/1/09	1/1/10
Population and Housing										
Total Population (000)	870.610	889.011	906.196	922.853	940.717	958.631	976.474	994.407	1,012.849	1,031.015
New Population (000)	18.401	17.185	16.656	17.864	17.914	17.843	17.933	18.441	18.166	18.666
Single Housing Permits (units) ¹	6,412.00	6,509.10	6,387.25	6,692.05	6,623.65	6,575.90	6,511.84	6,580.00	6,450.70	6,535.53
Multi Housing Permits (units) ¹	1,742.00	1,226.74	1,128.72	1,332.28	1,402.88	1,413.87	1,495.56	1,627.49	1,627.17	1,743.05
Employment (000's)										
Retail Trade: General Merchandise and Apparel	8.724	8.794	8.941	9.150	9.366	9.531	9.676	9.817	9.948	10.083
Retail Trade: Food Stores	8.287	8.314	8.283	8.313	8.397	8.429	8.453	8.455	8.434	8.417
Retail Trade: Automotive and Service Stations	5.673	5.551	5.684	5.857	5.985	6.119	6.250	6.364	6.485	6.663
Retail Trade: Eating and Drinking Places	25.015	24.396	25.165	26.153	27.397	28.420	29.241	30.132	31.006	32.023
Retail other than SIC 5356,54,55,58	14.218	14.552	15.161	16.014	16.780	17.492	18.156	18.868	19.536	20.333
Services: Hotel and other Lodging Places	8.477	8.145	8.978	9.368	9.788	10.188	10.568	10.942	11.318	11.717
Services: Business Services	28.413	26.392	27.500	28.601	29.598	30.641	31.675	32.689	33.715	34.730
Services: Health Services	27.751	27.935	29.462	31.110	32.643	34.034	35.384	36.865	38.002	39.332
Services other than SIC 70,73,80	52.530	54.224	56.927	59.761	62.414	65.099	67.785	70.725	73.312	76.214
Construction	21.947	21.284	21.657	22.232	22.875	23.463	23.983	24.581	25.115	25.703
Communication and Public Utilities	3.653	3.848	3.978	3.917	3.873	3.896	3.863	3.831	3.769	3.755
Durable Manufacturing	28.786	27.907	28.319	28.732	29.017	29.248	29.539	29.888	30.272	30.692
Finance, Insurance and Real Estate	14.982	15.357	15.710	16.353	16.859	17.263	17.744	18.255	18.664	19.128
Total Mining	1.847	1.469	1.606	1.573	1.504	1.473	1.448	1.413	1.371	1.334
Nondurable Manufacturing	5.036	4.388	4.645	4.816	4.969	5.111	5.236	5.363	5.480	5.611
Transportation	7.939	7.257	7.464	7.588	7.630	7.639	7.660	7.997	8.123	8.283
Wholesale Trade	10.398	9.840	9.827	10.316	10.763	11.175	11.487	11.745	12.001	12.290
80% of State and Local Education ²	36.329	37.283	37.881	38.469	39.055	39.610	40.129	40.698	41.282	41.860
20% of State and Local Education ²	9.082	9.321	9.470	9.617	9.764	9.902	10.032	10.175	10.320	10.465
80% State and Local Non Education ²	18.166	18.248	18.795	19.473	20.027	20.492	20.973	21.546	22.063	22.665
20% State and Local Non Education ²	4.542	4.562	4.699	4.868	5.007	5.123	5.243	5.387	5.516	5.666
80% Federal Government (non-mil) ²	7.270	7.478	7.654	7.782	7.902	8.018	8.074	8.207	8.226	8.286
20% Federal Government (non-mil) ²	1.818	1.870	1.914	1.945	1.976	2.004	2.019	2.052	2.057	2.072

Note: 1. Annual Values calculated as cumulative change.

2. Allocated totals

Adjusted Projections Scenario 1

	1/1/11	1/1/12	1/1/13	1/1/14	1/1/15	1/1/16	1/1/17	1/1/18	1/1/19
Population and Housing									
Total Population (000)	1,049.681	1,068.457	1,086.942	1,105.804	1,125.418	1,145.421	1,165.852	1,186.559	1,207.537
New Population (000)	18.776	18.485	18.863	19.614	20.002	20.431	20.707	20.978	21.414
Single Housing Permits (units) ¹	6,541.17	6,372.18	6,466.60	6,656.96	6,744.37	6,827.79	6,871.55	6,924.56	6,997.88
Multi Housing Permits (units) ¹	1,778.38	1,802.79	1,867.16	1,993.31	2,066.80	2,158.13	2,224.26	2,281.78	2,383.63
Employment (000's)									
Retail Trade: General Merchandise and Apparel	10.217	10.320	10.444	10.625	10.823	11.025	11.225	11.421	11.614
Retail Trade: Food Stores	8.398	8.377	8.356	8.344	8.334	8.322	8.312	8.310	8.319
Retail Trade: Automotive and Service Stations	6.806	6.917	7.075	7.318	7.589	7.876	8.158	8.434	8.756
Retail Trade: Eating and Drinking Places	33.095	33.950	35.027	36.674	38.606	40.748	43.041	45.429	47.951
Retail other than SIC 5356,54,55,58	21.072	21.661	22.566	23.672	24.848	26.094	27.342	28.630	29.978
Services: Hotel and other Lodging Places	12.134	12.502	12.936	13.521	14.183	14.890	15.624	16.383	17.176
Services: Business Services	35.767	36.793	37.973	39.400	40.947	42.601	44.331	46.126	48.003
Services: Health Services	40.756	42.128	43.673	45.585	47.614	49.679	51.651	53.514	55.334
Services other than SIC 70,73,80	79.171	81.763	84.350	86.950	89.590	92.433	95.319	98.244	101.239
Construction	26.293	26.807	27.348	28.031	28.769	29.509	30.212	30.895	31.597
Communication and Public Utilities	3.764	3.873	3.826	3.770	3.710	3.652	3.608	3.572	3.528
Durable Manufacturing	31.130	31.610	32.072	32.530	32.953	33.357	33.780	34.207	34.672
Finance, Insurance and Real Estate	19.598	20.071	20.529	21.014	21.512	22.043	22.576	23.110	23.679
Total Mining	1.306	1.244	1.245	1.254	1.262	1.273	1.273	1.287	1.286
Nondurable Manufacturing	5.729	5.824	5.969	6.135	6.303	6.473	6.636	6.799	6.960
Transportation	8.457	8.723	8.891	9.006	9.129	9.257	9.398	9.553	9.706
Wholesale Trade	12.568	12.819	13.259	13.799	14.408	15.059	15.741	16.466	17.221
80% of State and Local Education ²	42.432	42.997	43.655	44.276	44.862	45.459	46.089	46.758	47.462
20% of State and Local Education ²	10.608	10.749	10.914	11.069	11.215	11.365	11.522	11.690	11.865
80% State and Local Non Education ²	23.278	23.762	24.131	24.630	25.122	25.646	26.133	26.555	27.066
20% State and Local Non Education ²	5.819	5.940	6.033	6.157	6.280	6.411	6.533	6.639	6.766
80% Federal Government (non-mil) ²	8.386	8.476	8.622	8.809	9.000	9.194	9.390	9.586	9.785
20% Federal Government (non-mil) ²	2.097	2.119	2.156	2.202	2.250	2.299	2.348	2.396	2.446

Note: 1. Annual Values calculated as cumulative change.

2. Allocated totals

Adjusted Projections Scenario 1

	1/1/20	1/1/21	1/1/22	1/1/23	1/1/24	1/1/25	1/1/26	1/1/27	Buildout
Population and Housing									
Total Population (000)	1,228.951	1,250.561	1,272.220	1,294.255	1,316.473	1,339.127	1,361.706	1,384.501	1,944.480
New Population (000)	21.611	21.658	22.035	22.218	22.654	22.579	22.795	22.981	536.998
Single Housing Permits (units) ¹	7,020.81	7,007.59	7,040.61	7,067.73	7,103.97	7,051.87	7,065.18	7,111.87	166,182.91
Multi Housing Permits (units) ¹	2,437.12	2,464.58	2,575.72	2,621.28	2,751.35	2,764.00	2,832.18	2,863.73	66,916.81
Employment (000's)									
Retail Trade: General Merchandise and Apparel	11.794	11.951	12.087	12.232	12.385	12.531	12.683	12.843	18.038
Retail Trade: Food Stores	8.324	8.322	8.319	8.313	8.308	8.301	8.296	8.295	11.650
Retail Trade: Automotive and Service Stations	9.061	9.327	9.605	9.890	10.232	10.542	10.860	11.204	15.736
Retail Trade: Eating and Drinking Places	50.519	52.950	55.369	57.944	60.740	63.528	66.484	69.697	97.887
Retail other than SIC 5356,54,55,58	31.271	32.409	33.557	34.874	36.213	37.522	38.999	40.553	56.955
Services: Hotel and other Lodging Places	17.972	18.714	19.410	20.160	20.969	21.781	22.645	23.590	33.131
Services: Business Services	49.919	51.768	53.646	55.431	57.272	59.004	60.757	62.486	87.759
Services: Health Services	57.146	59.358	61.949	64.275	66.854	69.201	71.561	73.931	103.833
Services other than SIC 70,73,80	104.259	107.294	110.394	113.527	116.692	119.786	122.766	125.825	176.717
Construction	32.282	32.914	33.555	34.192	34.862	35.466	36.054	36.642	51.462
Communication and Public Utilities	3.480	3.427	3.358	3.300	3.231	3.187	3.131	3.067	4.307
Durable Manufacturing	35.152	35.617	36.097	36.609	37.163	37.739	38.345	38.970	54.732
Finance, Insurance and Real Estate	24.247	24.807	25.397	25.985	26.583	27.166	27.737	28.323	39.779
Total Mining	1.295	1.317	1.313	1.321	1.329	1.324	1.349	1.367	1.367
Nondurable Manufacturing	7.108	7.234	7.354	7.489	7.618	7.742	7.877	8.014	11.255
Transportation	9.855	10.019	10.160	10.313	10.441	10.588	10.727	10.866	15.261
Wholesale Trade	17.951	18.608	19.256	19.988	20.728	21.564	22.370	23.215	32.605
80% of State and Local Education ²	48.178	48.670	49.137	49.558	49.947	50.280	50.667	50.917	71.511
20% of State and Local Education ²	12.045	12.167	12.284	12.390	12.487	12.570	12.667	12.729	17.878
80% State and Local Non Education ²	27.534	27.986	28.566	29.072	29.702	30.212	30.742	31.229	43.860
20% State and Local Non Education ²	6.883	6.997	7.141	7.268	7.425	7.553	7.685	7.807	10.965
80% Federal Government (non-mil) ²	9.982	10.176	10.371	10.565	10.732	10.879	10.970	11.065	15.540
20% Federal Government (non-mil) ²	2.496	2.544	2.593	2.641	2.683	2.720	2.743	2.766	3.885

Note: 1. Annual Values calculated as cumulative change.

2. Allocated totals

Adjusted Projections Scenario 1	Annualized Growth Rate					Overall Change		
	02-11	02-22	02-27	12-21	12-27	02-11	12-21	22-Buildout
Population and Housing								
Total Population (000)	1.9%	1.8%	1.8%	1.8%	1.7%	179.45	203.76	672.260
New Population (000)	0.7%	1.3%	1.2%	1.8%	1.5%	179.45	203.76	672.260
Single Housing Permits (units) ¹	-0.2%	0.4%	0.4%	1.0%	0.7%	65,407.20	67,890.30	208,624.14
Multi Housing Permits (units) ¹	3.9%	3.8%	3.4%	3.6%	3.1%	14,776.15	21,679.55	83,325.09
Employment (000's)								
Retail Trade: General Merchandise and Apparel	1.6%	1.6%	1.5%	1.6%	1.5%	1.53	1.77	5.951
Retail Trade: Food Stores	0.1%	0.0%	0.0%	-0.1%	-0.1%	0.06	(0.06)	3.331
Retail Trade: Automotive and Service Stations	2.2%	2.8%	2.8%	3.3%	3.3%	1.37	2.69	6.131
Retail Trade: Eating and Drinking Places	3.4%	4.2%	4.3%	5.0%	4.9%	9.55	21.42	42.518
Retail other than SIC 5356,54,55,58	4.1%	4.3%	4.2%	4.5%	4.3%	7.11	11.90	23.398
Services: Hotel and other Lodging Places	4.4%	4.4%	4.3%	4.5%	4.3%	4.36	6.91	13.721
Services: Business Services	3.4%	3.6%	3.5%	3.8%	3.6%	10.40	16.85	34.113
Services: Health Services	4.2%	4.1%	4.0%	3.9%	3.8%	14.19	19.82	41.884
Services other than SIC 70,73,80	4.2%	3.6%	3.4%	3.0%	2.9%	27.54	28.63	66.323
Construction	2.3%	2.3%	2.2%	2.3%	2.1%	5.52	6.75	17.907
Communication and Public Utilities	0.1%	-0.7%	-0.9%	-1.4%	-1.5%	0.03	(0.52)	0.949
Durable Manufacturing	1.3%	1.3%	1.3%	1.3%	1.4%	3.70	4.49	18.635
Finance, Insurance and Real Estate	2.7%	2.5%	2.5%	2.4%	2.3%	4.71	5.33	14.382
Total Mining	-1.6%	-0.6%	-0.3%	0.5%	0.6%		0.07	0.054
Nondurable Manufacturing	2.9%	2.6%	2.4%	2.4%	2.2%	1.44	1.53	3.901
Transportation	1.9%	1.7%	1.6%	1.5%	1.5%	1.47	1.44	5.101
Wholesale Trade	2.7%	3.4%	3.5%	4.2%	4.0%	2.98	6.44	13.349
80% of State and Local Education ²	1.4%	1.4%	1.3%	1.3%	1.1%	5.71	6.14	22.374
20% of State and Local Education ²	1.4%	1.4%	1.3%	1.3%	1.1%	1.43	1.54	5.593
80% State and Local Non Education ²	2.7%	2.3%	2.2%	1.9%	1.8%	5.51	4.80	15.294
20% State and Local Non Education ²	2.7%	2.3%	2.2%	1.9%	1.8%	1.38	1.20	3.824
80% Federal Government (non-mil) ²	1.3%	1.6%	1.6%	2.0%	1.8%	1.00	1.90	5.169
20% Federal Government (non-mil) ²	1.3%	1.6%	1.6%	2.0%	1.8%	0.25	0.47	1.292

Note: 1. Annual Values calculated as cumulative change.

2. Allocated totals

Adjusted Projections Scenario 2

	1/1/01	1/1/02	1/1/03	1/1/04	1/1/05	1/1/06	1/1/07	1/1/08	1/1/09	1/1/10
Population and Housing										
Total Population (000)	870.610	889.011	906.196	922.853	944.519	963.951	984.004	1,005.114	1,027.625	1,051.929
New Population (000)	18.401	17.185	16.656	21.667	19.432	20.053	21.110	22.511	24.304	26.372
Single Housing Permits (units) ¹	6,412.00	6,509.10	6,387.25	8,116.48	7,184.83	7,390.35	7,665.44	8,031.85	8,630.07	9,233.50
Multi Housing Permits (units) ¹	1,742.00	1,226.74	1,128.72	1,615.87	1,521.74	1,588.99	1,760.50	1,986.59	2,176.91	2,462.60
Employment (000's)										
Retail Trade: General Merchandise and Apparel	8.724	8.794	8.941	9.203	9.439	9.630	9.810	9.998	10.192	10.413
Retail Trade: Food Stores	8.287	8.314	8.283	8.361	8.462	8.516	8.570	8.611	8.641	8.693
Retail Trade: Automotive and Service Stations	5.673	5.551	5.684	5.891	6.031	6.182	6.336	6.481	6.644	6.881
Retail Trade: Eating and Drinking Places	25.015	24.396	25.165	26.305	27.610	28.714	29.645	30.687	31.768	33.072
Retail other than SIC 5356,54,55,58	14.218	14.552	15.161	16.107	16.910	17.673	18.407	19.216	20.016	20.999
Services: Hotel and other Lodging Places	8.477	8.145	8.978	9.431	9.876	10.311	10.738	11.176	11.641	12.163
Services: Business Services	28.413	26.392	27.500	28.795	29.865	31.010	32.183	33.388	34.677	36.051
Services: Health Services	27.751	27.935	29.462	31.320	32.938	34.443	35.952	37.654	39.086	40.828
Services other than SIC 70,73,80	52.530	54.224	56.927	60.165	62.977	65.882	68.873	72.238	75.404	79.114
Construction	21.947	21.284	21.657	22.720	23.545	24.380	25.233	26.289	27.442	28.879
Communication and Public Utilities	3.653	3.848	3.978	3.983	3.960	4.013	4.017	4.035	4.037	4.111
Durable Manufacturing	28.786	27.907	28.319	29.007	29.387	29.745	30.208	30.791	31.492	32.342
Finance, Insurance and Real Estate	14.982	15.357	15.710	16.521	17.090	17.578	18.175	18.847	19.471	20.231
Total Mining	1.847	1.469	1.606	1.584	1.518	1.491	1.472	1.444	1.411	1.386
Nondurable Manufacturing	5.036	4.388	4.645	4.862	5.032	5.198	5.355	5.525	5.701	5.913
Transportation	7.939	7.257	7.464	7.716	7.801	7.868	7.966	8.423	8.700	9.067
Wholesale Trade	10.398	9.840	9.827	10.442	10.938	11.418	11.820	12.199	12.619	13.134
80% of State and Local Education ²	36.329	37.283	37.881	38.495	39.090	39.657	40.192	40.784	41.398	42.017
20% of State and Local Education ²	9.082	9.321	9.470	9.624	9.773	9.914	10.048	10.196	10.349	10.504
80% State and Local Non Education ²	18.166	18.248	18.795	19.486	20.045	20.516	21.006	21.592	22.125	22.750
20% State and Local Non Education ²	4.542	4.562	4.699	4.871	5.011	5.129	5.252	5.398	5.531	5.688
80% Federal Government (non-mil) ²	7.270	7.478	7.654	7.787	7.909	8.027	8.087	8.225	8.250	8.318
20% Federal Government (non-mil) ²	1.818	1.870	1.914	1.947	1.977	2.007	2.022	2.056	2.062	2.079

Note: 1. Annual Values calculated as cumulative change.

2. Allocated totals

Adjusted Projections Scenario 2

	1/1/11	1/1/12	1/1/13	1/1/14	1/1/15	1/1/16	1/1/17	1/1/18	1/1/19
Population and Housing									
Total Population (000)	1,078.300	1,107.453	1,141.150	1,161.355	1,182.359	1,203.791	1,225.675	1,247.851	1,270.319
New Population (000)	29.152	33.697	20.205	21.005	21.432	21.884	22.175	22.468	22.925
Single Housing Permits (units) ¹	10,156.26	11,616.28	6,926.78	7,128.85	7,226.36	7,313.29	7,358.94	7,416.50	7,491.46
Multi Housing Permits (units) ¹	2,761.24	3,286.43	2,000.03	2,134.60	2,214.50	2,311.58	2,382.03	2,443.89	2,551.75
Employment (000's)									
Retail Trade: General Merchandise and Apparel	10.663	10.921	11.052	11.244	11.454	11.667	11.879	12.086	12.291
Retail Trade: Food Stores	8.765	8.865	8.843	8.830	8.820	8.807	8.796	8.794	8.804
Retail Trade: Automotive and Service Stations	7.103	7.320	7.487	7.744	8.031	8.335	8.633	8.925	9.266
Retail Trade: Eating and Drinking Places	34.541	35.928	37.068	38.810	40.855	43.122	45.548	48.075	50.744
Retail other than SIC 5356,54,55,58	21.993	22.923	23.881	25.051	26.296	27.614	28.935	30.298	31.724
Services: Hotel and other Lodging Places	12.750	13.348	13.811	14.436	15.143	15.897	16.681	17.491	18.338
Services: Business Services	37.582	39.282	40.542	42.066	43.717	45.483	47.330	49.247	51.251
Services: Health Services	42.824	44.978	46.628	48.669	50.835	53.040	55.145	57.134	59.078
Services other than SIC 70,73,80	83.188	87.295	90.057	92.833	95.651	98.687	101.768	104.891	108.088
Construction	30.625	32.697	33.357	34.190	35.090	35.993	36.850	37.683	38.540
Communication and Public Utilities	4.239	4.525	4.470	4.405	4.335	4.267	4.215	4.173	4.122
Durable Manufacturing	33.361	34.631	35.137	35.639	36.103	36.545	37.009	37.476	37.986
Finance, Insurance and Real Estate	21.105	22.129	22.634	23.169	23.718	24.303	24.891	25.480	26.107
Total Mining	1.374	1.331	1.332	1.341	1.350	1.362	1.362	1.377	1.376
Nondurable Manufacturing	6.140	6.381	6.539	6.721	6.905	7.092	7.270	7.449	7.625
Transportation	9.525	10.192	10.388	10.522	10.666	10.816	10.980	11.161	11.340
Wholesale Trade	13.719	14.385	14.878	15.484	16.168	16.898	17.663	18.477	19.324
80% of State and Local Education ²	42.645	43.284	43.947	44.572	45.162	45.763	46.397	47.071	47.779
20% of State and Local Education ²	10.661	10.821	10.987	11.143	11.290	11.441	11.599	11.768	11.945
80% State and Local Non Education ²	23.394	23.920	24.293	24.794	25.290	25.817	26.308	26.733	27.247
20% State and Local Non Education ²	5.849	5.980	6.073	6.199	6.322	6.454	6.577	6.683	6.812
80% Federal Government (non-mil) ²	8.428	8.533	8.680	8.868	9.060	9.256	9.453	9.650	9.850
20% Federal Government (non-mil) ²	2.107	2.133	2.170	2.217	2.265	2.314	2.363	2.412	2.463

Note: 1. Annual Values calculated as cumulative change.

2. Allocated totals

Adjusted Projections Scenario 2

	1/1/20	1/1/21	1/1/22	1/1/23	1/1/24	1/1/25	1/1/26	1/1/27	Buildout
Population and Housing									
Total Population (000)	1,293.244	1,316.376	1,339.575	1,363.162	1,386.963	1,411.221	1,435.422	1,459.839	1,933.723
New Population (000)	23.132	23.199	23.587	23.801	24.258	24.201	24.417	24.631	449.253
Single Housing Permits (units) ¹	7,515.23	7,506.03	7,536.47	7,571.24	7,606.92	7,558.47	7,568.00	7,622.59	139,028.56
Multi Housing Permits (units) ¹	2,608.75	2,639.88	2,757.13	2,808.02	2,946.15	2,962.57	3,033.74	3,069.39	55,982.58
Employment (000's)									
Retail Trade: General Merchandise and Apparel	12.481	12.647	12.791	12.945	13.106	13.261	13.422	13.591	17.517
Retail Trade: Food Stores	8.809	8.807	8.804	8.797	8.792	8.785	8.779	8.778	11.314
Retail Trade: Automotive and Service Stations	9.589	9.870	10.165	10.466	10.828	11.156	11.493	11.857	15.281
Retail Trade: Eating and Drinking Places	53.462	56.035	58.595	61.320	64.278	67.229	70.357	73.757	95.060
Retail other than SIC 5356,54,55,58	33.093	34.297	35.512	36.906	38.323	39.708	41.271	42.915	55.310
Services: Hotel and other Lodging Places	19.188	19.980	20.723	21.524	22.388	23.255	24.177	25.186	32.460
Services: Business Services	53.296	55.270	57.275	59.181	61.147	62.996	64.868	66.714	85.982
Services: Health Services	61.012	63.374	66.140	68.624	71.377	73.883	76.402	78.933	101.730
Services other than SIC 70,73,80	111.313	114.553	117.863	121.208	124.587	127.890	131.072	134.338	173.137
Construction	39.375	40.146	40.928	41.705	42.522	43.259	43.976	44.693	57.601
Communication and Public Utilities	4.066	4.004	3.923	3.856	3.775	3.724	3.658	3.583	4.618
Durable Manufacturing	38.512	39.021	39.547	40.108	40.715	41.346	42.010	42.695	55.026
Finance, Insurance and Real Estate	26.733	27.351	28.001	28.649	29.309	29.951	30.581	31.227	40.246
Total Mining	1.385	1.409	1.404	1.413	1.422	1.416	1.443	1.462	1.462
Nondurable Manufacturing	7.787	7.925	8.057	8.205	8.346	8.482	8.630	8.780	11.316
Transportation	11.514	11.706	11.871	12.049	12.199	12.371	12.533	12.695	16.362
Wholesale Trade	20.143	20.881	21.608	22.429	23.260	24.198	25.102	26.050	33.574
80% of State and Local Education ²	48.500	48.995	49.465	49.890	50.281	50.616	51.006	51.257	71.115
20% of State and Local Education ²	12.125	12.249	12.366	12.472	12.570	12.654	12.751	12.814	17.779
80% State and Local Non Education ²	27.718	28.173	28.757	29.266	29.900	30.414	30.947	31.438	43.617
20% State and Local Non Education ²	6.929	7.043	7.189	7.317	7.475	7.603	7.737	7.859	10.904
80% Federal Government (non-mil) ²	10.049	10.244	10.441	10.635	10.804	10.952	11.044	11.139	15.454
20% Federal Government (non-mil) ²	2.512	2.561	2.610	2.659	2.701	2.738	2.761	2.785	3.864

Note: 1. Annual Values calculated as cumulative change.

2. Allocated totals

Adjusted Projections Scenario 2	Annualized Growth Rate					Overall Change		
	02-11	02-22	02-27	12-21	12-27	02-11	12-21	22-Buildout
Population and Housing								
Total Population (000)	2.2%	2.1%	2.0%	1.9%	1.9%	218.44	232.12	594.148
New Population (000)	7.0%	1.6%	1.5%	-3.5%	-2.1%	218.44	232.12	594.148
Single Housing Permits (units) ¹	6.0%	0.7%	0.6%	-4.2%	-2.8%	79,305.12	77,499.72	184,492.26
Multi Housing Permits (units) ¹	10.4%	4.1%	3.7%	-1.7%	-0.5%	18,229.89	24,573.44	73,559.57
Employment (000's)								
Retail Trade: General Merchandise and Apparel	2.2%	1.9%	1.8%	1.6%	1.5%	2.13	1.87	4.725
Retail Trade: Food Stores	0.6%	0.3%	0.2%	-0.1%	-0.1%	0.55	(0.06)	2.510
Retail Trade: Automotive and Service Stations	2.8%	3.1%	3.1%	3.3%	3.3%	1.77	2.84	5.117
Retail Trade: Eating and Drinking Places	3.9%	4.5%	4.5%	5.0%	4.9%	11.53	22.67	36.465
Retail other than SIC 5356,54,55,58	4.6%	4.6%	4.4%	4.5%	4.3%	8.37	12.59	19.798
Services: Hotel and other Lodging Places	5.1%	4.8%	4.6%	4.5%	4.3%	5.20	7.38	11.737
Services: Business Services	4.1%	4.0%	3.8%	3.8%	3.6%	12.89	17.99	28.706
Services: Health Services	4.9%	4.4%	4.2%	3.9%	3.8%	17.04	21.16	35.590
Services other than SIC 70,73,80	4.9%	4.0%	3.7%	3.0%	2.9%	33.07	30.57	55.274
Construction	4.4%	3.3%	3.0%	2.3%	2.1%	11.41	8.23	16.674
Communication and Public Utilities	1.6%	0.1%	-0.3%	-1.4%	-1.5%	0.68	(0.60)	0.695
Durable Manufacturing	2.2%	1.8%	1.7%	1.3%	1.4%	6.72	4.92	15.479
Finance, Insurance and Real Estate	3.7%	3.0%	2.9%	2.4%	2.3%	6.77	5.87	12.245
Total Mining	-1.0%	-0.2%	0.0%	0.5%	0.6%		0.07	0.058
Nondurable Manufacturing	3.8%	3.1%	2.8%	2.4%	2.2%	1.99	1.68	3.259
Transportation	3.5%	2.5%	2.3%	1.5%	1.5%	2.93	1.68	4.492
Wholesale Trade	3.9%	4.0%	4.0%	4.2%	4.0%	4.54	7.22	11.966
80% of State and Local Education ²	1.5%	1.4%	1.3%	1.3%	1.1%	6.00	6.18	21.650
20% of State and Local Education ²	1.5%	1.4%	1.3%	1.3%	1.1%	1.50	1.55	5.412
80% State and Local Non Education ²	2.7%	2.3%	2.2%	1.9%	1.8%	5.67	4.84	14.860
20% State and Local Non Education ²	2.7%	2.3%	2.2%	1.9%	1.8%	1.42	1.21	3.715
80% Federal Government (non-mil) ²	1.3%	1.7%	1.6%	2.0%	1.8%	1.05	1.91	5.014
20% Federal Government (non-mil) ²	1.3%	1.7%	1.6%	2.0%	1.8%	0.26	0.48	1.253

Note: 1. Annual Values calculated as cumulative change.

2. Allocated totals

Adjusted Projections Scenario 3

	1/1/01	1/1/02	1/1/03	1/1/04	1/1/05	1/1/06	1/1/07	1/1/08	1/1/09	1/1/10
Population and Housing										
Total Population (000)	870.610	889.011	906.196	922.853	944.519	963.951	984.004	1,005.114	1,027.625	1,051.929
New Population (000)	18.401	17.185	16.656	21.667	19.432	20.053	21.110	22.511	24.304	26.372
Single Housing Permits (units) ¹	6,412.00	6,509.10	6,387.25	8,116.48	7,184.83	7,390.35	7,665.44	8,031.85	8,630.07	9,233.50
Multi Housing Permits (units) ¹	1,742.00	1,226.74	1,128.72	1,615.87	1,521.74	1,588.99	1,760.50	1,986.59	2,176.91	2,462.60
Employment (000's)										
Retail Trade: General Merchandise and Apparel	8.724	8.794	8.941	9.203	9.439	9.630	9.810	9.998	10.192	10.413
Retail Trade: Food Stores	8.287	8.314	8.283	8.361	8.462	8.516	8.570	8.611	8.641	8.693
Retail Trade: Automotive and Service Stations	5.673	5.551	5.684	5.891	6.031	6.182	6.336	6.481	6.644	6.881
Retail Trade: Eating and Drinking Places	25.015	24.396	25.165	26.305	27.610	28.714	29.645	30.687	31.768	33.072
Retail other than SIC 5356,54,55,58	14.218	14.552	15.161	16.107	16.910	17.673	18.407	19.216	20.016	20.999
Services: Hotel and other Lodging Places	8.477	8.145	8.978	9.431	9.876	10.311	10.738	11.176	11.641	12.163
Services: Business Services	28.413	26.392	27.500	28.795	29.865	31.010	32.183	33.388	34.677	36.051
Services: Health Services	27.751	27.935	29.462	31.320	32.938	34.443	35.952	37.654	39.086	40.828
Services other than SIC 70,73,80	52.530	54.224	56.927	60.165	62.977	65.882	68.873	72.238	75.404	79.114
Construction	21.947	21.284	21.657	22.720	23.545	24.380	25.233	26.289	27.442	28.879
Communication and Public Utilities	3.653	3.848	3.978	3.983	3.960	4.013	4.017	4.035	4.037	4.111
Durable Manufacturing	28.786	27.907	28.319	29.007	29.387	29.745	30.208	30.791	31.492	32.342
Finance, Insurance and Real Estate	14.982	15.357	15.710	16.521	17.090	17.578	18.175	18.847	19.471	20.231
Total Mining	1.847	1.469	1.606	1.584	1.518	1.491	1.472	1.444	1.411	1.386
Nondurable Manufacturing	5.036	4.388	4.645	4.862	5.032	5.198	5.355	5.525	5.701	5.913
Transportation	7.939	7.257	7.464	7.716	7.801	7.868	7.966	8.423	8.700	9.067
Wholesale Trade	10.398	9.840	9.827	10.442	10.938	11.418	11.820	12.199	12.619	13.134
80% of State and Local Education ²	36.329	37.283	37.881	38.495	39.090	39.657	40.192	40.784	41.398	42.017
20% of State and Local Education ²	9.082	9.321	9.470	9.624	9.773	9.914	10.048	10.196	10.349	10.504
80% State and Local Non Education ²	18.166	18.248	18.795	19.486	20.045	20.516	21.006	21.592	22.125	22.750
20% State and Local Non Education ²	4.542	4.562	4.699	4.871	5.011	5.129	5.252	5.398	5.531	5.688
80% Federal Government (non-mil) ²	7.270	7.478	7.654	7.787	7.909	8.027	8.087	8.225	8.250	8.318
20% Federal Government (non-mil) ²	1.818	1.870	1.914	1.947	1.977	2.007	2.022	2.056	2.062	2.079

Note: 1. Annual Values calculated as cumulative change.

2. Allocated totals

Adjusted Projections Scenario 3

	1/1/11	1/1/12	1/1/13	1/1/14	1/1/15	1/1/16	1/1/17	1/1/18	1/1/19
Population and Housing									
Total Population (000)	1,078.300	1,107.453	1,141.150	1,161.355	1,182.359	1,203.791	1,225.675	1,247.851	1,270.319
New Population (000)	29.152	33.697	20.205	21.005	21.432	21.884	22.175	22.468	22.925
Single Housing Permits (units) ¹	10,156.26	11,616.28	6,926.78	7,128.85	7,226.36	7,313.29	7,358.94	7,416.50	7,491.46
Multi Housing Permits (units) ¹	2,761.24	3,286.43	2,000.03	2,134.60	2,214.50	2,311.58	2,382.03	2,443.89	2,551.75
Employment (000's)									
Retail Trade: General Merchandise and Apparel	10.663	10.921	11.052	11.244	11.454	11.667	11.879	12.086	12.291
Retail Trade: Food Stores	8.765	8.865	8.843	8.830	8.820	8.807	8.796	8.794	8.804
Retail Trade: Automotive and Service Stations	7.103	7.320	7.487	7.744	8.031	8.335	8.633	8.925	9.266
Retail Trade: Eating and Drinking Places	34.541	35.928	37.068	38.810	40.855	43.122	45.548	48.075	50.744
Retail other than SIC 5356,54,55,58	21.993	22.923	23.881	25.051	26.296	27.614	28.935	30.298	31.724
Services: Hotel and other Lodging Places	12.750	13.348	13.811	14.436	15.143	15.897	16.681	17.491	18.338
Services: Business Services	37.582	39.282	40.542	42.066	43.717	45.483	47.330	49.247	51.251
Services: Health Services	42.824	44.978	46.628	48.669	50.835	53.040	55.145	57.134	59.078
Services other than SIC 70,73,80	83.188	87.295	90.057	92.833	95.651	98.687	101.768	104.891	108.088
Construction	30.625	32.697	33.357	34.190	35.090	35.993	36.850	37.683	38.540
Communication and Public Utilities	4.239	4.525	4.470	4.405	4.335	4.267	4.215	4.173	4.122
Durable Manufacturing	33.361	34.631	35.137	35.639	36.103	36.545	37.009	37.476	37.986
Finance, Insurance and Real Estate	21.105	22.129	22.634	23.169	23.718	24.303	24.891	25.480	26.107
Total Mining	1.374	1.331	1.332	1.341	1.350	1.362	1.362	1.377	1.376
Nondurable Manufacturing	6.140	6.381	6.539	6.721	6.905	7.092	7.270	7.449	7.625
Transportation	9.525	10.192	10.388	10.522	10.666	10.816	10.980	11.161	11.340
Wholesale Trade	13.719	14.385	14.878	15.484	16.168	16.898	17.663	18.477	19.324
80% of State and Local Education ²	42.645	43.284	43.947	44.572	45.162	45.763	46.397	47.071	47.779
20% of State and Local Education ²	10.661	10.821	10.987	11.143	11.290	11.441	11.599	11.768	11.945
80% State and Local Non Education ²	23.394	23.920	24.293	24.794	25.290	25.817	26.308	26.733	27.247
20% State and Local Non Education ²	5.849	5.980	6.073	6.199	6.322	6.454	6.577	6.683	6.812
80% Federal Government (non-mil) ²	8.428	8.533	8.680	8.868	9.060	9.256	9.453	9.650	9.850
20% Federal Government (non-mil) ²	2.107	2.133	2.170	2.217	2.265	2.314	2.363	2.412	2.463

Note: 1. Annual Values calculated as cumulative change.

2. Allocated totals

Adjusted Projections Scenario 3

	1/1/20	1/1/21	1/1/22	1/1/23	1/1/24	1/1/25	1/1/26	1/1/27	Buildout
Population and Housing									
Total Population (000)	1,293.244	1,316.376	1,339.575	1,363.162	1,386.963	1,411.221	1,435.422	1,459.839	1,933.723
New Population (000)	23.132	23.199	23.587	23.801	24.258	24.201	24.417	24.631	449.253
Single Housing Permits (units) ¹	7,515.23	7,506.03	7,536.47	7,571.24	7,606.92	7,558.47	7,568.00	7,622.59	139,028.56
Multi Housing Permits (units) ¹	2,608.75	2,639.88	2,757.13	2,808.02	2,946.15	2,962.57	3,033.74	3,069.39	55,982.58
Employment (000's)									
Retail Trade: General Merchandise and Apparel	12.481	12.647	12.791	12.945	13.106	13.261	13.422	13.591	17.517
Retail Trade: Food Stores	8.809	8.807	8.804	8.797	8.792	8.785	8.779	8.778	11.314
Retail Trade: Automotive and Service Stations	9.589	9.870	10.165	10.466	10.828	11.156	11.493	11.857	15.281
Retail Trade: Eating and Drinking Places	53.462	56.035	58.595	61.320	64.278	67.229	70.357	73.757	95.060
Retail other than SIC 5356,54,55,58	33.093	34.297	35.512	36.906	38.323	39.708	41.271	42.915	55.310
Services: Hotel and other Lodging Places	19.188	19.980	20.723	21.524	22.388	23.255	24.177	25.186	32.460
Services: Business Services	53.296	55.270	57.275	59.181	61.147	62.996	64.868	66.714	85.982
Services: Health Services	61.012	63.374	66.140	68.624	71.377	73.883	76.402	78.933	101.730
Services other than SIC 70,73,80	111.313	114.553	117.863	121.208	124.587	127.890	131.072	134.338	173.137
Construction	39.375	40.146	40.928	41.705	42.522	43.259	43.976	44.693	57.601
Communication and Public Utilities	4.066	4.004	3.923	3.856	3.775	3.724	3.658	3.583	4.618
Durable Manufacturing	38.512	39.021	39.547	40.108	40.715	41.346	42.010	42.695	55.026
Finance, Insurance and Real Estate	26.733	27.351	28.001	28.649	29.309	29.951	30.581	31.227	40.246
Total Mining	1.385	1.409	1.404	1.413	1.422	1.416	1.443	1.462	1.462
Nondurable Manufacturing	7.787	7.925	8.057	8.205	8.346	8.482	8.630	8.780	11.316
Transportation	11.514	11.706	11.871	12.049	12.199	12.371	12.533	12.695	16.362
Wholesale Trade	20.143	20.881	21.608	22.429	23.260	24.198	25.102	26.050	33.574
80% of State and Local Education ²	48.500	48.995	49.465	49.890	50.281	50.616	51.006	51.257	71.115
20% of State and Local Education ²	12.125	12.249	12.366	12.472	12.570	12.654	12.751	12.814	17.779
80% State and Local Non Education ²	27.718	28.173	28.757	29.266	29.900	30.414	30.947	31.438	43.617
20% State and Local Non Education ²	6.929	7.043	7.189	7.317	7.475	7.603	7.737	7.859	10.904
80% Federal Government (non-mil) ²	10.049	10.244	10.441	10.635	10.804	10.952	11.044	11.139	15.454
20% Federal Government (non-mil) ²	2.512	2.561	2.610	2.659	2.701	2.738	2.761	2.785	3.864

Note: 1. Annual Values calculated as cumulative change.

2. Allocated totals

Adjusted Projections Scenario 3	Annualized Growth Rate					Overall Change		
	02-11	02-22	02-27	12-21	12-27	02-11	12-21	22-Buildout
Population and Housing								
Total Population (000)	2.2%	2.1%	2.0%	1.9%	1.9%	218.44	232.12	594.148
New Population (000)	7.0%	1.6%	1.5%	-3.5%	-2.1%	218.44	232.12	594.148
Single Housing Permits (units) ¹	6.0%	0.7%	0.6%	-4.2%	-2.8%	79,305.12	77,499.72	184,492.26
Multi Housing Permits (units) ¹	10.4%	4.1%	3.7%	-1.7%	-0.5%	18,229.89	24,573.44	73,559.57
Employment (000's)								
Retail Trade: General Merchandise and Apparel	2.2%	1.9%	1.8%	1.6%	1.5%	2.13	1.87	4.725
Retail Trade: Food Stores	0.6%	0.3%	0.2%	-0.1%	-0.1%	0.55	(0.06)	2.510
Retail Trade: Automotive and Service Stations	2.8%	3.1%	3.1%	3.3%	3.3%	1.77	2.84	5.117
Retail Trade: Eating and Drinking Places	3.9%	4.5%	4.5%	5.0%	4.9%	11.53	22.67	36.465
Retail other than SIC 5356,54,55,58	4.6%	4.6%	4.4%	4.5%	4.3%	8.37	12.59	19.798
Services: Hotel and other Lodging Places	5.1%	4.8%	4.6%	4.5%	4.3%	5.20	7.38	11.737
Services: Business Services	4.1%	4.0%	3.8%	3.8%	3.6%	12.89	17.99	28.706
Services: Health Services	4.9%	4.4%	4.2%	3.9%	3.8%	17.04	21.16	35.590
Services other than SIC 70,73,80	4.9%	4.0%	3.7%	3.0%	2.9%	33.07	30.57	55.274
Construction	4.4%	3.3%	3.0%	2.3%	2.1%	11.41	8.23	16.674
Communication and Public Utilities	1.6%	0.1%	-0.3%	-1.4%	-1.5%	0.68	(0.60)	0.695
Durable Manufacturing	2.2%	1.8%	1.7%	1.3%	1.4%	6.72	4.92	15.479
Finance, Insurance and Real Estate	3.7%	3.0%	2.9%	2.4%	2.3%	6.77	5.87	12.245
Total Mining	-1.0%	-0.2%	0.0%	0.5%	0.6%		0.07	0.058
Nondurable Manufacturing	3.8%	3.1%	2.8%	2.4%	2.2%	1.99	1.68	3.259
Transportation	3.5%	2.5%	2.3%	1.5%	1.5%	2.93	1.68	4.492
Wholesale Trade	3.9%	4.0%	4.0%	4.2%	4.0%	4.54	7.22	11.966
80% of State and Local Education ²	1.5%	1.4%	1.3%	1.3%	1.1%	6.00	6.18	21.650
20% of State and Local Education ²	1.5%	1.4%	1.3%	1.3%	1.1%	1.50	1.55	5.412
80% State and Local Non Education ²	2.7%	2.3%	2.2%	1.9%	1.8%	5.67	4.84	14.860
20% State and Local Non Education ²	2.7%	2.3%	2.2%	1.9%	1.8%	1.42	1.21	3.715
80% Federal Government (non-mil) ²	1.3%	1.7%	1.6%	2.0%	1.8%	1.05	1.91	5.014
20% Federal Government (non-mil) ²	1.3%	1.7%	1.6%	2.0%	1.8%	0.26	0.48	1.253

Note: 1. Annual Values calculated as cumulative change.

2. Allocated totals

Economic Forecasting Models at The University of Arizona

Marshall J. Vest
Forecasting Project Director

The Forecasting Project
Economic and Business Research Program
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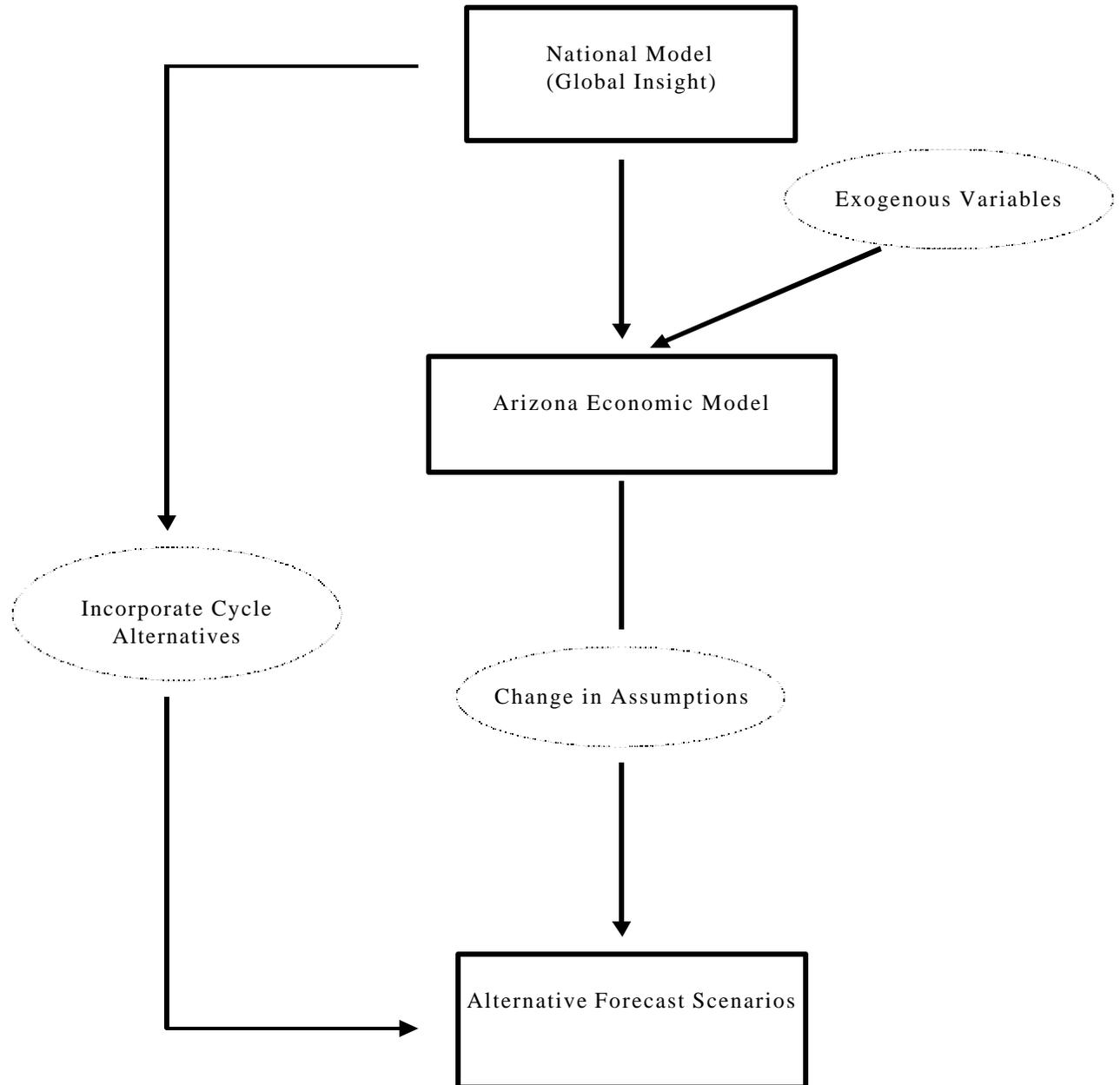


The Arizona Economic Model

- The model was originally developed in the late 1970's on the University of Arizona's mainframe computer. Over the years, the Forecasting Project at the UA Economic and Business Research Program (EBR) has re-built/re-specified the model and it currently resides on a personal computer in AREMOS[®] -- a software package provided by Global Insight, a national economic consulting and forecasting company. To reflect the latest available data, the Forecasting Project reviews and re-estimates the equations in the model at least once a year.
- Given its size relative to the U.S., Arizona has very little or no effect on national variables. Employment levels, wage rates and interest rates, for instance, are completely unaffected by local variables. Hence, U.S. data is used in this model with no feedback to the U.S. model (Exhibit 1).
- Equations are specified for the major economic indicators: employment, personal income, population, retail sales, housing permits, etc. Major employment sectors are: construction; fire, insurance & real estate (FIRE); government; manufacturing; mining; services; trade; and transportation, communications, & public utilities (TCPU).
- Much work has been done related to the theoretical underpinnings of this regional model by various researchers, notably Dr. Alberta Charney¹. The general specifications for the employment equations, for instance, are based on derived-demand for labor. As such, employment equations often include indicators of demand.
- As defined in AREMOS[®], the Arizona Economic Model is a simultaneous-equation model using quarterly data. The model consists of 100+ equations -- two-thirds of which are stochastic equations and the rest are identities. For the most part, the stochastic equations are estimated using Ordinary Least Squares (OLS). One exception is the use of a distributed lag structure in the equation for housing permits.
- Models for the metro Tucson and Phoenix areas follow the same format as described here, except that they are based on annual-frequency data, rather than quarterly. The Phoenix-Mesa model looks like the state model, as it should, since it comprises roughly two-thirds of state totals. Equations for individual sectors are structured similarly in both models. The metro Tucson model, in contrast, is much different, reflecting on its unique industrial structure.
- Using the Tarjan ordering algorithm, the equations are assigned to three basic blocks in the model. Block 1 consists of those equations with solely predetermined variables. Block 2 is the simultaneous block, which may take 8-to-30 iterations to achieve convergence using the Gauss-Seidel algorithm. Block 3 is the post-recursive block and mainly consists of identities. A listing of variables in each block is shown on page 5. The Tarjan algorithm creates this listing when the model is compiled.

¹ Charney, A.H., and Taylor, C.A. (1986) "Integrated State-Substate Econometric Modeling: Design and Utilization for Long-Run Economic Analysis." In Perryman, M.R., and Schmidt, J.R. (eds.) *Regional Econometric Modeling*. Kluwer/Nijhoff Publishing, pp. 43-92.

► **Exhibit 1: Schematic Representation of the Arizona Economic Model**



► Data Description

- The Arizona Economic Model is based on quarterly data.
- Most of the national data, both historical and forecasts, are provided by Global Insight.
- State and local historical data are collected from various sources such as: Bureau of Economic Analysis (BEA), Arizona Department of Economic Security (DES), US Census Bureau, etc. All documentation, regarding the source or transformation, is stored with the series in the AREMOS data banks.
- While income data is received from the issuing agency already seasonally adjusted, almost all other data is reported as unadjusted raw data. The unadjusted monthly data is seasonally adjusted using the Census Bureau's X-11 adjustment procedure provided in AREMOS. The monthly adjusted data is then converted to quarterly data and given the extension SAQ (for Seasonally Adjusted Quarterly).
- While we use the most recent data for most endogenous variables, there are some variables that we choose to truncate since current estimates are often unreliable and subject to substantial revision. For these variables, we have found our model estimates to be more accurate than published "actuals". For all categories of employment and wage rate data, we only consider data up to and including the last benchmark quarter. That is, we allow the model to estimate the next one-to-eight quarters of employment data. For instance, given a benchmark date of 2001q1, only published data through 2001q1 is used in the model. The model is used to estimate employment data from 2001q2 through 2002q2. Needless to say, this process creates a discrepancy between the official DES employment figures and the Forecasting Project's estimates for the last few quarters. This procedure has consistently produced more accurate current estimates than the "official" published numbers.
- Personal income, likewise, is estimated by the model for recent periods, and therefore varies from BEA published estimates.

► Arizona Economic Model Compilation

The following shows measures forecast by the Arizona model.

Block 1

US_FSWPRIV	EMPDUROTH@@	BR	BIRTHS
DEATHS	EMP32	CPIUWEST	EMP55
EMPRTRADOTH	WRGOVFMIL	WSGOVFMIL	WRGOVFCIV
WRGOVSL	DISC	EMPNCOP	

Block has 15 equations 0 simultaneous

86 temporary 0 simultaneous

Block 2

POPEND	POP	EMPFGOV	EMPED
EMPSLINED	EMPSL	EMPGOV	EMPPRIV
FSWPRIV	WRMAN	EMPAIR	EMP33
FSWCS	WRCON	EMP3536	EMPCON
EMP34	EMP24	EMP3334	EMPDUR
EMP20	WSMIN	WSMAN	WSCON
WRTCPU	EMPTRAN	EMPTCPU	*EMPCPU
WSTCPU	EMP5356	EMP54	TXS_RB11
EMP58	EMPRTRADE	EMPFIRE	EMP70
WRSERV	EMP80	EMPSERVOTH	EMP73
*EMPSERV	TXS_RS17LF	EMPWTRADE	*EMPCS
WRFIRE	WRRTRADE	WRWTRADE	WSFIRE
WSSERV	WSRTRADE	WSWTRADE	WSGOVFCIV
WSGOV	*WSGOVSL	WSSUM	WS
*YOTHLI	*YPRAZ	YTLP	YTP
YDIVINTRENT	YRESADJ	YPCSI	YPAZ
*YDAZ	EMPNDUROTH	EMP27	EMPTRADE
EMPNDUR	*EMPMAN	FSWNMAN	*WRMIN
EMPCOP	*EMPMIN	*EMPWS	*NETMIG

Block has 76 equations 12 simultaneous

38 temporary 5 simultaneous

Block 3

HUTOT	WRSUM	EMPMINN	PGAS
GAS	HU1	HU2&	HUMF
TXS_FOODM4	TXS_FOOD	TXS_RETAIL	UNRSA

Block has 12 equations 0 simultaneous

27 temporary 0 simultaneous

Model has 103 equations 12 simultaneous

151 temporary 5 simultaneous

► **Data Documentation: Endogenous Variables in the Arizona Economic Model**

BIRTHS 195501 200104

Arizona - Resident Births (000)

Seasonally Adjusted by E.B.R.

BR 195501 200102

Arizona - Resident Birth Rate

births/pop*4000

CPIUWEST 196001 200104

United States - Western Region Consumer Price Index for all Urban Consumers:

All Items, End of Quarter, Index 1982-84=1

U.S. Department of Labor, Bureau of Labor Statistics

DEATHS 195501 200104

Arizona - Resident Deaths (000)

Seasonally Adjusted by E.B.R.

DISC 194804 200004

$(ypaz - MOVAVG(4,tnt_tot)) / ypaz$

EMP20 194901 200104

Arizona Employment - NonDurable Manufacturing: Food and Kindred Products (000)

D.E.S. 790, Seasonally Adjusted by E.B.R.

EMP24 194901 200104

Arizona Employment - Durable Manufacturing: Lumber and Wood Products except Furniture (000)

D.E.S. 790, Seasonally Adjusted by E.B.R.

EMP27 194901 200104

Arizona Employment - NonDurable Manufacturing: Printing and Publishing (000)

D.E.S. 790, Seasonally Adjusted by E.B.R.

EMP32 196201 200104

Arizona Employment - Durable Manufacturing: Stone, Clay and Glass (000)
D.E.S. 790, Seasonally Adjusted by E.B.R.

EMP33 194901 200104

Arizona Employment - Durable Manufacturing: Primary Metals (000)
D.E.S. 790, Seasonally Adjusted by E.B.R.

EMP3334 196201 200104

Arizona Employment - Durable Manufacturing: Primary and Fabr. Metals (000)
D.E.S. 790, Seasonally Adjusted by E.B.R.
emp33+emp34

EMP34 196201 200104

Arizona Employment - Durable Manufacturing: Fabricated Metals (000)
D.E.S. 790, Seasonally Adjusted by E.B.R.

EMP3536 195201 200104

Arizona Employment - Durable Manufacturing: Machinery (000)
D.E.S. 790, Seasonally Adjusted by E.B.R.

EMP5356 194901 200104

Arizona Employment - Retail Trade: General Merchandise and Apparel (000)
D.E.S. 790, Seasonally Adjusted by E.B.R.

EMP54 194901 200104

Arizona Employment - Retail Trade: Food Stores (000)
D.E.S. 790, Seasonally Adjusted by E.B.R.

EMP55 194901 200104

Arizona Employment - Retail Trade: Automotive and Service Stations (000)
D.E.S. 790, Seasonally Adjusted by E.B.R.

EMP58 194901 200104

Arizona Employment - Retail Trade: Eating and Drinking Places (000)
D.E.S. 790, Seasonally Adjusted by E.B.R.

EMP70 194901 200104

Arizona Employment - Services: Hotels and Other Lodging Places (000)
D.E.S. 790, Seasonally Adjusted by E.B.R.

EMP73 196601 200104

Arizona Employment - Services: Business Services (000)
D.E.S. 790, Seasonally Adjusted by E.B.R.
Series was adjusted prior to 1988 to reflect changes in 1987 SIC codes using data from County Business Patterns. 7391 and 7392 were moved from 73 into 87 (considered a part of SERVOTH in our data bases). Variable EMP7391921 (a lagrangian interpolation of CBPs annual estimates) was subtracted from EMP73@. Prior to 1970, estimates are based on UI monthly data

EMP80 196401 200104

Arizona Employment - Services: Health Services (000)
D.E.S. 790, Seasonally Adjusted by E.B.R.

EMPAIR 197001 200104

Arizona Employment - Durable Manufacturing: Aircrafts and Missiles (000)
D.E.S. 790, Seasonally Adjusted by E.B.R.

EMPCON 194701 200104

Arizona Employment - Construction (000)
D.E.S. 790, Seasonally Adjusted by E.B.R.

EMPCOP 194901 200104

Arizona Employment - Copper Mining (000)
D.E.S. 790, Seasonally Adjusted by E.B.R.

EMPCPU 194901 200104

Arizona Employment - Comm. & Public Utilities including Salt River Project (000)
Seasonally Adjusted by E.B.R.

EMPCS 194901 200104
Arizona Employment - Commercial Sector (000)
Seasonally Adjusted by E.B.R.
empcon+empfire+empTrade+empserv+empwTrade

EMPDUR 196401 200104
Arizona Employment - Durable Manufacturing (000)
Seasonally Adjusted by E.B.R.

EMPDUROTH@@ 197001 200104
Arizona Employment - (000)
Seasonally Adjusted by E.B.R.
EMPDUROTH-EMP24-EMPAIR

EMPED 195401 200104
Arizona Employment - State and Local Government: Schools (000)
D.E.S. 790, Seasonally Adjusted by E.B.R.

EMPFGOV 194901 200104
Arizona Employment - Federal Government excluding Federal Military (000)
D.E.S. 790, Seasonally Adjusted by E.B.R.

EMPFIRE 194701 200104
Arizona Employment - Finance, Insurance and Real Estate (000)
D.E.S. 790, Seasonally Adjusted by E.B.R.

EMPGOV 194701 200104
Arizona Employment - Government (000)
Seasonally Adjusted by E.B.R.

EMPMAN 194701 200104
Arizona Employment - Manufacturing (000)
D.E.S. 790, Seasonally Adjusted by E.B.R.

EMPMIN 194901 200104

Arizona Employment - Mining (000)

Seasonally Adjusted by E.B.R.

EMPMINN 195001 200104

Arizona Employment - Estimated Normal Mining (000)

Seasonally Adjusted by E.B.R.

empcop+empncop+strikers

EMPNCOP 194901 200104

Arizona Employment - Mining and Quarrying other than Copper (000)

Seasonally Adjusted by E.B.R.

empmin-empcop

EMPNDUR 196401 200104

Arizona Employment - NonDurable Manufacturing (000)

D.E.S. 790, Seasonally Adjusted by E.B.R.

EMPNDUROTH 196401 200104

Arizona Employment - Other NonDurable, not in SIC 20,27 (000)

Seasonally Adjusted by E.B.R.

EMPNDUR-EMP20-EMP27

EMPPRIV 194901 200104

Arizona Employment - Private Sector (000)

Seasonally Adjusted by E.B.R.

empws-empsl-empgov

EMPRTRADE 194901 200104

Arizona Employment - Retail Trade (000)

Seasonally Adjusted by E.B.R.

EMPRTRADOTH 194901 200104

Arizona Employment - Other Retail Trade, not in SIC 5356,54,55,58 (000)

Seasonally Adjusted by E.B.R.

EMPRTrade-EMP5356-EMP54-EMP55-EMP58

EMPSERV 194701 200104

Arizona Employment - Services (000)

D.E.S. 790, Seasonally Adjusted by E.B.R.

EMPSERVOTH 196601 200104

Arizona Employment - Other Services, not in SIC 70,73,80 (000)

Seasonally Adjusted by E.B.R.

EMPSERV-EMP70-EMP73-EMP80

EMPSL 194901 200104

Arizona Employment - State and Local Government (000)

D.E.S. 790, Seasonally Adjusted by E.B.R.

EMPSLNED 195401 200104

Arizona Employment - State and Local Government: Non Education (000)

D.E.S. 790, Seasonally Adjusted by E.B.R.

empsl-emped

EMPTCPU 194701 200104

Arizona Employment - Transportation, Communications and Public Utilities (000)

D.E.S. 790, Seasonally Adjusted by E.B.R.

EMPTRADE 194701 200104

Arizona Employment - Trade (000)

D.E.S. 790, Seasonally Adjusted by E.B.R.

EMPTRAN 194901 200104

Arizona Employment - Transportation (000)

Seasonally Adjusted by E.B.R.

EMPWS 194901 200104

Arizona Employment - Total Wage and Salary (000)

Seasonally Adjusted by E.B.R.

$empcop+empncop+empcon+empman+emptcpu+empTrade+empfire+empserv+empsl+empfgov$

EMPWTRADE 194901 200104

Arizona Employment - Wholesale Trade (000)

D.E.S. 790, Seasonally Adjusted by E.B.R.

FSWCS 194901 200103

Fixed Sector-Weights Wage Rate, Commercial, AZ

$(0.116*WRCON)+(0.101*WRFIRE)+(0.321*WRRTRADE)+(0.382*WRSERV)+(0.081*WRWTRADE)$

FSWNMAN 194901 200103

Fixed Sector-Weights Wage Rate, Non-manufacturing, AZ

$(0.105*WRCON)+(0.091*WRFIRE)+(0.021*WRMIN)+(0.289*WRRTRADE)+(0.345*WRSERV)+(0.077*WR$
 $TCPU)+(0.073*WRWTRADE)$

FSWPRIV 194901 200103

Fixed Sector-Weights Wage Rate, Private, AZ

$(0.087*WRCON)+(0.075*WRFIRE)+(0.170*WRMAN)+(0.017*WRMIN)+(0.240*WRRTRADE)+(0.287*WR$
 $SERV)+(0.064*WRTCPU)+(0.060*WRWTRADE)$

GAS 196001 200104

Arizona - Gasoline Sales (000s of gallons)

Arizona Dept. of Transportation, M.V.D., Taxable Acquisitions and Refunds

Seasonally Adjusted by E.B.R.

HU1 196903 200104

Arizona - Housing Units Authorized By Building Permits: Single Units

US Dept. of Commerce, Bureau of the Census, C_40 Construction Reports

Seasonally Adjusted by E.B.R.

HU2& 196903 200104

Arizona - Housing Units Authorized By Building Permits: Multi-Family Units
US Dept. of Commerce, Bureau of the Census, C_40 Construction Reports
Seasonally Adjusted by E.B.R.
HUTOT-HU1

HUMF 196903 200104

Arizona - Housing Units Authorized By Building Permits: Multi-Family Units
US Dept. of Commerce, Bureau of the Census, C_40 Construction Reports
Seasonally Adjusted by E.B.R.
HU2&

HUTOT 195901 200104

Arizona - Housing Units Authorized By Building Permits: Total
US Dept. of Commerce, Bureau of the Census, C_40 Construction Reports
Seasonally Adjusted by E.B.R.

NETMIG 195501 200102

Arizona - Net Migration (000)
(popend-popend[-1])-(births-deaths)

PGAS 196301 200104

Arizona - Phoenix Price of Gas: Regular Unleaded, Retail, Self-Service incl. Taxes (\$/GAL)
Lundberg Survey Incorporated, Bimonthly Survey
Seasonally Adjusted by E.B.R.

POP 195103 200102

ARIZONA - MIDDLE OF THE QUARTER POPULATION ESTIMATES (000)
MOVAVG(2,POPEND)

POPEND 195102 200102

Arizona Population at the end of quarter (000)
Source: Quarterly estimates by EBR from annual data. Annual data from DES to 1979, ASU from 79 to 89, DES from 90 to present
popt:popend

TXS_FOOD 196001 199904

ARIZONA - Taxable Sales: Food (\$ millions)

The tax on food was repealed in 1985.

EBR estimates base on 5 years (80:7 85:6) of actual data

TXS_FOODM4 196001 199904

ARIZONA - Four Period Moving Average of Food Sales (\$ millions)

Updated with data from Marshall Vest quarterly forecasts.

TXS_RB11 196001 200104

Arizona - Taxable Sales: Restaurants and Bars *ACCRUAL* (\$ MILL)

Seasonally Adjusted by E.B.R.

TXS_RETAIL 196301 199904

Arizona - Taxable Sales: Total Retail (Restaurants and Bars, Gasoline and Retail (\$ MILL)

Seasonally Adjusted by E.B.R.

$txs_rs17lf+txs_foodm4+txs_rb11+(pgas*gas/1000)$

TXS_RS17LF 196001 200104

Arizona - Taxable Sales: Retail excluding food (\$ MILL)

Seasonally Adjusted by E.B.R.

UNRSA 196201 200104

ARIZONA UNEMPLOYMENT RATE **SEASONALLY ADJUSTED**

Arizona Dept of Economic Security

US_FSWPRIV 194801 200704

United States - Fixed Sector-Weights Wage Rate, Private Sector

$(0.170*WDMFG.q/EMEMFG.q)+(0.726*WDPSP.q/(EMEFIR.q+EMESER.q+EMETPU.q+EMEWRT.q))+(0.104*WDCPIOTH.q/(EMEMIN.q+EMECON.q))$

WRCON 194801 200103

Arizona: Wage Rate in Construction, Annual Rate

$1000*wscon/empcon$

WRFIRE 194801 200103

Arizona: Wage Rate in FIRE, Annual Rate

$1000 * \text{wsfire} / \text{empfire}$

WRGOVCIV 194901 200103

Arizona: Wage Rate in Government, Federal Civilian, Annual Rate

$1000 * \text{wsgovfciv} / \text{empfgov}$

WRGOVMIL 196901 200103

Arizona: Wage Rate in Government, Federal Military, Annual Rate

$1000 * \text{wsgovfmil} / \text{embgovfmil}$

WRGOVSL 194901 200103

Arizona: Wage Rate in Government, State & Local, Annual Rate

$1000 * \text{wsgovsl} / \text{empsl}$

WRMAN 194801 200103

Arizona: Wage Rate in Manufacturing, Annual Rate

$1000 * \text{wsman} / \text{empman}$

WRMIN 194901 200103

Arizona: Wage Rate in Mining, Annual Rate

$1000 * \text{wsmin} / \text{empmin}$

WRRTRADE 194901 200103

Arizona: Wage Rate in Retail Trade, Annual Rate

$1000 * \text{wsrtrade} / \text{emptrade}$

WRSERV 194801 200103

Arizona: Wage Rate in Services, Annual Rate

$1000 * \text{wsserv} / \text{empserv}$

WRSUM 194901 200103

Civilian Nonag Wage Rate, Annual Rate

$1000 * \text{wssum} / \text{empws}$

WRTCPU 194801 200103

Arizona: Wage Rate in Trans., Comm. & Publ. Utilities, Annual Rate
1000*wstcpu/emptcpu

WRWTRADE 194901 200103

Arizona: Wage Rate in Wholesale Trade, Annual Rate
1000*wswtrade/empwtrade

WS 194801 200103

ARIZONA WAGES AND SALARIES: TOTAL (MILL\$) S.A.A.R.
B.E.A. TABLE SQ7 - OLD TABLE 2

WSCON 194801 200103

ARIZONA WAGES AND SALARIES: CONSTRUCTION (MILL\$) S.A.A.R.
B.E.A. TABLE SQ7 - OLD TABLE 2

WSFIRE 194801 200103

ARIZONA WAGES AND SALARIES: FIN.INS.AND REAL ESTATE (MILL\$) S.A.A.R.
B.E.A. TABLE SQ7 - OLD TABLE 2

WSGOV 194801 200103

ARIZONA WAGES AND SALARIES: GOVERNMENT (MILL\$) S.A.A.R.
B.E.A. TABLE SQ7 - OLD TABLE 2

WSGOVFCIV 194801 200103

ARIZONA WAGES AND SALARIES: FEDERAL CIVILIAN (MILL\$) S.A.A.R.
B.E.A. TABLE SQ7 - OLD TABLE 2

WSGOVMIL 194801 200103

ARIZONA WAGES AND SALARIES: MILITARY (MILL\$) S.A.A.R.
B.E.A. TABLE SQ7 - OLD TABLE 2

WSGOVSL 194801 200103

ARIZONA WAGES AND SALARIES: STATE AND LOCAL GOVT. (MILL\$) S.A.A.R.
B.E.A. TABLE SQ7 - OLD TABLE 2

WSMAN 194801 200103

ARIZONA WAGES AND SALARIES: MANUFACTURING (MILL\$) S.A.A.R.
B.E.A. TABLE SQ7 - OLD TABLE 2

WSMIN 194801 200103

ARIZONA WAGES AND SALARIES: MINING (MILL\$) S.A.A.R.
B.E.A. TABLE SQ7 - OLD TABLE 2

WSRTRADE 194801 200103

ARIZONA WAGES AND SALARIES: RETAIL TRADE (MILL\$) S.A.A.R.
B.E.A. TABLE SQ7 - OLD TABLE 2

WSSERV 194801 200103

ARIZONA WAGES AND SALARIES: SERVICES (MILL\$) S.A.A.R.
B.E.A. TABLE SQ7 - OLD TABLE 2

WSSUM 194801 200103

Wage & Salary Disbursements less 3 Components
 $wsmmin+wsmmand+wsmmand+wscon+wstcpu+wsrtrade+wsrtrade+wsfire+wsserv+wsgov$

WSTCPU 194801 200103

ARIZONA WAGES AND SALARIES: TRANSP.COMM.AND PUB.UT.(MILL\$) S.A.A.R.
B.E.A. TABLE SQ7 - OLD TABLE 2

WSWTRADE 194801 200103

ARIZONA WAGES AND SALARIES: WHOLESALE TRADE (MILL\$) S.A.A.R.
B.E.A. TABLE SQ7 - OLD TABLE 2

YDAZ 194804 200004

ARIZONA - DISPOSABLE PERSONAL INCOME (\$ MILLIONS)
 $ypaz * ((ypaz-MOVAVG(4,tnt_tot))/ypaz)$

YDIVINTRENT 194801 200103

ARIZONA - DIVIDENDS, INTEREST AND RENT, S.A.A.R. (\$ MILLIONS)
B.E.A., TABLE SQ5 (OLD TABLE 2A)

YOTHLI 194801 200103

ARIZONA - OTHER LABOR INCOME, S.A.A.R. (\$ MILLIONS)
B.E.A., TABLE SQ5 (OLD TABLE 2A)

YPAZ 194801 200103

ARIZONA - TOTAL PERSONAL INCOME, S.A.A.R. (\$ MILLIONS)
B.E.A., TABLE SQ5 (OLD TABLE 2A)

YPCSI 194801 200103

ARIZONA - PERSONAL CONTRIBUTIONS FOR SOCIAL INSURANCE, S.A.A.R. (\$ MILLIONS)
B.E.A., TABLE SQ5 (OLD TABLE 2A)

YPAZ 194801 200103

ARIZONA - TOTAL PROPRIETORS INCOME, S.A.A.R. (\$ MILLIONS)
B.E.A., TABLE SQ5 (OLD TABLE 2A)

YRESADJ 194801 200103

ARIZONA - ADJUSTMENT FOR RESIDENCE, S.A.A.R. (\$ MILLIONS)
B.E.A., TABLE SQ5 (OLD TABLE 2A)

YTLP 194801 200103

ARIZONA - TOTAL LABOR AND PROPRIETORS INCOME, S.A.A.R. (\$ MILLIONS)
B.E.A., TABLE SQ5 (OLD TABLE 2A)

YTP 194801 200103

ARIZONA - TRANSFER PAYMENTS, S.A.A.R. (\$ MILLIONS)
B.E.A., TABLE SQ5 (OLD TABLE 2A)

Appendix C Land Absorption Scenarios

The land absorption model represents the interactions of the spatial GIS suitability model and the economic projections model.

Land Use Categories The land absorption model was developed to simulate the development patterns outside the built environment¹ at a ten and twenty year timeframe as well as at buildout.² This simulation utilized seven consolidated land use categories (see the table below) to allocate all expected growth outside the built environment. The use of a limited number of categories was necessitated due the magnitude of the land area being studied and the various municipalities and unincorporated county areas within the study.

Consolidated Model Land Use Categories

Category	Description
LDR	Represents residential uses of relatively low densities. Existing categories in the jurisdictions were placed here where density is less than 3 RAC. ¹
HDR	Represents residential uses of higher densities. All jurisdictional categories with densities of 3 RAC or above were classified here.
COM	Non-industrial commercial uses.
IND	Industrial uses.
OS	The urban open space classification included park land and golf courses.
NR	This classification was applied to zoning that allows non-residential uses that fall into more than one of our categories (such as commercial or industrial). Our GIS land absorption model evaluated this land for relative suitability across these uses.
ANY	This classification was applied to zoning that allows any / multiple uses that fall into residential and non-residential categories (such as PAD or specific area plans). Our GIS land absorption model evaluated this land for relative suitability across these uses.

Note: 1. Residences per Acre

Development Inside and Outside the Built Environment The built environment was isolated from the GIS modeling procedure for reasons of computing processing time and the timeframe to complete the project. Development inside of that constraint was not mapped, but remained an important factor to account for in conceptualizing overall

¹ The built environment includes all parcels within the current sewer service area, as well as all other parcels that are either occupied or have improvements with values of more than \$10,000.

² The concept of buildout of a large, multi-jurisdictional area like Eastern Pima County is nonsensical, since the market will continue to identify redevelopment opportunities in perpetuity even if/after all vacant land has been developed. Here this concept is applied to mean the maximum theoretical population and municipal development possible given existing water rights.

land absorption in Eastern Pima County. This section details how projected land absorption was allocated inside or outside of the built environment.

Employment and population projections used are non-georeferenced, but rather refer to the projected level of activity throughout Eastern Pima County.³ It should be noted that the study team examined sub-county projections developed by the Pima Association of Governments (PAG) but decided against using them for a number of reasons. Primarily, the political aspect of allocating employment and population within various jurisdictions and areas of the county was judged to be too detrimental to the purpose of our analysis. Our goals were 1) to model likely development patterns spatially and 2) to understand how changes to spatial and economic assumptions (in relation to obtaining a Section 10 Permit by the county) would change the level, character, and location of development in Eastern Pima County. Of particular concern was outside of the built environment where the impacts to species habitats, agricultural and ranching land, and State Land would be the most substantial.

An analysis of recent (1998 to 2001 construction year) new development was used to determine the allocation of development inside and outside the built environment for the first ten years.⁴ The following adjustments were made to the data. First, the urban parks and open space category was assumed to be equal to LDR in all cases, since it is not **overall** parks and preserves activity that this measure was intended to capture, but rather urban parks and golf courses. Second, industrial and HDR shares were adjusted slightly based on our judgment and conversations with the staff at the assessor's office, to compensate for developments that are in fact the impetus **for** and/or congruent with expansions of the sewer service area.

Within the existing sewer service area⁵ there are still approximately 102 square miles of vacant land. The majority of this land is likely to be developed at some point in the future. Our visual examination of a map of this land indicated that not all of the vacant land was suitable for development; some appeared to be roads and other undevelopable thin land masses. In the interest of a conservative estimate, 80 percent of the 102 square miles was assumed to be potentially developable. This figure was used as an aggregate constraint for the level of total development

³ Technically all of Pima County, but operating under the assumption that incremental changes take place entirely in Eastern Pima County.

⁴ This analysis was conducted using Pima County Assessor data and use codes. Residential types were classified into LDR and HDR categories by parcel size and quantified by units built. Industrial types by use codes ranging from 30** to 37** and commercial types were all other use codes from the commercial building database excluding exempt properties (use codes 9***) and vacant/residential/special classifications (use codes 00** through 03**) analyzed by area.

⁵ Which is a subset of the built environment.

activity inside the existing sewer service area. After ten years of development the ratio for each development type was adjusted upward, subject to the constraint of **remaining** available land and a maximum of 83 percent of a development category taking place outside the built environment. After twenty years (through buildout) the remaining vacant land (to the 80 percent constraint) was assumed to be filled and the remainder of development to take place outside the built environment (approximately 99 percent optimized to fit the constraint).

The percentage of development by type and timeframe taking place outside of the built environment is shown on the following table.

Percentage of Total New Development to Take Place Outside the Built Environment by Type, Scenario, and Timeframe				
		First 10	Second 10	Through
		Years¹	Years²	Buildout³
Scenario 1	LDR	25.5%	53.4%	99.6%
	HDR	10.0%	20.9%	99.6%
	Urban Park / Golf Course	25.5%	53.4%	99.6%
	Commercial	57.7%	83.0%	99.6%
	Industrial	9.3%	19.5%	99.6%
Scenario 2	LDR	25.5%	83.0%	98.2%
	HDR	10.0%	35.2%	98.2%
	Urban Park / Golf Course	25.5%	83.0%	98.2%
	Commercial	57.7%	83.0%	98.2%
	Industrial	9.3%	32.8%	98.2%
Scenario 3	LDR	25.5%	83.0%	98.2%
	HDR	10.0%	35.2%	98.2%
	Urban Park / Golf Course	25.5%	83.0%	98.9%
	Commercial	57.7%	83.0%	98.9%
	Industrial	9.3%	32.8%	98.2%

- Note: 1. Percentages of new development activity (including infill) within the built environment by category were calculated based on recent (construction year 1998-2001) share of activity outside of the built environment. Adjustments were made for urban park / golf course (set equal to LDR development), HDR (assumed at 10 percent) and Industrial (three times derived calculation) based on conversations with Pima County Assessor's Office staff.
2. Percentages increased proportionately based on vacant land remaining (capped at a maximum of 83 percent of all development outside the built environment).
3. Percentages calculated to set our rough calculation of vacant land inside the built environment to 80 percent occupied, with the remainder occurring outside the built environment.

Source: Pima County Assessor, ESI Corporation

Spatial Allocation Model

The allocations between the development occurring inside and outside the built environment were calculated from total land demand less the share allocated inside the existing sewer service area. The demand for land outside the built environment was allocated using the following steps:

1. Allocation of economic model – Projected new housing and employment from the economic model were classified between the first five of the seven consolidated land use categories presented in the preceding table.
2. Allocation of zoning – The current zoning of all political jurisdictions (Pima County, and the cities of Marana, Oro Valley, Sahuarita, and Tucson) outside of the built environment was classified between the seven consolidated land use categories (the same five as the economic projections used as well as two additional categories which captured the flexibility to allow multiple development types).
3. Combination of economic model and zoning allocations – The five categories used for the economic model were then allocated among the seven categories used for zoning to arrive at the final spatial allocation of development. The “siting” of new development in each land use category began with the land most suitable for that development type.

Land Absorption by Industry - Scenario 1

Industry	SF per Employee	Consolidated Land Use	Total New S.F. (000)			Total New Acres ¹		
			02-11	12-21	22-Buildout	02-11	12-21	22-Buildout
General Merchandise and Apparel	442	Com	674.49	781.01	2,630.13	44.24	51.23	172.51
Food Stores	543	Com	34.21	(31.49)	1,808.74	2.24	(2.07)	118.64
Automotive and Service Stations	699	Com	954.83	1,878.91	4,285.29	62.63	123.24	281.08
Eating and Drinking Places	538	Com	5,140.05	11,523.42	22,874.60	337.14	755.83	1,500.37
Retail other than SIC 5356,54,55,58	478	Com	3,398.10	5,686.29	11,184.33	222.88	372.97	733.59
Hotel and other Lodging	1100	Com	4,792.70	7,598.80	15,093.41	314.36	498.41	989.99
Business Services	350	Com	3,640.35	5,898.55	11,939.64	238.77	386.89	783.13
Health Services	358	Com	5,081.09	7,095.92	14,994.60	333.27	465.43	983.51
Services other than SIC 70,73,80	350	Com	9,638.65	10,020.85	23,212.89	632.21	657.28	1,522.56
Construction	112	Com	618.58	755.78	2,005.62	40.57	49.57	131.55
TCPU	201	Ind	299.69	185.32	1,216.13	19.66	12.16	79.77
Durable Manufacturing	448	Ind	1,658.94	2,010.18	8,348.44	108.81	131.85	547.58
FIRE	350	Com	1,649.90	1,864.10	5,033.56	108.22	122.27	330.16
Nondurable Manufacturing	448	Ind	643.33	685.44	1,747.81	42.20	44.96	114.64
Wholesale Trade	784	Ind	2,335.54	5,046.61	10,465.31	153.19	331.01	686.43
80% of State and Local Education	969	HDR	5,536.48	5,949.66	21,680.36	363.14	390.24	1,422.04
20% of State and Local Education	969	LDR	1,384.12	1,487.42	5,420.09	90.79	97.56	355.51
80% State and Local Non Education	400	Com	2,205.44	1,921.60	6,117.64	144.66	126.04	401.26
20% State and Local Non Education	400	Ind	551.36	480.40	1,529.41	36.16	31.51	100.32
80% Federal Government (non-mil) ²	400	Com	399.04	758.08	2,067.56	26.17	49.72	135.61
20% Federal Government (non-mil) ²	400	Ind	99.76	189.52	516.89	6.54	12.43	33.90

Note: 1. Assumes floor to area ratio (FAR) of .35 for all development types.

Note: 2. Assumes no new military bases. Mining also not included in land use model.

Land Absorption by Industry - Scenario 2

Industry	SF per Employee	Consolidated Land Use	Total New S.F. (000)			Total New Acres ¹		
			02-11	12-21	22-Buildout	02-11	12-21	22-Buildout
General Merchandise and Apparel	442	Com	940.22	826.51	2,088.64	61.67	54.21	137.00
Food Stores	543	Com	299.20	(33.33)	1,362.89	19.62	(2.19)	89.39
Automotive and Service Stations	699	Com	1,236.50	1,988.37	3,576.50	81.10	130.42	234.59
Eating and Drinking Places	538	Com	6,204.10	12,194.73	19,618.29	406.93	799.86	1,286.78
Retail other than SIC 5356,54,55,58	478	Com	4,001.28	6,017.55	9,463.63	262.45	394.70	620.73
Hotel and other Lodging	1100	Com	5,723.11	8,112.90	12,910.71	375.38	532.13	846.83
Business Services	350	Com	4,511.58	6,297.62	10,047.18	295.92	413.07	659.00
Health Services	358	Com	6,101.46	7,575.99	12,741.22	400.20	496.92	835.71
Services other than SIC 70,73,80	350	Com	11,574.74	10,698.81	19,346.03	759.20	701.75	1,268.92
Construction	112	Com	1,278.27	921.84	1,867.44	83.84	60.46	122.49
TCPU	201	Ind	725.95	216.52	1,042.49	47.62	14.20	68.38
Durable Manufacturing	448	Ind	3,012.42	2,202.30	6,934.43	197.59	144.45	454.84
FIRE	350	Com	2,370.18	2,055.23	4,285.75	155.46	134.80	281.11
Nondurable Manufacturing	448	Ind	892.70	750.95	1,459.99	58.55	49.26	95.76
Wholesale Trade	784	Ind	3,562.98	5,662.96	9,381.63	233.70	371.44	615.35
80% of State and Local Education	969	HDR	5,815.02	5,989.44	20,978.71	381.41	392.85	1,376.01
20% of State and Local Education	969	LDR	1,453.75	1,497.36	5,244.68	95.35	98.21	344.00
80% State and Local Non Education	400	Com	2,268.98	1,934.45	5,944.19	148.82	126.88	389.89
20% State and Local Non Education	400	Ind	567.25	483.61	1,486.05	37.21	31.72	97.47
80% Federal Government (non-mil) ²	400	Com	421.71	763.15	2,005.44	27.66	50.06	131.54
20% Federal Government (non-mil) ²	400	Ind	105.43	190.79	501.36	6.92	12.51	32.88

Note: 1. Assumes floor to area ratio (FAR) of .35 for all development types.

Note: 2. Assumes no new military bases. Mining also not included in land use model.

Land Absorption by Industry - Scenario 3

Industry	SF per Employee	Consolidated Land Use	Total New S.F. (000)			Total New Acres ¹		
			02-11	12-21	22-Buildout	02-11	12-21	22-Buildout
General Merchandise and Apparel	442	Com	940.22	826.51	2,088.64	61.67	54.21	137.00
Food Stores	543	Com	299.20	(33.33)	1,362.89	19.62	(2.19)	89.39
Automotive and Service Stations	699	Com	1,236.50	1,988.37	3,576.50	81.10	130.42	234.59
Eating and Drinking Places	538	Com	6,204.10	12,194.73	19,618.29	406.93	799.86	1,286.78
Retail other than SIC 5356,54,55,58	478	Com	4,001.28	6,017.55	9,463.63	262.45	394.70	620.73
Hotel and other Lodging	1100	Com	5,723.11	8,112.90	12,910.71	375.38	532.13	846.83
Business Services	350	Com	4,511.58	6,297.62	10,047.18	295.92	413.07	659.00
Health Services	358	Com	6,101.46	7,575.99	12,741.22	400.20	496.92	835.71
Services other than SIC 70,73,80	350	Com	11,574.74	10,698.81	19,346.03	759.20	701.75	1,268.92
Construction	112	Com	1,278.27	921.84	1,867.44	83.84	60.46	122.49
TCPU	201	Ind	725.95	216.52	1,042.49	47.62	14.20	68.38
Durable Manufacturing	448	Ind	3,012.42	2,202.30	6,934.43	197.59	144.45	454.84
FIRE	350	Com	2,370.18	2,055.23	4,285.75	155.46	134.80	281.11
Nondurable Manufacturing	448	Ind	892.70	750.95	1,459.99	58.55	49.26	95.76
Wholesale Trade	784	Ind	3,562.98	5,662.96	9,381.63	233.70	371.44	615.35
80% of State and Local Education	969	HDR	5,815.02	5,989.44	20,978.71	381.41	392.85	1,376.01
20% of State and Local Education	969	LDR	1,453.75	1,497.36	5,244.68	95.35	98.21	344.00
80% State and Local Non Education	400	Com	2,268.98	1,934.45	5,944.19	148.82	126.88	389.89
20% State and Local Non Education	400	Ind	567.25	483.61	1,486.05	37.21	31.72	97.47
80% Federal Government (non-mil) ²	400	Com	421.71	763.15	2,005.44	27.66	50.06	131.54
20% Federal Government (non-mil) ²	400	Ind	105.43	190.79	501.36	6.92	12.51	32.88

Note: 1. Assumes floor to area ratio (FAR) of .35 for all development types.

Note: 2. Assumes no new military bases. Mining also not included in land use model.

Appendix D Land Acquisition Costs Including the Tortolita Fan

Based on conversations with Pima County staff, land needed to mitigate for development on species habitat could be acquired from three key areas: Altar Valley, Cienega-Rincon, and the Tortolita Fan. The Costs and Benefits Chapter presented an option that drew land in equal amounts from the Altar Valley and Cienega-Rincon areas only. This appendix presents an option of drawing land in equal amounts from all three areas.

These three areas were used to query the Assessor database and assemble a database of parcels meeting three criteria; 1) parcels which intersect one of the key areas and have relatively high habitat value, 2) parcels one acre or larger, and 3) with \$10,000 or less in improvements on them (recall this is the working GIS definition of “vacant.”) Three values for each of these areas and the mean of the three are shown on the table below.

The median represents the middle value of all full cash value of land per acre calculations. This measure is similar to a mean, but less sensitive to extreme values. The other land value points (low and high) represent the first and third quartiles of the data set.¹ The range of land values varies greatly in the Tortolita Fan area, which is also the most expensive of the three areas identified.

Land Value Per Acre in Three Geographic Areas Identified for Preserve Lands (\$ 2002)

	Altar Valley	Cienega - Rincon	Tortolita Fan	Combined Mean
Land Value Per Acre ¹				
Low	\$ 736	\$ 791	\$ 240	\$ 589
Middle (Median)	\$ 894	\$ 2,180	\$ 16,614	\$ 6,563
High	\$ 1,202	\$ 4,505	\$ 46,507	\$ 17,405

Note: 1. Low and high represent the first and third quartiles of the data

The table on the following page presents the value of land to be acquired under a number of different conditions. The figures in this table are the result of multiplying the acres of land presented in Table 8 of the main document by the “Combined Mean” land values from the table above. Due to the slightly lower land needs, the value of land to be acquired for the

¹ The median is actually the second quartile. Quartiles sort a data set and separate it into four equal parts. The distance (number of records) is equal between quartiles, so the first quartile (our low estimate) is halfway between the lowest value and the median and the third quartile (our high estimate) is halfway between the highest value and the median.

Biologically Preferred Alternative is slightly less than the value of land to be acquired for Listed Species only.

Cumulative Value of Land to Be Acquired to Accommodate Development at Each by Scenario (\$ millions 2002) ¹

	<u>10 Years Development</u>			<u>20 Years Development</u>			<u>Through Buildout</u>			
	<u>Low</u>	<u>Mid</u>	<u>High</u>	<u>Low</u>	<u>Mid</u>	<u>High</u>	<u>Low</u>	<u>Mid</u>	<u>High</u>	
Scenario 1	Listed Species Only									
	1:1 Mitigation	\$ 3.8	\$ 42.7	\$ 113.2	\$ 13.9	\$ 155.3	\$ 411.9	\$ 90.2	\$ 1,005.1	\$ 2,665.5
	2:1 Mitigation	\$ 7.7	\$ 85.4	\$ 226.4	\$ 27.9	\$ 310.6	\$ 823.9	\$ 180.4	\$ 2,010.1	\$ 5,331.0
	3:1 Mitigation	\$ 11.5	\$ 128.1	\$ 339.7	\$ 41.8	\$ 466.0	\$ 1,235.8	\$ 270.6	\$ 3,015.2	\$ 7,996.5
	4:1 Mitigation	\$ 15.3	\$ 170.8	\$ 452.9	\$ 55.7	\$ 621.3	\$ 1,647.7	\$ 360.7	\$ 4,020.2	\$10,662.0
	Biologically Preferred									
	1:1 Mitigation	\$ 3.4	\$ 38.0	\$ 100.9	\$ 13.0	\$ 145.1	\$ 384.8	\$ 62.1	\$ 692.1	\$ 1,835.5
	2:1 Mitigation	\$ 6.8	\$ 76.1	\$ 201.7	\$ 26.0	\$ 290.2	\$ 769.6	\$ 124.2	\$ 1,384.2	\$ 3,671.0
	3:1 Mitigation	\$ 10.2	\$ 114.1	\$ 302.6	\$ 39.1	\$ 435.3	\$ 1,154.5	\$ 186.3	\$ 2,076.3	\$ 5,506.5
	4:1 Mitigation	\$ 13.7	\$ 152.1	\$ 403.5	\$ 52.1	\$ 580.4	\$ 1,539.3	\$ 248.4	\$ 2,768.4	\$ 7,342.0
Scenario 2	Listed Species Only									
	1:1 Mitigation	\$ 4.7	\$ 52.1	\$ 138.1	\$ 22.0	\$ 245.4	\$ 650.8	\$ 87.7	\$ 976.9	\$ 2,590.8
	2:1 Mitigation	\$ 9.3	\$ 104.2	\$ 276.3	\$ 44.0	\$ 490.8	\$ 1,301.6	\$ 175.3	\$ 1,953.8	\$ 5,181.6
	3:1 Mitigation	\$ 14.0	\$ 156.3	\$ 414.4	\$ 66.1	\$ 736.2	\$ 1,952.3	\$ 263.0	\$ 2,930.7	\$ 7,772.4
	4:1 Mitigation	\$ 18.7	\$ 208.4	\$ 552.6	\$ 88.1	\$ 981.5	\$ 2,603.1	\$ 350.6	\$ 3,907.5	\$10,363.1
	Biologically Preferred									
	1:1 Mitigation	\$ 4.1	\$ 46.2	\$ 122.6	\$ 20.6	\$ 229.2	\$ 608.0	\$ 60.2	\$ 671.3	\$ 1,780.3
	2:1 Mitigation	\$ 8.3	\$ 92.5	\$ 245.2	\$ 41.1	\$ 458.5	\$ 1,215.9	\$ 120.5	\$ 1,342.5	\$ 3,560.5
	3:1 Mitigation	\$ 12.4	\$ 138.7	\$ 367.8	\$ 61.7	\$ 687.7	\$ 1,823.9	\$ 180.7	\$ 2,013.8	\$ 5,340.8
	4:1 Mitigation	\$ 16.6	\$ 184.9	\$ 490.5	\$ 82.3	\$ 917.0	\$ 2,431.9	\$ 240.9	\$ 2,685.1	\$ 7,121.1
Scenario 3	Listed Species Only									
	1:1 Mitigation	\$ 4.8	\$ 53.8	\$ 142.6	\$ 22.1	\$ 245.8	\$ 651.9	\$ 90.4	\$ 1,007.5	\$ 2,671.9
	2:1 Mitigation	\$ 9.7	\$ 107.6	\$ 285.3	\$ 44.1	\$ 491.6	\$ 1,303.9	\$ 180.8	\$ 2,014.9	\$ 5,343.7
	3:1 Mitigation	\$ 14.5	\$ 161.3	\$ 427.9	\$ 66.2	\$ 737.5	\$ 1,955.8	\$ 271.2	\$ 3,022.4	\$ 8,015.6
	4:1 Mitigation	\$ 19.3	\$ 215.1	\$ 570.5	\$ 88.2	\$ 983.3	\$ 2,607.8	\$ 361.6	\$ 4,029.8	\$10,687.5
	Biologically Preferred									
	1:1 Mitigation	\$ 4.2	\$ 47.2	\$ 125.2	\$ 20.1	\$ 224.3	\$ 594.9	\$ 64.6	\$ 720.5	\$ 1,910.7
	2:1 Mitigation	\$ 8.5	\$ 94.4	\$ 250.4	\$ 40.3	\$ 448.6	\$ 1,189.8	\$ 129.3	\$ 1,440.9	\$ 3,821.5
	3:1 Mitigation	\$ 12.7	\$ 141.6	\$ 375.5	\$ 60.4	\$ 673.0	\$ 1,784.7	\$ 193.9	\$ 2,161.4	\$ 5,732.2
	4:1 Mitigation	\$ 16.9	\$ 188.8	\$ 500.7	\$ 80.5	\$ 897.3	\$ 2,379.7	\$ 258.6	\$ 2,881.9	\$ 7,643.0

Note: 1. Low, middle, and high values presented in this table reflect a range of land acquisition costs per acre as presented in the previous Table.

Appendix E Personal Income

The purpose of this analysis was to build a reliable projection model of future income under the different scenarios. Income includes salary and a number of other adjustments such as dividends, interest and rent which were in turn used to analyze taxable sales and as inputs to our property valuation model.

Correlation in this study is a measure of the degree of linear relationship between two variables: the exogenous factor (independent variable) and the target assessment factor (dependant variable). The correlation coefficient may take on any value between plus and minus one. The sign of the correlation coefficient defines the direction of the relationship, either positive or negative. A positive correlation coefficient means that as the value of one variable increases, the value of the dependant variable increases; as one decreases the other decreases. A negative correlation coefficient indicates that as one variable increases, the other decreases, and vice-versa. Taking the absolute value of the correlation coefficient measures the strength of the relationship. Thus a correlation coefficient of zero indicates the absence of a linear relationship, while correlation coefficients of +1.0 and -1.0 indicate a perfect linear relationship.

Marshall Vest the Director of Economic and Business Research at the Eller College of Business and Public Administration at the University of Arizona provided the majority of the historic socioeconomic data (exogenous factors) and baseline projections used in the analysis, the remainder were supplemented by ESI Corp.

Appendix B discusses the methodology behind the changes in population growth and employment mix that were developed for Scenarios 2 and 3. Detailed tables at the end of this appendix show year to year data per scenario.

Personal income by place of residence¹ is a comprehensive measure that includes wage and salary income, federal military income, and other income derived from transfer payments (such as social security received), dividends, interest and rent, a residence adjustment (to correct for persons living in one county but working in another), and social insurance contributions (such as payments to social security).

¹ Projections of personal income exclude other non-wage and salary components (“other wage and salary income which is made up of wage payments to US citizens employed by international organizations and foreign embassies, and proprietor’s income, including inventory and capital consumption adjustment) due to lack of available data. See <http://www.bea.doc.gov/bea/regional/reis/action.cfm> for further descriptions of these data elements.

Wage and salary income is a function of employment by industry and the average wage of each industry, which are projected as part of Forecasting Project data. Average wages were held constant across scenarios. Federal military employment and average wages are projected by Global Insight² and are held constant across scenarios.

Other factors were correlated to exogenous variables. The initial assessment of correlations by using statistical tools yielded promising results (high linear relationship), which reaffirmed the economic premises for choosing the exogenous factors and establishing incentives for further pursuits of this study. Notably in conducting this analysis, multiple regressions are necessarily absent to avoid time-series colinearity problems and directional causal relationship. A brief discussion of correlations used is provided below:

Transfer payments, dividend, interest and rent, and residence adjustment each showed high (greater than 90 percent correlation) relationships to total population. Social insurance was found to be strongly related to total wage and salary employment. The following Table shows the values used for each variable and the correlation from 1970-2000 between the variable and activity driver.

Projections of Non-Wage Income Adjustments to Exogenous Factors and Correlation			
	2002 Value	Per	Correlation 1970 to 2000
Transfer Payments	\$ 4,189	Capita	95.4%
Dividend Interest and Rent	\$ 5,754	Capita	97.2%
Residence Adjustment	\$ 115	Capita	91.8%
Social Insurance	\$(2,361)	Job ¹	96.4%

Note: 1. Wage and Salary Employment

Source: Eller College of Business and Public Administration, ESI Corporation

With these adjustments, total personal income could then be calculated. Not all personal income is available to be spent by households. By definition,³ disposable personal income equals total personal income less personal tax and non-tax payments. The relationship between total personal income and disposable personal income has remained relatively constant over time (disposable personal income ranged between 85.8 and 90.7 percent of total personal income from 1970-2000) and is projected each year as part of Forecasting Project data.

² Global Insight is a national business and economic forecasting company that provides national forecasts which are in turn inputs to state and regional forecasts developed by the Forecasting Project.

³ <http://www.bea.gov/briefrm/tables/abr4.htm>

Appendix F Property Value and Property Tax

The purpose of this analysis was to build a reliable projection model of future property value assessment under the different scenarios. We used historical analysis of past data to build the model using correlations of various exogenous socioeconomic factors to property valuations.

Correlation in this study is a measure of the degree of linear relationship between two variables: the exogenous factor (independent variable) and the target assessment factor (dependant variable). The correlation coefficient may take on any value between plus and minus one. The sign of the correlation coefficient defines the direction of the relationship, either positive or negative. A positive correlation coefficient means that as the value of one variable increases, the value of the dependant variable increases; as one decreases the other decreases. A negative correlation coefficient indicates that as one variable increases, the other decreases, and vice-versa. Taking the absolute value of the correlation coefficient measures the strength of the relationship. Thus a correlation coefficient of zero indicates the absence of a linear relationship, while correlation coefficients of +1.0 and -1.0 indicate a perfect linear relationship.

In designing this correlation study, the exogenous factors used were based on recommendations from Bruce Basemann the Pima County Principal Finance Analyst, and a review of technical reports and research literature. Lags and leads were put in place for the exogenous factors because the ripple effects of economic markets may not manifest themselves immediately from a real property perspective.

Marshall Vest the Director of Economic and Business Research at the Eller College of Business and Public Administration at the University of Arizona provided the majority of the historic socioeconomic data (exogenous factors) used in the analysis, the remainder were supplemented by ESI Corp. Mr. Basemann provided historic Full Net Value (FNV).¹

A standard adjustment was made to all of the exogenous factors to convert them from a calendar year (January to December) to a fiscal year measure (July to June). Each pair of exogenous data points (1997 and 1998 for example) were averaged, and this result was used to compare to the NAV

¹ Basemann, 2001. "Because Pima County has large amounts of property that are exempt from taxation, it is best to look at the market value of taxable property in the county. An approximation of the market value is computed by dividing the total net assessed value of each legislative class by its assessment ratio and summing the results. In this document this value is referred to as the *full net value* of the tax base."

See the report entitled *Pima County Tax Base and Property Valuation* (June 11, 2001) by Bruce Basemann for a further discussion of Net Assessed Value.

data that were already provided in fiscal years (fiscal year 1997-1998 for example). All dollars figures in the datasets were nominal (without adjustment for inflation).

The initial assessment of correlations by using statistical tools yielded promising results (high linear relationship), which reaffirmed the economic premises for choosing the exogenous factors and establishing incentives for further pursuits of this study. Notably in conducting this analysis, multiple regressions are necessarily absent to avoid time-series colinearity problems and directional causal relationship.

The property tax structure in Arizona is divided into the following two categories:

- ⊠ Primary – “Primary property tax revenues help to fund the maintenance and operation budgets of state and local governments.”² Growth in the primary assessed values are limited, as is the growth in the total amount that can be collected.
- ⊠ Secondary – “Secondary values fund such things as bond issues, budget overrides and special districts. There is no limit on either the amount of taxes that may be assessed or the growth rate of assessed values.”³

Since the secondary values approximate market conditions, the correlation analysis was conducted on these figures. The primary values were calculated using the rules mandated in state statute:

*The primary value may increase in one of two ways: 1) Up to 10% or the previous year’s value, or 2) 25% of the difference between the current year’s secondary value and previous year’s primary value. The amount that the limited value will increase depends on the method that produces the greater result. In no event should the primary value exceed the secondary value.*⁴

It should be noted that while in actuality, primary values tend to be lower than secondary values, the application of the above rules to the projected data resulted in most primary values being equal to the secondary values.

For the purposes of this analysis, personal property and all “centrally valued” real property except mines were excluded from the analysis. Centrally valued property is appraised by the State and then allocated back to the counties and includes such categories as railroads and airlines. In the 2002/2003 tax year the excluded factors totaled 13.7 percent of the total net assessed value in the county.

² Arizona Tax Research Foundation, *2002 Property Tax Rates & Assessed Values* (Page II)

³ Ibid. (Page I)

⁴ Ibid. (Page I)

A brief discussion for each pair of correlation is provided below. Note that correlation does not imply causation.

- ✧ Mining employment squared (lag 2 years) correlates to the value of mines. The correlation coefficient yielded was 0.92, which indicates an increase of mining employment had a strong compounding positive impact on the value of mines.
- ✧ Population squared (lag 3 years) correlates to the value of commercial real property. The correlation coefficient yielded was 0.95, which indicates an increase in total population has strong compounding positive impact on the value of commercial real property.
- ✧ Construction employment (lead 3 years) correlates to the value of vacant land. The correlation coefficient yielded was -0.91, which indicates an increase of construction employment has a strong negative impact on the value of vacant land.
- ✧ Wage and salary earnings (lag 3 years) correlates to the value of owner-occupied residential property. The correlation coefficient yielded was 0.99, which indicates an increase of wage and salary earnings almost necessarily leads to an increase in owner-occupied residential property value.
- ✧ Population squared (lag 3 years) correlates to the value of rental-occupied residential property. The correlation coefficient yielded was 0.93, which indicates an increase of population has a strong compounding positive impact on rental-occupied residential property value.
- ✧ Wage and salary earnings squared (lag 3 years) correlates to the value of other properties. The correlation coefficient yielded was 0.96, which indicates an increase of wage and salary earnings has a strong compounding positive impact on the value of other properties.

Property Value Correlation Summary				
Assessment Class	Exogenous Factor	Lag/Lead	Years of Property Tax Data	Correlation
Mines	Mining Emp. Squared	Lag-2 Years	88-89 to 02-03	0.9217
Commercial Real Property	Population Squared	Lag-3 Years	88-89 to 02-03	0.9480
Vacant Land	Construction Employment	Lead-3 Years	88-89 to 99-00	-0.9088
Residential – Owner Occ.	Wage and Salary Earnings	Lag-3 Years	88-89 to 02-03	0.9932
Residential - Rental Occ.	Population Squared	Lag-3 Years	88-89 to 02-03	0.9435
Other Real Property	Wage and Salary Earnings Squared	Lag-3 Years	88-89 to 02-03	0.9601

Based on the strengths of these correlations, the percent changes in the projected exogenous factors, discussed in detail in Appendix B and Appendix E were applied to the property values to project the future value of property in the county.

Since the data used in the analysis were for all Pima County, the results will overstate the impacts to Eastern Pima County due to development on the west side of the county.

**Land Value and Property
Tax Projections - Scenario 1**

Rate	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11
EXOGENOUS FACTORS									
CPI (2002=1.00)	1.013	1.041	1.070	1.100	1.130	1.160	1.190	1.222	1.255
Population (lag 3 years)	833,931	855,557	876,626	897,604	914,525	931,785	949,674	967,553	985,441
Emp. - Mining (lag 2 yrs)	1,870	1,658	1,538	1,590	1,539	1,489	1,461	1,431	1,392
Emp. - Const. (lead 3 years)	23,169	23,723	24,282	24,848	25,409	25,998	26,550	27,078	27,690
Wage&Sal. Earn (lag 3 yrs) (\$M)	10,516.04	11,196.07	11,642.00	12,202.63	13,079.44	13,999.86	14,893.56	15,808.48	16,759.46
FULL NET VALUE: SEC (\$M)									
Mines	139.81	109.96	94.56	101.07	94.68	88.63	85.33	81.86	77.51
Commercial Real Property	4,395.40	4,626.32	4,856.98	5,092.22	5,286.02	5,487.43	5,700.16	5,916.80	6,137.60
Vacant Land	2,020.78	1,972.46	1,925.99	1,881.09	1,838.62	1,796.00	1,757.87	1,722.94	1,684.00
Residential - Owner Occupied	23,474.74	24,992.74	25,988.20	27,239.67	29,196.95	31,251.59	33,246.57	35,288.95	37,411.78
Residential - Rental Occupied	4,087.35	4,302.09	4,516.58	4,735.34	4,915.55	5,102.85	5,300.67	5,502.13	5,707.45
Other Real Property	212.89	241.31	260.92	286.65	329.32	377.31	427.01	481.09	540.71
Total	34,330.97	36,244.89	37,643.23	39,336.04	41,661.15	44,103.81	46,517.61	48,993.76	51,559.06
FULL NET VALUE: PRI (\$M)									
Mines	139.81	109.96	94.56	101.07	94.68	88.63	85.33	81.86	77.51
Commercial Real Property	4,164.52	4,580.97	4,856.98	5,092.22	5,286.02	5,487.43	5,700.16	5,916.80	6,137.60
Vacant Land	1,645.44	1,809.98	1,925.99	1,881.09	1,838.62	1,796.00	1,757.87	1,722.94	1,684.00
Residential - Owner Occupied	23,164.76	24,992.74	25,988.20	27,239.67	29,196.95	31,251.59	33,246.57	35,288.95	37,411.78
Residential - Rental Occupied	3,925.92	4,302.09	4,516.58	4,735.34	4,915.55	5,102.85	5,300.67	5,502.13	5,707.45
Other Real Property	201.30	221.43	243.57	267.93	294.72	324.19	356.61	392.27	431.50
Total	33,241.75	36,017.18	37,625.88	39,317.32	41,626.54	44,050.69	46,447.20	48,904.95	51,449.84
FULL NET VALUE: SEC (\$M02)									
Mines	138.01	105.66	88.35	91.86	83.78	76.39	71.67	67.00	61.77
Commercial Real Property	4,338.87	4,445.39	4,538.13	4,628.53	4,677.11	4,729.74	4,788.13	4,842.92	4,891.27
Vacant Land	1,994.80	1,895.32	1,799.55	1,709.80	1,626.83	1,548.01	1,476.61	1,410.23	1,342.04
Residential - Owner Occupied	23,172.85	24,015.30	24,282.12	24,759.29	25,833.70	26,936.44	27,927.12	28,884.10	29,814.77
Residential - Rental Occupied	4,034.79	4,133.84	4,220.08	4,304.15	4,349.32	4,398.26	4,452.56	4,503.51	4,548.47
Other Real Property	210.15	231.87	243.79	260.55	291.39	325.21	358.69	393.77	430.91
Total	33,889.46	34,827.39	35,172.02	35,754.20	36,862.12	38,014.05	39,074.79	40,101.53	41,089.24

**Land Value and Property
Tax Projections - Scenario 1**

	Rate	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11
FULL NET VALUE: PRI (\$M02)										
Mines		138.01	105.66	88.35	91.86	83.78	76.39	71.67	67.00	61.77
Commercial Real Property		4,110.96	4,401.81	4,538.13	4,628.53	4,677.11	4,729.74	4,788.13	4,842.92	4,891.27
Vacant Land		1,624.28	1,739.20	1,799.55	1,709.80	1,626.83	1,548.01	1,476.61	1,410.23	1,342.04
Residential - Owner Occupied		22,866.85	24,015.30	24,282.12	24,759.29	25,833.70	26,936.44	27,927.12	28,884.10	29,814.77
Residential - Rental Occupied		3,875.44	4,133.84	4,220.08	4,304.15	4,349.32	4,398.26	4,452.56	4,503.51	4,548.47
Other Real Property		198.71	212.77	227.58	243.53	260.77	279.43	299.55	321.08	343.88
Total		32,814.25	34,608.58	35,155.81	35,737.18	36,831.50	37,968.27	39,015.65	40,028.83	41,002.20
NET ASSESS VALUE: SEC (\$M)										
Mines	25%	34.95	27.49	23.64	25.27	23.67	22.16	21.33	20.46	19.38
Commercial Real Property	25%	1,098.85	1,156.58	1,214.24	1,273.05	1,321.50	1,371.86	1,425.04	1,479.20	1,534.40
Vacant Land	16%	323.33	315.59	308.16	300.97	294.18	287.36	281.26	275.67	269.44
Residential - Owner Occupied	10%	2,347.47	2,499.27	2,598.82	2,723.97	2,919.70	3,125.16	3,324.66	3,528.89	3,741.18
Residential - Rental Occupied	10%	408.74	430.21	451.66	473.53	491.56	510.28	530.07	550.21	570.75
Other Real Property	5%	10.64	12.07	13.05	14.33	16.47	18.87	21.35	24.05	27.04
Total		4,223.98	4,441.21	4,609.57	4,811.13	5,067.07	5,335.68	5,603.70	5,878.50	6,162.18
NET ASSESS VALUE: PRI (\$M)										
Mines	25%	34.95	27.49	23.64	25.27	23.67	22.16	21.33	20.46	19.38
Commercial Real Property	25%	1,041.13	1,145.24	1,214.24	1,273.05	1,321.50	1,371.86	1,425.04	1,479.20	1,534.40
Vacant Land	16%	263.27	289.60	308.16	300.97	294.18	287.36	281.26	275.67	269.44
Residential - Owner Occupied	10%	2,316.48	2,499.27	2,598.82	2,723.97	2,919.70	3,125.16	3,324.66	3,528.89	3,741.18
Residential - Rental Occupied	10%	392.59	430.21	451.66	473.53	491.56	510.28	530.07	550.21	570.75
Other Real Property	5%	10.06	11.07	12.18	13.40	14.74	16.21	17.83	19.61	21.57
Total		4,058.49	4,402.89	4,608.70	4,810.19	5,065.34	5,333.03	5,600.18	5,874.06	6,156.72
NET ASSESS VALUE: SEC (\$M02)										
Mines		34.50	26.42	22.09	22.97	20.94	19.10	17.92	16.75	15.44
Commercial Real Property		1,084.72	1,111.35	1,134.53	1,157.13	1,169.28	1,182.43	1,197.03	1,210.73	1,222.82
Vacant Land		319.17	303.25	287.93	273.57	260.29	247.68	236.26	225.64	214.73
Residential - Owner Occupied		2,317.28	2,401.53	2,428.21	2,475.93	2,583.37	2,693.64	2,792.71	2,888.41	2,981.48
Residential - Rental Occupied		403.48	413.38	422.01	430.41	434.93	439.83	445.26	450.35	454.85
Other Real Property		10.51	11.59	12.19	13.03	14.57	16.26	17.93	19.69	21.55
Total		4,169.66	4,267.52	4,306.96	4,373.04	4,483.39	4,598.94	4,707.11	4,811.57	4,910.86

**Land Value and Property
Tax Projections - Scenario 1**

	Rate	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11
NET ASSESS VALUE: PRI (\$M02)										
Mines		34.50	26.42	22.09	22.97	20.94	19.10	17.92	16.75	15.44
Commercial Real Property		1,027.74	1,100.45	1,134.53	1,157.13	1,169.28	1,182.43	1,197.03	1,210.73	1,222.82
Vacant Land		259.88	278.27	287.93	273.57	260.29	247.68	236.26	225.64	214.73
Residential - Owner Occupied		2,286.69	2,401.53	2,428.21	2,475.93	2,583.37	2,693.64	2,792.71	2,888.41	2,981.48
Residential - Rental Occupied		387.54	413.38	422.01	430.41	434.93	439.83	445.26	450.35	454.85
Other Real Property		9.94	10.64	11.38	12.18	13.04	13.97	14.98	16.05	17.19
Total		4,006.29	4,230.69	4,306.15	4,372.19	4,481.85	4,596.66	4,704.15	4,807.93	4,906.51
PROPERTY TAXES: SEC (\$M02)										
County	1.0732	44.75	45.80	46.22	46.93	48.12	49.36	50.52	51.64	52.70
Cities and Towns	0.4276	17.83	18.25	18.41	18.70	19.17	19.66	20.13	20.57	21.00
Community Colleges	0.3803	15.86	16.23	16.38	16.63	17.05	17.49	17.90	18.30	18.68
Schools	2.1202	88.40	90.48	91.32	92.72	95.06	97.51	99.80	102.01	104.12
All Other	0.9362	39.04	39.95	40.32	40.94	41.97	43.05	44.07	45.05	45.97
Total		205.87	210.71	212.65	215.91	221.36	227.07	232.41	237.57	242.47
PROPERTY TAXES: PRI (\$M02)										
County	4.5609	182.72	192.96	196.40	199.41	204.41	209.65	214.55	219.28	223.78
Cities and Towns	0.0995	3.98	4.21	4.28	4.35	4.46	4.57	4.68	4.78	4.88
Community Colleges	1.1530	46.19	48.78	49.65	50.41	51.68	53.00	54.24	55.44	56.57
Schools	5.9688	239.13	252.52	257.03	260.97	267.51	274.37	280.78	286.98	292.86
All Other	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total		472.03	498.47	507.36	515.14	528.06	541.59	554.25	566.48	578.09
PROPERTY TAXES: TOT (\$M02)										
County		227.47	238.76	242.62	246.34	252.53	259.00	265.07	270.92	276.48
Cities and Towns		21.81	22.45	22.70	23.05	23.63	24.23	24.80	25.35	25.88
Community Colleges		62.05	65.01	66.03	67.04	68.73	70.49	72.14	73.73	75.25
Schools		327.53	343.00	348.34	353.68	362.57	371.87	380.58	388.99	396.98
All Other		39.04	39.95	40.32	40.94	41.97	43.05	44.07	45.05	45.97
Total		677.90	709.17	720.01	731.05	749.42	768.66	786.66	804.05	820.56
PROP. TAXES: TOT CUM. (\$M02)										
County		227.47	466.23	708.85	955.19	1,207.72	1,466.73	1,731.79	2,002.72	2,279.20
Cities and Towns		21.81	44.27	66.96	90.01	113.64	137.87	162.68	188.03	213.91
Community Colleges		62.05	127.06	193.09	260.13	328.86	399.35	471.49	545.22	620.47
Schools		327.53	670.53	1,018.88	1,372.56	1,735.13	2,107.00	2,487.58	2,876.58	3,273.56
All Other		39.04	78.99	119.31	160.25	202.22	245.28	289.34	334.39	380.36
Total		677.90	1,387.08	2,107.09	2,838.14	3,587.57	4,356.22	5,142.88	5,946.93	6,767.49

**Land Value and Property
Tax Projections - Scenario 1**

Rate	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20
EXOGENOUS FACTORS									
CPI (2002=1.00)	1.290	1.328	1.369	1.412	1.459	1.509	1.562	1.619	1.677
Population (lag 3 years)	1,003,628	1,021,932	1,040,348	1,059,069	1,077,699	1,096,373	1,115,611	1,135,420	1,155,636
Emp. - Mining (lag 2 yrs)	1,353	1,320	1,275	1,245	1,250	1,258	1,268	1,273	1,280
Emp. - Const. (lead 3 years)	28,400	29,139	29,861	30,554	31,246	31,940	32,598	33,235	33,874
Wage&Sal. Earn (lag 3 yrs) (\$M)	17,709.51	18,710.63	19,775.95	20,699.29	21,789.38	23,325.75	25,107.93	27,076.96	29,163.56
FULL NET VALUE: SEC (\$M)									
Mines	73.17	69.70	65.03	61.95	62.45	63.31	64.27	64.82	65.54
Commercial Real Property	6,366.24	6,600.57	6,840.61	7,089.02	7,340.62	7,597.21	7,866.17	8,147.99	8,440.73
Vacant Land	1,640.79	1,598.10	1,558.53	1,522.36	1,487.85	1,454.83	1,424.83	1,397.01	1,370.15
Residential - Owner Occupied	39,532.57	41,767.35	44,145.44	46,206.58	48,639.98	52,069.57	56,047.89	60,443.33	65,101.20
Residential - Rental Occupied	5,920.07	6,137.98	6,361.20	6,592.19	6,826.16	7,064.77	7,314.88	7,576.95	7,849.17
Other Real Property	603.75	673.94	752.87	824.81	913.98	1,047.41	1,213.58	1,411.38	1,637.29
Total	54,136.60	56,847.64	59,723.67	62,296.92	65,271.04	69,297.10	73,931.62	79,041.49	84,464.09
FULL NET VALUE: PRI (\$M)									
Mines	73.17	69.70	65.03	61.95	62.45	63.31	64.27	64.82	65.54
Commercial Real Property	6,366.24	6,600.57	6,840.61	7,089.02	7,340.62	7,597.21	7,866.17	8,147.99	8,440.73
Vacant Land	1,640.79	1,598.10	1,558.53	1,522.36	1,487.85	1,454.83	1,424.83	1,397.01	1,370.15
Residential - Owner Occupied	39,532.57	41,767.35	44,145.44	46,206.58	48,639.98	52,069.57	56,047.89	60,443.33	65,101.20
Residential - Rental Occupied	5,920.07	6,137.98	6,361.20	6,592.19	6,826.16	7,064.77	7,314.88	7,576.95	7,849.17
Other Real Property	474.65	524.47	581.57	642.38	710.28	794.56	899.32	1,027.33	1,179.82
Total	54,007.50	56,698.17	59,552.37	62,114.49	65,067.34	69,044.25	73,617.36	78,657.44	84,006.62
FULL NET VALUE: SEC (\$M02)									
Mines	56.71	52.47	47.50	43.87	42.81	41.96	41.14	40.05	39.07
Commercial Real Property	4,933.94	4,968.84	4,996.79	5,019.45	5,032.10	5,035.25	5,035.11	5,033.98	5,031.89
Vacant Land	1,271.64	1,203.03	1,138.44	1,077.92	1,019.94	964.23	912.03	863.10	816.81
Residential - Owner Occupied	30,638.36	31,442.04	32,246.42	32,717.05	33,343.37	34,510.47	35,876.07	37,343.01	38,809.66
Residential - Rental Occupied	4,588.15	4,620.61	4,646.59	4,667.67	4,679.43	4,682.36	4,682.23	4,681.18	4,679.23
Other Real Property	467.92	507.34	549.94	584.02	626.54	694.20	776.81	871.98	976.06
Total	41,956.71	42,794.33	43,625.68	44,109.98	44,744.19	45,928.46	47,323.38	48,833.29	50,352.72

**Land Value and Property
Tax Projections - Scenario 1**

	Rate	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20
FULL NET VALUE: PRI (\$M02)										
Mines		56.71	52.47	47.50	43.87	42.81	41.96	41.14	40.05	39.07
Commercial Real Property		4,933.94	4,968.84	4,996.79	5,019.45	5,032.10	5,035.25	5,035.11	5,033.98	5,031.89
Vacant Land		1,271.64	1,203.03	1,138.44	1,077.92	1,019.94	964.23	912.03	863.10	816.81
Residential - Owner Occupied		30,638.36	31,442.04	32,246.42	32,717.05	33,343.37	34,510.47	35,876.07	37,343.01	38,809.66
Residential - Rental Occupied		4,588.15	4,620.61	4,646.59	4,667.67	4,679.43	4,682.36	4,682.23	4,681.18	4,679.23
Other Real Property		367.86	394.82	424.81	454.85	486.91	526.62	575.65	634.71	703.34
Total		41,856.66	42,681.81	43,500.55	43,980.81	44,604.55	45,760.88	47,122.22	48,596.02	50,080.01
NET ASSESS VALUE: SEC (\$M)										
Mines	25%	18.29	17.42	16.26	15.49	15.61	15.83	16.07	16.21	16.38
Commercial Real Property	25%	1,591.56	1,650.14	1,710.15	1,772.25	1,835.16	1,899.30	1,966.54	2,037.00	2,110.18
Vacant Land	16%	262.53	255.70	249.36	243.58	238.06	232.77	227.97	223.52	219.22
Residential - Owner Occupied	10%	3,953.26	4,176.74	4,414.54	4,620.66	4,864.00	5,206.96	5,604.79	6,044.33	6,510.12
Residential - Rental Occupied	10%	592.01	613.80	636.12	659.22	682.62	706.48	731.49	757.69	784.92
Other Real Property	5%	30.19	33.70	37.64	41.24	45.70	52.37	60.68	70.57	81.86
Total		6,447.83	6,747.49	7,064.08	7,352.44	7,681.14	8,113.71	8,607.54	9,149.32	9,722.69
NET ASSESS VALUE: PRI (\$M)										
Mines	25%	18.29	17.42	16.26	15.49	15.61	15.83	16.07	16.21	16.38
Commercial Real Property	25%	1,591.56	1,650.14	1,710.15	1,772.25	1,835.16	1,899.30	1,966.54	2,037.00	2,110.18
Vacant Land	16%	262.53	255.70	249.36	243.58	238.06	232.77	227.97	223.52	219.22
Residential - Owner Occupied	10%	3,953.26	4,176.74	4,414.54	4,620.66	4,864.00	5,206.96	5,604.79	6,044.33	6,510.12
Residential - Rental Occupied	10%	592.01	613.80	636.12	659.22	682.62	706.48	731.49	757.69	784.92
Other Real Property	5%	23.73	26.22	29.08	32.12	35.51	39.73	44.97	51.37	58.99
Total		6,441.38	6,740.02	7,055.52	7,343.32	7,670.95	8,101.06	8,591.83	9,130.12	9,699.82
NET ASSESS VALUE: SEC (\$M02)										
Mines		14.18	13.12	11.88	10.97	10.70	10.49	10.28	10.01	9.77
Commercial Real Property		1,233.48	1,242.21	1,249.20	1,254.86	1,258.02	1,258.81	1,258.78	1,258.49	1,257.97
Vacant Land		203.46	192.48	182.15	172.47	163.19	154.28	145.93	138.10	130.69
Residential - Owner Occupied		3,063.84	3,144.20	3,224.64	3,271.70	3,334.34	3,451.05	3,587.61	3,734.30	3,880.97
Residential - Rental Occupied		458.81	462.06	464.66	466.77	467.94	468.24	468.22	468.12	467.92
Other Real Property		23.40	25.37	27.50	29.20	31.33	34.71	38.84	43.60	48.80
Total		4,997.17	5,079.45	5,160.02	5,205.97	5,265.52	5,377.57	5,509.66	5,652.62	5,796.12

**Land Value and Property
Tax Projections - Scenario 1**

	Rate	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20
NET ASSESS VALUE: PRI (\$M02)										
Mines		14.18	13.12	11.88	10.97	10.70	10.49	10.28	10.01	9.77
Commercial Real Property		1,233.48	1,242.21	1,249.20	1,254.86	1,258.02	1,258.81	1,258.78	1,258.49	1,257.97
Vacant Land		203.46	192.48	182.15	172.47	163.19	154.28	145.93	138.10	130.69
Residential - Owner Occupied		3,063.84	3,144.20	3,224.64	3,271.70	3,334.34	3,451.05	3,587.61	3,734.30	3,880.97
Residential - Rental Occupied		458.81	462.06	464.66	466.77	467.94	468.24	468.22	468.12	467.92
Other Real Property		18.39	19.74	21.24	22.74	24.35	26.33	28.78	31.74	35.17
Total		4,992.17	5,073.82	5,153.76	5,199.51	5,258.54	5,369.19	5,499.60	5,640.76	5,782.49
PROPERTY TAXES: SEC (\$M02)										
County	1.0732	53.63	54.51	55.38	55.87	56.51	57.71	59.13	60.66	62.20
Cities and Towns	0.4276	21.37	21.72	22.06	22.26	22.51	22.99	23.56	24.17	24.78
Community Colleges	0.3803	19.00	19.32	19.62	19.80	20.02	20.45	20.95	21.50	22.04
Schools	2.1202	105.95	107.69	109.40	110.38	111.64	114.01	116.81	119.85	122.89
All Other	0.9362	46.78	47.55	48.31	48.74	49.30	50.34	51.58	52.92	54.26
Total		246.73	250.79	254.77	257.04	259.98	265.51	272.03	279.09	286.18
PROPERTY TAXES: PRI (\$M02)										
County	4.5609	227.69	231.41	235.06	237.14	239.84	244.88	250.83	257.27	263.73
Cities and Towns	0.0995	4.96	5.05	5.13	5.17	5.23	5.34	5.47	5.61	5.75
Community Colleges	1.1530	57.56	58.50	59.42	59.95	60.63	61.91	63.41	65.04	66.67
Schools	5.9688	297.97	302.85	307.62	310.35	313.87	320.48	328.26	336.69	345.15
All Other	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total		588.19	597.81	607.23	612.62	619.57	632.61	647.97	664.60	681.30
PROPERTY TAXES: TOT (\$M02)										
County		281.32	285.92	290.44	293.01	296.35	302.60	309.96	317.93	325.94
Cities and Towns		26.33	26.76	27.19	27.43	27.74	28.33	29.03	29.78	30.53
Community Colleges		76.56	77.82	79.05	79.75	80.66	82.36	84.36	86.53	88.71
Schools		403.92	410.54	417.02	420.73	425.51	434.49	445.08	456.53	468.03
All Other		46.78	47.55	48.31	48.74	49.30	50.34	51.58	52.92	54.26
Total		834.92	848.60	862.00	869.66	879.55	898.12	920.01	943.70	967.48
PROP. TAXES: TOT CUM. (\$M02)										
County		2,560.52	2,846.44	3,136.88	3,429.89	3,726.24	4,028.84	4,338.80	4,656.73	4,982.67
Cities and Towns		240.24	267.00	294.19	321.62	349.36	377.69	406.72	436.50	467.03
Community Colleges		697.03	774.85	853.90	933.64	1,014.30	1,096.66	1,181.02	1,267.56	1,356.27
Schools		3,677.48	4,088.02	4,505.04	4,925.77	5,351.28	5,785.77	6,230.84	6,687.38	7,155.41
All Other		427.15	474.70	523.01	571.74	621.04	671.38	722.96	775.88	830.15
Total		7,602.41	8,451.01	9,313.01	10,182.67	11,062.22	11,960.34	12,880.35	13,824.05	14,791.53

**Land Value and Property
Tax Projections - Scenario 1**

	Rate	20-21	21-22	22-23	23-24	Buildout	Annual Percent Change		
							1st 10 Yrs	2nd 10 Yrs	21st to BO
EXOGENOUS FACTORS									
CPI (2002=1.00)		1.739	1.803	1.871	1.942	4.167			
Population (lag 3 years)	1,176,205	1,197,048	1,218,244	1,239,756	1,944,480				
Emp. - Mining (lag 2 yrs)	1,287	1,291	1,306	1,315	1,367				
Emp. - Const. (lead 3 years)	34,527	35,164	35,760	36,348	51,462				
Wage&Sal. Earn (lag 3 yrs) (\$M)	31,349.52	33,692.65	36,243.52	38,854.10	195,107.21				
FULL NET VALUE: SEC (\$M)									
Mines	66.21	66.62	68.23	69.17	74.75		-6.72%	-0.21%	0.35%
Commercial Real Property	8,743.88	9,056.50	9,380.07	9,714.27	23,897.07		4.15%	3.58%	3.66%
Vacant Land	1,343.72	1,318.93	1,296.57	1,275.25	744.97		-2.32%	-2.07%	-2.11%
Residential - Owner Occupied	69,980.86	75,211.39	80,905.63	86,733.19	435,533.68		5.93%	6.84%	6.69%
Residential - Rental Occupied	8,131.07	8,421.79	8,722.68	9,033.46	22,222.28		4.15%	3.58%	3.66%
Other Real Property	1,891.94	2,185.32	2,528.75	2,906.16	73,281.14		12.21%	14.14%	13.82%
Total	90,157.68	96,260.55	102,901.93	109,731.51	555,753.90		5.17%	6.11%	6.70%
FULL NET VALUE: PRI (\$M)									
Mines	66.21	66.62	68.23	69.17	74.75		-6.72%	-0.21%	0.35%
Commercial Real Property	8,743.88	9,056.50	9,380.07	9,714.27	23,897.07		4.71%	3.58%	3.66%
Vacant Land	1,343.72	1,318.93	1,296.57	1,275.25	744.97		-0.29%	-2.07%	-2.11%
Residential - Owner Occupied	69,980.86	75,211.39	80,905.63	86,733.19	435,533.68		6.07%	6.84%	6.69%
Residential - Rental Occupied	8,131.07	8,421.79	8,722.68	9,033.46	22,222.28		4.57%	3.58%	3.66%
Other Real Property	1,357.85	1,564.72	1,805.73	2,080.84	73,281.14		10.05%	13.16%	15.31%
Total	89,623.59	95,639.95	102,178.91	108,906.19	555,753.90		5.48%	6.07%	6.73%
FULL NET VALUE: SEC (\$M02)									
Mines	38.07	36.94	36.47	35.62	17.94		-9.22%	-3.57%	-2.69%
Commercial Real Property	5,028.12	5,021.87	5,013.70	5,002.77	5,735.17		1.36%	0.09%	0.52%
Vacant Land	772.70	731.35	693.03	656.75	178.79		-4.93%	-5.37%	-5.08%
Residential - Owner Occupied	40,242.16	41,705.00	43,244.47	44,666.87	104,525.74		3.10%	3.24%	3.45%
Residential - Rental Occupied	4,675.74	4,669.91	4,662.32	4,652.16	5,333.23		1.36%	0.09%	0.52%
Other Real Property	1,087.95	1,211.77	1,351.63	1,496.65	17,587.08		9.21%	10.30%	10.37%
Total	51,844.74	53,376.84	55,001.61	56,510.81	133,377.95		2.36%	2.54%	3.47%

Land Value and Property Tax Projections - Scenario 1							Annual Percent Change		
	Rate	20-21	21-22	22-23	23-24	Buildout	1st 10 Yrs	2nd 10 Yrs	21st to BO
FULL NET VALUE: PRI (\$M02)									
Mines		38.07	36.94	36.47	35.62	17.94	-9.22%	-3.57%	-2.69%
Commercial Real Property		5,028.12	5,021.87	5,013.70	5,002.77	5,735.17	1.91%	0.09%	0.52%
Vacant Land		772.70	731.35	693.03	656.75	178.79	-2.96%	-5.37%	-5.08%
Residential - Owner Occupied		40,242.16	41,705.00	43,244.47	44,666.87	104,525.74	3.24%	3.24%	3.45%
Residential - Rental Occupied		4,675.74	4,669.91	4,662.32	4,652.16	5,333.23	1.77%	0.09%	0.52%
Other Real Property		780.83	867.64	965.17	1,071.61	17,587.08	7.11%	9.35%	11.81%
Total		51,537.62	53,032.71	54,615.15	56,085.78	133,377.95	2.66%	2.50%	3.49%
NET ASSESS VALUE: SEC (\$M)									
Mines	25%	16.55	16.65	17.06	17.29	18.69	-6.72%	-0.21%	0.35%
Commercial Real Property	25%	2,185.97	2,264.13	2,345.02	2,428.57	5,974.27	4.15%	3.58%	3.66%
Vacant Land	16%	215.00	211.03	207.45	204.04	119.20	-2.32%	-2.07%	-2.11%
Residential - Owner Occupied	10%	6,998.09	7,521.14	8,090.56	8,673.32	43,553.37	5.93%	6.84%	6.69%
Residential - Rental Occupied	10%	813.11	842.18	872.27	903.35	2,222.23	4.15%	3.58%	3.66%
Other Real Property	5%	94.60	109.27	126.44	145.31	3,664.06	12.21%	14.14%	13.82%
Total		10,323.31	10,964.39	11,658.79	12,371.87	55,551.81	4.80%	5.62%	6.19%
NET ASSESS VALUE: PRI (\$M)									
Mines	25%	16.55	16.65	17.06	17.29	18.69	-6.72%	-0.21%	0.35%
Commercial Real Property	25%	2,185.97	2,264.13	2,345.02	2,428.57	5,974.27	4.71%	3.58%	3.66%
Vacant Land	16%	215.00	211.03	207.45	204.04	119.20	-0.29%	-2.07%	-2.11%
Residential - Owner Occupied	10%	6,998.09	7,521.14	8,090.56	8,673.32	43,553.37	6.07%	6.84%	6.69%
Residential - Rental Occupied	10%	813.11	842.18	872.27	903.35	2,222.23	4.57%	3.58%	3.66%
Other Real Property	5%	67.89	78.24	90.29	104.04	3,664.06	10.05%	13.16%	15.31%
Total		10,296.60	10,933.36	11,622.64	12,330.61	55,551.81	5.20%	5.60%	6.20%
NET ASSESS VALUE: SEC (\$M02)									
Mines		9.52	9.24	9.12	8.91	4.48	-9.22%	-3.57%	-2.69%
Commercial Real Property		1,257.03	1,255.47	1,253.42	1,250.69	1,433.79	1.36%	0.09%	0.52%
Vacant Land		123.63	117.02	110.88	105.08	28.61	-4.93%	-5.37%	-5.08%
Residential - Owner Occupied		4,024.22	4,170.50	4,324.45	4,466.69	10,452.57	3.10%	3.24%	3.45%
Residential - Rental Occupied		467.57	466.99	466.23	465.22	533.32	1.36%	0.09%	0.52%
Other Real Property		54.40	60.59	67.58	74.83	879.35	9.21%	10.30%	10.37%
Total		5,936.37	6,079.80	6,231.69	6,371.41	13,332.13	1.99%	2.07%	2.97%

**Land Value and Property
Tax Projections - Scenario 1**

	Rate	20-21	21-22	22-23	23-24	Buildout	Annual Percent Change		
							1st 10 Yrs	2nd 10 Yrs	21st to BO
NET ASSESS VALUE: PRI (\$M02)									
Mines		9.52	9.24	9.12	8.91	4.48	-9.22%	-3.57%	-2.69%
Commercial Real Property		1,257.03	1,255.47	1,253.42	1,250.69	1,433.79	1.91%	0.09%	0.52%
Vacant Land		123.63	117.02	110.88	105.08	28.61	-2.96%	-5.37%	-5.08%
Residential - Owner Occupied		4,024.22	4,170.50	4,324.45	4,466.69	10,452.57	3.24%	3.24%	3.45%
Residential - Rental Occupied		467.57	466.99	466.23	465.22	533.32	1.77%	0.09%	0.52%
Other Real Property		39.04	43.38	48.26	53.58	879.35	7.11%	9.35%	11.81%
Total		5,921.01	6,062.59	6,212.36	6,350.16	13,332.13	2.39%	2.05%	2.98%
PROPERTY TAXES: SEC (\$M02)									
County	1.0732	63.71	65.25	66.88	68.38	143.08	1.99%	2.07%	2.97%
Cities and Towns	0.4276	25.38	25.99	26.64	27.24	57.00	1.99%	2.07%	2.97%
Community Colleges	0.3803	22.58	23.12	23.70	24.23	50.70	1.99%	2.07%	2.97%
Schools	2.1202	125.86	128.90	132.12	135.09	282.66	1.99%	2.07%	2.97%
All Other	0.9362	55.58	56.92	58.34	59.65	124.81	1.99%	2.07%	2.97%
Total		293.10	300.18	307.68	314.58	658.26	1.99%	2.07%	2.97%
PROPERTY TAXES: PRI (\$M02)									
County	4.5609	270.05	276.51	283.34	289.62	608.07	2.39%	2.05%	2.98%
Cities and Towns	0.0995	5.89	6.03	6.18	6.32	13.26	2.39%	2.05%	2.98%
Community Colleges	1.1530	68.27	69.90	71.63	73.22	153.72	2.39%	2.05%	2.98%
Schools	5.9688	353.41	361.87	370.81	379.03	795.77	2.39%	2.05%	2.98%
All Other	0.0000	0.00	0.00	0.00	0.00	0.00	0.00%	0.00%	0.00%
Total		697.63	714.31	731.95	748.19	1,570.82	2.39%	2.05%	2.98%
PROPERTY TAXES: TOT (\$M02)									
County		333.76	341.76	350.22	358.00	751.15	2.31%	2.05%	2.98%
Cities and Towns		31.27	32.02	32.82	33.56	70.26	2.07%	2.06%	2.97%
Community Colleges		90.85	93.02	95.33	97.45	204.42	2.29%	2.05%	2.98%
Schools		479.28	490.77	502.93	514.12	1,078.44	2.28%	2.05%	2.98%
All Other		55.58	56.92	58.34	59.65	124.81	1.99%	2.07%	2.97%
Total		990.73	1,014.49	1,039.64	1,062.77	2,229.08	2.27%	2.05%	2.98%
PROP. TAXES: TOT CUM. (\$M02)									
County		5,316.43	5,658.18	6,008.40	6,366.40	19,826.82	28.75%	7.76%	4.70%
Cities and Towns		498.30	530.33	563.15	596.71	1,856.89	28.46%	7.75%	4.70%
Community Colleges		1,447.12	1,540.14	1,635.47	1,732.92	5,396.41	28.72%	7.76%	4.70%
Schools		7,634.69	8,125.46	8,628.38	9,142.50	28,469.86	28.71%	7.76%	4.70%
All Other		885.72	942.64	1,000.98	1,060.63	3,299.81	28.38%	7.75%	4.69%
Total		15,782.26	16,796.75	17,836.38	18,899.16	58,849.80	28.70%	7.76%	4.70%

**Land Value and Property
Tax Projections - Scenarios 2 & 3**

Rate	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11
EXOGENOUS FACTORS									
CPI (2002=1.00)	1.013	1.041	1.070	1.100	1.130	1.160	1.190	1.222	1.255
Population (lag 3 years)	833,931	855,557	876,626	897,604	914,525	933,686	954,235	973,978	994,559
Emp. - Mining (lag 2 yrs)	1,870	1,658	1,538	1,595	1,551	1,505	1,482	1,458	1,428
Emp. - Const. (lead 3 years)	23,963	24,806	25,761	26,866	28,160	29,752	31,661	33,027	33,774
Wage&Sal. Earn (lag 3 yrs) (\$M)	10,516.04	11,196.07	11,642.00	12,202.63	13,125.87	14,112.11	15,052.16	16,031.78	17,073.44
FULL NET VALUE: SEC (\$M)									
Mines	139.81	109.96	94.56	101.76	96.22	90.56	87.81	85.04	81.54
Commercial Real Property	4,395.40	4,626.32	4,856.98	5,092.22	5,286.02	5,509.85	5,755.04	5,995.64	6,251.71
Vacant Land	2,020.78	1,949.64	1,874.61	1,794.22	1,707.73	1,611.21	1,507.83	1,442.78	1,410.17
Residential - Owner Occupied	23,474.74	24,992.74	25,988.20	27,239.67	29,300.60	31,502.16	33,600.62	35,787.39	38,112.68
Residential - Rental Occupied	4,087.35	4,302.09	4,516.58	4,735.34	4,915.55	5,123.69	5,351.71	5,575.45	5,813.57
Other Real Property	212.89	241.31	260.92	286.65	331.67	383.38	436.16	494.78	561.16
Total	34,330.97	36,222.06	37,591.85	39,249.86	41,637.79	44,220.85	46,739.16	49,381.07	52,230.83
FULL NET VALUE: PRI (\$M)									
Mines	139.81	109.96	94.56	101.76	96.22	90.56	87.81	85.04	81.54
Commercial Real Property	4,164.52	4,580.97	4,856.98	5,092.22	5,286.02	5,509.85	5,755.04	5,995.64	6,251.71
Vacant Land	1,645.44	1,809.98	1,874.61	1,794.22	1,707.73	1,611.21	1,507.83	1,442.78	1,410.17
Residential - Owner Occupied	23,164.76	24,992.74	25,988.20	27,239.67	29,300.60	31,502.16	33,600.62	35,787.39	38,112.68
Residential - Rental Occupied	3,925.92	4,302.09	4,516.58	4,735.34	4,915.55	5,123.69	5,351.71	5,575.45	5,813.57
Other Real Property	201.30	221.43	243.57	267.93	294.72	324.19	356.61	392.27	434.49
Total	33,241.75	36,017.18	37,574.50	39,231.14	41,600.85	44,161.66	46,659.62	49,278.57	52,104.16
FULL NET VALUE: SEC (\$M02)									
Mines	138.01	105.66	88.35	92.50	85.14	78.05	73.76	69.60	64.98
Commercial Real Property	4,338.87	4,445.39	4,538.13	4,628.53	4,677.11	4,749.06	4,834.24	4,907.45	4,982.21
Vacant Land	1,994.80	1,873.39	1,751.54	1,630.84	1,511.02	1,388.74	1,266.57	1,180.92	1,123.81
Residential - Owner Occupied	23,172.85	24,015.30	24,282.12	24,759.29	25,925.41	27,152.40	28,224.52	29,292.08	30,373.35
Residential - Rental Occupied	4,034.79	4,133.84	4,220.08	4,304.15	4,349.32	4,416.23	4,495.44	4,563.52	4,633.04
Other Real Property	210.15	231.87	243.79	260.55	293.46	330.44	366.37	404.98	447.21
Total	33,889.46	34,805.45	35,124.02	35,675.87	36,841.45	38,114.93	39,260.90	40,418.54	41,624.60

**Land Value and Property
Tax Projections - Scenarios 2 & 3**

	Rate	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11
FULL NET VALUE: PRI (\$M02)										
Mines		138.01	105.66	88.35	92.50	85.14	78.05	73.76	69.60	64.98
Commercial Real Property		4,110.96	4,401.81	4,538.13	4,628.53	4,677.11	4,749.06	4,834.24	4,907.45	4,982.21
Vacant Land		1,624.28	1,739.20	1,751.54	1,630.84	1,511.02	1,388.74	1,266.57	1,180.92	1,123.81
Residential - Owner Occupied		22,866.85	24,015.30	24,282.12	24,759.29	25,925.41	27,152.40	28,224.52	29,292.08	30,373.35
Residential - Rental Occupied		3,875.44	4,133.84	4,220.08	4,304.15	4,349.32	4,416.23	4,495.44	4,563.52	4,633.04
Other Real Property		198.71	212.77	227.58	243.53	260.77	279.43	299.55	321.08	346.26
Total		32,814.25	34,608.58	35,107.81	35,658.85	36,808.76	38,063.91	39,194.08	40,334.64	41,523.65
NET ASSESS VALUE: SEC (\$M)										
Mines	25%	34.95	27.49	23.64	25.44	24.06	22.64	21.95	21.26	20.38
Commercial Real Property	25%	1,098.85	1,156.58	1,214.24	1,273.05	1,321.50	1,377.46	1,438.76	1,498.91	1,562.93
Vacant Land	16%	323.33	311.94	299.94	287.07	273.24	257.79	241.25	230.84	225.63
Residential - Owner Occupied	10%	2,347.47	2,499.27	2,598.82	2,723.97	2,930.06	3,150.22	3,360.06	3,578.74	3,811.27
Residential - Rental Occupied	10%	408.74	430.21	451.66	473.53	491.56	512.37	535.17	557.54	581.36
Other Real Property	5%	10.64	12.07	13.05	14.33	16.58	19.17	21.81	24.74	28.06
Total		4,223.98	4,437.56	4,601.35	4,797.40	5,057.00	5,339.65	5,619.01	5,912.04	6,229.62
NET ASSESS VALUE: PRI (\$M)										
Mines	25%	34.95	27.49	23.64	25.44	24.06	22.64	21.95	21.26	20.38
Commercial Real Property	25%	1,041.13	1,145.24	1,214.24	1,273.05	1,321.50	1,377.46	1,438.76	1,498.91	1,562.93
Vacant Land	16%	263.27	289.60	299.94	287.07	273.24	257.79	241.25	230.84	225.63
Residential - Owner Occupied	10%	2,316.48	2,499.27	2,598.82	2,723.97	2,930.06	3,150.22	3,360.06	3,578.74	3,811.27
Residential - Rental Occupied	10%	392.59	430.21	451.66	473.53	491.56	512.37	535.17	557.54	581.36
Other Real Property	5%	10.06	11.07	12.18	13.40	14.74	16.21	17.83	19.61	21.72
Total		4,058.49	4,402.89	4,600.48	4,796.47	5,055.15	5,336.69	5,615.03	5,906.91	6,223.29
NET ASSESS VALUE: SEC (\$M02)										
Mines		34.50	26.42	22.09	23.12	21.29	19.51	18.44	17.40	16.25
Commercial Real Property		1,084.72	1,111.35	1,134.53	1,157.13	1,169.28	1,187.26	1,208.56	1,226.86	1,245.55
Vacant Land		319.17	299.74	280.25	260.93	241.76	222.20	202.65	188.95	179.81
Residential - Owner Occupied		2,317.28	2,401.53	2,428.21	2,475.93	2,592.54	2,715.24	2,822.45	2,929.21	3,037.33
Residential - Rental Occupied		403.48	413.38	422.01	430.41	434.93	441.62	449.54	456.35	463.30
Other Real Property		10.51	11.59	12.19	13.03	14.67	16.52	18.32	20.25	22.36
Total		4,169.66	4,264.01	4,299.28	4,360.56	4,474.47	4,602.36	4,719.96	4,839.02	4,964.61

**Land Value and Property
Tax Projections - Scenarios 2 & 3**

	Rate	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11
NET ASSESS VALUE: PRI (\$M02)										
Mines		34.50	26.42	22.09	23.12	21.29	19.51	18.44	17.40	16.25
Commercial Real Property		1,027.74	1,100.45	1,134.53	1,157.13	1,169.28	1,187.26	1,208.56	1,226.86	1,245.55
Vacant Land		259.88	278.27	280.25	260.93	241.76	222.20	202.65	188.95	179.81
Residential - Owner Occupied		2,286.69	2,401.53	2,428.21	2,475.93	2,592.54	2,715.24	2,822.45	2,929.21	3,037.33
Residential - Rental Occupied		387.54	413.38	422.01	430.41	434.93	441.62	449.54	456.35	463.30
Other Real Property		9.94	10.64	11.38	12.18	13.04	13.97	14.98	16.05	17.31
Total		4,006.29	4,230.69	4,298.47	4,359.71	4,472.84	4,599.81	4,716.62	4,834.82	4,959.56
PROPERTY TAXES: SEC (\$M02)										
County	1.0732	44.75	45.76	46.14	46.80	48.02	49.39	50.65	51.93	53.28
Cities and Towns	0.4276	17.83	18.23	18.38	18.64	19.13	19.68	20.18	20.69	21.23
Community Colleges	0.3803	15.86	16.22	16.35	16.58	17.02	17.50	17.95	18.40	18.88
Schools	2.1202	88.40	90.40	91.15	92.45	94.87	97.58	100.07	102.60	105.26
All Other	0.9362	39.04	39.92	40.25	40.82	41.89	43.09	44.19	45.30	46.48
Total		205.87	210.53	212.27	215.30	220.92	227.24	233.04	238.92	245.12
PROPERTY TAXES: PRI (\$M02)										
County	4.5609	182.72	192.96	196.05	198.84	204.00	209.79	215.12	220.51	226.20
Cities and Towns	0.0995	3.98	4.21	4.28	4.34	4.45	4.57	4.69	4.81	4.93
Community Colleges	1.1530	46.19	48.78	49.56	50.27	51.57	53.04	54.38	55.75	57.18
Schools	5.9688	239.13	252.52	256.57	260.22	266.98	274.55	281.53	288.58	296.03
All Other	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total		472.03	498.47	506.45	513.67	527.00	541.96	555.72	569.65	584.34
PROPERTY TAXES: TOT (\$M02)										
County		227.47	238.72	242.19	245.64	252.02	259.19	265.78	272.44	279.48
Cities and Towns		21.81	22.44	22.66	22.98	23.58	24.25	24.87	25.50	26.16
Community Colleges		62.05	65.00	65.91	66.85	68.59	70.54	72.33	74.15	76.06
Schools		327.53	342.93	347.72	352.68	361.84	372.13	381.60	391.18	401.29
All Other		39.04	39.92	40.25	40.82	41.89	43.09	44.19	45.30	46.48
Total		677.90	709.00	718.73	728.97	747.92	769.20	788.77	808.57	829.47
PROP. TAXES: TOT CUM. (\$M02)										
County		227.47	466.19	708.38	954.02	1,206.04	1,465.23	1,731.00	2,003.45	2,282.93
Cities and Towns		21.81	44.25	66.91	89.89	113.47	137.72	162.59	188.09	214.25
Community Colleges		62.05	127.05	192.96	259.81	328.40	398.93	471.27	545.42	621.48
Schools		327.53	670.46	1,018.18	1,370.86	1,732.70	2,104.83	2,486.43	2,877.61	3,278.89
All Other		39.04	78.95	119.20	160.03	201.92	245.00	289.19	334.49	380.97
Total		677.90	1,386.90	2,105.63	2,834.60	3,582.52	4,351.72	5,140.48	5,949.05	6,778.52

**Land Value and Property
Tax Projections - Scenarios 2 & 3**

Rate	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20
EXOGENOUS FACTORS									
CPI (2002=1.00)	1.290	1.328	1.369	1.412	1.459	1.509	1.562	1.619	1.677
Population (lag 3 years)	1,016,369	1,039,777	1,065,115	1,092,877	1,124,301	1,151,252	1,171,857	1,193,075	1,214,733
Emp. - Mining (lag 2 yrs)	1,399	1,380	1,352	1,331	1,337	1,346	1,356	1,362	1,369
Emp. - Const. (lead 3 years)	34,640	35,542	36,422	37,267	38,112	38,957	39,761	40,537	41,316
Wage&Sal. Earn (lag 3 yrs) (\$M)	18,149.24	19,325.52	20,637.82	21,894.30	23,217.80	24,854.53	26,754.46	28,853.65	31,077.28
FULL NET VALUE: SEC (\$M)									
Mines	78.27	76.21	73.17	70.89	71.46	72.43	73.53	74.17	74.99
Commercial Real Property	6,528.91	6,833.10	7,170.18	7,548.83	7,989.20	8,376.81	8,679.34	8,996.49	9,326.09
Vacant Land	1,373.98	1,338.23	1,305.10	1,274.81	1,245.91	1,218.26	1,193.14	1,169.85	1,147.35
Residential - Owner Occupied	40,514.17	43,139.94	46,069.36	48,874.18	51,828.60	55,482.25	59,723.41	64,409.39	69,373.14
Residential - Rental Occupied	6,071.34	6,354.21	6,667.67	7,019.78	7,429.28	7,789.73	8,071.06	8,365.99	8,672.48
Other Real Property	634.11	718.97	819.92	922.80	1,037.74	1,189.21	1,377.96	1,602.68	1,859.22
Total	55,200.78	58,460.66	62,105.40	65,711.29	69,602.19	74,128.69	79,118.46	84,618.58	90,453.28
FULL NET VALUE: PRI (\$M)									
Mines	78.27	76.21	73.17	70.89	71.46	72.43	73.53	74.17	74.99
Commercial Real Property	6,528.91	6,833.10	7,170.18	7,548.83	7,989.20	8,376.81	8,679.34	8,996.49	9,326.09
Vacant Land	1,373.98	1,338.23	1,305.10	1,274.81	1,245.91	1,218.26	1,193.14	1,169.85	1,147.35
Residential - Owner Occupied	40,514.17	43,139.94	46,069.36	48,874.18	51,828.60	55,482.25	59,723.41	64,409.39	69,373.14
Residential - Rental Occupied	6,071.34	6,354.21	6,667.67	7,019.78	7,429.28	7,789.73	8,071.06	8,365.99	8,672.48
Other Real Property	484.40	543.04	612.26	689.90	776.86	879.94	1,004.45	1,154.01	1,330.31
Total	55,051.07	58,284.73	61,897.74	65,478.39	69,341.31	73,819.43	78,744.94	84,169.90	89,924.37
FULL NET VALUE: SEC (\$M02)									
Mines	60.66	57.37	53.45	50.19	48.99	48.01	47.07	45.82	44.70
Commercial Real Property	5,060.01	5,143.89	5,237.52	5,345.03	5,476.70	5,551.95	5,555.62	5,558.20	5,559.69
Vacant Land	1,064.86	1,007.41	953.32	902.64	854.09	807.43	763.73	722.75	683.99
Residential - Owner Occupied	31,399.12	32,475.32	33,651.77	34,605.87	35,529.22	36,772.31	38,228.75	39,793.31	41,356.35
Residential - Rental Occupied	4,705.38	4,783.39	4,870.46	4,970.43	5,092.88	5,162.85	5,166.26	5,168.66	5,170.04
Other Real Property	491.44	541.23	598.92	653.40	711.38	788.18	882.03	990.17	1,108.36
Total	42,781.47	44,008.60	45,365.43	46,527.56	47,713.25	49,130.73	50,643.46	52,278.92	53,923.14

**Land Value and Property
Tax Projections - Scenarios 2 & 3**

	Rate	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20
FULL NET VALUE: PRI (\$M02)										
Mines		60.66	57.37	53.45	50.19	48.99	48.01	47.07	45.82	44.70
Commercial Real Property		5,060.01	5,143.89	5,237.52	5,345.03	5,476.70	5,551.95	5,555.62	5,558.20	5,559.69
Vacant Land		1,064.86	1,007.41	953.32	902.64	854.09	807.43	763.73	722.75	683.99
Residential - Owner Occupied		31,399.12	32,475.32	33,651.77	34,605.87	35,529.22	36,772.31	38,228.75	39,793.31	41,356.35
Residential - Rental Occupied		4,705.38	4,783.39	4,870.46	4,970.43	5,092.88	5,162.85	5,166.26	5,168.66	5,170.04
Other Real Property		375.42	408.79	447.23	488.49	532.55	583.21	642.94	712.97	793.06
Total		42,665.45	43,876.16	45,213.75	46,362.65	47,534.42	48,925.76	50,404.37	52,001.72	53,607.83
NET ASSESS VALUE: SEC (\$M)										
Mines	25%	19.57	19.05	18.29	17.72	17.86	18.11	18.38	18.54	18.75
Commercial Real Property	25%	1,632.23	1,708.27	1,792.55	1,887.21	1,997.30	2,094.20	2,169.84	2,249.12	2,331.52
Vacant Land	16%	219.84	214.12	208.82	203.97	199.35	194.92	190.90	187.18	183.58
Residential - Owner Occupied	10%	4,051.42	4,313.99	4,606.94	4,887.42	5,182.86	5,548.23	5,972.34	6,440.94	6,937.31
Residential - Rental Occupied	10%	607.13	635.42	666.77	701.98	742.93	778.97	807.11	836.60	867.25
Other Real Property	5%	31.71	35.95	41.00	46.14	51.89	59.46	68.90	80.13	92.96
Total		6,561.89	6,926.81	7,334.35	7,744.44	8,192.19	8,693.89	9,227.47	9,812.51	10,431.37
NET ASSESS VALUE: PRI (\$M)										
Mines	25%	19.57	19.05	18.29	17.72	17.86	18.11	18.38	18.54	18.75
Commercial Real Property	25%	1,632.23	1,708.27	1,792.55	1,887.21	1,997.30	2,094.20	2,169.84	2,249.12	2,331.52
Vacant Land	16%	219.84	214.12	208.82	203.97	199.35	194.92	190.90	187.18	183.58
Residential - Owner Occupied	10%	4,051.42	4,313.99	4,606.94	4,887.42	5,182.86	5,548.23	5,972.34	6,440.94	6,937.31
Residential - Rental Occupied	10%	607.13	635.42	666.77	701.98	742.93	778.97	807.11	836.60	867.25
Other Real Property	5%	24.22	27.15	30.61	34.49	38.84	44.00	50.22	57.70	66.52
Total		6,554.40	6,918.01	7,323.97	7,732.79	8,179.14	8,678.43	9,208.79	9,790.08	10,404.92
NET ASSESS VALUE: SEC (\$M02)										
Mines		15.16	14.34	13.36	12.55	12.25	12.00	11.77	11.46	11.18
Commercial Real Property		1,265.00	1,285.97	1,309.38	1,336.26	1,369.18	1,387.99	1,388.90	1,389.55	1,389.92
Vacant Land		170.38	161.19	152.53	144.42	136.65	129.19	122.20	115.64	109.44
Residential - Owner Occupied		3,139.91	3,247.53	3,365.18	3,460.59	3,552.92	3,677.23	3,822.88	3,979.33	4,135.64
Residential - Rental Occupied		470.54	478.34	487.05	497.04	509.29	516.28	516.63	516.87	517.00
Other Real Property		24.57	27.06	29.95	32.67	35.57	39.41	44.10	49.51	55.42
Total		5,085.57	5,214.43	5,357.44	5,483.53	5,615.85	5,762.10	5,906.47	6,062.35	6,218.59

**Land Value and Property
Tax Projections - Scenarios 2 & 3**

	Rate	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20
NET ASSESS VALUE: PRI (\$M02)										
Mines		15.16	14.34	13.36	12.55	12.25	12.00	11.77	11.46	11.18
Commercial Real Property		1,265.00	1,285.97	1,309.38	1,336.26	1,369.18	1,387.99	1,388.90	1,389.55	1,389.92
Vacant Land		170.38	161.19	152.53	144.42	136.65	129.19	122.20	115.64	109.44
Residential - Owner Occupied		3,139.91	3,247.53	3,365.18	3,460.59	3,552.92	3,677.23	3,822.88	3,979.33	4,135.64
Residential - Rental Occupied		470.54	478.34	487.05	497.04	509.29	516.28	516.63	516.87	517.00
Other Real Property		18.77	20.44	22.36	24.42	26.63	29.16	32.15	35.65	39.65
Total		5,079.77	5,207.81	5,349.86	5,475.28	5,606.91	5,751.86	5,894.52	6,048.49	6,202.83
PROPERTY TAXES: SEC (\$M02)										
County	1.0732	54.58	55.96	57.50	58.85	60.27	61.84	63.39	65.06	66.74
Cities and Towns	0.4276	21.74	22.29	22.91	23.45	24.01	24.64	25.25	25.92	26.59
Community Colleges	0.3803	19.34	19.83	20.37	20.85	21.36	21.91	22.46	23.05	23.65
Schools	2.1202	107.82	110.56	113.59	116.26	119.07	122.17	125.23	128.53	131.85
All Other	0.9362	47.61	48.82	50.16	51.34	52.57	53.94	55.30	56.75	58.22
Total		251.10	257.46	264.52	270.74	277.28	284.50	291.63	299.32	307.04
PROPERTY TAXES: PRI (\$M02)										
County	4.5609	231.68	237.52	244.00	249.72	255.73	262.34	268.84	275.87	282.90
Cities and Towns	0.0995	5.05	5.18	5.32	5.45	5.58	5.72	5.86	6.02	6.17
Community Colleges	1.1530	58.57	60.05	61.68	63.13	64.65	66.32	67.96	69.74	71.52
Schools	5.9688	303.20	310.85	319.32	326.81	334.67	343.32	351.83	361.02	370.24
All Other	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total		598.51	613.59	630.33	645.11	660.62	677.69	694.50	712.65	730.83
PROPERTY TAXES: TOT (\$M02)										
County		286.26	293.48	301.50	308.57	316.00	324.18	332.23	340.93	349.64
Cities and Towns		26.80	27.47	28.23	28.89	29.59	30.36	31.12	31.94	32.76
Community Colleges		77.91	79.88	82.06	83.98	86.00	88.23	90.43	92.79	95.17
Schools		411.03	421.40	432.91	443.07	453.73	465.49	477.06	489.56	502.08
All Other		47.61	48.82	50.16	51.34	52.57	53.94	55.30	56.75	58.22
Total		849.60	871.05	894.85	915.85	937.90	962.19	986.13	1,011.97	1,037.87
PROP. TAXES: TOT CUM. (\$M02)										
County		2,569.19	2,862.67	3,164.17	3,472.74	3,788.74	4,112.91	4,445.14	4,786.07	5,135.71
Cities and Towns		241.05	268.52	296.75	325.64	355.22	385.58	416.70	448.63	481.39
Community Colleges		699.39	779.27	861.32	945.31	1,031.31	1,119.55	1,209.97	1,302.77	1,397.93
Schools		3,689.92	4,111.32	4,544.23	4,987.30	5,441.03	5,906.52	6,383.58	6,873.14	7,375.22
All Other		428.58	477.40	527.55	578.89	631.47	685.41	740.70	797.46	855.68
Total		7,628.12	8,499.18	9,394.03	10,309.88	11,247.77	12,209.97	13,196.10	14,208.07	15,245.93

**Land Value and Property
Tax Projections - Scenarios 2 & 3**

	Rate	20-21	21-22	22-23	23-24	Buildout	Annual Percent Change		
							1st 10 Yrs	2nd 10 Yrs	21st to BO
EXOGENOUS FACTORS									
CPI (2002=1.00)		1.739	1.803	1.871	1.942	3.690			
Population (lag 3 years)	1,236,763	1,259,085	1,281,781	1,304,810	1,304,810	1,933,723			
Emp. - Mining (lag 2 yrs)	1,376	1,380	1,397	1,407	1,407	1,462			
Emp. - Const. (lead 3 years)	42,113	42,890	43,617	44,335	44,335	57,601			
Wage&Sal. Earn (lag 3 yrs) (\$M)	33,405.68	35,900.58	38,611.82	41,390.42	41,390.42	165,148.94			
FULL NET VALUE: SEC (\$M)									
Mines	75.75	76.22	78.07	79.15	79.15	85.53	-5.89%	0.24%	0.42%
Commercial Real Property	9,667.42	10,019.54	10,384.02	10,760.49	10,760.49	23,633.40	4.51%	4.27%	3.81%
Vacant Land	1,125.22	1,104.46	1,085.74	1,067.89	1,067.89	748.33	-4.04%	-2.07%	-1.68%
Residential - Owner Occupied	74,570.78	80,140.10	86,192.34	92,394.96	92,394.96	368,658.48	6.27%	7.17%	6.83%
Residential - Rental Occupied	8,989.89	9,317.33	9,656.27	10,006.36	10,006.36	21,977.09	4.51%	4.27%	3.81%
Other Real Property	2,148.26	2,481.12	2,870.03	3,297.96	3,297.96	52,504.58	12.94%	14.85%	14.12%
Total	96,577.32	103,138.78	110,266.46	117,606.80	117,606.80	467,607.40	5.47%	6.55%	6.79%
FULL NET VALUE: PRI (\$M)									
Mines	75.75	76.22	78.07	79.15	79.15	85.53	-5.89%	0.24%	0.42%
Commercial Real Property	9,667.42	10,019.54	10,384.02	10,760.49	10,760.49	23,633.40	5.08%	4.27%	3.81%
Vacant Land	1,125.22	1,104.46	1,085.74	1,067.89	1,067.89	748.33	-2.05%	-2.07%	-1.68%
Residential - Owner Occupied	74,570.78	80,140.10	86,192.34	92,394.96	92,394.96	368,658.48	6.42%	7.17%	6.83%
Residential - Rental Occupied	8,989.89	9,317.33	9,656.27	10,006.36	10,006.36	21,977.09	4.93%	4.27%	3.81%
Other Real Property	1,534.80	1,771.38	2,046.04	2,359.02	2,359.02	52,504.58	10.43%	14.18%	15.89%
Total	95,963.86	102,429.03	109,442.47	116,667.86	116,667.86	467,607.40	5.78%	6.50%	6.82%
FULL NET VALUE: SEC (\$M02)									
Mines	43.56	42.27	41.73	40.76	40.76	23.18	-8.40%	-3.13%	-2.64%
Commercial Real Property	5,559.20	5,555.87	5,550.31	5,541.56	5,541.56	6,404.96	1.72%	0.76%	0.65%
Vacant Land	647.05	612.43	580.33	549.95	549.95	202.81	-6.60%	-5.37%	-4.67%
Residential - Owner Occupied	42,881.57	44,437.99	46,070.24	47,582.63	47,582.63	99,911.25	3.43%	3.56%	3.58%
Residential - Rental Occupied	5,169.59	5,166.49	5,161.32	5,153.19	5,153.19	5,956.08	1.72%	0.76%	0.65%
Other Real Property	1,235.34	1,375.79	1,534.04	1,698.42	1,698.42	14,229.42	9.92%	10.98%	10.65%
Total	55,536.33	57,190.84	58,937.99	60,566.52	60,566.52	126,727.70	2.65%	2.96%	3.54%

Land Value and Property Tax Projections - Scenarios 2 & 3							Annual Percent Change		
	Rate	20-21	21-22	22-23	23-24	Buildout	1st 10 Yrs	2nd 10 Yrs	21st to BO
FULL NET VALUE: PRI (\$M02)									
Mines		43.56	42.27	41.73	40.76	23.18	-8.40%	-3.13%	-2.64%
Commercial Real Property		5,559.20	5,555.87	5,550.31	5,541.56	6,404.96	2.27%	0.76%	0.65%
Vacant Land		647.05	612.43	580.33	549.95	202.81	-4.66%	-5.37%	-4.67%
Residential - Owner Occupied		42,881.57	44,437.99	46,070.24	47,582.63	99,911.25	3.57%	3.56%	3.58%
Residential - Rental Occupied		5,169.59	5,166.49	5,161.32	5,153.19	5,956.08	2.13%	0.76%	0.65%
Other Real Property		882.58	982.24	1,093.62	1,214.88	14,229.42	7.48%	10.34%	12.37%
Total		55,183.56	56,797.29	58,497.56	60,082.98	126,727.70	2.95%	2.92%	3.58%
NET ASSESS VALUE: SEC (\$M)									
Mines	25%	18.94	19.06	19.52	19.79	21.38	-5.89%	0.24%	0.42%
Commercial Real Property	25%	2,416.86	2,504.88	2,596.00	2,690.12	5,908.35	4.51%	4.27%	3.81%
Vacant Land	16%	180.04	176.71	173.72	170.86	119.73	-4.04%	-2.07%	-1.68%
Residential - Owner Occupied	10%	7,457.08	8,014.01	8,619.23	9,239.50	36,865.85	6.27%	7.17%	6.83%
Residential - Rental Occupied	10%	898.99	931.73	965.63	1,000.64	2,197.71	4.51%	4.27%	3.81%
Other Real Property	5%	107.41	124.06	143.50	164.90	2,625.23	12.94%	14.85%	14.12%
Total		11,079.31	11,770.45	12,517.60	13,285.80	47,738.25	5.07%	6.10%	6.27%
NET ASSESS VALUE: PRI (\$M)									
Mines	25%	18.94	19.06	19.52	19.79	21.38	-5.89%	0.24%	0.42%
Commercial Real Property	25%	2,416.86	2,504.88	2,596.00	2,690.12	5,908.35	5.08%	4.27%	3.81%
Vacant Land	16%	180.04	176.71	173.72	170.86	119.73	-2.05%	-2.07%	-1.68%
Residential - Owner Occupied	10%	7,457.08	8,014.01	8,619.23	9,239.50	36,865.85	6.42%	7.17%	6.83%
Residential - Rental Occupied	10%	898.99	931.73	965.63	1,000.64	2,197.71	4.93%	4.27%	3.81%
Other Real Property	5%	76.74	88.57	102.30	117.95	2,625.23	10.43%	14.18%	15.89%
Total		11,048.64	11,734.97	12,476.40	13,238.85	47,738.25	5.48%	6.07%	6.29%
NET ASSESS VALUE: SEC (\$M02)									
Mines		10.89	10.57	10.43	10.19	5.79	-8.40%	-3.13%	-2.64%
Commercial Real Property		1,389.80	1,388.97	1,387.58	1,385.39	1,601.24	1.72%	0.76%	0.65%
Vacant Land		103.53	97.99	92.85	87.99	32.45	-6.60%	-5.37%	-4.67%
Residential - Owner Occupied		4,288.16	4,443.80	4,607.02	4,758.26	9,991.12	3.43%	3.56%	3.58%
Residential - Rental Occupied		516.96	516.65	516.13	515.32	595.61	1.72%	0.76%	0.65%
Other Real Property		61.77	68.79	76.70	84.92	711.47	9.92%	10.98%	10.65%
Total		6,371.10	6,526.76	6,690.72	6,842.08	12,937.69	2.26%	2.52%	3.04%

**Land Value and Property
Tax Projections - Scenarios 2 & 3**

	Rate	20-21	21-22	22-23	23-24	Buildout	Annual Percent Change		
							1st 10 Yrs	2nd 10 Yrs	21st to BO
NET ASSESS VALUE: PRI (\$M02)									
Mines		10.89	10.57	10.43	10.19	5.79	-8.40%	-3.13%	-2.64%
Commercial Real Property		1,389.80	1,388.97	1,387.58	1,385.39	1,601.24	2.27%	0.76%	0.65%
Vacant Land		103.53	97.99	92.85	87.99	32.45	-4.66%	-5.37%	-4.67%
Residential - Owner Occupied		4,288.16	4,443.80	4,607.02	4,758.26	9,991.12	3.57%	3.56%	3.58%
Residential - Rental Occupied		516.96	516.65	516.13	515.32	595.61	2.13%	0.76%	0.65%
Other Real Property		44.13	49.11	54.68	60.74	711.47	7.48%	10.34%	12.37%
Total		6,353.47	6,507.08	6,668.70	6,817.90	12,937.69	2.66%	2.50%	3.06%
PROPERTY TAXES: SEC (\$M02)									
County	1.0732	68.37	70.05	71.80	73.43	138.85	2.26%	2.52%	3.04%
Cities and Towns	0.4276	27.24	27.91	28.61	29.25	55.32	2.26%	2.52%	3.04%
Community Colleges	0.3803	24.23	24.82	25.44	26.02	49.20	2.26%	2.52%	3.04%
Schools	2.1202	135.08	138.38	141.86	145.06	274.30	2.26%	2.52%	3.04%
All Other	0.9362	59.65	61.10	62.64	64.05	121.12	2.26%	2.52%	3.04%
Total		314.57	322.25	330.35	337.82	638.79	2.26%	2.52%	3.04%
PROPERTY TAXES: PRI (\$M02)									
County	4.5609	289.78	296.78	304.15	310.96	590.08	2.66%	2.50%	3.06%
Cities and Towns	0.0995	6.32	6.47	6.63	6.78	12.87	2.66%	2.50%	3.06%
Community Colleges	1.1530	73.26	75.03	76.89	78.61	149.17	2.66%	2.50%	3.06%
Schools	5.9688	379.23	388.40	398.04	406.95	772.23	2.66%	2.50%	3.06%
All Other	0.0000	0.00	0.00	0.00	0.00	0.00	0.00%	0.00%	0.00%
Total		748.58	766.68	785.72	803.30	1,524.34	2.66%	2.50%	3.06%
PROPERTY TAXES: TOT (\$M02)									
County		358.15	366.83	375.96	384.39	728.92	2.58%	2.51%	3.06%
Cities and Towns		33.56	34.38	35.24	36.03	68.18	2.33%	2.52%	3.05%
Community Colleges		97.48	99.85	102.33	104.63	198.37	2.56%	2.51%	3.05%
Schools		514.31	526.78	539.90	552.01	1,046.53	2.55%	2.51%	3.05%
All Other		59.65	61.10	62.64	64.05	121.12	2.26%	2.52%	3.04%
Total		1,063.15	1,088.93	1,116.07	1,141.12	2,163.13	2.54%	2.51%	3.05%
PROP. TAXES: TOT CUM. (\$M02)									
County		5,493.86	5,860.69	6,236.65	6,621.03	17,447.17	28.82%	8.10%	4.79%
Cities and Towns		514.95	549.33	584.57	620.60	1,634.45	28.54%	8.09%	4.78%
Community Colleges		1,495.42	1,595.27	1,697.60	1,802.23	4,748.84	28.79%	8.10%	4.79%
Schools		7,889.53	8,416.30	8,956.20	9,508.21	25,053.60	28.79%	8.10%	4.79%
All Other		915.32	976.43	1,039.06	1,103.12	2,904.73	28.45%	8.09%	4.78%
Total		16,309.08	17,398.01	18,514.08	19,655.20	51,788.79	28.77%	8.10%	4.79%

Appendix G Hotel/Motel Sales Tax

The purpose of this analysis was to build a reliable projection model of future hotel/motel taxable sales under the different scenarios. We used historical analysis of past data to build the model using correlations of an exogenous socioeconomic factor to taxable sales.

Correlation in this study is a measure of the degree of linear relationship between two variables: the exogenous factor (independent variable) and the target assessment factor (dependant variable). The correlation coefficient may take on any value between plus and minus one. The sign of the correlation coefficient defines the direction of the relationship, either positive or negative. A positive correlation coefficient means that as the value of one variable increases, the value of the dependant variable increases; as one decreases the other decreases. A negative correlation coefficient indicates that as one variable increases, the other decreases, and vice-versa. Taking the absolute value of the correlation coefficient measures the strength of the relationship. Thus a correlation coefficient of zero indicates the absence of a linear relationship, while correlation coefficients of +1.0 and -1.0 indicate a perfect linear relationship.

Marshall Vest the Director of Economic and Business Research at the Eller College of Business and Public Administration at the University of Arizona provided the historic socioeconomic data (exogenous factor) and baseline projections used in the analysis, the remainder were supplemented by ESI Corp.

Hotel/Motel Taxable Sales

Hotel/motel taxable sales activity shows a strong relationships to the total wage and salary employment squared in Pima County. It should be noted that tax revenues do not necessarily show these relationships since tax rates can change over time. The tax base (what items are taxable) can also change over time, but differences are less frequent. The table that follows shows correlations of taxable hotel/motel sales in unincorporated areas of Pima County to the total employment from the year 1997 to 2002.

Taxable Hotel & Motel Sales Correlations to Employment Square		
Year	Hotel & Motel Taxable Sales	Total Employment Squared
1997	113,544,652	163,187,721,225
1998	120,260,423	175,794,879,841
1999	126,366,769	185,225,222,884
2000	138,670,665	197,240,797,924
2001	132,240,442	195,732,801,889
2002	128,262,017	190,136,114,116
Correlation: 0.9706		

Since we were only able to obtain six years worth of historic taxable sales data for the unincorporated county, we conducted the same analysis on the nine years of data available for the county as a whole. This analysis resulted in similar correlation results. Furthermore, when the overlapping years were compared, the ratio of unincorporated to total taxable sales ranged from 44.8 percent to 47.1 percent, showing very little variance. These two factors combined provided additional support to the use of the total wage and salary employment to project future taxable sales.

Based on the strength of this correlation, the percent changes in the projected exogenous factor, discussed in detail in Appendix B was applied to the taxable sales values to project the future value of property in the county.

Since the data used in the analysis were for all Pima County, the results will overstate the impacts to Eastern Pima County due to development on the west side of the county.

Appendix H Relevant Sections from Habitat Conservation Planning Handbook and Addendum

From: U.S. Department of the Interior. Fish and Wildlife Service. U.S. Department of Commerce. National Oceanic and Atmospheric Administration. National Marine Fisheries Service. 1996. *Habitat Conservation Planning And Incidental Take Permit Processing Handbook*, November 4, 1996. <http://endangered.fws.gov/hcp/hcpbook.html>

4. Monitoring Measures.

The section 10 regulations require that an HCP specify the measures the applicant will take to "monitor" the impacts of the taking resulting from project actions [50 CFR 17.22(b)(1)(iii)(B) and 50 CFR 222.22(b)(5)(iii)]. Monitoring measures described in the HCP should be as specific as possible and be commensurate with the project's scope and the severity of its effects.

For regional and other large-scale HCPs, monitoring programs should include periodic accountings of take, surveys to determine species status in project areas or mitigation habitats, and progress reports on fulfillment of mitigation requirements (e.g., habitat acres acquired). Monitoring plans for HCPs should establish target milestones, to the extent practicable, or requirements throughout the life of the HCP, and where appropriate, adaptive management options (see Chapter 3, Section B.3(g)).

The following steps are logical elements for consideration in developing HCP monitoring programs for regional or other large-scale HCPs:

Develop objectives for the monitoring program. Any monitoring program associated with HCPs should answer specific questions or lead to specific conclusions. If the objectives are well developed, they will help shape a complete monitoring program.

Describe the subject of the monitoring program--e.g., effects on populations of affected species, effects on the habitat of the species, or effects on both.

Describe variables to be measured and how the data will be collected. Make sure these are consistent with the objectives of the monitoring program.

Detail the frequency, timing, and duration of sampling for the variables. Determining how frequently and how long to collect data is important to the success or failure of the monitoring program. If the interval between samples is too long or too short, the monitoring program may not detect an effect. The frequency, timing, and duration of the sampling regimen should also relate to the type of action being evaluated, the species affected by the action, and the response of the species to the effects produced by the action.

Describe how data are to be analyzed and who will conduct the analyses. A monitoring program is more effective when analytical methods are integrated into the design. For example, parametric and non-parametric statistical analyses require different sample sizes, which affect the frequency, timing, and duration of sampling.

Monitoring must be sufficient to detect trends in species populations in the plan area but should be as economical as possible. Avoid costly monitoring schemes that divert funds away from other important HCP programs, such as mitigation.

Monitoring programs can be carried out by a mutually-identified party other than the permittee, so long as this is specified in the HCP, funding is provided, and the party is qualified.

The FWS and NMFS also have a responsibility to monitor the implementation and success of HCPs. The Services may agree to specific monitoring responsibilities under the HCP, Implementing Agreement, or as part of the incidental take statement issued in conjunction with the section 7 biological opinion. Even if not specified in this manner, the agency still has the responsibility to monitor compliance with the terms of particular HCPs, including any adaptive management commitments incorporated into the HCP, and the section 10 program generally. One way to achieve this is to ensure that requirements for monitoring and status reports are included in HCPs where needed and by ensuring that such reports are submitted by permittees and reviewed by FWS or NMFS staff.

For regional HCPs, another way is to establish technical review teams to periodically evaluate HCP compliance and the success of adaptive management programs. Such teams could include species experts and representatives of the permittee, FWS, NMFS, and other affected public agencies. To maintain the credibility of the HCP, it may be beneficial to submit the technical team's findings to occasional review by recognized experts in pertinent fields (e.g., conservation biologists, re-vegetation specialists, etc.). Not all of the above steps are necessary for small-scale, low-effect HCPs, and should only be used as appropriate.

From: Federal Register Notice, June 1, 2000. Addendum to HCP Planning Handbook

MONITORING ISSUES AND RESPONSES

Issue 16: Several commenters stated that the Services should establish minimum standards or require scientific standards for the monitoring program within an HCP.

Response 16: The implementing regulations for an HCP (50 CFR 17.22, 17.32, and 222.307) require a monitoring component. The HCP Handbook includes guidance on what the monitoring component of an HCP should look like. However, we have refined that guidance and have incorporated it into the addendum. The Services agree that any methodology and techniques involved in biological aspects of monitoring should be based on science. The addendum does state that “The monitoring program will be based on sound science. Standard survey or other previously-established monitoring protocols should be used. Although the specific methods used to gather necessary data may differ depending on the species and habitat types, monitoring programs should use a multispecies approach when appropriate.” Monitoring approaches that are consistent with the Handbook and addendum should be adequate for assessing whether the HCP is achieving its biological goals and objectives.

Issue 17: Some commenters stated that it was difficult to distinguish between compliance monitoring and effects and effectiveness monitoring.

Response 17: The Services recognize that it may be difficult to distinguish between the two types of monitoring particularly when the actual monitoring actions may overlap. One way to distinguish between the two types is that compliance monitoring verifies that the permittee is carrying out the terms of the HCP, permit, and IA (if one is used) while effects and effectiveness monitoring evaluates the biological effects of the permitted action and determines whether the effectiveness of the operating conservation program of the HCP is consistent with the assumptions and predictions made when the HCP was developed and approved. The permittee is primarily responsible for ensuring that their HCP is working as planned and the Services are primarily responsible for monitoring whether the permittee is complying with permit requirements.

Issue 18: A few commenters suggested that the Services identify, in the addendum, minimum qualifications for personnel conducting monitoring.

Response 18: The addendum does state that the personnel conducting the monitoring should be qualified. However, the necessary qualifications depend upon what is being monitored. Since HCPs are highly variable, the addendum is flexible about the minimum qualifications of personnel conducting the monitoring, and the Services' staff will determine whether the person or company conducting the monitoring is qualified.

Issue 19: One commenter suggested the Services require all monitoring programs to include population counts.

Response 19: Population monitoring may not be appropriate for all HCPs. The scope of any HCP monitoring program should be in proportion to the scope of that HCP. If an HCP affects only a portion of a population, the permittee should not be responsible for monitoring the entire population. In addition, it may or may not be appropriate for a particular HCP to include counting of populations or individuals. The appropriate unit of measure in a monitoring program depends upon the specific impacts and operating conservation program within an HCP and the biological goals and objectives of the HCP. The unit of measure also depends on how the species uses the habitat to be affected. However, the Services should coordinate monitoring programs to obtain a larger picture of the status of a population.

Issue 20: Some commenters suggested that self-reporting should not be used as a means to demonstrate that the permittee is in compliance with the terms of an HCP.

Response 20: We are not limited to self-reporting for compliance monitoring. However, the limited resources available to the Services to conduct monitoring necessitates our reliance on the working relationships between us and the permittees to verify compliance. As discussed in the addendum, where appropriate, we may conduct our own evaluation, including site visits. The Services should be able to use the periodic reports made by permittees as one method in determining whether the permittee is in compliance. Periodic reports may be our first source of information about the implementation of an HCP. From these reports, we may catch discrepancies that alert us to possible implementation problems. Also, the information obtained to determine effects and effectiveness may be the same information needed to determine compliance. We do not want to use limited resources on duplicative monitoring efforts.

The Effect of Additional Policy Guidance on HCP Monitoring

This addendum does not impose any new monitoring requirements. Monitoring is already required by the section 10 regulations. In the preamble to the final rule promulgating the section 10 regulations, we agreed with a commenter that the Service should monitor the implementation of a conservation plan and accordingly finalized revisions to sections 17.22(b)(1)(iii)(B), 17.22(b)(3), 17.32(b)(1)(iii)(B) and 17.32(b)(3) to require that conservation plans specify the monitoring measures to be used and to authorize imposition of necessary monitoring as a condition of each permit." 50 FR 39681, 39684 (September 30, 1985). NMFS also included a monitoring requirement in their section 10 regulations (50 CFR 307 (d)). This addendum seeks to refine existing monitoring policy by organizing the types of monitoring being conducted into categories, including compliance monitoring, effect monitoring, and effectiveness monitoring. The addendum also seeks greater compatibility of monitoring data across HCPs. Neither of these policy additions is expected to have any economic impact. Current practice entails the HCP applicant and the Services working together to arrive at a monitoring program that, based on the specifics of the HCP and the species involved, is robust enough to provide the information the parties feel will be needed. This addendum does not alter current practice and instead reiterates the regulatory requirement and provides policy recognition and support for the current practice.

Monitoring

What Is Monitoring in the HCP Program?

Monitoring is a mandatory element of all HCPs (See 50 CFR 17.22, 17.32, and 222.307). When properly designed and implemented, monitoring programs for HCPs should provide the information necessary to assess compliance and project impacts, and verify progress toward the biological goals and objectives. Monitoring also provides the scientific data necessary to evaluate the success of the HCP's operating conservation programs with respect to the possible use of those strategies in future HCPs or other programs that contribute to the conservation of species and their habitat. The HCP Handbook already provides guidance for developing monitoring measures (Chapter 3, section B.4.) and discusses reporting requirements (Chapter 6, section E.4.). The following information further clarifies and provides additional guidance for the monitoring component of an HCP, permit, or IA.

What Are the Types of Monitoring That Can Be Incorporated Into HCPs?

The Services and the applicant must ensure that the monitoring program of an HCP provides information to: (1) Evaluate compliance; (2) determine if biological goals and objectives are being met; and (3) provide feedback information for an adaptive management strategy, if one is used. HCP monitoring is divided into two types. Compliance Monitoring is verifying that the permittee is carrying out the terms of the HCP, permit, and IA, if one is used. Effects and Effectiveness Monitoring evaluates the effects of the permitted action and determines whether the effectiveness of the operating conservation program of the HCP are consistent with the assumptions and predictions made when the HCP was developed and approved; in other words, is the HCP achieving the biological goals and objectives.

Scientific literature discussing monitoring uses similar terms as the addendum but the terms may have different meanings. For instance, the term "validation monitoring" is the same concept as the addendum's term "effectiveness monitoring." However, "effectiveness monitoring" in the scientific literature simply means measuring the status of species. "Implementation monitoring" is roughly equivalent to the addendum's term "compliance monitoring" with the added regulatory nature of the involvement of a permit.

What Determines the Extent of a Monitoring Program?

The scope of the monitoring program should be commensurate with the scope and duration of the operating conservation program and the project impacts. Biological goals and objectives provide a framework for developing a monitoring program that measures progress toward meeting those goals and objectives. If an HCP, permit, and/or IA has an adaptive management strategy, integrating the monitoring program into this strategy is crucial in order to guide any necessary changes in management.

Monitoring programs for large-scale or regional planning efforts may be elaborate and track more than one component of the HCP (e.g., habitat quality or collection of mitigation fees). Conversely, monitoring programs for HCPs with smaller impacts of short duration might only need to file simple reports that document whether the HCP has been implemented as described. For example, if an HCP affects only a portion of a population, the permittee should not generally be responsible for monitoring the entire population. In addition, it may not be appropriate for a monitoring program to involve counting of populations or individuals or making an assessment of habitat. The appropriate unit of measure in a monitoring program depends upon the specific impacts and operating conservation program within an HCP. The Services are responsible for ensuring that the appropriate units of measure and protocols are used and should coordinate monitoring programs to obtain a larger view of the status of a population. The applicant and the Services should also design the monitoring program to reflect the structure of the biological goals and objectives.

The monitoring program should reflect the measurable biological goals and objectives. The following components are essential for most monitoring protocols (the size and scope of the HCP will dictate the actual level of detail in each item): (1) Assess the implementation and effectiveness of the HCP terms and conditions (e.g., financial responsibilities and obligations, management responsibilities, and other aspects of the incidental take permit, HCP, and the IA, if applicable); (2) determine the level of incidental take of the covered species; (3) determine the biological conditions resulting from the operating conservation program (e.g., change in the species' status or a change in the habitat conditions); and (4) provide any information needed to implement an adaptive management

strategy, if utilized. An effective monitoring program is flexible enough to allow modifications, if necessary, to obtain the appropriate information.

Monitoring programs will vary based on whether they are for low-effect or for regional, multispecies HCPs; however, the general elements of each program are similar. Post-activity or postconstruction monitoring, along with a single report at the end of the monitoring period, will often satisfy the monitoring requirements for low-effect HCPs. For other HCPs, monitoring programs will be more comprehensive and may include milestones, timelines, and/or trigger points for change.

Effects and effectiveness monitoring includes, but is not limited to, the following:

1. Periodic accounting of incidental take that occurred in conjunction with the permitted activity;
2. Surveys to determine species status, appropriately measured for the particular operating conservation program (e.g., presence, density, or reproductive rates);
3. Assessments of habitat condition;
4. Progress reports on fulfillment of the operating conservation program (e.g., habitat acres acquired and/or restored); and
5. Evaluations of the operating conservation program and its progress toward its intended biological goals.

What Units Should Be Monitored in an HCP?

Each HCP's monitoring program should be customized to reflect the biological goals, the scope, and the particular implementation tasks of the HCP. In order to obtain meaningful information, the applicant and the Services should structure the monitoring methods and standards so that we can compare the results from one reporting period to another period or compare different areas, and the monitoring protocol responds to the question(s) asked. Monitored units should reflect the biological objective's measurable units (e.g., if the biological objective is in terms of numbers of individuals, the monitoring program should measure the number of individuals). The monitoring program will be based on sound science. Standard survey or other previously established monitoring protocols should be used. Although the specific methods used to gather necessary data may differ depending on the species and habitat types, monitoring programs should use a multispecies approach when appropriate.

What Role Do the Services Have in Monitoring?

Both the Services and the permittee are responsible for monitoring the implementation of the HCP. The Services' primary monitoring responsibilities (with the assistance of the permittee) are ensuring compliance with the permit's terms and conditions, including proper implementation of the HCP by the permittee. Permittee assistance with compliance monitoring includes monitoring the implementation and reporting their findings/results. The permittee, with the assistance of the Services, is responsible for verifying the effects and effectiveness of the HCP. To monitor all aspects of an HCP effectively, and to ensure its ultimate success, the entire monitoring program should incorporate both types of monitoring. The Services and the applicant should coordinate the two aspects of monitoring, and the monitoring program should also clearly designate who is responsible for the various aspects of monitoring.

The Services are responsible for ensuring that the permittee is meeting the terms and conditions of the HCP, its accompanying incidental take permit, and IA, if any (i.e., compliance monitoring). The Services should verify adherence to the terms and conditions of the incidental take permit, HCP, IA, and any other related agreements and should ensure that incidental take of the covered species does not exceed the level authorized under the incidental take permit. Regulations at 50 CFR §§ 13.45 and 222.301, provide the authority for the Services to require periodic reports unless otherwise specified by the incidental take permit. Also, the Services will ensure that the reporting requirements are tailored for documenting compliance with the incidental take permit (e.g., documentation of habitat acquisition, use of photographs). These reports help determine whether the permittee is properly implementing the terms and conditions of the HCP, its incidental take permit, and any IA, and will provide a long-term administrative record documenting progress made under the incidental take permit.

In addition to reviewing reports submitted by the permittee, it is important for the Services to make field visits to verify the accuracy of monitoring data submitted by the permittees. These visits allow the Services to check for information, identify unanticipated deficiencies or benefits, develop closer cooperative ties with the permittee, prevent accidental violations of the incidental take permit's terms and conditions, and assist the permittee and Services in developing corrective actions when necessary.

For large-scale or regional HCPs, oversight committees, made up of representatives from significantly affected entities (e.g., State Fish and Wildlife agencies), are often used to ensure proper and periodic review of the monitoring program and to ensure that each program properly implements the terms and conditions of the incidental take permit. For example, the Wisconsin Statewide HCP for the Karner blue butterfly includes an auditing approach to ensure incidental take permit compliance. The lead permittee, Wisconsin Department of Natural Resources (Wisconsin DNR), will initially conduct annual on-site audits of each partner. FWS will audit the Wisconsin DNR in a similar fashion. In addition, FWS will accompany the Wisconsin DNR on the partner audits as appropriate to understand partner compliance levels. Over time, if performance levels are acceptable, Wisconsin DNR will conduct the audits less frequently. Each partner will provide an annual monitoring report and will submit these along with their audit report to FWS.

For large-scale or regional HCPs, oversight committees should periodically evaluate the permittee's implementation of the HCP, its incidental take permit, and IA and the success of the operating conservation program in reaching its identified biological goals and objectives. Such committees usually include species experts and representatives of the permittee, the Services, and other affected agencies and entities. Submitting the committee's findings to recognized experts in pertinent fields (e.g., conservation biologists or restoration specialists) for review or having technical experts conduct field investigations to assess implementation of the terms and conditions would also be beneficial. Because the formation of these committees may be subject to the Federal Advisory Committee Act, the role of the participants and the purpose of the meetings must be clearly identified. Oversight committees should meet at least annually and review implementation of the monitoring program and filing of reports as defined in the HCP, permit, and/or IA, if one is used.

What Role Does the Permittee Have in Monitoring?

Not only do permittees provide regular implementation reports, they are also involved in effects and effectiveness monitoring. Effects monitoring determines the extent of impacts from the permitted activity. Effectiveness monitoring, in the HCP program, assesses progress toward the biological goals and objectives of the HCP (e.g., if the conservation strategies are producing the desired habitat conditions or population numbers). Effects and effectiveness monitoring may also involve assessing threats and population trends of the covered species related to the permitted activities, as well as monitoring the development of targeted habitat conditions. Permittees, with assistance from the Services, should ensure that the HCP includes provisions for monitoring the effects and effectiveness of the HCP. The Services and the HCP permittee will cooperatively develop the effects and effectiveness monitoring program and determine responsibility for its various components. In multi-party HCPs, different parties may monitor different aspects of the HCP. The Services must periodically review any monitoring program to confirm that it is conducted according to their standards.

What Should Be Included in Monitoring Reports?

The Services will streamline the reporting requirements for monitoring programs by requesting all reports in a single document. The HCP, permit, or IA should specifically state the level of detail and quantification needed in the monitoring report and tailor report due dates to the activities conducted under the incidental take permit (e.g., due at the end of a particular stage of the project or the anniversary date of incidental take permit issuance). Most monitoring programs require reports annually, usually due on the anniversary date of incidental take permit issuance. Wherever possible, the Services will coordinate the due dates with other reporting requirements (e.g., State reports), so the permittee can satisfy more than one reporting requirement with a single report. The following list represents the information generally needed in a monitoring report:

1. Biological goals and objectives of the HCP (which may need to be reported only once);

2. Objectives for the monitoring program (which may need to be reported only once);
3. Effects on the covered species or habitat;
4. Location of sampling sites;
5. Methods for data collection and variables measured;
6. Frequency, timing, and duration of sampling for the variables;
7. Description of the data analysis and who conducted the analyses; and
8. Evaluation of progress toward achieving measurable biological goals and objectives and other terms and conditions as required by the incidental take permit or IA.

These elements may be simplified for periods of no activity or low-effect HCPs. If a required report is not submitted by the date specified in the HCP or incidental take permit terms and conditions, or is inadequate, the Services will notify the permittee. The Services have discretion to offer the permittee an extension of time to demonstrate compliance. The Services have examined this reporting guidance under the Paperwork Reduction Act of 1995 and found that it does not contain requests for additional information or an increase in the collection requirements other than those already approved for incidental take permits (OMB approval for FWS, # 1018-0094; for NMFS, #0648-0230).

How Are Monitoring Programs Funded?

The ESA and the implementing regulations (50 CFR 17 and 222) require that HCPs specify the measures the permittee will adopt to ensure adequate funding for the HCP. The Services should not approve an HCP that does not contain an adequate funding commitment from the applicant/permittee to support an acceptable monitoring program unless the HCP establishes alternative funding mechanisms. The Services and the applicant should work together to develop the monitoring program and determine who will be responsible for monitoring the various components of the HCP. Specific monitoring tasks may be assigned to entities other than the permittee (e.g., State or Tribal agencies) as long as the Services and parties responsible for implementing the HCP approve of the monitoring assignment. The terms of the HCP, incidental take permit, and IA may contain funding mechanisms that provide for a public (e.g., local, State, or Federal) or a private entity to conduct all or portions of the monitoring. This funding mechanism must be agreed upon by the Services and the parties responsible for implementing the HCP.

Appendix I Specific Examples and Related Costs from Consulting Projects

Biological Evaluation and Biological Surveys of a Linear Project Area, Pima County

For a five-mile long proposed trail project, the contractor was hired to complete a BE for federally-listed species and PVS, and to conduct surveys for CFPO and Pima pineapple cactus (PPC), both of which are endangered, and noxious weeds listed by the Arizona Department of Agriculture (ADA). The contract included preparation of three separate technical memorandums, and a report summarizing the results of the BE. Services also include coordination with AGFD and review of the USFWS Ecological Services web site to determine species potentially occurring in the study area. The results of the surveys will be used as a planning tool by Pima County engineers to avoid or minimize potential impacts to special-interest species. CFPO survey call stations were placed at 400 meter intervals, with the exception of an approximately 1-mile portion nearest to I-19 where the call stations were placed at 150 meter intervals due to increased noise levels. This approach was agreed to by the County and USFWS. Costs: \$13,950.00 (CFPO: \$3,650.00; PPC: \$5,900.00; Noxious weeds: 950.00; BE: 3,650.00). Total cost per acre: \$115.00.

Biological Evaluation of a Drainage Improvement Project Area, Green Valley

For this drainage improvements project in an existing residential development, the contractor was hired to complete a BE for federally-listed species and PVS, and to conduct surveys for CFPO and PPC. Although the development encompassed hundreds of acres, the survey and evaluation focused only on drainages within the area. The contract included preparation of separate technical memorandums for the CFPO surveys, and a report summarizing the results of the BE and PPC survey. Services also include coordination with AGFD and review of the USFWS Ecological Services web site to determine species potentially occurring in the study area. The contractor will also probably be contracted for 2003 CFPO surveys. CFPO survey call stations were placed at 150 m intervals. Costs: Year 2002 CFPO: \$2,356.00, Year 2003 CFPO: \$2,450.00. Year 2002 BE and PPC Survey \$3,100. Total: \$7,906. Per acre cost cannot be accurately calculated.

CFPO Surveys of a Large Parcel Proposed for Development

The contractor was hired to complete CFPO surveys from 1999-2003 on approximately 2,500 acres. Per discussions with USFWS, the contractor was required to survey only the corridor along drainages on the property because it was determined that no "suitable CFPO habitat" was present in the surrounding uplands. This, combined with call stations at 400 m apart, helped contain costs. The contract included annual Technical Memoranda summarizing the survey results. Costs: Year 2001-2002 CFPO: \$8,500.00 per year; however, the contractor experienced cost overruns due to staff overturn and vehicle damage. Year 2003: \$9,000. Cost per acre: \$3.60.

PPC Survey of 640-acre parcel

The contractor was hired to conduct a single pass survey for PPC to cover 100% of the project area based upon a method acceptable to USFWS. The location of each PPC was mapped using coordinates determined via a correctable GPS unit and an aerial photograph of the project area. The PPC locations were transferred onto an electronic copy of the aerial photograph and polygons were delineated on the aerial distinguishing the area into low, medium, and high quality PPC habitats based on the locations of the cacti and site characteristics including topography and vegetation characteristics. The results were summarized in a brief Technical Memorandum, which included a foldout aerial photograph graphic. Costs: \$17,000 for survey and report production. Cost per acre: \$26.50.

CFPO Survey of 6,000 acres

The contractor was hired to conduct a second year of CFPO surveys on approximately 6,000 acres in accordance with AGFD and USFWS protocol. Calling stations were placed at 400-meter intervals. The contract included preparation of separate technical memorandums for the CFPO surveys. Costs: \$19,500 for survey and Technical Memorandum production. Cost per acre \$3.25.

CFPO Survey of 1,200 acres

The contractor was hired to conduct two years of CFPO surveys on approximately 1,200 acres in accordance with AGFD and USFWS protocol (2000). Calling stations were placed at 400-meter intervals. The contract included preparation of separate technical memoranda for each of the CFPO surveys. Costs: \$5,300 per year for two years totaling \$10,600. Cost per acre: \$4.40.

Appendix J Existing HCPs in Pima County

Monitoring Requirements

Lazy K Bar Ranch

The first HCP in Pima County was for the Lazy K Bar Ranch.¹ The subject property consisted of a 160-acre parcel in northwest Tucson. It is an existing guest ranch, and development of 50 residential lots and expansion of guest ranch facilities was proposed. A CFPO was detected during surveys on a portion of, or in the immediate vicinity of, the subject parcel. Development of the proposed lots and associated roads was expected to result in the loss of a maximum of 31.3 acres of Sonoran desertscrub habitat. It was alleged to also have the potential to displace one or more of the individual CFPO that have been detected within a few hundred meters east of the property and on or very near the southern boundary of the property. Conditions of the HCP with regard to RIM are:

6.1.2.2.1 Site Monitoring During Development and Construction

6.1.2.2.2 There are no seasonal restrictions on construction activities except as noted below.

6.1.2.2.3 Areas identified on Figures 6 to 8 as No-Grade Zones shall not be impacted at any time except for impacts that result from linear crossing of these areas for driveway and utility access.

6.1.2.2.4 Prior to any infrastructure (which includes, but is not limited to, roads, water, sewer/septic, gas, telephone, cable TV, electric, and common use areas and facilities) construction activity involving the clearing of vegetation during the nesting period (as defined in Section 6.1 [between January 1 and June 30], all saguaros greater than eight feet in height and all trees greater than six inches dbh [diameter at breast height] that occur within the proposed grading limits will be inspected to determine if they are being used as a nest site by CFPO. If a tree or saguaro is being used as a nest site, construction activities will be curtailed within a 300-foot radius of the nest cavity until after the nesting period. If practicable, the nest tree or saguaro shall be preserved in place. If it is not practicable to preserve the nest tree or saguaro in place and if the nest tree/saguaro is salvageable, it should be transplanted to an appropriate location. If salvage of the nest tree or saguaro is not practicable, construction activities may proceed and can include destruction of the tree or saguaro containing the nest cavity outside of the nesting period. If a nest tree or saguaro

¹ WestLand Resources, Inc. 1998. Lazy K Bar Ranch Environmental Assessment and Habitat Conservation Plan for Cactus Ferruginous Pygmy-owl (*Glaucidium brasilianum cactorum*).

must be destroyed, the developer will plant three saguaros (minimum of 12 feet tall) as replacements.

If inspected trees or saguaros are not being used for nesting, construction may proceed. Following inspections with negative results (no CFPO detection), the developer and/or lot owner will cover the inspected cavities with wire mesh or other appropriate material to preclude use of the cavities by CFPO until grading and construction activities have ceased. All cover material will be removed at the completion of building activities. Materials used to cover cavities shall be placed in a manner that does not injure the plant.

6.1.2.2.5 Prior to clearing vegetation for individual home sites or the resort venue sites during the nesting period, saguaros greater than eight feet in height and all trees greater than six inches dbh that occur within the proposed grading limits will be inspected to determine if the tree or saguaro is being used as a nest site by CFPO. If the tree or saguaro is being used as a nest site, construction activities within that lot shall be curtailed until after the nesting period. If practicable, the nest tree or saguaro shall be preserved in place. If it is not practicable to preserve the nest tree or saguaro in place and if the nest tree/saguaro is salvageable, it should be transplanted to an appropriate location within the same lot. If salvage of the nest tree or saguaro is not practicable, construction activities may proceed outside of the nesting period and can include destruction of the tree or saguaro containing the nest cavity. If a nest tree or saguaro must be destroyed, the developer or lot owner will plant three saguaros (minimum 12 feet tall) as replacement.

If the tree or saguaro is not being used for nesting, construction may proceed. Following inspections with negative results (no CFPO detection), the developer/lot owner will cover the inspected cavities with wire mesh or other appropriate material to preclude use of the cavities by CFPO until grading and construction activities have ceased. All material used to cover cavities in saguaros and trees will be removed at the completion of building activities. Materials used to cover cavities shall be placed in a manner that does not injure the plant.

6.1.2.2.6 All inspections shall be conducted by a qualified biologist who has obtained a permit from the Service to conduct inspections of potential CFPO nest sites.

6.1.2.2.7 The inspection requirements of paragraph 6.1.2.2.3 and 6.1.2.2.4 shall only apply to construction that is commenced during the

nesting period. No inspection shall be required for construction commenced outside of the nesting period.

6.1.2.2.8 Reporting and Other Monitoring Requirements

Compliance and effect/effectiveness monitoring and reporting requirements that are part of this HCP for both the Transitional and Residential Phases of the proposed project are summarized below. All reports should be sent annually on October 1st to the Field Supervisor of the Service's Ecological Field Office, Phoenix, Arizona. Failure by the Applicant to file a report is not a breach of this HCP unless and until either 1) it is an intentional omission, or 2) after notification by the Service of the failure, the Applicant does not respond within 20 days.

The Applicant and the Service acknowledge that even with provisions for monitoring, minimizing, and mitigating impacts to the CFPO, unforeseen/extraordinary circumstances may arise which were not fully anticipated by the conservation plan but which may adversely affect the CFPO. When either party becomes aware of circumstances that may adversely affect the CFPO or the Applicant's ability to implement this plan, the party identifying them shall notify the other party within 48 hours. The Applicant and the Service commit to meeting promptly to jointly review new information related the unforeseen circumstance, and discuss and identify possible protective measures. In keeping with the Service's "No Surprises" Policy, any additional protective measures shall not require the commitment by the Applicant of additional land or financial resources beyond the level of mitigation which was otherwise adequately provided for the CFPO under the terms of this HCP.

The Transitional Period begins upon approval of this HCP and includes the period of time the site is being used for ongoing guest ranch and proposed resort venue activities and concludes on initiation of construction pursuant to the final development plat for a residential subdivision. The Residential Period begins upon initiation of construction pursuant to the final development plat for the residential subdivision depicted in Section 4.1 and extends for the duration of this HCP.

6.1.2.3.1. Transitional Phase Compliance Monitoring.

- HCP Consistency Review. Proposed venue plans (half-size acceptable) used to obtain approved building permits will be submitted prior to construction to the Service with a cover letter indicating the anticipated construction start date. The submittal shall be made to the Field Supervisor for the Service's Arizona Ecological Services Field Office.
- Cavity Inspection Reports. The Applicant will be required to submit any necessary nest cavity inspection reports within 10 days of completion of fieldwork to the Service's Arizona

Ecological Services Field Office. (Refer to HCP Sect. 6.1.2.2 to determine if inspection is necessary.)

- Unforeseen Circumstances. Should the Applicant become aware of the accidental death of a CFPO on the subject property, the remains shall be preserved (stored in a freezer or other suitable storage facility) if possible, and the Services Arizona Field Office shall be notified within 24 hours of detection.

6.1.2.3.2. Transitional Phase Effect and Effectiveness Monitoring.

- Survey and Inventory. The entire property shall be surveyed for CFPO using the field survey procedures currently proposed by the USFWS during year one and two of the Transitional Phase (currently anticipated to be calendar years 1999 and 2000). Specifically, the survey call stations will be placed at approximately 450 meter intervals along survey transects and survey transects shall be spaced at approximately 800 meter intervals. Approximately nine call stations will be established on the property. The time spent at each call station shall be approximately 11 to 15 minutes. Three field surveys of the property will be conducted each year. Within each calendar year, field surveys shall be conducted between January and June and shall be a minimum of 15 days apart, with 30 days between surveys preferred. At least one of the surveys conducted each calendar year shall be conducted between February 15 and April 15. The Applicant shall be responsible for funding these surveys. Personnel shall conduct all surveys with appropriate survey permits from the USFWS. Should any owl be detected during these the Applicant shall notify the USFWS as required under the conditions of the surveyor's permit to conduct survey.
- Follow-up Studies. Should an owl be detected, a more in-depth monitoring effort may be implemented at the USFWS's discretion. The USFWS may request the Arizona Game and Fish Department (AGFD), under the AGFD's existing permit, to conduct telemetry studies of detected owls(s). Prior to initiating these surveys, the USFWS and AGFD shall coordinate with the Applicant to ensure that there is no conflict between the telemetry protocol and the Applicant's activities on the property. The applicant shall fund this telemetry effort at up to \$1,000 per bird for up to five birds. The total potential maximum commitment of funds by the Applicant for follow-up survey/telemetry is a total of \$5,000 for both the Transitional and Residential phases of the project combined. AGFD shall provide, on a confidential basis, a copy of their telemetry results to the Applicant and

to the USFWS. The Applicant shall not release this information to the public or otherwise make it available without the prior written consents of the USFWS. The Applicant's responsibility for funding telemetry studies is triggered by CFPO detection on or adjacent to the Lazy K Bar Ranch during field inventory survey. CFPO detected on (not adjacent to or near) the Lazy K Bar Ranch property at any other time during the Transitional development phase can also trigger this obligation.

- **Habitat Condition.** A native plant salvage inventory identifying the trees and saguaro that would be impacted by development activities, a determination of their salvageability, and whether they will be salvaged or replaced at a 3:1 ration, as provided for previously, will be submitted with the annual monitoring report. It is recommended that this information be supplemented with fixed-point ground photography of proposed construction areas that depict before and after conditions.

6.1.2.3.3. **Transitional Phase Reporting.** An annual report will be submitted to the USFWS on October 1st of each year. This report will be provided in a standard form (See Appendix E) and will include as attachments, necessary documentation regarding survey results, follow-up study results, etc. Annual reporting is in addition to any event-specific reporting requirements identified in this HCP.

6.1.2.3.4. **Residential Phase Compliance Monitoring.**

- **HCP Consistency Review.** The final plat (half-size acceptable) depicting roadways, lot boundaries, no-build zones, lot setbacks and easements will be submitted to the Service with a cover letter indicating the anticipated construction start date for road and infrastructure development. The Architectural Review Committee of the Homeowners Association shall review individual lot plans for consistency with applicable CC&R's and this HCP. The lot owner shall be responsible for compliance with all applicable grading limitations.
- **Cavity Inspection Reports.** Each lot owner must submit required nest-cavity inspection reports within 10 days of completion of fieldwork to the Applicant and to the Service's Arizona Ecological Services Field Office. The Service must be notified within 48 hours of detection of a CFPO. (Refer to HCP Sect. 6.1.2.2 to determine if inspection is necessary.)
- **Unforeseen Circumstances.** Should the Applicant become aware of an accidental death of a CFPO on the subject property, the remains shall be preserved (stored in a freezer or other suitable storage facility) if possible, and the Service's

- Arizona Field Office shall be notified within 24 hours of detection.
- Residential Lot Owner Information. Upon request by the Service, the Applicant or Homeowners Association shall provide the names and addresses of residential lot owners to the Service. The names provided will be as reported in the records of the Homeowners Association and shall be provided on a confidential basis. None of the names shall be released by the Service to any individual or group without the expressed written authorization of each residential lot owner.

6.1.2.3.5. Residential Phase Effect and Effectiveness Monitoring.

- Survey and Inventory. During the residential phase of the project, The Applicant or his successors or assigns shall survey the entire property for CFPO using the field survey procedures currently proposed by the USFWS at two different points in the development process. One of the surveys shall occur during the calendar year following attainment of 40 percent build-out, defined as the time when homes have been constructed on 20 of the residential lots. The second survey shall occur during the calendar year after attainment of 80 percent build-out, defined as the time when homes have been constructed on 40 of the residential lots. Specifically, the survey call stations will be placed at approximately 450 meter intervals along survey transects and survey transects shall be space at approximately 800 meter intervals. Approximately nine call stations will be established on the property. The time spent at each call station shall be approximately 11 to 15 minutes. Three field surveys of the property will be conducted each year. Within each calendar year, field surveys shall be conducted between January and June and shall be a minimum of 15 days apart, with 30 days between surveys preferred. At least one of the surveys conducted each calendar year shall be conducted between February 15 and April 15. The Applicant shall be responsible for funding these surveys. Personnel shall conduct all surveys with appropriate survey permits from the USFWS. Should any owl be detected during these the Applicant shall notify the USFWS as required under the conditions of the surveyor's permit to conduct survey.
- Follow-up Studies. Should an owl be detected, a more in-depth monitoring effort may be implemented at the Service's discretion. The USFWS may request the Arizona Game and Fish Department (AGFD), under the AGFD's existing permit, to conduct telemetry studies of detected owls(s). Prior to initiating these surveys, the USFWS and AGFD shall coordinate with the Applicant to ensure that there is no conflict between the telemetry protocol and the Applicant's

activities on the property. The applicant shall fund this telemetry effort at up to \$1,000 per bird for up to five birds. The total potential maximum commitment of funds by the Applicant for follow-up survey/telemetry is a total of \$5,000 for both the Transitional and Residential phases of the project combined. The Applicant's obligation to fund telemetry studies shall cease within one year of completion of inventory survey conducted at 80 percent build-out. AGFD shall provide, on a confidential basis, a copy of their telemetry results to the Applicant and to the USFWS. The Applicant shall not release this information to the public or otherwise make it available without the prior written consents of the USFWS. The Applicant's responsibility for funding telemetry studies is triggered by CFPO detection on or adjacent to the Lazy K Bar Ranch during field inventory survey. CFPO detected on (not adjacent to or near) the Lazy K Bar Ranch property at any other time during the Residential Development phase (up to 80 percent build-out) can also trigger this obligation.

- **Habitat Condition.** A native plant salvage inventory identifying the trees and saguaro that would be impacted by development activities, a determination of their salvageability, and whether they will be salvaged or replaced at a 3:1 ration, as provided for previously, will be submitted with by each lot owner/developer to the Architectural Review Committee of the Homeowners Association for approval. This submittal shall be made prior to the initiation of any vegetation clearing activities. The Applicant shall submit these inventories as an attachment with the annual monitoring report. It is recommended that this information be supplemented with fixed-point ground photography of proposed construction areas that depict before and after conditions.

6.1.2.3.6. **Residential Phase Reporting.** An annual report will be submitted to the USFWS on October 1st of each year through the completion of the 80 percent build-out inventory survey. This report will be provided in a standard form (See Appendix E) and will include as attachments, necessary documentation regarding survey results, follow-up study results, etc. This annual report is in addition to any event-specific reporting requirements identified in this HCP. A final report will be submitted to the USFWS at the completion of lot build-out.

Skyranch

A HCP was prepared for S kyranch, a proposed residential development in Marana. The project will consist of a 103-acre residential development and a 412-acre reserve. The term of the permit is 20 years. In 2000, the

AGFD and USFWS informed the project proponents and their consultants that portions of three known territories of individual CFPOs occur within or adjacent to the property and that two dispersing juvenile CFPOs with radio transmitters occupied a portion of the property, at least briefly. In 2001 and 2002, CFPOs were observed on and around the property, but no confirmed occupied territories were found. A HCP was developed for this property to protect CFPO, and was approved by the U.S. Fish and Wildlife Service in 2002.²

Specific conservation guidelines of the HCP include:

- Monitoring of development activities within the home range of a new CFPO
- If a nest or activity center is located within 400 meters (0.25 mile) of a construction phase, the Permittee will employ an on-site monitor during construction in order to ensure compliance with the terms and conditions of the HCP and Incidental Take Permit (ITP).
- Environmental compliance monitors (ECMs) will be present on site during the clearing, grading, and construction phase of the project. The ECMs will have the authority to ensure that the project is executed in compliance with all environmental regulations and permit conditions. Specific responsibilities of the ECMs will include, but are not limited to, the following:
 - a Ensure that all construction management personnel have attended the environmental training session;
 - b Prevent any unauthorized encroachment into the Reserve;
 - c Monitor all construction activities;
 - d Provide relevant biological information and assistance to construction personnel; and
 - e Report any instances of non-compliance with environmental regulations and permit conditions.

Monitoring and Reporting conditions³ include:

“The Permittee will submit to the USFWS an annual (by January 1 of each year until development activities are completed) written report on compliance with the terms and conditions of the HCP, ITP, and IA [implementing agreement], and maps to keep the USFWS informed of the status of activities (e.g., CFPO surveys, ongoing and completed construction phases, etc.). In addition, the Permittee will seek technical assistance from the USFWS in implementing these terms and conditions in a manner most effective for minimizing CFPO impacts. The Permittee will also adhere to the following monitoring and reporting requirements.

² Thomas Olsen Associates, Inc. 2002. *Habitat Conservation Plan And Environmental Assessment For A Section 10(A) Permit For Incidental Take Of The Endangered Cactus Ferruginous Pygmy-Owl (Glaucidium brasilianum cactorum) For The Proposed Sky ranch Project In The Town Of Marana, Pima County, Arizona.*

³ Thomas Olsen Associates, Inc. 2002. *Op. cit.* quoted exactly and including apparent grammatical errors.

- The Permittee will submit an annual report describing its activities and that of the Reserve management entity required by or other pertinent parties to the HCP, this Agreement, or the Permit and an analysis of whether the terms of the HCP, this Agreement, and the Permit were met for the reporting period. The report shall provide all reasonably available data regarding any incidental take of CFPO, and where required by the USFWS, any known changes to the overall population of CFPO that occurred in or immediately adjacent to the Property during the reporting period. In the case of a corporate Permittee, the report shall also include the following certification from a responsible company official who supervised or directed the preparation of the report:

”Under penalty of law, I certify that, to the best of my knowledge, after appropriate inquiries of all relevant persons involved in the preparation of this report, the information submitted is true, accurate, and complete.”

- Pre-construction presence/absence surveys for the CFPO will be conducted on the Property according to the established protocol.
- On-site monitoring of the Project according to established protocol, during construction if construction takes place during the breeding season (January-June).
- Areas identified on Figure 6 as the Reserve shall not be impacted at any time.
- Prior to any Project construction activities (which include, but are not limited to, residential areas, road, water, sewer/septic, gas, telephone, cable TV, electric, and common use areas and facilities) that involve the clearing of vegetation during the nesting period (February 15 to July 31), all saguaros greater than eight feet in height and all trees greater than six inches dbh [diameter at breast height] that occur within the proposed grading limits will be inspected to determine if they are being used as a nest site by CFPO. If a tree or saguaro is being used as a CFPO nest site, construction activities will be curtailed within a 100-meter radius of the nest cavity until after the nesting period. If practicable, the nest tree or saguaro will be preserved in place. If it is not practicable to preserve the nest tree or saguaro in place and if the nest tree/saguaro is salvageable, it will be transplanted to an appropriate location. The Permittee will make every reasonable effort to preserve saguaros and nest trees in place. The USFWS will be notified prior to the removal of saguaros and nest trees and given the opportunity to inspect them prior to removals. The USFWS will have 15 days subsequent to notification to conduct their inspection. All

inspections will be conducted in the presence of a qualified biologist retained by the Permittee.

- If salvage of the nest tree or saguaro is not practicable, construction activities may proceed and can include destruction of the tree or saguaro containing the nest cavity outside of the nesting period. If a nest tree or saguaro must be destroyed, the Permittee will plant three saguaros (minimum of 12 feet tall) as replacements.
- If inspected trees or saguaros are not being used for nesting, construction may proceed. Following inspections with negative results (no CFPO detection), the Permittee will require the developer and/or lot owner to cover the inspected cavities with wire mesh or other appropriate material to preclude use of the cavities by CFPO until grading and construction activities have ceased. All cover material will be removed at the completion of building activities. Materials used to cover cavities will be placed in a manner that does no injure the plant.
- All inspections will be conducted by a qualified biologist who has obtained a permit from the USFWS to conduct inspections of potential CFPO nest sites.
- The cavity inspection requirements will only apply to construction that is commenced during the nesting period. No cavity inspection will be required for construction commenced outside of the nesting period.
- Compliance and effect/effectiveness monitoring and reporting requirements that are part of this HCP for the Project are summarized below. All reports will be sent annually on January 1 to the Field Supervisor of the USFWS Ecological Services Field Office, Phoenix, Arizona. Failure by the Permittee to file a report is not a breach of this HCP unless and until either: 1) it is an intentional omission; or 2) after notification by the USFWS of the failure, the Permittee does not respond within 30 days.
- Cavity Inspection Reports. The Permittee will be required to submit any necessary nest-cavity inspection reports within 10 days of completion of fieldwork to the USFWS Arizona Ecological Services Field Office.
- Accidental Death. Should the Permittee become aware of the accidental death of a CFPO on the Property, if possible, the remains will be preserved (stored in a freezer or other suitable storage facility) and the USFWS Services Arizona Ecological Field Office shall be notified within 24 hours of detection.
- During the implementation phase of the Project, the Permittee will conduct annual surveys on the entire Property for using current survey

protocol. The Permittee will be responsible for funding these surveys. Personnel will conduct all surveys with appropriate survey permits from the USFWS. Should any owl be detected during these surveys, the Permittee will notify the USFWS as required under the conditions of the surveyor's permit to conduct survey.

Should an owl be detected, a more in-depth monitoring effort may be implemented at the USFWS's discretion. Prior to initiating these surveys the USFWS will coordinate with the Permittee to ensure that there is no conflict between the telemetry protocol and the Permittee's activities on the property. The Permittee will fund this telemetry effort at up to \$1,000 per bird for up to five birds. The total potential maximum commitment of funds by the Permittee for follow-up survey/telemetry is a total of \$5,000. All telemetry activities within the Property will be conducted in the presence of a qualified biologist retained by the Permittee. The Permittee's obligation to fund telemetry studies will cease within one year of completion of build-out. On a confidential basis, a copy of the telemetry results will be provided to the Permittee. The Permittee will not release this information to the public or otherwise make it available without the prior written consent of the USFWS. The Permittee's responsibility for funding telemetry studies is triggered by CFPO detection on or immediately adjacent (within 400 meters) to the Property.

If it is determined that a CFPO has established an active breeding territory on the Property, the Permittee will provide funding for AGFD to intensively monitor the activities of the breeding pair. The Permittee will provide up to \$15,000.00 for this effort. It is hoped this intensive monitoring will provide the scientific community with valuable information regarding CFPO breeding productivity, foraging ecology, habitat use, and time activity budgets. The collection and analysis of this information will aid in the conservation and recovery of CFPO. All monitoring activities within the Property will be conducted in cooperation with a biological consultant retained by the Permittee. On a confidential basis, a copy of the monitoring results will be provided to the Permittee. The Permittee will not release this information to the public or otherwise make it available without the prior written consent of the USFWS. The Permittee's responsibility for funding intensive monitoring studies is triggered by the detection of an active CFPO breeding territory on the Property. The Permittee's obligation to fund monitoring studies will cease within one year of completion of build-out.

Appendix K AGFD Costs for Survey, Monitoring and Research Costs for Selected Species

AGFD Costs for Survey, Monitoring and Research Costs for Selected Species

Project	Cost
Cactus Ferruginous Pygmy-owl Research and Monitoring	
Distribution, demography, diet, habitat selection, home range analysis and dispersal patterns of cactus ferruginous pygmy-owls in southern Arizona. 2 year study	\$239,702
Nest site selection by Cactus Ferruginous Pygmy-owls in southern Arizona. 1 year study	\$22,145
Mitigation of Road Design for Cactus Ferruginous Pygmy-owls. 2 year study	\$150,000
Cactus Ferruginous Pygmy-owl surveys within the planning area associated with the Town of Marana HCP. 1 year.	\$49,969 (approximately \$4.00/acre)
Cactus Ferruginous Pygmy-owl Inventory	
Cactus Ferruginous Pygmy-owl Surveys on BLM's "Middle Gila" area, near Florence, AZ.	\$2,500 (approximately \$5.00/acre)
Cactus Ferruginous Pygmy-owl Spring Surveys within National Guard Training areas in Pinal County, Arizona	\$32,793 (approximately \$4.50/acre).
Burrowing Owl Research, Inventory and Monitoring (2 years)	
Development of information on migration, habitat selection, and demography of Burrowing Owls (<i>Athene cunicularia</i>) in southern Arizona to aid in development and redrafting of relevant planning documents.	Cost - \$124,400 (\$62,200/year)
Lesser-long nosed bat Research	
Development of a survey protocol for Lesser-long nosed bats on their foraging grounds.	Cost - \$30,000 (1 year)

Source: Dr. Michael Ingraldi, AGFD Research Branch

Appendix L Budget for Completing Bird Inventory at Saguaro National Park (SAGU)

Budget for completing bird inventory at Saguaro National Park (SAGU).

Source: Inventory Proposal –Sonoran Desert Network, the following table is a direct quotation from that document). Much more detail is in that document than is included here. Assumptions: Technicians are students, paid \$12.50 per hour with employee-related expenses at 1.6%. All focal points and transects will be sampled four times. Administrative costs and equipment are not included.

Category	Item	Number	Person	Cost
Surveys - general	Strata ^a	6		
	Focal points per strata	7		
	Focal points	42		
	Days to complete study		185	
	Cost for personnel			18,500
Surveys - special areas	Riparian areas			
	Focal points	14		
	Days to complete study		62	
	Cost for personnel			6,200
	Cliffs ^b			
	Days to complete study		12	
	Cost for personnel			1,200
	Raptor surveys ^c			0
	Night surveys ^d			
	Routes	40		
Days to complete study		40		
Cost for personnel			4,000	
Special species ^e	Call counts ^f	200		
	Days to complete study		36	
	Cost for personnel			3,600
Personnel	Personnel subtotal	33,500		
	Field work preparation and data managements			10,050
	1.6 % ERE for one-half of personnel cost			349
	10.6 % ERE for one-half of personnel cost			2,308
Travel	Vehicle miles @ \$0.325/mile	5,000		1,625
	Days of vehicle rental @ \$50/ day	140		7,000
	Per diem (335 days @ \$30/day) ^g			10,050
Totals for SAGU			335	\$64,882

^a Strata for SAGU: 4 in Rincon Mountain District and 2 in Tucson Mountain District.

^b Cliff surveys will include surveying for turkey vultures, ravens, and counting swifts and swallows at nesting locations.

^c SAGU often applies for grants for some raptor (Mexican spotted owls, cactus ferruginous pygmy owls, goshawks, zone-tailed hawks, golden eagles, and prairie and peregrine falcons) surveys. We will assist the park in obtaining these moneys, but for this budget they are not a high priority. Copper's, grey, and red-tailed hawks, and kestrels are often counted during general inventories.

^d Call-count surveys for goatsuckers and some owls (western and whiskered screech, great-horned, and barn) along well-established trails (for safety).

^e Includes rare or uncommon diurnal species such as buff-breasted flycatcher, yellow-billed cuckoo, and Baird's and rufous-winged sparrows.

^f This can often take place at points (within plots) after the completion of VCP counts. However, it will be necessary to survey historical locations.

^g Data entry, analysis, storage, and report writing (30% of subtotal).

^h Per diem rates for camping (\$30/day) and meals (\$30/day) when based out of Tucson

Appendix M Information from Other HCPs. ---

Clark County, Nevada MSHCP

The Desert Conservation Program (DCP), a division of Clark County government, is responsible for the implementation of the provisions of Section 10(a)(1)(B) Incidental Take Permit, issued by the United States Fish and Wildlife Service, pursuant to the Endangered Species Act of 1973. Clark County administers the plan by assuming responsibility for the collection of mitigation fees and ensuring adherence to all compliance measures associated with the Permit, as well as overseeing implementation of the Plan. The HCP is intended to promote a balance between economic stability and environmental integrity in Clark County. The permit area includes all private land within Clark County and all land that becomes private through any means. The Plan will initially provide coverage for approximately 79 species and will expand to include over 200 species in the next few years, thereby assuring that clearly established conservation measures are not jeopardized alongside a growing local economy and the sustained appreciation of natural resources. The Clark County includes a biennial planning process during which a committee (the Implementation and Monitoring Committee (I&M Committee), consisting of stakeholder and agency representatives) calls for and reviews proposals for its RIM program, and votes on whether or not to fund proposals and how much to fund them.

There are two major sources of funding for the DCP:

1. A \$550 per acre mitigation fee on development within the plan area. This will provide up to \$1.625 million annually for the first 10 years, and up to \$1.3 million annually for the remaining 20 years of the permit.
2. The Southern Nevada Public Lands Management Act (PLMA) provides an unprecedented opportunity to fund projects. The sale of the approximately 27,000 acres of Federal lands scattered within the urban areas within the Las Vegas Valley, as mandated in the Act, is expected to generate an estimated \$420 million during the initial six years of implementation of its provisions, from 1998 to 2003. The Special Account from which Clark County would draw funds would receive an estimated \$357 million over the six-year period, or approximately \$60 million per year (85 percent of total proceeds).

Additional sources of extramural funding were expected to include matching funds grants with University of Nevada Reno (UNR) in collaboration with the Biological Resources Research Center (BRRC) as well as grants solicited from foundations such as the John D. and Catherine T. MacArthur Foundation, the Pew Charitable Trust, and the Richard Mellon Foundation, among others, whose interests in conservation principles and practices are particularly reflected in this plan's ecosystem-

centered approach to conservation. These have not been a significant part of the process so far.

At the present time, funds granted to the Clark County MSHCP are subject to the I&M Committee budgetary process. Funds are expended only to fulfill the goals and intent of the MSHCP with the consent of the I & M Committee, the USFWS, the Bureau of Land Management (BLM), and the Clark County Board of County Commissioners. The RIM program consists of a large and growing number of projects that are developed and executed as contracts within the context of the I&M Committee meetings and the actions of many Federal and local agencies that are parties to the MSHCP. A formal proposal process is followed biennially, and the I&M Committee makes recommendations on funding proposals to the BLM and Board of Commissioners. Usually the BLM and Board follow the recommendations of the Committee.

Much of the money is currently used to fund projects that come generally under the heading Research, Inventory, and Monitoring. The following tables include a description of projects funded in the 2001 biennium (\$6,133,484) and brief information on proposals submitted and recommended for the 2003 biennium (\$13,515,823). From this information, it is evident that a great deal of money is being spent on a wide variety of projects, and that amount of money is growing from one biennium to the next. Much more information, including details of proposals and reports on projects, is available at the Clark County website (<http://134.197.55.93/default.html>). It is not possible to determine per acre costs for the RIM program from the available information on Clark County's program.

An example of projects funded by this process that relate to some of the topics being currently considered in the SDCP STAT meetings is discussed briefly below.

Indicators and indicator species. In the 2001 biennium, BRRC proposed and received funding in the amount of \$680,000 to conduct a project to search for "indicators." The project was designed explicitly to search for "shortcuts" to facilitate monitoring species assemblages without monitoring every individual species. The identification of indicators was considered to be the first step in the development of an inventory and monitoring program. The research was designed to detect species responses associated with given existing levels of human disturbance. Sites were selected so as to encompass a range of conditions of variables. Presence/absence and abundance of species were sampled at numerous sites differing in amount (including absence) and kinds of disturbance. Statistical analyses of data attempted to identify the strength of correlation among species, biological communities, and conditions. Out of this analysis, BRRC hoped to attempt to select the most cost-effective

elements that can be monitored to estimate the health of the entire system.

In their proposal to continue this project in the 2003 biennium, BRRC asked for \$583,000 (a rare instance of reduction in the amount asked for by scientists). Their proposal stated:

“The MSHCP needs to be assessed to determine the extent to which decisions on management represents the best direction for the covered species. The BRRC was assigned the tasks of finding appropriate indicator species which could be used to assess the health of the systems managed. Actually, we found that small vertebrate population characteristics varied with respect to human disturbance in the bajadas in the Mojave Desert of southern Nevada. Human disturbances were quantified with respect to roads and off-road vehicle use. Roads and off-road use negatively affected species richness and species diversity. *Cnemidophorus tigris* abundance was positively related to roads, but *Cnemidophorus* abundance was negatively associated with species richness. *Dipodomys merriami* presence was negatively affected by off-road use, and where abundant there was a high species richness. Roads negatively influenced the presence of *Ammospermophilus leucurus*, and off-road use negatively affected the presence of *Chaetodipus penicillatus*. *D. merriami* and *C. tigris* are candidates for surrogate status based on their ability to predict species richness across all sites. These results indicate that we have found adequate indicator species. However, to use them to assess ecosystem health could be prohibitively expensive. Nevertheless, the information gleaned from this study has been extremely valuable. With these data, we can understand the ‘natural history’ of disturbance. In particular, we have learned how bajada systems respond to differences in, and changes to, disturbance. Thus, we need only to develop a means to assess disturbance now, and we will be able to predict the responses of biota to those changes. These predictions need verification, but this will be very much less expensive than using the biota itself to assess responses of the ecosystem to change.

We propose to purchase a complete set of digital orthophotos from 1994 (the last date for which the orthophotos are available). We will use these orthophotos to create comprehensive basemaps of Clark County including detailed maps of sensitive features that will be the focus of our attention in the first biennium of this study: roads of all sizes and kinds, sand habitats including unstable dunes and stabilized sandy habitats, mesquite and catclaw stands, and weeds by species. These are the dynamic elements, which we need to track in the MSHCP, and these elements cannot be monitored from data collected on the ground because the magnitude of the tasks is formidable. Furthermore, these elements can be extremely dynamic, and proposed changes to Clark County could cause each of these elements to change much more rapidly that it is possible to document except by remote

sensing. For example, the huge increase in population in Clark County has resulted in significant potential to increase vehicular recreation in the public lands. Creation of new roads represent a problem as any roads are taken as having always been present and covered under protection as RS 2477 roads. Remote sensing can allow us to map all roads, find redundancy in roads, monitor changes in roads including production of new roads, etc. Thus, frequent analysis of new remote sensing will allow us to monitor and manage roads in our Intensively Managed Areas and Less Intensively Managed Areas.

Some habitats are very dynamic and particularly sensitive to changes caused by people. For example, sandy habitats and mesquite/catclaw habitats are potentially extremely dynamic in extent and configuration. Sandy habitats (particularly dune habitats) depend on regular aeolian production of new sands. Development projects like the new airport and new power plants need to be sited in places where ecosystem function, such as aeolian production of new sand must be monitored or else we could lose sand dependent species (e.g., several species of plants and several bees and beetles) without understanding why they were lost. Only by using remote sensing can we keep track of the dynamics of sandy habitats.

Another example is keeping track of mesquite stands as habitat. Mesquite stands have a unique assemblage of associated species ranging from the relatively rare phainopepla to several species of bees, which specialize on pollen from these large pea trees. Many proposed changes in Clark County involve use of ground water which could lower the water table and jeopardize the continued existence of mesquite stands. Remote sensing will allow us to monitor the effects of changes in water table better than can be accomplished by on-the-ground data.

Finally, perhaps the most dynamic changes in habitat will come from invasion of aggressive weeds such as Tall White Top. It could exhaust all resources to monitor changes in weed distribution by on-the-ground means. Thus, remote sensing may be our only recourse.

We propose to hire an image analyst to help us analyze past data (1994 data), and organize the assembly of new data collected by aerial photography and ortho referenced. This imaging technology will allow us to accumulate data on ecosystem change more rapidly than possible by conventional means. We will house the image analyst with the Clark County Science Advisory Team GIS technicians in the USFS offices on Rancho near Torrey Pines. The acquisition of aerial photos will be accomplished through a collaboration with USGS and image analysis will be accomplished in house in collaboration with David Charlet who has talents in image analysis as well as vegetation analysis. This is a very ambitious project, but it can be accomplished

with the resources of our current GIS capability and a new image analyst.”

Clearly, the indicators project has evolved, answered some questions and discovered new questions to answer, and may have found some useful information about potential indicators of certain conditions in specific vegetation types. Just as clearly, it has not shed useful light on potential indicators for the majority of vegetation types within the Clark County area, and offers limited promise for providing inexpensive methods for assessing conditions with regard to the majority of species included in the HCP.

Clark County 2001 Biennium Research, Inventory, and Monitoring Projects		
Amount	Title and Description	Proponent
\$10,000	Bearpoppy Research. Seedbank samples from two poppy populations Las Vegas Valley were collected during 2000. Samples from other locations will be collected Water District during 2001. All of these samples will be sent to the Moran Forest Seed (LVVWD) Lab during 2001 for analysis. Analysis will consist of separating the seeds from the soil and determining seed viability with x-ray.	
\$10,000	Buckwheat Salvage Study. This study is needed to determine the best LVVWD salvage method, time of year to salvage, supplemental watering needs, soil material requirements, and best plant size at salvaging for the Las Vegas Valley Buckwheat. Buckwheat plants would be salvaged from various populations in the Las Vegas Valley with traditional methods (shovel and PVC pipe) and new methods (tree spade, backhoe, and box). Salvaged buckwheat plants would be planted in a trial area behind the Desert Demonstration Gardens on LVVWD property. Plants would be monitored to determine survival, growth, and reproductive success.	
\$10,000	Soil Studies. To ensure that soils at the LVSP are adequate for salvaged LVVWD poppies, it is important that soils at other known poppy habitats in the Las Vegas Valley and possibly near Lake Mead be sampled and compared to soils at the LVSP. To determine the physical and chemical characteristics of the soils and the presence of mychorrhizal fungi, LVVWD biologists would collect samples from several bearpoppy and buckwheat habitats and the LVSP site. These samples would be sent to a soils laboratory for analysis. Results from LVSP soils would be compared to results from the other sites to ensure that the LVSP can support additional poppy and buckwheat plants.	
\$20,000	Germination Trials. Research is needed to determine the germination LVVWD requirements of the Las Vegas Bearpoppy. During past mitigation efforts, emphasis has been placed on transplanting poppies. However, to date, no one has successfully transplanted a Las Vegas bearpoppy plant and had it survive for longer than 10 months. Methods are not specifically defined, except that the project will involve Dr. Susan Meyer at the US Forest Service	

Clark County 2001 Biennium Research, Inventory, and Monitoring Projects

Amount	Title and Description	Proponent
\$260,820	<p>Muddy River Watershed Assessment. The Moapa Valley NWR is managed for the spring habitats that support the endangered Moapa dace in the headwaters of the Muddy River. The springs and fluvial habitats in the Muddy River watershed comprise a unique ecosystem providing habitat for the Moapa dace, southwestern willow flycatcher, Virgin River chub, and many other species of concern. The Muddy River watershed is a myriad of various land management. A geomorphic assessment and an integrated science plan are needed to integrate and guide conservation efforts in an efficient manner.</p>	The Nature Conservancy
\$162,670	<p>Inventory and Monitoring-Recreation Use. Forest Service will provide recreation expertise to mitigate impacts of take as outlined in the Clark County Multiple Species Habitat Conservation Plan (MSHCP). Clark County MSHCP will fund \$162,670 to Humboldt-Toiyabe National Forest for recreation expertise in return for which the Forest Service will: A. Maintain 1/2 of a permanent full-time Dispersed Recreation Technician (GS-5/6/7) that inventories and monitors recreation use on the westside of the Spring Mountains during spring, summer, fall; and is available for inventory and monitoring on the east side during the winter. Salary, benefits, vehicle, supplies, training, and office rent/lease \$72,480. B. Maintain 2/3 of a permanent seasonal (18/8) Wilderness Ranger (GS-5/6/7) to inventory and monitor the Mt. Charleston Wilderness. Salary, benefits, vehicle, supplies, and training \$57,850. C. Hire and maintain one permanent part-time Climbing Ranger (GS-5/7) to inventory and monitor the cliff habitats. Salary, benefits, vehicle, supplies, and training \$32,340.</p>	U.S. Forest Service (USFS)
\$90,000	<p>Inventory and Monitoring-Species of Concern. The Forest Service will hire, maintain and provide administrative, supervisory, and office support to the one part-time biologist (GS-7/9) position. The Clark County Multiple Species Habitat Conservation program will fund \$90,000 for salary, equipment and materials. Forest Service will continue with the ongoing Species of Concern and habitat monitoring on the SMNRA: · Rough Angelica monitoring (2 sites) · Clokey eggvetch monitoring (2 sites) · Palmer's chipmunk monitoring (in cooperation with Nevada Department Of Wildlife (NDOW) & University of Nevada, Las Vegas (UNLV)) · Butterfly monitoring (5 species, 3 sites in cooperation with Nevada St. Museum) · Elk/wild horse and burro forage utilization cages (17 sites) · High Elevation Plant Community Monitoring (in cooperation with The Nature Conservancy (TNC))</p>	USFS

Clark County 2001 Biennium Research, Inventory, and Monitoring Projects

Amount	Title and Description	Proponent
\$318,696	<p>Muddy River Watershed Assessment. 1. Geomorphic Assessment. Literature review, field work and data will be compiled and shared through the University of Nevada Biological Resources Research Center database. Complex The river model will be based on field-determined data for reaches of the river that include geologic, hydrologic, ecologic and geomorphic information. The goal of the assessment is to characterize key features of the river and its floodplain and to determine what restoration options are available for conservation targets. Restoration needs and issues will be covered through a series of workshops with partners, experts, agencies, etc. Restoration recommendations will be made based on this assessment and goals set for key conservation targets identified by agencies and stakeholders. 2. Integrated Science Plan. TNC will convene a series of meetings that will bring together scientists from BRRRC, agencies, consultants, and partners to share findings related to the conservation targets and processes on the Muddy River. The objective of the meetings will be to understand the requirements of species and communities or their surrogates, to define restoration goals for these conservation targets, and to link these needs to the geomorphic assessment of the Muddy River. Restoration goals and long-term management practices for the River will be compiled in to a final watershed assessment report. TNC staff will continue to provide assistance and coordination for the various field projects being undertaken related to conservation targets on the Muddy River. (It is not clear how this relates to the project of The Nature Conservancy—it appears to be the same thing.)</p>	Desert National Wildlife Refuge
\$50,000	<p>Desert NWR plant community and biodiversity hotspot mapping. The Desert National Wildlife Range includes approximately 1,000,000 acres of uplands on the Desert Range in Clark County, including important habitats for the threatened desert tortoise and 20 or more other species of reptiles and plants to be covered under the Clark County MSHCP. The existing data on plant communities and species occurrence are limited. Updated information will facilitate Refuge management of the MSHCP covered and evaluated species. This work, to be conducted by the University of Nevada, Reno, would entail creating GIS coverages from GAP data as a preliminary analysis of the vegetation community types present on the Refuge. The GIS data would be analyzed for potential hotspots of biodiversity on the refuge, followed by on-the-ground comparison of GIS analysis results and GPS existing community boundaries. The focus of the fieldwork will be to validate GAP analyses and quantify extant community characteristics that suggest hotspots of biodiversity.</p>	DNWRC
\$609,500	<p>Desert Tortoise Monitoring. This proposal implements the desert tortoise monitoring protocol developed by BRRRC and adopted by the Management Oversight Group Technical Advisory Committee (MOG-TAC) and the Fish and Wildlife Service Desert Tortoise Coordination Office.</p>	BRRRC

Clark County 2001 Biennium Research, Inventory, and Monitoring Projects

Amount	Title and Description	Proponent
\$272,171	Spatial analysis- database- GIS (SADG). The goal of this component is to create a functional digital database of biological resources and their locations in Clark County. BRRRC is developing a consolidated database that can be queried by request (for sensitive data) and queried over the web (for general distribution, management, and planning data). This large database depends upon collaboration among all Plan participants. This database will be a tool of the AMP, facilitating implementation, validation, and effectiveness monitoring of Plan and AMP activities.	BRRRC
\$680,000	Indicators and indicator species. The indicators project is designed explicitly to search for "shortcuts" to facilitate monitoring species assemblages without monitoring every individual species. The identification of indicators is the first step in the development of an inventory and monitoring program. The research is designed to detect species responses associated with given existing levels of human disturbance. Sites will be selected so as to encompass a range of conditions of variables. Presence/absence and abundance of species will be sampled at numerous sites differing in amount (including absence) and kinds of disturbance. Statistical analyses of data will attempt to identify the strength of correlation among species, biological communities, and conditions. Out of this analysis, we will attempt to select the most cost-effective elements that can be monitored to estimate the health of the entire system.	BRRRC
\$520,000	Biological considerations and rural roads management. Evaluate the biological effects of roads, and to relate those effects to the degree of use and condition of the roads studied and the species of plants and wildlife present. Project includes: mapping roads, mapping vegetation with respect to roads, evaluating intensity of use of selected roads, gathering data on microclimate and edaphic effects of roads, and review of existing data. It also includes monitoring tortoise fencing and developing a database on problem locations for fence maintenance.	BRRRC
\$79,999	Individual species studies. With help from the various land management agencies and the regulatory agencies, we will assemble lists of species for special attention, including: aggressive and destructive exotic species; putative sensitive species; and species for which sufficient information exists for them to be included in the Plan as newly covered species. Building these lists will require meetings with agencies and university scientists, and proposals for actions and scientific assessment, as well as compilation of the available literature on each species.	BRRRC

Clark County 2001 Biennium Research, Inventory, and Monitoring Projects

Amount	Title and Description	Proponent
\$170,401	Muddy river. Evaluate effects of tamarisk removal program, conduct surveys of butterflies and birds. Conduct stream invertebrate surveys along the Muddy River. Examine breeding, larval and adult habitat for all amphibian species in the context of biotic restoration planning for the Muddy River System, and determine the advisability of a genetic analysis. Assess the potential of the western reaches of the Muddy River system to sustain reengineering of its physical structure to regain natural processes, stream meander, vegetation dynamics, and instream features. An attempt will be made to define the various major stages of historic and prehistoric conditions, and to develop a concept of desirable and attainable future conditions.	BRRC
\$300,000	Red Rocks to the Summit. At selected sampling sites along an elevation gradient, multiple data gathering techniques will be employed annually. Vegetation composition and structure will be characterized by sampling each site within a circle of 10-meter radius. All trees and overstory shrubs within the circle will be identified to species, diameter and height will be measured, and present canopy cover of each species will be estimated. Understory vegetation will be measured along four randomly selected transects from the center to the edge of the site. Along each transect, we will identify all subshrubs, grasses, and forbs, where conditions allow specific identification, and estimate the percent cover of each, together with the percent cover of rocks, bare ground, cryptobiotic crusts, and litter. Pitfall arrays will be installed to sample for reptiles, amphibians, small mammals, and ground-dwelling invertebrates. Point sampling for butterflies and birds will be conducted. At each site, grazing impact assessments are made, using techniques currently used by agency range conservationists.	BRRC
\$89,999	Marginal species studies. Several species included in the Plan as Covered or Evaluation Species (e.g., phainopepla, summer tanager, blue grosbeak, Arizona Bell's vireo) are highly vagile, and they are also at the margins of their geographic distributions. Definition of success for conservation actions may be elusive for these species. Investigation is necessary to define what can be expected as a best response to conservation actions for these marginal species. We will use the phainopepla as a model for definition of these difficult species. Our approach will be to study the presence and abundance of mistletoe throughout Clark County and make a GIS coverage for this resource. Then we will assess the extent to which mistletoe produces berries each year for several years. Finally, we will survey for nesting success in phainopepla to determine the temporal and spatial distribution of nesting by this species.	BRRC
\$820,000	Adaptive management of desert tortoise management. Conduct observations and experiments to determine the density of tortoises appropriate for translocation areas to maintain optimum healthy populations. Also conduct a study to determine if management actions are promoting population recruitment and subsequent increases in density and an upward trend. Finally, to determine the actual population effects of the disease Upper Respiratory Tract Disease (URTD).	BRRC

Clark County 2001 Biennium Research, Inventory, and Monitoring Projects

Amount	Title and Description	Proponent
\$100,000	Bat Inventory. Systematically inventory abandoned mining edits, shafts, etc. for bat use to ensure that important bat roosting, hibernacula and maternity habitats are not closed or modified that would impact these species. Data collected will be provided to the AMP Contractor (UNR).	Bureau of Land Management
\$280,000	Monitoring & Analysis (GIS). BLM will track all surface disturbances (including wildfire) and projects proposed or constructed in Desert Tortoise ACECs through the use of GIS, and all other relevant information on species of concern and conservation activities. All on-the-ground activities will be digitized from maps or GPS data.	BLM
\$130,000	Field Monitoring and Plant Inventory. BLM will monitor ecological trend in key areas and map forage utilization by wild horse and burros in the herd management areas where conflicts between wild horses and burros and covered species exist. BLM will also conduct plant surveys for covered and evaluation species which need more information to assess the distribution and stressors of such species. A contractor will conduct forage utilization surveys in the spring of 2002 and 2003. Trend plots studies will be continued in the key areas established within the 1)Red Rock, 2) Johnnie, and 3) Muddy Herd Management Areas. Inventories for special status plants species will be conducted in the appropriate season, and surveys will focus on low elevation covered plant species.	BLM
\$337,000	Ecological Site Inventory and Soil Survey for Wild Horse and Burro Management Areas. 1) BLM will perform an Ecological Site Inventory (ESI) across 600,000 acres in the wild horse and burro Herd Management Area (HMA) in Spring Mountains, including Red Rock Canyon National Conservation Area. 2) contract with Natural Resource Conservation Service (NRCS) to do an Order 3 soil survey on FS lands where potential conflicts between wild horses and burros and covered species exists. The lands to be evaluated will be mutually determined by FS, BLM, and NRCS. (BLM already has the soil survey on their lands).	BLM
\$161,000	Rare Plant Inventory and Monitoring, Alien Plant Inventory. A list of rare and sensitive plants in Lake Mead NRA with formal status designations will be prepared. Monitoring programs for three covered species will be continued. A baseline map of the locations and numbers of alien species will be completed.	National Park Service (NPS)
\$287,180	Wildlife Surveys and Monitoring. Survey and monitoring of rare or sensitive wildlife species: birds (specifically raptors and neotropical migrants), bats, desert tortoise, and relict leopard frog and other amphibians. For birds, management involves surveys for southwestern willow flycatchers, peregrine falcons, and bald eagles, and the operation of a banding station, which is part of a continent-wide effort to monitor avian productivity and survivorship. For bats, the park needs to conduct inventories in selected areas, monitor known populations of rare species, and continue to identify and protect vulnerable populations and habitat features. Tortoise management involves the continued monitoring of 14 permanent study plots located throughout the park. For amphibians, the park will continue to monitor populations of <i>Rana onca</i> and its habitat, and conduct surveys for this and other species in springs throughout the park.	NPS

Clark County 2001 Biennium Research, Inventory, and Monitoring Projects

Amount	Title and Description	Proponent
\$115,048	Data Collection and Analysis for MSHCP Development. Collect and NPS analyze resource information, including inventories of rare and sensitive species, in a Geographic Information System (GIS) format. This project pays for a GIS technician position. The position will assist in the organization and management of the inventory and monitoring database, conduct basic and complex GIS analysis, prepare maps, and ensure data accessibility.	
\$225,000	GPS Rural Roads. Work with BLM in designating roads in ACEC already Partners GPSed (Gold Butte and Mormon Mesa)-1st year deliverable. Work with Conservation BLM in placing signage in ACEC already GPSed (Gold Butte and Mormon Mesa)-1st year deliverable. Compile information specific to Northeastern Clark County, re: dirt roads and specific points of interest. Identify and GPS all dirt roads of ACECs. Research, document, and GPS points of interest. Produce pamphlets--if additional other funding is obtained. Produce media presentations, i.e. maps, website. Distribute and educate with media presentations. Produce database of all information gathered. Release database to any and all pertinent government agencies.	in
\$24,000	Consulting. Work with and assist Clark County with highway barrier (fencing) construction, monitoring, and maintenance efforts that will benefit species in Clark County.	HDR Engineering, Inc.
\$6,133,484.00	Total Research, Inventory, and Monitoring Projects funded in 2001 Biennium	

Information from <http://134.197.55.93/default.html> by searching for all projects and selecting only those to do with Research, Inventory, and Monitoring.

Clark County 2003 Biennium Research, Inventory, and Monitoring Proposals

Amount	Title Or Description of Proposal	Proponent
\$118,000	Songbird Monitoring as a tool for guiding Restoration at Lake Mead NRA	Habitat National Park Service
\$182,850	Relict Leopard Frog Monitoring and Management	National Park Service
\$20,000	Palmer's Chipmunk Monitoring	US Forest Service
\$2,388,386	SMNRA Landscape Assessment	US Forest Service
\$90,513	Inventory and Monitoring of rare plant species on the SMNRA	US Forest Service
\$239,108	Wildlife Inventory Monitoring and Management	National Park Service
\$48,450	Temperature Acclimation and Oxygen Consumption of Rana Onca larvae	National Park Service
\$145,526	Evaluation of the impact of Vegetation Encroachment on Relict Leopard Frog populations	National Park Service
\$221,950	Lake Mead NRA Data Collection and Analysis	National Park Service
\$810,000	Baseline Density Monitoring: Southern Nevada Desert Wildlife Management Area populations of the Desert	BRRC
\$35,000	Relict Leopard Frog Recovery Strategy	TNC
\$35,797	Investigation of Bat Species Diversity and Distribution along the Las Vegas Wash	Southern Nevada Water Authority (SNWA)
\$27,810	Investigation of Amphibian Diversity and Distribution along the Las Vegas Wash	SNWA
\$162,000	Translocation long-term monitoring, tortoise density evaluation, and establishment of new LSTSS	BRRC
\$60,000	The effects of Athel (Tamarix aphylla) on riparian habitats	National Park Service
\$37,950	Floristic Survey of Select Springs along the Colorado River below Hoover Dam	National Park Service
\$60,000	Factors affecting rarity of the Las Vegas Bearpoppy	National Park Service
\$50,600	Lake Mead NRA Monitoring of Ground Disturbance; Illegal Tracks and Traces	National Park Service
\$113,100	Plant Conservation Plan for Clark County	The Nature Conservancy
\$30,340	An Evaluation of the Non-Vascular Plants of Concern in Clark County	National Park Service
\$126,500	Cooperative Weed Management Program Development	Clark County
\$885,170	Ecological Inventory for the Spring Mountains Ecosystem	Bureau of Land Management
\$208,611	Pollinator Ecology	Agriculture Research Service
\$2,022,350	Virgin River Conservation Strategy Plan	Bureau of Land Management
\$390,600	GIS Support	Bureau of Land Management
\$160,200	Evaluating Impacts of Cattle Grazing on Vegetation and Vegetative Recovery following removal of cattle	Bureau of Land Management
\$642,270	Vegetation Monitoring Program: Rare Plants, Plant Poaching, and Weed Management Programs	National Park Service
\$128,100	Integrated Mesquite-Acacia Conservation Strategy Plan	Bureau of Land Management
\$447,600	Red Rocks to the Summit (RRTTS)	BRRC
\$100,000	Meadow Valley Wash Riparian Habitat Conservation Management Plan	Clark County
\$260,000	Clark County PIE - Mojave Education Project	Clark County
\$106,000	Clark County PIE - Strategic Planning and Program Assessment	Clark County
\$500,000	Conservation Management Plan Development	Clark County
\$583,000	Ecosystem Indicators	BRRC
\$44,000	Bat Inventories of the Spring Mountains	USDA Forest Service

Clark County 2003 Biennium Research, Inventory, and Monitoring Proposals

Amount	Title Or Description of Proposal	Proponent
\$9,000	Peregrine Falcon Nesting Survey of the Spring Mountains	USDA Forest Service
\$88,300	All Bird Monitoring Program in Clark County, Nevada	USDA Forest Service
\$40,080	Northern Goshawk Survey of the Spring Mountains and other suitable nesting areas in Clark County	USDA Forest Service
\$100,000	Desert NWARA/Developed Community Interface Inventory and Assessment	Clark County
\$11,000	Butterfly monitoring in the Spring Mountains	USDA Forest Service
\$15,500	The use of detection dogs to increase recovery of desert tortoise and their sign	Working Dogs for Conservation
\$177,147	Muddy River Interim Management Plan Development and Partner Coordination	The Nature Conservancy
\$1,593,015	Clark County MSHCP Adaptive Management Coordination, Science Advice and Effectiveness Monitoring Strategy Development	Clark County
\$13,515,823	Total Research, Inventory, and Monitoring Proposals in 2003 Biennium	

Source: PLMA Round Four Submissions List—Proposals not yet funded, some may not be funded and others may be added. Only proposals clearly identifiable as R.I.M. are included here.

Washington County, Utah HCP

Washington County, Utah, and the USFWS signed the Washington County HCP for the endangered Mohave population of desert tortoise in March 1996, prior to the institution of AMP and RIM programs for HCPs. The permit allows incidental take of desert tortoise, pursuant to section 10(a)(1)(B) of the Act, in association with various private projects. The time period for the permit is 20 years and includes development on up to 12,264 acres of private lands within potential desert tortoise habitat within Washington County, Utah. The accompanying HCP details the County’s proposed measures to minimize, monitor, and mitigate impacts of the proposed take of desert tortoise.

Primary mitigation for take of desert tortoise habitat is accomplished through compensatory acquisition and management of lands consolidated into a 62,000-acre Red Cliffs Desert Reserve designed primarily for desert tortoise conservation, but which also provides habitat for other wildlife and plant species. The reserve lands were acquired through land purchases and exchanges, with assistance from USFWS in the form of a grant of \$ 6,063,750 under the Habitat Acquisition Program. The Utah Department of Wildlife Resources (UDWR), Washington County Water Conservation District, Washington County, and private organizations provided matching funds to complete the purchase. Management of the reserve includes fencing reserve boundaries; prohibiting specific activities in areas of high sensitivity; acquiring all grazing permits in zones; managing all free-roaming dogs and feral animals within the reserve; and enforcement of all Federal, State and local regulations within the reserve. The County is also responsible for conducting desert tortoise surveys in take areas prior to development. A number of desert tortoises found in these areas are to be translocated by the USFWS.

Sources of permanent funding for the HCP include collection of a countywide fee assessed when building permits are issued. A second county wide fee of \$250.00 per acre applies to developers of subdivisions, condominiums, town homes, or planned unit developments. It was estimated that over the 20-year period of the section 10(a) permit, revenues from these fees would exceed \$9 million. Of this total, approximately \$7 million would be expended on implementing measures for desert tortoise preservation. The balance would be expended on other threatened, endangered, and sensitive species within Washington County. The Applicant sought additional cost-sharing agreements with the Utah Department of Transportation, UDWR, and USFWS for additional funding for HCP implementation. The estimated total cost of implementation of the HCP was \$11,555,000.

Lori Rose, HCP Biologist and Resource Specialist for Washington County provided the following update information on 13 March 2003. The research that has been conducted in association with the Washington County HCP to date includes a translocation study completed by Dr. Richard Tracy and University of Nevada Reno Biological Resources Research Center (BBRC). While \$150,000 a year for 5 years (\$750,000) was budgeted for this study, it was paid by USFWS, so Ms. Rose does not have record of actual expenditures if they varied. UDWR conducts population monitoring for the County. The work that they have conducted in the reserve since 1996 has provided baseline population data and annual density estimates. UDWR initially received \$50,000 in HCP funds for this work, in addition to what they secured through USFWS Section 6 funds. UDWR requested a change to the HCP after a year or two, and was successful in getting approval to channel the UDWR law enforcement funding (which was funded for 5 years by the HCP, 1996-2001) into funding for a biologist. In 1998 they began to receive \$115,000 a year in HCP funds (\$50K for monitoring, \$65K for biologist). In 2001 it was decided to proceed with full monitoring effort every other year. For 2002, UDWR received \$50K in HCP funds though they did not monitor. Beginning in 2003, annual HCP funding has been increased to \$65K, though monitoring of the transects occurs every other year.

Mitigation costs were budgeted at \$9 million for 20 years. \$7 million is for tortoise related actions and \$2 million for other species. This budget includes staff, office land exchange facilitation, habitat acquisition (a very small portion of the overall HCP land acquisition program that the local BLM has undertaken), reserve management, fencing, purchasing grazing permits, reserve monitoring (as described above), law enforcement, translocation, and education. Generally, expenditures have been close to the budget, though the program generally underspends the budget each year to keep a funding cushion in the bank. These funded actions and the establishment of the 62,000-acre Red Cliffs Desert Reserve are the primary mitigation for the incidental take permit. Of course, the budget reflects only a part of the uncountable agency resources that go into

**San Diego,
California Multiple
Species HCP**

helping this HCP to be successful. Another aspect is that the HCP was written with the assumption that the reserve would receive National Conservation Area (NCA) status by Year 5 and costs associated with law enforcement and reserve management would be picked up by federal dollars that would fund the operations of the NCA. That status has not yet been achieved, and is not expected for another few years. In summary, it is not possible to accurately separate out the costs of a RIM program from the other costs of the HCP based on the data available.

The City of San Diego's Multiple Species Conservation Program (MSCP) is a comprehensive HCP program for southwestern San Diego County. The MSCP study area covers approximately 900 square miles (582,243 acres) in southwestern San Diego County and includes the City of San Diego, portions of the unincorporated County of San Diego, ten additional city jurisdictions, and several independent special districts.

In addition to preserving a network of habitat and open space, the MSCP seeks to provide an economic benefit by reducing constraints on future development and decreasing the costs of compliance with federal and state laws protecting biological resources and streamlining existing permit procedures for development projects that have potential to impact habitat. Local jurisdictions and special districts are partners that will implement their portions of the MSCP Plan through subarea plans, which describe specific implementing mechanisms. The MSCP Plan, with its attached subarea plans, will serve as:

- ✧ a multiple species HCP pursuant to Section 10(a) of the federal ESA;
- and,
- ✧ a Natural Community Conservation Program (NCCP) Plan pursuant to the California NCCP Act of 1991 and the state ESA.

The MSCP preserve was designed based on an evaluation of 93 species as indicators of the range of habitats and biological diversity in the study area. Included within the 93 species were 41 species that are federally or state listed, candidates for listing, or proposed for listing. The plan also includes provisions for adding uncovered species to the covered species list. The plan attempts to maximize the presence of these species and their habitats in the designated reserve. Sixteen core biological resource areas and associated habitat linkages, totaling approximately 202,757 acres of habitat, were identified to assist local jurisdictions and special districts as one element to be considered in identifying their portion of the MSCP preserve and/or preserve design criteria. The most critical biological resources were prioritized for preservation to maximize the conservation value of the preserve, to efficiently use acquisition funds and to identify less important habitat areas that could be developed.

Subarea plans with specific preserve boundaries maximize inclusion of unfragmented core areas and linkages in their preserve design to the

extent possible. The study area contains 315,940 acres of habitat with almost two-thirds (about 194,563 acres) being privately owned. Over one-third of the habitat is in military (20,082 acres) or other public ownership (101,295 acres).

Wildlife agencies, as partners in MSCP implementation, will issue take authorizations for covered species based on the subarea plans and implementing agreements; contribute and manage identified existing federal and state lands and those acquired with federal and state funds; coordinate the biological monitoring program; meet annually with take authorization holders; ensure that other wildlife agency permits/consultations are coordinated and consistent with the MSCP; provide technical assistance; include MSCP funding in annual budget proposals; and assist jurisdictions and other agencies in developing a regional funding source and in public outreach or education programs.

Tracking MSCP implementation involves two independent processes:

- ✧ annual accounting of the acreage, type and location of habitat conserved and destroyed (taken) by permitted land uses and other activities; and,
- ✧ biological monitoring to determine if the preserve system is meeting conservation goals for covered species.

The analysis of MSCP costs and alternative funding programs is based on the splitting of acquisition costs between the federal and state governments and local jurisdictions, and the sharing of costs and responsibilities for preserve management and biological monitoring. Funding of local costs will be carried out on a regional basis, and local elected officials have established the policy that any regional funding for the MSCP will be submitted to the voters for approval.

If the MSCP is implemented using a 30-year benefit assessment program, the total cost to the local jurisdictions, residents, and businesses to implement the MSCP is estimated to range from \$339 to \$411 million in 1996 dollars, based on a range in estimated value of habitat lands to be acquired. The jurisdictions that estimated land acquisition needs also estimated land acquisition costs in their respective jurisdictions, and determined collectively that the cost of purchasing 27,000 acres would range from \$262 to \$360 million. One half of the acquisition need will be met by the local jurisdictions, funded through a regional funding source. Based on the jurisdictions' estimates, the average acquisition cost ranges from \$9,700 to \$13,300 per acre. In comparing these estimates to recent sales prices, about 89% of lands recently sold had prices below the average estimated acquisition cost of the jurisdictions' low estimates (\$9,700/acre). The total costs to the local jurisdictions for preserve management, biological monitoring and program administration over the first 30 years is estimated to be approximately \$120 million, with an annual projected cost beyond that time of \$4.6 million per year (\$3.4 million more than current funding). An endowment could be created during the 30-year financing

program to permanently cover recurring costs, or, as an alternative, a new funding program could be established before the end of the 30-year program. The participating local jurisdictions will manage, using funds from the regional funding source, approximately 106,120 acres of habitat lands in the preserve at preserve build-out, at a cost of \$4.2 million per year. Preserve management costs are estimated to range from \$37 per acre per year for areas isolated from urban development to \$47 per acre per year for areas near urban development. The federal and state governments would manage 50,010 acres at preserve build-out, at an estimated cost of \$2 million per year. Biological monitoring costs will vary each year as a result of the type and frequency of monitoring required, with the average annual costs over a 10-year cycle estimated to be \$230,400. Annual administration costs (e.g. land acquisition activities, subarea plan implementation, legal support, financial management, reporting and database management, and facilities and equipment) will also vary, reaching a peak of \$1.3 million in 2004 during the period of land acquisition, and declining to \$255,000 per year at preserve build-out.

The federal and state governments will acquire lands using funds from existing and future programs. Other sources of funding include the National Fish and Wildlife Challenge Grants (with average grants to California of \$1.9 million per year from 1989-1994), the Cooperative Endangered Species Conservation Fund, USFWS annual appropriations, and state acquisition funds through the Wildlife Conservation Board.

State of Wisconsin HCP

This statewide HCP for the endangered Karner Blue Butterfly (*Lycaeides melissa samuelis*) in Wisconsin was developed by Region 3 of the USFWS and a large group of partners with the Wisconsin Department of Natural Resources (DNR) as the lead. The HCP, Environmental Impact Statement (EIS), and application for an Incidental Take Permit under the ESA were completed in April, 1999. Based on information in the HCP, the EIS, and public comments on the Plan and EIS, the permit was issued covering all citizens of the State of Wisconsin. The permit authorizes take of the butterfly during otherwise lawful activities.

The Wisconsin DNR and USFWS monitor projects for compliance with the terms and conditions of the ITP. The HCP identifies an auditing program to be implemented by the Wisconsin DNR that involves annual audits of each partner for compliance with the HCP and Incidental Take Permit. (Violation of the terms of an Incidental Take Permit are a violation of the ESA and penalties are prescribed by law.) In compliance with the AMP, the partners agreed to modify their conservation strategies if the need for change was demonstrated. The term of the Incidental Take Permit is 10 years with potential extensions beyond that period.

The magnitude of the initial outreach effort was estimated and the initial costs were committed as outlined below.

Wisconsin HCP Estimated Annual Commitments for 10-Year Permit Period

Annual Commitment Activity	Estimated Costs
Surveying (pre-management)	\$72,920
Monitoring (post-treatment validation and statewide effectiveness)	\$69,585
Record Keeping and Data Mgmt.	\$83,620
Research	\$59,150
Public Outreach and Education	\$94,004
Public Awareness	\$4,000
Training	\$43,482
Administration	\$84,000
HCP-IOC Participation	\$49,370
Conservation Efforts	\$60,375
Long-Term Management	\$64,855
Land Acquisition	\$70,000
Total	\$ 597,361

Source: www.dnr.state.wi.us; Site accessed March 7, 2003

In order to anchor the HCP implementation infrastructure, DNR agreed to provide a full-time, permanent employee as the HCP Coordinator. In addition, the plan relies on in-kind monitoring, as most partners will choose to provide monitoring on their lands; and the possibly a portion of inclusion fees and in-kind services from future applicants. Each Partner will support pre-management surveying (pre-management and reconnaissance) and monitoring (self-monitoring for validation) of lands entered into the management strategies under the conservation agreement as related to normal management activities. The funding to support pre-management surveying and monitoring related to partners' normal management activities is the responsibility of each partner. Each partner is obligated to perform this monitoring by their commitment in their conservation agreement. Verification that this obligation has been met will be part of the compliance auditing process.

Initial funding was provided in the DNR's and the partners' commitments outlined in the Implementing Agreement and individual conservation agreements. With the guidance of the IOC, the DNR established funding mechanisms needed to support the implementation of the HCP; the DNR will include in its annual budget requests for funds to fulfill its obligations under the HCP and the Implementing Agreement. However, the DNR was unable to guarantee state funds for future activities to administer the ITP and implement the HCP that were not yet appropriated by the state legislature.

The USFWS agreed to seek adequate funding to fulfill its administration and assistance commitments and meet its statutory requirements (e.g., assist with permit monitoring and oversight issues and provide assistance

on permit and HCP implementation issues). The USFWS further agreed to assist in identifying and pursuing funding for activities in the HCP that contribute to the recovery of the Karner blue butterfly.

As a contingency, the DNR agreed that, if at any point in the implementation and administration of the HCP funding appeared to be unavailable to meet commitments, the DNR would consult with the USFWS to determine whether the HCP or ITP needs amendment or modification.

Appendix N SDCP –Priority Vulnerable Species and Pima County Federally-listed Species, Range and Habitat Requirements, and Potential Inventory and Monitoring Procedures.

SDCP - Priority Vulnerable Species and Pima County Federally-listed Species, Range and Habitat Requirements, and Potential Survey and Monitoring Procedures.			
Status Definitions: USFWS E=Endangered, USFWS T=Threatened, USFWS P=Proposed Threatened or Endangered, USFWS C=Candidate for listing, USFWS CA= Conservation Agreement; USFWS SOC= Species of Concern; WSCA= Wildlife of Special Concern in Arizona; PVS= Priority Vulnerable Species in Pima County.			
Species	Status	Range and Habitat Requirements	Potential Inventory and Monitoring Recommendations
PLANTS			
Kearney’s Blue Star (<i>Amsonia kearneyana</i>)	USFWS-E	Known only from a few locations in the Baboquivari Mountains at 3,600-3,800 feet with Arizona walnut, Mexican blue oak, and velvet mesquite.	<u>Inventory:</u> Field survey closely-spaced transects in appropriate habitats. <u>Monitoring:</u> Establish monitoring plots in known populations to document population demographics.
Huachuca Water Umbel (<i>Lilaeopsis schaffneriana</i> ssp. <i>recurva</i>)	USFWS-E PVS	A semi-aquatic plant (requiring permanent water) that inhabits springs, cienegas, and drainage systems in southeastern Arizona. Historically, this species was documented within the Santa Cruz River near Tucson, but that population was extirpated when the River dried. Critical habitat was designated for this species in 1999, but none in Pima County. Populations have been documented in recent years in Pima County portions of the San Pedro River and Cienega Creek.	<u>Inventory:</u> Field survey closely-spaced transects in appropriate habitats. <u>Monitoring:</u> Establish monitoring plots or transects in known populations to document population demographics.
Nichol’s Turk’s Head Cactus (<i>Echinocactus horizonthalonius</i> var. <i>nicholii</i>)	USFWS-E PVS	Known only from a very small area between 2,400-4,100 feet on dissected alluvial fans at the foot of limestone mountains or on limestone mountainsides.	<u>Inventory:</u> Field survey closely-spaced transects in appropriate habitats. <u>Monitoring:</u> Establish monitoring plots in known populations to document population demographics.

SDCP - Priority Vulnerable Species and Pima County Federally-listed Species, Range and Habitat Requirements, and Potential Survey and Monitoring Procedures.

Status Definitions: USFWS E=Endangered, USFWS T=Threatened, USFWS P=Proposed Threatened or Endangered, USFWS C=Candidate for listing, USFWS CA= Conservation Agreement; USFWS SOC= Species of Concern; WSCA= Wildlife of Special Concern in Arizona; PVS= Priority Vulnerable Species in Pima County.

Species	Status	Range and Habitat Requirements	Potential Inventory and Monitoring Recommendations
Pima Pineapple Cactus <i>(Coryphantha scheeri</i> <i>var. robustispina)</i>	USFWS-E PVS	The entire range is south of Tucson, between the Santa Rita and Baboquivari Mountains, where it occurs at elevations between 2,300 and 4,500 feet. Most of the known locations are in the Altar and Avra Valleys, Santa Cruz River Basin, and the alluvial fans of the Sierrita, Santa Rita, Empire, Coyote, and Pajarito Mountains.	<u>Inventory:</u> Field survey closely-spaced transects in appropriate habitats. <u>Monitoring:</u> Establish monitoring plots in known populations to document population demographics.
Acuña Cactus <i>(Echinomastus erectocentrus</i> <i>var. acunensis)</i>	USFWS-C PVS	Inhabits Arizona Upland Subdivision of the Sonoran Desertscrub on well-drained knolls and gravel ridges at elevations between 1,300 to 2,000 feet. In 1992, known to occur in only two Arizona locations, near Organ Pipe Cactus National Monument and in Pinal County near Florence.	<u>Inventory:</u> Field survey closely-spaced transects in appropriate habitats. <u>Monitoring:</u> Establish monitoring plots in known populations to document population demographics.
Gooddings Onion <i>(Allium gooddingii)</i>	USFWS-CA	This species occurs in forested drainage bottoms and on moist north facing slopes of mixed conifer and spruce forest at elevations above 7,500 feet.	<u>Inventory:</u> Field survey closely-spaced transects in appropriate habitats. <u>Monitoring:</u> Establish monitoring plots in known populations to document population demographics.
Gentry Indigobush <i>(Dalea tentaculoides)</i>	USFWS-SOC PVS	Not currently known from Pima County, but unknown populations may occur in rocky canyon bottoms that are not grazed. Currently known only in Sycamore Canyon drainage in the Atascosa Mountains, Pajarito Mountains, Santa Cruz County, and Baboquivari Mountains.	<u>Inventory:</u> Field survey closely-spaced transects in appropriate habitats. <u>Monitoring:</u> Establish monitoring plots in known populations to document population demographics.
Needle-spined Pineapple Cactus <i>(Echinomastus erectocentrus</i> <i>erectocentrus)</i>	USFWS-SOC PVS	Pima County encompasses much of the known range of this cactus variety; all records are from east of Tucson. Occurs in Sonoran Desertscrub and Semidesert Grassland vegetation communities where it is found on alluvial fans and hills generally from 3,000 to 4,600 feet.	<u>Inventory:</u> Field survey closely-spaced transects in appropriate habitats. <u>Monitoring:</u> Establish monitoring plots in known populations to document population demographics.

SDCP - Priority Vulnerable Species and Pima County Federally-listed Species, Range and Habitat Requirements, and Potential Survey and Monitoring Procedures.

Status Definitions: USFWS E=Endangered, USFWS T=Threatened, USFWS P=Proposed Threatened or Endangered, USFWS C=Candidate for listing, USFWS CA= Conservation Agreement; USFWS SOC= Species of Concern; WSCA= Wildlife of Special Concern in Arizona; PVS= Priority Vulnerable Species in Pima County.

Species	Status	Range and Habitat Requirements	Potential Inventory and Monitoring Recommendations
Tumamoc Globeberry (<i>Tumamoca macedougali</i>)	USFWS-Delisted in 1993 PVS	The range of this plant covers some 31,000 square miles of Sonoran Desert from Sonora, Mexico to Tucson, Arizona, west to Organ Pipe Cactus National Monument and north to Pinal County, Arizona. In Tucson, found on hot, dry, south facing slopes of basalt and along desert washes. The largest population is found in creosote bush desertscrub on gravelly loams primarily derived from weathered granites.	<u>Inventory:</u> Field survey closely-spaced transects in appropriate habitats in specific season. <u>Monitoring:</u> Establish monitoring plots in known populations to document population demographics and monitor during appropriate season.
ANIMALS			
INVERTEBRATES			
Arkenstone Cave Pseudoscorpion (<i>Albiorix anophthalmus</i>)	PVS	Known from only one cave (Arkenstone Cave) in Colossal Cave Park east of Tucson.	<u>Inventory:</u> expert cave biologists are required in order to conduct inventory and monitoring program. <u>Monitoring:</u> continue existing program using existing experts and protocol.
Talus Snails (<i>Sonorella</i> spp.) (15 taxa)	USFWS-CA (one taxon only- <i>S. eremita</i>) PVS-all 15 taxa	All 15 taxa occur on steep, talus slopes (generally or exclusively of limestone) in isolated, undisturbed areas in mountains or hills.	<u>Inventory:</u> Field survey closely-spaced transects in appropriate habitats during summer rain or moist conditions. <u>Monitoring:</u> Conduct mark-recapture surveys in established monitoring plots in known populations to document population demographics.
FISH			
Desert Pupfish (<i>Cyprinodon macularius</i>)	USFWS-E WSCA PVS	Species historically present in the Santa Cruz River, but is considered extirpated.	<u>Inventory:</u> Search appropriate habitats using dipnets, seines, and minnow traps. Extirpation can be documented using methods described by Weedman <i>et al.</i> (1997). <u>Monitoring:</u> Annual or semi-annual mark-recapture studies within known populations.

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Species	Status	Range and Habitat Requirements	Potential Inventory and Monitoring Recommendations
Gila Topminnow (<i>Poeciliopsis occidentalis occidentalis</i>)	USFWS-E WSCA PVS	In Arizona, most of the remaining populations occur in the upper Santa Cruz River system, Sonoita Creek, and Cienega Creek, and the middle Gila River.	<u>Inventory:</u> Search appropriate habitats using dipnets, seines, and minnow traps. Extirpation can be documented using methods described by Weedman <i>et al.</i> (1997). <u>Monitoring:</u> Annual or semi-annual mark-recapture studies within known populations.
Loach Minnow (<i>Tiaroga cobitis</i>)	USFWS-T WSCA	Currently known populations are found in the upper Gila, San Francisco, Blue, Tularosa, and White rivers, as well as Aravaipa, Eagle, Campbell Blue, and Dry Blue creeks. A population was found in the Black River in 1996.	<u>Inventory:</u> Search appropriate habitats using dipnets, seines, and minnow traps. Extirpation can be documented using methods described by Weedman <i>et al.</i> (1997). <u>Monitoring:</u> Annual or semi-annual mark-recapture studies within known populations.
Spikedace (<i>Meda fulgida</i>)	USFWS-T WSCA	In Arizona, populations are found in Aravaipa Creek, Eagle Creek, and a portion of the upper Verde River. Undiscovered populations may exist in unsampled Gila basin streams.	<u>Inventory:</u> Search appropriate habitats using dipnets, seines, and minnow traps. Extirpation can be documented using methods described by Weedman <i>et al.</i> (1997). <u>Monitoring:</u> Annual or semi-annual mark-recapture studies within known populations.
Gila Chub (<i>Gila intermedia</i>)	USFWS-PE WSCA PVS	The Gila chub is currently known from the following drainages: Santa Cruz River (Cienega Creek, Sabino Canyon, Sheehy Spring), middle Gila River, San Pedro River, Agua Fria River, and Verde River.	<u>Inventory:</u> Search appropriate habitats using dipnets, seines, and minnow traps. Extirpation can be documented using methods described by Weedman <i>et al.</i> (1997). <u>Monitoring:</u> Annual or semi-annual mark-recapture studies within known populations.
Desert Sucker (<i>Catostomus</i> = <i>Pantosteus clarkii</i>)	USFWS-SOC PVS	Historically this fish occurred in the Santa Cruz River. Occurs in the lower Colorado River downstream from the Grand Canyon, generally including tributary streams of the Gila River drainage upstream of Gila, Arizona. Has been recorded in Aravaipa Creek.	<u>Inventory:</u> Search appropriate habitats using dipnets, seines, and minnow traps. Extirpation can be documented using methods described by Weedman <i>et al.</i> (1997). <u>Monitoring:</u> Annual or semi-annual mark-recapture studies within known populations.

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Longfin Dace (<i>Agosia chrysogaster</i>)	USFWS-SOC PVS	Historically found throughout Arizona. Currently found in a broad area as disjunct populations. In Pima County, found in Cienega Creek, Springwater Canyon, and Buehman Canyon.	<u>Inventory:</u> Search appropriate habitats using dipnets, seines, and minnow traps. Extirpation can be documented using methods described by Weedman <i>et al.</i> (1997). <u>Monitoring:</u> Annual or semi-annual mark-recapture studies within known populations.
Sonora Sucker (<i>Catostomus insignis</i>)	USFWS-SOC PVS	Historically this fish occurred in the Santa Cruz River. Native to the Gila and San Francisco drainages; widespread in the Gila and Bill Williams river basins.	<u>Inventory:</u> Search appropriate habitats using dipnets, seines, and minnow traps. Extirpation can be documented using methods described by Weedman <i>et al.</i> (1997). <u>Monitoring:</u> Annual or semi-annual mark-recapture studies within known populations.
AMPHIBIANS AND REPTILES			
Chiricahua Leopard frog (<i>Rana chiricahuensis</i>)	USFWS-T WSCA PVS	This species typically occurs in a wide variety of permanent aquatic habitats in deserts, grasslands, chaparral, and oak woodlands.	<u>Inventory:</u> Conduct a Visual Encounter Survey (AGFD 2002a) along the perimeter of appropriate habitats such as perennial streams and cattle tanks using dipnets, seines, and minnow traps. If daytime surveys are unsuccessful, at least one nighttime survey must be utilized to assess potential presence. <u>Monitoring:</u> Repeat surveys over one or more seasons as part of a statistically-valid monitoring plan designed to address monitoring goals.

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Lowland Leopard Frog (<i>Rana yavapaiensis</i>)	USFWS-SOC WSCA PVS	Occurs in south central, central, west central, and extreme northwestern Arizona, south and west of the Mogollon Rim. Recently found in 5 canyons in the Rincon Mountain District of Saguaro National Park in Pima County. Known from approximately 10-20 eastern Pima County sites.	<u>Inventory:</u> Conduct a Visual Encounter Survey in accordance with USFWS guidelines (2002) along the perimeter of appropriate habitats such as perennial streams and cattle tanks using dipnets, seines, and minnow traps. If daytime surveys are unsuccessful, at least one nighttime survey must be utilized to assess potential presence. <u>Monitoring:</u> Repeat surveys over one or more seasons as part of a statistically-valid monitoring plan designed to address monitoring goals.
Sonoyta Mud Turtle (<i>Kinosternon sonoriense longifemorale</i>)	USFWS-C	Known populations are restricted to Quitobaquito, Organ Pipe Cactus National Monument (OPCNM), and at a similar site in Quitovac and nearby Río Sonoyta, both in Sonora, Mexico (Knowles <i>et al.</i> 2002).	<u>Inventory:</u> Visual encounter surveys and use of baited turtle traps. <u>Monitoring:</u> Mark-recapture or telemetry surveys in known populations or designated reserve system lands.
Desert Box Turtle (<i>Terrapene ornata luteola</i>)	PVS	In Arizona, occurs in the southern portion of the state from the New Mexico border to the eastern base of the Baboquivari Mountains at elevations ranging from sea level to 6,600 feet. Has been observed in grasslands of the Empire-Cienega Resource Conservation Area and in the valley of the Santa Cruz River near Sahuarita. Primarily a prairie turtle that inhabits arid and semi-arid treeless plains and rolling grass and shrub lands where soils are sandy.	<u>Inventory:</u> Conduct surveys along line transects or time-constrained searches of specified appropriate habitats at appropriate seasons and hours. <u>Monitoring:</u> Mark-recapture or telemetry surveys in known populations or designated reserve system lands.

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Sonoran Desert Tortoise (<i>Gopherus agassizi</i>)	USFWS-SOC WSCA	In Arizona, this species is generally found in rocky areas or along steep-sided washes in generally rocky areas, where it takes shelter under rocks or in small caves.	<u>Inventory:</u> Conduct surveys along line transects or time-constrained searches of specified appropriate habitats. <u>Monitoring:</u> Mark-recapture or telemetry surveys in known populations or designated reserve system lands.
Giant Spotted Whiptail (<i>Cnemidophorus burti stictogrammus</i>)	USFWS-SOC PVS	In Pima County, this species has been recorded in the Santa Catalina, Santa Rita, and Baboquivari Mountains. Formerly common in Sabino Canyon. Extirpated from most of the Santa Cruz River valley. Inhabits mountain canyons, arroyos, and mesas, entering lowland desert along stream courses and riparian areas.	<u>Inventory:</u> Conduct surveys along standardized line transects or time-constrained searches of specified appropriate habitats as described by Rosen and Lowe (1995). <u>Monitoring:</u> Repeated transect surveys or time constrained searches as described by Rosen and Lowe (1995) in known populations or designated reserve-system lands during summer months.
Red-backed Whiptail (<i>Cnemidophorus burti xanthonotus</i>)	USFWS-SOC PVS	The entire range of this subspecies includes the southwest-central border of Arizona in Pima County and northern Sonora. In Pima County, known primarily from the Ajo Mountains at Organ Pipe Cactus National Monument.	<u>Inventory:</u> Conduct surveys along standardized line transects or time-constrained searches of specified appropriate habitats as described by Rosen and Lowe (1995). <u>Monitoring:</u> Repeated transect surveys or time constrained searches as described by Rosen and Lowe (1995) in known populations or designated reserve-system lands during summer months.
Ground Snake (<i>Sonora semiannulata</i>)	PVS	In Pima County, small numbers occur in many small populations on the Tohono O'odham Nation, its eastern border between Marana and Eloy, and rarely around Tucson. Inhabits plains, valleys, and foothill habitats; found mostly near mountains with higher slopes.	<u>Inventory:</u> Conduct area-constrained searches within appropriate habitats. <u>Monitoring:</u> Conduct telemetry studies designed to address monitoring goals within known populations.

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Mexican Garter Snake (<i>Thamnophis eques megalops</i>)	USFWS-SOC WSCA PVS	In Pima County, currently known only from Cienega Creek; extirpated from the Santa Cruz and Rillito rivers, and Tanque Verde and Pantano washes in the Tucson area. Inhabits areas of permanent water with lush vegetation at elevations ranging from approximately 1,700 to 6,200 feet.	<u>Inventory:</u> Visual encounter surveys in appropriate habitats. <u>Monitoring:</u> <u>Monitoring:</u> Conduct telemetry studies designed to address monitoring goals within known populations.
Organ Pipe Shovel-nosed Snake (<i>Chionactis palurostris organica</i>)	PVS	In Arizona, most if not all of the current range is in Organ Pipe Cactus National Monument. May occur on the Tohono O’odham Nation in western and central Pima County.	<u>Inventory:</u> Conduct road surveys, line transect surveys, or area constrained searches in appropriate habitats. <u>Monitoring:</u> <u>Monitoring:</u> Conduct telemetry studies designed to address monitoring goals within known populations.
Tucson Shovel-nosed Snake (<i>Chionactis occipitalis klauberi</i>)	PVS	Occurs from south of Tucson northward along Avra Valley to Pinal County and Maricopa County. Current distribution in Pima County poorly known, but it has never been recorded east of the Tucson Mountains and may have been eliminated from much of the Avra Valley. Found on lowland valley floors in areas with sand and loose soil.	<u>Inventory:</u> Conduct road surveys, line transect surveys, or area constrained searches in appropriate habitats. <u>Monitoring:</u> Conduct telemetry studies designed to address monitoring goals within known populations.
BIRDS			

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Cactus Ferruginous Pygmy-owl (<i>Glaucidium brasilianum cactorum</i>)	USFWS-E WSCA PVS	Historically, the primary central and southern Arizona habitat for this owl was apparently cottonwood-willow forests, mesquite bosques, and Sonoran Desertscrub vegetation communities. Currently, it is known to occur in the following two vegetation communities: (1) Sonoran Desertscrub in braided-wash systems with paloverde, ironwood, and mesquite; and (2) Semidesert Grassland with drainages containing mesquite, hackberry, and ash. Geographically, the majority of current CFPO records are concentrated in northwest Tucson and the Altar Valley. Critical habitat was designated for this species in 1999, but was rescinded by a court order. New critical habitat was proposed in November 2002. The proposed study area is not within the formerly designated (USFWS 1999a) or newly proposed critical habitat area (USFWS 2002b).	<u>Inventory:</u> Follow survey methods for project clearance or large area searches as recommended by AGFD and USFWS (2000). Methods consist of broadcasting recorded songs at designated survey points during specified time periods between January 1 st and June 30 th . <u>Monitoring:</u> Depending on specific monitoring goals, it may be appropriate to band birds, conduct nest monitoring efforts, and telemetry or other studies. At present, most monitoring efforts are conducted by AGFD and USFWS personnel.

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Southwestern Willow Flycatcher (<i>Empidonax traillii extimus</i>)	USFWS-E WSCA PVS	Nests in dense riparian habitats along streams, rivers, and other wetlands vegetated with cottonwood, willow, boxelder, buttonbush, and arrowweed.	<u>Inventory:</u> Follow survey methods for project clearance or large area searches as described in Sogge <i>et al.</i> (1997) and the protocol revision recommended by USFWS (2000). Methods consist of broadcasting recorded songs at designated survey points during specified time periods between May 15 th and July 17 th . <u>Monitoring:</u> Depending on specific monitoring goals, it may be appropriate to band birds, conduct nest monitoring efforts, and telemetry or other studies, following establish guidelines such as those described by Rourke <i>et al.</i> (1999).
California Brown Pelican (<i>Pelicanus occidentalis californicus</i>)	USFWS-E	Nests in southern coastal areas and afterward forages northward along the Pacific before returning southward for the winter. This Pacific Coast subspecies is an uncommon transient to Arizona lakes and rivers, with individuals wandering up from Mexico during summer and fall. Diet consists primarily of fish. No breeding records in Arizona.	<u>Inventory:</u> Search all appropriate habitats, such as large waterbodies and rivers, and surrounding areas with the use of binoculars and spotting scope. <u>Monitoring:</u> Should be determined on a case-by-case basis based on monitoring goals.
Masked Bobwhite (<i>Colinus virginianus ridgewayi</i>)	USFWS-E WSCA	The one known population in the state is a reintroduced population at Buenos Aires National Wildlife Refuge.	<u>Inventory:</u> Broadcast recorded whistles at designated survey points during breeding season. <u>Monitoring:</u> Depending on specific monitoring goals, it may be appropriate to band birds, conduct nest monitoring efforts, and telemetry or other studies.

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Mexican Spotted Owl (<i>Strix occidentalis lucida</i>)	USFWS-T WSCA	Occurs in mature forest and woodland, shady wooded canyons and steep canyons at elevations from 4,100 to 9,000 feet.	<u>Inventory:</u> Broadcast recorded calls at designated survey points during breeding season following methods. U.S. Forest Service Southwest Region monitoring and inventory protocols. <u>Monitoring:</u> Depending on specific monitoring goals, it may be appropriate to band birds, conduct nest monitoring efforts, and telemetry or other studies.
Bald Eagle (<i>Haliaeetus leucocephalus</i>)	USFWS-T WSCA	A small resident population of about 40 pairs nests primarily along the Salt and Verde rivers. Additional nest sites are along the Gila, Bill Williams, Agua Fria, and San Pedro River drainages. Nest sites are high in trees, on cliffs, or on pinnacles in close proximity to water.	<u>Inventory:</u> Search all appropriate habitats, such as large waterbodies and rivers, potential roosts, and surrounding areas with the use of binoculars and spotting scope. Continuous or point-count surveys by road for large areas. <u>Monitoring:</u> Depending on specific monitoring goals, it may be appropriate to monitor winter roosts, band birds, conduct nest monitoring efforts, and telemetry or other studies. Repeat surveys of known winter roosts.
Mountain Plover (<i>Charadrius montanus</i>)	USFWS-P	Breeds in shortgrass prairies and shrub-steppe landscapes, primarily in the Rocky Mountains. Winters in small flocks on fallow fields and barren desert flats in Florence, Phoenix, Sulphur Springs Valley, and Gila Bend-Parker regions (Monson and Phillips 1981). Wintering habitats consist of sites with short vegetation and bare ground, often with manure piles or rocks nearby (USFWS 1999b).	<u>Inventory:</u> Conduct flushing surveys along transects from mid-April through early July as described by USFWS guidelines (1999). <u>Monitoring:</u> Depending on specific monitoring goals, it may be appropriate to band birds, conduct nest monitoring efforts, and telemetry or other studies.

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Yellow-billed Cuckoo (<i>Coccyzus americanus</i>)	USFWS-C WSCA PVS	In Arizona, yellow-billed cuckoos breed primarily in large blocks of cottonwood/willow riparian habitat (USFWS 2001) along central and southern Arizona rivers (AGFD 1996). Rarely observed as transient in xeric desert or urban settings (Corman 1992).	<u>Inventory:</u> Broadcast songs and calls in appropriate habitats in accordance with Laymon (1998). <u>Monitoring:</u> Depending on specific monitoring goals, it may be appropriate to band birds, conduct nest monitoring efforts, and telemetry or other studies.
Swainson's Hawk (<i>Buteo swainsoni</i>)	USFWS-SOC WSCA PVS	In Arizona, this species breeds throughout the state in suitable open grassland habitats and open desertscrub that includes a grassland component. Migrating Swainson's hawks are regularly sighted in the Gila and Santa Cruz River Valleys (Glinski and Hall 1998). Prey items include insects, small mammals, and reptiles.	<u>Inventory:</u> Search all appropriate potential roosting and foraging sites with the use of binoculars and spotting scope. Continuous or point-count surveys by road for large areas. <u>Monitoring:</u> Depending on specific monitoring goals, it may be appropriate to band birds, conduct nest monitoring efforts, and telemetry or other studies.
Abert's Towhee (<i>Pipilo aberti</i>)	PVS	In Pima County, this species is relatively common along brushy washes and the effluent-dominated riparian woodland portion of the Santa Cruz River; may be present in urban backyards especially those that are along washes.	<u>Inventory:</u> Point-count census stations established in appropriate habitats. <u>Monitoring:</u> Depending on specific monitoring goals, it may be appropriate to band birds, conduct nest monitoring efforts, and telemetry or other studies.
Bell's Vireo (<i>Vireo belli</i>)	PVS	In Pima County, this species is a common summer resident in dense shrubs and trees of lower canyons, generally below the oak zone, and along desert streams and washes in dense riparian vegetation.	<u>Inventory:</u> Point-count census stations established in appropriate habitats. <u>Monitoring:</u> Depending on specific monitoring goals, it may be appropriate to band birds, conduct nest monitoring efforts, and telemetry or other studies.

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Burrowing Owl (<i>Athene cunicularia</i>)	PVS	Considered rare in Pima County where it inhabits grasslands, open areas of desert-scrub vegetation, and disturbed areas. Recent reliable areas include the agricultural fields near Pinal Air Park and along the airstrip at Davis Monthan Air Force Base. Inhabits grasslands, pastures, desertscrub, edges of agricultural fields, golf courses, vacant lots, and road embankments.	<u>Inventory:</u> Pedestrian survey transects in appropriate habitats to document burrowing owls and potential burrowing sites. <u>Monitoring:</u> Depending on specific monitoring goals, it may be appropriate to survey during the February 1 st through August 31 st nesting season, band birds, conduct nest monitoring efforts, and telemetry or other studies.
Rufous-winged Sparrow (<i>Aimophila carpalis</i>)	PVS	In Pima County, this species is fairly widespread in appropriate habitat. Specific locations include Saguaro National Park (east) and the Tucson area. Inhabits flat or gently hilly Sonoran Desertscrub vegetation with scattered trees and shrubs, in close proximity to grassland.	<u>Inventory:</u> Point-count census stations established in appropriate habitats. <u>Monitoring:</u> Depending on specific monitoring goals, it may be appropriate to band birds, conduct nest monitoring efforts, and telemetry or other studies.
MAMMALS			
Lesser Long-nosed Bat (<i>Leptonycteris curasoae yerbabuena</i>)	USFWS-E WSCA PVS	Day roosts are in caves, abandoned tunnels, and unoccupied buildings. Forages on nectar, pollen, and fruits of paniculate agaves and columnar cacti.	<u>Inventory:</u> During appropriate season, search appropriate potential roost sites and utilize mist nets, Tuttle traps, to determine presence and relative abundance in the area. <u>Monitoring:</u> Repeat inventories with care to ensure consistency in level of effort, placement of traps or detectors and weather conditions.
Jaguar (<i>Panthera onca</i>)	USFWS-E WSCA	Inhabits savannah, Sonoran Desertscrub and subalpine forests, usually near water; rarely found in extensive arid areas (USFWS 1998).	<u>Inventory:</u> Area constrained searches for tracks and other signs; set up motion sensor cameras and scent station transects within in appropriate range and habitats. <u>Monitoring:</u> Telemetry studies designed to address monitoring goals as appropriate.

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Mexican Gray Wolf (<i>Canis lupus baileyi</i>)	USFWS-E WSCA	Extirpated from the U.S. Has been re-introduced to sites in the Apache and Gila National Forests. Inhabits oak and pine/juniper savannahs in the foothills and mixed conifer woodlands above 4,000 feet.	<u>Inventory:</u> Area constrained searches for tracks and other signs; set up motion sensor cameras and scent station transects within in appropriate range and habitats. <u>Monitoring:</u> Telemetry studies designed to address monitoring goals as appropriate.
Ocelot (<i>Felis pardalis</i>)	USFWS-E WSCA	Inhabits desert scrub communities with dense cover; there are unconfirmed reports of individuals in extreme southern Arizona.	<u>Inventory:</u> Area constrained searches for tracks and other signs; set up motion sensor cameras and scent station transects within in appropriate range and habitats. <u>Monitoring:</u> Telemetry studies designed to address monitoring goals as appropriate.

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Sonoran Pronghorn (<i>Antilocapra americana sonoriensis</i>)	USFWS-E WSCA	Small population in southwestern Arizona and adjacent Mexico.	<u>Inventory:</u> Visual surveys from a high vantage point using a spotting scope, or aerial surveys of appropriate landscapes. <u>Monitoring:</u> Telemetry studies designed to address monitoring goals.
Arizona Shrew (<i>Sorex arizonae</i>)	USFWS-SOC WSCA PVS	Has not been found in Pima County; previous records from the Santa Rita Mts. are from outside of Pima County. All records are from high mountain ranges in southeastern Arizona and western New Mexico. In Arizona, they have been recorded in the Huachuca, Santa Rita, and Chiricahua mountains.	<u>Inventory:</u> Use pitfall traps in appropriate habitat. <u>Monitoring:</u> Conduct mark-recapture surveys in known populations.
Mexican Long-tongued Bat (<i>Choeronycteris mexicana</i>)	USFWS-SOC WSCA PVS	Known to occur at scattered locations in Pima County. In summer occupies mine tunnels, caves, and rock fissures primarily at elevations of 4,000 to 6,000 feet from the lower edge of the oak zone, through the pine-oak woodland, possibly to the pine-fir belt. In Pima County and elsewhere, paniculate agaves are the primary food source. Also known to occur along Cienega Creek in eastern Pima County.	<u>Inventory:</u> Inventory of appropriate food-bearing plants. During appropriate season, search appropriate potential roost sites and utilize mist nets, Tuttle traps, to determine presence and relative abundance in the area. <u>Monitoring:</u> Repeat inventories with care to ensure consistency in level of effort, placement of traps or detectors and weather conditions.
Pale Townsend's Big-eared Bat (<i>Plecotus townsendii</i>)	USFWS-SOC WSCA PVS	In Pima County, this species is frequently found in inactive mines and caves, and occasionally in buildings. Diet consists of small moths and other insects. Occurs through a range of elevations and vegetation communities in Arizona including Sonoran Desertscrub, Madrean Evergreen Woodland, and coniferous forests.	<u>Inventory:</u> During appropriate season, search appropriate potential roost sites and utilize mist nets, Tuttle traps, or Anabat detectors, preferably near water sources, to determine presence and relative abundance in the area. <u>Monitoring:</u> Repeat inventories with care to ensure consistency in level of effort, placement of traps or detectors and weather conditions.

SDCP - Priority Vulnerable Species and Pima County Federally-listed Species, Range and Habitat Requirements, and Potential Survey and Monitoring Procedures.

Status Definitions: USFWS E=Endangered, USFWS T=Threatened, USFWS P=Proposed Threatened or Endangered, USFWS C=Candidate for listing, USFWS CA= Conservation Agreement; USFWS SOC= Species of Concern; WSCA= Wildlife of Special Concern in Arizona; PVS= Priority Vulnerable Species in Pima County.

Species	Status	Range and Habitat Requirements	Potential Inventory and Monitoring Recommendations
California Leaf-nosed Bat <i>(Macrotis californicus)</i>	USFWS-SOC WSCA PVS	Populations are known from inactive mines in most of the mountain ranges in Pima County. Nearby roosts include Tucson Mountain Park and Colossal Cave Mountain Park. Diet consists of large flying insects.	<u>Inventory:</u> During appropriate season, search appropriate potential roost sites and utilize mist nets, Tuttle traps, or Anabat detectors, preferably near water sources, to determine presence and relative abundance in the area. <u>Monitoring:</u> Repeat inventories with care to ensure consistency in level of effort, placement of traps or detectors and weather conditions.
Allen's Big-eared Bat <i>(Idionycteris phyllotis)</i>	USFWS-SOC PVS	Not currently known from Pima County. In Arizona, most specimens have been collected from the southern Colorado Plateau, the Mogollon Rim, and adjacent mountain ranges. Inhabits ponderosa pine, pinyon-juniper, and riparian woodland vegetation types, as well as desertscrub.	<u>Inventory:</u> During appropriate season, search appropriate potential roost sites and utilize mist nets, Tuttle traps, or Anabat detectors, preferably near water sources, to determine presence and relative abundance in the area. <u>Monitoring:</u> Repeat inventories with care to ensure consistency in level of effort, placement of traps or detectors and weather conditions.
Cave Myotis <i>(Myotis velifer)</i>	USFWS-SOC	This bat is known to roost in caves and inactive mines in the general area and to forage widely over desert land.	<u>Inventory:</u> During appropriate season, search appropriate potential roost sites and utilize mist nets, Tuttle traps, or Anabat detectors, preferably near water sources, to determine presence and relative abundance in the area. <u>Monitoring:</u> Repeat inventories with care to ensure consistency in level of effort, placement of traps or detectors and weather conditions.

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Species	Status	Range and Habitat Requirements	Potential Inventory and Monitoring Recommendations
Merriam's Mouse (<i>Peromyscus merriami</i>)	PVS	Known primarily from heavy, forest-like stands of mesquite (bosques); also found in thick stands of mesquite, cholla, prickly pear, paloverde, and grasses. There apparently is only one record of this species from Pima County in the last 30 years (from Organ Pipe Cactus NM). Most historic locations have been altered and recent records are lacking. Unknown whether this species still occurs along the Santa Cruz River.	<u>Inventory:</u> Set up baited Sherman traps along gridlines in appropriate habitats just before dusk. Check traps at first light of the following morning. <u>Monitoring:</u> Conduct mark-recapture surveys designed to address monitoring goals in known populations.
Western Red Bat (<i>Lasiurus blossevillii</i>)	WSCA PVS	In Pima County, known to occur along riparian corridors with oaks, sycamores, and cottonwoods. Has been recorded at Santa Rita Experimental Range, Empire Gulch, SE of Baboquivari Mts., Rincon Mts., Santa Catalina Mts., and Colossal Cave Mountain Park.	<u>Inventory:</u> During appropriate season, search appropriate potential roost sites and utilize mist nets, Tuttle traps, or Anabat detectors, preferably near water sources, to determine presence and relative abundance in the area. <u>Monitoring:</u> Repeat inventories with care to ensure consistency in level of effort, placement of traps or detectors and weather conditions.
Western Yellow Bat (<i>Lasiurus xanthinus</i>)	WSCA PVS	Most known records of yellow bats from Arizona are from urban Tucson and Phoenix where they are associated with planted fan palms. This bat roosts in palm trees and riparian deciduous trees.	<u>Inventory:</u> During appropriate season, search appropriate potential roost sites and utilize mist nets, Tuttle traps, or Anabat detectors, preferably near water sources, to determine presence and relative abundance in the area. <u>Monitoring:</u> Repeat inventories with care to ensure consistency in level of effort, placement of traps or detectors and weather conditions.