DRAFT

Reserve Design Process Update

Sonoran Desert Conservation Plan

May 2001



Pima County, Arizona
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County Administrator
Chuck Huckelberry

MEMORANDUM

Date: May 15, 2001

To: The Honorable Chair and Members
Pima County Board of Supervisors

From: C.H. Huckelberry
County Administrator

Re: **Reserve Design Process Update**

I. Overview

This memorandum provides a brief introduction to the two attached summaries by Recon Consulting on the status of the Science Technical Advisory Team's work to create a reserve system from the biological perspective. The first document is a short white paper on *Reserve Design Process*, and the second document is the material presented to the Steering Committee on March 22, 2001. I am forwarding these status reports now since more detailed information about the priority conservation areas of each species is being described under separate cover in a study by the peer reviewers to the Science Technical Advisory Team. In addition, the Science Team's biological goals for the 56 species proposed for protection under the regional multi-species plan will be completed and issued in the near future, which will lead to greater refinement of the biological reserve alternatives and set the stage for the public participation process. Through Land Panel and Steering Committee meetings, biological information and other resource considerations will shape the final Sonoran Desert Conservation Plan as participants to the process formulate recommendations and proposals for the preferred alternative of the reserve.

II. Workprogram - Background and Status

Recon began working with the Science Team sixteen months ago to develop the Multi-Species Conservation Plan, which is the biological component of the Sonoran Desert Conservation Plan. Studies by the Recon team include:

- Land Cover Data Assessment
- Biological Stress Assessment
- Review of Vulnerable Species List
- Priority Vulnerable Species: Data Compilation and Synthesis
- Priority Vulnerable Species: Habitat Data Analysis
- Potentially Problematic Species, Ecological Effects and Management Strategies
- Draft Reserve Design Guidelines, Goals, Opportunities and Constraints
- The Role of Adaptive Management
- Draft Preliminary Biological Reserve

The science community has generated a number of additional studies, including riparian mapping which achieves a much finer delineation than we have seen previously.

In the future, we will receive studies, reports, and documents from the Recon team that cover these subject areas:

- Priority Vulnerable Species: Analysis and Review
- Habitat Suitability Modeling for Covered Species
- Vulnerable Species Goals
- Reserve Design Recommendations
- Evaluations of Reserve Effectiveness
- Adaptive Management Plan and Manual
- Drafts of the Multi-Species Conservation Plan (4 drafts and final plan)
- Drafts of the Environmental Impact Statement (4 drafts and final document)

III. Biological Reserve Design Principles

In the October 2000 study on *Draft Reserve Design Guidelines, Goals, Opportunities and Constraints,* the evolution of reserve design principles were detailed, going back to the 1967 origins when an influential text was published by Robert MacArthur and E.O. Wilson entitled *The Theory of Island Biogeography*. This volume was written almost as a pilot study but it launched a quarter century of discussion within the scientific community about general conservation principles. Scientists, including those working on the Sonoran Desert Conservation Plan, have developed and distilled these early ideas into a comprehensive expression of the generalizations about reserve design, and these generalizations have been adopted by the science community as a means of identifying and prioritizing land areas in need of protection.

A. Goals -- The biological goal of the Sonoran Desert Conservation Plan, established by the Science Technical Advisory Team, is:

> To ensure the long term survival of the full spectrum of plants and animals that are indigenous to Pima County through maintaining or improving the habitat conditions and ecosystem functions necessary for their survival.

B. Objectives -- Objectives that arise from this goal include:

- Promote recovery of federally listed and candidate species to the point where their continued existence is no longer at risk.
- Where feasible and appropriate, reintroduce and recover species that have been extirpated from this region.
- Maintain or improve the status of unlisted species whose existence in Pima County is vulnerable.
- Identify biological threats to the region's biodiversity posed by exotic and non-native species of plants and animals, and develop strategies to reduce these threats and avoid additional invasive exotics in the future.

- Identify compromises to ecosystem functions within target plant communities selected for their biological significance and develop strategies to mitigate them.

- Promote long-term viability for species, environments and biotic communities that have special significance to people in this region because of their aesthetic or cultural values, regional uniqueness, or economic significance.

C. Guidelines -- The guidelines for biological reserve design outlined in previous reports are inclusive of, and build upon the knowledge of, the last quarter century of conservation research. By dividing analysis into guidelines for individual species and guidelines for the reserve system as a whole, the method described captures both the traditional and progressive aspects of biological planning. Guidelines include:

- The reserve system guidelines that concern individual species primarily focus on metapopulation characteristics of the populations in Pima County. The ultimate goal for each of the species considered will be to provide adequate habitat under conservation management in a configuration that will ensure the long-term persistence of the population.
    - comprehensive conservation of vulnerable species
    - maximum patch size containing large populations of focal vulnerable species
    - adjacency and proximity of habitat blocks
    - contiguity of habitat at the landscape level
    - connectivity of reserves with functional corridors
- Reserve guidelines for the system as a whole are achieved through protection of components that provide the structure for conservation on a landscape scale. These guidelines are primarily concerned with diversity of species (beyond the vulnerable species list), sites with exceptional biodiversity, diversity of vegetation characteristics, and representativeness.
    - diverse representation of physical and environmental conditions
    - intact ecosystem function with few or no impacts from exotic or invasive species
    - minimum fragmentation and maximum roadlessness

IV. Status of the Reserve Design Process

On March 19, 2001, the Preliminary Draft Biological Reserve was issued, representing the Science Team's first step in applying the assembled biological information to design a reserve system that addresses the biological conservation goals. The next steps in the reserve design process guided by the Science Team will focus on the development of a biologically preferred alternative reserve system, which accomplishes the biological goals of the Sonoran Desert Conservation Plan.

These steps will include the:

- Continued refinement of the biological information used in the analysis;
- Adjustment of the reserve system boundaries to better accomplish the biological goals;
- Identification of core areas within the reserve system where more intensive conservation management should occur;
- Identification of multiple use areas within the reserve system where conservation management is balanced with other compatible land use activities; and
- Establishment of criteria for assessing how well the reserve system performs in achieving the conservation plan biological goals.

The biologically preferred alternative will then provide the basis for development of alternative reserve system configurations that balance biological goals with the Sonoran Desert Conservation Plan goals for ranch conservation, cultural resources conservation, mountain parks, as well as, land use and economic considerations.

A. Technical Look at the Reserve Design Process -- The first attached summary report provides a view of from the technical perspective of how the biological reserve has been assembled. Included in this account is:

- A description of the Science Team workshops over the past eight months;
- The role of Geographic Information System Information in defining the reserve;
- The components of biological value in the reserve formula;
- The role of modeling habitat characteristics and environmental variables;
- The role of the expert community in refining species distribution maps;
- The method for delineating exterior reserve system boundaries;
- The method for differentiating areas within the boundaries based on relative value;
- Identification of biological core areas, and critical habitat cores;
- Identification of multiple use areas;
- Identification of urban buffer areas; and
- A description of on-going iterative design reviews and boundary assessments.

B. General Look at the Reserve Design Process -- The second attached summary report provides a view of from the historical and process perspective of how the biological reserve has been assembled. Included in this account is:

- A description of the Science Team, peer reviewers and consulting team;
- A flowchart describing the relation of types of data in the study process;
- A list of tasks carried out from January through June of 2000;
- A summary of Science Team workshops;
- Representative maps and a description of how they are integrated;
- A summary of the priority vulnerable species and special elements;
- An introduction to peer review processes;
- A description of how biological elements are integrated with other elements;
- A summary of working groups for the conservation plan;
- A description of how conservation and economic goals are balanced; and
- An overview of the Sonoran Desert Conservation Adaptive Management Plan.

V. Conclusion

The attached documents provide status reports on the reserve design process and set the stage for future reports and the upcoming public process. The Recon approach encompasses the fundamental principles of conservation biology in addition to the most progressive methods and theories in conservation biology today.

Attachments

Reserve Design Process

Reserve design for the Sonoran Desert Conservation Plan (SDCP) has been the focus of Scientific Technical Advisory (STAT) meetings for the past eight months during which time 12 workshops have been held to discuss and design the reserve system. The foundation for this work was laid by Pima County staff who undertook the development of hundreds of data layers of information relating to both natural and built environments in Pima County. Since that time the database has grown significantly, and the approach to building the reserve system has evolved.

During the past eight months a biologically preferred alternative has been the focus of reserve development. Additional alternatives have been built on the biologically preferred alternative based on the potential non-participation of each jurisdiction within Pima County, and will continue to change as the biologically preferred alternative changes. The proposed alternative will evolve from these and will include additional analyses of cost and feasibility.

The approach to reserve design has been developed by STAT and RECON, and is founded on the principles of conservation biology applied to the particular species and habitats of concern in Pima county. Reserve development has centered on the conservation of priority vulnerable species – an approach which insures the continued existence of these species of concern in Pima County, thereby allowing coverage of these species under the USFWS section 10A permit.

Geographic Information Systems (GIS) has been an important tool in building reserve design, primarily because of its ability to manage large amounts of spatial data. One of the main functions of GIS is overlaying multiple data layers in order to understand complex spatial patterns on the landscape, whether the issues are biology, land use, or an intersection of the two. This kind of overlay analysis has provided the basis for building component layers and ultimately reserve design.

The biologically preferred alternative reserve system is built based on biological value as assessed by the STAT in cooperation with many experts in the community. The major components of biological value are vulnerable species habitat, other special habitats identified by STAT, expert-defined priority conservation areas and USFWS critical habitat for endangered species. A subsequent analysis of urban density enabled areas of lower biological value within the original reserve system to be identified and removed.

STAT and RECON identified the vulnerable species richness data layer as the most robust data upon which to base the initial assessment of biological value. This layer is comprised of high potential habitat for the 41 vulnerable species modeled. (Habitat for pseudoscorpion and talus snails were not modeled since the limits of their restricted habitat are known and included as constraints in the reserve system.) Potential habitat was mapped based on GIS modeling of multiple environmental variables as habitat for species, with review and additional mapping conducted by STAT and species experts. This has been an intensive effort where biologists and GIS analysts worked together to review and revise model parameters, which included scoring species habitat for 115 characteristics of 15 environmental variables. Model parameters were revised five times and each environmental data layer was updated with new mapping at least once. Discussion and results of this modeling process are presented in the May 2001 report,

"PRIORITY VULNERABLE SPECIES: Analysis and Review of Species Proposed for Coverage by the Multi-Species Conservation Plan."

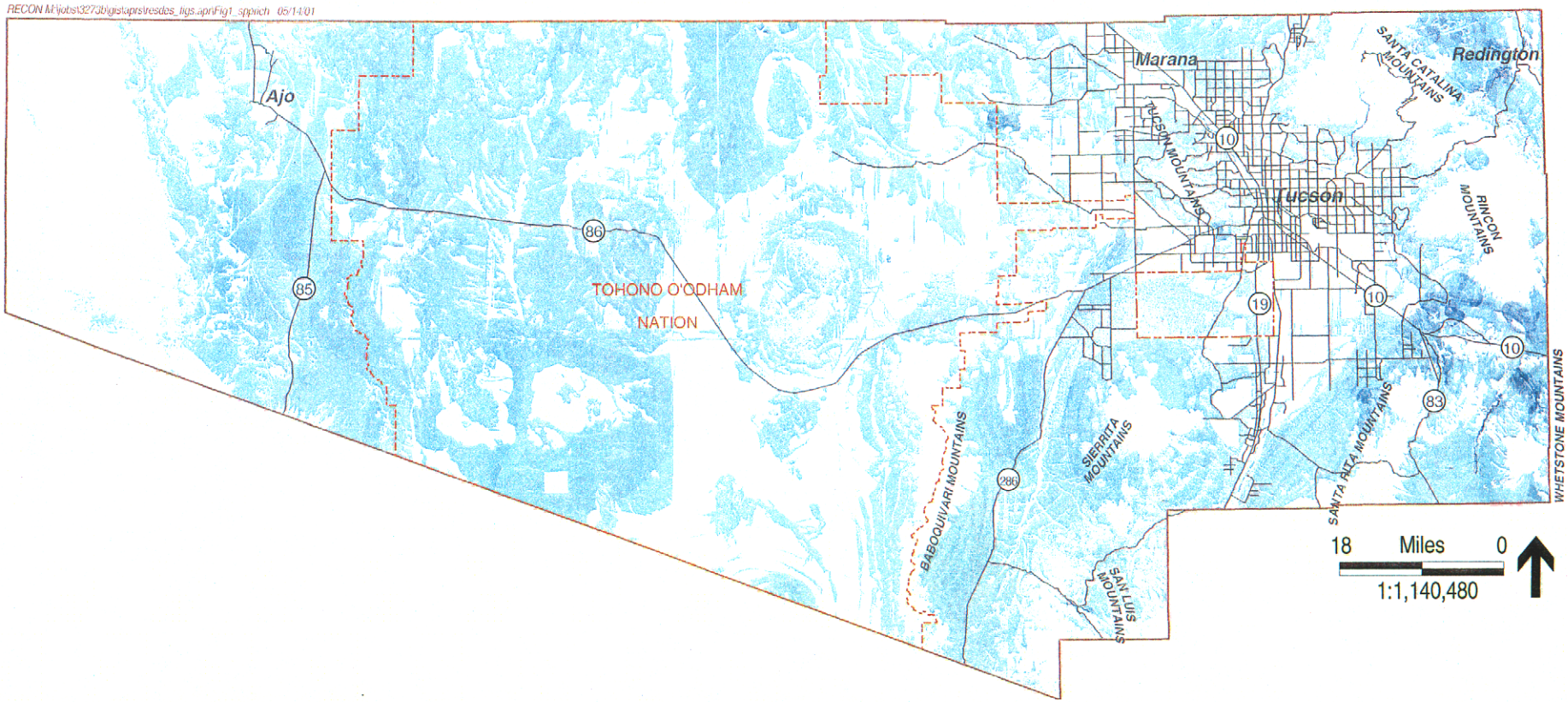
In the species richness layer, shown in Figure 1, places where three or more species have overlapping high potential habitat are shown in graduated shades of blue. These areas provided the basis for drawing initial reserve system boundaries, which were delineated based on a complex system of rules developed in STAT workshops and based on principles of reserve design (Appendix A). For example, small isolated areas of higher value were excluded from the reserve system, and small areas of lower value were included if they formed important connections or were surrounded by areas of higher value. These rules were developed to insure that reserve system boundaries formed large, connected areas that captured the highest biological value. Rules were applied systematically to insure that all parts of the reserve were delineated in the same way.

Next, special elements (important habitats identified by STAT) were overlaid with the reserve system to insure that most elements identified as "constraints" were included. Special elements "preferences" were included in the reserve system when choosing important reserve connections. Mapping for special elements was updated continually throughout the reserve design process. Figure 2 shows the most current mapping for special elements constraints and preferences. A table of special elements is included in Appendix B.

Reserve system boundaries were modified again based on overlapping priority conservation areas. Priority conservation areas were delineated for each vulnerable species in order to identify the most important areas for conservation. These areas were identified by local species experts, and digitized by GIS analysts. The forthcoming report "Priority Conservation Area," May 2001, describes this process. Places designated "priority conservation area 1" are considered to be highest priority according to species experts and critical to include in the reserve system. Because these high-priority conservation areas are broadly defined and map refinement is currently underway, we chose to augment the reserve system only where five or more high-priority conservation areas overlapped. Figure 3 shows a surface of overlapping high-priority conservation areas. Five or more overlapping areas are shown in graduated shades of red.

Another check performed to insure the reserve system included all important areas of biological value, involved the overlay of new riparian mapping with the existing reserve system. Because all assessments of biological value ultimately rely on vegetation mapping, deficiencies in this mapping ultimately lead to deficiencies in reserve boundary delineation. Riparian mapping based on extensive fieldwork became available in January 2001 (Harris 2001) and provides a significant improvement over previous mapping. Overlaying these riparian areas with reserve system (Figure 4) enabled important connections to be made between areas of high biological value.

Finally critical habitat, designated by USFWS, was added to reserve system boundaries. The largest of these in Pima County is the critical habitat area for cactus ferruginous pygmy-owl. Smaller areas include those for Mexican spotted owl and southwestern willow flycatcher. The majority of these areas were already included in the reserve system based on assessments of biological value. Figure 5 shows the overlap between reserve system boundary and species critical habitat.



Reserve Design Process: Vulnerable Species Richness

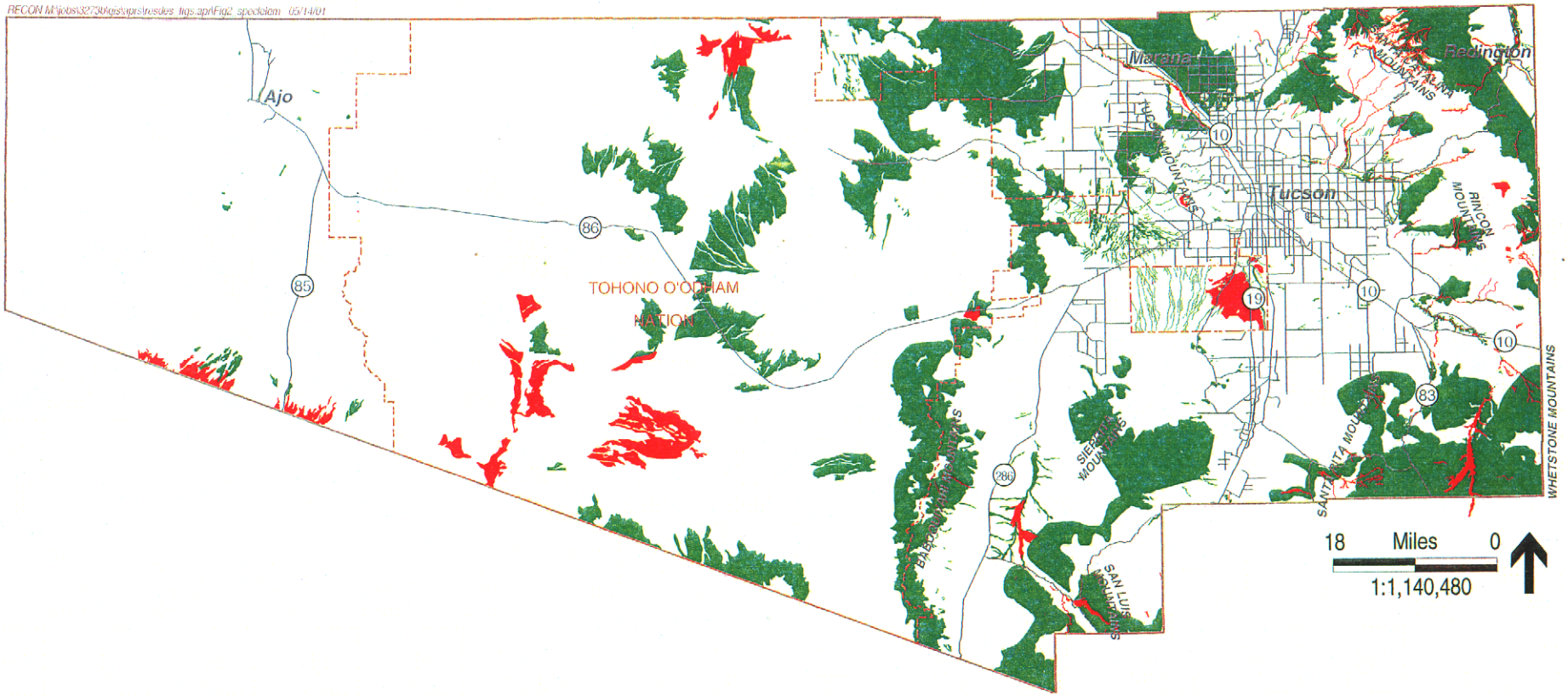
Pima County Boundary

Major Road or Highway

Species Richness Layer
(RECON, May 2001)

0	6	12
1	7	13
2	8	14
3	9	15
4	10	16
5	11	17

Figure 1

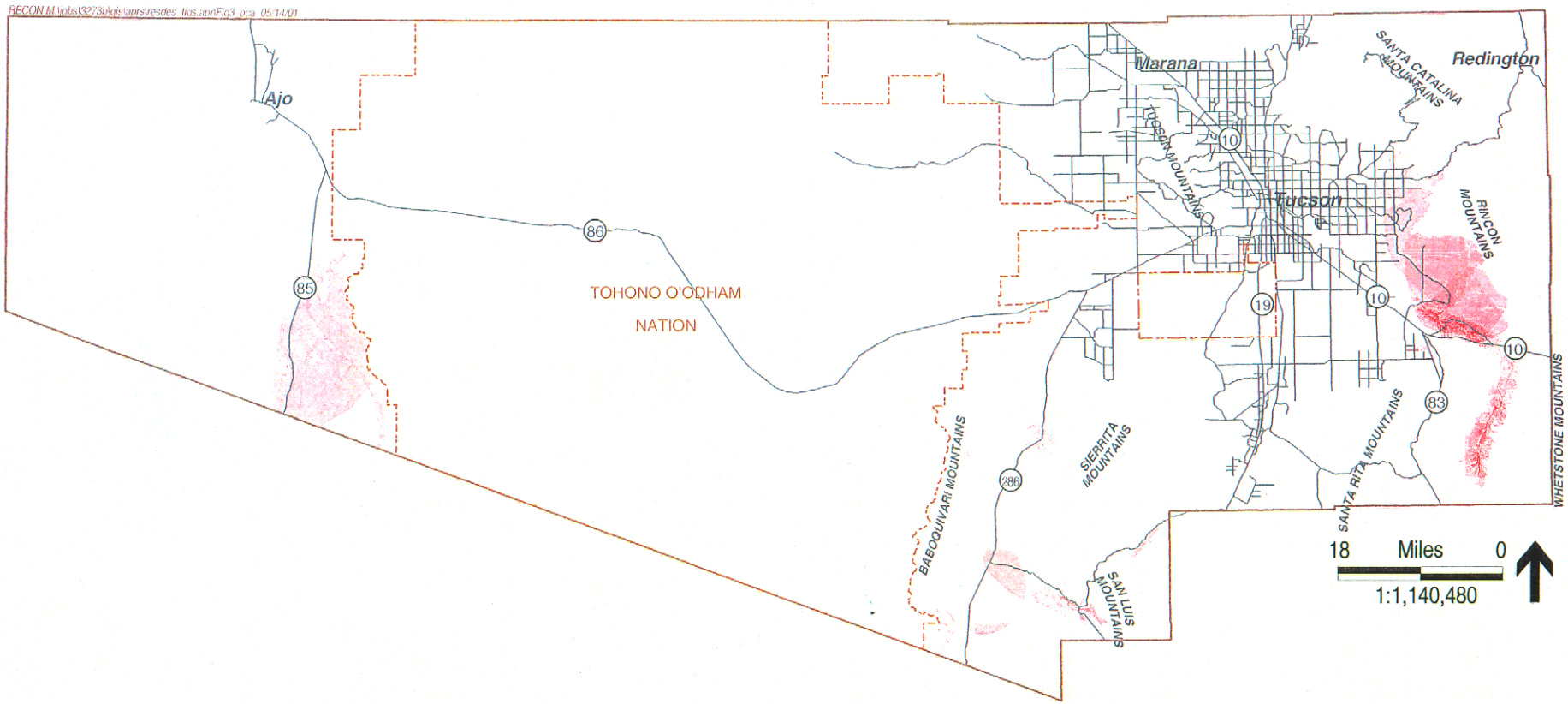


Reserve Design Process: Special Elements

Pima County Boundary
Major Road or Highway

Special Elements
(RECON, May 2001)
Constraints
Preferences

Figure 2



Reserve Design Process: Priority Conservation Areas

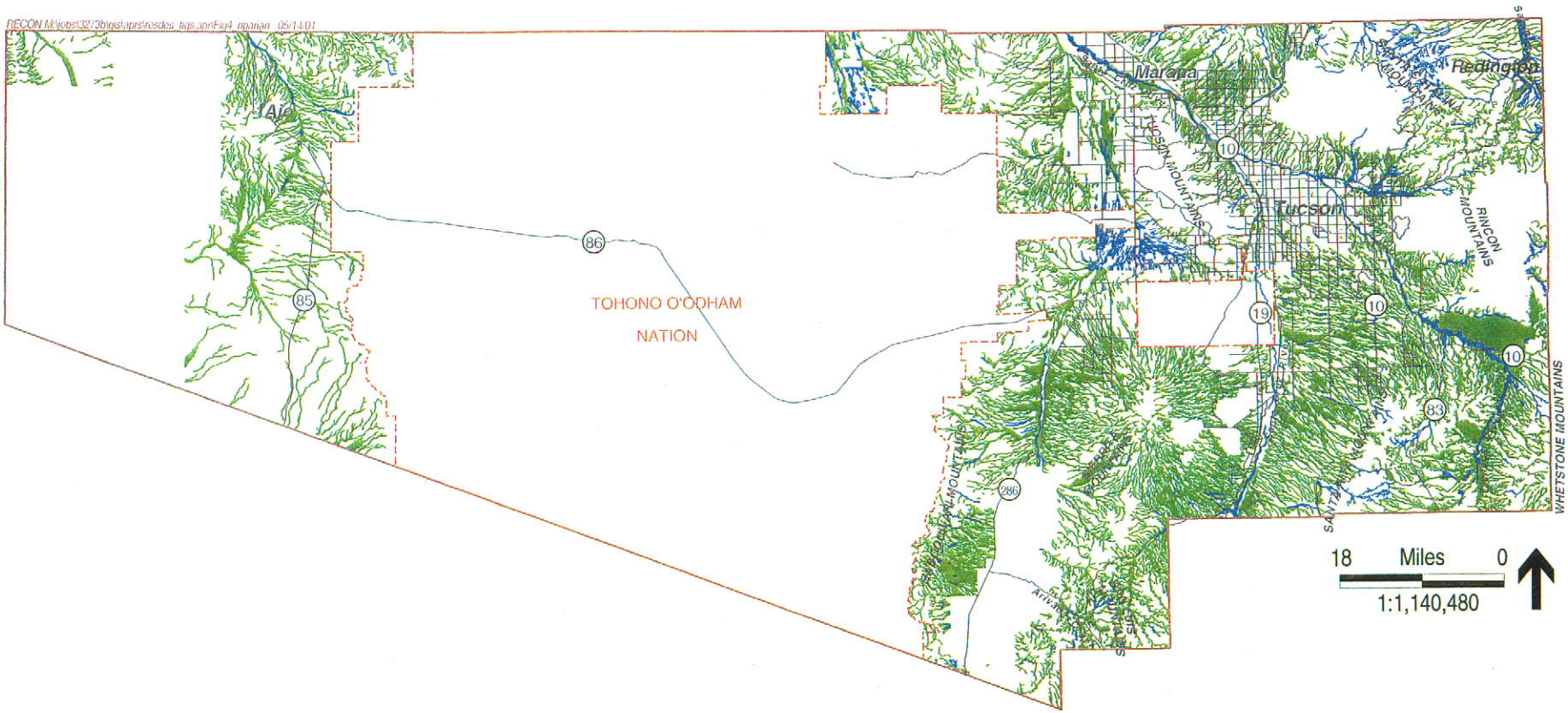
Pima County Boundary

Major Road or Highway

Species Richness Layer
(RECON, May 2001)

0 1 2 3 4 5 6 7 8 9 10 11 12 13

Figure 3



Reserve Design Process: Riparian Areas

Pima County Boundary

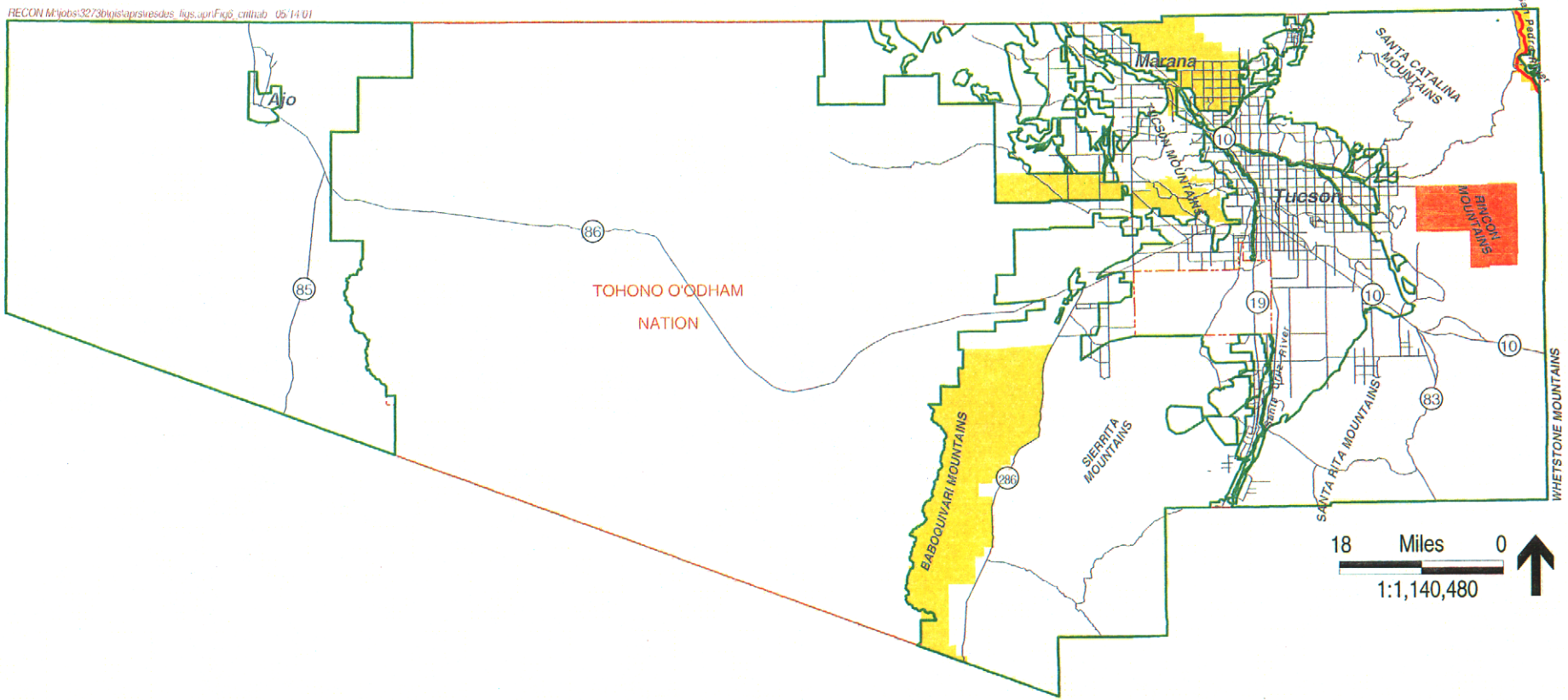
Major Road or Highway

Riparian Areas
(Harris & Associates, January 2001)

Meso-riparian (200-series of Brown, Lowe & Pace vegetation classification system)

Xero-riparian (100-series of Brown, Lowe & Pace vegetation classification system)

Figure 4



Reserve Design Process: USFWS Designated Critical Habitat

Pima County Boundary

Major Road or Highway

Critical Habitat (USFWS)

Southwestern Willow Flycatcher

Mexican Spotted Owl

Cactus Ferruginous Pygmy Owl

Reserve System Boundary

Figure 5

After exterior reserve system boundaries were delineated, interior areas were differentiated based on relative biological value. Procedures for this process were presented to STAT in April (Appendix C) and have since been refined. First, biological core areas were identified. These are areas with exceptionally high biological value, which will be managed primarily for biological conservation. Biological cores were developed by overlaying areas with high potential habitat for five or more vulnerable species plus areas of special element constraints plus mesoriparian corridors (Figure 6).

Additional areas are identified as critical habitat cores. These are areas of designated critical habitat which did not meet all the criteria for designation as a biological core. These areas will be managed primarily for the species of concern but may include other land uses, such as urban development in pre-existing urban areas. Critical habitat is shown in Figure 5 above.

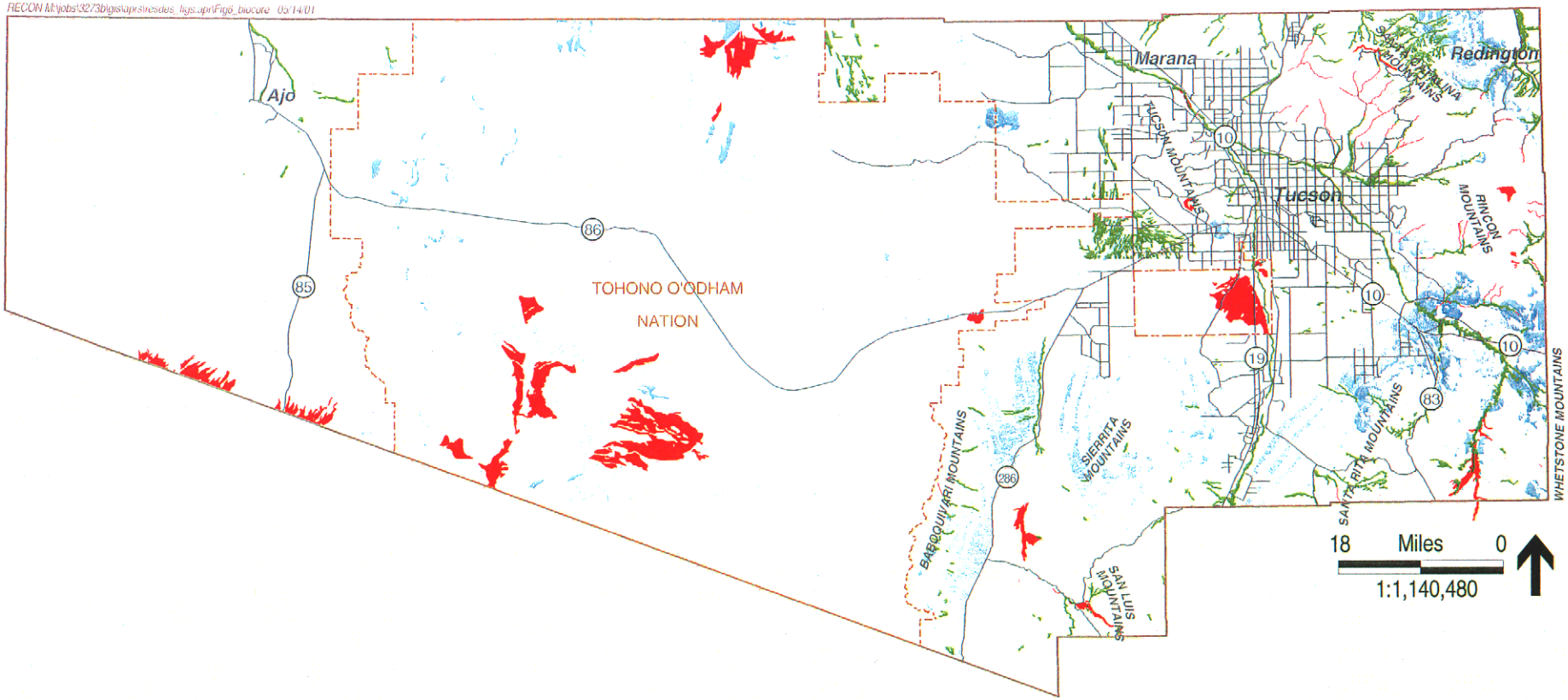
Multiple use areas are primarily open space areas with high biological value that will be managed for biological conservation but may include other land uses, such as ranching. These are areas not designated as biological or critical habitat core.

Urban buffer areas within the reserve system identify areas that are a mixture of open space and low-density urban development (1 house per 3.3 acres up to 1 house per 5 acres). These areas currently retain high biological value and will be managed for multiple uses so that biological value is maintained. These areas were defined by conducting a pattern analysis of urban density. The purpose of conducting an analysis of urban density was to compensate for deficiencies in land cover data. The intent was to identify urbanized areas that have low biological value and remove them from the reserve system.

For all parcel data where adequate information was available, residences per acre (actual land use) was calculated. Important classes were identified as high density (1 house or more per 1 acre), medium density (1 house per 1 acre to 1 house per 3.3 acres), low density (1 house per 3,3 acres to 1 house per 5 acres), and lower density (1 house per 5 acres or more). Figure 7 illustrates these urban density classes in eastern Pima County. Because all areas are a patchwork of various urban densities, it was necessary to analyze and classify the pattern of urban density across broader areas. This visual assessment followed these rules: areas having greater than 50 percent medium and high urban density were excluded from the reserve, areas having greater than 50 percent low urban density were included in the reserve as urban buffer, and areas having greater than 50 percent lower urban density were included in the reserve and assigned a reserve system category based on previously described biological criteria.

All categories of the draft biologically preferred reserve system are shown in Figure 8. This alternative is currently under review and revision by STAT to assess the adequacy of the reserve system for covering vulnerable species. Based on this assessment, exterior and interior reserve system boundaries could change. More importantly, land cover revision is currently underway, and species habitat model revision will be conducted in June. Changes in mapping for these data layers could significantly affect reserve system boundaries – but are most likely to affect interior boundaries.

Regardless of changes to data layers used to build reserve design, the process is in place. The reserve design process, which has evolved significantly after months of



Reserve Design Process: Biological Core Areas

Pima County Boundary

Major Road or Highway

Biological Core Areas:
Species Richness Layer
(RECON, May 2001)

0	6	12
1	7	13
2	8	14
3	9	15
4	10	16
5	11	17

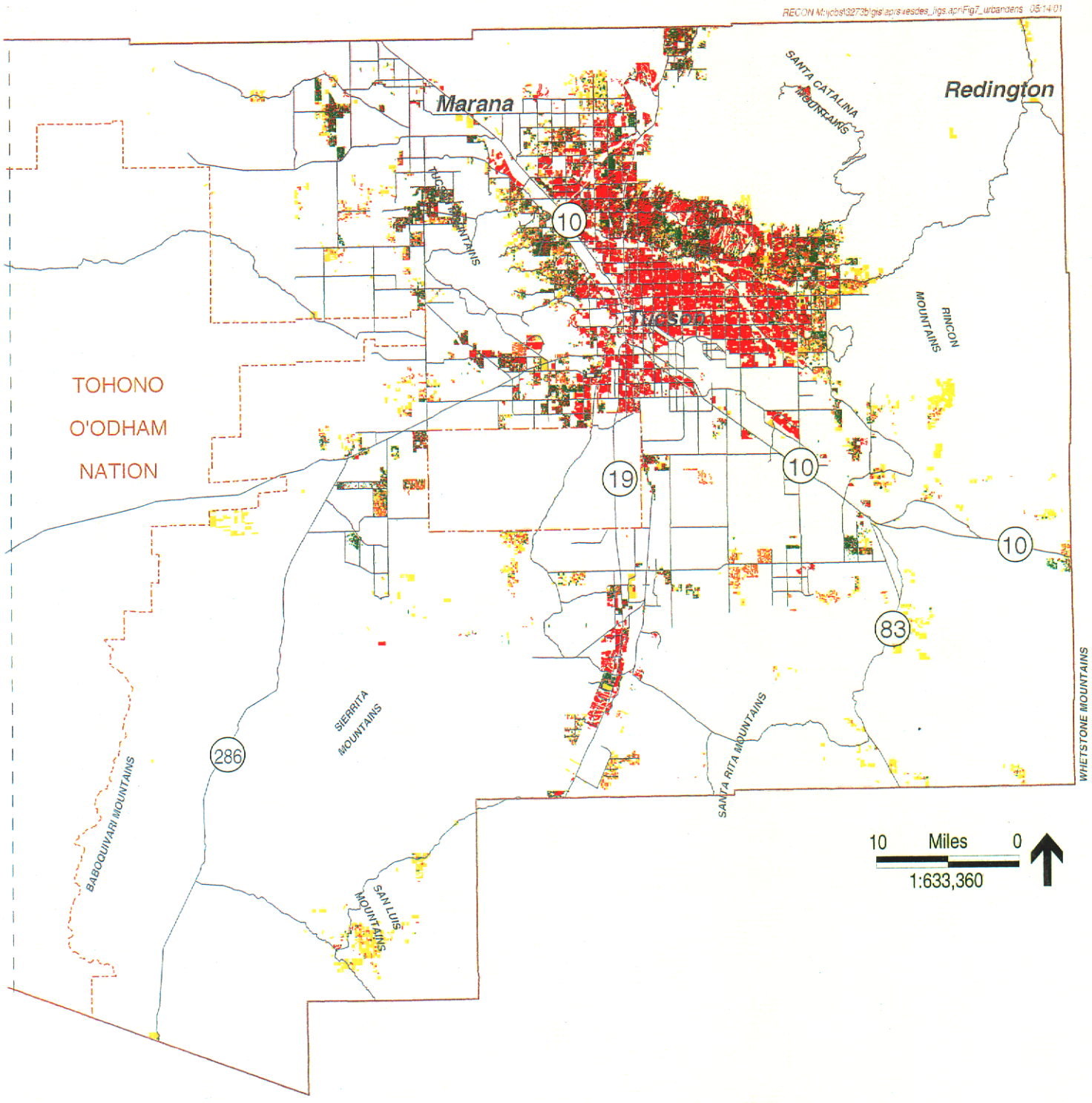
Special Elements
(RECON, May 2001)

Constraints

Riparian Areas
(Harris & Associates, January 2001)

Meso-riparian (200-series of Brown, Lowe & Pace vegetation classification system)

Figure 6

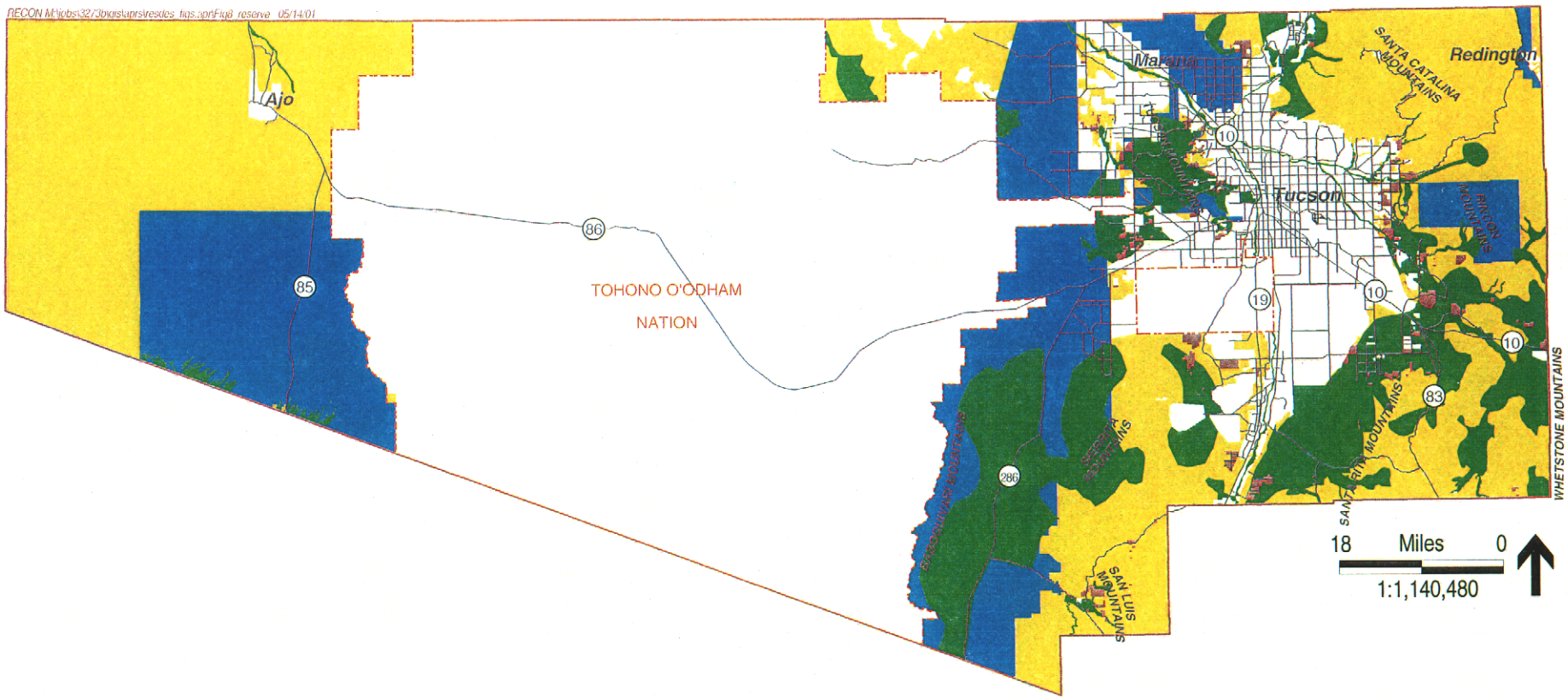


Reserve Design Process: Urban Density
(Eastern Pima County)

Pima County Boundary
Major Road or Highway

Urban Density
(RECON, May 2001)
- High Density
- Medium Density
- Low Density
- Lower Density

Figure 7



Draft Biologically-Preferred Reserve System

Pima County Boundary

Major Road or Highway

Reserve System Categories
(RECON, May 2001)

- Biological Core
- Critical Habitat Core
- Multiple Use
- Urban Buffer

Figure 8

review and refinement by STAT, is in its final stages of development, and will serve to guide new iterations of reserve design based on future data update.

APPENDIXES

APPENDIX A

SDCP Reserve Design Process

Progress, Issues, Procedures 2/22/01 – 3/21/01

February 22 STAT Workshop: RECON presented an overview of the process to date and a review of GIS data layers including habitat modeling for individual species, summary of high potential habitat for species (species richness surface), special elements mapping, biological value surface composed of species richness plus special elements mapping, expert priority conservation areas (EPCAs), and TNC conservation areas.

The goals identified for this meeting were to:

1) build a reserve system boundary for Avra Valley that meets biological goals and objectives and

2) develop procedures and criteria in drawing these boundaries that can be applied county wide.

In building the reserve system our tasks included delineating a reserve system boundary, then identifying within this boundary areas that would function as core reserves, corridors or connections, and matrix or buffer areas. It was also suggested that we identify areas appropriate for restoration within the reserve system.

Working in the Avra Valley study area for this meeting, we reviewed the species richness layer, special elements identified as constraints, EPCAs, TNC areas and existing reserves to identify which layers would provide the most useful base for drawing reserve system boundaries. As we evaluated each area, viewing various data layers overlayed with one another, the following issues were identified and discussed:

1) We should use the most robust layer as a base from which to begin drawing reserve system boundaries: it was decided that this was the species richness layer, since it was based on the best available mapping for multiple environmental variables, scored as species habitat by multiple expert reviewers.

2) Species richness 2, 3, and 4 or more were examined as starting points for delineating reserve system boundaries. We decided that values of 2 were too broad – they included most of Avra Valley, and failed to differentiate especially valuable or habitat rich areas. Values of 4 and above were too restrictive – polygons having high habitat richness were small and fragmented. Habitat surface value of 3 adequately differentiated habitat rich vs. habitat poor areas of Avra Valley and included relatively large, contiguous areas. Therefore, **species richness value of 3 or more** was chosen as the starting point for drawing reserve system boundaries.

3) Other important data layers used to delineate reserve system boundaries were special elements. Constraints and preferences were shown separately, and as boundaries were drawn efforts were made to include all constraint special elements and as many preference special elements as possible, according to rules established by STAT in a previous meeting.

4) It was determined that expert's "priority conservation areas" were too broadly defined, and included too many areas of non-habitat to use in delineating reserve system boundaries. Instead, it was suggested that we conduct an accounting of priority conservation areas (especially habitat within EPCAs) included or excluded in various versions of reserve system boundaries. This kind of assessment would provide a check for our reserve system.

5) Automatically generating reserve polygons from species richness values using GIS was infeasible since this produced thousands of isolated polygons (representing a patchwork of 300 ft grid cells). Therefore truly contiguous reserve polygons had to be manually delineated by visually assessing the species richness surface. This process is necessarily synthetic and subjective to some extent thus emphasizing the need for rules to follow as these boundaries are drawn.

6) **Connectivity** is important in drawing reserve boundaries, so small areas with low species richness were included in the reserve system if areas of high richness surrounded them. Large areas of low species richness, represented by mountain ranges, were also included if they were surrounded by high value since it is a) important to include the landscape gradient represented by valley to mountain top, b) entire watersheds can be included this way, and c) endemics of value which are not vulnerable species can be included in the reserve system. In order to assess where mountain ranges occurred, the DEM layer was displayed with hillshading to show topographic relief.

7) **Minimum patch size** is important to consider in drawing reserve system boundaries. In general, isolated patches > 1000 acres of high species richness were included in the reserve system. Smaller patches of high value within close proximity to reserve system boundaries were also included. It was suggested that isolated patches less than 1000 acres would suffer from higher extinction rates, and higher costs to maintain, and were

therefore excluded from the reserve system. However, smaller areas representing critical features such as riparian areas and springs were also included by mapping around areas of special elements considered constraints.

8) **Patch shape** is important to consider in drawing reserve system boundaries. In general, we drew rounded boundaries that minimized the edge to area ratio.

9) We decided to **ignore existing reserve boundaries** during the first run of building reserve system boundaries since we are looking to build a biologically-based design, regardless of land ownership or protection status.

10) It was suggested that we may want to consider **weighting certain species** – currently the species richness surface is based on an equal weighting of all vulnerable species.It was also suggested that **all pygmy owl critical habitat be included** in the reserve system.

11) We discussed **changes that have occurred on the urban fringe** that may make some areas undesirable for inclusion in the reserve system (ie already developed/urbanized) that appear as high value areas based on best available mapping (5+ years old). We will seek out additional data that will help us locate and exclude these areas.

A reserve system boundary was roughly delineated for Avra Valley following the above guidelines developed during the meeting. Further classification of core, corridor and matrix areas was not conducted.

February 23rd-March 6th - Based on the STAT discussion of issues, RECON delineated reserve system boundaries for the entire study area based on the following procedures:

1) Species richness surface with values 3 and above was used together with special elements mapping to provide the basis for delineating reserve system boundaries. Ancillary data layers used during delineation included vegetation/land cover and elevation.

2) Boundaries were drawn to generally include all areas of species richness 3 and above and to include as many special elements as possible. Specific rules include the following:

    a. Small (< 1000 acres) isolated patches of high value were excluded

    b. Large (>1000 acres) isolated patches of high value were included

    c. Small areas (<1000 acres) of low value surrounded by high value were included

d. Large areas (>1000 acres) of low value were included in the following cases:

   i. Low value area representing mountainous area surrounded by high value valleys

   ii. Low value area representing an important connection between reserve patches and consists of natural vegetation

   iii. Low value areas contiguous to high value area and including underrepresented priority conservation areas

e. Large areas (>1000 acres) of mixed high and low value were included when they were contiguous to high value areas and did not appear to be urbanized (included urban land cover or covered by a dense road network)

March 7, 2001 STAT Workshop

At this interim STAT meeting, previously defined procedures and rules were reviewed and RECON's subsequent work was presented. The following issues were discussed:

1) It was suggested that since "corridors" are species and scale-dependent, we should treat connections between reserves as landscape linkages. Furthermore, since reserve function (and related management) will really be decided further along in the process, we decided that we should not be defining corridor, buffer and restoration areas at this point – only core reserves and multiple use areas within the reserve system.

2) Inclusion of agricultural areas – some people felt that agricultural areas provide important habitat and linkage to habitat for some species and that these areas should be included in the reserve system. Currently most agricultural areas are excluded from reserves since overall they scored low in terms species habitat value. This issue was not resolved. Inclusion or exclusion of agricultural areas will need to be revisited on a case-by-case basis for areas.

3) Inclusion of urban fringe areas and the possibility of designating developed, roaded areas as multiple use areas within the reserve system. The difficulty we face here is accurate information about what is on the ground now. Most of our "urban" designations in the land cover mapping are based on 1995 data. We also cannot make assumptions about urbanization where we see road networks since some developments have not been built.

4) Including existing reserves – Regardless of biological value for vulnerable species we do want to include all existing reserves in the reserve system.

5) Information to present to 3/22 Steering Committee – A broadly delineated biologically preferred reserve system, without differentiating between core and multiple use areas, will be presented, with the understanding that it is all under further study and definition.

6) Weighting schemes for species – Are we losing important species in certain areas because species richness is low? Should we weight vertebrate fauna more heavily than other species? We will be more able to address this when we assess how well each of the species fares within the preliminary reserve.

7) Identification of Core Areas: It was suggested that the cores should contain globally ranked species. Global ranking limits the species list to fewer species for which reserves are critical. Alternatively, to delineate core areas we can use the species richness surface, our most "robust" layer) at higher values (i.e., where 4 or more species overlap); and/or use constraints and special elements in conjunction with either of these layers.

8) Further consideration should be given to including agricultural and low-density residential (i.e., 1 house/acre) into the reserve system.

March 8th- 21st: RECON reviewed and revised the reserve system boundary using the criteria agreed upon to date. The riparian mapping was reviewed and considered in order delineate connections along riparian corridors and to include new areas where riparian vegetation was not previously mapped. The expert reviewers' Priority conservation Areas were reviewed to determine which EPCA's had been omitted. We created a EPCA surface (the sum of all EPCA's) and focused on areas where 4 or more EPCA's overlapped; reviewed in detail any of these areas that were not previously included, and expanded certain areas accordingly. The reserve areas that were expanded because of this high PCA value were mostly along riparian corridors (e.g., Sopori Wash, Pantano Wash, Tanque Verde Wash, Sabino Creek). We included large "fingers" of low species richness in the Santa Ritas since these low valley areas are likely an artifact of slope. We need more information here in order to consider which areas have higher or lower values here. All areas of CFPO Critical Habitat were included.

March 22 STAT Workshop: RECON will present the following:

- An abbreviated version of the information to be shown to the Steering Committee this evening,

- A close-up look at various areas of the County and how they are represented by the preliminary biological reserve.
- Review and revision of reserve system boundaries and rules
- Discussion, development of rules to define core vs. multiple use areas

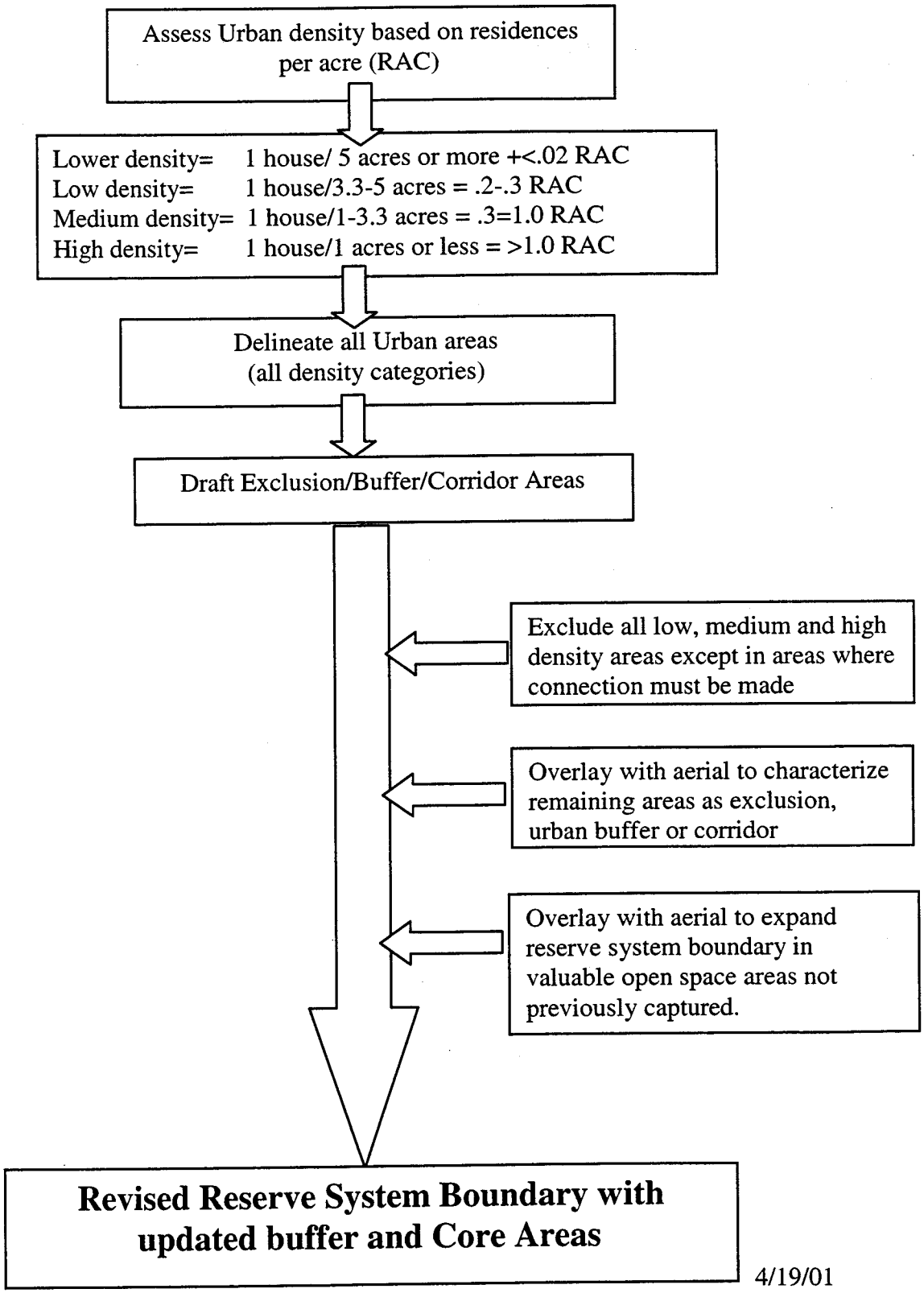
APPENDIX B

"Special Element" Conservation Targets--revised April 20, 2001

Conservation Target	Goal	BLP Series	BLP Class	Data Layer
unincised floodplain with grass/ contributing watershed	constraint/ preference	Unincised floodplain	143.1	Harris-incised+rainfall (David refining)
sacaton	constraint/restore	Sacaton-scrub	143.14	vegetation/land cover (David refining)
native upland grassland	preference	Mixed-grass-scrub	143.15	vegetation/land cover
desert scrub	accounting	Creosotebush-bursage	154.11	vegetation/land cover
desert scrub	accounting	Paloverde-mixed cacti	154.12	vegetation/land cover
desert scrub	preference	Ironwood	154.12/154.13	PAG vegetation/land cover + other
desert scrub	constraint	Saltbush	154.17	PAG vegetation/land cover
riparian	constraint	Cottonwood-willow (Int. SW)	223.21	vegetation/land cover
riparian	constraint	Mixed broadleaf (Int. SW)	223.22	vegetation/land cover
riparian	preference /restore	Mesquite	224.52	vegetation/land cover
riparian	constraint/restore	Cottonwood-willow (Son.)	224.53	vegetation/land cover
riparian	preference	Sonoran Riparian scrub	234.71/154.1	vegetation/land cover
aquatic/wetlands	constraint	Cattail	Cattail	Cattail
perennial/intermittent streams	constraint	n/a	n/a	Streams - effluent?
springs/cienegas	constraint	n/a	n/a	prioritized springs/cienegas
oak/grassland ecotone	preference	Oak/oak savanna w/ des. grassland	123.31/143.1	vegetation/land cover
mixed conifer	constraint	Douglas-fir-mixed conifer	122.61	vegetation/land cover
talus slopes	constraint	n/a	n/a	PAG landform
caves and occupied adits	constraints	n/a	n/a	adits from cave coverages
bat roosts (bridges)	management	n/a	n/a	
low elevation valley floors	accounting	n/a	n/a	PAG landform + elevation
limestone outcrop	preference	n/a	n/a	PAG geology + carbonates

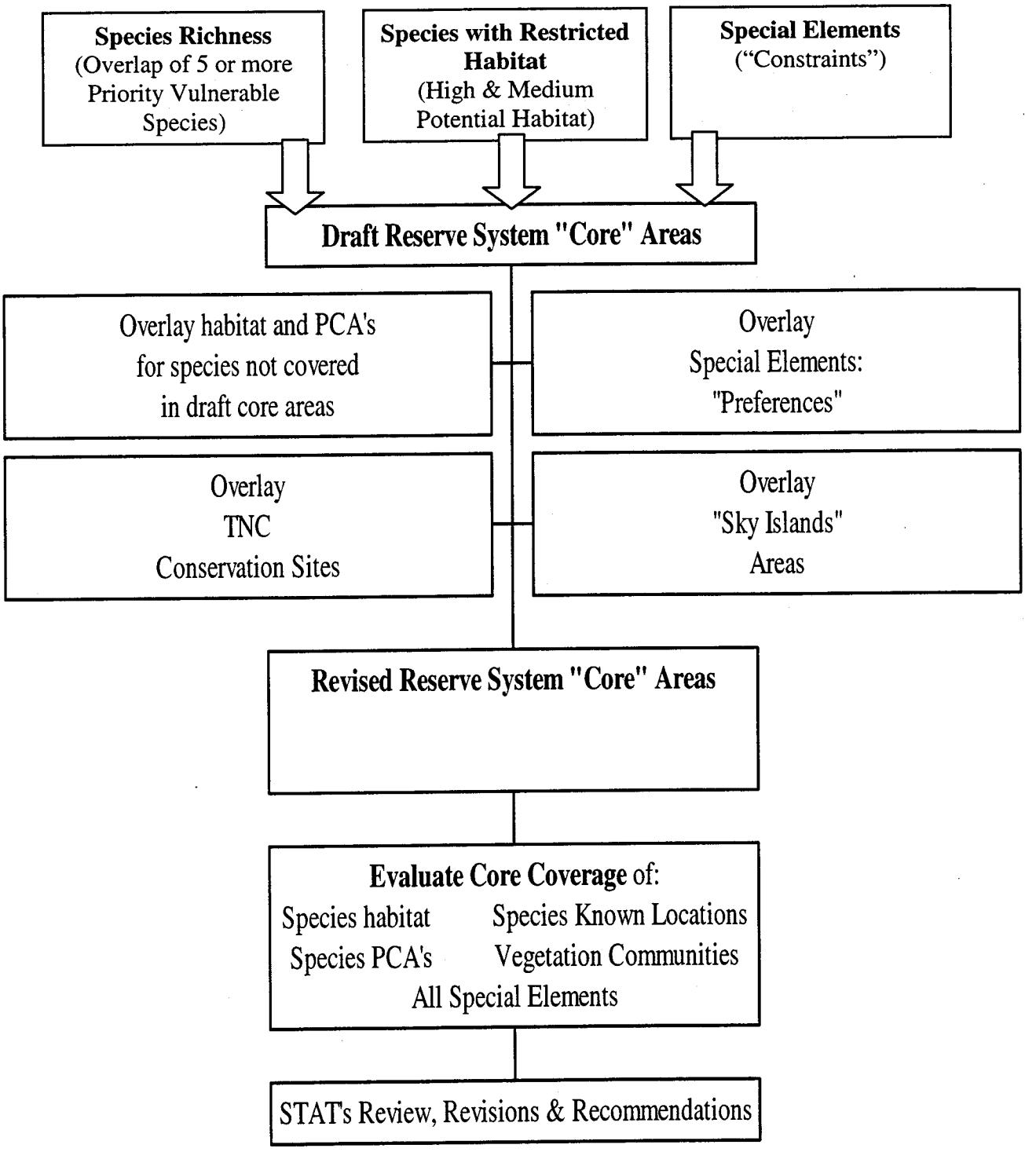
APPENDIX C

Defining Exclusion, Buffer & Corridor Areas



4/19/01

Defining Reserve Cores



Sonoran Desert Conservation Plan

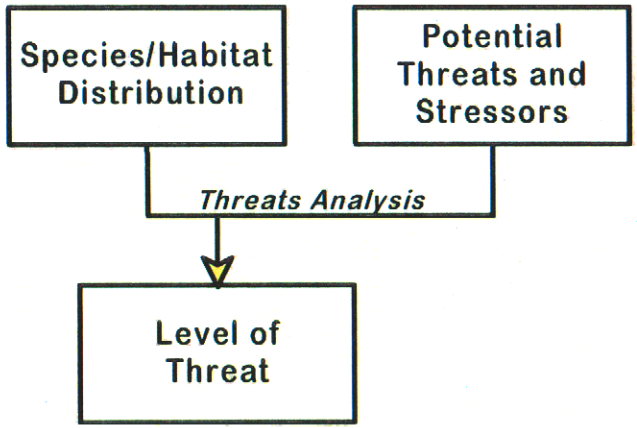
Reserve Design Process Update

March 22, 2001

Biological Resources Team

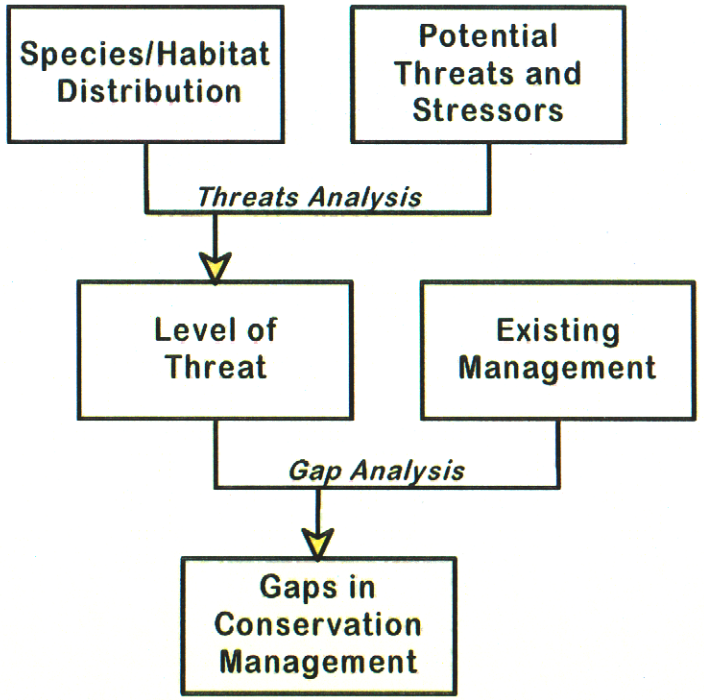
- **Pima County Staff**
- **Science Technical Advisory Team (STAT), Bill Shaw, Chair**
- **Linwood Smith, PhD and experts within the community**
- **RECON Team:**
  - ✓ **Paul Fromer, Conservation Biologist, Project Manager, RECON San Diego**
  - ✓ **Leslie Smith, GIS Coordinator, RECON San Diego**
  - ✓ **Lori Woods, Landscape Architect, Assistant Project Manager, RECON Tucson**
  - ✓ **Ken Kingsley, PhD Biologist, SWCA Tucson**
  - ✓ **Christina Liang, RECON GIS Specialist**
  - ✓ **Others at RECON and SWCA**

Biological Resources Process



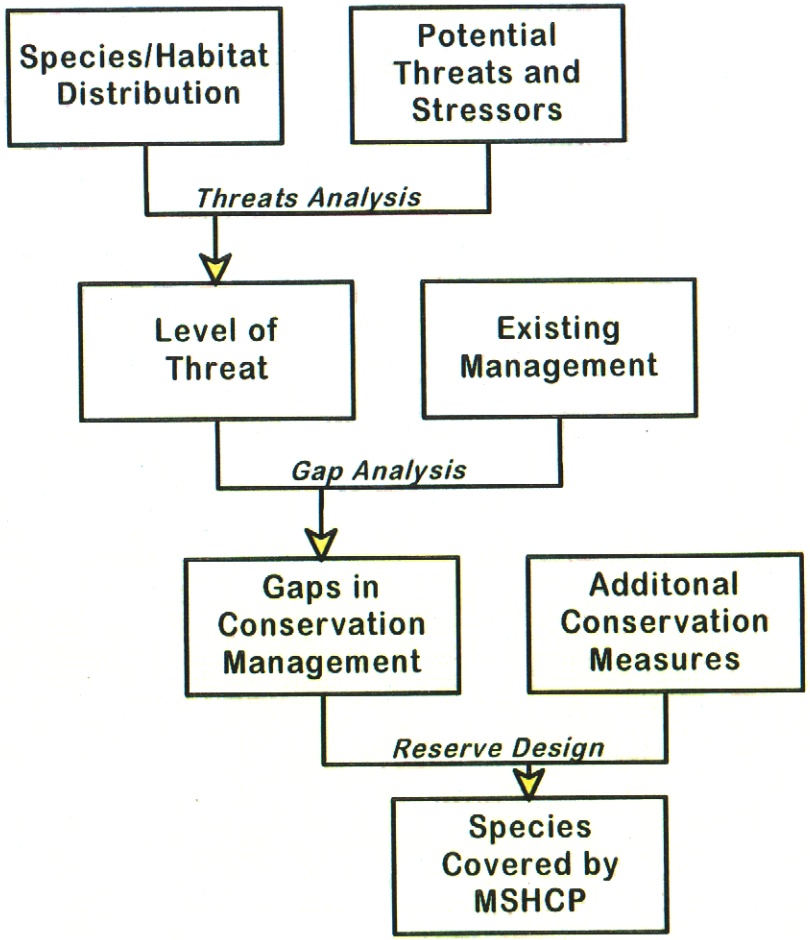
RECON

Biological Resources Process



RECON

Biological Resources Process



RECON

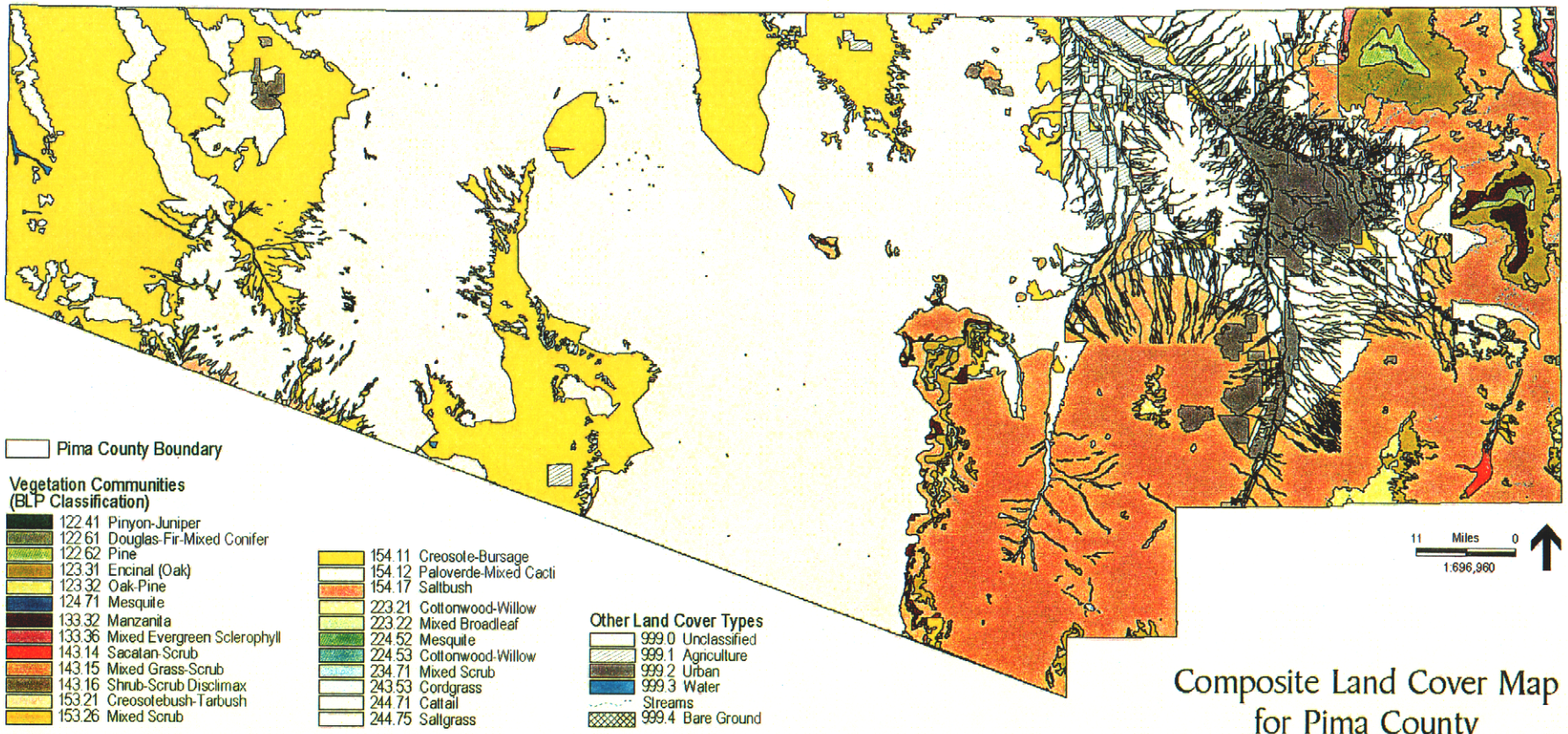
January-June 2000

- **Tasks:**
  - ✓ Land Cover Data Assessment
  - ✓ Biological Stress Assessment
  - ✓ Evaluation of Priority Vulnerable Species
  - ✓ Evaluation of Problematic Species
  - ✓ Habitat Analysis & Species Distribution
  - ✓ Develop Reserve Design Guidelines
  - ✓ Conservation Opportunities and Constraints

STAT Workshop Schedule

- **October**
  - ✓ discussion of technical issues involved in the reserve design process
- **November**
  - ✓ continue discussion of technical issues involved in the reserve design process
  - ✓ review potential biological value surface(s)
- **December**
  - ✓ review potential biological value surface(s)
  - ✓ review negative effects surface(s)
- **January - March**
  - ✓ review results of overlays with existing reserves and conservation management to develop potential reserve system alternatives

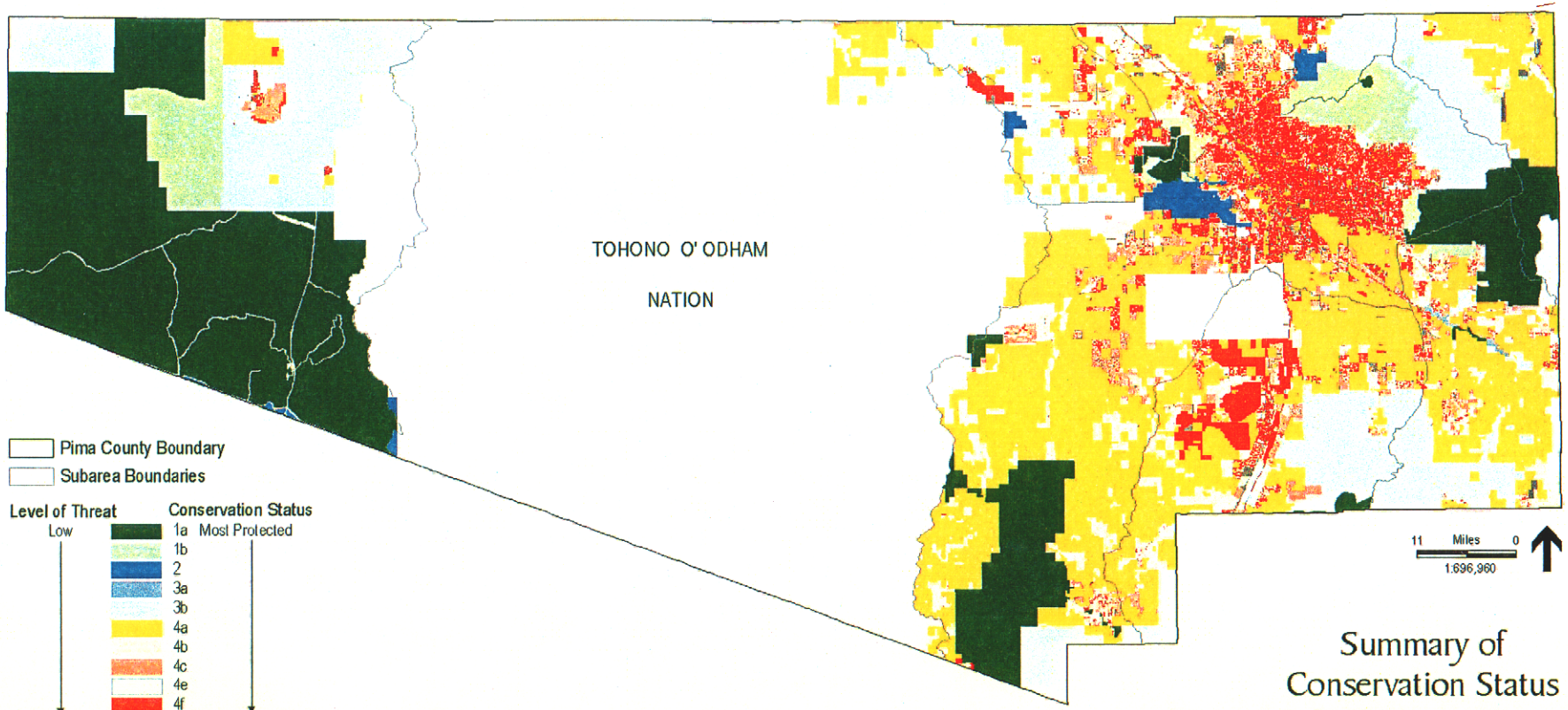
RECON



Composite Land Cover Map for Pima County

SDCP

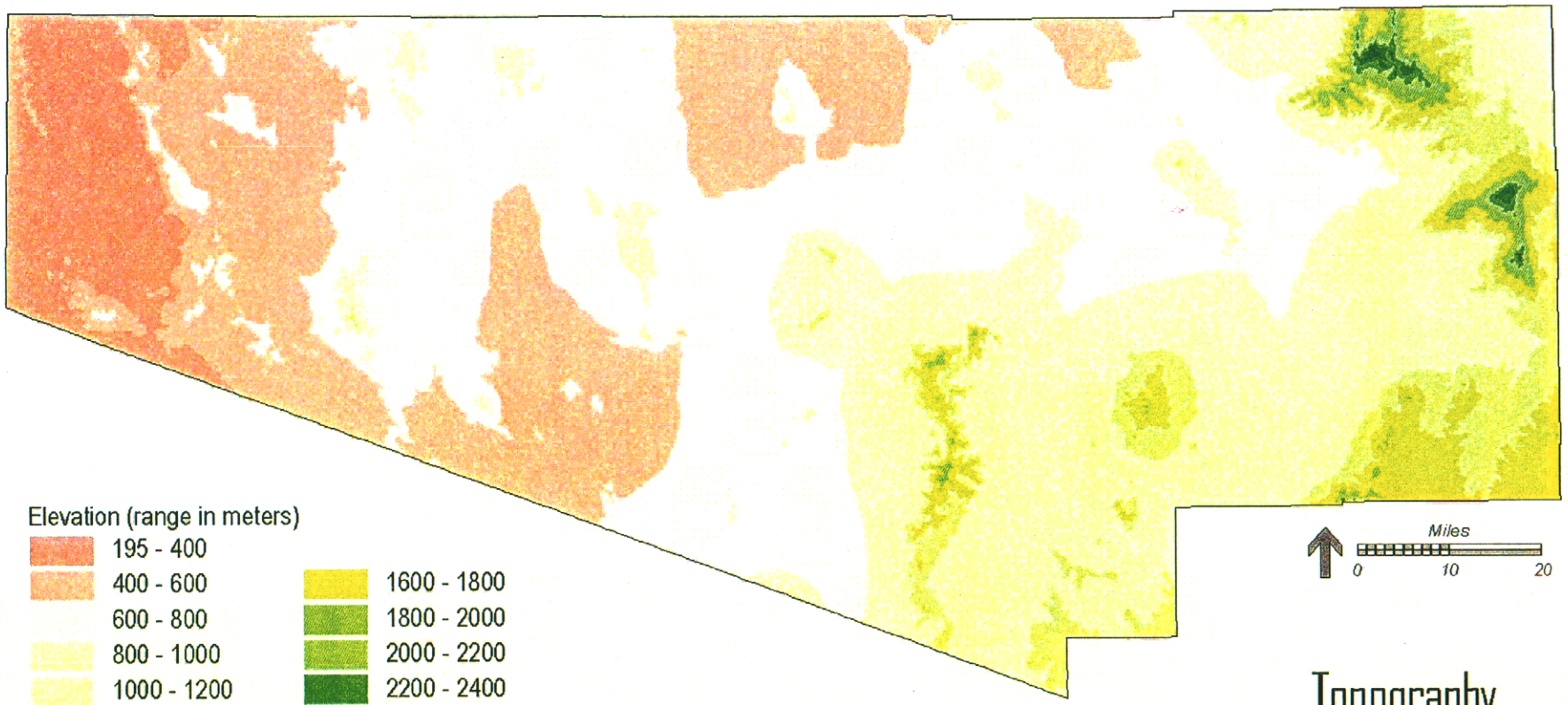
RECON



Summary of Conservation Status for Pima County

SDCP

RECON

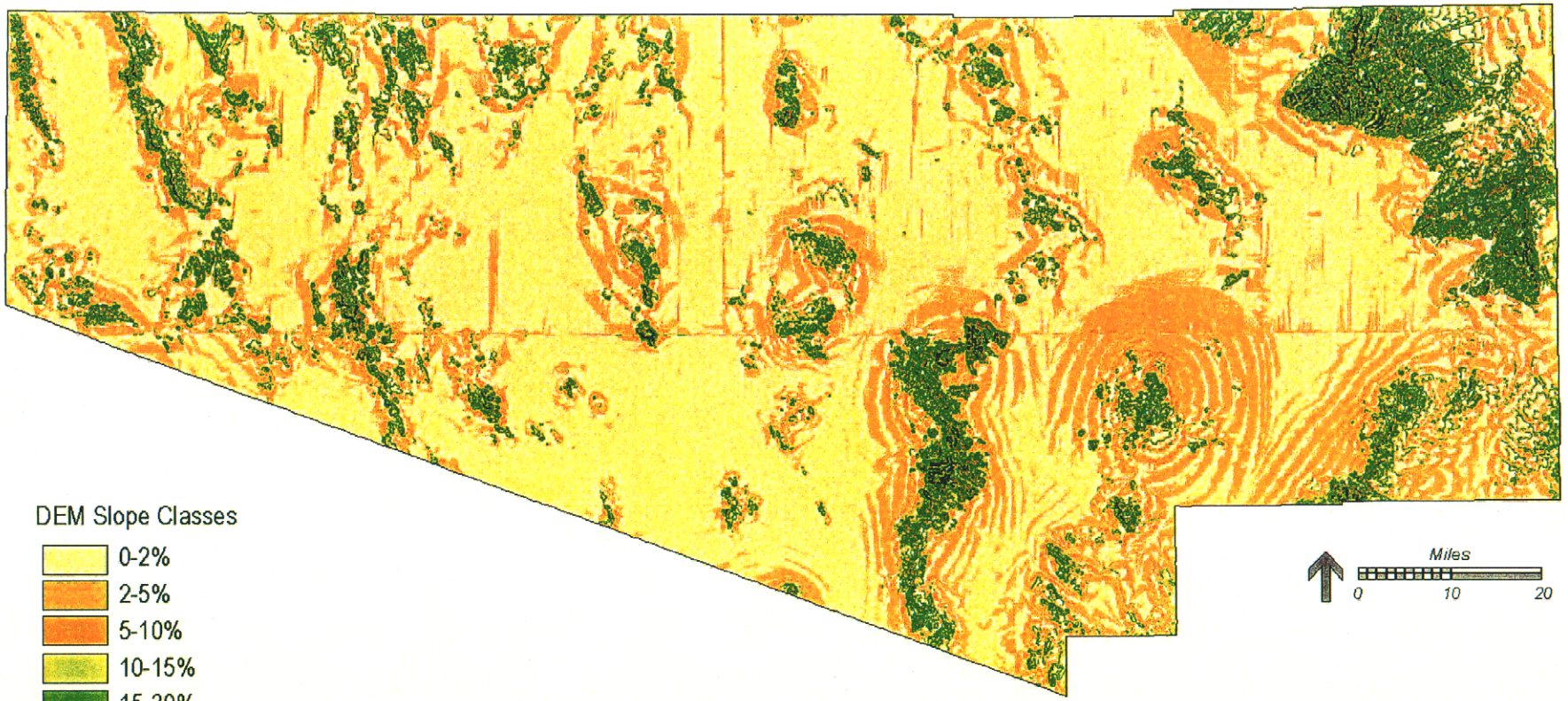


Topography

Based on 100 meter DEM

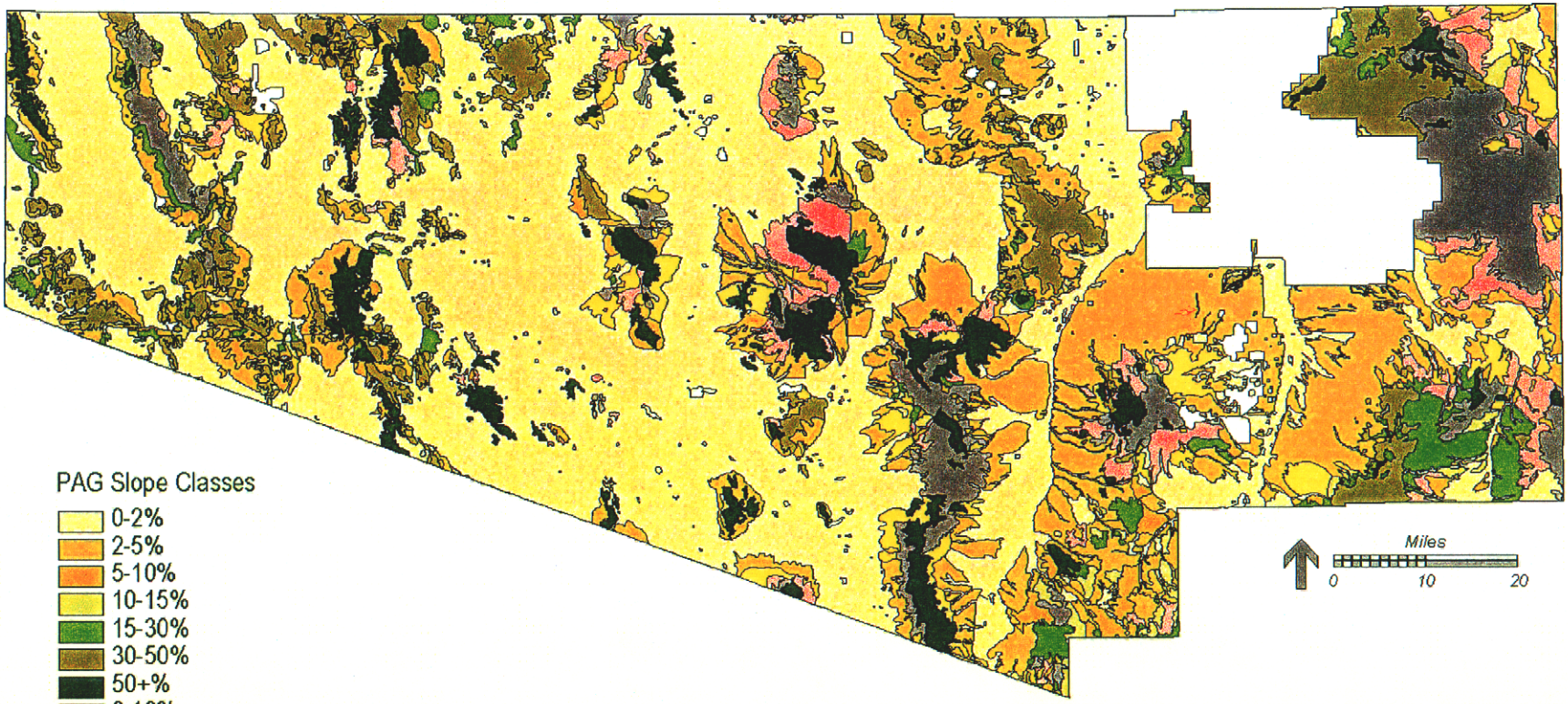
SDCP

RECON



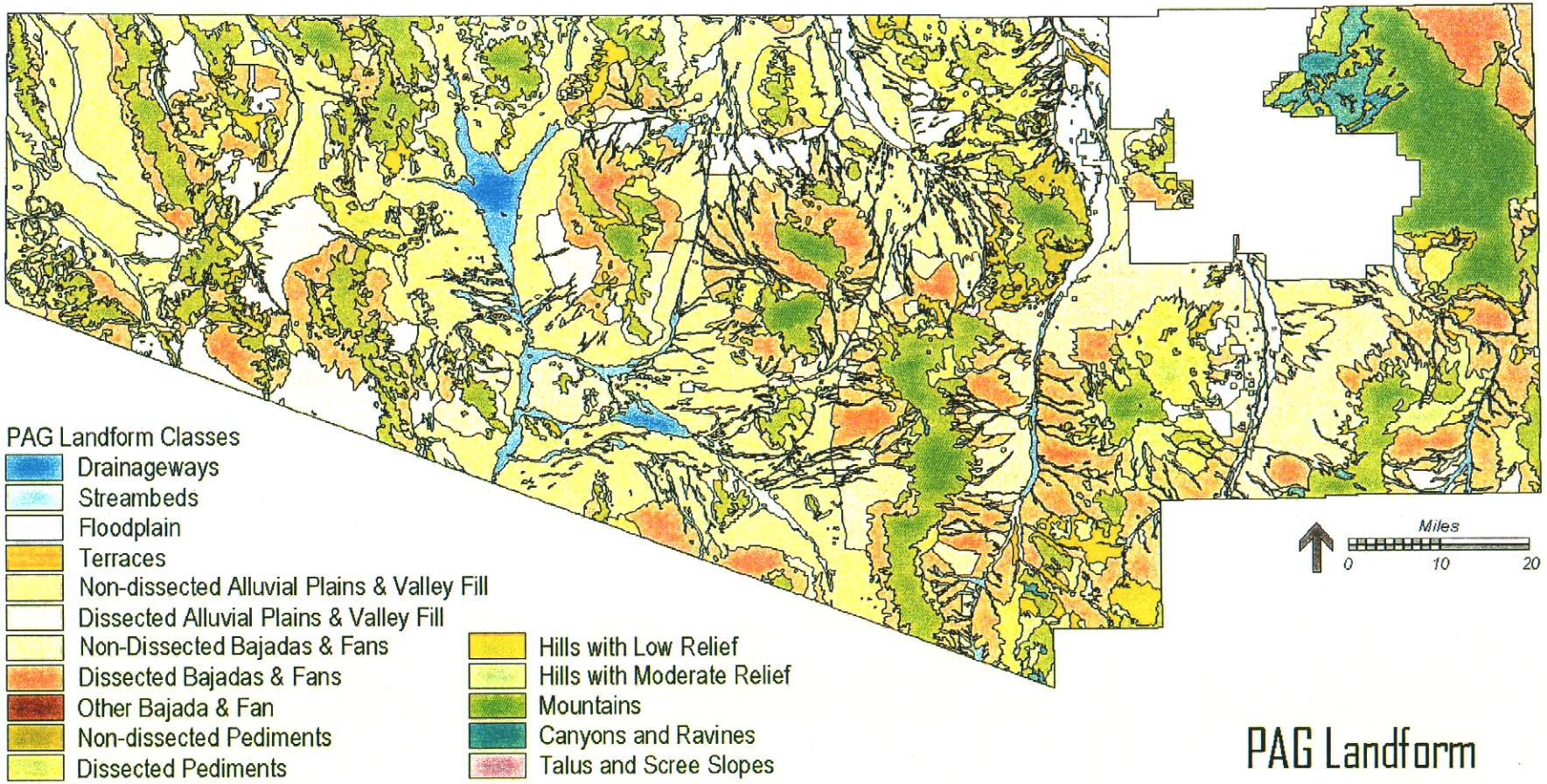
DEM Slope

RECON



PAG Slope

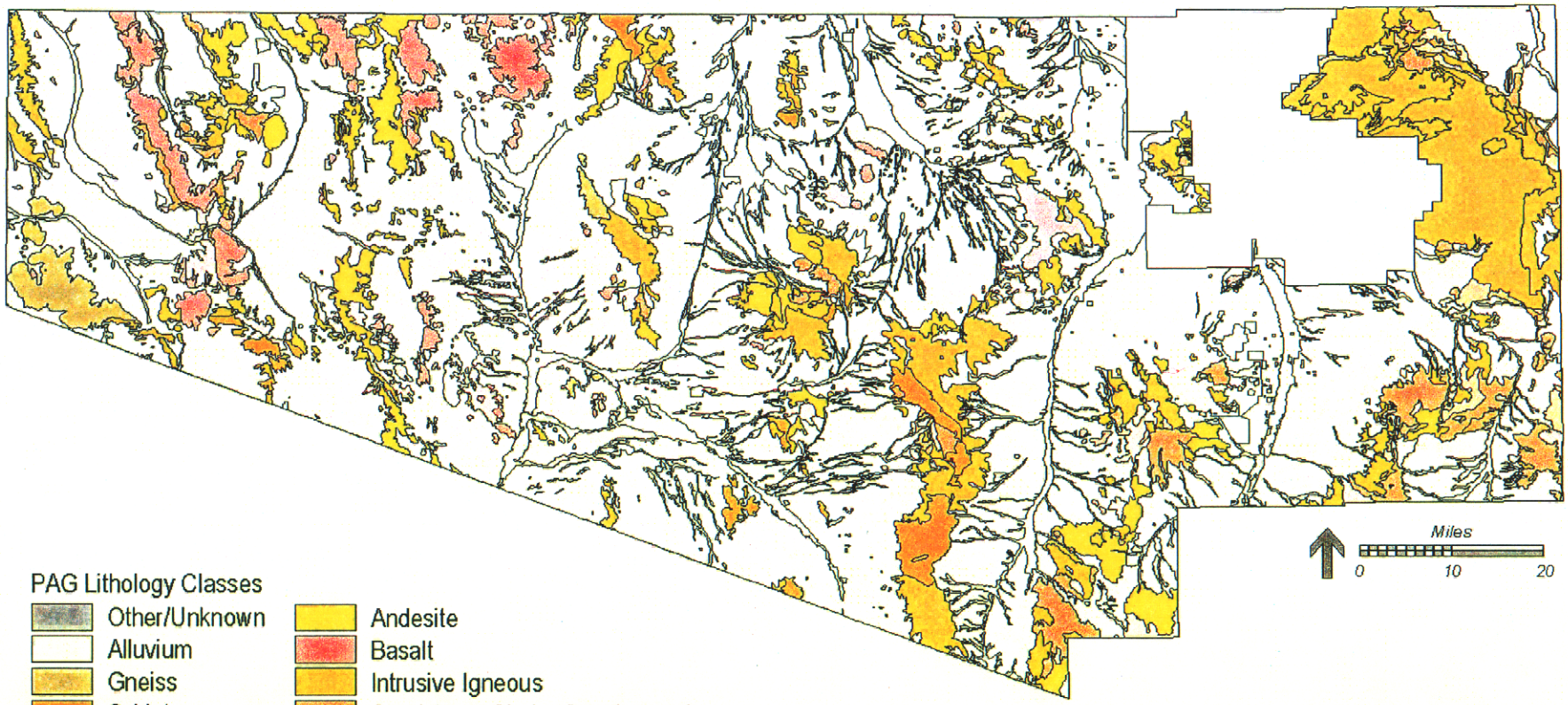
RECON



PAG Landform

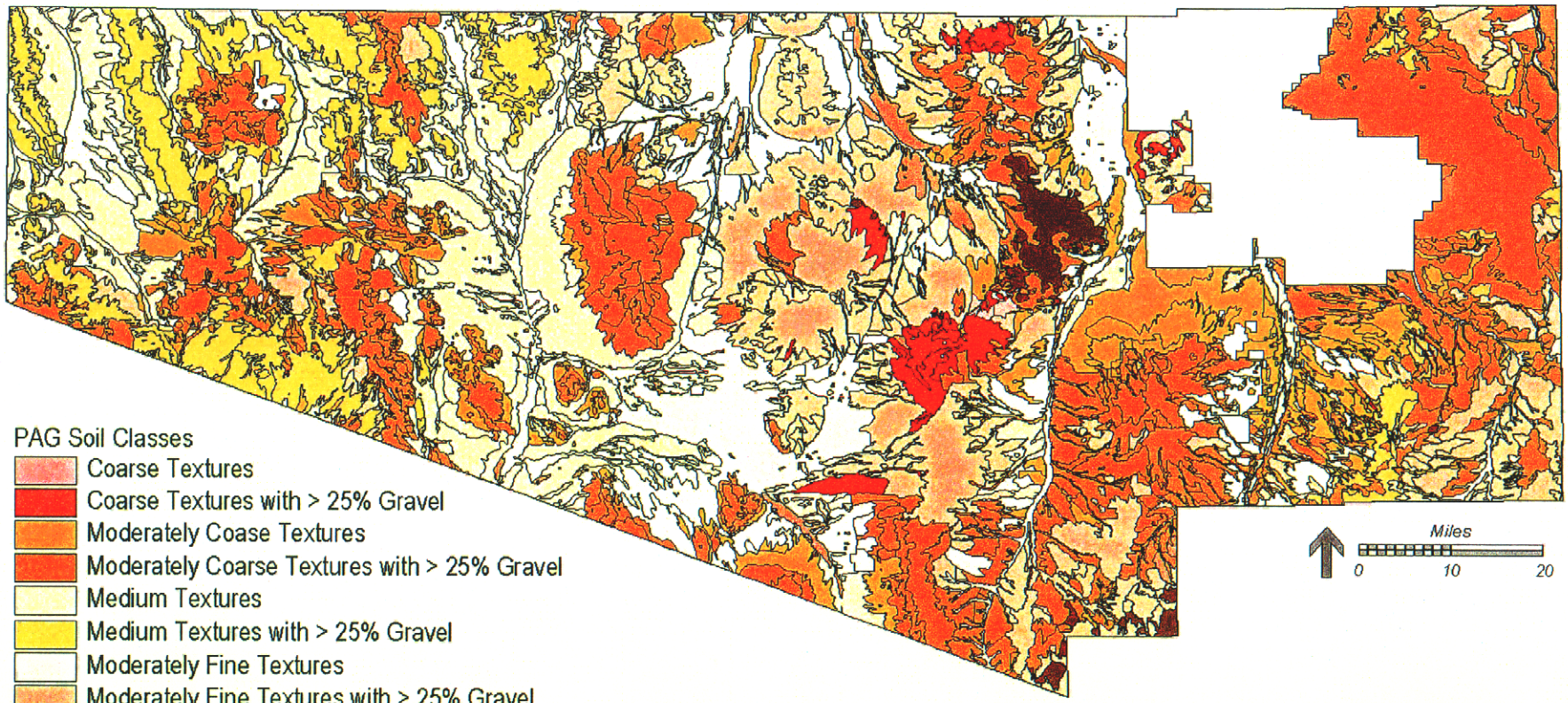
SDCP

RECON



PAG Geology

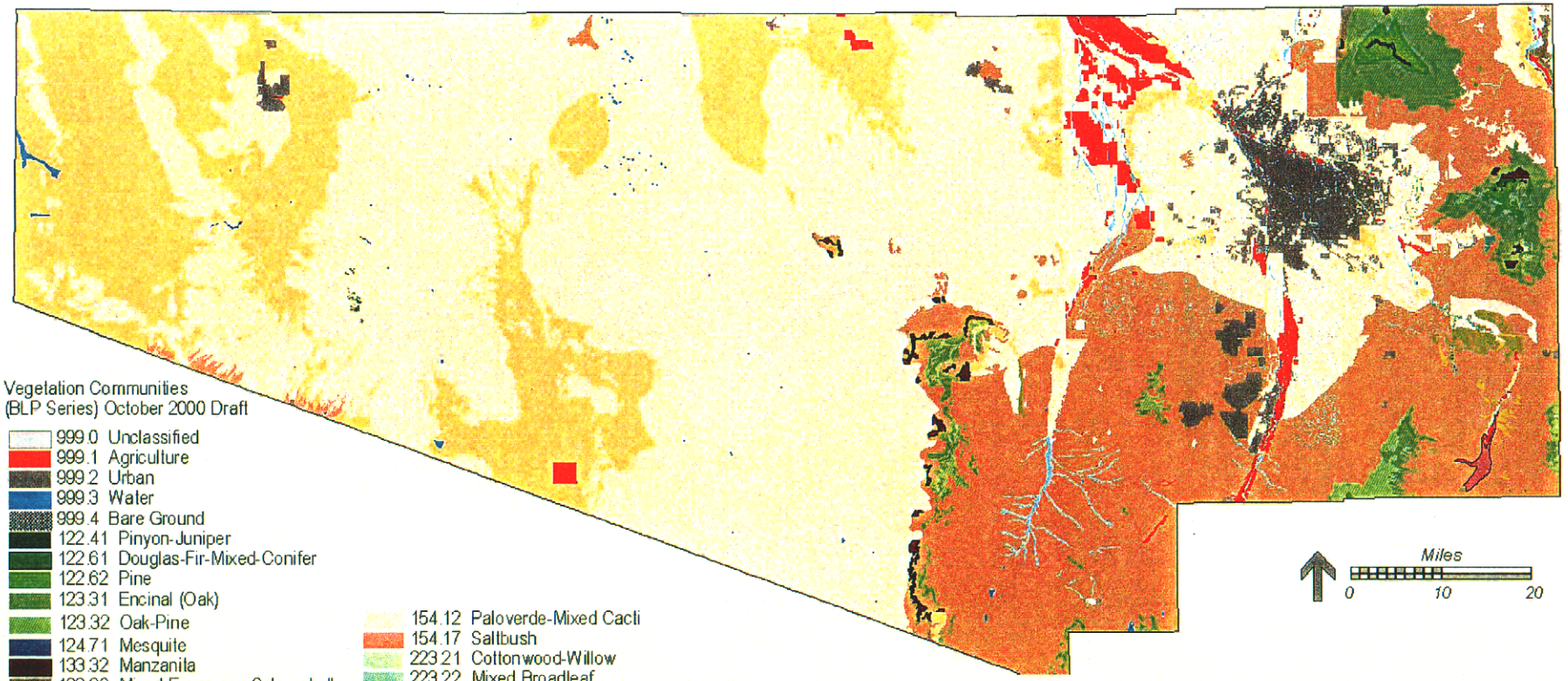
RECON



PAG Soils

SDCP

RECON

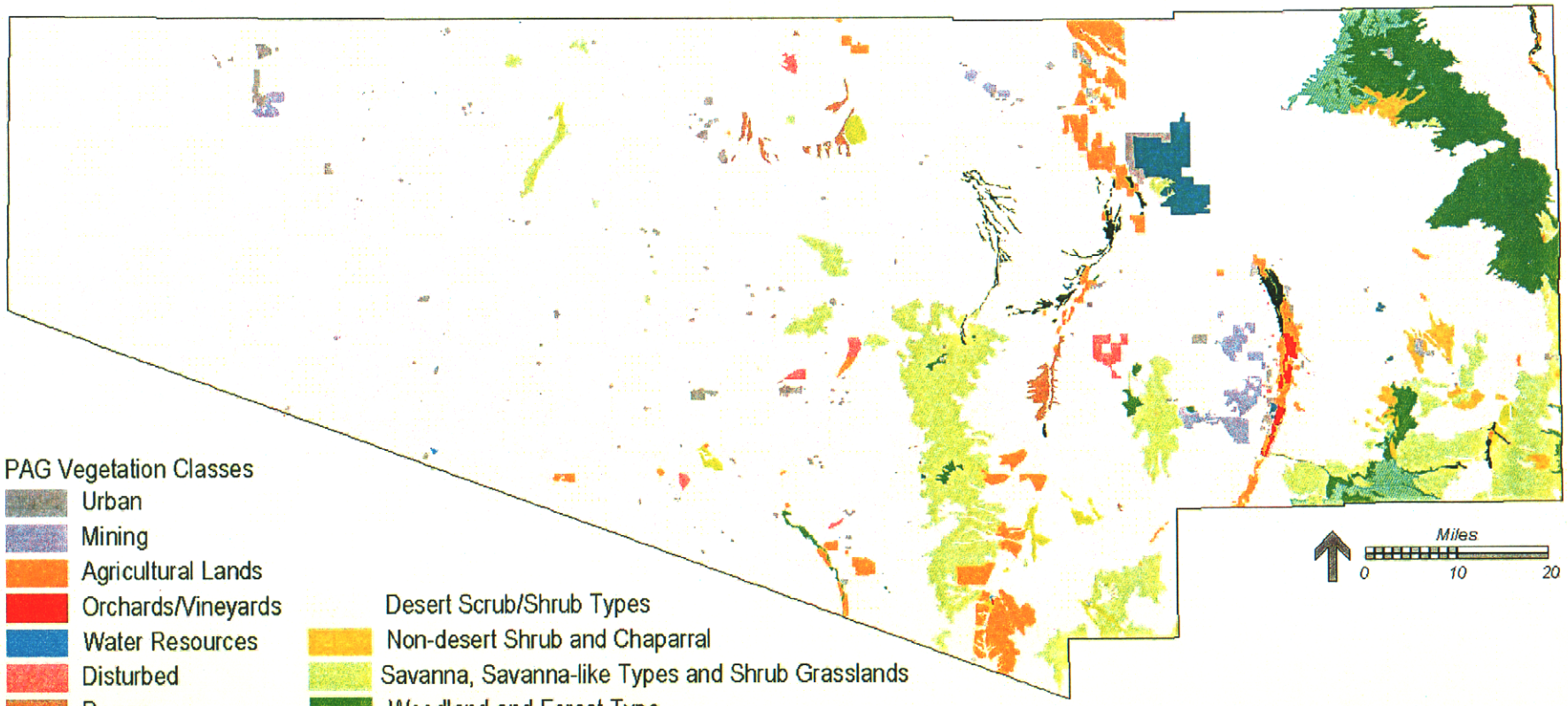


Vegetation Communities

October 2000

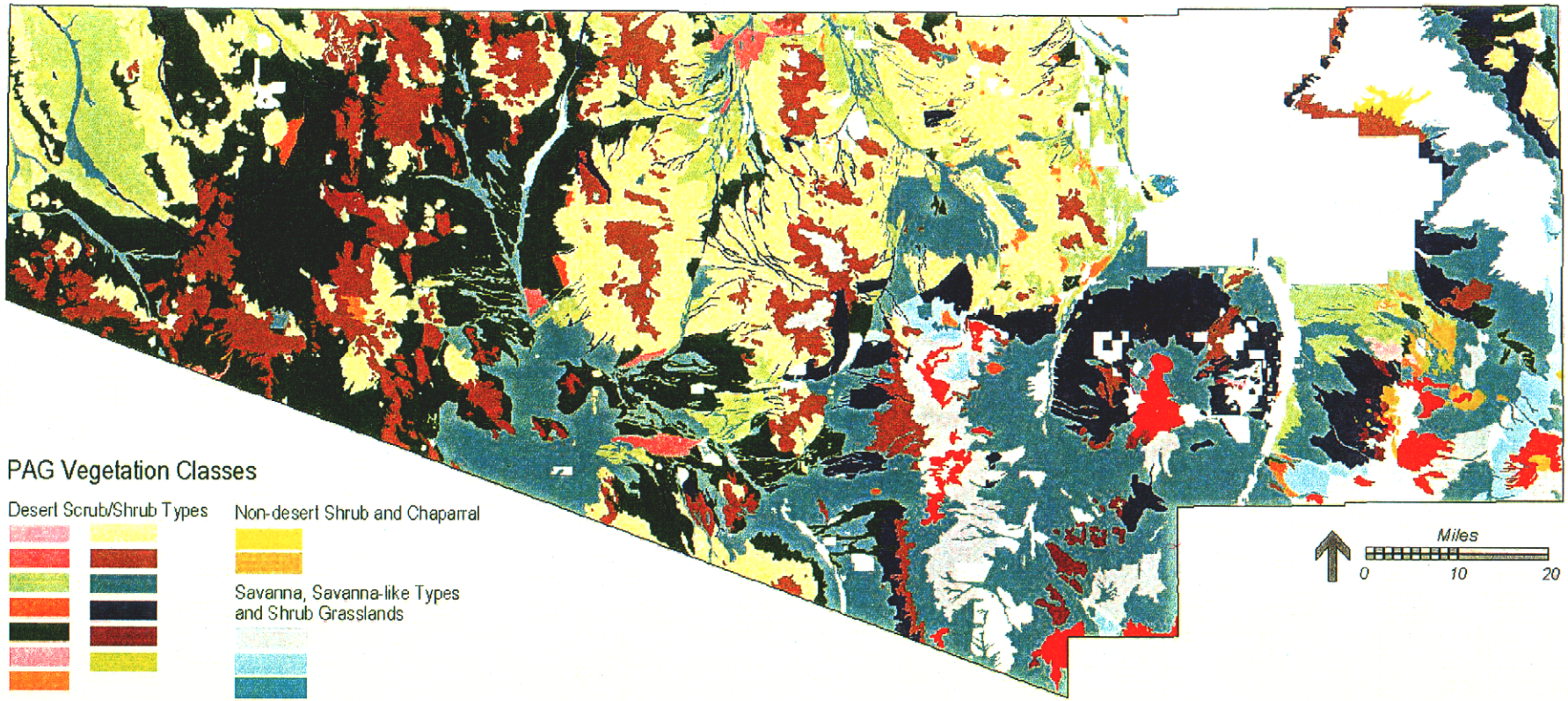
SDCP

RECON



PAG Vegetation

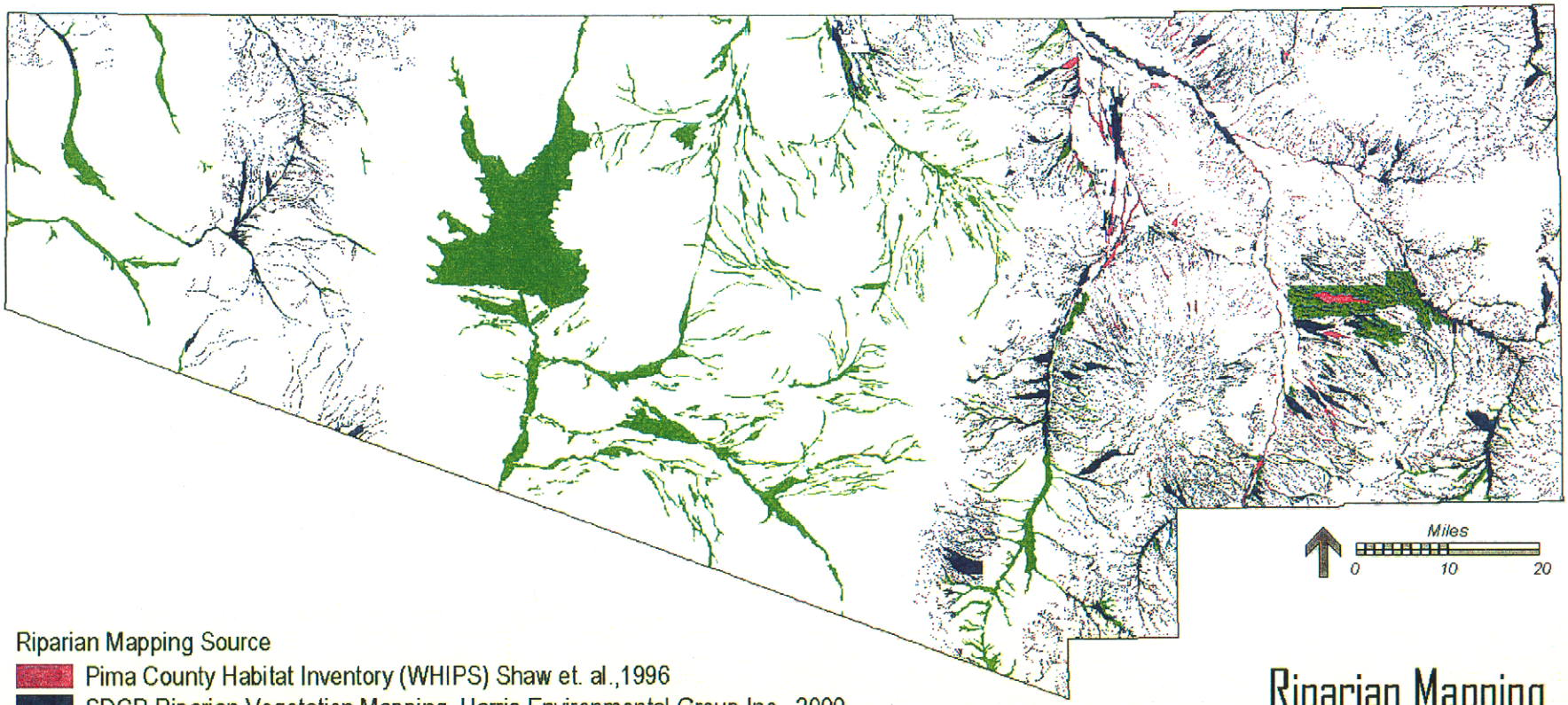
RECON



PAG Vegetation

SDCP

RECON



Riparian Mapping Source

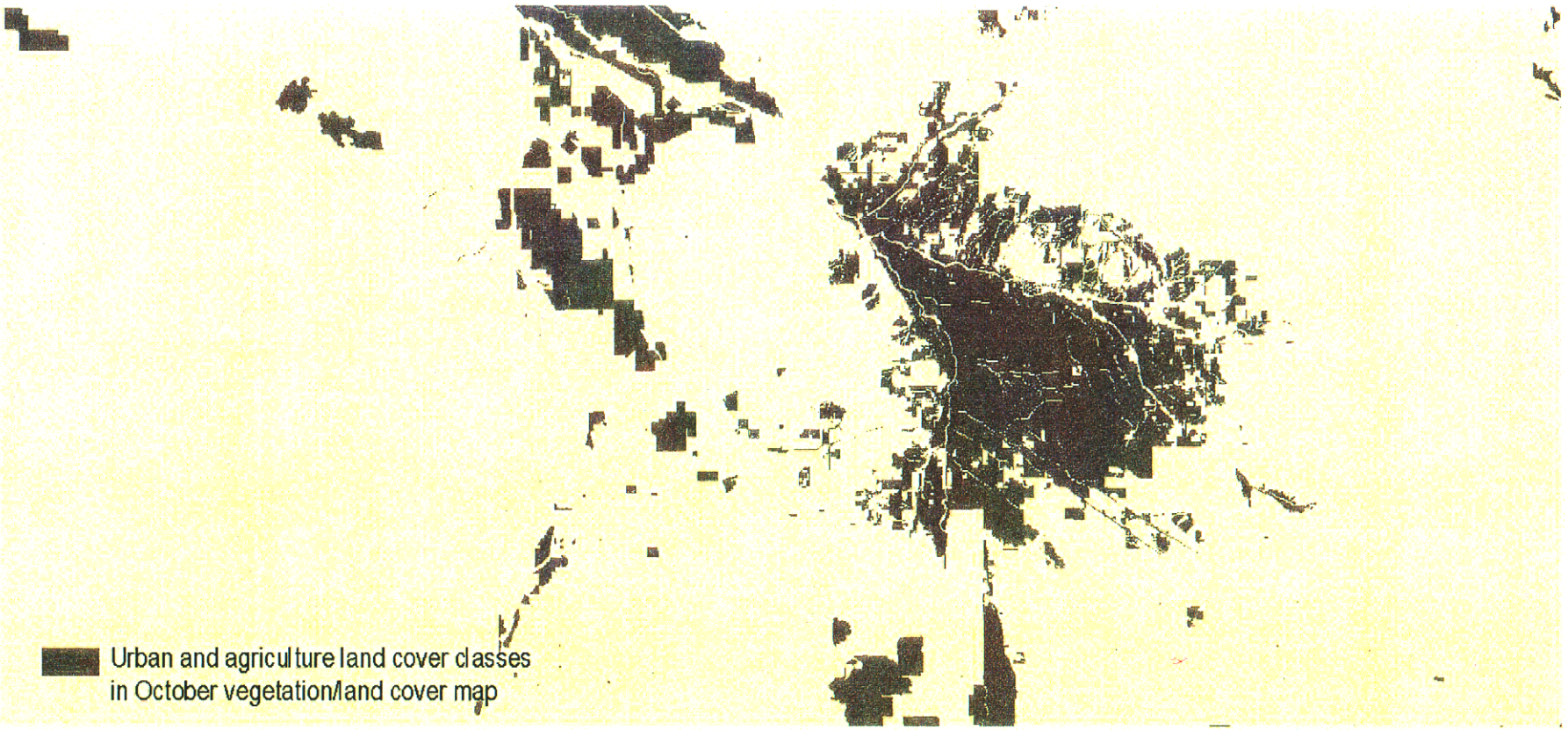
- Pima County Habitat Inventory (WHIPS) Shaw et. al.,1996
- SDCP Riparian Vegetation Mapping, Harris Environmental Group Inc., 2000
- P.A.G. 208 Resource Series Pima Association of Governments, 1977

Riparian Mapping

November 2000

SDCP

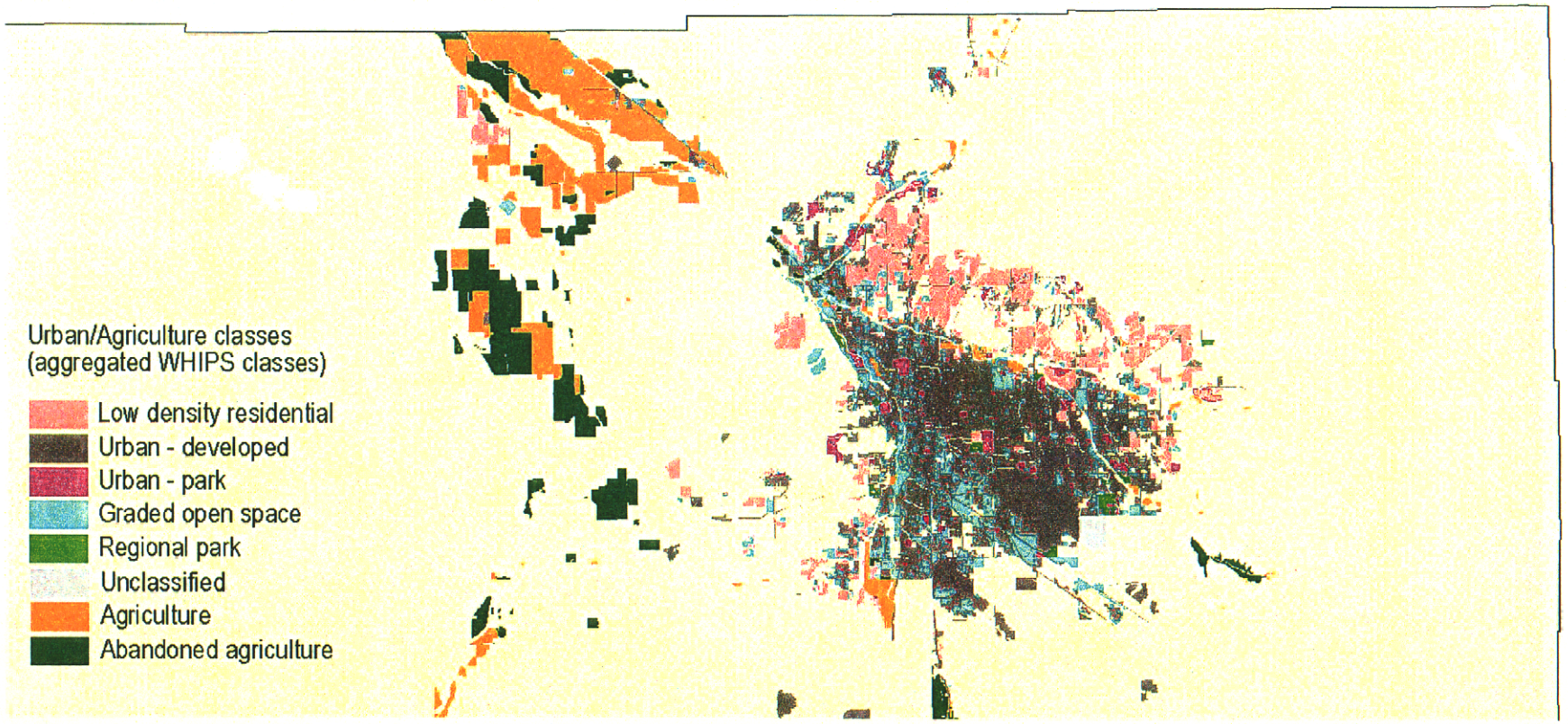
RECON



Urban and Agriculture (General)

SDCP

RECON



Urban and Agriculture (Detail)

SDCP

RECON

Species Habitat Modeling

- **Existing information**
- **Matrix of habitat/special element associations associations**
- **Modeled distributions**
- **Iterative review by STAT and species biologists**

Priority Vulnerable Species

"Short-List" of Vulnerable Species

9 mammals	(7 bats)
8 birds	(6 riparian dependent or associated)
7 reptiles	(3 aquatic/riparian dependent)
2 frogs	(aquatic dependent)
6 fish	(aquatic dependent)
17 Invertebrates	(mostly snails)
7 plants	(2 aquatic or riparian)

Note: Of the 40 non-snail species, 25 (>60%) are dependent upon or associated with aquatic or riparian ecosystems.

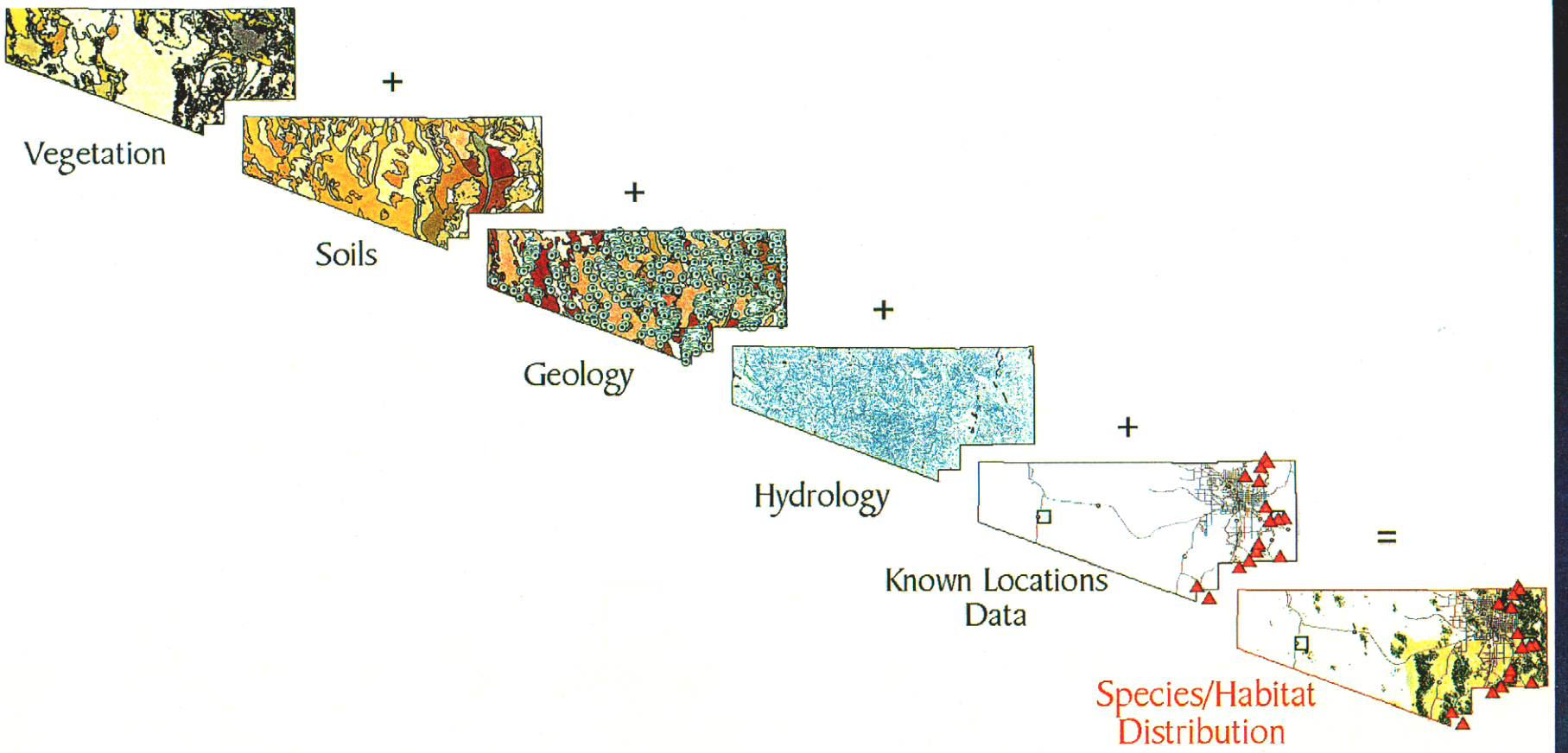
RECON

56 Priority Vulnerable Species

9 mammals	(7 bats)
8 birds	(6 riparian dependent or associated)
7 reptiles	(3 aquatic/riparian dependent)
2 frogs	(aquatic dependent)
6 fish	(aquatic dependent)
17 Invertebrates	(mostly snails)
7 plants	(2 aquatic or riparian)

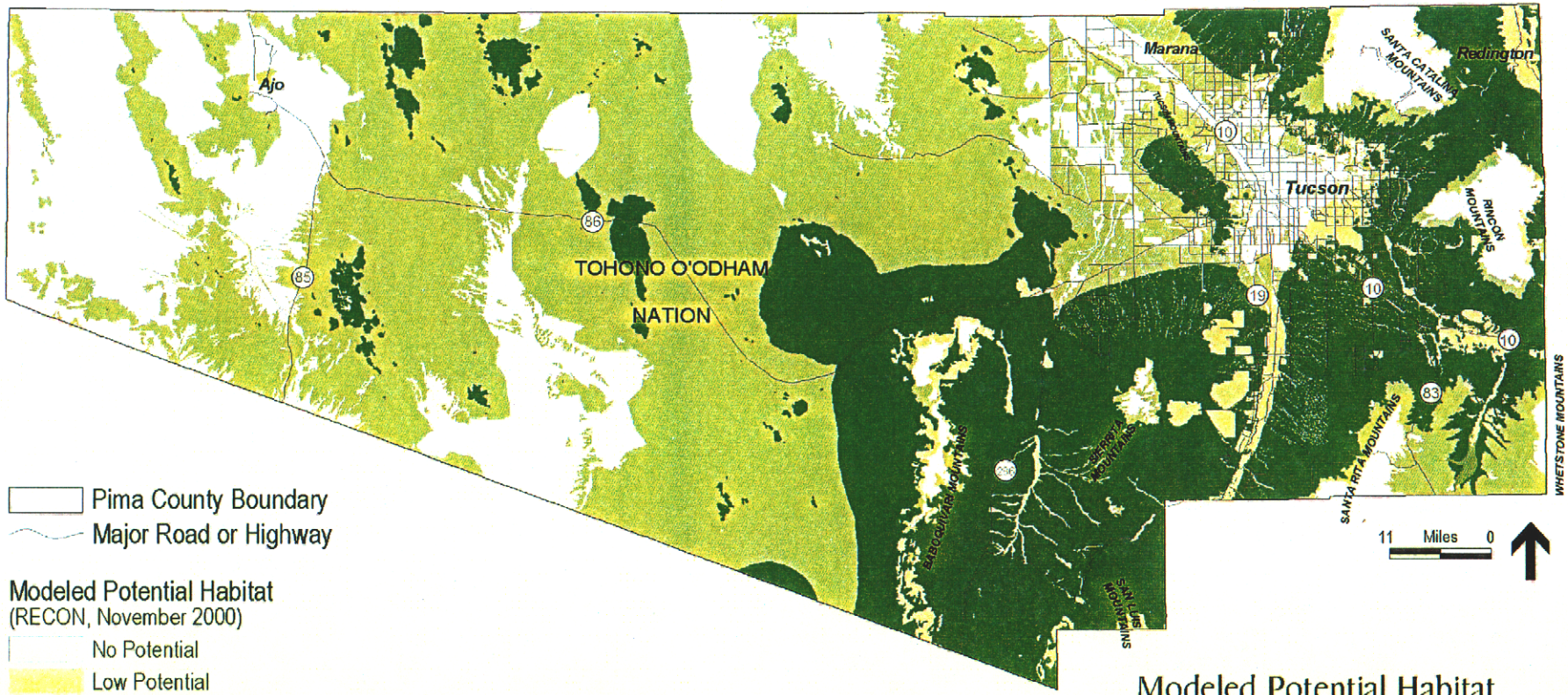
Note: Of the 40 non-snail species, 25 (>60%) are dependent upon or associated with aquatic or riparian ecosystems.

RECON


Vegetation
+
Soils
+
Geology
+
Hydrology
+
Known Locations
Data
=
Species/Habitat
Distribution

SDCP

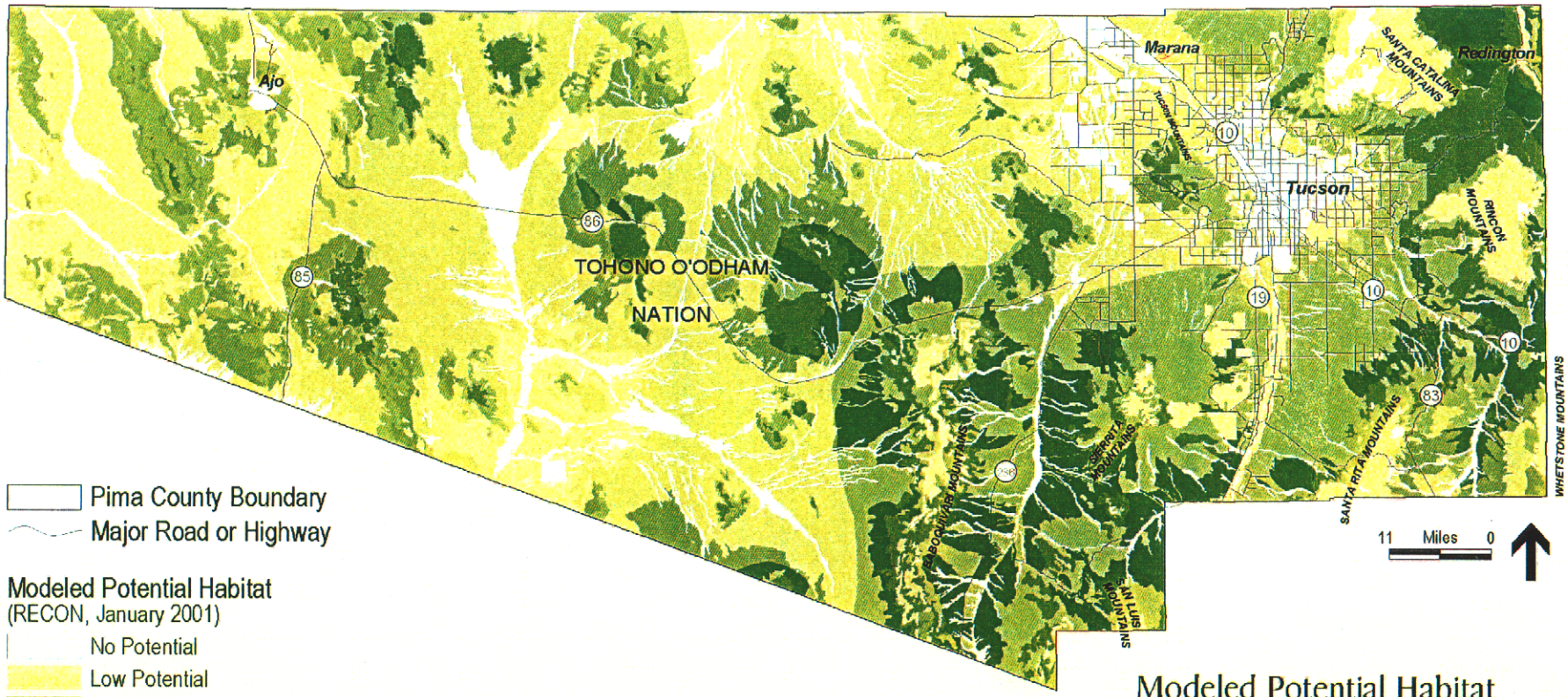
RECON



Modeled Potential Habitat
Needle-spined Pineapple Cactus
(Echinomastus erectocentrus erectocentrus)

SDCP

RECON



Pima County Boundary

Major Road or Highway

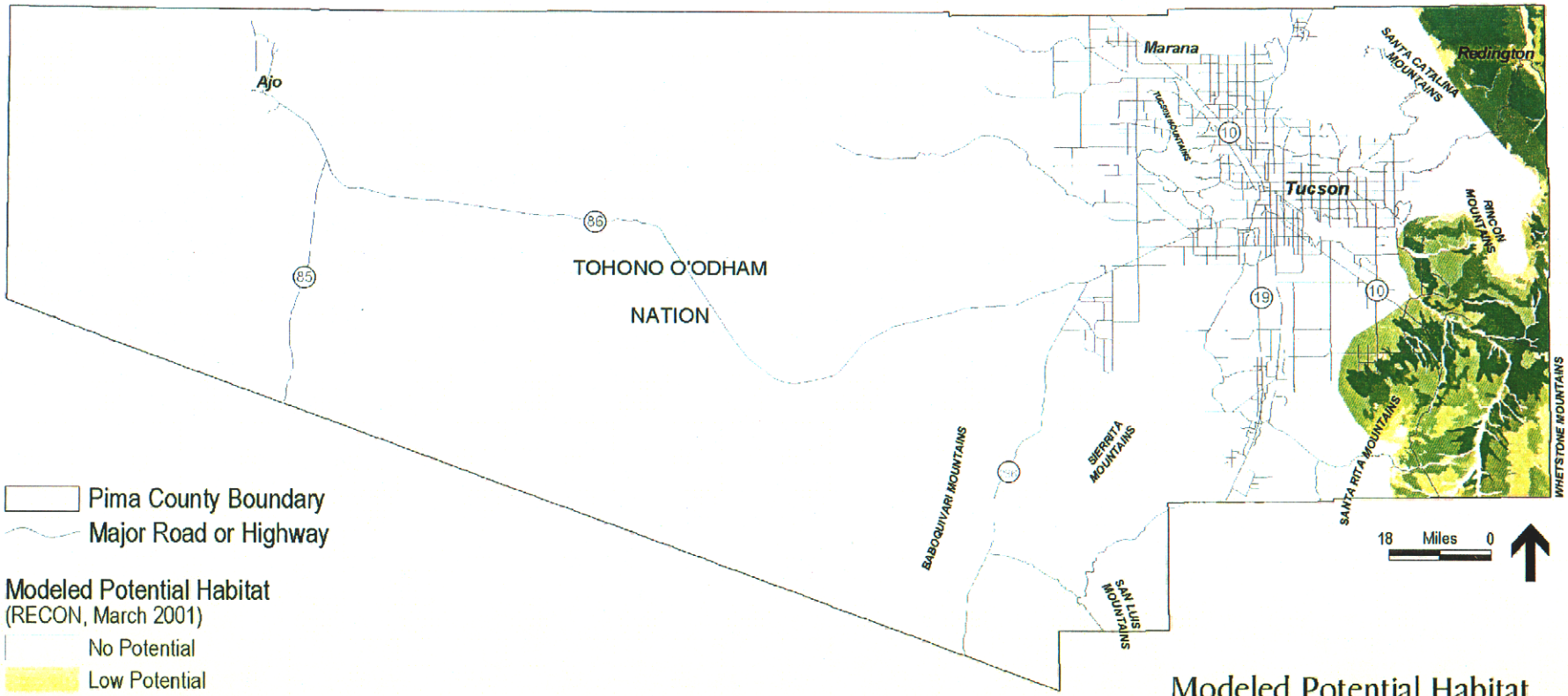
Modeled Potential Habitat
(RECON, January 2001)

- No Potential
- Low Potential
- Medium Potential
- High Potential

Modeled Potential Habitat
Needle-spined Pineapple Cactus
(Echinomastus erectocentrus erectocentrus)

SDCP

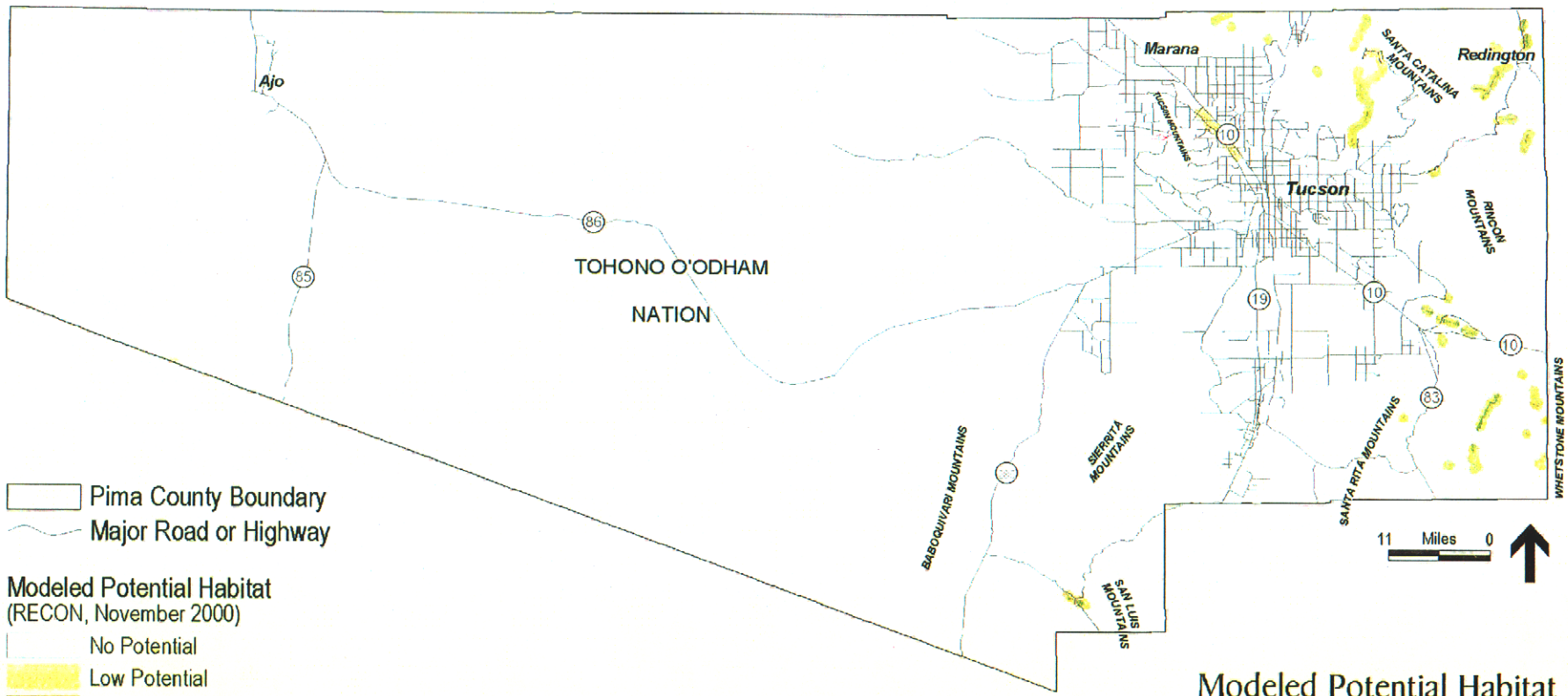
RECON



Modeled Potential Habitat
Needle-spined Pineapple Cactus
(Echinomastus erectocentrus erectocentrus

SDCP

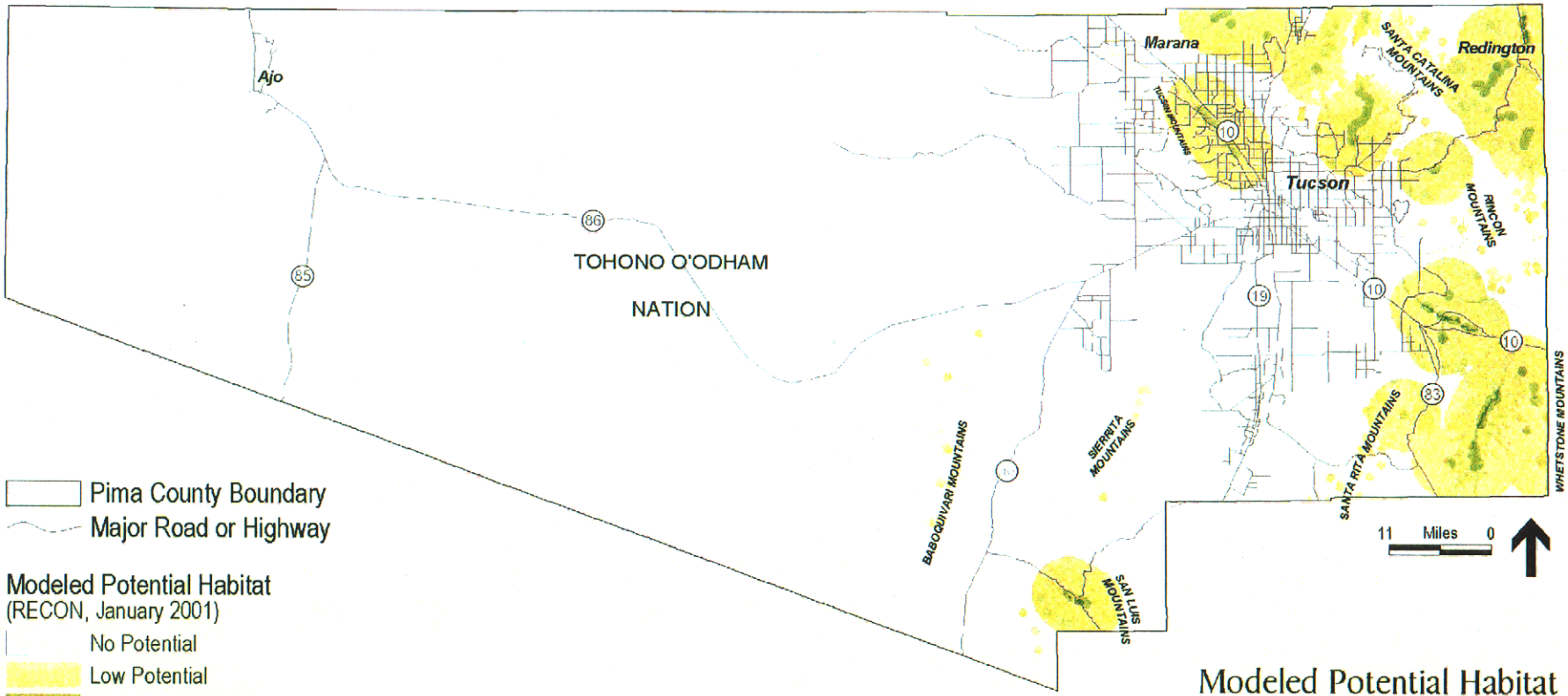
RECON



Modeled Potential Habitat
Lowland Leopard Frog
(Rana yavapaiensis)

SDCP

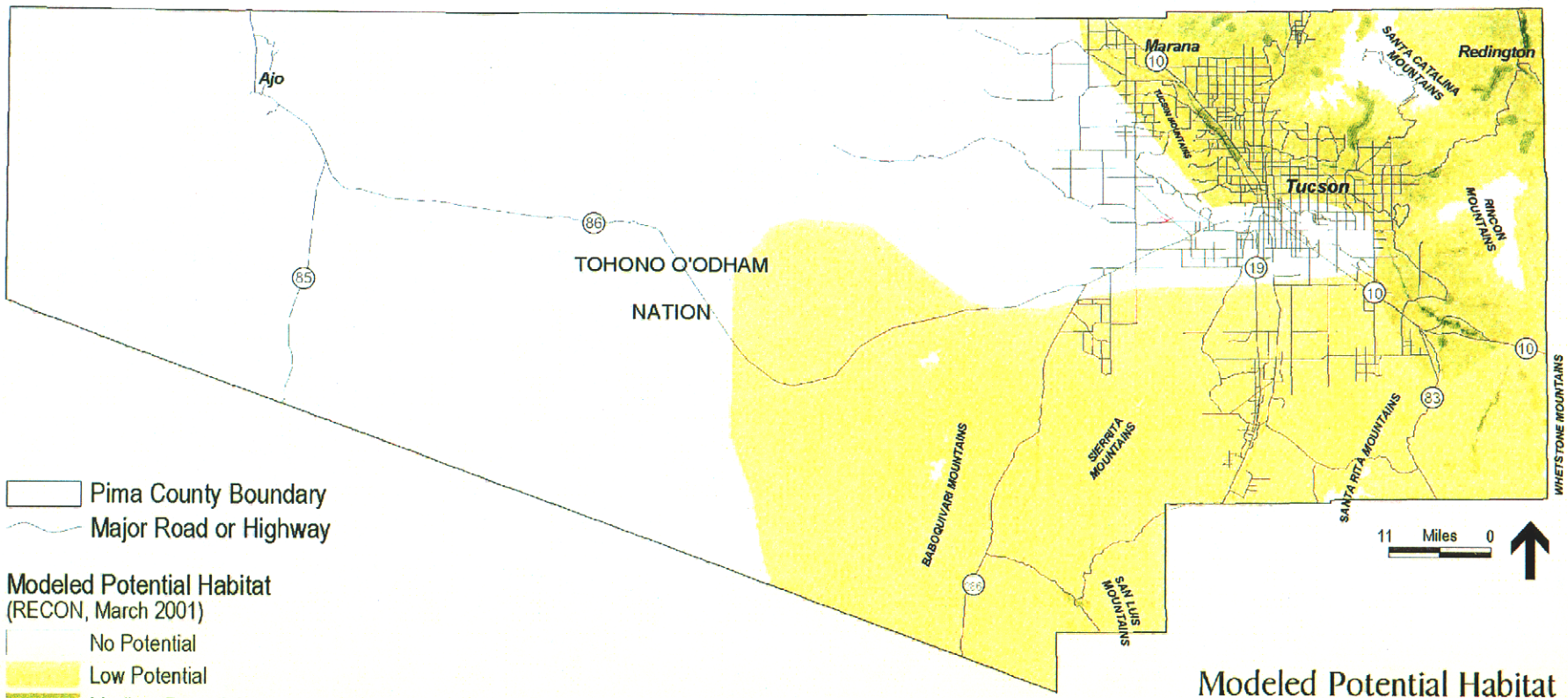
RECON



Modeled Potential Habitat
Lowland Leopard Frog
(Rana yavapaiensis)

SDCP

RECON



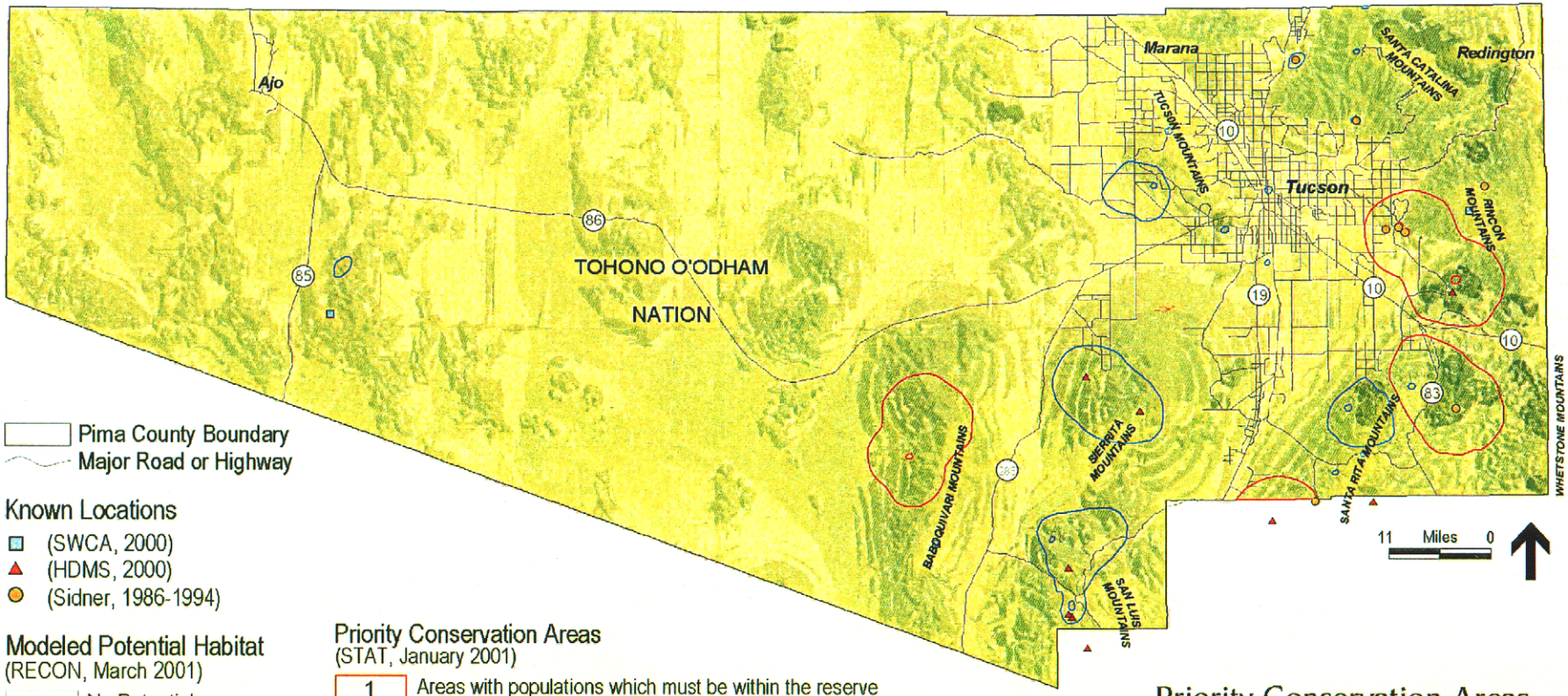
Modeled Potential Habitat
Lowland Leopard Frog
(Rana yavapaiensis)

SDCP

RECON

Priority Conservation Areas

- **Areas most critical for conservation of species**
- **Areas that would be of value to a reserve system**
- **Critical landscape linkages**
- **Areas with potential for habitat restoration or enhancement**



Pima County Boundary
Major Road or Highway

Known Locations

- (SWCA, 2000)
- (HDMS, 2000)
- (Sidner, 1986-1994)

Modeled Potential Habitat

(RECON, March 2001)

- No Potential
- Low Potential
- Medium Potential
- High Potential

Priority Conservation Areas

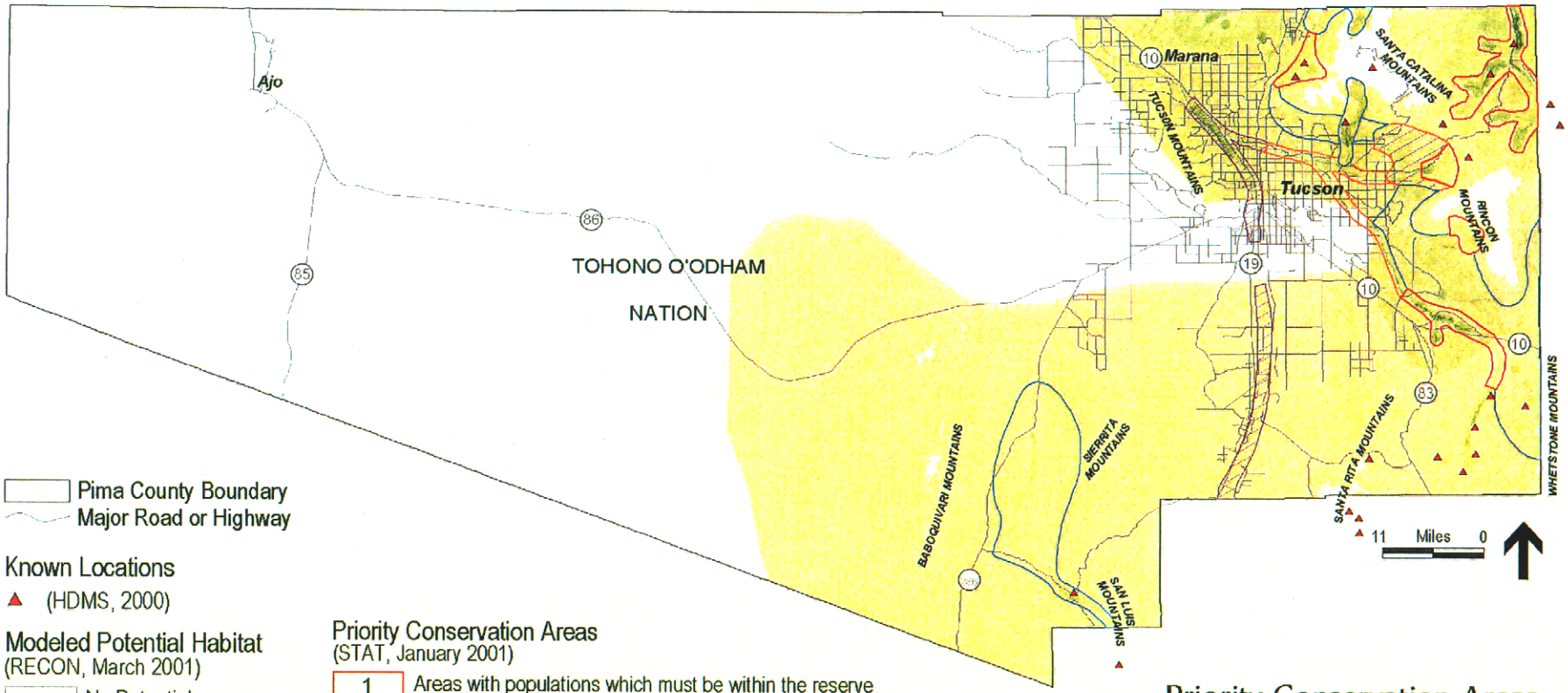
(STAT, January 2001)

1. Areas with populations which must be within the reserve system (excluding the Tohono O'odham Nation)
2. Areas that would be of value to the reserve system
3. Critical landscape linkages
4. Areas with the potential for restoration or enhancement

Priority Conservation Areas
Pale Townsend's Big-eared Bat
(Plecotus townsendii pallescens)

SDCP

RECON



Pima County Boundary
Major Road or Highway

Known Locations
▲ (HDMS, 2000)

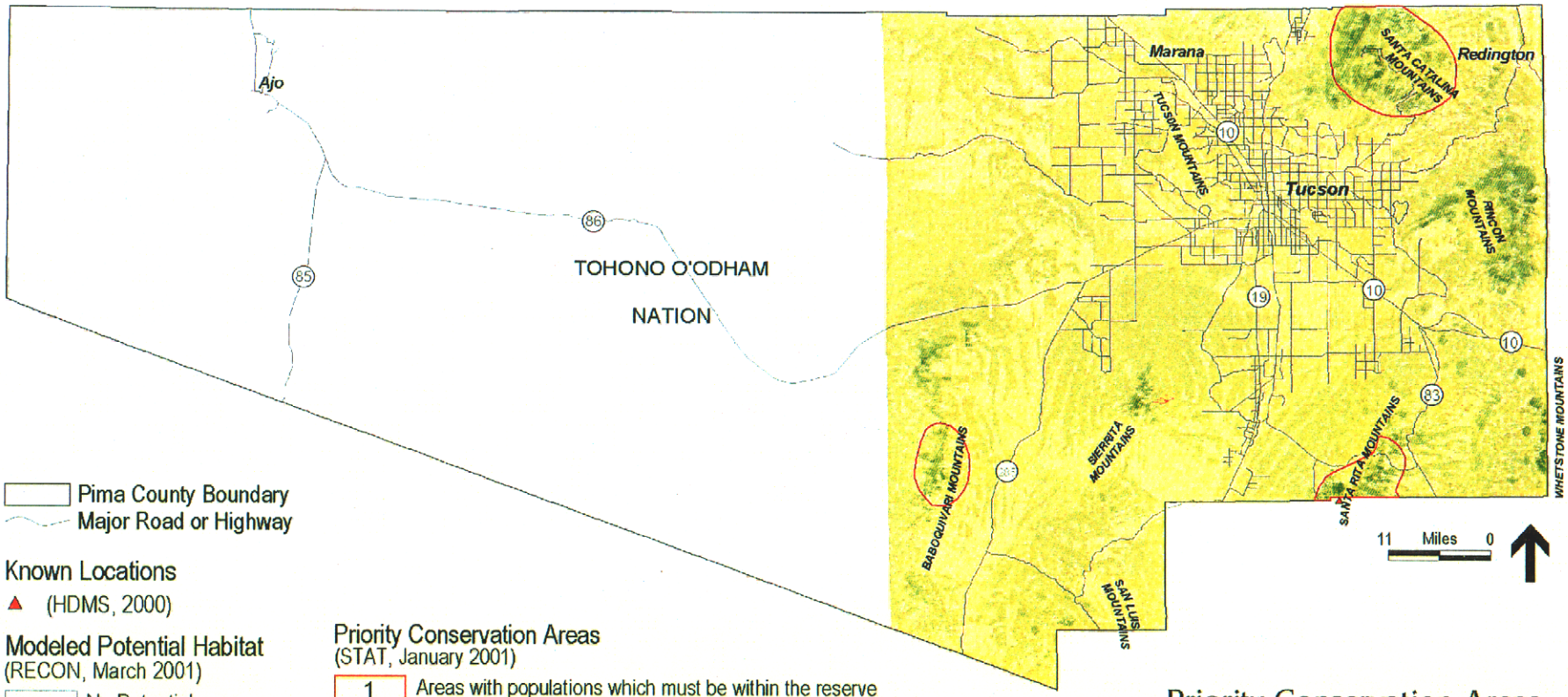
Modeled Potential Habitat
(RECON, March 2001)
- No Potential
- Low Potential
- Medium Potential
- High Potential

Priority Conservation Areas
(STAT, January 2001)
- 1 Areas with populations which must be within the reserve system (excluding the Tohono O'odham Nation)
- 2 Areas that would be of value to the reserve system
- 3 Critical landscape linkages
- 4 Areas with the potential for restoration or enhancement

Priority Conservation Areas
Lowland Leopard Frog
(Rana yavapaiensis)

SDCP

RECON



Pima County Boundary
Major Road or Highway

Known Locations
▲ (HDMS, 2000)

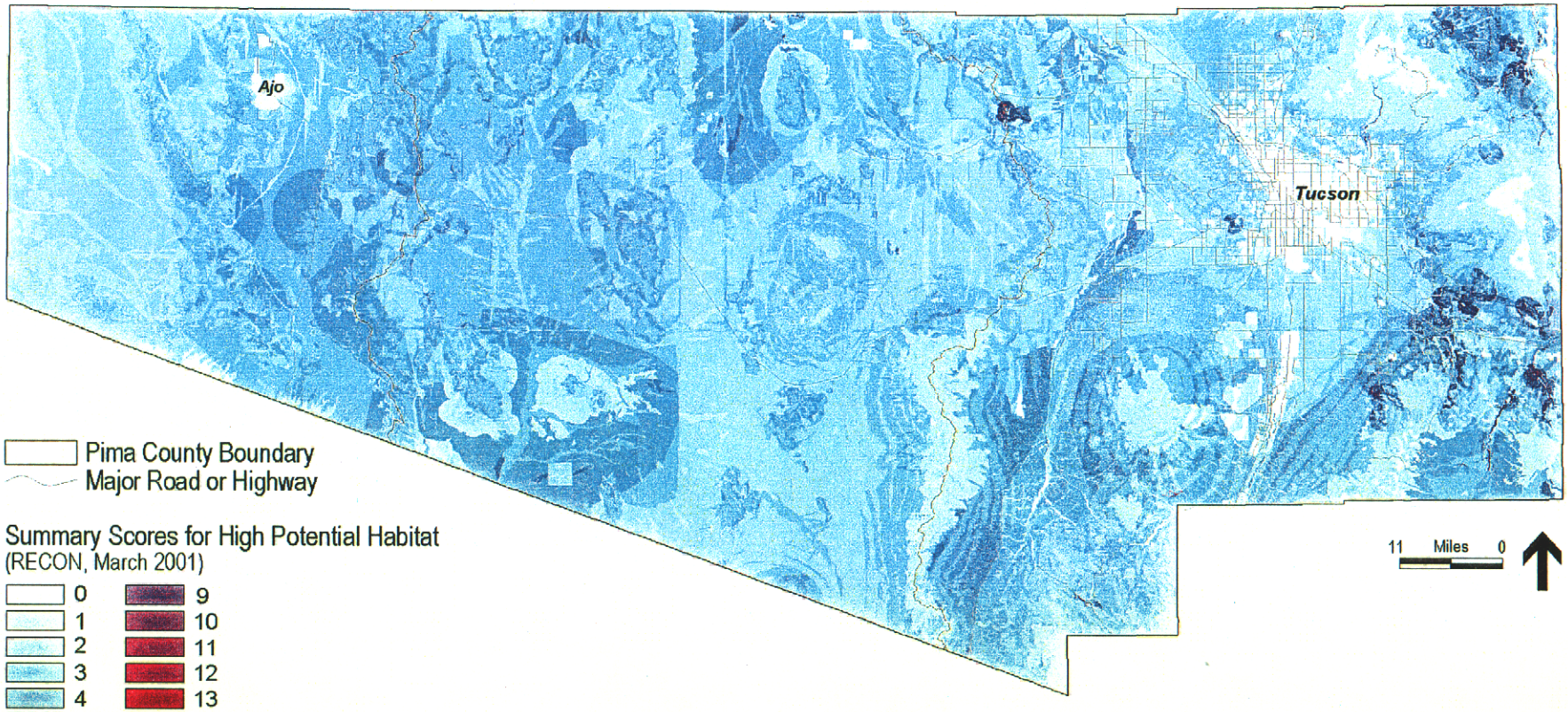
Modeled Potential Habitat
(RECON, March 2001)
- No Potential
- Low Potential
- Medium Potential
- High Potential

Priority Conservation Areas
(STAT, January 2001)
- 1 Areas with populations which must be within the reserve system (excluding the Tohono O'odham Nation)
- 2 Areas that would be of value to the reserve system
- 3 Critical landscape linkages
- 4 Areas with the potential for restoration or enhancement

Priority Conservation Areas
Arizona Shrew
(Sorex arizonae)

SDCP

RECON



Pima County Boundary
Major Road or Highway

Summary Scores for High Potential Habitat
(RECON, March 2001)

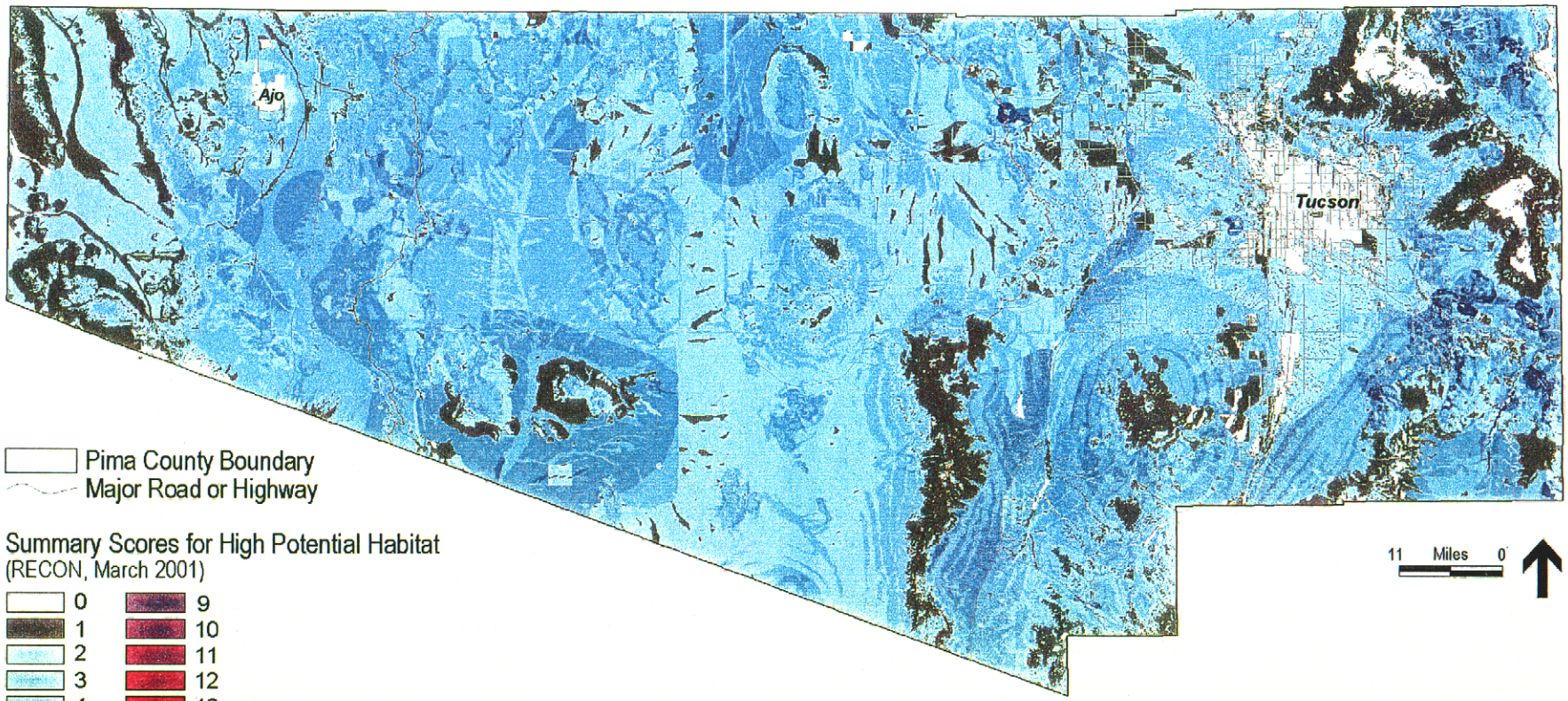
0	9
1	10
2	11
3	12
4	13
5	14
6	15
7	16
8	17

11 Miles 0

Summary of High Potential Habitat
All Vulnerable Species

SDCP

RECON



Pima County Boundary
Major Road or Highway

Summary Scores for High Potential Habitat
(RECON, March 2001)

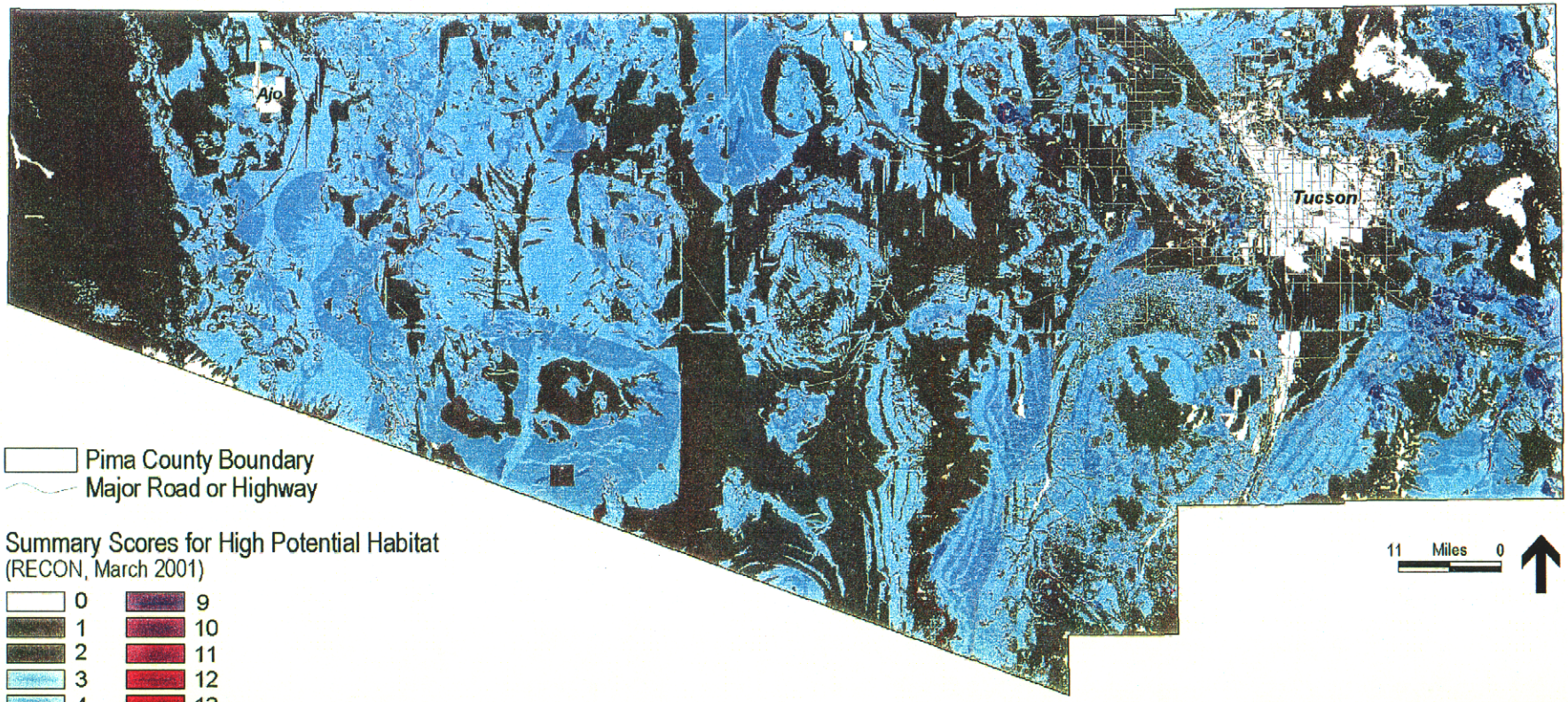
0	9
1	10
2	11
3	12
4	13
5	14
6	15
7	16
8	17

11 Miles 0

Summary of High Potential Habitat
All Vulnerable Species
Two or More Species

SDCP

RECON



Pima County Boundary
Major Road or Highway

Summary Scores for High Potential Habitat
(RECON, March 2001)

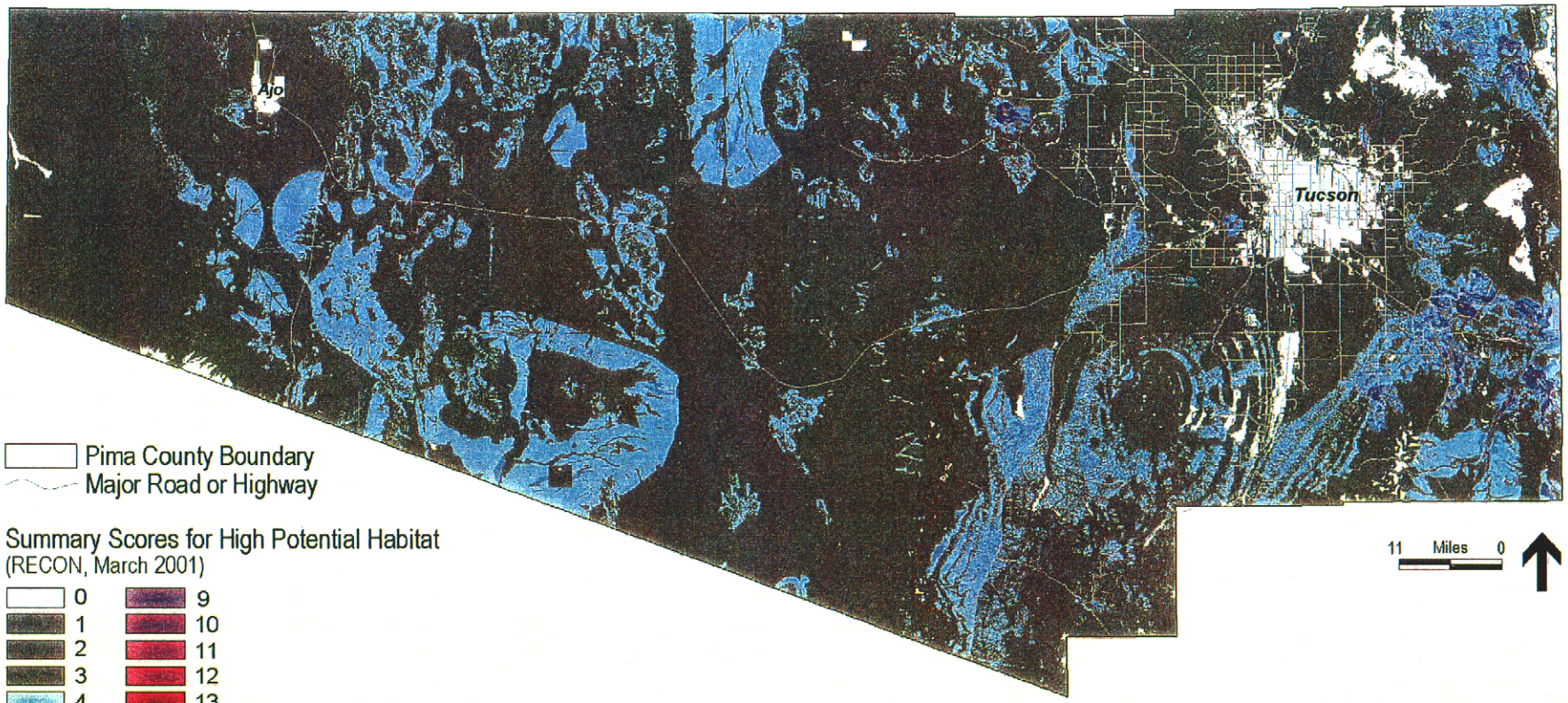
0	9
1	10
2	11
3	12
4	13
5	14
6	15
7	16
8	17

11 Miles 0

Summary of High Potential Habitat
All Vulnerable Species
Three or More Species

SDCP

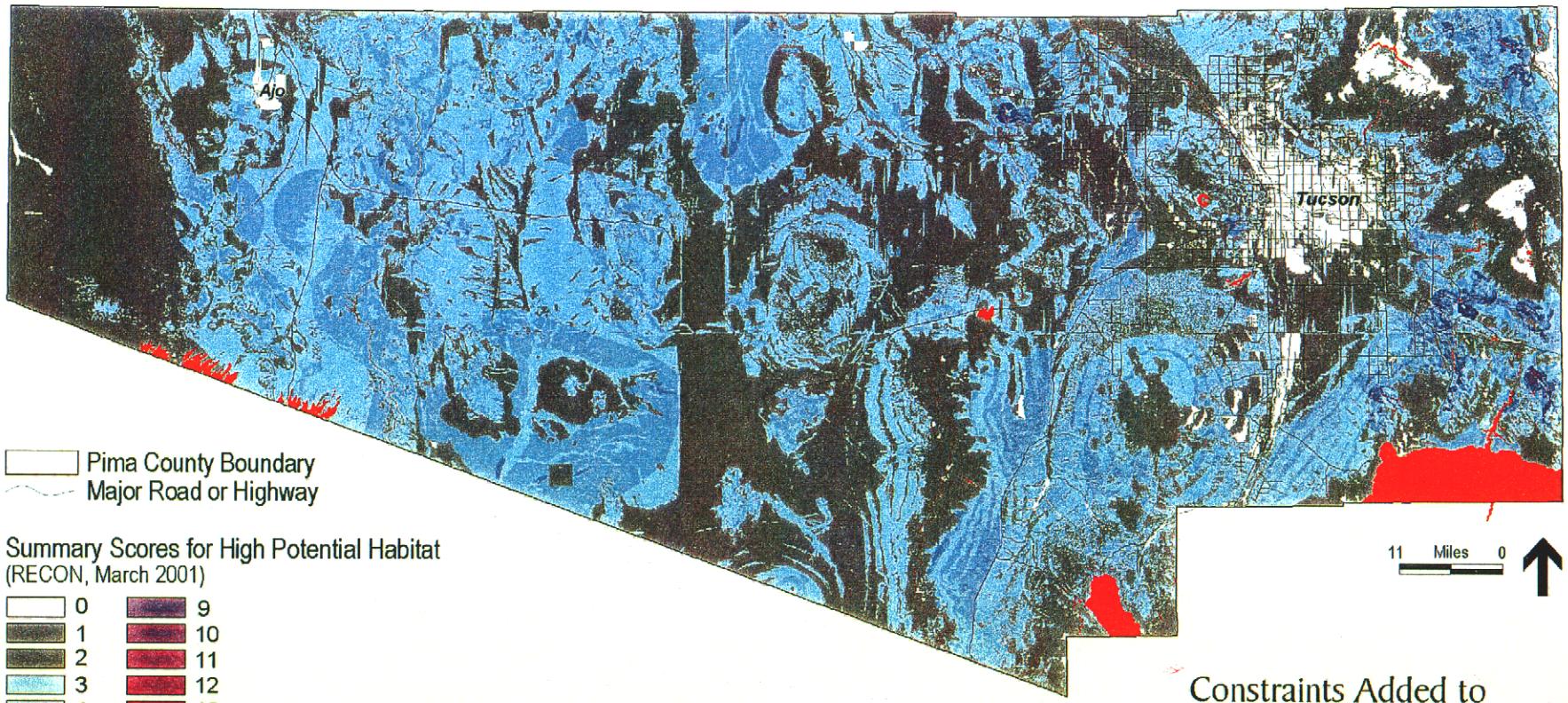
RECON



Summary of High Potential Habitat
All Vulnerable Species
Four or More Species

SDCP

RECON



Pima County Boundary
Major Road or Highway

Summary Scores for High Potential Habitat
(RECON, March 2001)

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

Constraints

11 Miles 0

Constraints Added to
Summary of High Potential Habitat
All Vulnerable Species
Three or More Species

SDCP

RECON

Initial Draft Reserve Design

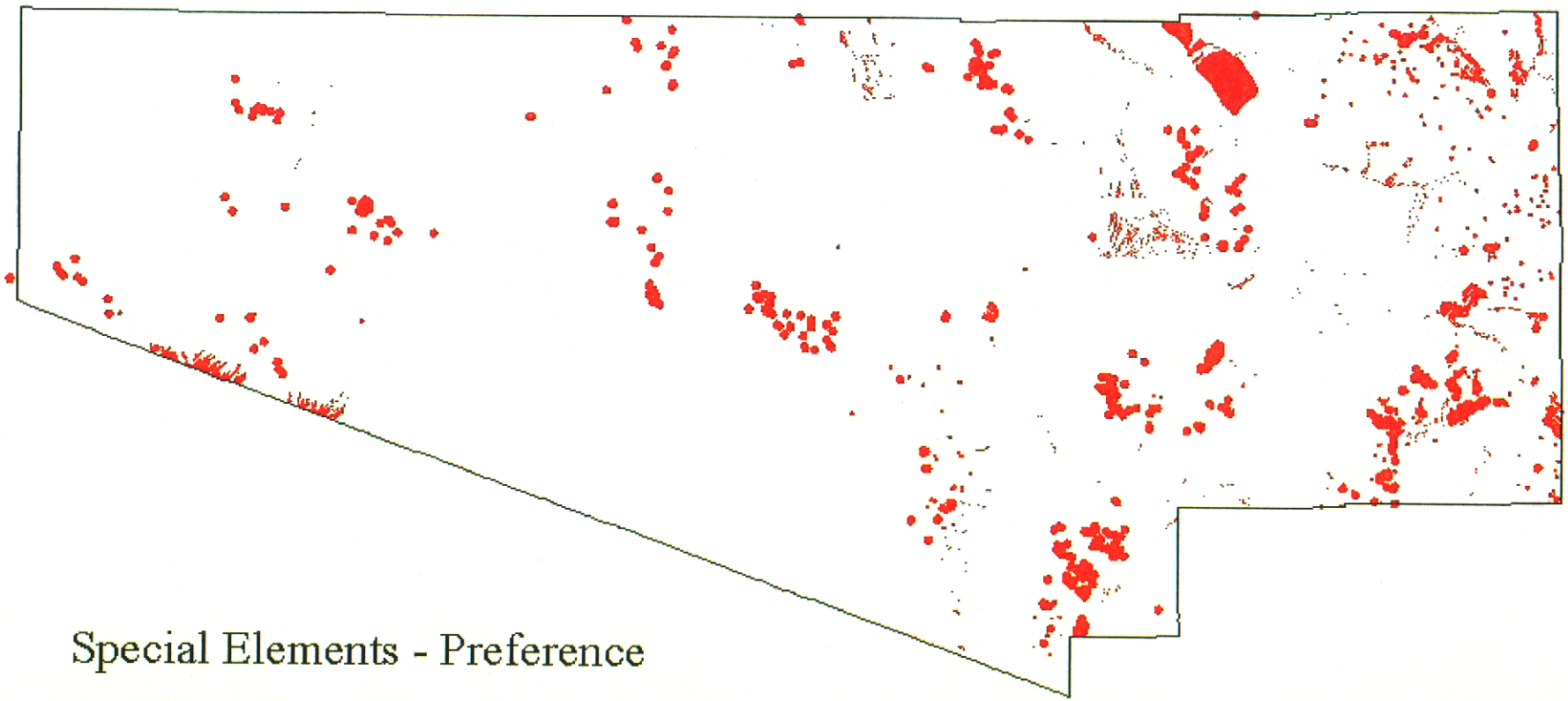
- Overlay of vulnerable species distributions
- Special elements
- Topography
- TNC Conservation Areas
- Reserve design considerations
  - ✓ Larger contiguous areas
  - ✓ Minimum edge to area
  - ✓ Connectedness
  - ✓ Minimum of urban/agriculture/roads
- Priority conservation areas
- Urban, agriculture, roads

RECON

Special Elements

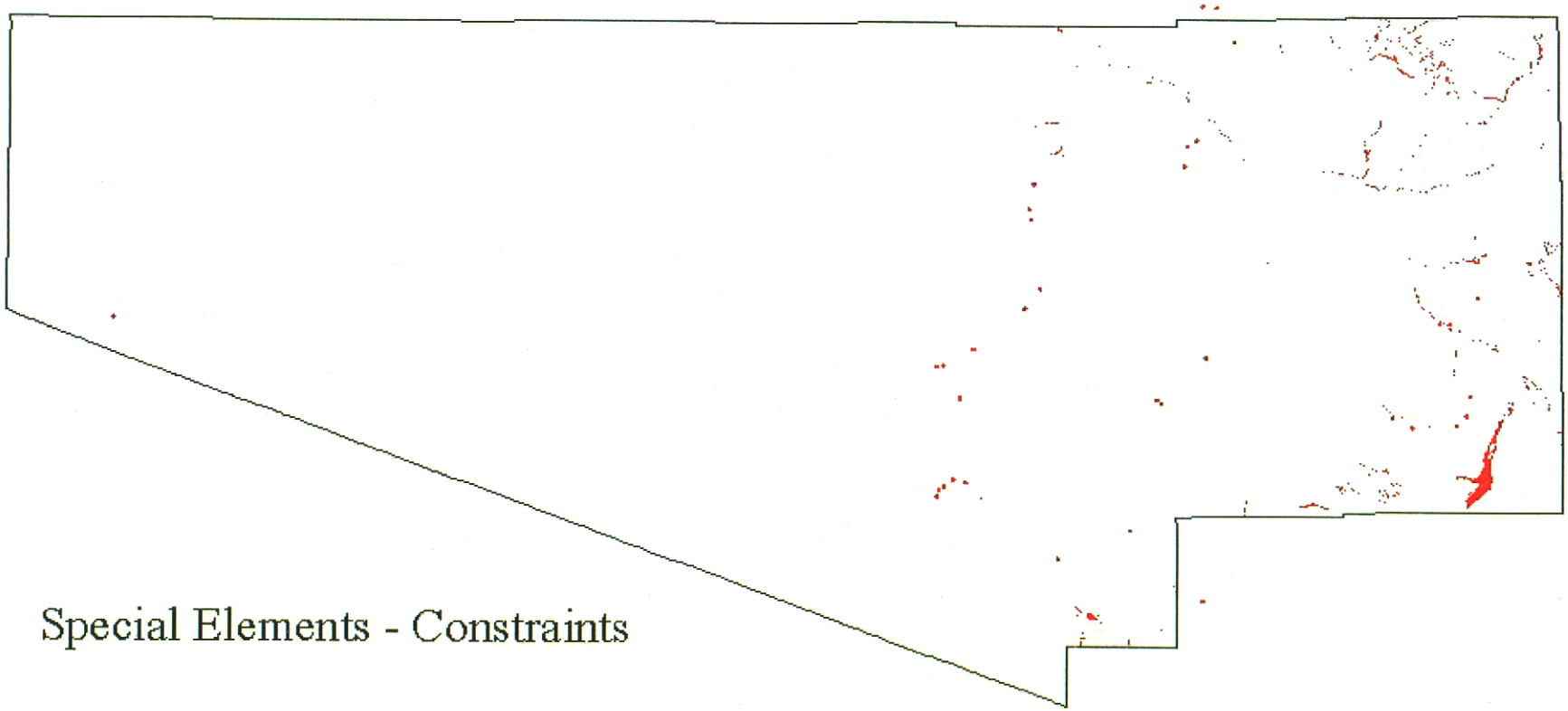
- tobosa grass-scrub
- sacaton-scrub
- mixed-root perennial grass
- grama
- creosotebush-Hilaria
- paloverde-mixed cacti
- brittlebush-ironwood
- saltbush
- cottonwood-willow
- broadleaf
- mesquite
- mixed scrub (riparian)
- mixed scrub (strand)
- annual (strand)
- cattail
- giant reed
- bulrush
- threesquare
- pondweed
- milfoil
- mixed conifer
- talus slopes
- caves
- bridges (bats)
- springs
- low elevation valley floors
- limestone soils

RECON



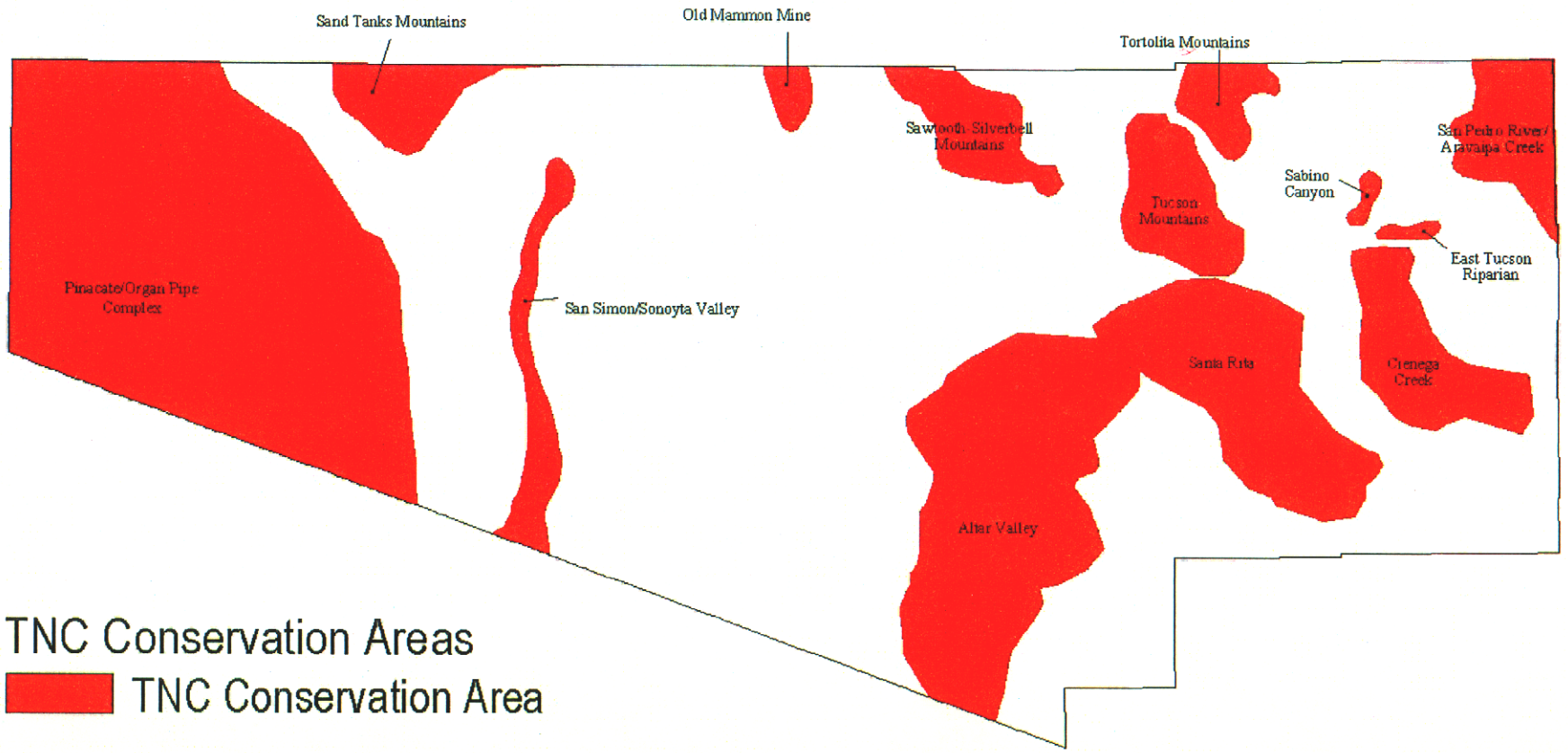
Special Elements - Preference

RECON

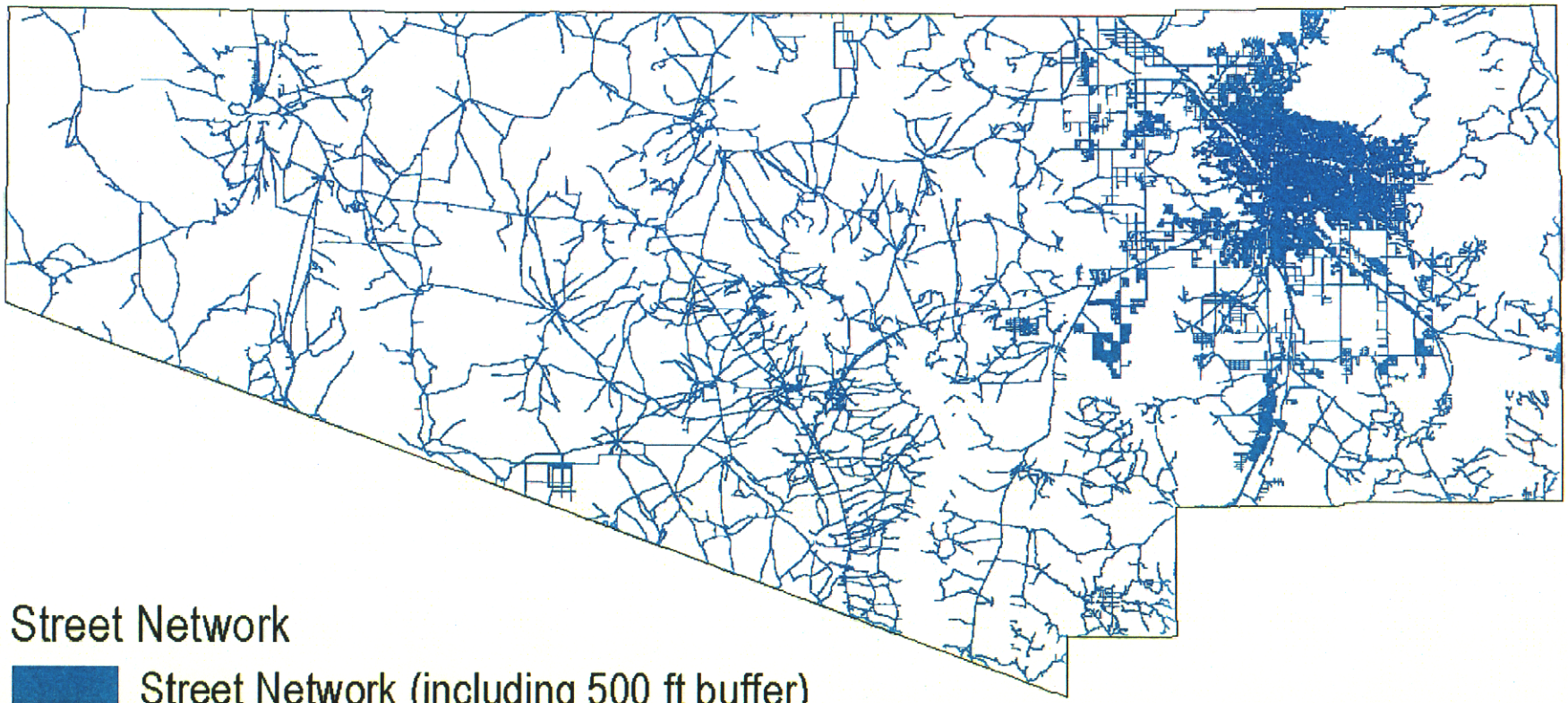


Special Elements - Constraints

RECON


Sand Tanks Mountains
Old Mammon Mine
Tortolita Mountains
Sawtooth Silverbell Mountains
San Pedro River/ Aravaipa Creek
Sabino Canyon
Tucson Mountains
East Tucson Riparian
Pinacate/Organ Pipe Complex
San Simon/Sonoyta Valley
Santa Rita
Cienega Creek
Altar Valley
TNC Conservation Areas
TNC Conservation Area

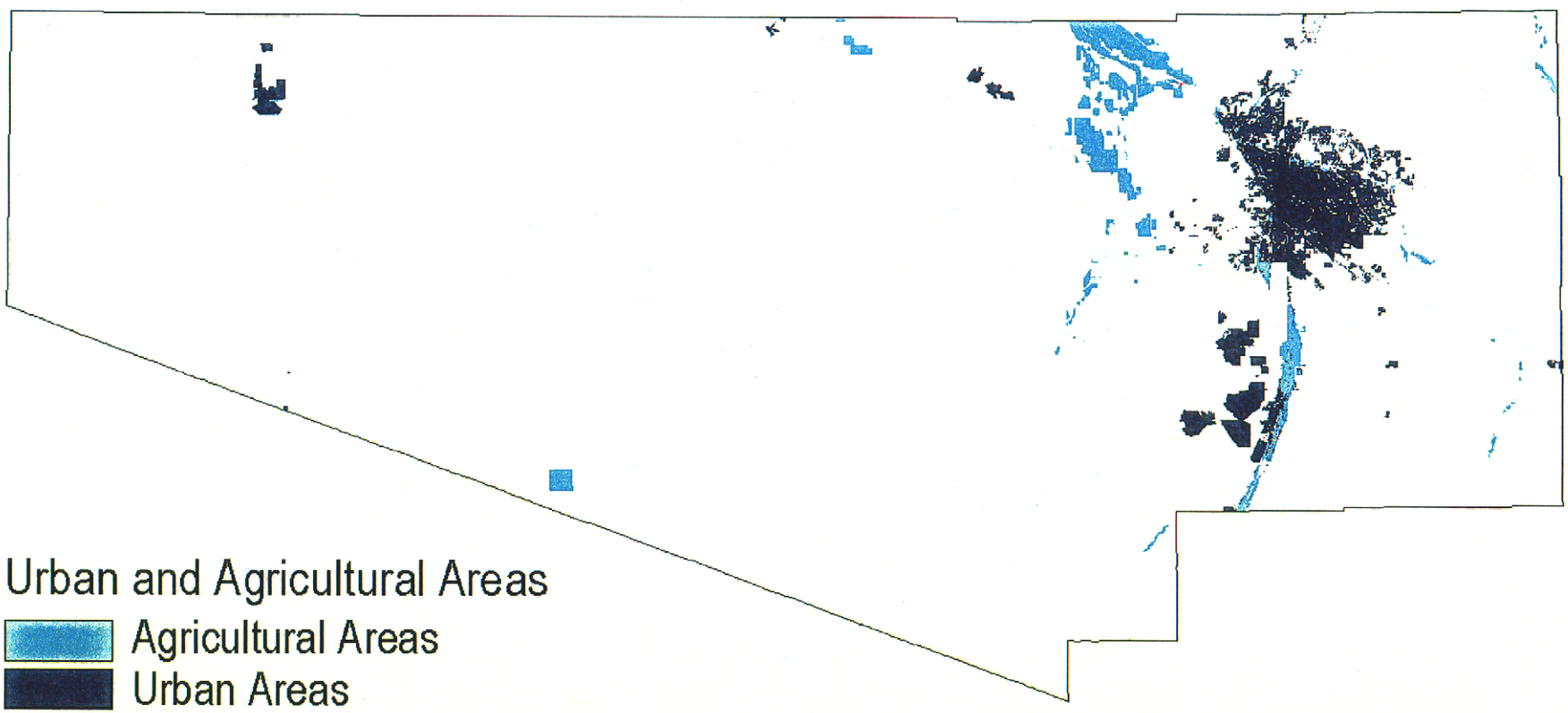
RECON



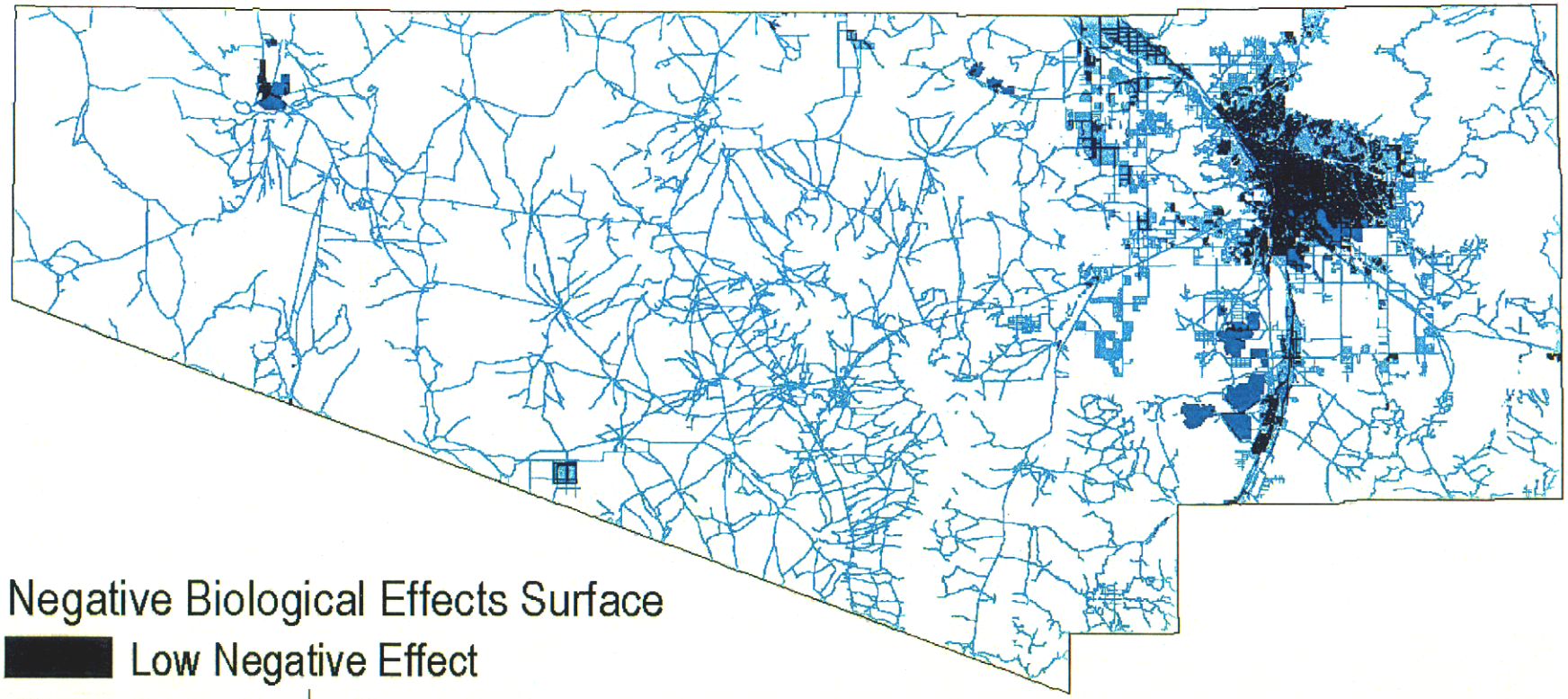
Street Network

Street Network (including 500 ft buffer)

RECON


Urban and Agricultural Areas
Agricultural Areas
Urban Areas

RECON



Negative Biological Effects Surface

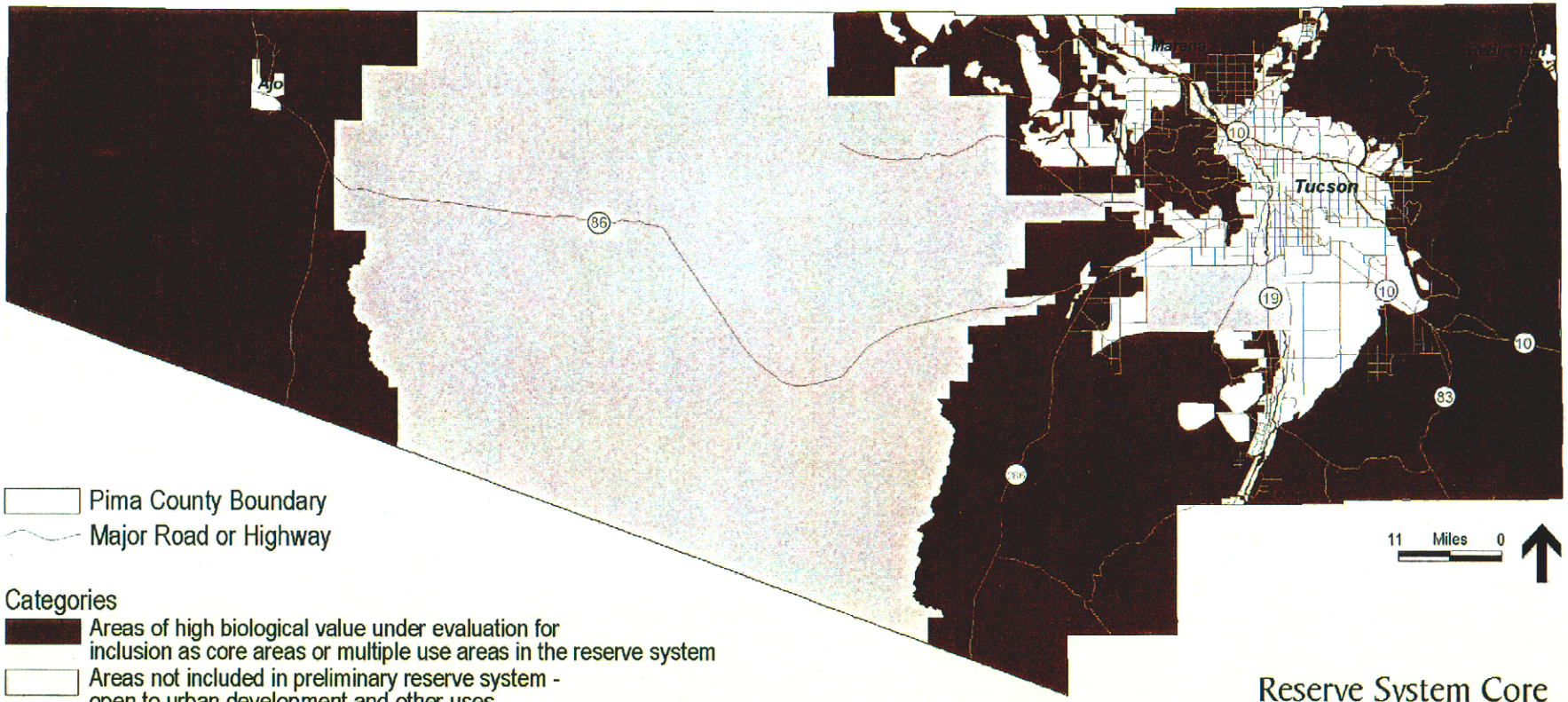
Low Negative Effect

High Negative Effect

RECON

Preliminary Reserve System

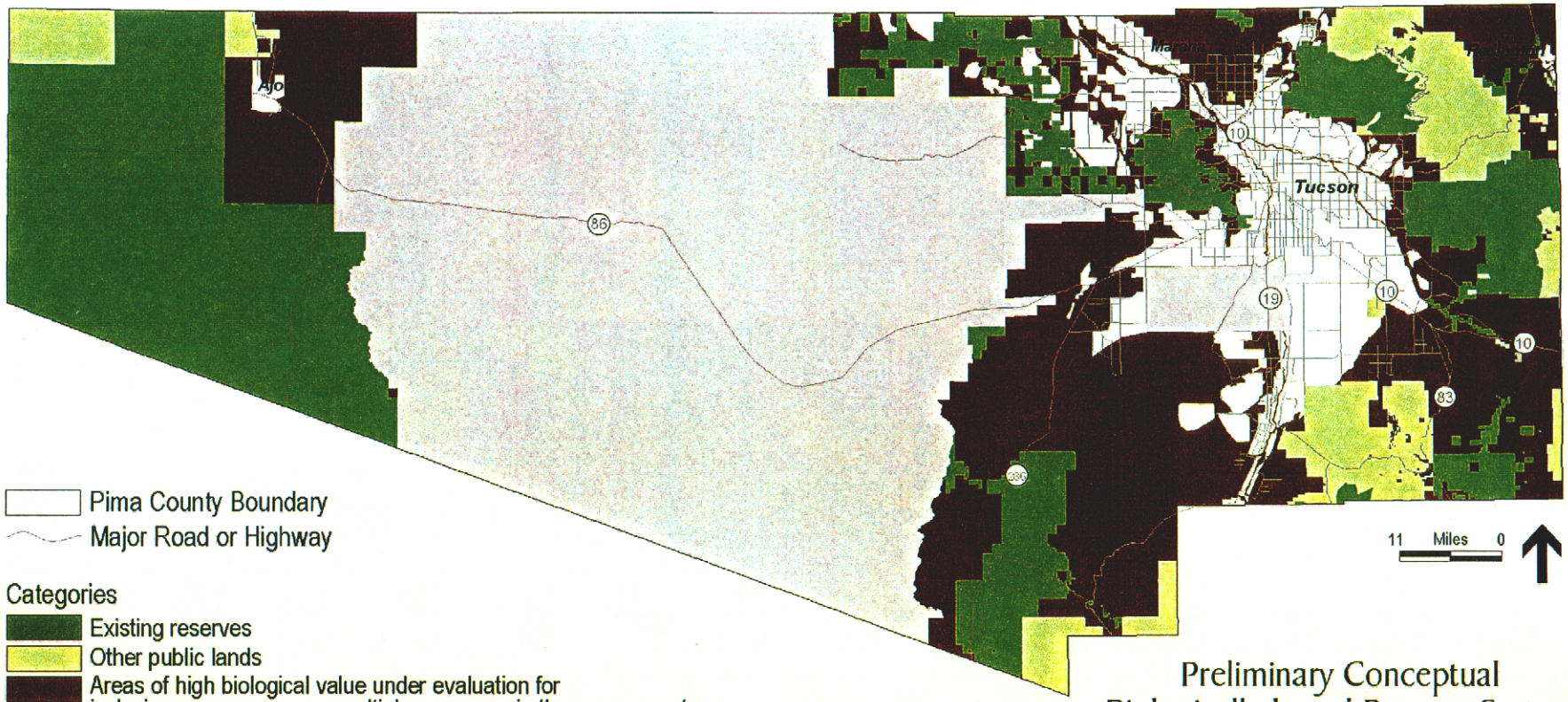
- **Biologically based**
- **First iteration, to be refined**
- **Differing conservation management areas to be defined**



Reserve System Core and Mulitple Use Areas

SDCP

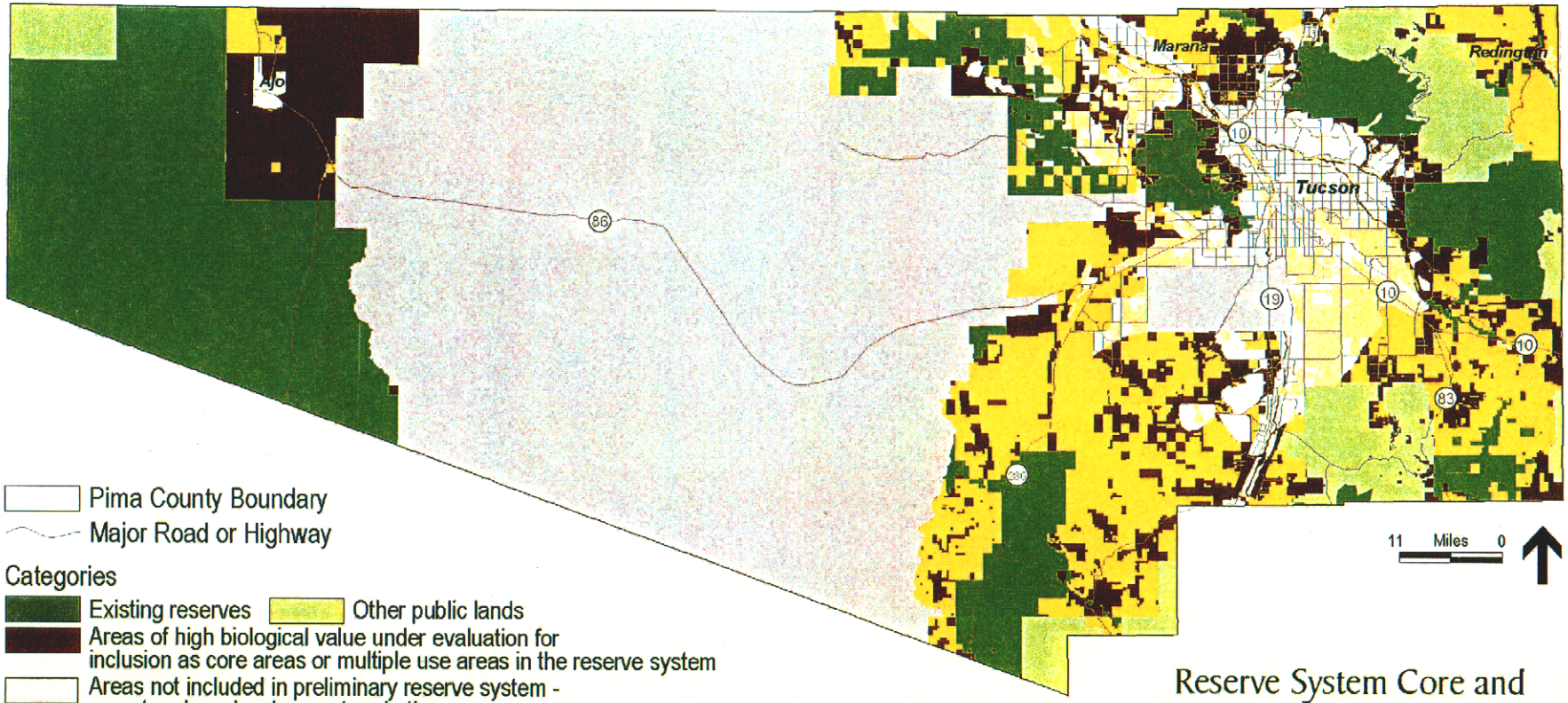
RECON



Preliminary Conceptual Biologically-based Reserve System Including Core Areas and Multiple Use Areas

SDCP

RECON



Pima County Boundary

Major Road or Highway

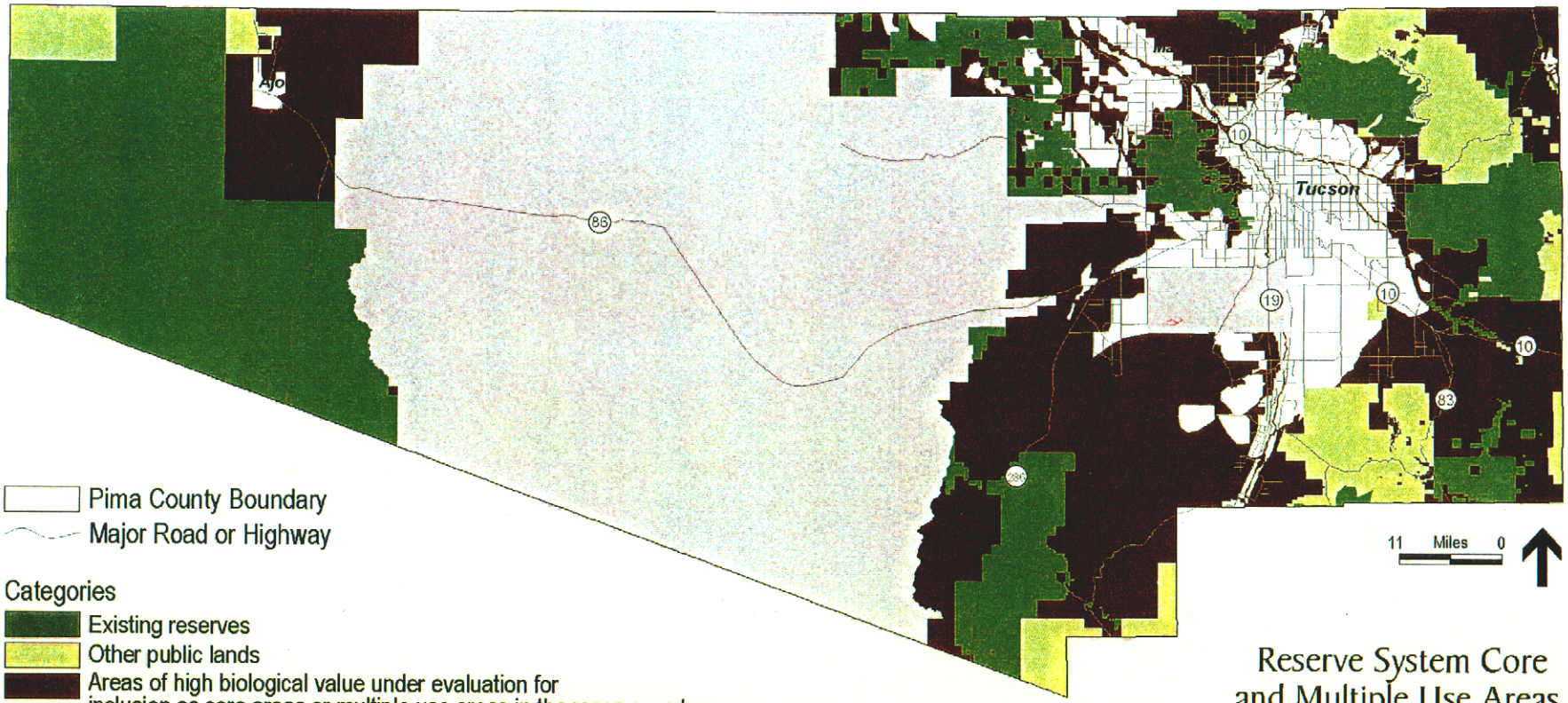
Categories

- Existing reserves
- Other public lands
- Areas of high biological value under evaluation for inclusion as core areas or multiple use areas in the reserve system
- Areas not included in preliminary reserve system - open to urban development and other uses
- State lands within reserve system
- State lands outside of reserve system
- Tohono O'Odham Nation

Reserve System Core and Multiple Use Areas, Existing Reserves, Public Lands and State Lands

SDCP

RECON



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11 Miles 0

Reserve System Core and Multiple Use Areas, Existing Reserves and Public Lands

SDCP

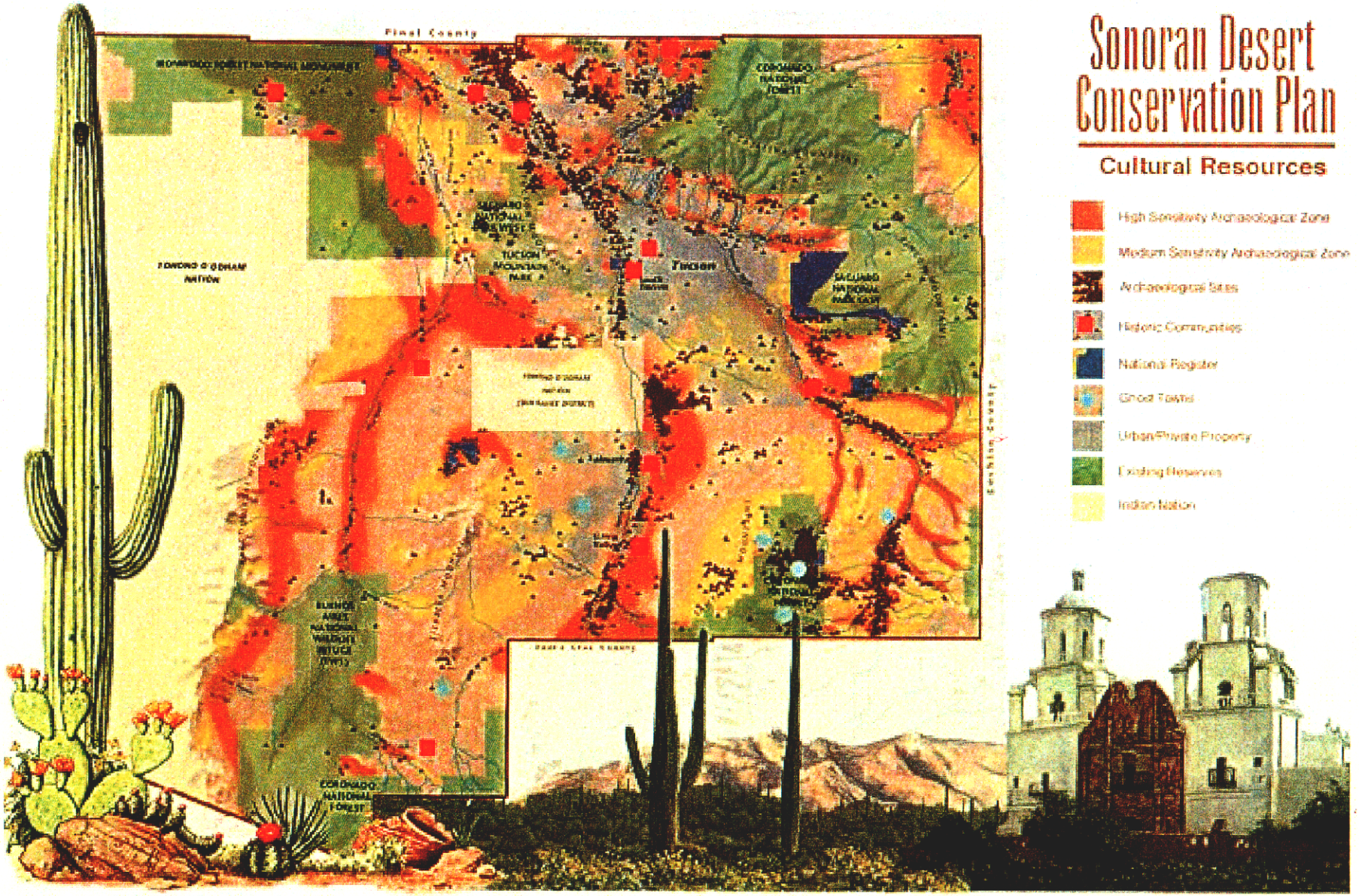
RECON

Sonoran Desert Conservation Plan

- **Integrating biological goals with planning for other elements**
  - ✓ **Cultural resources**
  - ✓ **Riparian conservation**
  - ✓ **Mountain parks and open space**
  - ✓ **Ranch conservation**
  - ✓ **Land use planning**

Sonoran Desert Conservation Plan

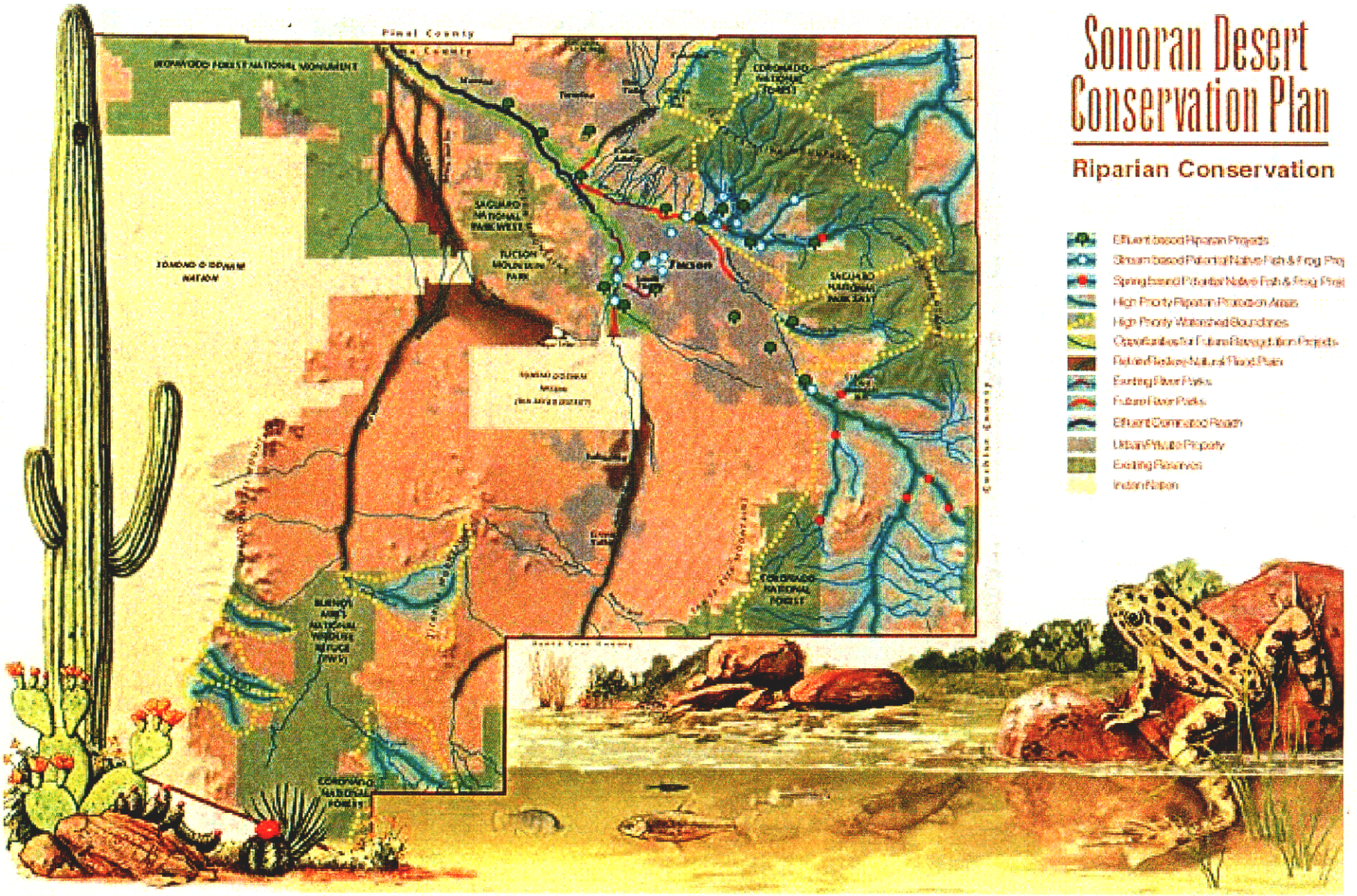
Cultural Resources



RECON

Sonoran Desert Conservation Plan

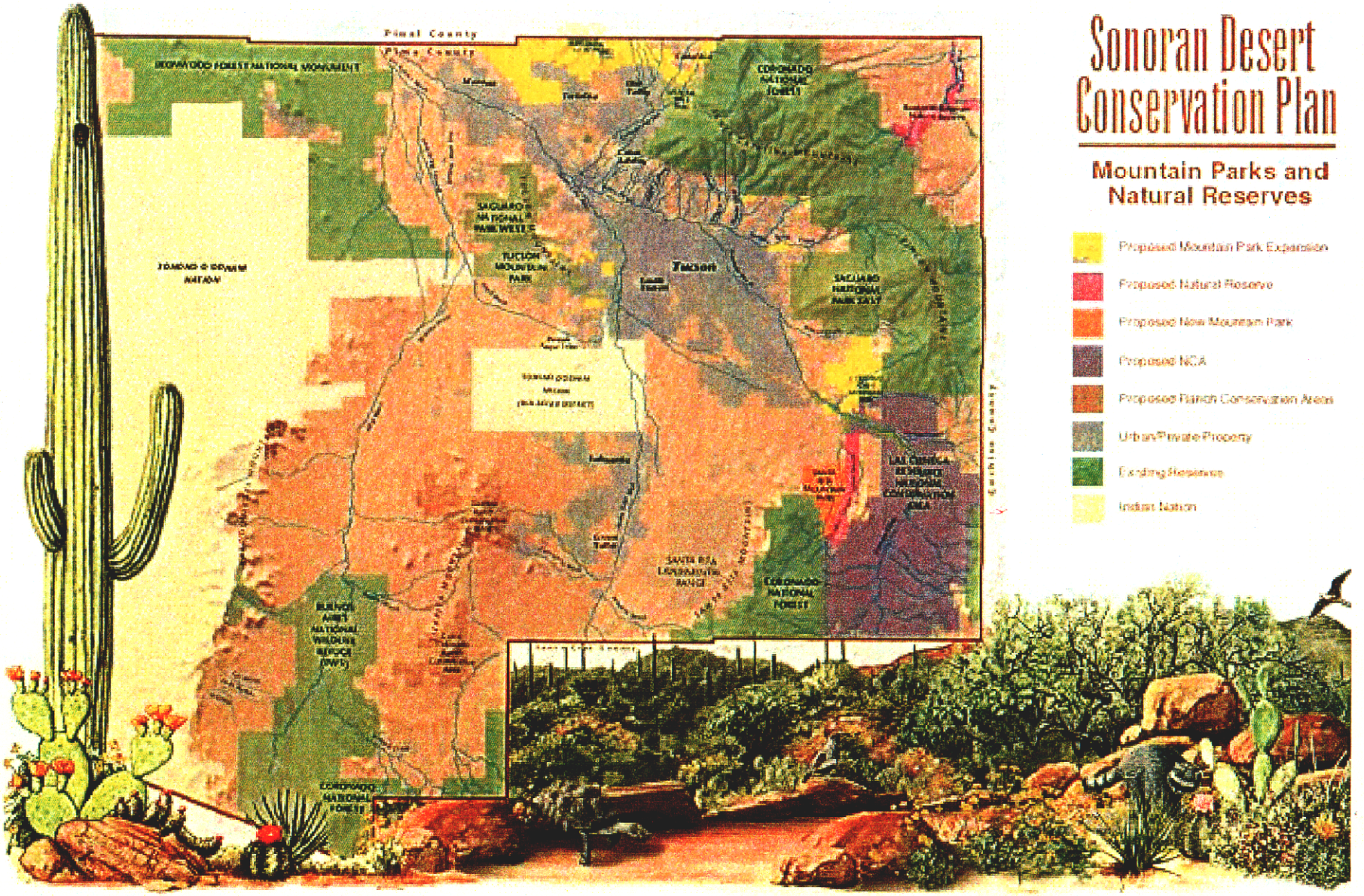
Riparian Conservation



RECON

Sonoran Desert Conservation Plan

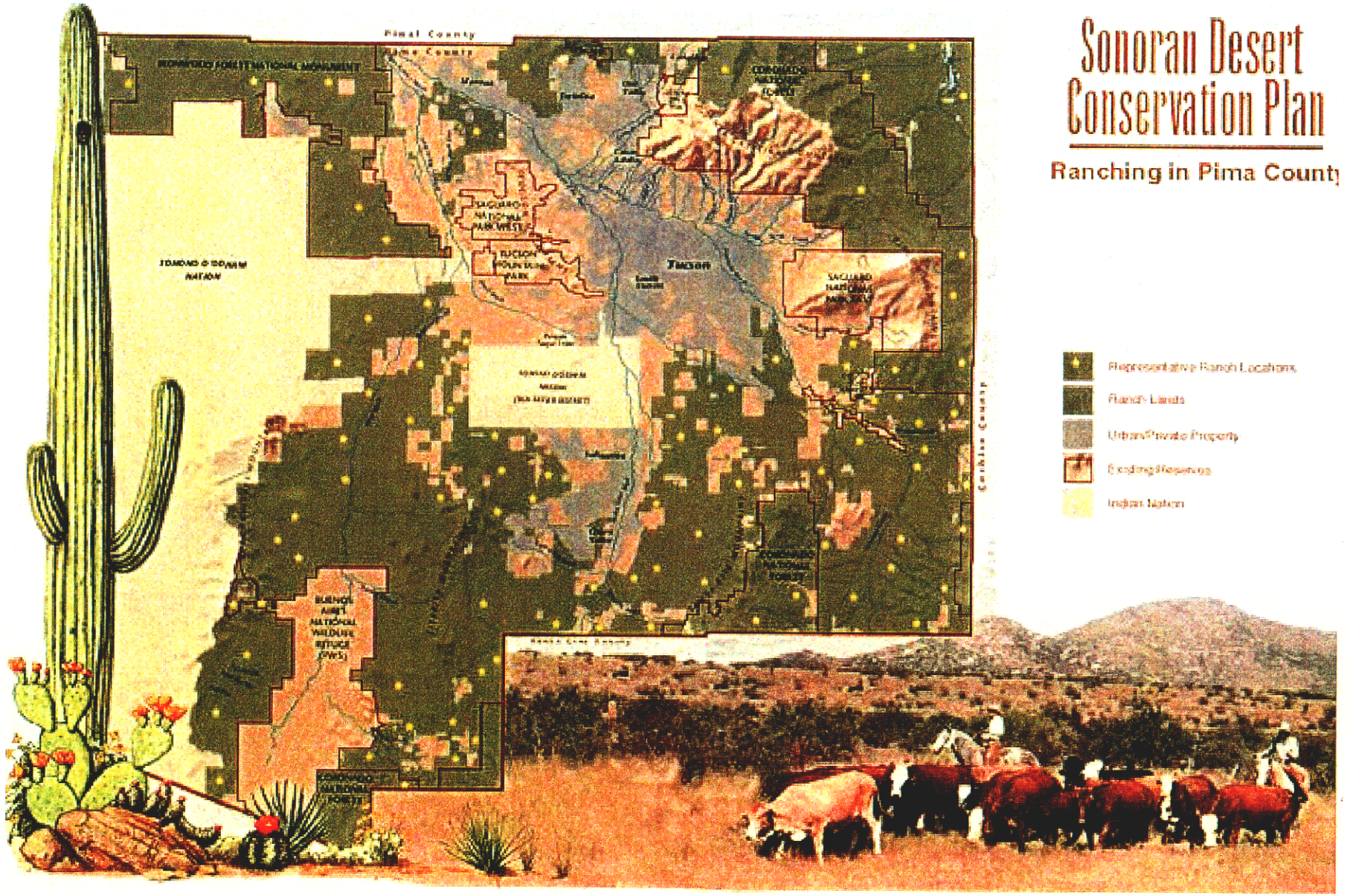
Mountain Parks and Natural Reserves



RECON

Sonoran Desert Conservation Plan

Ranching in Pima County



RECON

SDCP Working Groups

- Steering Committee
- Government Working Group
- Ranch Technical Advisory Team
- Science Technical Advisory Team
- Land Use Panels for sub-areas

Regional Growth and Conservation Planning to Sustain Economic Development

- **The Comprehensive Plan will conform to selected Biological Reserve Design**
- **NEPA and Planning processes**
- **Develop a biologically preferred plan to address vulnerable species rare communities and elements, and landscape scale features**
- **Integrate biological goals with planning for other elements**
- **Balance these goals with land use issues, cost considerations, and infrastructure needs**

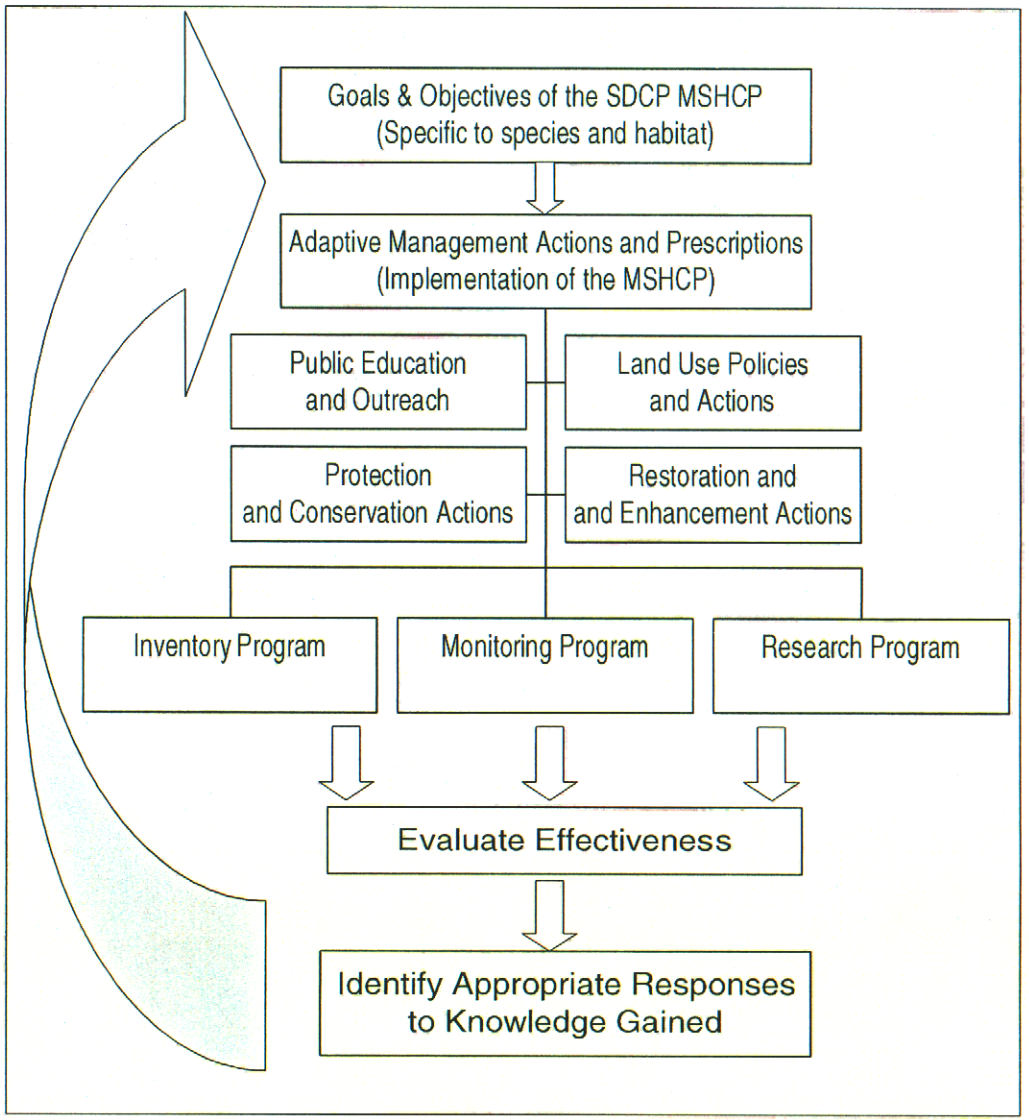
RECON

Regional Growth and Conservation Planning to Sustain Economic Development (cont.)

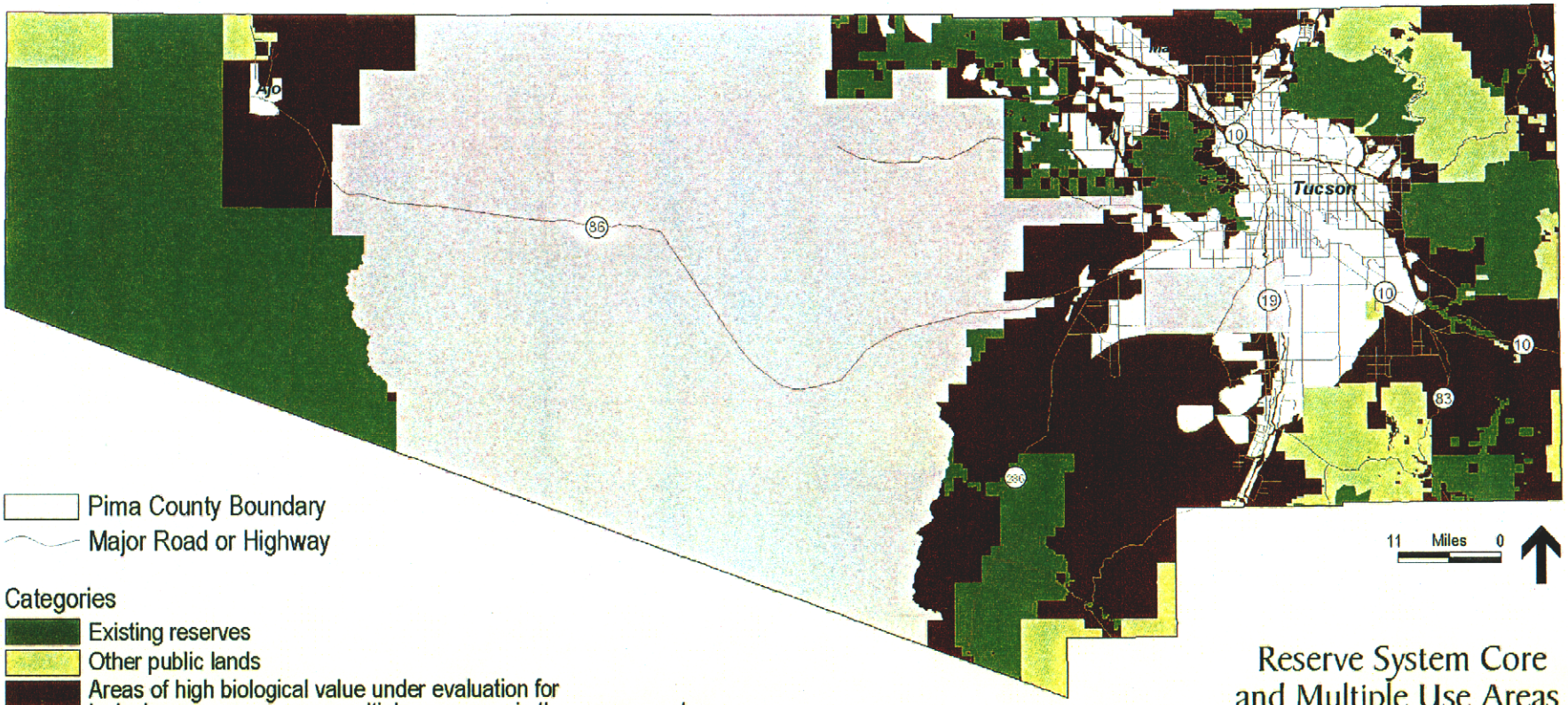
- Develop a range of real alternatives to evaluate in the NEPA process
- Steering Committee, technical teams, citizens, advise the Board of Supervisors on the best solution for Pima County
- Implementing agreements and commitments to manage the reserve system in a way that incorporates new information, to allow for future improvements and changes in management

SDCP

- **Adaptive Management Plan**



Adaptive Management Feedback Loop



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11 Miles 0

Reserve System Core and Multiple Use Areas, Existing Reserves and Public Lands

SDCP

RECON

Biological Value Surfaces

- **Overlay of vulnerable species distributions**
- **Special elements**
  - ✓ **Constraints**
  - ✓ **Preferred**