

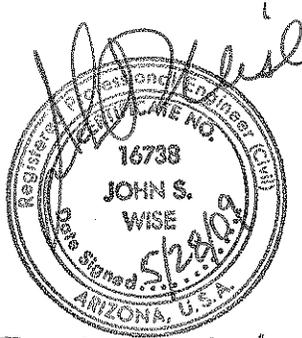
Lee Moore Wash Basin  
Management Study -  
Existing Conditions Analysis

February 8, 2008

Stantec Project No.: 185120071-110



Stantec



Expires 12/31/2010



EXPIRES 09/30/2010

# Lee Moore Wash Basin Management Study

## Existing Conditions Analysis

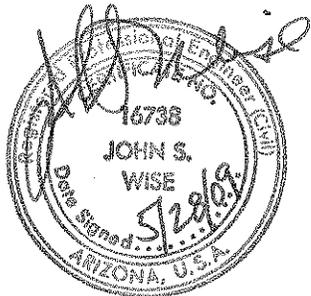
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## **1.0 Project Description**

The purpose of the Lee Moore Wash Basin Management Study (LMWBMS) is to provide a comprehensive flood control protection program. Furthermore, it will develop floodplain management protocol, which will affirm public safety, fiscal responsibility, habitat preservation and a balanced multi-objective approach to managing the watersheds, floodplains and resources in the study area. The goal of the current study is to identify flood and erosion hazard areas and drainage problems, and identify cost-effective solutions to alleviate or manage floodwaters in the Lee Moore Wash watershed study area.

The Lee Moore Wash Basin Management Study area encompasses approximately 213 square miles, or 136,319 acres in southern Pima County. Generally, the study area is bounded by Sonoita Highway to the east, Coronado National Forest and the Santa Rita Experimental Range to the south, Old Nogales Highway to the west, and Old Vail Connection Road and Interstate 10 Freeway to the north.

This Existing Conditions Analysis report of the Lee Moore Wash Basin Management Plan identifies and describes current physical characteristics of the study area, as well as future plans for the region.

**2.0 Jurisdictional Boundaries**

The Lee Moore Wash Basin Management Study area is composed of six various jurisdictional entities, including Pima County, City of Tucson, Town of Sahuarita, Santa Rita Experimental Range, Coronado National Forest, and the San Xavier District / Tohono O’Odham Nation. The unincorporated areas within the Pima County jurisdiction encompass the majority of the study area. The City of Tucson has annexed the northern portion of the study area, including annexations in 2001 of 17,286 acres south of Interstate 10 Freeway and 1650 acres south of the Tucson International Airport. The Town of Sahuarita, which includes 160 acres of the Lee Moore Wash study area, plans to eventually expand easterly beyond current corporate limits. The southern reaches of the study area include the foothills of the Santa Rita Mountains located within the Coronado National Forest and the Santa Rita Experimental Range (SRER). The SRER consists of 53,159 acres (12,580 acres within the study area), which was established in 1903 by the Federal government to protect native rangeland from grazing and to conduct research on livestock production. Today, the SRER is administered by the University of Arizona as an outdoor laboratory available to various research organizations and scientists.

The area associated with the Lee Moore Wash Basin Management Study contains the following approximate distribution of jurisdictional entities:

● Pima County	87,249 acres or 136.3 square miles	64.0%
● City of Tucson	25,620 acres or 40.0 square miles	18.8%
● Santa Rita Exp. Range	12,580 acres or 19.7 square miles	9.2%
● Coronado Nat. Forest	9820 acres or 15.3 square miles	7.2%
● Tohono O’Odham Nation	890 acres or 1.4 square miles	0.7%
● Town of Sahuarita	<u>160 acres or 0.3 square miles</u>	<u>0.1%</u>
Total	136,319 acres or 213.0 square miles	100.0%

The jurisdictional boundaries of the study area are displayed on Figure 1 of this report.

**3.0 Land Ownership**

The majority of land ownership (67%) within the Lee Moore Wash Basin Management Study area is controlled by governmental entities, including the State of Arizona (54%) and the U.S. Federal government (10%). The U.S. government holds title to the Coronado National Forest, San Xavier District / Tohono O’Odham Nation land, while the U.S. Bureau of Land Management (BLM) ownership includes 1,190 acres situated within three sections of land in the vicinity of the intersection of Sahuarita Road and Wilmot Road. The U.S. Bureau of Land Management (BLM) ownership also includes 1,270 acres immediately west of the Coronado National Forest. The State of Arizona ownership includes 61,860 acres of state trust land, as well as 12,580 acres within the Santa Rita Experimental Range. The Arizona State Land Department plans and manages the state trust lands, which over the long-term are sold at public auction for residentially zoned properties, or leased for commercial parcels with proceeds benefiting the public school system.

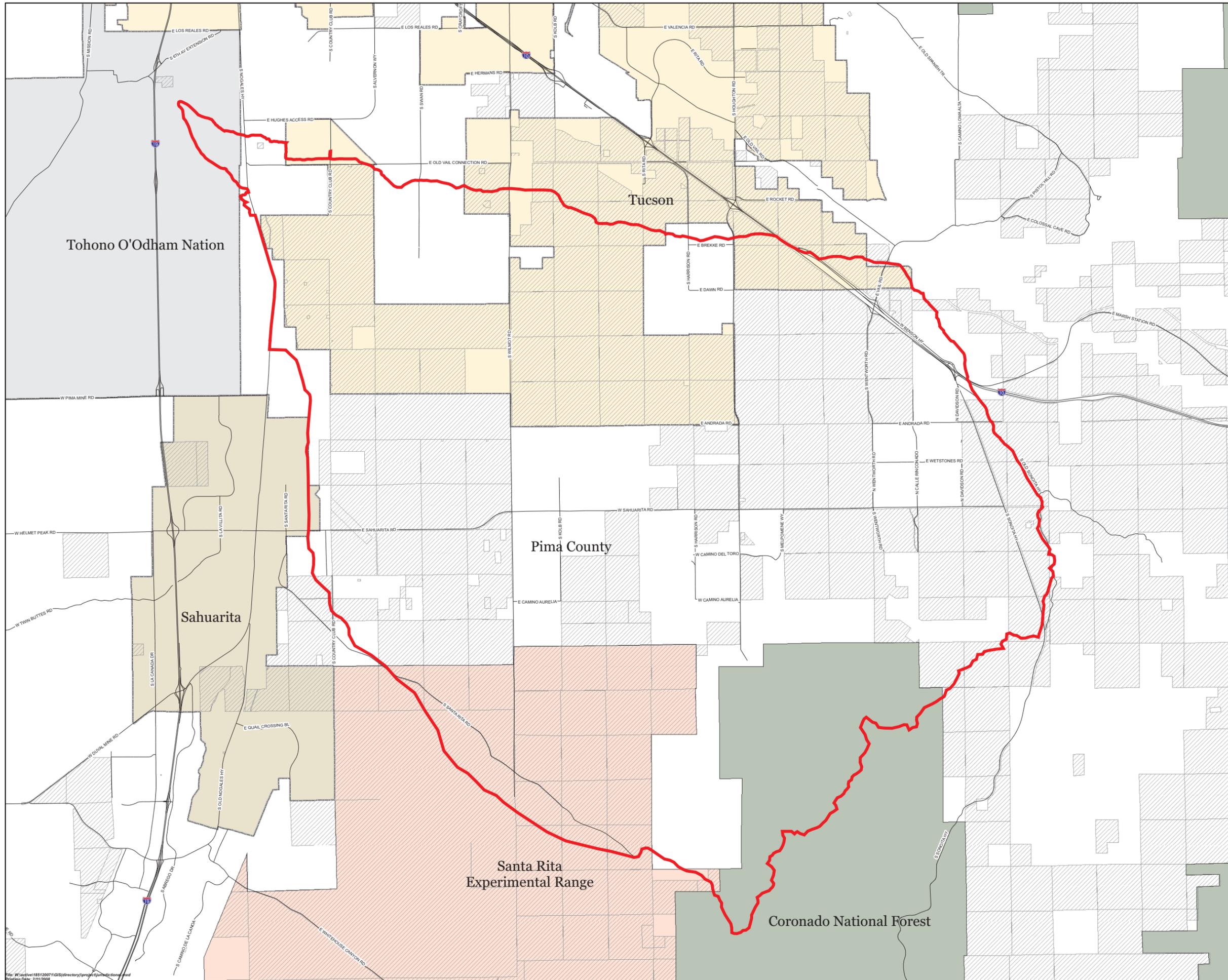
Land ownership within the Lee Moore Wash Basin Management Study area is comprised of the following approximate ownership distribution:

● State of Arizona (State Trust Land)	61,860 acres or 96.6 square miles	45.3%
● State of Arizona (Santa Rita Exp. Range)	12,580 acres or 19.7 square miles	9.2%
● USA (Coronado Nat. Forest)	9,820 acres or 15.3 square miles	7.2%
● USA/BLM, etc.	2,490 acres or 3.9 square miles	1.8%
● USA (Tohono O’Odham Nation)	890 acres or 1.4 square miles	0.7%
● Pima County	2,940 acres or 4.6 square miles	2.2%
● City of Tucson	1,340 acres or 2.1 square miles	1.0%
● Private	<u>44,399 acres or 69.4 square miles</u>	<u>32.6%</u>
Total	136,319 acres or 213.0 square miles	100.0%

The ownership boundaries of the study area are also illustrated on the previously referenced Figure 1.

# Lee Moore Wash Basin Management Study

## Figure 1 Jurisdictional Boundaries & Land Ownership



### Legend

- Study Area
- U.S. Forest Service
- Santa Rita Experimental Range
- Tohono O'odham Nation
- Sahuarita
- Tucson
- Pima County
- State Land



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#### **4.0 Existing Land Uses**

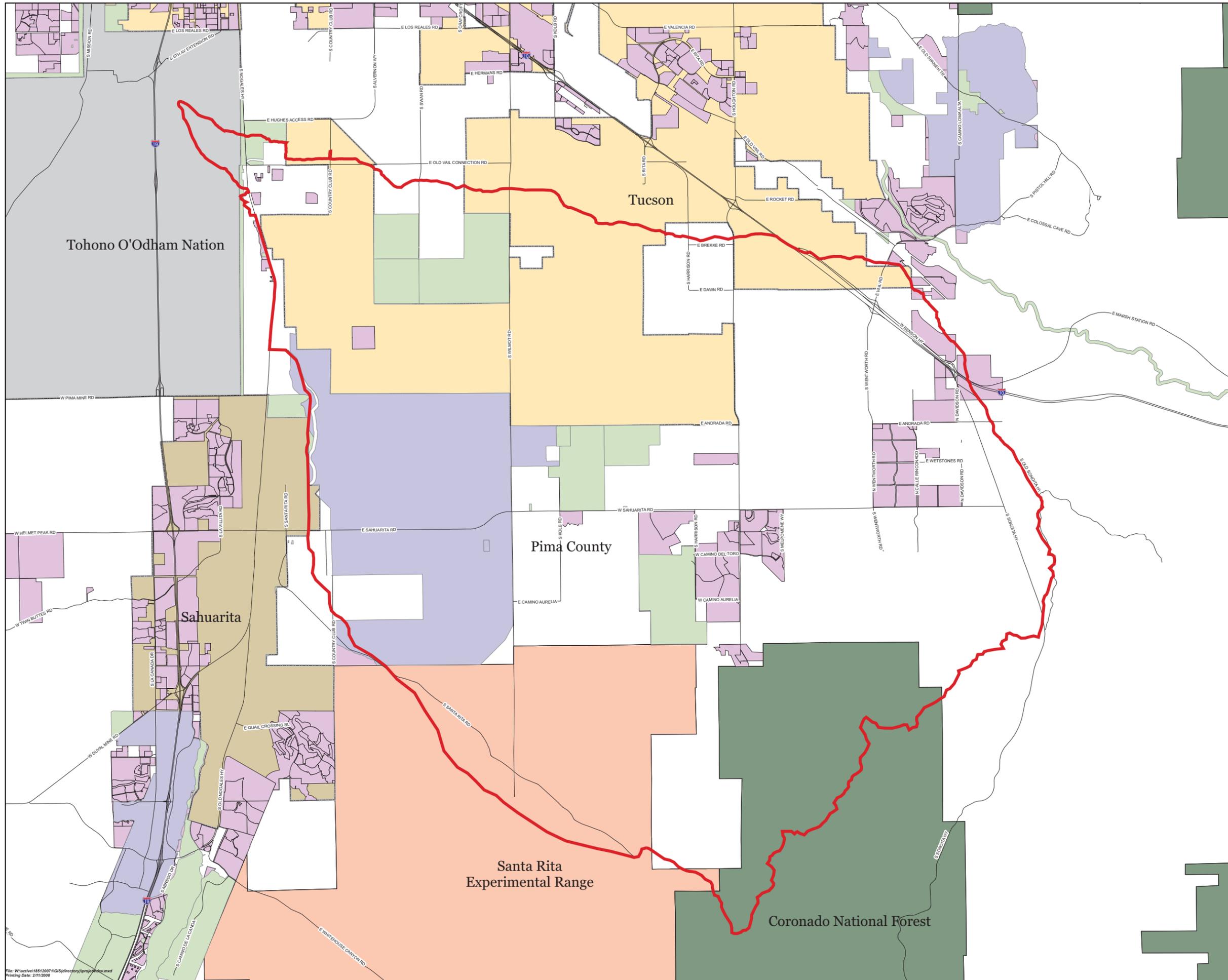
The majority of the land within the Lee Moore Wash Basin Management Study area is managed by governmental entities and presently undeveloped. The private land holdings have developed as rural residential and limited areas of suburban residential land uses. The rural residential land uses typically consist of four acre-sized lots within unrecorded ‘wildcat’ subdivisions dispersed throughout the study area. The suburban residential land uses are concentrated near the intersection of Sahuarita Road and Houghton Road. This area includes the *Sycamore Springs* subdivision located along the southern side of Sahuarita Road, and features residential lots of 2 acres in size and considerable open space areas. Master planned communities in the region include *Santa Rita Ranch* located southeast of the Sahuarita/Houghton intersection, and *Rancho Sahuarita* situated immediately west of the study area. Both master planned communities include a variety of single-family detached residential lot sizes.

Existing zoning also reflects the rural residential ambiance associated with the study area. The prevalent zoning district is Rural Homestead, RH, which allows rural residential development of 4.13 acre minimum-sized lots, with a maximum building height of 30 feet in the City of Tucson and 34 feet in Pima County. Higher residential density zoning districts are limited to the Houghton Road corridor and existing residential development near the intersection of Sahuarita Road and Houghton Road. Figures 2 and 3 illustrate the land uses and zoning classifications within the Lee Moore study area.

Recreation facilities within the Lee Moore Wash Basin Management Study area offer both passive and active recreational activities, including the Coronado National Forest located in the southeast portion of the study area. Pima County maintains the Southeast Regional Park (3,004 acres), just south of the Interstate 10 Freeway and Houghton Road interchange, and contains the Pima County Fairground and Tucson Raceway Park. In addition, Sahuarita District Park provides active recreational opportunities north of Sahuarita Road along the western boundary of the study area.

# Lee Moore Wash Basin Management Study

**Figure 2**  
Future & Existing Developments



## Legend

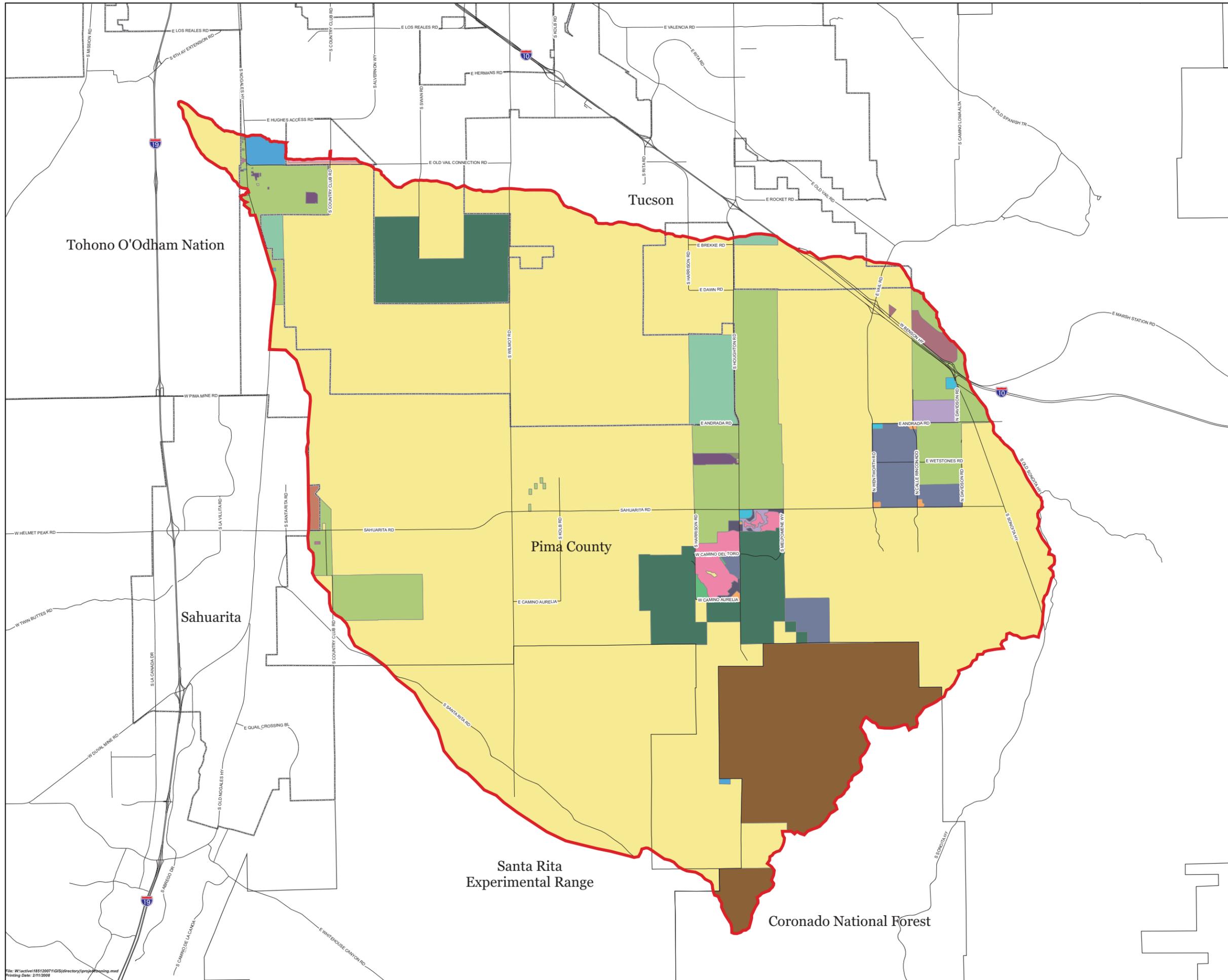
-  Study Area
-  Rezoning and Special Area Policies Part 1
-  Rezoning and Special Area Policies Part 2
-  Recorded Subdivisions
-  National Park or Wilderness Area
-  Santa Rita Experimental Range
-  Tohono O'odham Nation
-  Tucson
-  Sahuarita



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# Lee Moore Wash Basin Management Study

Figure 3  
Existing Zoning



### Legend

- |             |                |
|-------------|----------------|
| Study Area  | GR-1 Rural Res |
| <b>ZONE</b> | I-2            |
| CB-1        | IR             |
| CB-2        | P-I            |
| CI-1        | RH             |
| CI-2        | RH Rural Hmstd |
| CMH-1       | RX-1           |
| CMH-2       | SH             |
| CR-1        | SP             |
| CR-2        | SR             |
| CR-3        | TH             |
| GR-1        | TR             |



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## **5.0 Proposed Land Uses**

Future development within the Lee Moore Wash Basin Management Study area must comply with the various jurisdictional land use plans, including the Pima County Comprehensive Plan, the City of Tucson General Plan, and the Town of Sahuarita General Plan, as shown on Figure 4.

The Pima County Comprehensive Plan Rincon/Southeast Subregion designates future land uses for the study area as primarily Low Intensity Rural residential, with a maximum density of 0.3 residences per acre (rac). The plan also designates higher residential densities for proposed and existing master planned communities within the study area. The proposed *Swan Southlands/Verano* master planned community of approximately 3,200 acres, located along South Swan Road and South Wilmot Road in the northwest portion of the study area, is designated for Medium Intensity Urban residential land uses with a maximum density of 10 rac. The 18,945 acres located east of the Town of Sahuarita along the northern and southern side of Sahuarita Road is designated Low Intensity Urban residential, with a maximum density of 0.3 rac and a minimum 50% natural open space requirement. The *Hook M Ranch/BLM* property of 1,900 acres located northeast of the Sahuarita Road and Kolb Road intersection is planned for Low Intensity Urban residential at 3.0 rac, and the existing and proposed suburban residential area surrounding the Houghton Road and Sahuarita Road intersection is designated for Medium Intensity Urban residential uses with densities up to 10 rac.

The City of Tucson General Plan Rincon/Southeast Subregional Plan adopted in 1995 and amended in 2005 covers approximately 400 square miles where the Harrison/I-10 plan area and the Houghton Road/Dawn Drive plan area are located in the northern portion of the Lee Moore Wash Basin Management Study area. The Harrison/I-10 plan area covers approximately 10,600 acres and is generally located south of the Interstate 10 and Rita Road interchange, west of the Melpomene Road alignment, east of the Craycroft Road alignment, and north of the Dawn Road alignment. This plan land use designations reflect current zoning, and the majority of the area is planned Low Intensity Rural which is consistent with the large expanses of RH zoning (minimum 4.13 acre sized residential lots) and Medium Intensity Rural. The Houghton Road/Dawn Drive plan area comprises approximately 3,500 acres located north and south of Interstate 10, situated between Houghton Road along the west and Colossal Cave Road on the east. The area south of Interstate 10 is planned Low Intensity Rural and Medium Intensity Rural, which corresponds to the existing RH zoning (minimum 4.13 acre sized residential lots) and RX-1 zoning (minimum 36,000 square foot sized residential lots) within the area.

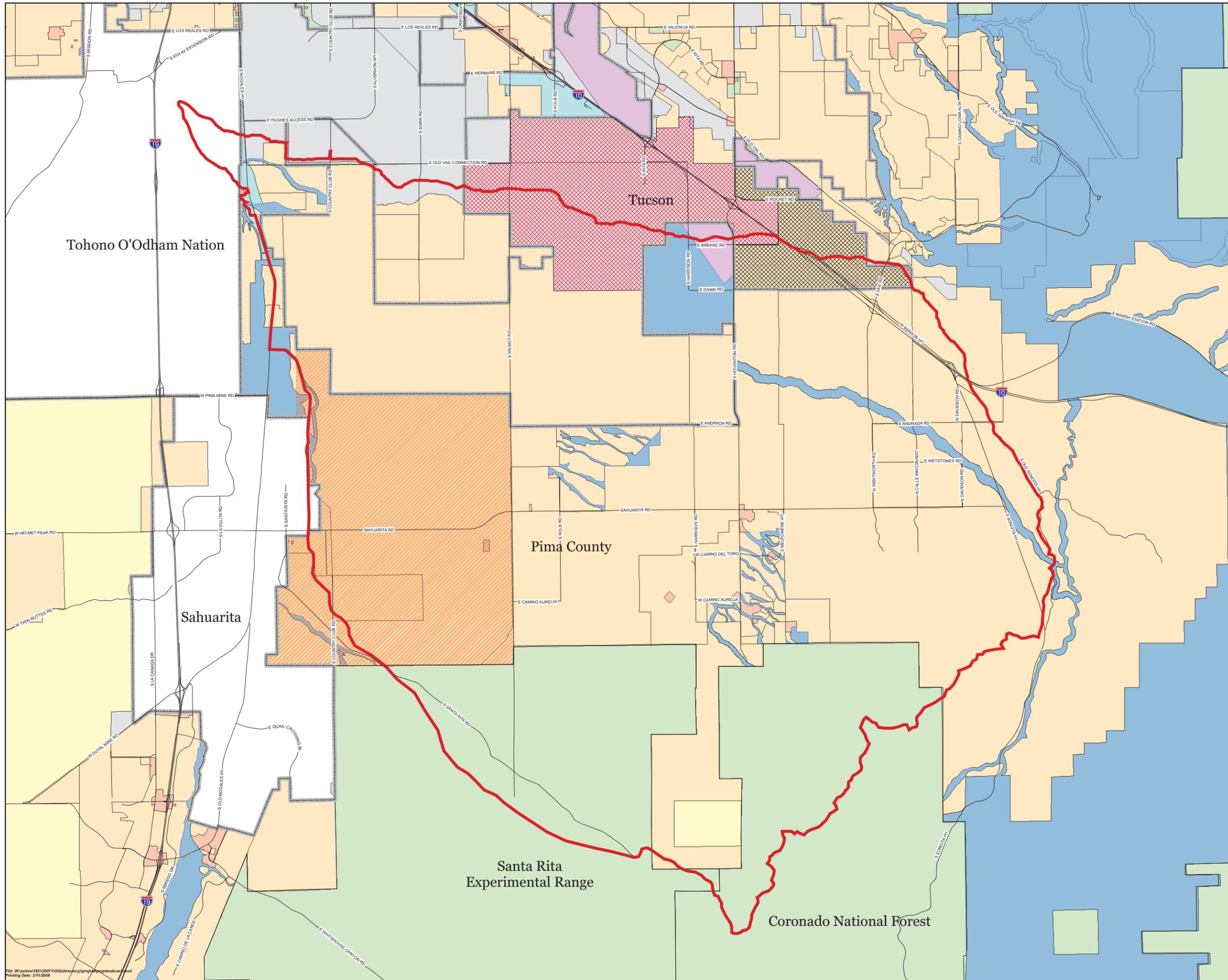
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The Town of Sahuarita General Plan adopted in 2002 established a sphere of influence beyond current corporate limits extending easterly into the western portion of the Lee Moore Wash Basin Management Study area.

# Lee Moore Wash Basin Management Study

## Figure 4 Proposed Land Uses



### Legend

- Study Area
- Tucson Planning Area rs2-4
- Tucson Planning Area rs2-8
- Approximate Boundary of Sahuarita AFR
- Residential
- Industrial
- Activity Center
- Multifunctional Corridor
- Military Airport
- Resource Productive
- Resource Transition
- Public Preserves



0 1 2 4 Miles



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## **6.0 Environmentally Sensitive Lands**

Environmentally sensitive lands, including riparian habitat resources, biological corridors, historic and cultural sites within the Lee Moore Wash Basin Management Study area have been designated for conservation purposes by various jurisdictional plans.

The Pima County Sonoran Desert Conservation Plan (SDCP) initiated in 1998 and adopted by the Board of Supervisors in 2001 is a long-range conservation plan that seeks to protect and enhance the natural and cultural environment. The planning efforts focused on six elements, including Habitat Corridors, Cultural Resources, Mountain Parks, Ranch Conservation and Riparian Protection. Pima County's plan is structured to reflect the natural system through the conservation of large landscape reserve areas, including parks, preserves and riparian resources in order to provide protection of endangered and vulnerable species.

The Pima County Conservation Land System and Riparian Resources elements of the SDCP identified biological resource areas and corridors throughout the Lee Moore Wash Basin Study area, as shown on Figures 5 and 6 in this report. According to the Conservation Land System policies, Important Riparian Areas have the highest level of biological resources and should retain 95% of their existing resources, while the Biological Core Management Areas located primarily in the southeast portion of the study area should retain 80% of their biological resources.

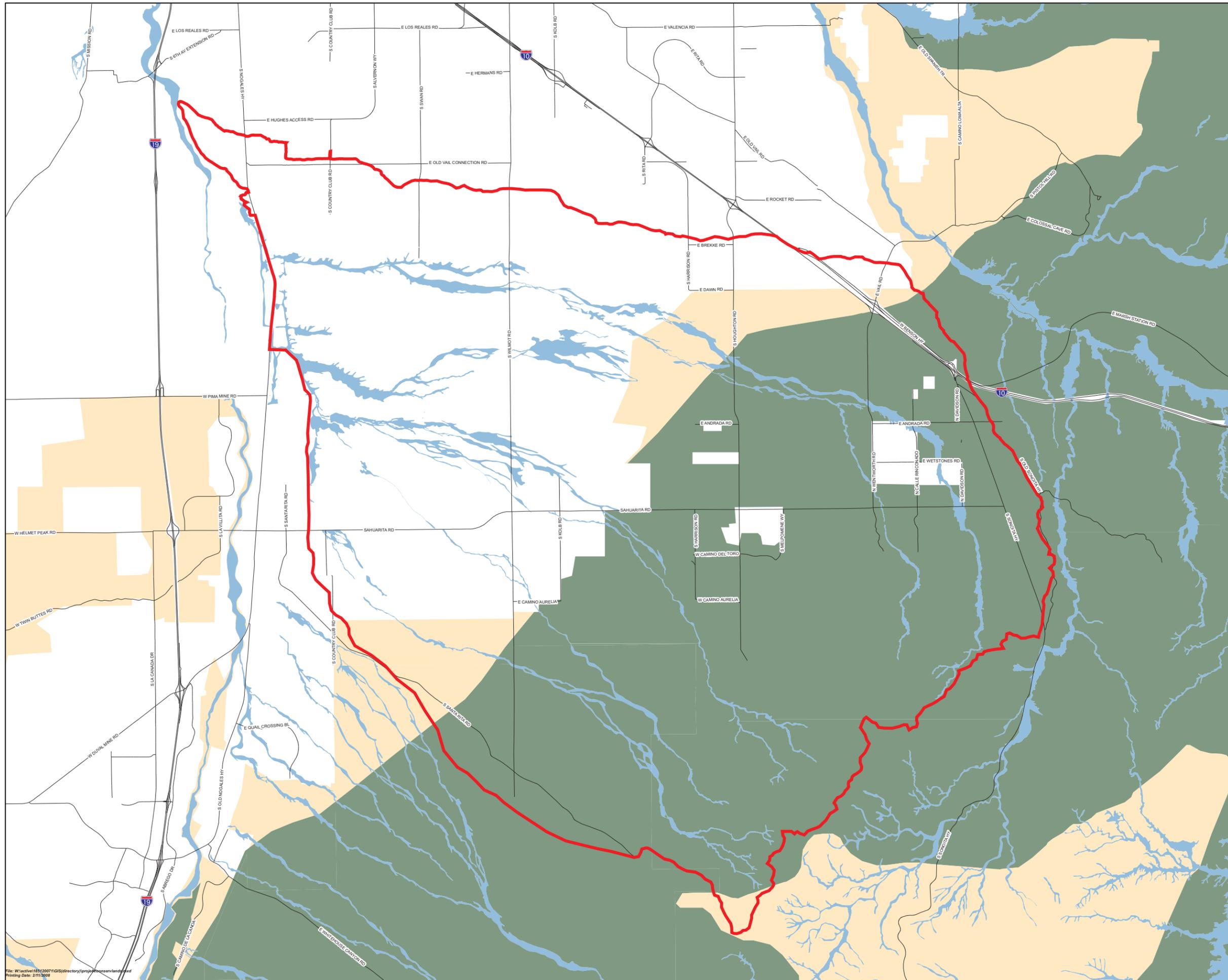
Pima County's Watercourse and Riparian Habitat Protection ordinance has designated and mapped 'regulated riparian habitat' including Important Riparian Areas and Xeroriparian habitats within the study area as shown on the Riparian Habitats exhibit (Figure 6). Important Riparian Areas are valued for their higher water availability, vegetation density and biological corridors, whereas Xeroriparian habitats are generally associated with an ephemeral water supply. The Xeroriparian habitat is further divided into four subclasses for Class A, B, C, and D habitat based upon vegetative volume.

The City of Tucson in 2006 prepared the Preliminary Draft Habitat Conservation Plan (HCP) that includes the Southlands sub-area, of which 25,620 acres of city annexed land is situated within the Lee Moore Wash Basin Management Plan area. The City's HCP is intended to promote conservation of natural resources while providing for future growth, as well as complement other regional conservation planning efforts such as Pima County's SDCP. The primary component of the HCP Southlands conservation program is the protection of habitat within the Petty Ranch and Fagan watersheds.

Harris Environmental Group Inc. has prepared an inventory of previously-recorded cultural resources and surveys within the study area.

# Lee Moore Wash Basin Management Study

## Figure 5 Conservation Areas



### Legend

-  STUDY AREA
- CONSERVATION LANDS SYSTEM**
-  BIOLOGICAL CORE MANAGEMENT AREAS
-  IMPORTANT RIPARIAN AREAS
-  MULTIPLE USE MANAGEMENT AREAS

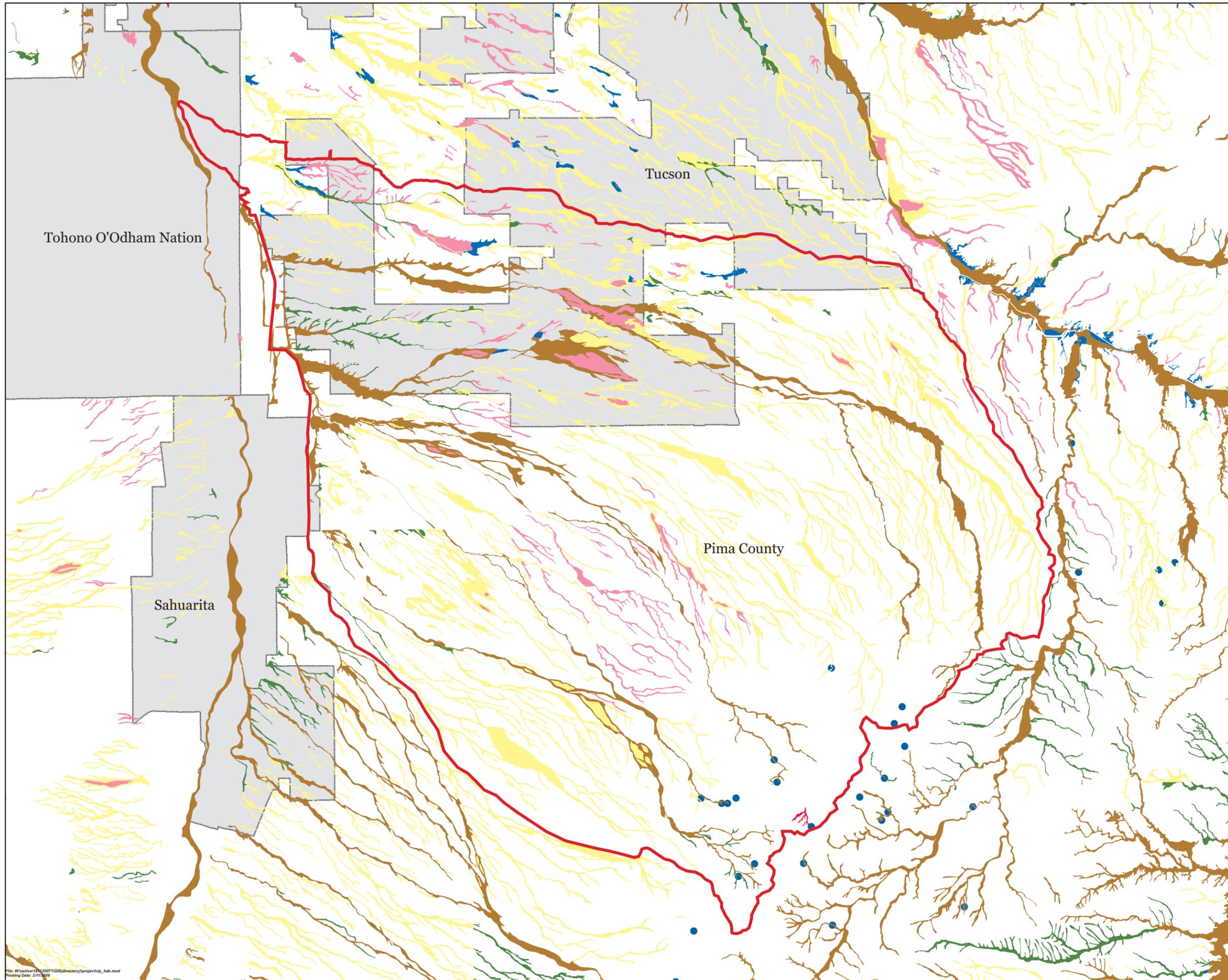


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# Lee Moore Wash Basin Management Study

## Figure 6 Riparian Habitats



### Legend

- Study Area
- Springs
- Riparian Habitat - Pima County Ord. 2005-FC2**
  - Important Riparian Areas
  - Hydromesoriparian or Mesoriparian
  - Xeriparian A
  - Xeriparian B
  - Xeriparian C
  - Xeriparian D



0 1 2 4 Miles



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## **7.0 Regional Transportation**

In 2002, the Pima Association of Governments (PAG) initiated an extensive 3-year planning effort to develop a new long range transportation plan for eastern Pima County and the Tucson metropolitan area, known as the 2030 Regional Transportation Plan (RTP). The RTP process included input from representatives of Pima County, the Cities of Tucson and South Tucson, and the Towns of Marana, Oro Valley and Sahuarita, as well as the region's Tribal representatives resulting in the identification of critical issues related to land use and transportation planning. The PAG 2030 RTP immediately identified the need for further study of the southeastern portion of the County, including the Lee Moore Wash Basin Management Study area, and in 2003 PAG commenced the Southeast Area Arterial Study. The purpose of this 18-month Southeast Area Arterial Study was to recommend a Major Streets and Routes Plan for an area roughly bounded by I-19 Freeway on the west, Valencia Road and I-10 Freeway to the north, State Route 83 to the east and the Santa Rita Experimental Range and Coronado National Forest on the south side of the study area.

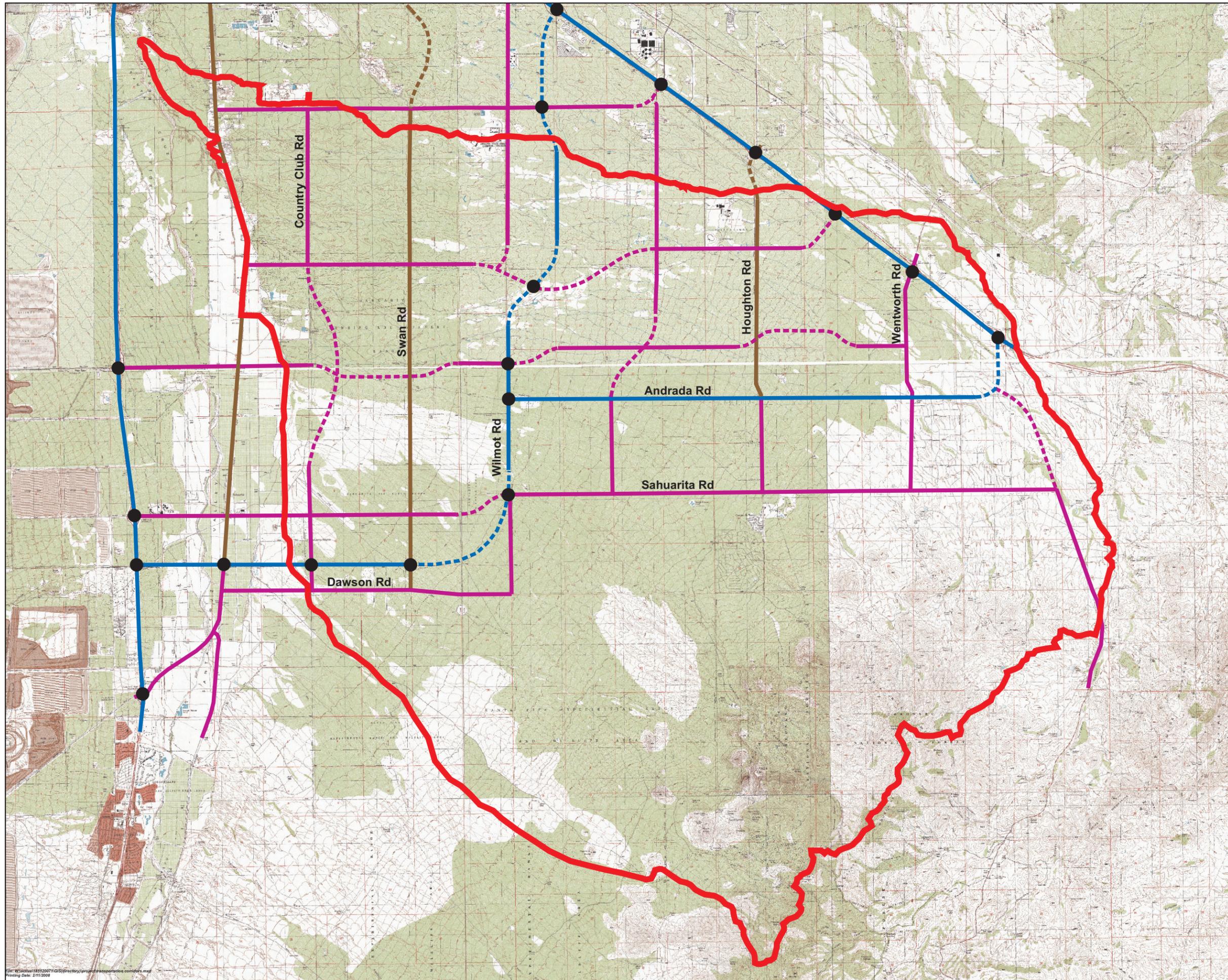
The existing and proposed arterial highway corridors for the region as designated by the PAG 2030 Regional Transportation Plan and the PAG Southeast Area Arterial Study are illustrated on Figure 7. The plans include the improvement of east/west arterial highway corridors of Old Vail Connection Road, Dawn Drive, Pima Mine Road, Andrada Road and Sahuarita Road, while the north/south arterials include Country Club Road, Swan Road, Wilmot Road, Rita Road and Houghton Road.

The Regional Transportation Authority (RTA) Plan approved by voters in May of 2006, features roadway improvements, public transit upgrades and other safety improvements to the regional transportation infrastructure during the next 20 years. The RTA plan includes the purchase and preservation of right-of-way for Pima Mine Road, Sahuarita Road and Swan Road arterial corridors within the Lee Moore Wash Basin Management Study area, and the improvement of Wilmot Road and Houghton Road within phase 2 of the RTA plan.

The northern portion of the Lee Moore Wash Basin Management Study area is impacted by the Davis Monthan Air Force Base Approach and Departure Corridor and the Tucson International Airport Noise Zones, as depicted on the Regional Transportation exhibit (Figure 7). The Davis Monthan Air Force Base Approach and Departure Corridor mainly affects properties located near the Interstate 10 Freeway and Houghton Road interchange by limiting residential development and requiring sound attenuation measures in new construction. Similarly, the Tucson International Airport Noise Zones require specific land uses to provide sound attenuation measures, including additional building insulation to reduce the interior noise levels within new structures.

# Lee Moore Wash Basin Management Study

## Figure 7 Regional Transportation Plans



### Legend

- Study Area
- Service Interchange
- Conceptual Alignments**
  - Arterial (150-foot ROW)
  - Parkway (300-foot ROW)
  - Parkway (150-foot ROW)
- Alignments to be Determined**
  - Arterial (150-foot ROW)
  - Parkway (300-foot ROW)
  - Parkway (150-foot ROW)



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## **8.0 Existing Drainage Conditions**

The existing drainage setting of the Lee Moore Wash Basin Management Study area has been the subject of two previous studies. In 1988, a watershed-wide study was performed by the Pima County Department of Transportation and Flood Control District, Planning Division that employed hydrologic modeling utilizing the U.S Army Corps of Engineers HEC-1 Flood Hydrograph program. More recently, a study funded by the Arizona State Land division is in the process of being prepared by URS, identifying peak flow impacting existing State Land holdings using the U.S. Geological Survey (USGS) regression equation.

The Lee Moore Wash watershed area is generally comprised of eight tributaries draining to Lee Moore Wash, varying in size from a few square miles to in excess of 30 square miles. Specifically, these watercourses have been designated as Gunnery Range Wash, Sycamore Canyon Wash, Fagan Wash, Cuprite Wash, Petty Ranch Wash, Flato Wash, Summit Wash, and Franco Wash. The overall Lee Moore drainage area consists of approximately 197 square miles, with the headwaters situated to the southeast within the Santa Rita Mountains and/or associated alluvial fan and foothill areas. With the exception of Franco Wash, watercourses generally drain west-northwest to the Lee Moore Wash, which ultimately discharges to the Santa Cruz River west of the Lee Moore Basin Management Plan area. Franco Wash discharges directly to the Santa Cruz River just north of Lee Moore Wash, but is still generally considered as a portion of the Lee Moore watershed. The major watersheds within the study area are displayed on Figure 8. Limited FEMA floodplains have been mapped within the Lee Moore watershed area, and no detailed study areas defining base flood elevations have been performed to this date. Floodplain areas that have been mapped are illustrated in Figure 9.

Watercourses within the study area display the full range of channel types typical of the semi-arid southwest. Within the upstream reaches of the watershed, mountain valleys are relatively well-defined with distinct watershed boundaries. Generally, as watercourses discharge from their well-defined mountain valleys, high sediment loads induce sedimentation and the formation of alluvial fan deposits along the base of the mountain terrain. Channels within these areas transition into less-defined watercourses as drainage generally flows west-northwest. As watercourses drain further into the valley areas, commonly an ill-defined network of channels develops which are characterized by channel avulsion and lateral migration, with potential for diversions and split flow dynamics. A more detailed description of prevalent flow patterns is provided in the next section.

The existing development within the project area is primarily rural residential subdivisions, with minimal roadway and drainage improvements. Growth has accelerated over the last 10 to 15 years. The existing drainage infrastructure

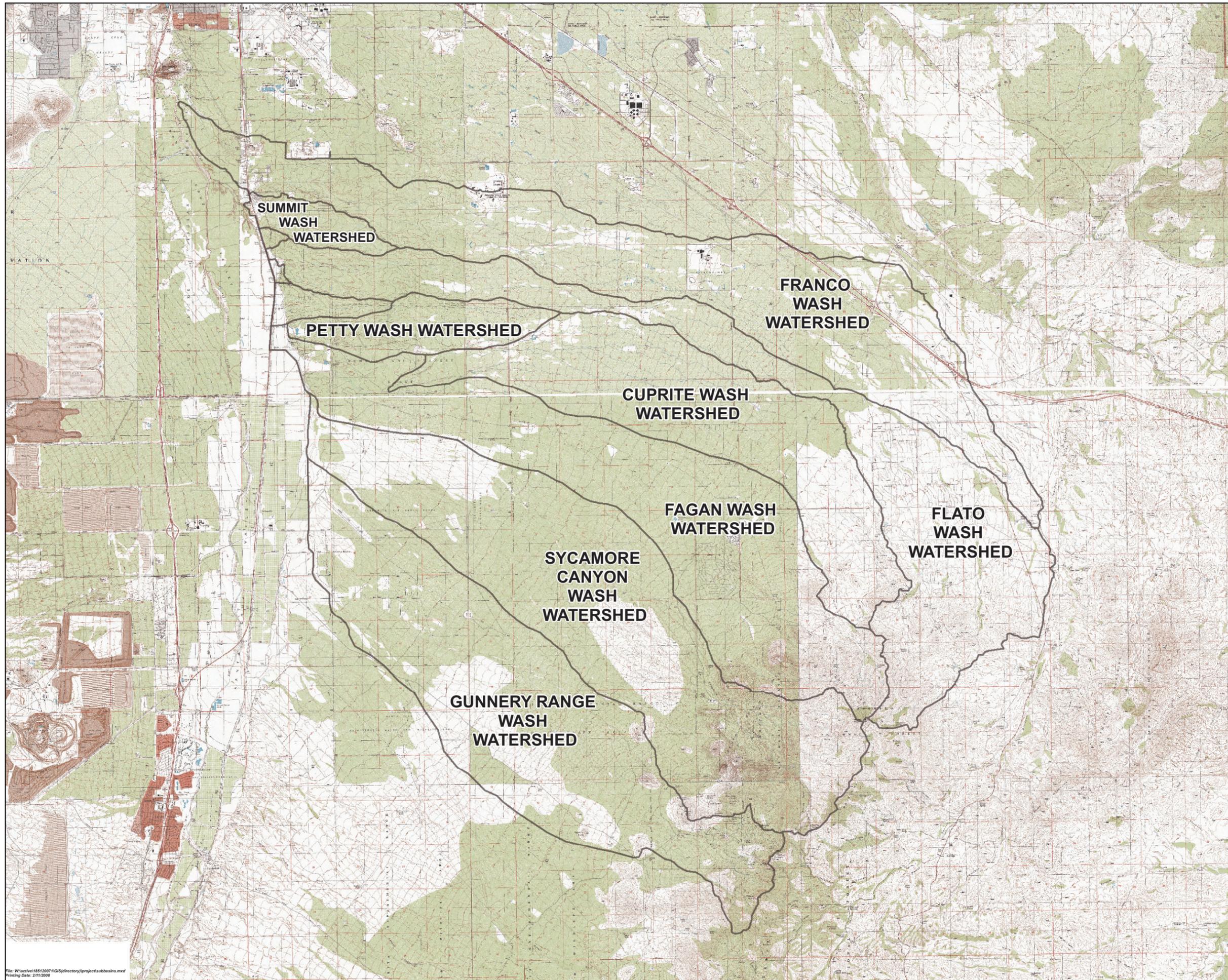
was documented using Pima County Map Guide, data provided by Pima County, as well as culvert and bridge locations identified from field survey not referenced from the previously-noted sources. These data for culvert crossings and bridge locations were summarized, and their locations are displayed on Figure 10. In addition to the existing drainage infrastructure, innumerable locations of existing stock ponds and historic flow diversions were also mapped and identified, and are also displayed on Figure 10. An extensive survey of available existing aerial photography was performed during this task. A complete inventory of these structures may be warranted in the future.

Extensive drainage complaints within the Lee Moore Wash watershed have been recorded over the last 10 years by Pima County. These complaints were provided by Pima County staff, and sorted into three general categories; Flooding, Roadway/Access, and Conveyance/Ponding. These categories were determined as a result of each complaint's primary drainage emphasis. With these efforts, each complaint has been paraphrased with a brief description, and a comprehensive list of the complaints compiled. The locations of each complaint within the Lee Moore watershed are displayed on Figure 11. In general, the complaints attribute flooding in the Lee Moore Wash Watershed to undersized culvert crossings; development occurring within floodplains and setback areas; erosion, dumping and excavating within the banks of washes; poor roadway conditions; flow diversion; and overtopping of the wash channel during storm events.

Recent newspaper articles from 2005-2006 were retrieved from on-line archives of the Arizona Daily Star. The articles reported monsoon rains had caused several flooding incidents within the Lee Moore Wash watershed area, predominantly along Franco Wash and associated areas near Old Nogales Highway and Old Vail Connection. Approximately 32 square miles of upstream watershed area contributes runoff to this location along the Franco and Summit Washes which drain through these developed areas. This area, known as the Summit area, has experienced significant population growth in recent years, with the current population estimated as 4 times the population in 1990. Much of the growth has occurred with 'wildcat' development, which typically requires little regulation relative to permitting along floodprone areas. This circumstance combined with heavy rainfall events in August of both 2005 and 2006 (and continuing in 2007) led to flooding of mobile homes, as well as access problems along private and public roadways. This area is targeted for an individual, more in-depth study than other areas within the Lee Moore study area, and alternative interim mitigation measures will be evaluated in order to determine the feasibility of providing flood relief to these areas as a joint effort between Pima County and existing residents in the area.

# Lee Moore Wash Basin Management Study

Figure 8  
Lee Moore Wash Watersheds



### Legend

- Lee Moore Wash
- Watershed Boundary



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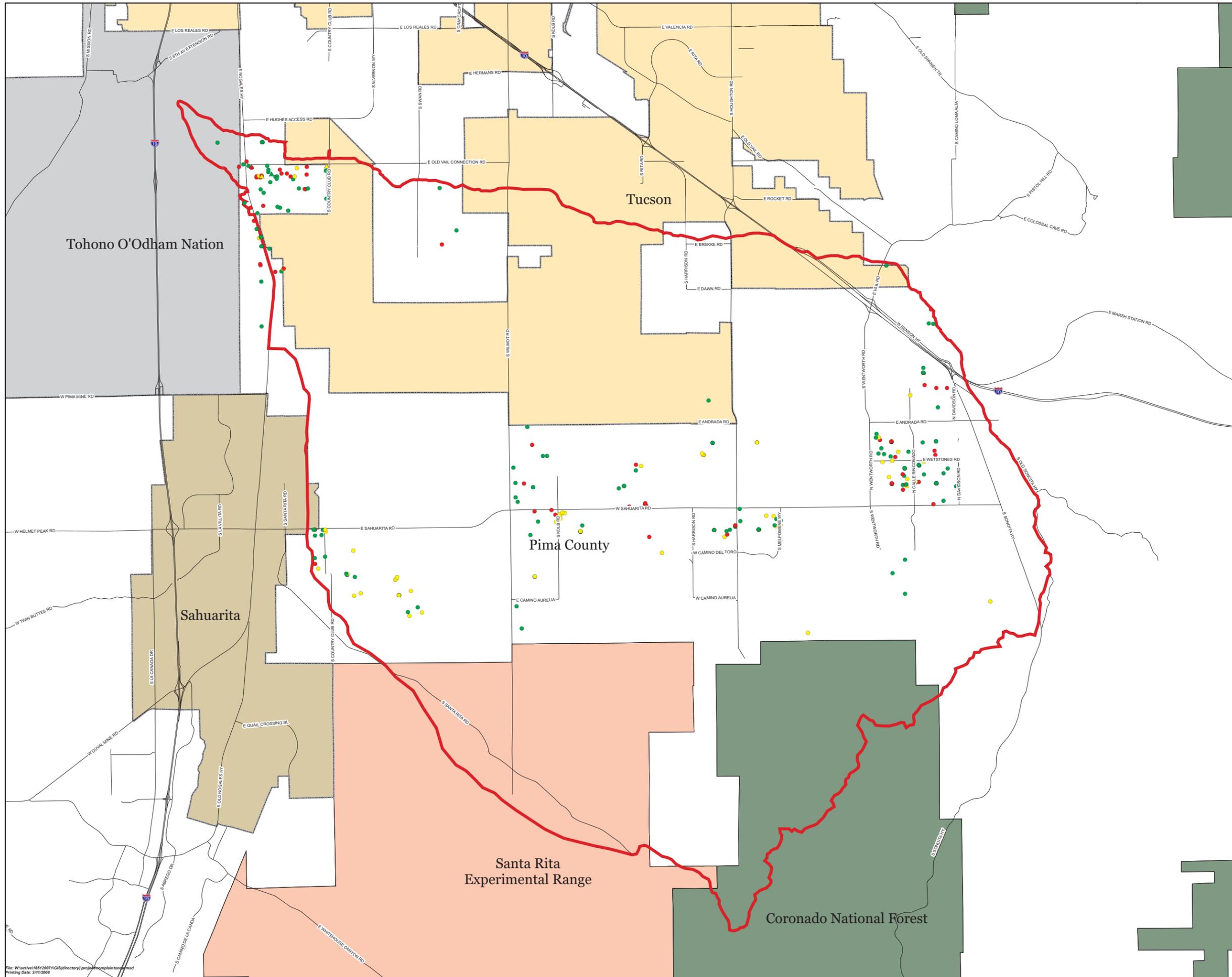
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# Lee Moore Wash Basin Management Study

## Figure 11 Drainage Complaints



- Legend**
- Drainage Complaints From Public Meetings**
- ▲ Flooding
  - ▲ Roadway/Access
  - ▲ Conveyance/Ponding
- Drainage Complaints From Pima County**
- Flooding
  - Roadway/Access
  - Conveyance/Ponding
- Study Area



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## **9.0 Geomorphic Setting**

The Lee Moore Wash watershed is an alluvial basin situated on the western piedmont of the Santa Rita Mountains and east of the Santa Cruz River. The basin is within the Sonoran Desert subprovince of the Basin and Range physiographic province, an area formed by tectonic activity that stretched and extended the crust forming north-south trending normal faults. A period of weathering of the exposed bedrock, subsequent alluvial fan formation and filling of the intermontane basins followed the tectonic activity. Incision of axial streams which began in the late Pliocene still occurs throughout the Tucson basin. The Santa Cruz River has experienced substantial downcutting over a geologic time frame, cutting into its own Quaternary and Tertiary deposits. The lowering of the Santa Cruz River during the Quaternary period caused the subsequent downcutting of tributaries and adjacent piedmonts. Formerly active and aggrading fan surfaces became isolated, and are currently experiencing degradation.

The primary geomorphic issues affecting this basin are distributary flow patterns, headcutting, and local scour and sedimentation issues. The prevalence and severity of these issues vary with position within the watershed, as the fluvial geomorphology, landform, and other issues are different across the study area. Therefore the study area has been divided into four broad geomorphic zones as shown on Figure 12.

The southernmost zone is the Pediment Zone, a sediment production zone which is almost entirely composed of weathered bedrock and/or weathered bedrock covered with a relatively thin alluvium veneer. The hillslopes are typically smooth and rounded. The transition from the Pediment Zone to the Tributary Piedmont Zone is a flat landscape dotted with inselbergs. Drainage within the Pediment Zone is primarily contained within well defined corridors with significant lateral relief. Drainage channel beds are composed of alluvium generated within the upstream hillslopes.

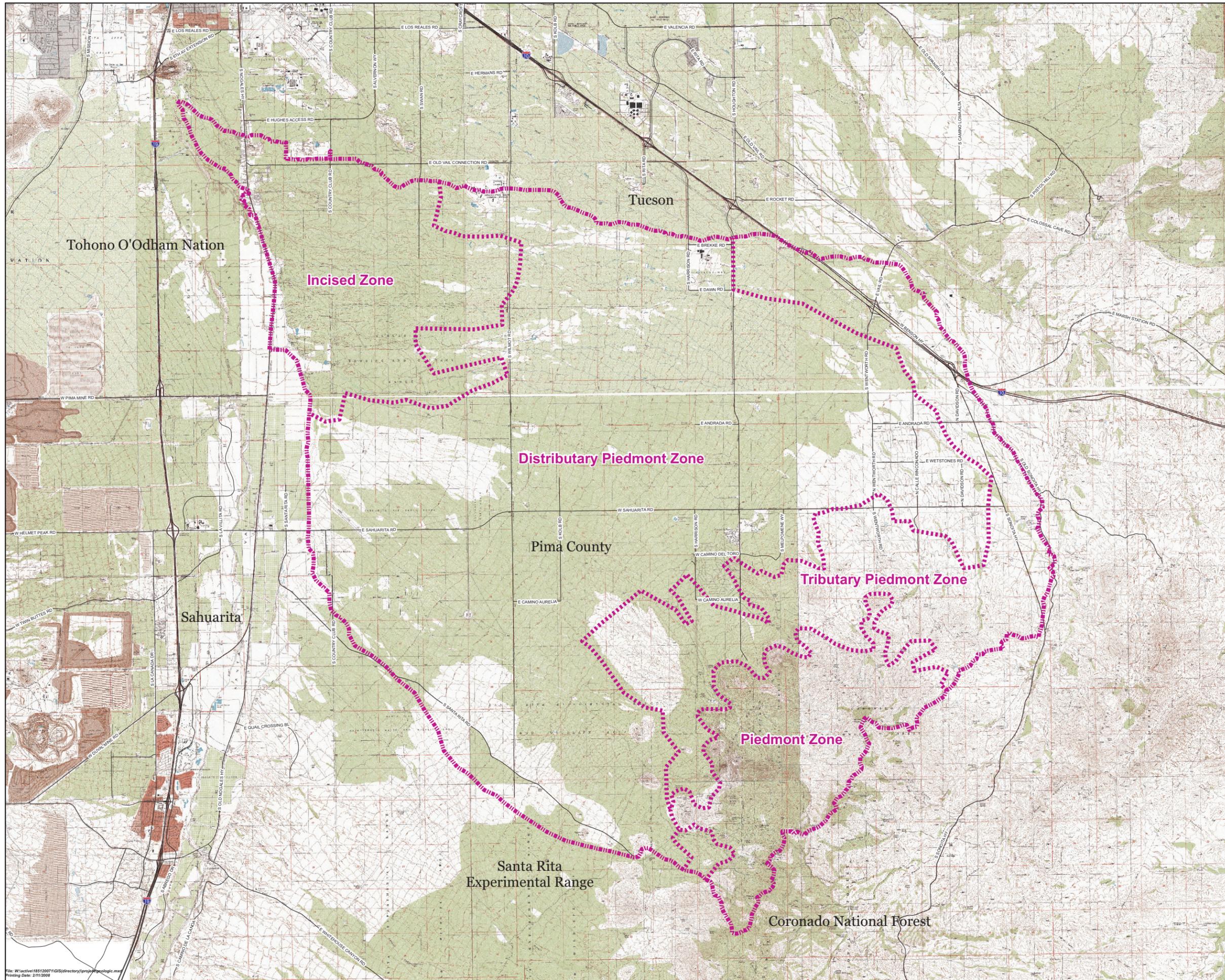
Below the pediment in the upland areas of the piedmont are well defined, tributary flow corridors. These areas make up the Tributary Piedmont Zone which represents a transition from sediment production to sediment transport. This zone contains limited areas of rock outcrops, inselbergs, and knobs. The drainage in this zone is predominantly contained in well defined wash corridors.

The Tributary Piedmont Zone is followed by a vast distributary flow region defined as the Distributary Piedmont Zone. This zone is the largest zone within the study area and is a sediment deposition area with undefined flow paths. Flow is not only contained in large wash corridors, but is also found in smaller swales on the terraces, as well as uncontained flow on the terraces and floodplains.

The distributary flow eventually returns to tributary flow in the northwest end of the basin. This area is defined as the Incised Zone, or sediment transport zone. The washes within this zone have developed into significant flow corridors which are linked to the Santa Cruz River, which has recently downcut due to headcuts which have moved up the reach (and other processes such as subsidence due to ground water pumping). The local drainage has responded with entrenchment and erosion of alluvial fan toes. The headcuts extend a substantial distance into the Distributary Piedmont Zone.

# Lee Moore Wash Basin Management Study

## Figure 12 Existing Geomorphic Zones



### Legend

- Geomorphic Zone Boundary
- Study Area Boundary

Exhibit taken from information provided by  
JE Fuller Hydrology and Geomorphology Inc.



0 1 2 4 Miles



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## **10.0 Hydrogeology**

The Lee Moore Wash study area is located in the southern portion of the Tucson Basin, which is a sub-basin of the Upper Santa Cruz River Basin within the southern Basin and Range physiographic province. The study area is bound by the Santa Rita Mountains in the south and south-east, the Franco Wash to the north and the Santa Cruz River to the west.

The study area lies across a deep sedimentary basin, with depths to bedrock ranging from less than 400 ft below ground surface (bgs) at the base of the Santa Rita Mountains, 3,200 ft bgs at the Santa Cruz River, up to 11,200+ ft bgs in the north-central portion. The upper basin fill material contains the primary aquifer and is comprised of surficial alluvial deposits overlying the Fort Lowell Formation, which in turn overlie the Tinaja Beds. These latter two units overlie the lower basin fill associated with the Pantano Formation.

Surface alluvial deposits constitute the primary material through which water would recharge from a potential stormwater control basin. The estimated permeability of soil association layers in the upper 20 to 30 inches below ground surface range over 2 orders of magnitude from 8.3 ft/day to 0.06 ft/day. Permeabilities range from moderately rapid in the basin floor, floodplain, alluvial fans, and relic fan terrace landforms to moderately slow in fans, terraces, and piedmont plains. That is, there appears to be an inverse relation between the relative elevation of landforms and the permeability of the soil associations.

Present-day stream channels contain the youngest surficial deposits, which were laid down by a north-northwest-flowing stream system; deeper, older stratigraphic units, including the Fort Lowell Formation and the Tinaja beds, were deposited primarily in closed basin environments (i.e. no interbasin through-flow drainage) and, hence, may contain more fine-grained materials. Surficial deposits along streams are 40 to 100 ft thick, and on the average contain approximately 50 ft of coarse material. The older terrace deposits are more compacted and cemented than the younger stream deposits, and are therefore not favorable for groundwater recharge of retained stormwater.

The Fort Lowell deposits consist of 300 to 400 ft of gravel to clayey silt throughout most of the basin, but the thickness thins toward the mountains. The formation grades from a silty gravel near the margin of the basin to a silty sand and clayey sand, with decreasing permeabilities, in the central part of the basin. Based on 2005-2006 well data, the Fort Lowell unit appears to be fully saturated in the eastern portion of the study area, and unsaturated in the upper one-quarter to two-thirds of the unit to the west. Well test data from other parts of the Tucson Basin indicates that Fort Lowell permeabilities range from 150 to at least 700 gpd/ft<sup>2</sup>; water supply wells commonly yield 500 to 1,500 gpm, and specific capacities range from 10 to 100 gpm per ft of drawdown. Although the saturated portion of the Fort Lowell Formation likely will provide no obstacles to natural or

artificial recharge, lower-permeability layering in the overlying unsaturated zone, when laterally extensive, may restrict the downward movement of water and result in perching and lateral spreading.

The Upper Tinaja Beds, which also contain lower-permeability facies, are another major producing aquifer in the Tucson Basin. Parameters related to the water-producing capability of the Upper Tinaja Beds are expected to be slightly less favorable than those presented for the Fort Lowell Formation.

Groundwater flow is toward the northwest, except near the Santa Cruz River where groundwater levels have been elevated by the implementation of the Pima Mine Road Recharge Project (PMRRP ) located just west of the study area. Based on data from 63 wells having water level measurements in both 1995-6 and 2005-6, 3 wells showed no change, 27 wells showed declines between 1 and 25 feet and 33 showed recoveries between 3 and 76 ft (mean recovery of 38 ft) near the PMRRP. Water levels in wells located east of that area range in depth from 42 to 555 ft bgs and have declined an average of 12 feet in the 10-year period.

Regional groundwater levels below riparian habitat corridors identified by Pima County within the study area are well below the maximum depth (10-30 feet bgs) typically used by facultative phreatophytes, such as mesquite, which inhabit these zones. Although the groundwater elevation data in some areas are sparse, these data indicate that the riparian species in these areas are most likely supported by seasonal precipitation stored within the vadose zone (i.e. perched water), and are not connected to the regional aquifer system.