



Pascua Yaqui

Solar Feasibility  
Study

Final Report

November 19 2013

*PREPARED BY:*



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## Introduction

Pascua Yaqui Tribe (PYT) is a federally recognized Native American tribe, with official recognition occurring on September 18, 1978. The Pascua Yaqui Indian Reservation is located in the southwestern part of the Tucson Metropolitan area. The tribe also owns fee land that is close by.

In 2012, PYT was awarded a grant from the Department of Energy Tribal Energy Program to conduct a Renewable Energy Development and Deployment Feasibility Study that would define the technical and economic viability of renewable energy on tribal lands. Red Mountain Energy Partners (RMEP) was hired by PYT to complete the study.

The PYT Scope of Work document provides excellent background information, as described in the following excerpt from their Scope of Work document:

“Pascua Yaqui Tribe is a federally recognized Native American tribe of over 17,000 enrolled members. The reservation, known as “Pascua Pueblo”, is located thirteen (13) miles southwest of downtown Tucson, Arizona. Over four-thousand (4,000) members live on the reservation, as well as several thousand non-member residents that have married Tribal members, with the remaining members residing primarily in established Yaqui communities throughout Arizona. PYT is seeking to provide increased economic opportunities by developing southern Arizona’s under-explored resource: solar energy.”

PYT set the following goals and objectives for the project:

### Goals

1. Provide increased economic opportunities by developing the solar energy resource.
2. Offset the costs of increasing energy consumption and energy demands generated by the operation of existing facilities.
3. Generate revenues via the sale of solar energy into the energy market, thereby adding increased diversity to the tribal income streams.

### Objectives

1. A feasibility study that assesses the energy resource potential and marketability. Decision making tools will be provided for leadership as an aid.
2. Solar development that provides jobs and income to PYT and its members.
3. A cost decrement for tribal energy consumption and reduced reliance on utility energy.
4. Creation of an institutional culture of conservation and sustainability.





## Executive Summary

There is vast potential for the Pascua Yaqui Tribe to participate in the solar industry and work towards energy self-sufficiency, diversifying investments and minimizing impacts on the environment. Through this study, Red Mountain concluded that there are viable opportunities for solar at Tortuga Ranch, the Casino del Sol and a third site near the Justice Center on Camino de Oeste.

Tortuga Ranch consists of thousands of acres of some previously disturbed and undisturbed lands that are within a flood zone. The site is both remote from visibility, relatively flat terrain with a variety of transmission lines available for potential interconnection. Nearby transmission provides access to energy markets in Arizona, California, Nevada and New Mexico. In California, Nevada, New Mexico, and Arizona the preferred project size is typically in the 10-25 MW range because power purchases are currently seeking this size. The market for renewable power today that appears to offer the most opportunity for Tortuga Ranch lies in the federal government; the federal government has various plans for renewables, one of which is for military bases to procure 3 GW by 2025. Recently, there have been multiple requests for proposals to sell power to federal agencies; the project size varies by location.

Another market that offers some opportunity is in California; California set a goal to be 33% renewable by 2020. There is one request for proposal (RFP) for renewable power that is currently out by the Southern California Public Power Authority (SCPPA). This is a competitive RFP that will require a solid proposal. There is currently way more renewable energy projects under development in California than California needs to achieve their goals so there will be many competing projects.

Depending on where the market is for power generated at Tortuga Ranch, the project will most likely be subject to "wheeling" costs. Wheeling costs arise when a power provider (ie. Tortuga Ranch) opts to use one utility's transmission lines to sell power to another utility or entity. Wheeling costs can add up to an additional \$0.010-0.025/kWh to the price for power at Tortuga Ranch. Pascua Yaqui ought to continue to monitor market opportunities for the Tortuga Ranch site.

The Casino Del Sol site looks promising with Trico Electric's net metering program. The financial analysis of the project proved to be viable and would generate desirable returns. The Casino Del Sol's load is monitored by multiple meters. If the Casino proceeds with installing solar at the Casino, meters could be consolidated into one primary meter. If the meters are consolidated, this will put the Casino into a different customer category that will decrease energy costs significantly; we estimate a 50% reduction. Red Mountain recommends consolidating energy meters regardless of whether or not Pascua Yaqui decides to proceed with solar for this will immediately decrease energy costs at the Casino.

Red Mountain assessed multiple locations for a solar project for the Casino; all viable options vary with costs depending on the configuration. Red Mountain assessed:

- (1) Covered parking on the garage
- (2) Covered parking near the amphitheater
- (3) A ground mount installation approximately 3 miles away from the Casino near the Justice Center on Camino de Oeste



Interestingly, the Camino de Oeste site offers an added benefit of being centrally located in the community. It is a 200 acre site, within a flood plain thus making it less desirable for other development. Because it is centrally located in the community, this site merits further exploration as an alternative site for community scale power. The benefit of this location is that there is an obvious customer for power - the Pascua Yaqui community. Pascua Yaqui's current demand for power is approximately **7 MW**.

The future for energy in the United States is moving towards smaller centrally located distributed generation to supply local loads. In addition, the federal government and certain communities are experimenting with "microgrid" technology. Microgrids are emerging communications and controls technologies that manage energy consumption and supply in the most efficient manner. These energy systems decrease costs for power and improve energy security. Microgrid technology may be of interest to Pascua Yaqui in the future if the Camino de Oeste site progresses. The Camino de Oeste site appears to be the best location for Pascua Yaqui to begin developing their energy resources in order to meet the energy demands for the community today and for the future, with the added benefits of lower energy cost and increased energy security.

The Camino de Oeste site offers potential for future expansion for firm energy<sup>1</sup> such as biomass or geothermal to serve the community. Pascua Yaqui has the potential to be energy self-sufficient beginning with developing its solar resource and can eventually firm its energy with other locally available energy resources such as nearby biomass, geothermal and gas. Local studies indicate that there is more than enough biomass available from citrus trimmings to meet the energy demands of the Pascua Yaqui Tribe. The future utility likely will have a resource portfolio that is a hybrid of centralized power plants, distributed generation, microgrids, and demand response programs that result in a more efficient system of both generation and consumption.

Lastly, Western Area Power Administration (WAPA) will begin marketing their relatively "inexpensive" hydro power from the Hoover Dam called the Boulder Canyon Project during a short window early in 2014. This provides an opportunity for Tribes and others to apply for a long term contract for hydro power beginning in 2017. Pascua Yaqui could potentially apply for an allocation up to current loads of 7 MW. The application process is competitive and available for a limited amount of MW, there is no guarantee that Pascua Yaqui will receive an allocation, but it could make an impact on energy rates if Pascua Yaqui received an allocation. Pascua Yaqui would need to make arrangements for the power for example, wheeling power through Trico.

### **Disruption for electrical utilities and cooperatives**

Pascua Yaqui incurs significant electrical bills each month to operate the two casinos and several other energy intensive entities. Electrical rates for businesses and consumers have been fairly stable for many, many years but looming changes, driven primarily by electrical generation technology improvements, are threatening the stability of electrical rates. Significant rate increases could adversely impact the financial wellbeing of the Tribe.

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<sup>1</sup> Firm energy delivers power 24 hours a day as contrasted to solar energy without storage.



A 2013 whitepaper<sup>2</sup> by the Edison Electric Institute (EEI) provides a statement of the issues and potential paths forward for the electrical companies. EEI describes itself as “the association that represents all U.S. investor-owned electric companies.” Tucson Electric Power is an investor owned utility (i.e. they sell shares of stock as well as bonds to investors) as contrasted with Trico, which is an electrical cooperative. While the ownership structures are different, the same issues identified in the whitepaper are relevant for cooperatives.

The heart of the argument made in the paper is that significant technology advances in areas like solar, wind, geothermal, etc. electrical generating technologies are threatening to cause a major impact on the business models of the utilities. The impacts include:

1. Falling costs of distributed generation
2. Enhanced focus on further development of these technologies
3. Increased customer, regulatory, and political interest in demand side management (e.g. energy efficiency programs).
4. Government programs that incent certain technologies
5. Declining price of natural gas
6. Slowing economic trends
7. Rising electrical prices in certain areas of the country

For over half a century, electrical utilities and coops have operated in an environment where the very large investment in electrical generating plants and the transmission/distribution networks required to deliver the electricity could be recovered over a 30 year (sometimes longer) period. That model is now facing potential disruption in no small part due to the factors listed above. Other regulated industries, such as the airlines and telecommunications sectors, have experienced disruptive changes that considerably altered the industries.

For Pascua Yaqui, the immediate concern is the potential impact on electrical bills. The Arizona Corporation Commission (ACC) is actively looking at adjusting some programs that incented the implementation of renewable energy technologies throughout the state. The ACC is seeking ways to keep electrical bills from rising too quickly. However, electrical bills are highly likely to be increased as the challenges identified in the white paper increase. Users, especially high dollar users like PYT, can mitigate the impact via several options:

1. Monitor the situation closely to be aware of impending changes
2. Make changes in usage or management of electricity that will help control costs. Consolidation of the meters at Casino del Sol, as described later in this report, is an example where a fairly low cost change can quickly bring about savings.
3. Continue exploration of distributed generation options. This report includes information showing solar is feasible for Casino del Sol as well as at Tortuga Ranch. The next step for the projects would be to develop the projects and get a project built.
4. Pascua Yaqui may be adversely affected by increased utility bills if no actions are taken.

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<sup>2</sup> “Disruptive Challenges: Financial Implications and Strategic Responses to a Challenging Retail Electric Business”, Peter Kind of Energy Infrastructure Advocates for Edison Electric Institute, January 2013.



## Section 1: Project Background

### Pascua Yaqui

The Pascua Yaqui Tribe (PYT) is a federally recognized Native American Tribe with over 17,000 enrolled members. The reservation, known as “Pascua Pueblo”, is located thirteen (13) miles southwest of downtown Tucson, Arizona. Over four-thousand (4,000) tribal members and several thousand non-member residents live on reservation; remaining members reside primarily in established Yaqui communities throughout Arizona.

Inspired by sovereignty and self-sufficiency, the PYT is seeking to increase economic opportunities by developing a viable energy resource: solar energy. The Pascua Yaqui Strategic Economic Development Plan champions the following vision:

*“The Tribe will achieve economic self-sufficiency and financial prosperity through the diversification of their economy, which includes the pursuit of new business opportunities and partnerships...”*

An economic development goal and recommendation resulting from the Strategic plan endorses the Pascua Yaqui government to “*diversify the economic base and enhance revenue streams*” and to “*leverage assets and capitalize on limited existing resources*”. Locally available solar insolation data indicates that Pascua Yaqui Tribal lands are located within an area of very high solar insolation levels; solar maps indicate outstanding potential for photovoltaic (PV). The average daily solar radiation for PV is within the range of 6 - 6.8 kWh/m<sup>2</sup>/day.

The Pascua Yaqui Tribe is in one of the most active regions in the United States for renewable energy development. Several states in the Southwest (Arizona, Nevada, New Mexico, and California) have state Renewable Portfolio Standards. Currently, the Arizona Corporation Commission (ACC) requires utilities to generate a minimum of 15% of their total retail energy sales from renewable sources by 2025. California has the highest goal in the Country - 33% by 2020.

In 2009, Red Mountain completed a feasibility study for Pascua Yaqui. The following is a summary of key finds from the analysis:

- **Solar Resources:** Solar Radiation for Pascua Yaqui was identified for the 30-year period from 1961 – 1990 for fixed tilt PV at latitude (6.5 kWh/m<sup>2</sup>/day), single-axis tracking PV (8.7 kWh/m<sup>2</sup>/day) and 2-axis concentrating solar collectors (9.0 kWh/m<sup>2</sup>/day)
- **Electric Usage and Costs:** Electric usage and costs were analyzed in total and by category for the period 2002 – 2008, reflecting a 69% increase in usage and a 106% increase in electric costs
- **Solar Technologies:** Six solar technologies were evaluated and compared for possible Pascua Yaqui projects
- **Transmission Access:** Pascua Yaqui sites are roughly 2 miles from the nearest 115 kV/69 kV Trico substation at Valencia, suggesting good potential to move project power to southern Arizona markets (AEPSCO and TEP)
- **Power Market Assessment:** Based on RPS requirements and limits on available transmission capacity to CA, Pascua Yaqui should focus on identifying in-state power/REC purchasers for any solar projects developed; power market potential was



summarized by ranking the top 5 potential utility offtakers for Pascua Yaqui solar power

- Project Site Identification: Eleven possible community-scale and commercial-scale solar project sites were identified and evaluated
- Facility-Scale Solar Projects: Viability of project opportunities for Casino del Sol, Casino of the Sun, the Amphitheatre, Fire Station, Administration and Parking Lot Pole Mounted projects was evaluated, assuming use of Trico incentives
- Community-Scale Solar Projects: Viability of 1, 3, and 5 MW community-scale projects was evaluated, assuming use of Trico incentives
- Commercial-Scale Solar Projects: Viability of 10 and 50 MW commercial-scale solar projects was evaluated utilizing available Federal and State tax incentives
- Numerous solar projects on Pascua Yaqui sites were indicated to be feasible, based on reasonable financing assumptions. In all cases, these projects assumed the inclusion of incentives available from Trico as well as Federal and State tax incentives utilized through partnerships with tax investors.

One of the challenges Pascua Yaqui faced as it considered possible solar project development is limited reservation land. For the following analysis, Pascua Yaqui has selected Tortuga Ranch as a site of interest to evaluate the feasibility of a commercial-scale solar project. Tortuga Ranch is located on 6,289 acres of fee land Northwest of the reservation. Because it is fee land, it was not eligible for inclusion in the previous DOI-funded feasibility study but provides a good potential site for solar project development.

In addition, the Casino del Sol was selected as another potential location for solar. This location was evaluated in the previous feasibility study and was indicated as a preferred location for solar.

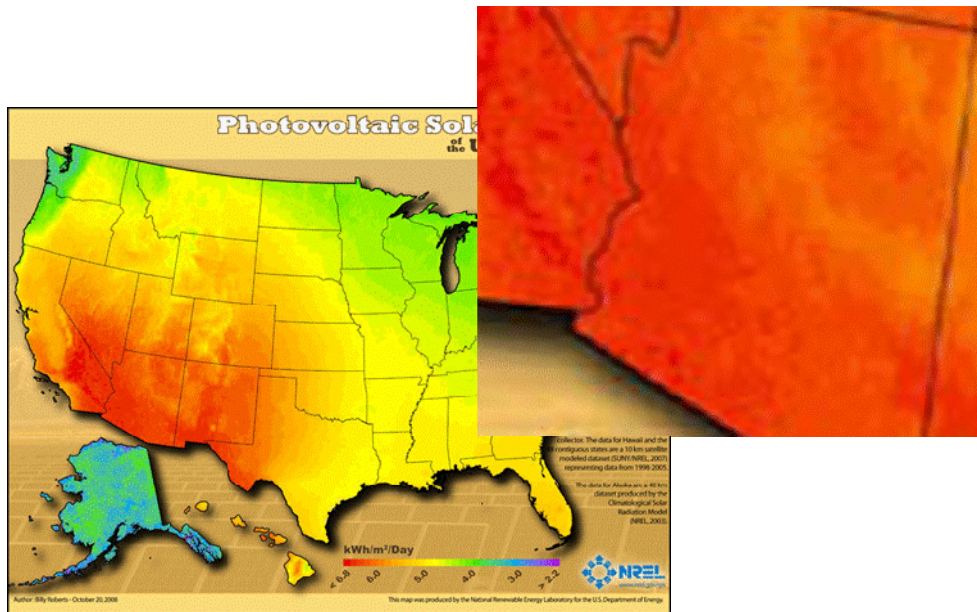




## Section 2: Resource Assessment

Pascua Yaqui is located in one of the best regions in the Country for solar energy; see Figure 1 below. Figure 1 is a map of direct normal radiation values for the United States. The map is based on historical weather data and was created by National Renewable Energy Laboratory (NREL). The entire state of Arizona varies between red and orange representing the highest irradiance values on the map. The map indicates that a solar PV system in Pascua Yaqui could generate up to **6.0 – 6.5 kWh/m<sup>2</sup>/day**; that is the total kWh generated per square meter per day. Actual generation will depend on equipment selection, system orientation, system design and tracking capabilities.

Figure 1: Direct Normal Radiation Resources



### Single Axis Tracking

Figure 2 below provides a comparison of the maximum, average and minimum monthly solar radiation for single axis tracking solar collectors on the Pascua Yaqui reservation for the 30-year period from 1961 - 1990. As the dashed line indicates, the annual average monthly solar radiation is **6.5 kWh/m<sup>2</sup>/day**.

Figure 2: Monthly Average Solar Radiation at Fixed Tilt, kWh/m<sup>2</sup>/day

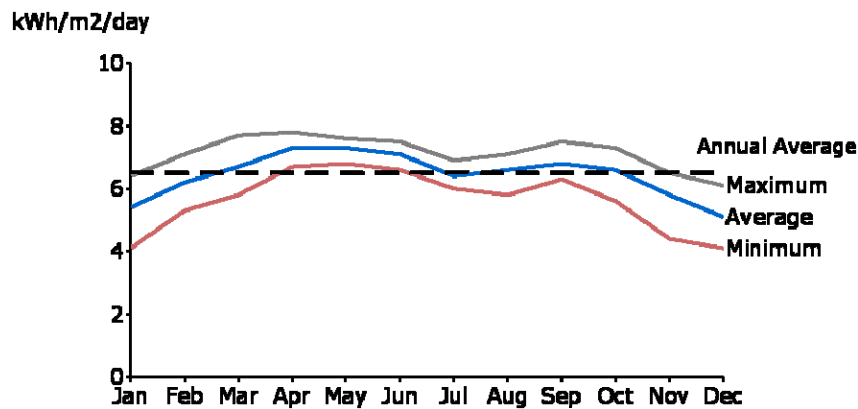
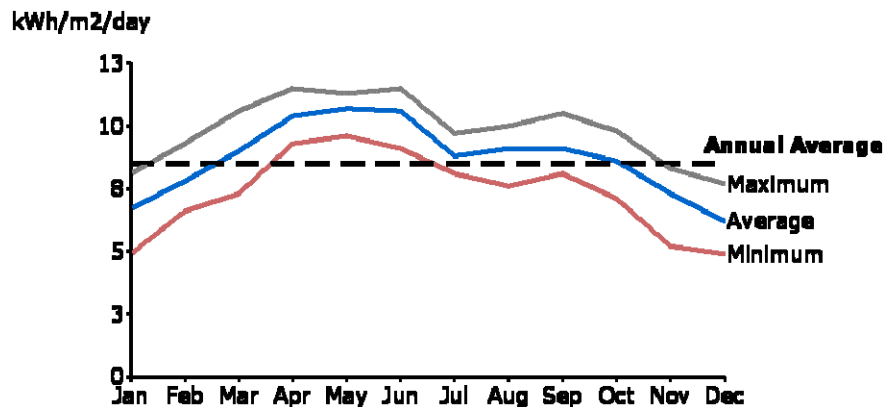


Figure 3 below provides a comparison of the maximum, average and minimum irradiation for single-axis tracking solar collectors on the Pascua Yaqui reservation for the 30-year period from 1961 – 1990. As the dashed line indicates, the annual average monthly solar radiation is 8.7 kWh/m<sup>2</sup>/day.

Figure 3: Monthly Solar Radiation for Single-Axis Tracking, kWh/m<sup>2</sup>/day



As the maps and graphs above indicate, solar resources for either PV or concentrating equipment are very good at potential Pascua Yaqui sites, and as indicated previously, provide Pascua Yaqui a wide variety of options for development of possible solar projects. While concentrating solar resources are indicated to be good, that does not necessarily mean that concentrating solar equipment would be preferred. PV equipment can often produce more power, even at lower irradiation levels, since power can be produced with PV equipment during times of diffused light, which is not the case for concentrating solar equipment.

The information on renewable energy resources is continuing to be refined. More sophisticated GIS mapped data is available on the National Renewable Energy Laboratory website. The specific resource data can be integrated into the Pascua Yaqui Tribe GIS maps.

## Section 3: Tortuga Ranch - Siting Analysis

### Location & Site Access

The Tortuga Ranch site is located 18 miles southwest of Tucson near Tucson's Groundwater Recharge Station; see Figure 4 below. West of site is the Ironwood National Forest where there are known petroglyphs. Further West is the T'Ohonom Odom Reservation. Ryan Air Field is approximately 5 ½ miles east of Tortuga. Highway 86 is 2 miles due south and Palm Valley Airport 7.5 miles north. The Tortuga Ranch site is composed of 11 parcels totaling 6,288 acres; see Table 1 below.

**Table 1 - Tortuga Ranch Parcels**

| <b>Parcel Number</b> | <b>Acres</b> |
|----------------------|--------------|
| 208490050            | 2,263.8      |
| 211350190            | 1,722        |
| 21135018C            | 359          |
| 209070010            | 319.18       |
| 208530010            | 160          |
| 208530020            | 481.22       |
| 208530030            | 80.6         |
| 209070020            | 22.62        |
| 20853008A            | 240          |
| 208530090            | 320          |
| 20853010A            | 320          |

### Site Access

Access to the site is available from the east via West Donaldson Ranch Rd. West Donaldson Ranch Rd. is a dirt road that runs east to west through the center of the Project site and turns northwest and becomes S. Avra Rd. On google earth, West Parker Rd. appears on the east side of the Project site and further south, however, it dead ends before it actually reaches the Project site. W. Garcia Ranch Rd. runs north-south on the western side of the property.

### Electric Grid Proximity

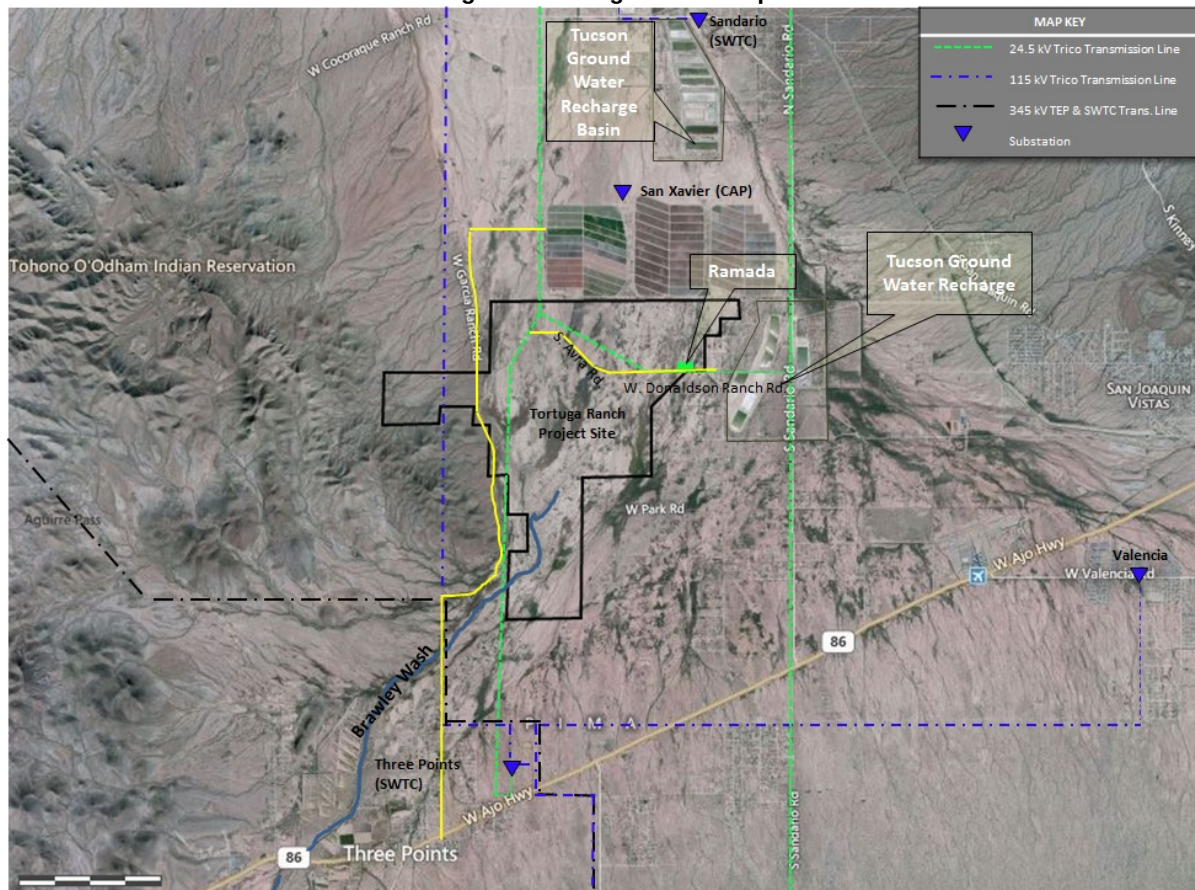
There are multiple transmission and distribution lines adjacent to and that cross the Tortuga Ranch site:

- 24.5 kV Trico Electric Distribution Lines – a distribution line runs North-South and East-West through Tortuga. In addition, there is another distribution line approximately 0.5 miles East of the Project site.
- 115 kV Southwest Transmission Cooperative Transmission Line- this line runs North-South on the west side of Tortuga.
- 115 kV Western Area Power Administration Substation – this substation is 0.5 miles north of the Project site.
- 345 kV Tucson Electric Power Transmission Line





**Figure 4: Tortuga Ranch Map**



### **Land Ownership**

Lands east of Tortuga Ranch are owned by the City of Tucson where Tucson's groundwater recharge basin is located, in addition there are private landowners with some scattered residential; see Figure 5 below. South and west of the site are state lands and north and west of the site are federal lands. Pascua Yaqui manage some of the adjacent state land property.

### **Tortuga Ranch Topography**

The majority of the Tortuga Ranch site is relatively flat with slopes in the 5% range; see Figures 6-7. Further west, the terrain becomes more mountainous with slopes in the 20% range. Figure 7 is a topographic map of the western most part of the property. Western Tortuga Ranch should be avoided for solar.

Figure 5 - Tortuga Ranch Adjacent Landowners

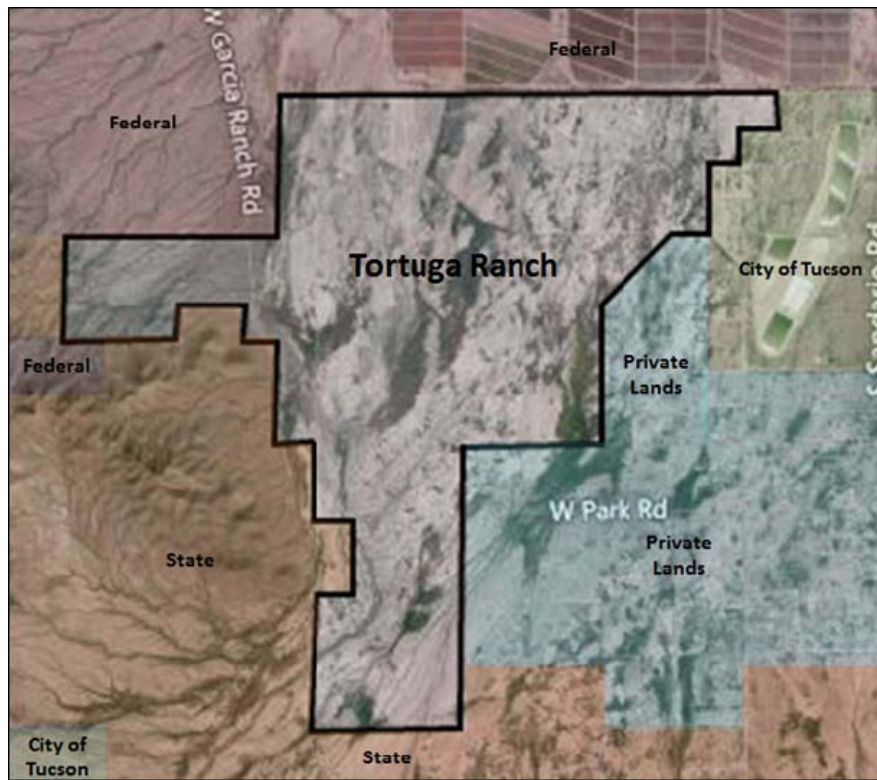
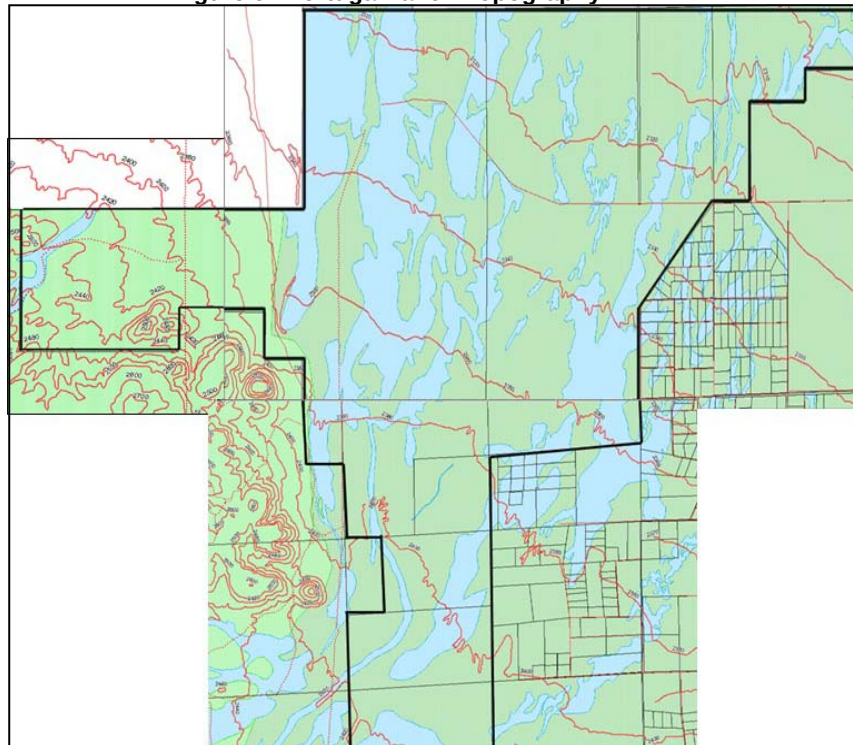
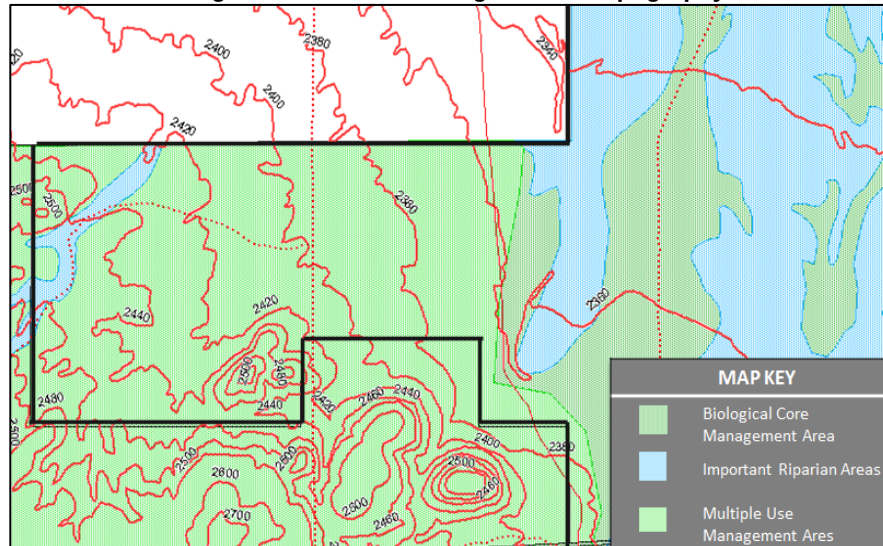


Figure 6 - Tortuga Ranch Topography





**Figure 7 – Western Tortuga Ranch Topography**



### **Permitting**

The Tortuga Ranch fee lands consists of multiple parcels all zoned “RH”, Rural Homestead totaling 6,288.4 Acres; most of which is considered agriculture lands. None of the parcels will require rezoning for a solar power plant facility. The entitlement process for a solar facility will depend on the customer for power. Pima County has a policy for solar projects that exempts projects from their conditional use permit (CUP) process and their Development Plan process (DP) if the power generated by the plant is for internal use and sold directly to Pascua Yaqui. The project will bypass the CUP and the DP processes and will proceed directly to the building permit process.

If the power is sold to a utility, Pascua Yaqui can opt to conduct the CUP and the DP processes concurrently. One package can be submitted for both the CUP Process and the Development Plan Process.

### *Conditional Use Process*

The conditional use process requires submitting a CUP application, a preliminary development plan and an application fee of \$1,600; see Appendix 1 for the CUP application. The CUP process will consist of two public hearings and can take up to 4 months to complete the process. The Project site is zoned “RH” which calls for a “Type 2” CUP and will require a biological impact report.

Some conditions to anticipate during the CUP process are with regards to parking, paving, landscaping, storm water management, flood control, cultural, transportation and fire. The county typically requires a buffer around the project and may require a buffer wall and or planting. Minimal paved parking spaces will also be required.

### *Development Plan Process*

The Development Plan Process requires a development plan to be submitted to the Subdivision and Development Review Committee (SDRC) who will assess the flood plain, archeology, native plant preservation, transportation, cultural, and environmental impacts. Prior to a formal submittal, Pascua Yaqui may meet with the SDRC for a presubmittal

meeting. The purpose of this meeting would be to obtain information to prepare a more complete submittal and as general guidance in plan preparation. See Appendix 2 for SDRC Project App for Development Plan and Appendix 3 for the Solar Farm Fees.

Pascua Yaqui will then submit the development plan; the review agencies will review the development plan and post comments to the internet at [www.pimaxpress.com](http://www.pimaxpress.com). Pascua Yaqui may meet with the SDRC to discuss the review comments, if necessary. The development plan shall be revised to comply with the comments received and resubmitted. The Development Plan Process takes approximately 21 days for the Planning Department to review applications. The project will receive comments back on the development plan and may require revisions to be resubmitted through the 21 day review period. The County recommends using local engineers that are familiar with County requirements in order to minimize the likelihood of the plan getting denied. See Table 2 below that describes the Development Plan process followed by the building permit process in further detail.

When all requirements of the SDRC have been satisfied, the Subdivision Coordination Office will forward an approval letter for the development plan. Within 30 days from receipt of the approval letter, the developer must submit the development plan and landscape/native plant to the Subdivision Coordination Office. The development plan will be approved for one year from the date of the signature on the bond copy. Once the development plan is approved, any subsequent revisions to the plan will be considered a new development plan. See Appendix 4 for the Development Plan Checklist and Appendix 5 for more details on the Development Plan Process.



**Table 2 - Site Development Plan and Permitting Guidelines**

|                                                   | Permit/<br>Authorization                       | Issuing<br>Agency                                    | Estimated<br>Timeline  | Notes                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------------------------------------------|------------------------------------------------|------------------------------------------------------|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Step 1<br/>Site Development<br/>Plan (SDP)</b> | Zoning Approval                                | Pima County<br>Development<br>Services               | 2 weeks to<br>4 months | Type 2 conditional use in rural zones (IR, RH, GR-1, SR, SR-2, SH); permitted use in CB-2, CI-1, CI-2 and CI-3. See "Site Development Plan" at the web site <a href="http://www.pimaxpress.com/SubDivision">www.pimaxpress.com/SubDivision</a> for additional information. The following agency reviews are included in the integrated SDP process: Flood Plain, Archaeology, NPPP, and Transportation. |
|                                                   | Type II Grading Permit (Improvement Plan)      |                                                      |                        |                                                                                                                                                                                                                                                                                                                                                                                                         |
|                                                   | Right-of-way Permit                            |                                                      |                        |                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Step 2<br/>Building Permitting</b>             | Building Permit                                | Pima County<br>Development<br>Services               | <1 month               | Plans by a registered architect or engineer with: Structural - Foundation design, towers, structures; Electrical - single line and three line with grounding, conductor and conduit sizing                                                                                                                                                                                                              |
|                                                   | Flood Plain use Permit                         | PC Regional<br>Flood Control<br>District             | <1 month               | If site is located in regulatory floodplain, erosion hazard area, and/or regulated riparian habitat (determined in the SDP in Step 1).                                                                                                                                                                                                                                                                  |
| <b>Step 3<br/>Construction Permits</b>            | AZPDES Storm Water Construction General Permit | Arizona<br>Department of<br>Environmental<br>Quality | <1 month               | Coverage obtained through ADEQ Smart NOI process. SWPPP must be developed and implemented before construction begins <a href="https://az.gov/app/noi/(S(zg5ahvrpb35uo45fkblo02s))/Default.aspx">https://az.gov/app/noi/(S(zg5ahvrpb35uo45fkblo02s))/Default.aspx</a>                                                                                                                                    |
|                                                   | Activity Permit                                | Pima County<br>Department of<br>Air Quality          | < 1 month              | Address dust control during construction. See <a href="http://www.deq.pima.gov/air/FugitiveDustProgram.htm">http://www.deq.pima.gov/air/FugitiveDustProgram.htm</a> for requirements and Fee Schedule                                                                                                                                                                                                   |

### *Grading Plans*

Grading plans may not be submitted until all first submittal comments on the development plan have been received. An archeological clearance letter from Pima County Cultural Resources and an approved native plant preservation plan (NPPP) are also required prior to the issuance of a grading permit. A Type 2 Grading Permit is required for development which requires a development plan; see Appendix 6 for more details on the grading permit.

### *Fugitive Dust Permit*

A fugitive dust permit is required if greater than 1 acre of surface is stripped, if greater than 300 ft. of trench is cut or if blasting is conducted. Fugitive dust permits may be obtained from Pima County Department of Environmental Quality. Stormwater Construction General Permits may be required in accordance with Arizona Administrative Code R18-9-C901 and ADEQ's AZPDES Construction General Permit.

At any time during the review of the development plan, the building plans may be submitted to Building Codes Division, however, the development plan and the grading plan must be approved prior to obtaining a building permit. The permit application will be reviewed to ensure it is in compliance with all zoning, NPPO, grading, HDZ and building requirements. Note that certain building permits may require associated approvals from other County agencies such as: Regional Wastewater Reclamation Department, Regional Flood Control District and Department of Environmental Quality. Building permits must be obtained and



substantial construction must be completed within one year or the development plan will expire.

*Fees*

Conditional Use Permit Fee.....\$1,600

Building Permit Fees (Moderate or major electrical)

- Minimum fee for all permits requiring an inspection..... \$77
- Office building: .01864 for the first 1,000 sq. ft.; 0.01003 if greater than 1,000 sq. ft.
- Walls/fences (per lineal ft.)..... \$0.30
- Minor electrical work (service upgrade, electrical reconnect, residential PV)..... \$32
- Major electrical work (re-wiring of commercial/industrial facility)..... \$1,466

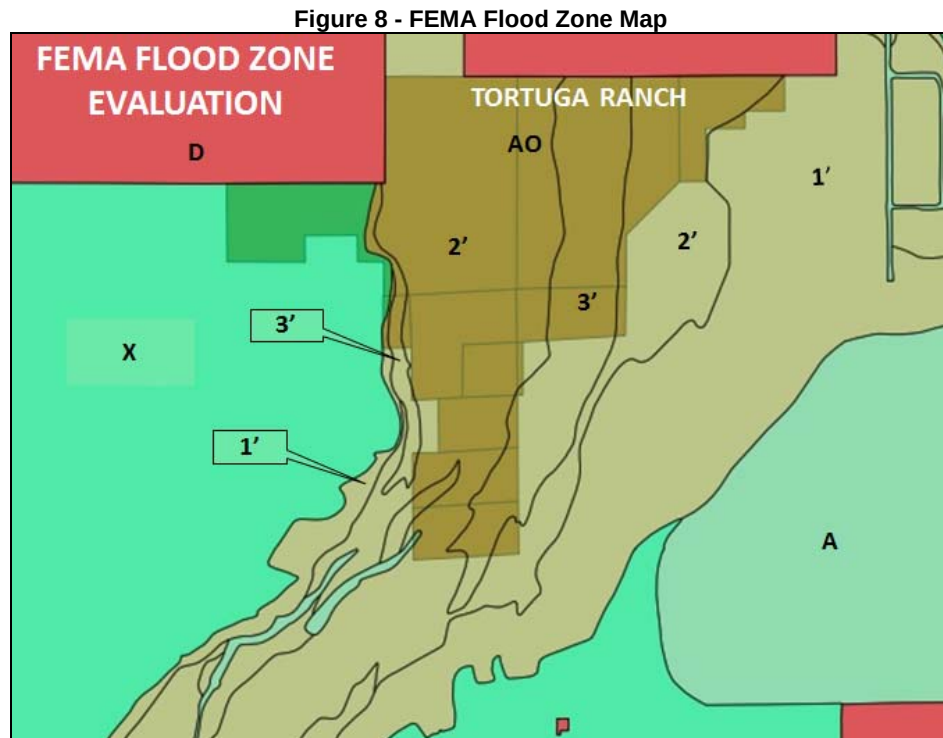


## Section 4: Environmental Assessment

### Flood Plain

Flood hazard areas identified on the Flood Insurance Rate Map are identified as a Special Flood Hazard Area (SFHA). SFHA are defined as the area that will be inundated by the flood event having a 1% chance of being equaled or exceeded in any given year. The 1% annual chance flood is also referred to as the base flood or 100-year flood. SFHAs are labeled as Zone A, Zone AO, Zone AH, Zones A1-A30, Zone AE, Zone A99, Zone AR, Zone AR/AE, Zone AR/AO, Zone AR/A1-A30, Zone AR/A, Zone V, Zone VE, and Zones V1-V30. Moderate flood hazard areas, labeled Zone B or Zone X (shaded) are also shown on the FIRM, and are the areas between the limits of the base flood and the 0.2 % -annual-chance (or 500-year) flood. The areas of minimal flood hazard, which are the areas outside the SFHA and higher than the elevation of the 0.2 % -annual-chance flood, are labeled Zone C or Zone X.

The entire Tortuga Ranch site is located within a 100-year flood zone. Figure 8 below illustrates the various flood zones across the Tortuga Ranch Project Site. The majority of the project site is within the flood zone AO while the most westerly part of the site is in flood zone X. Zone AO are areas subject to inundation by 1%-annual-chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between one and three feet. From east to west within the AO zone, the base flood depths vary from 1 ft. then increase up to 3 ft. and then decrease to 2 ft. The project will need to elevate the installation 3-5 ft. if it is in zone AO2 or AO3.





## **Riparian Habitat**

Riparian Habitat is the community of plants found along watercourses or washes. Riparian habitat can range from a narrow band of grasses and shrubs along an ephemeral desert wash to a closed canopy of large mature trees along a perennial stream. Riparian habitat differs from adjacent upland areas by having different soil types, higher soil moisture, larger plant size and quantity, and/or more diverse plant species. Riparian areas are of particular importance to wildlife, providing food, nesting habitat, cover, and migration or movement corridors. Riparian vegetation slows flood flows, provides erosion protection for river banks, improves water quality, and provides numerous economic benefits, recreational opportunities, and aesthetic values.

### *Conservation Land System*

The Conservation Lands System (CLS) Regional Plan Policy was adopted as part of the Environmental Element of the Pima County Comprehensive Plan 2001 Plan Update in December 2001. The CLS categorizes identifies locations of priority biological resources within Pima County, and provides policy guidelines for the conservation of these resources. The Conservation Lands System (CLS) is designed to protect biodiversity and provide land use guidelines consistent with the conservation goal of the Sonoran Desert Conservation Plan (SDCP). The overarching purpose of the SDCP is to ensure the long-term survival of the full spectrum of plants and animals that are indigenous to Pima County.

CLS category designations and Conservation Guidelines policies apply to land uses and activities under the jurisdiction of Pima County and Pima County Flood Control District. These policies apply to Type II and Type III conditional use permit requests.

See Figure 9 below for the Tortuga Ranch map of CLS categories. The majority of Tortuga Ranch is within the dark green area, designated as Biological Core Management Area. In addition, there is a significant amount of Important Riparian Area and minimal Multiple Use Management Area.

The conservation guidelines for the identified categories are as follows:

- 95% set aside – blue “Important Riparian Areas”; at least 95% of the total acreage of lands within this designation shall be conserved in a natural or undisturbed condition. Important Riparian Areas occur along the major river systems and washes that provide critical watershed and water resource management functions as well as providing a framework for landscape linkages and biological corridors. IRAs include: Hydroriparian, Mesoriparian, and Xeroriparian habitat, as well as those areas that provide connectivity between the Hydroriparian, Mesoriparian, and Xeroriparian habitat.
- 80% set aside – dark green “Biological Core Management Areas”; at least 80% of the total acreage of lands within this designation shall be conserved in a natural or undisturbed condition.
- 66% set aside – light green “Multiple Use Management Areas” at least 80% of the total acreage of lands within this designation shall be conserved in a natural or undisturbed condition.

While any disturbance to RRH requires District review and approval, a Riparian Habitat Mitigation Plan (RHMP) is required when greater than 1/3 acre of RRH (14,520 square feet)



is disturbed. The Ordinance requires that replacement habitat (mitigation area) be of similar or equal value. The Riparian Habitat Mitigation Guidelines can also be viewed at: <http://rfcd.pima.gov/rules/index.cfm>.

The mitigation ratio for disturbance of IRA is one and one-half to one (1.5:1.0).<sup>3</sup> For example, if a property owner will be disturbing 1.0 acre (in size) of Class H habitat, the mitigation requirement would be the equivalent number of plants required for disturbance of 1.5 acres. The amounts are calculated as follows:

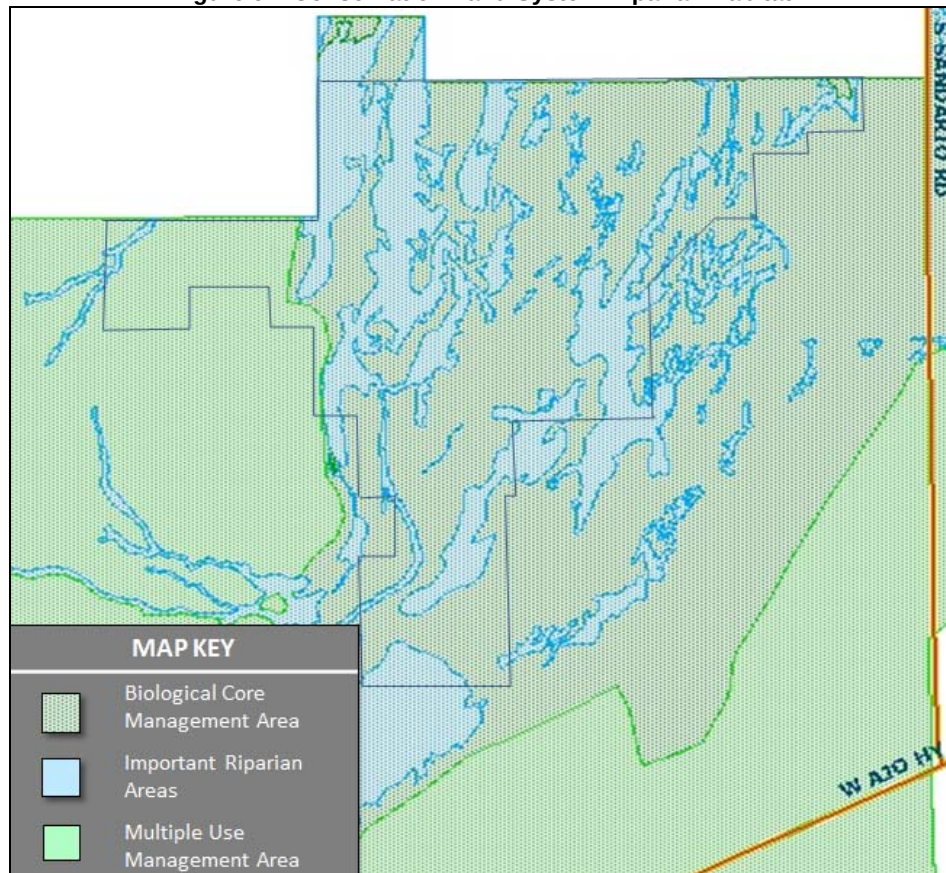
1.0 ac x 90 trees/ac x 1.5 mitigation ratio = 135 trees

1.0 ac x 100 shrubs/ac x 1.5 mitigation ratio = 150 shrubs

All remaining mitigation requirements for disturbance of IRA are determined by the underlying riparian classification. The Tortuga Ranch IRAs are considered to be Class H.

In addition to Important Riparian Areas (IRA) throughout the site, The Brawley Wash Corridor traverses the majority of the Tortuga Ranch; see Figures 10 and 11 below. The Tortuga Ranch site consists of washes greater than 10,000 cubic feet per second (cfs).

**Figure 9 – Conservation Land System Riparian Habitat**



<sup>3</sup> Regulated Riparian Habitat Mitigation Standards and Implementation Guidelines, Pima County Regional Flood Control District, Nov. 2011. <http://rfcd.pima.gov/rules/index.cfm>



Figure 10 - Brawley Wash Corridor

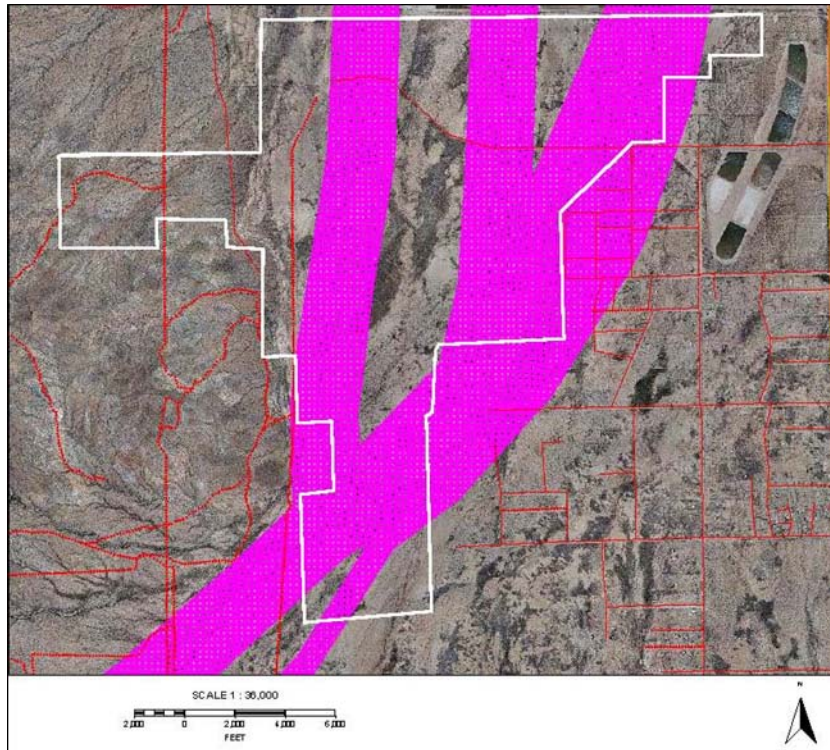
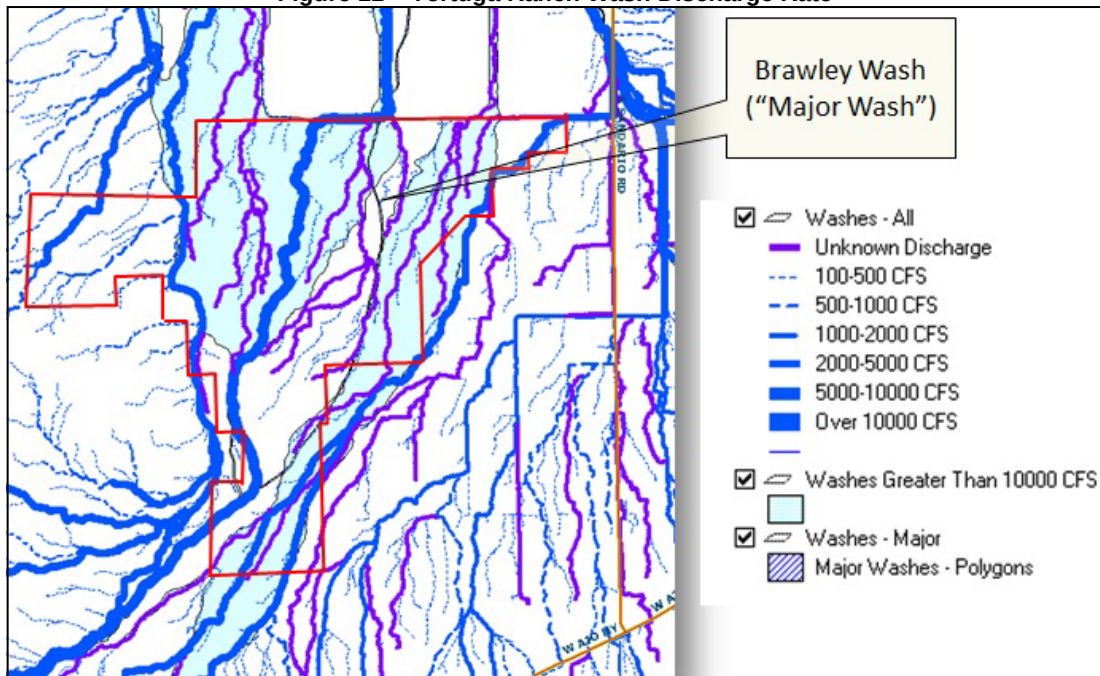


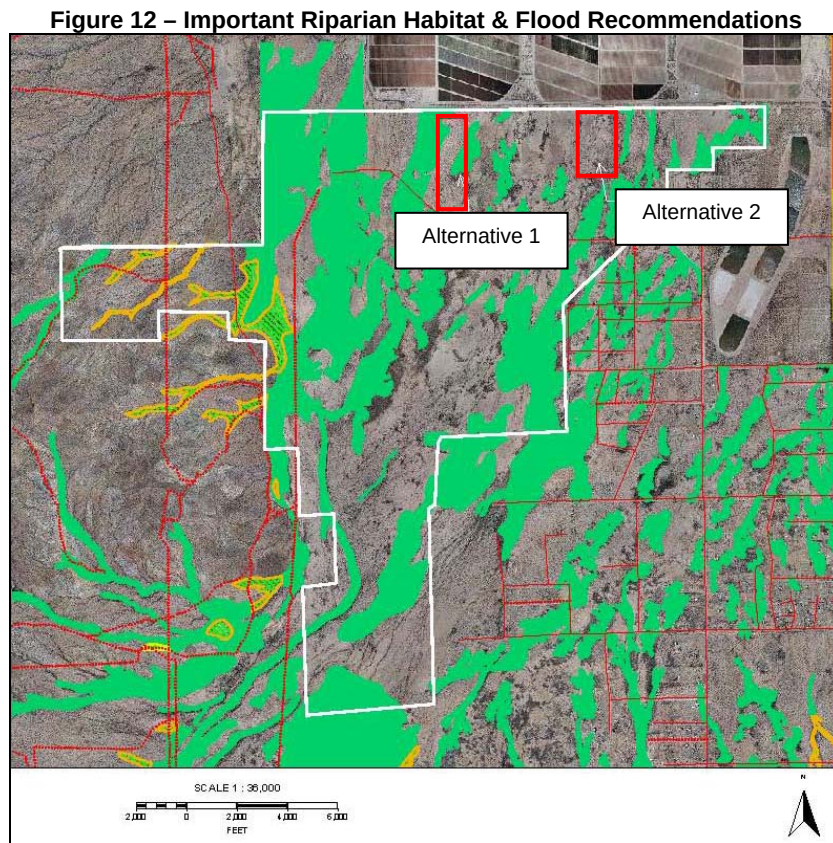
Figure 11 – Tortuga Ranch Wash Discharge Rate



The Pima County Regional Flood Control District (RFCD) analyzed the Tortuga Ranch site and made recommendations on preferred locations for a 20 MW solar photovoltaic project. In figure 12, RFCD outlined 2 preferred sites in red that avoid the

Brawley Wash and FEMA AO3 zone, the most hazardous flood zones on the property. Alternative Site 1, as shown, will reduce the amount of disturbance within the mapped IRA and Alternative Site 2 will completely avoid IRA.

Since Tortuga Ranch is 6,288 acres and a 20 MW project would encompass approximately 150 acres, the project would meet all of the set aside requirements described above. While any disturbance to RRH requires District review and approval, a Riparian Habitat Mitigation Plan (RHMP) is required when greater than 1/3 acre of RRH (14,520 square feet) is disturbed. This would be the case for Alternative 1 in Figure 12 below. The Ordinance requires that replacement habitat (mitigation area) be of similar or equal value to removed habitat within 5 years of installation.



Red Mountain conducted multiple site visits to Tortuga Ranch; see Figures 13-15 below and Table 3 for a summary of observations.



**Table 3: Tortuga Ranch Site Visit Observations**

| <b>Issue</b>          | <b>Tortuga Ranch Site</b>                                           |
|-----------------------|---------------------------------------------------------------------|
| Wildlife Habitat      | None Observed                                                       |
| Fish/Wildlife Species | None Observed                                                       |
| Land Use              | Small area of abandoned farm with fencing & small dilapidated house |
| Visual Resources      | Non-issue, project site is remote from public view                  |
| Hazardous Waste       | None reported or observed                                           |
| Traffic               | No significant impacts expected                                     |
| Site Access           | Sufficient for construction                                         |
| Health/Human Safety   | None expected                                                       |
| Cultural Resources    | No known cultural resources                                         |

**Figure 13: Tortuga Ranch Site Access Road**



**Figure 14: Tortuga Ranch Project Site Facing North**





**Figure 15: Tortuga Ranch Project Site Facing South**



## **Soils**

An excellent analysis of the soils at Tortuga Ranch is referenced as part of a Rapid Watershed Assessment of the Brawley Wash prepared by USDA Natural Resource Conservation Service and the University of Arizona. The document is included in the Appendix. Within the document, the section on soils points toward detailed soils information available from the Natural Resource Conservation Service. This online information allows for a custom report generation of a specific area. This was done and is attached in the Appendices.

At a higher level, the RWA describes several Common Resource Areas (CRA) for Brawley Wash. The specific CRA containing Tortuga Ranch is Upper Sonoran Desert. The dominant soils orders are Aridisols and Entisols. Another name for



Aridsols is Desert Soils, which would be expected for this area. Entisols may be loosely described as topsoils.

Solar systems have been installed with a variety of methods used to support the solar modules, including concrete ballasted footings, driven piles, screw type earth auger, concrete piers, and ballast material on holding trays that are part of the structure. This variety allows installation adaptable to many different soil conditions.

## **Geology**

A good summary of the area is described in the NCRS Rapid Watershed Assessment. "The Brawley Wash-Los Robles Wash Watershed is located within Arizona's Basin and Range Province. The Basin and Range Province of southern and western Arizona is an area where the Earth's crust has been stretched and broken by numerous faults so that mountain ranges and basins (broad valleys) have formed by the vertical motion of large crustal blocks. The Basin and Range Province was formed from 28 to 12 million years ago as the Baja California portion of the Earth's tectonic Pacific Oceanic plate began diverging from the continental plate, stretching the continental plate and forming the equivalent of stretch marks in the earth's crust, nearly parallel to the strike (direction) of the plate boundary. As the earth's crust is stretched, blocks of crust break and drop in a pattern of valley basins and high peak ranges, and is known as the Basin and Range Province within Arizona and other regions of Mexico and the western United States.

The watershed is bounded on the west by the Baboquivari Mountains, a range of block-faulted mountains that are crosscut by northwest-striking faults and shear zones that are part of a regional structural pattern. The Baboquivari, and the closely related Quinlan Mountains to the north, are composed of Jurassic, Cretaceous, and Tertiary granite interspersed with small amounts of schist and sedimentary rocks (Goodwin, 1985). Volcanic remnants of a large caldera, the Tucson, Sierrita, and Tumacacori Mountains delineate the eastern limit of the watershed, and to the south the Mountains form a barrier that acts as the watershed's southeastern limit. The Sierritas, which combine Paleozoic and Mesozoic sedimentary rocks with Cretaceous-aged volcanic rocks, are a valuable source of copper in the region; several open-pit mines on the east side of the range mine the large deposits of porphyry copper found there (Chronic, 1983)."<sup>4</sup>

## **Archeology**

The Santa Cruz Valley, which includes the Tortuga Ranch area, has been long known as an area where a number of different groups resided or traversed, going back as far as 4000 years. The people who lived in the area were farmers and canal builders who left behind artifacts. Tortuga Ranch is located in Brawley Wash, a part of the Santa Cruz Valley. The wash has indications of archeological sites throughout and it is very likely that the Tortuga Ranch property has some sites. A solar development in this area should have an early assessment by Pascua Yaqui Tribe cultural officers to ascertain specific sites that must be avoided or addressed through a mediation plan.

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<sup>4</sup> Brawley Wash - Los Robles Wash Watershed – Arizona, (Altamira Wash - Brawley Wash Watershed) Rapid Watershed Assessment.



The Appendix includes five documents providing more detail and context about the archeological conditions in the area. These include:

- “The Hohokam”, a short item on the Desert Museum website. The article describes a group residing in the area about 600 years ago.
- “Marana History” is published by the city of Marana. The timeline starts around 2200 BCE and concludes in the present.
- A item from Pima County describing the purchase of the Northern Altar Valley Reserve, which is just north of Tortuga Ranch
- A draft Appendix from an Environmental Impact Statement by the Central Arizona Project. The Appendix is for Tohono O’Odham Nation, with archeological observations in section IV.D.2.
- A June, 2013 Pima County document about planning a new Interstate 11 that would connect I-19 to I-10 northwest of Tucson. The Tortuga Ranch property is referred to as the Garcia Strip of the Tohono O’Odham Nation. Specific identification of cultural resource impacts is included.

## **Drainage**

Drainage in the Brawley Wash is described as “axial portions of valleys occupied by unentrenched drainages with very broad floodplains. Along the upper portion of Brawley Wash, where the channel is entrenched and well-defined, flood hazards consist mainly of lateral erosion of unprotected channel banks. Farther downstream along Brawley Wash, channel capacity diminishes and inundation during large floods may be very widespread (Lewis, 1963; Roeske, 1978). The most widespread flood hazards in the quadrangle are those associated with numerous smaller tributary drainages, where the extent of flood-prone area varies with the size of the stream and local topographic confinement of floodwater. Brawley Wash is a regional drainage with a broad, intermittently entrenched floodplain.”<sup>5</sup>

## **Geology**

A good summary of the area is described in the NCRS Rapid Watershed Assessment. “The Brawley Wash-Los Robles Wash Watershed is located within Arizona’s Basin and Range Province. The Basin and Range Province of southern and western Arizona is an area where the Earth’s crust has been stretched and broken by numerous faults so that mountain ranges and basins (broad valleys) have formed by the vertical motion of large crustal blocks. The Basin and Range Province was formed from 28 to 12 million years ago as the Baja California portion of the Earth’s tectonic Pacific Oceanic plate began diverging from the continental plate, stretching the continental plate and forming the equivalent of stretch marks in the earth’s crust, nearly parallel to the strike (direction) of the plate boundary. As the earth’s crust is stretched, blocks of crust break and drop in a pattern of valley basins and high peak ranges, and is known as the Basin and Range Province within Arizona and other regions of Mexico and the western United States.

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<sup>5</sup> Geologic Map and Geologic Hazards of the Three Points Quadrangle, Pima County, Arizona, by Philip A. Pearthree, Charles A. Ferguson, Wyatt G. Gilbert, and Steven J. Skotnicki, Arizona Geological Survey Digital Geologic Map 4, October, 2000



The watershed is bounded on the west by the Baboquivari Mountains, a range of block-faulted mountains that are crosscut by northwest-striking faults and shear zones that are part of a regional structural pattern. The Baboquivari, and the closely related Quinlan Mountains to the north, are composed of Jurassic, Cretaceous, and Tertiary granite interspersed with small amounts of schist and sedimentary rocks (Goodwin, 1985). Volcanic remnants of a large caldera, the Tucson, Sierrita, and Tumacacori Mountains delineate the eastern limit of the watershed, and to the south the Mountains form a barrier that acts as the watershed's southeastern limit. The Sierritas, which combine Paleozoic and Mesozoic sedimentary rocks with Cretaceous-aged volcanic rocks, are a valuable source of copper in the region; several open-pit mines on the east side of the range mine the large deposits of porphyry copper found there (Chronic, 1983)."<sup>6</sup>

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<sup>6</sup> Brawley Wash - Los Robles Wash Watershed – Arizona, (Altar Wash - Brawley Wash Watershed) Rapid Watershed Assessment.





## Section 5: Market Analysis

### Arizona Corporation Commission

In 2006, the Commission approved the Renewable Energy Standard and Tariff (REST). These rules require that regulated electric utilities must generate 15 % of their energy from renewable resources by 2025. The Commission's Renewable Energy Standards encourage utilities to use solar, wind, biomass, biogas, geothermal and other similar technologies to generate "clean" energy to power Arizona's future. The ACC regulates nearby Trico, APS and TEP among others.

### Trico Electric Cooperative

#### *Trico SunWatts Program*

**Applicability:** Residential and business customers a rebate for installing photovoltaic (PV) systems and solar water heaters.

**Limits:** Systems sized 10 kW – 1.0 MW or greater are eligible for a performance based incentive (PBI) negotiated on a case-by-case basis. Systems over 1 MW negotiated on a per-project basis relative to market conditions. PBIs will be subject to a competitive selection process. Therefore Renewable Energy Credit ("REC") price should be competitive; the evaluation includes REC price, community and system benefits, program budget, system output and other considerations. If a project is not selected, it can be resubmitted at a subsequent time.

Trico's current Renewable Energy Credit (REC) Production Based Incentive (PBI), greater than 10 kW is \$0.025/kWh.<sup>7</sup> This incentive for PBI projects is based on a competitive selection process at the time of the interconnection application, which is subject to change with the renewable incentive market conditions and Trico's availability of renewable funds. The current PBI rate relates to net metered projects for commercial and residential member driven projects. Trico as a small non-profit cooperative has very limited funds in its renewable program for utility scale projects (non-net metered). It is unlikely that Trico could provide PBI funds for a 10 MW or greater renewable project. Trico's renewable program and process is in accordance with the Arizona Corporation Commission (ACC) Renewable Energy Standard and Tariff (REST) Rules.

The SunWatts rebate program would continue to provide incentives to residential customers for installation of qualifying renewable systems. Trico is proposing to pay an Up-Front Incentive ("UFI") of \$0.10 per watt, for PV systems up to 10 kW in size. For PV systems up to 10 kW in size, Trico will own all the Renewable Energy Credits ("RECs") over a 20-year period. Trico would continue to allow systems that exceed 10 kW in size to participate in Up-Front Incentive ("UFI") of \$0.10 per watt for a 10 kW system; this equates to \$1,000.

See Table 4 below for Trico's proposed 2013 REST budget.

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<sup>7</sup> Karen Cathers, Trico Electric Coop, Email correspondence, May 21, 2013.



**Table 4: 2013 Trico Budget for Solar Incentives**

| <b>Category</b>                | <b>Total Budget</b> |
|--------------------------------|---------------------|
| Residential PV UFI Rebates     | \$326,890           |
| Non-Residential PV UFI Rebates | \$13,750            |
| Large-Scale PV PBI Rebates     | \$529,334           |
| Educational Grant Program      | \$2,500             |
| PV for Schools                 | \$310,000           |

*SunWatts Educational Grant Program*

This program was suspended in 2012. Trico has reinstated the program for 2013. This program offers teachers in its service territory an education grant for the development of renewable curricula for the classroom.

*PV for Schools Program*

Trico suspended the PV for Schools Program in 2011 and 2012. However, Trico reinstated this program for 2013. In addition, Trico is proposing to modify its PV for Schools Program to a competitive application process. The successful school would receive renewable energy through a purchased power agreement that Trico would negotiate directly with a solar firm.

*TRICO Net Metering Program*

Applicability: Is operated by or on behalf of the customer and is located on the customer's premises, intended to provide part or all of the customer's requirements for electricity. Facilities with generation capacity that exceeds 1 MW which are interconnected presently, or desire to become interconnected, at Arizona Electric Power Cooperative's (AEP CO) option, be subject to the negotiated terms and conditions set forth in contracts among the customer, AEP CO, Southwest Transmission Cooperative and the Cooperative (SWTC).

In a recent ruling (Nov. 14), the ACC will be modifying their net metering program. Starting January 1, 2014, net metering customers will be charged a fixed fee of \$0.70/kW per month to cover impacts to the grid.

Limits: Has a generating capacity less than or equal to 125% of the customer's total connected load. If the kWh energy generated by the customer exceeds the kWh energy supplied by Trico in the billing period, the customer shall be credited during subsequent billing periods for the excess kWh energy generated. Trico shall apply the credit by using the excess kWh energy generated during the billing period to reduce the kWh energy and billed by the Trico during the subsequent billing periods.

Each calendar year, for the customer bills produced in October (September usage) or in the last billing period that the customer discontinues service under this tariff, Trico shall issue a check or billing credit to the customer for the balance of any credit due in excess of amounts owed by the customer to Trico for Non-Firm Power. The payment for any remaining credits shall be Trico's Annual Average Avoided Cost of \$0.04205 per kWh.

*Trico Electric Cooperative Self-Directed Tariff*

Applicability: Single and three phase service for Non-Residential Members/Customers with multiple meters that pay more than \$25,000 annually in RES Surcharge funds pursuant to the Renewable Energy Standard Tariff for any number of related accounts or services within the Trico Electric Cooperative service territory.



Limits: An Eligible Customer may apply to receive funds to install Distributed Renewable Energy Resources. Eligible customer shall provide at least half of the funding necessary to complete the project described in its application. The funds annually received by an eligible customer may not exceed the amount annually paid by the eligible customer pursuant to the RES Surcharge Tariff.

Process: Application submitted to Trico.

#### *Power Purchase Agreement Opportunities with Trico<sup>8</sup>*

Trico indicated their need for renewable energy is minimal. If Pascua Yaqui were to sell power to Trico, it would be at Trico's current avoided cost for power which is currently approximately \$0.030/kWh. The avoided energy cost rate changes as Trico's average energy costs change on a monthly basis.

#### **Tucson Electric Power (TEP)**

TEP is requiring the generation of 15% of electricity from renewable sources by 2025 in order to comply with Arizona's Renewable Portfolio Standard. The Arizona Corporation Commission (ACC) recently approved modifications to their Renewable Energy Standard and Tariff (REST). Performance-based incentives, which had previously been available for larger renewable energy systems have been terminated. Only upfront incentives for smaller systems are now available.

Residential and small commercial PV, Wind and Geothermal Electric (up to 25 kW): \$0.10/watt. PV installed on Schools: \$0.09/kWh (15 years) or \$0.085/kWh (20 years).<sup>9</sup> A scheduled \$1.7 million in TEP UFI's were cut completely.<sup>10</sup>

TEP far exceeded its 2011 utility-scale REC requirement with 330,005,553 available RECs. Included in this number are RECs that were carried over (not retired) from 2010 as well as RECs purchased in 2011. Of these, 209,972,408 were retired to meet compliance; and 6,999,080 were retired to meet the 10% wholesale non-residential allowance. RECs in excess of what is needed for compliance will be carried forward for use in future years. Distributed Energy reservations exceeded compliance requirements in all categories at 164% compliant. Annualized-actual production compliance in 2011 increased dramatically over 2010 by 237% and reached 102% compliant excluding outstanding customer projects still in construction. TEP expects this type of annualized-actual increase to continue into 2012 and 2013 as reserved customer-sited projects continue to come on line and the average development time of larger projects continues to reduce. See Table 5 for a list of TEP's solar installations.

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<sup>8</sup> Karen Cathers, Trico Electric Coop, Email correspondence, May 21, 2013

<sup>9</sup> Arizona Incentives/Incentives for Renewable & Efficiency.

[http://www.dsireusa.org/incentives/incentive.cfm?Incentive\\_Code=AZ04F&re=0&ee=0](http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=AZ04F&re=0&ee=0)

<sup>10</sup> "A Sneak Attack on Commercial Solar," January 25, 2013.

<http://www.greentechmedia.com/articles/read/an-arizona-regulator-sneak-attack-on-commercial-solar/>



Table 5: TEP Renewable Contracts and Projects

| Resource/ Counterparty | Technology       | Location   | Operator           | Completion Date | Term (Years) | Purchase Option          | Capacity MW  |
|------------------------|------------------|------------|--------------------|-----------------|--------------|--------------------------|--------------|
| <b>Solar</b>           |                  |            |                    |                 |              |                          |              |
| Amonix                 | Concentrating PV | Tucson, AZ | Amonix             | Mar-11          | 20           | On or after yr. 6 at FMV | 2            |
| Swan Solar             | Concentrating PV | Tucson, AZ | Amonix             | Oct-12          | 20           |                          | 12           |
| NRG Solar              | Fixed PV         | Tucson, AZ | NRG Solar          | Sep-12          | 20           |                          | 25           |
| AstroSol               | Fixed PV         | Tucson, AZ | Astronergy         | Jun-12          | 20           |                          | 5            |
| Emcore Solar           | Concentrating PV | Tucson, AZ | Emcore             | Sep-12          | 20           |                          | 2            |
| FRV Tucson Solar       | SAT PV           | Tucson, AZ | Renewable Ventures | Jul-12          | 20           |                          | 25           |
| FSP Solar One          | SAT PV           | Tucson, AZ | Foresight Solar    | Sep-12          | 20           |                          | 4            |
| FSP Solar Two          | SAT PV           | Tucson, AZ | Foresight Solar    | Dec-12          | 20           |                          | 12           |
| Avalon Solar           | Fixed PV         | Marana, AZ | Avalon             | Dec-12          | 20           |                          | 35           |
| <b>Wind</b>            |                  |            |                    |                 |              |                          |              |
| Macho Springs          | Wind             | Deming, NM | Element Power      | Sep-11          | 20           | None                     | 50           |
| <b>Landfill Gas</b>    |                  |            |                    |                 |              |                          |              |
| Sexton Energy          | Landfill Gas     | Tucson, AZ | Sexton Energy      | Dec-13          | 15           | None                     | 2.2          |
| <b>Total</b>           |                  |            |                    |                 |              |                          | <b>174.2</b> |

TEP will meet the 2013 utility-scale requirement by having renewable generation capacity of 217 MW in place by the end of 2013. Of the 217 MW, 185 MW will come from renewable PPAs currently in effect or with anticipated completion dates in early 2013. The remaining 32 MW will come from TEP-owned renewable facilities.

The combination of TEP-owned generation facilities and PPAs will enable TEP to meet or exceed its renewable energy requirements for the next five years. Table 5 below depicts TEP's utility-scale target and how TEP will meet that requirement through 2017 with the current expected generation portfolio. Red Mountain contacted TEP to discuss the procurement plans for the 25 MW and 40 MW for 2014-2015 indicated below. TEP indicated that they have already identified projects to fulfill their procurement plans as indicated in the Table 6 below.

Table 6: TEP Renewable Energy Procurement Plans

| TEP Future Renewable Generation | MW        | In-Service Date | TEP Owned |
|---------------------------------|-----------|-----------------|-----------|
| Amonix Solar                    | 12        | Dec-12          | No        |
| NRG Solar                       | 32        | Oct-12          | No        |
| SunEdison                       | 25        | Dec-12          | No        |
| EMCORE                          | 2         | Dec-12          | No        |
| Foresight Solar                 | 6         | Dec-12          | No        |
| Foresight Solar                 | 14        | Dec-12          | No        |
| Avalon Solar                    | 35        | Jun-13          | No        |
| <b>Expected Procurement</b>     | <b>25</b> | <b>2014</b>     | <b>No</b> |
| <b>Expected Procurement</b>     | <b>40</b> | <b>2015</b>     | <b>No</b> |

## Southwest Transmission Cooperative (SWTC)

SWTC delivers wholesale cooperative energy from the Arizona Electric Power Cooperative's (AEP) Apache Power Generating Station in Cochise, AZ, to its six member distribution electric co-ops, which serve members in Arizona, California and New Mexico. SWTC has not established any renewable energy goals or plans to procure renewables.



## Arizona Public Service (APS)

Greg Bernosky, renewable energy program manager at APS, said the utility has enough renewable energy to meet its residential installation requirements through 2015 and commercial installations for several years beyond that based on what already is being installed or planned.<sup>11</sup> APS has terminated their production based incentives (PBIs) for commercial systems. APS had previously scheduled \$400,000 in up front incentives (UFIs) and were recently reduced to \$100,000.

## SRP

SRP officials have set a goal to meet 20% of the municipal utility's demand for electricity with conservation and renewable sources by 2020. SRP currently meets 7% of its demand with renewable resources, exceeding its goal, which increases each year until 2020. SRP has nearly enough renewable energy under development to meet their renewable energy goals through 2017.

## Federal Policies

### *The Energy Policy Act of 2005 (EPACT) Section 203*

This law mandates the minimum contribution of renewable energy to an installation's total electricity consumption. The targets are:

- 3% or more in fiscal years 2007 through 2009
- 5% or more in fiscal years 2010 through 2012 (currently at 4%)
- 7.5% or more by 2013

### *The National Defense Authorization Act (NDAA) of 2007*

This act codifies Department of Defense's (DoD) voluntary goal of 25% renewable power of all energy consumed by 2025, but does not include any interim targets.

### *10 U.S.C §2911(e) Renewable Energy Goal*

This law states that the Department of Defense's goal is to produce or procure not less than 25 % of the total quantity of facility energy it consumes within its facilities during fiscal year 2025 and each fiscal year thereafter from renewable energy sources. The 2018 goal is 15%; current production and procurement of renewable energy is at 9.6 %.

One of the benefits of being a Tribal Energy Project, if the Project were to sell power to the federal government, the federal government would receive double credit for the power. This means that they will earn double credit for each kWh produced to meet federal RPS mandate (203(c)(3)). Preference is given to Tribal Energy no more and no less than prevailing market price and conditions.

### *USC 2911 of DOD's title 10 Energy Performance Goals*

VA specific goal: At least 15% of electricity used to be renewable energy by 2013.

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<sup>11</sup> Phoenix Business Journal, "Arizona solar industry unloads on corporation commission for cutting commercial incentives". Jan 25, 2013.

<http://www.bizjournals.com/phoenix/blog/business/2013/01/arizona-solar-industry-unloads-on.html?page=all>.





### *Military Bases*

The US Air Force, along with the Army and Navy, has a plan to develop over 1,000 MW of renewable energy on Air Force installations by 2016. The Department of Defense (DOD) made one of the largest commitments to clean energy in history: it set a goal of deploying **3 gigawatts (GW) of renewable energy by 2025**. The Army, Navy and Air Force will each install 1 GW, including solar, wind, biomass, and geothermal.

### *US Army*

The Army Energy Initiatives Task Force EITF is tasked with achieving the Army's goal of deploying 1,000 MW of renewable energy by 2025.<sup>12</sup> The (EITF) partners with Army installations to implement large-scale renewable energy projects, leveraging private sector financing. The Task Force focuses on biomass, geothermal, solar and wind 10 MW or greater and located on Army installations in the US; projects may be off-base, but are a secondary priority. They seek innovative and collaborative partnerships with private industry and businesses to finance, plan and execute a portfolio of large-scale renewable energy projects on Army installations.

The EITF worked closely with the U.S. Army Corps of Engineers, Huntsville for the development and announcement of a \$7 billion Multi-Award Task Order Contract (MATOC) Request for Proposal for the procurement of clean energy on or near Department of Defense (DoD) installations. The MATOC is a contract vehicle that establishes a pool of qualified firms/contractors for each renewable technology (solar, wind, biomass, and geothermal) to compete for individual PPA task order contracts. The RFP closed on October 2, 2012 and evaluations are currently ongoing. Awards are expected to begin in late 2nd Quarter of FY13 and completed by end of calendar year 2013.

### *US Air Force*

The US Air Force will utilize RFPs to secure renewable energy projects. A parcel of non-excess and underutilized land will be leased at fair market rent to the developer. As a long term and reliable off taker of power, the Air Force provides a committed payment stream for the energy the developer works to produce. The Air Force will administer an RFP for developers. The proposals would include information on past experience and performance, planned technical solution and proposed pricing structure.

The Air Force strategy relies on a large use of Enhanced Use Leases at large project capacities (typically over 50 MW) with a combination of Power Purchase Agreements. The Air Force plans to use third-party financing where a private developer brings third-party funding and enters into a long-term agreement with the Air Force to use property and sell the energy produced mainly to the Air Force but also to the commercial power grid.<sup>13</sup>

### *Department of the Navy (DoN)*

The Navy currently produces 12% of its total annual energy needs from renewable sources. The Navy is pursuing renewable and alternative energy technology using a "Watch-Partner-Lead" approach:

- Watch maturing technologies and invest when/where viable

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<sup>12</sup> Energy Initiatives Task Force. <http://www.armyeitf.com/>

<sup>13</sup> US Air Force Civil Engineer Center. Power Purchase Agreements. <http://www.afcec.af.mil/energy/ratesandrenewables/index.asp>



- Partner to develop needed technologies with other government organization and/or industries
- Lead the development of mission-critical technology

A \$200 million multiple award construction contract was awarded in February 2010 to construct up to 40 MW of solar photovoltaic power plants at Navy and Marine Corps installations throughout the Southwestern U.S. Five solar development teams were awarded contracts to provide power to the Navy through construction of PV power plants on military land. The developers will construct, own, operate and maintain the systems, and sell the power to the Navy through PPAs of up to 30 years. Initial projects are targeted for Naval Air Weapons Station China Lake, Marine Corps Air Ground Combat Center Twenty-nine Palms and Marine Corps Logistics Base Barstow.

On June 5, 2013, the DoN released a Request for Information (RFI) to purchase renewable energy from various locations for Department of Navy Installations in California.<sup>14</sup> The DoN is interested in identifying existing or potential new renewable energy generation to be consumed at various DoN installations. The goal is to determine market viability of purchasing renewable energy from offsite sources for these installations. The DoN will consider using several different acquisition authorities and/or strategies which may include partnerships with Federal Power Marketing authorities, such as Western Area Power Authority (WAPA). The total annual consumption of these installations is approximately 1.2 million MWh. The response deadline is July 20, 2013. See list below:

- Naval Base San Diego
- Naval Base Coronado
- Naval Base Point Loma
- Naval Air Facility El Centro
- Naval Weapons Station Seal Beach
- Naval Base Ventura
- Naval Air Weapons Station China Lake
- Naval Air Station Lemoore
- Naval Support Activity Monterey
- Marine Corps Recruit Depot San Diego
- Marine Corps Base Camp Pendleton
- Mountain Warfare Training Center Bridgeport
- Marine Corps Logistic Base Barstow
- Marine Corps Air Ground Combat Center 29 Palms
- Marine Corps Air Station Miramar

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<sup>14</sup> NECO Synopsis Database. "Request for Information (RFI) to purchase renewable energy." Aug. 4, 2013.

<https://www.neco.navy.mil/synopsis/detail.aspx?id=391536>



### *Nearby Military Bases to Pascua Yaqui*

There are 7 military bases in Arizona. All of them are quite large, with around five to six thousand military personnel each.

- Army:
  - o Fort Huachuca - 70 Miles SE
  - o Yuma Proving Grounds - 180 Miles Northwest
- Marine Corps
  - o MC Air Station, Yuma - 200 Miles West
- Air Force
  - o Davis –Monthan AFB - 25 Miles East
  - o Luke AFB, Glendale - 115 Miles Northwest
  - o Gila Bend AF Auxiliary Field - 100 Miles Northwest
  - o Camp Navajo near Flagstaff - 220 Miles North

Other Facilities in AZ: US Army National Guard, Silverbell Army Heliport, Marana; AZ Air National Guard, Tucson; US Army Reserve Center, Tucson; Northrop Grumman Information Systems, Sierra Vista; Dept. of Homeland Security, Nogales; Army National Guard Recruiting Office; US Army Reserve Center, Arizona Air National Guard, US Army Area Commander, US Defense Department; US Marine Corps Reserve Center; US Air Force Base Information.

Future projects in the conceptual stage include PV systems on the order of 100+MW at Marine Corps Air Station (MCAS) Yuma (the Barry Goldwater Range) in Arizona and Naval Air Station (NAS) Lemoore in California.

### *Davis-Monthan Air Force Base, AZ*

The Air Force recently constructed a 14.5 MW photovoltaic solar array at Davis-Monthan AFB on 170 acres of underutilized base property. SunEdison, LLC designed, financed, and constructed the facility and will operate and maintain the array. The PPA provides electricity to Davis-Monthan at a reduced rate for 25 years, saving the base approximately \$500,000 a year in utility costs. Davis-Monthan has a 6 MW solar array at Soaring Heights Community; together, the two solar facilities provide 35% of the AFB energy needs.

According to recent conversations with the Davis-Monthan AFB Energy Manager, Mr. Greg Noble, they signed a 20 year contract for their **14.5 MW** solar power at **\$0.045/kWh** with a **1.5%** escalation rate. Mr. Noble recommended following up with the command level to discuss energy prices for solar at Pascua Yaqui.

### *Fort Huachuca, AZ*

On May 23, 2013, the U.S. Army Engineering & Support Center in Huntsville, Alabama, (USACE-HNC) along with the Army Energy Initiatives Task Force, released a notice of "Source Sought" for a large scale renewable energy project at Fort Huachuca, Arizona.<sup>15</sup> The Solicitation, number W912DY-13-R-0030, is posted on the Federal Business

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<sup>15</sup> Energy Initiatives Task Force. "Fort Huachuca Renewable Energy Project Notice of Sources Sought Solicitation Release." <http://www.armyeitf.com/index.php/opportunities/request-for-information>. May 23, 2013.



Opportunities website at [www.fbo.gov](http://www.fbo.gov) and closes on June 24, 2013. The Government is performing market research, prior to issuing a request for proposal, in order to determine which businesses possess the interest and capability to execute the requirements outlined for the project.

The U.S. Army intends to procure electrical power from a Photovoltaic (PV) generation system with a peak capacity of approximately 20 MW located at Fort Huachuca. It is the Government's intent to purchase only the energy that is produced by the PV system, and not to acquire any generation assets. In the coming months, USACE-HNC will issue an RFP for the purpose of selecting, through a competitive selection process, a third party developer who shall finance, design, build, operate, own and maintain the facility.

#### *Luke Air Force Base (AFB)*

The Luke AFB has a 17 MW solar photovoltaic array.

#### *Fort Irwin, CA*

Recently, Fort Irwin released an RFP to procure renewable energy through a Power Purchase Agreement (PPA) for up to 25 years.<sup>16</sup> The selected contractor will finance, design, build, operate, own and maintain the renewable energy generation system. Under the PPA, the Army will only purchase the energy that is produced; no generation assets will be acquired. All interested companies are encouraged to prepare a response to the solicitation, which closes on July 1, 2013.

### **California Market Analysis**

Governor Brown's Clean Energy Jobs Plan set a goal of adding 20,000 MW of renewable generating capacity by 2020; see Figure 16. The state's RPS requires investor-owned utilities (IOUs), electric service providers, and community choice aggregators regulated by the CPUC to procure 33% of retail sales per year from eligible renewable sources by 2020. The RPS also requires retail sellers to achieve intermediate RPS targets of 20% from 2011-2013 and of 25% from 2014-2016.

CA has roughly 3,000 MW of renewable energy capacity installed and IOUs have signed contracts for 14,000 MW of renewable energy within the state of CA. In 2011, CA IOUs served 20.6% of their electricity with renewable energy (up from 17% in 2010).<sup>17</sup>

There is substantially more Solar MW's in the development pipeline in California, Arizona and Nevada than are required to meet current Request for Proposal offerings and even future RPS goals; see Figure 17. Notice that in 2012, California needs 11,000 MW in order to meet their renewable energy goals and by the end of 2013, 40,000 MW of renewable energy projects will have interconnection studies completed.

In addition, utilities have downsized their target from larger to smaller projects. Many of the current PPA's are being offered for projects less than 20 MW's and Utility goals are targeting distributed generation to meet RPS goals. The Renewable Auction Mechanism (RAM),

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<sup>16</sup> Fort Irwin, CA Renewable Energy Project Request for Proposal. "Fort Irwin, CA Renewable Energy Project Request for Proposal

Solicitation Release." <http://www.army.mil/procurementactions>. May 9, 2013.

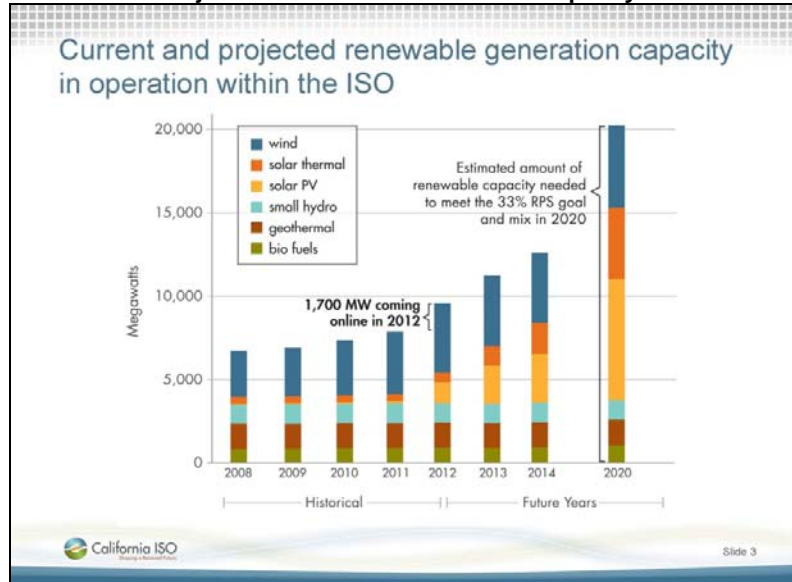
<sup>17</sup> CPUC. "CPUC 1<sup>st</sup> and 2<sup>nd</sup> Quarter 2012 Renewables Report to the Legislature."

[http://www.cpuc.ca.gov/PUC/energy/Renewables/RPS\\_Q1Q2\\_2012\\_report\\_to\\_leg.htm](http://www.cpuc.ca.gov/PUC/energy/Renewables/RPS_Q1Q2_2012_report_to_leg.htm)

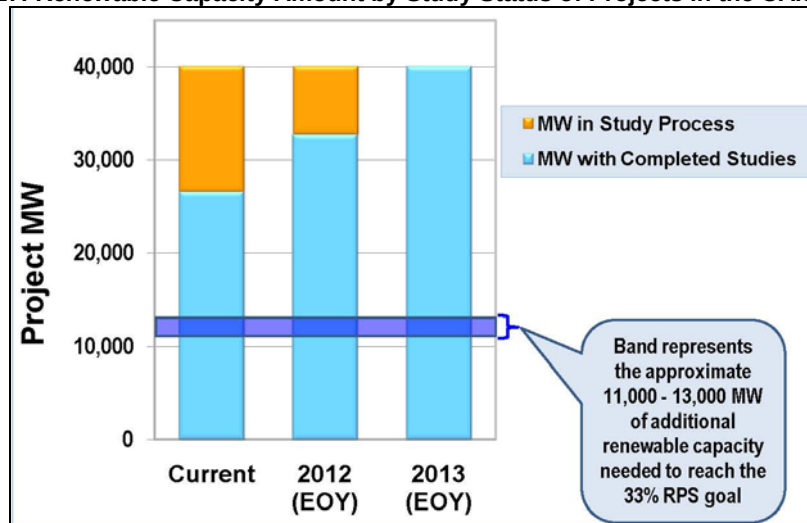


approved by the California Public Utilities Commission (CPUC) in December 2010, is expected to result in 1,299 MW of new distributed generation over the course of two years. RAM is designed to streamline the procurement process for distributed generation projects up to 20 MW in capacity while ensuring the lowest costs for ratepayers. The RAM is for projects within CA only.

**Figure 16: Current and Projected Renewable Generation Capacity within the California ISO**



**Figure 17: Renewable Capacity Amount by Study Status of Projects in the CAISO Queue**



#### *Southern California Public Power Authority (SCPPA)*

The Southern California Public Power Authority (SCPPA) currently has a rolling RFP out for utility scale solar projects; **the proposal deadline is Dec. 31, 2013**. The projects must be priced below \$95/MWh for this RFP. The RFP is seeking renewable energy projects that can deliver 2,000 gigawatt-hours (GWh) per year in 2014 and an additional combination of projects able to deliver another 3,000 GWh per year beginning in 2017, for a total addition of approximately 5,000 (GWh) per year by 2020. SCPPA represents twelve Member Agencies,



Many of these projects have advanced into specific contract negotiations, and over 800 MW are now being delivered in support of our members' renewable objectives.

### **NV Energy**

NV Energy is currently fully compliant with the RPS and forecasted to remain in compliance through 2019.

### **NM Market Analysis**

New Mexico's RPS goals are to be 20% renewable by 2020 for investor-owned utilities and 10% by 2020 for rural electric cooperatives. IOU's in New Mexico are procuring renewable energy and renewable energy certificates from New Mexico renewable generation facilities to meet the Renewable Portfolio Standard (RPS) requirements of the REA and Rule 572.

### **Western Area Power Administration (WAPA)**

Western's mission is to Market and deliver reliable, renewable, cost-based hydroelectric power and related services. Western sells and transmits power generated at 14 different multipurpose water resource projects throughout the West, which are managed by the U.S Bureau of Reclamation, U.S. Army Corps of Engineers and the State Department's International Boundary and Water Commission. Western is a wholesale power provider; power is generated at 56 Federal dams plus the coal-fired Navajo Generating Station and sold to Federal and state agencies, cities and towns, rural electric cooperatives, public utility districts, irrigation districts and Native American tribes. They, in turn, provide retail electric service to millions of consumers in the West. WAPA assists their customers in achieving their renewable energy goals. As part of Western's strategic goals for 2011, they intend to encourage customers' voluntary use of renewable resources and energy efficiency measures.

WAPA may purchase power from Tribes for firming and reserve requirements, but no more than market prices. In addition, WAPA can provide technical assistance to tribes seeking to use transmission.



## Section 6: Tortuga Ranch - Transmission Access/Interconnection Study

Red Mountain assessed all possible interconnection options for the Tortuga Ranch site; see Figure 18 below.

### Interconnection Option 1: 115 kV WAPA San Xavier Substation

Utility: Western Area Power Administration, Central Arizona Project (CAP)

Point of Interconnection (POI): 115 kV San Xavier Substation

Rating: 167 MVA

Gen-tie Line Easement: Parallel Trico's 24.9 kV distribution line north 1.5 miles then east along what appears to be a dirt road for 1.1 miles.

Gen-tie Offsite Landownership: Federally owned lands to the north

### Interconnection Option 2: 115 kV Southwest Transmission Cooperative (SWTC)

#### Transmission Line

Utility: Southwest Transmission Cooperative (SWTC)

POI: 115 kV Three Points-Sandario Transmission Line

Rating: 64 MVA. (Previous plans to upgrade to 219 MVA)

Gen-tie Line Easement:

- Option A: Parallel Trico's 24.9 kV line due south 7 miles to the 115 kV
- Option B: Parallel Trico's 24.9 kV line due north 1.75 miles then west 1.5 miles along W. Garcia Rd. to 115 kV Line; need to verify access to 115 kV line in mountainous terrain

Gen-tie Offsite Landownership: Option A: State owned (1.5-2.5 miles); Option B: Federal

### Interconnection Option 3: 345 kV TEP Transmission Line

Utility: Tucson Electric Power

POI: 345 kV TEP South – Pinal West Transmission Line

Gen-tie Line Easement: Parallel Trico's 24.9 kV distribution line due south 7.5 miles to the 345 kV Three Points Substation

Gen-tie Offsite Landownership: State lands 2.3 miles.

### Interconnection Option 4: 24.9 kV Trico Distribution Line

Utility: Trico

Point of Interconnection (POI): 24.9 kV Distribution Line

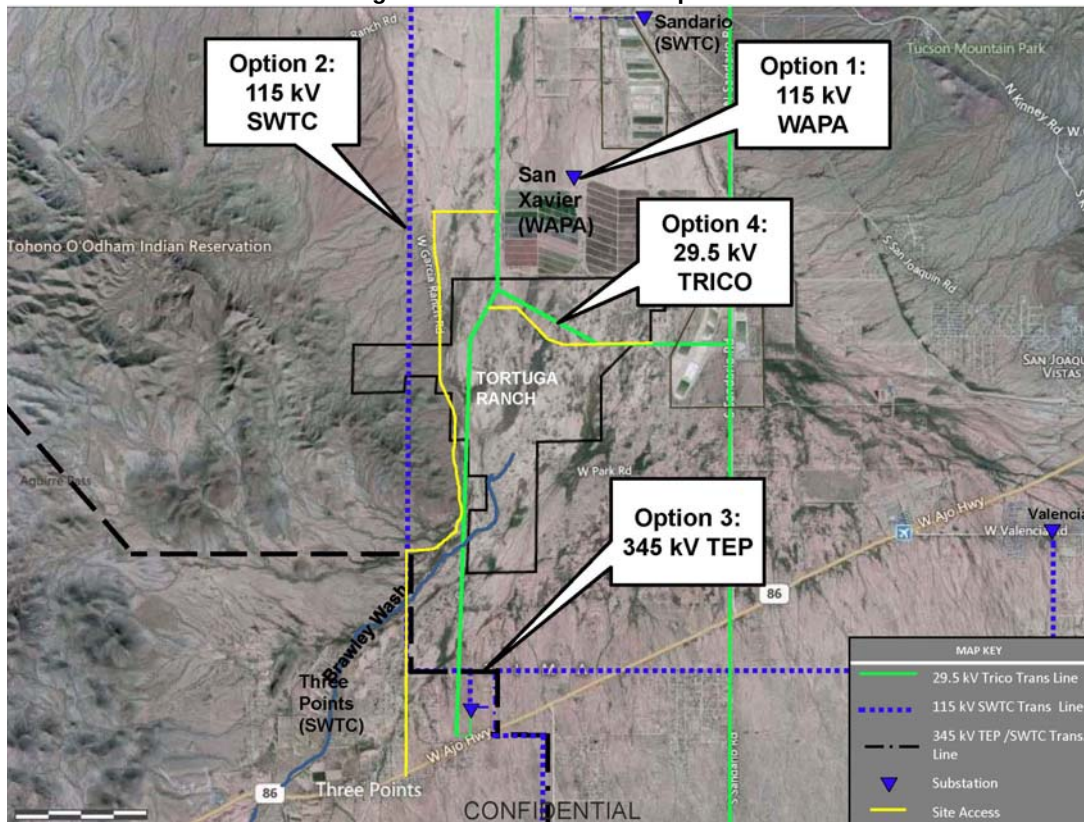
Capacity: Trico indicated approximately 5 MW of available capacity

Gen-tie Line Easement: Onsite or East of site on Sandario Rd.

Gen-tie Offsite Landownership: Land owned by the City of Tucson (offsite)



Figure 18: Interconnection Options

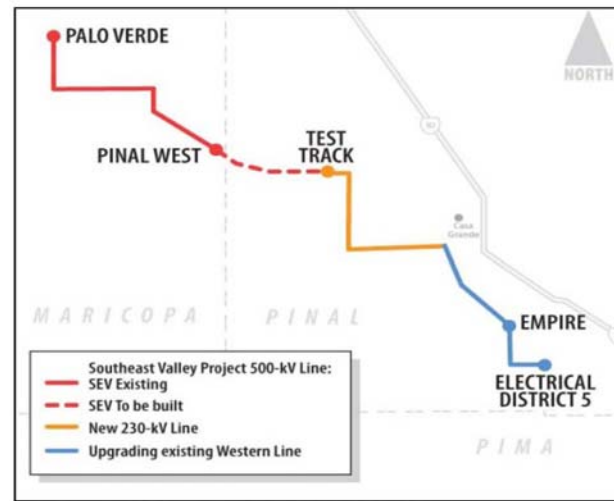


#### Transmission Line Upgrades & Planned Transmission

The following is a list of nearby transmission line upgrades planned and recently completed:

- Avra Valley to Sandario tap 115 kV Line upgrade to 219 MVA capacity. Current rating 72 MVA. - completed
- 115 kV Marana-Avra Valley line upgrade to 219 MVA (SWTC) -completed
- Saguaro to Tucson 115 kV line loop into Marana; 219 MVA- 2014 (SWTC); Interconnection of Tortolita – North Loop 138 kV with future Marana 138 kV Substation - 2018
- ED5- Marana 230 kV Line (SCWPDA, SPPR), not yet filed
- WAPA ED5-Palo Verde Hub – WAPA is currently developing a new transmission line with Southwest Public Power Resource Group (SWPPRG). It is a 109 mile transmission project that will add up to 410 MW of bi-directional capacity. See Figure 19 for a map of the transmission line.

Figure 19: WAPA ED5-Palo Verde Hub



#### Power Delivery Opportunities

##### Option 1: 115 kV WAPA San Xavier Substation

For the 115 kV San Xavier interconnection, power can get to test track and then ultimately be delivered to Palo Verde or West Wing; see Figure 20. Palo Verde is a major power delivery hub that provides access to the CAISO, APS, El Paso, PNM, TEP and SRP. For this POI, the project would be subject to CAP & ED5-Palo Verde wheeling charges; see Table 6.

CAP wheeling rates are \$1.34 mills/kWh and ED5-Palo Verde are \$2.50/kW<sub>month</sub>. For a 20 MW solar PV project, this is approximately equivalent to adding an additional **\$0.0254/kWh** to the energy price. WAPA is considering decreasing ED5-PV wheeling rates to \$1.50/kW<sub>month</sub> if they are successful with securing sufficient customers. This would decrease the \$/kWh rate to \$0.0206/kWh.

##### Option 2: 115 kV SWTC Transmission Line

For the 115 kV SWTC interconnection, power can be delivered to Palo Verde as well; see Figure 21. SWTC's wheeling rates are \$3.911/kW<sub>month</sub>. For a 20 MW project, this is approximately equivalent to adding an additional **\$0.0188/kWh** to the energy price. This transmission line is rated at 219 MVA.

##### Option 3: 345 kV TEP Transmission Line

For the 345 kV TEP interconnection, power can be delivered to Palo Verde for \$2.461/kW<sub>month</sub>; see Figure 22. This is approximately equivalent to adding an additional **\$0.0118/kWh** to the energy price for a 20 MW project. The substation costs for a 345 kV substation may be cost prohibitive for a 20 MW size project. If it is desirable to develop a larger solar project, in the 100 MW range, a 345 kV interconnection may be more cost effective. This line is rated at 925 MVA.

##### Option 4: 24.5 kV Trico Interconnection

For the 24.5 kV Trico interconnection, the project could deliver power to Trico; see Figure 23.

See Table 7 for a summary of wheeling rates. Table 8 describes the delivery points for power, the utilities Pascua Yaqui has access to sell power to, the path to get the power to the point of delivery and the wheeling charges the project would be subject to.

Figure 20: Option 1 115 kV WAPA Interconnection Transmission Path

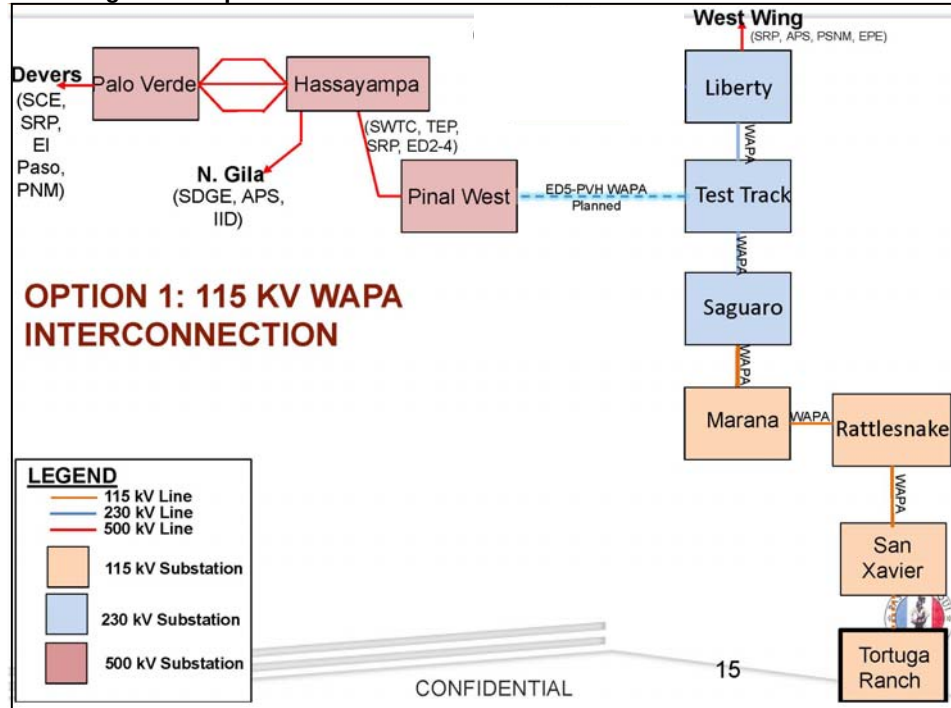


Figure 21: Option 2 115 kV SWTC Interconnection Transmission Path

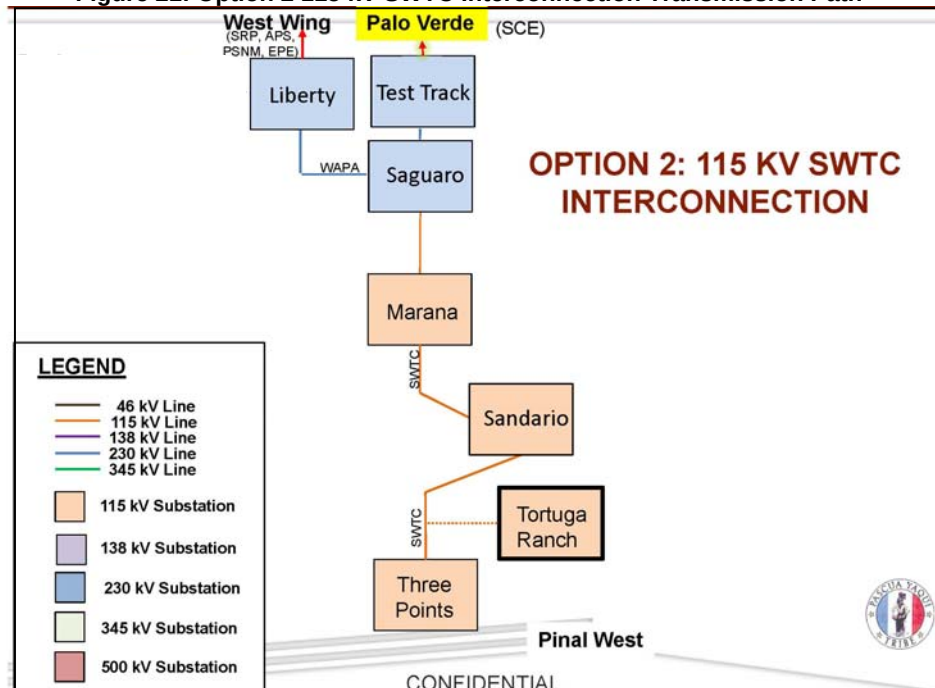




Figure 22: Option 3 345 kV TEP Interconnection Transmission Path

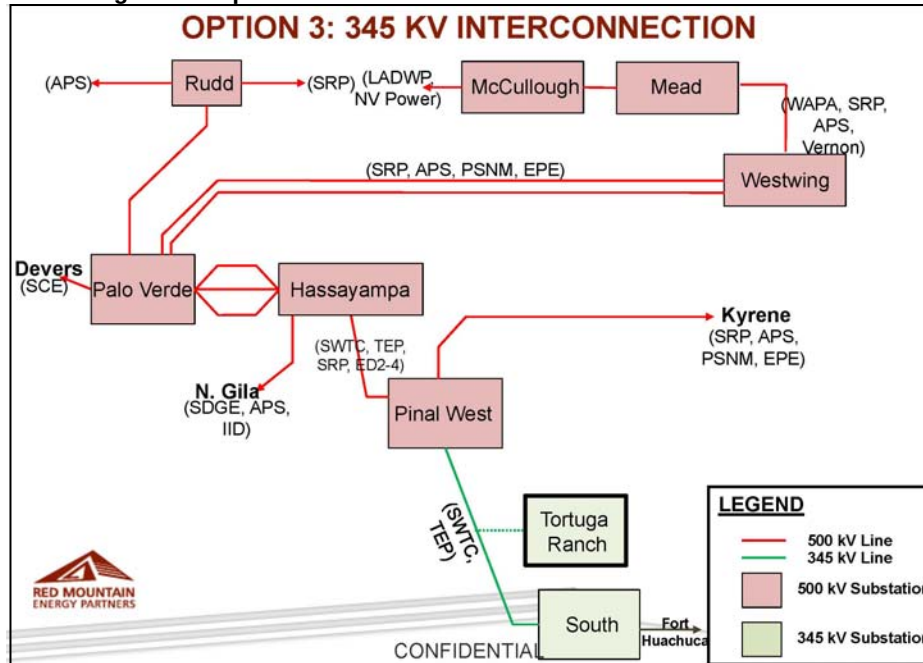


Table 7: Wheeling Rates

|                               | Rate          | Option 1: 115<br>kV WAPA | Option 2: 115<br>kV SWTC | Option 3: 345<br>kV TEP |
|-------------------------------|---------------|--------------------------|--------------------------|-------------------------|
| CAP, mills/kWh                | \$1.340       | \$1.34                   |                          |                         |
| Parker Davis, mills/kWh       | \$1.700       |                          |                          |                         |
| SWTC, \$/kW-mo                | \$3.911       |                          | \$3.911                  |                         |
| ED5-PV, \$/kW-mo              | \$2.500       | \$2.50                   |                          |                         |
| TEP 345, \$/kW-mo             | \$2.461       |                          |                          | \$2.461                 |
| <b>Total \$/Month - 20 MW</b> |               | <b>\$ 105,833</b>        | <b>\$ 78,220</b>         | <b>\$ 49,220</b>        |
|                               | <b>\$/kWh</b> | <b>\$0.0254</b>          | <b>\$0.0188</b>          | <b>\$0.0118</b>         |

Table 8: Delivery Market Hubs

| Point of<br>Delivery<br>(POD) | Utility                                                            | Path                                                                     | Wheeling       |
|-------------------------------|--------------------------------------------------------------------|--------------------------------------------------------------------------|----------------|
| West Wing                     | SCE, APS, SRP,<br>PSNM, El Paso,<br>WAPA, TEP, LADWP,<br>NV Energy | 345 kV South-Pinal West- WW                                              | SWTC or<br>TEP |
| Palo Verde<br>(ED5)           | SCE, APS, SRP,<br>PSNM, El Paso,<br>WAPA, TEP                      | 115 kV Three Points-Avra<br>Valley(SWTC)-<br>Marana-Saguaro (WAPA) - ED5 | SWTC+WA<br>PA  |
| Palo Verde                    | SCE, APS, SRP,<br>PSNM, El Paso,<br>WAPA, TEP                      | 345 kV South-Pinal West(TEP)-<br>Hass-PV                                 | TEP            |
| West Wing                     | WAPA, APS, SRP,                                                    | 345 kV South-West Wing (TEP                                              | TEP            |

|               |                           |                                                                                                           |                                            |
|---------------|---------------------------|-----------------------------------------------------------------------------------------------------------|--------------------------------------------|
|               | TEP, SWTC, PSNM, EI PASO, | Proposed)                                                                                                 |                                            |
| Fort Huachuca |                           | 345 kV Pinal West –South<br>46kV South – Ft. Huachuca                                                     | TEP                                        |
| Apache        |                           | 115 kV Three Points- Bicknell –<br>230 kV Bicknell-Sahuarita-New<br>Tucson-Pantano-Butterfield-<br>Apache | SWTC                                       |
| NM            |                           | Saguaro-Sunzia Line                                                                                       | SWTC or<br>WAPA and<br>TEP (SRP<br>or APS) |

## Section 7: Tortuga Ranch Technology & Preliminary System Design

### Introduction

Red Mountain assessed three different solar technologies: solar photovoltaics (PV), solar thermal, and concentrating solar photovoltaics. In the past few years, solar PV has dominated the market due to significant price drops in solar panels that solar thermal technologies could not compete with. One challenge with PV consists of grid stability due to intermittency. Solar thermal companies are working diligently to revive their technology by offering dispatchable power by integrating storage into their facilities.

For the solar photovoltaic application, Red Mountain identified a variety of reputable PV panel manufacturers.

### Solar Photovoltaic Panels

Photovoltaic technology converts sunlight directly into electricity, thus making panels effective during daylight hours. Many companies are working towards large scale storage applications for PV in order to enable excess PV energy to be stored and utilized at night. However, battery technology is still under development and large scale battery banks are not yet bankable unless Pascua Yaqui were able to leverage significant grant funds for storage applications. Red Mountain does not recommend adding storage to a PV project. PV panel suppliers typically offer 20-25 year linear output warranties. There are two main types of solar panels: crystalline silicon and thin-film. Nearly 90% of the World's PV today is based on some variation of silicon; the main difference between the panels is the purity of the silicon.

Monocrystalline – single crystalline silicon; they have the highest efficiency rates since they are made out of the highest-grade silicon. They produce approximately four times the amount of electricity as thin-film solar panels thus requiring less space for the same amount of power output. Monocrystalline panels live the longest but are also the most expensive.

Polycrystalline – the process used to make polycrystalline silicon is simpler and cost less and the heat tolerance is slightly lower than monocrystalline (solar panel output decrease with increasing temperatures). Because of lower silicon purity, polycrystalline solar panels are not as efficient as monocrystalline solar panels.



Thin-Film – thin film solar cells generally consist of depositing one or several thin layers of PV material onto a substrate. The different types of thin-film solar cells can be categorized by which photovoltaic material is deposited onto the substrate:

- Amorphous silicon (a-Si)
- Cadmium telluride (CdTe)
- Copper indium gallium selenide (CIS/CIGS)
- Organic photovoltaic cells (OPC)

Depending on the technology, thin-film module prototypes have reached efficiencies between 7–13%. Future module efficiencies are expected to climb close to 10–16%. They are cheaper to manufacture than crystalline-based solar cells. High temperatures and shading have less impact on panel performance. In situations where space is not an issue, thin-film solar panels can make sense. Thin-film solar panels tend to degrade faster than mono- and polycrystalline solar panels, which is why they typically come with a shorter warranty.

Cadmium telluride is the only thin-film solar panel technology that has surpassed the cost-efficiency of crystalline silicon solar panels in a significant portion of the market. First Solar has installed over 5 GW of cadmium telluride thin-film solar panels worldwide. First Solar holds the world record for CdTe PV module efficiency of 14.4%.

### **Top 10 PV Module Suppliers in 2012**

Table 9 is a list of the top 10 PV module suppliers in 2012. Seven of the Top 10 companies are public-listed, vertically-integrated crystalline-Silicon (c-Si) manufacturers located in China. First Solar, Sharp and SunPower are the only non-Chinese based suppliers in the rankings for 2012.<sup>18</sup> Over the last four quarters, US based manufacturers First Solar and SunPower were the leaders in module shipments to the US market. In Japan, leading domestic PV module suppliers Sharp, Kyocera, Panasonic, and Solar Frontier also outperformed Chinese competitors during the same time period. Chinese solar PV module suppliers continue to dominate the global supply landscape, with 41% of module shipments coming from the top 10 tier 1 Chinese suppliers over the past four quarters.<sup>19</sup> This is most evident among the top 10 Chinese tier 1 PV module suppliers such as Yingli Green Energy, Trina Solar, Canadian Solar, Jinko Solar, and Renesola.

Total module shipment from the Top10 companies was equivalent to less than 50% of global module demand in 2012. This suggests that further consolidation (or shakeout) of global PV module suppliers has some way to go and is likely to continue for the next few years.

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<sup>18</sup> Jan 2013. PVTEch. "Top 10 PV Module Suppliers in 2012." [http://www.pv-tech.org/guest\\_blog/top\\_10\\_pv\\_module\\_suppliers\\_in\\_2012](http://www.pv-tech.org/guest_blog/top_10_pv_module_suppliers_in_2012)

<sup>19</sup> NPD Solarbuzz. "Top-20 Solar Photovoltaic Module Suppliers Grab 70% Market Share in Q1'13." May 2013. <http://www.solarbuzz.com/news/recent-findings/top-20-solar-photovoltaic-module-suppliers-grab-70-market-share-q1-13>



Table 9: Top 10 PV Module Suppliers in 2012

| 2012 Rank | Module Supplier            | Change from 2011 |
|-----------|----------------------------|------------------|
| 1         | <u>Yingli</u> Green Energy | +1               |
| 2         | First Solar                | +2               |
| 3         | <u>Suntech</u>             | -2               |
| 4         | Trina Solar                | -1               |
| 5         | Canadian Solar             | -                |
| 6         | Sharp Solar                | -                |
| 7         | <u>Jinko</u> Solar         | +2               |
| 8         | JA Solar                   | +7               |
| 9         | <u>SunPower</u>            | -1               |
| 10        | <u>Hanwha</u> SolarOne     | -3               |

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Analysis featured in forthcoming Marketbuzz 2013 Report



While solar PV module pricing levels continue to vary across the key solar PV end-markets, the average sales price for the top 20 tier 1 suppliers showed signs that it was stabilizing at \$0.76/Watt in Q1'13. This compares to \$1.03/Watt in Q1'12.

Even with the current PV module over-capacity within the solar industry, pricing variation still exists across different types of technology, origin of manufacture, brand recognition, or a combination of these and other factors. Over the past year, thin film modules have retained higher Average Sale Prices (ASPs) than most c-Si modules, the exception being the higher prices obtained by c-Si Tier 1 Premium Brand products. Two factors contribute to this trend. First, some thin film technologies have higher production costs than standard efficiency c-Si modules. Therefore, while ASPs may be higher than c-Si modules in some cases, the margins on thin film products are not by default higher.

Second, the higher price of some thin film products can also be due to their ability to fill niche markets not addressable by c-Si PV, such as low weight-bearing rooftops, non-uniform surfaces which require flexible substrates, or in low-light or high irradiation climates where sales teams are effective in selling thin film components against c-Si modules.

Reputation (or 'brand') and bankability are also major factors when selecting PV components, as evidenced by c-Si premium brand pricing. With most companies offering 20+ year warranties, customers want to be assured that these obligations will be met in the future and will often pay more for such assurances. In summary, while comparative pricing

between PV modules is a major decision-point, it is certainly not the sole factor behind the purchase of such components.<sup>20</sup>

Compared to their c-Si counterparts, thin film PV modules offer a different proposition as there are only a handful of manufacturers currently offering high quantities of product to the market. As a result, these companies are differentiated less by brand and more by type of product or business model. Thin film technologies often have very different cost and efficiency metrics, a big difference compared to c-Si modules. As such, thin film products exhibit a wider range of pricing differentials. But even these have been converging over the past year. Since thin film technologies have also been impacted by the global oversupply situation, they now see increased competition from the c-Si segment.

There has been a direct correlation between the growth of the PV industry since 2007 and increased allocation of financial resources from leading PV module manufacturers towards R&D activities. See Tables 10 and 11 for a list of the Top 12 Research and Development spenders and their panel efficiencies.

Table 10: Top R&D Companies

| R&D Ranked | 2007            | 2008            | 2009            | 2010            | 2011            | 2012            | Market Ranked 2012 |
|------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|--------------------|
| 1          | REC             | REC             | First Solar     | First Solar     | First Solar     | First Solar     | 2                  |
| 2          | First Solar     | First Solar     | REC             | REC             | SunPower        | SolarWorld      | N/A                |
| 3          | Suntech         | SunPower        | SunPower        | SunPower        | REC             | SunPower        | 9                  |
| 4          | SolarWorld      | SolarWorld      | Suntech         | Suntech         | ReneSola        | ReneSola        | N/A                |
| 5          | SunPower        | Suntech         | Yingli Green    | ReneSola        | Yingli Green    | REC             | N/A                |
| 6          | Hanwha SolarOne | ReneSola        | ReneSola        | SolarWorld      | Trina Solar     | Yingli Green    | 1                  |
| 7          | Trina Solar     | Yingli Green    | SolarWorld      | Yingli Green    | Suntech         | Trina Solar     | 4                  |
| 8          | Yingli Green    | JA Solar        | JA Solar        | Trina Solar     | SolarWorld      | Suntech         | 3                  |
| 9          | ReneSola        | Trina Solar     | Trina Solar     | JA Solar        | Canadian Solar  | Hanwha SolarOne | 10                 |
| 10         | Canadian Solar  | Hanwha SolarOne | Hanwha SolarOne | Hanwha SolarOne | Hanwha SolarOne | JA Solar        | 8                  |
| 11         | JA Solar        | Canadian Solar  | Canadian Solar  | Canadian Solar  | JA Solar        | Canadian Solar  | 5                  |
| 12         | Jinko Solar     | Jinko Solar     | Jinko Solar     | Jinko Solar     | Jinko Solar     | Jinko Solar     | 7                  |

Table 11: Top R&D Companies Panel Efficiencies

| Manufacturer        | ID             | STC | Density | Eff.   | Tier |
|---------------------|----------------|-----|---------|--------|------|
| Sanyo Electric      | HIP-200BA19    | 200 | 14.89   | 17.24% | 1    |
| SunPower            | SPR-200-WHT-U  | 200 | 13.55   | 16.08% | 1    |
| Canadian Solar      | CS5A-200M      | 200 | 13.29   | 15.66% | 2    |
| Suntech Power       | PLUTO200-Ada   | 200 | 13.28   | 15.66% | 2    |
| Trina Solar         | TSM-200DA01A   | 200 | 13.12   | 15.64% | 2    |
| Kyocera Solar       | KC200GT        | 200 | 12.03   | 14.74% | 3    |
| Schuco USA          | SPV 200 SMAU-1 | 200 | 11.82   | 14.21% | 3    |
| BP Solar            | SX3200B        | 200 | 11.52   | 14.17% | 3    |
| Yingli Green Energy | YL200P-26b     | 200 | 11.26   | 13.65% | 4    |
| ET Solar Industry   | ET-P654200     | 200 | 11.18   | 13.61% | 4    |
| Evergreen Solar     | ES-200-RL      | 200 | 10.69   | 13.40% | 4    |
| Sharp               | ND-200U1       | 200 | 9.86    | 12.27% | 5    |

<sup>20</sup> Feb 2013. "What's Happening with c-Si and Thin Film Pricing Categories?"

<http://www.solarbuzz.com/resources/analyst-insights/what-happening-with-c-si-and-thin-film-pricing-categories>



### Tiers of Solar Panel Quality

Tier 1: Top 2% of solar manufacturers, vertically integrated, invests heavily in R&D, advanced robotic processes, manufacturing solar panels for longer than 5 years.

Tier 2: Small-medium scale manufacturers, no or little investment in R&D, use some robotics and rely on some manual work from human production lines, usually producing panels for 2-5 years.

Tier 3: Assemblers only – 90% of new solar PV, no investment in R&D, Assembly panels only, does not manufacture silicon cells, uses human production lines for manual soldering of solar cells instead of advanced robotics; assembling panels for 1-2 years.

### First Solar

First Solar is the only thin film maker in the top 10 list due to their business model; they shifted from supplying modules to external customers to using them predominantly on internal projects. First Solar has recently reported a range of record CdTe thin-film cell and module efficiencies both in the lab and at the manufacturing level. This year, R&D test cells produced at First Solar's Perrysburg, Ohio factory have been verified by NREL to have reached a new record cell conversion efficiency of 18.7%.

First Solar has launched its Series 3 CdTe thin-film PV module platform. The 'Series 3 Black' is said to incorporate First Solar's latest advances in conversion efficiency as well as additional features to enhance its performance in utility-scale power plants. The majority of PV power plants are located in hot temperature climates where module temperatures are above 25°C. Due to temperature coefficient impacts on module yields, limiting the temperature impact provides operators and owners with the best possible plant yield. Providing further enhancements due to harsh desert environments could increase the reliability of the modules.

The all-black module's change in appearance results from the use of an advanced, all-black edge seal technology combined with an innovative encapsulation material that further enhances its field durability and demonstrates improvements in accelerated life testing results. The Series 3 Black's performance in a wide range of operating environments is further validated by its new IEC 60068-2-68 "sand and dust test" certification, which measures durability in harsh desert environments characterized by blowing abrasive sand. First Solar retains its energy yield advantage in high temperature climates (temperature coefficient) where 90% of a PV plant's generation can occur when module temperatures are above 25°C. The Series 3 Black is expected to have module conversion efficiencies greater than 12.9% to 13%. First Solar began to implement the Series 3 Black enhancements in production modules earlier this year.

### Jinko Solar

Jinko Solar also developed projects in China, and was one of the main beneficiaries from strong domestic market demand during the second half of 2012 from China.

### SunPower Corporation

SunPower recently launched its 'X-Series' module that employs its latest 'Maxeon Gen 3' solar cell technology, which has conversion efficiencies of over 24%. The modules have efficiencies of 21.5% and above. SunPower has delivered over 120 large-scale solar photovoltaic systems over the past decade.



### Sharp

Sharp Solar Panels are currently the best-selling panel in the UK - comprising 180W, 185W and 235W series, module efficiencies of 13.7%-14.1%, 5 year product warranty and 10 and 25 year performance warranty of outputs of 90% and 80%.

### Hanwha Solar One

Hanwha Q CELLS has introduced its polycrystalline-based 'Q.PRO-G3' series module. Using its 'Q.ANTUM' high-efficiency solar cell technology (19.5% conversion efficiencies) and performance induced degradation (PID) free technology, the module employs a lighter and slimmer design, using higher tensile aluminum frame. Slimmer module design and low weight allow for more modules per box and provide easier installation. Reducing logistics burdens and storage costs as well as less packaging waste support overall cost reductions.

The new polycrystalline module features high performance cells based on Q.ANTUM technology, which generates higher module power. The Q.ANTUM dielectric cell back side reflects light waves which have passed through the cell, thus enabling the use of otherwise lost light energy. The module's new high-quality anti-reflection glass further boosts power yields to facilitate polycrystalline solar modules with power classes of up to 265 Wp. Q.PRO-G3's lighter and slimmer design allows easier handling, and reduces warehousing and logistics costs by up to a claimed 29%.

According to the latest edition of the International Technology Roadmap for PV, significant changes, especially in the field of solar cell design and related move to N-type mono wafers and a switch to copper metallization starting in 2015, are predicted. An entire suite of evolutionary changes from wafers, materials, cells and modules are expected that should require and have already forced some leading companies to continue to invest in R&D activities, a trend that is expected to continue in the mid-term.<sup>21</sup>

### Yingli

Yingli is one of the world's largest vertically integrated manufacturers, high efficiency, 210 W, 235 W outputs, module efficiency of 14.4%, 5 year product warranty and 25 years performance warranty of outputs of 80%.

### Kyocera

Kyocera high-performance solar cells, with efficiency of over 16%, provide high annual energy yields. Kyocera is one of the world's largest vertically-integrated producers and suppliers of solar energy panels. Kyocera Solar, Inc. (KSI) is headquartered in Scottsdale, Arizona, manufacturing and installing more than 1.2 gigawatts of solar collection.

### Trina Solar

Trina Solar is planning to introduce the 60-cell PDG5, the first in a new line of dual rated frameless modules. The PDG5 is optimized for reliable performance under stressful environmental conditions. Although glass/glass modules are believed to offer higher levels of robustness, especially in harsh environments they have typically suffered from higher cost and carry a weight penalty. The PDG5 features front and back layers of special heat-strengthened glass replacing the traditional backsheet materials of conventional solar modules. The PDG5 provides a heavy-duty solution for environments of high temperature and humidity, conditions that can accelerate performance degradation. The resulting module

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<sup>21</sup> Jun 2013. PVTech. "Friday Focus: R&D spending analysis of top PV module manufacturers in 2012."

has increased resistance to micro-cracking, potential induced degradation (PID), module warping, and degradation from UV rays, sand, alkali, acids and salt mist.

By reducing the module's glass thickness from the industry standard of 3.2mm to 2.5 mm, and applying an antireflective coating to the front glass, transmission is enhanced by an estimated 2.5%. MC4PLUS photovoltaic connectors increase system reliability. Modules are designed for higher 1000V IEC and 1000 V UL applications, which enables longer installation runs to enable improve cabling, hardware and labor installation costs. By eliminating the aluminum frame of conventional modules, grounding requirements are eliminated, which can extend Balance of System (BoS) cost savings. The new modules are backed by a 25-year linear power warranty.

### SunEdison

SunEdison are tier 1 solar panels: vertically integrated, invests heavily in R&D, and have an advanced robotic processes.

When assessing potential solar panel manufacturers, look for large publicly traded, government sponsored or large U.S. based manufacturer. Always ask for the manufacturer's stock symbol, sponsoring government identity or U.S. solar panel manufacturing facility address. With the flood of solar panels that are entering the U.S. market that are coming from hundreds of tiny, financially unsound overseas manufacturers. If a catastrophic manufacturing defect were to occur and a major portion of a manufacturer's production were to result in a recall, it would be highly unlikely that a small privately held overseas company would be able to survive the replacement of even a moderate portion of their production. A larger publicly traded, government sponsored or U.S. based manufacturer would be far more likely to possess the financial strength to honor their warranty.

### Suntech

Suntech Power Holdings Co. (STP), forced to put its Chinese solar unit into bankruptcy this year. Regulatory filings show customers linked to the founder couldn't pay their bills and the company booked the sales as revenue anyway.

### **Solar Thermal<sup>22</sup>**

Solar thermal electric energy generation concentrates the light from the sun to create heat, and that heat is used to run a heat engine, which turns a generator to make electricity. The working fluid that is heated by the concentrated sunlight can be a liquid or a gas. Different working fluids include water, oil, salts, air, nitrogen, helium, etc. Different engine types include steam engines, gas turbines, Stirling engines, etc. All of these engines can be quite efficient, often between 30% and 40%, and are capable of producing 10's to 100's of megawatts of power.

Line focus is less expensive, technically less difficult, but not as efficient as point focus. The basis for this technology is a parabola-shaped mirror, which rotates on a single axis throughout the day tracking the sun. Point focus technique requires a series of mirrors surrounding a central tower, also known as a power tower. The mirrors focus the sun's rays onto a point on the tower, which then transfers the heat into more usable energy.

Point focus, though initially more expensive and more complex, is more efficient. The point

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<sup>22</sup> "An Industry Report on Solar Thermal," <http://www.solar-thermal.com/>



of focus in a line focus mirror array temperatures can reach 250°C, enough to run a steam turbine, however, point focus can achieve higher temperatures in the 500°C range thus offering greater efficiencies. Improved efficiencies minimize land usage and the effective cost per kWh of the plant.

Spain and Australia are the current leading countries in solar thermal energy production. Spain produces a large percentage of their electricity through their solar thermal facilities, built by solar thermal powerhouses such as Acciona and Abengoa. California based solar thermal company, eSolar, and the Israeli company, Brightsource, are fast growing competitors.

Abengoa is opening the first power tower to be used for commercial energy production. eSolar is working with Southern California Edison to use solar thermal technology to generate 245 MW of power. Similarly, Brightsource has contracts with Pacific Gas and Electric Company to bring even more solar thermal generated power to California. SolarReserve, a California company, is building a 110 MW Crescent Dunes facility in Nevada, which will be the largest solar tower system with integrated storage.

eSolar has a different strategy to other solar tower technology developers that are building large-scale power plants of between 100 MW and 400MW with large towers soaring between 150 m and 200 m high. eSolar is developing smaller arrays in the 46 MW range around 65m high. eSolar recently completed a molten storage integration study funded by the Department of Energy. With molten salt technology would enable collecting more energy throughout the day and enable the plant to run after the sun goes down. Molten salt storage technology is still in the research and development (R&D) phase.

Compared to PV, solar thermal requires more area and water for cooling purposes.

### **Concentrator Photovoltaic Systems<sup>23</sup>**

A concentrator makes use of relatively inexpensive materials such as plastic lenses and metal housings to capture the solar energy shining on a fairly large area and focuses that energy onto a smaller area—the solar cell. A typical concentrator unit consists of a lens to focus the light, a cell assembly, a housing element, a secondary concentrator to reflect off-center light rays onto the cell, a mechanism to dissipate excess heat produced by concentrated sunlight, and various contacts and adhesives. Both reflectors and lenses have been used to concentrate light for PV systems.

Concentrator PV systems use less solar cell material than other PV systems. PV cells are the most expensive components of a PV system, on a per-area basis.

Concentrator PV systems have several advantages over flat-plate systems. First, concentrator systems reduce the size or number of cells required and allow for more efficient semiconductor materials that would otherwise be cost prohibitive. Second, a solar cell's efficiency increases under concentrated light. Third, a concentrator can be made of small individual cells; it is harder to produce large-area, high-efficiency solar cells than it is to produce small-area cells.

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<sup>23</sup> US DOE Energy Efficiency and Renewable Energy. "Concentrator PV Systems".

[http://www.eere.energy.gov/basics/renewable\\_energy/concentrator\\_pv\\_systems.html](http://www.eere.energy.gov/basics/renewable_energy/concentrator_pv_systems.html)



One challenge for concentrating PV is the concentrating optics are significantly more expensive than the covers necessary for flat-plate PV systems. In addition, most concentrators must track the sun throughout the day and year to be effective; thus, achieving higher concentration ratios means using expensive tracking mechanisms that incorporate more precise controls. Concentrators cannot focus diffuse sunlight, which makes up about 30% of the solar radiation available on a clear day.

High concentration ratios also introduce a heat problem; concentrating solar radiation generates significant amounts of heat. Cell efficiencies decrease as temperatures increase, and higher temperatures also threaten the long-term stability of solar cells. Therefore, the solar cells must be kept cool in a concentrator system, requiring sophisticated heat sync cooling designs.

### **Microgrids**

Microgrids are emerging communications and controls technologies that are evolving rapidly to support demand management and the integration of distributed generation into electricity grids. The shift toward greater reliance on distributed resources is one of the trends that are shifting the U.S. energy system away from fossil fuels to efficiency and renewables. The control and operation of the electricity grid is a key enabler for using smaller distributed technologies to solve energy problems.

The transmission and distribution grid is inherently prone to blackouts that scientists at Lawrence Berkeley National Laboratory estimate cost U.S. businesses and residents up to \$160 billion annually. Perpetuating this system would not only degrade national security but also drive up carbon emissions 40% by 2050—nearly 600% above levels needed to meet U.S. treaty obligations.<sup>24</sup>

At the University of California San Diego (UCSD), the microgrid provides the ability to manage 42 MW of generating capacity, including a central cogeneration plant, an array of solar photovoltaic installations and a fuel cell that operates on natural gas reclaimed from a landfill site.<sup>25</sup> The central microgrid control allows operators to manage the diverse portfolio of energy generation and storage resources on the campus to minimize costs. In addition, the campus can “island” from the larger grid to maintain power supply in an emergency, as in the case of the power blackout that struck parts of Southern California, Arizona and Mexico in September 2011. The microgrid at UCSD serves as a laboratory to experiment with integration and management of local resources and to optimize the use of these resources in interaction with market signals from the larger grid.

At UCSD, renewable energy provides 100% of load. Cloud tracking technology is utilized to predict the clouds and estimates several minutes and days in advance. Microgrids save millions of dollars, increase sustainability, and reduce the effects of climate change.

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<sup>24</sup> Rocky Mountain Institute. “The Science Behind Reinventing Fire: Electricity,” <http://www.rmi.org/Electricity>.

<sup>25</sup> UC San Diego, “Smart Power Generation at UCSD,” Nov. 2010.

[http://ssi.ucsd.edu/index.php?option=com\\_content&view=article&id=416:smart-power-generation-at-ucsd-november-1-2010&catid=8:newsflash&Itemid=20](http://ssi.ucsd.edu/index.php?option=com_content&view=article&id=416:smart-power-generation-at-ucsd-november-1-2010&catid=8:newsflash&Itemid=20)





### **WAPA Boulder Canyon Allocation Act of 2011<sup>26</sup>**

The Western Area Power Administration (WAPA) is in the process of finalizing marketing criteria for allocating federal power from the Boulder Canyon Project (BCP), whereas Tribes are given preference to their relatively inexpensive hydro power. They have created a 5% resource pool of 103.7 MW referred to as "Schedule D" that will be allocated to new customers. Pascua Yaqui would need to make arrangements for the power by "wheeling" power through Trico or by making arrangements with nearby Tohono O'odham. WAPA anticipates publishing the final marketing criteria in December 2013, followed by a 90 day comment period. Pascua Yaqui could make a request for enough power to meet their entire load requirements. Red Mountain highly recommends submitting an application for the Boulder Canyon Allocation. Mike Simonton, the Project Manager for Boulder Canyon Remarketing can be reached at 602-605-2675 or [Simonton@wapa.gov](mailto:Simonton@wapa.gov).

### **Technology Summary**

Based on current market conditions and technological advances, Red Mountain recommends the solar project size to be in the 20-30 MW range. Solar project sizes in Arizona and California have decreased significantly and improve the likelihood of grid interconnection and minimize network upgrades. The actual project size will depend on the actual customer for power. Based on the results of the market analysis, government entities have been administering RFP's for specific sized renewable energy projects.

For the technology, Red Mountain recommends PV panels. Currently PV is the most cost competitive solar technology for utility scale generation applications and also requires minimal operations and maintenance. It is the most prevalent technology in the industry and has penetrated the Arizona renewable energy market. Utilities and investors are familiar with the technology and it is an economically viable technology. Pascua Yaqui can consider adding additional generation to firm the solar or other storage technologies for the project site.

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<sup>26</sup> WAPA. Boulder Canyon Project Remarketing Effort.

[https://www.wapa.gov/dsw/pwrmkt/BCP\\_Remarketing/default.htm](https://www.wapa.gov/dsw/pwrmkt/BCP_Remarketing/default.htm)



## Section 8: Tortuga Ranch Economics

Red Mountain made a list of assumptions for the Tortuga Ranch Project; see list of assumptions below. Red Mountain assumed there would be an agreement signed with a taxable entity in order to qualify for the 30 % Federal Investment Tax Credit, a critical program to ensure bankability.

### Financial Model Overview

- Conventional Partnership
- Tax Assumptions
  - o 5 Year Accelerated Depreciation
  - o 30% Investment Tax Credit
  - o Corporate Income Tax Rate (State Tax =6.98%) = 25%
  - o New Market Tax Credits = 39%
  - o Indian Employment Tax Credit
- Schedule
  - o Begin Development: 1/1/2014
  - o Begin Construction: 5/1/2014
  - o COD: 8/1/2014
- Financing Assumptions
  - o Construction Financing = 60%
  - o Interest Rate = 8%
  - o Construction Loan Term = 15 years
  - o DOE Grant = \$1-1.5 MM
  - o Trico Production Based Incentive =\$0.025/kWh

Red Mountain ran financial model sensitivities on the Project PPA pricing and the interest rate to understand how they impact the internal rate of return (IRR) of the Project. Red Mountain assumed a 20 MW Solar PV Project size; see size and technology assumptions in Table 12 below. Table 13 describes the capital costs of the Project. Note the capital costs include development costs and are estimated to be approximately \$58.6 MM. Depending on where the project interconnects, interconnection costs will vary between \$2 MM- \$10MM. For modeling purposes, Red Mountain assumed \$5 MM in interconnection costs.

See Table 14 below for results. Red Mountain ran sensitivities on PPA pricing and interest rates and assumed the PPA price includes a 2% annual escalation rate. For example, a Project with a PPA price of \$65.00/MWh and a conventional loan interest rate of 6.0% would achieve an IRR of **8.9%**. If the PPA price increases to \$70.00/MWh with a 6% interest rate, the Project would achieve a **10.9% IRR**. See Appendix 7 for the detailed financial model assumptions, income projections, and cash flow for the 67.50/MWh price and 6% interest rate. Typical returns for a solar PV investor today are in the 7-10% range today.



Table 12: Tortuga Ranch Project Assumptions

**Plant Assumptions**

|                                               |             |
|-----------------------------------------------|-------------|
| Plant Capacity (MW <sub>DC</sub> )            | 23.77       |
| Plant Capacity (MW <sub>AC</sub> )            | 20.00       |
| Yr 1 Output (MWh)                             | 46,219      |
| Technology                                    | Fixed Tilt  |
| Module                                        | REC – 250PE |
| Inverter                                      | Power One   |
| Residual Value at end of 20 Yr PPA ~ \$500/kW | \$10MM      |

Table 13: Tortuga Ranch Project Cost

**PROJECT COSTS, MM**

|                                          |           |               |
|------------------------------------------|-----------|---------------|
| Capital Costs* (\$2.36/W <sub>DC</sub> ) | \$        | 58.608        |
| Interconnection                          | \$        | 5.000         |
| Capitalized Interest                     | \$        | 0.591         |
| <b>TOTAL PROJECT COSTS</b>               | <b>\$</b> | <b>64,199</b> |

Table 14: Tortuga Ranch Economics

|               | INTERNAL RATE OF RETURN |          |          |
|---------------|-------------------------|----------|----------|
|               | \$/MWh                  |          |          |
|               | \$ 65.00                | \$ 67.50 | \$ 70.00 |
|               |                         |          |          |
| Interest Rate | 8.0%                    | 6.0%     | 7.0%     |
|               | 7.0%                    | 7.4%     | 8.5%     |
|               | 6.0%                    | 8.9%     | 9.9%     |

Typically, Tribes will partner with taxable entities and setup a partnership “flip” arrangement. For this scenario, the taxable entity invests all of the capital into the project and owns the project for the first 7 years in order to recap all of the tax benefits. The ownership “flips” back to the Tribe at a discounted price. Red Mountain engaged Kyocera to provide an estimate of what they may be able to offer in terms of a partnership flip.

Kyocera estimated by year 7, they could offer up the Project for an estimated \$1.30/W; this equates to \$30.2 MM; see Table 14 below for an estimated total project cost. Red Mountain modeled this scenario as well. Red Mountain assumed the PPA price to be \$68/MWh with a 2% escalator. At this price, Pascua Yaqui would achieve an IRR = **11.61%**.

Table 15: Tortuga Ranch Project Cost

**PROJECT COSTS, MM**

|                                          |           |               |
|------------------------------------------|-----------|---------------|
| Capital Costs* (\$1.30/W <sub>DC</sub> ) | \$        | 29.901        |
| Capitalized Interest                     |           | 0.299         |
| <b>TOTAL PROJECT COSTS</b>               | <b>\$</b> | <b>30.200</b> |



## Section 9: Business Opportunity Assessment

Red Mountain identified potential sources of funds described below.

### **Finance Opportunities, Grants & Loans**

#### *Qualified Energy Conservation Bonds – QECBs (Tribes)<sup>27</sup>*

Applicability: Qualified Energy Conservation Bonds may be used by state, local and tribal governments to finance certain types of energy projects. QECBs are qualified tax credit bonds similar to CREBs

Limits: Total volume of QECBs available is \$3.2 billion, with \$67 million available in Arizona, based on state population

Process: Application process, per IRS Notice 2009-29

#### *US Department of Agriculture Rural Energy for America Program REAP (Tribes/taxpayers)*

REAP provides financial assistance to agriculture producers and rural small business for the specific purpose of purchasing, installing and constructing renewable energy systems. May require that a business level feasibility study be completed; SBA's Small Business Standards.

#### *USDA REAP Loan Guarantees<sup>28</sup>*

USDA REAP is currently the acceptance of applications for Fiscal Year 2013 for financial assistance as follows: grants, guaranteed loans, and combined grants and guaranteed loans for the development and construction of renewable energy systems and for energy efficiency improvement projects; and grants for conducting renewable energy system feasibility studies. The USDA also announced the availability of up to \$20.8 million of Fiscal Year 2013 budget authority to fund these REAP activities, which will support up to \$10.4 million in grant program level and up to \$43.4 million in guaranteed loan program level.

See grant opportunity for 2013: <https://www.federalregister.gov/articles/2013/03/29/2013-07275/notice-of-funding-availability-for-the-rural-energy-for-america-program>

#### *Department of the Interior Loan Guarantees*

Borrower must be a federally recognized American Indian Tribe, with no less than 51% ownership. Borrower must be projected to have at least 20% equity in the business being financed immediately after the loan is funded.

Indian Guaranteed Loan Program – The budget provides \$5.0 million for the loan program, a reduction of \$2.1 million from the 2012 enacted level, while the program undergoes an independent evaluation.

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<sup>27</sup> US Dept. of Energy. Database of State Incentives for Renewables & Efficiency.

[http://www.dsireusa.org/incentives/incentive.cfm?Incentive\\_Code=US51F&re=1&ee=1](http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=US51F&re=1&ee=1)

<sup>28</sup> USDA. The Rural Energy for America Program. [http://www.rurdev.usda.gov/BCP\\_Reap.html](http://www.rurdev.usda.gov/BCP_Reap.html)



*New Energy Frontier Initiative* –The 2013 budget request provides a total of \$8.5 million to support energy resource development on tribal lands. Of that amount, \$6.0 million is provided for renewable energy projects. The primary purpose of these projects is to provide a reliable renewable energy resource that will be utilized in manufacturing or alternatively, industrial processes on Indian Trust lands. The remaining \$2.5 million is provided for conventional energy and audit compliance in support of leasing activities on the Fort Berthold Reservation.

#### *Department of Energy- Community Scale Clean Energy Projects*

The Department of Energy recently released a grant opportunity on May 24<sup>th</sup>, 2013 for Community Scale renewable energy projects. The following is a list of requirements for the grant:

- Eligibility: must reduce fuel use by 15%
- Minimum of 50 kW rated capacity
- Maximum and Minimum Award Amount - Ceiling (i.e., the maximum amount for an individual award made under this announcement): **\$1,500,000**
  - o Floor (i.e., the minimum amount for an individual award made under this announcement): \$50,000.
  - o DOE anticipates making ten (10) to twenty (20) awards under this announcement, depending on the size of the awards and level of Congressional appropriations, if any
  - o DOE will accept only new applications under this announcement (i.e., applications for renewals of existing DOE funded projects will not be considered).
- The potential energy savings, level of commitment, and capabilities of the applicant and project participants to accomplish the project objectives will be major factors in selecting projects for funding.
- A 50% cost share of the total project costs (100% match against DOE funds) is required under this Funding Opportunity Announcement. Applicants may request a cost share reduction of no less than 10% of total project costs. Requests for reduction of cost share must be accompanied by a written justification and evidence of financial need. All cost share must come from non-Federal sources unless otherwise allowed by law. Cost share may include cash or in-kind contributions (e.g., contribution of time, services, or property; donated equipment, buildings, or land; donated supplies; or unrecovered indirect costs).
- Approximately \$2,500,000 to \$4,500,000 is expected to be available for new awards under this announcement in Fiscal Year 2013 (FY2013). The actual level of funding depends on Congressional appropriations for this program.

#### *Department of Energy Loan Guarantees*

The Department of Energy (DOE) Loan Guarantee Program helps to bring down the financing costs for large energy projects. Since its inception, the program has supported 28 energy projects creating thousands of construction and manufacturing jobs nationwide. The





DOE Loan Guarantee Program was created in the Energy Policy Act of 2005 to overcome the great challenges that large nuclear, renewable, and other energy projects face in obtaining affordable long-term financing in the commercial marketplace. Since its creation, the DOE Loan Guarantee Program has closed loan guarantees for 28 energy projects and made commitments to two others, sparking private investment of more than \$25 billion.

Through the Loan Guarantee Program, DOE guarantees the debt of privately held energy generation and manufacturing projects, guaranteeing to a private lender that if the company defaults on a loan related to the project, the government will step in to repay the outstanding balance. The Loan Guarantee Program is designed to encourage private investment while minimizing risk to the taxpayer. Each dollar appropriated for the program leverages up to thirteen dollars in private sector investment. In addition, applicants undergo a rigorous review process to decrease the risk of each project. Funds are set aside to cover any future defaults. For more information, see website: <http://www.lgprogram.energy.gov/>.

### *EPA Programs*<sup>29</sup>

EPA is encouraging renewable energy development on current and formerly contaminated lands, landfills, and mine sites when it is aligned with the community's vision for the site. This initiative identifies the renewable energy potential of these sites and provides other useful resources for communities, developers, industry, state and local governments or anyone interested in reusing these sites for renewable energy development.

EPA grant programs and other funding opportunities:

- Air Grants: includes competitive grant funding announcements for projects and programs relating to air quality, transportation, climate change, indoor air and other related topics.
- Community Action for a Renewed Environment (CARE): provides funding to build broad-based partnerships to reduce environmental risks at the local level.
- Environmental Education Grants: projects to help the public make informed decisions that affect environmental quality.
- Environmental Justice: includes the EJ Community/University Partnership Grants Program and the Environmental Justice Through Pollution Prevention Grants Program.
- People, Prosperity and the Planet: college students address challenges from a wide range of categories: agriculture, built environment, materials and chemicals, energy, and water. These can be challenges found in the developed or developing world and the solutions will move us towards a sustainable future.
- Pollution Prevention Grant Program: provides matching funds to state and tribal programs to support pollution prevention and to develop State-based programs.

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<sup>29</sup> EPA. "Why Site Renewable Projects on Contaminated Land?" <http://www.epa.gov/oswercpa/>



- Science to Achieve Results (STAR) Grants and Fellowships: funds research grants in numerous environmental science and engineering disciplines through a competitive solicitation process and independent peer review.
- Water Grants: includes the state revolving funds for drinking water and wastewater, grants for water pollution prevention and wetlands protection, and tribal grants.

## **Tax Incentives**

### *Investment Tax Credit*

Tax policies related to renewable energy play a vital role in creating new high-wage American jobs, spurring economic growth, ensuring U.S. global competitiveness, lowering energy bills for consumers & businesses, and reducing pollution. The solar investment tax credit (ITC) reduces the tax liability for individuals or businesses that purchase qualifying solar energy technologies. As a stable, multi-year incentive, the ITC encourages private sector investment in solar manufacturing and solar project construction. The solar ITC is the cornerstone of continued growth of solar energy in the United States.

In the U.S. tax code, the ITC is a 30% tax credit for solar systems on residential and commercial properties. Under current law, the ITC will remain in effect through December 31, 2016. The existence of the ITC through 2016 provides market certainty for companies to develop long-term investments that drive competition and technological innovation, which in turn, lowers costs for consumers.

### *New Market Tax Credits – NMTCs (Tribes and nontaxpayers)<sup>30</sup>*

On January 3, 2013 President Obama signed the American Taxpayer Relief Act of 2012 which included an extension of the New Markets Tax Credit Program for 2012 and 2013. The tax credit allocation authority is \$3.5 billion for each year. The following is a list of NMTC highlights:

- Investors receive tax credit equal to 5% of the investment amount in each of the first 3 years following initial investment; 6% following four years; total equals 39 % of the initial investment amount.
- Investors are required to maintain their investment in the CDE for the entire 7-yr period.
- Qualified CDE is a corporation, partnership, or other entity that is engaged in the development of a low-income area, defined as a census tract with a poverty rate > 20 %, or with a median family income below the greater of the median income for metropolitan areas or statewide median income (only the latter criterion is used for non-metro areas).
- Qualifying CDEs must invest at least 85 % of their tax-preferred financing in the development of a low-income community. CDEs may be community development banks, venture funds, or for-profit subsidiaries of community development

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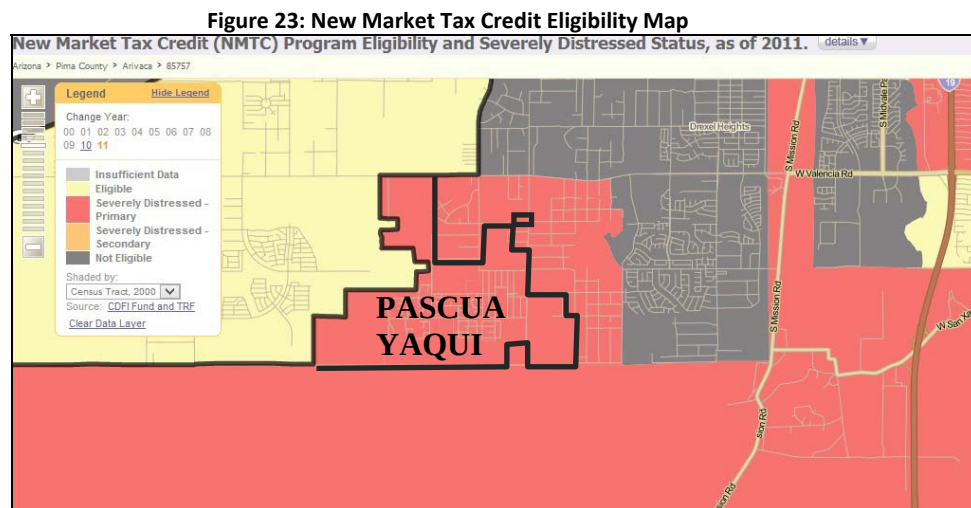
<sup>30</sup> US. Dept. of Treasury. Community Development Financial Institutions Fund.

[http://www.cdfifund.gov/what\\_we\\_do/programs\\_id.asp?programID=5](http://www.cdfifund.gov/what_we_do/programs_id.asp?programID=5)



corporations, among others. Through August 2011, the CDFI Fund had authorized \$29.5 billion in NMTC allocation authority.

See Figure 23 for a map of Pascua Yaqui and NMTC designation. The red areas on the map are Census tracts that the CDFI Fund has determined are eligible and meet the primary criteria requirements for the CDFI Fund's NMTC program severely distressed status. Orange areas are Census tracts that are NMTC Eligible and meeting the requirements for Secondary Criteria Severely Distressed Status. Yellow areas indicate those census tracts that meet the NMTC Program eligibility but are not severely distressed. Gray areas on the map are considered ineligible for NMTC Program funding.



### *Indian Employment Tax Credit*

The Indian employment credit (claimed on Form 8845) is 20% of the excess, if any, of the sum of qualified wages and qualified employee health insurance costs (not in excess of \$20,000 per employee) paid or incurred (other than paid under salary reduction arrangements) to qualified employees (enrolled Indian tribe members and their spouses who meet certain requirements) during the tax year. Tax credits claimed for certain terminated employees are recaptured and deductions for wages and health insurance costs are reduced by the credit Tribal Jurisdictional Primacy.

### **Technical Assistance**

#### *DOE Office of Indian Energy Policy and Programs Technical Assistance*

The Tribal Energy Program provides federally recognized Indian tribes, bands, nations, tribal energy resource development organizations, and other organized groups and communities—including Alaska Native villages or regional and village corporations—with technical assistance designed to advance renewable energy and energy efficiency projects. The application process requires a complete the technical assistance request form.

Technical assistance is typically limited to 40 hours and may include, but is not limited to, the following priority areas:

- Strategic energy planning



- Grantee support
- Transmission/interconnection
- Project development
- Finance
- Lease agreements

### **Renewable Energy Credit Sales**

Renewable Energy projects create energy as well as environmental attributes called Renewable Energy Credits (RECs). RECs represent the package of environmental attributes. Even though power from a renewable energy project may not physically be delivered to a customer, the environmental credits can be attributed to that customer. Every time a renewable energy producer adds electricity to the national electric grid, it also generates a renewable energy credit. A REC represents the additional cost and value of a specific amount of renewable energy that is generated. These credits are also the industry standard method of accounting for renewable energy production and they are audited and guaranteed by an independent third-party Green-e program run by the Center for Resource Solutions in San Francisco.

Renewable Choice sells these RECs on behalf of renewable energy producing partners to people and businesses who want to support renewable energy, as well as to utilities that are required to generate a percentage of the power they deliver from renewable sources.

*Purchases of Renewable Energy/RECs:* Only renewable energy certificates (RECs)/renewable energy where the renewable and environmental attributes are retained by the agency or retired can be counted against the Renewable Energy requirement. Therefore agencies shall include contract language that explicitly states that the federal agency retains ownership of the renewable energy attributes of any renewable energy/RECs that they purchase.

That portion of renewable energy/RECs that is used by another party (including electric service providers who claim ownership of renewable energy attributes to meet renewable portfolio standards), or transferred or sold by the federal agency to a third party, cannot be counted toward the Federal Renewable Energy Requirement.

Subsection c of Section 203 of the Energy Policy Act of 2005 provides for doubling of qualified Renewable Energy generation or purchases, if:

- (1) the renewable energy is produced and used on-site at a Federal facility;
- (2) the renewable energy is produced on Federal lands and used at a Federal facility; or
- (3) the renewable energy is produced on Indian land as defined in title XXVI of the Energy Policy Act of 1992 (25 U.S.C. 3501 et seq.) and used at a Federal facility.

If one Federal agency sells the renewable energy or RECs produced on its land to another Federal agency or to a Tribe, the purchasing agency shall receive double credit for each kWh purchased. If a federal agency (such as DOD, BLM, USFS, etc) develops a renewable project on their land, they get double credit as long as they retain the RECs.



## **Conventional Project Financing**

Project finance is asset-based financing, meaning that the project lenders have recourse only to the underlying assets of a project. It involves both debt and equity, where the debt-to-equity ratio is typically large (e.g., 70% debt to 30% equity). Debt is used when available and when it is the least expensive form of financing, with equity still needed for credit worthiness. Most important, revenue from the project must be able to generate a return to the equity investors, and pay for interest and principal on the debt, transaction costs associated with developing and structuring the project, and operations and maintenance costs.

Successful project financing must provide a structure to manage and share risks in an optimal way that benefit all participants, allocating risks to those entities that are able to mitigate each specific risk, and to share information about putting risk management in the proper hands at the proper stage of project development. Contractual agreements are, thus, important in risk mitigation. Today's project financing typically involves the creation of a stand-alone project company that is the legal owner of the project assets, and that has contractual agreements with other parties, such as purchasers of the products, suppliers, lenders, investors, sponsors, operators, insurers; and firms that engineer, procure, and construct the project. Traditionally, project financing has focused on large-scale projects—typically greater than \$500 million. In contrast, clean-energy projects are typically much smaller, whose size does not allow them to easily absorb high administrative and transaction costs. The ability to attract an affordable combination of debt, equity, and other sources of funding for the project is key to commercial success.

Other financial players also have a stake in the ultimate availability of project financing. For instance, the public sector has invested a lot of money in R&D for these technologies, and its goals depend on their eventual commercialization. Further, while there clearly is a gap between venture capital and project financing, venture capitalists want to see clear path to commercialization even in their early venture investments. Project financing availability also enables follow-on venture investment to occur.

Project investors worry foremost about technology risk. This worry must be effectively addressed as a prerequisite to any dialogue with lenders and equity investors, or they will not finance the project. Project-financing lenders will not accept the risk that the technology will be unable to perform consistently in a commercial setting to commercial standards over the life of the project. Nor will they accept risk that a technology will become prematurely obsolete—a concern that arises when a project involves a state-of-the-art technology in an industry whose technology is rapidly evolving.

One key challenge with many clean-energy technologies is that there is often no information on which to make comparisons, or no experience base or track record in the marketplace, which is needed for due diligence and risk assessment by the project financiers. Hence, technology risk is a particularly thorny issue with the plants employing new technology that is manufactured by an early-stage company, and that carry high costs because of their innovative and less-mature nature.

It also should be recognized that different investors along the technology-maturation spectrum often interpret technology risk differently; and/or have different tolerances for that risk. For example, a public-sector sponsor of high-risk R&D tends to see less risk than a venture capitalist, which, in turn, tends to see less risk than a project financier, who wants to





accept no technical risk and to see well-documented technical verification and acceptance in the marketplace. Often the most optimistic view is held by the entrepreneur, who has progressed through a working bench model, an alpha test, and a pilot-scale site that seems to be working—and who thinks commercialization is close at hand.

The amount of debt a project can raise is a function of the project's expected capacity to service debt from project cash flow—or, more simply, its credit strength. Typically, a project has no operating history at the time of its initial debt financing. In general, a project's credit strength derives from (1) the inherent value of the assets included in the project; (2) the expected profitability of the project; (3) the amount of equity that project sponsors have at risk (after debt financing is completed); and, indirectly, (4) the pledges of credit-worthy third parties or sponsors involved in the project.

With many projects based on clean-energy technology, especially with relatively new technology, credit worthiness is a concern to lenders. Often the relatively new clean-energy technology not only lacks sufficient testing and verification, it also lacks sufficient acceptance in the marketplace. Plus, the technology is frequently manufactured by an early-stage company that may have a weak balance sheet and no credit track record. This credit issue is compounded when the start-up company manufactures the technology and acts as the project owner (in such cases the project is de facto the company, whose viability depends on project success).

Distributed generation (“DG”) projects using renewable energy are typically smaller than large infrastructure projects that tend to dominate the project-financing industry. This should be evident since DG is meant to be smaller, located nearer to the customer and therefore not requiring costly transmission and distribution (“T&D”) infrastructure. Large projects have a competitive advantage because they can absorb large due-diligence and transaction costs. With the small size of many renewable-energy projects, due-diligence and transaction costs can make the cost of project financing prohibitive.

### **Pascua Yaqui Partnership Options**

A Pascua Yaqui partnership project could take several forms. These could include, for example, a partnership with a solar panel manufacturer, renewable energy developer, utility or non-operating tax partner.

A developer could partner with the Tribe, providing funding for development, equipment and a credit-worthy entity for financing purposes. Typically, a developer's profit motive or tax appetite would drive this type of interest, although it is possible that a developer could partner in this way on a cost basis.

A utility could potentially partner with Pascua Yaqui, since development of such a project on tribal lands could create project cost reduction potential, while providing multiple tax credit opportunities. Renewable development on reservation lands of a willing and eager Tribe could potentially reduce environmental review costs, property tax costs, equipment costs, and land costs. And, by taking advantage of all of the tax-related incentives available for renewable projects, a utility, or non-operating tax partner could benefit, and reduce the overall project cost of power, while creating valuable, and needed solar Renewable Energy Credits to meet its Renewable Portfolio Standard requirements.



## Section 10: Tribal Benefits and Professional Development Planning

### Job Opportunities

Red Mountain has identified the optimal use of the Job Opportunities and Training Program that will work towards creating a valuable workforce for the Pascua Yaqui community. The best use of this program is to train individuals to install photovoltaic systems while creating an apprenticeship program where they will work directly on the project. Creating apprenticeships for solar PV installers and electricians will not only serve the project directly, but it will work towards building a workforce to serve Tucson & Greater Arizona's long term goals to install solar. The resulting workforce will have the capacity to install residential, commercial and utility scale PV systems. This training program will be utilized for employed and unemployed members of Pascua Yaqui.

The following is a tabulated list of job descriptions identified for the job training program:

Table 16: Job Opportunities & Training

| PROJECT COMPONENT     | POTENTIAL TASKS                                                                  | SKILLSET               |
|-----------------------|----------------------------------------------------------------------------------|------------------------|
| Structural Installers | Install solar system support structure for the panels.                           | Laborer                |
| PV System Installers  | Installation of system, panels, wiring, controls, inverters, etc.                | Laborer or Electrician |
| Electrician           | Check electrical installation of system and approve the installation.            | Electrician            |
| System Maintenance    | Routine maintenance of panels, balance of systems, and quarterly panel cleaning. | Laborer                |

### Training

Central Arizona College, Coolidge, AZ<sup>31</sup>

The photovoltaic program at Central Arizona College offers advanced photovoltaic energy and system installation training; includes safety basics, stand-alone PV system sizing, grid-tied system sizing, National Electric Code (NEC) compliant wire sizing, grounding of PV systems, site analysis and array mounting, and PV system commissioning, troubleshooting, maintenance and performance evaluation.

The PV course is both lecture and hands-on lab. The students learn of safe design practices and installation of an off-grid and grid-tied residential PV system in a lab setting. The lab offers the students to work in teams and to communicate effectively to better prepare the students in the solar energy workforce. This program is currently sponsored by a grant and available free.

For more information on the photovoltaic program, contact Debby Tewa at Deborah.Tewa@centralaz.edu or 520.494.5910.

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<sup>31</sup> Central Arizona College. "Solar"

[http://www.centralaz.edu/home/academics/divisions\\_and\\_programs/engineering\\_technology\\_division/renewable\\_energy/solar.htm](http://www.centralaz.edu/home/academics/divisions_and_programs/engineering_technology_division/renewable_energy/solar.htm)



### North American Board of Certified Energy Practitioners (NABCEP)-

NABCEP offers certification and certificate programs to renewable energy professionals throughout North America including PV and Solar Heating Installation. NABCEP is the most respected and widely recognized certification organization for North American solar professionals.

#### Entry Level

The NABCEP Entry Level Program is designed for those individuals wanting to get into the solar field; achievement of the NABCEP Entry Level Exam is a way for candidates to demonstrate that they have achieved a basic knowledge of the fundamental principles of the application, design, installation and operation of PV and Solar Heating systems.

Upon successful completion of coursework offered by NABCEP, a student is eligible to sit for one of the Entry Level Exams. Prior to taking the NABCEP PV or Solar Heating Entry Level Exam, students should have demonstrated a basic understanding of the principles outlined in the Learning Objectives. The knowledge demonstrated by passing this test does not replace the knowledge, skills or abilities of the electrical or other construction trades, or those of other professions or degree programs that require considerably more academic and/or practical experience.

Students achieving this industry-sponsored Entry Level Exam may find that their employment opportunities are enhanced by starting the job with an understanding of the basic terms and operational aspects of a PV or Solar Heating system. However, completing coursework and passing the exam does not qualify an individual to install these systems.

The PV Entry Level Learning Objectives include ten (10) knowledge content domains:

1. PV Markets and Applications
2. Safety Basics
3. Electricity Basics
4. Solar Energy Fundamentals
5. PV Module Fundamentals
6. System Components
7. PV System Sizing Principles
8. PV System Electrical Design
9. PV System Mechanical Design
10. Performance Analysis, Maintenance and Troubleshooting

The following is a list of local colleges that provide the NABCEP Entry Level Training:



|                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><i>Pima Community College</i><br/> Contact/Instructors: Lazaro Hong, Ph.D, ChienWei Han, Ph.D<br/> e-mail: Lazaro.Hong@pima.edu, Chien.Han@pima.edu<br/> Tele. (520) 206-6603<br/> www.pima.edu</p>                          | <p>TEC 198T5: Photovoltaic Installation Training: Introduction to PV energy and PV systems installation. Includes markets and applications, safety basics, electricity basics, energy efficient appliances, solar energy fundamentals, PV materials, module fundamentals, concentrators, system components, system sizing, electrical design, mechanical design and performance analysis and troubleshooting. 3 credit hours, lecture and lab. Traditional classroom with heavy hands-on component.</p> |
| <p><i>Tucson College</i><br/> Contact: Al Valenzuela<br/> e-mail: al.valenzuela@tucsoncollege.edu<br/> Tele. (520) 258-0431<br/> www.tucsoncollege.ed</p>                                                                       | <p>SE 100 Solar Energy – Photovoltaic Systems: Student will study basic solar electricity, PV application &amp; system components, also included are solar site analysis, utility-interactive PV systems, component specification, and system cost and economics. Student will research &amp; evaluate cases studies and real life systems application. Traditional classroom lecture: 48 hours</p>                                                                                                     |
| <p><i>Tucson Electrical Joint Apprenticeship &amp; Training Program</i><br/> Contact: Karen King, Training Director<br/> Email: tejatp@tucsonelectricaljatp.org<br/> Tele. (520) 790-4690<br/> www.tucsonelectricaljatp.org</p> | <p>PV Systems Class: Apprenticeship training:<br/> Introduction to PV systems; solar radiation;<br/> site surveys and preplanning; system components and configurations; cells, modules and arrays; batteries; charge controllers; inverters; mechanical integration; electrical integration; utility interconnection; permitting &amp; inspection. Traditional hands-on application and course curriculum. Held on Saturdays.</p>                                                                      |

#### Certification

Certification offers the public a high degree of protection because practitioners have to voluntarily meet standards and qualifications and pass an exam. All applicants for NABCEP certification must complete an application with all required documentation, pay an application fee of \$125, and submit the application for review. NABCEP accepts applications on an ongoing basis, but in order to qualify to sit for any particular exam date, applications must be completed, paid for, and submitted prior to the Application Deadline for that exam.

The NABCEP PV Installation Professional certification is a voluntary certification that provides a set of national standards by which PV Installation Professionals with skills and experience can distinguish themselves from their competition. Certification provides a measure of protection to the public by giving them a credential for judging the competency



of practitioners. It is not intended to prevent qualified individuals from installing PV systems or to replace state licensure requirements. The target candidate for the certification includes, but not limited to: installers, project managers, foreman/supervisor, and designers.

NABCEP is a member of the Institute for Credentialing Excellence (I.C.E.) and has endeavored to follow the requirements of ISO/IEC Standard 17024: General Requirements for Bodies Operating Certification Systems of Persons.

All candidates for the Solar PV Installation Professional Certification must have experience in the field acting as the person responsible for installing PV systems, a minimum of 58 hours of advanced PV training and an OSHA 10 hour construction industry card or equivalent. Specific requirements for each candidate vary by category according to your experience and background. It is important to review the Certification Handbook in order to choose a category under which to apply.

#### Department of Energy Office of Indian Energy Policy and Programs<sup>32</sup>

- Renewable Energy Online Learning
- Tribal Leader Energy Forums
- Tribal Renewable Energy Webinar Series
- Past Tribal Workshops and Presentations

The DOE Office of Indian Energy is working to build tribal energy capacity by providing education and training resources such as renewable energy online learning, forums, webinars, presentations, and more. See Website for the following training opportunities:

- Solar,
- Energy Strategic Planning,
- Project Development Concepts
- Project Development Process
- Project Financing Concepts
- Project Financing Process and Structures
- Commercial Scale Projects
- Community Scale Projects
- Facility Scale Projects

#### *Energy Resource Library*

Establishing a Tribal Utility Authority Handbook (Energy Resource Library)

- Municipal Electric Utilities
- Power Market Primers
- Tribal Authority Process Case Studies: The Conversion of On-Reservation Electric Utilities to Tribal Ownership and Operation
- Legal and Regulatory
- Transmission
- Utilities
- Renewable Energy Technologies

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<sup>32</sup> Office of Indian Energy Policy and Programs. "Renewable Energy Online Learning.  
<http://energy.gov/indianenergy/renewable-energy-online-learning>





### Department of Energy Efficiency & Renewable Energy

Tribal Energy Program webinars are designed to provide Indian Country with relevant, timely information on energy efficiency and renewable energy technologies and project development.

The U.S. Department of Energy's (DOE)'s Tribal Energy Program, together with DOE's Office of Indian Energy Policy and Programs, provides strategic energy planning and project development technical assistance to federally recognized Indian tribes, tribal energy resource development organizations, and other organized tribal groups and communities to advance tribal renewable energy and energy efficiency projects.

### Solar Energy International (SEI)

SEI's Native American program helps Native Americans meet their energy and housing needs with renewable energy and natural building. SEI works with Native American groups and nonprofit organizations, training people from the Western Shoshone, Skull Valley Goshute, Lakota Sioux, Yurok, Zuni, Hopi, and Chippewa Nations in renewable energy technologies.

### Tucson Solar Alliance

The Tucson Solar Alliance is a non-profit community coalition dedicated to helping people access solar energy and related measures more easily on a practical and cost-effective basis. The Solar Alliance provides unbiased, noncommercial, expert advice and support. Through Cooperative Buyers Groups, it helps in obtaining such products at greatly reduced prices.

Through the Alliance's Community Solar Program, which includes dozens of non-profit organization partners, as well as the City of Tucson, Pima County and the State of Arizona, Tucson became the first community in the nation to be accepted on that basis for participation and funding in the national photovoltaic program. The Tucson homeowners and builders who have taken advantage of that program have been able to obtain top-quality pv systems for prices far lower than anywhere else.

### Strategic Technical Assistance Response Team (START)

The START Program is part of the DOE Office of Indian Energy effort to assist in the development of tribal renewable energy projects. Through START, Tribes in the 48 contiguous states and Alaska can apply for and are selected to receive technical assistance from DOE and national laboratory experts to move projects closer to implementation.



## Section 11: Project Development Plan

### **Project Development Tasks**

Red Mountain has outlined the major tasks for solar power plant development below.

#### Sale of Power - Power Purchase Agreement (PPA)

In order for the Tortuga Ranch Project to be viable, Pascua Yaqui must secure a Power Purchase Agreement for power generated on site. The PPA defines the commercial terms for the sale of power between the two parties, including when the project will begin commercial operation, schedule, penalties for under delivery, payment terms, and termination. Key PPA items are as follows: price, certainty of revenues, curtailment, conditions precedent and timing, cure and lender step-in rights, and interconnection. The PPA contractual terms for the sale of power may last anywhere between 5 and 20 years. The PPA is a central document in the development process because it defines the revenue terms for the project and credit quality, it is key to obtaining non-recourse project financing. If there is no customer for the Project (no PPA), the Project is not viable, securing a PPA is a critical task for the Project; A PPA is a key instrument of project finance.

The PPA price is critical for the Project economics. Typically, solar investors require a return on investment in the 7-12% range that is directly correlated to the PPA price. The PPA price must cover the initial investment costs and earn a reasonable return on investment. PPAs typically allow a project to be curtailed, or disconnected from transmission for reliability or safety reasons. The negotiated terms for curtailment and what the compensation can also impact returns.

Obtaining a PPA is typically a competitive process where utilities, cities or other entities administer Request for Proposals (RFPs) for renewable power, often times indicating specific requirements for the power and for the power provider. If the Project is selected during the RFP process, some utilities require a significant security deposit. After selected, the seller and the buyer will negotiate the terms for the PPA before the final PPA is signed and approved by all relevant parties.

#### Project Budgets/Financial Models

Through this feasibility study, Pascua Yaqui has a draft estimate for Project costs and economics. As the project becomes more defined, detailed financial models will be prepared and updated regularly. The financial model includes capital costs and project development costs and cash flow schedules. The financial model determines where the PPA price needs to be in order for the Project to be economically viable. It is a key component for PPA negotiations and is typically kept confidential.

#### Interconnection

It is during the interconnection process where the cost for interconnecting the Project to the nearby transmission system is determined. Depending on the Project's Point of Interconnection (POI), the utility that owns the transmission line will conduct the interconnection study on behalf of the Project. Utilities need to determine how the Project will impact the transmission system; this is accomplished by conducting detailed interconnection studies that can take up to 2 years to complete and can cost as much as \$250,000 for the study. The results of the interconnection study determine Project impacts



to the transmission system and associated costs for the impacts (network upgrades) and interconnection facility costs (Project substation). For example, if the Project results in “overloading” (overburden) a transformer on the transmission system, that transformer may need to be upgraded in order for the energy to be able to flow and for Project to interconnect to the system.

The interconnection study results in an “interconnection agreement” between the Project owner and the utility. The interconnection agreement gives the owner the right to interconnect the Project at its indicated POI with mutually agreed upon terms. The Developer will be responsible for managing all of the interconnection activities in order to secure the interconnection agreement.

#### Land Entitlement – Permits, Easements & Environmental

The permitting and environmental process and requirements are described in detail in Section 3: Tortuga Ranch - Siting. The development team will work with local permitting experts, Pascua Yaqui, Pima County and other relevant parties in order to conduct entitle the Project.

In order to entitle the Project, site engineering work must be completed. The site layout must be completed for the major project components on a comprehensive map including: PV layout, substation location, access roads, and expansion plans.

The Project may need to obtain an easement for the Project gen-tie depending on the Point of Interconnection (POI). If the POI is off-site, the Project will need to obtain an easement to run the gen-tie from the Project site to the POI. The regulating authority for the easement will depend on who owns the land in between the Project site and the POI. The time to obtain the easement will depend on who’s jurisdiction the gen-tie is in. The developer will be responsible for procuring all entitlements and easements for the Project.

#### Engineering, Procurement & Construction

Plant engineering occur during different phases of development. For example site engineering is completed during the permitting process. Final site, PV system, and electrical drawings are drafted are required in order to secure building permits. In addition, equipment selection must be finalized for the building permits. For the Project interconnection, that is typically completed by the utility and is usually completed after the Project has signed the interconnection agreement depending the Project commercial online date.

Upon completion of major project milestones described above: entitlements, interconnection agreement, and PPA signed, then the Project can obtain financing in order to complete Project engineering and procure equipment. The procurement schedule is critical in order to ensure the Project will meet its projected online date that is indicated in the PPA. Some equipment has a longer lead time than others and must be taken into consideration in the procurement schedule.

After financing is secured and equipment is ordered, the plant can begin construction. See Appendix 8 for a detailed schedule for development activities and construction activities. After the plant is fully constructed, the Project must be fully tested and commissioned to ensure reliability and comply with established commercial practices. The commercial operation date is defined as the date after which all testing and commissioning has been



completed and is the initiation date to which the Project can start producing electricity for sale (i.e. when the project has been substantially completed). The commercial operation date also specifies the period of operation, including an end date that is contractually agreed upon.

The developer is responsible for managing all of the engineering, procurement and construction activities. Sometimes, Developers will contract this work out the third party contractors.

### **Sources of Funding**

See Section 8: Business Opportunity. Third party investors such as Kyocera, SunEdison, First Solar take an integrated approach, not only do they supply panels, but they develop, finance and construct their Projects.

List of developers with PV projects built or under construction in the southwest:

- MMA Renewable Ventures
- Florida Power & Light Co.
- NRG Solar
- Seimens Solar
- Axio Power
- Borrego Solar
- BP Solar
- Cenergy Power
- Cleantech America Inc.
- Cupertino Electric
- EDF Renewables
- Eurus
- First Solar
- Solar Project Solutions
- Juwi solar
- Iberdrola
- Global Solar Energy (TEP)
- Kyocera
- Main Street Power (APS)
- Nextera
- SunPower
- Q Cells
- REC Solar
- Recurrent Energy
- Sempra Generation
- S-Energy America
- Smart Energy Capital
- Solon (Tucson)
- Sol Orchard
- Solar Power Inc.
- SolarWorld
- SunEdison
- SunPeak Power



- Suntechnics
- 8minuteenergy
- Abengoa
- AES Solar
- Albiasa

**Schedule**

See Appendix 8 for a detailed Microsoft Project Schedule of key activities that include project development, engineering and construction.



## Section 12: Casino Loads Assessment

The following analysis is based on energy bills for the Casino del Sol facility from April 23, 2012 through March 23, 2013. Energy bills were included for six metered locations at the Casino: Phase I, Phase II, Chiller, Warehouse, Hotel and Monument Sign. The total energy consumption was 20,672 MWh and the average demand of the facility was 3.2 MW.

Figures 24 and 25 graphically illustrates the monthly energy consumption and demands for the casino; maximum demands are from May through September. Figures 26-31 illustrates the daily hourly average energy demands for power for each meter for June and July 2012. For Phase I, peak demands are between 7 and 9pm and are approximately 950 kW. For Phase II, peak demands are from 11am-10pm and are approximately 640 kW. For the warehouse, energy demands are steady throughout the day from 8am-10pm and are around 90 kW. For the hotel, peak demands are from 8-10pm at 375 kW. For the chiller, peak demands are from 1-7pm at around 1,000 kW.

**Table 17 - Casino Del Sol Energy Summary – Apr 2012 – Mar 13**

|                                    |            |
|------------------------------------|------------|
| Total Energy Consumption, kWh      | 20,672,317 |
| Average Demand, kW                 | 3,223      |
| Maximum Demand, kW                 | 3,819      |
| Trico Charge per kWh, \$/kWh       | 0.083      |
| Trico Charge per kW, \$/kW         | \$16.65    |
| Total Annual Energy Costs, Million | \$2.15     |

**Figure 24 - Casino Del Sol Monthly Energy Consumption – Apr 12 – Mar 13, kWh**

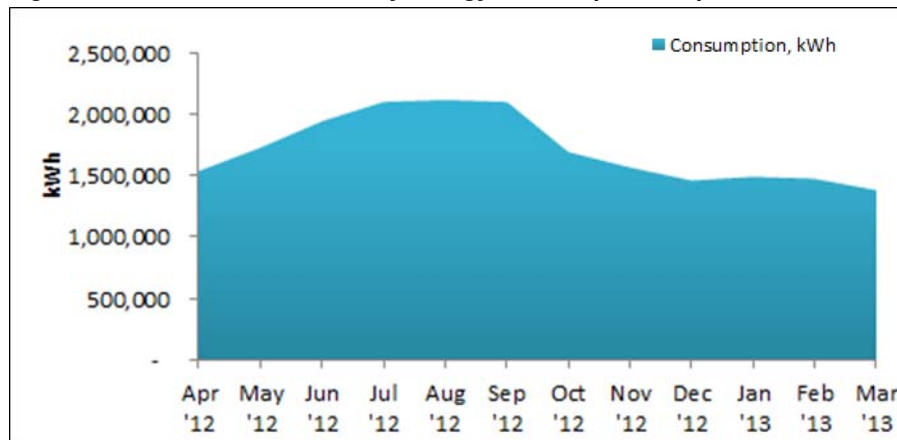


Figure 25 - Casino Del Sol Monthly Energy Demand, kW

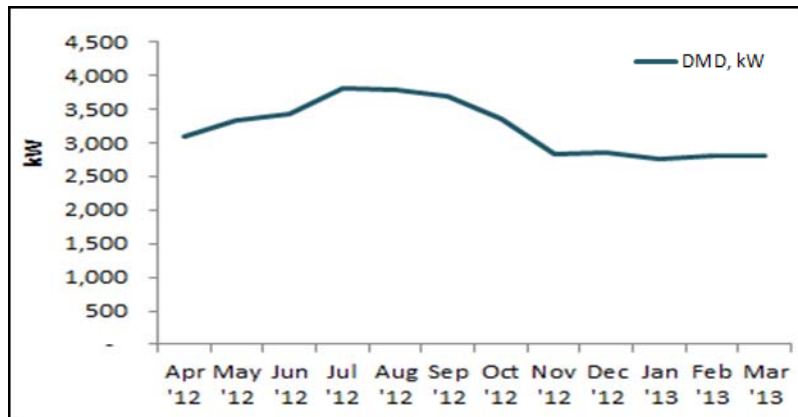


Figure 26: June-July 2012 Phase I Daily Average Hourly Energy Demands

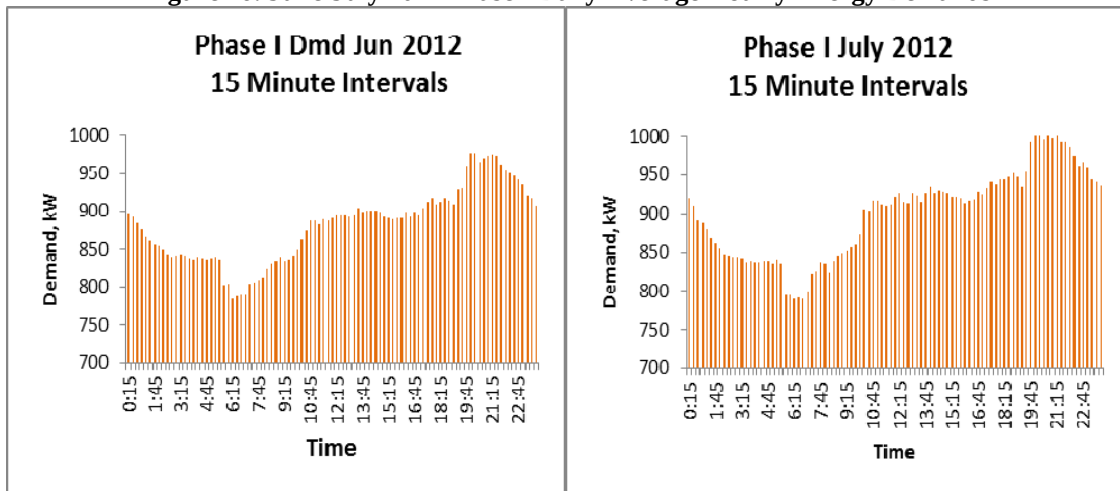
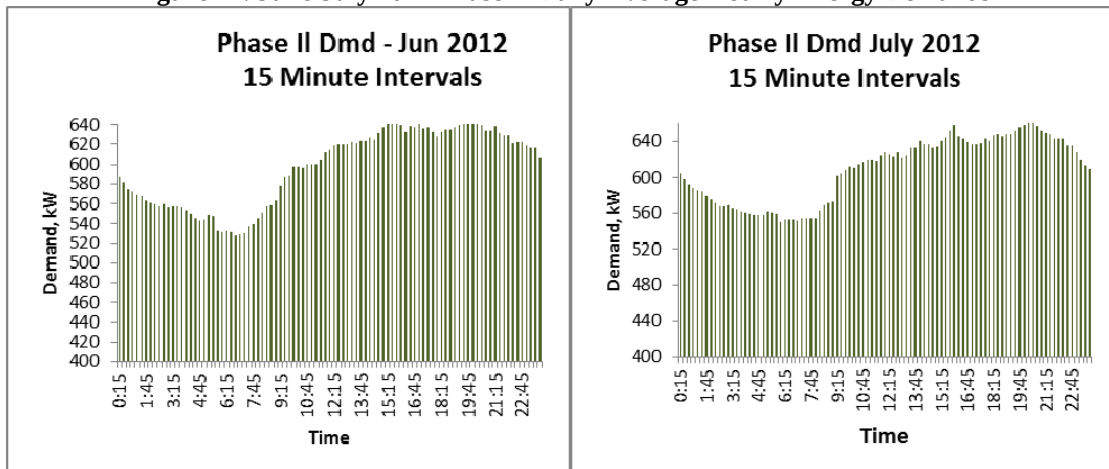
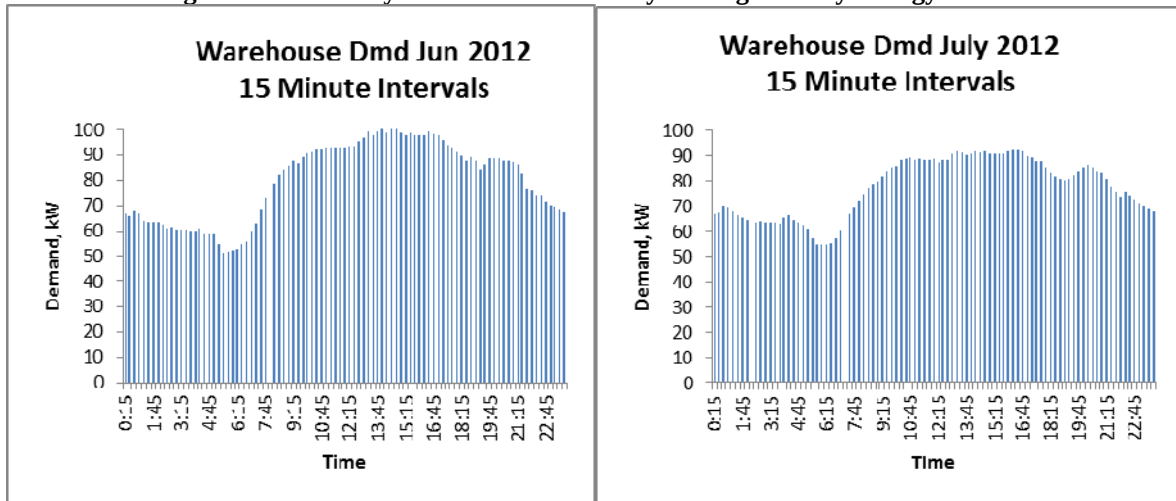


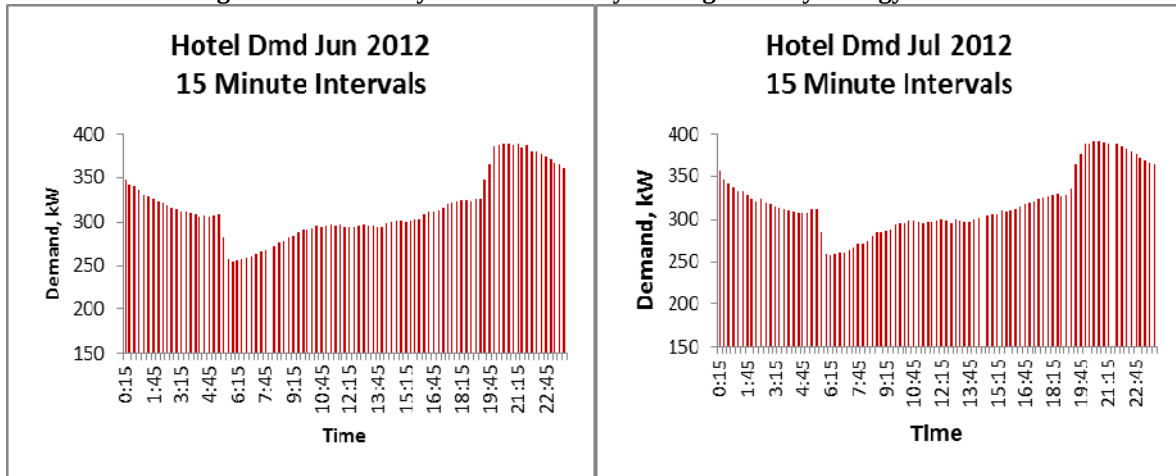
Figure 27: June-July 2012 Phase II Daily Average Hourly Energy Demands



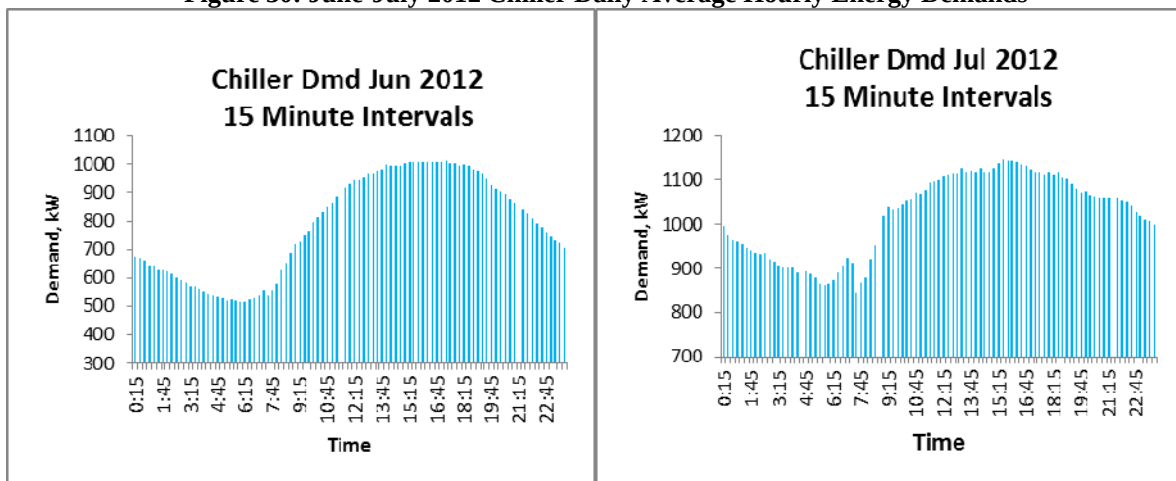
**Figure 28: June-July 2012 Warehouse Daily Average Hourly Energy Demands**



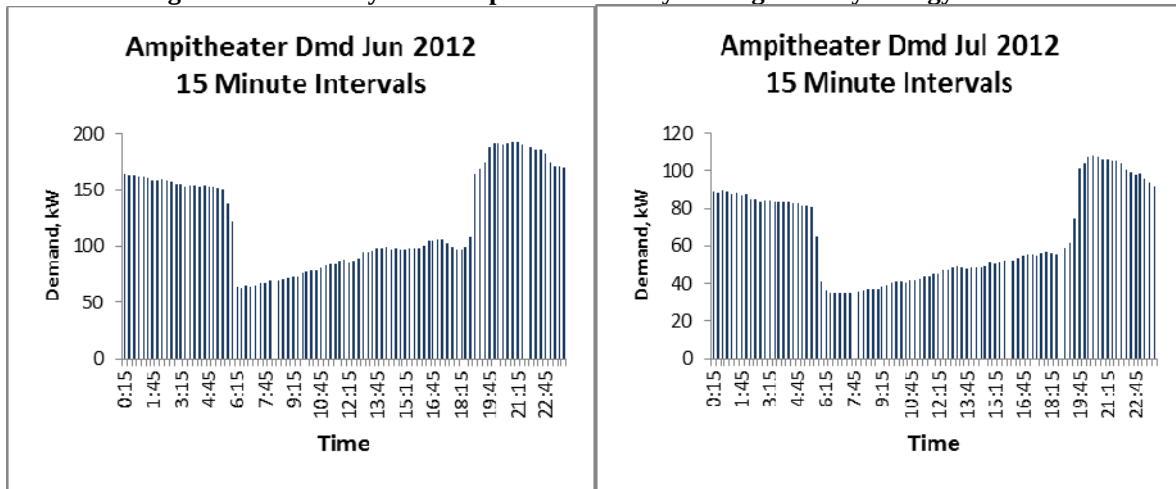
**Figure 29: June-July 2012 Hotel Daily Average Hourly Energy Demands**



**Figure 30: June-July 2012 Chiller Daily Average Hourly Energy Demands**



**Figure 31: June-July 2012 Amphitheater Daily Average Hourly Energy Demands**



## Section 13: Casino Del Sol Energy Profile Summary

Figure 32 below is an aerial photo of the Casino Del Sol. Table 16 summarizes energy consumption, costs and demands for the Casino Del Sol. The average demand for the Casino from April 2012-May 2013 is **3.2 MW** and the maximum demand is **3.8 MW**. The Casino is currently paying \$0.083/kWh for energy consumed and \$16.65/kW for energy demands.

Red Mountain assessed multiple areas for solar within a 3 mile radius of the Casino:

- Casino garage rooftop
- Casino Amphitheater parking
- 200 acre parcel approximately 3.0 miles Southeast from Project site

### Casino Garage Solar

The Casino garage rooftop is approximately 79,252 sq. ft.; see Figures 32. Figure 32 is a google earth image of the Casino site. Notice in Figure 33, there are existing structures on the garage that was designed to support covered parking and solar.

IronCo designed a layout of solar panels covering the rooftop of the garage as solar canopies or covered parking; see Figures 36 and 37. The rooftop can accommodate 819 kW<sub>dc</sub> of Kyocera 250 W panels.

### Amphitheater

Additional solar can be installed as covered parking near the Amphitheater. The solar system at the Amphitheater would be close enough to the Casino to supply power to the Casino. Cabling could run underground from the amphitheater to the Casino. See Figure 38 for a layout of this system. The amphitheater system is 2.65 MW<sub>dc</sub>. The system is not facing due south due to the parking lot configuration.

Figure 32: Casino Del Sol Aerial Photo





**Table 18: Casino Del Sol Solar April 2013-May 2013 Energy Bills**

| <b>April 2012-May 2013</b>         |         |
|------------------------------------|---------|
| Total Energy Consumption, MWh      | 20,672  |
| Average Demand, kW                 | 3,223   |
| Maximum Demand, kW                 | 3,819   |
| Trico Charge per kWh, \$/kWh       | \$0.083 |
| Trico Charge per kW, \$/kW         | \$16.65 |
| Total Annual Energy Costs, Million | \$2.15  |

**Table 19: Casino Del Sol Solar**

|                      | <b>Sq. ft.</b> | <b>kW<sub>DC</sub></b> | <b>MWh</b> |
|----------------------|----------------|------------------------|------------|
| Parking Garage       | 79,252         | 819                    | 1,325      |
| Amphitheater Parking |                | 2,650                  | 4,287      |

**Figure 33: Casino Del Sol Parking Garage**



Figure 34: Casino Del Sol Parking Garage



Figure 35: Casino Del Sol Parking Structure

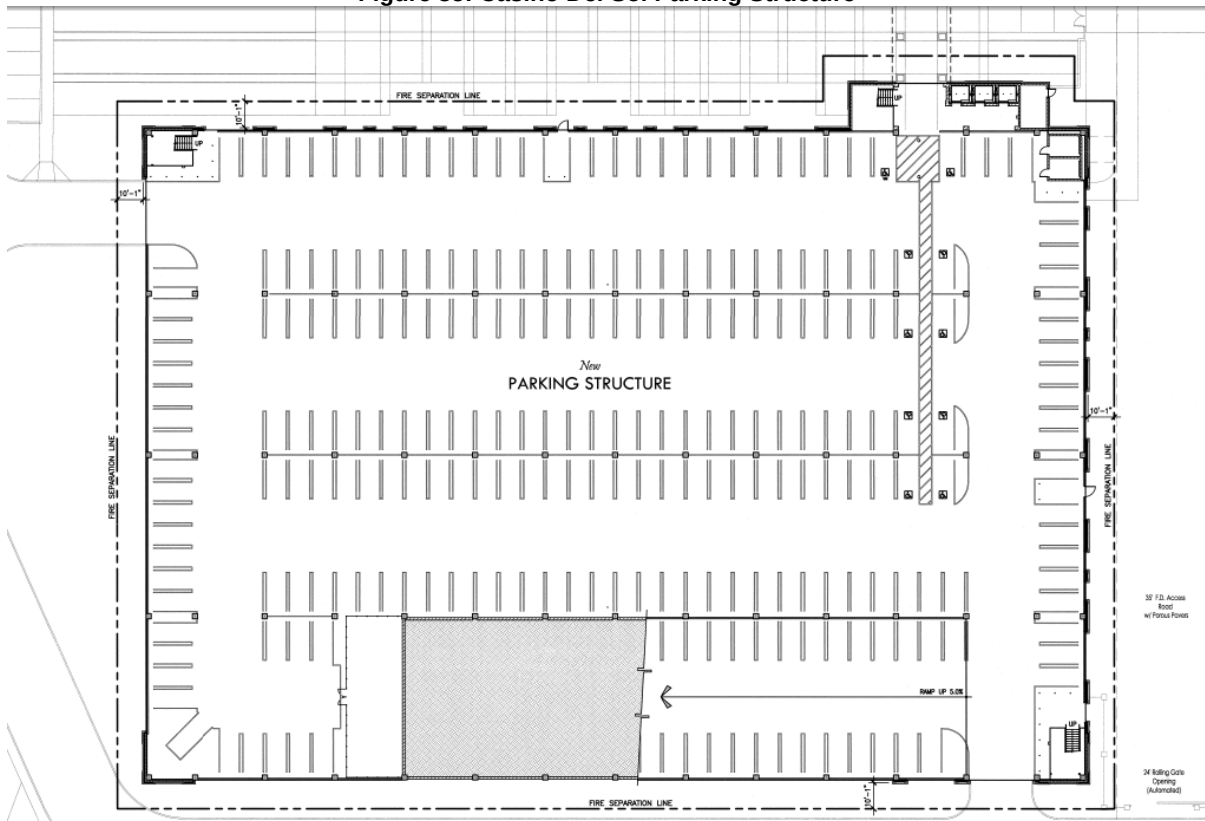




Figure 36: Casino Del Sol Parking Structure Solar Layout

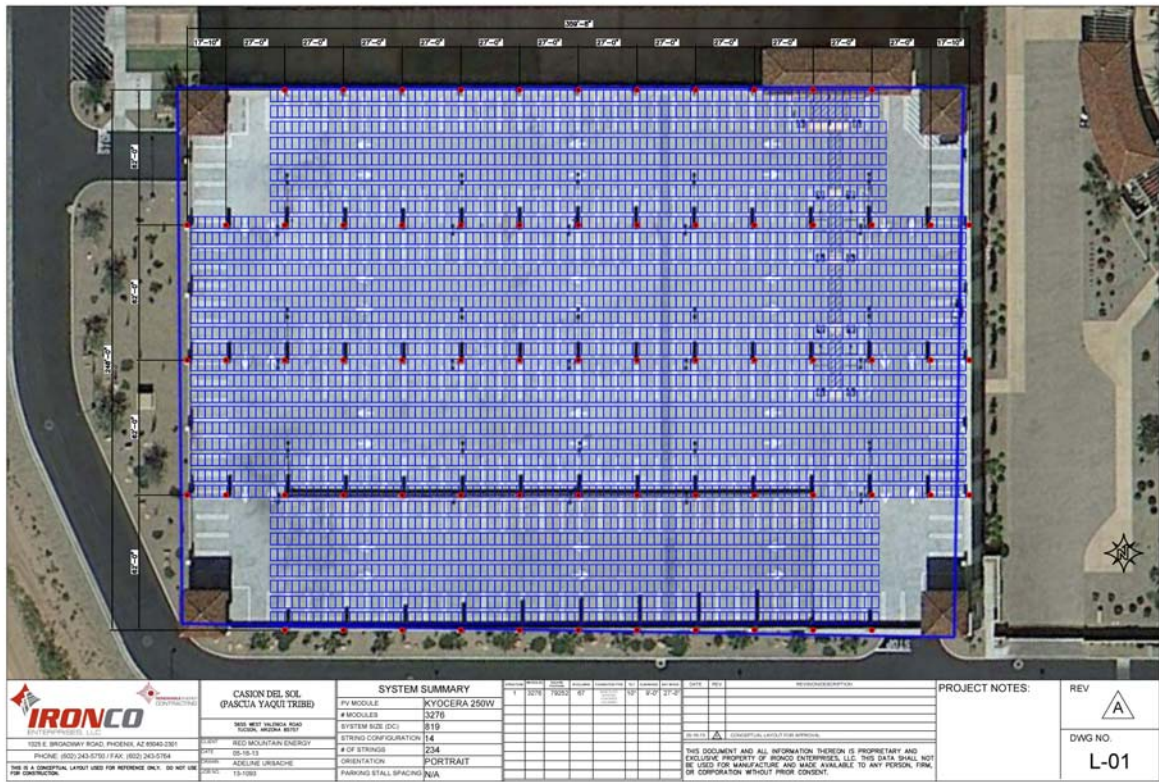
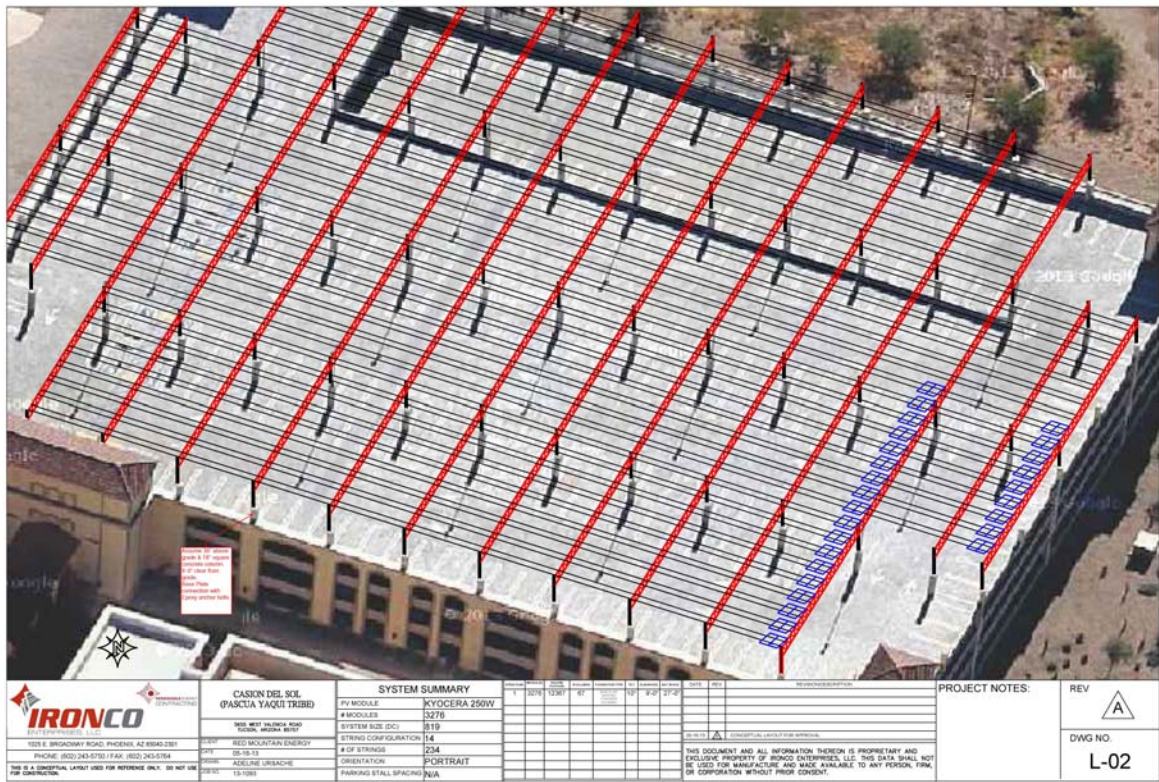


Figure 37: Casino Del Sol Parking Structure Solar Layout





**IRONCO**  
1025 E. BROADWAY ROAD, PHOENIX, AZ 85040-2801  
PHONE: (602) 243-5761 / FAX: (602) 243-5764

**CASON DEL SOL  
(PARCIA YAQUI TRIBU)**

**SYSTEM SUMMARY**

|                           |                       |               |
|---------------------------|-----------------------|---------------|
| 2000' RED MOUNTAIN ENERGY | PV MODULE             | KYCOCERA 250W |
| 2000' RED MOUNTAIN ENERGY | # MODULES             | 10812         |
| 2000' RED MOUNTAIN ENERGY | SYSTEM SIZE (DC)      | 2.65 MW       |
| 2000' RED MOUNTAIN ENERGY | STRING CONFIGURATION  | 14            |
| 2000' RED MOUNTAIN ENERGY | # OF STRINGS          | 750           |
| 2000' RED MOUNTAIN ENERGY | ORIENTATION           | SOUTH         |
| 2000' RED MOUNTAIN ENERGY | PARKING STALL SPACING | 10'           |

**PROJECT NOTES:**

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**REV**

**DWG NO.**

**L-02**

Red Mountain assessed an alternative site near the Casino to add additional solar to meet the demands of the Casino; see Figure 39. The alternative site is a 200 acre parcel on Camino de Oeste near the Justice Center. This site is 3.0 miles south east from the Casino. A ground mount system is less expensive than a covered parking solar system. Even with a 3.0 mile transmission line, this Project can be cost competitive.

## Financial Model Overview

- Conventional Partnership
- Tax Assumptions
  - o 5 Year Accelerated Depreciation
  - o 30% Investment Tax Credit
  - o Corporate Income Tax Rate (State Tax =6.98%) = 25%
  - o New Market Tax Credits = 39%
  - o Indian Employment Tax Credit
- Schedule



- o Begin Development: 1/1/2014
- o Begin Construction: 5/1/2014
- o COD: 8/1/2014
- Financing Assumptions
  - o Construction Financing = 60%
  - o Interest Rate = 8%
  - o Construction Loan Term = 15 years
  - o DOE Grant = \$1-1.5 MM
  - o Trico Production Based Incentive = \$0.025/kWh

### Trico Net Metering Policy

- Generating Capacity < or = 125% of Customer's Total Connected Load
- If kWh energy generated > kWh energy supplied, customer is credited during subsequent billing periods for excess
- In the last billing period, Coop will credit the balance of any credit due in excess of amounts owed by the customer
- Company for any remaining credits shall be at the Coop's annual average avoided costs at \$0.04205/kWh
- Projects greater than 1 MW will be subject to negotiated terms and conditions with Trico, AEPCO & SWTC

### Maximum Project Size

Based on Trico's net metering policy, the maximum solar project size for the facility would be 125% x the maximum demand for the Casino. See Appendix 9 for Trico's net metering policy. The Casino's energy is currently monitored through 6 different meters; see Table 18. There are a couple of options for sizing the solar facility for the Casino:

- 1) A solar facility could be designed to serve one of the loads described below, for example, the chiller. For this scenario, the solar facility could be **1,807 kW**; that is, 1,446 kW x 125%.

A solar facility could be designed to meet the demands for the Casino for all six loads described in Table 20. For this scenario, all of the loads could be combined into one meter. Trico indicated the maximum demand from the Casino is actually **3,000 kW** (note summing the maximum demands in Table 20 would not give you an accurate estimate for the maximum demands, this is because the maximum demand for each load is from different months).

However, when the casino combines its loads into one primary meter, this puts the Casino into a different customer category. The Casino is currently under the GS3 Tariff; by combining loads into one primary meter, the Casino would fall under the GS4 Tariff. The GS4 service is for customers with loads greater than 2,000 kW. As a GS4 customer, the Casino would eliminate demand charges. From April 2012-April 2013, the Casino paid \$695,587 in demand charges based on the current rate of \$16.65/kW. In addition, kWh charges would drop significantly to Trico's avoided cost for energy; it is currently \$0.0425. Note, Trico's avoided cost for energy could fluctuate and is based on their costs for power. The Casino currently pays \$0.083/kWh. Trico indicated approximate costs to primary meter the Casino would be \$100,000. By going to a primary meter at the Casino, this would cut the energy bills in half.





**Table 20: Casino Del Sol Energy Demands**

| <b>Casino Load</b> | <b>Max Dmd, kW</b> | <b>kWh</b>        |
|--------------------|--------------------|-------------------|
| Phase I            | 1,086              | 7,892,400         |
| Phase II           | 720                | 4,907,520         |
| Chiller            | 1,446              | 4,516,800         |
| Warehouse          | 124                | 596,360           |
| Hotel              | 475                | 2,712,800         |
| Monument Sign      | 9                  | 46,437            |
| <b>Total kWh</b>   |                    | <b>20,672,317</b> |

### **Financial Model Sensitivities**

Red Mountain created financial models for three different scenarios:

1. Casino garage canopy covered parking – 687 kW
2. Casino garage & Casino Amphitheater parking – 3,000 kW
3. Casino garage & ground mount solar 1.5 miles from Project site – 3,000 kW

Each scenario described above varies slightly in capital costs.

### **Garage Canopy Covered Parking – 687 kW**

The following is a summary of the assumptions made for the garage canopy covered parking. The solar project costs are based on an estimate provided by Sky Engineering. The residual value is the value of the solar system at the end of its lifetime. Note the project cost is a conservative estimate that includes development, finance and interconnection costs.

Project Size, DC = 816 kW<sub>DC</sub>

Project Size, AC = 687 kW<sub>AC</sub>

Garage Canopy Solar Project Costs = \$3.17/W

Annual Operations & Maintenance Costs = \$20,000

Residual Value = \$500/kW

Loan Interest Rate = 6%

Total Capital Costs = \$2.72 M

Investment Tax Credit (ITC) = \$689,399

New Market Tax Credit (NMTC) = \$313,676

Red Mountain ran multiple sensitivities on the project on power pricing, interest rate and grant subsidies; see Tables 21-23 below. According to Trico, the Production Based Incentive (PBI) is \$0.025/kWh. Trico indicated that they would likely support a project size up to 10 MW.

Red Mountain ran sensitivities on the following power prices:

- \$67.50/MWh; this is Trico's avoided cost for power plus PBI, this would be the approximate rate if the Casino consolidated the meters



- \$83/MWh; this is the Casino's current rate for power
- \$108/MWh; this is the Casino's current rate for power plus PBI

Red Mountain also varied the loan interest rate of the Project and the residual value. The metric of key interest is the internal rate of return (IRR) for the Project. Typical solar energy investments achieve IRR's in the range of 7-12%.

Without any grant subsidies, the interest rate must be **below 6%** in order for the economics to work at \$83/MWh. The best scenario includes grant funding, see Table 23. With a \$750,000 grant and power pricing at \$67/MWh, the IRR is approximately 9.4%.

**Table 21: Garage Canopy After Tax IRR – Interest Rate**

| Interest Rate | Internal Rate of Return |          |
|---------------|-------------------------|----------|
|               | Price for Power \$/MWh  |          |
|               | \$83.00                 | \$108.00 |
|               | 8.0%                    | 12.8%    |
| Interest Rate | 7.0%                    | 14.5%    |
|               | 6.0%                    | 16.3%    |

**Table 22: Garage Canopy IRR After Tax – Residual Value**

| Residual Value \$/kW | Internal Rate of Return |          |
|----------------------|-------------------------|----------|
|                      | Price for Power \$/MWh  |          |
|                      | \$83.00                 | \$108.00 |
|                      | \$0                     | 15.6%    |
| Residual Value \$/kW | \$150                   | 15.8%    |
|                      | \$250                   | 16.0%    |
| Residual Value \$/kW | \$500                   | 16.3%    |

**Table 23: Garage Canopy After Tax IRR - Grant**

| Grant | Internal Rate of Return |       |
|-------|-------------------------|-------|
|       | Price for Power \$/MWh  |       |
|       | \$67.50                 |       |
|       | \$500k                  | 6.5%  |
| Grant | \$750k                  | 10.3% |
|       | \$1M                    | 14.9% |

### Casino Garage & Casino Amphitheater Parking – 3,000 kW

The following is a summary of the assumptions made for the garage canopy covered parking and an expansion in front of the Amphitheater. The solar project costs are based on an estimate provided by Sky Engineering. Note the project cost is a conservative estimate that includes development, finance and interconnection costs.

Garage Project Size, DC = 816 kW<sub>DC</sub>  
 Garage Project Size, AC = 687 kW<sub>AC</sub>  
 Amphitheater Project Size, DC = 2,750 kW<sub>DC</sub>  
 Amphitheater Project Size, AC = 2,313 kW<sub>AC</sub>  
 Total Project Size = 3,000 kW<sub>AC</sub>  
 Amphitheater Solar Project Costs = \$2.57/W  
 Total Project Costs = \$12.6 MM  
 Residual Value = \$0.5/W

Red Mountain ran the same sensitivities as described above. Without any grant subsidies, the interest rate must be **below 6%** in order for the economics to work at \$67.50/MWh; see Table 24 below. The best scenario includes grant funding, see Table 26. With a \$500,000 grant and power pricing at \$67.50/MWh, the IRR is approximately 7.8%.

Table 24: Garage Canopy & Amphitheater Parking After Tax IRR – Interest Rate

| Interest Rate | Internal Rate of Return |         |         |
|---------------|-------------------------|---------|---------|
|               | Price for Power \$/MWh  |         |         |
|               |                         | \$67.50 | \$83.00 |
|               | \$108.00                |         |         |
|               |                         |         |         |
| 8.0%          | 3.3%                    | 9.0%    | 18.2%   |
| 7.0%          | 4.6%                    | 10.5%   | 20.0%   |
| 6.0%          | 6.0%                    | 12.0%   | 21.2%   |

Table 25: Garage Canopy & Amphitheater Parking After Tax IRR – Residual Value

| Residual Value \$/kW | Internal Rate of Return |         |
|----------------------|-------------------------|---------|
|                      | Price for Power \$/MWh  |         |
|                      | \$67.50                 | \$83.00 |
|                      |                         |         |
|                      |                         |         |
| \$ -                 | 3.6%                    | 10.8%   |
| \$ 150               | 4.5%                    | 11.2%   |
| \$ 250               | 5.0%                    | 11.5%   |
| \$ 500               | 6.0%                    | 12.0%   |

Table 26: Garage Canopy & Amphitheater Parking After Tax IRR – Grant

| Grant  | Internal Rate of Return |  |
|--------|-------------------------|--|
|        | Price for Power \$/MWh  |  |
|        | \$67.50                 |  |
|        |                         |  |
|        |                         |  |
| \$500k | 7.3%                    |  |
| \$1M   | 8.8%                    |  |
| \$1.5M | 10.4%                   |  |



### Casino garage & ground mount solar 3.0 miles from Project site

The following is a summary of the assumptions made for the garage canopy covered parking and a ground mount system 3.0 miles from the Project site. The solar project costs are based on an estimate provided by Sky Engineering. Note the project cost is a conservative estimate that includes development, finance and interconnection costs.

Project Size, DC = Garage Project Size, DC = 816 kW<sub>DC</sub>

Garage Project Size, AC = 687 kW<sub>AC</sub>

Ground Mount Project Size, DC = 2,750 kW<sub>DC</sub>

Ground Mount Project Size, AC = 2,313 kW<sub>AC</sub>

Total Project Size = 3,000 kW<sub>AC</sub>

Ground Mount Solar Project Costs = \$2.36/W

Total Project Costs = \$12.3 MM

The best scenario includes grant funding, see Table 27. With a \$500,000 grant and power pricing at \$67.50/MWh, the IRR is approximately 9.1%. See Appendix 10 for the detailed financial model that includes assumptions and cash flow for the \$1.5 MM Grant scenario.

Table 27: Garage Canopy & Ground Mount After Tax IRR – Grant

| Grant | Internal Rate of Return |         |
|-------|-------------------------|---------|
|       |                         | \$67.50 |
|       | 0                       | 7.6%    |
|       | \$500k                  | 9.1%    |
|       | \$1M                    | 10.7%   |
|       | \$1.5M                  | 12.4%   |

Red Mountain also modeled a “buy back” in year 7. Often times, Tribes will partner with third party investors in order to leverage tax exemptions such as the investment tax credit for solar projects. Red Mountain obtained some high level cost estimates for the Casino given the anticipated price for power. Kyocera estimated by year 7, it may sell the Project to Pascua Yaqui for \$1.30/W. Actual pricing will be based on fair market value. See Table 28 below for results. Worst case scenario, Pascua Yaqui does not obtain the grant, the Project will still achieve an IRR of 8%.

Table 28: Casino Buy Back After Year 7 - Grant

| Grant | Internal Rate of Return |         |
|-------|-------------------------|---------|
|       |                         | \$67.50 |
|       | 0                       | 8.0%    |
|       | \$500k                  | 12.3%   |
|       | \$1M                    | 17.7%   |
|       | \$1.5M                  | 24.9%   |



## Section 14: Tribal Benefits

See Section 9 Tribal Benefits and Programs.

## Section 15: Project Development Planning

### Garner Community Support for the Project

In order to proceed with any renewable energy project, the Pascua Yaqui Energy Committee must garner community support for a solar energy project. The Project will need an advocate. Renewable energy projects are more likely to succeed if there is a member (or members) of the community, like the energy committee, advocating on behalf of the Project and following it through the entire process. Developing any renewable energy Project requires dedication and commitment to getting the Project built.

### Community Decisions

Pascua Yaqui will need to determine the level of investment it would like to make in the solar project; this will dictate the size of the Project. Pascua Yaqui will then need to determine the location for the Project. Red Mountain proposed multiple options for the Project location for the casino.

### Develop Request for Proposal (RFP)

For the Casino Del Sol Project, Pascua Yaqui will need to develop an RFP for a company that can permit, engineer, finance, procure equipment, finalize net metering agreement and construct the solar project. Pascua Yaqui can hire a consultant to develop the bid package and work closely with Pascua Yaqui in order to draft a bid package that is in complete alignment with Pascua Yaqui goals. There are many examples of RFP's from government agencies and other Tribes that can be utilized as a template. The bid package could include pursuing funding opportunities identified in Section 8: Business Opportunity Assessment.

After finalizing the RFP, the consultant can create a list of "preferred companies" to send the RFP to and then administer the RFP. Pascua Yaqui will need to put together a diverse team that consists of Pascua Yaqui staff and technical consultants to review proposals and make selections.

After selecting the contractor, Pascua Yaqui and the contractor will sign an agreement. Pascua Yaqui will need an attorney familiar with energy deals in order to draft the agreement.

An alternative to an RFP would be to hire a consultant to pursue the funding opportunities and write grants on behalf of the Project.

### Finance & Construction

Through the RFP process, Pascua Yaqui and consultants will be able to select the team to finance and construct the solar project.





The following companies provide third party financing for commercial scale solar: Real Goods Solar, SolarCity, SunEdison, Kyocera and Smart Energy Capital. Smart Energy Capital develops solar energy projects and provides development capital for pre-construction activities, project construction and long-term ownership. Smart Energy Capital has completed over 75 MW of projects and deployed over \$250 million of project capital for public and private schools and universities, municipalities, commercial entities, investor owned utilities, municipal utilities and electric cooperatives. Smart Energy Capital is an indirect wholly-owned subsidiary of NextEra Energy Resources, LLC, the largest generator of solar and wind power in North America.

Real Goods Solar Energy Capital is an alliance between RGS Energy and Smart Energy Capital, a market leader in solar project financing. RGS Energy Capital finances solar energy projects and sells power back to the customer at a fixed rate below market price that will not rise alongside future utility prices thus eliminating variable, volatile electricity rates. With RGS Energy financing, there is no upfront investment, no risk assumption, and no management or service responsibilities required.

SolarCity has extensive experience with Fortune 500 companies, cities, schools and other businesses. SolarCity provides technology, project financing, competitive pricing, and environmental stewardship on every SolarCity commercial project.

Kyocera and SunEdison are two others that also offer a variety of financing options for solar.

#### Community Outreach & Education

Pascua Yaqui could host community solar workshops in order to continue to educate community members on solar. In addition, solar and renewable energy curriculums could be added to Pascua Yaqui Schools. Trico is currently offering a grant program to create an education curriculum. See Section 4 for more information.

Another opportunity to bring education opportunities to the community would be to host a DOE Tribal Energy event. Pascua Yaqui could also partner with experts in the field to provide renewable energy workshops for community members.

#### Create a Long Term Strategic Energy Plan

A long term strategic energy plan could provide a valuable road map for Pascua Yaqui. The energy plan would establish the energy vision for the community and set goals with deadlines. An energy plan could assist Pascua Yaqui with obtaining goals to “reduced reliance on utility energy and create an institutional culture of conservation and sustainability.”



## Section 16: Camino de Oeste Site

Red Mountain conducted a high level evaluation of an additional site near the Justice Center on Camino de Oeste; see highlighted area in green in Figure 39 below. This site is approximately 200 acres and has some washes that run through the property; see Figure 40.

This site is approximately 14 miles southwest from the nearby Davis-Monthan Air Force Base; see Figure 41. The Department of Defense, including the Air Force, currently has a major mandate for renewable energy to fulfill; see Section 4: Market analysis for further information. Accordingly, Red Mountain learned that Davis-Monthan is open to discuss further renewable energy opportunities at Pascua Yaqui and the potential to sell power to the base. Davis-Monthan recently signed a PPA for solar power for 0.045/kWh with a 1.5 % escalation rate. The price for power from a Pascua Yaqui solar project would have to be competitive. Unless Pascua Yaqui were able to leverage about 1/3 of the project costs in grant funding, the project would not be able to compete at that rate.

Finally, Red Mountain realized this Project site is centrally located to the Pascua Yaqui community and major commercial facilities; see Figure 42. Within a 3 mile radius of the Project site is the: Casino of the Sun, Casino Del Sol, Justice Center, Wellness Center, Senior Center, and the Warehouse. That's a total of **4.5 MW**. This location appears to offer an ideal location for power plant development to meet the energy demands of the Pascua Yaqui Tribe. If residential loads are included, total demands of the community are **7 MW**. Today, commercial facilities in Pascua Yaqui are paying \$0.083/kWh and residential customers are paying \$0.12/kWh. A solar facility could be installed and provide power at a more competitive rate than \$0.083/kWh and be a bankable investment for Pascua Yaqui.

There is a wash that cuts through the site; see Figure 40. This can be mitigated by increasing the height of the solar system or by diversion.

Long term, Pascua Yaqui could develop other energy resources to be completely energy efficient and self-sufficient. Other nearby renewable resources that appear to be viable options are biomass and geothermal. Every year millions of tons of "waste woody biomass" primarily from citrus trimmings are dumped in landfills. In the Tucson area alone, there is more than enough woody biomass to meet the energy demands of Pascua Yaqui. In addition, a map generated by NREL indicates geothermal resources surrounding Pascua Yaqui; see Figure 43 and Appendix 11.

As technology continues to progress, Pascua Yaqui could implement microgrid technologies and maximize its energy system as described above. Pascua Yaqui has taken initiatives in new construction and constructing facilities that are energy efficient and minimize energy demands.







Figure 41: Camino de Oeste Project Site & Davis Monthan AFB

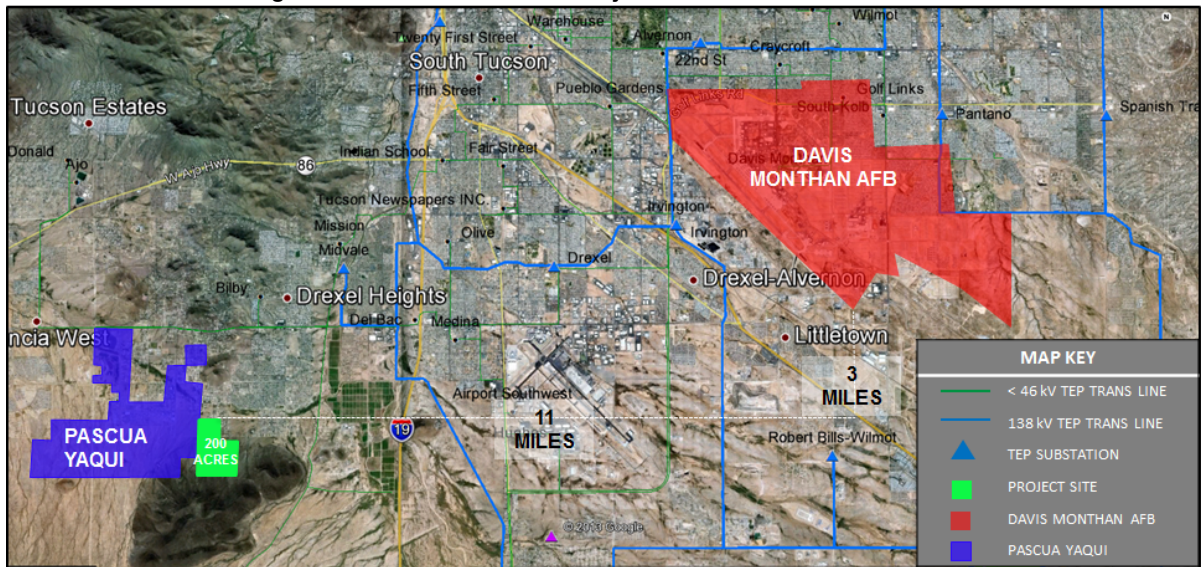


Figure 42: Camino de Oeste Project Site & the Community

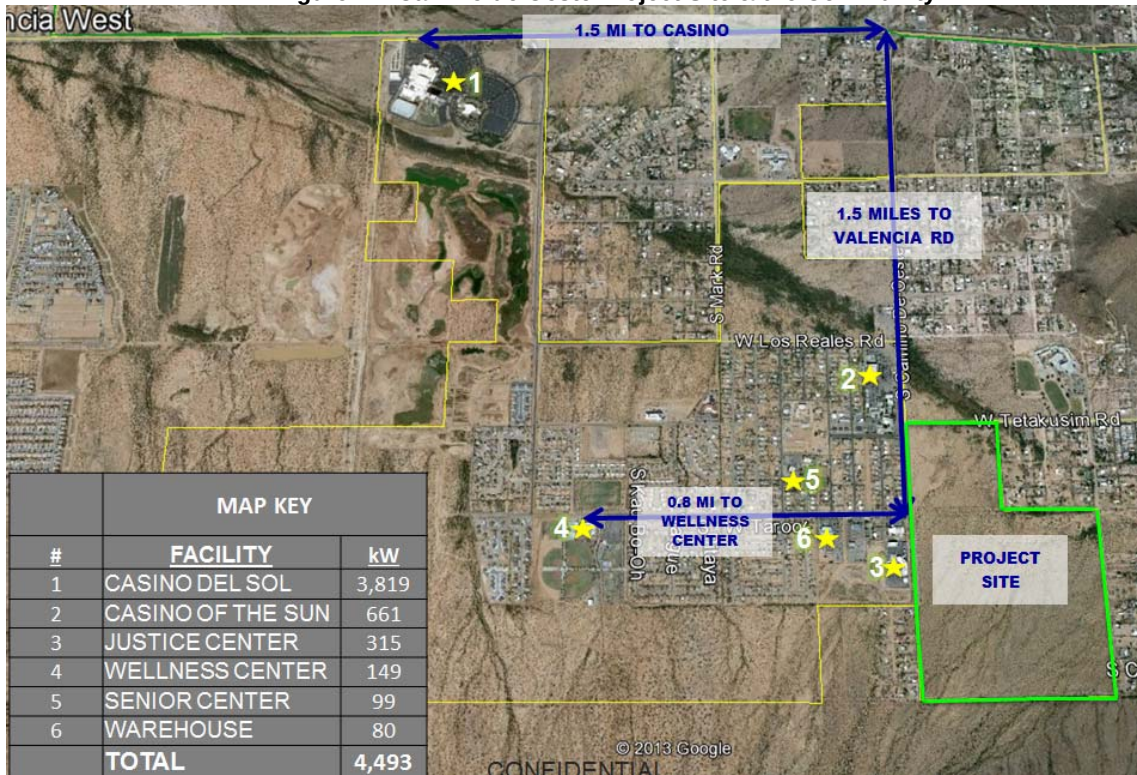
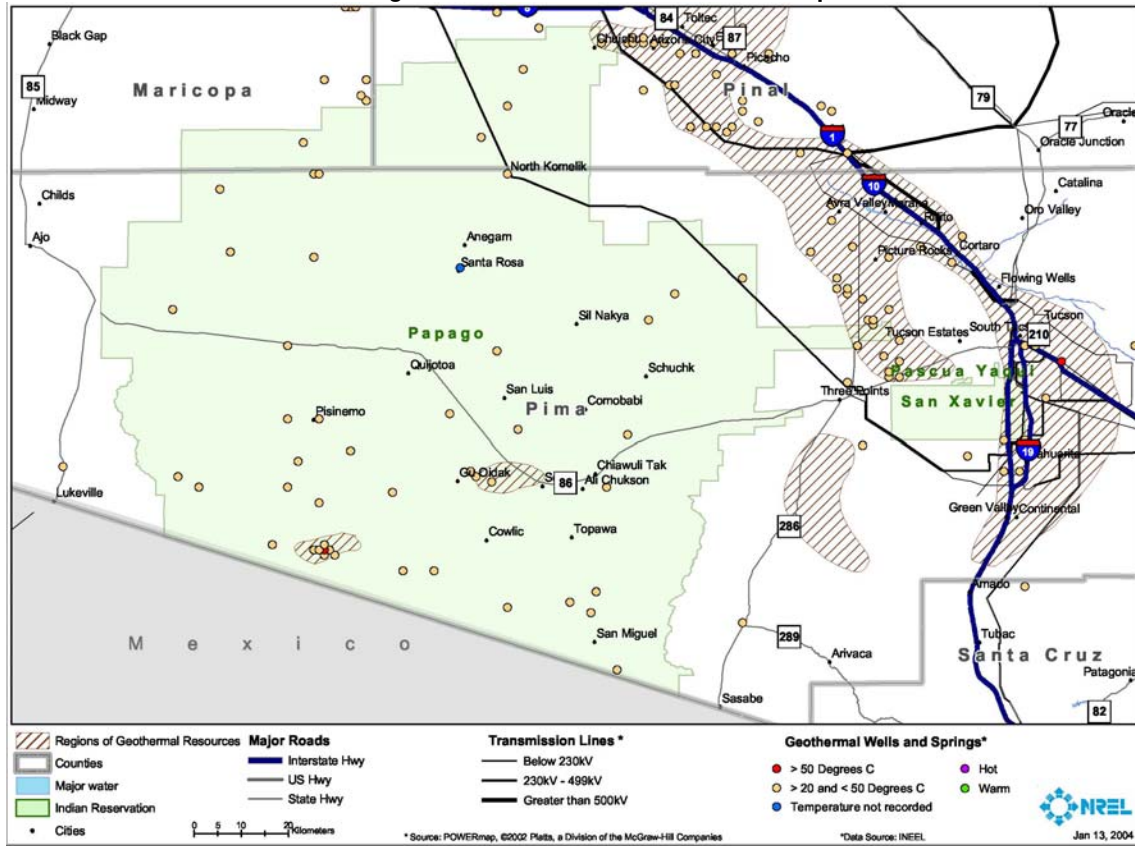


Figure 43: Geothermal Near Pascua Yaqui





**APPENDIX 1**

**APPLICATION FOR**

**CONDITIONAL USE PERMIT**



ZONING ENFORCEMENT DIVISION  
201 N. Stone Avenue, 1<sup>st</sup> Floor  
Tucson, Arizona 85701-1207  
(520) 740-6675

**APPLICATION FOR CONDITIONAL USE PERMIT**

OWNER: \_\_\_\_\_ PHONE: \_\_\_\_\_

ADDRESS: \_\_\_\_\_ CITY: \_\_\_\_\_ ZIP: \_\_\_\_\_

APPLICANT (*if not owner*) \_\_\_\_\_ PHONE: \_\_\_\_\_

APPLICANT EMAIL ADDRESS: \_\_\_\_\_

ADDRESS: \_\_\_\_\_ CITY: \_\_\_\_\_ ZIP: \_\_\_\_\_

PROPERTY ADDRESS: \_\_\_\_\_ ZONE: \_\_\_\_\_

TAX CODE(S): \_\_\_\_\_

\_\_\_\_\_ TOWNSHIP, RANGE SEC.: \_\_\_\_\_

LOT DIMENSIONS: \_\_\_\_\_ LOT AREA: \_\_\_\_\_

TYPE OF USE PROPOSED FOR PROPERTY (BE SPECIFIC) : \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

STATE THE REASONS WHY THE USE IS PROPOSED AND WHY YOU THINK IT WOULD BE COMPATIBLE WITH THE SURROUNDING AREA:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

ESTIMATED STARTING DATE: \_\_\_\_\_ ESTIMATED COMPLETION DATE: \_\_\_\_\_

**THE FOLLOWING DOCUMENTS ARE REQUIRED:**

1. Preliminary Development Plan
  - a. 5 copies are needed for Type I (In accordance with Pima County Fee Schedule)
  - b. 25 copies are needed for Type II (In accordance with Pima County Fee Schedule)
  - c. 40 copies are needed for Type III (In accordance with Pima County Fee Schedule)  
(Make check payable to Pima County Treasurer)
2. Assessor's Map showing location and boundaries of the property.
3. Assessor's Property Information showing ownership of the property.
4. Letter of Authorization if applicant is not the owner
5. Floor Plan that pertains to interior access or use if required
6. Biological Impact Report \*\* - For Type 2 or 3 permit requests

**I, the undersigned, represent that all the facts in this application are true to the best of my knowledge.**

\_\_\_\_\_  
Signature of Applicant

\_\_\_\_\_  
Date

\_\_\_\_\_  
Print Name

\_\_\_\_\_  
Applicant Phone Number

***Applicant agrees to provide staff with written proof of notice to the United States Fish and Wildlife Service of this conditional use request at least 15 days prior to the date of the public hearing. Failure to do so may result in cancellation of the public hearing. In addition, the applicant or authorized representative must appear in person at the public hearing to present the request, otherwise the case may be dismissed.***

Please initial here: \_\_\_\_\_

---

---

**OFFICE USE ONLY**

Case #: \_\_\_\_\_ Case Title: \_\_\_\_\_

Type: \_\_\_\_\_ Fee: \_\_\_\_\_ Receipt Number: \_\_\_\_\_ Hearing Date: \_\_\_\_\_

Notification Area: \_\_\_\_\_ Sections: \_\_\_\_\_

Zoning Approval: \_\_\_\_\_

Special Conditions: \_\_\_\_\_

---

---

**A request for continuance of an advertised application or a change in original request by applicant, must be accompanied by an additional fee.**

**\*\* Applicant should consult with Pima County Planning staff to determine the extent to which this requirement applies to the subject property. The Biological Impact Report pertains to expected impacts on endangered and threatened species as identified in the Sonoran Desert Conservation Plan.**

**APPENDIX 2**

**SDRC PROJECT APPLICATION  
FOR DEVELOPMENT PLAN**



## SDRC Project Application

Project Name \_\_\_\_\_

Rezoning Case (C09#) \_\_\_\_\_

Previous Project Numbers (if any) \_\_\_\_\_

Zoning Designation \_\_\_\_\_

Use of Project \_\_\_\_\_

Assessor Parcel # \_\_\_\_\_  
(Example 123-45-678)

Number of Addresses or Units \_\_\_\_\_

Use of Project \_\_\_\_\_

School District \_\_\_\_\_

Fire District \_\_\_\_\_

Water Company \_\_\_\_\_

Within 3 miles of \_\_\_\_\_ (City or Town)



Location Map  
T\_\_\_\_, R\_\_\_\_, Sec\_\_\_\_

---

### Applicant Information:

Company \_\_\_\_\_

Contact Person \_\_\_\_\_

Address \_\_\_\_\_  
\_\_\_\_\_

Phone \_\_\_\_\_

Email \_\_\_\_\_

### Developer Information:

Company \_\_\_\_\_

Contact Person \_\_\_\_\_

Address \_\_\_\_\_  
\_\_\_\_\_

Phone \_\_\_\_\_

Email \_\_\_\_\_



**APPENDIX 3**

**PIMA COUNTY COMMERCIAL**

**SOLAR FARM FEE**

# Pima County Commercial Solar Farm Fees and Site Development Plan and Permitting Guidelines

Last Revision: November, 2011

Pima County Development Services has prepared the following for developers of solar generating stations (solar farms) for initial budget estimates of fees and timelines relating to the site development plan process and the permitting process. Fees and timelines will vary depending on the size, complexity and location of the proposed solar farm.

In general, the **fees for a Site Development Plan (SDP) are \$6,255** for the Initial Submittal (includes a base fee of \$203 and a 2<sup>nd</sup> submittal, if applicable). Additional fees, some of which are site specific, are calculated as follows:

|                                                                                   |       |
|-----------------------------------------------------------------------------------|-------|
| 3 <sup>rd</sup> and Subsequent Submittals (percent of Initial Submittal fee)..... | 15%   |
| PDF Submittals/Quality Assurance (per submittal).....                             | \$273 |

## Landscape Plan/Native Plant Preservation Plan:

|                                                                            |       |
|----------------------------------------------------------------------------|-------|
| Initial Submittal (includes 2 <sup>nd</sup> submittal)                     |       |
| Base Fee                                                                   | \$485 |
| Per Sheet Fee                                                              | \$131 |
| 3 <sup>rd</sup> & Subsequent Submittals (percent of Initial Submittal fee) | 15%   |

## Improvement Plans & Grading Permits:

|                                                                            |        |
|----------------------------------------------------------------------------|--------|
| Initial Submittal (includes 2 <sup>nd</sup> submittal)                     |        |
| Base Fee                                                                   | \$150  |
| Per Sheet Fee (includes all sheets)                                        | \$114  |
| 3 <sup>rd</sup> & Subsequent Submittals (percent of Initial Submittal fee) | 15%    |
| Type II Grading Permit Fee (500 cubic yards or less)                       |        |
| Base Fee                                                                   | \$40   |
| Plus Per Cubic Yard                                                        | \$0.27 |
| Type II Grading Permit Fee (greater than 500 cubic yards)                  |        |
| Base Fee                                                                   | \$175  |
| Plus Per Cubic Yard                                                        | \$0.07 |

## Technical Reports/Documents, if applicable:

|                                                                                          |       |
|------------------------------------------------------------------------------------------|-------|
| Traffic Impact Study (includes 1 <sup>st</sup> & 2 <sup>nd</sup> submittal)              | \$400 |
| Archeology Report (includes 1 <sup>st</sup> & 2 <sup>nd</sup> submittal)                 | \$120 |
| Geotechnical/Soils Report (includes 1 <sup>st</sup> & 2 <sup>nd</sup> submittal)         | \$160 |
| 3 <sup>rd</sup> & Subsequent Submittal Technical Report Fee                              | 15%   |
| Other Technical Reports/Documents (includes 1 <sup>st</sup> & 2 <sup>nd</sup> submittal) | \$160 |

Additional fees may apply depending on the size, complexity and location of the proposed solar farm.

Building permit fees are contingent on the type of equipment and construction system used. Site walls/fences and accessory buildings are feed separately per the [Development Services Fee Schedule](#) effective July 1, 2011. A typical solar installation employing a pylon foundation system includes a minimum fee of \$77 for all permits requiring an inspection and would be feed at \$1,466 for major electrical work and \$1,173 for major mechanical/plumbing work. Systems employing slab foundation systems could incur much larger fees. Fee estimates may be obtained by submitting a project design draft to Building Safety.

In general, plan on a total timeline of less than one month for projects that do not require a conditional use permit. The reviews for the Site Development Plan and building plans can be performed concurrently, and there is a 10 working day review period. For projects that require conditional use permits, plan on a timeline of up to four months. These timelines are based on the assumption that submittal documents have addressed all of the requirements for submittal and significant revision and re-review cycles will not occur.

Development Services is committed to working with solar farm developers to expedite these processes. Your first step in developing your solar farm is to contact our solar concierge at the number at the bottom of the page. We will provide you with initial guidance and set up a preliminary review meeting on your project. The Pima County GIS system has extensive information on parcels, see <http://www.dot.pima.gov/gis/maps/mapguide/>.

The following table outlines requirements and is generally in the process order. Many elements will be reviewed concurrently in an integrated process resulting in the over all timelines mentioned above.

|                                                   | Permit/<br>Authorization                       | Issuing<br>Agency                                    | Estimated<br>Timeline  | Notes                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------------------------------------------|------------------------------------------------|------------------------------------------------------|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Step 1<br/>Site Development<br/>Plan (SDP)</b> | Zoning Approval                                | Pima County<br>Development<br>Services               | 2 weeks to<br>4 months | Type 2 conditional use in rural zones (IR, RH, GR-1, SR, SR-2, SH); permitted use in CB-2, CI-1, CI-2 and CI-3. See “Site Development Plan” at the web site <a href="http://www.pimaxpress.com/SubDivision">www.pimaxpress.com/SubDivision</a> for additional information. The following agency reviews are included in the integrated SDP process: Flood Plain, Archaeology, NPPP, and Transportation. |
|                                                   | Type II Grading Permit (Improvement Plan)      |                                                      |                        |                                                                                                                                                                                                                                                                                                                                                                                                         |
|                                                   | Right-of-way Permit                            |                                                      |                        |                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Step 2<br/>Building Permitting</b>             | Building Permit                                | Pima County<br>Development<br>Services               | <1 month               | Plans by a registered architect or engineer with: Structural - Foundation design, towers, structures; Electrical - single line and three line with grounding, conductor and conduit sizing                                                                                                                                                                                                              |
|                                                   | Flood Plain use Permit                         | PC Regional<br>Flood Control<br>District             | <1 month               | If site is located in regulatory floodplain, erosion hazard area, and/or regulated riparian habitat (determined in the SDP in Step 1).                                                                                                                                                                                                                                                                  |
| <b>Step 3<br/>Construction Permits</b>            | AZPDES Storm Water Construction General Permit | Arizona<br>Department of<br>Environmental<br>Quality | <1 month               | Coverage obtained through ADEQ Smart NOI process. SWPPP must be developed and implemented before construction begins<br><a href="https://az.gov/app/noi/(S(zg5ahvrpjb35uo45fkblo02s))/Default.aspx">https://az.gov/app/noi/(S(zg5ahvrpjb35uo45fkblo02s))/Default.aspx</a>                                                                                                                               |
|                                                   | Activity Permit                                | Pima County<br>Department of<br>Air Quality          | < 1 month              | Address dust control during construction. See <a href="http://www.deq.pima.gov/air/FugitiveDustProgram.htm">http://www.deq.pima.gov/air/FugitiveDustProgram.htm</a> for requirements and Fee Schedule                                                                                                                                                                                                   |

For further information contact: Betty Stamper, Pima County Regional Solar Coordinator, at 520-740-6463, or [betty.stamper@dsd.pima.gov](mailto:betty.stamper@dsd.pima.gov).

The Federal and State requirements on the following page may apply.

**FEDERAL:**

1. The Hazard Communication Act, CFR 1910-1200- handling hazardous materials
2. Resource Conservation and Recovery Act, 42 USC 6901 et. Seq.-Hazardous waste disposal
3. 36 CFR 800 - Protection of Historical and Cultural Properties
4. National Historic Preservation Act of 1996
5. 23 CFR 771 – Environmental Impact and Related Procedures
6. Americans with Disabilities Act (ADA), PL 101-336
7. Section 49(f) of the Department of Transportation Act
8. Executive Order 11988 (Flood Plain Management)
9. FHPM 7-7-3 – Procedures for Abatement of Highway Traffic Noise and Construction Noise
10. FHPM 7-7-9 – Air Quality Guidelines
11. National Environment Policy Act of 1969, 1973 and supplements
12. Executive Order 11990 (Protection of Wetlands)
13. Wild and Scenic Rivers Act of 1968
14. Section 404 of the Clean Water Act of 1977
15. Federal Farmlands Act of 1981
16. FHWA Technical Advisory T6640.8m, “Guidance Material for the Preparation of Environmental Documents”
17. Section 1424 (e) of the Safe Drinking Water Act (Sole Source Aquifer Review)
18. 36 CFR 60 – Determinations of Eligibility for Inclusion in the National Register of Historic Places
19. Public Law – 91-646 - Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970
20. Wilderness Act of 1964, Public Law 88-577
21. Arizona Deserts Wilderness Act of 1990, Public Law 101-628
22. Resource Conservation and Recovery (RCRA)
23. Comprehensive Environmental Response, Compensation and Recovery Act of 1980 (CERCLA)
24. Superfund Amendments and Reauthorization Act (SARA)
25. United States Forest Service, Integrated Resource Management (3<sup>rd</sup> Edition), August 1990
26. Endangered Species Act
27. Other Authorities : OSHA, Occupational Safety & Healthy Administration
28. Other governmental authorities having jurisdiction over the design or implementation of the Project.

**STATE:**

1. ARS Title 41 Section 41-844 – Findings of subsurface archeological remains
2. ARS Title 34 Section 34-401 - Designing for the physically disabled
3. Arizona Native Plant Law - ARS 3-904-Notice of Intent to Clear Land;  
<http://www.azda.gov/ESD/clearland.pdf>
4. Arizona Historic Preservation Law
5. State Water Quality Law (See attached guidance from ADWR)
6. ADOT Action Plan
7. ADOT Highways Division Policy and Implementation Memorandum 89-05, “Preservation of Arizona’s Wetlands,” August 1, 1989
8. Noise Abatement Policy for State Funded Projects
9. Arizona Environmental Quality Act (EQA)
10. Hazardous Waste Management Act (HWMA)
11. Underground Storage Tank Act of 1986

**APPENDIX 4**

**DEVELOPMENT PLAN**

**REQUIREMENTS**



# Checklist Requirements

Per Chapter 18.71 of the  
Pima County Zoning Code

This document is available on line at [www.pimaxpress.com](http://www.pimaxpress.com)

**PIMA COUNTY  
DEVELOPMENT PLAN REQUIREMENTS  
Per Chapter 18.71**

**I. DEVELOPMENT PLAN REQUIREMENTS**

A development plan is an engineering document, which shows the site layout for a proposed commercial project overlaid on a map of the site and the surrounding area. The plan shows the proposed building locations and footprints, parking lot layout, access and drainage facilities in their environmental context so that the designer and the members of the Subdivision and Development Review Committee (SDRC) can determine whether the project is designed in conformance with applicable regulations and will function safely.

A development plan is required in the following circumstances in accordance with Chapter 18.71 of the Pima County Zoning Code.

- Any new commercial development (defined as any development other than three residential units or less located on an individual lot).
- Any expansion of an existing site for which there has never been an approved development plan.
- Any change of use for an existing site with or without an approved development plan.
- An expansion of more than 2000 square foot of gross floor area and/or land use area for an existing site with an approved development plan. The 2000 square foot threshold is cumulative, beginning with the initial development plan approval, and has no time limit.

It is recommended that a registered professional civil engineer or registered architect prepare all development plans. A professional seal, however, is not required for projects, which meet all the following criteria:

- The site is less than one acre in size.
- Detention is not required.
- Total graded area is less than 14,000 square feet.
- New pavement area is less than 3,000 square feet.

All other projects and public improvements required as part of the development plan must be sealed by a professional civil engineer or registered architect. All development plans, including those that are not sealed by a registered architect or registered civil engineer, must comply with Pima County requirements for format and content.

A development plan must be prepared for the entire development. A development may include multiple parcels and/or a rezoning area even if the project is to be built in phases. An inclusive development plan is necessary to insure that the overall site is planned and will function as a cohesive and coordinated unit with respect to access, traffic circulation and hydrology rather than as a series of small independent developments.

Information shall be provided on the development plan to indicate the existing conditions on site and within 100 feet of the site. In situations where the site is bounded by a street with a width of 100 feet or greater, existing conditions across the street shall be provided.

If the project is to be developed in phases, the phase line(s) must be shown on the development plan and each phase must be able to stand alone with respect to parking, landscaping, hydrology and access. Final inspection will be performed only for complete phases as shown on the development plan. Any change to the approved phasing plan will require a revised development plan.

The development plan submittal consists of at least two sheets showing the following information. The development site plan sheet must show the following information:

- Boundary survey data
- Building footprints (with building height and square footage)
- Easements
- Setbacks
- Parking lot layout and dimensions
- Bufferyards
- Access points
- Adjacent streets and developments

The utility/hydrology plan sheet(s) must show the following information:

- Building footprints
- Drainage Basins
- Existing topography
- Sewer systems
- Septic systems
- Utilities & Utility Easements
- Details and cross sections (add separate sheet if necessary)
- Proposed spot elevations, high and low points
- Flood prone limits
- Erosion hazard setbacks

## II. DEVELOPMENT PLAN FORMAT (all Sheets)

- A. The information required for the development plan submittal shall be shown graphically or provided in notes on the plan. The plan may comprise several sheets showing various elements of required data.
- B. The plan sheet size shall be 24" X 36" and shall include a one-inch margin on each side. This allows for standardization of material for more efficient record keeping.  
(See Development Plan Example)
- C. All mapped data on the plan will be drawn at a standard engineering scale that will show all required details. A scale of 1" = 20' to 1" = 40' is required unless specifically waived by SDRC.
- D. All lettering and dimensions will be no smaller than 1/8" in size. The purpose of this requirement is to assure that the lettering is legible when reproduced for record-keeping purposes.
- E. The development plan drawing and lettering should be oriented with north toward the top or to the right of the sheet.
- F. The north arrow and scale will be placed together in the upper right corner of each sheet.
- G. The number of sheets must be noted on the bottom right corner (i.e., Sheet \_\_\_\_ of \_\_\_\_).
- H. If Key Notes are used, a complete and accurate list should be placed on each sheet. Do not list Key Notes that are not identified on the plan. Key Notes are **not acceptable** for the following:
  - Boundary survey data
  - Building footprints
  - Easements
  - Setbacks
  - Parking lot layout and dimensions
  - Bufferyards
  - Access points
  - Adjacent streets and developments
  - Drainage Basins
  - Existing topography
  - Sewer systems
  - Septic systems

I. Provide a Title Block at the lower right corner of each sheet, consisting of:

1. Label the plan as "Development Plan."
2. Name of the development.
3. A brief legal description of the property, including lot numbers, subdivision name and recording information, section, township and range reference (G & S R M, Pima County, Arizona).
4. The new P12 number, in bold print larger than the cross-reference numbers.  
(See Example Development Plan)

J. All applicable Pima County case numbers affecting the parcel must be listed on the cover sheet. These cross-reference numbers will be located at the bottom right corner near, but outside the title block on each sheet.

Typical case numbers and subjects are:

|                                                 |                                |
|-------------------------------------------------|--------------------------------|
| Co7 - Comprehensive Plan                        | Co20 – Design Review Committee |
| Co9 – Rezoning                                  | Co23 – Specific Plan           |
| Co10 – Board of Adjustment                      | Co24 – HDZ Variance            |
| P12 or Co12 – Subdivision Plat/Development Plan |                                |

All special conditions, approvals and restrictions associated with any of these cases must be identified on the initial submittal so that staff may adequately review the proposal. With the **initial development plan submittal**, provide an **OFFICIAL COPY OF THE BOARD OF SUPERVISOR REZONING HEARING MINUTES** for each of the dates that this rezoning appeared before the Board of Supervisors at a Public Hearing, or a **COPY OF THE RECORDED ZONING ORDINANCE and A COPY OF THE APPROVED PRELIMINARY DEVELOPMENT PLAN** for any rezoning case applicable to the project. Board of Supervisor minutes and rezoning ordinances are available at the Clerk of the Board's Office. Also, provide a copy of the official documentation for any other county action including but not limited to Board of Adjustment, Design Review Committee, etc. Provide copies of any documents referenced in rezoning minutes. (See Distribution List)



### III. COVER SHEET

- A. A small location map shall be provided, drawn at a scale of 3" = 1 mile. The map will be located in the upper right corner of the cover sheet. The location map will provide the following information:
1. The subject property identified and centered within a one square mile area.
  2. Identify conditions within the square mile area, such as major streets (including subject property access), rivers, railroads, subdivisions, reservations, national forests and city, town or other jurisdictional limits. Reference recorded subdivision plats by book and page numbers. Label section corners.
  3. Below the map, include a north arrow oriented with the north toward the top of the sheet; the section, township and range (G&SRM, Pima County, Arizona); and the scale, 3" = 1 mile.  
(See Development Plan Example)
  4. If the plan contains more than one sheet, a small index drawing of the site showing the area represented on each sheet is to be placed on the first sheet.
- B. The plan notes shall be divided into two sections. The "General Notes" shall include all informational and standard notes. The "Permitting Notes" shall include all notes, which affect the issuance of any permits.
- C. Individually list (if not one and the same) the name, address, zip code and telephone number of the developer and owner of the project and the person, firm or organization that prepared the development plan.
- D. Provide a blank 3" X 5" block for addressing purposes, in the lower right corner of the plan adjacent to the title block. (See Development Plan Sample)
- E. Include a signature block as follows:

APPROVED BY THE SUBDIVISION AND DEVELOPMENT REVIEW COMMITTEE:

---

Subdivision Coordinator

---

Date

#### IV. DEVELOPMENT PLAN CONTENT

The following information shall be shown on the development plan to indicate the proposed development and improvements. The information is listed by division and includes the General Notes and Permitting Notes that are required by each division to be included on the development plan.

##### A. ADDRESSING

1. Instructions
  - a. Provide interior street names, if applicable.
  - b. Indicate the number of floors for each commercial building.
  - c. For apartment complexes, label building numbers and provide the unit numbering scheme on the Development Plan in accordance with county standards.
  - d. For Commercial Developments (not apartments), identify the primary exterior entrances to the shell building.
  - e. Number buildings sequentially.
  - f. For commercial retail buildings having more than 1 floor, a 24" x 36" right reading mylar of the floor plan for each additional floor is required if not able to fit on the same sheet. This sheet must be to scale.

## B. CURRENT ZONING

### 1. Instructions

- a. The development plan boundary will be the assessor parcel or rezoning boundary.
- b. The development plan boundary shall be delineated with a solid BOLD line, which shall be the boldest line on the plan. Show the bearing and distance of each tangent section and the radius, arc length and central angle of each curve section of the boundary line.
- c. Locate the project by tying a property corner to a known point (i.e., a section corner, section line, roadway intersection, etc.)
- d. If more than one zone applies, show the zoning boundary line on the plan. Zoning boundaries shall be delineated with bearings and distances.
- e. Any existing structures or improvements on the property that are to be removed should not be shown on the plan. Any existing improvements that are to remain and be incorporated into the development plan should be shown and labeled as “existing”.
- f. The development plan shall have the same layout as the landscape plan. Show and label all required landscape buffer yards by letter and width designation on the development plan and in accordance with Chapter 18.73 of the Pima County Zoning Code. Verify that no conflict with utility easements or public right-of-way exist with the placement of bufferyard elements. Bufferyards shall be identical to those shown on the landscape plan.
- g. Any use within county right-of-way or county owned property must obtain a written authorization from the Real Property Division (and the Department of Transportation if right-of-way is involved) prior to the approval of the development plan.
- h. Delineate front, side, and rear yards. Show and label zoning setbacks. Show Major Streets and Routes (MSR) and Major Streets and Scenic Routes (MSSR) building setbacks as measured from the centerline of the required right-of-way. Label the streets as MSR or MSSR accordingly.
- i. If applicable, show and label the two hundred foot (200') Scenic Route area of applicability as measured from the property line(s) adjacent to the Scenic Route(s). In accordance with Chapter 18.77 provide a color rendering of all elevations that are visible from the Scenic Route. Also provide the corresponding color paint sample(s).

- j. For all structures that exceed twenty-four feet (24') in height within the scenic route area of applicability, provide a viewshed analysis in accordance with Sections 18.77.040.E1b.
- k. Show and label all patio and retaining walls on the development plan. Indicate height as measured from the outside of the wall.
- l. Label the footprint of each building with square footage of buildings, building height, number of stories and use. If multiple uses, label individual uses for each building footprint.
- m. Provide parking calculations, which verify that the project meets the requirements of Chapter 18.75, Pima County Zoning code. Delineate a typical parking space with dimensions. Specify the uses, calculations, number of parking spaces required, number provided, loading zones, bicycle parking, etc.  
(See Development Plan Example)
- n. In cases where zoning is conditionally approved as part of rezoning, a rezoning ordinance must be adopted by the Board of Supervisors and a Certificate of Compliance must be issued by the Planning Official prior to the issuance of any building permits. The owner/agent should contact the Planning Division Rezoning Section for details in order to assure appropriate timing and processing. Failure of the owner/agent to complete the requirements on time will delay the issuance of permits. Approval of the development plan does not necessarily indicate compliance with all rezoning conditions.
- o. Prior to the approval of the development plan and prior to the issuance of grading permits, an approved preservation plan is required. Prior to the approval of the development plan an approved landscape plan is required. Consult the landscape plan and native plant plan checklists for specific requirements.

## 2. General Notes

The following General Notes are required on all development plans.

- a. Total area of development plan is \_\_\_\_\_ acres.
- b. Net area of development site is \_\_\_\_\_ acres.
- c. Assessors Tax Parcel (s) # \_\_\_\_\_. (or portion of)

3. Permitting Notes

- a. The following Permitting Notes are required on all development plans.

1. Existing zoning is \_\_\_\_\_.

(If more than one zone is involved, the note should be expanded to indicate the number of gross acres of each zone.)

2. The use of this project is \_\_\_\_\_ and is permitted in accordance with Section 18. \_\_\_\_\_ of the Pima County zoning code.

3. Areas and spaces designated for required parking shall not be converted to other uses unless it can be demonstrated that sufficient on site parking exists.

- b. The following Permitting Notes are required on development plans in specific situations. Include as appropriate

1. If the project is subject to a rezoning, include the following permitting note:

This project is subject to Board of Supervisors Rezoning Conditions as found in case number Co9-\_\_\_\_\_ as approved on  (date)  [and amended on  (dates) ]. The following conditions affect the issuance of building permits:  (list conditions, if any) .

2. If the project is subject to Design Review Committee requirements, include the following permitting note:

This project is subject to Design Review Committee requirements as found in case number Co20-\_\_\_\_\_ as approved on  (date) . [and amended on  (dates) ]. The following requirements of the Design Review Committee affect the issuance of building permits:  (list requirements) .

3. If the project is subject to a variance, include the following permitting note:

This project is subject to the conditions of a variance approved by Board of Adjustment as found in case number Co10-\_\_\_\_\_, approved on  (date) . (State the Board of Adjustment's decision, verbatim).

4. If the project is on a Scenic Route, include the following permitting note:

This project is subject to Section 18.77.040, Scenic Routes.

5. If this project is a conditional use, include the following permitting note:

This project is subject to a type \_\_\_\_ conditional use process in accordance with section 18 \_\_\_\_ of the Zoning Code.

6. If this project is located along a Gateway Corridor, include the following note:

This project is subject to Chapter 18.78 “Gateway Overlay Zone” and approved in accordance with the Design Review Committee (DRC) requirements as found in case number CO20 \_\_\_\_ as approved on \_\_\_\_ (date). [and amended on \_\_\_\_ (dates)] The following requirements of the DRC affect the issuance of building permits: (list requirements)



#### 4. Impact Fees

The Pima County Board of Supervisors has implemented impact fees for non-residential uses. Fees are assessed at the time of building permit issuance and are based upon land use categories and square footage of same. The land use category and square footage for each category shall be shown on the development plan in a similar fashion as the parking calculations.

Referring to the Roadway Development Impact Fee Program, determine the following:

- Benefit Area (If your project is not within a benefit area, it is not subject to Roadway Impact Fees).
- Non-residential Land Use Category
- Number of Units (1000 SF equals 1 unit)

The total assessment due is determined by the fee schedule in effect at the time of building permit issuance.

Information regarding the Impact fee Program is located at the following web address: <http://www.dot.pima.gov/transsys/impactfees/faq.pdf> or by contacting the Impact Fee Program Manager in the Pima County Department of Transportation. The applicant may request an Administrative Review of the Non-Residential Roadway Development Impact Fees by submitting the required form and a copy of the development plan to the Impact Fee Program Manager in the Pima County Department of Transportation.

## C. DOCUMENT SERVICES

In addition to a general review performed by the other reviewing agencies of the development plan, Document Services works with the other reviewing agencies within SDRC to coordinate the preparation of documents which include dedication of right-of-ways and granting of easements.

### 1. Instructions

- a. All easements, existing or proposed, shall be shown on the development plan and shall be drawn with a dashed line, not a keynote. The easements shall include the following:
  1. Label each easement as public, private or to a specific entity.
  2. Label each right-of-way as public or private.
  3. Show the dimensions of each right-of-way and each easement.
  4. Provide the purpose of the easements, i.e. drainage, slope, utility, etc.
  5. Provide the recording information for existing right-of-ways and existing easements.
  6. Indicate to whom the easement has been granted or will be granted, i.e. Tucson Electric Power, Southwest Gas, Pima County, etc.
- b. During the initial review of the development plan, a reviewing agency may request a dedication or an easement. The Deed (prepared for right-of-ways) and Public Easement Agreements must be done by separate instrument. Document Services prepares all necessary documents for execution by the property owner. In order to prepare the documents, the following items must be submitted:
  1. Status Title Report current to within 60 days.
  2. Completed "Pima County Environmental Questionnaire".
  3. A legal description of the right-of-way or easement AND a location map, each on 8.5" x 11" paper.

Upon staff's review and approval of the above submitted documents, the legal description and location map will be attached to the Deed or the Public Easement Agreement. After the property owner has executed the documents and returned the ORIGINALS to Subdivision Coordination, they will be recorded by Pima County. The recording information will be shown on the development plan mylars.

D. ENVIRONMENTAL QUALITY (PDEQ)

1. Instructions

- a. In accordance with Arizona Administrative Code, R18-9-A309, PDEQ shall require connection to a sewage collection system if the connection is considered practical. A connection is considered practical if the sewer is located within 400 feet of the subject parcel and the cost to connect to the sewer is less \$6000, excluding permits and connection fees, and if capacity in the downstream sewer and treatment facility is available. If a sewer connection is not practical due to excessive cost, a waiver shall be obtained from PDEQ prior to construction.

Additionally, in accordance with Pima County Code, 7.21.037, if a sewer with adequate capacity is within 200 feet of the property line of the subject parcel, connection is required unless the sewer is not accessible by gravity flow, is not accessible by recorded legal access, or it can be demonstrated that the cost of connection to the sewer, excluding permit and sewer connection fees, is greater than twice the cost of constructing an on-site disposal system. In these cases, a waiver shall be obtained from the PDEQ to allow the use of an on-site disposal system.

- b. If an individual on-site sewage disposal system is proposed, the development plan shall show the following:
- Daily design flow of the facility, based on the Arizona Administrative Code, Title 18, Chapter 9, Unit Flows Table, including assumptions made
  - Results of percolation testing or soil analysis, including any limiting soil layers
  - Suitable primary and reserve disposal areas, based on the design flow and the results of the soil analysis and/or percolation testing, meeting all required setbacks
  - Any well site on or within 100 feet of the subject parcel
  - Depth to high seasonal groundwater

2. General Notes

The following General Note is required on all development plans:

- a. The water company that will serve this development is \_\_\_\_\_.

3. Permitting Notes

- a. If an on-site sewage disposal system is proposed, the following Permitting Note is required:

The proposed development will be served by an on-site sewage disposal system. Prior to construction, a Notice of Intent to Discharge shall be submitted to PDEQ in order to receive a Construction Authorization.

## E. FLOOD CONTROL DISTRICT

The Flood Control District review responsibility is for Federal Emergency Management Agency (FEMA) requirements, riparian habitat impacts, offsite drainage improvements required by rezoning conditions, maintenance design requirements (private or public), and all other hydrology or drainage requirements determined by the Deputy Director of the Flood Control District. If the proposed development project is affected by any of the Flood Control District responsibilities, they should be addressed in the Hydrology Report. Two reports and Development Plans are required, one set for the Flood Control District and the other set for the Hydrology Section.

The Hydrology Report must be prepared in conformance with the Hydrology instructions. Most of the onsite drainage design concept and hydraulic details will be addressed in the Hydrology report. The report can also address many FEMA floodplain and offsite impacts or other Flood Control District responsibilities. Some responsibilities are explained in the following:

### 1. Instructions

- a. If the development project impacts a Federal Emergency Management Agency (FEMA) 100-year floodplain, a Conditional Letter of Map Revision (CLOMR) is recommended, and a Letter of Map Revision (LOMR) is required to address revisions to the FEMA floodplain. Floodplain impacts include, but are not limited to, encroachments and base flood determinations in FEMA Zone A. CLOMR approval by Pima County and by FEMA will expedite the future LOMR submittal. Flood Control District approval is required before submitting the CLOMR, and the FEMA-assigned Case Number shall be added to the Development Plan notes. Construction as-built drawings and a Flood Control District signature are required with the LOMR submittal to FEMA. For any CLOMR or LOMR, provide the floodplain modeling basis of elevation, NGVD 1929 or NAVD 1988.
- b. Any mapped Riparian Habitat must be shown on the Development Plan. If there is any disturbance that exceeds the ordinance requirements, a Mitigation Plan must be approved by the Flood Control District before Development Plan approval.
- c. Rezoning conditions that require onsite or offsite drainage improvements approved by the Flood Control District must be addressed and agreed upon during the Development Plan process. The actual drainage requirements may be shown on the construction improvement plans.
- d. The design of onsite and offsite drainage or flood control improvements shall be in accordance with the documents in the Hydrology instructions 1.b. The documents instruct drainage and maintenance design, including access that shall be addressed during the Development Plan process and may be shown on the construction improvement plans.

## 2. General Notes

The following General Notes are required on all development plans that impact a FEMA 100-year floodplain.

- a. This project is impacted by the FEMA 100-year floodplain Zone \_\_\_ as shown on Flood Insurance Rate Map (FIRM) panel number \_\_\_\_\_ with effective date \_\_\_\_\_.
- b. (If applicable) A Conditional Letter of Map Revision (CLOMR) with FEMA case number \_\_\_\_\_ was submitted to FEMA on date.
- c. The basis of elevation for the CLOMR (if applicable) and LOMR floodplain modeling is \_\_\_\_\_ (NGVD 1929 or NAVD 1988).

## 3. Permitting Note

The following Permitting Note is required on all development plans that will require construction work in a 100-year floodplain, regulatory or FEMA.

- a. A Floodplain Use Permit is required before any grading or construction work within a 100-year floodplain. The Floodplain Use Permit will require an Elevation Certificate for any structure within the FEMA floodplain.



## F. HYDROLOGY

### 1. Instructions

#### Drainage Requirements:

If the site is not affected by 100-year flows of 100 cfs, or greater, a Drainage Statement sealed by a professional registered civil engineer is required.

- a. A Drainage Statement is a brief description of the site drainage conditions. The objective is to demonstrate adequate site drainage and to establish finished-floor elevations, which assure the all structures are free from flooding during a 100-year flood. The statement should also address detention and/or retention requirements, if necessary.

On the development plan, use flow arrows to show existing drainage patterns on site. The proposed drainage scheme should be clearly shown, with drainage being collected and released from the development at the locations and in the manner indicated by the original topography.

If the site is affected by a significant watercourse and 100-year flows of 100 cfs, or greater, a Hydrology Report is required.

- b. A complete Hydraulic and Hydrologic Report, prepared, sealed and signed by an Arizona registered professional civil engineer, must be submitted with the first submittal of the development plan. The report must be prepared in conformance with the following documents:
  - Hydrology Manual for Engineering Design and Floodplain Management in Pima County,
  - Pima County Floodplain and Erosion Hazard Management Ordinance,
  - Stormwater Detention/Retention Manual
  - Drainage and Channel Design Standards for Local Drainage.
  - Standards Manual for Drainage Design and Floodplain Management in Tucson, Arizona.

In addition to the above requirements, the report shall also include:

- A list of floodplain/hydrology related rezoning conditions,
  - A current aerial photo of project area
  - A statement of compliance with Section 404 of the Federal Clean Water Act, including a list of any mitigation requirements or other conditions of the permit.
- c. The proposed drainage scheme should be clearly shown on the development plan with the technical documentation provided in the Hydraulic and Hydrologic Report. Drainage must be collected and released from the development at the locations and in the manner indicated by the original topography. Use flow arrows, where necessary, to show drainage patterns on site. Show proposed 100-year floodplain limits and associated erosion hazard setback lines. Label any proposed drainage easements as public or private.
- d. Show cross sections, with dimensions, for all proposed drainage channels. The sections should indicate how the channel slopes would be protected.
- e. Show all proposed drainage structures such as detention/retention basins, inlet and outlet structures, culverts and dip sections with all required dimensions and associated hydraulic data.
- f. Riparian habitat areas must be shown and labeled. In areas where riparian habitat will be altered, a mitigation plan in conformance with the Floodplain and Erosion Hazard Management Ordinance must be approved before the development plan can be approved.
- g. When construction is proposed that changes the configuration of a delineated floodplain - regulatory or FEMA - whether upstream of, downstream from, or adjacent to the development, provide a new delineation of the floodplain affected by the drainage improvement. The new delineation and report shall be prepared in conformance with the requirements of the Floodplain and Erosion Hazard Management Ordinance, the Director of Water Resources, and the National Flood Insurance Program if a FEMA floodplain.
- h. Show and label the Section 404 jurisdictional waters as defined by the U.S. Army Corps of Engineers.

- i. For land in the FEMA 100-year floodplain, show the flood limits with a dashed line (different line type than the county regulatory floodplain) and label as the FEMA 100-year floodplain with the appropriate FEMA Zone.
- j. For drainage areas with 100-year flows of 100 cfs or more, the 100-year water surface elevations and regulatory flood limits must be shown and clearly labeled. The linear distance between water surface contour intervals should not exceed 200 feet. For FEMA floodplains show the existing base flood elevations (as shown on the current FIRM panel) and proposed 100-year water surface elevations that may be further than 200 feet apart.

## G. LANDSCAPE AND NATIVE PLANT PRESERVATION

### 1. INSTRUCTIONS

#### a. Landscape Plans

A landscape plan is required for every development plan with the following qualifications:

1. If the development plan is an expansion of less than 25% of a previously approved development plan, a landscape plan must be prepared for the entire project, however, only the landscaping associated with the expansion must meet current code requirements. The 25% expansion threshold is cumulative beginning with the original development plan.
2. If the development plan is an expansion of 25% or more of a previously approved development plan, a landscape plan must be prepared for the entire project and the entire site must meet current code requirements.

#### b. Native Plant Preservation Plan (NPP)

A native plant preservation plan is required for all development plans unless a waiver has been attained by demonstrating the historical use of the property prior to August, 1998 has left the property without any plants protected by Chapter 18.72 of the Pima County Zoning Code.

### 2. REQUIREMENTS

- a. Consult the separate Landscape Plan and Native Plant Preservation Plan checklists for submittal requirements.

## H. PARKS AND RECREATION DEPARTMENT

The Parks and Recreation Department reviews development plans for compliance with Sections 18.71.030C of the Pima County Zoning Code. This section of the code includes a minimum requirement of 460 square feet per unit and must include recreational facilities and structures for apartments and condominiums. Section 18.71.030.D states commercial developments will construct a segment of a trail corridor if the trail is listed on the trail system master plan and abuts the project.

### 1. Instructions

#### a. Residential Apartment Houses

For every new development of residential apartments, a new residential recreation area shall be created. The recreation area must include 460 square feet per apartment unit and must include recreational facilities and structures. The developer shall submit a proposed recreation Area plan (RAP) with the development plan. The RAP must depict all recreational facilities and structures to be developed, which may include, but are not limited to the following: turfing areas, swimming pool, paths, ramada, recreational center, tot play lot. The RAP must be approved by Pima County Natural Resources Parks & Recreation Department as a condition of development plan approval.

#### b. Commercial Developments

Commercial Developments that encompass or abut trail corridors listed on the Eastern Pima County Trails System Master Plan, including linear park corridors, shall provide space to accommodate the subject trail corridor, and shall construct the segment of the trail or linear park, consistent with the standards and requirements of the Pima County Natural Resources Parks & Recreation Department.

#### c. Trail Easements

If a trail is required, the applicant shall submit the legal description and location map of the trail easement, each on 8.5" x 11" paper to the Subdivision Coordination Office. Staff will review and approve the documents, attach the documents to the Public Non-Motorized Trail Easement, which will be prepared and recorded by Pima County. The easement describes the construction, width, materials and maintenance of the trail. Once the trail has been recorded, the recording information must be shown on the development plan.

## I. TRANSPORTATION

### 1. Instructions

- a. Paved legal access from a paved public road to the site must be provided. If the site is not adjacent to a public street an easement of sufficient width to provide paved, two-way access is required.
- b. For existing streets adjacent to the project, show the following information:
  - ROW recording information
  - ROW width
  - Pavement width
  - Cross section elements such as medians, curbs and sidewalks
  - Intersecting streets and driveways on the opposite side of the street
  - Intersecting streets and driveways within 150 feet on the same side of the street
  - Label street as public or private
  - Street name
- c. The Arizona Department of Transportation must approve all proposals involving State right-of-way. It is the developer's responsibility to coordinate with Arizona Department of Transportation (ADOT).

An approval letter from ADOT for the location and design of any driveways to state highways or other work in state ROW must be provided prior to the approval of the development plan.

- d. Show all proposed access points in conformance with the zoning code spacing requirements and/or rezoning requirements.
- e. Show parking lot layout to scale and fully dimension all PAALs, parking spaces and driveways.
- f. Show, by light shading, the extent of paving on the site. Show the proposed pavement section(s) and driveway details such as aprons or returns.
- g. Show sight visibility triangles with appropriate dimensions at all driveways and street intersections if the sight triangles encroach on the project site or if project landscaping in the street ROW is within the sight triangle.



## 2. Permitting Notes

The following permitting notes are required on all development plans.

- a. Prior to the request for final inspection, a letter certifying completion in conformance with the approved plans, sealed by a registered professional engineer or architect must be submitted to the development review division.

Note: If the project consists of modular unit construction only, change “final inspection” to “building permits.”

- b. No building permits shall be issued until a type 2 grading permit is issued.

The following Permitting Notes are required on development plans in specific situations. Include as appropriate.

If the project includes any construction in state ROW, add the following note:

- c. Prior to the request for final inspection, written approval from ADOT for all construction in State ROW must be provided to the Development Review Division.

If sight visibility triangles are shown on the development plan, include the following permitting note:

- d. Materials within sight visibility triangles shall be placed so as not to interfere with a visibility plane described by two horizontal lines located 30 inches and 72 inches above finished grade of the roadway surface.

If off-site improvements are being constructed in conjunction with the project, include the following permitting note:

- e. There will be no Final Inspections until improvements to \_\_\_\_\_ have been completed, and accepted by Pima County Department of Transportation and Flood Control District.

## J. WASTEWATER:

### 1. Instructions:

- a. Provide a letter from Pima County Wastewater Management Department (PCWMD) Planning Services; written within the past 90 days, stating that treatment and conveyance system capacity for the project is available. PCWMD Planning Services may be contacted regarding this matter.
- b. The Applicant may propose that public or private sewage collection lines or a combination of both serve the development. Pima County staff will determine what portion, if any, of the proposed sewage collection lines will be accepted into the public sewer system, pursuant to Pima County Code Title 13.20.030.A.1. The on-site sewage collection lines are typically required to be private when flow-through is not required. The Building Connection Sewer (BCS) lines are always required to be private.
- c. Pima County staff may require public flow-through sewage collection lines pursuant to Pima County Code Title 13.20.030.A.1.
- d. Design all public and private sanitary sewers for gravity flow. Sewage pump stations and force mains will be allowed only when no alternative is deemed viable by Pima County staff. Private lift stations must meet the requirements of Pima County Code Title 13.20.040.A.5
- e. Design all private sanitary sewage collection lines with design flows equal to or greater than 3000 gpd in accordance with Arizona Administrative Code, Title 18, Chapter 9. Design all proposed private sewers with design flows less than 3000 gpd (including BCS lines) in accordance with the Uniform Plumbing Code.
- f. Design all public sanitary sewers in accordance with Arizona Administrative Code, Title 18, Chapter 9, Pima County Code Title 13, and the latest editions of PCWMD's Manual of Engineering Standards and Procedures and the Pima County/City of Tucson (PC/COT) Standard Specifications and Standard Details for Public Improvements.
- g. Design all public and private sanitary sewers with the manholes and sewer lines in the parking area access lanes (PAALs) and access drives to the maximum extent possible.
- h. Do not restrict PCWMD's vehicular access to existing manholes in the public sewer system, or encroach into any existing public sewer easements. PCWMD's sewer maintenance vehicles have a 35' minimum inside turning radius, and 55' outside turning radius. Design the PAALs accordingly, if any public sewers are to be on-site.

- i. Design all landscaping over existing or proposed public sewer lines in accordance with PC/COT Standard Detail WWM A-4.
- j. Design all public and private sanitary sewers to minimize the amount of rainwater runoff entering the public sewer system. Sewer lines will not be allowed in drainageways, or within 10' of the top edge of a retention/detention basin, if an alternative alignment can be used. Manholes must not be located in rainwater runoff pathways.
- k. Design all public sewer easements to lie on the fewest possible number of parcels or lots possible, and in accordance with Pima County Code Title 13.20.030.A.1 and PC/COT Standard Details WWM 109, WWM 110, and WWM 111. Pima County staff will determine the required width and configuration of any necessary **public** sewer easements on a case-by-case basis.
- l. Show the public and private sewer lines using different line-types, so that they can readily be distinguished from each other.
- m. Show the existing sewer lines with thinner, or shaded, lines to distinguish them from the proposed sewer lines.
- n. Label all existing public and private sanitary sewer lines with their size and plan number as shown on PCWMD's section or base maps. These maps are available on-line at [www.wwm.co.pima.az.us/smap.htm](http://www.wwm.co.pima.az.us/smap.htm). These maps also show some, but not all, private sewer lines.
- o. Show all existing and proposed public and private sewer easements, labeled with their width, type (public or private) and recording information.
- p. Provide a legal description and location map of all proposed public sewer easements (on 8½" x 11" paper, in the format required by the Pima County Recorder's Office for recording) for review and acceptance. **Note:** This requirement does not pertain to private sewer easements.
- q. Show the location and method of connection to existing public or private sanitary sewers, including the manhole rim and invert elevations of any new or existing manhole that will be the point of connection. Label existing manhole(s) that are, or will be, the point of connection to public sewer system, as shown on PCWMD's section or base maps.

- r. Show all PCWWM wastewater fixture unit equivalent calculations (calculated using Table 13.20.040(F)(1) in Pima County Code 13.20.040(F).) and private sewer design flow calculations (calculated using the Unit Flows Table found at the end of Arizona Administrative Code, Title 18, Chapter 9 ).
- s. Show the size (diameter), length (in feet, to two decimal places) and slope (percent of grade, to two decimal places) of each proposed public or private sewer line. These values must be shown in labels within the drawings.
- t. Show the manhole rim and invert elevations (in feet, to two decimal places) of all proposed manholes. These values must be shown in labels within the drawings.
- u. Show one sewer flow direction arrow between each set of manholes.
- v. Show all existing building connection sewer (BCS) lines that will remain in use after development is complete. Label each of these existing BCS lines with its size and the letters, EX BCS. Do not show any BCS lines that will be abandoned and plugged.
- w. Show all proposed BCS lines, labeled with their size and the letters, BCS.
- x. Show the proposed invert elevations for the ends of all culverts, storm sewers, or other underground structures near, or that cross, the existing and proposed public or private sewer lines.

2. Required General Notes:

- a. The following General Note is required on the first sheet of all development plans, including those where the proposed development is served by existing or proposed on-site wastewater treatment and disposal (septic) systems:
  - 1. Any relocation, modification, etc., of the existing utilities and/or public improvements required by this development will be at no expense to the public.
- b. The following General Note is are required on the first sheet of all development plans showing a new or existing connection to Pima County's public sewer system:
  - 1. This project has \_\_\_\_\_ proposed and \_\_\_\_\_ existing wastewater fixture unit equivalents, per Table 13.20.040(F)(1) in Pima County Code 13.20.040(F).

Note: A formal Sewer Service Agreement for the project may be required when the total number of wastewater fixture unit equivalents exceeds 144.

- c. The following General Note is required on the first sheet of all development plans showing commercial or industrial developments discharging to Pima County's existing public sewer system:
  - 1. Any wastewater discharged into the public sanitary sewerage system shall meet the requirements of the Industrial Waste Ordinance (Pima County Ordinance No. 1991-140, as amended).
- d. If no new BCS or on-site or off-site sewage collection lines are proposed, and the proposed development will be served by the existing on-site private sewer lines, show the following note on the first sheet of the development plan:
  - 1. The on-site sewers are existing and private. No new sewers are proposed.
- e. If new BCS lines or private on-site sewage collection lines are proposed, show the following General Note on the first sheet of the development plan:
  - 1. On-site sanitary sewers will be private and will be constructed, operated and maintained on a private basis, and in accordance with an approved operation and maintenance plan, if required. The location and method of connection to an existing public sanitary sewer is subject to review and approval by the Pima County Wastewater Management Department.
- f. If existing or proposed public sewage collection lines are on-site, and new BCS or private on-site sewage collection lines are proposed, show the following General Note on the first sheet of the development plan:
  - 1. On-site sanitary sewers, except public sewers within public sewer easements or rights-of-way, will be private and will be constructed, operated and maintained on a private basis, and in accordance with an approved operation and maintenance plan, if required. The location and method of connection to an existing public sanitary sewer is subject to review and approval by the Pima County Wastewater Management Department.
- g. If the proposed on-site sewage collection lines will be public, show the following General Note on the first sheet of the development plan:
  - 1. The on-site sanitary sewage collection lines will be public and designed and constructed to Pima County Wastewater Management Department standards. All building connection sewers will be privately maintained.

- h. If any off-site public sewage collection and/or transmission lines are proposed, show the following General Note on the first sheet of the development plan:
  - 1. The required off-site public sanitary sewer line will be designed and constructed to Pima County Wastewater Management Department standards.

Note: This note should be omitted when the off-site public sewer line is in the streets or easements immediately adjacent to the proposed development.

3. Required Permitting Notes:

- a. The following Permitting Note must be shown on the first sheet of all development plans showing a new or existing connection to Pima County's public sewer system:
  - 1. A project construction permit must be secured from Pima County Wastewater Management Department before beginning any work on this project.
- b. If the proposed on-site sewage collection lines will be public, or the design flow of the proposed private sewage collection lines is equal to or greater than 3000 gpd, using the Unit Flows Table found in Arizona Administrative Code, Title 18, Chapter 9, the following Permitting Note must be shown the first sheet of the development plan:
  - 1. Construction authorization from the Pima County Department Of Environmental Quality is required before beginning any work on this project. Approval of this development plan does not constitute construction authorization.
- c. If any new or existing public sewer easements are shown, the following Permitting Note must be added to the first sheet of the development plan:
  - 1. No permits shall be issued for any permanent structures to be built within the public sewer easements shown hereon without separate written authorization from the Pima County Wastewater Management Department.
- d. If any new or existing public sewer easements are shown, the following Permitting Note must be added to the first sheet of the development plan:
  - 1. All landscaping within the public sewer easements shown hereon shall be in accordance with the planting guidelines contained within Pima County / City of Tucson Standard Detail WWM A-4.



4. Additional Information:

- a. All necessary public and private sewer easements for the development must be created by separate instrument and recorded prior to approval of the Mylars of the development plan, so that the recording information can be shown on the Mylars and verified by Pima County staff.
- b. In those instances where a formal Sewer Service Agreement has been required, the three signed and notarized originals of the Agreement must be returned to this office prior to the approval of the Mylars of the development plan.
- c. In those instances where a Joint Use, Maintenance and Access Agreement has been required for a shared private sewer line, it also must be reviewed and approved by Pima County staff, and recorded prior to the approval of the Mylars of the development plan.

## K. UTILITIES

### 1. Instructions

- a. Utilities are to be shown only on the utility/hydrology sheet.
- b. Show and label all existing and proposed utility easements per the Document Services Section requirements of this document.
- c. Please contact the individual utility companies that will serve this project for easement location and other requirements.

# **SOLAR PROJECT DRAINAGE REPORT AND SITE CONDITIONS REVIEW CHECKLIST**

Project Number \_\_\_\_\_ Project Name \_\_\_\_\_

Date Submitted \_\_\_\_\_ Due Date \_\_\_\_\_

FEMA Yes ☐ No ☐ Zone \_\_\_\_\_ FIRM Panel \_\_\_\_\_ Effective Date \_\_\_\_\_

LOMR Case No. \_\_\_\_\_ Effective Date \_\_\_\_\_

|                  |                                                          |                        |                                                          |                                 |                                                          |
|------------------|----------------------------------------------------------|------------------------|----------------------------------------------------------|---------------------------------|----------------------------------------------------------|
| Sheet Flood Area | Yes <input type="checkbox"/> No <input type="checkbox"/> | Floodway               | Yes <input type="checkbox"/> No <input type="checkbox"/> | Structure(s) Proposed           | Yes <input type="checkbox"/> No <input type="checkbox"/> |
| Regulatory FP    | Yes <input type="checkbox"/> No <input type="checkbox"/> | Flow Corridors         | Yes <input type="checkbox"/> No <input type="checkbox"/> | Structure(s) $\geq 200$ sq. ft. | Yes <input type="checkbox"/> No <input type="checkbox"/> |
| Mapped FP        | Yes <input type="checkbox"/> No <input type="checkbox"/> | Drainage complaints    | Yes <input type="checkbox"/> No <input type="checkbox"/> | Fill Proposed                   | Yes <input type="checkbox"/> No <input type="checkbox"/> |
| Mapping Req.     | Yes <input type="checkbox"/> No <input type="checkbox"/> | Reg. Discharge Points  | Yes <input type="checkbox"/> No <input type="checkbox"/> | Walls/Fences Proposed           | Yes <input type="checkbox"/> No <input type="checkbox"/> |
| Riparian         | Yes <input type="checkbox"/> No <input type="checkbox"/> | Adj. IP/DP Plans/Plats | Yes <input type="checkbox"/> No <input type="checkbox"/> | FPUP / EI Cert Req.             | Yes <input type="checkbox"/> No <input type="checkbox"/> |
|                  |                                                          |                        |                                                          | At-Grade Access / PAALs         | Yes <input type="checkbox"/> No <input type="checkbox"/> |

Wash Name (if named) \_\_\_\_\_  $Q_{100}$  \_\_\_\_\_

RFCD Special Study \_\_\_\_\_

## **Cover sheet**

Yes No N/A

- |                          |                          |                          |                             |
|--------------------------|--------------------------|--------------------------|-----------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Project Name / Number       |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Engineer's Seal             |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Project Contact Information |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Submittal Date              |

## **Statement/Report Content**

Yes No N/A

- |                          |                          |                          |                                          |
|--------------------------|--------------------------|--------------------------|------------------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | General Location Description             |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Description of Proposed Dev              |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Description of Existing Conditions       |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Description of FEMA Zones                |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Description of Special Studies           |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Description of Reg FP/Sheet Flood        |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 404 Compliance Statement                 |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Soil's Map or Description                |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Peak Discharges with Hydro Sheets        |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Table of CP's, Drainage Areas, $Q_{100}$ |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Encroachment Criteria                    |

## **Additional Site Specific Information**

Yes No N/A

- |                          |                          |                          |                                   |
|--------------------------|--------------------------|--------------------------|-----------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Elevation Requirements            |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Fill Pad Requirements (TECH-006)  |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Scour Analysis                    |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Critical Facility (TECH-029)      |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | At-Grade Access & PAALs preferred |

## **Required Exhibits**

Yes No N/A

- |                          |                          |                          |                                    |
|--------------------------|--------------------------|--------------------------|------------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Location Map                       |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Aerial Photo                       |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | FEMA FIRM Panel w/ Site Location   |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Offsite/Onsite Existing Conditions |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Site Plan / Proposed Improvements  |

## **Information Required on Exhibits**

Yes No N/A

- |                          |                          |                          |                                    |
|--------------------------|--------------------------|--------------------------|------------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Legible Topography                 |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Clear Drainage Pattern             |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Watershed Boundaries               |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Existing Drainage Infrastructure   |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Entering/Exiting CP's              |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Regulatory Floodplains             |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Erosion Hazard Setbacks            |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Hydraulic Cross-sections w/ WSEL's |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Depth of Flow for Sheet Flood      |

## **Site Inspection**

Yes No N/A

- |                          |                          |                          |                      |
|--------------------------|--------------------------|--------------------------|----------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Inspection Completed |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Photos on I:drive    |

Notes: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**APPENDIX 5**

**DEVELOPMENT PLAN REVIEW**

**PROCEDURES**

# Review Procedures



Per Chapter 18.71 of the  
Pima County Zoning Code

This document is available on line at [www.pimaxpress.com](http://www.pimaxpress.com)

August 2012

## DEVELOPMENT PLAN REVIEW PROCEDURES

THE DEVELOPMENT PLAN PROCESS  
CONSISTS OF THE FOLLOWING GENERAL STEPS:

1. Filing of development plan and fee.
2. SDRC review.
3. SDRC meeting (Not required, per applicant request).
4. Resubmittal of development plan with required revisions.
5. Approval of development plan by the Subdivision and Development Review Committee (SDRC).

I. FILING OF DEVELOPMENT PLANS

A. SUBMITTAL REQUIREMENTS

1. All submittals will be made through the Subdivision Coordination Office and will be prepared in accordance with the current Development Plan Requirements. Incomplete or incorrect submittals will not be accepted.
2. Submittals will be accepted Monday through Friday, 8:00 a.m. to 4:00 p.m.
3. Submittals must include:
  - a. Complete application forms.
  - b. Plan sets. Plan sets must be folded with the County fold. (Refer to Folding Instructions and Distribution List)
  - c. Status of title report current within 60 days of submittal. (Refer to the Document Services Section).
  - d. Fees. (Refer to current Fee Schedule)
  - e. Provide an **OFFICIAL COPY OF THE BOARD OF SUPERVISOR REZONING HEARING MINUTES** for each of the dates that this rezoning appeared before the Board of Supervisors at a Public Hearing, or a **COPY OF THE RECORDED ZONING ORDINANCE and A COPY OF THE APPROVED PRELIMINARY DEVELOPMENT PLAN** for any rezoning case applicable to the project Board of Supervisor minutes and rezoning ordinances are available at the Clerk of the Board's Office. Also, provide a copy of the official documentation for any other county action including but not limited to Board of Adjustment, Design Review Committee, etc. Provide copies of any documents referenced in rezoning minutes. (See Distribution List)
    - OFFICIAL COPY OF THE BOARD OF SUPERVISOR REZONING HEARING MINUTES or a COPY OF THE RECORDED ZONING ORDINANCE  
and
    - PRELIMINARY DEVELOPMENT PLAN



## B. REVIEW PROCESS

1. Prior to formal submittal of the project, the consultant may elect to meet with the Subdivision and Development Review Committee (SDRC) for a presubmittal meeting. The purpose of this meeting is to allow the consultant the opportunity to ask questions about the project and obtain information to enable the consultant to prepare a more complete submittal. The presubmittal meeting is not intended to be a complete review of the plan since only the most critical issues will be addressed. Any comments provided by SDRC at the meeting should not be construed as a complete set of review comments, but considered as general guidance in plan preparation. The SDRC meetings are held in the Public Works Building, 201 N. Stone Avenue, on Friday mornings at 9:00 a.m. in the 1<sup>st</sup> floor conference room. These meetings are first come, first serve. You must sign in and each project will be taken in order.
2. The consultant shall submit the required number of plan sets and correct fees to the Subdivision Coordination Office.
3. The Subdivision Coordination Office will distribute the development plan to the appropriate review agencies and committee members.
4. The review agencies will review the development plan and post comments to the internet at [www.pimaxpress.com](http://www.pimaxpress.com). Search for comments by project number to access the comment letter.
5. The consultant may meet with the Subdivision and Development Review Committee (SDRC) at a Friday morning meeting to discuss the review comments, if necessary.
6. The development plan shall be revised to comply with the comments received and shall be resubmitted through the Subdivision Coordination Office.
7. The resubmittal must include the appropriate number of plan sets (one copy for each agency requesting changes and one copy for the Subdivision Coordination Office) and a letter from the consultant itemizing the requested changes from the various review agencies explaining how these comments were addressed. Copies of the letter should be included to attach to each plan set submitted. The review agencies will review the development plan and post comments to the internet at

www.pimaxpress.com. Search for comments by project number to access the comment letter. This procedure continues until all of the requirements have been satisfied.

In the event, a development plan be submitted more than 3 times, a mandatory meeting with the applicant, developer/owner and the SDRC will be required prior to accepting any further submittals. The Subdivision Coordinator will contact the developer/owner to set up a Friday morning meeting with the SDRC.

**Resubmittals of the development plan must be received within 6 months of completion of the previous review. The project will be permanently closed after a six-month period of inactivity if no extension is requested. The applicant may request a one-time 3-month extension per project. The extension request shall be submitted to the Subdivision Coordination Office for review. If closed, the applicant will be required to submit a new development plan complete with new documents and fees.**

**Please Note:** If, for some reason, design changes are made on the development plan after it has been approved by one or more review agency(s), a redlined plan and a transmittal letter must be submitted to the Subdivision Coordination Office for review. A determination will be made as to what procedure to follow to complete the review of the development plan.

### C. APPROVAL PROCESS

When all requirements of the SDRC have been satisfied, the Subdivision Coordination Office will forward an approval letter for the development plan to the consultant and Developer. Within 30 days from receipt of the approval letter, the consultant must submit on CD to the Subdivision Coordination Office, the development plan and landscape/native plant plans in a .PDF format. A final check of the plans will be made by staff. Once approved, the consultant will submit a set of bond copies of the development plan and landscape/native plant plans for signature. The development plan will be approved for one year from the date of the signature on the bond copy. If the CD of the development plan and landscape/native plant plans are not received within 30 days from the receipt of the approval letter, a revised development plan and landscape/native plant plans will be required.

### D. PERMITS

Grading plans may not be submitted until all first submittal comments on the development plan have been received by the applicant. If no major changes are required on the development plan due to the review comments, the grading plan may be submitted to the **Development Review Division** for review; however, a grading permit will not be issued until the development plan is approved by SDRC. An archeological clearance letter from Pima County Cultural Resources and an approved native plant preservation plan (NPPP) are also required prior to the issuance of a grading permit.

At any time during the review of the development plan the building plans may be submitted to Building Codes Division, however, prior to obtaining a building permit, the development plan and the grading plan must be approved.

Air Quality Permits may be required in accordance with Pima County Code 17.12.470 and 17.16.050. Stormwater Construction General Permits may be required in accordance with Arizona Administrative Code R18-9-C901 and ADEQ's AZPDES Construction General Permit. Contact the Pima County Department of Environmental Quality.

#### E. TIME LIMITS

An approved development plan is valid for a period of one year from the signature date on the approved development plan. There is no provision in the Zoning Code for a development plan extension. Building permits must be obtained and substantial construction must be completed within one year or the development plan will expire. Once expired, a new development plan must be submitted complete with new documents and fees.

#### F. DEVELOPMENT PLAN REVISIONS

Once the development plan is approved, any subsequent revisions to the plan will be considered a *new development plan* and will be processed with a new project number. In the title block, the name of the project will remain the same with the addition of a revision number, i.e. revision #1.

All improvements constructed under the previous development plan must be shown and clearly labeled as existing. Proposed changes and/or additions must also be clearly shown and labeled and must be graphically distinct from the existing improvements.

# **APPENDIX 7**

## **TORTUGA FINANCIAL MODEL**

**Tortuga Ranch**  
Key Financial Assumptions

| Financial Close                                      |           |        | 5/1/2014             | Funding Sources                                                    |       |               |
|------------------------------------------------------|-----------|--------|----------------------|--------------------------------------------------------------------|-------|---------------|
| Funding Requirements                                 |           |        |                      | Funding Sources                                                    |       |               |
| <b>PROJECT COSTS</b>                                 |           |        | <b>Total</b>         | <b>PROJECT FUNDING</b>                                             |       |               |
|                                                      |           |        |                      |                                                                    |       | <b>\$000</b>  |
| Eligible Capital Costs Incurred (sales tax included) | \$        |        | 63,608               | Equity                                                             |       | 31,233        |
| Ineligible Capital Costs                             | \$        |        | -                    | Term Loan                                                          |       | 32,966        |
| Development Costs                                    | \$        |        | -                    | Total Project                                                      | \$    | <u>64,199</u> |
| Land Acquisition Cost                                | \$        |        | -                    | <b>Debt Structure - Acquisition Facility</b>                       |       |               |
| Legal / Closing Costs                                | \$        |        | -                    | Quarterly Payments - interest paid in arrears - levelized payments |       |               |
| Financing Fees - % of loan amt                       | \$        |        | 591                  | Term - Years / Payments                                            | 15    | 60            |
| Capitalized Interest                                 | \$        |        | -                    | Balloon Payment due after                                          | 0     | -             |
| <b>TOTAL PROJECT COSTS</b>                           | <b>\$</b> |        | <b><u>64,199</u></b> | Loan Amortization Period                                           | 15    | 60            |
| Working Capital Requirements                         | <b>\$</b> |        | <b><u>-</u></b>      | Rate                                                               | 6.00% |               |
| <b>Residual Value</b>                                |           |        | <b>\$000</b>         | Amount                                                             | \$    | 32,966        |
| Value (net of Taxes at end of PPA \$/kW)             | \$        | 500.00 | \$                   | Debt Amount                                                        | \$    | 32,966        |
|                                                      |           |        | 10,000               | Construction Loan Interest Rate                                    |       | 6.00%         |
| Tax Rate - Combined Federal & AZ                     |           |        | 28.0%                | <b>Depreciation</b>                                                |       |               |
|                                                      |           |        |                      | Eligible Capital Costs                                             | \$    | 64,199        |
|                                                      |           |        |                      | Investment Tax Credit                                              | 30.0% | \$ 19,260     |
|                                                      |           |        |                      | Eligible 5 Yr MACRS                                                |       | 100.0%        |
|                                                      |           |        |                      | Remaining Depreciable Basis                                        | \$    | 54,569        |
|                                                      |           |        |                      | New Market Tax Credit                                              | 39%   | 8,763.16      |
|                                                      |           |        |                      |                                                                    | 5%    |               |
|                                                      |           |        |                      |                                                                    | 6%    |               |

**Tortuga Ranch**  
Key Financial Results

| Revenues & Income |                 |                   | Operating Cash Flows & Debt Coverage |                         |                           |                                               |                     |                                  |
|-------------------|-----------------|-------------------|--------------------------------------|-------------------------|---------------------------|-----------------------------------------------|---------------------|----------------------------------|
| <u>Year</u>       | <u>Revenues</u> | <u>Net Income</u> | <u>EBITDA</u>                        | <u>Interest Expense</u> | <u>Principal Payments</u> | <u>Cash Available **<br/>For Distribution</u> | <u>Loan Balance</u> | <u>End Bal %<br/>of Original</u> |
| 2014              | 0               | 0                 | 0                                    | 0                       | -                         | (22,470)                                      | 0                   |                                  |
| 2015              | 3,246           | 766               | 3,011                                | 1,947                   | 1,402                     | 18,923                                        | 31,564              | 95.7%                            |
| 2016              | 3,311           | (439)             | 3,069                                | 1,861                   | 1,488                     | (279)                                         | 30,077              | 91.2%                            |
| 2017              | 3,377           | (327)             | 3,135                                | 1,770                   | 1,579                     | (214)                                         | 28,498              | 86.4%                            |
| 2018              | 3,445           | (209)             | 3,201                                | 1,673                   | 1,676                     | (148)                                         | 26,822              | 81.4%                            |
| 2019              | 3,513           | (86)              | 3,269                                | 1,570                   | 1,779                     | (80)                                          | 25,043              | 76.0%                            |
| 2020              | 3,584           | 6                 | 3,288                                | 1,461                   | 1,888                     | (61)                                          | 23,155              | 70.2%                            |
| 2021              | 3,655           | 139               | 3,357                                | 1,345                   | 2,004                     | 9                                             | 21,152              | 64.2%                            |
| 2022              | 3,728           | 279               | 3,428                                | 1,222                   | 2,127                     | 79                                            | 19,025              | 57.7%                            |
| 2023              | 3,803           | 425               | 3,500                                | 1,091                   | 2,257                     | 152                                           | 16,768              | 50.9%                            |
| 2024              | 3,879           | 577               | 3,574                                | 953                     | 2,396                     | 225                                           | 14,372              | 43.6%                            |
| 2025              | 3,957           | 629               | 3,499                                | 806                     | 2,543                     | 150                                           | 11,830              | 35.9%                            |
| 2026              | 4,036           | 797               | 3,575                                | 650                     | 2,699                     | 227                                           | 9,131               | 27.7%                            |
| 2027              | 4,117           | 972               | 3,653                                | 484                     | 2,864                     | 305                                           | 6,267               | 19.0%                            |
| 2028              | 4,199           | 1,156             | 3,733                                | 308                     | 3,040                     | 385                                           | 3,227               | 9.8%                             |
| 2029              | 4,283           | 1,349             | 3,814                                | 122                     | 3,227                     | 466                                           | (0)                 | 0.0%                             |
| 2030              | 4,368           | 1,496             | 3,897                                | 0                       | -                         | 3,897                                         | 0                   | 0.0%                             |
| 2031              | 4,456           | 1,557             | 3,982                                | 0                       | -                         | 3,982                                         | 0                   | 0.0%                             |
| 2032              | 4,545           | 1,620             | 4,068                                | 0                       | -                         | 4,068                                         | 0                   | 0.0%                             |
| 2033              | 4,636           | 1,683             | 4,156                                | 0                       | -                         | 4,156                                         | 0                   | 0.0%                             |
| 2034              | 4,729           | 1,748             | 4,246                                | 0                       | -                         | 14,246                                        | 0                   | 0.0%                             |
| IRR               |                 |                   |                                      |                         |                           | 9.94%                                         |                     |                                  |



|                                               |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |      |
|-----------------------------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|------|
| <b>PY Solar</b>                               |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |      |
|                                               | Jan-15             | Jan-16             | Jan-17             | Jan-18             | Jan-19             | Jan-20             | Jan-21             | Jan-22             | Jan-23             | Jan-24             | Jan-25             |      |
| <b>PLANT OUTPUT</b>                           | <b><u>2015</u></b> | <b><u>2016</u></b> | <b><u>2017</u></b> | <b><u>2018</u></b> | <b><u>2019</u></b> | <b><u>2020</u></b> | <b><u>2021</u></b> | <b><u>2022</u></b> | <b><u>2023</u></b> | <b><u>2024</u></b> | <b><u>2025</u></b> |      |
| Percent Of Year of Operations                 | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 100.0%             |      |
| Year of Operation                             | 1.00               | 2.00               | 3.00               | 4.00               | 5.00               | 6.00               | 7.00               | 8.00               | 9.00               | 10.00              | 11.00              |      |
| <b>Plant Output</b>                           |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |      |
| Net Output (MWh)                              | 46,219             | 45,873             | 45,529             | 45,187             | 44,848             | 44,512             | 44,178             | 43,847             | 43,518             | 43,191             | 42,867             |      |
| Degradation - annual                          | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.75%              |      |
| Net By Yr                                     | 20                 | 19.9               | 19.7               | 19.6               | 19.4               | 19.3               | 19.1               | 19.0               | 18.8               | 18.7               | 18.5               | 18.4 |
| <b>REVENUES</b>                               |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |      |
| <b>Output Available For Sales</b>             |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |      |
| Total Energy Output Available                 | 46,219             | 45,873             | 45,529             | 45,187             | 44,848             | 44,512             | 44,178             | 43,847             | 43,518             | 43,191             | 42,867             |      |
| <b>Electricity Price</b>                      |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |      |
| Energy Price (\$/kWh)                         | \$0.07             | \$0.07             | \$0.07             | \$0.07             | \$0.07             | \$0.08             | \$0.08             | \$0.08             | \$0.08             | \$0.08             | \$0.08             |      |
| <b>Revenues - \$000</b>                       |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |      |
| PPA Revenue                                   | 3,246              | 3,311              | 3,377              | 3,445              | 3,513              | 3,584              | 3,655              | 3,728              | 3,803              | 3,879              | 3,957              |      |
| <b>TOTAL REVENUES</b>                         | <b>3,246</b>       | <b>3,311</b>       | <b>3,377</b>       | <b>3,445</b>       | <b>3,513</b>       | <b>3,584</b>       | <b>3,655</b>       | <b>3,728</b>       | <b>3,803</b>       | <b>3,879</b>       | <b>3,957</b>       |      |
| <b>OPERATING EXPENSE</b>                      | <b><u>2015</u></b> | <b><u>2016</u></b> | <b><u>2017</u></b> | <b><u>2018</u></b> | <b><u>2019</u></b> | <b><u>2020</u></b> | <b><u>2021</u></b> | <b><u>2022</u></b> | <b><u>2023</u></b> | <b><u>2024</u></b> | <b><u>2025</u></b> |      |
| <b>Variable</b>                               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               |      |
| Plant Value - Insurable                       | 58,608             | 57,435             | 56,287             | 55,161             | 54,058             | 52,977             | 51,917             | 50,879             | 49,861             | 48,864             | 47,887             |      |
| <b>Operating Expense - Fixed</b>              |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |      |
| Management Fees                               |                    |                    |                    |                    |                    | 50                 | 51                 | 53                 | 54                 | 55                 | 57                 |      |
| Insurance                                     | 234                | 241                | 242                | 244                | 245                | 246                | 247                | 248                | 249                | 250                | 251                |      |
| Property Taxes                                | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |      |
| Inverter Replacement & Repair - O&M yrs 11-20 | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 150                |      |
| Major Maintenance - BOP                       |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |      |
| Lease Payments                                | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |      |
| Energy Purchase                               | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |      |
| <b>Total Fixed Expenses</b>                   | <b>234</b>         | <b>241</b>         | <b>242</b>         | <b>244</b>         | <b>245</b>         | <b>296</b>         | <b>298</b>         | <b>300</b>         | <b>303</b>         | <b>305</b>         | <b>458</b>         |      |
| <b>TOTAL OPERATING EXPENSES</b>               | <b>234</b>         | <b>241</b>         | <b>242</b>         | <b>244</b>         | <b>245</b>         | <b>296</b>         | <b>298</b>         | <b>300</b>         | <b>303</b>         | <b>305</b>         | <b>458</b>         |      |
| <b>TOTAL OPERATING PROFIT</b>                 | <b>3,011</b>       | <b>3,069</b>       | <b>3,135</b>       | <b>3,201</b>       | <b>3,269</b>       | <b>3,288</b>       | <b>3,357</b>       | <b>3,428</b>       | <b>3,500</b>       | <b>3,574</b>       | <b>3,499</b>       |      |

|                                               |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
|-----------------------------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| <b>PY Solar</b>                               |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
|                                               | Jan-26             | Jan-27             | Jan-28             | Jan-29             | Jan-30             | Jan-31             | Jan-32             | Jan-33             | Jan-34             | Jan-35             |
| <b>PLANT OUTPUT</b>                           | <b><u>2026</u></b> | <b><u>2027</u></b> | <b><u>2028</u></b> | <b><u>2029</u></b> | <b><u>2030</u></b> | <b><u>2031</u></b> | <b><u>2032</u></b> | <b><u>2033</u></b> | <b><u>2034</u></b> | <b><u>2035</u></b> |
| Percent Of Year of Operations                 | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 0.0%               |
| Year of Operation                             | 12.00              | 13.00              | 14.00              | 15.00              | 16.00              | 17.00              | 18.00              | 19.00              | 20.00              | 20.00              |
| <b>Plant Output</b>                           |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Net Output (MWh)                              | 42,546             | 42,227             | 41,910             | 41,596             | 41,284             | 40,974             | 40,667             | 40,362             | 40,059             | 40,059             |
| Degradation - annual                          | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.00%              |
| Net By Yr                                     | 20                 | 18.3               | 18.1               | 18.0               | 17.9               | 17.7               | 17.6               | 17.5               | 17.3               | 17.2               |
| <b>REVENUES</b>                               |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| <b>Output Available For Sales</b>             |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Total Energy Output Available                 | 42,546             | 42,227             | 41,910             | 41,596             | 41,284             | 40,974             | 40,667             | 40,362             | 40,059             | 40,059             |
| <b>Electricity Price</b>                      |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Energy Price (\$/kWh)                         | \$0.09             | \$0.09             | \$0.09             | \$0.09             | \$0.09             | \$0.09             | \$0.10             | \$0.10             | \$0.10             | \$0.10             |
| <b>Revenues - \$000</b>                       |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| PPA Revenue                                   | 4,036              | 4,117              | 4,199              | 4,283              | 4,368              | 4,456              | 4,545              | 4,636              | 4,729              |                    |
| <b>TOTAL REVENUES</b>                         | <b>4,036</b>       | <b>4,117</b>       | <b>4,199</b>       | <b>4,283</b>       | <b>4,368</b>       | <b>4,456</b>       | <b>4,545</b>       | <b>4,636</b>       | <b>4,729</b>       | <b>-</b>           |
| <b>OPERATING EXPENSE</b>                      |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| <b>Variable</b>                               | <b><u>2026</u></b> | <b><u>2027</u></b> | <b><u>2028</u></b> | <b><u>2029</u></b> | <b><u>2030</u></b> | <b><u>2031</u></b> | <b><u>2032</u></b> | <b><u>2033</u></b> | <b><u>2034</u></b> | <b><u>2035</u></b> |
|                                               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               |
| Plant Value - Insurable                       | 46,929             | 45,990             | 45,071             | 44,169             | 43,286             | 42,420             | 41,572             | 40,740             | 39,925             | 39,127             |
| <b>Operating Expense - Fixed</b>              |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Management Fees                               | 58                 | 59                 | 61                 | 62                 | 64                 | 66                 | 67                 | 69                 | 71                 | 0                  |
| Insurance                                     | 252                | 254                | 255                | 256                | 257                | 258                | 259                | 261                | 262                | 0                  |
| Property Taxes                                | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| Inverter Replacement & Repair - O&M yrs 11-20 | 150                | 150                | 150                | 150                | 150                | 150                | 150                | 150                | 150                | 0                  |
| Major Maintenance - BOP                       |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Lease Payments                                | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| Energy Purchase                               | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| <b>Total Fixed Expenses</b>                   | <b>460</b>         | <b>463</b>         | <b>466</b>         | <b>468</b>         | <b>471</b>         | <b>474</b>         | <b>477</b>         | <b>479</b>         | <b>482</b>         | <b>0</b>           |
| <b>TOTAL OPERATING EXPENSES</b>               | <b>460</b>         | <b>463</b>         | <b>466</b>         | <b>468</b>         | <b>471</b>         | <b>474</b>         | <b>477</b>         | <b>479</b>         | <b>482</b>         | <b>0</b>           |
| <b>TOTAL OPERATING PROFIT</b>                 | <b>3,575</b>       | <b>3,653</b>       | <b>3,733</b>       | <b>3,814</b>       | <b>3,897</b>       | <b>3,982</b>       | <b>4,068</b>       | <b>4,156</b>       | <b>4,246</b>       | <b>0</b>           |

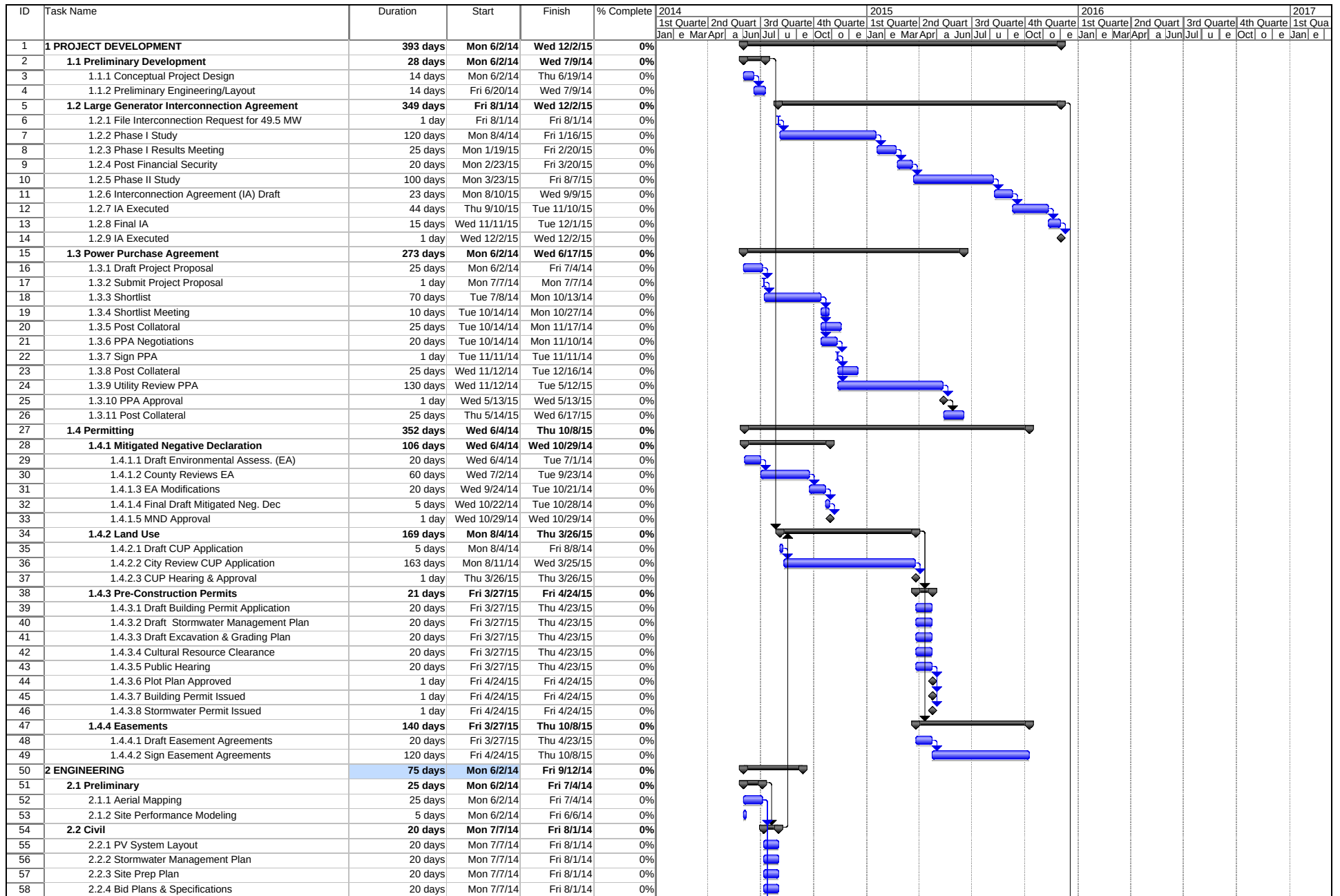
**Tortuga Ranch**

| <b>CASH FLOW</b>                                    | <b><u>2014</u></b> | <b><u>2015</u></b> | <b><u>2016</u></b> | <b><u>2017</u></b> | <b><u>2018</u></b> | <b><u>2019</u></b> | <b><u>2020</u></b> | <b><u>2021</u></b> | <b><u>2022</u></b> | <b><u>2023</u></b> | <b><u>2024</u></b> | <b><u>2025</u></b> |
|-----------------------------------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| <b>Project Financing</b>                            |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Initial Equity Infusion                             | 31,233             | -                  | -                  |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Acquisition Facility Proceeds                       | -                  | -                  | -                  |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Working Capital Facility Proceeds                   | -                  | -                  | -                  |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Initial Capital Inflows                             | 31,233             | -                  | -                  |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Base Project Cost                                   | -                  | -                  | -                  |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Working Capital Requirements                        | -                  | -                  | -                  |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Initial Capital Requirements                        | -                  | -                  | -                  |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| <b>Operating Activity</b>                           |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Operating Profit (from Operating Results Worksheet) |                    | 3,011              | 3,069              | 3,135              | 3,201              | 3,269              | 3,288              | 3,357              | 3,428              | 3,500              | 3,574              | 3,499              |
| <b>Operating Cash Flow</b>                          |                    | 3,011              | 3,069              | 3,135              | 3,201              | 3,269              | 3,288              | 3,357              | 3,428              | 3,500              | 3,574              | 3,499              |
| <b>Operating Activity</b>                           |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Acquisition Facility Debt Service                   | (3,348)            | (3,348)            | (3,348)            | (3,348)            | (3,348)            | (3,348)            | (3,348)            | (3,348)            | (3,348)            | (3,348)            | (3,348)            | (3,348)            |
| Interest on Working Capital Facility                | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| Income Taxes                                        | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| Working Capital Changes - Yr 2 Requirement          | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| Repayment of Working Capital Facility               | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| Cash Available for Maintenance Reserve              | (337)              | (279)              | (214)              | (148)              | (80)               | (61)               | 9                  | 79                 | 152                | 225                | 150                | 150                |
| Residual Value                                      | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| <b>Investment Tax Credit</b>                        | 19,260             | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| <b>New Market Tax Credit</b>                        |                    |                    |                    | 0                  |                    |                    |                    | 0                  | 0                  |                    |                    |                    |
| Cash Flow After Debt Service & Taxes                | 18,923             | (279)              | (214)              | (148)              | (80)               | (61)               | 9                  | 79                 | 152                | 225                | 150                | 150                |

| Tortuga Ranch                                       |             |             |             |             |             |             |             |             |             |                   |
|-----------------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------------|
| CASH FLOW                                           | <u>2026</u> | <u>2027</u> | <u>2028</u> | <u>2029</u> | <u>2030</u> | <u>2031</u> | <u>2032</u> | <u>2033</u> | <u>2034</u> | 0%<br><u>2035</u> |
| <b>Project Financing</b>                            |             |             |             |             |             |             |             |             |             |                   |
| Initial Equity Infusion                             |             |             |             |             |             |             |             |             |             |                   |
| Acquisition Facility Proceeds                       |             |             |             |             |             |             |             |             |             |                   |
| Working Capital Facility Proceeds                   |             |             |             |             |             |             |             |             |             |                   |
| Initial Capital Inflows                             |             |             |             |             |             |             |             |             |             |                   |
| Base Project Cost                                   |             |             |             |             |             |             |             |             |             |                   |
| Working Capital Requirements                        |             |             |             |             |             |             |             |             |             |                   |
| Initial Capital Requirements                        |             |             |             |             |             |             |             |             |             |                   |
| <b>Operating Activity</b>                           |             |             |             |             |             |             |             |             |             |                   |
| Operating Profit (from Operating Results Worksheet) | 3,575       | 3,653       | 3,733       | 3,814       | 3,897       | 3,982       | 4,068       | 4,156       | 4,246       | 0                 |
| <b>Operating Cash Flow</b>                          | 3,575       | 3,653       | 3,733       | 3,814       | 3,897       | 3,982       | 4,068       | 4,156       | 4,246       | 0                 |
| <b>Operating Activity</b>                           |             |             |             |             |             |             |             |             |             |                   |
| Acquisition Facility Debt Service                   | (3,348)     | (3,348)     | (3,348)     | (3,348)     | 0           | 0           | 0           | 0           | 0           | 0                 |
| Interest on Working Capital Facility                | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0                 |
| Income Taxes                                        | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0                 |
| Working Capital Changes - Yr 2 Requirement          | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0                 |
| Repayment of Working Capital Facility               | <u>0</u>    | <u>0</u>    | <u>0</u>    | <u>0</u>    | <u>0</u>    | <u>0</u>    | <u>0</u>    | <u>0</u>    | <u>0</u>    | <u>0</u>          |
| Cash Available for Maintenance Reserve              | 227         | 305         | 385         | 466         | 3,897       | 3,982       | 4,068       | 4,156       | 4,246       | 0                 |
| Residual Value                                      | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 10,000      | 0                 |
| <b>Investment Tax Credit</b>                        | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0                 |
| <b>New Market Tax Credit</b>                        |             |             |             |             |             |             |             |             |             |                   |
| Cash Flow After Debt Service & Taxes                | 227         | 305         | 385         | 466         | 3,897       | 3,982       | 4,068       | 4,156       | 14,246      | 0                 |

# **APPENDIX 8**

## **SCHEDULE**



Project: Blythe Airport Solar 1  
Date: Sat 10/12/13

Task

Progress

Milestone

Summary

Rolled Up Task

Rolled Up Milestone

Rolled Up Progress

Split

External Tasks

Project Summary

Group By Summary

Deadline

[illegible]



**Tortuga Ranch**  
**Key Financial Assumptions**

| Funding Requirements                                 |           |                      |        | Funding Sources                                                    |          |               |                   |
|------------------------------------------------------|-----------|----------------------|--------|--------------------------------------------------------------------|----------|---------------|-------------------|
| <b>PROJECT COSTS</b>                                 |           | <b>Total</b>         |        | <b>PROJECT FUNDING</b>                                             |          | <b>\$000</b>  | <b>% of Total</b> |
| Eligible Capital Costs Incurred (sales tax included) | \$        | 63,608               |        | Equity                                                             |          | 22,470        | 35.0%             |
| Ineligible Capital Costs                             | \$        | -                    |        | Term Loan                                                          |          | 41,729        | 65.0%             |
| Development Costs                                    | \$        | -                    |        | Total Project                                                      | \$       | <u>64,199</u> | 100.0%            |
| Land Acquisition Cost                                | \$        | -                    |        | <b>Debt Structure - Acquisition Facility</b>                       |          |               |                   |
| Legal / Closing Costs                                | \$        | -                    |        | Quarterly Payments - interest paid in arrears - levelized payments |          |               |                   |
| Financing Fees - % of loan amt                       | \$        | 591                  |        | Term - Years / Payments                                            |          | 15            | 60                |
| Capitalized Interest                                 | \$        | -                    |        | Balloon Payment due after                                          |          | 0             | -                 |
| <b>TOTAL PROJECT COSTS</b>                           | <b>\$</b> | <b><u>64,199</u></b> |        | Loan Amortization Period                                           |          | 15            | 60                |
| Working Capital Requirements                         | 0.0 \$    | <u>-</u>             |        | Rate                                                               |          | 6.00%         |                   |
| <b>Residual Value</b>                                |           | <b>\$000</b>         |        | Amount                                                             | \$       | 41,729        |                   |
| Value (net of Taxes at end of PPA \$/kW)             | \$        | 500.00               | \$     | Debt Amount                                                        | \$       | 41,729        |                   |
|                                                      |           |                      | 10,000 | Debt Commitment Development                                        |          | 65.0%         |                   |
|                                                      |           |                      |        | Construction Loan Interest Rate                                    |          | 6.00%         |                   |
| Tax Rate - Combined Federal & AZ                     |           | 28.0%                |        | <b>Depreciation</b>                                                |          |               |                   |
|                                                      |           |                      |        | Eligible Capital Costs                                             | \$       | 64,199        |                   |
|                                                      |           |                      |        | Investment Tax Credit                                              | 30.0% \$ | 19,260        | 9,630             |
|                                                      |           |                      |        | Eligible 5 Yr MACRS                                                |          | 100.0%        |                   |
|                                                      |           |                      |        | Remaining Depreciable Basis                                        | \$       | 54,569        |                   |
|                                                      |           |                      |        | New Market Tax Credit                                              | 39%      | 8,763.16      |                   |
|                                                      |           |                      |        |                                                                    | 5%       |               |                   |
|                                                      |           |                      |        |                                                                    | 6%       |               |                   |

**Tortuga Ranch**  
Key Financial Results

| Revenues & Income |                 |                   | Operating Cash Flows & Debt Coverage |                         |                           |                                               |                     |                                  |
|-------------------|-----------------|-------------------|--------------------------------------|-------------------------|---------------------------|-----------------------------------------------|---------------------|----------------------------------|
| <u>Year</u>       | <u>Revenues</u> | <u>Net Income</u> | <u>EBITDA</u>                        | <u>Interest Expense</u> | <u>Principal Payments</u> | <u>Cash Available **<br/>For Distribution</u> | <u>Loan Balance</u> | <u>End Bal %<br/>of Original</u> |
| 2014              | 0               | 0                 | 0                                    | 0                       | -                         | (22,470)                                      | 0                   |                                  |
| 2015              | 3,246           | 394               | 3,011                                | 2,464                   | 1,774                     | 19,156                                        | 39,955              | 95.7%                            |
| 2016              | 3,311           | (796)             | 3,069                                | 2,355                   | 1,883                     | (46)                                          | 38,072              | 91.2%                            |
| 2017              | 3,377           | (666)             | 3,135                                | 2,240                   | 1,999                     | 19                                            | 36,073              | 86.4%                            |
| 2018              | 3,445           | (529)             | 3,201                                | 2,117                   | 2,121                     | 311                                           | 33,952              | 81.4%                            |
| 2019              | 3,513           | (387)             | 3,269                                | 1,987                   | 2,252                     | 378                                           | 31,700              | 76.0%                            |
| 2020              | 3,584           | (274)             | 3,288                                | 1,849                   | 2,390                     | 397                                           | 29,311              | 70.2%                            |
| 2021              | 3,655           | (118)             | 3,357                                | 1,702                   | 2,536                     | 467                                           | 26,774              | 64.2%                            |
| 2022              | 3,728           | 45                | 3,428                                | 1,547                   | 2,692                     | (811)                                         | 24,082              | 57.7%                            |
| 2023              | 3,803           | 216               | 3,500                                | 1,381                   | 2,857                     | (739)                                         | 21,225              | 50.9%                            |
| 2024              | 3,879           | 395               | 3,574                                | 1,206                   | 3,032                     | (665)                                         | 18,193              | 43.6%                            |
| 2025              | 3,957           | 475               | 3,499                                | 1,020                   | 3,219                     | (740)                                         | 14,974              | 35.9%                            |
| 2026              | 4,036           | 672               | 3,575                                | 823                     | 3,416                     | (663)                                         | 11,558              | 27.7%                            |
| 2027              | 4,117           | 880               | 3,653                                | 613                     | 3,626                     | (585)                                         | 7,932               | 19.0%                            |
| 2028              | 4,199           | 1,097             | 3,733                                | 390                     | 3,848                     | (505)                                         | 4,084               | 9.8%                             |
| 2029              | 4,283           | 1,326             | 3,814                                | 154                     | 4,084                     | (424)                                         | 0                   | 0.0%                             |
| 2030              | 4,368           | 1,496             | 3,897                                | 0                       | -                         | 3,897                                         | 0                   | 0.0%                             |
| 2031              | 4,456           | 1,557             | 3,982                                | 0                       | -                         | 3,982                                         | 0                   | 0.0%                             |
| 2032              | 4,545           | 1,620             | 4,068                                | 0                       | -                         | 4,068                                         | 0                   | 0.0%                             |
| 2033              | 4,636           | 1,683             | 4,156                                | 0                       | -                         | 4,156                                         | 0                   | 0.0%                             |
| 2034              | 4,729           | 1,748             | 4,246                                | 0                       | -                         | 14,246                                        | 0                   | 0.0%                             |
| IRR               |                 |                   |                                      |                         |                           | 9.14%                                         |                     |                                  |

**Tortuga Ranch**

|                                               |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
|-----------------------------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| 13-Oct-13                                     | Jan-15             | Jan-16             | Jan-17             | Jan-18             | Jan-19             | Jan-20             | Jan-21             | Jan-22             | Jan-23             | Jan-24             | Jan-25             |
| <b>PLANT OUTPUT</b>                           | <b><u>2015</u></b> | <b><u>2016</u></b> | <b><u>2017</u></b> | <b><u>2018</u></b> | <b><u>2019</u></b> | <b><u>2020</u></b> | <b><u>2021</u></b> | <b><u>2022</u></b> | <b><u>2023</u></b> | <b><u>2024</u></b> | <b><u>2025</u></b> |
| Percent Of Year of Operations                 | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 100.0%             |
| Year of Operation                             | 1.00               | 2.00               | 3.00               | 4.00               | 5.00               | 6.00               | 7.00               | 8.00               | 9.00               | 10.00              | 11.00              |
| <b>Plant Output</b>                           |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Net Output (MWh)                              | 46,219             | 45,873             | 45,529             | 45,187             | 44,848             | 44,512             | 44,178             | 43,847             | 43,518             | 43,191             | 42,867             |
| Degradation - annual                          | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.75%              |
| Net By Yr                                     | 19.9               | 19.7               | 19.6               | 19.4               | 19.3               | 19.1               | 19.0               | 18.8               | 18.7               | 18.5               | 18.4               |
| <b>REVENUES</b>                               |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| <b>Output Available For Sales</b>             |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Total Energy Output Available                 | 46,219             | 45,873             | 45,529             | 45,187             | 44,848             | 44,512             | 44,178             | 43,847             | 43,518             | 43,191             | 42,867             |
| <b>Electricity Price</b>                      |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Energy Price (\$/kWh)                         | \$0.07             | \$0.07             | \$0.07             | \$0.07             | \$0.07             | \$0.08             | \$0.08             | \$0.08             | \$0.08             | \$0.08             | \$0.08             |
| <b>Revenues - \$000</b>                       |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| PPA Revenue                                   | 3,246              | 3,311              | 3,377              | 3,445              | 3,513              | 3,584              | 3,655              | 3,728              | 3,803              | 3,879              | 3,957              |
| <b>TOTAL REVENUES</b>                         | <b>3,246</b>       | <b>3,311</b>       | <b>3,377</b>       | <b>3,445</b>       | <b>3,513</b>       | <b>3,584</b>       | <b>3,655</b>       | <b>3,728</b>       | <b>3,803</b>       | <b>3,879</b>       | <b>3,957</b>       |
| <b>OPERATING EXPENSE</b>                      | <b><u>2015</u></b> | <b><u>2016</u></b> | <b><u>2017</u></b> | <b><u>2018</u></b> | <b><u>2019</u></b> | <b><u>2020</u></b> | <b><u>2021</u></b> | <b><u>2022</u></b> | <b><u>2023</u></b> | <b><u>2024</u></b> | <b><u>2025</u></b> |
| <b>Variable</b>                               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               |
| Plant Value - Insurable                       | 58,608             | 57,435             | 56,287             | 55,161             | 54,058             | 52,977             | 51,917             | 50,879             | 49,861             | 48,864             | 47,887             |
| <b>Operating Expense - Fixed</b>              |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Management Fees                               |                    |                    |                    |                    |                    | 50                 | 51                 | 53                 | 54                 | 55                 | 57                 |
| Insurance                                     | 234                | 241                | 242                | 244                | 245                | 246                | 247                | 248                | 249                | 250                | 251                |
| Property Taxes                                | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| Inverter Replacement & Repair - O&M yrs 11-20 | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 150                |
| Major Maintenance - BOP                       |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Lease Payments                                | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| Energy Purchase                               | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| <b>Total Fixed Expenses</b>                   | <b>234</b>         | <b>241</b>         | <b>242</b>         | <b>244</b>         | <b>245</b>         | <b>296</b>         | <b>298</b>         | <b>300</b>         | <b>303</b>         | <b>305</b>         | <b>458</b>         |
| <b>TOTAL OPERATING EXPENSES</b>               | <b>234</b>         | <b>241</b>         | <b>242</b>         | <b>244</b>         | <b>245</b>         | <b>296</b>         | <b>298</b>         | <b>300</b>         | <b>303</b>         | <b>305</b>         | <b>458</b>         |
| <b>TOTAL OPERATING PROFIT</b>                 | <b>3,011</b>       | <b>3,069</b>       | <b>3,135</b>       | <b>3,201</b>       | <b>3,269</b>       | <b>3,288</b>       | <b>3,357</b>       | <b>3,428</b>       | <b>3,500</b>       | <b>3,574</b>       | <b>3,499</b>       |

**Tortuga Ranch**

|                                               |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
|-----------------------------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| 13-Oct-13                                     | Jan-26             | Jan-27             | Jan-28             | Jan-29             | Jan-30             | Jan-31             | Jan-32             | Jan-33             | Jan-34             | Jan-35             |
| <b>PLANT OUTPUT</b>                           | <b><u>2026</u></b> | <b><u>2027</u></b> | <b><u>2028</u></b> | <b><u>2029</u></b> | <b><u>2030</u></b> | <b><u>2031</u></b> | <b><u>2032</u></b> | <b><u>2033</u></b> | <b><u>2034</u></b> | <b><u>2035</u></b> |
| Percent Of Year of Operations                 | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 0.0%               |
| Year of Operation                             | 12.00              | 13.00              | 14.00              | 15.00              | 16.00              | 17.00              | 18.00              | 19.00              | 20.00              | 20.00              |
| <b>Plant Output</b>                           |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Net Output (MWh)                              | 42,546             | 42,227             | 41,910             | 41,596             | 41,284             | 40,974             | 40,667             | 40,362             | 40,059             | 40,059             |
| Degradation - annual                          | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.00%              |
| Net By Yr                                     | 18.3               | 18.1               | 18.0               | 17.9               | 17.7               | 17.6               | 17.5               | 17.3               | 17.2               | 17.2               |
| <b>REVENUES</b>                               |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| <b>Output Available For Sales</b>             |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Total Energy Output Available                 | 42,546             | 42,227             | 41,910             | 41,596             | 41,284             | 40,974             | 40,667             | 40,362             | 40,059             | 40,059             |
| <b>Electricity Price</b>                      |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Energy Price (\$/kWh)                         | \$0.09             | \$0.09             | \$0.09             | \$0.09             | \$0.09             | \$0.09             | \$0.10             | \$0.10             | \$0.10             | \$0.10             |
| <b>Revenues - \$000</b>                       |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| PPA Revenue                                   | 4,036              | 4,117              | 4,199              | 4,283              | 4,368              | 4,456              | 4,545              | 4,636              | 4,729              |                    |
| <b>TOTAL REVENUES</b>                         | <b>4,036</b>       | <b>4,117</b>       | <b>4,199</b>       | <b>4,283</b>       | <b>4,368</b>       | <b>4,456</b>       | <b>4,545</b>       | <b>4,636</b>       | <b>4,729</b>       | <b>-</b>           |
| <b>OPERATING EXPENSE</b>                      | <b><u>2026</u></b> | <b><u>2027</u></b> | <b><u>2028</u></b> | <b><u>2029</u></b> | <b><u>2030</u></b> | <b><u>2031</u></b> | <b><u>2032</u></b> | <b><u>2033</u></b> | <b><u>2034</u></b> | <b><u>2035</u></b> |
| <b>Variable</b>                               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               |
| Plant Value - Insurable                       | 46,929             | 45,990             | 45,071             | 44,169             | 43,286             | 42,420             | 41,572             | 40,740             | 39,925             | 39,127             |
| <b>Operating Expense - Fixed</b>              |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Management Fees                               | 58                 | 59                 | 61                 | 62                 | 64                 | 66                 | 67                 | 69                 | 71                 | 0                  |
| Insurance                                     | 252                | 254                | 255                | 256                | 257                | 258                | 259                | 261                | 262                | 0                  |
| Property Taxes                                | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| Inverter Replacement & Repair - O&M yrs 11-20 | 150                | 150                | 150                | 150                | 150                | 150                | 150                | 150                | 150                | 0                  |
| Major Maintenance - BOP                       |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Lease Payments                                | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| Energy Purchase                               | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| <b>Total Fixed Expenses</b>                   | <b>460</b>         | <b>463</b>         | <b>466</b>         | <b>468</b>         | <b>471</b>         | <b>474</b>         | <b>477</b>         | <b>479</b>         | <b>482</b>         | <b>0</b>           |
| <b>TOTAL OPERATING EXPENSES</b>               | <b>460</b>         | <b>463</b>         | <b>466</b>         | <b>468</b>         | <b>471</b>         | <b>474</b>         | <b>477</b>         | <b>479</b>         | <b>482</b>         | <b>0</b>           |
| <b>TOTAL OPERATING PROFIT</b>                 | <b>3,575</b>       | <b>3,653</b>       | <b>3,733</b>       | <b>3,814</b>       | <b>3,897</b>       | <b>3,982</b>       | <b>4,068</b>       | <b>4,156</b>       | <b>4,246</b>       | <b>0</b>           |

|                                                     |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
|-----------------------------------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| <b>Tortuga Ranch</b>                                |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| 13-Oct-13                                           |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| <b>CASH FLOW</b>                                    | <b><u>2014</u></b> | <b><u>2015</u></b> | <b><u>2016</u></b> | <b><u>2017</u></b> | <b><u>2018</u></b> | <b><u>2019</u></b> | <b><u>2020</u></b> | <b><u>2021</u></b> | <b><u>2022</u></b> | <b><u>2023</u></b> | <b><u>2024</u></b> | <b><u>2025</u></b> | <b><u>2026</u></b> | <b><u>2027</u></b> |
| <b>Project Financing</b>                            |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Initial Equity Infusion                             | 22,470             | -                  | -                  |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Acquisition Facility Proceeds                       | -                  | -                  | -                  |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Working Capital Facility Proceeds                   | -                  | -                  | -                  |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Initial Capital Inflows                             | 22,470             | -                  | -                  |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Base Project Cost                                   | -                  | -                  | -                  |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Working Capital Requirements                        | -                  | -                  | -                  |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Initial Capital Requirements                        | -                  | -                  | -                  |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| <b>Operating Activity</b>                           |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Operating Profit (from Operating Results Worksheet) |                    | 3,011              | 3,069              | 3,135              | 3,201              | 3,269              | 3,288              | 3,357              | 3,428              | 3,500              | 3,574              | 3,499              | 3,575              | 3,653              |
| <b>Operating Cash Flow</b>                          |                    | 3,011              | 3,069              | 3,135              | 3,201              | 3,269              | 3,288              | 3,357              | 3,428              | 3,500              | 3,574              | 3,499              | 3,575              | 3,653              |
| <b>Operating Activity</b>                           |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Acquisition Facility Debt Service                   | (4,239)            | (4,239)            | (4,239)            | (4,239)            | (4,239)            | (4,239)            | (4,239)            | (4,239)            | (4,239)            | (4,239)            | (4,239)            | (4,239)            | (4,239)            | (4,239)            |
| Interest on Working Capital Facility                | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| Income Taxes                                        | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| Working Capital Changes - Yr 2 Requirement          | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| Repayment of Working Capital Facility               | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| Cash Available for Maintenance Reserve              | (1,227)            | (1,169)            | (1,104)            | (1,038)            | (970)              | (951)              | (881)              | (811)              | (739)              | (665)              | (740)              | (663)              | (585)              |                    |
| Residual Value                                      | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| <b>Investment Tax Credit</b>                        |                    | 19,260             | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| <b>New Market Tax Credit</b>                        |                    | 1,123              | 1,123              | 1,123              | 1,348              | 1,348              | 1,348              | 1,348              | 0                  |                    |                    |                    |                    |                    |
| Cash Flow After Debt Service & Taxes                |                    | 19,156             | (46)               | 19                 | 311                | 378                | 397                | 467                | (811)              | (739)              | (665)              | (740)              | (663)              | (585)              |

|                                                 |                    |                    |                    |                    |                    |                    |                    |                    |
|-------------------------------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| Tortuga Ranch                                   |                    |                    |                    |                    |                    |                    |                    |                    |
| 13-Oct-13                                       |                    |                    |                    |                    |                    |                    |                    | 0%                 |
| <b>CASH FLOW</b>                                | <b><u>2028</u></b> | <b><u>2029</u></b> | <b><u>2030</u></b> | <b><u>2031</u></b> | <b><u>2032</u></b> | <b><u>2033</u></b> | <b><u>2034</u></b> | <b><u>2035</u></b> |
| <b>Project Financing</b>                        |                    |                    |                    |                    |                    |                    |                    |                    |
| Initial Equity Infusion                         |                    |                    |                    |                    |                    |                    |                    |                    |
| Acquisition Facility Proceeds                   |                    |                    |                    |                    |                    |                    |                    |                    |
| Working Capital Facility Proceeds               |                    |                    |                    |                    |                    |                    |                    |                    |
| Initial Capital Inflows                         |                    |                    |                    |                    |                    |                    |                    |                    |
| Base Project Cost                               |                    |                    |                    |                    |                    |                    |                    |                    |
| Working Capital Requirements                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Initial Capital Requirements                    |                    |                    |                    |                    |                    |                    |                    |                    |
| <b>Operating Activity</b>                       |                    |                    |                    |                    |                    |                    |                    |                    |
| Operating Profit (from Operating Results Worksh | 3,733              | 3,814              | 3,897              | 3,982              | 4,068              | 4,156              | 4,246              | 0                  |
| <b>Operating Cash Flow</b>                      | 3,733              | 3,814              | 3,897              | 3,982              | 4,068              | 4,156              | 4,246              | 0                  |
| <b>Operating Activity</b>                       |                    |                    |                    |                    |                    |                    |                    |                    |
| Acquisition Facility Debt Service               | (4,239)            | (4,239)            | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| Interest on Working Capital Facility            | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| Income Taxes                                    | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| Working Capital Changes - Yr 2 Requirement      | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| Repayment of Working Capital Facility           | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| Cash Available for Maintenance Reserve          | (505)              | (424)              | 3,897              | 3,982              | 4,068              | 4,156              | 4,246              | 0                  |
| Residual Value                                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 10,000             | 0                  |
| <b>Investment Tax Credit</b>                    | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| <b>New Market Tax Credit</b>                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Cash Flow After Debt Service & Taxes            | (505)              | (424)              | 3,897              | 3,982              | 4,068              | 4,156              | 14,246             | 0                  |

**APPENDIX 9**

**TRICO NET METERING**

**PROGRAM**



**ORIGINAL**

**ELECTRIC RATES**

**TRICO ELECTRIC COOPERATIVE, INC.**

**8600 W. Tangerine Road**

**Marana, Arizona 85653**

**Filed By: Vincent Nitido**

**Title: General Manager/CEO**

Effective Date: January 26, 2010

**STANDARD OFFER TARIFF**

**NET METERING TARIFF**

**SCHEDULE NM**

**Availability**

Net Metering service is available to all customers of Trico Electric Cooperative, Inc. (Cooperative) with a qualifying Net Metering Facility. Participation under this schedule is subject to availability of enhanced metering and billing system upgrades. The electric energy generated by or on behalf of the customer from a qualifying Net Metering Facility and delivered to the Cooperative's distribution facilities may be used to offset electric energy provided by the Cooperative during the applicable billing period.

Net Metering Facility means a facility for the production of electricity that:

- a. Is operated by or on behalf of the customer and is located on the customer's premises;
- b. Is intended primarily to provide part or all of the customer's requirements for electricity;
- c. Uses Renewable Resources, a Fuel Cell or CHP (as defined below);
- d. Has a generating capacity less than or equal to 125% of the customer's total connected load, or in the absence of customer load data, capacity less than or equal to the customer's electric service drop capacity; and
- e. Is interconnected with and can operate in parallel and in phase with the Cooperative's existing distribution system.

Service under this tariff is available provided the rated capacity of the customer's Net Metering Facility does not exceed the Cooperative's service capacity. The customer shall comply with all of the Cooperative's interconnection standards. The customer is also required to sign and complete a net metering application prior to being provided Net Metering Service.

Net Metering Facilities with generation capacity that exceeds 1,000 kilowatts, which are interconnected presently, or desire to become interconnected, may, at Arizona Electric Power Cooperative's option, be subject to the negotiated terms and conditions set forth in multilateral contracts among the customer, Arizona Electric Power Cooperative, Southwest Transmission Cooperative and the Cooperative.

**Metering**

Metering installed for the service provided under this tariff shall be capable of registering and accumulating the kilowatt-hours (kWh) of electricity flowing in both directions in a billing period.

APPROVED FOR FILING

DECISION #: 71462



# ORIGINAL

## NET METERING TARIFF SCHEDULE NM

### Monthly Billing

If the kWh energy supplied by the Cooperative exceeds the kWh energy that are generated by the customer's Net Metering Facility and delivered back to the Cooperative during the billing period, the customer shall be billed for the net kWh energy supplied by the Cooperative in accordance with the rates and charges under the customer's Standard Rate Schedule.

If the kWh energy generated by the customer's Net Metering Facility and delivered back to the Cooperative exceeds the kWh energy supplied by the Cooperative in the billing period, the customer shall be credited during subsequent billing periods for the excess kWh energy generated. The Cooperative shall apply the credit by using the excess kWh energy generated during the billing period to reduce the kWh energy supplied (not kW or kVA demand or customer charges) and billed by the Cooperative during the subsequent billing periods.

Customers taking service under time-of-use rates who are to receive credit in a subsequent billing period for excess kWh energy generated shall receive such credit during the following billing periods during the on- or off- peak periods corresponding to the on- or off- peak periods in which the kWh energy were generated by the customer.

Each Calendar Year, for the customer bills produced in October (September usage) or in the last billing period that the customer discontinues service under this tariff, the Cooperative shall issue a check or billing credit to customers with Net Metering Facilities for the balance of any credit due in excess of amounts owed by the customer to the Cooperative for Non-Firm Power. The payment for any remaining credits shall be at the Cooperative's Annual Average Avoided Cost. The Cooperative's Annual Average Avoided Cost shall be set at \$0.04205 per kWh. Any payment for Firm Power will be pursuant to a separate contract.

### Administrative Charge

In order to determine accurate billing and usage, net metering customers will need to have interval meter data available (minimum data collection of every half hour). This information is needed to ensure accurate billing and to calculate the net kWh energy billed or credited to the customer's account. The following table shows the incremental costs for the increased data collection applicable to all rate classes.

| Administrative Charge | Monthly Rate |
|-----------------------|--------------|
| Monthly Data Cost     | \$3.38       |





# ORIGINAL

## NET METERING TARIFF SCHEDULE NM

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### Definitions

1. Annual Average Avoided Cost: Defined as the average annual wholesale fuel and energy costs per kWh energy purchased from the Cooperative's wholesale power supplier during the calendar year. The Cooperative's Annual Average Avoided Cost shall be set at \$0.040205 per kWh.
2. Calendar Year: The Calendar Year is defined as October 1 through September 30, for the purpose of determining the billing credit for the balance of any credit due in excess of amounts owed by the customer to the Cooperative.
3. Renewable Resource: Means natural resources that can be replenished by natural processes, including biomass, biogas, geothermal, hydroelectric, solar or wind.
4. Combined Heat and Power or CHP: Means a system that generates electricity and useful thermal energy in a single, integrated system such that the useful power output of the facility plus one-half the useful thermal energy output during any 12-month period must be no less than 42.5 percent of the total energy input of fuel to the facility (also known as cogeneration).
5. Fuel Cell: Means a device that converts the chemical energy of a fuel directly into electricity without intermediate combustion or thermal cycles. The source of the chemical reaction must be from Renewable Resources.
6. Non-Firm Power: Electric power which is supplied by the customer's generator at the customer's option, where no firm guarantee is provided, and the power can be interrupted by the customer at any time.
7. Firm Power: Electric power available from the customer's facilities, upon demand, at all times with an expected or demonstrated reliability that is covered by a separate multiparty purchase agreement among the customer, the Cooperative, Arizona Electric Power Cooperative and Southwest Transmission Cooperative.
8. Time Periods: Mountain Standard Time shall be used in the application of this rate schedule. On-peak and off-peak time periods will be determined by the applicable Standard Rate Schedule.
9. Standard Rate Schedule: Any of the Cooperative's retail rate schedules with metered kWh charges.

APPROVED FOR FILING  
DECISION #: 71462

# **APPENDIX 10**

## **CASINO FINANCIAL MODEL**

**Casino Del Sol**  
Key Financial Assumptions

| Financial Close                                      |     |        |    | 5/1/2014               | Funding Sources                                                    |       |                 |    |
|------------------------------------------------------|-----|--------|----|------------------------|--------------------------------------------------------------------|-------|-----------------|----|
| Funding Requirements                                 |     |        |    |                        | Funding Sources                                                    |       |                 |    |
| <u>PROJECT COSTS</u>                                 |     |        |    | <u>Total</u>           | <u>PROJECT FUNDING</u>                                             |       |                 |    |
|                                                      |     |        |    |                        |                                                                    |       |                 |    |
| Eligible Capital Costs Incurred (sales tax included) |     |        |    | \$ 8,516               | Equity                                                             |       | 4,204           |    |
| Ineligible Capital Costs                             |     |        |    | \$ -                   | Term Loan                                                          |       | 4,437           |    |
| Development Costs                                    |     |        |    | \$ -                   | Total Project                                                      |       | <u>\$ 8,641</u> |    |
| Land Acquisition Cost                                |     |        |    | \$ -                   | <u>Debt Structure - Acquisition Facility</u>                       |       |                 |    |
| Legal / Closing Costs                                |     |        |    | \$ -                   | Quarterly Payments - interest paid in arrears - levelized payments |       |                 |    |
| Financing Fees - % of loan amt                       |     |        |    | \$ 125                 | Term - Years / Payments                                            |       | 15              | 60 |
| Capitalized Interest                                 |     |        |    | \$ -                   | Balloon Payment due after                                          |       | 0               | -  |
| <b>TOTAL PROJECT COSTS</b>                           |     |        |    | <u><b>\$ 8,641</b></u> | Loan Amortization Period                                           |       | 15              | 60 |
| Working Capital Requirements                         | 0.0 | \$     |    | <u>-</u>               | Rate                                                               |       | 6.00%           |    |
| <b>Residual Value</b>                                |     |        |    | <b>\$000</b>           | Amount                                                             | \$    | 4,437           |    |
| Value (net of Taxes at end of PPA \$/kW)             | \$  | 500.00 | \$ | 1,500                  | Debt Amount                                                        | \$    | 4,437           |    |
|                                                      |     |        |    |                        | Debt Commitment Development                                        |       | 0.0%            |    |
|                                                      |     |        |    |                        | Construction Loan Interest Rate                                    |       | 6.00%           |    |
|                                                      |     |        |    |                        | <u>Depreciation</u>                                                |       |                 |    |
|                                                      |     |        |    |                        | Eligible Capital Costs                                             | \$    | 8,641           |    |
|                                                      |     |        |    |                        | Investment Tax Credit                                              | 30.0% | \$ 2,592        |    |
|                                                      |     |        |    |                        | Eligible 5 Yr MACRS                                                |       | 100.0%          |    |
|                                                      |     |        |    |                        | Remaining Depreciable Basis                                        | \$    | 7,345           |    |
|                                                      |     |        |    |                        | New Market Tax Credit                                              | 39%   | 1,179.46        |    |
|                                                      |     |        |    |                        |                                                                    | 5%    |                 |    |
|                                                      |     |        |    |                        |                                                                    | 6%    |                 |    |

**Casino Del Sol**  
Key Financial Results

| Revenues & Income |                 |                   | Operating Cash Flows & Debt Coverage |                         |                           |                                               |                     |                                  |
|-------------------|-----------------|-------------------|--------------------------------------|-------------------------|---------------------------|-----------------------------------------------|---------------------|----------------------------------|
| <u>Year</u>       | <u>Revenues</u> | <u>Net Income</u> | <u>EBITDA</u>                        | <u>Interest Expense</u> | <u>Principal Payments</u> | <u>Cash Available **<br/>For Distribution</u> | <u>Loan Balance</u> | <u>End Bal %<br/>of Original</u> |
| 2014              | 0               | 0                 | 0                                    | 0                       | -                         | (3,024)                                       | 0                   |                                  |
| 2015              | 487             | 139               | 455                                  | 262                     | 189                       | 2,597                                         | 4,248               | 95.7%                            |
| 2016              | 497             | (23)              | 464                                  | 250                     | 200                       | 13                                            | 4,048               | 91.2%                            |
| 2017              | 507             | (7)               | 474                                  | 238                     | 213                       | 23                                            | 3,836               | 86.4%                            |
| 2018              | 517             | 10                | 484                                  | 225                     | 226                       | 33                                            | 3,610               | 81.4%                            |
| 2019              | 527             | 27                | 494                                  | 211                     | 239                       | 43                                            | 3,371               | 76.0%                            |
| 2020              | 538             | 24                | 474                                  | 197                     | 254                       | 23                                            | 3,117               | 70.2%                            |
| 2021              | 548             | 42                | 484                                  | 181                     | 270                       | 33                                            | 2,847               | 64.2%                            |
| 2022              | 559             | 61                | 494                                  | 164                     | 286                       | 43                                            | 2,561               | 57.7%                            |
| 2023              | 571             | 81                | 504                                  | 147                     | 304                       | 54                                            | 2,257               | 50.9%                            |
| 2024              | 582             | 102               | 515                                  | 128                     | 322                       | 64                                            | 1,934               | 43.6%                            |
| 2025              | 594             | 108               | 503                                  | 108                     | 342                       | 52                                            | 1,592               | 35.9%                            |
| 2026              | 605             | 131               | 514                                  | 87                      | 363                       | 63                                            | 1,229               | 27.7%                            |
| 2027              | 618             | 155               | 525                                  | 65                      | 386                       | 74                                            | 843                 | 19.0%                            |
| 2028              | 630             | 180               | 536                                  | 42                      | 409                       | 85                                            | 434                 | 9.8%                             |
| 2029              | 642             | 206               | 548                                  | 16                      | 434                       | 97                                            | 0                   | 0.0%                             |
| 2030              | 655             | 227               | 559                                  | 0                       | -                         | 559                                           | 0                   | 0.0%                             |
| 2031              | 668             | 235               | 571                                  | 0                       | -                         | 571                                           | 0                   | 0.0%                             |
| 2032              | 682             | 244               | 584                                  | 0                       | -                         | 584                                           | 0                   | 0.0%                             |
| 2033              | 695             | 253               | 596                                  | 0                       | -                         | 566                                           | 0                   | 0.0%                             |
| 2034              | 709             | 262               | 609                                  | 0                       | -                         | 1,938                                         | 0                   | 0.0%                             |
| IRR               |                 |                   |                                      |                         |                           | 12.42%                                        |                     |                                  |

**Casino Del Sol**

|                                               | Jan-15             | Jan-16             | Jan-17             | Jan-18             | Jan-19             | Jan-20             | Jan-21             | Jan-22             | Jan-23             | Jan-24             | Jan-25             |
|-----------------------------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| <b>PLANT OUTPUT</b>                           | <b><u>2015</u></b> | <b><u>2016</u></b> | <b><u>2017</u></b> | <b><u>2018</u></b> | <b><u>2019</u></b> | <b><u>2020</u></b> | <b><u>2021</u></b> | <b><u>2022</u></b> | <b><u>2023</u></b> | <b><u>2024</u></b> | <b><u>2025</u></b> |
| Percent Of Year of Operations                 | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 100.0%             |
| Year of Operation                             | 1.00               | 2.00               | 3.00               | 4.00               | 5.00               | 6.00               | 7.00               | 8.00               | 9.00               | 10.00              | 11.00              |
| <b><u>Plant Output</u></b>                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Net Output (MWh)                              | 6,934              | 6,882              | 6,830              | 6,779              | 6,728              | 6,678              | 6,627              | 6,578              | 6,528              | 6,479              | 6,431              |
| Degradation - annual                          | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.75%              |
| Net By Yr                                     | 3.0                | 3.0                | 2.9                | 2.9                | 2.9                | 2.9                | 2.8                | 2.8                | 2.8                | 2.8                | 2.8                |
| <b>REVENUES</b>                               |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| <b><u>Output Available For Sales</u></b>      |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Total Energy Output Available                 | 6,934              | 6,882              | 6,830              | 6,779              | 6,728              | 6,678              | 6,627              | 6,578              | 6,528              | 6,479              | 6,431              |
| <b><u>Electricity Price</u></b>               |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Energy Price (\$/kWh)                         | \$0.07             | \$0.07             | \$0.07             | \$0.07             | \$0.07             | \$0.08             | \$0.08             | \$0.08             | \$0.08             | \$0.08             | \$0.08             |
| <b><u>Revenues - \$000</u></b>                |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| PPA Revenue                                   | 487                | 497                | 507                | 517                | 527                | 538                | 548                | 559                | 571                | 582                | 594                |
| <b>TOTAL REVENUES</b>                         | <b>487</b>         | <b>497</b>         | <b>507</b>         | <b>517</b>         | <b>527</b>         | <b>538</b>         | <b>548</b>         | <b>559</b>         | <b>571</b>         | <b>582</b>         | <b>594</b>         |
| <b>OPERATING EXPENSE</b>                      | <b><u>2015</u></b> | <b><u>2016</u></b> | <b><u>2017</u></b> | <b><u>2018</u></b> | <b><u>2019</u></b> | <b><u>2020</u></b> | <b><u>2021</u></b> | <b><u>2022</u></b> | <b><u>2023</u></b> | <b><u>2024</u></b> | <b><u>2025</u></b> |
| <b>Variable</b>                               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               |
| Plant Value - Insurable                       | 7,982              | 7,822              | 7,666              | 7,513              | 7,362              | 7,215              | 7,071              | 6,929              | 6,791              | 6,655              | 6,522              |
| <b><u>Operating Expense - Fixed</u></b>       |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Management Fees                               |                    |                    |                    |                    |                    | 30                 | 31                 | 32                 | 32                 | 33                 | 34                 |
| Insurance                                     | 32                 | 33                 | 33                 | 33                 | 33                 | 33                 | 34                 | 34                 | 34                 | 34                 | 34                 |
| Property Taxes                                | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| Inverter Replacement & Repair - O&M yrs 11-20 | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 23                 |
| Major Maintenance - BOP                       |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Lease Payments                                | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| Energy Purchase                               | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| <b>Total Fixed Expenses</b>                   | <b>32</b>          | <b>33</b>          | <b>33</b>          | <b>33</b>          | <b>33</b>          | <b>63</b>          | <b>64</b>          | <b>65</b>          | <b>66</b>          | <b>67</b>          | <b>91</b>          |
| <b>TOTAL OPERATING EXPENSES</b>               | <b>32</b>          | <b>33</b>          | <b>33</b>          | <b>33</b>          | <b>33</b>          | <b>63</b>          | <b>64</b>          | <b>65</b>          | <b>66</b>          | <b>67</b>          | <b>91</b>          |
| <b>TOTAL OPERATING PROFIT</b>                 | <b>455</b>         | <b>464</b>         | <b>474</b>         | <b>484</b>         | <b>494</b>         | <b>474</b>         | <b>484</b>         | <b>494</b>         | <b>504</b>         | <b>515</b>         | <b>503</b>         |

**Casino Del Sol**

|                                               | Jan-26             | Jan-27             | Jan-28             | Jan-29             | Jan-30             | Jan-31             | Jan-32             | Jan-33             | Jan-34             | Jan-35             |
|-----------------------------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| <b>PLANT OUTPUT</b>                           | <b><u>2026</u></b> | <b><u>2027</u></b> | <b><u>2028</u></b> | <b><u>2029</u></b> | <b><u>2030</u></b> | <b><u>2031</u></b> | <b><u>2032</u></b> | <b><u>2033</u></b> | <b><u>2034</u></b> | <b><u>2035</u></b> |
| Percent Of Year of Operations                 | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 100.0%             | 0.0%               |
| Year of Operation                             | 12.00              | 13.00              | 14.00              | 15.00              | 16.00              | 17.00              | 18.00              | 19.00              | 20.00              | 20.00              |
| <b><u>Plant Output</u></b>                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Net Output (MWh)                              | 6,383              | 6,335              | 6,287              | 6,240              | 6,193              | 6,147              | 6,101              | 6,055              | 6,010              | 6,010              |
| Degradation - annual                          | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.75%              | 0.00%              |
| Net By Yr                                     | 2.7                | 2.7                | 2.7                | 2.7                | 2.7                | 2.6                | 2.6                | 2.6                | 2.6                | 2.6                |
| <b>REVENUES</b>                               |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| <b><u>Output Available For Sales</u></b>      |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Total Energy Output Available                 | 6,383              | 6,335              | 6,287              | 6,240              | 6,193              | 6,147              | 6,101              | 6,055              | 6,010              | 6,010              |
| <b><u>Electricity Price</u></b>               |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Energy Price (\$/kWh)                         | \$0.09             | \$0.09             | \$0.09             | \$0.09             | \$0.09             | \$0.09             | \$0.10             | \$0.10             | \$0.10             | \$0.10             |
| <b><u>Revenues - \$000</u></b>                |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| PPA Revenue                                   | 605                | 618                | 630                | 642                | 655                | 668                | 682                | 695                | 709                | -                  |
| <b>TOTAL REVENUES</b>                         | 605                | 618                | 630                | 642                | 655                | 668                | 682                | 695                | 709                | -                  |
| <b>OPERATING EXPENSE</b>                      | <b><u>2026</u></b> | <b><u>2027</u></b> | <b><u>2028</u></b> | <b><u>2029</u></b> | <b><u>2030</u></b> | <b><u>2031</u></b> | <b><u>2032</u></b> | <b><u>2033</u></b> | <b><u>2034</u></b> | <b><u>2035</u></b> |
| <b>Variable</b>                               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               | \$ -               |
| Plant Value - Insurable                       | 6,391              | 6,264              | 6,138              | 6,015              | 5,895              | 5,777              | 5,662              | 5,549              | 5,438              | 5,329              |
| <b><u>Operating Expense - Fixed</u></b>       |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Management Fees                               | 35                 | 36                 | 37                 | 37                 | 38                 | 39                 | 40                 | 41                 | 42                 | 0                  |
| Insurance                                     | 34                 | 35                 | 35                 | 35                 | 35                 | 35                 | 35                 | 35                 | 36                 | 0                  |
| Property Taxes                                | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| Inverter Replacement & Repair - O&M yrs 11-20 | 23                 | 23                 | 23                 | 23                 | 23                 | 23                 | 23                 | 23                 | 23                 | 0                  |
| Major Maintenance - BOP                       |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Lease Payments                                | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| Energy Purchase                               | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| <b>Total Fixed Expenses</b>                   | 92                 | 93                 | 94                 | 95                 | 96                 | 97                 | 98                 | 99                 | 101                | 0                  |
| <b>TOTAL OPERATING EXPENSES</b>               | 92                 | 93                 | 94                 | 95                 | 96                 | 97                 | 98                 | 99                 | 101                | 0                  |
| <b>TOTAL OPERATING PROFIT</b>                 | 514                | 525                | 536                | 548                | 559                | 571                | 584                | 596                | 609                | 0                  |



**Casino Del Sol**

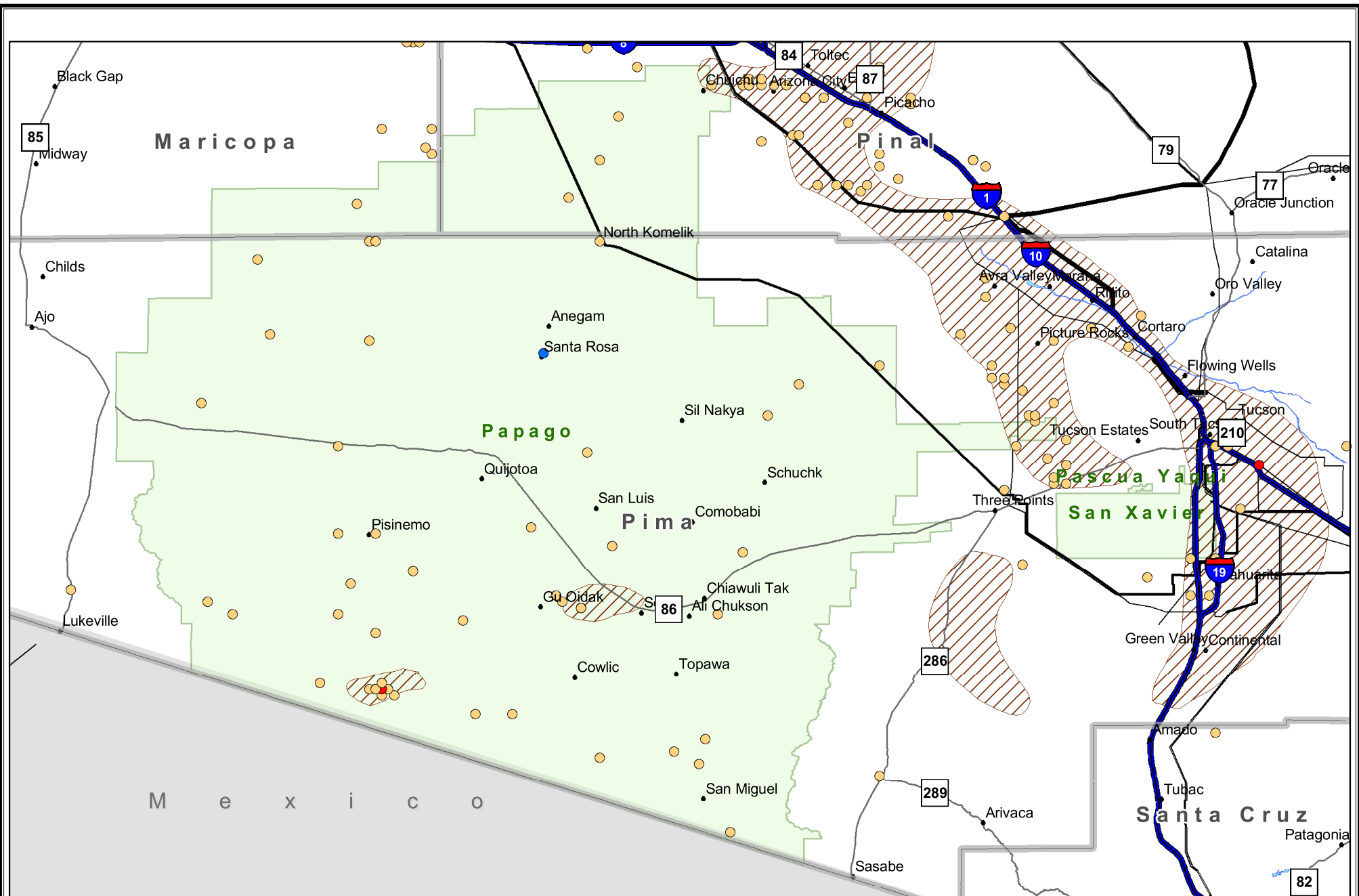
| <b>CASH FLOW</b>                                    | <b><u>2014</u></b> | <b><u>2015</u></b> | <b><u>2016</u></b> | <b><u>2017</u></b> | <b><u>2018</u></b> | <b><u>2019</u></b> | <b><u>2020</u></b> | <b><u>2021</u></b> | <b><u>2022</u></b> | <b><u>2023</u></b> | <b><u>2024</u></b> | <b><u>2025</u></b> |
|-----------------------------------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| <b>Project Financing</b>                            |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Initial Equity Infusion                             | 4,204              | -                  | -                  |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Acquisition Facility Proceeds                       | -                  | -                  | -                  |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Working Capital Facility Proceeds                   | -                  | -                  | -                  |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Initial Capital Inflows                             | 4,204              | -                  | -                  |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Base Project Cost                                   | -                  | -                  | -                  |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Working Capital Requirements                        | -                  | -                  | -                  |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Initial Capital Requirements                        | -                  | -                  | -                  |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| <b>Operating Activity</b>                           |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Operating Profit (from Operating Results Worksheet) |                    | 455                | 464                | 474                | 484                | 494                | 474                | 484                | 494                | 504                | 515                | 503                |
| <b>Operating Cash Flow</b>                          |                    | 455                | 464                | 474                | 484                | 494                | 474                | 484                | 494                | 504                | 515                | 503                |
| <b>Operating Activity</b>                           |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Acquisition Facility Debt Service                   |                    | (451)              | (451)              | (451)              | (451)              | (451)              | (451)              | (451)              | (451)              | (451)              | (451)              | (451)              |
| Interest on Working Capital Facility                |                    | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| Income Taxes                                        |                    | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| Working Capital Changes - Yr 2 Requirement          |                    | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| Repayment of Working Capital Facility               |                    | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| Cash Available for Maintenance Reserve              |                    | 4                  | 13                 | 23                 | 33                 | 43                 | 23                 | 33                 | 43                 | 54                 | 64                 | 52                 |
| Residual Value                                      |                    | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| <b>Investment Tax Credit</b>                        |                    | 2,592              | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  | 0                  |
| Cash Flow After Debt Service & Taxes                |                    | 2,597              | 13                 | 23                 | 33                 | 43                 | 23                 | 33                 | 43                 | 54                 | 64                 | 52                 |

Casino Del Sol

|                                                     |           |             |             |             |             |             |             |             |             |             | 0%          |
|-----------------------------------------------------|-----------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
|                                                     | CASH FLOW | <u>2026</u> | <u>2027</u> | <u>2028</u> | <u>2029</u> | <u>2030</u> | <u>2031</u> | <u>2032</u> | <u>2033</u> | <u>2034</u> | <u>2035</u> |
| <b>Project Financing</b>                            |           |             |             |             |             |             |             |             |             |             |             |
| Initial Equity Infusion                             |           |             |             |             |             |             |             |             |             |             |             |
| Acquisition Facility Proceeds                       |           |             |             |             |             |             |             |             |             |             |             |
| Working Capital Facility Proceeds                   |           |             |             |             |             |             |             |             |             |             |             |
| Initial Capital Inflows                             |           |             |             |             |             |             |             |             |             |             |             |
|                                                     |           |             |             |             |             |             |             |             |             |             |             |
| Base Project Cost                                   |           |             |             |             |             |             |             |             |             |             |             |
| Working Capital Requirements                        |           |             |             |             |             |             |             |             |             |             |             |
| Initial Capital Requirements                        |           |             |             |             |             |             |             |             |             |             |             |
|                                                     |           |             |             |             |             |             |             |             |             |             |             |
| <b>Operating Activity</b>                           |           |             |             |             |             |             |             |             |             |             |             |
| Operating Profit (from Operating Results Worksheet) |           | 514         | 525         | 536         | 548         | 559         | 571         | 584         | 596         | 609         | 0           |
| <b>Operating Cash Flow</b>                          |           | 514         | 525         | 536         | 548         | 559         | 571         | 584         | 596         | 609         | 0           |
| <b>Operating Activity</b>                           |           |             |             |             |             |             |             |             |             |             |             |
| Acquisition Facility Debt Service                   |           | (451)       | (451)       | (451)       | (451)       | 0           | 0           | 0           | 0           | 0           | 0           |
| Interest on Working Capital Facility                |           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           |
| Income Taxes                                        |           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | (31)        | (170)       | 0           |
| Working Capital Changes - Yr 2 Requirement          |           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           |
| Repayment of Working Capital Facility               |           | <u>0</u>    | <u>0</u>    | <u>0</u>    | <u>0</u>    | <u>0</u>    | <u>0</u>    | <u>0</u>    | <u>0</u>    | <u>0</u>    | <u>0</u>    |
| Cash Available for Maintenance Reserve              |           | 63          | 74          | 85          | 97          | 559         | 571         | 584         | 566         | 438         | 0           |
| Residual Value                                      |           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 1,500       | 0           |
|                                                     |           |             |             |             |             |             |             |             |             |             |             |
| <b>Investment Tax Credit</b>                        |           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           |
|                                                     |           |             |             |             |             |             |             |             |             |             |             |
| Cash Flow After Debt Service & Taxes                |           | 63          | 74          | 85          | 97          | 559         | 571         | 584         | 566         | 1,938       | 0           |

# **APPENDIX 11**

## **GEOHERMAL MAP**



**Regions of Geothermal Resources**

**Major Roads**

- Interstate Hwy
- US Hwy
- State Hwy

**Legend:**

- Counties
- Major water
- Indian Reservation
- Cities

0 5 10 20 Kilometers

**Transmission Lines \***

- Below 230kV
- 230kV - 499kV
- Greater than 500kV

**Geothermal Wells and Springs\***

- > 50 Degrees C
- > 20 and < 50 Degrees C
- Temperature not recorded
- Hot
- Warm

\* Source: POWERmap, ©2002 Platts, a Division of the McGraw-Hill Companies

\*Data Source: INEEL

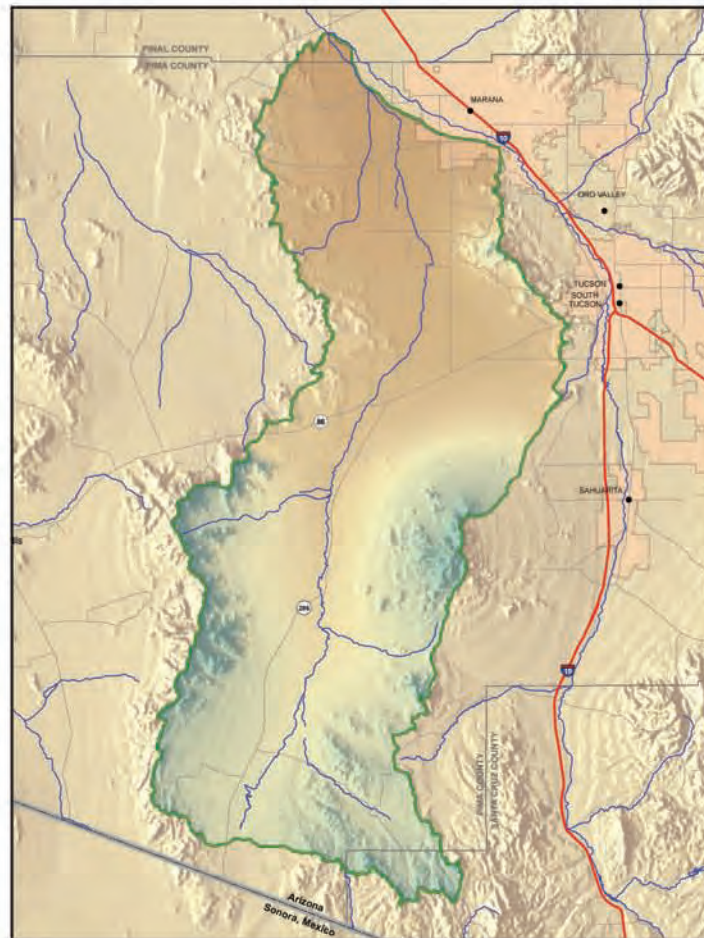
# **APPENDIX 12**

## **Environmental Information**

# Brawley Wash - Los Robles Wash Watershed - Arizona (Altar Wash - Brawley Wash Watershed)

## Rapid Watershed Assessment

June 2008



*Prepared by:*  
USDA Natural Resource Conservation Service – Arizona  
University of Arizona, Water Resources Research Center



The University of Arizona



*In cooperation with:*  
Arizona Association of Conservation Districts  
Arizona Department of Agriculture  
Arizona Department of Environmental Quality  
Arizona Department of Water Resources  
Arizona Game & Fish Department  
Arizona State Land Department  
USDA Forest Service  
USDI Bureau of Land Management

Released by:

Sharon Medgal  
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University of Arizona  
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Cite as:

USDA Natural Resource Conservation Service, Arizona and University of Arizona Water Resources Research Center. 2008. *Brawley Wash - Los Robles Wash Watershed, (Altar Wash - Brawley Wash Watershed), Arizona, Rapid Watershed Assessment.*

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**Brawley Wash-Los Robles Wash  
Watershed 15050304  
(Altar Wash-Brawley Wash  
Watershed)  
8-Digit Hydrologic Unit  
Rapid Watershed Assessment**

**Section 1: Introduction**

Overview of Rapid Watershed  
Assessments

A Rapid Watershed Assessment (RWA) is a concise report containing information on natural resource conditions and concerns within a designated watershed. The "rapid" part refers to a relatively short time period to develop the report as compared to a more comprehensive watershed planning effort. The "assessment" part refers to a report containing maps, tables and other information sufficient to give an overview of the watershed including physical characteristics and socioeconomic trends.

The assessments involve the collection of readily available quantitative and qualitative information to develop a watershed profile, and sufficient analysis of that information to generate an appraisal of the conservation needs of the watershed. These assessments are conducted by conservation planners, using Geographic Information System (GIS) technology. Conservation Districts and other local leaders, along with public land management agencies, are involved in the assessment process.

An RWA serves as a communication tool between the Natural Resources Conservation Service (NRCS) and partners for prioritizing conservation

work in selected watersheds. RWAs serve as a platform for conservation program delivery, provide useful information for development of NRCS and Conservation District business plans, and lay a foundation for future cooperative watershed planning.

General Description of the Brawley  
Wash-Los Robles Wash Watershed

The Brawley Wash-Los Robles Wash Watershed (also locally referred to as the Altar Wash-Brawley Wash Watershed or Altar and Avra Valleys) is located in the south-central portion of the state of Arizona. The Watershed lies west of I-19 and east of the Baboquivari Mountains, north of the U.S.-Mexico border and, south of Pinal County, except for a small section located in Pinal County (Figure 1-1).

The watershed can be defined as the area drained by the Altar Wash, Brawley Washes and Los Robles Wash to the confluence with the Santa Cruz River.

The watershed comprises 900,480 acres (1,407 square miles), and is located approximately 97% in Pima County and about 2% in Santa Cruz County and 1% in Pinal County. Forty-one percent of the land is state owned, 24% is privately owned, 11% is wildlife preserve, 10% is managed by the Bureau of Land Management, 8% is Tohono O'odham Indian Reservation, 3% is National Forest, 2% is national parks and 1% is state parks.

There are about 10,000 acres of irrigated cropland in the watershed; however, much of this cropland is being rapidly converted to urban uses and this trend is expected to continue in the

future. Important crops include alfalfa and cotton. The remaining area is primarily rangeland and urban land. Livestock use is dominated by ephemeral steer operations at the lower elevations, and cow calf operations at the higher elevations.

Major towns and cities include Arivaca and a portion of the Town of Marana. The metropolitan area of Tucson is east of, and outside, the watershed. Conservation assistance is provided through two Natural Resource Conservation Districts: Pima and Tohono O'odham. There are two U.S. Department of Agriculture (USDA) Service Centers in the area, located in Tucson and Sells.

Resource concerns in the watershed include soil erosion; rangeland site stability; rangeland hydrologic cycle; excessive runoff (causing flooding or ponding); aquifer overdraft; effect of air quality on visibility and plant health; threatened or endangered plant and animal species; noxious and invasive plants, wildfire hazard; inadequate water for fish and wildlife; habitat fragmentation; and inadequate distribution of water for domestic animals (NRCS Factsheet).

## Section 2: Physical Description

### Watershed Size

The Brawley Wash-Los Robles Wash Watershed covers approximately 1,407 square miles (900,480 acres), representing about 1.2% of the State of Arizona. The watershed has a maximum width of about 25 miles east to west, and a maximum length of about 65 miles north to south. The high point in the watershed is the Baboquivari Mountains near Baboquivari Peak at 7,257 feet, and the low point is the confluence of Brawley Wash and the Santa Cruz River at 1,847 feet.

The Brawley Wash-Los Robles Wash Watershed was delineated by the U.S. Geological Survey and has been subdivided by the NRCS into smaller watersheds or drainage areas. Each drainage area has a unique hydrologic unit code number (HUC) and a name based on the primary surface water feature within the HUC. These drainage areas can be further subdivided into even smaller watersheds as needed. The Brawley Wash-Los Robles Wash Watershed is an 8-digit HUC of 15050304 and contains the following 10-digit HUCs (Figure 2-1):

- 1505030401 Arivaca Creek
- 1505030402 Puertocito Wash
- 1505030403 Altar Wash
- 1505030404 Upper Brawley Wash
- 1505030405 Lower Brawley Wash
- 1505030406 Los Robles Wash

### Geology

The Brawley Wash-Los Robles Wash Watershed is located within Arizona's Basin and Range Province. The Basin and Range Province of southern and western Arizona is an area where the Earth's crust has been stretched and broken by numerous faults so that mountain ranges and basins (broad valleys) have formed by the vertical motion of large crustal blocks.

The Basin and Range Province was formed from 28 to 12 million years ago as the Baja California portion of the Earth's tectonic Pacific Oceanic plate began diverging from the continental plate, stretching the continental plate and forming the equivalent of stretch marks in the earth's crust, nearly parallel to the strike (direction) of the plate boundary. As the earth's crust is stretched, blocks of crust break and drop in a pattern of valley basins and high peak ranges, and is known as the Basin and Range Province within Arizona and other regions of Mexico and the western United States.

The watershed is bounded on the west by the Baboquivari Mountains, a range of block-faulted mountains that are crosscut by northwest-striking faults and shear zones that are part of a regional structural pattern. The Baboquivaris, and the closely related Quinlan Mountains to the north, are composed of Jurassic, Cretaceous, and Tertiary granite interspersed with small amounts of schist and sedimentary rocks (Goodwin, 1985). Volcanic remnants of a large caldera, the Tucson, Sierrita, and Tumacacori Mountains delineate the eastern limit of the watershed, and to the south the

Atascosa Highlands and Pajarita Mountains form a barrier that acts as the watershed's southeastern limit. The Sierritas, which combine Paleozoic and Mesozoic sedimentary rocks with Cretaceous-aged volcanic rocks, are a valuable source of copper in the region; several open-pit mines on the east side of the range mine the large deposits of porphyry copper found there (Chronic, 1983). (Figure 2-2)

### Soils

Soils within the Brawley Wash – Los Robles Wash Watershed are diverse and formed as the result of differences in climate, vegetation, geology, and physiography. Detailed soils information for the watershed is available from the Natural Resources Conservation Service (NRCS) within the following Soil Surveys: "Soil Survey of Pima County, AZ, Eastern Part"; and "Soil Survey of the Tucson – Avra Valley Area, Pima County, AZ." Soils data and maps from these Soil Surveys can be accessed through the NRCS Web Soil Survey website:

<http://websoilsurvey.nrcs.usda.gov>.

### Common Resource Areas

The USDA, Natural Resources Conservation Service (NRCS) defines a Common Resource Area (CRA) as a geographical area where resource concerns, problems, or treatment needs are similar (NRCS 2006). It is considered a subdivision of an existing Major Land Resource Area (MLRA). Landscape conditions, soil, climate, human considerations, and other natural resource information are used to determine the geographic boundaries of a Common Resource Area.

The Brawley Wash-Los Robles Wash Watershed is comprised of four Common Resource Areas (Figure 2-3 and Table 2-2).

*Table 2-1: Brawley Wash – Los Robles Wash Watershed Common Resource Areas*

| <b>Common Resource Area Type</b>                       | <b>Area (sq. mi.)</b> | <b>Percent of Watershed</b> |
|--------------------------------------------------------|-----------------------|-----------------------------|
| <b>40.1 Upper Sonoran Desert</b>                       | <b>694</b>            | <b>49%</b>                  |
| <b>40.2 Middle Sonoran Desert</b>                      | <b>49</b>             | <b>3%</b>                   |
| <b>41.1 Chihuahuan – Sonoran Desert Shrubs</b>         | <b>69</b>             | <b>5%</b>                   |
| <b>41.3 Chihuahuan – Sonoran Semidesert Grasslands</b> | <b>596</b>            | <b>42%</b>                  |

Data Sources: GIS map layer "cra". Arizona Land Information System (ALRIS 2004). Natural Resource Conservation Service (NRCS 2006)

Beginning at the lower end of the watershed, CRA 40.2 "Middle Sonoran Desert" occurs at elevations ranging from 1200 to 2000 feet. Precipitation averages 7 to 10 inches per year. Vegetation includes saguaro, palo verde, creosote bush, triangle bursage, brittlebush, prickly pear, cholla, desert saltbush, wolfberry, bush muhly, threeawns, and big galleta. The soils in the area have a hyperthermic soil temperature regime and a typical aridic soil moisture regime. The dominant soil orders are Aridisols and Entisols. Deep, stratified, coarse to fine-textured soils occur on floodplains and alluvial fans. Deep, moderately fine and fine-textured and gravelly, moderately fine-textured soils occur on fan terraces.

CRA 40.1 "Upper Sonoran Desert" occurs at elevations ranging from 2000

to 3200 feet with precipitation averaging 10 to 13 inches per year. Vegetation includes saguaro, ironwood, palo verde, mesquite, range ratany, creosotebush, triangle bursage, prickly pear, cholla, wolfberry, bush muhly, threeawns, ocotillo, and globe mallow. The soils in the area have a thermic soil temperature regime and a typic aridic soil moisture regime. The dominant soil orders are Aridisols and Entisols. Deep, moderately coarse-textured to fine textured soils occur on alluvial fans and drainageways. Deep, gravelly, limy, moderately coarse to moderately fine-textured, soils occur on fan terraces. Shallow, cobbly and gravelly soils and rock outcrop occur on hills and mountains.

Moving up the watershed, CRA 41.3 “Chihuahuan – Sonoran Semidesert Grasslands” occurs at elevations ranging from 3200 to 5000 feet with precipitation averaging 12 to 16 inches per year. Vegetation includes mesquite, catclaw acacia, palo verde, range ratany, fourwing saltbush, tarbush, littleleaf sumac, sideoats grama, black grama, plains lovegrass, cane beardgrass, tobosa, threeawns, Arizona cottontop and bush muhly. The soils in the area have a thermic temperature regime and an ustic aridic soil moisture regime. The dominant soil orders are Entisols, Aridisols, and Mollisols. Deep fine-textured and gravelly, moderately coarse to moderately fine-textured soils occur on fan terraces. Shallow, cobbly and gravelly soils and rock outcrop occur on hills and mountains.

In the upper portions of the watershed occurs CRA 41.1 “Mexican Oak-Pine Forest and Oak Savannah” with  
Table 2-2: *Brawley Wash – Los Robles*

elevations ranging from 4500 to 7500 feet. Precipitation averages 16 to 30 inches. Vegetation includes Emory oak, Arizona white oak, one-seed juniper, alligator juniper, California bristlebush, skunkbush sumac, Arizona rosewood, wait-a-bit mimosa, sideoats grama, blue grama, woolly bunchgrass, plains lovegrass, squirreltail, and pinyon ricegrass. The soils in the area have a thermic to mesic temperature regime and an aridic ustic to typic ustic soil moisture regime. The dominant soil orders are Entisols and Mollisols. Shallow, cobbly and gravelly soils and rock outcrop occur on hills and mountains.

These four Common Resource Areas (40.2, 40.1, 41.3, 41.1) occur within the Basin and Range Physiographic Province which is characterized by numerous mountain ranges rising abruptly from broad, plain-like valleys and basins. Igneous and metamorphic rock classes dominate the mountain ranges and sediments filling the basins represent combinations of fluvial, lacustrine, colluvial and alluvial deposits.

### Slope Classifications

Slope, as well as soil characteristics and topography, are important when assessing the vulnerability of a watershed to erosion. Approximately 78% of the Brawley Wash – Los Robles Wash Watershed has a slope less than 15%, while 10% of the watershed has a slope greater than 15% (Table 2-2 and Figure 2-4). The Lower Brawley Wash Watershed is relatively flat, with only 4% of its area over 15% slope, and 87% less than 5% slope. The Arivaca Creek Watershed is relatively steeper, with

### Wash Watershed Slope Classifications

| Watershed Name                   | Area<br>(sq. mi.) | Percent Slope |       |      |
|----------------------------------|-------------------|---------------|-------|------|
|                                  |                   | < 5%          | 5-15% | >15% |
| Los Robles Wash<br>1505030406    | 210               | 83%           | 11%   | 6%   |
| Lower Brawley Wash<br>1505030405 | 410               | 87%           | 9%    | 4%   |
| Upper Brawley Wash<br>1505030404 | 149               | 70%           | 13%   | 17%  |
| Altar Wash<br>1505030403         | 350               | 74%           | 11%   | 15%  |
| Puertocito Wash<br>1505030402    | 149               | 83%           | 9%    | 7%   |
| Arivaca Creek<br>1505030401      | 139               | 55%           | 29%   | 16%  |
| Brawley Watershed                | 1407              | 78%           | 12%   | 10%  |

Data Sources: Derived from DEM, obtained from U.S. Geological Survey, April 8, 2003  
<http://edc.usgs.gov/geodata/>

16% of the area greater than 15% slope  
and 55% less than 5% slope.

### Streams, Lakes and Gaging Stations

The locations of active and inactive gaging stations, and their respective annual mean stream flow, are found in Table 2-3.1. Nearly all streams and washes in this watershed are intermittent, and therefore flows only occur during runoff periods. Altar Wash near Three Points has the largest active stream flow with 5.35 cfs. Arivaca Creek at Arivaca has the lowest active stream flow with 0.16cfs. Table 2.3.2 lists major lakes and reservoirs in the Brawley Wash – Los Robles Wash, as well as their watershed position, surface area, elevation and dam name. Arivaca Lake is the largest surface water in the

watershed with an area of about 118 acres. Figure 2-5 lists the major streams and washes and their lengths. Stream and wash lengths range from 36 miles for Brawley Wash to 2.0 miles for Bailey Wash.

The purpose of the Central Arizona Project (CAP) Canal is to transfer Colorado River water to cities and farms in central and southern Arizona. Thirty-six miles, of the total 349 mile long CAP canal, are in the watershed. In addition to the CAP, there are 31 miles of irrigation canals managed by water providers for agricultural water use.

**Table 2-3.1: USGS Brawley Wash – Los Robles Wash Watershed Stream Gages and Annual Mean Stream Flow**

| USGS Gage ID   | Site Name                      | Begin Date | End Date   | Annual Mean Stream Flow (cfs) |
|----------------|--------------------------------|------------|------------|-------------------------------|
| Active Gages   |                                |            |            |                               |
| 09486590       | Arivaca Creek at Arivaca       | 05-01-2002 | 09-30-2006 | 0.16                          |
| 09486800       | Altar Wash near Three Points   | 01-11-1966 | 09-30-2006 | 5.35                          |
| 09487000       | Brawley Wash near Three Points | 12-14-1990 | 09-30-2006 | 5.06                          |
| Inactive Gages |                                |            |            |                               |
| 09486580       | Arivaca Circle at Arivaca      | 10-01-1995 | 04-30-2002 | 0.87                          |
| 09486600       | Arivaca Wash Near Arivaca      | 03-17-1967 | 09-30-1972 | 3.46                          |

*\*Discontinuous years of data*

Data Sources: GIS dataset "usgs\_gages\_utm" USGS 2007; USGS website, National Water Information System <http://waterdata.usgs.gov/nwis/>

**Table 2-3.2: Brawley Wash – Los Robles Wash Watershed Major Lakes and Reservoirs**

| Lake Name (if known) | Watershed       | Surface Area (acres) | Elevation (feet above mean sea level) | Dam Name (if known) |
|----------------------|-----------------|----------------------|---------------------------------------|---------------------|
| Aguirre Lake         | Puertocito Wash | 51                   | 3,455                                 |                     |
| Arivaca Lake         | Arivaca Creek   | 118                  | 3,773                                 | Arivaca Dam         |
| BK Tank              | Los Robles Wash | 34                   | 1,995                                 |                     |

Data Sources: GIS data layer "Lakes", Arizona State Land Department, Arizona Land Resource Information System (ALRIS), February 7, 2003 <http://www.land.state.az.us/alris/index.html>



*Table 2-3.3: Brawley Wash – Los Robles Wash Watershed  
Major Streams and Canals Lengths*

| Stream Name                         | Watershed                                       | Stream Length (miles) |
|-------------------------------------|-------------------------------------------------|-----------------------|
| Alambre Wash                        | Upper Brawley Wash, Altar Wash                  | 15                    |
| Altar Wash                          | Altar Wash                                      | 23                    |
| Arivaca Creek                       | Arivaca Creek                                   | 15                    |
| Arroyo del Compartidero             | Puertocito Wash                                 | 7                     |
| Bailey Wash                         | Puertocito Wash                                 | 2                     |
| Blanco Wash                         | Los Robles Wash                                 | 19                    |
| Brawley Wash                        | Lower Brawley Wash, Upper Brawley Wash          | 35                    |
| Los Robles Wash                     | Los Robles Wash, Lower Brawley Wash             | 19                    |
| Penitas Wash                        | Altar Wash                                      | 13                    |
| Puertocito Wash                     | Puertocito Wash                                 | 10                    |
| Central Arizona Project (CAP) Canal | Lower Brawley Wash                              | 36                    |
| Irrigation Canals                   | Altar Wash, Los Robles Wash, Lower Brawley Wash | 31                    |

*Data Sources: GIS data layer "Streams", Arizona State Land Department, Arizona Land Resource Information System (ALRIS), October, 10, 2002.  
<http://www.land.state.az.us/alris/index.html>*

### Riparian Vegetation

The Arizona Game & Fish Department has identified and mapped riparian vegetation associated with perennial waters in response to the requirements of the state Riparian Protection Program (July 1994). This map was used to identify riparian areas in the Brawley Wash – Los Robles Wash Watershed (Figure 2-6).

Four of the ten types of riparian areas occur within the Brawley Wash – Los Robles Wash Watershed. Riparian areas encompass approximately 17,000 acres (27 sq. mi.) or less than 0.2% of the entire watershed. North American

Warm Desert Riparian Mesquite Bosque comprises about 15,397 acres, or 90% of the riparian areas. North American Warm Desert Riparian Woodland and Shrubland, and North American Warm Desert Lower Montaine Riparian Woodland and Shrubland, comprise the remaining 1,281 acres and 459 acres of the watershed, respectively (Table 2-4).

Altar Wash has the greatest amount of riparian vegetation with 7,664 acres (12 square miles). The Tanque Verde Creek/Rillito River Watershed has about 2,243 acres (4 sq. mi.) and the Los Robles Wash Watershed has only 1,923 acres (3 sq. mi.).

*Table 2-4: Brawley Wash – Los Robles Wash Watershed Riparian Vegetation (acres) by 10 Digit Watershed (Part 1 of 2).*

| Riparian Vegetation Community                                             | Los Robles Wash<br>1505030406 | Lower Brawley Wash<br>1505030405 | Upper Brawley Wash<br>1505030404 | Altar Wash<br>1505030403 | Puertocito Wash<br>1505030402 |
|---------------------------------------------------------------------------|-------------------------------|----------------------------------|----------------------------------|--------------------------|-------------------------------|
| North American Warm Desert Lower Montaine Riparian Woodland and Shrubland | -                             | 1                                | 51                               | 332                      | 45                            |
| North American Warm Desert Riparian Woodland and Shrubland                | 896                           | 97                               | 64                               | 185                      | -                             |
| North American Warm Desert Riparian Mesquite Bosque                       | 1,027                         | 1,747                            | 1,806                            | 7,147                    | 1,493                         |
| Total Area (acres)                                                        | 1,923                         | 1,845                            | 1,921                            | 7,664                    | 1,538                         |

Data Sources: GIS data layer "newgapveg", Southwest Regional GAP Program, October 13, 2005  
<http://fws-nmcfwru.nmsu.edu/swregap/>

*Table 2-4: Brawley Wash – Los Robles Wash Watershed Riparian Vegetation (acres) by 10 Digit Watershed (Part 2 of 2).*

| Riparian Vegetation Community                                             | Arivaca Creek<br>1505030401 | Brawley Wash – Los Robles Wash Watershed |
|---------------------------------------------------------------------------|-----------------------------|------------------------------------------|
| North American Warm Desert Lower Montaine Riparian Woodland and Shrubland | 29                          | 459                                      |
| North American Warm Desert Riparian Woodland and Shrubland                | 38                          | 1,281                                    |
| North American Warm Desert Riparian Mesquite Bosque                       | 2,176                       | 15,397                                   |
| Total Area (acres)                                                        | 2,243                       | 17,137                                   |

Data Sources: GIS data layer "newgapveg", Southwest Regional GAP Program, October 13, 2005  
<http://fws-nmcfwru.nmsu.edu/swregap/>

## Land Cover

The Riparian Vegetation map (Figure 2-6) and Land Cover map (Figure 2-7) were created from the Southwest Regional GAP (GAP Analysis Project) land cover map (Lowry et. al, 2005). Within the Brawley Wash – Los Robles Wash Watershed, Table 2-5 identifies the Scrub/Shrub as the most common land cover type over the entire watershed, encompassing about 76% of the watershed. The next most common types are Grassland/Herbaceous (8%) and Evergreen Forest (6%).

Note: There are a total of 26 GAP vegetation categories present within the Brawley Wash-Los Robles Watershed boundary. Some of these categories occur only in small concentrations, and are not visible at the small scale in which the maps are displayed. Some of the vegetation categories were re-grouped in order to increase the legibility of the map. In collaboration with NRCS, staff were able to create a total of 14 grouped GAP vegetation categories, as shown on Table 2-5.

*Table 2-5: Brawley Watershed Southwest Regional GAP Analysis Project Land Cover, Percent of 10-digit Watershed (Part 1 of 2)*

| Watershed                        |                               |                                  |                                  |                          |                               |
|----------------------------------|-------------------------------|----------------------------------|----------------------------------|--------------------------|-------------------------------|
| Land Cover                       | Los Robles Wash<br>1505030406 | Lower Brawley Wash<br>1505030405 | Upper Brawley Wash<br>1505030404 | Altar Wash<br>1505030403 | Puertocito Wash<br>1505030402 |
| Agriculture (Irrigated Cropland) | 4%                            | 6%                               | 0.2%                             | -                        | -                             |
| Altered or Disturbed             | 1%                            | 0.3%                             | -                                | -                        | 3%                            |
| Developed High Intensity         | 1%                            | 0.6%                             | -                                | -                        | -                             |
| Developed Low Intensity          | 4%                            | 10%                              | 1%                               | -                        | -                             |
| Emergent Herbaceous Wetland      | -                             | -                                | -                                | 0.3%                     | 0.2%                          |
| Evergreen Forest                 | -                             | 0.4%                             | 13%                              | 11%                      | 6%                            |
| Grassland /Herbaceous            | -                             | 0.2%                             | 6%                               | 11%                      | 25%                           |
| Open Water                       | -                             | 0.1%                             | -                                | -                        | -                             |
| Scrub/Shrub                      | 89%                           | 79%                              | 77%                              | 74%                      | 63%                           |
| Sparsely Vegetated/Barren        | 0.9%                          | 4%                               | 1%                               | 1%                       | 1%                            |
| Woody Wetland                    | 1%                            | 1%                               | 2%                               | 4%                       | 2%                            |
| Area (Sq. mi.)                   | 210                           | 410                              | 149                              | 350                      | 149                           |

*Table 2-5: Brawley Watershed Southwest Regional GAP Analysis Project Land Cover, Percent of 10-digit Watershed (Part 2 of 2)*

| Watershed                         |                             |                     |
|-----------------------------------|-----------------------------|---------------------|
| Land Cover                        | Arivaca Creek<br>1505030401 | Percent of<br>Total |
| Agriculture                       | -                           | 2%                  |
| Altered or<br>Disturbed           | -                           | 0.5%                |
| Developed High<br>Intensity       | -                           | 0.3%                |
| Developed Low<br>Intensity        | -                           | 3%                  |
| Emergent<br>Herbaceous<br>Wetland | 1%                          | 0.1%                |
| Evergreen Forest                  | 13%                         | 6%                  |
| Grassland<br>/Herbaceous          | 16%                         | 8%                  |
| Open Water                        | 0.1%                        | -                   |
| Scrub/Shrub                       | 66%                         | 76%                 |
| Sparsely<br>Vegetated/Barren      | 2%                          | 2%                  |
| Woody Wetland                     | 3%                          | 2%                  |
| Area (Sq. mi.)                    | 140                         | 1408                |

*\*Not necessarily irrigated land.*

*Data Sources: GIS data layer "newgapveg", Southwest Regional GAP project, 2005*

*Originated by Southwest Regional GAP project: <http://fws-nmcfwru.nmsu.edu/swregap/>*

### Meteorological Stations, Precipitation and Temperature

For the years 1961-1990, the average annual precipitation for the Brawley Wash – Los Robles Wash Watershed was about 15 inches (WRCC, 2004) (Table 2-6). Puertocito Wash and Arivaca Creek Watersheds receives the most rainfall with about 19 inches of annual rain on average, while Los Robles Watershed receives the least rainfall with an average of 11

inches annually. Average Temperature for the Brawley Wash – Los Robles Wash Watershed range from 63.3°F to 70.3°F. Active meteorological stations in the watershed are located in Figure 2-8.

The Western Regional Climate Center calculates the average minimum and maximum temperatures for each month for the period of record and then takes an annual average.

*Table 2-6: Brawley Watershed Meteorological Stations, Temperature (°F) and Precipitation (in/yr) with Recent Long-term Records.*

| 10-digit Watershed Name          | Meteorological Stations and Map ID | Temperature (°F) |           |      | Precipitation (in/yr) |           |                  |
|----------------------------------|------------------------------------|------------------|-----------|------|-----------------------|-----------|------------------|
|                                  |                                    | Avg. Min.        | Avg. Max. | Avg. | Avg. Min.             | Avg. Max. | Weighted Average |
| Los Robles Wash<br>1505030406    | Red Rock                           | 52.8             | 85.1      | 68.9 | 9                     | 13        | 11               |
| Lower Brawley Wash<br>1505030405 | Tucson 17NW                        | 56.5             | 84.1      | 70.3 | 9                     | 23        | 13               |
| Upper Brawley Wash<br>1505030404 | Anvil Ranch                        | 48.9             | 83.5      | 66.2 | 13                    | 29        | 17               |
| Altar Wash<br>1505030403         | -                                  |                  |           |      | 13                    | 31        | 17               |
| Puertocito Wash<br>1505030402    | Sasabe                             | 49.3             | 79.1      | 64.2 | 15                    | 23        | 19               |
| Arivaca Creek<br>1505030401      | Ruby                               | 49.9             | 76.6      | 63.3 | 15                    | 21        | 19               |
| Brawley Watershed                | -                                  | -                | -         | -    | 9                     | 31        | 15               |

*Data Sources: GIS data layer "precip\_a\_az" Water and Climate Center of the NRCS (1998); GIS data layer "NWS\_Stations" Western Regional Climate Center (WRCC), Temperature data. July 15, 2004; <http://www.wrcc.dri.edu/summary/climsmaz.htm>*

### Land Ownership/Management

There are 11 different land ownership/management entities in the Brawley Wash – Los Robles Wash Watershed (Figure 2-9 and Table 2-7). State Land is the largest category, representing about 41% of the watershed, followed by the Private Land

with about 24%, and Wildlife Preserve with about 11%. Saguaro National Park, the Bureau of Land Management, Game & Fish, Coronado National Forest, Tohono O'odham Indian Reservations and the Military hold smaller amounts of land in the watershed.

*Table 2-7: Brawley Wash – Los Robles Wash Watershed Land Ownership/Management. (Percent of each 10-digit Watershed) (part 1 of 2)*

| Land Owner            | Los Robles Wash<br>1505030406 | Lower Brawley Wash<br>1505030405 | Upper Brawley Wash<br>1505030404 | Altar Wash<br>1505030503 | Puertocito Wash<br>1505030402 |
|-----------------------|-------------------------------|----------------------------------|----------------------------------|--------------------------|-------------------------------|
| BLM                   | 38%                           | 4%                               | 5%                               | 5%                       | 1%                            |
| Bureau of Reclamation | -                             | 1%                               | -                                | -                        | -                             |
| Game and Fish         | --                            | <1%                              | <1%                              |                          |                               |
| National Forest       | -                             | -                                | -                                | -                        | 2%                            |
| Indian Reservation    | 11%                           | 16%                              | 19%                              | 0.25%                    | <1%                           |
| State Parks           | -                             | 4%                               | -                                | -                        | -                             |
| Military              | -                             | -                                | -                                | -                        | -                             |
| National Parks        | -                             | 6%                               | -                                | -                        | -                             |
| Private Land          | 26%                           | 40%                              | 27%                              | 13%                      | 8%                            |
| State Land            | 25%                           | 29%                              | 49%                              | 66%                      | 44%                           |
| Wildlife Preserve     | -                             | -                                | -                                | 16%                      | 45%                           |
| Area (square miles)   | 210                           | 410                              | 149                              | 350                      | 149                           |

*Table 2-7: Brawley Watershed Land Ownership/Management. (Percent of each 10-digit Watershed) (part 2 of 2)*

| Land Owner            | Arivaca Creek<br>1505030401 | Brawley Watershed |
|-----------------------|-----------------------------|-------------------|
| BLM                   | 6%                          | 10%               |
| Bureau of Reclamation | -                           | <1%               |
| Game and Fish         | <1%                         | <1%               |
| National Forest       | 30%                         | 3%                |
| Indian Reservation    | -                           | 8%                |
| State Parks           | -                           | 1%                |
| Military              | -                           | -                 |
| National Parks        | -                           | 2%                |
| Private Land          | 20%                         | 24%               |
| State Land            | 22%                         | 41%               |
| Wildlife Preserve     | 21%                         | 11%               |
| Area (square miles)   | 139                         | 1,408             |

*Data Sources: GIS data layer "ownership", Arizona State Land Department, Arizona Land Resource Information System (ALRIS), February 7, 2007*

## Land Use

The Land Use map (Figure 2-10) was created from the Southwest Regional GAP Analysis Project land cover map (Lowry et. al, 2005).

The land use condition during the early 1990's was determined using the National Land Cover Dataset (NLCD).

The NLCD classification contains 21 different land cover and use categories (USGS, NLCD Land Cover Class Definitions); however, these categories have been consolidated into five land cover types (Figure 2-10 and Table 2-8). The five groupings for the land cover categories are:

- Crop, which includes confined feeding operations; cropland and pasture; orchards, groves, vineyards, nurseries and ornamental horticulture; other agricultural land.
- Forest, includes areas characterized by tree cover (natural or semi-natural woody vegetation, generally greater than

6 meters tall); tree canopy accounts for 25-100 percent of the cover

- Water, identifies all areas of surface water, generally with less than 25% cover of vegetation/land cover
- Range, which includes herbaceous rangeland; mixed range; shrub and brush rangeland.
- Urban (high density & low density) includes residential areas; commercial and services; industrial and commercial complexes; mixed urban or built-up land; other urban or built-up land; strip mines quarries and gravel pits; transportation, communication and utilities.

The most common land cover type is Range which makes up about 94% of the watershed. Urban Low Intensity is the next most common type with about 3% of the total area.



**2-8: Brawley Wash – Los Robles Wash Watershed Land Use, Percent of 10-digit Watershed**

| Land Cover/Location                                 | Crop  | Forest | Urban High Intensity | Urban Low Intensity | Range | Water | Area (sq.mi.) |
|-----------------------------------------------------|-------|--------|----------------------|---------------------|-------|-------|---------------|
| Los Robles Wash<br>1505030406                       | 4.0%  | -      | 1.0%                 | 4.0%                | 92%   | <1.0% | 210           |
| Lower Brawley Wash<br>1505030405                    | 6.0%  | -      | 1.0%                 | 10%                 | 84%   | <1.0% | 410           |
| Upper Brawley Wash<br>1505030404                    | <1.0% | <1.0%  | -                    | 1.0%                | 99%   | -     | 149           |
| Altar Wash<br>1505030403                            | -     | <1.0%  | -                    | -                   | >99%  | <1.0% | 350           |
| Puertocito Wash<br>1505030402                       | -     | <1.0%  | -                    | -                   | >99%  | <1.0% | 149           |
| Arivaca Creek<br>1505030401                         | -     | -      | -                    | -                   | >99%  | <1.0% | 139           |
| Percent of Brawley Wash – Los Robles Wash Watershed | 2.0%  | <1.0%  | <1.0%                | 3.0%                | 94%   | <1.0% | 1,407         |

Data Sources: GIS data layer “Southwest Regional GAP Program”, originated by Southwest Regional GAP program, 2005. <http://ftp.nr.usu.edu/swgap/>

**Mines - Primary Ores**

Table 2-9 and Figure 2-11 show the types of ores being mined in the Brawley Wash – Los Robles Wash

Watershed. The most common type of ore is gold with 94 mines (Ward, J.S. and Associates. 1973). Other common known ore types are copper, silver, lead, tungsten, manganese, and uranium.

*Table 2-9: Brawley Wash – Los Robles Wash Watershed Mines – Primary Ores*

| Ore Type       | Total Number of Mines |
|----------------|-----------------------|
| Asbestos       | 2                     |
| Barium         | 1                     |
| Beryllium      | 3                     |
| Copper         | 48                    |
| Fluorine       | 6                     |
| Geothermal     | 11                    |
| Gold           | 94                    |
| Iron           | 1                     |
| Lead           | 33                    |
| Lithium        | 1                     |
| Manganese      | 11                    |
| Perlite        | 1                     |
| Quartz Crystal | 1                     |
| Rare Earth     | 2                     |
| Silicon        | 1                     |
| Silver         | 69                    |
| Stone          | 4                     |
| Tungsten       | 12                    |
| Uranium        | 11                    |
| Zeolites       | 1                     |
| Zinc           | 1                     |

*Note: If a mine contains more than one ore, only the major ore is noted. Data Source: "mines" Arizona Land Information Service, 2006*

### Section 3: Resource Concerns

#### Introduction

Conservation Districts and other local leaders, along with NRCS and other resource management agencies, have identified priority natural resource concerns for this watershed. These

concerns can be grouped under the broad resource categories of Soil, Water, Air,

Plants, or Animals (SWAPA). Refer to Table 3-1 for a listing of priority resource concerns by land use within the Brawley Wash - Los Robles Wash Watershed.

*Table 3-1: Brawley Wash - Los Robles Wash Watershed Priority Resource Concerns by Land Use*

| Resource Category         | Cropland Concerns | Rangeland Concerns                                                       | Forest Concerns | Urban Concerns             |
|---------------------------|-------------------|--------------------------------------------------------------------------|-----------------|----------------------------|
| Soil Erosion              |                   | Sheet & Rill Erosion                                                     |                 | Roads & Construction Sites |
| Water Quality             |                   |                                                                          |                 |                            |
| Water Quantity            | Aquifer Depletion | Aquifer Depletion                                                        |                 | Aquifer Depletion          |
| Air Quality               |                   |                                                                          |                 | Roads & Construction Sites |
| Plant Condition           |                   | Plant Productivity, Health & Vigor                                       |                 |                            |
| Noxious & Invasive Plants |                   | Noxious & Invasive Plants                                                |                 | Noxious & Invasive Plants  |
| Domestic Animals          |                   | Inadequate Quantities & Quality of Feed & Forage & Distribution of Water |                 |                            |
| Species of Concern        |                   | T&E Species & Declining Species & Species of Concern                     |                 |                            |

(NRCS, 2008)

#### Soil Erosion

Soil erosion is defined as the movement of soil from water (sheet and rill or gully) or wind forces requiring treatment when soil loss tolerance levels are exceeded. Sheet and rill erosion is a concern

particularly on rangeland in areas of shallow soils and poor vegetative cover. Soil loss results in reduced water holding capacity and plant productivity. Gully erosion can be a significant problem in areas of steep slopes and deep soils. Loss of vegetative cover and down-cutting of streams contribute to gully formation. Wind erosion is

locally significant where adequate vegetative cover is not maintained.

Headcutting of the Santa Cruz River in the far northern portion of the watershed will become a major concern when it reaches Los Robles Wash and causes loss of archaeological sites in the northern Los Robles Archaeological District.

Conservation practices applied to address this resource concern are generally those that help improve vegetative cover, stabilize sites, and control water flows. Practices may include critical area planting, deferred grazing, grade stabilization structures, herbaceous wind barriers, prescribed grazing, range planting, stream channel stabilization, tree and shrub establishment, water and sediment control basins, water spreading, windbreak establishment, and wildlife upland habitat management.

### Water Quality

The Arizona Department of Environmental Quality (ADEQ) assesses surface water quality to identify which surface waters are impaired or attaining designed uses and to prioritize future monitoring. Strategies must be implemented on impaired waters to reduce pollutant loadings so that surface water quality standards will be met, unless impairment is *solely* due to natural conditions.

Once a surface water has been identified as impaired, activities in the watershed that might contribute further loadings of the pollutant are not allowed. Agencies and individuals planning future projects in the watershed must be sure

that activities will not further degrade these impaired waters and are encouraged through grants to implement strategies to reduce loading. One of the first steps is the development of a Total Maximum Daily Load (TMDL) analysis to empirically determine the load reduction needed to meet standards.

The draft 2006 Status of Ambient Surface Water Quality in Arizona indicates that very little monitoring has been completed in Brawley Wash Watershed. This is due to very little perennial or even intermittent flows in this watershed. However, one lake in this watershed has been listed as impaired:

Arivaca Lake, a 118 acre reservoir in the Arivaca Creek Sub-watershed (HUC 150530401), is listed as impaired due to mercury in fish tissue. A TMDL was completed in 1999. The primary sources of mercury appear to be atmospheric deposition and natural deposition from local substrates. Atmospheric deposition is thought to be coming from other countries and is therefore not readily controllable. A fish consumption advisory is in place to warn the public concern risks associated with eating these contaminated fish (Figure 3-1).

Although some data was collected at a few other sites in this watershed, there was insufficient data to assess any other lake or stream in the draft 2006 assessment report.

## Water Quantity

In the Brawley Wash-Los Robles Wash Watershed (also known as the Avra Valley Subbasin), Altar Wash originates in the southern portion and flows northward to become Brawley Wash. Brawley Wash flows to the north and northwest through Avra Valley to its confluence with the Santa Cruz River. A portion of Arivaca Wash in the southwest portion of the watershed is perennial (ADWR, 1999).

Water quantity is a resource concern whenever water supplies are inadequate to meet the needs for agricultural or domestic uses. Conservation practices applied to address this resource concern on irrigated cropland are generally those that improve the quantity and efficient distribution of water. Practices may include irrigation land leveling, irrigation system, irrigation water conveyance (ditch or pipeline), irrigation water management, and structure for water control.

## Air Quality

The Rillito Area in the northern part of the Brawley Wash-Los Robles Watershed is classified by the Arizona Department of Environmental Quality as a PM-10 nonattainment area (ADEQ, 2008) (Figure 3-2). Emission sources include the Arizona Portland Cement Company, construction, unstabilized river banks, agriculture, unpaved roads and unstabilized road shoulders.

Air quality is a resource concern whenever human activities contribute significantly to airborne sediment and smoke, resulting in property damage and health problems. Conservation

practices applied to address this resource concern are generally those that reduce wind erosion and smoke. Practices may include atmospheric resource quality management, critical area planting, heavy use area protection, road closures and treatments, and windbreak establishment.

## Environmental Sites

There are no environmental Superfund or Water Quality Assurance Revolving Fund (WQARF) cleanup sites located within the watershed (Figure 3-3). However, in the Tucson area, about five miles east of the watershed, there are three WQARF sites and one EPA Superfund site.

## Plant Condition

Plant condition is a resource concern whenever plants do not manufacture sufficient food to continue the growth cycle or to reproduce. Plant condition is frequently a concern where proper grazing management is not being applied.

Conservation practices applied to address this resource concern are generally those that maintain or improve the health, photosynthetic capability, rooting and reproductive capability of vegetation. Practices may include brush management, critical area planting, deferred grazing, fencing, herbaceous wind barriers, nutrient management, pest management, prescribed grazing, prescribed burning, range planting, recreation area improvement, wildlife upland habitat management, and windbreak establishment.

### Noxious and Invasive Plants

Noxious and invasive plants are a resource concern whenever these species cause unsuitable grazing conditions for livestock or wildlife and due to their potential to out-compete native species which are generally preferred for wildlife habitat value. Increases in noxious and invasive plants can result from poor grazing management, drought, motorized off-road travel, road paving and other causes.

Conservation practices applied to address this resource concern are generally those that control the establishment or reduce the population of noxious and invasive plant species. Practices may include brush management, deferred grazing, fencing, forest stand improvement, pest management, prescribed burning, prescribed grazing, and wildlife upland habitat management.

### Bark Beetle, Drought and Wildfire

Arizona has been in an extended drought since 1996. Most areas of the state continue to experience record low winter precipitation and snowpack, above-average temperatures, and low soil moisture. These conditions have led to high vegetation stress, high fire potential, below-normal streamflow, decreasing water supplies and deteriorating range and pasture conditions. Although in more forested regions of the state these conditions have led to Bark Beetle infestation, this has not been observed in the Brawley Wash – Los Robles Wash Watershed (adapted from Arizona Drought Preparedness Annual Report, 2006).

The Climate Assessment for the Southwest (CLIMAS) website ([www.ispe.arizona.edu/climas](http://www.ispe.arizona.edu/climas)) and ADWR Statewide Drought Program website ([www.azwater.gov/dwr/drought](http://www.azwater.gov/dwr/drought)) provide information on Arizona's drought status. The area of Arizona that encompasses the Brawley Wash - Los Robles Wash Watershed has received less than 50% of average annual precipitation, placing it in moderate drought status. The long-term drought status is severe.

### Domestic Animal Concerns

Domestic animal concerns occur whenever the quantity and quality of food are not adequate to meet the nutritional requirements of animals, or adequate quantity or distribution of water is not provided. This is frequently a concern on rangeland when changes in species composition resulting from poor grazing management and drought can reduce the availability of suitable forage. This is also a concern where stock water is not evenly distributed resulting in poor grazing management.

Conservation practices applied to address this resource concern are generally those that maintain or improve the quantity, quality, and diversity of forage available for animals, reduce the concentration of animals at existing water sources, and insure adequate quantity and reliability of water for the management of domestic animals. Practices may include brush management, deferred grazing, fencing, pest management, prescribed burning, prescribed grazing, pipelines, ponds, range planting, water spreading, wells,

spring development, watering facility, and wildlife upland habitat management.

### Species of Concern

There are 55 threatened and endangered species listed for Arizona (U. S. Fish and Wildlife Service website). In 1990 Arizona voters created the Heritage Fund, designating up to \$10 million per year from lottery ticket sales for the conservation and protection of the state's wildlife and natural areas. The Heritage Fund allowed for the creation of the Heritage Data Management System (HDMS)

which identifies elements of concern in Arizona and consolidates information about their status and distribution throughout the state. (Arizona Game & Fish website, 2006)

The Brawley Wash-Los Robles Wash Watershed contains 8 species that are either listed, species of concern, or candidate species, under the U.S. Endangered Species Act (Table 3-2). Of the eight species listed in the watershed, six of the species are designated as being in imminent jeopardy of extinction.

*Table 3-2: Brawley Wash-Los Robles Wash Watershed Species of Concern and Endangered Species Classifications and Observations<sup>(1)</sup>*

| Common Name                     | Species Name                          | USESA<br>(2) | USFS<br>(3) | STATE<br>(4) |
|---------------------------------|---------------------------------------|--------------|-------------|--------------|
| Chiricahua Leopard Frog         | Rana chiricahuensis                   | LT           | S           | WSC          |
| Gila Topminnow                  | Poeciliopsis occidentalis             | LE           |             | WSC          |
| Jaguar                          | Panthera onca                         | LE           | S           | WSC          |
| Kearney's Blue Star             | Amsonia kearneyana                    | LE           |             | HS           |
| Masked Bobwhite                 | Colinus virginianus<br>ridgwayi       | LE           |             | WSC          |
| Nichol Turk's Haed<br>Cactus    | Echinocactus<br>horizonthalonius var. | LE           |             | HS           |
| Pima Pineapple Cactus           | Coryphantha scheeri var.              | LE           |             | HS           |
| Western Yellow-billed<br>Cuckoo | Coccyzus americanus<br>occidentalis   | C            | S           | WSC          |

Data Sources: Arizona Land Information System (ALRIS), Natural Resource Conservation Service (NRCS).

Note: Status Definitions as Listed by Arizona Game and Fish Department, November 26, 2006  
[http://www.gf.state.az.us/w\\_c/edits/hdms\\_status\\_definitions.shtml](http://www.gf.state.az.us/w_c/edits/hdms_status_definitions.shtml)

#### **(1) Proposed for Listing: (USEA) Federal U.S. Status**

ESA Endangered Species Act (1973 as amended)  
US Department of Interior, Fish and Wildlife Service

#### **(2) Listed:**

LE Listed Endangered: imminent jeopardy of extinction.  
 LT Listed Threatened: imminent jeopardy of becoming Endangered.

Candidate (Notice of Review: 1999):

C Candidate. Species for which USFWS has sufficient information on biological vulnerability and threats to support proposals to list as Endangered or Threatened under ESA. However, proposed



rules have not yet been issued because such actions are precluded at present by other listing activity.

**(3) USFS US Forest Service** (1999 Animals, 1999 Plants)

US Department of Agriculture, Forest Service, Region 3

S Sensitive: those taxa occurring on National Forests in Arizona which are considered sensitive by the Regional Forester.

**(4) State Status**

NPL Arizona Native Plant Law (1993)

Arizona Department of Agriculture

HS Highly Safeguarded: no collection allowed.

WSC Wildlife of Special Concern in Arizona. Species whose occurrence in Arizona is or may be in jeopardy, or with known or perceived threats or population declines, as described by the Arizona Game and Fish Department's listing of Wildlife of Special Concern in Arizona (WSCA, in prep).

Resource Concern Summary

The Brawley Wash Watershed is a mosaic of federal, state, tribal and private lands where livestock grazing, agriculture and recreation are the primary land uses. The southern portion of the watershed is primarily managed by the U.S. Forest Service and U.S. Fish and Wildlife Service. The northern portion of the watershed is a mixture of state and private lands. Livestock grazing is the primary land use activity on the private and state lands. The watershed is located near the cities of Tucson and Marana and the southern half of the watershed has seen significant development over the last decade.

Several important natural areas are located in the watershed. The Saguaro National Park West and the Tucson Mountain Park are located in the lower portion of the watershed. A portion of Ironwood Forest National Monument is located within the watershed. The world famous Arizona-Sonora Desert Museum is located in the watershed near Saguaro National Park West. Old Tucson, an old movie studio and tourist

attraction is also located in this area. This area is heavily used for recreation by both Tucson residents and tourists.

The Buenos Aires National Wildlife Refuge is located in the upper portion of the watershed. The Buenos Aires NWR is one of the largest wildlife refuges in the United States and is a reintroduction location for the endangered masked bobwhite quail (*Colinus virginianus ridgwayi*). Arivaca Creek and Arivaca Cienega, located on the refuge, are valuable birding areas in southern Arizona and support a local ecotourism economy in the town of Arivaca. Other species of concern found in the watershed include Chiricahua leopard frog (*Rana chiricahuensis*), Gila topminnow (*Poeciliopsis occidentalis*), jaguar (*Panthera onca*), western yellow-billed cuckoo (*Coccyzus americanus occidentalis*), Kearney's blue star (*Amsonia kearneyana*), Nichol's Turk's head cactus (*Echinocactus horizonthalonius* var.), and Pima pineapple cactus (*Coryphantha scheeri* var.).

Erosion and sedimentation are major problems in the watershed. Brawley Wash started to incise in the early 1900's and today is a large entrenched channel. Tributaries to Brawley Wash are also entrenching due to increased channel gradients resulting from channel incisions. Erosion control protections have been proposed in the area. Arivaca Lake on the headwaters of Arivaca Creek is listed by the Arizona Department of Environmental Quality as impaired due to metals.

The watershed will see continued development due to population growth in Tucson and Marana. Local flooding and continued channel degradation are likely without the implementation of progressive watershed management practices.

Local leaders have identified watershed health as a priority concern for the Brawley Wash - Los Robles Wash Watershed (Pima County, 2000). This includes both the upland areas of the watershed and the riparian or stream course areas. The condition of the

upland areas is integral to hydrologic function, such that when precipitation falls on the land its disposition is affected by the soil and vegetation, which in turn are affected by land uses, both historical and current. The amount of the precipitation which immediately runs off the land surface, and that which infiltrates into the soil to either be used for plant growth or to recharge ground water, is dependent on this critical interface.

The main concern in the Watershed is rapidly expanding urbanization of cropland and increased recreational use of public lands, resulting in impacts to vegetation and soil surfaces which may affect hydrologic function and result in accelerated erosion. The desert and semi-desert ecosystems have developed in a climatic regime of wide fluctuations of precipitation, ranging from drought to flood. Human uses superimposed on that climatic regime can tend to exacerbate or ameliorate their effects on soils, vegetation and wildlife.

### Conservation Progress/Status

Conservation progress for the previous five years in the Brawley Wash-Los Robles Wash Watershed has focused on addressing the following primary resource concerns:

- ✓ Soil Condition – Organic Matter Depletion
- ✓ Soil Erosion – Sheet and Rill Erosion
- ✓ Water Quantity – Inefficient Water Use on Irrigated Land
- ✓ Plant Condition – Productivity, Health and Vigor
- ✓ Domestic Animals – Inadequate Quantities and Quality of Feed and Forage

The following table presents conservation accomplishments in this watershed during fiscal years (FY) 2003 through 2007, according to the NRCS Progress Reporting System.

*Table 3-3: Brawley Wash-Low Robles Wash Watershed Conservation Treatment Applied*

| Brawley Wash-Los Robles Wash Watershed (15050304)<br>Conservation Treatment Applied | FY03-07<br>TOTAL |
|-------------------------------------------------------------------------------------|------------------|
| Conservation Crop Rotation (328) (acres)                                            | 1,599            |
| Fence (382) (feet)                                                                  | 123,187          |
| Irrigation Land Leveling (464) (acres)                                              | 176              |
| Irrigation Water Conveyance, Ditch and Canal Lining, (428) (feet)                   | 2,319            |
| Irrigation Water Conveyance, Pipeline, Underground, Plastic (430) (feet)            | 3,470            |
| Irrigation Water Management (449) (acres)                                           | 1,956            |
| Nutrient Management (590) (acres)                                                   | 1,430            |
| Pest Management (595) (acres)                                                       | 1,771            |
| Pipeline (516) (feet)                                                               | 28,628           |
| Prescribed Grazing (528) (acres)                                                    | 182,092          |
| Residue Management, Seasonal (344) (acres)                                          | 2,016            |
| Upland Wildlife Habitat Management (645) (acres)                                    | 25,119           |

## **Section 4: Census, Social and Agricultural Data**

This section discusses the human component of the watershed and the pressure on natural resources caused by humans and by population change.

### Population Density, 1990

Census block statistics for 1990 were compiled from information prepared by Geo-Lytics (Geo-Lytics, 1998). These data were linked with census block data and used to create a density map (Figure 4-1) through a normalization process using a grid of 7 km squares. This process involves calculating density per census block and intersecting it with the grid, which is then used to calculate the number of people and thus density per grid square.

Table 4-1 shows the tabulated minimum, maximum and mean number of people per square mile in 1990 for the watershed. In 1990, the mean population density for the entire watershed was about 19 people per square mile. Lower Brawley Wash Watershed had the highest population mean with about 51 people per square mile, and a maximum of 2,470 people per square mile. Altar Wash Watershed had the lowest density with a mean of only about 0.5 people per square mile.

### Population Density, 2000

The Census Block 2000 statistics data were downloaded from the Environmental Systems Research Institute (ESRI) website (ESRI Data Products, 2003) and are shown in Table 4-2.

A population density map (Figure 4-2) was created from these data. The mean population density in 2000 was about 29 people per square mile. Lower Brawley Wash Watershed had the highest mean population density (78 people/sq. mi.) and the highest maximum population density, (2,643 people/sq.mi).

### Population Density Change, 1990-2000

The 1990 and 2000 population density maps were used to create a population density change map. The resulting map and table (Figure 4-3 and Table 4-3) show population increase or decrease over the ten year time frame. Overall, mean population density increased by about 10 people per square mile during this ten-year time period. Lower Brawley Wash Watershed had the largest increase in mean population at 27 people per square mile.

**Table 4-1: Brawley Wash – Los Robles Wash Watershed 1990 Population Density (people/square mile)**

| 10-digit Watershed Name                        | Area (sq. miles) | Population Density (people/sq.mi.) |       |      |
|------------------------------------------------|------------------|------------------------------------|-------|------|
|                                                |                  | Min                                | Max   | Mean |
| Los Robles Wash<br>1505030406                  | 210              | 0                                  | 651   | 14   |
| Lower Brawley Wash<br>1505030405               | 410              | 0                                  | 2,470 | 51   |
| Upper Brawley Wash<br>1505030404               | 149              | 0                                  | 53    | 3    |
| Altar Wash 1505030403                          | 350              | 0                                  | 8     | 0.5  |
| Puertocito Wash<br>1505030402                  | 149              | 0                                  | 10    | 0.4  |
| Arivaca Creek 1505030401                       | 139              | 0                                  | 73    | 4    |
| Total Brawley Wash – Los Robles Wash Watershed | 1,408            | 0                                  | 2,470 | 19   |

*Note: Adjacent watersheds may share a grid square. Data Sources: Census block statistics for 1990 were compiled from a CD prepared by Geo-Lytics (GeoLytics, Inc.1998. Census 1990. Census CD + Maps. Release 3.0.) New Mexico Resource Geographic Information (RGIS 2007).*

**Table 4-2: Brawley Wash – Los Robles Wash Watershed 2000 Population Density (people/square mile)**

| 10-digit Watershed Name                        | Area (sq. miles) | Population Density (people/sq.mi.) |       |      |
|------------------------------------------------|------------------|------------------------------------|-------|------|
|                                                |                  | Min                                | Max   | Mean |
| Los Robles Wash<br>1505030406                  | 210              | 0                                  | 975   | 24   |
| Lower Brawley Wash<br>1505030405               | 410              | 0                                  | 2,643 | 78   |
| Upper Brawley Wash<br>1505030404               | 149              | 0                                  | 204   | 5    |
| Altar Wash 1505030403                          | 350              | 0                                  | 11    | 0.3  |
| Puertocito Wash<br>1505030402                  | 149              | 0                                  | 1     | 0.2  |
| Arivaca Creek 1505030401                       | 139              | 0                                  | 96    | 5    |
| Total Brawley Wash – Los Robles Wash Watershed | 1,408            | 0                                  | 2,643 | 29   |

*Note: Adjacent watersheds may share a grid square. Data Sources: Census block statistics for 1990 were compiled from a CD prepared by Geo-Lytics (GeoLytics, Inc.1998. Census 1990. Census CD + Maps. Release 3.0.) New Mexico Resource Geographic Information (RGIS 2007).*

*Table 4-3: Brawley Wash – Los Robles Wash Watershed Population Density Change 1990 – 2000 (people/square mile)*

| 10-digit Watershed Name                        | Area (sq. miles) | Population Density Change (people/sq.mi.) |     |      |
|------------------------------------------------|------------------|-------------------------------------------|-----|------|
|                                                |                  | Min                                       | Max | Mean |
| Los Robles Wash<br>1505030406                  | 210              | -60                                       | 646 | 10   |
| Lower Brawley Wash<br>1505030405               | 410              | -79                                       | 761 | 27   |
| Upper Brawley Wash<br>1505030404               | 149              | -46                                       | 152 | 3    |
| Altar Wash 1505030403                          | 350              | -7                                        | 11  | -0.2 |
| Puertocito Wash<br>1505030402                  | 149              | -10                                       | 0.6 | -0.2 |
| Arivaca Creek 1505030401                       | 139              | -15                                       | 71  | 1    |
| Total Brawley Wash – Los Robles Wash Watershed | 1,408            | -79                                       | 761 | 10   |

*Note: Adjacent watersheds may share a grid square. Data Sources: Derived from data from the GIS data used for tables 4-1 and 4-2.*

### Housing Density, 2000 and 2030

The Watershed Housing Density Map for the year 2000 and projections for the year 2030 were created with data developed by David M. Theobald (Theobald, 2005). Theobald developed a nationwide housing density model that incorporates a thorough way to account for land-use change beyond the “urban fringe.”

Exurban regions are the “urban fringe”, or areas outside suburban areas, having population densities greater than 0.68 – 16.18 ha (1.68 – 40 acres) per unit. Theobald stresses that exurban areas are increasing at a much faster rate than urban sprawl, are consuming much more land, and are having a greater impact on ecological health, habitat fragmentation and other resource concerns.

Theobald estimates that the exurban density class has increased at a much faster rate than the urban/suburban density classes. Theobald’s model

forecasts that this trend will continue and may even accelerate by 2030. This indicates that development patterns are shifting more towards exurban, lower density, housing units, and are thereby consuming more land. He suggests that exurban development has more overall effect on natural resources because of the larger footprint and disturbance zone, a higher percent of impervious surfaces, and higher pollution because of more vehicle miles traveled to work and shopping.

Figure 4-4 and Table 4-4, Brawley Wash-Robles Wash Watershed Housing Density for 2000, identifies that about 63% of housing is located in “undeveloped private” areas, about 27% is located in “rural” areas and 9% located in “exurban”. Figure 4-5 and Table 4-5, Brawley Wash-Robles Wash Watershed Housing Density for 2030, projects “undeveloped private” areas being reduced to about 5% of the watershed, “rural” decreasing to 7%, and exurban increasing to 82%.

**Table 4-4: Brawley Wash – Los Robles Wash Watershed Housing Density 2000 (Percent of Watershed) (Part 1 of 2).**

| Housing Density     | Los Robles Wash<br>1505030406 | Lower Brawley Wash<br>1505030405 | Upper Brawley Wash<br>1505030404 | Altar Wash<br>1505030403 | Puertocito Wash<br>1505030402 |
|---------------------|-------------------------------|----------------------------------|----------------------------------|--------------------------|-------------------------------|
| Undeveloped Private | 70%                           | 72%                              | 72%                              | 59%                      | 54%                           |
| Rural               | 26%                           | 10%                              | 25%                              | 41%                      | 46%                           |
| Exurban             | 4%                            | 16%                              | 4%                               | 0.2%                     | -                             |
| Suburban            | -                             | 1.1%                             | >0.00%                           | >0.00%                   | -                             |
| Urban               | 0.01%                         | 0.3%                             | -                                | -                        | -                             |

Source: Theobald, D. 2005. Landscape patterns of exurban growth in the USA from 1980 to 2020. *Ecology and Society* 10(1): 32. [online] URL: <http://www.ecologyandsociety.org/vol10/iss1/art32/>

**Table 4-4: Brawley Wash – Los Robles Wash Watershed Housing Density 2000 (Percent of Watershed) (Part 2 of 2).**

| Housing Density     | Arivaca Creek<br>1505030401 | Brawley Wash – Los Robles Wash Watershed | Brawley Wash – Los Robles Wash Watershed (sq. miles) |
|---------------------|-----------------------------|------------------------------------------|------------------------------------------------------|
| Undeveloped Private | 32%                         | 63%                                      | 181                                                  |
| Rural               | 38%                         | 27%                                      | 77                                                   |
| Exurban             | 29%                         | 9%                                       | 27                                                   |
| Suburban            | 0.06%                       | 0.3%                                     | 1                                                    |
| Urban               | 0.06%                       | 0.07%                                    | 0.2                                                  |

Source: Theobald, D. 2005. Landscape patterns of exurban growth in the USA from 1980 to 2020. *Ecology and Society* 10(1): 32. [online] URL: <http://www.ecologyandsociety.org/vol10/iss1/art32/>

**Table 4-5: Brawley Wash – Los Robles Wash Watershed Housing Density 2030 (Percent of Watershed) (Part 1 of 2).**

| Housing Density     | Los Robles Wash<br>1505030406 | Lower Brawley Wash<br>1505030405 | Upper Brawley Wash<br>1505030404 | Altar Wash<br>1505030403 | Puertocito Wash<br>1505030402 |
|---------------------|-------------------------------|----------------------------------|----------------------------------|--------------------------|-------------------------------|
| Undeveloped Private | 3%                            | 4%                               | 4%                               | 9%                       | 7%                            |
| Rural               | 15%                           | 1%                               | 1%                               | 11%                      | 19%                           |
| Exurban             | 81%                           | 80%                              | 91%                              | 80%                      | 74%                           |
| Suburban            | 0.6%                          | 4%                               | 0.1%                             | 0.02%                    | -                             |
| Urban               | 0.3%                          | 11%                              | 3%                               | -                        | -                             |

Source: Theobald, D. 2005. Landscape patterns of exurban growth in the USA from 1980 to 2020. *Ecology and Society* 10(1): 32. [online] URL: <http://www.ecologyandsociety.org/vol10/iss1/art32/>

*Table 4-5: Brawley Wash – Los Robles Wash Watershed Housing Density 2030 (Percent of Watershed) (Part 2 of 2).*

| Housing Density     | Arivaca Creek<br>1505030401 | Brawley Wash – Los Robles Wash Watershed | Brawley Wash – Los Robles Wash Watershed (sq. miles) |
|---------------------|-----------------------------|------------------------------------------|------------------------------------------------------|
| Undeveloped Private | 6%                          | 5%                                       | 15                                                   |
| Rural               | 9%                          | 7%                                       | 19                                                   |
| Exurban             | 76%                         | 82%                                      | 236                                                  |
| Suburban            | 6%                          | 2%                                       | 5                                                    |
| Urban               | 3%                          | 4%                                       | 12                                                   |

*Source: Theobald, D. 2005. Landscape patterns of exurban growth in the USA from 1980 to 2020. Ecology and Society 10(1): 32. [online] URL: <http://www.ecologyandsociety.org/vol10/iss1/art32/>*



## Brawley Wash-Robles Wash Watershed Agricultural Statistics

Arizona is known as one of the most productive and efficient agricultural regions in the world, with beauty that also provides the food and fiber to sustain life in the desert. Arizona is also one of the most diverse agricultural producing states in the nation, producing more than 160 varieties of vegetables, livestock, field crops and nursery stock. The climate, natural resources, agribusiness infrastructure and farm heritage help make agriculture a \$9.2 billion dollar industry employing more than 72,000 individuals.

According to the United States Department of Agriculture's, 2002 Census, there are more than 7,000 farms and ranches, seventy-eight percent of which are owned by individuals or families. The total farmland in Arizona is comprised of more than 26,000,000 acres with irrigated crops on 1,280,000 acres and pasture for animals on 23,680,000.

Brawley Wash-Robles Wash Watershed is comprised of considerable grazing land for many livestock operations, a significant number of apiary (honey bee) operations, a mixed variety of crops, including cotton and alfalfa, several recreational equestrian facilities, a few equestrian breeding and training facilities, a number of dairy facilities, variety of vegetable growing operations, a few nursery facilities, miscellaneous plantings of fruit trees, including apples and peaches (Brill, 2008).

Most farms in the Brawley Wash-Robles Wash Watershed are fairly small.

Eighty-four percent of all farms in the watershed are less than 1,000 acres in size, and 54% are less than 50 acres (Table 4-6 and Figure 4-6). Of the 100 farms that have pasture and rangeland, 43% have 100 or more acres (Table 4-7 and Figure 4-7). Of the 413 farms that harvest crops, 83% are 49 acres or less in size (Table 4-8 and Figure 4-8).

The NASS (National Agricultural Statistics Service, United States Department of Agriculture) has farm data by zip code. We used the U.S. Census Bureau ZIP Census Tabulation Areas (ZCTA) to generate maps. A typical 5-digit ZCTA (there are 3-digit ZCTAs as well) is typically nearly identical to a 5-digit U.S. Postal Service ZIP code, but there are some distinctions. Unlike ZIP codes, ZCTA areas are spatially complete and they are easier to map. The Bureau created special `XX ZCTAs (ZCTAs with a valid 3-digit ZIP but with "XX" as last two characters of the code) which represent large unpopulated areas where it made no sense to assign a census block to an actual ZIP code. Similarly, HH ZCTAs represent large bodies of water within a 3-digit zip area. There is typically no population in either an XX or HH ZCTA.

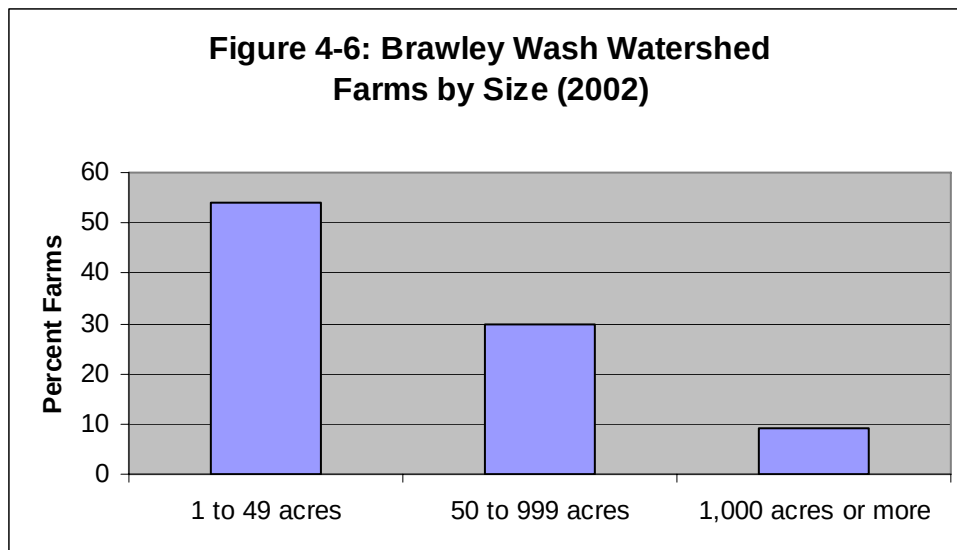
Data is withheld by NASS for categories with one to four farms. This is to protect the identity of individual farmers. Farm counts for these zip codes are included in the "State Total" category. Some categories only contained stars instead of numbers. Each star was counted as one farm. But because each star could represent as many as 4 farms, each number on the tables are actually greater than or equal to the number listed. In some cases this results in

percentages that add up to more or less than 100 percent.

Tables Include data from zip codes both contained within the watershed and zip codes crossing watershed boundaries. It is important to note that the figures in the tables include significant agricultural areas adjacent to but outside of the

watershed area along the Santa Cruz and the San Pedro Rivers and other nearby drainages.

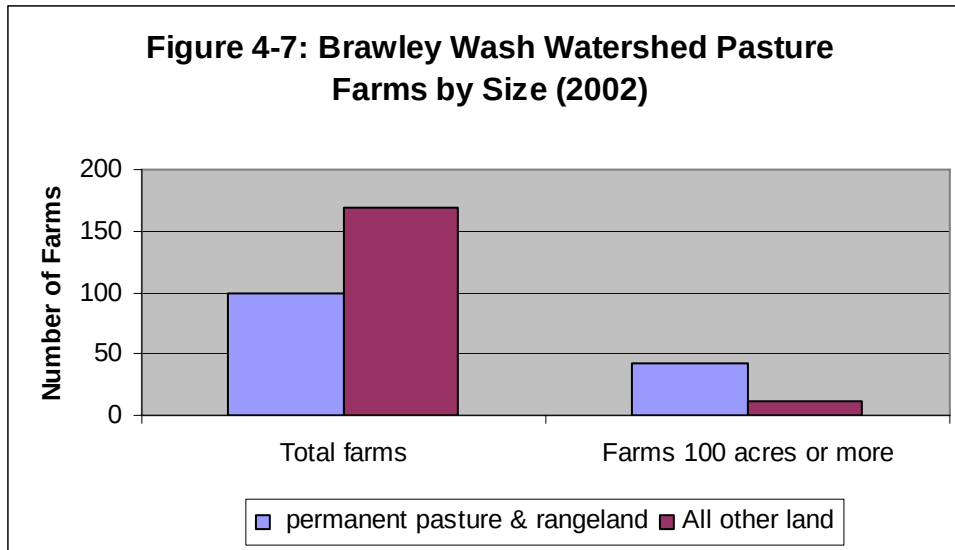
NASS assumes that when no agricultural information exists for a zip code, no agricultural activity takes place within that area.



*Table 4-6: Brawley Wash-Robles Wash Watershed Farms by Size*

| All farms | 1 to 49 acres | 50 to 999 acres | >1000 acres |
|-----------|---------------|-----------------|-------------|
| 523       | 54%           | 30%             | 9%          |

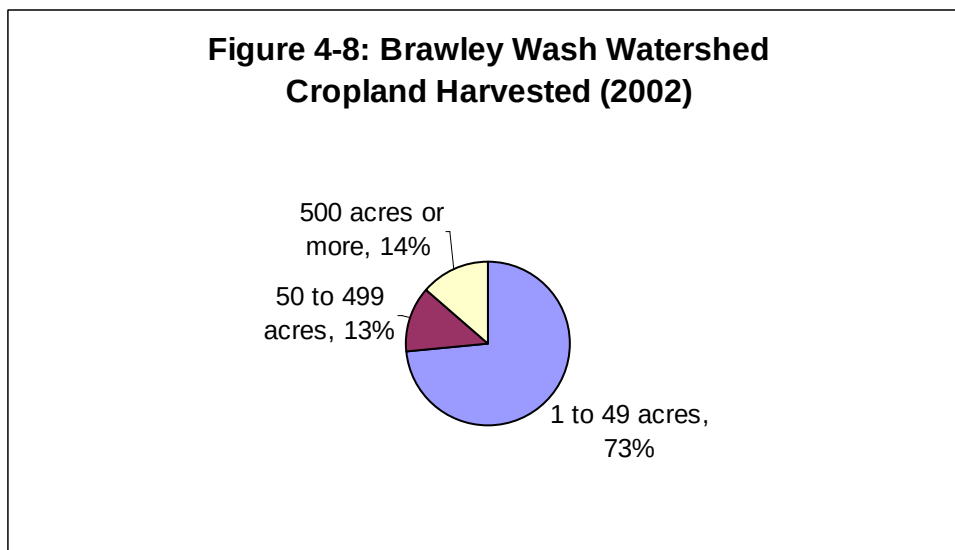
NASS defines A "farm" as an operation with at least \$1000 in agricultural sales from agriculture. Percents rounded. Data source: NASS (National Agricultural Statistics Service, United States Department of Agriculture)



**Table 4-7: Brawley Wash-Robles Wash Watershed Pasture and Rangeland (2002)**

| Category                        | Total farms | Farms 100 acres or more |
|---------------------------------|-------------|-------------------------|
| Permanent pasture and rangeland | 100         | 43%                     |
| All other land                  | 169         | 11%                     |

*Grazing lands are the USDA Pastureland, as defined by NASS, includes cropland used only for pasture or grazing, woodland pastured, and other pastureland and rangeland. Percents rounded. Data source: NASS (National Agricultural Statistics Service, United States Department of Agriculture)*



**Table 4-8: Brawley Wash-Robles Wash Watershed Cropland Harvested**

| Total farms | 1 to 49 acres | 50 to 999 acres | >1000 acres |
|-------------|---------------|-----------------|-------------|
| 80          | 75%           | 13%             | 14%         |

According to the NASS, "harvested cropland" includes all land from which crops were harvested including: cut hay; all land in orchards; citrus groves; and, nursery and greenhouse crops. Land from which two or more crops were harvested was counted only once even though there was more than one use of that land. Percents rounded. Data source: NASS (National Agricultural Statistics Service, United States Department of Agriculture)

## Section 5: Resource Assessment Tables

The following Resource Assessment Tables summarize current and desired future natural resource conditions for the Brawley Wash – Los Robles Wash Watershed. The tables present information on benchmark and future conservation systems and practices, qualitative effects on primary resource concerns, and estimated costs for conservation implementation. Conservation District board members, NRCS conservationists, and other people familiar with conservation work in the watershed were consulted for estimating current and future natural resource conditions.

The tables show three levels of conservation treatment (Baseline, Progressive, Resource Management System) for each of the major land uses (range and urban) within the watershed. **Baseline** is defined as a low level of conservation adoption with landowners who are typically not participating in conservation programs. There are, however, a few practices that have been commonly adopted by all landowners in this watershed. **Progressive** is defined as an intermediate level of conservation adoption with landowners who are actively participating in conservation programs and have adopted several practices but not satisfied all of the

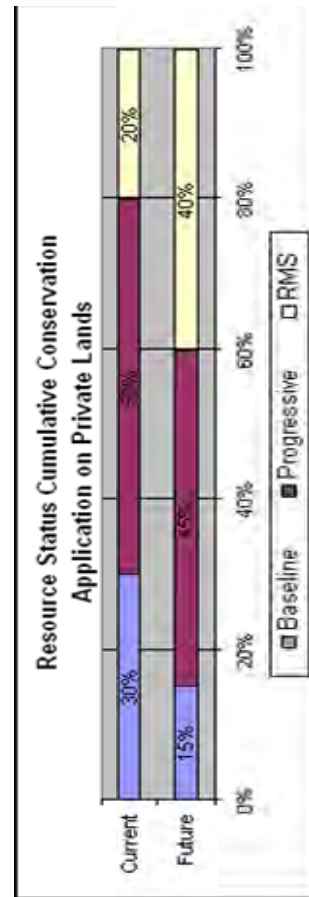
Quality Criteria in the NRCS Field Office Technical Guide. **Resource Management System** (RMS) is defined as a complete system of conservation practices that addresses all of the Soil, Water, Air, Plant, and Animal (SWAPA) resource concerns typically seen for this land use in this watershed.

For each land use, the results of the assessment are presented in two parts. Part 1 (Assessment Information) summarizes the conservation practices at each treatment level and the quantities of practices for current benchmark conditions and projected future conditions. Part 1 also displays the four primary resource concerns, along with individual practice effects and an overall Systems Rating (ranging from a low of 1 to a high of 5) indicating the effectiveness of the conservation system used at each treatment level. Part 2 (Conservation Cost Table) summarizes the installation, management, and related costs by conservation practice and treatment level for the projected future conditions by federal and private share of the costs. Part 2 also displays the benchmark and future conservation conditions status bars.

Credit goes to NRCS in Oregon for development of the template for these Resource Assessment Tables.

| WATERSHED NAME & CODE                                         |                                                               | BRAWLEY WASH - LOS ROBLES WASH - 15050304 |                     |             |                                           | LANDUSE ACRES                                            |                                                                 | 10,000                                           |   |
|---------------------------------------------------------------|---------------------------------------------------------------|-------------------------------------------|---------------------|-------------|-------------------------------------------|----------------------------------------------------------|-----------------------------------------------------------------|--------------------------------------------------|---|
| LANDUSE TYPE                                                  |                                                               | CROP                                      |                     |             |                                           | TYPICAL UNIT SIZE ACRES                                  |                                                                 | 500                                              |   |
| ASSESSMENT INFORMATION                                        |                                                               |                                           |                     |             |                                           | CALCULATED PARTICIPATION                                 |                                                                 | 34%                                              |   |
| Conservation Systems by Treatment Level                       | Benchmark Conditions                                          | Future Conditions                         |                     |             | RESOURCE CONCERNS                         |                                                          |                                                                 |                                                  |   |
|                                                               |                                                               | Existing Unchanged Units                  | New Treatment Units | Total Units | Soil Condition – Organic Matter Depletion | Water Quantity – Inefficient Water Use on Irrigated Land | Water Quality – Excessive Nutrients and Organics in Groundwater | Plant Condition – Productivity, Health and Vigor |   |
|                                                               | Total Units                                                   |                                           |                     |             |                                           |                                                          |                                                                 |                                                  |   |
|                                                               | System Rating ->                                              |                                           |                     |             |                                           |                                                          |                                                                 |                                                  |   |
|                                                               |                                                               | 750                                       | 375                 | 0           | 375                                       | 1                                                        | 5                                                               | 3                                                | 1 |
|                                                               | Irrigation Land Leveling (ac.) 464                            |                                           |                     |             |                                           |                                                          |                                                                 |                                                  |   |
|                                                               | Irrigation Water Conveyance, Ditch and Canal Lining (ft.) 428 | 6,000                                     | 3,000               | 0           | 3,000                                     | 1                                                        | 5                                                               | 3                                                | 1 |
|                                                               | Irrigation Water Conveyance, Pipeline (ft.) 430               | 3,000                                     | 1,500               | 0           | 1,500                                     | 1                                                        | 5                                                               | 3                                                | 1 |
|                                                               | Total Acreage at Baseline                                     | 3,000                                     | 1,500               | 0           | 1,500                                     |                                                          |                                                                 |                                                  |   |
|                                                               | System Rating ->                                              |                                           |                     |             |                                           |                                                          |                                                                 |                                                  |   |
| Progressive                                                   |                                                               |                                           |                     |             |                                           |                                                          |                                                                 |                                                  |   |
| Conservation Crop Rotation (ac.) 328                          | 2,500                                                         | 1,875                                     | 375                 | 2,250       | 5                                         | 1                                                        | 3                                                               | 5                                                |   |
| Irrigation Land Leveling (ac.) 464                            | 2,500                                                         | 2,063                                     | 188                 | 2,250       | 1                                         | 5                                                        | 3                                                               | 1                                                |   |
| Irrigation Water Conveyance, Ditch and Canal Lining (ft.) 428 | 20,000                                                        | 16,500                                    | 1,500               | 18,000      | 1                                         | 5                                                        | 3                                                               | 1                                                |   |
| Irrigation Water Conveyance, Pipeline (ft.) 430               | 10,000                                                        | 8,250                                     | 750                 | 9,000       | 1                                         | 5                                                        | 3                                                               | 1                                                |   |
| Irrigation Water Management (ac.) 449                         | 2,500                                                         | 1,875                                     | 375                 | 2,250       | 1                                         | 5                                                        | 5                                                               | 3                                                |   |
| Total Acreage at Progressive Level                            | 5,000                                                         | 3,750                                     | 750                 | 4,500       |                                           |                                                          |                                                                 |                                                  |   |
| System Rating ->                                              |                                                               |                                           |                     |             |                                           |                                                          |                                                                 |                                                  |   |
| RMS                                                           |                                                               |                                           |                     |             |                                           |                                                          |                                                                 |                                                  |   |
| Conservation Crop Rotation (ac.) 328                          | 2,000                                                         | 2,625                                     | 1,375               | 4,000       | 5                                         | 1                                                        | 3                                                               | 5                                                |   |
| Irrigation Land Leveling (ac.) 464                            | 2,000                                                         | 2,813                                     | 1,188               | 4,000       | 1                                         | 5                                                        | 3                                                               | 1                                                |   |
| Irrigation Water Conveyance, Ditch and Canal Lining (ft.) 428 | 20,000                                                        | 26,500                                    | 13,500              | 40,000      | 1                                         | 5                                                        | 3                                                               | 1                                                |   |
| Irrigation Water Conveyance, Pipeline (ft.) 430               | 8,000                                                         | 11,250                                    | 4,750               | 16,000      | 1                                         | 5                                                        | 3                                                               | 1                                                |   |
| Irrigation Water Management (ac.) 449                         | 2,000                                                         | 2,625                                     | 1,375               | 4,000       | 1                                         | 5                                                        | 5                                                               | 3                                                |   |
| Nutrient Management (ac.) 590                                 | 2,000                                                         | 2,000                                     | 2,000               | 4,000       | 1                                         | 1                                                        | 5                                                               | 5                                                |   |
| Pest Management (ac.) 595                                     | 2,000                                                         | 2,000                                     | 2,000               | 4,000       | 1                                         | 1                                                        | 3                                                               | 3                                                |   |
| Residue Management, Seasonal (ac.) 344                        | 2,000                                                         | 2,000                                     | 2,000               | 4,000       | 5                                         | 1                                                        | 3                                                               | 5                                                |   |
| Total Acreage at RMS Level                                    | 2,000                                                         | 2,000                                     | 2,000               | 4,000       |                                           |                                                          |                                                                 |                                                  |   |

| WATERSHED NAME & CODE                                         |  | BRAWLEY WASH - LOS ROBLES WASH - 15050304 |                       |                              |                          | LANDUSE ACRES            |                       | 10,000                        |
|---------------------------------------------------------------|--|-------------------------------------------|-----------------------|------------------------------|--------------------------|--------------------------|-----------------------|-------------------------------|
| LANDUSE TYPE                                                  |  | CROP                                      |                       |                              |                          | TYPICAL UNIT SIZE ACRES  |                       | 500                           |
| CONSERVATION COST TABLE                                       |  |                                           |                       |                              |                          | CALCULATED PARTICIPATION |                       | 34%                           |
| Conservation Systems by Treatment Level                       |  | FUTURE                                    |                       | FEDERAL                      |                          | PRIVATE                  |                       |                               |
|                                                               |  | New Treatment Units                       | Installation Cost 50% | Management Cost - 3 yrs 100% | Technical Assistance 20% | Total Present Value Cost | Installation Cost 50% | Annual O & M + Mgt Costs 100% |
|                                                               |  |                                           |                       |                              |                          |                          |                       |                               |
|                                                               |  |                                           |                       |                              |                          |                          |                       |                               |
|                                                               |  |                                           |                       |                              |                          |                          |                       |                               |
| Progressive                                                   |  |                                           |                       |                              |                          |                          |                       |                               |
| Conservation Crop Rotation (ac.) 328                          |  | 375                                       | \$0                   | \$11,250                     | \$2,250                  | \$12,274                 | \$0                   | \$3,750                       |
| Irrigation Land Leveling (ac.) 464                            |  | 188                                       | \$93,750              | \$0                          | \$18,750                 | \$112,500                | \$93,750              | \$5,625                       |
| Irrigation Water Conveyance, Ditch and Canal Lining (ft.) 428 |  | 1,500                                     | \$6,000               | \$0                          | \$1,200                  | \$7,200                  | \$6,000               | \$240                         |
| Irrigation Water Conveyance, Pipeline (ft.) 430               |  | 750                                       | \$3,750               | \$0                          | \$750                    | \$4,500                  | \$3,750               | \$150                         |
| Irrigation Water Management (ac.) 449                         |  | 375                                       | \$0                   | \$11,250                     | \$2,250                  | \$12,274                 | \$0                   | \$3,750                       |
| Subtotal                                                      |  | 750                                       | \$103,500             | \$22,500                     | \$25,200                 | \$148,748                | \$103,500             | \$13,515                      |
| RMS                                                           |  |                                           |                       |                              |                          |                          |                       |                               |
| Conservation Crop Rotation (ac.) 328                          |  | 1,375                                     | \$0                   | \$41,250                     | \$8,250                  | \$45,004                 | \$0                   | \$13,750                      |
| Irrigation Land Leveling (ac.) 464                            |  | 1,188                                     | \$593,750             | \$0                          | \$118,750                | \$712,500                | \$593,750             | \$35,625                      |
| Irrigation Water Conveyance, Ditch and Canal Lining (ft.) 428 |  | 13,500                                    | \$54,000              | \$0                          | \$10,800                 | \$64,800                 | \$54,000              | \$2,160                       |
| Irrigation Water Conveyance, Pipeline (ft.) 430               |  | 4,750                                     | \$23,750              | \$0                          | \$4,750                  | \$28,500                 | \$23,750              | \$950                         |
| Irrigation Water Management (ac.) 449                         |  | 1,375                                     | \$0                   | \$41,250                     | \$8,250                  | \$45,004                 | \$0                   | \$13,750                      |
| Nutrient Management (ac.) 590                                 |  | 2,000                                     | \$0                   | \$60,000                     | \$12,000                 | \$65,460                 | \$0                   | \$20,000                      |
| Pest Management (ac.) 595                                     |  | 2,000                                     | \$0                   | \$60,000                     | \$12,000                 | \$65,460                 | \$0                   | \$20,000                      |
| Residue Management, Seasonal (ac.) 344                        |  | 2,000                                     | \$0                   | \$36,000                     | \$7,200                  | \$39,276                 | \$0                   | \$12,000                      |
| Subtotal                                                      |  | 2,000                                     | \$671,500             | \$238,500                    | \$182,000                | \$1,066,004              | \$671,500             | \$118,235                     |
| Grand Total                                                   |  | 2,750                                     | \$775,000             | \$261,000                    | \$207,200                | \$1,214,752              | \$775,000             | \$131,750                     |
|                                                               |  |                                           |                       |                              |                          |                          |                       | \$1,097,427                   |

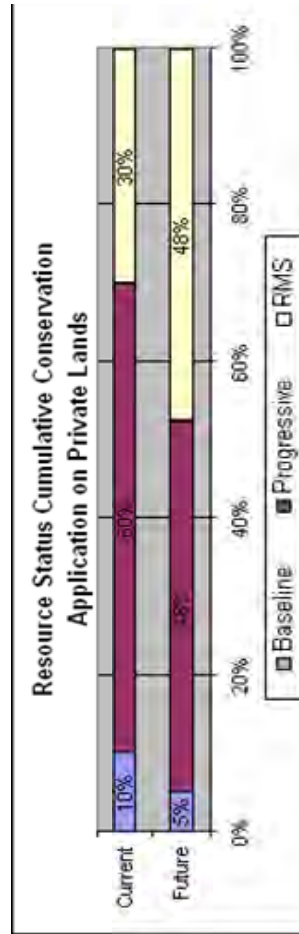


| Chart Refers To               |      |
|-------------------------------|------|
| Landuse Type                  | CROP |
| Calculated Participation Rate | 34%  |

| Average PV Costs per Ac |          |
|-------------------------|----------|
| System                  | Private  |
| Prog                    | \$187.18 |
| RMS                     | \$478.52 |

| WATERSHED NAME & CODE                        |                    | BRAWLEY WASH - LOS ROBLES WASH - 15050304 |                          |                     |             | LANDUSE ACRES                 |                                                                             | 838,000                                          |                                                                         |
|----------------------------------------------|--------------------|-------------------------------------------|--------------------------|---------------------|-------------|-------------------------------|-----------------------------------------------------------------------------|--------------------------------------------------|-------------------------------------------------------------------------|
| LANDUSE TYPE                                 |                    | RANGE                                     |                          |                     |             | TYPICAL UNIT SIZE ACRES       |                                                                             | 50,000                                           |                                                                         |
| ASSESSMENT INFORMATION                       |                    |                                           |                          |                     |             | CALCULATED PARTICIPATION      |                                                                             | 29%                                              |                                                                         |
| Conservation Systems by Treatment Level      |                    | Benchmark Conditions                      | Future Conditions        |                     |             | RESOURCE CONCERNS             |                                                                             |                                                  |                                                                         |
|                                              |                    | Total Units                               | Existing Unchanged Units | New Treatment Units | Total Units | Soil Erosion – Sheet and Rill | Water Quality – Excessive Suspended Sediment and Turbidity in Surface Water | Plant Condition – Productivity, Health and Vigor | Domestic Animals – Inadequate Quantities and Quality of Feed and Forage |
|                                              |                    |                                           |                          |                     |             |                               |                                                                             |                                                  |                                                                         |
|                                              | Baseline           | System Rating ->                          |                          |                     |             | 2                             | 2                                                                           | 2                                                | 4                                                                       |
|                                              | Fence (ft.) 382    | 8,380                                     | 4,190                    | 0                   | 4,190       | 3                             | 3                                                                           | 3                                                | 5                                                                       |
|                                              | Pipeline (ft.) 516 | 8,380                                     | 4,190                    | 0                   | 4,190       | 3                             | 3                                                                           | 3                                                | 5                                                                       |
| Total Acreage at Baseline                    |                    | 83,800                                    | 41,900                   | 0                   | 41,900      |                               |                                                                             |                                                  |                                                                         |
|                                              |                    |                                           |                          |                     |             |                               |                                                                             |                                                  |                                                                         |
| Progressive                                  | System Rating ->   |                                           |                          |                     | 4           | 4                             | 4                                                                           | 5                                                | 5                                                                       |
| Fence (ft.) 382                              | 251,400            | 190,645                                   | 8,380                    | 199,025             | 3           | 3                             | 3                                                                           | 5                                                | 5                                                                       |
| Pipeline (ft.) 516                           | 251,400            | 190,645                                   | 8,380                    | 199,025             | 3           | 3                             | 3                                                                           | 5                                                | 5                                                                       |
| Prescribed Grazing (ac.) 528                 | 251,400            | 188,550                                   | 10,475                   | 199,025             | 5           | 5                             | 5                                                                           | 5                                                | 5                                                                       |
| Total Acreage at Progressive Level           |                    | 502,800                                   | 377,100                  | 20,950              | 398,050     |                               |                                                                             |                                                  |                                                                         |
|                                              |                    |                                           |                          |                     |             |                               |                                                                             |                                                  |                                                                         |
| RMS                                          | System Rating ->   |                                           |                          |                     | 5           | 5                             | 5                                                                           | 5                                                | 5                                                                       |
| Fence (ft.) 382                              | 251,400            | 316,345                                   | 81,705                   | 398,050             | 3           | 3                             | 3                                                                           | 5                                                | 5                                                                       |
| Pipeline (ft.) 516                           | 251,400            | 316,345                                   | 81,705                   | 398,050             | 3           | 3                             | 3                                                                           | 5                                                | 5                                                                       |
| Prescribed Grazing (ac.) 528                 | 251,400            | 314,250                                   | 83,800                   | 398,050             | 5           | 5                             | 5                                                                           | 5                                                | 5                                                                       |
| Upland Wildlife Habitat Management (ac.) 645 | 25,140             | 25,140                                    | 14,665                   | 39,805              | 5           | 5                             | 5                                                                           | 5                                                | 3                                                                       |
| Total Acreage at RMS Level                   |                    | 251,400                                   | 251,400                  | 146,650             | 398,050     |                               |                                                                             |                                                  |                                                                         |

| WATERSHED NAME & CODE                        |             | BRAWLEY WASH - LOS ROBLES WASH - 15050304 |                       |                              |                          | LANDUSE ACRES            |                       | 838,000                       |
|----------------------------------------------|-------------|-------------------------------------------|-----------------------|------------------------------|--------------------------|--------------------------|-----------------------|-------------------------------|
| LANDUSE TYPE                                 |             | RANGE                                     |                       |                              |                          | TYPICAL UNIT SIZE ACRES  |                       | 50,000                        |
| CONSERVATION COST TABLE                      |             |                                           |                       |                              |                          | CALCULATED PARTICIPATION |                       | 29%                           |
| Conservation Systems by Treatment Level      |             | FUTURE                                    | FEDERAL               |                              |                          | PRIVATE                  |                       |                               |
|                                              |             | New Treatment Units                       | Installation Cost 50% | Management Cost - 3 yrs 100% | Technical Assistance 20% | Total Present Value Cost | Installation Cost 50% | Annual O & M + Mgt Costs 100% |
|                                              |             |                                           |                       |                              |                          |                          |                       |                               |
|                                              |             |                                           |                       |                              |                          |                          |                       |                               |
|                                              |             |                                           |                       |                              |                          |                          |                       |                               |
| Progressive                                  |             |                                           |                       |                              |                          |                          |                       |                               |
| Fence (ft.) 382                              |             | 8,380                                     | \$12,570              | \$0                          | \$2,514                  | \$15,084                 | \$12,570              | \$503                         |
| Pipeline (ft.) 516                           |             | 8,380                                     | \$33,520              | \$0                          | \$6,704                  | \$40,224                 | \$33,520              | \$1,341                       |
| Prescribed Grazing (ac.) 528                 |             | 10,475                                    | \$7,856               | \$0                          | \$1,571                  | \$9,428                  | \$7,856               | \$0                           |
|                                              | Subtotal    | 20,950                                    | \$53,946              | \$0                          | \$10,789                 | \$64,736                 | \$53,946              | \$1,844                       |
|                                              |             |                                           |                       |                              |                          |                          |                       |                               |
| RMS                                          |             |                                           |                       |                              |                          |                          |                       |                               |
| Fence (ft.) 382                              |             | 81,705                                    | \$122,558             | \$0                          | \$24,512                 | \$147,069                | \$122,558             | \$4,902                       |
| Pipeline (ft.) 516                           |             | 81,705                                    | \$326,820             | \$0                          | \$65,364                 | \$392,184                | \$326,820             | \$13,073                      |
| Prescribed Grazing (ac.) 528                 |             | 83,800                                    | \$62,850              | \$0                          | \$12,570                 | \$75,420                 | \$62,850              | \$0                           |
| Upland Wildlife Habitat Management (ac.) 645 |             | 14,665                                    | \$0                   | \$57,194                     | \$11,439                 | \$62,398                 | \$0                   | \$19,065                      |
|                                              | Subtotal    | 146,650                                   | \$512,228             | \$57,194                     | \$113,884                | \$677,071                | \$512,228             | \$37,040                      |
|                                              | Grand Total | 167,600                                   | \$566,174             | \$57,194                     | \$124,673                | \$741,807                | \$566,174             | \$38,883                      |
|                                              |             |                                           |                       |                              |                          |                          |                       | \$617,292                     |
|                                              |             |                                           |                       |                              |                          |                          |                       | \$679,004                     |



| Chart Refers To               |       |
|-------------------------------|-------|
| Landuse Type                  | RANGE |
| Calculated Participation Rate | 29%   |

| Average PV Costs per Ac |         |         |
|-------------------------|---------|---------|
| System                  | Federal | Private |
| Prog                    | \$3.09  | \$2.95  |
| RMS                     | \$4.62  | \$4.21  |



| WATERSHED NAME & CODE                                         |                      | BRAWLEY WASH - LOS ROBLES WASH - 15050304 |                     |             |                                           | LANDUSE ACRES                                            |                                                                 | 33,000                                                                        |
|---------------------------------------------------------------|----------------------|-------------------------------------------|---------------------|-------------|-------------------------------------------|----------------------------------------------------------|-----------------------------------------------------------------|-------------------------------------------------------------------------------|
| LANDUSE TYPE                                                  |                      | URBAN                                     |                     |             |                                           | TYPICAL UNIT SIZE ACRES                                  |                                                                 | 10                                                                            |
| ASSESSMENT INFORMATION                                        |                      |                                           |                     |             |                                           | CALCULATED PARTICIPATION                                 |                                                                 | 10%                                                                           |
| Conservation Systems by Treatment Level                       | Benchmark Conditions | Future Conditions                         |                     |             | RESOURCE CONCERNS                         |                                                          |                                                                 |                                                                               |
|                                                               | Total Units          | Existing Unchanged Units                  | New Treatment Units | Total Units | Soil Condition – Organic Matter Depletion | Water Quantity – Inefficient Water Use on Irrigated Land | Water Quality – Excessive Nutrients and Organics in Groundwater | Air Quality – Particulate matter less than 10 micrometers in diameter (PM 10) |
|                                                               |                      |                                           |                     |             |                                           |                                                          |                                                                 |                                                                               |
|                                                               |                      |                                           |                     |             |                                           |                                                          |                                                                 |                                                                               |
|                                                               |                      |                                           |                     |             |                                           |                                                          |                                                                 |                                                                               |
| Baseline                                                      |                      | System Rating ->                          |                     |             |                                           |                                                          |                                                                 |                                                                               |
| No Conservation Practices being applied at this level         |                      | 0                                         | 0                   | 0           | 0                                         | 0                                                        | 0                                                               | 0                                                                             |
| Total Acreage at Baseline                                     |                      | 29,700                                    | 26,730              | 0           | 26,730                                    |                                                          |                                                                 |                                                                               |
| Progressive                                                   |                      | System Rating ->                          |                     |             |                                           |                                                          |                                                                 |                                                                               |
| Irrigation Water Conveyance, Ditch and Canal Lining (ft.) 428 |                      | 82,500                                    | 74,250              | 74,250      | 148,500                                   | 1                                                        | 5                                                               | 3                                                                             |
| Irrigation Water Conveyance, Pipeline (ft.) 430               |                      | 82,500                                    | 74,250              | 74,250      | 148,500                                   | 1                                                        | 5                                                               | 3                                                                             |
| Total Acreage at Progressive Level                            |                      | 3,300                                     | 2,970               | 2,970       | 5,940                                     |                                                          |                                                                 |                                                                               |
| RMS                                                           |                      | System Rating ->                          |                     |             |                                           |                                                          |                                                                 |                                                                               |
| Irrigation Land Leveling (ac.) 464                            |                      | 0                                         | 0                   | 330         | 330                                       | 1                                                        | 5                                                               | 3                                                                             |
| Irrigation Water Conveyance, Ditch and Canal Lining (ft.) 428 |                      | 0                                         | 8,250               | 8,250       | 16,500                                    | 1                                                        | 5                                                               | 3                                                                             |
| Irrigation Water Conveyance, Pipeline (ft.) 430               |                      | 0                                         | 8,250               | 8,250       | 16,500                                    | 1                                                        | 5                                                               | 3                                                                             |
| Irrigation Water Management (ac.) 449                         |                      | 0                                         | 0                   | 330         | 330                                       | 1                                                        | 5                                                               | 5                                                                             |
| Nutrient Management (ac.) 590                                 |                      | 0                                         | 0                   | 330         | 330                                       | 1                                                        | 1                                                               | 5                                                                             |
| Pest Management (ac.) 595                                     |                      | 0                                         | 0                   | 330         | 330                                       | 1                                                        | 1                                                               | 3                                                                             |
| Total Acreage at RMS Level                                    |                      | 0                                         | 0                   | 330         | 330                                       |                                                          |                                                                 |                                                                               |



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## GLOSSARY

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Drainage Basin</b>           | A region or area bounded by a topographic divide and occupied by a drainage system, also known as a watershed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Drought</b>                  | There is no universally accepted quantitative definition of drought. Generally, the term is applied to periods of less than average precipitation over a certain period of time; nature's failure to fulfill the water wants and needs of man.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Flood</b>                    | A flood is an overflow or inundation that comes from a river or other body of water and causes or threatens damage. It can be any relatively high streamflow overtopping the natural or artificial banks in any reach of a stream. It is also a relatively high flow as measured by either gage height or discharge quantity.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Ground Water</b>             | The supply of fresh and saline water found beneath the Earth's surface which is often used for supplying wells and springs. Because ground water is a major source of drinking water, there is a growing concern over areas where leaching agricultural or industrial pollutants are contaminating ground water.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Soil Moisture Regimes</b>    | <p><b>Aridic</b> is a soil moisture regime that has no water available for plants for more than half the cumulative time that the soil temperature at 50 cm (20 in.) below the surface is &gt;5°C (41° F.), and has no period as long as 90 consecutive days when there is water for plants while the soil temperature at 50 cm (20 in.) is continuously &gt;8°C (46°F.).</p> <p><b>Udic</b> is a soil moisture regime that is neither dry for as long as 90 cumulative days nor for as long as 60 consecutive days in the 90 days following the summer solstice at periods when the soil temperature at 50 cm (20 in.) below the surface is above 5°C (41° F.).</p> <p><b>Ustic</b> is a soil moisture regime that is intermediate between the aridic and udic regimes and common in temperate subhumid or semiarid regions, or in tropical and subtropical regions with a monsoon climate. A limited amount of water is available for plants but occurs at times when the soil temperature is optimum for plant growth.</p> |
| <b>Soil Orders</b>              | A soil order is a group of soils in the broadest category. In the current USDA classification scheme there are 12 orders, differentiated by the presence or absence of diagnostic horizons.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Soil Temperature Regimes</b> | <p><b>Hyperthermic</b> is a soil temperature regime that has mean annual soil temperatures of 22°C (72°F.) or more and &gt;5°C (41° F.) difference between mean summer and mean winter soil temperatures at 50 cm (20 in.) below the surface.</p> <p><b>Thermic</b> is a soil temperature regime that has mean annual soil temperatures of 15°C (59°F.) or more but &lt;22°C (72°F.), and &gt;5°C (41° F.) difference between mean summer and mean winter soil temperatures at 50 cm (20 in.) below the surface.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |



|                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                      | <b>Mesic</b> A soil temperature regime that has mean annual soil temperatures of 8°C (46°F.) or more but <15°C (59°F.), and >5°C (41° F.) difference between mean summer and mean winter soil temperatures at 50 cm (20 in.) below the surface.                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Surface Water</b> | Water on the earth's surface. Lakes, bays, ponds, impounding reservoirs, springs, rivers, streams, creeks, estuaries, wetlands, marshes, inlets, canals, and all other bodies of surface water, natural or artificial, inland or coastal, fresh or salt, navigable or non-navigable, and including the beds and banks of all watercourses and bodies of surface water, that are wholly or partially inside or bordering the state or subject to the jurisdiction of the state; except that waters in treatment systems which are authorized by state or federal law, regulation, or permit, and which are created for the purpose of waste treatment. |
| <b>Watershed</b>     | The area of land that contributes surface run-off to a given point in a drainage system and delineated by topographic divides.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

## **Acknowledgements**

The following University of Arizona staff and students contributed to the production of this report.

Terry Sprouse  
Erin Westfall  
Lainie Levick  
Cassie Holmgren  
Ariel Fisher  
Melisa Kennedy

NRCS Field Office, Area Office and State Office staff contributed to the development of this assessment.

Figure 1-1: Brawley Wash - Los Robles Wash Watershed Location Map

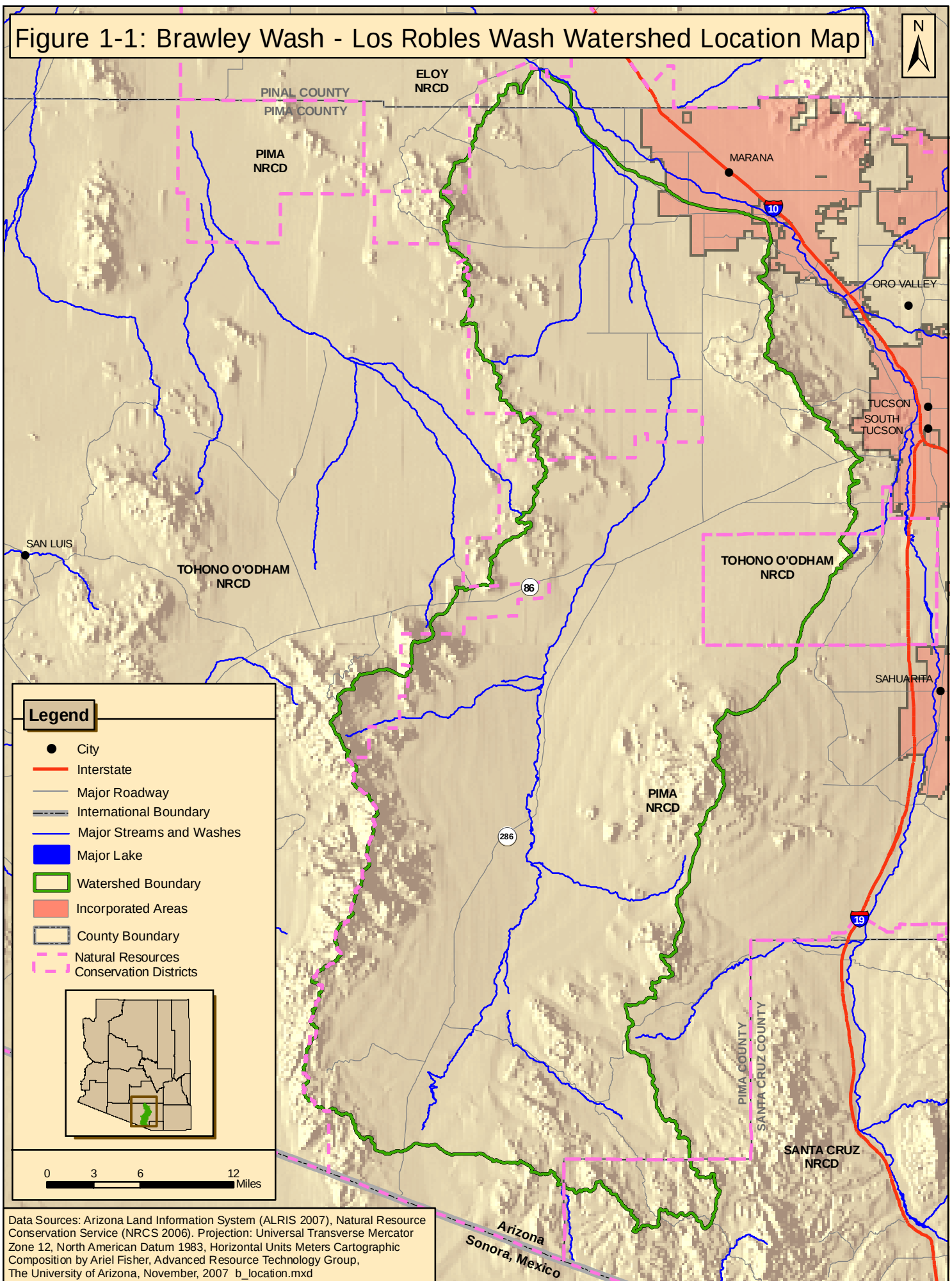


Figure 2-1: Brawley Wash - Los Robles Wash Watershed 10 Digit HUCs

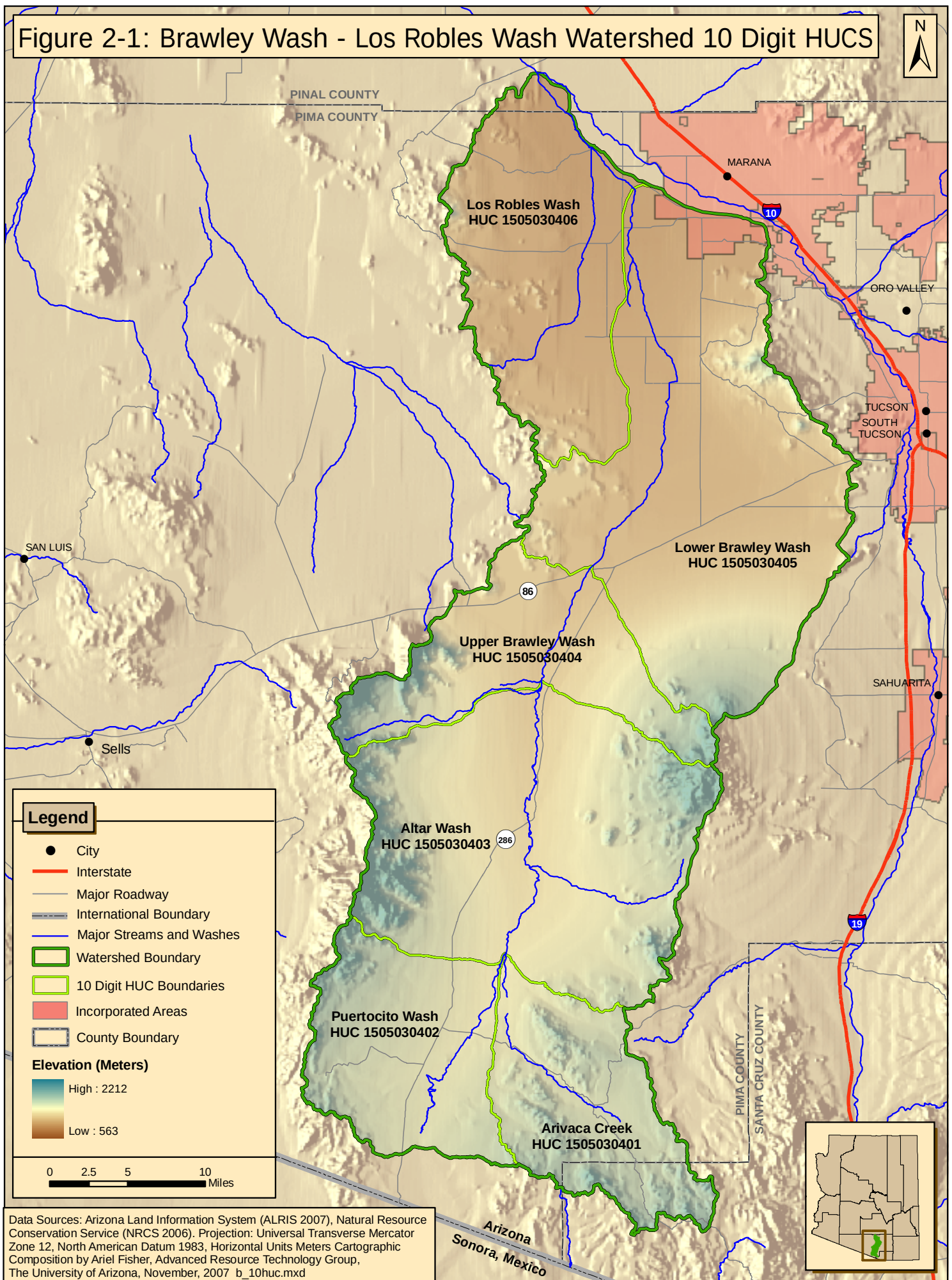




Figure 2-2: Brawley Wash - Los Robles Wash Watershed Geology

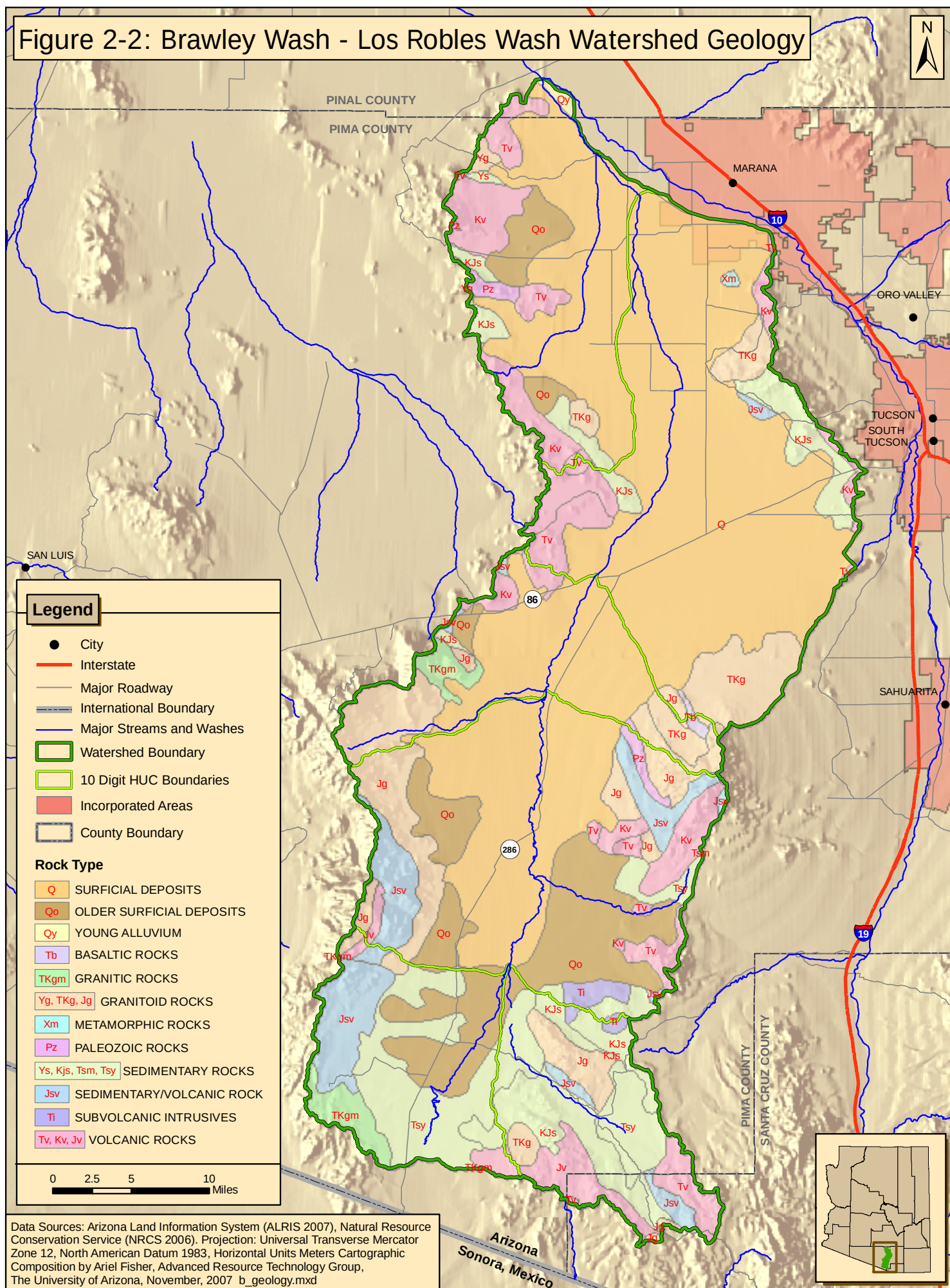


Figure 2-3: Brawley Wash - Los Robles Wash Watershed Common Resource Areas

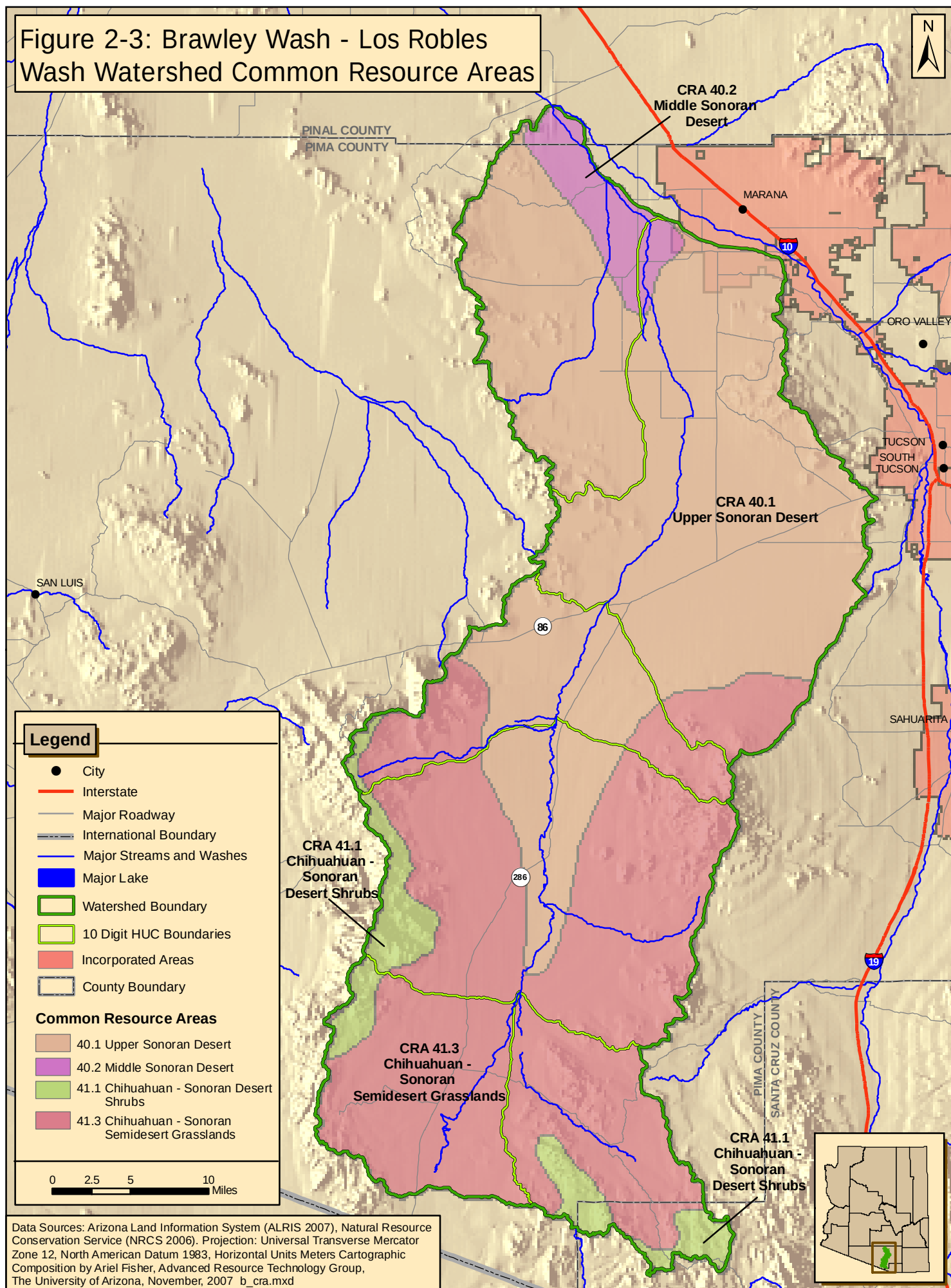


Figure 2-4: Brawley Wash - Los Robles Wash Watershed Slope Classifications

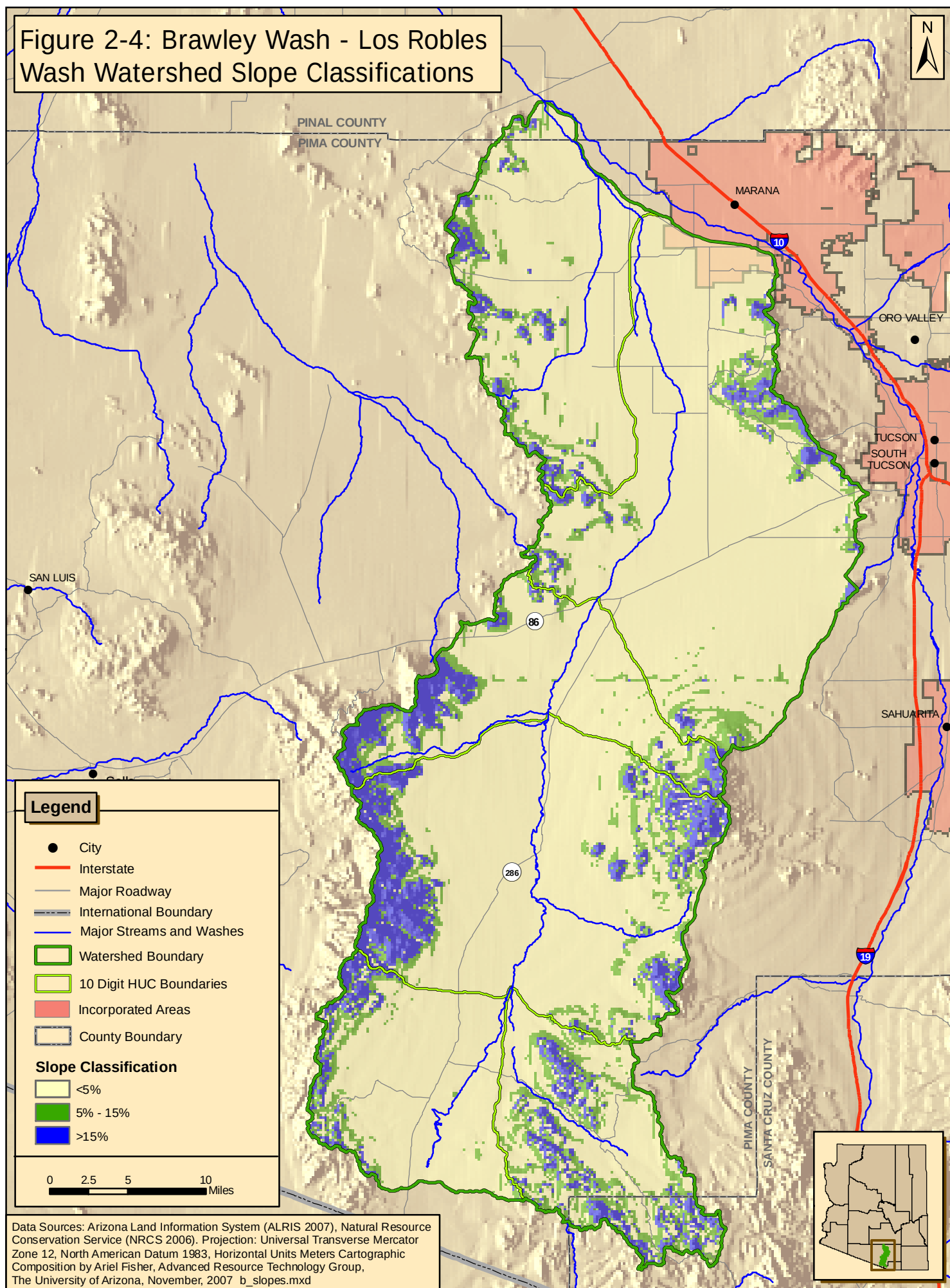
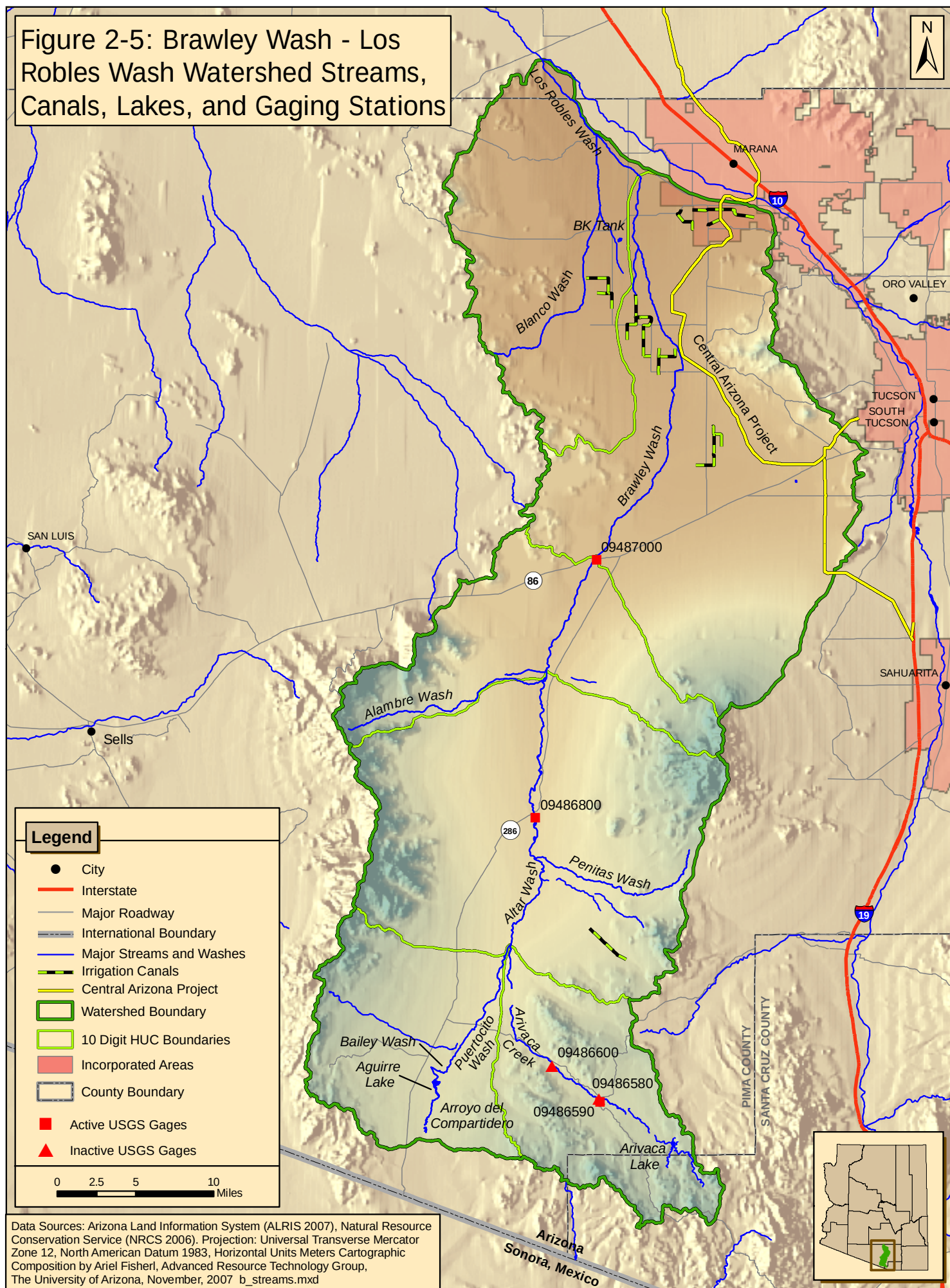




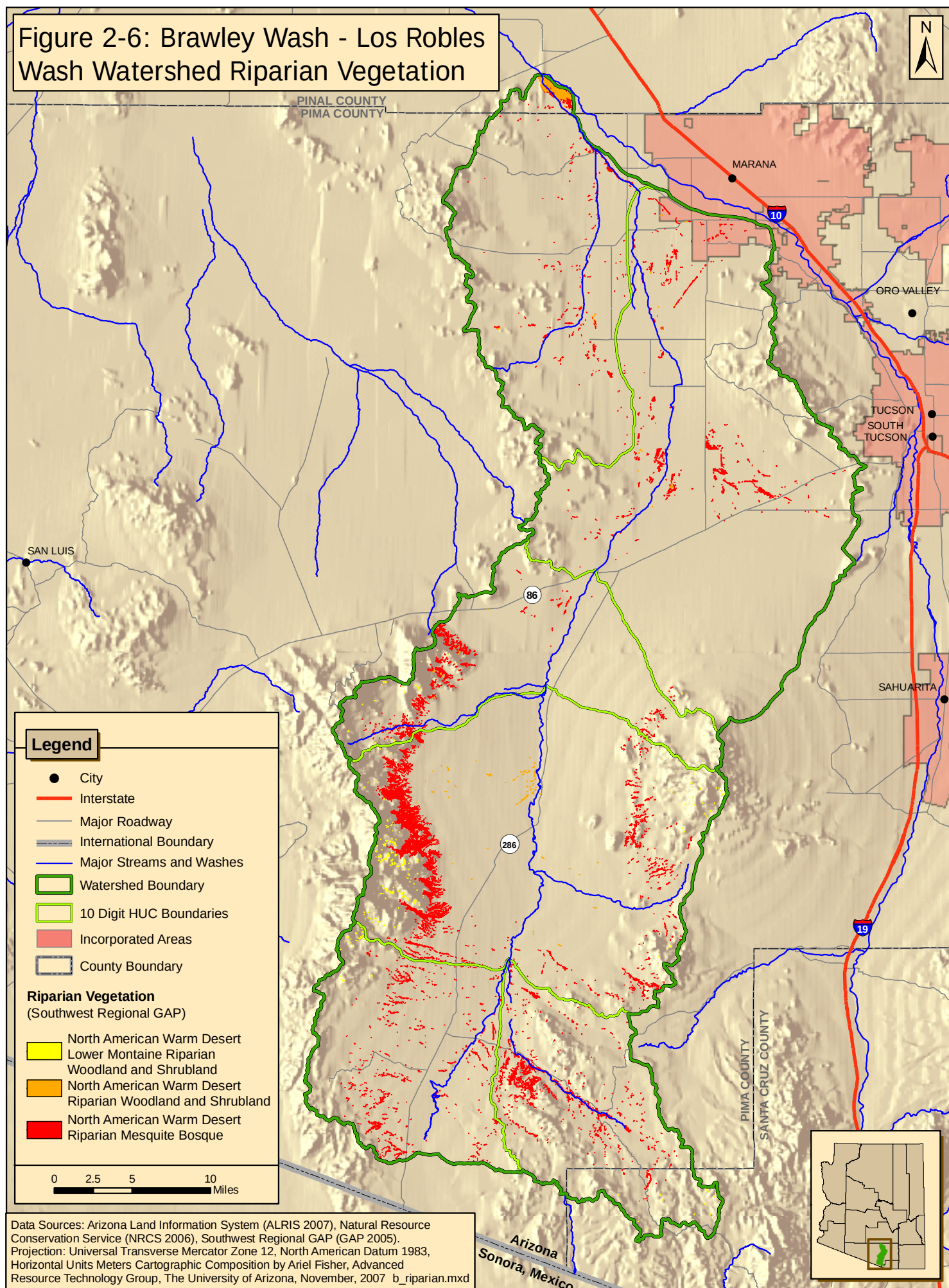
Figure 2-5: Brawley Wash - Los Robles Wash Watershed Streams, Canals, Lakes, and Gaging Stations



Data Sources: Arizona Land Information System (ALRIS 2007), Natural Resource Conservation Service (NRCS 2006). Projection: Universal Transverse Mercator Zone 12, North American Datum 1983, Horizontal Units Meters Cartographic Composition by Ariel Fisher, Advanced Resource Technology Group, The University of Arizona, November, 2007 b\_streams.mxd

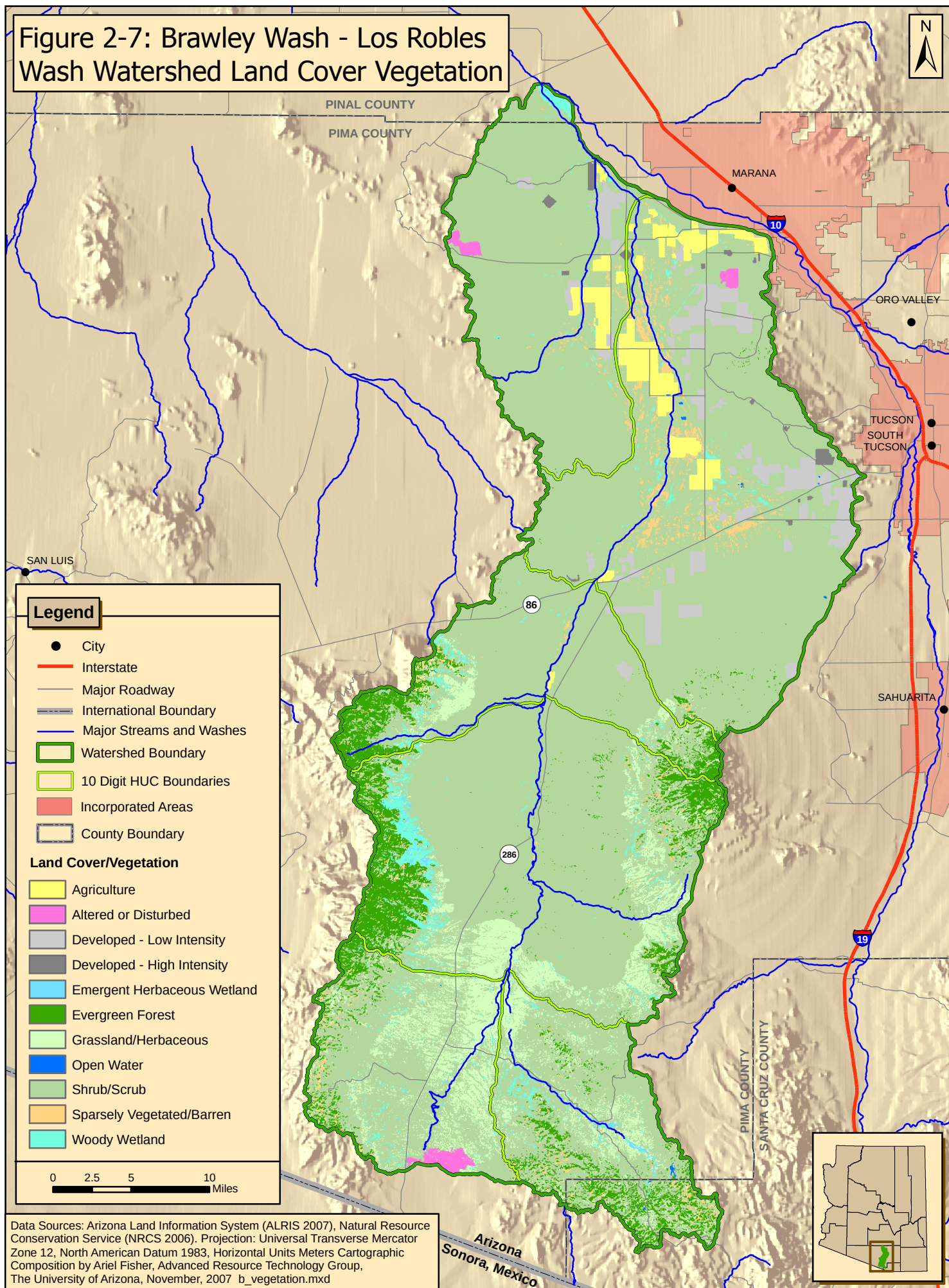


Figure 2-6: Brawley Wash - Los Robles Wash Watershed Riparian Vegetation





**Figure 2-7: Brawley Wash - Los Robles Wash Watershed Land Cover Vegetation**





**Figure 2-8: Brawley Wash -  
Los Robles Wash Watershed  
Average Annual Precipitation  
and Meteorological Stations**

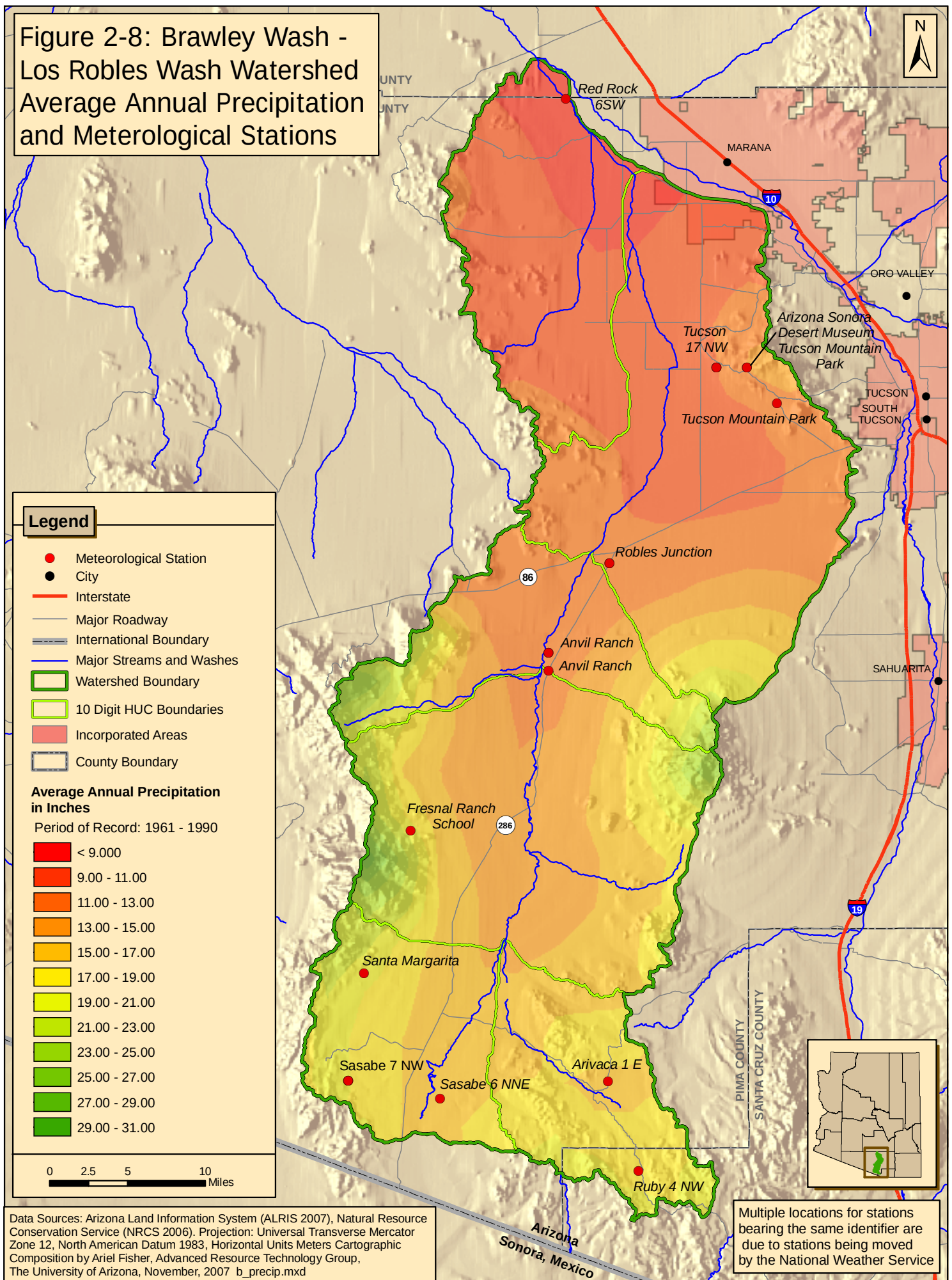


Figure 2-9: Brawley Wash - Los Robles Wash Watershed Land Ownership

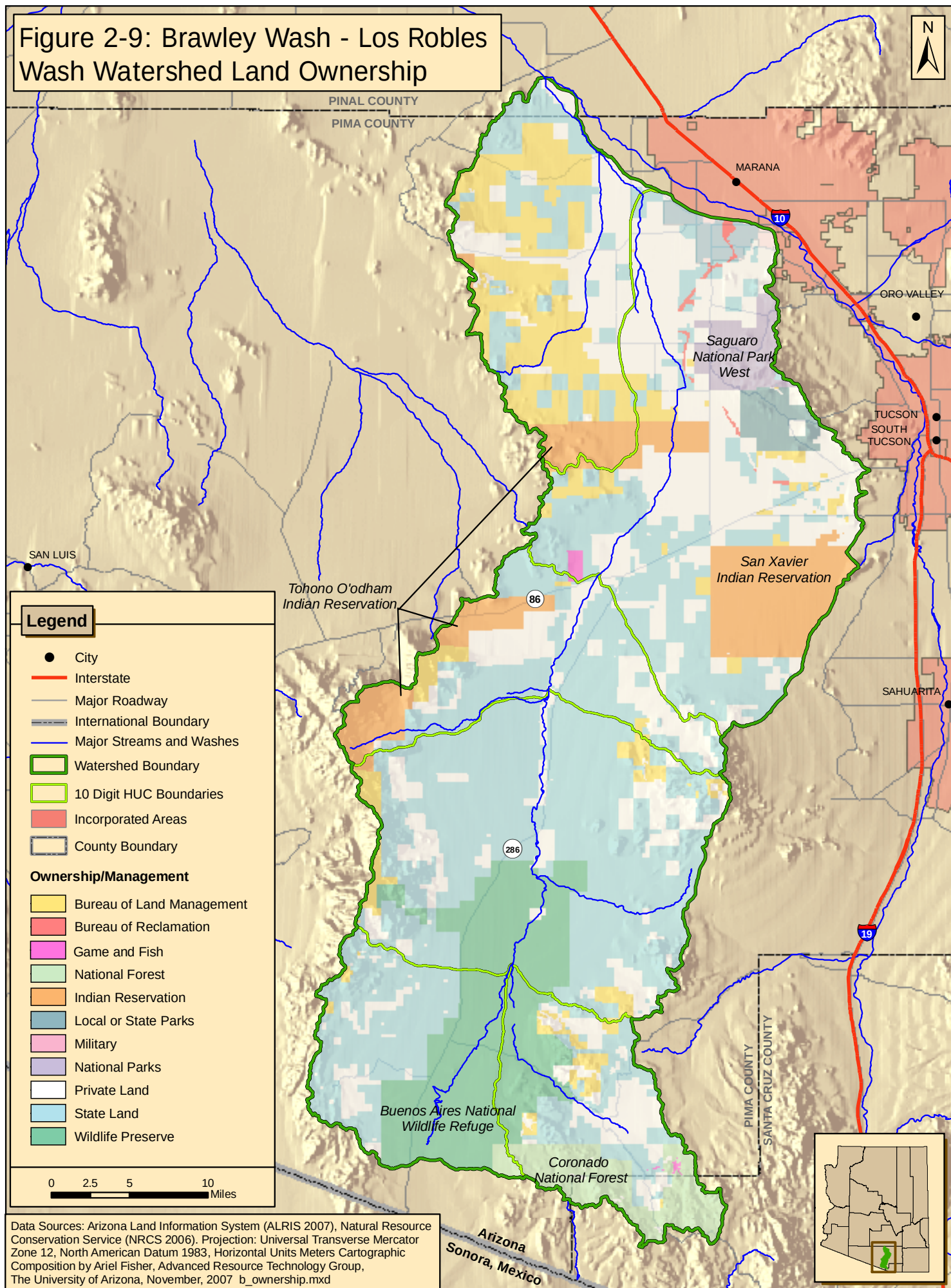
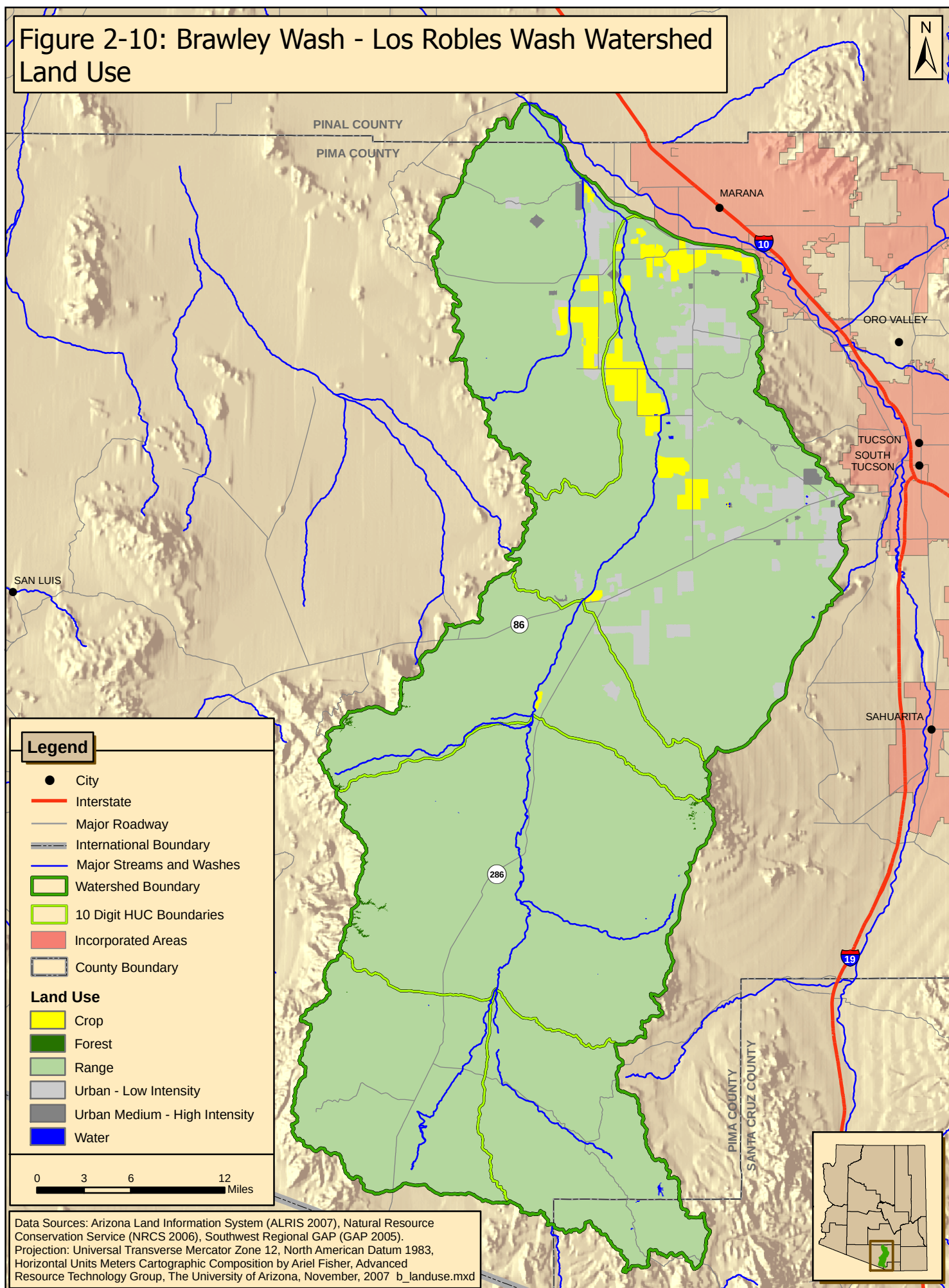
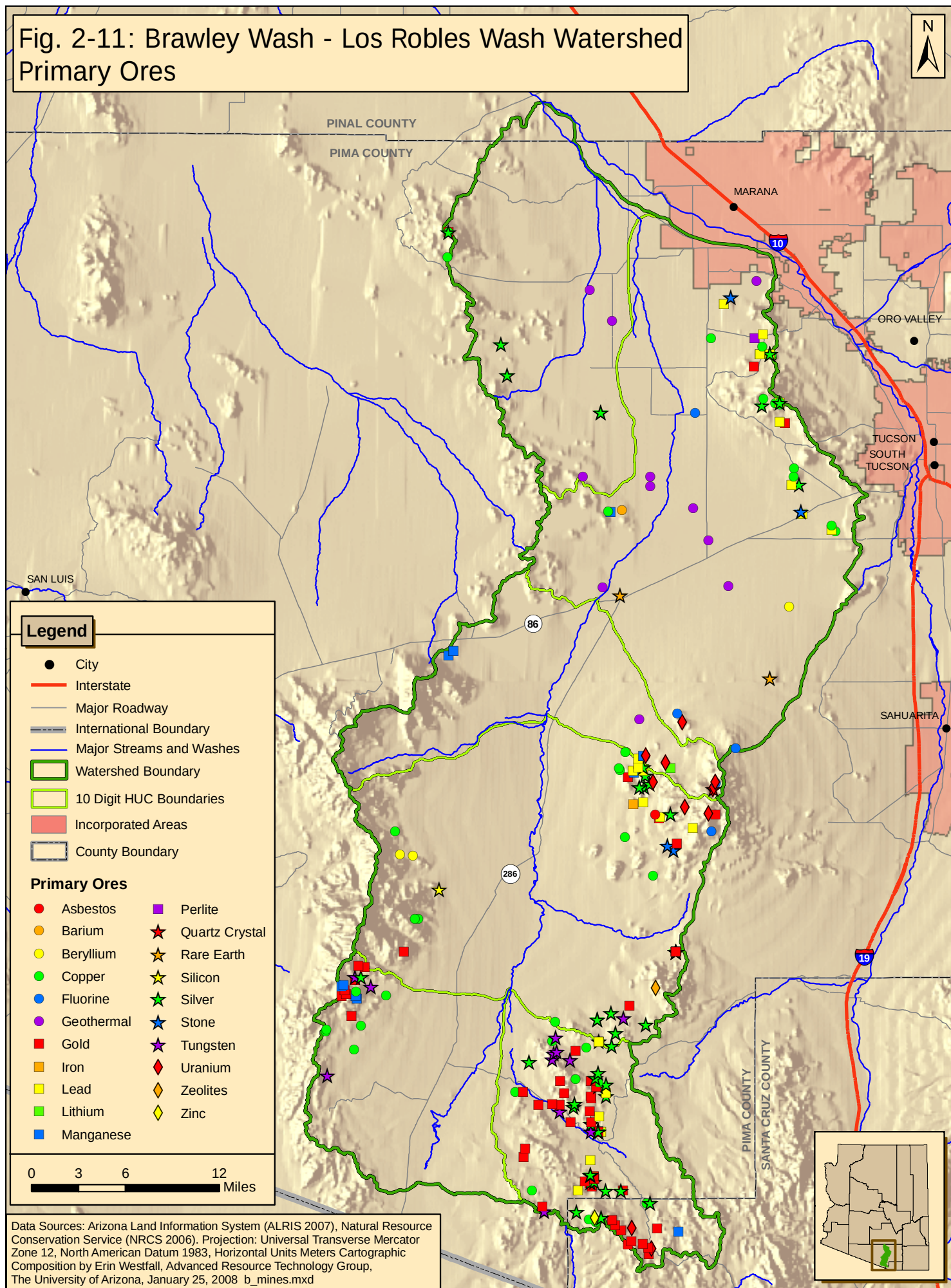




Figure 2-10: Brawley Wash - Los Robles Wash Watershed Land Use

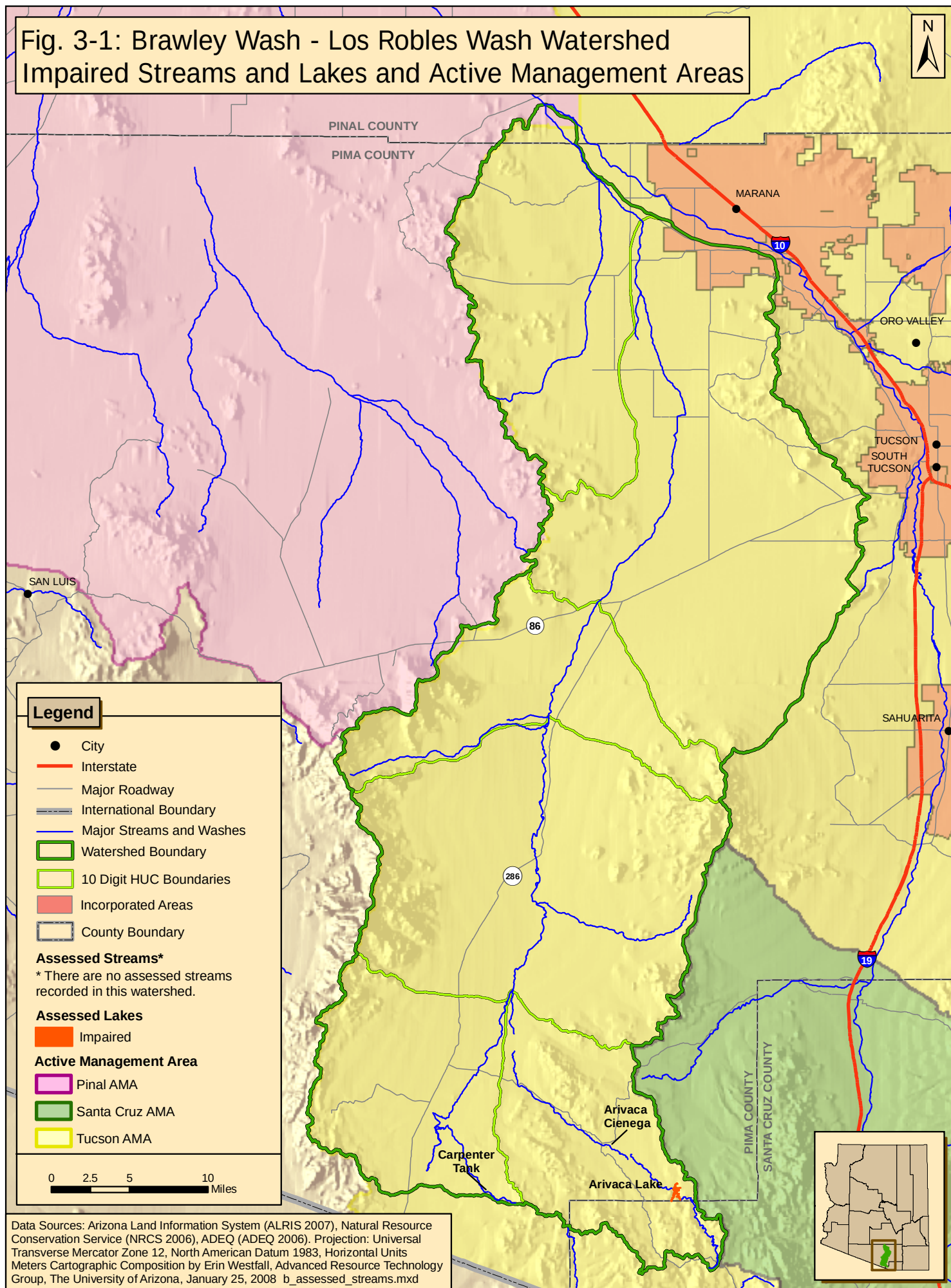


**Fig. 2-11: Brawley Wash - Los Robles Wash Watershed  
Primary Ores**



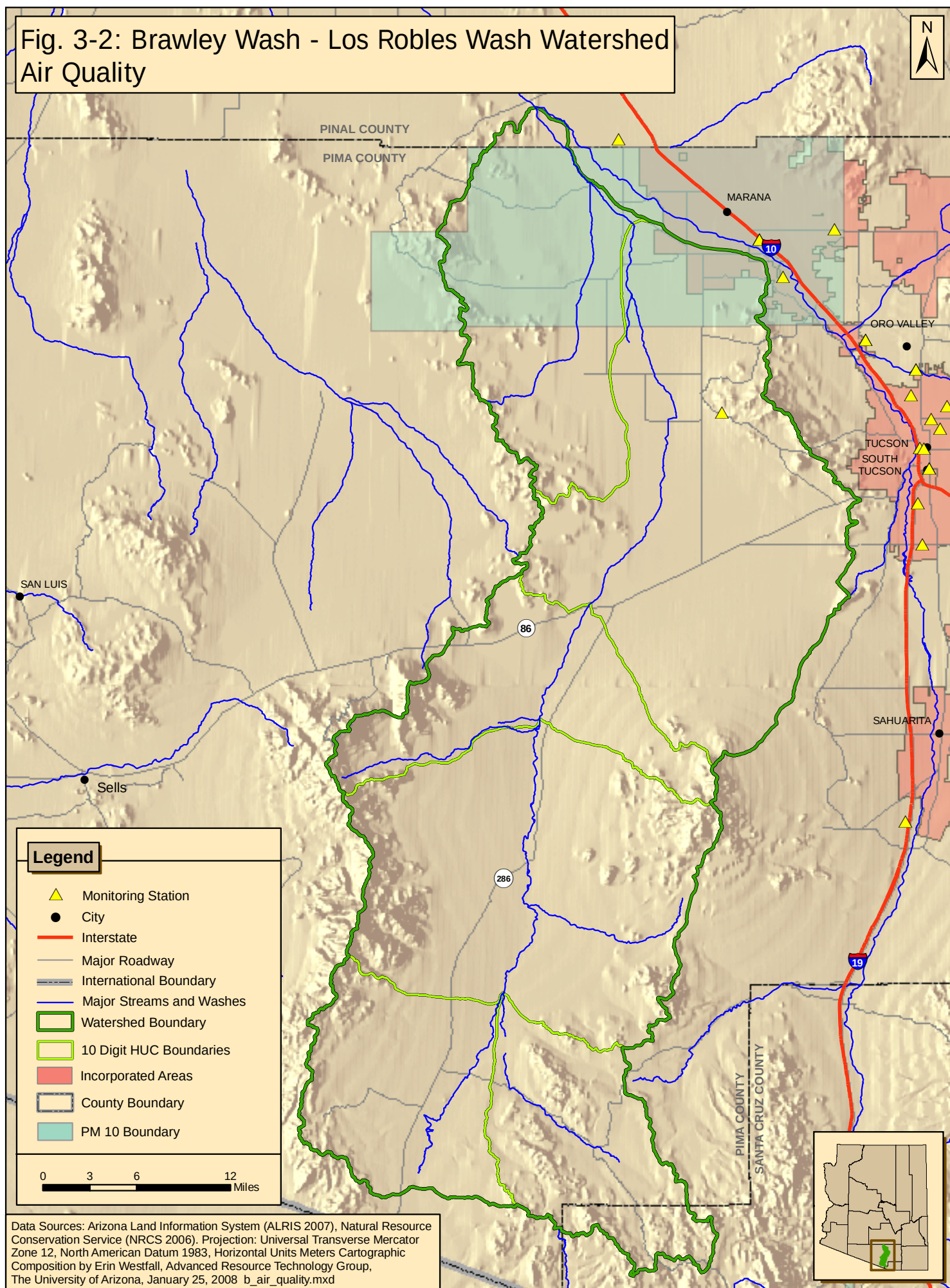


**Fig. 3-1: Brawley Wash - Los Robles Wash Watershed  
Impaired Streams and Lakes and Active Management Areas**



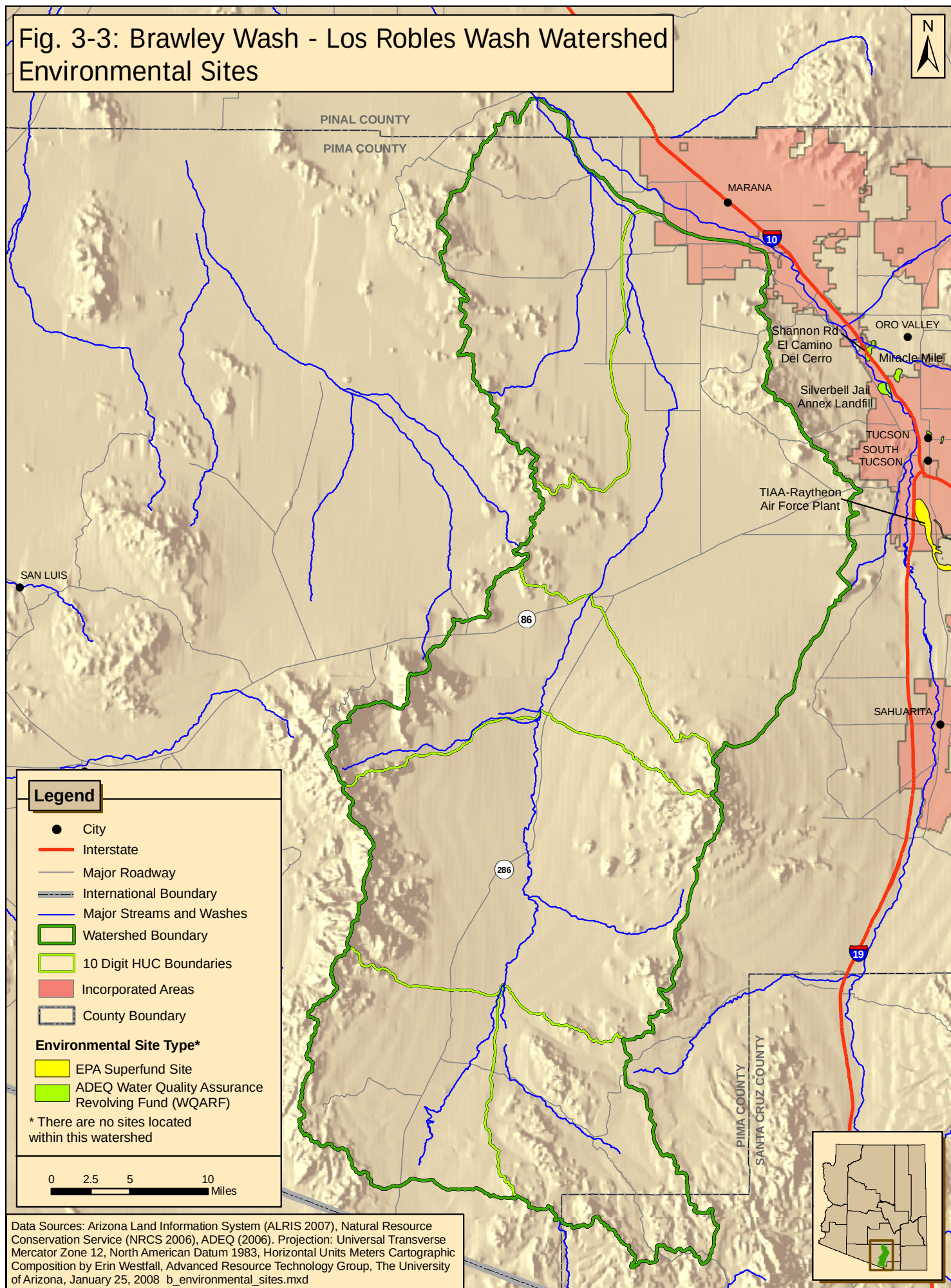


**Fig. 3-2: Brawley Wash - Los Robles Wash Watershed  
Air Quality**

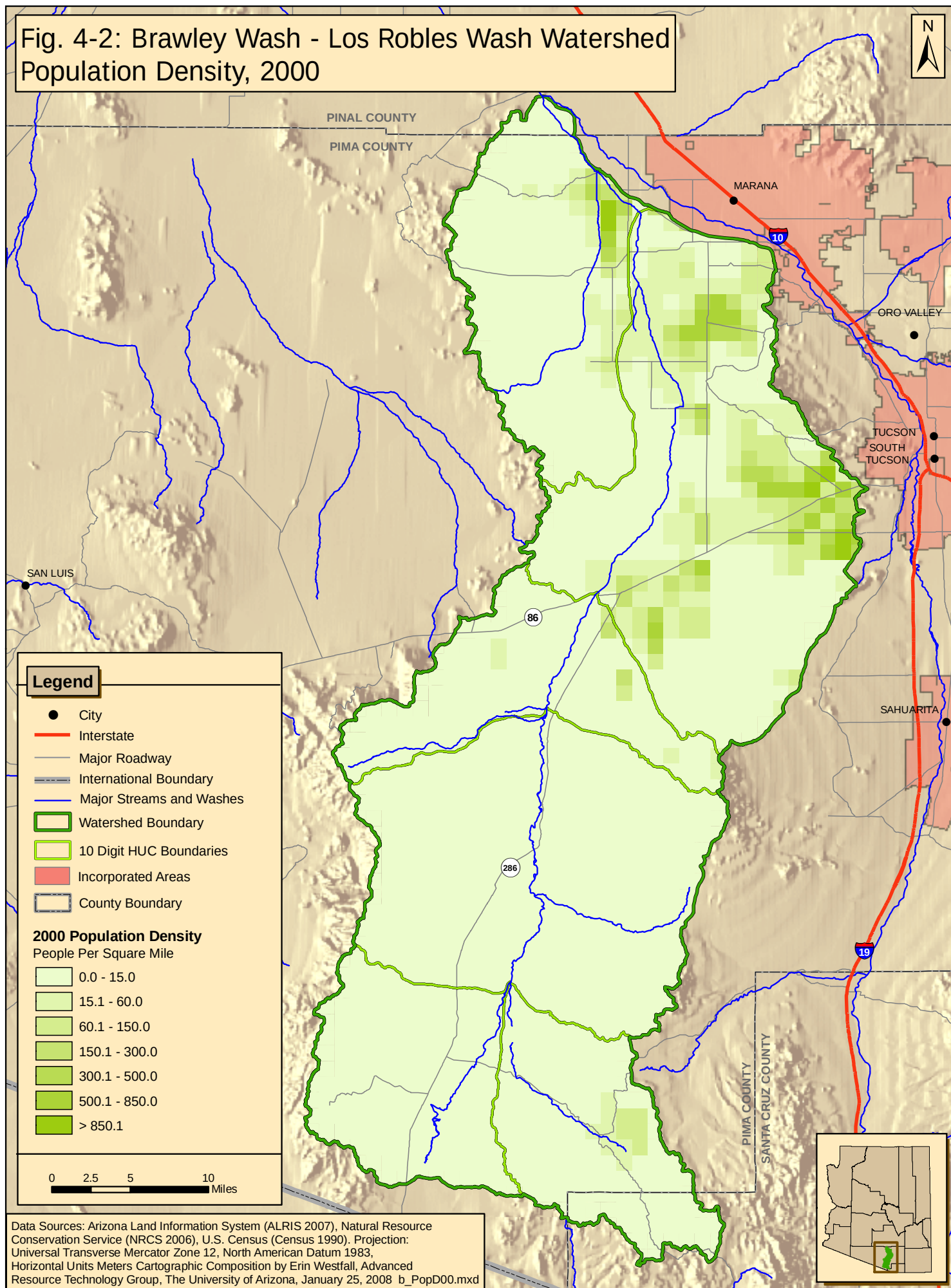




**Fig. 3-3: Brawley Wash - Los Robles Wash Watershed Environmental Sites**

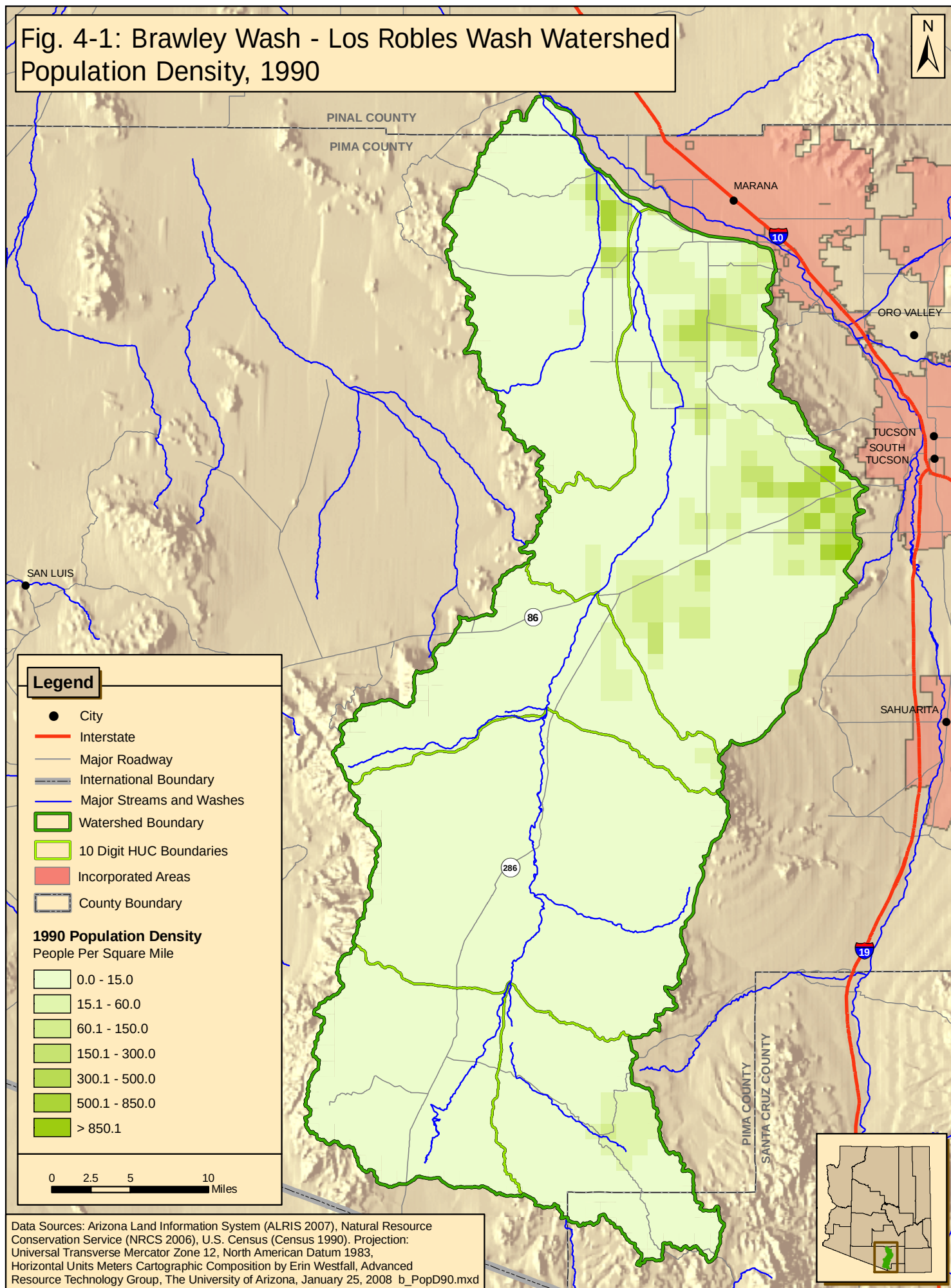


**Fig. 4-2: Brawley Wash - Los Robles Wash Watershed  
Population Density, 2000**

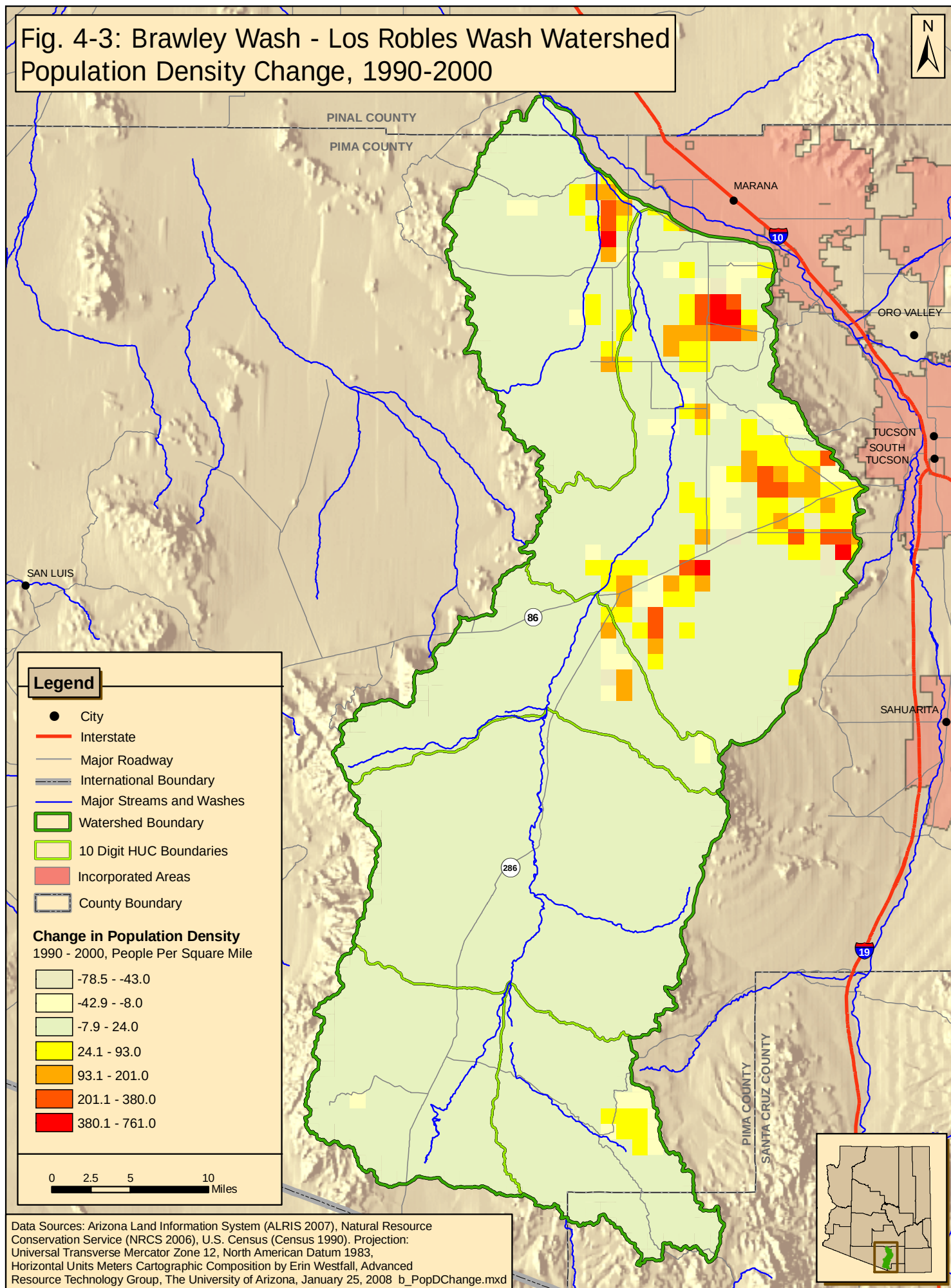




**Fig. 4-1: Brawley Wash - Los Robles Wash Watershed  
Population Density, 1990**



**Fig. 4-3: Brawley Wash - Los Robles Wash Watershed  
Population Density Change, 1990-2000**





**Fig. 4-4: Brawley Wash - Los Robles Wash Watershed  
Housing Density, 2000**

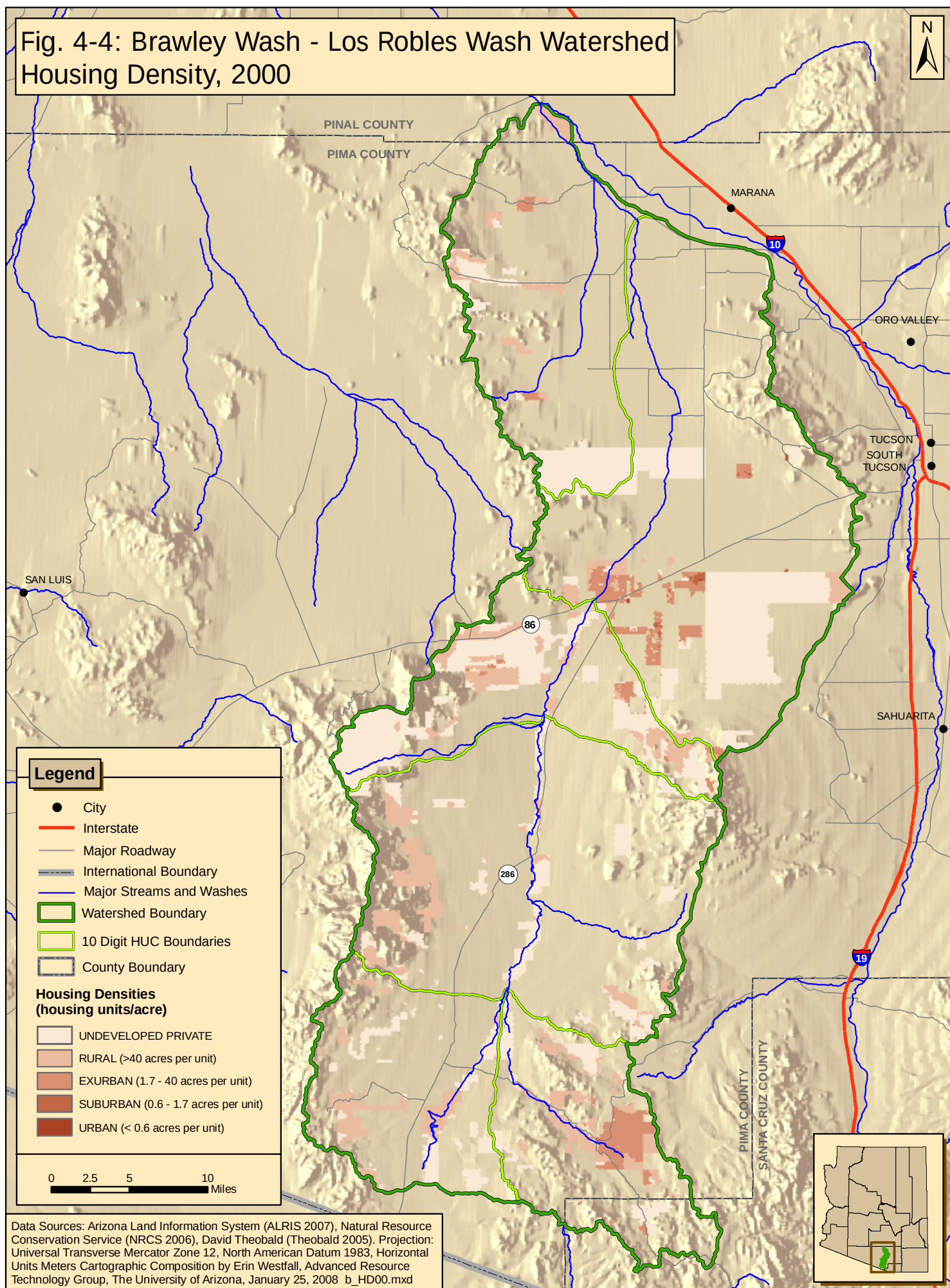
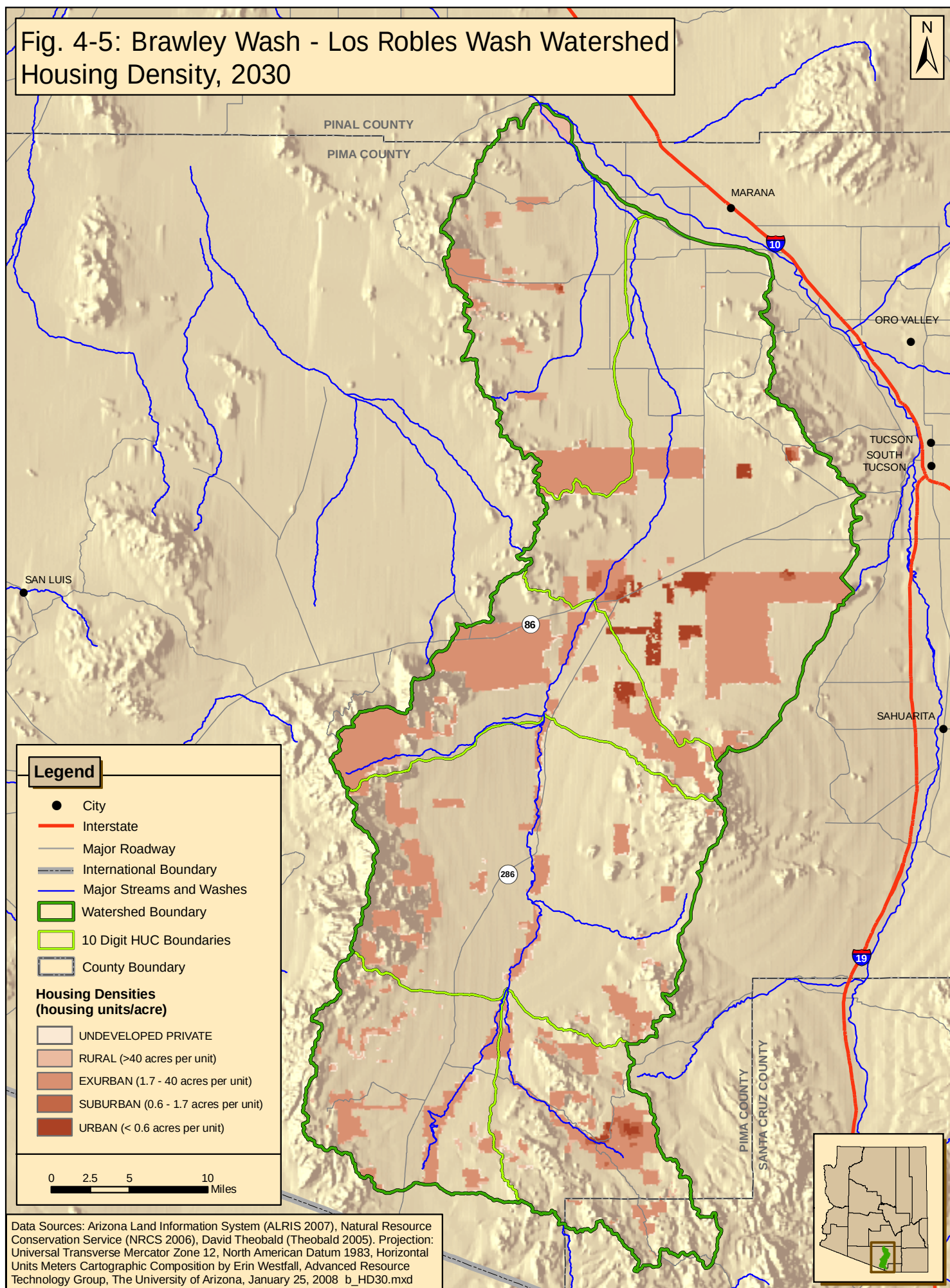




Fig. 4-5: Brawley Wash - Los Robles Wash Watershed  
Housing Density, 2030





# Geologic Map of the West of Avra 7.5' Quadrangle, Pima County, Arizona

by

Philip A. Pearthree, Ann Youberg, and Steven J. Skotnicki

October 2000

Arizona Geological Survey Digital Geologic Map 5

Arizona Geological Survey  
416 W. Congress, Suite 100, Tucson, AZ 85701

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citation for this map:

Pearthree, P.A., Youberg, Ann, and Skotnicki, S.J., 2000, Geologic map of the West of Avra 7.5' quadrangle, Pima County, Arizona: Tucson, Arizona Geological Survey Digital Geologic Map 5 (DGM-05), 1 Adobe PDF file (1 plate), layout scale 1:24,000.

Research supported by the Arizona Geological Survey and U.S. Geological Survey, National Cooperative Geologic Mapping Program, under USGS award #99HQAG0171. The view and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.



# GEOLOGIC MAP OF THE WEST OF AVRA 7.5' QUADRANGLE, PIMA COUNTY, ARIZONA

By  
Philip A. Pearthree, Ann Youberg, and Steven J. Skotnicki

October, 2000

Arizona Geological Survey Digital Geologic Map 5

digital cartography by  
Tim R. Orr

citation for this map:  
Pearthree, P.A., Youberg, Ann, and Skotnicki, S.J., 2000, Geologic map of the West of Avra 7.5' quadrangle, Pima County, Arizona: Tucson, Arizona Geological Survey Digital Geologic Map 5 (DGM-05), 1 Adobe PDF file (1 plate), layout scale 1:24,000.

Research supported by the Arizona Geological Survey and U.S. Geological Survey, National Cooperative Geologic Mapping Program, under USGS award #99HQAG0171. The view and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

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## MAP EXPLANATION

### Geologic Symbols

- contact (solid where accurate; dashed where approximate)
- intraformational contact
- sample location
- flow foliation (showing dip)

### Geologic Map Units

#### Piedmont Alluvium

Quaternary and late Tertiary deposits cover the piedmont areas southeast and northwest of Brawley Wash. This sediment was deposited primarily by streams that head in the mountains. Smaller streams that head on the piedmont have eroded and reworked some of these deposits. Deposits range in age from modern to Pliocene or late Miocene. Deposits derived from the Sierrita and Coyote mountains typically are finer-grained, primarily sand and pebbles with some cobbles. Alluvial fan deposits derived from the fine-grained volcanic rocks of the Roskrige Mountains typically contain more cobbles and boulders. The lower margin of the piedmonts are defined by their intersection with stream terraces and the basin-floor deposits of Brawley Wash. Approximate age estimates for the various units are given in parentheses after the unit name. Abbreviations are ka, thousands of years before present, and Ma, millions of years before present.

**Qy2 Late Holocene alluvium (~2 ka)**  
Unit Qy2 consists of channels, low terraces, and small alluvial fans composed of sand, cobbles, silt, and boulders that have been recently deposited by modern drainages. In areas proximal to the Roskrige Mountains, channel sediment is generally sand, pebbles and cobbles, with some boulders; terraces typically are mantled with sand and finer sediment. On lower piedmont areas, young deposits consist predominantly of sand and silt, and some cobbles in channels. Channels generally are incised less than 1 m below adjacent terraces and fans, but locally incision may be as much as 2 m. Channel morphologies generally consist of a single-thread channel or multi-threaded channels with gravel bars adjacent to low flow channels. Downstream-branching distributary channel patterns are common on the Sierrita piedmont. In these areas, channels typically are discontinuous, with small, well-defined channels alternating with broad expansion reach where channels are very small and poorly defined. Local relief varies from fairly smooth channel bottoms to the undulating bar-and-swale topography that is characteristic of coarser deposits. Terrace surfaces typically have planar surfaces, but small channels are also common on terraces. Soil development associated with Qy2 deposits is minimal. Terrace and fan surfaces are brown, and on aerial photos they generally appear darker than surrounding areas, whereas sandy to gravelly channels appear light-colored on aerial photos. Vegetation density is variable. Channels typically have sparse, small vegetation. The densest vegetation in the map area is found along channel margins and on Qy2 terraces along channels. Along the larger washes, tree species include mesquite, palo verde, and acacia; smaller bushes and grass may also be quite dense. Smaller washes typically have palo verde, mesquite, large creosote and other bushes along them.

**Qy1 Holocene alluvium (0 to ~10 ka)**  
Unit Qy1 consists of low terraces and broad, minimally dissected alluvial fans. Qy1 surfaces are slightly higher and/or farther from active channels, and thus are less subject to inundation than Qy2 surfaces. Qy1 surfaces are generally planar; local relief may be up to 1 m where gravel lags are present, but typically is much less. Qy1 surfaces are less than 2 m above adjacent active channels. Surfaces typically are sandy but locally have fine, unvarnished open gravel lags. Qy1 surfaces generally appear fairly dark on aerial photos, but where a gravel lag is present, surfaces are light colored. Channel patterns on alluvial fans are weakly integrated distributary (branching downstream) systems. Qy1 terrace surfaces support mesquite and palo verde trees, and smaller bushes may be quite dense. Qy1 fans support scattered trees along channels, but creosote and other small bushes are dominant. Qy1 soils typically are weakly developed, with some soil structure but little clay and stage I to II calcium carbonate accumulation (see Machette, 1985, for description of stages of calcium carbonate accumulation in soils).

**Qiy Holocene to late Pleistocene alluvium (0 to ~130 ka)**  
Broadly rounded alluvial fan surfaces approximately 1 m above active channels composed of mixed alluvium of late Pleistocene and Holocene age. Drainage networks consist of a mix of distributary channel networks associated with larger drainages and tributary channels associated with smaller drainages that head on Qiy surfaces. Qiy areas are mainly covered by a thin veneer of Holocene fine-grained alluvium (unit Qy1), but reddened Pleistocene alluvium (unit Ql and less commonly, Qm) is exposed in patches on low ridges and in roads and cut banks of washes. The Holocene surfaces usually are light brown in color and soils have weak subangular blocky structure and minor carbonate accumulation. Qiy fans support palo verde and mesquite trees along washes and low shrubs and grass in interfluve areas.

**Ql Late Pleistocene alluvium (~10 to 130 ka)**  
Unit Ql consists of moderately dissected relict alluvial fans and terraces found on the upper, middle and lower piedmont. Well-developed, moderately incised tributary drainage networks are typical on Ql surfaces. Active channels are incised up to about 2 m below Ql surfaces, with incision typically increasing toward the margins of Ql fans and terraces are commonly lower in elevation than adjacent Qm and older surfaces, but the lower margins of Ql deposits lap out onto more dissected Qm surfaces in some places. Ql deposits consist of pebbles, cobbles, and finer-grained sediment. Ql surfaces commonly have loose, open lags of pebbles and cobbles; surface clasts exhibit weak rock varnish. Ql surfaces appear light orange on aerial photos, reflecting slight reddening of surface clasts and the surface soil horizon. Ql soils are moderately developed, with orange to reddish brown clay loam argillic horizons and stage II calcium carbonate accumulation. Dominant forms of vegetation include creosote, bursage, and ocotillo.

**Qm Middle Pleistocene alluvium (~130 to 500 ka)**  
Unit Qm consists of moderately to highly dissected relict alluvial fans and terraces with moderate to strong soil development. Qm surfaces are drained by well-developed, moderately incised tributary channel networks. On the low-relief Sierrita piedmont, Qm areas they are traversed by larger distributary channels that are typically one to several meters below adjacent Qm ridges. Well-preserved, planar Qm surfaces on the Roskrige piedmont are smooth with pebbles and cobble lags; rock varnish on surface clasts is typically orange or dark brown. More eroded, rounded Qm surfaces typical of the Sierrita piedmont are characterized by loose cobble lags with moderate to strong varnish, broad ridge-like topography and carbonate filler on the surface. Well-preserved Qm surfaces have a distinctive dark color on aerial photos, reflecting reddening of the surface soil and surface clasts. More dissected Qm surfaces show up as complex, light-colored ridges. Soils typically contain reddened, clay argillic horizons, with obvious clay skins and subangular blocky structure. Soil carbonate development is typically stage III to IV, but indurated neotectonic are uncommon. Qm surfaces generally support bursage, ocotillo, creosote, cholla, and saguaro.

#### Axial Stream Deposits

Sediment deposited by Brawley Wash covers the eastern part of the map area. Surfaces consist of channels, young stream terraces that compose the geologic floodplain, and older relict floodplain deposits that date to the Pleistocene. Deposits are primarily sand and finer, with minor gravel, and channels are generally quite small and discontinuous. Much of the area covered by axial stream deposits has been altered by agricultural activity. In these areas, deposits are subdivided into Holocene and Pleistocene units based on soils information obtained from a soil survey of this area (Gelderman, 1972).

**Qy2r Late Holocene proximal floodplain (<2 ka)**  
Generally fine-grained deposits on the active floodplain of Brawley Wash. Deposits generally consist of sand, silt, and clay, with local gravel concentrations in small channels and fans. Shallow, small, discontinuous channels are common; many of them are linear, suggesting that channels developed along roads or wagon tracks. Soil development is minimal, consisting of brown A horizons and carbonate filaments (weak stage I calcic horizons); surface colors are brown to grayish brown. Vegetation typically is creosote and low grass and shrubs, with local concentrations of mesquite, acacia, and palo verde trees along channels. Variegated surface color depends mainly on vegetation density, dark brown color along channels and where vegetated, brown where more sparsely vegetated. These areas are prone to inundation in floods and may be subject to intense erosion along existing small channels.

**Qy1r Holocene distal floodplain and terrace deposits (0 to ~10 ka)**  
Deposits associated with low terraces of Brawley Wash. Typically, they are flat surfaces that are on the fringes of and less than 1 m above the active floodplain, but small channels exist in some places within this unit. Deposits are generally fine-grained, but locally surfaces have weak, discontinuous gravel lags composed of mixed lithologies. Soil development is weak, with cambic horizons and carbonate filaments (stage I calcic horizons). Surface color typically is light brown, and surface clasts have no varnish. Very limited low (0.5 m high), heavily bioturbated coppice dunes are associated with creosote bushes. Portions of the Qy1r surfaces may be inundated in the largest floods.

**Qyrs Holocene stream terrace deposits and eolian deposits (< 10 ka)**  
Mixed young river terrace deposits and eolian deposits. Landforms consist of low coppice dunes and intervening flat surfaces with minimal gravel lags and no pavement development, less than 1 m above adjacent floodplains. Drainage networks typically are discontinuous and channels are very small. Low coppice dunes are abundant. Soil development is weak, with cambic horizons and carbonate filaments (stage I calcic horizons). Surface color typically is light brown. Vegetation is sparse, desert shrubs are relatively concentrated in dunes and along small channels. The preservation of eolian deposits indicates that these areas have not been subject to substantial flooding recently.

**Qyr Holocene floodplain and terrace deposits (0 to ~10 ka)**  
Holocene deposits underlying areas that have been impacted by intensive agricultural activity, generally irrigated fields. In these areas, it is not possible to subdivide Holocene deposits.

**Qmr Middle to late Pleistocene river deposits (~10 to 500 ka)**  
Relict late or middle Pleistocene river terrace deposits on the basin floor. Deposits are dominated by clay, sand and silt, with some fine gravel. Soil development is moderate to strong, with reddish brown clay loam to clay argillic horizons and soft carbonate nodules and whitening of calcic horizons (stage II to III calcic horizons). Reddish brown surfaces are typically fairly flat and slightly elevated above the adjacent floodplain. In areas that have been cultivated, topographic differences between Pleistocene and Holocene surfaces are generally undetectable. In these areas, Qmr deposits are distinguished from Holocene deposits based on soil survey mapping (Gelderman, 1972).

#### Hillslope Deposits

##### Qc Quaternary hillslope colluvium

Unit Qc consists of very poorly sorted, angular deposits mantling bedrock on hillslopes. This unit is generally very thin, probably less than a few meters in all cases.

#### Bedrock

##### Tx Trachyte of El Cerrito de Represso (Oligocene or Miocene)

Several crystal-rich (25-40%) trachyte lava flows containing plagioclase, biotite, and sparse clinopyroxene or amphibole, sanidine, and quartz phenocrysts.

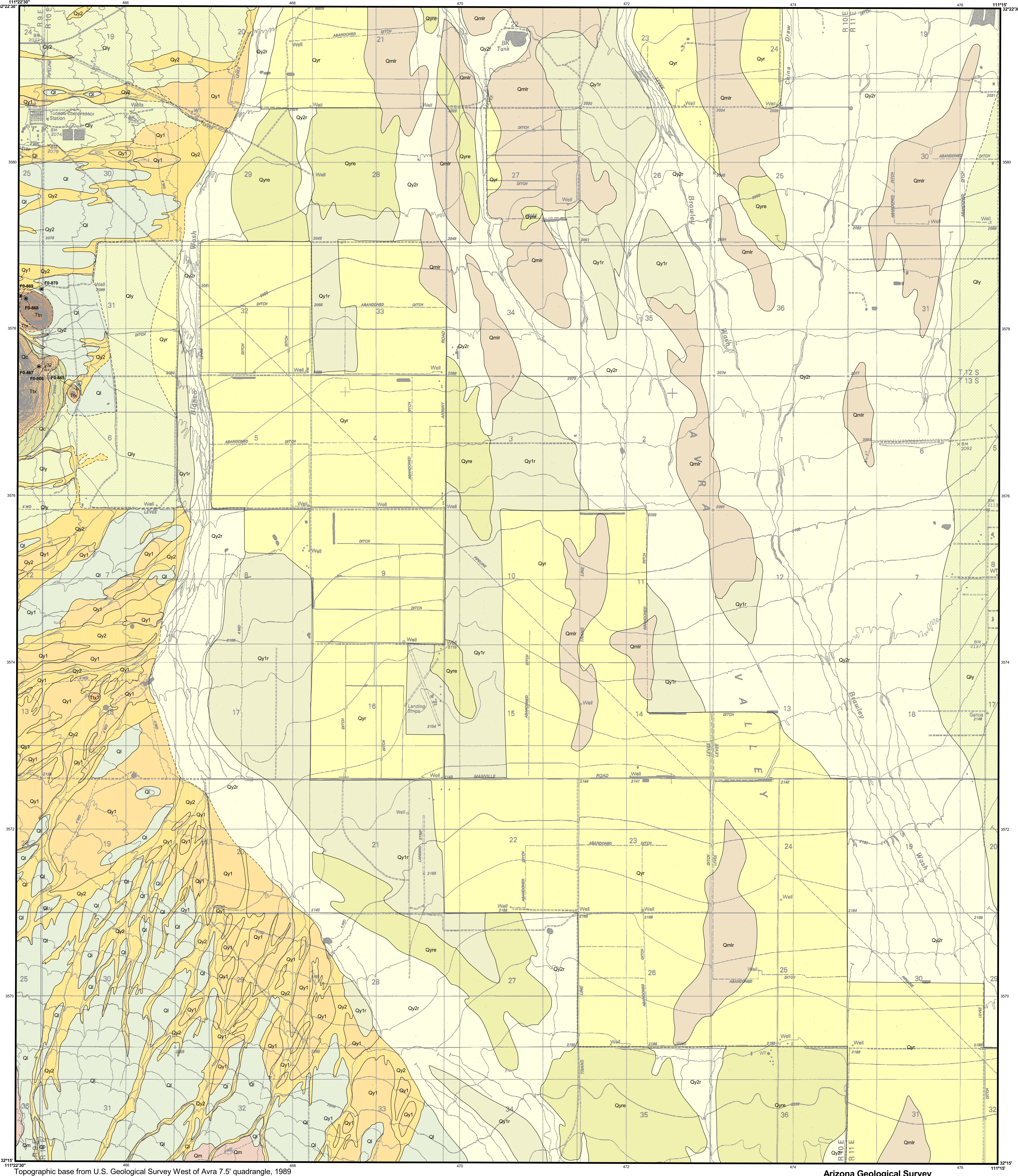
##### Th Trachyte of Nessler's Hill (Oligocene or Miocene)

Moderately crystal-poor, dark gray trachyte lava containing crystals of plagioclase up to 4mm diameter, biotite, and sparse clinopyroxene or amphibole.

## REFERENCES

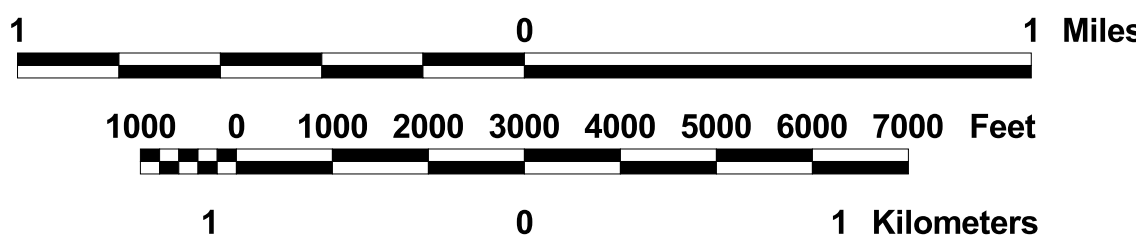
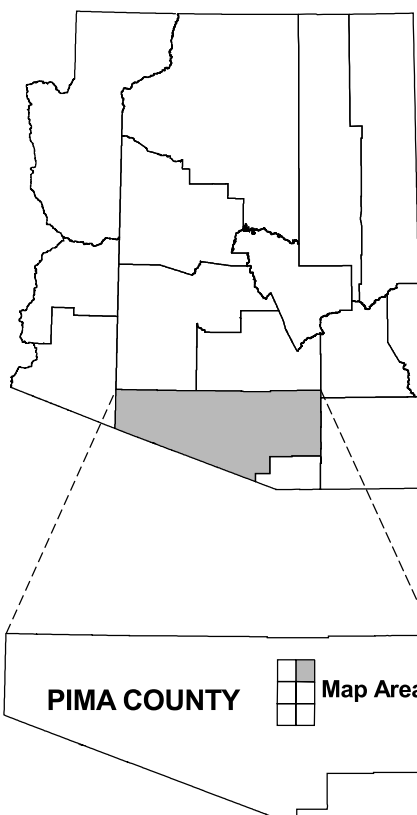
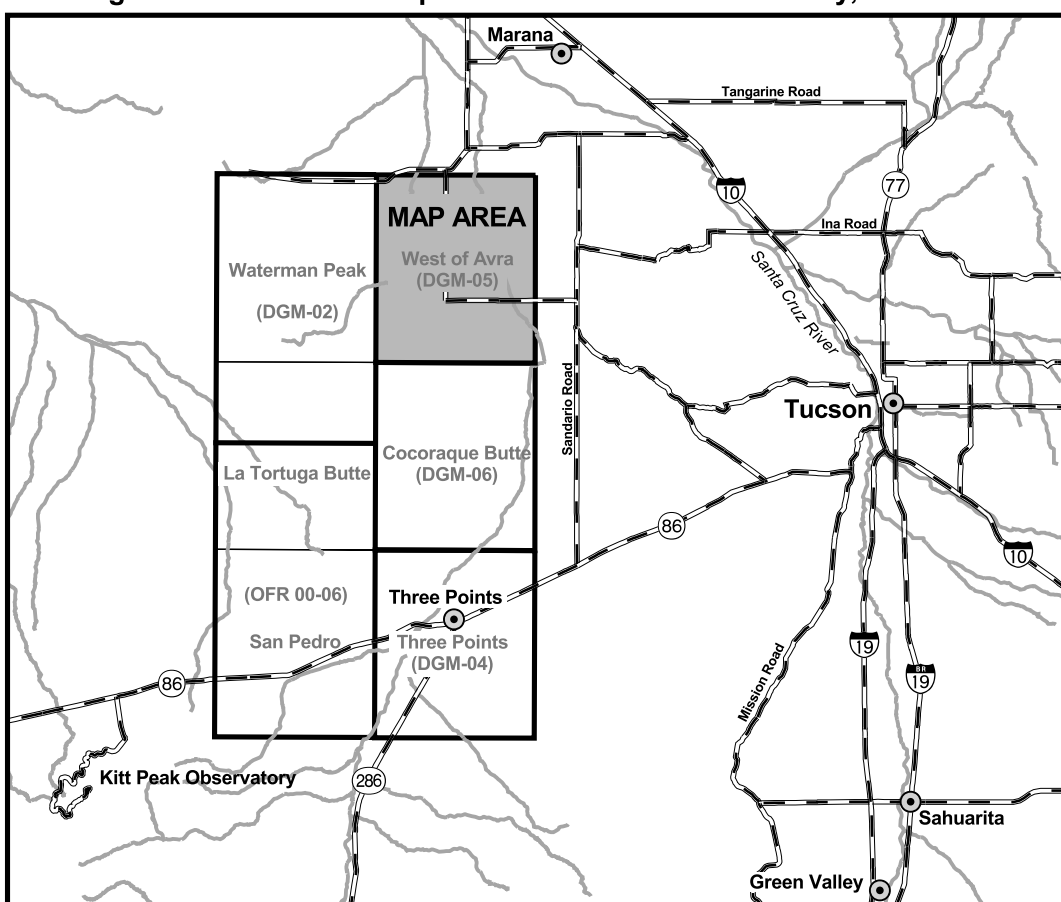
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## Arizona Geological Survey Digital Geologic Map 5, plate 1 of 1, with text



Topographic base from U.S. Geological Survey West of Avra 7.5' quadrangle, 1989

## INDEX MAP OF THE ROSKRIGE MOUNTAINS AND WESTERN AVRA VALLEY AREA Showing the location of the map area in relation to Pima County, Arizona and the greater Tucson region



1 0 1 Miles  
1000 0 1000 2000 3000 4000 5000 6000 7000 Feet

1 0 1 Kilometers

32°22'11"22"30" 111°15'22"20"

32°15' 111°15'

## MAPPING RESPONSIBILITY

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