Tucson Electric Power Orange Grove Substation

Power Substation Permit Application / Pima County

July 2014

THE PLANNING CENTER
a division of TPC Group, Inc
110 s church ste 6320 tucson az 85701

Tucson Electric Power Orange Grove Substation
Power Substation Permit Application

Orange Grove Road & La Cañada Drive
Pima County, Arizona

Submitted to:

Pima County
Development Services Department
201 North Stone Avenue, Second Floor
Tucson, Arizona 85701

Prepared for:

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July 2014

List of Exhibits

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Tucson Electric Power Orange Grove Substation

I. Introduction

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Tucson Electric Power (TEP) is submitting this Power Substation Permit (PSP) application for the proposed 138 kilovolt (kV) Orange Grove Substation (the "Orange Grove Substation") in accordance with Pima County Code Section 18.07.040 (B)(5). According to this Code substations with an input voltage of 115 kilovolt (kV) or greater are permitted within any zone in Pima County, but are subject to review and approval by the Pima County Board of Supervisors (BOS).

The substation would is would be located at the southwest corner of Orange Grove Road and La Canada Drive. The selected site is located within a portion of the northwest quarter of Section 10, Township 13 South, Range 13 East and a portion of Section 3, Township 13 South, Range 13 East; Gila and Salt River Baseline and Meridian (G&SRM) in Pima County, Arizona (the "site"). The site is comprised of Assessor Parcel Numbers 102-11-131E, 102-11-1320, and 102-11-131D totaling 9.085 acres (See Exhibit I.1: Location Map, Exhibit I.2: Assessor's Parcel Map; Exhibit I.3: Aerial Map and).

A. Purpose and Need

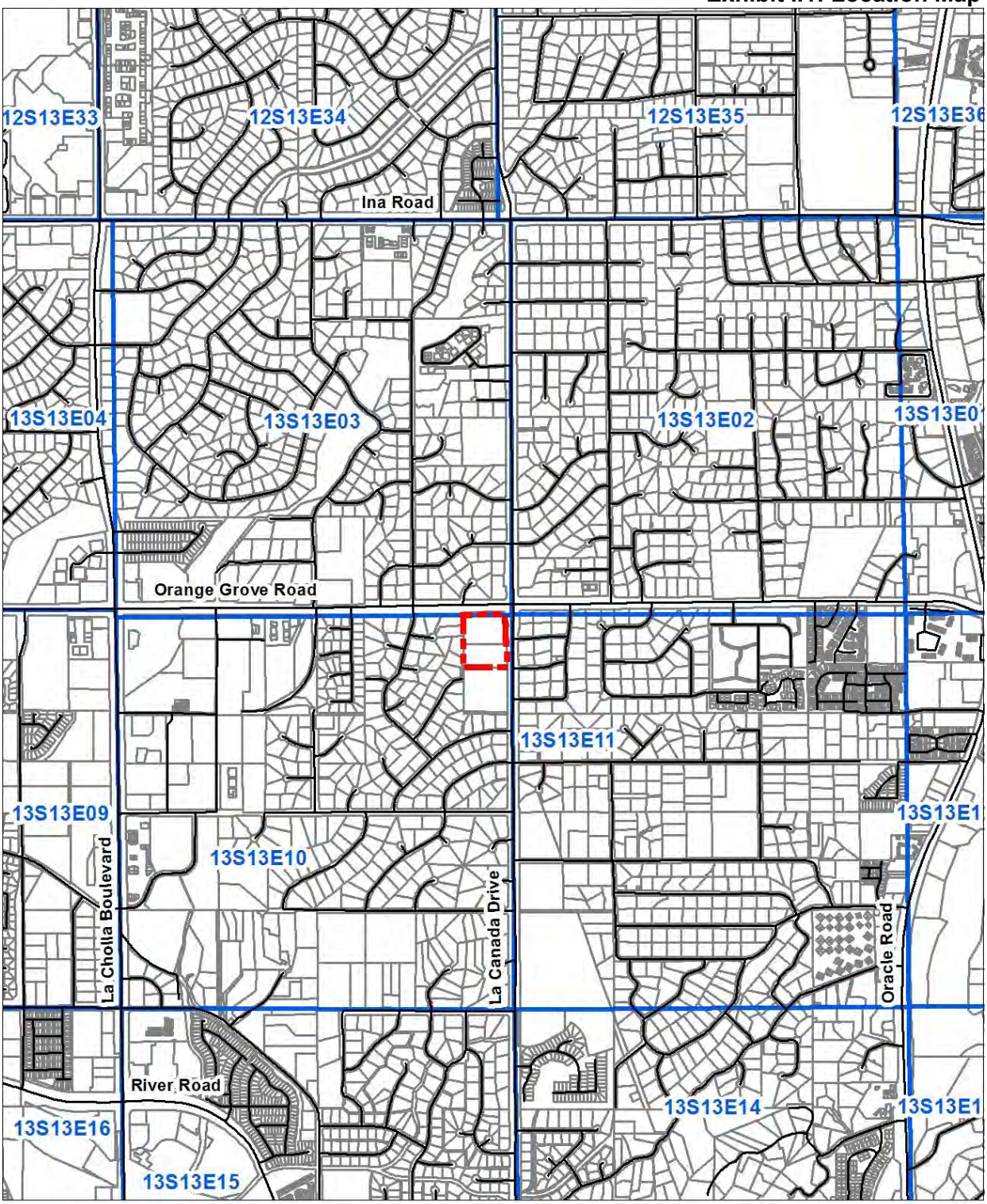
With continuing residential, commercial, and light-industrial growth in northwest Tucson, the demand for electricity has nearly exceeded available capacity of the existing electric facilities. TEP proposes to construct and operate a 50 mega volt ampere (MVA), 138 kV-13.8 kV distribution substation in northwest metropolitan Tucson. This area is currently serviced by the Del Cerro, La Canada, Rillito, and West Ina substations (See Exhibit I.A.1: Northwest Metropolitan Tucson Substations Map). A new substation is needed to relieve the existing electric system and provide sufficient power to meet the present and projected electrical load needs in this service area.

TEP's mission is to provide safe and reliable electric service to its customers, in addition to meeting federal standards. The Orange Grove Substation will benefit customers in the northwest metropolitan Tucson service area. Some of these benefits include:

- Reduction of system outages due to maintenance or unintended service disruptions from storm events or equipment failure.
- Reduction of current and future system overload conditions.
- Increased system capacity to meet future growth.
- Greater integrity and reliability of the existing electric system.

Development of the Orange Grove Substation would improve system reliability by relieving overloaded circuits (five in this vicinity ranging from 2.8% to 35.2% overloaded) and an overloaded transformer (presently 4.2%) at the surrounding substations. It would also improve single-outage contingencies (fifteen ranging from 2.0% to 100%) by increasing backup capacity of the electrical system, primarily in the portion of TEP's service territory bounded by River Road, Shannon Road, Magee Road and First Avenue. As described above, locating the new substation near the center of the projected customer demand will maximize system efficiency and reliability. Placing the substation next to an existing 138kV transmission line would avoid the need to site a new transmission line, minimize environmental impacts, reduce project costs, and minimize potential rate increases.

Exhibit I.1: Location Map



LEGEND

Site Boundary

Township, Range & Section

Notes:

Project Site is located at:
Township 13S, Range 13E,
and Section 10
Acreage: Approx. 9.08 AC
Parcel ID #:102-11-131E, 130-11-131D, 102-11-132

NORTH 0' 1,000' 2,000'

FILE NAME: TEP-22_location.mxd
SOURCE: Pima County GIS, 2013

Exhibit I.2: Assessor's Parcel Map

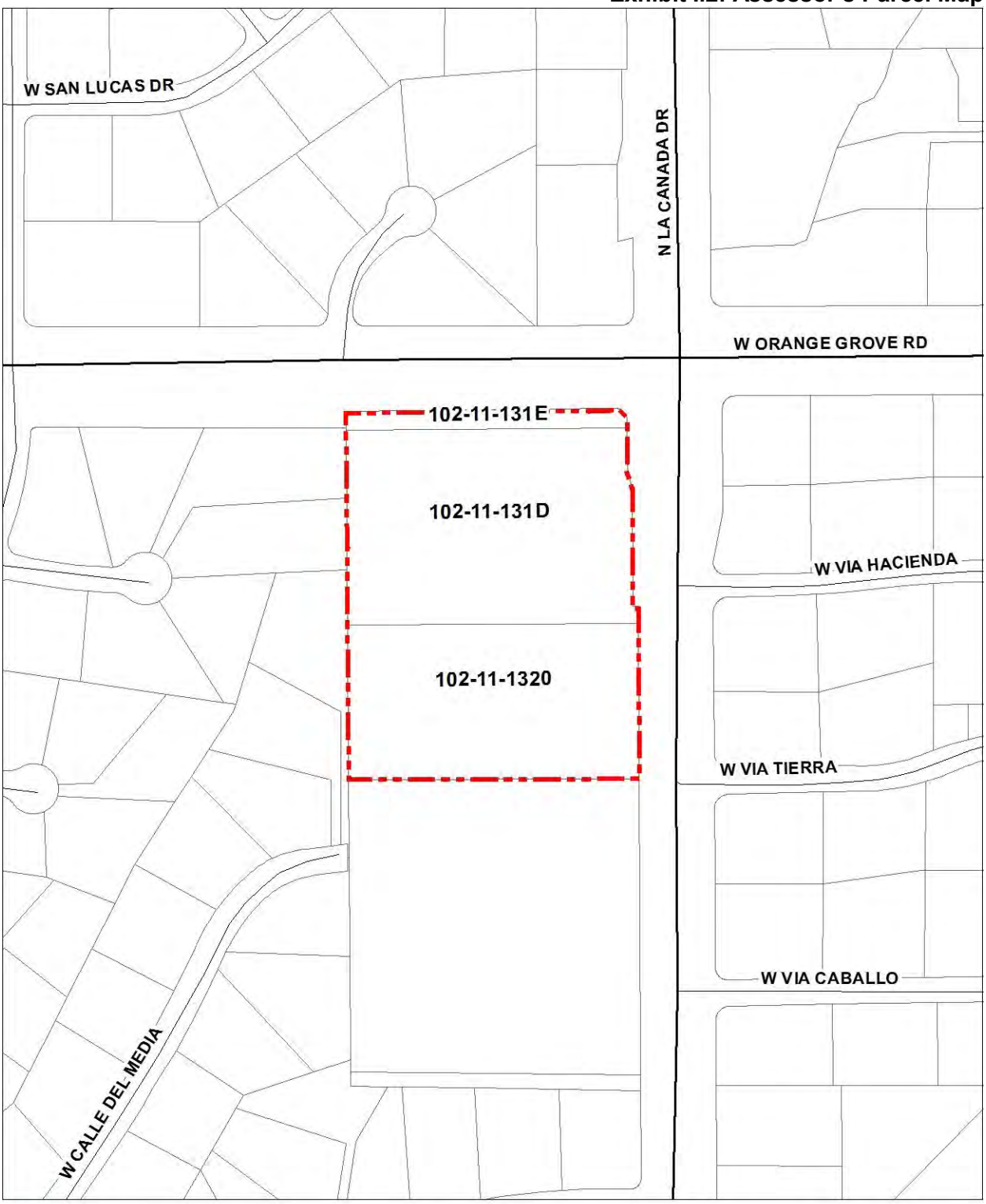


Exhibit I.3: Aerial Map

LEGEND

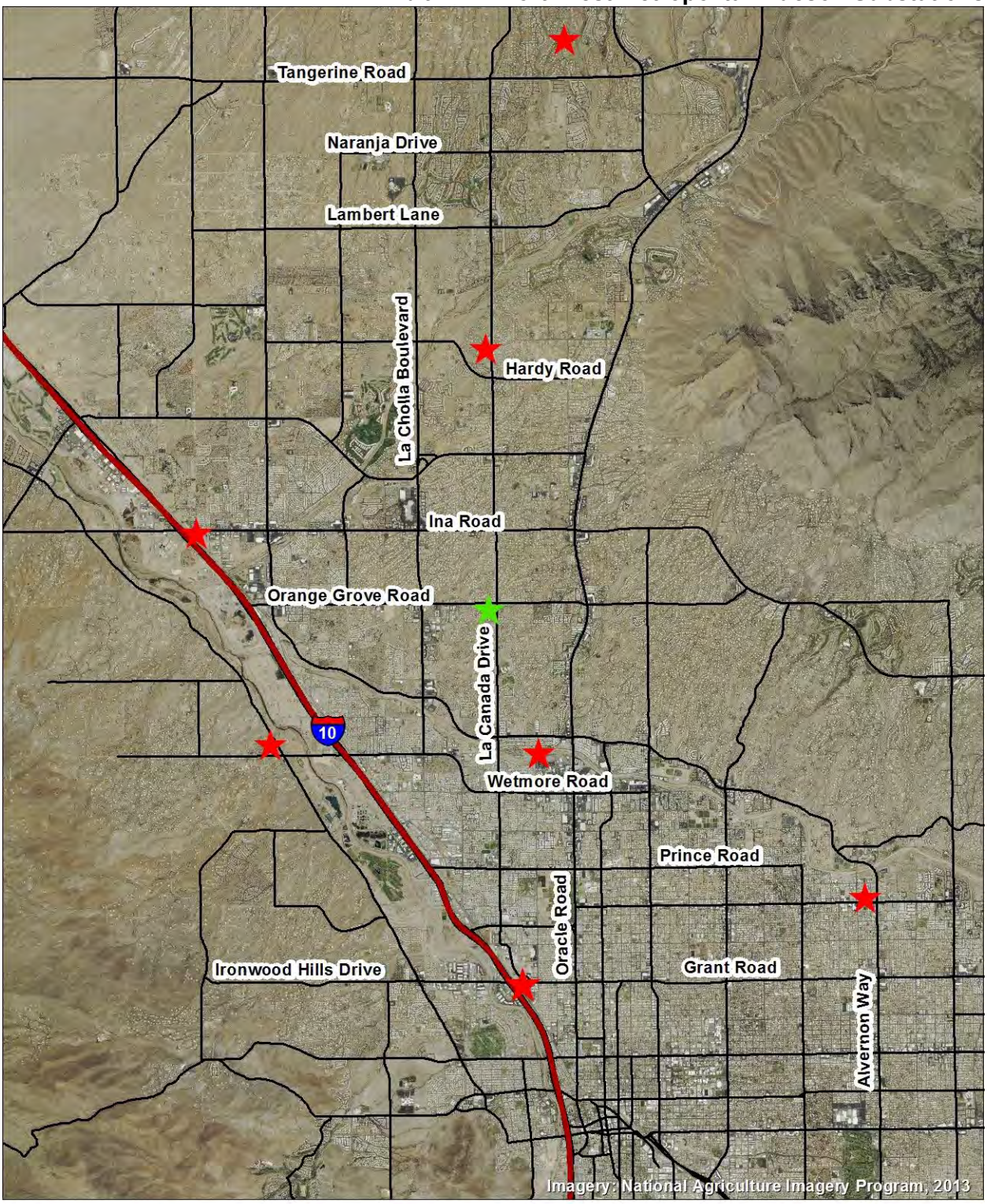
Site Boundary

Parcels

NORTH 0' 250' 500'

FILE NAME: TEP22_aerial_6x8.mxd
SOURCE: Pima County GIS, 2014

Exhibit I.A.1: Northwest Metropolitan Tucson Substations



The need for the Orange Grove Substation to provide additional electrical capacity in the northwest metropolitan Tucson area has been identified in TEP's 10-Year Transmission Plan, filed with the Arizona Corporation Commission (ACC), since 2000. Power flow analysis was conducted to identify thermal overloads and voltage violations under normal and contingency conditions required by the North American Electric Reliability Corporation (NERC) Planning Standards and the Western Electricity Coordinating Council (WECC) System Performance Criteria. This resulted in a schedule for new facilities and upgrades to existing facilities assuring adequate transmission capacity within TEP's service territory as Pima County continues to develop.

Over the past 14 years, TEP has implemented system upgrades to meet the growing electrical demand. System improvements have included upgrading transmission and distribution equipment such as substation switch gear, distribution feeder lines, reconductoring of existing overhead transmission and distribution lines. The current growth projections in Pima County indicate the substation is necessary to support customer demand.

In the Ten-Year Transmission Plan filed with the ACC, TEP conducted a review of its local 138kV transmission system performance over a 10-year planning horizon. The Orange Grove Substation is a priority capital improvement, necessary to meet the requirements of increased line loading in the service area.

B. Site Selection

The process of site selection begins with an evaluation of available properties located within the electrical load center, previously developed by TEP Substation and Distribution Planning. TEP used the following criteria to select the most suitable site:

- Must meet Substation and Distribution Planning technical system requirements.
- A location within two spans of the connection transmission line (allows for connection to existing transmission line, avoids ACC approval and additional cost associated with building new transmission facilities).
- The size of the site must accommodate a substation footprint of 408-feet by 242-feet, landscaping and buffering, as well as setbacks required by Pima County Ordinance 18.07.040 of the Pima County Zoning Code (Approximately nine to ten acres minimum).
- Avoid or minimize impacts to natural or cultural resources (i.e. washes, riparian areas, vegetation, historic properties, etc.).
- The site must be available for sale with a willing seller.
- The substation's potential development impact on surrounding land uses, particularly on existing adjacent residential land uses.
- Cost of the property and associated improvements necessary to distribute power from the location.

The TEP site selection process for the Orange Grove substation was limited by the availability of undeveloped property that would provide sufficient land area to construct a substation in accordance with Pima County regulations and requirements set forth by the ACC. Based on this evaluation, five properties were identified as potential candidates for the new substation. The undeveloped site at the southwest corner of Orange Grove Road and La Canada is the best alternative, as indicated by the Site Selection and Acquisition Matrix presented in Table I.B. and Exhibit I.B: TEP Site Selection Map.

Table I.B: Orange Grove Substation Site Selection and Acquisition Matrix

Site Selection Criteria	1. SW Corner Orange Grove & La Canada	2. SE Corner of Orange Grove and Mona Lisa	3. East of La Cholla and North of Magee	4. North of Magee & west of La Cholla	5. East of La Cholla & North of Ina
Proximity to Load Center	X	X			
Limited Infrastructure cost for transmission/ distribution	X				
Within 2 Spans of the existing 138 kV Transmission Line (No CEC required)	X		X		
Vacant Land	X	X	X		
Property Size (9 – 10 Acres)	X			X	X
Minimal Environmental Impacts	X	X	X		X
Minimal Residential Impacts	X	X			X
TOTAL	**8**	**4**	**3**	**1**	**3**

C. Existing Zoning

The property was conditionally rezoned to TR – Transitional in 2007 for office development. Power substations are permitted by right within all zoning districts in Pima County (See Exhibit I.C: Existing Zoning).

Exhibit I.B: TEP Site Selection Map

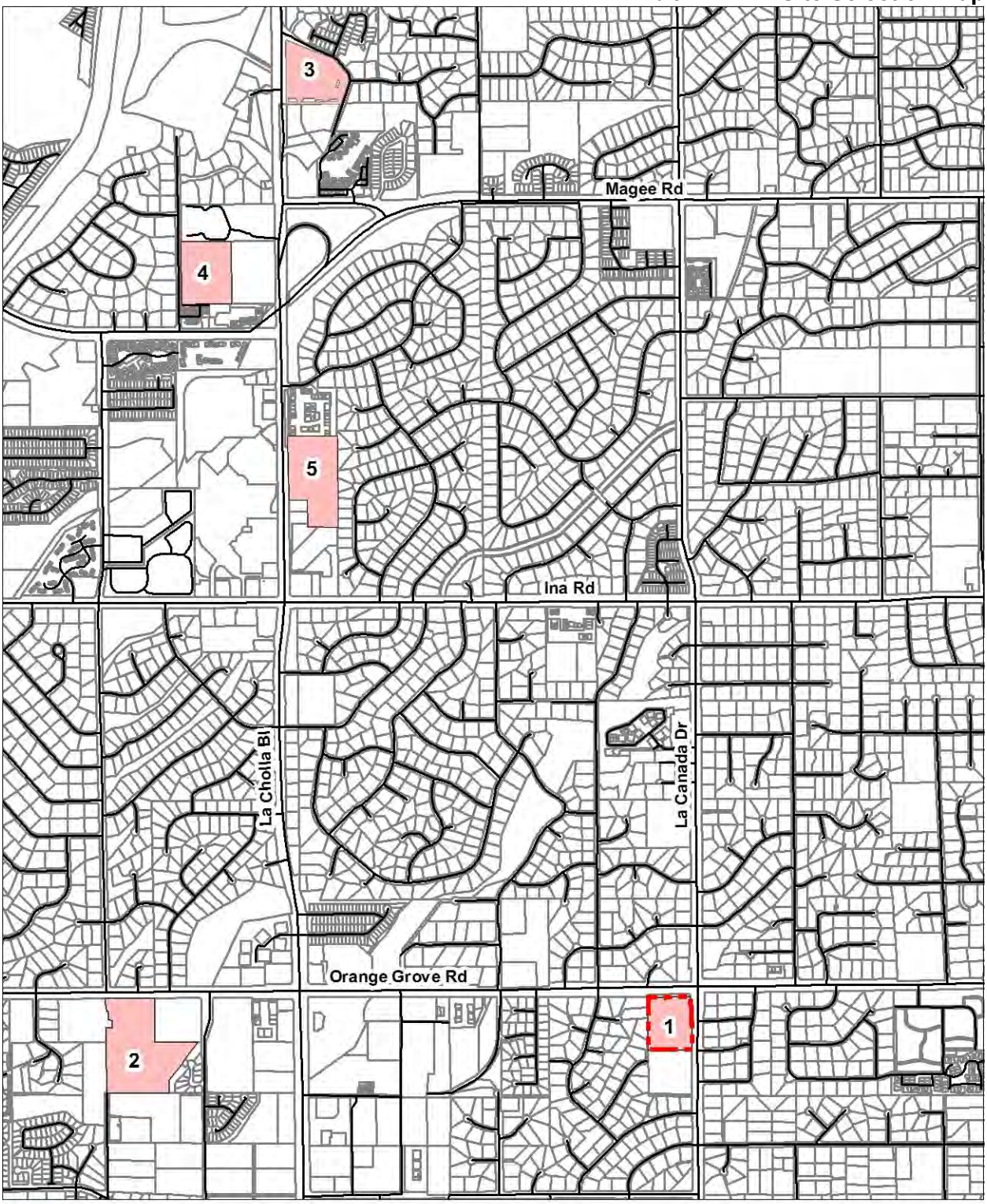
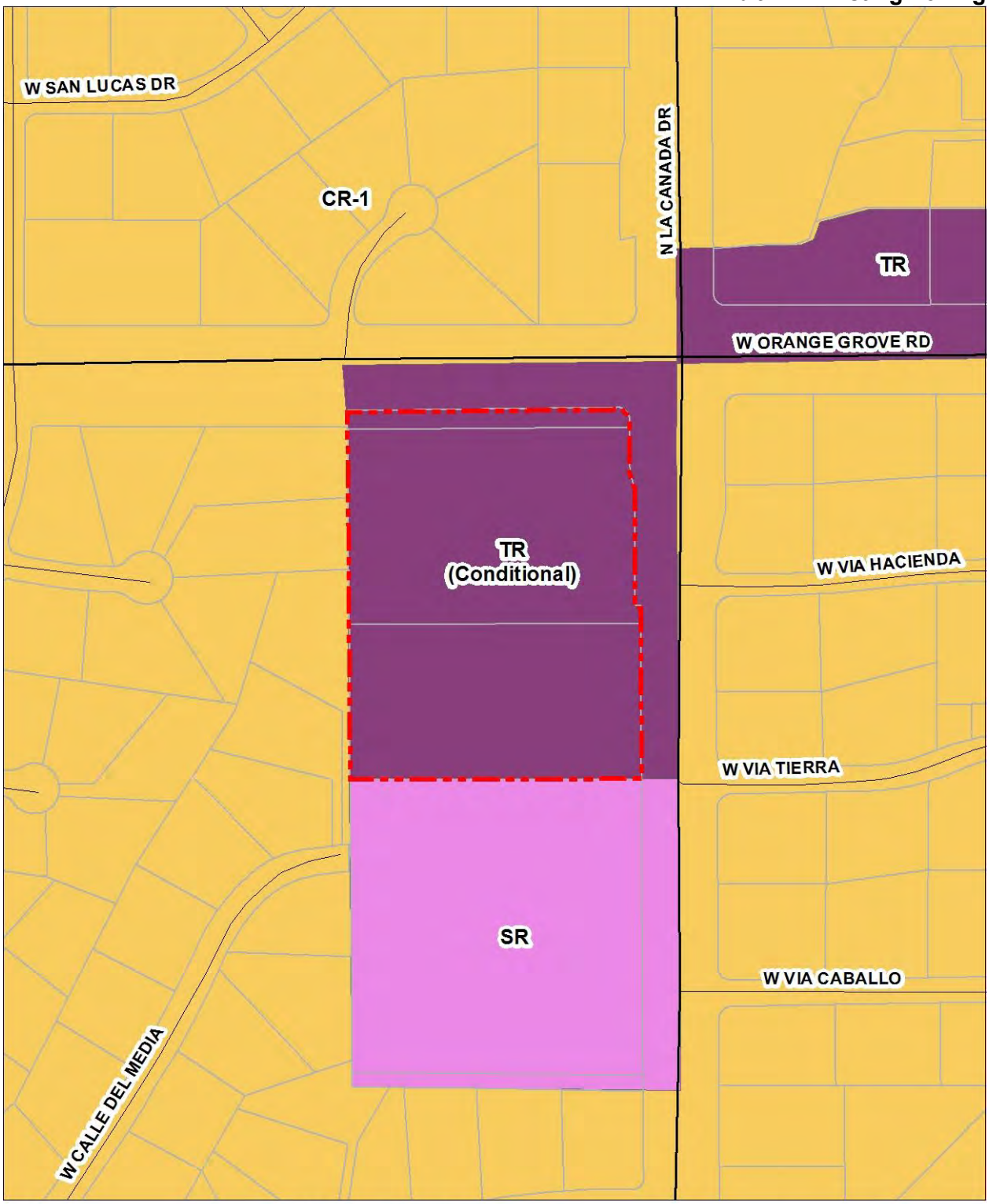


Exhibit I.C: Existing Zoning



Tucson Electric Power Orange Grove Substation

II. Land Use Proposal

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A. Description of Site

The proposed substation site is gently rolling native desert terrain with topography that generally slopes from northeast to southwest, dropping approximately 15 feet across the site from the northeast corner to the southwest corner of the property. The site's highest elevation is approximately 2,405 feet at the northeast corner of the site, and the lowest elevation is approximately 2,390 feet at the southwest corner of the site. As shown in Exhibit I.2 Aerial Map, the site is undeveloped with native vegetation coverage.

B. Setbacks

Pima County Code Section 18.070.040(B)(5)(a) requires all power substation facility walls and equipment be set back a minimum 200 feet from the nearest residential property line. The proposed Orange Grove Substation facility walls and equipment will be set back 200 feet from the nearest residential lot line to the west (adjacent to the property) and 288 feet from the nearest residential lot line to the east of the site (east side of La Canada Drive). (See Exhibit II.G: Preliminary Development Plan)

C. Screening

The proposed substation is a low profile neighborhood facility, designed to be compatible with surrounding residential development. Pima County Code Section 18.070.040(B)(5)(b) requires both a 10-foot high earth tone colored screen wall and vegetative landscaping when the facility is adjacent to a residential zone. The proposed Orange Grove Substation will include a 10-foot high earth tone substation screen wall to enclose all electric equipment. Native desert landscaping will be planted around the perimeter of the substation to augment existing vegetation as well as buffer and screen the substation from offsite properties.

Photo-simulations were prepared that identify both existing and proposed (post-development) views from three locations along the perimeter of the site (See Exhibit II.C.1: Photo-Simulation 1, Exhibit II.C.2: Photo-Simulation 2, and Exhibit II.C.3: Photo-Simulation 3). These simulations demonstrate how the combination of the 10-foot tall screen wall, landscape plantings, and substation setback requirements provide substantial visual screening from adjacent residential properties. A formal landscape plan in accordance with Pima County Development Standards will be prepared as part of the final Development Plan Submittal.

D. Height

The electric transformer equipment located within the substation enclosure area will be approximately 14 feet in height. In addition, a single 35-foot tall communication pole and eight 60-foot tall lightning protection static masts that taper from 14 inches in diameter at the base to 6 inches in diameter at their peak will be located within the substation enclosure. A 65-foot tall transmission line drop structure pole will be located between the substation enclosure and La Canada Drive to support the transmission lines entering and exiting the facility. One existing 85-foot tall transmission pole located within the La Canada

Drive west side right-of-way will be replaced with a similar 85-foot tall transmission pole to provide connection to the drop structure pole. (See Exhibit II.C.1: Photo Simulation 1, Exhibit II.C.2: Photo Simulation 2, and Exhibit II.C.3: Photo Simulation 3).

E. Pre-Application and Neighborhood Notification

The Planning Center coordinated a pre-application meeting between TEP representatives and Pima County Planning Staff on January 16, 2014 to discuss the proposed substation and PSP submittal requirements. Subsequent to that meeting, TEP invited property owners within 600 feet of their proposed Orange Grove Substation project and all neighborhood associations within a one mile radius of the site, to attend two neighborhood meetings held on April 16, 2014 and May 25, 2014 at the Metropolitan Water Company Board Room located at 6265 N. La Canada Drive, Tucson, Arizona. The purpose for the two meetings was to introduce neighborhood residents to representatives from TEP, as well as review plans for the project and address neighborhood questions and concerns. A total of 36 residents attended the two meetings. TEP mailed a written summary of the neighborhood meetings to the property owners and HOA's on the mailing list.. A copy of the Neighborhood Meetings Summary Letter, Neighborhood Meeting Minutes, Neighborhood Meeting Notices, Copies of the Neighborhood Meeting Sign-in Sheets, the Property Notification Lists, and additional information addressing neighborhood concerns, are included in Appendix B.

F. Previous Hydraulic/Hydrologic Studies

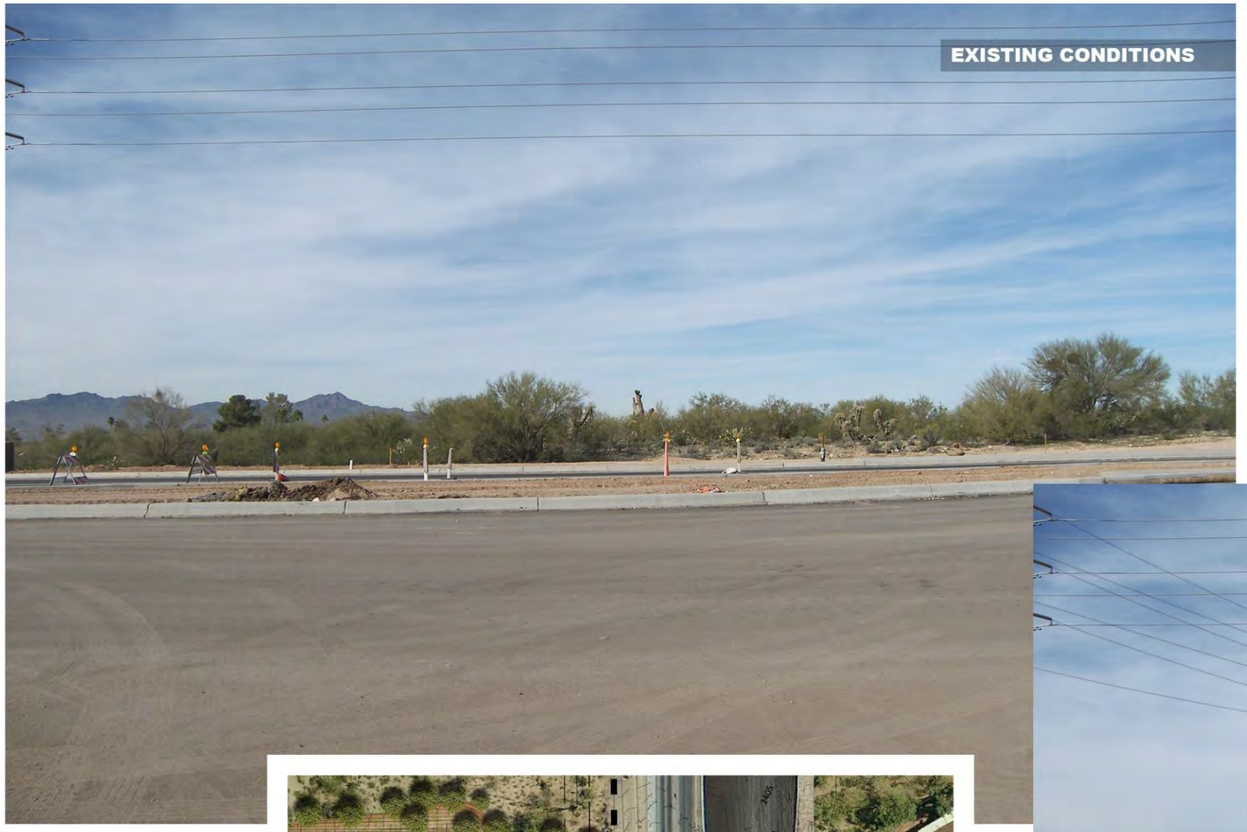
The preliminary hydrologic report prepared for the site by EEC Engineering is located in Appendix E: EEC Hydrology Report. Results of the report indicate offsite drainage flows enter the site on the northwest and southeast portion of the property. The flow on the northwest is generated from the Casas Adobes Wash (1,788 cubic feet per second (cfs) and enters the site through a box culvert under Orange Grove Road. The flow on the southeast (64cfs) is generated from upstream developments and enters the property through a pipe culvert under La Canada Road.

The proposed drainage scheme maintains the discharge points and provides retention/detention to mitigate any increases in flow due to the substation development. The general onsite flow is from the northeast to the southwest with half the graded area draining to the southeast. Flow through the site is typically shallow sheet and rill flow draining to one of two retention/detention basins and/or one of two washes that flow through the site. TEP avoided impacting the Casas Adobes Wash, thus the existing flow discharges of 1,788cfs from Casas Adobes Wash will not be altered by this proposed development. Approximately 45cfs of additional flows from run-off due to disturbance from this proposal is anticipated. These flows will be retained on site and discharged from the site at current flow rates. (See Exhibit II.F.1: Post Development On-site Hydrology and Exhibit II.F.2: Post Development On-site Hydrology).

G. Preliminary Site Plan

TEP substation planners, engineers, and their consultants (the "design team"), have prepared a preliminary site plan that shows the proposed configuration of the Orange Grove Substation. The design team carefully considered site hydrology, required property setbacks, location of existing infrastructure, configuration of transformers and switching equipment, and other technical constraints to identify the optimal location and layout of the substation facility. A Preliminary Site Plan has been included (See Exhibit II.G. Preliminary Site Plan).

Exhibit II.C.1: Photo Simulation 1



TUCSON ELECTRIC POWER
ORANGE GROVE SUBSTATION
PHOTO SIMULATION #1

ON THE CORNER OF
VIA HACIENDA
AND LA CAÑADA DR,
LOOKING WEST

LANDSCAPING TREATMENT IS REPRESENTATIVE ONLY, AND REFLECTS THE ANTICIPATED TYPE OF LANDSCAPE PLANTINGS AT MATURITY.

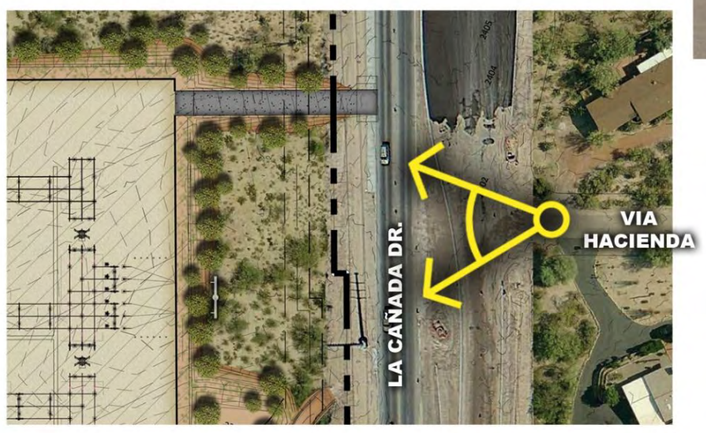
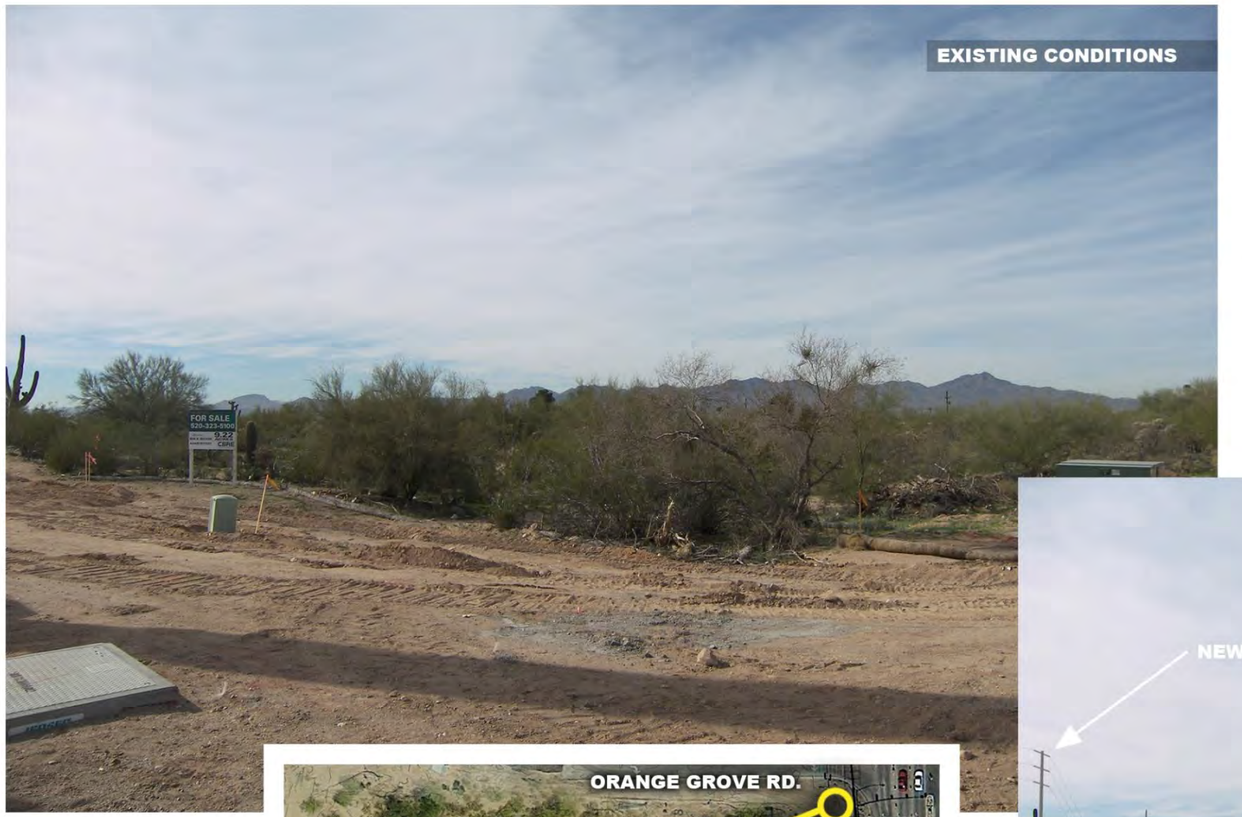


Exhibit II.C.2: Photo Simulation 2



TUCSON ELECTRIC POWER
ORANGE GROVE SUBSTATION
PHOTO SIMULATION #2

ON THE CORNER OF
ORANGE GROVE RD
AND LA CAÑADA DR,
LOOKING SOUTHWEST

LANDSCAPING TREATMENT IS REPRESENTATIVE ONLY, AND REFLECTS THE ANTICIPATED TYPE OF LANDSCAPE PLANTINGS AT MATURITY.

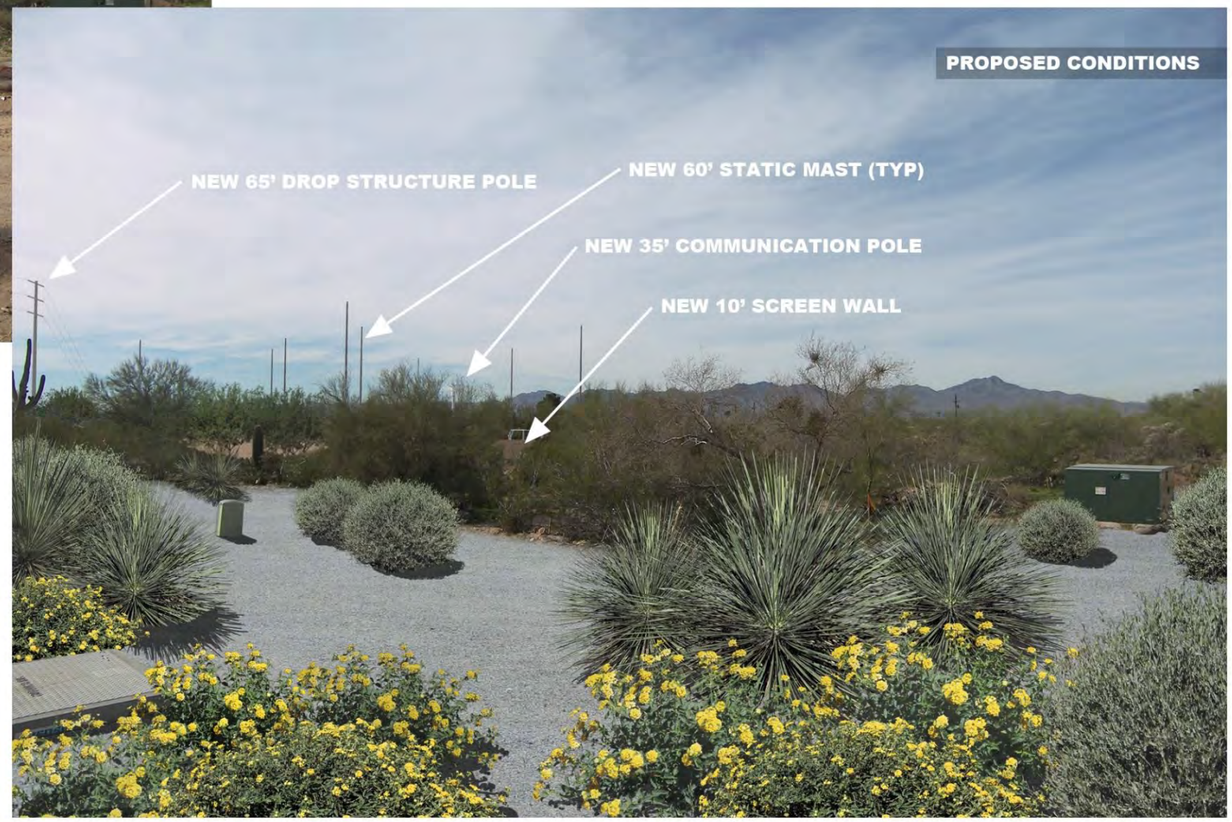
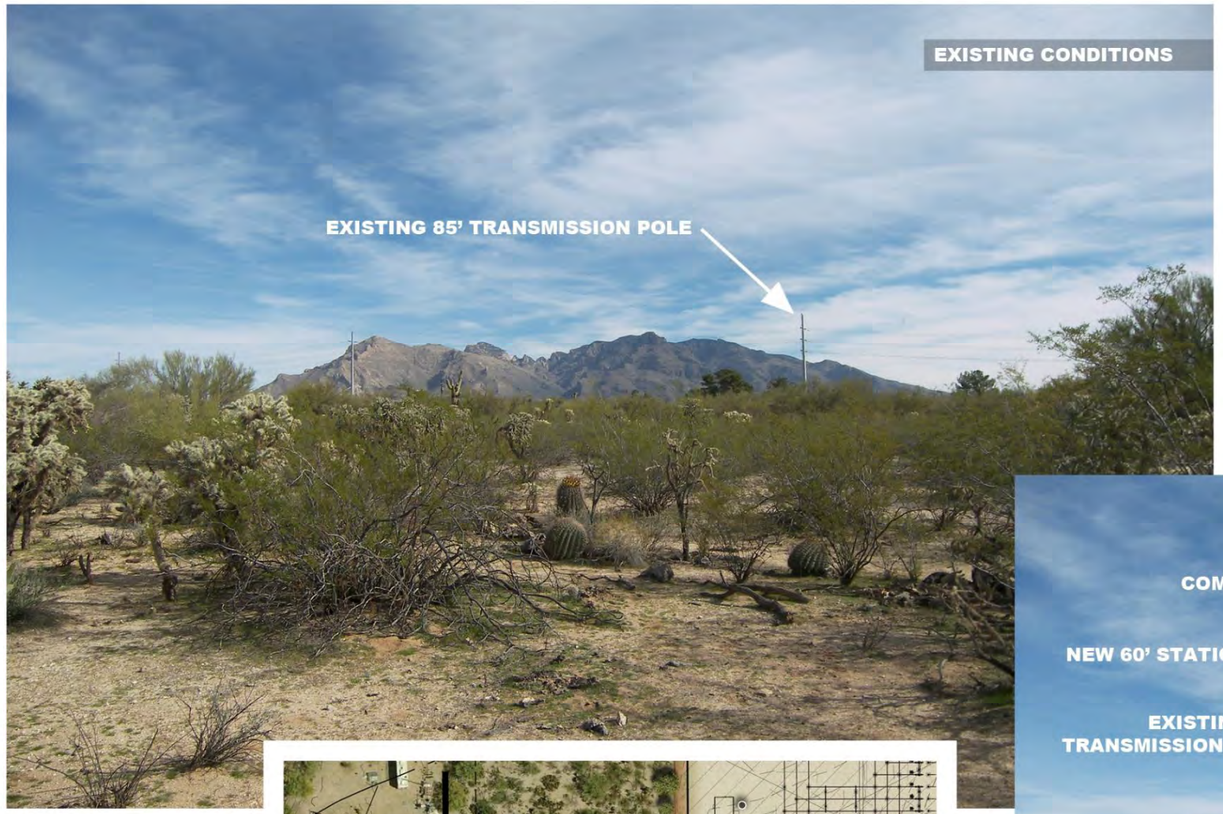


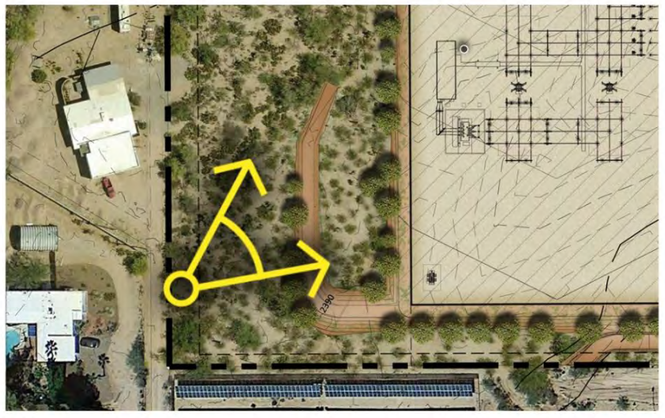
Exhibit II.C.3: Photo Simulation 3



TUCSON ELECTRIC POWER
ORANGE GROVE SUBSTATION
PHOTO SIMULATION #3

ON THE SOUTHWEST
CORNER OF THE
PROJECT SITE,
LOOKING NORTHEAST

LANDSCAPING TREATMENT IS REPRESENTATIVE ONLY, AND REFLECTS THE ANTICIPATED TYPE OF LANDSCAPE PLANTINGS AT MATURITY.



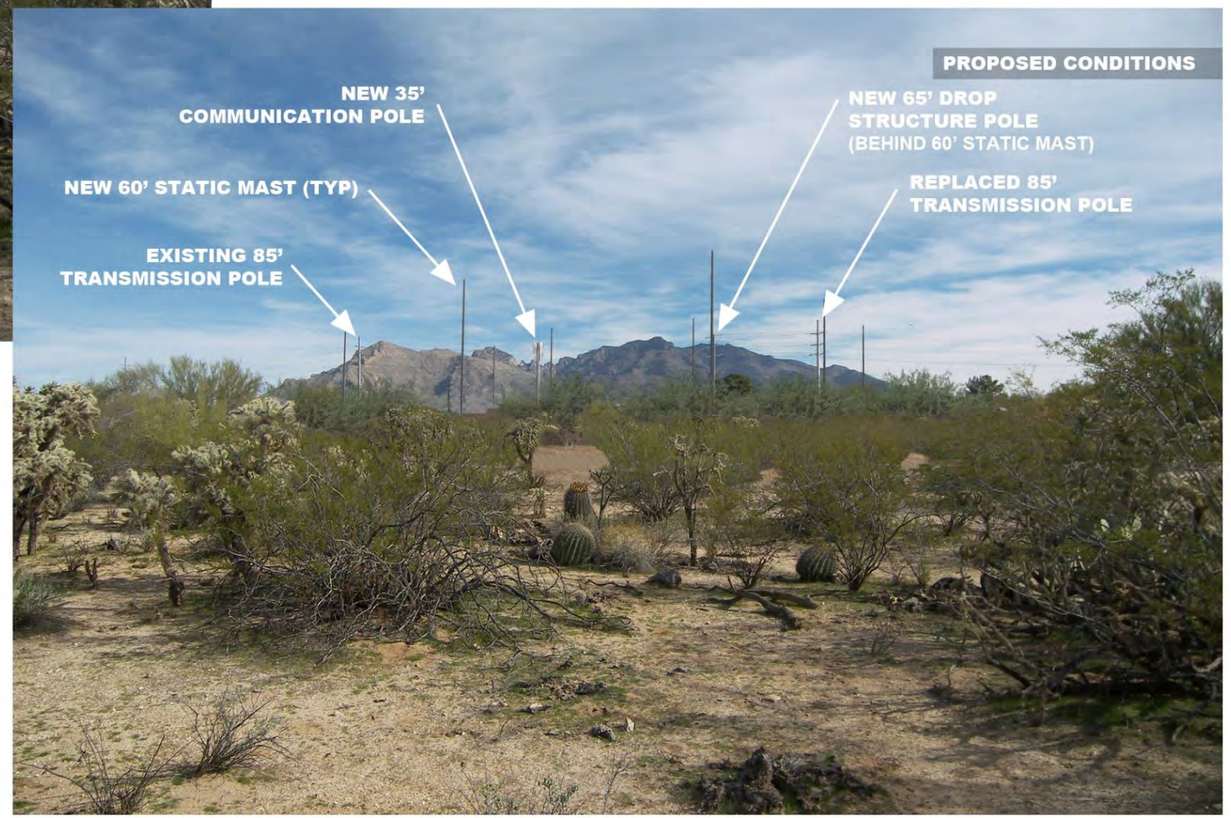
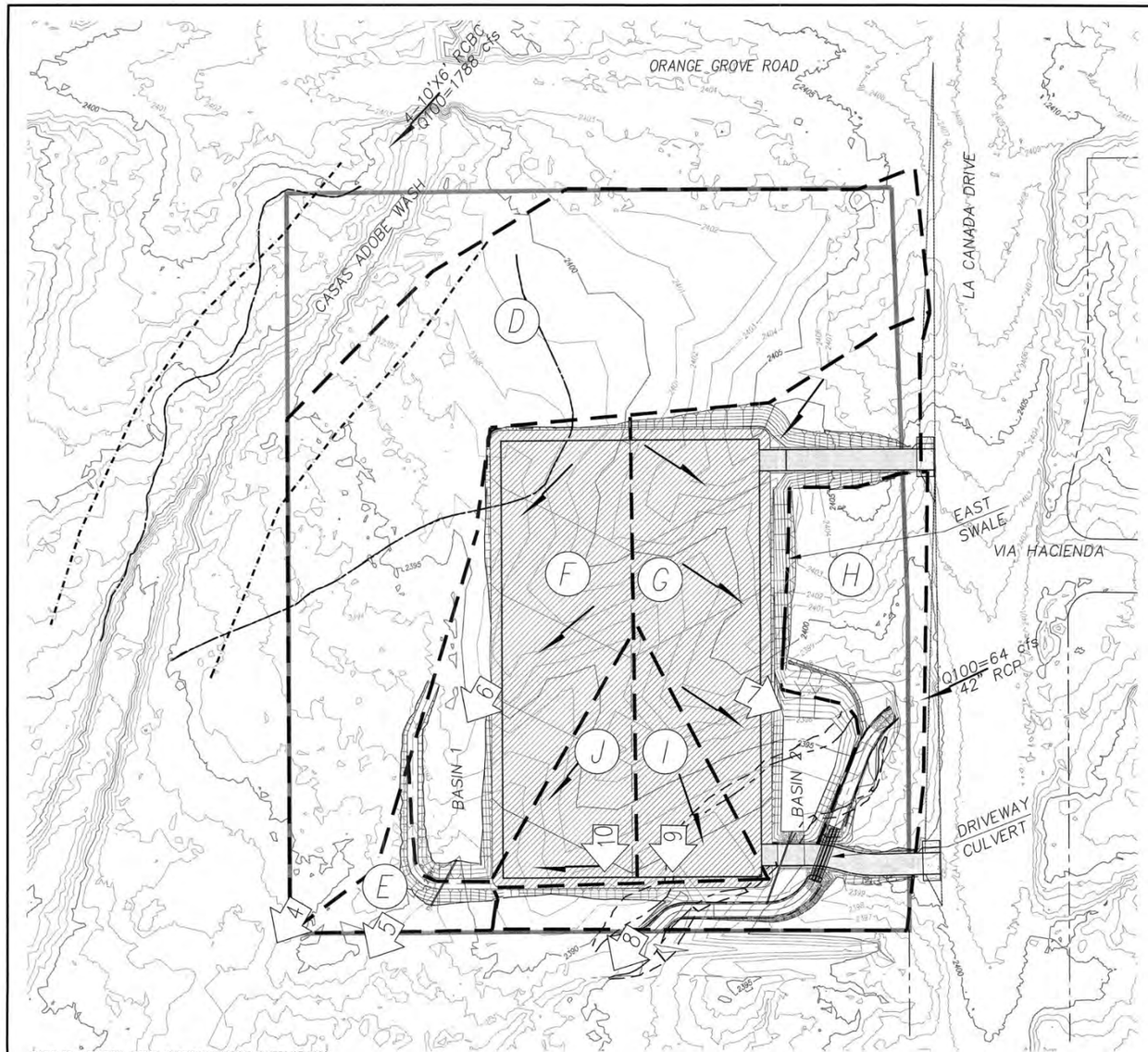


Exhibit II.F.1: Post Development On-site Hydrology



DISCHARGE SUMMARY		
WATERSHED	AREA (AC)	100-YEAR DISCHARGE
D	4.17	30
E	0.03	0.2
F	1.71	15
G	2.01	18
H	1.32	10
I	0.37	3.2
J	0.37	3.2

CONCENTRATION POINT SUMMARY		
CONCENTRATION POINT	CONTRIBUTORY WATERSHEDS	100-YEAR DISCHARGE
4	D	30
5	E	.2
6	F	15
7	G	18
8	H,I,J, OFFSITE	78.4
9	I	3.2
10	J	3.2

KEY

- 1 2 — CROSS SECTION
- (1A) — DRAINAGE AREA
- ---------- — EROSION HAZARD SETBACK LINE
- — — — — — WATERSHED BOUNDARY
- FLOW DIRECTION
- ---·---·--- — 100 YEAR FLOODPLAIN
- PROPERTY BOUNDARY
- X — CONCENTRATION POINT

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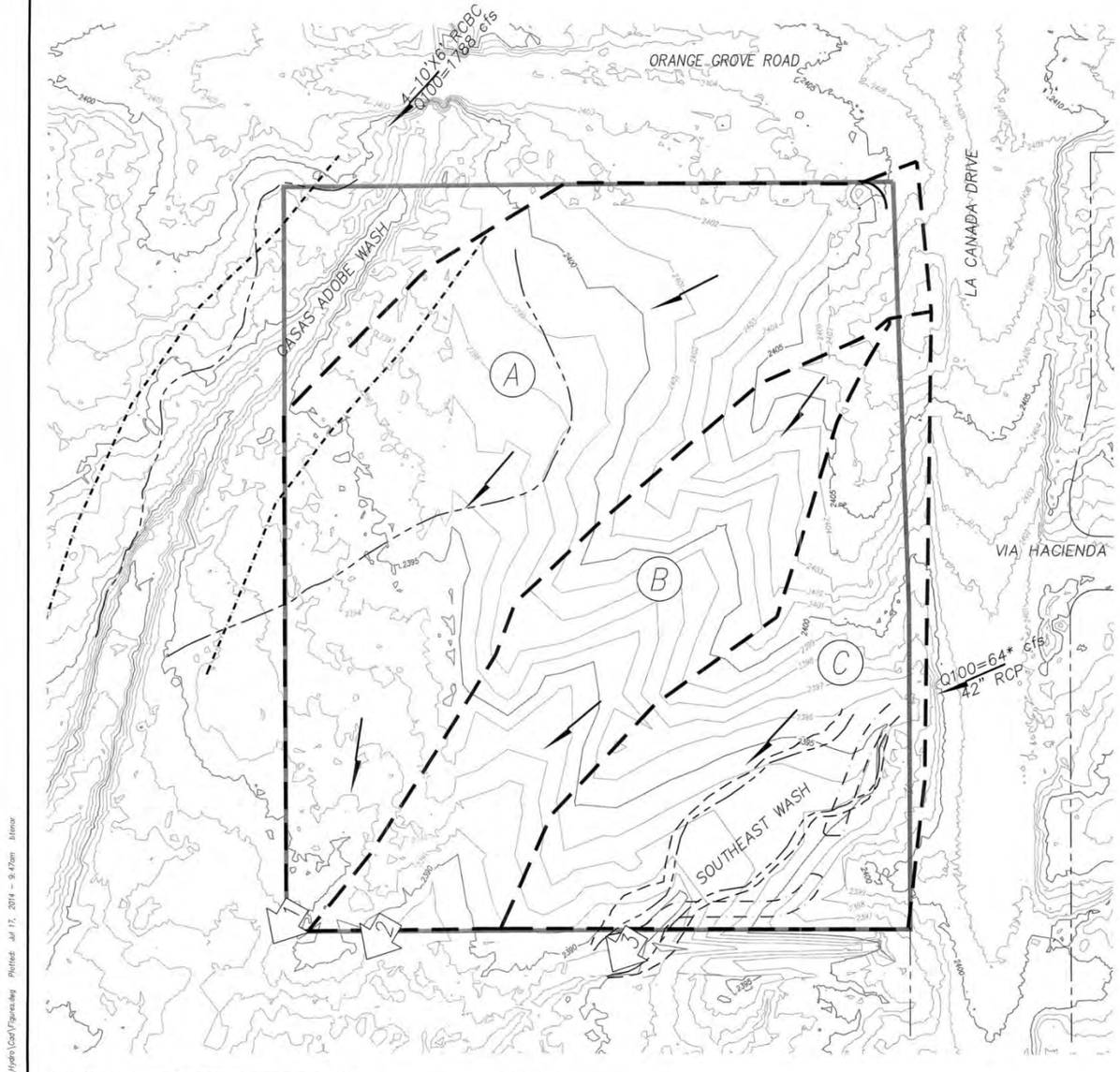
Engineering and Environmental Consultants, Inc.
4625 E. FT. LOWELL RD.
TUCSON, ARIZONA 85712 520-321-4625

FIGURE 4-PROPOSED
TEP--ORANGE GROVE SUBSTATION
A PORTION OF SECTION 10
TOWNSHIP 13 RANGE 13 G&SRM
PIMA COUNTY, ARIZONA

DESIGNED BY: JAL
DRAWN BY: JAL
CHK'D BY: JTM
DATE: SEE COVER
SCALE: AS NOTED

D:\20414.74 TEP Orange Grove\Hydro\Cad\Figures.dwg Plotted: Jul 17, 2014 - 9:37am blenor

Exhibit II.F.2: Pre-Development On-site Hydrology



DISCHARGE SUMMARY		
WATERSHED	AREA (AC)	100-YEAR DISCHARGE
A	4.28	30
B	1.91	14
C	2.71	20

CONCENTRATION POINT SUMMARY		
CONCENTRATION POINT	AREA (AC)	100-YEAR DISCHARGE
1	4.28	30
2	1.91	14
3	2.71+OFF SITE	20+64

*DISCHARGE AFTER LA CANADA DRIVE–RIVER ROAD TO INA ROAD IMPROVEMENTS 100–YEAR DISCHARGE PRIOR TO IMPROVEMENTS WAS REPORTED AS 163 CFS.

KEY

1A — DRAINAGE AREA
EROSION HAZARD SETBACK LINE
WATERSHED BOUNDARY
FLOW DIRECTION
100 YEAR FLOODPLAIN
PROPERTY BOUNDARY
X — CONCENTRATION POINT

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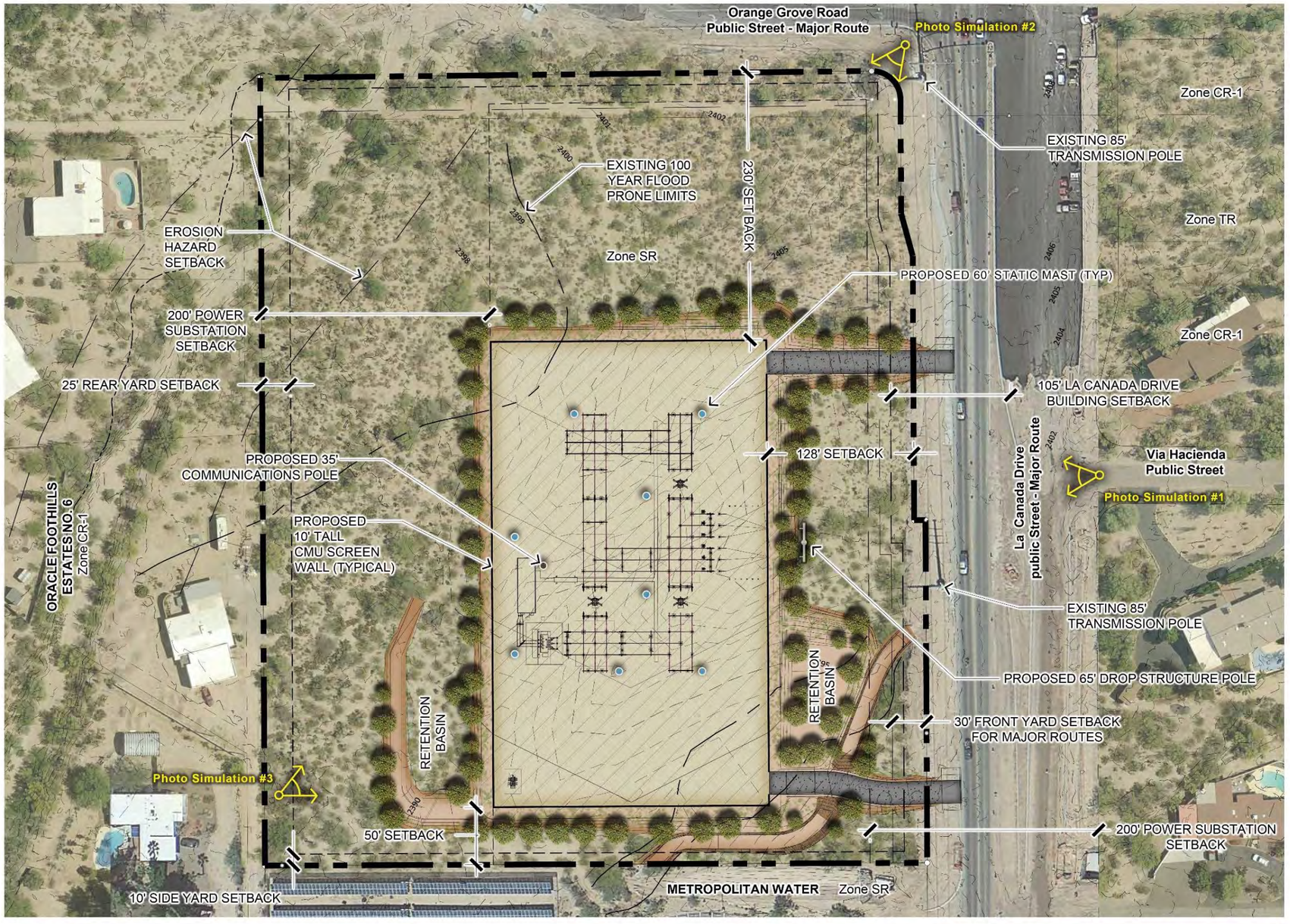
TUCSON, ARIZONA 85712 520-321-4625

FIGURE 3-EXISTING
TEP–ORANGE GROVE SUBSTATION
A PORTION OF SECTION 10
TOWNSHIP 13 RANGE 13 G&SRM
PIMA COUNTY, ARIZONA

Exhibit II.G: Preliminary Site Plan



LEGEND

- Proposed 4" Stabilized Base
- Proposed Pavement
- Existing Contour - 1' Interval
- Proposed Contour - 1' Interval
- Building Setback
- Proposed 10' Tall CMU Screen Wall
- Existing 100 Year Flood Prone Limits
- Proposed Tree - 15 Gallon Size
- SR — Existing Zoning

LOCATION MAP

SECTION 10, TOWNSHIP 13 SOUTH, RANGE 13 EAST, G&SRB&M, PIMA COUNTY, ARIZONA

LOCATION MAP
SCALE: 3" = 1 MILE

PROPOSED TEP ORANGE GROVE SUBSTATION

THIS EXHIBIT WAS CREATED USING THE MOST RECENT AVAILABLE BOUNDARIES, ROAD ALIGNMENT, AND EASEMENT DATA PROVIDED BY THE DIFFERENT GOVERNMENTAL ENTITIES AND ENGINEERING FIRMS AND IS FOR PLANNING PURPOSES ONLY. FINAL AREA TOTALS BASED ON ENGINEERED DATA MAY VARY FROM THOSE SHOWN ON THIS EXHIBIT.

0' 40' 80' NORTH

PROJECT:TEP-22 DATE:07/17/14
FILE NAME: TEP-22 SITEPLANRENDERING-B.DWG

TEP Tucson Electric Power

eec

THE PLANNING CENTER a division of TPG Group, Inc. 110 S Church Ste 6320 Tucson AZ 85701

Tucson Electric Power Orange Grove Substation

III. Environmental Analysis

THE PLANNING CENTER
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A. Existing Land Use

The Orange Grove Substation site consists of undeveloped private land that is surrounded by single- and multi-family residential and commercial development. Pima County road right-of-way is adjacent to the north and east property boundaries of the site.

Table III.A lists the existing land uses that occur within a quarter-mile of the proposed substation. These land uses are shown on Exhibit III.A.

Table III.A: Existing Land Uses

Use	Notes
Oracle Heights Estates	• Located north of the proposed substation (north of Orange Grove Road) • Existing single-family residential homes • Lots 298 - 349
Orange Grove Office Park	• Located on the Northeast corner of Orange Grove Road & La Canada Drive • Existing medical office condominium development
Ranch House Estates	• Located east of the proposed substation (east of La Canada Road) • Existing single-family residential homes • Lots 1-26
Metropolitan Water Company	• Located south of the proposed substation • Existing corporate office building and solar power facility.
Oracle Foothills Estates No. 6	• Located west of the proposed substation • Existing single-family residential homes • Lots 1-23 & Lots 35-37
Oracle Foothills Estates No. 6	• Located south and southwest of the proposed substation (south of the Metropolitan Water Company parcel) • Existing single-family residential homes • Lots 24-34 & Lots 38-130

Exhibit III.A: Existing Land Uses

LEGEND

- Site Boundary
- Approved Development Plans
- Approved Subdivisions

NORTH 0' 250' 500'

FILE NAME: TEP22_ex_uses_6x8.mxd
SOURCE: Pima County GIS, 2014

B. Fish, Wildlife and Plant Life

Bowers Environmental Consulting (BEC) conducted a Biological Evaluation (BE) of the proposed substation site in November 2013 (see Appendix C of this report). The purpose of the BE is to evaluate the potential for occurrence of any threatened and or endangered species, as well as other species of concern (special status species) within the project area and identify any impacts on these species. Special status species include all plants and wildlife that are protected, considered for protection, or afforded special conservation status by federal, state, and local government agencies. The scope of the BE that included background research, a site visit, and special status species screening analysis followed standard industry protocol that is commonly used by consulting biologists to evaluate potential effects of commercial projects on special status species.

1. Vegetation

Native vegetation within the project area is consistent with the Arizona Upland Subdivision of the Sonoran desertscrub biotic community. This vegetation community consists of a scrubland or low woodland of leguminous trees with an understory of shrubs and perennial succulents. Dominant plants include foothill palo verde (*Cercidium microphyllum)*, *Prosopis velutina* (velvet mesquite), catclaw acacia (*Acacia greggii)* cholla cactus (*Opuntia* spp.), and triangle-leaf bursage (*Ambrosia deltoidea)*. Several mature saguaro cactus are also located on the property (See Exhibit III.B.1: Vegetation Associations.)

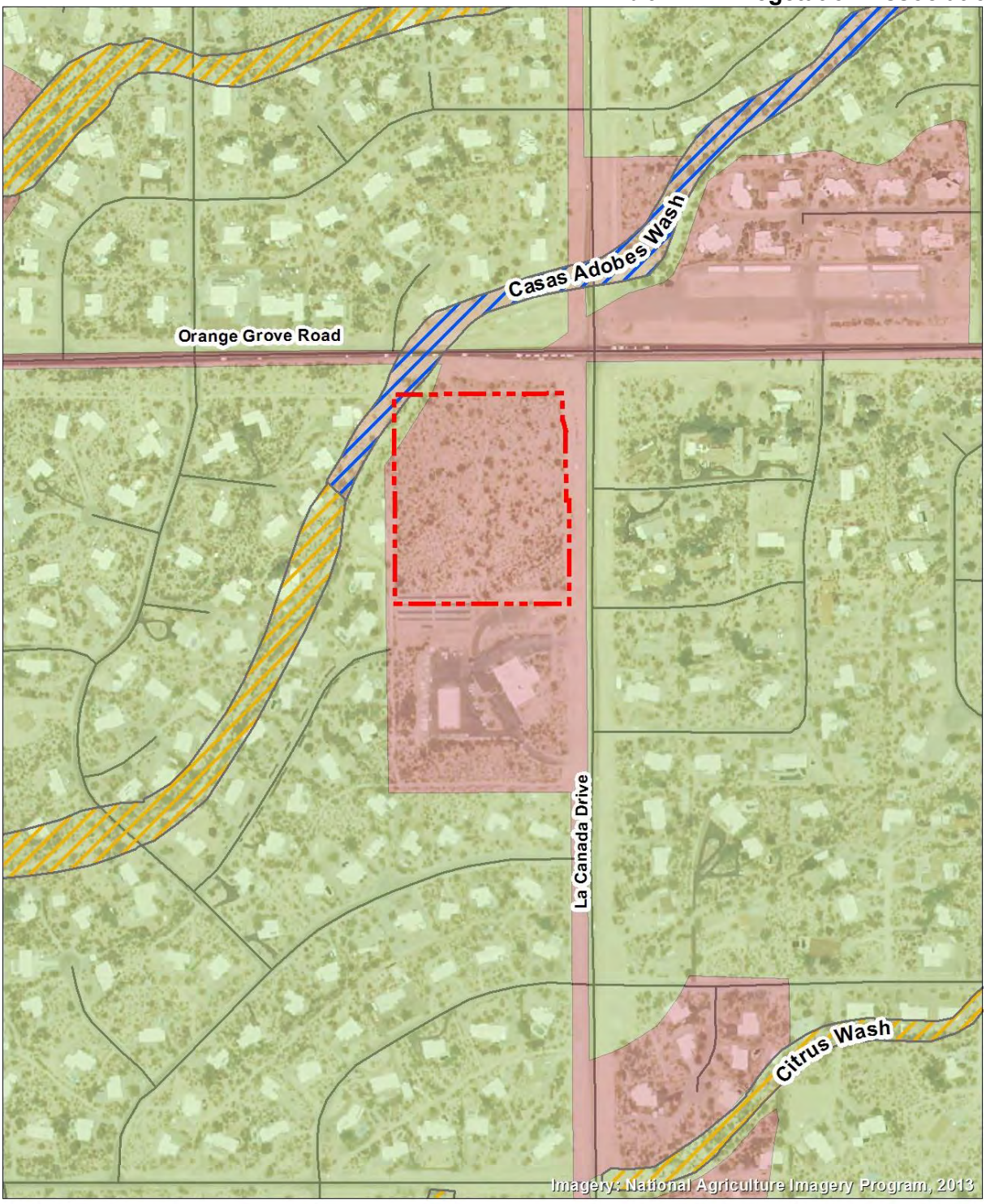
2. Sources of Surface Water

According to the BE there is no natural perennial surface water within the site. Casas Adobes Wash that crosses the northwest corner of the site is an ephemeral drainage that only flows in response to sustained summer and winter storm events. The dense vegetation that grows along this wash is classified as Xeroriparian “C” regulated riparian habitat (RRH) by Pima County Regional Flood Control District (PCRFD).

3. Rock Outcrops, Talus Slopes, Other Habitat Features

There are no rock outcrops, talus slopes, caves, adits, cliffs, tall trees or snags, or similar habitat features within the vicinity of the site.

Exhibit III.B.1: Vegetation Associations



LEGEND

- Site Boundary
- Xeroriparian C
- Mesoriparian H
- Agriculture / Developed / Water / Bare Ground
- Sonoran Desertscrub

NORTH 0' 250' 500'

FILE NAME: TEP-22_vegetation_6x8.mxd
SOURCE: Pima County GIS, 2014

4. State and Federal Special Status Species

BEC obtained a list of threatened or endangered species for the Project Area from the U.S. Fish and Wildlife Service (USFWS) Information, Planning, and Conservation System (IPAC) online database. They also used the HDMS On-line Environmental Review Tool to identify any known accounts of federal or state special-status species that may occur within a 3-mile radius of the Project Area. The endangered lesser long-nosed bat and the threatened Northern Mexican gartersnake are the only two federally listed species that were identified as potentially occurring at or near the project area. Table III.B.5 lists all the special status species identified as potentially occurring within the project area.

Table II.B.5: Special Status Species That May Occur on the Orange Grove Substation Site

Scientific Name	Common Name	ESA	USFS	BLM	State
Bat Colony					
Choeronycteris mexicana	Mexican long-tongued bat	SC	S	S	WSC
Chionactis occipitalis klauberi	Tucson shovel-nosed snake	C			
Coccyzus americanus	Yellow-billed cuckoo	PE			
Empidonax traillii extimus	Southwestern willow flycatcher	E			
Gopherus morafkai	Sonoran desert tortoise	C			
Kinosternon sonoriense longifemorale	Sonoyta mud turtle	E			
Panthera onca	Jaguar	E			
Leptonycteris curasoae yerabuenae	Lesser long-nosed bat	E			WSC
Macrotus californicus	California leaf-nosed bat	SC	S	S	WSC
Mammillaria thornberi	Thomber fishhook cactus				SR
Sterna antillsrum browni	California least tern	E			
Strix occidentalis lucida	Mexican spotted owl	T			
Thamnophis eques megalops	Northern Mexican gartersnake	T	S		WSC
Tumamoca macdougalii	Tumamoc Globeberry		S	S	SR
Status Definitions:	SC - Special Concern C - Federal Candidate E - Endangered / PE - Proposed Endangered T - Threatened / PT - Proposed Threatened S - Sensitive SR - Salvage Restricted WSC - Wildlife of Special Concern				

The screening analysis completed in the BE discounted all of the special status species except the lesser long-nosed bat. Suitable habitat for these species does not occur or the site is not within the documented range and distribution for the special status species. While there is no roosting habitat for the lesser long-nosed bat (LLNB), this species may forage on saguaro cacti that are found on the site and adjacent lands. There are approximately 8 mature (>8 feet tall) flowering saguaro cactus on the site that may provide forage opportunities for the lesser long-nosed bat. All existing Saguaro cacti, Ironwood trees, and other protected native vegetation will be mapped and identified at the time of development. TEP will avoid and or re-plant any saguaros and other vegetation in order to comply with the Pima County Native Plant Preservation Ordinance. Thus, any effects of the project on foraging habitat for lesser long-nosed bat would be temporary and minimal. Based on this evaluation and the proposed conservation measures, the Project may effect, but is not likely to adversely affect the current population of LLNB in Arizona. Furthermore, the Project would not jeopardize the continued existence of LLNB in Arizona or throughout its current range. None of the other listed species for Pima County have the potential to occur on or near the site.

5. Migratory Bird Act

According to the Biological Evaluation conducted by BEC, a variety of migratory birds occur within the project area including mourning dove (*Zenaida macroura*), song sparrow (*Melospiza melodia*), and cactus wren (*Campylorhynchus brunneicapillus*). Recommendations suggest site grading not take place during the breeding/fledging season (May-August) and that disturbance be minimized by avoiding large trees if possible. If site grading occurs during the breeding/fledging period, trees and other plants suitable for nesting such as cholla and saguaro should be inspected for active bird nesting activity before construction begins.

6. Vegetation Inventory

The substation would be constructed near the southern property boundary to avoid Casas Adobes Wash, Pima County Regulated Riparian Habitat, and the saguaro cactus which are located near the north side of the site. More than 30% of the site will be avoided in accordance with the Set Aside Methodology of the Pima County Native Plant Protection Ordinance.

7. Sonoran Desert Conservation Plan

In accordance with the Conservation Lands System Map, a small segment of important riparian area is located along Casas Adobes Wash near the northwest corner of the site. This habitat will be avoided and preserved in place (See Exhibit III.B.1: Vegetation Associations).

The site is not within a designated Critical Landscape Connection.

8. Preliminary Mitigation Measures

Preliminary mitigation measures for the proposed Orange Grove Substation include an inventory of existing native plants located on site and planting of native vegetation to screen the proposed substation from the adjacent neighbors. The proposed vegetative screen will incorporate transplanted trees as well as newly planted trees, shrubs, and ground cover that are consistent with the surrounding neighborhood landscape. This includes native Mesquite, Palo Verde, Acacia and Saguaros.

The installation size of the landscape trees (other than transplants) will include1/3 of the trees @ 15-gallon size and 2/3 of remaining trees @ 24" box size. The installation size of the landscape shrubs will be a minimum 5-gallon size as required by the Pima County Development Standards. TEP will be responsible for assuring the establishment of the proposed landscape improvements through proper irrigation and maintenance until the vegetation is self-sustaining (estimated at 3 years). The landscape and irrigation improvements are intended to establish a native plant screen around the substation.

A Native Plant Preservation Plan (NPPP), Landscape Plan, and Irrigation Plan will be prepared and submitted to Pima County as required by the Pima County Land Use Code prior to construction. It is expected that the NPPP will follow the 30% set-aside Methodology and viable Saguaros and any Ironwood trees on site will be salvaged for transplant. Maintenance of the landscape improvements (including the screen wall) will be the responsibility of TEP. Trees, shrubs, and/or cacti that die within the establishment period (3 years) will be replaced by TEP.

C. Noise Emissions

Substation equipment will comply with noise emission requirements under Pima County Code Section 18.07.040 (B)(5)(e) (1&2) for a power substation. The sound level emitted by the facility shall not exceed 45 dBA at the property line and the operation of electrical equipment will not result in TV interference (TVI) or radio frequency interference (RFI).

D. Recreational Activity

The substation site will not be designed to encourage recreational activity. Access into the substation will be gated and strictly limited to TEP employees and contractors.

E. Scenic Areas, Historical Sites and Structures or Archaeological Sites

Tierra Right of Way Services, LLC (Tierra) performed a Class III archaeological survey of the site on November 8, 2013 (See Appendix D). The purpose of the survey is to identify, record, and assess the significance of any prehistoric or historic cultural resources that might be adversely affected by ground-disturbing activities associated with the installation of the substation. This survey was conducted to meet the requirements of Section 106 of

the National Historic Preservation Act (NHPA) and federal regulations at 36 CFR 800, as well as state and county requirements.

La Canada Drive and Orange Grove Road are designated Major Routes. Neither roadway is a designated Scenic Route in Pima County.

No archaeological sites, isolated occurrences, or historic buildings requiring recordation, or any other properties potentially eligible for inclusion on the National Register of Historic Places (NRHP), or Arizona's State Register of Historic Places (SRHP), were identified on the project area. Tierra's report recommends that a finding of "no historic properties affected by this proposed undertaking" be issued. They further recommend that authorization for TEP to proceed with installation of the substation within the bounds of the area covered by this survey be granted without any further archaeological work.

F. Cost Estimate

The estimated cost is approximately 10.4 million dollars. This estimate includes land acquisition, engineering and planning, site preparation and construction costs.

G. Safety and Health Effects

TEP will comply with all federal, state, and local safety and health regulations during the construction and operation of the Orange Grove Substation. Based on the operation of similar substations in Pima County, no adverse effects on human health and safety is anticipated. Dust emissions will be managed as required, and all noise/dust impacts will be construction related and temporary in nature and will therefore not cause any adverse safety or health issues.

Bibliography

Aerial Photographs, Pima County GIS, 2014.

Biological Evaluation, Bowers Environmental Consultants, 2014.

Class III Archaeological Survey, Tierra Right of Way Services, LLC November 8, 2013.

F.I.R.M. Flood Insurance Rate Map, Pima County, Arizona.

Final Planning Memo 06-38 Rev-1, Tucson Electric Power Company, October 18, 2007.

North American Electric Reliability Corporation Planning Standards.

Pima County Wildlife Habitat Inventory Phase II, University of Arizona, 1995.

Pima County Geographic Information Systems Mapguide, 2014.

Proposal for Phased Data Recovery at AZ DD:4:43(ASM), Tierra Archaeological Report No. 2007-103, March 26, 2008.

Sonoran Desert Conservation Plan Interactive Mapguide. 2014.

Tucson Electric Power Ten-Year Transmission Plan, 2014.

USGS Topographic Map, Tucson North Quadrangle Map.

Western Electricity Coordinating Council System Performance Criteria.

Tucson Electric Power Orange Grove Substation

Appendix A

Neighborhood Meeting Summary

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110 s church ste 6320 tucson az 85701

TEP Orange Grove Substation Neighborhood Meetings Summary

Tucson Electric Power Company (TEP) invited neighbors residing within 600 feet of the proposed Orange Grove Substation project to attend two neighborhood meetings held on April 16, 2014 and May 28, 2014 at the Metropolitan Water Company Board Room located at 6265 N. La Canada Drive, Tucson, Arizona. The purpose for the two meetings was to introduce neighborhood residents to representatives from TEP, as well as to review plans for the project and address neighborhood questions and concerns. The proposed Orange Grove Substation will be located on 9.085 acres at the southwest corner of La Canada Drive and Orange Grove Road. A total of 36 residents attended the two meetings.

Following initial introductions of TEP representatives and the consultant team, Larry Lucero, Senior Director of Government Relations & Economic Development, opened both meetings by providing background of the project and the need for a substation at this location. The Orange Grove Substation project is an urgent priority for TEP to ensure capacity and reliability to its current and future residential and commercial customers in their northwest service area. The project will include a new 138 kV power substation that will connect to the existing 138 kV transmission line located on the west-side of La Canada Drive. Mr. Lucero explained that the Orange Grove Substation is located in an area of continued growth and is presently experiencing capacity problems with overloaded circuits, an overloaded transformer, and several single-outage contingency problems. The proposed Orange Grove Substation will address the current and future overload situation and bring existing transformers under their load ratings.

Steve Hagedorn of The Planning Center provided general site and zoning information and explained the Power Substation Permit process, noting the proposed substation has been designed as a low profile neighborhood substation. Mr. Hagedorn explained that electric substations are permitted by right within any zoning district in Pima County. To assure that a substation is compatible with surrounding residential development, Pima County requires a Power Substation Permit be obtained that complies with certain additional design criteria and setback requirements. Each of these requirements has been met. The Power Substation Permit Application will be submitted to Pima County Staff, who will review the application and make recommendations to the Board of Supervisors (BOS) for their approval. Pima County Staff will notify all property owners residing within 600 feet of the substation property when the date for the BOS Hearing has been set.

Mr. Hagedorn reviewed specifics of the site plan with the audience to explain how the plan meets all substation permit requirements, zoning setback requirements, landscape and screening requirements, and various other elements of the site layout. Bruce Wilson from EEC Engineering reviewed specifics of the site grading and hydrology of the property detailing how the development of the site will not negatively impact existing drainage patterns. He explained that Pima County requires the difference in run off, pre to post development, must be contained on site and that the retention basins shown on the site plan will assure that post development runoff is equal to or less than pre development runoff from the 9 acre site.

The meetings were then opened up for questions from the audience. Residents attending the two neighborhood meetings raised numerous questions focusing on a variety of topics related to the project, including:

- Specifics of the site development plans;
- Specifics of the substation permit process;
- Substation impact on residents and the neighborhood;
- TEP site selection criteria;
- Safety concerns;
- Technical issues of substation operation.

TEP representatives and project consultants addressed each of the questions.

Detailed meeting minutes from both neighborhood meetings will be included in the Substation Permit Application to Pima County. Residents who wish to obtain a copy of those minutes may contact:

Pima County Development Services Department
201 N. Stone Avenue
Tucson, Arizona 85701
(520) 724-9000

Or

Tucson Electric Power
c/o Steven Eddy
TEP Governmental and External Affairs
Tucson Electric Power
520-919-8315
seddy@tep.com

Tucson Electric Power Orange Grove Substation

Appendix B

Neighborhood Meetings

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Appendix B.1: Neighborhood Meeting – April 16, 2014 Meeting Minutes

Planning

Landscape Architecture

Public Involvement

Graphic Communications

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MEETING MINUTES

Date:	April 17, 2014	**Job No:**	TEP-22
Attendees	**Project Team:** Larry Lucero (TEP), Eric Bakken (TEP), Cheryl Eamick (TEP), Rene Marruffo (TEP), Rion Bowers (TEP), Bruce Wilson (EEC), Bob Tenor (EEC), Steve Hagedorn, (TPC), Tim Johnson (TPC) **Neighborhood Representatives:** 21 Neighbors (see attached sign-in sheet)		
Location:	Metro Water Offices - 6265 N La Canada Drive		
Meeting Time	6:00 pm	**Project**	TEP Orange Grove Substation
Meeting Date	4/16/14	**Author**	Tim Johnson
Distribution:	TEP and Application		

Purpose: **TEP Orange Grove Power Substation Permit Application Neighborhood Meeting**

Larry Lucero of Tucson Electric Power (TEP) opened the meeting by explaining the background of the project and the need for a substation in this location. Items of consideration in determining this location included growth of development within the specific service area and that infrastructure needs have been growing. The three existing substations (West Ina, Rillito, and La Canada) servicing this area are close to their capacity and it was determined that a substation is needed.

Questions raised by neighbors during the presentation included:

Question: What does the existing transmission line on La Canada Drive feed.

Response: The existing transmission line provides electricity to the distribution system through existing substations for the greater northwest area of TEP's service territory.

Question: Does the existing transmission line support downtown Tucson electricity needs? What about the proposed substation?

Response: No, however, the transmission system is a looped system providing electricity to all customers within our service territory. The new substation will reduce

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electricity from the larger transmission system (La Canada power lines) to the distribution system, which provides electricity at a level that can be used by businesses and residences. The distribution system will be underground leaving the substation and the conduit for this underground system is already in place.

Question: Is the purpose of the substation to "power down" the electricity for houses?

Response: Yes, the proposed substation is needed to relieve the existing electric system deficiency and provide enough power to meet present and projected electrical loads needed in northwest Tucson. The substation will convert the electricity from the transmission lines into a usable form for businesses and residences that are serviced by the distribution system.

Question: Is it possible to increase the size / capacity of existing facilities to handle the new needs?

Response: No, the three existing substations are at their maximum buildout and cannot handle additional facilities/equipment.

Question: How big is the proposed substation?

Response: Steve Hagedorn of The Planning Center explained the power substation permit process and where the project currently is in that process. He also explained details of the site plan including the exact size of the substation property (9 acres) and the substation footprint (2.2 acres within the wall).

Question: To whom should residents send comments?

Response: Comments can be sent to Steven Eddy of TEP or Steve Hagedorn of The Planning Center and these comments will be included in the application to Pima County.

Question: What is the size of the developed/disturbed area?

Response: The disturbed areas will be approximately 3 acres, but exact calculations will be provided to neighbors.

Question: How much will neighbors lose in property values?

Response: TEP has no record of information indicating that power substations either positively or negatively impact property values of surrounding properties. Property values are commonly tied to comparable property values and current market values in a given neighborhood.

Comment: The neighbors are just recovering from loss in property values resulting from the recession and drop in property values from the recent roadway construction.

Comment: A number of neighbors expressed concern over drainage and hydrology such as recent erosion and flooding concerns relating to recent roadway work and Metro Water's installation of solar PVs.

Response: Bruce Wilson of EEC explained the cut and fill scenario for the proposed substation and how the site grading will balance the amount of graded cut and graded fill needed to create a level building pad for the substation (2-3' cut at the north end and 2-3' of fill at the south end).

Question: Can the whole substation be lowered so that there is not fill on the south end?

Response: Larry Lucero answered that TEP will take that questions back to the engineering department and look into that option.

Question: How will drainage be affected by the proposed substation?

Response: Bruce answered that two retention basins were designed to capture on-site drainage so that surface water will leave the site as it does now, with no increase in peak or overall flows.

Question: What will the ground surface be inside the wall? And will it increase the flow?

Response: Ground surface inside the wall will be compacted and stabilized aggregate base (AB). This will lead to more runoff than the current natural condition; hence the need for the proposed retention basins as shown on the site plan.

Comment: The neighborhood is now in a local flood plain and the neighbors were not notified of this change of classification.

Comment: The Metro Water solar farm has created a lot of erosion in the downstream wash.

Comment: TEP is hearing concerns related to flooding and erosion caused by roadway improvements and Metro Water development.

Question: What will be the height of the transformers?

Response: Steve Hagedorn answered that transformers will be approximately 14' tall and behind a 10' wall.

Question: What is the highest structure proposed on site?

Response: Larry Lucero explained that the drop structure will be 65' tall and a communication tower (should it be needed) will be 35' tall.

Response: Cheryl Eamick explained that the communications tower may not be needed, but that TEP wants to be upfront and show all possible conditions to the neighbors now.

Question: How many more transformers could be added to the proposed substation?

Response: Larry Lucero explained that the substation will initially have one transformer, with room to expand to a total of two transformers in the future.

Question: Will there be any noise pollution from the proposed substation?

Response: Larry Lucero explained that TEP is governed by strict noise standards and that there will be a limit of 60 dB measured at the property line. (Subsequent to this meeting, it was determined that the current Pima County Zoning Code requires a limit of 45 dB at the property lines.)

Question: What about the problems of noise at existing TEP substations?

Response: Larry Lucero was not aware of any noise issues.

Question: From where is the noise limit of 60 dB measured?

Response: Per Pima County Zoning Code, the noise limit of 60 dB is measured from the substation property line. (Subsequent to this meeting, it was determined that the current Pima County Zoning Code requires a limit of 45 dB at the property lines.)

Question: How loud is the "crackling" sound from rain when it hits wires?

Response: We do not know, but will look into it and provide an answer.

Question: What happens if lightning strikes the equipment in the substation?

Response: Larry Lucero explained that in the very unlikely event of a lightning strike there are numerous safety measures in place.

Question: Has TEP purchased the property yet?

Response: No, but TEP has an option to buy the property contingent upon approval of the power substation permit process.

Question: What about Electric and Magnetic Fields (EMF)s? Will there be any negative effects due to the proposed substation and the existing transmission lines?

Response: Larry Lucero described that the best protection from EMFs is distance and that this substation is setback 200 feet from all residential boundaries. Larry is confident that there is no impact to the neighbors and that he would personally be more concerned about electrical appliances in the home than the existing transmission lines or the proposed substation. TEP will provide neighbors with general EMF information.

Question: How is it determined how many substations are needed and where they are needed?

Response: Rene Marruffo of TEP explained the multi-year process that has occurred and what factors determine the location such as: load, need, vacant land, proximity to transmission line, property size (trying to avoid assemblage), among others. There were a couple other site looked at as possible options.

Comment: A neighbor made the comment that the proposed facility will be more attractive than the older existing facilities.

Question: Why not build the substation at another location in the flood plain where it won't bother anyone?

Response: TEP evaluates a number of factors in determining the viability for substation sites. One factor is proximity to flood prone areas that are not suitable due the critical infrastructure nature of substation facilities. Substation facilities must provide services during certain conditions.

Question: The growth at the NW Hospital is causing the need for this substation so why not put the substation there?

Response: TEP looked into site alternatives and there are very limited options. One of the overriding criteria is proximity to transmission lines, which this site meets.

Question: What other sites were considered?

Response: TEP looked at a number of other available sites within the electrical load area and evaluated them against certain criteria such as center of load, proximity to transmission lines, availability, size, etc.

The following is from the power substation permit application that will be submitted to Pima County and is provided herein as additional information.

Selection Criteria (Not Necessarily in order of Importance)

1. *The site's location within the electrical load area as determined by TEP Substation District Planning.*
2. *The site location within two spans of the connection transmission line.*
3. *The size of the site. The site needed to be nine to ten acres minimum size in order to meet various jurisdictional setback requirements for substation development.*
4. *The site's potential impact to local environmentally sensitive washes and riparian areas.*
5. *The availability of the site. The site needed to be for sale or have a willing seller.*
6. *The substation's potential development impact on surrounding land uses, particularly on existing adjacent residential land uses.*

Question: Why does TEP need 9 AC?

Response: This is needed due to setback requirements.

Question: Were other alternative locations also in residential areas?
Response: Yes, some of them were even further into the neighborhoods.

Question: What drives the locations of the new substations?

Response: Rene Marruffo of TEP answered that to a very large extent it is the load and the need. Numerous factor go into the evaluation of possible sites such as: area, center of load, within 2 spans of transmission lines, impacts to neighbors, impact to natural resources, and availability. (See answer in in questions above).

Question: What is the EMF emitted from the poles of the transmission line?

Response: Larry Lucero explained there is no EMF from the poles. The line conducts the electricity, not the poles. He further explained the type of transmission lines located along the La Canada corridor, which include TEP's 138 kV and WAPA's 115 kV circuits that are co-located on the transmission poles.

Question: What is the EMF inside the substation wall? And what effect does it have on neighbors?

Response: TEP will provide neighbors with EMF information.

Question: What effect will the proposed substation have on neighbor's Wi-Fi and TVs?

Response: Larry Lucero explained that TEP facilities cannot cause interference with personal or public electronic devices by law.

Question: What size trees will be installed?

Response: Some 15 gal and 24" box trees and some transplanted trees will be installed. Details will be determined when the Native Plant Preservation Plan (NPPP) is submitted during the development plan process after the Power Substation Permit Application is approved. The landscape concept for the substation is to revegetated areas of disturbance outside of the substation wall and provide for a vegetative screen consisting of native tress, plants, and accents.

Question: Will bill rates be lowered for neighbors since the substation is going in their area?

Response: Larry Lucero explained that TEP is trying to be cost effective for the all users. TEP just completed a rate increase request/review and they are not permitted another request until three years into the current rate increase. Larry explained that the current rate increase has to do mainly with requirements related to infrastructure improvements, increased efficiency, renewable energy portfolio, and environmental constraints.

Question: What is TEP going to do about impacts to wildlife?

Response: Rion Bowers of TEP explained that the Casa Adobes Wash will remain undisturbed. Other environmental and cultural clearances have been performed.

Question: What can currently be built on the site if TEP's application does not get approved?

Response: Steve Hagedorn explained the status of the conditionally approved TR zoning on the property and that it allows development of an office complex with building heights of up to 24 feet (limited to one story at northwestern corner). The conditionally approved rezoning includes: 80,000 sq.ft. of office space between four buildings, 267 parking stalls, and a 14,700 sq.ft. retention basin. Steve explained that comparatively, TEP's substation would be a relatively benign use with no traffic, no parking, no employees, and no lighting.

Question: What about lights? Will the substation be lit at night?

Response: Emergency lighting is available for emergencies and maintenance. There will be no dusk to dawn lighting within the substation.

Question: Who is responsible for cleaning up any graffiti?

Response: TEP is responsible for graffiti abatement and removal.

Question: What is the timeline for the project?

Response: Steve Hagedorn explained that the Power Substation Permit Application process will hopefully be approved this year. Construction not likely to start until 2016-2017 and would last about 18 months.

Question: What if all the neighbors' comment are negative? Will the Board of Supervisors (BOS) take that into consideration?

Response: The BOS will take into consideration staff recommendations, neighbors' comments, and other information they are presented in public hearing before making a decision. It is the sincere hope of TEP that neighbors will see the benefit of this project and show their support.

Question: Does the existing La Canada substation have a communications tower?

Response: Yes

Steve Hagedorn of TPC then explained the photo-simulations that were prepared to depict the post development views.

Meeting was adjourned and neighbors were asked to sign in if they had not already and provide written comments via the comment sheets handed out during the meeting (see attached written comments from those present).
Authored by: Tim Johnson

THE PLANNING CENTER

Appendix B.2: April 16, 2014 Neighborhood Meeting Sign-in Sheets

Tucson Electric Power

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Neighborhood Meeting
Sign-in Sheet
Tucson Electric Power Orange Grove Substation **4/16/2014**

Name	Address	Phone	Email Address
Cherie Landan	1530 W. Calle Del Media	760-8826	Clamdan@yahoo.com
Sheila + Richard Huguenin	1540 W. Calle del Media	297-0474	shuguenin@centurylink.net
Ben Becken	17320 W. San Blas Pl	909-2302	ben.becker@cbre.com
Adam Becken	1200 E. River Rd. K-144	271-4082	adam.becker@cbre.com
Bill + Denise Gose	1550 W. Calle del Media	575-8487	bdgose@gmail.com
[illegible]	1560 W Placita Almeda	742-3254	vitalp_sal@hotmail.com
Josh Lake	1550 W Placita Almeda	(520) 248-0046	jlake1222@Hotmail.com
John Cullor	1521 W. Calle Tiburon	888.6533	JOHN@CULLORSIGNS.COM
Rian Bowers	Bowers Environmental Consulting	520-909-8864	rbowers@TEP.com

TEP Tucson Electric Power

THE PLANNING CENTER a division of TPC Group, Inc.

Neighborhood Meeting
Sign-in Sheet
Tucson Electric Power Orange Grove Substation **4/16/2014**

Name	Address	Phone	Email Address
Rebecca Rodrigues	3228 E. GLENN ST TUCS, AZ	520-312-4991	rdrgsb@aol.com
RON CARREON	6405 N. PLACITA TRANQUILA	7421065	Ronard JCarreon@AOL
Bruce Wilson	4625 E Ft. Lowell	321-4625	bwilson@eeccorp.com
Gina Genova	1340 W. Via Hacienda	297-0440	genova-71@gmail.com
[illegible]	1340 W Via Hacienda	17	
[illegible]		745-3407	
[illegible]	1510 N Calle Tiburon	297 1533	sanspang@gmail.com
[illegible]	6110 N. Placita Tiburon	297-5376	michelle71@Comcast.net
Robert MacDonald	6110 N. Placita Tiburon	297-5376	
KEITH & GAIL ADAMS	1600 N. CATALINA DEL MORTA	797-1795	KGADAMS@LIVE.com
DANIEL & ROBIN LUBBEN	1609 W Placita Malaga	909-9732	LUBBEN1956@MSN.COM
Steven Amestoy	1435 W Calle Tiburon	219-1002	steveayuu@hotmail.com
RITA SILVERBERG	1435 W. Calle Tiburon	360-0545	silverbergrita011@gmail.com
Troy & Kim Olson	1342 W Via Caballo	9771127	tkogoalies@msn.com

Appendix B.3: Neighborhood Meeting 1 – April 16, 2014 Notification List

ABRAMS LUCY & SMITH BRADLEY SR JT/RS
1540 W SAN LUCAS DR
TUCSON AZ
857040000

APPIAN ESTATES AT CASA ADOBES HOA INC
1250 W APPIAN PL
TUCSON AZ
857042900
Cannot find info

ARRIETA JAVIER D & KAREN S CP/RS
1320 W VIA TIERRA
TUCSON AZ
857042813

ARTER BILLY G
6415 N PLACITA TRANQUILA
TUCSON AZ
857041103

BARKER CHAD SIDNEY & HEIDI CATHERINE CP/RS
1540 W PLACITA ALINADA
TUCSON AZ
857041065

BINNIE KARIN A
1500 W CALLE TIBURON
TUCSON AZ
857040000

BOURGEOIS HENRITETTA B
1340 W VIA TIERRA
TUCSON AZ
857040000

CAMPBELL NATHAN C & BAENA CRISTINA JT/RS
1545 W SAN LUCAS DR
TUCSON AZ
857041123

CARREON RONALD J & VICTORIA L CP/RS
6405 N PLACITA TRANQUILA
TUCSON AZ
857040000

CIRELLI JOHN & LINDA L JT/RS
1505 W SAN LUCAS DR
TUCSON AZ
857040000

COOPER FAMILY TR
ATTN: MICHAEL J & LIDIA T COOPER TR
1561 W PLACITA ALINADA
TUCSON AZ
857041065

CROSWELL JAMES K & PATRICIA A JT/RS
1541 W PLACITA ALINADA
TUCSON AZ
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DANGLE CHRISTOPHER W & LISA G CP/RS
1600 W PLACITA MALAGA
TUCSON AZ
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DILLAVOU KIM M & ELVA A JT/RS
1302 W VIA HACIENDA
TUCSON AZ
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DOWDALL REGINALD J 1/4 INT & DOWDALL JACQUELYN A
1/4 INT & DOWDALL DOUGLAS A 1/4 INT &
1321 W VIA CABALLO
TUCSON AZ
857040000

DU FOUR JEAN MARC & DU FOUR ALEXANDER L
& YVETTE D
1451 W SAN LUCAS DR
TUCSON AZ
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EAKER BOBBY E & VERNEASE JT/RSS
1341 W VIA HACIENDA
TUCSON AZ
857040000

EBELING BELINDA
1500 W CALLE DEL MEDIA
TUCSON AZ
857040000

FIRST CREDIT UNION
ATTN: BUSINESS SERVICES
25 S ARIZONA PL STE 111
CHANDLER AZ
852255537

FIRST CREDIT UNION
ATTN: BUSINESS SERVICES
25 S ARIZONA PL STE 111
CHANDLER AZ
852255537

FOX HUGH M & ARDITH EL-KAREH CP/RS
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FURRIER THOMAS K & CHERYL L CP/RS
1301 W VIA TIERRA
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GENOVA GINA L & GENOVA PEGGY N JT/RS
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GILBERT JEANNETTE TR
1355 W SAN LUCAS DR
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GOSE WILLIAM H & DENISE KRAMER CP/RS
1550 W CALLE DEL MEDIA
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GREENE DENNIS I & MARY J FORAN
6360 N POMONA
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GRUBER JOHN G
1401 W SAN LUCAS DR
TUCSON AZ
857041121

HANDY KATHERINE V
1301 W VIA HACIENDA
TUCSON AZ
857040000

HITCHCOCK NICHOLAS D & MARIA JT/RS
1341 W VIA TIERRA
TUCSON AZ
857042812

HOLLOWAY JAMES & TERESA REVOC TR
1510 W CALLE DEL MEDIA
TUCSON AZ
857041064

HOWARD JAMES R TR
1555 W SAN LUCAS DR
TUCSON AZ
857041123

HUGUNIN RICHARD & SHEILA MAE
1540 W CALLE DEL MEDIA
TUCSON AZ
857040000

JPMORGAN CHASE BANK
ATTN: TIFFANY & BOSCO
2525 E CAMELBACK RD STE 300
PHOENIX AZ
850164237

KONECNIK FAMILY REVOC TR
ATTN: STEPHEN E & PATRICIA L KONECNIK TR
7401 N MOUNTAIN SHADOWS DR
TUCSON AZ
857181082

LAMDAN ODED & CHERIE L CP/RS
1530 W CALLE DEL MEDIA
TUCSON AZ
857041064

LIBENGOOD DALE W SR & DOLORES O CP/RS
6410 N PLACITA TRANQUILA
TUCSON AZ
857041103

LOGSDON ALAN & ADELINE LIVING TR
1325 W APPIAN PL
TUCSON AZ
857042955

LUBBEN DANIEL L
1609 W PLACITA MALAGA
TUCSON AZ
857041037

METROPOLITAN DOMESTIC WATER IMPROVEMENT
DISTRICT OF PIMA COUNTY
.
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MURRAY JOAN A
1525 W CALLE DEL MEDIA
TUCSON AZ
857041063

NORTHWEST FIRE DISTRICT
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OLIWOOLABODE SUSAN E
6420 N PLACITA TRANQUILA
TUCSON AZ
857040000

OLSON KIMBERLY A & TROY R CP/RS
1342 W VIA CABALLO
TUCSON AZ
857042809

ORANGE GROVE PROPERTY LLC
1955 W GRANT RD STE 125G
TUCSON AZ
857451470
Art Kelley 520-884-5315

PANOUSOPOULOS CONSTANTINO T & NELIDA JT/RS
PO BOX 1806
NOGALES AZ
856280000

PAVONE BRENT
1302 W VIA CABALLO
TUCSON AZ
857042809

RAY DONALD EDWARD TR
6224 N PLACITA POMONA
TUCSON AZ
857041040

RICE AARON J
6401 N POMONA RD
TUCSON AZ
857041119

RICH GERALD M JR & DIANE I JT/RS
1500 W ORANGE GROVE RD
TUCSON AZ
857040000

RUBLY WILLIAM G & KIMBERLY J JT/RS
1421 W SAN LUCAS DR
TUCSON AZ
857040000

RUSSELL RANDALL & LINDA H CP/RS
1320 W APPIAN PL
TUCSON AZ
857042955

RYDER MALCOLM K & LORI M
180 E 5TH
TUCSON AZ
857058364

SHEPPERD FAMILY TR
ATTN: TYLER W & REBECCA PORTER
1601 W PLACITA MALAGA
TUCSON AZ
857041037

SMITH FAMILY REVOC TR
ATTN: JOHN ALLEN JR & SANDRA SMITH TR
1535 W CALLE DEL MEDIA
TUCSON AZ
857041063

STEWART KIM C & MARY ANN
6431 N LA CANADA DR
TUCSON AZ
857041101

STUART HEWITT J & MARY M CP/RS
1545 W CALLE DEL MEDIA
TUCSON AZ
857040000

SWINSON KAREN R
1321 W VIA HACIENDA
TUCSON AZ
857040000

TUELL GARY E & FRANCES T CP/RS
PO BOX 35865
TUCSON AZ
857405865

VAN BLOIS JOHN P & NELLY NEWMAN CP/RS
550 NE WATERWAY LN
BOCA RATON FL
334322828

VANDERAH TODD W & ANTOINETTE CP/RS
1335 W APPIAN PL
TUCSON AZ
857042955

VITALE SAL
1560 W PLACITA ALINADA
TUCSON AZ
857041065

VITALE SALVATORE & VITALE FAYBRA JT/RS
1550 W PLACITA ALINADA
TUCSON AZ
857041065

VOLPE CHRISTOPHER T & M JOANNE CP/RS
1320 W VIA HACIENDA
TUCSON AZ
857042811

WIDENER CHRISTINE A
228 S AVENIDA DEL PORVENIR
TUCSON AZ
857452540

WILT ANDREW N & MA-WILT YAN CP/RS
1565 W SAN LUCAS DR
TUCSON AZ
857041123

WOOD-BONNELL JENNIFER C & BONNELL CHARLES MICHAEL JT/RS
1520 W CALLE DEL MEDIA
TUCSON AZ
857040000

LA CHOLLA RIDGE HOA
CADDEN COMMUNITY MANAGEMENT
1870 W PRINCE RD STE 47
TUCSON AZ 85705-2969
Agnus @Cadden 520-297-0797

HILLS ON LA CANADA HOA
LEWIS MANAGEMENT
180 W MAGEE RD STE 134
TUCSON AZ 85704-6495
Kolleen @ Lewis 520-742-5674

PASEO DEL RIO COMMUNITY ASSOCIATION
CADDEN COMMUNITY MANAGEMENT
1870 W PRINCE RD STE 47
TUCSON AZ 85705-2969
Kathy @Cadden 520-297-0797

RIVER TERRACE COMMUNITY ASSOCIATION
CADDEN COMMUNITY MANAGEMENT
1870 W PRINCE RD STE 47
TUCSON AZ 85705-2969
Agnus @Cadden 520-297-0797

PUEBLO VIALLGE WEST HOA
ATTN: ADAM LLC
516 E FORT LOWELL RD
TUCSON AZ 85705-3965
Howie Hibbs @ Adam 520-624-1206

CASA DEL RIO HOA
CADDEN COMMUNITY MANAGEMENT
1870 W PRINCE RD STE 47
TUCSON AZ 85705-2969
Agnus @Cadden 520-297-0797

PUEBLO VILLAS HOA
COPPER ROSE COMMUNITY MANAGEMENT
6601 E 22ND ST STE 101
TUCSON AZ 85710-5118
Sandy&Jim@Copper Rose 520-888-0474

CASITAS DE CASTILIAN CONDOMINIUM HOA
643 W LAS LOMITAS RD
TUCSON AZ 85704
Bob Prisbe 520-293-6804

LAS LOMITAS HOA
Y CROSS MANAGEMENT
8375 N ORACLE RD STE 150
TUCSON AZ 85704-7317
Sara Butler @ Y Cross 520-219-4520

ORACLE NORTH HOA
LEWIS MANAGEMENT
180 W MAGEE RD STE 134
TUCSON AZ 85704-6495
Matthew @ Lewis 520-742-5674

PANORAMA RIDGE ESTATES HOA
PO BOX 68694
ORO VALLEY AZ 85737-0003
Chris Bruyn 520-742-3018

SUNSET RIDGE HOA
PAUL ASH MANAGEMENT CO LLC
3499 N CAMPBELL AVE STE 907
TUCSON AZ 85719-2376
Barry Edberg 520-795-2100 Ext 106

APPIAN ESTATES @ CASAS ADOBES HOA
1250 W APPIAN PL
TUCSON AZ 85704-2900
Cannot find info

PLAZA CAMPANA PROPERTY OWNERS ASSOC
6855 N ORACLE RD
TUCSON AZ 85704
Cannot find info

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110 s church ste 6320 tucson az 85701

PHOENIX AZ 852
31 MAR 2014 PM 1 L
TUCSON AZ MAR.31.14
U.S.POSTAGE 00.48
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PLAZA CAMPANA PROPERTY OWNERS
ASSOC
6855 N ORACLE RD
TUCSON AZ 85704

NIXIE 850 5E 1009 0004/02/14
RETURN TO SENDER
NO SUCH NUMBER
UNABLE TO FORWARD
BC: 85701762695 *2514-03291-31-42

Important Zoning Notice

857044282265

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110 s church ste 6320 tucson az 85701

PHOENIX AZ 852
31 MAR 2014 PM 1 L
TUCSON AZ MAR.31.14
U.S.POSTAGE 00.48
POSTALIA 309921

LIBENGOOD DALE W SR & DOLORES O
CP/RS
6410 N PLACITA TRANQUILA
TUCSON AZ
857041103

NIXIE 850 5E 1009 0004/02/14
RETURN TO SENDER
ATTEMPTED - NOT KNOWN
UNABLE TO FORWARD
BC: 85701762695 *1514-04542-31-42

Important Zoning Notice

857044160410

Appendix B.4: Neighborhood Meeting 1 – April 16, 2014 Neighborhood Meeting Notice

Tucson Electric Power Company
88 East Broadway Boulevard, P.O. Box 7, Tucson, Arizona 85702

March 31, 2014

Notice of Public Meeting to discuss the location of the planned TEP Orange Grove Substation

Dear Neighbor,

Tucson Electric Power Company invites you to attend a meeting on Wednesday evening, April 16th from 6:00 to 7:30 p.m., at Metropolitan Water Company to discuss the proposed new Orange Grove Substation.

Date: Wednesday April 16, 2014
Time: 6:00 – 7:30 p.m.
Location: Metropolitan Water Company
Board Room
6265 N. La Canada Drive
Tucson, Arizona

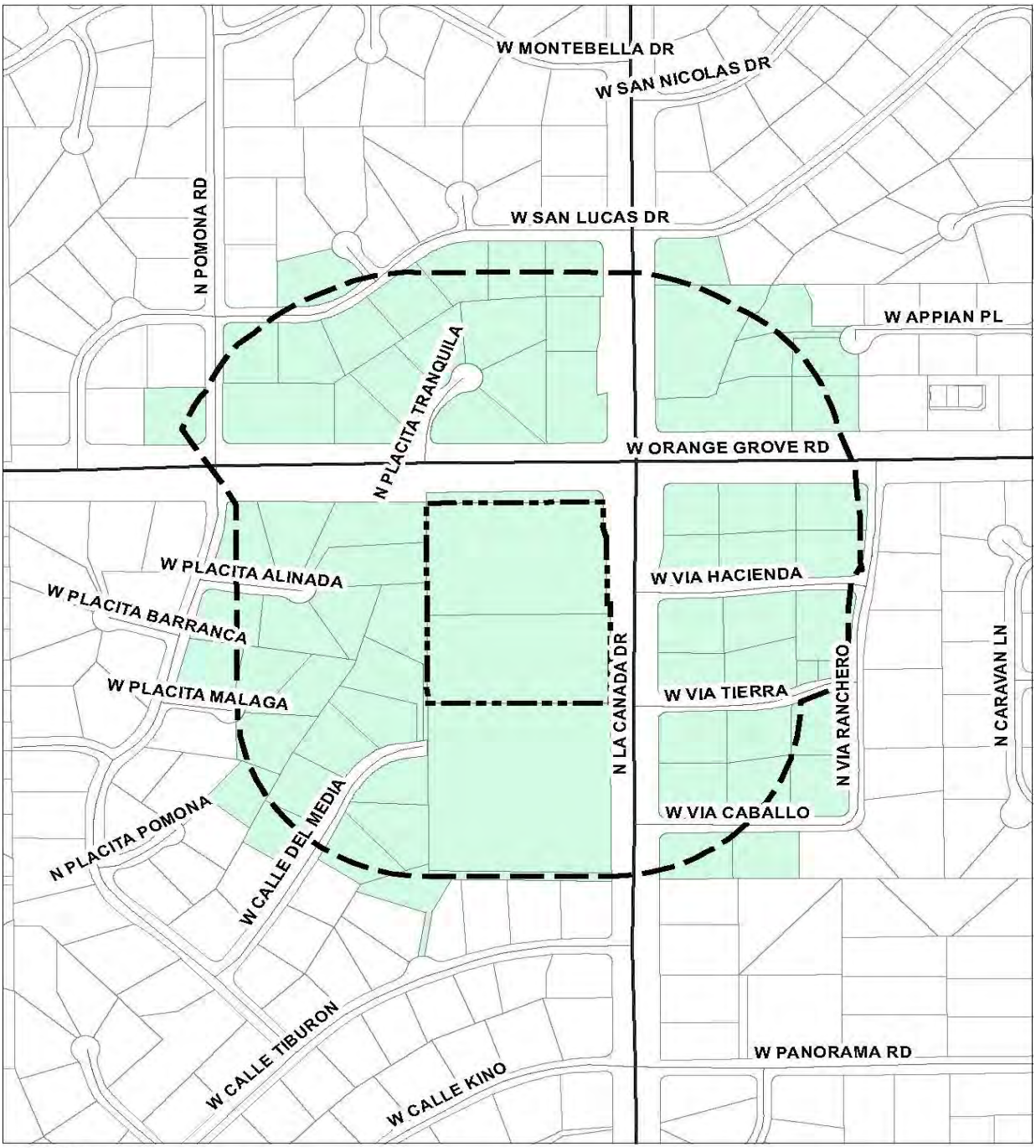
The Orange Grove Substation project is an urgent priority for Tucson Electric Power (TEP) to ensure capacity and reliability to its current and future residential and commercial customers in their northwest service area. TEP is proposing to build a new 138 kV power substation on property located at the southwest corner of La Canada Drive and Orange Grove Road. The proposed substation will connect to the existing 138 kV transmission line located within the La Canada Drive Right-of-Way.

TEP and consultant representatives will be in attendance. If there are specific areas of concern you would like to discuss or if you prefer to provide comments outside of the meeting please contact:

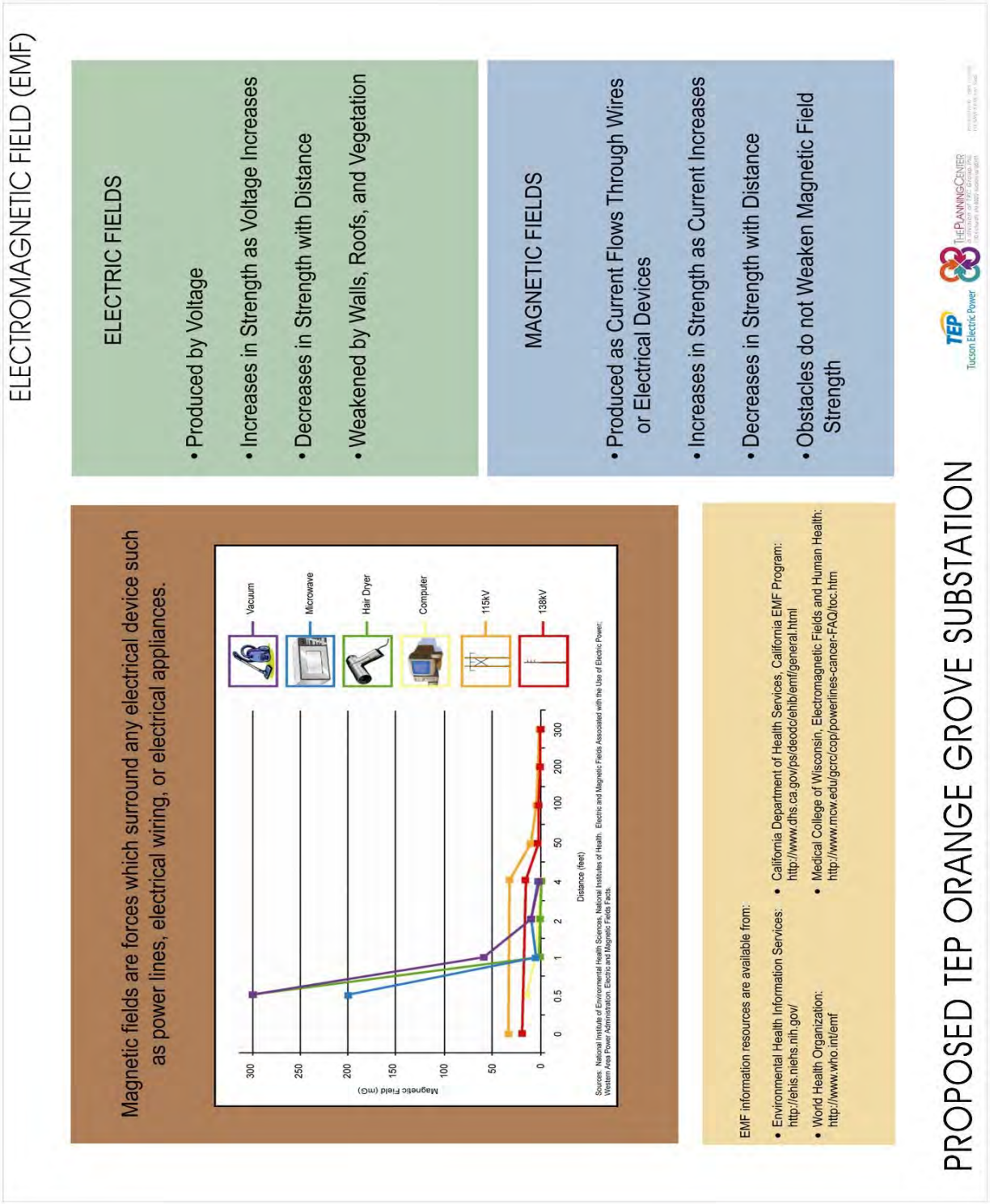
Steven Eddy
Governmental and External Affairs
Tucson Electric Power Company
520-919-8315
seddy@tep.com

We look forward to your input!

Appendix B.5: Neighborhood Meeting 1 – April 16, 2014 Neighborhood Notice Area Map



Appendix B.6: EMF Information Presented at Neighborhood Meeting



Appendix B.7: Neighborhood Meeting 2 – May 28, 2014 Meeting Minutes

Planning

Landscape Architecture

Public Involvement

Graphic Communications

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MEETING MINUTES

Date:	May 30, 2014	**Job No:**	TEP-22
Attendees	**Project Team:** Larry Lucero (TEP), Eric Bakken (TEP), Rene Marruffo (TEP), Rion Bowers (TEP), Donovan Sandoval (TEP), Rick Burrows (TEP), Bruce Wilson (EEC), Bob Tenor (EEC), Steve Hagedorn, (TPC), Tim Johnson (TPC) **Neighborhood Representatives:** Neighbors (see attached sign-in sheet)		
Location:	Metro Water Offices - 6265 N La Canada Drive		
Meeting Time	6:00 pm	**Project**	TEP Orange Grove Substation
Meeting Date	5/28/14	**Author**	Tim Johnson
Distribution:	TEP		

Purpose: **Follow up meeting to the 1st TEP Orange Grove Power Substation Permit Application Neighborhood Meeting**

Larry Lucero of Tucson Electric Power (TEP) opened the meeting by explaining that the Project team had already met once with the neighbors and this was intended to be a follow up meeting to answer some questions that had been posed at the first meeting as well as provide some new detailed information. He explained the background of the project and the need for a substation in this location.

TEP's northwest service area infrastructure is at a point where it needs an upgrade, such as this proposed substation. A number of locations where looked at, and this location was deemed the best due to a variety of reasons.

Steve Hagedorn of The Planning Center provided general site and zoning info (size, location, zone, history of approved TR rezoning). He then explained the Power Substation Permit (PSP) process including this meeting, application submittal and public hearing process.

Bruce Wilson of EEC explained the grading concept for the site and general hydrological issues of the property and how the development of the site would not negatively impact the drainage. The access to La Canada Dr. and desire to balance cut and fill on site lead to the setting of the finished grade of the substation.

a 110 Lynpark, Ste 5320, Tucson, AZ 85710
p 520.623.6145
f 520.622.1950
w tpcplanningcenter.com

Bruce explained the difference in run off (pre to post development) must be contained on site and that the retention basins will assure that post development runoff is equal to or less than pre development runoff from the 9 acres. Bruce explained that the developed area will be set outside of the Casa Adobes Wash.

Questions raised by neighbors during the presentation included:

Question: How will water get outside of the substation walls?

Response: Rainwater falling within the substation wall will drain through weepholes at the base of the wall and into the onsite drainage system (detention basin).

Question: Will the berms be earthen?

Response: Yes, the earthen berm will also be revegetated with native plant material and seed mix.

Question: Why does Pima County have strict hydrology requirements of the TEP site and not of themselves for their roadwork projects?

Response: Rick Ellis from Pima County Transportation was introduced as manager for Pima County road work in the area. Rick made himself available at the end of the meeting to address any neighborhood concerns about the roadway projects. There will also be a neighborhood meeting Friday 5/30 to address concerns about the roadway projects.

Question: Would future changes to TEP's proposed plan require Pima County approval?

Response: Yes, any changes to the site plan would require Pima County review and approval. However, if an additional transformer is needed many years from now, then there is no need to change the developed area footprint. In other words, it would fit within the currently proposed wall..

Question: What plans are there for additional development outside of the substation walls?

Response: There are no plans for development outside of the substation walls. And likely that any future proposed use would require Pima County review and approval.

Question: What will the landscape along the west boundary look like when complete?

Response: Pima County Native Plant Preservation (NPP) and landscape buffer yard requirements state that it will be revegetated with partially transplanted material from on site and partial nursery grown plants of various sizes (trees 15 gal and 24:" box, and 5 gall shrubs/accents).

Question: Where will the retention basins drain to?

Response: Locations depicted on hydrology plan (existing location where drainage leave property). Post development peak flow cannot be increased per Pima County requirements.

Steve Hagedorn provided more detail on the equipment/structures required and shown on the site plan, including; eight 65' tall lighting masts that taper from 18" at their base to 6" at their top; one 60' tall "drop structure"; one 35' tall communication pole; and one existing 85' tall transmission line pole that will be replaced. He then explained that the Overton substation located north of Overton Road on La Canada Drive is an old model substation and gave details on the new standards similar to Cienega and del Cerro substations that include split-face concrete block perimeter screen walls painted desert toned colors and perimeter landscaping to further screen the substation walls.

Question: How does a substation tap into the transmission line?

Response: The substation will be feed through a propose drop structure (pole) that will drop the lines into the electrical equipment within the substation walls. The drop structure pole will be located along the existing La Canada transmission lines alignment. After the electricity is transformed into a voltage that home and businesses can use, the underground distribution lines will distribute away from the substation.

Question: Where will the communications tower be located?

Response: The 35' tall communications tower will be located on the western portion of the site (within the substation walls) and approximately midway between the north and south walls.

Question: Why not hard line instead of communications tower?

Response: The communication tower is required for safety operations and the only viable alternative would be fiber optics, which are not available in the area.

Question: Will the communication tower be camouflaged (to look like saguaro)?

Response: The communications tower will not be camouflaged . Camouflaged towers are typically cell towers.

Question: Why is the substation proposed at this location and not where the new demand is required?

Response: TEP answered that to a very large extent it is the load and the need. Numerous factor go into the evaluation of possible sites such as: area, center of load, within 2 spans of transmission lines, impacts to neighbors, impact to natural resources, and availability.

Question: What is the size of the substation on Ina and why not expand there since it is in the 10 year plan?

Response: The 10 year plan does not identify the exact size of the required substation, but rather identifies only the likely need in the NW area.

Question: Was a cost analysis done for a communications tower vs fiber optics?

Response: TEP cannot add a fiber optics wire to the existing transmission lines without de-energizing the system.

Question: Is this transmission line a single circuit?

Response: No, the transmission line is looped and can feed the substation from either the north or the south. This allows for redundancy in case of emergency.

Question: Are any more transmission lines planned?

Response: No, there is no more room as this is a shared transmission corridor with TEP and Western Area Power Administration (WAPA).

Question: Is the communications tower only for TEP?

Response: Yes, there will be no other use of the communications tower.

Question: Can TEP put into writing that the communications tower will only be for TEP use?

Response: Residents were encouraged to talk to Pima County staff directly about concerns they might have and staff may recommend certain conditions for approval of the Permit.

Question: What else could TEP do on this site after the substation is approved?

Response: TEP has no other plans other than the proposed substation.

Question: Does TEP plan for solar generation at this site?

Response: No. TEP is a utility scale solar provider and this site is too small.

Question: What happens to the site after UNS is acquired by new company in January?

Response: The acquisition process was explained to the neighbors and there will be no effect on site conditions as a result.

Question: Will the substation be loud?

Response: The substation is not permitted to exceed Pima Co noise requirements, which state that the max aloud is 45 dB at the property line*. Examples of dB levels given: 60 dB = conversation in a restaurant, 50 dB = quiet conversation at home, 40 dB = library setting.

**Note: This was an update from information given at the first neighborhood meeting when it was stated that there would be a 60 dB limit.*

Question: What about EMFs?

Response: The best protection against EMFs is distance and barriers. TEP provided examples of EMFs related to other household appliances and items (vacuum, microwave, hair dryer, and computer). The setback provided in the design of the substation site are a deterrent and provide mitigation to EMF impacts.

Question: What time of day will substation be noisiest?

Response: Peak demand for this region is 3:00 – 5:30 PM. But it still may not exceed the Pima County requirements of 45 dB at all property lines.

Question: Will any distribution lines go west toward property line?

Response: No. All distribution lines will go underground and toward La Canada and Orange Grove (the conduit for which was already installed as part of the roadway project).

Question: How will the substation affect property values?

Response: TEP can share information on how over time the substation will not negatively nor positively impact property values.

Meeting was adjourned and neighbors were asked to sign in if they had not already and provide written comments via the comment sheets handed out during the meeting (see attached written comments from those present).

Authored by: Tim Johnson

Appendix B.8: May 28, 2014 Neighborhood Meeting Sign-in Sheet

Tucson Electric Power

THE PLANNING CENTER
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Neighborhood Meeting No. 2
Sign-in Sheet
Tucson Electric Power Orange Grove Substation **5/28/2014**

Name	Address	Phone	Email Address
NICK HITCHCOCK	1341 W. VIA TIERRA	580-575-2887	NICKHITCHCOCK79@YAHOO.COM
ZENA McMULLEN	6310 N. Via Rinchera	520-297-5641	
KAY Hanby	1301 W Via Hacienda	297-4223	
Adeline Logsdon	1325 W Appian Pl	5203274524	amlog@q.com
Alan Logsdon	1325 W Appian Pl	5203274524	aalog@q.com
MITCH DOBSON	8731 N. PLACITA DE RESVALSA	520-275-3098	MDOBSON@ENNA-INC.COM
Donavan Sandoval			
Ben Becker	7320 W. Sam Blks	520 904-2302	
ADAM Becker	1200 E. River Rd	520-271-4082	
Kip Welpe	1320 W. VIA HACIENDA	520-797-1089	ITIN4FOX@COMCAST.NET
Richard Huguenin	1540 Calle del Media	297 0474	shuguenin@century21.net
Kurt [illegible]	1320 W. Via Hacienda		
Rebecca Sheppard	1601 W. Placita Malaga	235-7796	

Appendix B.9: Neighborhood Meeting 2 – May 28, 2014 Notification List

ABRAMS LUCY & SMITH BRADLEY SR JT/RS
1540 W SAN LUCAS DR
TUCSON AZ
857040000

APPIAN ESTATES AT CASA ADOBES HOA INC
1250 W APPIAN PL
TUCSON AZ
857042900
Cannot find info

ARRIETA JAVIER D & KAREN S CP/RS
1320 W VIA TIERRA
TUCSON AZ
857042813

ARTER BILLY G
6415 N PLACITA TRANQUILA
TUCSON AZ
857041103

BARKER CHAD SIDNEY & HEIDI CATHERINE CP/RS
1540 W PLACITA ALINADA
TUCSON AZ
857041065

BINNIE KARIN A
1500 W CALLE TIBURON
TUCSON AZ
857040000

BOURGEOIS HENRITETTA B
1340 W VIA TIERRA
TUCSON AZ
857040000

CAMPBELL NATHAN C & BAENA CRISTINA JT/RS
1545 W SAN LUCAS DR
TUCSON AZ
857041123

CARREON RONALD J & VICTORIA L CP/RS
6405 N PLACITA TRANQUILA
TUCSON AZ
857040000

CIRELLI JOHN & LINDA L JT/RS
1505 W SAN LUCAS DR
TUCSON AZ
857040000

COOPER FAMILY TR
ATTN: MICHAEL J & LIDIA T COOPER TR
1561 W PLACITA ALINADA
TUCSON AZ
857041065

CROSWELL JAMES K & PATRICIA A JT/RS
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DILLAVOU KIM M & ELVA A JT/RS
1302 W VIA HACIENDA
TUCSON AZ
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DOWDALL REGINALD J 1/4 INT & DOWDALL JACQUELYN A
1/4 INT & DOWDALL DOUGLAS A 1/4 INT &
1321 W VIA CABALLO
TUCSON AZ
857040000

DU FOUR JEAN MARC & DU FOUR ALEXANDER L
& YVETTE D
1451 W SAN LUCAS DR
TUCSON AZ
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1341 W VIA HACIENDA
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EBELING BELINDA
1500 W CALLE DEL MEDIA
TUCSON AZ
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FIRST CREDIT UNION
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25 S ARIZONA PL STE 111
CHANDLER AZ
852255537

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TUCSON AZ
857040000

FURRIER THOMAS K & CHERYL L CP/RS
1301 W VIA TIERRA
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GENOVA GINA L & GENOVA PEGGY N JT/RS
1340 W VIA HACIENDA
TUCSON AZ
857042811

GILBERT JEANNETTE TR
1355 W SAN LUCAS DR
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6360 N POMONA
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1401 W SAN LUCAS DR
TUCSON AZ
857041121

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1301 W VIA HACIENDA
TUCSON AZ
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857042812

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TUCSON AZ
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HOWARD JAMES R TR
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HUGUNIN RICHARD & SHEILA MAE
1540 W CALLE DEL MEDIA
TUCSON AZ
857040000

JPMORGAN CHASE BANK
ATTN: TIFFANY & BOSCO
2525 E CAMELBACK RD STE 300
PHOENIX AZ
850164237

KONECNIK FAMILY REVOC TR
ATTN: STEPHEN E & PATRICIA L KONECNIK TR
7401 N MOUNTAIN SHADOWS DR
TUCSON AZ
857181082

LAMDAN ODED & CHERIE L CP/RS
1530 W CALLE DEL MEDIA
TUCSON AZ
857041064

LIBENGOOD DALE W SR & DOLORES O CP/RS
6410 N PLACITA TRANQUILA
TUCSON AZ
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LOGSDON ALAN & ADELINE LIVING TR
1325 W APPIAN PL
TUCSON AZ
857042955

LUBBEN DANIEL L
1609 W PLACITA MALAGA
TUCSON AZ
857041037

METROPOLITAN DOMESTIC WATER IMPROVEMENT
DISTRICT OF PIMA COUNTY
.
000000000

MURRAY JOAN A
1525 W CALLE DEL MEDIA
TUCSON AZ
857041063

NORTHWEST FIRE DISTRICT
5225 W MASSINGALE RD
TUCSON AZ 85743

OLIWOOLABODE SUSAN E
6420 N PLACITA TRANQUILA
TUCSON AZ
857040000

OLSON KIMBERLY A & TROY R CP/RS
1342 W VIA CABALLO
TUCSON AZ
857042809

ORANGE GROVE PROPERTY LLC
1955 W GRANT RD STE 125G
TUCSON AZ
857451470
Art Kelley 520-884-5315

PANOUSOPOULOS CONSTANTINO T & NELIDA JT/RS
PO BOX 1806
NOGALES AZ
856280000

PAVONE BRENT
1302 W VIA CABALLO
TUCSON AZ
857042809

RAY DONALD EDWARD TR
6224 N PLACITA POMONA
TUCSON AZ
857041040

RICE AARON J
6401 N POMONA RD
TUCSON AZ
857041119

RICH GERALD M JR & DIANE I JT/RS
1500 W ORANGE GROVE RD
TUCSON AZ
857040000

RUBLY WILLIAM G & KIMBERLY J JT/RS
1421 W SAN LUCAS DR
TUCSON AZ
857040000

RUSSELL RANDALL & LINDA H CP/RS
1320 W APPIAN PL
TUCSON AZ
857042955

RYDER MALCOLM K & LORI M
180 E 5TH
TUCSON AZ
857058364

SHEPPERD FAMILY TR
ATTN: TYLER W & REBECCA PORTER
1601 W PLACITA MALAGA
TUCSON AZ
857041037

SMITH FAMILY REVOC TR
ATTN: JOHN ALLEN JR & SANDRA SMITH TR
1535 W CALLE DEL MEDIA
TUCSON AZ
857041063

STEWART KIM C & MARY ANN
6431 N LA CANADA DR
TUCSON AZ
857041101

STUART HEWITT J & MARY M CP/RS
1545 W CALLE DEL MEDIA
TUCSON AZ
857040000

SWINSON KAREN R
1321 W VIA HACIENDA
TUCSON AZ
857040000

TUELL GARY E & FRANCES T CP/RS
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TUCSON AZ
857405865

VAN BLOIS JOHN P & NELLY NEWMAN CP/RS
550 NE WATERWAY LN
BOCA RATON FL
334322828

VANDERAH TODD W & ANTOINETTE CP/RS
1335 W APPIAN PL
TUCSON AZ
857042955

VITALE SAL
1560 W PLACITA ALINADA
TUCSON AZ
857041065

VITALE SALVATORE & VITALE FAYBRA JT/RS
1550 W PLACITA ALINADA
TUCSON AZ
857041065

VOLPE CHRISTOPHER T & M JOANNE CP/RS
1320 W VIA HACIENDA
TUCSON AZ
857042811

WIDENER CHRISTINE A
228 S AVENIDA DEL PORVENIR
TUCSON AZ
857452540

WILT ANDREW N & MA-WILT YAN CP/RS
1565 W SAN LUCAS DR
TUCSON AZ
857041123

WOOD-BONNELL JENNIFER C & BONNELL CHARLES MICHAEL JT/RS
1520 W CALLE DEL MEDIA
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CADDEN COMMUNITY MANAGEMENT
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TUCSON AZ 85705-2969
Agnus @Cadden 520-297-0797

HILLS ON LA CANADA HOA
LEWIS MANAGEMENT
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Kolleen @ Lewis 520-742-5674

PASEO DEL RIO COMMUNITY ASSOCIATION
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PUEBLO VIALLGE WEST HOA
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Howie Hibbs @ Adam 520-624-1206

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CADDEN COMMUNITY MANAGEMENT
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Agnus @Cadden 520-297-0797

PUEBLO VILLAS HOA
COPPER ROSE COMMUNITY MANAGEMENT
6601 E 22ND ST STE 101
TUCSON AZ 85710-5118
Sandy&Jim@Copper Rose 520-888-0474

CASITAS DE CASTILIAN CONDOMINIUM HOA
643 W LAS LOMITAS RD
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Bob Prisbe 520-293-6804

LAS LOMITAS HOA
Y CROSS MANAGEMENT
8375 N ORACLE RD STE 150
TUCSON AZ 85704-7317
Sara Butler @ Y Cross 520-219-4520

ORACLE NORTH HOA
LEWIS MANAGEMENT
180 W MAGEE RD STE 134
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SUNSET RIDGE HOA
PAUL ASH MANAGEMENT CO LLC
3499 N CAMPBELL AVE STE 907
TUCSON AZ 85719-2376
Barry Edberg 520-795-2100 Ext 106

APPIAN ESTATES @ CASAS ADOBES HOA
1250 W APPIAN PL
TUCSON AZ 85704-2900
Cannot find info

PLAZA CAMPANA PROPERTY OWNERS ASSOC
6855 N ORACLE RD
TUCSON AZ 85704
Cannot find info

ALLY MILLER
PIMA COUNTY SUPERVISOR
DISTRICT 1
130 W CONGRESS 11TH FLOOR
TUCSON AZ 85701

METROPOLITAN DOMESTIC WATER IMPROVEMENT DISTRICT OF PIMA COUNTY
6265 N LA CANADA DR
TUCSON AZ 85704

Appendix B.10: Neighborhood Meeting 2 – May 28, 2014 Neighborhood Meeting Notice

Tucson Electric Power

May 8, 2014

Notice of Public Meeting to discuss the location of the planned TEP Orange Grove Substation

Dear Neighbor,

Tucson Electric Power Company invites you to attend a meeting on Wednesday evening, May 28th from 6:00 to 7:30 p.m., at Metropolitan Water Company to discuss additional information requested by neighbors at a Neighborhood Meeting held April 16, 2014. Residents had questions focusing on a variety of topics related to the project, including: the substation permit process; specifics of the site development plans; the project's impact on residents and the neighborhood; TEP site selection criteria, and safety concerns related to lightning protection and other technical issues of substation operation.

TEP and consultant representatives will be in attendance with additional information to address these questions with residents.

Date: **Wednesday May 28, 2014**
Time: **6:00 – 7:30 p.m.**
Location: **Metropolitan Water Company**
Board Room
6265 N. La Canada Drive
Tucson, Arizona

For those residents who were not able to attend the April 16th meeting, the Orange Grove Substation project is an urgent priority for Tucson Electric Power (TEP) to ensure capacity and reliability to its current and future residential and commercial customers in their northwest service area. TEP is proposing to build a new 138 kV power substation on property located at the southwest corner of La Canada Drive and Orange Grove Road. The proposed substation will connect to the existing 138 kV transmission line located within the La Canada Drive Right-of-Way.

Steven Eddy
Governmental and External Affairs
Tucson Electric Power Company
520-919-8315
seddy@tep.com

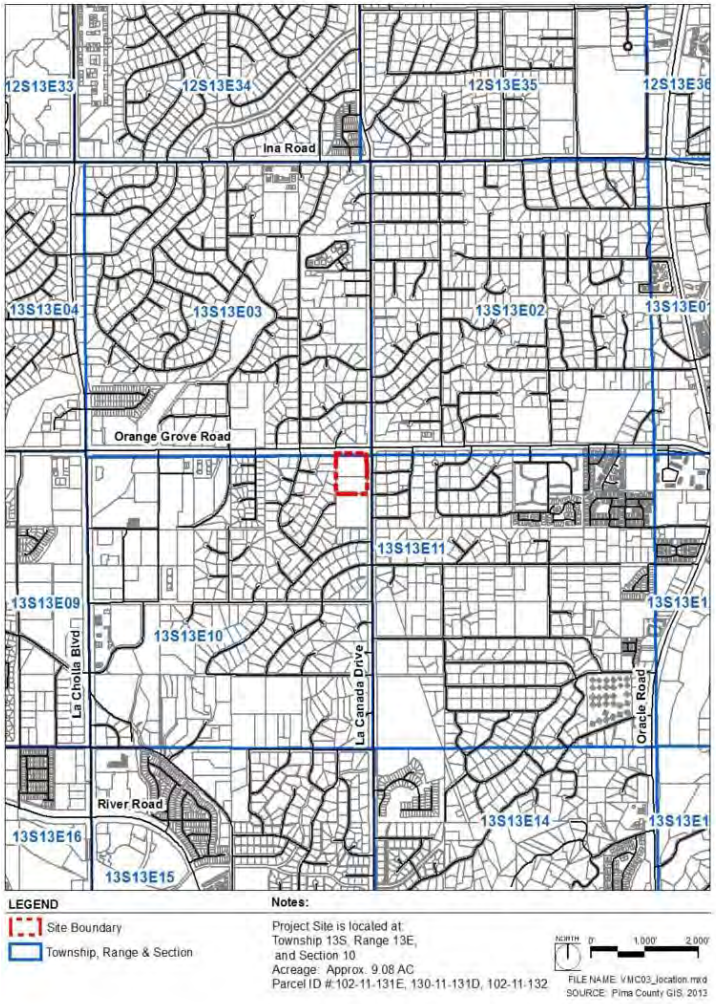
We look forward to your input!

Tucson Electric Power Company

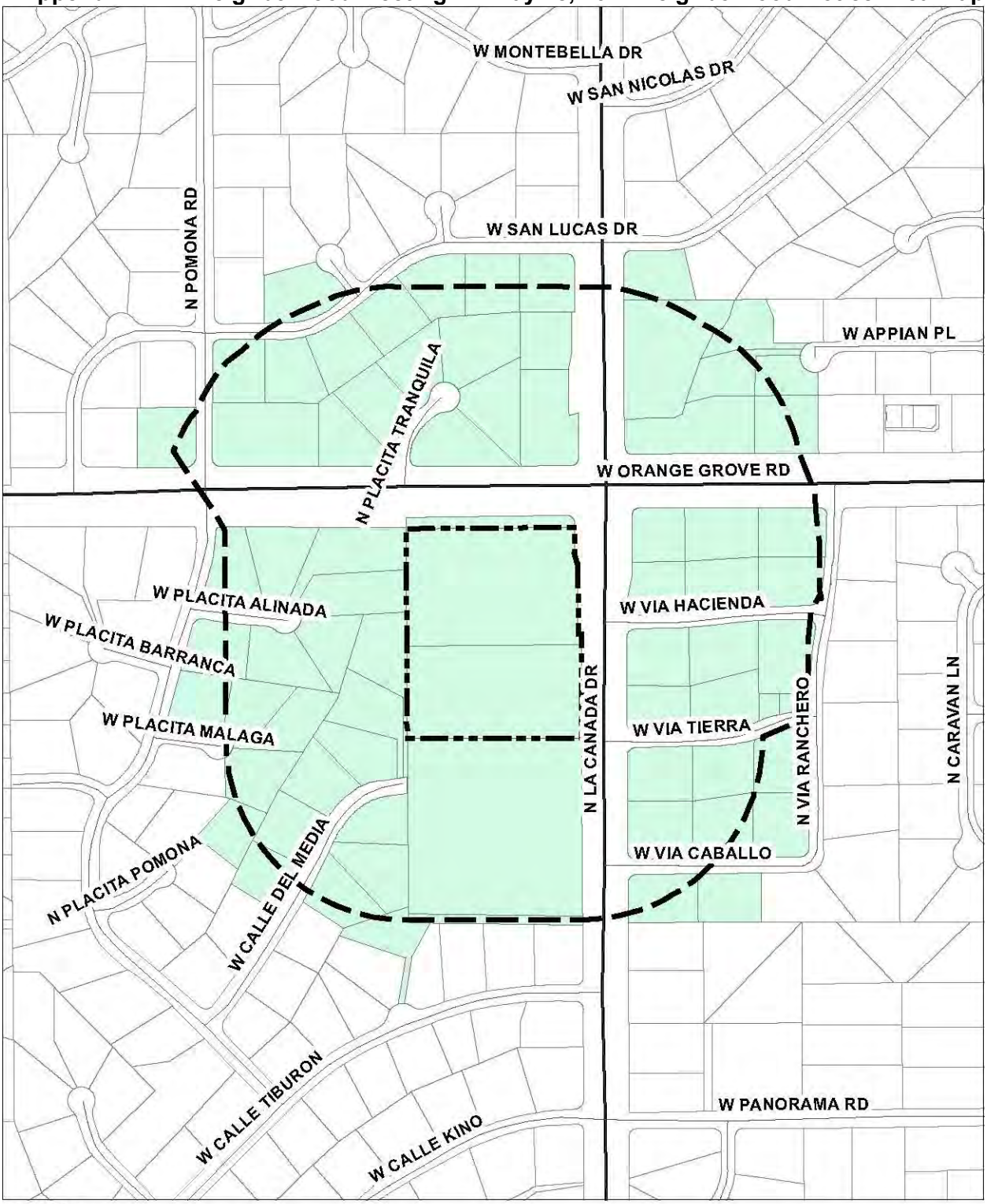
88 East Broadway Boulevard, P.O. Box 7, Tucson, Arizona 85702

Location:

The proposed 138 kV Orange Grove Road Substation is located in Pima County at the southwest corner of Orange Grove Road and La Canada Drive. The project site is 9.08 acres.



Appendix B.11: Neighborhood Meeting 2 – May 28, 2014 Neighborhood Notice Area Map



Tucson Electric Power Orange Grove Substation

Appendix C

Biological Evaluation

THE PLANNING CENTER
a division of TPC Group, Inc
110 s church ste 6320 tucson az 85701

ORANGE GROVE 138 KV SUBSTATION PROJECT

BIOLOGICAL EVALUATION

Prepared by

Bowers Environmental Consulting, LLC
2164 N Jacana Loop
Tucson, Arizona 85745

Prepared for

PO Box 711 Mail Stop HQW602
Tucson, Arizona 85702

Date:
July 17, 2014

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EXECUTIVE SUMMARY

Bowers Environmental Consulting, LLC (BEC) prepared this Biological Evaluation (BE) for the proposed Orange Grove 138 kV Substation (the "Project"). The Project is located on 9.085 acres of private land within the northeast quarter of the northeast quarter of the northeast quarter, Section 10, Township 13 South, Range 13 East; southeast of the Gila and Salt River Baseline and Meridian, Pima County, Arizona (the "Project Area"). Coordinates for the center of the Project Area are: Latitude 32.321858 North, Longitude -110.996423 West. The Project Area is on the southwest corner of Orange Grove Road and La Canada Drive in Tucson.

The purpose of the BE is to evaluate the potential for occurance of any federally listed threatened or endangered, as well as other species of concern (special status species) within the Project Area, and identify any impacts on these species. Special-status species include all plants and wildlife that are protected, considered for protection, or afforded special conservation status by federal, state, and local government agencies. The BE includes an ecological description of the Project Area and documents vegetation and wildlife observed during the field survey.

BEC completed the BE in three steps: 1) the list of federally listed species for Pima County was reviewed and background research on the natural history for each species was conducted; 2) a field reconnaissance was conducted to identify vegetation and habitat on the site; and, 3) a screening analysis was conducted to evaluate the potential for occurrence of each listed species.

Results of the BE indicate only the Lesser long-nosed bat (LLNB) has the potential to occur or disperse through the Project Area. Detailed analysis for this species indicates that known roost sites for this species occur in a 20 to 60 mile radius of the Project Area, which is within the foraging range of this species. However, only a few mautre Saguaro cactus that serve as forage for this species may be affected during construction of the Project. Conservation measures, such as salvaging and replanting Saguaro cactus on the Project Area would mitigate for any short-term affects or modification of LLNB foraging habitat. Based on this evaluation and the proposed conservation measures, the Project may effect, but is not likely to adversely affect the current population of LLNB in Arizona. Furthermore, the Project would not jepordize the continued existance of LLNB in Arizona or throughout its current range. None of the other listed species for Pima County have the potential to occur on or near the site.

1.0 INTRODUCTION

Bowers Environmental Consulting, LLC (BEC) was retained by Tucson Electric Power Company (TEP) to prepare this Biological Evaluation (BE). The BE will support property acquisition due diligence, engineering design, and compliance with applicable local, state, and federal permitting requirements for the proposed construction of a 138 kV Substation (the "Project").

The purpose of the BE is to evaluate the potential for occurance of any federally listed threatened or endangered, as well as other species of concern (special status species) within the Project Area, and identify any impacts on these species. Special-status species include all plants and wildlife that are protected, considered for protection, or afforded special conservation status by federal, state, and local government agencies. The BE includes an ecological description of the Project Area and documents vegetation and wildlife observed within the Project Area during the field reconnaissance. The scope of work for this BE follows standard protocol that is commonly used by consulting biologists to evaluate the potential presence of special-status species and effects of proposed project activities on these species. BEC's scope of work included the following steps to complete the BE:

- Review of the U.S. Fish and Wildlife Service (USFWS) Information, Planning, and Conservation System (IPAC) database;
- Search of the AGFD Natural Heritage Program, Heritage Data Management System (HDMS) using the Arizona Online Environmental Review Tool;
- Field reconnaissance to evaluate vegetation and habitat characteristics on the Project Area; and,
- Production of this report that evaluates and documents the potential for special-status species to occur on the Project Area and potential effect on any species or designated critical habitat.

This report is formatted in the following Sections: 1. Introduction; 2. Project Area Description; 3. Special Status Species Screening Analysis; 4. Conclusions; 5. References and Literature Citations.

2.0 PROJECT AREA DESCRIPTION

2.1 LOCATION AND GENERAL DESCRIPTION

The Project is located on 9.085 acres of private land within the northeast quarter of the northeast quarter of the northeast quarter, Section 10, Township 13 South, Range 13 East; southeast of the Gila and Salt River Baseline and Meridian, Pima County, Arizona (the "Project Area"). The Project Area is located generally at the southwest corner of West Orange Grove Road and North La Canada Drive, in Tucson, Arizona. Geographic coordinates for the centroid of the Project Area are latitude 32.321858 North, longitude -110.996423 West. Figures 1 and 2 depict the location and aerial view of the Project Area. The Project Area consists of undeveloped land that is surrounded, and isolated, by residential and commercial development. Headquarters for the Metropolitan Water District, which includes a solar facility, abuts the southern property line while the Ranch House Estates subdivision is located east of the site. La Colina Estates and Appian Estates subdivisions are to the north and the Orange Grove Medical Plaza and Angelo Estates are located north of the Project Area. Casas Adobes Wash crosses the northwest corner of the Project Area and there are several well-worn pedestrian paths and evidence of off road vehicle use throughout the site. Orange Grove Road abuts the north boundary and La Canada Drive abuts the eastern boundary of the site. These two roadways are currently under construction. Heavy construction equipment and materials were observed within the adjacent road right-of-way and a large box culvert is being installed at the Orange Grove Road crossing adjacent to the Project Area.

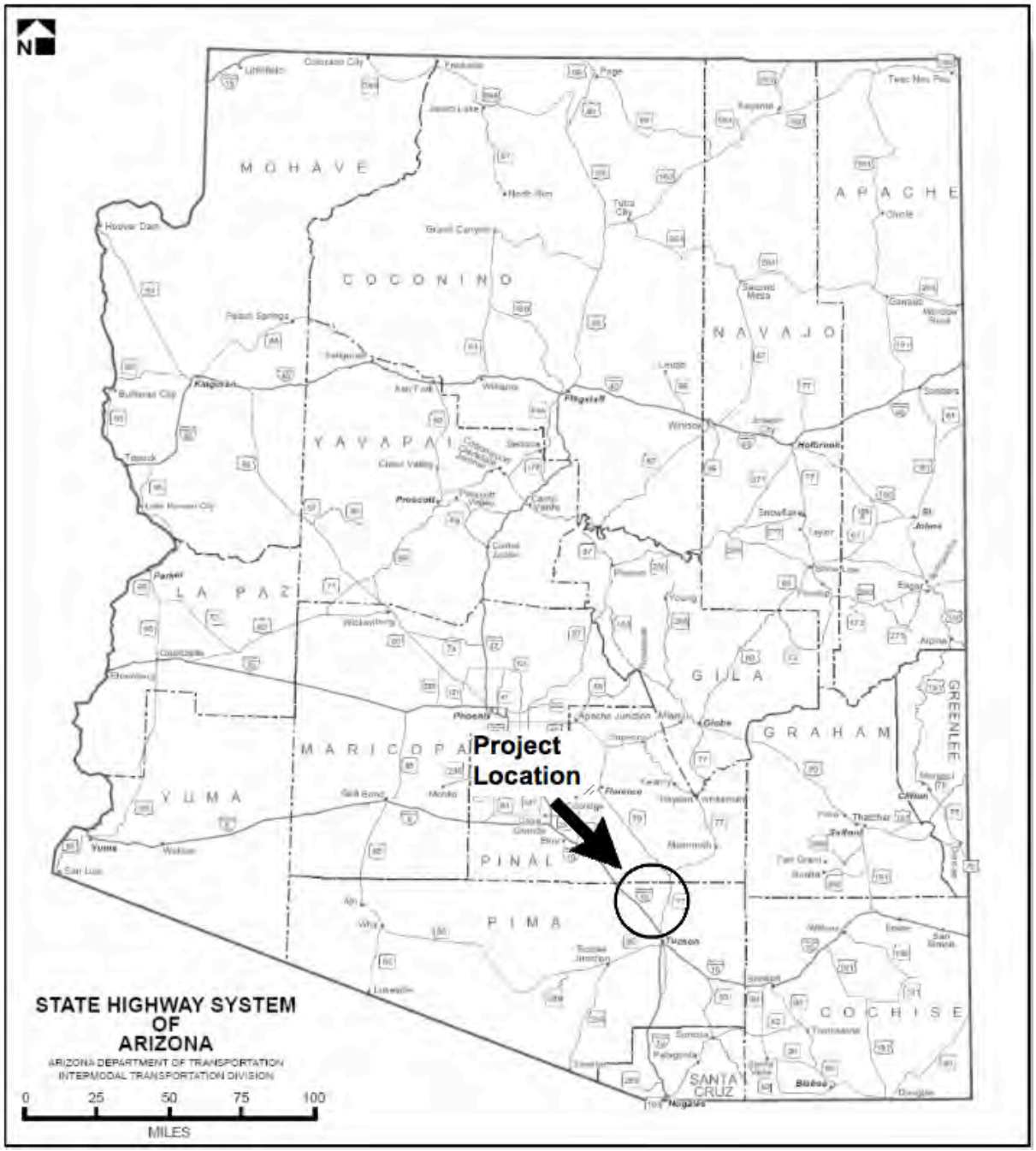

Figure 1. Project Location – Orange Grove Substation

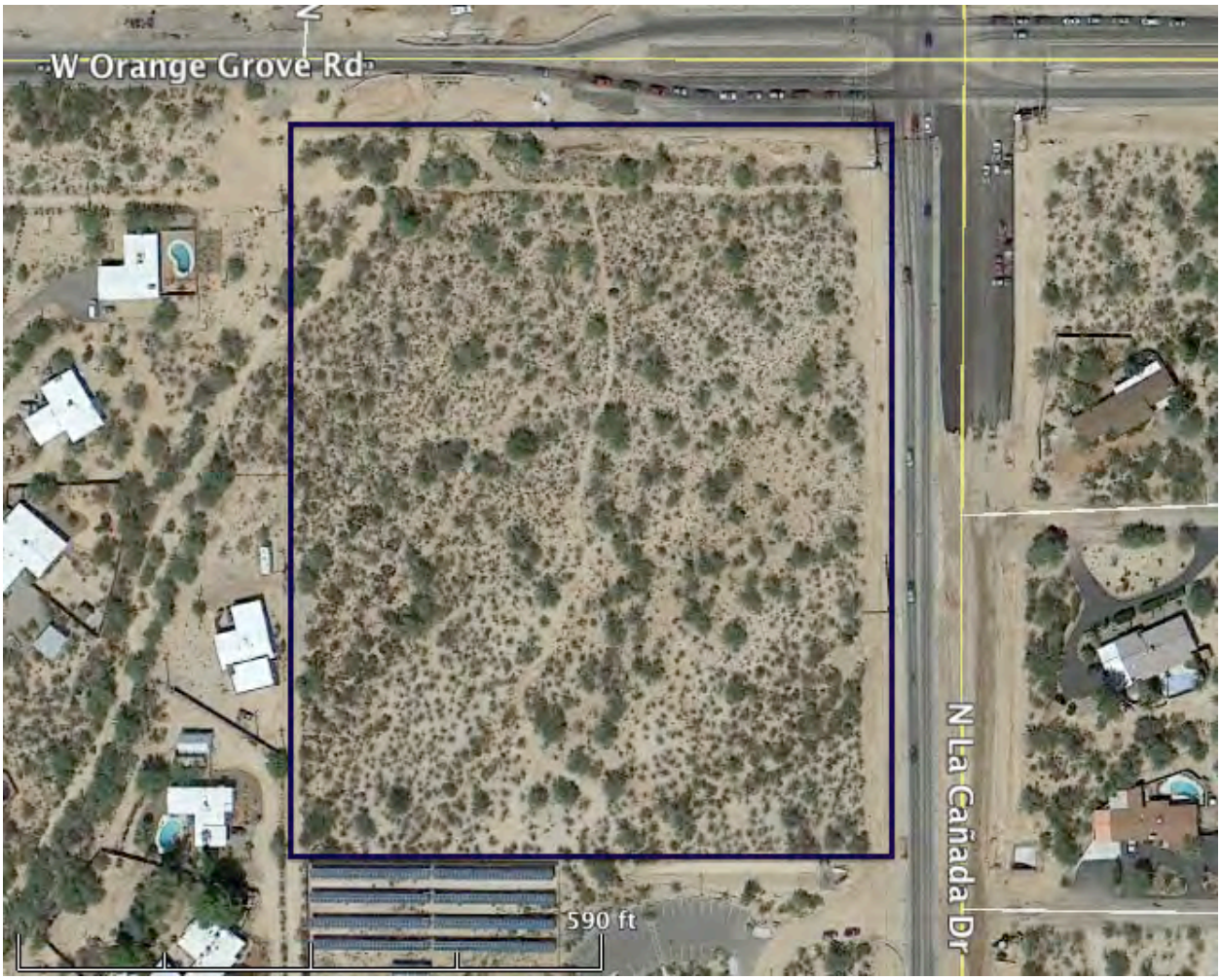

Figure 2. Aerial Overview – Orange Grove Substation Project Area

2.2 ECOLOGICAL OVERVIEW

The Project Area lies within the Basin and Range Physiographic Province of southern Arizona at an elevation between 2,355 to 2,240 feet above mean sea level. This province is characterized by linear, north to south trending alluvial filled basins surrounded by normal fault-block mountain ranges. The project lies within the Tucson Basin that is surrounded by the Santa Catalina Mountains, Rincon Mountains, Tortolita Mountains and Tucson Mountains. The Rillito River, located approximately 1.8 miles south of the Project Area discharges into the Santa Cruz River that generally flows from south to north following the Tucson Basin axial trough. Ephemeral drainages, such as Casas Adobes Wash, located on the mountains and foothills collect and convey surface runoff, from summer and winter storms towards the Santa Cruz River. Climate is characterized as semi-arid with temperatures ranging from 37 to 105 degrees fairennheight and precipitation averaging less than 10 inches annually. Native vegetation within the project area is consistent with the Arizona Upland subdivision of the Sonoran desertscrub biotic community (Brown 1994). This subdivision consists of a scrubland or low woodland of leguminous trees with an understory of shrubs and perennial succulents.

Figure 3. Upland Habitat on the Project Area

Figure 4. Xeroriparian habitat along wash

3.0 SPECIAL STATUS SPECIES SCREENING ANALYSIS

The screening analysis methods used to develop this BE consisted of species identification, habitat assessment, potential for occurrence determination and potential affects determination for each federally listed special-status species that may occur in the Project Area. These methods are described in the following section.

3.1. SPECIES SCREENING ANALYSIS METHODS

Species Identification - The list of federal special-status species for the Project Area was obtained from the USFWS IPAC online database (Appendix A). Species range and habitat data was obtained from information provided on the USFWS and the Arizona Game & Fish Department (AGFD) Heritage Database Management System (HDMS) abstracts. Natural history for each of these species was reviewed to determine habitat and life history requirements and to identify the parameters requiring investigation during the field reconnaissance portion of the evaluation. We also searched the HDMS On-line Environmental Review Tool (Appendix B) to identify any known accounts of federal or state special-status species within a 3-mile radius of the Project Area. A more rigorous literature review and evaluation was conducted for any species that have known ranges or designated critical habitat close to or within the Project Area.

Habitat Assessment - Field reconnaissance was conducted on November 5, 2013, by BEC biologists Rion Bowers, who was accompanied by TEP's Planning Intern Rebecca Rodrigues. The purpose of the field reconnaissance is to identify and record dominant plants, vegetation communities and habitat features on the Project Area and adjacent lands. Pedestrian reconnaissance was conducted around the perimeter and generally within the interior of the Project Area to identify the dominant plant and wildlife species, review areas that exhibited high value habitat (i.e., ephemeral drainages) and photograph the habitat and significant habitat features.

Potential for Occurrence Evaluation – Results from the species identification and field survey described above was used to facilitate the screening analysis to determine the potential for special-status species to occur on or in the vicinity of the Project Area. Species were eliminated from further consideration if the Project Area is located outside of their known range or if required habitat components are not present. In addition, the presence or absence of proposed or designated critical habitat was reviewed for each federally listed species. The potential for occurrence of each species was then carefully

evaluated and is categorized in Table 3 and 4 presented in the results section. The four occurrence categories are defined as follows:

- *Known to occur*—the species is documented to occur in the project area or vicinity.
- *May occur*—the project area is within the species' currently known range or distribution and vegetation communities, habitat, soils, or other biotic and abiotic indicators resemble those known to support the lifecycle and/or natural history requirements of the species.
- *Unlikely to occur*—the project area is within the species' currently known range or distribution, but vegetation communities, soils, and other biotic and abiotic indicators do not resemble those known to support the lifecycle and/or natural history requirements of the species.
- *Does not Occur* – the project area is not within the known range or distribution and other biotic and abiotic indicators do not resemble those known to support the lifecycle and/or natural history requirements of the species.

Potential Affects Evaluation – Potential for the project to affect any of the special-status species identified as potentially occurring in Pinal County is also considered in this BE. This affects evaluation is similar in nature to the affects determination described in the Endangered Species Act Handbook for Section 7 consultations. The three affects categories used in this BE are defined below:

- *May affect, is likely to adversely affect*—the project is likely to adversely affect a species if: 1) the species is known to occur in the project area; and 2) project activities would disturb areas or habitat elements known to be used by the species, or would directly affect an individual.
- *May affect, is not likely to adversely affect*—the project is not likely to adversely affect a species if: 1) the species may occur but its presence has not been documented; and 2) project activities would not result in disturbance to areas or habitat elements known to be used by the species.
- *No effect*—the project will have no effect on a species if: 1) the species is considered unlikely to occur (range, vegetation, etc., are inappropriate); and 2) the species or its sign was not observed during surveys of the project area.

3.2. SPECIES SCREENING ANALYSIS RESULTS

3.2.1. Habitat Characteristics

Vegetation on the Project Area is consistent with the upland subdivision of the Sonoran desertscrub biotic community. Common plants and wildlife observed during the field reconnaissance are listed in Tables 1 and 2. Approximately 8 large multi-stem saguaro cactus and 15 juveniles are located on the Project Area. The vegetation community is relatively homogenous throughout the Project Area with a variety of cactus species, small shrubs, and several large tree species, however plants growing along the banks of Casas Adobes Wash are slightly more robust than the vegetation found on the upland areas. Grasses and other ground cover species are absent from the site and there are no large snags, permanent surface water, cliffs, caves, adits or other habitat features that would provide nesting, breeding, cover or forage opportunities for wildlife.

Table 1. Common Plants Observed on the Project Area

Common Name	Scientific Name
Velvet Mesquite	*Prosopis velutina*
Foothills Palo Verde	*Cercidium microphyllum*
Desert Acacia	*Acacia greggii*
Catclaw Acacia	*Acacia greggii*
Creosote Bush	*Larrea tridentate*
Triangle Leaf Bursage	*Ambrosia deltoidea*
Saguaro Cactus	*Carnegiea gigantea*
Hedgehog Cactus	*Echinocereus triglochidiatus*
Prickly Pear Cactus	*Opuntia littoralis var. vaseyi*
Barrel Cactus	*Ferocactus wisilizenii*
Chain-fruit Cholla Cactus	*Opuntia fulgida*
Teddy Bear Cholla Cactus	*Cylindropuntia bigelovii*

Table 2. Common Wildlife Observed on the Project Area

Common Name	Scientific Name
Gamble's Quail	*Callipepla gambelii*
Morning Dove	*Zeniada macroura*
Desert Cottontail rabbit	*Sylvilagus audubonii*
Cactus wren	*Campylorhynchus brunnedicapillus*
Desert spiny lizard	*Sceloporus magister*
Pack rat	*Neotoma cinerea*

3.2.2. Special Status Species Evaluation

Federally listed species that have the potential to occur in Project Area include 4 endangered, 2 threatened, 1 proposed threatened and 3 candidate species and 4 other special status species were identified by the AGFD environmental review tool as potentially occurring within 3-miles of the Project Area. The screening analysis results for each of the special status species are presented in Tables 3 and 4. The analysis includes background information such as the listing status, designation of Critical Habitat, known range and habitat requirements, and the potential occurrence and affects determinations for each listed species.

Table 3. Federally Listed Species Potentially Occurring in the Project Area

Common Name (Species Name)	Status*	Range or Habitat Requirements	Potential for Occurrence in Project Area	Determination of Effect
California least tern (*Sterna antillsrum browni*)	USFWS E	Least terns are shorebirds that require bare or sparsely vegetated sandbars, gravel pits, or exposed flats along shorelines of inland rivers, lakes, reservoirs, or drainage systems.	Does not occur in the Project Area or vicinity. There are no aquatic habitats on or near the Project Area.	No effect.

Table 3. Federally Listed Species Potentially Occurring in the Project Area

Southwestern willow flycatcher (*Empidonax traillii extimus*)	USFWS E	Found in dense riparian habitats along streams, rivers, and other wetlands where cottonwood, willow, boxelder, tamarisk, Russian olive, buttonbush, and arrowweed are present. Nests are found in thickets of trees and shrubs, primarily those that are 13 to 23 feet tall, among dense, homogeneous foliage. Habitat occurs at elevations below 8,500 feet.	Does not occur in the Project Area or vicinity. There is no riparian habitat in the project area.	No effect.
Yellow-billed cuckoo (*Coccyzus americanus*)	USFWS PE	Typically found in riparian woodland vegetation (cottonwood, willow, or tamarisk) at elevations below 6,600 feet. Dense understory foliage appears to be an important factor in nest site selection. The highest concentrations in Arizona are along the Agua Fria, San Pedro, upper Santa Cruz, and Verde river drainages and Cienega and Sonoita creeks.	Does not occur in the Project Area or vicinity. There are no suitable riparian woodlands in the Project Area itself.	No effect.
Mexican Spotted Owl (*Strix occidentalis lucida*)	USFWS T	Found in mature montane forests and woodlands, and steep, shady, wooded canyons. Can also be found in mixed-conifer and pine-oak vegetation types. Generally nests in older forests of mixed conifers or ponderosa pine/Gambel oak. Nests in live trees on natural platforms (e.g., dwarf mistletoe brooms), snags, and on canyon walls at elevations between 4,100 and 9,000 feet.	Does not occur in the Project Area or vicinity.	No effect.
Jaguar (*Panthera onca*)	USFWS E	This species has been found in Sonoran Desertscrub through subalpine conifer forests. Jaguars were probably closely associated with rivers and cienegas (marshes), once prominent in southern Arizona.	Does not occur in the Project Area or vicinity. This species is very rare and there are no rivers or cienegas in the Project Area.	No effect.
Lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*)	USFWS E	Ranges from the Picacho Mountains southwesterly to the Agua Dulce Mountains and southeasterly to the Galiuro and Chiricahua mountains at elevations between 1,600 and 11,500 feet. Roosts in caves, abandoned mines, and unoccupied buildings at the base of mountains where agave, saguaro, and organ pipe cacti are present. Forages at night on nectar, pollen, and fruit of paniculate agaves and columnar cacti. The foraging radius of *Leptonycteris* bats may be 30 to 60 miles or more.	Likely to occur. While it is possible that this bat may forage in the Project Area, foraging activity is likely to be infrequent given the relatively small number of saguaros.	May effect, not likely to adversely affect.

Table 3. Federally Listed Species Potentially Occurring in the Project Area

Northern Mexican gartersnake (*Thamniphis eques megalops*)	USFWS T	This snake inhabits cienegas, stock tanks and riparian areas located between 130 and 8,500 feet elevation. The core populations for this species in Arizona are found in the Verde River drainage, Tonto Creek, and San Rafael Valley.	Does not occur in the Project Area or vicinity. There are no riparian or other aquatic habitats located on or near the project area.	No effect.
Sonoran Desert tortoise (*Gopherus morafkai*)	USFWS C	This tortoise is found on below 7,800 feet on rocky, steep, hillsides and bajadas of Mohave and Sonoran desertscrub. Occasionally found in wash bottoms that can be used for dispersal.	May occur in the Project Area or vicinity. However, the Project Area consists of sandy alluvium that is not primary habitat used to create burrows for this species.	No effect.
Sonoyta mud turtle (*Kinosternon sonoriense longifemorale*)	USFWS E	In Arizona, found only in pond and stream habitat at Quitobaquito Springs in Organ Pipe Cactus National Monument.	Does not occur in the Project Area or vicinity. There is no aquatic habitat in the Project Area.	No effect.
Tucson shovel-nosed snake (*Chionactis occipitalis klauberi*)	USFWS C	This species range includes portions of Maricopa, Pima and Pinal counties in primarily in creosote-mesquite floodplain areas within Sonoran desertscrub habitat. Shovel nose snakes require soft, sandy soils having sparse gravel and are often found under desert shrubs. These secretive snakes are active during dawn and dusk hours.	Does not occur in the Project Area. This species is very rare, and is found in Pinal County north of the Project Area.	No effect.

*USFWS Status Definitions:

E = Endangered. The ESA specifically prohibits the take of a species listed as endangered. Take is defined by the ESA as: to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to engage in any such conduct.

T = Threatened. The ESA specifically prohibits the take of a species listed as threatened. Take is defined by the ESA as: to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to engage in any such conduct.

PE = Proposed Endangered. These species are treated the same as E.

C = Candidate. Candidate species are those for which USFWS has sufficient information on biological vulnerability and threats to support proposals to list as endangered or threatened under the ESA. However, proposed rules have not yet been issued because they are precluded by other listing activity that is a higher priority. This listing category has no legal protection.

Range or habitat information is from the following sources: Heritage Data Management System (HDMS 2006); USFWS Arizona Ecological Services Field Office (USFWS 2006); *Arizona Rare Plant Field Guide* (Arizona Rare Plant Committee); and Corman and Wise-Gervais (2005).

Table 4. Other Special Status Species Potentially Occurring in the Project Area

Common Name (Species Name)	Status*	Range or Habitat Requirements	Potential for Occurrence in Project Area	Determination of Effect
Mexican long-tongued bat (*Choeronycteris Mexicana*)	FWS: SC USFS, BLM: S State: WSC	Southern California, Southern Arizona, southwestern New Mexico, southern tip of Texas and into central Mexico. Typically found in mesic areas in canyons of mixed oak-conifer forest in mountains. Caves and abandoned mines are favored daytime roosts. Preferred elevation ranges from 2,540 to 7,320 feet above sea level.	Does not occur in the Project Area or vicinity. There are no caves or adits in the area and the Project Area is lower than the preferred elevation range for this species.	No effect.
California leaf-nosed bat (*Macrotus californicus*)	FWS: SC USFS, BLM: S State: WSC	Found in Sonoran desertscrub; primary summer and winter ranges essentially the same; roosts in mines, caves, and rock shelters. Preferred elevation ranges from 160 to 4,000 feet above sea level.	Does not occur in the Project Area or vicinity. There are no caves or adits in the area.	No effect.
Thomber fishhook cactus (*mammmillaria thornberi*)	State: SR	Found in desert scrub habitat; typically grows beneath branches of white bursage. Two main populations are known in Pima County: the Avra Valley and Saguaro National Monument. This cactus has also been found on the Tohono O'odham Indian Reservation.	Does not occur in the Project Area or vicinity.	No effect.
Tummaoc Globeberry (*Tumamoca macdougalii*)	USFS, BLM: S State: SR	This plant ranges from southern Pinal and Maricopa counties, south into Sonora Mexico. This vine grows in association with a variety of nurse plants in Sonoran desertscrub habitat. Habitat includes sandy valley bottoms to rocky bajadas slopes.	Does not occur in the Project Area or vicinity.	No effect.

*Status Definitions:

SC = Species of Concern. This designation is made by the USFWS.
S = Sensitive. This designation is made by the U.S. Forest Service or the Bureau of Land Management.
WSC = Candidate. This is a State of Arizona designation.
SR = Salvage Restricted. This is a State designation for protected native plants.

Range or habitat information is from the following sources: HDMS; USFWS Arizona Ecological Services Field Office; *Arizona Rare Plant Field Guide* (Arizona Rare Plant Committee); and Corman and Wise-Gervais (2005).

3.3. DETAILED SPECIES ANALYSIS

Lesser Long-nosed Bat (*Leptonycteris yerbabuenae*)

ESA status: Listed Endangered under the ESA (USFWS 1988).

Range: The lesser long-nosed bat is known to occur in parts of Arizona, New Mexico, and Mexico. Within Arizona, this bat has been found throughout much of the southern portion of the state, from the Picacho Mountains southwest to the Agua Dulce Mountains and southeast to the Chiricahua Mountains. It is a seasonal resident in Arizona, usually arriving in early April and departing in mid- to late-September (USFWS 1997).

Biology: In Arizona, the lesser long-nosed bat feeds almost exclusively on the nectar, pollen, and fruit of saguaro (*Carnegiea gigantea*) and organ pipe (*Stenocereus thurberi*) cacti during the spring and early summer and on the nectar and pollen of agaves (primarily *Agave palmeri*) during the late summer and early fall (Cole and Wilson 2006). Foraging groups of lesser long-nosed bats are known to fly long distances (80 to 100 km [50 to 62 miles]) each night between their day roosts and nighttime foraging areas (USFWS 1997). Extensive populations of suitable agave and cactus species are required to support this species (USFWS 1997).

Habitat: The lesser long-nosed bat is found in arid and semiarid habitats. It is associated primarily with desertscrub, semidesert grassland, and oak woodland vegetative communities below approximately 6,000 ft amsl (1,830 m) (USFWS 1997). This species roosts in caves and abandoned mines.

Potential Occurrence at the Analysis Area: AGFD HDMS reports no records of this species within 3 miles of the Analysis Area. Presently, the closest known maternity site for these bats is approximately 60 miles from the Project Area at Old Mammon Mine, and the closest known post-maternity dispersal colony is approximately 20 miles from the Project Area at Box Canyon Crevice. The closest lesser long-nosed bat record is from the Picacho Mountains, approximately 20 miles from the Analysis Area, noted as being active between 1955-1986. Hoffmeister (1986) notes a record for lesser long-nosed bat at the Drive In Mine at Picacho Peak. Although this species has not been documented in the immediate vicinity, the Project Area is within the foraging range of the species.

Potential Impacts: Suitable roosting resources (caves or abandoned mines) are not within the Project Area and thus would not be disturbed by the Project. The Project Area contains forage resources (saguaros) that may be impacted by the Project, and is within, but on the far northern end of, the foraging range of the lesser long-nosed bat from known active roost sites. Therefore, Project construction is anticipated to minimally impact foraging opportunities for the lesser long-nosed bat. No agaves were observed, but approximately 15 saguaros were identified within the Project Area. Not all of these saguaros are of size class that will flower; saguaro ≥8 ft tall is considered of flowering size (Dimmitt 2000). Moreover, removal of saguaros is expected to be restricted to the southeastern portion of the site where there are few saguaros. Furthermore, the number of potentially impacted saguaro represents a very small percentage of the available forage resource within the vicinity of the Project Area. In addition, saguaros would be transplanted to outside of the disturbance areas as part of the landscaping plan and to retain their resource value for wildlife. Transplant of viable saguaros would minimize the potential for the Project to impact this species.

3.4 CONSERVATION MEASURES

TEP proposes to implement the following measures to promote the conservation of the natural habitat and wildlife species that occur in the area.

- Avoid impacting Pima County designated riparian areas located on the Project Area
- Replant Saguaros and native vegetation in disturbed areas in accordance with the Native Plant Preservation Ordinance for Pima County.
- Clear vegetation within the footprint of the Project prior to the nesting/breeding season for migratory birds.

4.0 CONCLUSIONS

This BE documents the vegetation and habitat on the site and the potential for occurrence of 11 special-status species that are listed under the ESA for Pima County by the USFWS. Screening criteria such as known range and habitat requirements were used to identify whether any listed species have the potential to occur on the site. Species with distribution ranges that are known to be far from the site and/or species that occupy habitats not found within or adjacent to the Project Area were eliminated or discounted from detailed evaluation in this BE.

Only the LLNB was found to have a slight potential for occurrence on the site. The site is within the geographic range of the LLNB and the potential occurrence for this species was evaluated during the screening analysis. Life-cycle requirements and known range and roost site information for LLNB were reviewed and compared with field data collected during the field reconnaissance. The Project Area and surrounding lands do not contain roost sites and there is only marginal forage (e.g., no agave) habitat for LLNB. Affects to LLNB foraging habitat would be minimal as very few saguaros would be affected and saguaros would be transplanted onsite as part of the landscaping plan and to retain wildlife habitat values. Based on this evaluation and the proposed conservation measures listed above, the Project may effect, but is not likely to adversely affect the current population of LLNB in Arizona. Furthermore, the Project would not jepordize the continued existance of LLNB in Arizona or throughout its current range.

Based upon the field habitat assessment and screening analysis and proposed conservation measures, BEC determined that the site is unlikely to support or thus adversely affect, any of the other listed species for Pima County and no proposed or designated Critical Habitat is locate on or near site.

5.0 LITERATURE CITED / REFERENCES

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Sellers, W. D. and Hill, R. H. 1974 Arizona Climate 1931–1972. University of Arizona Press, Tucson.

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APPENDIX A

U.S. FISH AND WILDLIFE SERVICE
INFORMATION, PLANNING, AND CONSERVATION SYSTEM
REPPORT DATABASE

U.S. Fish and Wildlife Service

Natural Resources of Concern

This resource list is to be used for planning purposes only — it is not an official species list.

Endangered Species Act species list information for your project is available online and listed below for the following FWS Field Offices:

Arizona Ecological Services Field Office
2321 WEST ROYAL PALM ROAD, SUITE 103
PHOENIX, AZ 85021
(602) 242-0210
http://www.fws.gov/southwest/es/arizona/
http://www.fws.gov/southwest/es/EndangeredSpecies/lists/

Project Name:

Orange Grove Substation

U.S. Fish and Wildlife Service

Natural Resources of Concern

Project Location Map:

Project Counties:

Pima, AZ

Geographic coordinates (Open Geospatial Consortium Well-Known Text, NAD83):

MULTIPOLYGON (((-110.9952917 32.3206079, -110.9973484 32.3205854, -110.9973425 32.3230202, -110.9952707 32.3230109, -110.9952917 32.3206079)))

Project Type:

Transmission Line

U.S. Fish and Wildlife Service

Natural Resources of Concern

Endangered Species Act Species List (USFWS Endangered Species Program).

There are a total of **10** threatened, endangered, or candidate species on your species list. Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fishes may appear on the species list because a project could cause downstream effects on the species. Critical habitats listed under the **Has Critical Habitat** column may or may not lie within your project area. See the **Critical habitats within your project area** section below for critical habitat that lies within your project area. Please contact the designated FWS office if you have questions.

Species that should be considered in an effects analysis for your project:

Birds	Status		Has Critical Habitat	Contact
California Least tern (*Sterna antillarum browni*)	Endangered	species info		Arizona Ecological Services Field Office
Mexican Spotted owl (*Strix occidentalis lucida*) Population: Entire	Threatened	species info	Final designated critical habitat	Arizona Ecological Services Field Office
Southwestern Willow flycatcher (*Empidonax traillii extimus*) Population: Entire	Endangered	species info	Final designated critical habitat	Arizona Ecological Services Field Office
Yellow-Billed Cuckoo (*Coccyzus americanus*) Population: Western U.S. DPS	Proposed Threatened	species info		Arizona Ecological Services Field Office
Mammals				
jaguar (*Panthera onca*) Population: U.S.A (AZ,CA,LA,NM,TX),Mexico,Central and South America	Endangered	species info	Final designated critical habitat	Arizona Ecological Services Field Office

Natural Resources of Concern

Lesser Long-Nosed bat (*Leptonycteris curasoae yerbabuenae*) Population: Entire	Endangered	species info		Arizona Ecological Services Field Office
Reptiles				
Northern Mexican gartersnake (*Thamnophis eques megalops*)	Proposed Threatened	species info	Proposed critical habitat	Arizona Ecological Services Field Office
Sonoran desert tortoise (*Gopherus morafkai*) Population:	Candidate	species info		Arizona Ecological Services Field Office
Sonoyta Mud turtle (*Kinosternon sonoriense longifemorale*) Population:	Candidate	species info		Arizona Ecological Services Field Office
Tucson Shovel-Nosed Snake (*Chionactis occipitalis klauberi*)	Candidate	species info		Arizona Ecological Services Field Office

Critical habitats within your project area:

There are no critical habitats within your project area.

FWS National Wildlife Refuges (USFWS National Wildlife Refuges Program).

There are no refuges found within the vicinity of your project.

U.S. Fish and Wildlife Service

Natural Resources of Concern

FWS Migratory Birds (USFWS Migratory Bird Program).

Most species of birds, including eagles and other raptors, are protected under the Migratory Bird Treaty Act (16 U.S.C. 703). Bald eagles and golden eagles receive additional protection under the Bald and Golden Eagle Protection Act (16 U.S.C. 668). The Service's Birds of Conservation Concern (2008) report identifies species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become listed under the Endangered Species Act as amended (16 U.S.C 1531 et seq.).

Migratory bird information is not available for your project location.

NWI Wetlands (USFWS National Wetlands Inventory).

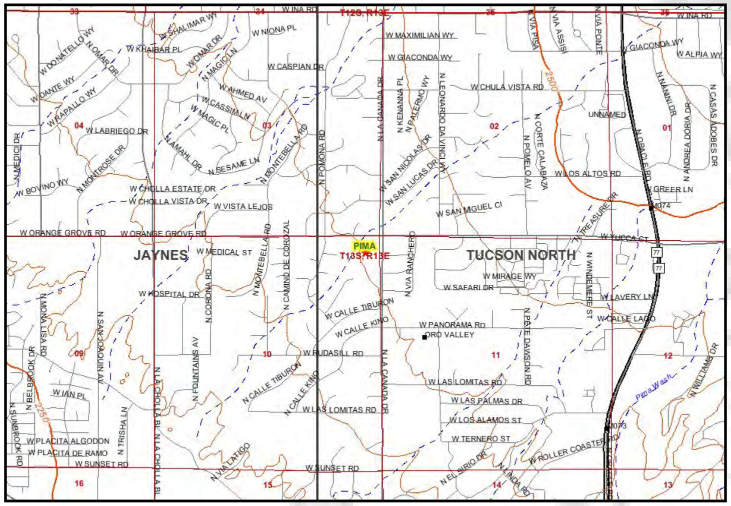
The U.S. Fish and Wildlife Service is the principal Federal agency that provides information on the extent and status of wetlands in the U.S., via the National Wetlands Inventory Program (NWI). In addition to impacts to wetlands within your immediate project area, wetlands outside of your project area may need to be considered in any evaluation of project impacts, due to the hydrologic nature of wetlands (for example, project activities may affect local hydrology within, and outside of, your immediate project area). It may be helpful to refer to the USFWS National Wetland Inventory website. The designated FWS office can also assist you. Impacts to wetlands and other aquatic habitats from your project may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal Statutes. Project Proponents should discuss the relationship of these requirements to their project with the Regulatory Program of the appropriate U.S. Army Corps of Engineers District.

There are no wetlands found within the vicinity of your project.

APPENDIX B

ARIZONA GAME AND FISH DEPARTMENT
ON-LINE ENVIRONMENTAL REVIEW TOOL

Project Location



Project Name: Orange Grove Substation
Submitted By: Rion Bowers
On behalf of: PIMA
Project Search ID: 20131115021848
Date: 11/15/2013 10:31:01 AM
Project Category: Energy Storage/Production/Transfer,Energy Transfer,substation
Project Coordinates (UTM Zone 12-NAD 83): 500334.141, 3576140.081 meter
County: PIMA
USGS 7.5 Minute Quadrangle ID: 1728
Quadrangle Name: TUCSON NORTH
Project locality is not anticipated to change

Location Accuracy Disclaimer

Project locations are assumed to be both precise and accurate for the purposes of environmental review. The creator/owner of the Project Review Receipt is solely responsible for the project location and thus the correctness of the Project Review Receipt content.

The Department appreciates the opportunity to provide in-depth comments and project review when additional information or environmental documentation becomes available.

Special Status Species Occurrences/Critical Habitat/Tribal Lands within 3 miles of Project Vicinity:

Name	Common Name	FWS	USFS	BLM	State
Bat Colony					
Choeronycteris mexicana	Mexican Long-tongued Bat	SC	S	S	WSC
Leptonycteris curasoae yerbabuenae	Lesser Long-nosed Bat	LE			WSC
Macrotus californicus	California Leaf-nosed Bat	SC	S	S	WSC
Mammillaria thornberi	Thornber Fishhook Cactus				SR
Thamnophis eques megalops	Northern Mexican Gartersnake	PT	S		WSC
Tumamoca macdougalii	Tumamoc Globeberry		S	S	SR

 APPLICATION INITIALS: ___________

Tucson Electric Power Orange Grove Substation

Appendix D

Class III Cultural Resource Survey

THE PLANNING CENTER
a division of TPC Group, Inc
110 s church ste 6320 tucson az 85701

A Class III Cultural Resource Survey of 9.085 Acres Southwest of the Intersection of West Orange Grove Road and North La Canada Drive, in Tucson, Pima County, Arizona

Prepared by:
Jenna M. Hamlin, Ph.D.

Tierra Archaeological Report No. 2013-127
ASM Accession No. 2013-pending
November 14, 2013

A Class III Cultural Resource Survey of 9.085 Acres Southwest of the Intersection of West Orange Grove Road and North La Canada Drive, in Tucson, Pima County, Arizona

Prepared by:
Jenna M. Hamlin, Ph.D.

Prepared for:
Tucson Electric Power
88 E. Broadway Blvd.
Mail Stop HQW603
Tucson, AZ 85701

Submitted by:
Tierra Right of Way Services, Ltd.
1575 East River Road, Suite 201
Tucson, Arizona 85718

Tierra Archaeological Report No. 2013-127
ASM Accession No. 2013-pending
November 14, 2013

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ABSTRACT

PROJECT TITLE:	A Class III Cultural Resource Survey of 9.085 Acres Southwest of the Intersection of West Orange Grove Road and North La Canada Drive, in Tucson, Pima County, Arizona
LAND STATUS:	Private
FUNDING SOURCE:	Private
PROJECT DESCRIPTION:	Tucson Electric Power intends to install new power substation with an approximately 137-m-long (450-foot-long) by 76-m-wide (250-foot-wide) footprint on an approximately 229-m-long (750-foot-long) by 168-m-wide (550-foot-wide) project area southwest of the intersection of West Orange Grove Road and North La Canada Drive, in Pima County, Arizona
TIERRA PROJECT NO.:	13T0-318
TIERRA REPORT NO.:	2013-127
ASM ACCESSION NO.:	2013-pending
PERMIT NO.:	Arizona State Museum Blanket Permit No. 2013-004bl
FIELDWORK DATE:	November 8, 2013
PROJECT LOCATION:	The project area consists of an approximately 229-m-long (750-foot-long), 168-m-wide (550-foot-wide) project area southwest of the intersection of West Orange Grove Road and North La Canada Drive, in Pima County, Arizona. In legal terms, the project area is located in the NE ¼ of the NE ¼ of Section 10, Township 13 South, Range 13 East, Gila and Salt River Baseline and Meridian (G&SRB&M), in unincorporated Pima County, Arizona, as depicted on the Tucson North, Arizona, U.S. Geological Survey 7.5-minute topographic quadrangle.
NO. OF ACRES SURVEYED:	3.676 ha (9.085 acres)
NO. OF CULTURAL RESOURCES:	0

ASSESSMENT OF EFFECTS AND TREATMENT RECOMMENDATIONS:

This survey was conducted to meet the requirements of Section 106 of the National Historic Preservation Act (NHPA) and federal regulations at 36 CFR 800, as well as state and county requirements. No archaeological sites, isolated occurrences, or historic buildings requiring recordation, or any other properties potentially eligible for inclusion on the National Register of Historic Places (NRHP) or Arizona's State Register of Historic Places (SRHP), were identified in the APE during the current survey. Tierra recommends that a finding of "no historic properties affected by this proposed undertaking" be issued. We recommend that authorization for Tucson Electric Power to proceed with the installation of their substation within the bounds of the area covered by this survey be granted without any requirement for further archaeological work.

The client and all subcontractors are reminded that, in accordance with Section 41-865 of the Arizona Revised Statutes, should buried human remains or funerary goods be encountered incidentally on private lands during any ground-disturbing activities associated with the current project or any follow-up work done at any time in the future, all such work must immediately be halted in the vicinity of the finding and the Director of the Arizona State Museum must immediately be informed, so that a consultation process can be initiated and an appropriate course of treatment decided upon. Under the statute the Director must make an initial response to such a notification within ten working days; there is, however, no specified limit on the length of time that work may be delayed in order to deal with the finding in an appropriate manner. In any case, work is not to resume until authorization is received from the museum director. Should the Director fail to respond to the notification within the ten-day window provided in the statute, it can be assumed that authorization to resume work has been given.

INTRODUCTION

On November 8, 2013, archaeologist Jenna M. Hamlin of Tierra Right of Way Services, Ltd. (Tierra), performed a Class III archaeological survey of an approximately 229-m-long (750-foot-long), 168-m-wide (550-foot-wide) project area southwest of the intersection of West Orange Grove Road and North La Canada Drive, in Pima County, Arizona. The purpose of the survey was to identify, record, and assess the significance of any prehistoric or historic cultural resources that might be adversely affected by ground-disturbing activities associated with the installation of a new Tucson Electric Power substation within the designated project area. The work was done on behalf of Tucson Electric Power (TEP), the contractor which intends to install the new substation, and under the authority of Arizona Antiquities Act Blanket Permit No. 2013-004bl, issued by the Arizona State Museum (ASM). Although an archaeological review is required by a permit at this time, TEP has elected to have this survey performed as part of their due diligence for future site construction. This survey was conducted to meet the requirements of Section 106 of the National Historic Preservation Act (NHPA) and federal regulations at 36 CFR 800, as well as state and county requirements.

THE PROJECT AREA

The area of potential effect (APE) (Figure 1) consists of an approximately 229-m-long (750-foot-long), 168-m-wide (550-foot-wide) project area southwest of the intersection of West Orange Grove Road and North La Canada Drive, in Pima County, Arizona. In legal terms, the project area is located in the NE ¼ of the NE ¼ of Section 10, Township 13 South, Range 13 East, Gila and Salt River Baseline and Meridian (G&SRB&M), in unincorporated Pima County, Arizona, as depicted on the Tucson North, Arizona, U.S. Geological Survey 7.5-minute topographic quadrangle.

The APE is 9.085 acres at the southwest corner of West Orange Grove Road and North La Canada Drive. It is an undeveloped area with dense native vegetation (Photo 1) cut by natural washes (Photo 2). The northern boundary of the project area is approximately 70 feet south of the southern edge of West Orange Grove Road, the eastern boundary is approximately 75 feet west of the centerline of North La Canada Drive, the western boundary is a TEP powerline easement and private property, and the southern boundary is private, commercial property (Photo 3).

The project area falls within the range of the Arizona Upland Subdivision of the Sonoran Desertscrub biotic community. The Sonoran Desertscrub community as a whole is spread across the southwestern quarter of Arizona, the deserts of Riverside and San Diego Counties in California, and much of the Mexican states of Baja California Norte, Baja California Sur, and Sonora. The Sonoran Desert is distinguished from others in the region (the Mohave, the Great Basin, and the Chihuahuan) by a bimodal distribution of rainfall, with some precipitation in both winter and summer, which has contributed to the survival of larger plant species than in other deserts—in particular, of trees, large cacti, and massive succulents (Turner and Brown 1994). Several subdivisions of the Sonoran Desertscrub community have been identified; however, of these, only two, the Lower Colorado River Subdivision and the Arizona Upland Subdivision, occur within the United States.

The Arizona Upland Subdivision is described by Turner and Brown (1994) as "the best watered and least desert-like desertscrub in North America." The range of this subdivision is characterized by the prevalence of substantial slopes; this does not necessarily translate to greater elevations, as elevations

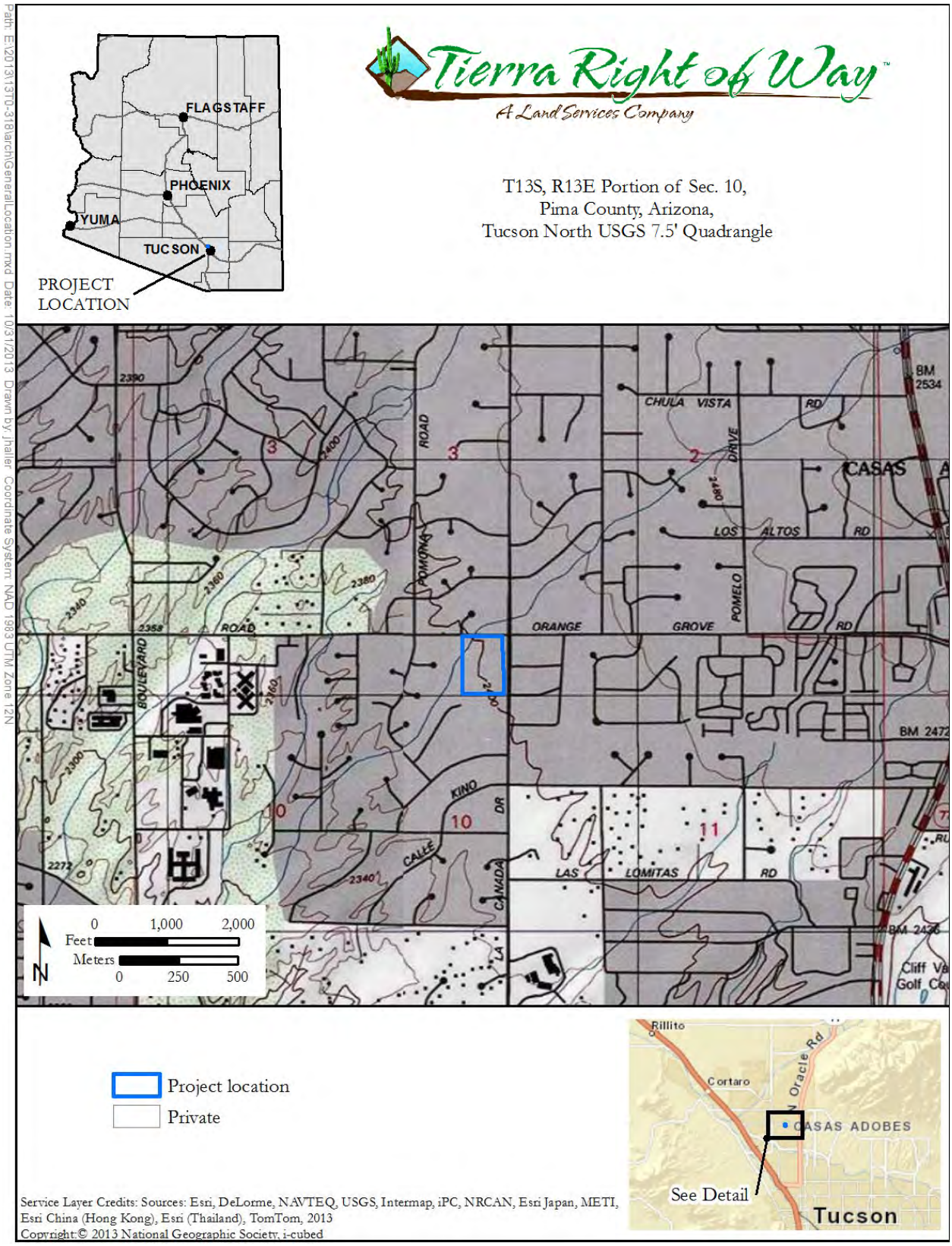

Figure 1. Project location.

Photo 1. Overview of project area, looking north.

Photo 2. Natural wash cutting through project area, looking SSW.

Photo 3. Southern boundary of project area, looking east.

within the Arizona Upland Subdivision range from as low as 300 m (1,000 feet) to as high as1,000 m (3,300 feet) above mean sea level (AMSL). Rainfall is greater than in the Lower Colorado Subdivision at 20.0–42.5 cm (8.0–16.5 inches), and mean temperatures range between 80–90° F (27–32° C) in summertime and between 44–57° F (7–14° C) in winter over the range of the subdivision (Turner and Brown 1994).

Because this subdivision receives more rainfall than the Lower Colorado Subdivision, species that are confined to washes in the Lower Colorado are spread much more widely here. Overall, this subdivision is dominated by taller, woodier species, enough so that Turner and Brown (1994:181) speculated that many geographers would not identify this as a desertscrub community at all, but rather a "depauperate thornscrub community." Saguaro *(Carnegeia gigantean)*, organ pipe cactus *(Stenocereus thurberi)*, fishhook barrel cactus *(Ferocactus wislizenii)*, compass barrel cactus *(F. acanthodes)*, night-blooming cereus *(Peniocereus greggii)*, pencil cholla *(Cylindropuntia arbuscula*), christmas cactus *(C. leptocaulis)*, cane cholla *(C. spinosior)*, buckhorn cholla *(C. acanthocarpa)*, teddy bear cholla *(C. bigelovii)*, chain fruit cholla *(C. fulgida)*, and many other cacti are strongly represented within this subdivision. The most widely distributed plant community within this subdivision is a palo verde–cacti–mixed scrub series, which is best developed away from valley floors (which are dominated by the creosotebush–white bursage communities typical of the Lower Colorado Subdivision), on bajadas and mountain slopes. The dominant plants in this series are foothills palo verde *(Cercidium microphyllum)* and the giant saguaro *(Carnegiea gigantea)*, with ironwood *(Olneya tesota)* being prominent in places away from valley floors; northern slopes are dominated by palo verde. The white leaf bursage of the valley floors gives way to triangle leaf bursage *(Ambrosia deltoidea)* on the slopes, with whitethorn acacia *(Acacia constricta)*, ocotillo *(Fouquieria splendens)*, jojoba *(Simmondsia chinensis)*, desert hackberry *(Celtis pallida)*, and numerous other species also appearing as part of the upslope

community. In localized areas near the upper limit of the range jojoba, an economic plant, achieves dominance, while elsewhere at high elevations (often extending past the limit of the desertscrub community), a creosotebush-crucifixion-thorn series dominates.

Mammals common within the Arizona Upland Subdivision include desert mule deer *(Odocoileus hemionous crooki)*, javelina *(Dicotyles tajacu)*, California leaf-nosed bat *(Macrotus californicus)*, black-tailed jackrabbit *(Lepus californicus)*, desert cottontail *(Sylvagius audubonii)*, Arizona pocket mouse *(Perognathus amplus)*, Bailey's pocket mouse *(P. baileyi)*, cactus mouse *(Peromyscus eremicus)*, gray fox *(Urocyon cinereoargenteus)*, and Harris' antelope squirrel *(Ammospermophilus harisii)*. While numerous well-known types of bird are common to this community, most, including Harris' hawk *(Parabuteo unicinctus)*, white-winged dove *(Zenaida macroura)*, Inca dove *(Scardiafella inca)*, elf owl *(Micrathene whitneyi)*, pyrrhuloxia *(Cardinalis sinuatus)*, and assorted cactus woodpeckers are equally common to other biotic communities as well. Perhaps the animal species most characteristic of this community are the reptiles, including regal horned lizard *(Phrynosoma solare)*, western whiptail *(Cnemidophorus tigris gracilis)*, Gila monster *(Heloderma suspectum)*, Arizona coral snake *(Micruroides euryxanthus)*, and tiger rattlesnake *(Crotalus tigris)*.

CULTURAL BACKGROUND

Paleoindian Period (11,300–8,500 B.C.)

The first known inhabitants of southern Arizona are referred to by archaeologists as Paleoindians. These groups were migratory peoples who entered North America during the Pleistocene epoch. Two classic characteristics of Paleoindian sites are the presence of fluted, lanceolate projectile points (Clovis points; see below) and the fossil remains of now extinct species, particularly Pleistocene megafauna such as mammoth (*Mammuthus* spp.) and ancient bison *(Bison antiquus)* (Reid and Whittlesey 1997:30–37). The Paleoindians were originally conceptualized purely as big-game hunters, but it is now understood that these people actually exploited a spectrum of biological resources that were in some ways akin to later Archaic subsistence strategies (Mabry 1998:105–107).

The earliest definitively dated archaeological sites in the Southwest are Clovis occupations, typified by Clovis points. These points display concave bases, basal fluting, and lateral and marginal grinding (Slaughter 1992:72). Several important Clovis sites, including Naco, Lehner, Escapule, and Murray Springs, are located in the upper San Pedro valley of southeastern Arizona (Faught and Freeman 1998:41). At the Murray Springs site, two Clovis points were found in association with an unbutchered mammoth. Apart from these sites, much of the evidence for a Clovis presence in Arizona is reflected in isolated occurrences of Clovis points (either whole or fragments). Clovis points are known from the St. Johns and Winslow areas, for example (Neily 1985:10), and from the San Pedro valley near Kartchner Caverns (Faught and Freeman 1998:44). In Tucson, a Clovis point was discovered in a disturbed context at the Valencia site (Doelle 1985:181). The Clovis complex was succeeded by the Folsom complex, which, like the Clovis, is typified by its distinctive projectile points. Folsom points, unlike Clovis points, have flutes that extend all the way from their proximal to distal ends and have pressure-flaked marginal edges. In Arizona, the only known Folsom points have been found in surface contexts on the Colorado Plateau and the mountain transition zone to the south of the Mogollon Rim (Faught and Freeman 1998:45).

Early Archaic Period (ca. 8500–6000 B.C.)

The Early Archaic period is known in southern Arizona as the Sulphur Spring phase. This phase was originally defined by Sayles and Antevs in 1941 in the Sulphur Springs Valley in southeastern Arizona (Sayles and Antevs 1941). Problems with dating (a result of the work having taken place prior to the development of carbon-dating techniques) originally led Sayles to conclude that a Paleoindian tradition (typified by the exploitation of megafauna) coexisted here with a hunting-and-gathering tradition that exploited smaller game and various plant resources, as reflected in an artifact assemblage composed of flat milling stones, unifacial scrapers, and other lithic implements. This assessment turned out to be incorrect; however, a reexamination of the material from the Sulphur Springs Valley did establish a reliable beginning date for the Sulphur Spring phase. Even though they have now been dated with certainty, the sites investigated by Sayles did not include any artifacts (e.g., projectile points) that were stylistically distinctive and, therefore, temporally diagnostic. In southern Arizona, there has been an overall lack of diagnostic projectile points recovered from Early Archaic sites that can be directly correlated in time with the Sulphur Spring phase. It is therefore difficult to date sites to this phase when other, more-direct methods of dating, such as radiocarbon dating, cannot be used (Huckell 1996:329). One exception to this lack of diagnostic artifacts at Sulphur Spring phase sites is Ventana Cave, where 17 stemmed Ventana-Amargosa points were recovered by Haury (1950) under the Red Sand deposit. The stratigraphic location of these points suggested they were manufactured and deposited sometime after 6700 B.C. Similar points have been reported from Archaic contexts in the northern Santa Rita Mountains, but again, no associated datable material was found in the same context as the points (Huckell 1996:330–331).

Middle Archaic Period (6000–2100 B.C.)

The Middle Archaic period, also known as the Chiricahua phase of the Cochise culture in the tripartite stage designation schema of Sayles and Antevs (1941) and Sayles (1945), is part of the broader cultural entity that archaeologists have conceptualized as the Archaic period. In terms of material culture, the Middle Archaic period is typified by the addition of shallow basin metates, mortars and pestles, various bifacial tools, and distinctive side-notched projectile points to the overall tool assemblage of the preceding Early Archaic period. Generally, the Middle Archaic period is viewed as a time when regional variations in this material culture across the Southwest became less pronounced. In particular, notched projectile points take on a general similarity of design over large geographic regions. Chiricahua points, for example, are similar in style and manufacturing technique to Pinto and San Jose points, which are found in other areas of Arizona (Slaughter 1992:70); it is thought that this uniformity of technology is related to the high degree of mobility that was presumably characteristic of populations living during this period. Similarly, concave-base Cortaro points, often associated with the succeeding Late Archaic–Early Agricultural period but that are also present in Middle Archaic contexts, are widely distributed across southern Arizona and have possible equivalents in southern New Mexico and California (Justice 2002:181–182).

In the Tucson Basin, surface Middle Archaic period sites are known from montane and bajada contexts, with the typical artifacts mentioned above in addition to fire-cracked rock and occasional rock cairn burials (Huckell 1995:3). Subsurface Middle Archaic remains are known from two sites in the Santa Cruz River valley—the Los Pozos (Gregory 1999) and Rillito Fan sites (Wallace 1996).

Late Archaic–Early Agricultural Period (2100 B.C.–A.D. 150)

As the name implies, the Late Archaic–Early Agricultural period in the Southwest is marked by the widespread adaptation of cultivated food resources. In this region, this period is also marked by the

appearance of permanent or semipermanent domestic architecture; canal irrigation; and the first Mesoamerican cultivars, which arrived as early as the beginning of the second millennium B.C. (Huckell 1996:343), although maize may have arrived somewhat earlier. At the same time, the period is generally thought to be a time in which people continued a lifeway that remained relatively mobile with the objective of exploiting wild food resources; sites that reflect these activities continue to be categorized under the designation of Late Archaic (Huckell 1995). This period is thought to be one in which groups of people practicing a relatively mobile lifeway began, over a long span of time, to incorporate agricultural products as significant elements of their subsistence.

Work in the Southwest during the past two decades (particularly in the Santa Cruz River valley) has resulted in the discovery of numerous Late Archaic–Early Agricultural period sites and the establishment of a phase sequence for the period. The earliest phase (dated 2100–1500 B.C.) is presently unnamed and is defined by the first appearance of maize; pepo squash *(Cucurbita pepo)*; storage pits; and large, circular pit structures. Fired sherds (perhaps from incipient vessels) and figurine fragments that date to about 2100 B.C. have been recovered in the Tucson Basin (Mabry 2007:7). The San Pedro phase (1500–800 B.C.) continued to include these attributes, with the addition of a hallmark of the phase, corner-notched San Pedro dart points and, in the San Pedro core area, Empire points (Mabry 2007:Figure 1.3). Cultivars added to the crop complex included cotton (*Gossypium* sp.) and possibly the common bean *(Phaseolus vulgaris)*. Also appearing during the San Pedro phase were specialized storage structures with large, interior bell-shaped pits; oval and round house-in-pit type structures; a wider variety of functional extramural pits; flexed inhumations, often in cemeteries; stone and bone pipes; distinctive ceramic figurines; canid burials; refinements in ground stone technology; and, in the Santa Cruz River valley, canal-irrigated farming (Mabry 2007:7–9, 15–18). Large, communal-ritual pit structures (perhaps descendents of even larger pre–San Pedro types) were present during the San Pedro phase. The bow and arrow may also have appeared in the Southwest during this time.

The Cienega phase completes the Late Archaic–Early Agricultural period phase sequence. The Cienega phase was initially proposed by Huckell (1995) and is marked by the appearance of Cienega points, which are distinguished morphologically by deep, oblique corner-notching and flaring stems and were used as dart and possibly arrow points (Lorentzen 1998:150). The Cienega phase was also characterized by an emphasis on large, circular pit structures that often had cylindrical and, less frequently, bell-shaped subfloor pits (Huckell 1995); a more diverse ground stone artifact assemblage that included stone disks and well-made stone trays; and large, communal houses that may have developed from San Pedro phase predecessors.

Early Ceramic Period (A.D. 150–650)

In both the Tucson and Phoenix Basins, the Early Ceramic period appears to have developed out of the cultural matrix of the Late Archaic–Early Agricultural period; work in the Tucson area in particular has, over the past several years, yielded a large amount of data supporting this idea. Sites in the Tucson region where the Early Ceramic period has been studied extensively include the Houghton Road site (Ciolek-Torrello 1998) and several sites along the Santa Cruz River.

Two Early Ceramic phases have been proposed for the Tucson Basin: the Agua Caliente and the Tortolita. The Agua Caliente phase (A.D. 150–450) is marked by the appearance of plain ware vessels produced by the coil-and-scrape technique and represents the ceramic plain ware horizon in the Tucson Basin. Vessel forms across the Southwest at this time consisted predominately of neckless

seed jars, which were well suited for storage purposes, and small hemispherical bowls. This phase was also characterized by an assemblage of milling stones, an expedient flaked stone industry accompanied by a remnant Archaic period bifacial tool technology, and domestic and communal pit houses (Whittlesey and Heckman 2000a:6). Flexed inhumations and small grinding equipment typical of the Late Archaic–Early Agricultural period continued into this phase (Ciolek-Torrello 1995:542). Architecture became more formal in design, with houses incorporating formal plastered hearths and clearly defined entryways. House shapes are generally rectangular, or in some cases kidney-bean shaped, with plastered pillars or post supports on either side of the house entryways. The communal structures are larger but share morphological attributes of the smaller houses and are strikingly similar to Mogollon communal structures, which eventually evolved into Great Kivas (Reid and Whittlesey 1997:143).

The Tortolita phase (A.D. 450–650) represents the red ware horizon in the Tucson Basin and corresponds approximately with the beginning of the Vahki phase (characterized by Vahki Red Ware) in the Phoenix Basin. Tortolita Red is hard slipped (usually, but not always, on both vessel surfaces) and is typically sand tempered (Bernard-Shaw 1990; Heidke 2003:148). An additional important change in ceramic manufacture during the Tortolita phase is the expansion of vessel forms from the Agua Caliente–type seed jar to a variety of vessel forms (including flared-rim forms) intended for cooking and serving (Heidke 2003:148). Tortolita phase settlements are larger with more formal patterning than previous Agua Caliente phase settlements, were increasingly dependent on maize, and a placed greater emphasis on sedentism. In the Santa Cruz River valley, Tortolita phase sites or sites with a Tortolita component have become relatively well documented and are currently more well known than Agua Caliente sites.

Pioneer Period (A.D. 650–750)

The Pioneer period in the Tucson Basin is not currently well understood. As mentioned earlier, the first phase of the Pioneer period, the Vahki phase of the Salt-Gila Basin, is equivalent to the Tortolita phase red ware horizon in the Tucson Basin. The remaining phases of the Salt-Gila sequence—Estrella, Sweetwater, and Snaketown—are marked by the appearance of decorated pottery. The Estrella phase pottery (Estrella Red-on-gray) is distinguished by painted, broadline designs in quartered layouts (typically within bowl interiors). It has been suggested that the appearance of this pottery tradition marks a broadline ceramic horizon, similar to the earlier plain and red ware horizons (Whittlesey and Heckman 2000a:8). Incised pottery also appeared during the Estrella phase (Whittlesey and Heckman 2000b:98).

In the Tucson Basin, red ware ceramics continued to be produced into the Cañada del Oro phase (Wallace et al. 1995:596), and the beginning of the broadline horizon appears to be more reflective of an addition of broadline decorated pottery to the existing plain and red ware ceramic complex. Broadline ceramics are not common in the Tucson Basin and appear to have been restricted to a relatively short span of time. Similar remarks apply to Sweetwater Red-on-gray and Snaketown Red-on-buff ceramics, which display fine-lined and increasingly elaborate designs.

It is during the final phase of the Pioneer period, the Snaketown phase, that distinctly Hohokam traits in material culture become evident in the Tucson Basin (in ceramic design and other technologies). The Snaketown phase, when true red-on-buff ceramics began to be produced, has been viewed by some archaeologists as being the actual beginning of what can be reliably defined as Hohokam, although others believe that Hohokam culture cannot be defined until the Colonial

period, when hallmark traits such as ballcourts and a distinctive mortuary complex appeared (Wallace et al. 1995:576, 606).

The Pioneer period in the Tucson Basin, if accepted as being truly present at all, lasted approximately a century. It was characterized by a temporally limited appearance of the broadline horizon in the form of Estrella and Sweetwater Red-on-gray ceramics, with a similarly brief appearance of the Snaketown phase (at least in terms of ceramic tradition) as a precursor to the Cañada del Oro phase.

Colonial Period (A.D. 750–950)

The Tucson Basin Colonial period comprises two phases, the Cañada del Oro (A.D. 750–850) and the Rillito (A.D. 850–950). Several distinguishing cultural traits mark the advent of the Colonial period; some of these will be described briefly.

Canal irrigation had been widespread in the Salt-Gila Basin during the Snaketown phase and continued to expand there during the Colonial period. Ballcourts were spaced at an average of 5.5 km (3.4 miles) along the Phoenix canals, suggesting that ballcourts served to identify their villages as the centers of "irrigation communities" (Wilcox and Sternberg 1983). During the Colonial period, the Santa Cruz River was recovering from a period of entrenchment that had begun about 50 B.C. This resulted in an environment that was increasingly conducive to floodwater farming (Waters 1992:175). Settlement expanded in the Tucson Basin, with ballcourt villages being constructed in the Santa Cruz River valley at several sites. Ballcourts, primary indicators of Mesoamerican influence in the Southwest at this time (Wilcox and Sternberg 1983), likely served as focal points for regional socioeconomic interaction. The large communal houses that had been constructed at many sites from the Late Archaic–Early Agricultural period onward disappeared during the Colonial period. Village settlement was patterned on individual houses organized into house clusters (also termed courtyard groups) that were oriented around a central plaza—a pattern that was already evident during the Pioneer period. Ceramic design began incorporating zoomorphic and anthropomorphic imagery and micaceous temper, which has been interpreted as a result of cultural influence originating in the Salt-Gila Basin (Wallace et al. 1995:601, 605–607).

Cremation burial virtually replaced inhumation burial by the middle of the Colonial period (Wilcox 1991:270). Even though this trait is a defining characteristic of the Colonial period, it, like the courtyard group settlement pattern, had precedents in the Pioneer period (Crown 1991:145–146). Hohokam cremation burials typically included palettes, worked shell, and stone censors as mortuary offerings. The cremations were placed in discrete cemeteries that became components of the typical Hohokam village and are frequently associated with plazas and house groups and their accompanying trash mounds. Such cemeteries were apparently associated with the suprahouseholds represented by the house cluster–plaza–trash mound complexes (Wilcox 1991:256).

Sedentary Period (A.D. 950–1150)

The Sedentary period in the Tucson Basin is divided into three subphases: the Early, Middle, and Late Rincon. In the Salt-Gila Basin, it is composed of a single phase, the Sacaton. During the Early Rincon subphase (A.D. 950–1000), the settlements that had been established along major drainages during the Colonial period increased in size, and new settlements expanded along secondary drainages and into bajada environments, which allowed for a diversification of agricultural strategies (Crown 1991:149; Wellman and Lascaux 1999:24). Major habitation sites were established at regular

intervals along waterways. Villages continued to resemble their Colonial predecessors with their ballcourts and plaza-oriented clusters of dwellings, but smaller settlement types (such as farmsteads) started to appear around the peripheries of larger villages. The construction of ballcourts, and the intricate trade network associated with them, reached its maximum extent during the Sedentary period (Doyel 1991b:247), although their construction decreased in the Tucson Basin.

In ceramics, design motifs took on increasingly geometric forms. Sedentary motifs were less carefully executed than the fine-line work of Colonial period ceramics. The distinctive Gila shoulder, which was formed by the sides of a vessel sloping downward sharply from the neck to create a low shoulder near the base, became a diagnostic marker of the Sedentary period. Red ware also began to be produced again (after having been abandoned around the end of the Cañada del Oro phase in Tucson). Mortuary practice continued to consist of cremation as the most common form of burial, but inhumations became more frequent after having been very uncommon or nonexistent during the Colonial period (Crown 1991:149–150). Copper bells, imported from western Mexico, first appeared during the Sedentary period; shell etching was another innovation in material culture (Haury 1976:319).

Around A.D. 1000, at the beginning of the Middle Rincon subphase (A.D. 1000–1100), the Santa Cruz River again became entrenched. One result of this was a shift in settlement to the north and to the eastern region of the valley (Waters 1992:175–177). This in turn resulted in increasingly scattered settlements as villages became less riverine oriented, at least in this area of the Tucson Basin. In the eastern Tucson region, established villages continued to expand. By the Late Rincon subphase, the continued adaptation of farming strategies (such as *ak chin* and runoff diversion) to secondary drainages and bajadas had become widespread, with some of these niches being farmed for the first time. Environmental uncertainty may have served as the stimulus for non-floodwater farming. For example, there was an increased emphasis on the cultivation of agave on bajadas (Doyel 1991b:246; Whittlesey 2004:26–27).

During the final years of the Rincon phase, the ballcourt system began to decline, although ballcourts continued to be constructed into the Soho phase in the Phoenix region (Crown 1991:151–152). Formally constructed platform mounds—in contrast to caliche-capped trash mounds, which are known from the Snaketown phase—began to be constructed and eventually eclipsed ballcourts as the primary form of public architecture by about A.D. 1200 (Doyel 2000:308). This has been interpreted as a change in overall polity as the Hohokam regional system and its accompanying trade relationships collapsed, or at least were reorganized (Crown and Judge 1991:297). This change may likewise be reflected in the construction of single-room structures (possibly associated with rituals) on the mound summits and the incorporation of surrounding palisades and, later, adobe-walled compounds (Doyel 2000:305–307).

Classic Period (A.D. 1150–1450)

Southern Arizona societies experienced drastic changes during the Classic period—settlement patterns shifted and public and domestic architecture changed. In the Tucson Basin, these changes occurred in two broad phases, the Tanque Verde (A.D. 1150–1300) and the Tucson (A.D. 1300–1450). During the Tanque Verde phase, Tanque Verde Red-on-brown became common across southern Arizona, while in Phoenix the production of red-on-buff ceramics declined (Reid and Whittlesey 1997). Some researchers have suggested that the widespread appearance of Tanque Verde Red-on-brown reflects an increasing complexity in the configuration of Hohokam economic and

social relationships (Slaughter and Roberts 1996:14). While pit house architecture continued, above-ground adobe or stone masonry structures, which were constructed within surrounding compound walls, became common. These structures were frequently freestanding, unlike multiroom pueblos commonly constructed elsewhere in the Southwest (Rice 2003:10).

In the Phoenix Basin, the platform mounds that appeared during the Soho phase were generally constructed at sites with extant ballcourts and were spaced along canals at 5 km (3.1 miles). The location of the mounds in relation to the canal system could suggest that the mounds marked the centers of irrigation communities during this period, much like the ballcourts did in the Colonial period (Crown 1991). In the Tucson Basin, ballcourt construction had ceased by the Classic period, but the Marana community flourished (Fish et al. 1992). The Marana community extended across the northern circumference of the Tucson Basin and consisted of numerous types of sites centered around a platform mound (the Marana Mound site) that had replaced the regional ballcourts as the focal point of social integration. The community also had extensive agricultural fields that were irrigated by both dry-farming techniques and canals. Agave (*Agave* spp.) was the principal crop grown in these fields, presumably expanding from agave cultivation within the bajada environments that began during the Rincon phase (Fish et al. 1992:21–24). Agave is more drought resistant than many of the other Hohokam cultivars, which would have made it a reliable food source during the drier climatic conditions that prevailed during the early Classic period (Masse 1991). A serious drought, sometimes called the Great Drought, occurred between A.D. 1276 and 1299 (Reid and Whittlesey 1999:17). The Great Drought had the effect of forcing people who lived in regions north of the Mogollon Rim to travel southward across and off the Colorado Plateau in search of food sources, because local agriculture had failed and could not support the population base. This resulted in an intercultural exchange between several cultural groups, including the Mogollon, Hohokam, Salado, and Paquimé cultures. Some Anasazi migrants from the Kayenta region arrived in southeastern Arizona as well, as reflected at Reeve Ruin in the San Pedro River valley (Whittlesey and Heckman 2000a:14).

During the Tucson phase, the cultural interaction that resulted from the drought became the impetus for further widespread social changes. Following the abandonment of many of the Tanque Verde phase sites, settlements aggregated into fewer (but larger) sites. This has been interpreted as a defensive tactic in the face of an increasing threat of warfare (Doelle and Wallace 1991:331). Freestanding adobe structures declined, and contiguous (sometimes multistoried) room blocks and stronger, more substantial walls became the structure of choice (Doyel 1991a:253). Great houses, notably at Casa Grande and Pueblo Grande, appear at this time. The great houses at both sites were constructed on platform mounds. Village settlements frequently consisted of multiple compounds, occasionally concentrically arranged around a central compound-mound (such as at Casa Grande and Los Muertos), similar to the older village plan of house clusters arranged around a central plaza, such as at Snaketown (Doyel 1991a:254–256).

After the beginning of the Tucson phase, evidence for the Salado culture appears in southeastern Arizona in the form of Roosevelt Red Ware ceramics, and it has been thought that the Salado superseded the Hohokam in the lower San Pedro River valley (in the region north of Benson) at about this time (Phillips et al. 1993). The culture known by archaeologists as "Salado" was initially formulated in the 1920s to describe and explain sites in the Tonto Basin and the upper Salt River that, on one hand, had a strong resemblance to Mogollon sites but at the same time possessed Hohokam traits, such as platform mounds (but, perhaps significantly, not ballcourts). Initially, it was thought that the Salado were pueblo-dwelling people migrating from the north and expanding into

the Tonto Basin whose lifeways were imposed upon or adopted by the Hohokam people already living there. Archaeologists Florence Hawley and Harold Gladwin hypothesized that this migration originated from two areas: the upper Gila region and, later, from the Little Colorado area. Finally, Emil Haury presented a somewhat modified version of the migration model, concluding that the Salado peoples did not "invade" the Hohokam so much as coexist in the same geographical region (Reid and Whittlesey 1997:238–239). Eventually, the migration hypothesis fell into disfavor, and by the 1980s, most Southwestern archaeologists had come to believe that the Salado had developed "in place" from extant Hohokam populations, the result of increased "social complexity" rather than an influx of new people. Recent speculation on the Salado has led to a reconsideration of the migration model (Elson et al. 2000:175), resulting from the intense demographic movements during the Classic period.

Protohistoric Period (A.D. 1450–1540)

The Protohistoric period, the era between the end of the Classic period and the arrival of the Spanish missionaries, is an obscure period in the prehistory of the Southwest. This period is not well represented in the archaeological record, but well-established agricultural settlements inhabited by Piman-speaking peoples were present when the first Euroamericans passed through this region. It is not clear whether these people were direct descendants of the Hohokam peoples who had weathered the social and economic changes that marked the end of the Classic period, or a new population that moved in from elsewhere, who may have integrated with a remnant population that was already present—a possibility that is arguably supported by oral tradition (Saxton and Saxton 1973; Teague 1993:444). During this period the region also came to be occupied by another population, who clearly came in from elsewhere—nonsedentary peoples of Athabaskan origin who became known as the Apache.

Historic Period (A.D. 1540–1950)

The first person of Old World descent known to have passed through southeastern Arizona was an African named Esteban, who survived a 1527-1535 trek across the Gulf Coast, Texas, and northern Mexico, only to be sent back out, in 1539, as a guide on an expedition from Sonora northward to the Pueblo country of northern New Mexico. When other members of his party fell ill, Esteban is believed to have travelled alone, across the eastern edge of present-day Arizona, to Zuñi, where he was killed (Weber 1992). The nominal leader of the expedition, Fray Marcos de Níza, may or may not have eventually followed along; but in any case, based on reports of their expedition, in 1540 a much larger follow-up expedition was dispatched northward under the command of Francisco Vásquez de Coronado (Weber 1992). Coronado's party searched across broad parts of Arizona, northern New Mexico, and even the Great Plains for the sort of treasure that had made the Spanish conquerors of Mexico and Peru wealthy, but after two years, the party returned to Sonora empty handed, having accomplished little other than to provoke hostility among the native peoples (Sauer 1971).

Jesuit missionary Eusebio Francisco Kino arrived in Sonora in 1681. Kino and his fellow Jesuits established a chain of missions that began in present-day Sonora, but were, by 1700, ultimately extended northward into what is now Arizona. The Pima Indians of the missions revolted against the Spanish in 1751; this rebellion was put down quickly, and in the following year a presidio was established at Tubac (Weber 1992). Apart from guarding against further internal revolt, the presidio was intended to help stem incursions by the Apache. Apaches had been raiding Piman settlements since shortly prior to the time of Kino's initial contact (Spicer 1962:234), and the escalation of

raiding over time resulted in increasing resettlement of the Piman-speaking populace into defensible locations. From the late 1780s the implementation of a policy of "carrot-and-stick" diplomacy, by which Apaches and other nomadic tribes were supplied with gifts of food and other items in exchange for halting their raids on settlements, allowed for an expansion of ranching and stock raising all along Mexico's northern frontier. This time of relative peace ended with the independence of Mexico from Spain in 1821: the Mexican government dropped the policy of purchasing a state of relative peace with stipends, and raiding resumed, the result being that ranching once again ceased to be viable (Morrisey 1950:151).

Most of Arizona passed into the hands of the United States at the conclusion of the Mexican-American War of 1846–1848. The boundary between New Mexico and Texas was established in 1850, at which time the entire region south of the 37th parallel, stretching from the new Texas-New Mexico border west to the eastern boundary of California, became the Territory of New Mexico. In 1853, the Gadsden Purchase expanded New Mexico Territory from the Gila River south to the present-day Mexican border (Walker and Bufkin 1979:22). The Territory of Arizona was split off from the Territory of New Mexico in 1863. The first railroad, the Southern Pacific, reached Arizona from the west 1877, but did not reach Tucson until 1880 (Myrick 1975). Conflict between the Apache and the Euroamerican settlers continued until 1886, when Geronimo surrendered and peace was negotiated (Collins et al. 1993:32). With the end of open hostilities, settlers resumed their migration to the area with the aid of the railroad. Mining and cattle ranching, which had already begun to become established in Arizona prior to the Civil War, became the Territory's main industries. Arizona attained statehood in 1912 and became a major military training center in the 1940s. Exposure to the region and the development of climate-control systems helped spur a population increase after World War II, with retirees representing a large portion of the newcomers.

SURVEY METHODS

The survey was conducted in accordance with standards established by the ASM for pedestrian surveys on State-administered lands. According to these standards, 100 percent coverage of an area can be claimed if the entire area is surveyed by crews walking transects spaced no more than 20 meters (66 feet) apart. The survey was performed by having an archaeologist walk one transect down the centerline of each corridor designated for survey.

Cultural properties identified during survey were to have been evaluated against standards established by the ASM for determining the significance of properties. Under these standards, a property may be of interest if it is at least 50 years of age. If, in addition, it contains either 30 or more artifacts of a single class (i.e., potsherds, or ground stone fragments, or fragments of historic glass); 20 or more artifacts when more than a single class of artifact is present; a single fixed feature (i.e., a cobble foundation, or a historic road) with any number of artifacts in association; or more than one fixed feature, with or without associated artifacts, within a 15-m-diameter (50-foot-diameter) area, then the property must be recorded as an archaeological *site*.

A property of appropriate age that does not meet with any of the above-cited additional criteria may be recorded as an *isolated occurrence,* a lesser class of property. However, should the archaeologist believe that, for whatever reason, such a property is of greater significance than the isolated occurrence designation would imply, they may record such a property as a site at his or her discretion. A site is recorded in greater detail than an isolated occurrence, which generally involves merely logging a description of the finding and its location (obtained with a GPS unit) in a table.

Recording a site generally involves setting a permanent datum in the ground, recording the position of the datum with the help of a hand-held global positioning system (GPS) unit, preparing a detailed plan map, taking photographs, and making a full or partial inventory of artifacts and features.

No properties requiring evaluation against these standards were encountered during the survey.

PREVIOUS RESEARCH

Prior to survey, a Class I archaeological records check was performed using the ASM's AZSITE online database. The AZSITE database was queried to see if any surveys had previously been performed or any archaeological sites had been recorded within a 1.6-km (1-mile) radius of the current project area. A total of 31 previous surveys were found to have been performed and 10 sites recorded within the 1.6-km (1-mile) radius (Tables 1 and 2; Figure 2). The northern and southern portions of the project area were previously surveyed (1990-40.ASM and 1997-200.ASM, respectively). However, the majority of the project area has not been previously surveyed and the surveys that were previously conducted were completed more than 10 years ago. No previously recorded archaeological or historic sites were identified within the project area.

In addition to the AZSITE records check, historic General Land Office (GLO) maps of the project area were consulted to see if any properties that might be of interest, but are not documented on AZSITE, could be identified. GLO Map No. 1994, filed on May 28, 1871, which covers Township 13 South, Range 13 East, G&SRB&M, shows no cultural properties within 1.6 km (1 mile) from the project area (Figure 3).

SURVEY EXPECTATIONS

Although no cultural resources were expected in the project area, there was potential that small prehistoric artifact scatters or historic structures could be found.

SURVEY RESULTS AND RECOMMENDATIONS

No archaeological sites, isolated occurrences, historic buildings requiring recordation, or any other properties potentially eligible for inclusion on the National Register of Historic Places (NRHP) or Arizona's State Register of Historic Places (SRHP), were identified during the current survey. Tierra recommends that a finding of "no historic properties affected by the proposed undertaking" be issued. We recommend that authorization for Tucson Electric Power to proceed with the installation of their proposed substation within the bounds of the area covered by this survey be granted without any requirement for further archaeological work.

The client and all subcontractors are reminded that, in accordance with Section 41-865 of the Arizona Revised Statutes, should buried human remains or funerary goods be encountered incidentally on private lands during any ground-disturbing activities associated with the current project or any follow-up work done at any time in the future, all such work must immediately be halted in the vicinity of the finding and the Director of the Arizona State Museum must immediately be informed, so that a consultation process can be initiated and an appropriate course of treatment decided upon. Under the statute the Director must make an initial response to such a notification within ten working days; there is, however, no specified limit on the length of time that work may be delayed in order to deal with the finding in an appropriate manner. In any case, work is not to resume until authorization is received from the museum director. Should the Director fail to

respond to the notification within the ten-day window provided in the statute, it can be assumed that authorization to resume work has been given.

Table 1. Previously Conducted Surveys within 1.6 km (1 mile) of the Project Area

Project No.	Performing Institution	Project Name/Description	Report Reference
1979-19.ASM	Arizona State Museum	Block for development	Huckell and Brew 1979
1979-39.ASM	Arizona State Museum	Linear for power line	Rozen 1979
1981-5.ASM	Arizona State Museum	Block survey for development	Creel 1981
1981-32.ASM	Arizona State Museum	Hillcrest Park survey	Urban 1981a
1981-145.ASM	Arizona State Museum	Oracle Road Village Apartments	Urban 1981b
1986-37.ASM	Arizona State Museum	Block survey for development	Kaler 1998
1990-40.ASM	Statistical Research	Linear along Orange Grove Road	None given
1992-327.ASM	Professional Archaeological Services and Technologies	Intergroup NW survey	Stephen 1997a
1994-42.ASM	Tierra Right of Way Services	Luckow-Alexander Survey	Roth 1994a
1994-59.ASM	Tierra Right of Way Services	Chula Vista Survey	Roth 1994b
1994-279.ASM	Western Cultural Resource Management	Linear for power line	Brown and Rohman 1994
1994-284.ASM	Tierra Right of Way Services, Ltd.	Block survey for development	Carpenter 1994
1995-430.ASM	Cultural and Environmental Systems	Block survey for development	Heuett 1995
1996-368.ASM	SWCA, Inc.	Oracle Jaynes Survey	Terzis 1996
1996-400.ASM	Professional Archaeological Services and Technologies	Block survey for development	Stephen 1997b
1997-12.ASM	Old Pueblo Archaeology Center	Block survey for development	Jones 1997a
1997-20.ASM	Old Pueblo Archaeology Center	Block survey for development	Jones 1997b
1997-200.ASM	Old Pueblo Archaeology Center	Block survey for development	Jones 1997c
1998-235.ASM	Old Pueblo Archaeology Center	Block survey for development	Jones 1998
1999-446.ASM	Tierra Archaeological and Environmental Consultants	Orange Grove and N. Hospital Rd. Survey	Fratt 1999
2000-7.ASM	Old Pueblo Archaeology Center	Block and linear survey for development	Jones 2000
2000-173.ASM	Lone Mountain Archaeological Services	Block survey for development	Watson 2000
2000-604.ASM	Tierra Right of Way Services, Ltd.	Block survey for development	Hayes 2000
2001-154.ASM	Old Pueblo Archaeology Center	Orange Grove Rd. from Thornydale Rd. to Corona Rd.	Kaldahl and Dart 2001
2001-227.ASM	SWCA, Inc.	Linear along Orange Grove Rd.	Tucker 2001
2002-274.ASM	SWCA, Inc.	Block survey for development	Hesse 2002

Project No.	Performing Institution	Project Name/Description	Report Reference
2003-656.ASM	Tierra Right of Way Services	La Cholla Survey	Moses 2003
2005-727.ASM	Archaeological Research Services	La Canada and Orange Grove survey	Kennedy 2005
2006-630.ASM	Harris Environmental Group	Oracle Road and Pomelo Avenue Survey	Luchetta and Twilling 2006
2010-362.ASM	Antigua Archaeology	AT&T T666-A	Luchetta and Moses 2010
2011-508.ASM	POWER Engineers	Panorama Road Archaeology Survey	Euler 2011

Table 2. Previously Recorded Sites within 1.6 km (1 mile) of the Project Area

Site No.	Site Description	Temporal Placement	Register Status
AZ AA:12:137(ASM)	Hohokam artifact scatter	ceramic (AD 200-1500)	not evaluated by recorder
AZ AA:12:138(ASM)	Hohokam artifact scatter	ceramic (AD 200-1500)	not evaluated by recorder
AZ AA:12:139(ASM)	Hohokam artifact scatter	ceramic (AD 200-1500)	not evaluated by recorder
AZ AA:12:775(ASM)	Hohokam processing site with 2 roasting pits	ceramic (AD 200-1500)	not considered eligible by recorder
AZ AA:12:823(ASM)	2 rock piles, no associated artifacts	no information available	no information available
AZ BB:5:123(ASM)	Oracle - Tucson Transmission Line	historic (AD 1500-1950)	determined ineligible by SHPO
AZ BB:9:80(ASM)	rock circle and lithic scatter	unknown	considered eligible by recorder
AZ BB:9:81(ASM)	historic trash dump	recent (AD 1950-present)	determined ineligible by SHPO
AZ BB:9:244(ASM)	Large roasting pit w. associated sherd and flaked-stone scatter	Hohokam Sedentary Period (AD 950-1100)	not evaluated by recorder
AZ BB:9:313(ASM)	historic homestead	late historic (AD 1900-1950)	not evaluated by recorder

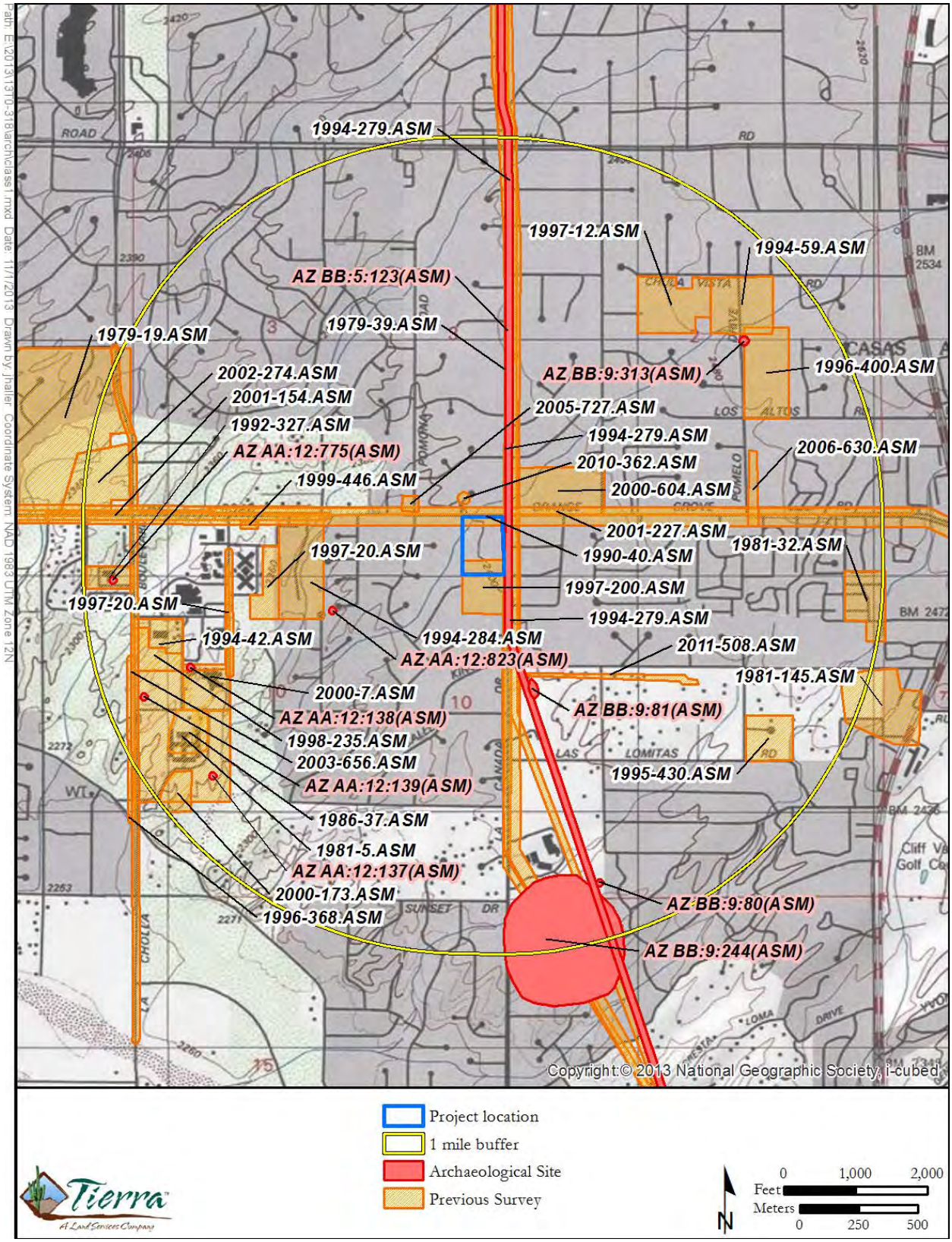

Figure 2. Previously conducted surveys and previously identified archaeological sites within 1.6 km (1 mile) of the project area.

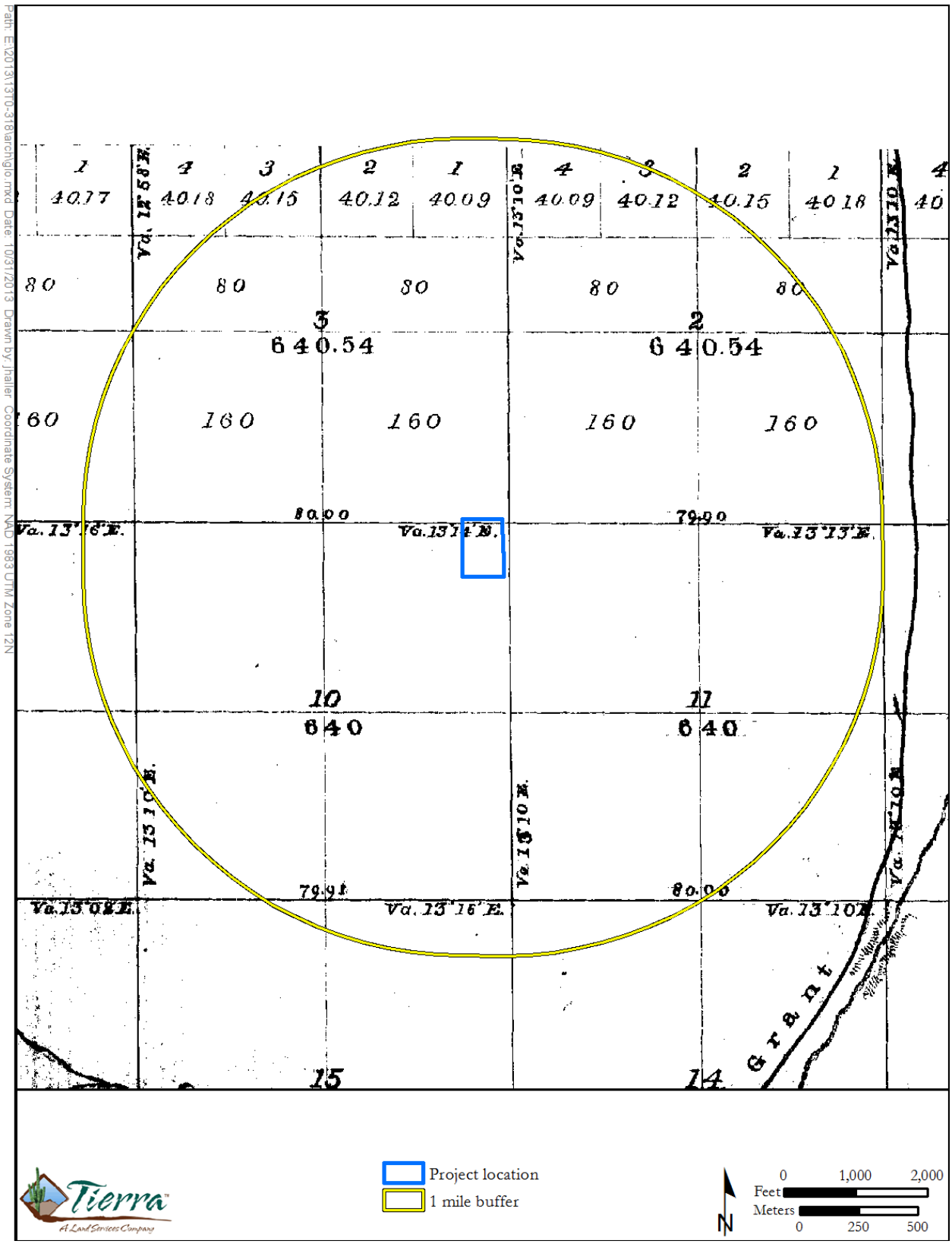

Figure 3. Detail of GLO Map No. 1994 showing an area extending out 1.6 km (1 mile) from the project area.

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Tucson Electric Power Orange Grove Substation

Appendix E

EEC HYDROLOGY REPORT

THE PLANNING CENTER
a division of TPC Group, Inc
110 s church ste 6320 tucson az 85701

DRAINAGE REPORT

-FIRST SUBMITTAL-

TEP-ORANGE GROVE SUBSTATION

A portion of Section 10
Township 13 South Range 13
East of the Gila and Salt
River Meridian
Pima County, Arizona

December, 2013

PREPARED FOR:

Tucson Electric Power Company
4350 East Irvington Road
Tucson, Arizona 85702

PREPARED BY:

Engineering and Environmental Consultants, Inc.
4625 E Fort Lowell Road
Tucson, Arizona 85712

EEC Project No. 204014.74

Datum of NAVD 88 Unless Otherwise Noted

DRAINAGE REPORT

-FIRST SUBMITTAL-

TEP-ORANGE GROVE SUBSTATION

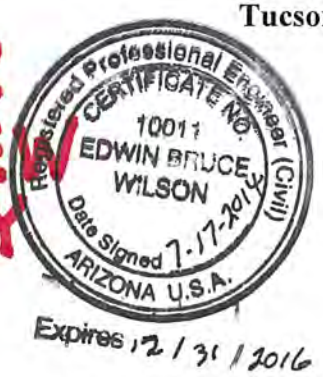
A portion of Section 10
Township 13 South Range 13
East of the Gila and Salt
River Meridian
Pima County, Arizona

March, 2014

PREPARED FOR:

Tucson Electric Power Company
4350 East Irvington Road
Tucson, Arizona 85702

FOR REVIEW ONLY



PREPARED BY:

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Table of Contents

I. INTRODUCTION

A. Site Location and Project Description

This project is located at the south west corner of Orange Grove and La Canada Drive in Pima County Arizona. It can be further described as a portion of Section 10, Township 13 South, Range 13 East, of the Gila and Salt River Meridian, Pima County Arizona. Refer to Figure 1.

This project consists of the development of the property for a new substation. This includes grading, installation of equipment, erosion protection, and other related activities.

B. Purpose and Objectives

The purpose of this Report is to identify the existing drainage characteristics and propose a drainage scheme that preserves them. The information from this Report is intended to support the development of his project.

C. Development Requirements

This substation property is located in a Critical Basin therefore this development shall meet Critical Basin detention/retention requirements. A critical basin is identified as already having severe flooding problems as a result of existing watershed conditions. Stormwater detention/retention facilities shall be incorporated to the extent necessary to ensure a fifteen percent reduction in existing peak discharges from the site.

D. Previous Studies

Previous known studies of the area include the FEMA FIS for Incorporated and unincorporated areas of Pima County Arizona. The referenced map, 04019C1680L, indicates that this site is located in an un-shaded Zone X, or outside the 500 year flood. Refer to Figure 2.

A Drainage Report for La Canada Drive, River Road to Ina Road prepared by HDR, January 2011 quantifies the offsite flow impacting the property from the Casas Adobes Wash and Via Hacienda Watershed (referred to as Culvert 12A in the previous study and referred to as the Southeast wash in this report).

E. Long-Term Maintenance Responsibility

The long-term maintenance is the responsibility of Tucson Electric Power Company.

F. Required Permits

The substation property encompasses several washes. With the exception of the Casas Adobes Wash at the North West corner of the property, these washes are non-regulatory.

A floodplain use permit will be required for the development due to a portion of the northwest corner of the proposed substation pad that encroaches onto the existing Casas Adobes Wash floodplain. Refer to Figure 4.

There are several potential 404 Jurisdictional Waters that cross the substation property. The construction of the substation and related activities within any jurisdictional waters is required to comply with Nation Wide Permit 12 of Section 404 of the Clean Water Act. Refer to Appendix C. It is expected that no notification to the Corps is required.

II. HYDROLOGY

Discharges for the local watersheds were computed using PC-Hydro, a computer program that generates peak flows based on the methodology outlined in the Pima County Hydrology Manual. There were no offsite discharges calculated for this project, they were referenced from the adjacent La Canada Drive project. Refer to Appendix A for the calculation data and Appendix D for the referenced sheets.

A. Offsite

Offsite flow enters the site on the northwest and southeast portion of the development. This flow on the northwest is generated from the Casas Adobe Wash and is conveyed in a southwesterly direction under Orange Grove Road through box culverts. The flow on the southeast is generated from upstream developments and enters the property through a CMP under La Canada Road. Throughout this report the flow from this pipe is referred to as the Southeast Wash within the property. Prior to the construction of the La Canada improvements a total of 99 cfs overtopped La Canada Drive and 64 cfs outlet through culvert 138+27.31 Via Hacienda. Under existing conditions, a collector channel located adjacent to Orange Grove Road diverts the overtopping flow to the west down Orange Grove Road. The discharges for the Casas Adobes Wash and Via Hacienda Watershed were excerpted from the La Canada Drive River to Ina Road Final Drainage Report. Refer to Appendix D for supporting documentation.

Wash	Culvert	Road	100-Year Discharge (cfs)
Casas Adobe	4-10'x6' RCBC	Orange Grove	1788
Via Hacienda	42-inch RCP	La Canada	64

B. Existing

The general flow is of north east to south west. There are two points this site accepts discharge, each from a cross culvert. There are no other offsite watersheds contributing to the site. The site has been divided into 3 watersheds, Watersheds A thru C. These watersheds discharge from the site at three locations, Concentration Points 1-3. Refer to Figure 3 for a map of existing conditions.

Concentration Point	Contributory Watershed	Area(Ac)	100-Year Discharge
1	A	4.28	30
2	B	1.91	14
3	C+(Offsite)	2.71+Offsite	84*

*Includes Offsite Discharge of 64cfs (Culvert 138+27.31 Via Hacienda).

C. Proposed

Under proposed conditions the three watersheds are split up to account for onsite grading, resulting in seven watersheds, D thru J. The proposed drainage scheme maintains the discharge points and provides retention to mitigate any increases in flow due to the substation development. Refer to Figure 4 for a map of the proposed site.

Concentration Point	Contributory Watershed	Area(Ac)	100-Year Discharge
4	D	4.17	30
5	E	0.03	0.2
6	F	1.71	15
7	G	2.01	18
8	H	1.32	10
9	I	0.37	3.2
10	J	0.37	3.2

III. HYDRAULICS

A. Washes

A total of two washes were modeled using HEC-RAS to determine the 100-year water surface elevations and erosion hazard setback limits. The output can be found in Appendix B.

The 100-year discharge of 1788 cfs was used to establish water surface elevations for Casas Adobe Wash ranging from 2399.47 feet at the north and 2388.32 feet at the south. The recommended Erosion Hazard Setback (EHS) of 50 feet was established in accordance with Ordinance No. 2010-FC5, Section 16.28030, Setbacks for minor washes. Refer to Figure 5.

As a result of the hydraulic model, the northwest corner of the proposed substation pad was determined to be within the 100-year floodplain of the Casas Adobe Wash. A post-developed HEC-RAS Model was computed to verify that the existing water surface elevation would not increase by more the 0.1 feet. An obstruction was added to cross section 6+00 to represent the pad. As a result the water surface elevation increased from 2398.21 feet to 2398.30 feet and the velocity went from 7.76 ft/s to 7.94 ft/s. The results show the increase in water surface elevation is less than 0.1 feet and the existing drainage characteristics are maintained.

The 100-year discharge of 64 cfs was used to establish water surface elevations for Southeast Wash ranging from 2395.88 feet at the north and 2389.31 feet at the south. The flow entering the site is not considered regulatory therefore a developed hydraulic model was not computed. Under proposed conditions the flow will be channelized around the southeast corner of the substation pad and released at the same location as under existing conditions.

B. Channels

A trapezoidal channel located on the southeast will convey a total discharge of 80 cfs (16 cfs from local Watersheds H, I, and J, and 64 cfs from the Via Hacienda Watershed). The channel is divided into two sections by 4-24" RCP under the south east entrance of the substation. The channel upstream of the driveway has a 12 foot bottom width, 1:1 side slope and depth of flow of 0.99 feet. The downstream channel has a 12 foot bottom width, 1:1 side slopes, and a depth of flow of 1.48 feet. The sides of the channels will be rock lined and the bottom width will be unlined.

A small amount of flow from Watershed G sheet flows into a collector swale located on the southern portion of the north substation entrance. This flow is channelized along the east side of the pad in a swale ultimately discharging into Basin 2. The flow from Watershed H sheets flows into the proposed trapezoidal channel located between the north and south entrances of the substation. Refer to Figure 4.

C. Culverts

Culvert 1 is located beneath the south entrance to the substation. This culvert intercepts the offsite flow entering from the Via Hacienda Watershed and the local Watershed H.

Culvert	Size/Type	Headwater Elevation (ft)	100-Year Discharge (cfs)
Drive way	4-24 inch RCPs	2393.99	80

D. Retention/Detention

There are two proposed basins, Basin 1 and 2. Basin 1 is located at the west of the graded site and Basin 2 is located on the east of the graded site.

The design of the basins follows the guidelines as presented in the Stormwater Detention/Retention Manual. The total calculated required retention volume to retain 100% of the discharge is 0.439 ac-ft. (0.22 ac.ft. each). The provided volume in Basin 1 is 0.302 ac.ft and Basin 2 is 0.331 ac.ft, respectively for a total retention volume of 0.633 ac.ft. The water surface elevation in Basin 1 is 2393.47 ft. and 2393.66 ft. in Basin 2. Both basins will have a 12-inch bleeder pipe with a 6-inch orifice plate. At an estimated minimum discharge of 0.5 cfs, the bleeder pipes will drain each basin within 12 hours. Basin 2 will have an emergency weir on the south portion of the basin. The bottom of the weir is located at the top elevation of the basin therefore not limiting the basins total volume. Refer to Appendix B and Figure 4.

Basin	Required Retention Volume (ac-ft)	Total Basin Volume (ac-ft)	Water Surface Elevation (ft)
1	0.217	0.302	2393.47
2	0.217	0.331	2393.66

As a result of the drainage scheme and retention basins the pre-developed 100-year discharge at CP 1 has been maintained at 30 cfs. The pre-developed 100-year discharge at CP 2 has been reduced from 14 cfs to 0.2 cfs. The pre-developed discharge at CP 3 has been reduced from 20 cfs local, 64 cfs offsite flow (84cfs) to 14 cfs local and 64 cfs offsite flow (74cfs).

E. Wall Openings

The perimeter of the substation pad will be enclosed by a masonry wall. Openings in the proposed wall were designed according to Section 12.5 of the Standards Manual for Drainage Design and Floodplain Management in Tucson, Arizona. These openings are located on the south wall and at each basin. The computed minimum opening at the south wall is 17 blocks, 39 blocks for Basin 1, and 47 for Basin 2. The calculation sheets are included in Appendix B.

F. Erosion Protection

The erosion protection includes bank protection of the constructed channels, inlet and outlet protection of the culverts, and protection of the driveway. Refer to Appendix D for the detail sheets and Appendix B for supporting calculations.

All riprap is a 6 inch median diameter (D50). Dumped riprap is to utilize a filter fabric. The recommended bank protection of the channels includes grouted rip with a recommended toe down of 2 feet. The bank protection at the drive way culvert inlet and outlet is similar to the channel bank protection. At the drive culvert outlet a dumped riprap apron of 8 feet in length is recommended. The erosion protection at the outlet of the 42" culvert that was part of the La Canada Drive was neglected. It is recommended that, at a minimum, a riprap apron consisting of a D50 rock of 14" and extending 21' from the outlet be used to mitigate the excessive velocities from this culvert (~10fps).

IV. SUMMARY AND CONCLUSIONS

The proposed improvements include the grading of the site and associated drainage improvements. Two retention basins will retain 100% of the design discharge and meter it off with bleeder pipes to provide positive drainage within 12 hours. With the basins the discharge exiting the site is reduced 15% below pre development conditions. There are no improvements within regulatory washes and no Section 404 permitting is required.

The drainage design concept presented in this Flood Statement assures that drainage affecting the project will be handled in a manner that does not conflict with any federal, state and/or county regulations intended to protect adjacent properties and/or the project itself form adverse impacts during design storm events specified in the current regulations.

V. REFERENCES

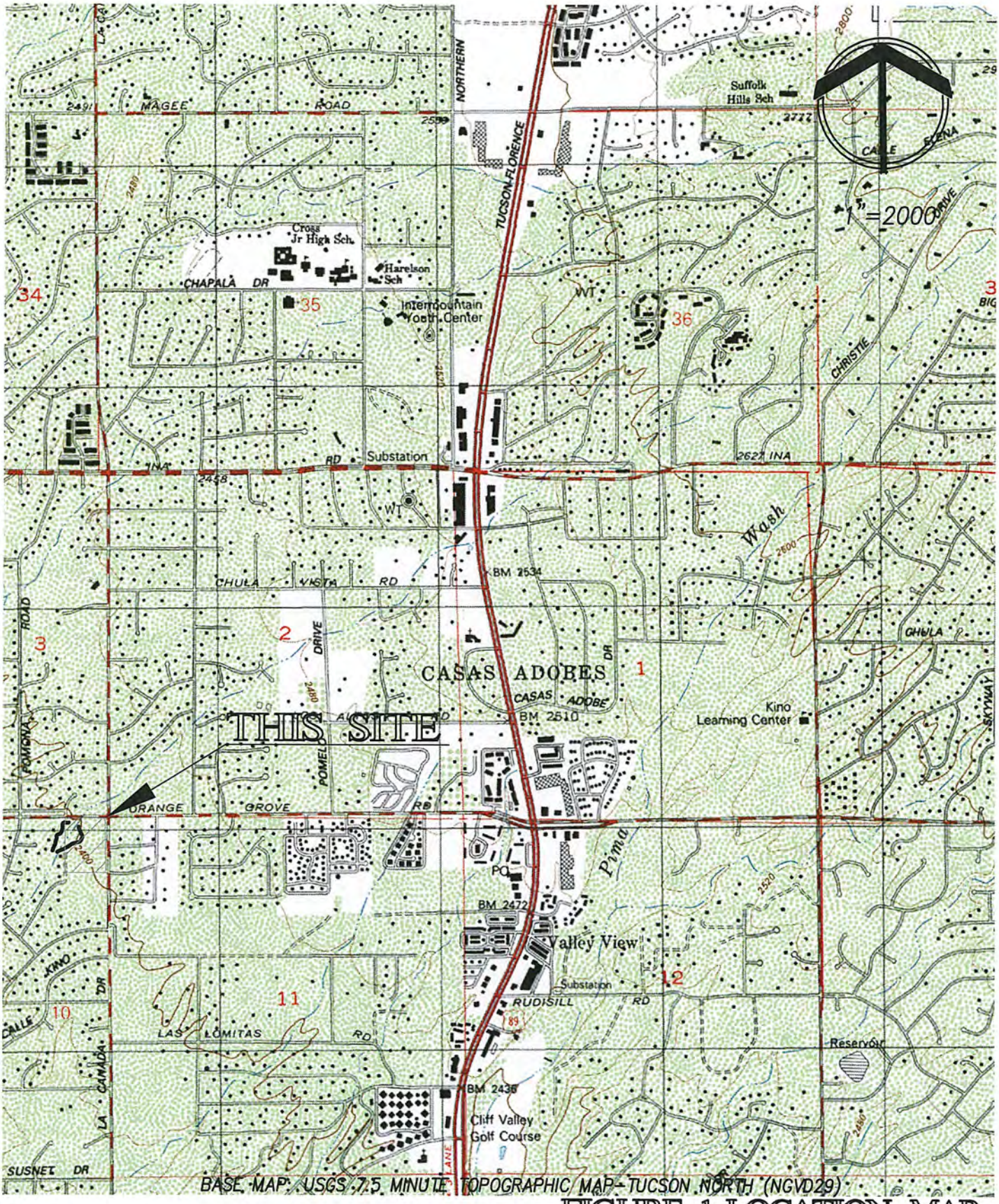
1. Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map, 04019C1680L, Effective Date June 16, 2011.

2. Flood Insurance Study: Pima County, Arizona and Incorporated and unincorporated Areas. Federal Emergency Management Agency. June 16, 2011.

3. Hydrology Manual for Engineering Design and Flood Plain Management Within Pima County, Arizona Pima County Department of Transportation and Flood Control District, September 1979.

4. US NRCS Web Soil Survey http://websoilsurvey.nrcs.usda.gov/app/

5. La Canada Drive, River Road to Ina Road prepared by HDR, January 2011



BASE MAP: USGS 7.5 MINUTE TOPOGRAPHIC MAP - TUCSON NORTH (NGVD29)

FIGURE 1-LOCATION MAP

Engineering and Environmental Consultants, Inc.
4625 E. FT. LOWELL RD.
TUCSON, ARIZONA 85712 520-321-4625

DESIGNED BY:	JAL
DRAWN BY:	JAL
CHK'D BY:	BW
DATE:	SEE COVER
SCALE:	AS NOTED

TEP-ORANGE GROVE SUBSTATION
A PORTION OF SECTION 10
TOWNSHIP 13 RANGE 13 G&SRM

PIMA COUNTY,
ARIZONA

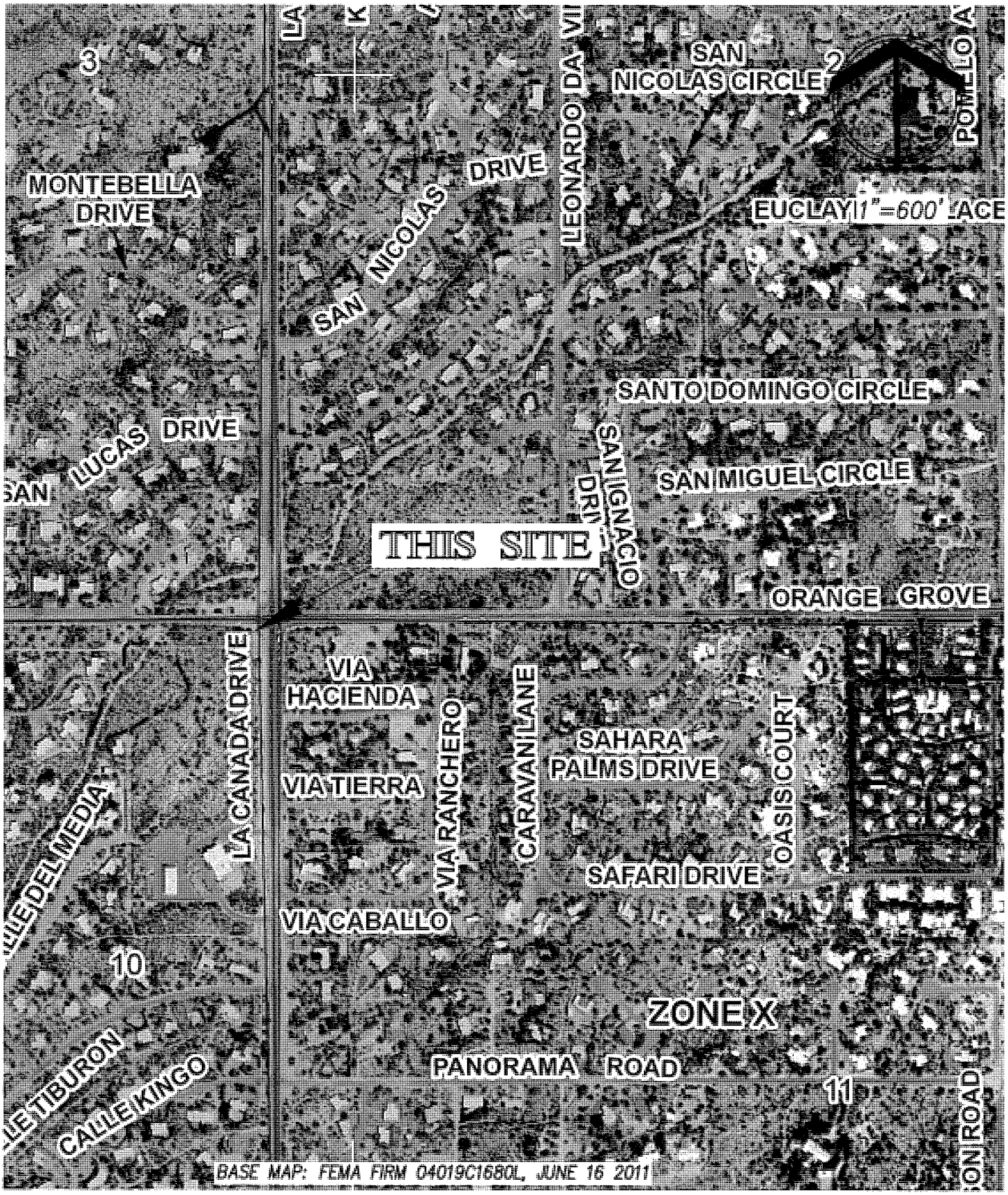


FIGURE 2-FEMA FIRM

Engineering and Environmental Consultants, Inc.
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DESIGNED BY:	JAL
DRAWN BY:	JAL
CHK'D BY:	BW
DATE:	SEE COVER
SCALE:	AS NOTED

TEP-ORANGE GROVE SUBSTATION
A PORTION OF SECTION 10
TOWNSHIP 13 RANGE 13 G&SRM

PIMA COUNTY,
ARIZONA

Map Pocket/LFC

1"=100'
C.I.= 1'

KEY

7+00 _____ CROSS SECTION

— · — · — · — · — EROSION HAZARD SETBACK LINE

— — — — — — 100 YEAR FLOODPLAIN

FIGURE 5-FLOODPLAIN MAP

DESIGNED BY: JAL	TEP–ORANGE GROVE SUBSTATION A PORTION OF SECTION 10 TOWNSHIP 13 RANGE 13 G&SRM
DRAWN BY: JAL	
CHK'D BY: BW	
DATE: SEE COVER	
SCALE: AS NOTED	PIMA COUNTY, ARIZONA

Engineering and Environmental Consultants, Inc.
4625 E. FT. LOWELL RD.
TUCSON, ARIZONA 85712 520-321-4625

APPENDICES

A Hydrologic Data
B Hydraulic Computations
C Section 404
D Referenced Plans

A. Hydrologic Data

Precipitation Data

NOAA Atlas 14, Volume 1, Version 5TUCSON
CAMP AVE EXP FM
Station ID: 02-8796
Location name: Tucson, Arizona, US*
Coordinates: 32.2817, -110.9436
Elevation:
Elevation (station metadata): 2330ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF tabular | PF graphical | Maps & aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.247 (0.221-0.282)	0.319 (0.285-0.364)	0.423 (0.374-0.479)	0.500 (0.440-0.566)	0.606 (0.527-0.683)	0.687 (0.589-0.776)	0.770 (0.650-0.873)	0.852 (0.708-0.971)	0.964 (0.781-1.11)	1.05 (0.833-1.21)
10-min	0.377 (0.335-0.429)	0.485 (0.433-0.554)	0.643 (0.569-0.728)	0.761 (0.670-0.862)	0.923 (0.802-1.04)	1.05 (0.896-1.18)	1.17 (0.989-1.33)	1.30 (1.08-1.48)	1.47 (1.19-1.68)	1.60 (1.27-1.85)
15-min	0.467 (0.416-0.531)	0.602 (0.537-0.686)	0.797 (0.706-0.903)	0.943 (0.831-1.07)	1.14 (0.993-1.29)	1.30 (1.11-1.46)	1.45 (1.23-1.65)	1.61 (1.34-1.83)	1.82 (1.47-2.09)	1.98 (1.57-2.29)
30-min	0.628 (0.560-0.716)	0.810 (0.724-0.924)	1.07 (0.951-1.22)	1.27 (1.12-1.44)	1.54 (1.34-1.74)	1.74 (1.50-1.97)	1.96 (1.65-2.22)	2.17 (1.80-2.47)	2.45 (1.98-2.81)	2.67 (2.12-3.08)
60-min	0.778 (0.693-0.886)	1.00 (0.895-1.14)	1.33 (1.18-1.51)	1.57 (1.38-1.78)	1.91 (1.66-2.15)	2.16 (1.85-2.44)	2.42 (2.04-2.75)	2.68 (2.23-3.05)	3.03 (2.45-3.48)	3.30 (2.62-3.81)
2-hr	0.900 (0.805-1.02)	1.15 (1.03-1.30)	1.50 (1.33-1.69)	1.77 (1.56-1.98)	2.14 (1.87-2.39)	2.43 (2.10-2.71)	2.72 (2.32-3.05)	3.03 (2.53-3.40)	3.44 (2.80-3.90)	3.76 (3.00-4.30)
3-hr	0.954 (0.856-1.08)	1.21 (1.08-1.36)	1.55 (1.39-1.75)	1.83 (1.62-2.06)	2.22 (1.94-2.48)	2.52 (2.18-2.82)	2.84 (2.41-3.19)	3.18 (2.64-3.59)	3.65 (2.94-4.16)	4.02 (3.16-4.63)
6-hr	1.09 (0.979-1.23)	1.37 (1.23-1.54)	1.72 (1.54-1.93)	2.01 (1.79-2.26)	2.42 (2.12-2.71)	2.74 (2.37-3.07)	3.08 (2.62-3.45)	3.44 (2.87-3.86)	3.93 (3.18-4.45)	4.33 (3.44-4.95)
12-hr	1.24 (1.12-1.38)	1.55 (1.40-1.73)	1.93 (1.73-2.15)	2.23 (1.99-2.49)	2.66 (2.35-2.96)	3.00 (2.61-3.34)	3.34 (2.87-3.73)	3.70 (3.12-4.16)	4.19 (3.45-4.75)	4.58 (3.70-5.23)
24-hr	1.39 (1.28-1.53)	1.74 (1.60-1.91)	2.19 (2.00-2.39)	2.54 (2.32-2.78)	3.04 (2.75-3.33)	3.43 (3.08-3.76)	3.84 (3.41-4.24)	4.26 (3.74-4.74)	4.84 (4.17-5.45)	5.30 (4.51-6.03)
2-day	1.54 (1.41-1.68)	1.93 (1.77-2.11)	2.42 (2.22-2.64)	2.82 (2.57-3.07)	3.38 (3.06-3.68)	3.81 (3.42-4.18)	4.27 (3.79-4.70)	4.75 (4.16-5.27)	5.39 (4.64-6.06)	5.91 (5.00-6.70)
3-day	1.63 (1.50-1.79)	2.05 (1.88-2.24)	2.58 (2.36-2.82)	3.03 (2.76-3.30)	3.66 (3.31-3.99)	4.16 (3.73-4.57)	4.71 (4.16-5.19)	5.28 (4.60-5.87)	6.08 (5.18-6.85)	6.74 (5.63-7.68)
4-day	1.73 (1.59-1.90)	2.17 (1.99-2.37)	2.74 (2.51-3.00)	3.23 (2.95-3.53)	3.94 (3.56-4.30)	4.51 (4.03-4.96)	5.14 (4.53-5.68)	5.81 (5.04-6.47)	6.77 (5.71-7.64)	7.57 (6.26-8.66)
7-day	1.99 (1.82-2.18)	2.49 (2.28-2.72)	3.16 (2.89-3.46)	3.74 (3.40-4.08)	4.58 (4.13-5.02)	5.29 (4.71-5.83)	6.06 (5.33-6.74)	6.90 (5.98-7.74)	8.12 (6.87-9.25)	9.15 (7.56-10.6)
10-day	2.23 (2.04-2.45)	2.79 (2.55-3.06)	3.53 (3.21-3.88)	4.16 (3.77-4.57)	5.07 (4.55-5.57)	5.83 (5.17-6.43)	6.65 (5.82-7.40)	7.54 (6.51-8.47)	8.82 (7.41-10.1)	9.89 (8.15-11.4)
20-day	2.89 (2.64-3.17)	3.61 (3.30-3.96)	4.56 (4.16-5.02)	5.34 (4.85-5.88)	6.46 (5.81-7.11)	7.35 (6.54-8.12)	8.31 (7.31-9.22)	9.32 (8.08-10.4)	10.7 (9.12-12.2)	11.9 (9.90-13.7)
30-day	3.49 (3.20-3.80)	4.36 (3.99-4.73)	5.42 (4.95-5.90)	6.28 (5.73-6.83)	7.45 (6.75-8.12)	8.37 (7.52-9.15)	9.32 (8.30-10.3)	10.3 (9.08-11.4)	11.6 (10.1-13.1)	12.7 (10.8-14.4)
45-day	4.26 (3.92-4.61)	5.31 (4.89-5.76)	6.53 (6.00-7.08)	7.47 (6.87-8.10)	8.70 (7.97-9.46)	9.62 (8.75-10.5)	10.5 (9.54-11.5)	11.4 (10.3-12.6)	12.6 (11.2-14.0)	13.5 (11.8-15.0)
60-day	4.80 (4.41-5.22)	5.98 (5.50-6.52)	7.37 (6.79-8.00)	8.44 (7.75-9.17)	9.84 (9.00-10.7)	10.9 (9.92-11.9)	11.9 (10.8-13.1)	12.9 (11.7-14.3)	14.3 (12.7-15.9)	15.2 (13.4-17.2)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Back to Top

PF graphical

Soils Data

United States Department of Agriculture

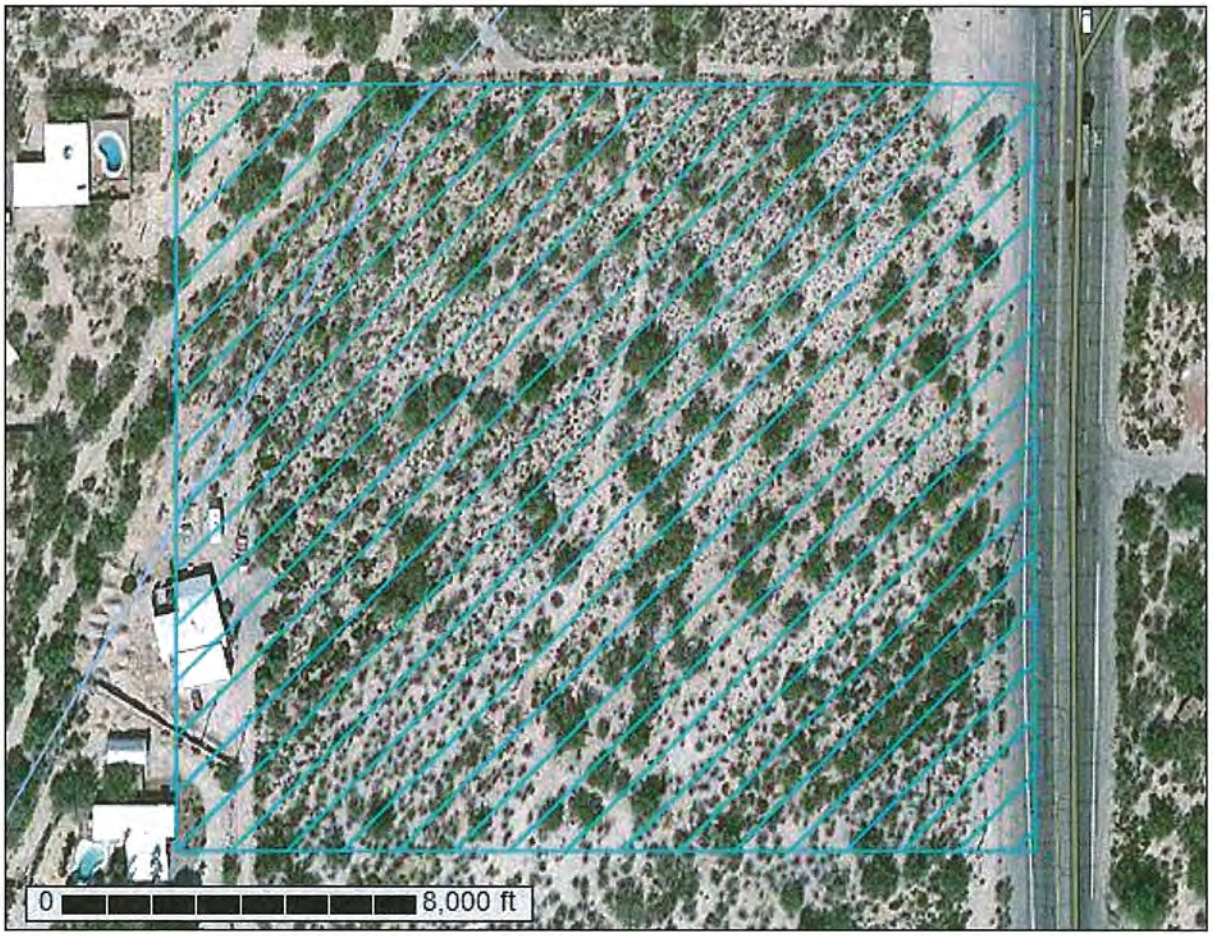
NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Pima County, Arizona, Eastern Part

TEP Orange Grove Substation



December 4, 2013

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://soils.usda.gov/sqi/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://soils.usda.gov/contact/state_offices/).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Soil Data Mart Web site or the NRCS Web Soil Survey. The Soil Data Mart is the data storage site for the official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the

individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

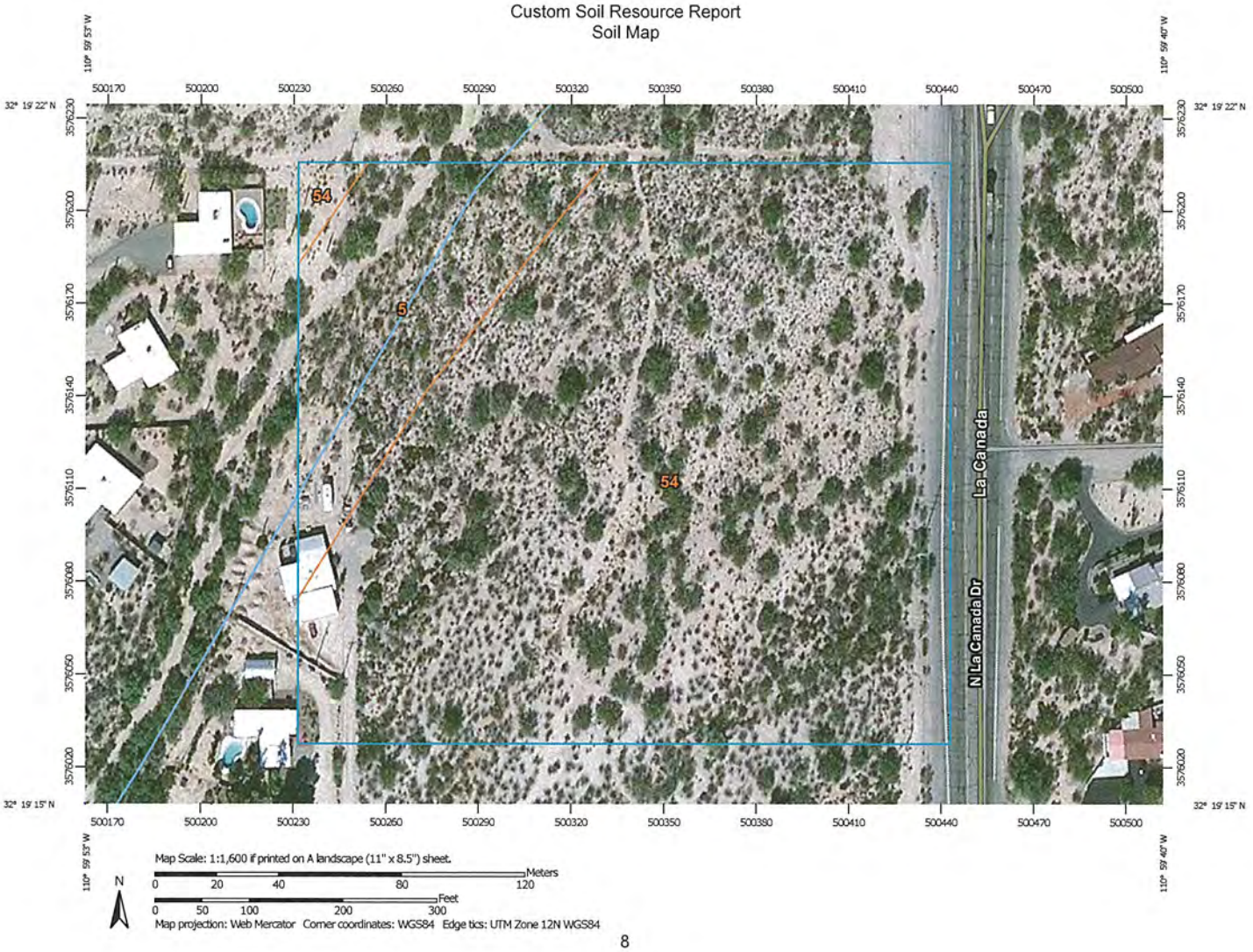
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Pima County, Arizona, Eastern Part
Survey Area Data: Version 8, Sep 8, 2008

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 20, 2010—Nov 27, 2010

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Pima County, Arizona, Eastern Part (AZ669)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
5	Arizo-Riverwash complex, 0 to 3 percent slopes	1.5	15.6%
54	Palos Verdes-Jaynes complex, 2 to 8 percent slopes	8.3	84.4%
Totals for Area of Interest		**9.9**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If

intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Pima County, Arizona, Eastern Part

5—Arizo-Riverwash complex, 0 to 3 percent slopes

Map Unit Setting

Elevation: 2,000 to 3,000 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 64 to 70 degrees F
Frost-free period: 220 to 280 days

Map Unit Composition

Arizo and similar soils: 50 percent
Riverwash: 20 percent

Description of Arizo

Setting

Landform: Flood plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed alluvium

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Calcium carbonate, maximum content: 1 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water capacity: Very low (about 2.3 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 6w
Hydrologic Soil Group: A
Ecological site: Sandy Wash 10-13" p.z. (R040XA115AZ)

Typical profile

0 to 18 inches: Gravelly loamy sand
18 to 60 inches: Very gravelly loamy sand

Description of Riverwash

Properties and qualities

Drainage class: Excessively drained
Frequency of flooding: Frequent

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 8

54—Palos Verdes-Jaynes complex, 2 to 8 percent slopes

Map Unit Setting

Elevation: 2,200 to 3,200 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 64 to 70 degrees F
Frost-free period: 220 to 280 days

Map Unit Composition

Palos verdes and similar soils: 40 percent
Jaynes and similar soils: 35 percent

Description of Palos Verdes

Setting

Landform: Fan terraces
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Mixed alluvium

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: 8 to 20 inches to densic material
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 3.0
Available water capacity: Very low (about 2.4 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 7s
Hydrologic Soil Group: C
Ecological site: Loamy Upland 10-13" p.z. (R040XA114AZ)

Typical profile

0 to 3 inches: Gravelly sandy loam
3 to 15 inches: Gravelly sandy clay loam
15 to 19 inches: Gravelly sandy loam
19 to 38 inches: Sandy loam
38 to 64 inches: Gravelly loamy coarse sand

Description of Jaynes

Setting

Landform: Fan terraces
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Alluvium derived from schist and/or alluvium derived from gneiss

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: 4 to 16 inches to densic material
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 3.0
Available water capacity: Very low (about 0.9 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: Limy Upland 10-13" p.z. (R040XA111AZ)

Typical profile

0 to 5 inches: Gravelly sandy loam
5 to 10 inches: Gravelly sandy loam
10 to 60 inches: Loamy fine sand

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Calculated Discharges

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: TEP-

Prepared by:

Project Name: TEP Orange Grove Substation

Date: 12/5/2013

Concentration Point: WS-A

Job #: 204014.74

Watershed Area: 4.3 ac

Watershed Type: Undeveloped-Valley

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	17.0	980	0.0173	.040

Length of Watercourse (Lc): 980 feet

Mean Slope: 0.0173

Length to Cen. of Gravity (Lca): 490 feet

Weighted Basin Fac.: 0.040

Veg. Cover Type(s): Desert Brush

Veg. Cover Density: 20 %

RETURN PERIOD: 100-years

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3218 Longitude: -110.9964

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.86	1.31	1.63	2.19	2.71	3.01	3.15	3.42	3.67	4.38
Areal Values (in)	0.86	1.31	1.63	2.19	2.71	3.01	3.15	3.42	3.67	4.38

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	0	.	.	0.000
C	56	89.	91.62	0.685
D	44	91.	93.27	0.739
Imp.	0	99.	99.	0.000

Weighted Runoff Coef. (Cw): 0.708

Time of Concentration: 5.7 min

Rainfall Intensity (i) @ Tc: 9.72 in/hr

Runoff Supply Rate (q) @ Tc: 6.88 in/hr

PEAK DISCHARGE: 30 cfs

Lesser Return Periods

Return Period	Ratio	Qpeak
2-year	0.10	3.0
5-year	0.23	6.8
10-year	0.35	10
25-year	0.55	16
50-year	0.75	22

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: TEP- | Prepared by:

Project Name: TEP Orange Grove Substation | Date: 12/5/2013

Concentration Point: WS-B | Job #: 204014.74

Watershed Area: 1.9 ac | Watershed Type: Undeveloped-Valley

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	16.0	730	0.0219	.040

Length of Watercourse (Lc): 730 feet | Mean Slope: 0.0219

Length to Cen. of Gravity (Lca): 365 feet | Weighted Basin Fac.: 0.040

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 100-years

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3218 Longitude: -110.9964

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.86	1.31	1.63	2.19	2.71	3.01	3.15	3.42	3.67	4.38
Areal Values (in)	0.86	1.31	1.63	2.19	2.71	3.01	3.15	3.42	3.67	4.38

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	0	.	.	0.000
C	56	89.	91.62	0.685
D	44	91.	93.27	0.739
Imp.	5	99.	99.	0.957

Weighted Runoff Coef. (Cw): 0.721

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 10.32 in/hr

Runoff Supply Rate (q) @ Tc: 7.44 in/hr

PEAK DISCHARGE: 14 cfs

Lesser Return Periods

Return Period	Ratio	Qpeak
2-year	0.10	1.4
5-year	0.23	3.3
10-year	0.35	5.0
25-year	0.55	7.9
50-year	0.75	11

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: TEP | Prepared by:

Project Name: TEP Orange Grove Substation | Date: 12/5/2013

Concentration Point: WS-C | Job #: 204014.74

Watershed Area: 2.7 ac | Watershed Type: Undeveloped-Valley

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	18.0	600	0.0300	.040

Length of Watercourse (Lc): 600 feet | Mean Slope: 0.0300

Length to Cen. of Gravity (Lca): 300 feet | Weighted Basin Fac.: 0.040

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 100-years

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3218 Longitude: -110.9964

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.86	1.31	1.63	2.19	2.71	3.01	3.15	3.42	3.67	4.38
Areal Values (in)	0.86	1.31	1.63	2.19	2.71	3.01	3.15	3.42	3.67	4.38

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	0	.	.	0.000
C	56	89.	91.62	0.685
D	44	91.	93.27	0.739
Imp.	0	99.	99.	0.000

Weighted Runoff Coef. (Cw): 0.708

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 10.32 in/hr

Runoff Supply Rate (q) @ Tc: 7.31 in/hr

PEAK DISCHARGE: 20 cfs

Lesser Return Periods

Return Period	Ratio	Qpeak
2-year	0.10	2.0
5-year	0.23	4.6
10-year	0.35	7.0
25-year	0.55	11
50-year	0.75	15

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: TEP

Project Name: TEP Orange Grove Substation

Concentration Point: WS-D

Prepared by:

Date: 12/5/2013

Job #: 204014.74

Watershed Area: 4.2 ac

Watershed Type: Undeveloped-Valley

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	17.0	980	0.0173	.040

Length of Watercourse (Lc): 980 feet

Length to Cen. of Gravity (Lca): 490 feet

Mean Slope: 0.0173

Weighted Basin Fac.: 0.040

Veg. Cover Type(s): Desert Brush

Veg. Cover Density: 20 %

RETURN PERIOD: 100-years

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3218 Longitude: -110.9964

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.86	1.31	1.63	2.19	2.71	3.01	3.15	3.42	3.67	4.38
Areal Values (in)	0.86	1.31	1.63	2.19	2.71	3.01	3.15	3.42	3.67	4.38

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	0	.	.	0.000
C	56	89.	91.62	0.685
D	44	91.	93.27	0.739
Imp.	5	99.	99.	0.957

Weighted Runoff Coef. (Cw): 0.721

Time of Concentration: 5.7 min

Rainfall Intensity (i) @ Tc: 9.75 in/hr

Runoff Supply Rate (q) @ Tc: 7.03 in/hr

PEAK DISCHARGE: 30 cfs

Lesser Return Periods

Return Period	Ratio	Qpeak
2-year	0.10	3.0
5-year	0.23	6.8
10-year	0.35	10
25-year	0.55	16
50-year	0.75	22

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: TEP | Prepared by:

Project Name: TEP Orange Grove Substation | Date: 12/5/2013

Concentration Point: WS-E | Job #: 204014.74

Watershed Area: 0.0 ac | Watershed Type: Undeveloped-Valley

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	3.0	80	0.0375	.040

Length of Watercourse (Lc): 80 feet | Mean Slope: 0.0375

Length to Cen. of Gravity (Lca): 40 feet | Weighted Basin Fac.: 0.040

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 100-years

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3218 Longitude: -110.9964

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.86	1.31	1.63	2.19	2.71	3.01	3.15	3.42	3.67	4.38
Areal Values (in)	0.86	1.31	1.63	2.19	2.71	3.01	3.15	3.42	3.67	4.38

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	0	.	.	0.000
C	56	88.	90.95	0.664
D	44	91.	93.27	0.739
Imp.	0	99.	99.	0.000

Weighted Runoff Coef. (Cw): 0.697

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 10.32 in/hr

Runoff Supply Rate (q) @ Tc: 7.19 in/hr

PEAK DISCHARGE: 0.2 cfs

Lesser Return Periods

Return Period	Ratio	Qpeak
2-year	0.10	0.0
5-year	0.23	0.1
10-year	0.35	0.1
25-year	0.55	0.1
50-year	0.75	0.2

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: TEP | Prepared by:

Project Name: TEP Orange Grove Substation | Date: 12/5/2013

Concentration Point: WS-F | Job #: 204014.74

Watershed Area: 1.7 ac | Watershed Type: Suburban-Valley

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	10.0	450	0.0222	.034

Length of Watercourse (Lc): 450 feet | Mean Slope: 0.0222

Length to Cen. of Gravity (Lca): 225 feet | Weighted Basin Fac.: 0.034

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: %

RETURN PERIOD: 100-years

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3218 Longitude: -110.9964

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.86	1.31	1.63	2.19	2.71	3.01	3.15	3.42	3.67	4.38
Areal Values (in)	0.86	1.31	1.63	2.19	2.71	3.01	3.15	3.42	3.67	4.38

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	0	.	.	0.000
C	56	88.	90.95	0.664
D	44	91.	93.27	0.739
Imp.	55	99.	99.	0.957

Weighted Runoff Coef. (Cw): 0.840

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 10.32 in/hr

Runoff Supply Rate (q) @ Tc: 8.67 in/hr

PEAK DISCHARGE: 15 cfs

Lesser Return Periods

Return Period	Ratio	Qpeak
2-year	0.15	2.2
5-year	0.28	4.2
10-year	0.40	6.0
25-year	0.60	9.0
50-year	0.80	12

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: TEP | Prepared by:

Project Name: TEP Orange Grove Substation | Date: 12/5/2013

Concentration Point: WS-G | Job #: 204014.74

Watershed Area: 2.0 ac | Watershed Type: Suburban-Valley

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	12.0	500	0.0240	.034

Length of Watercourse (Lc): 500 feet | Mean Slope: 0.0240

Length to Cen. of Gravity (Lca): 250 feet | Weighted Basin Fac.: 0.034

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 100-years

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3218 Longitude: -110.9964

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.86	1.31	1.63	2.19	2.71	3.01	3.15	3.42	3.67	4.38
Areal Values (in)	0.86	1.31	1.63	2.19	2.71	3.01	3.15	3.42	3.67	4.38

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	0	.	.	0.000
C	56	88.	90.95	0.664
D	44	91.	93.27	0.739
Imp.	55	99.	99.	0.957

Weighted Runoff Coef. (Cw): 0.840

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 10.32 in/hr

Runoff Supply Rate (q) @ Tc: 8.67 in/hr

PEAK DISCHARGE: 18 cfs

Lesser Return Periods

Return Period	Ratio	Qpeak
2-year	0.10	1.8
5-year	0.23	4.0
10-year	0.35	6.1
25-year	0.55	9.7
50-year	0.75	13

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: TEP | Prepared by:

Project Name: TEP Orange Grove Substation | Date: 12/5/2013

Concentration Point: WS-H | Job #: 204014.74

Watershed Area: 1.3 ac | Watershed Type: Undeveloped-Valley

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	15.0	540	0.0278	.040

Length of Watercourse (Lc): 540 feet | Mean Slope: 0.0278

Length to Cen. of Gravity (Lca): 270 feet | Weighted Basin Fac.: 0.040

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 100-years

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3218 Longitude: -110.9964

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.86	1.31	1.63	2.19	2.71	3.01	3.15	3.42	3.67	4.38
Areal Values (in)	0.86	1.31	1.63	2.19	2.71	3.01	3.15	3.42	3.67	4.38

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	0	.	.	0.000
C	56	89.	91.62	0.685
D	44	91.	93.27	0.739
Imp.	5	99.	99.	0.957

Weighted Runoff Coef. (Cw): 0.721

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 10.32 in/hr

Runoff Supply Rate (q) @ Tc: 7.44 in/hr

PEAK DISCHARGE: 10.0 cfs

Lesser Return Periods

Return Period	Ratio	Qpeak
2-year	0.10	1.0
5-year	0.23	2.3
10-year	0.35	3.5
25-year	0.55	5.5
50-year	0.75	7.5

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: TEP

Project Name: TEP Orange Grove Substation

Concentration Point: WS-I

Prepared by:

Date: 12/5/2013

Job #: 204014.74

Watershed Area: 0.4 ac

Watershed Type: Suburban-Valley

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	2.5	233	0.0107	.034

Length of Watercourse (Lc): 233 feet

Mean Slope: 0.0107

Length to Cen. of Gravity (Lca): 115 feet

Weighted Basin Fac.: 0.034

Veg. Cover Type(s): Desert Brush

Veg. Cover Density: %

RETURN PERIOD: 100-years

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3218 Longitude: -110.9964

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.86	1.31	1.63	2.19	2.71	3.01	3.15	3.42	3.67	4.38
Areal Values (in)	0.86	1.31	1.63	2.19	2.71	3.01	3.15	3.42	3.67	4.38

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	0	.	.	0.000
C	56	88.	90.95	0.664
D	44	91.	93.27	0.739
Imp.	55	99.	99.	0.957

Weighted Runoff Coef. (Cw): 0.840

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 10.32 in/hr

Runoff Supply Rate (q) @ Tc: 8.67 in/hr

PEAK DISCHARGE: 3.2 cfs

Lesser Return Periods

Return Period	Ratio	Qpeak
2-year	0.15	0.5
5-year	0.28	0.9
10-year	0.40	1.3
25-year	0.60	1.9
50-year	0.80	2.6

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: TEP

Project Name: TEP Orange Grove Substation

Concentration Point: WS-J

Prepared by:

Date: 12/5/2013

Job #: 204014.74

Watershed Area: 0.4 ac

Watershed Type: Suburban-Valley

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	2.5	233	0.0107	.034

Length of Watercourse (Lc): 233 feet

Mean Slope: 0.0107

Length to Cen. of Gravity (Lca): 115 feet

Weighted Basin Fac.: 0.034

Veg. Cover Type(s): Desert Brush

Veg. Cover Density: %

RETURN PERIOD: 100-years

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3218 Longitude: -110.9964

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.86	1.31	1.63	2.19	2.71	3.01	3.15	3.42	3.67	4.38
Areal Values (in)	0.86	1.31	1.63	2.19	2.71	3.01	3.15	3.42	3.67	4.38

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	0	.	.	0.000
C	56	88.	90.95	0.664
D	44	91.	93.27	0.739
Imp.	55	99.	99.	0.957

Weighted Runoff Coef. (Cw): 0.840

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 10.32 in/hr

Runoff Supply Rate (q) @ Tc: 8.67 in/hr

PEAK DISCHARGE: 3.2 cfs

Lesser Return Periods

Return Period	Ratio	Qpeak
2-year	0.15	0.5
5-year	0.28	0.9
10-year	0.40	1.3
25-year	0.60	1.9
50-year	0.80	2.6

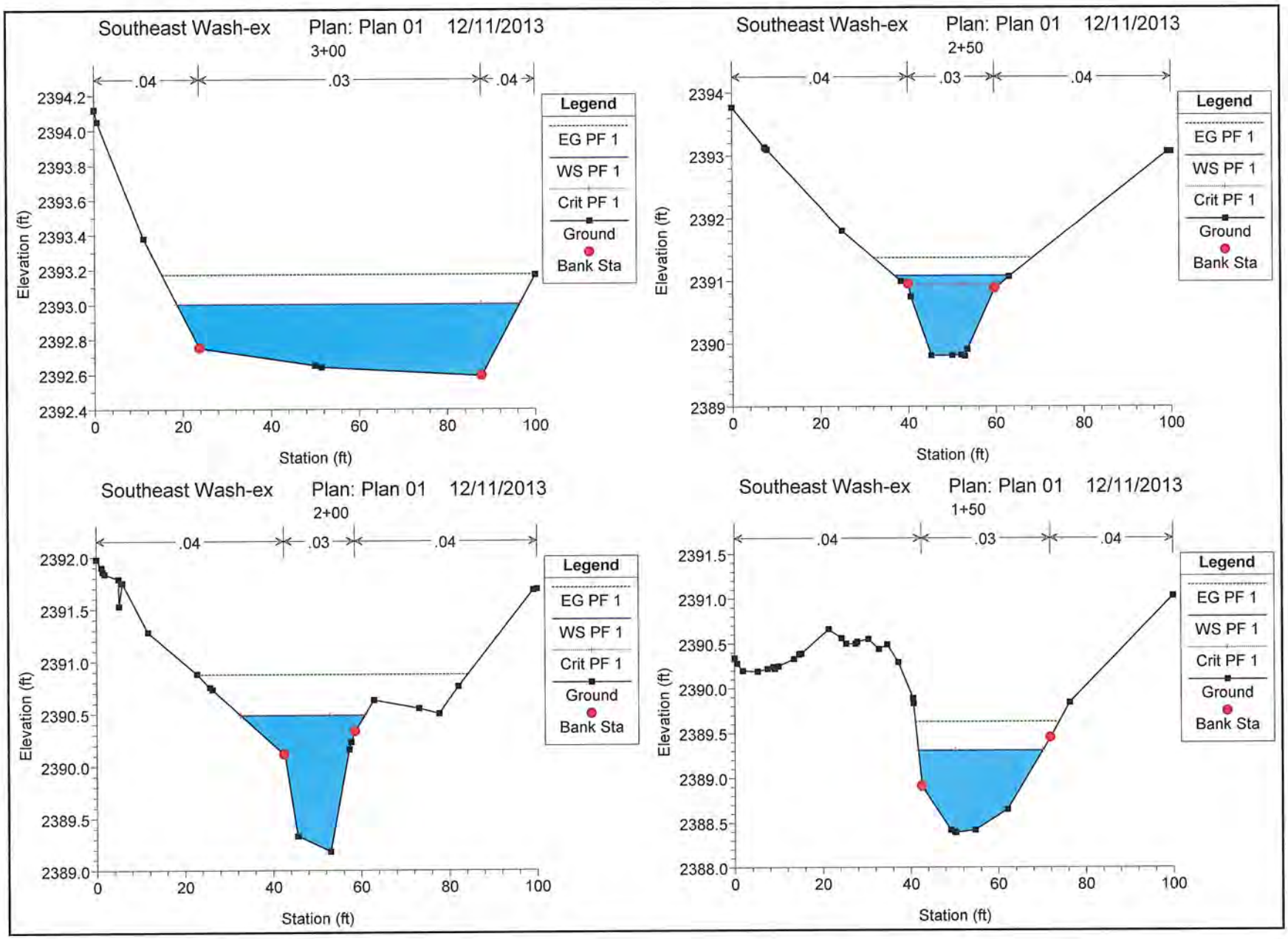
B. Hydraulic Computations

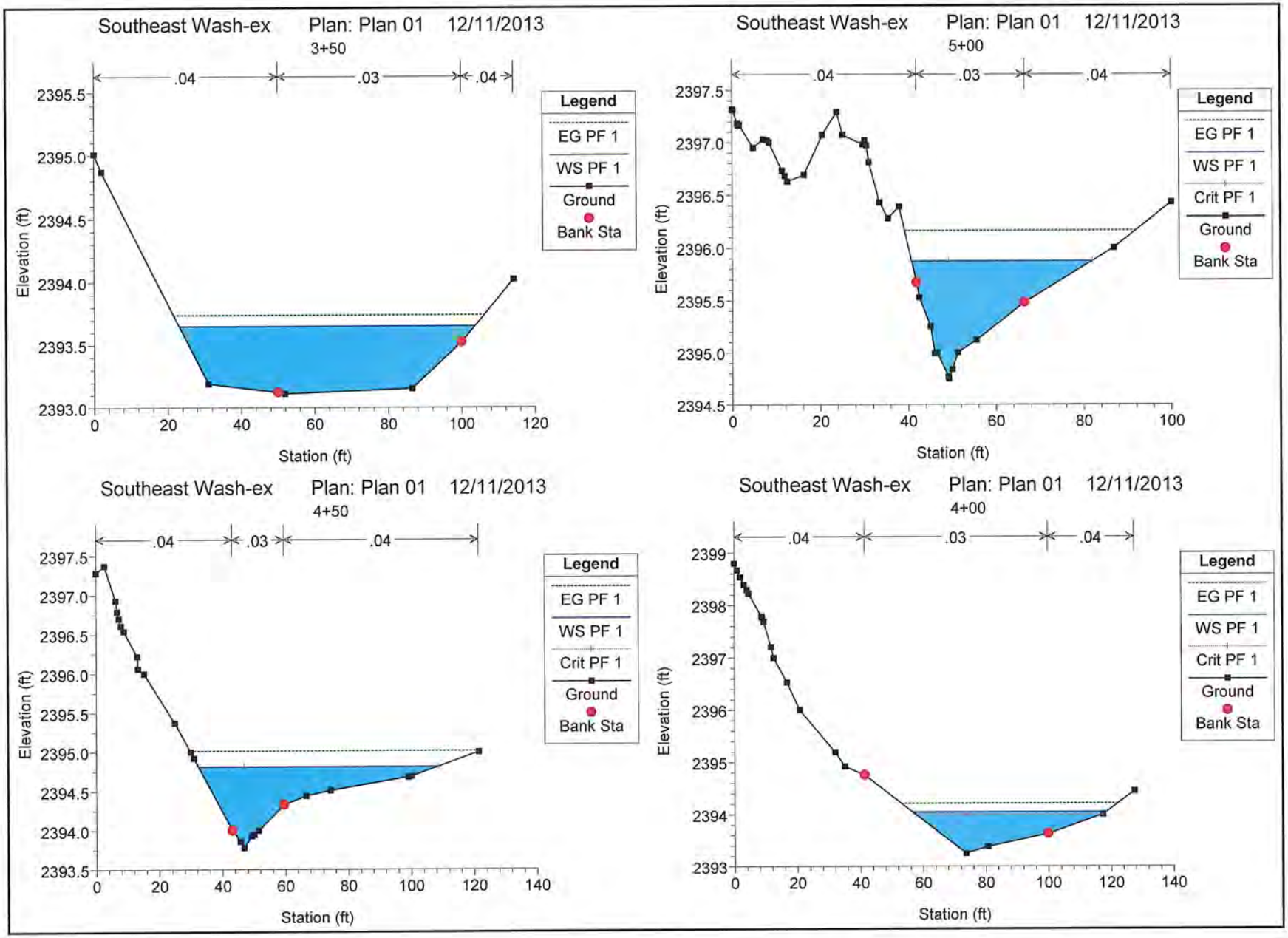
Channels

EXISTING EAST WASH

HEC-RAS Plan: Plan 01 River: Little Wash Reach: WASHES Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
WASHES	500	PF 1	80.00	2394.75	2395.88	2395.88	2396.16	0.012959	4.41	20.29	41.22	0.93
WASHES	450	PF 1	80.00	2393.78	2394.81	2394.81	2395.02	0.010118	4.22	28.90	76.16	0.84
WASHES	400	PF 1	80.00	2393.25	2394.05	2394.00	2394.21	0.010880	3.32	26.43	61.88	0.81
WASHES	350	PF 1	80.00	2393.11	2393.65		2393.74	0.007462	2.57	34.73	80.62	0.66
WASHES	300	PF 1	80.00	2392.59	2393.00	2393.00	2393.17	0.018506	3.36	25.04	77.84	1.00
WASHES	250	PF 1	80.00	2389.80	2391.08	2390.94	2391.37	0.008148	4.28	19.23	26.37	0.77
WASHES	200	PF 1	80.00	2389.18	2390.49	2390.49	2390.88	0.011532	5.08	17.26	28.17	0.92
WASHES	150	PF 1	80.00	2388.39	2389.31	2389.31	2389.63	0.015397	4.54	17.71	28.36	1.00

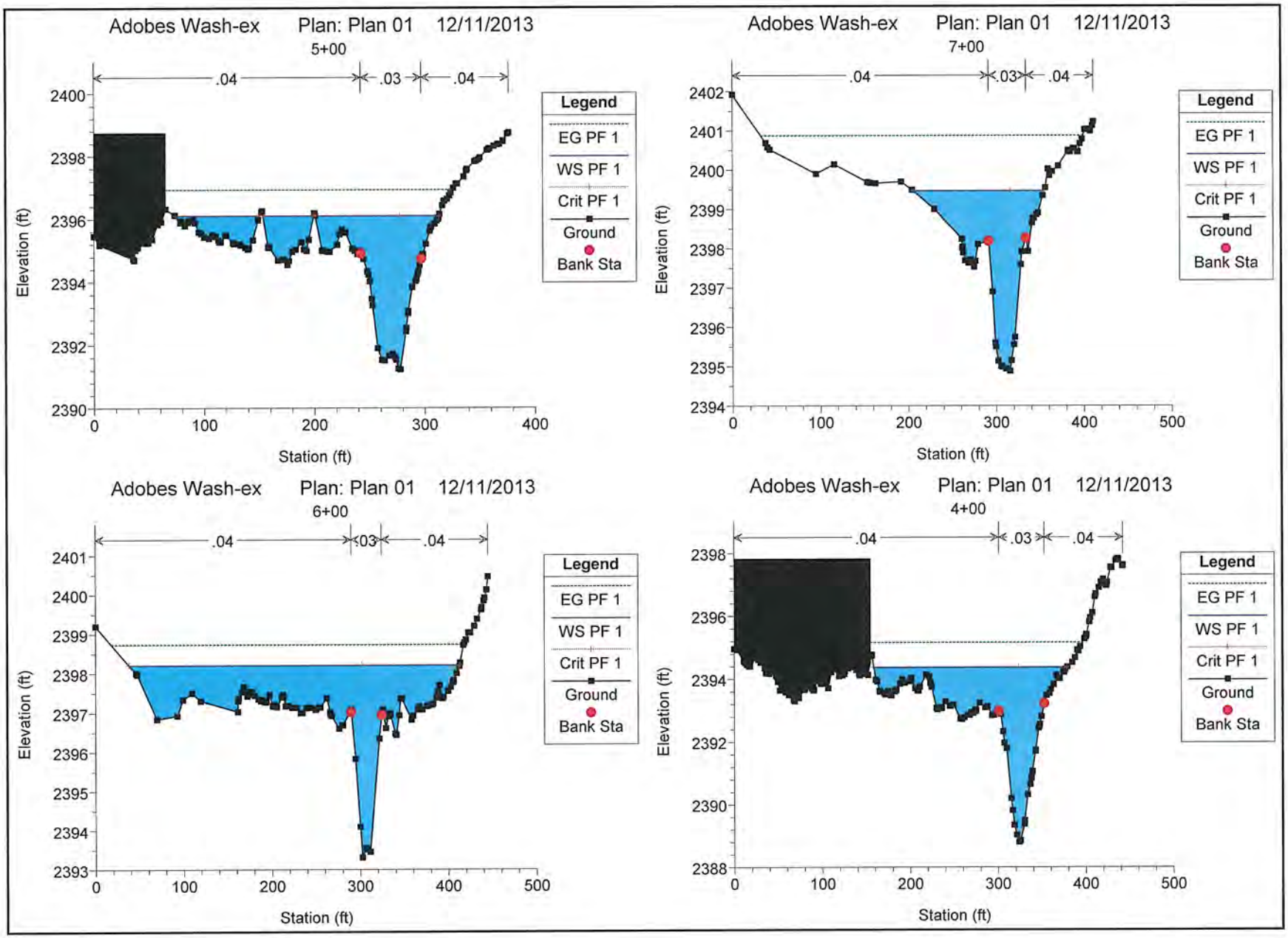

Southeast Wash-ex Plan: Plan 01 12/11/2013
3+00
.04
.03
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Southeast Wash-ex Plan: Plan 01 12/11/2013
2+50
Southeast Wash-ex Plan: Plan 01 12/11/2013
2+00
Southeast Wash-ex Plan: Plan 01 12/11/2013
1+50

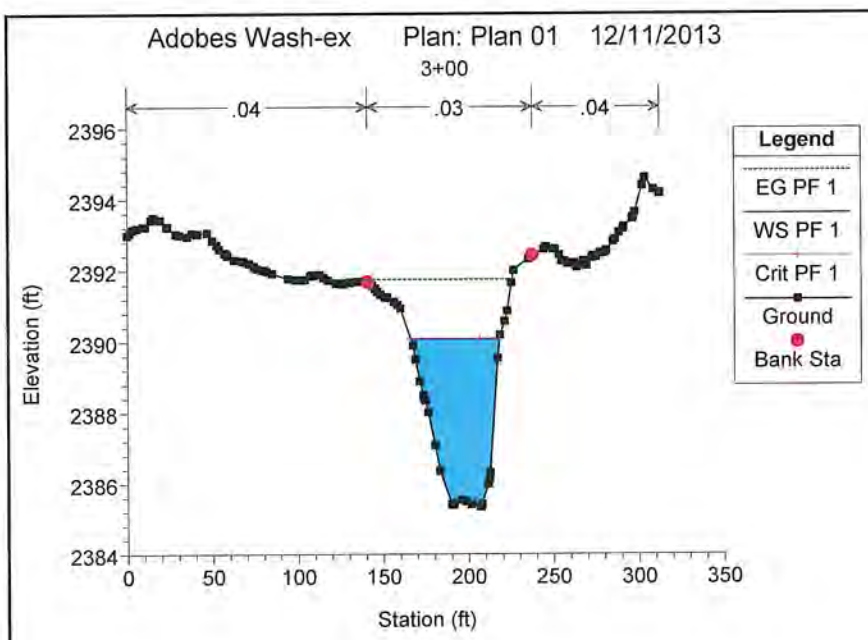

Southeast Wash-ex Plan: Plan 01 12/11/2013
3+50
.04
.03
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Southeast Wash-ex Plan: Plan 01 12/11/2013
5+00
.04
.03
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Southeast Wash-ex Plan: Plan 01 12/11/2013
4+50
.04
.03
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Southeast Wash-ex Plan: Plan 01 12/11/2013
4+00
.04
.03
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta

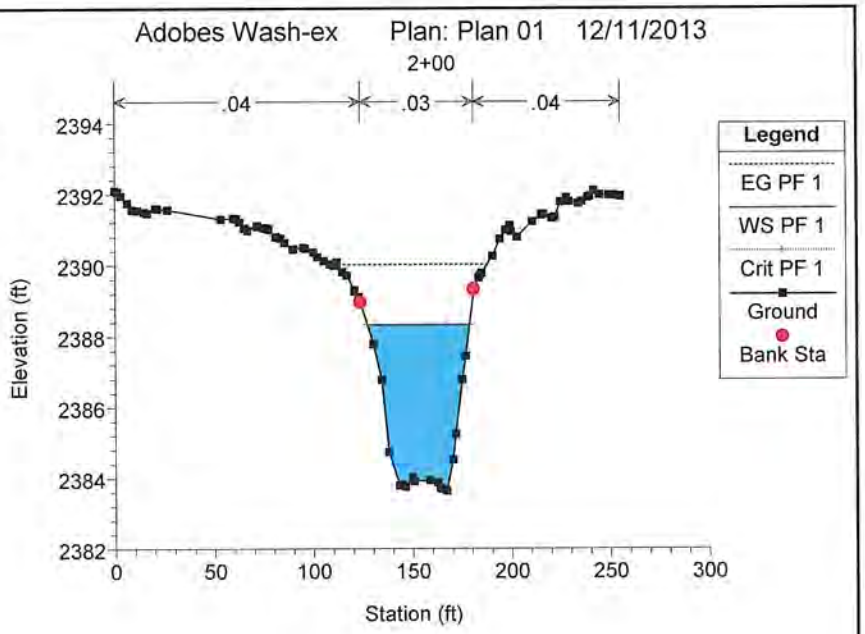
EXISTING CASAS ADOBE WASH

HEC-RAS Plan: Plan 01 River: Casas Adobe Wash Reach: WASHES Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
WASHES	700	PF 1	1788.00	2394.89	2399.47	2399.47	2400.87	0.008928	10.34	237.64	149.28	1.00
WASHES	600	PF 1	1788.00	2393.31	2398.21	2398.21	2398.73	0.004941	7.76	455.12	374.68	0.74
WASHES	500	PF 1	1788.00	2391.22	2396.11	2396.11	2396.93	0.005350	7.99	321.02	234.98	0.77
WASHES	400	PF 1	1788.00	2388.81	2394.37	2394.37	2395.16	0.004983	7.90	330.48	220.03	0.75
WASHES	300	PF 1	1788.00	2385.35	2390.07	2390.07	2391.75	0.009340	10.39	172.06	52.05	1.01
WASHES	200	PF 1	1788.00	2383.64	2388.32	2388.32	2390.01	0.009313	10.42	171.62	51.58	1.01


Adobes Wash-ex Plan: Plan 01 12/11/2013
5+00
.04
.03
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Adobes Wash-ex Plan: Plan 01 12/11/2013
7+00
.04
.03
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Adobes Wash-ex Plan: Plan 01 12/11/2013
6+00
.04
.03
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Adobes Wash-ex Plan: Plan 01 12/11/2013
4+00
.04
.03
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta

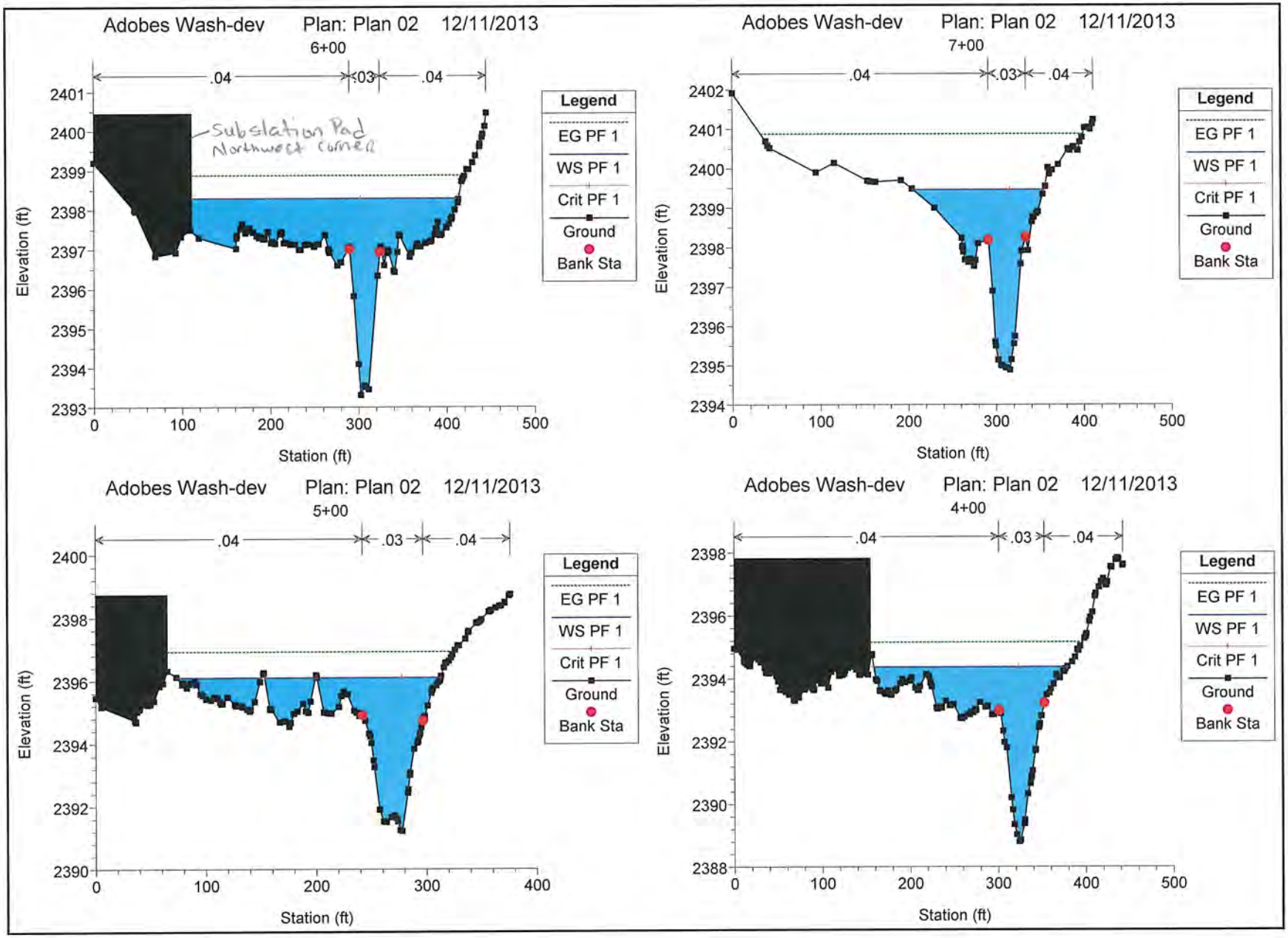

Adobes Wash-ex Plan: Plan 01 12/11/2013
3+00
.04
.03
.04
Elevation (ft)
2396
2394
2392
2390
2388
2386
2384
0
50
100
150
200
250
300
350
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta

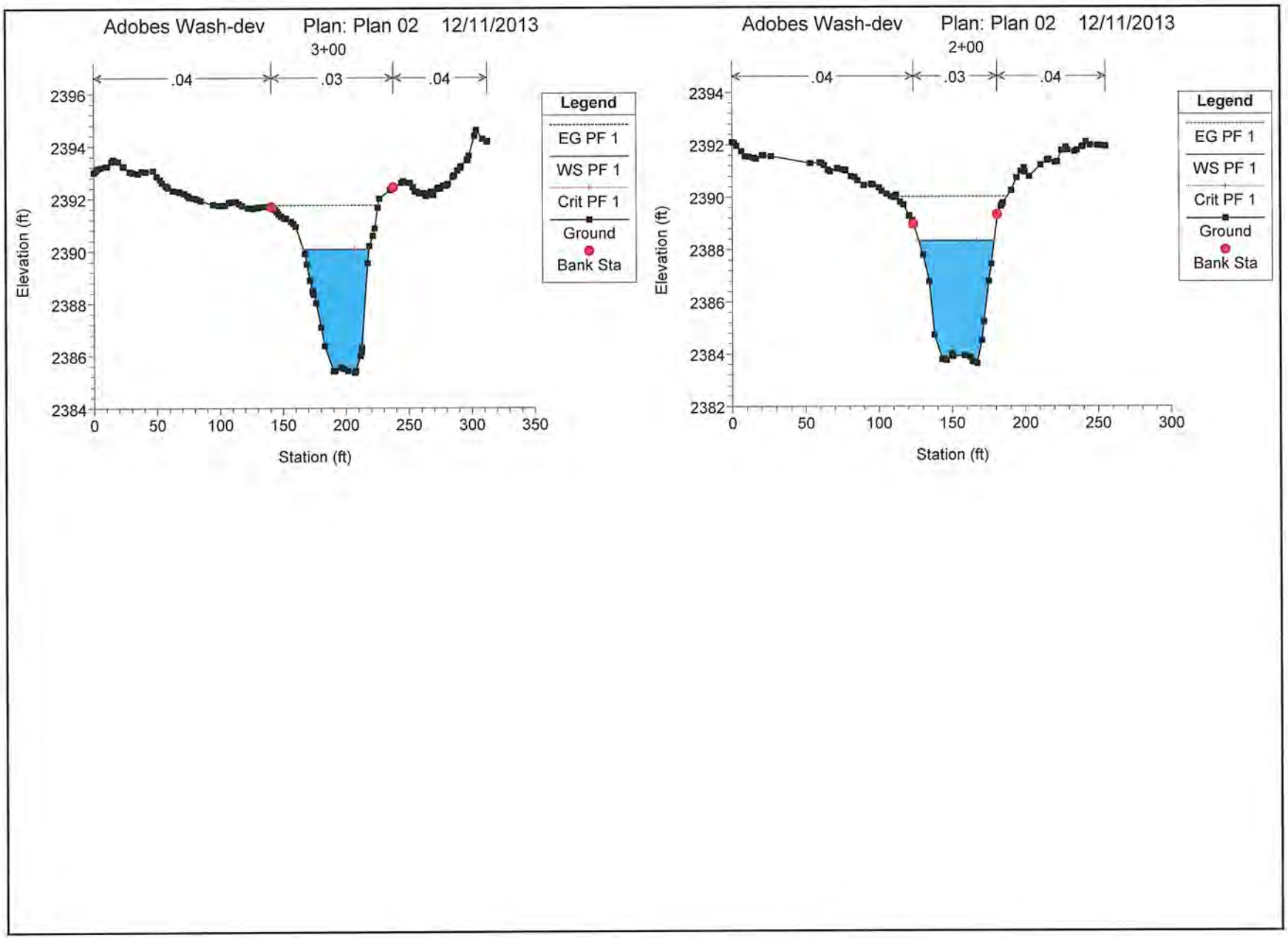

Adobes Wash-ex Plan: Plan 01 12/11/2013
2+00
.04
.03
.04
Elevation (ft)
2394
2392
2390
2388
2386
2384
2382
0
50
100
150
200
250
300
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta

PROPOSED CASAS ADOBE WASH

HEC-RAS Plan: Plan 02 River: Casas Adobe Wash Reach: WASHES Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
WASHES	700	PF 1	1788.00	2394.89	2399.47	2399.47	2400.87	0.008928	10.34	237.64	149.28	1.00
WASHES	600	PF 1	1788.00	2393.31	2398.30	2398.30	2398.88	0.004999	7.94	417.07	302.69	0.75
WASHES	500	PF 1	1788.00	2391.22	2396.11	2396.11	2396.93	0.005350	7.99	321.02	234.98	0.77
WASHES	400	PF 1	1788.00	2388.81	2394.37	2394.37	2395.16	0.004983	7.90	330.48	220.03	0.75
WASHES	300	PF 1	1788.00	2385.35	2390.07	2390.07	2391.75	0.009340	10.39	172.06	52.05	1.01
WASHES	200	PF 1	1788.00	2383.64	2388.32	2388.32	2390.01	0.009313	10.42	171.62	51.58	1.01


Adobes Wash-dev Plan: Plan 02 12/11/2013
6+00
.04
.03
.04
Substation Pad
Northwest corner
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Adobes Wash-dev Plan: Plan 02 12/11/2013
7+00
Adobes Wash-dev Plan: Plan 02 12/11/2013
5+00
Adobes Wash-dev Plan: Plan 02 12/11/2013
4+00


Adobes Wash-dev Plan: Plan 02 12/11/2013
3+00
.04
.03
.04
Elevation (ft)
2396
2394
2392
2390
2388
2386
2384
0
50
100
150
200
250
300
350
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Adobes Wash-dev Plan: Plan 02 12/11/2013
2+00
.04
.03
.04
Elevation (ft)
2394
2392
2390
2388
2386
2384
2382
0
50
100
150
200
250
300
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta

Worksheet for East Channel US

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03200	ft/ft
Discharge	80.40	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	3.50
0+04	0.00
0+16	0.00
0+19	3.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 3.50)	(0+04, 0.00)	0.069
(0+04, 0.00)	(0+16, 0.00)	0.030
(0+16, 0.00)	(0+19, 3.50)	0.069

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.99	ft
Elevation Range	0.00 to 3.50 ft	
Flow Area	13.21	ft²
Wetted Perimeter	15.19	ft
Hydraulic Radius	0.87	ft
Top Width	14.33	ft
Normal Depth	0.99	ft

Worksheet for East Channel US

Results

Critical Depth		1.06	ft
Critical Slope		0.02518	ft/ft
Velocity		6.08	ft/s
Velocity Head		0.58	ft
Specific Energy		1.56	ft
Froude Number		1.12	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.99	ft
Critical Depth	1.06	ft
Channel Slope	0.03200	ft/ft
Critical Slope	0.02518	ft/ft

Worksheet for East Channel DS

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00950	ft/ft
Discharge	80.40	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	3.50
0+04	0.00
0+16	0.00
0+19	3.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 3.50)	(0+04, 0.00)	0.069
(0+04, 0.00)	(0+16, 0.00)	0.030
(0+16, 0.00)	(0+19, 3.50)	0.069

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.48	ft
Elevation Range	0.00 to 3.50 ft	
Flow Area	20.61	ft²
Wetted Perimeter	16.56	ft
Hydraulic Radius	1.24	ft
Top Width	15.26	ft
Normal Depth	1.48	ft

Worksheet for East Channel DS

Results

Critical Depth		1.06	ft
Critical Slope		0.02935	ft/ft
Velocity		3.90	ft/s
Velocity Head		0.24	ft
Specific Energy		1.72	ft
Froude Number		0.59	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.48	ft
Critical Depth	1.06	ft
Channel Slope	0.00950	ft/ft
Critical Slope	0.02935	ft/ft

Worksheet for East Swale

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.01000	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Discharge	7.20	ft^3/s

Results

Normal Depth	0.92	ft
Flow Area	2.53	ft^2
Wetted Perimeter	5.81	ft
Hydraulic Radius	0.44	ft
Top Width	5.51	ft
Critical Depth	0.81	ft
Critical Slope	0.01898	ft/ft
Velocity	2.85	ft/s
Velocity Head	0.13	ft
Specific Energy	1.04	ft
Froude Number	0.74	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.92	ft
Critical Depth	0.81	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.01898	ft/ft

Channel Freeboard

Project Name: Whetstone
Project #: 208019.00

Design Following Methods as provided in Section 8.5.1.4 of the
Standards Manual for Drainage Design and Floodplain Management in Tucson, Arizona

Equation 8.4

$$FB = \frac{1}{6}\left(Y_{MAX} + \frac{V^2}{2g}\right)$$

Where

FB= Freeboard, ft.
Y_{MAX}= Max depth of flow, ft.
V= Average velocity of flow, ft/s.
g= Acceleration due to gravity, ft/s^2

Channel	Velocity (ft/s)	Max Depth (ft.)	Freeboard (ft.)
East-US	6.08	0.99	0.26
East-DS	3.9	1.48	0.29
Swale	2.85	0.92	0.17

Culverts

Culvert Calculator Report
Worksheet-1
DRIVE WAY CULVERT

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	95.00	ft	Headwater Depth/Height	1.33	
Computed Headwater Elev	93.99	ft	Discharge	80.00	cfs
Inlet Control HW Elev.	93.99	ft	Tailwater Elevation	0.00	ft
Outlet Control HW Elev.	93.98	ft	Control Type	Inlet Control	

Grades					
Upstream Invert	91.33	ft	Downstream Invert	91.00	ft
Length	53.30	ft	Constructed Slope	0.006191	ft/ft

Hydraulic Profile					
Profile	M2		Depth, Downstream	1.61	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	1.61	ft
Velocity Downstream	7.40	ft/s	Critical Slope	0.008120	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	2.00	ft
Section Size	24 inch		Rise	2.00	ft
Number Sections	4				

Outlet Control Properties					
Outlet Control HW Elev.	93.98	ft	Upstream Velocity Head	0.69	ft
Ke	0.20		Entrance Loss	0.14	ft

Inlet Control Properties					
Inlet Control HW Elev.	93.99	ft	Flow Control	Submerged	
Inlet Type	Groove end projecting		Area Full	12.6	ft²
K	0.00450		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	3	
C	0.03170		Equation Form	1	
Y	0.69000				

Culvert Calculator Report
1-42" RCP

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	2,403.27	ft	Headwater Depth/Height	1.22	
Computed Headwater Elev	2,401.35	ft	Discharge	64.00	cfs
Inlet Control HW Elev.	2,401.19	ft	Tailwater Elevation	2,396.42	ft
Outlet Control HW Elev.	2,401.35	ft	Control Type	Entrance Control	

Grades					
Upstream Invert	2,397.09	ft	Downstream Invert	2,395.42	ft
Length	185.36	ft	Constructed Slope	0.009009	ft/ft

Hydraulic Profile					
Profile	S2		Depth, Downstream	2.10	ft
Slope Type	Steep		Normal Depth	2.10	ft
Flow Regime	Supercritical		Critical Depth	2.51	ft
Velocity Downstream	10.61	ft/s	Critical Slope	0.005437	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	3.50	ft
Section Size	42 inch		Rise	3.50	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	2,401.35	ft	Upstream Velocity Head	1.17	ft
Ke	0.50		Entrance Loss	0.58	ft

Inlet Control Properties					
Inlet Control HW Elev.	2,401.19	ft	Flow Control	Transition	
Inlet Type	Square edge w/headwall		Area Full	9.6	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

Retention/Detention

Retention/Detention Estimates

Project Name: TEP Orange Grove
Project #: 204014.74
BASIN 1

Retention Volume

Stormwater Detention/Retention Manual, Pima County Department of Transportation & Flood Control District City of Tucson
Use method provided by Section 3.1 Guidelines for Stormwater Storage Facilities

$$V = \frac{1}{12} (C) P_1 A$$

P_1	A	C
2.42	1.28	0.84

V_r (ac.ft)	V_r (ft^3)
0.217	9,445

* P_1= 100 year, 1 hour

Water Surface Elevation @ 0.217 ac.ft

Elevation (ft)	Area (sq.ft.)	Volume (cu.ft.)	Volume (ac.ft.)
2390	17	0.001	0.001
2391	954	485.5	0.011146
2392	2726	2325.5	0.053386
2393	4934	6155.5	0.141311
2394	9115	13180	0.302571

Volume	Elevation
0.217	2393.47

Retention/Detention Estimates

Project Name: TEP Orange Grove
Project #: 204014.74
BASIN 2

Retention Volume

Stormwater Detention/Retention Manual, Pima County Department of Transportation & Flood Control District City of Tucson
Use method provided by Section 3.1 Guidelines for Stormwater Storage Facilities

$$V = \frac{1}{12}(C)\, P_1\, A$$

P_1	A	C
2.42	1.28	0.84

V_r (ac.ft)	V_r (ft^3)
0.217	9,445

* P_1= 100 year, 1 hour

Water Surface Elevation @ 0.217 ac.ft

Elevation (ft)	Area (sq.ft.)	Volume (cu.ft.)	Volume (ac.ft.)
2392	4641	0	0
2392.5	5242	2470.75	0.056721
2393	5853	5244.5	0.120397
2393.5	6491	8330.5	0.191242
2394	7155	11742	0.269559
2394.36	7661	14408.88	0.330782

Volume	Elevation
0.217	2393.66

Worksheet for East Basin Overflow

Project Description

Solve For	Crest Length

Input Data

Discharge		11.00	ft³/s
Headwater Elevation		0.30	ft
Crest Elevation		0.00	ft
Tailwater Elevation		0.00	ft
Weir Coefficient		3.00	US
Number Of Contractions	0		

Results

Crest Length	22.31	ft
Headwater Height Above Crest	0.30	ft
Tailwater Height Above Crest	0.00	ft
Flow Area	6.69	ft²
Velocity	1.64	ft/s
Wetted Perimeter	22.91	ft
Top Width	22.31	ft

Erosion Protection/Wall Openings

Wall Opening Design

Project Name: Orange Grove Substation
Project #: 204014.74
Location: Basin 1

Wall Opening Design as Presented in Section 12.5 of
The Standards Manual for Drainage Design and Floodplain Management in Tucson, Arizona

$$L = 0.52\left(\frac{Q}{HW^{1.33} D^{0.17}}\right)$$

Where,

Q	Total Design Discharge, cfs
HW	Head Water Height at the Inlet, ft.
D	Height of Flow Through Wall Openings, ft.

Limiting head water depth to 2/3 the total opening height (.67 ft. for masonry blocks) and applying a Saftey Facrot of 2 for natural watersheds and 1.5 for urban watersheds.

SF	Q	HW	D	L
2	15	0.4466	0.4466	52.27

Rounding to whole blocks (16 in. long)

Block Openings Required
39

Source: Standards Manual for Drainage Design and Floodplain Management in Tucson Arizona, Section 12.5

Wall Opening Design

Project Name: Orange Grove Substation
Project #: 204014.74
Location: Basin 2

Wall Opening Design as Presented in Section 12.5 of
The Standards Manual for Drainage Design and Floodplain Management in Tucson, Arizona

$$L = 0.52\left(\frac{Q}{HW^{1.33}D^{0.17}}\right)$$

Where,

Q	Total Design Discharge, cfs
HW	Head Water Height at the Inlet, ft.
D	Height of Flow Through Wall Openings, ft.

Limiting head water depth to 2/3 the total opening height (.67 ft. for masonry blocks) and applying a Saftey Factor of 2 for natural watersheds and 1.5 for urban watersheds.

SF	Q	HW	D	L
2	18	0.4466	0.4466	62.72

Rounding to whole blocks (16 in. long)

Block Openings Required
47

Source: Standards Manual for Drainage Design and Floodplain Management in Tucson Arizona, Section 3.4

Wall Opening Design

Project Name: Orange Grove Substation
Project #: 204014.74
Location: South Wall

Wall Opening Design as Presented in Section 12.5 of
The Standards Manual for Drainage Design and Floodplain Management in Tucson, Arizona

$$L = 0.52\left(\frac{Q}{HW^{1.33}D^{0.17}}\right)$$

Where,

Q	Total Design Discharge, cfs
HW	Head Water Height at the Inlet, ft.
D	Height of Flow Through Wall Openings, ft.

Limiting head water depth to 2/3 the total opening height (.67 ft. for masonry blocks) and applying a Saftey Facrot of 2 for natural watersheds and 1.5 for urban watersheds.

SF	Q	HW	D	L
2	6.4	0.4466	0.4466	22.30

Rounding to whole blocks (16 in. long)

Block Openings Required
17

Source: Standards Manual for Drainage Design and Floodplain Management in Tucson Arizona, Section 12.5

Scour Calculation Sheet

Project Name: Orange Grove Substation
Project #: 204014.74

Equations

Total Scour Calculation

$$Z_t = 1.3\left(Z_{gs} + Z_a + Z_{ls} + Z_{bs} + Z_{lft}\right)$$

Where,

Zt = Total Scour
Zgs = General Scour
Za = Anti-Dune
Zls = Local Scour
Zbs = Bend Scour
Zlft = Low-Flow Thalweg
1.3 = Factor of Safety

General Scour Calculation

$$Z_{gs} = Y_{\max}\left(\frac{0.0685\,V_m^{0.8}}{Y_h^{0.4}S_e^{0.3}} - 1\right)$$

Where,

Zgs = General Scour
Ymax = Maximum Depth of Flow
Yh = Hydraulic Depth of Flow
Se = Energy Slope
Vm = Average Velocity of Flow

Anti-Dune Calculation

$$Z_a = .0137 \quad V_m^2$$

Where,

Za = Anti-Dune
Vm2 = Average Velocity of Flow

Local Scour Calculation

$$Z_{lp} = 2.2Y\left(\frac{b_p}{Y}\right)^{.65} F_u^{0.43}$$

Where,

b_p=Pier Width Normal to the Flow Direction (ft)
F_u=Upstream Froude Number V/(gd)$^{.5}$
Z_{lsp}=Local Scour Due to Pier

Bend Scour Calculation

$$Z_{bs} = \frac{.0685 Y_{\max} V_m^{0.8}}{Y_h^{0.4} S_e^{0.3}} \left(2.1\left[\frac{\sin^2(\alpha/2)}{\cos\alpha}\right]^{0.2} - 1\right)$$

Where,

Zbs = Bend Scour
Ymax = Maximum Depth of Flow
Vm = Average Velocity of Flow
Se = Energy Slope
Yh = Hydraulic Depth of Flow
α =Angle in Rad

Low-Flow Thalweg Calculation

If a low-Flow Thalweg is predicted to be present, it should be assumed to be at least two feet deep within regional watercourses, and at least one foot deep within all other watercourses, unless field observations dictate otherwise.

Input

Location	General				Bend	Local		Lowflow
	Y_{max}	Y_h	S_e	V_m	α	Reduction Factor	Pier Width (ft)	1' for <500cfs. 2 ' for >500cfs
East US	1.01	0.941	0.032	6.14	0	0.9	0	1
East DS	1.52	1.377	0.0095	3.93	0	0.9	0	1

Results

Location	General	Anti-Dune	Local	Bend	Lowflow	Total	
East US	0	0.51648	0	0	1	1.971429876	**2**
East DS	0	0.2116	0	0	1	1.575073669	**2**

Riprap Apron Design

Project: Orange Grove Substation
Job No.: 204017.74

Culvert: 4-24" RCP

Chapter 10 of Hydraulic Engineering Circular No. 14

Riprap Apron Design -

Equation 10.4

$$D_{50} = 0.2D\left(\frac{Q}{g^{1/2}D^{2.5}}\right)^{4/3}\left(\frac{D}{TW}\right)$$

Where,

D_{50}	=	riprap size (ft)
Q	=	Discharge per cell (cfs)
D	=	Culvert Diameter (ft)
TW	=	Tailwater depth (ft) (=0.4D when unknown)
g	=	Acceleration of gravity, 32.2 (ft/s^2)

Equation 10.5
(supercritical adjustment)

$$D' = \frac{D + Y_n}{2}$$

Where,

D'	=	adjusted culvert rise (ft)
Yn	=	normal (supercritical) depth in the culvert, (ft)

Data:

Q_{100}	=	20	cfs	(Per Cell)
D	=	2	ft	
TW	=	1.63	ft	
Yn	=	1.61	ft	

Results

D' (ft)	D_{50} (ft)	D_{50} (in)
1.81	0.30	3.6

Table 10.1 - Riprap Classes and Apron Dimensions

Class	D_{50} (in)	Apron Length (ft)	Apron Depth (ft)
1	5	4D	$3.5D_{50}$
2	6	4D	$3.3D_{50}$
3	10	5D	$2.4D_{50}$
4	14	6D	$2.2D_{50}$
5	20	7D	$2.0D_{50}$
6	22	8D	$2.0D_{50}$

Design Parameters:

L_s= 4D (ft)	8
h_s=$3.5D_{50}$ (ft)	1.5
W_s=4D+(2/3)L_s (ft)	13
D_{50} (Class 1, in)	5

Riprap Apron Design

Project: Orange Grove Substation
Job No.: 204017.74

Culvert: 1-42" RCP

Chapter 10 of Hydraulic Engineering Circular No. 14

Riprap Apron Design -

Equation 10.4

$$D_{50} = 0.2D\left(\frac{Q}{g^{1/2}D^{2.5}}\right)^{4/3}\left(\frac{D}{TW}\right)$$

Where,

D_{50}	=	riprap size (ft)
Q	=	Discharge per cell (cfs)
D	=	Culvert Diameter (ft)
TW	=	Tailwater depth (ft) (=0.4D when unknown)
g	=	Acceleration of gravity, 32.2 (ft/s^2)

Equation 10.5
(supercritical adjustment)

$$D' = \frac{D + Y_n}{2}$$

Where,

D'	=	adjusted culvert rise (ft)
Yn	=	normal (supercritical) depth in the culvert, (ft)

Data:

Q_{100}	=	64	cfs	(Per Cell)
D	=	3.5	ft	
TW	=	1.4	ft	
Yn	=	2.1	ft	

Results

D' (ft)	D_{50} (ft)	D_{50} (in)
2.80	0.92	11.0

Table 10.1 - Riprap Classes and Apron Dimensions

Class	D_{50} (in)	Apron Length (ft)	Apron Depth (ft)
1	5	4D	$3.5D_{50}$
2	6	4D	$3.3D_{50}$
3	10	5D	$2.4D_{50}$
4	14	6D	$2.2D_{50}$
5	20	7D	$2.0D_{50}$
6	22	8D	$2.0D_{50}$

Design Parameters:

L_s= 6D (ft)	21
h_s=$2.2D_{50}$ (ft)	2.6
W_s=D+(2/3)L_s (ft)	18
D_{50} (Class 4, in)	14

C. Section 404

NATIONWIDE PERMIT 12

Utility Line Activities

Effective Date: March 19, 2012
(NWP Final Notice, 77 FR 10184)

Utility Line Activities. Activities required for the construction, maintenance, repair, and removal of utility lines and associated facilities in waters of the United States, provided the activity does not result in the loss of greater than 1/2-acre of waters of the United States for each single and complete project.

Utility lines: This NWP authorizes the construction, maintenance, or repair of utility lines, including outfall and intake structures, and the associated excavation, backfill, or bedding for the utility lines, in all waters of the United States, provided there is no change in pre-construction contours. A "utility line" is defined as any pipe or pipeline for the transportation of any gaseous, liquid, liquescent, or slurry substance, for any purpose, and any cable, line, or wire for the transmission for any purpose of electrical energy, telephone, and telegraph messages, and radio and television communication. The term "utility line" does not include activities that drain a water of the United States, such as drainage tile or french drains, but it does apply to pipes conveying drainage from another area.

Material resulting from trench excavation may be temporarily sidecast into waters of the United States for no more than three months, provided the material is not placed in such a manner that it is dispersed by currents or other forces. The district engineer may extend the period of temporary side casting for no more than a total of 180 days, where appropriate. In wetlands, the top 6 to 12 inches of the trench should normally be backfilled with topsoil from the trench. The trench cannot be constructed or backfilled in such a manner as to drain waters of the United States (e.g., backfilling with extensive gravel layers, creating a french drain effect). Any exposed slopes and stream banks must be stabilized immediately upon completion of the utility line crossing of each waterbody.

Utility line substations: This NWP authorizes the construction, maintenance, or expansion of substation facilities associated with a power line or utility line in non-tidal waters of the United States, provided the activity, in combination with all other activities included in one single and complete project, does not result in the loss of greater than 1/2-acre of waters of the United States. This NWP does not authorize discharges into non-tidal wetlands adjacent to tidal waters of the United States to construct, maintain, or expand substation facilities.

Foundations for overhead utility line towers, poles, and anchors: This NWP authorizes the construction or maintenance of foundations for overhead utility line towers, poles, and anchors in all waters of the United States, provided the foundations are the minimum size necessary and separate footings for each tower leg (rather than a larger single pad) are used where feasible.

Access roads: This NWP authorizes the construction of access roads for the construction and maintenance of utility lines, including overhead power lines and utility line substations, in non-tidal waters of the United States, provided the activity, in combination with all other activities included in one single and complete project, does not cause the loss of greater than 1/2-acre of non-tidal waters of the United States. This NWP does not authorize discharges into non-tidal wetlands adjacent to tidal waters for access roads. Access roads must be the minimum width necessary (see Note 2, below). Access roads must be constructed so that the length of the road minimizes any adverse effects on waters of the United States and must be as near as possible to pre-construction contours and elevations (e.g., at grade corduroy roads or geotextile/gravel

roads). Access roads constructed above pre-construction contours and elevations in waters of the United States must be properly bridged or culverted to maintain surface flows.

This NWP may authorize utility lines in or affecting navigable waters of the United States even if there is no associated discharge of dredged or fill material (See 33 CFR Part 322). Overhead utility lines constructed over section 10 waters and utility lines that are routed in or under section 10 waters without a discharge of dredged or fill material require a section 10 permit.

This NWP also authorizes temporary structures, fills, and work necessary to conduct the utility line activity. Appropriate measures must be taken to maintain normal downstream flows and minimize flooding to the maximum extent practicable, when temporary structures, work, and discharges, including cofferdams, are necessary for construction activities, access fills, or dewatering of construction sites. Temporary fills must consist of materials, and be placed in a manner, that will not be eroded by expected high flows. Temporary fills must be removed in their entirety and the affected areas returned to pre-construction elevations. The areas affected by temporary fills must be revegetated, as appropriate.

Notification: The permittee must submit a pre-construction notification to the district engineer prior to commencing the activity if any of the following criteria are met: (1) the activity involves mechanized land clearing in a forested wetland for the utility line right-of-way; (2) a section 10 permit is required; (3) the utility line in waters of the United States, excluding overhead lines, exceeds 500 feet; (4) the utility line is placed within a jurisdictional area (i.e., water of the United States), and it runs parallel to or along a stream bed that is within that jurisdictional area; (5) discharges that result in the loss of greater than 1/10-acre of waters of the United States; (6) permanent access roads are constructed above grade in waters of the United States for a distance of more than 500 feet; or (7) permanent access roads are constructed in waters of the United States with impervious materials. (See general condition 31.) (Sections 10 and 404)

Note 1: Where the proposed utility line is constructed or installed in navigable waters of the United States (i.e., section 10 waters) within the coastal United States, the Great Lakes, and United States territories, copies of the pre-construction notification and NWP verification will be sent by the Corps to the National Oceanic and Atmospheric Administration (NOAA), National Ocean Service (NOS), for charting the utility line to protect navigation.

Note 2: Access roads used for both construction and maintenance may be authorized, provided they meet the terms and conditions of this NWP. Access roads used solely for construction of the utility line must be removed upon completion of the work, in accordance with the requirements for temporary fills.

Note 3: Pipes or pipelines used to transport gaseous, liquid, liquescent, or slurry substances over navigable waters of the United States are considered to be bridges, not utility lines, and may require a permit from the U.S. Coast Guard pursuant to Section 9 of the Rivers and Harbors Act of 1899. However, any discharges of dredged or fill material into waters of the United States associated with such pipelines will require a section 404 permit (see NWP 15).

Note 4: For overhead utility lines authorized by this NWP, a copy of the PCN and NWP verification will be provided to the Department of Defense Siting Clearinghouse, which will evaluate potential effects on military activities.

Nationwide Permit General Conditions

Note: To qualify for NWP authorization, the prospective permittee must comply with the following general conditions, as applicable, in addition to any regional or case-specific conditions imposed by the division engineer or district engineer. Prospective permittees should contact the appropriate Corps district office to determine if regional conditions have been imposed on an NWP. Prospective permittees should also contact the appropriate Corps district office to determine the status of Clean Water Act Section 401 water quality certification and/or Coastal Zone Management Act consistency for an NWP. Every person who may wish to obtain permit authorization under one or more NWPs, or who is currently relying on an existing or prior permit authorization under one or more NWPs, has been and is on notice that all of the provisions of 33 CFR §§ 330.1 through 330.6 apply to every NWP authorization. Note especially 33 CFR § 330.5 relating to the modification, suspension, or revocation of any NWP authorization.

1. Navigation. (a) No activity may cause more than a minimal adverse effect on navigation.

(b) Any safety lights and signals prescribed by the U.S. Coast Guard, through regulations or otherwise, must be installed and maintained at the permittee's expense on authorized facilities in navigable waters of the United States.

(c) The permittee understands and agrees that, if future operations by the United States require the removal, relocation, or other alteration, of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the permittee will be required, upon due notice from the Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

2. Aquatic Life Movements. No activity may substantially disrupt the necessary life cycle movements of those species of aquatic life indigenous to the waterbody, including those species that normally migrate through the area, unless the activity's primary purpose is to impound water. All permanent and temporary crossings of waterbodies shall be suitably culverted, bridged, or otherwise designed and constructed to maintain low flows to sustain the movement of those aquatic species.

3. Spawning Areas. Activities in spawning areas during spawning seasons must be avoided to the maximum extent practicable. Activities that result in the physical destruction (e.g., through excavation, fill, or downstream smothering by substantial turbidity) of an important spawning area are not authorized.

4. Migratory Bird Breeding Areas. Activities in waters of the United States that serve as breeding areas for migratory birds must be avoided to the maximum extent practicable.

5. Shellfish Beds. No activity may occur in areas of concentrated shellfish populations, unless the activity is directly related to a shellfish harvesting activity authorized by NWPs 4 and 48, or is a shellfish seeding or habitat restoration activity authorized by NWP 27.

6. Suitable Material. No activity may use unsuitable material (e.g., trash, debris, car bodies, asphalt, etc.). Material used for construction or discharged must be free from toxic pollutants in toxic amounts (see Section 307 of the Clean Water Act).

7. Water Supply Intakes. No activity may occur in the proximity of a public water supply intake, except where the activity is for the repair or improvement of public water supply intake structures or adjacent bank stabilization.

8. Adverse Effects From Impoundments. If the activity creates an impoundment of water, adverse effects to the aquatic system due to accelerating the passage of water, and/or restricting its flow must be minimized to the maximum extent practicable.

9. Management of Water Flows. To the maximum extent practicable, the pre-construction course, condition, capacity, and location of open waters must be maintained for each activity, including stream channelization and storm water management activities, except as provided below. The activity must be constructed to withstand expected high flows. The activity must not restrict or impede the passage of normal or high flows, unless the primary purpose of the activity is to impound water or manage high flows. The activity may alter the pre-construction course, condition, capacity, and location of open waters if it benefits the aquatic environment (e.g., stream restoration or relocation activities).

10. Fills Within 100-Year Floodplains. The activity must comply with applicable FEMA-approved state or local floodplain management requirements.

11. Equipment. Heavy equipment working in wetlands or mudflats must be placed on mats, or other measures must be taken to minimize soil disturbance.

12. Soil Erosion and Sediment Controls. Appropriate soil erosion and sediment controls must be used and maintained in effective operating condition during construction, and all exposed soil and other fills, as well as any work below the ordinary high water mark or high tide line, must be permanently stabilized at the earliest practicable date. Permittees are encouraged to perform work within waters of the United States during periods of low-flow or no-flow.

13. Removal of Temporary Fills. Temporary fills must be removed in their entirety and the affected areas returned to pre-construction elevations. The affected areas must be revegetated, as appropriate.

14. Proper Maintenance. Any authorized structure or fill shall be properly maintained, including maintenance to ensure public safety and compliance with applicable NWP general conditions, as well as any activity-specific conditions added by the district engineer to an NWP authorization.

15. Single and Complete Project. The activity must be a single and complete project. The same NWP cannot be used more than once for the same single and complete project.

16. Wild and Scenic Rivers. No activity may occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a "study river" for possible inclusion in the system while the river is in an official study status, unless the appropriate Federal agency with direct management responsibility for such river, has determined in writing that the proposed activity will not adversely affect the Wild and Scenic River designation or study status. Information on Wild and Scenic Rivers may be obtained from the appropriate Federal land management agency responsible for the designated Wild and Scenic River or study river (e.g., National Park Service, U.S. Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service).

17. Tribal Rights. No activity or its operation may impair reserved tribal rights, including, but not limited to, reserved water rights and treaty fishing and hunting rights.

18. Endangered Species. (a) No activity is authorized under any NWP which is likely to directly or indirectly jeopardize the continued existence of a threatened or endangered species or a species proposed for such designation, as identified under the Federal Endangered Species Act (ESA), or which will directly or indirectly destroy or adversely modify the critical habitat of such species. No activity is authorized under any NWP which "may affect" a listed species or critical habitat, unless Section 7 consultation addressing the effects of the proposed activity has been completed.

(b) Federal agencies should follow their own procedures for complying with the requirements of the ESA. Federal permittees must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements. The district engineer will review the documentation and determine whether it is sufficient to address ESA compliance for the NWP activity, or whether additional ESA consultation is necessary.

(c) Non-federal permittees must submit a pre-construction notification to the district engineer if any listed species or designated critical habitat might be affected or is in the vicinity of the project, or if the project is located in designated critical habitat, and shall not begin work on the activity until notified by the district engineer that the requirements of the ESA have been satisfied and that the activity is authorized. For activities that might affect Federally-listed endangered or threatened species or designated critical habitat, the pre-construction notification must include the name(s) of the endangered or threatened species that might be affected by the proposed work or that utilize the designated critical habitat that might be affected by the proposed work. The district engineer will determine whether the proposed activity "may affect" or will have "no effect" to listed species and designated critical habitat and will notify the non-Federal applicant of the Corps' determination within 45 days of receipt of a complete pre-construction notification. In cases where the non-Federal applicant has identified listed species or critical habitat that might be affected or is in the vicinity of the project, and has so notified the Corps, the applicant shall not begin work until the Corps has provided notification the proposed activities will have "no effect" on listed species or critical habitat, or until Section 7 consultation has been completed. If the non-Federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from the Corps.

(d) As a result of formal or informal consultation with the FWS or NMFS the district engineer may add species-specific regional endangered species conditions to the NWPs.

(e) Authorization of an activity by a NWP does not authorize the "take" of a threatened or endangered species as defined under the ESA. In the absence of separate authorization (e.g., an

ESA Section 10 Permit, a Biological Opinion with "incidental take" provisions, etc.) from the U.S. FWS or the NMFS, The Endangered Species Act prohibits any person subject to the jurisdiction of the United States to take a listed species, where "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. The word "harm" in the definition of "take" means an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering.

(f) Information on the location of threatened and endangered species and their critical habitat can be obtained directly from the offices of the U.S. FWS and NMFS or their world wide web pages at http://www.fws.gov/ or http://www.fws.gov/ipac and http://www.noaa.gov/fisheries.html respectively.

19. Migratory Birds and Bald and Golden Eagles. The permittee is responsible for obtaining any "take" permits required under the U.S. Fish and Wildlife Service's regulations governing compliance with the Migratory Bird Treaty Act or the Bald and Golden Eagle Protection Act. The permittee should contact the appropriate local office of the U.S. Fish and Wildlife Service to determine if such "take" permits are required for a particular activity.

20. Historic Properties. (a) In cases where the district engineer determines that the activity may affect properties listed, or eligible for listing, in the National Register of Historic Places, the activity is not authorized, until the requirements of Section 106 of the National Historic Preservation Act (NHPA) have been satisfied.

(b) Federal permittees should follow their own procedures for complying with the requirements of Section 106 of the National Historic Preservation Act. Federal permittees must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements. The district engineer will review the documentation and determine whether it is sufficient to address section 106 compliance for the NWP activity, or whether additional section 106 consultation is necessary.

(c) Non-federal permittees must submit a pre-construction notification to the district engineer if the authorized activity may have the potential to cause effects to any historic properties listed on, determined to be eligible for listing on, or potentially eligible for listing on the National Register of Historic Places, including previously unidentified properties. For such activities, the pre-construction notification must state which historic properties may be affected by the proposed work or include a vicinity map indicating the location of the historic properties or the potential for the presence of historic properties. Assistance regarding information on the location of or potential for the presence of historic resources can be sought from the State Historic Preservation Officer or Tribal Historic Preservation Officer, as appropriate, and the National Register of Historic Places (see 33 CFR 330.4(g)). When reviewing pre-construction notifications, district engineers will comply with the current procedures for addressing the requirements of Section 106 of the National Historic Preservation Act. The district engineer shall make a reasonable and good faith effort to carry out appropriate identification efforts, which may include background research, consultation, oral history interviews, sample field investigation, and field survey. Based on the information submitted and these efforts, the district engineer shall determine whether the proposed activity has the potential to cause an effect on the historic properties. Where the non-Federal applicant has identified historic properties on which the

activity may have the potential to cause effects and so notified the Corps, the non-Federal applicant shall not begin the activity until notified by the district engineer either that the activity has no potential to cause effects or that consultation under Section 106 of the NHPA has been completed.

(d) The district engineer will notify the prospective permittee within 45 days of receipt of a complete pre-construction notification whether NHPA Section 106 consultation is required. Section 106 consultation is not required when the Corps determines that the activity does not have the potential to cause effects on historic properties (see 36 CFR §800.3(a)). If NHPA section 106 consultation is required and will occur, the district engineer will notify the non-Federal applicant that he or she cannot begin work until Section 106 consultation is completed. If the non-Federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from the Corps.

(e) Prospective permittees should be aware that section 110k of the NHPA (16 U.S.C. 470h-2(k)) prevents the Corps from granting a permit or other assistance to an applicant who, with intent to avoid the requirements of Section 106 of the NHPA, has intentionally significantly adversely affected a historic property to which the permit would relate, or having legal power to prevent it, allowed such significant adverse effect to occur, unless the Corps, after consultation with the Advisory Council on Historic Preservation (ACHP), determines that circumstances justify granting such assistance despite the adverse effect created or permitted by the applicant. If circumstances justify granting the assistance, the Corps is required to notify the ACHP and provide documentation specifying the circumstances, the degree of damage to the integrity of any historic properties affected, and proposed mitigation. This documentation must include any views obtained from the applicant, SHPO/THPO, appropriate Indian tribes if the undertaking occurs on or affects historic properties on tribal lands or affects properties of interest to those tribes, and other parties known to have a legitimate interest in the impacts to the permitted activity on historic properties.

21. Discovery of Previously Unknown Remains and Artifacts. If you discover any previously unknown historic, cultural or archeological remains and artifacts while accomplishing the activity authorized by this permit, you must immediately notify the district engineer of what you have found, and to the maximum extent practicable, avoid construction activities that may affect the remains and artifacts until the required coordination has been completed. The district engineer will initiate the Federal, Tribal and state coordination required to determine if the items or remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

22. Designated Critical Resource Waters. Critical resource waters include, NOAA-managed marine sanctuaries and marine monuments, and National Estuarine Research Reserves. The district engineer may designate, after notice and opportunity for public comment, additional waters officially designated by a state as having particular environmental or ecological significance, such as outstanding national resource waters or state natural heritage sites. The district engineer may also designate additional critical resource waters after notice and opportunity for public comment.

(a) Discharges of dredged or fill material into waters of the United States are not authorized by NWPs 7, 12, 14, 16, 17, 21, 29, 31, 35, 39, 40, 42, 43, 44, 49, 50, 51, and 52 for

any activity within, or directly affecting, critical resource waters, including wetlands adjacent to such waters.

(b) For NWPs 3, 8, 10, 13, 15, 18, 19, 22, 23, 25, 27, 28, 30, 33, 34, 36, 37, and 38, notification is required in accordance with general condition 31, for any activity proposed in the designated critical resource waters including wetlands adjacent to those waters. The district engineer may authorize activities under these NWPs only after it is determined that the impacts to the critical resource waters will be no more than minimal.

23. Mitigation. The district engineer will consider the following factors when determining appropriate and practicable mitigation necessary to ensure that adverse effects on the aquatic environment are minimal:

(a) The activity must be designed and constructed to avoid and minimize adverse effects, both temporary and permanent, to waters of the United States to the maximum extent practicable at the project site (i.e., on site).

(b) Mitigation in all its forms (avoiding, minimizing, rectifying, reducing, or compensating for resource losses) will be required to the extent necessary to ensure that the adverse effects to the aquatic environment are minimal.

(c) Compensatory mitigation at a minimum one-for-one ratio will be required for all wetland losses that exceed 1/10-acre and require pre-construction notification, unless the district engineer determines in writing that either some other form of mitigation would be more environmentally appropriate or the adverse effects of the proposed activity are minimal, and provides a project-specific waiver of this requirement. For wetland losses of 1/10-acre or less that require pre-construction notification, the district engineer may determine on a case-by-case basis that compensatory mitigation is required to ensure that the activity results in minimal adverse effects on the aquatic environment. Compensatory mitigation projects provided to offset losses of aquatic resources must comply with the applicable provisions of 33 CFR part 332.

(1) The prospective permittee is responsible for proposing an appropriate compensatory mitigation option if compensatory mitigation is necessary to ensure that the activity results in minimal adverse effects on the aquatic environment.

(2) Since the likelihood of success is greater and the impacts to potentially valuable uplands are reduced, wetland restoration should be the first compensatory mitigation option considered.

(3) If permittee-responsible mitigation is the proposed option, the prospective permittee is responsible for submitting a mitigation plan. A conceptual or detailed mitigation plan may be used by the district engineer to make the decision on the NWP verification request, but a final mitigation plan that addresses the applicable requirements of 33 CFR 332.4(c)(2) – (14) must be approved by the district engineer before the permittee begins work in waters of the United States, unless the district engineer determines that prior approval of the final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation (see 33 CFR 332.3(k)(3)).

(4) If mitigation bank or in-lieu fee program credits are the proposed option, the mitigation plan only needs to address the baseline conditions at the impact site and the number of credits to be provided.

(5) Compensatory mitigation requirements (e.g., resource type and amount to be provided as compensatory mitigation, site protection, ecological performance standards, monitoring

requirements) may be addressed through conditions added to the NWP authorization, instead of components of a compensatory mitigation plan.

(d) For losses of streams or other open waters that require pre-construction notification, the district engineer may require compensatory mitigation, such as stream rehabilitation, enhancement, or preservation, to ensure that the activity results in minimal adverse effects on the aquatic environment.

(e) Compensatory mitigation will not be used to increase the acreage losses allowed by the acreage limits of the NWPs. For example, if an NWP has an acreage limit of 1/2-acre, it cannot be used to authorize any project resulting in the loss of greater than 1/2-acre of waters of the United States, even if compensatory mitigation is provided that replaces or restores some of the lost waters. However, compensatory mitigation can and should be used, as necessary, to ensure that a project already meeting the established acreage limits also satisfies the minimal impact requirement associated with the NWPs.

(f) Compensatory mitigation plans for projects in or near streams or other open waters will normally include a requirement for the restoration or establishment, maintenance, and legal protection (e.g., conservation easements) of riparian areas next to open waters. In some cases, riparian areas may be the only compensatory mitigation required. Riparian areas should consist of native species. The width of the required riparian area will address documented water quality or aquatic habitat loss concerns. Normally, the riparian area will be 25 to 50 feet wide on each side of the stream, but the district engineer may require slightly wider riparian areas to address documented water quality or habitat loss concerns. If it is not possible to establish a riparian area on both sides of a stream, or if the waterbody is a lake or coastal waters, then restoring or establishing a riparian area along a single bank or shoreline may be sufficient. Where both wetlands and open waters exist on the project site, the district engineer will determine the appropriate compensatory mitigation (e.g., riparian areas and/or wetlands compensation) based on what is best for the aquatic environment on a watershed basis. In cases where riparian areas are determined to be the most appropriate form of compensatory mitigation, the district engineer may waive or reduce the requirement to provide wetland compensatory mitigation for wetland losses.

(g) Permittees may propose the use of mitigation banks, in-lieu fee programs, or separate permittee-responsible mitigation. For activities resulting in the loss of marine or estuarine resources, permittee-responsible compensatory mitigation may be environmentally preferable if there are no mitigation banks or in-lieu fee programs in the area that have marine or estuarine credits available for sale or transfer to the permittee. For permittee-responsible mitigation, the special conditions of the NWP verification must clearly indicate the party or parties responsible for the implementation and performance of the compensatory mitigation project, and, if required, its long-term management.

(h) Where certain functions and services of waters of the United States are permanently adversely affected, such as the conversion of a forested or scrub-shrub wetland to a herbaceous wetland in a permanently maintained utility line right-of-way, mitigation may be required to reduce the adverse effects of the project to the minimal level.

24. Safety of Impoundment Structures. To ensure that all impoundment structures are safely designed, the district engineer may require non-Federal applicants to demonstrate that the structures comply with established state dam safety criteria or have been designed by qualified persons. The district engineer may also require documentation that the design has been

independently reviewed by similarly qualified persons, and appropriate modifications made to ensure safety.

25. Water Quality. Where States and authorized Tribes, or EPA where applicable, have not previously certified compliance of an NWP with CWA Section 401, individual 401 Water Quality Certification must be obtained or waived (see 33 CFR 330.4(c)). The district engineer or State or Tribe may require additional water quality management measures to ensure that the authorized activity does not result in more than minimal degradation of water quality.

26. Coastal Zone Management. In coastal states where an NWP has not previously received a state coastal zone management consistency concurrence, an individual state coastal zone management consistency concurrence must be obtained, or a presumption of concurrence must occur (see 33 CFR 330.4(d)). The district engineer or a State may require additional measures to ensure that the authorized activity is consistent with state coastal zone management requirements.

27. Regional and Case-By-Case Conditions. The activity must comply with any regional conditions that may have been added by the Division Engineer (see 33 CFR 330.4(e)) and with any case specific conditions added by the Corps or by the state, Indian Tribe, or U.S. EPA in its section 401 Water Quality Certification, or by the state in its Coastal Zone Management Act consistency determination.

28. Use of Multiple Nationwide Permits. The use of more than one NWP for a single and complete project is prohibited, except when the acreage loss of waters of the United States authorized by the NWPs does not exceed the acreage limit of the NWP with the highest specified acreage limit. For example, if a road crossing over tidal waters is constructed under NWP 14, with associated bank stabilization authorized by NWP 13, the maximum acreage loss of waters of the United States for the total project cannot exceed 1/3-acre.

29. Transfer of Nationwide Permit Verifications. If the permittee sells the property associated with a nationwide permit verification, the permittee may transfer the nationwide permit verification to the new owner by submitting a letter to the appropriate Corps district office to validate the transfer. A copy of the nationwide permit verification must be attached to the letter, and the letter must contain the following statement and signature:

"When the structures or work authorized by this nationwide permit are still in existence at the time the property is transferred, the terms and conditions of this nationwide permit, including any special conditions, will continue to be binding on the new owner(s) of the property. To validate the transfer of this nationwide permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below."

_____

(Transferee)

_____

(Date)

30. Compliance Certification. Each permittee who receives an NWP verification letter from the Corps must provide a signed certification documenting completion of the authorized activity and any required compensatory mitigation. The success of any required permittee-responsible mitigation, including the achievement of ecological performance standards, will be addressed separately by the district engineer. The Corps will provide the permittee the certification document with the NWP verification letter. The certification document will include:

(a) A statement that the authorized work was done in accordance with the NWP authorization, including any general, regional, or activity-specific conditions;

(b) A statement that the implementation of any required compensatory mitigation was completed in accordance with the permit conditions. If credits from a mitigation bank or in-lieu fee program are used to satisfy the compensatory mitigation requirements, the certification must include the documentation required by 33 CFR 332.3(l)(3) to confirm that the permittee secured the appropriate number and resource type of credits; and

(c) The signature of the permittee certifying the completion of the work and mitigation.

31. Pre-Construction Notification. (a) Timing. Where required by the terms of the NWP, the prospective permittee must notify the district engineer by submitting a pre-construction notification (PCN) as early as possible. The district engineer must determine if the PCN is complete within 30 calendar days of the date of receipt and, if the PCN is determined to be incomplete, notify the prospective permittee within that 30 day period to request the additional information necessary to make the PCN complete. The request must specify the information needed to make the PCN complete. As a general rule, district engineers will request additional information necessary to make the PCN complete only once. However, if the prospective permittee does not provide all of the requested information, then the district engineer will notify the prospective permittee that the PCN is still incomplete and the PCN review process will not commence until all of the requested information has been received by the district engineer. The prospective permittee shall not begin the activity until either:

(1) He or she is notified in writing by the district engineer that the activity may proceed under the NWP with any special conditions imposed by the district or division engineer; or

(2) 45 calendar days have passed from the district engineer's receipt of the complete PCN and the prospective permittee has not received written notice from the district or division engineer. However, if the permittee was required to notify the Corps pursuant to general condition 18 that listed species or critical habitat might be affected or in the vicinity of the project, or to notify the Corps pursuant to general condition 20 that the activity may have the potential to cause effects to historic properties, the permittee cannot begin the activity until receiving written notification from the Corps that there is "no effect" on listed species or "no potential to cause effects" on historic properties, or that any consultation required under Section 7 of the Endangered Species Act (see 33 CFR 330.4(f)) and/or Section 106 of the National Historic Preservation (see 33 CFR 330.4(g)) has been completed. Also, work cannot begin under NWPs 21, 49, or 50 until the permittee has received written approval from the Corps. If the proposed activity requires a written waiver to exceed specified limits of an NWP, the permittee may not begin the activity until the district engineer issues the waiver. If the district or division engineer notifies the permittee in writing that an individual permit is required within 45 calendar days of receipt of a complete PCN, the permittee cannot begin the activity until an individual

permit has been obtained. Subsequently, the permittee's right to proceed under the NWP may be modified, suspended, or revoked only in accordance with the procedure set forth in 33 CFR 330.5(d)(2).

(b) Contents of Pre-Construction Notification: The PCN must be in writing and include the following information:

(1) Name, address and telephone numbers of the prospective permittee;

(2) Location of the proposed project;

(3) A description of the proposed project; the project's purpose; direct and indirect adverse environmental effects the project would cause, including the anticipated amount of loss of water of the United States expected to result from the NWP activity, in acres, linear feet, or other appropriate unit of measure; any other NWP(s), regional general permit(s), or individual permit(s) used or intended to be used to authorize any part of the proposed project or any related activity. The description should be sufficiently detailed to allow the district engineer to determine that the adverse effects of the project will be minimal and to determine the need for compensatory mitigation. Sketches should be provided when necessary to show that the activity complies with the terms of the NWP. (Sketches usually clarify the project and when provided results in a quicker decision. Sketches should contain sufficient detail to provide an illustrative description of the proposed activity (e.g., a conceptual plan), but do not need to be detailed engineering plans);

(4) The PCN must include a delineation of wetlands, other special aquatic sites, and other waters, such as lakes and ponds, and perennial, intermittent, and ephemeral streams, on the project site. Wetland delineations must be prepared in accordance with the current method required by the Corps. The permittee may ask the Corps to delineate the special aquatic sites and other waters on the project site, but there may be a delay if the Corps does the delineation, especially if the project site is large or contains many waters of the United States. Furthermore, the 45 day period will not start until the delineation has been submitted to or completed by the Corps, as appropriate;

(5) If the proposed activity will result in the loss of greater than 1/10-acre of wetlands and a PCN is required, the prospective permittee must submit a statement describing how the mitigation requirement will be satisfied, or explaining why the adverse effects are minimal and why compensatory mitigation should not be required. As an alternative, the prospective permittee may submit a conceptual or detailed mitigation plan.

(6) If any listed species or designated critical habitat might be affected or is in the vicinity of the project, or if the project is located in designated critical habitat, for non-Federal applicants the PCN must include the name(s) of those endangered or threatened species that might be affected by the proposed work or utilize the designated critical habitat that may be affected by the proposed work. Federal applicants must provide documentation demonstrating compliance with the Endangered Species Act; and

(7) For an activity that may affect a historic property listed on, determined to be eligible for listing on, or potentially eligible for listing on, the National Register of Historic Places, for non-Federal applicants the PCN must state which historic property may be affected by the proposed work or include a vicinity map indicating the location of the historic property. Federal applicants must provide documentation demonstrating compliance with Section 106 of the National Historic Preservation Act.

(c) Form of Pre-Construction Notification: The standard individual permit application form (Form ENG 4345) may be used, but the completed application form must clearly indicate

that it is a PCN and must include all of the information required in paragraphs (b)(1) through (7) of this general condition. A letter containing the required information may also be used.

(d) Agency Coordination: (1) The district engineer will consider any comments from Federal and state agencies concerning the proposed activity's compliance with the terms and conditions of the NWPs and the need for mitigation to reduce the project's adverse environmental effects to a minimal level.

(2) For all NWP activities that require pre-construction notification and result in the loss of greater than 1/2-acre of waters of the United States, for NWP 21, 29, 39, 40, 42, 43, 44, 50, 51, and 52 activities that require pre-construction notification and will result in the loss of greater than 300 linear feet of intermittent and ephemeral stream bed, and for all NWP 48 activities that require pre-construction notification, the district engineer will immediately provide (e.g., via e-mail, facsimile transmission, overnight mail, or other expeditious manner) a copy of the complete PCN to the appropriate Federal or state offices (U.S. FWS, state natural resource or water quality agency, EPA, State Historic Preservation Officer (SHPO) or Tribal Historic Preservation Office (THPO), and, if appropriate, the NMFS). With the exception of NWP 37, these agencies will have 10 calendar days from the date the material is transmitted to telephone or fax the district engineer notice that they intend to provide substantive, site-specific comments. The comments must explain why the agency believes the adverse effects will be more than minimal. If so contacted by an agency, the district engineer will wait an additional 15 calendar days before making a decision on the pre-construction notification. The district engineer will fully consider agency comments received within the specified time frame concerning the proposed activity's compliance with the terms and conditions of the NWPs, including the need for mitigation to ensure the net adverse environmental effects to the aquatic environment of the proposed activity are minimal. The district engineer will provide no response to the resource agency, except as provided below. The district engineer will indicate in the administrative record associated with each pre-construction notification that the resource agencies' concerns were considered. For NWP 37, the emergency watershed protection and rehabilitation activity may proceed immediately in cases where there is an unacceptable hazard to life or a significant loss of property or economic hardship will occur. The district engineer will consider any comments received to decide whether the NWP 37 authorization should be modified, suspended, or revoked in accordance with the procedures at 33 CFR 330.5.

(3) In cases of where the prospective permittee is not a Federal agency, the district engineer will provide a response to NMFS within 30 calendar days of receipt of any Essential Fish Habitat conservation recommendations, as required by Section 305(b)(4)(B) of the Magnuson-Stevens Fishery Conservation and Management Act.

(4) Applicants are encouraged to provide the Corps with either electronic files or multiple copies of pre-construction notifications to expedite agency coordination.

D. District Engineer's Decision

1. In reviewing the PCN for the proposed activity, the district engineer will determine whether the activity authorized by the NWP will result in more than minimal individual or cumulative adverse environmental effects or may be contrary to the public interest. For a linear project, this determination will include an evaluation of the individual crossings to determine whether they individually satisfy the terms and conditions of the NWP(s), as well as the cumulative effects caused by all of the crossings authorized by NWP. If an applicant requests a

waiver of the 300 linear foot limit on impacts to intermittent or ephemeral streams or of an otherwise applicable limit, as provided for in NWPs 13, 21, 29, 36, 39, 40, 42, 43, 44, 50, 51 or 52, the district engineer will only grant the waiver upon a written determination that the NWP activity will result in minimal adverse effects. When making minimal effects determinations the district engineer will consider the direct and indirect effects caused by the NWP activity. The district engineer will also consider site specific factors, such as the environmental setting in the vicinity of the NWP activity, the type of resource that will be affected by the NWP activity, the functions provided by the aquatic resources that will be affected by the NWP activity, the degree or magnitude to which the aquatic resources perform those functions, the extent that aquatic resource functions will be lost as a result of the NWP activity (e.g., partial or complete loss), the duration of the adverse effects (temporary or permanent), the importance of the aquatic resource functions to the region (e.g., watershed or ecoregion), and mitigation required by the district engineer. If an appropriate functional assessment method is available and practicable to use, that assessment method may be used by the district engineer to assist in the minimal adverse effects determination. The district engineer may add case-specific special conditions to the NWP authorization to address site-specific environmental concerns.

2. If the proposed activity requires a PCN and will result in a loss of greater than 1/10-acre of wetlands, the prospective permittee should submit a mitigation proposal with the PCN. Applicants may also propose compensatory mitigation for projects with smaller impacts. The district engineer will consider any proposed compensatory mitigation the applicant has included in the proposal in determining whether the net adverse environmental effects to the aquatic environment of the proposed activity are minimal. The compensatory mitigation proposal may be either conceptual or detailed. If the district engineer determines that the activity complies with the terms and conditions of the NWP and that the adverse effects on the aquatic environment are minimal, after considering mitigation, the district engineer will notify the permittee and include any activity-specific conditions in the NWP verification the district engineer deems necessary. Conditions for compensatory mitigation requirements must comply with the appropriate provisions at 33 CFR 332.3(k). The district engineer must approve the final mitigation plan before the permittee commences work in waters of the United States, unless the district engineer determines that prior approval of the final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation. If the prospective permittee elects to submit a compensatory mitigation plan with the PCN, the district engineer will expeditiously review the proposed compensatory mitigation plan. The district engineer must review the proposed compensatory mitigation plan within 45 calendar days of receiving a complete PCN and determine whether the proposed mitigation would ensure no more than minimal adverse effects on the aquatic environment. If the net adverse effects of the project on the aquatic environment (after consideration of the compensatory mitigation proposal) are determined by the district engineer to be minimal, the district engineer will provide a timely written response to the applicant. The response will state that the project can proceed under the terms and conditions of the NWP, including any activity-specific conditions added to the NWP authorization by the district engineer.

3. If the district engineer determines that the adverse effects of the proposed work are more than minimal, then the district engineer will notify the applicant either: (a) That the project does not qualify for authorization under the NWP and instruct the applicant on the procedures to

seek authorization under an individual permit; (b) that the project is authorized under the NWP subject to the applicant's submission of a mitigation plan that would reduce the adverse effects on the aquatic environment to the minimal level; or (c) that the project is authorized under the NWP with specific modifications or conditions. Where the district engineer determines that mitigation is required to ensure no more than minimal adverse effects occur to the aquatic environment, the activity will be authorized within the 45-day PCN period, with activity-specific conditions that state the mitigation requirements. The authorization will include the necessary conceptual or detailed mitigation or a requirement that the applicant submit a mitigation plan that would reduce the adverse effects on the aquatic environment to the minimal level. When mitigation is required, no work in waters of the United States may occur until the district engineer has approved a specific mitigation plan or has determined that prior approval of a final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation.

E. Further Information

1. District Engineers have authority to determine if an activity complies with the terms and conditions of an NWP.

2. NWPs do not obviate the need to obtain other federal, state, or local permits, approvals, or authorizations required by law.

3. NWPs do not grant any property rights or exclusive privileges.

4. NWPs do not authorize any injury to the property or rights of others.

5. NWPs do not authorize interference with any existing or proposed Federal project.

F. Definitions

Best management practices (BMPs): Policies, practices, procedures, or structures implemented to mitigate the adverse environmental effects on surface water quality resulting from development. BMPs are categorized as structural or non-structural.

Compensatory mitigation: The restoration (re-establishment or rehabilitation), establishment (creation), enhancement, and/or in certain circumstances preservation of aquatic resources for the purposes of offsetting unavoidable adverse impacts which remain after all appropriate and practicable avoidance and minimization has been achieved.

Currently serviceable: Useable as is or with some maintenance, but not so degraded as to essentially require reconstruction.

Direct effects: Effects that are caused by the activity and occur at the same time and place.

Discharge: The term "discharge" means any discharge of dredged or fill material.

Enhancement: The manipulation of the physical, chemical, or biological characteristics of an aquatic resource to heighten, intensify, or improve a specific aquatic resource function(s). Enhancement results in the gain of selected aquatic resource function(s), but may also lead to a decline in other aquatic resource function(s). Enhancement does not result in a gain in aquatic resource area.

Ephemeral stream: An ephemeral stream has flowing water only during, and for a short duration after, precipitation events in a typical year. Ephemeral stream beds are located above the

water table year-round. Groundwater is not a source of water for the stream. Runoff from rainfall is the primary source of water for stream flow.

Establishment (creation): The manipulation of the physical, chemical, or biological characteristics present to develop an aquatic resource that did not previously exist at an upland site. Establishment results in a gain in aquatic resource area.

High Tide Line: The line of intersection of the land with the water's surface at the maximum height reached by a rising tide. The high tide line may be determined, in the absence of actual data, by a line of oil or scum along shore objects, a more or less continuous deposit of fine shell or debris on the foreshore or berm, other physical markings or characteristics, vegetation lines, tidal gages, or other suitable means that delineate the general height reached by a rising tide. The line encompasses spring high tides and other high tides that occur with periodic frequency but does not include storm surges in which there is a departure from the normal or predicted reach of the tide due to the piling up of water against a coast by strong winds such as those accompanying a hurricane or other intense storm.

Historic Property: Any prehistoric or historic district, site (including archaeological site), building, structure, or other object included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior. This term includes artifacts, records, and remains that are related to and located within such properties. The term includes properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization and that meet the National Register criteria (36 CFR part 60).

Independent utility: A test to determine what constitutes a single and complete non-linear project in the Corps regulatory program. A project is considered to have independent utility if it would be constructed absent the construction of other projects in the project area. Portions of a multi-phase project that depend upon other phases of the project do not have independent utility. Phases of a project that would be constructed even if the other phases were not built can be considered as separate single and complete projects with independent utility.

Indirect effects: Effects that are caused by the activity and are later in time or farther removed in distance, but are still reasonably foreseeable.

Intermittent stream: An intermittent stream has flowing water during certain times of the year, when groundwater provides water for stream flow. During dry periods, intermittent streams may not have flowing water. Runoff from rainfall is a supplemental source of water for stream flow.

Loss of waters of the United States: Waters of the United States that are permanently adversely affected by filling, flooding, excavation, or drainage because of the regulated activity. Permanent adverse effects include permanent discharges of dredged or fill material that change an aquatic area to dry land, increase the bottom elevation of a waterbody, or change the use of a waterbody. The acreage of loss of waters of the United States is a threshold measurement of the impact to jurisdictional waters for determining whether a project may qualify for an NWP; it is not a net threshold that is calculated after considering compensatory mitigation that may be used to offset losses of aquatic functions and services. The loss of stream bed includes the linear feet of stream bed that is filled or excavated. Waters of the United States temporarily filled, flooded, excavated, or drained, but restored to pre-construction contours and elevations after construction, are not included in the measurement of loss of waters of the United States. Impacts resulting from activities eligible for exemptions under Section 404(f) of the Clean Water Act are not considered when calculating the loss of waters of the United States.

Non-tidal wetland: A non-tidal wetland is a wetland that is not subject to the ebb and flow of tidal waters. The definition of a wetland can be found at 33 CFR 328.3(b). Non-tidal wetlands contiguous to tidal waters are located landward of the high tide line (i.e., spring high tide line).

Open water: For purposes of the NWPs, an open water is any area that in a year with normal patterns of precipitation has water flowing or standing above ground to the extent that an ordinary high water mark can be determined. Aquatic vegetation within the area of standing or flowing water is either non-emergent, sparse, or absent. Vegetated shallows are considered to be open waters. Examples of "open waters" include rivers, streams, lakes, and ponds.

Ordinary High Water Mark: An ordinary high water mark is a line on the shore established by the fluctuations of water and indicated by physical characteristics, or by other appropriate means that consider the characteristics of the surrounding areas (see 33 CFR 328.3(e)).

Perennial stream: A perennial stream has flowing water year-round during a typical year. The water table is located above the stream bed for most of the year. Groundwater is the primary source of water for stream flow. Runoff from rainfall is a supplemental source of water for stream flow.

Practicable: Available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes.

Pre-construction notification: A request submitted by the project proponent to the Corps for confirmation that a particular activity is authorized by nationwide permit. The request may be a permit application, letter, or similar document that includes information about the proposed work and its anticipated environmental effects. Pre-construction notification may be required by the terms and conditions of a nationwide permit, or by regional conditions. A pre-construction notification may be voluntarily submitted in cases where pre-construction notification is not required and the project proponent wants confirmation that the activity is authorized by nationwide permit.

Preservation: The removal of a threat to, or preventing the decline of, aquatic resources by an action in or near those aquatic resources. This term includes activities commonly associated with the protection and maintenance of aquatic resources through the implementation of appropriate legal and physical mechanisms. Preservation does not result in a gain of aquatic resource area or functions.

Re-establishment: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former aquatic resource. Re-establishment results in rebuilding a former aquatic resource and results in a gain in aquatic resource area and functions.

Rehabilitation: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural/historic functions to a degraded aquatic resource. Rehabilitation results in a gain in aquatic resource function, but does not result in a gain in aquatic resource area.

Restoration: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former or degraded aquatic resource. For the purpose of tracking net gains in aquatic resource area, restoration is divided into two categories: re-establishment and rehabilitation.

Riffle and pool complex: Riffle and pool complexes are special aquatic sites under the 404(b)(1) Guidelines. Riffle and pool complexes sometimes characterize steep gradient sections

of streams. Such stream sections are recognizable by their hydraulic characteristics. The rapid movement of water over a course substrate in riffles results in a rough flow, a turbulent surface, and high dissolved oxygen levels in the water. Pools are deeper areas associated with riffles. A slower stream velocity, a streaming flow, a smooth surface, and a finer substrate characterize pools.

Riparian areas: Riparian areas are lands adjacent to streams, lakes, and estuarine-marine shorelines. Riparian areas are transitional between terrestrial and aquatic ecosystems, through which surface and subsurface hydrology connects riverine, lacustrine, estuarine, and marine waters with their adjacent wetlands, non-wetland waters, or uplands. Riparian areas provide a variety of ecological functions and services and help improve or maintain local water quality. (See general condition 23.)

Shellfish seeding: The placement of shellfish seed and/or suitable substrate to increase shellfish production. Shellfish seed consists of immature individual shellfish or individual shellfish attached to shells or shell fragments (i.e., spat on shell). Suitable substrate may consist of shellfish shells, shell fragments, or other appropriate materials placed into waters for shellfish habitat.

Single and complete linear project: A linear project is a project constructed for the purpose of getting people, goods, or services from a point of origin to a terminal point, which often involves multiple crossings of one or more waterbodies at separate and distant locations. The term "single and complete project" is defined as that portion of the total linear project proposed or accomplished by one owner/developer or partnership or other association of owners/developers that includes all crossings of a single water of the United States (i.e., a single waterbody) at a specific location. For linear projects crossing a single or multiple waterbodies several times at separate and distant locations, each crossing is considered a single and complete project for purposes of NWP authorization. However, individual channels in a braided stream or river, or individual arms of a large, irregularly shaped wetland or lake, etc., are not separate waterbodies, and crossings of such features cannot be considered separately.

Single and complete non-linear project: For non-linear projects, the term "single and complete project" is defined at 33 CFR 330.2(i) as the total project proposed or accomplished by one owner/developer or partnership or other association of owners/developers. A single and complete non-linear project must have independent utility (see definition of "independent utility"). Single and complete non-linear projects may not be "piecemealed" to avoid the limits in an NWP authorization.

Stormwater management: Stormwater management is the mechanism for controlling stormwater runoff for the purposes of reducing downstream erosion, water quality degradation, and flooding and mitigating the adverse effects of changes in land use on the aquatic environment.

Stormwater management facilities: Stormwater management facilities are those facilities, including but not limited to, stormwater retention and detention ponds and best management practices, which retain water for a period of time to control runoff and/or improve the quality (i.e., by reducing the concentration of nutrients, sediments, hazardous substances and other pollutants) of stormwater runoff.

Stream bed: The substrate of the stream channel between the ordinary high water marks. The substrate may be bedrock or inorganic particles that range in size from clay to boulders. Wetlands contiguous to the stream bed, but outside of the ordinary high water marks, are not considered part of the stream bed.

Stream channelization: The manipulation of a stream's course, condition, capacity, or location that causes more than minimal interruption of normal stream processes. A channelized stream remains a water of the United States.

Structure: An object that is arranged in a definite pattern of organization. Examples of structures include, without limitation, any pier, boat dock, boat ramp, wharf, dolphin, weir, boom, breakwater, bulkhead, revetment, riprap, jetty, artificial island, artificial reef, permanent mooring structure, power transmission line, permanently moored floating vessel, piling, aid to navigation, or any other manmade obstacle or obstruction.

Tidal wetland: A tidal wetland is a wetland (i.e., water of the United States) that is inundated by tidal waters. The definitions of a wetland and tidal waters can be found at 33 CFR 328.3(b) and 33 CFR 328.3(f), respectively. Tidal waters rise and fall in a predictable and measurable rhythm or cycle due to the gravitational pulls of the moon and sun. Tidal waters end where the rise and fall of the water surface can no longer be practically measured in a predictable rhythm due to masking by other waters, wind, or other effects. Tidal wetlands are located channelward of the high tide line, which is defined at 33 CFR 328.3(d).

Vegetated shallows: Vegetated shallows are special aquatic sites under the 404(b)(1) Guidelines. They are areas that are permanently inundated and under normal circumstances have rooted aquatic vegetation, such as seagrasses in marine and estuarine systems and a variety of vascular rooted plants in freshwater systems.

Waterbody: For purposes of the NWPs, a waterbody is a jurisdictional water of the United States. If a jurisdictional wetland is adjacent – meaning bordering, contiguous, or neighboring – to a waterbody determined to be a water of the United States under 33 CFR 328.3(a)(1)-(6), that waterbody and its adjacent wetlands are considered together as a single aquatic unit (see 33 CFR 328.4(c)(2)). Examples of "waterbodies" include streams, rivers, lakes, ponds, and wetlands.

ADDITIONAL INFORMATION

This nationwide permit is effective March 19, 2012, and expires on March 18, 2017.

Information about the U.S. Army Corps of Engineers regulatory program, including nationwide permits, may also be accessed at http://www.swf.usace.army.mil/regulatory or http://www.usace.army.mil/Missions/CivilWorks/RegulatoryProgramandPermits.aspx

D. Referenced Plans

La Cañada Drive
River Road to Ina Road

Final Drainage Report

January 2011

Pima County Department of Transportation
Project No. 4LCRRI
TRACS No. SS639 03D
Federal Project No. STP-PPM-0(201)A

THE SEAL OF PIMA COUNTY ARIZONA

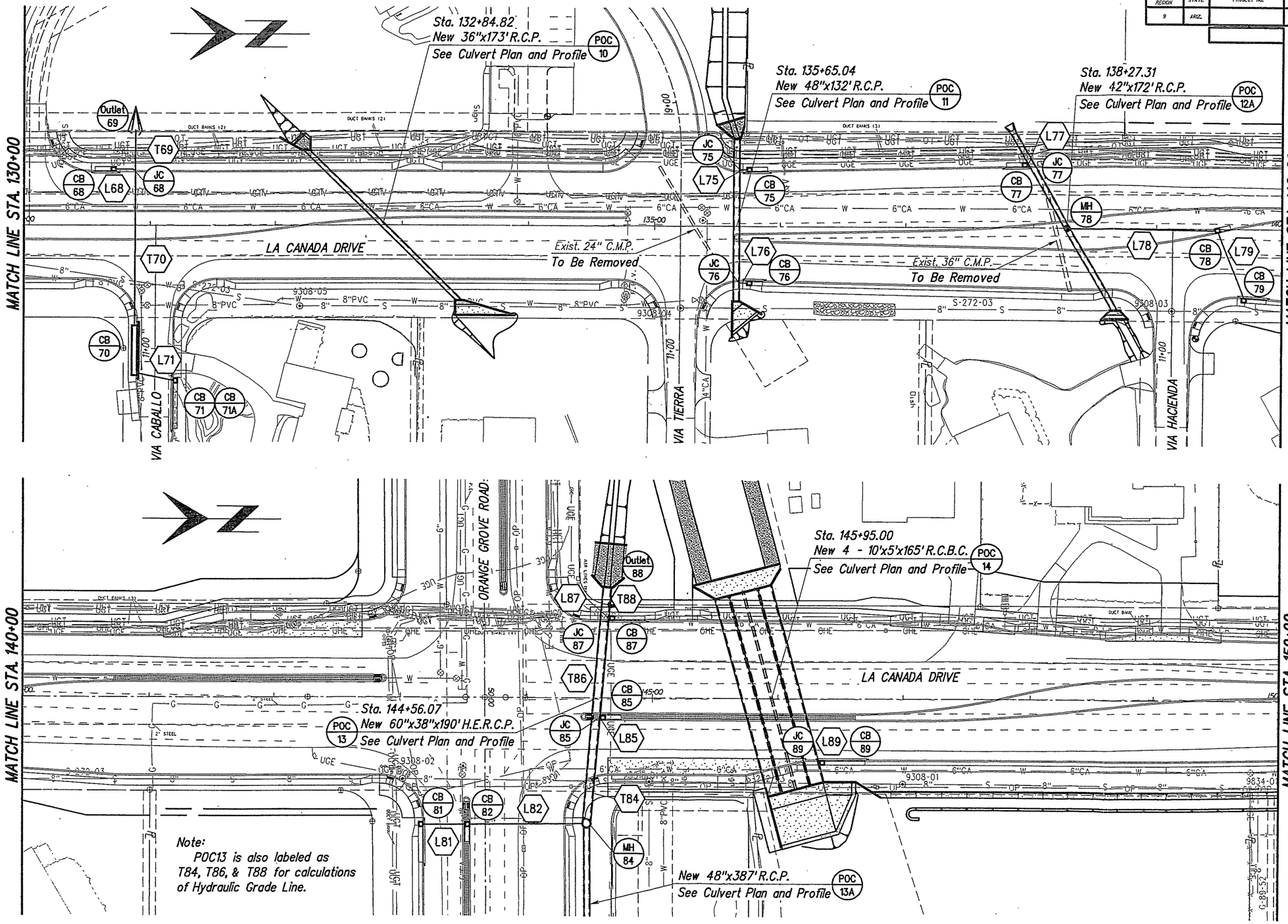
RTA Regional Transportation Authority

Registered Professional Engineer
CERTIFICATE NO.
9364
JOSEPH A.
HATCH
DATE SIGNED
1/27/11
ARIZONA U. S. A.

Exp 3/31/2011

HDR

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				



STORM DRAIN PLANS

PRISCILLA S. CORNELIO, P.E., DIRECTOR

PIMA COUNTY DEPARTMENT OF TRANSPORTATION

LA CANADA DRIVE
RIVER ROAD TO INA ROAD
W.O. 4LCARR

60% SUBMITTAL
PRELIMINARY - NOT FOR CONSTRUCTION

HDR Engineering, Inc.
5210 E Williams Circle, Suite 530
Tucson, AZ 85711-4459

No.	Revision Description	Engineer	Date

Designed	
Drawn	
Checked	
Proj. Engr.	

Date
01/2011
01/2011
01/2011
01/2011

Scales	Horiz. 1"=40'
	Vert. 1"=4'

Sheet 5 of 9

Project ID: 0000005187
Client Number: 012145

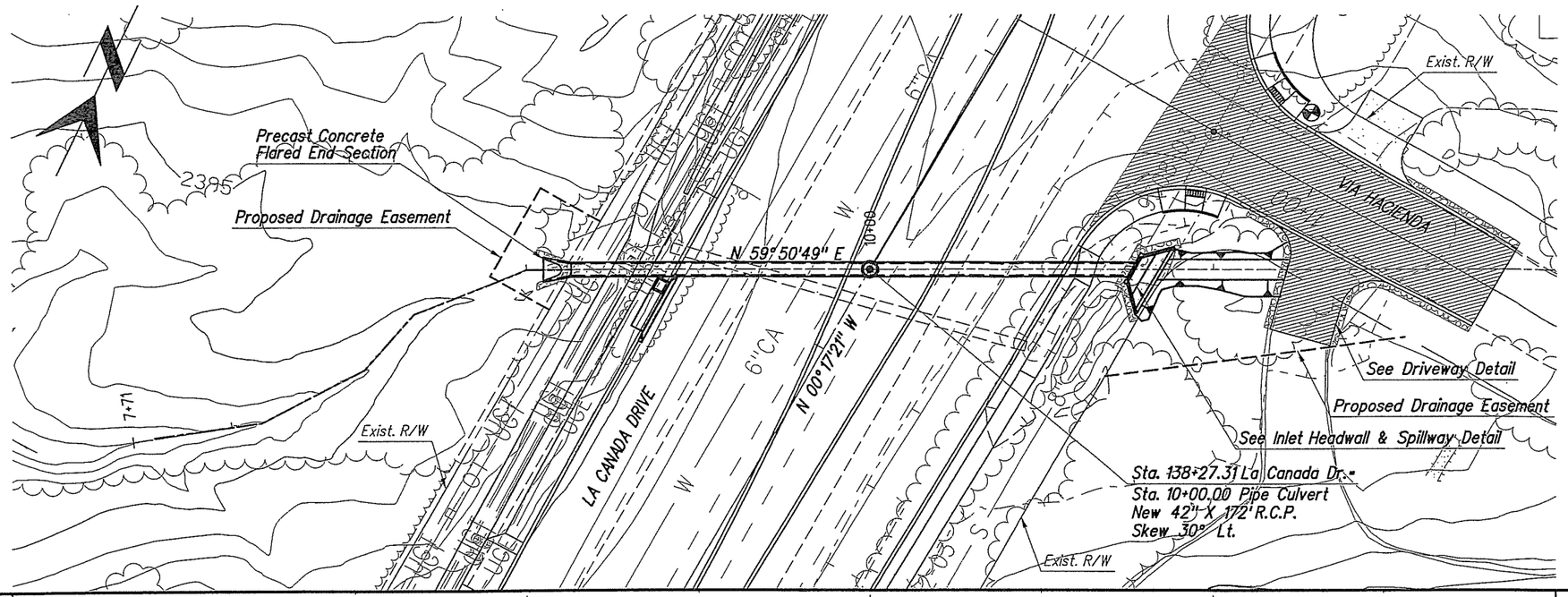
Pentable: 51587_PLOTORDR.TBL
Plotdriver: 51587_SYSPR_B&W.plt

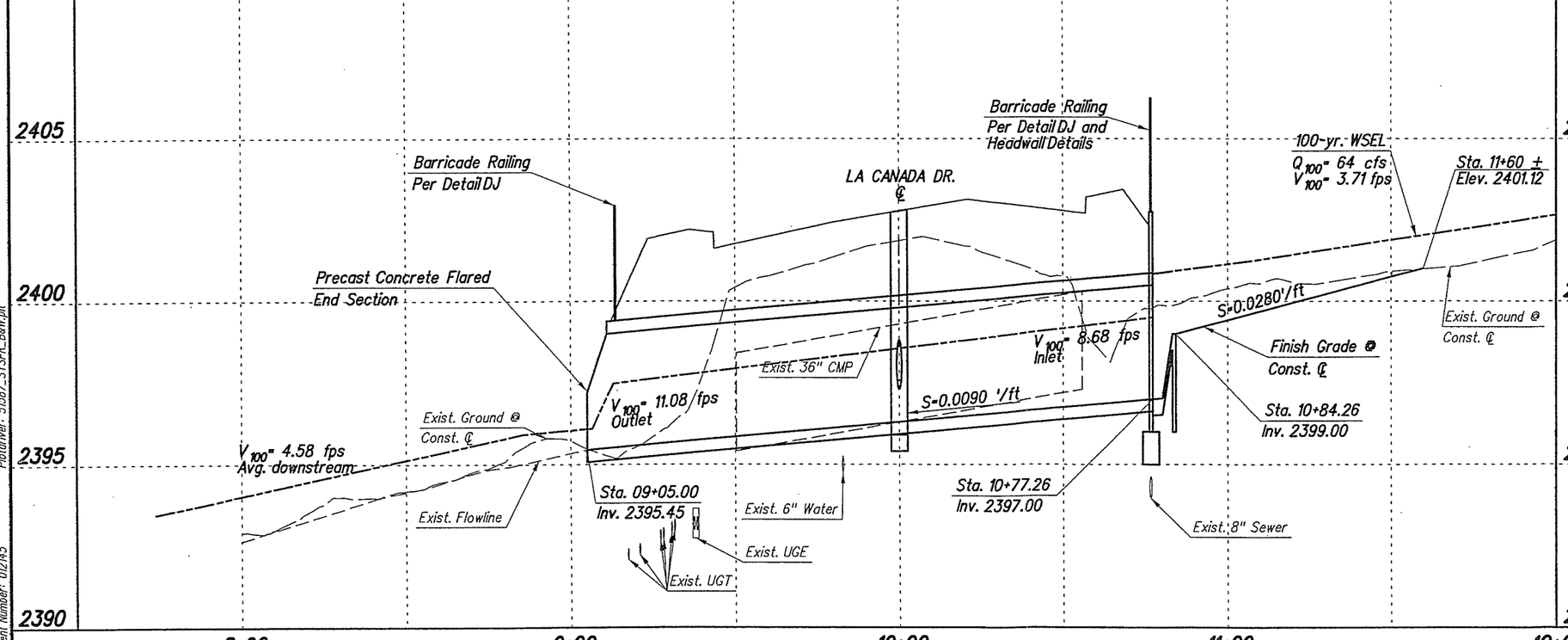
ProjectWise Directory: Pima_County_Dept_of_Transportation\PCDOT_La_Canada_River_to_Ina\13.00_CAD\Drainage\09C-05.dgn
Model: 09C-05

Printed by: jhatch Date: 01\03\11 2:31:16 PM

Print Scale: 1:80

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				





No.	Revision Description	Engineer	Date

	Date
Designed	JAH 01/2011
Drawn	JMF 01/2011
Checked	JLA 01/2011
Proj. Engr.	MRB 01/2011

PRISCILLA S. CORNELIO, P.E., DIRECTOR

STAGE V SUBMITTAL PRELIMINARY NOT FOR CONSTRUCTION

HDR Engineering, Inc.
5210 E Williams Circle, Suite 530
Tucson, AZ 85711-4459

PIMA COUNTY DEPARTMENT OF TRANSPORTATION

LA CANADA DRIVE
RIVER ROAD TO INA ROAD
W.O. 41 CRRH

STA. 138+27.31
VIA HACIENDA
SHEET 1 OF 1

CULVERT PLAN/PROFILE & DETAILS

Scales	Horiz. 1"=20'	Sheet 12 of 29	Page 154 of 282
	Vert. 1"=2'		

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Client Number: 012145
Pentable: 51587_PLOTORDR.TBL
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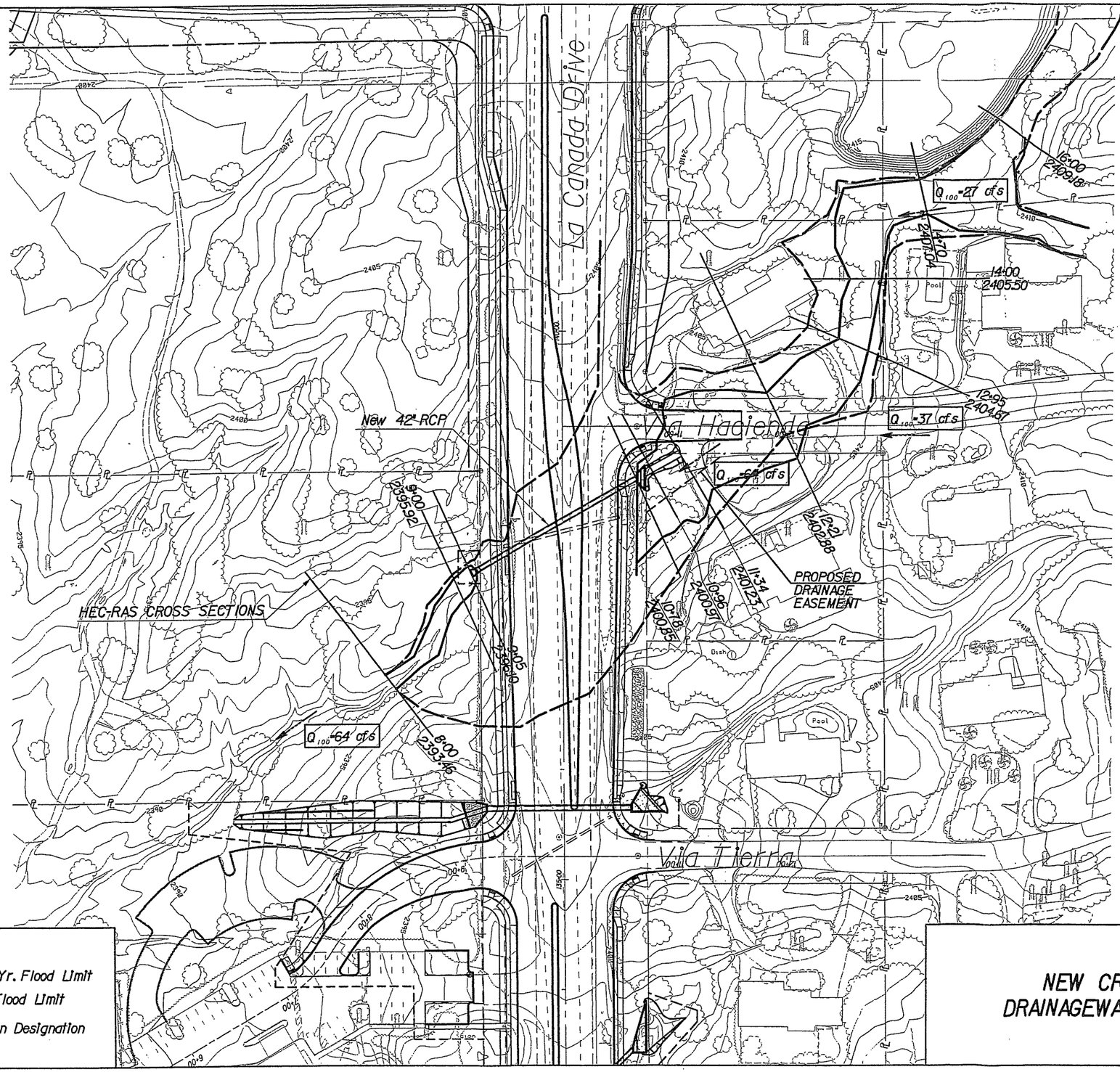
Model: 11C1101
Printed by: jhatch Date: 01\18\11 9:39:47 AM
Print Scale: 1:40



LEGEND

- Existing 100 Yr. Flood Limit
- New 100 Yr. Flood Limit
- 90+32 100 YR WSE — Cross Section Designation

NEW CROSSING FOR DRAINAGEWAY @ STA. 138+27

c:\pwworking\phx\dms68446\New Crossing 138+27.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

MATCH LINE STA. 14+50

See Headwall Details (Typ.)

Exist. Bank Protection To Remain

Const. ℄

5:00

2420

4:1

Sta. 57+30.07, 80' Lt. to
Sta. 57+90.07, 80' Lt. Orange Grove Rd.
New 53" x 34" x 60' H.E.R.C.P.

See Headwall Details (Typ.)

Exist. 24" C.M.P.

Exist. R/W

11:09

N 89°23'17" E

4:1

UGE

VIA RANCHERO

See Headwall Detail

ORANGE GROVE ROAD

55+00

N 89°23'17" E

Existing Parking Lot Grade

Barricade Railings Per Detail DJ and Headwall Details (Typ.)

Finish Grade @ Back of Sidewalk

Existing Ground

Via Ranchero ℄

100-yr. WSEL
Q_{100} = 70 cfs
V_{100} = 0.80 fps

V_{100} Inlet = 8.52 fps

V_{100} Outlet = 11.92 fps

Sta. 17+10.00
Elev. 2417.56
Begin Cutoff Wall & Rip Rap
D_{50} = 9"

Q_{100} = 99 cfs
V_{100} = 2.76 fps

S=0.0162 '/ft

S=0.0162 '/ft

V_{100} = 16.62 fps Inlet

18"

4'

Exist. UGE

Exist. 2" Gas

Sta. 17+30.00
Inv. 2417.88

Sta. 18+30.53
Match Exist.
Elev. = 2419.50

Sta. 17+90.00
Inv. 2418.85

Sta. 15+00.00
Inv. 2414.16

Sta. 14+90.00
Inv. 2413.00

2420
2415
2410
2405

15+00
16+00
17+00
18+00
19+00

Channel ℄
Roadway ℄
Varies 5' to 15'
80'
2'
2%
1
Varies 3 to 4
Existing Bank Protection to Remain
SECTION (C)

PRISCILLA S. CORNELIO, P.E., DIRECTOR

No.	Revision Description	Engineer	Date

	Designed	JHH	01/2011
	Drawn	JMF	01/2011
	Checked	J.L.A	01/2011
	Proj. Engr.	MHB	

STAGE V SUBMITTAL PRELIMINARY NOT FOR CONSTRUCTION

HDR Engineering, Inc.
5210 E Williams Circle, Suite 530
Tucson, AZ 85711-4459

PIMA COUNTY DEPARTMENT OF TRANSPORTATION

LA CANADA DRIVE
RIVER ROAD TO INA ROAD
W.O. 4LCRRI

STA. 144+56.07
VIA RANCHERO
SHEET 3 OF 3

CULVERT PLAN/PROFILE & DETAILS

Scales: Horiz. 1"=20' Vert. 1"=2'

Sheet 15 of 29

Page 157 of 282

Print Scale: 1:40

Penlable: 51587_PLOTORDR.TBL
Plotdriver: 51587_SYSPR_B&W.plt

Project ID: 00uuuu0051587
Client Number: 012145

ProjectWise Directory: Pima_County_Dept_of_Transportation\PCDOT_La_Canada_River_to_Ina\13.00_CAD\Drainage\11C-12.dgn
Model: 11C1203

Printed by: jhatch Date: 01\18\11 9:47:43 AM

1 = 100'

Q_{100} = 110 cfs
San Lucas Channel

LA CAÑADA DRIVE

CASAS ADOBES WASH

Qwell = 394 cfs

Q_{100} = 1677 cfs

23+97 2418.23

PROPOSED DRAINAGE EASEMENT

New (4) Cell 10' X 5' RCBC

22+84 2414.70

New 68" x 43" H.E.R.C.P.

Exist. 24" C.M.P.

CASAS ADOBES WASH

21+20 2413.20

20+87 2413.20

21+35 2413.33

20+92 2413.74

New 48" R.C.P.

Q_{100} = 99 cfs

15+90 2419.01

17+10 2418.96

17+30 2419.04

17+90 2422.74

18+10 2422.74

18+35 2422.74

Q_{100} = 70 cfs

Exist. 2-24" C.M.P.

New 68" x 43" H.E.R.C.P.

15+15 2419.00

15+40 2419.01

7+50 2404.76

7+75 2405.29

8+00 2405.46

8+50 2406.07

8+75 2406.58

9+00 2405.77

8+90 2406.71

ORANGE GROVE ROAD

Exist. 36" C.M.P.

LEGEND

- Existing 100 Yr. Flood Limit
- New 100 Yr. Flood Limit
- 90+32 100 YR WSE — Cross Section Designation

NEW CROSSING FOR DRAINAGEWAY @ STA. 144+56

c:\pwworking\phx\dms68446\New Crossing 144+56.dgn

Appendix D - Culvert Data
La Cañada Drive, River Road to Ina Road

POC No.	Station	Wash name or location	Existing condition	100-year Q (cfs)	Proposed Culvert Size	Proposed skew (degrees)	Existing headwater elevation from HEC RAS (feet)	Design headwater elevation from HEC RAS (feet)	Elevation at top of drop inlet	Weir Length	Depth of flow over weir (Pond Depth)	Depth of flow over weir (Pond Depth less Velocity Head)	Elevation of Water surface from weir equation	New culvert slope in %	Culvert length (feet)	New inlet flow line elevation	New outlet flow line elevation	Upstream avg channel velocity (feet/ second) From HEC RAS	Culvert Velocity (feet/ second) at Outlet From HEC RAS	Downstream avg channel velocity (feet/ second) From HEC RAS	Pima County Test for Culvert Velocity greater than 1.5 times downstream velocity
14	145+95	Casas Adobes Wash	Dip crossing	1788	4 cell 10' X 4'	15	2412.81	2413.43	2409.5	79.23	3.77	2.81	2412.31	1.61%	165	2406.8	2404.15	7.85	17.91	15.89	outlet protection not required
14A	150+00	San Lucas Drive	Side ditch to 145+95	110	2 - 53" X 34" HERCP	30	2418.91	2418.25	2417.5	33.05	1.05	0.48	2417.98	0.70%	53	2415.09	2414.72	6.05	9.09	5.38	outlet protection required
15	156+42	San Nicolas Drive	18" CMP	27	1 - 24" RCP	25	2423.88	2423.64	2422.34	18.26	0.61	0.58	2422.92	1.00%	147	2420.07	2418.6	1.47	9.04	2.39	outlet protection required
16	160+11	Montebella Drive	30" CMP	76	1 - 42" RCP	30	2425.96	2425.18	2423	26.48	0.95	0.61	2423.61	1.00%	151	2420.74	2419.23	4.70	11.86	4.68	outlet protection required
17	164+90	Pet Clinic	Dip crossing	176	1 - cell 8' X 3' RCBC	45	2430.28	2430.02	2429.5	41.76	1.23	1.05	2430.55	0.80%	173	2425.78	2424.4	3.37	12.05	6.22	outlet protection required
18	169+02	La Cañada Place	18" CMP	78	1 - 42" RCP	45	2436.52	2434.43	2433	31.65	0.86	0.56	2433.56	1.40%	173	2430	2427.58	4.39	13.40	4.50	outlet protection required
19	174+26	Desert Harbor Circle	Dip crossing	21	1 - 24" RCP	15	2437.19	2436.01	2435.5	9.85	0.78	0.64	2436.14	1.00%	162	2433.25	2431.63	3.00	9.18	4.37	outlet protection required
20	179+38	Chula Vista Wash (south)	Dip crossing	479	2 cell 8' X 4'	20	2437.24	2436.75	2436	238	0.75	0.47	2436.47	0.53%	133	2430	2429.3	8.57	11.59	6.34	outlet protection required
21	179+97	Chula Vista Wash (north)	Dip crossing	193	1 cell 8' X 4'	20	2438.01	2438.04	2436	44	1.26	0.65	2436.65	0.60%	132	2430.09	2429.3	6.28	11.28	6.34	outlet protection required
22	183+63	Giaconda Way	Dip crossing	134	1 - cell 6' X 3'	None	2439.60	2434.60	2437.2	105	0.55	0.14	2437.34	0.80%	490	2430.7	2426.78	10.38	11.00	9.88	outlet protection not required
22A	186+00	Alley north of Giaconda Way	To 183+63	67	1 - 36" RCP	90	2439.51	2439.13	2438.5	21.08	1.02	0.79	2439.29	1.74%	234	2434.61	2430.55	3.84	9.48	11.00	outlet protection not required

Orange Grove Road

23	45+09	Casas Adobes Wash	3 cell 10' X 6' RCBC	1788	4 Cell 10' X 6'	30 and 45	2405.18	2404.26					N/A	1.60%	164	2397.79	2395.17	15.89	12.76	11.22	outlet protection not required
24	57+68	Via Ranchero	2 - 24" CMPs	70	1 - 53" X 34" HERCP	4.5	2422.74	2421.79					N/A	1.67%	60	2418.85	2417.85	0.80	11.92	2.76	outlet protection required

Rudasill Road

25	6+41	Rudasill Road	Dip crossing	1050	2 - 36" CMP's	46.5	2376.02	2375.00	2372	40	4.17	2.58	2374.58	0.99%	76	2367	2366.25	10.12	7.78	10.25	outlet protection not required

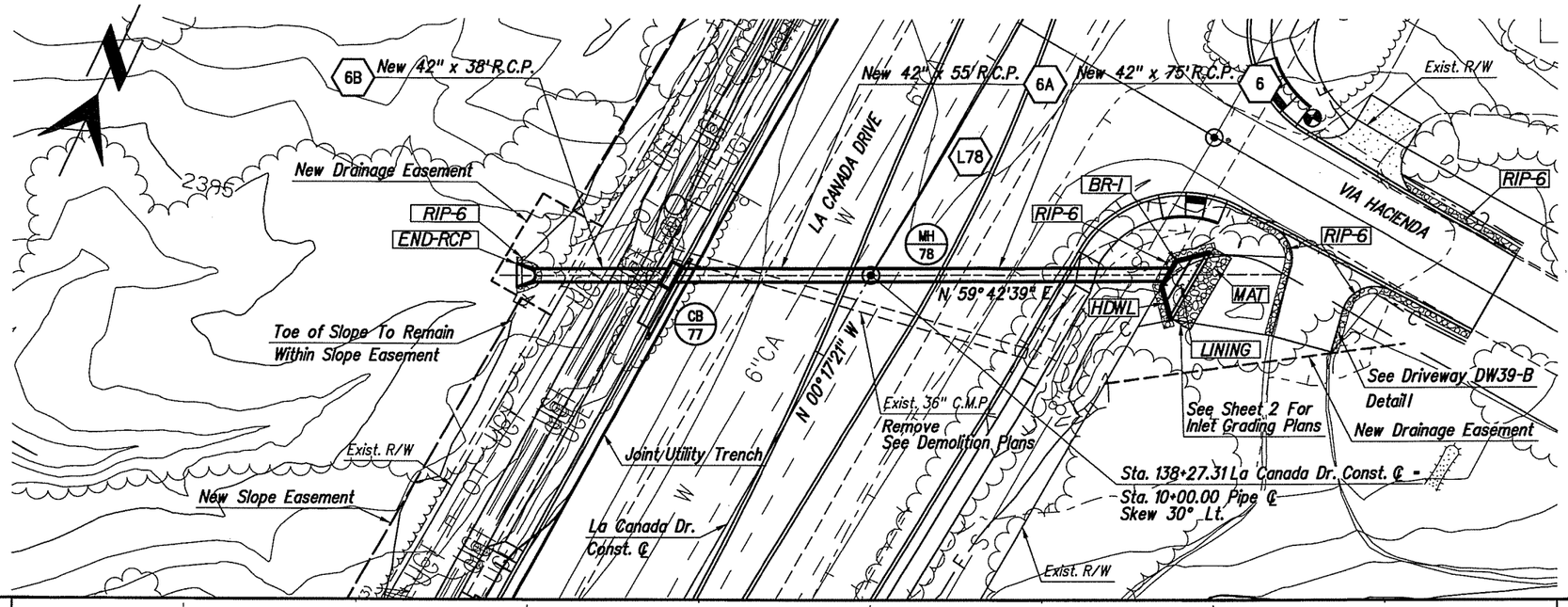
Spreadsheet Author Joe Hatch
Equation Check Julie Amos
Data Input By Joe Hatch
Data Check Julie Amos
c:\pwworking\phx\d0195558\[Appendix C and D_June 2010.xlsx]Appendix D Culvert Data

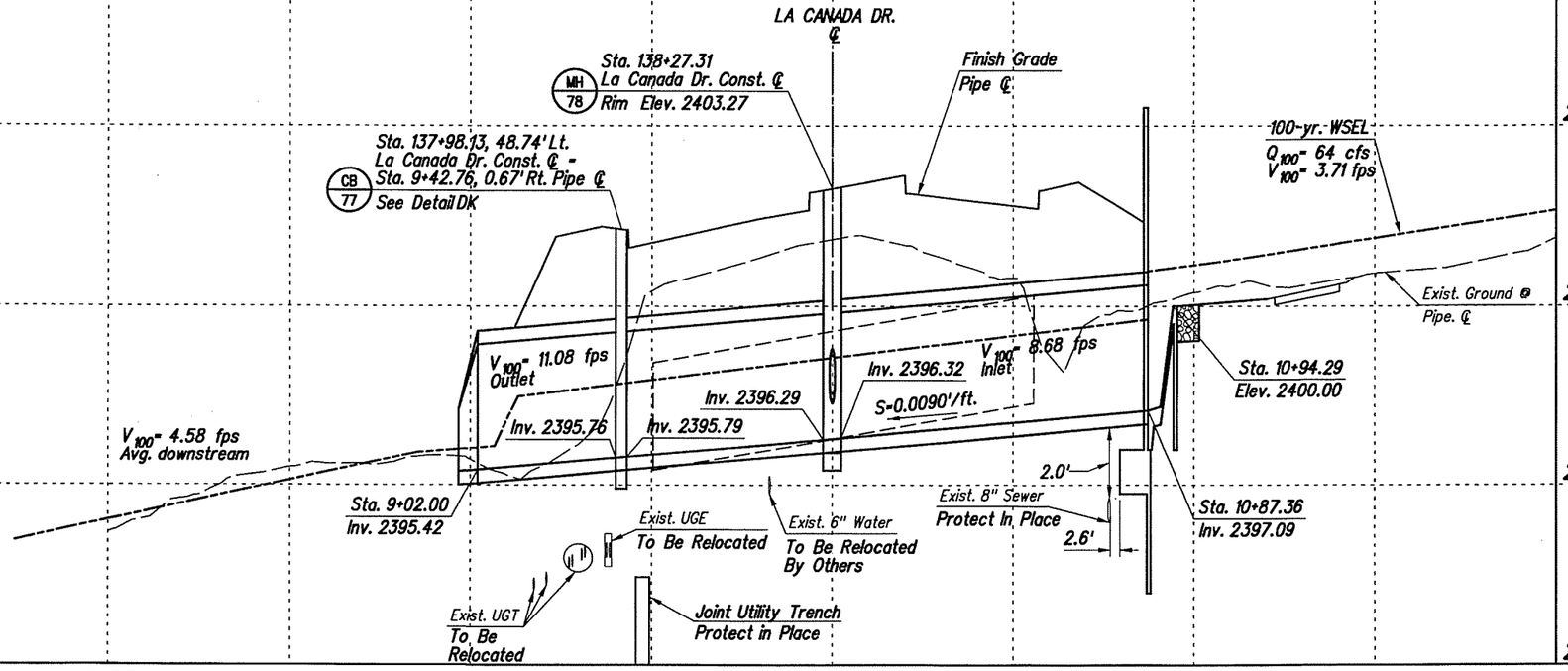
Appendix D - Culvert Data
La Cañada Drive, River Road to Ina Road

July 2010
Calculated By JAH
Checked By JLA

POC No.	Station	Wash name or location	Existing condition	100-year Q (cfs)	Proposed Culvert Size	Proposed skew (degrees)	Existing headwater elevation from HEC RAS (feet)	Design headwater elevation from HEC RAS (feet)	Elevation at top of drop inlet	Weir Length	Depth of flow over weir (Pond Depth)	Depth of flow over weir (Pond Depth less Velocity Head)	Elevation of Water surface from weir equation	New culvert slope in %	Culvert length (feet)	New inlet flow line elevation	New outlet flow line elevation	Upstream avg channel velocity (feet/second) From HEC RAS	Culvert Velocity (feet/second) at Outlet From HEC RAS	Downstream avg channel velocity (feet/second) From HEC RAS	Pima County Test for Culvert Velocity greater than 1.5 times downstream velocity
0	60+14 Exist. 58+00	Ponding , River Rd. to Roller Coaster	24" RCP	263	additional - 30" RCP	None	2282.98	2282.90						Part of the River Road storm drain system							
1	65+48	Roller Coaster Wash	3 cell 10' X 5' RCBC	1831	5 cell 10' X 5' RCBC	None	2287.30	2285.80	2282.5	53.66	4.96	3.81	2286.31	0.53%	127	2278.32	2277.65	8.60	8.02	7.29	outlet protection not required
2	86+59	Las Lomitas Wash	2 - 60" CMPs	897	2 cell 10' X 5' RCBC	15	2333.84	2333.94	2329	72	2.53	2.26	2331.26	1.09%	127	2326.9	2325.51	4.24	15.52	10.80	outlet protection not required
3	100+25	La Cima School North 1	36" CMP	199	2 - 53" X 34" HERCP	15	2360.39	2358.03	2354.5	31.91	1.60	1.34	2355.84	2.51%	126	2353	2349.83	4.10	16.64	4.67	outlet protection required
4	105+15	La Cima School North 2	36" CMP	208	2 - 42" RCP	20	2366.89	2363.05	2360.15	31.91	1.65	1.45	2361.60	1.39%	130	2357	2355.2	3.53	14.96	6.26	outlet protection required
5	109+58	Las Lomitas Road (east)	Dip crossing	56	1 - 36" RCP	N/A	2373.16	2371.82	2371.5	25.78	0.79	0.49	2371.99	2.44%	441	2365.95	2355.2	4.39	9.14	5.61	outlet protection required
6	116+62	South Citrus Wash	3 - 36" CMPs	464	2 cell 8' X 5' RCBC	20	2382.69	2381.89	2379.5	60.55	1.83	1.60	2381.10	1.20%	132	2377	2375.42	3.86	14.10	4.62	outlet protection required
7	120+47	North Citrus Wash Lateral	Side ditch to South Citrus Wash	61	1 - 60" X 38" HERCP	37.5	2384.75	2384.90	2383.77	28	0.79	0.06	2383.83	0.34%	70	2381.67	2381.43	6.85	8.45	17.07	outlet protection not required
8	120+53	North Citrus Wash	3 - 48" CMPs	729	2 cell 10' X 5' RCBC	52.5	2388.73	2388.22	2385	35	3.57	2.77	2387.77	1.50%	215	2383	2379.78	7.16	17.07	10.12	outlet protection required
9	130+88	Via Caballo	Dip crossing	55	1 - 36" RCP	None	2396.12	2397.43	2396.5	80	0.37	0.26	2396.76	0.80%	161	2391.97	2390.68	2.66	6.87	7.19	outlet protection not required
10	132+85	Metro Water	To 130+88	46	1 - 36" RCP	45	2400.44	2398.23	2398	43.35	0.49	0.13	2398.13	0.76%	173	2393.69	2392.38	4.82	9.65	3.83	outlet protection required
11	135+65	Via Tierra	24" CMP	99	1- 48" RCP	None	2401.98	2398.92	2399.5	26.17	1.14	0.80	2400.30	1.00%	132	2393.79	2392.47	4.69	12.41	6.72	outlet protection required
12	138+27	Via Hacienda	36" CMP	163	Existing upstream	N/A	2402.05	N/A					See Via Ranchero (48" RCP		N/A	N/A					See Via Ranchero
12A	138+27	Via Hacienda	36" CMP	64	1- 42" RCP	30	N/A	2401.12	2399	19.94	1.03	0.81	2399.81	0.90%	172	2397	2395.45	3.71	11.08	4.58	outlet protection required
13	144+56	Via Ranchero	36" CMP	99	1- 60" X 38" HERCP	4.5	N/A	N/A						0.50%	190	2405.45	2404.5	9.29	10.30	3.61	outlet protection required
13A	144+56	Via Ranchero	36" CMP	99	1- 48" RCP	4.5	2419.58	2417.71	2414.16	23.97	1.21	1.10	2415.26	1.94%	389	2413	2405.45	2.76	16.62	9.29	outlet protection required

Spreadsheet Author	Joe Hatch
Equation Check	Julie Amos
Data Input By	Joe Hatch
Data Check	Julie Amos





F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	STP-PPH-0200A	202	505	

0000 PM PPH 55539 00C

Item	Qty.	Unit
6	85	L.F.

42" R.C.P. Class II
Paid as Bid Item 5011047

6A	55	L.F.

42" R.C.P. Class II
Paid as Bid Item 5011047

6B	38	L.F.

42" R.C.P. Class II
Paid as Bid Item 5011047

END-RCP	1	EACH

Concrete Flared End Section Per
ADOT Std. C-13.20
Paid as Bid Item 5014142

CB 77	1	EACH

See Detail DK
Paid as Bid Item 5030716

MH 78	1	EACH

PC/COT Detail 300
8' Base, 4 - #6 bars Top & Bottom
Paid as Bid Item 5050006

HDWL	1	EACH

Inlet Headwall
See Detail on Sheet 2
Paid as Bid Item 6016087

RIP-6	14	C.Y.

Dumped Riprap, D_{50}=6"
See Detail DC for Gradation
Paid as Bid Item 9130001

MAT	5	C.Y.

Slope Mattress
See Detail DC
Paid as Bid Item 9130004

LINING	14	S.Y.

Concrete Channel Lining
See Inlet Detail on Sheet 2
Paid as Bid Item 9130100

BR-1	29	L.F.

Type 1 Barricade Railing
Per Detail DJ
Paid as Bid Item 9330021

Note:

Contractor must obtain permit from PCRWRD prior to constructing drainage structures inside the sewer impact zone. PCRWRD inspector must be present during construction in lieu of a F.M.P.

PRISCILLA S. CORNELIO, P.E., DIRECTOR

PIMA COUNTY DEPARTMENT OF TRANSPORTATION

No.	Revision Description	Engineer	Date

Designed	JAH, RAP	05/2011
Drawn	JMF	05/2011
Checked	ROB, MRB	05/2011
Proj. Engr.	MRB	05/2011

HDR Engineering, Inc.
5210 E Williams Circle, Suite 530
Tucson, AZ 85711-4459

Registered Professional Engineer
No. 23505
MICHAEL H. BERTRAM
Date Signed 5-27-11
ARIZONA U.S.A.
EXPIRES 3/31/14

LA CANADA DRIVE
RIVER ROAD TO INA ROAD
W.O. 4LCARI

PIPE CULVERT 6, 6A, & 6B
STA. 138+27.31
VIA HACIENDA
SHEET 1 OF 2
CULVERT PLAN/PROFILE & DETAILS

Scales: Horiz. 1"=20' Vert. 1"=2'

Sheet 38 of 73

Pentable: 51587_PLOTORDR.TBL
PlotDriver: 51587_V8FULL_R&W_PDF.plt
Project ID: 00000000051587
Client Number: 012145

ProjectWise Directory: Pima_County_Dept_of_Transportation\PCDOT_La_Canada_River_to_Ina\13.00_CAD\Drainage\11C-11.dgn
Model: 11C1101
Printed by: hevers
Date: 06\27\11 3:47:46 PM
Print Scale: 1:20