APPENDIX A

Cordova Hills Final Mitigation Proposal

Wetland Mitigation Proposal

Cordova Hills Project

Sacramento County, California

(U.S. Army Corps of Engineers # SPK-2004-00116)

(U.S. Fish and Wildlife Service # 08ESMF00-2015-I-1008)

Prepared For:

Cordova Hills, LLC

Original Date:
13 November 2015

Superseded:
19 November 2015

ECORP Consulting, Inc.
ENVIRONMENTAL CONSULTANTS

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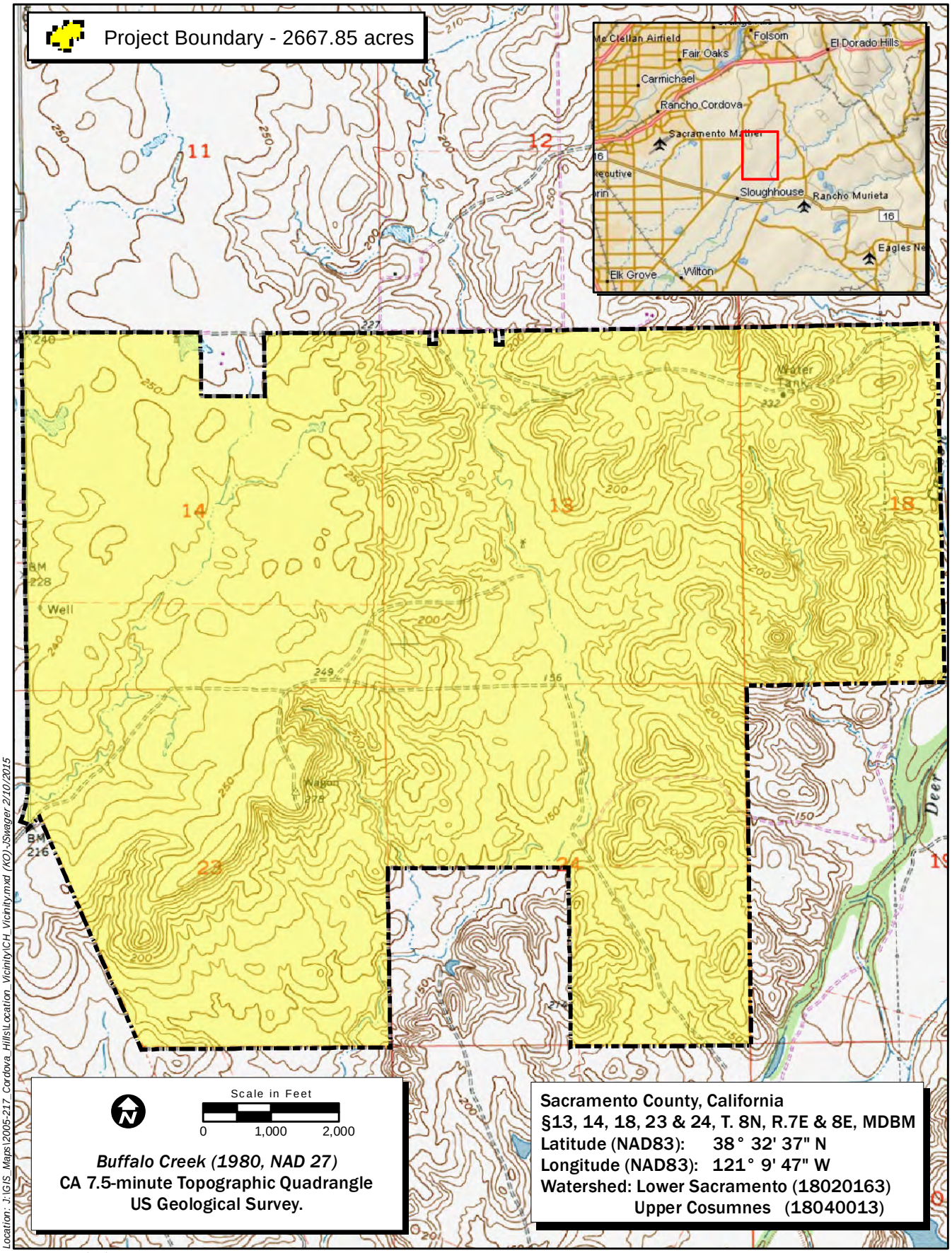
1.0 SUMMARY

This Wetland Mitigation Proposal (Proposal) has been prepared for the Cordova Hills Project (Project). This Proposal was prepared to provide information to the U.S. Army Corps of Engineers (USACE), the U.S. Fish and Wildlife Service (USFWS), the Environmental Protection Agency (collectively, Regulatory Agencies) and the public regarding the mitigation package that has been proposed by the Project Applicant to offset impacts to wetlands/Waters of the U.S. (collectively, Waters) and species listed as threatened or endangered under the federal Endangered Species Act (ESA). The purpose of the proposed mitigation is to minimize impacts and provide compensatory mitigation for unavoidable impacts resulting from the Project. It is anticipated that final mitigation monitoring plans, long-term management plans and financial assurance, as appropriate, will be developed for each off-site mitigation property as well as the on-site preserves as required under USACE regulation and the forthcoming USFWS biological opinion (BO) as the USACE reviews and approves the final mitigation plan. These final documents will incorporate the requirements of the recent *South Pacific Division Final Compensatory Mitigation and Monitoring Guidelines* (USACE 2014).

The Project that is the subject of this Proposal is the approximately ±2,668 acres mixed use land development called the Cordova Hills Project (Project). The Project described in this Proposal is the Modified Proposed Action (MPA) Alternative, which will be identified in the Final Environmental Impact Statement as the Applicant's preferred alternative (USACE anticipated in 2015). The Project is located immediately east of Grant Line Road and south of Glory Lane, in the southeast portion of Sacramento County (Figure 1. *Cordova Hills Project Location and Vicinity*). The Project consists of a mixture of different land uses, including residential, senior housing, retail, commercial, and a university/college campus center, as well as parks and open space. A total of 89.106 acres of Waters were delineated on the Project site; including vernal pools, seasonal wetlands, seasonal wetland swales, seeps, intermittent drainages, a perennial creek, and man-made stock ponds and 0.36 acres were delineated at the off-site road improvement areas.

The Project would impact approximately ±34.598 acres of Waters, including wetlands both on-site and at associated off-site road improvement areas. Of these impacts, 18.316 acres provide habitat for federally listed vernal pool species, including the threatened vernal pool fairy shrimp (*Branchinecta lynchi*) and the endangered vernal pool tadpole shrimp (*Lepidurus packardi*). Collectively, the vernal pool fairy shrimp and the vernal pool tadpole shrimp are referred to as vernal pool crustaceans. The endangered Sacramento Orcutt grass (*Orcuttia viscida*) is also present on the Project site with all occupied habitat located entirely within the on-site preserve system.

Based on preliminary mitigation checklist results from the USACE, mitigation for impacts to Waters is proposed within four on-site wetland preserves, at two off-site mitigation properties, and through the purchase of credits at Agency-approved mitigation banks. The two off-site properties include the Chester Drive Property and the Shehadeh Property (collectively, Mitigation Properties) (Figure 2. *Cordova Hills and Mitigation Properties Locations*).



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Map Date: 2/10/2015

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Figure 1. Cordova Hills Project Location and Vicinity

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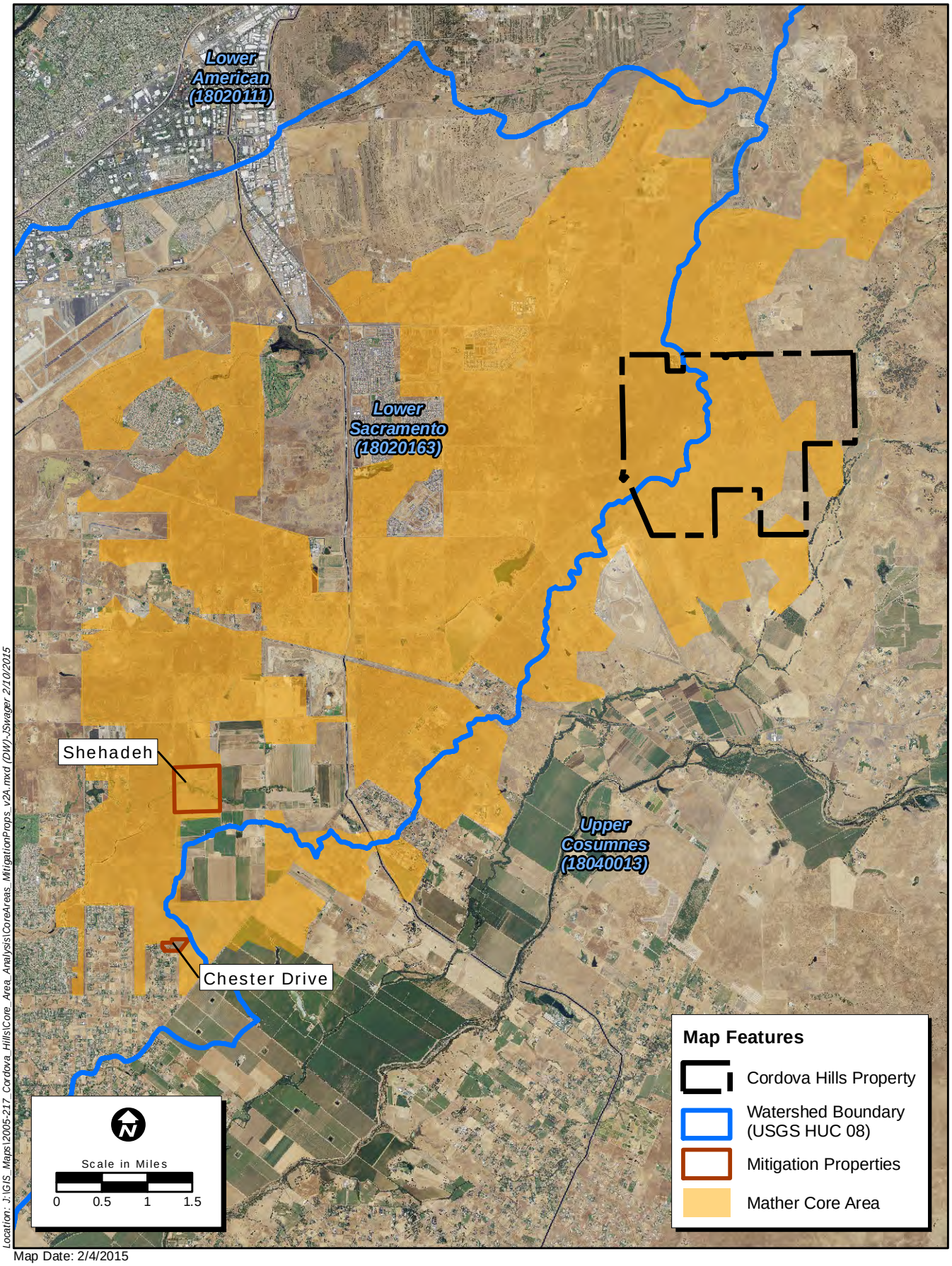

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Map Date: 2/4/2015
Photo Source: NAIP (2012)

Figure 2. Cordova Hills and Mitigation Properties Locations

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The on-site preserves provide the opportunity to preserve ±54.871 acres of Waters. At the Shehadeh property, ±14.790 acres of vernal pools have been created, and at the Chester Drive Property, ±1.780 acres of vernal pool restoration will occur. The remaining creation credits for impacts on Waters would be purchased at the Toad Hill Ranch Mitigation Bank and Cosumnes Floodplain Mitigation Bank. Compensation for ESA impacts of 32.2 acres of onsite vernal pool crustacean habitat preservation, of which ±27.731 would receive mitigation credit; preservation of ±21.95 acres of vernal pool crustacean habitat at the Mitigation Properties; and the purchase of preservation credits at the Gill Ranch Conservation Bank.

As the Regulatory Agency review of the proposed Project continues, additional mitigation sites may become available and will be evaluated by the Applicant and the Regulatory Agencies to ensure that unavoidable impacts to Waters will be compensated for in the most appropriate manner feasible.

2.0 RESPONSIBLE PARTIES

2.1 Applicant

Cordova Hills, LLC
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Fax: (916) 565-3649

2.2 Present and Long-term Owner of the Mitigation Properties

Cordova Hills, LLC, owns the Shehadeh Property. The Chester Drive Property is owned by BWB Investments, LLC, and an option to purchase it is held by Cordova Hills, LLC.

2.3 Parties Responsible for Long-Term Maintenance of the Mitigation Properties

To be determined for each Mitigation Property.

2.4 Preparer of the Mitigation Proposal

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3.0 PROJECT REQUIRING MITIGATION

3.1 Location of Project

The approximately ±2,668-acre Project site is located in unincorporated eastern Sacramento County, California. The site is bordered to the west by Grant Line Road. Glory Lane, a dirt road since the 1930's, abuts the Project to the north. The eastern and southern boundaries are not marked by physical features such as roads. Generally, the site is north of Kiefer Road and west of the Carson Creek drainage (see Figure 1). The site corresponds to portions of Sections 13, 14, 23 and 24, Township 8 North, and Range 7 East [Mount Diablo Base Meridian (MDBM)] and Section 18, Township 8 North, and Range 8 East (MDBM) of the "Buffalo Creek, California" 7.5-minute quadrangle (U.S. Department of the Interior, Geological Survey [USGS], 1980).

The approximate center of the Project is located at 38° 32' 37" North and 121° 9' 47" West within the Lower Sacramento and Upper Cosumnes watersheds (Hydrologic Unit Code [HUC] #18020163 and #18040013, respectively, (USGS 1980). The Project is partially located in the Mather Core Area (MCA), as defined in the *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (Recovery Plan; USFWS 2005) (Figure 2). The Project also includes a suite of road improvement projects in Sacramento County, California, the effects of which are also considered in this Proposal.

3.2 Summary of Overall Project

The approximately ±2,688-acre Project consists of a mixture of planned land uses. The Project will include approximately ±1,000 gross acres of residential uses ranging in density from one dwelling unit per net acre to 40 units per net acre, with an overall average net residential density of ten dwelling units per acre. The Project may also contain a senior housing component. In addition, the Project will include retail and commercial space and a university/college campus center situated on approximately ±223 acres. The university/college campus center will be designed to provide a residential learning environment with sufficient capacity to provide on-campus housing to the majority of the approximately 6,000 students anticipated upon build out. In addition to the university/college campus center, the Project will accommodate the growing educational facility needs of the region by providing sites for the development of future elementary and secondary schools.

The Project includes approximately ±582 acres of on-site preserves to protect Waters and federally listed and other special-status species. These areas will be protected and managed in perpetuity for the benefit of these resources. Project design took into account existing terrain and drainage patterns, and includes Low Impact Development design concepts (outlined in the Project's Special Planning Area Master Plan, which has been adopted by Sacramento County), as well as extensive edge treatments, which include a combination of trails, drainage swales, and native and/or drought-tolerant landscaping to buffer the on-site preserves from the long-term effects of development.

3.3 Regulatory History of the Project

On 28 April 2008, the Applicant submitted an application to the USACE for an Individual Permit (Permit) under Section 404 of the Clean Water Act (CWA) for the Project. Due to Project modifications, including a significant increase in on-site preservation, an amended Section 404 permit application was submitted to the USACE on 15 March 2011. Wetland impacts have been reduced from the Applicant's initial proposal in 2008 of 50 percent on-site wetlands impacted, to the Applicant's current preferred alternative, "the Modified Proposed Action", of only 38 percent on-site wetlands impacted. Vernal Pool avoidance has increased from 53 percent in the Applicant's initial proposal (2008), to 68 percent in the MPA, which represents a 15 percent increase. The two Mitigation Properties presented in this Proposal have been discussed during the planning process with the USACE from 2012 to present and the USFWS from 2012 to 2013. On 22 December 2014, the USACE submitted the Applicant's biological assessment for project impacts on federally listed species, along with a request for formal Section 7 ESA consultation, to the USFWS for the proposed MPA Alternative.

3.4 Existing Site Conditions

3.4.1 Topography and Hydrology

The Project site is generally composed of level to steeply rolling topography and is situated at elevations ranging from 130 to 278 feet above mean sea level (MSL). The western portion of the site is a relatively flat terrace supporting a number of vernal pool complexes at an approximate average elevation of 245 feet above MSL. The central portion of the site is comprised of the valley formed by an intermittent tributary to Deer Creek, which drains from north to south. The eastern portion of the site is occupied by a series of steeply rolling hills and Carson Creek along the eastern boundary. The site contains an annual grassland community that is interspersed with complexes of ephemeral wetlands (i.e., vernal pools, seasonal wetlands, and seasonal wetland swales) and intermittent drainages. Two stock ponds are located in the western portion of the site, and Carson Creek borders the Project along a portion of its eastern boundary. The intermittent drainages on-site are tributaries to Deer and Laguna creeks. The site has traditionally been used as pastureland for livestock grazing. Surrounding land uses include rural residences, roadways, a landfill, and cattle pastures. Residential development is ongoing in the Sunrise Douglas Community Plan and associated specific plans, which are located immediately west of the Project site.

3.4.2 Vegetation

The site is composed of annual grassland. This community is dominated by nonnative naturalized Mediterranean grasses including medusahead grass (*Elymus caput-medusae*), ripgut brome (*Bromus diandrus*), soft brome (*Bromus hordeaceus*), wild oats (*Avena fatua*), and ryegrass (*Festuca perennis*). Other herbaceous species in this community included rose clover (*Trifolium hirtum*), bicolored lupine (*Lupinus bicolor*), cut-leaf geranium (*Geranium dissectum*), common vetch (*Vicia sativa*), filaree (*Erodium botrys*), sticky tarweed (*Holocarpha virgata*), Fitch's spikeweed (*Centromadia fitchii*), yellow star-thistle (*Centaurea solstitialis*), hairy hawkbit (*Leontodon saxatalis*), and turkey mullein (*Croton setigerus*).

3.4.3 Soils

According to the *Soil Survey of Sacramento County, California* (U.S. Department of Agriculture, Soil Conservation Service 1993), 16 soil units, or types have been mapped within the Project site (Table 1 and Figure 3. *Natural Resources Conservation Service Soil Types*).

Table 1. Hydric Status of Soil Units Mapped within the Cordova Hills Project Site[1]

Map Unit Number	Map Unit Name	Hydric Components	Hydric Inclusions
101	Amador-Gillender complex, 2-15% slopes	N	N
125	Corning complex, 0-8% slopes	Y	N
126	Corning-Redding complex, 8-30% slopes	N	N
132	Creviscreek sandy loam, 0-3% slopes	N	N
156	Hadselville-Pentz complex, 2-30% slopes	N	N
158	Hicksville loam, 0-2% slopes	N	Y
160	Hicksville sandy clay loam, 0-2% slopes	N	Y
163	Keyes sandy loam, 2-15% slopes	N	N
187	Pardee-Rancho Seco complex, 2-5% slopes	N	N
188	Pentz-Lithic xerothents complex, 30-50% slopes	N	N
189	Peters clay, 1-8% slopes	N	N
192	Red Bluff loam, 2-5% slopes	N	Y
193	Red Bluff-Redding complex, 0-5% slopes	N	Y
198	Redding gravelly loam, 0-8% slopes	N	Y
215	San Joaquin silt loam, 3-8% slopes	N	Y
242	Xerofluvents, 0-2% slopes	Y	Y

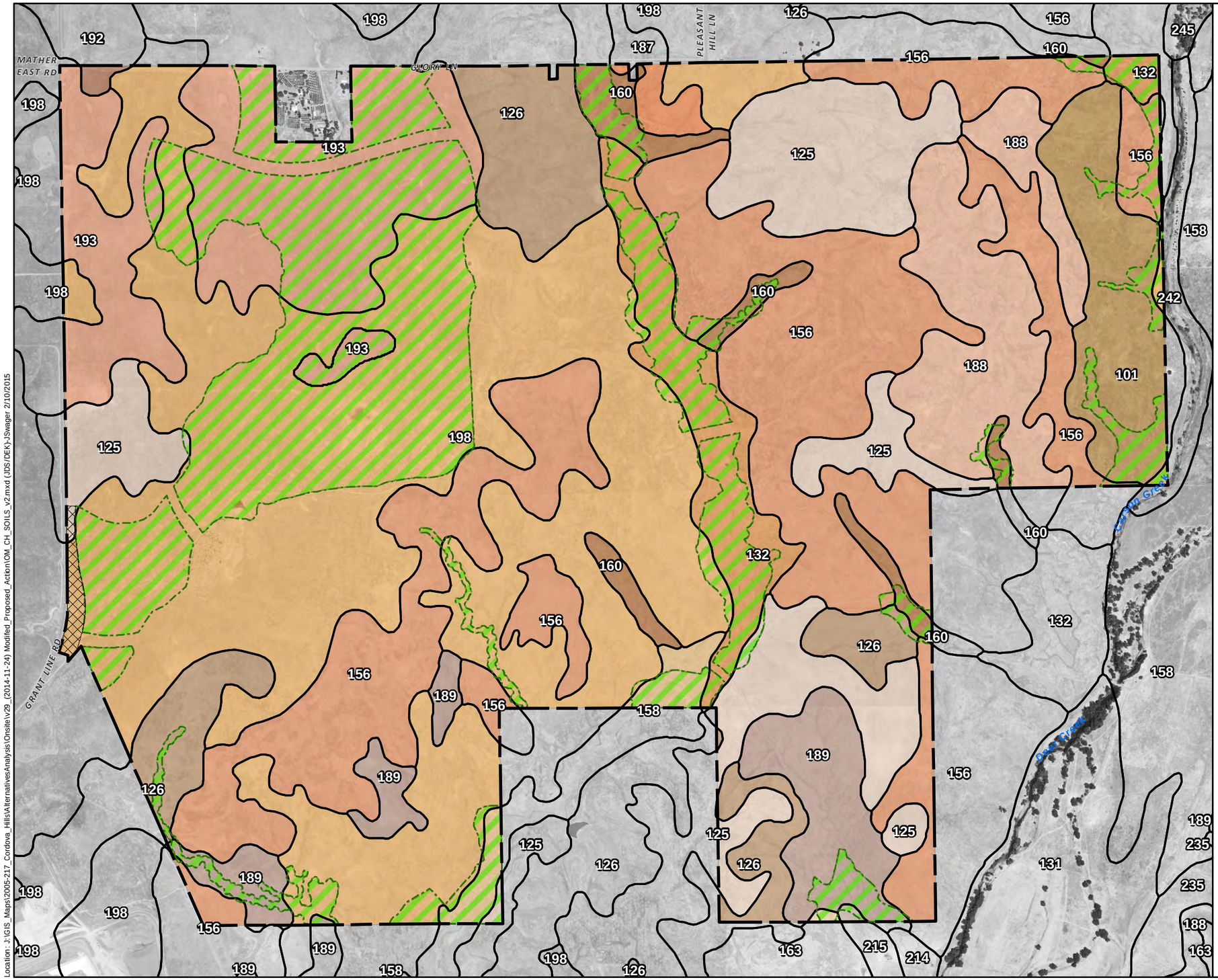
1Source: Sacramento County Hydric Soils List

3.4.4 Waters

Three separate wetland delineations were conducted by ECORP Consulting, Inc. (ECORP) within the Project site (ECORP 2008a). These wetland delineations were conducted in accordance with the *Corps of Engineers Wetlands Delineation Manual* ([USACE Manual], Environmental Laboratory 1987). All three of these wetland delineations have been verified by the USACE (Regulatory Number SPK-2004-00116). These three wetland delineations cover the entire Project site and the various wetland habitats found within the Project are described below and shown in Figure 4. *Wetland Preserves, Edge Treatments & Impacts by HUC 8*.

For off-site road improvement areas, ECORP did not have physical access to conduct a wetland delineation in accordance with the USACE Manual. In these areas, Six Counties Aquatic Resources Inventory ([SCARI], USACE 2011) data were utilized, along with aerial photography interpretation, to determine potential wetland extents and classifications (ECORP 2013a). A site visit with the USACE was conducted on 15 April 2013 and a preliminary jurisdictional determination was issued by the USACE on 10 May 2013, which identified 0.360 acre of potentially jurisdictional Waters of the U.S. (Attachment A). To the extent possible, general conditions of these Waters are detailed in the sections below. All delineated wetlands are summarized in Table 2.

Figure 3.
Natural Resources Conservation Service Soil Types



Map Features

- Cordova Hills Project Boundary
- JPA Reservation
- Preserve

Series Number - Series Name

- 101 - Amador-Gillender complex, 2-15% slopes
- 125 - Corning complex, 0-8% slopes
- 126 - Corning-Redding complex, 8-30% slopes
- 132 - Creviscreek sandy loam, 0-3% slopes
- 156 - Hadselville-Pentz complex, 2-30% slopes
- 158 - Hicksville loam, 0-2% slopes, occasionally flooded
- 160 - Hicksville sandy clay loam, 0-2%, occasionally flooded
- 163 - Keyes sandy loam, 2-15% slopes
- 187 - Pardee-Ranchoseco complex, 3-15% slopes
- 188 - Pentz-Lithic Xerorthents complex, 30-50% slopes
- 189 - Peters clay, 1-8% slopes
- 192 - Red Bluff loam, 2-5% slopes
- 193 - Red Bluff-Redding complex, 0-5% slopes
- 198 - Redding gravelly loam, 0-8% slopes
- 215 - San Joaquin silt loam, 3-8% slopes
- 242 - Xerofluvents, 0-2% slopes, flooded

Natural Resources Conservation Service (NRCS) Soil Survey Geographic (SSURGO) Database for Sacramento County, CA

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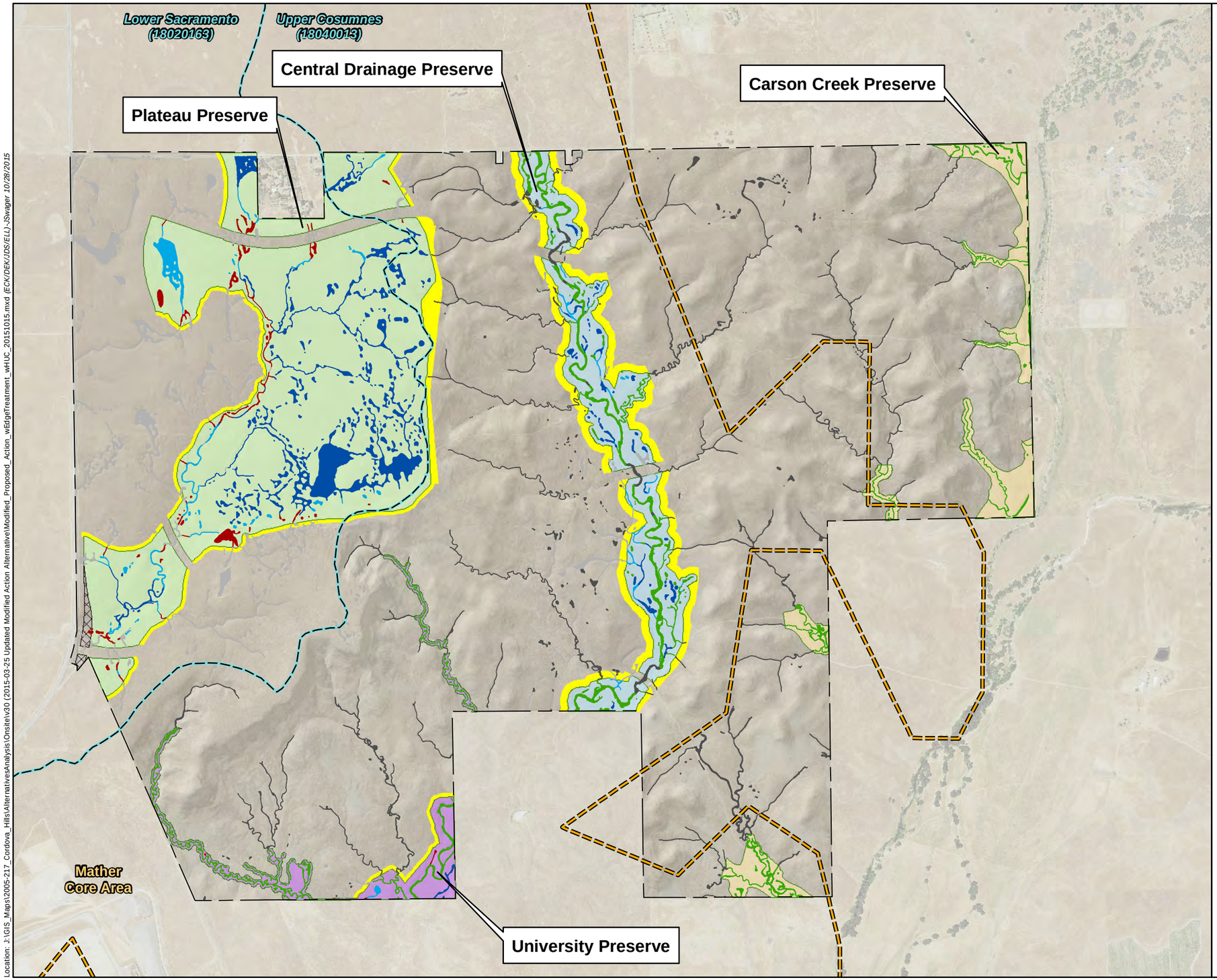
Scale in Feet
0 1,000 2,000

Photo Source: NAIP 2012

Map Date: 2/10/2015

Figure 4. Wetland Preserves, Edge Treatments & Impacts by HUC 8

All Waters Listed Below Fall Under the Jurisdiction of the CWA.



Map Features

- Project Boundary
- JPA Reserve [3]
- Overall Preserve Area
- Edge Treatment [4]
- Watershed Boundary (USGS HUC 08)
- Mather Core Area

Preserve Name

- Carson Creek (59.2 ac.) [5]
- Central Drainage (99.9 ac.)
- Plateau (381.6 ac.)
- University Preserve (37.7 ac.) [5]

404 Wetland Impacts [1]

- Avoided
- Direct Impact

ESA Wetland Impacts [2]

- Avoided (Credit)
- Avoided (No Credit)
- Indirect Impact
- Direct Impact

[1] Non-Branchiopod Habitat Wetlands within 50 feet of Preserve edge are considered Indirectly Impacted

[2] All Non Directly Impacted Depressional Features within Central Drainage are Classified as Avoided.

[3] JPA Southest Connector is responsible for the interchange that will be built at Grant Line Rd and University Rd.

[4] Edge Treatment consists of 50 ft. trail/swale buffer. Areas shown greater than 50ft will consist of additional low intensity land use as identified in the SPA.

[5] Portions of the University and Carson Creek preserves without edge treatment will have a 50ft. buffer encumbered by a deed restriction to limit earth work and other intrusive development activities.

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Scale in Feet
0 2,000

Photo Source: NAIP 2014

Map Date: 10/28/2015

Location: J:\GIS_Maps\2005-217_Cordova_Hills\AlternativesAnalysis\Onsite\v30 (2015-03-25 Updated Modified Action Alternative\Modified_Proposed_Action_wEdgeTreatment_wHUC_20151015.mxd (ECK/DEK/JDS/ELL) -lSvager 10/28/2015

Table 2. Delineated Wetlands in the Cordova Hills Project Site

Type	Project Site	Road Improvements	Total Acreage
Vernal pool	47.509	0.081	47.590
Seasonal wetland	4.771	0	4.771
Seasonal Impoundment	0	0.025	0.025
Seasonal wetland swale	18.219	0.046	18.265
Seep	0.012	0	0.012
Intermittent Drainage	16.899	0	16.899
Creek	0.174	0.109	0.283
Stock Pond	1.522	0	1.522
Roadside Ditch	0	0.099	0.099
Total:	89.106	0.360	89.466

SCARI data was also used to assess off-site indirect impacts on ESA habitat features. All depressional wetland types within the data set that fell within ¼ mile of the Project boundary were assessed; in the absence of more detailed information, these depressional wetlands have been classified as vernal pools for the purposes of ESA impact assessment and mitigation. Due to a lack of more detailed information, these wetlands are not discussed in more detail below; however, they likely have characteristics similar to the vernal pools described below.

3.4.4.1 Vernal Pool

A total of 47.509 acres of vernal pools were mapped on-site within the Project and 0.081 acre of vernal pool was mapped within the off-site road improvement areas (Table 2). Vernal pools are scattered through the site's annual grassland habitats and are topographic basins within the grassland community and typically are underlain with an impermeable or semi-permeable hardpan or duripan layer. Vernal pools typically are inundated through the wet season and are dry by late spring through the following wet season. The composition of plant species within the vernal pools on-site is predominantly native annual species that include little quaking grass (*Briza minor*), creeping spikerush (*Eleocharis macrostachya*), double-horned downingia (*Downingia bicornuta*), Solano downingia (*Downingia ornatissima*), Vasey's coyote-thistle (*Eryngium vaseyi*), white-head navarretia (*Navarretia leucocephala*), smooth goldfields (*Lasthenia glaberrima*), slender popcorn flower (*Plagiobothrys stipitatus*), Mediterranean barley (*Hordeum marinum*), toad rush (*Juncus bufonius*), ryegrass, and Carter's buttercup (*Ranunculus bonariensis*).

3.4.4.2. Seasonal Wetland

A total of 4.771 acres of seasonal wetlands were mapped within the Project (Table 2). Seasonal wetlands are ephemerally wet areas where runoff accumulates within low-lying depressions and/or adjacent to watercourses. Inundation periods tend to be relatively short and are commonly dominated by nonnative annual, and sometimes perennial, hydrophytic species. The dominant wetland vegetation found in seasonal wetland areas on-site includes creeping spikerush, Vasey's coyote-thistle, toad rush, ryegrass, Carter's buttercup, and spiny-fruit buttercup (*Ranunculus muricatus*).

3.4.4.3 Seasonal Wetland Swale

A total of 18.219 acres of seasonal wetland swale were mapped within the Project and 0.046 acre of seasonal wetland swale was mapped within the off-site road improvements area (Table 2). Seasonal wetland swales are shallow, ephemerally wet areas that convey water between larger drainages or other Waters features during storm events. They usually occur as linear features. Wetland swales may remain saturated into the growing season and support hydrophytic vegetation and exhibit hydric soil characteristics. The dominant wetland vegetation observed in seasonal wetland swales on-site included creeping spikerush, Vasey's coyote-thistle, Mediterranean barley, toad rush, ryegrass, slender popcorn-flower, Carter's buttercup, and cut-leaf geranium.

3.4.4.4 Seep

A total of 0.012 acre of seep occurs within the Project site (Table 2). Seeps are seasonally or perennially wet areas resulting from discharge of groundwater to the surface. The seeps are located on a hillside in the southeastern portion of the property. Dominant plant species identified in the seeps included iris-leaf rush (*Juncus xiphioides*), white-tip clover (*Trifolium variegatum*), and ryegrass. Other species found in the seeps include cut-leaf geranium and common coyote thistle (*Eryngium castrense)*.

3.4.4.5 Intermittent Drainage

A total of 16.899 acres of intermittent drainage were mapped within the Project site (Table 2). Intermittent drainages are linear features that exhibit an ordinary high water mark (OHWM). These features tend to be unvegetated due to the depth and scouring effects of flowing water. Plants observed sparsely within the intermittent drainages on-site include ryegrass, hairy hawkbit, toad rush, brome fescue (*Vulpia bromoides*), Vasey's coyote-thistle, Carter's buttercup, creeping spikerush, and bractless hedge-hyssop (*Gratiola ebracteata*).

3.4.4.6 Creek

A total of 0.174 acre of Carson Creek was mapped within the Project site, and 0.085 acre of Laguna Creek and 0.024 acre of unnamed creeks were mapped within the off-site road improvements area (Table 2). Carson Creek is a seasonal feature that conveys runoff following rain events and support intermittent pools and year-round water in deeper scour pools. The substrate within the channel is a matrix of sand, gravel, silt, and small boulders. The stream channel has well-defined banks with an OHWM, and is largely unvegetated due to the scouring effects of fast moving water. Large cottonwoods (*Populus fremontii*) occur in scattered areas along portions of the creek margin, although not within the Project site. The portions of Laguna Creek and unnamed creeks within the off-site road improvements area have a less defined bed and bank, and are largely lacking riparian vegetation.

3.4.4.7 Stock Pond

A total of 1.522 acres of stock pond were mapped within the Project (Table 2). Stock ponds are ephemeral or perennial deep, water-filled basins that are human-made and generally used for water storage for irrigation or cattle grazing. As with other seasonally wet areas, the periodically inundated

margins of the ponds support seasonal wetland vegetation including toad rush, ryegrass, and spiny-fruit buttercup. The deeper portions of these pond supported emergent aquatic vegetation including white water buttercup (*Ranunculus aquatilis*) and mannagrass (*Glyceria declinata*).

3.4.4.8 Roadside Ditch

A total of 0.099 acre of roadside ditch was mapped within the off-site road improvements area (Table 3). These ditches are generally barren to sparsely vegetated, with a base of rock or gravel in some places, and are flashy features that convey road runoff for short durations.

3.4.4.9 Seasonal Impoundment

A total of 0.025 acre of seasonal impoundment was mapped within the off-site road improvements area (Table 2). These areas appeared to be similar to vernal pools and swales in the area, but were classified based on SCARI wetland data types (USACE 2011).

3.5 Impact and Preservation Analysis of Jurisdictional Waters

Table 3 outlines the anticipated acres of on-site and off-site direct impacts and acres of on-site preservation of Waters resulting from the Project.

Table 3. Acres of Waters Preserved and Directly Impacted by the Cordova Hills Project Site

	Impact Location		
Wetland/Waters Type	On-site	Off-site Road Improvement Areas	On-site Preserve
Vernal Pool	15.292	0.081	32.217
Seasonal Wetland	2.730	0.000	2.041
Seasonal Wetland Swale	11.090	0.046	7.130
Seep	0.012	0.000	--
Intermittent Drainage	4.426	0.000	12.474
Creek/Stream	0.000	0.109	0.174
Stock Pond	0.688	0.000	0.835
Seasonal Impoundment	0.000	0.025	--
Roadside Ditch	0.000	0.099	--
Total:	34.238	0.360	54.871

3.6 Federally-Listed Species

Two species of federally listed vernal pool crustaceans and one species of federally listed plant are known to be present within the Project site and are discussed in more detail below.

3.6.1 Vernal Pool Crustaceans

Assessment level wet-season large crustacean surveys were conducted between 2 January and 4 February 2013 by ECORP biologists (ECORP 2013b). These surveys targeted the federally listed as threatened vernal pool fairy shrimp and endangered vernal pool tadpole shrimp. During surveys, approximately 50 percent of all depressional wetlands (vernal pools and seasonal wetlands) and 95 percent of ephemeral and intermittent drainages within the entire Project site were surveyed once.

Of the 944 features surveyed, listed crustaceans were only found in approximately 10 percent (95) of the features. Vernal pool fairy shrimp was observed in 36 aquatic features and vernal pool tadpole shrimp were observed in 74 aquatic features.

During the 2013 wet-season surveys, listed vernal pool crustaceans were identified within a total of 89 wetlands and other Waters on the western plateau (ECORP 2013b). These occurrences account for 94 percent of all the crustacean occurrences detected in 2013. Topography east and south of the western plateau becomes much steeper, and as such, the aquatic habitat becomes linear and hydrologically episodic ("flashy"). The only known occurrences outside of the western plateau are six occurrences of vernal pool fairy shrimp, which are located in depressional wetlands on the west side of the central drainage.

In addition to the 2013 wet season surveys, 41 vernal pools and seasonal wetlands east of the western plateau were subsequently targeted for dry season surveys during the summer of 2013 (ECORP 2013c). These surveys were intended to confirm the relative distribution of vernal pool crustaceans on the Project site by supplementing the broader wet season surveys. These wetlands were selected, in consultation with the USFWS, because they appeared to provide the highest quality habitat for listed vernal pool crustaceans east of the western plateau. No evidence of federally listed crustaceans (carapaces or cysts) was identified during these targeted dry-season surveys.

In an effort to gain still more certainty on the distribution of vernal pool crustaceans on the Project site (other than on the plateau, where distribution is known to be widespread) and determine effects to these species, protocol-level wet and dry season surveys were conducted in 2014. The results of this effort largely confirmed the assessment that the majority of on-site vernal pool crustacean habitat occurs in the western plateau, with additional occurrence in depressional features associated with the central drainage (ECORP 2015). Table 4 outlines the presence of vernal pool crustacean habitat on the Project site. The majority of vernal pool crustacean habitat and occurrence is located within the Plateau and Central Drainage preserves (Figure 4).

No surveys for vernal pool crustaceans have been conducted on off-site portions of the Action Area supporting wetland resources including the off-site road improvement areas. For purposes of this analysis, presence of vernal pool crustaceans are anticipated in vernal pools and seasonal wetlands associated with the road improvement areas (Table 4).

Table 4. Acreage of Waters within the Cordova Hills Project Site with Habitat for Vernal pool Crustaceans

Wetland Type	Project Site	Road Improvements	Total
Vernal pool	44.006	0.081	44.087
Seasonal wetland	1.936	0.000	1.936
Seasonal Impoundment	0.000	0.025	0.025
Seasonal wetland swale	6.390	0.046	6.436
Intermittent Drainage	1.652	0.000	1.652
Stock Pond	1.522	0.000	1.522
Total:	55.506	0.152	55.658

3.6.2 Special-Status Plants

Six special-status plant surveys were conducted within the Project site between 2007 and 2011 (ECORP 2007, 2008b, 2009a, 2009b, 2010, 2011). One population of the federally endangered Sacramento Orcutt grass was detected within the Project during both the 2007 and 2008 surveys. This population included occurrences in three vernal pools within the Project site.

These three occurrences of Sacramento Orcutt grass will be avoided by Project activities and will be included within the on-site Plateau Preserve. In addition, a minimum buffer of 300 feet around each occupied vernal pool will be maintained in order to reduce indirect effects from construction activities and eliminate edge effects to this species. As a result, no hydrologic impacts to the pools containing Sacramento Orcutt grass are anticipated; therefore, no mitigation for Project-related impacts to Sacramento Orcutt grass has been proposed. It is anticipated that long-term management of the on-site preserves and mitigation properties will benefit Sacramento Orcutt grass.

While vernal pools that may serve as habitat for special-status plants occur within the off-site road infrastructure areas, no surveys have been done to date due to access constraints. It is not certain at this time if this Project will complete these off-site road improvements prior to them being constructed by another entity (the necessary road improvements are of regional importance). Should this Project fill suitable special-status plant habitat within the off-site road improvements area, targeted surveys will be completed prior to construction.

3.7 Impact and Preservation Analysis for Vernal Pool Crustacean Habitat

Attachments B through D outline the preservation and impact analysis for vernal pool crustacean habitat associated with the Project. The Applicant worked closely with the USFWS in determining an appropriate impact and avoidance strategy.

Table 5 summarizes each on-site impact and avoidance category for vernal pool crustacean habitat (please note that these impact acreages represent a subset of those included in Table 3, which is a presentation of all wetlands and Waters on the Project site or affected by off-site improvements associated with the Project). For the purposes of mitigation planning, it has been assumed that Waters categorized in Table 5 as "Avoided (No Preservation Credit)" will not be impacted, will not require mitigation, and will not be credited as Preservation. Waters that are categorized in Table 5 as "Avoided (Preservation Credit)" will count towards the Project's mitigation requirements for direct and indirect impacts on vernal pool crustaceans. Where changes in hydrology may occur due to development within the micro-watershed of the preserved features, indirect effects were assessed (Table 5). Proposed Preserves are described in detail in Section 8.0 below.

For planning purposes, it has been assumed that vernal pool, seasonal wetland swale, and seasonal impoundment within the off-site road improvement areas may serve as habitat for vernal pool crustaceans. Within these habitats, 0.152 acres of direct impacts and 1.693 acres of indirect impacts are anticipated. Additionally, 2.787 acres of potentially suitable habitat within the off-site ¼-mile radius of the Project site may be indirectly impacted (Attachments B through D). These acreages are included in Table 5.

Table 5. Acres of Vernal Pool Crustacean Habitat Preserved and Directly or Indirectly Affected by the Cordova Hills Project Site

Acreage	Avoided (Credit)	Avoided (No Credit)	Direct Impact	Indirect Impact
On-Site	27.731	6.021	18.316	3.439
Off-Site (1/4 mile radius)	--	--	--	2.787
Off-Site (Roads)	--	--	0.152	1.693
Total:	27.731	6.021	18.468	7.919

4.0 FRAMEWORK FOR PROPOSED MITIGATION OF IMPACTS ON WATERS

4.1 Mitigation Approach for Impacts on Waters

To determine the compensatory mitigation requirements for the Project, the Applicant used the following guidelines:

1. Reduce Project-related wetland impacts to the extent practicable by avoiding impacts to Waters including wetlands to the extent practicable [33 CFR 332.1(c)(2)].
2. Seek in-watershed mitigation [33 CFR 332.3(a)]. For this Project, the affected watersheds are the Lower Sacramento and Upper Cosumnes.
3. Purchase of credits at a mitigation bank is favored over permittee-responsible mitigation (PRM) unless it can be demonstrated that PRM is environmentally preferable [33 CFR 332.3(a) and 332.3(b)].
4. Impacts on vernal pools within the MCA should be mitigated within the MCA (USACE 2011) to the extent practicable.
5. Compensate for wetland impacts through creation of or purchase of credits for similar wetland types affected by the Project (i.e., in-kind mitigation).

Following this approach, wetland impacts have been substantially reduced from the Applicant's initial proposal in 2008, which affected 50 percent of the on-site wetlands, to the Applicant's current preferred alternative, the MPA alternative, which affects 38 percent of the on-site wetlands. Vernal pool avoidance has also increased from 53 percent in the Applicant's initial proposal, to 69 percent in the MPA, which represents a 16 percent increase.

When developing this Proposal, in-watershed mitigation was given priority. The Project site is bisected by two distinct 8-digit HUC watersheds, the Lower Sacramento and the Upper Cosumnes. ECORP conducted a lidar-based analysis to identify watershed "breaks" along Waters to determine with greater accuracy which Waters were attributed to which watersheds in actuality (Figure 4).

In-watershed mitigation will help ensure that replacement Waters are of similar functions and values to those impacted, and will be created/preserved in the same relative geographic location of those being impacted. Table 6 details on-site and off-site impacts to Waters within each watershed. Note that vernal pool impacts within the MCA are discussed below.

Table 6. On-Site and Off-Site Direct Impacts on Waters by HUC 8 Watershed for the Cordova Hills Project Site

	Direct Impacts	
Waters	Lower Sacramento	Upper Cosumnes
Vernal Pool (non-MCA)	0.000	1.030
Creek	0.109	0.000
Intermittent Drainage	0.301	4.124
Seasonal Wetland	0.682	2.048
Seasonal Wetland Swale	1.545	9.590
Seep	0.000	0.012
Stock Pond	0.688	0.000
Seasonal Impoundment	0.025	0.000
Roadside Ditch	0.099	0.000
Total:	3.449	16.804

A portion of the MCA, as defined in the Vernal Pool Species Recovery Plan (USFWS 2005), is located on the Project site (Figure 2).

As discussed in the Record of Decision for the nearby Sun Ridge Project and Project-specific guidance from the USACE on the Project, impacts to vernal pools were analyzed independently from the 8-digit HUC watersheds. For the purposes of no-net-loss mitigation for vernal pools, the Applicant has proposed to mitigate for impacts to vernal pools that occur in the MCA within the MCA to the extent practicable and appropriate.

Table 7. U.S. Army Corps of Engineers Jurisdictional Impacts on Vernal Pools in the Mather Core Area (MCA) and Proposed Acres of Creation/Restoration

Type	Impacts	Proposed Creation/Restoration
Vernal Pools in the MCA	14.343*	16.570**

*Includes 0.081 acre of vernal pools within the off-site road improvements area.

**Includes 14.790 acres of creation at Shehadeh and 1.780 acres of restoration at Chester Drive mitigation properties.

4.2 Mitigation Proposal for Impacts on Waters

To the maximum extent practicable mitigation for impacts to Waters will be mitigated in-watershed. A combination of purchase of credits at Regulatory Agency-approved mitigation bank(s) and permittee-responsible mitigation at the Mitigation Properties and On-site Preserves is proposed to accomplish mitigation requirements (Table 8). Table 8 summarizes Cordova Hills' impacts and proposed mitigation into broader resource categories in order to compare the impact type and location with the mitigation type and location.

Table 8. Acres of Waters Impacts and Anticipated U.S. Army Corps of Engineers Credits by Compensation Type – Clean Water Act Compliance

		Acres of Credit/Compensation by Type Restoration/Creation					
Type	Impacts	On-site Preserves (partial credit to be determined by USACE)	Cosumnes Mitigation Bank	Chester Drive	Shehadeh	Toad Hill	Total Mitigation
Vernal Pool (MCA)	14.343	31.780	-	1.780	14.790	-	48.350
Vernal Pool (non-MCA)	1.030	0.438	--	--	--	7.120	7.558
Seasonal wetlands, ponds, ditches, etc.	14.690	10.005	4.900 (Floodplain Riparian Credits)	--	--	--	14.905
Creek and Intermittent Drainage Impacts	4.535	12.648	24.660 (Floodplain Mosaic Credits)	--	--	--	37.308
Total:	34.598	54.871	29.560	1.780	14.790	7.120	108.121

In summary, the Applicant is currently proposing 108.121 acres of preservation and creation/restoration plus another 23.73 acres of vernal pool crustacean habitat preservation at Shehadeh, Chester, and Gill Ranch for a total of 131.851 acres of preservation/creation to offset 34.617 acres of impacts to waters of the U.S.

Due to the lack of available vernal pool creation credits from an Agency-approved mitigation bank within the MCA, it is environmentally preferable for the Applicant to use permittee-responsible mitigation within the MCA rather than buying credits from mitigation banks outside of the MCA. Mitigation within the MCA will ensure that replacement vernal pools are of similar quality to those impacted, share similar soils and vegetative characteristics, and generally contribute to the regional goals and objectives of the Recovery Plan (USFWS 2005). Impacts to MCA vernal pools will be offset through restoration/creation of 16.570 acres of vernal pools within and directly adjacent to the MCA at the permittee-responsible mitigation properties (Chester Drive and Shehadeh Properties). The Shehadeh Property is located entirely within the MCA. Additionally, a portion of the 17.9-acre Chester Drive Property is located within the MCA (Figure 2). The majority (13.35 acres) of the Chester Drive Property consists of one large vernal pool, which is part of a much larger vernal pool on the Bryte Ranch Conservation Bank. It is unclear why the MCA boundary bisects this vernal pool; therefore, it is logical to receive MCA vernal pool preservation and restoration credit at the Chester Drive Property.

Additional credit for on-site preservation of vernal pools is also anticipated; the acreage of credit will be determined by the USACE. Lastly, the balance of required creation credits for vernal pool impacts would be purchased at the Toad Hill Ranch Mitigation bank.

Impacts for non-vernal pool impacts would be mitigated through on-site preservation and the purchase of credits at a mitigation bank. As the Project site will be preserving in perpetuity large amounts of Waters, the Applicant has discussed with the USACE the potential to receive some credit towards the Applicant's creation requirement for this significant preservation component (Table 8). The balance of required credits would be purchased at the Cosumnes Floodplain Mitigation Bank, including 4.900 acres of floodplain riparian credits and 24.660 acres of floodplain wetland mosaic credits.

5.0 FRAMEWORK FOR MITIGATION OF IMPACTS ON VERNAL POOL CRUSTACEAN HABITAT

5.1 Mitigation Approach for Impacts on Vernal Pool Crustacean Habitat

The Project would affect habitat for federally listed vernal pool crustaceans. Impacts on vernal pool crustaceans are regulated by the USFWS. The majority of directly and indirectly impacted vernal pool crustacean habitat associated with the Project is located within the MCA. Therefore, for the purposes of compensation for impacts on vernal pool crustacean habitat, the Applicant has attempted to secure as much on-site and off-site preservation of Waters within the MCA as practicable. The Project Applicant has attempted to meet the approximately 2.6:1 preservation to impact ratio for direct impacts to listed vernal pool crustacean habitat within the MCA that was included in the USFWS' 2 November 2011 BO for the Rio del Oro Project (USFWS #81420-2010-F-0891-1), which is located approximately 2.25 miles northwest of the Project in Sacramento County. Table 9 outlines the Project's anticipated direct and indirect impacts and proposed preservation and mitigation ratios for vernal pool crustacean habitat.

Table 9. Impacts on Vernal Pool Crustacean Habitat at the Cordova Hills Project Site, Proposed Mitigation Ratios, and Required preservation

Type	Impacts	Proposed Mitigation Ratio	Required Preservation
Direct Impact – MCA	15.671*	2.6:1	40.745
Direct Impact – nonMCA	2.797	1:1	2.797
Indirect Impacts			
Onsite	3.439	1:1	3.439
Offsite ¼-mile radius	2.787	1:1	2.787
Offsite Roads	1.693	1:1	1.693
Total:	26.387		51.461

*Includes 0.152 acres of vernal pool crustacean habitat impacts from off-site road impacts.

5.2 Mitigation Proposal for Impacts on Vernal Pool Crustacean Habitat

As shown in Table 9, a total of 51.461 acres of preservation are required to compensate for Project effects (direct and indirect, on-site and off-site impacts) on vernal pool crustacean habitat to comply with the ESA. As noted in Table 10, the applicant is proposing the preservation of 56.284 acres of vernal pool crustacean habitat, of which nearly 50 acres (90 percent) is within the MCA. All indirect impacts associated with the Project are proposed to be mitigated at a ratio of 1:1 (preservation), which may be secured within or outside of the MCA. Table 10 summarizes impacts, acres of compensation required (see Table 9) and proposed habitat preservation through the on-site preserves, off-site Mitigation Properties, and an agency-approved mitigation bank.

As demonstrated in Table 10, the on-site preserves provide the opportunity to preserve ±27.731 acres of vernal pool crustacean habitat. Preservation of 13.350 acres and 8.600 acres would occur at the Chester Drive and Shehadeh mitigation properties, respectively. An additional 1.78 acres of preservation is proposed at the Gill Ranch Conservation Bank.

Table 10. Acres of Vernal Pool Crustacean Habitat Impacts, Required Mitigation*, and Proposed Preservation by Property Location for the Cordova Hills Project.

Properties	Impacts (Direct and Indirect)	Acres of Preservation Required	Acres of Preservation Credit Proposed by Location
Cordova Hills Project (in MCA)	23.590	48.664	27.731
Cordova Hills Project (nonMCA)	2.797	2.797	
Chester Drive (in MCA)	--	--	13.350
Shehadeh (in MCA)	--	--	8.600
Gill Ranch	--	--	1.78
Total:	26.387	51.461	51.461

*See Table 9 for Required Mitigation

6.0 MITIGATION BANKS

The Project applicant is proposing to use three Agency-approved mitigation banks: the Toad Hill Ranch Mitigation Bank, the Cosumnes Floodplain Mitigation Bank, and the Gill Ranch Conservation Bank.

6.1 Toad Hill Mitigation Bank

The Toad Hill Ranch Mitigation Bank is a USACE, USEPA, and USFWS-approved mitigation bank located in northern Sacramento County and western Placerville County. This 1,630-acre mitigation bank provides credits for Vernal Pool Preservation, Vernal Pool Creation, and Swainson's hawk *(Buteo swainsoni)* foraging habitat. The bank provides habitat for federally or state listed species including, but not limited to: Swainson's hawk, vernal pool fairy shrimp, and vernal pool tadpole shrimp. The Mitigation Bank service area includes parts of Placer, Sutter, Sacramento, El Dorado, Amador, San Joaquin, Yuba, Nevada and Calaveras counties. The Cordova Hills Project site is within the Bank's service area. Cordova Hills' indirect impacts and vernal pool impacts outside the Mather Core are proposed to be mitigated at the Toad Hill Ranch Mitigation Bank. The Cordova Hills Project site is within the Bank's service area.

6.2 Cosumnes River Mitigation Bank

The Cosumnes River Floodplain Mitigation Bank is a USACE-, USEPA-, and California Department of Fish & Wildlife (CDFW)-approved mitigation bank located at the confluence of the Cosumnes and Mokelumne Rivers in the upper Cosumnes watershed. The site encompasses 472 acres in Sacramento County; the mitigation bank provides compensatory mitigation for Floodplain Mosaic Wetlands, Floodplain Riparian Habitats, and Shaded Riverine Aquatic Habitats. The bank provides habitat for federally or state listed species including, but not limited to: Chinook salmon(*Oncorhynchus tshawytscha)*, tricolored blackbird *(Agelaius tricolor)*, and Swainson's hawk. In addition, the Mitigation Bank is within the service area for Sacramento County, as well parts of Sutter, Contra Costa, Calaveras, San Joaquin, Alameda, Solano, Yolo, and Amador counties. The Cordova Hills Project site is within the Bank's service area.

6.3 Gill Ranch Conservation Bank

The approximately 1,800-acre Gill Ranch Conservation Bank is located within the Cosumnes watershed. Gill Ranch is a 7,052-acre ranch in southeast Sacramento County near the community of Wilton. The ranch consists of mostly gently rolling grasslands with over 500 acres of wetlands in the Cosumnes Watershed. Gill Ranch Conservation Bank is a USFWS-approved bank. The site provides compensatory mitigation for the preservation of vernal pool fairy shrimp and vernal pool tadpole shrimp habitat. The service area for the conservation bank covers a broad area from Marysville to the Calaveras River east of Lodi and from Auburn to San Andreas. The Cordova Hills Project site is within the Bank's service area.

7.0 MITIGATION PROPERTIES

Two properties are proposed as off-site wetland mitigation areas for the Project. These are the Chester Drive Property and the Shehadeh Property (collectively, "Mitigation Properties"). The Mitigation Properties lie within seven miles of the Project within the Lower Sacramento watershed (Figure 2).

In compliance with the USACE recommendation to mitigate Mather Core impacts within the Mather Core, Cordova Hills is mitigating for all 14.343 acres of Mather Core vernal pool impacts entirely within the MCA (16.57 acres at Shehadeh and Chester). The Shehadeh Property is located within the MCA and the Chester Drive Property is partially inside the MCA. The large vernal pool that occurs on the Chester Drive Property is hydrologically connected to another large vernal pool on the adjacent Bryte Ranch Conservation Bank (which is mapped inside the MCA). For the purposes of this Proposal it has been assumed that the Applicant will receive mitigation credit within the MCA for vernal pool restoration at the Chester Drive Property. Additional details for each of these Mitigation Properties are presented below.

7.1 Chester Drive Property

The approximately 17.3-acre Chester Drive Property is located in Sections 13 and 14, Township 7 North, Range 6 East (MDBM) Sacramento County, California (Figure 1). The property can be found at UTM 650,252 M E; 4,258,065 M N (Zone 10 North) and is portrayed on the Elk Grove, California 7.5-minute quadrangle (USGS 1979). It is within the Lower Sacramento HUC-8 watershed and is considered to be within the MCA (see Section 6.2 below).

Currently, Cordova Hills, LLC has control over this property through an option to purchase.

A jurisdictional delineation was completed at the Property in 2012 (Gibson and Skordal 2012; USACE 2013a – SPK2012-00909). Based on that determination, the Chester Drive Property supports 13.241 acres of vernal pool and one 0.612-acre seasonal pond (Figure 5. *Chester Drive Property Wetland Delineation*).

Figure 5. Chester Drive Property Wetland Delineation

7.1.1 Hydrology, Topography, and Vegetation

The Chester Drive Property sits at an elevation of approximately ±90 feet above MSL and consists primarily of a large vernal pool but also supports a home-site and stock pond. The on-site vernal pool is part of an approximately ±150-acre vernal pool at the adjacent Bryte Ranch Mitigation Bank. The site is northeast of a tributary of Laguna Creek. Surface water potentially exits the property from the southwest corner and flows to this tributary during wetter portions of the year. The site has less ponding than it did historically, which has contributed in a shift in the dominant vegetation from vernal pool endemics to nonnative seasonal wetlands dominated by rye grass and Mediterranean barley in normal years.

7.1.2 Soils

According to the Natural Resources Conservation Service (NRCS) Soil Survey, two soil map units occur within the Chester Drive Property. The first unit is Galt clay, 0-2 percent slopes (152). This typic chromoxerert is moderately deep, moderately well drained, and possesses a calcareous hardpan that is weakly cemented with silica at a depth of approximately ±32 inches. It contains inclusions of Clear Lake, Dierssen, and San Joaquin soils and urban land. The second map unit found within the study area is San Joaquin silt loam, 0-3 percent slopes (214). It is a moderately deep, moderately well drained soil with a 23-inch surface layer over a 5-inch claypan. Under this lies an 11-inch indurated hardpan situated above a 15-inch silica cemented hardpan. Surface water often pools after over-irrigation or heavy winter/spring rains. This unit also includes inclusions of Bruella, Galt, Hedge, and Kimball soils.

7.1.3 Historical, Present, and Proposed Uses

Review of current and historic aerial photographs of the Chester Drive Property indicates that the property had supported vernal pool complex habitat and has been used historically for farming. A rectangular-shaped growth of trees is located on the southwestern portion of the Property around an artificial pond (Figure 5). As seen in historic photographs of the property, the Chester Drive Property once supported vernal pool complex habitat (Figure 6. *Chester Drive Property 1937 Historical Aerial Photograph*). Currently, the property includes a private residence, stock pond, and large vernal pool.

The property is proposed to be used as off-site mitigation for Waters and vernal pool crustaceans, and will be restored and managed for the benefit of these resources. Management of the Chester Drive Property will increase the ecological functions and value of the restored vernal pool habitat.

7.1.4 Special-Status Species at the Chester Drive Property

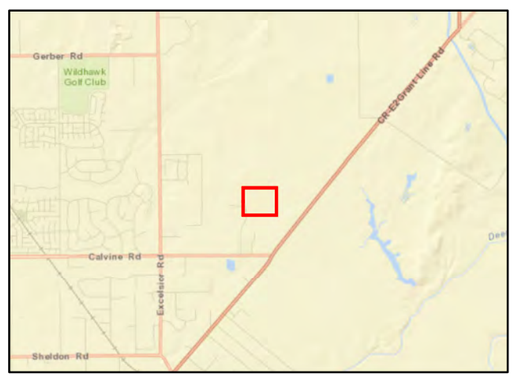
Surveys for vernal pool crustaceans were conducted during the 2011-2012 and 2012-2013 wet seasons, and vernal pool tadpole shrimp were observed on the Chester Drive Property, as well as California linderiella (*Linderiella occidentalis*) (Gibson & Skordal 2012). Vernal pool fairy shrimp were not observed on the site, but have high potential to occur on the property since the vernal pool on-site is part of a larger vernal pool in the Bryte Ranch mitigation bank, where both vernal pool fairy shrimp and vernal pool tadpole shrimp have been documented. There is a known population of Sacramento Orcutt grass approximately 2.5 miles from the Property. There is also one occurrence of

Figure 6. Chester Drive Property 1937 Historical Aerial Photograph

Map Features

Chester Drive Boundary [2]

Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom,



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Location: J:\GIS_Maps\2005-217_Cordova_Hills\Mitigation_Plan\v2 Mitigation Proposal (20150209)\(Figure6) ChesterProperty_1937Aerial.mxd (JDS) -elawson 7/6/2015

2005-217 Cordova Hills

Scale in Feet
0 150

Photo Source: USDA 1937
[1] Verified by the Army Corps of Engineers SPK-2012-00909, March 7, 2013
[2] Gibson and Skordal

Map Date: 7/6/2015

slender Orcutt grass (*Orcuttia tenuis*) less than one mile from the Property and another 1.3 miles from the Property (California Department of Fish and Wildlife 2015). Based on feedback from the USFWS that it would be ideal to document both vernal pool fairy shrimp and vernal pool tadpole shrimp at the mitigation properties, ECORP is currently conducting additional surveys (2015-2016).

7.1.5 Proposed Creation/Restoration of Waters at the Chester Drive Property

A vernal pool restoration plan for the Chester Drive Property is included in Attachment E. The restoration plan has determined that the site is hydrologically suitable to sustain restored Waters based upon topography of the local catchments and soil profiles and to ensure that existing vernal pools and other wetland resources will not be negatively impacted by the restoration of Waters.

Approximately ±1.780 acres of vernal pool restoration are proposed at the Chester Drive Property. This will be achieved by removing the home site and restoring the area (Attachment B). The vernal pool on the Chester Drive property is part of a larger vernal pool located on the adjacent Bryte Ranch Conservation Bank that is within the MCA (Figure 5).

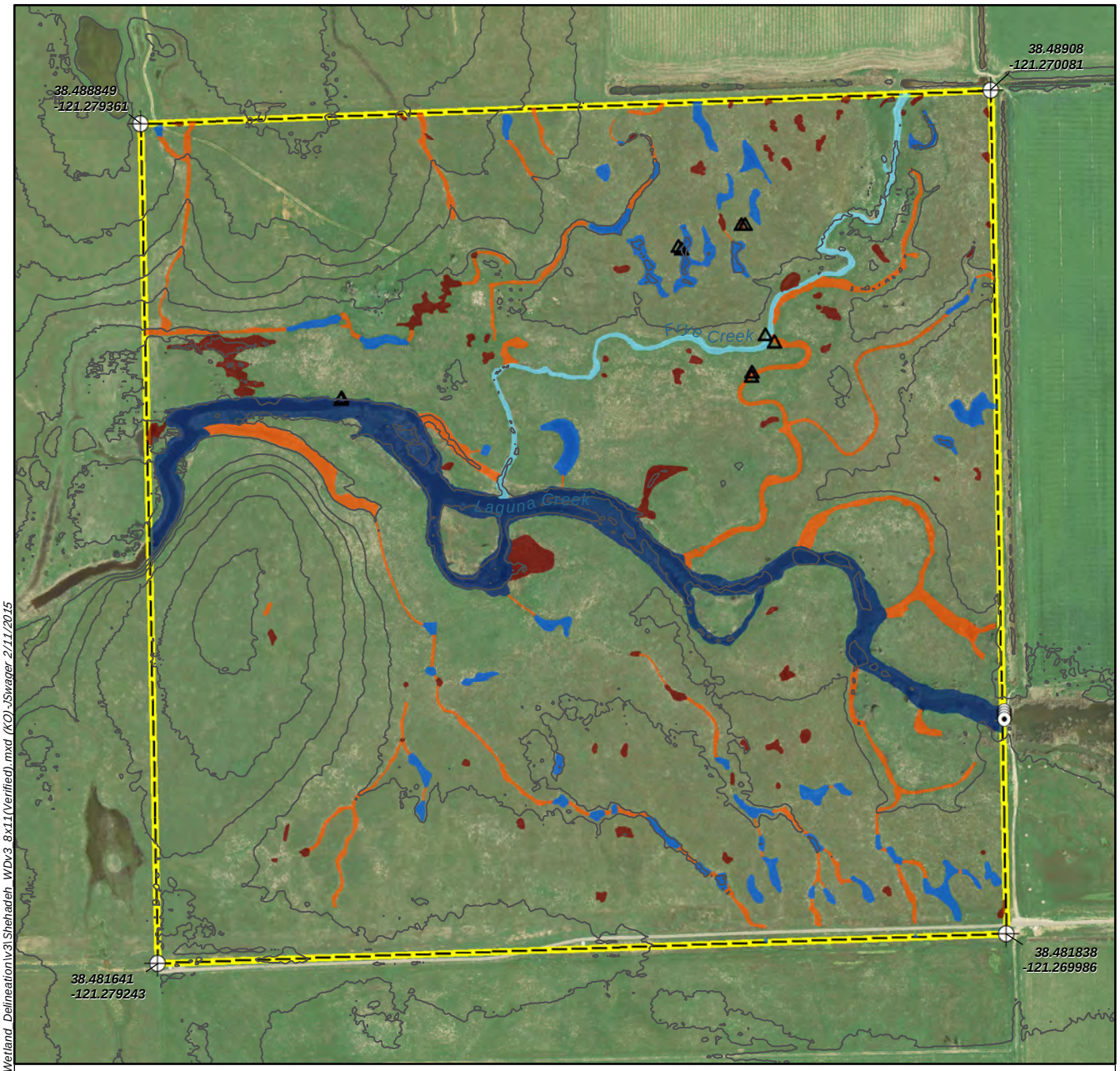
7.2 Shehadeh Property

The approximately 160-acre Shehadeh Property is located south of Florin Road, east of Excelsior Road, west of Eagles Nest Road, and north of Grant Line Road, Sacramento County, California. The property corresponds to a portion of Sections 1, 2, 11 and 12 of Township 7 North, Range 6 East (MDBM) of the Elk Grove, California 7.5-minute quadrangle (USGS 1979). This property is within the Lower Sacramento HUC-8 watershed and within the MCA. Currently, Cordova Hills, LLC owns this property.

The Shehadeh Property supports 16.235 acres of jurisdictional Waters including 2.677 acres of vernal pool, 1.933 acres of seasonal wetland, 3.990 acres of seasonal wetland swale, and 7.635 acres of other Waters (ECORP 2013d; USACE 2013b - SPK2013-00998). These other Waters include 0.832 acre of Frye Creek (intermittent drainage), and 6.803 acres of Laguna Creek (Perennial Creek) (Figure 7. *Shehadeh Property Wetland Delineation*).

7.2.1 Hydrology, Topography, and Vegetation

The site is composed of generally flat to gently rolling terrain and is situated at an elevation of approximately ±85 feet to 130 feet above MSL. Surrounding land uses include intensive agriculture to the northeast, east, and south and conservation areas to the northwest, west, and southwest. The site is divided by Laguna Creek which flows from east to west through the site. Vegetation surrounding Laguna Creek includes willow thickets (*Salix* species), Valley oak (*Quercus lobata*), Himalayan blackberry (*Rubus armeniacus*), and cattail (*Typha* species). The northern and southern portions of the property are dominated by an annual grassland community with scattered ephemeral wetlands including vernal pools, seasonal wetlands, and seasonal wetland swales. The annual grassland community is dominated by nonnative annual grasses including soft brome, wild oats, medusahead grass, and ryegrass. Other species occurring in the annual grassland include rose clover, hairy hawkbit, smooth cat's ear (*Hypochaeris glabra*), sticky tarweed, filaree, and cut-leaf geranium (ECORP 2012).



Property Boundary +/- 160 acres

Three-criteria Sample Point

Culvert

Reference Coordinate (NAD83)

Scale in Feet

0 500

WATERS OF THE U.S. ACREAGE [1]

CLASSIFICATION	ACREAGE	LINEAR FT
WETLANDS:		
Vernal Pool	2.677	----
Seasonal Wetland	1.933	----
Seasonal Wetland Swale	3.990	----
OTHER WATERS:		
Frye Creek (Intermittent Drainage)	0.832	2,602
Laguna Creek (Perennial Creek)	6.803	4,547
TOTAL:	16.235	7,149

[1] *Verified by U.S. Army Corps of Engineers SPK-2013-00998, November 26, 2013. This exhibit depicts information and data produced in strict accord with the wetland delineation methods described in the 1987 Corps of Engineers Wetlands Delineation Manual and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region and conforms to Sacramento District specifications. However, wetland boundaries have not been legally surveyed and may be subject to minor adjustments if exact locations are required.*

Location: N:\2012\2012-099 Shehadeh Property\MAPS\Wetland_Mapping\Wetland_Delineation\v3\Shehadeh_WDv3_8x11(Verified).mxd (KO)-JSwager 2/11/2015

Map Date: 2/11/2015
Photo: USGS 2011
Delineation: T. Wood

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Figure 7. Shehadeh Property Wetland Delineation

2005-217 Shehadeh Property

7.2.2 Soils

According to the NRCS Soil Survey, five soil units or types have been mapped within the Shehadeh Property: Fiddyment Fine Sandy Loam, 1-8 percent slopes, Hedge Loam, 0-2 percent slopes, Redding Gravelly Loam, 0-8 percent slopes, San Joaquin Silt Loam, 0-3 percent slopes, and Xerarents-San Joaquin Complex, 0-1 percent slopes.

7.2.3 Historical, Present, and Proposed Uses

A review of current and historic aerial photographs of the Shehadeh Property indicates that the Property was used historically for ranching or farming. Agricultural roads and fences outline the boundaries of the Property along all sides. A dirt road enters through the northwestern corner of the Property and travels approximately 300 meters southeast where it terminates at what appear to be foundations or structural remains. This property is currently used for livestock grazing. The property is proposed to be used as off-site mitigation for Waters and vernal pool crustaceans and will be managed for the benefit of these resources.

7.2.4 Special-Status Species at the Shehadeh Property

ECORP conducted dry-season surveys on the Shehadeh Property on 5 May 2013; vernal pool tadpole shrimp cysts and cysts for *Branchinecta* sp. were identified within the soil samples (ECORP 2013d). It is anticipated that all vernal pools and seasonal wetlands on the Property, as well as future-created vernal pools, will represent suitable habitat for both vernal pool tadpole shrimp and vernal pool fairy shrimp. There are two occurrences of slender Orcutt grass approximately ±1.5 miles southwest of the Property, and four occurrences of Sacramento Orcutt grass approximately ±5 miles northeast of the Property (CDFW 2015). Special-status plant surveys have not been conducted on this Property to date. Based on feedback from the USFWS that it would be ideal to document both vernal pool fairy shrimp and vernal pool tadpole shrimp at the mitigation properties, ECORP is currently conducting additional wet-season assessment surveys (2015-2016) to identify the *Branchinecta* on site to species.

7.2.5 Proposed Creation/Restoration of Waters at the Shehadeh Property

A vernal pool creation plan for the Shehadeh Property is included in Attachment C. Approximately ±14.789 acres of vernal pool creation were planned at the Shehadeh Property; and the proposed vernal pools are distributed throughout the site. The overall vernal pool density for the Shehadeh Property would be approximately 10.9 percent following creation; however, slight modifications made based on site conditions may have resulted in a higher acreage of created pools. Final area of the created vernal pools will be determined during hydrological monitoring in upcoming wet seasons.

8.0 On-site Preserves

The Modified Proposed Action Alternative includes approximately 578.3 acres of on-site land preservation incorporated in four on-site preserves: 1) the Plateau Preserve, 2) the Central Drainage Preserve, 3) the University Preserve, and 4) the Carson Creek Preserve (Figure 8. *Wetland Preserves, Edge Treatments & Impacts by Phase*), which are described in further detail below. The on-site preserves are centered on the largest and most complex arrays of Waters of the U.S. and federally listed species habitat. The boundaries of the preserves were delineated to account for existing terrain and drainage patterns.

8.1 Plateau Preserve

The premier on-site preserve is the Plateau Preserve. The Plateau Preserve lies on the western plateau of the Project site and is biologically important because it contains the highest number and density of vernal pools on the Project site. The western plateau differs from the remainder of the Project site, as it consists of a single geologic unit (the Laguna Formation), is relatively flat with gently rolling topography, and falls within the Laguna Creek Watershed (a distinct watershed from the rest of the Project site, see Figure 7). The Plateau Preserve also lies within the MCA.

This portion of the Project site supports the highest quality and density of vernal pools on the site as evidenced by results of the California Rapid Assessment Method analysis completed for the Project site. A total of 24 Assessment Areas were completed on a subset of wetlands. Scores ranged from 72.8/100 (for wetlands east of the plateau) to 84.7/100 (for the wetlands on the western plateau) see, "Updated On-Site Wetland Preservation Analysis for the Modified Proposed Action Alternative", contained Attachment B. The Plateau Preserve is hydrologically connected to vernal pool complexes to the north and west and represents the highest quality habitat within the Project site for the federally listed vernal pool fairy shrimp, vernal pool tadpole shrimp, and Sacramento Orcutt grass (ECORP 2015 *Shrimp Report in production*).

8.2 Central Drainage and University Preserves

To the east and south of the western plateau, elevation drops off steeply, and existing water resources are mostly steep and flashy intermittent drainages. Topography again begins to flatten toward the center of the Project site, where the proposed 99.9-acre Central Drainage and 37.7-acre University Preserves are located. These preserves have been configured to encompass the highly incised intermittent "central drainage," as well as the majority of adjacent swales, drainages, and depressional wetlands in order to maintain the integrity of the central drainage system. This linear preserve will also allow for wildlife connectivity north and south of the Project site. Several vernal pools and seasonal wetlands associated with the central drainage provide vernal pool crustacean habitat.

Location: J:\GIS_Maps\2005-217_Cordova_Hills\AlternativesAnalysis\Onsite\v30 (2015-03-25 Updated Modified Action Alternative\Modified_Proposed_Action_wEdgeTreatment_wPhasing_20151015.mxd (ECK/DEK/JDS/ELL)-JSwager 10/28/2015

Figure 8.
Wetland Preserves, Edge Treatments & Impacts by Phase

All Waters Listed Below Fall Under the Jurisdiction of the CWA.

Central Drainage Preserve

Plateau Preserve

Carson Creek Preserve

University Preserve

Map Features

- Project Boundary
- JPA Reserve [3]
- Overall Preserve Area
- Edge Treatment [4]

Preserve Name

- Carson Creek (59.2 ac.) [5]
- Central Drainage (99.9 ac.)
- Plateau (381.6 ac.)
- University Preserve (37.7 ac.) [5]

Project Phase

- Phase 1
- Phase 2

404 Wetland Impacts [1]

- Avoided
- Direct Impact

ESA Wetland Impacts [2]

- Avoided (Credit)
- Avoided (No Credit)
- Indirect Impact
- Direct Impact

[1] Non-Branchiopod Habitat Wetlands within 50 feet of Preserve edge are considered Indirectly Impacted

[2] All Non Directly Impacted Depressional Features within Central Drainage are Classified as Avoided.

[3] JPA Southest Connector is responsible for the interchange that will be built at Grant Line Rd and University Rd.

[4] Edge Treatment consists of 50 ft. trail/swale buffer. Areas shown greater than 50ft will consist of additional low intensity land use as identified in the SPA.

[5] Portions of the University and Carson Creek preserves without edge treatment will have a 50ft. buffer encumbered by a deed restriction to limit earth work and other intrusive development activities.

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2005-217 Cordova Hills

Scale in Feet
0 2,000

Photo Source: NAIP 2014

Map Date: 10/28/2015

8.3 Carson Creek Preserve

To the east of the central drainage, the Project site begins to gain elevation, and becomes a series of rolling hills until its eastern edge. In this area, the topography begins to flatten toward Carson Creek to the east. This area contains the proposed 59.2-acre Carson Creek Preserve, a portion of which abuts the approximately 139-acre off-site Carson Creek East Property, which will be protected for the purposes of agricultural preservation and Swainson's hawk habitat for this Project. The Project is designed to limit direct and indirect impacts to wetlands and other Waters within the four on-site preserves through the incorporation of edge conditions (Figure 3). Edge conditions are defined as the physical edge conditions surrounding all preserve edges. The edge conditions are located outside the preserve boundaries proper, and the widths vary based on the specific edge area and its characteristics (watersheds, gradients, and land use type). Edge conditions were designed based on input from the USFWS and the California Native Plant Society and are expected to serve as an important transition zone between the preserved wetlands and Waters and the adjacent build-out, which will greatly limit indirect impacts on protected resources. The edge condition will serve as an additional buffer decreasing "edge effects" on wildlife and habitat within the preserve. Native landscaping within the edge condition will also help protect the Preserves against the migration of invasive nonnative species commonly found in the urban environment. Drainage swales will intercept runoff from surrounding land uses and will sustain the hydrology and inundation regime of the preserved wetlands.

Site-specific edge conditions are described in Attachment G. The edge conditions at the Plateau Preserve, central drainage Preserve and a portion of the University Preserve will include a 50-foot buffer with a drainage swale, an 8-foot naturalized area planted with native straw seeding, a pedestrian trail, and a second drainage swale. Drainage swales will function as a hydrological barrier between urban runoff/nuisance flows and the preserves.

Where the edge condition along the Plateau and Central Drainage preserve is wider (up to 100 feet in some locations), the additional buffer area would be located on the development side of the edge condition area and serve as an additional buffer by supporting low-intensity land uses such as parks, trails, and water treatment basins, further decreasing potential "edge effects" to wildlife and habitat.

The Carson Creek Preserve and the remainder of the University Preserve will be surrounded by less intensive land uses (primarily low-density residential). These areas will include a 50-foot buffer restriction within the adjacent residential properties. Activities on adjacent residential properties will be restricted through Covenants, Conditions, and Restrictions and deed restrictions that prohibit ground disturbing activities within 50 feet of the preserve boundary.

9.0 PROPOSED MITIGATION AT THE MITIGATION PROPERTIES

Permittee-responsible compensatory mitigation is proposed at the Mitigation Properties (Chester Drive and Shehadeh). Based on the USACE direction to provide mitigation within the MCA to the extent practicable, the 14.343 acres of vernal pool impacts within the MCA at the Cordova Hills Project site are proposed for mitigation within the MCA. Approximately 14.79 acres of vernal pool creation has been constructed at the Shehadeh and 1.78 acres of restoration is propsed at the Chester Drive property. As there are no vernal pool creation credits currently available at Regulatory

Agency-approved mitigation banks within the MCA, this Proposal relies heavily on permittee-responsible mitigation. It should be noted that the Project falls primarily within the Urban Development Area outlined in the South Sacramento Habitat Conservation Plan (SSHCP). Timely completion and approval of the SSHCP may allow for the mitigation of the Project through the mechanisms established in the SSHCP. These mechanisms include payment of fees, acquisition of conservation easement(s), and/or acquisition of mitigation land(s) in fee title that are not presented in this Proposal. Therefore, the Applicant reserves the right to fulfill all or part of the Project's mitigation requirements using allowed SSHCP mechanisms should SSHCP approval and implementation occur, and/or by purchasing credits should vernal pool creation credits become available from a Regulatory Agency-approved mitigation bank within the MCA.

9.1 Proposed Mitigation Phasing

Impacts and corresponding mitigation to Waters, including those that are potential habitat for the vernal pool crustaceans, are proposed to be phased corresponding to the Project's anticipated development phasing (Figure 8). Table 11 describes the impacts to Waters and vernal pool crustacean habitat that will occur during each anticipated phase.

Table 11. Acres of Direct and Indirect On-Site and Off-Site Impacts to Waters and Vernal Pool Crustacean Habitat by Project Phase

	Impacts by Project Phase	
Waters	Phase 1	Phase 2
404 Wetlands/Waters Direct Impact	24.563	9.674
Acres that are also Vernal Pool Crustacean Habitat	*17.861*	*0.455*
Vernal Pool Crustacean Habitat Indirect Impact	7.919	0.000

9.2 Proposal Goals

The goal of this Proposal is for the Project to result in no-net-loss of Waters as well as preservation of vernal pool crustacean habitat. The mitigation proposed within Sacramento County will benefit the County by increasing the local abundance of endemic plant species associated with local vernal pool ecosystems, by contributing to the survival and recovery of vernal pool species listed under ESA, including preservation within the MCA to the maximum extent practicable, and will result in no-net-loss of wetland habitat resulting from the implementation of the Project. Additionally, the Mitigation Properties will add to the adjacent regional open space preserves that exist currently as well as those that are planned due to implementation of the SSHCP, resulting in larger contiguous preserved areas.

9.2.1 Hydrology and Topography

The restoration/creation of Waters will be designed to have hydrology typical of similar Waters in the region. Direct precipitation and overland flows resulting from precipitation will make up the source of water for the wetlands.

9.2.2 Vegetation

Given that the wetlands will be designed to have hydrology typical of vernal pools, seasonal wetlands, and seasonal wetland swales in the Central Valley, the target plant species for the habitat is the suite of plants typically associated with these habitat types. The vernal pools are expected to be dominated by species such as slender popcorn-flower, Carter's buttercup, smooth goldfields, white-head navarretia, annual hairgrass (*Deschampsia danthonioides)*, downingia (*Downingia* sp.), and Vasey's coyote-thistle. The seasonal wetlands are expected to be dominated by wetland generalist plant species that occur in the area such as Italian rye-grass *(Lolium multiflorum)*, Mediterranean barley, rabbit's-foot grass *(Polypogon monspeliensis)*, and cut-leaf geranium. The seasonal wetland swales are expected to be dominated by most of the same wetland generalist plants as the seasonal wetlands.

9.2.3 Wildlife Habitat

As a result of wetland restoration efforts, there will be an increase in wetland habitat at the Mitigation Properties. This in turn, will result in an increase in wintering waterfowl, shorebirds, invertebrates, and amphibians that utilize ephemeral wetlands. Wetland restoration may also result in an increase in vernal pool fairy shrimp, vernal pool tadpole shrimp, and Sacramento Orcutt grass habitat suitability, and occurrences at the Mitigation Properties.

9.2.4 Presence of Vernal Pool Tadpole Shrimp and Vernal Pool Fairy Shrimp

As described above in Section 3.6, as well as in Attachment C, vernal pool crustaceans are present at the Project site, including within two of the on-site preserves. Table 9 summarizes the preservation of vernal pool crustacean habitat both within the on-site preserves and at the Mitigation Properties.

An assessment level dry season (cyst/embryonic egg) survey was conducted on 23 aquatic features at the Shehadeh Property (ECORP 2013e). Cysts belonging to the genus *Branchinecta* were observed in 13 aquatic features and cysts belonging to the federally endangered vernal pool tadpole shrimp were observed in two aquatic features on-site. Several species within the genus *Branchinecta* are federally listed as threatened or endangered and these cysts are not identifiable to a species level. However, given the location of the Shehadeh Property, and the general types of habitats in which the cysts were found, the cysts most likely belong to the federally threatened vernal pool fairy shrimp.

The Chester Drive property contains vernal pool tadpole shrimp (Gibson and Skordal 2013). There is a high likelihood that the on-site vernal pool also supports vernal pool fairy shrimp given its connectivity to the adjacent Bryte Ranch Conservation Bank, which supports both vernal pool tadpole shrimp and vernal pool fairy shrimp.

9.3 Rationale for Expecting Implementation Success

ECORP has successfully designed and overseen the establishment of numerous compensatory wetland mitigation projects in Sacramento and Placer counties, including those in locations with similar attributes to the Mitigation Properties. This experience will be used in the design and

restoration of the off-site Mitigation Properties. As wetland mitigation proposed at the Chester Drive Property consists of restoration to historic conditions, and will result in greater connectivity to a larger adjacent and highly functioning vernal pool, it has a high likelihood of success. The Applicant has retained the Institute for Ecohydrology Research to prepare detailed wetland creation plans for the Shehadeh Property and Chester Drive Property (Attachments F and G). These wetland creation plans include detailed topographic, ground-penetrating radar, and hydrologic data in order to determine not only where the placement of created wetlands is feasible, but also to ensure existing wetland hydrology is not negatively impacted. Detailed monitoring and success criteria will be developed for each site, as discussed below. The on-site preserves are protected from impacts by buffers and edge treatments along their borders.

9.4 Success Criteria and Monitoring

If the mitigation outlined in this Proposal is determined by the USACE to be acceptable, detailed Mitigation Monitoring Plans will be developed and sent to the USACE for coordination with other Agencies, review, and approval. These Mitigation Monitoring Plans will include the specifics of the proposed wetland restoration (e.g., construction plans), success monitoring methodology for the restored wetlands, performance criteria, adaptive management plans and annual reporting requirements.

Success criteria will comply with USACE Standard Operating Procedure for Uniform Performance Standards and focus on physical, hydrologic, faunal-diversity, and floral performance standards for depressional wetlands. These detailed criteria will be site-specific, and have not been completed to date.

9.5 Long-Term Management

Following wetland restoration efforts and the completion of the wetland success monitoring, all three of the Mitigation Properties as well as the on-site preserves will be managed in perpetuity as open space preserves in accordance with all requirements of the Regulatory Agencies, including the implementation of an Agency-approved long term management plan, conservation easement, funding mechanism, and the assignment of a Preserve Manager. It is anticipated that a land-trust accredited non-profit manager (Sacramento Valley Conservancy or similar) or other organization deemed suitable by the Regulatory Agencies will serve as the Preserve Manager.

10.0 STATUS OF THE PROPOSED PLAN IN RELATION TO USACE MITIGATION REGULATION

This Proposal is being developed consistent with the USACE mitigation regulation at 33 CFR 3324(c) and with the recently announced USACE South Pacific Division's *Final 2015 Regional Compensatory Mitigation and Monitoring Guidelines*.

10.1 Objectives

The goal of this Proposal is for the Project to result in no net functional loss of Waters as well as preservation of vernal pool crustacean habitat. The mitigation proposed within Sacramento County will benefit the County by increasing the local abundance of endemic plant species associated with local vernal pool ecosystems, by contributing to the survival and recovery of vernal pool species listed under ESA, including preservation within the MCA to the maximum extent practicable, and will result in no net loss of wetland habitat resulting from the implementation of the Project. Additionally, the Mitigation Properties will add to the adjacent regional open space preserves that exist currently as well as those that are planned due to implementation of the SSHCP, resulting in larger contiguous preserved areas.

Specifically, for CWA compliance, the Applicant proposes the following compensatory mitigation:

- Preserve 27.731 acres of MCA vernal pools on-site.
- Preserve 2.680 acres of MCA vernal pools at Shehadeh mitigation property.
- Create 14.790 acres of MCA vernal pools at Shehadeh mitigation property.
- Rehabilitate 13.350 acres of vernal pools at Chester Drive mitigation property.
- Re-establish 1.780 acres of vernal pools at Chester Drive mitigation property.
- Purchase 24.660 floodplain wetland mosaic credits at the Cosumnes Floodplain mitigation bank.
- Purchase 4.900 floodplain riparian credits at the Cosumnes Floodplain mitigation bank.
- Purchase 7.120 vernal pool creation credits at the Toad Hill Ranch mitigation bank.

10.2 Site Selection

The Mitigation Properties in this Proposal were selected based largely on the importance of in-watershed mitigation for the purposes of the USACE. The Project site is bisected by two 8-digit HUC watersheds, the Lower Sacramento and the Upper Cosumnes. Proposed mitigation for impacts in each watershed is, to the extent practicable, located in the same watershed. Based on the USACE direction to provide mitigation within the MCA to the extent practicable, a mix of purchase of credits at Regulatory Agency-approved mitigation bank(s) and permittee-responsible mitigation at the two Mitigation Properties in the vicinity of the proposed Project site and within the MCA is proposed.

10.3 Site Protection Instrument

Site protection instruments will be prepared when the final mitigation plan is submitted to the USACE for review and approval. These instruments will be USACE- and USFWS-approved conservation easements at the two permittee-responsible Mitigation Properties and at the Project's on-site preserves.

10.4 Baseline Information

Baseline information on the Project site is presented in Section 3.4 above.

10.5 Determination of Credits

The Applicant has coordinated extensively with the USACE to determine the appropriate suite of compensatory mitigation for CWA compliance for unavoidable impacts to aquatic resources resulting from the permitted activity. The mitigation proposed in this document is based on the South Pacific Division Mitigation Ratio Setting Checklists, completed for the Project by the USACE. The final acreages of compensatory mitigation will ultimately be determined by the USACE during the permitting process.

For unavoidable impacts to threatened and endangered vernal pool crustaceans regulated by the USFWS, the Applicant has attempted to meet the approximately 2.6:1 preservation to impact ratio for direct impacts to listed vernal pool crustacean habitat within the MCA that was included in the USFWS' 2 November 2011 BO for the Rio del Oro Project (USFWS #81420-2010-F-0891-1), which is located approximately 2.25 miles northwest of the Project in Sacramento County. The acreage of compensatory mitigation for vernal pool crustaceans will ultimately be determined by the USFWS during the consultation process.

10.6 Mitigation Work Plan

Mitigation work plans for the Mitigation Properties are included in Attachments E and F.

10.7 Maintenance Plan

Complete maintenance plans will be developed for each mitigation site prior to USACE permit issuance.

10.8 Ecological Performance Standards

Complete ecological performance standards will be developed for each mitigation site prior to USACE permit issuance.

10.9 Monitoring Requirements

Complete monitoring plans will be developed for each mitigation site prior to USACE permit issuance. The mitigation monitoring plan will include specifics of the proposed wetland restoration (e.g., construction plans), a success monitoring methodology for the restored wetlands, performance criteria, adaptive management plan and annual reporting requirements.

10.10 Long-term Management Plan

Complete long-term management plans will be developed prior to USACE permit issuance. The plans will contain the information identified in the May 2008 "Long Term Management Plan" template, developed by the USACE and the USFWS.

The approach to the long-term management of the sites' biological resources is to conduct annual site examinations and monitoring of selected characteristics to determine stability and ongoing trends of the preserved and created Waters including wetlands, vernal pools, listed vernal pool crustacean species, and special-status plant species. Annual monitoring will assess the sites'

condition, degree of erosion, invasion of exotic or deleterious (e.g., thatch producing) species, water quality, fire hazard, and/or other aspects that may warrant management actions. While it is not anticipated that major management actions will be needed, an objective of this long-term management plan is to conduct monitoring to identify any issues that arise, and use adaptive management to determine what actions might be appropriate. Those chosen to accomplish monitoring responsibilities will have the knowledge, training, and experience to accomplish monitoring responsibilities.

10.11 Adaptive Management Plan

To the extent appropriate, adaptive management plans will be incorporated into the individual mitigation and management plan for each Mitigation Property and on-site preserves.

10.12 Financial Assurances

Financial assurance for components of the mitigation proposal will be identified, as appropriate, in the final mitigation and management plans for the mitigation properties and on-site preserves.

10.13 Other Information

Other information will be included, as appropriate, in the final mitigation and management plans for the mitigation properties and on-site preserves.

11.0 REFERENCES

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ECORP 2013c. 2013 Dry Season Sampling 90-day Report of Findings Regarding Federally Listed Large Branchiopods, Sacramento County, California. Prepared for Cordova Hills, LLC. Prepared by ECORP Consulting, Inc. Rocklin, CA. Dated 4 September 2013.

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ECORP 2013e. 2013 Assessment Level Dry Season 90-Day Report of Findings Regarding Federally-Listed Large Branchiopods for the Shehadeh Property, Sacramento, California. Prepared for Cordova Hills, LLC. Prepared by ECORP Consulting, Inc. Rocklin, CA. Dated 25 July 2013.

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U.S. Department of the Interior, 1980. Buffalo Creek, California 7.5-Minute Quadrangles, U.S. Geological Survey.

LIST OF ATTACHMENTS

Attachment A – Revised Request for Preliminary Jurisdictional Determination for Off-Site Road Improvements

Attachment B – Updated On-Site Wetland Preservation Analysis for the Modified Proposed Action Alternative for Cordova Hills

Attachment C – Summary of Off-Site Indirect Effects to Federally Listed Species

Attachment D – Summary of Indirect Effects to Federally Listed Species Associated with Off-Site Road Improvements

Attachment E – Vernal Pool Restoration Plan and Hydrological Analysis for the Chester Property, Sacramento County, California

Attachment F – Vernal Pool Creation Plan and Hydrological Analysis for Existing Wetlands at the Shehadeh Property, Sacramento County, California

Attachment G – Cordova Hills Edge Conditions, 21 July 2014

ATTACHMENT A

Revised Request for Preliminary Jurisdictional Determination for Off-Site Road Improvements

23 April 2013

Ms. Lisa Gibson
ATTN: Regulatory Branch
1325 J Street, Room 1350
Sacramento, California 95814

RE: Cordova Hills, Sacramento County, California – Revised Request for Preliminary Jurisdictional Determination for Offsite Road Improvements

Dear Ms. Gibson:

Based on the comments you provided on our previous request for a preliminary jurisdictional determination for impacts to Waters of the U.S. associated with offsite road improvements for the Cordova Hills Project, ECORP Consulting, Inc. is submitting a revised request on behalf of Cordova Hills, LLC. The revised project area maps (attached) eliminated potential Waters of the U.S. that fall outside of the project footprint, and include some additional features as identified during a site visit conducted on April 15, 2013, including yourself, Mr. Mark Hanson of Cordova Hills, LLC., and Mr. Ben Watson of ECORP Consulting, Inc. Our request for a preliminary jurisdictional determination now includes 0.360 acres of potential Waters of the U.S. (Table 1).

Table 1 – Potential Waters of the U.S.

Type	**Acreage**
Wetlands	
Vernal Pool	0.081
Seasonal Wetland Swale	0.046
Seasonal Impoundment	0.025
Other Waters	
Creek/Stream	0.109
Roadside Ditch	0.099
Total:	**0.360**

With this letter, we are respectfully requesting a preliminary jurisdictional determination for these wetlands. Please feel free to call me at (916) 782-9100 if you have any questions regarding this request.

Sincerely,

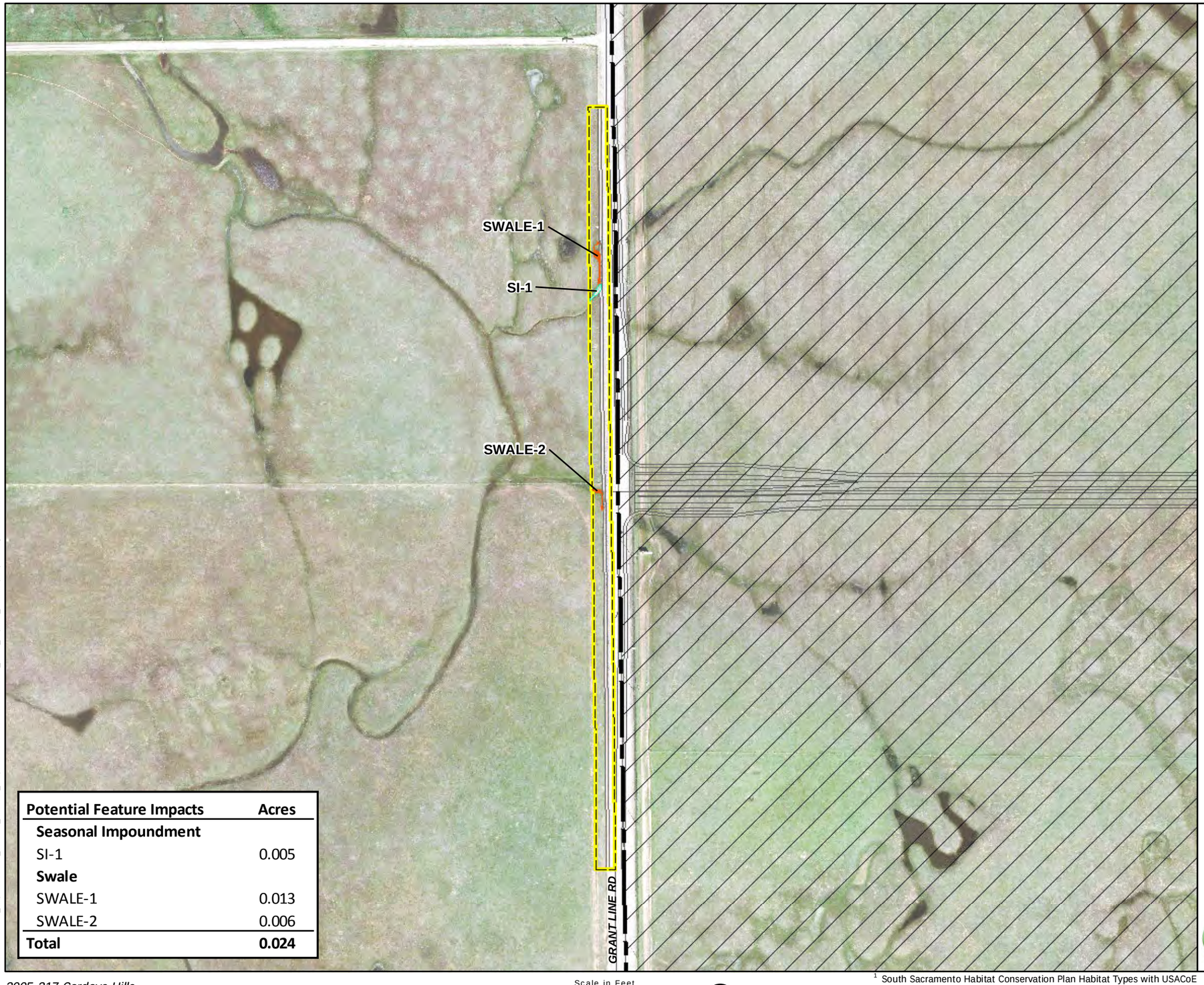
Ben Watson
Project Manager

Cc: Mr. Mark Hanson, Cordova Hills, LLC.

Attachment(s)

Rocklin, CA 95677 • Tel: (916) 782-9100 • Fax: (916) 782-1381 • Web: www.ecorpconsulting.com

At Connection-Trigger Intersection Improvements Grant Line Rd. & Chrysanthy Blvd.



Potential Feature Impacts	Acres
Seasonal Impoundment	
SI-1	0.005
Swale	
SWALE-1	0.013
SWALE-2	0.006
Total	**0.024**

Map Features

- Cordova Hills Project Boundary
- Impact Area

Potentially Impacted Feature [1]

- Seasonal Impoundment
- Swale

Service Layer Credits: National Geographic, Esri, DeLorme, NAVTEQ, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, iPC

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Location: J:\GIS_Maps\2005-217_Cordova_Hills\404_Graphics\404\v4\Offsite\AtConnect_GLCB_Impacts_v4.mxd (JDS)-KOrtega 4/19/2013

2005-217 Cordova Hills

1 " = 200 '

Scale in Feet
0 200

[1] South Sacramento Habitat Conservation Plan Habitat Types with USACoE

Base CAD Data: MSCE
Photo Source: USGS 2009

Map Date: 4/19/2013

At Connection-Trigger Intersection Improvements Grant Line Rd. & North Loop Rd.

Potential Feature Impacts	Acres
Vernal Pool	
VP-1	0.001
VP-2	0.005
Seasonal Impoundment	
SI-2	0.010
Swale	
SWALE-3	0.003
Total	**0.019**

Map Features

- Cordova Hills Project Boundary
- Impact Area

Potentially Impacted Feature [1]

- Seasonal Impoundment
- Swale
- Vernal Pool

Service Layer Credits: National Geographic, Esri, DeLorme, NAVTEQ, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, iPC

ECORP Consulting, Inc.
ENVIRONMENTAL CONSULTANTS

Location: J:\GIS_Maps\2005-217_Cordova_Hills\404_Graphics\404\v4\Offsite\AIConnect_GLNL_Impacts_v4.mxd (JDS)-KOrtega 4/18/2013

2005-217 Cordova Hills

1 " = 200 '

Scale in Feet
0 200

[1] South Sacramento Habitat Conservation Plan Habitat Types with USACoE
Base CAD Data: MSCE
Photo Source: USGS 2009

Map Date: 4/18/2013

At Connection-Trigger Intersection Improvements University Blvd. at Grant Line Rd.

Map Features

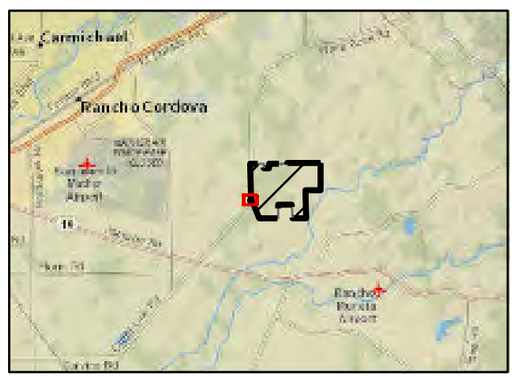
- Cordova Hills Project Boundary
- Impact Area

Potentially Impacted Feature [1]

- Streams/Creeks
- Vernal Pool

Potential Feature Impacts	Acres
Vernal Pool	
VP-3	0.005
VP-4	0.021
Streams/Creeks	
CREEK-1	0.003
Total	**0.029**

Service Layer Credits: National Geographic, Esri, DeLorme, NAVTEQ, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, iPC



ECORP Consulting, Inc.
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Location: J:\GIS_Maps\2005-217_Cordova_Hills\404_Graphics\4041v4\Offsite\AIConnect_GLUB_Impacts_v4.mxd (JDS)-KOrtega 4/18/2013

2005-217 Cordova Hills

1 " = 200 '

Scale in Feet
0 200

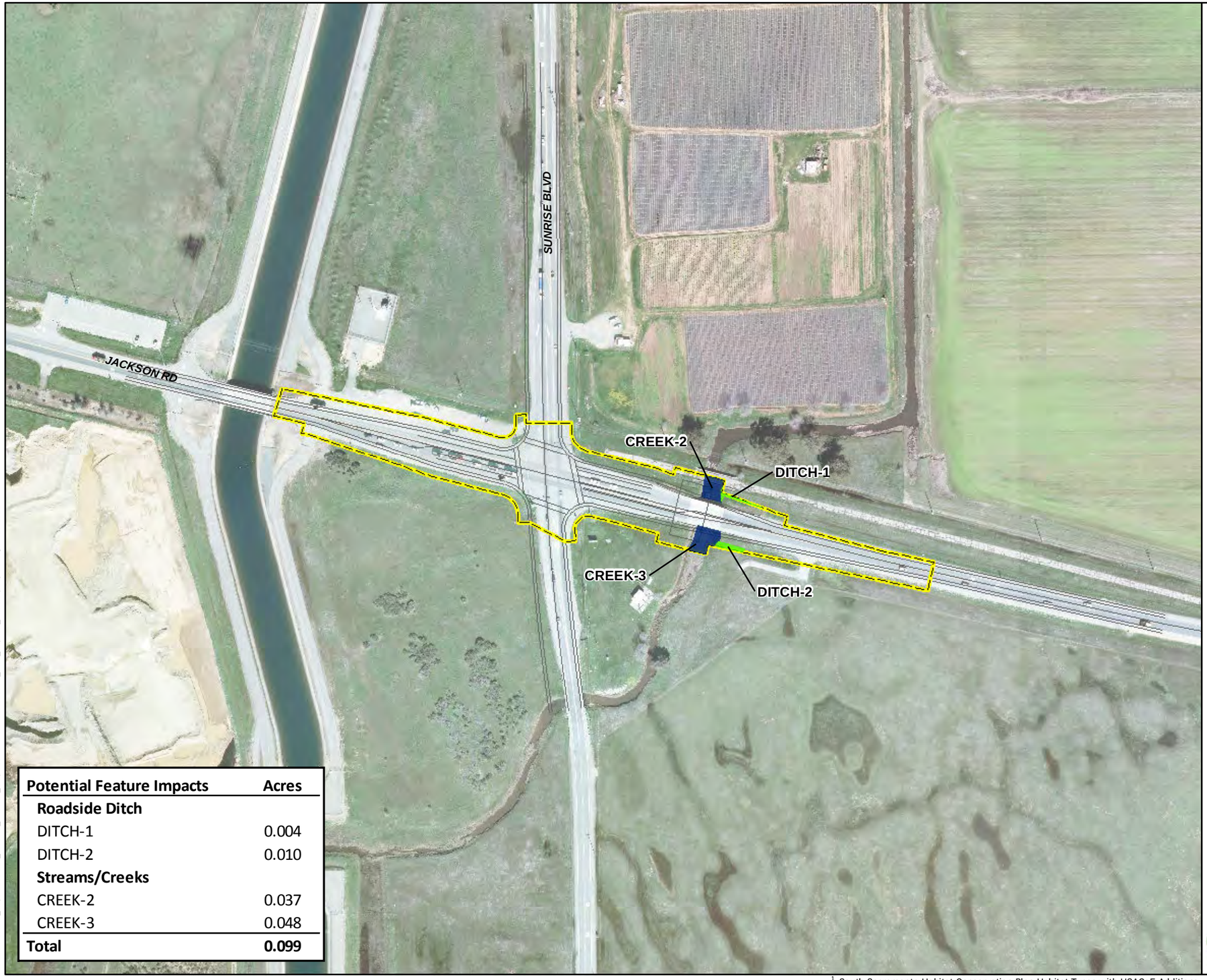
[1] South Sacramento Habitat Conservation Plan Habitat Types with USACoE Additions

Base CAD Data: MSCE

Photo Source: USGS 2009

Map Date: 4/18/2013

250 DU at Jackson Road and Sunrise Blvd.



Potential Feature Impacts	Acres
Roadside Ditch	
DITCH-1	0.004
DITCH-2	0.010
Streams/Creeks	
CREEK-2	0.037
CREEK-3	0.048
Total	**0.099**

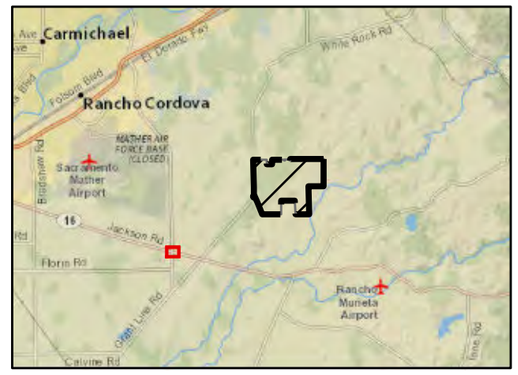
Map Features

- Cordova Hills Project Boundary
- Impact Area

Potentially Impacted Feature [1]

- Roadside Ditch
- Streams/Creeks

Service Layer Credits: National Geographic, Esri, DeLorme, NAVTEQ, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, iPC



ECORP Consulting, Inc.
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2005-217 Cordova Hills

1 " = 200 '

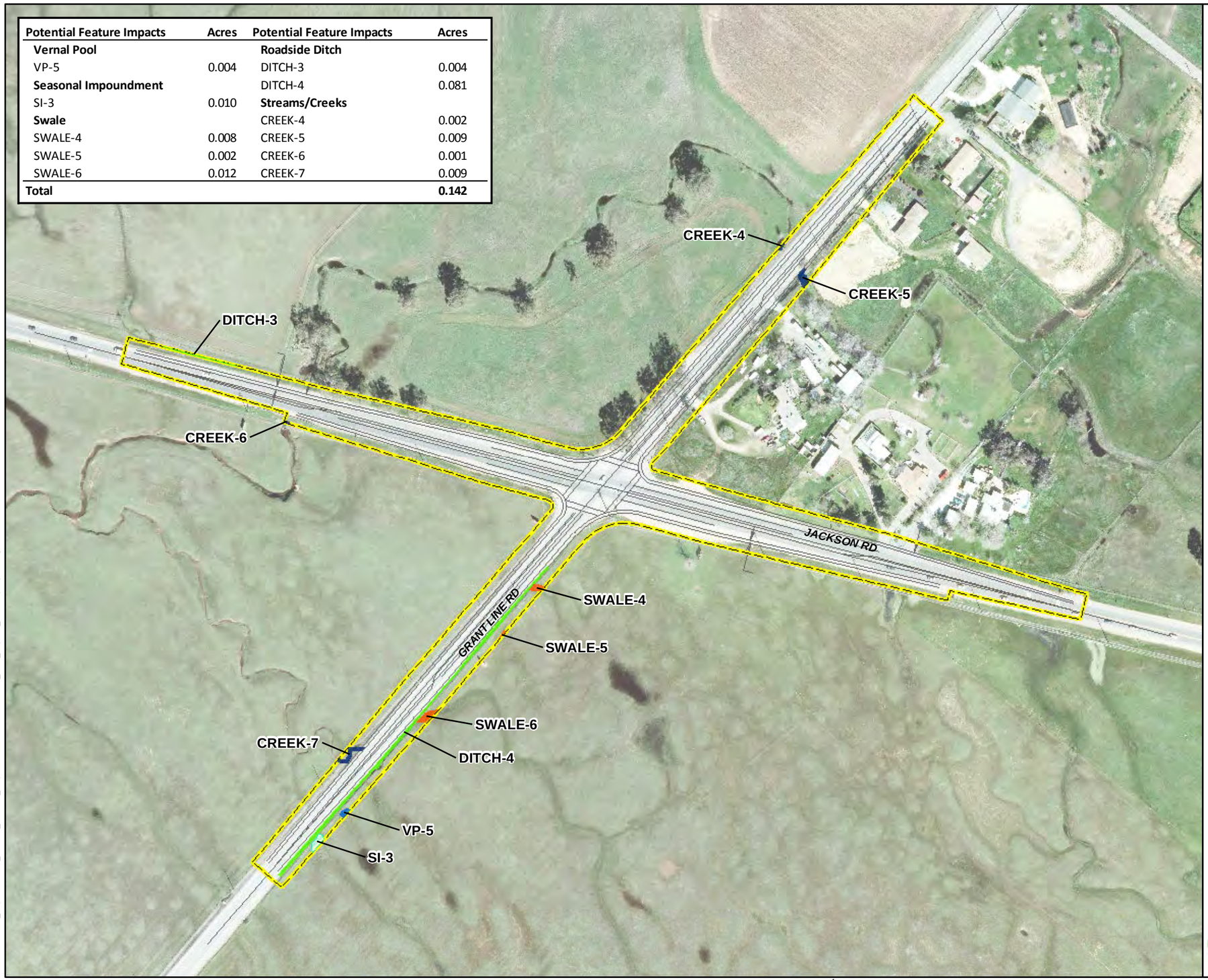
Scale in Feet
0 200

[1] South Sacramento Habitat Conservation Plan Habitat Types with USACoE Additions.
Base CAD Data: MSCE
Photo Source: USGS 2009

Map Date: 4/19/2013

Location: J:\GIS_Maps\2005-217_Cordova_Hills\404_Graphics\404\v4\Offsite\0250DU_JKSB_Impacts_v4.mxd (JDS) KOrtega 4/19/2013

Potential Feature Impacts	Acres	Potential Feature Impacts	Acres
Vernal Pool		**Roadside Ditch**	
VP-5	0.004	DITCH-3	0.004
Seasonal Impoundment		DITCH-4	0.081
SI-3	0.010	**Streams/Creeks**	
Swale		CREEK-4	0.002
SWALE-4	0.008	CREEK-5	0.009
SWALE-5	0.002	CREEK-6	0.001
SWALE-6	0.012	CREEK-7	0.009
Total			**0.142**



500 DU at Grant Line Road and Jackson Road

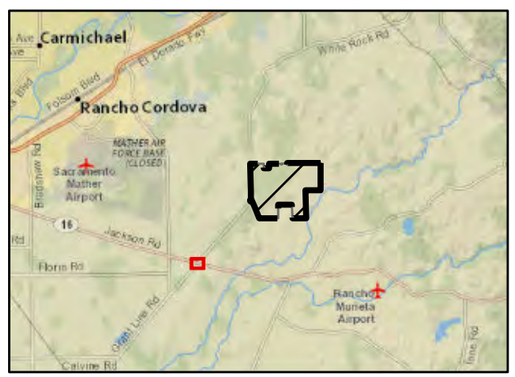
Map Features

- Cordova Hills Project Boundary
- Impact Area

Potentially Impacted Feature [1]

- Roadside Ditch
- Seasonal Impoundment
- Streams/Creeks
- Swale
- Vernal Pool

Service Layer Credits: National Geographic, Esri, DeLorme, NAVTEQ, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, iPC



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Location: J:\GIS_Maps\2005-217_Cordova_Hills\404_Graphics\404\v4\Offsite\0500DU_GLJK_Impacts_v4.mxd (JDS)-KOrtega 4/19/2013

2005-217 Cordova Hills

1 " = 200 '

Scale in Feet
0 200

[1] South Sacramento Habitat Conservation Plan Habitat Types with USACoE Additions.
Base CAD Data: MSCE
Photo Source: USGS 2009

Map Date: 4/19/2013

850 DU at Grant Line Road and Douglas Road

Map Features

- Cordova Hills Project Boundary
- Impact Area

Wetlands_Impacts_20130416_Clip

Potentially Impacted Feature [1]

- Vernal Pool

Potential Feature Impacts	Acres
Vernal Pool	
VP-6	0.031
Total	**0.031**

Service Layer Credits: National Geographic, Esri, DeLorme, NAVTEQ, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, iPC

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Location: J:\GIS_Maps\2005-217_Cordova_Hills\404_Graphics\404\v4\Offsite\0850DU_GLDR_Impacts_v4.mxd (JDS, 4/18/2013) - KOrtega

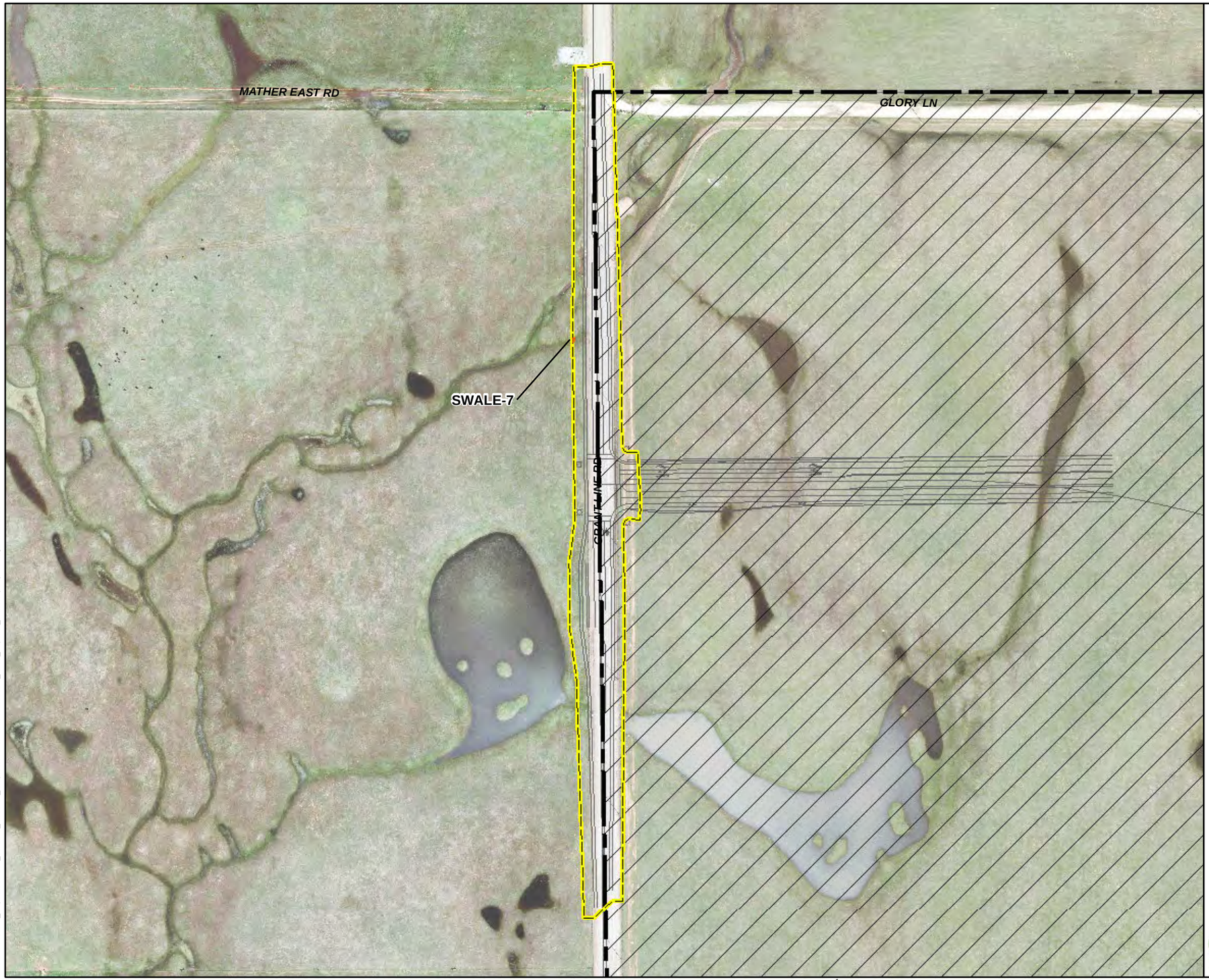
2005-217 Cordova Hills

1 " = 300 '

Scale in Feet
0 300

[1] South Sacramento Habitat Conservation Plan Habitat Types
Base CAD Data: MSCE
Photo Source: USGS 2009

Map Date: 4/18/2013



1250 DU at North Loop Road and Grant Line Road

Map Features

- Cordova Hills Project Boundary
- Impact Area

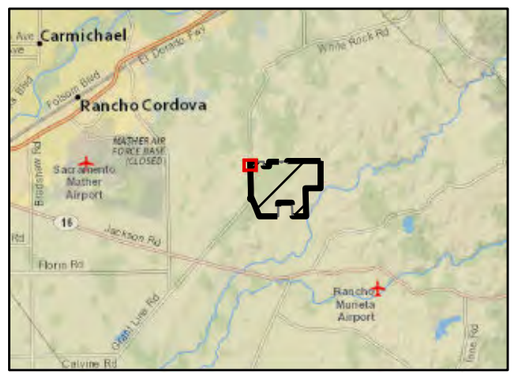
Potentially Impacted Feature [1]

- Swale

Potential Feature Impacts [2]	Acres
Swale	
SWALE-7	0.001
Total	**0.001**

[2] Features within impact area not shown as impacted are features impacted by an another DU.
SSHCP within the Cordova Hills project boundary were excluded from impact analysis

Service Layer Credits: National Geographic, Esri, DeLorme, NAVTEQ, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, iPC



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Location: J:\GIS_Maps\2005-217_Cordova_Hills\404_Graphics\404\v4\Offsite\1250DU_NLGL_Impacts_v4.mxd (JDS) KOrtega 4/18/2013

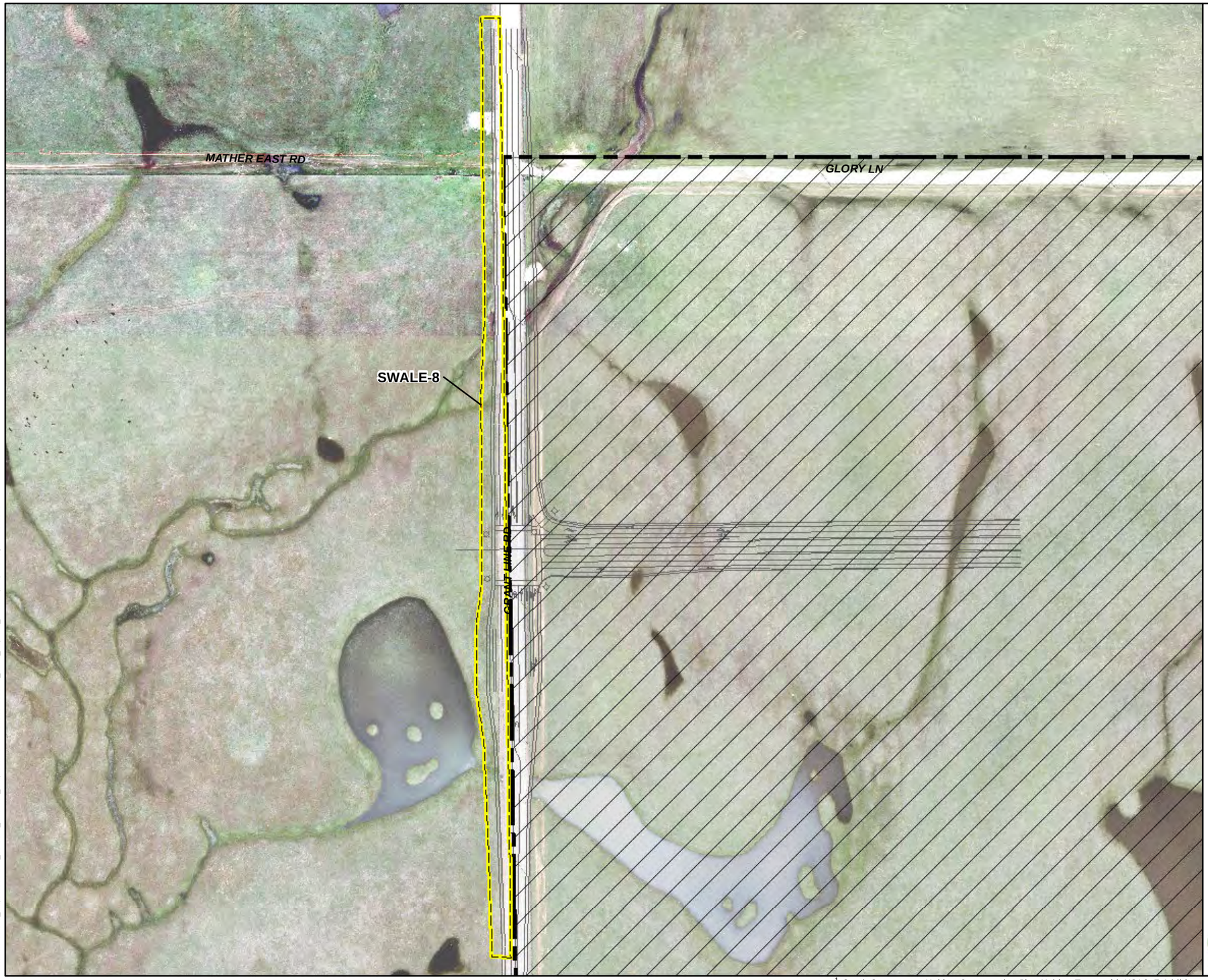
2005-217 Cordova Hills

1 " = 200 '

Scale in Feet
0 200

[1] South Sacramento Habitat Conservation Plan Habitat Types with USACoE Additions
Base CAD Data: MSCE
Photo Source: USGS 2009

Map Date: 4/18/2013



1800 DUE Trigger
Intersection Improvements
Grant Line Rd. & North Loop Rd.

Map Features

- Cordova Hills Project Boundary
- Impact Area

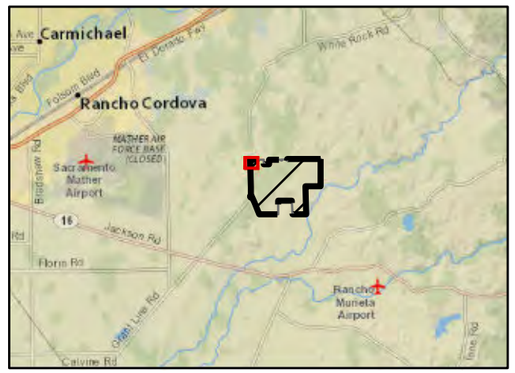
Potentially Impacted Feature [1]

- Swale

Potential Feature Impacts [2]	Acres
SWALE	
SWALE-8	0.001
Total	**0.001**

[2] Features within impact area not shown as impacted are features impacted by an another DU.

Service Layer Credits: National Geographic, Esri, DeLorme, NAVTEQ, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, iPC



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Location: J:\GIS_Maps\2005-217_Cordova_Hills\404_Graphics\404\v4\Offsite\1800DU_GLNL_Impacts_v4.mxd (JDS)-KOrtega 4/18/2013

2005-217 Cordova Hills

1 " = 200 '

Scale in Feet
0 200

[1] South Sacramento Habitat Conservation Plan Habitat Types with USACoE Additions
Base CAD Data: MSCE
Photo Source: USGS 2009

Map Date: 4/18/2013

1800 DU
Grant Line and Douglas

Map Features

- Cordova Hills Project Boundary
- Impact Area

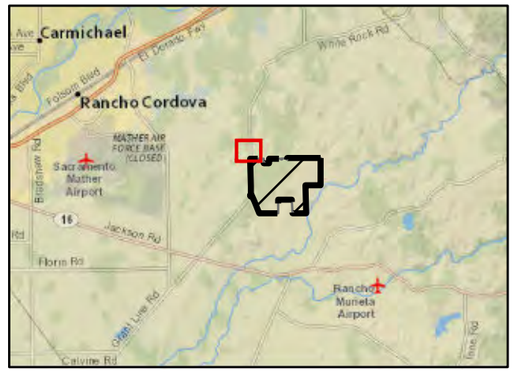
Potentially Impacted Feature [1]

- Vernal Pool

Potential Feature Impacts [2]	Acres
Vernal Pool	
VP-7	0.014
Total	**0.014**

[2] Features within impact area not shown as impacted are features impacted by an another DU.

Service Layer Credits: National Geographic, Esri, DeLorme, NAVTEQ, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, iPC



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DOUGLAS RD
GRANT LINE RD
VP-7
MATHER EAST RD
GLORY LN

Location: J:\GIS_Maps\2005-217_Cordova_Hills\404_Graphics\404v4\Offsite\1800DU GLDR_Impacts_v4.mxd (JDS)-KOrtega 4/18/2013

2005-217 Cordova Hills

1 " = 400 '

Scale in Feet
0 400

[1] South Sacramento Habitat Conservation Plan Habitat Types with USACoE Additions
Base CAD Data: MSCE
Photo Source: USGS 2009

Map Date: 4/18/2013

ATTACHMENT B

Updated On-Site Wetland Preservation Analysis for the Modified Proposed Action Alternative for Cordova Hills

Updated On-Site Wetland Preservation Analysis for the Modified Proposed Action Alternative

For

Cordova Hills

Sacramento County, California

(U.S. Army Corps of Engineers # SPK-2004-116)
(U.S. Fish and Wildlife Service # TBD)

DRAFT

December 8, 2014

Prepared For:
Cordova Hills, LLC

ECORP Consulting, Inc.
ENVIRONMENTAL CONSULTANTS

CONTENTS

On-Site Wetland Preservation Analysis for the Modified Proposed Action Alternative for Cordova Hills

LIST OF FIGURES

LIST OF ATTACHMENTS

1.0 INTRODUCTION

The overarching goal of the proposed Cordova Hills Project (Project) is to provide a master-planned community in southeastern Sacramento County. The Project will minimize and mitigate for its impacts on biologically sensitive natural resources through a combination of on-site and off-site preserves, which will include both preservation and creation of Waters of the U.S. (Waters) and federally listed species habitat. This document has been prepared by ECORP Consulting, Inc. (ECORP) on behalf of Cordova Hills, LLC in an effort to memorialize discussions with the U.S. Fish and Wildlife Service (USFWS) and U.S. Army Corps of Engineers (USACE) regarding Project impacts. The purpose of this document is to provide:

1) A description of the on-site preserves within the Project;
2) A rationale for determining which aquatic features within the Project site have been considered federally listed species habitat;
3) A justification for the Project's on-site preservation credit of Waters and federally listed species habitat; and
4) A description of anticipated indirect effects to Waters and federally listed species habitat.

The intent of this analysis is to provide information in support of the Project's Clean Water Act section 404 Individual Permit application with the USACE (USACE # SPK-2004-116), and to support consultation with the USFWS under Section 7 of the federal Endangered Species Act.

1.1 Project Location

The Project site is located east of Grant Line Road, north of Kiefer Road, south of Glory Lane and west of Carson Creek (Figure 1. *Project Location and Vicinity*). The overall Project site corresponds to portions of Sections 13, 14, 23, and 24 of Township 8 North and Range 7 East (Mount Diablo Base Meridian [MDBM]) and Section 18 of Township 8 North and Range 8 East (MDBM) of the "Buffalo Creek, California" 7.5-minute quadrangle (U.S. Department of the Interior, Geological Survey [USGS], 1980). The approximate center of the Project is located at 38° 32' 30" North and 121° 10' 30" West within the Lower Deer Creek Watershed (#180400130503, USGS 1978) (Figure 2. *Cordova Hills Watersheds*).

1.2 Project Description and Background

The approximately 2,688-acre Project consists of a mixture of planned land uses. The Project will include approximately 1,000 gross acres of residential uses ranging in density from one dwelling unit per net acre to forty units per net acre, with an overall average net residential density of ten dwelling units per acre. The Project may also contain a senior housing component. In addition, the Project will include approximately 1.38 million square feet of retail and commercial space, and a university/college campus center situated on approximately 240 acres. The university/college campus center will be designed to provide a residential learning environment, with sufficient capacity to provide on-campus housing to the majority of the approximately 6,000 students anticipated upon build out. In addition to the university/college campus center, the Project will accommodate the growing educational facility needs of the region by providing sites for the development of future elementary and secondary schools. The retail, commercial, institutional and residential uses are planned for various locations

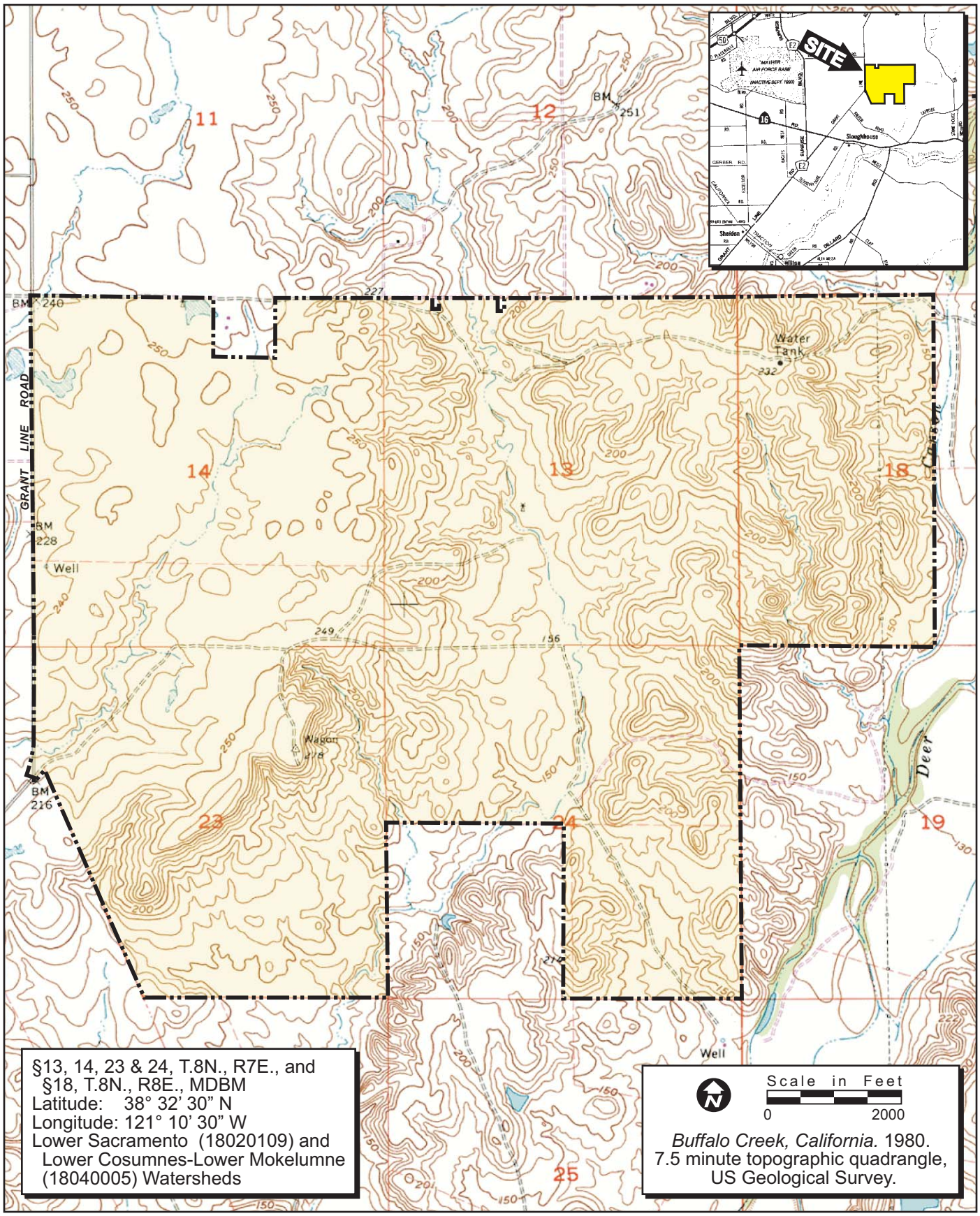

Figure 1. Project Location and Vicinity

Figure 2.
Cordova Hills Watersheds

Map Features

- Project Boundary
- Preserve
- Project Wetlands
- HUC 06 Watershed Boundary
- HUC 12 Watershed Boundary

Morrison Creek
Morrison Creek
180201630402
Upper Morrison Creek
Coyote Creek
Carson Creek
180400130501
Carson Creek
Little Deer Creek
180400130502
Upper Deer Creek
180201630403
Laguna Creek
180400130503
Lower Deer Creek
Crevis Creek
180400130605
Arkansas Creek-Cosumnes River
Deer Creek

Location: J:\GIS_Maps\2005-217_Cordova_Hills\Alternatives\Analysis\Onsite\v29_(2014-11-24) Modified_Proposed_Action\OM_CH_HUC12.mxd (ECK) dkrolick 11/26/2014

2005-217 Cordova Hills

Miles
0 0.5 1 1.5

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Map Date: 11/26/2014

throughout the Project, including a unique "Town Center" which will be located in the western portion of the Project, adjacent to the Plateau Preserve.

The Project includes approximately 687 acres of open space, parks, preserves, and agricultural areas. Approximately 592 acres will be preserved to protect Waters and federally listed and other special-status species, and these areas will be protected and managed in perpetuity for the benefit of these resources. Project design took into account existing terrain and drainage patterns, and includes Low Impact Development (LID) design concepts (outlined in the Project's Specific Plan Area Master Plan, which has been adopted by Sacramento County), as well as extensive edge treatments, which include a combination of trails, drainage swales, and native and/or drought tolerant landscaping to buffer the on-site preserves from the long-term effects of development. The preserve edge treatments are described in more detail in Section 5.0.

There are four proposed on-site preserves: 1) the 393.6-acre Plateau Preserve; 2) the 100.5-acre Central Drainage Preserve; 3) the 37.7-acre University Preserve; and 4) the 60.1-acre Carson Creek Preserve (Figure 3. *Wetland Preserves, Edge Treatments & Impacts*), which are described in further detail in Section 3.0 below.

2.0 EXISTING SITE CONDITIONS

2.1 General Conditions

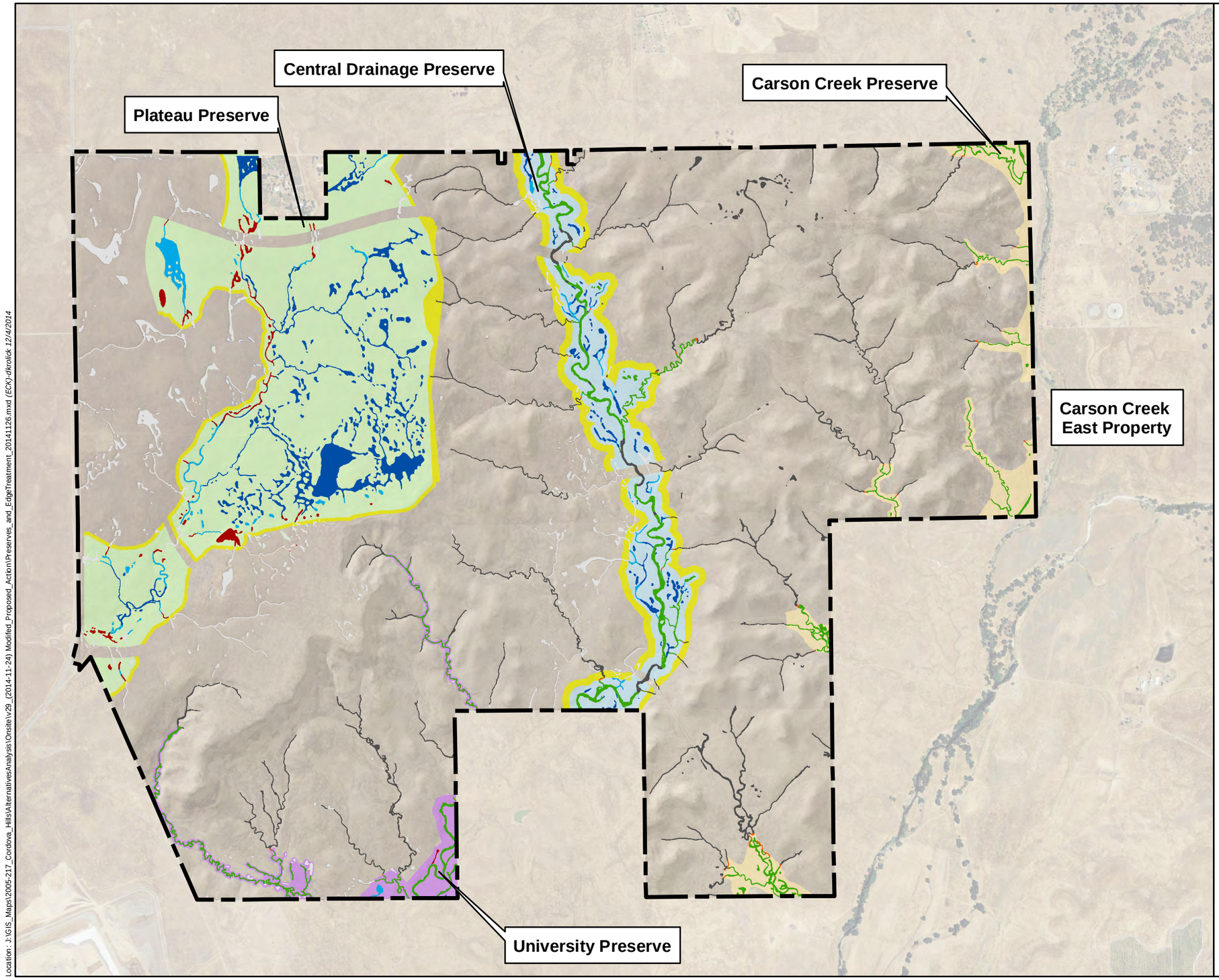
The Project site is generally comprised of level to steeply rolling topography, and is situated at elevations ranging from 130 to 278 feet above mean sea level (MSL). The western portion of the site is a relatively expansive plateau supporting a number of vernal pool complexes at an approximate average elevation of 245 feet above MSL. The central portion of the site is comprised of an unnamed intermittent drainage that is tributary to Deer Creek, referred to as the central drainage, which bisects the Project and drains from north to south. The eastern portion of the site is occupied by a series of gently rolling hills, with Carson Creek situated along the eastern boundary. The site supports an annual grassland community that is interspersed with complexes of ephemeral wetlands (i.e., vernal pools, seasonal wetlands, and seasonal wetland swales) and intermittent drainages.

The greater Project site has historically, and is currently (2014) being used as rangeland for livestock grazing. Surrounding current land uses include rural residences, roadways, a landfill, and livestock operations. Residential development is approved directly to the west and a proposed development (SunCreek) is located generally to the southwest.

2.2 Waters of the U.S.

A total of 89.107 acres of Waters have been delineated within the Project site, including: vernal pools, seasonal wetlands, seasonal impoundments, seasonal wetland swales, seep, freshwater marshes, intermittent drainages, man-made stock ponds, and creek (also called streams/creeks by the SSHCP) (ECORP 2007a) (Figure 4. *Wetland Delineation*).

Figure 3.
Wetland Preserves, Edge Treatments & Impacts



Map Features

- Project Boundary
- Edge Treatment (R2)[3]
- Land Use

PresID

- Carson Creek (60.1 ac.)
- Central Drainage (100.5 ac.)
- Plateau (393.6 ac.)
- University (37.7 ac.)

404 Wetland Impacts [1]

- Avoided
- Indirect Impact
- Direct Impact

ESA Wetland Impacts[2]

- Avoided (Credit)
- Avoided (No Credit)
- Indirect Impact
- Direct Impact

	Acreage
404 Avoided	*16.24*
Creek	0.17
Intermittent Drainage	11.16
Seasonal Wetland	0.32
Seasonal Wetland Swale	3.85
Vernal Pool	0.74
404 Direct Impact	*13.72*
Intermittent Drainage	4.01
Seasonal Wetland	0.43
Seasonal Wetland Swale	8.03
Seep	0.01
Vernal Pool	1.24
404 Indirect Impact	*0.29*
Intermittent Drainage	0.08
Seasonal Wetland	0.01
Seasonal Wetland Swale	0.18
Vernal Pool	0.02
ESA Avoided (Credit)	*28.56*
Intermittent Drainage	0.48
Seasonal Wetland	1.38
Seasonal Wetland Swale	1.49
Vernal Pool	25.22
ESA Avoided (No Credit)	*6.08*
Intermittent Drainage	0.74
Seasonal Wetland	0.04
Seasonal Wetland Swale	1.06
Vernal Pool	4.24
ESA Direct Impact	*20.92*
Intermittent Drainage	0.34
Seasonal Wetland	2.43
Seasonal Wetland Swale	3.09
Stock Pond	0.69
Vernal Pool	14.37
ESA Indirect Impact	*3.29*
Intermittent Drainage	0.09
Seasonal Wetland	0.16
Seasonal Wetland Swale	0.53
Stock Pond	0.83
Vernal Pool	1.67
Total Wetlands/Waters	**89.11**

1 - Non-Branchiopod Habitat Wetlands within 50 feet of Preserve edge are considered Indirectly Impacted
2 - All Non Directly Impacted Depressional Features within Central Drainage are Classified as Avoided.
3 - Edge Treatment constists of 50 ft. exterior addtion to all preserve areas, except for the Central Drainage, which has a 100 ft. buffer except where this would encroach upon planned development areas.

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Location: J:\GIS_Maps\2005-217_Cordova_Hills\Alternatives Analysis\Onsite\v29_(2014-11-24) Modified_Proposed_Action\Preserves_and_EdgeTreatment_20141126.mxd (ECK)-dkrollick 12/4/2014

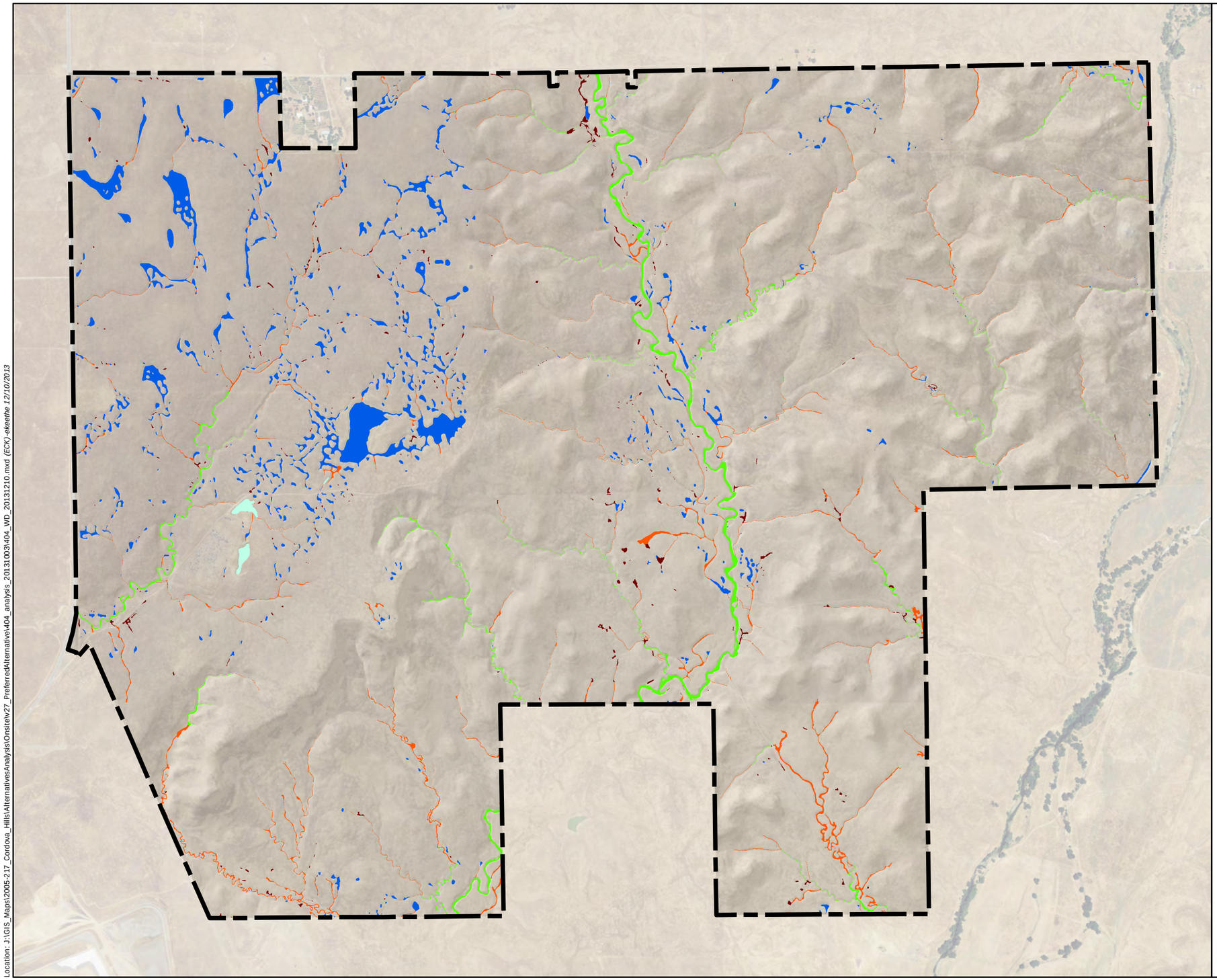
2005-217 Cordova Hills

Scale in Feet
0 2,000

Photo Source: NAIP 2012

Map Date: 12/4/2014

Figure 4.
Wetland Delineation



Map Features

Project Boundary

Wetland Features

- Vernal Pool
- Seasonal Wetland
- Seasonal Wetland Swale
- Seep
- Intermittent Drainage
- Creek
- Stock Pond

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Location: J:\GIS_Maps\2005-217_Cordova_Hills\AlternativesAnalysis\Onsite\v27_PreferredAlternative\404_analysis_20131003\v404_WD_20131210.mxd (ECK) -ekeethe 12/10/2013

2005-217 Cordova Hills

Scale in Feet
0 2,000

Photo Source: NAIP 2012

Map Date: 12/10/2013

2.3 Federally Listed Species

2.3.1 Plants

Special-status plant surveys were conducted throughout the Project site by ECORP biologists in accordance with the USFWS *Guidelines for Conducting and Reporting Botanical Inventories for Federally Listed, Proposed and Candidate Plants* (USFWS 2000, ECORP 2007b, ECORP 2008). Sacramento Orcutt grass (*Orcuttia viscida*) was the only federally listed plant species observed, and has been documented within two vernal pool complexes that are located within the northeastern corner of the Plateau Preserve (Attachments Af and Ag of Attachment A – *On-Site Avoidance, Preservation and Indirect Impact Detail Map Book*). There will be a minimum avoidance buffer of 300 feet where possible around each of these vernal pools to reduce indirect effects from construction activities (the Project boundary interferes with the extent of this buffer to the north and west). This buffer, in conjunction with the edge treatments (discussed in Section 3.0 below), is anticipated to fully preserve these populations of Sacramento Orcutt grass. As such, indirect impacts to Sacramento Orcutt grass are not anticipated. Because the Plateau Preserve will be protected and managed in perpetuity for the benefit of vernal pools and the endemic species within, and will result in a large, contiguous preserve area, the Sacramento Orcutt grass population will persist and may occupy additional preserved vernal pools in the future.

2.3.2 Vernal Pool Branchiopods

Assessment-level wet-season large branchiopod surveys (ECORP 2013a) were conducted between 2 January and 4 February 2013 by ECORP biologists. These surveys targeted the federally listed as threatened vernal pool fairy shrimp (*Branchinecta lynchi*) and endangered vernal pool tadpole shrimp (*Lepidurus packardi*). During surveys, approximately 50% of all depressional wetlands (vernal pools and seasonal wetlands) and 95% of ephemeral and intermittent drainages within the entire Project site were surveyed once. Of the 944 features surveyed, listed branchiopods were only found in approximately 10% (95) of the features.

During the wet-season surveys, listed vernal pool branchiopods were identified within a total of 89 wetlands and other Waters on the western plateau. These occurrences account for 94% of all the branchiopod occurrences on the entire Project site. Topography east and south of the western plateau becomes much steeper, and as such the aquatic habitat becomes linear and hydrologically episodic ("flashy"). The only known occurrences outside of the western plateau are six occurrences of vernal pool fairy shrimp, which are located in depressional wetlands on the west side of the central drainage. These occurrences may not persist long-term due to flooding of the central drainage, and are likely re-colonized due to runoff from the western plateau during heavy rain events.

In addition to the 2012-2013 wet-season surveys, 41 vernal pools and seasonal wetlands east of the western plateau were subsequently targeted for guideline-level dry-season surveys during the summer of 2013 (ECORP 2013b). These wetlands were selected, in consultation with the USFWS, because they appeared to provide the highest quality habitat for listed vernal pool branchiopods east of the western plateau. No evidence of federally listed branchiopods (carapaces or cysts) was identified during these targeted dry-season surveys. Known vernal pool branchiopod occurrences on the Project site are included in Attachment A.

In an effort to better define the distribution of fairy shrimp and tadpole shrimp on the Project site, guideline level dry-season surveys are currently (2014) being conducted for all Waters, with the exception of those on the western plateau and the 41 vernal pools and seasonal wetlands that were previously surveyed in the dry season (described above). Additionally, guideline level wet-season surveys are planned for 2014-2015 wet season for all Waters excluding those on the western plateau. Fairy shrimp and tadpole shrimp occupancy is so consistent across the high quality vernal pool habitat on the western plateau that it has been assumed that all suitable habitat in that portion of the Project site is occupied by these species.

3.0 ON-SITE PRESERVES

There are four proposed on-site preserves: 1) the Plateau Preserve, 2) the Central Drainage Preserve, 3) the University Preserve, and 4) the Carson Creek Preserve (Figure 3), which are described in further detail below.

3.1 Plateau Preserve

The Project site is characterized by a large, undulating, relatively flat plateau on the western edge, which contains the majority (66%) of the Project site's vernal pools, as well as both of the Sacramento Orcutt grass populations (ECORP 2007b, ECORP 2008) and nearly all (94%) of the vernal pool branchiopod occurrences (ECORP 2013a). This portion of the Project site will contain the largest preserve, the 393.6-acre Plateau Preserve. While the on-site preserves have been sited to reduce impacts to waters of the U.S., a particular emphasis has been placed on the Plateau Preserve due to its extensive biological resources. The edge treatments around this preserve were sited to reduce effects to the waters of the U.S. within.

The Plateau Preserve lies on the western plateau of the Project site, and is important because it contains the highest number and density of vernal pools, and represents the highest quality habitat within the Project site for the federally listed vernal pool fairy shrimp, vernal pool tadpole shrimp, and Sacramento Orcutt grass. The western plateau differs from the remainder of the Project site, as it consists of a single geologic unit (the Laguna Formation), is relatively flat with gently rolling topography, falls within the Laguna Creek Watershed (a distinct watershed from the rest of the Project site, see Figure 2.), and contains vernal pools and swales with a high degree of hydrological connectivity. Overall, the western plateau is significantly unique from the rest of the Project site. The Mather Core Area (MCA), as described in the *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (Recovery Plan, USFWS 2005), has been targeted as an important vernal pool preservation zone by the USACE and the USFWS, and a portion of the MCA encompasses the western side of the Project site. Based on existing resources within the Project site, there is evidence that the authors of the Recovery Plan may have intended for the eastern edge of the western plateau to serve as the boundary of the MCA. Attachment B. *Refinements to the Mather Core Area at Cordova Hills*, has been prepared to further support this position, and a summary of the unique physical and biological characteristics of the western plateau are included below.

3.1.1 Hydrologic Connectivity

The Plateau Preserve is located within the Laguna Creek watershed, which flows to the Sacramento River, while the remainder of the Project site is in the Carson Creek and Deer Creek watersheds, which flow to the Cosumnes River (Figure 2).

3.1.2 Biological Resources

In 2009, ECORP conducted a California Rapid Assessment Method (CRAM) analysis of a subset of wetlands at the Project Site in order to determine their relative habitat quality values (ECORP 2009). A total of 24 Assessment Areas (AA) were identified, and the AAs that received the highest scores were located on the western plateau. The average CRAM score by AA on the western plateau was 84.7, while the average score for the remaining AAs was 72.8, further supporting the fact that the resources on the western plateau are of relatively high ecological value. A map of the CRAM analysis results and a more detailed discussion are included in Attachment B.

As discussed in Section 2.4.1 above, 94% of all currently documented listed branchiopod occurrences and all Sacramento Orcutt grass occurrences on the Project site are located on the Western Plateau. This further supports the assertion that the vernal pools and other Waters on the Western Plateau are of higher biological value than the remainder of the site.

3.1.3 Soils

The Plateau Preserve is comprised exclusively of one geologic unit – the Laguna Formation, which is the oldest alluvialy-deposited surface in the Central Valley (CNPS 2009). The remaining geologic units on-site are Mehrten Formation, Valley Springs Formation, Lower Modesto Formation, and Gopher Ridge Volcanics. The Mehrten Formation is derived from volcanic mudflow deposits, the Valley Springs Formation is derived from volcanic ash flow deposits, the Lower Modesto Formation is comprised of recent alluvial deposits, and the Gopher Ridge Volcanics are comprised of metamorphic rocks. Although there are a few pockets of Laguna Formation on the Project site east of the western plateau, the majority of the formation corresponds with the watershed break at the eastern edge of the western plateau as discussed above. The Laguna Formation is well known for supporting high quality vernal pools.

3.2 Central Drainage and University Preserves

To the east and south of the western plateau, elevation drops off steeply, and existing Waters are mostly steep and flashy intermittent drainages. Topography again begins to flatten toward the center of the Project site, where the 100.5-acre Central Drainage and 37.7-acre University Preserves are located. These preserves have been configured to encompass the highly incised intermittent "central drainage," as well as the majority of adjacent depressional wetlands in order to maintain the integrity of the central drainage system. This linear preserve will also allow for wildlife connectivity north and south of the Project site. The University Preserve consists of approximately 37.7 acres, and is essentially a continuation of the Central Drainage Preserve, along with several long, linear "fingers" designed to avoid several steep, incised drainages. Portions of this preserve lie south of the proposed university, and may be used as an ecological study area in conjunction with the University's educational curriculum.

3.3 Carson Creek Preserve

To the east of the central drainage, the Project site begins to gain elevation, and becomes a series of rolling hills until its eastern edge. In this area, the topography begins to flatten toward Carson Creek to the east. This area contains the 60.1-acre Carson Creek Preserve, a portion of which abuts the approximately 139-acre off-site Carson Creek East Property, which will be protected in perpetuity by Cordova Hills, LLC under a conservation easement for the purposes of preservation of Waters and Swainson's hawk habitat as mitigation for this Project. This off-site property will also contain a pedestrian trail, which will connect to a planned future regional trail system. The remainder of the Carson Creek Preserve has been designed to preserve depressional wetlands and drainages that flow into the greater floodplain of Carson Creek.

4.0 FRAMEWORK FOR AVOIDANCE, PRESERVATION, AND IMPACT ANALYSIS

On-site preservation potential and indirect impacts were assessed for all wetlands and other Waters within the on-site preserves based on whether they serve as habitat for federally listed species and are regulated by both the Endangered Species Act and section 404 of the Clean Water Act, or do not serve as habitat and are anticipated to be regulated by only section 404 of the Clean Water Act. All Waters within the Plateau Preserve and a subset of Waters west of the central drainage have been determined to represent potentially suitable habitat for the vernal pool fairy shrimp and vernal pool tadpole shrimp. Additionally, and as discussed above, all known occurrences of Sacramento Orcutt grass on-site are located within the Plateau Preserve.

A description and rationale for preservation and impact analysis under each regulatory framework are described below, and shown graphically for all wetlands and other Waters within the Project site in Attachment A.

4.1 Endangered Species Act—Federally Listed Species

Initially, wetlands that may serve as habitat for federally listed vernal pool species were placed into one of the following four impact categories based on distance from preserve edge: 1) directly impacted; 2) indirectly impacted (will not be filled, but may be subject to altered hydrology and or other effects in the future due to Project build-out based on watershed reduction and/or distance from development); 3) avoided (no credit); and 4) avoided (credit). Waters classified as "avoided (no credit)" are not expected to be subject to indirect effects during or after Project buildout, but are not expected to count as on-site preservation credit for the purposes of mitigation, and those classified as "avoided (credit)" are expected to receive on-site preservation credit towards the Project's habitat preservation requirements. Subsequently, wetlands were re-categorized based on field visits, feedback from the USFWS during meetings throughout 2012 and 2013, and a desktop assessment of site conditions (watershed limits, flow paths, topography). Ultimately, nearly every individual wetland and other Water that serves as habitat for federally listed species has been classified individually based on the categories described above (Attachment A).

Some preserve configuration modifications were made after impact analysis meetings with the USFWS, and for those areas the following criteria were used in determining preserve and impact categories for listed vernal pool crustacean habitat: 1) if a wetland was 50 feet or less from preserve edge, it was classified as indirectly impacted; 2) if a wetland was 50-100 feet from preserve edge and any portion of its watershed would be impacted, it was classified as avoided (no credit); and 3) if a wetland was greater than 100 feet from preserve edge and its watershed would not be affected by the Project, it was classified as preserved (credit).

4.2 Clean Water Act—Waters of the U.S.

Based on topography and inundation characteristics, as well as a lack of listed species occurrences, wetlands and other Waters east of the central drainage (i.e., preserved within the Carson Creek Preserve) and the two linear portions of the University Preserve are not considered to be habitat for federally listed species, and therefore were assessed differently from those within and west of the central drainage. No federally listed plants were identified east of the Central Drainage Preserve during focused surveys, and assessment level wet and dry season surveys failed to detect vernal pool crustaceans. Due to land use and topographic constraints, it was not feasible to avoid these Waters by 50 feet used elsewhere on the Project. For these preserve areas, a minimum 25-foot buffer from Project development was used to assess indirect impacts for the purposes of the Clean Water Act. Additional preserve setbacks would require extensive retaining walls and other reinforcement structures, which would result in substantial costs and loss of developable land. As such, these portions of the University and Carson Creek Preserves include 25-foot buffers. Based on the nature of these Waters and discussions with the USACE, this buffer is assumed sufficient to avoid indirect impacts for the purposes of this document.

This preserve impact and avoidance analysis is displayed graphically within Attachment A. Waters that do not represent potentially suitable habitat for federally listed vernal pool species have been classified into three categories: 1) directly impacted; 2) indirectly impacted; and 3) avoided.

5.0 EDGE TREATMENTS

The Project is designed to limit direct and indirect impacts to wetlands and other Waters within the four on-site preserves. The Plateau Preserve and Central Drainage Preserve will be bordered by substantial "edge treatments" to minimize impacts related to development. The incorporation of edge treatments, variations of which are detailed in Attachment C – *Cordova Hills Edge Treatments*, will provide a substantial transition zone buffer to these on-site preserves from adjacent build-out (Figure 3). Edge treatments are defined as the physical edge conditions surrounding the Plateau and Central Drainage Preserve edges. In general, edge treatments will provide at minimum an additional 50-foot buffer to these preserve areas, although the edge treatments are greater than 50 feet where Project design allows, and the Central Drainage Preserve will have an approximately 100-foot buffer. Buffer sizes vary based on the specific edge area and its characteristics (watersheds, gradients, and land use type). These buffers are located outside of the preserve boundaries proper, and consist of open space, trails, drainage corridors, hydrological barriers (swales), native straw seeding, irrigated and non-irrigated landscaping, Parks, detention basins, and fencing. Edge treatments were designed based on input from the USFWS and the California Native Plant Society.

Various edge treatment designs have been developed specific to certain areas throughout the Project; however, all edge treatments adjacent to on-site preserves will be buffered by the most naturalized edge treatment design to minimize the effects of development and maximize the long-term functionality of the Waters and other natural resources within the preserves. All preserve edge treatments will include a drainage swale, an 8-foot naturalized area planted with native straw seeding, a pedestrian trail, and a second drainage swale. Drainage swales will function as a hydrological barrier between urban runoff/nuisance flows and the preserves. The landscaped area would be located on the development side of the edge treatment area, and serve as an additional buffer, further decreasing potential "edge effects" to wildlife and habitat.

Based on the presence of a 50- to 100-foot or more edge treatment along the Plateau and Central Drainage preserve edges, which are designed to eliminate runoff and reduce human disturbance, indirect effects to federally listed species and Waters are anticipated to be minimal. The Carson Creek and University Preserves will be surrounded by less intensive land uses (primarily low-density residential). For these smaller, linear preserves, including an edge condition with landscaping and trails is not practical due to design and access constraints. Effects due to adjacent low-density residential development are anticipated to be minor.

6.0 ON-SITE AVOIDANCE, PRESERVATION, AND INDIRECT IMPACTS

6.1 Plateau Preserve

The Plateau Preserve was designed to preserve as many waters of the U.S. as practicable, and extra consideration was given to the placement and sizes of the edge treatment areas in order to minimize indirect effects. The western plateau is a unique area on the Project site due to its relatively flat topography, which drops off steeply on the eastern edge. Because of the interconnected nature of the Waters on the plateau, ECORP analyzed the watersheds of the Waters that fall within the preserve to determine which features will maintain most or all of their watersheds following Project construction, and which features may be subject to potential indirect effects. The edge treatment areas will be subject to grading during construction, but the end result will primarily be naturalized grassland with a pedestrian trail and drainage swales to ensure that extra irrigation water from surrounding land uses will not affect the hydrology and inundation regime of the preserved wetlands. Attachment A shows the edges of the Plateau Preserve, including the placement of the additional edge treatment, as well as the existing watersheds and flow directions for wetlands and swales on-site.

The eastern edge of the plateau drops sharply in elevation at the edge of the preserve boundary, as can be seen in the "hillshade" and "flow directions" shown in Attachment A. The eastern edge of the plateau corresponds very closely with this topographic break, and it is anticipated that none of the wetlands within that portion of the preserve will be impacted following Project construction due to this significant hydrological break and the minimum 50-foot edge treatments.

Topographic changes were not as pronounced on the western edge of the Plateau Preserve. The preserve boundary and edge treatments in these areas attempt to capture large areas of watersheds where possible, and the Project's edge treatment design will serve as a naturalized buffer along the preserve edge (Attachments Aa-Ae).

The southern edge of the Plateau Preserve did not offer a clean topographic break between development and preserve. Some of the watersheds of the avoided wetlands in this portion of the Plateau Preserve are relatively long and linear, and extend roughly from north to south. Because of this, some of the avoided wetlands have been placed in the "indirect impacts" category due to reductions in watershed size and the general flow direction of south to north (from development to preserve). These areas can be seen in Attachments Ad-Ae and Ah-Ai. Land uses adjacent to the western and southern edges of the Plateau Preserve will consist primarily of mixed-use development.

The northern edge of the Plateau Preserve is bordered by an existing partially-paved road (Glory Lane), and there is one residential parcel located near the center of the northern edge of the Preserve. This parcel contains some light agricultural uses, and it appears that it contributes irrigation or other runoff in the preserve. The proposed Project will not change the land use in this area, and it is anticipated that the wetlands within this portion of the preserve will continue to function the way they are currently. Because the baseline conditions in this area are not expected to change as a result of Project implementation, many of these features have been placed in the "avoided (credit)" category. Attachments Aa and Af detail these portions of the Plateau Preserve.

6.2 Central Drainage and University Preserves

The Central Drainage, a tributary to Deer Creek, is located at the lowest elevation on the Project site. There are significant slopes both east and west of the central drainage, and it has a large overall watershed. Because of this, the watersheds for individual wetlands in this portion of the site tend to be large, and are generally long, linear, and relatively steep. Development of the Project will necessitate the collection of excess stormwater runoff (magnified by an increase in impermeable surfaces), and this water will be captured in a series of detention basins on either side of the Central Drainage Preserve (these basins will be located within the edge treatment rather than the on-site preserve). The basins will be designed such that they percolate water down to the water table during periods of low to moderate flow, and will spill into the central drainage during large storm events. The basins will be designed to dry within 2-3 days following rain events, and discharges will be released below the restrictive layer. Because of the storage and discharge design of these detention basins, water capture and storage is not expected to affect surrounding wetlands, and excess water (primarily due to irrigation and a reduction in permeable surfaces) will be discharged into the central drainage, which will also reduce potential effects to adjacent preserved wetlands. It is anticipated that the central drainage itself will retain its existing inundation pattern and hydrological function.

The Central Drainage and University Preserves have been designed to preserve the existing hydrology of the large central drainage and adjacent swales, other drainages, and depressional wetlands in order to preserve the hydrological and habitat connectivity north and south of the Project site. Due to the narrow nature of the central drainage, the Central Drainage and University Preserves are also relatively narrow. Because of this, 100 feet of edge treatment have been provided along the majority of the Central Drainage Preserve (design constraints limit this 100-foot width in some locations) and it is anticipated that this additional buffer will protect preserved depressional wetlands from adverse effects resulting from Project development. The University Preserve abuts the edge of the Project site, which is not currently planned for development. Because these preserves contain such extensive buffers, and

because the Project has been designed to capture stormwater runoff for storage and eventual release into the central drainage proper, all depressional wetlands within these preserves that will not be directly affected by Project construction and are considered avoided (Attachments Aj-Ao).

6.3 Carson Creek Preserve

While the Carson Creek Preserve appears rather small and disconnected within the Project site, the Applicant also controls a property immediately east of a portion of the Carson Creek Preserve (Figure 3), and has committed to recording a conservation easement over this adjacent Property (the Carson Creek East property). While the specifics of said conservation easement are not currently known, the Applicant will retain the ability to use this property for the purposes of mitigation for the loss of agricultural lands, Swainson's hawk habitat, open space, and/or Waters associated with the Project.

The Carson Creek Preserve was designed to preserve the linear, relatively steep drainages located in this portion of the Project site. Based on the topography of the area, it is anticipated that the preserved Waters in the Carson Creek Preserve will maintain their character and continue to function as contributory drainages into Carson Creek and adjacent water bodies. These preserves, along with the adjacent Carson Creek East property, will contribute to the extensive habitat corridor located along Carson Creek (Attachments Ap-As).

7.0 CONCLUSION

The Applicant has made every effort to preserve as many Waters as practicable while still meeting Project objectives. The extensive Plateau Preserve will protect all known Sacramento Orcutt grass occurrences on the Project site, as well as extensive complexes of vernal pools occupied by vernal pool branchiopods. Additionally, the Applicant has gone to great lengths to develop edge treatments that will significantly reduce the potential for indirect impacts from adjacent development. The Central Drainage Preserve and the University Preserve have not only been designed to protect the character and functionality of the drainage within, but will also result in a north-to-south habitat connectivity corridor that bisects the entire Project site. The Carson Creek Preserve has been sited to protect the steep, linear drainages that are tributary to Carson Creek. The Carson Creek Preserve, along with the Carson Creek East property, will contribute to the extensive habitat available along the Carson Creek corridor. Overall, each preserve and associated edge treatment placement has been designed, in consultation with the USFWS and the USACE, to minimize impacts to wetlands and other Waters, in particular those that represent habitat for federally listed species, preserve the natural resources of the area, and contribute to the overall conservation goals of the region.

Of the total 89.107 acres of Waters on-site, 58.857 acres have been classified as habitat for federally listed large branchiopods, and 28.563 acres (49%) are expected to receive on-site preservation credit from the USFWS towards the Project's habitat preservation requirements. An additional 6.084 acres will be preserved but may not receive on-site preservation credit due to their proximity to development, and 3.291 acres will be avoided but may be subject to indirect effects. Overall, only 36% of potential listed branchiopod habitat will be directly affected by the Project. The Project will directly impact 13.720 acres, indirectly impact 0.285 acres, and avoid 16.245 acres of Waters that are not habitat for listed branchiopods but are

regulated under section 404 of the Clean Water Act. All avoidance and impact classifications are summarized by preserve and shown graphically in Attachments Aa-As.

8.0 REFERENCES

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LIST OF ATTACHMENTS

Attachment A – On-Site Avoidance, Preservation and Indirect Impact Detail Map Book

Attachment B – Refinements to the Mather Core Area at Cordova Hills

Attachment C – Cordova Hills Edge Treatments

ATTACHMENT A

On-Site Avoidance, Preservation and Indirect Impact Detail Map Book

Attachment Aa
On-Site Avoidance, Preservation and Indirect Impact Detail

Map Features

- Project Boundary
- Preserve Area
  - Carson Creek
  - Central Drainage
  - Plateau
  - University
- 404 Wetland Impacts [1]
  - Avoided
  - Indirect Impact
  - Direct Impact
- ESA Wetland Impacts[2]
  - Avoided (Credit)
  - Avoided (No Credit)
  - Indirect Impact
  - Direct Impact
- DEM Derived Flowlines
- Land Use
- Edge Treatment (R2)[3]
- Feature Watersheds
- Survey Results
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  - Lepidurus packardi
  - Sacramento Orcutt Grass

1 - Non-Branchiopod Habitat Wetlands within 50 feet of Preserve edge are considered Indirectly Impacted
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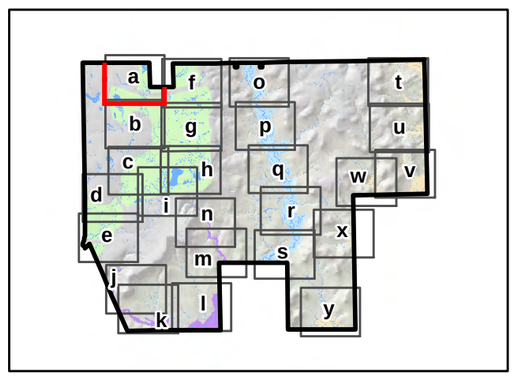
3 - Edge Treatment constists of 50 ft. exterior addtion to all preserve areas, except for the Central Drainage, which has a 100 ft. buffer except where this would encroach upon planned development areas.



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2005-217 Cordova Hills

Scale in Feet
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Map Date: 12/3/2014

Attachment Ab
On-Site Avoidance, Preservation and Indirect Impact Detail

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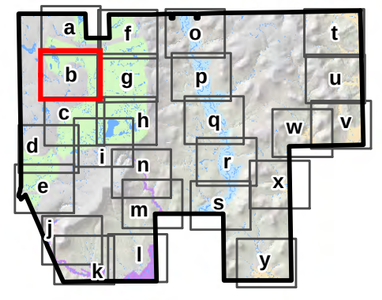

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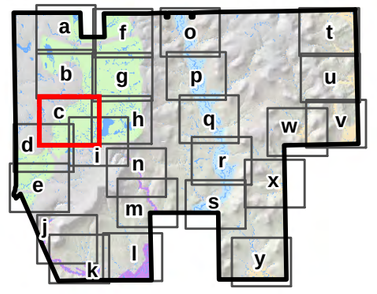

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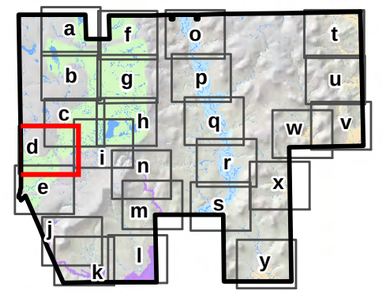

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Attachment Ae
On-Site Avoidance, Preservation and Indirect Impact Detail

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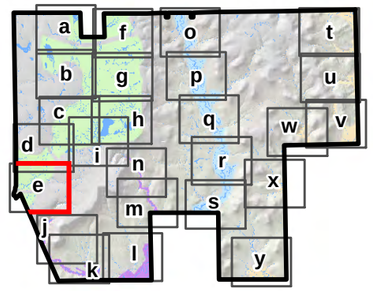

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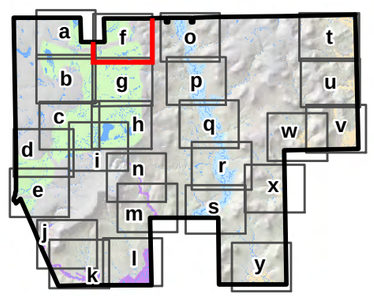

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Attachment Ag
On-Site Avoidance, Preservation and Indirect Impact Detail

Map Features

- Project Boundary
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  - Carson Creek
  - Central Drainage
  - Plateau
  - University
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  - Avoided
  - Indirect Impact
  - Direct Impact
- ESA Wetland Impacts[2]
  - Avoided (Credit)
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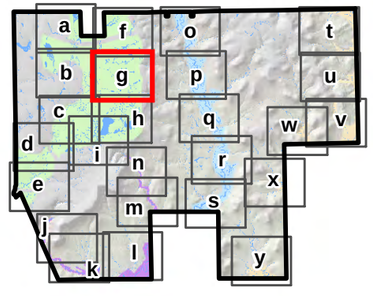

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Location: J:\GIS_Maps\2005-217_Cordova_Hills\AlternativesAnalysis\Onsite\v29_(2014-11-24) Modifed_Proposed_Action\404_ImpactAnalysis_20141126.mxd (eck) dkrolick 12/4/2014

2005-217 Cordova Hills

Scale in Feet
0 200 400

Map Date: 12/3/2014

Attachment Ah
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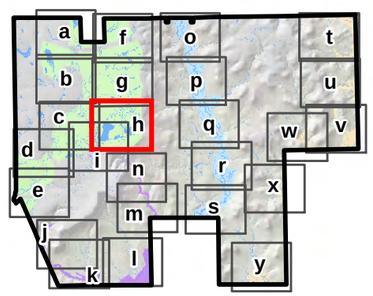

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2005-217 Cordova Hills

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Map Date: 12/3/2014

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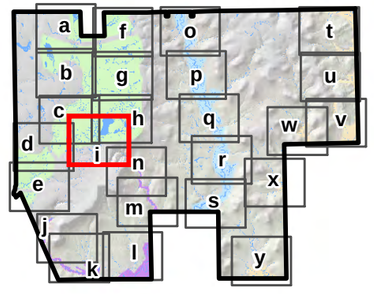

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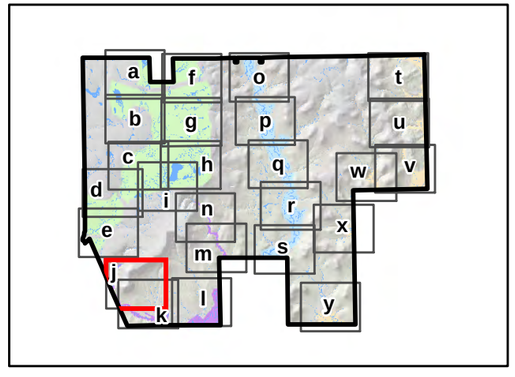

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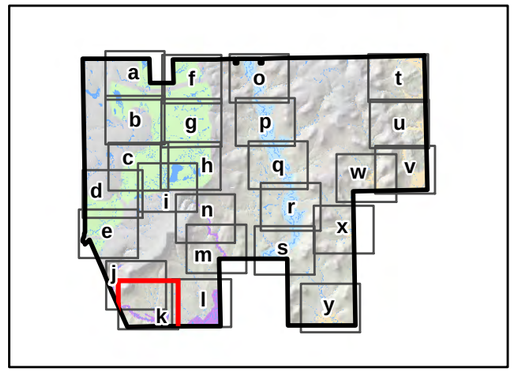

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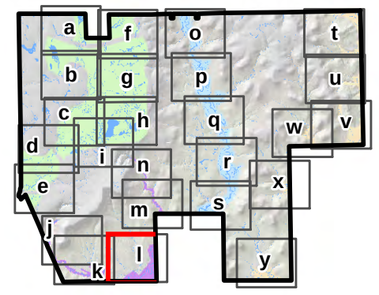

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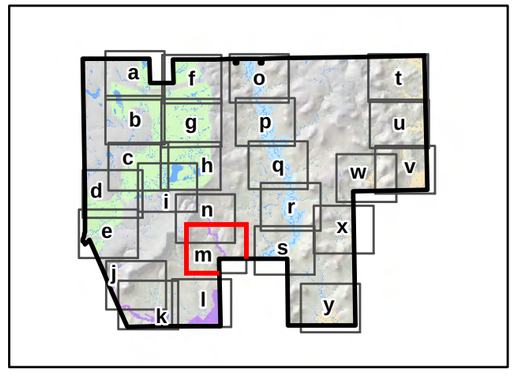

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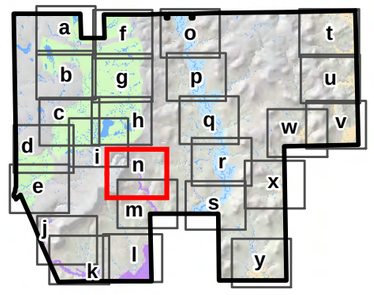

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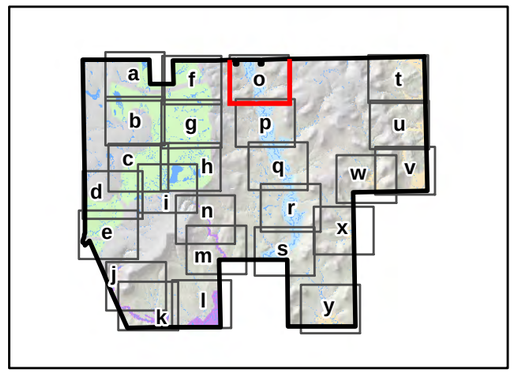

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2005-217 Cordova Hills

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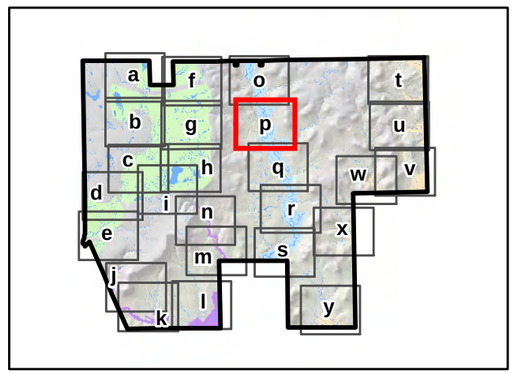

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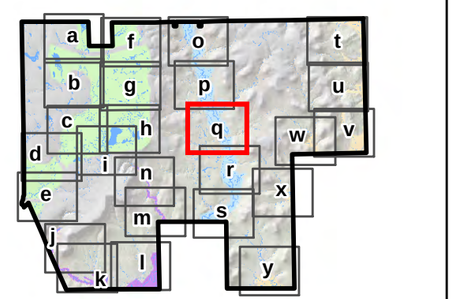

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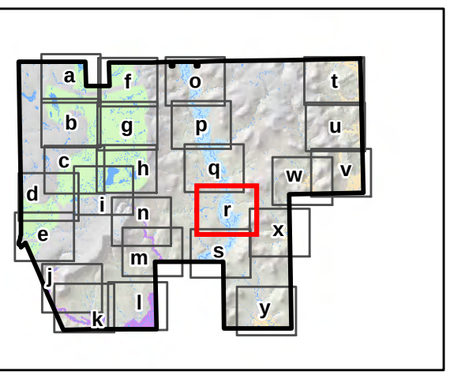

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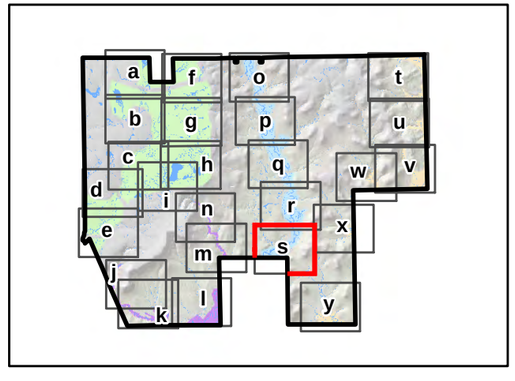

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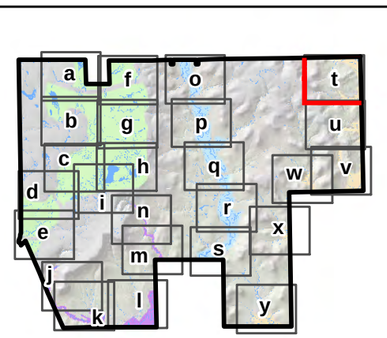

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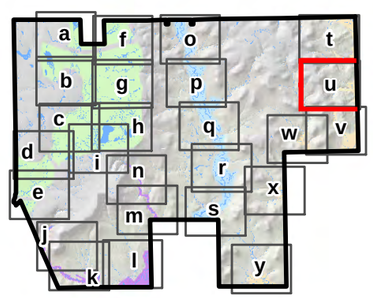


ECORP Consulting, Inc.
ENVIRONMENTAL CONSULTANTS

Location: J:\GIS_Maps\2005-217_Cordova_Hills\AlternativesAnalysis\Onsite\v29_(2014-11-24) Modified_Proposed_Action\404_ImpactAnalysis_20141126.mxd (eck)-dkrolick 12/4/2014

2005-217 Cordova Hills

Scale in Feet
0 200 400

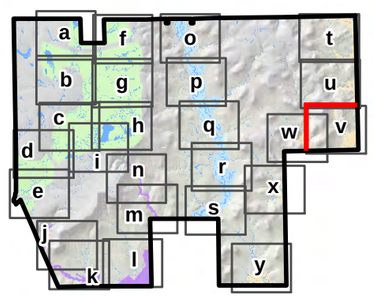
Map Date: 12/3/2014

Attachment Av
On-Site Avoidance, Preservation and Indirect Impact Detail

Map Features

- Project Boundary
- Preserve Area
  - Carson Creek
  - Central Drainage
  - Plateau
  - University
- 404 Wetland Impacts [1]
  - Avoided
  - Indirect Impact
  - Direct Impact
- ESA Wetland Impacts[2]
  - Avoided (Credit)
  - Avoided (No Credit)
  - Indirect Impact
  - Direct Impact
- DEM Derived Flowlines
- Land Use
- Edge Treatment (R2)[3]
- Feature Watersheds
- Survey Results
  - Branchinecta lynchi
  - Lepidurus packardi
  - Sacramento Orcutt Grass

1 - Non-Branchiopod Habitat Wetlands within 50 feet of Preserve edge are considered Indirectly Impacted
2 - All Non Directly Impacted Depressional Features within Central Drainage are Classified as Avoided.
3 - Edge Treatment constists of 50 ft. exterior addtion to all preserve areas, except for the Central Drainage, which has a 100 ft. buffer except where this would encroach upon planned development areas.



ECORP Consulting, Inc.
ENVIRONMENTAL CONSULTANTS

Location: J:\GIS_Maps\2005-217_Cordova_Hills\AlternativesAnalysis\Onsite\v29_(2014-11-24) Modified_Proposed_Action\404_ImpactAnalysis_20141126.mxd (eck)-dkrolick 12/4/2014

2005-217 Cordova Hills

Scale in Feet
0 200 400

Map Date: 12/3/2014

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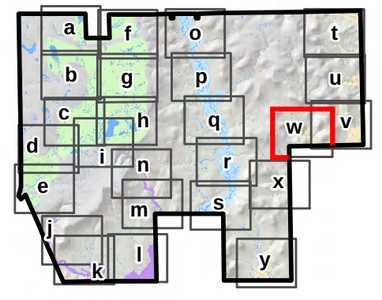

ECORP Consulting, Inc.
ENVIRONMENTAL CONSULTANTS

Location: J:\GIS_Maps\2005-217_Cordova_Hills\AlternativesAnalysis\Onsite\v29_(2014-11-24) Modified_Proposed_Action\404_ImpactAnalysis_20141126.mxd (eck) dkrolick 12/4/2014

2005-217 Cordova Hills

Scale in Feet
0 200 400

Map Date: 12/3/2014

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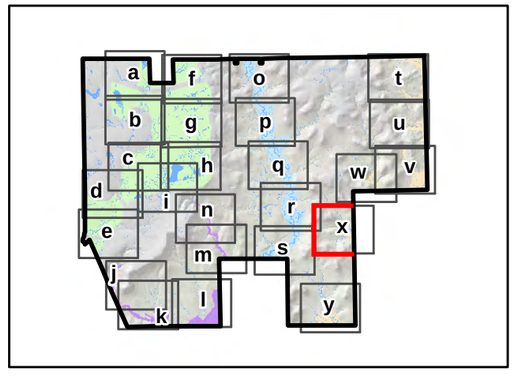

ECORP Consulting, Inc.
ENVIRONMENTAL CONSULTANTS

Location: J:\GIS_Maps\2005-217_Cordova_Hills\AlternativesAnalysis\Onsite\v29_(2014-11-24) Modifed_Proposed_Acton\404_ImpactAnalysis_20141126.mxd (eck)-dkrolick 12/4/2014

2005-217 Cordova Hills

Scale in Feet
0 200 400

Map Date: 12/3/2014

Attachment Ay
On-Site Avoidance, Preservation and Indirect Impact Detail

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- Preserve Area
  - Carson Creek
  - Central Drainage
  - Plateau
  - University
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  - Avoided
  - Indirect Impact
  - Direct Impact
- ESA Wetland Impacts[2]
  - Avoided (Credit)
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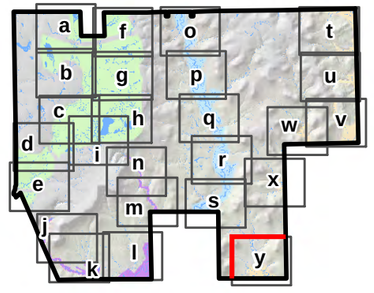


ECORP Consulting, Inc.
ENVIRONMENTAL CONSULTANTS

Location: J:\GIS_Maps\2005-217_Cordova_Hills\AlternativesAnalysis\Onsite\v29_(2014-11-24) Modified_Proposed_Action\404_ImpactAnalysis_20141126.mxd (eck)-dkrolick 12/4/2014

2005-217 Cordova Hills

Scale in Feet
0 200 400

Map Date: 12/3/2014

ATTACHMENT B

Refinements to the Mather Core Area at Cordova Hills

ECORP Consulting, Inc.
ENVIRONMENTAL CONSULTANTS

MEMORANDUM

TO: Mark Hanson / Cordova Hills, LLC.

FROM: Ben Watson / ECORP Consulting, Inc.

DATE: 7 August 2013

RE: ***Refinements to the Mather Core Area at Cordova Hills***

A portion of the Mather Core Recovery Area (MCA), as defined in the *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (USFWS 2005), is located on the Cordova Hills project site. In reviewing the polygon of the current MCA, there does not appear to be consistency in the existing MCA boundary based on topography, wetland type/density, watersheds, geology, or soil types. As such, it appears that the MCA boundary on the Cordova Hills site was originally drawn on a small scale map prior to the advent of high quality digital mapping analysis tools, and was never refined to reflect biotic or abiotic conditions on the ground.

In an attempt to determine what was intended for inclusion in the MCA, we reviewed the description of the MCA in the documents that reference it. The only thorough description we identified was located in the *Vernal Pool Tadpole Shrimp 5-Year Review* (USFWS 2007):

> *Prior to urban development, vernal pools in the Mather core area of Southeastern Sacramento Valley were hydrologically connected during high rainfall years. Vernal pools in this area exist in a "sub-watershed" matrix, roughly delineated by Highway 50 to the north and the Cosumnes River to the south. High rainfall leads to surface flooding, which connects old terrace vernal pools into large, shallow, slow-flowing, temporary lakes. This hydrologic system of connectivity during flooding supports the metapopulation dynamic of recolonization of vernal pools that are subject to localized extirpation during drought years. The hydrological connectivity in this area comprises a functioning ecosystem, underlain by old terrace soils, that is characterized by one of the densest and highest quality vernal pools areas in California (Service 2007; C. Witham, CNPS, pers. comm., 2007; R. Radmacher, Sacramento County, pers. comm., 2007).*

The emphasis in this description appears to be on both the hydrologic connectivity of vernal pools and the presence of old terrace soils. ECORP Consulting, Inc. (ECORP) reviewed available hydrology and soils data, and conducted additional biological surveys in an attempt to refine the MCA boundary to better reflect the existing biotic and abiotic conditions at Cordova Hills. The results are described below, and we believe that this information supports a Refined Mather Core Area (RMCA) boundary at the Cordova Hills site (Figure 1).

Hydrologic Connectivity

While vernal pools in complexes throughout California have some degree of connectivity, the vernal pools on the western terrace of Cordova Hills have a high degree of connectivity, and interconnectivity, not found on many other sites in the region. The western terrace of the Cordova Hills project site is within the Laguna Creek watershed, which flows to the Sacramento River, while the remainder of the site is in the Carson Creek and Deer Creek watersheds, which flow to the Cosumnes River (Figure 1). Due to this significant watershed break, the western terrace vernal pools, while connected to vernal pools west of the project boundary, lack hydrologic and geologic connectivity with features on the eastern portion of the site. It appears that the boundary of the MCA might have been more appropriately drawn as terminating at this watershed break, which also closely corresponds to the extent of the Laguna Formation soils on-site.

Geology

The western terrace of Cordova Hills seems to be consistent with soil horizon characteristics of "old terrace" restrictive layers. The western terrace is comprised exclusively of one geologic unit – the Laguna Formation, which is the oldest alluvialy-deposited surface in the Central Valley (CNPS 2009). The remaining geologic units on-site are Mehrten Formation, Valley Springs Formation, Lower Modesto Formation, and Gopher Ridge Volcanics. The Mehrten Formation is derived from volcanic mudflow deposits, the Valley Springs Formation is derived from volcanic ash flow deposits, the Lower Modesto Formation is comprised of recent alluvial deposits, and the Gopher Ridge Volcanics are comprised of metamorphic rocks. The Laguna Formation is clearly the only geologic formation on-site that fits the description of "old terrace." Furthermore, 73% of the greater MCA occurs on the Laguna Formation. Although there are a few pockets of Laguna formation on the Cordova Hills project site east of the western terrace, the majority corresponds with the watershed break discussed above (Figure 1).

Biology

In 2009, ECORP conducted a California Rapid Assessment Method (CRAM) analysis of a subset of wetlands at Cordova Hills in order to determine their relative habitat quality values. A total of 24 Assessment Areas (AA) were identified, and the AA's that received the highest scores were located on the western terrace. The average CRAM scores for the MCA were 80.7, and the average CRAM scores for the RMCA were 84.7 (out of a possible 100) (Figure 2).

ECORP biologists conducted assessment level wet season surveys for large vernal pool branchiopods during the 2012-2013 wet season. During surveys, approximately 50% of all depressional wetlands (vernal pools and seasonal wetlands) and 100% of ephemeral and intermittent drainages were surveyed once. In addition, 41 vernal pools and seasonal wetlands east of the western terrace (and the RMCA) were subsequently targeted for protocol-level dry season surveys. These wetlands were selected, in consultation with Mr. Terry Adelsbach of the U.S. Fish and Wildlife Service, because they appeared to provide the highest quality habitat for listed vernal pool branchiopods east of the western terrace.

All vernal pool tadpole shrimp (*Lepidurus packardi*) identified during surveys were located within the RMCA, and all but six (83%) of the vernal pool fairy shrimp (*Branchinecta lynchi*) occurrences were located within the RCMA. No listed vernal pool branchiopod cysts were detected during dry season surveys outside of the RMCA (Figure 3). Rare plant surveys were conducted throughout the Cordova Hills site in 2007 and 2008, and Sacramento Orcutt grass was detected in two vernal pools in the northeastern corner of the RMCA. The results of the rare plant surveys, the vernal pool branchiopod surveys, and the wetland CRAM scores support the premise that the highest quality wetlands within the Cordova Hills site occur in the RMCA, and that the habitat for listed species to the east is much different and of lower value than the habitat located in the RMCA.

Conclusion

While it appears that the MCA boundary was intended to be defined based on the hydrologic connectivity of the vernal pools in the region, as well as by soil type, the actual boundary appears to include topography, soil types and upland habitat not consistent with the objectives of MCA preservation goals. Based on mapped soil types, watershed breaks, wetland CRAM scores, and survey data for federally listed species on the Cordova Hills site, it appears that the RMCA boundary is a more valid representation of what the MCA boundary was intended to be.

Literature Cited:

California Native Plant Society (CNPS). 2009. Vernal Pool Geology. Published by the Sacramento Valley Chapter of the California Native Plant Society at: http://www.sacvalleycnps.org/conservation/vernalpools/mather3.htm

U.S. Department of the Interior, Fish and Wildlife Service (USFWS). 2005. Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon. Dated 15 December 2005.

U.S. Department of the Interior, Fish and Wildlife Service (USFWS). 2007. Vernal Pool Tadpole Shrimp (*Lepidurus packardi*), 5-Year Review: Summary and Evaluation. Sacramento Fish and Wildlife Office, Sacramento, California. Dated September 2007.

Figure 1.
Cordova Hills - Mather Core Areas

18020163
Lower
Sacramento

18040013
Upper
Cosumnes

Map Features

- Project Boundary
- Wetlands
- Mather Core Area from Recovery Plan (2,015 acres on-site)
- Refined Mather Core Area (905 acres on-site)
- HUC 08 Boundary

Geologic Features

- Jgo - Gopher Ridge Volcanics: 21 ac. on-site
- Qm2 - Lower Modesto Formation (alluvium): 21 ac. on-site
- Tl - Laguna Formation: 1087 ac. on-site
- Tm - Mehrten Formation: 1451 ac. on-site
- Tvs - Valley Springs Formation: 89 ac. on-site

ECORP Consulting, Inc.
ENVIRONMENTAL CONSULTANTS

Location: J:\GIS_Maps\2005-217_Cordova_Hills\Meetings\2012-02-23 Mather Core Area Memo\1_RMCA_Geology.mxd (ECK) eKeethe 8/6/2013

2005-217 Cordova Hills

Scale in Feet
0 2,000

Photo Source: Aerials Express, 2006

Map Date: 8/6/2013

Figure 2.
Cordova Hills CRAM Scores

1 (88)
2 (90)
3 (90)
4 (88)
5 (87)
6 (82)
7 (88)
8 (92)
9 (94)
10 (89)
11 (87)
12 (70)
13 (83)
14 (81)
15 (83)
16 (73)
17 (71)
18 (65)
19 (80)
20 (87)
21 (62)
22 (65)
23 (72)
24 (77)
25 (73)
26 (68)
27 (81)
28 (67)
29 (88)
30 (76)

Map Features

- Project Boundary
- Assessment Area - Number (Score)
- Wetlands
- Mather Core Area from Recovery Plan
  (2,015 acres on-site)
  (AVG CRAM Score Inside MCA: 80.7, Outside MCA: 72.7)
- Refined Mather Core Area
  (905 acres on-site)
  (AVG CRAM Score Inside RMCA: 84.7, Outside RMCA: 72.8)

ECORP Consulting, Inc.
ENVIRONMENTAL CONSULTANTS

Location: J:\GIS_Maps\2005-217_Cordova_Hills\Meetings\2012-02-23 Mather Core Area Memo\2_RMCA_CRAM_scores.mxd (ECK) -ekeethe 8/2/2013

2005-217 Cordova Hills

Scale in Feet
0 2,000

Photo Source: Aerials Express, 2006

Map Date: 8/2/2013

Figure 3.
Cordova Hills
Vernal Pool Crustacean
Survey Results

Map Features

- Project Boundary
- Non Surveyed Wetlands
- Mather Core Area from Recovery Plan (2,015 acres on-site)
- Refined Mather Core Area (905 acres on-site)
- Sacramento Orcutt Grass
- Dry Season Survey (Negative Results - All)
- Wet Season Survey (Negative Results)
- Wet Season Survey (Positive Results)

Wet Season Survey Results

- Lepidurus packardi
- Branchinecta lynchi

ECORP Consulting, Inc.
ENVIRONMENTAL CONSULTANTS

Location: J:\GIS_Maps\2005-217_Cordova_Hills\Meetings\2012-02-23 Mather Core Area Memo\3_RMCA_ShrimpResults.mxd (ECK) -ekeethe 8/2/2013

2005-217 Cordova Hills

Scale in Feet
0 2,000

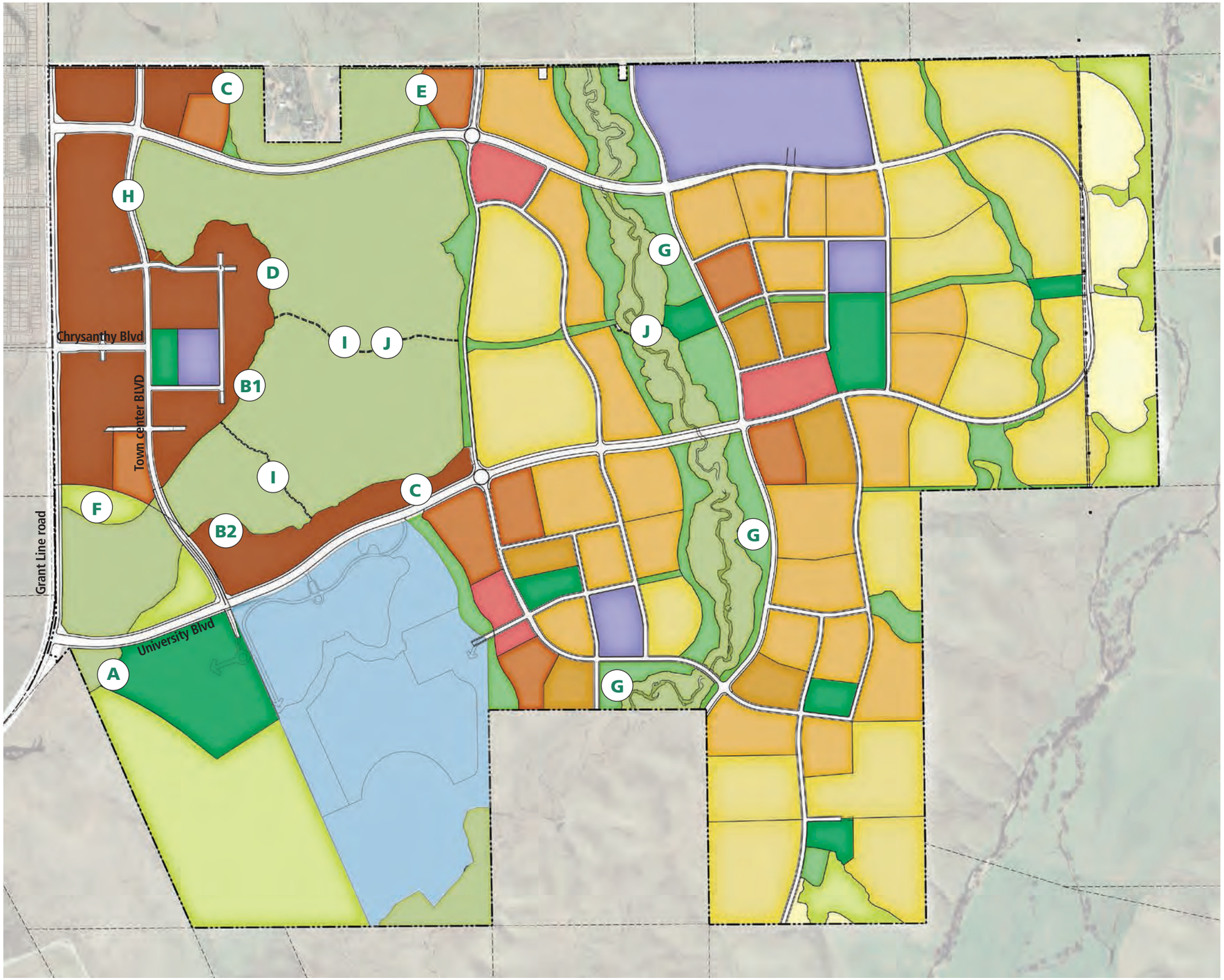
Photo Source: Aerials Express, 2006

Map Date: 8/2/2013

ATTACHMENT C

Cordova Hills Edge Treatments

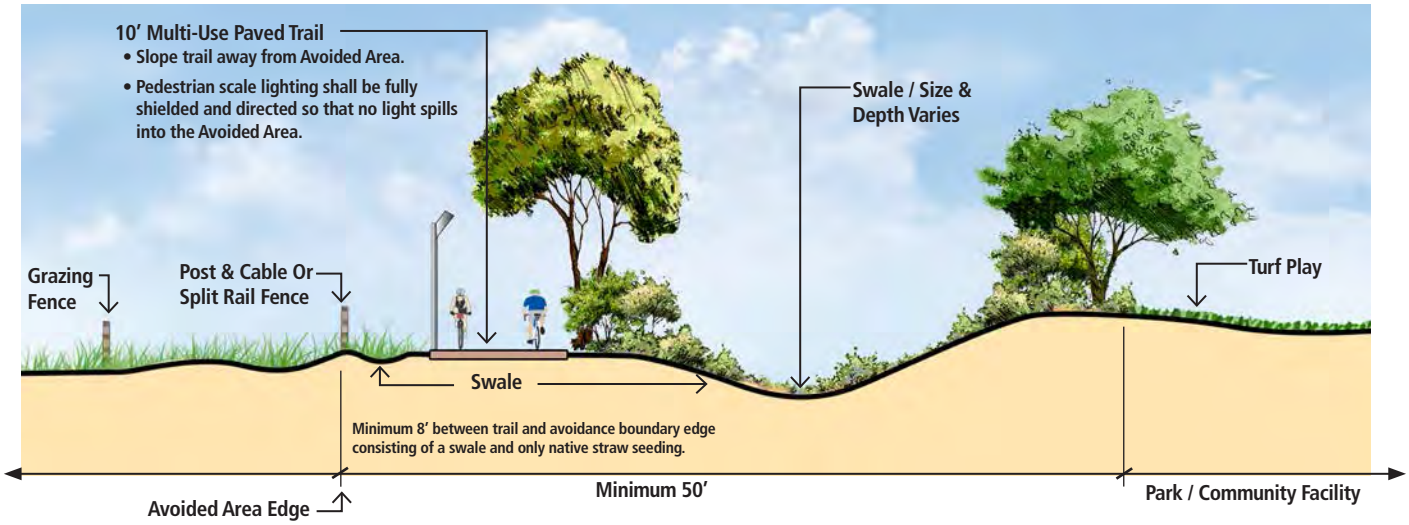
404 Permit
July 21, 2014



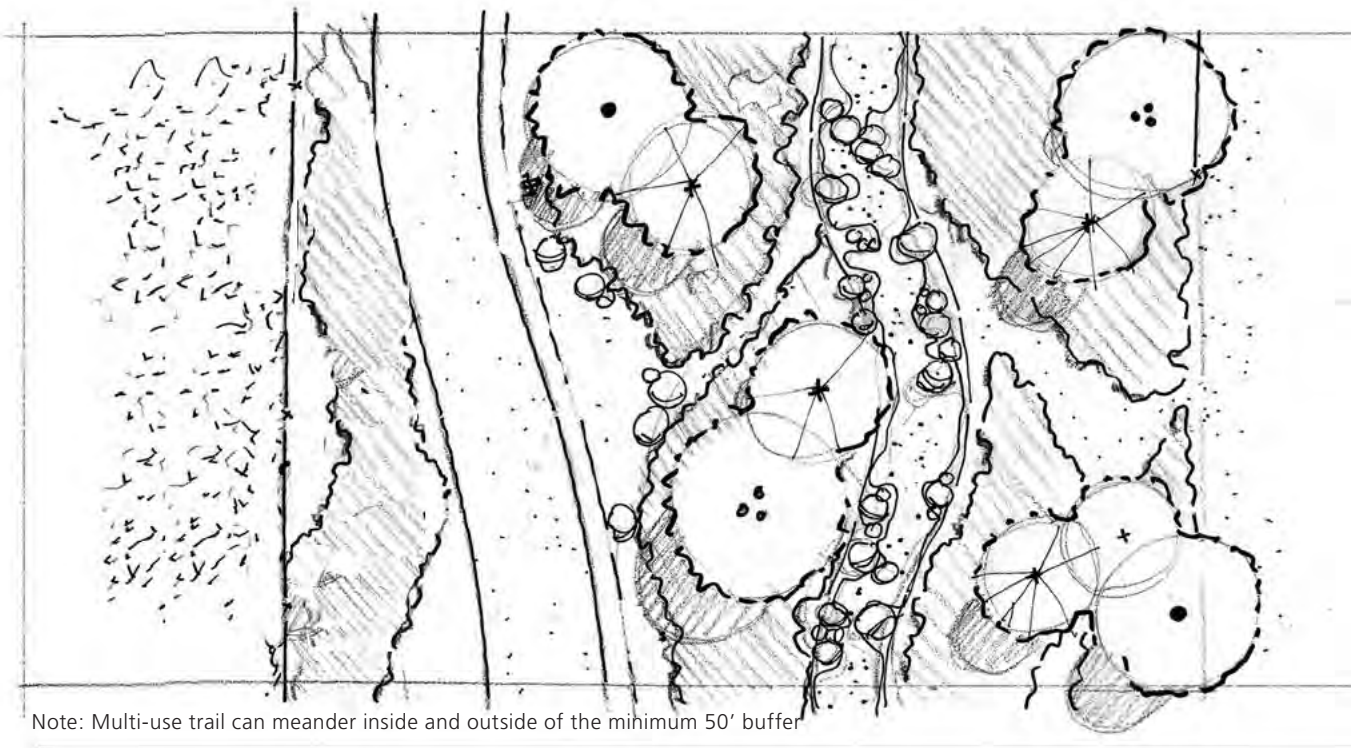
Conceptual Section and Vignette Location Map

Legend	
A	Park
B1	Mixed-Use
B2	Mixed-Use Common Space
C	Residential Side-On
D	Residential Front-On
E	Residential Back-On
F	Detention Basin
G	Paseo Central
H	Neighborhood Street / Arterial
I	Community Trail Through Avoided Area: At Grade
J	Community Trail Over Hydrological Connections (elevated)

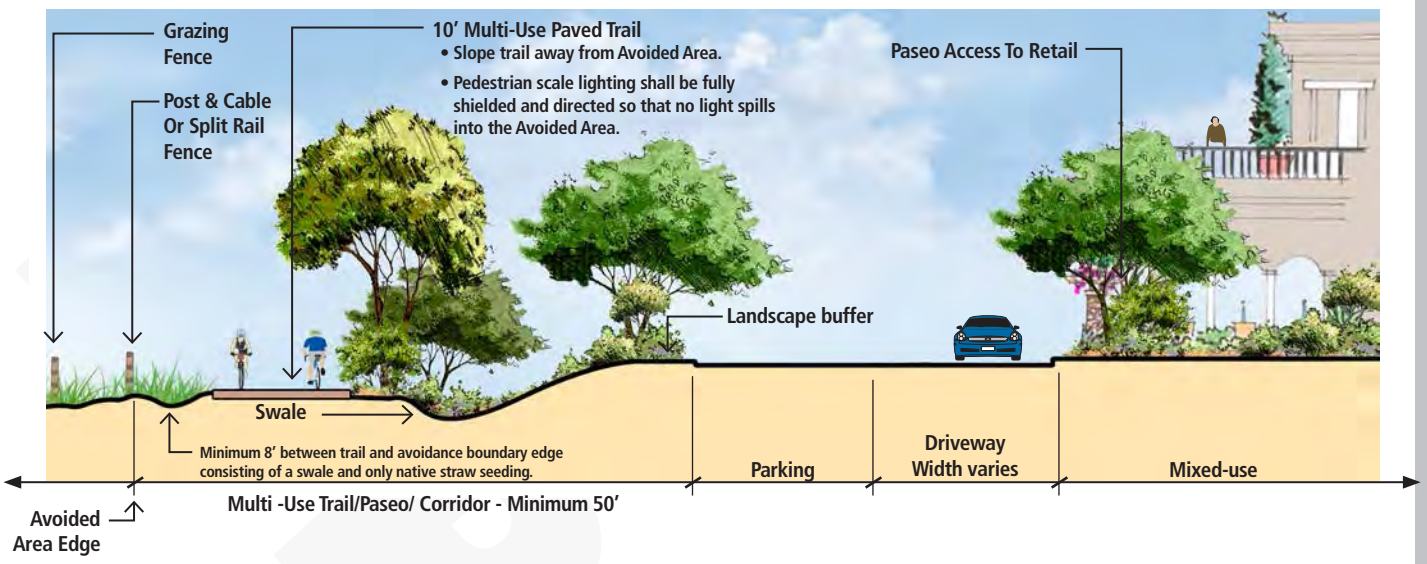
Note: Lettered Marker locations indicate potential locations in a generalized manner.



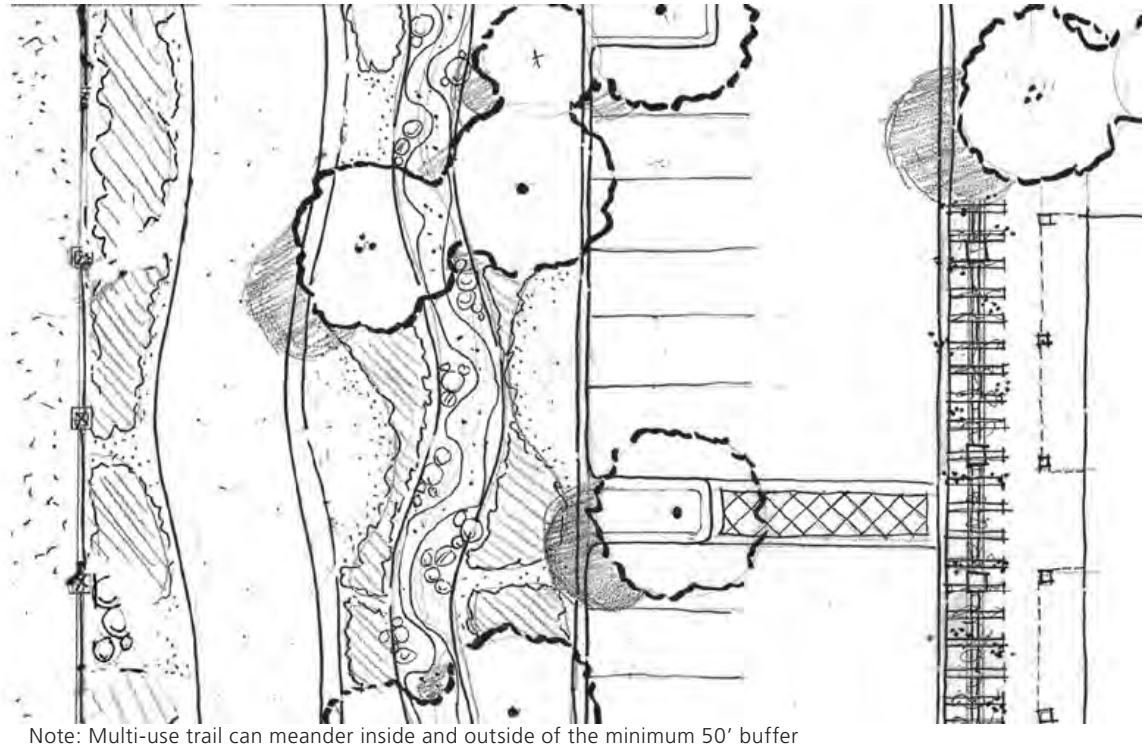
Edge Condition "A" Section
Sports Park



Edge Condition "A" Vignette
Sports Park

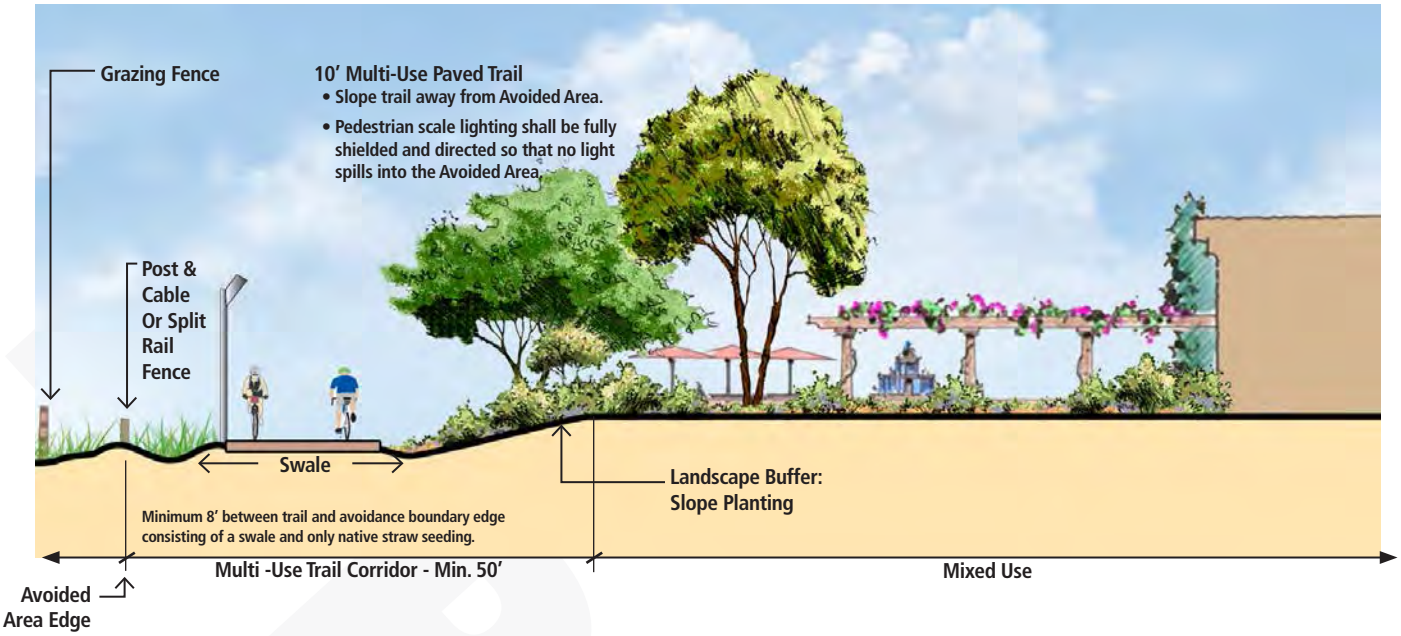


Edge Condition "B1" Section
Retail / Mixed Use

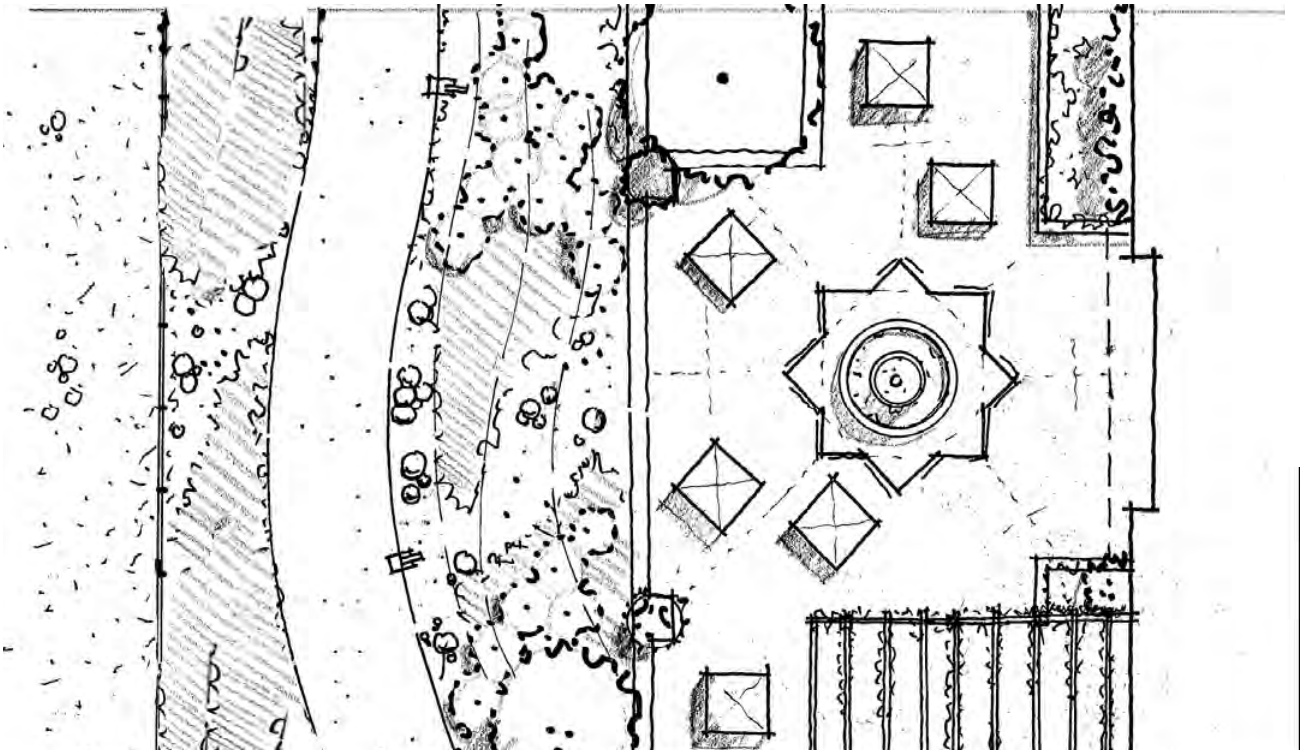


Note: Multi-use trail can meander inside and outside of the minimum 50' buffer

Edge Condition "B1" Vignette
Retail / Mixed Use

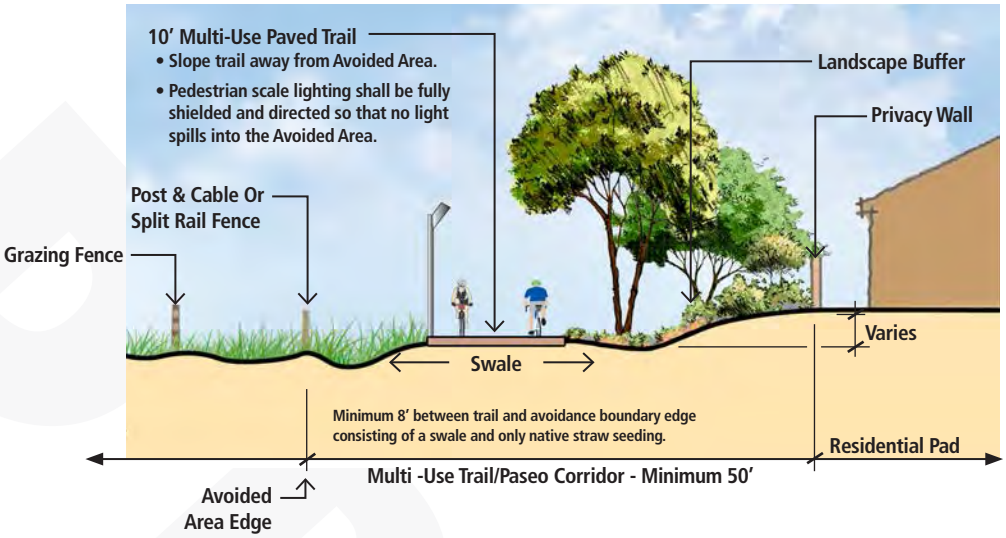


Edge Condition "B2" Section
Retail / Mixed Use Common Space



Note: Multi-use trail can meander inside and outside of the minimum 50' buffer

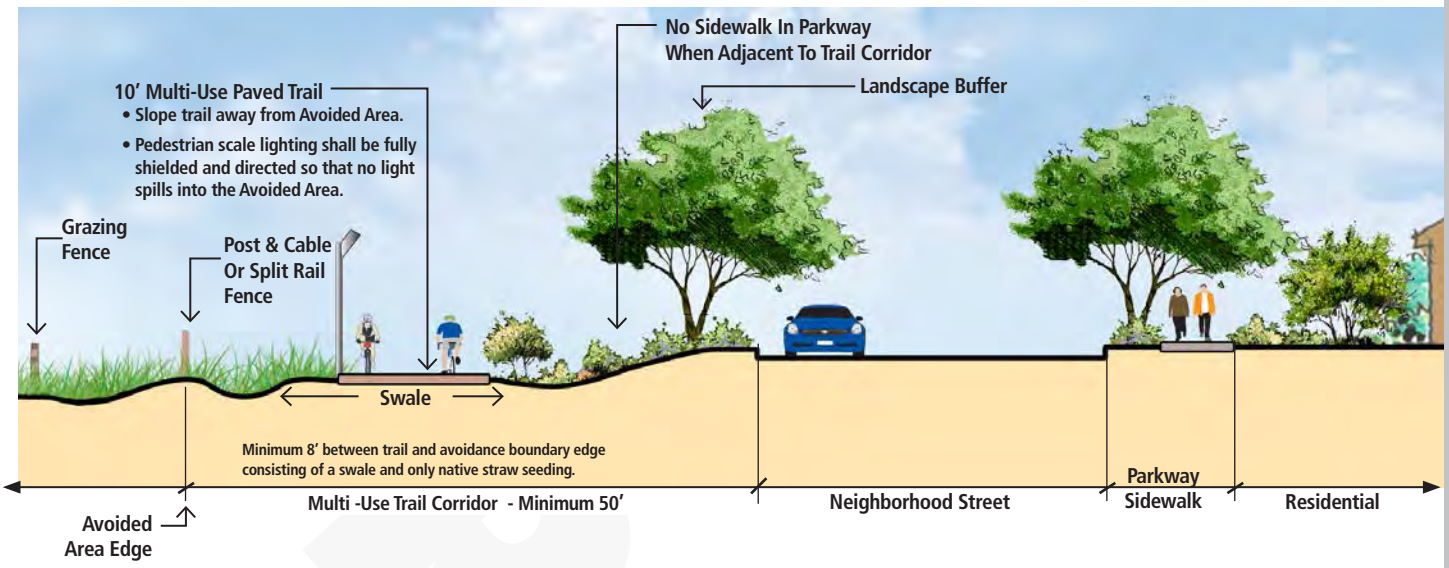
Edge Condition "B2" Vignette
Retail / Mixed Use Common Space



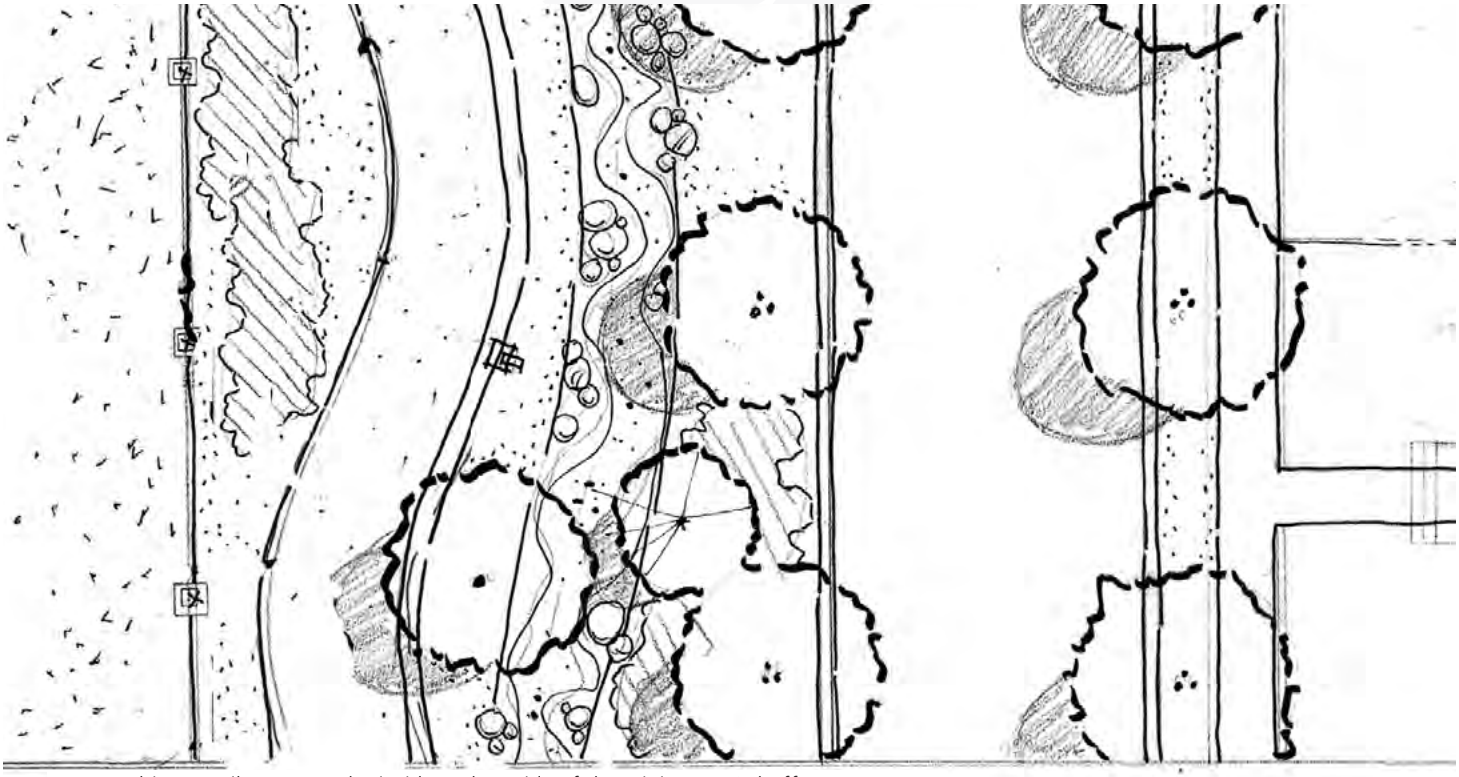
Edge Condition "C" Section
Residential Side-On

Note: Multi-use trail can meander inside and outside of the minimum 50' buffer

Edge Condition "C" Vignette
Residential Side-On

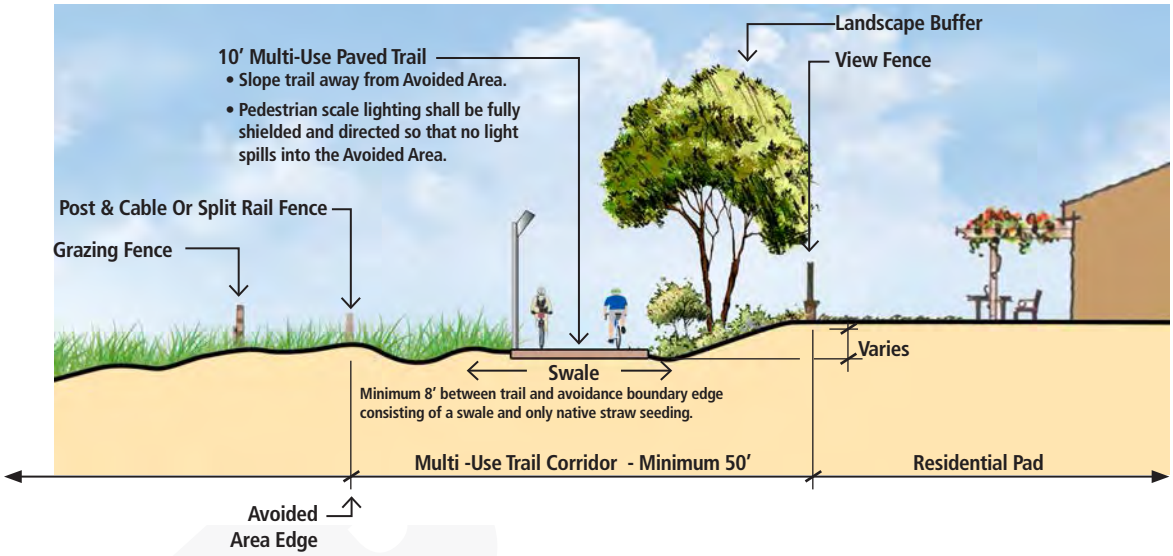


Edge Condition "D" Section
Residential Front-On With Street



Note: Multi-use trail can meander inside and outside of the minimum 50' buffer

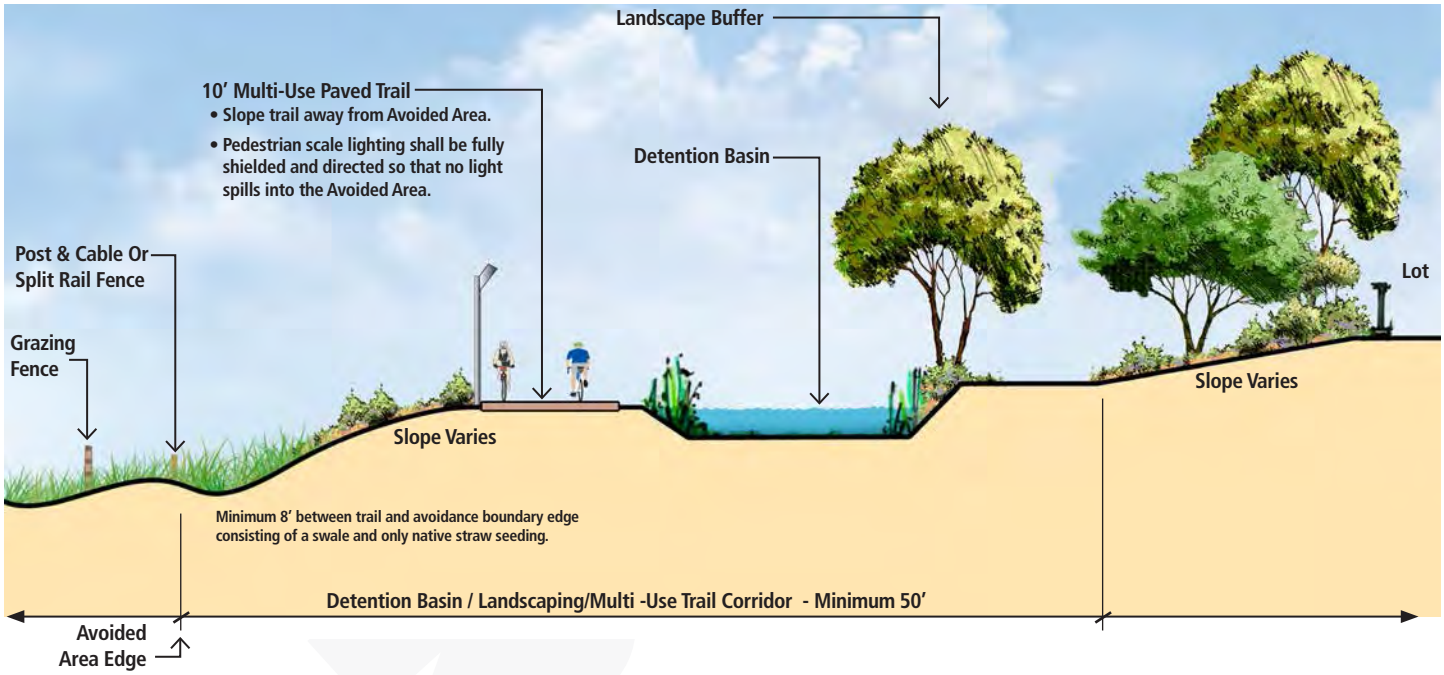
Edge Condition "D" Vignette
Residential Front-On With Street



Edge Condition "E" Section
Residential Back-On

Note: Multi-use trail can meander inside and outside of the minimum 50' buffer

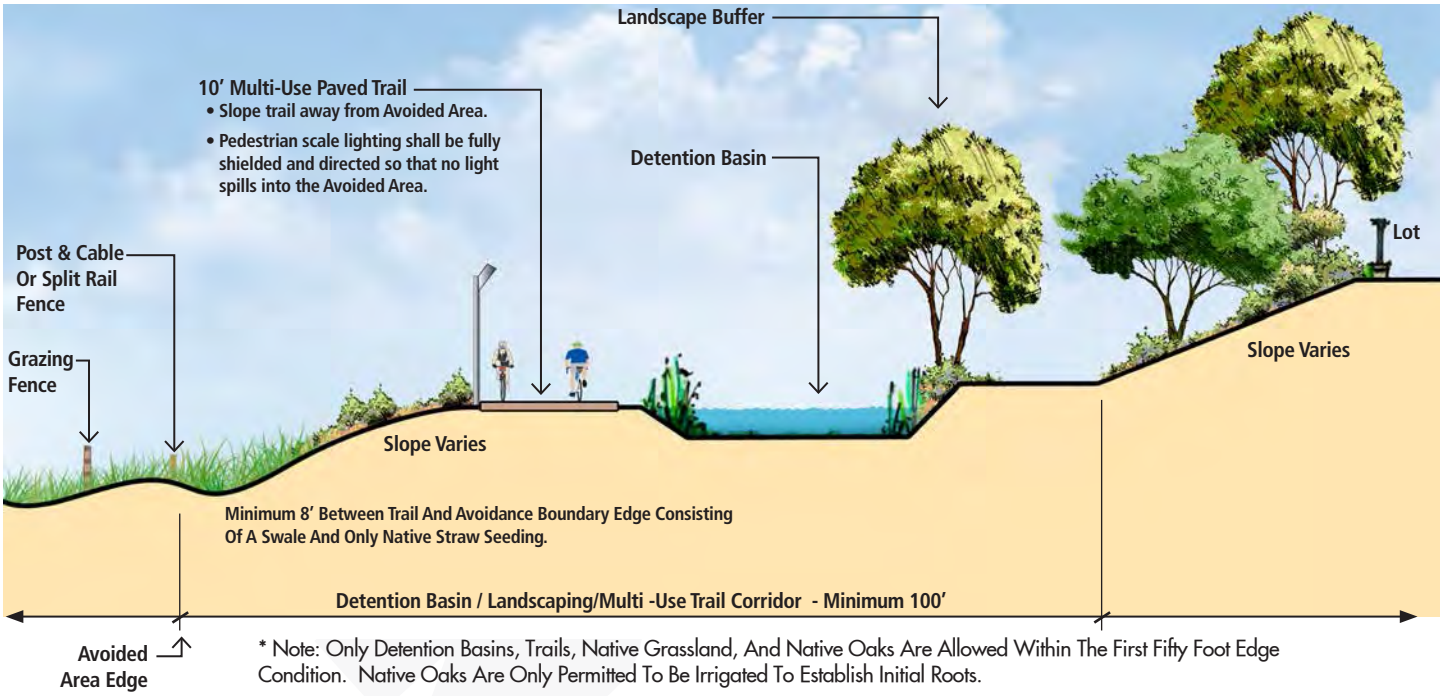
Edge Condition "E" Vignette
Residential Back-On



Edge Condition "F" Section
Detention Basin (Town Center)

Note: Multi-use trail can meander inside and outside of the minimum 50' buffer

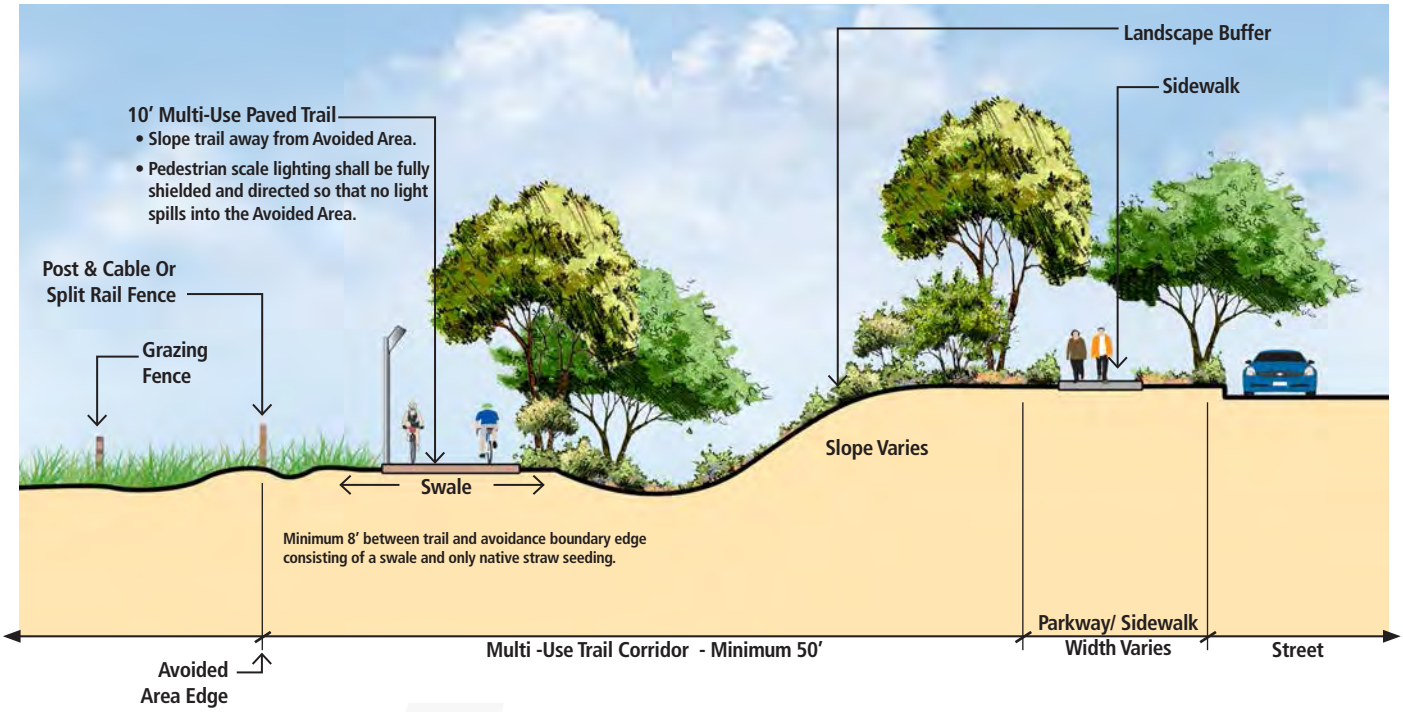
Edge Condition "F" Vignette
Detention Basin (Town Center)



Edge Condition "G" Section
Paseo Central

Note: Multi-use trail can meander inside and outside of the outer minimum 50' buffer

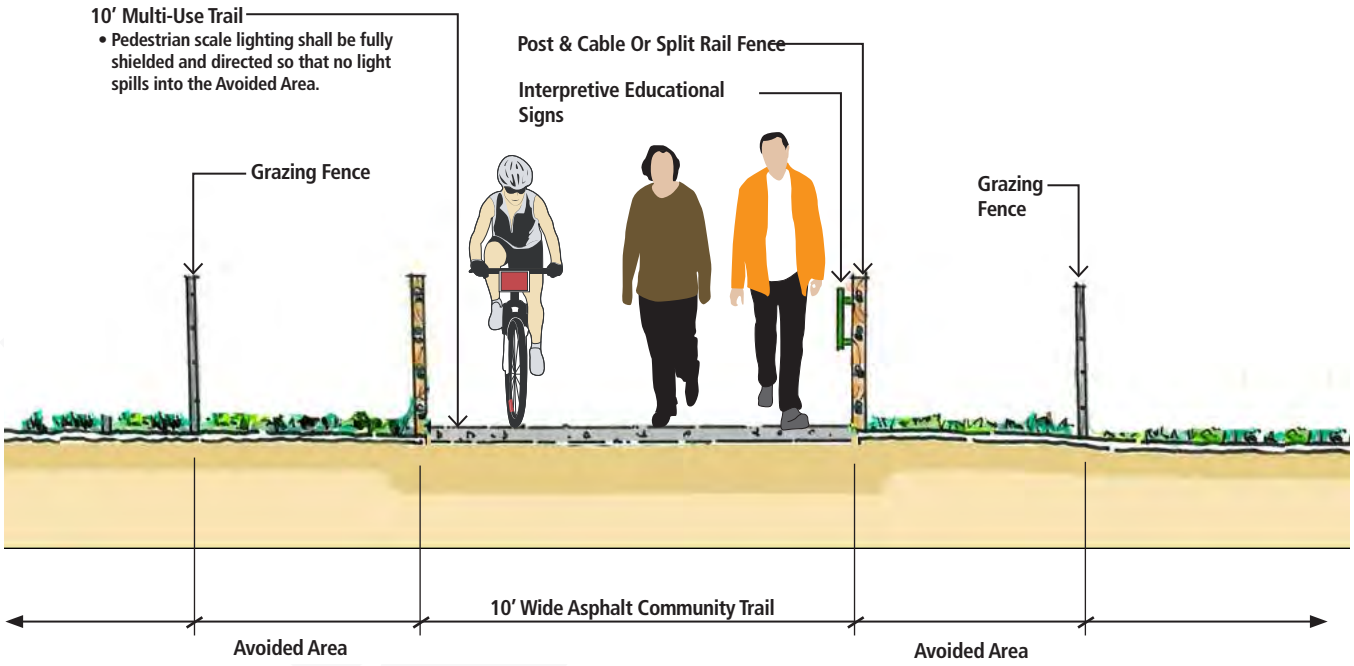
Edge Condition "G" Vignette
Paseo Central



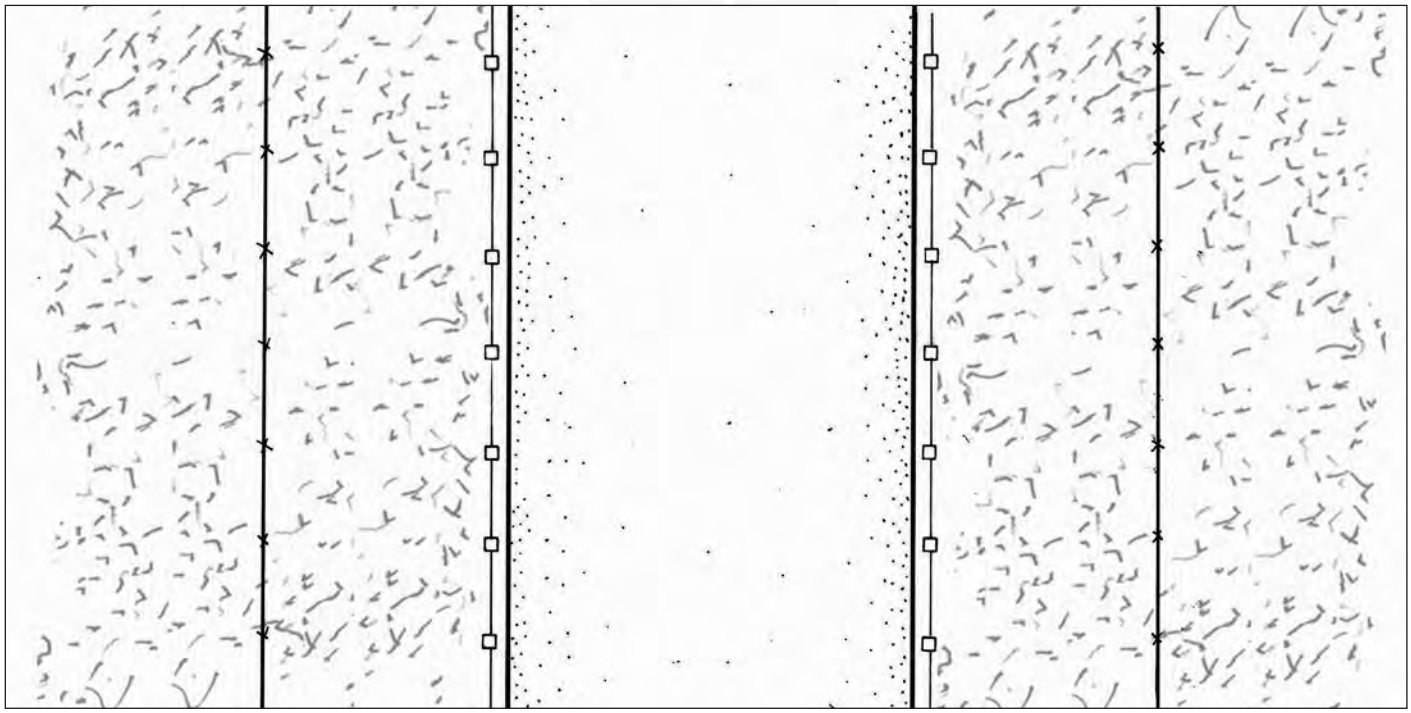
Edge Condition "H" Section
Neighborhood Street / Arterial

Note: Multi-use trail can meander inside and outside of the minimum 50' buffer

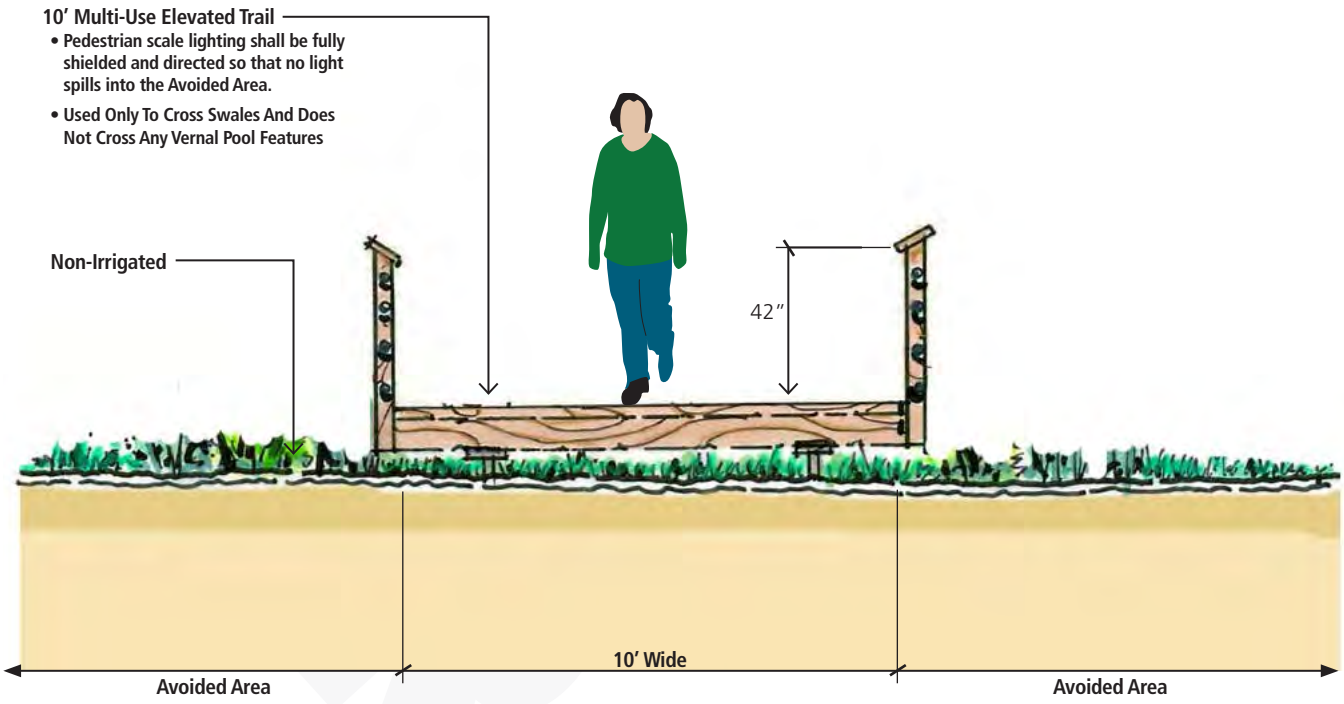
Edge Condition "H" Vignette
Neighborhood Street / Arterial



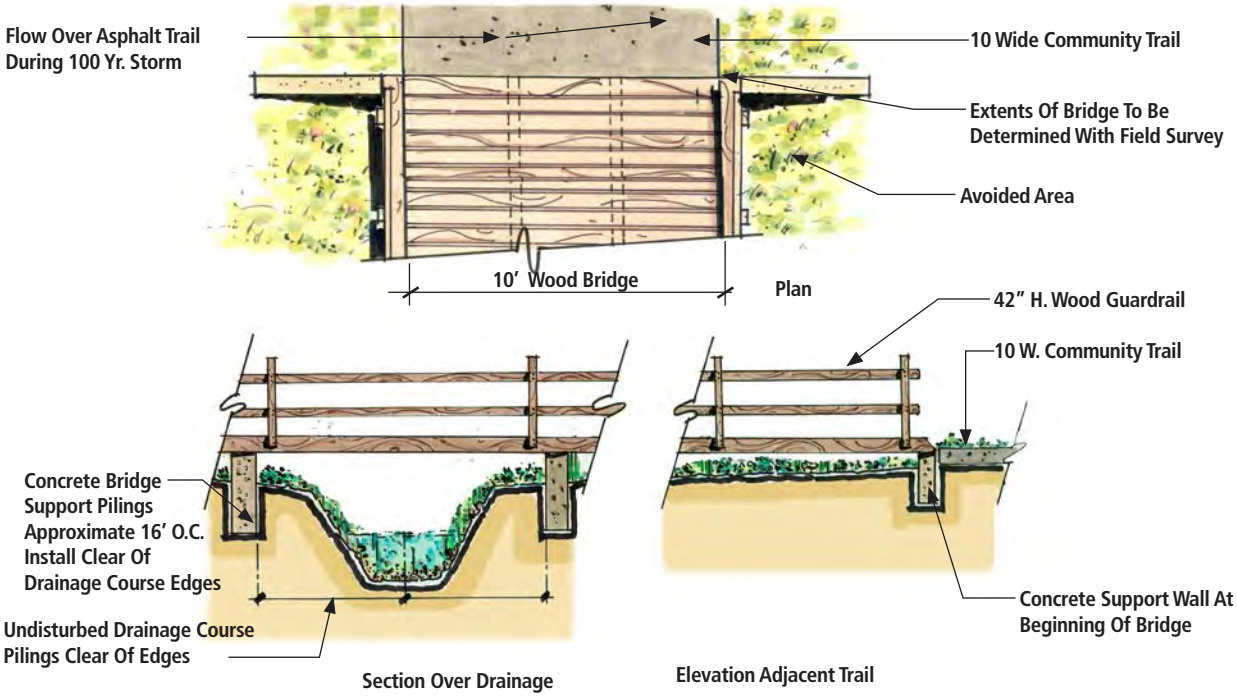
Edge Condition "I" Section
Community Trail Through Avoided Area: At Grade



Edge Condition "I" Vignette
Community Trail Through Avoided Area: At Grade



Edge Condition "J" Section
Community Trail Over Hydrological Connections (elevated)



Edge Condition "J" Vignette
Community Trail Over Hydrological Connections (elevated)

ATTACHMENT C

Summary of Off-Site Indirect Effects to Federally Listed Species

20 February 2014

Mr. Mark Hanson
Cordova Hills, LLC
5241 Arnold Ave
McClellan Park, California 95652

RE: Cordova Hills Project – Summary of Off-Site Indirect Effects to Federally-Listed Species

INTRODUCTION

This document summarizes the analysis ECORP Consulting, Inc. (ECORP) used to determine potential off-site indirect effects to federally-listed vernal pool crustacean habitat associated with the Cordova Hills Project (Project). ECORP utilized available LIDAR data (U.S. Army Corps of Engineers [USACE] 2011) to determine the location of all depressional wetlands within ¼ mile of the Project boundary, as well as to analyze the individual and nested watersheds (i.e. watersheds of entire wetland complexes, where individual pools fill and spill into adjacent pools) for each wetland both pre and post-Project. A 250-foot distance is typically used for determining which wetlands to analyze, as this is the range utilized by the U.S. Fish and Wildlife Service (USFWS) to assess indirect effects to federally-listed vernal pool species in the absence of sufficient data (i.e. watershed and flow direction data). As ECORP was utilizing a watershed approach for analyzing potential off-site indirect effects, a ¼ mile range was selected to insure that all potentially affected wetlands were incorporated in the analysis.

EXISTING CONDITIONS

The Project is bounded by existing roads to the west and north (paved Grant Line Road and unpaved Glory Lane, respectively). Because of this, surface flow is only able to exit the Project site at the few locations where culverts exist. The eastern and southern edges of the Project site are largely in their natural state, but due to the hilly terrain in these areas, surface water collects and flows off-site in a limited number of locations. ECORP used GIS analysis to determine where surface flow would be affected by future development in an effort to determine where downstream flows may be reduced due to loss of upstream watershed area. Figure 1. *Surface Flow Downstream of Impact Areas*, shows the few areas in which surface

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Figure 1. Off-site Wetland Indirect Impact Analysis

Map Features

- Project Boundary
- 0.25 Mile Buffer

Off-site Wetland

- Indirect Impact-2.787 Ac. (0-80% Watershed Retained)
- Non-Indirect Impact-0.936 Ac. (80-99.5% Watershed Retained)
- Avoided-1.464 Ac. (>99.5% Watershed Retained)
- Shed not in Project Area
- Off-site Watershed
- Project Impact Area
- Project Avoided Area

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Location: J:\GIS_Maps\2005-217_Cordova_Hills\Offsite\Offsite_Wetland_Watershed_Analysis\Draft Off-site Watershed Analysis (2014-12-09) AINP.mxd (DEK, 12/19/2014)

2005-217 Cordova Hills

Scale in Feet
0 1,000 2,000

Map Date: 12/19/2014
[1] Received from Sacramento County

water exits the Project site. This illustrates how limited the hydrological connectivity is between the Project site and surrounding properties, indicating that loss of upland areas due to project build-out would have minimal impacts on the off-site watersheds of a limited selection of wetlands.

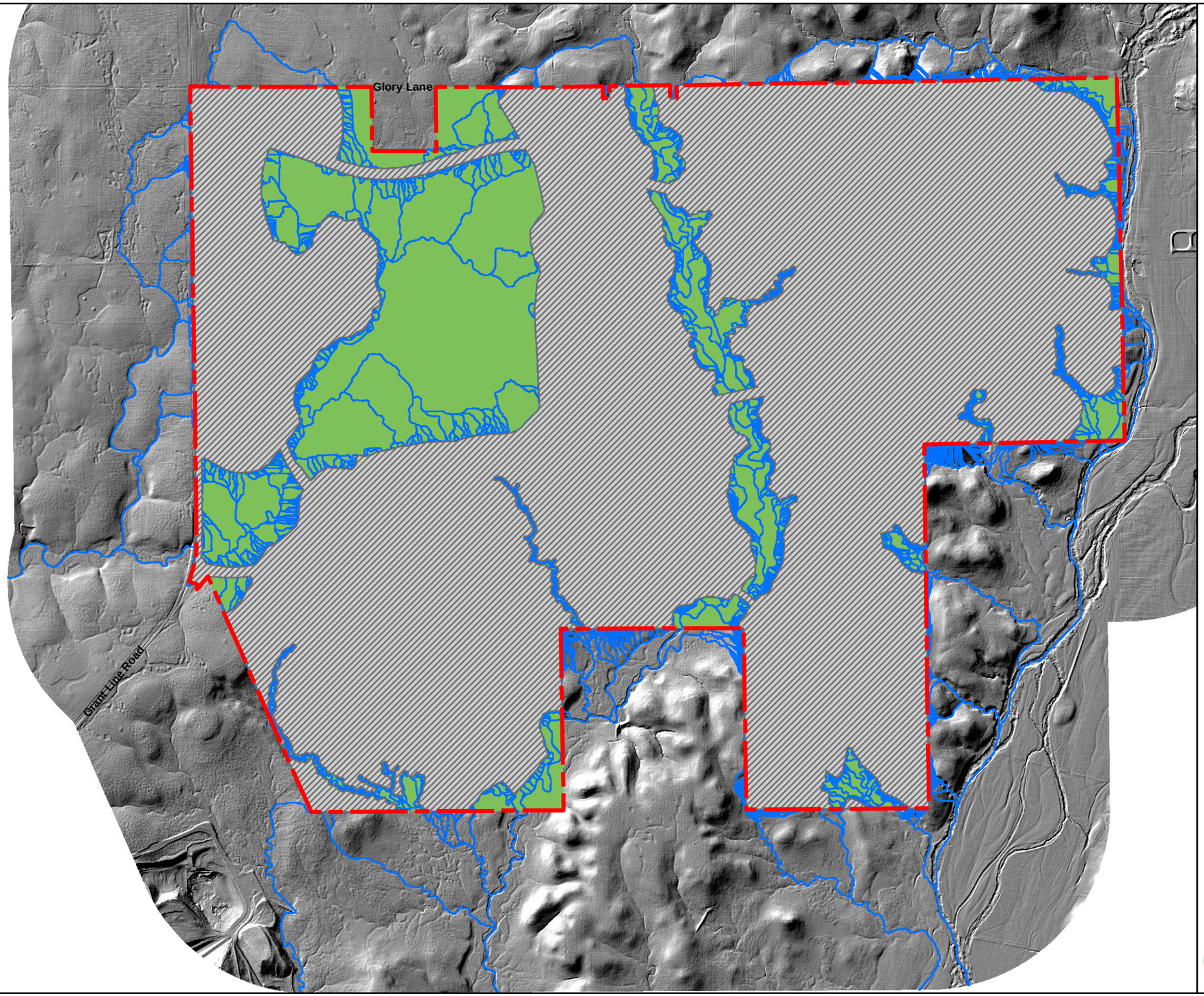
WATERSHED ANALYSIS

In order to determine which off-site wetlands may be indirectly affected by Project build-out, ECORP first examined each watershed to determine if it intersected with the Project boundary. Figure 2. *Off-Site Wetland Indirect Impact Analysis*, shows all wetlands within ¼ mile of the Project boundary[1] and their associated watersheds. If a watershed was completely off-site (a threshold of 99.5% was used to account for watershed boundaries that intersect with the Project boundary), it was presumed that indirect effects to the wetland would not occur, and that they would be completely avoided. There are 1.464 acres of avoided wetlands within the off-site analysis area. Any activities associated with Project build-out that would result in nuisance runoff or pollutants would be captured on-site, and the existing watersheds of these wetlands would not be impacted

There are a total of 22 wetlands (totaling 0.936 acre) which would retain 80-99.5% of pre-Project nested watersheds. Previous analysis (ECORP 2013) done by ECORP at the Project site determined that watersheds will remain functional with highly reduced watersheds. This is in part due to the fact that many of the wetlands in the area have extremely large nested watersheds (up to several hundred acres in some cases). ECORP determined that wetlands will remain functional if they have a wetland:watershed ratio (WWR) of roughly 4:1 (the actual ratio varies based on wetland size). Of the wetlands that would retain 80-99.5% of their nested watersheds, the smallest post-Project WWR is 8.9:1, although most will have much larger WWRs, see Table 1 below. It should be noted that the wetland with the 8.9:1 WWR (vernal pool-59) currently has a WWR of 10.1:1, so the watershed reduction is negligible (0.048 acre). It is anticipated that each of these wetlands will retain sufficient upstream watershed area,

[1] *One large (approximately 5 acre) wetland from the LIDAR data set was manually removed. This wetland occurred along the southeastern Project boundary, and was not identifiable during a 2013 reconnaissance-level site visit by ECORP biologists.*

Figure 2. Surface Flow Downstream of Impact Areas



Map Features

- Development Area
- Drainage Paths
- Preserve
- Project Boundary

Location: J:\GIS_Maps\2005-217_Cordova_Hills\OffsiteOffsite_Wetland_Watershed_Analysis\DownstreamCells (2014-12-05).mxd (DEK, 12/12/2014)

2005-217 Cordova Hills

Scale in Feet
0 1,000 2,000

ECORP Consulting, Inc.
ENVIRONMENTAL CONSULTANTS

Map Date: 12/9/2014
[1] *Received from Sacramento County*

such that surface water contribution from the Project site would not be reduced significantly enough to modify habitat suitability, and indirect impacts would not occur.

Table 1. Cordova Hills Project Proposed Wetland:Watershed Ratios (WWR)

Wetland ID	Wetland Size (Ac.)	Pre-development Nested Watershed Size	Wetland:Watershed Ratio (WWR)	Retained Watershed	Impacted Watershed	Post Project WWR	% Watershed Remaining
Vernal Pool-43	0.039	0.8	21.2	0.7	0.2	17.0	80%
Vernal Pool-40	0.010	0.9	87.7	0.7	0.2	71.3	81%
Vernal Pool-22	0.363	300.7	827.8	245.4	55.3	675.6	82%
Vernal Pool-60	0.008	0.2	28.4	0.2	0.0	23.4	83%
Vernal Pool-59	0.036	0.4	10.1	0.3	0.0	8.9	88%
Vernal Pool-20	0.099	195.9	1970.7	173.5	22.5	1744.7	89%
Vernal Pool-29	0.014	198.1	14243.0	175.6	22.5	12627.8	89%
Vernal Pool-2	0.004	465.3	105674.3	420.4	44.9	95470.3	90%
Vernal Pool-7	0.018	235.4	13348.1	212.9	22.5	12074.3	90%
Vernal Pool-24	0.016	1.4	86.9	1.3	0.1	78.9	91%
Vernal Pool-6	0.010	248.7	25192.7	226.2	22.5	22916.9	91%
Vernal Pool-46	0.158	2.5	16.0	2.4	0.2	14.9	93%
Vernal Pool-8	0.081	172.8	2133.4	161.0	11.8	1987.7	93%
Vernal Pool-28	0.014	0.6	41.5	0.5	0.0	38.7	93%
Vernal Pool-64	0.009	2.8	299.9	2.6	0.2	281.0	94%
Vernal Pool-42	0.015	5.0	334.9	4.7	0.3	314.4	94%
Vernal Pool-25	0.019	2.6	137.5	2.4	0.1	129.7	94%
Vernal Pool-63	0.023	3.3	143.2	3.1	0.2	135.6	95%
Vernal Pool-39	0.011	0.5	43.6	0.4	0.0	41.5	95%
Vernal Pool-38	0.003	0.5	158.9	0.5	0.0	152.2	96%
Vernal Pool-37	0.004	0.6	150.7	0.5	0.0	145.0	96%
Vernal Pool-36	0.007	0.6	83.8	0.6	0.0	80.9	97%

There are 2.787 acres of wetlands within the off-site analysis area that will retain less than 80% of their existing watersheds. This acreage is comprised of one large vernal pool (1.91 acres) to the west, and several much smaller wetlands. Watershed reduction due to Project build-out may result in reduced surface flow contributions to these wetlands, which might potentially

reduce their suitability for federally-listed vernal pool crustaceans. None of these offsite wetlands will be filled or physically altered due to the Project.

CONCLUSION

Of the approximately ±5.187 acres of wetlands within the off-site analysis area that may serve as habitat for federally-listed vernal pool crustaceans and which have watersheds that touch or intersect the Project's boundary, 2.787 acres may be subject to indirect impacts due to hydrologic modification. All of these wetlands are located within the Mather Core Recovery Area, as defined in the *USFWS's Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (USFWS 2005). The Project applicant will propose suitable mitigation for these anticipated indirect effects.

If you have any questions, please contact me at BWatson@ecorpconsutling.com or (916) 782-9100.

Sincerely,

DRAFT

Ben Watson
Senior Regulatory Project Manager

Attachment(s)

REFERENCES

ECORP 2013. *Revised Watershed Analysis of the Existing Wetlands for Cordova Hills.* Prepared by ECORP Consulting, Inc. for Cordova Hills LLC. 18 April 2013.

U.S. Army Corps of Engineers (USACE). 2011. Six County Aquatic Resources Inventory. U.S. Army Corps of Engineers, Sacramento District, Regulatory Division. Available Online: http://mapping.sacog.org/scari/.

U.S. Department of the Interior, Fish and Wildlife Service (USFWS). 2005. *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon*. USFWS. Sacramento, California.

ATTACHMENT D

Summary of Indirect Effects to Federally Listed Species Associated with Off-Site Road Improvements

25 February 2015

Mr. Mark Hanson
Cordova Hills, LLC
5241 Arnold Ave
McClellan Park, California 95652

RE: Cordova Hills Project – Summary of Indirect Effects to Federally Listed Species Associated with Off-Site Road Improvements

INTRODUCTION

The Cordova Hills Project (Project) is responsible for a variety of off-site roadway improvements located in southern Sacramento County, California, each of which are "triggered" at various dwelling unit construction thresholds. These improvements will result in the fill of Waters of the U.S., and is being permitted as part of the pending Section 404 Individual Permit. This document summarizes the analysis ECORP Consulting, Inc. (ECORP) used to determine potential indirect effects to federally listed vernal pool fairy shrimp (*Branchinecta lynchi*) and vernal pool tadpole shrimp (*Lepidurus packardi*) (collectively referred to as vernal pool crustaceans) habitat associated with these off-site road improvements for the purposes of Endangered Species Act (ESA) compliance.

ECORP utilized available LIDAR data (U.S. Army Corps of Engineers [USACE] 2011) to determine the location of all depressional wetlands within 250 feet of the off-site road improvement areas, as well as analyzing the individual and nested watersheds (i.e., watersheds of entire wetland complexes, where individual pools fill and spill into adjacent pools) for each wetland both pre and post-Project. While a larger (1/4 mile) buffer was used around the Project site to assess potential indirect effects to vernal pool crustaceans, a smaller buffer was used for off-site road improvements due to the characteristics of the existing roadways and a much more limited scope of work.

EXISTING CONDITIONS

Off-site road improvements will include the expansion of existing roadways while maintaining culvert locations to sustain cross road flow and drainage. Improvement areas largely consist of compacted road shoulders, drainage swales along road edges, and non-native annual grassland with interspersed depressional wetlands. Wetlands located along road edges, particularly Grant Line Road where most improvements are occurring, are generally degraded and trash and debris are prevalent. Wetlands located further from the road edge are generally of higher value, and are more likely to be occupied by vernal pool crustaceans. Road improvement areas are narrow and linear by nature; therefore road improvements will not result in any new hydrological barriers. Following construction, the landscape will be largely the same as it is today, and any potentially suitable habitat for vernal pool crustaceans will likely remain suitable habitat upon completion of these road improvements. ECORP used GIS analysis to determine where road expansion would reduce contributory watersheds for existing wetlands in an effort to determine if any individual wetlands may be indirectly impacted by reduced hydrology.

Watershed Analysis

In order to conclude which wetlands may be indirectly affected by off-site road improvements, ECORP first examined each watershed to determine if it intersected with the improvement areas. Wetlands in the vicinity of each improvement area are shown in Figure 1. The wetlands within 250 feet of the improvement areas are classified as: 1) Avoided; 2) No Indirect Impact; or 3) Indirectly Impacted. If a watershed was completely outside of the improvement areas, it was presumed indirect effects to the wetland would not occur (Avoided). As a result, the existing watersheds of Avoided wetlands would not be impacted, and surrounding land uses would remain largely the same as they are today. No effects to vernal pool crustaceans will occur.

There are a total of 4.143 acres of wetlands within the improvement areas that would retain 80-99.5% of pre-Project nested watersheds. Previous Project analysis conducted by ECORP (ECORP 2013) determined watersheds may remain functional with highly reduced watersheds. This is in part due to the fact many of the wetlands in the area have extremely large nested watersheds, up to several hundred acres in some cases. ECORP determined wetlands may remain functional if they have a wetland:watershed ratio (WWR) of roughly 4:1 (the actual ratio

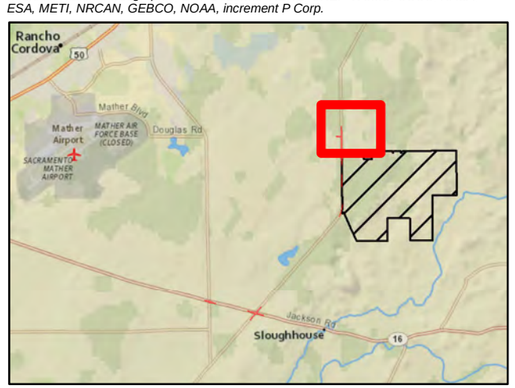
Figure 1.
Indirect Impacts Area

Map Features

- Named Road Improvement Area
- Road Improvement Area 250' Buffer
- Total Extents of Road Improvement Areas
- Watersheds of Features Adjacent to Impact Area
- Cordova Hills Boundary

Wetland Impacts

- Avoided - 1.209 Ac.
- No Indirect Impact - 2.799 Ac.
- Indirectly Impacted - 1.394 Ac.
- Wetland Features (SCARI)



ECORP Consulting, Inc.
ENVIRONMENTAL CONSULTANTS

2005-217 Cordova Hills

Scale in Feet
0 1,000

DRAFT

Map Date: 2/19/2015

Location: J:\GIS_Maps\2005-217_Cordova_Hills\Meetings\2015-02-05 Offsite Road Indirects\Indirect_Impact_Calcs.mxd (DEK) JSvager 2/19/2015

varies based on wetland size). Of the wetlands that would retain 80-99.5% of their nested watersheds, the minimum post-Project WWR is 4.3:1, although most will have much larger WWRs (see Table 1 below). It should be noted the wetland with the 4.3:1 WWR (vernal pool-166) currently has a WWR of 4.4:1; therefore watershed reduction is negligible. This is the case for the majority of the wetlands in this category, which is to be expected based on the narrow and linear nature of the road improvement areas. It is anticipated each of these wetlands will retain sufficient upstream watershed area, such that existing surface water contribution would not be reduced significantly enough to modify habitat suitability. Adjacent land use and potential sources of indirect effects (vehicles, pollutants, etc.) would remain the same as they are today, and indirect effects would not occur.

Table 1. Cordova Hills Project Proposed Wetland:Watershed Ratios (WWR)

Wetland ID	Wetland Size (Ac.)	Pre-development Nested Watershed Size	Wetland:Watershed Ratio (WWR)	Retained Watershed	Impacted Watershed	Post Project WWR	% Watershed Remaining
Vernal Pool-158	0.087	5.2	60.2	4.2	1.1	48.1	80%
Vernal Pool-137	0.079	0.6	7.3	0.5	0.1	5.9	80%
Vernal Pool-161	1.097	8.1	7.4	6.5	1.6	5.9	80%
Vernal Pool-168	0.213	2.9	13.4	2.3	0.6	10.8	81%
Vernal Pool-159	0.158	11.9	75.1	10.1	1.8	63.6	85%
Other Depressional Wetland-41	0.068	13.2	193.9	11.3	1.8	166.7	86%
Other Depressional Wetland-54	0.058	3.9	68.1	3.5	0.4	61.0	90%
Vernal Pool-127	0.027	0.4	15.8	0.4	0.0	14.3	90%
Vernal Pool-145	0.004	0.3	84.2	0.3	0.0	76.7	91%
Other Depressional Wetland-33	0.075	0.0	0.0	0.0	0.0	0.0	92%
Vernal Pool-148	0.825	5.9	7.1	5.5	0.4	6.6	93%
Vernal Pool-134	0.092	1.8	20.1	1.7	0.1	18.8	93%
Other Depressional Wetland-48	0.021	0.2	8.8	0.2	0.0	8.3	94%
Vernal Pool-126	0.017	0.8	43.1	0.7	0.0	40.8	95%
Other Depressional Wetland-46	0.118	25.4	216.4	24.1	1.3	204.9	95%
Other Depressional Wetland-35	0.124	6.3	50.9	6.0	0.3	48.7	96%
Other Depressional Wetland-31	0.194	290.0	1495.1	277.9	12.1	1432.9	96%
Other Depressional Wetland-34	0.003	245.3	88240.8	238.1	7.2	85652.1	97%
Other Depressional Wetland-13	0.003	0.8	250.3	0.8	0.0	244.1	98%
Other Depressional Wetland-52	0.004	0.8	188.7	0.8	0.0	184.1	98%

Wetland ID	Wetland Size (Ac.)	Pre-development Nested Watershed Size	Wetland:Watershed Ratio (WWR)	Retained Watershed	Impacted Watershed	Post Project WWR	% Watershed Remaining
Vernal Pool-166	0.108	0.5	4.4	0.5	0.0	4.3	98%
Other Depressional Wetland-11	0.703	46.6	66.3	45.8	0.8	65.2	98%
Other Depressional Wetland-26	0.036	3.4	94.8	3.4	0.0	93.7	99%
Other Depressional Wetland-64	0.033	7.7	234.4	7.6	0.1	232.0	99%

There are 1.693 acres of wetlands within the off-site analysis area that will retain less than 80% of their existing watersheds. Watershed reduction due to road improvements may result in reduced surface flow contributions to these wetlands, which may reduce their suitability for vernal pool crustaceans. None of these wetlands will be filled or physically altered.

CONCLUSION

Of the wetlands that may serve as habitat for federally listed species that intersect with the road improvement areas, 1.693 acres may be subject to indirect effects due to hydrologic modification. The Project Applicant will propose suitable mitigation for these anticipated indirect effects.

If you have any questions, please contact me at BWatson@ecorpconsutling.com or (916) 782-9100.

Sincerely,

DRAFT

Ben Watson
Senior Regulatory Project Manager

Attachment(s)

REFERENCES

ECORP Consulting, Inc. (ECORP). 2013. Revised Watershed Analysis of the Existing Wetlands for Cordova Hills. Prepared by ECORP Consulting, Inc. for Cordova Hills LLC. 18 April 2013.

U.S. Army Corps of Engineers (USACE). 2011. Six County Aquatic Resources Inventory. U.S. Army Corps of Engineers, Sacramento District, Regulatory Division. Available Online: http://mapping.sacog.org/scari/.

U.S. Department of the Interior, Fish and Wildlife Service (USFWS). 2005. Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon. USFWS. Sacramento, California.

ATTACHMENT E

Vernal Pool Restoration Plan and Hydrological Analysis for the Chester Property, Sacramento County, California

VERNAL POOL RESTORATION PLAN AND HYDROLOGICAL ANALYSIS FOR THE CHESTER PROPERTY, SACRAMENTO COUNTY, CALIFORNIA

PREPARED FOR:
Cordova Hills, LLC.
5241 ARNOLD AVENUE
MCCLELLAN, CALIFORNIA
95652

PREPARED BY:
INSTITUTE FOR ECOHYDROLOGY RESEARCH
2106 SARATOGA PLACE
DAVIS, CALIFORNIA

July 11, 2015

CONTENTS

LIST OF FIGURES

SECTION 1

SUMMARY

This Vernal Pool Restoration Plan for the 16.5 acre Chester Property in Sacramento County, California proposes to restore 1.78 acres of vernal pool area. This site is within the Mather Core area of the Southeastern Sacramento Valley Region of the US Fish & Wildlife Service's Vernal Pool Recovery Plan (USFWS 2005). The site currently supports approximately 13.35 acres of vernal pools and another 0.6 acre of seasonal pond. Historically, the site was part of an extensive area of vernal pools. By 1937 significant alteration of the topography caused degradation of the vernal pools within and beyond the Chester site. At least 86 acres of vernal pool landscape had been plowed and graded including the Chester site. However, historic aerial photos show the site was within a complex network of vernal pools and swales and one extensive swale traversed the property. Based on current topography of the general area filling of the degraded wetlands was conducted up through 2003 presumably to reduce flooding and to provide higher elevation uplands for home sites. Loss of vernal pool and swale wetland features continued through the time period from prior to 1937 to about 2003. By 2010 landscape changes leading to the existing conditions observed during 2015 had taken place.

The proposed project followed the US Army Corps of Engineers Wetland Mitigation and Monitoring Guidelines (2015) and first made an assessment of the site's suitability by studying the hydrology and soils. Modifications of the topography may or may not have resulted in loss of soil features, such as high clay content soil horizons or duripan, that form a water-restricting layer resulting in a seasonal water table that supports vernal pools within landscape depressions. The loss of the natural, historic topography limits the ability to restore the same landscape that existed previously. However, other opportunities are present and discussed below to restore the hydrological functioning to the site.

A detailed site survey to evaluate suitability included conducting global positioning system (GPS) topographic surveys to map the existing catchments of the landscape and existing wetlands. In

addition, ground-penetrating radar (GPR) was used to conduct a non-invasive survey throughout the property to determine the presence, depth, and continuity of water-restricting layers needed to support vernal pool hydrology. A survey of the property found existing degraded vernal pools over much of the property. This wetland area occurs within an elevation range from about 91 to 92 feet above mean sea level (msl). The area of the property where there is a house and lot occurs at an elevation from about 93.5 up to 95 feet msl. The GPR surveys determined the soils are relatively high in clay which would support the idea that the fill soils probably were taken from wetland areas such as the seasonal pond and elsewhere. Hand auger bore holes confirmed that the upper soil horizon were a clay loam in the upland and the wetlands. Although in the upland at 94 feet elevation point the depth from the soil surface to the clay horizon that would function as a water-restricting layer was 2 feet 9 inches. While in the wetland the depth to the clay horizon was about 1 foot. Construction of the seasonal pond included digging into the duripan which is apparent on the inner edge of the pond.

The existing wetlands function as a vernal pool based on the presence of typical vernal pool plants. Sites within the existing wetland with lower elevations support plants that are known as obligate wetland species such as spike rush and historic aerial photos show these areas pond for longer periods than the majority of the existing wetland. There are two main drainages within the existing wetland that divert water to the seasonal pond. An artificial berm was constructed after 1964 and prior to 1993 separating the eastern wetland area presumably to prevent flooding.

The proposed restoration would excavate the filled soil area after removing the house and structures. A fifteen foot setback with a one foot elevation drop per five feet would represent the proposed change in elevation grade from the west side of the property and establish an elevation of 92 feet msl. This elevation would be equivalent to the existing vernal pool elevation at the higher elevation. The proposed excavation would remove about 2 feet to 2 ½ feet of the upper loam and leaving clay loam with a clay horizon 0.5 to 1 foot deep providing a good root zone for plants. Existing drainages that divert water to the seasonal pond would be filled and the discharge points to the point blocked from diverting water. This would provide a longer hydroperiod and

inundation height thus improving the hydrology of the existing vernal pools as well. The approximately 3 acre seasonal pond which provides flood control of about 3 acre feet would continue to provide the same amount of flood storage when the vernal pool overflows at an elevation of 93.5 feet. The restoration of 1.78 acres of vernal pool would add 3.56 acre feet of additional flood storage and simultaneously provide hydrological functioning of the vernal pool.

SECTION 2

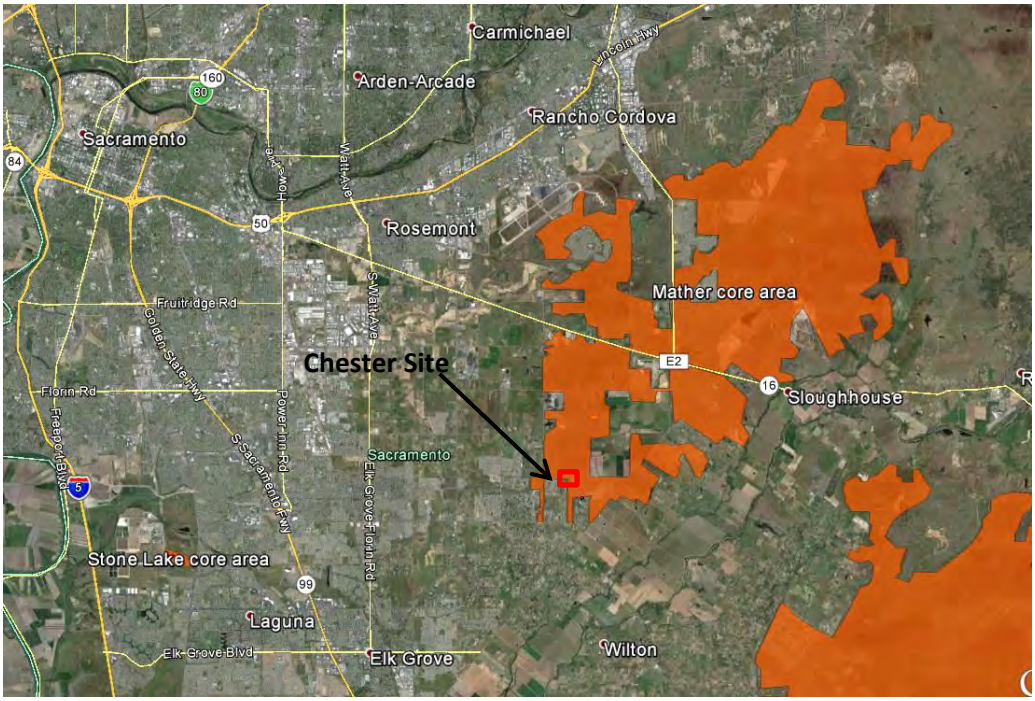
INTRODUCTION

This Restoration Plan is for vernal pools at the Chester property, Sacramento, California (**Figure 1**). This restoration is part of the proposed vernal pool wetland mitigation implementation for the Cordova Hills development project (**Figure 1**). The Cordova Hills property also includes extensive on-site preservation of high quality natural vernal pools. This site is within the Mather Core area of the Southeastern Sacramento Valley Region (**Figure 2**) of the US Fish & Wildlife Service's Vernal Pool Recovery Plan (USFWS 2005).

The US Army Corps of Engineers Mitigation and Monitoring Guidelines (2015) defines restoration as "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: reestablishment and rehabilitation." Compensatory mitigation through vernal pool restoration is an excellent method because the site of lost or degraded vernal pools indicates the site had the required soil and watershed parameters needed for the hydrological functioning. Restoration has been used in a variety sites in California (DeWeese 1998, Ferren and Hubbard 1998, McCarten et al. 2014). The biology of vernal pools in California has been studied extensively (Barbour et al. 2007, Bauder 2000, 2005, Holland and Jain 1981). Failures in restoration, however, are due to the lack of information on the hydrological functioning of vernal pools as it relates to soil, catchment, and weather variables. DeWesse (1998) determined that hydrological functioning was the more common of the success criteria in created or restored vernal pools. Applying hydrological principles to vernal pool restoration or creation has been lacking and it has not been emphasized until recently (Christopherson et al. 2013, McCarten and Christman 2014, McCarten et al. 2008, 2010, O'Geen et al. 2007, Rains et al. 2008). A key to wetland functions and services is ensuring the natural soil and watershed parameters of the site are present as identified by the US Army Corps of Engineers Mitigation and Monitoring Guidelines (2015).

Figure 1 Location of Chester Restoration Site.

Figure 2 Location of Chester Restoration Site within the Mather Core Recovery Area.



The majority of vernal pools in the Sacramento Valley occur on geomorphic terraces that support soils that have clay or duripan horizons that function as a water-restricting layer (Smith and Verrill 1998, O'Geen et al. 2007). The presence of a clay or duripan horizon can form a shallow seasonal water table (Rains et al. 2006, McCarten et al. 2008). Failures related to hydrological functioning of created vernal pools have been attributed to designs that have not considered the soils or hydrology (DeWeese 1998, Christopherson et al. 2013).

2.1 Project Goals

This Vernal Pool Restoration Plan established a series of goals in the development of the vernal pool restoration on the site:

- Goal 1 – Gather historic information on the site to understand the possible structure and distribution of the historic vernal pool wetlands and collect physical environmental data on the hydrology and soils to determine the suitability of the site to currently support vernal pools,
- Goal 2 – Clearly identify how any existing vernal pools or other wetlands are functioning based on the physical structure of the site, and
- Goal 3 – Develop a restoration plan that uses the topography and soils data to determine how restoration of the landscape would result in a functioning vernal pool ecosystem.

2.2 APPROACH AND METHODS

The USACOE Wetland Mitigation and Monitoring Guidelines (2015) identified hydrology and soils as two critical parameters important to the site assessment for suitability for wetlands mitigation. A third parameter, connectivity, is also important and discussed later. Also those Guidelines recommend a "watershed" approach to wetland design. The previous jurisdictional wetland delineation study (Gibson and Skordal 2012) provided baseline information on the current conditions of the site.

METHODS

First we conducted a survey of historic aerial photos of the site to determine the prior condition when vernal pool and other wetlands may have been present. Then we conducted field surveys of the site to determine the topography and soil profiles. We made comparisons with existing wetlands and any former vernal pools or other wetlands. We used a Trimble Real Time Kinematic Global Positioning System (GPS) to gather surface topographic data with a spatial resolution of +/- 1 cm and elevation of +/- 2 cm. This level of precision is needed to develop a topographic model for vernal pools and low elevation gradient terraces.

A Mala Geosciences ground-penetrating radar (GPR) system using an 800 MHz shielded antenna on a cart was used to survey the soil profile at the site. The GPR sends an energy wave from the antenna and collects a reflection wave from the soil based on the density variation within the soil profile. The GPR system was programmed to collect a data sample every 1.3 inches and the depth of soil horizon measurement was typically set at 3 to 4 feet. GPR transects were conducted throughout the site (see Section 3). Soil series for the site was determined using the Natural Resources Conservation Services SoilWeb application. Hand augered soil pits were made with a 2 ½ inch auger to determine the soil horizon textures and depth to clay or duripan restricting layers which were used to calibrate the GPR.

SECTION 3

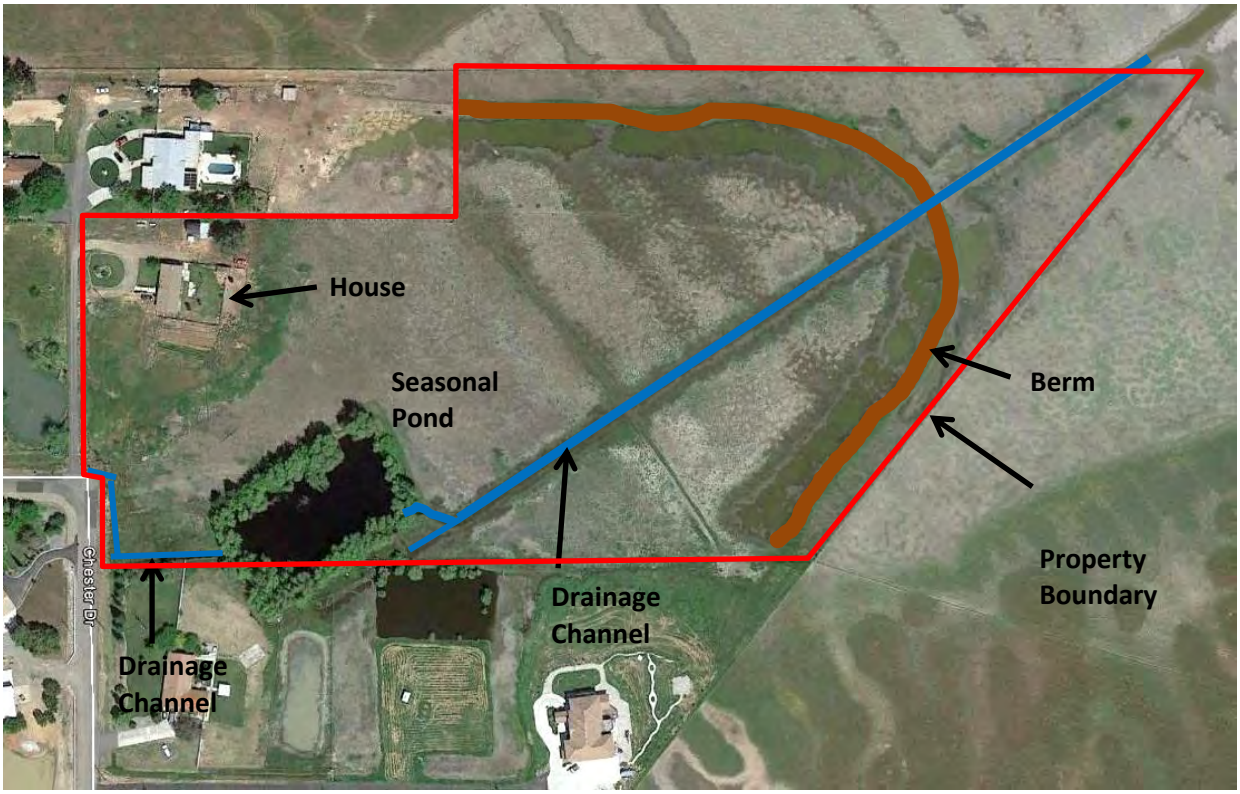
SITE EVALUATION AND SUITABILITY

This section of the report describes the history and existing site conditions and functions determined as part of the background and field investigation and data analysis. Numerous historic photos and data figures were created in this process. To maintain organization of the restoration plan a majority of the photos and figures are provided in Appendices.

3.1 PROJECT SITE

Figure 3 shows a 2015 aerial photo of the Chester site including the property boundary, house with gardens, seasonal pond, artificial berm, and constructed drainages the discharge into the seasonal pond.

Figure 3 Hydrological Characteristics of the Property (Google Earth Image 4-16-2015).



3.2 HISTORIC AERIAL PHOTOGRAPHY

Appendix A is a series of historic aerial photos taken from 1937 up to 2014. It is evident that by 1937 an extensive area of plowed and graded field had been created in the middle of a formerly extensive vernal pool landscape. This plowed area extends over about 86 acres including the Chester site. An historic swale is apparent along the northern edge of the plowed field which had drained south through the Chester site. Also, there was a shallow channel about 10 feet wide that exist today. The 1947, 1957, and 1964 aerials show the extent of the vernal pool landscape and that a vernal pool and swale system occurred within the Chester site. The 1964 aerial shows that the historic swale and drainage ditch were combined into what appears as a channelized ditch. The 1993 aerial shows the presence of existing artificial berm that is about 4 to 5 feet high. It is also apparent in that photo the seasonal swale was modified and the channelized ditch is gone. The 2003 aerial photo shows the houses are in the process of development but a remnant of the seasonal swale is evident. The 2013 and 2014 photos show a green area in the location of the historic swale but this area is fill soil that transitions from the higher elevation created upland for the house pad. In those photos is observable that water is ponding on the edge of the berm.

3.3 EXISTING WETLANDS

Figure 4 shows the existing wetlands previously delineated by Gibson and Skordal. There are approximately 14 acres of existing vernal pool wetlands. The vegetation observed on the site included many dominant, non-native wetland plants such as *Crypsis schoenoides* (swamp pricklegrass) and *Rumex crispus* (curly dock). Native plants in areas with longer hydroperiods included *Eleocharis macrostachya* (spike rush).

Figure 4 Existing Wetlands.

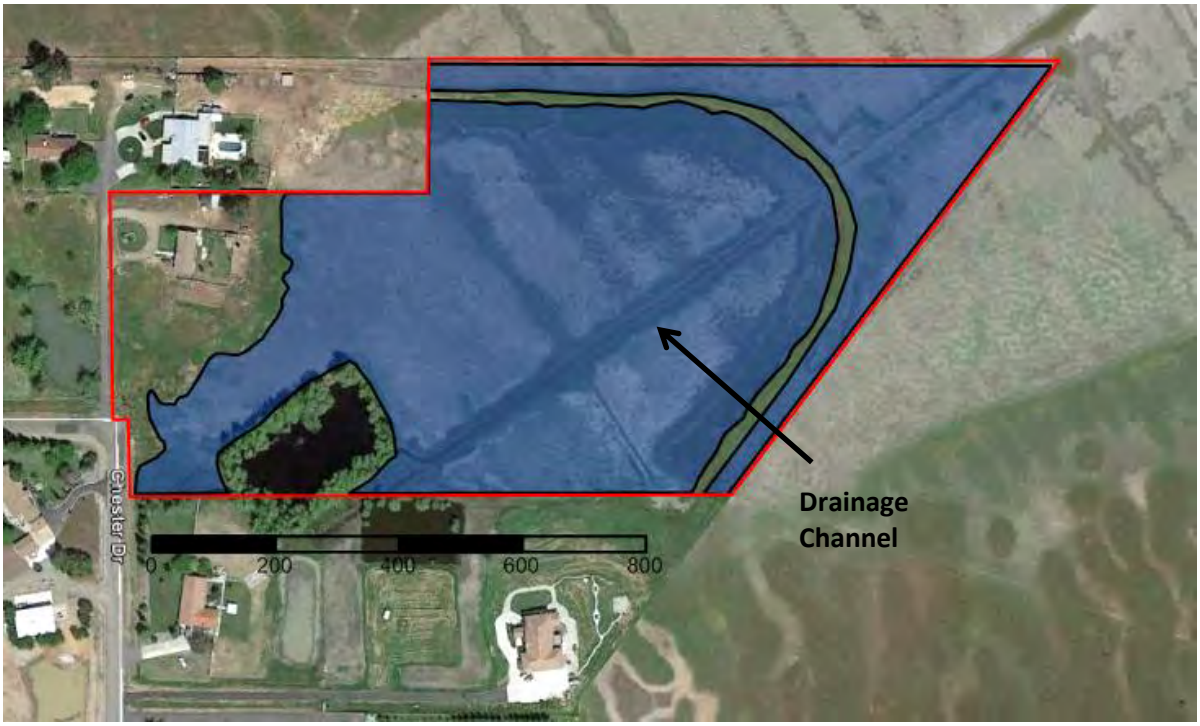


Figure 5 Photo of Drainage Channel in the Direction of Discharge into the Seasonal Pond.

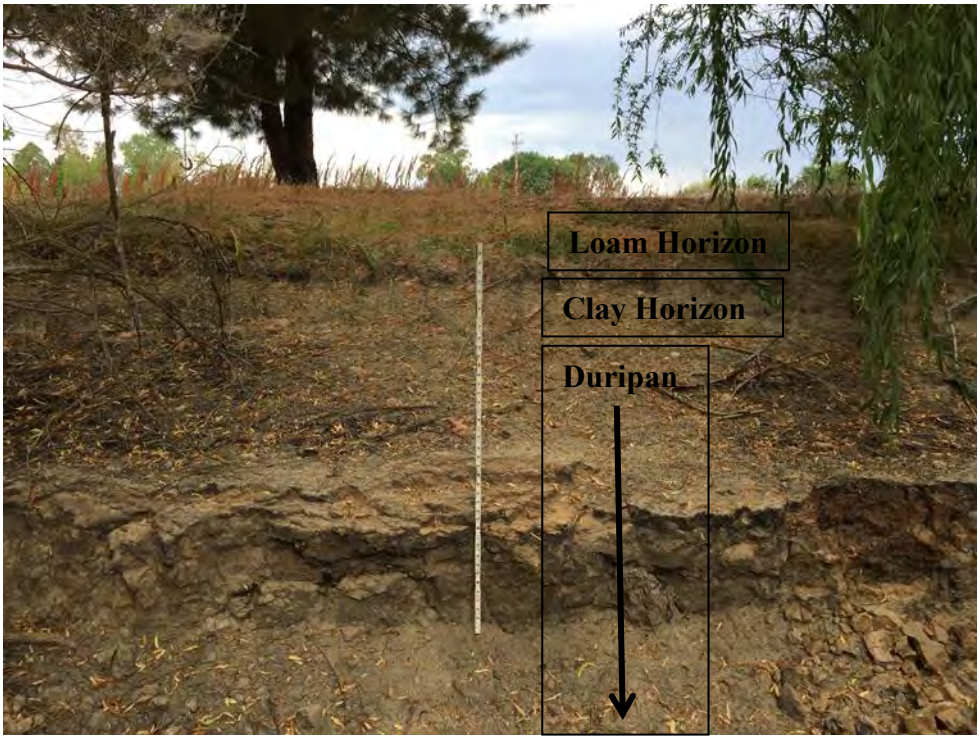
3.4 TOPOGRAPHY

Appendix B shows a 1993 aerial photo with point elevations taken from Google Earth (2015). These data indicate that the Chester site and areas east are the lowest elevation. The elevations show that the existing and historic vernal pool landscape has a broad range of elevations from a high elevation of 100 feet msl to about 90 feet msl. The seasonal pond is the lowest point on the site at 86 feet msl which is lower than the surface of the lowest wetlands point. It is not known if the plowed field area had, in fact, caused a reduction of the natural surface elevation. There are some elevations near the Chester site that are within existing vernal pool landscape that are at 90 feet msl. RTK GPS data were converted to an elevation contour map (**Appendix B**). The elevation varies from 95 feet msl on the western edge of the property to a low of 91 feet msl on the east side. The existing wetlands are overlain on the topography indicating there is a small (1 foot) elevation difference. Topographic data analysis was used to create a catchment map and vector flow map (**Appendix B**). The catchment map is simple and reflects the west to east elevation gradient and the low area at the seasonal pond. The vector flow map adds some details showing the direction of flow into locally low elevation areas such as the toe of the berm and the drainage ditches.

3.5 SOILS

The natural soil is mapped by NRCS as San Joaquin series (**Appendix C**). The profile typically in the upper layer is a loam which overlays increasing clay content to a clay horizon which overlays the duripan. Hand auger holes in the upland at 94 feet elevation msl observed loam to 2 feet 9 inches. At that depth there was an abrupt change to dense clay. Various types of gravel, cobbles and human created material in the upland indicate it was probably fill soils. In an auger hole at 92 feet elevation msl within the vernal pool the depth to the clay horizon was 1 foot 1 inch. The duripan is exposed on the inner edge of the seasonal pond (**Figure 6**).

Figure 6 Photograph of Duripan and Inner Edge of Seasonal Pond.



Sixteen GPR transects were taken and are shown on an aerial photo in **Appendix D**. Twelve of the GPR transects are also shown in Appendix D. Transects 36 and 37 are within the existing vernal pool wetland. The GPR of these transects indicate a change in soil density starting about 1.2 feet deep which is a good correlation with the 1 foot 1 inch depth of clay along transect 37. Changes in soil density were observed at about1.5 to 2 feet below the surface in the higher elevation (transect 38) while the augered hole indicated the clay horizon was observed at 2 feet 9 inches. The variation may be due to fill soils having various levels of clay content. Transect 35 was initiated at the higher elevation then transitioned into the lower elevation vernal pool. The clay horizon is between 1.5 and 2 feet deep in the vernal pool along that transect. Transects 47, 33, 41, 49, 34, and 40 are all in various locations in the upland at 94 feet elevation msl. All of these transect profile did not show one distinct higher density horizon that could be attributed to a clay horizon. This type of multi-signal throughout the profile can be due to different zones of compaction. Also, there is a lack of continuity of the signals that indicate the soil is heterogeneous. These observations further support the uplands are composed of mixed fill soil.

SECTION 4

VERNAL POOL RESTORATION PLAN

The historical aerial photo and recent aerial photos show the Chester site was part of an extensive vernal pool landscape. Agricultural land development modified a central area of vernal pools that included the Chester site which had a continuous series of vernal pools and swales and a regional swale traversing the site. Changes in topography from grading and filling and redirecting water flow with drainage ditches have modified the elevations and hydrology of the site. The existing vernal pool is more-or-less a single large pool with a range of elevations creating local areas with longer hydroperiod and larger depths. The seasonal pond is the point of discharge of a lot of the seasonal water in the existing vernal pool thus reducing the natural hydrology it would normally experience. The house and surrounding non-wetland area covers about 1.9 acres at elevation 94 to 95 feet msl are most likely on fill soil that helped prevent flooding of the proposed housing. An additional area of mounded fill soils exists along the edge of the vernal pool and within the vernal pool.

It is proposed that the upland and fill mounds be excavated and removed and the area graded to an elevation of 92 feet msl. A 15 foot set back from the property boundary on the west and north side will buffer the adjacent lands and create a 1 foot elevation drop for every 5 feet of horizontal distance. **Figure 7** shows the proposed area of the restoration vernal pool and connected with the existing vernal pool. **Figure 8** shows the existing cross-section and **Figure 9** shows the profile following excavation and contouring. The restoration would be grading 1.78 areas of filled area to its historic, natural elevation of 92 feet msl. This would increase the existing 13.35 acre vernal pool by 1.78 acres for a total of 15.13 acres.

Figure 7 Proposed Wetland Restoration and Existing Wetlands. Darker Polygon is the Proposed Restoration Vernal Pool. The Red Line is a Profile Line (See figures 8 & 9).

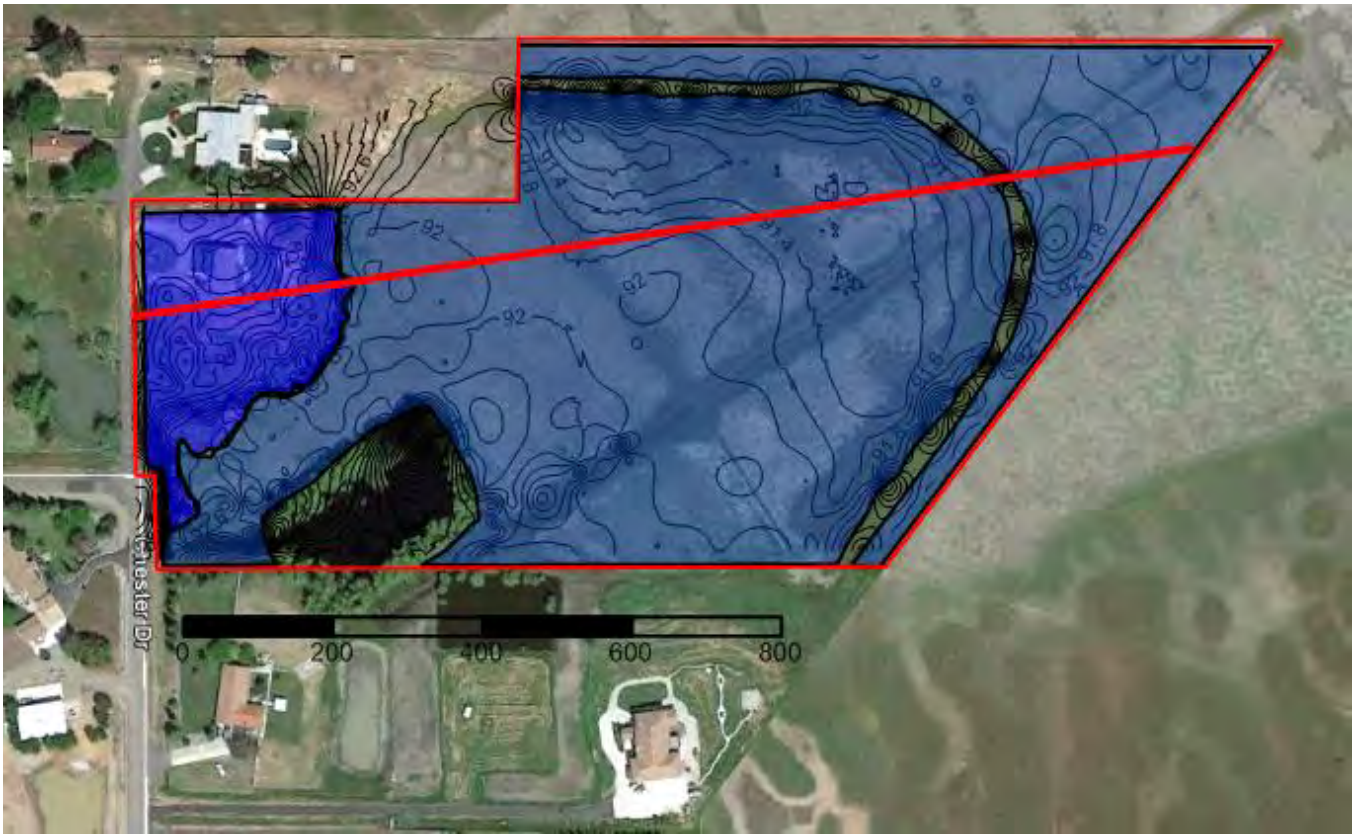


Figure 8 Existing Cross-Section.

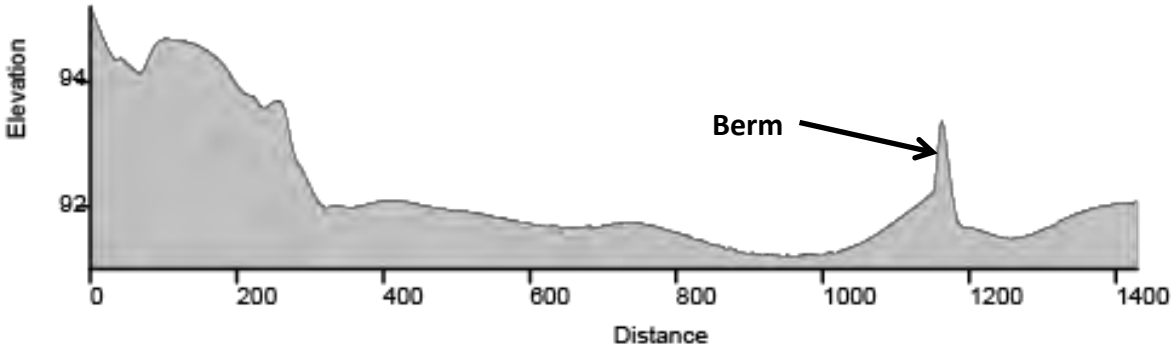
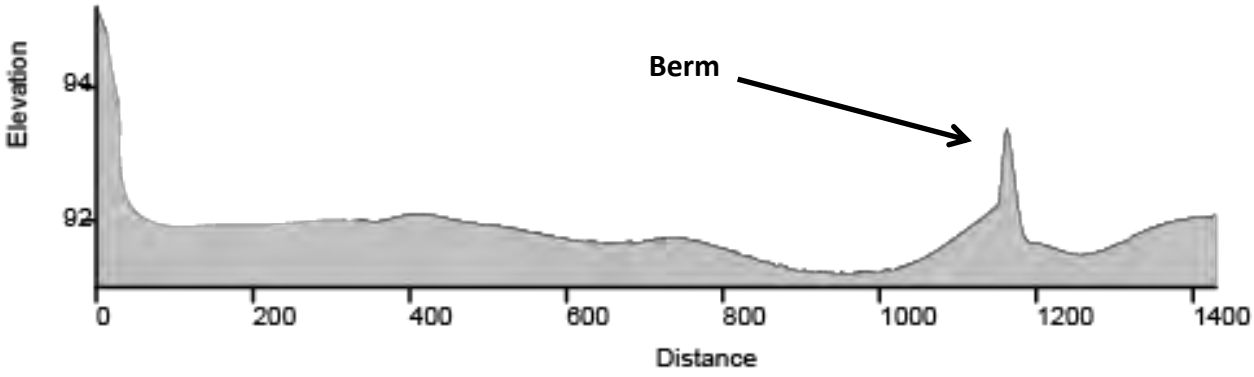


Figure 9 Proposed Restoration Cross-Section.



The proposed vernal pool restoration would create an additional 1.78 acres of wetlands that function as a vernal pool with direct rainfall and surrounding catchment inputs of water. The restored area would be directly connected and continuous with the existing vernal pool. In addition to excavation and grading of the fill soils additional activities will need to occur to prevent water loss from discharge into the seasonal pond. The existing vernal pool wetlands are, in fact, degraded due to loss of water that follows created ditches and discharge into the seasonal pond. This likely reduces the water in the vernal pool by 50 percent or more. Blocking the discharge into the seasonal pond will improve the existing wetland hydrology but also be important in the hydrological functioning of the restored vernal pool. The seasonal pool would continue to provide flooding water storage when the vernal pool overflows at about 93.5 feet elevation. The restored vernal pool area of 1.78 acres would add 3.56 acres of additional flood storage. This restoration would, therefore, provide additional vernal pool habitat, increase the hydrology and improved the ecological functioning of the existing vernal pool and provide additional flood control water storage to the site.

SECTION 5

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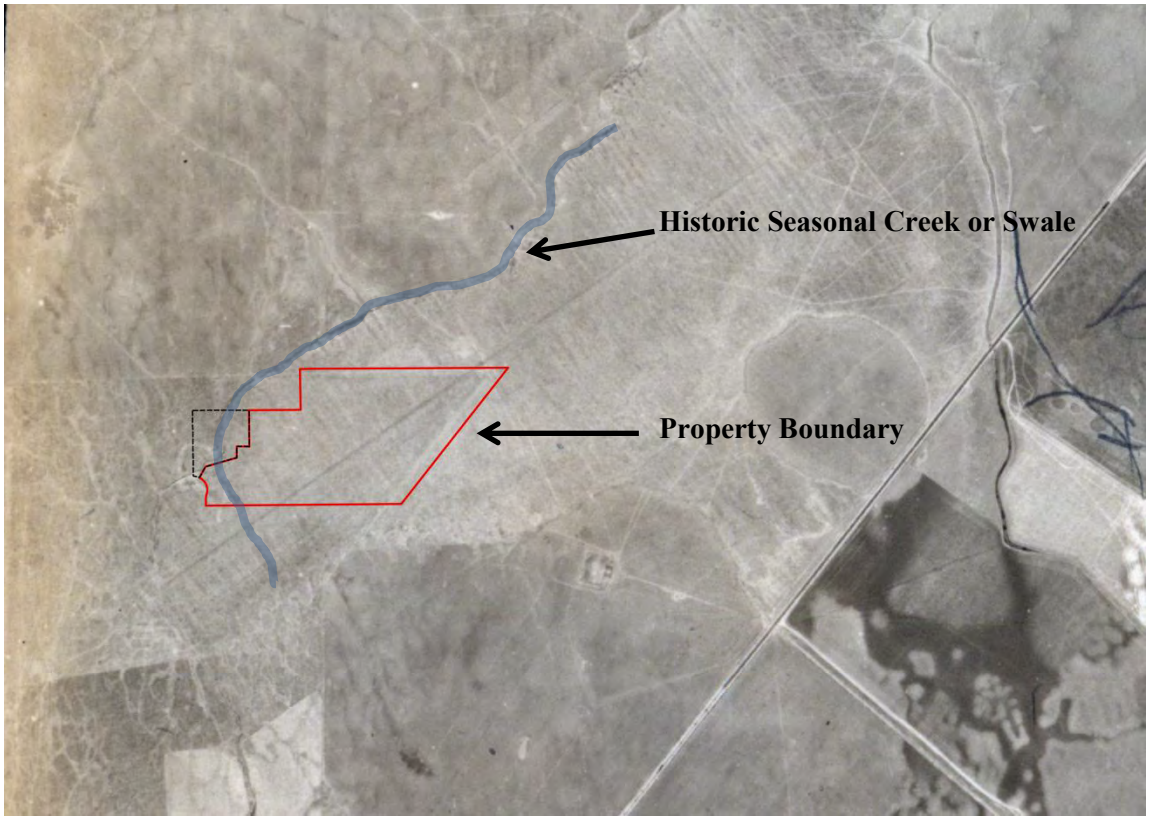
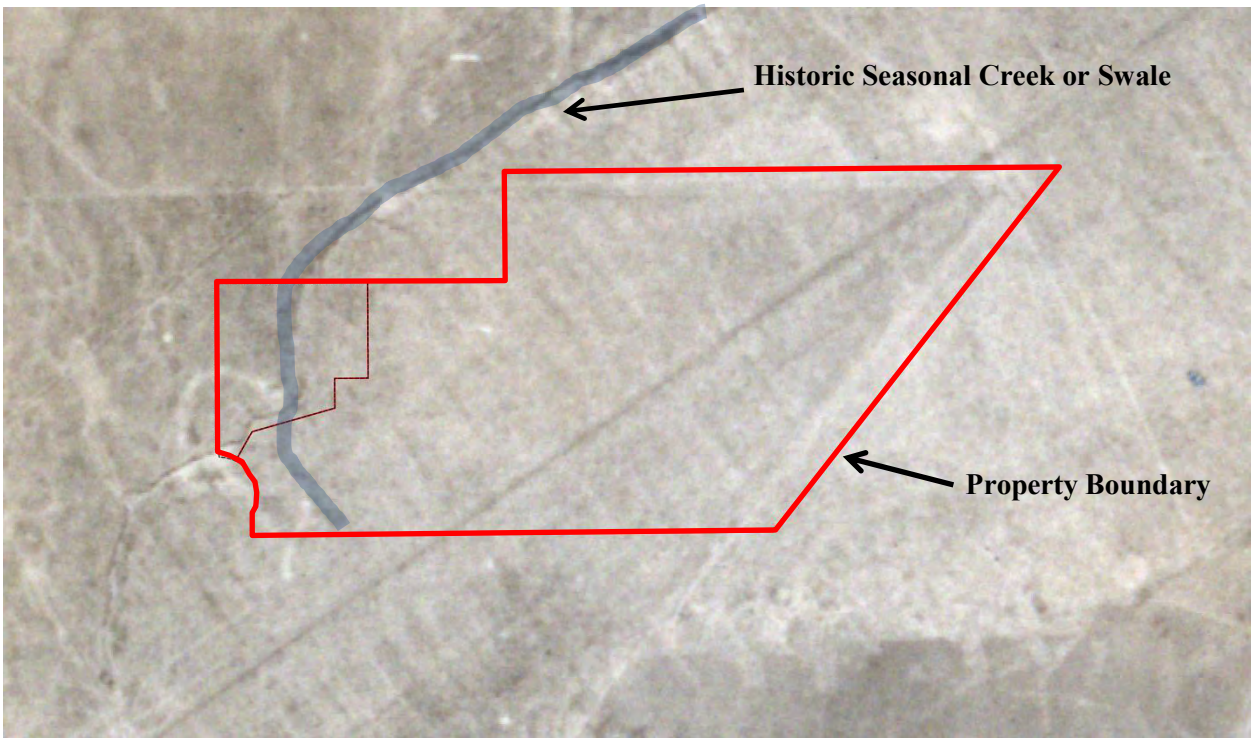
1937 Historic Aerial Photo of Chester Restoration Site Broad View.



Historic 1937 Aerial Photo of Chester Restoration Site Close Up View.

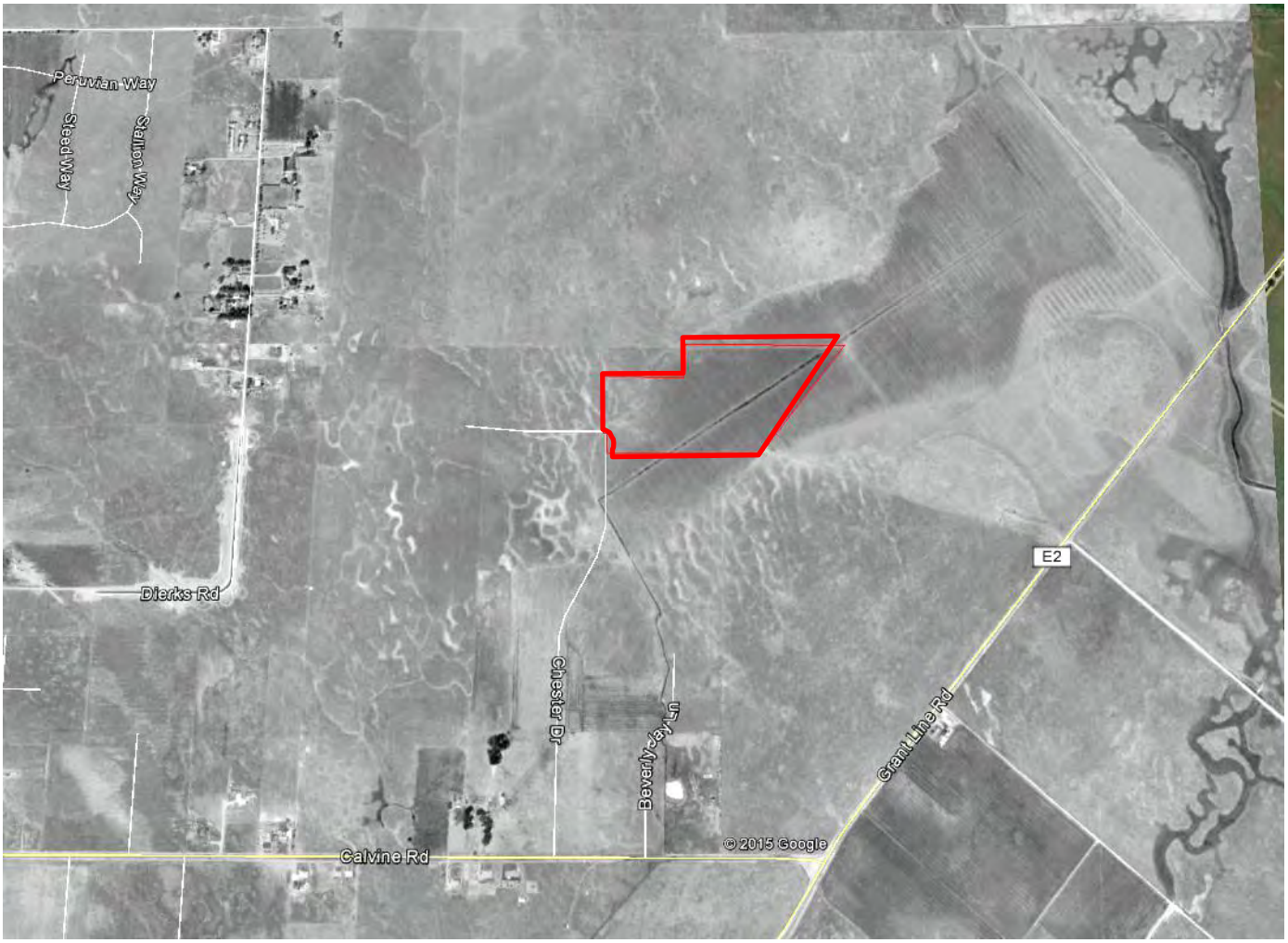


1947 Aerial Photo

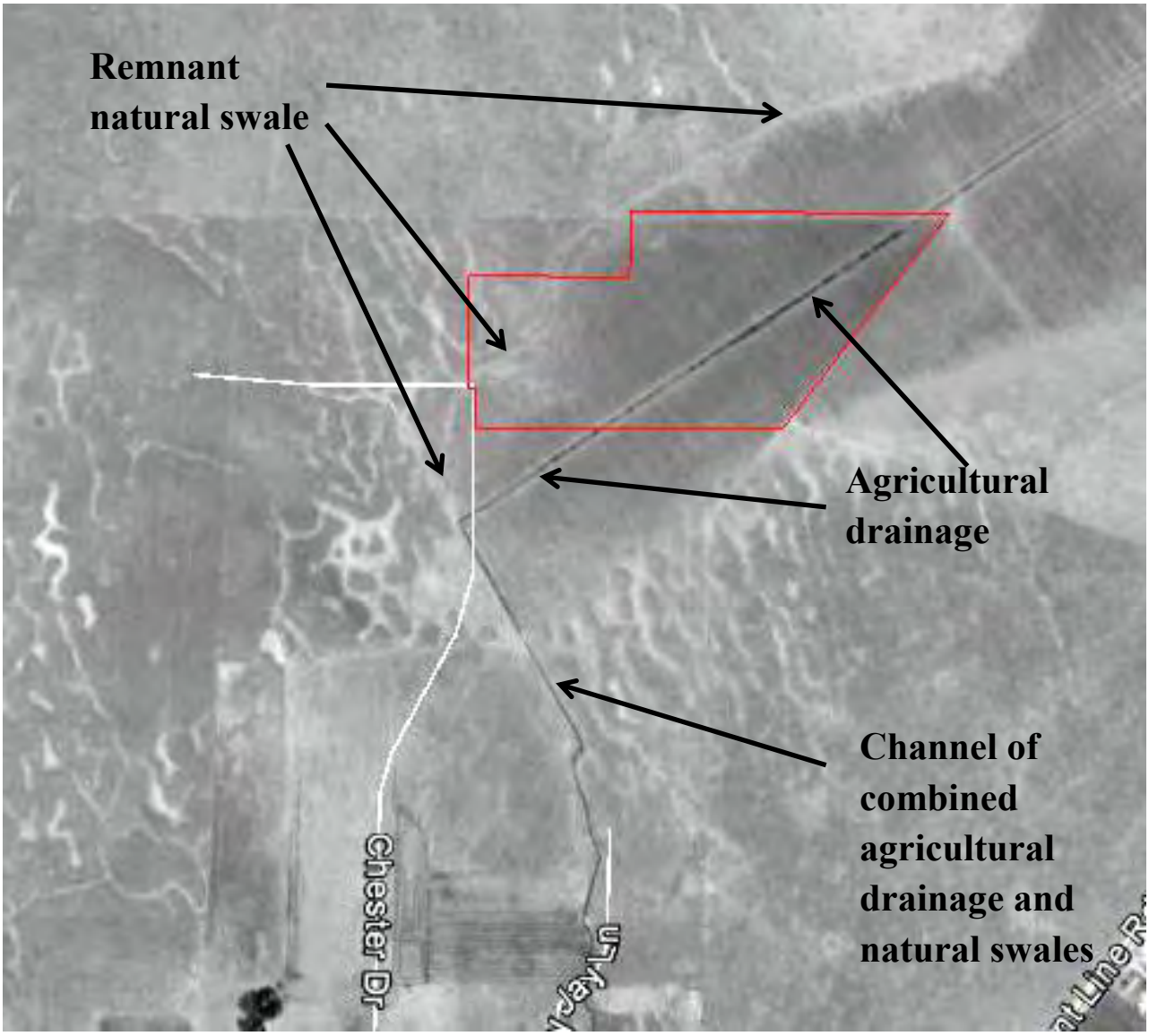
1947 Aerial Photo

1957 Aerial Photo

1964 Aerial Photo.

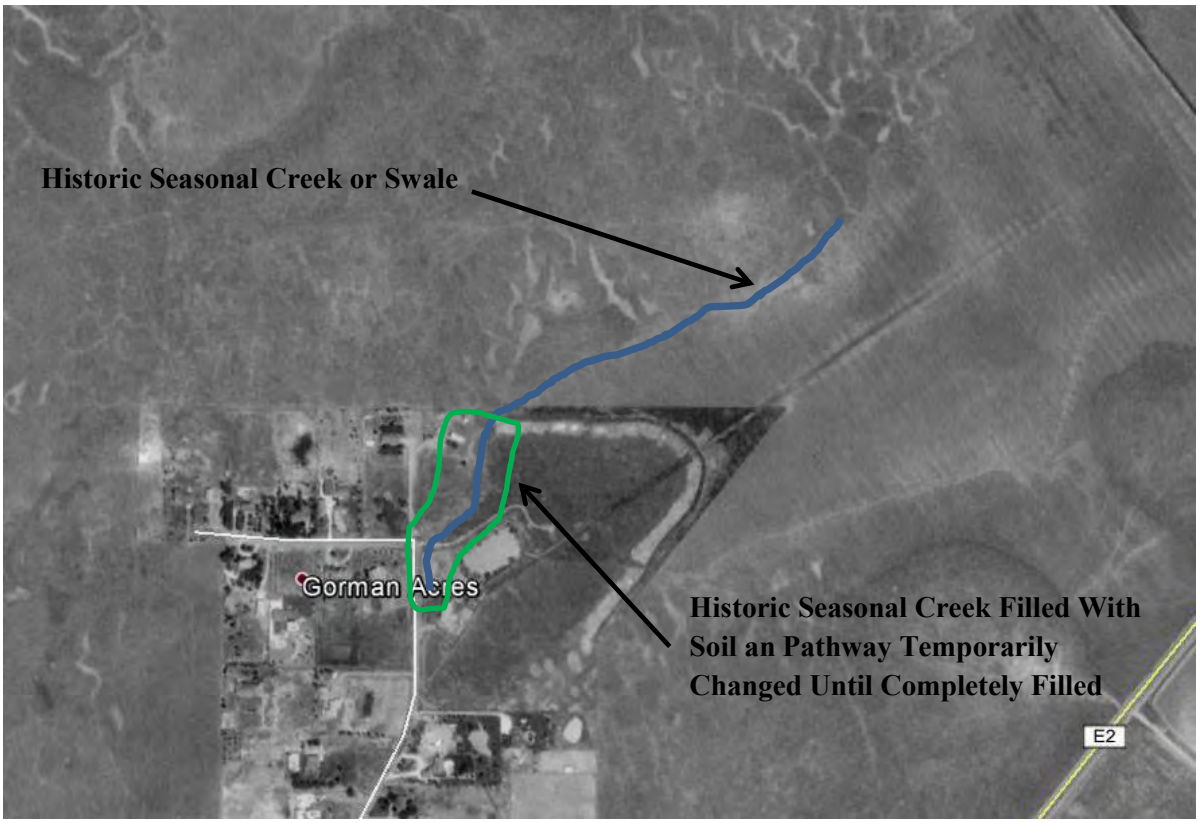


1964 Arial Photo Showing Drainages and Channelization Prior to Housing Development.



5-19-1993 Aerial Photo

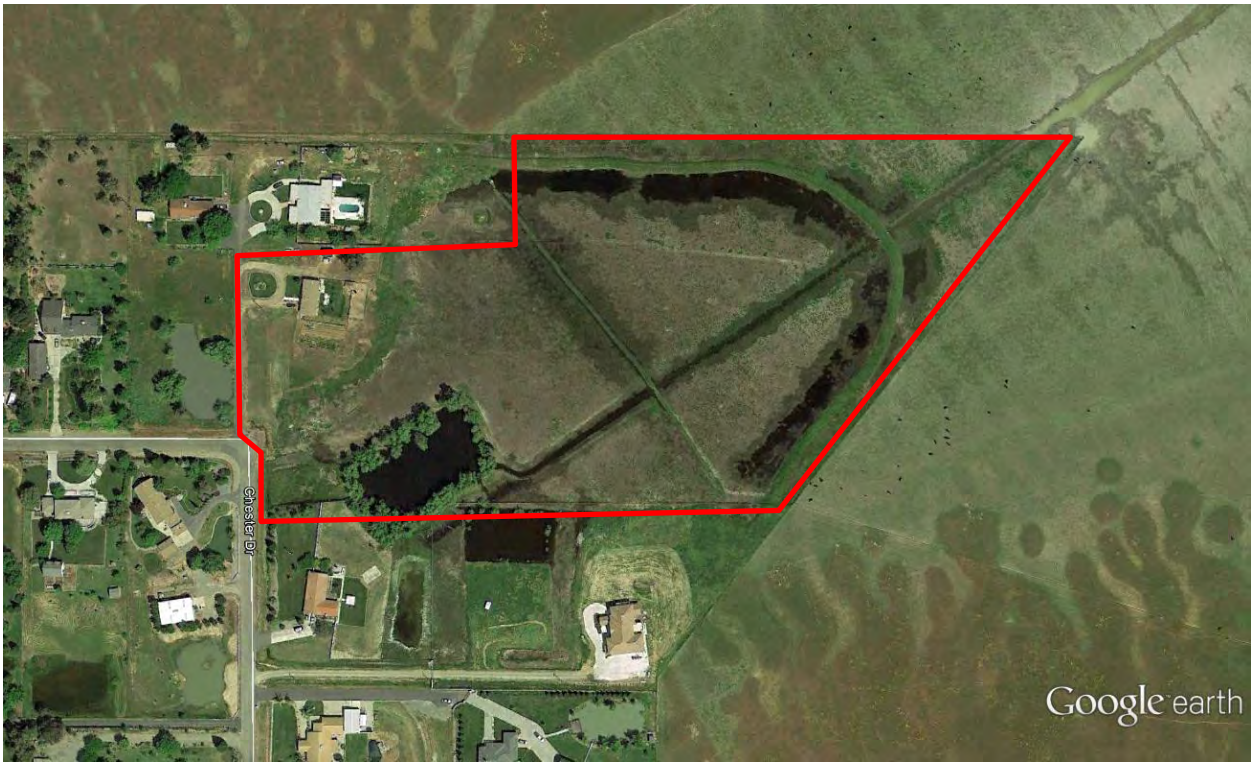
1993 Aerial Photo Showing Remnant Swale



11-20-2003 Aerial Photo

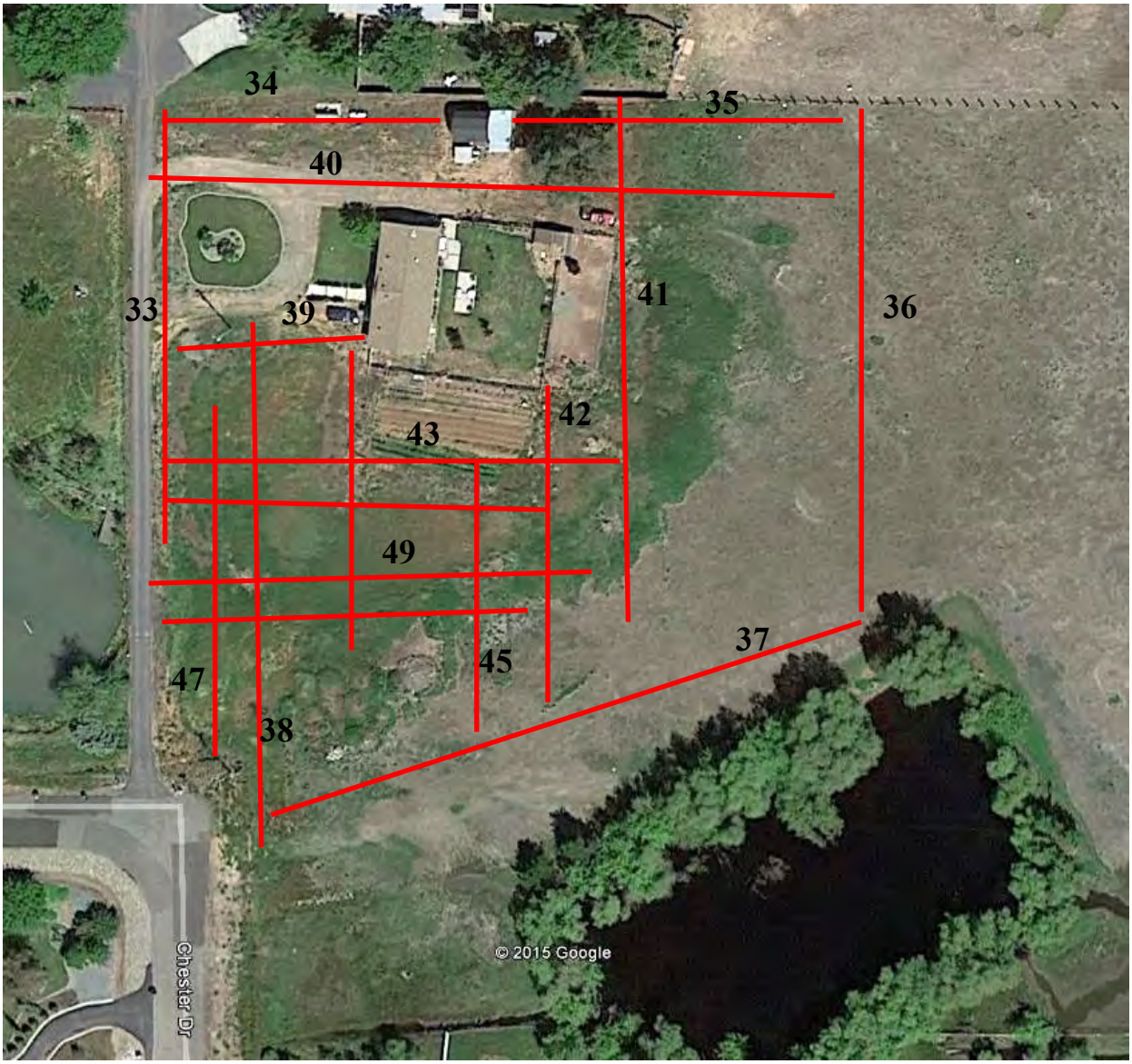
4-6-2010 Aerial Photo Showing Ponding of Water at Lower Elevations at Toe of Berm

4-12-2013 Aerial Photo

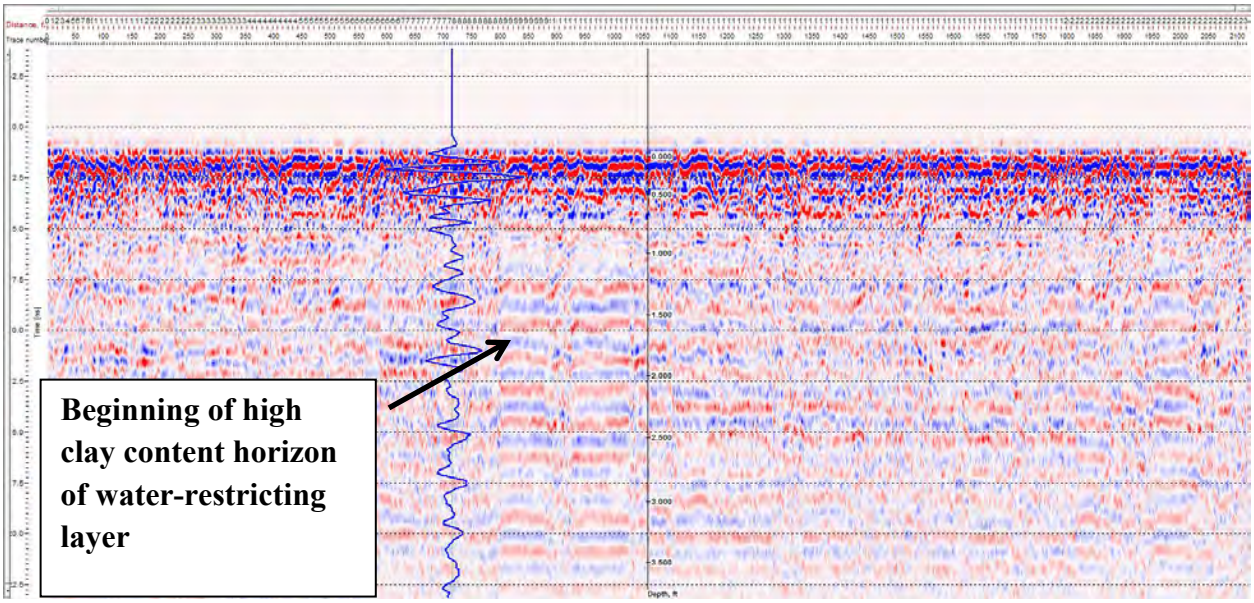


4-18-2014 Aerial Photo (Blue area is flooded and red line is the property boundary)

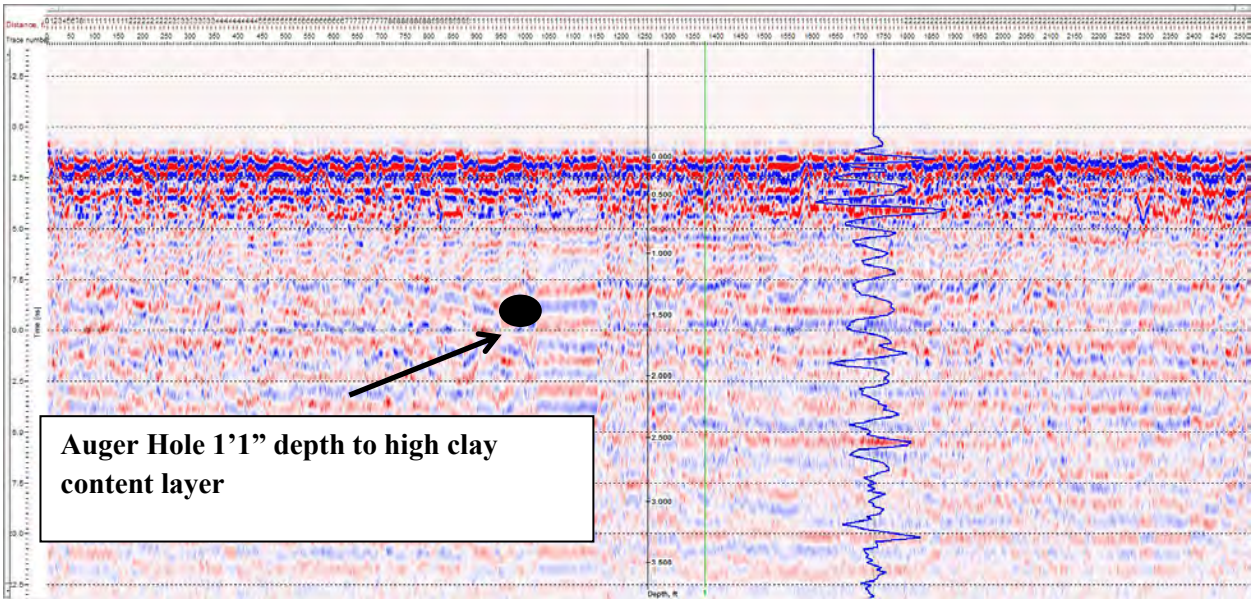
Figure 18 GPR Transects



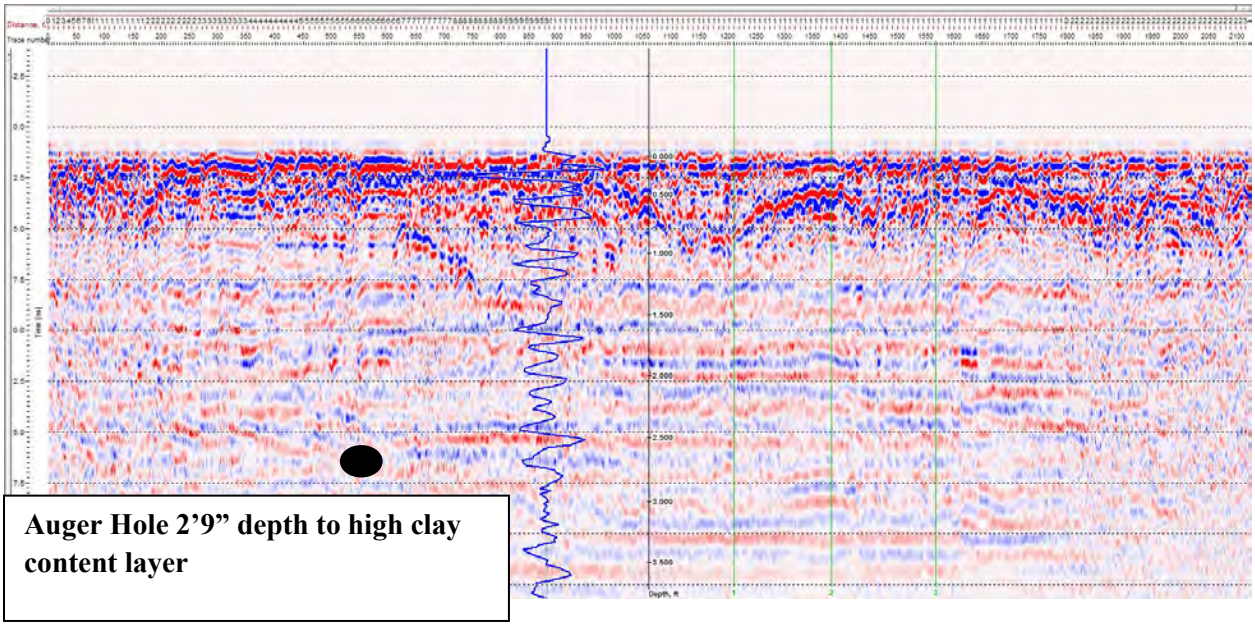
Transect 36 In Existing Vernal Pool Area (Elevation 92 feet)



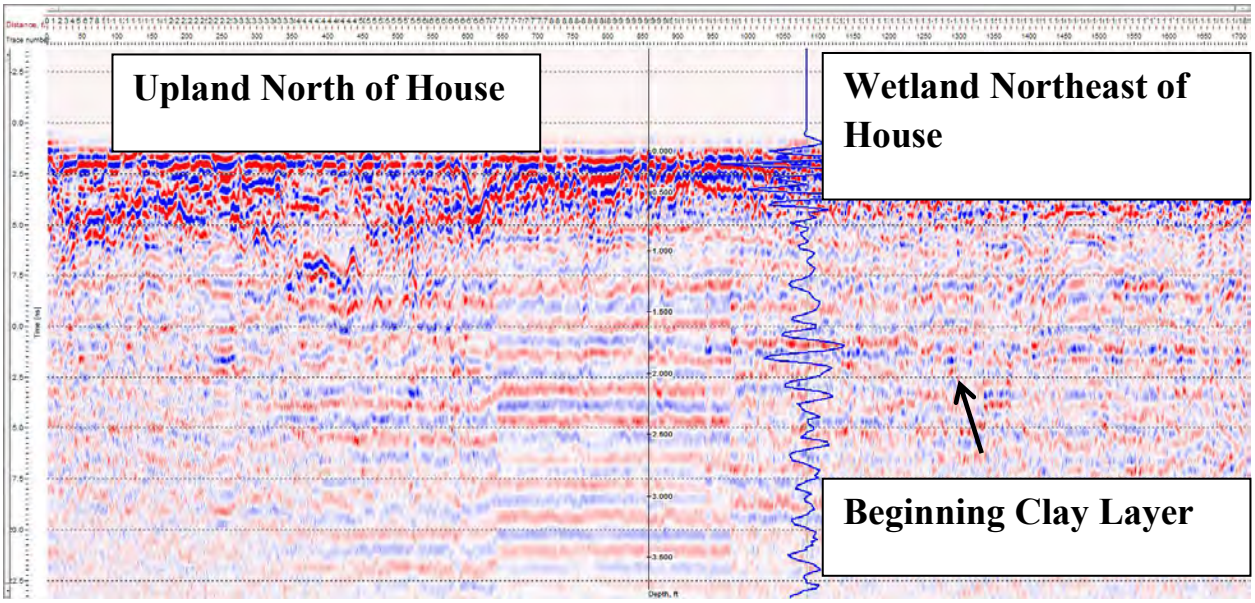
Transect 37 – In Existing Vernal Pool Area (Elevation 92 feet)



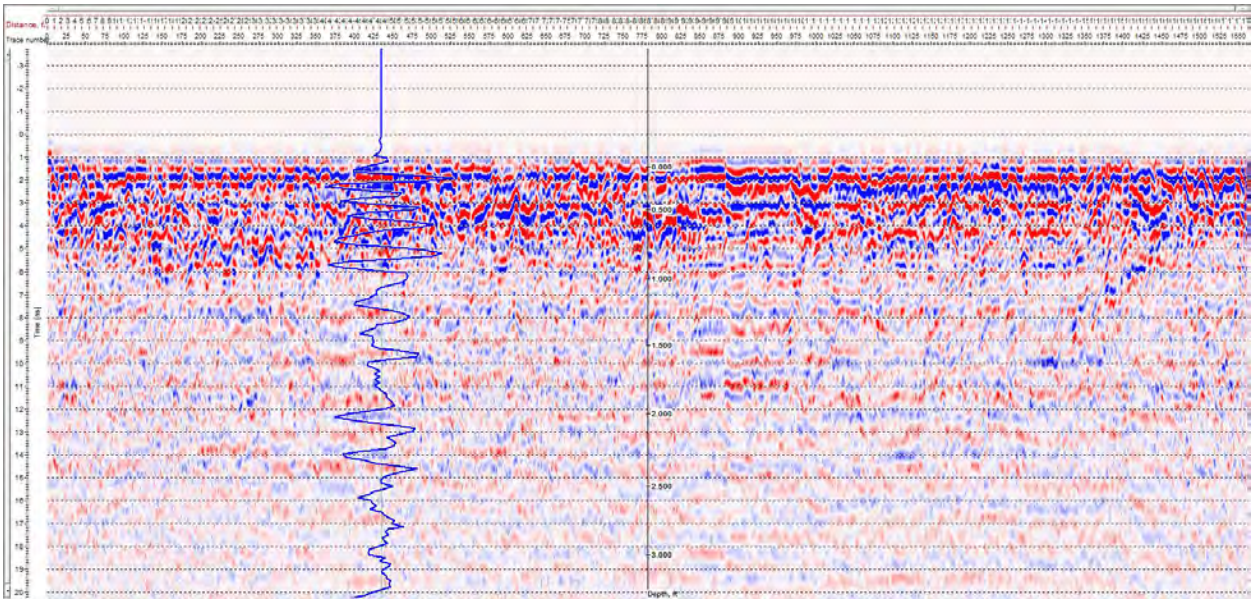
Transect 38 On House Lot Elevation (94 feet)



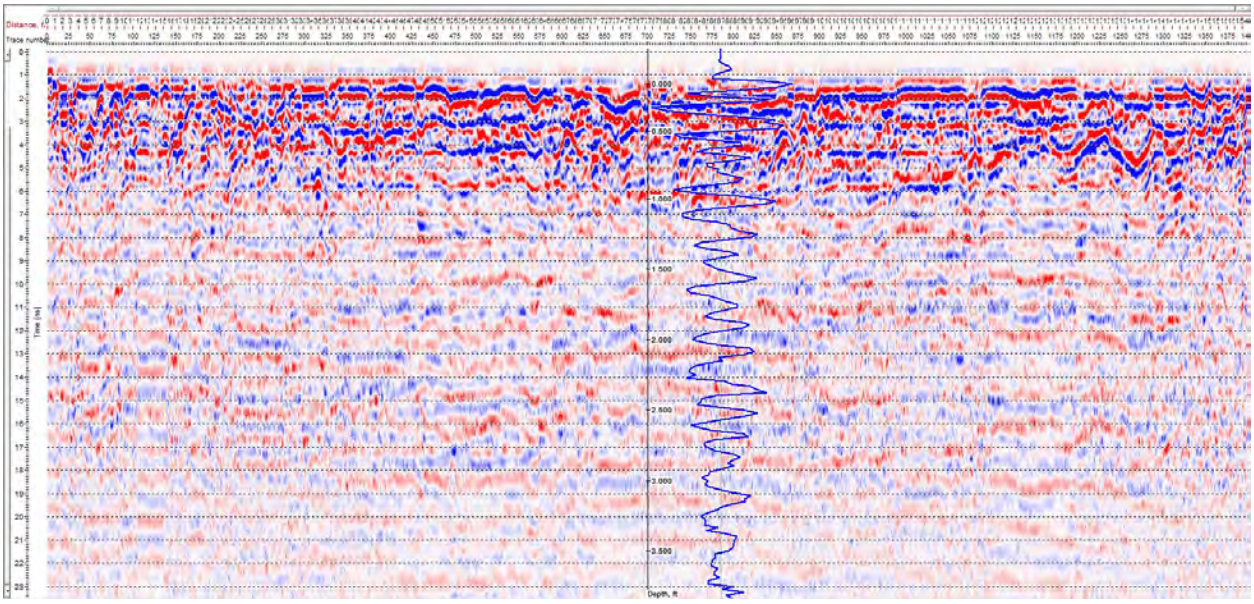
Transect 35 North Side of House Transition from House Elevation 94 Feet to Existing Wetlands Elevation 92 Feet.



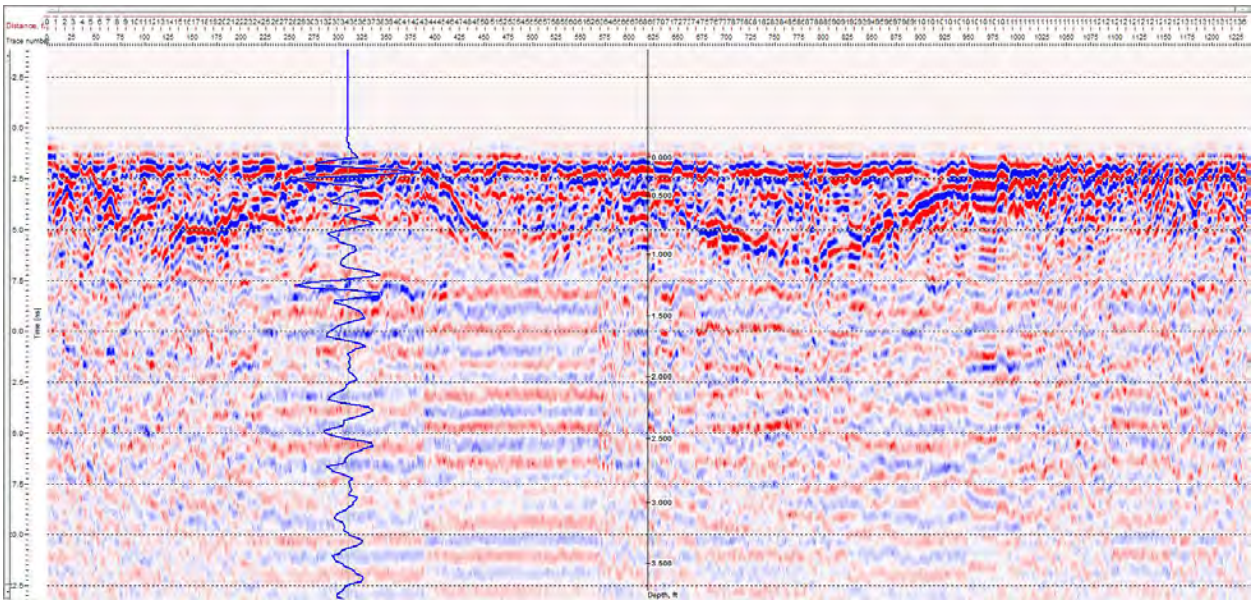
Transect 47 In House Lot Elevation (94 feet)



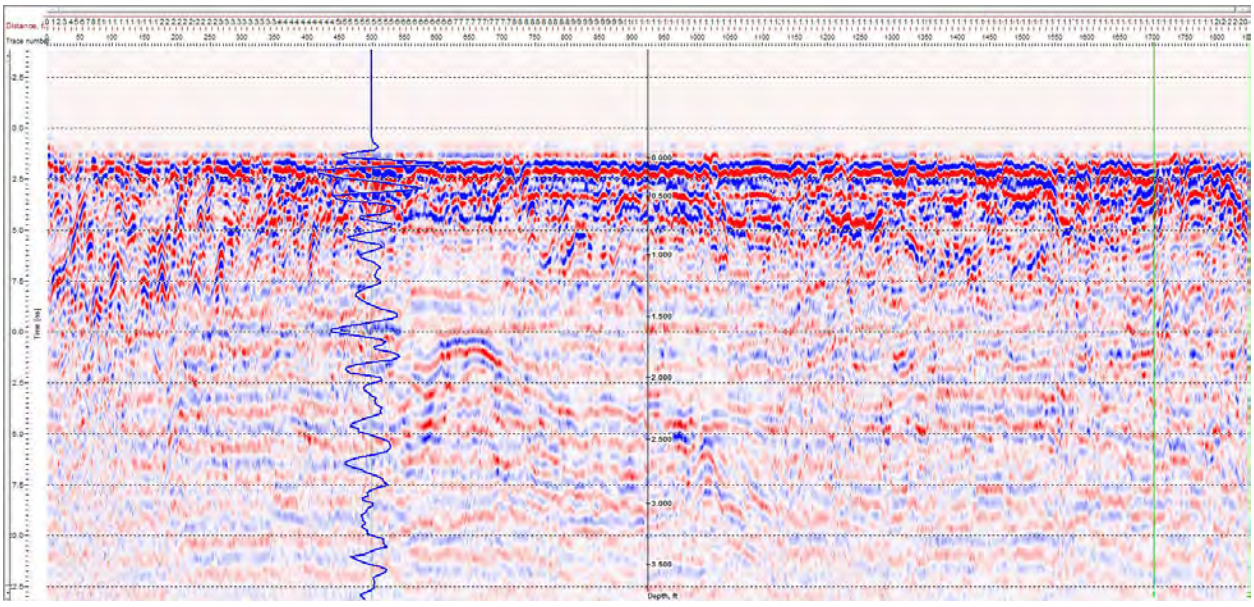
Transect 33 Parallel to Driveway off Chester Road (Elevation 95 feet).



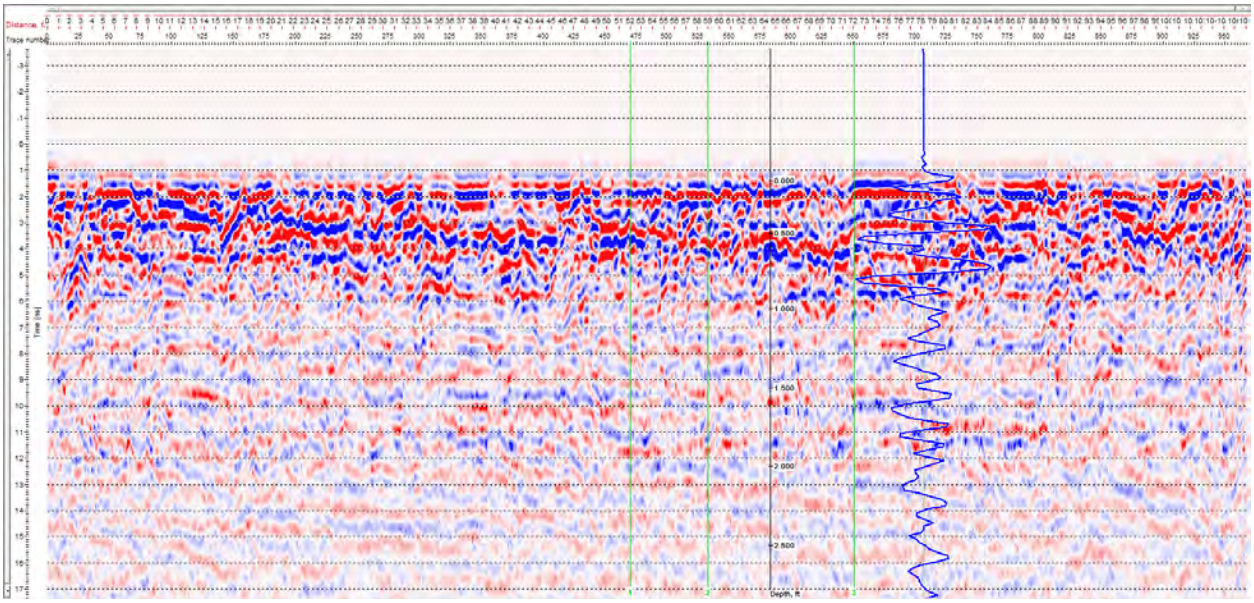
Transect 42 South Side of House Significant Surface Disturbance and Compaction.



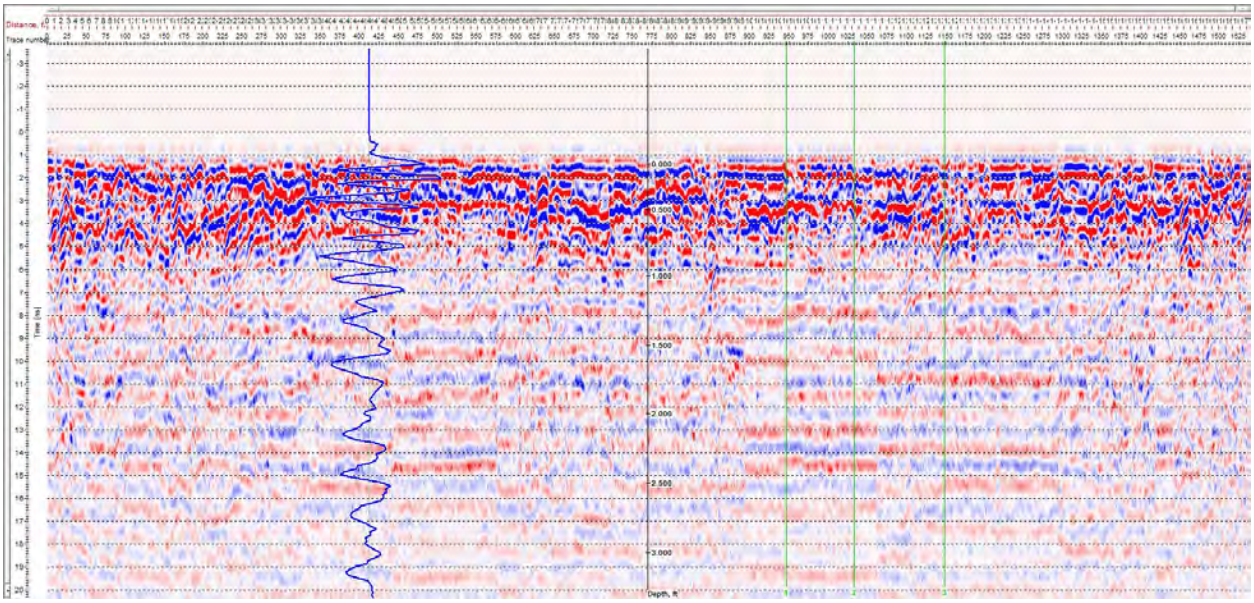
Transect 41 East Side of House and Garden Subsurface Disturbance may be Utility or Septic System (Elevation 94 feet).



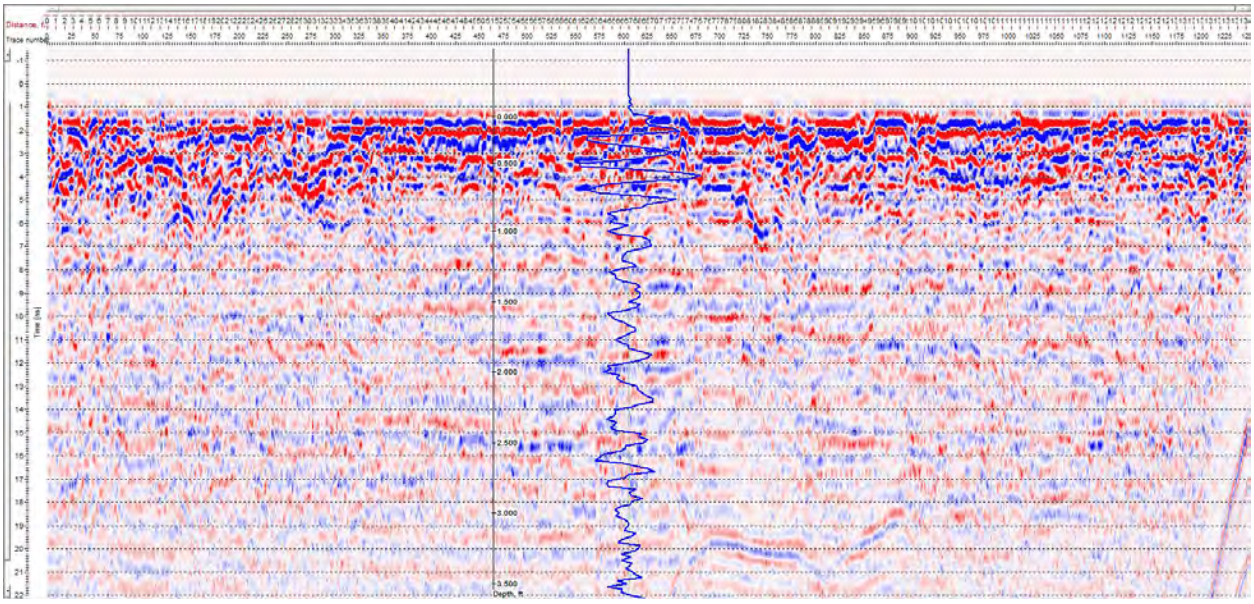
Transect 49 South Side of House (Elevation 94 feet)



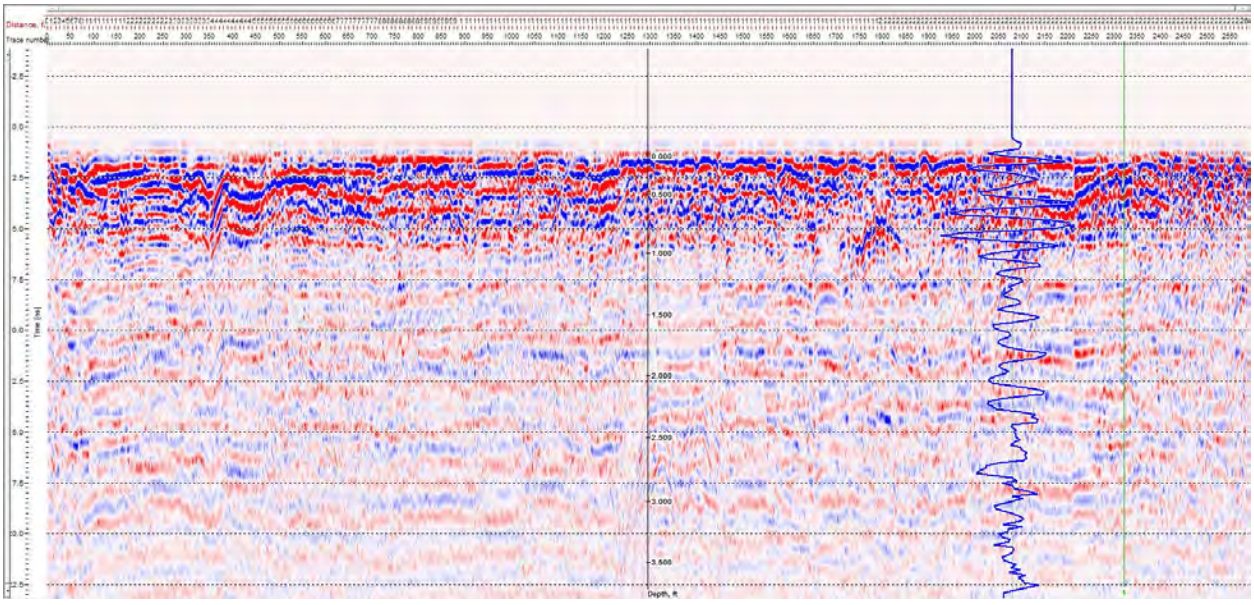
Transect 43 South Side of House Near Garden. Elevation Gradient 95 to 93.5 feet)



Transect 34 North Side of House along Property Line



Transect 40 Driveway of House (Elevation 94 feet).



ATTACHMENT F

Vernal Pool Creation Plan and Hydrological Analysis for Existing Wetlands at the Shehadeh Property, Sacramento County, California

VERNAL POOL CREATION PLAN AND HYDROLOGICAL ANALYSIS FOR EXISTING WETLANDS AT THE SHEHADEH PROPERTY, SACRAMENTO COUNTY, CALIFORNIA

PREPARED FOR:
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July 4, 2015

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LIST OF FIGURES

SECTION 1

SUMMARY

This Vernal Pool Creation and Hydrological Analysis of Existing Wetlands Plan for the Shehadeh Property in Sacramento County, California proposes to create 39 vernal pools totaling 14.79 acres of wetlands on an approximately 160 acre site. This site is within the Mather Core area of the Southeastern Sacramento Valley of the US Fish & Wildlife Service's Vernal Pool Recovery Plan (USFWS 2013). The site currently supports 2.677 acres of vernal pools and another 5.923 acres of seasonal wetlands and swales. In addition, Laguna Creek and the intermittent Frye Creek cross the property. Key goals of the project included: 1) determine that the site is hydrologically suitable to sustain vernal pools based upon topography of the local catchments and soil profiles and 2) ensure that existing vernal pools and other wetland resources will not be negatively impacted by the addition of the created vernal pools.

The proposed project followed the US Army Corps of Engineers Wetland Mitigation and Monitoring Guidelines (2015) and first made an assessment of the site's suitability by studying the hydrology and soils. A comparison of the site with adjacent and nearby natural vernal pool landscapes provided a model used to determine the size and density of any proposed creation vernal pools. The detailed site survey to evaluate suitability included conducting global positioning system (GPS) topographic surveys to map the existing catchments of the landscape and existing wetlands. In addition, ground-penetrating radar (GPR) was used to conduct a non-invasive survey throughout the property to determine the presence, depth, and continuity of water-restricting layers needed to support vernal pool hydrology. Based on these studies it was determined that the property had extensive areas of soils including Redding, San Joaquin, and Hedge Soil Series that have water-restricting horizons including clay layers and duripans. In addition, it was found that some existing vernal pools and other wetlands adjacent to Laguna Creek did not have distinct water-restricting soil horizons but did have a shallow water table associated with the hyporheic zone of the creek which functioned as a seasonal water table for these wetlands. The topography of the site was found to have many localized catchments situated on a series of terraces that drain downslope to Laguna Creek. Existing vernal pools

were situated within specific catchments primarily on the mid to low terraces. We used the physical environmental parameters of slope and soil profile as a model in our design of creation pools. Catchments containing natural vernal pools were avoided in the design.

Placement of the proposed creation vernal pools was done using the topography and catchment location and identifying the direction of gravitational water flow. The majority of existing vernal pools were determined to be located within specific catchments. Thus, the placement of the majority of proposed creation vernal pools was done in different catchments. In cases where existing vernal pools shared a catchment, the proposed creation vernal pools were downslope of the existing pools or within a catchment that can form a flow-through, cascading system of pools observed at natural reference site. The depth of the proposed construction excavation for the vernal pool basin was modelled from those of existing natural vernal pools and using the depth to the clay horizon or duripan from the GPR soil profile. The vernal pool basins were designed to vary in depth to create a range of hydrological conditions as is observed in natural vernal pools. The hydrology of vernal pools is described in relation to the variable weather conditions of Sacramento, California and the potential variation from wet, average, and dry rainfall years is described. Hydrology of example vernal pools and Laguna Creek water elevation was measured at the site during November 2014 through April 2015 to provide baseline information on how natural pools function in different locations at the site. This supported our concept that vernal pools in the upper slopes were dependent on direct rainfall and significant upland water inputs while vernal pools near Laguna Creek experienced subsurface water and occasionally surface water inputs.

SECTION 2

INTRODUCTION

This Vernal Pool Creation and Hydrological Analysis of Existing Wetlands Plan was developed specifically for the Shehadeh Property, Sacramento, California (**Figures 2.1**). This site is within the Mather Core area of the Southeastern Sacramento Valley (**Figure 2.2**) of the US Fish & Wildlife Service's Vernal Pool Recovery Plan (USFWS 2013) and this site is within the Laguna Creek watershed (**Figure 2.3**). Also, **Figure 2-3** shows the location of the Cordova Hills property which includes the proposed development area for which the Shehadeh property is part of the proposed mitigation area. The Cordova Hills property also includes a proposed 450 acre preserve of high quality natural vernal pools.

Compensatory mitigation by creating vernal pools is a relatively common practice in California (USACOE 2015, DeWeese 1998, Ferren and Hubbard 1998, Black and Zedler 1998). The biology of vernal pools in California has been studied extensively (Barbour et al. 2007, Bauder 2000, 2005, Holland and Jain 1981). However, the importance of hydrological processes of vernal pools as a function of soils and weather variables has not been emphasized until more recently (Christopherson et al. 2013, McCarten and Christman 2014, McCarten et al. 2008, 2010, O'Geen et al. 2007, Rains et al. 2008).

The USACOE Wetland Mitigation and Monitoring Guidelines (2015) specify the need for knowledge and understanding of the hydrologic and soil characteristics of a site in the planning and site design process. A prior soil study (ICF International 2013); found Redding, San Joaquin, Hedge soil series occur on site. Those soils have clay or duripan horizons that function as a water restricting layer (Smith and Verrill 1998). The presence of a clay or duripan horizon can form a shallow seasonal water table (Rains et al. 2006, McCarten et al. 2008). Failures related to hydrological functioning of created vernal pools have been attributed to designs that have not considered the soils or hydrology (DeWeese 1998, Christopherson et al. 2013).

2.1 Project Goals

This Vernal Pool Creation Plan established a series of goals in the development of the vernal pool creation on the site:

- Goal 1 – Gather sufficient field and other data on the hydrology and soils to determine the suitability of the site to support vernal pools,
- Goal 2 – Determine the physical structure of the site to map the topography and determine locations of local catchments,
- Goal 3 – Collect detailed soils data to determine the locations where clay or duripan water-restricting layers occur and accurately determine their depth below surface and continuity,
- Goal 4 – Use the hydrology and soils data to determine the placement of every vernal pool proposed for creation and provide scientific support that these pools will function similar to natural pools existing in the area,
- Goal 5 – Ensure the placement of created vernal pools will not have a negative impact directly or indirectly on the hydrology or other parameters of existing natural vernal pools and other wetlands,
- Goal 6- Show the proposed vernal pool mitigation is comparable to natural vernal pool landscapes by using adjacent and nearby sites as references for vernal pool size and density.

2.2 APPROACH AND METHODS

The USACOE Wetland Mitigation and Monitoring Guidelines (2015) identified hydrology and soils as two critical parameters important to the site assessment for suitability for wetlands mitigation. A third parameter, connectivity, is also important and discussed later. Also those Guidelines recommend a "watershed" approach to wetland design. The previous biological studies (ECORP 2013) and soil study (ICF International 2013) provided good basic information on the current conditions and biological and wetland resources of the site. Vernal pool and other seasonal wetlands require more detailed data and analyses to determine the physical parameters

of the landscape and soils to assess suitability for hydrological functioning. Vernal pools have two key physical environmental components that provide natural functioning including adequate upland water inputs within a catchment and the presence of a water-restricting soil layer. The area of the catchment and the presence and depth of a water-restricting layer combined with seasonal precipitation determines the hydrological functioning of a vernal pool (Rains et. al 2006, McCarten, et al. 2008).

Reference Sites

Vernal pool landscapes are unique in their structure, and individual vernal pools have hydrological functioning that is dependent on the input of water from the surrounding local catchment. Limits on the size of vernal pool basins and the density of pool basins in terms of optimal hydrological functioning can be determined from comparison of vernal pool sizes and densities in nearby natural vernal pool landscapes. Two references sites (**Figures 2-4** and **2-5**) were used to compare their vernal pool size and density with existing and proposed creation vernal pools on the Shehadeh property. In addition to the two reference sites, the Shehadeh property has existing vernal pools that provide a model for size, distribution and density of vernal pools in a landscape. These reference sites were studied by Witham et al. (2013) for their percent vernal pool cover and found to have greater than 10% vernal pool area. The Shehadeh site covers 160 acres of which 16.198 acres are wetlands and creeks and an additional 16.3 acres are slopes greater than 3% and not suitable for vernal pools. Therefore, about 126 acres of the site have potential for vernal pool creation assuming the catchment and soils are suitable and there would be no direct or indirect impacts to existing vernal pools from the construction activities. Natural vernal pools on the Cordova Hills site have pool densities ranging from 3 percent up to 18 percent. For them to function hydrologically their areal distribution in the landscape is a cascading series of interconnected pools.

METHODS

We used a Trimble Real Time Kinematic Global Positioning System (GPS) to gather surface topographic data with a spatial resolution of +/- 1 cm and elevation of +/- 2 cm. This level of precision is needed to develop a topographic model for vernal pools and low elevation gradient terraces. Nearly 4,000 data points were collected on the site with higher density point data collection in and around existing vernal pools and other wetlands.

A Mala Geosciences ground-penetrating radar (GPR) system using an 800 MHz shielded antenna on a cart was used to on-destructively survey the soil profile at the site. The GPR sends an energy wave from the antenna and collects a reflection wave from the soil based on the density variation within the soil profile. The GPR system was programmed to collect a data sample every 2 cm and the depth of soil horizon measurement was typically set at 4 feet. Measurements combining the GPS with GPR to provide topographic adjustment to the GPR soil profiles were conducted by using simultaneous GPS topo point collection with single radar trace collection. GPR transects were conducted throughout the site (see Section 3), and all 29 of the soil pits dug and evaluated by ICF International (2013) were measured to calibrate the GPR observations with soil horizon texture. In some cases, a hand auger was used to check a GPR measurement. Over 100 GPR transects were conducted on the site varying from 25 feet long to more than 2,000 feet long.

SECTION 3

SITE EVALUATION AND SUITABILITY

This section describes the results of the field investigation and data analyses.

3.1 TOPOGRAPHY

The RTK GPS data were converted to elevation contour and digital elevation models (**Figure 3.1)**. The lowest elevation is about 95 feet msl is the water surface in Laguna Creek and the height of the creek depends on the seasonal water flows and irrigation runoff. The highest elevation measured is 119 feet msl on the two hilltops (one on the north side of Laguna Creek and one on the south side). Profiles of the terrain are shown in **Figure 3.2**. There are three distinct terraces on the north side of Laguna Creek. The lowest terrace is within the 100 year floodplain. The majority of vernal pools that exist on the site are within lower three terraces.

3.2 EXISTING WETLANDS

ECORP (2013) identified the existing wetland resources in a verified jurisdictional wetland delineation report. **Figure 3.3** shows the locations and extent of those wetlands overlain on a contour map and the reader should refer to the original jurisdictional wetland delineation for details as this figure groups all the wetlands together and does not differentiate natural vernal pools. The wetland report measured 2.68 acres of vernal pool wetlands and 5.923 acres of other seasonal wetlands and swales. Laguna Creek crosses the property down slope from east to west. Frye Creek is a seasonal drainage traversing from the northeast and entering Laguna Creek mid property. **Figure 3.4** shows a network of local catchments. Most of the existing wetlands are bounded by a single catchment that contributes to the water inputs to enclosed wetlands. Some vernal pool swale complexes on the South side of Laguna Creek cross catchment boundaries where both catchments are oriented downslope (**Figure 3.4**). A gravitational direction of surface flow is shown in **Figure 3.5** with vector arrows indicating the direction which water could flow from a surface point. In general, the direction of flow is toward Laguna Creek. Most of the site obtains water from direct rainfall and indirect rainfall from upland discharge downslope. Occasional flooding of vernal pools and other wetlands

could occur in the lower terrace from Laguna and Frye Creeks as described in the Hydrology Section below. Most offsite irrigation drains offsite into a canal on the east side of the property which is at an elevation equal to Laguna Creek and, therefore, would not influence the existing vernal pools. Some seasonal irrigation north of the property drains into Frye Creek but it does not appear to have any hydrological effect on the vernal pools or other seasonal wetlands and swales outside the creek based on 2014 observations. Groundwater within the hyporheic zone of Laguna Creek can influence the hydrology of vernal pools and seasonal wetlands in the lower terrace and adjacent to the creek.

3.3 SOILS

The ICF International soil study (2013) adequately provided the general soil series as determined by 29 soil pits and should be referred to for further information. None of the soil pits were located within existing vernal pools or other wetlands due to concern over impacting them. Redding, San Joaquin, Hedge and Fiddyment Soil series were previously identified on the site as mapped by NRCS. Hedge soil series are the least developed with respect to the formation of a water-restricting layer and occur in close proximity to Laguna Creek on the lowest terrace. San Joaquin soil series are more developed and the most common series on the site occurring on the two middle terraces. It is on the San Joaquin soils that the majority of vernal pools occur. Redding soil series occurs on the higher terrace and slopes. Fiddyment is mapped by NRCS but may not occur on the site (ICF International 2013). The three main soils all typically have a loam texture in the upper horizon with a silty loam or clay loam beneath. With depth there is an increase in clay content which has a low permeability and can form a water-restricting layer when saturated. A duripan occurs in most of these soils sometimes within one foot of the surface on the upper terrace but more often at 2 to 3 feet depth below the clay horizon. The soil pits by ICF International (2013) identified varying degrees of clay content and concretion forming a clay or duripan water- restricting layer. The GPR survey of the site used the soil pit soil horizon data from that study and from many previous GPR/soil pit correlations to identify a relationship between soil texture type and density with GPR profile wave energy signatures.

The GPR survey initially conducted 67 transects on the site and **Figure 3.6** shows a representation of some of those transects which ranged in length from about 40 feet up to 1,200 feet. Additional transects were made as part of the vernal pool design phase of the study. Further comparison was made with the soil pit information and GPR data. **Figure 3.7** shows a GPR transect from west to east covering about 330 feet and transitioning from Redding to San Joaquin Soil series. The positive/negative wave energy reflections identify the contrasting density between air to loam soil at the surface. Further below there is a second relatively higher intensity wave corresponding with higher density from increased percent clay. The lowest high intensity wave energy reflection is the duripan. Another view of the same soil profile comes from **Figure 3.8** which shows the reflection strength of the return energy wave. A blue line or "wiggle" line through part of the profile confirms the change in density of the soil and the analysis process requires passing the wiggle line through the profile and confirming continuity of the high density trace signals. This GPR profile passed over ICF International's soil study pits which confirmed the depth of the beginning of the clay and duripan horizons. The GPR wave energy trace signal will not change until a new change in soil density occurs. Therefore, the clay trace signal in **Figure 3.7** between 15 and 25 cm did not show any significant new trace signal until about 0.58 meters where the duripan abruptly begins. It should be noted the ICF International soil study could only measure the depth of the clay horizon and/or duripan based on the soil pits. The GPR, as can be seen in **Figure 3.7** and other figures presented show a lot of variation in depth. **Figure 3.9** is another GPR transect on the south side of Laguna Creek through San Joaquin soil series with numerous vernal pool/swale complexes and associated uplands. Using simple soil texture names of loam, clay, and hardpan to identify differences through the soil horizon, a simple model approach is applied to the GPR energy wave data to characterize the soil profile in the transect (**Figure 3.10**).

Measuring the soil profile of existing, natural vernal pools was important to determine how the soil profile and depth to water-restricting layer compared with surrounding uplands. **Figure 3.11** shows a GPR transect crossing a natural vernal pool at the site. The hardpan begins at about 0.5 feet and continues downward in the vernal pool zone indicated. It appears the wave energy signal continues with increasing reflective strength at least to 2 feet below the surface. It is

observed that the hardpan does continue although with less reflection strength than within the pool boundary. Comparison with the ICF International soil pit data indicate that energy wave reflection trace signals in the uplands outside vernal pools are sufficiently cemented to form a good water-restricting layer. It is important to use GPR to survey all areas for creating or restoring vernal pools.

Combining GPR with RTK GPS can adjust the GPR profile to fit the elevation gradient so it is easier to understand the relationship of the soil surface and especially vernal pool depressions with respect to the GPR profile as seen in **Figure 3.12** occurring on a San Joaquin soil series. **Figure 3.13** is a topographically adjusted GPR transect through a vernal pool mapped as Hedge soil series. The Hedge soil pit data often showed a weaker hardpan presence but the GPR energy wave signal in the field and in the office analysis showed a relatively strong signal. A hand auger was used to bore a hole to 3 ½ feet in the upland immediately adjacent to a natural vernal pool. The soil texture was sandy loam changing to sandy clay. The sandy clay potentially could form a restricting layer when dry. The auger hole found moist soil at 1.2 feet and saturated soil at 2 feet below the surface on April 29, 2014 after vernal pools throughout the site were dry to water-restricting layer in terraces at higher elevation. This indicated a shallow groundwater table and it was concluded that this is a hyporheic zone associated with Laguna Creek. The depth of soil saturation had an equal elevation as the surface water in Laguna Creek about 40 ft. south of the auger hole. Smith and Verrill (1998) identify some vernal pools as forming on soils including poorly developed xerfluvents that have a shallow groundwater. It is probable that all surface soil depression wetlands and swales within the lower terrace (e.g. up to about 102 feet elevation), could experience seasonal hyporheic groundwater inputs. **Figures 3.14** and **3.15** show other GPR transects through other types of geomorphic situations including drainage and a seasonal swale, respectively.

3.4 HYDROLOGICAL PROCESS OF CASCADING VERNAL POOLS

The hydrological experience of a vernal pool in any year is the result of the physical setting as determined by the catchment or surrounding uplands that contribute water from upslope to the pool and the depth of the clay or duripan water-restricting layer (**Figure 3-16, 3-17, and 3-18**) and the seasonal weather variables. Christopherson et al. (2013) identified that small or restricted catchments surrounding a natural or created vernal pool can result in a short hydroperiod. Therefore, vernal pools require sufficient upland water inputs to meet the seasonal requirements to saturate the soil followed by inundation within the pool basin. Vernal pools in sequence along an elevation gradient will share portions of the catchment water inputs with those pool basins higher up the slope receiving typically less water than those downslope. Those pool basins lower on the slopes obtain water through subsurface connectivity from those pools upslope (**Figures 3-17 and 3-18**). The only water losses from pools upslope are from evapotranspiration. The most important parameter of cascading vernal pools is the area of the upland catchment will provide sufficient water inputs with direct rainfall to result in soil saturation and basin inundation. **Figure 3-18** shows the cross-section of a cascading vernal pool system with the water inputs and outputs. Natural vernal pools on the Shehadeh property were measured to have an upland catchment greater than twice the area of the vernal pool. Therefore, a vernal pool basin would represent about 30% or less of the total area of the local catchment.

Weather variables and regional climate are the other parameters needed to fully evaluate the existing and potential hydrology of vernal pools. California's Mediterranean climate is characteristically highly variable from year to year. **Figure 3.19** shows annual rainfall values from 1975 to 2013 for Sacramento, California. This time span includes some of the lowest rainfall values recorded, such as about 6 inches during the 1976-1977 drought, as well as some of the highest values recorded, including 37 inches during El Niño in 1982-1983 and again with 33 inches in 1997-1998. Locally, in Fair Oaks, California, during the 1997-1998 El Niño event rainfall was measured at 38.32 inches (Department of Water Resources, CIMIS Station). **Figure 3.20** shows monthly rainfall values and it is important to keep in mind that the seasonal timing of the rainfall can have a significant effect on the ultimate hydrology of a vernal pool.

It was also found that relatively deep soils (> 20 inches) overlaying a clay or duripan can require too much of the direct rain water and catchment water to saturate the soil before the perched water table appears in the pool depression. In contrast, a very shallow (< 5 inches) soil horizon over the water-restricting layer will result in the soil drying out too quickly and vernal pool plants will fail to complete their reproductive cycle. These two parameters combined with the annual weather variables of rainfall and evapotranspiration (ET) determine the hydroperiod of each vernal pool. **Figure 3.21** gives the relationship between weather variables of rainfall and ET and the resulting hydrology for two years associated with one vernal pool at Mather Field, Rancho Cordova, CA. Given that the area of a catchment and the depth to clay or duripan are constants over our short time scales, then differences in rainfall and ET play a significant role. **Figure 3.22** shows how the climate water balance of rainfall minus ET can affect the hydroperiod of vernal pools. Every vernal pool has a water balance, which is determined given the soil and catchment input plus the weather variables for any year (McCarten et al. 2009). Measuring annual hydrology through monitoring will confirm a result that can be predicted based on this vernal pool water balance model (see **Figure 3-18**).

Two vernal pools were hydrologically monitored during November 2014 through April 2015 as well as Laguna Creek water levels. **Figure 3-23** shows the hydrograph of a shallow vernal pool in the middle terrace. It shows the surface water level (above zero on graph) of about half a foot which was discontinuous because of the long period without rainfall. **Figure 3-24** shows the hydrograph of a vernal pool near to Laguna Creek. This pool has some additional water input due to subsurface water from Laguna Creek which helped maintain water levels in the pool during the period without rainfall. Spikes in the hydrograph of the vernal pool correlate with water level increases in Laguna Creek due to rainfall and watershed inputs. At specific points in time Laguna Creek water levels were higher than the banks and entered the floodplain as surface water. These hydrographs show how two vernal pools with different positions in the landscape and water inputs function during a well below average rainfall year.

SECTION 4

VERNAL POOL CREATION PLAN

4.1 PROPOSED VERNAL POOLS AND EXISTING WETLAND RESOURCES

Using the data gathered and analyzed as described in the previous section, we identified 39 sites for potentially creating vernal pools (**Figures 4.1 and 4.2**). **Table 4.1** lists each of the numbered pools and provides the acreage for each pool and a total value of 14.79 acres. The average area of the created vernal pools is 0.479 acres. In addition, below we describe how the data collected were used to identify the location and size of proposed vernal pools. We used the following features and parameters in our decision-making:

- Avoid impacting the hydrology of existing vernal pools and other wetland resources,
- Use the natural topography and catchment areas to provide the hydrological setting,
- Ensure the soils have water-restricting layers,

Figure 4.3 shows the proposed created vernal pools within the mapped existing jurisdictional wetlands identified by ECORP (2013).

Table 4.1 Proposed Creation Vernal Pools and Acreage.

New Numbers	Pool Area (Acres)	Area (square feet)
1	0.31	13,370
2	0.17	7,366
3	0.58	25,212
4	0.52	22,492
5	0.38	16,385
6	0.30	13,258
7	0.33	14,591
8	0.31	13,437
9	0.50	21,701
10	0.16	6,941
11	0.36	15,538
12	0.10	4,326
13	0.88	38,459
14	0.39	17,001
15	0.32	13,728
16	0.28	12,386
17	0.36	15,834
18	0.38	16,414
19	0.08	3,414
20	0.18	7,668
21	0.15	6,528
22	0.56	24,403
23	0.09	3,837
24	0.34	14,683
25	0.11	4,603
26	2.32	101,101
27	0.32	13,735
28	0.07	3,194
29	0.34	14,626
30	0.17	7,278
31	0.37	16,029
32	1.28	55,892
33	0.16	7,068
34	0.11	4,633
35	0.48	20,947

New Numbers	Pool Area (Acres)	Area (square feet)
37	0.10	4,507
38	0.11	4,611
39	0.71	30,808
Totals	14.79	644,217

4.2 TOPOGRAPHY AND CATCHMENT LOCATIONS

Figure 4.3 shows the position and areal extent of each proposed creation vernal pool with respect to the contour map of the site. The proposed creation vernal pools are distributed throughout the site. **Figure 4.4** shows the position and areal extent of each proposed creation vernal pool and existing wetlands overlain on the local catchments. The existing vernal pools are primarily clustered within catchments that are separated from proposed creation vernal pools. **Figure 4.5** shows the proposed creation vernal pools and existing vernal pools and wetlands overlain on a vector surface flow map. This map gives the direction of surface flow based on down slope direction indicated by the vector arrows. This figure shows the surface topography slope which parallels the subsurface water-restricting layer (see below) indicating how water discharge from the uplands through the landscape enters the vernal pools and wetlands and then discharges toward Laguna Creek. These two figures are significant because they show natural vernal pools occupy separate catchments from proposed creation vernal pools in most cases. The density of 14.79 acres of proposed creation vernal pools plus 2.66 acres of existing vernal pools within the 160 acre potential area would be 10.9 percent which is within the range of densities observed in the reference sites. The topographic position of the proposed vernal pools primarily considered the up slope inputs of water that combined with direct rainfall created a flow through, cascading system. This type of approach utilizes the existing topography of the slopes and is modelled after the existing natural vernal pool systems observed at the Shehadeh Property and the reference sites. Proposed creation vernal pool on the lower terrace and with the 100 year flood plain will experience contributions of water from the subsurface or hyporheic zone.

4.3 SOIL AND WATER-RESTRICTING LAYERS

The suitability of a site for creating a vernal pool also requires the local soils have a water-restricting layer. After identifying potential vernal pool creation sites using the topographic and catchment analysis, GPR data was used to determine if the locations had a water-restricting layer, the type of water-restricting layer (clay, duripan, or groundwater table), and the depth required

for excavation to provide sufficient soil depth for a rooting zone yet not be too deep to require many inches of water to meet saturation prior to water inundation within the surface depression. All the proposed creation vernal pools had at least one GPR transect. **Figure 4.6** shows representative GPR transects associated with proposed creation vernal pools that are shown as figures in this section. The following figures show the GPR profile with the soil horizons of the clay and hardpan depths and these are paired with a second copy of the GPR profile that show the approximate placement of the specific proposed creation pools. **Figures 4.7(A & B), 4.8(A & B), 4.9(A & B), 4.10(A & B),** and **4.11(A & B)** show the GPR soil profiles and cross-sections of proposed creation vernal pools 3, 9, 11, 6, 13, and 19 respectively. These examples show how the vernal pool basin was designed so excavation of surface soil creates a pool basin with the lowest depth at the zone where there is a soil horizon transition to a higher clay content causing a reduction in water infiltration. There is typically 1 foot of clay horizon +/- 4 inches above the hardpan creating adequate depth for plant roots while requiring 6 inches +/- 2 inches of water to saturate the soil. The bottom of the pool basins vary in depth to create a range of hydrological conditions within each pool which is common in natural vernal pools and leads to higher plant species diversity. This variation in depth also allows for deeper parts of the pool basin to continue to have longer hydroperiods even during dry years so that native vernal pool plant species are sustained. Further, having deeper parts of the pools permits a broader range of hydrology that potentially can benefit vernal pool macroinvertebrates and rare vernal pool plants which are typically found in deeper pools. **Appendix A** shows the proposed modelled contours of all 39 vernal pools.

4.4 HYDROLOGY SOURCE AND POTENTIAL

The estimated hydrology of the proposed creation vernal pools was calculated based on estimated direct rainfall (P) and additional rainfall that has infiltrated into the soil in the uplands within a pool catchment area. As stated above, natural vernal pools have at least twice the area of the vernal pool basin as uplands indirectly contribute water to the pools. The proposed creation vernal pools all have at least twice the upland area relative to the pool basin (**Table 4-1**). Most of the proposed creation pools have relatively large catchments and upland water contributions. In

ten cases, the pools are near Laguna and Frye Creeks and they will experience some groundwater contribution when the water levels in the creeks are seasonally high. All the proposed vernal pools have sufficient upland catchment area to sustain natural seasonal hydrology equal to the conditions experienced by the natural vernal pools onsite.

CONCLUDING STATEMENTS

This proposed vernal pool creation mitigation plan identified the Shehadeh Property as having suitable hydrological and soil characteristics as recommended by the USACOE Wetland Mitigation and Monitoring Guidelines (2004). We determined the suitability based on the following factors:

- Occurrence of natural vernal pools and other seasonal wetlands,
- Presence of soils, including Redding, San Joaquin, and Hedge soil series, that are well known to have water-restricting layers that are required for the development of a seasonal perched water table and the observation that wetlands adjacent to Laguna Creek have a shallow water table that substitutes for a water-restricting layer,
- Data were collected on the topography of the site to develop detailed contour maps, vector flow maps, and local catchment boundaries,
- GPR was used to conduct non-invasive surveys of the soil profiles throughout the site and found extensive areas having clay, duripan, and shallow water table conditions that would function as water-restricting layers,
- Weather variables and history was evaluated with respect to hydrological processes of vernal pools from the region, and
- Existing wetland resources were evaluated and reference vernal pool landscapes were used to set thresholds for the area and density of vernal pools proposed for creation.

The siting and size of the proposed creation vernal pools was based on the following features:

- Local catchments were identified where vernal pool creation could occur without negatively impacting existing vernal pool or other wetland resources,
- Contour maps, and vector flow gradient maps identified that all vernal pools are hydrologically isolated or can form a flow-through, cascading connection with existing vernal pools,
- GPR soil profiles were used to show the presence and depth of water-restricting layers and the proposed creation vernal pool cross-section were overlain on the GPR profiles to show the depth needed for excavation for the bottom of the vernal pool to occur just

above or on the initial clay layer and providing about 1 foot of depth to the duripan which is an average soil depth for natural vernal pools. The pool basins were designed to vary in their depth to create a broader hydrological gradient within each pool.

SECTION 5

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Figures

Section 2

Figure 2.1 Regional Location Map of Shehadeh Property, Sacramento County, California

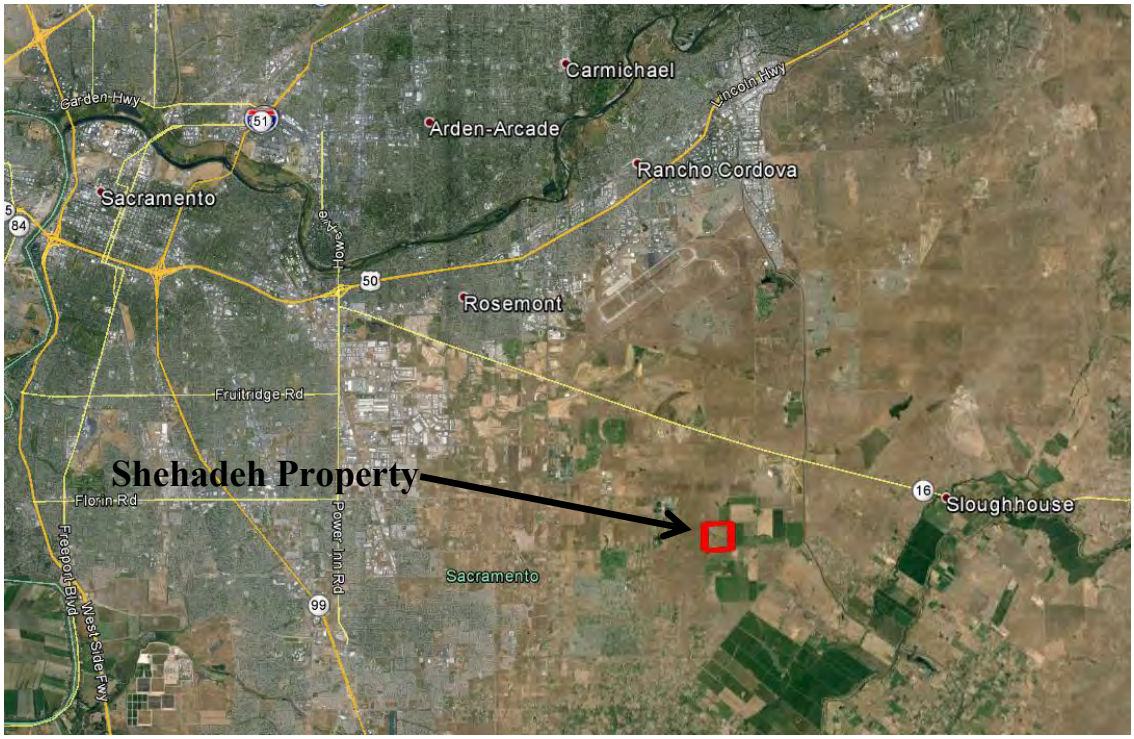


Figure 2.2 Regional Location Map of Shehadeh Property and Associated Cordova Hills Property, Sacramento County, California

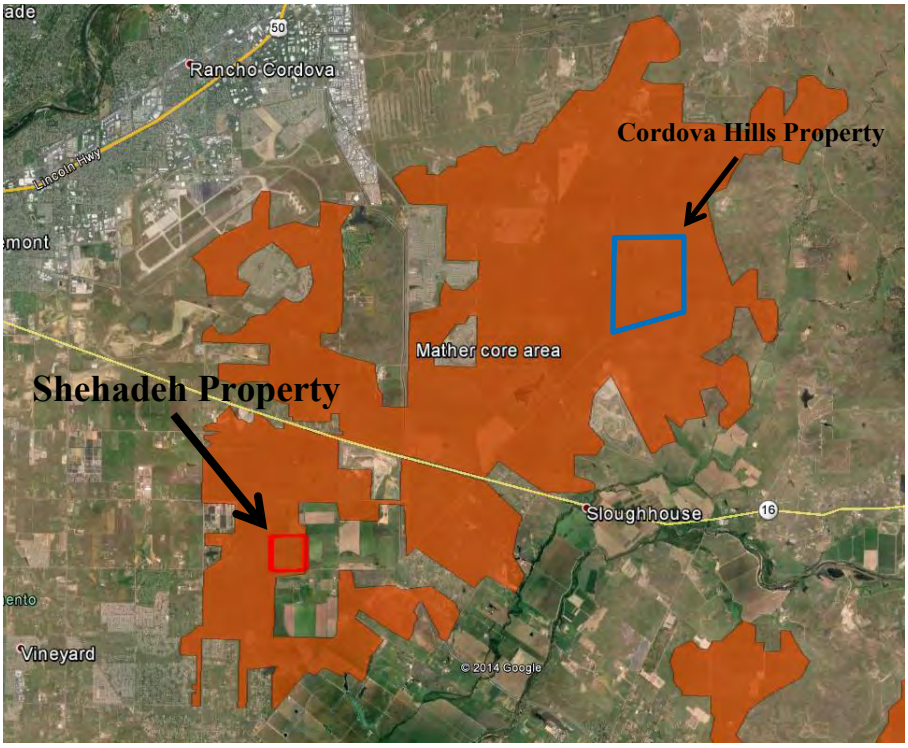


Figure 2.3 Showing Shehadeh Property Boundary and Landscape Setting in a Natural Vernal Pool Landscape Associated with Laguna Creek and Irrigated Farmland.

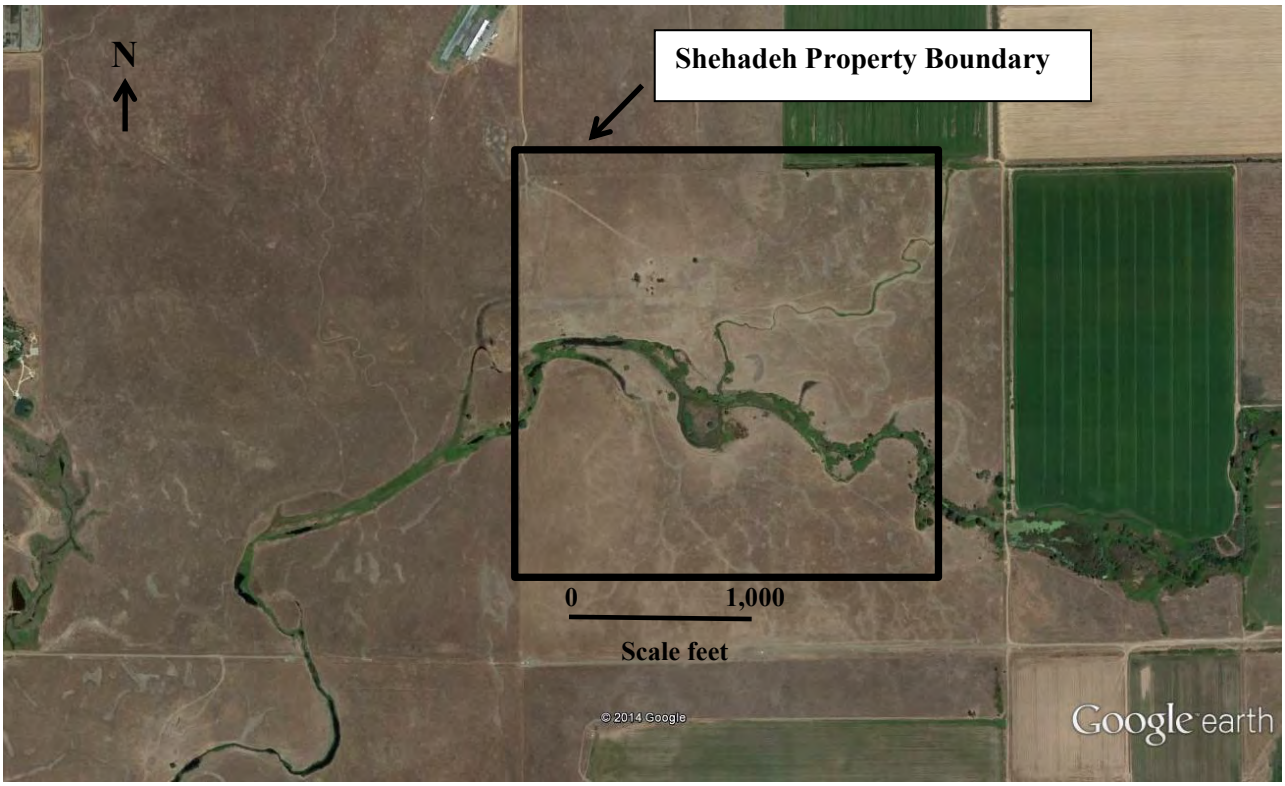


Figure 2.4 Reference Vernal Pool Landscapes Sites

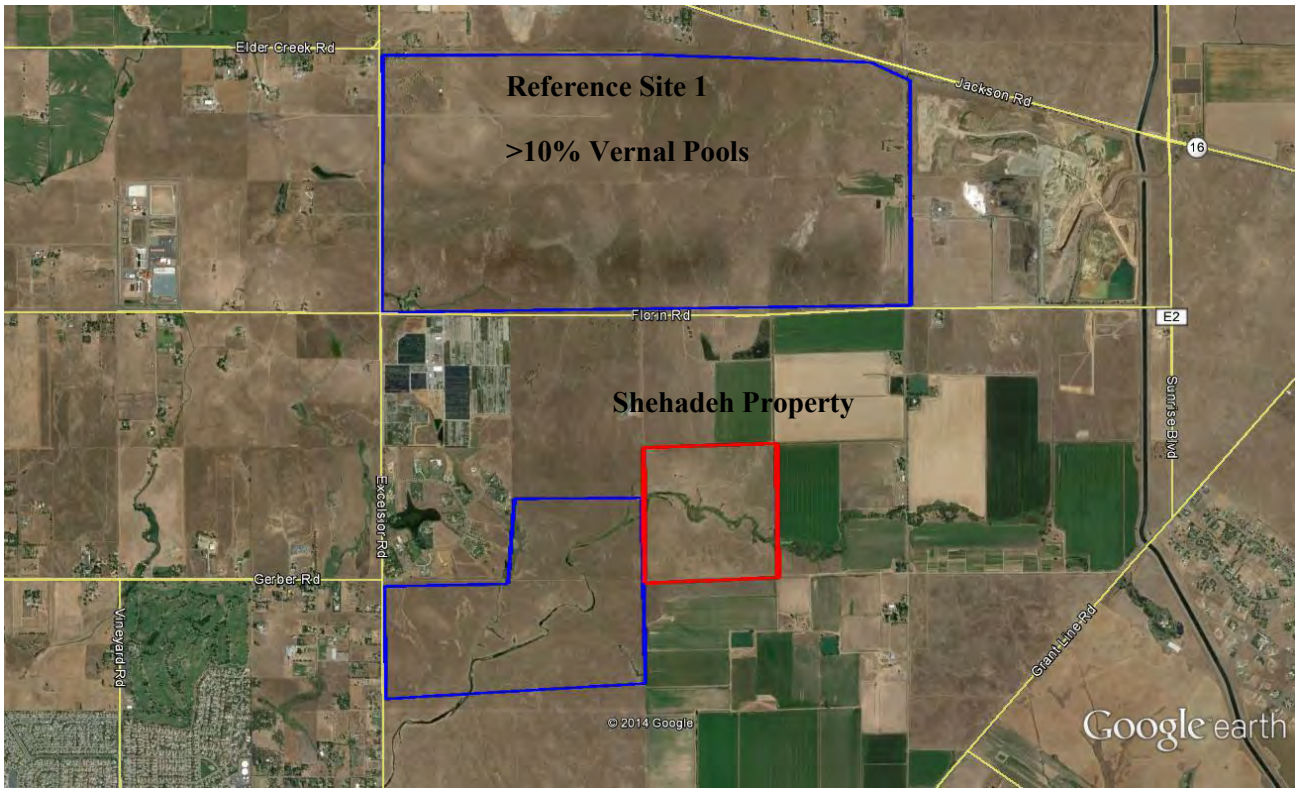
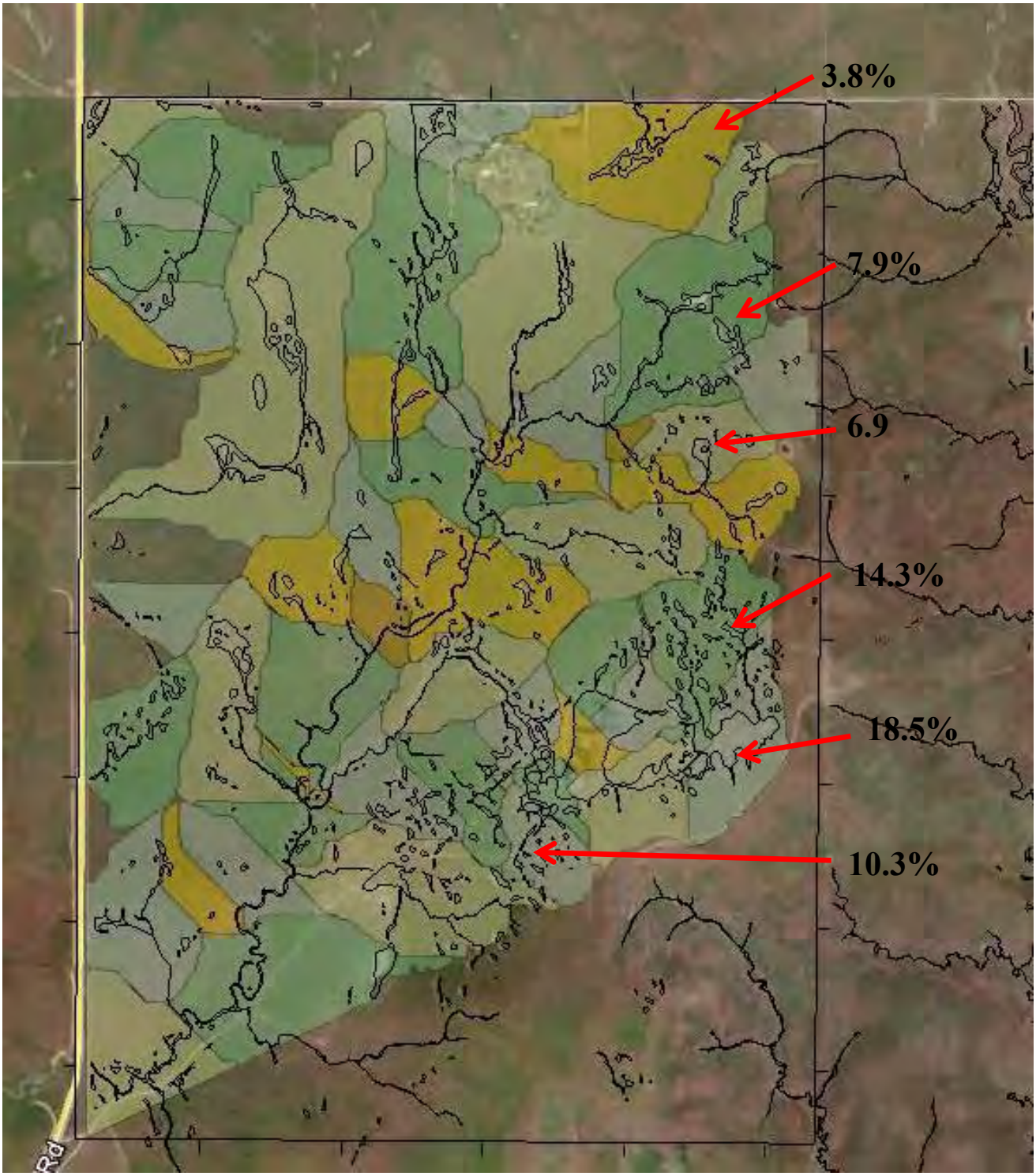


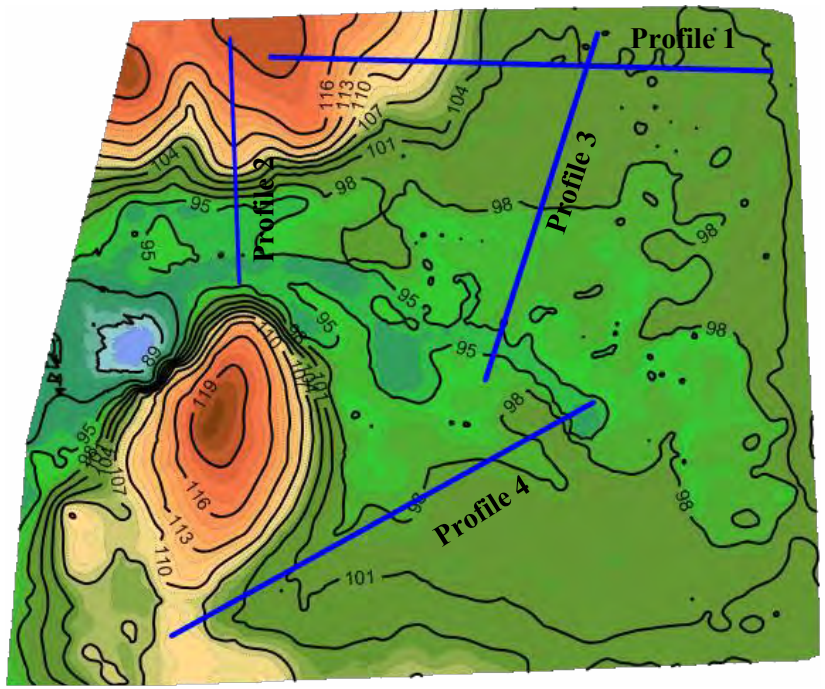
Figure 2-5 Natural Vernal Pool Density Variation at Cordova Hills Site, Sacramento County, CA.



Section 3

Figures 3.1 Elevation Contour Map of Shehadeh Property

Figure 3-2 Cross-Section Profiles of Terraces on Shehadeh Property.



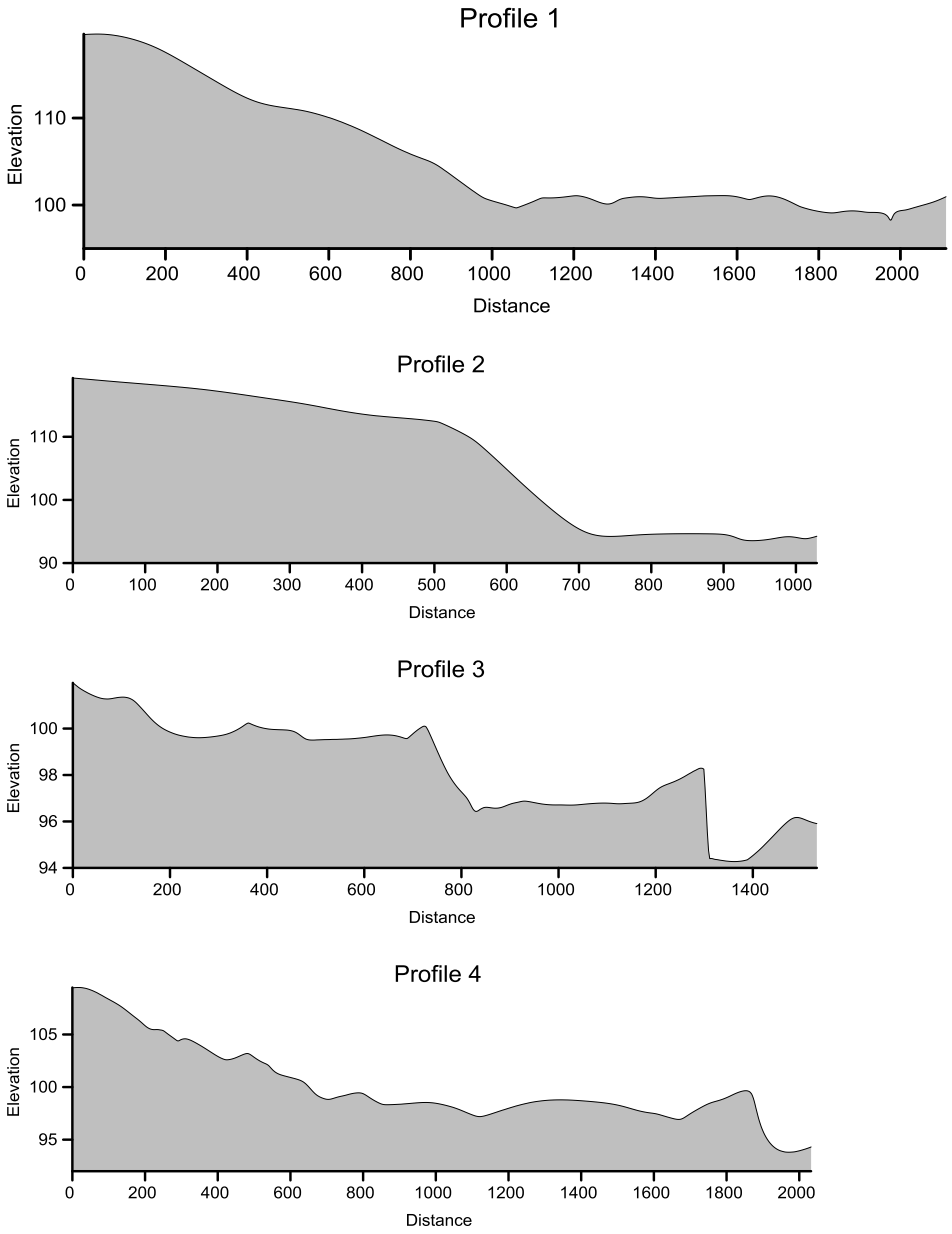


Figure 3-3 Contour Map with Existing Wetlands Features

Figure 3-4 Existing Wetland Features Overlain on Catchment Boundaries.

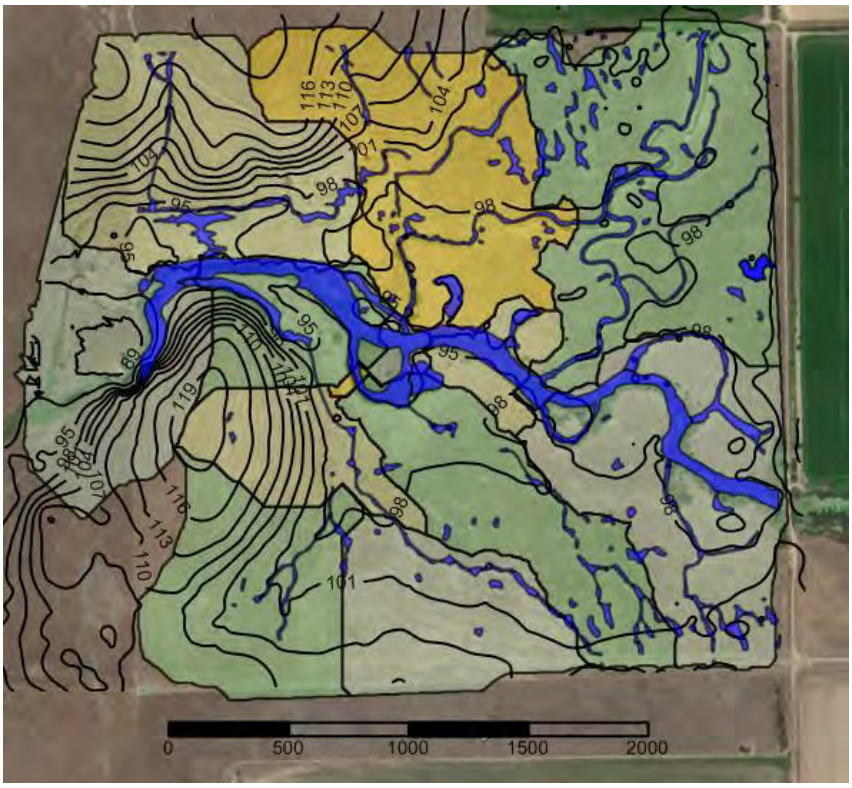


Figure 3-5 Gravitational Flow Vectors Associated with Topography and Existing Wetland Features

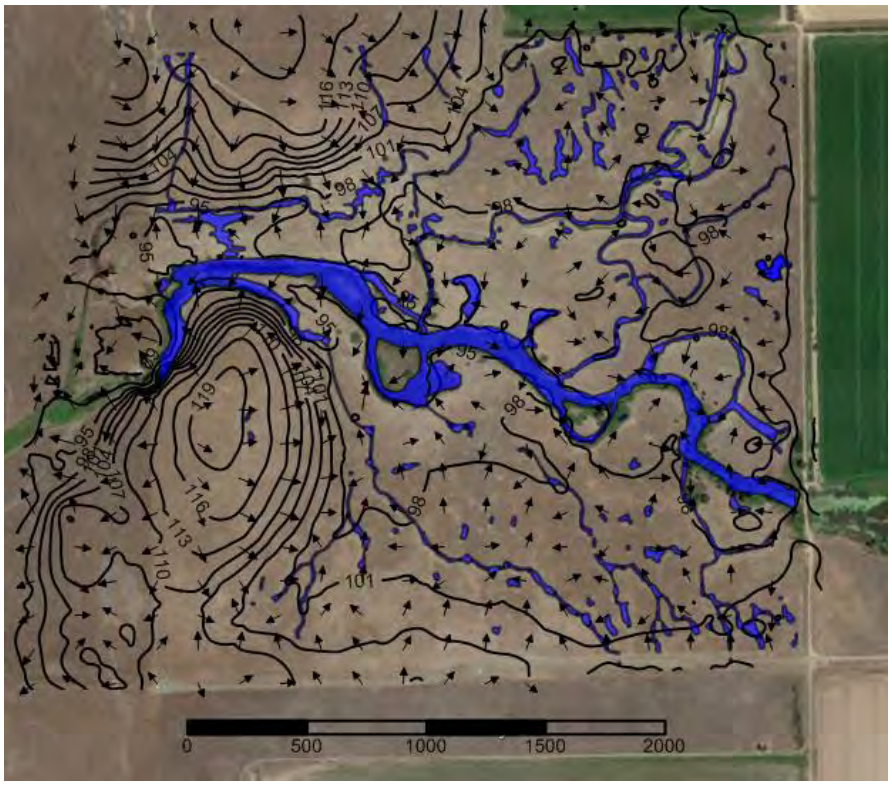


Figure 3.6 Ground-penetrating radar transects.

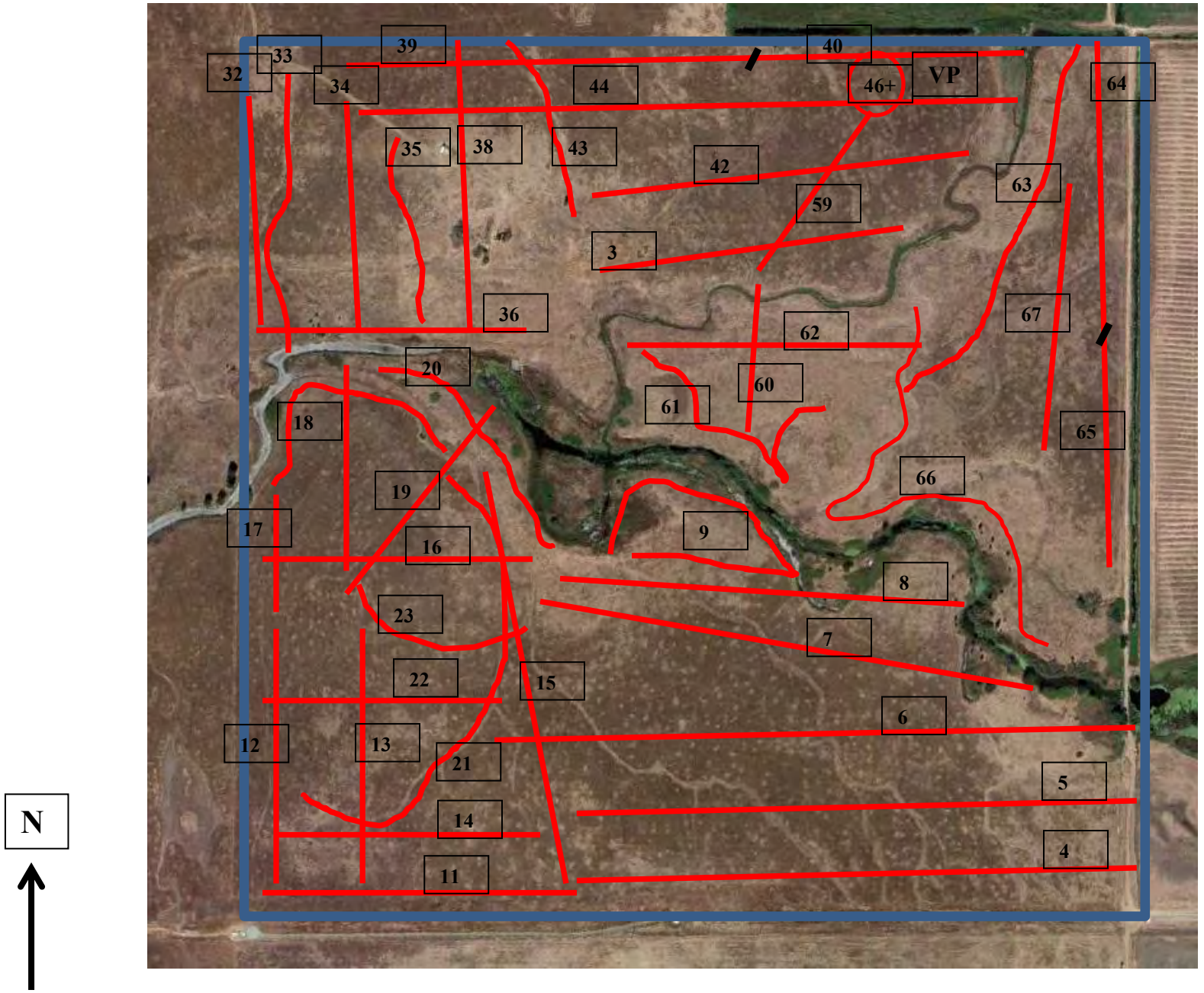


Figure 3.7 GPR Transect 39 West to East. Radargram wave data show colored view of positive and negative radar wave return signal. Density changes in soil cause stronger signals.

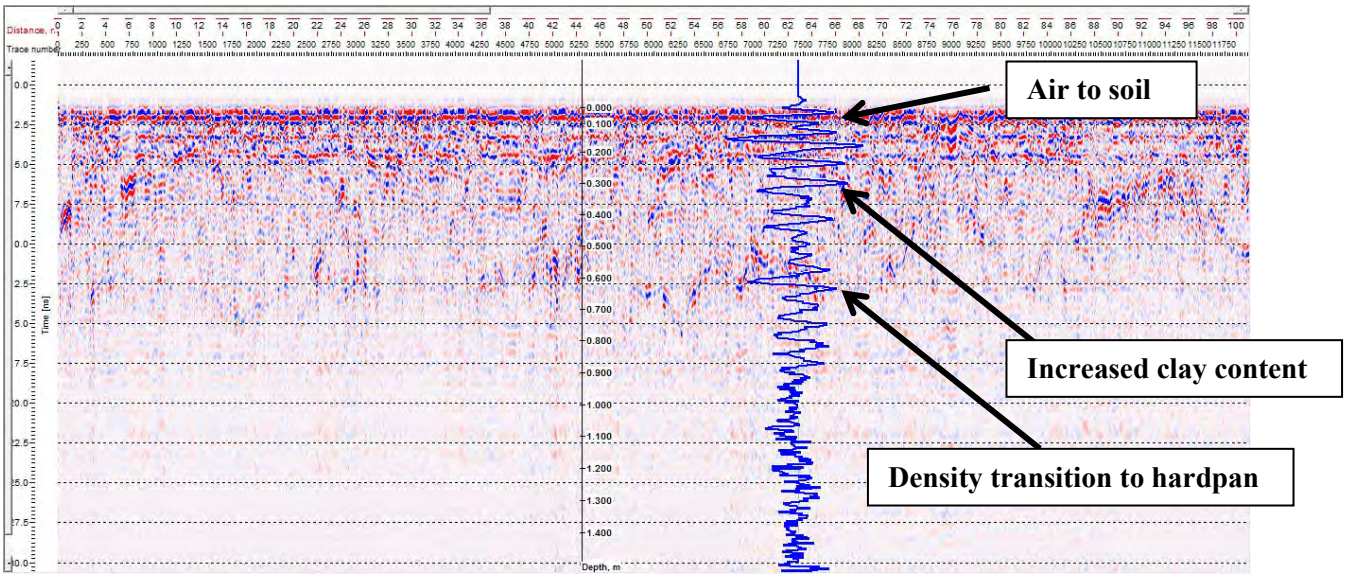


Figure 3.8 GPR Transect 39 West to East. Radargram showing reflection strength differences in the soil profile. Density changes in soil cause stronger signals.

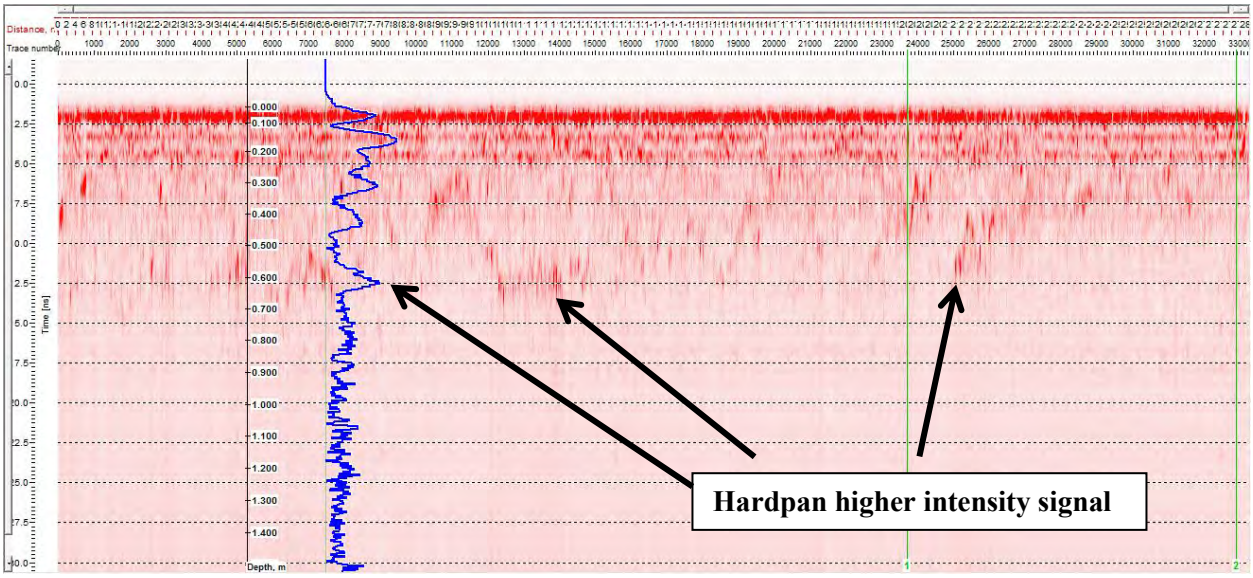


Figure 3.9 GPR transect 4 south side of Laguna Creek crossing a vernal pool – swale complex.

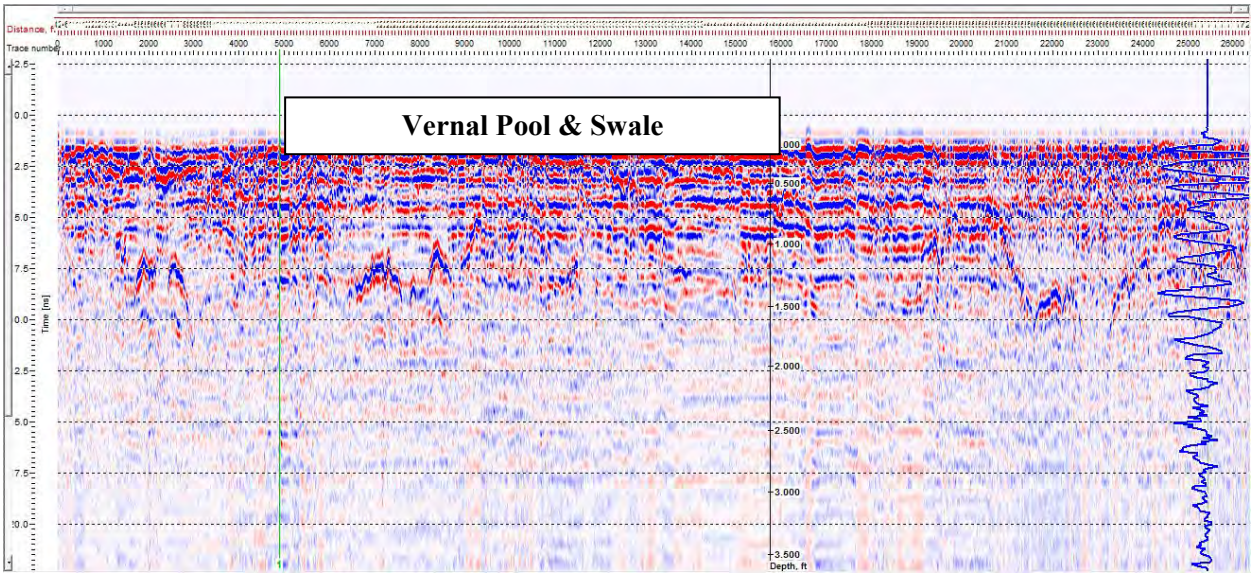


Figure 3.10 GPR transect 4 soil profile model south side of Laguna Creek crossing a vernal pool – swale complex.

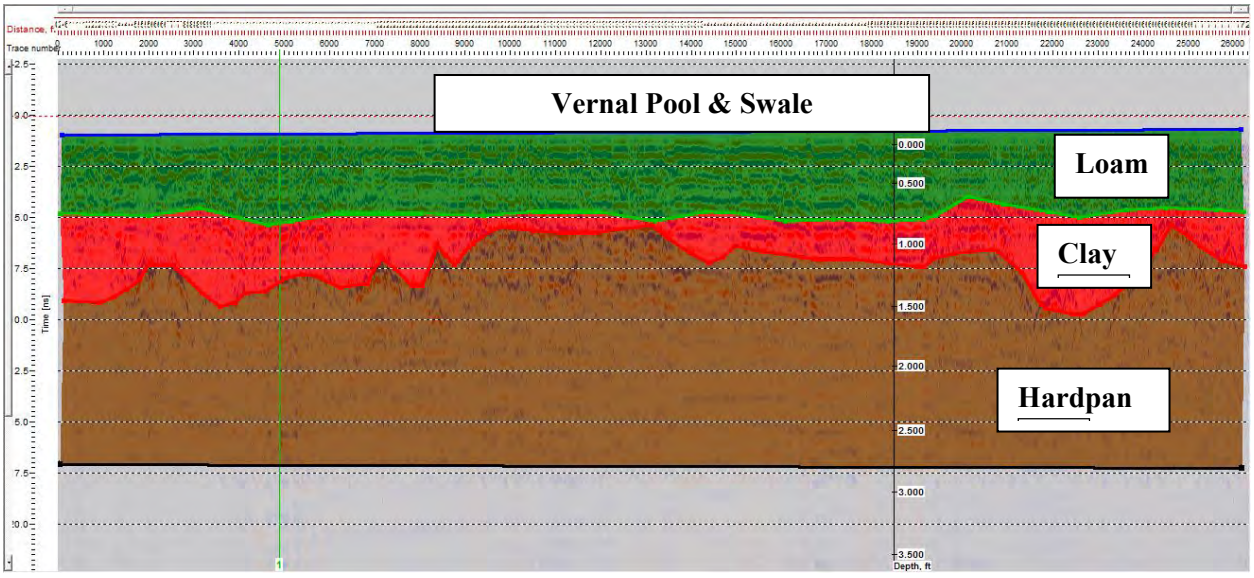


Figure 3.11 Natural Vernal Pool East Side (DAT 117) San Joaquin Soil Series

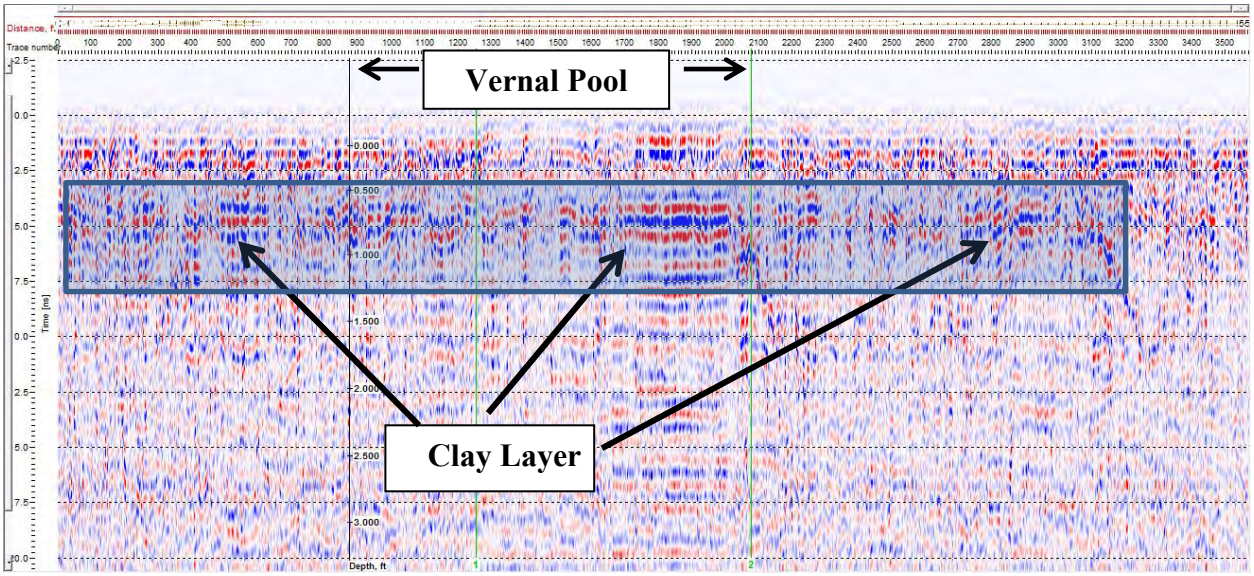


Figure 3.12 Natural Vernal Pool GPR (DAT 129) San Joaquin Soil Series

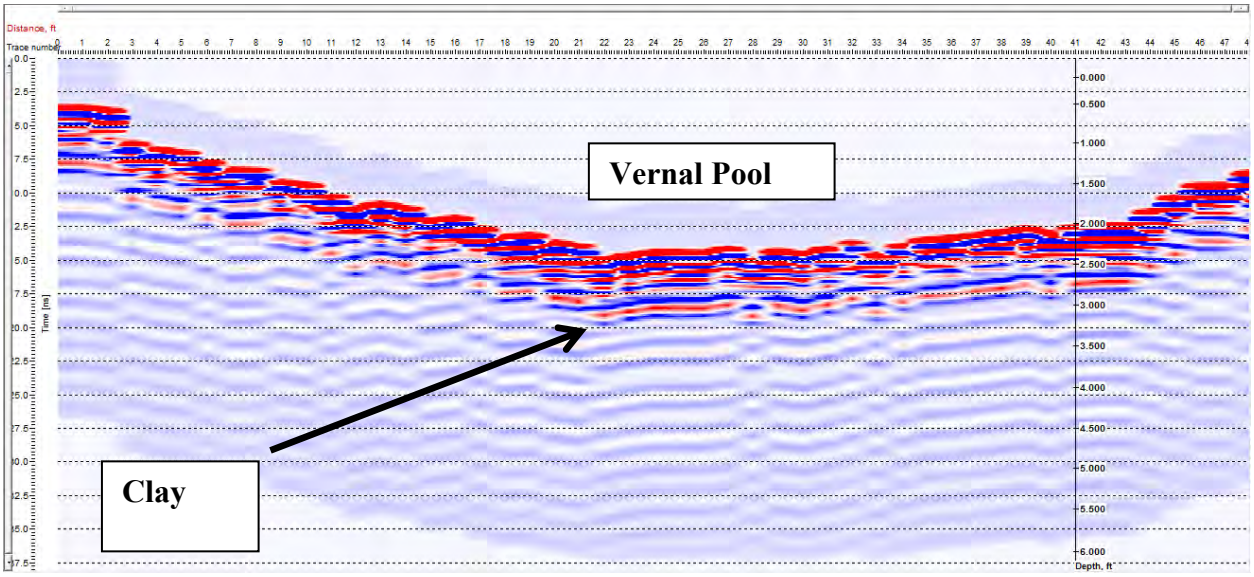


Figure 3.13 Natural Vernal Pool GPR (DAT 131) Hedge Soil Series

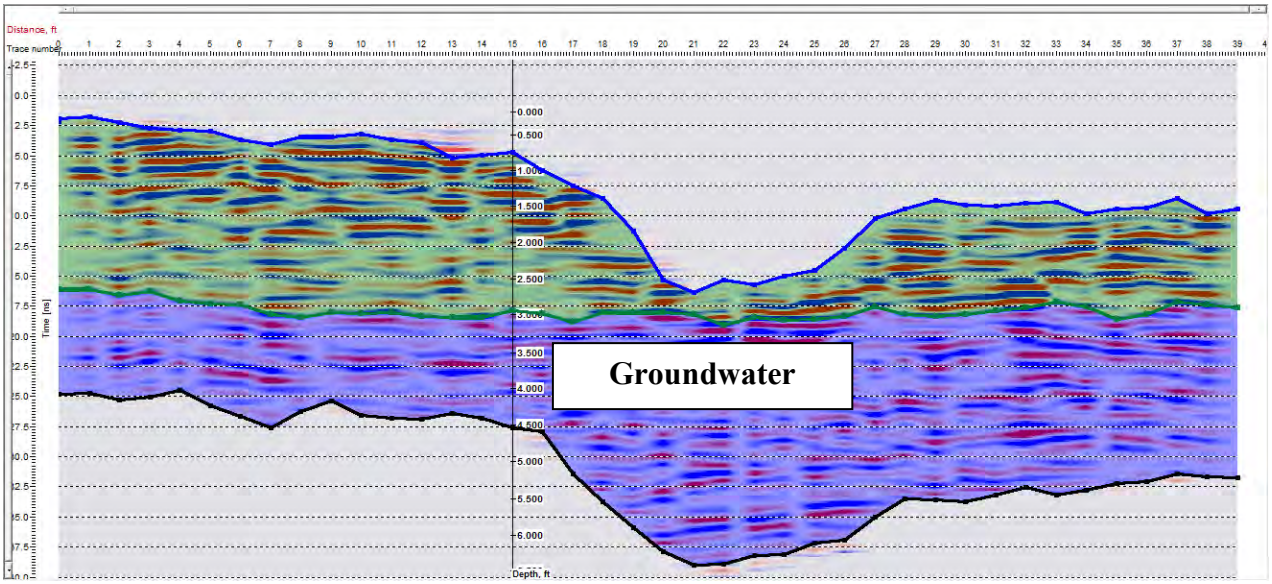


Figure 3.14 GPR (DAT 21) along toe of slope on south side of Laguna Creek follows a small drainage

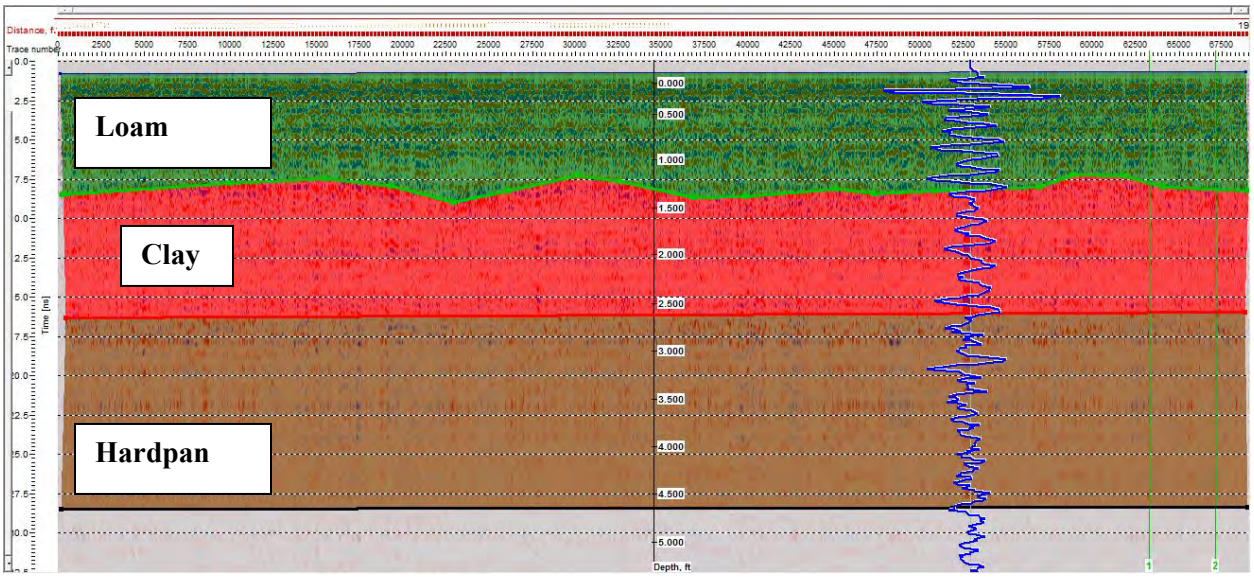


Figure 3.15 GPR Transect (DAT 006) South of Laguna Creek

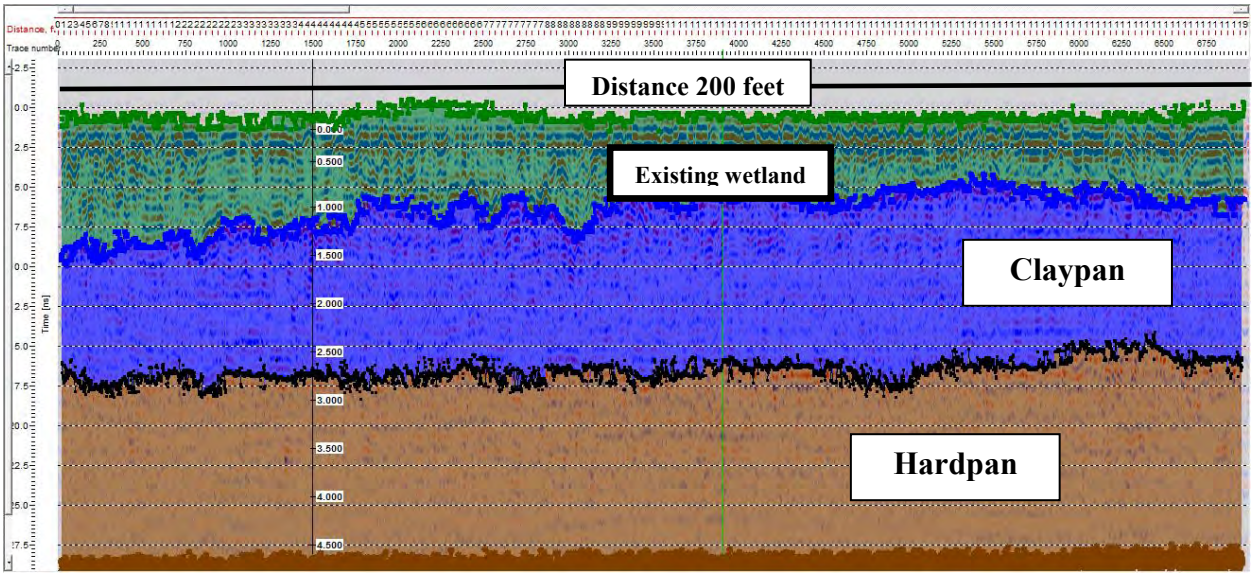


Figure 3-16 Catchments with Cascading Vernal Pool Basins

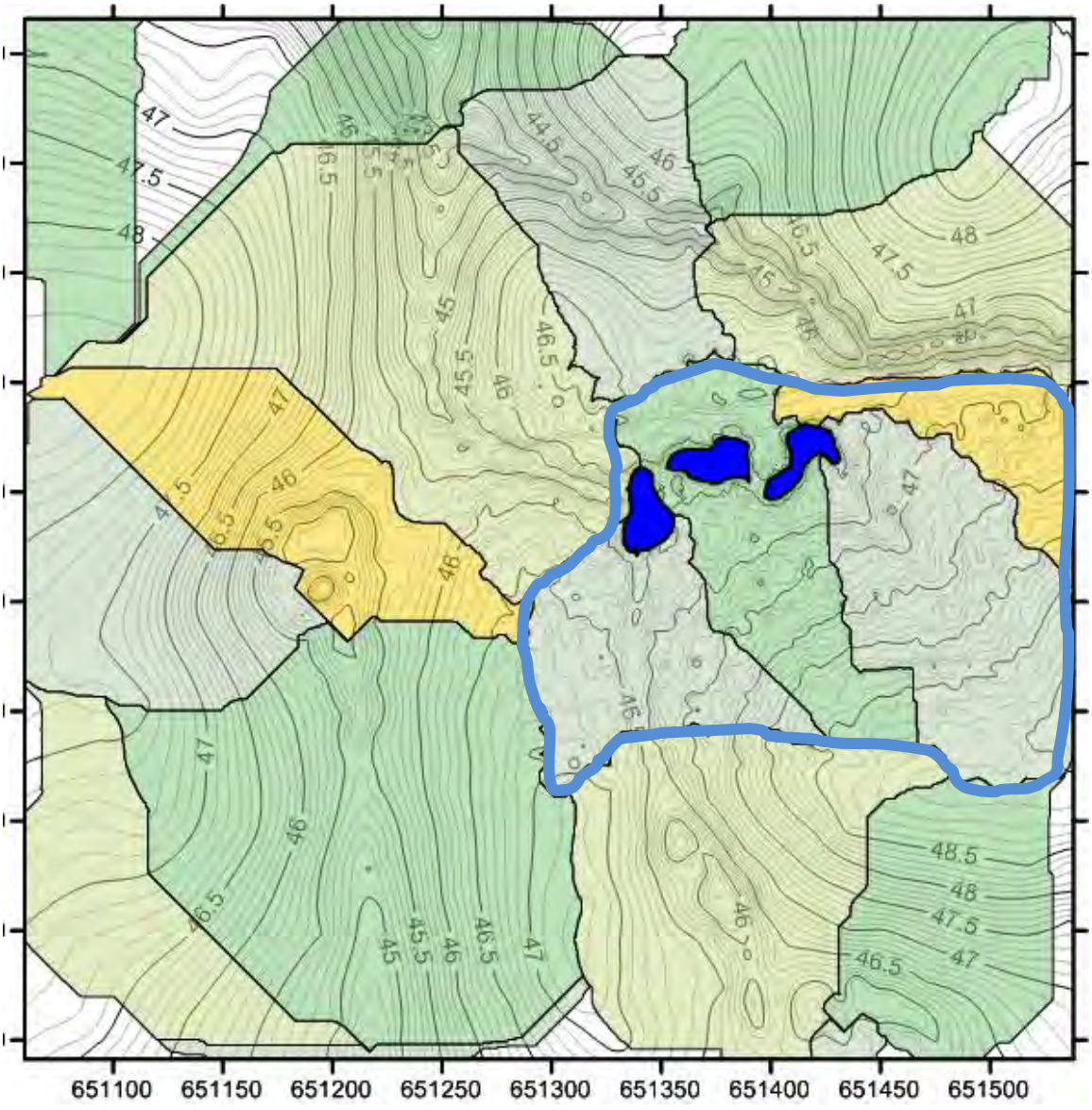


Figure 3.17 Vernal Pool Landscape Cross-Section.. (Copyright Institute for Ecohydrology Research).

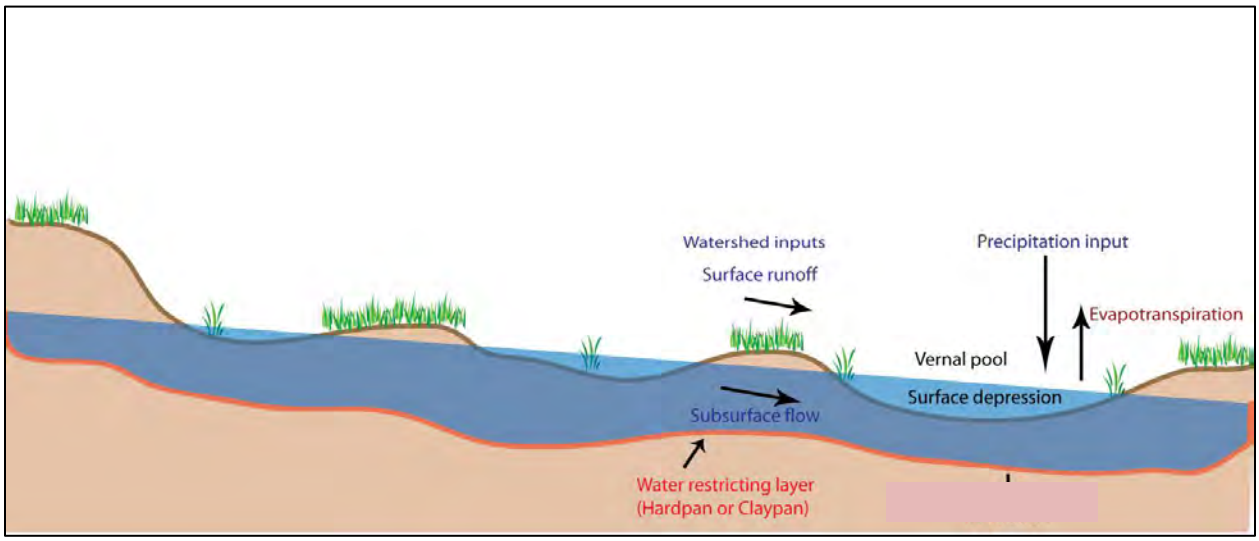


Figure 3.18 Cross-Section of Vernal Pool Landscape Showing Components of Water Input from Rainfall (P) and Subsurface (Qgi) and Surface (Qsi) Catchment Discharge and Outputs from Evapotranspiration (ET) and Downslope Subsurface (Qgo) and Surface (Qso) Discharge Out. (Copyright Institute for Ecohydrology Research).

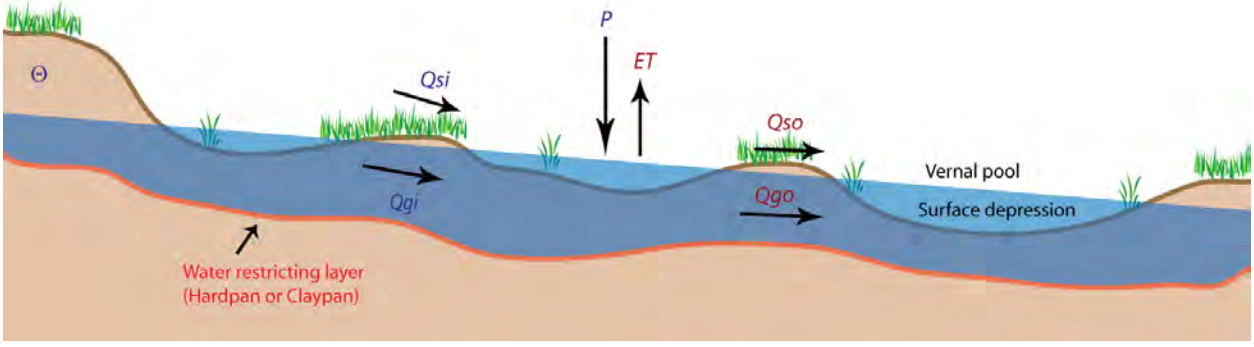


Figure 3.19 Annual Rainfall Sacramento, California

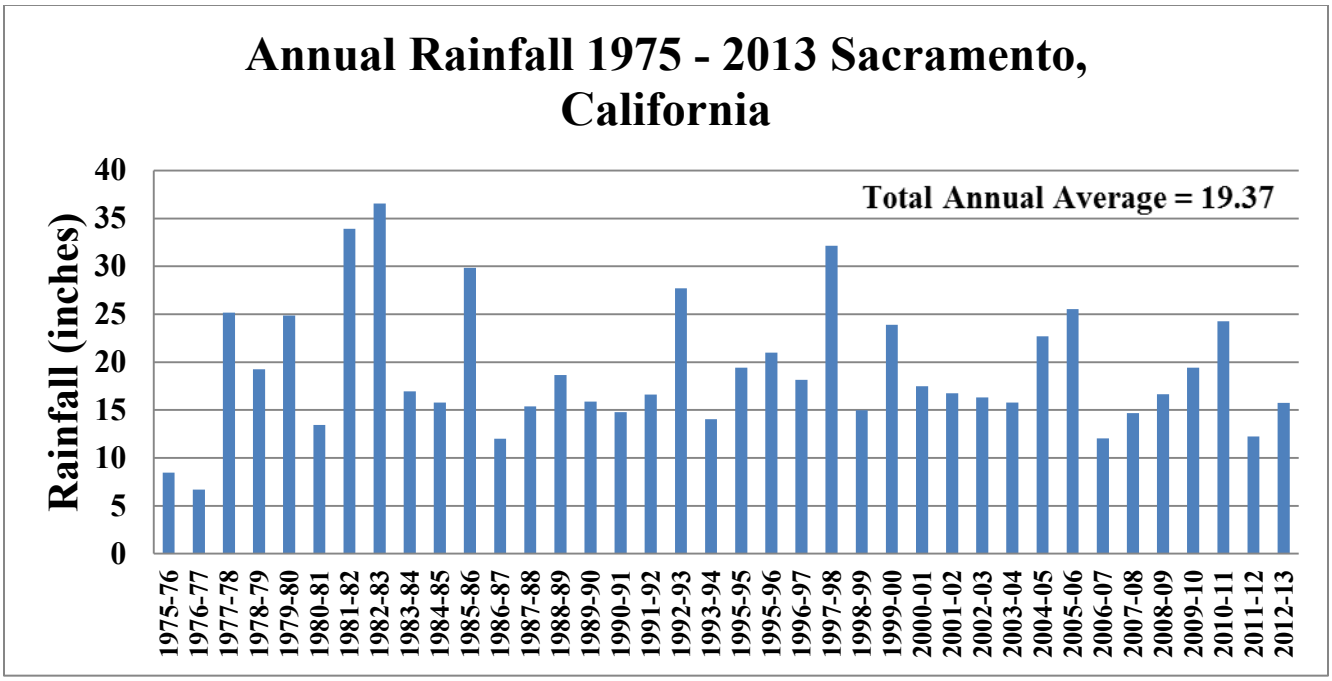


Figure 3.20 Monthly Average Distribution of Rainfall Sacramento, California

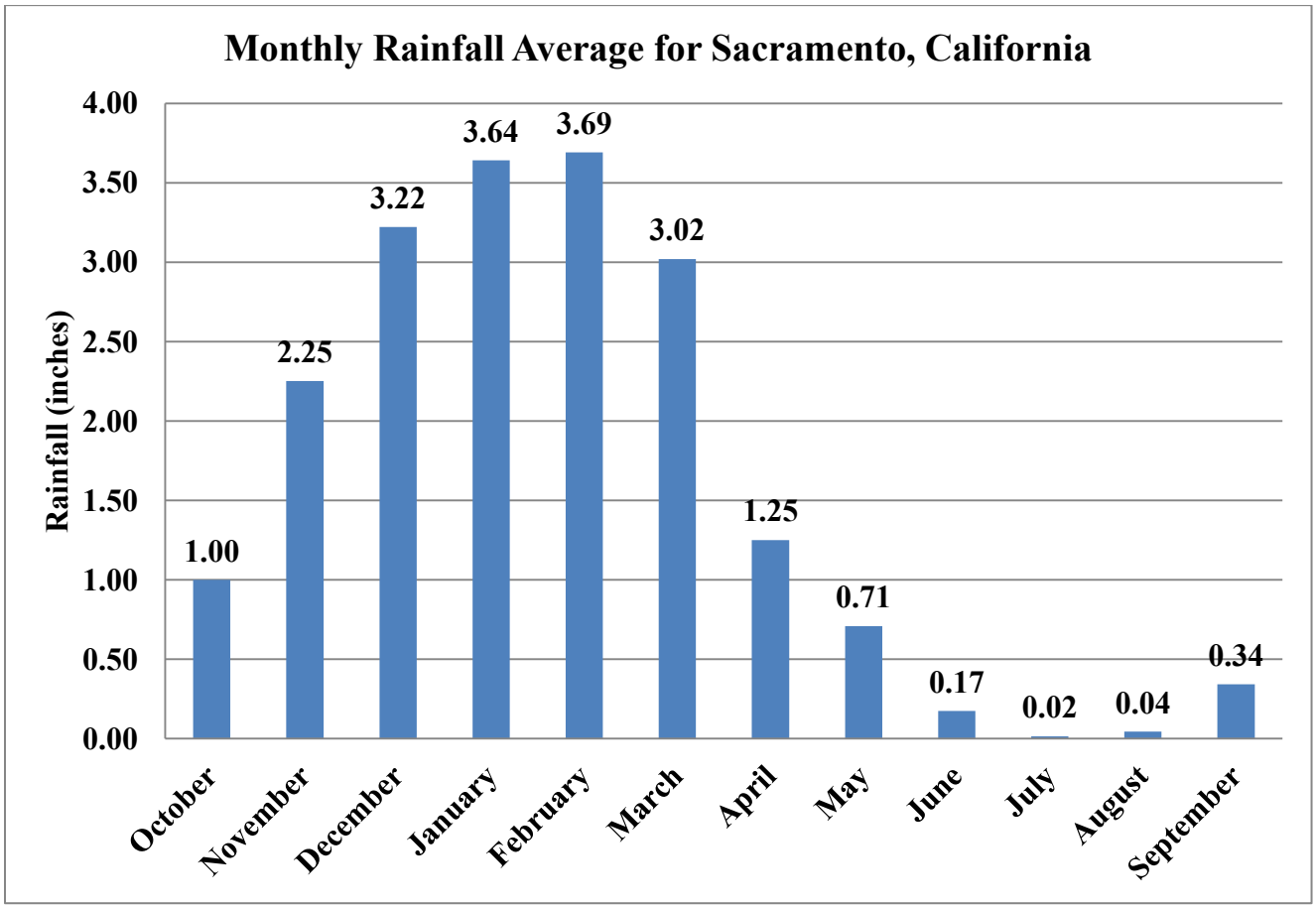
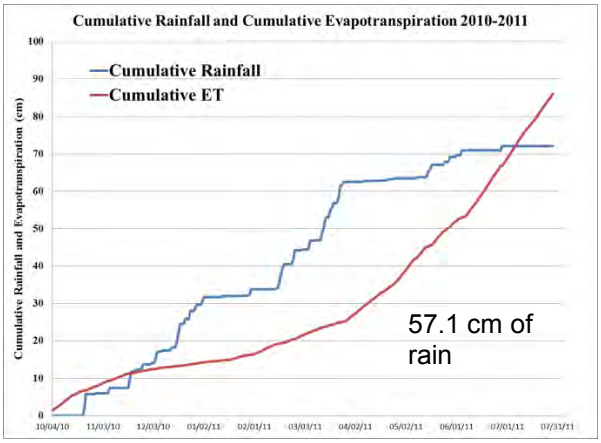
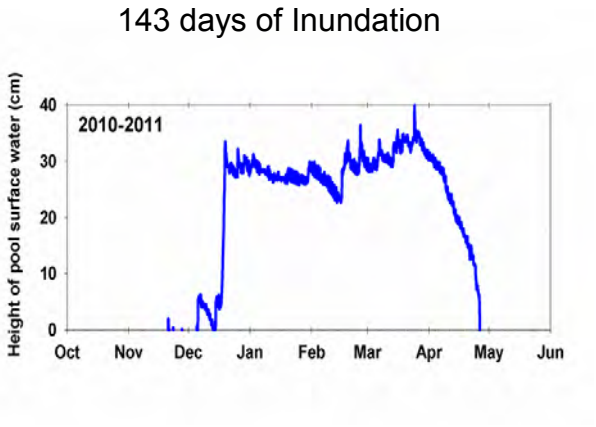
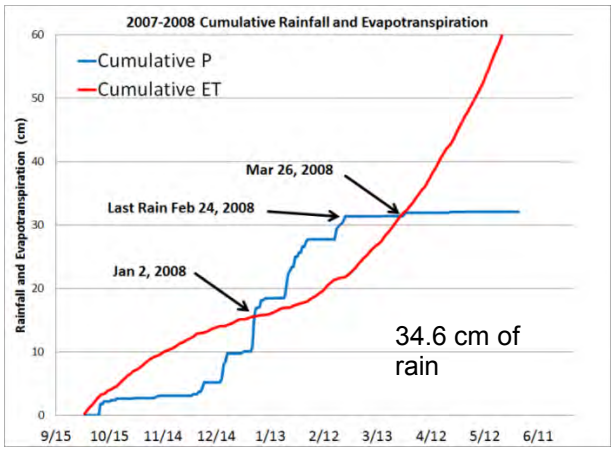


Figure 3.21Comparison of Rainfall and Evapotranspiration with Natural Vernal Pool Hydrographs Showing How the Water Balance of Water Input from Rain and Water Loss from Evapotranspiration Determines the Hydroperiod. (Data analysis from McCarten and Christman 2013 with hydrographs from vernal pools at Mather Field, Sacramento Co., California).







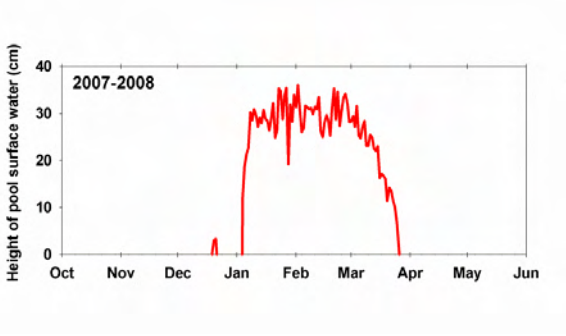


Figure 3.22 Potential Hydrograph During Average Rainfall Year (2009-2010), Dry Rainfall Year (2006-2007), and Wet El Niño Rainfall Year (1997-1998).

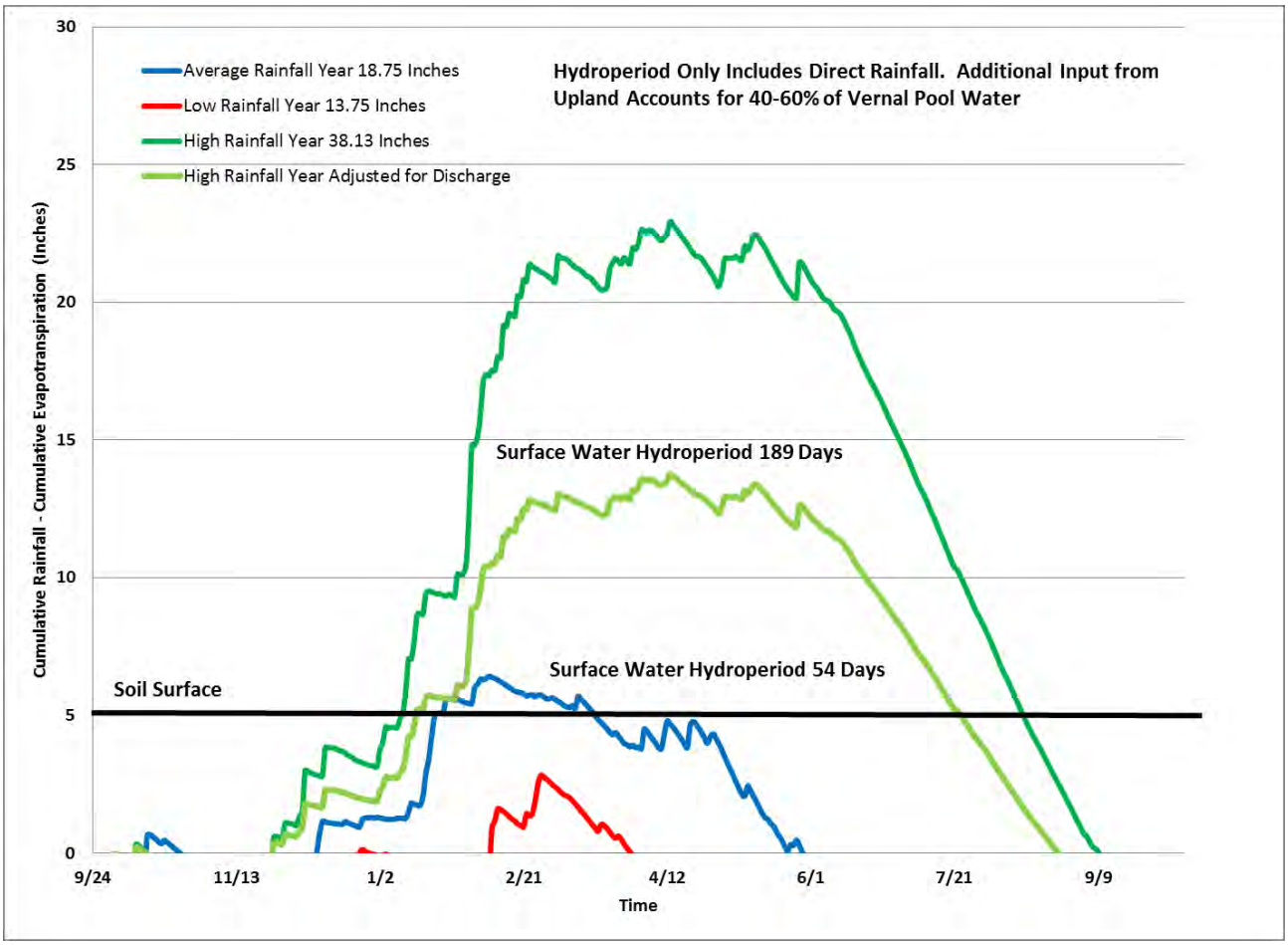


Figure 3-23 Hydrograph of Vernal Pool in Middle Terrace at Shehadeh Property.

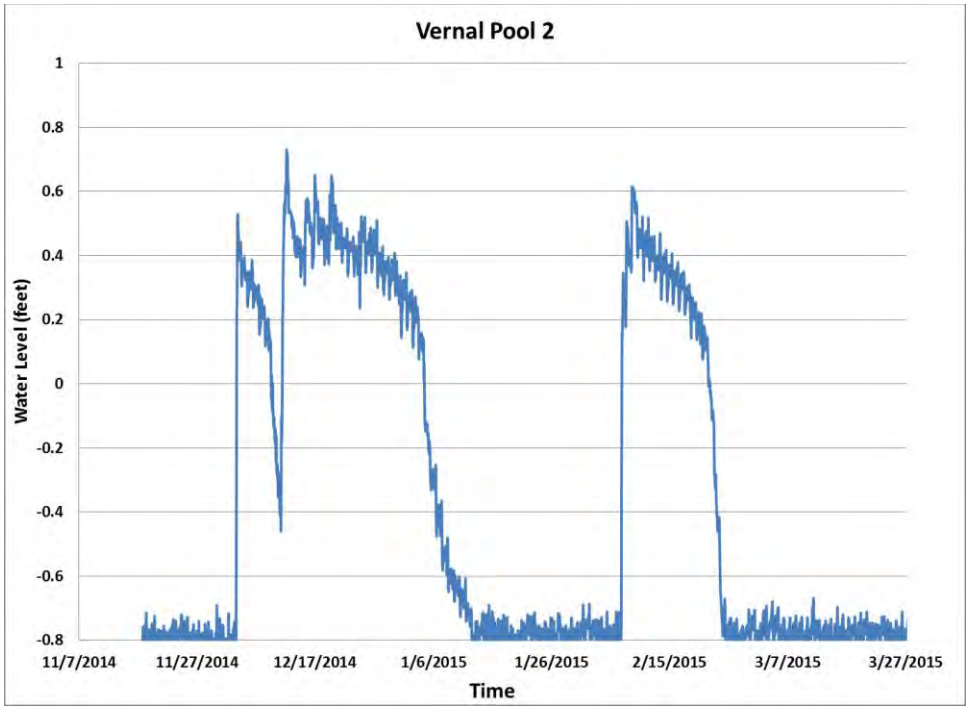
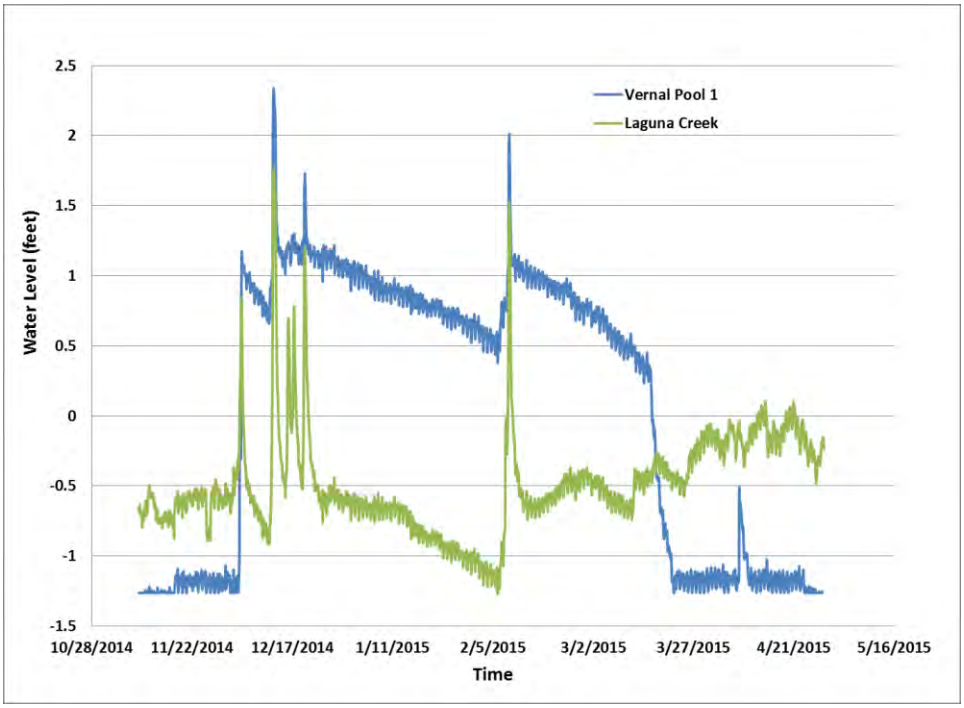


Figure 3.24 Hydrographs of Low Terrace Vernal Pool and Nearby Water Fluctuation of Laguna Creek at Shehadeh Property. Water Level Spikes in the Vernal Pool are Due to Laguna Creek Overflow of Banks.



Section 4

Figure 4.1 Proposed Creation Vernal Pools

Figure 4.2 Proposed Creation Vernal Pools Numbered for Listing in Table with Acreage

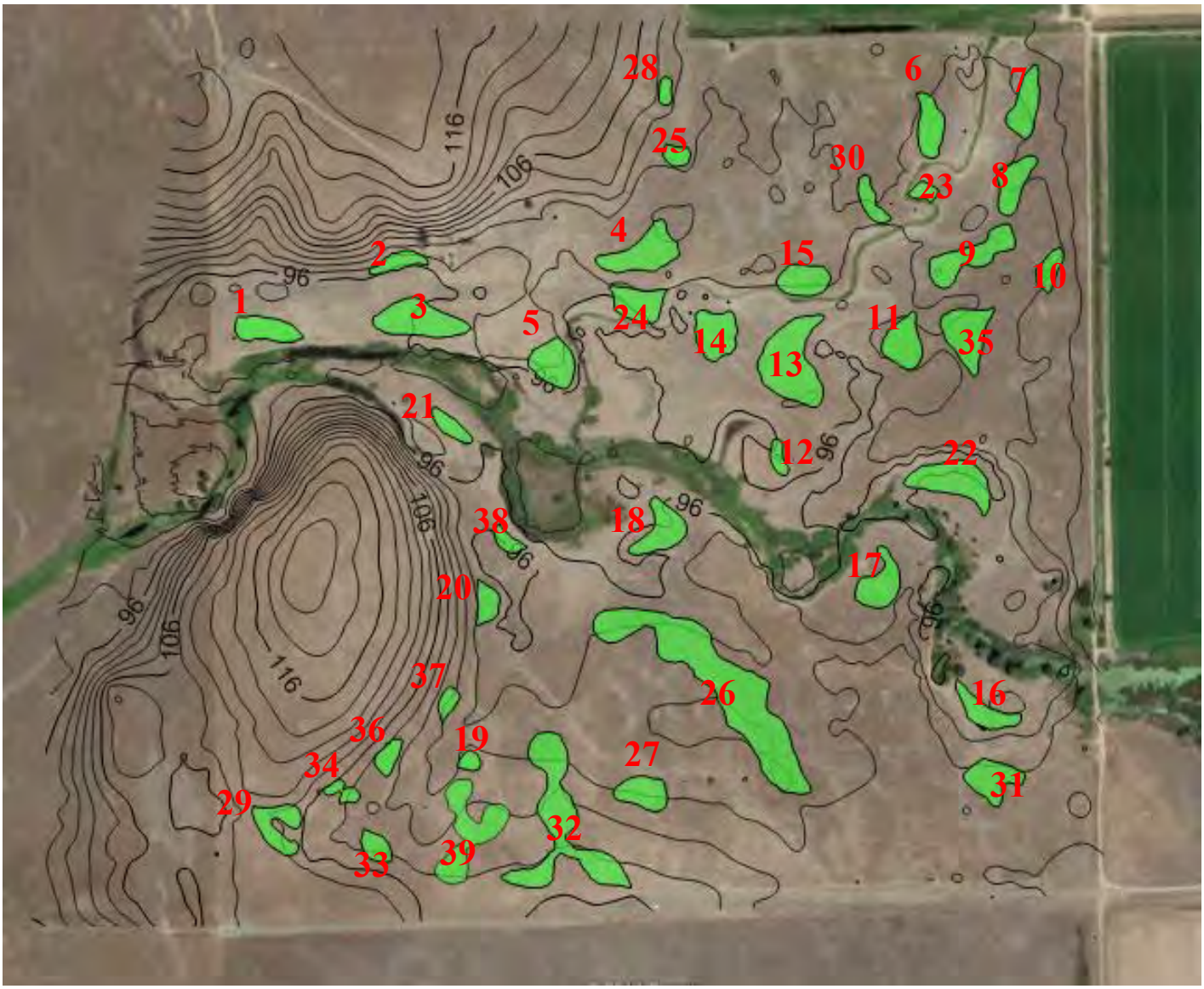


Figure 4.3 Proposed Creation Vernal Pools (green) with Existing Wetland Features Including Vernal Pools (blue).

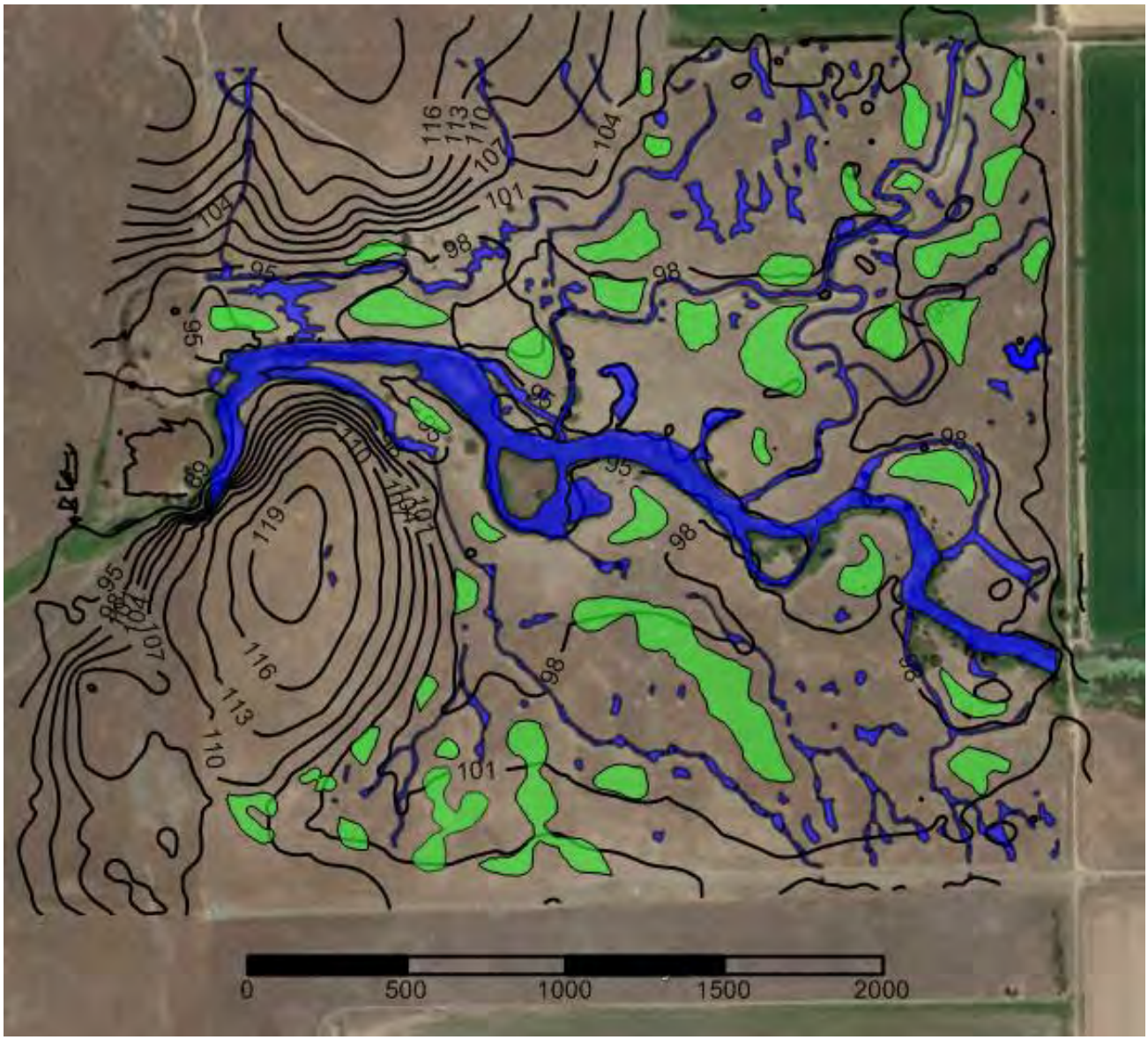


Figure 4.4 Proposed Creation Vernal Pools and Existing Wetland Features Overlaying the Catchment Boundaries

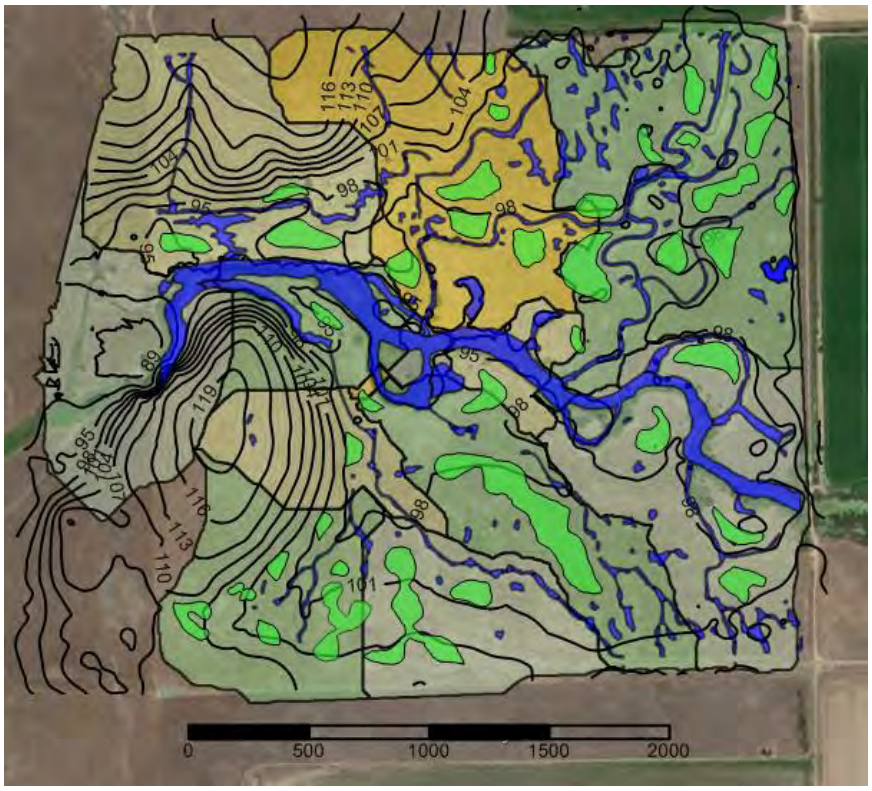


Figure 4.5 Exiting Wetlands and Created Wetlands with Vector Flow Arrows

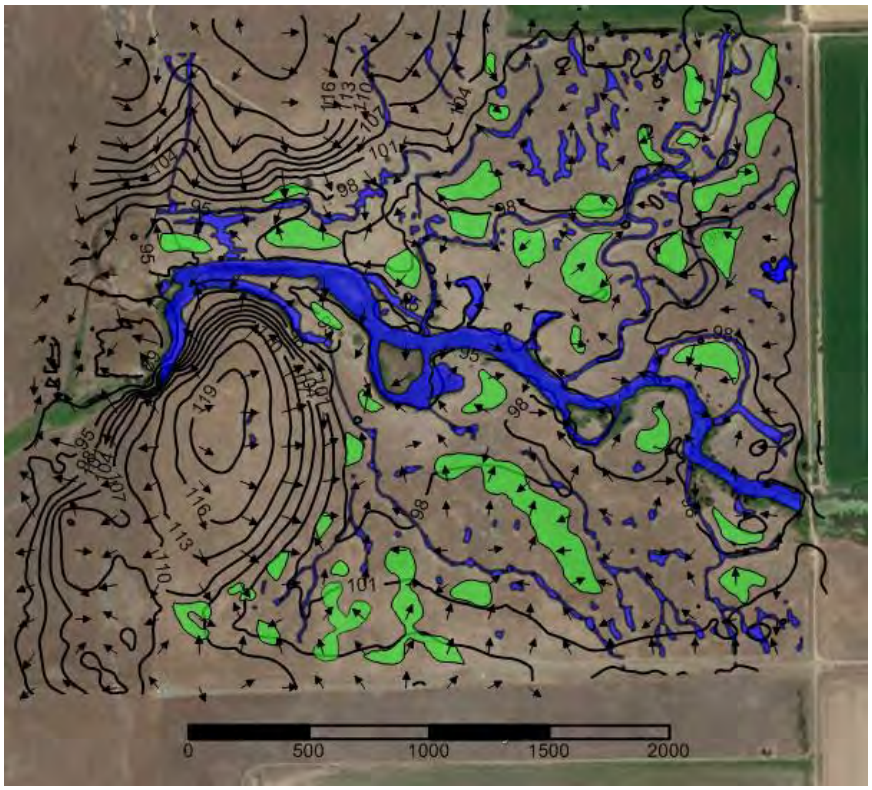
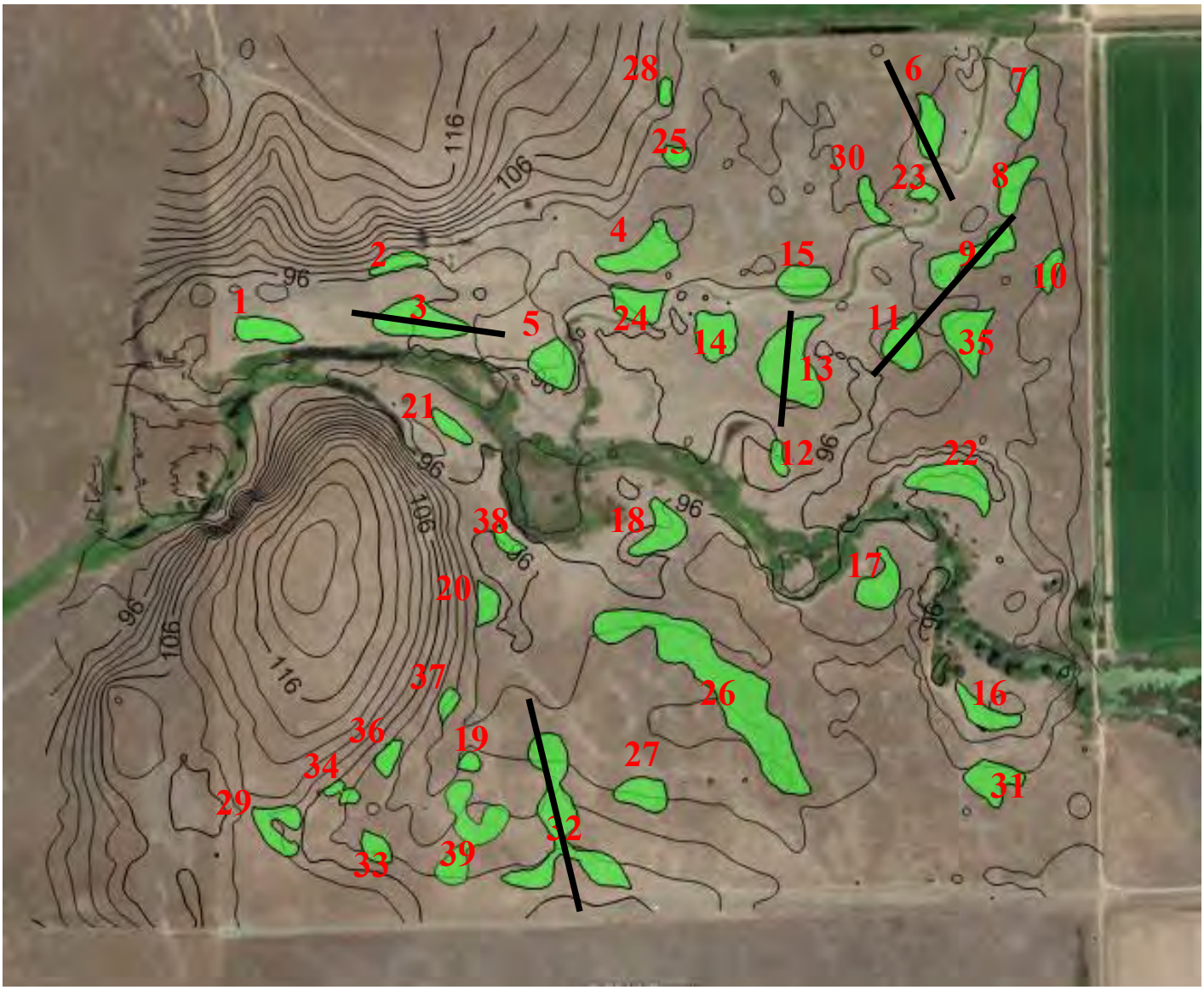


Figure 4.6 Proposed Created Vernal Pools and GPR Transect Profiles Shown in this report.



Legend: Proposed created vernal pool Red numbers refer to individual pools

Black lines are GPR transects

Figure 4.7A GPR Transect (DAT 105) Potential Vernal Pool Creation Area Pools 3.

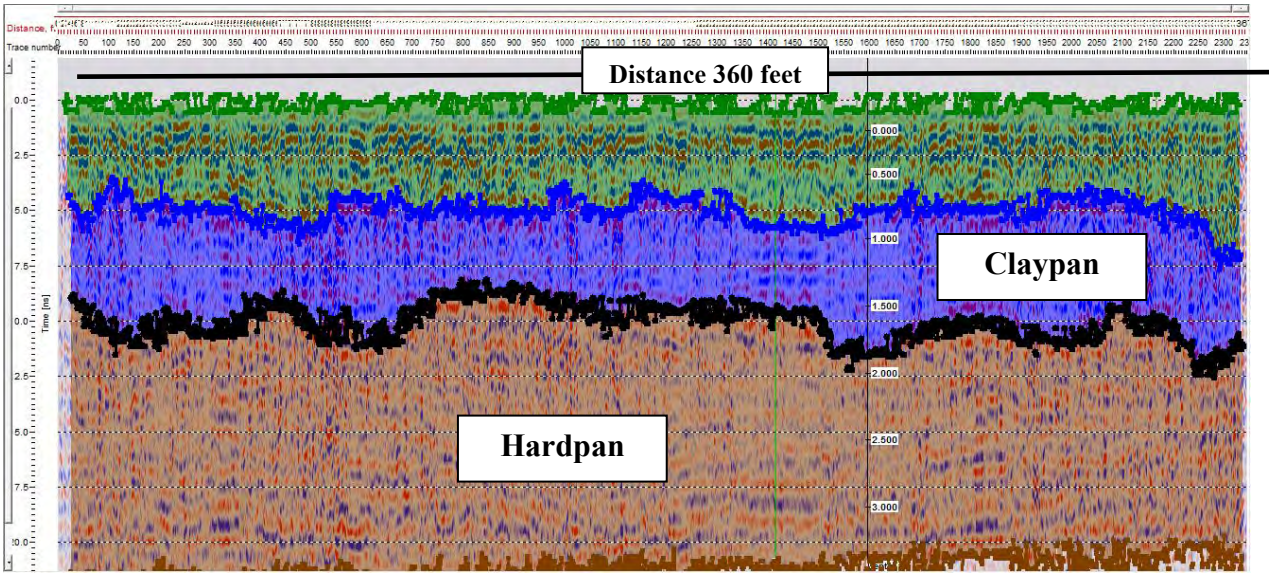


Figure 4.7B Cross Section Showing Proposed Pool 3.

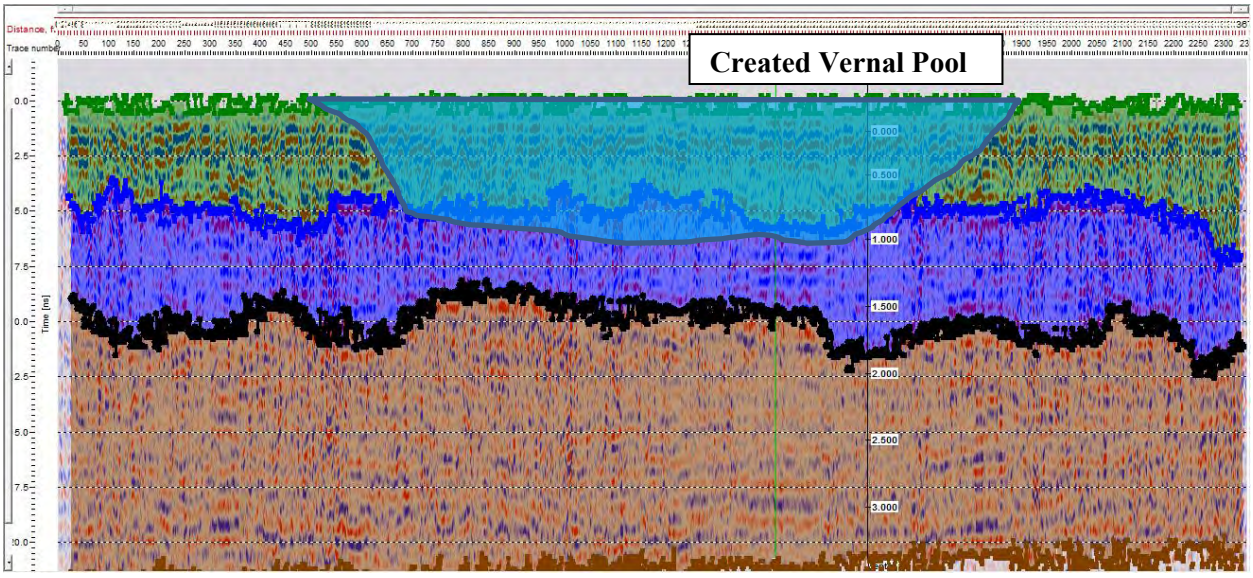


Figure 4.8 A GPR Transect (DAT 118) East Side Through Proposed Vernal Pool Creation Area Pools 9 and 11.

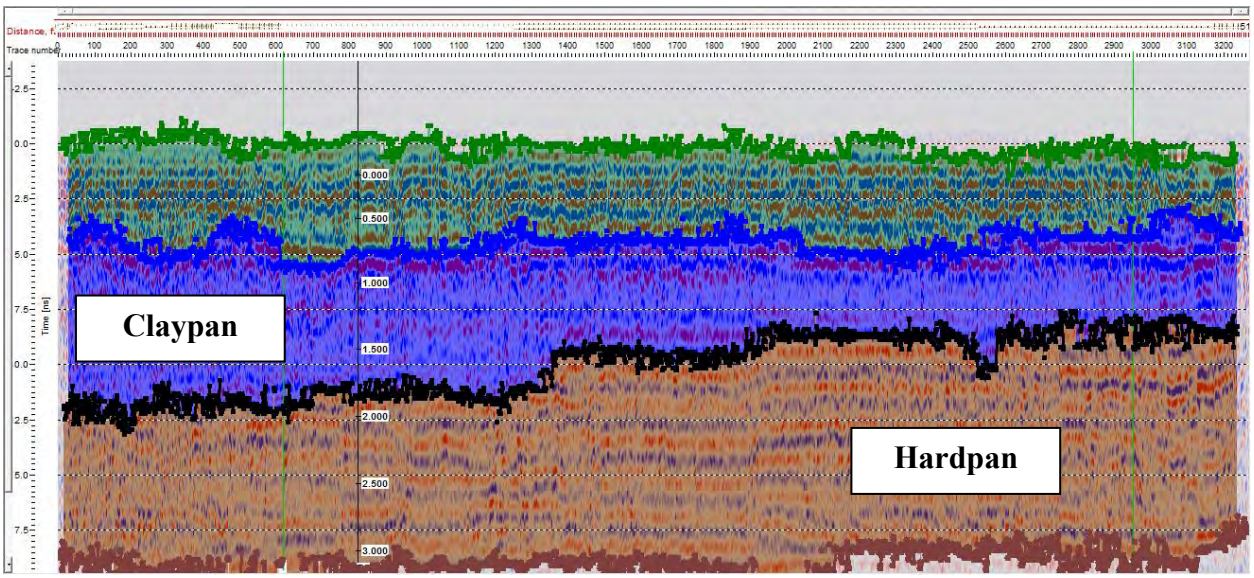


Figure 4.8 B Cross Section Showing Proposed Pools

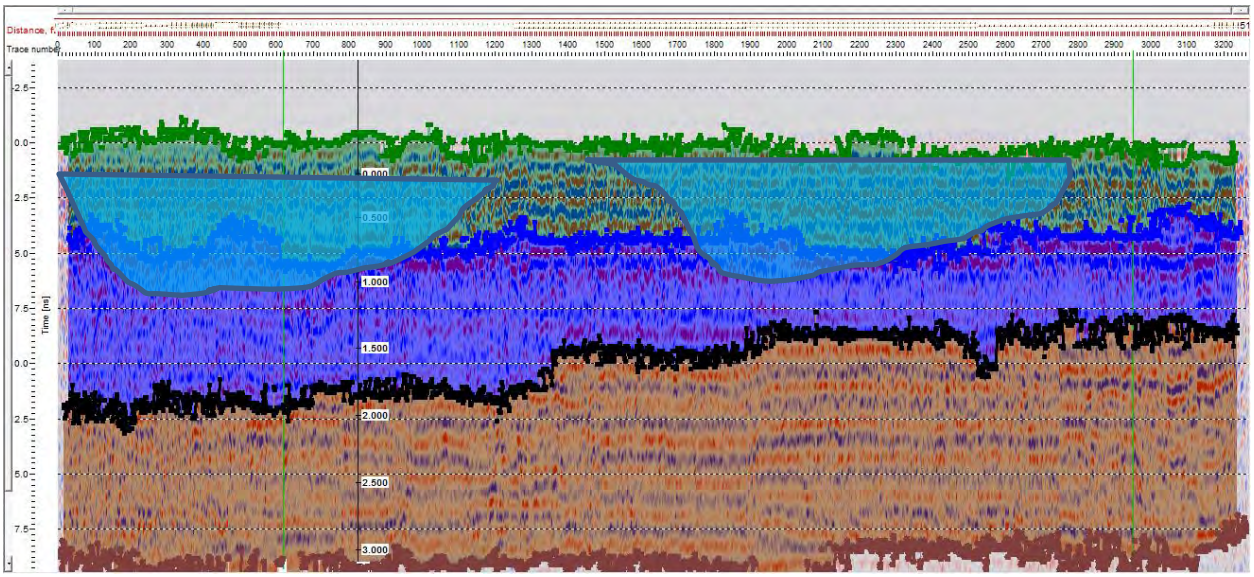


Figure 4.9 A GPR Transect (DAT 111) Proposed Vernal Pool Creation Area Pool 6

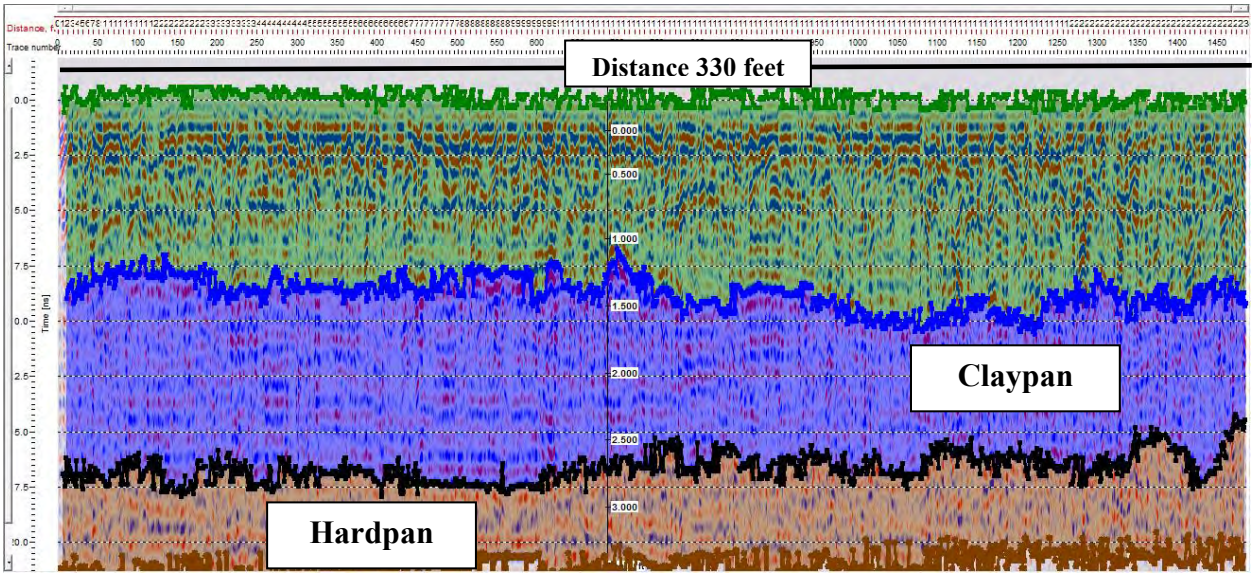


Figure 4.9B GPR Cross Section Showing Proposed Pool 6

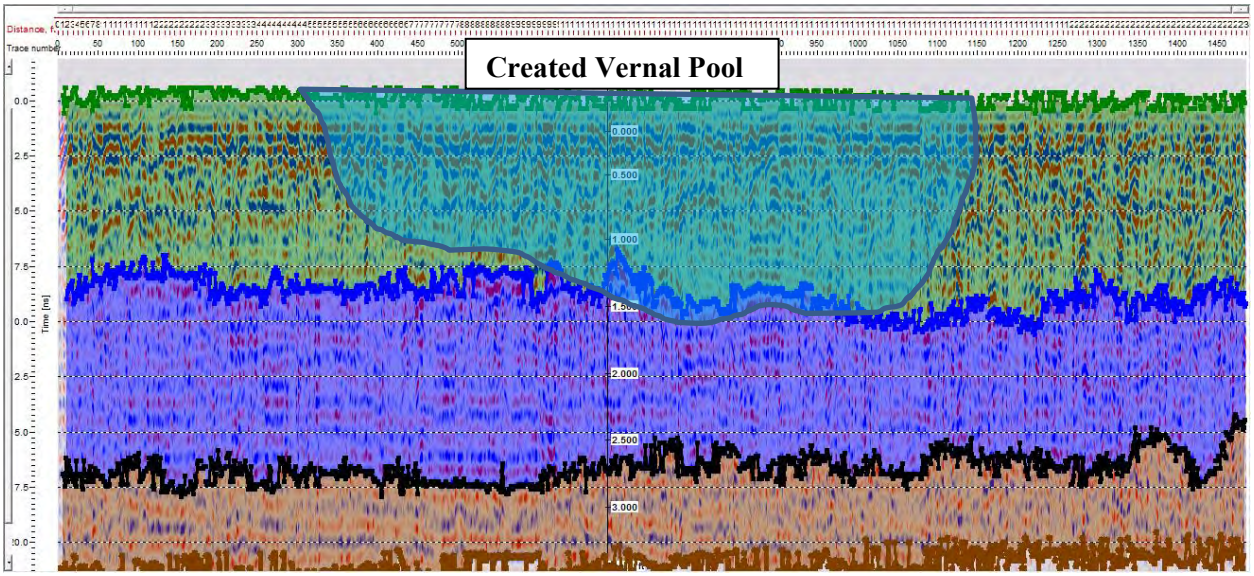


Figure 4.10A GPR Transect DAT 109 Potential Vernal Pool Restoration Area Pool 13

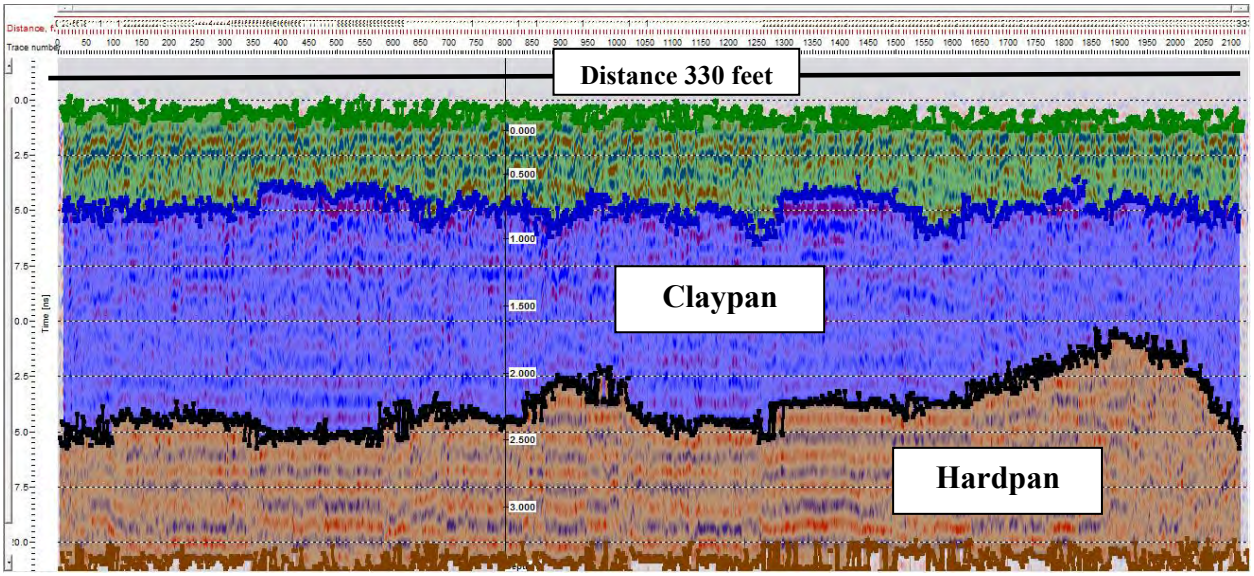


Figure 4.10B Cross Section of Proposed Creation Vernal Pool 13

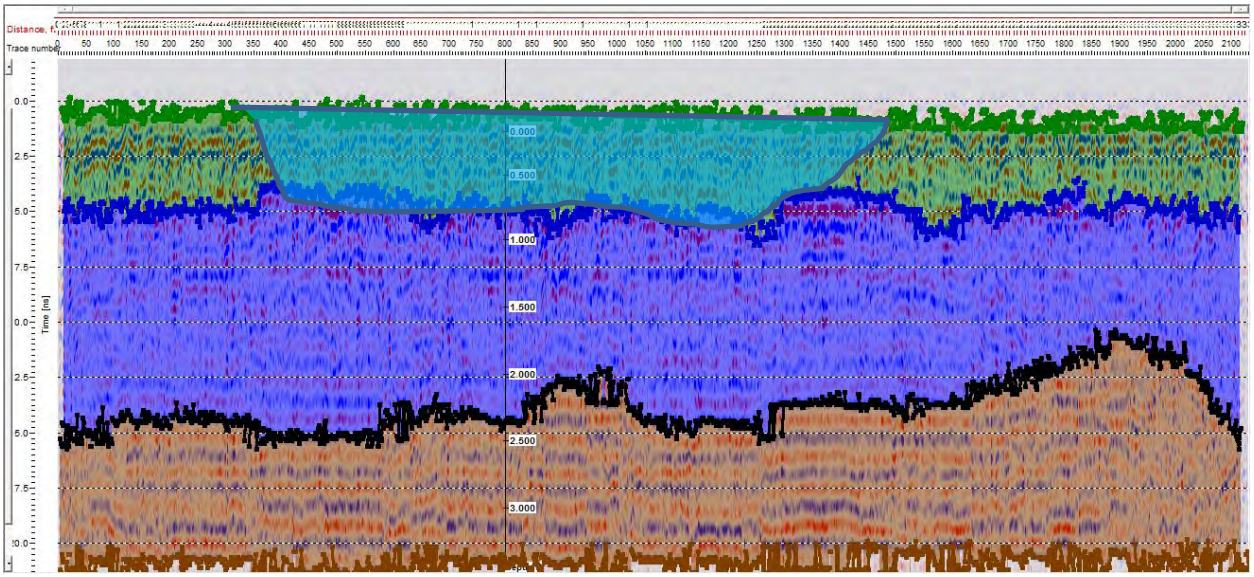


Figure 4.11A GPR Transect (DAT 015) Proposed Vernal Pool Creation Area Pool 32

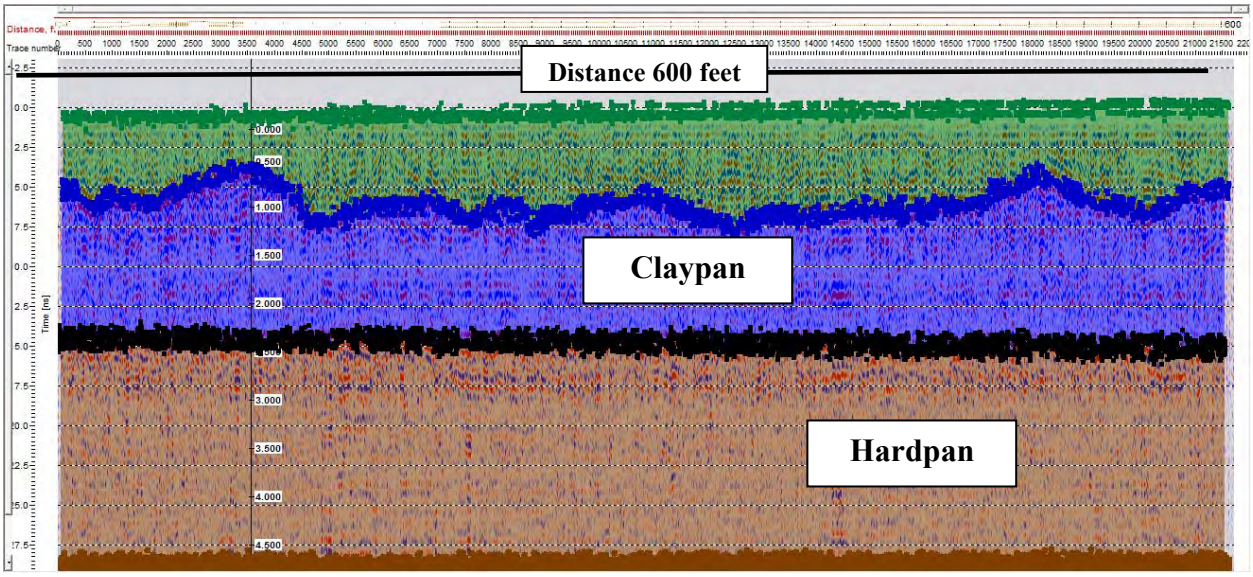
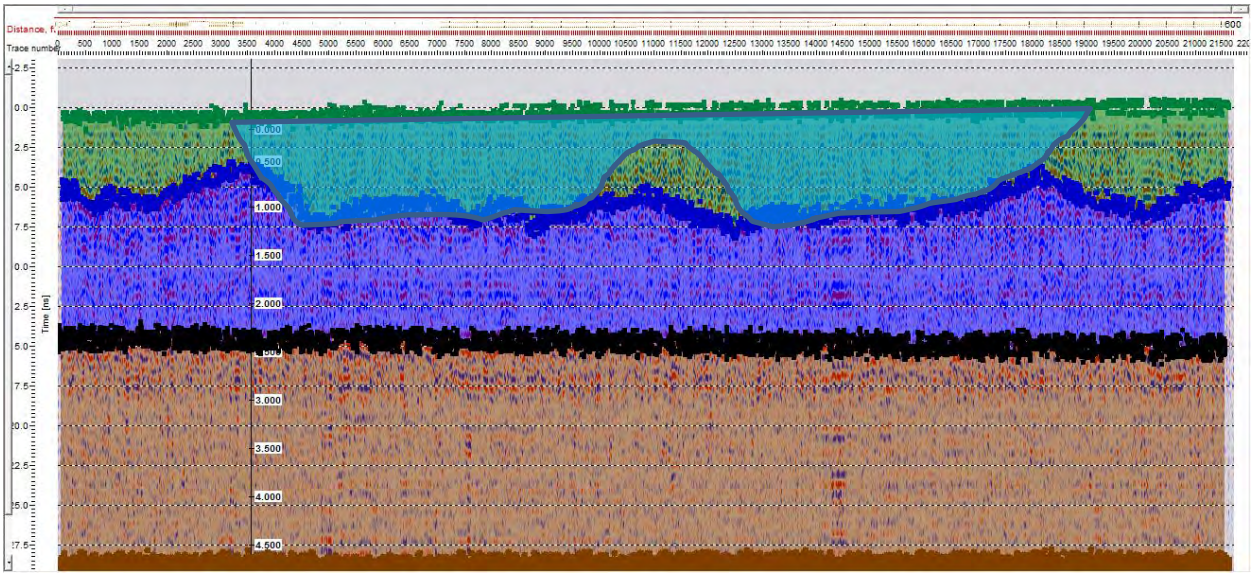


Figure 4.11 B Cross Section of Proposed Creation Vernal Pool 32

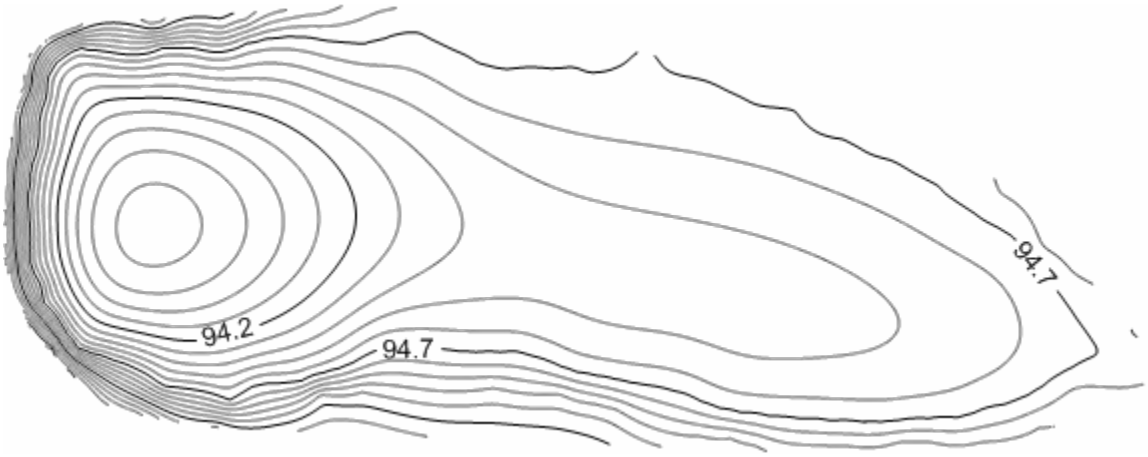


Appendix A

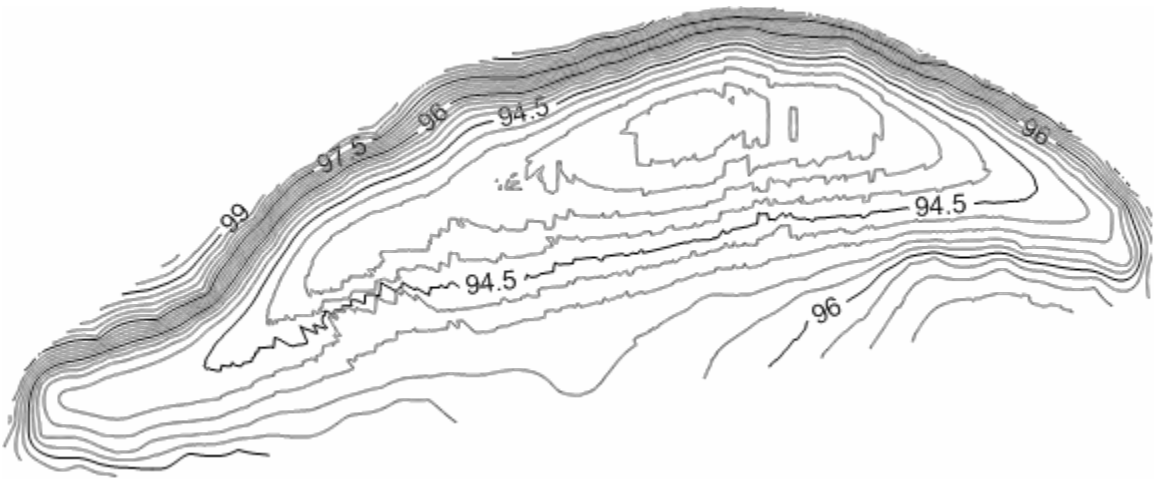
Vernal Pool Contours

Vernal Pool Contours (all scales in feet)

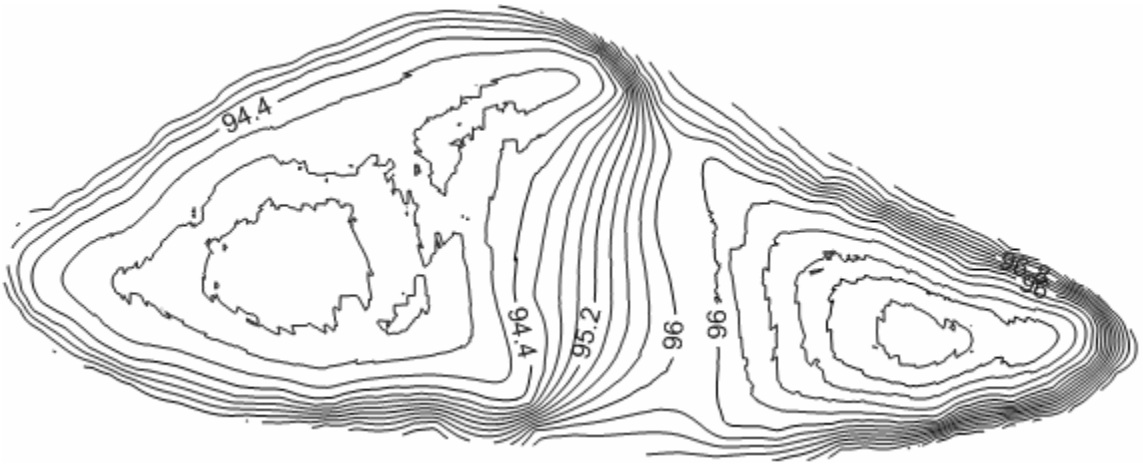
VERNAL POOL 1



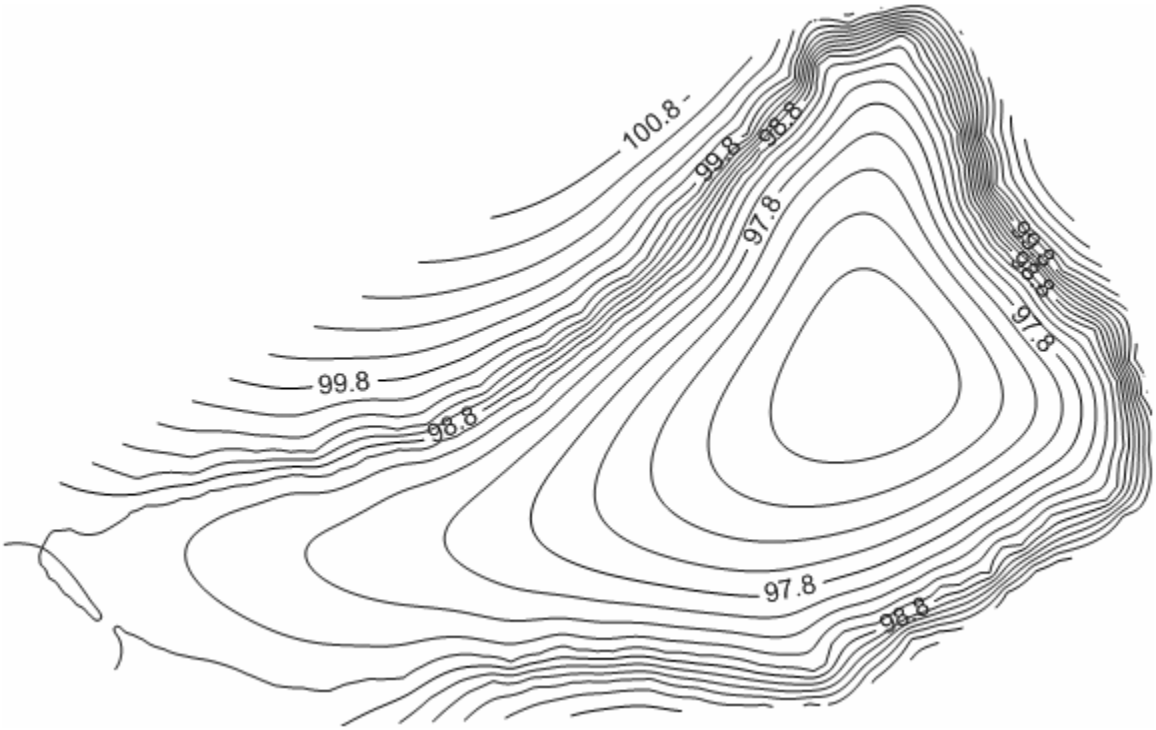
VERNAL POOL 2



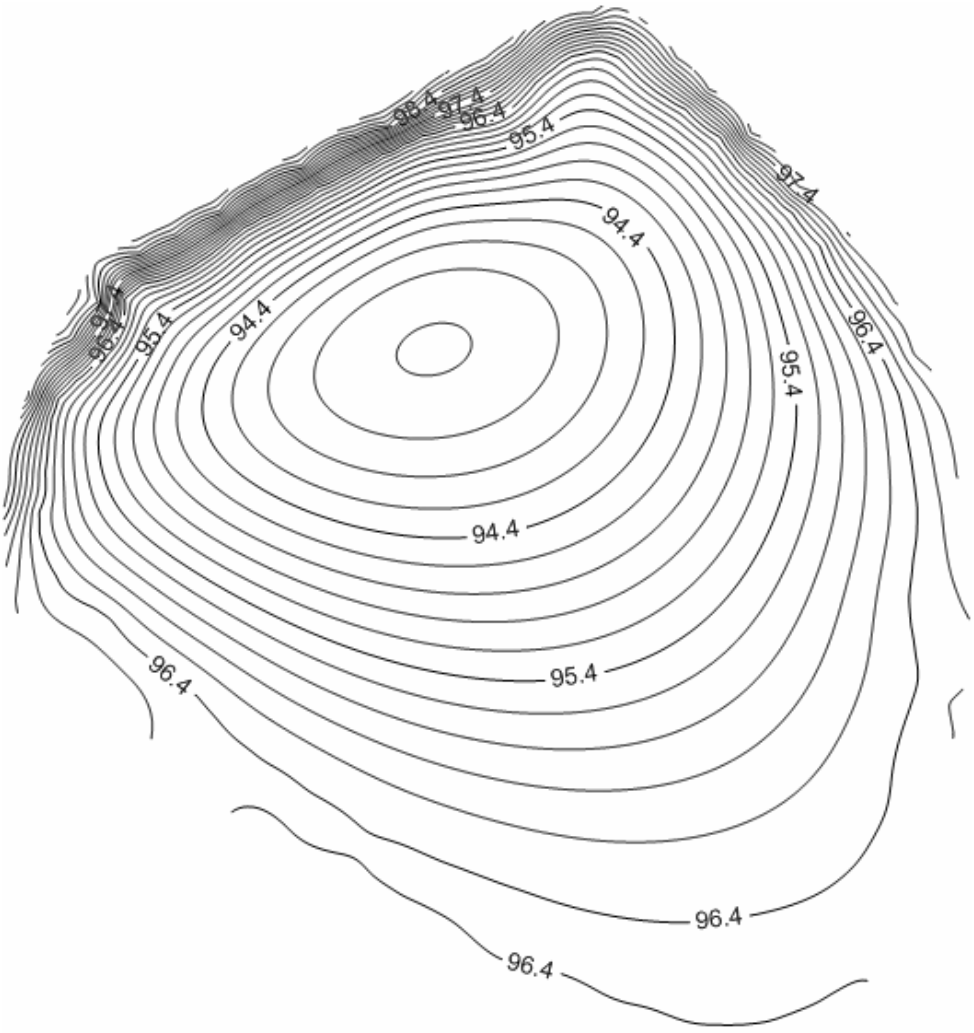
VERNAL POOL 3



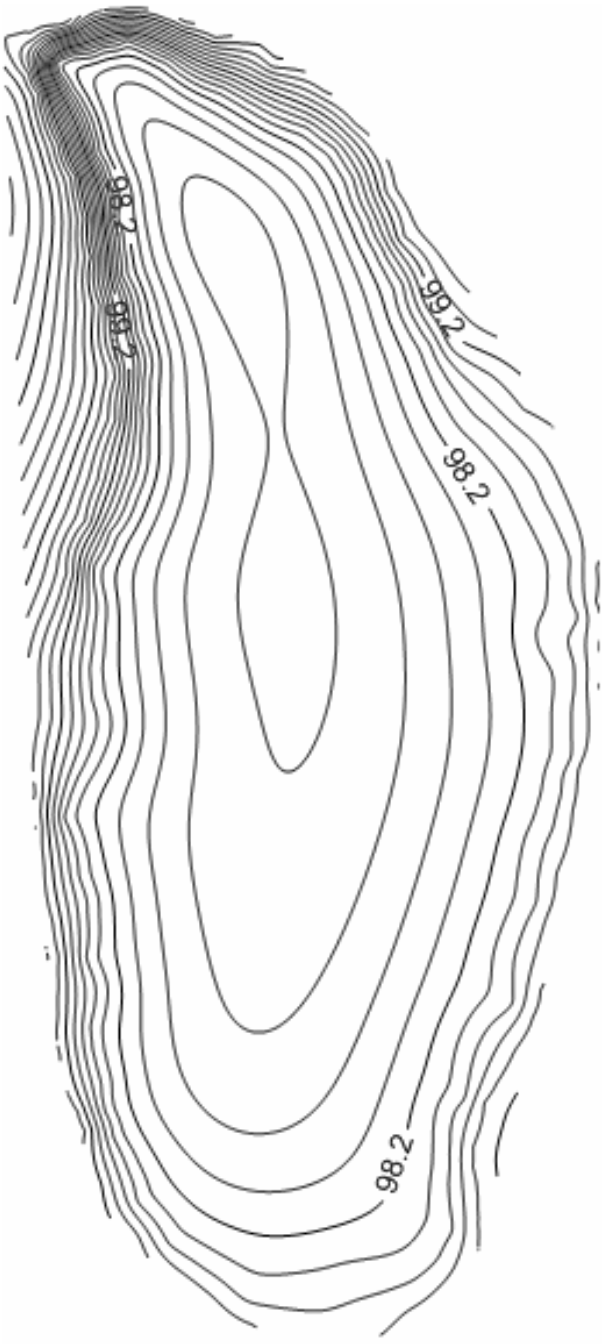
VERNAL POOL 4



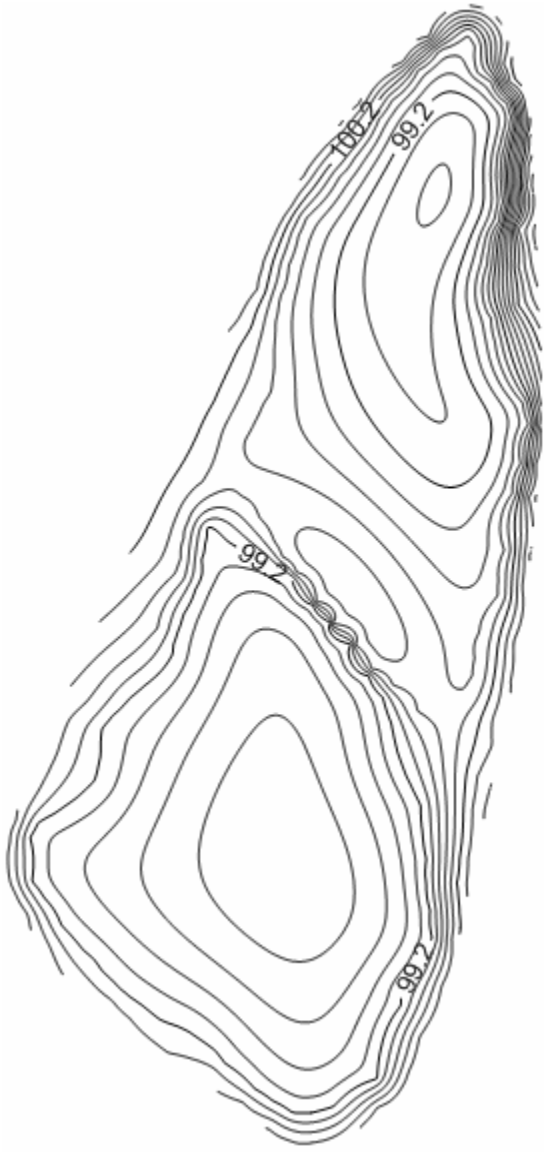
VERNAL POOL 5



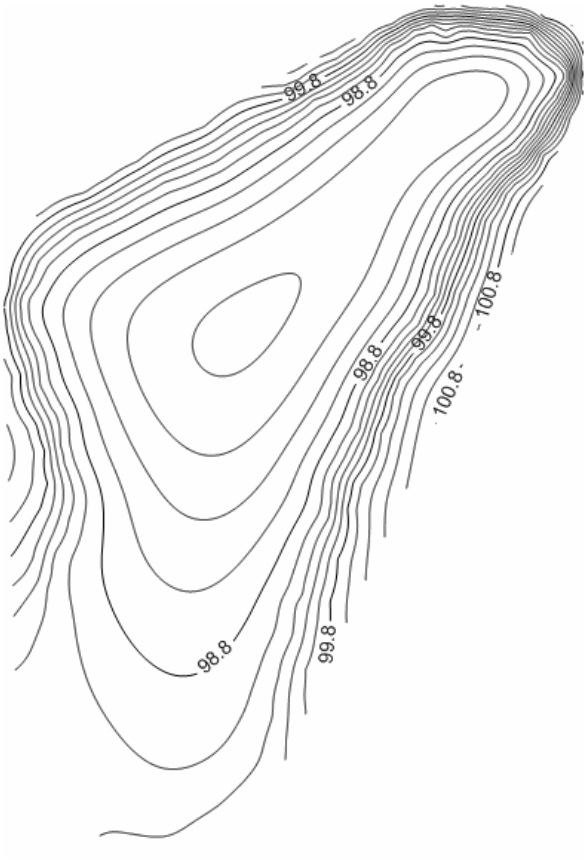
VERNAL POOL 6



VERNAL POOL 7



VERNAL POOL 8



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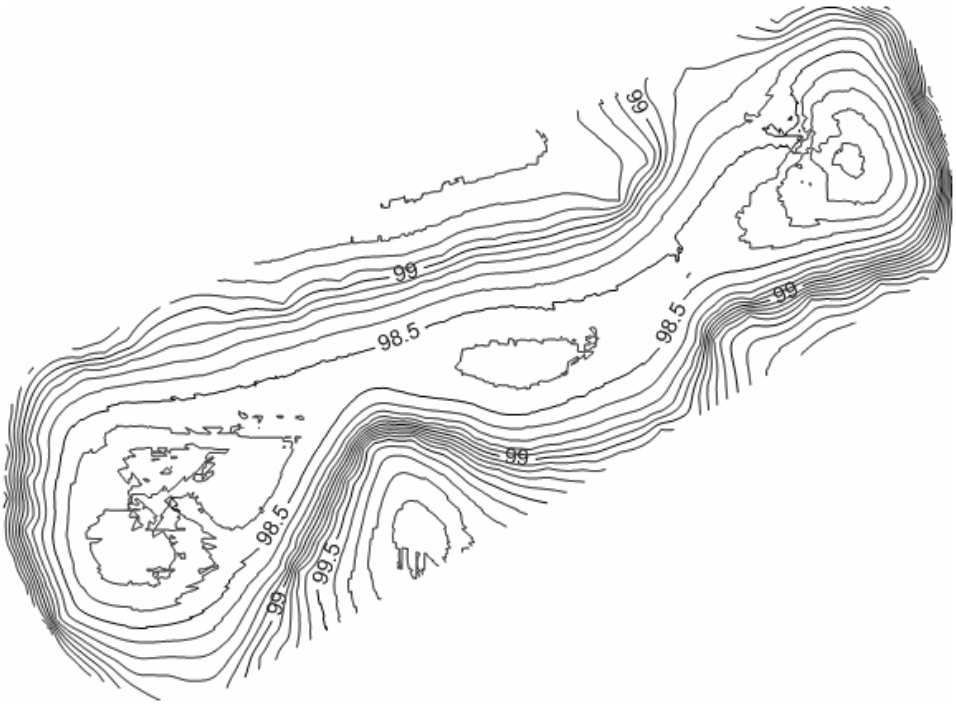

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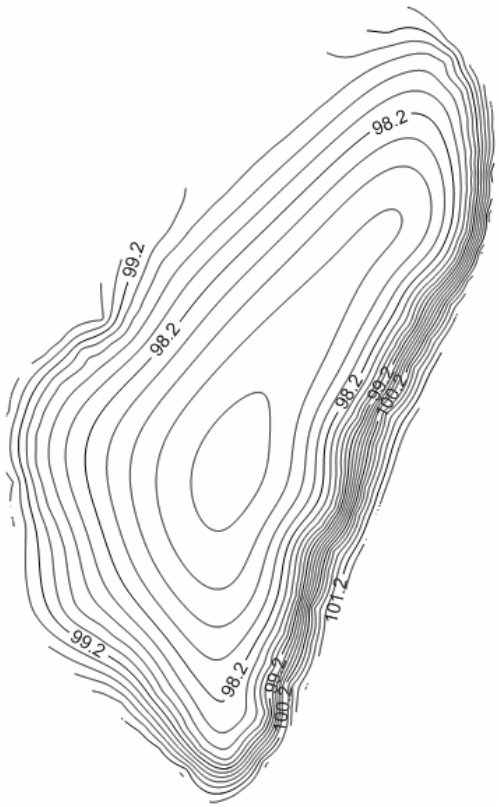

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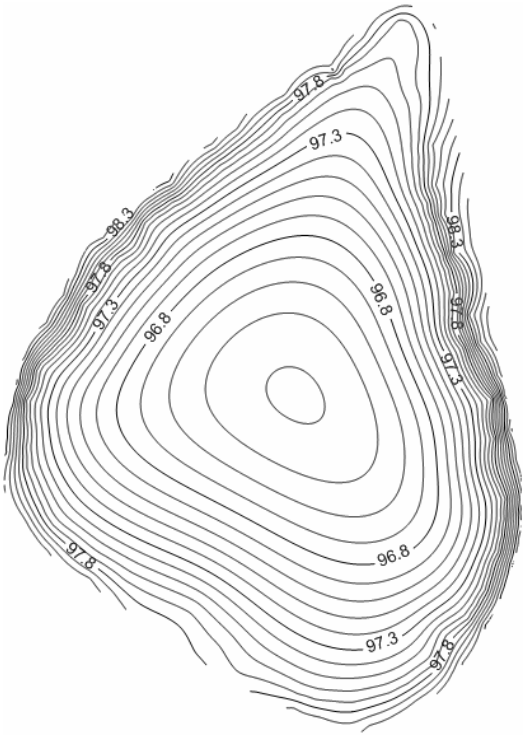

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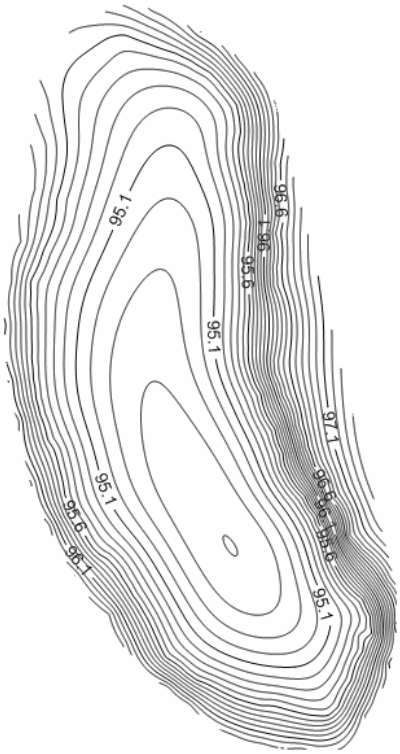

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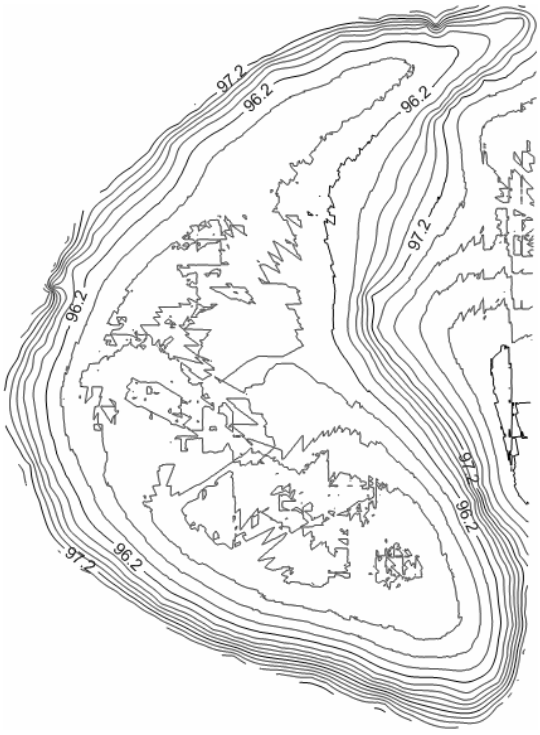

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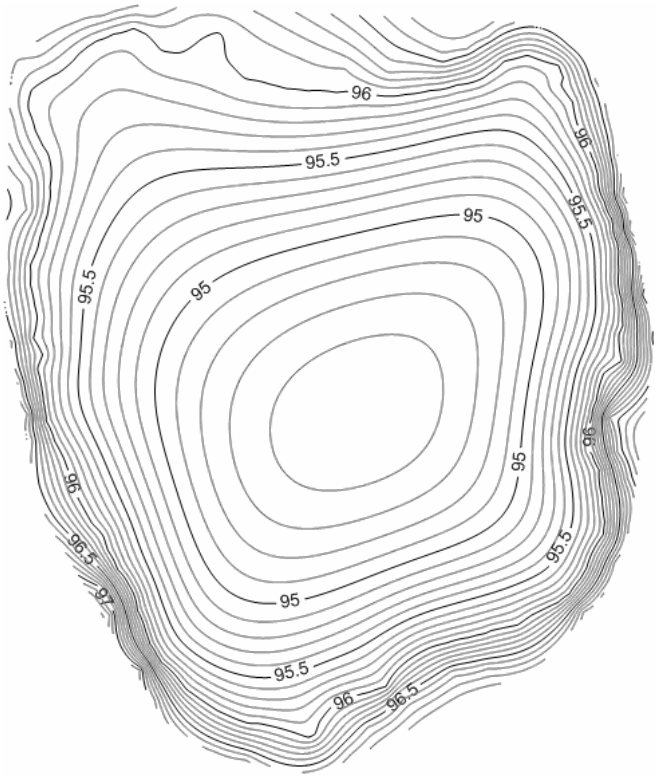

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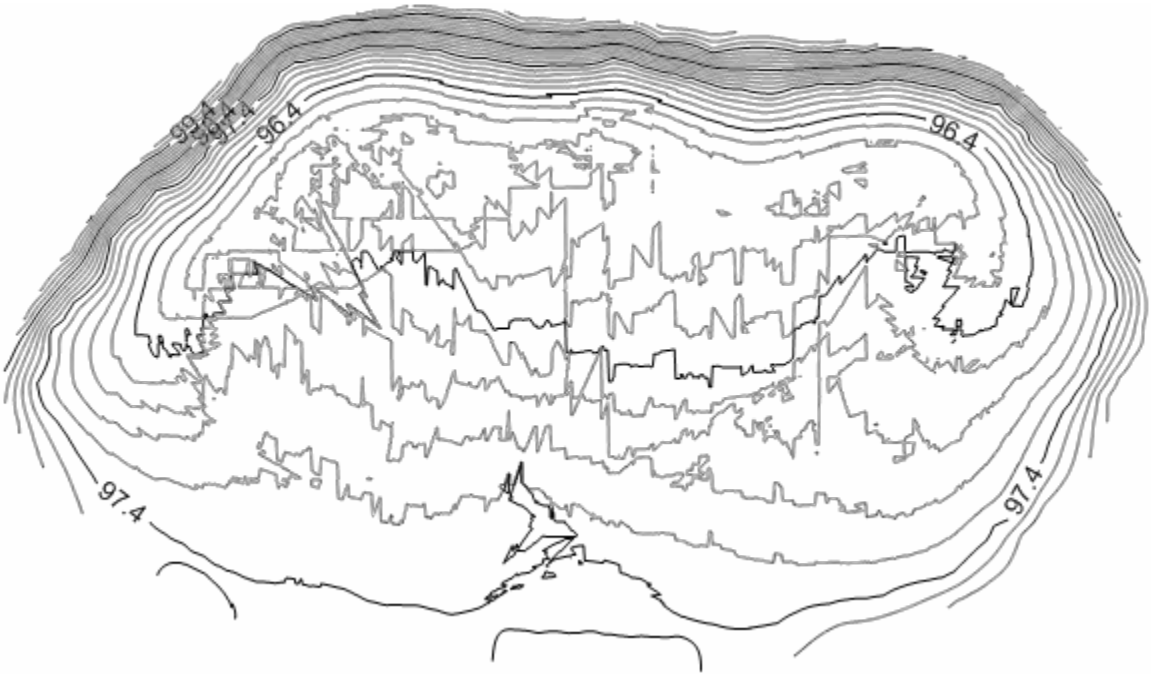

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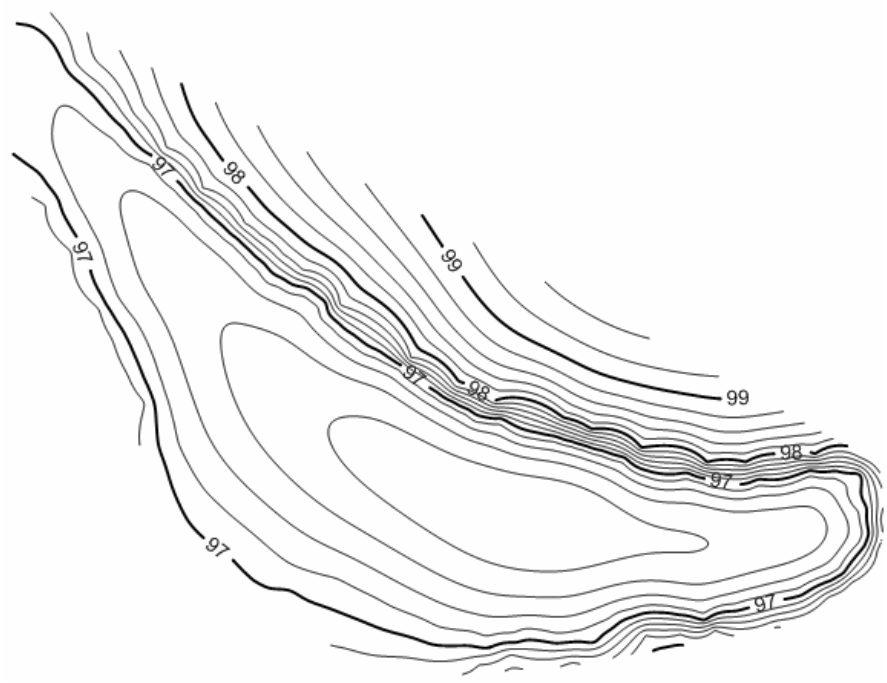

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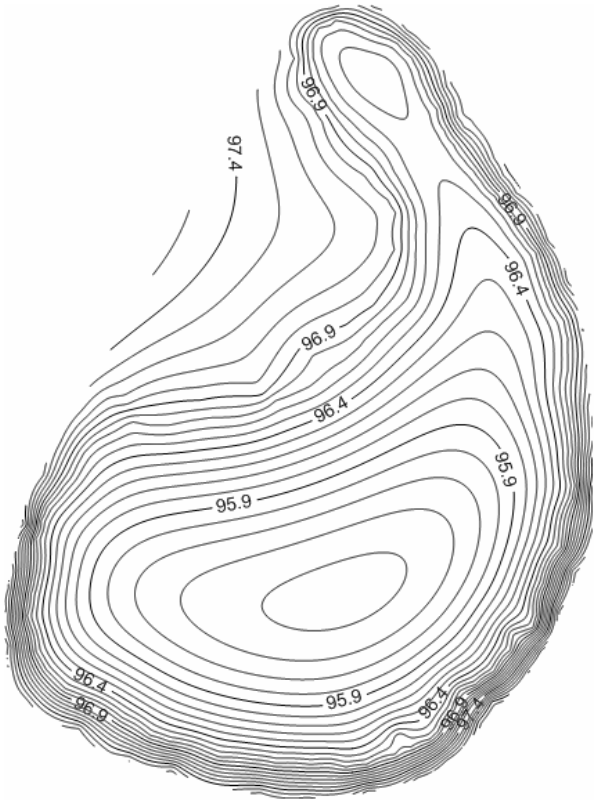

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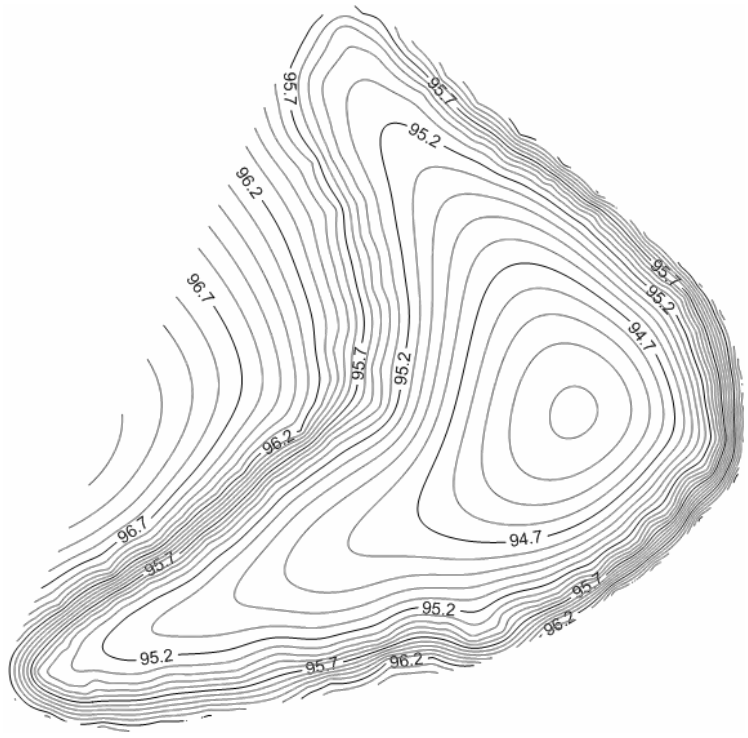

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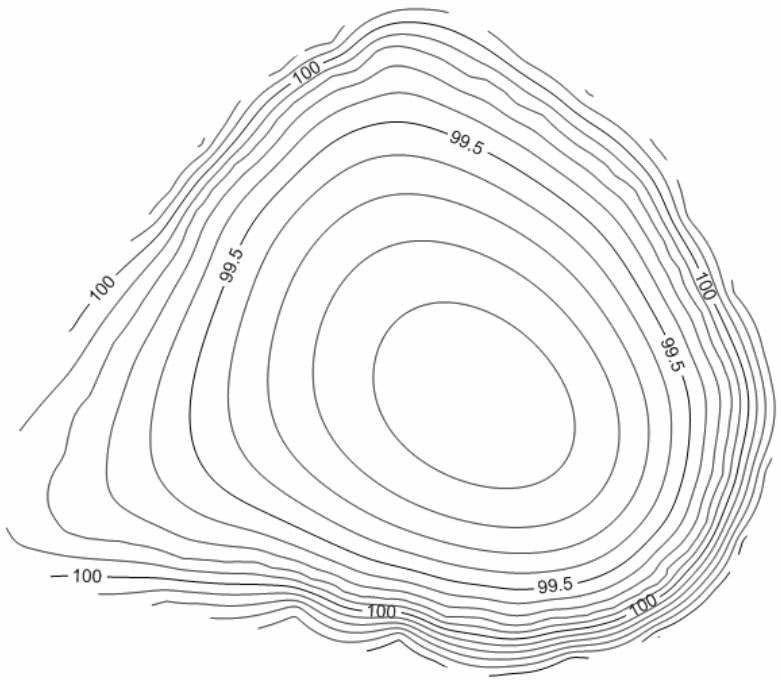

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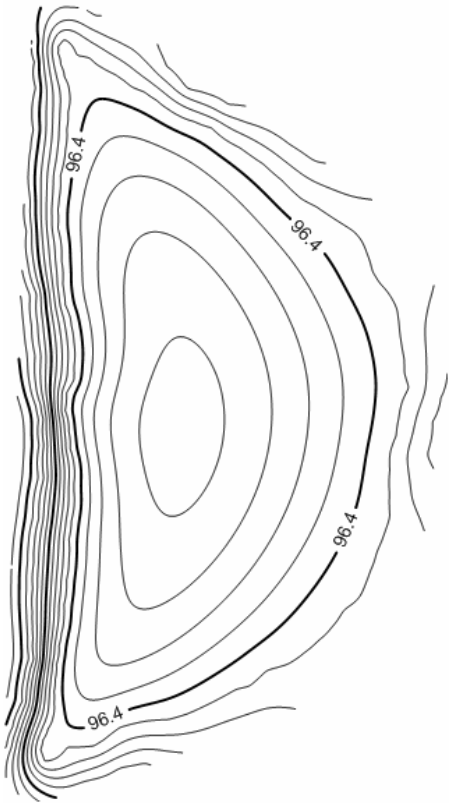

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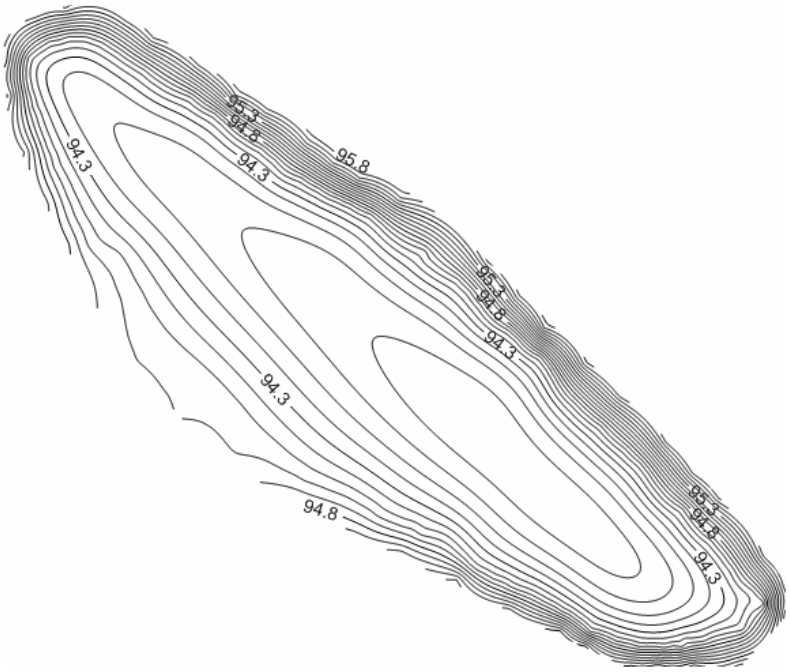

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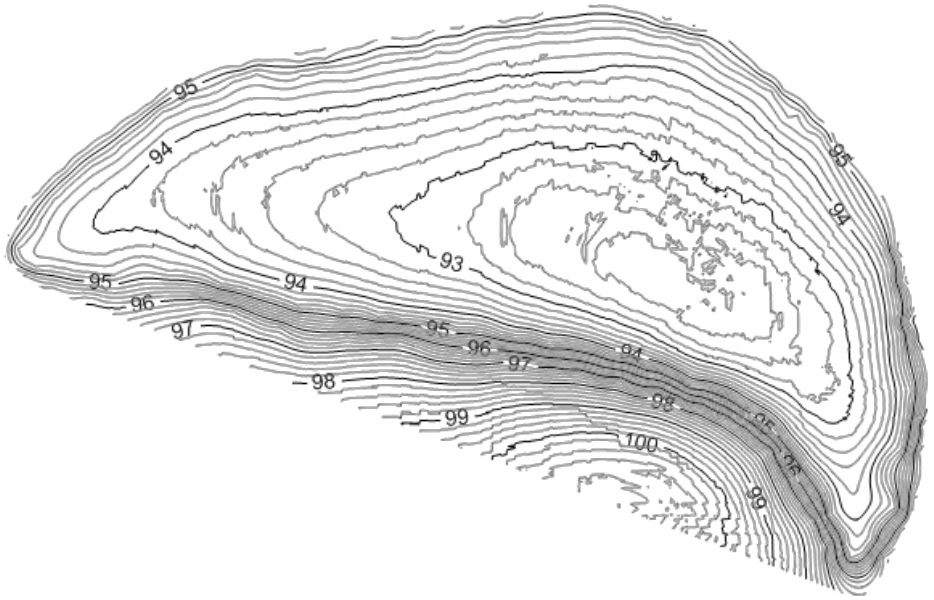

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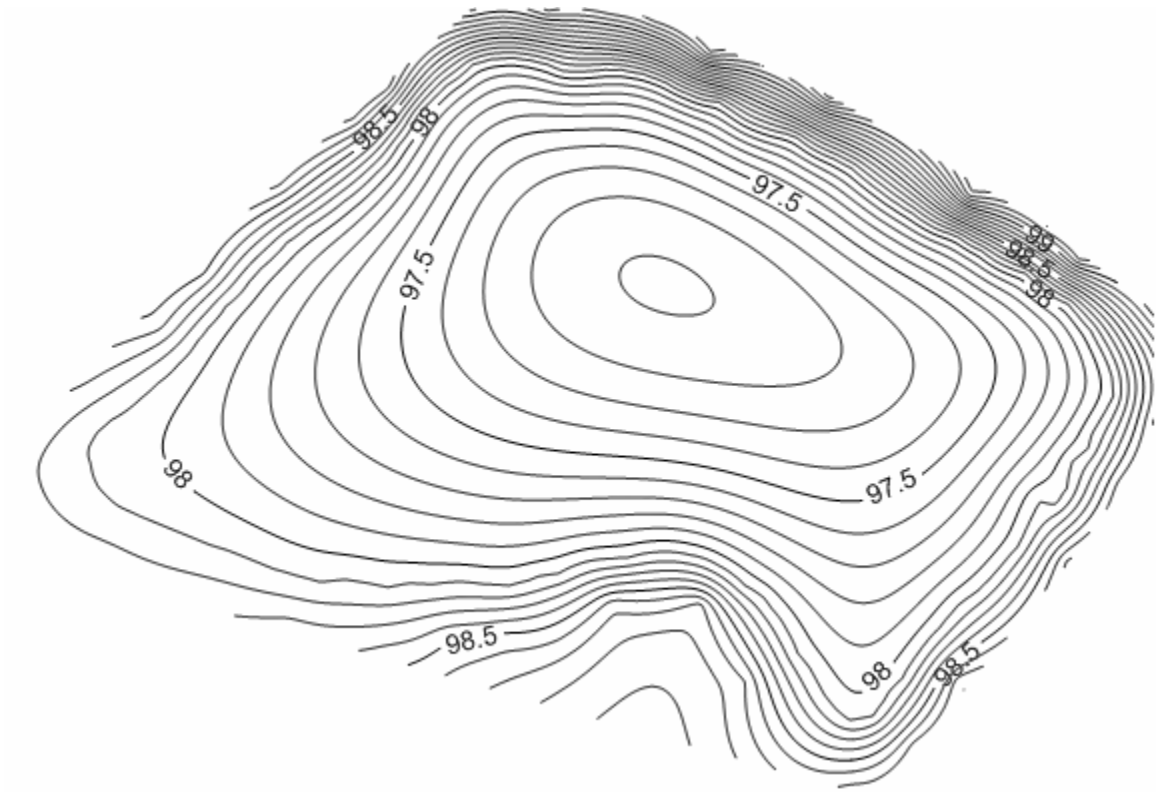

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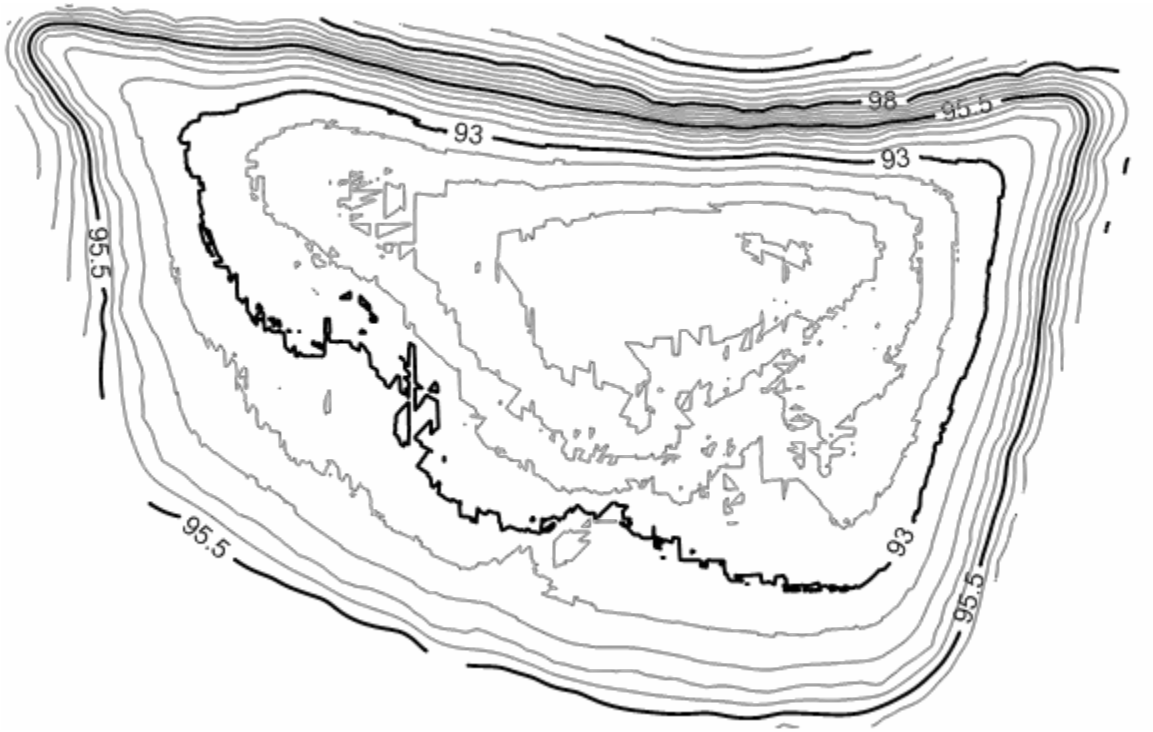

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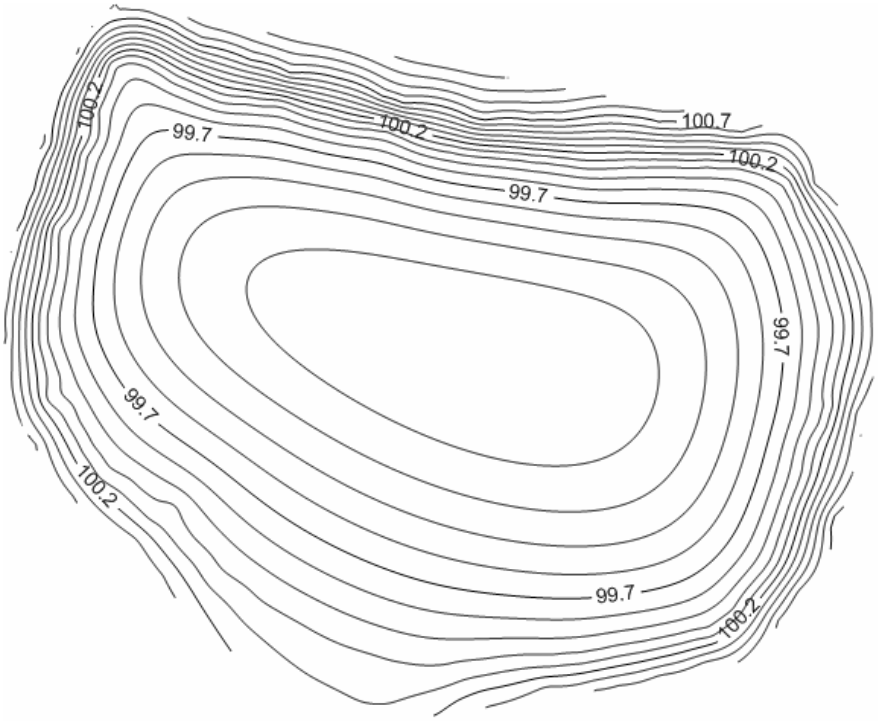

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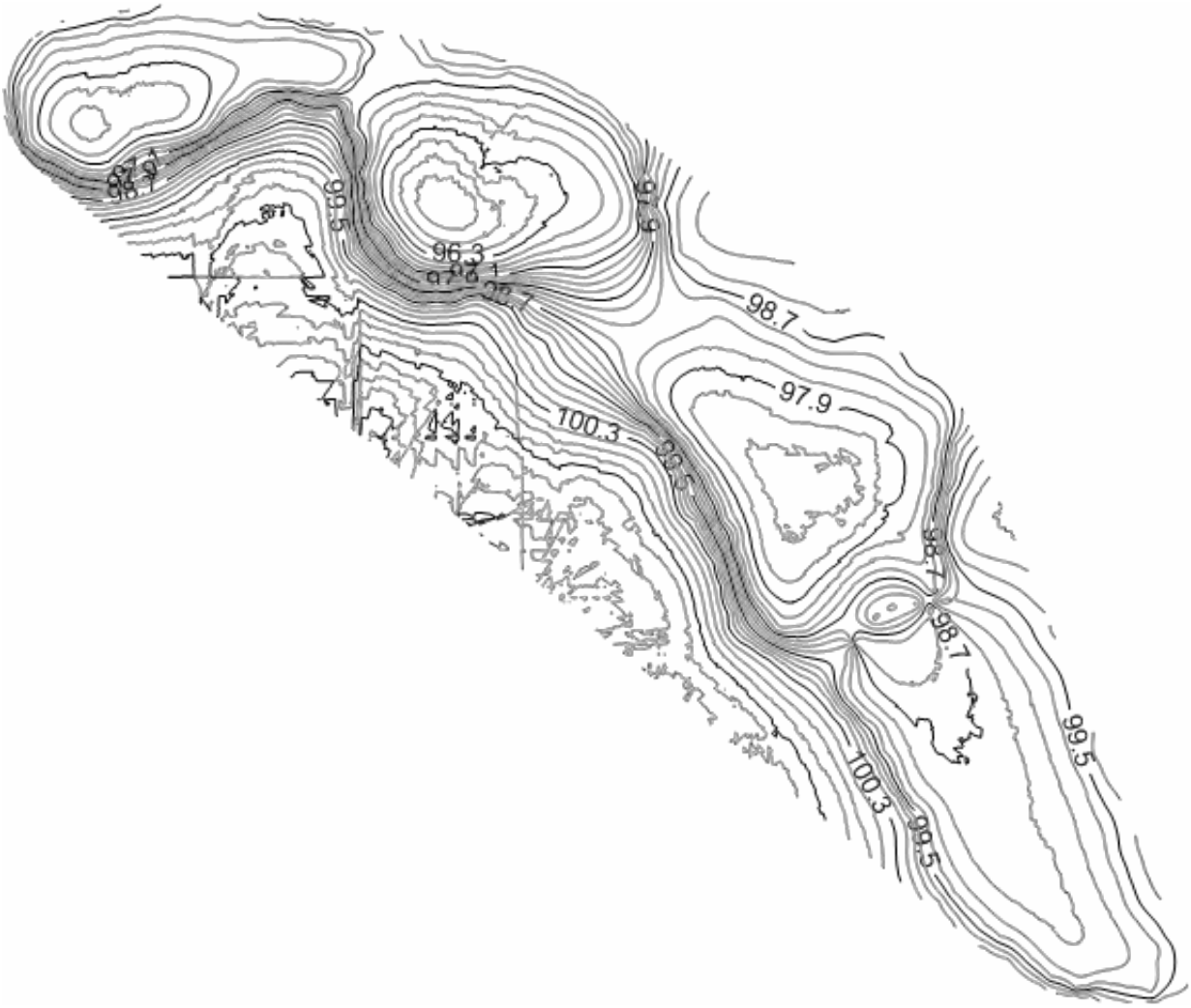
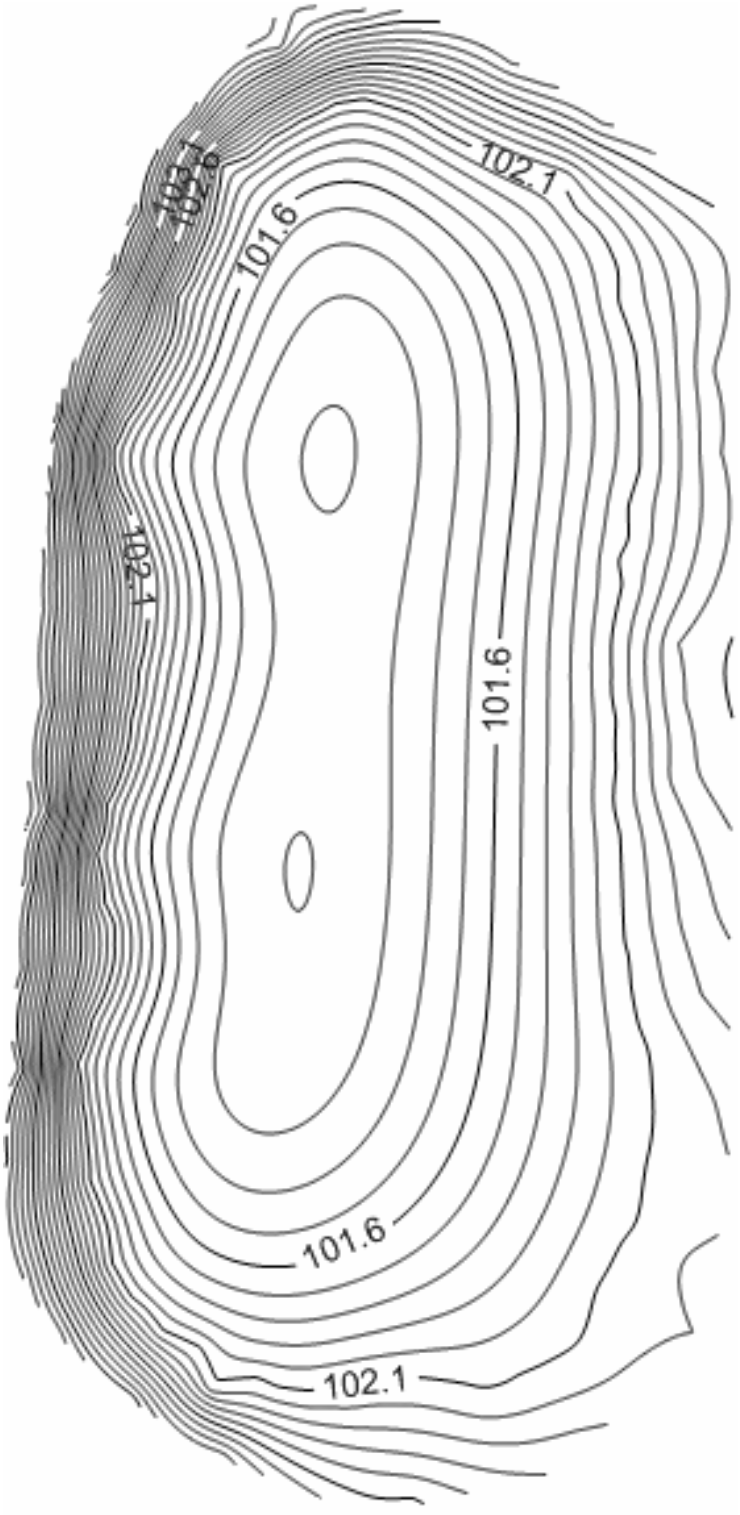


VERNAL POOL 27

VERNAL POOL 28



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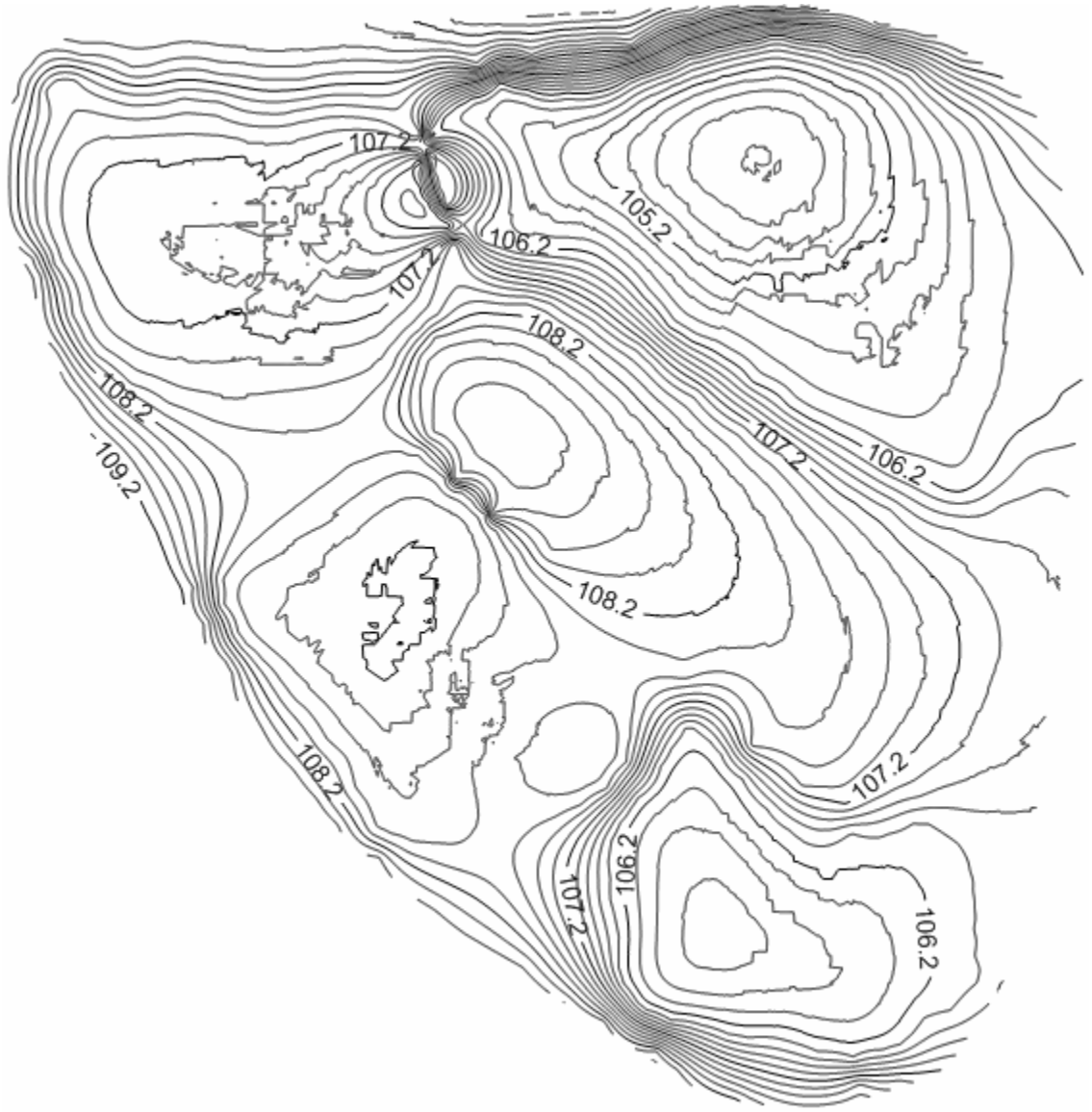

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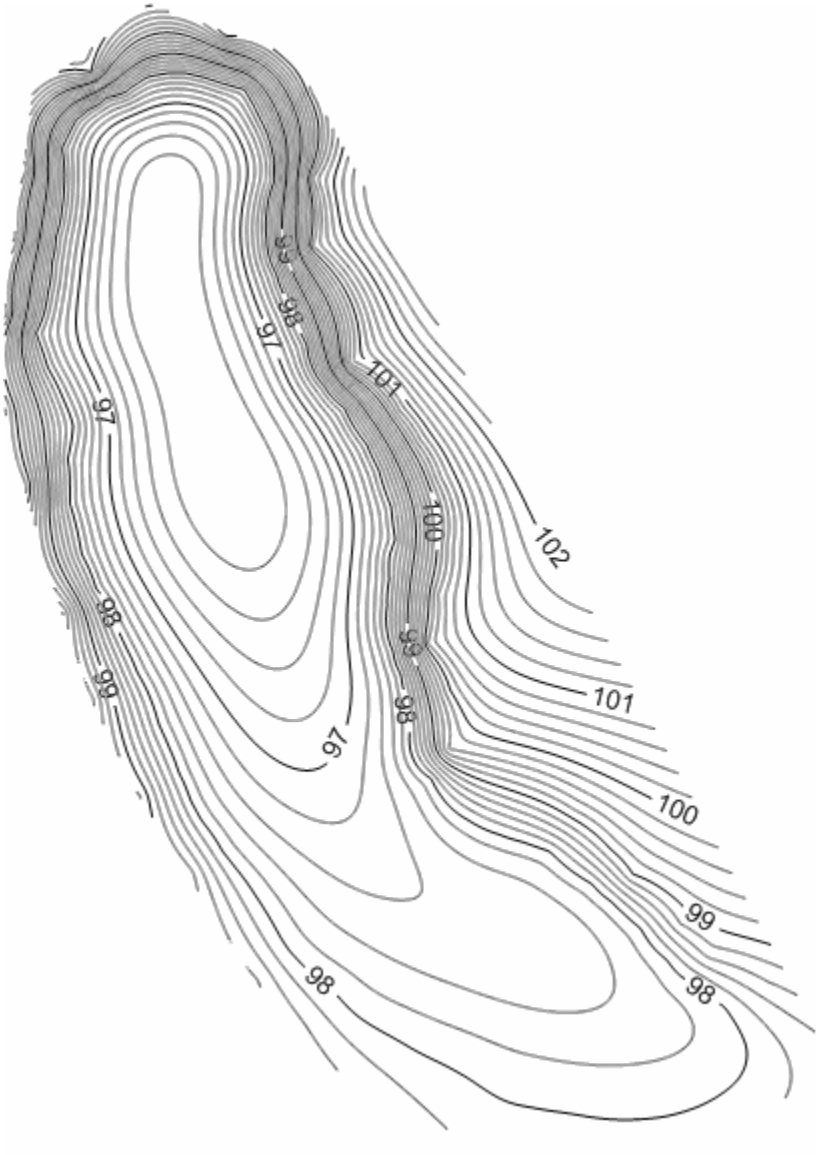

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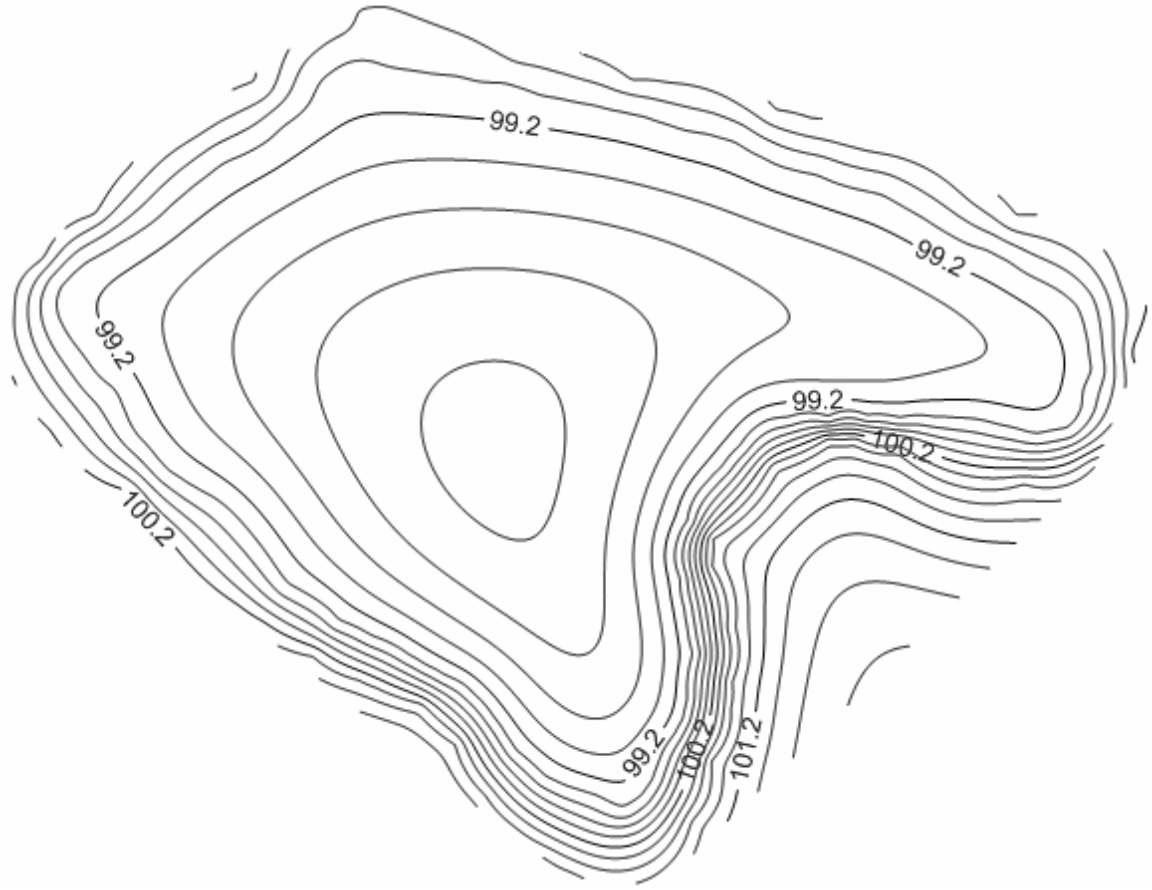

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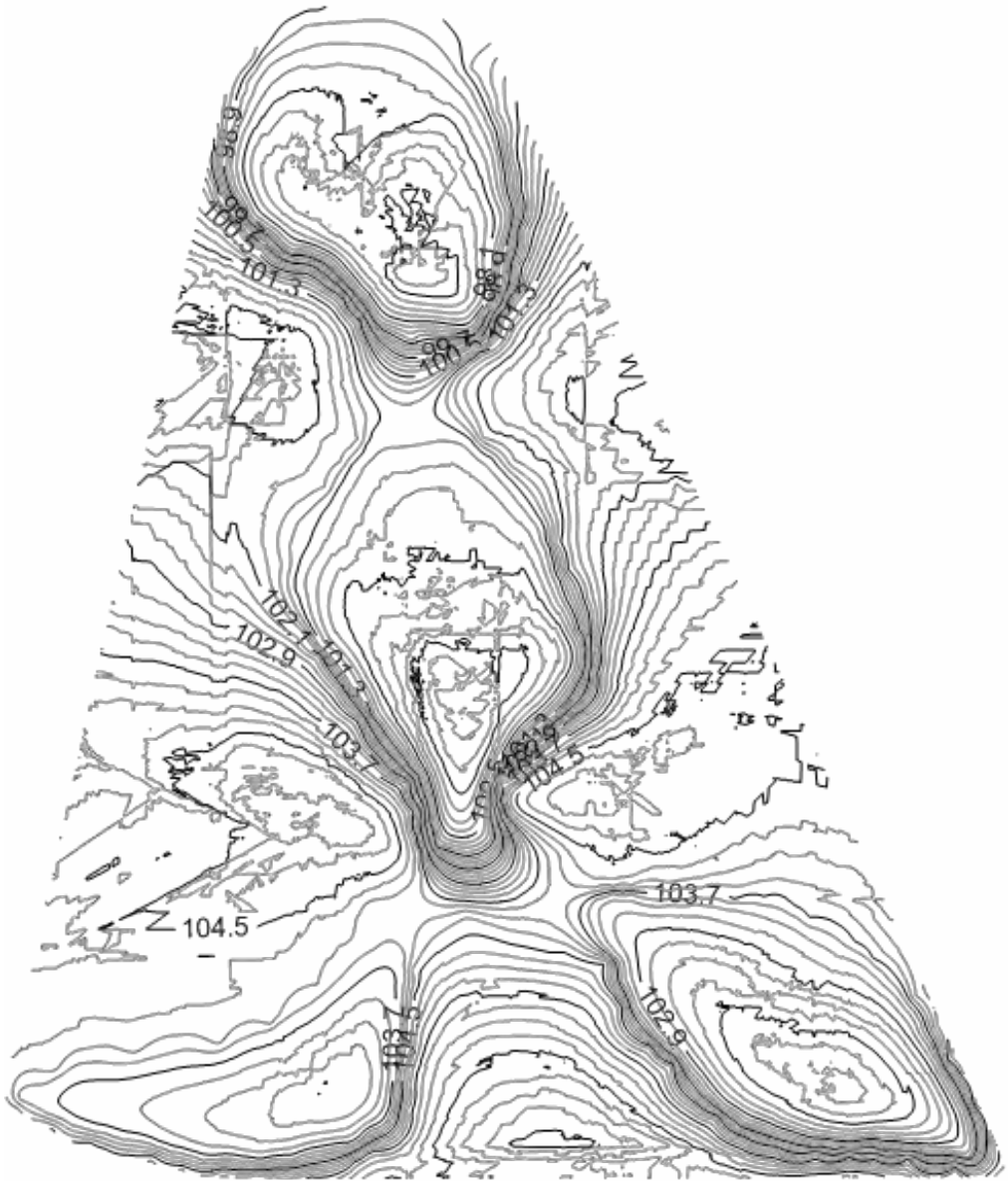

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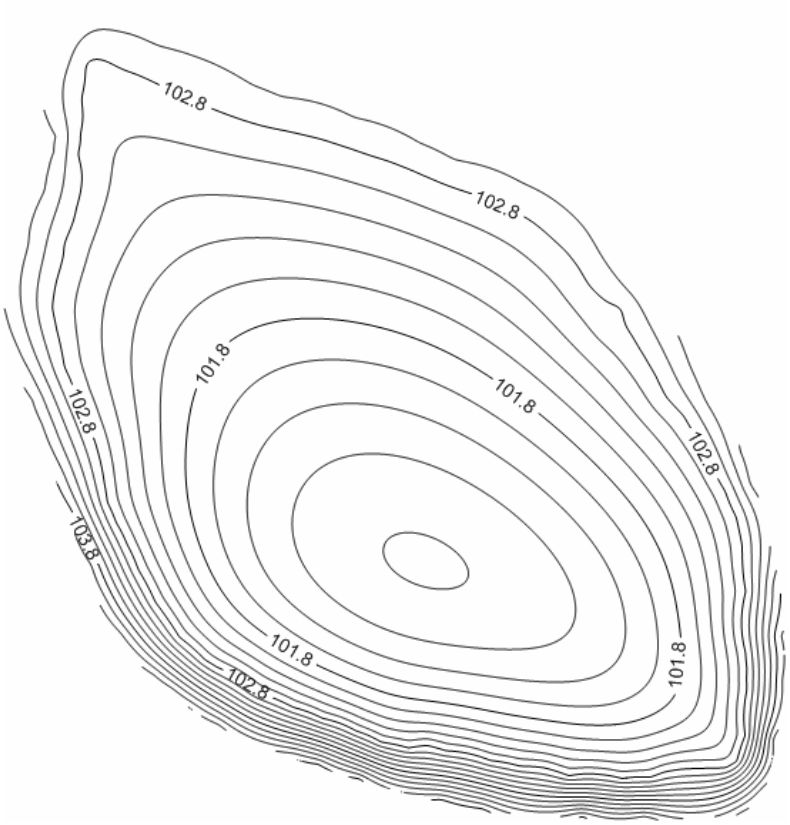

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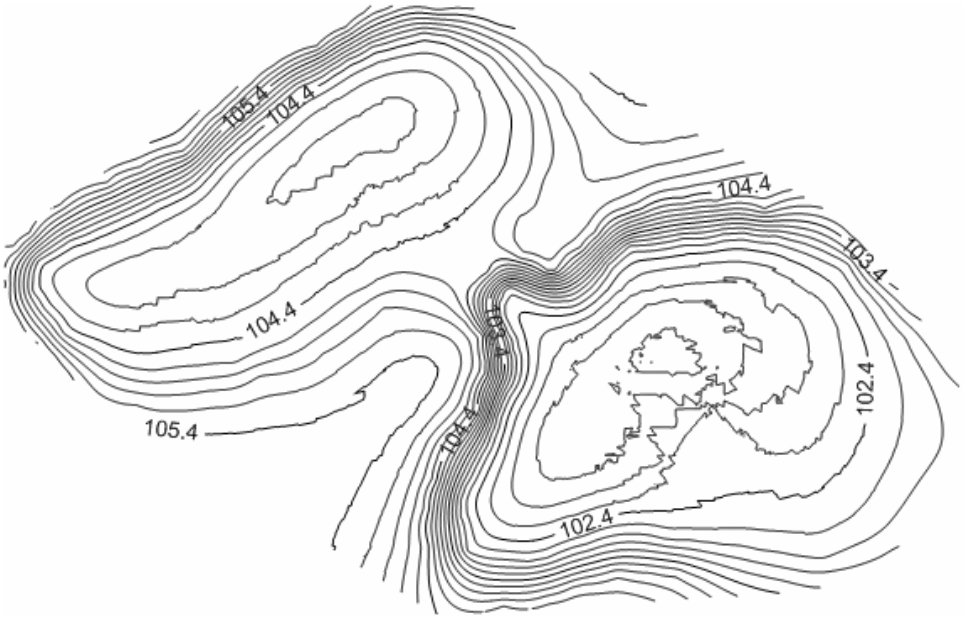

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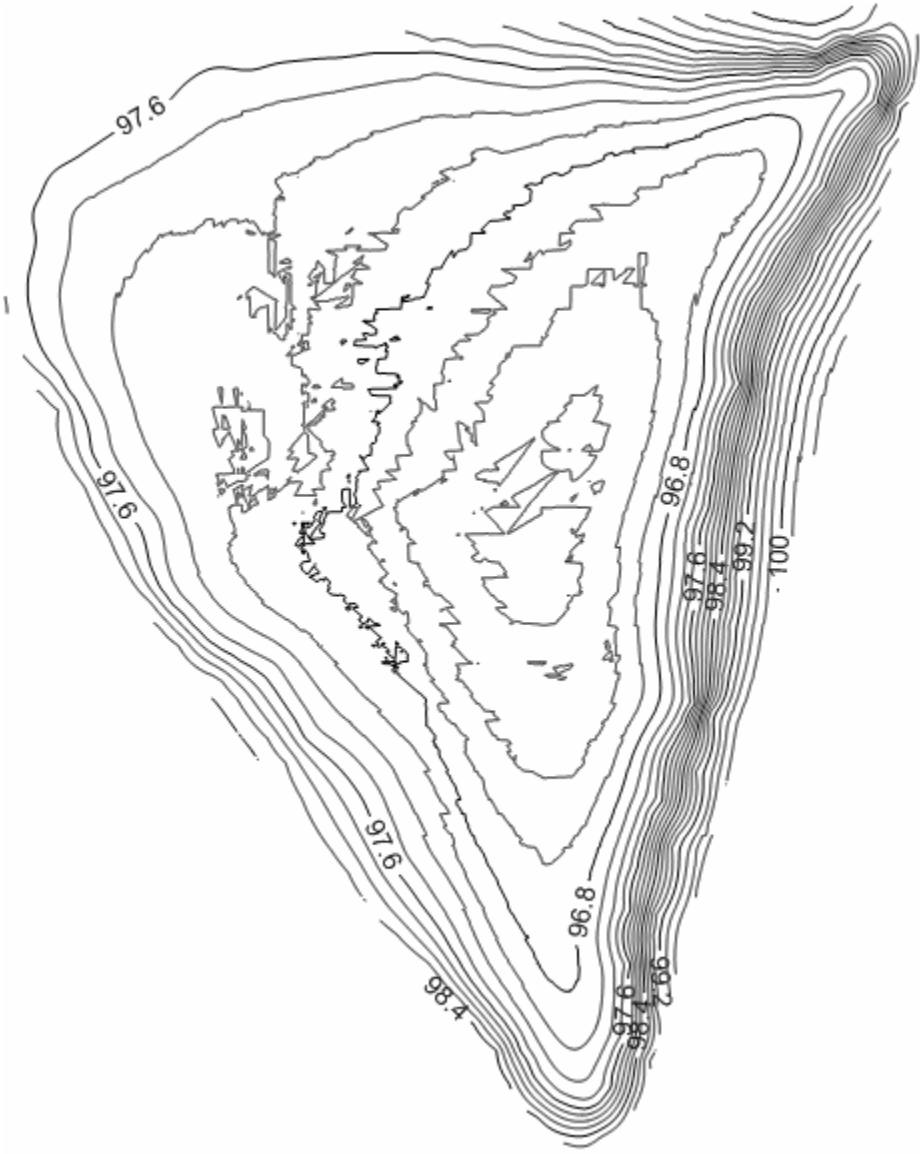

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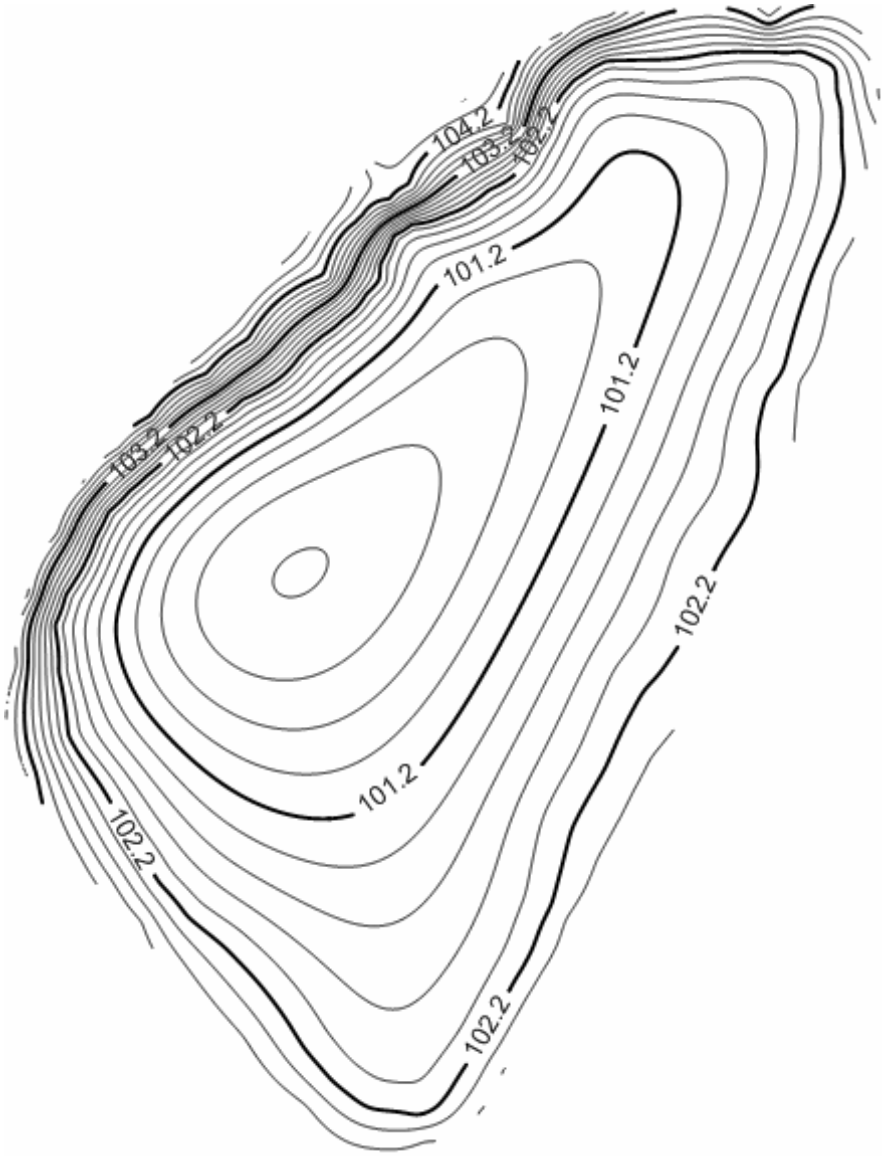

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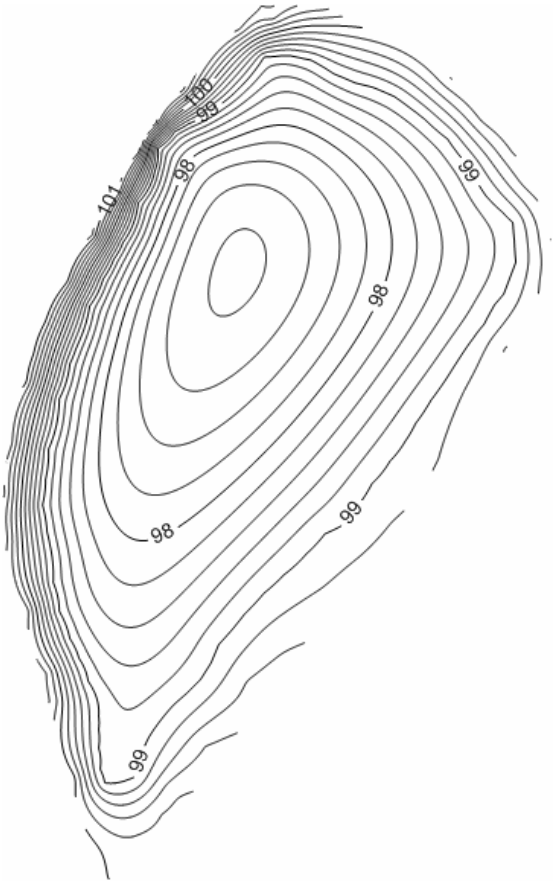

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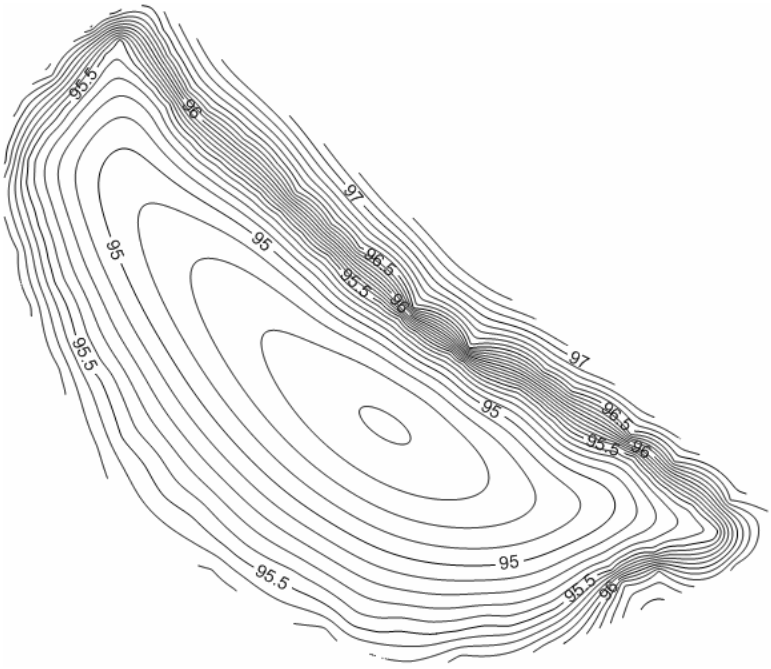

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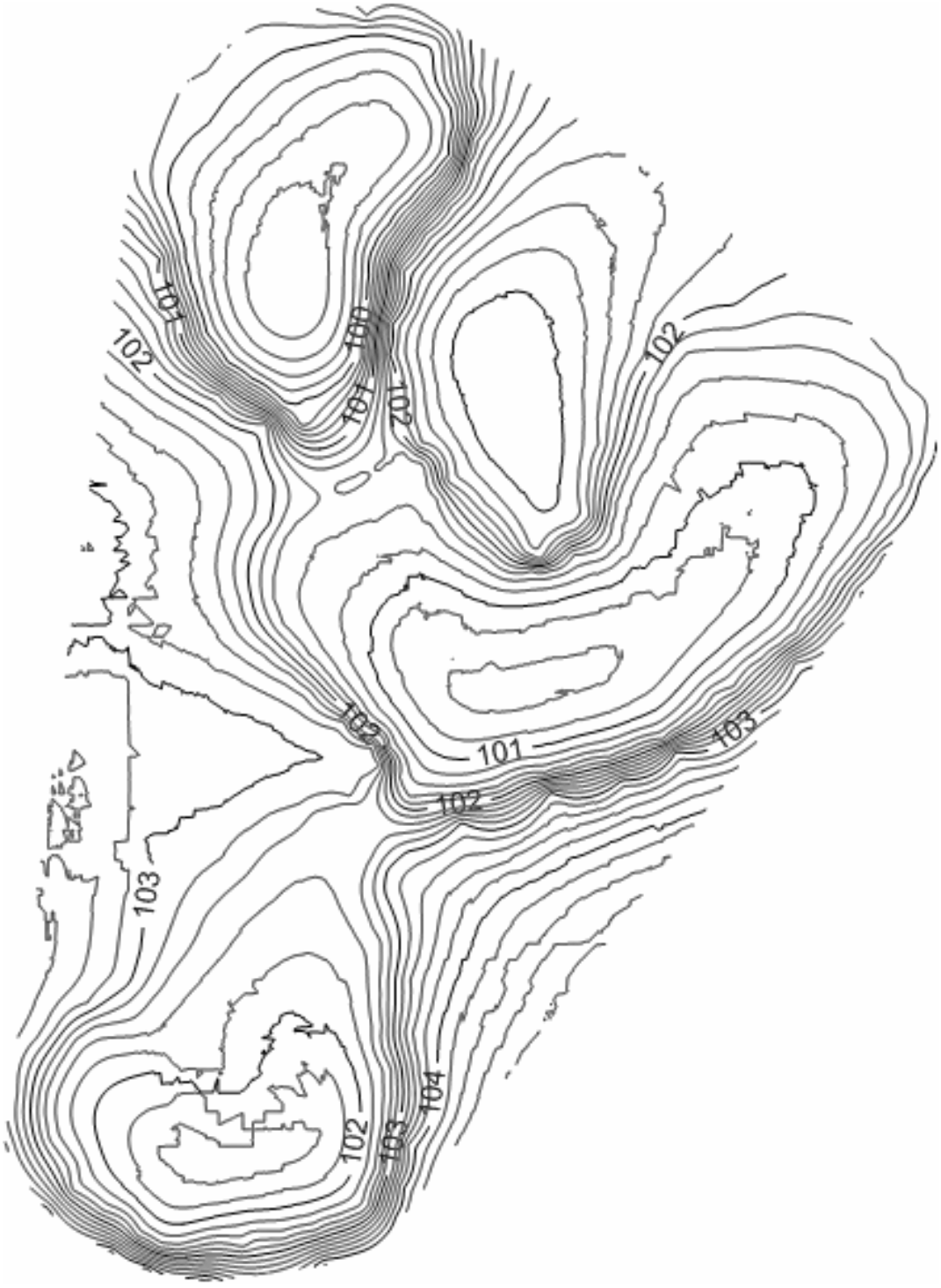


ATTACHMENT G

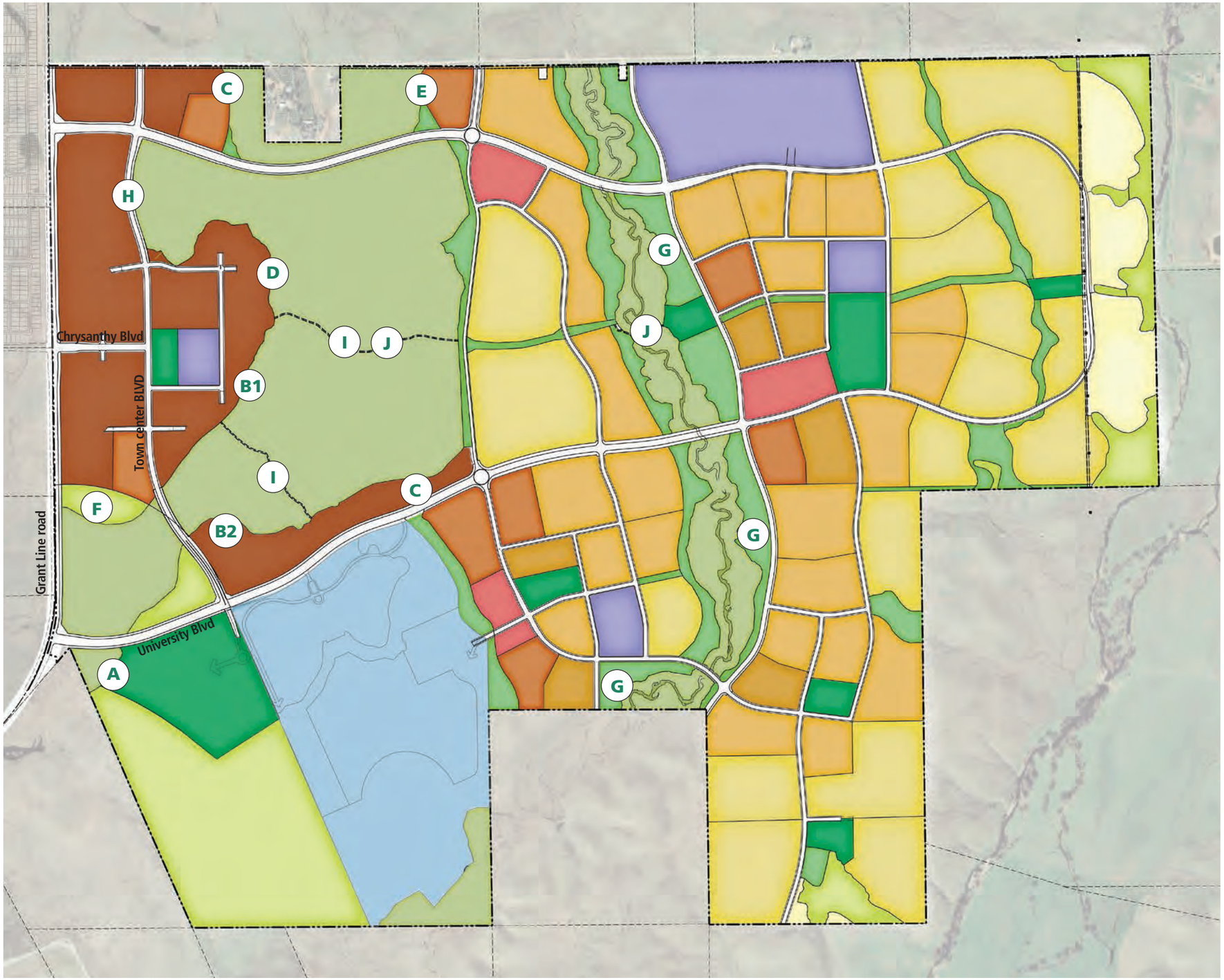
Cordova Hills Edge Conditions, 21 July 2014

404 Permit
July 21, 2014

ToC

or

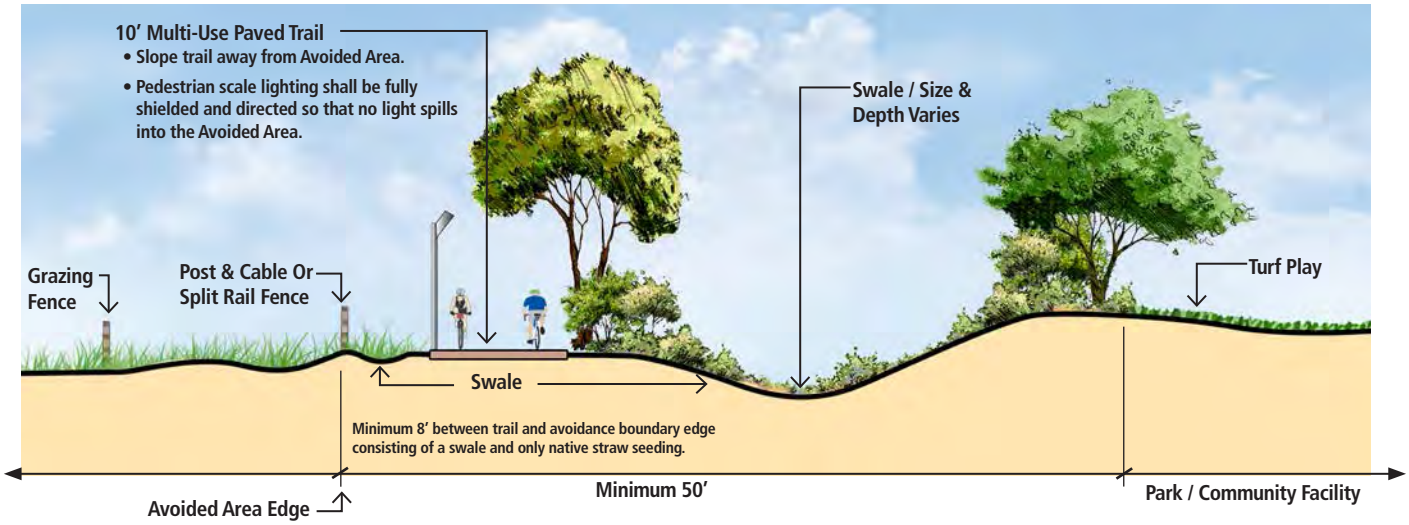
Cover Letter



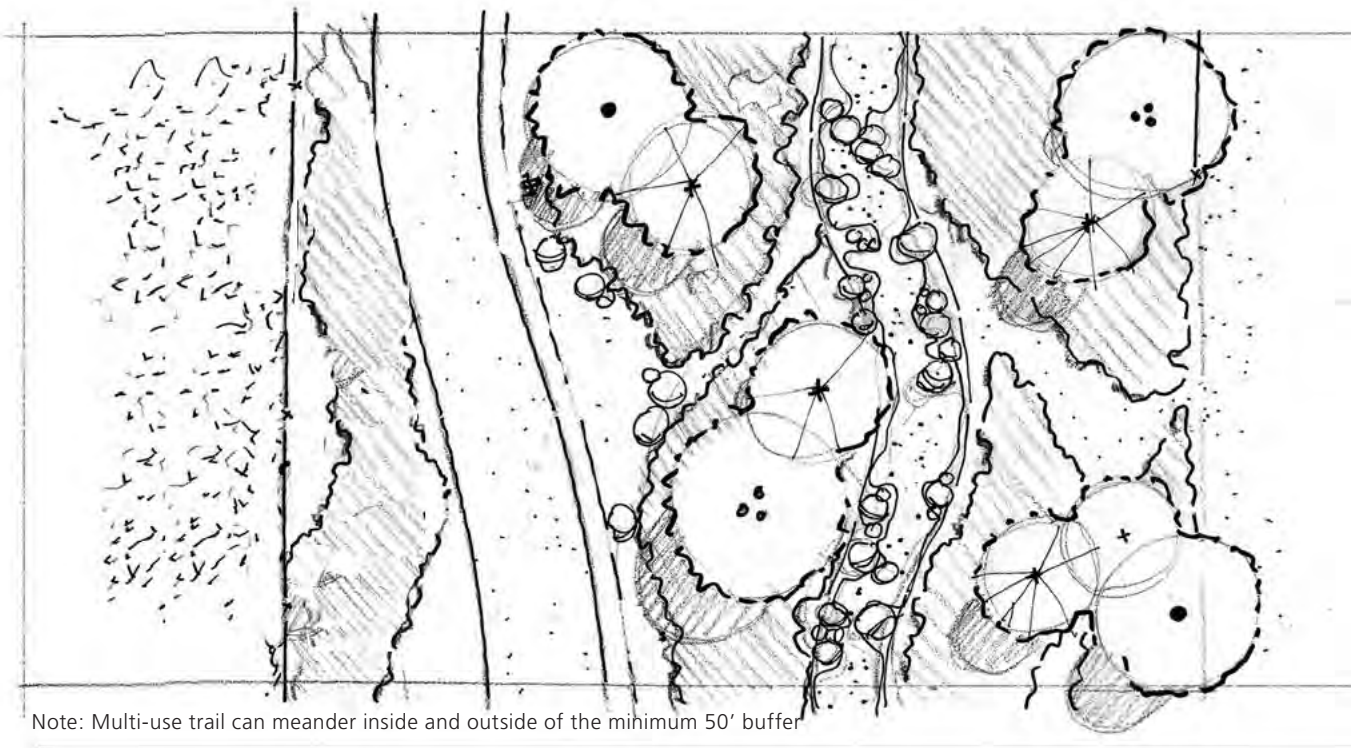
Conceptual Section and Vignette Location Map

Legend	
A	Park
B1	Mixed-Use
B2	Mixed-Use Common Space
C	Residential Side-On
D	Residential Front-On
E	Residential Back-On
F	Detention Basin
G	Paseo Central
H	Neighborhood Street / Arterial
I	Community Trail Through Avoided Area: At Grade
J	Community Trail Over Hydrological Connections (elevated)

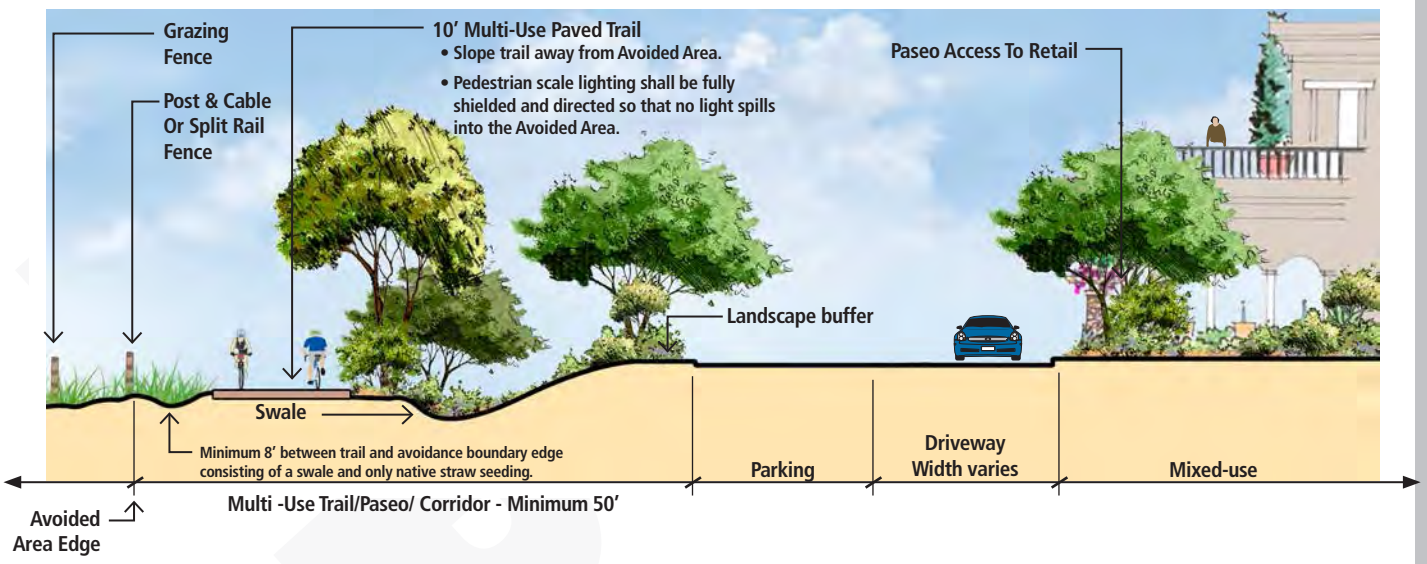
Note: Lettered Marker locations indicate potential locations in a generalized manner.



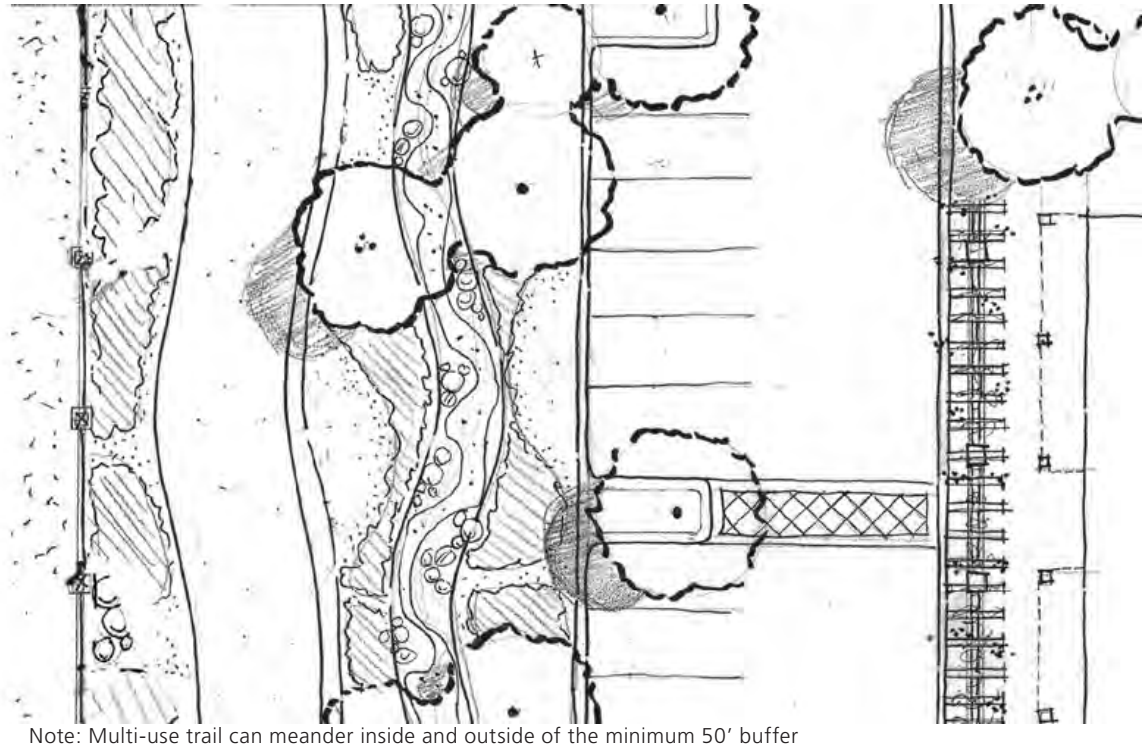
Edge Condition "A" Section
Sports Park



Edge Condition "A" Vignette
Sports Park

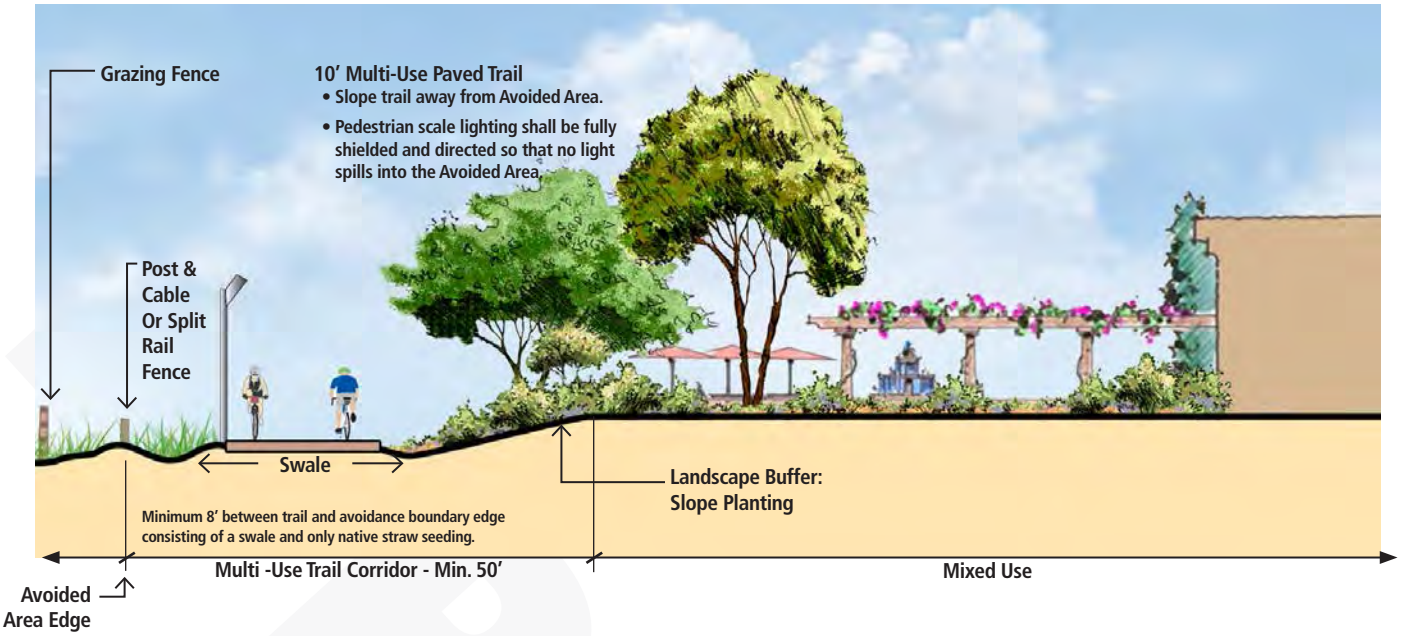


Edge Condition "B1" Section
Retail / Mixed Use

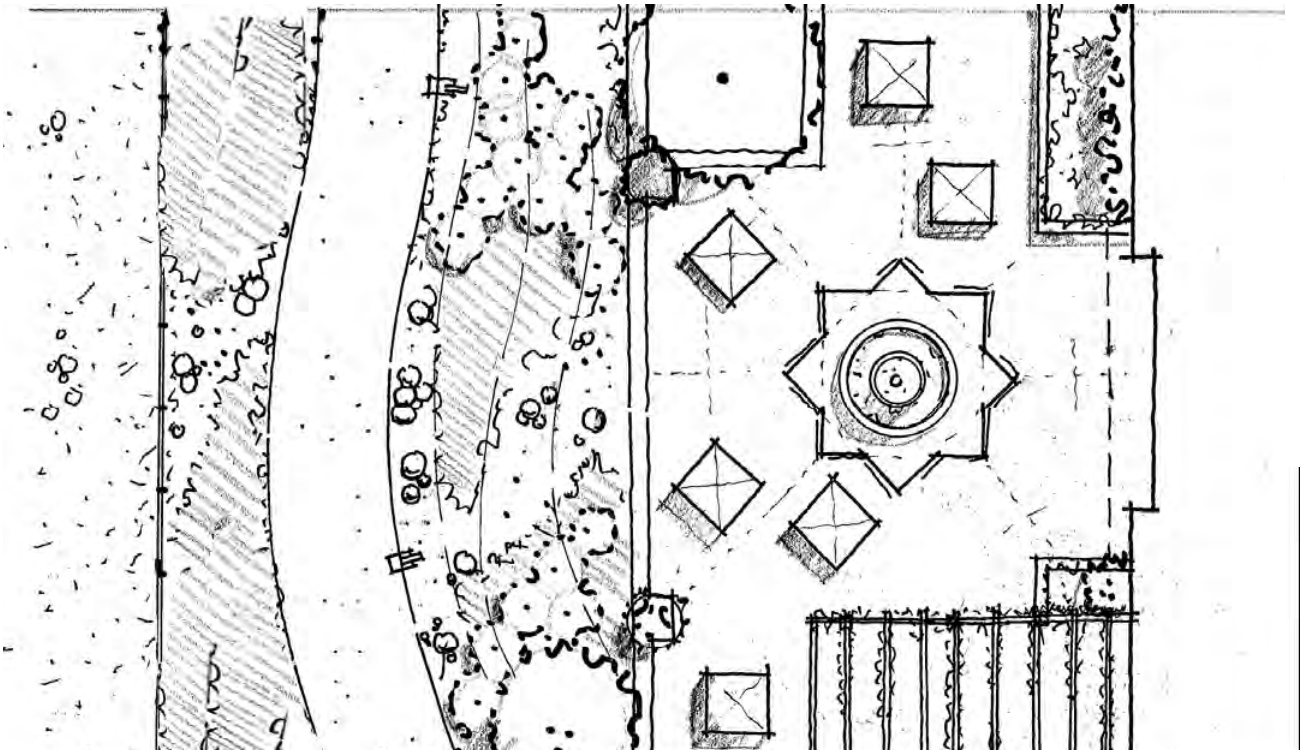


Note: Multi-use trail can meander inside and outside of the minimum 50' buffer

Edge Condition "B1" Vignette
Retail / Mixed Use

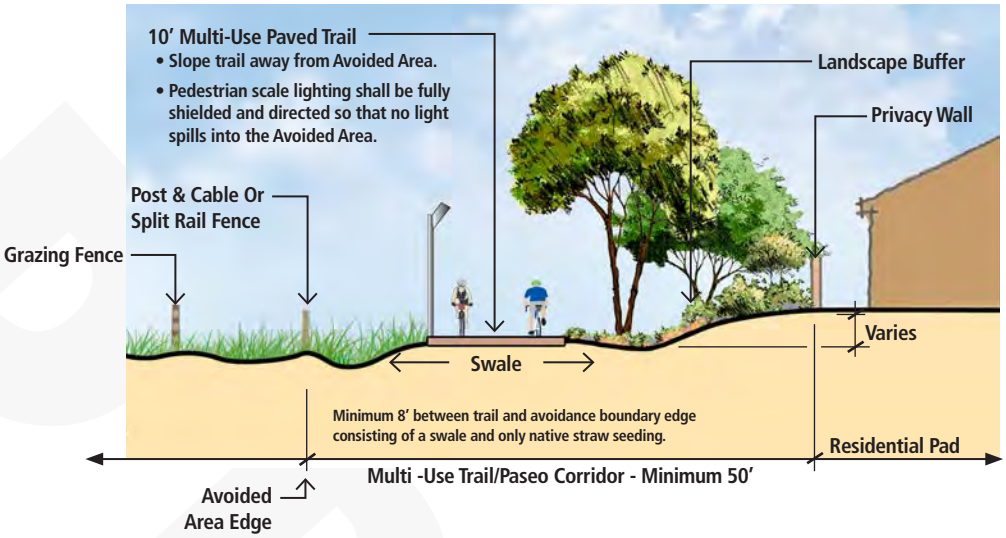


Edge Condition "B2" Section
Retail / Mixed Use Common Space



Note: Multi-use trail can meander inside and outside of the minimum 50' buffer

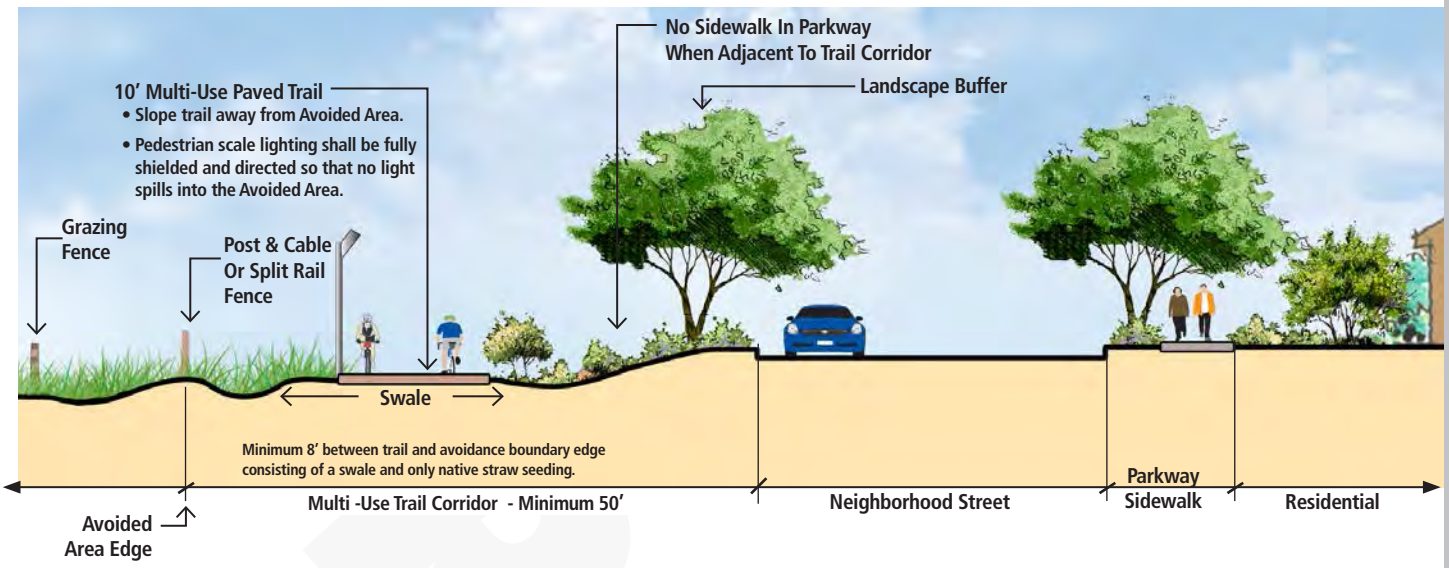
Edge Condition "B2" Vignette
Retail / Mixed Use Common Space



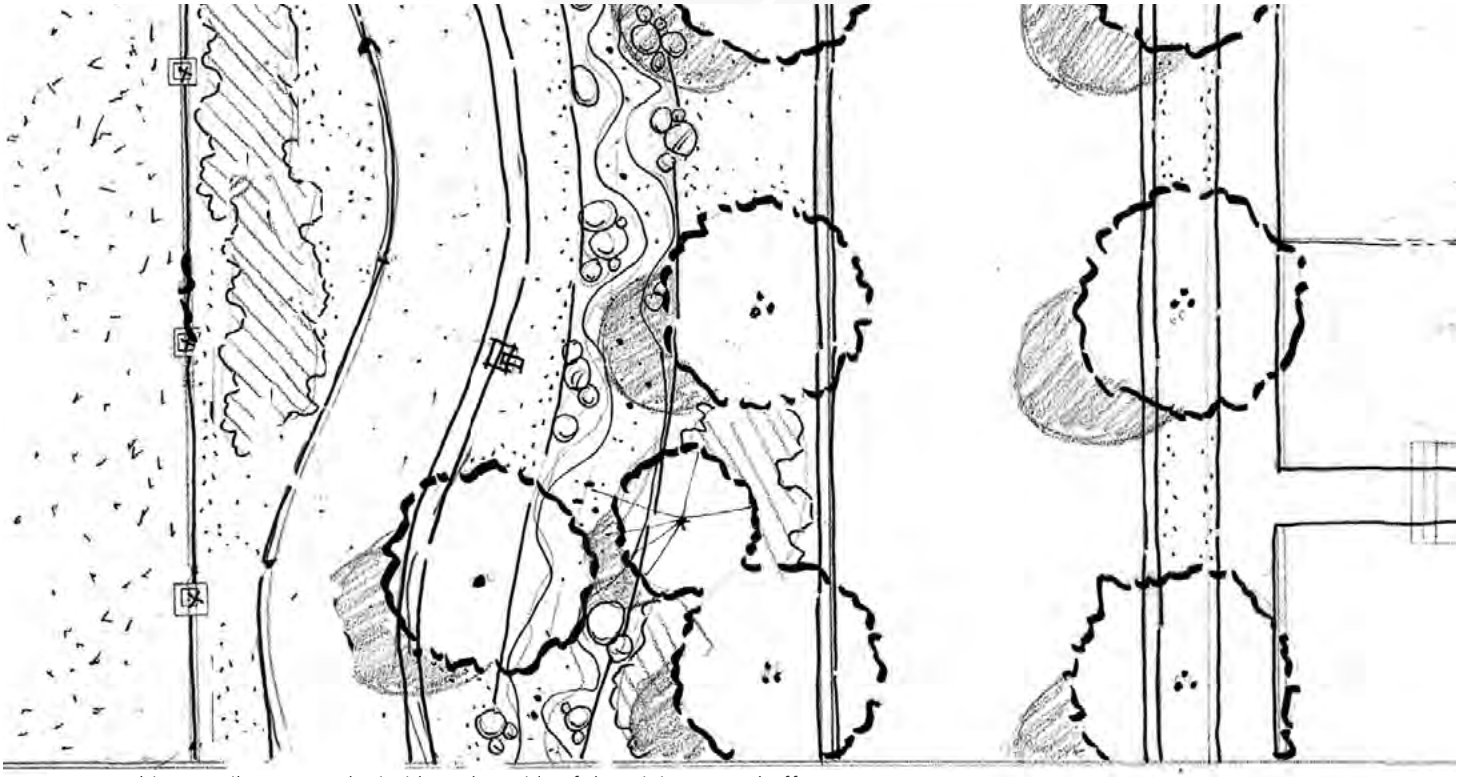
Edge Condition "C" Section
Residential Side-On

Note: Multi-use trail can meander inside and outside of the minimum 50' buffer

Edge Condition "C" Vignette
Residential Side-On

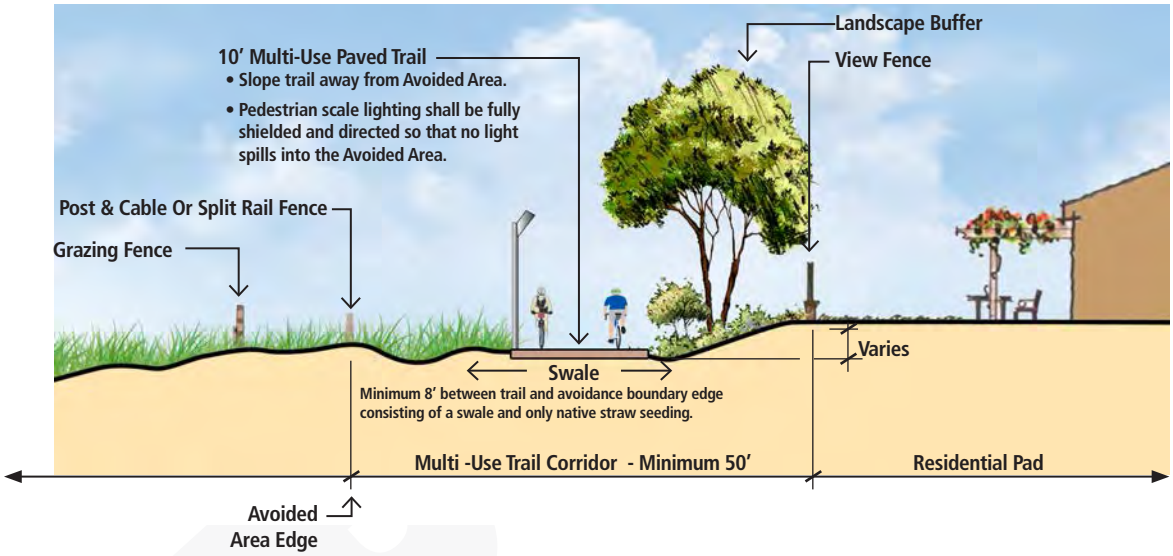


Edge Condition "D" Section
Residential Front-On With Street



Note: Multi-use trail can meander inside and outside of the minimum 50' buffer

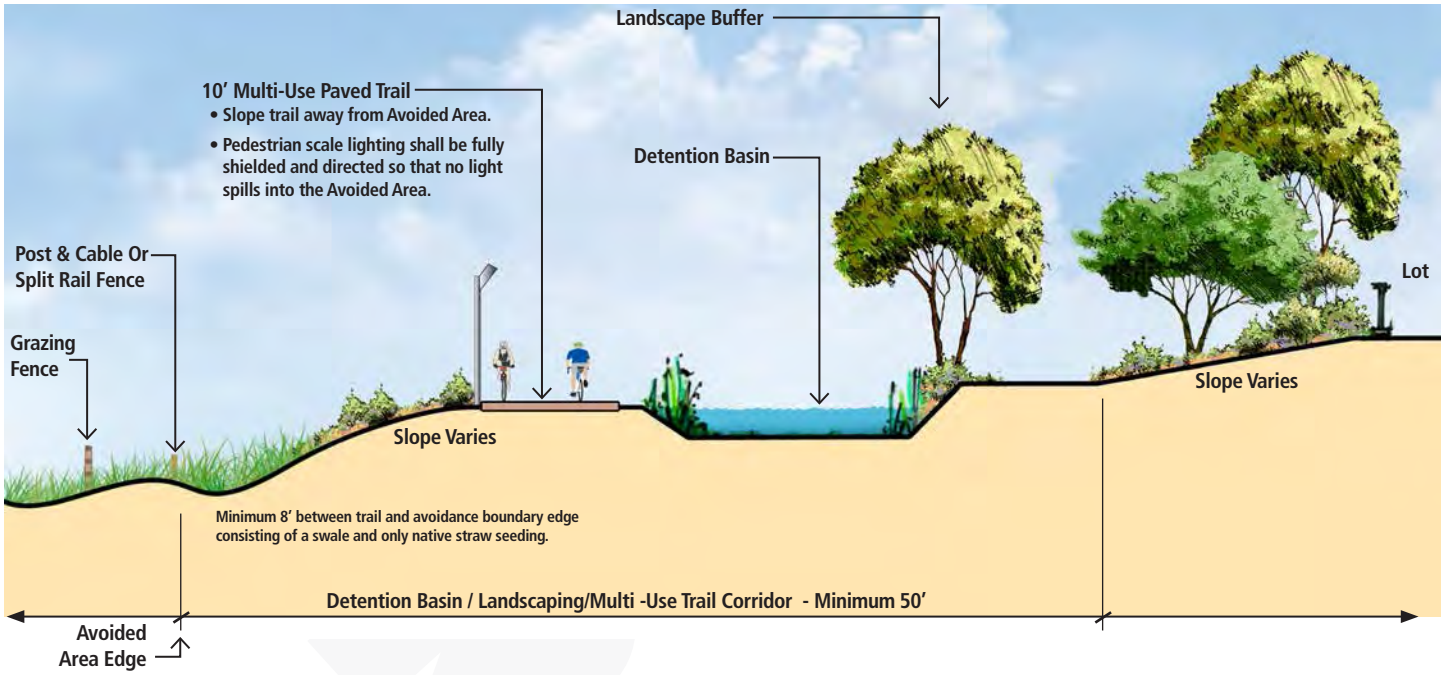
Edge Condition "D" Vignette
Residential Front-On With Street



Edge Condition "E" Section
Residential Back-On

Note: Multi-use trail can meander inside and outside of the minimum 50' buffer

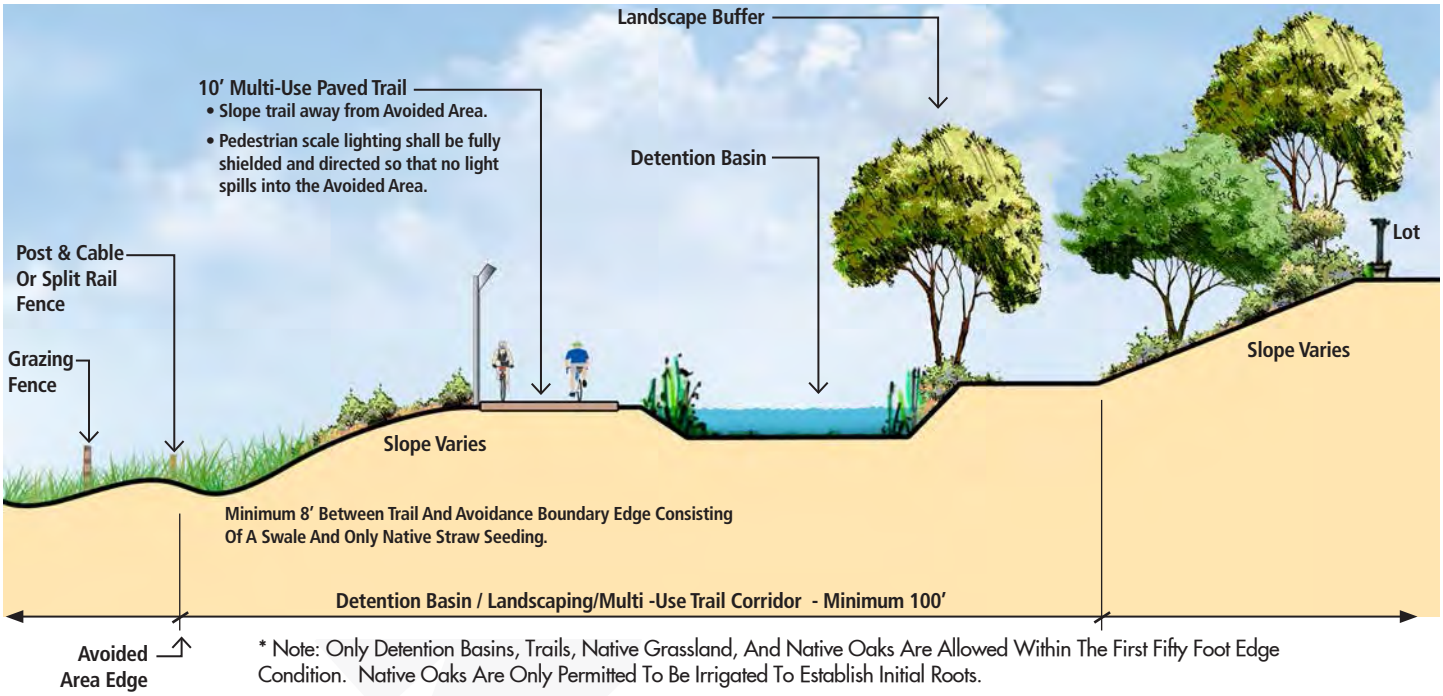
Edge Condition "E" Vignette
Residential Back-On



Edge Condition "F" Section
Detention Basin (Town Center)

Note: Multi-use trail can meander inside and outside of the minimum 50' buffer

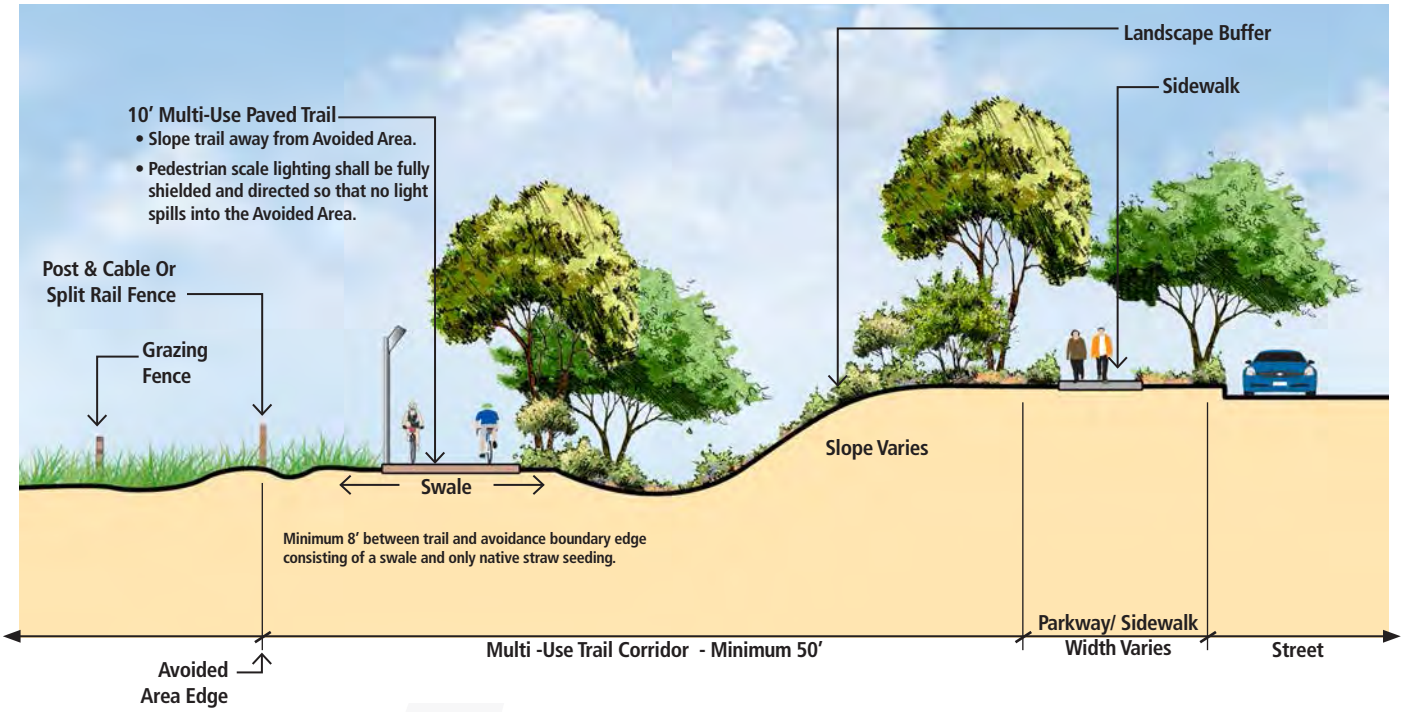
Edge Condition "F" Vignette
Detention Basin (Town Center)



Edge Condition "G" Section
Paseo Central

Note: Multi-use trail can meander inside and outside of the outer minimum 50' buffer

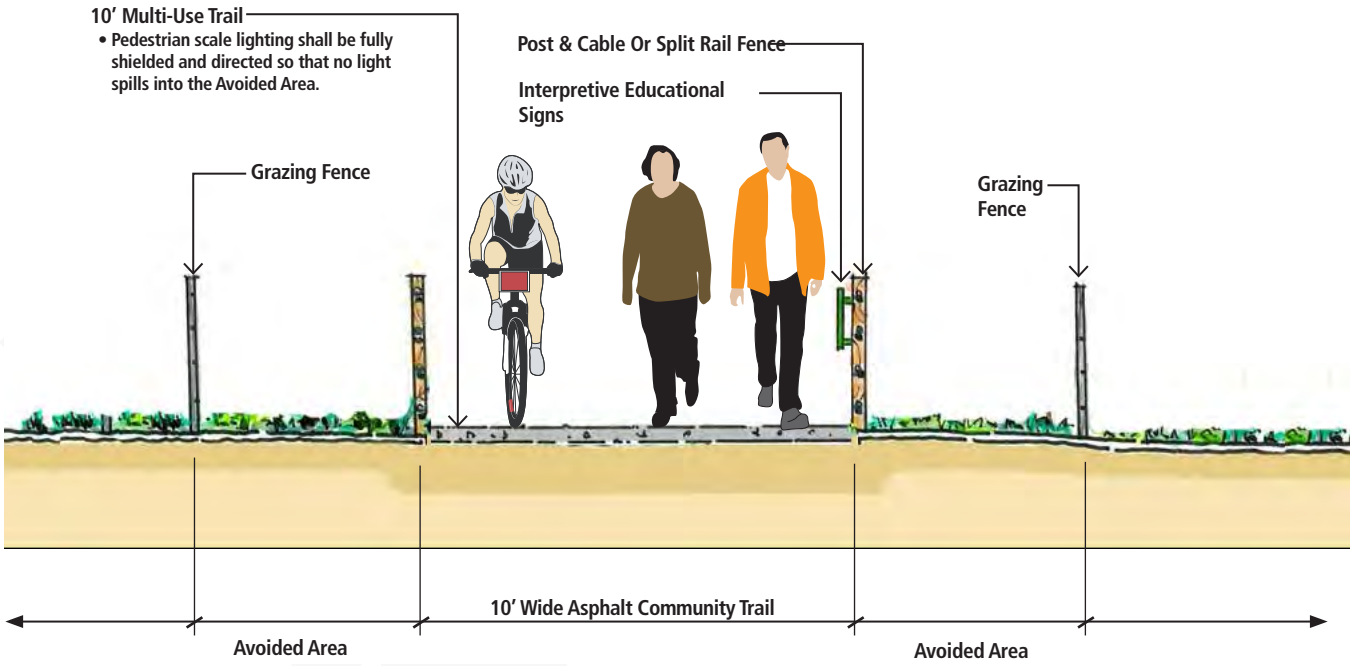
Edge Condition "G" Vignette
Paseo Central



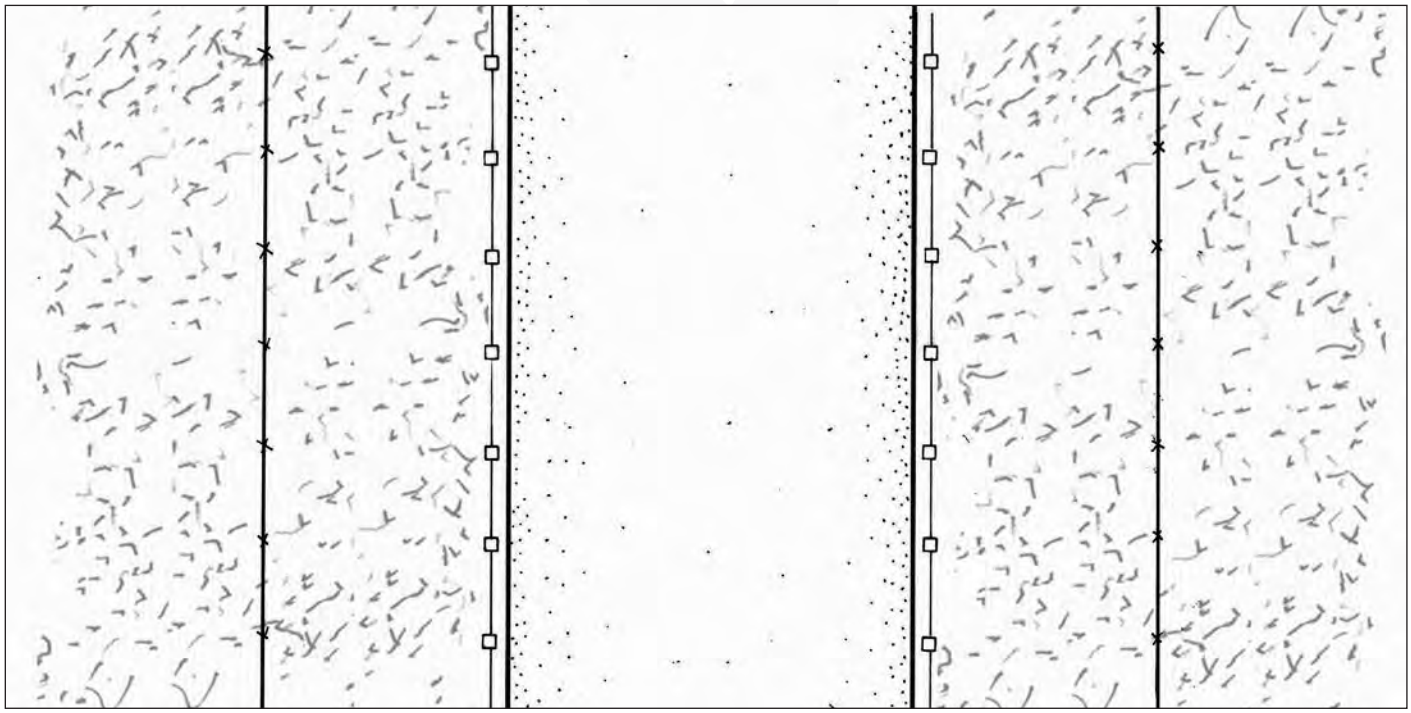
Edge Condition "H" Section
Neighborhood Street / Arterial

Note: Multi-use trail can meander inside and outside of the minimum 50' buffer

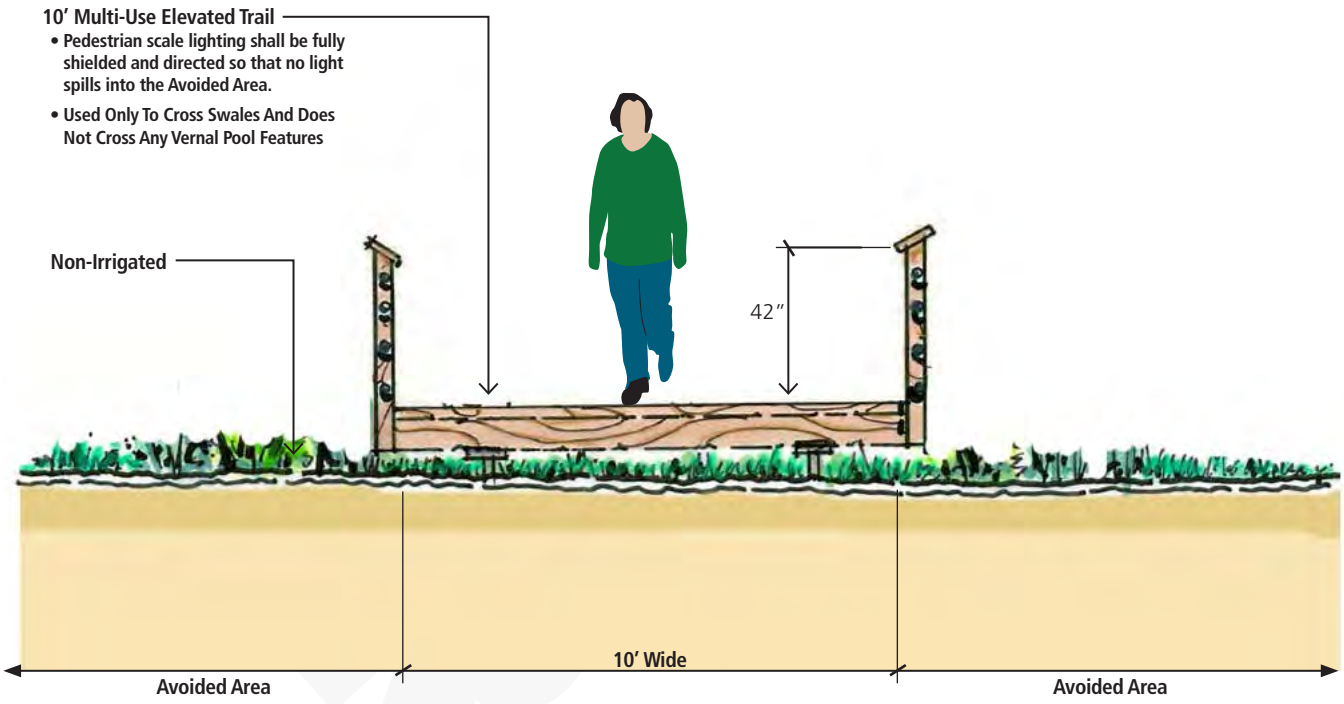
Edge Condition "H" Vignette
Neighborhood Street / Arterial



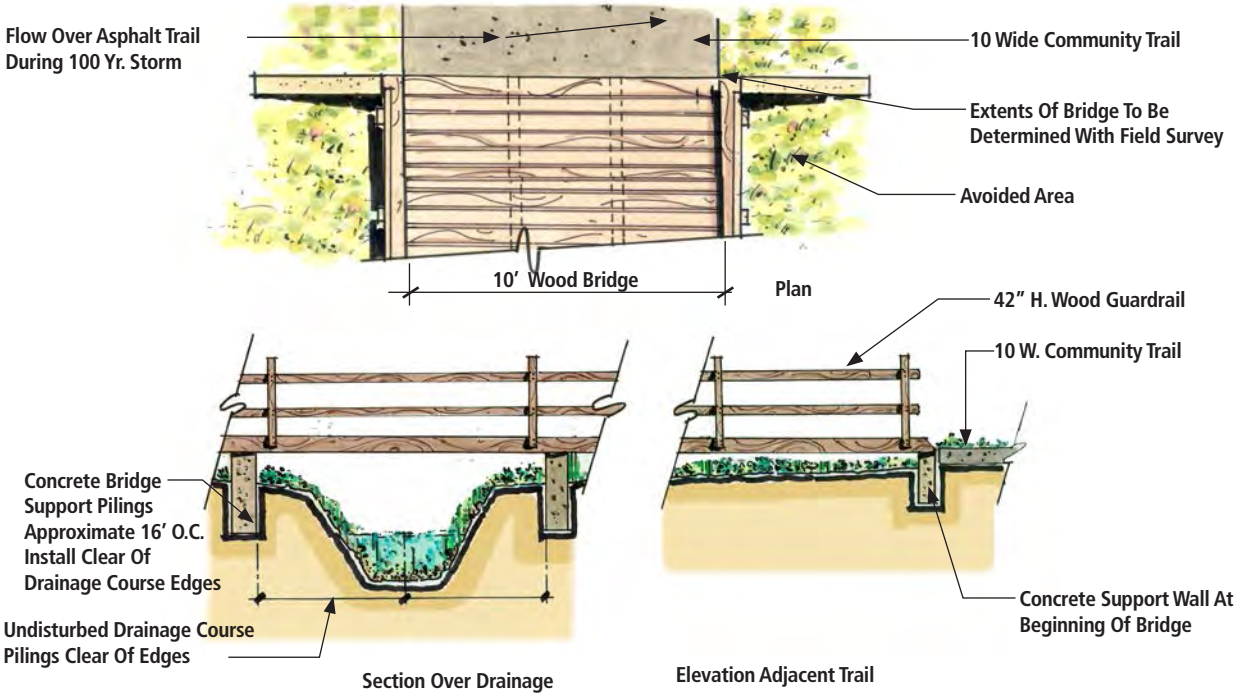
Edge Condition "I" Section
Community Trail Through Avoided Area: At Grade



Edge Condition "I" Vignette
Community Trail Through Avoided Area: At Grade



Edge Condition "J" Section
Community Trail Over Hydrological Connections (elevated)



Edge Condition "J" Vignette
Community Trail Over Hydrological Connections (elevated)

APPENDIX B

North Loop Road Memo

MEMORANDUM

TO: Cordova Hills, LLC

FROM: Ms. Kathleen Ports

DATE: 1 December 2015

RE: ***Cordova Hills – North Loop Road Alignment Analysis***

At the request of the U.S. Army Corps of Engineers (USACE), this memorandum transmits additional analysis of the potential environmental impacts associated with alternative alignments for North Loop Road within the Cordova Hills Project (Project).

BACKGROUND

On 29 September 2015 the U.S. Fish and Wildlife Service (USFWS) submitted comments to the USACE on the *Cordova Hills Draft Environmental Impact Statement* (EIS). In its comment letter, the USFWS specifically requested that the *"…Draft EIS analyze alternatives that avoid placing the proposed North Loop Road…between the onsite occurrences or within the microwatersheds of the endangered Sacramento Orcutt grass…"* Based on this request, the USACE subsequently requested that the Project Applicant analyze a suite of alternative alignments for North Loop Road.

The purpose of this document is to analyze the biological, safety, and policy implications associated with the Project's currently Proposed Alignment of North Loop Road, as well as three potential alternative alignments that were selected to address concerns raised by USFWS and the USACE on the Proposed Alignment of North Loop Road.

There are two known occurrences of Sacramento Orcutt grass (*Orcuttia viscida*) at the Project site, as well as one across the large "central drainage" just north of the Project site (within the Pilatus Property). The central drainage bisects the Pilatus Property before traveling south across the Project site. There are a handful of other occurrences of this species in the region, including several occurrences directly south of the Project site at the Kiefer Preserve. Known occurrences are shown in Figure 1. *California Natural Diversity Database Occurrences of Sacramento Orcutt Grass*.

DESIGN CRITERIA

In selecting the currently proposed location of North Loop Road, three criteria were used to identify an appropriate alignment.

Criteria 1: A minimum one-half mile spacing is required for intersections on Grant Line Road.

Sacramento County's adopted General Plan and the Capital Southeast Connector Joint Power Authority's 2014 adopted Design Guidelines require a minimum of one-half mile spacing between

intersections along Grant Line Road. This spacing criteria has been established in order to provide adequate distance for safe maneuvering of vehicles for ingress and egress.

Criteria 2: To meet fire and safety requirements, three access points to the Project site are required along Grant Line Road and a minimum of two roads should extend into the eastern area of the project.

The Sacramento Metropolitan Fire District analyzed the Project and concluded in a 19 December 2011 letter, provided as Attachment A, *"Based upon the fire and emergency services modeling Citygate Associates, LLC completed on August 29, 2011 regarding the Cordova Hills project, Sacramento Metropolitan Fire District has determined the need for three access points into Cordova Hills along Grant Line Road. Also, a minimum of two roadways extending to the eastern area of the project must be maintained."* As such, from an emergency services perspective, the Project must maintain three access points with two roads looping through the Project site.

Criteria 3: Minimize impacts on wetlands and other Waters of the U.S. (Waters); particularly the vernal pools known to support the federally listed as endangered Sacramento Orcutt grass (Orcutt grass), including maintaining minimum preserve sizes (20 acres) and minimum distances (300 feet) between new development and Waters known to support Orcutt grass as detailed in the draft South Sacramento County Habitat Conservation Plan (SSHCP).

As shown in Figure 2. *Relationship of North Loop Road to Sacramento Orcutt Grass Occurrences*, the Proposed Alignment of North Loop Road is located along a small topographic "crest", which is only several feet higher than most of the surrounding topography. Watersheds tend to break at this crest and either flow north and off-property eventually entering the central drainage, or south into a series of tributaries to Laguna Creek (off-site to the southwest). Water only flows from north to south under the Proposed Alignment of North Loop Road in three locations, none of which connect the Orcutt grass occurrences. Open bottom culverts with a natural substrate will be utilized at all three drainage crossings in order to maintain surface flows under North Loop Road.

ALTERNATIVES ANALYSIS

The above three criteria were used to evaluate the Proposed Alignment as well as three alternative alignments of North Loop Road, which were selected specifically to avoid bisecting the Orcutt grass populations at the Project site.

Proposed Alignment (Modified Proposed Action Land Plan)

Criteria 1: The intersection with Grant Line Road for the Proposed North Loop Road alignment is located one-half mile from the Douglas Boulevard and Grant Line Road intersection, which is the subsequent intersection to the north on Grant Line Road (Figure 3. *North Loop MPA Alternative*). This Alternative meets the intersection spacing standards of the General Plan and Capital Southeast Connector.

Criteria 2: Alternative 1 is consistent with the Sacramento Metropolitan Fire District's requirement for three access points to the Project site along Grant Line Road.

Criteria 3: The proposed North Loop Road alignment results in 0.971 acre of impacts to Waters. The Proposed Alignment was strategically placed along a watershed break to maintain the integrity of microwatersheds; particularly those supporting Orcutt grass occurrences. The northern Orcutt grass occurrence flows to the northeast, eventually joining the central drainage off-property (on the Pilatus property, near where the Orcutt grass occurrence is located on that property). The southern Orcutt grass occurrence flows southwest across the plateau preserve, eventually joining Laguna Creek off-site to the southwest.

Conclusion: The Proposed Alignment meets criteria 1, 2, and 3. This alignment has minimal impacts to Waters when compared to the alternative alignments below, and was strategically located to minimize impacts to the Orcutt grass occurrences on-site.

Alternative 1 (Re-locate North Loop Road to Glory Lane using existing access at Grant Line Road)

Criteria 1: As Alternative 1 utilizes the same Grant Line Road access point as the Proposed Alignment, it meets the intersection spacing standards of the General Plan and Capital Southeast Connector.

Criteria 2: Alternative 1 is consistent with the Sacramento Metropolitan Fire District's requirement for three access points to the Project along Grant Line Road.

Criteria 3: This Alternative results in 2.549 acres of impacts to Waters (1.578 acres more than the Proposed Alignment). Further, as shown in Figure 4. *North Loop Road – Glory Lane Alternative 1*, the relocation of North Loop Road under Alternative 1 bisects the watershed of the northern population of Orcutt grass at the Project site, which may result in direct and indirect impacts to the species. This Alternative also locates North Loop Road much closer to the Orcutt grass occurrence than the minimum required distance in the draft SSHCP (300 feet). This Alternative would add an additional road crossing over Waters that directly drain the northern Orcutt grass occurrence within the Project site. This Alternative would also separate the northern Orcutt grass occurrence at the Project site from the occurrence on the Pilatus Property.

Conclusion: While Alternative 1 meets criteria 1 and 2, it results in more impacts to Waters compared to the Proposed Alignment. Further, Alternative 1 would impact the downstream flows of the northern population of Orcutt grass**,** and would result in development directly adjacent to the northern occurrence.

Alternative 2 (Eliminate North Loop Road and use Douglas Boulevard access point across Pilatus Property)

Criteria 1: This Alternative utilizes the existing Douglas Road intersection along Grant Line Road for access through the Pilatus Property, allowing it to meet intersection spacing standards of the General Plan and Capital Southeast (Figure 5. *North Loop Road – Glory Lane Alternative 2*).

Criteria 2: Alternative 2 is consistent with the Sacramento Metropolitan Fire District's requirement for three access points to the Project site along Grant Line Road. However, this Alternative provides the 3rd access point to Grant Line Road to the North of Glory Lane, which may not be agreeable to

the Fire District and Sacramento County Department of Transportation. Therefore, additional coordination with these entities would be required to confirm if this Alternative alignment would be consistent with their policies and standards.

Criteria 3: This Alternative results in 2.256 acres of impacts to Waters (1.285 acres more than the Proposed Alignment). This Alternative would result in an additional crossing of the large drainage near the central portion of the Project site. This crossing would be substantial in size and would be located just downstream from the Orcutt grass occurrence on the Pilatus Property. While this alignment would locate North Loop Road north of the Orcutt grass occurrences at the Project site (therefore not bisecting the on-site occurrences), it would further separate these southern occurrences from the occurrence on the Pilatus Property.

Conclusion: While Alternative 3 meets criteria 1 and potentially criteria 2, it would result in more impacts to Waters than the Proposed Alignment. This Alternative would also result in the need for a considerable road crossing over a large drainage on the Pilatus Property, which would be located just downstream from the Orcutt grass occurrence on that property.

Alternative 3 (Re-locate North Loop Road to Glory Lane using existing Glory Lane as access)

Criteria 1: Moving the North Loop Road access point to Glory Lane places it too close to the Douglas Road Intersection and therefore violates the intersection spacing standards of the General Plan and Capital Southeast Connector (Figure 6. *North Loop Road – Glory Lane Alternative 3*).

Criteria 2: Alternative 3 is consistent with the Sacramento Metropolitan Fire District's requirement for three access points to the Project site along Grant Line Road.

Criteria 3: This Alternative results in 2.482 acres of impacts to Waters (1.511 acres more than the Proposed Alignment). Further, as shown in Figure 6, the relocation of North Loop Road under Alternative 3 bisects the watershed of the northern population of Orcutt grass at the Project site, which may result in direct and indirect impacts on the species. This Alternative also locates North Loop Road much closer to the Orcutt grass occurrence than the minimum required distance in the draft SSHCP (300 feet).

Conclusion: Alternative 3 meets criteria 2, but violates criteria 1 and results in more impacts to Waters compared to the proposed North Loop Road alignment. Further, Alternative 1 would bisect the microwatershed of the northern population of Orcutt grass, separate the Orcutt grass occurrences on the Project site from the occurrence on the Pilatus Property, impact downstream flows of the northern occurrence, and encroach upon minimum buffer distances as outlined in the draft SSHCP.

SUMMARY

In conclusion, all of the Alternative alignments result in greater wetland impacts than the Proposed Alignment, and two of the Alternatives (1 and 3) would impact the microwatershed and downstream flows of the Project site northern Orcutt Grass occurrence. Alternative 2 would require an additional significant crossing of the central drainage.

As none of the three Orcutt grass occurrences (one on Pilatus and two on the Project site) share a watershed, none of the alignments would separate the occurrences hydrologically. Due to the distribution of the Orcutt grass occurrences at the Project site and on the Pilatus Property, all of these alignments, including utilizing the Pilatus Property, would result in North Loop Road physically separating at least one of the three occurrences from the others.

Of the Alternatives considered, the Proposed Alignment results in the least impacts on Waters, meets the design criteria for Sacramento County's General Plan and the Capital Southeast Connector Joint Powers Authority Design Guidelines, meets the Fire and Safety criteria stipulated by the Sacramento Metropolitan Fire District, and maintains the integrity of vernal pools supporting Orcutt grass on the Project site. While the Proposed Alignment would physically separate the two occurrences on-site, north-to-south surface flows would be maintained under North Loop Road using open bottom culverts with natural substrate. In addition, any impacts to the restrictive layer during Project construction would be minimized by backfilling with a lean density fill to replicate the existing hard pan in order to maintain existing subsurface flow.

LIST OF FIGURES

Figure 1. California Natural Diversity Database Occurrences of Sacramento Orcutt Grass

Distance From Project
- 1 mile
- 5 miles
- 10 miles

Boundaries
- Project Boundary [1]

CNDDB Occurrences [2]
- Sacramento Orcutt Grass
- Occurrence Extent

Critical Habitat
- Sacramento Orcutt Grass[3]

This map may include multiple species' occurrences at each location, some of which may not be visible on this graphic. The CNDDB occurrences shown may not reflect the actual location of the occurrence.

[1] Project Boundary: MacKay and Somps
[2] CDFW California Natural Diversity Database (CNDDB), October 2015 (GIS Shapefile)
[3] USFWS
CNDDB Occurrences Located on USGS 7.5' Quadrangles: Buffalo Creek, Elk Grove, Folsom, Goose Creek, CA

ECORP Consulting, Inc.
ENVIRONMENTAL CONSULTANTS

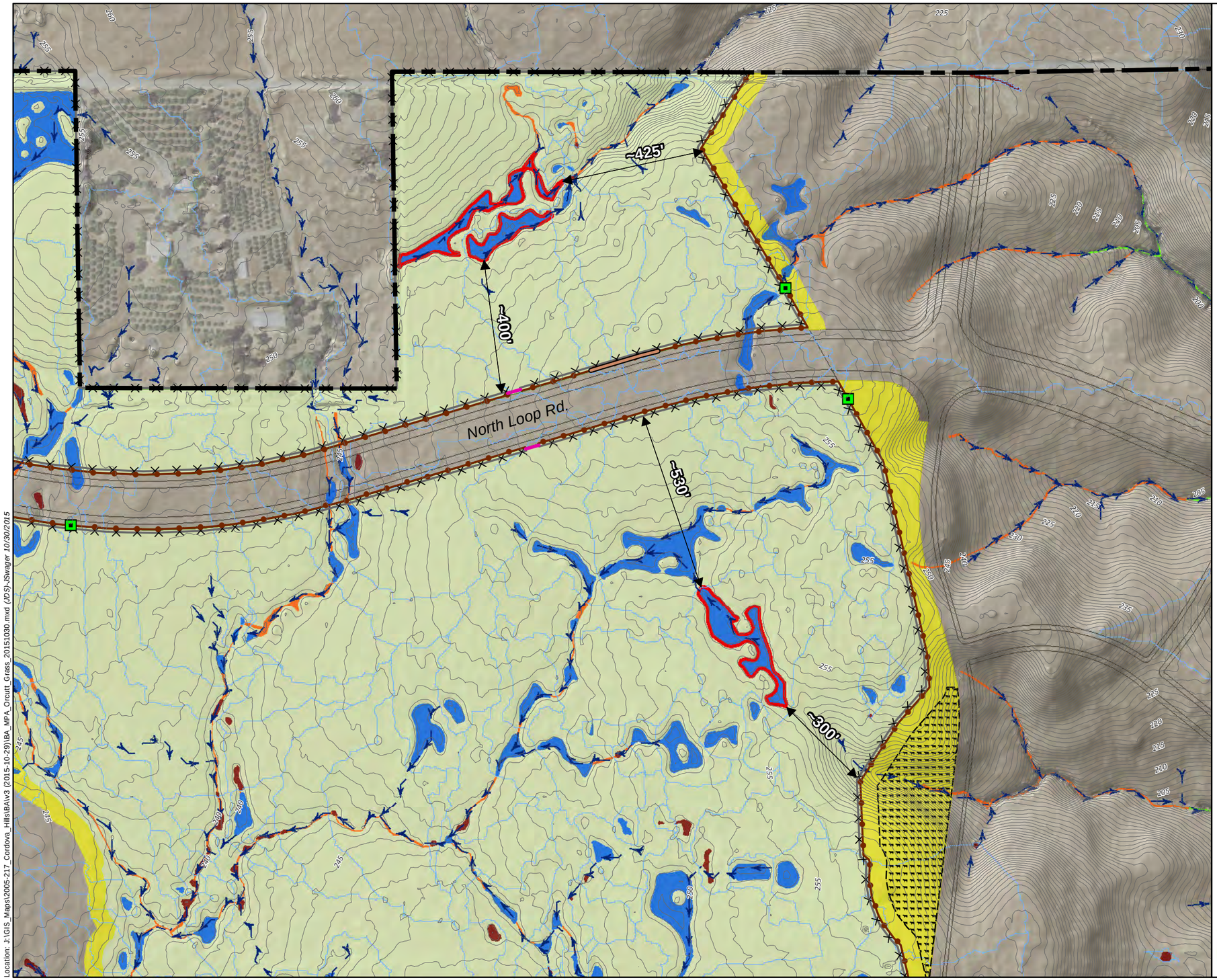
Location: J:\GIS_Maps\2005-217_Cordova_Hills\CNDDB\OrcuttGrass_CNDDB_20151021.mxd (ELL/JDS)-JSwager 10/28/2015

2005-217 Cordova Hills

Miles
0 3

Map Date: 10/27/2015

Figure 2. Relationship of North Loop Road to Sacramento Orcutt Grass Occurrences

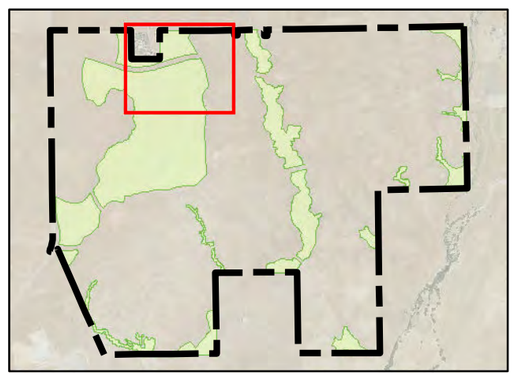


Map Features

- Project Boundary
- Sacramento Orcutt Grass Population
- Preserve Sign
- Grazing Access Gate
- Barbed Wire Fencing
- Split Rail or Post & Cable Fencing
- Fire Access Gate
- Potential Cattle Staging Area
- Preserve Boundary (578.4 Ac.)
- Edge Treatment

Wetlands/Waters

- Vernal Pool
- Seasonal Wetland
- Seasonal Wetland Swale
- Seep
- Intermittent Drainage
- Creek
- Stock Pond
- Micro-Watershed
- Flow Direction



ECORP Consulting, Inc.
ENVIRONMENTAL CONSULTANTS

Location: J:\GIS_Maps\2005-217_Cordova_Hills\BA\v3 (2015-10-29)\BA_MPA_Orcutt_Grass_20151030.mxd (JDS)-JSwager 10/30/2015

2005-217 Cordova Hills

Scale in Feet
0 300

Photo Source: NAIP 2014

Map Date: 10/30/2015

Figure 3.
North Loop Road
MPA Alternative

Map Features

- Property Boundaries
- MPA Alternative [1] - 18.8 ac.
- Flow Direction
- Micro-Watershed
- Sacramento Orcutt Grass Population

MPA Project

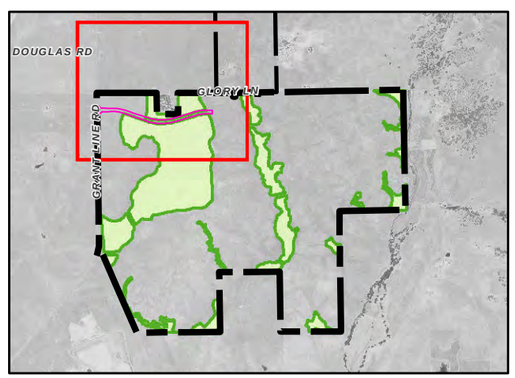
- Edge Treatment
- Grading in Preserve
- Preserve Boundary

MPA Alternative Wetland Impacts - 0.971 ac. *

- Vernal Pool - 0.844 ac.
- Seasonal Wetland - 0.072 ac.
- Seasonal Wetland Swale - 0.055 ac.

** Wetlands/Waters are a mix of wetland delineation data from Cordova Hills and Grant Line Pilatus as well as assessment level data on the Tracy property.*

The summary values for each feature have been rounded to the nearest round number or 1/100 decimal. Summation of these values in the table may not equal the total reported.



ECORP Consulting, Inc.
ENVIRONMENTAL CONSULTANTS

Location: J:\GIS_Maps\2005-217_Cordova_Hills\Meetings\2015-11-16_North_Loop_Alternatives\NorthLoopGlory_Alts_20151116.mxd (JDS) JSwager 11/17/2015

2005-217 Cordova Hills

Scale in Feet
0 600

Photo Source: 2009 USGS
[1] MSCE

Map Date: 11/17/2015

Figure 4.
North Loop Road - Glory Lane
Alternative 1

Map Features

- Property Boundaries
- Alternative 1 [1] - 14.9 ac.
- Flow Direction
- Micro-Watershed
- Sacramento Orcutt Grass Population

MPA Project

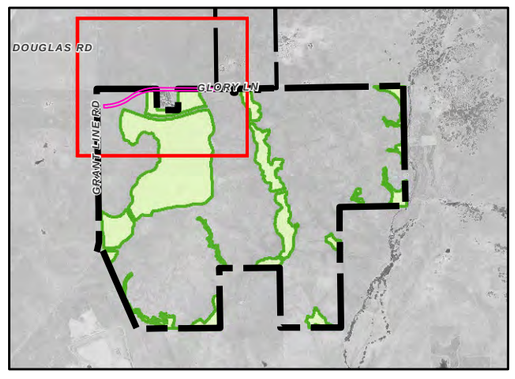
- Edge Treatment
- Grading in Preserve
- Preserve Boundary

Alternative 1 Wetland Impacts - 2.549 ac. *

- Vernal Pool - 2.478 ac.
- Seasonal Wetland - 0.027 ac.
- Seasonal Wetland Swale - 0.023 ac.
- Intermittent Drainage - 0.022 ac.

** Wetlands/Waters are a mix of wetland delineation data from Cordova Hills and Grant Line Pilatus as well as assessment level data on the Tracy property.*

The summary values for each feature have been rounded to the nearest round number or 1/100 decimal. Summation of these values in the table may not equal the total reported.



ECORP Consulting, Inc.
ENVIRONMENTAL CONSULTANTS

Location: J:\GIS_Maps\2005-217_Cordova_Hills\Meetings\2015-11-16_North_Loop_Alternatives\NorthLoopGlory_Alts_20151116.mxd (JDS) JSwager 11/17/2015

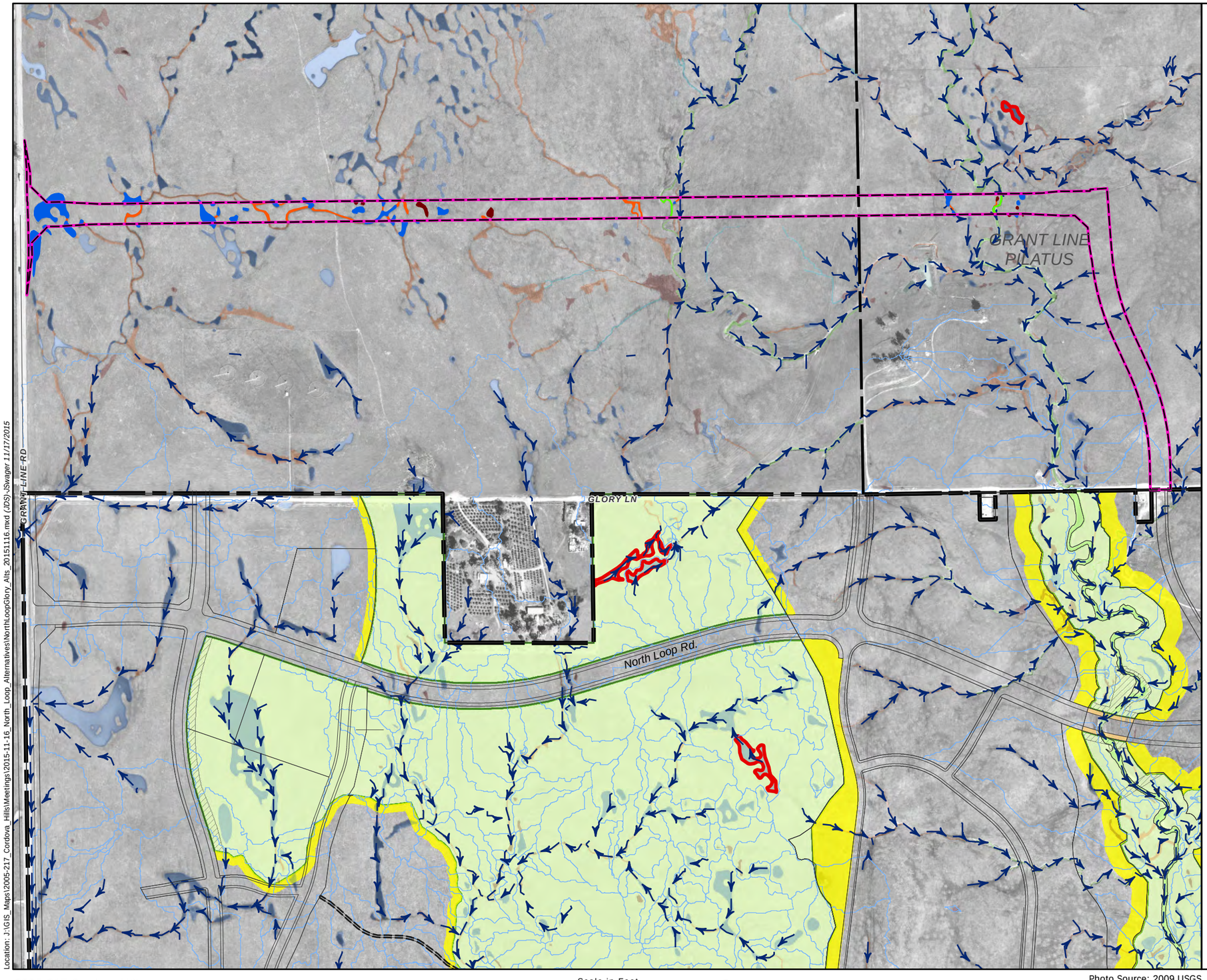
2005-217 Cordova Hills

Scale in Feet
0 600

Photo Source: 2009 USGS
[1] MSCE

Map Date: 11/17/2015

Figure 5.
North Loop Road - Glory Lane
Alternative 2



Map Features

- Property Boundaries
- Alternative 3 [1] - 26.1 ac.
- Flow Direction
- Micro-Watershed
- Sacramento Orcutt Grass Population

MPA Project

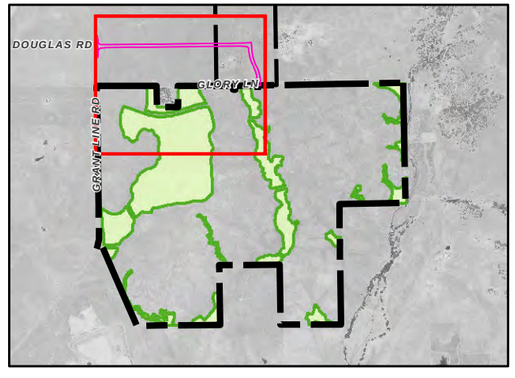
- Edge Treatment
- Grading in Preserve
- Landscape Corridor
- Preserve Boundary

Alternative 3 Wetland Impacts - 2.256 ac. *

- Vernal Pool - 1.729 ac.
- Seasonal Wetland - 0.128 ac.
- Seasonal Wetland Swale - 0.341 ac.
- Intermittent Drainage - 0.058 ac.

** Wetlands/Waters are a mix of wetland delineation data from Cordova Hills and Grant Line Pilatus as well as assessment level data on the Tracy property.*

The summary values for each feature have been rounded to the nearest round number or 1/100 decimal. Summation of these values in the table may not equal the total reported.



ECORP Consulting, Inc.
ENVIRONMENTAL CONSULTANTS

Location: J:\GIS_Maps\2005-217_Cordova_Hills\Meetings\2015-11-16_North_Loop_Alternatives\NorthLoopGlory_Alts_20151116.mxd (JDS) JSwager 11/17/2015

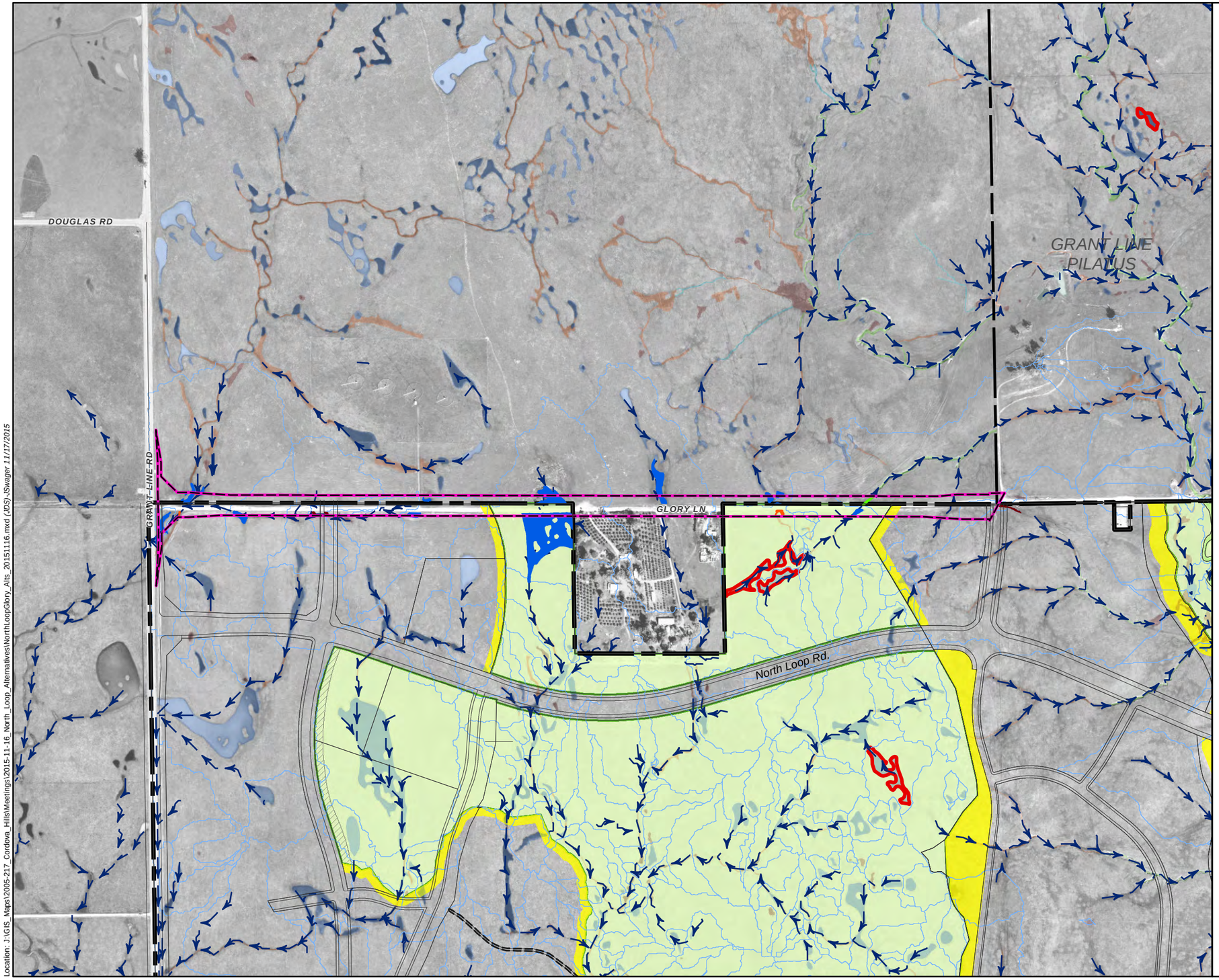
2005-217 Cordova Hills

Scale in Feet
0 600

Photo Source: 2009 USGS
[1] MSCE

Map Date: 11/17/2015

Figure 6.
North Loop Road - Glory Lane
Alternative 3



Map Features

- Property Boundaries
- Alternative 4 [1] - 16.1 ac.
- Flow Direction
- Micro-Watershed
- Sacramento Orcutt Grass Population

MPA Project

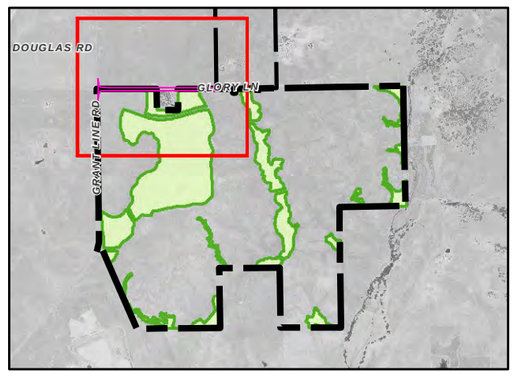
- Edge Treatment
- Grading in Preserve
- Preserve Boundary

Alternative 4 Wetland Impacts - 2.482 ac. *

- Vernal Pool - 2.377 ac.
- Seasonal Wetland - 0.043 ac.
- Seasonal Wetland Swale - 0.040 ac.
- Intermittent Drainage - 0.022 ac.

** Wetlands/Waters are a mix of wetland delineation data from Cordova Hills and Grant Line Pilatus as well as assessment level data on the Tracy property.*

The summary values for each feature have been rounded to the nearest round number or 1/100 decimal. Summation of these values in the table may not equal the total reported.



ECORP Consulting, Inc.
ENVIRONMENTAL CONSULTANTS

Location: J:\GIS_Maps\2005-217_Cordova_Hills\Meetings\2015-11-16_North_Loop_Alternatives\NorthLoopGlory_Alts_20151116.mxd (JDS) JSwager 11/17/2015

2005-217 Cordova Hills

Scale in Feet
0 600

Photo Source: 2009 USGS
[1] MSCE

Map Date: 11/17/2015

ATTACHMENT A

Cordova Hills Access Points and Circulation Letter from Sacramento Metropolitan Fire District dated 19 December 2011

Sacramento Metropolitan Fire District

10545 Armstrong Ave., Suite 200 • Mather, CA 95655 • Phone (916) 859-4300 • Fax (916) 859-3702

KURT P. HENKE

December 19, 2011

Mark Hanson
Conwy, LLC
5241 Arnold Ave
McClellan, CA 95652

RE: Cordova Hills Access Points and Circulation

Based upon the fire and emergency services modeling Citygate Associates, LLC completed on August 29, 2011 regarding the Cordova Hills project, Sacramento Metropolitan Fire District has determined the need for three access points into Cordova Hills along Grant Line Road. Also, a minimum of two roadways extending to the eastern area of the project must be maintained.

North Loop and University Blvd. access points are needed to serve the southern and northern areas of Town Center Village. These two roadways are also essential in providing emergency services to the eastern area of the project where 6,250 of the 8,000 residential units exist.

Chrysanthly Blvd. access point is needed to both serve the Town Center portion of the project and to provide adequate emergency access to the eastern residential portion of the Cordova Hills, as well the project's university/college campus and recreational facilities. Cordova Hills Phase 1 and 2 will be serviced by fire station(s) in Sunridge and/or Suncreek developments. Cordova Hills will also eventually be serviced by the fire station site planned to be built in Cordova Hills East Valley Village in phase 3. Until the East Valley Village fire station is operational, the fire stations on the Sunridge and/or Suncreek development will be required to access Cordova Hills via Chrysanthly Blvd. As such, it is critical Chrysanthly be maintained as a direct access point to Cordova Hills via Town Center Blvd. in order to meet the District's travel time policy.

If Grant Line Road south of Chrysanthly Blvd or the intersection of University Blvd. and Grant Line Rd. were congested, due to an accident or otherwise, the District would

suffer an unacceptable delay in responding to emergencies on the university/college campus or the project's recreational facilities, including the sports park, if alternative access via Town Center Blvd. is not provided. In addition, considering anticipated traffic volumes, the District requires three access points to adequately serve the approximately 966,000 sq. ft. of commercial buildings in the Town Center. Finally, the District requires three access points to serve the over six thousand units planned in the eastern portion of Cordova Hills to avoid both anticipated and unanticipated congestion resulting in unacceptable travel time delays. Town Center Blvd. will provide alternative access to the northeastern residential portions of the project if Grant Line Rd. or its intersection with North Loop Road is suffering from congestion.

In conclusion, without University Blvd., North Loop, and Chrysanthly access points and roadways, the Fire District could not service Cordova Hills according to the District's travel time policy.

Sincerely,

Duane Arend
Deputy Chief