Landscape Structure and Geophysical Parameters that Control the Hydrology of Venal Pools

Presentation by

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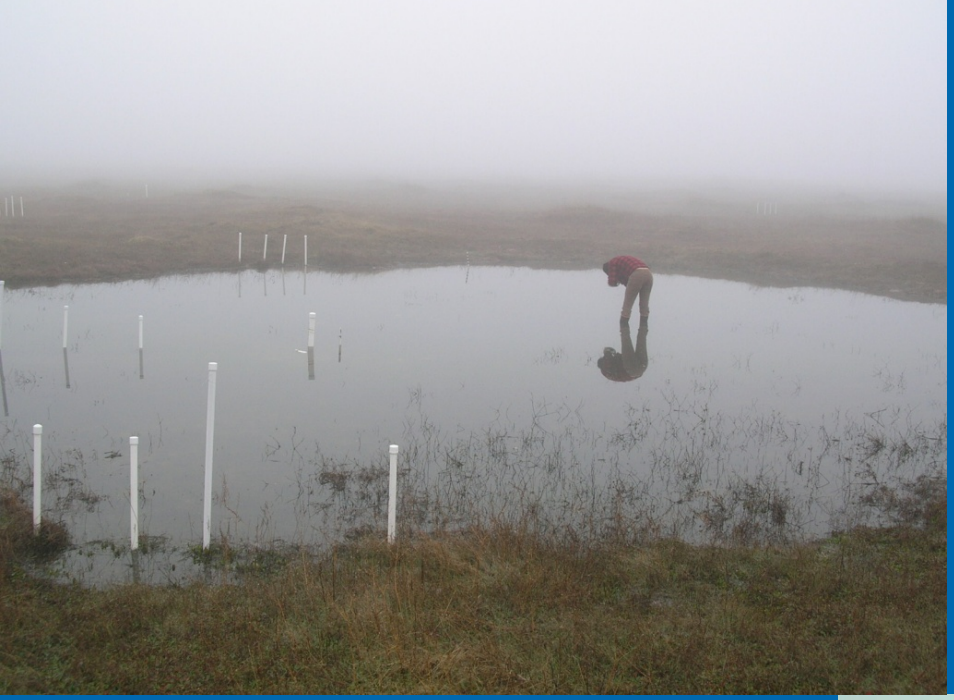
Overview of Presentation

- Landscapes and Spatial Scales of Vernal Pool Ecosystems
- Geophysical Parameters
  - Topography and Soils
  - Hydrological Relationships
- Vernal Pool Restoration Process

Vernal Pools



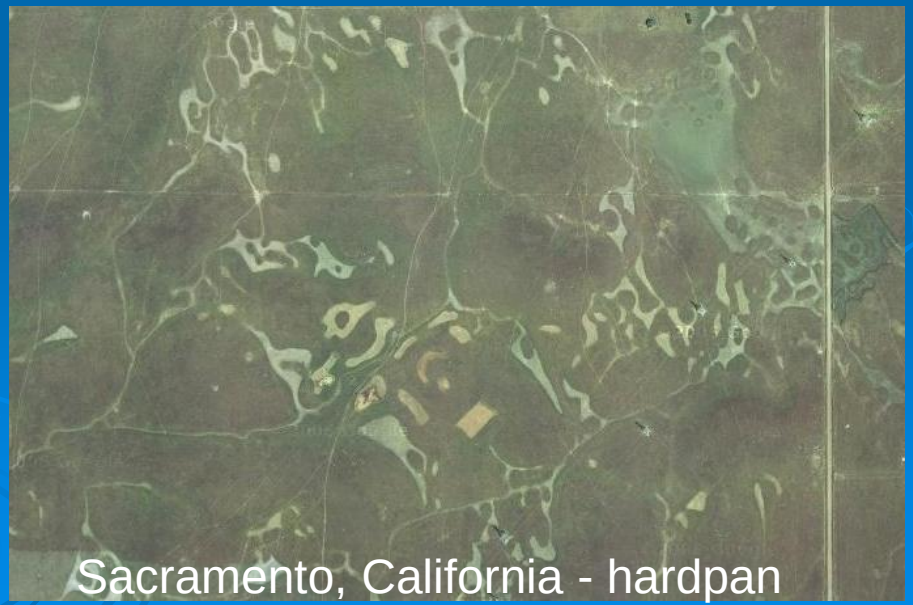
Vernal Pools

Vernal Pool Landscapes

Agate Desert, Oregon - Hardpan

Ecosystems develop in a variety of landscapes with different geology

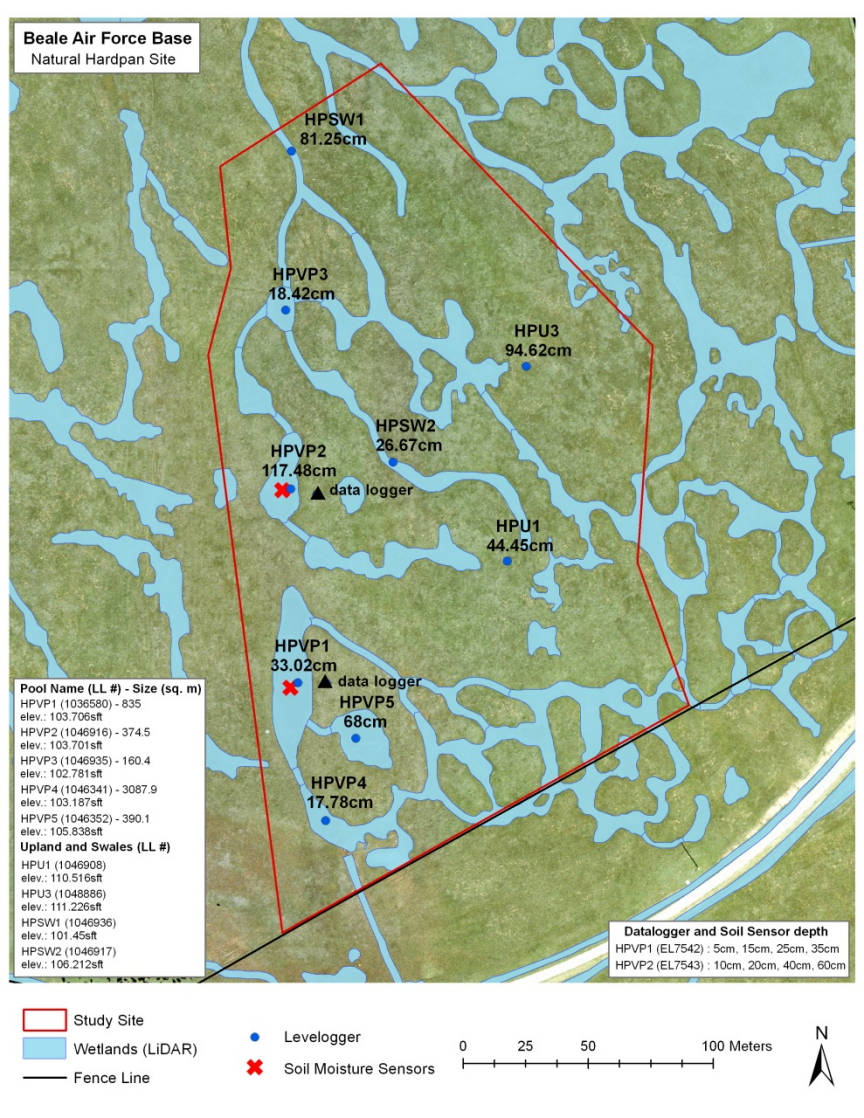
Table Mtn, California - Basalt Flow

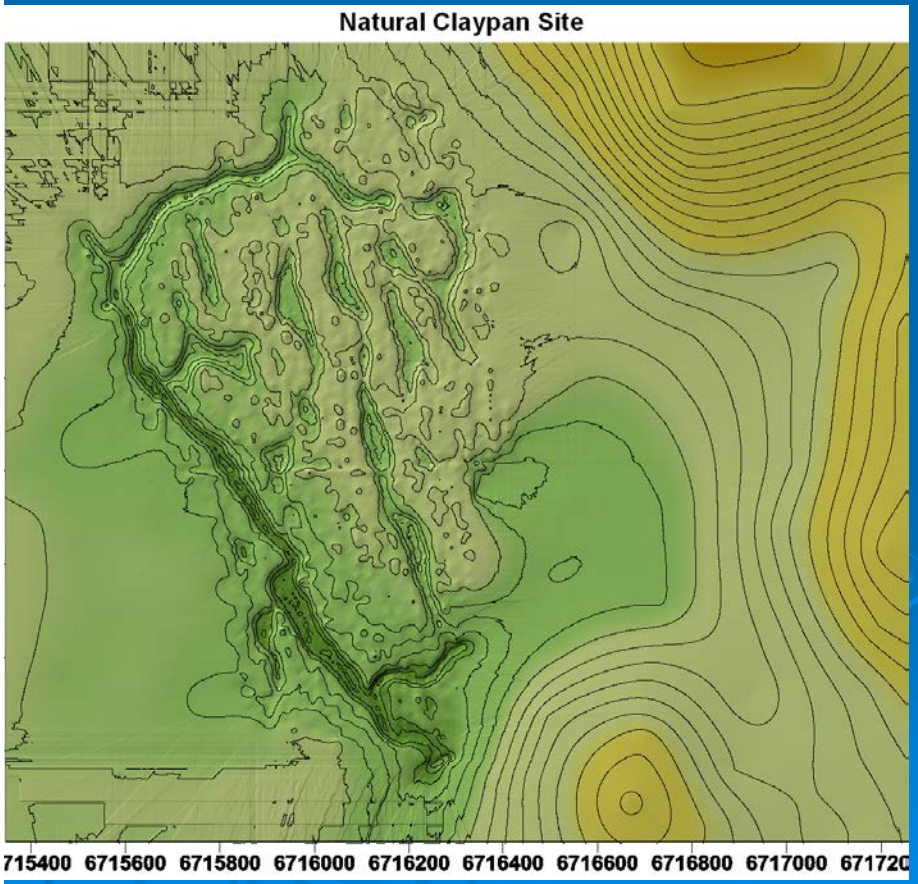


Sacramento, California - hardpan

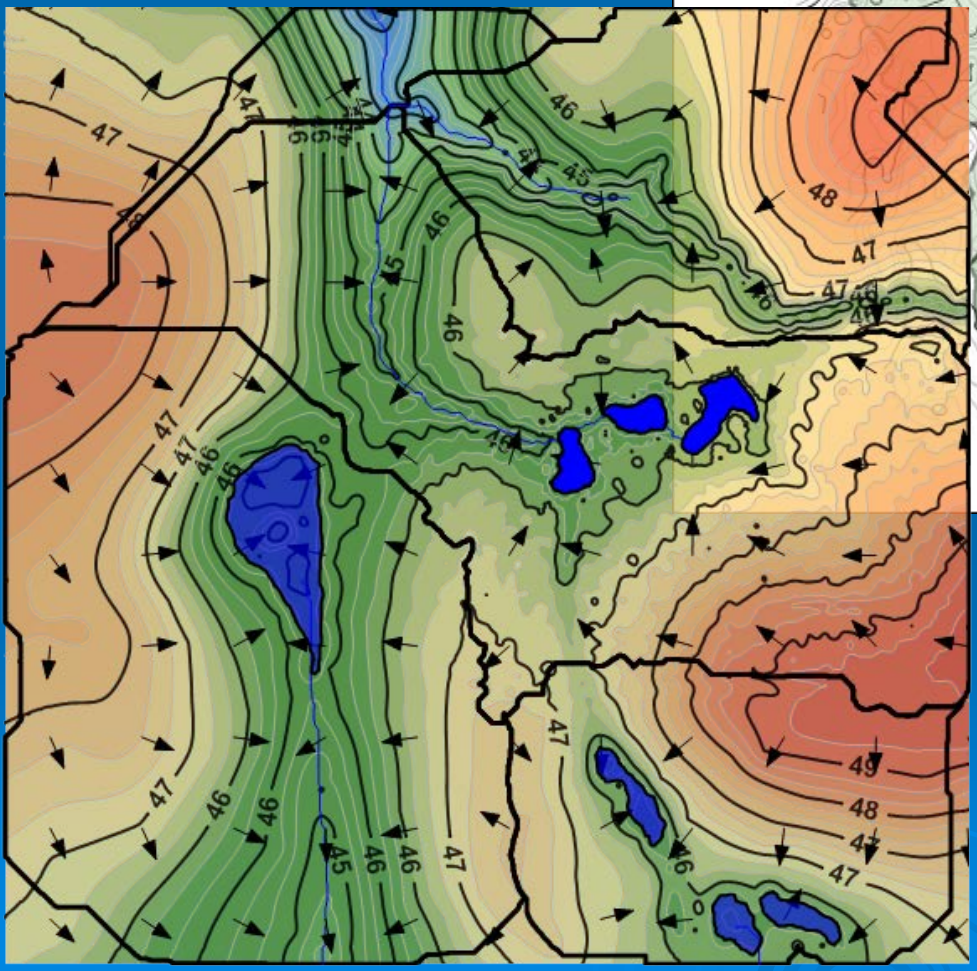
Surface Water and Connectivity

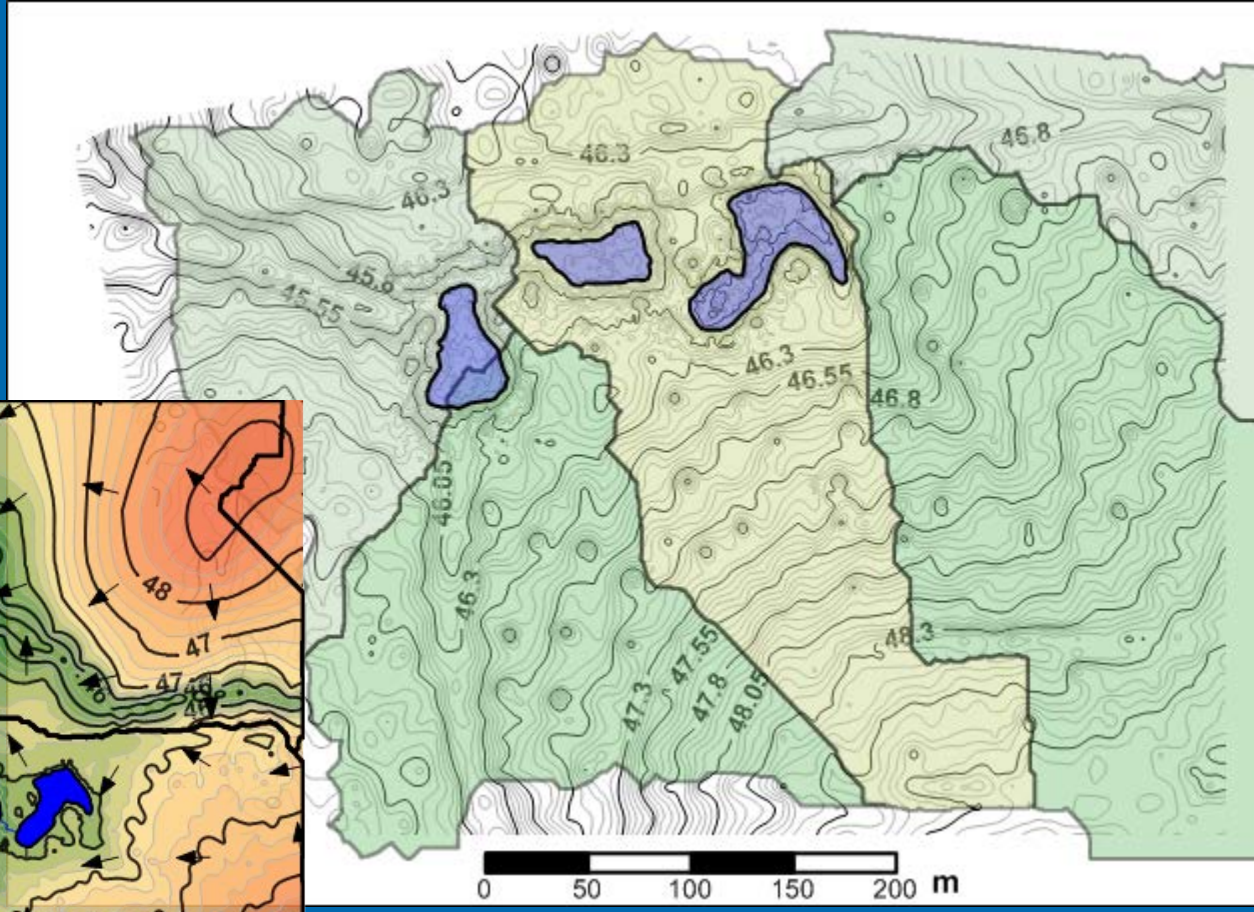
Vernal Pool Landscapes



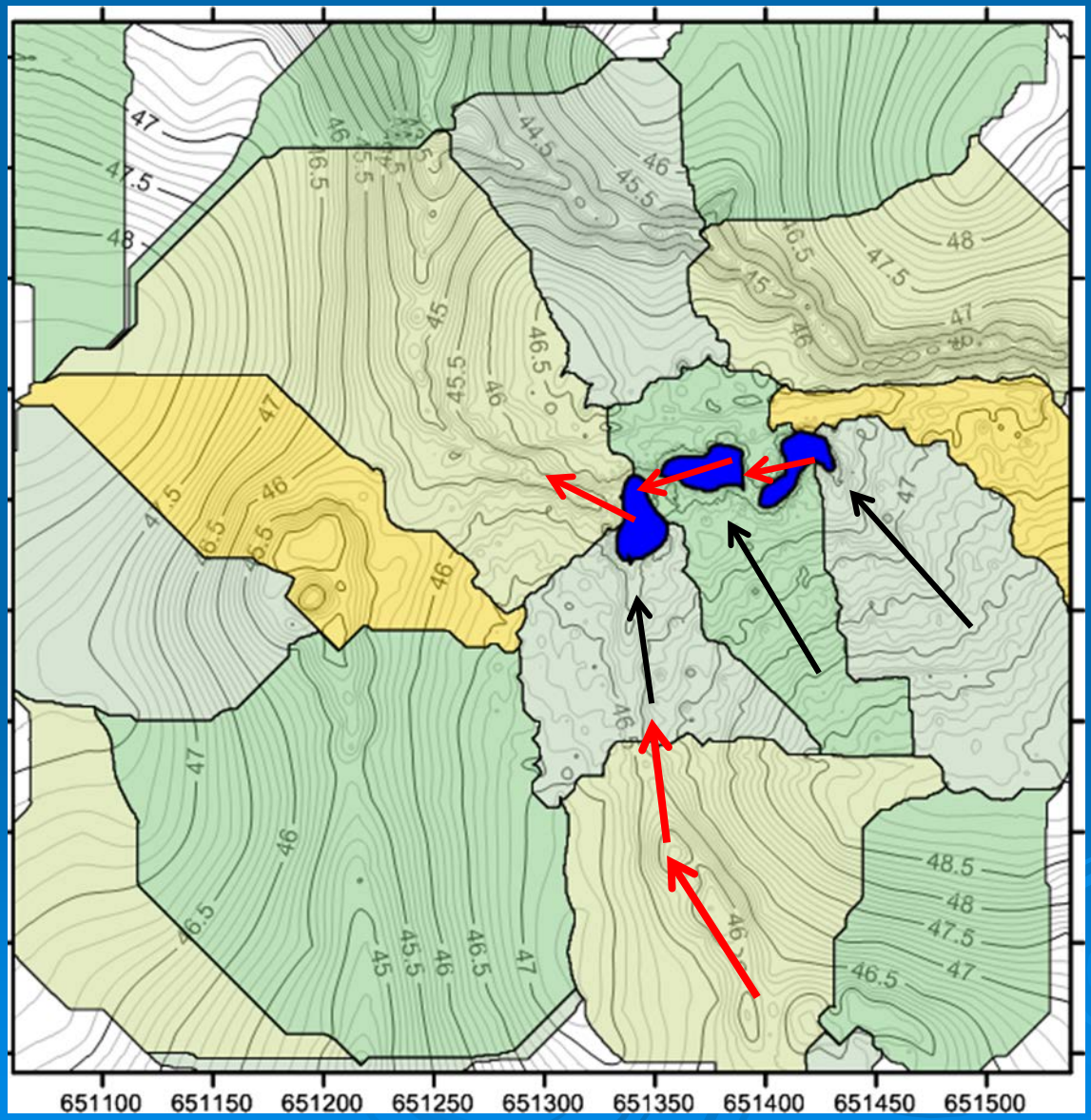


Mather Field Catchments



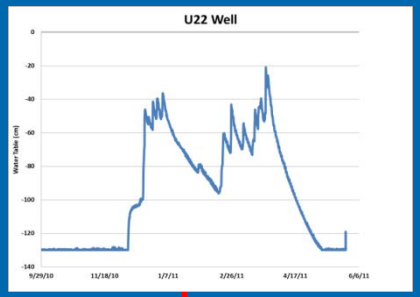


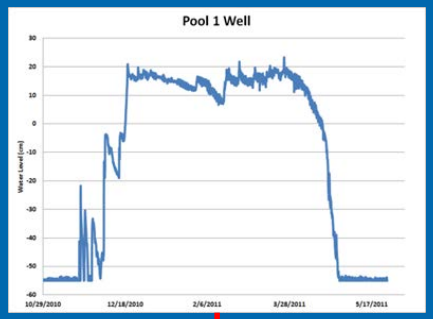
Catchment & Cascading Vernal Pools

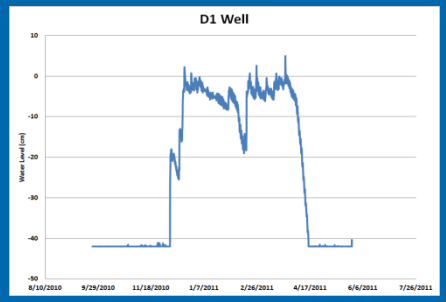


Water Balance

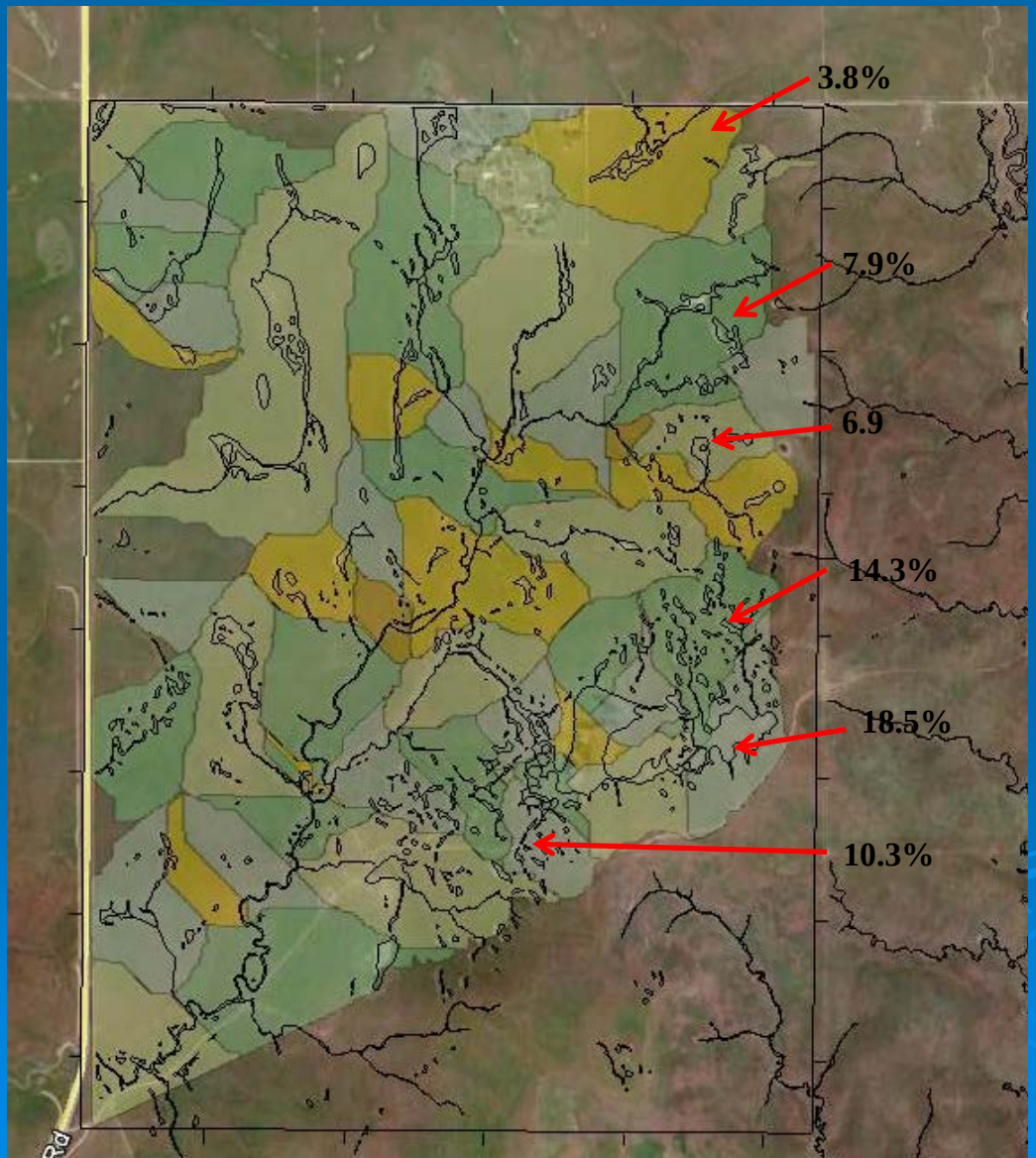
Storage = (Qi + P) – (Qo + Et)



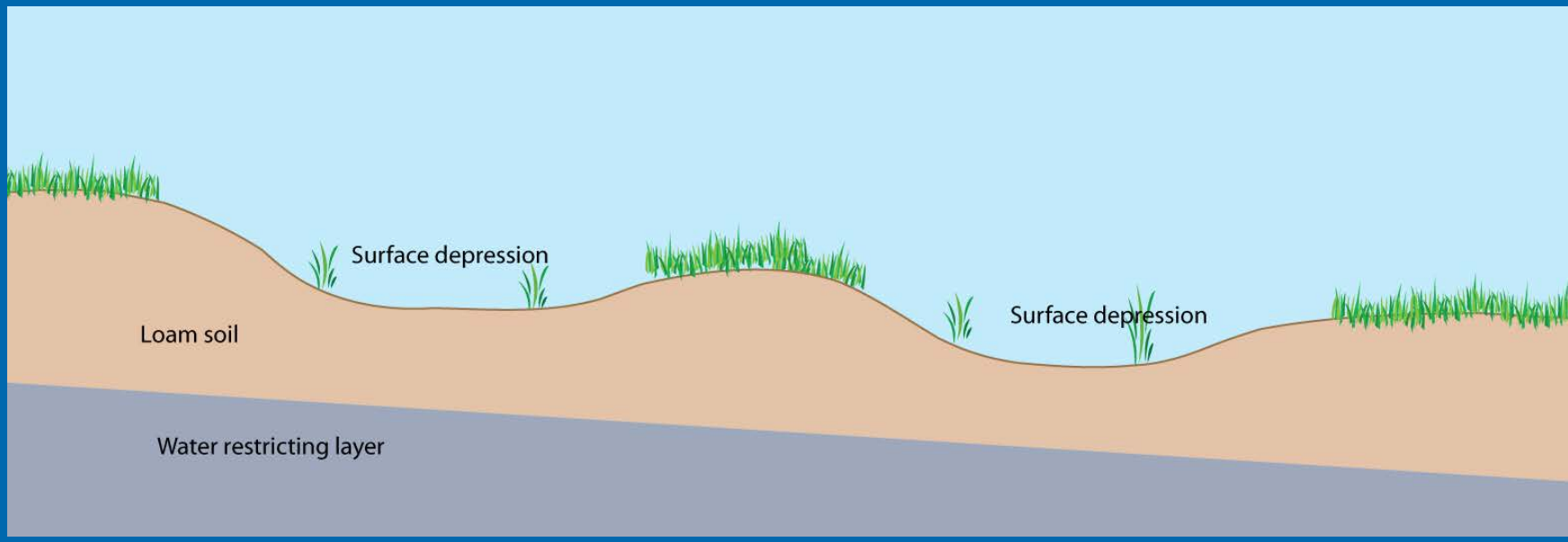


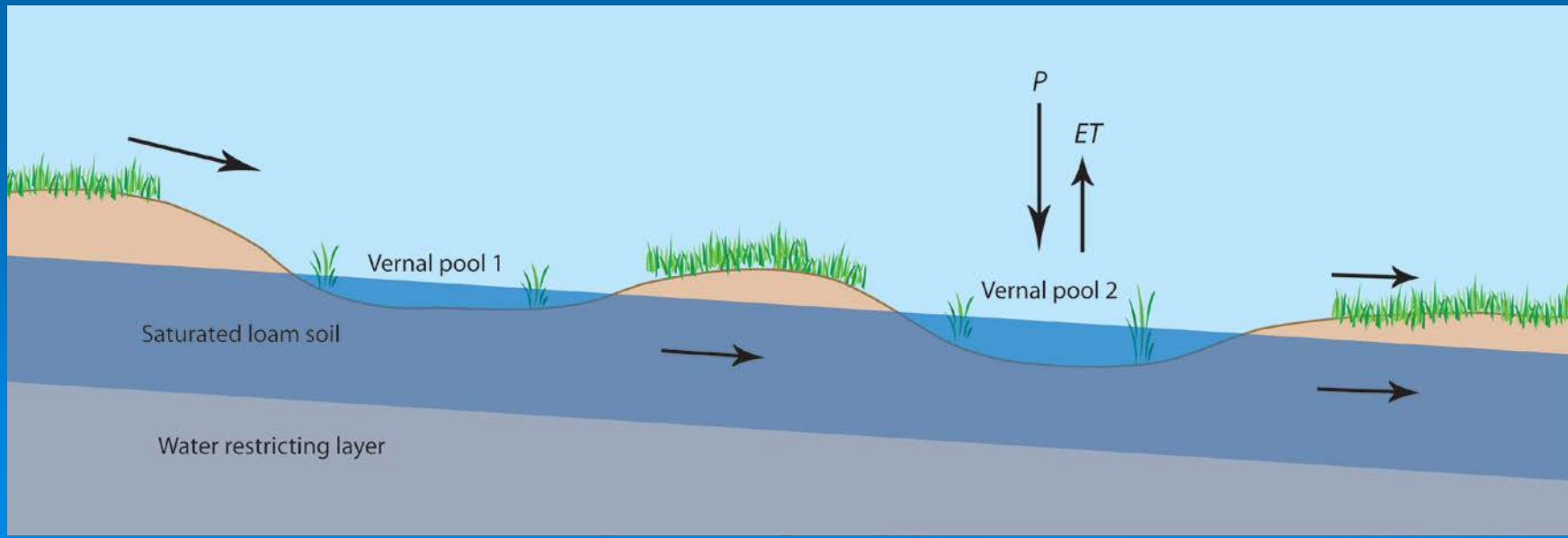


Catchments Within Catchments

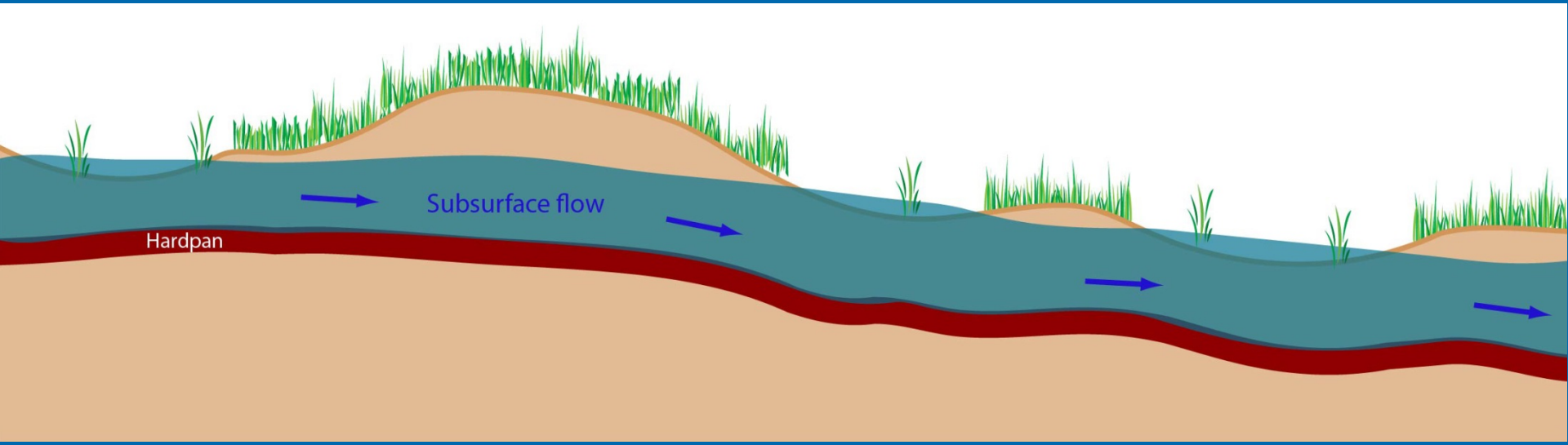


Cross-section of a vernal pool catchment





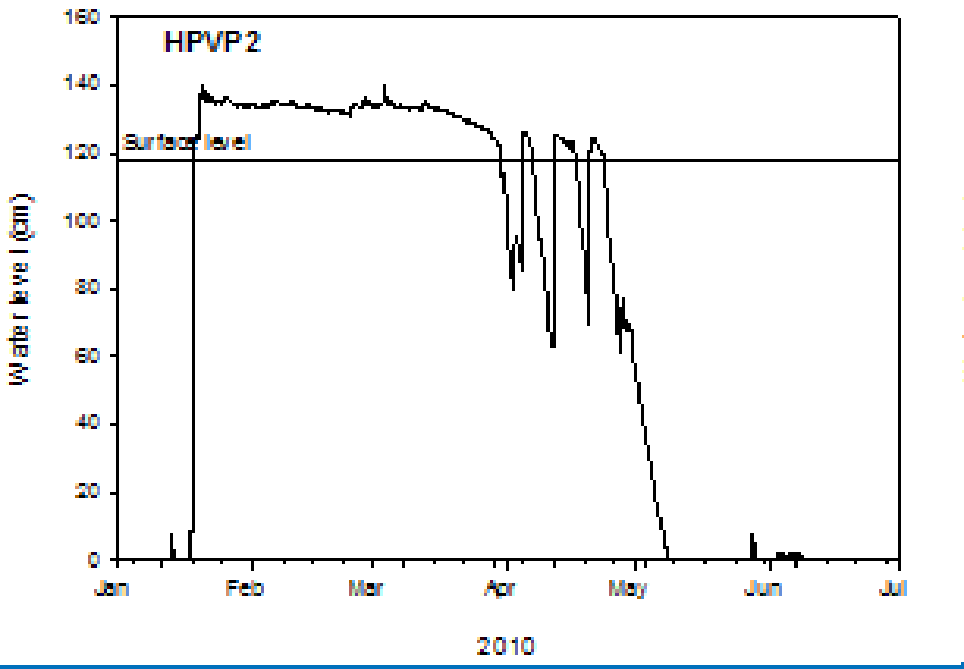
Soil Surface and Subsurface Water Relationships

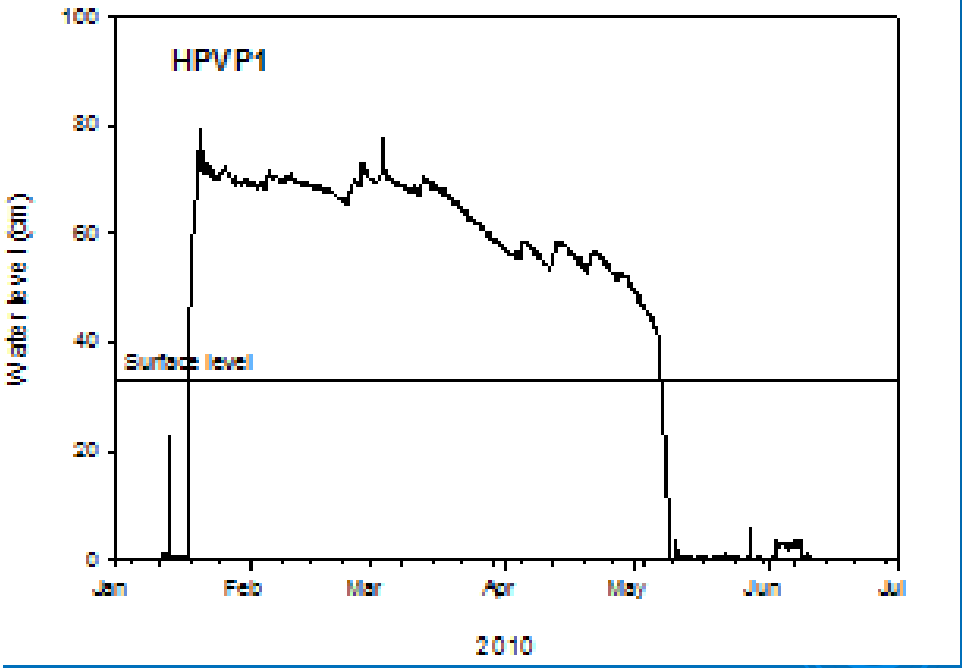


Water Input: Rainfall (40% to 60%) + Uplands

Enough Water to Saturate the Soil
(40% to 50% of soil is air)

Variation in Vernal Pool Hydrology Due to Soil Profile





Soils

Soil series known to have water-restricting zones in the soil profile:

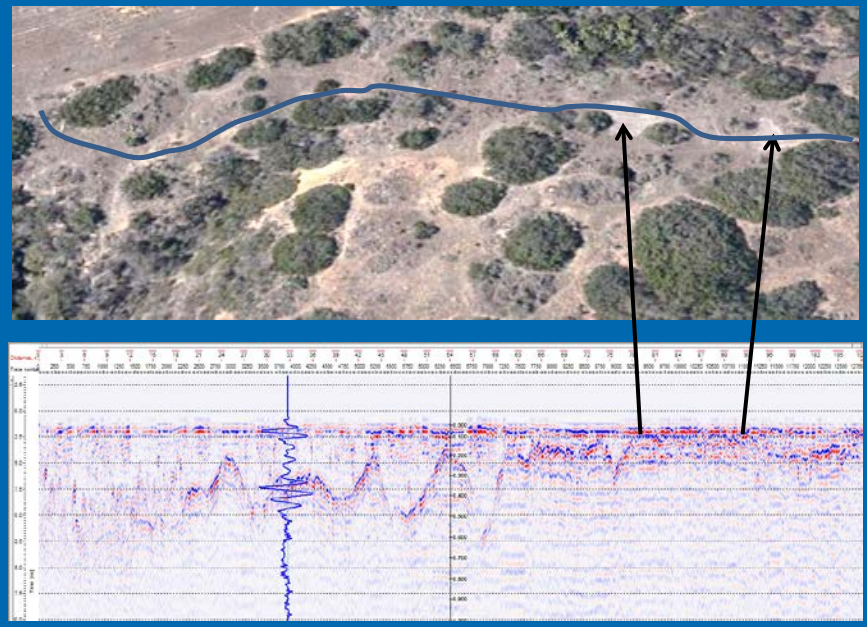
- San Joaquin Series
- Redding Series
- Hedge

Measuring Soil Water-Restricting Layers

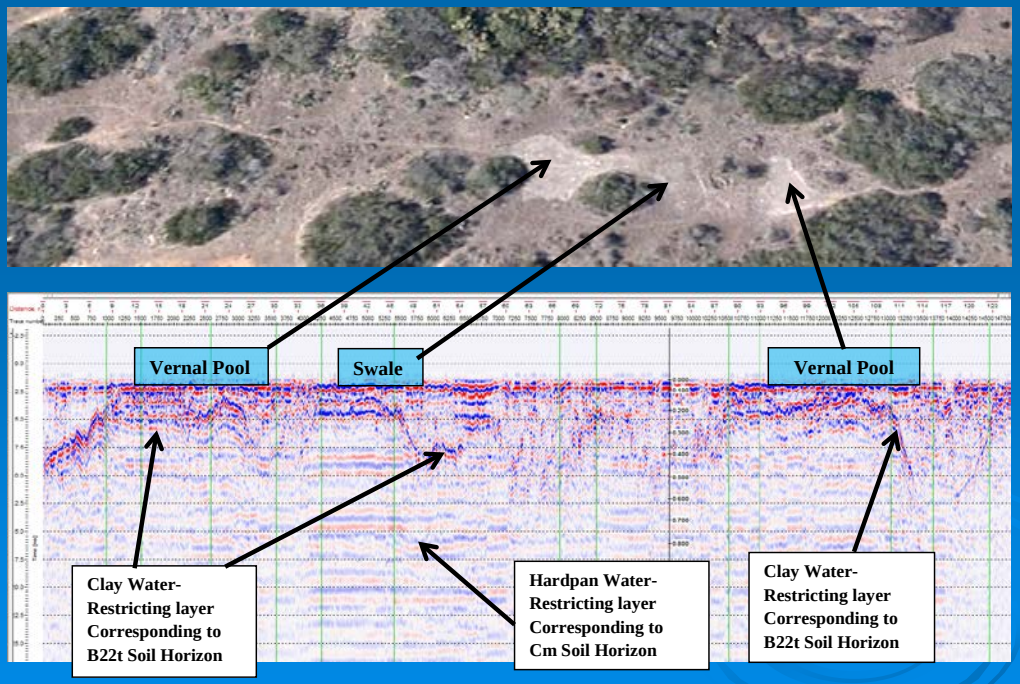
Ground-Penetrating Radar

GPR Maritime Chaparral

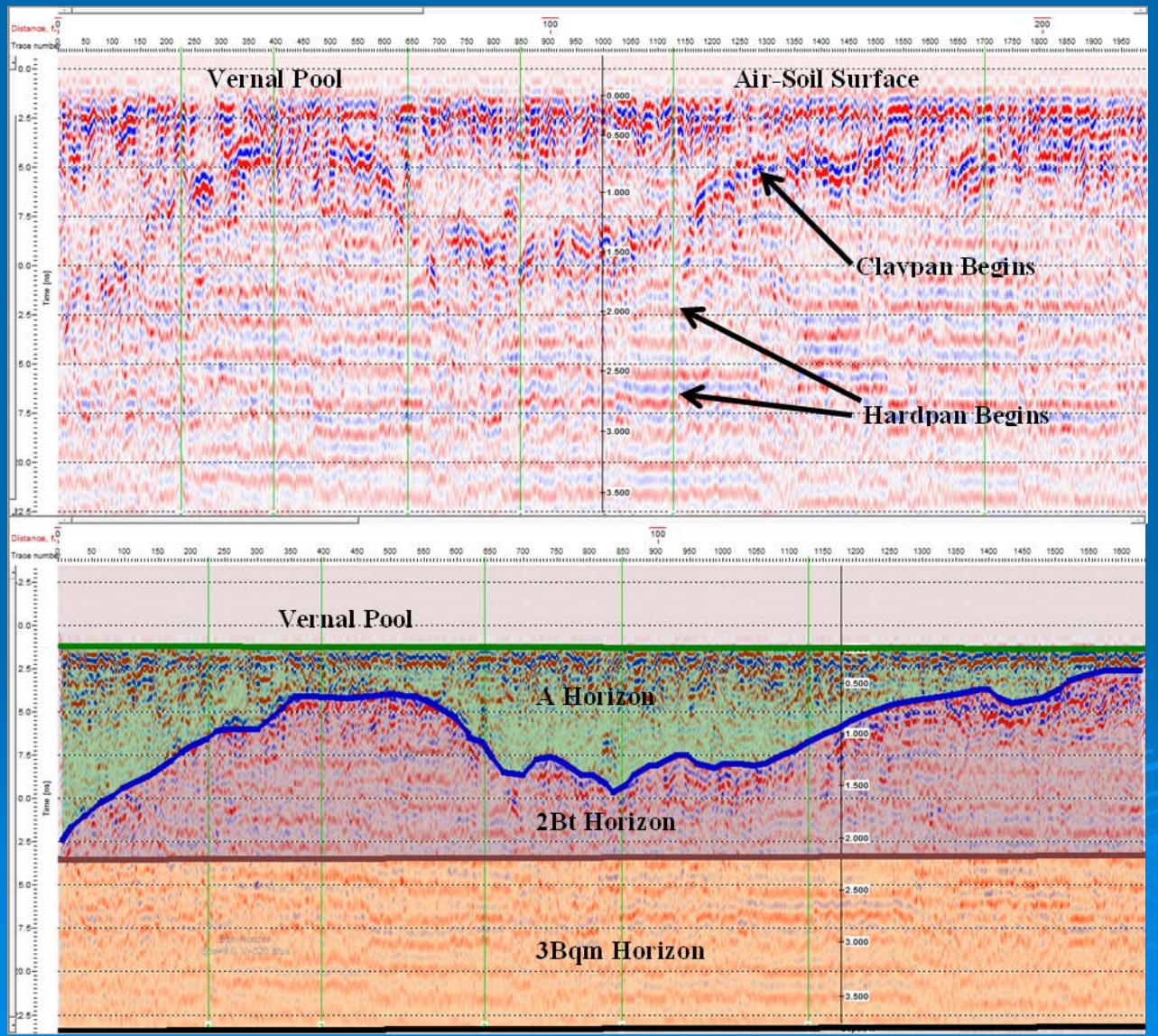
Figure GPR Transect Across Vernal Pool Landscape at MCB Camp Pendleton



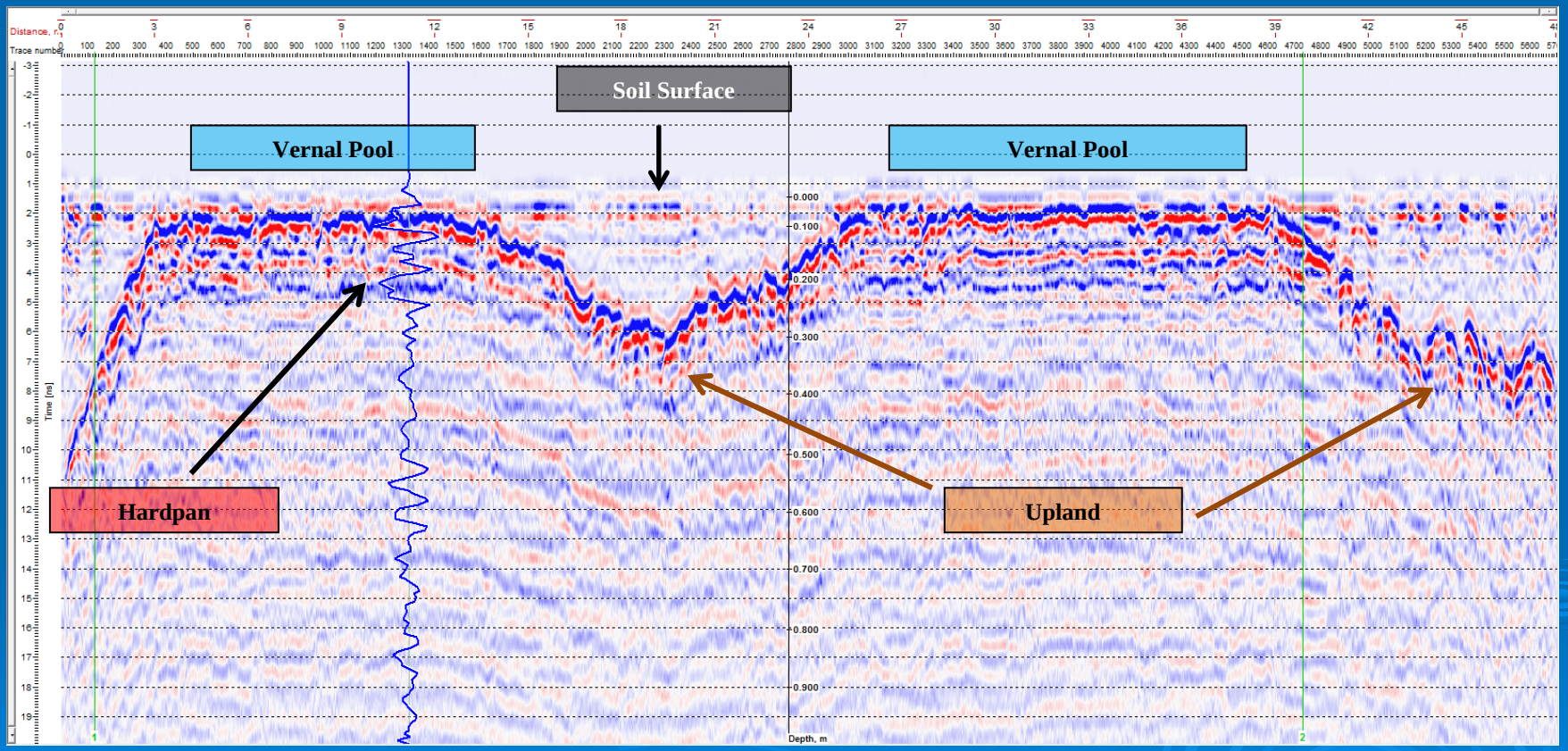
The GPR soil profile shows the presence and depth to the water-restricting layer along a surface transect at MCB Camp Pendleton.



Ground Penetrating Radar and Soil

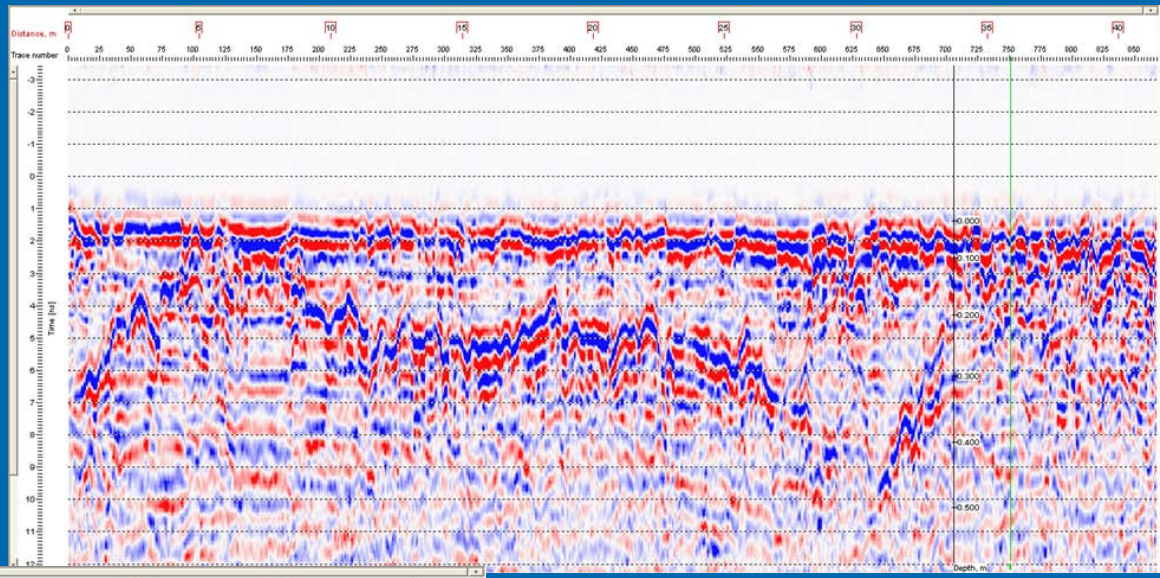


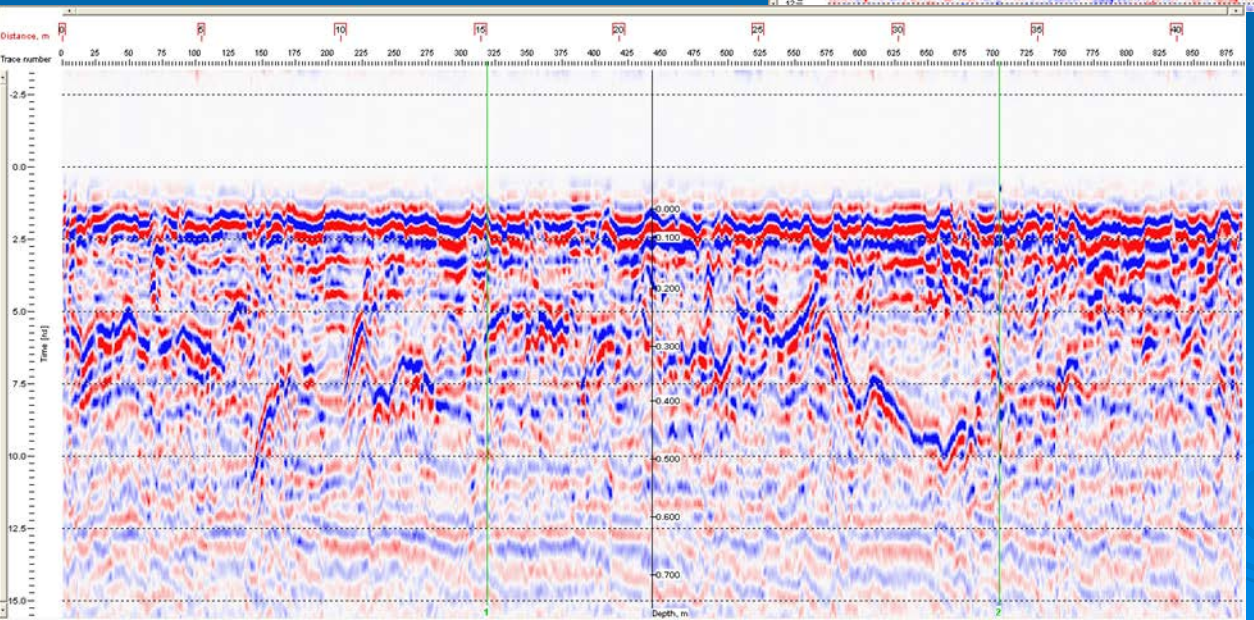
Ground-Penetrating Radar Profile of Vernal Pool Landscape



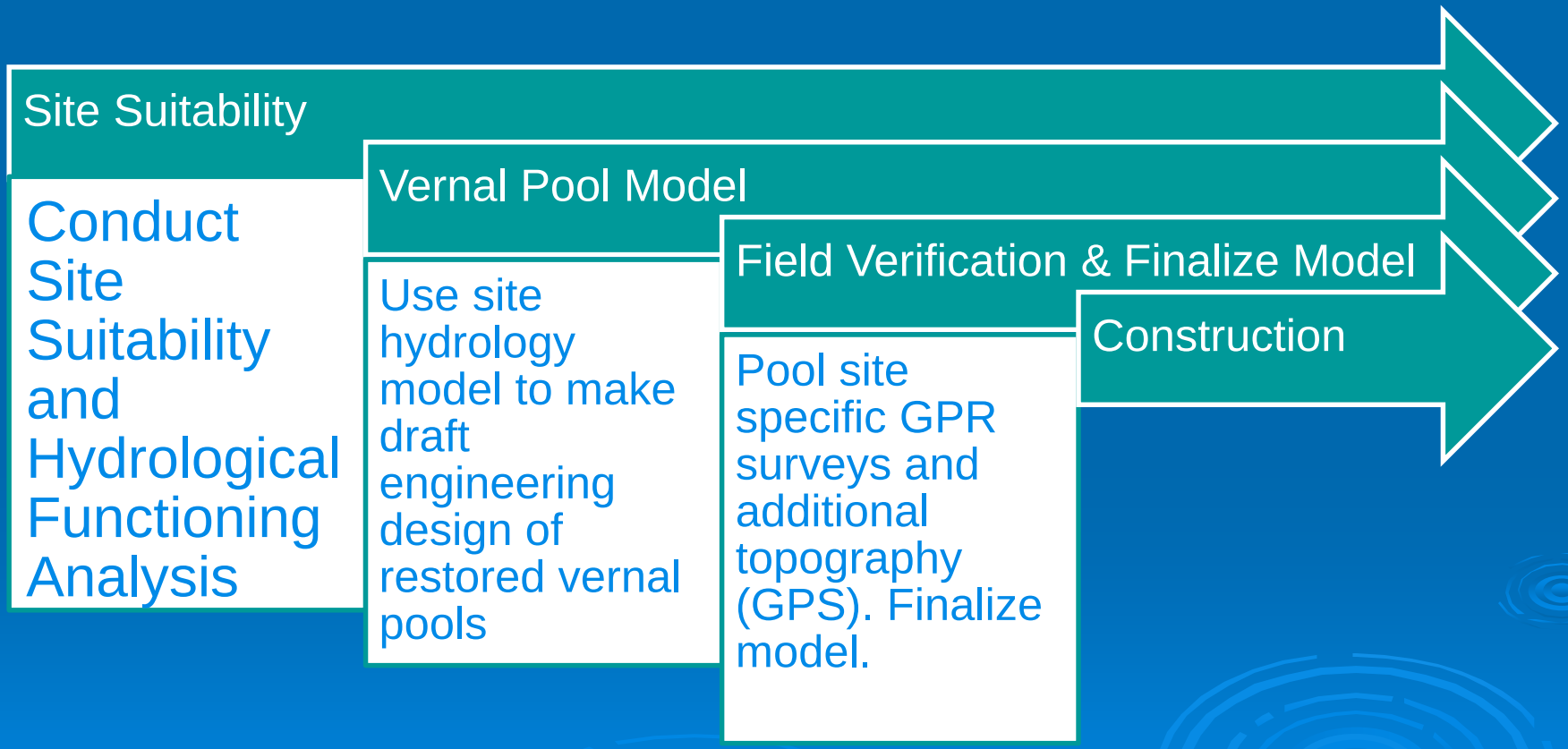
Huerhuero Loam

A Horizon = Loam
B Horizon = Clay
C = Sandstone





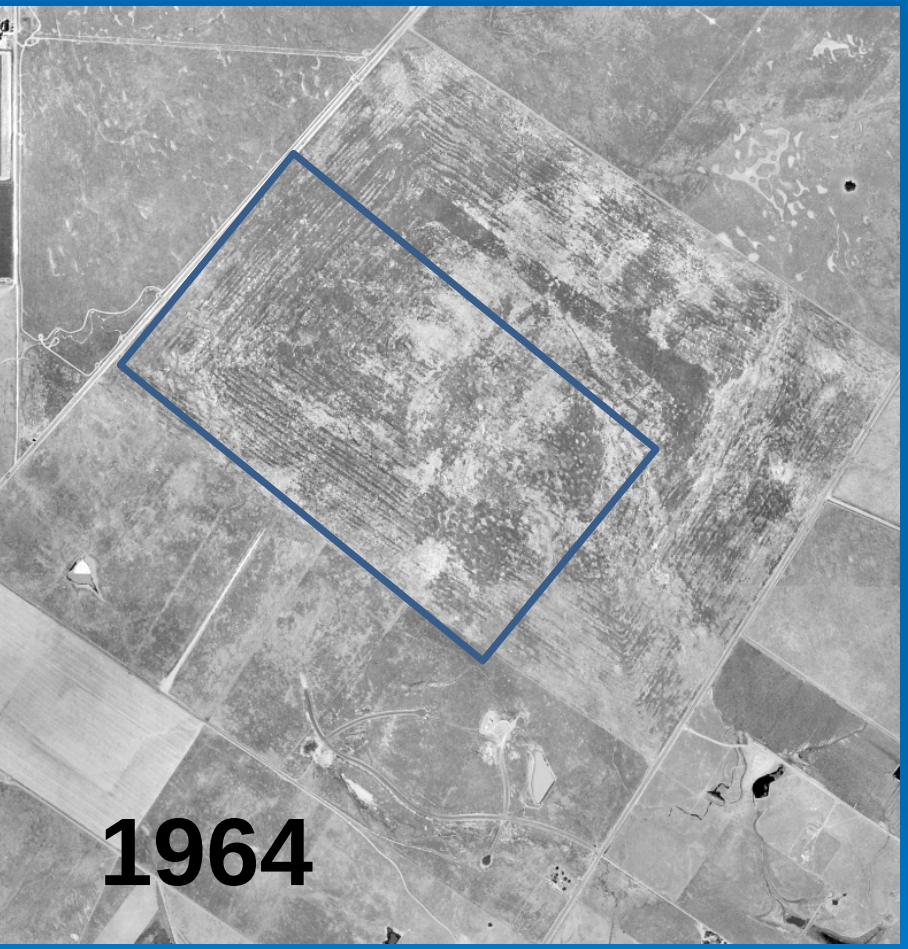
Vernal Pool Site Assessment and Restoration Engineering Design Process



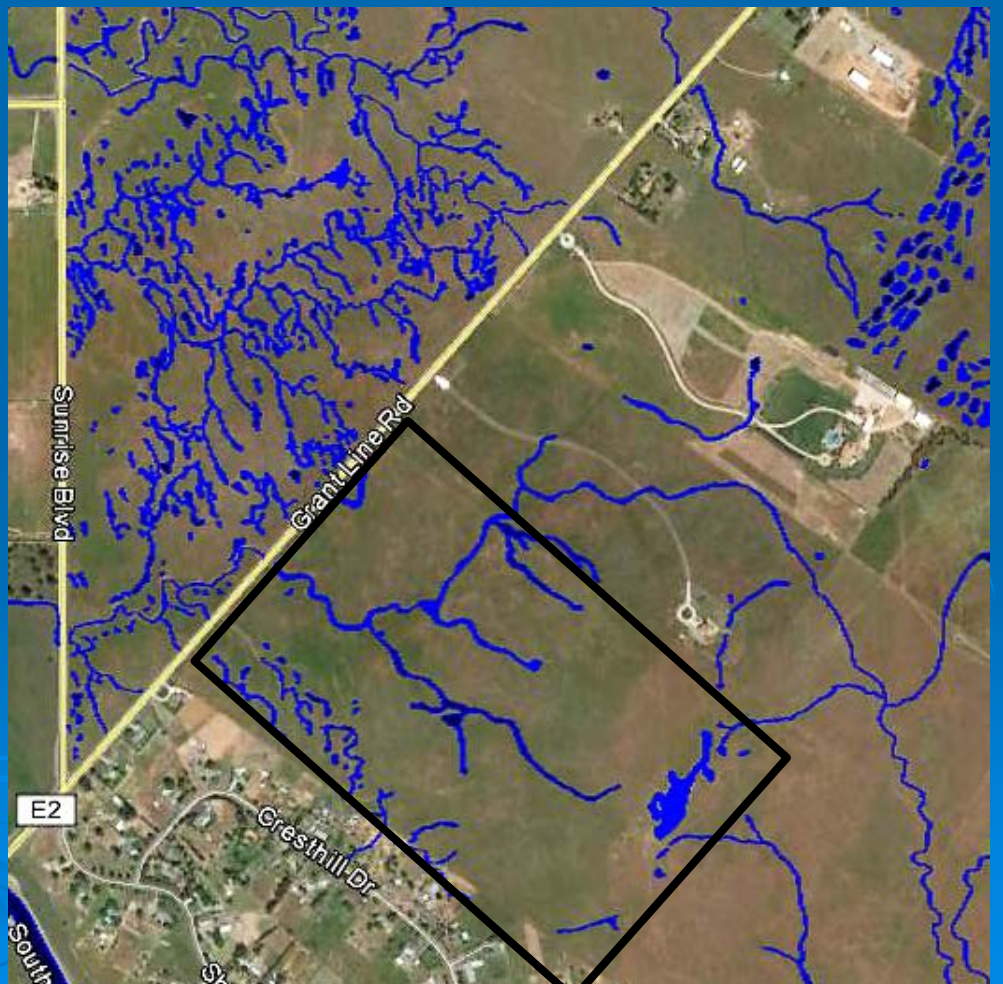
Step 1 Site Suitability & Constraints

- Identify the Site has Suitable Topography
- Identify the Site has Suitable Soil with Water-Restricting Layer and Depth
- Identify Location of Existing Wetlands
- Conduct Hydrological Analysis of the Site
  - Catchment/watershed area and slope
  - Direction of water flow
  - Measure seasonal hydrology or compare with similar sites and wetlands

Historical

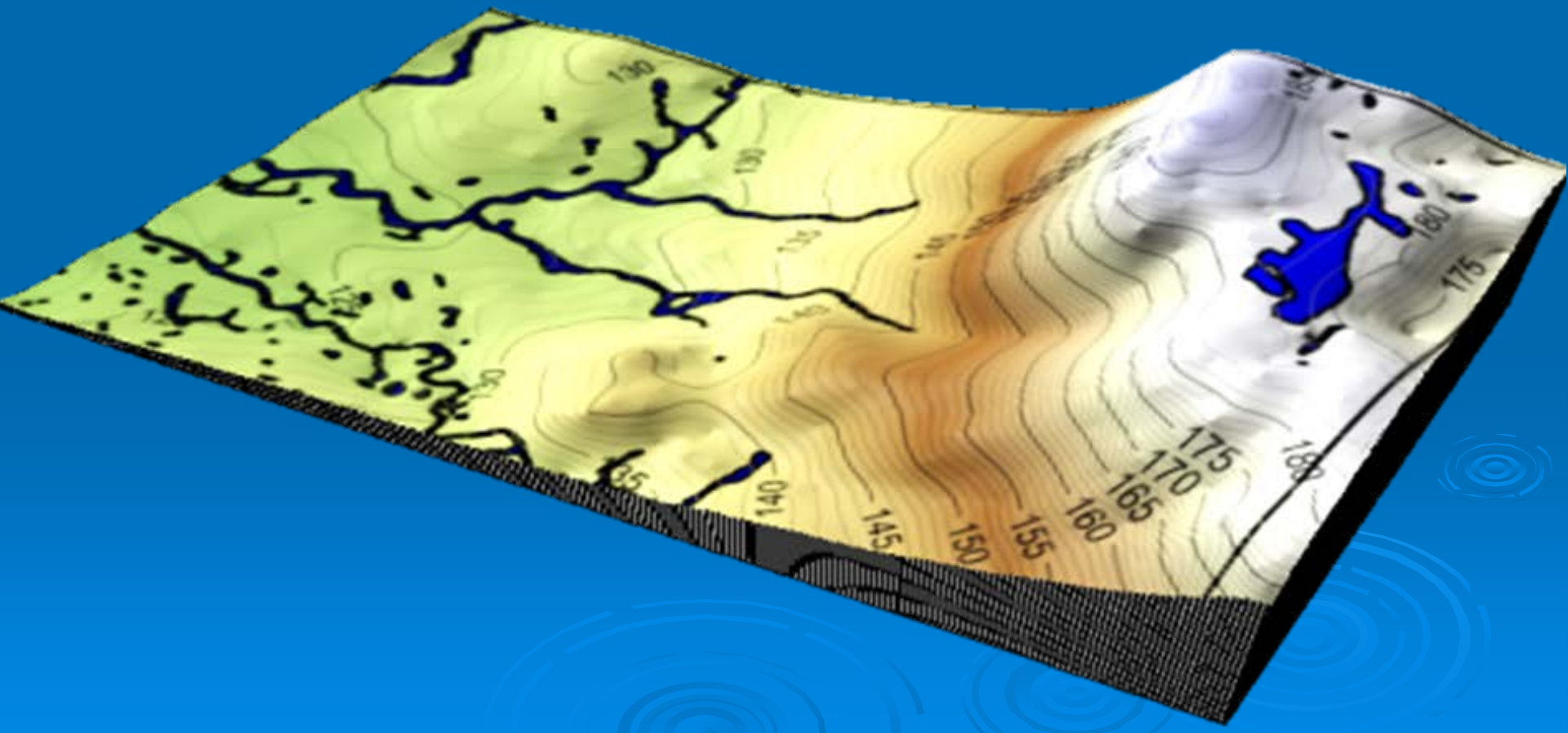


Current



142.8 acre site

Existing Topography and Wetlands



Soil Series

San Joaquin

A – Loam

Bt - Loam

2Bt- Clay (claypan)

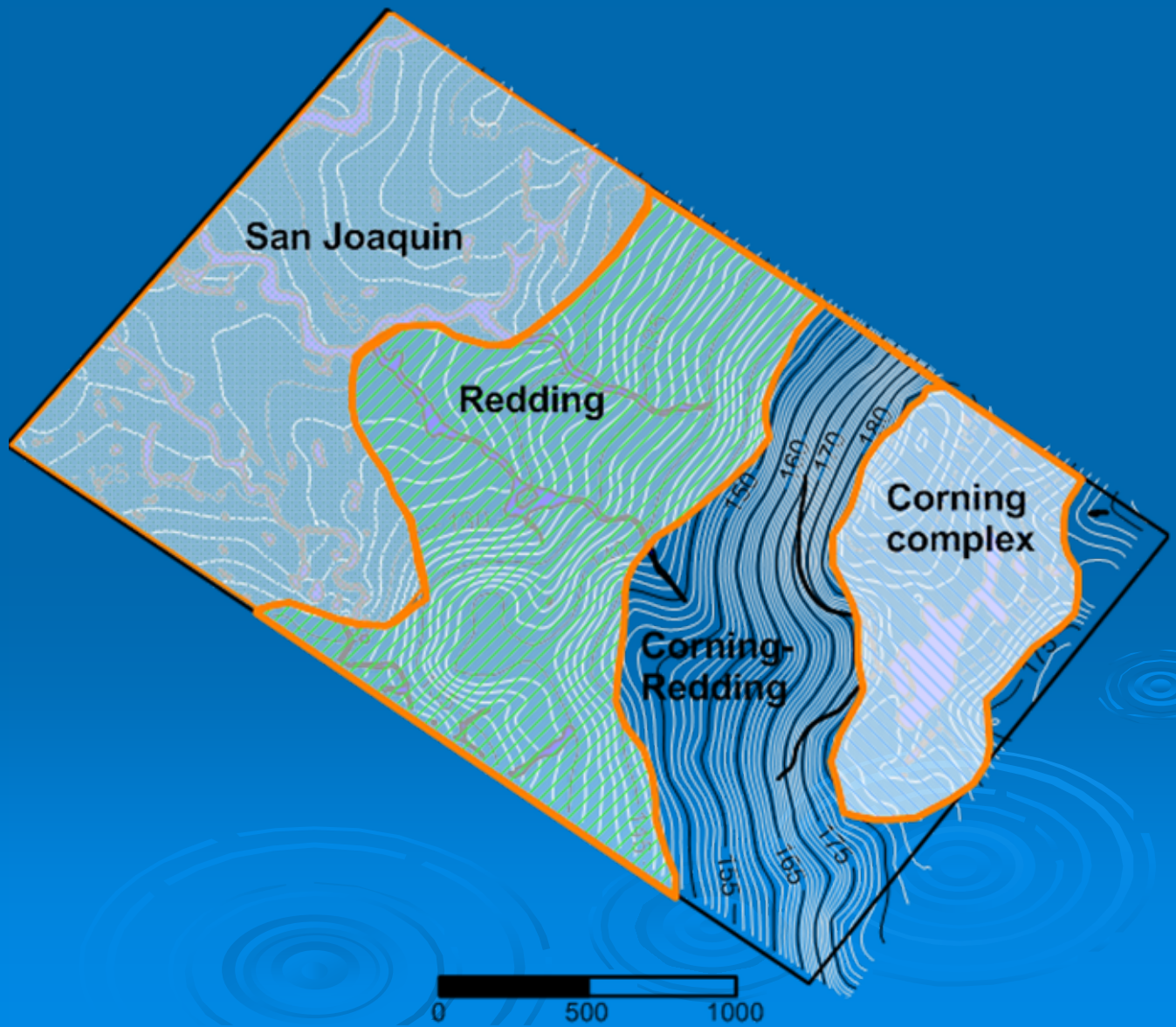
Bqm - Hardpan

Redding

A – Gravelly Loam

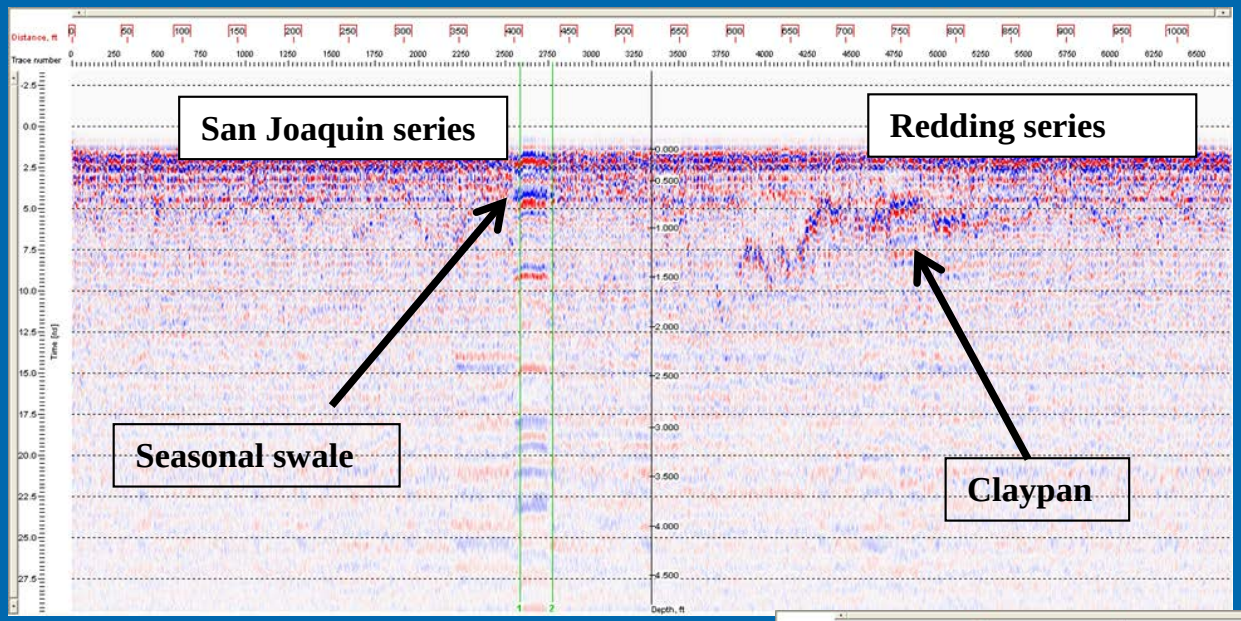
2Bt – Clay (claypan)

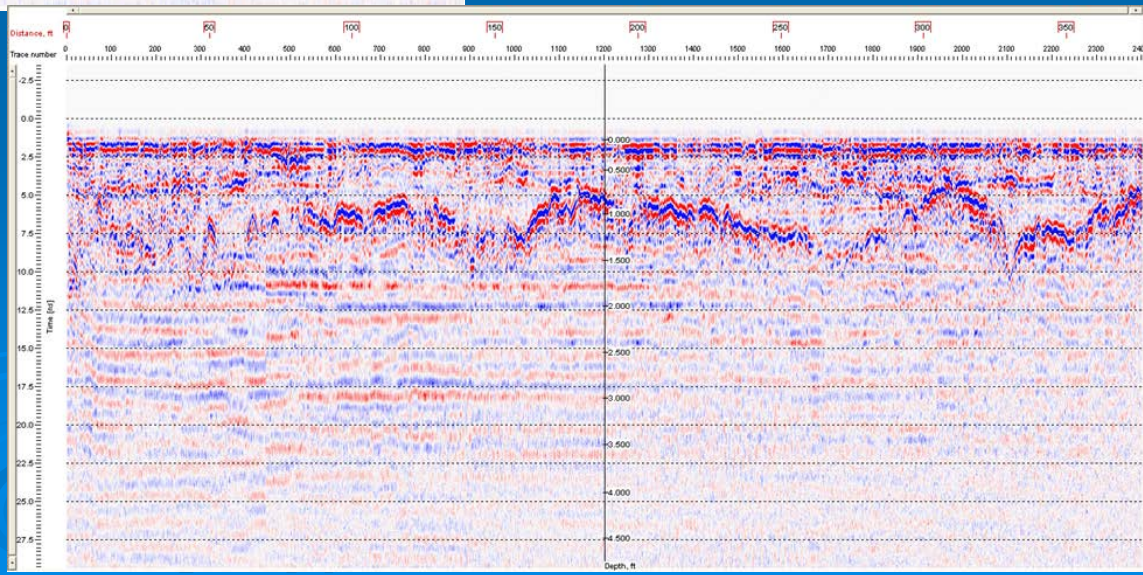
Bqm - Hardpan



Ground-Penetrating Radar Transects

Ground Penetrating Radar Transects

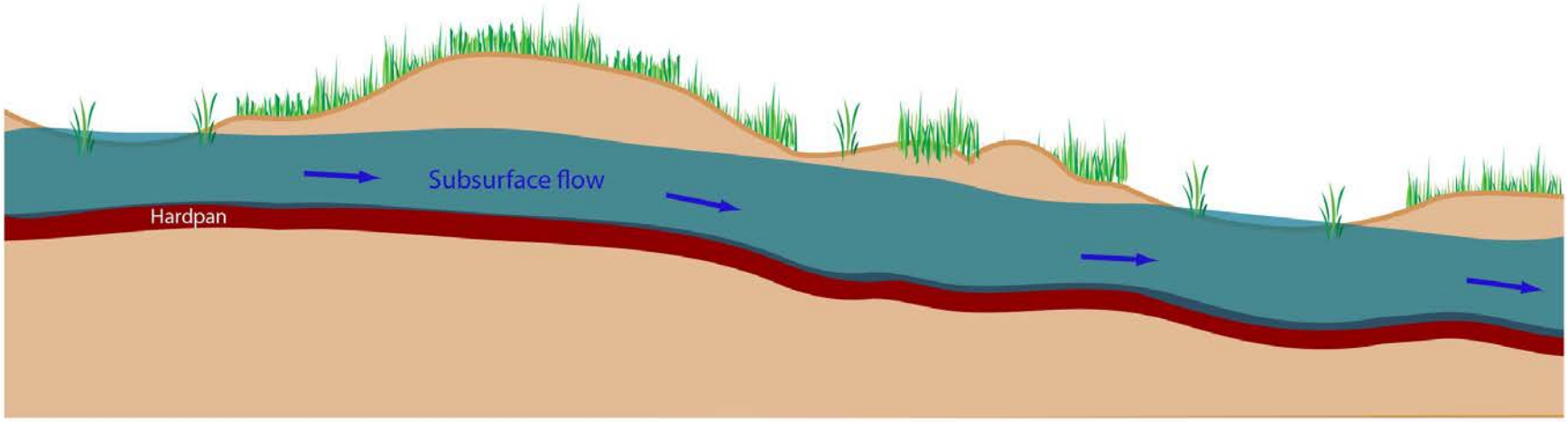




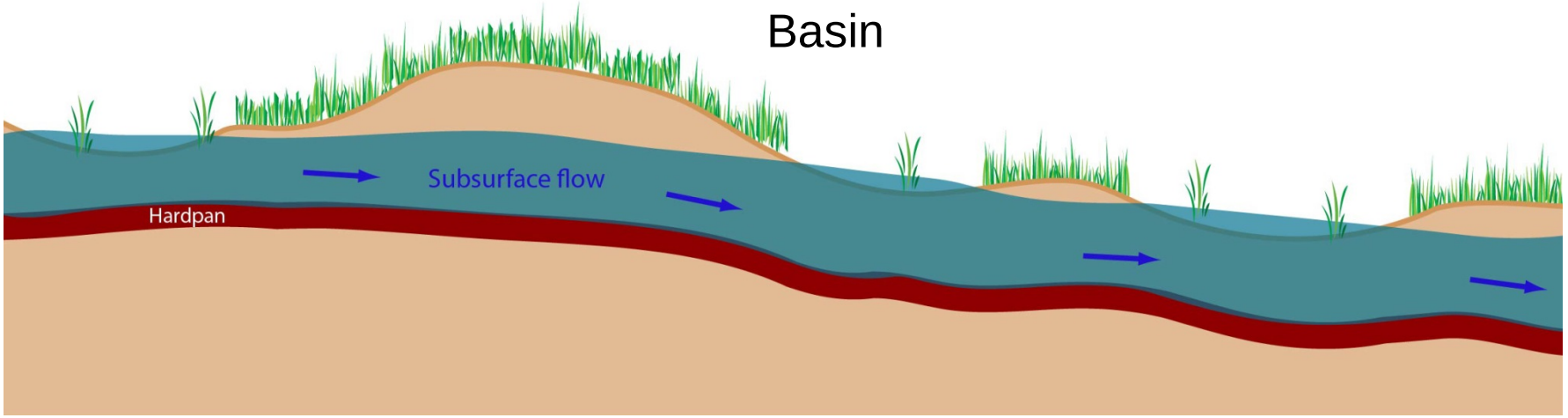
Step 2 Conceptual Design and Engineering of Created Pools

- Identify and Map Potential Locations for Wetland Restoration or Creation,
- Conduct Hydrological Analysis of Site with Created Vernal Pools
  - Model the affect of created pools on existing wetland hydrology,
  - Model the hydrology of the created pools.

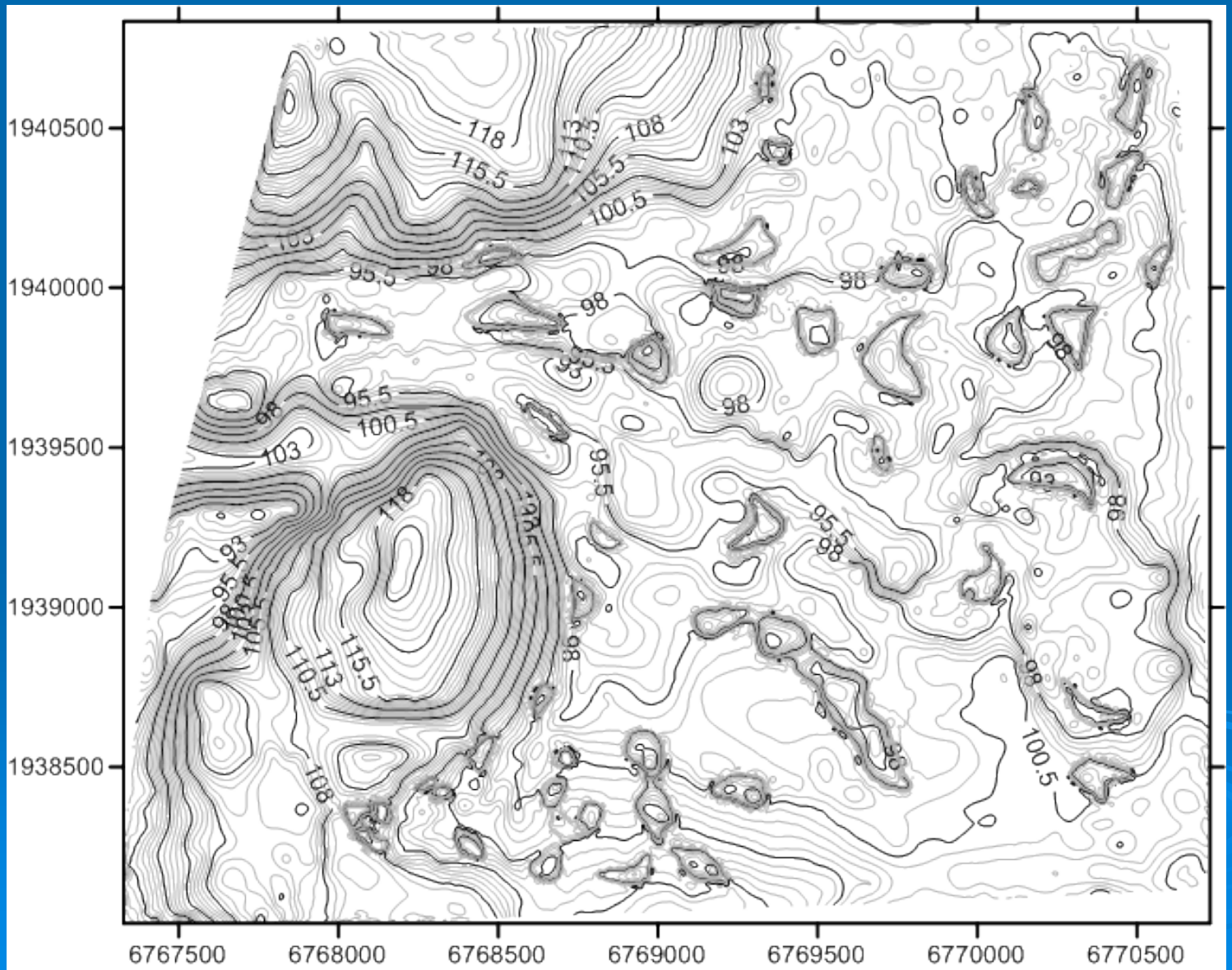
Model of Surface Change to Create New Vernal Pool Basin



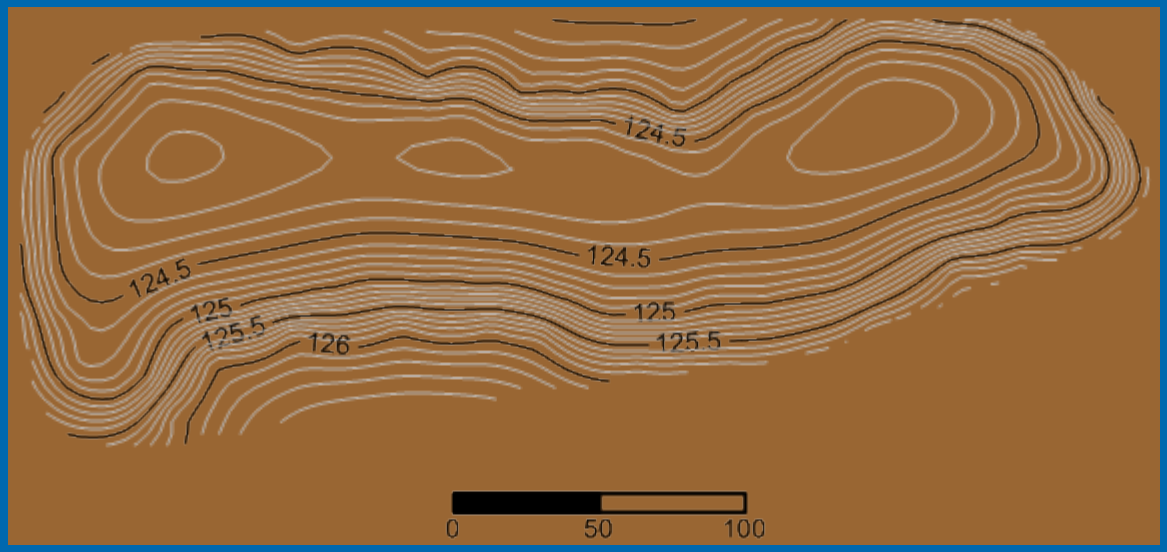
New Pool Basin

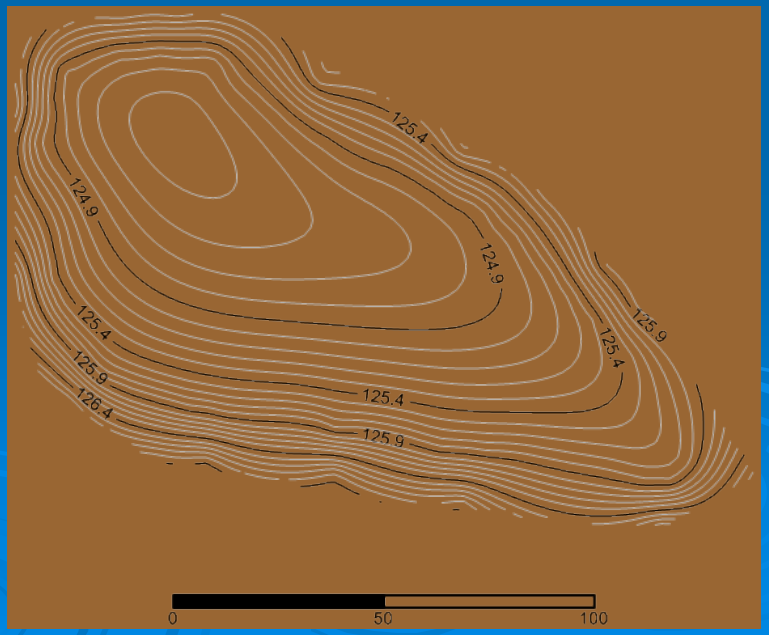


Complete Vernal Pool Grading Model



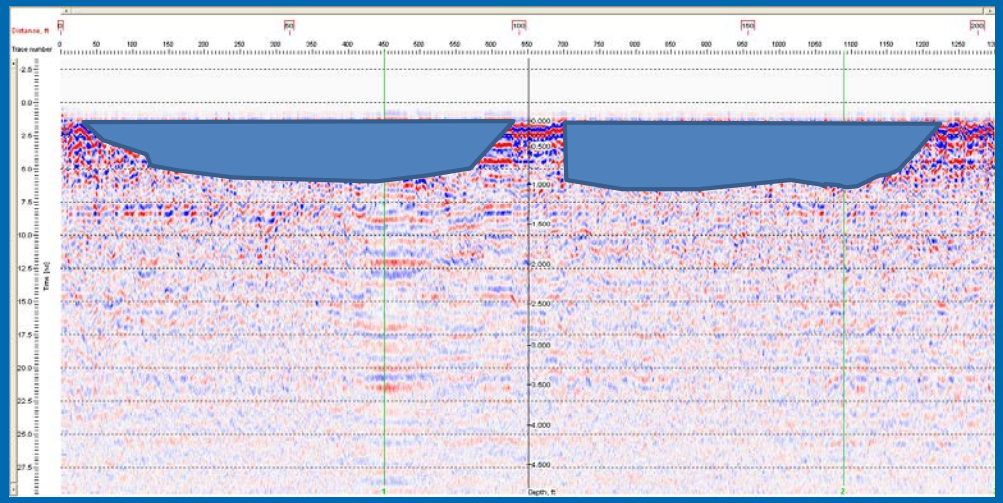
Vernal Pool Topography



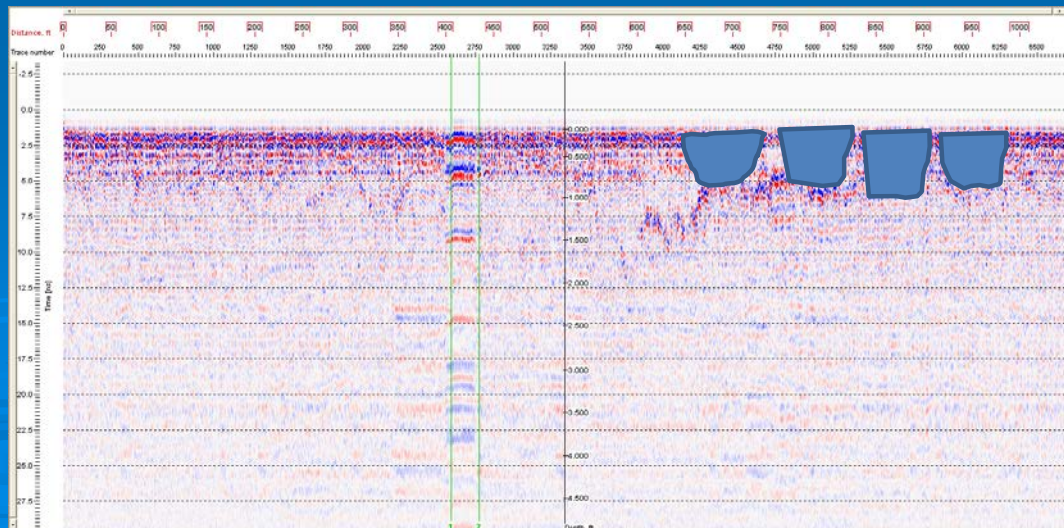


Pool Location & Soil Water Restricting Layers

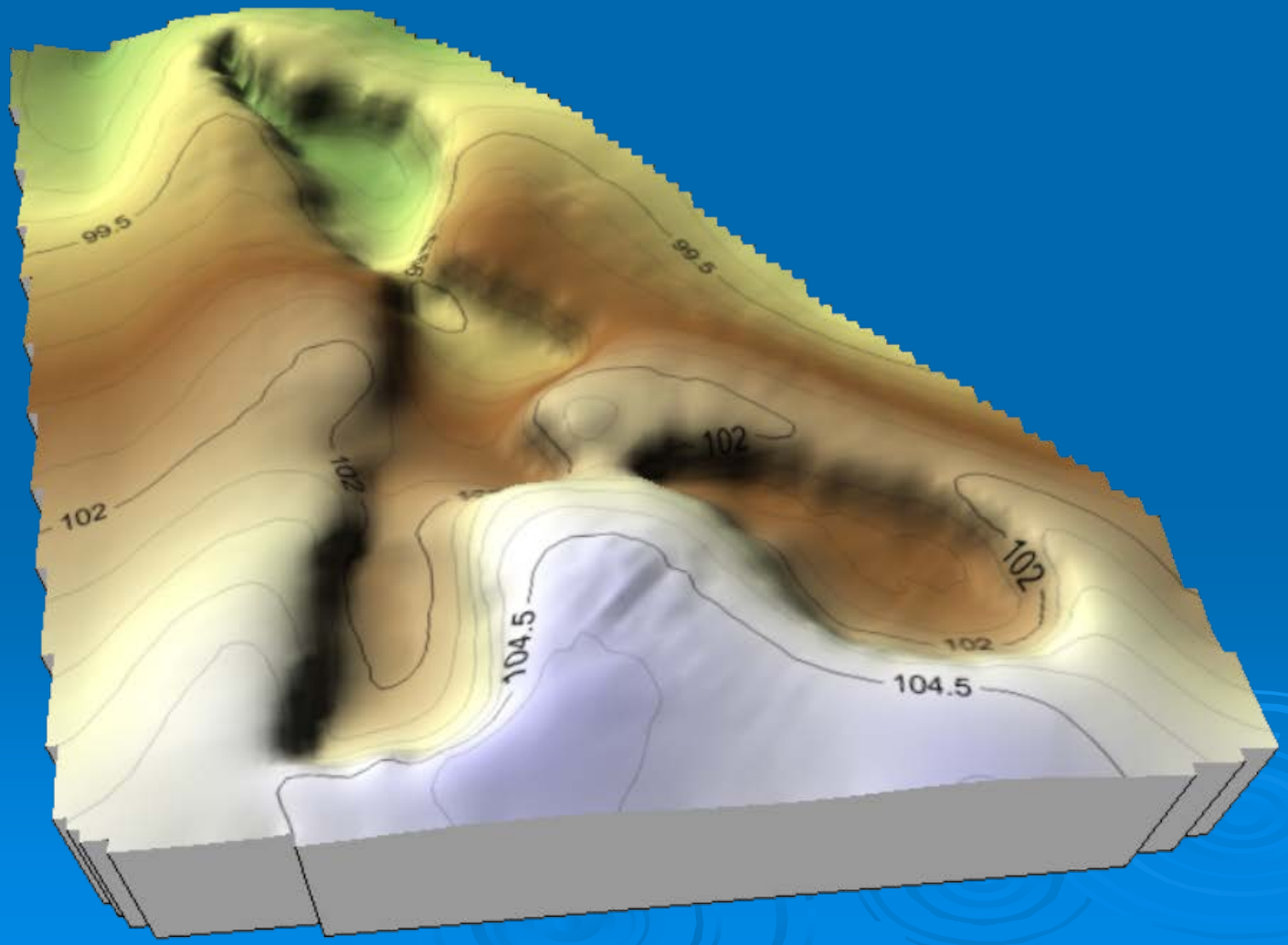
DAT 36B - Pools 6 & 7



DAT 39B – Pools 12, 13, 14, 17



Digital Elevation Model of Every Vernal Pool



Disturbed Soil Sites

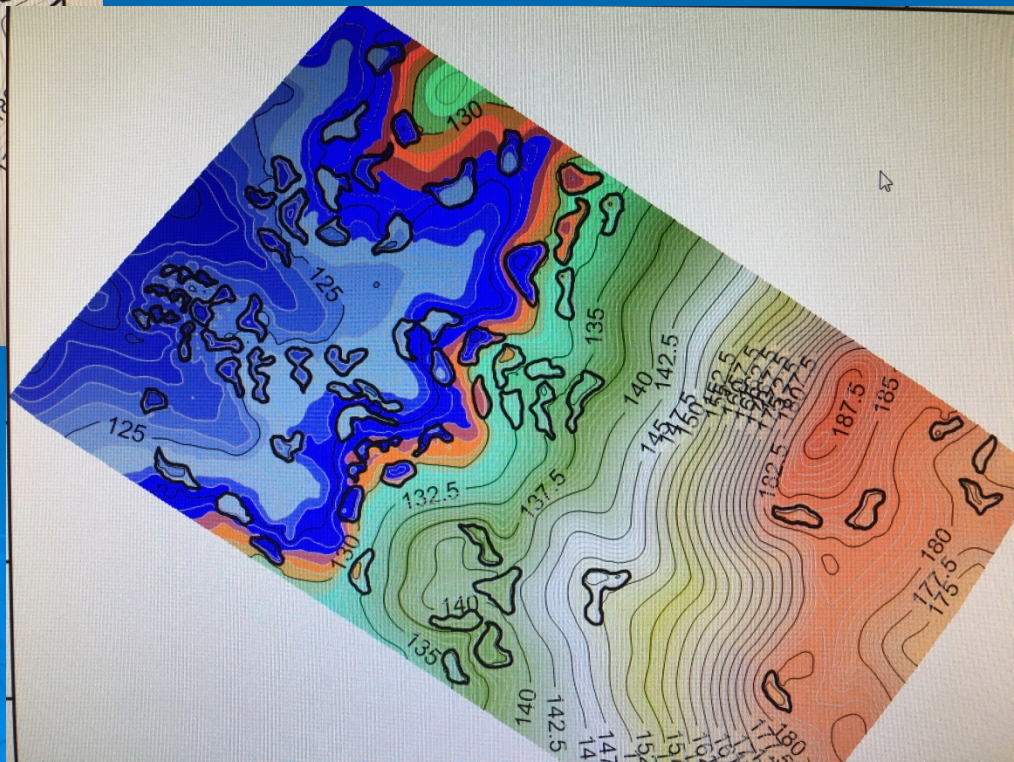
Disturbance of the natural topography and soils result in challenges in GPR measurements, and with continuity of the soil texture, and depth to water-restricting layers.

Examples of Disturbance:

Mixing of soil horizon, excavation, and compaction. Rice fields, farming equipment, tanks, and helicopters.

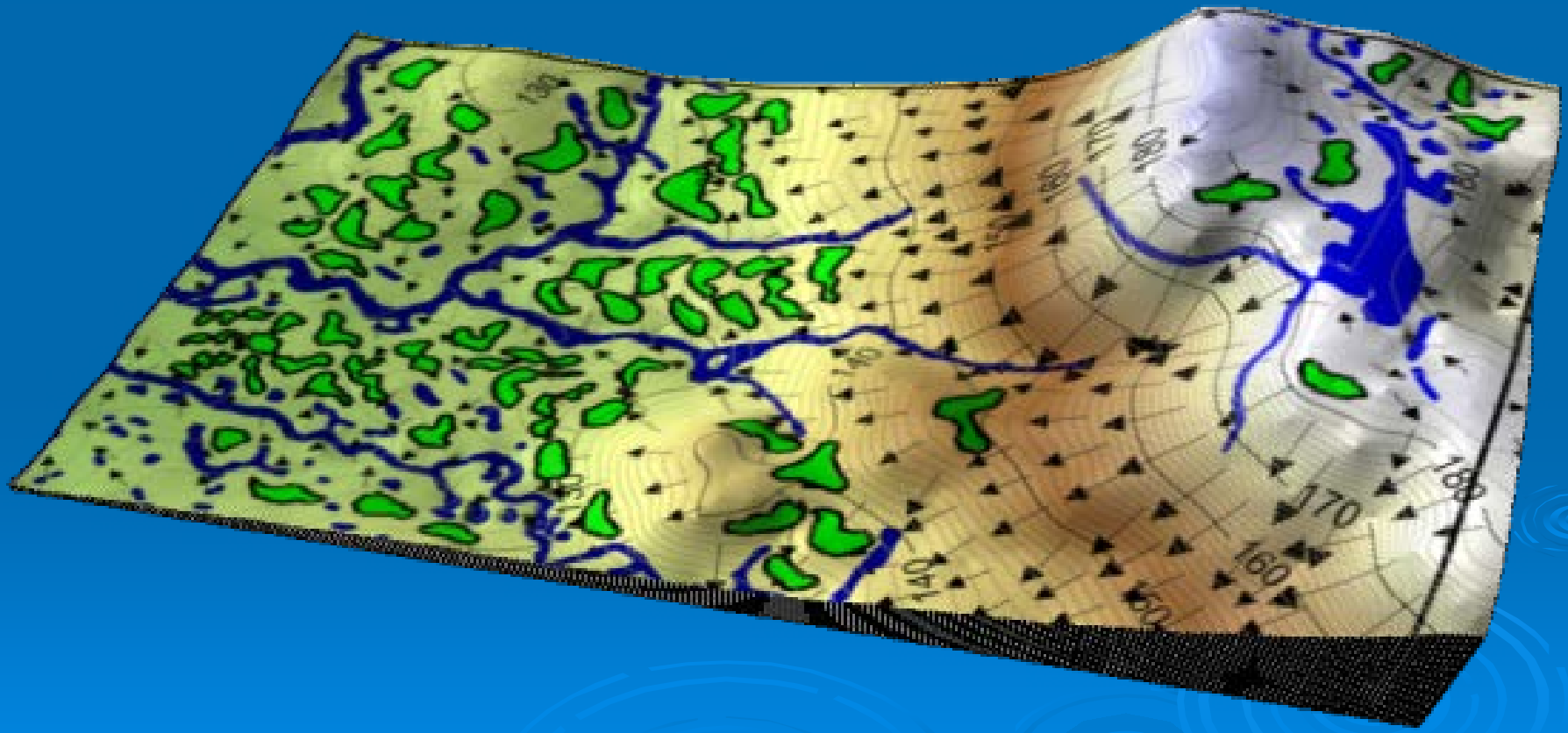
Vernal Pool Hydrology Modeling

Effect of different amount and seasonal timing of rainfall on the vernal pool hydrology

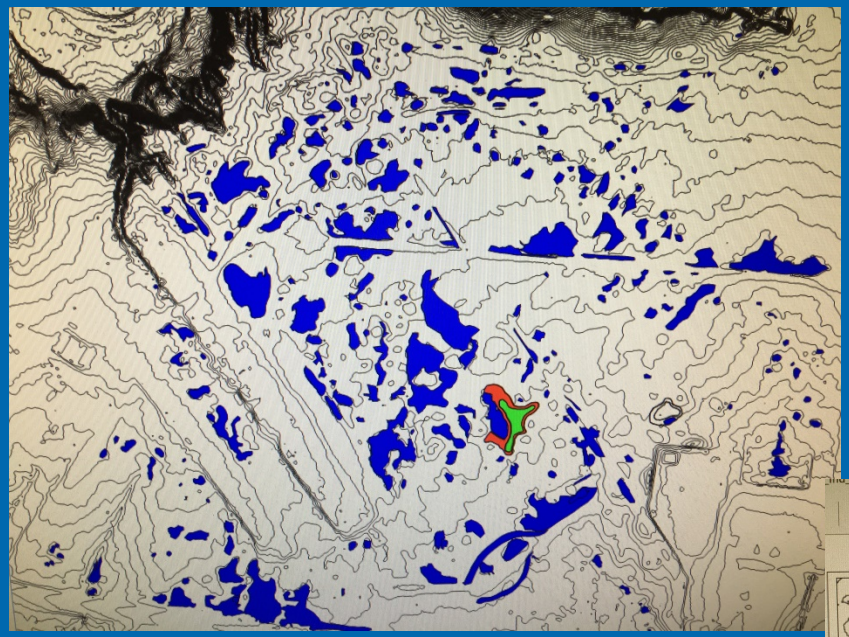


3-D Vernal Pool Landscape Model

Figure 4-5 Vector water flow model of post construction topography of the Rooney Property

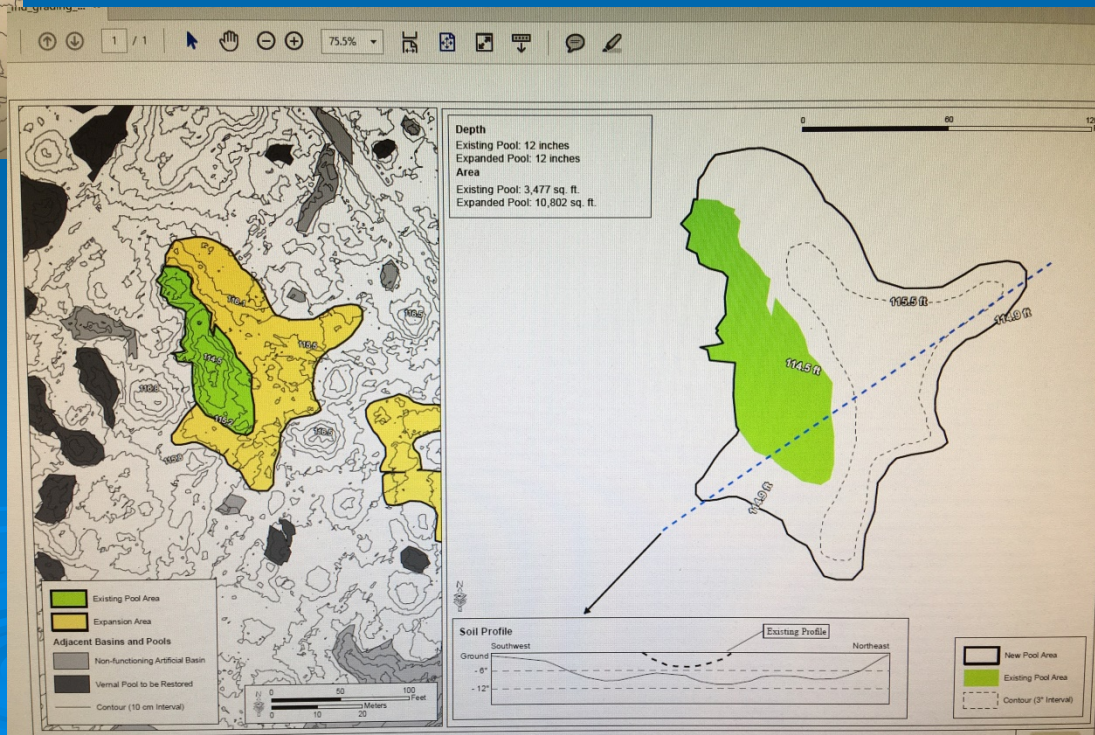


Lidar Topography



Restoration of vernal pools on

Huerhuero loam



Step 3 Field Verification and 4 Construction

- The locations of potential vernal pools is surveyed in more detail using GPR and additional GPS for a more accurate topographic model
- The vernal pool 3-D computer model is converted into a GPS coordinate model.
- The primary bulldozer has GPS antenna on each side of the blade.
- Grading of vernal pools within 0.1 feet.

Construction of Vernal Pools

Restored Vernal Pols

Notes

- The size, shape, and location of pools depends on the physical setting,
- Predicting the hydrology during dry to wet rainfall years with varying seasonal distribution is key to predicting the outcome,
- Hydrological monitoring critical. If they don’t have water the first year there is a problem.

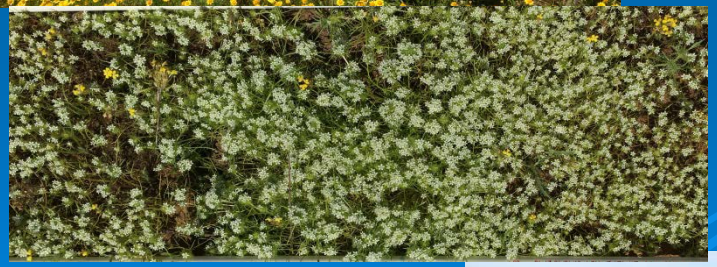
Potential Outcomes

Wetter

Eleocharis

Downingia

Lasthenia



Navarretia

Drier

Festuca perennis
non-native

QUESTIONS?