
Photo: Bruce Orr

Fillmore and Piru Basins Groundwater Dependent Ecosystems

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Stillwater Sciences

Outline

- What are GDEs
- Approach
- GDE Units and their composition
- GDE trends through time
- Groundwater-dependent special status species

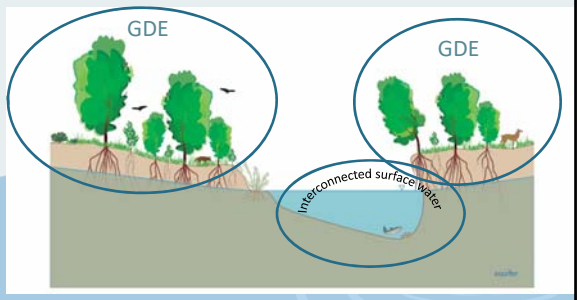

Photo: Bruce Orr

Groundwater Dependent Ecosystems (GDEs)

DWR defines GDEs as ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface.

GDEs occur in a variety of different environments ranging from seeps and springs, to groundwater-dependent wetlands, to aquatic and riparian ecosystems associated with rivers that partially or entirely rely on groundwater.

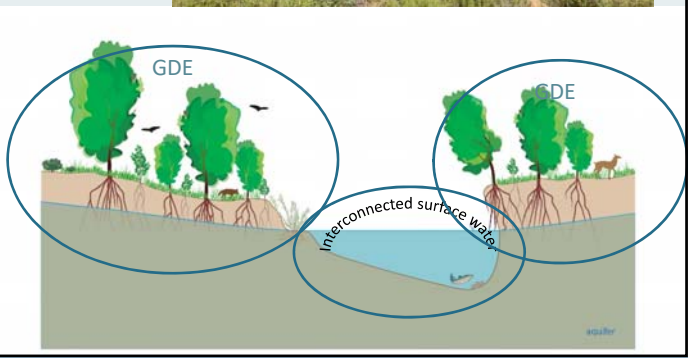
Our Goal is to define the extent and composition of groundwater dependent ecosystems to provide the basis for assessing



Braudrick et al., 2018 (figure by K. Rodriguez)

Part 1. GDE Mapping

1. What plant communities occur in the Fillmore and Piru Basins?
2. Are the plant species likely to be connected to groundwater ?
   - How deep are their roots?
   - How deep is the groundwater?
3. What is the extent of interconnected surface water?



Braudrick et al., 2018 (figure by K. Rodriguez and A. Merrill)

The Fillmore and Piru Basins have had 3 historical forested wetlands that correspond to areas of rising groundwater

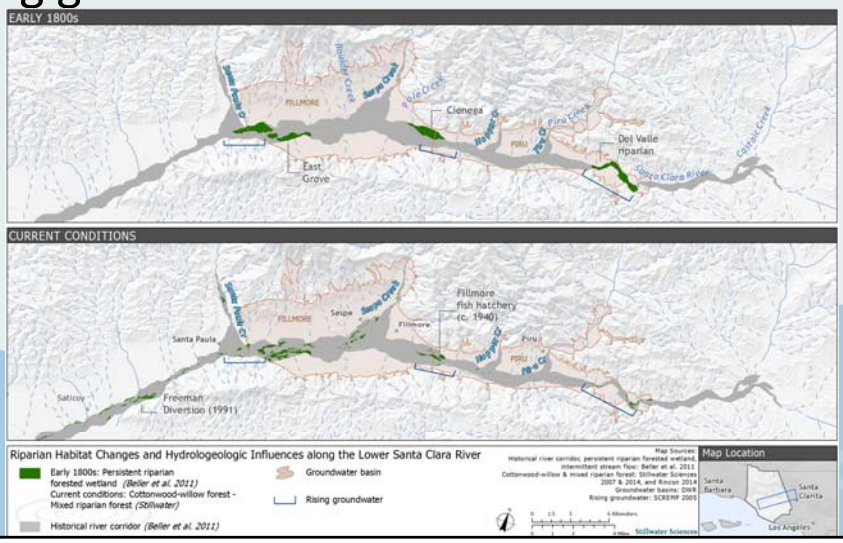
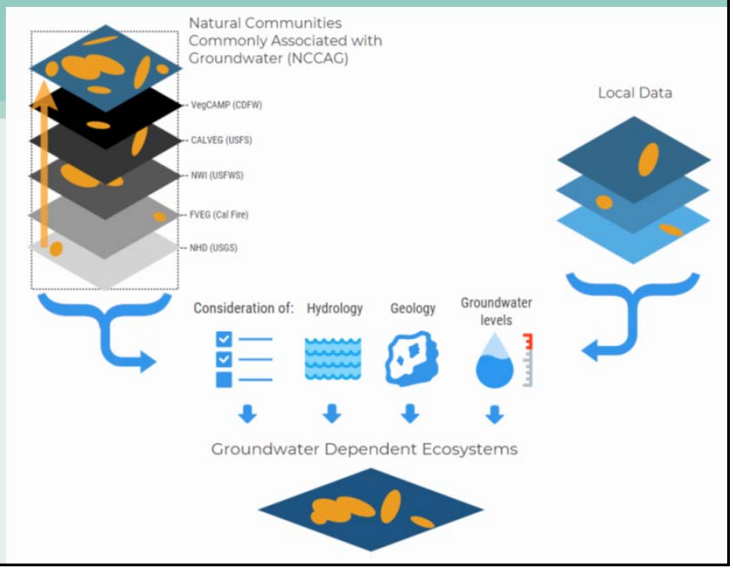


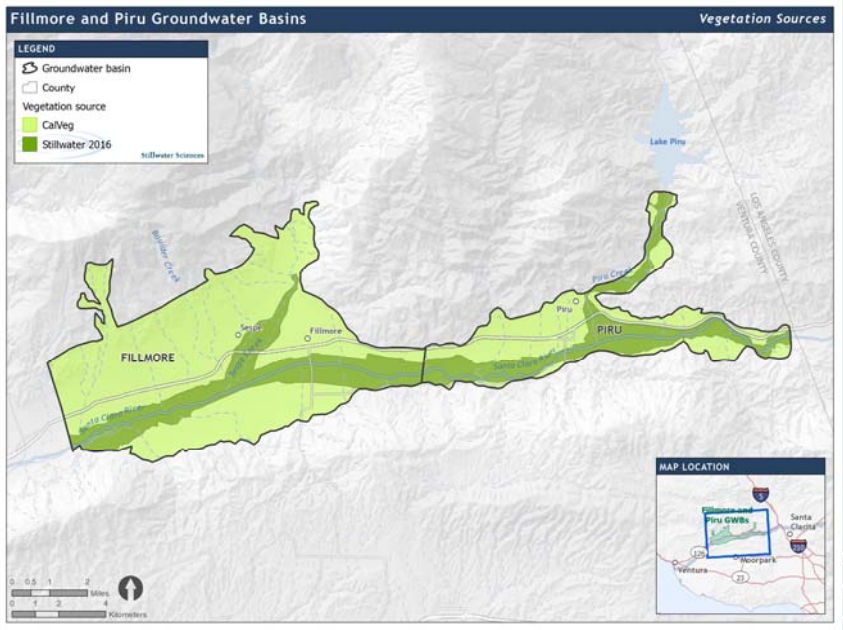

Photo: Bruce Orr

Approach



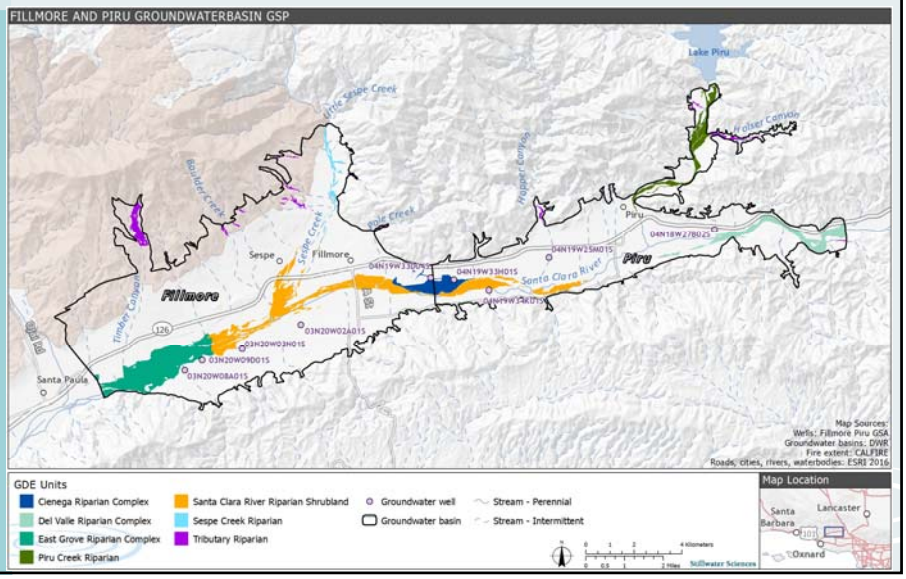
Source Data

- High quality data (Stillwater Sciences 2016) along the Santa Clara River, data quality is lower (CalVeg-2002) on the margins of the basin

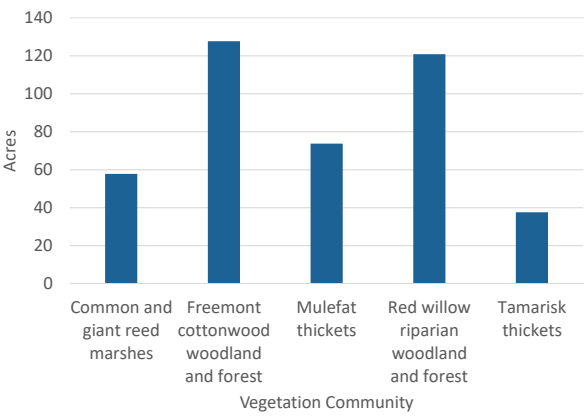


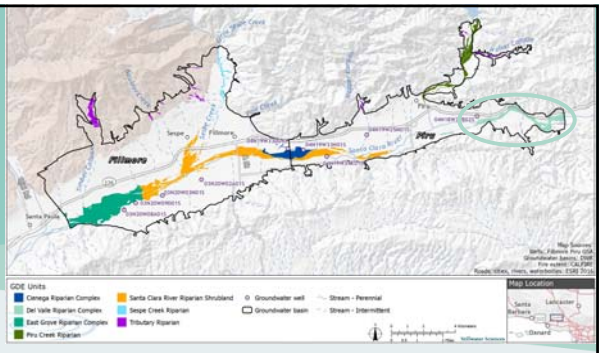
GDE Units

- We identified 8 GDE units.
- 3 have certain connections to groundwater
- 2 may be connected some of the time
- And 3 have little data



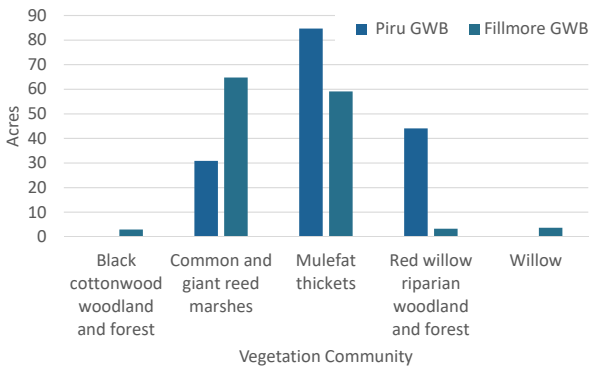
Del Valle Riparian Complex

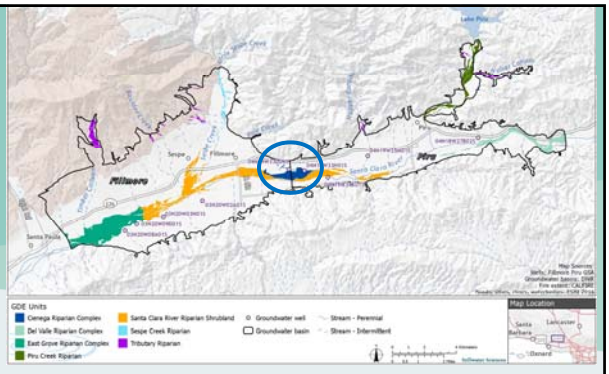




- Historical wetland
- Area of rising groundwater
- Fremont Cottonwoods, red willow, and mulefat at higher relative elevations. Also contains tamarisk and arundo
- Rooting depth of cottonwood and willows 6.7-10 ft
- Effluent releases from Los Angeles County may be important for maintaining the GDE

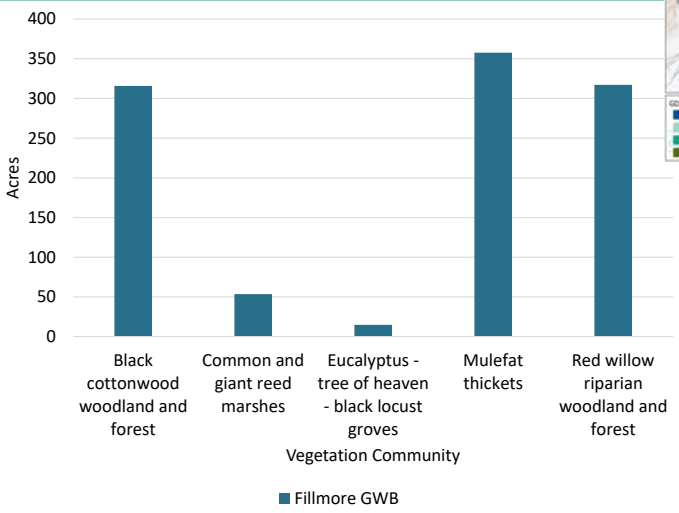
Cienega Riparian Complex GDE Unit

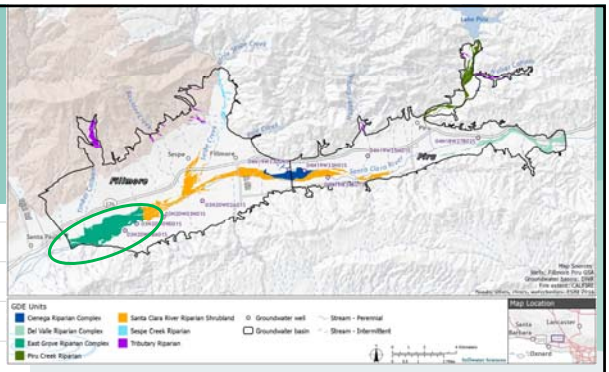




- Historical wetland
- Area of rising groundwater
- Prior to 2012-2016 had extensive cottonwoods and willows which died during the drought (see Chris Kliber presentation)
- Now some willow but mostly mulefat, and arundo.

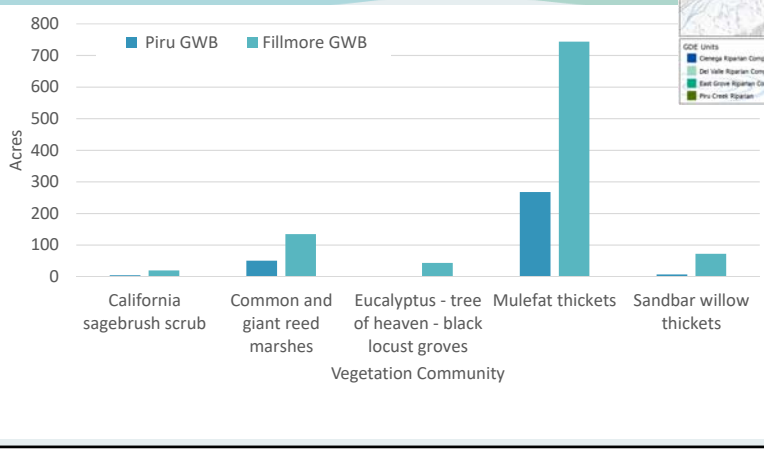
East Grove Riparian Complex

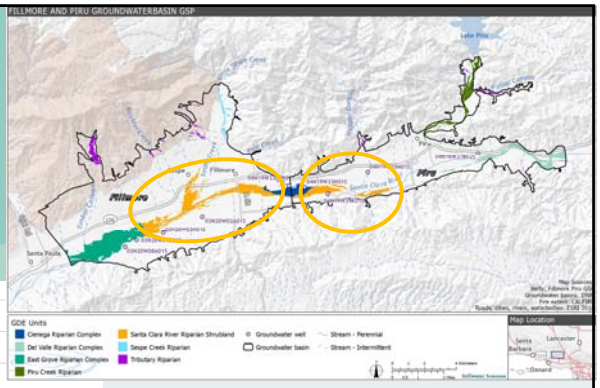




- Historical wetland
- Area of rising groundwater
- Most extensive GDE Unit
- Cottonwood and willows (rooting depth 7-10 ft)
- Mulefat at the higher relative elevation (rooting depth 2 ft)

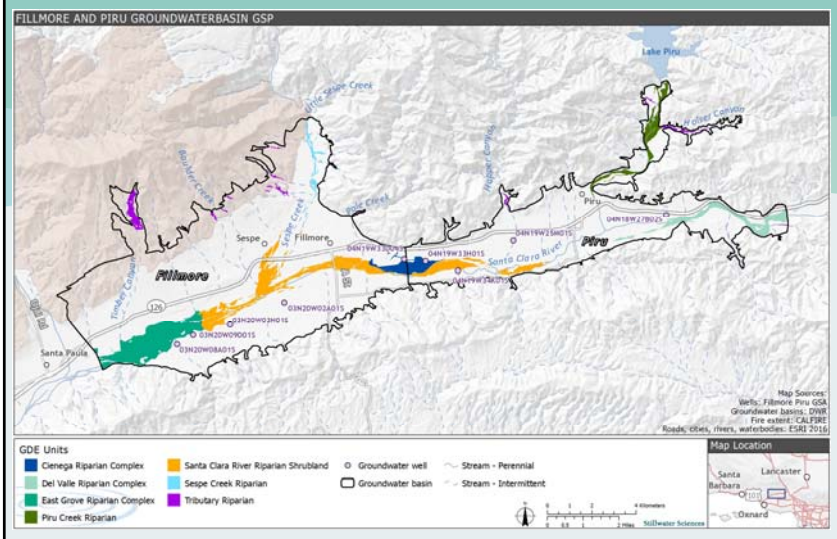
Santa Clara River Riparian Shrubland





- Intermittent section of the stream (no rising groundwater)
- Vegetation is primarily Mulefat (rooting depth ~ 2 ft) with some sandbar willows and invasive plants (e.g., arundo)
- May use groundwater when it is high, but not likely sensitive to groundwater management

Other GDE Units



Tributary riparian

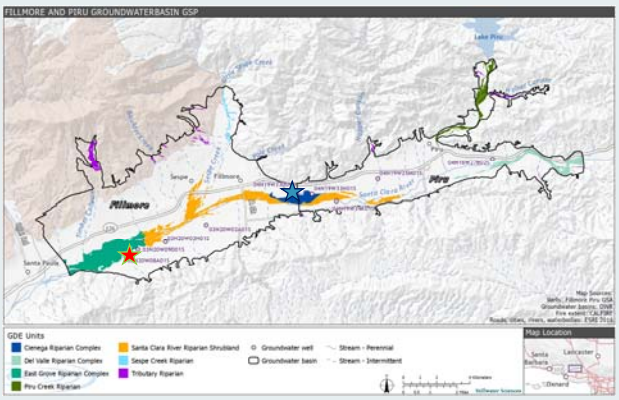
- (mostly oaks, little groundwater data) deep roots (30 ft) little groundwater data
- No shallow groundwater measurements.
- Unlikely to be affected by groundwater management

Sespe Creek Riparian

- (cottonwood, willow, arundo). Shallow groundwater unknown rooting depths of willows and cottonwoods = 7 ft, average relative elevation is 10 ft in SCR.
- Few shallow groundwater measurements

Piru Creek Riparian

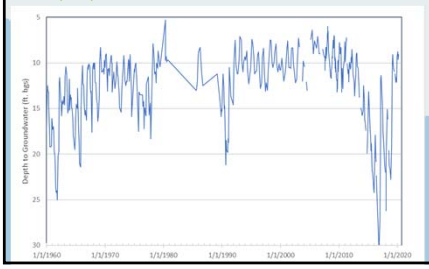
- Cottonwood, willow (roots 7-10 ft) and mulefat (root depth 2 ft)
- Releases from Santa Felicia Dam
- Few shallow groundwater measurements



Groundwater

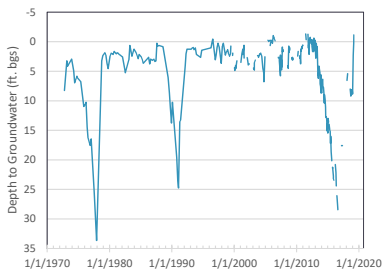
- Groundwater levels decline during droughts but subsequently recover
- Model results presented in January predict that climate change will not significantly alter groundwater levels
- Droughts have the largest impacts on GDEs, lowering the groundwater level below the rooting depth of vegetation

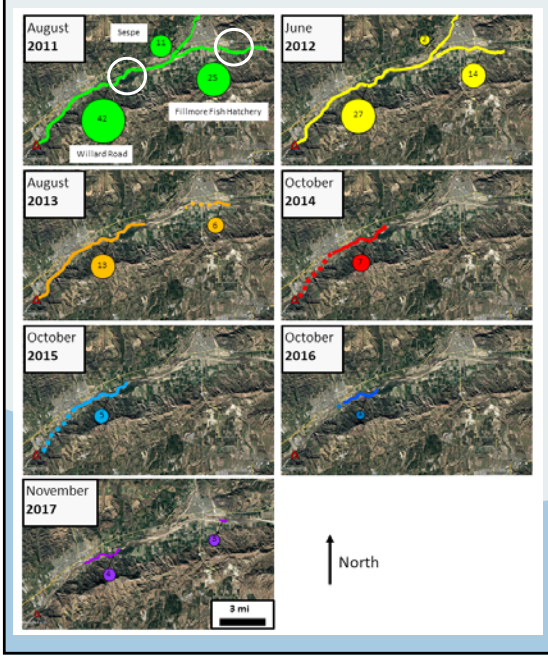
East Grove



The east grove well is 10-20 ft above the GDE elevation

Cienega





Rising Groundwater

- The extent of rising groundwater declined during the drought. This decline mirrored changes in groundwater levels.
- The downstream end of the East Grove maintained surface flow through the drought.
- Dry season rising groundwater in the Cienega Riparian Complex was not present after 2013.

Figure courtesy of United Water

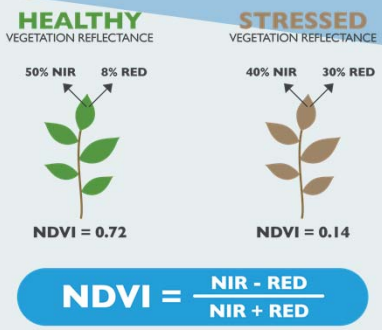
Tracking GDE Health

NDVI

Normalized **D**ifferential **V**egetation **I**ndex

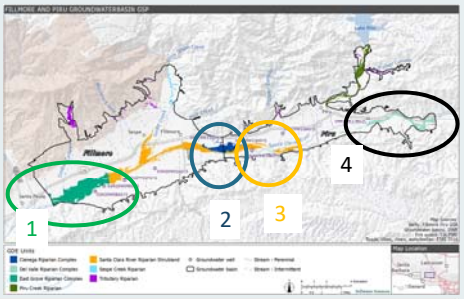
How green are the plants?

❖ Increases in NDVI correspond to higher plant density and leaf area



Source: https://www.agricolus.com/en/indici-vegetazione-ndvi-ndmi-istruzioni-luso/

Changes in GDE health (NDVI)



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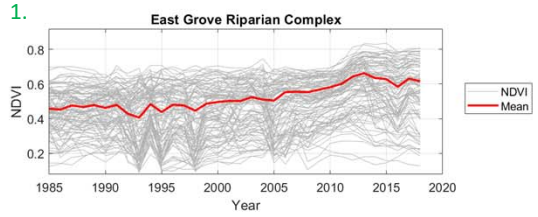

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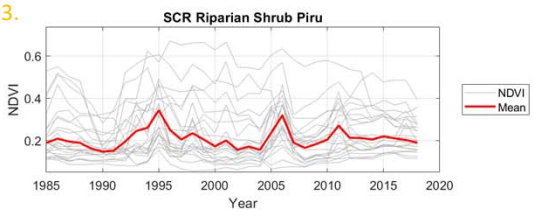

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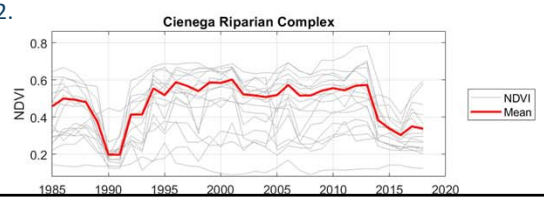

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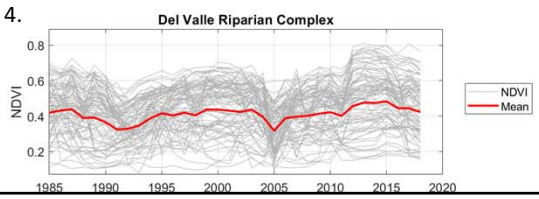
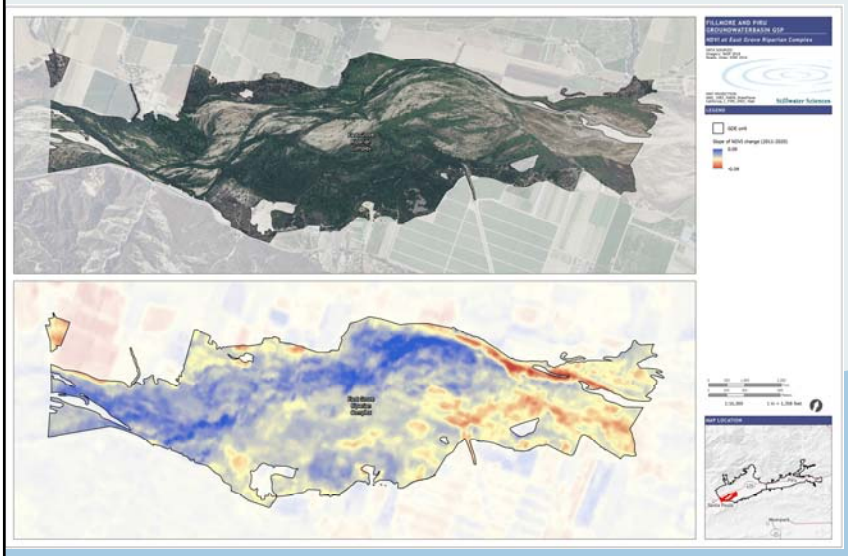
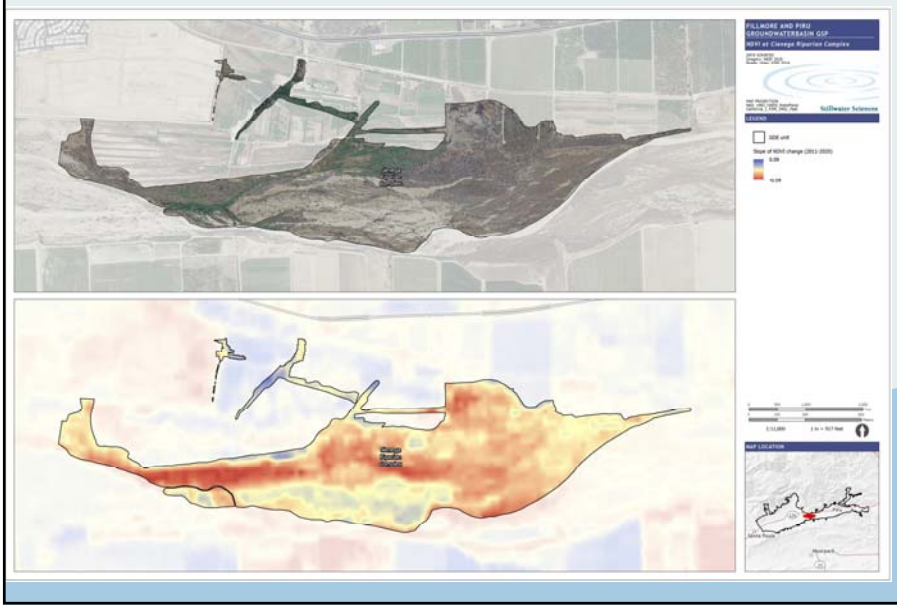


NDVI Change East Grove Riparian Complex



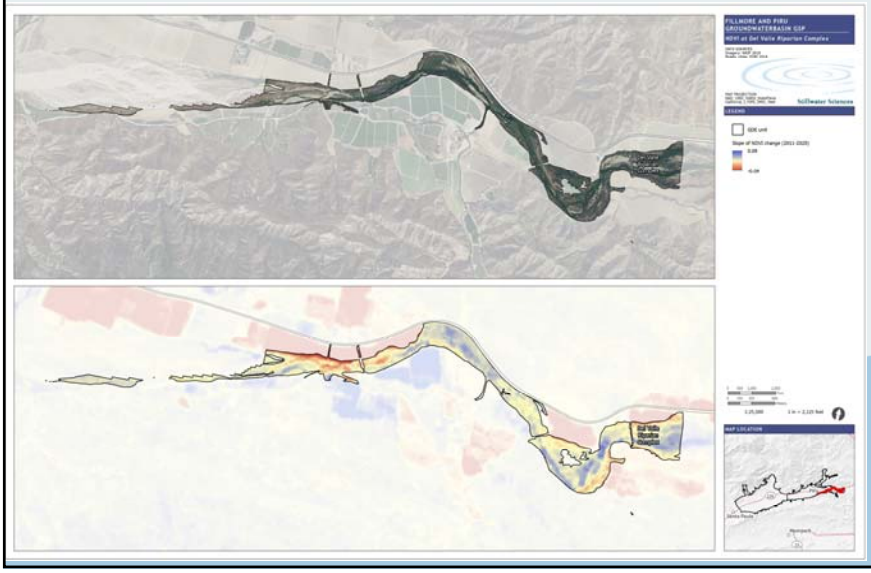
- Generally steady or improving GDEs
- Some decline at upstream end of GDE during 2012-2016 drought
- Groundwater declined by ~20 ft at one well

NDVI Change Cienega Riparian Complex



- Extensive cottonwood and willow die off during 2012-2016 drought.
- Groundwater levels dropped significantly (> 15 ft and up to 30 ft)

NDVI Change Del Valle Complex



- Extensive cottonwood and willow die off during 2012-2016 drought.
- Groundwater levels dropped significantly (> 15 ft and up to 30 ft)

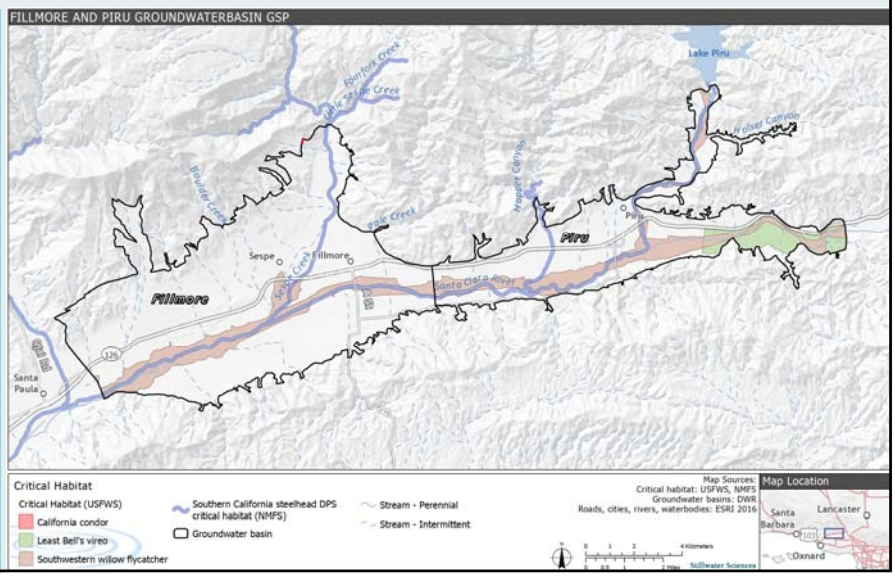
Groundwater dependent special status species

GDE Unit	Basin	Plants	Wildlife	Fish	Natural Communities
Del Valle Riparian Complex	Piru	2	7	2	3
Santa Clara River Riparian Shrubland	Piru	0	2	2	3
Cienega Riparian Complex	Piru	1	6	4	0
Piru Creek Riparian	Piru	1	7	4	5
Tributary Riparian	Piru	3	0	0	1
East Grove Riparian Complex	Fillmore	1	7	4	4
Santa Clara River Riparian Shrubland	Fillmore	0	7	2	4
Cienega Riparian Complex	Fillmore	1	5	4	1
Tributary Riparian	Fillmore	2	0	0	1
Sespe Creek Riparian Complex	Fillmore	0	4	4	2

Within the two groundwater basins, five special status plants, 11 natural communities, 10 wildlife, and four fish species were identified as indirectly or directly groundwater dependent

Critical Habitat (USFWS) for 4 species

- Critical habitat for California Condor, least Bell's vireo, Southwestern willow flycatcher, and Southern California steelhead.



Summary

- We identified 8 GDE units in the Fillmore and Piru basin. The GDE units at the basin boundaries (Del Valle, Cienega, and East Grove riparian complexes) are areas of rising groundwater and perennial flow
- Groundwater dependent vegetation includes willows, cottonwoods, and exotic species like arundo.
- Groundwater elevations decline during droughts to below the rooting depth of GDEs. Rising groundwater did not occur after 2013 in the Cienega Riparian Complex
- The 2012–2016 drought caused a decline in vegetation health throughout the Cienega Riparian complex and at the upstream margin of the East Grove Riparian Complex, and the downstream margin of the Del Valle Riparian Complex. The groundwater elevation at the Cienega riparian complex dropped 30 ft.
- The NDVI decline during the late 1980s early 1990s drought was similar to 2012–2016 in the Cienega Riparian Complex but NDVI recovered within a couple of years in the early 1990s.
- 19 groundwater-dependent special status species are likely to occur in the basins.