# Conservation Assessment for the Cuyama Valley: Current Conditions and Future Scenarios

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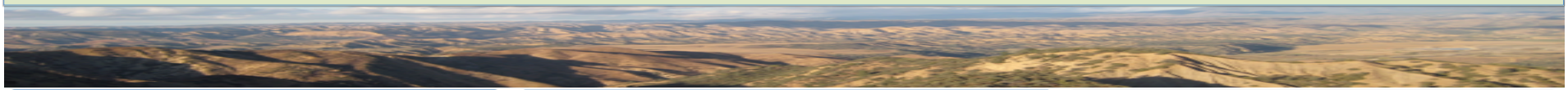
**Project Advisor: Frank Davis  Client: The Nature Conservancy**



## Overview

With The Nature Conservancy (TNC) as our client, we assessed current and potential future impacts of land use on habitat connectivity and groundwater resources. Additionally, we quantified changes in woody riparian vegetation over the last eighty years. Overall, our project results will provide the tools and knowledge to inform conservation planning in the region.

Results from our analysis allowed us to form a few main conclusions :

- If groundwater extraction continues at its current rate, we estimate that available water will be depleted in 50 years. Future land use will be governed by the availability of this limited resource.
- Habitat connectivity is relatively strong under current conditions and in all modeled scenarios. Major impediments include agriculture, developed regions, and major highways. Bridge underpasses help mitigate the effect of roads on species movement.
- Loss of historically present riparian vegetation and river complexity has occurred in conjunction with increasing groundwater extraction and agriculture.

## The Cuyama Valley

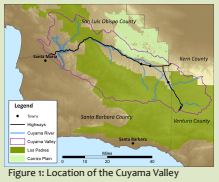


Figure 1: Location of the Cuyama Valley

Figure 2: San Joaquin kit fox

Figure 3: Blunt-nosed leopard

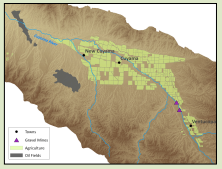


Figure 4: Land use in the Cuyama Valley

The Cuyama Valley (Figure 1), is located approximately 50 miles east of Santa Maria and 35 miles directly north of Santa Barbara.

The valley is ecologically diverse, contains rare plant communities, and has the potential to function as a wildlife corridor between the conserved lands of the Carrizo Plain National Monument and Los Padres National Forest.

There are a number of threatened and endangered species that inhabit the valley; such as, the San Joaquin kit fox (*Vulpes macrotis mutica*)(Figure 2), the California red-legged frog (*Rana draytonii)* and the Blunt-nosed leopard lizard (*Gambelia sila*) (Figure 3).

Irrigated agriculture is the dominant land use (Figure 4), with 20,000-25,000 acres primarily devoted to row crops rotated between root vegetables, alfalfa, and grains. Additionally, there are gravel, sand, and gypsum mines and several oil fields within the valley .

Rural residential development is currently limited to the unincorporated towns of Cuyama, New Cuyama, and Ventucopa totaling roughly 1,350 residents.

## Habitat Connectivity

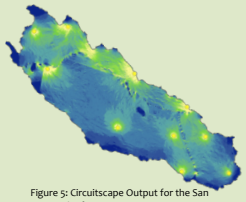


Figure 5: Circuitscape Output for the San Joaquin kit fox

We modeled habitat connectivity for four species: the San Joaquin kit fox, Blunt-nosed leopard lizard, Two-striped gartersnake (*Thamnophis hammondii*), and Pronghorn antelope (*Antilocapra americana*).

Model outputs (Figure 5) display species movement in terms of electrical current. High current (bright yellow) indicates "pinch points" where species are funneled through a narrow area. These areas could be interpreted as critical pathways. Where current is less concentrated (green to blue), many options exist for species movement.

Our analysis showed there is generally low resistance to species movement across the landscape.

## Hydrology and Water Use

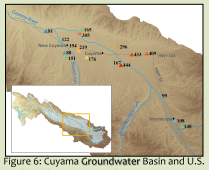


Figure 6: Cuyama Groundwater Basin and U.S. Geological Survey Groundwater Monitoring Wells, showing depth to groundwater (feet)

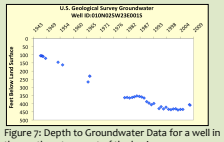



Figure 7: Depth to Groundwater Data for a well in the southeastern part of the basin

The Cuyama Groundwater Basin (Figure 6) is the only source of water for the region and supports all of the land use in the valley. Over 95% of water is applied towards agriculture. The groundwater basin is recharged by the Cuyama River, which is dry for most of the year except during winter storms.

The region faces serious hydrologic impacts as a result of low annual rainfall, high evapotranspiration rates, and intensive pumping for agriculture.

Groundwater levels have declined over 300 feet in the last 60 years in some parts of the basin (Figure 7). In our analysis, the groundwater budget for the region was updated. Our calculations indicate that total withdrawals in the basin exceed recharge by just over 30,500 acre-feet/year. We estimate that the total storage will deplete within 50 years.

## Historic Riparian Habitat

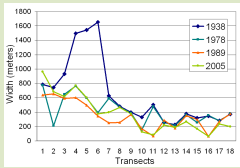



Figure 8: Change of Channel Width and Riparian vegetation for a portion of the Cuyama River

We analyzed historic aerial photographs of the river to understand how groundwater pumping and land conversion has affected riparian vegetation within the valley. Eighteen transects were placed along a section of the river that runs through agriculture, as this area has experienced the most drastic land use changes. The width of the river channel and woody riparian vegetation was measured across each transect and compared over time.

The analysis showed that the largest change occurred between 1938 and 1978, most likely due to the introduction of agriculture (Figure 8). Prominent changes include the narrowing of the river channel and an overall loss of woody vegetation.

## Scenario Planning

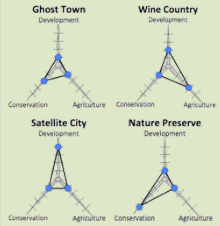



Figure 9: Illustration of the fundamental differences of each scenario along three axes of comparison: extent of agriculture, magnitude of human development, and level of dedicated conservation activity.

We evaluated potential threats to habitat connectivity and water resources through four scenarios that depict our vision of how the valley may look by the year 2050 (Figure 9) :

*Ghost Town* – groundwater pumping and treatment costs are so high that agriculture ceases and the towns are effectively deserted

*Wine Country* – the valley becomes a vibrant weekend destination providing boutique lodging, fine dining, and locally crafted wines

*Satellite City* – an increased demand for housing from Santa Maria spurs the growth of existing towns

*Nature Preserve* – the valley becomes a fully protected link between the Carrizo Plain and Los Padres National Forest

## Future Scenario Results

| | Current Conditions | Ghost Town | Wine Country | Satellite City | Nature Preserve |
|---|---|---|---|---|---|
| Recharge (AF/Y) | 11,500 | 11,500 | 11,500 | 11,500 | 11,500 |
| Net-Agricultural Water Use (AF/Y) | 33,541 | 0 | 2,326 | 0 | 0 |
| Net-Municipal and Industrial Water Use (AF/Y) | 200 | 0 | 2,192 | 4,800 | 0 |
| Natural Vegetative Consumption (AF/Y) | 1,440 | 840 | 1,440 | 1,440 | 2,148 |
| Total Withdrawals (AF/Y) | 44,681 | 10,340 | 20,458 | 15,740 | 11,648 |
| Deficit/Surplus (AF/Y) | -33,681 | 10,656 | 542 | -4,240 | -148 |

Figure 1: Groundwater budget for current conditions and for each planning scenario

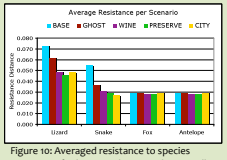



Figure 10: Averaged resistance to species movement for base conditions and across all modeled scenarios

**Impacts on Groundwater**

The current groundwater budget was adjusted to reflect changes in water use for each planning scenario (Table 1).

In all scenarios, the groundwater budget is no longer in a state of deficit.

Although the groundwater basin experiences surplus conditions in all scenarios, it would take an appreciable amount of time to recharge the basin to pre-agricultural conditions.

**Impacts on Habitat Connectivity**

We evaluated how each planning scenario impacted habitat connectivity as compared to current conditions.

Our analysis shows that resistance to species movement is reduced in all planning scenarios (Figure 10).

However, since baseline values are already so small (less than 0.08), the overall gains in habitat connectivity are minimal.

To make substantial improvements on habitat connectivity, Highways 166 and 33 would need to be altered to better facilitate species movement.

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