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GROUP PROJECT BRIEF

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CONSERVATION ASSESSMENT FOR THE CUYAMA VALLEY: CURRENT CONDITIONS AND PLANNING SCENARIOS

ON THE WEB AT HTTP://WWW.BREN.UCSB.EDU/~TNC2 SPRING 2009

PROJECT OVERVIEW

The Nature Conservancy (TNC) of California has identified the Cuyama Valley (Figure 1) as a potential priority area due to its ecological richness, rare plant communities, and potential to function as a wildlife corridor between the conserved lands of the Carrizo Plain National Monument and Los Padres National Forest. The goal of our project was to assess the impacts of human land use on habitat connectivity, groundwater resources, and riparian vegetation. This analysis was performed for current conditions as well as potential futures. Our project results will provide tools and knowledge that will inform conservation planning in the region.

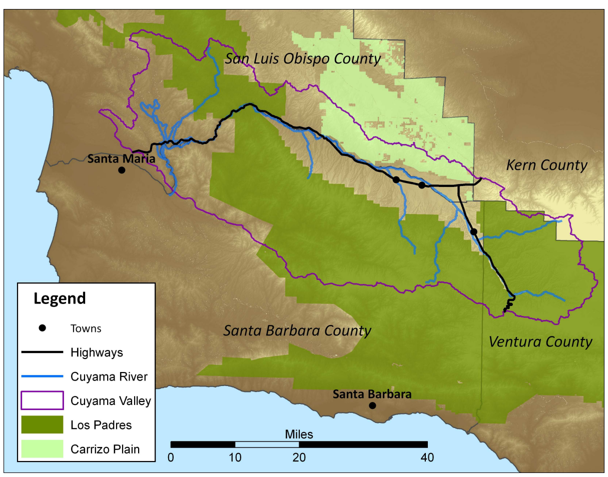

Figure 1: Location of the Cuyama Valley in California.

Results from our analysis allowed us to form a few main conclusions regarding the current status of conservation interests in the valley, as well as the likely impacts of planning scenarios.

- 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.

APPROACH

Land Use – researched the types of human activity within the valley and how each has changed over time

Water Use – updated the groundwater budget for the region and highlighted trends of decline

Historic River Habitat – analyzed how riparian vegetation has changed due to groundwater pumping and land conversion

Habitat Connectivity – used Circuitscape software to model habitat connectivity within the valley for the San Joaquin kit fox, Blunt-nosed leopard lizard, Two-striped gartersnake, and Pronghorn antelope

Scenario Planning – developed four scenarios to evaluate impacts of changing dominant land use practices. All scenarios depict a plausible future for the region in the year 2050. They represent shifts in agriculture, development, and level of dedicated conservation.

LAND USE

Irrigated agriculture is the dominant land use, with 20,000-25,000 acres primarily devoted to row crops rotated between root vegetables, alfalfa, and grains. Rural residential development is currently limited to the unincorporated towns of Cuyama, New Cuyama, and Ventucopa totaling roughly 1,350 residents. Additionally, there are gravel, sand, and gypsum mines and several oil fields within the valley (Figure 2).

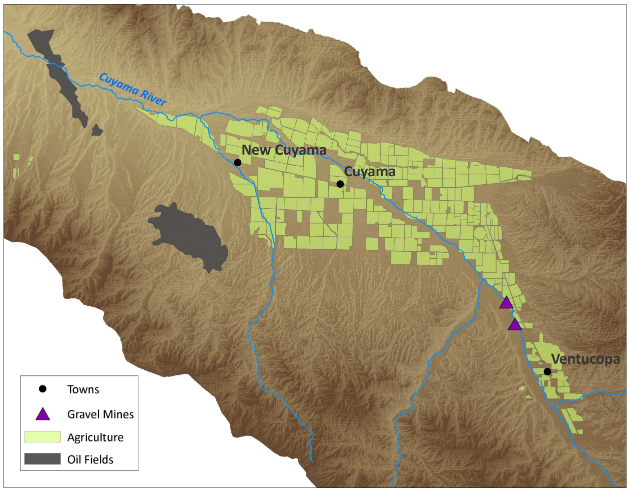

Figure 2: Current land uses in central portion of the Cuyama Valley.

HYDROLOGY AND WATER USE

The Cuyama groundwater basin is the sole 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 principal source of recharge to the basin is the Cuyama River, which is dry for most of the year except during winter storms. On average, the region receives less than ten inches of rain annually and faces serious hydrologic impacts as a result of low annual rainfall, high evapotranspiration rates, and intensive pumping for agriculture.

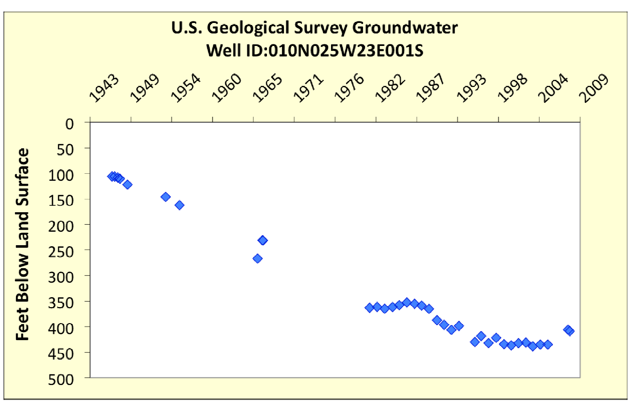

Figure 3: USGS Monitoring Data for a Cuyama Valley well.

Groundwater levels have declined over 300 feet in the last 60 years in some parts of the basin (Figure 3). We calculated that total withdrawals in the basin exceed recharge by just over 30,500 acre-feet/year. If the current rate of groundwater extraction continues, we estimate that the total storage will deplete within 50 years.

HISTORIC RIVER HABITAT

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 4). Prominent changes include the narrowing of the river channel and an overall loss of woody vegetation.

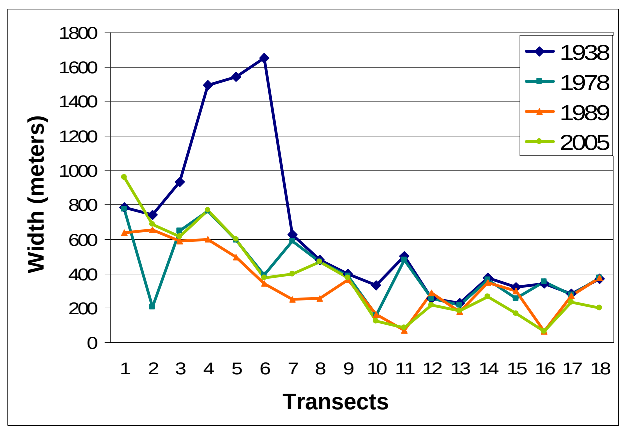

Figure 4: Combined channel and riparian vegetation width through time, from 1938 to 2005.

HABITAT CONNECTIVITY

The purpose of a connectivity analysis is to describe how easily a species can move through a landscape. We used a program called Circuitscape to model habitat connectivity across the valley, as well as along the river. Habitat suitability maps were created for four species – San Joaquin kit fox (*Vulpes macrotis mutica*), Blunt-nosed leopard lizard (*Gambelia sila*), Two-striped gartersnake (*Thamnophis hammondii*), and Pronghorn antelope (*Antilocapra americana*). Habitat types were assigned suitability values between 0 and 100 based on species preference, with a 0 being the least suitable. These habitat preference maps serve as the input to Circuitscape. The output from Circuitscape (Figure 5) displays 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.

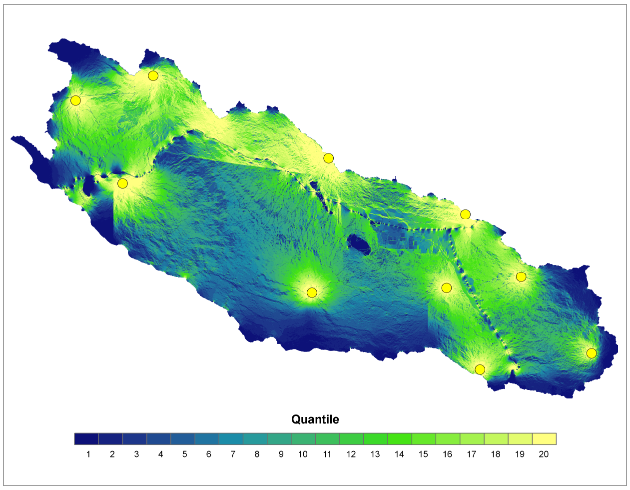

Figure 5: Circuitscape map for San Joaquin kit fox. Yellow and blue indicate high and low levels of current, respectively.

Our analysis showed there is low resistance across the landscape, indicating that connectivity is strong for all four species. Highways 166 and 33 impose the greatest barriers to movement. However, because resistance values overall are very low, this suggests that bridge underpasses provide adequate connections across the valley.

PLANNING SCENARIOS

The future of the Cuyama Valley is uncertain; however, it is important to consider possible future land use changes and their effect on conservation interests. These scenarios depict our vision of how the valley may look by the year 2050.

Ghost Town – groundwater pumping and treatment costs are so high that agriculture ceases and with no replacement industry, the valley is 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 Cuyama and New Cuyama and groundwater is entirely diverted from agriculture to support this growth

Nature Preserve – conservation entities invest in the valley creating a fully protected link between the Carrizo Plain National Monument and Los Padres National Forest

Figure 6 illustrates the fundamental differences of each scenario along three axes of comparison: extent of agriculture, magnitude of human development, and level of dedicated conservation activity.

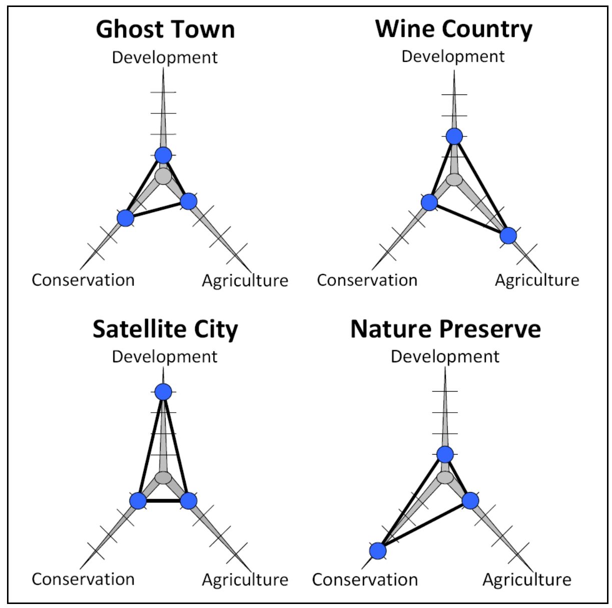

Figure 6: Scenario Comparison Figure.

SCENARIO METHODOLOGY

We made a few assumptions that dictate the outcome of all scenarios. First, it was assumed that no new water supply is brought to the region so development was limited by the natural supply of groundwater in the Wine Country and Satellite City scenarios. Secondly, climate change is expected to have minimal effects on the region by 2050, and was not incorporated into any scenario.

To understand the scenario impacts on the valley's connectivity and groundwater resources, the total acreages of (1) rural development, (2) industry, (3) row crop agriculture, (4) orchards and vineyards, and (5) natural vegetation were altered and new water budget calculations and connectivity analyses were performed.

	Development	Industrial	Row Crop Agriculture	Orchard & Vineyard	Natural Vegetation
Current Conditions	274	2,643	26,228	2,299	51,220
Ghost Town	274	2,643	26,228	2,299	51,220
Wine Country	846	0	579	3,661	77,577
Satellite City	9,651	3,391	501	0	69,121
Nature Preserve	99	0	137	0	82,428

Table 1: Current and future land use acreage.

Table 1 summarizes how these land use acreages change for each scenario as compared to current conditions. An important feature to note is that land use acreages remain the same between current conditions and the Ghost Town scenario because it was assumed that the landscape would not drastically change. However, a deserted landscape will clearly function differently for species movement. Our Ghost Town connectivity analysis incorporated these considerations by assigning slightly higher suitability values for all species.

IMPACTS ON 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 7). 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.

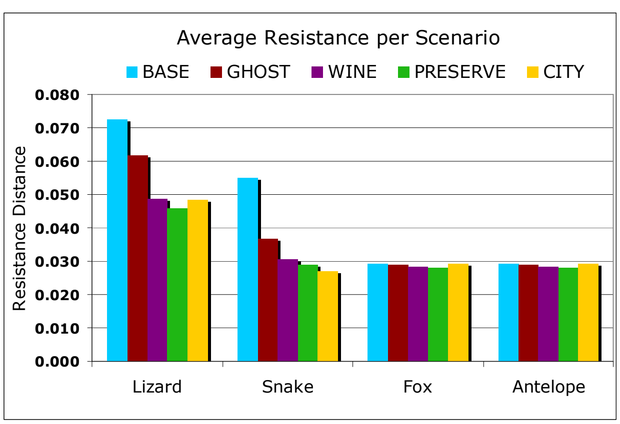

Figure 7: Average resistance per species per scenario.

IMPACTS ON GROUNDWATER

The current groundwater budget was adjusted to reflect changes in water use for each scenario (Table 2). It is important to reiterate that development in the Wine Country and Satellite City scenarios was limited by a groundwater extraction rate equal to recharge, and that no new water supplies are brought to the region.

In all scenarios, the groundwater budget is no longer in a state of deficit. There is now a small surplus in the Wine Country scenario even though agriculture is still expected to be the dominant user. There is a relatively large surplus in the Satellite City scenario, which is attributed to the 40% urban return flow assumed for this scenario. Both the Ghost Town and Nature Preserve scenarios experience significant surplus conditions due to the lack of groundwater extraction for human use. 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.

	Recharge AF/Yr	Net Irrigation AF/Yr	Net Muni. & Indust. AF/Yr	Natural Vegetation AF/Yr	Deficit or Surplus AF/Yr
Current Conditions	11,500	40,392	200	1,440	-30,532
Ghost Town	=	↓	↓	↓	10,660
Wine Country	=	↓	↑	=	542
Satellite City	=	↓	↑	=	5,260
Nature Preserve	=	↓	↓	↑	9,352

Table 2: Water balance calculations for current conditions and planning scenarios.

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