CROSS-TESTING TRANSFERABILITY OF NATIONAL MITIGATION PLANNING TOOLS WITH CALIFORNIA'S REGIONAL ADVANCE MITIGATION PLANNING (RAMP) FRAMEWORK ON A NEW PILOT REGION (450 MILES OF US 101) AND DEVELOPMENT OF PROTOCOLS FOR WETLANDS AND WILDLIFE CONNECTIVITY.

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ABSTRACT

Regional Advance Mitigation Planning (RAMP) is a methodology that can incorporate regional planning principals and environmental considerations early in the development of transportation infrastructure and other construction plans and projects. The Strategic Highway Research Program (SHRP 2) is administered by the Transportation Research Board of the National Academies (TRB) to focus on applied research in safety, renewal, reliability and capacity. SHRP2 has identified the need to apply geospatial ecological screening tools and data at the planning phase of new highway projects in order to agree on priority areas for conservation. The goals of this particular SHRP2 project are twofold: 1) to test the transferability of a RAMP approach in a new region along U.S. Highway 101 (U.S. 101) in California, and 2) to use this study area and results to comparatively test a national impacts assessment tool currently under development. The objective of the comparison is to evaluate how results from a national-level tool compare with local and regional assessments, in order to optimize the performance of the national tool. The pilot area is a 450-mile stretch of U.S. 101 from Mendocino County to Santa Barbara County, encompassing three Caltrans districts. This paper focuses on District 4, the San Francisco Bay Area. We have completed the RAMP process for this section of U.S. 101, and species and habitat impact totals have been calculated. For the District 4 region, 310.26 acres of impacts were recorded for specific species, and 232 acres of general vegetation habitat and agricultural lands were impacted by a total of 36 planned transportation projects. Tricolored blackbird (*Agelaius tricolor*) and California red-legged frog (*Rana draytonii*) were the two species with habitat most heavily impacted in the study area. Farmland was also heavily impacted, with 212.3 acres impacted by projects planned in that area.

National-level conservation planning tools are currently available, and provide useful ways for users to effectively collect and visualize data, identify environmental impacts and facilitate the environmental review process. However, they are relatively new, not always populated with data in all states, or not yet widely available. Under the SHRP2 program, an integrated, geospatial ecological screening tool is being developed that could incorporate existing and emerging tools and data sets and would have the ability to make use of the best data and technology available for any regional transportation planning project. The results from our pilot area study will be used to test the functioning and transferability of data of the new integrated tool.

INTRODUCTION

Transportation systems in California have responsibilities beyond providing avenues for goods and people to travel from place to place. They are also obligated to offset impacts from transportation projects to species and ecosystems. This obligation is addressed through the process of mitigation, in which the impacts from transportation-related construction are required, through regulatory processes to be offset.

Regional advance mitigation planning (RAMP) is an innovative methodology that can incorporate regional planning principals and environmental considerations early in the development of transportation infrastructure and other construction plans and projects (Thorne et al., 2009a; Thorne et al., 2009b). It provides a way to direct funds from infrastructure projects that are required for environmental mitigation to fund more ecologically effective land acquisitions and restorations. By pooling funds from several projects together, larger parcels can be acquired. It is also possible to coordinate those actions with regional open space and conservation plans, thereby integrating the mitigation into larger, regional sustainability designs. Under a RAMP, transportation infrastructure agencies work with resource agencies to consider the environmental impacts of several planned projects at once, bundle the mitigation needs of those projects, and use the recognized needs to protect habitat at broader, more ecologically effective scales, and to link mitigation actions with conservation priorities as identified by a 'regional greenprint.'

This approach addresses a known inefficiency in the way transportation, and other infrastructure projects, are typically implemented. Infrastructure agencies often engage in project-by-project mitigation, usually at the end of a project's timeline, thereby losing valuable dollars to real estate appreciation, and also losing potential habitat acquisition opportunities to encroaching development and speculation. In addition, project-by-project mitigation often overlooks regional and ecosystem scale impacts to species and critical habitats, thereby missing opportunities for efficient, reliable and effective environmental mitigation. Economic savings are also possible for infrastructure agencies through reduction of real estate transactions costs, in that bundling mitigation needs from several projects may permit the acquisition of fewer properties. This can be particularly useful if there are many projects with small area mitigation requirements.

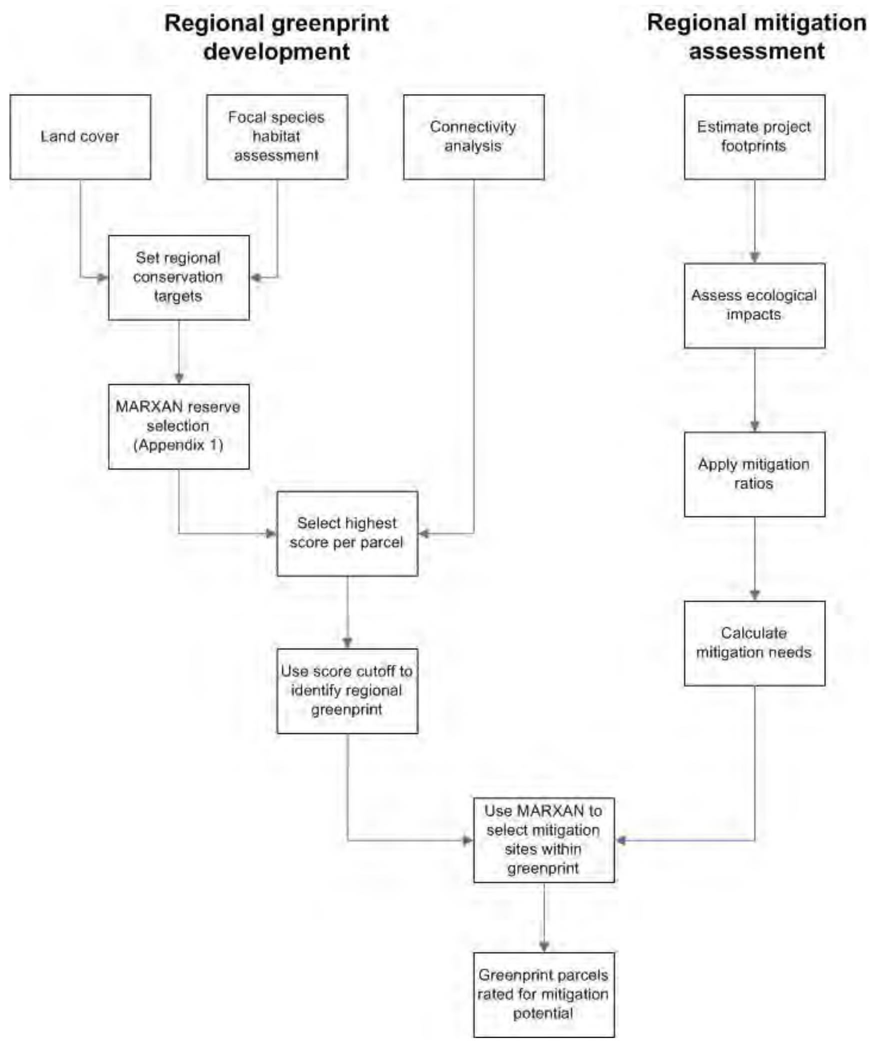

FIGURE 1 This image shows an accounting of California Highway projects in various states of development (Thorne et al., 2009b) and demonstrates the capacity to inventory divergent highway projects for regional mitigation accounting purposes.

In California, RAMP approaches are being used in San Diego and Orange Counties, authorized as environmental mitigation programs through their respective transportation sales tax measures (SANDAG 2012; OCTA, 2006). Caltrans, the Department of Water Resources, Department of Fish and Game, the US Fish and Wildlife Service, US Army Corps of Engineers, UC Davis, The Nature Conservancy and other state and federal agencies have been working to identify a statewide approach to RAMP, and have a pilot project in California's central valley. Additionally, the Bay Area's Metropolitan Transportation Commission (MTC) and Association of Bay Area Governments (ABAG) recently conducted the first part of a RAMP for transportation projects in the nine-county Bay Area Region.

The Strategic Highway Research Program (SHRP 2) is administered by the Transportation Research Board of the National Academies (TRB) to focus on applied research in four areas: safety, renewal, reliability and capacity. The SHRP2 Capacity program centers on the early stages of the transportation planning process through project development. The publication of *Eco-Logical* in 2006, which was signed by the Federal Highway Administration, describes an approach to environmental protection, similar to a RAMP approach, of considering entire watersheds and habitats when mitigating the effects of development. SHRP2 has also identified the need to apply geospatial ecological screening tools and data at the planning phase of new highway projects in order to agree on priority areas for conservation. There are two main objectives of our SHRP2 project. First, to test the transferability of RAMP methods by performing the analysis on a new pilot study area. Second, the results of this pilot area analysis will be used to evaluate performance of a national impacts assessment tool under development that can be used by regional transportation agencies to inform the environmental review process. We will use the national tool to assess impacts from the same projects on which we conducted a RAMP analysis, and compare the projections of impacts from the two approaches. The results of this test can be used to improve the pre-release version of the national tool.

The pilot area for this project is a 450-mile span of U.S. Highway 101 (U.S. 101), which runs from Mendocino County in the North Coast Region down to Santa Barbara County in the Central Coast Region. The area spans three California Department of Transportation (Caltrans) districts: District 1, District 4 and District 5 (Figure 2).

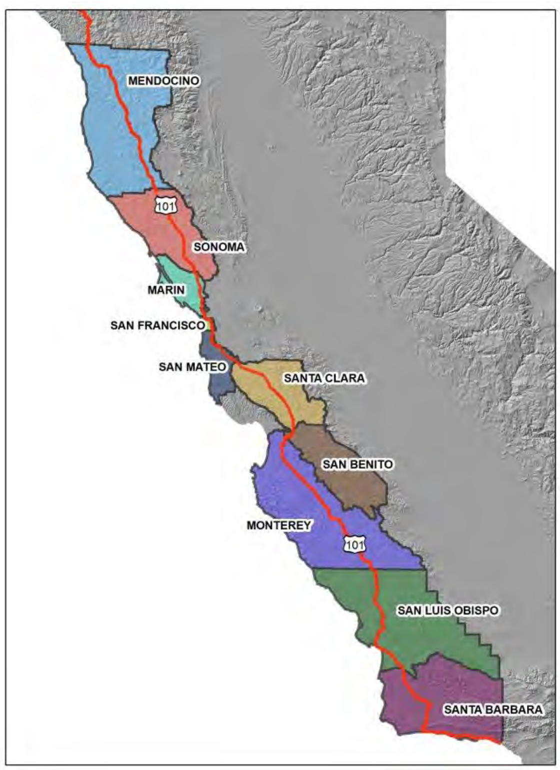

FIGURE 2 Map showing the pilot region for the SHRP 2 project along U.S. Highway 101.

Each Caltrans district has unique circumstances that will inform the study and analysis being carried out in that region. District 1 (North Coast) will require methods for assessing and projecting the aquatic impacts and mitigation needs from many bridge retrofits programmed for the area. Wetland and stream mitigation can be an especially challenging obstacle for water quality and social equity, as seen in other areas in North America and around the world (BenDor and Stewart, 2011; BenDor, Sholtes and Doyle, 2009; Chen et al., 2009; Meriano, Eyles and Howard, 2009). District 4, including the San Francisco Bay Area, is highly urbanized. Transportation projects in urban settings can usually expect less compensatory environmental mitigation, but also issues of increased congestion and air quality management, as well as potential mitigation for impacts to personal property (Thorne et al., 2006). District 5 (Central Coast) includes large expanses of oak woodlands, grasslands and agriculture. There are also many habitat corridors that can be impacted by transportation projects in that area, which can create additional complications (Thorne et al., 2005; Huber et al., 2010; Caliskan, 2013).

Currently we have completed the analysis for District 4, and analysis of District 5 is under way. Once the analysis of the three regions is complete, the same areas will be used to test a developing national tool for transportation planning. There are some existing national tools, such as the ESA WebTool (FHWA, 2008), NEPAssist (Environmental Protection Agency, 2012) and Environmental Conservation Online System, or ECOS (U.S. Fish and Wildlife Service, 2007). While these tools allow users to effectively collect and visualize data, identify environmental impacts and facilitate the environmental review process, they are also relatively new, not populated with data in all states, or not yet widely available. These existing tools also don't allow for collaborative sharing of data and don't have the ability to import user-defined data. An integrated, geospatial ecological screening tool that could incorporate existing and emerging tools and data sets would have the ability to make use of the best data and technology available for any regional transportation planning project.

METHODS

The following steps were employed to evaluate the impact to species' habitats from highway construction in Caltrans District 4:

1. Acquire and review a collection of transportation projects from the different transportation agencies in a geographic information system (GIS).
2. Calculate the footprint for each transportation project
    a. Overlay the GIS polyline layer of the transportation projects with aerial imagery provided by Google and calculate the additional area projected by the planned project
    b. Modify the spatial layer using geoprocessing tools such as the Buffer Tool to create a GIS polygon layer of the planned project footprints.
3. Compile a list of threatened and endangered species that would possibly be impacted by the new transportation projects. Habitat likely to require compensatory mitigation was identified as follows:

a. California Natural Diversity Data Base (CNDDB) points were selected that occurred within and up to five miles beyond the nine county MTC region. These data represent the known and available inventory of threatened and endangered species and some habitats.
b. From the CNDDB points, those that were listed as "presumed Extant" and from 1980-present were selected.
c. Federal and/or state-listed species and other species requiring mitigation were selected.
d. The subset of CNDDB points were buffered by two and four miles.
e. Buffered points were overlaid on a land cover dataset comprised of data from: the Conservation Lands Network (cln_veg; http://www.bayarealands.org/), National Wetlands Inventory (http://www.fws.gov/wetlands/), San Francisco Estuary Institute' Bay Area Aquatic Resources Inventory (BAARI_wetlands_01; http://www.sfei.org/ecoatlas/gis), USFWS vernal pools (VP_2005; http://www.fws.gov/sacramento/es/Critical-Habitat/Vernal-Pool/es_critical-habitat-maps_vernal-pool.htm), the National Hydrography Dataset (http://nhd.usgs.gov/), and important farmland as identified from the Greenbelt Alliance (ImportantSoil_2010; http://www.greenbelt.org/).
f. Appropriate habitat types for each mitigation species were selected as follows:
    i. Vegetation types with a "High" rating in the California Wildlife Habitat Relationships model (CWHR) (California Department of Fish and Wildlife; http://www.dfg.ca.gov/biogeodata/cwhr/wildlife_habitats.asp) for terrestrial vertebrate species were selected
    ii. Calflora listed land cover types for plant species were selected (http://www.calflora.org/)
    iii. Various online sources for invertebrate species were used to define appropriate habitat types
    iv. For plants, invertebrates, and unique types identified from the literature, the habitat requirements were cross-walked to CWHR types, so that their potential locations on the landscape could be identified using our reference maps.
g. Species-specific habitat types were then selected from the buffer/land cover overlay for each species.

4. Overlay the buffered CNDDB subset layer with the buffered transportation projects and sum the impacted areas by species and aggregate to county and regional scales.

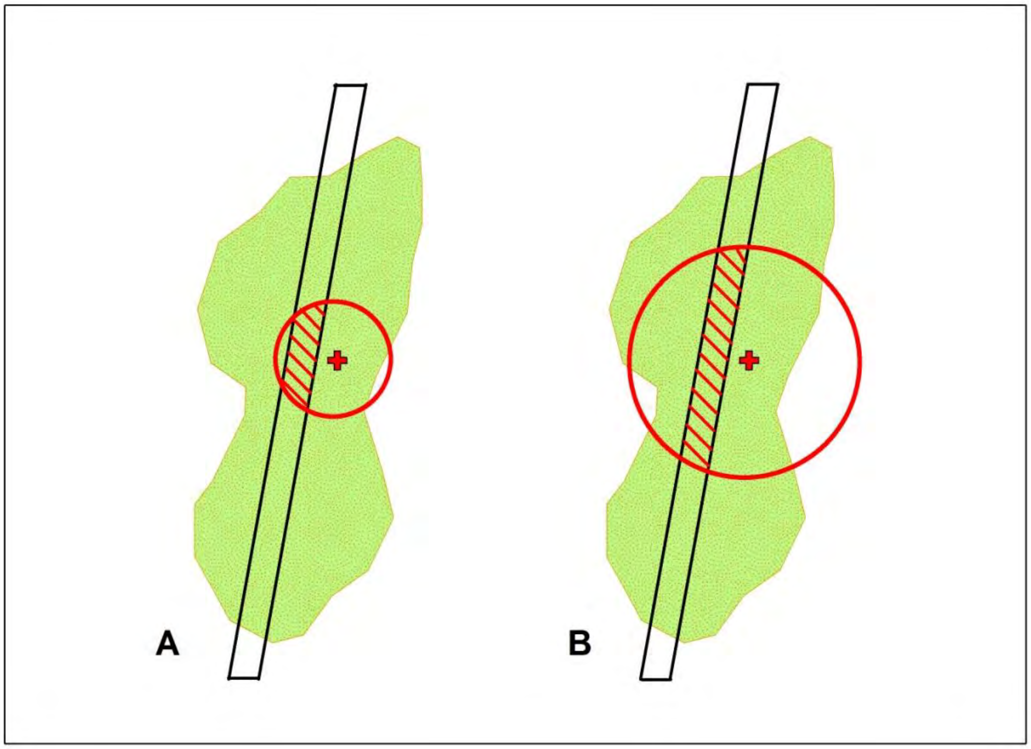

FIGURE 3 This image shows the use of CNDDB records with project impact footprints, to project the extent of suitable habitat that could be impacted by a project. The black rectangles represent the transportation project footprints, including the additional buffered project area. The red circles represent the 2- and 4-mile buffers of a CNDDB point that is within a project footprint. The green areas show all suitable habitat for which the species represented by the CNDDB point are generally known to be found. Last, the cross-hatching area represents the final area that is calculated as impacted by a species and suitable habitat combination. Any appropriate habitat types within the cross hatching for the species were the summed to provide the impact estimate for that species on that project.

RESULTS

The following tables show the projected impacts to mitigation species using a 2-mile and a 4-mile buffered area surrounding critical species occurrences. This project status is ongoing, and currently only District 4, the San Francisco Bay Area analysis has been completed.

TABLE 1 A list of the species encountered in the buffered planned transportation projects area and the amount of suitable habitat impacted

Scientific Name	Common Name	2 mile buffer Area (ac)	4 mile buffer area (ac)
Rana draytonii	California red-legged frog	70.96	114.88
Agelaius tricolor	tricolored blackbird	54.96	113.81
Athene cunicularia	burrowing owl	8.81	42.09
Ambystoma californiense	California tiger salamander	31.79	31.87
Laterallus jamaicensis coturniculus	California black rail	5.05	5.10
Trifolium amoenum	showy rancheria clover	0.00	1.26
Reithrodontomys raviventris	salt-marsh harvest mouse	0.03	0.53
Lasthenia burkei	Burke's goldfields	0.16	0.30
Calochortus tiburonensis	Tiburon mariposa-lily	0.00	0.21
Castilleja affinis ssp. neglecta	Tiburon paintbrush	0.00	0.21
Total	**Total**	**171.75**	**310.26**

TABLE 2 A list of the general habitat types impacted by the planned transportation projects

Habitat	Impact (m^2)	Impact (ac)
riparian	1,211.9	0.3
vernal pools	0.0	0.0
wetlands	21,702.4	5.4
open water	30,602.7	7.6
farmland	858,946.6	212.3
Total	**938,885.5**	**232.0**

For the Metropolitan Transportation Commission (MTC) area, there are a total of 36 planned transportation projects that are connected to U.S. 101. With the buffer distances calculated using the methods described above, the total area of impacts for these projects is 310.26 acres. This area is anticipated to impact 7 individual species within 2 miles of the transportation projects and 10 species with 4 miles. The species with the largest amount of impacted area were the California red-legged frog (*Rana draytonii*) and the tricolored blackbird (*Agelaius tricolor*). These two species are heavily impacted along several areas of U.S. 101.

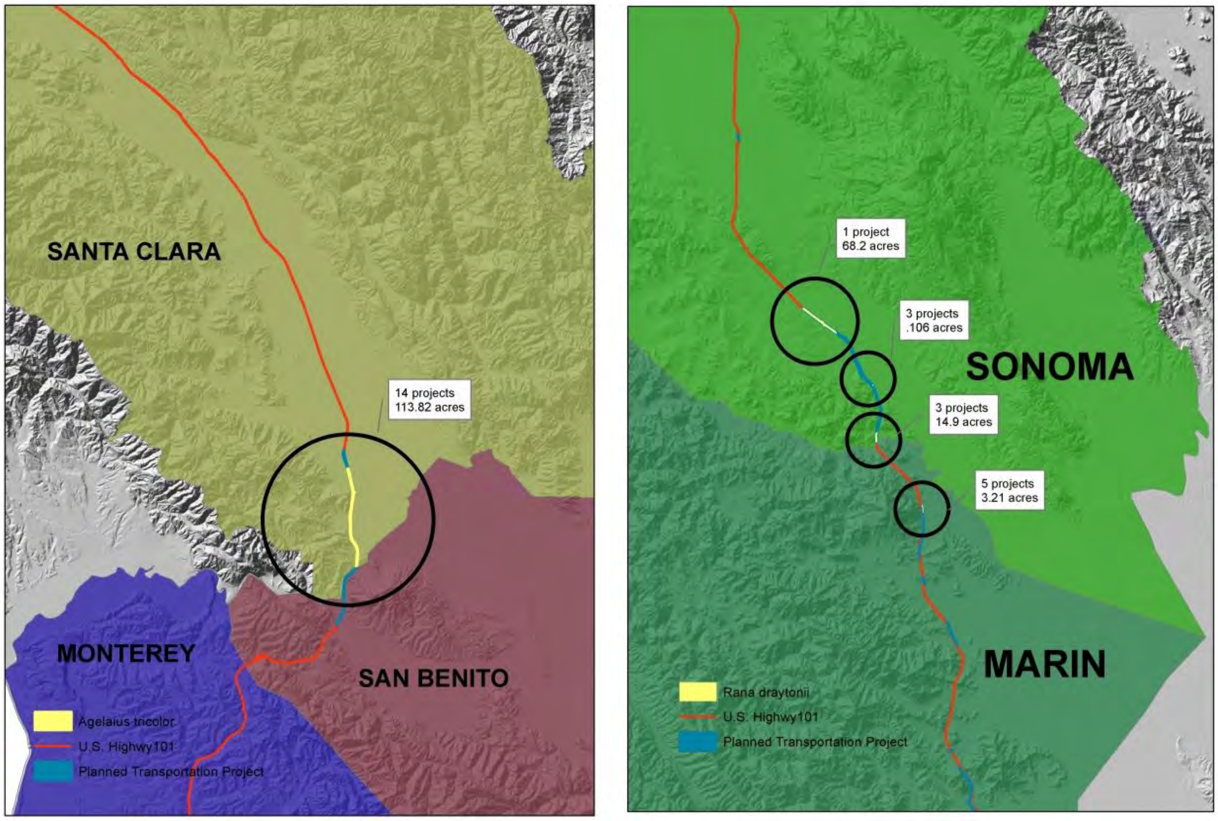

FIGURE 4 Map of U.S. Highway 101 showing the planned transportation projects and the occurrences of species like the Tricolored blackbird (Agelaius tricolor) (left) and the California Red-legged Frog (Rana draytonii) (right) along several sites and within three different counties.

Figure 4 shows how different effected species can be consolidated in one area, like the tricolored blackbird is in the southern part of Santa Clara County, or spread out among multiple portions of U.S. 101 and in different counties, like the California red-legged frog. Even in the case of the tricolored blackbird, the consolidated area still occurs in an area with 14 different planned transportation projects.

In addition, there were five general vegetation and wildlife habitats that were impacted in the San Francisco Bay Area, including farmland, which was the most heavily affected. The following figure shows the same area of Santa Clara County, with four planned transportation projects projecting to impact prime farmland, unique farmland and farmland of statewide and local importance.

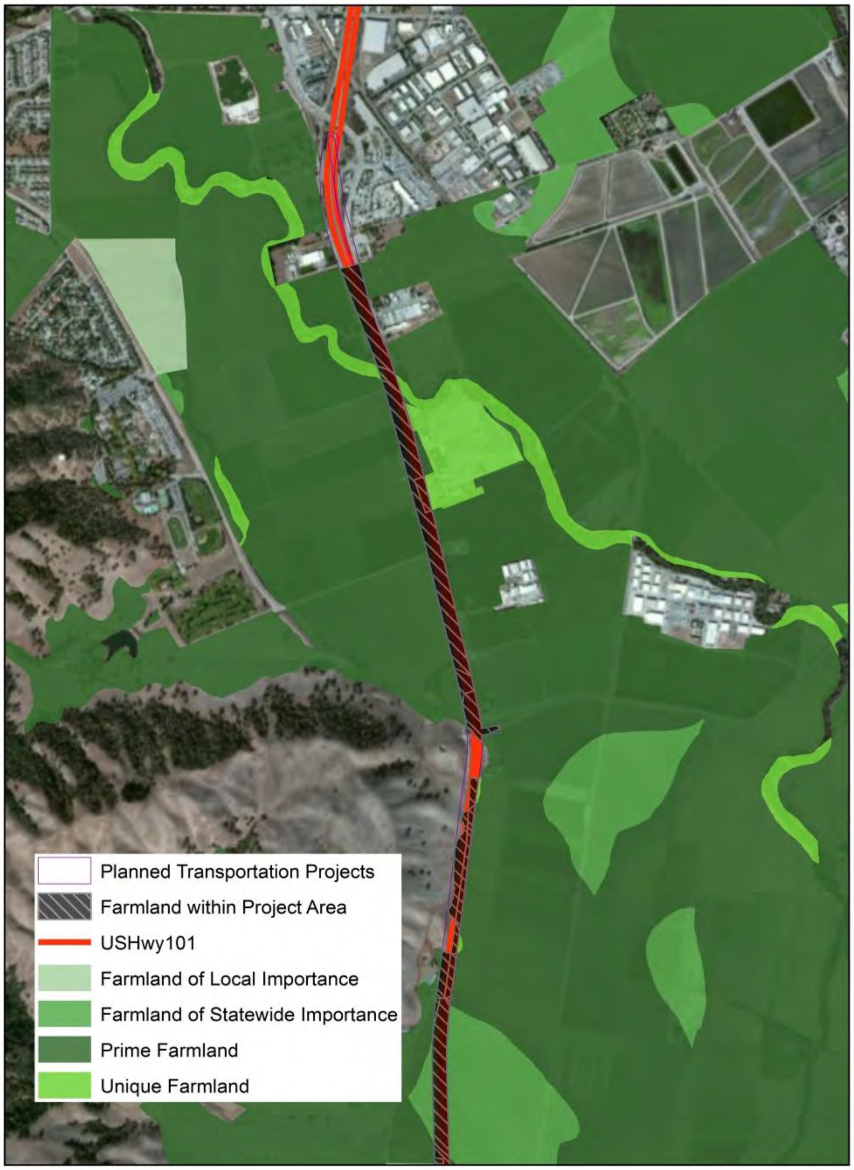

FIGURE 5 Map of Santa Clara County showing planned transportation projects and the potential impacts to valuable farmland.

DISCUSSION

This particular SHRP2 project is about one third completed. We have finished the impact assessment on the central section of the U.S. 101 corridor under study, and have assembled the majority of the data for the southern section. Initial contact has been made for the northern section. Similar analyses will be conducted on the two other districts in the study: District 1 (North Coast) and District 5 (Central Coast). Once completed, these three study areas will be used to test the national-level conservation planning tool created by the SHRP2 group, with input from the participants from this study and other SHRP2 collaborators.

The analysis on the central section (District 4 – San Francisco Bay Area) planned transportation projects along U.S. 101 found 36 planned transportation projects spanning five counties, with impacts both to threatened and endangered species and to a variety of habitats. A conventional approach to mitigation would have tallied these species and habitat impacts on a project-by-project basis and planned mitigation actions accordingly. An Eco-logical, or RAMP, approach aggregates the impacts, as was done here, as represented in the right-hand work flow in Figure 1.

While there is considerable interest in these regional planning approaches, they require some investment in planning and design that is typically earlier in the cycle of project development than business as usual. Therefore, for regional studies such as this one, a key consideration is whether there is enough “demand” (biological impacts that will need mitigation) from infrastructure projects to justify rolling the mitigation process into a more regional approach by identifying potential suitable habitat to meet obligations from multiple projects. Our project with the SHRP2 program was intended to demonstrate the transferability of the methods for impact assessment. The level of impacts we found, and the restricted availability of suitable mitigation lands for these impacts in an urban setting such as the Bay Area, suggest that a RAMP process for the mitigation acquisition would be beneficial.

It is likely that both infrastructure and regulatory agencies will find that the economics of incorporating regional planning such as RAMP into the mitigation process will be valuable. On the transportation side, benefits will accrue because environmental review and assignment of mitigation obligations will be faster, and potentially because pooling of mitigation need will permit fewer individual land transactions to occur, which saves funds on a per transaction basis. On the regulatory agency side, a transparent assessment of impacts provided through the RAMP process can support the review of projects. Additionally, the mitigation solutions for pooled impacts can provide more effective ecological solutions through the purchase of larger land blocks, and conducting the mitigation in advance allows the use of more effective conservation science so that the placing of such blocks can accomplish secondary environmental objectives (such as landscape connectivity and climate adaptation).

Federal interest in promoting this approach is well-founded, from the perspective of the California experience. In addition to our findings, other regions of California have used a RAMP-like approach to engage multiple sectors in regional mitigation. Perhaps the most mature programs are San Diego County Association of Governments’ (SANDAG) Environmental Mitigation Program (EMP) and Orange County Transportation Authority’s (OCTA) Environmental Mitigation Program. These programs have developed methods, approaches, and agreements that can serve as models and be helpful in considering implementation of a RAMP in the Bay Area.

While RAMPs exist in San Diego and Orange Counties, each of those programs involves one county with one transportation authority covering the county. The Bay Area Metropolitan Transportation Commission/Association of Bay Area Government’s region involves nine counties spanning multiple land cover types with many different governing entities. A multi-county RAMP has not, to our knowledge, been conducted in California before. Implementation of a full RAMP methodology across the five counties in this study will likely require some new operational modes of conducting the process. Further consideration should be given to the scope and scale of RAMP (i.e., a RAMP covering the whole region vs. multiple county RAMPs vs. single county RAMPs) given mitigation needs and institutional support and interest. It is important to note that efficiencies are available throughout the process, and that local agencies may be able to take advantages of part of the framework, in the event that a multi-county integrated RAMP may not be feasible or operational.

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BIOGRAPHICAL SKETCHES

James H. Thorne – James is a landscape ecologist working at the University of California, Davis. His work focuses on environmental impact assessment methods in a landscape context. He currently has projects addressing impacts from climate change, road, and urban growth. He also is instrumental in development of regional conservation plans, or greenprints.

Jacquelyn S. Bjorkman – Jacquelyn is a research analyst with the Information Center for the Environment at the University of California, Davis. Her work focuses on regional planning, urban and rural growth, and the environmental and economic impacts related to the increased development in California.

Patrick R. Huber – Patrick Huber is currently a Project Scientist with the Information Center for the Environment at the University of California, Davis. He has served as lead on numerous projects involving habitat and wildlife connectivity modeling, as well as led the development of a Marxan component for several projects. Patrick has experience in hardware/software modeling evaluation, including the use of Marxan reserve selection software to combine and weigh biodiversity, land use, and recreational factors, as well as a new spatially-explicit population model (HexSim) to model potential tule elk herd population growth and movement under possible release scenarios. Patrick has designed habitat modeling and reserve design curricula to aid conservation decision making under climate change. Using RAMP methodologies, Patrick delineated transportation project footprints and compared these with habitat for mitigation species and ecosystems, including collection of large mammal GPS-collar data and roadkill data to model wildlife movement and assess the impact of roadway systems.

Elizabeth O'Donoghue – As Director of Infrastructure and Land Use, Elizabeth oversees The Nature Conservancy's California Chapter's policy agenda on infrastructure development and land use, innovative mitigation approaches, strategic growth and integration with natural resource protection and is The Nature Conservancy's lead on transportation policy. Elizabeth currently serves on the California Public Infrastructure Advisory Commission and on the Executive Committee of the Bay Area Open Space Council. She helped develop and direct the Conservancy's strategies on public policy, public funding, legislation, bonds, and constituency building.

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