Nature Based Assets: Economic Assessment

Prepared for the Nature Conservancy

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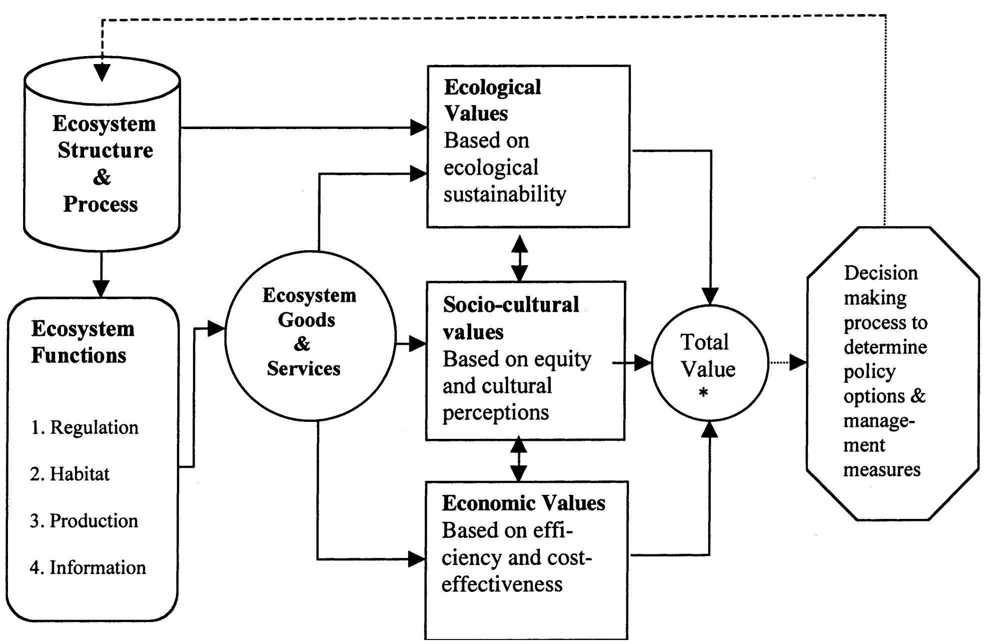
Introduction

A large and rapidly growing body of scientific evidence indicates that human activity is altering the earth's climate systems, leading to profound long term environmental changes that can only be partially mitigated over the next generation. For this reason, adaptation to ongoing climate change is emerging as one of the most prominent challenges facing humanity. Many of the natural assets that are threatened by climate change can themselves make important contributions to climate defense and adaptation. Conservation, remediation, and facilitation of the environmental services offered by such assets, including wetlands, forests, farmland, riverbeds, etc., could all support our emerging adaptation needs. Better evidence is needed, however, for these approaches to be recognized and effectively integrated into public and private adaptation strategies (see e.g. McLeod et al: 2005).

Figure 1: Integrated Assessment of Resource Management Decisions



Source: de Groot et al (2002).

As adaptation priorities become more important to public and private investment in infrastructure, land use, and building activities, we believe it is essential to promote more integrated assessment methods. As Figure 1 above illustrates, any significant land or other resource development activity will lead a complex array of interdependent impacts. Some of these have transparent economic costs and benefits, while the effects of others are more difficult to measure. To appraise both grey and green projects completely and compare them responsibly, both aspects should be included in an integrated assessment framework. By contrast, many grey projects have been accepted in the past on the basis of simple economic benefit-cost criteria (e.g. some dams), but eventually led to unacceptable environmental outcomes. Likewise, many green projects have been rejected because their economic characteristics were not fully appreciated (e.g. marine extinction). Both types of decision-making risk can be more effectively managed with integrated assessment.

This project seeks to reduce the risk of rejecting beneficial green resource management strategies, reviewing and applying a variety of tools for evaluating the net economic benefits of “nature-based adaptation” (NBA) approaches to address climate risk and compare them more effectively with conventional, engineered solutions. In addition to presenting assessment methodologies, this report applies them to a case study of flood risk in Ventura County, California, explicitly addressing projects relevant to TNC’s activities. While it application highlights one location, the tools, research findings, and policy inferences developed here can support TNC’s overall mission and other NBA strategies in similar contexts nationally and potentially globally.

The assessment and decision tools developed for this project, as well the Ventura County case study, are intended to support public policy and communications that promote nature-based actions for climate defense, risk reduction and adaptation. They will also strengthen the basis of evidence environmental stewardship, with a view to supporting conservation activities across TNC’s larger natural asset portfolio.

Because this work represents an extensive review of established and alternative valuation approaches, we include a research bibliography at the end of this report that far exceeds the references needed to acknowledge direct sources and quoted material. We hope this will provide entry points for interested researchers and case workers to expand these methods across a much larger range of policy applications, helping to restore a better balance in the use of public and private funds to manage natural resources and facilitate sustainable adaptation to climate change.

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Economic Assessment of Nature Based Adaptation Strategies

Natural assets offer human and animal communities many benefits that appear relatively intangible, and this fact often complicates policy dialog, particularly when green assets are being compared to grey ones. While we wholeheartedly support advancement of environmental defense in all its dimensions, we believe it essential that green assets be evaluated according to generally accepted economic metrics where possible. This emphasis has three main advantages:

1. Level "playing field" Comparisons – The methods proposed here are compatible with investment and risk management standards in the private sector. Green investment alternatives are often at a disadvantage because their benefits are not adequately accounted for in this way.
2. More effective dialog with policy makers, who more likely to be conversant with economic cost-benefit measures.
3. More inclusive communication with stakeholders, many of who are likely to interpret their wellbeing in terms of livelihood and other economic metrics.

To effectively address the economic characteristics of both green and grey strategies for climate risk management, an assessment methodology need three salient features. We summarize each of these in turn below, discuss how they are assessed in the next sub-section, and finally apply them to an actual case study in Second 4.

Risk Assessment – Riverine flooding, sea level rise, and storm damage

a. Assets at Risk

b. Loss of Use

For this we will be applying and demonstrating the HAZUS methodology applied to the Ventura projects. We will incorporate enough detail and supporting appendices so that your national people can see how it could be extended to any US county. Once tamed, this thing is amazing. Developed with about $50M of FEMA money, free to use, but a fairly steep learning curve. Still, if offers more environmental impact detail than any other single source out there.

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Cost Assessment

This section will present methods for cost assessment that can be applied to components of the Ventura project (including some that have) and like TNC projects. The basic idea here is to set baseline comparisons for cost of implementing grey and green alternatives.

Benefits Assessment

This part is where the comparisons really expand the green perspective. We include the usual benefits in terms of project direct and indirect job creation, but also estimate downstream benefits from the natural assets (tourism, recreation, etc.). For this report, we'll provide Ventura-specific estimates using the standard IMPLAN economic assessment framework, again showing how this could be extended to other TNC initiatives. We'll also include a section on how to carry out and use Willingness to Pay and Contingent Valuation surveys to get more location-specific benefit estimates. These are more intensive data gathering, but usually buttress the case for natural assets significantly.

Taken together, these are the three essential components of an eye-to-eye, level playing field comparison between green and grey. As far as I know, nobody has put these together with tools of this caliber. I hope the report will launch 100 face-offs because I think green alternatives will look much better, and for the right reasons.

Assessment of Natural Assets

Identification and selection of the case studies takes explicit account of the diversity of NBA assets, geographically and geophysically. The diversity of natural assets and adaptation challenges is too great for one decision tool to fit them all, so we propose three generic categories of assessment, each of which will be represented by a case study and recommended assessment/decision-support tools.

Loss/Damage Aversion

A prominent category of climate adaptation is flood protection, as this risk will be aggravated by climate change induced increases in storm severity and rising sea level. For NBA, this category of assessment entails comparison of "grey" solutions like levees and storm drainage with reservation of estuaries and wetlands that act as buffers and sinks. The basic methodology compares long-term costs and expected damages of these options, usually relying on historical construction/maintenance/costs (e.g. Army Corps) and scientific evidence (e.g. NOAA) on prospective weather patterns. Such an approach is represented by studies of the Santa Clara and Pajero Rivers currently under way at the behest of TNC, as well as a variety of international applications (e.g. Andrade Pérez et al: 2011). In the following section, we present an alternative tool for loss risk assessment that could be implemented by TNC anywhere in the US.

Project Analysis

The term project analysis historically refers to a large universe of public investment decision tools, mainly associated with international economic development (e.g. Dasgupta et al: 1972, Little and Mirlees: 1968, summarized in Sen: 2000). This approach has been refined in many ways (particularly by UNIDO and the World Bank: 2010), and would be appropriate to support more fully integrated green infrastructure assessment, comparing them to grey alternatives. Generically, these approaches measure private and public costs and benefits of investment alternatives, taking account to the maximum extent possible of both direct and indirect effects. For our work we will need to take account the uncertainty endemic to environmental risk, as well as some financial considerations specific to the infrastructure being considered. For example, in context of flood/storm drainage, the following characteristics would need to be captured

Table 1: Grey vs. Green Approaches to Drainage Infrastructure

Grey	Green
Sized to capture large storm events	Sized to capture smaller storm events
Energy intensive – pumping and actively treating storm water	Passive –don't use energy or emit GHG directly
Reduce water in tributaries – divert rainwater from local streams	Can support natural hydrology –recharging groundwater and feeding local streams
Not scalable – doesn't allow for (e.g.) population growth or climate change	Scalable – relatively easy to replicate according to changing local conditions
No positive externalities	Can host flora (GHG mitigation) and fauna, link habitats, visual amenity, and temperature modulation

This comparison illustrates some of the important gaps that remain in our capacity to measure and compare grey and green project costs and benefits. Fortunately, a strong body of research is rapidly emerging to fill these gaps. For example, on the issue of comparing storm drains/conduit vs. reserved urban landscapes, Alonso et al (2011) review a good repertoire of assessment strategies. Recent work on dams vs. upland drainage conservation is setting new standards for grey-green comparison on developing countries (see, e.g. Roy: 1999). Taken together, this new generation of project assessment tools will make essential contributions to more integrated assessment. In the next section, we present a project assessment tool that can be applied across most TNC asset classes to evaluate resource management investments.

Value-of-Use

Natural assets provide a broad spectrum of goods and services, many of which can be valued in terms of direct market pricing and indirect effects like of induced employment, income, willingness to pay, etc. By protecting these assets, NBA can be credited with such benefits against alternatives that would displace them or render them vulnerable to climate damage. Value-of-use calculations have been widely used in the environmental policy literature, including PERI studies of northeastern fisheries (Odell et al:2011 and Hoagland et al: 2011), reforestation programs (PERI, NAFO: 2009, and many others). State-of-the art techniques are available to carry out IMPLAN based value of use assessment and we should consider doing so for one of the following categories in California:

a. Coastal Beaches
b. Forests
c. Fisheries

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Assessment Methodology

Although climate adaptation is a relatively new and rapidly emerging policy issue, environmental assessment methods are well established and a wide array of empirical tools exists to support the present research. Given the diversity of natural assets, no single assessment tool will fit them all. Moreover, to effectively promote NBA in a setting with well-established (e.g., technology and infrastructure) competing approaches, it is essential that assessment tools be able to account for as many as possible of the very complex and diffuse benefits arising from natural assets. Finally, given the innovative nature of the NBA agenda, this project is an important opportunity to make a meaningful contribution to the emerging discourse in this area. To develop an integrated assessment approach that combines state of the art, evidence-based methods with metrics and verifiable indicators that are widely accepted in the policy dialog, we surveyed the research literature exhaustively. The result is a three-part suite of assessment tools, each capturing a different dimension of the cost and benefit issues discussed above.

HAZUS Risk/Cost Assessment

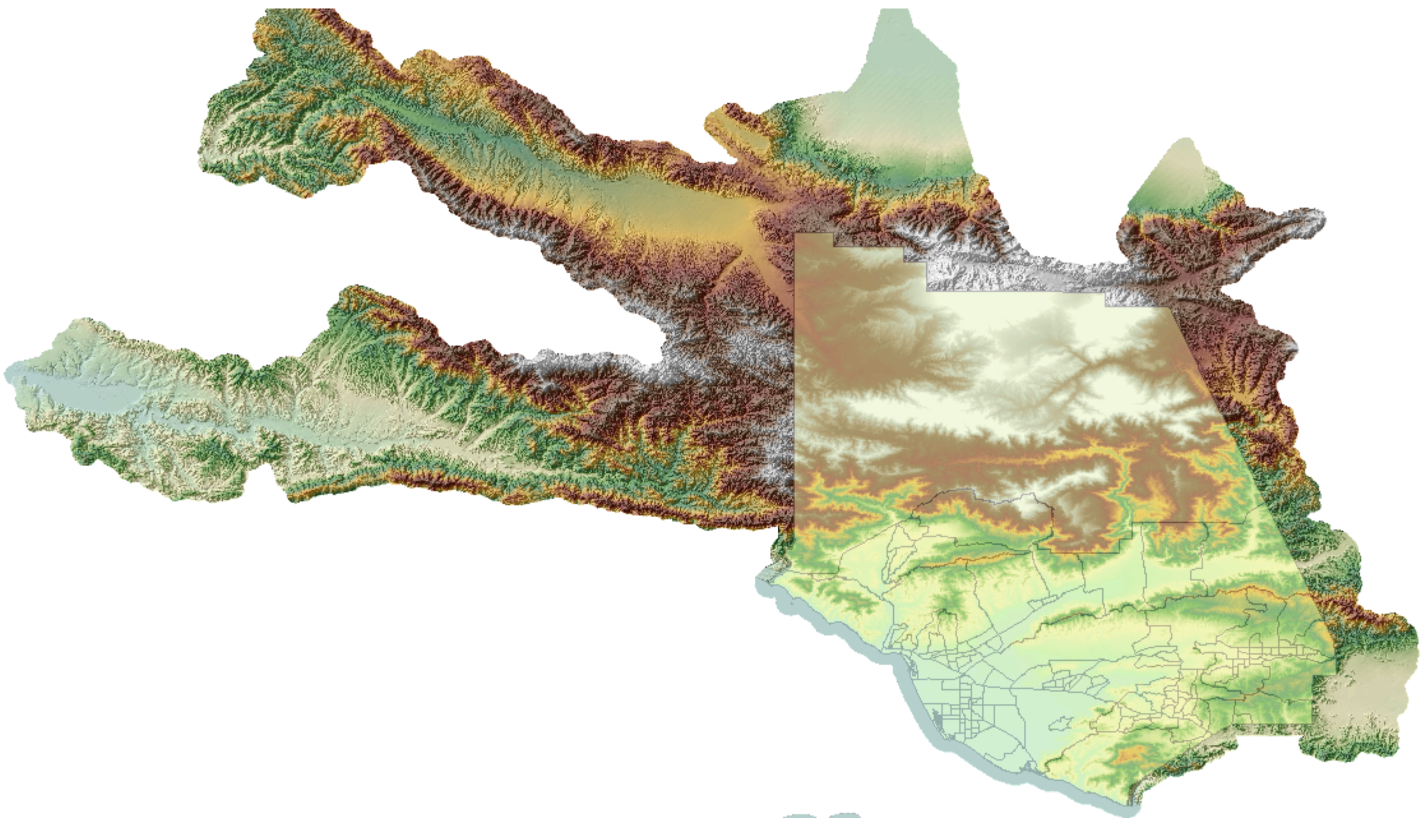
HAZUS is a GIS-based natural hazard loss estimation software package developed by the Federal Emergency Management Agency (FEMA). This software integrates extensive public database information on topography, hydrology, building and infrastructure inventories, and detailed census tract data for every county in the United States. Version 2.0 of the software, HAZUS-MH, evaluates “Multiple Hazards': flooding, hurricanes, coastal surge, and earthquakes. The package is available from FEMA at no cost to the public, but requires ARCGIS software on a Windows platform for implementation and has a relatively steep learning curve. That being said, anyone with moderate computer expertise who is willing to become conversant with natural hazard analysis can master this software.[1]

The model estimates natural hazard risk, measured by a variety of structural, economic, and demographic metrics, in three steps. First it calculates the overall risk exposure for a selected area. Secondly, it characterizes the level or intensity of the hazard affecting the exposed area, and third, it uses the estimates for exposed area and hazard to calculate the potential losses in terms of economic losses, structural damage, loss of life, livelihood, shelter, etc. Taken together, HAZUS represents the most detailed risk assessment tool available for evaluating the human consequences of flood, earthquake, storm, and sea level events. For this reason, it has become a de facto standard for publicly financed evaluations of this kind, and will likely be

[1] Extensive user support is available online, also at no cost, and there are several high quality user groups available, e.g. http://www.useHAZUS.com/.

applied by agencies contemplating grey alternatives to defense against adverse natural events. In order to sustain policy dialog with these counterparts, as well as to extend its own internal capacity to identify and assess opportunities for NBA interventions, we strongly recommend the HAZUS be adopted for application to TNC regions of interest. In this section, we present an application of HAZUS cost assessment applied to Ventura County.

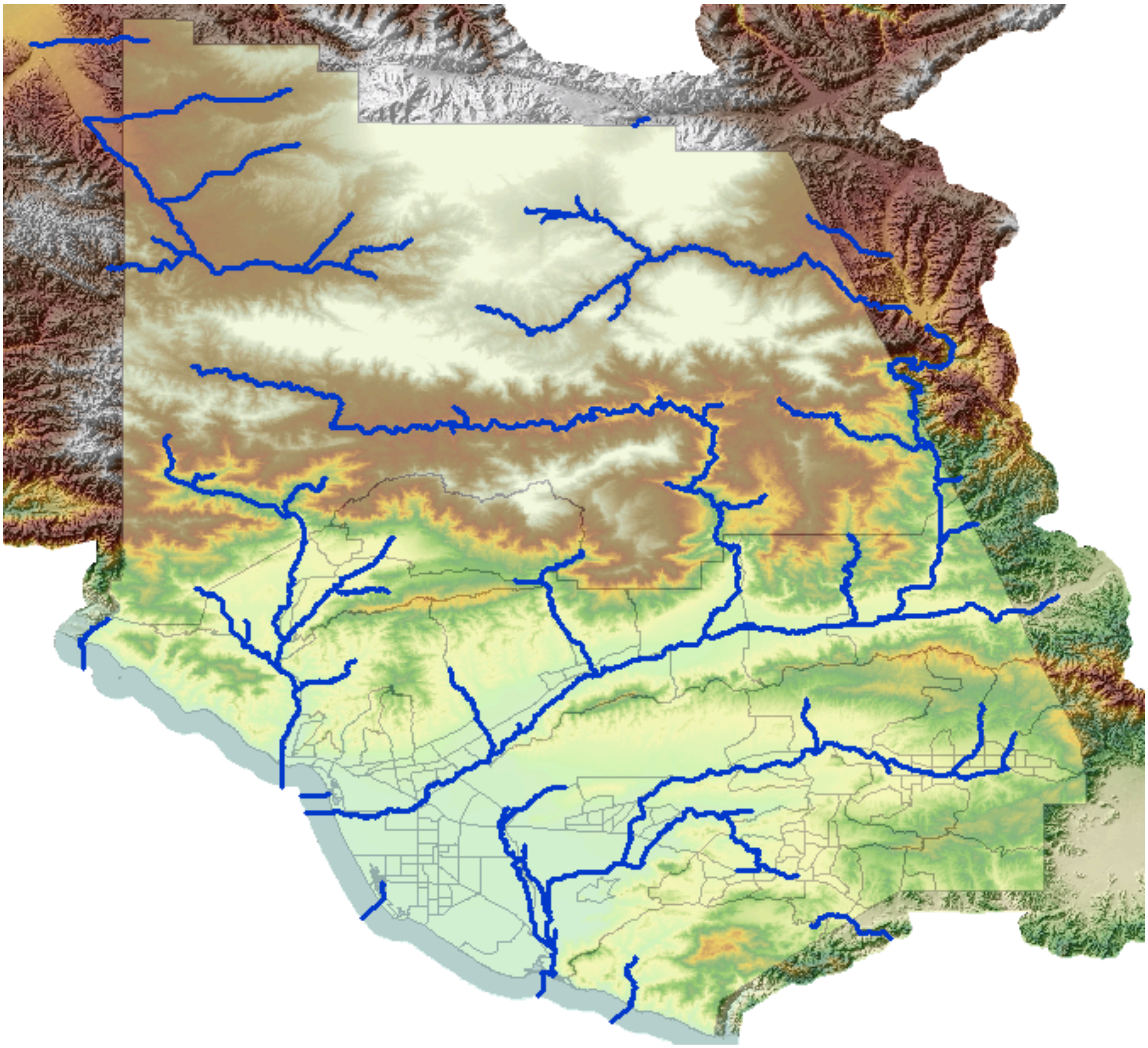
Figure 2: High Resolution Map of Ventura County



For a given geographic and administrative area, HAZUS economic risk assessment begins with a detailed GIS map that acts as a substrate for natural hazard analysis and spatial organization of assets at risk and damage assessment. For all U.S. counties, the basic data for this is obtained in real time from the USGS website, home of the most accurate and highest resolution national topographic data. Once HAZUS identifies the boundaries of your assessment area, the software directs you to the relevant USGS data caches on the internet, where they can be downloaded. HAZUS then uses ARCGIS to assemble them into maps such as that displayed for

Ventura County in Figure 2 above. In addition to the county boundaries and zoomable topographic detail, note that in the figure census tract boundaries are also recorded. These correspond to parallel local HAZUS datasets of demographic, property, infrastructure, agriculture, and other economic variables.

Figure 3: Main Riverine Drainages of Ventura County



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For analysis of flood and storm damage risks, HAZUS offers two perspectives: riverine and coastal risk. The present example will focus on flood risk arising from two riverine drainages in Ventura County. The same techniques described here can be applied to any other riverine reaches or coastal boundaries in the county.

After setting up the GIS and related datasets for a given region, the next step is to identify a drainage area of interest. Figure 3 shows how HAZUS describes riverine drainage systems. The user specifies the density of interest, corresponding approximately to a minimum stream size. Then the software analyzes the detailed topographic information to identify where actual and potential water flows would take place. Figure 3 essentially corresponds to year-round active streams and rivers in the county, with an average flow of at least 10cfs. From this enhanced data, we then specify the drainages to be assessed economically for flood risk. In Figures 4 and 5 below, we have specified two examples of assessment areas: 1) the main stem and first tributaries of the Santa Clara River (highlighted in red), 2) Zone 3 of the Ventura County Watershed Protection District, the primary drainage for San Bonaventura and Oxnard, as well as the drainage terminating in the Ormond Beach area whose restoration we evaluate later by other methods.

Figure 4: Main Stem and First Tributaries of the Santa Clara River

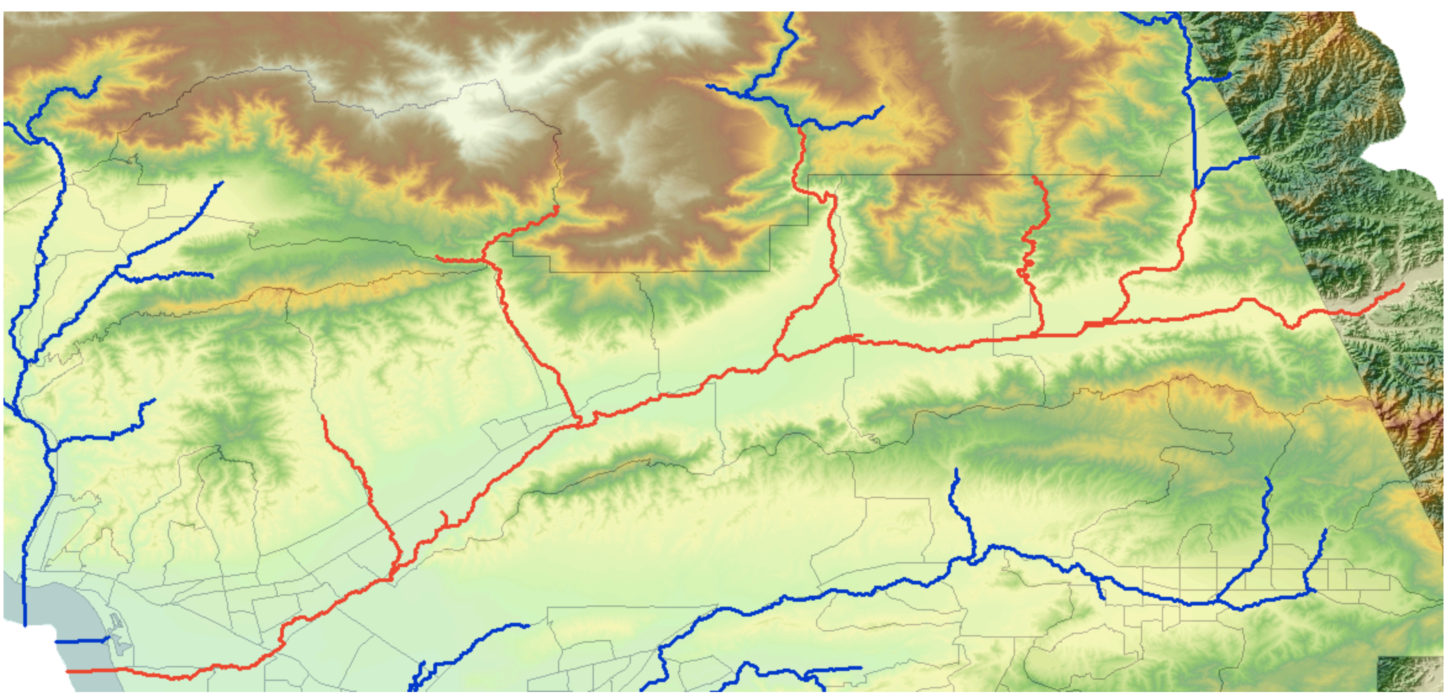
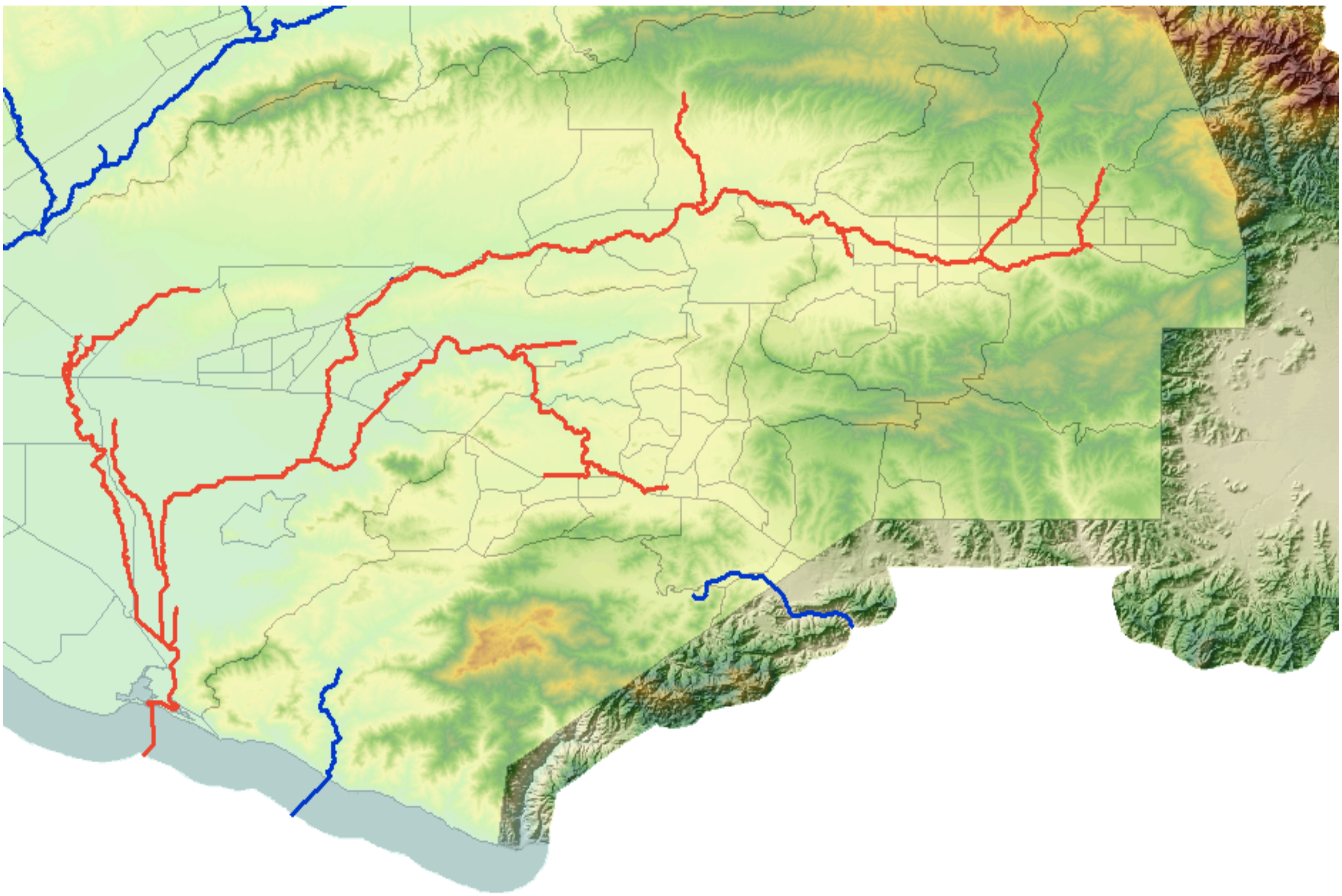


Figure 5: Zone 3 of the Ventura County Watershed Protection District



Now we are ready to begin the risk assessment. Considering the Zone 3 example, the next step is to specify a flood hazard interval or "return period," which HAZUS will use as a basis for delineating a maximal floodplain. The Figures 6 and 7 show the results for a 100-year return period in the two study areas, i.e. based on the latest topographic data the blue region represents the inundation resulting from the most severe flood expected over a century. This descriptive information gives an intuitive sense of flood risk, but HAZUS contains much more explicit information that can be rendered graphically and numerically.

Figure 6: Santa Clara River, Inundation from a 100-year Flood

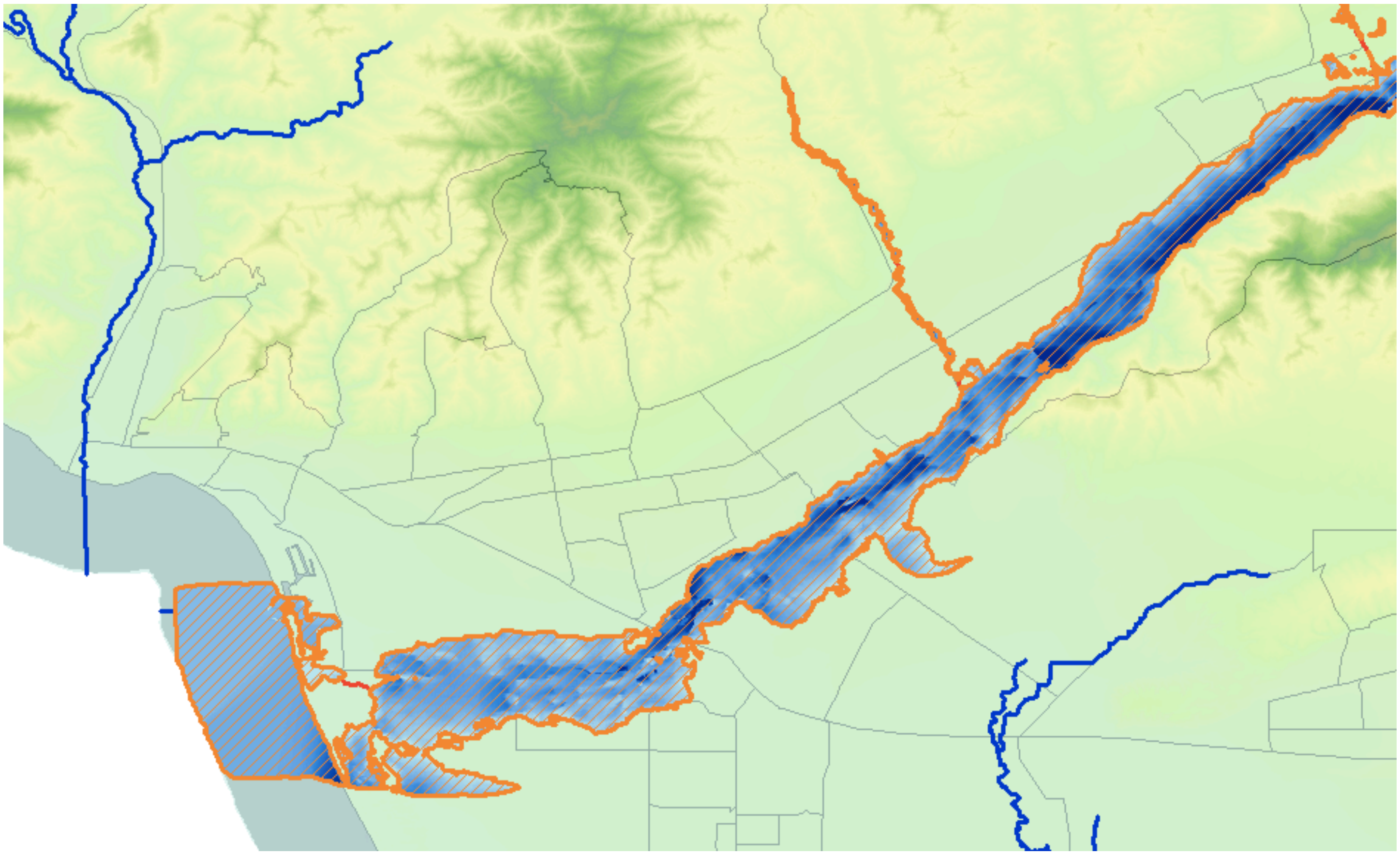
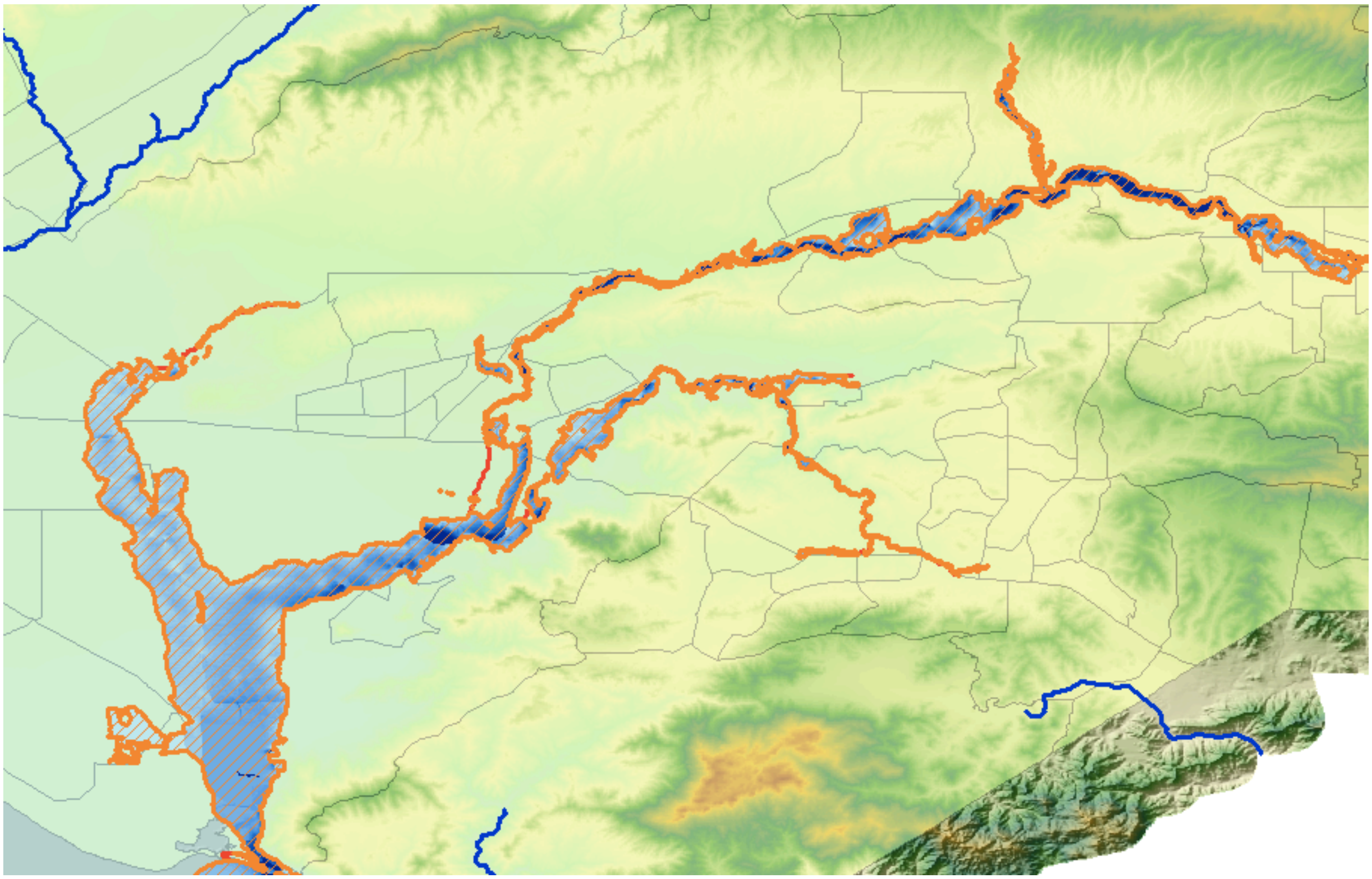


Figure 7: Estimated Inundation from a 100-Year Flood – Zone 3



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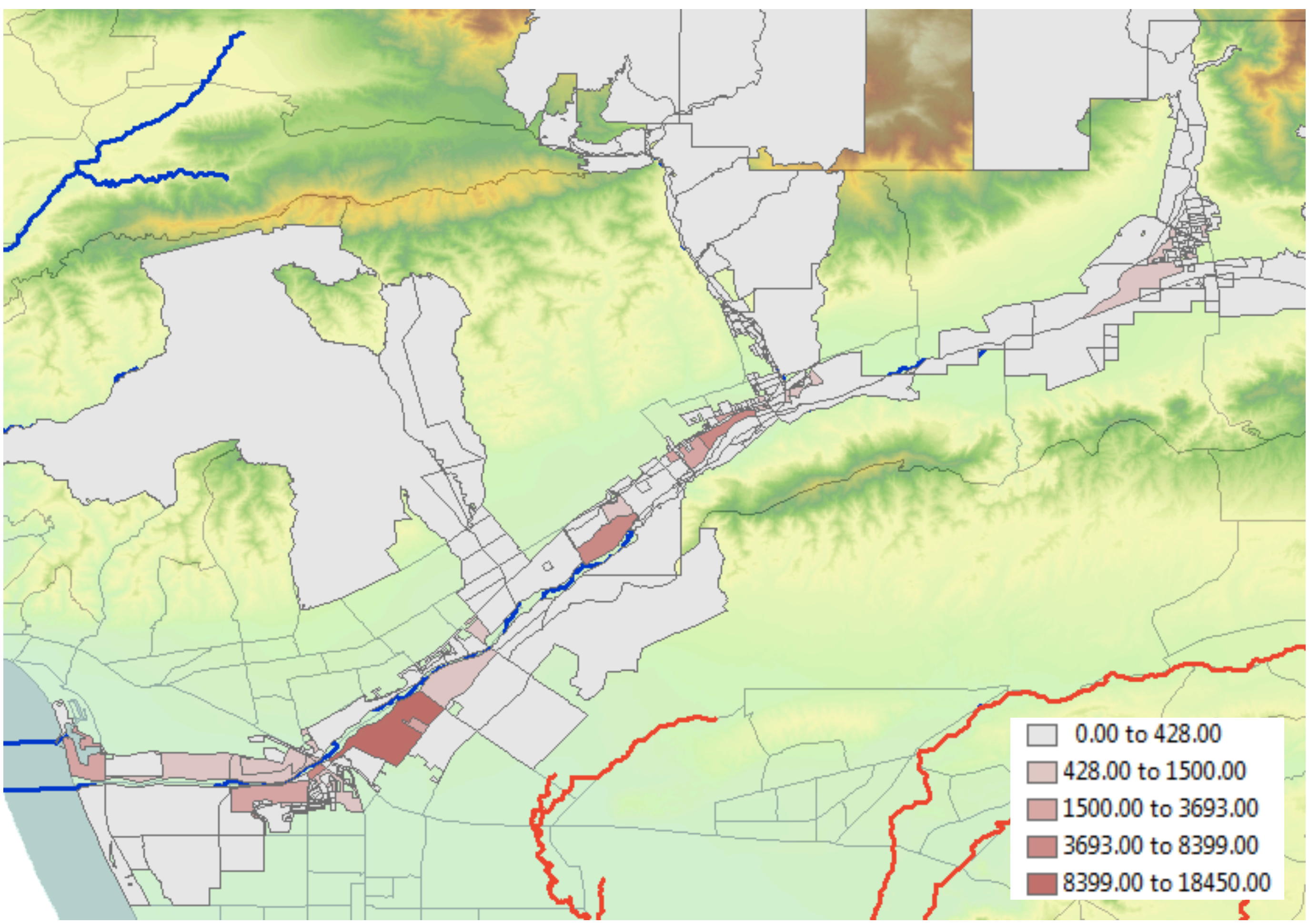
Consider now the rendering in Figure 8, which zooms in on the lower drainage of the Santa Clara River. In addition to running the 100-year flood scenario, we have asked HAZUS to estimate property losses by census tract. As the companion key indicates, these vary considerably across census tracts. In addition to informing public policy makers, this kind of information that can be used to identify stakeholder groups. Particularly when risk management alternatives include local environmental remediation, easements, etc., high asset-at-risk populations will likely have elevated interests in alternative solutions.

Figure 8: Property Damages from a 100-year Flood, Lower Santa Clara River (losses in thousands of 2008 dollars)



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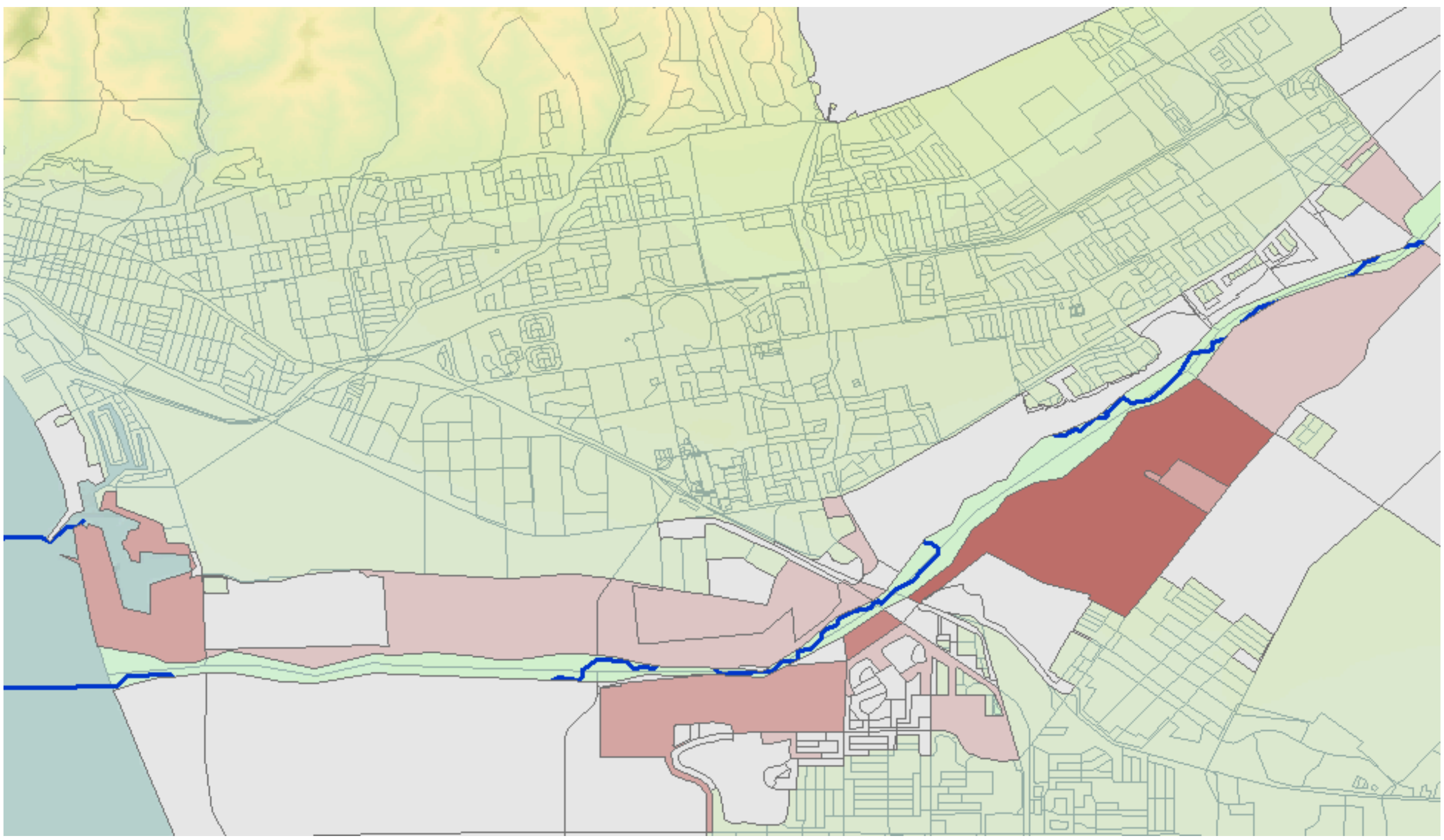
As Figure 9 reveals, HAZUS' level of detail even makes it possible to engage in local canvassing/survey activities to extend stakeholder engagement. In this example, it is clear that a dense population with limited flood risk are still close enough to the high risk zone to benefit from environmental services that would flow from green solutions like waterside parks and recreation. More generally speaking, experience has shown that green alternatives, because of their wider array of non-market services, often benefit from more inclusive public-private dialog, and this assessment tool supports that quite effectively.

Figure 9: Detailed Assets-at-Risk from Flooding, Santa Clara River Mouth



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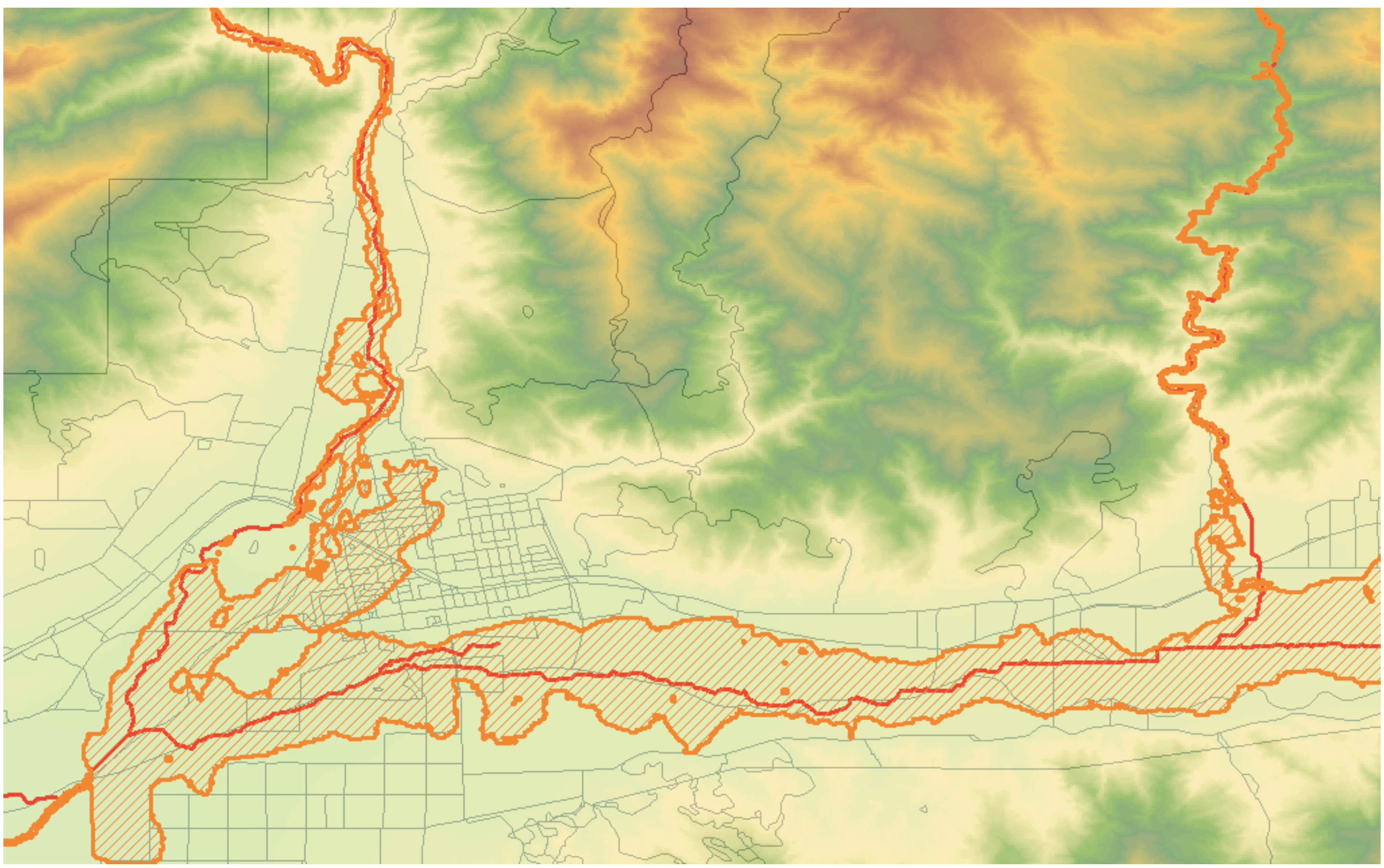
The same reasoning can be applied to the middle zone of the Santa Clara. Shown in Figure 10 without blue fill but still showing the flood boundary, adversely affected census tracts are immediately apparent. Also apparent are the proximate, densely populated tracts that should have a stake in the kind of risk management solution that is implemented. Even if a grey investment "solves" the flood problem for the first group, the second will loose the opportunity for environmental services that a green solution would provide. Descriptive approaches like HAZUS make it easier to identify these trade-offs and the stakeholders associated with them.

Figure 10: Flood Risk Boundaries in the Middle Santa Clara River Zone



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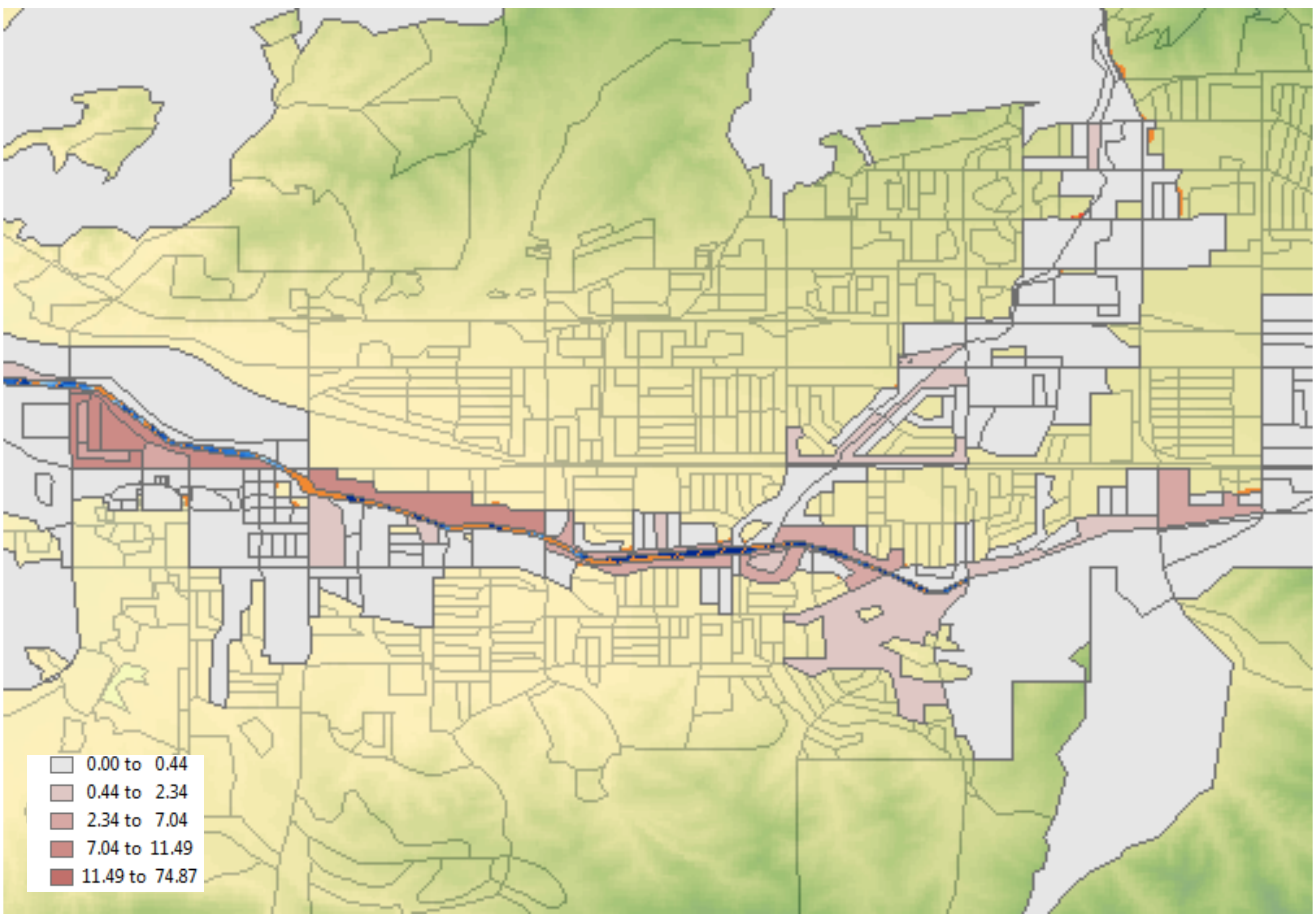
Other hazard information includes scope of damages, important for understanding the incidence of asset risk across a given population. Figure 11 shows Simi Valley, with scope of damage measuring the percent of structural square footage with substantial (i.e. replacement) damage. As the figure and key suggest, a flood of this magnitude would impose lasting damages on at-risk neighborhoods. As we have learned from Katrina and other severe hurricanes, the scope of damage has a self-fulfilling aspect. If emergency and restoration resources are overextended and recovery is delayed, long-term damages to property and its value can be much higher.

Figure 11: Scope of Damages, Simi Valley
(percent of square footage with substantial damage)



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Behind the graphic renderings discussed above, a very rich data structure also provides detailed quantitative results. For example, the maps depict estimated damage levels are drawn from extensive, location specific building and other asset inventories maintained for every county in the United States by FEMA and other agencies. To the extent that this information might be relevant for more intensive stakeholder engagement, it can be extracted and used for public outreach. Moreover, the census tract framework, alluded to above in terms of cost and benefit distribution, invites synthesis with other demographic, public health, educational, and even original survey data.

These applications are outside the scope of the present study, but we give a general indication of the numerical resources available from HAZUS applications in Table 2 below.

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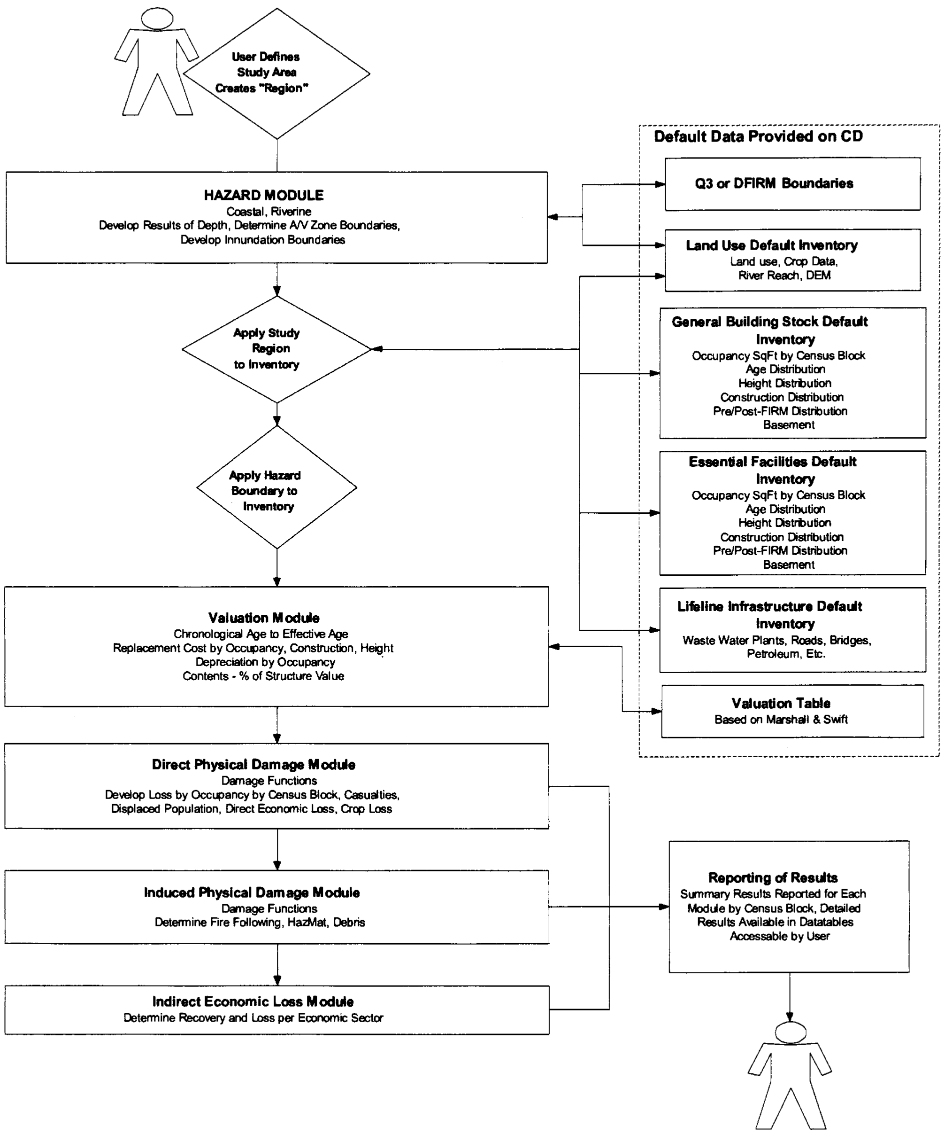
Table 2: Aggregate Assets at Risk, Santa Clara River Study Area
(all figures in thousands of 2008 dollars)

Building Stock Exposure								
	Wood	**Steel**	**Concrete**	**Masonry**	**Mfg Housing**	**Total**		
By Type	$49,799,220	$3,148,607	$5,118,289	$4,343,733	$479,906	$62,889,755		
	Residential	**Commercial**	**Industrial**	**Agriculture**	**Religion**	**Government**	**Educatn**	**Total**
By Occupancy	50,081,349	7,987,120	2,758,893	519,906	581,033	286,065	675,272	62,889,638
Infrastructure Exposure								
	Highway	**Railway**	**Light Rail**	**Bus Facility**	**Ports**	**Ferries**	**Airport**	**Total**
Segments	$5,270,816	$134,159	$55,066	$-	$-	$-	$-	$5,460,041
Bridges	$788,738	$1,660	$-	$-	$-	$-	$-	$790,398
Tunnels	$2,037	$-	$-	$-	$-	$-	$-	$2,037
Facilities	$-	$13,315	$13,315	$6,431	$23,964	$2,662	$42,604	$102,291
Total	$6,061,591	$149,134	$68,381	$6,431	$23,964	$2,662	$42,604	$6,354,767
	Potable Water	**Waste Water**	**Oil Systems**	**Natural Gas**	**Electric Power**	**Total**		
Utilities	$196,470	$864,468	$236	$2,572	$519,200	$1,582,946		
Vehicle Exposure								
	Cars	**Light Trucks**	**Heavy Trucks**	**Total**				
Day	$1,453,254	$2,010,583	$468,454	$3,932,291				
Night	$1,615,561	$2,230,076	$494,089	$4,339,726				

The assessment example above focused on riverine flooding, but HAZUS also has dedicated capacity to model coastal storm, tidal, wave, and sea level risk. Features included in this component include dune erosion and dynamic (amplitude, frequency, duration) wave action modeling (see Scawthorn et al: 2006) for details. The overall structure of the assessment approach is depicted below.

Figure 12: Schematic HAZUS Flood Estimation Modeling



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IMPLAN Project and Economic Benefits Assessment

Rigorous policy research tools can shed important light on the detailed economic effects of adaptation responses to climate change and other adverse natural events, including both grey and green investments. The Impact Analysis for Planning (IMPLAN) data and modeling system is an example of such a framework, combining very detailed information on transactions across the economy in an explicit linkage framework that shows how investment and other demands create other income and employment through so-called multiplier linkages. IMPLAN tables have been developed for every county in the United States, and are updated annually to reflect the most recent available information. Like HAZUS, IMPLAN represents a de facto standard for economic assessment, this time on the benefits side of investment projects. Unfortunately, IMPLAN is sold by a private company, and can be expensive for complete national coverage.

IMPLAN was developed to model input-output transactions based upon local sources of economic activity. This software was designed for the U.S. Forest Service to catalog and forecast the local economic impact of a timber harvest. In addition to forest products, IMPLAN works as an input output-model that produces tables for linkages between NAICS (North American Industrial Classification System) defined industrial sectors. IMPLAN uses commodity flows from producers to intermediate and final consumers to describe a regional economy. The factors IMPLAN analyzes in this form of input-output analysis are: total industry purchases of commodities, services, employment compensation, value added and imports. The software runs as a detailed, data rich, inverse matrix and produces multipliers, which describe the final impact of an increase or decrease of one dollar of spending.

County data is run through IMPLAN software, creating tables that describe total industry output, total employment and final value-added are created. Output is defined as the value of production by a given industry per year. Employment is defined as wage and salaried employees for full and part-time workers within each industry. Total value-added describes the following: income to workers paid by employers, income, rents, royalties, dividends, profit, excise and sales tax. Each of these tables contains a set of numbers that describe the amount of money that must be spent to generate one unit in dollars, services, products or jobs. Direct effects account for production changes associated with final demand changes within an industry. Indirect effects describe backward-linked industries and the corresponding changes that result from changes in input demands for directly affected industries. Induced effects account for the changes in regional household spending.

IMPLAN is a much easier software package to use than HAZUS, so training cost savings can significantly compensate for data costs. By constructing transactions tables that describe the structure of a specific economic region, IMPLAN can create a localized model to investigate the consequences of projected economic transactions in that region. Used by over 2,000 public and private institutions, IMPLAN is the most widely adopted regional economic analysis software for predicting economic impacts. To strengthen TNC's capacity for assessment and facilitate its dialog with public and private stakeholders, it is strongly recommended that IMPLAN be adopted in this and related contexts. We give an example of IMPLAN evaluation for the TNC's Ventura County projects below.

By revealing detailed interactions across a broad spectrum of stakeholders, empirical evidence improves our understanding of the many indirect benefits of policies that promote timely and farsighted adaptation measures. Many studies emphasize the costs of investments and actions that mitigate climate and other adverse environmental impacts because they look only at the direct costs. In reality, spending on infrastructure and natural assets also yields a broad range of positive economic impacts, including employment, commercial risk reduction, etc. These overall benefits only become apparent when the economy-wide spillovers of targeted investments are taken into account. More narrow, industry-specific and bottom-up investment studies fail to capture these indirect benefits, giving disproportionate emphasis to direct costs. An economy-wide perspective like that of recommended here is needed to balance the long-term cost and benefit perspectives. In particular, NBA spending can be seen to offer economic stimulus through three channels, each summarized below.

Direct Economic Stimulus

Like any public investment, NBA spending can be expected to create direct employment, including program administration and implementation but, more interestingly in the present case, jobs for clean technology and building trade workers. These are not only relatively high paying jobs, but they are in-state service sector occupations that are particularly important because they represent (respectively) California's knowledge-intensive competitiveness and the group hardest hit by the recent recession. Clean technology is widely acknowledged to be the next breakout tech sector, and by stimulating demand for it's workers and products, NBA can help incubate these technologies that improve long-term competitive future. Conversely, the construction sector was one of our most robust local industries during the last decade, but has the highest unemployment rate since the housing-driven recession started. By creating more jobs in this sector, NBA can play a critical role in local and regional economic recovery.

Indirect Economic Stimulus

In addition to those employed directly with NBA monies, industries up and down the project investment supply chain will benefit, including suppliers of technologies and materials used in natural asset remediation, sales and distribution channels, and allied services. As program spending expands demand for building, retrofitting, and remediation systems, suppliers of all these and their distributors will see order books grow, supporting higher income and employment. Because the IMPLAN framework is based on the linkages of an input-output accounting system, our estimates take account of all these upstream and downstream spillover effects.

Induced Economic Stimulus

In addition to those working directly for an investment project and supplying them, another group will benefit. These are companies and workers producing goods and services purchased by those recruited into the first two job categories. As project spending creates more direct and indirect jobs, these workers will have new money to spend, creating new demand, profits, and jobs. Our experience shows that these induced jobs are about equal in number to Indirect employment. Moreover, in the United States, these are concentrated (about 70%) in service sectors, across a broad spectrum of bedrock, local and regional occupations that cannot be outsourced.

Project Benefit Assessment

Infrastructure investment projects, whether grey or green, entail expenditures on a variety of goods and professional services during the design, construction, and operations phases. Project budgets may details these expenses explicitly, and many accrue to the local economy. Generally, however, the overall impact of local investment is much larger than the direct outlays. As the IMPLAN description makes clear above, Indirect and Induced effects together can often be even greater than Direct spending impacts. The underlying multipliers all should be considered as economic benefits from the project, and a comprehensive analysis like this should be part of any larger assessment, whether for green or grey investments. A completely researched, single project IMPLAN assessments today cost between 50 and 100 thousand dollars, so it would make sense to internalize this capacity if it were of wider interest across TNC. To this end, a few representative case studies might increase awareness.

For the present, lacking detailed project expenditure accounts, we have produced a generic example based on the Ormond Beach restoration assessment (Aspen Environmental: 2009). The Aspen study considered a variety of coastal remediation projects, only one of which we consider in this example. Generally, a complete IMPLAN study would decompose the table below into more detailed activities that reflect the actual expertise and resources deployed for remediation, restoration, and other tasks. Appendix A below contains a list of such categories, complied by the USDA and Department of Interior, with their IMPLAN counterparts. Over 249 activities are represented, yielding very detailed evidence on the economic contributions of "green" and other jobs to the local economy.

Table 3: Project Budget for Ormond Beach Restoration, Alternative 2U

Activity	Cost (x1000)	Percent
Construction	$265,970	91
Prelim Engineering	$2,660	1
Env Review	$2,660	1
Construction Mgmt	$9,310	3
Final Engineering	$9,310	3
Env Monitoring	$2,660	1
Total	$292,570	100
Cost per acre	$167	

Table 4: IMPLAN Estimates for Direct, Indirect, and Induced Economic Impacts from Ormond Beach Restoration, Alternative 2U

	Direct	Indirect	Induced	Total
California GSP	$181,113	$177,447	$181,505	$540,065
Personal Income	$132,223	$106,974	$99,219	$338,416
Employment	2,666	2,057	2,377	7,100
Wages and Salaries	$100,760	$93,116	$88,745	$282,622
Enterprise Income	$30,753	$14,865	$11,732	$57,351
Business Taxes	$5,844	$18,204	$23,982	$48,030

Source: Author estimates from IMPLAN. Dollar amounts in thousands. Employment is FTE.

The results in Table 4 suggest that a strong economic argument could be made for Ormond restoration, quite apart from its intrinsic environmental benefits. The restoration project itself would more than double the value of direct investments in the state and local economies, yielding over half a billion dollars in Gross State Product (GSP), over seven thousand FTE jobs. Beyond private income and employment benefits, the stimulus from this project would generate nearly $50 million in new business tax revenue, or about 20% of the cost of the project.

Nature Based Assets: Economic Assessment

Use Benefit Assessment

When grey adaptation projects are completed, they generally become passive with respect to surrounding economic activities. Except when specifically designed for some conjunctive use (e.g. bike path on a seawall), their primary economic benefits come from aversion of future costs (flood, surge, etc.) and ongoing operations and maintenance activity. Green alternatives, on the other hand, offer a wide array of environmental services that confer direct and indirect economic value through current activities, including agriculture, recreation, tourism, etc. Because of their diversity, valuing these environmental services requires several approaches. Here we give an example of benefit assessment for recreation and tourism, which has been a popular application of the IMPLAN framework.

Recreation and Tourism

In a detailed study of 80 National Wildlife Refuges, Carter and Caudill (2007) used IMPLAN to estimate local and regional economic benefits of recreation and tourism.

Table 5: IMPLAN Sectors for Wildlife Refuge Tourism

Fish/ Hunt Survey Category	IMPLAN Activity/Sector	Percentage allocated to IMPLAN sector[3]
Lodging	hotels	100%
Food/drink	food for off-site consumption	Residents: 35% Non-residents 65%
..	purchased meals	Residents: 65% Non-residents: 35%
Air Transportation	airline	100%
Other Transportation	gas/oil	90%
..	car repairs	10%
Other	sporting goods	40%
..	tobacco	1%
..	alcohol	1%
..	shoes	8%
..	clothing: women	8%
..	clothing: men	8%
..	personal/misc.	8%
..	toilet articles	8%
..	telephone	6%
..	postage	6%
..	film development	6%

Nature Based Assets: Economic Assessment

Tourism in Ventura County has a different orientation, but is very important to the local and regional economy. According to the most recent publically available information, the county hosts an average of about 5 million visitors, spending about half a billion dollars, per year (see Table 6).

Table 6: Summary of Ventura County Tourism

Measure	Total	Hotel/Motel	Private Residence	Day Visitor
Visitors	**5,233,773**	**259,894**	**690,854**	**4,283,025**
Ratio	**100.00%**	**5.00%**	**13.20%**	**81.80%**
Average Stay	**1.44**	**3.43**	**3.64**	**1**
Total Days	**7,689,100**	**891,400**	**2,514,700**	**4,283,000**
Ratio	**100.00%**	**11.60%**	**32.70%**	**55.70%**
Group Size	**2.46**	**2.48**	**2.69**	**2.43**
Daily Individual Spending	**$59.61**	**$120.85**	**$63.88**	**$59.61**
Total Spending	**$458,315,800**	**$107,725,700**	**$160,639,000**	**$189,951,100**
Ratio	**100.00%**	**23.50%**	**35.00%**	**41.50%**

Source: Schlau (2007)

To conduct an IMPLAN impact analysis of how a given investment project (green or grey) would stimulate tourism and recreation revenues, we need to identify the counterfactual, meaning how much new activity and what kind of expenditure would result from completion of the project. Since we lack detailed information on this for any of the current Ventura projects, let's assume for the sake of an example that the Ormond Beach restoration increases average tourism in Ventura County by 1%. In reality, the percentage will differ and certainly the composition of spending will differ, according to the project being considered. As we see above, wildlife refuges attract some kinds of spending, surfing or golfing venues others, and the general beach scene quite a diverse mix of consumer goods, services, transport, and public services. In any case, from the same source we have a breakdown of average Ventura tourist spending in the Table 7.

Table 7: Average Composition of Tourist Expenditures, Ventura Country (2005/6)

	Daily Per-Person	Total Amount	Ratio
Meals	$17.40	$133,798,600	29.19%
Shopping/souvenirs/gifts	$16.08	$123,629,200	26.97%
Daily Transport/Parking	$9.41	$72,375,600	15.79%
Lodging	$5.60	$43,046,400	9.39%
Beverages	$5.45	$41,902,600	9.14%
Groceries/Incidentals	$5.37	$41,282,300	9.01%
Attractions	$0.30	$2,281,200	0.50%
Total	**$59.61**	**$458,316,100**	**100.00%**

Source: Schlau (2007)

Most of the retail goods and services that tourists buy have strong linkages to the local economy. The majority of their value is added locally through labor-intensive production (food service), wholesale, retail, and distribution margins. Moreover, local residents supply most of those upstream services. In this context, the virtuous expenditure cycle captured by the multiplier extends much further into the local economy. Indeed, across the IMPLAN sectors corresponding to activities in the table, the average gross state product multiplier is about 2.3, meaning every tourist dollar ultimately contributes $2.30 to the California state economy.[2]

Table 8: IMPLAN Estimates for Direct, Indirect, and Induced Economic Impacts from A One Percent Increase in Annual Ventura Country Tourist Expenditures

	Direct	Indirect	Induced	Total
California GSP	$4,006	$2,322	$2,866	$9,194
Personal Income	$2,563	$1,371	$1,620	$5,553
Employment	79	25	35	139
Wages and Salaries	$2,267	$1,145	$1,406	$4,818
Enterprise Income	$311	$228	$217	$756
Business Taxes	$602	$158	$258	$1,018

Source: Author estimates from IMPLAN. Dollar amounts in thousands. Employment is FTE.

[2] The amount contributed to the local economy cannot be calculated without a full IMPLAN assessment, but for service sector spending, the majority of stimulus benefits are local.

Agriculture

Across the United States, recognition of the environmental importance of farming and farmland has grown substantially. Not only can farms and farming practices contribute to today's climate and other environmental amenities, but they can significantly influence global warming pollution and play an important role in adaptation to climate change. Putting a value on all these environmental services is a difficult task, but if a green adaptation policy includes agriculture it is essential to do this to the extent possible. Later in this report we discuss valuation of more intangible environmental services, like natural landscapes, but here we give a more direct example of how IMPLAN has been used to value the economic contribution of farmland. This impact would be part of the benefits of easement agreements or other measures to keep farm land contributing to natural risk mitigation (e.g. floods). Indeed, there is a vast literature on such assessments for USDA sponsored conservation programs. The flagship of these programs, the Natural Resources Conservation Service, allocates billions to agricultural activities in recognition of environmental services. Their programs are popular candidates for IMPLAN assessment, and TNC should consider adding this technique to their benefit assessments for any acquisitions/partnerships that enlist active agricultural assets.

We do not have sufficient agronomic data on the proposed easements being considered for Ventura County, but a related example will give a good indication about the value of such an assessment. In their careful study of the purchase of agricultural conservation easements (PACE) program, the American Farmland Trust (AFT) assessed the value of several case study easements. In the table below, we see the case from Franklin County, Massachusetts. With complete profit and loss statements from the farm in question, AFT was able to us the IMPLAN county dataset to estimate the individual contribution of the farm to the local and regional economy.

Table 9: Agricultural Easement Valuation Example

Table 5: Multipliers and Total Impact for Output, Employment and Total Value Added				
Output				
Type of Multiplier	**Total Sales**	**APR Sales**	**Multiplier**	**Total Impact***
Type I	$ 2,615,104	$ 804,647	1.072911	$ 863,315
SAM		$ 804,647	1.160916	$ 934,128
Employment				
Type of Multiplier	**Total Employment**	**APR Employment**	**Multiplier**	**Total Impact***
Type I	30	9	1.052426	9
SAM		9	1.121656	11
Total Value Added				
Type of Multiplier	**Total Sales**	**APR Sales**	**Multiplier**	**Total Impact***
Type I	$ 2,615,104	$ 804,647	1.056669	$ 850,244
SAM		$ 804,647	1.122944	$ 903,574

* Total includes the portion from APR property as well as the multiplier effect.

Source: American Farmland Trust (2005).

On average, in addition to its own revenue, the farm was generating about 15% indirect and induced income for the local community, an attractive annual return before business, property, and other tax contributions. Based on the these findings, AFT reached eight conclusions, all of which are relevant to the Ventura case and to many other TNC asset classes:

1. The owners of property will achieve greater economic income in the future by selling the development rights on their property.
2. Adjacent properties can benefit from direct payments for leasing of property for agricultural operations, and there is a relatively higher increase in assessed values than other properties in the community.
3. Recreational opportunities, while not found as a direct payment to the operators of the case study farms, can be evaluated as an indirect community service or a potential future use.

4. Local businesses continue to receive financial benefits by selling goods and services to the operation.
5. The economic contribution from farming operations is fairly easy to quantify and has significant value.
6. Soil loss from erosion during development is a cost that can be avoided by keeping the land in agriculture, although the long-term cost of erosion during farming may negate that benefit.
7. Flood costs, though small, are quantifiable in watersheds without flood control structures.
8. Existing local data sources and reports can provide information that can be used as evidence to support funding for farmland protection.

Table 10: IMPLAN Estimates for Direct, Indirect, and Induced Economic Impacts from A One Million Dollar Increase in Ventura County Farm Output

	Direct	Indirect	Induced	Total
California GSP	$811	$463	$485	$1,759
Personal Income	$395	$300	$290	$985
Employment	10	8	6	24
Wages and Salaries	$261	$258	$270	$789
Enterprise Income	$126	$49	$32	$208
Business Taxes	$34	$41	$63	$138

Source: Author estimates from IMPLAN. Dollar amounts in thousands. Employment is FTE.

As a comparison exercise, we used aggregated agricultural data for Ventura County and the IMPLAN model to ask the question, what would be the impact on the state and local economy of $1,000,000 in farm operations? The estimates in Table 10 answer this question for a “representative” farm, i.e. one that practices (proportionately) all the crop and livestock activities currently in found in Ventura County. As in the previous two examples (Ormond beach and tourism), we can only assess a specific easement strategy with detailed information regarding the IMPLAN agricultural activities actually eligible. Having said this, it is apparent that agriculture in the Ventura has much higher multiplier linkages than national averages, and we see that an additional million dollars of local farm operations would generate nearly double this amount in state GDP. The reason for this is the labor intensity and higher value added in California agriculture generally, compared to commodity cereal crops or range livestock.

Extensions

This study evaluates grey and green investment stimulus at a relatively aggregate level, examining only the relationship between aggregate budget allocations and average responses across generic economic activities. In reality, local adaptation investments will probably comprise a diverse array of initiatives. This kind of program heterogeneity will probably achieve even greater economic benefits than our aggregated estimation suggests, but evaluating them in detail is beyond the scope of this study. An extended assessment, including more diverse and detailed investment initiatives, would of course be desirable, both to identify benefits and beneficiaries, and to support more effective adaptation program design and implementation.

Other Assessment Methods

Many environmental benefits are not readily addressed by economic techniques such as those discussed above. In particular, valuation schemes like HAZUS and modeling approaches like IMPLAN are generally calibrated to economic databases. Generally, these data represent market valuation of goods, services, transactions, and transfers. As such, they do not directly measure the benefits and costs of may environmental services, like biodiversity, air quality, scenic value, etc. The models are based on input-output models that do not incorporate qualitative data or future benefits that are difficult to quantify. This is a challenge for a decision support tool that is supposed to compare grey investments, where economic considerations generally predominate. It also handicaps natural assets in discussions of public and private land use decisions, where many alternative uses are directly economic.

To strengthen economic assessment of environmental services, economists have developed a variety of tools for measuring the value of public and private environmental goods and services directly. For example, the price of admission can be said to reflect the value of a recreation area, but we can only measure this if there is such a charge. Conversely, the fact that an environmental service is free does not mean it has no value. Moreover, an existing charge is a lower bound for the value to those who visit, but those who do not might still place a positive value on its existence and would even be willing to pay something to preserve it without consuming it directly ("I love the idea of Old Faithful, but have never been there.").

As these comments make clear, valuing environmental services is a complex subject. In practice, most of this work is survey based, data intensive, and difficult to generalize. Having said this, methods used to estimate "willingness to pay" (WTP) and "contingent valuation" (CV) techniques are now essential to modern environmental policy. For an extended review of alternative approaches and the challenges and opportunities they present, see e.g. de Groot et al (2002). For present purposes, a dedicated individual project assessment is outside the scope of this review, but we present instead a description of the leading alternative valuation techniques with examples relevant to TNC assets.

In the context of coastal and riverine adaptation, a very useful review of valuation approaches is given by Rouquette et al (2009). In particular, the seven main alternative strategies for valuing agricultural floodplains are compared and contrasted. Of seven methods, four are non-market (scoring) techniques, two are alternative market valuation approaches, and one is a targeting or quota allocation scheme. Each approach is defined and briefly described in the first three columns of the table below. For the reader's benefit, references to entry-level literature on each approach are also included in the last column.

Table 11: Alternative Approaches to Valuing Agricultural Floodplains

Method	Approach	Decision criteria	Outputs	Key references
Ecological Impact Assessment method	Assessment using pre-defined prioritization criteria	Designation status of the habitat, proportion of national and regional resource	Non-monetary score	Treweek (1999), Tucker (2005), IEEM (2006)
Reserve-selection criteria	Valuation using ecological criteria pre-determined by experts	Diversity, rarity, naturalness, size and fragility	Non-monetary score	Ratcliffe (1977), Margules & Usher (1981)
Target-based criteria	Assessment against government targets	Net area of priority BAP habitat created; percentage of national and regional targets created	Area; % of targets	Defra (2007), UK BAP (2004, 2006)
Stakeholder choice analysis	Expression of preferences of a range of stakeholders	Stakeholder preferences for key habitats, based on a wide range of criteria such as biodiversity, rarity, aesthetics, cultural history and personal preference	Non-monetary score	Sinden & Windsor (1981), Anselin, Meire & Anselin (1989)
Reserve-selection criteria guided by stakeholders	Uses stakeholders to guide and provide weightings for expert-derived criteria	Reserve selection criteria, plus additional criteria identified by stakeholders. Relative importance weighted by stakeholders	Non-monetary score	Marsh et al. (2007)
Agri-environment scheme payments	Revealed, expenditure-based preference for different habitats	Money payable to farmers and land managers through agri-environment schemes	Monetary value	Pretty et al. (2000), Farber, Costanza & Wilson (2002), Defra (2005a,b)
Contingent valuation	Benefits transfer of willingness to pay (expressed preference)	Members of the public willingness to pay for environmental goods, adjusted by socio-economic factors	Monetary value	Oglethorpe et al. (2000), Hanley et al. (2001), Oglethorpe (2005)

Source: Rouquette et al (2009).

Each approach has strengths and weaknesses, and indeed the point of the Rouquette et al study is to compare them across a unified set of natural assets. In actual applications, one or more approaches might be most cost effective, while others might be infeasible. One of the strongest messages of the study is a rank correlation analysis comparing these alternative measurement approaches. As the table below makes clear, there is substantial consistency across all the approaches, even including targeting according to other institutional constraints.

Table 12: Rank Correlation Between Different NBA Valuation Approaches

	Valuation method							
	EcIA method	Reserve selection 1	Reserve selection 2	Stakeholder choice	Agri-environment payments	Contingent valuation	BAP area created	National targets
Reserve selection 1	0·876***	–	–	–	–	–	–	–
Reserve selection 2	0·870***	0·985***	–	–	–	–	–	–
Stakeholder choice	0·881***	0·830***	0·804***	–	–	–	–	–
Agri-environment payments	0·796***	0·750***	0·771***	0·750***	–	–	–	–
Contingent valuation	0·866***	0·898***	0·880***	0·862***	0·734***	–	–	–
BAP area created	0·665**	0·595**	0·648**	0·594**	0·872***	0·685**	–	–
% national targets	0·847***	0·838***	0·856***	0·781***	0·697**	0·788***	0·767***	–
% regional targets	0·866***	0·901***	0·875***	0·786***	0·686**	0·769***	0·645**	0·860***

Correlations are Spearman's rank correlation coefficients (n = 25). The r_s values and the associated P values (** $P < 0{\cdot}01$, *** $P < 0{\cdot}001$) are shown.
EcIA, Ecological Impact Assessment.
Reserve selection 2, reserve selection criteria guided by stakeholders.

Source: Rouquette et al (2009).

For NBA assessment, the essential message of this work is that it is more important to include environmental services valuation than to worry about finding the optimal method. In the case studies above, all seven approaches offered useful information, generally consistent across alternatives. Additionally, each approach contributed to integrated assessment by elucidating a dimension of natural asset value that would be undervalued by private market participants, biasing choices in favor of grey solutions. Put another way, the disadvantage and bias of restricting grey-green comparisons to market impacts is greater than the risk of uncertainty that might arise from including non-market and environmental service valuation.

Conclusions

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Annex A – IMPLAN Sector Codes for Environmental Restoration Activities

Code	Description	2007 NAICS	IMPLAN Sector
100	CNMP		19
102	CNMP CAP		19
106	Forest Management Plan CAP		19
110	Grazing Management Plan CAP		19
114	Intergrated Pest Management Plan CAP		19
118	Irrigation Water Management Plan CAP		19
122	Agricultural Energy Management Plan - Headquarters		375
124	Agricultural Energy Management Plan - Landscape CAP		375
126	Comprehensive Air Quality Management Plan CAP		375
130	Drainage Water Management Plan CAP		19
134	Conservation Plan Supporting Transition from Irrigation to Dry-land Farming Plan CAP		19
138	Conservation Plan Supporting Organic Transition CAP		19
142	Fish and Wildlife Habitat Management Plan CAP		375
146	Polinator Habitat Enhancement Plan		375
150	Oil Spill, Prevention Control, and Countermeasure (SPCC)		375
154	Integrated Pest Management Herbicide Resistance Weed Conservation Plan		19
309	Agrichemical Handling Facility		36
310	Bedding		13
311	Alley Cropping		19
313	Waste Storage Facility	238910	26
314	Brush Management	115	19
315	Herbaceous Weed Control		19
316	Animal Mortality Facility		13
317	Composting Facility	562219	36
320	Irrigation Canal or Lateral		26
322	Channel Bank Vegetation		11
324	Deep Tillage	111191	2
326	Clearing and Snagging		26
327	Conservation Cover	561730	2
328	Conservation Crop Rotation	111191	2
329	Residue and Tillage Mgt, No Till	111191	2

329A	Residue Management-No Till		2
329B	Residue Management - Mulch		2
329C	Res manag ridge till (Ac)		2
330	Contour Farming		2
331	Contour Orchard and Other Fruit Area		5
332	Contour Buffer Strips		19
338	Prescribed Burning	115310	19
340	Cover Crop	561730	2
342	Critical Area Planting	561730	2
344	Residue Management, Seasonal		1
345	Residue and Tillage Mgt, Mulch Till	111191	2
346	Residue and Tillage Mgt, Ridge Till	111191	2
348	Dam, Diversion		26
350	Sediment Basin		26
351	Well Decommissioning	237110	26
353	Monitoring Well		36
355	Well Water Testing		19
356	Dike		26
359	Waste Treatment Lagoon		26
360	Closure of Waste Impoundments		26
362	Diversion	237110	26
365	Anaerobic Digestor, Ambient Temperature		36
366	Anaerobic Digester, Controlled Temperature		36
367	Waste Facility Cover		36
370	Atomospheric Resource Quality Mgt		19
371	Air Filtration and Scubbing		13
372	Combustion System Improvement		203
373	Dust Control on Unpaved Roads and Surfaces		19
374	On Farm Equipment Efficiency Improvements		203
375	Dust Control from Animal Activity on Open Lot Surfaces		11
378	Pond	237110	26
379	Multi-Story Cropping		4
380	Wind-/Shelter-break	561730	6
381	Silvopasture Establishment		11
382	Fence	238990	11
383	Fuel Break		15
384	Forest Slash Treatment		15
386	Field Border	111191	2
388	Irrigation Field Ditch		26
390	Riparian Herb. Cover	561730	2

391	Riparian Forest Buffer	561730	6
393	Filter Strip	561730	2
394	Firebreak	115310	2
395	Stream Habitat Improvement and Management		11
396	Fish Passage		33
397	Aquaculture Ponds		26
398	Fish Raceway or Tank		36
399	Fishpond Management		17
402	Dam		26
409	Prescribed Forestry		19
410	Grade Stabilization Structure	237990	26
412	Grassed waterway	237990	26
422	Hedgerow planting	561730	6
423	Hillside Ditch		26
428	Irrigation Ditch Lining		19
428A	Irrigation Water Conveyance Ditch and Canal Lining Nonreinforced Concrete		19
428B	Irrigation Water Conveyance Ditch and Canal Lining Flexible Membrane		19
428C	Irrigation Water Conveyance Ditch and Canal Lining Galvanized Steel		19
430	Irrigation pipeline		19
430DD	Irrigation Conveyance, High pressure, underground	237110	19
430EE	Irrigation Conveyance, Low pressure, underground	237110	33
431	Above Ground, Multi-Outlet Pipeline		19
432	Dry Hydrant		26
436	Irrigation Storage Reservoir		26
441	Irrigation system, microirrigation	237110	19
442	Irrigation system, sprinkler	237110	19
443	Irrigation System, Surface and Subsurface		26
447	Irrigation system, tailwater recovery	237110	26
449	Irrigation water mgt	237110	19
450	Anionic Polyacrylamide (PAM) Erosion Control		19
451	Land reclamation Fire Control		26
452	Land Reclamation Shaft and Adit Closing		26
453	Land Reclamation Landslide Treatment		26
455	Land Reclamation, Toxic Discharge Control		20
456	Land Reclamation Highwall Treatment		26
457	Mine Shaft and Adit Closing		36
460	Land Clearing		26

462	Precision Land Forming		26
464	Irrigation Land Leveling		26
466	Land Smoothing		26
468	Lined waterway	237990	26
472	Use exclusion	238990	11
482	Mole Drain		36
484	Mulching		2
490	Tree/shrub site preparation	561730	2
500	Obstruction removal	238910	26
511	Forage Harvest Management		10
512	Pasture and hay planting	111940	10
516	Pipeline	237110	201
521A	Pond Sealing or Lining, Flexible Membrane		26
521B	Pond Sealing or Lining, Soil Dispersant		26
521C	Pond Sealing or Lining, Bentonite Sealant		26
521D	Pond Sealing or Lining, Compacted Clay Treatment		26
527	Sinkhole and Sinkhole Area Treatment		26
528	Prescribed grazing	112111	12
528A	Prescribed grazing	112111	12
532	Pumped Well Drain		33
533	Pumping Plant		33
543	Land Reconstruction, Abandoned Mined Land		26
544	Land Reconstruction, Currently Mined Land		26
548	Grazing Land Mechanical Treatment		11
550	Range planting	561730	11
552	Irrigation Regulating Reservoir		26
554	Drainage Water Management		2
555	Rock Barrier		26
557	Row Arrangement		2
558	Roof Runoff Structure		36
560	Access Road		26
561	Heavy use area mgt	237990	26
562	Recreation Area Improvement		36
566	Recreation Land Grading and Shaping		26
568	Recreation Trail and Walkway		26
570	Runoff Management System		36
571	Soil salinity mgt	115112	2
572	Spoil Spreading		26
574	Spring Development		26
575	Animal Trails and Walkways	237990	26

578	Stream Crossing		26
580	Streambank and Shoreline Protection		26
582	Open Channel		26
584	Channel Stabilization		26
585	Stripcropping		2
587	Structure for water control	237110	26
588	Cross Wind Ridges		2
589A	Cross Wind Ridges		2
589C	Cross Wind Trap Strips		2
590	Nutrient mgt	115112	19
591	Amendments for the Treatment of Agricultural Waste		13
592	Feed Management		13
595	Pest mgt	115112	19
600	Terrace	237990	26
601	Vegetative Barrier		6
603	Herbaceous Wind Barriers		6
606	Subsurface Drain		19
607	Surface Drainage, Field Ditch		26
608	Surface Drainage Main or Lateral		19
609	Surface Roughening		2
610	Salinity and Sodic Soil Management		19
612	Tree/shrub establishment	561730	6
614	Watering facility	237110	11
620	Underground Outlet		26
629	Waste Treatment		11
630	Vertical Drain		36
632	Solid/Liquid Waste Separation Facility		36
633	Waste utilization	115112	19
634	Manure transfer	483	19
635	Wastewater Treatment Strip		26
636	Water Harvesting Catchment		26
638	Water and Sediment Control Basin		26
640	Waterspreading		26
642	Water well	237110	33
643	Restoration of declining habitats	111191	2
644	Wetland wildlife habitat mgt	111191	2
645	Upland wildlife habitat mgt	111191	2
646	Shallow Water Management for Wildlife		26
647	Early Successional Habitat Development/Management		10
648	Wildlife watering facility	237110	26

650	Windbreak/Shelterbelt Renovation		6
655	Forest Trails and Landings		26
656	Constructed Wetland		26
657	Wetland Restoration		26
658	Wetland Creation		26
659	Wetland Enhancement		26
660	Tree/Shrub Pruning		6
666	Forest Stand Improvement	115310	19
700	Fish Screen		36
702	Ag. Handling Facility		36
706	Shellfish Aquaculture Manageme		19
716	Renewable Energy Production		203
717	Livestock Shade Structure		36
718	Precision Pest Control		19
729	Dust Control on Unpaved Roads		19
734	Conservation Management Signs		113
737	Reduced Water and Energy Conveyance		36
740	Pond Sealing or Lining		26
747	Denitrifying Bioreactor		36
749	Waste Field Storage		19
751	Individual Terrace		2
753	Infiltration Ditch		2
755	Well Plugging		19
779	Livestock Cooling Pond		26
780	IWC Corrugated Metal Pipe		201
794	IWC Corrugated Ribbed Profile		201
797	Invasive Plant Species Control in Natural Habitats		19
798	High Tunnel		36
799	Monitoring & Evaluation (no)		375
910	TSP Plan		19
911	TSP Design		19
912	TSP Installation		19
913	TSP Checkout		19
AE	Architectural and Engineering Services		369
CCIB	Conservation Completion Incentive Second Year		2
closing	Closing Costs	531	360
CROP	Cropland Annual Payment		700
EAM	CSP Enhancement Air Resource Management		2
EDR	CSP Enhancement Drainage Management		2
EEM	CSP Enhancement Energy Management		19

EGM	CSP Enhancement Grazing Management		12
EHM	CSP Enhancement Habitat Management		2
ENM	CSP Enhancement Nutrient Management		2
EPL	CSP Enhancement Plant Management		12
EPM	CSP Enhancement Pest Management		2
EPP	CSP Enhancement Practice Payment		2
ESM	CSP Enhancement Soil Management		2
EWM	CSP Enhancement Water Management		2
Finance	Financial Institutions		354
litter	Litter transfer buyer incentive program	483	335
MINPAY	Minimum Payment Adjustment		700
NIPF	Non-Industrial Private Forest Land Annual Payment		700
PAST	Pasture Annual Payment		700
PCROP	Pastured Cropland Annual Payment		700
RCCR	Supplemental Payment		700
RE	Real Estate, Land Rights, and Appriasals		360
SP	CSP Stewardship Payment		700
TA	NRCS Staff Technical Assistance		439
TA	District and MDA Technical Assistance		439
TA ORG	Nonprofit Organizations Technical Assistance		425