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Governing Change: An Institutional Geography of Rural Land Use, Environmental
Management, and Change in the North Coastal Basin of California

by

Anne Garrity Short

A dissertation submitted in partial satisfaction of the

requirements for the degree of

Doctor of Philosophy

in

Energy and Resources

in the

Graduate Division

of the

University of California, Berkeley

Committee in charge:

Professor Timothy Duane, Co-Chair

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Professor Nathan Sayre

Fall 2010

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by Anne Garrity Short

Abstract

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Doctor of Philosophy in Energy and Resources

University of California, Berkeley

Professor Timothy Duane, Co-Chair
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In the past four decades, the migration of urban and suburban dwellers into rural areas of the United States has dramatically transformed the social, economic, and ecological conditions in rural areas. This migration places development pressure on forested, agricultural, and open space areas and leads to the subdivision of large tracts of land into smaller parcels, which can complicate the governance and management of human-environmental problems. The prevention and control of nonpoint source (NPS) pollution from rural private lands is a particularly pressing human-environmental challenge that may be exacerbated by the growing number and diversity of rural landowners. Reducing NPS pollution is increasingly dependent on understanding how to promote the adoption of pollution control measures (known as best management practices [BMPs]) by a growing and diverse group of private landowners.

In this dissertation, I address this governance challenge through an investigation of how regulations, non-regulatory programs, and other factors promote and impede the adoption of BMPs by different groups of landowners. I focus on the prevention and control of sediment (a common NPS pollutant) from private timber, ranch, residential, and marijuana producing lands in the rural North Coastal Basin of California. This research utilizes an institutional analysis approach and employs a combination of qualitative and quantitative methods applied at the watershed and regional scale.

Though the sediment pollution problem is associated with management practices on all land uses, this research reveals that sediment pollution is unevenly governed. I find that the stringency and enforcement of regulations, influence of non-regulatory programs, and landowners' knowledge and adoption of BMPs vary by land use. Landowners engaging in traditional rural land uses such as timber production and ranching are generally more knowledgeable about BMPs than other landowners. Their use of BMPs is associated with strictly enforced regulations and/or participation in non-regulatory programs. Residential landowners and those using their land for marijuana cultivation receive less attention from resource agencies and non-governmental organizations and are

less likely to be familiar with BMPs. Consequently, as residential uses and marijuana cultivation become more common across the region, these parts of the landscape become ungoverned leaving the area vulnerable to increases in NPS pollution.

The challenges of governing and managing sediment pollution in the transitioning rural region of the North Coastal Basin mirror the challenges associated with the governance of many complex and evolving human-environmental problems. In this dissertation, I focus on the social and institutional aspects of governance and management of these problems. In doing so, I draw attention to the ways that social complexity can complicate the governance of biophysically complex problems, highlight the influence of formal and informal social interactions on landowners' management decisions, and add insight into the design of regulatory and non-regulatory programs that recognize and capitalize on the social factors that affect management decisions on private lands.

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List of Acronyms

APN: Assessor Parcel Number
ATV: All-terrain vehicle
BMP: Best Management Practice
BOF: California Board of Forestry and Fire Protection
BRRRC: Bear River Regional Resources Conservancy
CAL FIRE: California Department of Forestry and Fire Protection (formerly CDF)
CAMP: Campaign Against Marijuana Planting
CCC: California Coastal Commission
CDFG: California Department of Fish and Game
CEQA: California Environmental Quality Act
CESA: California Endangered Species Act
CEU: Code Enforcement Unit
CFIP: California Forest Improvement Program
COE: United States Army Corps of Engineers
CWA: Clean Water Act
DPR: Department of Parks and Recreation
ECP: Erosion Control Plan
EPA: Environmental Protection Agency
EQIP: Environmental Quality Incentives Program
ESA: Endangered Species Act
ESU: Evolutionarily Significant Unit
FPA: Z'berg-Nejedly Forest Practice Act
FPR: Forest Practice Rules
FRAP: Fire and Resource Assessment Program
GREM: Grass-roots ecosystem management
GYE: Greater Yellowstone Ecosystem
HCP: Habitat Conservation Plan
HMP: Hillslope Monitoring Program
LSAA: Lake and Streambed Alteration Agreement
LTO: Licensed Timber Operator
MCR: Modified Completion Report
MRC: Mattole Restoration Council
NCRWQCB: North Coast Regional Water Quality Control Board
NOAA: National Oceanic and Atmospheric Administration
NMFS: National Marine Fisheries Service
NPDES: National Permit Discharge Elimination System
NPS: Nonpoint source
NRCS: Natural Resources Conservation Service
NTMP: Non-industrial Timber Management Plan
OLE: Office of Law Enforcement
PALCO: Pacific Lumber Company
PFL: Professional Foresters Law
PWA: Pacific Watershed Associates
RCD: Resource Conservation District

RPF: Registered Professional Forester
RWQCB: Regional Water Quality Control Board
SMA: Streamside Management Areas
SWRCB: State Water Resources Control Board
THP: Timber Harvest Plan
TMDL: Total Maximum Daily Load
UCCE: University of California Cooperative Extension
USDA: United States Department of Agriculture
USFWS: United States Fish and Wildlife Service
WDR: Waste Discharge Requirement
YES: Yager/Van Duzen Environmental Stewards

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Chapter 1

Introduction

Over the past four decades, the migration of urban and suburban dwellers into rural areas of the United States has dramatically transformed the rural landscape, placing development pressure on agricultural, forested, and open space areas and subdividing large tracts of land into smaller parcels (Brown et al. 2005, Hansen et al. 2005, Stein et al. 2005). These changes in rural land use alter the social, political, and economic conditions in rural areas (Duane 1999, Egan and Luloff 2000, Nelson 1992, Walker and Fortmann 2003) and may have profound effects on local ecosystems (Dale et al. 2005, Hansen et al. 2005, Hansen et al. 2002, Marvin 2003, Merenlender et al. 2005, Miller and Hobbs 2002, Wear and Bolstad 1998). The control of nonpoint source pollution (NPS) from rural private lands is a particularly pressing environmental challenge that may be exacerbated by changes in rural land use (Dale et al. 2000).

Nonpoint source pollutants are the primary cause of water quality impairments in the United States (US EPA 2008). NPS pollution is difficult to monitor and control because it originates from numerous sources that are unevenly dispersed across the landscape and can come from a variety of past and current land uses. Due to transitions in rural land use, regulatory and non-regulatory efforts to reduce NPS pollution face the emerging challenge of working on a relatively quickly changing landscape with an increasing number of landowners who have a wide range of attitudes, interests, and experiences.

Through an analysis of the governance¹ and management of sediment, a common NPS pollutant, on private lands in the North Coastal Basin of California, I address the challenge of NPS pollution control in transitioning rural regions. Since the late 1960s, land uses and the economic base of the North Coastal Basin have been evolving slowly from traditional resource-based land uses to more diverse mix that includes residential, amenity-based and alternative land uses including the cultivation of marijuana. The primary water quality issue in the region is sediment pollution, which is associated with the degradation of habitat for salmon and other aquatic organisms. Strong concern and the legal responsibility for the protection of salmon and water quality has led to a variety of regulatory and non-regulatory programs that require or promote the use of pollution control measures, known as best management practices (BMPs), to reduce sediment pollution from private lands within the basin.

¹ Though sometimes conflated with government or politics, the term *governance* encompasses more than government. It refers to the use of market mechanisms, collaborative processes, networks, partnerships, and non-regulatory mechanisms as well as top-down government regulations to distribute resources and direct activities to address problems in society. Goodwin (1998) describes the distinction well: “Where government signals a concern with the formal institutions and structures of the state, the concept of governance is broader and draws attention to the ways in which governmental and non-governmental organizations work together, and to the ways in which political power is distributed, both internal and external to the state” (p 5).

In this dissertation, I examine how regulations, non-regulatory programs, and other factors influence private landowners' adoption of BMPs across all land uses in the basin. To do so, I examine and compare the problem landscape, the governance landscape, and the landscape of action across the range of land uses in the North Coastal Basin. The *problem landscape* is the distribution of the human-environmental problem in a region. For sediment and other NPS pollution problems, the problem landscape is the geospatial distribution of the sources of pollution and the affected watersheds. The *landscape of governance* refers to the regulatory and non-regulatory programs that aim to prevent and control human-environmental problems. In the North Coastal Basin, this landscape includes an array of permitting requirements and regulations that mandate the use of particular BMPs as well as non-regulatory programs that implement sediment control projects on private lands and provide financial or technical assistance to landowners. The *landscape of action* includes the actual actions and activities that affect the human-environmental problem. This landscape refers to the land use, land management, and use of BMPs by landowners in the basin.

The sediment pollution problem is present throughout most of the North Coastal Basin and I find that sediment sources are distributed across all private land uses. Despite the relatively uniform distribution of the problem, my research reveals that the landscape of governance differs significantly by land use. The influence of regulations and non-regulatory programs to reduce sediment pollution is strong for more traditional rural land uses such as timber production and ranching, relatively weak for residential land uses, and the sediment pollution is effectively ungoverned on lands used for marijuana cultivation. I argue that the disparity between the landscape of the problem and governance landscape is partially due to the logistical challenges of governing a growing and evolving group of landowners but is more deeply rooted in historic and current social and political factors that constrain the reach of governing actors.

My research also shows that the landscapes of governance and action are linked. Landowners' experience with regulations and/or non-regulatory programs is significantly linked to their knowledge about and use of BMPs. Thus, the landscape of action also differs across land uses. Timber and ranching landowners demonstrate greater familiarity with and higher adoption of BMPs than residential and other landowners.

In the areas where regulatory and non-regulatory programs are strong, my research adds insight into the mechanisms through which these programs influence landowners' knowledge and action. I show that both regulations and non-regulatory programs can influence landowners' knowledge and action, but that they do so in different ways. Furthermore, regulations and non-regulatory programs often work in tandem and their combined influence extends beyond the reach of either one. I also show that interactions between landowners and professionals and amongst multiple landowners can also lead to increased knowledge about and adoption of BMPs.

The challenges of governing sediment pollution and protecting and restoring salmon populations across the transitioning rural landscape in the North Coastal Basin echo the challenges inherent in the governance of many complex and evolving human-

environmental problems. The sediment pollution problem and its relation to the health and survival of salmonid² populations and create a human-environmental problem that is biophysically and socially complex. However, in research and policy evaluations, the biophysical and technical aspects of these problems have received more attention than the social dimensions.³ My research takes a different approach and focuses on the social and institutional aspects of the sediment control problem. In doing so, I draw attention to the ways that social complexity can complicate the governance of biophysically complex problems, highlight the importance of identifying formal and informal social interactions that affect land management decisions, and add insight into the design of governance arrangements that recognize and capitalize on the social dimensions that feed management decisions on private lands.

In the remainder of this chapter, I provide a brief introduction to the conceptual framework for this study, which is based on work on institutions and human-environmental problems; describe my research design and methods; and outline the structure of this dissertation.

A Framework for Understanding the Governance of Human-Environmental Problems

Humans affect the environment directly and indirectly through land use, land management and the institutions that influence patterns of land use and management.⁴ *Land use* is “the purpose to which land is put by humans” (e.g., agriculture, forestry urban development) and *land management* refers specifically to the “way a given land-use is administered by humans” (e.g., till versus no-till agriculture, clear cut versus selective timber harvesting) (Dale et al. 2000, p 642). *Institutions* are the conventions, norms and rules of a society (Crawford and Ostrom , Vatn). These include formal laws and regulations as well as the informal norms and conventions that govern behavior.

The collective land-use and management decisions of humans directly influence ecological conditions. Institutions indirectly affect the environment by shaping the patterns of land use and management practices. Institutions are widely recognized as driving forces of land-use change and as arenas for intervention and action to address

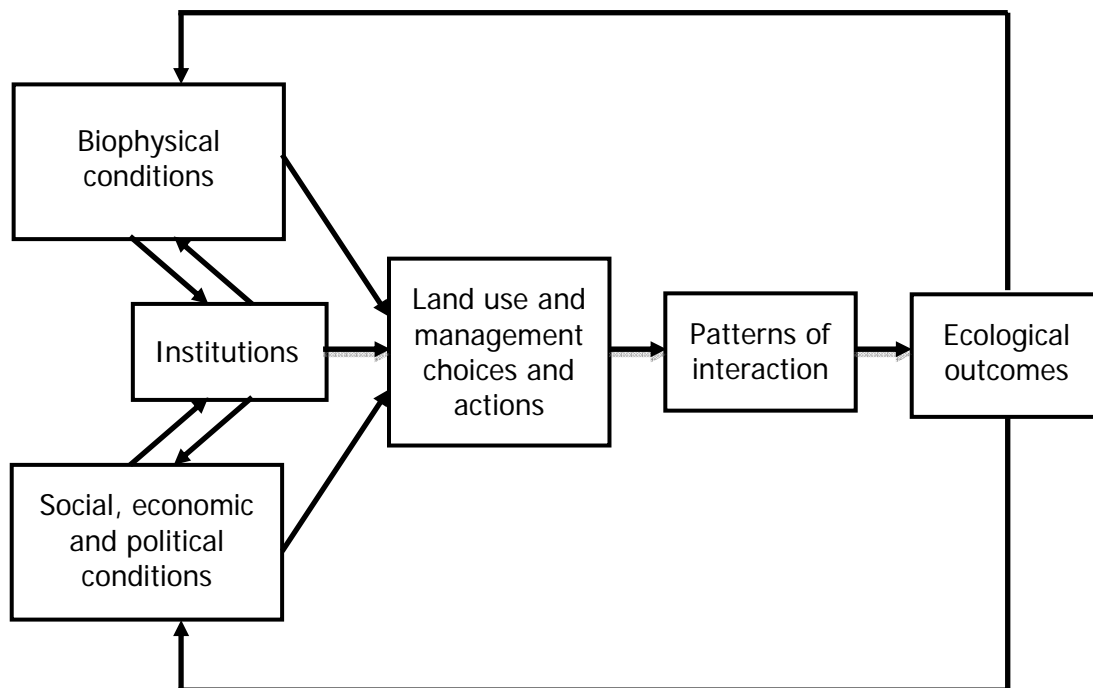
² The term *salmonids* refers to the family of fish including salmon and trout.

³ Chapter 2 provides a more complete review of research on NPS pollution and transitions in rural land use. The main points of the review are: (1) The majority of research on NPS pollution focuses on characterizing the biophysical aspects of the problem, developing technical solutions for the problem, and using economic models to identify the best policy tools; and (2) Work on transitions in rural land use tends to focus on either characterizing the ecological effects of the transition or examining the changing social and economic circumstances, but few studies examine how these are interrelated.

⁴ Dale et al. (2005) note that humans affect the environment through land use, land management, and “policy decisions regarding natural resources” (p 1879). I have altered their claim to reflect the institutional perspective that human actions are influenced by all types of institutions rather than only by policies.

human-environmental problems (Robbins , Young 2002).⁵ Land use, management, and institutions are interrelated with each other, and are shaped by and shape the biophysical and social, economic, and political context in which they exist (Figure 1.1). Addressing complex human-environmental problems thus requires an integrated understanding of the interrelations of land use, management, and institutions, and how they shape and are shaped by both the biophysical and social context in which they exist.

Figure 1.1: Conceptual Framework for Understanding the Governance of Human-Environmental Problems



Source: Figure adapted from Ostrom (1999)

Research Design and Methods

My research design is based on an institutional analysis approach (Ostrom 1999) and employs a mix of qualitative and quantitative methods at the watershed and regional

⁵ There is a rich history of investigation into the importance of institutions for the environment in the study of common property theory (e.g., Ostrom 1990) and global environmental change (e.g., Stern et al. 1992, Young 2002). Early work highlighting the importance of institutions and the environment was centered in the common property literature. This work challenged the dominance of the Garrett Hardin’s notion of the “tragedy of the commons” and demonstrated that local shared management can be a successful alternative to state or market intervention in the commons (Ostrom 1990). More recent work has established that no single institutional arrangement has a monopoly on good or bad management of natural resources, and that legitimacy, social cohesion, and authority are important factors in the success of institutions (Imperial and Yandle 2005, Ostrom et al. 1999, Ostrom and Nagendra 2006, Robbins 1998, Young 2002).

scale. An institutional analysis approach to the study of human-environmental issues explicitly acknowledges that the ‘rules in form’ (the legal regulations and policies that exist on paper) often differ from the ‘rules in use’ (the conventions, norms, and rules of society that are in operation on the ground) (Ostrom 1999) and places emphasis on understanding the outcomes associated with the ‘rules in use’ (Imperial and Yandle) and the authority that influences whether ‘rules in form’ are “enforced, respected, resisted, or subverted” (Robbins 1998, p 410). I conceptualize this approach as an effort to uncover the differences between the governance landscape and the landscape of action, identify the mechanisms through which governing programs as well as other social, political and cultural forces affect landowners management practices, and determine how these shape and are shaped by the problem landscape.

My primary research activities were completed between 2006 and 2008. During that time, I alternated between desk studies and fieldwork, taking several trips to the study region (with stays that ranged from a few days to seven months). The research was an iterative and adaptive process, with each step shaping the ones that followed. My methods included a mail survey of private landowners in the basin; semi-structured interviews with landowners, staff at natural resource agencies and other government organizations, members and staff at non-profit organizations, and private consultants; participant observation; and document review (See Appendices A, B, and C for more details on methods, the survey instrument, and interview protocols).

The foundation of this research is the documentation of the governance landscape (the regulatory rules and non-regulatory programs that require or promote the use of BMPs) and analysis of how these rules are applied and enforced across the range of land uses in the North Coastal Basin. To document the application and enforcement of regulations across the range of land uses, I reviewed sediment control laws, regulations, and other secondary documents; informally surveyed staff working on enforcement teams at regulatory agencies; and conducted semi-structured interviews with staff at natural resource agencies and landowners. To identify non-regulatory programs and analyze their range of influence, I mined publicly available databases on restoration funding and non-profit activities, reviewed secondary documents, and interviewed staff at non-profits regarding the scope and tactics of their programs.

To identify the landscape of action (the road management practices and use of BMPs on private lands) and identify explanatory factors associated with the use of BMPs, I administered a mail survey to private landowners in the basin and conducted follow-up interviews and site visits with a semi-random sub-sample of the survey population.

To tease out the mechanisms through which governing programs and other factors shape the landscape of action, I relied on data from the mail survey and landowner interviews; semi-structured interviews with staff at government agencies and organizations, staff and members of non-profit organizations, and private consultants; and other participant observation activities including completion of a three-day workshop on rural roads led by William Weaver and Danny Hagans of Pacific Watershed Associates; participation in the

2007 Coho Confab in the Mattole watershed;⁶ observation of meetings of the North Coast Regional Water Quality Control Board and the Board of Forestry's Monitoring Study Group; participation in volunteer activities and social events with watershed groups; and field tours of restoration projects and timber harvest areas.

To further and more deeply understand the factors influencing landowners' adoption of BMPs and the linkages between regulatory and non-regulatory programs, I conducted mini-case studies of sediment-control actions at the watershed level in three small watersheds: the Bear River Valley (Capetown Watershed), the Mattole watershed, and the Van Duzen watershed. For each case, I conducted additional interviews with landowners, staff and members of non-profit organizations, and agency staff; reviewed additional secondary documents (such as grant reports and newsletters); and conducted additional participant observation activities including attendance and observation of several watershed group meetings and social activities.

Structure of the Dissertation

In this dissertation, I aim to use my research on sediment control in the North Coastal Basin to provide insight into broader questions about the management and governance of complex and changing human-environmental problems. In Chapter 2, I provide broader context and motivation for this study through a review of the relevant work on NPS pollution policy, transitions in rural land use, and new environmental governance.

In Chapters 3 and 4, I describe and compare the problem landscape, the governance landscape, and the landscape of action. In doing so, I pay particular attention to how these landscapes align or diverge on different land uses. My analysis begins in Chapter 3 with an examination of the first two landscapes: the problem of road-related sediment pollution in the North Coastal Basin and the regulatory controls and non-regulatory programs that work to reduce and control sediment pollution in the basin. The fundamental finding presented in this chapter is that sediment pollution is unevenly governed across land uses. In other words, I find that regulatory controls and non-regulatory programs differ across land uses. The regulations on timberlands are more stringent and strictly enforced than those that apply to other land uses. In addition, many non-regulatory programs are also tailored more towards working lands (such as timber producing, ranching, and agricultural lands) than residential and other land uses.

⁶ According to the organizer's website, the Coho Confab is "a symposium to explore watershed restoration, learn restoration techniques to recover coho salmon populations, and to network with other fish-centric people. To confabulate literally means to informally chat or to fabricate to compensate for gaps in ones [*sic*] memory. Not to imply that restorationists are prone to hyperbole when recounting the size of a rescued fish, the magnitude of the waterfall coming out of the culvert, or the heroics of a particular restoration job. The Confab is an informal gathering of fishheads that allows for participants and instructors to learn from each other's experience. Participants learn skills and practices that can be applied to restore habitat in their home watershed. Each year the Confab is held in another location on the North Coast" (Trees Foundation 2010).

In Chapter 4, I use data from the mail survey and interviews with landowners to describe road networks in the North Coastal Basin and the landscape of action (landowners' knowledge about BMPs and their actual road and sediment management practices). I argue that the risks of road-related sediment pollution are common to all land uses and show that knowledge and the use of sediment control measures are significantly related to land use, parcel size, and experience with regulatory and non-regulatory programs. Together with Chapter 3, this chapter shows that the problem, governance, and action landscapes are not always aligned. Though the risk of sediment pollution from roads is comparable across all land uses in the basin, the governance of sediment and landowners' knowledge and actions differ across land uses.

In the second half of the dissertation, I rely on evidence from in-depth interviews and the mini-case studies to analyze the relationships between the three landscapes. I consider the specific mechanisms through which governing programs influence landowners' actual management practices and also examine why the landscape of the problem is not aligned with the landscapes of governance and action on all land uses. While the study and development of environmental policy often focuses on the biophysical complexity of the human-environmental issues, the findings presented in Chapters 5 and 6 highlight the social complexity of environmental management and policy and draw attention to the need to consider the social dimensions of private land management in the creation of policy.

In Chapter 5, I discuss the mechanisms through which regulatory and non-regulatory programs influence landowners' knowledge about and adoption of BMPs. I show that regulatory and non-regulatory programs affect management decisions on private lands in different ways but that they often work in tandem. In addition, I examine the social dimensions of governance and sediment management and show that informal social networks and high quality interactions between landowners and professionals (such as private consultants, regulators, and staff at non-profit organizations) can extend the reach and influence of regulatory and non-regulatory programs.

Chapter 6 contains an examination of areas that are weakly governed or out of the influence of governing programs. I show that residential lands and those used for marijuana cultivation generally fall outside of the influence of regulatory and non-regulatory programs and examine why the problem and governance landscapes diverge in these areas. I argue that the governance landscape is shaped by a variety of social, political, and economic factors rather than by the distribution of the problem itself.

I conclude the dissertation in Chapter 7 with a discussion of the significance of this research in and beyond the North Coastal Basin. I discuss the implications of this work for the study and development of environmental management strategies and policy in rural regions undergoing changes in land use as well as for the more general study of the governance of NPS pollution and other complex and evolving human-environmental issues.

Chapter 2

Background and Motivation: Transitions in Rural Land Use, Nonpoint Source Pollution, and Evolving Environmental Governance

This dissertation examines the governance and management of a common nonpoint source (NPS) pollutant across the range of land uses in the North Coastal Basin. In this chapter I provide context and motivation for this research through a review of research on transitions in rural land use, the prevention and control of nonpoint source pollution, and evolving environmental governance.

Transitions in Rural Land Use

Since the 1970s, rural areas in the United States⁷ have experienced a “renaissance” (Shumway and David 1996) or “restructuring” (Nelson 2002) associated with increased population growth and residential development in nonmetropolitan areas.⁸ The movement of urban and suburban dwellers into rural areas is transforming the social, economic, and ecological conditions in rural regions: large parcels are being subdivided for development; economies are diversifying; and social systems are blending urban expectations, lifestyles, and values with more traditional rural social relations (Duane 1999, Nelson 1992).

Low-density rural residential development is “the fastest growing component of the U.S. landscape” (Nelson 1992, p 350) and accounts for an estimated 25 percent of the land area of the continental U.S. (Brown et al. 2005, Hansen et al. 2005).⁹ Explanations for the migration to rural areas abound, ranging from a desire for the rural lifestyle to increased access to recreational opportunities and natural amenities to planning processes that create conditions favoring exurban development (See Bradshaw and Muller 1998, Davis et al. 1994, Duane 1999, Esparza and Carruthers 2000, Hansen et al. 2002, Merenlender et al. 2005, Nelson 1992, Radeloff et al. 2005, Shumway and David 1996, Walker and Fortmann 2003). As Beyers and Nelson (2000) suggest, the development process and drivers are complex and multidimensional.

⁷ Rural demographic and socioeconomic shifts are also documented and explored in other post-industrial contexts such as Australia (e.g., Curry et al. 2001, Holmes 2002, Holmes 2006), Canada (e.g., Dahms and McComb 1999, Klepeis et al. 2009), and the United Kingdom (e.g., Halfacree 2006, Smith and Phillips 2001). Gosnell and Abrams (2009) provide a global review of rural change specifically as it is associated with amenity migration.

⁸ Demographers note that the changes in population growth patterns in nonmetropolitan regions have not been constant – the initial period of rapid in-migration to rural areas in the 1970s was followed by slowed rural population growth in the 1980s and a subsequent resurgence of rural population growth in the 1990s – but argue that the trend of rural population growth is dominant and likely to continue (Shumway and David 1996).

⁹ Estimates of the land impacted by exurban development vary slightly depending on the exact definition of “exurban” and the technique for quantifying the area of affected land.

Increases in rural residential development alter the social and economic conditions of transitioning communities. In many rural areas, amenity or recreation-based economies can supplement or replace traditional natural resource and extractive economies (Robbins et al.).¹⁰ In addition, the attitudes, expectations, and values of the newer rural residents often differ from long-time residents and can create conflict between the two groups (Duane 1999, Egan and Luloff 2000, Walker and Fortmann 2003). These conflicts have been depicted in the media as ‘culture clashes’ between conservative longer-term residents and newer-residents with strong environmental values (Smith and Krannich 2000). However, many studies suggest that the differences between longer-term and newer residents are less dramatic than often depicted and, where they exist, may be associated more with economic interests than environmental values (Gosnell and Abrams 2009, Robbins et al. 2009). For example, Smith and Krannich (2000) find that newer and longer-term residents in the Rocky Mountain West have similar attitudes toward the environment, and Jones et al. (2003) show that both newer and longer-term residents in southern Appalachia demonstrate a commitment to environmental values, though the newer residents place a higher priority on environmental issues. In practice, the behaviors of newer and longer-term residents may even be contrary to what is expected. Yung and Belsky (2007) demonstrate that, in practice, ranchers in the Rocky Mountain region have more permeable conceptions of property boundaries than newer landowners, which is contrary to the expectation that ranchers hold conservative views on property rights.

Changes in the patterns of rural land use and management also affect ecological conditions. Concern about the effects of development on biodiversity, habitat connectivity, and water quality has prompted a substantial body of research investigating the effects of rural residential development on ecological processes (see, for example, Dale et al. 2005, Hansen et al. 2005, Hansen et al. 2002, Marvin 2003, Merenlender et al. 2005, Miller and Hobbs 2002, Wear and Bolstad 1998). Much of this work has focused on biodiversity and habitat retention; and rural residential development has been found to increase habitat fragmentation and edge effects (Gustafson et al. 2005, Merenlender et al. 2005, Radeloff et al. 2005) and to have non-linear impacts on species composition, decreasing the survival of native species and increasing the survival of nonnative species (Hansen et al. 2005, Maestas et al. 2003). Dale et al. (2005) also note that rural residential development can lead to changes in biogeochemical cycles via changes in air pollution, greenhouse gas emissions; and that changes in vegetation structure and composition can alter disturbance regimes such as fire, floods, and wind events.

Attention to the ecological effects of rural residential development in the American West is often framed as “cows versus condos” (Maestas et al. 2002, Sheridan 2001). Land-use changes in this region are characterized by the division of large ranches into smaller homes and ‘ranchettes,’ and a substantial body of research has sprung up to compare the

¹⁰ In a review of literature on the “New West,” Robbins et al. (2009) note the “consumption economy is accelerating in parts of the region, but a parallel expansion and restructuring of primary extractive industries is ongoing in some areas” (p 363). In other words, natural resource or extractive economies are not disappearing throughout the West, but there are pockets of rapidly changing economies.

ecological effects of ranching versus its presumed alternative, rural residential development. While several studies provide evidence that ranching (or particular forms of ranching) may provide better conservation opportunities and be ecologically preferable to residential development (Curtin et al. 2002, Maestas et al. 2003, Sheridan 2001), the debate is far from settled. Siegel (1996) argues that the entire debate is flawed as it is frequently framed around overgeneralizations and false assumptions about the effects of each land use. Vias and Carruthers (2005) find that the conversion of land and spatial patterns of growth vary significantly throughout the Rocky Mountain West, which leads to questions about the degree to which the ecological effects of residential growth can be generalized.

In general, the new-resident/old-resident dichotomy masks the complexity of changing rural spaces. Even outside of the cows versus condos debate, much of the ecological research has not recognized the social complexity of the changing landscape or accounted for the heterogeneity of management practices within land-use categories. This is problematic because, as Siegel (1996) and Marvin (2003) argue, not all ranchers or residential landowners use the same land management techniques, and each land use is thus associated with a range of ecological effects. Adding further evidence to these claims, research on the social dimensions of rural transitions has shown that the ideas, attitudes and positions of rural residents cannot be mapped to new versus old and frequently defy the expected ‘culture clashes.’

Sheridan (2007) and Robbins (2009) observe that development patterns are shaped primarily by social and economic conditions, which are rarely influenced by ecological science. Thus, while characterizing the range of effects of different land uses is certainly useful, it is also important to investigate the governance of these changes and the factors that influence land management decisions on whatever mix of rural land uses emerge. Such studies can provide practitioners with information that can aid the mitigation of potential negative environmental effects associated with land-use change. In the Greater Yellowstone Ecosystem (GYE), Gosnell et al. (2007) find that newer landowners have a variety of management practices that are likely to positively and negatively affect fisheries and suggest that the current regulatory structure is unable to address the changing range of management practices. In the same region, Haggerty et al. (2006) show that the changes in land tenure reduce the influence of natural resource agency staff on elk management. Beyond the GYE, little attention has been paid to assessing how changes in land use affect the governance of human-environmental problems; to understanding the range of management styles for a given land use; or to the integrated study of social and ecological processes in rural residential areas (Brown et al. 2005, Hansen et al. 2005, Marvin 2003).

The need for greater attention to the governance of land-use change and the motivators of landowners’ management practices across the range of land uses shapes my research focus and design. Since the back-to-the-land movement of the late 1960s brought homesteaders from the San Francisco Bay Area to the North Coastal Basin, the region has experienced slow but steady pressure to subdivide and develop large tracts of ranch and timber lands for residential uses and marijuana cultivation. Rather than trying to

compare or rank the relative ecological effects of these land uses, I focus on the governance and management of the range of land uses. In this dissertation, I identify factors that influence landowners' management decisions and examine how these differ across the range of land uses. Furthermore, I discuss how increases in rural residential development and marijuana production weaken the influence of regulatory and non-regulatory environmental programs in the region.

Prevention and Control of Nonpoint Source Pollution

Nonpoint source (NPS) pollutants are the primary cause of water quality impairments in the United States (US EPA 2008). Unlike point source pollution that comes from a “discernible, confined and discrete point,” such as a wastewater pipe at a factory, a storm sewer, or a vessel that discharges pollutants, NPS pollution comes from diffuse sources (CWA §502(14)). Some common NPS pollutants include fertilizers and pesticides from agricultural fields and lawns; bacteria and nutrients from faulty or leaking septic systems; oil and toxins from urban sources that are not carried through sewer systems; and sediment associated with construction sites, roads, and forestry practices. NPS pollutants are picked up by runoff from rain or snowmelt and carried over or through the ground into lakes, rivers or other bodies of water, or enter waterways through atmospheric deposition.

The diffuse nature of the pollutant creates challenges for the prevention and control of NPS pollution with traditional regulatory tools (Cochard et al. 2005, Horan and Ribaudo 1999, Segerson and Wu 2006). The sources are numerous, unevenly dispersed, and may come from past as well as current land uses. Pulses of pollution occur sporadically and the pathways from the source to the site of pollution are difficult to trace. These characteristics make the monitoring, enforcement, and evaluation of any regulatory strategy logistically challenging and costly.

In addition, there are political challenges to federal regulation of nonpoint sources. NPS pollution associated with agriculture is the leading cause of impairment in surveyed waters in the U.S. (US EPA Office of Water 2009). However, federal environmental agencies historically have not interfered with agricultural practices (Koontz et al. 2004).¹¹ NPS pollution associated with changes in land use and development is also politically hard to control as land-use planning and regulation is the traditional domain of local governments.

Since the enactment of the Clean Water Act (CWA) in 1972, federal pollution control regulations have achieved significant reductions in the levels of point source pollution in U.S. waterways (Davies and Mazurek 1998, Kraft 2001, Kraft and Vig 2000, Stavins 2000). However, these regulations are recognized as largely ineffectual for protecting surface and groundwater from NPS (Davies and Mazurek 1998, Howarth et al. 2000, John 1994, Kraft and Vig 2000). In response to these challenges, a wide variety of

¹¹ For example, the CWA explicitly exempts agriculture from regulation as a point source, noting that the “term [point source] does not include agricultural storm water discharges and returned flows from irrigated agriculture” (CWA §502(14)).

government agencies and non-governmental organizations have initiated non-regulatory programs to prevent and control NPS pollution around the nation (Hardy and Koontz 2008).

Two bodies of literature are directly relevant to understanding the prevention and control of NPS pollution.¹² The first lies primarily in the fields of agricultural economics and policy and is concerned with identifying the most effective and efficient regulatory and non-regulatory policy tools to prevent and control NPS pollution. The second brings together a variety of studies that aim to identify factors that lead landowners to (a) participate in voluntary pollution control or land management programs and (b) adopt pollution control or conservation management practices (usually best management practices [BMPs]).

NPS Policy Tools

The NPS policy literature relies primarily on rational-choice based models to determine the most cost-effective policy tools for NPS pollution control (see, for example, Cochard et al. 2005, Ribaudo and Horan 1999, Segerson and Wu 2006, Wu and Babcock 1999). NPS policy studies generally compare the effectiveness of two policy approaches (performance and design standards) and three broad classes of policy tools (conventional regulations, economic tools, and an assortment of voluntary measures).¹³

Performance standards limit total pollution discharges from a particular source and have been traditionally implemented through regulatory standards and permitting processes. While performance standards have been successfully used to control point sources, the difficulty in measuring and monitoring discharges of NPS pollution limits their effectiveness for NPS pollution problems (Cochard et al. 2005, Segerson and Wu 2006, Shortle and Horan 2002).¹⁴ Design standards, which require dischargers to adopt particular pollution control management measures, are more commonly used to limit NPS pollution (Dowd et al. 2008, Ribaudo et al. 1999). Design standards can be mandated through regulatory requirements, encouraged through economic tools or voluntary programs, or recommended through any combination of these tools.

Though the effectiveness of regulatory standards has been discussed in the literature on point source pollution, neither design nor performance-based regulatory standards have received much attention in the NPS policy literature (Dowd et al. 2008). Performance

¹² A vast body of research also examines NPS pollution from biological, ecological, and physical perspectives.

¹³ Two additional policy options that may apply to NPS pollution control but are not covered in this review are liability rules and research and development (Ribaudo et al. 1999). I do not cover these categories in this review because they only affect landowners indirectly.

¹⁴ Despite this limitation, the primary regulatory tool for the prevention and control of NPS pollution relies on performance standards. The Total Maximum Daily Load (TMDL) requirements under §303(d) of the CWA require states to allocate pollutant loads among dischargers for waterways impaired by NPS pollution. However, the CWA does not provide a legislative mandate to implement these standards and states generally do not use a conventional performance-based standard approach when addressing NPS pollution.

standards have been critiqued generally for their lack of flexibility, and because they do not provide any incentive for dischargers to reduce pollution levels beyond the standard (Davies and Mazurek 1998). For NPS pollution, the difficulty and cost of linking pollutants with their source makes it nearly impossible to monitor and enforce discharge limits specified by performance standards. Design standards have also been critiqued. The effectiveness of design standards depends on appropriate implementation and these approaches have been criticized because it can be costly to ensure proper implementation and difficult to link implementation to desired environmental outcomes (Dowd et al. 2008).

In the NPS policy literature and more generally, economic tools are widely promoted as more flexible and cost-effective alternatives to standard-based regulatory approaches (e.g., Davies and Mazurek 1998, Horan and Ribaudo 1999). These tools include taxes on pollution, taxes or subsidies on inputs associated with pollution, financial incentives from the government, and market-based incentives such as trading programs. The majority of research on economic policy tools uses models to evaluate a particular economic tool (e.g., DeVuyst and Ipe C. 1999), compare the cost-effectiveness of multiple economic approaches (e.g., Cochard et al. 2005), or compare the cost-effectiveness of economic approaches to standard-based regulatory or voluntary approaches (e.g., Wu and Babcock 1999).

Voluntary programs to reduce NPS pollution include a wide range of efforts such as financial assistance, education and training programs, and certification programs where participation is not required. Regulators and dischargers generally favor voluntary programs due to their low cost and lower levels of oversight (Dowd et al. 2008), and most NPS reduction programs in the agricultural sector fall in this category (Horan and Ribaudo 1999). Alberini and Segerson (2002) identified three primary incentives for participation: environmental stewardship, market incentives or economic benefits (such as decreased bottom line), and government incentives for participation. As with all policy tools, the success of these programs depends on the level of participation and the effectiveness of the pollution control measures implemented through these programs.

Dowd et al. (2008) observe that the study of NPS policy is primarily model-driven and that few studies offer empirical examinations of existing programs to reduce NPS pollution. These model-based studies provide useful observations to inform policy design. For example, this body of research strongly suggests that no single policy tool is ideal and NPS pollution may best be addressed using a suite of policy tools (see Horan and Ribaudo 1999, Segerson and Wu 2006). However, without empirical studies, we lack an understanding of the social and political context that influences how NPS pollution policy decisions are made and how these programs are implemented on the ground. My research directly addresses this gap by examining the implementation of regulatory and voluntary sediment control programs throughout the North Coastal Basin. As I will show throughout this dissertation, this empirical work draws attention to the importance of the social and political dimensions of environmental policy and provides practitioners and policy-makers with useful insights into the mechanisms that increase the effectiveness of these programs.

Participation in Voluntary Programs and Adoption of Best Management Practices

A separate set of research focuses on the factors that lead landowners to participate in voluntary land management programs or to adopt BMPs for pollution control or conservation. This work addresses participation and BMP adoption associated with NPS pollution as well as other conservation, pollution control, and restoration practices.

A large body of research examines the factors that drive traditional agricultural landowners to participate in conservation programs and to adopt BMPs for soil and water conservation (e.g., Knowler and Bradshaw 2007, Ryan et al. 2003). This work typically uses logistical regression models to identify variables that are correlated with participation or adoption of BMPs. The variables commonly investigated include characteristics of the farmer and farm household (such as age, education, attitudes, and social networks), biophysical characteristics of the farm (such as parcel size, area planted, slope, and soil characteristics), financial and management characteristics (such as tenure, farm profitability, and equipment availability), and other external factors (such as prices, membership in organizations, and use of technical assistance) (Knowler and Bradshaw 2007). Individual studies frequently find significant relationships for particular variables. However, in their review of 31 separate analyses (published in 23 articles) on farmers' adoption of BMPs, Knowler and Bradshaw (2007) find that few if any of these variables universally explain BMP adoption across the body of reviewed studies.¹⁵ Despite the inconclusive results, the whole body of work does point to the influence of non-economic factors as well as economic constraints.

Several studies have also examined non-industrial private forest-landowners' motivations for adopting particular management strategies and participating in formal management programs (e.g., Dutcher et al. 2004, Erickson et al. 2002, Kendra and Hull 2005, Kilgore et al. 2008, Stevens et al. 2002). These studies clearly document the diversity in demographic characteristics and motivations of forest-landowners (Erickson et al. 2002, Kendra and Hull 2005) and have linked a variety of socioeconomic, demographic, and lifestyle characteristics to particular management practices. Similar to research on farmers' motivations, the relationships with specific variables are not direct or universal (Erickson et al. 2002), but there is general agreement that non-economic factors (such as aesthetic considerations, attitudes, and lifestyle concerns) provide important influences on management practices.

Overall, these two bodies of work point to the strong influence of social, non-economic factors on landowners' management practices and participation in voluntary programs. However, the scope of this work is limited by the focus on formal government-led programs for a single type of landowner (Rosenberg and Margerum 2008). More attention should be paid to the investigation of (a) participation in collaborative initiatives

¹⁵ Variables that were investigated in multiple studies were often significant in some and insignificant in others. Many even had statistically significant effects in opposite directions in different studies. The variables that were always significant in the same direction were only investigated in a small number of studies and cannot yet be considered universal (Knowler and Bradshaw 2007).

or programs led by non-governmental organizations such as watershed groups or regional non-profit organizations and (b) to the ways in which informal social relations (such as landowners' interactions with family, friends, and neighbors) can influence decision-making.

Furthermore, though the literature on forestland-owners examines the diversity within that group, there has not been sufficient examination of programs across multiple groups of landowners. In a rare exception, Rosenberg and Margerum (2008) examine the motivations behind self-reported conservation practices across the entire range of landowners in two Oregon watersheds. They find significant variation in landowners' perspectives by socio-economic, cultural, and land use characteristics. Further understanding of the differences in decision-making and conservation behaviors within and between different groups of landowners is becoming ever more important as transitions in rural land use continue to increase the diversity of landowners and land uses in these areas.

Recognition of the importance of non-economic variables and the utility of a multi-pronged policy approach guides my investigation of the factors influencing the adoption of sediment control BMPs in the North Coastal Basin. I contribute to the understanding of NPS policy and BMP adoption by examining (a) the motivations and actions across the entire range of landowners in the North Coastal Basin, (b) formal as well as informal influences on management decisions, and (c) the effects of government and non-governmental interventions.

Evolutions in Environmental Governance

The late 1960s brought a deluge of federal pollution control policies that shifted the role of the federal government in pollution control. Prior to this time, most of the regulatory power and responsibility for setting environmental and public health standards resided with the states (Davies and Mazurek 1998, Kraft 2001). As the public developed a new awareness of environmental problems and public opinion shifted to support a stronger federal role in pollution control, the federal government assumed the role of the central coordinator of environmental standards (Andrews 1999, Davies and Mazurek 1998, John 1994, Kraft 2001, Malone 1990). Under this new design, the federal government established uniform national standards for environmental and public health protection but left the power and responsibility of implementation largely to the states (Davies and Mazurek 1998, Kraft 2001, Scheberle 1997). The majority of federal pollution control regulations promulgated during the 1970s took a 'command and control' approach to regulation in which the government sets standards and/or issues permits to polluters who are required to reduce their pollution to meet the standards or permits (Davies and Mazurek 1998, Freeman III 2000, Stavins 2000).

Federal pollution control regulations have made progress in improving air quality, decreasing levels of toxic contaminants, and reducing point source pollution in U.S. waterways (Davies and Mazurek 1998, Kraft 2001, Kraft and Vig 2000, Stavins 2000). However, this same system has been widely criticized and is undergoing significant changes. From an economic perspective, the system has been criticized as overly costly

(Davies and Mazurek 1998, Kraft 2001, Kraft and Vig 2000, Stavins 2000) and for not providing incentives for innovation (Freeman III 2000, Stavins 2000). A second set of critiques focuses on the decision-making process and characterizes the standard-based regulations as rigid (Freeman 1997), adversarial (Lowry 2000, Rosenbaum 2000), and undemocratic (Freeman 1997). Critics argue that these deficiencies and a reliance on top-down ‘expert’ decision-making processes leave the environmental protection system incapable of dealing with complex problems such as NPS pollution, integrated ecosystem management, and restoration (Davies and Mazurek 1998, Freeman 1997, Innes and Booher 2004, John 1994, Lowry 2000).

Scholars and practitioners have called for and observed the emergence of new approaches to pollution control and environmental management that are more flexible, integrative, and collaborative (Freeman 1997, Innes 2004, John 1994, Press and Mazmanian 2000, Rabe 2000, Sabel et al. 2000). Initiatives led by state and local government are being explored as promising locations for the next generation of environmental protection policies. John (1994) documents bottom-up environmental innovations at the state and local level – initiatives he has termed “civic environmentalism.” According to John, “the central idea animating civic environmentalism is that in some cases, communities and states will organize on their own to protect the environment, without being forced to do so by the federal government...Civic environmentalism is fundamentally a bottom up approach to environmental protection” (p 7). John argues that states and local governments are responding to the failures of federal environmental policies and that they have a comparative advantage in the use of non-regulatory and collaborative governance tools that are well suited to addressing complex environmental problems.

In addition to innovations in governmental programs, grass-roots environmental initiatives have developed outside of traditional policy institutions (Innes 2004, Sabel et al. 2000, Weber 2000). Sabel et al. (2000) document “backyard environmentalism” or partnerships between local citizen groups and government officials where local groups provide information to government programs charged with enforcing environmental programs. These efforts create a regulatory system that has “collaborative and mutual accountability of center to parts, parts to center, parts to other parts, and all to the whole enterprise – and to the public generally” (p 3). Weber (2000) writes about the emergence of the “grass-roots ecosystem management (GREM)” movement over the past two decades, which work more autonomously than ‘backyard’ groups. Organizations using GREM rely on “decentralization, collaboration, and citizen participation, and...[adopt] a holistic worldview that seeks to meld ecology with economics and the needs of community in pursuit of symbiotic sustainability” (Weber 2000 p 238). They challenge the “fundamental premises of environmental, natural resources, and public lands institutions” (Weber 2000 p 237) and place land management in local control.

The emergence of new arrangements centered away from the federal government is part of a global shift from ‘government’ to ‘governance.’ As Adger and Jordan (2009) explain, “governance is now widely used as a shorthand phrase which encapsulates the changing form and function of the state in contemporary industrial societies, specifically its diminishing size and its increasing tendency to deploy less coercive policy

instruments” (p 11). In general, this trend is characterized by the devolution of power away from centralized governments; reliance on more flexible and collaborative decision-making and management processes; and broad shifts in the balance of the state, market, and civil society involvement in environmental protection and natural resource management (Lemos and Agrawal 2006).

While proponents of alternative governance arrangements note these approaches can increase flexibility and reduce conflict and argue that they are better suited for addressing complex problems (e.g., Innes and Booher 2003), many also warn that there is danger in viewing these as replacements for strong federal regulations. John (1994) stresses that civic environmentalism complements rather than substitutes for federal regulation and that national regulatory standards remain an important component of pollution control. Others note that the federal government often plays an important role in collaborative and grassroots approaches providing financial support and technical assistance necessary to sustain many state and local initiatives (John 1994, Koontz et al. 2004, Rabe 2000). Nie (2008) documents an emerging debate regarding the appropriate integration of traditional regulatory and alternative approaches and argues that that traditional regulations often play a role in strengthening alternative approaches. Through an examination of a range of regulatory and non-regulatory approaches to NPS pollution in the North Coastal Basin, my research adds to and extends Nie’s arguments. In this dissertation, I show that regulatory and non-regulatory programs serve different functions but often act in synergistic ways.

Chapter 3

Landscapes of the Problem and Governance: Sediment Pollution in the North Coastal Basin

In this chapter, I examine the landscape of the sediment problem (the location of sediment-discharge risks and pollution) and the governance landscape (the distribution of regulatory and non-regulatory sediment control programs). I begin with an introduction to the North Coastal Basin and the sediment pollution problem in the region. I then describe the landscape of regulation by reviewing the primary regulatory controls on road-related sediment. This review reveals a remarkably complex web of rules that is difficult for landowners to navigate and for regulatory agencies to enforce. I also show that the regulatory tools are applied differently across the range of land uses. In the final section of this chapter, I describe the wide range of non-regulatory tools and programs that aim to reduce sediment pollution in the basin.

By examining the problem and governance landscapes, this chapter lays the foundation for my examination of the differences between the problem landscape, the governance landscape, and the landscape of action. I examine the landscape of action (the actual road and sediment management practices of landowners) in Chapter 4 and explore how and why these landscapes diverge, and the consequences of these differences in Chapters 5 and 6.

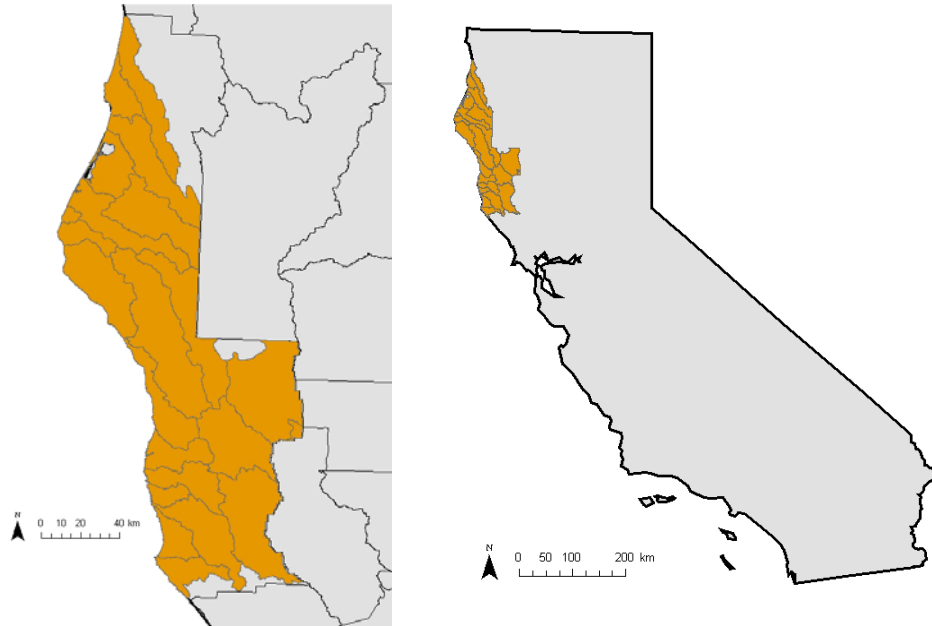
North Coastal Basin

Located along the northern coast of California, the North Coastal Basin covers an area of 5.5 million acres (2.2 million hectares) and is dissected by six major rivers and many smaller streams that drain into the Pacific Ocean (Map 3.1). The basin is ecologically diverse and provides habitat for several keystone, threatened, and endangered species including the spotted owl, marbled murrelet, pacific salmon, steelhead, and is home to redwood forests (The Conservation Fund 2005). The entire basin receives heavy rainfall during the wet season but can be divided into two distinct temperate zones: the coastal zone, which is the southernmost extension of the Pacific temperate rain forest and is characterized by a foggy and mild climate, and the inland region, which experiences more intense seasonal variation in temperature (NCRWQCB 2006). The steep terrain of the basin is geologically composed of Franciscan Assemblage and is highly unstable and erodible (Kramer et al. 2001, NCRWQCB 2006, Suttle et al. 2004).

Land uses in the region are primarily rural with the majority of urban activity concentrated in two urban centers, Santa Rosa in the south and the Eureka/Arcata area in the north. The economy is dominated by tourism and recreation; timber production; commercial and sport fishing; mining; ranching, vineyards and other agricultural activities; and the legal and illegal cultivation of marijuana. Much of the land is currently held in large tracts of land owned by industrial timber companies or public agencies. Similar to other forested landscapes across the nation, there is a slow but noticeable

pressure to sell large forested parcels and convert them to residential development (Eilperin 2006, Harris and Kocher 1998). Between 1990 and 2001, the housing stock of the region increased by approximately 10 percent, which is approximately the same rate as the state overall (California Department of Finance 2002). The development pressure is highest in the coastal areas and on the fringe of existing towns and urban areas (Harris and Kocher 1998, NCRWQCB 2006).

Map 3.1: Study Region: North Coastal Basin of California



Source: Maps created by Anita Milman and Anne Short

Note: The study basin is highlighted in orange. The dividing lines within the basin show the boundaries of the watersheds included in this study.

Sediment Pollution and Roads in the North Coastal Basin

Excess sediment (or sediment pollution) is the most common water quality problem in the North Coastal Basin.¹⁶ Sedimentation is a natural process through which soil erosion enters a stream channel. This process shapes river and stream channels, delivers fertile soils downstream, and creates habitat features (Dunne and Leopold 1978).

However, human activities (e.g., agriculture, construction activities, dams, grazing, resource extraction, road construction and use) can change the rate of sedimentation in a watercourse, which can have detrimental environmental and economic impacts. Excess

¹⁶ Per the requirements of Section 303(d) the federal Clean Water Act (CWA), the State Water Resources Control Board maintains a list of “impaired” or degraded watercourses throughout the state known as the 303(d) list. For North Coastal Basin watercourses included on the 303(d) list, sediment pollution is the most common cause of impairment. In 2008, 34 of the 60 (57%) North Coastal river segments on the 303(d) list were listed due to degradation by sediment, sediment/siltation or turbidity.

sediment can degrade habitat for fish and other aquatic organisms (Suttle et al. 2004, Waters 1995),¹⁷ alter channel patterns, fill in reservoirs and harbors, and degrade drinking water (Binkley and Brown 1993, US EPA 1999b).

Approximately 85 percent of the land area in the North Coastal Basin drains into a watercourse impaired by excess sediment.¹⁸ Sediment pollution is a particularly important problem because it is a primary factor in the degradation of habitat of threatened and endangered salmonids in the region, and the steep terrain and geology of the North Coastal Basin make rivers (and habitat for salmonids) in the region particularly susceptible to sedimentation (Suttle et al. 2004).

Roads and skid trails used for logging have been identified as one of the primary sources of sediment pollution. According to sediment source analyses conducted in impaired watersheds, roads and skid trails have contributed between 21 to 98 percent of the human-induced sediment loads in impaired watersheds in the basin (Figure 3.1).¹⁹ Roads account for over half of the anthropogenic sediment loads in ten of the 15 impaired watersheds that have a completed sediment source analysis.

Roads and stream crossings influence the hydrology and geomorphology of the region, which in turn impact the amount of sediment that enters streams and the quality of aquatic habitat. Roads are associated with both chronic, low-level contributions of fine sediment during small storms and catastrophic landslides and mass failures of road fill during large storms. (See Appendix D for definitions of technical terms associated with roads).

Roads alter hillslope hydrology by interrupting the natural paths water follows to the stream channel. In an undisturbed forest landscape, rainfall intensity rarely exceeds the infiltration capacity of the landscape and the dominant flow paths of water to the stream channel are beneath the surface (Dunne 1978, Hewlett and Hibbert 1967, Hornberger et al. 1998). Due to the imperviousness of the road surface and the interception of subsurface flows by the cutbank, roads concentrate runoff above the ground on the road surface or in adjacent ditches (Luce 2002, Montgomery 1994, Wemple and Jones 2003).

¹⁷ In particular, excess sediment degrades aquatic habitat by choking spawning gravels, filling in rearing pools that normally provide cover from prey and refuge from warmer waters, impairing food sources, clouding waters, which makes it difficult to find prey, reducing habitat complexity, and at very high levels, clogging gills (US EPA 1999b).

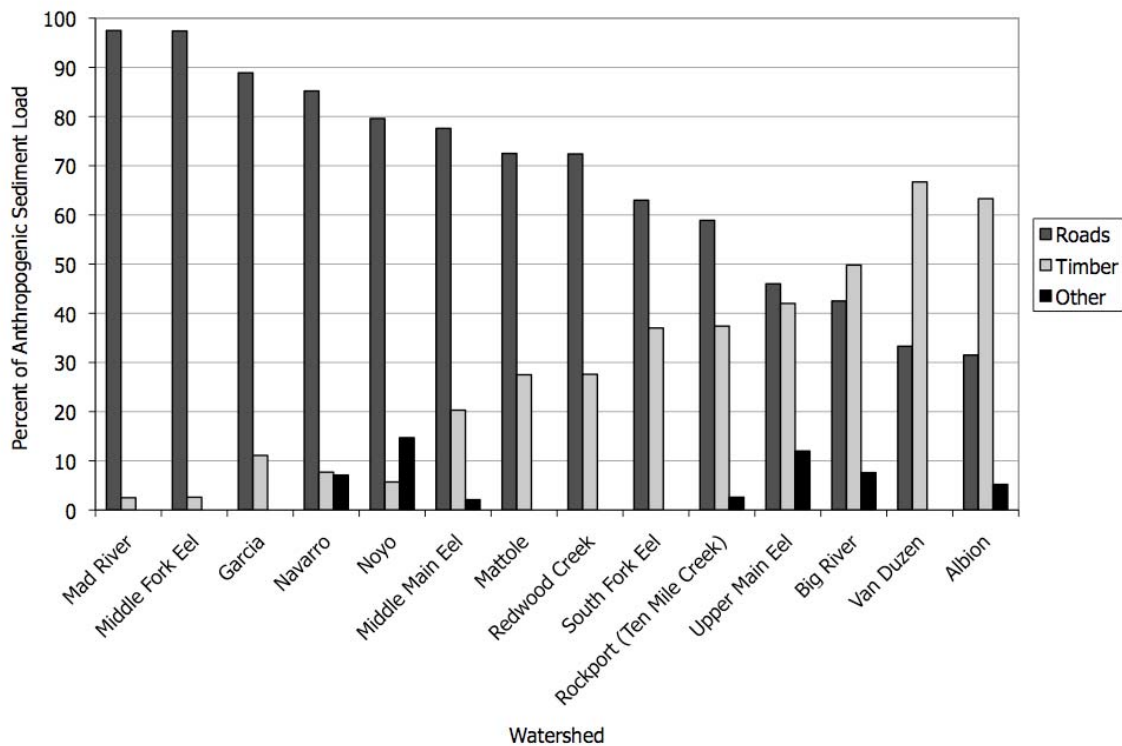
¹⁸ This figure was calculated by summing the area of watersheds listed on the 2008 303(d) list as impaired by sediment, sediment/siltation, or turbidity list and dividing by the total area of the basin.

¹⁹ The sources of sediment loading are compiled from the sediment source analysis included in the Total Maximum Daily Load (TMDL) document for each impaired watershed. The sediment source analyses use empirical data, aerial photography, and sediment models to estimate sediment loads from anthropogenic and background sources. The methods and models, as well as the assumptions and data underlying the models, differ between source analyses, so direct comparisons of loadings between watersheds should not be made. Despite this limitation, the estimates give a sense of the degree to which sediment from roads dominates the anthropogenic loading in impaired streams.

This effectively increases the drainage density of the catchment and can result in changes in the timing and magnitude of peak flows (Forman and Alexander 1998, Jones et al. 2000, Luce and Wemple 2001).

The disturbance of the hydrologic regime due to roads can lead to changes in geomorphic processes and sediment budgets. The concentration of runoff on the road surface and in ditches alongside the road alters the channel network, increases the risk of landslides, and may destabilize stream channels (Forman and Alexander 1998, Gucinski et al. 2001, Jones et al. 2000, Luce and Black 1999, McCashion and Rice 1983, Montgomery 1994, Reid and Dunne 1984). Runoff along the road surface also picks up sediment and debris exposed during the construction, use, and maintenance of roads, which increases surface erosion and the chronic delivery of fine sediments to the stream channel (Forman and Alexander 1998, Gucinski et al. 2001, Jones et al. 2000, Luce 2002, Meghan and Kidd 1972, Reid and Dunne 1984).

Figure 3.1: Anthropogenic Sediment Loads in Watersheds Impaired by Sediment in the North Coastal Basin



Source: Compiled from data in the Total Maximum Daily Load Sediment Source Analysis documentation for each impaired watershed

Notes: The 'Roads' category includes loading from roads and skid trails across all land uses. The 'Timber' category includes activities associated with timber harvest (except roads and skid trails, which are accounted for in the previous category). The 'Other' category includes a variety of other sources (e.g., grazing, homestead, railroad, vineyard).

Stream crossings and road segments that drain directly into streams or crossings create high risk for sediment delivery into streams (Furniss et al. 1998, Wemple et al. 1996).

Road segments and ditches draining into streams or crossings carry sediment from road surface erosion and cutbank failures directly into streams. Culverted stream crossings can deliver large amounts of sediment to streams if they fail during large storm events. Culverted stream crossings fail when flows exceed the hydraulic capacity of the culvert or when culverts plug with sediment or debris causing flows to overtop the culvert. In these circumstances, the stream flow can overtop the road, leading to erosion of fill at the crossing and delivery of sediment and other debris that has accumulated at the site since its construction (Furniss et al. 1998, Harris et al. 2008). Culvert failures can also lead to the diversion of streams out of their natural channels, which can cause extensive gullyng, destabilize fillslopes, and lead to further sediment delivery (Furniss et al. 1998, Madej 2001)

Prevention and Control of Sediment from Roads

The site conditions, use, and management of the road affect the degree of the sedimentation problem caused by any particular road segment. Some of the specific controls on surface erosion include soil texture and depth (Luce and Black 1999, Wemple and Jones 2003), weather (Luce and Wemple 2001), the slope of the road (Luce and Black 1999), the location or configuration of the road on the hillslope (Jones et al. 2000, Wemple and Jones 2003, Wemple et al. 2001), the design of ditches and drainage systems (Luce and Wemple 2001), traffic patterns (Reid and Dunne 1984), and weather patterns following construction and maintenance (Luce and Black 1999).

Though not all road-related erosion is preventable,²⁰ the use of best management practices (BMPs) in the design, construction, use, maintenance, and closure of roads and stream crossings can reduce the risk of sediment delivery associated with rural roads. The BMPs are guided by several general principles²¹ associated with reduced risk of sediment delivery:

- **Planning:** Minimize the disturbance area of road network;
- **Watercourses:** Avoid watercourses where possible, minimize stream crossings, and ensure that the road drainage is not connected to a watercourse;
- **Location:** Avoid steep slopes and unstable areas;
- **Drainage:** Get water off of the road surface as quickly as possible without concentrating the drainage;
- **Inspection and Maintenance:** Inspect roads and drainage structures frequently; and

²⁰ McCashion and Rice (1983) surveyed 344 miles of logging roads in Northern California to determine how much sediment delivery was preventable. They found that only 24 percent of erosion from surveyed roads could be avoided with conventional road engineering techniques. As McCashion and Rice note, this result is dependent on their definition of ‘avoidable road-related erosion,’ which they define as “erosion that could have been avoided by better design or by modifications of alignment within the 1-mile segment” (p 23). Additional erosion could have been avoided by considering additional options for re-routing or decommissioning roads.

²¹ These principles are compiled from a review of sediment regulations, guidance documents on rural road management, and scientific literature on the hydrologic and geomorphic affects of roads.

- **Design and use:** Ensure that road design matches the intended use-patterns for the road.

The desire and legal responsibility to protect and restore salmonid habitat and water quality has catalyzed a variety of regulatory and non-regulatory programs that seek to increase the utilization of BMPs to control and reduce road-related sediment. (Appendix E contains a list of BMPs mandated by regulations and/or recommended by guidance documentation published by government agencies, private consultants or non-profits). In the remainder of this chapter, I review the primary regulatory controls on road-related sediment and discuss the range of non-regulatory programs that aim to increase the use of BMPs.

Regulating Road-Related Sediment

Regulations designed to mitigate sediment from private roads may prescribe BMPs for the design, construction, maintenance, and use of roads; and/or often require a review and permitting process for the project. Multiple agencies at all levels of government are involved in the administration of sediment control regulations, including county governments, California Board of Forestry and Fire Protection (BOF), California Department of Fish and Game (CDFG), California Department of Forestry and Fire Protection (CAL FIRE formerly known as CDF), U.S. Environmental Protection Agency (EPA), North Coast Regional Water Quality Control Board (NCRWQCB), National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA NMFS), State Water Resources Control Board (SWRCB), U.S. Army Corps of Engineers (COE), and U.S. Fish and Wildlife Services (USFWS). The jurisdiction of these agencies clearly overlaps, as they are all involved in the regulation of rural roads. The focus and environmental goals underlying the agencies' programs are specific to the legislation that authorizes the regulatory program, and a single project may require permits from a variety of agencies.

Regulation of Sediment as a Water Quality Problem: Clean Water Act and Porter Cologne Act

The Federal Water Pollution Control Act Amendments of 1972 and 1987 (known as the Clean Water Act [CWA]) are the primary federal regulations for the protection of water quality. The objective of the CWA is to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (CWA §101(a)). In California, the SWRCB and nine Regional Water Quality Control Boards (RWQCBs) are responsible for implementing most of the CWA, and the EPA maintains oversight authority. The NCRWQCB is the regional board with oversight in the North Coastal Basin.

Under the CWA, States are required to adopt water quality standards and have the authority to regulate point source discharges into surface waters through the National Pollutant Discharge Elimination System (NPDES). Section 303(d) of the CWA contains provisions to address water quality problems that cannot be met through the permitting and control of point sources. States are required to identify such impaired water bodies, create a priority-ranking list (the 303(d) list), and develop a total maximum daily load (TMDL) for each impaired water body. A TMDL includes a calculation of how much of

a pollutant a water body can assimilate and still meet water quality standards, assessment of how much current inputs of pollution must be reduced to meet the targets, and an allocation of the responsibility for reducing pollutant loads among contributors.²² Section 319 of the 1987 CWA Amendments also requires states to assess NPS pollution problems and develop an NPS management program.²³

With the mandate that “the quality of all the waters of the state shall be protected for use and enjoyment by the people of the state,” the state’s Porter-Cologne Act regulates water quality (including both point sources and NPS pollution) in the surface waters, ground water, and wetlands of California (Porter-Cologne Act §13000). The SWRCB and RWQCBs have the responsibility for implementing the Porter-Cologne Act. The SWRCB allocates funding, provides guidance, and reviews RWQCB decisions. The RWQCBs are responsible for the permitting, inspection, and enforcement in their region, as well as the preparation of basin water quality control plans (known as ‘Basin Plans’). Basin Plans establish water quality standards for each watercourse in the basin and describe the measures (including prohibitions, action plans, and policies) for achieving or maintaining the water quality standards (NCRWQCB 2007d).

The SWRCB and the NCRWCB use a multi-faceted approach to control sediment and other NPS pollution that includes voluntary and incentive measures and regulatory approaches.²⁴ The primary regulatory approaches for the prevention and control of NPS pollution include the TMDL program (which includes implementation plans enacted through the Basin Plan), and administrative permitting tools (Waste Discharge Requirements [WDRs], waiver of WDRs, and basin plan prohibitions) (SWRCB and EPA 2004). In the North Coastal Basin, regulatory efforts to prevent and control sediment discharge include TMDLs and a TMDL Action Plan that applies to all landowners in the Garcia watershed, a region-wide prohibition on sediment discharges from activities associated with logging and construction, and WDRs and waivers for timber operations.²⁵

TMDLs and Action Plans for Sediment Control in the North Coastal Basin

In the North Coastal Basin, 17 watersheds contain water segments that are included on the 303(d) list as impaired by sediment and thus require sediment TMDLs (Table 3.1). As of December 2007, TMDLs have been completed for 15 of these watersheds. The

²² The CWA does not explicitly require States to develop plans to implement the allocated loads of a TMDL. However, under the state’s Porter-Cologne Act, the SWRCB and RWQCBs must develop plans to implement TMDLs.

²³ The CWA also contains several non-regulatory provisions/programs to reduce NPS pollution.

²⁴ In the discussion that follows, I do not distinguish between the specific provisions of the CWA and Porter-Cologne Act.

²⁵ Sediment discharges associated with construction are also regulated through the NPDES Stormwater Construction permit process. Construction projects affecting more than five acres must obtain an NPDES Storm Water permit, which entails the preparation and compliance with a Storm Water Pollution Prevention Plan (NCRWQCB 2007a). This permitting process is not discussed in detail here as it does not focus on road-related sediment, and does not mandate a set of BMPs.

TMDLs consistently identify roads as a major anthropogenic source of sediment throughout the basin (Figure 3.1).

Table 3.1: North Coastal Water Segments Impaired by Sediment

Watersheds with Water Segments Impaired by Sediment	Year Listed	TMDL Completion or Expected Completion Date	TMDL Implementation Plan
Albion River	1998	Dec 2001	
Big River	1998	Dec 2001	
Eureka Plain	1998;* 2002**	2019	
Garcia River	1996	Mar 1998	Jan 2003
Lower Eel River	1992	Dec 2007	
Mad River	1992	Dec 2007	
Mattole River	1992	Dec 2003	
Middle Fork Eel River	1992	Dec 2003	
Middle Main Eel River	1992	Dec 2005	
Navarro River	1994	Jan 2000	
Noyo River	1998	Dec 1999	
Redwood Creek	1996	Dec 1998	
Rockport	1998	Dec 2000	
South Fork Eel River	1998	Dec 1999	
Upper Main Eel River	1992	Dec 2004	
Upper Russian River	1998	2019	
Van Duzen River	1992	Dec 1999	

Notes: The Eureka Plain Watershed contains three river segments listed separately on the 303(d) list: Elk River, Freshwater Creek, and Jacoby Creek. The (*) indicates the listing date for the Elk River and Freshwater Creek and (**) indicates the listing date for Jacoby Creek.

The Garcia River watershed is currently the only impaired watershed with a TMDL implementation plan in the North Coastal Basin. The *Action Plan for the Garcia River Watershed Sediment TMDL* (known as the Garcia Action Plan) was enacted in 2003 and contains a general prohibition on the discharge of controllable sediment “from any logging, construction, gravel mining, agricultural, grazing, or other activity of whatever nature” directly or indirectly into any water body in the Garcia River watershed (NCRWQCB 2007d, p 4-38.00).²⁶ Landowners in the Garcia watershed must either comply with the prohibition through the prevention, mitigation, and/or restoration of sediment discharges, or comply with an approved Erosion Control Plan and either a Site Specific Management Plan or the Garcia River Management Plan. The Erosion Control

²⁶ Controllable sediment discharges are defined as “those discharges resulting from human activities that can influence the quality of the water of the State and that can be reasonably controlled through prevention, mitigation or restoration” (NCRWQCB 2007d, p 4-38.00). The discharge prohibitions of the Garcia Action Plan replace and apply more broadly than the region-wide prohibitions for logging, construction, and associated activities, which are discussed below (NCRWQCB 2007d).

Plan must contain an inventory of sediment discharge sites and a ten- or twenty-year plan for reducing the volume of deliverable sediment.²⁷ The Garcia River Management Plan specifies land management measures that must be applied to roads, watercourse crossings, unstable areas, and riparian zones to prevent the creation of sediment delivery sites (Appendix E includes a list of BMPs required by the Garcia Action Plan). The Site Specific Management Plan also contains measures that will be used to prevent the creation of future sediment delivery sites, but is prepared by the landowner and tailored to the specific activities and conditions of his or her land. The Site Specific Management Plan does not specify BMPs for road management but requires landowners to develop a long-term road management plan and to address all sediment delivery from roads.

Due to the challenges of developing and implementing the Garcia Action Plan, the widespread nature of sediment impairment in the North Coast region, and the need for immediate action to mitigate the sediment problem, the NCRWQCB shifted from a watershed-by-watershed approach to a more regional approach in 2004. Rather than developing implementation plans for each impaired water segment, the NCRWQCB directed staff to develop a regional work plan to address sediment pollution and to adopt a Basin Plan amendment to reduce and control sediment pollution throughout the basin (NCRWQCB 2004d). The *Work Plan to Control Excess Sediment in Impaired Watersheds*, adopted in 2008, is a non-binding planning document that describes and prioritizes actions the NCRWQCB staff plan to take to reduce sediment pollution over the next ten years (NCRWQCB 2008a). The proposed amendment to the Basin Plan, the *Measures to Control Excess Sediment Basin Amendment*, would contain a prohibition on all controllable sediment discharges from all land uses similar to the Garcia Action Plan and was intended to provide the legislative base to facilitate the actions described in the work plan (NCRWQCB 2007b, NCRWQCB 2008b). Despite a development schedule that aimed for an approval heading for the amendment at the May 2008 NCRWQCB Meeting, the amendment has not moved beyond the 2007 draft (NCRWQCB 2007c).

Basin Plan Prohibition from Timber, Construction, and Associated Activities

Without the approval of the region-wide prohibition through the proposed Basin Plan amendment, sediment control outside the Garcia Watershed is limited to discharges from timber operations, construction, and associated activities. The NPS pollution management plan outlined in the Basin Plan prohibits the direct or indirect discharge of sediment into watercourses “in quantities deleterious to fish, wildlife, or other beneficial uses” from logging, construction, and associated activities (NCRWQCB 2007d, p 4-26.00).²⁸ This prohibition provides mechanisms for enforcement but does not mandate the use of particular management practices.

²⁷ On non-agricultural lands, the volume of deliverable sediment must be reduced by 10 percent per year for ten years. On agricultural lands, the volume of deliverable sediment must be reduced by 20 percent every four years resulting in complete reduction over twenty years (NCRWQCB 2007d).

²⁸ This prohibition includes the discharge of organic materials directly into a watercourse or the placement of organic materials in a location where they could flow into a watercourse.

Waste Discharge Requirements and Waivers for Sediment Discharge Associated with Timber Operations

Sediment discharges associated with timber operations are subject to additional permitting requirements beyond the prohibition described above. Prior to harvest, landowners with a timber harvest plan approved under the FPA and FPR must also either comply with the conditions of individual or general WDRs or satisfy the conditions for a waiver of WDRs.²⁹ To obtain WDR coverage, dischargers must submit an application for coverage and satisfy the conditions specified in General WDRs or submit an individual report of waste discharge (NCRWQCB 2004b). Under the General WDRs, dischargers must prepare and submit an Erosion Control Plan that contains an inventory of controllable sediment discharges in the project area as well as a prioritized implementation schedule for minimizing and preventing sediment discharge.³⁰ (Appendix E includes a list of the planning BMPs required by the WDRs). When an individual report of waste discharge is required, the report is reviewed by the NCRWQCB, which then issues WDRs specific to the project area or an individual waiver.³¹

Dischargers that meet the eligibility criteria in one of six categories may obtain a Categorical Waiver of WDRs, which eliminates the reporting and permitting requirements described above. The waivers are intended for “low impact Projects that do not pose a significant threat to water quality.”³² To satisfy the conditions of the waiver, all projects must meet the general waiver requirements (which include the submission of a waiver application that documents satisfaction of eligibility criteria, compliance with applicable regulations, and permission for on-site inspection by NCRWQCB staff). Projects falling in Categories C, E, and F (which include projects in an area covered by an adopted TMDL Action Plan or approved timber permits) must also prepare, submit and adhere to an Erosion Control Plan that contains an inventory of controllable sediment discharges in the project area as well as a prioritized implementation schedule for minimizing and preventing sediment discharge. (Appendix E includes a list of the BMPs required for WDR Waivers for Categories C, E, and F).

²⁹ The WDR and waiver conditions described here apply only to timber operations on non-federal lands. Federally owned lands are covered under a separate WDR and waiver.

³⁰ The General WDR does not specify specific BMPs to prevent and control sediment discharge. At minimum, these include compliance with the FPRs, which are discussed below.

³¹ WDRs apply to proposed or ongoing operations as well as for legacy discharge sites found within the project area (Duggan and Mueller 2005).

³² Project categories that may fall under the waiver include: (a) Fire Safe Projects (fuel treatment projects or projects within 150 feet of existing structures), (b) Emergency and Exemption Projects (projects identified as Emergency or that qualify for an Exemption under the Forest Practice Rules), (c) Total Maximum Daily Load Project (projects in compliance with an adopted TMDL action plan), (d) Modified Timber Harvest Plan Projects (projects defined as Modified Timber harvest Plans under the Forest Practice Rules), (e) Nonindustrial Timber Management Plan Projects (projects defined as Nonindustrial Timber Management Plans under the Forest Practice Rules), and (f) Other Projects that meet specific restrictive conditions for the location and implementation of operations, road construction, and hauling practices (NCRWQCB 2004a, p 8).

Monitoring, Enforcement, and Sanctions

The NCRWQCB has two full time enforcement staff, two part time retired annuitants who work on enforcement issues, and several technical staff who engage in various enforcement activities (e.g., oversee permit compliance, follow up on complaints) in addition to their other duties. In terms of monitoring, the members of the staff collect water samples and may conduct inspections of regulated areas, investigate complaints regarding potential violations, and require regulated dischargers (e.g., timber companies) to self-monitor and submit periodic reports (Sato 2009). Though they have work on violations of sediment regulations, the dedicated enforcement staff spends the majority of their time working on violations associated with discharge from regulated facilities, primarily wastewater collection and treatment systems (Personal communication with NCRWQCB staff, 3/15/2010).

The NCRWQCB uses a “progressive enforcement” strategy that includes both informal and formal enforcement actions (Personal communication with NCRWQCB staff, 3/15/2010; Sato 2009). For an informal enforcement action, an agency staff person discusses the violation with the discharger, recommends actions to correct the problem, and may follow-up to confirm compliance with the recommendations. Formal enforcement actions include written notification followed by the potential of civil penalties, fees and court ordered injunctions.

Regulation of Sediment to Protect Endangered and Threatened Salmonids: Endangered Species Act

The Federal Endangered Species Act (ESA) and the California Endangered Species Act (CESA) are the primary federal and state legislation that aim to protect and conserve species that are considered endangered or threatened.³³ Both the federal ESA and the CESA are designed to prevent extinction and facilitate the recovery of species that may be headed toward extinction. Since the degradation of habitat for salmon and steelhead trout is one of the primary concerns associated with sediment pollution in the North Coastal Basin, this section focuses mainly on the administration of the federal ESA and CESA for the protection of threatened and endangered salmonids.

NOAA NMFS and USFWS are jointly responsible for implementing the federal ESA. The USFWS is generally responsible for managing land and freshwater species, and the NMFS manages marine and anadromous species, including salmon and steelhead trout. The CDFG is responsible for administering the CESA.

Under the ESA or CESA, species receive special protection if they are formally listed as “threatened” or “endangered.”³⁴ The North Coastal Basin contains several sub-

³³ The CESA is meant to work in conjunction with the federal ESA and is superseded by the federal ESA in cases where it would authorize activities prohibited by the federal ESA.

³⁴ Under the federal ESA, an *endangered species* is “any species which is in danger of extinction throughout all or a significant portion of its range” (ESA §1532(6)) and a *threatened species* is “any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range” (ESA §1532(20)). Under the CESA, an *endangered species* is any species that is “in serious danger of becoming extinct throughout all, or

populations of salmon and steelhead trout that are listed as endangered or threatened on the federal ESA list or both the federal and state lists (Table 3.2).³⁵ These fish are thus afforded special protections under the ESA and CESA. These include provisions for federal and state activities, as well as actions and activities on private lands. The discussion that follows only addresses protections associated with actions or activities on private lands.

Table 3.2: Endangered and Threatened Salmonids in the North Coastal Basin

	CESA Status	Federal ESA Status
Chinook Salmon – CA Coastal Chinook		Threatened
Coho Salmon – Central CA Coast	Endangered	Endangered
Coho Salmon – Southern OR/Northern CA Coast	Threatened	Threatened
Steelhead Trout – Central CA Coast		Threatened
Steelhead Trout – Northern CA		Threatened

Federal ESA Provisions Affecting Activities on Private Lands

Section 9 of the federal ESA prohibits the "take" of any species listed as endangered and, unless specifically authorized by regulation, also prohibits the "take" of any species listed as threatened.³⁶ Section 10(a) of the ESA contains a provision to allow the "incidental take" (as opposed to intentional) associated with an "otherwise lawful" activity. Under this provision, private landowners, corporations or other groups conducting otherwise lawful activities that may result in an "incidental take" of a listed species may conduct their activities provided they obtain an incidental take permit from NMFS or USFWS. Due to their effects on salmon and steelhead trout, a wide range of instream and upslope activities may be subject to the take prohibition including the construction, maintenance

a significant portion, of its range due to one or more causes, including loss of habitat, overexploitation, predation, competition, or disease" (CESA §2062) and a *threatened species* is one that "although not presently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of the special protection and management efforts required by [this act]" (CESA §2067). The USFWS or NMFS hold responsibility for listing species as endangered or threatened on the federal list. This process is started either in response to a citizen petition to list or through the initiative of the listing agency. CDFG is responsible for listing species as endangered or threatened on the state list. Similar to the federal listing process, this can be initiated through citizen petitions or by the CDFG.

³⁵ Sub-populations of salmonids that show "substantial reproductive isolation" and are an "important component of the evolutionary legacy of the species as a whole" can be listed on the endangered or threatened species list as a distinct sub-group (known as an evolutionarily significant unit, or ESU) (NOAA Fisheries Website).

³⁶ Under the ESA implementing regulations, *take* is defined as "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" (NOAA Fisheries). NMFS explicitly defines the term *harm* as "an act which kills or injures fish or wildlife," and concludes that "habitat modification or degradation that may harm listed species and, there, constitutes a take under the ESA" (64 Federal Register 60727).

and use of inadequate water-crossings or roads adjacent to habitat for a listed species (64 Federal Register 60727-60730).

The CESA was modeled after the federal ESA and contains similar provisions. The CESA prohibits the “take” of any species listed by the state as threatened or endangered, or any species that is a candidate for such listings and provides a permitting process to allow incidental takes associated with otherwise lawful activities (CESA §§2080-2081).³⁷

To receive a federal incidental take permit, an applicant must submit basic information about the proposed activity and affected species as well as a complete conservation plan (usually referred to as a Habitat Conservation Plan [HCP]). The HCP must describe (a) the anticipated effects of the proposed activity on the listed species, (b) the measures that will be used to monitor, minimize and mitigate these effects, and (c) alternative actions that were considered and why they are not being used (NOAA Fisheries Application Instructions Website). Since the ESA encompasses such a broad range of species and habitat, there are no specific provisions mandating particular road-related BMPs. HCPs associated with salmonids may mandate the use of BMPs as part of the mitigation measures and applicants usually work with agency staff to determine the appropriate BMPs and other mitigation measures for the HCP. The permit review process involves review by the NMFS or USFWS Regional Office or, in some cases, the Washington, D.C. office and a public review and comment period.

Similarly, to obtain a California incidental take permit, an applicant must submit a permit application package containing a description of the project activities and location; the affected species; analysis of the potential takings, associated impacts on species, and if the taking would place the continued existence of the species further at risk; a plan to minimize and mitigate the effects and to monitor compliance (which could be a federal HCP); and a description of the funding available to implement the monitoring and mitigation plan. The applicant can consult with CDFG as they prepare the application. Again, similar to the federal permit requirements, no specific BMPs are mandated by the CESA and, due to continued questions regarding the definition of “take,” it is unclear if habitat modification consists of a take under the CESA (see footnote 22). CDFG reviews the application and determines whether to issue or deny the permit.³⁸

CDFG can issue California incidental take permits when the following five conditions are satisfied: “(1) The authorized take is incidental to an otherwise lawful activity; (2) The impacts of the authorized take are minimized and fully mitigated; (3) The measures required to minimize and fully mitigate the impacts of the authorized take: a. are roughly proportional in extent to the impact of the taking on the species, b. maintain the applicant’s objectives to the greatest extent possible, and c. are capable of successful implementation; (4) Adequate funding is provided to implement the required

³⁷ *Take* is defined as “hunt, pursue, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill” (Fish and Game Code §86). This definition is more narrow than that of the ESA and it is unresolved if it includes habitat modification that could indirectly harm an endangered species (Duggan and Mueller 2005).

³⁸ The review process under the California Environmental Quality Act applies to this process.

minimization and mitigation measures and to monitor compliance with and the effectiveness of the measures; and (5) Issuance of the permit will not jeopardize the continued existence of a State-listed species” (CDFG CESA Incidental Take Process Website).

If a landowner or other private entity has obtained a federal incidental take permit under Section 10(a) of the ESA, the entity can apply for a Consistency Determination in lieu of a California incidental take permit (CESA §2080.1). To do so, the applicant must notify the CDFG Director that the incidental take permit has been issued and submit the permit documentation to be reviewed for consistency with the CESA. A Consistency Determination can be issued if the conditions of the federal permit are consistent with the CESA. Otherwise, the applicant must apply to CDFG for a separate California incidental take permit.

Monitoring, Enforcement and Sanctions

ESA provisions related to salmon are enforced by the NOAA Office of Law Enforcement (OLE). The OLE has 146 special agents and 17 enforcement officers that investigate and enforce potential violations of the ESA as well as over 30 other federal statutes across the United States (NOAA Office of Law Enforcement Website). The ESA can also be enforced through a citizen suit clause (Section 11(g)), which enables citizens to bring legal action against any person alleged to be in violation of the ESA or the agency for failure to perform any duty mandated by the ESA. Under Section 11 of the ESA, persons who knowingly violate any provision of the ESA or a permit issued under the ESA can be punished by a civil penalty of up to \$25,000 and criminal penalties up to \$50,000 or up to one year imprisonment; and persons who knowingly violate any regulations issued under the ESA can be punished by a civil penalty up to \$12,000 and criminal penalties up to \$25,000 or up to six months imprisonment. If the activity is ongoing, an injunction may be issued to stop further harm.

Violations of the CESA are a misdemeanor and punishable by fines up to \$5,000 for each violation though intentional take for commercial purposes or profit is punishable by a fine up to \$30,000 and a year imprisonment. In addition, injunctive relief can also be used to stop additional harm. CDFG Wardens are responsible for enforcing all Fish and Game Code, including the ESA. Wardens usually learn of violations through tips complaints from the public or CDFG staff working in the field and investigate potentially “egregious violations” (Personal communication with CDFG staff, 12/15/2008). Given the grey area surrounding the question of if habitat modification constitutes a “take,” it is not surprising that a 2006 report on CDFG enforcement actions shows no evidence of enforcement actions related to unpermitted habitat degradation under CESA (CDFG 2006).³⁹

³⁹ Wardens have issued citations for illegal fishing activities under CESA (CDFG 2006)

Regulation of Sediment Associated with Forest Practices: Z'berg-Nejedly Forest Practice Act and Forest Practice Rules

The Z'berg-Nejedly Forest Practice Act (FPA) of 1973 provides guidelines for the regulation of the harvest of timber products in California in order to ensure that “logging is done in a manner that will preserve and protect our fish, wildlife, forests and streams” (FPR 2007). The FPA outlines the intent behind the regulation of timber harvests and provides a regulatory framework for the submission and review of harvest permits that is implemented through Forest Practice Rules (FPR). The FPA designates responsibility for developing, amending and adopting the FPR to the BOF, a nine-member Governor-appointed body within CAL FIRE, and charges CAL FIRE with the responsibility to enforce the FPR (Duggan and Mueller 2005).

Under the FPA, individuals or organizations harvesting timber for commercial purposes must have an approved Timber Harvest Plan (THP) or Nonindustrial Timber Management Plan (NTMP).⁴⁰ The THP or NTMP must contain a physical description of the area where timber operations will take place, details of planned harvest operations, identification and description of sensitive areas (e.g., watercourses, habitat for protected species, archaeological and historical resources), evaluation and mitigation of environmental effects, and a list of pending permits in the plan area. Since roads are thought to be the greatest sediment source associated with timber operations, the THP or NTMP must explicitly address the prevention and control of road-related sediment (California Board of Forestry and Fire Protection 2006).

Sediment control under the Forest Practice Act and Forest Practice Rules

The FPR requires that logging roads and landings must be “planned, located, constructed, reconstructed, used and maintained in a manner which: is consistent with long-term enhancement and maintenance of the forest resource; best accommodates appropriate yarding systems, and economic feasibility; minimizes damage to soil resources and fish and wildlife habitat; and prevents degradation of the quality and beneficial uses of water” (FPR 2007 §§923, 943, 963). The FPR provides general planning guidelines as well as specific standards for the construction, location, management, and use of roads to prevent the degradation of soil resources and water quality, and the associated adverse effects on fish and wildlife.

⁴⁰ The THP is the standard harvest plan and permitting procedure. The NTMP is an alternative option available to nonindustrial landowners with less than 2500 acres. The NTMP streamlines the review process for harvests. The plan must be prepared by a Registered Professional Forester and the initial plan submission follows the same review process as a THP, except there are some additional requirements for documenting stands and the site conditions and some restrictions on harvesting techniques. However, the NTMP is valid in perpetuity, locking in the FPR at the time of submission; whereas the THP is initially valid for three years and can only be extended for two additional years. When a landowner intends to harvest, they simply file a notice of timber operations signed by an RPF certifying that the harvest does not deviate from the NTMP. Approval of the notice of timber operations is ministerial, meaning it is automatically approved assuming it is consistent with the NTMP. The BMPs requirements for roads under a NTMP are given by the FPR in place when the NTMP was approved.

In general, logging road networks must be planned to minimize total mileage and watercourse crossings, and to avoid sensitive and/or unstable areas. All logging roads, watercourse crossings, and existing road failures must be mapped in the THP or NTMP, and roads must be classified as ‘permanent,’ ‘temporary,’ or ‘seasonal’ (FPR 2007). All new roads must be constructed to meet the requirements of their use classification and all roads must meet specific guidelines regarding the maximum road grade, placement of roads on steep slopes and near watercourses or other sensitive areas, sizing of culverts and design of other watercourse crossings, placement of drainage structures, disposal of construction spoils and fill material, appropriate surface materials, allowed winter and wet season use, the abandonment of roads, and other erosion control measures (FPR 2007 §§923, 943, 963). Appendix E includes a list of BMPs mandated by the FPR.

If any of the FPR guidelines for roads or erosion control will not be met, the THP or NTMP must justify why an alternative design will be used and address how any associated environmental effects will be mitigated. This flexibility is designed to allow the use of site-specific BMPs that are tailored to the actual conditions of the harvest area.

Preparation and Review Process

The THP or NTMP must be prepared by a Registered Professional Forester (RPF) and is reviewed by a multi-agency and multi-disciplinary team. The review team is led by CAL FIRE and contains representatives from the CDFG, the appropriate RWQCB, and the Department of Conservation California Geological Survey (also known as the Division of Mines and Geology). The California Coastal Commission (CCC) joins the review team for plans in the Coastal Zone and the California Department of Parks and Recreation (DPR) is included when the plan affects park resources. Additionally, representatives from county government, and other federal, state or county agencies may also be included when requested by CAL FIRE or the interested agency.⁴¹ All harvest plan documents are available for public review and comment, and review meetings are open to the public.

There are four times when on-site inspections by CAL FIRE and other agencies may occur or are required: (1) during review of the plan, (2) during timber operations, (3) following completion of timber operations and work in the place, and (4) following completion of stocking. During the review of the plan, the review team may conduct a pre-harvest inspection (PHI). In a PHI, the review team, RPF and the plan submitter inspect the site to allow the review team to make recommendations based on the specific physical conditions of the site. PHIs are not legally required for all sites but they “occur more often than not” (Duggan and Mueller 2005 p 142). To ensure that operations proceed in accordance with the plan, CAL FIRE, CDFG, the appropriate Regional Board, or the SWRCB may conduct on-site inspections during or directly following completion of the timber harvest operations. Additionally, the FPA requires CAL FIRE to conduct on-site post-harvest inspections within six months of receiving the work completion report and the stocking report from the plan submitter or RPF. CAL FIRE must take corrective

⁴¹ In the Tahoe Basin, a representative of the California Tahoe Regional Planning agency may also join the review team.

action if timber operations (including environmental mitigation measures) or stocking was not completed according to the plan.

Monitoring, Enforcement and Sanctions

CAL FIRE and the BOF have the primary responsibility for enforcing the FPA and FPR. Enforcement actions can include administrative actions such as stop orders, corrective action notices, and administrative civil penalties; judicial remedies including civil and criminal penalties and injunctive relief; and administrative penalty orders (Duggan and Mueller 2005). Monitoring for compliance is conducted through the system of post-harvest inspections mandated in the FPA. When CAL FIRE inspectors find violations of any provision of the FPA or FPR, they can take informal actions (such as verbally requesting correction of the violation) or make a recommendation for more formal enforcement actions. The choice of enforcement action typically depends on the severity of the violation. More serious cases can be addressed through civil penalties (up to \$10,000 for each unintentional violation), misdemeanor criminal penalties (up to \$1,000 or imprisonment for up to six months for each willful violation), injunctive relief, and suspension of licenses where appropriate.

Private citizens also have some enforcement power. Private citizens can sue CAL FIRE, BOF and other agencies for violating nondiscretionary duties or abusing discretionary duties, and can also sue these agencies for injunctive relief (Duggan and Mueller 2005). Several watershed-based and regional environmental groups (e.g., Environmental Protection Information Center) in the North Coastal Basin act as watchdogs on the timber industry and exercise this enforcement power.

Regulation of Sediment to Protect Fish and Wildlife Habitat: Lake and Streambed Alteration Agreement Program

The California Department of Fish and Game is responsible for the protection, conservation, and management of fish, wildlife, and native plant resources throughout the state. The Lake and Streambed Alteration Agreement (LSAA) Program carries out CA Fish and Game Code §§1600-1616, which establishes procedures to protect fish and wildlife in and near water bodies from anthropogenic disturbances. Under this program, CDFG reviews plans for all activities that will alter water bodies in the state and may require mitigation measures to reduce any adverse effects of the proposed activities. Several road construction and reconstruction activities fall under the purview of this program (e.g., installation, replacement, or removal of a stream crossing; road construction, re-construction or decommissioning activities in or near a river, stream or lake) though CDFG does not specify BMPs to reduce the impacts of these activities.

Notification and Agreement Process

Landowners, businesses, government agencies and public utilities must notify CDFG of any planned activity that may (a) “substantially divert or obstruct the natural flow of, or substantially change or use any material from the bed, channel, or bank of, any river, stream, or lake,” or (b) “deposit or dispose of debris, waste, or other material containing crumbled, flaked, or ground pavement where it may pass into any river, stream, or lake”

(Fish and Game Code §1602).⁴² The notification form, supporting documents (which must include a detailed description of the project location and activities, a project map and names of affected waterways, construction plans and drawings where applicable, and copies of any applicable local, state or federal permits) and fee must be submitted *prior* to the initiation of the proposed activity.⁴³

Following receipt of the notification, CDFG reviews the project documents to “determine whether the activity may substantially adversely affect an existing fish and wildlife resource” and if special measures or BMPs will be required to mitigate any adverse effects (Fish and Game Code §§1602-1603). If CDFG finds that the activity will not affect fish and wildlife resources, then the applicant is able to carry out their proposed plan. However, if the proposed activity may adversely affect fish and wildlife, CDFG will draft an “agreement” that includes a “specific and detailed” description of the affected fish and wildlife resources as well as mitigation measures that are required to protect the resources. Provided the applicant finds these measures acceptable, they can proceed with the proposed activity but must implement the mitigation measures specified in the “agreement.” If the applicant finds the draft agreement unacceptable, they can meet with CDFG to resolve the disagreement and if they are unable to find an acceptable solution, the applicant may request that a panel of arbitrators⁴⁴ meet to issue a “final agreement.” The final agreement is a binding document containing mitigation measures the applicant must implement when carrying out the project (Fish and Game Code §1602).

Monitoring, Enforcement and Sanctions

Violations of the LSAA program are punishable by fines up to \$25,000 for each violation and temporary or permanent injunctions on the activity of concern (Fish and Game Code §1615). CDFG Wardens are responsible for enforcing LSAA and all Fish and Game Code. Wardens typically learn of violations through complaints and tips from the public or CDFG staff scientists in the field, and investigate any potentially “egregious violation” (Personal communication with CDFG staff, 12/15/2008). Wardens may issue a verbal warning, instruct the violating party to correct any problems, or pursue a citation, a process that may be accompanied by a temporary or permanent injunction. A Warden’s decision either to warn and educate or issue a citation is based on the significance of the violation as well as the likelihood of a successful prosecution (Personal communication with CDFG Warden 3/8/2010; Personal communication with CDFG staff, 12/15/2008).

⁴² The range of water-courses covered by this program is broad and includes “ephemeral streams, desert washes, and watercourses with a subsurface flow [and] may also apply to work undertaken within the flood plain of a body of water” (CDFG LSAA Website).

⁴³ An exception is made for certain types of emergency work provided that the entity performing the emergency work notifies CDFG within 14 days of starting the work (Fish and Game Code §1610).

⁴⁴ The panel is comprised of one representative selected by CDFG; one representative selected by the notifying party; and a third person who serves as the panel chair and is mutually agreed upon by CDFG and the notifying party.

Citations for violations of the LSAA program are not common. For the nine-month period between January and September 2008, a CDFG group dealing with non-timber 1600s found only nine citations for violations of the LSAA program (Personal communication with CDFG staff, 12/15/2008). According to data from CDFG, of the 14,034 violations reported in 2005, only 45 (0.32%) were violations of Fish and Game Code 1600. The vast majority of enforcement activities and violations are associated with sport fishing (80.74%) and hunting (11.23%) (CDFG 2006). A contact in the regulatory side of CDFG further explained:

Those of us in regulation would like to see more active enforcement of the environmental sections of the Code, but it is not easy since District Attorneys usually have an abundance of criminal cases to try and not much time for sediment issues and the Enforcement Branch continues to be understaffed. (Personal communication CDFG staff, 12/15/2008)

Regulation of Sediment Associated with Development: Local Ordinances

Land-use planning and regulation are primarily the domain of local municipalities. In California, the Planning and Zoning Law (Planning and Zoning Law §65000) establishes the State's interest in the social and environmental consequences associated with local land uses and planning processes. To protect those interests, the California General Plan Law requires every city and county to adopt a "comprehensive, long-term general plan for the physical development of the county or city" (Planning and Zoning Law §65300). The planning guidelines and implementation items expressed in the General Plan are executed through local ordinances.

Local municipalities have considerable flexibility in the planning processes but every General Plan must address seven mandated elements: land use, open space, conservation, housing, circulation, noise, and safety. The conservation element may contain provisions regarding the protection of water quality, prevention of sedimentation, and the general protection of watersheds (Planning and Zoning Law §65302(d)). Water quality, riparian habitat and sediment related provisions are executed primarily through local grading ordinances and streamside development ordinances.

Local Controls in Humboldt County

The Humboldt County General Plan identifies the protection and restoration of water quality and fish and wildlife habitat as planning and management goals for the county (Humboldt County General Plan 1984 §§3330, 3360, 3430). The plan specifically notes the deleterious effects of anthropogenic sedimentation associated with road construction, timber activities, vegetation removal, mining, and some ranching and agricultural activities and recommends the revision of county ordinances to limit the effects of these activities.

In 2002, the Humboldt County Board of Supervisors adopted ordinance revisions to reduce erosion and sediment pollution and protect streamside habitat (Humboldt County 2002). The revisions address grading, erosion control, geologic hazards, and streamside management areas (SMA). The grading ordinance requires any person undertaking

grading or related activities to obtain a permit.⁴⁵ The permit application must contain project plans and a description of erosion control measures. Grading projects in excess of 5,000 cubic yards are designated as ‘engineering grading’ and require the submission of more detailed plans prepared by a licensed professional. Grading projects must conform to the BMPs and standards laid out in the grading ordinance unless other measures are recommended in a soils engineering or engineering geology report. (Appendix E includes a list of the standards required by the grading ordinance). All projects requiring a permit are subject to inspection by a building inspector and all ‘engineered grading’ projects require post-project inspection by a civil engineer, soils engineer, or the engineering geologist to certify compliance with the plans.

The SMA ordinance restricts certain types of development in and near stream channels, requires a permit for developments in and near stream channels and mandates sediment mitigation measures for such permitted developments.⁴⁶ The process to obtain a SMA development permit and certificate of compliance includes (a) an onsite inspection prior to the development to determine if the development will occur within the SMA; (b) submission of a biological report including site conditions, potential effects of the development project, and mitigation measures prepared by a “qualified biologist” and refereed by staff at CDFG; and (c) implementation of all mitigation measures recommended in the biological report. (Appendix E includes a list of the management standards required by the SMA ordinance). For projects that require mitigation and/or monitoring beyond the construction period, the permittee must post a bond or security, which will be forfeited if mitigation and monitoring requirements are not met.

⁴⁵ Grading activities are defined as “grading, filling, land contouring, clearing and grubbing, drainage activities, site preparation, and road building.” (Humboldt County 2002, p B-3). Grading projects that are executed on a very small-scale (e.g., not exceeding 50 cubic yards of excavation or fill), determined to not damage water or biological resources, regulated by other state or federal legislation (e.g., timber harvest under the authority of the FPA, watercourse crossing work with a 1600 agreement with CDFG), or are standard practice (e.g., ‘normal agricultural practices’) are exempt from the permitting process, though they are still required to be executed in a manner that limits harm to streamside habitat and water quality.

⁴⁶ The SMA “includes a natural resource area along both sides of streams containing the channel and adjacent land... In areas outside of Urban Development and Expansion Areas... the [SMA] shall be defined as (1) 100 feet, measured as the horizontal distance from the stream transition line... on either side of perennial streams... (2) 50 feet, measured as the horizontal distance from the stream transition line on either side of intermittent streams... Where necessary, the width of Streamside Management Areas shall be expanded to include significant areas of riparian vegetation adjacent to the buffer area, slides and areas with visible evidence of slope instability, not to exceed 200 feet measured as a horizontal distance... The Streamside Management Area may be reduced or eliminated where the County determines, based on specific factual findings, that: 1. The USGS mapping of the stream as perennial or intermittent is not accurate, and typical stream flow can be shown to be less than that required to be classified as either perennial or intermittent, or 2. It will not result in a significant adverse impact to fish, wildlife, riparian habitat, or soil stability” (Humboldt County 2002, p D4-D5). SMA permits are not required for routine maintenance, activities regulated by other ordinances and agencies, and emergency developments.

Monitoring, Enforcement and Sanctions in Humboldt County

The responsibility for investigation and resolution of potential code violations lies with the Building Division of the Humboldt County Community Development Services Department and the Humboldt County Code Enforcement Unit (CEU). The Building and Planning Department investigates citizen complaints regarding potential violations of local ordinance requirements and refers egregious cases to the CEU. Since its inception in 1995, staffing of the CEU has ranged from one to two full-time equivalent positions.⁴⁷

The monitoring and enforcement of county ordinances is based primarily on complaints registered with the Building Division of the Humboldt County Community Development Services Department. Private citizens are able to submit complaints about violations of the grading ordinance or other county codes by filing a complaint form and submitting it to the Building Division. Staff at the Building Division attempt to resolve the issue directly and forward difficult cases to the Humboldt County CEU.

The approach to gathering information and ensuring compliance with county codes underwent significant changes during the study period. Under the direction the County Board of Supervisors, the CEU engaged in pro-active monitoring of the grading ordinance and other building codes in rural areas in 2007 and early 2008. The rural enforcement program was met with substantial resistance from citizens and the Board of Supervisors responded by suspended the program in April 2008. With the termination of the rural enforcement program, the CEU ceased proactive monitoring and again relies primarily on citizen complaints to locate violations.⁴⁸

Local Controls in Mendocino County

While Mendocino County's planning documents articulate the need to protect and restore salmonid habitat, the county has failed to adopt ordinances to do so. The 1981 Mendocino County General Plan establishes the goal of protecting water resources and directed the county to adopt a grading ordinance (Harris and Kocher 1998).⁴⁹ Despite

⁴⁷ The CEU has its roots in the Community Assistance Unit, which was formed in 1995 and responsible for investigating and responding to reported violations of County Code. In 2000, the program was renamed as the Code Enforcement Unit (What is the CEU? Website). Since its start in 1995, the number of code enforcement staff has fluctuated between one and two full time employees in response to mandates from the Board of Supervisors and budget limitations.

⁴⁸ The changes in monitoring and enforcement strategies affected the type of violations investigated by the CEU. During the 2007-2008 period of active monitoring, roughly 75 percent of enforcement actions were associated with violations of the grading ordinance and sediment problems; since the termination of the rural enforcement program, the Humboldt County CEU officer estimates that only 5 – 10 percent of his enforcement actions are spent on violations of the grading ordinance. The CEU officer attributes this change to the lack of active monitoring by him rather than increased compliance (Interview with Jeff Conner, Humboldt County CEU, 3/5/2010). Chapters 5 and 6 contain additional details about the conflict over enforcement.

⁴⁹ During the study period, the 1981 General Plan along with its periodic amendments was the guiding planning document for the county. Mendocino County revised and updated the General Plan in August 2009. The 2009 General Plan articulates similar goals in terms of resource management and the protection of water quality. However, movement towards the development of a grading ordinance has been abandoned in the more recent plan (Mendocino County 2009).

several attempts to pass a grading ordinance over the past three decades, the county has failed to do so. The most recent effort began in 2001 when the Mendocino County Board of Supervisors directed staff in the county planning and building department to establish a stakeholder committee and develop a grading ordinance. A draft ordinance was proposed in 2002 and went through several rounds of revision before the Board of Supervisors voted to terminate all action on the ordinance in May 2007 (Harris 2008).⁵⁰

In addition, the county developed a management plan for salmon and steelhead in 1984. The plan and associated policies direct the county to “inventory fish streams, protect and restore fish habitat, allow only compatible development along important stream sections, and protect riparian vegetation” and to develop a grading ordinance (Harris and Kocher 1998 p 9). However, as Harris and Kocher (1998) note, “Despite these strongly worded policy goals, most of the recommended changes in ordinances have not been adopted, leading to inconsistent implementation of these goals” (p 9).

Subdivision Map Act

The Subdivision Map Act provides another regulatory tool to oversee local development, and contains provisions that could pose restrictions on the construction of roads associated with the subdivision of parcels into multiple, smaller parcels. The Subdivision Map Act is designed to help track development patterns, ensure that new developments will have adequate infrastructure, and review the environmental impacts of the development. To that end, the act requires landowners or developers planning a “major” subdivision (five or more lots) to submit an application containing a detailed map of the proposed project to their local planning authority.⁵¹ The agency is responsible for conducting a review of the project and the act specifically requires attention to “proper grading and erosion control, including the prevention of sedimentation or damage to offsite property” though no specific BMPs are mandated (Subdivision Map Act §66411). This review process must comply with the California Environmental Quality Act (CEQA) and the planning authority can approve the subdivision as is, approve with mitigation measures (which could be BMPs for road construction), or deny the subdivision.

Though the Subdivision Map Act provides an additional review process that can help alleviate sedimentation associated with residential and other development, the Subdivision Map Act contains a grandfathering clause that allows the subdivision of land to occur without review if the landowner can prove that parcel was once divided into smaller historic parcels with divisions that date back before 1893 (Fulton and Shigley 2005). As many large parcels were originally assembled from smaller parcels, historic parcels pre-dating 1893 are common as is use of this loophole. This grandfathering reduces local control over road-related sediment associated with local development. In addition, my interviews suggest that illegal and unreported subdivisions are common throughout Mendocino and Humboldt counties.

⁵⁰ Chapter 5 contains additional details about this conflict.

⁵¹ No review process is required for a “minor” subdivision of a lot into two to four parcels though the developer must still submit a parcel map depicting subdivision to the local planning authority.

Sediment Regulations and Land Use

The regulation of road-related sediment in the North Coastal Basin differs by land use, across counties, and with respect to the designation of special protection zones associated with threatened or endangered species or impaired watersheds. (Table 3.3 summarizes these differences). The only activity that is regulated across all land uses and throughout the entire basin is the installation or alteration of stream-crossings, which requires action through the CDFG LSAA program. The construction of new roads is regulated across all land uses (except timberlands) within Humboldt County.⁵² More comprehensive requirements that apply to both new and existing road features apply to all land uses in the Garcia Watershed, which is regulated through the Garcia Action Plan. In areas where threatened or endangered species may be present, a federally approved HCP may require certain BMPs for road activities as conditions for an incidental take permit.⁵³

However, across the entire region, timberlands are uniformly more strongly regulated than other land uses both in the scope of the road-related activities that are regulated and in the standards that apply. As with other land uses, the implementation of certain BMPs for the construction of new roads and the installation or alteration of stream-crossings is mandated by regulations. In some cases, the standards for these actions are more stringent on timberlands. For example, the FPR require that stream crossing culverts are sized to withstand a 100-year storm event while the Garcia Action Plan only requires that they withstand a 50-year storm event. In addition, regulations on timberlands cover far more activities than those on other lands. Timber regulations require landowners to assess and remedy sediment sources associated with existing roads and stream-crossings, and mandate a set of BMPs for the inspection and use of existing as well as new road.

This review demonstrates that the landscape of regulation, or the rules in form, is varied across the North Coastal region. Further, as I will show in Chapter 4, the perceived importance of these regulations and thus compliance also differs by land use; so that even regulations that are assumed to apply to all land uses are actually stronger on timberlands. In the chapters that follow, I will argue that this is important because the risk of sediment from existing roads is similar across all land uses. I will also explore some of the reasons and consequences of these regulatory differences.

⁵² The Humboldt County grading ordinance does not apply in areas covered by a THP or NTMP, as the FPR is recognized to provide adequate regulatory oversight.

⁵³ The incidental take permit may not be specifically associated with the road activities and the mandated BMPs for roads may be required for a HCP that covers multiple activities on a land-holding.

Table 3.3: Sediment Control Regulations and Land Use

Land Use	Regulated Activities	Regulation(s)	Regulatory Authority
All	• Installation of new stream-crossing	Fish and Game Code §1600: LSAA	CDFG
	• Alteration or replacement of existing stream crossing	CWA §404	COE
All in Humboldt County (except timberlands)	• Construction of new road	Grading ordinance	Humboldt County
All that may affect habitat of endangered or threatened salmonids	<ul style="list-style-type: none"> • Construction of new road that may affect salmonid habitat • Installation of new stream-crossing that may affect salmonid habitat • Alteration or replacement of existing stream crossing that may affect salmonid habitat 	ESA §10(a): incidental take permit	NOAA NMFS
All in Garcia Watershed	<ul style="list-style-type: none"> • Construction of new road • Installation of new stream-crossing • Alteration or replacement of existing stream crossing • Use, maintenance, re-construction and decommissioning of existing roads 	Garcia Action Plan	NCRWQCB
Timberlands	• Construction of new road	FPR and FPA	CAL FIRE
	<ul style="list-style-type: none"> • Installation of new stream-crossing • Alteration or replacement of existing stream crossing • Use, maintenance, re-construction and decommissioning of existing roads 	CWA §401: WDR and waivers for sediment discharge	NCRWQCB

Non-Regulatory Programs and Tools to Control Sediment on Private Lands

A wide variety of government, non-profit, and private actors and citizens are involved in formal and informal non-regulatory programs to reduce sediment pollution from private lands in the North Coastal Basin.⁵⁴ Government actors come from all levels of government and include regulatory agencies that also administer or are involved in non-regulatory programs as well as non-regulatory agencies and organizations. CDFG, CAL FIRE, EPA, NCRWQCB, and USFWS are all involved in non-regulatory programs in addition to their regulatory authority. The AmeriCorps Watershed Stewards Project, California Conservation Corps, County Resource Conservation Districts (RCD), Natural Resource Conservation Services (NRCS), and the University of California Cooperative Extension (UCCE) are the most active non-regulatory government agencies in the region. Non-profit organizations include grassroots or community-based watershed groups, and non-profits operating at the county, basin or state level. Private actors include private consultants specializing in road management and sediment control (e.g., Pacific Watershed Associates (PWA), the most widely recognized private consulting firm working on sediment reduction and roads in the North Coastal Basin), road and neighborhood associations, and private citizens. Appendix F contains a list of groups and organizations with non-regulatory programs in the basin.

These actors work independently and in tandem to provide incentives or knowledge to encourage private landowners to implement sediment control BMPs on their roads. To do so, they use a range of informal and formal actions and tools. Informal actions include unfunded and grassroots activities like road association workdays. Formal non-regulatory approaches can be grouped into three categories: technical assistance, financial assistance, project implementation, and other activist actions.

The technical assistance category encompasses all efforts to disseminate information about the sediment pollution problem and BMPs that can address the problem, including active education campaigns as well as the availability of staff to provide consulting or advice. The goal is to provide landowners with the knowledge needed to implement improved road management practices. In the North Coastal Basin, government, non-profit organizations and private consultants provide a variety of technical assistance including:

- **Guidance documents and management guides:** Several pamphlets and books provide guidance on road management practices. The best known in the North Coastal Basin is the *Handbook for Forest and Ranch Roads*, written by William Weaver and Danny Hagans of PWA. This technical guide targets landowners who will be actively involved in the design, construction and maintenance of their roads. The UCCE Division of Agriculture and Natural Resources published a less-technical guide, *Rural Roads: A Construction and Maintenance Guide for California Landowners* (Kocher et al. 2007), which aims to introduce the fundamental concepts of rural road management so they can better communicate

⁵⁴ There are also non-regulatory programs that address sediment pollution on public lands. However, this review is limited to programs and tools that target private landowners and sediment pollution associated with private land uses.

with the contractors who will construct and do the heavy maintenance on their roads, also to educate landowners about the inspection and basic maintenance practices they can implement themselves.

- **Workshops and courses:** Several non-regulatory government organizations, non-profit organizations and private consultants have created workshops and courses that educate private landowners, equipment operators, and regulators on BMPs for sediment control. For example, PWA has worked with a variety of resource agencies to hold several multi-day workshops on road design, construction and maintenance practices to reduce sediment, and the UCCE periodically holds Ranch Water Quality short courses, which educate ranchers about water quality issues and guide them in the development and implementation of water quality plans for their property.
- **Advice and site visits:** A wide variety of resource agencies, non-regulatory government organizations, non-profit organizations, and private consultants are available to provide consultations and advice by phone, at their office, and/or on-site regarding sediment control and roads.

Financial assistance programs include grant and cost-share programs that provide funding for the planning and watershed assessment projects, education and outreach, and the implementation of BMPs and restoration projects on private lands and roads in the region. The majority of these programs are publicly funded through sources authorized by federal environmental legislation (e.g., CWA §319(h), the Nonpoint Source Implementation Grant Program), California Senate Bills (e.g., SB 271, which created the Salmon and Steelhead Trout Restoration Account), and voter-approved propositions (e.g., Proposition 50, which created the Integrated Regional Water Management Grant). Depending on the program stipulations, the funds may be distributed directly to private landowners or indirectly via other government organizations, non-profit groups, or road or homeowners associations that receive the funding. For example, the NRCS sponsored Environmental Quality Incentives Program (EQIP) and the CAL FIRE administered California Forest Improvement Program (CFIP) can provide cost-share funds directly to private landowners but funding from the CDFG Fisheries Restoration Program is limited to public agencies, nonprofit organizations and Native American Tribes.

Project implementation is a subset of the financial assistance category that encompasses programs that conduct sediment source assessments or directly implement BMPs and restoration projects on private property. In other words, while the financial assistance category contains projects where the private landowner may or may not be actively involved in the design and implementation of the program, the project implementation category is limited to programs where the landowner simply provides access to their land.⁵⁵ The project design, acquisition of funding, and implementation are completed entirely by a non-profit organization, government agency or organization, or another individual or road association (though the private landowner may have responsibility for maintenance following completion of the project following). While project implementation is reasonably common through road associations, it is less commonly

⁵⁵ I distinguish between these two categories because the direct or indirect involvement of landowners is associated with different benefits and constraints that are discussed in Chapter 5.

practiced by non-profit organizations. The leading project implementation program in the basin is the Mattole Restoration Council's (MRC) Good Roads, Clear Creeks Program, which is systematically inventorying, upgrading and restoring roads on private lands throughout the Mattole watershed in Humboldt County. MRC staff members take responsibility for every aspect of the project assessment, design and funding, and work with landowners to secure permission to work on their roads and, in some cases, to ensure that the project design matches the landowners' needs.

The final category of non-regulatory programs includes other advocacy and activist actions such as watchdog activities that may lead to complaints or litigation regarding regulatory violations, reviewing and commenting on regulatory processes, and lobbying for more stringent regulations. A wide variety of watershed-based, regional, statewide, and national non-profit organizations are involved in these activities. As I will discuss in Chapter 5 and 6, much of their attention focuses on the enforcement and strengthening of environmental regulations associated with timberlands.

Conclusion

In this chapter, I provide background on the sediment pollution problem in the study region and review the primary sediment control regulations and non-regulatory programs. In addition to providing a descriptive foundation for the rest of the dissertation, this chapter advances two points that are developed further in the chapters that follow.

First, I show that a wide range of government, non-profit and other private actors are involved in regulatory and non-regulatory programs that aim to reduce sediment pollution. The detailed description of the numerous and overlapping actors and rules hints at the complexity and unenforceability of this regulatory system, characteristics that are discussed further in Chapter 5.

Second, I demonstrate that the regulation of sediment differs by land use. Since the risk of sediment pollution from roads is common across land uses (a finding hinted at in this chapter and further developed in the next), the regulatory disparity indicates that problem and governance landscapes are not aligned.

Chapter 4

Landscape of Action: Road Management in the North Coastal Basin

The previous chapter describes best management practices (BMPs) for the management of sediment from private rural roads in the North Coastal Basin and the regulatory and non-regulatory programs that aim to increase the utilization of those BMPs. In this chapter, I use data from the mail survey and landowner interviews to describe North Coast landowners' actual road management practices and knowledge about BMPs, and analyze how these differ by land use, permitting history, and utilization of technical and financial assistance. I show that knowledge and adoption of BMPs are significantly related to land use, parcel size, permitting history, and utilization of technical and financial assistance.

This chapter lays the foundation for Chapters 5 and 6, which rely on data from in-depth interviews to understand the relationships between land use, permitting history, and utilization of technical and financial assistance, and how these explanatory variables influence landowners' knowledge and behavior.

I begin by introducing three landowners. The profiles provide a vivid picture of the diversity of practice, knowledge and experiences among landowners in the North Coastal Basin and contextualize the quantitative description that follows. I then describe the study population, their land and their road networks. Following this general description of landowners and roads in the North Coastal Basin, I describe respondents' permitting history, experience with financial and technical assistance programs, and their knowledge and adoption of BMPs. I then explain how these variables are linked and vary across different groupings of respondents.

Three Landowners: Don, Henry, and Kim⁵⁶

Don

When I got to Don's large ranch that lies over the ridge dividing two watersheds in Mendocino County, he invited me to jump in his pick-up truck and we drove out to a redwood grove that his family has set aside for conservation as a special place on their property. The surrounding ranch and timberland have been in Don's family for multiple generations, and he took over the management of the family land about two decades ago.

There are nearly one hundred miles of roads on the ranch. In the not too distant past, they were causing severe erosion and sediment pollution. Today, most of the erosion sites have been treated, Don routinely uses pollution control practices on his roads, and his ranch has become a showcase for good road management.

⁵⁶ Landowners' names have been changed for reasons of confidentiality.

Don learned about the sediment control techniques through his involvement in the regulatory process for timber harvests and other water quality regulations. He and his forester jointly developed an Erosion Control Plan for the regulated areas of his property. Through the process, Don began to believe that the erosion control measures could reduce the long-term maintenance costs on his property. He attended multiple workshops and seminars to learn more about BMPs and received funding from the National Resource Conservation Services (NRCS) Environmental Quality Incentives Program (EQIP) and California Department of Fish and Game (CDFG) Fisheries Restoration Grant Program to implement BMPs on his property.

Though he thinks he is over-regulated and hopes for regulatory relief someday, he attributes his initial learning about BMPs to the regulatory process. After a little practice with implementation, he has had quite a bit of success with these measures and believes they have been cost-effective as well as beneficial for sediment reduction.

Henry

For most of the year, Henry lives closer to my UC Berkeley office than his North Coastal property, but we elected to meet at his vacation home to talk about his land management practices and to check in on a stream-crossing replacement, road-reshaping, decommissioning, and restoration project that had just started on his roads.

Henry purchased a moderately sized parcel in Mendocino County several years ago to fulfill his vision of a vacation or retirement home with some forestland that could be restored. His long-term goal is to sustainably manage the forest for timber production. Shortly after purchasing the property, he hired a forester to do a preliminary assessment of the condition of the land and to develop a forestry management plan that would lay the foundation for future timber harvests.

In addition to assessing the trees, his forester also surveyed the five miles of roads on his property. She identified several road features on his property that created a risk of sedimentation, and suggested that Henry apply for cost-share funds through EQIP to address these problems. Through the EQIP grant, he learned of Pacific Watershed Associates (PWA), a private consulting firm that specializes in road restoration projects, and the availability of grant funding from CDFG. Working with PWA, he secured CDFG grant funding for the project we toured.

Henry became actively involved in his road association and the management of the 11-mile access road he shares with his neighbors in his rural subdivision. He worked with PWA to secure an additional grant from CDFG for a restoration and upgrade project on the shared access road. Through the grant, they added gravel, reshaped the road, put in rolling dips and replaced several culverts.

PWA designed and implemented both projects. By working with his forester and PWA, Henry learned the principles of road design and how to better maintain the roads following the completion of the projects. He and the other members of his subdivision now take responsibility for inspecting and maintaining the roads.

Kim

I interviewed Kim at her home, about 200 miles south of the small parcel she and her sister own in the southern part of Mendocino County. Kim's parents originally purchased the land as a place for her family to camp and vacation. She and her family vacationed on the property regularly throughout the seventies, occasionally in the 80s, and more frequently again after her father's death in 1990, but she has not been up to visit since the late 1990s.

Though she holds strong environmental values, her management goal for the road is primarily to maintain access to her property and avoid an extremely uncomfortable ride and complete washouts. Though she is vaguely aware of the relationship of drainage and washouts, Kim does not have much understanding of the sediment risk associated with gravel roads. She indicated that her roads have several problems, most notably deep gullies, that suggest they could be contributing to sediment pollution.

Living so far away, Kim takes a hands-off approach to management. She has not inspected the roads since her last visit and did little maintenance even when she was up there. She has not consulted any professional for advice and has never had the need to go through a regulatory process. She does not know many of her neighbors. She confessed that if she ever decided to actively manage the land, she has a few ideas of places she could get advice but would not really know where to turn.

Landowners in the North Coastal Basin

The parcel and road characteristics, history and experiences with regulations and non-regulatory programs, and management behaviors and knowledge described in this chapter are based on responses to the mail survey and in-depth interviews with a subset of survey respondents (See Appendix B for the survey instrument and Appendix C for interview protocols). The survey population includes landowners holding parcels larger than 10 acres in watersheds of the North Coastal Basin located in Mendocino and Humboldt Counties.⁵⁷

The responses summarized in this chapter are limited by the representativeness of survey and interview respondents. Based on landowner interviews and telephone and written comments from survey respondents as well as non-respondents, I identified three overlapping groups of landowners who are likely to be under represented in the survey and interview results.

The first group contains landowners who are wary of an involvement with 'outsiders,' government, or research associated with the University of California Berkeley (which is perceived by some landowners as liberal and overly sympathetic to heavy-handed environmental regulations). These landowners may be more reluctant to participate in

⁵⁷ In order to more easily compare the effects of the local sediment controls in Humboldt and Mendocino counties, the survey sample excluded North Coastal Basin watersheds that are located primarily outside of the two county region.

non-regulatory programs and/or have had more negative experiences with or attitudes towards regulators. However, based on my interviews, I expect that the road management practices and BMP knowledge of non-respondents in this group are not outside the range represented by respondents.

The second group includes landowners who do not actively manage their land. These landowners may have recently obtained the land or be long-term landowners who simply do not manage the land. The land may either be completely undeveloped or contain developed roads that are not maintained. As several absentee landowners and landowners with a hands-off management strategy did complete the survey, the management practices and BMP knowledge of this group are probably captured by the survey. However, this group may be under-represented in the results.⁵⁸

The third group includes landowners using their land for marijuana production (either indoor or outdoor plantings). These landowners may not have responded due to the grey area of legality surrounding marijuana production in California. Additionally, several interview respondents suggest that there is a subset of marijuana cultivators who do not care about the environment, and would thus be unlikely to respond. This group of landowners and their importance for understanding the effectiveness of various forms of governance will be explored in detail in Chapter 6.

General Characteristics of Respondents and their Land

Survey respondents include private individuals and families, one industrial timber company, two non-timber corporations, three churches, and three nonprofit organizations. Respondent ages range from 27 to 95 and the median age of respondents is 60. Sixty percent of respondents hold a bachelor's degree or higher.

Respondents own land in all surveyed watersheds in Humboldt and Mendocino counties (Table 4.1). The mean acreage owned by private individuals, families and small organizations who responded to the survey is 365 acres, and the industrial timber company holds over 200,000 acres.⁵⁹ Respondents have owned their property for a mean length of 22 years and approximately 28 percent of the parcels had been in the respondent's family for more than one generation.

⁵⁸ Several surveys were returned blank accompanied by notes explaining that the landowner could not fill out the survey because he or she rarely visited the property and/or did not actively manage the land. This suggests that a disproportionate number of absentee landowners may not have completed the survey.

⁵⁹ Due the extent of the industrial timber company's landholdings, I did not include the company's reported parcel size in the calculation of the mean acreage. Since the inclusion of the single industrial company would not skew any other descriptive or analytical statistic, the industry timber company data is represented in all other results reported in this chapter.

Table 4.1: Characteristics of Survey Respondents

	Number respondents	Percent of respondents
Watershed		
Albion	18	3.9
Big	20	4.4
Capetown	11	2.4
Eureka Plain	12	2.6
Garcia	22	4.8
Lower Eel	25	5.4
Mad	28	6.1
Mattole	25	5.4
Middle Fork Eel	20	4.4
Middle Main Eel	21	4.6
Navarro	25	5.4
Noyo	15	3.3
Oil Creek	9	2.0
Point Arena	29	6.3
Redwood Creek	28	6.1
Rockport	28	6.1
South Fork Eel	27	5.9
Trinidad	15	3.3
Upper Main Eel	20	4.4
Upper Russian	22	4.8
Van Duzen	35	7.6
Unknown	4	0.9
Parcel Size		
40 acres and smaller	179	39.0
41-150 acres	108	23.5
161-600 acres	112	24.4
More than 600 acres	53	11.5
Unknown	7	1.5
Land use		
Working with timber	128	27.9
Working without timber	40	8.7
Primary residence	108	23.5
Second or vacation home	71	15.5
Other	112	24.4

Respondents use their lands for a variety of purposes including (but not limited to) timber harvesting, ranching, recreation, firewood collection, gardening and residential purposes. Approximately 27.9 percent of the respondents use their land as a working landscape with timber production; 8.7 percent use their land as a working landscape without timber production; roughly 23.5 percent use their land as their primary residence; another 15.5 percent use their land as a second home; and the remaining 24.4 percent use their land for

other purposes.⁶⁰ Approximately eight percent of respondents reported that the majority (>50%) of their income comes from their land and 55 percent reported that they receive no income from their land.

The interview respondents are a subset of the survey respondents. The survey respondent population was stratified by size and watershed, and interview respondents were selected from each combination of watershed and size class. This stratification ensured that the interviews would capture experiences unique to watershed and size classes. (Appendix A includes additional details on the generation of the sample population). It also enabled me to interview landowners with a variety of land uses and experiences with regulation and non-regulatory programs.

Road Networks on Private Lands

Survey respondents report having zero to 400 miles of road on their parcels. The median density⁶¹ of roads on respondents' land is 6.8 miles of road per square mile of land.⁶² Survey respondents' mean expenditure on the construction and management of roads

⁶⁰ Land use categories are defined as follows: *working with timber* are parcels used for commercial timber production, these parcels may also be used for agriculture, ranching, or livestock activities, and the landowner may or may not live on the parcel; *working without timber* are parcels used for some combination of commercial agriculture, ranching or livestock activities; the landowner may or may not live on the parcel and does not commercially harvest timber; *primary residence* are parcels used as the primary residence of the landowner and not used for commercial purposes to generate income; *second or vacation home* are parcels used as second or vacation homes for the landowner and not used for commercial purposes to generate income; *other* are parcels that do not fall into any of the above categories (e.g., absentee owners) or parcels where the use is unknown. The term *ranch* is often associated with livestock and grazing activities. However, *ranchers* are often involved in timber production as well as livestock activities. In this dissertation, *ranch* is often used as a synonym for *working* and, unless explicitly specified, includes working lands with timber as well as those without.

⁶¹ Road density was calculated by dividing the reported length of road by the acreage of the parcel. The survey asked landowners to estimate the length of road on their parcel and gave them the option to write in the exact value, or check a box for "less than one mile of road" or "none." Consequently, if there is less than a mile, I don't have a self-reported estimate of length. In the calculation of the road density value quoted in the text, responses "less than one mile" were estimated to be 0.5 miles. I also estimated lower and upper bounds for reported road density by recalculating road densities with the substitution of 0.9 and 0.1 miles of road for those who checked "less than one mile." The lower and upper bounds were 10.4 miles per square mile and 16.2 miles per square mile.

⁶² The mean density is 13.3 miles of road per square mile of land. This figure is extremely high, indicating that landowners may have over-estimated the length of road on their property. To understand the magnitude of the difference, consider the mean road density in the Navarro watershed. Calculated from responses to the survey, the mean density is 15.8 miles per square mile. A survey of road density in a sub-watershed of the Navarro done by analysis of aerial photos found that road densities ranged from 2.5 to 8.5 miles per square mile (Klamath Resource Information System 2003). The tremendous disparity suggests that some respondents over-estimated the length of roads on their property.

over the past five years is \$5 annually per acre, or \$206 annually per mile of road.⁶³ Several landowners noted on the survey or in interviews that they also put a substantial amount of labor and/or equipment time into the maintenance of their roads.

The majority of respondents use and/or have private roads that are shared with other landowners: 20.8 percent use privately maintained roads on other people's property to access their land, 15.1 percent report that other people use roads on their property; and 34.0 percent of respondents have shared roads on their property and use shared roads on others' property.

Approximately one-fifth of respondents (21.1%) belong to a road, homeowners or neighborhood association that jointly maintains a road and slightly less than one-fifth of respondents (19.0%) contribute dues to an association responsible for maintaining roads. Dues-paying respondents contribute an average of \$376 per year to their home, neighborhood or road association.

In the past five years, roughly three-fifths of the survey respondents (58.8%) have had a road-related problem that may be associated with a sediment delivery site.⁶⁴ The most common road-related challenges (reported by more than a quarter of respondents) were potholes, rills or gullies on the road surface; washboarding; instability or landslides and problem culverts (Figure 4.1).

The prevalence of sediment-related challenges did not vary significantly by land use. This point is particularly important because it suggests that the risk posed by roads on different landowners may not be significantly different but the previous chapter showed that the governance of roads do differ by land use. The reasons for and consequences of this disparity will be explored in the next two chapters.

History with Regulatory and Non-Regulatory Programs

Regulatory history

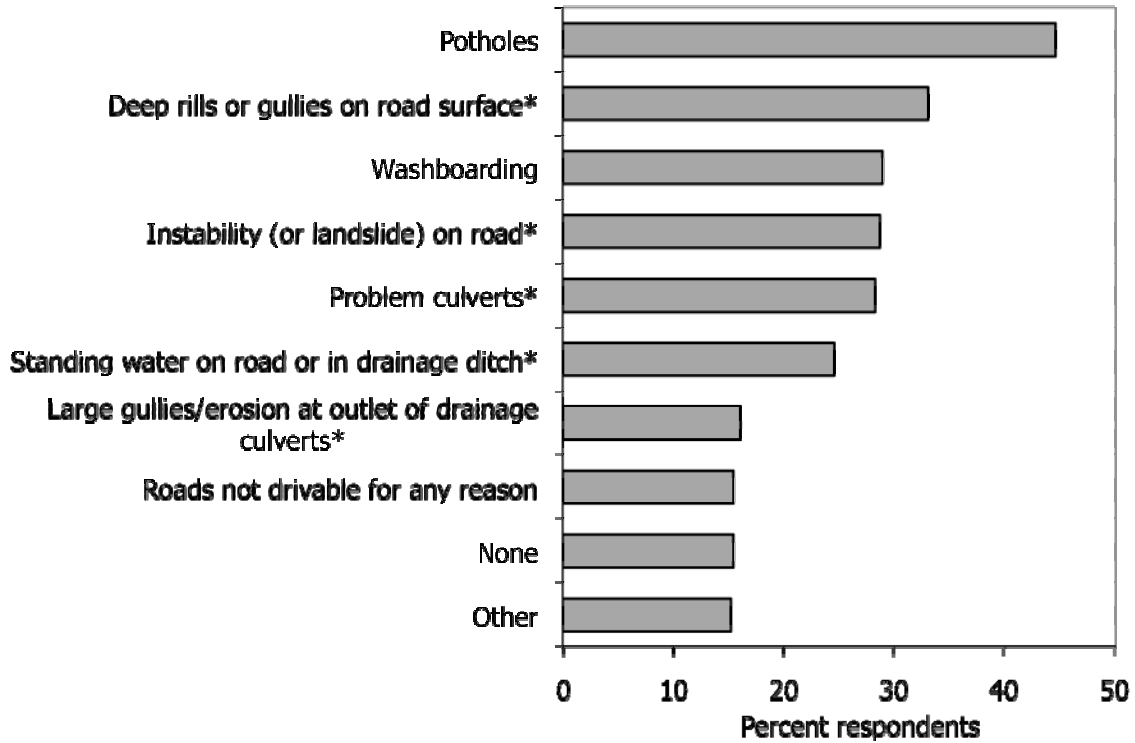
In the past five years, 15.3 percent of survey respondents obtained a permit for activities associated with roads. The majority of respondents with recent permit experience (45 out of 70) obtained a permit for harvesting timber (a timber harvest plan [THP] or a nonindustrial timber management plan [NTMP]). Following timber permits, the most frequently obtained permits were 1600 Streambed Alteration Agreements from CDFG

⁶³ Given the uncertainty surrounding the reported road lengths, it may be more instructive to consider expenses per acre rather than per mile of road.

⁶⁴ The survey asked landowners to indicate which of the following road-related challenges they have encountered on their roads or other privately maintained roads they use to access their land in the past five years: potholes, deep rills or gullies on road surface*, washboarding, instability or landslide on the road*, problem culverts*, standing water on road or in roadside ditch*, large gullies or erosion at the outlet of drainage culverts*, roads not drivable for any reason, and other. Depending on the magnitude, location and timing of the road-problem, each of the five challenges marked with an asterisk may be associated with sediment delivery to streams. The unmarked challenges are less likely to have underlying causes and resulting effects that are not associated with sediment delivery.

(35 permits, accounting for 23 percent of permits obtained) and Approval of an Erosion Control Plan (ECP) from the North Coast Regional Water Quality Control Board (NCRWQCB) (21 permits, accounting for 13.8 percent of permits obtained) (Table 4.2).

Figure 4.1: Reported Challenges with Roads in the Past Five Years (N=459)



Note: * Indicates a road challenge that could cause sediment delivery to stream but does not necessarily indicate a sediment delivery site

Table 4.2: Permits Obtained in the Past Five Years (N=459)

Obtained permit	Percent	
	respondents who obtained permit	Percent of permits obtained
Obtained permit	15.3	100.0
Timber Harvest Plan (CAL FIRE)	9.8	29.6
1600 Agreement (CDFG)	7.6	23.0
Erosion Control Plan (NCRWQCB)	4.6	13.8
Grading Permit (Hum County)	2.4	7.2
Sediment Waiver (NCRWQCB)	1.9	5.9
Incidental Take (USFWS)	1.5	4.6
CWA 401 (NCRWQCB)	1.3	3.9
CWA 404 (COE)	1.3	3.9
Incidental Take (NOAA)	0.9	2.6
Other	1.7	5.3

Technical assistance

Over the past five years, 61 percent of respondents have obtained some form of advice or technical assistance about sediment management and/or road construction, maintenance, and management: 45.1 percent of respondents have obtained technical assistance from a professional source, including staff at government organizations (e.g., natural resource agencies, the University of California Cooperative Extension [UCCE], Resource Conservation District [RCD], and NRCS), staff at non-governmental organizations, professional or industry associations, and private consultants (including registered professional foresters [RPFs]); 16.1 percent have sought technical information from a book or the internet; 34.6 percent have received advice or assistance from a friend, relative or neighbor; and 39.0 percent of survey respondents reported that they have not obtained any assistance or advice related to road management in the past five years (Table 4.3).

Table 4.3: Technical Assistance Obtained in the Past Five Years (N=459)

	Percent respondents
From any professional source:	45.1
From government	32.7
From NGO	9.2
From professional or industry association	5.4
From private consultant	26.8
From book or internet	16.1
From friend, relative or neighbor	34.6
Did not obtain technical assistance from any source	39.0

Financial Assistance

About one tenth of respondents have obtained cost-share or grant funding for sediment prevention work that involved road re-construction and/or decommissioning. The majority of these respondents received their financial assistance through the CDFG Fisheries Restoration Grant Program and/or a grant partnership with a non-profit organization (Table 4.4).

Table 4.4: Financial Assistance Obtained in the Past Five Years (N=459)

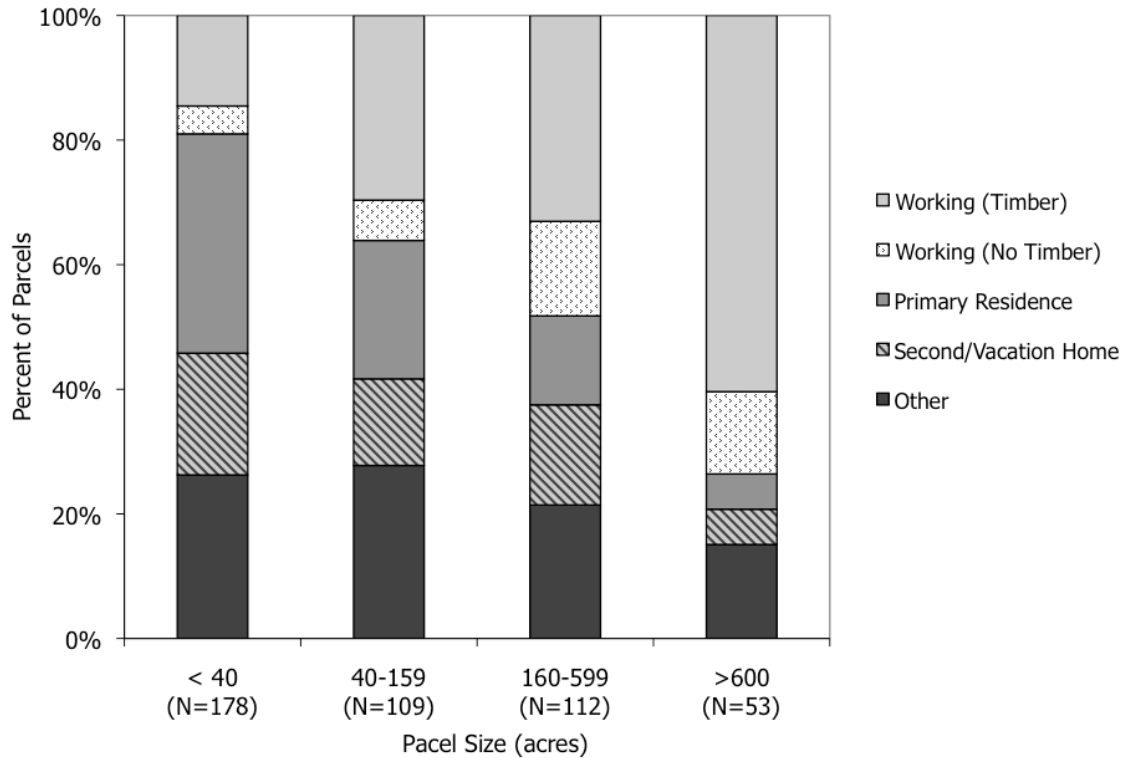
	Percent respondents
CDFG Fisheries Restoration Grant Program	3.5
Grant Partnership with Non-Profit Organization	3.1
Environmental Quality Incentives Program (EQIP)	2.4
California Forest Improvement Program (CFIP)	1.3
RCD Grant Program	1.3
Fish and Wildlife Assistance Program	0.7
Other	1.7

Land Use, Parcel Size and Experience with Regulatory and Non-regulatory Programs

In the sections on BMP adoption and knowledge that follow, I show the unsurprising yet important finding of this chapter, which is that land use, parcel size, regulatory experience, receipt of professional technical assistance, and receipt of financial assistance are each significantly correlated with a variety of measures of BMP knowledge and implementation. As I discuss here, these variables are also significantly related to each other. Chapters 5 and 6 will dissect the relationships between these explanatory variables and examine how they relate to BMP knowledge and adoption.

Land use and parcel size are strongly correlated (P-value < 0.001) with more of the larger parcels used as working landscapes and more of the smaller parcels used for residential purposes (Figure 4.2). The underlying reasons for the relationship between these variables is clear: working land uses (e.g., timber, grazing, agriculture) require larger areas than residential or vacation land uses.

Figure 4.2: Distribution of Land Uses in Parcel Size Categories



Land use and parcel size are each significantly correlated with permitting history and experience with professional technical assistance in the last five years (Table 4.5).⁶⁵ A

⁶⁵ In my analysis, I tested for correlations between the following explanatory variables: land use, parcel size, watershed, county, use of roads shared with neighbors, multi-generational ownership of parcel, receipt of permits, receipt of financial assistance, receipt of professional technical

higher percentage of landowners with the largest parcels (>600 acres) and those reporting using their land for commercial timber production obtained permits and technical assistance from a professional than those with smaller parcels and those not logging commercially (Table 4.5).

Table 4.5: Experience with Regulatory and Non-Regulatory Programs

	Percent Landowners who:		
	Obtained permits	Received professional assistance	Received financial assistance
All respondents (N=459)	15.3	45.1	10.7
Land use (N=459) ^{1a, 2a, 3NA}			
Owners Working (timber)	33.6	60.9	15.6
Owners Working (no timber)	10.0	50.0	10.0
Owners Primary residence	12.0	45.4	11.1
Owners Second/vacation home	5.6	40.1	9.9
Owners Other land uses	5.4	27.7	5.4
Parcel size (N=452) ^{1a, 2a, 3NS}			
Owners 10 – 39 acres	9.5	38.0	8.4
Owners 40 – 159 acres	13.9	45.4	12.0
Owners 160 – 599 acres	13.4	45.5	10.7
Owners > 600 acres	41.5	69.8	15.1

Notes: Significance was determined with chi-squared test. Each row variable contains superscripts indicating significance with the column variables:

P-values for receipt of permits ^{1a} P < 0.001;

P-values for receipt of professional technical assistance: ^{2a} P < 0.001;

P-values for receipt of financial assistance: ^{3NS} not significant

Since either a THP or NTMP is required for all commercial harvests and large parcel size is significantly related to commercial timber production, it is not surprising that the landowners with the largest parcels (> 600 acres) and those who report using their land for commercial timber production obtained proportionally more permits than those with smaller parcels and those not logging commercially.⁶⁶ Additionally, since THPs and

assistance, and use of books or internet for technical assistance. I also tested for correlations between each of those explanatory variables with characteristics of the road network, management practices, implementation of BMPs and familiarity with BMPs. All significant relationships with P-values < 0.05 are reported in this chapter.

⁶⁶ A THP or NTMP is required by every California landowner who logs for commercial purposes, but the permit requirement is only triggered prior to the harvest (Chapter 3). Though illegal logging does occur in the basin, it is incorrect to use the survey data to conclude that the two-thirds of timber producing survey respondents that have not obtained permits are doing so illegally. The survey only asked for respondents to indicate if they have obtained permits in the five years prior to the survey. If the landowner initiated his or her most recent harvest plan more than five years ago, he or she would not have been required to obtain a permit within the past five years. In addition, during follow-up interviews, I learned that several landowners who indicated

NTMPs must be prepared by an RPF, the relationship between timber harvesting and professional assistance is also easily understood.

Though respondents who have obtained financial assistance are significantly more likely to have also obtained professional technical assistance than other landowners, respondents' history with technical assistance was not significantly related to land use or parcel size.

BMP Adoption

Best Practices for Planning, Construction and Reconstruction of Roads

Natural resource agencies, environmental non-profit organizations, and private consultants have identified BMPs for the planning, construction, and reconstruction of private rural roads (Appendix E). The mail survey collected information about respondents' adoption of twelve BMPs required by regulations and/or recommended by non-regulatory guidelines:

- Plant vegetation on cutslopes and/or fillslopes,
- Outslope roads,
- Ensure fish passage at watercourse crossings
- Use erosion control measures,
- Develop a written land management plan that includes a plan for road management,
- Identify areas with high erosion risk,
- Inventory sediment delivery sites on land,
- Limit road construction to stable areas,
- Deposit construction waste away from streams,
- Develop a written land management plan that includes a plan for erosion control, and
- Identify unstable areas on land, and use rolling dips.

The following BMPs have been adopted by more than half of respondents who consider them applicable on their land: deposit construction waste away from streams, limit road construction to stable areas, identify unstable areas on land, ensure fish passage at watercourse crossings, outslope roads, identify areas with high erosion risk and use erosion control measures (Table 4.6).⁶⁷

The development of written land management plans that include plans for either road management or erosion control are the least commonly adopted practices, with only about one-sixth of respondents indicating that they would adopt that practice. The most

that they use their land for commercial timber production have not actually harvested yet and, though they have the intent to harvest, they have not gone through the regulatory process.

⁶⁷ There are many reasons why a BMP may not be applicable on a particular piece of land (e.g., there is no need to ensure fish passage at watercourse crossings if there are no crossings on the land). Survey respondents were able to indicate if the listed BMPs were not applicable for their land (Appendix B Question 22). Thus, this section reports only on the percentages for respondents that did not check 'not applicable' for the BMP of concern.

unknown or unfamiliar BMPs include taking an inventory of sediment delivery sites on land, using rolling dips, developing land management plans, and ensuring fish passage at watercourse crossings (Table 4.6).

Table 4.6: Adoption of Applicable BMPs

	Already do this (%)	Might do this (%)	Would never do this (%)	Don't know (%)
Plant vegetation on cutslopes or fillslopes	43.6	38.0	6.6	11.8
Outslope roads	54.1	25.5	5.3	15.1
Ensure fish passage at watercourse crossings	56.5	20.4	2.0	21.1
Use erosion control measures	52.9	34.2	2.5	10.5
Develop a written land management plan that includes a plan for road management	21.1	33.6	22.0	23.4
Identify areas with high erosion risk	53.7	31.0	5.2	10.1
Inventory sediment delivery sites on your land	26.0	36.1	10.5	27.4
Limit road construction to stable areas	64.3	23.5	2.4	9.8
Deposit construction waste away from streams	76.5	12.6	2.8	8.1
Develop a written land management plan that includes a plan for erosion control	20.3	39.5	18.2	22.0
Identify unstable areas on your land	58.9	27.9	2.4	10.8
Use rolling dips	48.0	17.7	7.0	27.2

Respondents' adoption of some or all of these BMPs differs significantly by their permitting history, receipt of professional technical assistance, and receipt of financial assistance (Table 4.7). For those BMPs where the relationship is significant, respondents who have obtained permits, received professional technical assistance, or received financial assistance are more likely to have already adopted the BMP and less likely to report that they do not know if they have or would adopt the BMP than those who have not obtained permits, technical assistance or financial assistance.

On average, survey respondents have already adopted 50.2 percent of BMPs that they consider applicable on their land.⁶⁸ The adoption rate differed significantly by regulatory history, receipt of financial assistance, receipt of professional technical assistance, land use and size class (Table 4.8). Respondents who obtained professional assistance, permits, or financial assistance report that they have adopted more BMPs than who have not. Additionally, respondents with larger land-holdings or working lands report that they have adopted more BMPs than those smaller parcels or those used for residential and other purposes.

⁶⁸ This value is calculated by taking the ratio of BMPs the respondent reports as 'already does' to the number of applicable BMPs on their land [# already adopted/(#BMPs - #NA)]; BMPs considered in this calculation include twelve management behaviors queried in Question 22 of the mail survey.

Table 4.7: Relationship between Adoption of Applicable BMPs and History with Regulatory and Non-Regulatory Programs

	P-Values Based on Receipt of:		
	Regulatory Permits	Technical Assistance	Financial Assistance
Plant vegetation on cutslopes or fillslopes	< 0.001	< 0.01	< 0.05
Outslope roads	< 0.01	< 0.01	NS
Ensure fish passage at watercourse crossings	< 0.001	< 0.001	NS
Use erosion control measures	< 0.001	< 0.001	< 0.001
Develop a written land management plan that includes a plan for road management	< 0.001	< 0.001	< 0.001
Identify areas with high erosion risk	< 0.01	< 0.01	NS
Inventory sediment delivery sites on your land	< 0.001	< 0.001	< 0.01
Limit road construction to stable areas	< 0.01	< 0.001	< 0.05
Deposit construction waste away from streams	< 0.05	< 0.05	NS
Develop a written land management plan that includes a plan for erosion control	< 0.001	< 0.001	< 0.001
Identify unstable areas on your land	< 0.05	< 0.05	NS
Use rolling dips	< 0.001	NS	< 0.001

Notes: Significance was determined with a two-sample *t*-test. Superscripts indicate that there is a significant relationship between the BMP (row variable) and permitting history, receipt of professional technical assistance, and/or receipt of financial assistance; NS = not significant

Table 4.8: Percent of Applicable BMPs ‘Already Adopted’ (N=389)

		BMPs adopted (%)
All Respondents		50.2
Regulatory experience ^a	Obtained permits	71.9
	No permits	46.6
Professional technical assistance ^a	Obtained professional technical assistance	57.9
	No professional technical assistance	41.2
Financial assistance ^a	Obtained financial assistance	67.2
	No financial assistance	47.8
Land use ^a	Working (timber)	62.1
	Working (no timber)	58.3
	Primary residence	48.3
	Second/vacation home	39.5
	Other land uses	40.5
Size class ^a	< 40 acres	46.0
	40-159 acres	45.5
	160-599 acres	51.6
	> 600 acres	69.2

Notes: A two-sample *t*-test was used to determine the significance of regulatory experience, technical assistance from a professional, and financial assistance with the column variable. A one-way analysis of variance (ANOVA) was used to determine the significance of land use and parcel size class with the column variable. Each row variable contains a superscript indicating significance with the percent of applicable BMPs already adopted. P-values: ^aP < 0.001

Best Practices for Use of Road Network

Due to the sediment transport power of the North Coastal Basin's heavy winter rains, roads are particularly vulnerable to sedimentation during the winter season. The risk of sediment delivery can be reduced by not traveling on roads during the winter season or by using a rocked or other protected surface on all-season roads. Under the Forest Practice Rules (FPR) and Garcia Action Plan, road surfacing and construction is required to match the proposed use of the road. More specifically, roads that will be used all year should have a rocked or other protected surface.

Approximately 62.8 percent of respondents use most of their roads during both the wet and dry seasons (Table 4.9).⁶⁹ On average, about 26.1 percent of the roads used during the wet season are not surfaced according to best practices and have an exposed dirt or native surface (Table 4.10). Respondents using their land for non-commercial and non-residential uses (i.e. other), timber production and as a second or vacation home have a higher percentage of all-year roads without the proper surfacing than those using their land for residential or non-timber commercial purposes. Additionally, larger parcels tend to have a higher percentage of all-year roads without proper surfacing than smaller parcels (Table 4.11).

Table 4.9: Percentage of Roads Used All Year (N=417)

	# respondents	% respondents
All	200	48.0
80-99%	31	7.4
60-79%	31	7.4
40-59%	32	7.7
20-39%	34	8.2
< 20%	45	10.8
None	44	10.6

Table 4.10: Percentage of All Year Roads with Native Surface (N = 378)

	# respondents	% respondents
All	50	13.2
> 75-99%	25	6.6
> 50-75%	13	3.4
> 25-50%	31	8.2
> 0-25%	41	10.8
None	218	57.7

⁶⁹ *Most* is defined as over 60 percent of roads on the parcel or used to access the parcel.

Table 4.11: Percentage of All-Year Roads with Native Surface by Land Use and Size Class (N=417)

		Percent all-year roads with a native surface
All Respondents		26.1
Land use ^a	Working (timber)	33.6
	Working (no timber)	23.0
	Primary residence	11.7
	Second/vacation home	24.8
	Other land uses	37.8
Size class ^a	< 40 acres	16.8
	40-159 acres	23.9
	160-599 acres	31.2
	> 600 acres	43.1

Notes: Significance was determined with a one-way analysis of variance (ANOVA). Each row variable contains a superscript indicating significance with the percent of applicable BMPs already adopted.

^a P < 0.001

Best Practices for Inspection and Maintenance of Road Network

Inspection and maintenance of watercourse crossings, road drainage systems, and erosion control structures is one of the least expensive and effective ways to reduce the risk of sediment pollution. The FPR and Garcia Action Plan mandate inspection and maintenance practices, and resource agencies and private consultants recommend that landowners inspect their road systems (including the road surface, cut and fill slopes, and drainage structures such as culverts, bridges, water bars, and ditches) at least once annually (before the rainy season) and preferably again during or after all large storms (Kocher et al. 2007, Weaver and Hagans 1994). Additionally, landowners are advised to clear ditch relief culverts, culverts at stream crossings, and trash racks during these inspections and when they are blocked.

Approximately 62 percent of survey respondents report that they inspect the condition of their roads at least once a year and 45.8 percent indicate they inspect their roads at the preferred frequency of at least twice a year and during or after large storms. Similar to other BMPs, this behavior differed significantly by interaction with professional technical assistance, history with regulations, financial assistance and land use (Table 4.12). Survey respondents who have received technical assistance from a professional, obtained permits, or obtained financial assistance in the past five years are more likely to inspect their road conditions at the preferred frequency than those who have not. Respondents using their land as a working landscape are also more likely to inspect their roads at the preferred frequency than other respondents.

Table 4.12: Frequency of Road Inspection (N=393)

		Inspect roads at preferred frequency*	Inspect roads at acceptable frequency**
Percent respondents		45.8	61.8
Technical assistance from a professional ^{1a,2a}	Obtained assistance from a professional	56.8	71.9
	Did not obtain professional assistance	34.5	51.5
Regulatory experience ^{1b,2c}	Obtained permits	62.1	74.2
	No permits	42.5	59.3
Financial assistance ^{1c,2NS}	Obtained financial assistance	61.2	73.5
	No financial assistance	43.6	60.2
Land use ^{1c,2NS}	Working (timber)	55.7	71.3
	Working (no timber)	53.1	56.3
	Home	45.5	57.6
	Second or vacation home	40.0	64.6
	Other	34.1	53.6

Notes:

* The preferred frequency is at least twice a year & during or after large storms;

** An acceptable frequency is at least once per year

Significance between the row and column variables was determined with a chi-squared test. Superscripts indicate that there is a significant relationship between the row and column variables.

P-values for inspecting at the recommended frequency: ^{1a} P < 0.001, ^{1b} P < 0.01, ^{1c} P < 0.05;

P-values for inspecting at an acceptable frequency: ^{2a} P < 0.001, ^{2b} P < 0.01, ^{2c} P < 0.05, ^{2NS} not significant.

BMP Knowledge

On average, survey respondents indicated that they were familiar with 85 percent of applicable BMPs.⁷⁰ The level of familiarity varied significantly when landowners were classified by their experience with professional technical assistance, land use, and their

⁷⁰ Question 22 on the mail survey contains a list of best management practices and other behaviors associated with sediment control and road construction (Appendix B). For each BMP and other behavior, respondents were asked to indicate if they already engaged in that practice, might engage in that practice, would never engage in that practice, did not know, or if the BMP was not applicable for them. To create a rough measure of respondents' familiarity with BMPs, I created the *BMP familiarity* metric, which is the ratio of the number of BMPs the landowner knows to the number of BMPs applicable for their land. $BMP\ familiarity = 1 - \frac{[\#DK/(\#BMPs - \#NA)]}{\#BMPs}$. Question 22 also collects data about some management practices that may be good practices but are not specifically recommended BMPs (e.g., participation in a road restoration program, consultation of a profession). The metric is based on the subset of twelve BMPs queried in the question: (1) plant vegetation on cutslopes or fillslopes, (2) outslope roads, (3) ensure fish passage when constructing or maintaining watercourse crossings, (4) use erosion control measures, (5) develop a written land management plan that includes a plan for road management, (6) identify areas on your land with high erosion risk, (7) inventory sediment delivery sites on your land, (8) limit road construction to stable areas, (9) deposit construction waste away from streams, (10) develop a written land management plan that includes a plan for erosion control, (11) identify unstable areas on your land, and (12) use rolling dips.

regulatory experience. Landowners who obtained professional technical assistance and those who obtained permits had a higher rate of familiarity than those who have not, and landowners with a working landscape were familiar with a higher percentage of applicable BMPs than those using their land for residential, vacation or other land uses (Table 4.13).⁷¹

Table 4.13: Mean Percent of Applicable BMPs with which Respondents are Familiar (N=389)

		Percent of BMPs with which respondent is familiar
All Respondents		85.1
Land use ^b	Working (timber)	89.8
	Working (no timber)	93.4
	Primary residence	85.2
	Second/vacation home	82.2
	Other land uses	77.3
Regulatory experience ^c	Obtained permits in past 5 years	91.1
	No permits in past 5 years	83.8
Professional technical assistance ^a	Obtained professional technical assistance in past 5 years	89.2
	No professional technical assistance in past five years	80.6

Notes: A two-sample *t*-test was used to determine the significance of regulatory experience and technical assistance from a professional with the column variable. A one-way analysis of variance (ANOVA) was used to determine the significance of land use and the column variable. Each row variable contains a superscript indicating significance with the percent of applicable BMPs already adopted: ^a P < 0.001; ^b P < 0.01; ^c P < 0.05

To further assess landowners' familiarity with BMPs, I asked all interview respondents "What makes a good rural road?" In their description of good roads and follow-up questions, interview respondents identified and described a variety of BMPs associated with the planning, construction, reconstruction, inspection, maintenance and use of roads (Table 4.14).

⁷¹ The *BMP familiarity* metric does not provide a perfect measure of knowledge about BMPs. Respondents may have indicated "DK" for reasons other than a lack of knowledge with the management practice and respondents may also have indicated that BMPs were not applicable when they actually did not know if it was applicable. However, the metric does provide a useful rough picture of familiarity with BMPs that is developed further through the analysis of interview data.

Table 4.14: BMPs Described by Interview Respondents (N=56)

	Number respondents mentioning BMP	Percent respondents mentioning BMP
Appropriate seasonal use	7	12.5
Appropriate maintenance	9	16.1
Avoid unstable areas	1	1.8
Critical dips	3	5.4
Proper placement, sizing and/or maintenance of culverts	15	26.8
Good base and surface	15	26.8
Minimize grade	8	14.3
Outslope	16	28.6
Rolling dips	11	19.6
Vegetate cut and fillslopes	3	5.4

Their responses to this question and follow-up questions were coded and divided into three groups: (1) respondents who linked roads to sediment control and described specific BMPs recommended by professionals, (2) respondents who linked roads to sediment control but did not indicate familiarity with specific BMPs, and (3) respondents who did not link roads to sediment control (Table 4.15).

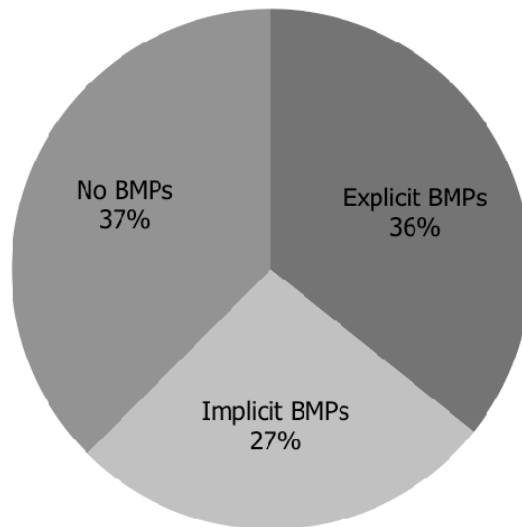
Twenty interview respondents (35.7%) described a good road in terms of BMPs recommended by professionals, demonstrating familiarity with BMPs and using language commonly used by professionals to describe a good road; 15 interview respondents (26.8%) described the importance of sediment control in their description of a good road but did not mention specific BMPs recommended by professionals; and 21 interview respondents did not link roads with sediment control and described only other concerns such as safety, comfort and cost (Figure 4.3).

Table 4.15: Coding of Responses to “What Makes a Good Rural Road?”

Coding	Content and key phrases of responses
<p>Explicit BMPs: Described specific BMPs in the language of professionals (N=20)</p>	<p>Description: Respondent demonstrated understanding of the relationship between roads and sediment pollution and mentioned more than one specific BMP recommended by professionals.⁷²</p> <p>BMPs mentioned by respondents: outslope roads, use rolling dips, use critical dips, use appropriately sized and spaced culverts, perform frequent inspections and maintenance to remove blockages from culverts and ditches, appropriate seasonal use</p> <p>Representative response: “It should be on stable ground, rocked if it doesn’t have a hard surface, out- sloped with rolling dips depending on the use: if it will be traveled more, it should have culverts and an inside ditch; if it’s a ranch road, rolling dips are really effective ... [The rolling dips] are good because you don’t have to worry about culverts but you do need culverts in some places and with crossings. My rule of thumb is to get a culvert a little bigger than what they recommend and then to put in trash guards to keep them from blowing out. We try to keep them up and we know where the problems are and check them in storms. The big thing is getting water off the road.” (Interview with Landowner #11846, 9/25/2008)</p>
<p>Implicit BMPs: Described concept of sediment control (N=15)</p>	<p>Description: Respondent demonstrated understanding of the relationship between roads and sediment pollution but did not mention specific BMPs.</p> <p>Concepts mentioned by respondents: good drainage, divert water, avoid erosion and sedimentation.</p> <p>Representative response: “A road with good drainage, you don’t want water to sit on the road and it seems like you have to have a good rock base... You want even drainage so it doesn’t drain to one spot where it causes a problem.” (Interview with Landowner # 11411, 8/31/2008)</p>
<p>No BMPs: Described only factors unrelated to sediment control (N=21)</p>	<p>Description: Respondent did not link road to sediment pollution. Responses in this category varied widely but all centered on issues unrelated to sediment control.</p> <p>Concerns mentioned by respondents: safety, comfort, access, and low maintenance requirements and expenses.</p> <p>Representative responses: “County maintained so you don’t have to pay for it, or forest service maintained” (Interview with Landowner # 10722, 8/27/2008) “A good road is one that has a few bumps and curves to keep people from driving too fast. You also want a fire engine to be able to come in and turn around” (Interview with Landowner # 20360, 8/9/2008)</p>

⁷² Though all respondents in this category mentioned specific BMPs recommended by professionals, they did not always use all of the recommended BMPs. Several respondents expressed the opinion that these are not one-size fits all solutions and provided responses that discussed when specific BMPs were appropriate and when agency-recommended solutions were not useful for them.

Figure 4.3: Distribution of Responses to “What Makes a Good Road?” (N=56)



Examining the distribution of responses by use of professional technical assistance, receipt of financial assistance, permitting history, and land use reveals patterns of BMP knowledge that are generally consistent with the survey results. Similar to the results of the measure of familiarity with BMPs from the survey (Table 4.13), more respondents who have obtained a permit, received financial assistance, or received professional technical assistance either described specific BMPs in the language of professionals or described good roads in relation to sediment control than those who have not received permits, professional technical assistance or financial assistance (Figure 4.4 and Figure 4.5).

These results preview the important role that professional technical assistance plays in transferring knowledge about BMPs. Professional specialists are effective vectors for transmitting knowledge about BMPs to landowners. The use of professionals is strongly associated with regulatory permits and grant funding and the influence of this relationship on BMP knowledge can be inferred by comparing Figure 4.4 and Figure 4.5. As I will explain in Chapter 5, there are clear pathways through which regulatory requirements can lead to the use of professional technical assistance and grant funding.

The relationship between land use and BMP knowledge revealed here (Figure 4.6) is reasonably consistent with the survey measure of BMP familiarity though some of the fine-scale distinctions are not aligned. Both the survey and interview results reveal that landowners with working lands have more familiarity than those using their land for residential or vacation purposes. The metrics disagree with respect to the distinctions within the class of working landowners. Considering only working lands, the survey metric suggests that landowners without timber are slightly more familiar with BMPs than those with timber, which is the opposite of the results suggested by the interview. The examination of the relationship of timber regulations and BMP knowledge in Chapter 5 provides a model to understand the links between timber, regulations, and BMP knowledge.

Figure 4.4: Permitting History, Financial Assistance and Response to ‘What Makes a Good Road?’



Figure 4.5: Professional Assistance and Response to ‘What Makes a Good Road?’

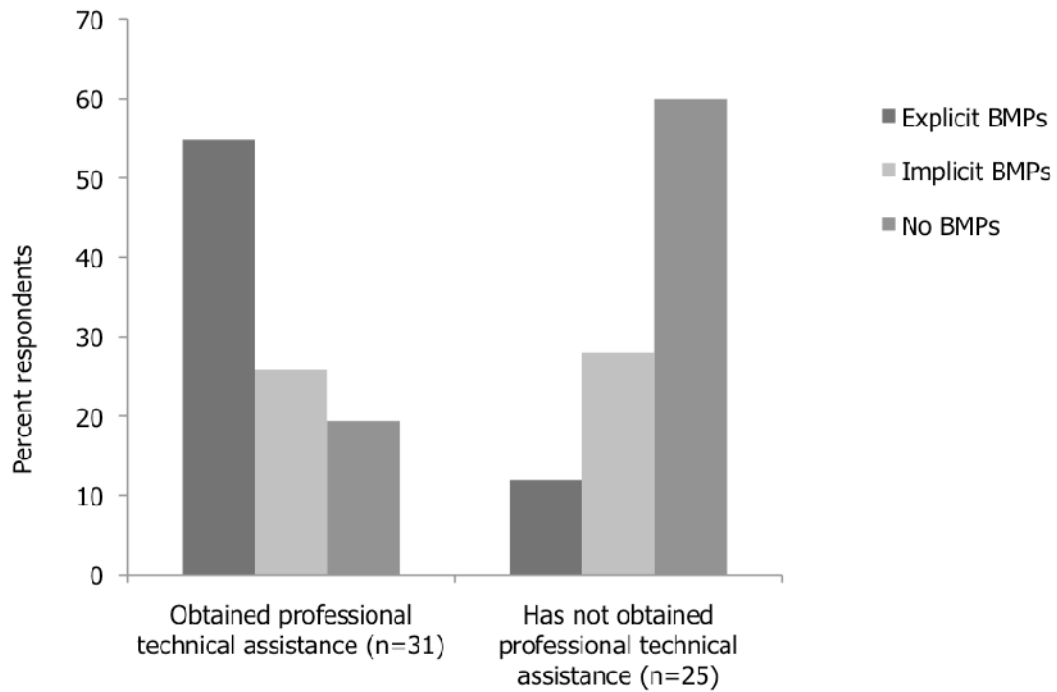
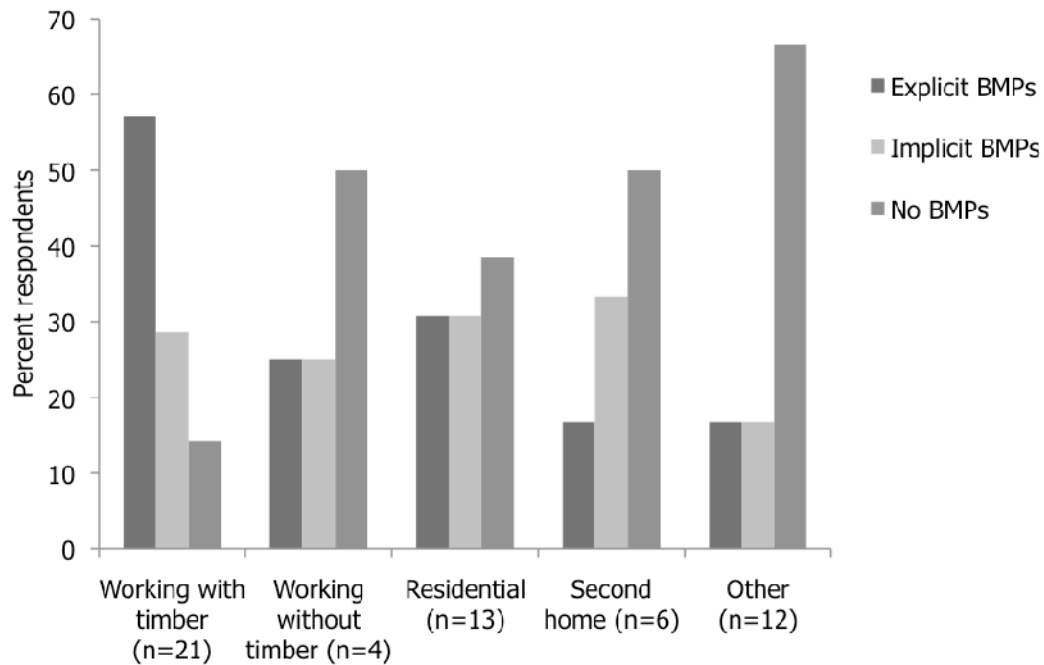


Figure 4.6: Land Use and Response to ‘What Makes a Good Road?’



Conclusion

This chapter describes road networks in the North Coastal Basin, and suggests how landowners’ permitting history, experience with technical and financial assistance, and land use are associated with knowledge about and adoption of BMPs for sediment control from private roads. The high reported road density and the occurrence of road management challenges that may be associated with sediment delivery indicate that road issues continue to be a concern in the North Coastal Basin. Additionally, the prevalence of high road densities and sediment-risks across all land uses demonstrates that sediment control from roads is not limited to a particular land use – the risks of road-related sediment pollution are common to all land uses. This is a particularly important point to consider in light of the analysis in Chapter 3, which showed that the regulation of roads differs by land use.

Though this chapter showed that there is widespread familiarity with sediment pollution as an issue, there is also a wide range of knowledge about and use of BMPs. This chapter firmly establishes the relationship between knowledge and adoption of BMPs for road management and land use, permitting history, experience with professional technical assistance, and experience with financial assistance within the survey and interview population. The relationships are robust in that they vary in similar ways across multiple measures of BMP adoption and knowledge. The explanatory variables (land use, permitting history, experience with professional technical assistance, and experience with financial assistance) are correlated with each other and, in the next two chapters, I tease out the relationships between these variables and BMP knowledge and adoption.

Chapter 5

Regulatory and Non-Regulatory Mechanisms of Influence

Together, Chapters 3 and 4 establish that the governance of road-related sediment differs by land use despite the comparable risk of sedimentation associated with roads on all land uses. Chapter 4 also established the relationship between the governance of sediment (receipt of permits and utilization of financial and professional technical assistance), land use, and the knowledge about and use of best management practices (BMPs) for road management and noted that the explanatory variables (permitting history, experience with professional technical assistance, experience with financial assistance, and land use) are correlated with each other. These relationships prompt the motivating questions for this chapter: What are the mechanisms through which experiences with regulatory and non-regulatory programs lead to the development of knowledge about BMPs and the adoption of BMPs? And, how do these differ by land use?

I begin this chapter by laying out a conceptual framework for understanding the factors that affect landowners' road management decisions. Using this framework, I proceed to examine the specific conditions and mechanisms through which regulatory and non-regulatory programs influence road management decisions. It is important to understand that these mechanisms function only when land management practices are visible and when staff at resource agencies and non-profits or the public can access the land and landowners. I provide this proviso here as a cautionary preview of Chapter 6, where I discuss areas that frequently are inaccessible by or merely out of sight of governing actors.

Decision-Makers and Other Key Actors Affecting BMP Implementation

In order to understand the factors that promote or impede the adoption of BMPs, it is fundamental to understand who makes decisions about the management and maintenance of the road network, as well as who implements those decisions. In the North Coastal Basin, there is significant diversity in who makes and implements these decisions.

The most common decision-makers include the landowner him- or herself; family, friends or neighbors of the landowner; paid professionals such as registered professional foresters (RPF) or private consultants; and/or representatives of road or homeowners' associations.⁷³ Routine road maintenance, construction, and the implementation of road-related management decisions are usually carried out by some combination of the decision-maker(s), a contracted equipment operator, and professionals.

⁷³ Within road or homeowners' associations, decision-making responsibility can lie with a single individual or with a committee that jointly makes decisions. These decision-makers may be elected, hired, or appointed per the rules of the association. In the absence of interest by other landowners, the association decision-maker may be self-appointed.

Not all landowners take an active role in the management of the roads on, or used to access, their parcel. This often occurs when the landowner does not live on or visit their land, or in cases where the landowner lacks the knowledge, resources, or interest in management of the road network. In some cases, another party (e.g., neighbors) may take responsibility for the road management. In others, there may be no active management.

Though it is important to understand the range of decision-making and implementation arrangements, these are not good predictors of the utilization of BMPs as there is a lot of diversity in the expertise and motivations of decision-makers and project implementers. Through my research, I encountered primary decision-makers and project implementers like Don who combine long-term experience in equipment operation, detailed knowledge of their lands, and specialized training in BMP implementation. I also met with primary decision-makers and project implementers who have taken up road management as a hobby and who may not have the specialized training to successfully implement more technical BMPs. Similarly, private contractors who are hired to implement road management plans have different levels of training and expertise with respect to roads and sediment management. The differences in training and experience affect the decisions to adopt BMPs as well as the quality of implementation (which can also affect the long-term satisfaction with particular BMPs and the use of them on other parts of a landowners' property).

Conceptual Framework: Factors Influencing Road Management Decisions

Research on the prevention of nonpoint source (NPS) pollution and farmers' adoption of BMPs for conservation has failed to establish universal relationships between demographics or parcel characteristics and the adoption of BMPs (Knowler and Bradshaw 2007). However, the factors that are most commonly found to affect land management decisions and BMP adoption can be usefully categorized into three groups: (1) desires or needs that motivate BMP adoption (e.g., Erickson et al. 2002, Rosenberg and Margerum 2008, Ryan et al. 2003), (2) knowledge about the effects of land management practices and BMPs (e.g., Dutcher et al. 2004), and (3) access to resources to implement BMPs (e.g., Rosenberg and Margerum 2008). I found that each of these factors comes into play in the North Coastal Basin:

- (1) **Motivating necessity and/or desire:** The implementation of BMPs can be motivated by a problem with an existing road that requires the landowner to take action to address the problem, the desire to preserve the function of the road and/or a commitment to environmental protection and restoration. A small number of interviewed landowners described how landslides, failed culverts or other problems with their roads led them to implement BMPs.

One landowner described a common situation where his commitment and concern for preserving the functionality of the road leads him to use BMPs for the maintenance of his road, while his neighbors, who don't care, don't participate:

I get out there and check [the culverts]. My son, neighbor and myself are always out there first. Some people won't do anything, but when you're

out there pulling debris out in chest deep water to save the road, you care. But I don't know if you can motivate people who don't care. Some people just think it is someone else's responsibility. (Interview with Landowner #10118, 10/15/2008)

Henry, who was profiled at the beginning of Chapter 4, explained that the use of BMPs in the major reconstruction and decommissioning of his roads is associated with his desire to manage and restore his land more sustainably:

The idea is to decrease the amount of sediment in the stream system by increasing the quality of the timber roads. My goal is to restore the land. (Interview with Henry, Landowner #21061, 9/10/2008)

- (2) **Knowledge:** Implementation of BMPs depends on knowledge about the effects of land management practices and familiarity with the recommended BMPs. Proper implementation of more technical BMPs (e.g., installation of critical dips) depends on specialized knowledge and experience. The lack of knowledge about BMPs, how to obtain information about BMPs, and/or how to find a skilled contractor to properly install BMPs are common barriers to implementation. As one landowner put it:

One of our challenges is that we have and want to have a conservation plan but we are operating with inexperience. We want to be good stewards but we may not know the best practices. (Interview with Landowner #20385, 9/15/2008)

And, another landowner explained:

One problem is knowing who to call to fix the road and how to find a good contractor. I want to know who is experienced and environmentally good... [but] we don't have a way to get that information. (Interview with Landowner # 21740, 9/13/2008)

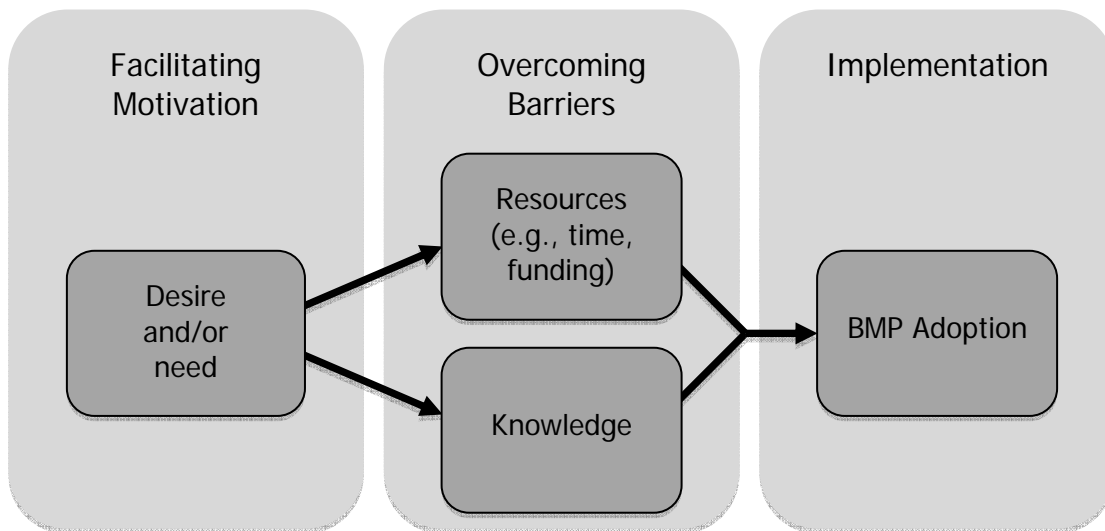
- (3) **Resource availability:** The use of BMPs for road maintenance, construction, re-construction, or decommissioning requires an investment of resources (e.g., capital, time, materials, equipment). While some of the BMPs for road inspection and maintenance are inexpensive or free to implement, BMPs for re-construction, upgrades and restoration are very costly (Appendix G contains cost estimates for upgrading existing roads). The cost and other resource requirements affect many road management decisions in the North Coastal Basin. Nearly half of the interviewed landowners discussed the availability of resources as a factor that affects their road management decisions.

In their discussion of landowner's motivations for participating in watershed restoration programs, Rosenberg and Margerum (2008) distinguish between values and beliefs that *facilitate* or motivate participation in restoration programs (e.g., desire to preserve property for future generations) and factors that are *barriers* to participation (e.g., finances, time, knowledge). Similarly, I find it useful to categorize these basic factors as

those that facilitate adoption of BMPs and those that are barriers. The motivation provided by desire and/or necessity *facilitates* BMP adoption. The other two categories, resource availability and knowledge, are *barriers* that need to be overcome in order to implement BMPs. This categorization suggests a standard model for how these factors affect BMP adoption: the desire or need to reduce sediment or re-construct roads can facilitate BMPs adoption by motivating them to overcome the common barriers by seeking advice and/or obtaining extra resources (Figure 5.1).

In the remainder of the chapter, I explore the mechanisms that affect landowners' desire or need to adopt BMPs and enable landowners to overcome the resources and knowledge barriers.

Figure 5.1: Conceptual Framework to Understand Factors that Affect BMP Adoption



Regulatory Mechanisms

Creating Regulatory Necessity through Monitoring and Enforcement

Regulations can create the 'necessity' for the use of particular BMPs prescribed by the regulation. I find that a particular regulation only creates this need when the level of monitoring and enforcement is high enough to create the perception that regulatory compliance is mandatory. In this way, my research supports the well-documented finding that regulatory compliance is associated with monitoring and enforcement of the regulation and sanctions for non-compliance.⁷⁴ I also find that these effective regulations can lead to the adoption of prescribed BMPs beyond the regulated area and that third

⁷⁴ An extensive and varied literature on monitoring (or inspection), enforcement, sanctions, and compliance addresses this topic from many angles (See, for example, Burby and Paterson 1993, Magat and Viscusi 1990, Tallberg 2002).

party professional consultants facilitate this process. In the sections that follow, I demonstrate the mechanisms through which effective regulations and interaction with third party consultants can stimulate a ‘need’ as well as a ‘desire’ to implement BMPs and can facilitate access to the knowledge and resources that enable landowners to implement BMPs beyond the regulated areas of their property.

Lacking Necessity: Weak Regulations and Enforcement

As discussed in detail in Chapter 3, several regulations at the federal, state and local level prescribe the use of particular BMPs for the construction, re-construction, use and maintenance of roads in the North Coastal Basin. These regulations differ by the number and types of BMPs required, the capacity to monitor and enforce compliance with the regulation, and the land use category to which they apply.

Regulations that are monitored and enforced create the ‘necessity’ or perceived necessity for implementing BMPs on the regulated areas of the land. In general, there is no single structure required for monitoring and enforcement. Effective monitoring and enforcement of rules and regulations can take the form of formal programs led by agency staff, informal citizen monitoring and enforcement, or some hybrid of the two (Ostrom et al. 1999). With the exception of the Forest Practice Act (FPA) and Forest Practice Rules (FPR) that apply to timber harvest sites, there is little formal or informal monitoring and enforcement of sediment-control regulations in the North Coastal Basin.

Resource agencies lack the staff, resources, and access to property necessary to monitor and enforce regulations (other than the FPR). Landowners in the North Coast “do not really see regulators unless we invite them” (Interview with Landowner #11928, 10/14/2008) and formal agency enforcement is complaint driven (rather than proactive as a response to inspection and monitoring by agency staff). Enforcement of most regulations thus lies primarily in the hands of citizens or non-profit watchdog groups, but citizen monitoring and enforcement is also relatively weak for lands not in timber production.

Due to the steep and challenging terrain and low population density, much of the North Coastal Basin is very remote and difficult for regulators or citizens to access. In a comment that describes the situation of many rural landowners, one interview respondent explained that he did not worry about regulatory enforcement from staff or citizens because:

We’re fifteen miles down a rural road and there’s a locked gate. Not too many people from Humboldt State or environmental groups actually see what’s going on out here. (Interview with Landowner #11564, 11/7/2008)

The basic logistical challenge of monitoring and enforcement in this remote region is exacerbated by landowners’ reluctance to interfere in each other’s management practices, a common unwillingness to report regulatory violations (unless the problem is directly affecting the reporting landowner), and their general protection of a culture of privacy and independence. Interview respondents expressed strong reluctance to report regulatory violations on neighboring property and some explained that even if they see a

solvable problem on someone else's property they generally do not offer unsolicited advice.⁷⁵ Their reluctance to interfere in other's business is associated with regional beliefs about the primacy of private property rights (in particular, the right to use your property without interference from others), as well as paranoia and desire for secrecy associated with the cultivation of marijuana in the region (both of which will be discussed in more detail in Chapter 6).

This stated reluctance to report violations is supported by the experiences of the Humboldt County Code Enforcement Unit (CEU). The CEU has relied primarily on public complaints to identify possible violations of county codes, but in late 2007 and early 2008, the CEU proactively targeted and monitored several rural areas in search of code violations. Jeff Conner, Humboldt County's full time staff person in the CEU, reports that during this time of active monitoring, he was focused on violations of the grading ordinance and building codes. During this time, he identified many unpermitted roads. He told me that some of these unpermitted roads were essentially built to code but further explained that:

Some of the stuff I saw was worse than anything I had ever seen [in my nine years] working in the woods – no attempt at any kind of erosion control, just putting in roads and access paths that must be for a four-wheeler because you couldn't ride a vehicle down in them, in some of the worst places. (Interview with Jeff Conner, Humboldt County CEU, 3/18/2010)

Outside of this period of proactive rural enforcement, the enforcement process is complaint-driven. Conner explained that he rarely addresses violations of the grading ordinance because they are hardly ever reported.

⁷⁵ This reluctance to interfere with or bring third parties into the management practices of neighbors is consistent with the patterns of conflict resolution in slow growing rural areas predicted by Rudel's (1989) framework for understanding social controls on local land use. He argues that there is a successive relationship between places and patterns of control: slow growing rural areas rely on informal agreements between neighboring landowners because the stability of ownership and low-density lead to the view that regulation is not necessary; as density increases, the changes associated with increased density – neighbors get closer, the population tends to be less stable, and land use disputes become more common – necessitate more formal mechanisms to mediating the conflicts. Framed another way, Rudel's framework suggests that actors will only pursue outside enforcement or third party mediation when the benefits of pursuing such a formal path outweigh the social costs (which include strained relationships with neighbors). In the North Coastal Basin, rural landowners generally avoid calling in a third party to enforce regulatory controls, and instead rely either on negotiated agreements with neighbors or, more commonly, simply ignoring the problem. In the few stories I heard where landowners report a violation on a neighboring property, there was always an existing conflict between the neighbors that motivated the extra scrutiny and the landowner that called in the violation is seen as acting outside of the norms for the region. As one landowner put it: "There is no enforcement of regulations. If somebody gets a bug in their butt and rats out their neighbor about something that's going on, then they come down on you and they stop what you're doing" (Interview with Landowner #10923, 8/15/2008). For the most part, in this region, the social costs of pursuing enforcement generally outweigh potential benefits.

Further compounding the lack of monitoring and enforcement actions is a lack of knowledge or misconceptions about permit requirements. Due to the weak nature of the regulations, landowners often erroneously assume that the regulations do not apply to them. In a conversation with one Humboldt County rancher, he mentioned that he had built roads through his property. I asked if he had obtained a Grading Permit as required by the Humboldt County Grading Ordinance, he replied:

The grading permits don't apply to rural landowners. No one gets a grading permit for ranch roads. I looked through the last ten years of grading permits and they are all for urban areas. (Interview with Landowner #10584, 7/22/2008)

The mistaken assumptions that regulatory requirements do not apply or that they are irrelevant are common among non-timberland owners in the region.

The limited formal monitoring and enforcement of regulations, the paucity of citizen complaints, the difficulty in viewing management activities in the more remote parts of the region, and the erroneous assumption that regulatory requirements do not apply to certain common practices all create the perception that most sediment control regulations are weak or irrelevant off of timberlands (Figure 5.2). Thus, for the majority of land uses in the region, existing regulations do not generate a 'need' to implement BMPs for most landowners. However, as I will discuss below, regulations on timber lands are strongly monitored and enforced and do create the need for the implementation of prescribed BMPs and can also lead to BMP adoption beyond the regulated areas. I will also discuss how the threat of strong future regulations has also created a perceived need, or desire, for some ranchers to implement BMPs before the regulations are in place.

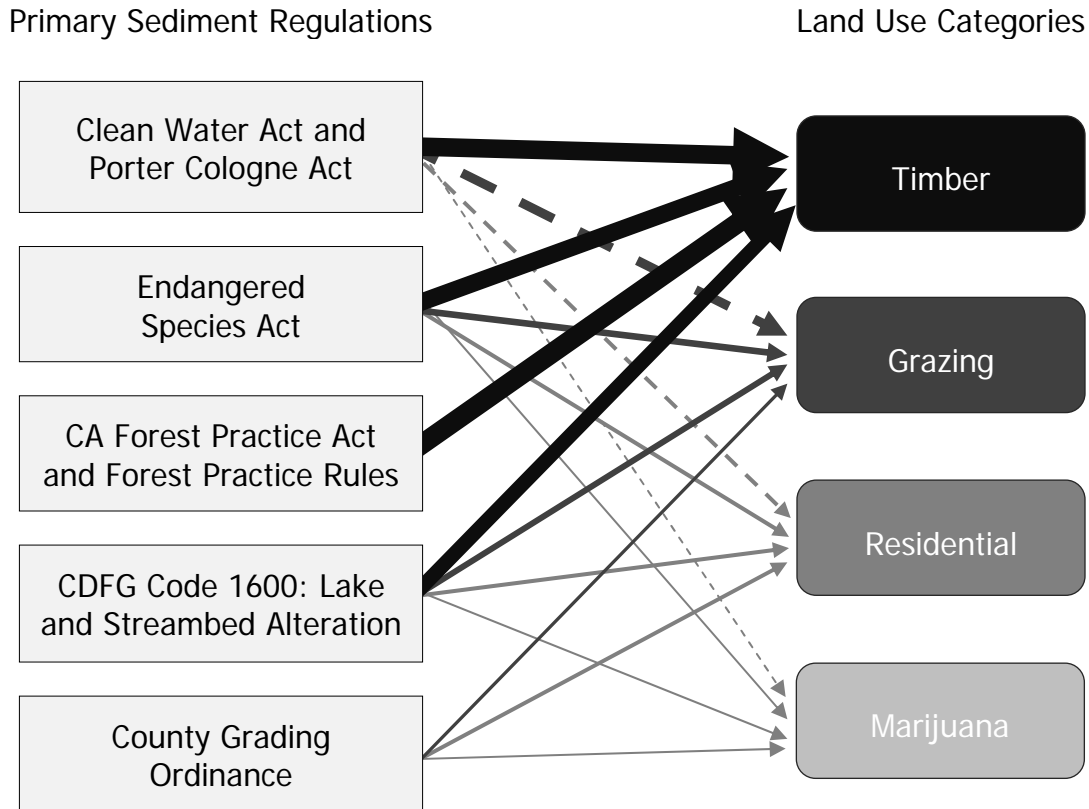
Generating Necessity: Strong Regulations and Enforcement on Timberlands

Unlike lands used for residential or grazing purposes, lands with planned timber harvests are subject to scrutiny by agency regulators and, in many cases, by private citizens as well. This monitoring and enforcement motivates a need to implement BMPs prescribed by the FPR and the process creates a direct pathway from the regulation to implementation of BMPs on the regulated parts of the landscape.⁷⁶

As described in Chapter 3, landowners planning to harvest timber must submit a timber harvest plan (THP). The THP (or its equivalent), which must be prepared by an RPF, contains details about the harvest and plans for mitigating environmental effects that could be associated with the harvest. This includes information about the road network and the use of the BMPs prescribed by the FPR. The THP undergoes a multi-step review process by regulators from several agencies. The review process includes a pre-harvest inspection on the harvest site with the landowner (or plan submitter), the RPF, and the staff from several resource agencies. Additionally, CAL FIRE is required to conduct an on-site post-harvest inspection within six months of the completion of the harvest and any of the involved agencies may also conduct their own post-harvest inspection.

⁷⁶ The THP or NTMP may not include all of the landowners' property.

Figure 5.2: Application and Perceived Strength of Sediment Regulations by Land Use



Notes: The left column contains the major federal, state and local regulations associated with sediment control and roads. They are listed roughly in order of the stringency with respect to activities covered and the type of BMPs required, with the most stringent regulations at the top and the least stringent at the bottom. The right column contains the primary land uses in the region. The arrows indicate the regulations that apply to each land use as well as how landowners in each land use category perceive the stringency of the regulations as applied to their lands. Solid arrows indicate that a regulation currently applies to a particular land use. Dashed arrows indicate that a regulation is being developed and is likely to apply to a particular land use in the future. The thickness of the arrows indicates landowners' perception of the strength of each regulation: thicker arrows indicate that landowners are more cognizant of regulation and believe that it applies to them while thin arrows indicate that landowners have little awareness of the regulation and/or that they do not believe it applies to them.

In addition to regulatory inspections and monitoring, citizens and non-profit groups also play a role in ensuring that the FPR is upheld. In general, there is less reluctance for public interference with timber management practices than with other land uses. There are formal mechanisms that provide public access to information about timber harvests – the review process has a built in commenting period that allows the public to offer comments on the proposed plan and all documents associated with the review process and inspections must be available to all interested public parties. My interviews with members of small watershed groups revealed that many of them focus primarily on the

timber industry and some review a large portion of THPs in their watershed. Several other non-profit organizations also act as watchdogs on the timber industry (e.g., the Environmental Protection Information Center, a regional environmental non-profit based in Southern Humboldt; the Bay Area Coalition for Headwaters, a San Francisco based non-profit organization focused on the protection of North Coast redwoods). These organizations and others also review and comment on THPs, do post-project monitoring where possible, and sometimes take legal action when they believe there are violations.

The relatively high levels of government and public monitoring are strongly associated with knowledge and adoption of BMPs. As discussed in Chapter 4, land use is a predictor of self-reported adoption of BMPs and familiarity with BMPs, and timber landowners have higher levels of both (Table 4.8 and 4.13, Figure 4.6). In addition, The Hillslope Monitoring Program (HMP) and the Modified Completion Report (MCR) project, two statewide studies of compliance with the FPR, both found high levels of compliance with the BMPs prescribed by the FPR. The HMP evaluated adherence to FPR and the effectiveness of the prescribed BMPs on a random sample of completed THPs between 1996 and 2001. Based on their evaluation of 300 harvest sites, the HMP found an implementation rate of 94 percent for required BMPs related to water quality (Ice et al. 2004). A follow-up monitoring effort, the MCR project, evaluated the adequacy of FPR implementation⁷⁷ on 281 randomly sampled completed THPs from 2001 to 2004. Building on focal areas identified in the HMP, the MCR project concentrated on BMPs associated with watercourse and lake protection, roads, and watercourse crossings. The MCR project found overall implementation of road-related rules exceeded the standards prescribed in the FPR 82 percent of the time, were 'marginally acceptable' 14 percent of time and were not acceptable 4 percent of the time (Brandow et al. 2006).⁷⁸ With respect to watercourse crossings, the MCR project found that 64 percent of crossings had acceptable implementation of FPRs, 19 percent had marginally acceptable implementation, and 17 percent had at least one unacceptable feature (Brandow et al. 2006).⁷⁹

The schedule of government inspections provides two direct pathways toward regulatory compliance and the implementation of BMPs. First, the potential for post-harvest inspections creates the motivating need for implementation of prescribed BMPs because it creates the perception that non-compliance could be discovered and is thus subject to a potential sanction. CAL FIRE completes over 7,000 inspections annually on about 700

⁷⁷ The MCR project collected data on the percent compliance with required BMPs as well as a measure of the quality of the implementation of BMPs.

⁷⁸ Brandow et al. (2006) found that the most common BMPs that were implemented poorly include waterbreak spacing and size and the number and location of drainage structure. Additionally, they found that sediment problems were most likely to be associated with roads where the BMPs were inadequately implemented, which suggests that BMPs are effective for erosion control when implemented properly.

⁷⁹ The common problems with watercourse crossings included diversion potential, fill slope erosion, culvert plugging, and scour at the outlet (Brandow et al. 2006).

THPs, NTMPs, and other projects overseen by CAL FIRE (2004). Ice and Dent (2004) report that between 1998 and 2000, inspectors found 975 violations on the 4,749 THPs that were open in that period. Violations discovered through inspections or via citizen complaints must be corrected, and CAL FIRE also has the authority to terminate harvest operations, cite or fine RPFs, licensed timber operators (LTO), and/or landowners for the violations (CAL FIRE Forest Practice Website).

In addition to providing the motivation for initial compliance, corrective avenues, and sanctions for non-compliance, the monitoring and enforcement programs also allow CAL FIRE to compile information on the most common violations. Synthesis of this information has driven the design of targeted educational workshops to increase knowledge of those responsible for implementing BMPs (Ice et al. 2004). This and other educational components of the regulatory process will be discussed in more detail in the next section on regulatory spillover.

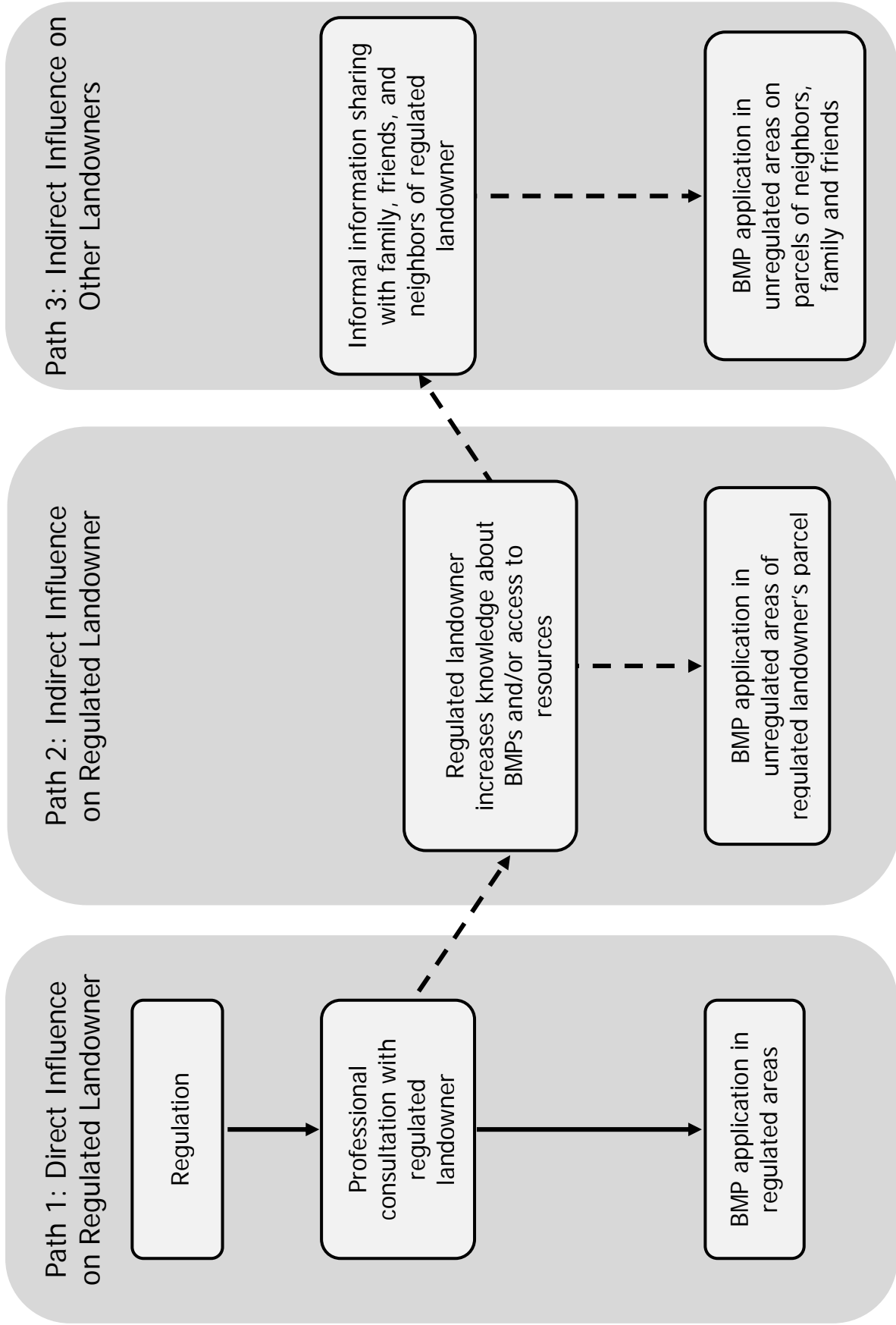
Regulatory Spillover

As shown above, the monitoring and enforcement of the FPR creates a ‘necessity’ that has driven the adoption of BMPs on regulated areas. I find that strongly enforced regulations, like the FPR, and those that are perceived to be strong, such as forthcoming implementation of Sediment TMDLs, can also indirectly lead to application of BMPs by increasing the motivation to implement BMPs and minimizing the barriers of knowledge and resources. In the following two sections, I explore two different drivers of regulatory spillover – the application of BMPs beyond the regulated areas. I first take a closer look at the operations of timber regulations and examine how and when this leads to regulatory spillover. I then use a discussion of a grassroots nonprofit organization, the Yager/Van Duzen Environmental Stewards (YES), to discuss how the perceived threat of future regulations can prompt the adoption of BMPs prior to the regulation.

Regulatory Spillover (I): Education and Access to Resources through Regulatory Process

The previous section shows how regulations that are perceived to be strongly enforced, such as the FPA, create a necessity for implementation of BMPs. My research reveals that these regulations can also lead to increased knowledge about the BMPs themselves and increased awareness and utilization of non-regulatory technical and funding resources, and that this can lead to the implementation of BMPs beyond the regulated area (Figure 5.3: Path 1). This process begins with regulated landowners becoming more educated about BMPs as a result of regulation. For timberland owners, the relationship between the landowner and their RPF is a fundamental component of this learning. The RPF must be certified by the Board of Forestry (BOF) but is also hired by the landowner (and serves at their will). This creates accountability from the RPF to both the regulating agencies and landowner, which positions the RPF to act as a trusted liaison between the two parties. As I describe below, the RPF often acts as a conduit of information about BMPs, helps landowners tailor agency BMP prescriptions to the unique circumstances of their property and also facilitates the use of non-regulatory resources by their landowning clients.

Figure 5.3: Pathways of Influence of Forest Practice Act and Forest Practice Rules on Regulated and Other Landowners



Consider my conversations with two very different but representative timberland owners. After the first timberland owner provided a detailed description of the road-related BMPs he applies across his properties, I asked him where he learned about roads:

LO: Through the Forest Practice Rules that I had to abide by. Once I had to deal with them, whenever I need to winterize roads, [implementing certain BMPs] is general practice whether I'm going to be logging the area or not. I want to keep my roads together and prevent washouts. The Forest Practice Rules have been a little cumbersome but I've learned a lot from them and learned a better way to do land management.

AS: Do you work with other individuals to implement them?

LO: I hire a registered professional forester and have done a lot of the groundwork with the forester, marking drainages and trees. I also meet with the loggers.

AS: Do you think you've learned from the forester, the regulations, or both?

LO: Both – couldn't say one without the other because the RPF is basically just following the Forest Practice Rules. (Interview with Landowner #11846, 9/25/2008)

The second timberland owner told me:

Our foresters have kept us honest. The regulations help us to manage the property to be used sustainably. I don't think we'd have done much differently... I think that the regulations that are there are, at some level, helpful to me as a landowner to avoid doing things that would otherwise seem harmless but could have a great deal of negative impact on the environment. It's a bit of a guidepost there. There are probably other things that I would do in managing the land to be even more conservative than that but at least they make me aware of the issues that I should care about. To the extent that I comply with the regulations, I am hopefully avoiding some of the harms that those regulations are put in place to prevent. (Interview with Landowner #20838, 6/26/2009)

The first landowner lives close to his timber properties, has owned and managed several properties for commercial purposes for the past ten years, and is an LTO.⁸⁰ The second manages old family land from the other side of the continent. She has little experience with land management or roads and rarely visits the property; but, with the assistance of her forester, she undertakes occasional timber harvests to supplement her income and pay the taxes on her property. Though they have very different backgrounds and management experience, they both speak of the learning associated with the FPR and

⁸⁰ LTOs are licensed by the BOF and authorized to conduct harvest operations. Their responsibilities include the inspection and maintenance of harvest roads and "proper construction, inspection and maintenance of erosion control during the prescribed maintenance period until the work completion report" (FPR 2007 §1050(c)). To obtain their license, LTOs must complete a state approved course covering California timber regulations, which typically run for two days.

their relationship to their RPF. This education and implementation of BMPs via knowledge gained through the forester and due to regulatory requirements was a typical experience described by interviewed timberland owners and falls from the consulting process required by the FPA.

Under the FPA, harvest plans (THP, NTMP, or their equivalent) must be prepared and certified by a RPF who is trained and experienced in several areas of forestry and licensed by the state.⁸¹ Landowners have the freedom to hire (and fire) their RPF as they see fit. With this power, the RPF is very accountable to the landowner. My research suggests that landowners trust the recommendations of their chosen forester and also assume that their RPF understands the unique conditions of the property and are acting in the best interest of the landowner. This trusting relationship sets the foundation for the exchange of knowledge about agency recommended BMPs and non-regulatory resources.⁸²

RPFs assume responsibility for ensuring that the harvest plan and all management activities associated with the plan are in compliance with the FPR. This regulatory responsibility, the strong system for inspection and monitoring of the FPR and the potential for disciplinary actions associated with violations of the FPA or the Professional Foresters Law (PFL) combine to make RPFs accountable to CAL FIRE, the BOF, and other natural resource agencies involved in regulating timber harvests. RPFs thus have training in regulatory requirements (including the latest BMPs) and a large incentive to ensure regulatory compliance on the lands where they work, which manifests itself in the application of BMPs on regulated areas of the landscape (Figure 5.3: Path 1).

The FPA also requires RPFs to ensure that their client, the timberland owner, understands his or her responsibilities “including the timberland owner(s)’ responsibilities for site

⁸¹ Under the Professional Foresters Law (PFL) of 1972 §§769-770, the requirements for becoming licensed as an RPF include:

- Good moral character and integrity (demonstrated through two references from licensed RPFs that can attest to the professional character of the applicant and three additional references that can attest to the business integrity and personal character of the applicant),
- Knowledge and experience in the forestry profession (demonstrated completion of seven years of education, training and employment in the field of forestry), and
- Successful completion (75% or higher) of foresters examination, which tests knowledge of several areas of forestry (e.g., silviculture, forest ecology, forest economics, forest policy, forest administration).

The PFL was created to “provide for the regulations of persons who practice the profession of forestry and whose activities have an impact upon the ecology of forested landscapes and the quality of the forest environment, and through that regulation enhance the control of air and water pollution, the preservation of scenic beauty, the protection and increased yield of natural resources, including timber, forage, wildlife, and water, and outdoor recreation, to meet the needs of the people” (PFL 1972 §751). In addition to specifying the licensing requirements, it also establishes guidelines for conduct and the criteria and procedures for disciplinary action.

⁸² This trusting relationship is in contrast to the typically adversarial or wary attitude timberlandowners have towards unknown agency staff. While landowners typically trust their RPF from the start of their relationship, agency staff and regulators must earn the trust of landowners.

preparation, stocking, and maintenance of roads, landings and erosion control facilities” (Duggan and Mueller 2005, p 55). This regulatory stipulation often increases landowners’ familiarity and knowledge about the BMPs that are required on their land. This pathway for knowledge transfer is strengthened because landowners tend to trust their RPF to explain when and why BMPs are required.

The FPR also mandates on-the-ground pre-harvest inspections where regulators, the RPF, and often the landowner review how the harvest and, more importantly, the mitigating BMPs will be implemented. The inspection often includes discussion (and sometimes disagreements) about the appropriate mitigating techniques and, in the right conditions, can provide opportunities for learning.⁸³ My interviews suggest that both regulators and landowners bear responsibility for shaping the dialogue and that the conditions are right for learning when the discussions are conducted as an exchange of ideas (albeit one where the power to influence the outcome is uneven as the regulators have the ultimate authority) rather than a top-down and adversarial process.⁸⁴

While the BMP prescriptions in the FPR are required only in areas used for the timber harvest process, the knowledge gained through the consultation between the RPF and landowner is often applied beyond the regulated areas. This can happen when the forester suggests the application of BMPs in areas outside of the harvest plan and when landowners themselves determine that BMP application beyond the harvest area would be useful. The first timberland owner who learned about road management techniques through both the regulations and his connections to his RPF also mentions that many of these BMPs have become standard practice across his property “whether [he’s] going to be logging the area or not” (Interview with Landowner #11846, 9/25/2008). At the suggestion of her forester, the second landowner quoted above did a series of road reconstruction and upgrades (which involved several BMPs, some required by the FPR and some not) across her entire property prior to her most recent harvest. Don, who was described at the beginning of the chapter, has also implemented BMPs beyond the regulated areas of his property because he has found that they increase the quality of his roads in addition to decreasing sediment.

In addition to the knowledge generated by these interactions and the desire to implement BMPs (associated with the perception that the BMPs improve road quality and/or the

⁸³ Other permitting requirements for activities typically associated with timber harvests (e.g., NCRWQCB Waste Discharge Requirements; CDFG 1600 Agreements for Streambed Alterations; NOAA/USFWS Habitat Conservation Plan or Incidental Take Permitting for activities affecting listed endangered or threatened species) may also involve on-site inspections that can create additional opportunities for learning between landowners and regulators in the right conditions.

⁸⁴ As suggested in Footnote 9, the relationship between landowners and regulators is often adversarial and begins without trust. My interviews suggest that a trusting relationship can grow from repeated interactions, respectful dialogue about regulatory requirements, and, most importantly, the landowner’s perception that the regulator is listening and considering their experience-based knowledge (even if the regulator ultimately disagrees with the landowner’s suggestions).

desire to reduce road-related sediment), foresters frequently alter landowners to the availability of grant or cost-share funding as well as technical assistance resources (e.g., workshops, contacts for private consultants or recommended contractors) that enable them to further overcome the knowledge and resources barriers to implement BMPs on non-regulated parts of their land. In this way, the requirements of the FPA, particularly the interaction between landowners and their RPF, creates a *necessity* for implementation of BMPs on the regulated areas of the landscape and also provide greater access to the resources (funding and knowledge) that can *facilitate* the application of BMPs beyond the regulated area (Figure 5.3: Path 2).

Regulatory Spillover (II): Regulatory Learning and Knowledge Networks

The knowledge gained through regulation of the timber industry also spills over to unregulated lands through informal networks of knowledge sharing and project implementation. A residential landowner in the Mattole watershed describes how she and her husband get information and ideas about how to manage their roads:

Driving around to other people's houses over the roads, and people talk about their roads almost as much as people talk about the weather. It's one of those conversations you have at a dinner party. Everyone's so opinionated about what you do. So, talking with people and listening to people who have maintained the roads around here for a long time. (Interview with Landowner #11411, 08/31/2008)

Their reliance on family, friends and neighbors for advice about road management is typical of North Coast landowners using their land for timber, ranch, residential, or vacation purposes. Approximately 35 percent of survey respondents reported that they obtained technical assistance about roads from family, friends or neighbors⁸⁵ and 37 percent of interview respondents noted that they received technical assistance or advice from family, friends or neighbors. Many of these landowners preferentially seek out advice from family, friends or neighbors that are involved in the timber industry as foresters or on the road crews at one of the industrial timber companies in the region (e.g., Pacific Lumber Company [PALCO], which was sold and reorganized as Humboldt Redwood Company in 2008; Green Diamond, which operated under the name Simpson Timber until 2004).

Since work in the timber industry involves roadwork (and, importantly, road work that is overseen by regulating agencies), many landowners trust that those working in the timber industry have specialized expertise in road design and management. A married couple who work in the lumber mill and at an administrative position for PALCO and own some ranch land explained:

LO1: It's a good thing we have some logging friends who, you know, they build roads. They know how to do it. We also ask them for advice... [And] our son. He worked for PALCO and he works for Humboldt Redwood. He's on the road crew and he's learned an awful lot of stuff. So now he's got suggestions. There

⁸⁵ There was no statistically significant difference in which groups of landowners (e.g., timber, ranch [no timber], residential, second home, other) consulted family, friends, and neighbors.

are things he wants to do on the road. There are places I think, ‘That’s kind of a rough go gathering cattle. Could we put a road in there?’ [He’ll say] ‘No, no, no. Too slippery – you can’t have a road over there.’ And I’ve before gotten advice from different ones at [PALCO]. I mean, I have a whole company full of advice. So, if I need to do something, we can find out.

LO2: It’s one of the perks from being there forever and ever and ever: you know everybody.

LO1: And then, well, their foresters – when it was PALCO, their foresters would take us on fieldtrips, a group up through, and we’d see what they did to roads and he’d tell us about it and everything. And that was helpful. (Interview with Landowners #11928, 10/14/2008)

Such trust in the knowledge of relatives and friends employed in the timber industry as well as their reliance on them was quite common among interview respondents. Several interview respondents explicitly mentioned the knowledge gained from the timber industry and described how relatives who work in the timber industry have recommended and/or implemented road construction, maintenance, or upgrade projects on their property.

Much of the trust in the knowledge of timber employees is well founded. The road crews at industrial timber companies have often been through workshops and other training opportunities, which introduce them to BMPs required by the FPR or recommended by the regulating agencies. One interview respondent who owns 1200 acres of timber and ranchlands and also worked on the road crew for Simpson Timber Company for about 30 years explained that, as part of ongoing training, Simpson sponsored lectures and workshops about new road design, construction, and maintenance techniques (Interview with Landowner #10424, 7/23/2008).

In many cases, these family members, friends and neighbors transmit the knowledge learned through those experiences to other landowners and/or directly implement the BMPs, which creates a third pathway through which knowledge and BMP information from regulations leads to implementation on a different set of lands (Figure 5.3: Path 3). However, it is important to recognize that the knowledge gained through these trainings does not guarantee that the timber employee will necessarily recommend the BMPs prescribed by the regulations. While this often happens, the landowner who worked for Simpson described his dissatisfaction with many of the newer BMPs (e.g., rolling dips, outsloping) now recommended by the agencies. So, while he has significant experience and knowledge, his employment in the timber industry did not guarantee a motivating desire to implement these BMPs (Interview with Landowner #10424, 7/23/2008). Spillover implementation via this third pathway occurs primarily when the employee of the timber industry has had positive experiences with the implementation of BMPs.

Regulatory Spillover (III): Threats of Future Regulation and BMP Implementation

The perceived threat of impending regulations can also create a necessity that leads to increased knowledge about and implementation of BMPs on roads that are not yet regulated. In this section, I use the links between proposed water quality regulations and

the formation and sediment control activities of a community-based non-profit organization, YES, to discuss this spillover pathway of regulatory influence. In this case, the threat of future regulations was an important organizing tool that motivated ranchers (who are normally resistant to working with government agencies) to collaborate with several natural resource agencies to determine the major sediment sources in their watershed, to utilize non-regulatory resources, and to implement BMPs across their ranch roads.

The Van Duzen River is a tributary of the mainstem Eel River in Humboldt County that supports Steelhead trout, Chinook salmon, and Coho salmon. In 1992, the Van Duzen was listed on the California's Clean Water Act (CWA) 303(d) list of impaired waters due to the degradation of salmonid habitat by excess sediment. Between 1997 and 1999, staff from the Region 9 EPA office worked collaboratively with the newly formed YES to assess the primary sediment sources in the watershed and develop the total maximum daily load (TMDL) (Interview with Chris Heppe, National Park Service formerly with EPA Region 9, 8/8/2007; Interview with Dina Moore, rancher and founding member of YES, 10/13/2008). Following the completion of the TMDL, YES received a series of grants to work with a private consultant, Pacific Watershed Associates (PWA), to inventory the sediment sources in the Middle Van Duzen, prioritize sites for treatment, and implement BMPs on roads in the watershed.⁸⁶

Dina Moore, a rancher in the region and one of the founding members of YES, described the impetus for the group as follows:

How the Yager/Van Duzen Environmental Stewards got started – really, what happened for me, I guess the impetus behind it was that the University Cooperative Extension was doing their short courses. I participated in their short course and realized that, you know, water quality is going to be an important issue for folks within my ranching community. So, sometime shortly thereafter, I went to my first Water Board meeting and realized that on that particular meeting – and I even remember exactly where it was – the creek that runs through our ranch, Yager Creek, was being listed as sediment impaired and I had no idea. We hadn't participated or anything like that and it was being listed based on input from individuals who said it was impaired. I was sort of dumbstruck and blindsided. Again, it sort of went in line with, again, what we had been talking about during the short course and all of that stuff.

So then following that and I can't quite give you the exact timeframe, this was all in, oh probably '97 or '98, we decided, I talked to my neighbors, and we decided to form a watershed group and at that same time Chris Heppe [staff at EPA Region 9] was working on the TMDL development and he started contacting me. And, he came to one of our very first meetings and from there, our group formed

⁸⁶ Since 2001, YES members have received over \$1.5 million in grant funding from grants administered by CDFG, SWRCB, and NRCS. Specific funding sources include CDFG Fisheries Restoration grants, the federally supported Clean Water Act Section 319(h) fund, and grants available from CA Senate Bill 271 and CA Proposition 50.

and we gelled and moved forward as a group. And, simultaneously I established a relationship with Chris and worked with EPA and got a grant to do this historical narrative process, which became a part of the background documents that he used in the development of the technical part of the TMDL and, you know, so that was sort of the beginning formation of it.

I spent hours with my neighbors forming this group and I spent hours working with Chris on the development of the technical TMDL. And, the end of that particular process was that the TMDL became adopted in December of '99 and there are elements of that TMDL that I felt we as a group really contributed to.

...

The come-on for my landowners was always look, we're sediment impaired – honestly for some of my landowners, I don't know if they honestly believed, there's a different degree of understanding or belief about sediment as an impairment – but the reality was that [the regulation] was coming, the train was coming; you either got on and led the direction or you took what you got. So, we were really proactive, that was the driver, being proactive, and my belief that being proactive would really benefit all of us.

(Interview with Dina Moore, rancher and founding member of YES, 10/13/2008)

Moore describes how she responded to the threat of impending water quality regulations by organizing a community-based watershed group and working with a key agency contact to become involved in the TMDL process. Chris Heppe, the key contact at the EPA, described the TMDL process as follows:

Rather than diving right in, we [the EPA] went to [YES] and asked what they thought. This way, they were involved from the start. This was important because they account for a third of the watershed and if they aren't involved and there's no access then you're missing a huge piece. We had a meeting where [a private consultant] brought in a geologist and everyone was able to ask questions and get informed and agreed to participate. So we did the random plots [to assess sediment sources] and when we threw the dice, some were on YES lands. So, when it came time to see the results, they were a part of it. They couldn't argue that the agency didn't know anything about their land. This got buy in for the process. They ended up supporting it because of the implications for the management practices for roads and rangelands (Interview with Chris Heppe, National Park Service formerly with EPA Region 9, 8/8/2007)

The collaborative assessment process described by Heppe found that roads were identified as the primary sediment source in the basin (US EPA 1999d). YES members accepted that roads are a sediment source, and the group used this finding to secure a series of grants to inventory and control sediment sources on roads in their member-landholdings. Gary Flosi, one of their contacts at the California Department of Fish and Game (CDFG) explained:

[CDFG] funded their whole road inventory, which I think was 420 miles of road and they've taken that – and we've funded some of that implementation. They

have done quite a bit of it on their own, and they've gotten some water quality money, and they've gotten some NRCS money, and they've kind of gone for a whole host of different things. There's an example of a number of landowners who were really apprehensive about working with government 10 years ago who have gone a long ways.

The other thing that's happened there that I think is really good is that some of the landowners and folks from the community have done a lot of the work. So working with folks like Pacific Watershed Associates, they have really learned how to do that work and I've seen some really, really excellent projects done there. So there's a situation that is kind of win-win for everybody. They are getting sediment control. They are learning how to do the work properly. They are doing a lot of stuff on their own, and it just kind of works to everyone's benefit over the long term. (Interview with Gary Flosi, CDFG, 10/20/2008)

As Flosi describes, the threat of regulation started a process that resulted in YES members obtaining non-regulatory funding and technical assistance and implementing BMPs in and beyond the grant funded project areas (a process similar to pathways 2 and 3 in Figure 5.3 except that it begins with a proposed regulation rather than an actual regulation). A small number of interviewed landowners with timber and/or ranch lands also described a similar pro-active response to the threat of regulation.⁸⁷

When considering how widespread this effect may be, it is important to recognize that landowners will only respond to the threat of regulation when they believe that the regulation will actually affect them. The majority of YES members are ranchers who have either gone through the regulatory process for timber harvests on their own land or have friends or family members who have gone through that process. These experiences have instilled recognition of the regulatory power of agencies. However, residential landowners in other sub-watersheds of the Van Duzen did not respond to the TMDL in a similarly proactive fashion. (I discuss this distinction in more detail in Chapter 6).

Non-Regulatory Mechanisms

The discussion of regulatory mechanisms above previews the important roles of non-regulatory programs, namely the provision of technical assistance and funding resources that reduce barriers to the application of BMPs. Non-regulatory resources help timber landowners implement BMPs beyond the regulated areas of their property. Non-regulatory assistance to landowners can take three different forms: technical assistance (e.g., workshops, guides or manuals, consultations), financial assistance (e.g., grant funding, cost-share), and project implementation. (See Chapter 3 for more complete descriptions). These non-regulatory programs provide the means to overcome the *barriers* to BMP implementation (access to knowledge and resources) but, with a few exceptions, they do not do much to *facilitate* interest in or the desire for the adoption of BMPs. That desire or interest has to come from elsewhere.

⁸⁷ The opposite effect is also possible, where the threat of impending regulation leads landowners to engage in activities that will be prohibited by the regulation in the hopes of being grandfathered in when the regulation arrives. I did not see evidence of this in my research.

In the sections that follow, I focus on when and how non-regulatory programs facilitate the adoption of BMPs. I begin with a general description of the utilization and effects of non-regulatory resources. I then analyze how landowners learn about these resources and identify the four major motivations for seeking out non-regulatory assistance. I end this section with a discussion of the benefits and limitations of these non-regulatory approaches.

Utilization and Effects of Non-Regulatory Resources

Technical Assistance: In order to reduce the knowledge barrier to BMP implementation, government agencies and non-profit organizations provide technical assistance through professional consultations by phone or on-site, training programs such as workshops, lecture, and short courses, and the publication of educational materials in print, online, and/or as video/DVDs. Approximately 45 percent of surveyed landowners have obtained technical assistance from a professional source (which includes government sources, non-profit organizations, professional or industry associations, and private consultants) and about 16 percent have obtained assistance from books or the internet (Chapter 4).⁸⁸ The mail survey and interviews demonstrate that utilization of these resources clearly helps landowners gain knowledge about BMPs and is significantly associated with self-reported adoption of BMPs.⁸⁹

Financial Assistance: Non-regulatory programs can help landowners overcome the resource barrier to implementation of cost-intensive BMPs through the provision of cost-share and grant funding opportunities. Approximately 10 percent of survey respondents obtained cost-share or grant funding for road-related sediment prevention work, and the acquisition of grant or cost-share funding is associated with self-reported adoption of BMPs in the survey population and demonstrated knowledge about BMPs in the interview population (Table 4.8 and Figure 4.4).

Direct Project Implementation: Direct implementation of BMPs on a landowner's property by a group or individual other than the landowner circumvents the need to find a motivating necessity or desire and overcome the knowledge and resource barriers. In the North Coastal Basin, direct project implementation takes two forms: (a) implementation by a nonprofit organization or agency that does not own land in the project region, in which the coordination and implementation of a project is completed by a nonprofit organization (e.g., Mattole Restoration Council (MRC) Good Roads, Clear Creeks Program) and (b) implementation spearheaded by an individual or road association that

⁸⁸ Some of the landowners who have obtained professional assistance have done so because of regulatory requirements that mandate consultation with an RPF or other professionals. This and other links between regulatory and non-regulatory programs are explicitly addressed "Linkages and Commonalities" section towards the end of this chapter.

⁸⁹ As described in Chapter 4, utilization of professional technical assistance is significantly associated with greater familiarity with BMPs and self-reported adoption of BMPs, and a similar relationship was demonstrated through interviews (Figure 4.5). In addition, utilization of book and internet resources is significantly associated with greater self-reported implementation of BMPs ($P < 0.05$).

owns a portion of the land in the project region, in which the project is organized by a key landowner who works with a granting agency and/or a non-profit to implement a project on roads crossing multiple properties (e.g., Henry's grant for his road association; grants with the Navarro River Resource Center). In both of these situations, the motivation for the project, technical expertise, and financial resources are all provided by an outside organization and/or individual(s) who initiates the project, and the project is implemented at little or no cost to landowners.

Factors Motivating Landowners to Seek Technical and Financial Assistance

Few agencies and nonprofit organizations in the North Coastal Basin undertake targeted outreach or direct project implementation.⁹⁰ Instead, they act as resources for landowners who seek out their services. Landowners must take the initiative to identify and obtain financial and technical assistance for themselves. Interview respondents who have utilized technical and financial resources available through non-regulatory programs learned of these programs through:

- Direct inquiries to non-profit organizations or government agencies,
- Word of mouth via connections with family, friends, neighbors and their RPF,
- Awareness generated through nearby grant and restoration projects, and
- Chance encounters with people knowledgeable about the programs.

I identified four overlapping factors that motivate landowners to actively seek out non-regulatory assistance to obtain more knowledge or funding to help implement BMPs on their land: environmental concerns, problems with existing roads, belief in the utility of BMPs, and the desire for autonomy.

Motivation 1: Environmental Concern

Concern for the environment and the desire to minimize the environmental effects of their land management practices leads some landowners to seek out non-regulatory assistance with their road network and other management practices. Environmentally oriented landowners often seek out technical assistance after purchasing their property in order to gain knowledge about how to take care of the land and their roads. In many cases they learn about grant or cost-share opportunities through their contact with the professional providing technical assistance and obtain grant funding to implement BMPs and restoration projects.

One landowner moved to Humboldt County from the San Francisco Bay Area after becoming very active with the Bay Area Coalition for Headwaters, a San Francisco based environmental group that “encourag[es] grassroots activism to confront and curtail the exploitation of forests and to understand the links between our lives and healthy forests” (Bay Area Coalition for Headwaters Website). He purchased 160 acres for recreation and retreat purposes and subsequently sought out technical assistance and grant funding from the CDFG. He explained:

⁹⁰ A notable exception is the Mattole Restoration Council, which initiates and implements road re-construction and restoration projects throughout the Mattole watershed in Humboldt County.

LO: I got involved in the Bay Area Coalition for the Headwaters and was very active in that. I made the move up here in the mid 1990s.

AS: Is that why you gave attention to your roads when you got the property?

LO: Absolutely. They were pretty bad. Every rainstorm you'd go out and the culverts were badly placed. There were two Humboldt crossings and the culvert between them would plug, which created a big lake. The guy who had the property before me would go in with some heavy equipment and dig out the sediment that would settle in the lake each storm and spread it on the road. It was apparent to me that this was a problem so I went to Fish and Game for help. (Interview with Landowner #11572, 11/3/2008).

Henry, who was profiled at the beginning of Chapter 4, provides another clear example of how this motivation can lead to the utilization of grant funding. His stated land management goal is to "restore the land" and, shortly after purchasing the property, he consulted with a forester to develop a sustainable land management plan (Interview with Henry, Landowner #21061, 9/10/2008). By working with his forester, he learned about the relationship between roads and sediment as well as the availability of grant funding for restoration projects. His concern for the environment and his need for additional technical assistance and funding ultimately led him to seek out grant funding.

As is the case with the two landowners quoted above, many of the landowners with this motivation do not have a long history of land management. Though many of the ranchers whose land has been held by multiple generations express a strong stewardship ethic, their stewardship is associated with confidence in their understanding of their land. While many ranchers implement BMPs, their utilization of non-regulatory resources is rarely motivated strictly by their concern for the environment.

Motivation 2: Problems with the Road Network

Severe road problems such as washouts from failed culverts or catastrophic slides that make the road impassible as well as other more minor concerns about the quality of the road network are the second motivating factor. A staff person working jointly with the Mendocino Resource Conservation District (RCD) and a watershed-based nonprofit organization explained:

We do very little knocking on doors. Instead we work with landowners that call us. So, our projects are spearheaded by landowners, homeowners associations, [and involve] a few select landowners that are in key locations that we reach out to. Very few of the people that call are motivated by water quality or TMDLs. Very few people are cited for violations so that's little incentive. Instead, most are motivated by experience with the road, whether it's a culvert or bank failure, or that they are tired of fixing and patching their road, they want to drive faster, or sometimes they are motivated by the looks and are worried about resale value. (Interview with Anonymous, Mendocino RCD and watershed-based nonprofit, #M1, 5/29/2007)

The staff-person further reported that, in the cases where these problems are contributing to sediment pollution, the watershed organization helps the landowner to obtain grant

funding to assess the entire road network and implement BMPs that address the reported problem and other potential sediment delivery sites.

Only one interviewed landowner described seeking out technical assistance directly in response to a sudden road problem.⁹¹ He explained:

A while back we had about 100 inches of rain. Part of the road above the creek caved in. A lot of the landowners are big environmentalists so wanted to do something. We had an agency staffer come out to look at it, he said it wasn't such a big deal and said he would look the other way if we carefully used our own equipment to clear it out rather than hiring someone which would cost around \$20,000 and they wouldn't have done any better of a job than we did ourselves. (Interview with Landowner #21712, 7/29/2008)

However, other landowners mentioned seeking out technical assistance associated with other land management problems. These landowners turned to resource agencies (primarily CDFG) or non-regulatory government programs (e.g., NRCS, RCD) for technical assistance. In some cases, the consultation occurred by phone and in others, an agency staff person made a site visit and provided recommendations about how to remedy the problem.

Motivation 3: Belief in the Utility of BMPs

The third reason landowners seek out non-regulatory technical or financial assistance is the belief that the use of BMPs improves the quality of their roads and reduces the resources required for long-term maintenance. Don, who was also profiled at the beginning of Chapter 4, provides a good example of this. He learned about BMPs through his interactions with his RPF and agency regulators as required through the FPA and the Garcia Action Plan, and was forced to implement several BMPs by these regulations. He found these BMPs reduced maintenance, road failures, and long-term expense and wanted to implement them across the unregulated areas of his property. Referring to a time before he was exposed to the BMPs, he reflects:

If I had known about rolling dips before, I would have used them. They are much better than putting in and ripping out water bars every year but the learning curve is expensive. (Interview with Don, Landowner #21176, 9/5/2008).

In order to obtain the knowledge and resources to further implement BMPs beyond the regulated area, Don attended road design and sediment prevention workshops to gain more information about BMPs. He sought out and received significant grant funding from CDFG and EQIP to implement these BMPs. Like Don, other landowners in this category are motivated by their belief that BMPs increase the quality of their roads and have long-term management benefits. Though they may also have environmental

⁹¹ While most interviewed landowners that sought out technical assistance or receive grant funding described having a chronic road problem, they did not use the problems themselves as their primary motivation for seeking out the assistance. They explained their motivation in terms of one of the other three factors listed here. However, these categories are not mutually exclusive and the drivability of the road itself did contribute in these other cases.

concerns or a strong stewardship ethic, this motivation is distinct in the focus on the actual resource savings (in terms of time and/or cost) to the landowner.

Motivation 4: Desire to Maintain Autonomy

The final factor motivating landowners to seek out regulatory assistance is the desire to maintain the freedom to make land management decisions when faced with a perceived threat to their autonomy. The threat to their autonomy could come from a variety of sources. As seen in the earlier discussion of the regulatory spillover and threats of regulation, ranchers in the Yager Creek sub-watershed of the Van Duzen collaborated with agencies in a non-regulatory setting, utilized technical assistance resources, and obtained grant funding to upgrade their road networks in order to ensure they had a voice in the formation of future water quality regulations. Ranchers in the Bear River Valley also formed a non-profit group and utilized technical and financial assistance to fight off a threat to their autonomy. However, in this case, the ranchers acted in response to perceived threats stemming from the formation of grassroots groups in a neighboring watershed.

The Bear River Valley is a small watershed adjacent to the Mattole watershed in Humboldt County. Landownership in the valley has been relatively stable over the past 150 years with most land passed down through ranching families with limited migration of new families into the area. The landowners are protective of each other, their lifestyle and the valley. As one Bear River landowner put it:

The Bear River community is a pretty tight group. I don't think they like a lot of outside involvement. (Interview with Landowner #11914, 10/16/2008)

The adjacent Mattole watershed also has a history of ranching and timber activities but the culture of the Mattole began to change with the migration of "back to the land" settlers into the watershed beginning in the 1960s (US EPA 2003a). Motivated by concern over the declining numbers of salmonids in the river, many of the newer residents of the Mattole began to work together to proactively restore salmonid habitat in the late 1970s and early 1980s (House 1999, MRC Website). Their efforts resulted in the formation of three nonprofit organizations that work together on a variety of instream and upslope restoration and mitigation projects throughout the Mattole: the MRC, the Mattole Salmon Group, and Sanctuary Forest.

Around the mid-1990s, ranchers and other landowners in the Bear River Valley began to fear that the Mattole groups were trying to extend their programs into the Bear River watershed. Motivated by the concern that this would lead to the loss of their ability to drive land management decisions throughout their watershed, several Bear River ranchers formed their own non-profit group, the Bear River Regional Resources Conservancy (BRRRC) in 1998. A BRRRC member and Bear River landowner explained that the origins of the BRRRC were in:

The Mattole Group - that's what started the Bear River Group, because we didn't want them coming in and trying to run our watershed. We'll run our watershed. (Interview with Landowner #11928, 10/14/2008)

Between 1998 and 2003, BRRRC obtained \$39,452 in grant funding from the CDFG Fisheries Grant Program to support planning, organization and training activities for landowners in the watershed. In 1999, the CDFG Fisheries Grant program provided BRRRC with \$269,973 to hire a consultant to conduct a watershed assessment. Based on the priorities identified in the assessment, individual landowners obtained another \$266,182 in grant funding (mostly from CDFG Fisheries Grant program) to implement projects to reduce erosion and improve instream and riparian habitat conditions (\$28,209 of this went to road-improvement projects).

The ranchers and other landowners that organized YES and BRRRC felt threatened by outside interest in the management of their watershed and organized their small nonprofit groups to provide a way to maintain decision-making control in their watershed. In each case, the groups utilized both non-regulatory technical and financial assistance to assess the health of the watershed and implement BMPs on roads and other restoration projects.

Benefits and Limitations of Non-Regulatory Approaches

Non-regulatory programs have the benefits of increasing knowledge and implementation of BMPs. As voluntary and incentive-based programs, all three non-regulatory approaches have the clear benefit of being less adversarial than regulatory approaches. In some cases, this non-adversarial approach can even change landowners' negative views towards agencies and reduce some of the common reluctance to work with agencies. One landowner explained:

I'm just extraordinarily pleased [with my grant experience]. I wish I could remember the lady I worked with in Ukiah – she was just very, very supportive and good to work with. She helped walk us through everything. I think we, when I say we, it was certainly predominantly my daughter and, darn, I forget her [the staff liaison] name (it's right on the tip of my tongue and I can't remember it) – well, we had a kind of a mutual trust, so that we knew that if she said something would be done, we could count on that and if we told her something would be done, we would do it. So, that was a good experience. And, I'll share with you that typically, I'm a little reticent to get involved in those programs because compliance can be a little onerous, especially if I'm not there, but this was a delightful little program and I think it worked well (Interview with Landowner #20580, 12/5/2008).

There are also some spillover effects associated with grant, cost-share and project implementation programs. I found some evidence that landowners apply knowledge and BMPs learned through participation in these programs in other areas of their lands. For example, members of YES have implemented BMPs learned through education programs and grant projects beyond the grant project areas. Another landowner explained that his experience in a grant project changed how he views roads and creeks, and he has assessed and addressed excess sediment pollution in other creeks near his home (Interview with Landowner #21342, 8/22/2008).

In addition, re-construction and restoration projects can generate general awareness and interest in sediment control, BMPs, and the availability of non-regulatory resources. A

landowner's positive experiences with funding agencies and organizations may lead friends or neighbors to also seek out funding for projects on their land. Other landowners may learn about the availability of resources simply due to the visibility of a project. A landowner who was involved in a restoration project implemented by a local watershed group in Humboldt County described how this can happen:

I have to say that I've seen a big change in the attitude of the ranchers because of this [restoration project]. Some of it was brought about by us buying materials from them: logs (we use logs in a lot of the instream structures), rock, and boulders (especially huge boulders because they're not easy to find). Actually, being there on that main road, there were a lot of people who would stop. I spent a lot of my time explaining to people what we were doing, why we were doing it, just the PR aspect of it. As soon as these ranchers found out that Fish and Game would actually give them money to help them to fix these things, even though their ranches were up to CDF [now CAL FIRE] standards as far as logging, by explaining these things to them and them wanting to actually keep the ranches in good shape—these places have been in the families for a hundred years or so and they're interested in maintaining them that way—and as soon as they find out that the Fish and Game will give them a little bit of money to help them do it right, they're interested. And, a lot of them have their own equipment so they can do the work themselves and not have to worry about some idiot in there with an excavator tearing things up. (Interview with Landowner #11211, 8/25/2008)

In addition to these broad benefits common to all three approaches, there are also some benefits and limitations that are specific to each approach. I describe these in the following two sections.

Technical and Financial Assistance

Landowners' consultation with professionals is strongly associated with increased knowledge about the relationship between roads and sediment, and BMPs (Figure 4.5). The availability of free technical assistance provides the clear benefit of increasing landowners' knowledge about BMPs.

Landowners who have obtained financial assistance as well as those who have not identified several clear benefits associated with these programs. When asked if cost-share and grant programs are a good use of public funds, landowners gave a variety of justifications for supporting the programs:

I do [think cost-share and grant programs are a good use of public funds] and not just because I have benefited from them. It's because we all live down stream and there's great value in keeping land in resources. It adds a lot for habitat and salmon habitat. That's a really good use. I think it can improve stewardship too. People learn a lot when they do it. They get the expertise of the agencies to help them. (Interview with Landowner #11572 who has received a grant, 11/3/2008)

I'm glad EQIP and Fish and Game make the money available. It should be the past landowners that are paying for the problems they caused (though I know regulations are different now). Now it is the public paying for the remediation of

what was done in the past, which is great but probably not enough. The money is good and it leads to some benefits for air quality, water quality, fish, recreational possibilities, the management of the forest and wood. It does tremendous good for the public. I wish they would do more of it but I know funds are tight. (Interview with Landowner #21061 who has received a grant, 9/10/2008)

[EQIP] pay[s] 50 percent. It's a good program that helps to fill in a void so we are able to do it. Otherwise, we wouldn't do it. We ended up with \$30,000 this year and we do our own work and have our own equipment, which we can bill, so we can break even or come out ahead. (Interview with Landowner #11564 who has received a grant, 11/7/2008)

I think funding is really important...I think [the funding] is right because it is the public mandating upgrades, so they should be responsible for making the funding available. (Interview with Landowner #21176 who has received a grant, 9/5/2008)

I think it can be a very good use of funds because some old roads I've seen were built poorly and without regards to watershed conditions. Decommissioning roads like that – for the homeowner/landowner – can be kind of expensive. I think you can spend some money and improve water quality quite a bit. (Interview with Landowner #11644 who has not received a grant, 10/21/2008)

As expressed through these quotes and in other interviews, the perceived function and outcomes of grant and cost-share funding include:

- Implementation of projects that landowners would otherwise not be able to afford and the associated environmental benefits,
- Providing public resources to support projects that are implemented by individuals but that benefit and preserve public goods and/or are mandated by regulatory directives,
- Providing public resources to mitigate and restore legacy damages incurred from prior land uses,
- Indirect benefit educational benefits associated with collaborative work between landowner and the funding agency or organization, and
- Additional financial resources that help support the rural lifestyle.

However, the benefits of technical and financial assistance programs are limited by the resource constraints and scope of the programs. Agencies and non-profit organizations face perpetual staffing challenges and budget limitations that constrain their actions, and there are always more problems than resources. As such, few agencies or nonprofit organizations in the North Coastal Basin undertake targeted outreach to encourage utilization of their resources. Instead the resources are primarily available to those that seek them out. While there is some prioritization in the distribution of grant and cost-share funds, the process is still limited by who chooses to apply. Thus, the reach of these programs is uneven and may not occur in the areas or for the landowners most needing the assistance. A staff-person at the Mendocino RCD summed the situation up as follows:

The challenge is that if you wait for people to knock on your door, you get scattered impacts and you can't reach everyone or where it is most important. (Interview with Anonymous, Mendocino RCD and watershed-based nonprofit, #M1, 5/29/2007)

Direct Project Implementation

The project implementation approach has the clear benefit of simultaneously addressing the three basic factors affecting BMP adoption (motivation, knowledge, and resources; Figure 5.1) and allowing organizations to target the roads and areas believed to be most critical. Landowners involved in these projects must agree to the project but do not have to contribute time or financial resources. As long as the landowner is not actively obstructing the project, his or her motivations and access to knowledge and resources become irrelevant. Groups using this strategy can implement BMPs on roads where landowners would otherwise lack the interest, knowledge and/or resources to treat their own roads.

However, there are several challenges and limitations of this approach. Henry obtained a grant on behalf of his road association to upgrade their shared access road. Though most of the road association members are supportive of his project implementation effort, some have actively tried to obstruct the process, making it more difficult to move forward:

AS: How do people obstruct the process?

Henry: Sometimes by sabotage and working against the goals. We have some individuals that pride themselves on their self-sustaining survival skills without help from the government. They have ideas about how things should be done and don't listen to others. There is one family who threatens to sue us and say that we are doing things the wrong way and when we do nothing, says that he will sue because nothing's been done.

There's one individual who is very disruptive. If the neighbors are out working, he'll go out with his video camera, taping to get evidence for the lawsuit. He doesn't contribute to the road association but lives at the end of the road and has a business for vacation rentals that requires a lot of users on the road. (Interview with Henry, Landowner #21061, 9/10/2008)

The success of direct implementation projects can be threatened or reduced due to lack of landowner interest and buy-in in the process. Obstruction or sabotage of projects (as described by Henry) does occur but does not appear to be common. As Joel Monschke, director of the MRC's Good Roads, Clear Creeks program, put it, "People don't mind the free road work" (Interview with Joel Monschke, 11/24/2008).

The failure to maintain the BMPs is a more common challenge with this approach and can reduce the long-term sediment reduction from projects implemented this way. Several landowners living along roads that have been treated described this challenge. A landowner whose access road was upgraded through the MRC Good Roads, Clear Creeks

program as well as an additional project funded by a wealthy neighbor described the challenge as follows:

When I first moved out, the road to this cooperative, there were people who had just moved there, back-top-the-land people from the East Coast – the ones who started communes and things, real granola types. It was great then. It was just those people and a couple of families who had been there for 50 years. Everybody just carried hand tools in their rig all year and anytime there was anything plugged or needed another water-bar, you'd just take care of it as soon as you see it – on your way out or on your way in. Kick a clogged culvert loose or whatever. People don't do that anymore. I'm the only person, out of probably more than 50 people out there, that does hand maintenance.

Now they spent \$20,000 on a big road job last year, the rich guys did. That was fine but they don't do anything [in terms of maintenance] so it's already rutted. It's already eroded. They've got the proper rolling dips finally for the first time since I've been there – with that kind of traffic you need it – but without maintenance, within five years, it will be back to where it was. And everybody keeps telling them that.

The Mattole Restoration Council, they came out and put in new culverts for free and did a lot of work. And people are just kind of pissed off at them for blocking the road. It was weird. (Interview with Landowner #11452, 10/22/2008)

Several other recipients of direct implementation aid described a similar lack of gratitude and unwillingness to alter driving patterns or maintenance practices to preserve the upgrade.

The MRC, the non-profit organization that implemented the project described above and is responsible for the majority of the direct project implementation in the region, addresses this challenge by (a) prioritizing projects that do not require much maintenance, (b) only implementing projects that are supported by most landowners, and (c) trying to educate the contractors and equipment operators who do most of the road work in the region. Joel Monschke, their program director explains:

JM: Usually on the road upgrades, we'll put in structures large enough that there will be no problems and no worries. We're trying to show them the right way so that in 20, 30, 50 years, their kids will do it again.

With the road reshaping, we want them to understand that we are trying to keep the water off the roads so that the next time it gets graded they will try to encourage the contractor to keep the shape there. Part of it is also working with local operators. We work with four or five operators who also do a lot of the private roads around here. That's where most of the education is happening. For the most part they are pretty good, they are a critical part of the whole.

AS: Do you try to get people to use rolling dips, outsloping?

JM: We never push those if people don't want them. I think it's bad practice to push anything unless you really know it's going to work. I don't believe very firmly in outsloping and rolling dips on all season roads. They aren't long-term

solutions unless the landowners are very enthusiastic. They wear through the outcroppings and dips with their wheel tracks. I might recommend them on roads with only one to two families but not more than that. (Interview with Joel Monschke, MRC, 11/24/2008)

Each approach provides resources that help landowners overcome the knowledge and resource barriers to implementation of BMPs. The passive technical and financial assistance approach that is common to agencies and non-profits in the basin has the benefit of providing resources to landowners who are willing to apply them. However, the reliance on landowners to seek out the resources may lead to uneven effects across the landscape. The project implementation approach allows agencies or non-profits to concentrate their resources in high priority areas and to reach landowners that otherwise would not have the desire or perceived need to seek out assistance and implement BMPs. The drawback of this model is that it may not generate sufficient buy in from landowners to ensure that they will maintain the structures. All three approaches carry the potential for spillover through landowners' information sharing networks or through chance exposure.

Linkages Between and Commonalities in Regulatory and Non-Regulatory Programs

The previous sections considered how governance strategies affect the adoption of BMPs across different categories of private lands in the North Coastal Basin. Though I treated regulatory and non-regulatory programs separately, in this discussion I argue that this common distinction can be misleading. For NPS pollution control, these mechanisms necessarily work in tandem and share some common characteristics. In the remainder of this chapter, I first consider the interdependencies of regulatory and non-regulatory approaches and discuss the importance of these links in the context of work on new environmental governance. I then explore a key feature of the regulatory and non-regulatory programs that can lead to implementation of BMPs beyond the program site: the role of personal relations and open communication between landowners and professional contacts.

Interdependency of Regulatory and Non-Regulatory Policy Tools in the Age of New Environmental Governance

Over the past two decades, several scholars have documented a trend towards 'new environmental governance' in the United States. New environmental governance involves the decentralization of environmental protection, incorporation of collaborative, participatory and flexible styles of governance, and an expansion of place-based grassroots environmental initiatives (Freeman 1997, Innes 2004, John 1994, Lubell et al. 2002, Press and Mazmanian 2000, Rabe 2000, Sabel et al. 2000, Weber 2000). These strategies are generally less adversarial than traditional command and control regulation and involve more voluntary and non-regulatory approaches. These new forms of governance are viewed as responses to the failure of federal environmental regulations to address the complex environmental problems of NPS pollution, integrated ecosystem management, and restoration (Andrews 1999, John 1994, Kraft and Vig 2000, Lowry 2000, Lubell et al. 2002, Rosenbaum 2000).

Though some still view state and national regulatory standards as important components of pollution control (John 1994, Rabe 2000), the newer less adversarial and often non-regulatory policy tools are often evaluated independently of regulation. The literature on collaborative environmental policy is particularly prone to discussing and evaluating collaborative approaches without considering the role of regulation in the process. Koontz et al. (2004) begin to address this gap by explicitly examining the multiple roles that government actors play in the collaborative process.⁹² Though Koontz et al. (2004) implicitly recognize the links between regulation and collaborative processes, they focus more on the role of government actors and institutions rather than the power or role of the regulations themselves. Few studies have explicitly examined the actual linkages and interdependencies between regulatory and non-regulatory policy tools.

In an article that strives to bring this issue to the forefront of the policy studies literature, Nie (2008) notes that there is an “emerging debate in the fields of environmental and natural resources law regarding the interactions between policy tools,” and especially the degree to which regulatory tools are relevant in this age of new environmental governance (p 140). He goes on to highlight some examples of recent research that show how regulatory enforcement can lead to the use of non-regulatory or less adversarial strategies (e.g., collaborative agreements, land and resource acquisition) to achieve conservation goals. In each of these cases, it is the threat of regulatory enforcement that drives or contributes to the success of alternative approaches. He argues that weakening the regulatory hammer could also weaken non-regulatory tools and suggests that regulatory enforcement is thus a fundamental component of the environmental policy portfolio. This coercive function of regulation and the need for a multi-pronged policy approach that includes a suite of regulatory and non-regulatory tools is well recognized in the economics literature on NPS policy (See, for example, Alberini and Segerson 2002, Ribaud and Horan 1999, Segerson and Wu 2006).⁹³ My research reinforces this argument and shows additional ways that regulatory and non-regulatory programs are linked and highly interdependent.

This chapter reveals three ways that the linkages between regulations and non-regulatory programs lead to greater regulatory compliance and more widespread use of BMPs for the reduction and control of NPS pollution. First, the threat of impending regulations can lead the would-be-regulated parties to participate in non-regulatory programs that accomplish the regulatory goals. With respect to the implementation of BMPs to prevent

⁹² Koontz and collaborators have contributed several studies that build on the framework introduced in Koontz et al. (2004) and examine the roles of government actors in non-regulatory processes (e.g., Koontz 2006, Nikolic and Koontz 2008).

⁹³ The economics literature frames the problem a bit differently. Rather than looking generally at the ways in which regulatory and non-regulatory programs may be linked, this work specifically examines the conditions that lead to successful voluntary strategies (e.g., voluntary BMP implementation, education). The specific economic argument that links regulations and non-regulatory programs is that the success of voluntary NPS policies is contingent on a regulatory threat that can be used as a back-up plan should the voluntary program fail (Segerson and Wu 2006).

sediment pollution in the North Coastal Basin, the perceived threat of future regulations can lead landowners to utilize non-regulatory resources to increase their knowledge about sediment pollution and BMPs, and also to implement BMPs before the regulations arrive. This pathway can be seen through the example of the Yager/Van Duzen Environmental Stewards (YES). The formation of YES and subsequent use of cost-share and grant funding to implement BMPs was a direct response to the TMDL process for the Van Duzen. Participation in these non-regulatory programs increased YES members' knowledge about BMP implementation and ultimately changed road management practices in and beyond the grant and cost-share project areas, thus accomplishing some of the TMDL goals. Without the regulatory threat, the Yager Creek and Van Duzen ranchers would not have had a strong incentive to form YES, and it is unlikely they would have collaborated with staff at the EPA, learned about BMPs, obtained grant and cost-share funding, and applied BMPs across their properties.

Second, regulations can have an educative component that can lead regulated landowners to utilize non-regulatory resources to bring unregulated areas up to regulatory standards. For regulations associated with sediment pollution, this means that the regulatory requirements that force the application of BMPs and/or interaction with professionals (e.g., RPF, agency staff) can increase the regulated landowner's knowledge about both the utility of BMPs and the availability of non-regulatory resources, which can lead to the utilization of non-regulatory resources beyond the regulated areas of the property. This pathway is seen most clearly in the discussion of timber regulations. The FPA and FPR require landowners to consult extensively with an RPF and implement BMPs in harvest areas. This process increases the regulated landowner's knowledge about BMPs, which may increase their desire to implement them on unregulated areas of their property. In addition, RPFs often make these landowners aware of the availability of non-regulatory resources (both technical assistance and grant funding), which they then use to implement BMPs in unregulated areas of their property.

Third, participation in non-regulatory programs can lead to greater compliance with regulations. This chapter notes that enforcement beyond timberlands tends to be relatively weak as non-timber landowners are often off of the enforcement radar (a phenomena that will be discussed in greater detail in Chapter 6). However, participation in a grant-funded or cost-share project brings a particular management activity into the sight of regulating agencies since acquisition of all required permits is a condition of the funding. In some cases, working with agency staff to obtain permits for grant or cost-share projects simply adds an extra layer of bureaucracy to a NPS mitigation project. In other cases, the process can change participating landowners' awareness about regulatory requirements and their attitudes about regulatory agencies. Working with agency staff in a primarily non-regulatory context reduces some of the fear associated with regulatory agencies, which can facilitate future exchange of knowledge about BMPs.

The first link highlighted through this research parallels the linkages discussed by Nie (2008) and briefly mentioned by Koontz et al. (2004) in that the threat of a regulatory action compels alternative non-regulatory activities. This coercive model underlies the current NPS policy strategy of the State Water Resources Control Board (SWRCB) and

the North Coast Regional Water Quality Control Board (NCWQCB). The California NPS Pollution Strategy (SWRCB and EPA 2004), which guides the NCRWQCB sediment control policies as well as the NPS pollution control policies throughout the state, utilizes a “Three-Tiered Approach” that includes:

- Tier 1: Self-Determined Implementation of Management Practices [formerly referred to as “voluntary” implementation],
- Tier 2: Regulatory Based Encouragement of Management Practices, and
- Tier 3: Effluent Limitations and Enforcement Actions.

This approach and staff at the NCRWQCB recognize the limits of a solely regulatory or non-regulatory approach for addressing NPS pollution and aim to use an approach that uses the regulatory hammer to prompt landowners to utilize non-regulatory incentives.

However, the influence and interdependency of regulatory and non-regulatory efforts need not always be as coercive as this first model. The second model reveals how regulation can have an educative function that motivates landowners to undertake voluntary actions even in the absence of any additional regulatory threat. Such links, which do not depend on regulatory duress, merit additional consideration as they suggest additional governance strategies that have not received much attention. In particular, it is important to consider the characteristics that make this model successful in this case, and if and how this model could be replicated for other problems.

Though a complete answer to these questions reaches beyond my research, I can suggest three conditions I believe are fundamental for the successful replication of this model. First, the mandated BMPs have tangible benefits for the landowner as well as the environment. Regulated landowners that have utilized non-regulatory resources to apply BMPs beyond the regulated areas of their land may do so because of concern for the environment. More often, they do so because the BMPs reduce long-term maintenance costs and thus bring them tangible benefits. Second, non-regulatory resources must be readily available. This is particularly important when the costs of implementing BMPs are high. Finally, this model relies on the presence of a trusted knowledge broker who can effectively act as a liaison between the landowner and the regulating agency. This liaison is built into the regulatory process for timber harvests through the requirement for using a RPF. For regulations that do not require a third party consultation, my experiences suggest that in the right conditions a trusted agency staff person could also serve this role. The next section examines the qualities of an effective liaison or knowledge broker in more detail.

Commonalities in Regulatory and Non-Regulatory Mechanisms

Landowners’ involvement or association with regulatory and non-regulatory programs can lead to increased knowledge about BMPs and spillover implementation of BMPs beyond the regulated or grant project area. I saw these spillover effects most frequently with landowners who harvest timber, though I also encountered evidence of this process on other land uses. These observations led me to consider: What are the key factors that contribute to the most frequent spillover effects? And, why is the effect more common on timberlands?

Answering these questions leads back to a key finding from Chapter 4; namely, that the utilization of professional technical assistance is highly correlated with increased familiarity and knowledge of BMPs as well as self-reported rates of implementation (Table 4.7, Table 4.8, and Table 4.13, Figure 4.5). Landowners encounter and interact with professionals (from regulatory and non-regulatory agencies, non-profits and private consultancies) through the regulatory process, grant or cost-share programs, utilization of professional technical assistance, and chance encounters. Only some of these interactions lead to a significant exchange of knowledge or to further implementation of BMPs. Through interviews with landowners as well as agency staff and other professionals, I identified three key characteristics of the interactions between landowners and professionals that facilitate spillover effects: (1) the interaction must be an *exchange* of knowledge, where the professional respectfully listens and considers landowners' ideas, (2) the professional must have local experience and an understanding of the community, and (3) the professional must also use "common sense" and tailor recommendations to fit local conditions.

Three representative conversations provide a vivid picture of these characteristics. The first is from an interview with a Humboldt County landowner who owns and harvests timber from multiple properties:

LO: I've dealt with Fish and Game for the crossings and they seem pretty fair. There is one inspector who is really fair. It's not that he's easy. It's just that you always know what he expects and as long as everything is done according to the agreement, you will be fine. I would say that my experiences with Fish and Game are positive. That's the thing with Water Quality and different agencies, if it could be more black and white, and the inspectors couldn't interpret things differently, then it would be better.

AS: Are you able to have a back-and-forth about ideas with the Fish and Game inspector?

LO: This guy really knows what he is doing. He's not fresh out of college and has a lot of experience working in this area. I know that at some point he was out of college but he's beyond that now. He would listen and think about a landowner's suggestion but if he doesn't think it's right, he'll still make you do it his way but if it makes sense, he will change. That's what landowners want – someone who will listen if they have an idea about how to do something and consider if it will work. (Interview with Landowner #11846, 9/25/2008)

The second is from an interview with Gary Flosi, who works on restoration projects throughout the North Coastal Basin and often works directly with landowners. Our conversation frequently found its way to a discussion of the relationships he develops with landowners. He discussed his contacts with the ranching community as follows:

GF: My children...were active in 4H and FFA [Future Farmers of America] and, through those contacts, I've met a lot of people in that community. So, I would say that there's some benefit to that getting to know people – there's a huge benefit of getting to know people outside of 'Gary Flosi from State Department of Fish and Game.' They see you at the fair or they see you at a woolgrowers

meeting or they see you at a soccer game or whatever. There's a huge benefit to that and I kind of preach that to the younger guys here to have people get to know you somewhere outside of this. It can have huge benefits on what you are able to do. (Interview with Gary Flosi, CDFG, 10/20/2008).

Later in the interview, I asked him about how much education he does when working with different groups of landowners. His answer wound its way to this point:

GF: You have to be careful because you don't want to alienate [the landowners] by going in and saying "what you are doing is wrong." But, you want to say "how about trying this?" [laughs] "And we'll pay for it." And all of a sudden, they see it a little differently, if it works. So you have to kind of feel your way into that stuff. You have to be really careful that you don't go in there and say, "what you are doing is wrong." If they get their defenses up then it's over.

AS: When you started doing this kind of work, did you anticipate that there would be so much... "people work," I guess?

GF: No, they don't teach you that in school, and it really is people and relationships and getting people to work with you – that is a huge part of it. You have to have that skill or at least want to do that. (Interview with Gary Flosi, CDFG, 10/20/2008).

The third is from an interview with a Humboldt County residential landowner who worked with a watershed-based non-profit on a large restoration project and several sediment source inventories on ranches and subdivisions. We talked about his experiences with the ranching community, both on the assessed ranches and elsewhere:

AS: Were [the ranchers] receptive to your recommendations?

LO: They were pretty receptive, but it depends on how you talk to them. There was a guy that came through and put himself out as an environmentalist and he really irritated people. His attitude put people off. A lot of it has to do with being local and going around with local people. Working with [a local contractor] gave us credibility and the way we presented things made people receptive. You don't wear an LL Bean hat or anything like that. (Interview with Landowner #11211, 8/25/2008)

All of these conversations highlight the importance of *how* information is presented and the tone of the interaction. Gary Flosi and the landowner doing outreach with ranchers discussed the importance of not imposing solutions from above. The timber-landowner described his positive experience with the CDFG inspector who would listen to his suggestions, even if he did not always incorporate them. Many of the multi-generational landowners in the ranching community pride themselves on being good stewards of the land and their knowledge of the land. Professionals who acknowledge and respect this long-term experience have more positive interactions with landowners. My research has led me to believe that this translates into greater exchange of knowledge and willingness on the part of the landowner to experiment with new road management techniques. Top-

down and heavy-handed recommendations and requirements result in resentment, which can lead landowners to discount the knowledge of professionals.

The importance placed on local experience in establishing positive interactions also cannot be overstated. This comes to play in the second and third characteristics. Local experience establishes contacts and credibility in the community, a credibility that comes from understanding the goals, needs, and experiences of the landowner. As one landowner put it, “If they have a background similar to landowners, they usually know what the property owner or the citizen is going through, which I think is very important” (Interview with Landowner #10443, 8/25/2008). Local experience is also associated with better understanding of site-specific conditions, the need to tailor BMPs to match these conditions and what many landowners termed “common sense.” In contrast to the positive experiences described above, many landowners expressed tremendous frustration at dealing with bureaucrats or environmentalists who recommend BMPs based on “books” without visiting or understanding the field. Professionals who demonstrate attention to site-specific conditions garner trust from the landowners and are also more likely to recommend BMPs that will be successful in the local conditions, which can lead to more widespread use of BMPs.

While the interviews cannot be used to directly link these interactions to the spillover effects, the frequency with which landowners and agencies described these characteristics, the importance placed on them, and the quantitative links between professional interaction and BMP knowledge and implementation from the survey combine to suggest that they are the driving forces behind successful information exchange and learning.

Furthermore, it is important to note that such trusting, respectful and reciprocal relationships between landowners and professionals can be established even when the parties involved are normally in conflict with one another. In each of the conversations highlighted above, the interactions discussed were between groups that are usually portrayed as in conflict with each other: regulations with landowners, and ‘environmental’ residential landowners with multi-generational ranchers. The stereotyped conflicts are not as rigid as they seem and, in particular, my fieldwork suggests there is a softening of rancher’s attitudes towards both agency staff and newer landowners.

Understanding these particular characteristics of profession-landowner relationships that facilitate the exchange of knowledge also helps to explain the second question of why spillover appears to be more common with landowners involved in the timber industry. The structure of the regulatory process associated with timber harvests forces landowners to interact with a RPF, or to transfer decision-making power to their RPF. The RPF is an ideal knowledge broker and liaison, easily satisfying the conditions of good relationships described above. Since the landowner has the power to select and fire their RPF, the RPF is accountable to the landowner and timber-landowners tend to trust their RPF wholeheartedly. Though RPFs may receive their forestry training outside of the region, they live locally and have substantial experience with crafting management plans appropriate

for local conditions. During the preparation of the harvest plan, the RPF surveys the land extensively, often taking many trips across the property to flag trees for the harvest and to understand the site conditions. Some interviewed landowners explained that they accompany their RPF on these surveys, offering suggestions based on their own experiences and listening to the RPF explain the requirements of the FPR and also new management techniques. In these conversations, landowners and RPFs can freely and candidly discuss the BMPs required by the FPR and associated regulations, and consider which they believe would be useful to implement elsewhere on the property.

In this consideration of the factors that facilitate the exchange of knowledge and more widespread implementation of BMPs, I focus on openness and respect on the part of the professional, who is often an agency staff-person. Though this adds additional evidence supporting the value of non-adversarial governance approaches, I want to avoid the trap of suggesting that voluntary and collaborative approaches are the only and necessarily best approaches to the situation. More heavy-handed regulatory approaches play an important role in mandating the interaction between landowners and RPF and providing incentives for engagement with agencies (as in the case of the Yager/Van Duzen Environmental Stewards). Even beyond that important role of regulations, the “bad-cop” can play an important role in imposing sanctions or mandating BMPs for landowners who remain resistant to engagement with professionals.

Conclusion

This chapter examines the mechanisms through which regulatory and non-regulatory programs lead to the development of knowledge about BMPs and adoption of BMPs. To do so, I propose a conceptual framework that helps to explore the factors that *facilitate* the need or desire to utilize BMPs as well as those that help motivated landowners to overcome the knowledge and resource *barriers* to BMP implementation.

I find that regulations or the threat of regulations that are perceived to be strong can create a regulatory necessity that can facilitate learning about and implementation of BMPs on and beyond the regulated areas. Environmental concern, belief in the economic utility of BMPs, and serious problems with the road network are also motivating factors that facilitate learning about and adoption of BMP. Non-regulatory programs are most effective in helping motivated landowners overcome the barriers to BMP implementation.

Since the strength and enforcement of regulations differ by land use, this explains the finding of Chapter 4 that landowners with working lands, which are or are perceived to be more heavily regulated, have more consistently high levels of BMP knowledge and implementation.

These findings clearly demonstrate the interdependencies of regulatory and non-regulatory programs. Regulatory and non-regulatory programs in the North Coastal Basin work in tandem, with regulatory programs facilitating motivation and non-regulatory programs helping to overcome the barriers to BMP implementation.

Finally, this analysis highlights the important (but often unnoticed) role key professionals can play in facilitating the exchange of knowledge between landowners and agencies, and demonstrates that the particular style of interaction used by professionals affects landowners' management practices and thus shapes environmental outcomes.

Chapter 6

Limits of Governability: Weak Control of Roads Used for Residential Purposes and Marijuana Cultivation

“As a rancher and timberland owner, I am a good steward of the land. We have operated here for four generations. The big problems are the small 5-10 acre house lots. They have poor quality roads. Most ranchers take care of their own property with their equipment. Another big issue are the marijuana growers. They are getting away with pumping the creeks dry, killing animals and moving large amounts of dirt, all for pure greed of money. Why does government not go after these people? They suck off the system by not paying taxes, then mess up the environment. This is a huge problem. Most responsible landowners like me are very angry at this unfair two-tier system. Government needs to enforce the laws for everyone!!”

~ Anonymous comment from landowner written on mail survey

The previous three chapters identify the formal regulatory and non-regulatory governance arrangements that aim to limit sediment pollution in the North Coastal Basin (Chapter 3), document road management practices on different land uses in the basin (Chapter 4), and explain the mechanisms through which regulations and voluntary programs directly and indirectly influence management practices (Chapter 5). These chapters collectively explore when and how governance arrangements influence landowner’s knowledge and management practices.

The governance arrangements explored in the previous three chapters do not evenly influence the management practices across the entire spectrum of land uses. This chapter moves away from the success stories of Chapter 5 and into the murkier area of identifying and analyzing the land uses that generally fall outside of the direct and indirect influence of governing actors. In particular, I show how lands used for residential purposes⁹⁴ as well as those used for marijuana cultivation fall beyond the influence of the major regulatory and non-regulatory programs examined in earlier chapters.

My goal in this chapter is to draw attention to the presence of ‘ungoverned’ land uses in the North Coastal Basin and suggest that similarly ‘ungoverned’ areas may be present across the rural United States as well as in other counties and contexts. My overarching argument is that the governance of environmental problems is shaped by the governability of the landscape and landowners rather than just by the environmental

⁹⁴ The category of ‘residential’ land uses includes landowners using their lands as their primary residence as well as those using their lands for second or vacation homes. Many of the observations and conclusions also apply to absentee landowners.

problem itself. I advance this argument separately for the cases of residential land use and marijuana cultivation.

I first discuss the weak governance of private residential roads. I begin by showing that residential roads pose a risk of sedimentation that is comparable to or greater than the risk associated with roads on timberlands, and that residential landowners' knowledge and rate of application of best management practices (BMPs) varies widely. I argue that this variance is due to the weakness of regulatory controls on residential roads and the limited influence of non-regulatory programs in residential areas. While the failure to more uniformly govern residential roads is partially linked to the logistical challenges of governing residential landowners, the roots of this failure are deeper than these logistical arguments. I argue that the difference in governance stems primarily from beliefs about private property rights and historic location of land-use planning power at the local level rather than the state or federal level. I conclude the residential section with a discussion of the consequences of this weak governance in light of trends in land-use change in the North Coastal Basin and across the rural United States.

In the second section, I turn my attention to lands used for marijuana cultivation. I contrast the widespread public and media recognition of the marijuana industry in the region with the near absence of formal strategies to address the environmental problems associated with marijuana cultivation. Building on interviews with staff from natural resource agencies, drug enforcement agencies, and nonprofits as well as the first hand experiences of landowners, I discuss the range of environmental problems associated with marijuana cultivation and the (lack of) agency response to these problems. I show that the lack of environmental governance stems from the potential illegality of the land use and the perceived threat of violence associated with that practice.⁹⁵ This discussion provides a clear example of an 'ungoverned' and arguably 'ungovernable' area in the United States, and I conclude this section by suggesting the need for further investigation of the causes and consequences of ungovernable lands across and beyond the U.S.

Weak Governance of Residential Roads

As the quote at the beginning of this chapter suggests, many ranchers and timberland owners point to rural residential roads as having some of the most egregious erosion problems in the region. Though these claims about the relative quality of residential roads can be motivated by the desire to turn regulatory attention away from ranch and timberlands, they are supported by road assessments in the region as well as anecdotal evidence from staff at natural resource agencies, nonprofit organizations, and private consultancies.

⁹⁵ It is important to recognize that my argument is that the *environmental issues* on lands used for marijuana cultivation are ungoverned, not that the lands are entirely ungoverned. There are other formal and informal controls that govern other behaviors on these lands (e.g., plant eradication programs run by the Campaign Against Marijuana Planting, informal social norms regarding territory), but environmental issues do not receive much attention from natural resource agencies or non-profit environmental groups.

One residential landowner I interviewed worked with a local watershed group for several years in the early 2000s.⁹⁶ In this position, he was trained by professional consultants and staff at regulatory agencies to assess the sediment risks associated with roads and completed inventories of road-related sediment risks on both timber-producing ranches and residential subdivisions. He explained his experiences as follows:

I did road inventories and assessments of two big ranches and two subdivisions. The subdivisions are nightmares, while the ranchers have had to get to the CDF [now CAL FIRE] standards because of the logging. There's a lot of petty squabbling with a lot of road associations. Ours is okay because we have legal power to take action if someone doesn't pay but on [one of the assessed subdivisions], the roads were absolutely terrible and sometimes impassable because no one pays or cares to maintain them. (Interview with Landowner #11211, 8/25/2008)

Later in that interview, I asked that same landowner and watershed group employee if he thought landowners impacted the environment. He responded:

LO: I think there are two categories: large ranches, which have a positive effect, and subdivisions, which have a negative effect. Subdivisions have an extensive road system and they don't pay attention to the drainage and don't think of erosion as a problem. To them, the only problem with erosion is it makes big ruts and you can't drive fast on the roads. I would like to think that by now, most of these subdivisions are aware. It's too bad.

I know that [one particular residential landowner] was interested from the environmental aspects not just driving faster – not only from the point of having good roads but also from the detrimental effects on the water. These other subdivisions – I can't speak for all of them but, like I said, if they are aware, they aren't motivated to put the money into it. They have their own self-interests and don't really care.

AS: Do you think they have the knowledge to stop those impacts?

LO: The ranchers have been educated by CDF to a certain point. The CDF standards aren't the same as Fish and Game standards. But having been exposed to the CDF standards and the fact that they do have to do something has changed a lot.

(Interview with Landowner #11211, 8/25/2008)

Gayle Garman, an environmental scientist working on the California Department of Fish and Game (CDFG) Northern Region Coho Recovery program, also noted that some rural residential roads pose a risk for sedimentation due to improper design or maintenance. She explained:

We find that some of the roads in rural residential developments are important sources of sediment delivery to streams. These roads often were built in past

⁹⁶ The name of the watershed group is withheld to maintain confidentiality of the interview respondent.

decades, before the standard of practice included knowledge of culvert capacity or fail-safe design. In many cases these roads and their stream crossings are not maintained often enough to catch problems before they become expensive to fix. (Interview with Gayle Garman, CDFG, 11/24/2008)

The observations of the landowner and Garman represent the general perception of the quality of rural residential roads. Though there are certainly many high quality and well-maintained rural residential roads scattered throughout the region, rural residential roads are often relatively poorly designed and maintained and thus pose a high risk for sedimentation. The above quotes hint at several reasons that rural residential roads may pose a higher risk of sedimentation than roads on working timber and ranch landscapes. The fundamental reasons are (a) that the original construction of the residential roads does not match the current use patterns and (b) that rural residential landowners may not have the resources, knowledge or sense of responsibility to maintain the roads properly.

My interview data and observations suggest that when large timber or ranch parcels are subdivided for rural residential development, the new landowners often keep the original road networks. These roads were originally constructed as ranch or timber roads, and thus usually designed for dry-season use and low traffic. However, residential landowners typically use their roads all year round (in both the dry season and the wet season, when there is a higher risk of sedimentation). Approximately 67 percent of residential survey respondents report that they use their entire road network in both the dry and wet seasons (while only 24 percent of timber land owners and 36 percent of non-timber ranchers use all of their road network all year round). In addition, the subdivision of large parcels often increases the frequency of traffic on the roads, with more drivers taking more trips each day. My interview data also suggests that many residential landowners do not maintain their roads to minimize sedimentation, and the survey results show that residential landowners have implemented fewer BMPs than timberland owners and non-timber ranchers (Table 4.8).

Contributing to and compounding the relatively high risk of sedimentation from residential roads is that residential landowners tend to have less knowledge about BMPs than those with timber or non-timber ranch lands. On average, residential landowners (including landowners using their property as their primary residence as well as those with second or vacation homes on their property) demonstrated less BMP knowledge and self-reported application of BMPs than landowners using their land for timber, ranching, or agriculture (Chapter 4). In addition, there was more diversity in the knowledge of residential landowners than in timber-landowners. While the vast majority of interviewed timber-landowners (85.7 percent) demonstrated knowledge about the relationship of roads and sediment, residential landowners displayed more diversity in their knowledge about BMPs (Figure 4.6).

In the sections that follow, I argue that the greater diversity in knowledge and lower average familiarity with and implementation of BMPs stems from the comparatively weak regulatory oversight and sparse non-regulatory attention for residential lands. While timber landowners and non-timber ranchers are more uniformly compelled to implement BMPs through the direct necessity created by regulations or the threat of

regulations, residential landowners lack a regulatory necessity that facilitates broad implementation of BMPs. Their acquisition of the knowledge and resources to implement BMPs is thus contingent on self-motivation and desire, which explains the diversity of knowledge as compared to the timber landowners. I follow this argument with a discussion of the logistical as well as the deeper historical cultural and legal factors that reinforce the uneven governance arrangements. I conclude this section with a consideration of the consequences of this disparity in light of the trends in land-use change in the North Coastal Basin and a discussion of the broader implications of this finding.

Lacking regulatory necessity and scattered non-regulatory assistance

The regulatory landscape is weaker on residential lands than timberlands and the perceived threat of regulation is less on residential lands than on non-timber ranchlands (Chapters 3 and 5). The scope of regulated activities and prescribed standards are less stringent on private residential roads than those for roads on timberlands (Table 3.3).⁹⁷ While both existing and new roads are regulated on timberlands, only the construction of new roads and upgrades to stream crossings are regulated on other land uses.⁹⁸ Where road construction and re-construction activities are regulated on all land uses, the BMPs and construction standards required for the residential roads are often less stringent than those mandated by the Forest Practice Rules (FPR) for timberlands. For example, the FPR requires all culverts used for stream crossings to be sized large enough to accommodate the 100-year flood event while the Garcia Action Plan (which applies to all land uses in the Garcia watershed) only requires them to accommodate the 50-year flood event and other general regulations do not mandate a particular size.⁹⁹

⁹⁷ Roads on non-timber producing ranches are also weakly regulated and non-timber producing ranchers report a wider range of BMP adoption than timber producers. However, non-producing timber ranchers receive more attention from non-regulatory organizations, have a strong fear of regulatory requirements, and generally have more connections to timber landowners. These factors lead ranchers to have more direct relationships with governing actors than residential landowners.

⁹⁸ The Forest Practice Rules (FPR) mandate the use of certain BMPs on existing and new roads associated with timber harvest plans (THPs) on timberlands. In contrast, the regulatory standards for residential roads that apply in both Mendocino and Humboldt Counties are limited to the alteration of watercourse crossings and regulations that apply only to ecologically impaired or sensitive zones (e.g., the impaired Garcia watershed where roads on all land-uses are technically regulated under the Garcia Action Plan, areas with an endangered species where a professional consultation and/or a Habitat Conservation Plan may require mitigation measures associated with road). In Humboldt County, the Grading and Streamside Management Ordinance places some regulatory controls on the construction of new roads.

⁹⁹ Across all land uses, erosion control or other project plans that are developed to comply with the Endangered Species Act (ESA), CDFG Code 1600, and the Garcia Total Maximum Daily Load (TMDL) Implementation Plan may include BMPs that go beyond the requirements of the FPR, but this extension is not strictly required. While these site-specific permitting processes can apply to all land uses, timber landowners are more likely to obtain regulatory permits than residential landowners. While 26.6 percent of timber landowners have obtained permits other than THPs, only 8.4 percent of residential landowners (both primary residence and

Differences in the monitoring, enforcement, and perception of the importance of regulations further compound the discrepancy in the regulatory landscapes and the resulting differences in management practices. While the Forest Practice Act (FPA) and FPR require an extensive and funded monitoring program associated with timber harvests, monitoring and enforcement of road regulations for non-timber land uses is essentially non-existent. Most agencies do not have sufficient enforcement staff to cover their entire region. Humboldt County has a single code enforcement officer for the entire county and the North Coast Regional Water Quality Control Board (NCRWQCB) has only four staffed enforcement positions for the North Coast region (which includes the North Coastal Basin and the Klamath River basin). With thousands of miles of roads dispersed across the landscape and so few enforcement staff, comprehensive on the ground monitoring is unrealistic.

Agency enforcement activities on residential roads are thus limited to responses to citizen or public tips and complaints about non-compliance. However, citizen complaints are rare. Since the roads are on private property, there are few opportunities for legal access for interested citizens to monitor private roads and, except in cases where there is animosity between neighbors, landowners in the region do not frequently interfere in the management decisions of their neighbors. Residential landowners' perception of the risk of agency or citizen enforcement of existing regulations are well-represented by the following observations about enforcement:

The county doesn't have any resources. They can't even enforce the building codes. And the community really minds its own business. No one can afford to stick their neck out. (Interview with Landowner #11211, 8/25/2008)

[Landowners] don't worry [about enforcement] because it hasn't happened and it's been so long that they feel like they have a right to do these things. It's a culture of having a right to do as you want and not have the government involved. (Interview with Landowner #10746, 8/27/2008)

Overall, residential landowners express little concern about enforcement and little awareness about their regulatory responsibilities. Even in the Garcia watershed in southern Mendocino County, where the Garcia Action Plan does mandate standards for residential roads, residential landowners expressed little awareness or concern about these regulatory responsibilities. The residential landowner I interviewed in the Garcia watershed expressed little worry about relevance of the regulatory standards for his roads and none of the 14 survey respondents who own non-timber property in the Garcia watershed indicated that they had completed an Erosion Control Plan (ECP) as mandated by the Garcia Action Plan (while three of the eight survey respondents with timberlands in the Garcia watershed do have an approved ECP).

second/vacation home) and 7.5 percent of non-timber working landowners have obtained non-THP permits. These differences are statistically significant with a P-value < 0.001.

In addition to regulatory weakness and the lack of concern with respect to the enforcement of current regulations on residential lands, residential landowners in the North Coastal Basin are also relatively unaware of and unconcerned by proposed regulations that would apply to their roads. This can be seen clearly through a comparison of the responses of residential and ranching landowners to the process of developing more comprehensive sediment control regulations that would apply to all land uses throughout the basin.

From 2004 to 2008, NCRWQCB staff took steps to develop more comprehensive regulations to address sediment pollution in impaired watersheds throughout the basin. The steps included:

- The development of a staff work plan to prioritize and guide regulatory and non-regulatory sediment control programs across the region (NCRWQCB 2004d, NCRWQCB 2008a), and
- A shift from a watershed-by-watershed approach for the development of Total Maximum Daily Load (TMDL) implementation plans to the development of a Basin Plan amendment that would include a region-wide prohibition on sediment discharges, including sediment sources associated with “road construction, reconstruction, maintenance and decommissioning” on all land uses (NCRWQCB 2007b).¹⁰⁰

The 2004 Resolution that mandated these activities was thought to create “a ‘level playing field,’ as it is applicable to all landowners and land uses within watersheds that drain to sediment-impaired water bodies” (NCRWQCB 2004c). However, the perception of its importance varied tremendously across different groups of landowners.

Residential landowners conveyed very little awareness or concern for the impending regulations and I did not find any evidence of residential landowners who implemented BMPs or accessed non-regulatory resources in response to the threat of this developing regulation. When asked if “people worry about regulators telling [them] what to do and how to use [their] land,” one landowner with a second home in Mendocino gave a typical response when he explained:

No, absolutely not. Nobody’s said a word about anything in all the time I’ve been there. (Interview with Landowner #20349, 7/25/2008)

Many timber landowners and non-timber ranchers, on the other hand, are keenly aware of this regulatory process and expressed concerns about the wide-reaching effects (and costs) of the forthcoming regulations.¹⁰¹ Many of the public comments expressing

¹⁰⁰ As described in Chapter 2, the Garcia watershed is the only impaired watershed to have a TMDL Implementation Plan, the Garcia Action Plan. The process to develop a basin-wide sediment prohibition included public workshops, meetings, and opportunities for public comments. Despite several years of effort on this basin-wide comprehensive program to implement the Sediment Controls, the Sediment Amendment never moved beyond the 2007 draft and was not brought before the NCRWQCB for approval.

¹⁰¹ The difference in attention and awareness reflect general differences in the expectations that residential and ranching landowners have towards regulation as well as differences in how

concern about the effects of the draft Sediment Implementation Plan and Work Plan came from agricultural and timber interests (NCRWQCB 2004c, NCRWQCB 2008c).¹⁰² This type of concern can facilitate the utilization of non-regulatory programs and the eventual implementation of BMPs prior to the regulations. The formation of the Yager/Van Duzen Environmental Stewards (YES) and their subsequent implementation of BMPs as a way to maintain control when threatened by TMDL regulations provides an example of this (Chapter 5).

With the exception of a few project implementation programs (e.g., the Mattole Restoration Council's Good Roads, Clear Creeks Program), non-regulatory programs also have more interaction with and effect on ranching and timber landowners than on residential landowners. Survey respondents with ranch lands, agricultural lands, and/or timberlands were significantly more likely to have utilized technical assistance resources than those with residential lands (Table 4.5). Education resources, workshops, and outreach efforts utilize information networks associated with the ranching, timber producing, and agricultural communities and are more easily accessed by those communities. For example, the primary organizations providing technical assistance about road management are the county Resource Conservation Districts (RCD), the University of California Cooperative Extension (UCCE) offices, local watershed organizations, and natural resource agencies. While the RCD and UCCE make their services available to all landowners, they have historically provided assistance primarily

NCRWQCB staff reached out to each group of landowners during the process. Consider my conversation with Holly Lundborg, a Senior Environmental Scientist at the NCRWQCB who was responsible for much of the public outreach during this four year process:

AS: In terms of your work that you've done – I think it was last year that you did workshops related to the sediment implementation policy – what kind of landowners did you end up talking to in those workshops?

HL: Well, let's see, I met with the Farm Bureau in Humboldt County and I had maybe 30 people there that day. I've had pretty much anybody that wanted to talk to me. I met with the individual foresters. CDF [now CAL FIRE], and Fish and Game came to one of the county meetings. I met with the county. I was going to go out and meet with the Mattole Restoration Council at their request but it was one of those days when in Petrolia there was a foot or two of snow and I elected not to go.

(Interview with Holly Lundborg, NCRWQCB, 12/18/2008)

In this exchange, Lundborg describes meeting with agricultural, timber, and government interests but no residential landowners or representatives of residential landowners. The only time residential landowners might have participated would have been in the Mattole watershed, through a meeting that was actively solicited by the Mattole Restoration Council (one of the few watershed groups that focus on residential land management practices). As I discuss later in this section, this imbalance in outreach to agriculture, timber, and government versus residential landowners is common across both government agencies and non-profit organizations. The infrastructure and expectations for outreach are stronger for the timber and agricultural communities than for residential landowners.

¹⁰² Other comments came primarily from watershed groups and private consultants and expressed general support for the effort, the need for watershed specific information to be added, or concern that particular regulations or strategies were not sufficient.

for agricultural, ranching, and timber landowners and continue to be viewed mainly as resources for those groups of landowners. This focus can be seen in the location of the Humboldt RCD offices – one is located in the county agricultural center and the other is located in Ferndale, a small ranching and dairy town. In addition, my interviews with representatives of nine community-based watershed groups revealed that most of their efforts are devoted to watchdog activities, lobbying for increased regulation, restoration, and/or outreach focused on working lands. Of the nine watershed based groups, two were formed by landowners with working landscapes and focus on restoration and sediment mitigation on those working landscapes; five were composed of residential members and focus on addressing the effects of timber production in their watersheds; and only two were formed by residential members and focus on mitigating the effects of residential as well as working land uses.

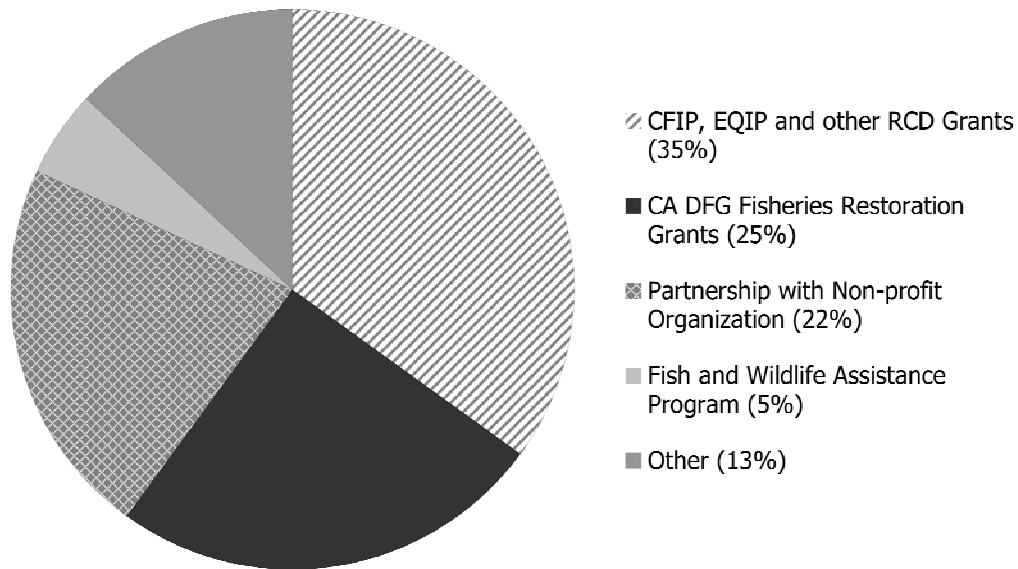
Financial assistance programs are also more readily available to landowners with working landscapes for two reasons.¹⁰³ First, several of the major financial assistance programs available for sediment reduction projects on rural roads are explicitly targeted at agricultural and forest landowners. Over a third of the financial assistance received by survey respondents came these programs: the CAL FIRE California Forest Improvement Program (CFIP), Natural Resource Conservation Services (NRCS) Environmental Quality Incentives Program (EQIP), and other grant or cost-share funds administered by county RCDs (Figure 6.1). Second, though grant-funding agencies will provide resources to be used on residential properties, my interviews with staff at grant funding natural resource agencies revealed that many of them prefer working with large landowners and several grant programs require smaller residential landowners to apply for funding through a non-profit organization or as a road association.

In Chapter 5, I argue that implementation of BMPs is facilitated by a necessity or desire that compels landowners to overcome the knowledge and resource barriers associated with the implementation of BMPs (Figure 5.1). I show that on timberlands, regulatory requirements create a necessity that directly leads to the implementation of BMPs in the regulated areas and can indirectly lead to BMP implementation in non-regulated areas (often through the utilization of non-regulatory resources). Though the discussion of YES and BRRRC, I also show that the threat of regulation or outside control can drive a similar necessity on ranch and other agricultural lands. In this section, I show that residential lands are weakly governed by both the state and civil society and argue that the weak governance contributes to residential landowners' lower average implementation of BMPs and the wider range of knowledge compared to landowners with timber, ranch, or other working lands. In particular, the weak standards and enforcement of sediment regulations on residential lands and the lack of pressure from non-regulatory groups leave many residential landowners without a compelling necessity to overcome the barriers to implement BMPs. Many of these landowners may not even

¹⁰³ Despite this focus on timber, ranch, and other agricultural land uses, survey respondents' utilization of cost-share and grant funding was not significantly associated with land use. The survey data does not separate grant and cost-share funding obtained by the landowner from that associated with project implementation programs. Excluding funds associated with project implementation may result in a stronger relationship between land use and financial assistance.

be aware that road-related sediment is an environmental concern. Utilization of non-regulatory resources and implementation of BMPs is thus linked more to underlying values and desires of individual residential landowners and/or dire problems with their road network rather than outside influence.

Figure 6.1: Distribution of Cost-Share and Grant Funding Received by Survey Respondents



Sources of Discrepancy: Logistics, Local Regulation, and Private Property Rights

As shown above, the risk of sediment pollution from residential roads is similar to or perhaps greater than the risk from timber and ranch roads, but the governance is much weaker for residential roads. This disparity motivates an exploration of the disconnection between the distribution of the sediment pollution problem and the governance of the problem.

To explain the lack of attention to residential roads, staff at natural resource agencies and non-profit organizations point to two primary logistical challenges of addressing management practices on residential lands. First, as addressed in the previous section, the pathways for residential regulation and outreach are less developed than the pathways for those with working lands. Second, working with many small residential landowners entails higher transaction costs than working with a single landowner with a large property used as a working landscape. The higher transaction costs are associated with the basic challenge of coordinating and communicating with multiple landowners as well as the deeper challenge of procuring agreement from neighboring landowners who may have conflicting goals and needs for the road and may also have personal conflicts that can obstruct the process. Conveying the experiences relayed to me by many agency and non-profit staff, Gary Flosi, the CDFG Program Coordinator for the Northern California-

North Coast Region, provides a clear description of these challenges:

GF: We've worked with road associations. We've worked with them in a variety of different ways. I will say it increases the cost and it increases the complexity of the project when you have to work with more landowners.

AS: Just in terms of coordination?

GF: Coordination, yeah, and you always get one or two people that seem like they are opposed to it or don't like something. You seem to have much more problems that way. Usually we are able to work it out but it takes a bit more effort. So anyway, it makes it a little bit harder.

(Interview with Gary Flosi, CDFG, 10/20/2008)

While these are real challenges and contribute to the lack of focus on residential roads, they do not fully explain the deeper reasons for the differences in the governance of sediment. My interviews and experiences in the North Coastal Basin (as well as general trends in environmental governance across the U.S.) suggest that the relatively weak governance of residential roads compared to timber roads is rooted in local attitudes regarding the sanctity of private property rights; the division of federal, state, and local regulatory power; and the way that policies tend to reflect the particular political circumstances and values of the times they are created. These three factors are well recognized as important forces that have shaped modern environmental politics and policies (Andrews 1999). In this section, I discuss each of these factors broadly and illustrate how they have shaped the governance of sediment in the North Coastal Basin.

First, the protection of private property rights is deeply entrenched in U.S. history and limits the government's power to control private land use. Ideologically, the colonial concern with limiting the government's involvement in land management was a reaction to the European system of feudal land tenure. Private property rights are constitutionally guaranteed by the Fifth Amendment, which protects individuals from the deprivation of life, liberty, or property without due process and ensures just compensation for the taking of private property for public uses. Conflicts over due process and the takings clause increasingly shape and limit governmental intervention in private land use for environmental protection (Andrews 1999, Fulton and Shigley 2005, Kraft 2001, Malone 1990, McSpadden 2000, Rabe 2000). Even where formal regulations apply to residential land uses, enforcement is rare, in part due to the fear of takings lawsuits. In addition, some environmental regulations include blanket exemptions for residential activities. In the North Coastal Basin, this contributes to the limited relevance of the Endangered Species Act (ESA), Garcia Action Plan, and other statewide or federal regulations on residential lands. In addition, community conceptions of private property rights further shield residential landowners from the responsibility to adhere to existing regulations because the shared beliefs in the right to use one's land as one sees fit and the right to exclude others from residential properties reduces the likelihood of interference and monitoring by other citizens. This contributes to the lack of citizen enforcement of environmental regulations on private residential lands.

Second, the division of federal, state, and local governing power is an important influence on environmental politics (Andrews 1999). Attitudes towards the appropriate division of power have changed throughout history (Andrews 1999, John 1994, Malone 1990, Rabe 2000) and the power to determine land-use controls and restrict private land uses currently resides with local municipalities (Fulton and Shigley 2005, Malone 1990). The local planning process is inherently political (Fulton and Shigley 2005).¹⁰⁴ Examinations of the practice of planning and other decision-making processes repeatedly reveal that rather than being politically neutral, objective, and reliant on scientific reason, local decision-makers are deeply interested, connected to politics, and influenced by anecdotal evidence (Sandercock 2003). As Duane (1999) observes “political power [is] a critical determinant of whether, how, and when information is used in decision-making” (p 37). Land-use decisions are thus replete with political conflict. Some of the well-recognized conflicts influencing the practice of land-use planning include the protection of private property rights (Andrews 1999, Fulton and Shigley 2005, Malone 1990) and conflicts between the protection of local and private economic interests and public goods (Duane 1999).

In the North Coastal Basin, the political nature of local sediment control can be seen in the controversies over the adoption of a grading ordinance in Mendocino County and the enforcement of the grading ordinance and other county codes in Humboldt County. Over the past two decades, the Mendocino County Board of Supervisors has attempted to adopt a grading ordinance several times. The process has been marred with intractable conflict between environmentalists and agricultural interests. The Board of Supervisors ended the most recent attempt in May 2007 when they ordered planning staff to discontinue work on the draft ordinance. The termination of the policy-development was justified with the concern that passing the ordinance would require a costly environmental impact review and a statement of confidence noting that state-level regulations would accomplish the goals of the grading ordinance (Mendocino County Board of Supervisors 2007). However, the Board’s justification has been linked to pressure from the Farm Bureau and other agricultural interests who claimed there would be a detrimental economic affect of the regulation (Interview with member and officer of Mendocino County watershed group M4, 5/31/2007) and is strongly linked to the local political pressures on the Board.

Humboldt County, on the other hand, has a grading ordinance and a streamside management ordinance. However, there is currently little monitoring or enforcement of either ordinance in the rural parts of the county. Under the direction of the Board of Supervisors, the Humboldt County Code Enforcement Unit (CEU) pro-actively enforced county codes in rural areas in 2007 and early 2008 (Interview with Jeff Conner, Humboldt County CEU, 3/18/2010). These actions were met with intense resistance from rural landowners who claimed that their property rights were violated.¹⁰⁵ After the

¹⁰⁴ All planning processes at any level are inherently political, but the actors and modes of influence vary. In local planning processes, those who are directly impacted have direct access to those making the rules.

¹⁰⁵ One of the early meetings was organized by the Civil Liberties Monitoring Project and drew over 600 residents to the Town Hall in Garberville, a town in southern Humboldt. The outrage and arguments are well documented in transcripts from meetings, media coverage of the conflict,

initial public outcry, the Board of Supervisors put a temporary moratorium on the rural enforcement program in April 2008 and essentially terminated the program after a series of public meetings over the next few months. In both of these conflicts over the creation and enforcement of local sediment controls, residents and interest groups successfully used arguments about private property rights and economic hardship to pressure the Board of Supervisors to reduce local regulatory sediment pollution control on private lands.

Third, environmental policies reflect the prevailing attitudes and values of the times they are created (Andrews 1999). While the previous two factors explain the weak governance of residential roads, attention to the historic attitudes and values regarding land use and the environment explain the strong governance of roads on timberlands. In the North Coastal Basin, environmental governance has been shaped by over four decades of intense conflict between environmentalists and the timber industry. This conflict has institutionalized the belief that timber companies have a public responsibility to mitigate the environmental effects of their land management practices, galvanized substantial political pressure for the regulation of timber activities, and led to significant involvement of private citizens and non-profit organizations in the governance of timber production. This attention to the general environmental effects of timber activities has created the public and private infrastructure to govern roads on timberlands. The FPA provides the regulatory base for sediment control on timberlands. Under the FPA, the specific rules for forest practices can be revised by the Board of Forestry to reflect changing understandings of timber practices and the environment and are meant to implement the provisions of the Z'berg-Nejedly Forest Practice Act of 1973 in a manner consistent with other laws, including but not limited to, the Timberland Productivity Act of 1982, the California Environmental Quality Act of 1970, the Porter Cologne Water Quality Act, and the California Endangered Species Act (FPR 2007 Article 1 896 (a)). This allows the incorporation of regulatory requirements for the control of sediment from roads into the FPR and creates a clear and funded system for the inspection of private timberlands (and their road networks) by multiple federal and state natural resource agencies. In addition, the FPA requirement for consultation with a Registered Professional Forester (RPF) created a framework for the exchange of knowledge between landowners and professionals, which has led to the greater awareness of and utilization of non-regulatory resources (Chapter 5). Finally, environmental groups at the watershed, regional, state, and national levels place additional pressure on agencies to adequately monitor and enforce environmental regulations through watchdog activities (including site visits, comments on timber harvest plans, and reports of violations), litigation regarding the enforcement of environmental controls, and lobbying for increased regulatory standards.

In summary, the disparity between the distribution of the sediment pollution problem and the governance arrangements addressing the problem is due to the logistical challenges of

and several prominent blogs, and include arguments that draw on or highlight several intertwined and emotionally loaded issues including the protection of private property rights, public health concerns, personal safety, economic constraints of rural property owners, and marijuana production.

regulating small residential landowners as well as deeper issues associated with private property rights, local land-use controls, and the local political context and history of environmental governance. These latter three challenges mirror well-recognized trends pervasive in most areas of environmental governance. The entire suite of challenges found in this case is representative of the difficulties faced as regulatory attention continues to “democratize,” shifting from the governance of point sources to NPS pollution and to the cumulative effects of other problems that are “small, diffuse, and ubiquitous” (Duane 1992, p 31). In the case of sediment control in the North Coastal Basin, the subdivision of large properties creates new dimensions of diffusion. Not only is the sediment itself difficult to monitor and locate, but the increased number and diversity of smaller landowners makes it even more difficult to identify, target, and coordinate pollution control activities.

Leaking Governance on a Changing Landscape

The uneven governance of roads (and, in particular, the relatively weak governance of private roads on residential properties) is especially important when considering the effects of rural land-use change on sediment pollution in the region. The subdivision and conversion of large parcels previously used for ranching and timber production to residential uses leads to the gradual reduction of the oversight and control of sediment pollution. Timber and ranch roads that were once directly and indirectly governed through timber regulations or the threat of regulations leak out of those governance arrangements when they become residential roads. As argued above, the weakened governance pressure leads to uneven implementation of BMPs on residential roads and an overall reduction of BMP implementation when compared to timber or ranch roads. The slow but ongoing land-use transition from timber and ranch lands to more rural residential development in the North Coastal region can thus be linked to an increased risk of sediment delivery to local streams and the continued degradation of habitat for salmonids. In this way, governance strategies have not kept pace with the evolution of land uses in the region.

Moving out from the case of sediment control to a more general consideration of rural land-use change and the environment, these findings suggest it is useful to be attentive to the links between land use, formal and informal governance arrangements and institutions, and the resulting management practices when examining or trying to mitigate the ecological effects of rural land-use change. In general, we can expect that changes in land ownership and use will be directly linked with changes in the formal and informal governance, and thus management, of other human-environmental problems.

Recent work in the portion of the Greater Yellowstone Ecosystem (GYE) that lies within southwestern Montana reinforces my argument for the importance of these dynamic links between changes in land tenure, governance, and management for two very different problems: fisheries protection and elk management. The GYE encompasses approximately 18 million acres in and surrounding Yellowstone and Grand Teton National Parks and, similar to the land-use trends seen in much of the rural American West, the ownership and use of the private land surrounding the parks has been

transitioning from traditional ranches used for full-time livestock production to more amenity based, conservation oriented, and absentee landowners (Gosnell et al. 2006).

Gosnell et al. (2007) explore if and how differences in the land management and restoration practices between new and longtime landowners in the region affect fisheries. They find that the management practices of newer and longtime owners differ and that newer landowners engage in practices that both positively and negatively affect regional fisheries. They suggest that the transition in land ownership creates logistical and regulatory challenges for fisheries management. In particular, they note that the “increasing number of private landowners managing their own fisheries has added to the many challenges already facing the state’s fisheries managers” (p 999). Further, they suggest that the current permitting processes and legal institutions for managing fisheries are not adequate to address the challenges of fisheries management on this evolving landscape.

Haggerty and Travis (2006) document how the changes in land ownership in the same region of the GYE have reduced the ability of state wildlife managers to manage elk populations. In this case, it is changes in the attitudes and the working relationships between state wildlife managers and the landowners (not the actual regulations or land management practices) that have altered the conditions of governance. State wildlife managers in the region historically relied on hunting on private ranches as a key tool to manage elk populations. However, newer landowners tend to be more tolerant of elk and less tolerant of hunting. The changing attitudes and access to private lands for hunting have left state wildlife managers with less ability to manage elk and “certain landscapes are ‘out of administrative control’” (p 816).

Together, the two GYE studies and my work in the North Coastal Basin provide a sampling of some of the diverse ways that changes in land tenure can be associated with changes in the governance of the landscape and consequently can alter the management of the landscape. The three cases show that changes in land tenure affect the formal and informal, as well as the direct and indirect, pathways for the oversight and control of public environmental issues on private lands. In each of these cases, we can see that the increased number and diversity of landowners creates logistical challenges for environmental governance. I argue that the governance arrangements are also difficult to change because they are limited by local socio-cultural values regarding the sanctity of private property rights. The result is that governance strategies have not kept pace with the evolution of land uses and it is increasingly difficult to meet existing environmental goals on transitioning landscapes.

Environmentally Ungoverned: Marijuana Production

“We experience ecologically damaging clearing of trees and destruction of watersheds; poisoning of the ground with chemicals, diesel, and used oil from industrial-size generators; streams drying up as water is siphoned for the marijuana crops, with significant consequences for wildlife; threats to livestock and neighbors from vicious dogs and young men wielding guns.”

~ Deborah Pruitt, Southern Humboldt County resident, quoted from her letter in *The New Yorker* (2008)

In the quote above, Humboldt County resident, Deborah Pruitt, catalogues some of negative environmental and social consequences of marijuana production in the North Coast of California. On the mail survey and in interviews, landowners throughout the region passionately echoed Pruitt's concerns about the environmental and social consequences of marijuana production in the region. In many of these comments (such as the one that opens this chapter), landowners also expressed frustration at the "two-tier system" of environmental governance that regulates timber and ranch operations but fails to adequately address the negative effects of marijuana production. These reflections led me to investigate further the environmental effects of marijuana production and the governance response by natural resource agencies. I found a striking disparity between the widespread awareness of and concern for the environmental effects of marijuana cultivation and the lack of regulatory and non-regulatory actions to address those issues. In this section, I document this disjuncture and argue that the grey area of legality and the perception of violence associated with marijuana cultivation render the landscape effectively ungovernable.

I begin with a brief overview of marijuana cultivation in the basin. Building on media accounts, reports, interviews with staff from natural resource agencies and nonprofit organizations, and the first hand experiences of landowners, I then discuss the environmental effects of marijuana cultivation and the lack of formal response to these issues by natural resource agencies and most non-profit organizations. In doing so, I show that the grey area of legality fosters a culture of secrecy and that fear about violence associated with marijuana cultivation makes the environmental effects of marijuana production illegible to natural resource agencies. These characteristics make this portion of the landscape effectively ungovernable. I conclude by considering other actions, areas, and processes that could render parts of the landscape environmentally ungovernable and suggest the need for further investigation of the causes and consequences of ungovernability.

Marijuana Cultivation in the North Coastal Basin

The North Coastal Basin is often thought of as synonymous with marijuana cultivation. The basin lies within the "Emerald Triangle," a region consisting of Humboldt, Mendocino, and Trinity counties, known nationally for the production of high quality marijuana. As Steve Bloom, the editor of *High Times Magazine*, an internationally distributed magazine focused on marijuana, puts it:

It's kind of like Napa to wine...Mendocino and Humboldt are the Napa and Sonoma of marijuana country. There's no doubt about it, it's got the No. 1 reputation in the country. (Bloom quoted in Durant 2002a)

Though my interview protocol focused on road management and land use, thirty-four landowners (approximately 60 percent of interviewed landowners) brought up issues associated with marijuana production without any prompting from me during our interviews. They described the ubiquity of marijuana production in the region; the

changing shape of the marijuana industry; and many of the economic, social, and environmental effects of the industry. Their overwhelming attention to marijuana production reflects the economic, cultural, political, and ecological importance as well as the controversial nature of marijuana cultivation in the region.

The region's history with marijuana cultivation stretches back to the 1960s when groups of back-to-the-land migrants moved to the rural North Coast. Many of these migrants began small-scale cultivation of marijuana for personal use or set up cottage industries (Durant 2002a, Regan 2009b, Ritter 2005). Since then, the industry has grown and diversified in terms of the number, size, and types of production sites (often referred to as 'grows'). Marijuana grows now occur in highly controlled indoor greenhouses or underground environments as well as outdoors on private and public lands, and the marijuana-growing population (known as 'growers') ranges from individuals growing for personal or medicinal use to small-scale and casual profit-driven operations to much larger organized operations, some of which are associated with international drug cartels (Regan 2010).

The independent culture of the region, profitability of marijuana cultivation, and the soil conditions and weather patterns combine to create social and biophysical climates favorable for the marijuana industry (Durant 2002b, Samuels 2008). In addition, much of the recent growth in the marijuana industry has been attributed to the passage of Proposition 215 in 1996, which legalized the cultivation and possession of marijuana for medicinal purposes under California state law (Compassionate Use Act 1996).¹⁰⁶ In 2003, the California legislature passed Senate Bill 420, the Medical Marijuana Program Act, to resolve ambiguities regarding the promulgation of Proposition 215. The Medical Marijuana Program Act specifies that a "qualified patient or primary caregiver may possess no more than eight ounces of dried marijuana per qualified patient... [and] may also maintain no more than six mature or 12 immature marijuana plants per qualified patient" (Medical Marijuana Program Act 2003 §11362.77 (a)) and also grants counties and cities the authority to establish guidelines for possession and cultivation that exceed these limits.

Humboldt and Mendocino counties initially had some of the most lax restrictions on marijuana cultivation. In Humboldt County, qualified patients or their caregivers can possess up to three pounds of dried marijuana per patient and can cultivate any number of plants within a cultivation area of less than 100 square feet (Hum. Cty. Medical Marijuana 2004).¹⁰⁷ The limits in Mendocino have undergone frequent revision, shifting from some of the most permissive laws in the state to more restrictive guidelines in line

¹⁰⁶ The growing involvement Mexican of drug cartels in the region is also attributed to increased border security following the September 11 attacks, which made domestic production more attractive to international drug actors (Ritter 2005).

¹⁰⁷ The original guidelines from the Humboldt County District Attorney limited the number of cultivated plants to 99 plants in an area of 100 square feet or less (Hum. Cty. DA Health & Safety Code 2003). In 2004 the Humboldt County Board of Supervisors approved an ordinance that removed the restriction on the number of plants.

with SB 420.¹⁰⁸ As of 2008, qualified patients and caregivers are restricted to the statewide guidelines and cultivation on a single parcel is limited to 25 marijuana plants regardless of the number of qualified patients growing on the parcel.¹⁰⁹

Despite legalization for medicinal purposes, the cultivation and possession of marijuana for non-medicinal purposes is still prohibited throughout California and, regardless of medical status, possession or cultivation of marijuana is a criminal act under federal law. Marijuana cultivation in California thus lies in a ‘grey area’ of legality and is “tolerated or not, to varying degrees, depending on where you live and on how aggressive your local sheriff is feeling that afternoon” (Samuels 2008). While the legality of medicinal marijuana provides some protections for marijuana growers, the continued illegality of most production gives rise to a veil of secrecy that surrounds the industry.

The mix of legal and illegal cultivation makes it impossible to accurately assess the size of the industry, but it is known to be extensive. Drug policy analyst and marijuana reform activist, Jon Gettman, estimates that in 2006, over 20 million marijuana plants were produced in California with a street value around \$13.8 billion, making marijuana the top cash crop in the state (Gettman 2006). Marijuana production is believed to be the primary economic activity in the North Coastal Basin. In Mendocino County alone, the marijuana industry is estimated to contribute \$1.5 billion to the county’s legal economy, which accounts for two-thirds of the economic activity in Mendocino (EPS 2007). In 2009, the Campaign Against Marijuana Planting (CAMP), a division of the California Bureau of Narcotics, seized nearly 580,000 plants from public and private lands in Humboldt and Mendocino counties last year. This represents only a small portion of the annual marijuana crop and is estimated to have a ‘farm value’ of about \$1.2 billion (a retail value of about \$2 billion).

While marijuana production supports the struggling local economy, there is a clear dark side to the vast industry. Local, regional, and national media coverage contains stories of burglaries, weapons, booby traps, violence, and gangs (See, for example, Del Barco 2009, Garmire 2009, Montgomery 2010, Regan 2009a, Ritter 2005). In my interviews with landowners, I heard several first and second-hand accounts of trespassing, violence, retaliation, threats, and property damage associated with marijuana production. I was

¹⁰⁸ County ordinances associated with marijuana in Mendocino County have undergone frequent revision, shifting from some of the most permissive laws in the state to more restrictive guidelines in line with SB 420. In 2000, Mendocino voters passed Measure G, which decriminalized the cultivation and possession of up to 25 plants or the equivalent amount of processed marijuana for medicinal or personal use and made enforcement of criminal laws applicable to small-scale producers the lowest priority for the Sheriff’s office. Measure B, passed by voters in 2008, repealed the decriminalization provisions of Measure G and set limits on the cultivation and possession of medicinal marijuana equal to the statewide limits under SB 420. Also in 2008, Mendocino County Board of Supervisors adopted an ordinance restricting cultivation on a single parcel to 25 plants regardless of the number of qualified patients or caregivers growing on that parcel.

¹⁰⁹ As I am writing this dissertation, the county guidelines continue to evolve. A 2010 county ordinance recently amended these limits to allow the cultivation of up to 99 plants with receipt of permit from the Mendocino County Sheriff’s Office.

repeatedly warned not to walk anywhere in the woods alone, particularly during the fall harvest season, to avoid stumbling on armed guards or viscous guard dogs.

Five landowners told me they had encountered marijuana grows or evidence of marijuana-related trespassing on their property, and many discussed the effects of grows on nearby lands. One landowner explained:

The kids were out playing and I looked around and saw some suspicious stuff. I thought I should check it out, and not more than 200 feet away, I found the pot. The thing was, they even cut down trees so the pot could get better light – not little trees either, big fir trees, and they terraced the hillside... They ruined the forest there but at least they didn't get the money from it because we destroyed the plants. (Interview with Landowner #20848, 10/23/2008)

Not all landowners would feel comfortable with such a proactive response. Many landowners are afraid that if they complain, marijuana growers will damage their property or retaliate in other violent ways. Their fears are linked to views of the marijuana industry as increasingly violent, territorial, and more generally associated with crime. These sentiments are well-represented by the following stories and concerns:

The neighboring property owners, the [name withheld] Ranch, they need to be pretty nice to the growers. They feel like they can't complain. We worry that if we complain, we'll find our cabin as ashes. This group [of marijuana growers] is under-educated, tough, and a rough group. It's not a group to cross. (Interview with Landowner #10746, 8/27/2008)

Now you can't safely ride around in the mountains. At one time you could ride and it would not be a big deal to run into a plant or garden but now you will be shot. (Interview with Landowner #21374, 9/17/2008)

[The marijuana industry is] not good because those guys can be violent. If you have kids it can be bad for the kids walking around if they stumble on that. It seems to breed crime whether they are Mexican gangs or whatever, the people doing it seem to have less regard for the law and can breed crime – that affects everyone. If someone is growing things, you can stumble on that, even if you're the landowner, and it can ruin your day. (Interview with Landowner #20848, 10/23/2008)

Landowners across the North Coastal Basin paint a picture of the marijuana industry that often shows the local economic benefits and cultural importance of marijuana production in the region, but usually focuses on the changing character of the industry and the social and environmental costs of the larger-scale, higher value grows that have replaced the mom-and-pop operations of the early 1970s.

Environmental Effects of Marijuana Cultivation

In addition to the negative social aspects of the marijuana industry, the negative environmental effects of cultivation can be extensive. Patrick Foy, a Game Warden with CDFG, describes the effects of marijuana cultivation as follows:

It is a very much an ecological disaster from all these different aspects: from the poaching aspect, from the pollution, from the habitat destruction, I mean hundreds of trees are cut down. It's a complete disruption of the natural environment and basically they clear-cut these areas and the vegetation that grows back to replace those areas cut down, even if the marijuana garden is removed, is completely different than what stood there before they went in. So it's permanent damage that they're causing. (Foy quoted in USFS Forest Focus: Episode 5)

My interviews with staff at government agencies as well as recent media coverage and reports provide additional evidence of the environmental degradation associated with indoor and outdoor marijuana grows on private and public lands (Mendocino County Grand Jury 2010, Service 2010, USFS Forest Focus: Episode 5, Interview with Rebecca Fitzgerald, NCRWQCB, 12/9/2008, Interview with John Heil, USFS, 3/25/2010, Interview with Holly Lundborg, NCRWQCB, 12/18/2008). The commonly mentioned environmental effects include:

- **Stream diversions and illegal water withdrawals:** Water is often diverted from streams to irrigate marijuana crops that may be miles away. These diversions can reduce streamflow and detrimentally affect fish and other aquatic organisms during the dry summer months.
- **Toxic contamination from herbicides, pesticides, and rodenticides:** Strong and sometimes illegal herbicides, pesticides, and rodenticides are often used to protect marijuana plants and irrigation systems. These chemicals can cause long-term effects on the ecosystem by contaminating waterways and killing fish and wildlife.
- **Nutrient pollution:** Large amounts of chemical fertilizers are often used to increase marijuana production and can cause nutrient pollution in nearby waterways. One pound of fertilizer can be used for every six marijuana plants (USFS Forest Focus: Episode 5), which implies a tremendous amount of fertilizer over the hundreds of thousands or possibly millions of plants grown in the basin.
- **Diesel spills:** Diesel generators often power the lighting systems for indoor grows and diesel spills are a relatively common occurrence. The fuel spills can contaminate streams and waterways, degrading aquatic ecosystems and damaging drinking water sources. For example, it is estimated that over 1,000 gallons of diesel have spilled into one Humboldt County creek (Service 2010).
- **Poaching:** Deer, bear, and other animals may be killed to prevent them from grazing on marijuana plants or, in some remote camps, they may be hunted for food.
- **Clear-cutting, other destruction of vegetation, and terracing of steep slopes:** Preparation of the grow site can entail clear-cutting, vegetation removal, and terracing, all of which can cause soil erosion and permanent damage to ecosystems.
- **Trash and waste:** For large remote grows, particularly those on public lands, marijuana growers may set up camps for several months and improperly dispose of large amounts of garbage, human waste, toxic chemicals, and animal carcasses.
- **Energy consumption:** Lighting for indoor grows requires a lot of energy; in Humboldt County, it is estimated that marijuana growers use about 90 million

kilowatt hours a year, which “pumps an estimated 40,000 metric tons of carbon dioxide into the atmosphere each year, as much as 7,000 cars” (Service 2010).

Landowners throughout the regional identified similar environmental effects of marijuana cultivation. Several landowners also discussed the ways that marijuana cultivation can stress the road network in rural subdivisions, which can lead to erosion and sediment pollution. These landowners linked marijuana production to increased traffic, poor road construction, and substandard practices for the use and maintenance of roads. Two residential landowners described the situation in their subdivisions as follows:

There are two large-scale cannabis growers [in our subdivision] and that’s created tension, not because people are concerned with the legality of it, but because of it creates a lot of traffic with the four thousand gallon water trucks coming in all the time and strangers on the property and people driving fast. (Interview with Landowner #20215, 9/11/2008)

[A]ll those summertime people that don’t belong in the woods, who go to the woods to build greenhouses and grow a lot of pot and who don’t belong there, they drive way too fast. They chew the clay up into an excessive amount of talc on the hard surface, sometimes six inches deep. So when we get our first big gully-washer [storm], in three or four weeks, there goes a lot of dead fish and what not down river. These are the people that live in the woods and don’t give a shit about the woods. (Interview with Landowner #11452, 10/22/2008)

A timber-landowner explained that many marijuana growers use old logging roads that were poorly designed, originally constructed for temporary use, abandoned, or otherwise inadequately constructed. The inappropriate use of these roads can be associated with erosion and sediment pollution:

I’ve stumbled upon areas that have the left over remnants of marijuana grows. There’s tremendous erosion with these sites. The old logging roads that had waterbars and are supposed to be out of operation are used to access the land for other operations. (Interview with Landowner #11826, 11/07/2008)

Some ranchers and timber-landowners spoke of the road building practices and erosion risks associated with marijuana production in relation to what they would be allowed to do under timber regulations. One rancher explained:

I spend time up in the other side of the valley with relatives and, golly, I see people punching roads way back in these little forty or eighty acre parcels that are clearly not economic units and it’s just blatantly for marijuana use. There are two issues that trouble me, one of which, as it turns out, is having an impact on our property but I’m hesitant to do anything about it because you have to be careful who you alienate. But, that one issue is water. Clearly when you look over or fly over the county, you’ll see all of these black tanks and that’s clearly for marijuana use. And the other is, environmentally, you know, they are punching roads in areas where, if we were to submit a timber harvest plan, there’d be no way that they would allow us to do that and I’ve seen a lot of erosion. (Interview with Landowner #20580, 12/05/2008)

In their descriptions of problems with road management practices and other environmental issues, landowners draw attention to several key factors that limit the informal mechanisms that could mitigate the environmental effects of marijuana production. In the previous chapter, I explain how knowledge about BMPs can be transferred through informal interactions between neighbors, friends, and family. The knowledge transfer and subsequent application of BMPs depends on personal interactions, some minimal stewardship ethic or desire to engage in a discussion about BMPs, and the availability of resources. Many of these aspects are missing from the networks of marijuana growers. The grey area of legality provides an incentive to maintain secrecy, which discourages discussion about land management practices. Many landowners (such as Landowner #11452 quoted above) also emphasize that marijuana growers are often motivated solely by profits and do not care about the land.¹¹⁰ Furthermore, landowners are often frustrated by the environmental effects of their marijuana growing neighbors but are reluctant to complain to regulatory agencies or engage in dialogue with those growing marijuana because they fear retaliation. The pathways that facilitate the transmission of knowledge between friends and neighbors (Figure 5.3) are blocked by the veil of secrecy that surrounds marijuana cultivation and the perceptions that growers lack concern for the environment and may be dangerous.

Among the community of ranchers and timber producers and many residential landowners, there is also a sense that the formal governance response is also inadequate and that natural resource agencies are not doing enough to address the negative effects of marijuana production. My conversation with a member of the YES demonstrates this sentiment well:

AS: What should the agencies be paying attention to?

LO: Pot growers. That's the thing that drives me nuts. The land is getting trashed. On the land above us – the perspective is that they just don't care. They have diesel spills, use generators, put in roads and buildings everywhere and just leave when they are done without cleaning up and no one wants to bust them because it is too expensive so it's not worth it. There needs to be more focus on the destruction of the land from that.

AS: Is that the common opinion?

LO: Among ranchers, yes.

(Interview with rancher and YES member, 11/18/2008)

The next section explores the claim that there is a lack of a formal governance of the environmental effects of marijuana production.

¹¹⁰ Marijuana growers' lack of concern is often linked to their short-term land tenure. Landowners explained that sharecropping arrangements or other short-term leases are common. In these arrangements, marijuana producers use a particular piece of land for a single season, or sometimes multiple seasons, and then abandon the land to the owner. In these cases, the growers do not have the year-round or long-term investment in the land that can motivate good stewardship.

Limits on the Response of Natural Resource Agencies to the Marijuana Industry

As suggested by the ranching community, natural resource agencies have had a very limited response to marijuana cultivation. Official documentation of the environmental effects of cultivation is rare and the unofficial policy of regulatory agencies in the region is to avoid addressing the issue. In the remainder of this section, I support these claims and argue that in addition to stifling informal sharing of information about land management practices, the grey area of legality, secrecy of the industry, and the perceived risks of violence limit the documentation of the extent of the environmental effects of marijuana cultivation and proactive formal governance responses.

Many of the environmental effects identified above (e.g., stream diversions, erosion, diesel spills) directly affect salmonid habitat and water quality. However, analysis of the effects of the marijuana industry is rarely included in reports on the threats to salmonid populations or TMDL water quality documents. The CDFG *Coho Salmon Recovery Strategy* (2004) provides a useful example of the complete neglect of marijuana production in a document that aims to be comprehensive. The discussion of threats to coho includes analysis of all primary land uses and management activities except marijuana cultivation.¹¹¹ The document also fails to mention marijuana as a land use in the analysis of threats and recovery plans for specific watersheds and recovery units. A typical description of land uses and threats can be seen in the following section on the Mattole River:

Land uses in the Mattole River HSA [hydrologic sub-area] include timber production, ranching, crop farming, and residential subdivision. Human activities such as road construction, grazing of livestock, and timber management, have interacted with natural geologic instability and sediment production, and major storm events (e.g., the 1964 flood) to impact aquatic habitats. Disturbances from an increasing human population include water diversions, conversion of near-stream areas to residential usage, removal of mature vegetation, widespread soil disturbance, construction of levees or armored banks, and the installation of dams and reservoirs that disrupt normal flow regimes and prevent free movement of salmonids and other fish. (CDFG 2004, p 6.27-28)

The effects of grazing, timber, agriculture, and residential development are clearly and broadly considered, but marijuana is not mentioned.

Furthermore, none of the 15 Sediment TMDLs in the North Coastal Basin mentions marijuana in any context and only one TMDL supporting document refers to marijuana cultivation. The *Mattole River Watershed Technical Support Document for the Total Maximum Daily Loads for Sediment and Temperature* mentions “the rumored underground industry of marijuana growing” and acknowledges that the industry may illegally withdraw water that is “neither permitted nor accounted for” (NCRWQCB 2002,

¹¹¹ Chapter 3 of the *Coho Salmon Recovery Strategy*, which addresses threats, is organized by land use and management activities and includes section on the effects of forestry activities, agriculture, urbanization, fishing (including illegal harvests), and alteration of the streambed and flow (e.g., water diversions, barriers).

p 1.10). However, no effort is made to estimate these effects of marijuana cultivation or to address them in the rest of the Supporting Document or the Mattole TMDL.

Even when looking beyond documents that focus on salmon and water quality, marijuana does not receive significant attention in the online publications and reports of natural resource agencies working in the North Coastal Basin. To provide a rough measure of the government agencies and organizations’ attention to marijuana cultivation relative to other land uses common in the North Coastal Basin, I performed key word searches for ‘marijuana,’ ‘agriculture,’ ‘ranch,’ ‘residential,’ ‘timber,’ and ‘vineyard’ in the websites of natural resource agencies active in the North Coastal Basin.¹¹² The number of instances of ‘marijuana’ is consistently much lower (in many cases an order of magnitude lower) than instances of the terms associated with other land uses (Table 6.1), which suggests that marijuana is not regularly incorporated into assessments of environmental quality or considered as a formal target for regulatory or non-regulatory interventions.

Table 6.1: Number of Instances of Key Terms on Agency Websites

	Search Term:					
	Marijuana	Timber	Agriculture	Ranch	Residential	Vineyard
CDFG Website	29	687	914	1500	451	102
CAL FIRE Website	9	1790	549	473	693	62
Humboldt- Del Norte UCCE Website ¹¹³	69	1000	1000	1000	1000	1000
NCRWQCB Website	15	3900	7220	6150	6000	2310
NMFS Southwest Regional Office Website	0	177	249	72	147	14
USFW Pacific Southwest Regional Office Website	36	3740	1920	16500	2270	161

The lack of public attention to marijuana is not because agency staff and decision-makers are oblivious to the presence and effects of marijuana cultivation. The natural resource agency employees I interviewed spoke knowledgeably about the environmental effects of marijuana production. However, their capacity to evaluate and document the range of environmental effects and respond is hindered by concerns for the safety of employees working in the field as well as a lack of support and direction from policy-makers.

¹¹² The results reported here are from searches completed on June 14, 2010. The websites searched include: California Department of Fish and Game Website <<http://www.dfg.ca.gov/>>, CAL FIRE website <<http://www.fire.ca.gov/>>, Humboldt-Del Norte University of California Cooperative Extension website <<http://cehumboldt.ucdavis.edu/>>, North Coast Regional Water Quality Control Board website <<http://www.swrcb.ca.gov/northcoast/>>, National Marine Fisheries Service Southwest Regional Office <<http://swr.nmfs.noaa.gov/>>, and US Fish and Wildlife Pacific Southwest Regional Office <<http://www.fws.gov/cno/>>.

¹¹³ The search engine for the UCCE websites appears to limit the number of returns on a search term to 1,000.

In my conversation with Rebecca Fitzgerald, an environmental scientist at the NCRWQCB, she explained that there had been some internal discussion about how to address marijuana but concludes that the current response is inadequate:

AS: Has there been any discussion of how to address the illegal production of marijuana, because I know you have looked at the impacts of vineyards, ranching, timber, all of those things?

RF: Well, there's been some light discussion about it. We certainly don't have an answer for that yet. We've spoken with sheriffs before and had them come into the office and talk about the marijuana cultivation. We're very protective of ourselves. We don't want to take that law enforcement role or put ourselves in physical danger by going out and dealing with illegal camps and such. We don't have a great response to it, I'd say. We certainly understand there's a great need for it and we're trying to make law enforcement and some of the sheriffs aware of some of the water quality issues associated with it. (Interview with Rebecca Fitzgerald, NCRWQCB, 12/9/2008)

The limited response from natural resource agencies is due, in part, from concerns about the safety of employees. At several natural resource agencies, staff people working in the field have an unofficial policy of avoiding any suspicious sites and ignoring marijuana grows. When I asked Holly Lundborg, a senior environmental scientist with the NCRWQCB, if there is a "protocol for what to do when [she or her staff] stumble across [marijuana]," she replied:

Safety first. We leave. It's not our job. We leave. (Interview with Holly Lundborg, NCRWQCB, 12/18/2008)

Gary Flosi, who heads the regional restoration program for the CA Department of Fish and Game, provides his field staff with a similar policy, advising them:

If you're uncomfortable, leave. It's not that important that we would get somebody hurt. (Interview with Gary Flosi, CDFG, 10/20/2008)

In addition to the safety concerns, comments by Gayle Garman, a staff environmental scientist with CDFG, suggests that agencies' capacity to gather information about and respond to marijuana production may also be constrained by a lack of designated funding from policy-makers as well as limited coordination between agencies. In a call for more action, she explains:

Ideally, we need to get everybody together – when I say everybody, I mean not only law enforcement but also the regulatory agencies. We need to get the agencies together to try to figure out how we can minimize impacts of grow operations to water quantity and quality, and to make sure we have effective methods for contaminant clean-up including an adequate source of funding to do so. It's a policy decision and so requires higher-level input, but it is such a big issue and it's not something that we – environmental regulators – can have so much control over, since law enforcement has the key role...

At least at this point I'm not aware of any kind of summit on what to do about this issue, but I think that needs to happen since the environmental problems associated with grow operations come up over and over again. (Interview with Gayle Garman, CDFG, 11/24/2008)

As Garman's comment suggests, the actions and budgets of agencies are directed and constrained by policy-makers and legislative directives. California policy-makers, lobbyists and voters have not directed attention or financial resources to the investigation or governance of environmental effects of marijuana production. Instead (and, given the controversial and lucrative nature of the industry, perhaps unsurprisingly), political attention has focused more on issues of legalization for medicinal purposes, law enforcement, safety, and taxes, leaving the environmental issues far behind.

Environmental Ungovernability

Lands and roads associated with the cultivation of marijuana are essentially ungoverned with respect to sediment pollution and other environmental problems. The 'ungovernability' of these lands stems from the illegality of marijuana cultivation and the perception of violence and danger linked to the industry. The environmental degradation associated with marijuana production is an extreme example of a human-environmental challenge that is not currently governed by natural resource agencies. However, it is far from the only example of land use or management activities that are ungovernable due to their illegality and invisibility. Illegal logging in the tropics, poaching of endangered or otherwise protected species, and all-terrain vehicle use and off-road activities in conversation areas all create similar governance challenges due to safety issues and the dispersed nature or secrecy of the activities.

Illegality and violence are not the only factors that contribute to the ungovernability of lands used for marijuana production. As Gayle Garman points out, one of the challenges of addressing marijuana cultivation is the lack of legislative direction and political focus. Without direction from the state or federal government, natural resource agencies lack the time and financial resources to coordinate multiple agencies in the investigation and mitigation of the environmental effects of marijuana cultivation. The lack of legislative direction also limits the ability of natural resource agencies to address other issues not receiving political attention and points to other ways that issues and activities can be ungoverned or weakly governed. These include shifts in priorities and funding, shifting conditions due to land-use change, fragmentation of agencies, the piecemeal approach of grant programs, the lack of mechanisms to address cumulative watershed impacts, and the lack of long-term and reliable funding mechanisms.

Conclusion

In this chapter, I show that sediment pollution in the North Coastal Basin is unevenly governed and that the governance landscape is not aligned with the problem landscape. In particular, the primary efforts to control sediment are focused on working ranches and timber producing land while sediment pollution is associated with roads on all types of land uses including residential lands and those used for marijuana cultivation.

Much of the challenge in governing sediment on residential and marijuana lands stems from the difficulty in accessing and assessing these lands and the consequent “illegibility” of these land uses. In *Seeing Like a State*, Scott (1998) claims that the power of the state stems from its ability to standardize the systems it governs and that the success of large-scale projects and policies rests on the ability of the state to simplify, order, and reduce complex social and ecological systems, making the systems more “legible.” He goes on to argue that state governments’ general tendency to rely on order and simplification ignores other less measurable aspects of the system and is ultimately associated with vulnerability to unplanned change and the failure of many large scale state projects.

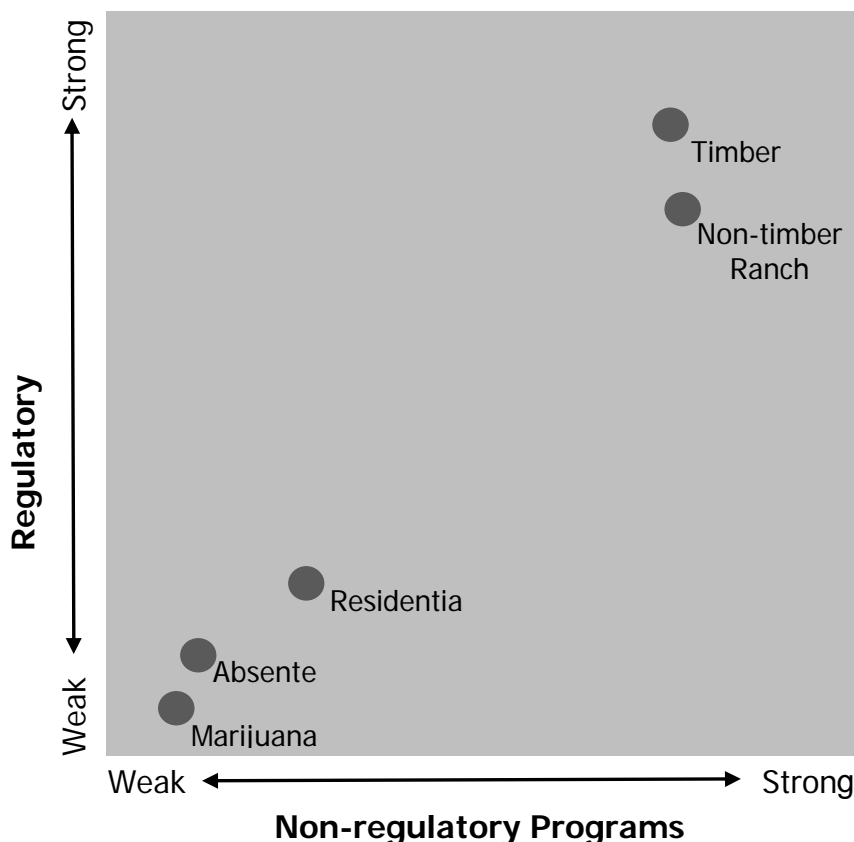
Residential and marijuana landscapes in the North Coastal Basin are less legible than working landscapes and thus, following Scott, create larger governance challenges. Residential landholdings tend to be smaller than working parcels and held by a more diverse set of landowners. Thus, the increased diversity associated with changes in land tenure diminishes the ability of natural resource agencies to order and govern the landscape. Similarly, on marijuana producing lands, the grey area of legality and perceived violence reduces the ability of the state or civil society to track and assess activities on these lands, which reduces their ability to use conventional regulatory and non-regulatory solutions to control sediment pollution.

Illegal land-use practices and the constant evolution of rural land use and management reduce the legibility of the landscape and add layers of social complexity to the challenge of governing human-environmental issues. While the ability of the state to access information about land uses and create technocratic solutions is often taken for granted, this chapter reinforces Scott’s argument that the reliance on simplified, legible systems creates vulnerable projects and policies, motivates the need to consider if and how to reach out beyond traditionally regulated land uses and into more illegible areas, and raises general questions about how to otherwise govern changing and unknown systems.

Chapter 7 Conclusions

Throughout this dissertation, I examine and compare the landscapes of the sediment pollution problem, governance, and action across the range of land uses in the North Coastal Basin. I find that the sediment pollution problem is common across all land uses. However, the governing programs and landowners' knowledge and adoption of best management practices (BMPs) differ by land use. The formal and informal influence of regulatory and non-regulatory programs is strong on timberlands and non-timber ranches, relatively weak on residential properties, and essentially non-existent on absentee landholdings and lands used for marijuana production (Figure 1.1). Similarly, landowners using their lands for timber production and ranching have more knowledge about and self-reported adoption of BMPs than other landowners. The findings of this study draw attention to the ways that social complexity can complicate the governance of biophysically complex human-environmental problems and highlights the importance of attending to the social dimensions of environmental research and policy.

Figure 7.1: Governance Space: Influence of Sediment Governance Arrangements on Different Land Uses in the North Coastal Basin



Though some of the particular dynamics reported in this dissertation are specific to the local conditions and history of the North Coastal Basin, the findings have implications for research about and the development of environmental management strategies and policy beyond the study region and for human-environmental challenges other than sediment control. In this concluding chapter, I discuss the implications of this dissertation for (a) the study and development of environmental management strategies and policy in transitioning rural regions and (b) the more general study of the governance of nonpoint source pollution and other complex and evolving human-environmental issues.

Research Directions and Implications for Transitioning Rural Landscapes

Since the early 1970s, the North Coastal Basin has experienced growth in rural residential development that parallels demographic and land-use changes in rural areas across the United States and other developed countries. This study draws attention to the inadequacy of the current governance infrastructure for addressing the ecological effects of these changes. In the study region, regulations of road related sediment are weaker and less consistently enforced on newer residential and amenity land uses than on more traditional working land uses, and many non-regulatory programs are geared primarily towards working landscapes rather than newer land uses. With the exception of organizations in the Mattole Watershed, few non-regulatory programs have aggressively addressed sediment from residential roads. Thus, as working landscapes are sold and developed for residential and amenity purposes, these areas leak out of the strongly governed landscape.

I argue that the leaking governance in the North Coastal Basin is due to a combination of factors including (a) the logistical challenges of interfacing with a growing and diverse population of landowners scattered across a large and remote region, (b) the paucity of social networks that facilitate information exchange, (c) the dominance of community values regarding the sanctity of private property rights, and (d) the historic focus on the governance of the environmental effects of timber production in the region. Each of these factors helps to explain why most existing programs have not adapted to changing circumstances and why there are few new programs focused on residential sediment control.

The leakage of control over environmental issues is not unique to the North Coastal Basin or to the issue of sediment control. Haggerty and Travis (2006) document a similar leakage of government control over the management of elk populations in the Greater Yellowstone Ecosystem (GYE) associated with changes in land tenure. Gosnell et al. (2007) suggest that the regulatory system for fisheries management has not kept pace with changing land ownership in the GYE. The similar trends in this small but varied sampling of issues suggests that governance leakage associated with land-use change is likely to be widespread across the rural United States and perhaps also in transitioning regions in other countries.

These observations are important because private lands in rural areas play a key role in environmental quality and conservation in the United States. Privately owned forestland

accounts for approximately 60 percent of the total U.S. forestland and plays an important role in the provision of water, protection of water quality, and habitat for fish and wildlife (Stein et al. 2005). Rural agricultural and rangelands account for nearly 46 percent of U.S. land area (Lubowski et al. 2005). Rangelands play an important role in conservation (Maestas et al. 2002, Sayre 2005) and agricultural practices are a major determinant of water quality (US EPA 2008). In addition, approximately 80 percent of federally listed endangered species have some habitat on private lands and 50 percent of endangered species have all of their habitat on privately owned lands (Thomas 2000). Changing land tenure and the associated increases in amenity and residential development are the most prominent trends shaping private lands in rural regions. The ways in which these changes affect environmental quality and conservation depend largely on the management decisions of newer landowners and the degree to which governing programs influence those practices. This study thus points to the need for greater consideration of the governance of changing rural land uses in future research and on the ground.

Research on rural land-use change has begun to compare the ecological effects of residential and more traditional rural land uses and examines some of the social and economic dynamics associated with rural land-use change. This body of work has not yet fully engaged with questions about environmental governance in these changing circumstances and across the full range of rural land uses. More work is needed to (a) identify and understand the political, social, and economic barriers to the governance of residential and amenity development in rural areas, (b) identify areas where efforts have been made to adapt environmental governance programs to changing rural circumstances, and (c) to examine the range of regulatory and non-regulatory tools used to address non-traditional rural land uses. As Robbins et al. (2009) note in their review of research on one transitioning rural region, the New West, there are considerable opportunities and need for comparative investigation of these issues across transitioning rural regions in the United States and in other post-industrial contexts. Such comparative studies will need to account for the local context but aim to identify the key institutional elements that contribute to more effective governance of changing conditions.

To more effectively address the ecological effects of rural land-use change, practitioners must directly confront the challenges of governing non-traditional rural land uses and build innovative regulations and non-regulatory programs to engage and educate residential landowners. In the development of such programs, regulators, land managers, and staff at nonprofit organizations will have to address the logistical challenges of a growing and diverse population of landowners scattered across a large region, a paucity of social networks, and strongly held notions of private property.

Regulatory approaches are likely to be resisted and, without widespread and costly enforcement, may be ignored or simply remain unknown to landowners. The changing circumstances thus necessitate new approaches to generate the need or desire that will motivate landowners to seek out and implement more sustainable land management practices. Early steps could include developing educational materials tailored to the circumstances and range of knowledge of residential and amenity landowners, building the infrastructure to distribute these materials, and a network of professionals familiar

with the particular circumstances of newer land uses. In areas where many newer residents are migrating for amenity purposes, interest in the protection of local scenery and resources may be a useful hook to build new landowners' interest in improved land management techniques. While each of these steps requires the allocation of scarce resources to a new cause, the alternative is continued leakage of these areas out of the influence of governing actors.

Research Directions and Implications for the Governance of Nonpoint Source Pollution and other Complex and Evolving Human-Environmental Issues

In the North Coastal Basin, considerable attention and resources have been devoted to the biophysical and technical aspects of the sediment pollution problem such as modeling the sources of sediment and the maximum allowable sediment loads in each impaired watershed, studying stressors on salmonid populations, and developing ways to prevent excess sediment and restore impaired streams. Building on this technical knowledge, regulatory and non-regulatory actors have sought to implement technical solutions on the ground. However, little attention has been paid to the social dimensions of sediment management. In this dissertation, I focus my attention on the social dimensions of sediment control and find that the social and political dynamics at work in the region strongly influence the effectiveness and reach of regulatory and non-regulatory programs.

The biophysical and technological aspects of complex human-environmental problems often receive more attention than the social and political aspects of the problem, and policy and natural resource management proceed as if the entire landscape is governable. The findings of this dissertation draw attention to the need to consider how social complexity affects the governance of nonpoint source (NPS) pollution and other complex and evolving human-environmental problems. In research and on the ground, more attention should be paid to (a) the social and political factors affecting the governability of the landscape and (b) the social dimensions of complex human-environmental problems.

Governability

This research revealed that the sediment problem is unevenly governed across land uses in the North Coastal Basin. Absentee and residential landowners receive little attention from regulatory or non-regulatory actors and lands used for marijuana production are effectively ungoverned (Figure 7.1). I argue that the challenges in governing sediment pollution associated with these land uses stem from a combination of historic and current social, political, and economic conditions, and that governing actors have not proactively addressed the social complexities created by these conditions.

This finding and argument are important for two reasons. First, addressing the sediment pollution problem in the basin requires attention to all sediment sources, including roads on residential, absentee, and marijuana lands. Natural resource agencies and non-profit organizations in the North Coastal Basin need to confront the logistical, social, and political conditions that contribute to the uneven governance and identify new ways to reach areas that are currently ungoverned. Similarly, in other locations and for other

human-environmental problems, practitioners should query if they need to find ways to extend their reach.

Second, the ‘illegibility’ of residential and marijuana lands calls attention to the possibility that there are other areas and issues that may be illegible and ungovernable. Some potential examples include illegal logging, poaching, and other activities that are varied in nature, scattered across a wide region, and may be associated with violence. In addition, the findings suggest that other common political and social dynamics (e.g., budget reductions, shifting political priorities) can reduce the governability of an issue. This suggests that the social and political aspects of the problem are as complex and important as the biophysical characteristics of the problem.

Future research in this area could investigate other areas, problems, and issues that are weakly governed. These efforts should seek to identify common factors that reduce the governability of the landscape, locate examples where regulatory or non-regulatory efforts have gained influence over previously ungovernable problems or regions, and examine if there are alternative formal or informal mechanisms that are better suited for oversight of ungovernable spaces.

Social Dimensions of the Governance of Complex Human-Environmental Issues

Where the influence of governing programs is relatively strong, paying attention to the social dimensions of management and governance can also add insight into the design of institutions that more effectively address nonpoint source pollution and other complex human-environmental issues on private lands. The call for more attention to the social dimensions of land management is not new. Focusing specifically on rangeland management, Sayre (2004) notes that the ecological dimensions of rangeland management are better studied and understood than the social dimensions and argues that more qualitative research is needed to better understand the key social factors that influence land management decisions. The need for additional research focused on the social dimensions of management and policy extends beyond rangelands and ranchers. Future research in this area should pay attention to how social dynamics and governability differs across the range of land uses and other relevant groupings of land managers.

Three specific findings of this study speak to these issues and can aid in the development of stronger governing programs on private lands. In keeping with the discussion above, each of these lessons learned departs from the singular focus on the biophysical and technical aspects of the problem and relates to the social dimensions of pollution control and private land management.

First, this research clearly shows that regulatory and non-regulatory programs affect management decisions on private lands in different ways, but that they are intertwined and can work in tandem. I argue that regulations tend to generate the need or desire that motivates the adoption of BMPs while non-regulatory programs function primarily to remove barriers that would prevent otherwise motivated landowners from adopting

BMPs. The differing function of regulatory and non-regulatory programs suggests that they may work well in tandem, and this study provides evidence of this.

Knowledge and implementation of BMPs by landowners in the North Coastal Basin is strongly correlated with their experience with both regulatory and non-regulatory programs. As suggested by Figure 7.1 (which shows that land use groups are roughly lined up along the diagonal of the governance space), regulatory and non-regulatory programs appear to exert similar levels of influence on each group of landowners. Landowner groups subject to the strongest regulations are also those most strongly influenced by non-regulatory approaches. Often landowners that are influenced by non-regulatory programs are also forced into greater compliance with regulations. Among landowners in the North Coastal Basin, relatively strong regulations and the perceived threat of strong future regulations generate a need for BMP implementation that facilitates the utilization of non-regulatory resources and the adoption of BMPs in and beyond regulated areas. Landowners who are self-motivated to seek out non-regulatory assistance sometimes comply with regulations they may otherwise ignore due to the terms of the non-regulatory resources they utilize.

Recognition of the distinct but mutually reinforcing functions of regulatory and non-regulatory programs adds insight to the ongoing debate on the interaction of regulatory and non-regulatory policy tools. Nie (2008) argues that the importance of regulatory programs is underplayed in the policy arena and in the academic literature. He documents a rollback in regulatory approaches in favor of more flexible and voluntary approaches, notes that the focus on new environmental governance (such as collaborative planning and other flexible approaches) removes attention from regulatory programs, and argues that this is dangerous because the strength of many non-regulatory programs is related to the threat of regulatory alternatives. This study adds evidence for and extends this argument.

I find clear evidence that regulatory and non-regulatory programs reinforce and strengthen each other. Rolling back of regulations would remove one of the greatest incentives for BMP adoption that is enabled by participation in non-regulatory programs. On the ground in the North Coastal Basin, many resource agencies understand this link. The State Water Resources Control Board (SWRCB) uses a three-tiered approach to water quality improvements that aims to encourage voluntary action and collaboration where possible but also utilizes regulatory approaches in circumstances where extra incentives are needed or non-regulatory approaches prove inadequate (SWRCB and EPA 2004). Though not as formally stated, staff at California Department of Fish and Game (CDFG) and U.S. Fish and Wildlife Services (USFWS) expressed similar ideas about the value of multiple approaches in interviews. Beyond the North Coastal Basin, this experiential knowledge of agency staff should be better incorporated into the collaborative policy literature and should shape development of environmental policies and programs.

Furthermore, while many of the examples in the literature focus on the ways regulatory duress can motivate non-regulatory actions, I find evidence of non-coercive interactions

between regulatory and non-regulatory programs. In the North Coastal Basin, the regulatory process can have an educative component. Landowners can gain knowledge through regulations that motivates them to seek out non-regulatory resources and voluntarily implement BMPs even in the absence of additional regulatory threats. Further research is needed to understand if there are other examples of non-coercive links between regulatory and non-regulatory programs, the characteristics that facilitate non-coercive links, and if and how these links can be reproduced in other circumstances.

The second lesson for institutional design is that professionals can play an important role in facilitating the exchange of knowledge between landowners and staff at natural resource agencies. This research shows that the utilization of professional technical assistance from registered professional foresters (RPFs), staff at natural resource agencies and non-profit organizations, and private consultants is highly correlated with increased knowledge about BMPs and self-reported rates of BMP implementation. However, not all interactions between landowners and professionals lead to a positive exchange of information or to BMP implementation. I argue that the tone and characteristics of the interaction directly influence the degree of information exchanged and suggest that three conditions must be satisfied to result in a positive exchange of information: (1) the interaction must be a respectful exchange of knowledge, where the professional listens to and considers the landowner's ideas, (2) the professional's knowledge must be grounded in local experience, and (3) the professional must demonstrate "common sense" and have the flexibility to tailor their recommendations to fit local conditions.

The most common interactions resulting in information exchange in the North Coastal Basin occurred between timber-landowners and their RPF. The widespread success of these exchanges is rooted in California's forest practice regulations, which mandate the use of a licensed registered professional forester. Though this provides a tempting model for replication, the tremendous expense of the process (which is borne primarily by the landowner) is a major drawback. Additional investigation into the role of other professional liaisons could offer insight into alternative, perhaps less costly, models to facilitate positive interactions and exchanges of information between landowners and professionals.

Paying more attention to the tone and quality of interactions between professionals and landowners on the ground could lead to more widespread exchange of information and use of more sustainable management practices. Natural resource agencies and non-profit organizations may be able to extend their reach by addressing the three conditions of positive interaction through training programs focused on information exchange, staffing more local (as opposed to regional) offices, and providing opportunities to tailor regulations to local conditions. However, as with any effort to use a more collaborative, voluntary, or flexible approach, precautions should be taken to prevent a weakening of regulatory controls. Any flexibility should meet the minimum environmental standards provided by regulations and it may not be appropriate for more collaborative exchanges to replace underlying regulations.

Finally, this research shows that informal governance and social networks play key roles in the exchange of knowledge and expanding the reach of formal regulations and non-regulatory programs. Among landowners in the North Coastal Basin, learning about and subsequent adoption of BMPs often occurs through informal exchanges of information between neighbors, friends, and relatives. Road management and other land management practices are common topics of discussion, and landowners often call on neighbors, friends, and relatives for advice or the implementation of roadwork.

Learning about BMPs through informal networks appears to be most effective among timber-landowners and ranchers. The strength of the informal information exchange between working landowners can be linked to their presence in longer, more established networks as well as their ties to the agency knowledge that result from regulatory requirements. The networks of residential landowners are more variable. In some cases, residential landowners belong to homeowner or road associations that frequently deliberate about road management and seek additional information from outside sources. In other cases, residential landowners do not interact with neighbors and are closed to interactions that would facilitate the exchange of information. Such private and closed nature is presumed to be associated with the marijuana industry though the actual range and type of information exchange among marijuana producers is unknown.

In this case, the groups that are the most strongly governed and governable also have the strongest informal networks. This suggests that there is a relationship between the formal and informal institutions, and between strong networks and the characteristics that make certain groups more governable. However, this is not necessarily the case, and additional research could examine the relationships of informal networks and governability. Practitioners should continue to utilize informal networks to spread knowledge by providing opportunities for trusted professionals to exchange information with key landowners. They can also attempt to cultivate informal relationships and networks with weakly governed populations.

The problem, governance, and action landscapes of many human-environmental issues are complex and constantly changing. This research provides insights into the design and implementation of governing programs that address the social dimensions of governance and management and guides these programs toward a greater likelihood of successful social and ecological outcomes in changing conditions.

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Appendix A

Methods

In this study, I used a mix of qualitative and quantitative methods applied at the regional and watershed scale. My research methods included a mail survey of private landowners in the basin; semi-structured interviews with landowners, staff at natural resource agencies and other government organizations, members and staff at non-profit organizations, and private consultants; participant observation; and document review. I conducted additional interviews, document review, and participant observation in three adjacent watersheds in Humboldt County and used these mini-case studies to add depth to my examination of the interrelated functions of regulatory and non-regulatory programs.

This mixed method and multi-scaled approach allowed me to access correlations and causal mechanisms affecting road management and sediment control practices and provided a means to triangulate the data from different sources in order to generate more robust findings.

This appendix provides additional details on my focus on roads, my selection of the study region and mini-cases, and the research methods used for this study.

Sediment Pollution from Private Roads as a Topical Focus

The governance and management of sediment pollution associated with private roads provides a particularly useful lens for the exploration of the environmental governance on transitioning landscapes and, more generally, the governance of complex human-environmental issues.

Regardless of their land use and approach to management, all landowners require roads to access and navigate their property. The potential to generate sediment pollution from roads is common to all land uses. The risk of sedimentation from a particular road is linked to the landowner's patterns of road use and implementation of specific maintenance, construction, and restoration practices. The study of the management of road-related sedimentation thus allows a relatively direct comparison of the environmental governance and management practices across multiple land uses. Through this focus, I am able to identify institutional dynamics that may be present in other transitioning regions but that would be more difficult to for human-environmental challenges that are not comparable across multiple land uses.

In addition, sediment pollution associated with roads is a complex environmental problem. Like all NPS pollution problems, sediment pollution is diffuse across the landscape – the sources are numerous and unevenly dispersed; the pathways are difficult to trace; the monitoring and enforcement of any regulatory strategy is costly; and the effectiveness of interventions is difficult to measure. Sedimentation is also a natural process that shapes rivers and streams over long time periods. It can be difficult to

distinguish between natural and anthropogenic sedimentation, determine how much sediment is too much sediment, and select an appropriate time-scale on which changes associated from pollution control measures should be visible. These biophysical characteristics complicate efforts to govern sediment pollution.

In addition, social and political complexity is introduced to the governance challenge because those who have polluting roads are not necessarily the same people who are directly impacted by the pollution problem. Due to this disconnect, landowners may not have a direct incentive for reducing sediment risk. In addition, many of the roads contributing sediment predate current landowners. New landowners may take advantage of existing roads regardless of whether they are appropriately designed for the new use.

Though care should be taken with mapping any local phenomena to a global scale, the biophysical, social, and political features of this case share many general features with some of the most pressing and complex global environmental challenges and provides an interesting yet accessible lens into complex human-environmental problems.

North Coastal Basin as Study Region

Several features of the North Coastal Basin make it an appropriate and useful site for the study of the governance of complex human-environmental issues and transitioning rural landscapes.

First, the North Coastal Basin is an example of a rural region in transition. The land uses and economy of the region were dominated by timber production, ranching and agriculture, and fishing until the back-to-the-land movement of the 1960s began to shift land uses towards more residential and homestead uses. Since then, land uses and the economy have continued to evolve and diversify and now include more amenity and recreation-based residential development, vineyard development, and subdivisions for marijuana production.¹¹⁴ This continuous and gradual evolution of land uses has created a region with landowners that have a variety of experiences and management strategies. The diversity of the population allows me to assess governance and management strategies across difference groups of landowners.

Second, since the 1960s, awareness of the decline of salmonid populations in the basin has prompted a wide variety of regulatory and non-regulatory responses from government and private organizations. The active attention of environmental agencies, private consultants, regional nonprofits, and watershed groups provides a rich set of governing programs to examine.

Lastly, the basin can be divided into sub-regions based on political and physical boundaries that provide useful units to compare the effects of different governance

¹¹⁴ Though the strong presence of the marijuana industry makes the North Coastal Basin somewhat unique in rural areas, I found that this difference strengthened my overall findings and highlighted governance dynamics that one can expect to see elsewhere, albeit in less extreme forms. (See discussion in Chapter 5).

arrangements. The majority of the basin is located within Humboldt County, which has a grading ordinance, and Mendocino County, which does not. I constrained the study to watersheds that fall entirely within these two counties, which allowed me to compare management practices in areas with and without county regulation of grading practices.¹¹⁵ In addition, the watersheds in the basin have relatively similar land use histories and patterns of residential and other development,¹¹⁶ but have received varying degrees of attention from regulatory agencies and non-governmental organizations. This combination of features allowed me to examine differences in watershed-level governance.

Selection of Mini-Case Studies

In order to more deeply understand the dynamics and inter-linkages of regulatory and non-regulatory programs and explore cross-watershed interactions, I conducted mini-case studies in three adjacent watersheds in Humboldt County: the Bear River Valley, Mattole, and Van Duzen watersheds. These three watersheds are useful for this analysis because they share similar land-use characteristics, county sediment control regulations, and have communities that are linked and networked but differ in their histories with the federal TMDL process and the types of non-regulatory groups that are active in the watershed (Table A.1).

Table A.1: Regulations and Non-Regulatory Programs in Mini-Case Studies

Watershed	Regulatory Regime	Local Non-Regulatory Efforts
Bear River Valley (sub-watershed of Capetown)	Not listed on 303(d) list; No TMDL required	Bear River Regional Resources Conservancy (BRRRC) is a coalition of ranchers who have obtained grant funding to implement sediment control and road restoration projects
Mattole River Watershed	Sediment TMDL completed in 2004; Lead agency on TMDL: NCRWQCB	Three citizen led organizations (Mattole Restoration Council, Mattole Salmon Group, Sanctuary Forest) work collaboratively with landowners to prevent sediment pollution and restore salmon habitat; the groups pre-date the TMDL and have been active for over 25 years
Van Duzen River Watershed	Sediment TMDL completed in 2004; Lead agency on TMDL: EPA	Friends of the Van Duzen is a citizen monitoring group and timber watchdog that has been active since the mid-1990s; Yager Environmental Stewards is a coalition of ranchers formed during the TMDL process to work with the EPA on the process and who have collaboratively secured funding for road restoration projects

¹¹⁵ The study did not include North Coastal Basin watersheds that are located primarily outside of Humboldt and Mendocino Counties (including the Bodega, Gualala, Lower Russian, Middle Russian, North Fork Eel and Russian Gulch watersheds).

¹¹⁶ Watersheds in the North Coastal Basin share a common legacy of timber and ranching and have similar patterns diversification in land uses and economies. However, the region is far from homogeneous. The watersheds differ in the degree to which different land uses and cultural movements dominate as well as in their biophysical characteristics.

Survey Methods

The mail survey collected data associated with regulatory compliance, familiarity with BMPs, self-reported BMP adoption, and potential explanatory variables (e.g., land use, regulatory experience, use of technical and financial assistance, perception of watershed health).

Survey development

The survey questions used to assess road conditions, familiarity with BMPs, and BMP adoption were based on a review of road management manuals for rural landowners and the design, construction, and maintenance practices stipulated in relevant regulations (FPR 2007, Duggan and Mueller 2005, Humboldt County 2002, Keller and Sherar 2003, Kocher et al. 2007, Kramer 2001, NCRWQCB 2007d, Sommerstrom 2002, Weaver and Hagans 1994, Wiest 1998). The questions were refined in consultation with road management and sediment control specialists at the Mattole Restoration Council, the North Coast Water Quality Control Board, Pacific Watershed Associates, the University of California Cooperative Extension, and the USDA Forest Service Redwood Sciences Laboratory. Potential explanatory variables were identified through a literature review and preliminary research in the region conducted in August 2006.

The questionnaire was pre-tested on residential landowners and ranchers in the region and revised for clarity. The final survey instrument is included in Appendix B.

Survey sample and administration

The survey sample was drawn from a database containing assessor parcel numbers (APN), parcel size, watershed location of each parcel, parcel address, landowner name, and landowner's mailing address. Size and watershed data for each APN were obtained from the CAL FIRE Fire and Resource Assessment Program (FRAP). Landowner information, including names, mailing addresses, and the parcel address, were obtained from county tax assessor data compiled by ParcelQuest. All public and tribal landholdings as well as parcels less than ten acres were removed from the database. Landowners holding multiple parcels were condensed into a single database entry identified by the APN of their largest parcel. The University of California Cooperative Extension (UCCE) administered a survey of rural landowners in California concurrent with my survey. I obtained a list of recipients of the UCCE survey in Humboldt and Mendocino counties and removed UCCE survey recipients from my sample to avoid reduced response rates due to survey fatigue. The sample was stratified by watershed¹¹⁷ and parcel size.¹¹⁸ 1293 landowners were randomly selected from this database.

¹¹⁷ In order to allow comparison across watersheds based on their TMDL history, watershed boundaries corresponded with the classification system used by the NCWQCB TMDL program. The sample was thus stratified by 21 watersheds in the North Coastal Basin: Albion, Big, Capetown, Eureka Plain, Garcia River, Lower Eel, Mad, Mattole, Middle Fork Eel, Middle Main Eel, Navarro, Noyo, Oil Creek, Point Arena, Redwood Creek, Rockport, South Fork Eel, Trinidad, Upper Main Eel, Upper Russian, and Van Duzen.

¹¹⁸ The sample was divided into four size classes: 10–39 acres; 40–159 acres; 160–599 acres; 600 acres and larger.

The survey was administered in accordance with the Tailored Design Method (Dillman 2007) in March through May 2008. The distribution included four mailings: (1) an introductory letter, (2) a survey package including a cover letter, the survey questionnaire, and a stamped addressed return envelope, (3) a reminder postcard, and (4) a replacement survey package including a cover letter, answers to frequently asked questions about the project and me, a replacement survey questionnaire, and a stamped addressed return envelope. Recipients of the survey were given a toll-free phone number and email address so they could contact me with questions or comments about the survey.

Response rate

Of the 1293 mailed surveys, 40 were returned undeliverable and 17 were disqualified due to duplication, the recipient being deceased or the recipient not owning the property, leaving an effective sample size of 1235 surveys presumed to be delivered and valid. 459 surveys were returned and usable giving an effective response rate of 37.2 percent. The response rate was equivalent across counties, watershed, and parcel size classes.

Several survey recipients who chose not to participate in the survey provided written or telephone comments explaining their decision. The most common reasons for non-participation were (a) mistrust of research activities (particularly those associated with the University of California Berkeley), (b) belief that the response would not be useful because the land is not actively managed and/or the landowner has not visited the land, (c) involvement in an ongoing permitting conflict that reduced the recipient's willingness to disclose any information that may be connected to their property, and (d) busyness. In addition, several survey and interview respondents provided their own assessments of who might not respond. These comments were based on either their first-hand knowledge of friends and neighbors who received the survey and chose not to participate or their general experiences in the region. These respondents suggested that the pool of non-respondents also includes landowners who do not trust agencies or outsiders and those involved in the cultivation of marijuana.

The results are thus likely to over-represent landowners who are sympathetic to environmental concerns and comfortable working with professionals and under-represent those who do not trust outsiders as well as those involved in the cultivation of marijuana.

Analysis

I entered all survey responses into a master database and analyzed them using R, a software environment for statistical analysis. I produced descriptive statistics for the survey responses and used contingency tables to analyze the relationships between variables. To determine the significance of variable relationships, I used the Chi-square statistic for categorical variables, the ANOVA test for associating categorical and continuous variables, and the *t*-test for continuous variables.

Interview Methods

I conducted semi-structured interviews with 56 landowners throughout the North Coastal Basin and 30 key staff and members of county, state, and federal agencies, non-profit

organizations, and private consultants. All interviews covered some common themes (e.g., the characteristics of good roads, important issues in the area). Since the interviews were semi-structured, the exact questions varied from interview to interview. (Appendix C contains the interview protocols).

Interviews were conducted either in person or by phone and lasted from 25-120 minutes. Most interviews were audio recorded and transcribed. For respondents who preferred not to be recorded, detailed notes were taken during the interview and a rough transcription was produced immediately after the interview. All interview data was coded, compiled, and analyzed (per Creswell 2003, Weiss 1994) using TAMS Analyzer, a software package for qualitative analysis.

Interview subjects

Respondents for the landowner interviews were randomly selected from the population of survey respondents, and included landowners from all watersheds, classes of parcel sizes, and a wide range of land uses (Table A.2).

Table A.2: Characteristics of Landowner Interview Respondents

Watershed	Parcel Size	Land Use	Watershed	Parcel Size	Land Use
Albion	<40	R	Navarro	<40	S
	40-160	ST		40-160	RT
Big	<40	RT		160-600	ST
	160-600	T	Noyo	<40	ST
Capetown	160-600	GT		160-600	ST
	Eureka Plain	160-600	G	Oil Creek	40-160
<40		GT	160-600		G
<40		GT	Point Arena	160-600	ST
160-600	G	40-160		S	
Garcia	<40	R		160-600	T
	40-160	A	Redwood Creek	<40	R
	>600	GT		40-160	S
Lower Eel	<40	S		160-600	ST
	160-600	ST	Rockport	<40	S
	160-600	R		South Fork Eel	<40
Mad	<40	R	40-160		R
	160-600	GT	160-600		G
	160-600	S	>600		G
Mattole	<40	R	Trinidad	>600	T
	40-160	RT		40-160	GT
	160-600	S	Upper Main Eel	40-160	S
Middle Fork Eel	<40	S		160-600	R
	40-160	R		>600	S
	>600	GT	Upper Russian	<40	S
	>600	G		<40	S
Middle Main Eel	<40	R	160-600	S	
	40-160	S	Van Duzen	<40	RT
	160-600	S		160-600	S

Notes: A= Absentee; G=Grazing/Ranch; R=Residence; S=Second Home or Vacation Home; T=Timber

I also conducted semi-structured interviews with the following agency staff, non-profit staff and members, and private consultants:

- Anonymous, Bear River Regional Resource Conservancy, Ferndale CA
- Anonymous, Buckeye Conservancy, Eureka CA
- Anonymous, Registered Professional Forester, Eureka CA
- Anonymous (1), Natural Resource Services, Redwood Community Action Agency, Eureka CA
- Anonymous (2), Natural Resource Services, Redwood Community Action Agency, Eureka CA
- Anonymous, Officer, Yager/Van Duzen Environmental Stewards (YES), Rancher, Kneeland CA
- Anonymous, Member, Friends of the Van Duzen, Carlotta CA
- Anonymous, Mendocino Resource Conservation District, Boonville CA
- Anonymous, Mendocino Land Trust, Fort Bragg CA
- Anonymous, Redwood Forest Foundation, Mendocino CA
- Anonymous, Fish and Wildlife Biologist, Habitat Restoration Program, U.S. Fish and Wildlife Services, Arcata CA
- Teri Jo Barber, Hydrologist/Private Consultant, Ridge to River, Fort Bragg CA
- Jeff Conner, Humboldt County Code Enforcement Unit, Eureka, CA
- Norma de Vall, President, Redwood Coast Watersheds Alliance, Elk CA
- Peter Dobbins, Board Member (no longer on board), Friends of the Garcia, Point Arena, CA
- Rebecca Fitzgerald, Environmental Scientist, TMDL and Watershed Protection Division, North Coast Regional Water Quality Control Board, Santa Rosa CA
- Gary Flosi, Senior Biologist Supervisor, Northern California-North Coast Region (NCNCR) Program Coordinator, California Department of Fish and Game, Fortuna CA
- Gayle Garman, Environmental Scientist, Coho Recovery, California Department of Fish and Game, Eureka, CA
- Steven Hall, Member, Friends of the Navarro, Boonville CA
- Chris Heppe, National Park Service, previously at Environmental Protection Agency-Region 9
- John Heil, Media Representative, U.S. Forest Service Pacific Southwest Regional Office, Vallejo CA
- Pat Higgins, Fisheries Biologist, Arcata CA
- Michael Furniss, Hydrologist, U.S. Forest Service Pacific Northwest and Pacific Southwest Research Stations, Arcata CA
- Curtis Ihle, Program Manager, Humboldt County Resource Conservation District, Eureka CA
- Alan Levine, Environmental Lawyer and President, Coast Action Group, Point Arena CA
- Holly Lundborg, Senior Environmental Scientist, Planning Division, North Coast Regional Water Quality Control Board, Santa Rosa CA

- Dina Moore, Founder and President, Yager/Van Duzen Environmental Stewards (YES), Rancher and Water Board member, Kneeland CA
- Joel Monschke, Good Roads Clear Creeks Program Director, Mattole Restoration Council, Whitethorn CA
- Louisa Morris, Program Manager, Mendocino Land Trust, Fort Bragg CA
- Leslie Reid, Research Geologist, U.S. Forest Service Pacific Southwest Station Redwood Sciences Laboratory Arcata, CA
- Kimberly Rodrigues, Regional Director, North Coast and Mountain Region University of California Cooperative Extension, Davis CA
- Sal Steinberg, Outreach Coordinator, Friends of the Van Duzen, Carlotta, CA

Other Field Activities

During my visits to the study region, I also attended and participated in several community activities, field tours, meetings, workshops, and other events. These provided me with the opportunity to observe the interactions of landowners and regulators and to have informal conversations with a variety of people owning land, living, and/or working in the North Coastal Basin. The activities included:

- Field excursion and tour of roads and restoration sites with Campbell Lumber Company, Ukiah CA, 8/2/2006
- Tour of Harwood Lumber Mill, Branscomb CA, 8/4/2006
- Participation in the Scott River Watershed Road Inventory with the 5 Counties organization, Etna CA, 8/12/2006
- Board of Forestry Monitoring Study Group Meeting, Willits CA, 9/7/2006
- Bird Survey with the Big River Stewards, 5/30/2007
- Conservation Fund Salmon Creek Timber Harvest Plan Pre-Harvest Community Tour, 6/1/2007
- Conservation Fund Garcia Timber Harvest Plan Pre-Harvest Community Tour, 6/1/2007
- Discussion of draft sediment implementation plan at the NCRWQCB Meeting, Yreka CA, 7/25/2007
- Friends of Van Duzen Meeting Watershed Project Community Meeting, 8/8/2007
- Redwood Community Action Agency Humboldt Bay Meeting, 8/10/2007
- Ranch visit in the Mattole Valley (accompanied ranching family as they rounded up their cattle, separated the cows and calves, and transported the calves to another ranch), 8/13-8/14/2007
- 10th Annual Coho Confab in the Mattole, sponsored by Salmonid Restoration Federation, Trees Foundation, Sanctuary Forest, Mattole Restoration Council, and the Mattole Salmon Group, 8/17-8/19/2007
- Central Coast Field School: Culvert and Road Drainage Workshop, sponsored by Salmonid Restoration Federation and led by Danny Hagans and William Weaver of Pacific Watershed Associates, Arroyo Grande, 10/23-10/25/2007
- Sediment Workshop at the NCRWQCB Meeting, Santa Rosa CA, 1/17/2008
- UC Cooperative Extension Landowner Outreach Workshop, Davis CA, 2/27/2008
- Buckeye Conservancy Annual Meeting, Fortuna CA, 3/8/2008

- Catchments meetings (social meeting of water-oriented professionals in the Humboldt Bay Area), 7/10/2008
- NCRWQCB Meeting, Santa Rosa CA, 7/24/2008
- Bear River Regional Resource Conservancy membership meeting, 9/23/2008
- Meet and greet picnic for Bear River Regional Resource Conservancy and Humboldt Redwood Company, 11/8/2008

Appendix B
Mail Survey Instrument

North Coast Landowners' Survey:
Your land, roads, and experiences



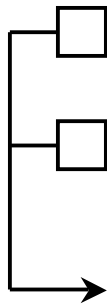
Welcome to the North Coast Landowner's Survey

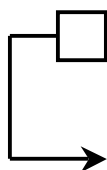
This survey is part of a project to learn about the management of land and roads from landowners and land managers in Mendocino and Humboldt counties.

This questionnaire should be answered by someone who owns or manages land in Mendocino or Humboldt County.

The letter that came with this questionnaire lists an Assessor's Parcel Number (APN) under your address. Do you own or manage the parcel listed in the cover letter?

- Yes**, I own or manage the parcel listed in the cover letter
- I **don't know** about the parcel listed in the cover letter but I do own or manage property in Humboldt or Mendocino County.

 ***Please fill out this questionnaire to help us understand the experiences and opinions of landowners in Humboldt and Mendocino counties. The survey should take approximately 20 – 30 minutes to complete. If you find a question that does not apply to your land, write "NA" in the margin. If you don't know the answer to a question, write "DK" in the margin and move on to the next question. Please return the questionnaire in the enclosed stamped envelope when you are finished***

- No**, I do not own or manage the parcel listed in the cover letter or any other property in Humboldt or Mendocino Counties.
-  ***Please return the questionnaire unanswered in the enclosed stamped return envelope. We thank you for taking the time to return the questionnaire because it helps us with our record keeping, and keeps us from contacting you again.***

Thank you for your time and thoughts!

**We are interested in your experiences and opinions
about land and road management practices!**

Please start by answering a few questions about your land. As you fill out the questionnaire, consider the parcel mentioned in the letter that came with this questionnaire as well as any nearby lands that you own and manage with this property.

1. Approximately how many acres are managed at this location?

_____ acres

2. In what county is this land located? (Mark all that apply)

- Humboldt County
- Mendocino County
- Don't know

3. In what watershed is this land located? (Write "DK" if you do not know)

_____ watershed

4. Do you or your spouse own the parcel mentioned in the cover letter? (Please mark one)

Yes
↓

No
↓

<p><i>If you answered yes to question 4:</i></p> <p>Approximately how many years has this land been in your family?</p> <p>_____ years</p> <p>How many years have you or your spouse owned this land?</p> <p>_____ years</p>	<p><i>If you answered no to question 4:</i></p> <p>Please explain your relationship to the owner:</p>
---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------

5. Is someone other than the owner paid to make management decisions about this land?

- Yes
 No
 Don't know

If you answered yes to question 5:

We hope to talk with a few land managers about how they make land management decisions. Please provide the name of your land manager and/or managing company:

6. Do you live on this land for all or part of the year? (Please mark one)

Yes



No



If you answered yes to question 6:

Please mark all that apply:

- It is my primary residence
 It is my second home
 It is my vacation home

How many months of the year do you live on this land? (Please mark one)

- Less than 1 month
 1-4 months
 5-8 months
 9-12 months

If you answered no to question 6:

How many miles do you live from this land? (Please mark one)

- Less than 5 miles
 5 – 20 miles
 21 – 50 miles
 51 – 100 miles
 More than 100 miles

Do you plan to live on the land in the future? (Please mark one)

- I plan to have a primary residence there
 I plan to have a second home there
 I plan to have a vacation home there
 I have no plans to live there

7. Is your land used in any of the following ways? (Mark all that apply)

	No	Yes, for personal and guest use	Yes, to sell or for a fee
Crop production	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Firewood	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fishing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Grazing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hunting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Off road vehicle recreation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Raise livestock	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Timber	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Vacation home	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

8. Is there a conservation easement on this property?

- Yes
 No
 Don't know

If you answered yes to question 8:

Did you donate or sell the conservation easement?

- Donate
 Sell
 Don't know

In what year was it donated or sold? (If you don't know, write "DK")

To whom was it donated or sold? (If you don't know, write "DK")

Please answer a few questions about your roads. When answering these questions, consider only privately maintained roads.

9. Please provide your best estimate of the length of roads on your property:

_____ miles (Please write your best estimate)

- Less than one mile
- There are no roads on my property → Skip to question 30

10. Do you share roads with your neighbors? (Mark all that apply)

- Yes, other people use roads on my property to access their land
- Yes, I use privately maintained roads on other peoples' property to access my land
- No → Skip to question 16

11. Please provide your best estimate of the length of private roads you use to access your land that are located on other peoples' property:

_____ miles of road on other peoples' property (Please write your best estimate)

- Less than one mile of road on other peoples' property
- None

12. Please answer three questions about how you and your neighbors manage shared roads. (Mark one box for each question)

	Usually	Some-times	Never	Does not apply
A. Do you and your neighbors agree about how to maintain your shared roads?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
B. Do you and your neighbors agree about how to divide the cost of maintaining your shared roads?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C. Do your shared roads create conflict with your neighbors?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

13. Are you a member of a road, homeowners, or neighborhood association that jointly maintains a road?

- Yes
- No
- Don't know

14. Do you pay dues to a road, homeowners, or neighborhood association to help pay for road maintenance?

- Yes
- No → *Skip to question 16*
- Don't know → *Skip to question 16*

15. Approximately how much money in dues do you contribute to this association each year?

_____ dollars

Don't know

16. Over the past 5 years, approximately how much money did you spend on road construction and maintenance? Do not include any association dues or any cost share funds you may have received in your estimate.

_____ dollars

Don't know

17. What percentage of your roads are used all year round (in both the dry and wet seasons)?

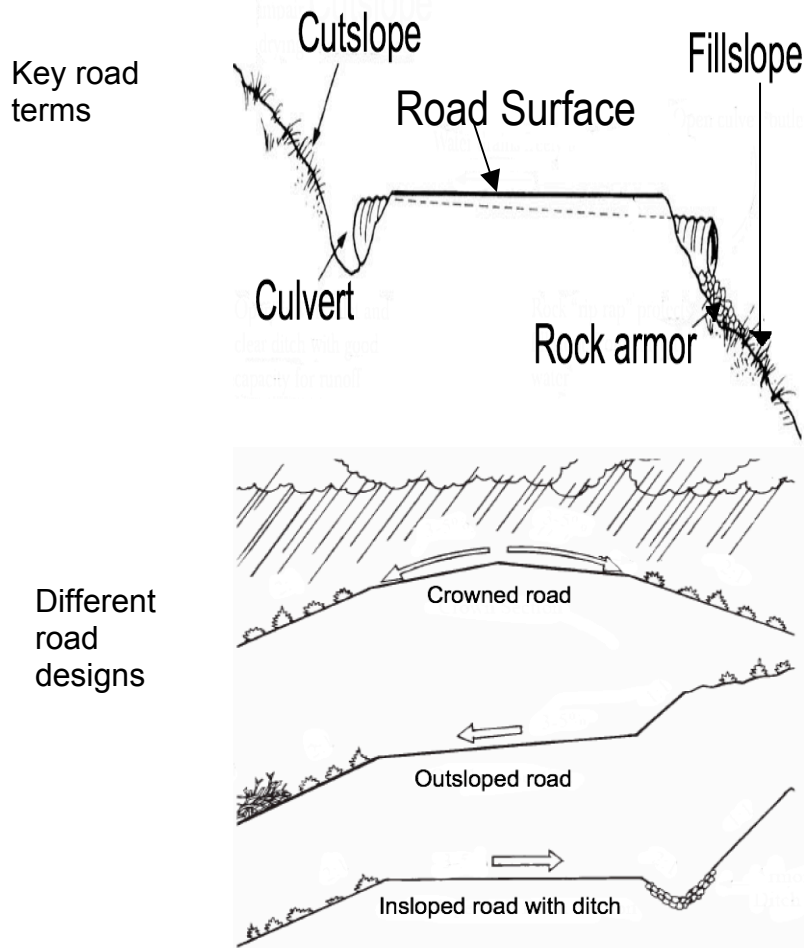
- None → *Skip to question 19*
- Less than 20%
- 20-39%
- 40-59%
- 60-79%
- 80-99%
- All

18. What road surfacing types are on your roads that are used all year round?

Write the percentage of roads with each surfacing type. If you don't have any roads with a surfacing type, write "0" for that surfacing type.

Surfacing type	Approximate Percentage of roads
Native surface (exposed dirt)	_____ %
Paved	_____ %
Rock/gravel surface (recently rocked/in good condition)	_____ %
Rock/gravel surface (worn down)	_____ %
Vegetation/grass	_____ %
Other (please specify) _____	_____ %
Total	100%

These pictures show some terms that may be helpful for questions 19-23.



Drawings adapted from Oregon State University 1998 and Keller and Sherar 2003

19. This question lists challenges that landowners often encounter with their roads. In the last five years, what challenges have you experienced on your roads or the privately maintained roads you use to reach your land? (Mark all that apply)

- Deep rills or gullies on road surface
- Instability (or landslide) on road
- Large gullies or erosion at outlet of drainage culverts
- Potholes
- Problem culverts
- Roads not drivable for any reason
- Standing water on road or in roadside ditch
- Washboarding
- Other (please describe) _____
- None of these

20. This question contains a list of several ways people might update their road infrastructure. Consider all of the privately maintained roads on your land and those used to access your land, and please tell us if you or the person responsible for managing your roads have done any of these activities in the time period indicated. (Mark all that apply for each line)

	In the last 6 months	In the last 6-12 months	In the last 1-2 years	In the last 2-5 years	In the last 5-10 years	Not in last 10 years	Don't know
Build a new road or driveway	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Grade a portion of an existing road	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Replace a culvert or other stream crossing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Stabilize or armor stream bank	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Remove landslide debris from road surface	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Decommission or 'put to bed' a road	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

21. Indicate the frequency that you or the person responsible for maintaining your roads does the following management activities. (Mark one box for each line)

	Never	When needed and in emergencies	Once a year	Twice a year	At least twice a year and during or after large storms	Does not apply to my roads	Don't know
Inspect the condition of roads	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Inspect the condition of road drainage structures (ex. ditch relief culverts, ditches)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Inspect erosion control structures (ex. rock armoring, silt fences, check dams)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Remove debris from ditch-relief culverts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Remove debris from inlet and outlet of stream crossings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Remove debris from trash racks	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

22. This question contains a list of several things people might do to manage their roads and land. For each of the actions listed, please tell us if you or the person responsible for your roads already does or would do these. (Mark one box for each line)

	Already do this	Might do this	Would never do this	Does not apply	Don't know
Plant vegetation on cutslopes or fillslopes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Outslope roads	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ensure fish passage when constructing or maintaining watercourse crossings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Use erosion control measures (ex. rock armoring, sediment basins, silt traps)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Develop a written land management plan that includes a plan for road management	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Identify areas on your land with high erosion risk	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Inventory sediment delivery sites on your land	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Limit road construction to stable areas	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Deposit construction waste away from streams	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Participate in a road restoration project to reduce sedimentation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Develop a written land management plan that includes a plan for erosion control	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Identify unstable areas on your land	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Consult a professional about a road management problem	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Implement water quality control projects on your land	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Consult another landowner about how to manage your road	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Use rolling dips	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify) _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

23. In the last five years, did you discuss or get technical assistance about sediment management and/or road construction, maintenance and/or management from the following organizations, programs, or sources? If yes, please rate the quality of advice by circling a number.

Got advice?		If Yes →	Quality of advice				
Yes	No		Very good	Good	Neutral	Poor	Very poor
<input type="checkbox"/>	<input type="checkbox"/>	Book (please specify) _____	2	1	0	-1	-2
<input type="checkbox"/>	<input type="checkbox"/>	CA Department of Fish and Game (DFG)	2	1	0	-1	-2
<input type="checkbox"/>	<input type="checkbox"/>	CA State Department of Forestry (CalFire formerly CDF)	2	1	0	-1	-2
<input type="checkbox"/>	<input type="checkbox"/>	Fish Friendly Farming Certification Program	2	1	0	-1	-2
<input type="checkbox"/>	<input type="checkbox"/>	Industry association (please specify) _____	2	1	0	-1	-2
<input type="checkbox"/>	<input type="checkbox"/>	Internet	2	1	0	-1	-2
<input type="checkbox"/>	<input type="checkbox"/>	Land conservation organization (ex. Pacific Forest Trust, the Nature Conservancy)	2	1	0	-1	-2
<input type="checkbox"/>	<input type="checkbox"/>	Local land trust (please specify) _____	2	1	0	-1	-2
<input type="checkbox"/>	<input type="checkbox"/>	Local non-profit organization (please specify) _____	2	1	0	-1	-2
<input type="checkbox"/>	<input type="checkbox"/>	Natural Resource Conservation Service (NRCS)	2	1	0	-1	-2
<input type="checkbox"/>	<input type="checkbox"/>	Private company or consultant (please specify) _____	2	1	0	-1	-2
<input type="checkbox"/>	<input type="checkbox"/>	Professional association (please specify) _____	2	1	0	-1	-2
<input type="checkbox"/>	<input type="checkbox"/>	Relative, friend, or neighbor	2	1	0	-1	-2
<input type="checkbox"/>	<input type="checkbox"/>	Resource Conservation District (RCD)	2	1	0	-1	-2
<input type="checkbox"/>	<input type="checkbox"/>	Road management workshop (please specify) _____	2	1	0	-1	-2
<input type="checkbox"/>	<input type="checkbox"/>	University of California Cooperative Extension (Farm or Forestry Advisor or Specialist)	2	1	0	-1	-2
<input type="checkbox"/>	<input type="checkbox"/>	US Forest Service (USFS)	2	1	0	-1	-2
<input type="checkbox"/>	<input type="checkbox"/>	Other (please specify) _____	2	1	0	-1	-2
<input type="checkbox"/>	<input type="checkbox"/>	Other (please specify) _____	2	1	0	-1	-2

24. How do you prefer to get information about land management practices? (Mark all that apply)

- Website
- Book
- Email newsletter
- Written newsletter
- Pamphlet
- Workshop
- Contacting professional or non-profit
- Talking with neighbors, relatives or friends
- Other (please specify) _____
- None of the above

25. In the last five years, did you receive cost-share funds or other financial assistance for road work from any of the following programs? (Please mark one box for each line)

	Yes	No	Don't know
California Forest Improvement Program (CFIP)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Environmental Quality Improvement Program (EQIP)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fish and Wildlife Assistance Program	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fisheries Restoration Grant Program (run by the CA Department of Fish and Game)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Grant partnership with a local non-profit organization (please specify the organization)_____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Jobs in the Woods Watershed Restoration Program	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Resource Conservation District Grant Program	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Wildland Habitat Incentives Program (WHIP)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify) _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify) _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Please answer a few questions about your experiences with and opinions of the regulations that affect roads and sediment control.

26. In the last five years, have you obtained any permits associated with roads or sediment control?

- Yes
- No → Skip to question 30
- Don't know → Skip to question 30

27. Have you obtained the following permits for road-work or sediment control in the last five years? (Please mark one box for each item)

	Yes	No
1603 agreement from California Department of Fish and Game (CA DFG)	<input type="checkbox"/>	<input type="checkbox"/>
Erosion control plan approval from the North Coast Regional Water Quality Control Board (NCRWQCB)	<input type="checkbox"/>	<input type="checkbox"/>
Grading Permit from County	<input type="checkbox"/>	<input type="checkbox"/>
Incidental Take Permit from National Oceanic and Atmospheric Administration (NOAA)	<input type="checkbox"/>	<input type="checkbox"/>
Incidental Take Permit from U.S. Fish and Wildlife Service	<input type="checkbox"/>	<input type="checkbox"/>
Sediment Discharge Waiver from the North Coast Regional Water Quality Control Board (NCRWQCB)	<input type="checkbox"/>	<input type="checkbox"/>
Section 401 Permit from the North Coast Regional Water Quality Control Board (NCRWQCB)	<input type="checkbox"/>	<input type="checkbox"/>
Section 404 Permit from U.S. Army Corps of Engineers (US ACE)	<input type="checkbox"/>	<input type="checkbox"/>
Timber Harvest Plan approval from California Department of Forestry (CalFire formerly known as CDF)	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify) _____	<input type="checkbox"/>	<input type="checkbox"/>

28. Consider the road construction, maintenance, restoration or other project(s) that required a permit. Were you ever required to change any part of your project(s) because of the permitting process?

- Yes
- No
- Don't know

29. Did you receive sufficient assistance in the preparation of the required documents?

- Yes
- No
- Don't know

30. Are you familiar with regulations that affect roads and/or sediment control?

Yes
 No

If you answered yes to question 30:
 For questions A and B, mark one box for each question

	Very Much	Some-what	Not at all	Don't know
A. Do the regulations limit your ability to manage your property as you wish?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
B. Do the regulations limit your ability to earn a profit from the management of your property?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C. Please list the regulations that most constrain your management practices. You can also explain your answer if you like.				

31. Below is a list of statements about LAND MANAGEMENT, ROADS, AND WATER QUALITY. Please indicate the extent to which you agree or disagree with each statement. (Circle one number for each statement)

	Strongly Agree		Neutral			Strongly disagree	
The streams and rivers in my watershed are impaired.	3	2	1	0	-1	-2	-3
It is a good idea to work with neighbors to plan road routes that cross property lines	3	2	1	0	-1	-2	-3
My land management practices have an impact on water quality	3	2	1	0	-1	-2	-3
Working with neighbors on land management is usually not helpful	3	2	1	0	-1	-2	-3
The streams and rivers in my watershed are good habitat for fish	3	2	1	0	-1	-2	-3

32. Below is a list of statements about LANDOWNER RIGHTS AND RESPONSIBILITIES. Please indicate the extent to which you agree or disagree with each statement (Circle one number for each statement)

	Strongly Agree		Neutral			Strongly disagree	
I have the right to exclude others from access to my land	3	2	1	0	-1	-2	-3
I have the responsibility to leave my land in better shape than it was in when I acquired it	3	2	1	0	-1	-2	-3
I have the right to do anything I want with my land without regard for others	3	2	1	0	-1	-2	-3
I have the exclusive right to use of the natural resources provided by my land	3	2	1	0	-1	-2	-3
I should make sure that actions on my land do not conflict with the interests and values of the local community	3	2	1	0	-1	-2	-3
I am obligated to maintain my land in good condition for future generations	3	2	1	0	-1	-2	-3
I have the right to do anything I want with my land without regard for the environment	3	2	1	0	-1	-2	-3
Restrictions on my rights as a landowner are a threat to my civil liberties	3	2	1	0	-1	-2	-3
I should make sure that actions on my land do not negatively impact water quality	3	2	1	0	-1	-2	-3
I am obligated to be a good steward of my land	3	2	1	0	-1	-2	-3
I should make sure that actions on my land do not harm endangered species	3	2	1	0	-1	-2	-3
I have the right to transfer ownership of my land to others without restriction	3	2	1	0	-1	-2	-3
My rights as a landowner place no obligations on me	3	2	1	0	-1	-2	-3
My rights as a landowner have become increasingly restricted over time	3	2	1	0	-1	-2	-3
I am obligated to take into account the values and interests of society at large when making land management decisions	3	2	1	0	-1	-2	-3
I should ensure that actions on my land do not infringe upon neighbors' rights	3	2	1	0	-1	-2	-3

33. In the space below, please write a statement that you think describes landowners' rights and responsibilities. (This could be a statement from the list in question 32 or something completely different).

34. Below is a list of statements about the REGULATION OF PRIVATE LANDS IN CALIFORNIA AND THE ENVIRONMENT. Please indicate the extent to which you agree or disagree with each statement. (Circle one number for each statement)

	Strongly Agree		Neutral			Strongly disagree	
The government should regulate how people use their land in order to protect water quality	3	2	1	0	-1	-2	-3
Landowners should be able to use natural resources on their own land without asking permission from the government	3	2	1	0	-1	-2	-3
Government agencies do more harm to the land than they do good	3	2	1	0	-1	-2	-3
The government does a good job consulting citizens before making natural resource regulations	3	2	1	0	-1	-2	-3
Government regulation results in a loss of essential liberties and freedoms	3	2	1	0	-1	-2	-3
The government listens to landowners' concerns when developing regulations	3	2	1	0	-1	-2	-3
The government should regulate how people use their land in order to protect threatened and endangered species	3	2	1	0	-1	-2	-3
The government has the right to regulate resource management on private land if it pays compensation	3	2	1	0	-1	-2	-3
The government should regulate how people use their land in order to preserve the beauty of the region	3	2	1	0	-1	-2	-3
Government employees don't know or understand my land as well as I do	3	2	1	0	-1	-2	-3

Finally, please answer a few questions about yourself. This information will only be used for statistical purposes to make general statements about land managers in the North Coast. Your answers are confidential and will not be connected with you.

35. How old are you?

_____ years

36. Are you... ? (Please mark one)

- Male
- Female

37. Which category best describes your career or employment status? (Mark all that apply)

- Home-maker
- Self-employed
- Blue collar/skilled trade
- Professional/management
- Student
- Retired
- Unemployed
- Other _____

38. What is your highest level of education? (please mark one)

- Some school
- High school diploma or GED
- Some college or graduate of junior college
- Bachelor's degree
- Post-graduate degree

39. Please mark the box that comes closest to your total household income before taxes.

- less than \$29,999
- \$30,000 - \$59,999
- \$60,000 - \$99,999
- \$100,000 - \$129,999
- \$130,000 - \$159,999
- \$160,000 or more

40. Approximately what percentage of your gross annual income comes from your land? (Place a mark at the closest point on the following line)

0-----10-----20-----30-----40-----50-----60-----70-----80-----90-----100%

41. Which of the following best describes the area where you have lived most of your life? (Please mark one box)

- A major city or metropolitan area (over one million people) or its suburb
- A large city (100,000 people to one million people) or its suburb
- A medium-sized city (25,000 to 99,999 people) or its suburb
- A smaller city (5,000 to 24,999 people)
- A town or village (2,500 to 4,999 people)
- In the country or a very small town (under 2,500)
- A rural farm or ranch
- No one choice describes where I have lived

42. Have you been a member of any of the following groups in the last five years? (Please mark all that apply)

- CA Farm Bureau Federation
- Livestock association
- Local cooperative (please specify) _____
- Local environmental association (please specify) _____
- Local fraternal organization
- State or national environmental association
- Taxpayers, neighborhood, homeowners or roads association
- Timber or logging association
- Town or county government
- Other (please specify) _____
- None of the above

Thank you for participating in the North Coast Landowner Survey

Your time and help are greatly appreciated.

Is there anything else you would like to tell us? Please use the remaining space for any additional information you would like to share.

Would you like to hear about the results of this survey?

To request a copy of the results, please:

Print your name and mailing address on back of the return envelope containing this questionnaire

OR

Send an email to me (ashort@berkeley.edu) with your name and mailing address

No matter which option you choose, your name and address will never be connected with the survey results.

Please feel free to contact me with any questions about this survey or my research:

Anne Short
Energy and Resources Group
310 Barrows Hall #3050
University of California
Berkeley, CA 94720-3050

Toll free phone: (888) 889-4787
Email: ashort@berkeley.edu



Appendix C

Interview Protocols

The exact interview questions varied from interview to interview because the interviews were semi-structured. However, all interview subjects were asked: “What makes a good road?” and interviews of subjects in different groups (landowners, members of non-profit organizations, agency staff, staff at non-profit organizations, private consultants) covered common topics. The topics and sample questions for each topic area are listed below.

Interview topics and sample questions for interviews with landowners

Background and use of parcel

- Please describe when and why you (or your family) acquired this land.
- Please describe how this parcel has been used in the past and how you now use it.

BMP knowledge and road management practices

- What makes a good road?
- Is there anything you would like to do to improve your road network?
 - If yes: why haven't you done this work yet?

Advice and technical assistance

- How have you gained experience with road construction and maintenance?
- Do you talk with your neighbors or friends about your roads or land?
- Have you ever sought out advice about road management? For other land management challenges?
- Who is the best source of advice for road construction and maintenance? For other land management questions?

Experiences with regulators and regulations

- Have you ever received any permits?
 - If yes: Please describe your experience with the regulatory process.
- Have you interacted with any agency staff for any other reason?
 - If yes: Please describe any experiences you've had with staff at natural resource agencies or other government offices.
- Are regulations effective for addressing issues associated with land management and roads?

Experiences with cost-share and/or grant programs

- Have you ever received any cost-share or grant funding for a road upgrading, restoration and/or decommissioning project?
 - If yes: Please describe your experience with that program.
 - If no: Are you aware of any programs like this in your area? Would you ever consider such a program? Why or why not?
- Do you think cost-share and grant projects are a good use of public funds?

Land management practices, roads, and the environment

- Do your land management practice affect the environment (positively or negatively)?
 - If yes: how?
- What kinds of land uses or management practices have the biggest effect on the environment in this region?
- Do you think roads affect the environment?
- Who should make decisions about what management practices landowners are required to adopt in order to protect the environment? Why?

Other issues

- What are the three most important issues for you as a landowner?
- What are the three most important issues for this region, the community here, and/or the environment in this region?

Interview topics and sample questions for interviews with members of non-profit organizations

Participation in non-profit organizations

- Please describe how and why you got involved with this organization.
- Please describe the activities you've done with this organization.
- Has your participation in this organization changed the way you care for your roads or land?
- Has your participation in this organization changed your attitudes towards regulators?
- Do you think the organization has changed the way other landowners care from their roads or land?

Roads

- What makes a good road?

Land management practices, roads, and the environment

- Do your land management practice affect the environment (positively or negatively)?
 - Is yes: how?
- What kinds of land uses or management practices have the biggest effect on the environment in this region?

Other issues

- What are the greatest threats to salmonids and watershed health?
- What are the most important issues in the region?

Interview topics and sample questions for interviews with staff at agencies, staff at non-profits, and private consultants

Program goals and needs

- Please describe the major goals and priorities of your program and how it fits into the priorities of your agency.
- What are the greatest threats to salmonids and watershed health?

Roads

- What makes a good road?

Governance strategies

- Please describe your program's approach to reducing sediment.
- How do you monitor and/or enforce compliance with regulations or program requirements?
- Are these measures effective for the protection of the environment?

Experience working with landowners

- Please describe your experiences working with different types of landowners: large and small; ranching, timber and residential.
- Do landowners that consult with you and/or participate in non-regulatory programs have flexibility to deviate from suggested BMPs?

Marijuana

- Does marijuana cultivation impact the environment? How?
- How does your agency or program address the environmental impacts of marijuana cultivation?

Additional interview topics and sample questions for interviews with staff at agencies

Governance strategies

- Please describe the costs and benefits of a regulatory versus a non-regulatory approach to sediment reduction?

Relationship with other agencies

- Do you work with other agencies?
- How do your priorities differ from those of other agencies?

Additional interview topics and sample questions for interviews staff at non-profit organizations and non-regulatory agencies

Outreach

- How do you get landowners to participate in your program?

Appendix D

Glossary of Technical Terms for Road Construction, Reconstruction, Maintenance, and Abandonment¹¹⁹

Berm: ridge of rock or soil at the outside of the road shoulder that controls water on the road surface by preventing it from discharging onto the hillslope

Critical dip: shallow, rounded dip in the road near culverted stream cross that is designed to capture overflow from a culverted stream crossing and redirect the water back into the stream channel

Culvert: pipes that move water from the inside of the road (next to the cutslope) through a pipe under the road surface to the outside of the road (next to the fillslope); used to drain stream, springs, and flow from inside ditches across the road (Figure D.1)

Cutslope: face or bank cut into the ground surface (soils or rock) at the inside of a road (Figure D.1)

Decommission (road): take road out of service and remove the features of the road that alter the hillslope drainage or create erosion risks due to instability of the slope

Ditch relief culvert: culvert that drains water that has accumulated in the inside ditch to the outside of the road

Gully: erosion channel formed by concentrated flow, generally defined to be larger than one square foot in cross sectional area

Fillslope: section of road fill between the edge of the road and the base of the fill (Figure D.1)

Inboard ditch: drainage ditch on the inside of the road, usually at the base of the cutslope (Figures D.1 and D.2)

Insloped road: road surface that is sloped toward the cutslope; usually has an inboard ditch that collects and drains water from the road surface (Figure D.2)

Outsloped road: road surface that is sloped at a slight angle away from the cutslope and toward the fillslope, which diverts water off the road surface in a dispersed manner onto the adjacent hillside (Figure D.2)

Reconstruction (road): repair, upgrading or rebuilding of some elements of an abandoned or otherwise substandard road (usually to reduce erosion or the risk of erosion)

Rill: erosion channel, similar to a gully but smaller, formed by concentrated flow

Rolling dip: shallow, rounded dip in the road that breaks the road grade in order to direct water from the road surface into the dip, where it is funneled to the outside of the road (next to the fillslope) or to a ditch relieve culvert on the inside of the road (next to the cutslope)

¹¹⁹ Definitions based on Weaver and Hagans (1994) and Kocher et al. (2007).

Stream crossing (also called watercourse crossing): location where a road crosses a stream challenge; common structures used in stream crossings include bridges, culverts, and fords

Trash barrier (also called trash rack): barriers constructed just upstream from a culvert inlet to prevent the culvert from plugging by trapping logs and other floating organic debris

Waterbar: shallow ditch or a mound of soil accompanied by a ditch constructed at an angle across the road surface to divert water off the surface of the road; usually constructed on seasonal or temporary roads as they are often not passable by vehicles

Figure D.1: Key Features of Road and Drainage

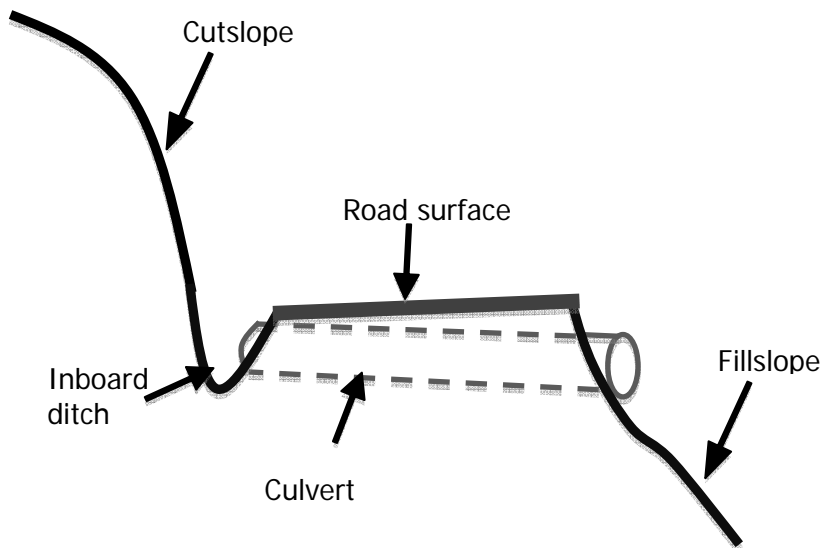
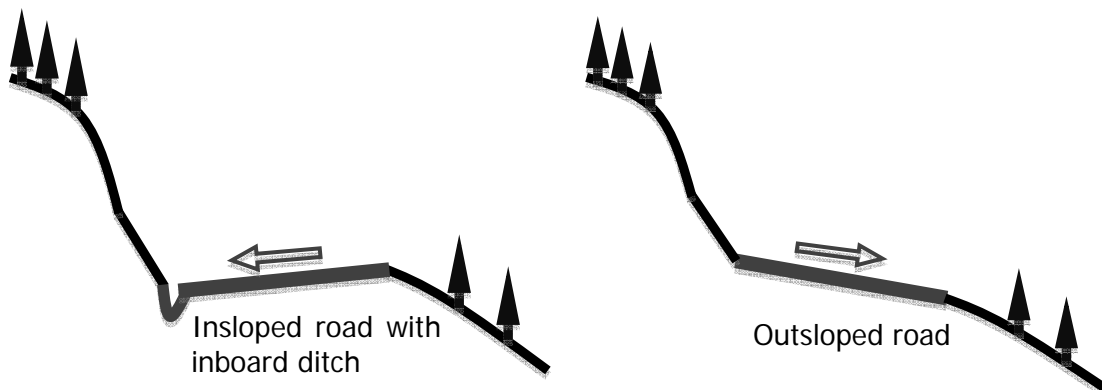


Figure D.2: Insloped and Outsloped Road Design



Note: Arrows represent the flow of water off of the road surface

Appendix E

Best Management Practices to Reduce Road-Related Sediment Delivery

Planning	<ul style="list-style-type: none"> • Prepare and follow an erosion control plan, sediment management plan, or road management plan approved by a professional consultant^{CATCEF, GAP, HUM, WDR,} • Inventory and map existing and planned roads, watercourse crossings, unstable areas, and sediment delivery sites^{CATCEF, FPR, GAP, WDR} • Do field reconnaissance to determine drainage needs, stream location and incision, obstacles, and geology⁵ • New road construction limited to 1000 linear feet (unless further construction is justified through Sediment Management Plan)^{CATF} • Avoid the construction of new roads when possible^{FPR} • Minimize the length and width of roads^{FPR,1,2} • Minimize the number of stream crossings^{FPR,1,2,6} • Fit road to local topography^{FPR} • No road use, reconstruction or construction in channel^{GAP} • Roads should be located out of Watercourse and Lake Protection Zone^{FPR} • Identify and avoid wet areas^{FPR,3,4,5} • Identify and avoid unstable areas^{FPR, GAP, HUM,3,4,5} • In areas with unstable ground, use professional engineer, geologist;^{2,5} Construction in unstable areas is only allowed following consultation with California Certified Geologist and report to NCRWQCB^{GAP}
General drainage	<ul style="list-style-type: none"> • Install sufficient drainage (in terms of size, number, and location of drainage structures) to minimize erosion^{FPR} • Dissipate energy of flowing water onto non-erodible material at point of discharge^{GAP, FPR, HUM,1,4,5} • Do not use outside ditches¹ • Ditches should have a minimum grade of 3% to keep water moving⁶ • Ditch relief culverts should be at least 2% steeper than ditch grade¹ • Ditch relief culverts should be skewed 30-45 degrees across the road³ • Ditch relief culverts should exit at the toe of the fill^{1,3} • In areas with springs or seeps, use inboard drainage ditch regardless of prism shape of road⁶ • Disconnect drainage from stream (i.e. make sure drainage does not go directly into stream) through infiltration area or filter strip^{1,3,6}
Drainage for insloped roads	<ul style="list-style-type: none"> • Depth of inboard ditch should be at least 12 inches below the roadway⁵ • Minimum culvert diameter is 18 inches^{1,5} and 24 inches in areas with unstable cutslopes and raveling problems¹ • Construct according to specified maximum distance between ditch relief culverts and waterbars^{GAP,1,2,5,6} • Filter ditch with vegetation^{1,2,5}

Drainage for outsloped roads	<ul style="list-style-type: none"> • Use rolling dips or waterbars as needed;^{1,3,5} use rolling dips (rather than waterbars) as needed;^{GAP} use rolling dips on roads with 2-8% grade and waterbars for grade over 8%³ • Surface should have appropriate grade (3-5% grade;¹ 2-4% cross slope;⁴ 4-6% cross grade⁶) • Remove berms on outside edge of the road^{FPR,1,2}
Road design and surface	<ul style="list-style-type: none"> • Use outsloped roads when safe^{GAP,2,3,4,5,6} • Use rock surface for all-season roads^{FPR,GAP,1,2,3,4,5} • Native surface with spot rocking in sensitive areas can be used on seasonal roads^{FPR,GAP} • Roads within 50-100 ft of stream must be surfaced with rock and 'stable'^{GAP} • Use stable cut and fillslope angles;^{HUM,1} balance cut and fillslope^{FPR} • Vegetate cut and fillslope^{1,2,6} • Road grade should be at least 2% to avoid collecting water in ruts and ditches³ • Fillslope should be compacted^{HUM,1} • Minimize road gradient;^{2,5,6} road grade must be less than 15%, except pitches 15-20% are allowed for less than 500 continuous feet^{FPR} • Use cut and fill in gentle terrain and full bench cut on steep slopes (60%;^{1,2,5} 65%^{FPR}) and no skid trails on slopes greater than 40% if located within 200 ft of watercourse^{CATF,GAP}
Watercourse crossings	<ul style="list-style-type: none"> • Ensure fish passage^{FPR,1,2,5} • Use appropriate sized culvert to accommodate 50 year flood plus debris;^{GAP,1,3,5} 100 year flood^{FPR,2} • Cover culverts with at least 12 inches of fill and compact fill^{1,3} • Use a single large culvert rather than multiple small culverts⁶ • Use critical dip to reduce diversion potential^{FPR,GAP,1,2,5,6} • Align crossing with natural channel^{FPR,1,4,5,6} • Install trash barriers where there is plug potential^{FPR,1,2} but avoid on fish migrating streams⁶

Use and maintenance	<ul style="list-style-type: none"> • Design and construction of roads and watercourse crossings must match use and maintenance abilities^{FPR,GAP,2} • Time grading and other construction activities to minimize soil exposure during the rainy season^{HUM} • Close road in very wet conditions^{FPR,1,2,3} • Minimize hauling during wet season;⁵ No hauling from 10/15-5/1^{CATF} • Construction and maintenance should occur from late spring to early fall;^{FPR,GAP,1,4,5,6} Only emergency road work between 10/15-5/1^{FPR,GAP} • Use dust control for summer hauling,⁵ and grading^{HUM,4} • Avoid over-grading but routine grading may be necessary for seasonal roads to maintain shape and drainage^{2,3} • Do not grade ditches in routine grading in order to maintain vegetation in the ditch^{1,2,4,5,6} <ul style="list-style-type: none"> • Remove excess berm material after grading⁴ • Never sidecast into waterway or adjacent riparian area;^{4,6} Haul spoils to stable disposal site and vegetate spoils^{FPR,HUM1,4,5} • Use sediment control measures to stabilize disturbed or bare slopes;^{FPR,HUM,1,4,6} Vegetate and mulch bare soil before 10/15^{FPR,HUM} • Carry a shovel in vehicle to clean out ditches and redirect water off road surface when necessary²
Special provisions for the use and maintenance of seasonal roads	<ul style="list-style-type: none"> • Seasonal roads must be closed and have maintained waterbars prior to 10/15^{FPR,2} • Roads used for heavy equipment between 10/15-5/1 must be rocked with permanent drainage from 10/15-5/1;^{FPR,GAP} Roads used for hauling between 10/15-5/1 must be operated under a Winter Operation Plan^{FPR} • Approaches to temporary crossings must be stabilized^{GAP} • Temporary watercourse crossings on seasonal roads must be removed before 10/15^{FPR,GAP}
Inspection	<ul style="list-style-type: none"> • Inspect roads regularly;^{1,2} At minimum inspect roads and drainage structures prior to the beginning of the rainy season and ideally during or after big storms;^{3,4,5,6} Inspect roads at least once annually and perform maintenance at least once between 10/15-5/1^{GAP} • Catalogue and sign culverts;⁵ Map location of all watercourse crossings^{CATCEF,FPR,GAP,WDR} • Inspect culvert inlets and outlets on stream crossings^{FPR,1,2,3,4,5,6} • Inspect inlet and outlet of ditch relief culverts^{FPR,1,2,3,4,5,6} • Inspect road surface drainage structures (e.g., waterbars, outsloping)^{2,5} • Inspect ditches and clear blockage in inboard ditches^{1,2,4,5} • Inspect and excavate unstable fillslope material^{1,4,5} • Inspect and clear trash barriers after storms^{1,2,3} • Inspect and maintain sediment control measures⁴ • Remove slide material when blocks drainage^{2,4} • Perform emergency maintenance following big storm⁵

Road closures and abandonment	<ul style="list-style-type: none"> • Either inspect unused roads annually or ‘put them to bed’ (i.e. remove erosion hazards, excavate stream crossings, remove unstable areas, and revegetate)^{GAP,1,2,5,6} • Road abandonment should be planned and conducted to ensure permanent maintenance-free drainage, minimize instability and concentrated run-off, and to promote regeneration^{FPR} • Exposed soil on cuts, fills, and sidecast materials must be stabilized^{FPR} • Road surface must be graded or shaped to allow dispersal of water^{FPR} • Watercourse crossings must be removed^{FPR}
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Notes: Superscripts indicate if the BMPs is mandated by regulation (indicated by abbreviated regulation title) and/or recommended in guidance documents (indicated by number corresponding to source)

Regulations:

CATCEF: Requirements for Categories C, E, and F in NCRWQCB (2004a) "Order NO. R1-2004-0016: Categorical Waiver of Waste Discharge Requirements for Discharges Related to Timber Harvest Activities on Non-Federal Lands in the North Coast Region." Santa Rosa, CA: North Coast Regional Water Quality Control Board.

CATF: Requirements for Category F: Other Projects in NCRWQCB (2004a) "Order NO. R1-2004-0016: Categorical Waiver of Waste Discharge Requirements for Discharges Related to Timber Harvest Activities on Non-Federal Lands in the North Coast Region." Santa Rosa, CA: North Coast Regional Water Quality Control Board.

FPR: California Forest Practice Rules of 2007, Title 14, C.C.R. Chapters 4, 4.5, and 10.

GAP: "Garcia Action Plan" in NCRWQCB (2007d) *Water Quality Control Plan for the North Coast Region*. Santa Rosa, CA: North Coast Regional Water Quality Control Board, p 4-34.00 – 4-53.00.

HUM: Humboldt County (2002) "Grading, Erosion Control, Geological Hazards, Streamside Management Areas, and Related Ordinance Revisions." Eureka, CA: County of Humboldt Departments of Community Development Service and Public Works.

WDR: NCRWQCB (2004b) "Order NO. R1-2004-0030: General Waste Discharge Requirements for Discharges Related to Timber Harvest Activities on Non-Federal Lands in the North Coast Region." Santa Rosa, CA: North Coast Regional Water Quality Control Board.

Guidance documents

1: Keller, G. and J. Sherar (2003) "Low-Volume Roads Engineering: Best Management Practices Field Guide." USDA Forest Service/USAID.

2: Kocher, S.G., J.M. Gerstein, and R.R. Harris (2007) "Rural Roads: A Construction and Maintenance Guide for California Landowners." University of California Agriculture and Natural Resources, Oakland, CA. Publication 8262.

3: Kramer, B.W. (2001) "Forest Road Contracting, Construction, and Maintenance for Small Woodland Owners." Forest Research Laboratory, Oregon State University. Research Contribution 35.

4: Sommerstrom, S. (2002) "5C Roads Manual: A Water Quality and Stream Habitat Protection Manual for County Road Maintenance in Northwestern California Watersheds." Five Counties Salmonid Conservation Program. *Note:* NOAA Fisheries approved this manual under Limit 10 of ESA Section 4(d), indicating that road management activities completed in accordance with the manual are in compliance with the ESA and are believed to adequately protect the habitat of threatened and endangered salmonids

5: Weaver, W.E., and D.K. Hagans (1994) "Handbook for Forest and Ranch Roads: A guide for Planning, Designing, Constructing, Reconstructing, Maintaining and Closing Wildland Roads." Pacific Watershed Associates for the Mendocino County Resource Conservation District, Ukiah, CA

6: Wiest, R.L. (1998) "A Landowner's Guide to Building Forest Access Roads." USDA Forest Service, Randor, PA. NA-TP-06-98.

Appendix F

Groups and Organizations in the North Coastal Basin with Non-Regulatory Programs

This appendix contains a list of groups and organizations that administer non-regulatory programs addressing some aspect of sediment pollution prevention, the protection and restoration of salmonid habitat, and/or land conservation in the North Coastal Basin. The non-regulatory programs include financial assistance through grants or cost-share, technical assistance and education programs, project implementation, watchdog activities, and conservation easements.

Non-Governmental Groups and Organizations

Note: This category includes landowner and citizen groups; community- and/or watershed-based organizations; and regional, state and national non-profit organizations

- Albion River Watershed Protection Association
- Anderson Valley Land Trust
- Bay Area Coalition for the Headwaters
- Bear River Regional Resource Conservancy
- Big River Stewards
- Buckeye Conservancy
- California Trout
- Coast Action Group
- Coastal Land Trust
- Coastal Headwaters Association
- Conservation Fund
- Eel River Watershed Improvement Group
- Environmental Protection Information Center
- Friends of the Big River
- Friends of the Garcia River
- Friends of the Eel River
- Friends of the Navarro
- Friends of the Ten Mile
- Friends of the Van Duzen River
- Garcia River Watershed Advisory Council
- Jacoby Creek Land Trust
- Jacoby Creek Protection Association
- Mattole Restoration Council
- Mattole Salmon Group
- Mendocino Land Trust
- Navarro Watershed Working Group

- North Coast Regional Land Trust
- Noyo Watershed Alliance
- Pacific Coast Fish, Wildlife and Wetland Restoration Association
- Pacific Coast Joint Venture
- Pacific Federation of Fishermen Association
- Pacific Forest Trust
- Redwood Creek Landowners Association
- Redwood Creek Watershed Group
- Redwood Coast Watersheds Alliance
- Redwood Community Action Agency, Natural Resources Services
- Redwood Forest Foundation, Inc
- Salmon Forever
- Salmonid Restoration Federation
- Sanctuary Forest
- Save the Redwoods League
- Trout Unlimited
- Yager/Van Duzen Environmental Stewards

Non-Regulatory Government Organizations

- AmeriCorps Watershed Stewards Project
- California Conservation Corps
- Humboldt County Resource Conservation District
- Mendocino County Resource Conservation District
- National Resource Conservation Service
- University of California Cooperative Extension

Regulatory Agencies with Non-Regulatory Programs

- California Department of Fish and Game
- California Department of Forestry and Fire Protection
- California Coastal Commission
- Environmental Protection Agency
- North Coast Regional Water Quality Control Board
- State Water Resources Control Board
- U.S. Department of Agriculture
- U.S. Fish and Wildlife Service

Appendix G

Costs for Common Modifications to Existing Roads

Note: Cost estimates from Kocher et al. 2007

- Out-sloping road and filling ditch: \$280/1,000 ft
- Installing rolling dip: \$130 to \$260 each
- Removing berm or cleaning ditch: \$140/1,000 ft
- Rock surfacing road: \$6,250 to \$12,500/1,000 ft
- Installing ditch relief culvert: \$1,950 each
- Installing stream crossing: \$4,965
- Upgrading road completely: \$45,000 to \$77,000 /mile