A Geographical Assessment of the Santa Monica Mountains North Area Community Standards District Vineyard Ordinance

by

Steven James Warner

A Thesis Presented to the
Faculty of the USC Graduate School
University Of Southern California
In Partial Fulfillment of the
Requirements for the Degree
Master Of Science
(Geographic Information Science and Technology)

May 2017

Table of Contents

List of Figures

List of Tables

Acknowledgements

I would like to thank all the educators and the student support team who helped me during my time at USC. Specifically, I thank Dr. John Wilson and Elisabeth Sedano for their guidance while forming, writing, and editing this thesis. I'm thankful for Dr. Travis Longcore's advice while serving on my thesis committee. I give special thanks to my roommate, Nikole Zivalich, for allowing me to use her computer as my ArcMap workstation. Lastly, I would like to thank my parents, Jon and Kathryn Warner, for their encouragement, their love, and for helping me achieve my goals.

List of Abbreviations

CSD	Community Standards District
CUP	Conditional Use Permit
CZB	Coastal Zone Boundary
DEM	Digital Elevation Model
GIS	Geographic Information System
LAC	Los Angeles County
LACGDP	Los Angeles County GIS Data Portal
LCP	Local Coastal Plan
NPS	National Park Service
NWI	National Wetlands Inventory
RCDSMM	Research Conservation District of the Santa Monica Mountains
SEA	Significant Ecological Area
SMM	Santa Monica Mountains
SMMC	Santa Monica Mountains Conservancy
SMMCZ	Santa Monica Mountains Coastal Zone
SMMNA	Santa Monica Mountains North Area
SMMNRA	Santa Monica Mountains National Recreation Area
VO	Vineyard Ordinance

Abstract

In early 2015, a surge of vineyard applications alerted Los Angeles County to a potentially large-scale habitat change in the Santa Monica Mountains North Area. The County took action by placing a ban on all applications until an ordinance could be written to protect the natural environment of the mountains. Then in December 2015, the Los Angeles County Board of Supervisors adopted a vineyard ordinance regulating the presence of vineyards in the Santa Monica Mountains North Area. The ordinance limits the size of vineyards and creates a set of regulations for landowners to follow. Several of these regulations have spatial manifestations that can be analyzed through the use of GIS. This project sought to visualize these regulations spatially and to evaluate their effectiveness in protecting the habitats of the Santa Monica Mountains North Area. This project evaluated the ordinance's effectiveness in three ways: (1) by determining the amount of land protected by the ordinance as a whole; (2) by quantifying the impact of each regulation spatially and understanding how they compare to each other; and (3) through a statistical evaluation of the amount of vegetation saved due to the ordinance. The ordinance was effective in achieving its goal of preserving the natural habitat of the North Area by protecting 16,223 acres, which is an 88% drop in potential habitat change. The ordinance also protects nearly all vegetation classes by 50% or more, with 13 of them being fully protected. The natural habitat of the Santa Monica Mountains North Area is a rare and fragile Mediterranean ecosystem that should be closely monitored by its residents and local government. This project gives the community a quantifiable representation of the ordinance and its effects.

Chapter 1: Introduction

On December 8, 2015, the Los Angeles County Board of Supervisors adopted an amendment to the Santa Monica Mountains North Area Community Standards District (CSD) called the Vineyard Ordinance (VO). This ordinance laid out regulations to be followed when a parcel owner seeks to add a vineyard to their property. The topic of regulating vineyards in the North Area began in 2014 after new vineyards were banned from the Coastal Zone of the Santa Monica Mountains. Fearful of a similar all-out ban in the North Area, many landowners applied for vineyards before regulations could be put into effect. The sudden surge of 44 vineyard applications alerted the county to the scale of potential habitat change in the area and prompted the supervisors to place a temporary ban on new vineyard applications and expansions in June 2015 (County of Los Angeles, 2015a). The ban gave them time to assess the integration of vineyards into the natural habitat of the Santa Monica Mountains North Area (SMMNA). The supervisors wrote the VO as a way to allow landowners the opportunity to establish a vineyard on their property while protecting the natural habitat from undergoing potentially large-scale change. This thesis assessed the change in potential vineyard acreage caused by the ordinance using Pre- and Post-Ordinance maps.

The temporary vineyard ban and resulting VO sparked debate amongst residents, vintners, local government, and conservationists. Some said that the ordinance is too strict and is impeding on a tradition of growing wine in the Santa Monica Mountains. Others said that the ordinance did not go far enough due to large loopholes that may allow residents to plant olive gardens and avocado orchards that use significantly more water than a vineyard. This thesis provides a visual representation of the potential vineyards and gives quantifiable results as to the potential acreage change.

The goal of this project was to create maps to help visualize the effects of the ordinance in the SMMNA and analyze the total acreage that might be affected. The main map depicts the potential extent of vineyards under the new ordinance. A Pre-Ordinance map shows the potential extent of vineyards before the VO was put into effect. Lastly, a change map shows the areas where vineyards can no longer exist due to the new regulations. Using these maps and the supporting commentary, the readers of this thesis will be able to visualize the magnitude of change that could have occurred before the VO and that can now occur after the VO, and the specific areas affected by the VO. The Geographic Information System (GIS) used for this study facilitated the integration and manipulation of the relevant data in order to create accurate maps of the SMMNA.

In addition to the creation of vineyard maps, this project also analyzed the maps in several ways. Primarily, the total acreage of allowable vineyards was calculated, along with the acres of land protected by the VO. A vegetation impact assessment was made by calculating the protected and at-risk areas of each type of vegetation. Some of the ordinance's regulations are subject to review and approval before allowing landowners to convert their land into a vineyard. The maps identify these areas and determine the total extent of these fuzzy "review and approval" areas. This project evaluated each regulation in the VO by calculating how many acres were preserved by each one. This enabled a comparison of each regulation's effectiveness in preserving the land. Lastly, a judgment was made as to whether or not the VO is likely to succeed in protecting the surrounding natural environment of the SMMNA, which was its primary goal.

1.1 Santa Monica Mountains and Surrounding Areas

The Santa Monica Mountains (SMM) is a coastal mountain range located in Ventura and southwest Los Angeles Counties. The SMM contains incorporated cities, unincorporated areas, a national recreational area, and the Coastal Zone Boundary (CZB). The focus of this project was on the unincorporated zone of the SMM north of the CZB, which is defined as the SMMNA. Figure 1 shows the original drawing of the SMMNA prepared by the Los Angeles County Department of Regional Planning. A greater understanding of the areas surrounding the SMMNA is necessary to understand its origin. The SMMNA was originally governed by the Malibu/Santa Monica Mountains Interim Area Plan but has since been governed by the County of Los Angeles per the *Santa Monica Mountains North Area Plan,* which was adopted in 2000 (County of Los Angeles, 2012). The current shape of the SMMNA is created by the five incorporated cities surrounding it (i.e. Agoura Hills, Calabasas, Hidden Hills, Los Angeles, and Westlake Village), the CZB, and Ventura County).

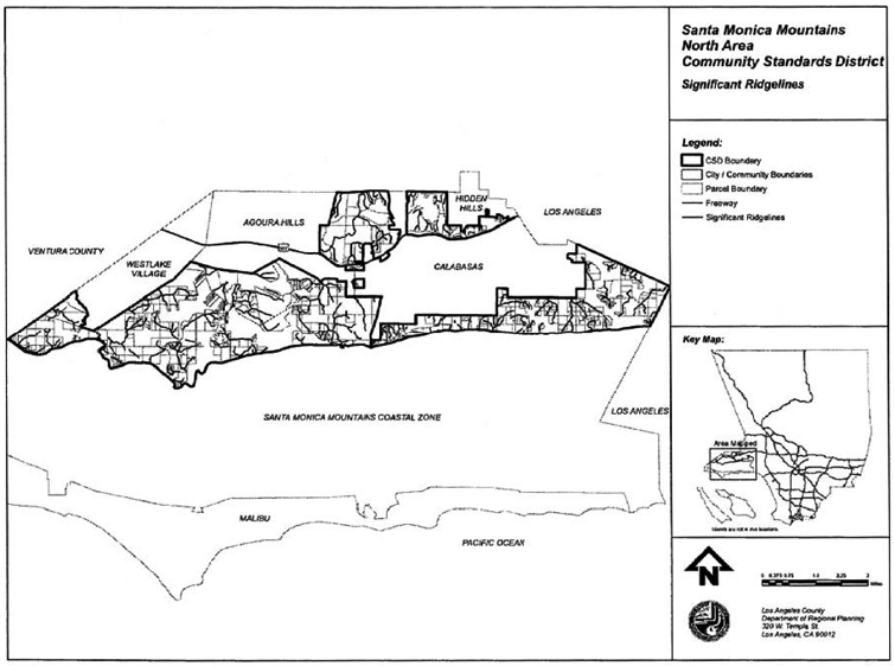

Figure 1 The Santa Monica Mountains North Area (Source: Department of Regional Planning)

The story of the SMMNA must be told through the stories of its neighbors. The five cities bordering the SMMNA, listed in order of incorporation date, are Los Angeles (1850), Hidden Hills (1961), Westlake Village (1981), Agoura Hills (1982), and Calabasas (1991). Each of these cities elects their own city council to govern them; while the Los Angeles County Board of Supervisors governs the remaining unincorporated areas (County of Los Angeles, 2012). This series of incorporations left a large unincorporated zone inbetween these cities. In 1986, the Coastal Commission certified a Local Coastal Plan (LCP) for the SMM, which regulates land use and natural resource protection in the Coastal Zone. In order to define the Coastal Zone, the LCP drew its boundary, the CZB, approximately five miles away from the coast towards the SMM (County of Los Angeles, 2009). The effects of the boundary split the unincorporated zone of the SMM into two parts: the Santa Monica Mountains Coastal Zone (SMMCZ) and the SMMNA. The SMMCZ was now governed by the new LCP, while the Malibu/Santa Monica Mountains Interim Area Plan, adopted in 1981, governed the SMMNA. It was not until 1999 that the SMMNA was identified as an area needing its own unique regulations to protect the natural environment of the area (Chan, 1999). The Santa Monica Mountains North Area Plan was adopted in 2000 as part of the larger Los Angeles County General Plan. The County's stated purpose for the North Area Plan was "to provide more focused policy for the regulation of development within the unincorporated area of the Santa Monica Mountains" (County of Los Angeles, 2000). This is when the SMMNA became a distinct area to be governed rather than a part of the general rulings over all unincorporated areas in the county.

Ventura County and the Santa Monica Mountains National Recreational Area (SMMNRA) also play a role in the SMMNA. Ventura County is a part of the western and northern border of the SMMNA and it governs the portions of the mountains that fall within its

county boundary. The SMMNRA is a U.S. National Recreation Area jointly managed by the National Park Service (NPS), California State Parks, and the Santa Monica Mountains Conservancy (SMMC). It covers more than 150,000 acres of land consisting of mountains, valleys, parks, trails, coastline, and a wide array of vegetation (NPS, 2003). The SMMNRA is an area much larger than the focus of this project but is relevant in the fact that it shares area with the SMMNA. Much of the SMMNA is actually part of the SMMNRA; however, landowners residing in the SMMNA will still need to abide by the regulations put forth in the Santa Monica Mountains North Area Community Standards District, which includes the newly passed VO.

A general description of the SMMNA can now be given after defining the areas surrounding it. The SMMNA is the unincorporated area of the Santa Monica Mountains located between Ventura County, the cities of Los Angeles, Hidden Hills, Westlake Village, Agoura Hills, and Calabasas, and above the CZB. It is defined by the Santa Monica Mountains North Area Plan and governed by the Santa Monica Mountains North Area Community Standards District, whose rules are written and edited by the County of Los Angeles Department of Regional Planning.

1.2 Local Ecology

The importance of the SMMNA lies in its unique and diverse ecosystem. The NPS beautifully captivates much of the area's diverse life and topography when they describe the SMMNRA as: "Grassy hills, oak woodlands, valley oak savannas, rock outcrops, and riparian woodlands give way to chaparral-covered sloped, coastal marshes, and rural residential and agricultural areas" (NPS, 2002). Many of these unique habitats also fall in the SMMNA. This uniqueness stresses the importance of visualizing the potential habitat change due to vineyards. The entire area is a rare Mediterranean climate ecosystem. Mediterranean climates "occur on

about two percent of the world's total land area" (Dallman, 1998). The SMMNA is actually part of one of the largest and most significant examples of a Mediterranean ecosystem found anywhere in the world (NPS, 2016). The Mediterranean climate creates a suitable area for many diverse habitats and species to coexist in close proximity to a large and dense urban city (Sikich et al. 2013). The VO aimed to protect this diversity by controlling the potential vineyard acreage in the SMMNA.

Oak trees are a vital part of the SMMNA ecosystem and thus are protected by law. Almost every document on the SMMNA and the SMMNRA ecosystem discusses the role and importance of oaks in the area. "Over 5,000 species of insects, 58 species of reptiles and amphibians, 105 species of mammals and over 150 species of birds rely on oaks for some of their life cycle. If the oaks are gone, so are these associated species" (RCDSMM, 2015). The LAC Department of Regional Planning knew this when they wrote the VO and created specific regulations that protect the valuable trees.

The VO specifically protects certain habitats in the SMMNA. A later look at the wording of the VO will list all of these habitats but the most important of them are the riparian areas and the habitats found to be Significant Ecological Areas (SEA). The ordinance gives special treatment to these zones due to their vital role in the SMMNA. The SMMC wrote a report to the Department of Regional Planning stressing the need to increase the setbacks of vineyards from sensitive habitats to help conserve them (Parks, 2015). These diverse habitats are important to the ecological stability of the area.

The approval and implementation of the VO came at an important time for the SMMNA due to the rise in vineyard applications during 2015. It is important to take a step back from the ordinance and understand the diverse nature of the SMMNA. The ecology of the area needs help

from the possible vineyard conversions but cannot protect itself. Therefore the VO is filling a need of the ecosystem by protecting it from ungoverned destruction and change.

1.3 Research Goals and their Significance

This project aimed to provide an accurate and unbiased map of the VO's effect, allowing readers to understand patterns of potential vineyard development in the SMMNA. The main goal of the project was to determine whether or not the VO is effective. The VO's purpose was to protect the natural habitat of the SMMNA. This project used GIS and spatial analysis to determine if the VO is effective in fulfilling its intended purpose. Another goal of this project was to analyze and compare each of the regulations that had unambiguous spatial manifestations. An individualized look at each regulation identified which of them aids in the protection of the habitat the most.

Great importance is assigned to both the protection of the natural habitat of the SMM and to local residents and their right to cultivate grapes for wine on their property. This project might be able to catalyze a healthy partnership between residents and their local government through the use of GIS.

The significance of this project lies in two matters: (1) the specific area; and (2) the new ordinance. The SMMNA has not been the sole focus of any prior vineyard study. However, the potential vineyard extent has been mapped in the much larger SMMNRA. The results determined that a significant percentage of the area could have been converted based on the regulations at the time (Geopel et al, 2012). The SMMNA was the specific focus of this project and will benefit from having its own assessment. The recently passed VO also brought further significance to this project. The regulations under the new ordinance point to the need for an assessment of the vineyards in SMMNA to be conducted. Vineyards that were once allowable may now be

forbidden and pending expansions may be declined. The total expanse of potential new vineyards may have significantly decreased due to the new ordinance. This project documented that decrease and can be used by the local government officials, other stakeholders, and residents to visualize the likely results of implementing this new policy.

This project is also significant to the environment because substantial fragmentation of a habitat can cause major ecological damage. Fragmentation is defined as "the breaking up of a habitat or land type into smaller parcels" (Forman, 1995). These small parcels become less able to sustain their original population causing a decline in native flora and fauna. The example of vineyard additions to a natural habitat is used in several fragmentation studies (Heaton and Merenlender, 2000; Rundel, 2011). The vineyard maps will help conservancy groups analyze the possible fragmentation effects that future vineyards could have on the SMMNA. Their analysis may prove to be useful to local government and offer some additional guidelines as to whether or not the ordinance adequately protects the natural habitat.

Lastly, this project addresses a need for GIS to be simultaneously adopted and used by local governments to visualize the outcome of policy options. This can provide policy makers with proper information before passing legislation. If GIS becomes more pervasive in governmental work, then everyone involved can have an understanding of where and who and what might be affected by certain policies. This project aimed to enlighten people on the specific vineyards policy; however, the same procedure could be used to help evaluate any spatially related policy. Politics govern an expanse of land; therefore, it is simple to see that utilizing GIS in politics can help to better understand the land and how to govern it.

1.4 Thesis Structure

The remainder of this thesis contains four chapters that examine the effectiveness of VO and its regulations. The habitat studies conducted in and out of the SMMs are described in Chapter 2. The specific regulations that have spatial significance are discussed in Chapter 3 along with a plan to represent them on maps. Chapter 4 discusses the results of this thesis, including the acres of protected land and vegetation. Chapter 5 concludes this thesis with an evaluation of the VO, its regulations, and the limitations faced in this thesis project.

Chapter 2: Background and Literature Review

The literature review is broken up into three parts that help provide insight into previous vineyard and environmental studies and the government documents surrounding the SMMNA. The first section looks at studies related to vineyards and the SMM. The second section looks at habitat fragmentation studies and their relation to this project. The final section discusses the VO and other government documents surrounding the SMMNA.

2.1 Studies on the Santa Monica Mountains and Vineyards

This section describes similar research reports and how they relate to this project. These reports examine the expanse of possible vineyards in the SMM before the VO was passed, potential habitat alterations in the SMM due to climate change, and the ramifications of vineyards in an ecosystem.

In a UCLA senior practicum in environmental science, students mapped out the potential extent of vineyards in the SMMNRA. They provided a useful model to follow to map and assess the vineyard acreage. Their focus was on the much larger SMMNRA and was completed three years before the VO was passed. Their practicum project came to many significant conclusions about the possible vineyard extent and stated that “in order to maintain native habitat, areas in danger of development should be carefully studied and development policy should reflect the use of practices that minimize habitat degradation” (Geopel et al., 2012). Such policy now exists for the SMMNA in the form of the VO and the vineyard maps produced for this thesis show the likely results of that policy.

A thesis presented to Arizona State University discussed how suitable habitat distributions in the SMMNRA may be altered by climate change. James (2013) used GIS to model the potential change in habitat due to climate change through distribution modeling.

Although the assessment of the VO does not focus on climate change, the potential change in habitat will be modeled using GIS. Both James's thesis and this VO project modeled hypothetical changes in the habitat in order to draw conclusions about ecological sustainability of the area.

Two research projects discussed the ramifications that vineyard expansions may have on the local ecosystem. One project focused on the Santa Monica Mountains and the other on Sonoma County. They both discussed the possible fragmentation effects that expansions may pose to the area. In Sonoma County, they linked fragmentation to several environmental concerns and the project determined several vineyard expansions that threaten future fragmentation (Heaton and Merenlender, 2000). The Santa Monica Mountains research found no significant habitat fragmentation regarding the expansion of vineyards (Rundel, 2011). Rundel's work only looked at expansions while this project examined the potential extent of vineyards under the VO. However, their use of several variables, such as vegetation, soil, elevation, slope, aspect, and distance, provided good insight into the many variables that affect the habitat of the SMM.

2.2 Fragmentation

Fragmentation is defined as an ecological concept in several ways. The most basic definition being "the breaking up of a habitat or land type into smaller parcels" (Forman, 1995). Forman went into greater depth about fragmentation and its many possible definitions and causes. Lindenmayer and Fischer (2006) offered a different take on fragmentation. They much rather use the term "landscape change" because "the term 'habitat fragmentation' has become so vague and ambiguous due to its imprecise use, thereby limiting its practical value for conservation managers." This project used the definition of fragmentation described by Forman.

Several studies highlighted the dangers of fragmentation to habitats and brought significance to this project. Fragmentation can have a profound effect on the behaviors of some animals. A study on bobcats and coyotes in northwest Los Angeles revealed that fragmentation can affect how the animals use their habitat, both spatially and temporally (Tigas, Van Vuren, and Sauvajot, 2002). The SMM are home to both bobcats and coyotes, so significant fragmentation to their home ranges can cause behavioral effects to occur. Roques and Stoica (2007) studied the effects of habitat fragmentation on species persistence using landscape models. They concluded that persistence, defined as a tendency to survive, decreases with habitat fragmentation. The unique Mediterranean environment of the SMMNA is home to many species and fragmentation in this area would negatively affect the persistence of those species.

A more global look at habitat fragmentation was explored in some studies. One study viewed the forests that span the globe as being threatened by large-scale fragmentation and documented the resulting negative edge effects that could be anticipated (Haddad et al., 2015). The authors of this last study argued for increased measures to help the recovery of landscape connectivity and, in turn, to improve habitat health. This thesis project assessed the VO's effectiveness in maintaining a healthy and stable habitat.

2.3 Government Documents

Given this background, the documents governing the SMMNA, specifically the VO are reviewed next. There are several government documents that relate to the SMMNA. These documents are the most important literature to understand for this project because they set forth all the regulations for the area.

One document is *The Santa Monica Mountains North Area Plan.* This document's "primary role is to provide more focused policy for the regulation of development within the

unincorporated area of the Santa Monica Mountains" (County of Los Angeles, 2000). This document led to the establishment of the SMMNA as a separate entity. This was the first time it was mentioned and given its own regulations separate from other zones in the county. The document specifically defined the physical area, including maps for reference, and laid out the laws governing the newly defined area.

The primary government document relating to this thesis is *The Santa Monica Mountains North Area Community Standards District Amendment (Vineyard Ordinance)*, referred to as the "VO" in this thesis. This ordinance set forth the regulations "intended to address the potential impacts of vineyard development in the Santa Monica Mountains North Area" (County of Los Angeles, 2015b). The many specific regulations address topics such as water and soil management, wildlife-permeable fencing, and road placement, most of which are not spatially significant in relation to this thesis. However a few of the guidelines are relevant to the creation of the vineyard maps due to their geographical specificity.

Several strict regulations prohibit vineyards in certain areas. The ordinance prohibits vineyards on slopes greater than 33% and on ridgelines. Each vineyard is limited to a two-acre area per parcel and the VO protects seven ecological features by prohibiting vineyards within 200 feet of them. The protected features are: alluvial scrub, wetlands, native grassland, riparian oak, rock outcrops, endangered populations, and common habitats that support endangered populations. Streams must have a 100-foot buffer zone around them where vineyards cannot exist. Significant ridgelines have a 50-foot vertical and horizontal buffer zone prohibiting vineyards and oak trees also have a protected zone safeguarded by the VO.

Two additional regulations are not strict rules against vineyards but rather recommended guidelines that are subject to review before a vineyard is allowed. The first one relates to the

SEAs found in the SMMNA. A vineyard can exist in a SEA so long as it complies with the requirements of Section 22.56.215, which does not necessarily prohibit development but rather requires approval and a permit. Therefore, a landowner is not completely restricted by the SEA regulation in the VO. This type of regulation will be referred to as "fuzzy" because it will be represented on the vineyard map as areas that cannot have vineyards unless approved. The other fuzzy regulation relates to the visibility of the vineyard. The VO states that a vineyard should not be visible from a scenic highway and the Backbone Trail. However, the VO gives landowners a chance to mitigate the visibility of the vineyard by designing it to minimize visibility from those viewpoints. Both of these fuzzy regulations are not so rigid that they prohibit vineyards. The effects of these regulations must be represented differently on maps to show that vineyards are not allowed in these areas unless measures are taken to mitigate potential problems.

The county also published a document that discussed a county hearing in which the Board of Supervisors discussed the possible VO (County of Los Angeles, 2015a). This document gave an overview of the SMMNA and its habitat, explained the rise in vineyard applications, and summarized the VO's regulations. The hearing document stated that the VO "would define vineyards as a use, require a Conditional Use Permit (CUP) for all new or expanding vineyards, and add development standards for all new and existing vineyards in the CSD area" (County of Los Angeles, 2015a). The document provided a general overview of the VO in simple terms to facilitate discussion in advance of the passing the VO.

The Green Visions Plan for 21st Century Southern California includes another useful set of documents discussing plans for habitat conservation in southern California. It is particularly useful because a team of GIS specialists were utilized in the development of the various conservation plan documents. The team was "tasked to take the lead in development of the Green

Visions Plan and the accompanying GIS planning tools and datasets" (Li et al., 2004). These documents also give relevance to the goal of integrating GIS into the business of government in order to properly understand the land that is being governed and the likely impact of various actions.

This chapter has described the related work for this thesis project through the studies that have been conducted in this area, the importance of fragmentation and how it may affect fragile ecosystems, and the government documents that regulate the SMM. Now that a greater understanding has been gathered regarding the area of focus, the next goal of the project is to outline the specific methods used to create an accurate visualization of the VO and the expanse of possible vineyards in the SMMNA.

Chapter 3: Methods

This chapter describes the methods that were used to create the Pre- and Post-Ordinance maps and the change map. It describes the process used to manipulate the available data to represent each spatial regulation. All the data were handled individually to allow for individual statistics to be calculated and to create a reproducible workflow when creating the three vineyard maps. The chapter concludes with a description of the statistics that were generated and analyzed from the resulting maps.

3.1 Study Area

The SMMNA was the focus of this thesis project. However, when working in ArcMap, the focus of the study area was extended beyond the boundary of the SMMNA to prevent edge effects during data manipulation and to allow viewsheds to be created beyond the scope of the SMMNA. The "workable area" in ArcMap was therefore extended to the coastline south of the SMMNA, two miles from the boundary of the SMMNA, and to the border of Los Angeles County in all remaining directions. The larger focus provided a workable area for accurate data manipulation and quantitative analyses.

3.2 Boundaries

The first category of data worked on was the boundary data. Two datasets representing boundaries were useful in data manipulation and creating the vineyard maps. These boundaries are politically drawn boundaries and were represented as polygons. They delineate Los Angeles County and the SMMNA.

The Los Angeles County boundary was used to prevent the study area from spilling over into Ventura County, which has its own laws, and the Pacific Ocean. The county is much larger

than the study area but provided good context when visualizing where the SMMNA lies in relation to the county as a whole. The county boundary did not need to be altered since it merely provided locational context.

The SMMNA boundary was acquired from the *Land Use Policy (Comm/Area Plan)* dataset from the Los Angeles County GIS Data Portal (LACGPD). The SMMNA was extracted from this dataset in order to work on it independently. The SMMNA was the sole focus of this project and its boundary was used to create the vineyard maps. This dataset was also used in conjunction with each regulation dataset to clip the extent of the data and help calculate total acreages within its boundary.

3.3 Pre-Ordinance Map

The Pre-Ordinance map was constructed using the SMMNA boundary as a starting polygon. All areas where a vineyard cannot exist were removed from the polygon: roads, rock outcrops, and waterways/bodies of water. The remaining area represented the total expanse of potential vineyards before the ordinance was passed and is the Pre-Ordinance Polygon.

The Pre-Ordinance Polygon was used in the creation of each regulation polygon. After the manipulation of each regulation dataset, the resulting regulation area was used to clip the Pre-Ordinance Polygon creating the final regulation shapefile. This process insured that the regulation shapefiles only show the newly regulated areas that fall within the Pre-Ordinance zone. The Pre-Ordinance map, seen in Figure 2, shows the Pre-Ordinance Polygon.

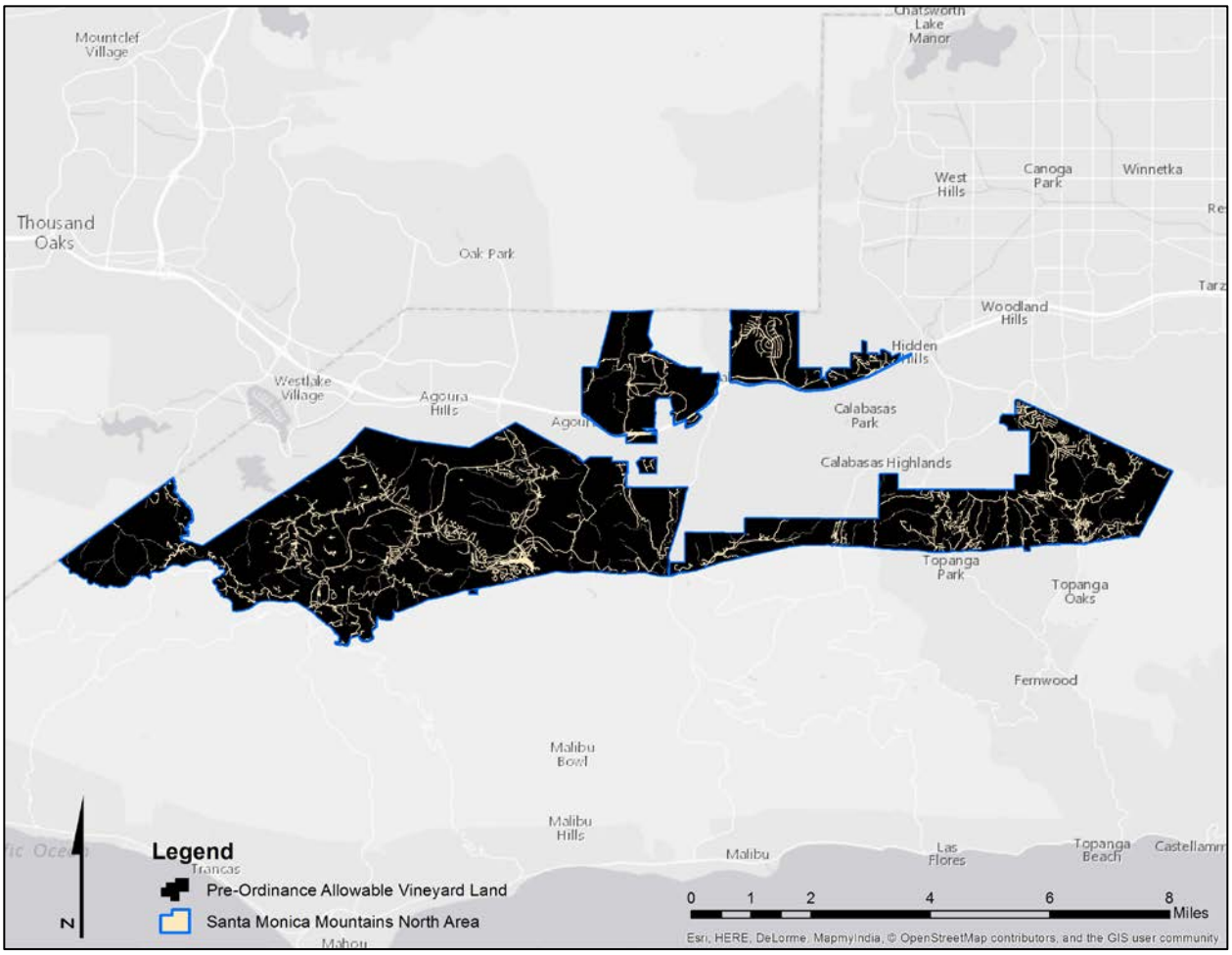

Figure 2 The Pre-Ordinance Polygon showing the allowable vineyard extent before the VO

3.4 Crisp Spatial Regulations

This section notes the exact wording of the spatially significant strict regulations, introduces the relevant datasets, and describes the manipulation of each dataset to reflect the regulations. This methodology can be seen as a flowchart reproduced in Figure 3. The qualifier "strict" indicates that these regulations would either apply or not apply to specific properties for which the addition of vineyards was contemplated.

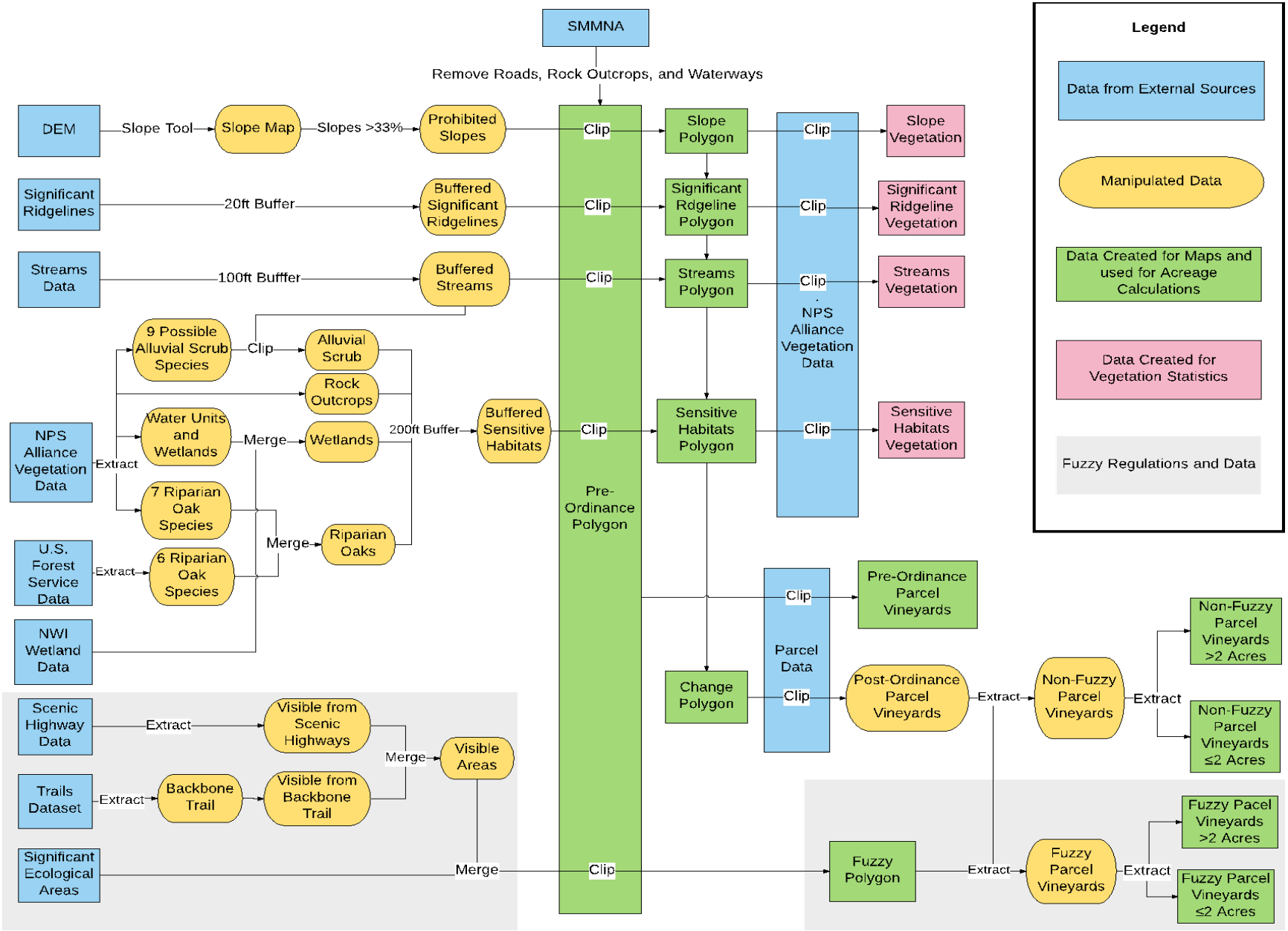

Figure 3 A flowchart showing the methods used to create the data

3.4.1 Slope

The ordinance prohibits vineyards on slopes >33%. “All new vineyard, pending vineyard, and vineyard expansions regardless of size including vineyards that are less than 4,356 square feet, shall not be planted on a slope with a slope ratio greater than 3:1 (33 percent slope)” (County of Los Angeles, 2015b). In order to represent this regulation, a slope map was generated from the *2006 10-foot Digital Elevation Model* (DEM) dataset from the LACGDP. The DEM was first clipped to the “workable area” to cut out the deep elevations in the ocean and much of the unnecessary areas of the county. The DEM was then used to generate a slope map using the “Slope” tool in ArcMap for Desktop 10.4. All slopes ≥33% were extracted from the data and merged. This merged forbidden area was used to clip the Pre-Ordinance Polygon creating the Slope Polygon, which represents the total area now protected by the slope regulation.

3.4.2 Significant Ridgelines

The VO prohibits vineyards on significant ridgelines. “The vineyard shall be prohibited on significant ridgelines as defined in this CSD” (County of Los Angeles, 2015b). The CSD provided a map of significant ridgelines in the SMMNA and defined them as “ridgelines which, in general, are highly visible and dominate the landscape” (County of Los Angeles, 2015b). The *Significant Ridgeline (within CSDs)* dataset from the LACGDP was used to represent this regulation. The protection zone for a significant ridgeline is defined as “at least 50 vertical feet and 50 horizontal feet” (County of Los Angeles, 2015b). A 50-foot buffer was added to the significant ridgeline dataset to represent the horizontal protection zone. The vertical protection zone can change significantly depending on the slope of the area. The vertical zone may extend much further than 50 horizontal feet from a ridgeline when the slope is gentle and much less than 50 horizontal feet when the slope is steep. This thesis did not analyze the vertical protection zone

of significant ridgelines due to the varying changes in slope accompanying the significant ridgelines. The horizontal 50-foot buffered area was used to clip the Pre-Ordinance shapefile creating the Significant Ridgeline Polygon, which represents the total area now protected by the significant ridgeline regulation.

3.4.3 Sensitive Habitat Types

Seven habitat types are deemed sensitive and must have a 200-foot buffer around them where vineyards are prohibited. "The vineyard shall not be located in or within 200 feet of an area containing any of the following sensitive habitat types:" alluvial scrub, a wetland, native grassland, riparian oak, rock outcrops, endangered populations, and common habitats that support endangered populations" (County of Los Angeles, 2015b). Three datasets were used to extract the locations of these habitats: the Alliance level vegetation data from the National Park Service (NPS), the CalVeg Zone 7 - South Coast vegetation dataset from the U.S. Forest Service, and the wetland data from the National Wetland Inventory (NWI).

The NPS vegetation data were used to extract the locations of rock outcrops and alluvial scrub. Rock outcrops were already identified in the dataset and easily extracted. The extraction process of alluvial scrub was more complicated. Alluvial scrub is defined through distinctive plant communities found near alluvial fans and floodplains (Barbour and Wirka, 1997). The ordinance specifically calls for protection of alluvial scrub in the SMMNA and states, "alluvial scrub is dominated by scalebroom (*Lepidospartum squamatum*)" (County of Los Angeles, 2015b). However, the NPS vegetation data does not show alluvial scrub or scalebroom in the SMMNA. This is due to the fact that the dataset was mostly derived from aerial photography and defined areas by the dominant vegetation alliance seen from the photos. Nine plant species were extracted from the NPS vegetation data to represent possible alluvial scrub: *Artemisia*

californica, Baccharis pilularis, Baccharis salicifolia, Cercocarpus betuloides, Eriogonum fasciculatum, Lotus scoparius, Platanus racemosa, Prunus ilicifolia, and *Rhus ovata*. These nine species were chosen based on three research papers describing alluvial scrub vegetation in Southern California (Hanes, Friesen, and Keane, 1989; Magney, 1992; Barbour and Wirka, 1997). The nine species were extracted and merged to represent possible alluvial scrub communities. However, these species are not considered alluvial scrub unless found near an alluvial fan or floodplain. Therefore only communities found within 100 feet of a stream were used to represent alluvial scrub in the SMMNA. A 100-foot stream buffer was used to clip the merged communities creating an alluvial scrub shapefile that represents the nine species located on possible alluvial fans and floodplains.

The NPS Vegetation data and the CalVeg dataset from the U.S. Forest Service were used to extract the riparian oak locations. The ordinance defines riparian oaks as "riparian, native oak, coast live and/or valley oak, sycamore, walnut, and/or bay woodlands: […] sycamore, coast live oak, black walnut, white alder, Fremont cottonwood, black cottonwood, mulefat, arroyo willow, red willow, blackberry, mugwort, and Mexican elderberry" (County of Los Angeles, 2015b). Seven vegetation alliances were extracted from the NPS dataset to represent riparian oak: California Bay, California Sycamore, California Walnut, Coast Live Oak, Mule Fat, Valley Oak, and Willow. Six vegetation classifications were extracted from the CalVeg dataset to represent riparian oak: California Bay, California Sycamore, California Walnut, Coast Live Oak, Valley Oak, and Willow. The extracted datasets were merged to create a riparian oak shapefile for this part of the habitat regulation.

The wetland habitat was represented using the NPS Vegetation dataset and the NWI dataset. The sensitive habitat regulation prohibits vineyards within 200 feet of a "wetland,

including a creek, stream, marsh, seep and/or a spring" (County of Los Angeles, 2015b). Wetlands and water mapping units were extracted from the NPS dataset. Wetland data was extracted from the NWI. The extracted NPS and NWI data were merged to create a wetland shapefile for part of the habitat regulation.

Native grassland, endangered populations, and common habitats that support endangered populations were not represented when creating the sensitive habitat 200-foot buffer shapefile. Native grasslands were not found in the available datasets; however, some native grassland is found "associated with coast live or valley oak" and therefore were already partially included within the riparian oak shapefile (County of Los Angeles, 2015b). Endangered populations and their common habitats can be found using a dataset from the U.S. Fish and Wildlife Service. However, the dataset is mostly based on very old sightings in the field and is represented by large hypothetical habitat polygons. The dataset was not used to represent the regulation due to the age and large generalizations of the habitat locations.

The extracted habitat types, rock outcrops, alluvial scrub, riparian oaks, and wetlands, were merged and a 200-foot buffer was added to the data. This newly created area was used to clip the Pre-Ordinance Polygon creating the Sensitive Habitat Polygon, which shows the total area now protected by the sensitive habitat regulation.

3.4.4 Streams and Oak Trees

The VO states that streams must have a 100-foot buffer around them and gives oak trees special protection. "Where a stream exists on or adjacent to the property containing the vineyard, a buffer shall be installed at least 100 feet in width from the outer edge of the bank of the stream […] The vineyard development shall not result in the damage, removal, and/or encroachment in to the protected zone, of an oak tree(s)" (County of Los Angeles, 2015b). The stream data was

extracted from the *Rivers, Streams, Water Conveyance (pipelines, aqueducts)* found on the LACGDP. A 100-foot buffer was added to the stream locations. The newly created area was used to clip the Pre-Ordinance shapefile creating the Stream Polygon, which shows the area now protected by the stream regulation.

The oak tree regulation was not represented in this project due to the lack of data representing specific oak tree locations. The oak tree protection zone is only 15 feet and therefore could not be accurately represented without detailed spot location data.

3.4.5 Parcel Limits

The *Assessor Parcels – 2015 Tax Roll* dataset was obtained from the LACGDP and represents all parcels in Los Angeles County. The data was clipped using the SMMNA boundary and is directly related to a VO regulation. Each parcel is limited to a two-acre vineyard according to the ordinance. “The vineyard shall not exceed a maximum of two acres in size per lot or parcel” (County of Los Angeles, 2015b). The parcel boundaries were used to divide the total area of allowable vineyards into individual “parcel vineyards”. Each parcel vineyard was then identified as containing more or less than 2 acres of allowable vineyard space. The parcel regulation cannot be visualized in the same way as other regulations because the regulation does not choose the location of the 2-acre limit per parcel, the landowners do. However, the regulation is still spatially significant and affects the total acreage of the Post-Ordinance map. The parcel data were used as the final step when creating the final Post-Ordinance map.

3.5 Fuzzy Spatial Regulations

This section notes the exact wording of the fuzzy regulations, introduces the relevant datasets, and describes the manipulation of the datasets to reflect these parts of the regulations.

These fuzzy regulations, unlike their strict counterparts, provide considerable latitude and will likely bring varying consequences from one site to the next.

3.5.1 Significant Ecological Areas

The SEAs of the SMMNA are protected by the VO. The ordinance states that vineyards located in a SEA must comply with previous regulations put forth in the CSD. It regulates that a conditional use permit must be obtained in order to place a vineyard in a SEA. "Any vineyard located in a Significant Ecological Area as shown in Figure 9.3 of the 2015 Los Angeles County General Plan, shall comply with the requirements of Section 22.56.215" (County of Los Angeles, 2015b). The requirements of Section 22.56.215 do not prohibit development but rather require approval and a permit:

> "A conditional use permit is required in order to protect resources contained in significant ecological areas as specified in the General Plan from incompatible development, which may result in or have the potential for environmental degradation […] It is not the purpose to preclude development within these areas but to ensure, to the extent possible, that such development maintains and where possible enhances the remaining biotic resources of the significant ecological areas, while allowing for limited controlled development therein" (County of Los Angeles, 2016).

Therefore, a landowner is not completely restricted by the SEA regulation in the VO. This creates a "fuzzy" regulation that may or may not allow a vineyard in an area depending on the approval of a permit. The fuzzy SEA was mapped using the *Significant Ecological Areas (SEA) – Existing/Adopted* dataset obtained from the LACGDP. The SEA area was used to clip the Pre-

Ordinance shapefile creating the SEA Polygon showing the expanse of SEAs affecting the Pre-Ordinance vineyard area.

3.5.2 Vineyard Visibility

The second fuzzy regulation pertains to the visibility of a vineyard from a scenic highway and the Backbone Trail: "To the extent feasible, the vineyard shall not be visible from a scenic highway or the Backbone Trail" (County of Los Angeles, 2015b). The trail and highway data were manipulated to represent the spatial nature of the regulation. The Backbone Trail was extracted from the *Department of Parks and Recreation Trails* dataset and the scenic highways located in the SMMNA were extracted from the *Scenic Highway* dataset, both found on the LACGDP. The "Viewshed" tool in ArcMap Desktop 10.4 was used on both to find the areas that are visible from either of these locations. The viewable areas were merged and used to clip the Pre-Ordinance map creating the Vineyard Visibility Polygon. The visibility regulation is "fuzzy" because the VO gives vintners a chance to mitigate the visibility of the vineyard. "If no feasible location on the proposed project site exists where the vineyard would not be visible from a scenic highway or the Backbone Trail, the vineyard shall be sited and designed to minimize its impacts on the involved scenic highway and/or the Backbone Trail" (County of Los Angeles, 2015b). The fuzzy Vineyard Visibility Polygon was merged with the SEA Polygon to represent the total fuzzy area in the SMMNA.

3.6 Change Map

The change map was made using the mandatory regulation shapefiles. All of the mandatory regulation shapefiles, with the exception of the parcel regulation, were merged to create the Change Polygon. However, the Change Polygon is inaccurate in terms of extent and total acreages due to the inability to show the exact area that the parcel regulation protects.

3.7 Post-Ordinance Map

The Post-Ordinance map was made using a combination of the Pre-Ordinance Polygon, the Change Polygon, the parcel dataset, and the Fuzzy Polygon. The “Erase” tool was used in ArcMap Desktop 10.4 to remove the prohibited areas, represented by the Change Polygon, from the Pre-Ordinance Polygon. The remaining vineyard area was used to clip the parcel data to divide the area into individual parcel vineyards. The parcels with > 2 acres of allowable vineyard land were separated from the parcels with the legal ≤ 2-acre limit. Lastly, the Fuzzy shapefile was used to identify all parcel vineyards that fall into the fuzzy area. The Post-Ordinance map was displayed using colored dots to distinguish the parcels that contain > 2 acres from the parcels with ≤ 2 acres of vineyard extent and the fuzzy vs. non-fuzzy parcel vineyards.

The method of creating the Post-Ordinance map generated an overall area where vineyards are allowed according to the VO. However, this method can be seen as a gross over-estimation of the areas that allow vineyards. In order to apply a more realistic measurement of potential vineyard acreages, the parcel vineyards were divided up once more. The vacant parcels were separated and removed from the Post-Ordinance map, which allowed for a separate quantitative analysis of the occupied parcel vineyards. The removal of the vacant parcels left only parcels with current potential for adding a vineyard, which gave a more realistic view of the current state of potential vineyard additions in the SMMNA. However, the Post-Ordinance analysis in this thesis focused more on the overall area of potential vineyards in order to analyze the VO as it pertains to the entire SMMNA, regardless of the ownership status of a parcel.

3.8 Quantitative Reports

A variety of spatial analysis tools were used to document the ordinance statistics. This included the total vineyard acreage allowed by the VO, the total acreage protected by each individual regulation, and the vegetation types protected by the VO.

3.8.1 Pre-Ordinance Statistics

The Pre-Ordinance Polygon provided the total allowable vineyard acreage before the ordinance passed. The polygon was used to clip the NPS alliance level vegetation dataset. The acreage of each vegetation class and their percentage in the polygon were calculated from the clipped vegetation layer.

3.8.2 Post-Ordinance Statistics

The Post-Ordinance Polygon provided the total allowable vineyard acreage after the ordinance passed, with the exception of the acres saved by the parcel regulation. The true acreage of the Post-Ordinance area was calculated by subtracting the total excess acreage of the > 2 acre parcel vineyards from the acreage of the Post-Ordinance Polygon. The same process was done again after removing the vacant parcels from the Post-Ordinance Polygon. The polygon was not used to clip the NPS alliance level vegetation dataset because it does not accurately represent the parcel regulation's acreage reduction.

3.8.3 Ordinance Regulation Statistics

Each ordinance regulation, except for the parcel regulation, has its own polygon representing the area it protects within the boundary of the SMMNA. The total acreage of each regulation polygon was calculated in ArcMap and compared. The regulation polygons were used to clip the NPS alliance level vegetation dataset to determine the acres and percentages of each

vegetation class that it protected. Fuzzy regulations were not used for this part of the analysis because these areas can allow vineyards with the appropriate approval.

The parcel regulation's acreage was calculated differently from the other regulations. The parcel vineyards > 2 acres in size cannot be manually reduced without making decisions about which 2 acres to choose. Therefore, the locations and vegetation statistics would depend on the owner. The parcel vineyards were not used to clip the NPS alliance level vegetation dataset, since this would have provided incorrect statistics. However, the total acreage saved by the parcel size regulation could be calculated. First, the parcel data was used to clip the Pre-Ordinance Polygon resulting in the total acres of allowable Pre-Ordinance vineyards. Then, the acreages of the > 2 acre parcels were recalculated by reducing them all to a 2 acre maximum. This was added to the sum of the < 2 acre vineyard acreages, which resulted in the total allowable acres after the parcel regulation's effects. The total acreages before and after the parcel regulation's effects were subtracted to get the total acreage saved by the parcel regulation.

The results of this analysis are described in Chapter 4 below.

Chapter 4: Results

This chapter presents the change and Post-Ordinance maps and discusses their limitations. It documents the quantitative analysis of the individual spatial regulations and the VO as a whole. The regulations are compared in terms of total acres protected and vegetation classes preserved.

4.1 Change Map

The change map, seen in Figure 4, is the combination of the mandatory regulation shapefiles, with the exception of the parcel regulation. The total area protected by the VO is 16,223 acres. However, the change map only shows an extent of 13,159 acres due to the missing area saved by the parcel regulation.

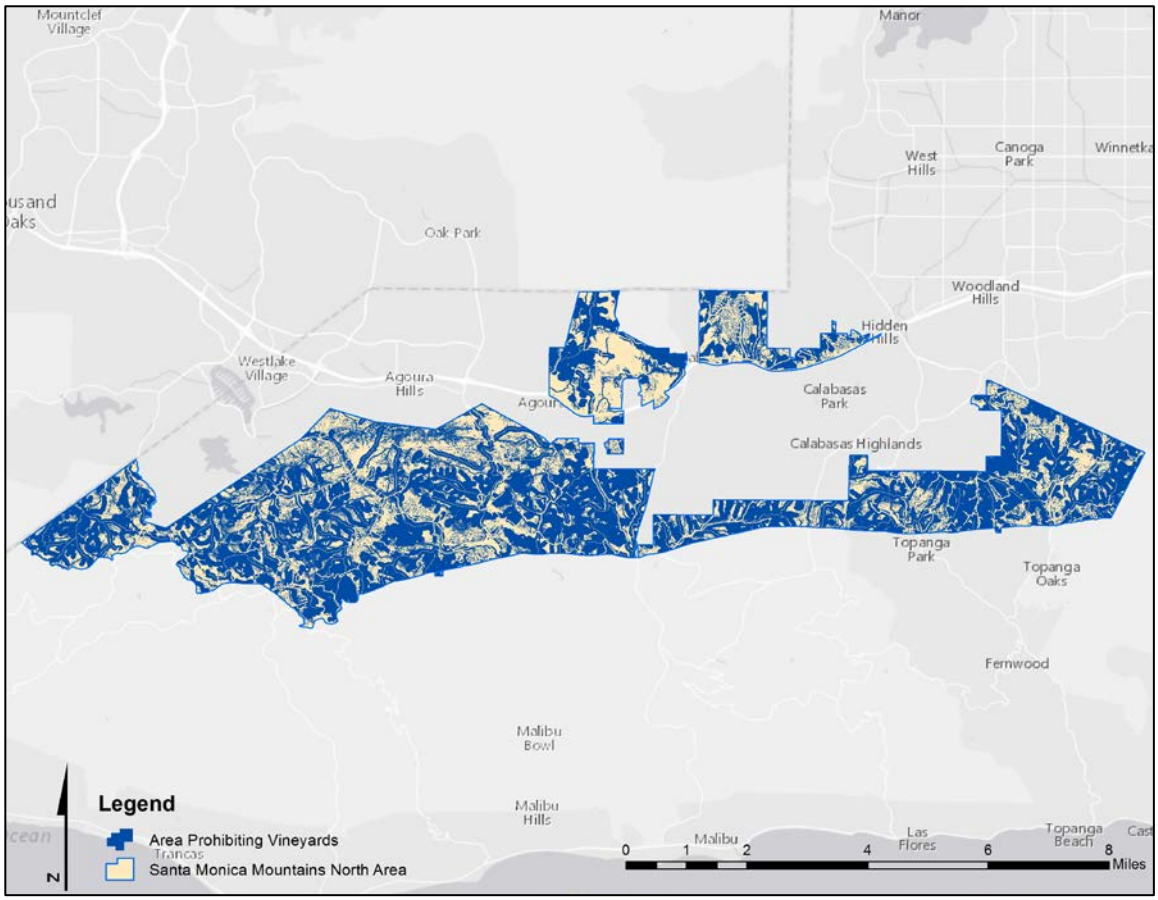

Figure 4 The Change Polygon showing the areas where vineyards are prohibited

4.2 Post-Ordinance Maps

The Post-Ordinance map shows the total area of allowable vineyard land after the VO passed. The most accurate way to represent the Post-Ordinance map is through the dot map that was described in Chapter 3 and is reproduced in Figure 5. Each dot represents a parcel that contains allowable vineyard land and they are colored to represent their size and fuzzy status. The red and purple dots represent parcels with > 2 acres of allowable vineyard land, while the green and blue dots represent parcels with ≤ 2 acres of allowable vineyard land. Additionally, the red and green dots represent parcels that fall within the Fuzzy Polygon, while the purple and blue dots represent parcels that do not. There are 3,393 parcels containing allowable vineyard land and of those parcels, 2,973 (88%) fall completely or partially in the fuzzy vineyard land. There are 2,695 (79%) parcels with ≤ 2 acres of allowable vineyard land and 698 (21%) parcels with > 2 acres of allowable vineyard land.

Visualizing the Post-Ordinance map in another format can be effective in understanding its acreage extent. Figure 6 shows the Post-Ordinance Polygon in its full extent, without the vineyard parcel reduction. The total allowable vineyard land seen on this map is 5,287 acres and 93% of it (4,896 acres) is fuzzy. The acreage dropped to 2,224 acres when the parcel reductions were included in the calculation. This means that the VO reduced the possible vineyard extent from 18,493 acres to 2,224 acres, which is an 88% decrease in potential habitat change.

The Post-Ordinance statistics changed when the vacant parcels were removed from analysis. A total of 1,181 vacant parcels were removed from the Post-Ordinance polygon, which equated to 3,087 acres of land removed. This left a total of 2,212 remaining occupied parcels, which equated to 2,200 acres before the vineyard parcel reduction. There were 1,807 (82%) parcels with ≤ 2 acres of allowable vineyard land and 405 (18%) with > 2 acres of allowable

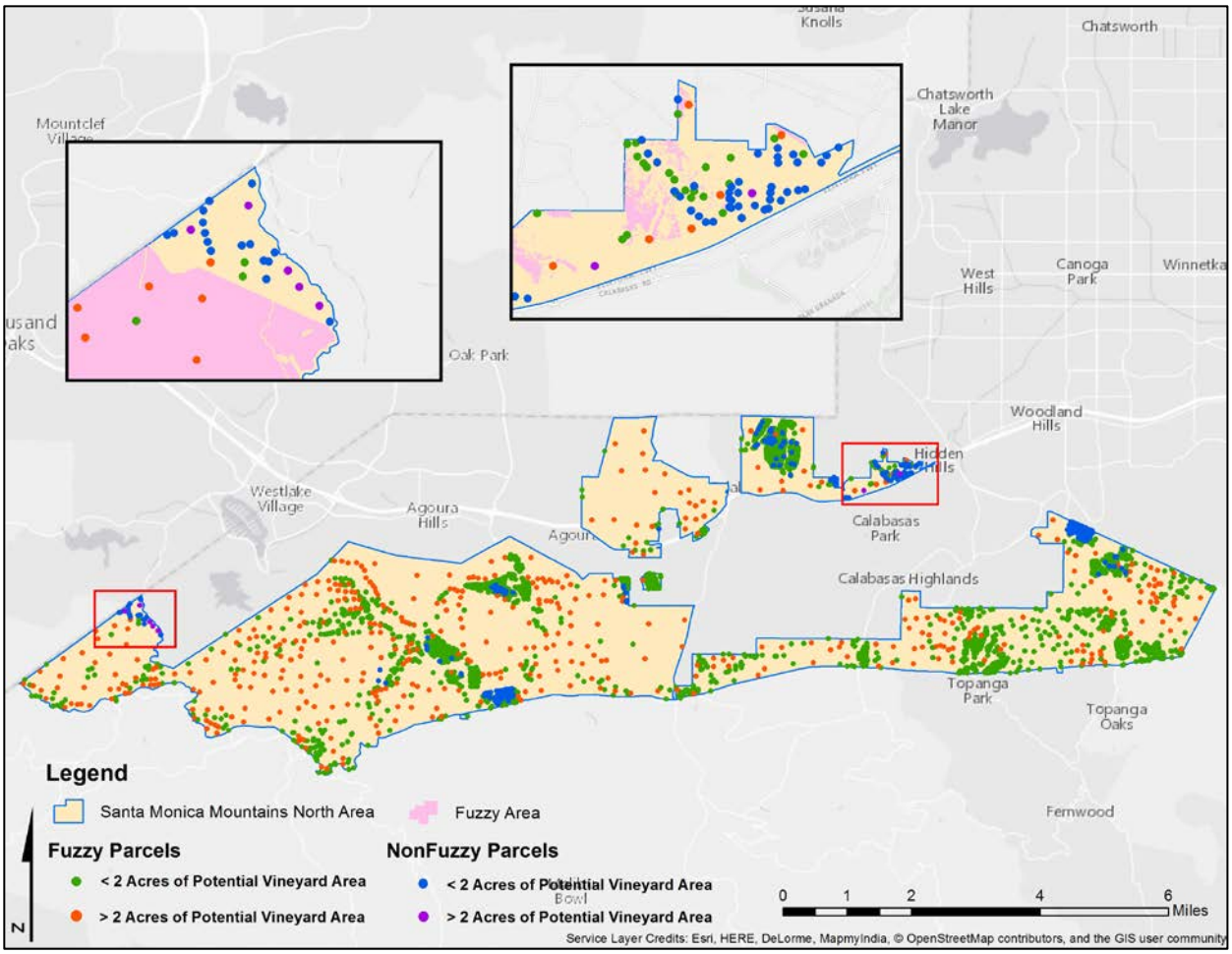

Figure 5 The Post-Ordinance map displayed as vineyard dots

vineyard land. The total acres of potential vineyard land dropped to 1,340 acres when the vineyard parcel reductions were calculated. This means that when the vacant parcels were removed from analysis, the VO reduced the possible vineyard extent by about 93%.

4.3 Spatial Regulations

The total acres protected by each regulation were collected and compared. The acres of protected NPS alliance vegetation classes were calculated for each regulation. Maps of each regulation's extent can be seen in Appendix A.

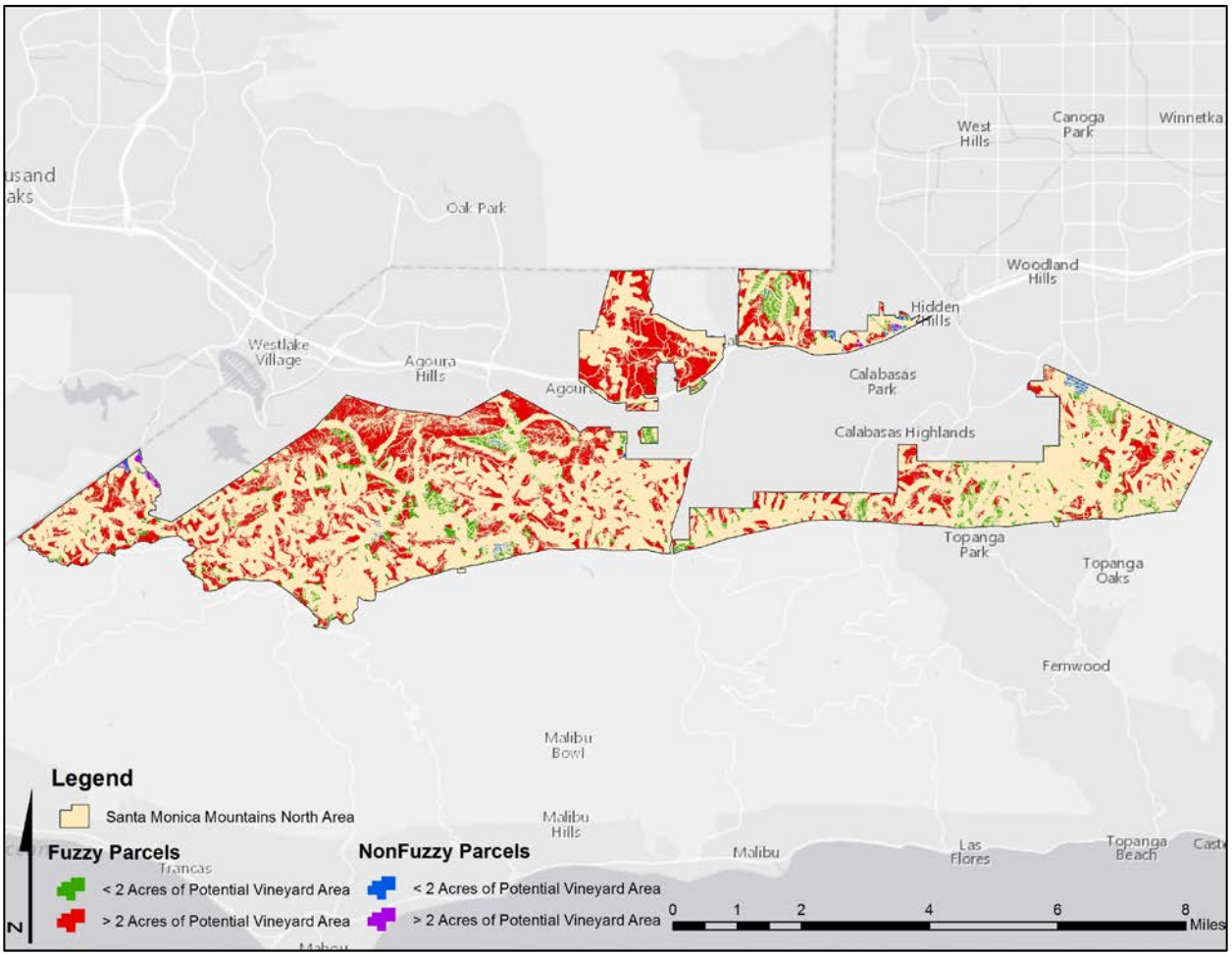

Figure 6 The Post-Ordinance Polygon extent without parcel reductions

4.3.1 Regulation Acreages

The five strict regulations and two fuzzy regulations were evaluated based on their coverage in the SMMNA. To prevent overlap of protected areas, each regulation was analyzed as if it were the only regulation in play. Figure 7 shows a comparison of the total acres protected by each of the regulations. The parcel regulation protected the most land, 14,644 acres, which is about 79% of the Pre-Ordinance area. The parcel regulation acreage had to be manually calculated due to the inability to choose the 2-acre locations of vineyards. The Pre-Ordinance

Polygon clipped the parcel data and the large parcel vineyards were reduced to a 2-acre size. The reduced large parcel acreages were added to the small parcel acreages. This total was then subtracted from the Pre-Ordinance clipped parcel acreage, which results in the total acres protected by the parcel size regulation.

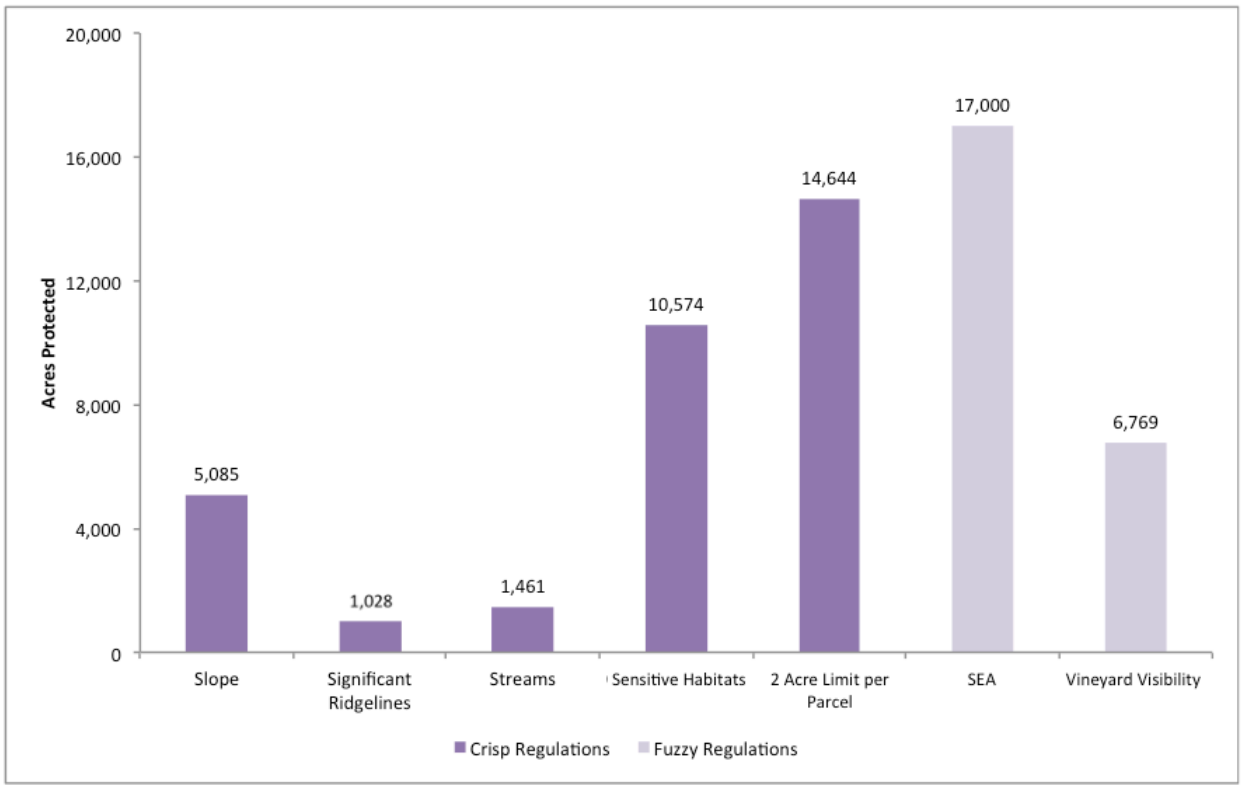

Figure 7 The total acres protected by each regulation

The sensitive habitat regulation protected the second largest amount of land, 10,574 acres, which is about 57% of the Pre-Ordinance area. However, this extent may be inaccurate because several habitats were not included in the calculation and the alluvial scrub extent was created based on research assumptions instead of observations. The actual extent of alluvial scrub in the SMMNA may be larger or smaller than this project's representation of the data.

Also, the NPS and CalVeg datasets do not provide accurate representations of a species exact location, but rather a representation of the dominant species found in an area.

The slope regulation protected 5,085 acres of land, which is about 27% of the Pre-Ordinance area. This calculation can be seen as somewhat irrelevant because most vintners would not choose slopes > 33% regardless of the existence of the regulation. However, in an effort to create an unbiased comparison of the regulations, this thesis will use the calculated 5,085 acres for the slope regulation.

The stream regulation and the significant ridgeline regulation protected significantly less than the others. The stream regulation protected 1,461 acres, which is about 8% of the Pre-Ordinance area. The significant ridgeline regulation protected 1,028 acres, which is about 6% of the Pre-Ordinance area. However, the significant ridgeline total is inaccurate due to the exclusion of the vertical 50-foot protection zone from the analysis. The actual extent would be larger due to some significant ridgelines having gentle slopes.

A site inspector will also have to approve any land that falls in the fuzzy area. The fuzzy SEA regulation covered a large portion of the Pre-Ordinance area. It spanned a total of 17,000 acres, which is about 92% of the area. The fuzzy vineyard visibility regulation spanned a total of 6,769 acres, which is about 37% of the Pre-Ordinance area. When both fuzzy regulations were combined they covered 17,566 acres, which is about 95% of the Pre-Ordinance area. This means that 95% of potential vineyard land needs special approval or mitigation in order to be allowed, even if the area complies with all of the other regulations.

As mentioned earlier, each regulation was worked on independently from the others in order to generate separate results. This method helped maintain accurate acreages because all their extents overlap each other. Table 1 is a contingency table of the overlapping acreage totals

for each pair of regulations. No overlapping values for the parcel regulation could be calculated and therefore this particular regulation was excluded from the table. The table highlights the importance of working on all of the regulations individually because the area covered by each regulation overlaps by > 90% the area covered by at least one other regulation.

Table 1 Contingency table showing the acres of overlap between regulations

	Slope	Ridgeline	Stream	Habitat	Visible	SEA	Parcel
Slope	**5,085**						
Ridgeline	179	**1,028**					
Stream	504	3	**1,461**				
Habitat	3,046	380	1,461	**10,574**			
Visible	1,883	615	236	3,081	**6,772**		
SEA	4,713	982	1,383	10,099	6,205	**17,000**	
Parcel							**14,644**

4.3.2 Protected Vegetation

The protected vegetation acreages can only be analyzed using four of the five strict regulations due to the non-spatially specific nature of the parcel regulation. According to the NPS vegetation dataset, 63 vegetation classifications were identified in the SMMNA. The Slope, Significant Ridgeline, Sensitive Habitat, and Stream Polygons were used to clip the NPS data and the acres of each protected vegetation class were calculated. Figure 8 shows the five largest vegetation acreages protected by each regulation on one graph. The high and low acreages of a vegetation type are reflections of the size of each regulation's protected extent (ie. the top five vegetation classes protected by the ridgeline regulation are much lower than the acreages protected by the habitat regulation, due to the fact that the ridgeline regulation protected much less acres in general). The vegetation classes shown in Figure 8 are identified as the most abundant classes found within each regulation's protected area.

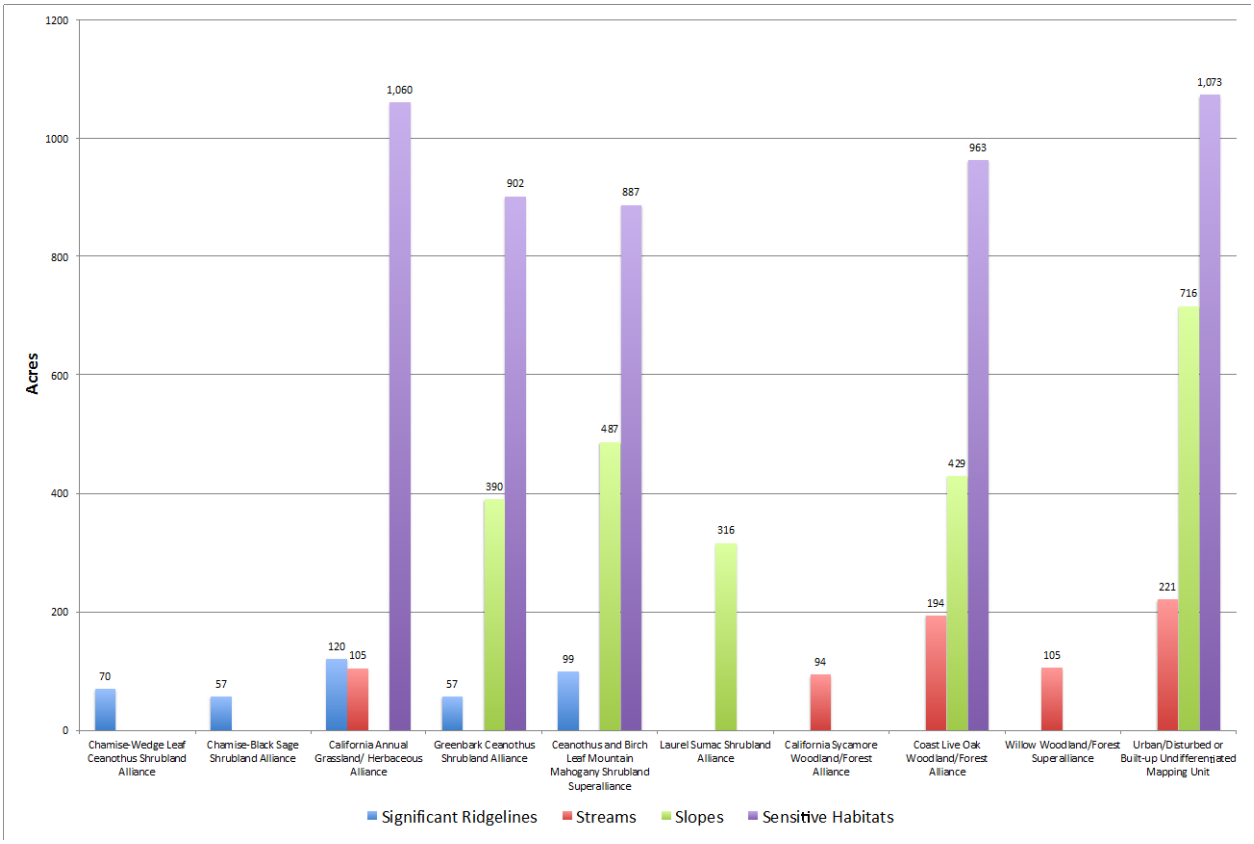

Figure 8 Histogram showing the most protected vegetation by total acres for the significant ridgeline, streams, slope, and sensitive habitat regulations.

It is perhaps more important to note the vegetation classes that are completely protected by these regulations. The only regulation that offers 100% protection of a vegetation class is the habitat regulation, which calls out the specific habitats to protect. Thirteen of the NPS vegetation classes are 100% protected but they are the only ones fully protected by the strict regulations.

Chapter 5: Conclusions

This chapter evaluates the effectiveness of the VO in achieving its goal based on the results from Chapter 4, highlights the limitations that were encountered when completing this thesis project, and offers suggestions for future research opportunities.

5.1 Effectiveness of the Vineyard Ordinance

The goal of the VO is to preserve the natural habitat of the SMMNA. The evaluation of the Post-Ordinance map in Chapter 4 was the best way to rate the VO's effectiveness in achieving its goal. The VO protects 16,223 acres of habitat in the SMMNA. This is approximately 78% of the > 20,000 acre SMMNA and 88% of the Pre-Ordinance area. The incredibly large amount of land protected by the VO is strong evidence that the VO will be effective at preserving the natural habitat of the SMMNA.

A detailed analysis of the vegetation protected by the VO was difficult due to the parcel regulation. However, a general understanding of the habitat protection levels, seen in Figure 9, helped quantify the effectiveness of the VO. Fifty-five of the 63 vegetation classes are more than 60% protected by the VO and 21 of the vegetation classes are more than 80% protected by the VO. The lowest level of protection is 48% (*Quercus berberidifolia-Cercocarpus betuloides* Shrubland Alliance), while 13 vegetation classes are 100% protected. These statistics are strong evidence that the VO is effective at protecting all types of vegetation, which in turn helps maintain ecological diversity in the SMMNA.

Figure 9 Percentages of each vegetation class protected as a result of the VO

5.2 Project Limitations

This thesis project had several limitations that affected the results. Data availability and accuracy were the main limitations. The dataset containing the endangered species locations was old and generalized and the oak tree locations were not available. Therefore both datasets were excluded from the sensitive habitat regulation analysis. The habitat regulation's extent was the least accurate due to the assumptions made about the NPS and CalVeg data. Both datasets contained much broader representations of vegetation than the actual vegetation found in the area. This means that the resulting Habitat Shapefile overestimated of the sensitive habitats listed in the VO.

The parcel regulation had its own limitations. The acres saved by the regulation could be calculated but not visually represented without bias. Only landowners can decide which land to

use, as long as it complies with the other regulations. Therefore, any representation of the parcel regulation would have to make large assumptions about where vineyards would be cultivated.

The thesis was also limited by the methods used to represent the significant ridgelines regulation. The 50-foot vertical distance from ridgelines was not included in the acreage calculations and therefore caused an under-estimation of the actual protection extent of the regulation. A more comprehensive representation of the significant ridgeline protection zone would have given more accuracy to the results of this thesis.

The scale used to calculate the slope regulation limits this thesis. This thesis used a 10-foot DEM to generate the slope map, which means the slope was calculated over a 30-foot or 42-foot distance depending on the direction of steepest decent across a three-by-three cell moving window. Since the VO gives no indication to scale when defining the slope regulation, the slope of an area becomes scale biased. For example, an entire vineyard may have a slope under 33% based on the extent of the vineyard. However, if the scale is reduced to a smaller extent (i.e. 10 feet) then there may be small pieces of the vineyard that are considered to be on slopes above 33%. Without a scale to define how slope is measured, landowners and site inspectors can define 33% slopes in different ways. The absence of scale in the VO is not only a weakness for this thesis but also the VO itself.

The judgment made about the VO's effectiveness is limited as well. The VO is much more complex than what is seen in the scope of this thesis. Most of the regulations in the VO cannot be analyzed through the use of GIS such as pesticide usage and the allowable fencing options. Therefore, it seems unreasonable to judge the effectiveness of the VO based solely on the spatial regulations. This thesis can only aid in judging the VO's effectiveness in reducing the amount of potential vineyard land through its spatially specific regulations.

5.3 Future Work

This thesis project can be taken further by refining the data. More accurate habitat extents and locations can be collected through field observations. Perhaps both oak tree and endangered species datasets can be created and/or found and included in the habitat regulation. In addition, it may be possible to find a way to reduce the parcel vineyards without making large assumptions about the vineyard area.

Future work can include improved and/or alternate methods of representing the regulations. The 50-foot vertical protection zone of significant ridgelines can be generated using additional tools. Additional variances of scale can be used to represent slope in the SMMNA creating new ways of looking at the slope regulation's extent. More work can be done to remove existing buildings from the potential vineyard extent, assuming that landowners will not remove their buildings in order to cultivate grapes on that piece of their parcel.

More research can be conducted on the vineyards that already exist in the SMMNA and whether they comply with the new regulations or not. Future projects can also take into consideration the ideal locations for a vineyard. The aspect of the land can be mapped, as well as the soil profile. Researchers can use these to create a map of ideal vineyard locations and compare it the Post-Ordinance map.

Lastly, the real effects of the VO will be seen as time passes. Each vineyard application is dependent on passing a site evaluation to determine if the land complies with all the regulations. Future researchers can use these site evaluations to create a more realistic Post-Ordinance map. The results of this thesis cannot be a guide to whether a location will qualify or not, only on-site evaluations can accurately represent the VO's regulations.

REFERENCES

Barbour, M. G., and J. Wirka. 1997. “Classification of Alluvial Scrub in Los Angeles, Riverside and San Bernardino Counties.” Sacramento, CA, California Department of Fish and Game.

California Coastal Commission. 2002. City of Malibu Local Coastal Program Land Use Plan. City of Malibu. Print.

Chan, C. 1999. “Land-Use Battle Shapes Up Near 101 Freeway.” *Daily News* (available at http://www.thefreelibrary.com/LAND-USE+BATTLE+SHAPES+UP+NEAR+101+FREEWAY.-a083612334).

County of Los Angeles. 2000. *The Santa Monica Mountains North Area Plan*. Los Angeles, CA, Los Angeles County Department of Regional Planning. Print.

County of Los Angeles. 2009. “Santa Monica Mountains Local Coastal Program.” Los Angeles, CA, Los Angeles County Department of Regional Planning (available at http://planning.lacounty.gov/coastal/smm).

County of Los Angeles. 2012. “The Santa Monica Mountains North Area Plan.” Los Angeles, CA, Los Angeles County Department of Regional Planning (available at http://planning.lacounty.gov/view/santa_monica_mountains_north_area_plan/).

County of Los Angeles. 2015a. *Hearing on Amendment to Los Angeles County Code (Title 22 – Planning and Zoning) to Regulate Vineyards in the Santa Monica Mountains North Area Community Standards District Project No. R2015-02310, Advance Planning Case No. RADV201500007, Environmental Case No. RENV201500182*. Los Angeles, CA, Los Angeles County Department of Regional Planning.

County of Los Angeles. 2015b. *The Santa Monica Mountains North Area Community Standards District*. Los Angeles, CA, Los Angeles County Department of Regional Planning.

County of Los Angeles. 2016. *Los Angeles County, California - Code of Ordinances*. Los Angeles, CA, Los Angeles County Department of Regional Planning.

Dallman, P. R. *Plant Life in the World's Mediterranean Climates: California, Chile, South Africa, Australia, and the Mediterranean Basin.* Berkley and Los Angeles: University of California Press.

Forman, R. T. T. 1995. *Land Mosaics: The Ecology of Landscapes and Regions.* Cambridge, UK: Cambridge University Press.

Goepel, C., K. Hoeberling, F. Keto, R. Pardo, J. Palmquist, M. Traverso, and A. Yoon. 2012. "Potential Extent of Vineyard Development in the Santa Monica Mountain National Recreation Area." Los Angeles, CA, University of California Los Angeles.

Haddad, N. M., L. A. Brudvig, J. Clobert, K. F. Davies, A. Gonzalez, R. D. Holt, T. E. Lovejoy, J. O. Sexton, M. P. Austin, C. D. Collins, W. M. Cook, E. I. Damschen, R. M. Ewers, B. L. Foster, C. N. Jenkins, A. J. King, W. F. Laurance, D. J. Levey, C. R. Margules, B. A. Melbourne, A. O. Nicholls, J. L. Orrock, D. Song, and J. R. Townshend. 2015. "Habitat Fragmentation and Its Lasting Impact on Earth's Ecosystems." *Science Advances*, 1(2): e1500052.

Hanes, T. L., R. D. Friesen, and K. Keane. 1989. "Alluvial Scrub in Coastal Southern California." In *Proceedings of the California Riparian Systems Conference: Protection, Management, and Restoration for the 1990s* (pp. 187-193). Berkeley, CA.

Heaton, E., and A.M. Merenlender. 2000. "Modeling Vineyard Expansion, Potential Habitat Fragmentation." *California Agriculture*, 54:12-19.

James, J. 2013. “Modeling Suitable Habitat Under Climate Change for Chaparral Shrub Communities in the Santa Monica Mountains National Recreation Area, California.” Masters Thesis. Arizona State University.

Li C., H. Chen, C. Lam, T. Longcore, J. Sayre, K. Schmoker, and J.R. Wolch. 2004. *Green Visions Plan for 21st Century Southern California: A Guide for Habitat Conservation, Watershed Health, and Recreational Open Space. 2. Phase I On-line Inventory of Southern California Plans Relating to Habitat, Watersheds, and Recreation*. Los Angeles, CA, University of Southern California GIS Research Laboratory and Center for Sustainable Cities.

Lindenmayer, D and J. Fischer. 2006. *Habitat Fragmentation and Landscape Change: an Ecological and Conservation Synthesis*. Washington D.C.: Island Press.

Magney, D. L. 1992. “Descriptions of Three New Southern California Vegetation Types: Southern Cactus Scrub, Southern Coastal Needlegrass Grassland, and Scalebroom Scrub.” *Crossosoma,* 18(1): 1-9.

NPS. 2002. *General Management Plan and Environmental Impact Statement: Santa Monica Mountains National Recreation Area*. Washington, D.C., United States Department of the Interior.

NPS. 2003. *Santa Monica Mountains National Recreation Area.* Washington, D.C., United States Department of the Interior.

NPS. 2016. “Santa Monica Mountains: Nature.” Retrieved from http://www.nps.gov/samo/learn/nature/index.htm.

Parks, L. 2015. “Draft Santa Monica Mountains North Area Community Standards District Vineyard Ordinance/R2015-02310-(3)/RADV201500007 and Draft Initial Study.” Los Angeles, CA, Santa Monica Mountains Conservancy.

RCDSMM. 2015. “Oak Trees.” Last modified 2015. http://www.rcdsmm.org/oak-trees

Roques, L. and R. S. Stoica. 2007. “Species Persistence Decreases with Habitat Fragmentation: An analysis in periodic stochastic environments.” *Journal of Mathematical Biology*, 55(2): 189-205.

Rundel, T. 2011. “Predictive Modeling of Vineyard Expansion in the Santa Monica Mountains.” Masters Thesis. California State Polytechnic University, Pomona.

Sikich, S., K. Pease, S. Diringer, M. Abramson, M. Gold, and S. Luce. 2013. *Malibu Creek Watershed:Ecosystem on the Brink.* Santa Monica, CA, Heal the Bay.

Swenson, J. J. and J. Franklin. 2000. “The Effects of Future Urban Development on Habitat Fragmentation in the Santa Monica Mountains.” *Landscape Ecology* 15(8): 713-730.

Tigas, L. A., D. H. Van Vuren, and R. M. Sauvajot. 2002. “Behavioral Responses of Bobcats and Coyotes to Habitat Fragmentation and Corridors in an Urban Environment.” *Biological Conservation.* 108(3): 299–306.

Appendix A: Regulation Maps

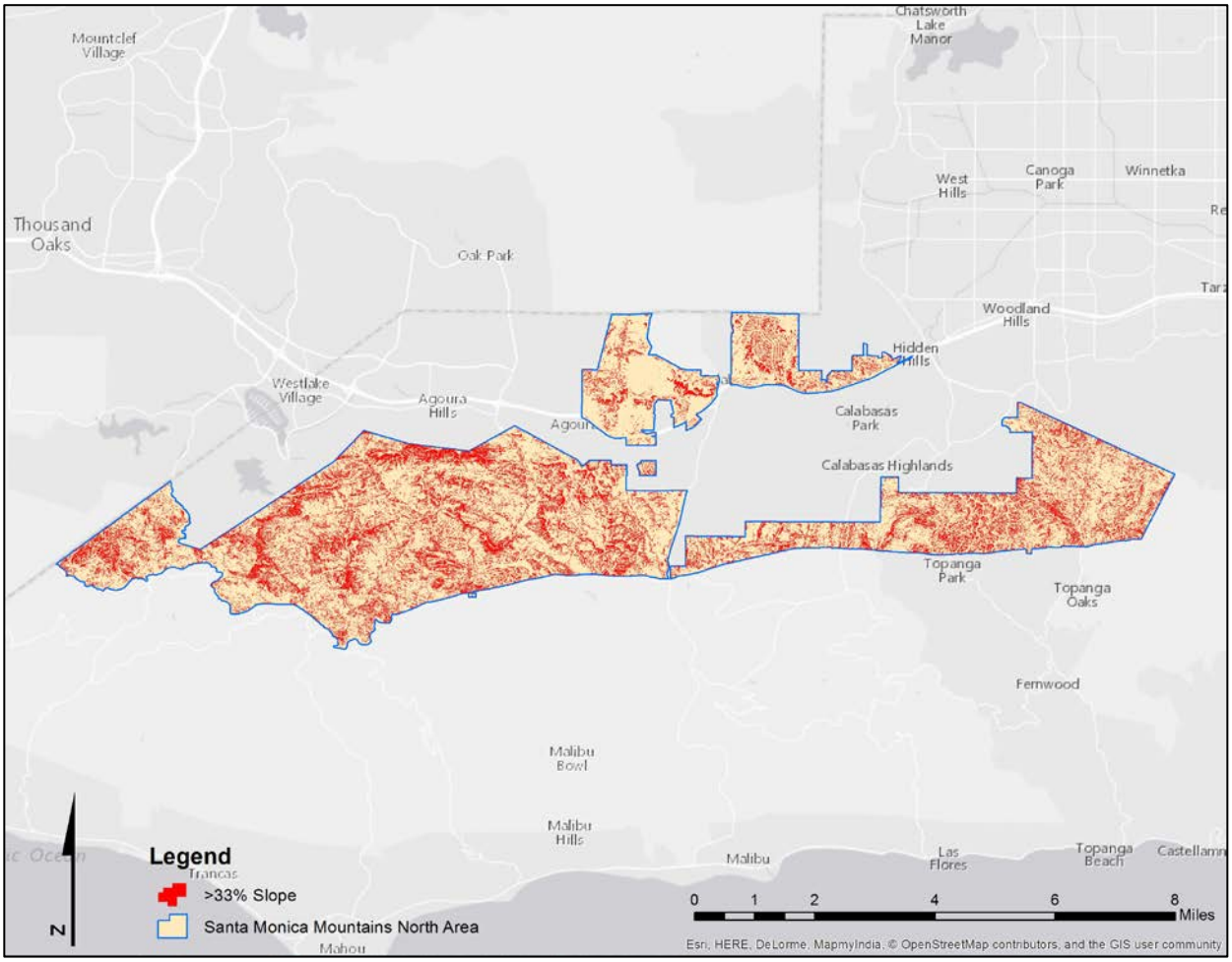

Figure 10 A map showing the area protected by the slope regulation

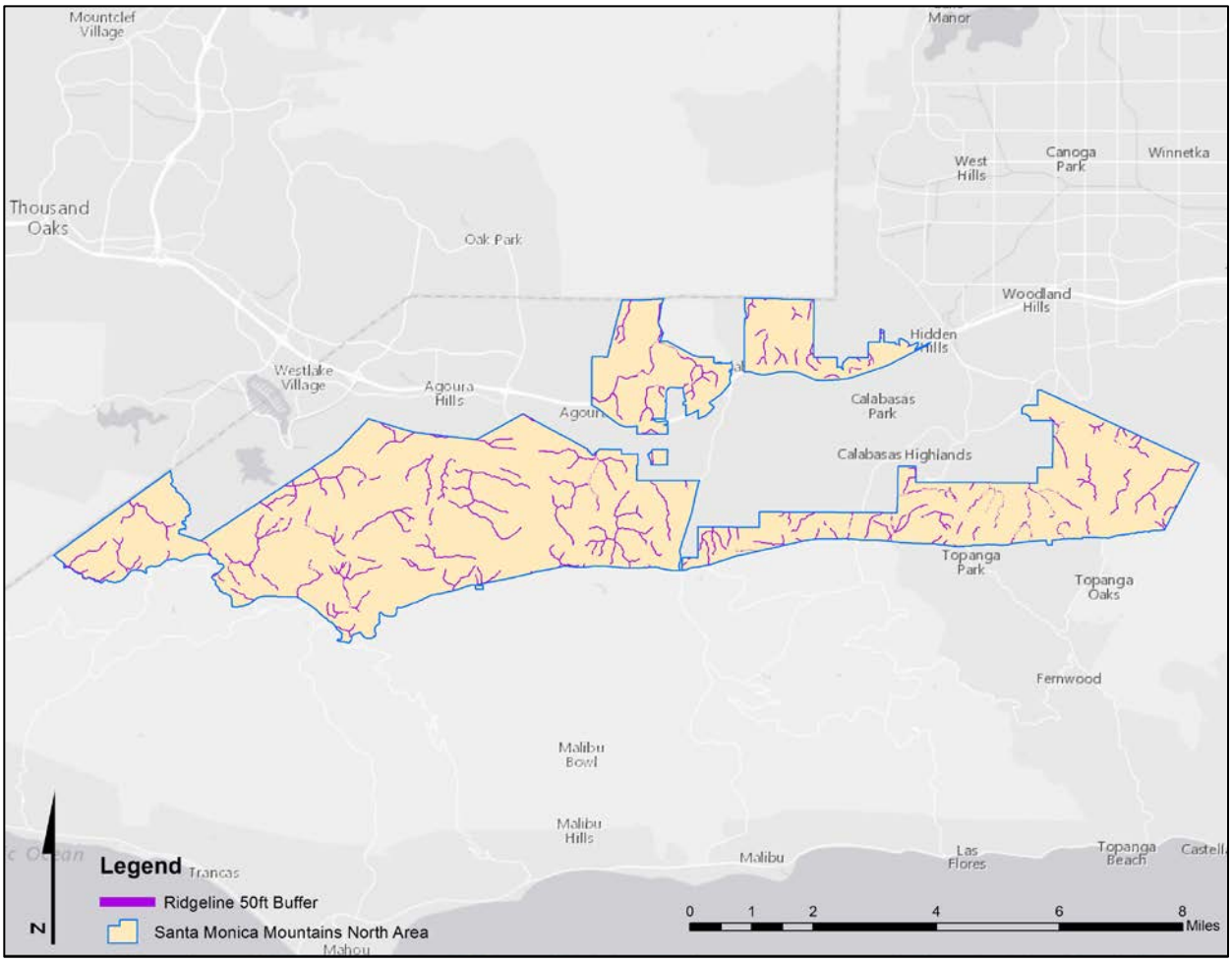

Figure 11 A map showing the area protected by the significant ridgeline regulation

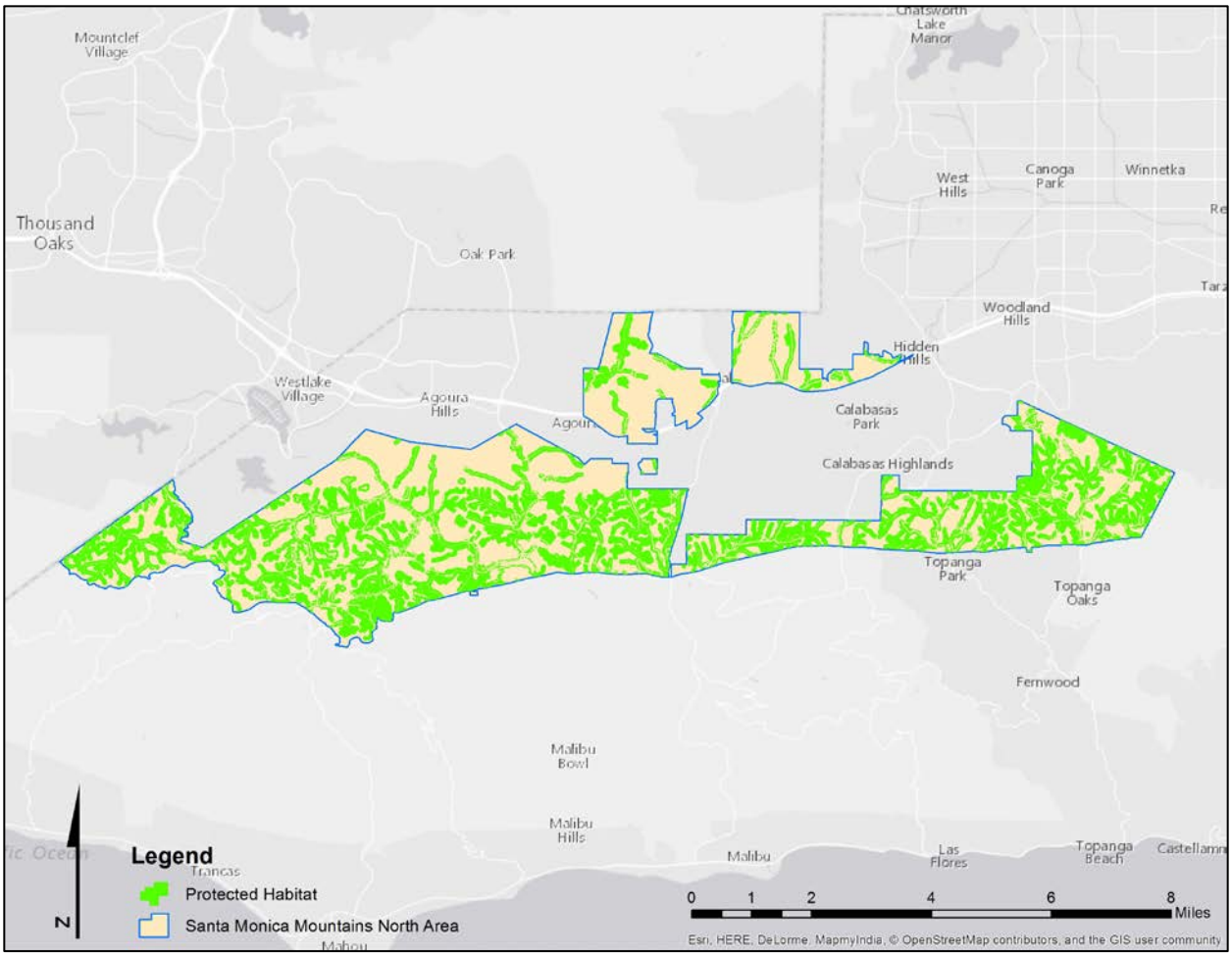

Figure 12 A map showing the area protected by the sensitive habitat regulation

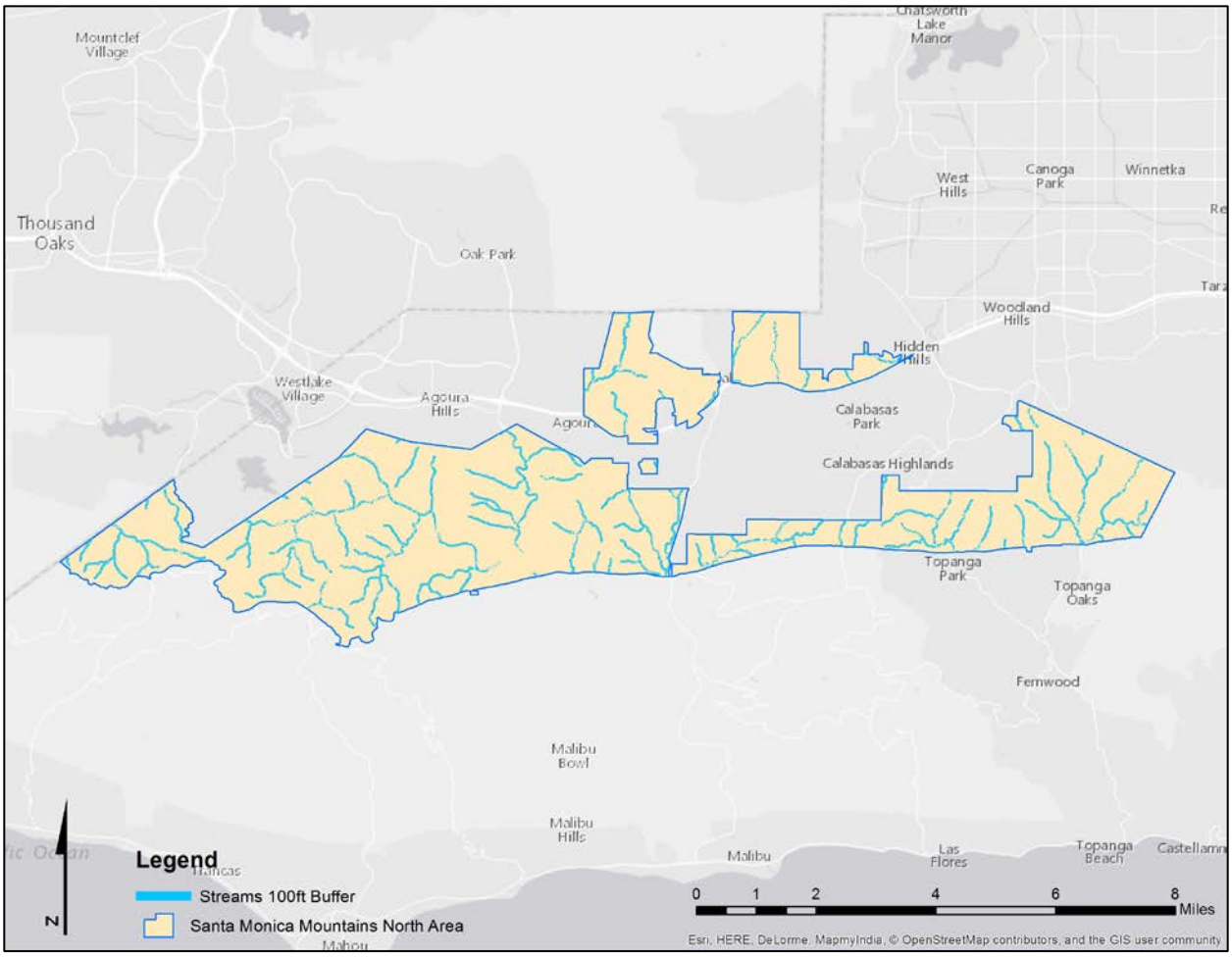

Figure 13 A map showing the area protected by the stream regulation

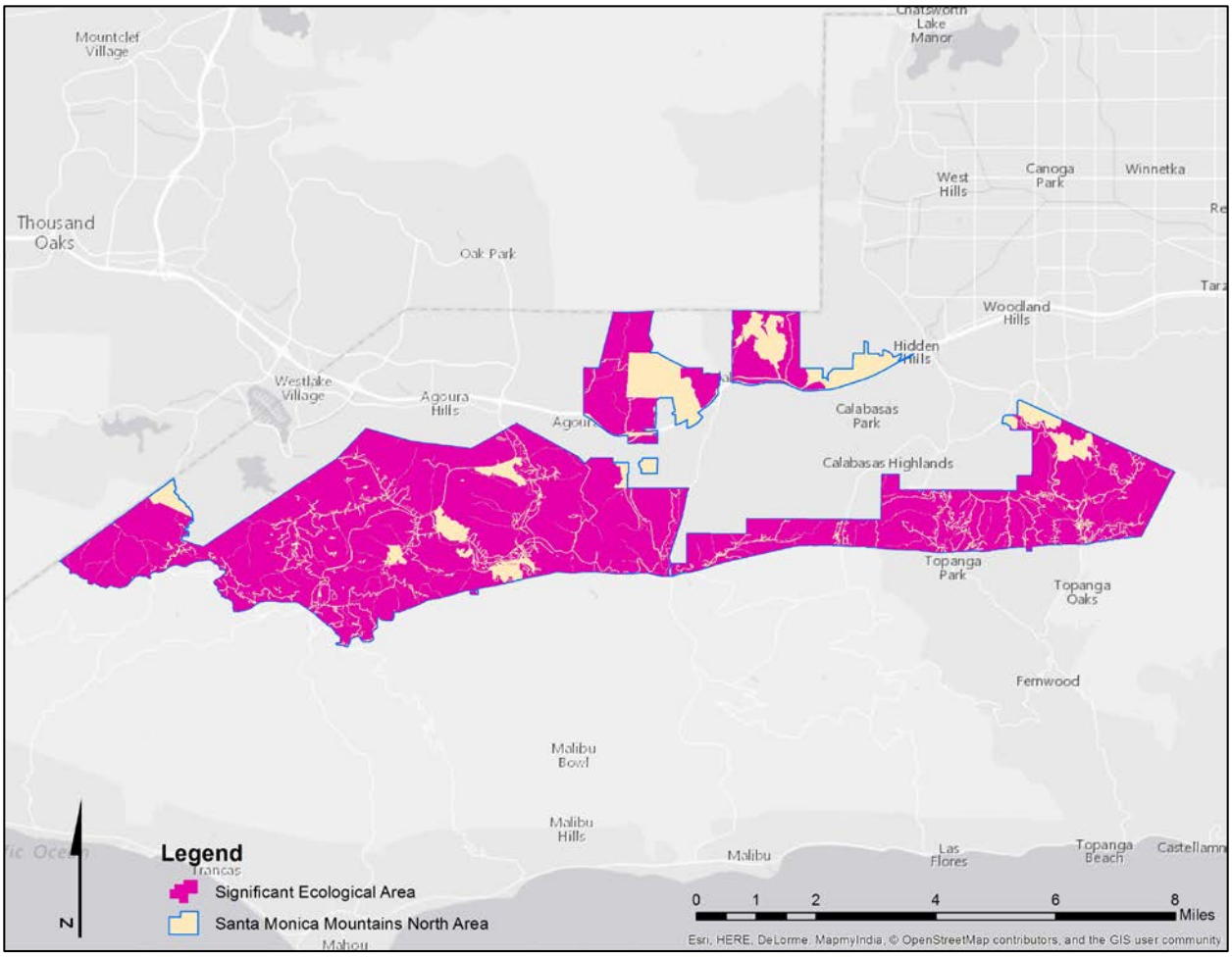

Figure 14 A map showing the area protected by the Significant Ecological Area regulation

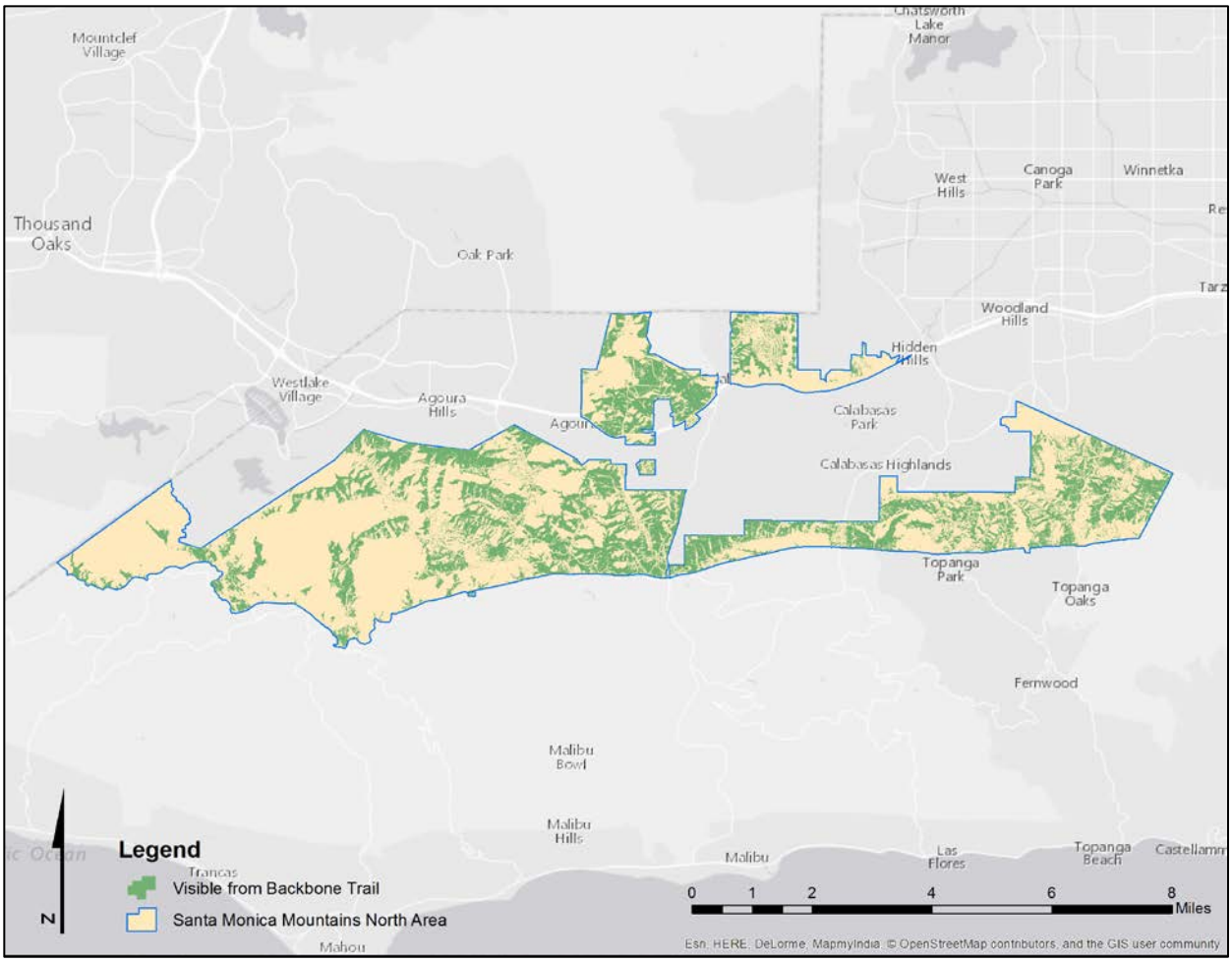

Figure 15 A map showing the area viewable from the Backbone Trail

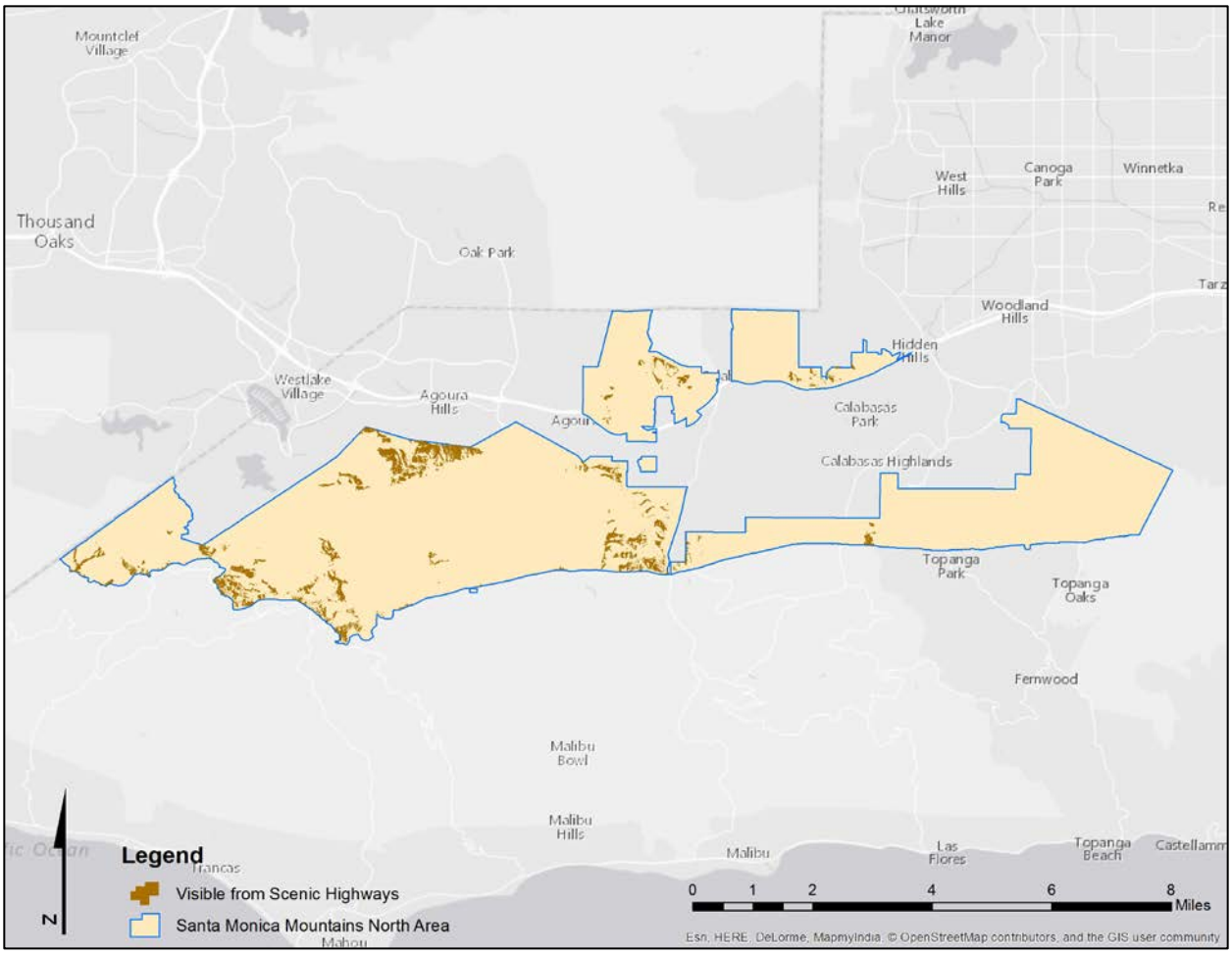

Figure 16 A map showing the area viewable from scenic highways