The Historical and Cultural Landscape of the Missoula Valley During the 19th and 20th Centuries

Mary Bobbitt

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The Historical and Cultural Landscape of the Missoula Valley During the 19th and 20th Centuries

By

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Bachelors of Arts in Anthropology, University of Montana, Missoula MT, 2011

Thesis

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Abstract

Archaeological case studies can be used as microcosms for understanding questions related to landscape transformations and climate change throughout the arid American West. The early 19th century marked a time when significant changes began to take place in the Missoula Valley due to influences of European exploration and settlement in the region. By incorporating multiple sources from a variety of disciplines and using a theoretical framework grounded in landscape theory, this research examines the ways in which humans have altered ecosystem structure, function, and transformations in the region over time, and specifically over the past 200 years. Historic General Land Office (GLO) survey records, archaeological site records, historic photographs, pollen data, Traditional Ecological Knowledge (TEK), modern ecological data, modern land cover data, and geographic information systems (GIS) were used as multiple lines of evidence to reconstruct early Missoula Valley conditions as well as a way to interpret how differing cultural values over time lead to new land use agendas with adaptive and production strategies that have influenced and impacted the valley’s modern cultural environmental settings.
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Chapter 1: Introduction

Diverse environmental practices used by American Indians of North America played an intricate role in shaping the landscape encountered by Europeans in the early 19th century (e.g. Mason et al. 2012:187; White 1991:57) and these different perspectives represent the framework of this thesis. Residents of this region have, over time, come to realize the importance in developing adaptive strategies for sustainable living in relatively arid environments such as that of western North America. Accustomed to lifestyles supported by wetter, well-timbered environments (in both Europe and the eastern United States), European settlers moving into the West encountered unfamiliar environmental conditions. In the early 19th century European settlers disrupted existing traditional economies and ecosystems (White 1991:212) through the introduction of foreign plants, animals, and diseases, which tend to be popular topics for environmental histories throughout the North American West (Cronon 1992:41). These foreign factors significantly impacted American Indian populations who held important traditional ecological knowledge about the region’s natural resources.

The Missoula Valley’s environmental setting underwent significant changes during the early 19th and 20th centuries and this research documents these transformations to investigate how the means of adaptation and production changed as people and cultures with different goals and lifestyles agendas began to inhabit the same area, with shared resources. The history of the Missoula Valley provides a case study highlighting landscape changes over the scale of a few centuries. Processes of human adaptation and production by both the Native and European populations played an intricate role in the consumption and exploitation of resources. For the American Indian people who used and lived in the Missoula Valley, this area was a place to
acquire bitterroot, fish, and large game which naturally made the Missoula Valley an ideal stopping area for a number of tribes. Over several millennia people adapted their lifestyles around seasonal resources that came from both the Missoula Valley and surrounding areas. As more Europeans settlers moved west, the regions indigenous people had to adapt to significant changes that took place upon their homelands and impacted their cultural traditions. Europeans eager to profit from the regions resources industrialized the environment by farming, mining, and logging. The resulting rapid landscape changes include irrigation ditches, introduction of non-native plants communities, bridges, the construction of railroads, and urbanization. To study human relationships with the environment, it is necessary to understand the rates of change that took place in the Missoula Valley during this time.

Traditional Ecological Knowledge (TEK), sometimes referred to as Traditional Knowledge (TK), is often defined as experiences “built on factual observations and practical experiences within a historical context, guided by spiritual belief, and implemented through traditions and cultural stories, interpersonal teaching, and practice” (Houde 2007:3). Western views of ecological knowledge, also referred to as scientific ecological knowledge (SEK), are based on theories that separate the actions of humans from studies of the environment (Mason et al. 2012; Kimmer 2000). The foundations of SEK systems and practices are drawn from European (non-indigenous) origins, which lose validity in comparison to traditional knowledge (TK) that has developed and evolved from the place of its use (Mason et al. 2012:188).

An examination of the adaptive strategies adopted by both American Indians and Europeans provides a starting point for understanding landscape changes that took place in the Missoula Valley beginning in the early 19th century. Europeans’ and American Indians’ relationship to their
environments differed significantly, causing a major shift in land use strategies and the consumption of natural resources by both groups in the Missoula Valley. But how did European settlers impact the Missoula Valley, and can this information be extracted from the historical documents created by early explorers or the oral stories told by Indigenous people experiencing sudden transformations of their traditional homelands? This thesis research addresses this question using interdisciplinary sources such as historic General Land Office (GLO) surveys, county records, archaeological site records, pollen data analysis, TEK, and modern land cover data for the Missoula Valley. Landscape archaeology provides a theoretical framework for this project, guiding interpretations of the various ways European and Indigenous groups placed significance and meaning on the landscape in the Missoula Valley. The Missoula Valley during the 19th and 20th centuries inevitably was in the center of a transitional period where American Indian groups and other people already living in the region were coping with capitalist agendas and steady streams of settlers arriving in from all over the world. As Europeans moved into areas of the North American West* they:

destroyed native plants and animals, and inevitably they undercut the economics and cultures of the people who used those plants and animals to produce food, clothing and shelter. When they exterminated buffalo, diverted streams, and planted or grazed holy grounds, they were subverting different ways of understanding and ordering the world (White 1991: 212).

* The American West has been defined by a number of historians of the U.S. West (Flores 2001; Limerick 1987; White 1991; Worster 1991) and was a term that developed as Europeans in the United States expanded westward. In spite of all the definitions, explanations, and colored maps, the West is probably best laid out by Dixon (2014:181) who defines it as, “the geographical area situated west of the 98th meridian in North America, and including the Great Plains, the Rocky Mountains, the Great Basin, the desert Southwest (Sonoran, Mojave, and Chihuahua Deserts), the Pacific Coast,
the temperate rainforests of the Pacific Northwest, Alaska, and technically, according to definitions of the U.S. West, Hawai‘i.”

How are measurements of environmental and landscape changes calculated, and how can researchers distinguish changes in ecosystems influenced by humans verses the cycle of natural changes? Cronon (1983:10) explains that in order to recognize human caused ecological changes, we must first determine ecological changes upon a place not impacted by humans; however, I would argue that such a place does not exist today.

The goal of this thesis is to address the question above by integrating various sources of historical ecological resources to present some of the specific environmental transformations that took place in the Missoula Valley during the 19th and 20th centuries. Focusing on this specific time span does not imply that the time period discussed in this paper is more important than any other moment in the history of the Missoula Valley; that is surely not the case. However, for this comparatively small window of time, GLO records and sources of TEK illuminate the valley’s historical ecology and influences of differing cultural agendas. The interdisciplinary nature of this thesis takes into account that records pertaining to the history of the Missoula Valley are in some cases fragmentary, so multiple sources from a number of academic fields are brought together to develop a more comprehensive landscape biography for the Missoula Valley. Historian Richard White states that, “techniques for recovering information on previous landscape conditions, which include dendrochronology, pollen studies, repeat photography, GIS mapping and numerous techniques are being developed almost constantly,” noting that this construction of evidence is critical to a methodological tool kit for historical landscape reconstructions (White 1997:95). He also explains that the use of interdisciplinary methods in the construction of environmental
histories can become very complex because this methodology requires constant attention in, “what you are doing and what those in the fields you plunder are doing” (White 1997:87).

As settlers moved into regions of the American West, the federal government began to assess and document landscape resources, creating the General Land Office (GLO) in 1812 to oversee national surveys of public lands to be sold to settlers (Galatowitsch 1990:181). Land surveys conducted in the central and western portions of the United States heavily influenced the character of the American landscape (Safford 2005; Shelly 2012). Land surveys for the state of Montana began in 1867 (Habeck 1994; Shelly 2012:9) and provided detailed descriptions of vegetation, landscape, and cultural features, as well as explicit inventories of natural resources (Hickman and Christy 2011:7). Historic GLO records were originally collected as a way to document and facilitate the sale of public lands into private ownership (Shelly 2012; White 1991:138). These records are used in numerous historic landscape reconstruction projects (see GLO section in this chapter 3) throughout the United States and British Columbia to identify historic landscapes conditions, vegetation patterns, tree type and density analysis, soil conditions, and cultural impacts of land use. Such sources have the potential to build an “interpretive bridge across multiple disciplines and can be used as a way to understand rapid natural and cultural changes that took place in the past (Dixon 2014:189), and to better understand the effects of human adaptive practices on the landscapes of this region.

In an attempt to understand environmental transformations that took place in the Missoula Valley during the 19th and 20th centuries, I began this project questioning how historical documents could be used to represent and measure such changes prior to and after the relatively recent urban settlement of the Missoula Valley. Could the rates of landscape and environmental change be
measured, and if so, how? I also wanted to test the accuracy of GLO records in order to determine their efficacy as a primary source for assessing historical landscape conditions. In addition to this, I intend to contribute to advances in the analysis of archaeological landscapes by using this thesis as a 21st century model of landscape archaeology dedicated to a better understanding of the spatial, temporal, ecological, and, cognitive factors through which people creatively interact with their environments.

Significant historical and archaeological research has been conducted in the American West focusing on landscape and cultural changes that took place during the inflow of Europeans into the western United States (Cronon 1991; Dixon 2014; Flores 2001; Hardesty 1985, 2003, 2010; Limerick 2000, 1987; White 1991; Worster 1988, 1992, and 1994). Europeans and American Indian groups held very different cultural views about land use practices and the use of natural resources. Adaptive choices made by Europeans caused dramatic landscape changes that affected the people, animals, plants, and natural resources of the region (cf. Anschuetz et al. 2001, Church 2002:223, Dixon 2014:189). An example of this can be heard in stories told by Salish and Pend d’Oreille about the old days when tribes of western Montana lived solely as hunter-gathers, sustaining themselves without agricultural practices for millennia. Pend d’Oreille elder Mitch Smallsalmon explains that the success of the tribes in Montana are attributed to the plentiful water and resources that came from the water (Thompson 2010:5).

Over the past 30 years, historical archaeologists have continued to explore environmental impacts brought on through the processes of colonization, urbanization, and industrialization. These ecological and biological dimensions, Mrozowski (2006:35) explains, are inseparable from
the cultural forces that continue to shape landscapes and perceptions about sustainable decision-making into the future. As explained by geographer Carl O. Sauer, cultural landscapes are fashioned from a natural landscape by a cultural group. Culture is the agent, the natural area is the medium, the cultural landscape is the result... under the influence of a given culture, itself changing through time, the landscape undergoes development, passing through phases, and probably reaching ultimately the end of its cycle of development. With the introduction of a different culture, a rejuvenation of the cultural landscape sets in, or a new landscape is superimposed on the remnants of an older one” (Sauer 1925:46).

Sauer has dedicated much of his work looking at the interrelatedness of human cultures to the land, and ways of life. The work of Sauer and others discussed in the next section provide examples of writings focused on human processes of adaptation during the early colonization of the West.

**Conclusion and Chapter Summary**

Chapter 1 of this thesis has provided an introduction and summary to this project. Chapter 2 presents an overview of published research that is relevant to this project and the theoretical influences of this research. Chapter 3 provides an environmental and historical background of the Missoula Valley, spanning from the time period of Glacial Lake Missoula and on up to the early 20th century. Information acquired from explorer journals and Indigenous sources are examined and used to present evidence of past landscape conditions in the Missoula Valley. The last section of this chapter outlines the history of GLO research conducted in the Missoula Valley in the nearby Bitterroot Valley.

A big part of this project required transcribing historical records from 1870 GLO surveys to be mapped onto ArcGIS; Chapter 4 looks at the various methods used in this process, and the
different data sources used to create these maps. In addition to GLO information, this chapter also looks at the process of soil samples collected for pollen analysis at the Fort Missoula Historic Dump (24MO0188). The use of information on archaeological site forms and their contribution to vegetation data in the Missoula Valley are also examined in the chapter. The last section of this chapter talks about the use of historical photos as a method of landscape analysis. As part of this project, four historic photos were compared with modern photos in an effort to help assess changes in the Missoula Valley.

Chapter 5 contains the results of this research and examines all township maps created from collected historical, TEK, and modern environmental information. In addition to township maps, this chapter also discusses pollen data results for the Fort Missoula Historic Dump Site (24MO0188). Four historic photos of the Missoula Valley are also examined in this chapter and are compared with similar modern images providing further data to be used in the discussion of landscape changes in the Missoula Valley. Chapter 6 includes a discussion and conclusions regarding the outcome of historic vegetation compared to modern land cover data today. This chapter also poses areas for future studies of landscape changes in the Missoula Valley.
Chapter 2: Literature Review

This chapter presents an overview of research that influences this thesis, with an emphasis on adaptation in the North American West. The first section below discusses the emergence of environmental histories and observations of evolving environmental conditions from the mid to late 19th century. Iconic presentations of the region (e.g., Fredrick Jackson Turner, Walter Prescott Webb, and James Malin) some would say, paved the way for future research in literature examining changing environments in the American West and established precedents for environmental decision making. The second section presents directions of environmental historic research following the decades of Turner, Webb, and Malin, highlighting insights from scholars such as Carole Crumley, William Cronon, Dan Flores, Patricia Nelson Limerick, Richard White, and Donald Worster.

The third section outlines the theoretical influences of this thesis, examining the foundations of landscape archaeology theory and the ways in which it is applied to research relevant to human environmental interactions. The fourth section outlines archaeological research emphasizing human-environmental interactions. The fifth section presents an overview of additional studies that have used General Land Office (GLO) records as a source of historic vegetation information to reconstruct landscapes. For example, the use of historic GLO records by Joseph Marschner in 1929 laid the ground work for future researchers interested in recreating historical landscapes across the United States with digital cartography and Geographical Information Systems (GIS) representing modern platforms for assessing information from historic GLO records.
Finally, the sixth section presents Indigenous sources (e.g. TEK) relevant to cultural traditions and land use practices that took place prior to and during the arrival of European settlers in the region. When used as a baseline for comparison with the GLO evidence, TEK underscores how collective data relevant to relatively sudden environmental changes can aid in understanding the evolving relationships between humans with different approaches to utilizing land resources.

**Literature Review Section 1: Emergence of Environmental Histories of the American West**

The relationship between humans and their environment -- that of the pristine wilderness versus those altered by human influence-- has been of interest to Americans for centuries (Williams 1994:4). Over the past century, environmental history emerged as a discipline allowing researchers to pose new questions and re-open past debates on human-environmental relationships (Williams 1994:3) and their role in landscape changes.

Between 1890 and 1950 essays and books written by traditional western writers such as Fredrick Jackson Turner (1893, 1920), Walter Prescott Webb (1931, 1952), and James Malin (1967) addressed ideologies and observations of environmental and landscape changes occurring throughout the United States (Flores 2001:6-7). However, one thing remains constant in the first era of writings on perspectives of the West; stories of western movement and prosperity, authored by white men, usually portrayed Indigenous groups as “obstacles or barriers” preventing the progress of western expansion (Limerick 2000:19). Unfamiliar with both the history of American Indians and their deep connection to the land, Europeans saw the West as a wilderness untamed and unchanged by humans (White 1991:57). Until recently, stories written by Native individuals on
their history and about European explorers into the West did not exist. American Indians traditionally did not write their histories or creation stories down; this information instead was passed down orally from generation to generation. Over the past several decades, efforts to document stories and histories (from native perspectives) have helped add a Native voice to the history of North America (see Salish-Pend d’Oreille Cultural Committee, Elders Cultural Advisory Council, Confederated Salish and Kootenai Tribes, 2005). Yet other documents written or recorded by American Indians exist as grey literature, unpublished, or on file with government and state organizations unavailable to the general public, making this information harder to examine.

In 1893 Fredrick Jackson Turner presented ideas in his essay, “The Significance of the Frontier to American History,” using a Darwinian approach to argue that newly encountered environments (frontiers) initially transformed individuals who experienced them to develop new adaptive behaviors in their relationship to the landscape (Cronon 1987; Flores 2001:90). It was a process of Americanization in Turner’s eyes, and the “struggle” with the wilderness is what turned Europeans into Americans (Limerick 1987:20). In his essay/address, Turner concluded that by 1890, four centuries after the “discovery of America,” frontier lands in the West existed no more (Limerick 1987:21). This conclusion has been debated and critiqued by many over the years (e.g., Patricia Nelson Limerick 1987; George Wilson Pierson 1941; and George Rogers Taylor 1956). To some, Turner’s attempt to shoehorn characteristics of western American history within the concept of “frontiers” was problematic, among other things. Topics such as, exploration, fur trade, overland travel, farming, mining, establishment of towns, merchandizing, grazing, and logging involved diverse behaviors acted out by numerous individuals of different ethnicities, and genders; categorizing these activities as one was problematic (Limerick 1987:21). Even so, Turner’s work
remains the foundation not only for the history of the American West, but also for much of the rest of American history (Cronon 1987:160).

In the 1930s, western scholars began drawing their attention to processes of human adaptation that developed in the West and how these actions affected the landscape and people. In 1931 historian Walter Prescott Webb published his well-known work, *The Great Plains: A Study in Institutions and Environment* and became one of the first historians to address challenges of aridity within the American West (Flores 2001:147; Worster 1931). Life in the eastern United States was considerably different than life for Americans in the West, and Webb argued that the natural environment of the West created an “institutional fault line” requiring the development of new innovations such as barbed wire, windmills, colt revolvers, and sod houses. Arguing that aridity is a defining characteristic to the American West, Webb explored the environmental history of the Great Plains and its correlations between ecological realities and human adaptation (Flores 2001:91; Webb 1931). Adaptation was the key for the story of the West - and westward movement of agriculture was seen as a process of conquest and adaptation by Webb (Worster 1992:249). For the European settlers, social and ecological challenges of the West created complex problems that resulted in many conflicts over issues such as water use rights by both Natives Americans and Europeans, the use of public lands, boom/bust economies, local authority verses federal authority, and Indian land use (Limerick 2000:19).

After experiencing the Dust Bowl in the 1930s, James Malin witnessed first-hand the full force nature could inflict on cultural landscapes overused by agriculture (Worster1992:94). In the 1950s, Malin began to interpret history as a process of “ecological adaption” advocating the use of grasslands in the Great Plains to explore his theory (White 1985:297; Worster 1992:94). Malin
(1946, 1950) argued that consequences of the Dust Bowl were the results of nature and not at fault were settlers of the Great Plains (also see Worster 1992:96); later Malin came to realize that the winds in this region were not entirely to blame. Historian Donald Worster (1979, 1992) argued that generations of aggressive entrepreneurs caught up in values of American agricultural capitalism prior to the Dust Bowl were inevitably to blame for this disaster; it was the nature of the beast -- the nature of capitalism--that caused the Dust Bowl (Worster 1992:101). The social and ecological landscape of the West underwent rapid changes as European settlers began to transform unfamiliar lands into places familiar to their own homelands (White 1991:181). Similar to colonized lands in eastern North America, Europeans moving into the West attempted to grasp control over the landscape. In regions such as the Great Plains, early settlers lacked knowledge of the vast grasslands and agricultural practices soon began to replace native (drought resistant) vegetation with crops adapted to more well-watered environments (such as wheat, oats, corn, and hay crop for livestock).

Aridity was a huge challenge to settlers, so much so that even attempts made by Congress to change the arid lands failed in the mid-19th century (see White 1991:150). One of the main requirements of an agricultural economy amid the West’s arid lands was the construction of irrigation ditches to convey water from streams and rivers to agricultural lands. For places such as Montana, storage and the diversion of water proved costly due to the far distances needed to redirect the water (Howard 1983:253). Although Montana holds two of the largest rivers in the United States (Missouri and the Columbia), water sources often become inadequate during the hot dry summer months (Howard 1983:252).
In the 1950s, and 1960s, modern environmental history began to emerge as a recognized field of study. This field offered stimulating research for environmentalism as a socio-political movement and for intellectual ideas about nature and specific environmental events of historical importance (Crumley 1994:4; Flores 2001:105; Williams 1994:3; Worster 1991:8). Some of the earliest of these environmental histories in the United States focused on relationships between frontier and wilderness to American culture and politics, including such topics as: the Dust Bowl; the development and impact of irrigated lands in the West; the creation of national parks; the relationship between environmentalism and scientific ecology; and the emergence of governmental regulation on environmentally sensitive activities (Winterhalder 1993:21). And yet other studies presented narratives of reciprocal relationships between culture and nature, projecting several dominant themes that included: European expansion and colonization of the New World (by people, weeds, animals, and disease); the expansion of market capitalism; and the expansion of science as a disciplined basis for pursuing mastery over nature (Winterhalder 1994:21). By the 1960s and 1970s growing awareness of environmental issues around the globe had cultivated “a worldwide cultural reassessment and reform” by environmentalist movements (Worster 1988:290).

Works to come out of this time period include Hayes (1959), Nash (1967), and regional histories in places such as Jasper, Canada. In 1969 John C. Bennett presented his work *Northern Plainsmen: Adaptive Strategies and Agrarian Life* that explores the adaptive processes and strategies exercised by four principal ethnic groups of Jasper—Cree Indians, the Hutterites, ranchers, and farmers. Bennett’s study examined changes that took place in this region beginning with the early nomadic Plains Cree tribes and continuing through the transition that took place as Euro-Americans began settling into the area during the late 18th century (Bennett 1969:11). Instead
of focusing solely on the social organization and patterns of the community around natural
resources, Bennett also explores the adaptive strategies used by individuals to cope with problems
created by their efforts to use resources productively (Bennett 1969).

Literature Review Section 2: New Directions in the Analysis of “Western” Environmental Histories

During environmental movements of the 1960s and 1970s, scholarly interest in environmental history expanded (Worster 1988:290). It became clear that questions could not be answered by one discipline alone; in turn this fostered interdisciplinary approaches that helped to establish a better understanding for evolving relationship between humans and the natural world (Worster 1988).

One cannot discuss influential authors in the field of environmental history during this period without mentioning the work of Donald Worster. Much of Worster’s work has focused on environmental history in the American West, and like other fellow historians, his research reflects experiences of his personal life. Worster is most recognized for his book, Dust Bowl, published in 1979 and considered one of the best examples of place-based environmental history (Flores 2001:99) [also see John W. Bennett Northern Plainsmen (1969), Richard White’s Roots of Dependency (1983), and William Cronon’s Natures Metropolis (1991)].

In his book, Worster presents the Dust Bowl as direct effects of capitalist systems operating in a fragile environment (Flores 2001:99 &127). Worster (1988:15) states that during the 19th century, the conversion of grasslands and forests into agricultural lands (for both crops and livestock grazing) dramatically altered the environment. For early settlers in the West,
environmental challenges made farming, livestock grazing, and the establishment of urban areas more difficult in comparison to the northern and southern sections of the United States (Worster 1992:36). Issues of aridity in the West became one of the greatest challenges for European settlers, and a mixture of overgrazing, plowing and a lack of rainfall only worsened their situation. For Worster, the West was seen as an unstable region that endured continuous changes reacting not only to the forces of nature, but to the forces of cultural as well (Worster 1988: xi).

A number of other historians have been recognized for their contributions toward understanding human-environmental relationships and for helping to assess the future of human obligations to the land. Dan Flores (1990, 1999, 2001) demonstrates this trend with cases highlighting regions in the American Southwest and American West in general: (see Caprock Canyonlands: Journey to into the Heart of the Southern Plains (1990), Horizontal Yellow: Nature and History in the Near Southwest (1999); and The Natural West (2001). Essays in The Natural West examine regional histories focusing on the roles humans have played in manipulating the landscape (i.e. fire, colonization, hunting, and agriculture to name a few) and how these human-environmental behaviors have formed over time. Regional histories told about the West contribute to the broader history of the region and presenting a regional history of the Missoula Valley is a goal of this thesis.

Environmental historian William Cronon has set the bar for writing histories of human-environmental relationships and understanding the ways in which human dependence on ecosystems sustains human populations (Cronon 1983, 1991, 1993, and 1996). Cronon’s examination of the past continues to underscore how history is constructed by people, a topic he recently presented (Cronon 2014) for his upcoming book, Portage, which presents stories of
selected individuals from the town of Portage, Wisconsin. His interests in this project lie specifically in how a sense of place is shaped by individuals and through the stories they tell about their homes, lives, and the landscapes they construct. This tactic of construing a deeper understanding the ways in which humans create a sense of place on the landscape is also shared by archaeologist Carole Crumley (1994:7), who explains that, “The memories and opinions living people have about their region are a rich and relatively untapped resource in contemporary environmental impact studies.” When looking at the small or large scale history of a town, Cronon has observed that history survives as fragmented information, and the process of writing environmental history requires recreating and telling history from human perspectives, as well as information acquired from the environment; thus, there are large human and nature systems, as well as the geographic history of a place, that needs to be considered when researching and creating environmental histories (Cronon 2014).

Interpretation of place based histories and stories can also be gleaned from sources of Traditional Ecological Knowledge (TEK). Place-based knowledge held by Native groups provides the foundation of history imperative to creating environmental histories for any place in the world. For North American Indigenous populations, creation stories and place names are intertwined with site specific, landscape based environmental information. Creation stories provide information about traditional ways of hunting and fishing, discuss traditional places and importance of plant collecting for food and medicinal purposes, and outline how tools and weapons were made and used. These stories also include information regarding proper ways of raising children, relationships between men and women, relationships between and with other tribes, spiritual dimensions of the world, and human relationships between plants and animals among other things
Information derived from creation stories offers another perspective of environmental and cultural history and reflects the intimate relationships Indigenous groups had with the environment. Including insights from TEK is essential to future human-environmental research in the American West.

The multidisciplinary approach to documenting changes occurring in the Missoula Valley during the early 19th and 20th centuries provides not only an environmental archaeological approach to this research, but also turns to approaches in cultural ecology, historical ecology, and TEK to provide a deeper evolutionary understanding of this area and early occupants of the valley. Before the 1940s, ecology was seen by biologists as separate from the realm of human culture and unrelated to processes of the natural world (Hardesty and Fowler 2001:74). Steward (1955) argued that the complex, culturally driven behaviors of humans were continually impacting the natural world (Hardesty and Fowler 2001:74).

More recently, research conducted by ecologist Nancy Grimm recognizes the importance of interdisciplinary research by studying the long term ecological processes taking place within urban ecological systems. Approaches to understanding and evaluating processes of human-environmental interactions over time were outlined in Grimm et al. (2000), the study of Long-Term Ecological Research (LTER) in two metropolitan cities --Phoenix, Arizona and Baltimore, Maryland. As a part of this study, Grimm and colleagues argue that in order to understand the impacts of human actions on ecosystems, it is necessary to use approaches developed in social, behavioral, and economic sciences, and explains that, “There is a need to incorporate interdisciplinary research in an effort to combine and agree on methodology and measurements of
ecological and social data across scales of time and space” (Grimm et al. 2000:139). Such approaches are also advocated in the work of Crumley (1994), Flores (2001), Rockman (2012), and Hardesty (2007).

As stated by Grimm (2004:202), existing data collected by agencies for urban areas such as Phoenix are numerous and are documented in great detail; however, these records are “not under an ecological paradigm,” which requires tedious time to be spent putting data into a format compatible for analysis (Grimm and Redman 2004:202). An underlying factor for interdisciplinary research is the issue of converting data into usable information across disciplines and perhaps through these processes of data conversion, our understanding of usable but “foreign” data is helpful in ways of understanding another method in data collection within another discipline. A case in point for the transcription and interpretations of historic land and environmental data was found within GLO records for the Missoula Valley. Thus this project has the potential to contribute a model that can help alleviate problems associated with diverse datasets.

Considered one of creators of “New Western History” (see Dixon 2014: 178; Limerick 2000:16; Moos 2005), Patricia Nelson Limerick’s work on histories of the American West has contributed greatly to new and often unfathomed realities experienced by individuals living in the West. In her book, The Legacy of the West, Limerick’s work not only debunks Turner’s ideologies, but also explores the ways in which “white Americans” saw and felt about the West to focus more closely on the “inner cultural history” (Limerick 1987: 35; Worster 1992:231). Limerick’s works, as well as the work of Richard White, have fostered new ways of studying the West and a nation’s dependency on economic industries (Moos 2005:8).
Literature Review Section 3: Landscape Archaeology

As a theoretical frame, sources of TEK, western environmental history, and GLO documents contain important information used to interpret the data sources assessed with this project. Collectively, these provide the foundations for this research. However, it is essential to interpret the findings. I have chosen landscape theory as the lens for explaining and understanding environmental changes in the Missoula Valley.

Archaeology, among other disciplines, plays a critical role in the reconstruction and understanding of past landscapes, ecosystems, and the impact human populations have had on them. It is no secret that humans, over time, have contributed to dramatic changes in landscapes by means of adaptation and resource consumption. Now more than ever archaeologists are becoming interested in a deeper meaning of landscape and how it has been “lived in” and interpreted by people over time. In some regions of the world, new methodologies have moved archaeological field work away from large scale field excavations as a means of research and towards less invasive approaches (Lucas 2001).

Over the last few decades archaeologists, along with other researchers, have developed theoretical approaches to better understand the formations of landscape and its relationship to time and space, both in the past and present. Theoretical approaches to the landscape have also served other disciplines such as geography, environmental studies, cultural ecology, historical ecological, art, and architecture (Foucault 1986; Ashmore and Knapp 1999; Johnson 1999). Landscape theory is an interdisciplinary theoretical approach that allows for the holistic interpretation of archaeological cultural and physical landscapes, fusing multiple disciplines, theories, and scientific methodologies.
Foundations of Landscape Theory

The development of landscape archaeology dates to the 1920s when archaeological approaches provided a backdrop against which cultural material traces were plotted and evaluated (Anschuetz et al. 2001). Theoretical landscape approaches have primarily come out of the geographical studies of the early twentieth century (Anschuetz et al. 2001; Fleming 1998). In 1850 German geographer and explorer, Alexander von Humboldt, was the first to state that nature was a vast landscape that required objective and subjective analytical frameworks. Humboldt’s concept of landscape has held fast; Eric Hirsch built upon this observation 145 years later, further developing these two related ways of understanding and viewing landscape (Fleming 1998).

According to Hirsch, the objective view is, “the presence of a person within a defined area,” and the subjective view is defined as, “how individuals interact with, perceive or understand their culture and physical environment” (Hirsch 1995:8). Both Hirsch and von Humboldt agree, the “feelings of mankind are reflected in the landscape” (Fleming 1998; Hirsch 1995). Multiple meanings and interpretation over time have been used to define the term landscape, including, “the topographic and landforms of a given religion, or a terrain where people dwell, or a fragment of the land which can be overseen from a single vantage point (Olwig 1993:307; Ingold 1997:29; Thomas 2001:166).

In 1925 Carl Sauer, an American geographer, defined “cultural” landscape as being a natural landscape modified by cultural groups (Sauer 1925; Ashmore and Knapp 1999; Fleming 1998). His concept of landscape acknowledged the roles of institutional frameworks in the shaping of societies, and he argued that the agency of culture operated as a driving force in visibly shaping features onto surface regions of the earth (Thomas 2001:16). The term agency refers to the strategies of an individual, looking at what a person actually does and not at what they have the
capacity to do (Johnson 1999:104; O’Brien et al. 2005:250). This was an approach that was supported by post processualists and borrowed from Anthony Gidden’s ideas of “a recursive relationship between structure and agency” (Johnson 1999:104).

Friedrich Ratzel, German geographer and ethnographer, along with Émile Durkheim, a French sociologist (Hirsch 1995), were also contributors to the foundations of landscape studies. They looked at how human cultures were positioned across space and how they separated themselves within natural environments (Ratzel 1896; Thomas 2001:170). This was an environmental determinist approach, which Sauer did not fully support (Hirsch 1995). Such an approach, like that employed by Ratzel and Durkheim, has its foundations in the theory that culture is determined by the physical environment in which it develops (Credo 2010) (also see Julian Steward 1937). Sauer took the opposing view of landscape and culture, arguing in his 1963 monograph that culture was the tool that shaped and produced the cultural landscape, stating, “Culture is the agent, the natural area is the medium, the cultural landscape is the result” (Sauer 1963:343).

During the early twentieth century, geographers and archaeologists began utilizing distribution maps and using them to locate and document cultural phenomena in space. This allowed researchers to form explanations of site distribution in terms of geographical features (Anschuetz et al. 2001). Regional settlement pattern research subsequently emerged in archaeological studies during the 1940s and 1950s. An example of this is work was conducted by Gordon Wiley in the Viru Valley; Wiley’s research represented a turning point in archaeological field work through his efforts to move questions of space beyond the scale of the site to understand how settlement patterns were arranged over a landscape (Anschuetz et al. 2001; Wiley 1953).
Along with Wiley, supporters of the settlement pattern approach to archaeology were J. Desmond Clark and Julian Steward. Their ecological approach to landscape viewed how cultural groups organized themselves to live off the natural resources in any given environment (Anschuetz et al. 2001; Clark 1939; Hardesty 2001; Steward 1937, 1955). Steward was interested in human adaptation to environmental conditions. Through his research, he predicted that human populations residing in comparable environments will adapt in similar ways (Steward 1955; Hardesty and Fowler 2001). His theoretical viewpoint was that the culturally determined behaviors of people interacted in a symbiotic and complex manner with the natural environment and that the two could not be separated. Steward saw the landscape as being pristine before humans and that the natural world is indeed a cultural construct and cannot exist absent of the human culture that defines it (Steward 1955).

These approaches provided a platform for the “New Archaeology” era that gained popularity in the 1960s and 1970s, and exemplified by the work of Lewis Binford, Kent Flannery and David Clark (Binford 1962, 1964; Clark 1968; Flannery 1976; Johnson 2007). The term “New Archaeology” was developed in the 1960s and it referred to a school of thought that was developed by a group of archaeologists displeased with how traditional archaeological research was being performed. The goal of this new archaeological method was to study cultural processes of the past and work to develop contributing thoughts to anthropological theory (Johnson 1999:20). Defenders of the new archaeology concept, such as Binford, argued that archaeological work needed to be more scientific in nature (Binford 1962, 1964; Johnson 2007).

Binford aimed to systematize settlement patterns by emphasizing the importance of variation within sites and between sites (Binford 1964). Using aspects of general systems theory, which worked to explain human interactions and how they played out over a landscape, Binford
and other archaeologists began to interpret how natural and cultural variables conditioned structural changes in settlement patterns (Anschuetz et al. 2001; Johnson 1999; O’Brien et al. 2005). General systems theory played an important role in the development of the “New Archaeology” era; this approach provides a way to apply scientific methods to archaeological data (O’Brien et al. 2005).

Inspired by the work of Ludwig von Bertalanffy, general systems theorists study a variety of systems within different disciplines, in order to develop an abstract empirical theory that can be applied to any physical or social system (Salmon 1978). Johnson (2007: 61) states that, “concepts of new archaeology viewed space as an abstract dimension where human activities and events in space took place, acting separately from one another and only semi-related”.

Much of today’s theoretical work in landscape archaeology can be understood through the research conducted by historical archaeologist, Donald Hardesty. For Hardesty, methods of landscape analysis are seen in the archaeological record of the modern world “through the actions and consequences of biological, social, and technological forces that transformed human lifestyles and environments” (Hardesty 2000:81). His approach to landscape archaeology addresses how archaeological studies can contribute and be applied to contemporary environmental issues, like the restoration of historic mining sites (Hardesty and Fowler 2001). Using environmental archaeological approaches, Hardesty proposes that research can move beyond common boundaries and focus on writing landscape histories (what he refers to as “ecohistories”), to incorporate various scales and time depths to investigate past environmental changes (Hardesty and Fowler 2001; Hardesty 2007).

Principals of Landscape Theory

The general assumptions of landscape theory vary somewhat depending on the discipline. For an archaeological approach, the underlying goal is to understand and address the issue of
landscape as a cultural phenomenon (Thomas 2001). Approaches in landscape theory try to provide a basis for considering the history of the ‘people’ which then contributes to variations that are observed in the archaeological record (Trigger 1991). In his 1999 article, “The Temporality of the Landscape”, Tim Ingold argues that, “human life is a process that involves the passage of time…..this life process is also the process of formation of the landscapes in which people have lived” (Ingold 1993:152). For Ingold, a landscape approach to archaeology drew from the idea that people’s culture derived from their relations with the world (Ingold 1993). He stated that, “Landscape is the world as it is known to those who dwell therein, who inhabit its places and journey along the paths connecting them” (Ingold, 1993:156). This approach to landscape is similar to the earlier work of Ratzel and Durkheim, taking an environmentally deterministic view of the landscape in that it shapes and creates the paths upon which culture is shaped.

Social anthropologist Eric Hirsch explains that, as humans, we see the landscape in two ways: 1) there is a landscape that we initially see; and 2) a landscape that is produced through local practices, and with this, we come to understand these concepts through fieldwork, ethnographic description, and interpretations (Hirsch 1995:5). Hirsch (1995) concluded that landscapes require a relationship between the foreground and background of social life. He argued that, “Western conventions of landscape representation are a particular expression of a more general foreground/background relationship that is found cross- culturally” (Hirsch 1995:7). The relationships between place and space are dependent on cultural and historical context (Hirsch and O’Hanlon 1995).

The new archaeology of the 1960s helped American archaeologists recognize that anthropogenic modifications to landscapes involved more than physical modifications of environmental processes; they also incorporated patterns linked to social and ideological
dimensions (Anschuetz et al. 2001; Deetz 1990). A landscape theoretical approach to archaeology addresses research methods at a regional level, which helps to incorporate geomorphological and actualistic studies into concepts, methods and theory (Rossingnol 1992). To better understand the organization of social and economic factors of the past, Rossingnol incorporated specific models to investigate land use through a landscape perspective, explaining that, “our landscape perspective embodies the view that the distribution of the archaeological artifacts and features relative to elements of landscape provide insight into social and economic organizations of the past” (Rossingnol 1992:4). Goals of her research were aimed at drawing out the multiple dimensions found in human land use strategies.

In the introduction to *Archaeologies of Landscapes*, Ashmore and Knapp note that concepts and interpretations of a landscape and space are hard to define because landscapes are “unstable” concepts that are interpreted differently from person to person (Ashmore and Knapp 1999). Seeing this as a common problem to landscape approaches, they develop three “interpretive descriptors” for understanding landscape meanings. Building off the UNESCO World Heritage criteria for cultural landscapes, Ashmore and Knapp present the following ways of categorizing landscapes:

- **Constructed landscapes** – landscapes that in some way have been visibly altered by humans.
- **Conceptualized landscapes**– landscapes that have powerful religious, artistic or other cultural meanings invested in natural features; and
- **Ideational landscapes**– landscapes that are both imaginative (in the sense of being a mental image of something) and emotional (in the sense of cultivating or electing some spiritual value or ideal). They may provide moral messages, recount mythical histories, record
genealogies or embrace scared meaning. The term also implies that an insider’s perspective is essential – even though archaeologists impose ideational notions as outside observers.

*Landscape Theory Applied Today*

Methodological approaches to archaeological interpretation have significantly changed over the past century. Advances in the quantity and quality of data documenting global environmental change have enabled researchers to analyze world environments at a whole new level. Global Climate Models (GCMs), fine-resolution remotely sensed data, and Geographic Information Systems (GIS) programs such as ArcGIS are among the current, “modern” methods used to illustrate spatial and temporal environmental changes (Crumley 1994:1). The use of historical documents can also contribute to analytical comparisons of landscape characteristics that can be used to support scientific data and vice versa. Historical ecology (used interchangeably with landscape history) is defined as “the study of past ecosystems by charting changes in landscapes over time” (Crumley 1994:6). Crumley’s research along with others alike play an important role in shaping public policy by providing knowledge of local and regional histories (also see Fisher et al. 2009; Hardesty 2007; Redman et al. 2004; and Rockman 2012).

As mentioned in the previous section, the work of Donald Hardesty has been influential in terms of applying archaeological contributions to sustainability issues and global change (Hardesty 2007). Global change archaeology emerged in the 1960s and 1970s out of ecological anthropology and environmental archaeology and during the 1990s began to evolve towards historical and political ecologies (Balee 2002; Crumley 1994; Hardesty 2007). Through this approach, Hardesty (2007) looks at the historical evolution of landscapes through processes, patterns and structures of human behavior and not just at the individual sites and their features.
Notable, as well, in the subject of landscape archaeology is National Park Service archaeologist Marcy Rockman. A large part of her work addresses environmental impacts of human behaviors and ways in which archaeology can support questions related to human vulnerability and risk in correlation to climate change (Rockman 2003, 2010, 2012). Concerned with the greenhouse gases produced by human activities, Rockman’s efforts have been focused on developing archaeological research that will answer the following questions: 1) through mitigation and adaptation changes, can aspects in human behavioral patterns be changed?; 2) how does the scope, rate, and persistence of individual and group behavioral change in response to information and changes in environmental circumstances?; and 3) how will these processes work within a time frame entailed by the current climate change situation? (Rockman 2003:194).

Landscape theory allows us to address the dichotomy and connectivity of natural and cultural environments, drawing the physical and intangible together to present a holistic picture of how people interacted with the land. It lets us formulate conclusions on the influences physical landscape had on cultures and the adaptive strategies played out by cultures on the landscape. A critique to the landscape approach is that no matter how much research is conducted, it will never be possible to completely analyze the meaning of place in the context and perception of others’ views or in the content of the past (Binford 1981). Cosgrove (1984:17) also made this point by stating that landscapes hold meanings that cannot be interpreted by science and therefore cannot be reduced to formal processes.

As a part of this thesis, landscape theory provides a lens from which to interpret human-environmental relationships in the Missoula Valley during the 19th and early 20th centuries. This theoretical framework helps to connect the relationships between nature and culture and compliments the directions of western environmental history while providing a platform for TEK’s
contributions. With this as a “higher level” theoretical scaffolding, the model of environmental reconstruction presented herein has the potential to demonstrate as Cronon (2014) states, how people have placed meaning onto the landscape.

Today, much like the conservation and preservation movements of the 1960s and 1970s, issues in environmental change continue to push research and policy makers for answers, which places a sobering light on the “meaning” of people and places. Hardesty (2007) discusses how the historical knowledge of past human-environmental interactions can be used as a tool for sustainable land management practices (Hardesty 2007:1). For example, Rockman’s archaeological “landscape learning model” demonstrates how “human individuals and groups gather, share and use environmental information” and pass this knowledge on to others (Rockman 2010:4), and such archaeological evidence provides a systematic collection of information relevant to climate change studies – specifically through the ability to identify social changes that have occurred in the context of measurable climate change, the capacity of past environments, and the effects of humans on those environments.

**Literature Review Section 4: General Land Office Records**

According to the Bureau of Land Management, the 1785 Land Ordinance Act prevented the legal sale and settlement of public lands until land surveys were accepted by the United States government. From 1793 through 1823, the United States grew and expanded westward; meanwhile, surveyors gathering data about this vast landscape ahead of the settlers, documented cartographic features, cultural, historical, and environmental information in their field notes and maps (BLM 2012). In 1812 the General Land Office (GLO) was formed to oversee national surveys. The purpose of land surveys was to facilitate the distribution of public lands, converting them into
private lands (Shelly 2012). The surveyed lands were to be partitioned into townships of thirty-six square miles that included one-mile-square sections (Galatowitch 1990:182). The GLO notes are landscape descriptions for each township surveyed. As part of this process, surveyor notes described historic information such as tree species, landforms, streams and wetlands, and much more. Trees that were marked and recorded at the section corners were referred to as bearing trees or witness trees. After the completion of a township section, surveyors noted the terrain, soil, vegetation, timber, and any unusual features (Nelson et al. 1988). Survey notes served as important historic references and can be used in conjunction with other historical records such as photographs, journals, and diaries to provide historical information post-European settlement (Galatowitsch 1990).

During the 19th century, surveying and mapping of lands played a significant role in shaping the American West (Safford 2005). Through laws and regulations put in place by federal authorities, white settlers were able to easily acquire legal land titles (Safford 2005; Shelly 2012). The GLO survey notes offer detailed documentation of landscape features as well as explicit inventories of natural resources (Hickman and Christy 2011:7) as they appeared in the late 19th century. Scholars have used these records to develop historic baseline data and vegetation community compositions throughout the midwestern and western United States (Bourdo 1956; Habeck 1994); and in the Pacific Northwest (Buckley 1992; Habeck 1961; and Christy 2011; Shelly 2012).

Over the last several decades, researchers in the fields of ecology, archaeology, geography, history, and forestry (to name a few) have begun to use historic General Land Office (GLO) records as a source for reconstructing landscape conditions at the onset of European colonization of
the United States. Methods of using historic land office records were first laid out by Francis J. Marschner in 1929 and were completed for the state of Minnesota (Brady 2003). Once completed, Marschner’s map illustrated historic vegetation and ecological conditions for Minnesota from 1847-1907 (Brady 2003:22). Details from this map later served as an important resource for ecologists, foresters, natural resource managers, historians, and landscape architects (Brady 2003). In 1966 Marschner passed away, leaving behind no details on his methods for the map’s construction, but this did not stop other individuals from applying his ideas toward similar work in other states across North America.

Numerous studies have been conducted over the years using historic GLO survey notes, and although these notes were initially created for sectioning land into private ownership, these maps and journals are also used to interpret historic landscapes, vegetation patterns, soil conditions, and cultural impacts (Shelly 2012:1). One study using GLO notes comes out of the Pacific Northwest, where historic journals were used in mapping 19th century vegetation in the Willamette Valley in Oregon through various projects from 1960-1994. One of the studies conducted was in 1961 when James Habeck used historic GLO notes to map historic vegetation in central Willamette Valley. Habeck’s work was later followed by Johannessen et al. (1971), Towel (1974, 1982), and Bowen (1978), who used GLO plat maps to map various townships in the Valley (Christy and Alverson 2011:94). Several other individuals have conducted GLO research in the area, including Boag (1992), Sedell and Froggatt (1984), Alverson (1993), Shively (1993), Day (2005), and Benner and Sedell (1997) (Christy and Alverson 2011:94). In 1994, wetlands ecologist John Christy and Edward Alverson of the Nature Conservancy transcribed 202 township sections in the Willamette Valley. As part of this project, Christy and Alverson classified vegetation based on descriptions
given by GLO surveyors. Historic vegetation for the entire state of Oregon is completed and is currently available through the Portland State University website (see http://www.pdx.edu/pnwlamp/glo-historical-vegetation-maps-for-oregon-0). Transcriptions of GLO records for the Willamette Valley reflect influences of topography, geomorphology, climate, and millennia of Native American land management practices in the area (Christy and Alverson 2011:103).

Eric Bourdo (1956) used GLO survey notes as a reference to collect quantitative data on historic forests in four areas located on the Upper Peninsula of Michigan (Bourdo 1990:754). Focusing primarily on methods of recorded tree data and tree diameters, Bourdo concluded that surveyor bias was common in the records. But despite possible inconsistencies in data collection, GLO notes still provided vegetation information of areas surveyed (Bourdo 1990:767). More recently in Michigan, D. A. Albert and Patrick Comer used GLO records to map historic forests, wetlands, and grasslands for pre-settlement analysis. Comer and Albert identified 80 different land cover types using information documented by surveyors and using existing knowledge of Michigan’s native vegetation (Albert and Comer 2008; Comer et al. 1995).

For the state of Wisconsin, GLO survey records for the Walker River Basin were used as a source to interpret changes in vegetation communities that took place in and around agricultural areas between 1860-1910 and the present (Dilts et al. 2012:6). In this case, GLO records corroborated early descriptions of the Walker River Basin as a “fertile country meadow of wild grass along the river” (Dilts et al. 2012: 16; Willis 1913). Using information from GLO documents, Dilts was able to quantify the change in historical land cover over the past 150 years for the Walker River Basin by comparing direct and indirect impacts of irrigated agricultural areas (Dilts et al. 2012:6)
2012). Information from the historic survey records allowed Dilts and his team to examine long-term impacts of shifting vegetation conditions and the effects of irrigation on ecosystem composition and structure in the Walker River Basin.

Historic survey records have also been used for comparison of modern vegetation to examine local-scale variation in vegetation prior to European settlement of Vancouver Island, British Columbia, Canada (McCune et al. in press). By using historic survey records and pollen analysis, McCune tested whether changes in vegetation aligned with known vegetation changes based on land survey records from the mid-1800s and compared this information with vegetation changes prior to European settlement (McCune et al. in press).

Although a complete historic vegetation map of Montana has not been completed, a handful of researchers have used GLO records to construct historic conditions in part of the state. Habeck (1994) used GLO notes as one source of evidence to reconstruct pre-settlement ponderosa pine/douglas-fir stands in the Pattee Canyon area near Missoula (Habeck 1994; Rich 2011:3). Robert Rich collected data from GLO notes to recreate and compare historic tree stand conditions for the purpose of calculating Fuel Characteristics Classes (FCC) for stand conditions in 1902 and 2007 (see Rich 2011:6). In 2010, Karen Shelly conducted historic vegetation research for six township and ranges in the Bitterroot Valley in western Montana. By mapping the six Township and Range section lines using historical GLO records, Shelly compared historical and modern vegetation data. Her goal was to create a methodology using GLO records to produce historical vegetation maps and geographical data summaries that could be used to compare historic land cover within the Bitterroot Valley (Shelly 2012).
A number of other projects have been performed across North America, incorporating information from historic GLO survey records as a means of understanding historical landscapes prior to European settlements [see Rankin and Davis (1971), Schroeder (1981), Batek (1994), Anderson (1996), Nelson (1997), Radeloff et al. (1998, 1999), Batek et al. (1999), Langley (2004) Anderson and Baker (2005), and Williams and Baker (2012)]. Clearly GLO notes have tremendous data potential to discern specific information depending on the goals of the researcher (e.g., vegetation comparison, trees densities, test in accuracy of historic documents etc.). The complexity of landscapes documented by surveyors is a factor that can vary, affecting the amount of information modern researchers can gain from historic GLO notes.

**Literature Review Section 5: Traditional Ecological Knowledge (TEK)**

Recorded oral stories and histories told by the Blackfeet, Nez Perce, Pend d’Oreille, Salish, Kootenai, provide non SEK perspectives on the human-environmental histories of the Missoula Valley. Definitions of Traditional Ecological Knowledge (TEK) also referred to as Traditional Knowledge (TK) are numerous. For example, Huntington (2000) states that TEK is the knowledge and insight acquired through extensive observation of an area or a species. Houde (2000) defines TK as the connection of traditional knowledge to ecological processes and is built on factual observations and practical experiences. Berkes (2008) states that TEK is a body of culturally transmitted knowledge and beliefs about the relationship of living beings (including humans) with one another and with their environment. McGregor (2004) defines TK as a system of classification, a set of empirical observations about the local environment, and a system of self-management that governs resource use. Cajete (1994) states that TK is known within all four aspects of being: mind,
Several interpretations of TEK exist perhaps because ideologies of TEK connect varied dimensions of knowledge unique to the holder of this knowledge (Houde 2000:4).

Several benefits come out of incorporating TEK sources into Western scientific research. Huntington (2000) explains that TEK improves scientific research and management by providing information predating written histories. TEK is an elusive source that is often difficult to find because information like this was not traditionally written down (Huntington 2000:1270).

The oral histories and perspectives told by Indigenous groups are often overlooked as primary source material with relevant historical information for places throughout the American West. Early American Indians did not leave behind written records so many records that do exist were compiled and written by non-Native individuals (White 1997:91). In some cases, sources of TEK can be found in archaeological reports, grey literature existing in government offices, and in documents provided by tribal members who share knowledge about their culture. These sources often provide information on such things as trails and camp locations, medicinal uses of plants, location and information of resources, place name histories, and seasonal migration patterns.

Traditionally, over hundreds of generations, American Indians in western Montana developed special relationships with the environment through observation, experimentation, and spiritual interaction. Oral histories and Indigenous perspectives on landscape practices offer a non-western view of human-environmental relationships that existed long before European settlements came to the region. Even so, more often than not, SEK (archaeological and ecological) and sources written by Europeans (Lewis and Clark Journals, Granville Stewart, David Thompson, and numerous other explorers, fur traders and homesteaders) are used as lines of evidence for interpreting early histories of a region. These sources commonly leave out Indigenous perspectives. Although sources written by Europeans contain valuable historical information for the 19th and 20th
centuries, they are perspectives written by people generally unfamiliar with the region and tend to lack a spiritual and reciprocal connection to the landscape.

In 2004, William Tallbull presented a lecture on cultural ecology at Chief Dull Knife College in Lame Deer, Montana. Tallbull discussed the power of the environment and the role it plays in the life of the Northern Cheyenne people. For the Northern Cheyenne, two aspects of the environment exist: the physical and the spiritual. Tallbull explained that most westerners are only concerned about the physical environment and have no concern over the spiritual environment, noting that the spiritual environment is very complex and a very powerful part of life for the Cheyenne people and cannot be separated from the physical environment (Tallbull 1995:3).

American Indians in Montana successfully used plants as both medicinal and food sources, using traditional practices about regionally and sustainably harvesting plant methods which were developed over centuries of acquired experience and knowledge. Enrolled Blackfeet Tribal member Rosalyn LaPier, an environmental historian and herbalist at the University of Montana, has research interests in American Indian Activism and TEK. LaPier also has over twenty years of ethnobotany experience gained from her late grandmother Annie Mad Plume Wall; LaPier (2005:4) presents insights about her grandmother’s knowledge of native plants in Montana. Learning from her family, Annie Mad Plume Wall learned the proper times in the season to collect certain plants, how to process them, and how to identify plants by sight, smell, and texture (LaPier 2005:4). LaPier explains that historically, the Blackfeet had over 200 different uses for plants, they served as sources of food, medicine, and as useful materials in various objects need in daily life (LaPier, 2005:4).

Historically the Missoula Valley was used most often by Salish, Kootenai, and Pend d’Oreille tribes as well as by Nez Perce and Blackfeet. This valley not only served as a thoroughfare,
it was a place that provided numerous resources and a meeting place for tribes traveling to and from the plains during the buffalo hunting seasons. Practical experience and spiritual guidance provided American Indians with knowledge and an ultimate understanding of their landscape that could only be gained by living in a place for many generations (Smith 2010:18). The tribes of this region considered the rivers and specifically the fish to be one of the most valuable resources of this region. For the American Indians of western Montana the bull trout played a critical role in the native economy and culture, it provided a sense of certainty that had arose from their knowledge of the land and resources provided by it (Smith 2010:18).

The book entitled, *The Salish People and the Lewis and Clark Expedition* (2005), written by the Salish-Pend d’Oreille Culture Committee and Elders Cultural Advisory Council Confederated Salish and Kootenai Tribes, offers their interpretations of historical events, such as the Lewis and Clark expedition. This book presents stories passed down by early ancestors who lived during the days of the Lewis and Clark expedition and presents the deep relationship Salish people had with their homeland in western Montana during the 19th and 20th centuries and today (Salish Pend d’Oreille Cultural Committee and Elder Advisory Council Confederated Salish Kootenai Tribes 2005: xii). Members of the Salish-Pend d’Oreille and Confederated Salish Kootenai Tribes challenge the biased views portrayed in American History recollections of this time period and explain that:

Until recently, the stories of traditional tribal elders have been given little weight by most historians. They have been treated as unreliable, hearsay, the shifting opinion of biased speakers. Over the past several decades, however, this view has gradually changed, as awareness has grown of the rigorous discipline and accountability surrounding the
transmission of oral tradition within many tribal societies (Salish Pend d’Oreille Cultural Committee and Elder Advisory Council Confederated Salish Kootenai Tribe 2005:xii).

The accounts in this book discuss the importance of valuable resources acquired within the Missoula Valley and surrounding areas. A section of this book also provides reference to Salish place names given to areas in the Missoula and Bitterroot Valleys. Embedded in the place names are stories of places that describe the way specific areas were used by Native groups and hold clues to tribal ways of life and the relationships indigenous groups hold with their land (Salish Pend d’Oreille Cultural Committee and Advisory Council Confederated Salish Kootenai Tribe 2005:35).

The memoirs of Emma Magee (1866-1950) provide another source of information detailing the transitional period of European settlers into the Missoula Valley. Magee, a woman of mixed blood, spent the younger years of her life in Missoula and later residing on the Flathead Reservation to the north. Written by her great niece Ida, this book discusses some of Emma’s life experiences in the newly established town of Missoula. Emma’s father and mother (Shoshone/Flathead Salish) settled in the valley.
Chapter 3: Environmental and Historical Background of the Missoula Valley

Located in western Montana, the Missoula Valley lies north of the Bitterroot Valley and is situated at the base of five mountain ranges: the Bitterroot Mountains, Sapphire Mountains, Cabinet Mountains, Mission Mountains, and the Coeur d’ Alene Mountains. The mountains surrounding the Missoula Valley feed the streams and rivers of this valley which provided reliable sources of fish (specifically bull trout) and other resources for people in the region for millennia (Thompson 2010). As Europeans made their way into the western United States, they encountered landscapes that were “neither purely natural nor wholly human-made.” (Limerick 2000:2189). As mentioned earlier, lifestyle goals and land use practices differed significantly between Europeans and American Indians, and this was illustrated during the colonization of the West in the mid-19th century. This chapter will discuss some of the human-environmental history of the Missoula Valley and explore processes of adaptation and production as discussed in the introduction.

Today the Missoula Valley’s landscape includes conifer forests, ecologically diverse riparian areas, prairie grasslands and wetland areas (Montana Natural Heritage 2014). The two main rivers flowing through the valley are the Clark Fork and the Bitterroot. The average annual flow of the Bitterroot River in 2013 was around 1,708 cubic feet per second with a drainage area of around 2,824 square miles. The average annual flow of the Clark Fork River in 2013 measured out to 4,149 cubic feet per second with a drainage area of around 9,017 square miles (USGS Water Data 2014). Prehistorically and historically, water from the Clark Fork and Bitterroot Rivers supported ecologically diverse plant and animal communities that provided resources for people for thousands of years. These resources proved equally appealing to Europeans in the 19th century and inspired rapid settlement in Missoula and Bitterroot Valleys during the mid to late 19th century.
This chapter will examine the historical background of the Missoula Valley discussing the history of the American Indians who occupied this region during the 19th and 20th centuries. This chapter will also look at various documented place names of Indigenous and non-Indigenous origins within and around the Missoula Valley, and consider the stories and meaning behind those place names. In addition to Indigenous place names, this chapter will also discuss information about the landscape gathered from historical journals written by early explorers and settlers who made their way into the region, including historic GLO survey journals as a source in historical vegetation conditions.

**Missoula Valley Under Glacial Lake Missoula**

![Figure 3.1 Map showing the extent of Glacial Lake Missoula and the floods. Photograph from http://www.nps.gov/iceagefloods/j.htm](http://www.nps.gov/iceagefloods/j.htm)

During the end of the last Ice Age 10,000 to 12,000 years ago, the Missoula Valley was submerged under 2,000 feet of water. The source of this water was the melting Cordilleran Ice Sheet that lay to the northwest, blocking the flow of the Clark Fork River. Glacial Lake Missoula
(Figure 3.1) was formed by an ice dam along the Clark Fork in Idaho along the Pend d’Oreille section of the Cordilleran Ice Sheet during the Pleistocene era, 11,500 - 1.8 million years ago (Alt 1979; McLeod and Melton 1986). It is believed that Glacial Lake Missoula was one of the largest lakes ever formed as a result of an ice dam. Glacial Lake Missoula covered a total of 3,000 square miles and held around 500 cubic miles of water (Alt 1979). During the Late Pleistocene and mid-Holocene the environment began to change and as the climate warmed, glaciers damming the lower Clark Fork melted and Glacial Lake Missoula drained (McLeod and Melton 1986). Today evidence of Glacial Lake Missoula can be seen in the form of shorelines along mountain slopes (Mount Jumbo and Mount Sentinel) in the Missoula Valley (Figure 3.2). Creation stories told by Salish – Pend d’Oreille tribes reference the occupation of western Montana confirming their tribal presence in this region over and immense span of time (Salish-Pend d’Oreille Culture Committee 2005).

Figure 3.2 Photo facing east showing the shorelines visible on Mount Jumbo Missoula, Montana. Photograph by the author.
There are of course no written records that describe Glacial Lake Missoula, but archaeological sites in the Missoula Valley do not date older than 6,000 to 9,000 years. Evidence of Glacial Lake Missoula is seen throughout the landscape, from western Montana moving west towards the Pacific Ocean in the form of beach ridges on mountains in the Missoula Valley and the channeled scablands in Eastern Washington. Knowledge of this landscape prior to 10,000 years ago is important as one attempts to understand both physical and cultural environments of the Missoula Valley. In the 1950s, Carling Malouf, an anthropology professor at the University of Montana, conducted several archaeological surveys throughout western Montana and in doing so he recognized that sites in this region were culturally distinct (Ryan 1977). Malouf concluded that sites in Montana west of the Continental Divide had a chronological sequence unlike any other across the state and determined that sites examined in western Montana dated to a more recent time compared to other sites across the state (McLeod and Melton 1986 P.IV-I).
Over the centuries, Salish, (also known as Flathead), Kootenai (sometimes spelled (Kutenai), Pend d’Oreille (aka as Kalispel), Nez Perce, Gros Ventre, Blackfoot, and other Indigenous groups used the Missoula Valley as a travel route and for their traditional economies (Boas and Teit 1929; Griswold and Larom 1954; Hall and Knudsen 2004). Oral histories told by the Salish and Pend d’ Oreille explain how Salish people used to be one great tribe long ago but once the population became too large to sustain, the tribe split up into smaller bands. Once the bands divided, it became easier for the groups to be supported by the seasonal supply of food and resources (Salish and Pend d’ Oreille Cultural Committee 2005).

A number of sources, including Malouf (1967, 1979) and Melton (1986), place the Salish and Pend d’Oreille territory during the 17th century east of the Missoula Valley; during the 18th century, their location shifted to include the Missoula Valley and Flathead Lake region. They were
among several hunter-gatherer groups in the region, organizing their movements in accordance to the seasonal cycles of plants and migration of large game for hunting (MacDonald 2012; Thompson 2010). Indigenous people in western Montana acquired horses from Spanish in the southwest United States. Horses allowed the region’s American Indians to become more mobile, carry more possessions, and aided in the efficiency of hunting (Ryan and McLeod 1982).

According to ethnographic reports by Boas and Teit (1929) and archaeological reports by Griswold and Larom (1953:3), the Missoula Valley was used regularly by the Kooteani, Salish and Pend d’Oreille, tribes who seasonally occupied the valley, as well as the Bitterroot Valley located to the south. Figure 2.3 shows a group of Salish Indians with their camp set up along the Clark Fork River with Mt. Sentinel in the background. Traditionally, both the Missoula and Bitterroot Valleys were areas used by the Salish, Pend d’Oreille, and Kootenai (and other tribes as well) for collecting camas and bitterroot during the spring season (Griswold and Larom1954:3; Hall and Knudsen 2004; Malouf 1982:1; MacDonald 2012; Salish-Pend d’Oreille Culture Committee 2005). Traditional knowledge of root collecting areas like those historically documented in Missoula Valley enabled tribes of this region to adapt their seasonal rounds around the root collecting times. The production of food and knowledge of resource availability was imperative to American Indians who continuously gathered food during the spring and summer in preparation for the winter.

Ecological communities in the Missoula Valley were undoubtedly influenced by American Indian seasonal campsites, fishing, hunting and gathering activities, and management of vegetation by means of fire. William Clark noted in 1805 that Indians in the Upper Missouri region would annually burn fields near their village to improve pastures for their horses (Krech III 1999:107).
The traditional use of fire to manipulate non-agricultural plants can be seen as an adaptive behavior by American Indians who over time realized the benefits using fire on their landscape. Fire was used as a basic tool to reshape landscapes, to clear forests creating grasslands (Cronon and White 1986). Prior to European settlements, environmental management of prairies and forest of the Missoula Valley and surrounding area were controlled with the use of fire. The region’s Indigenous residents purposefully set low-intensity fires as ways to prevent insect and disease outbreaks among tree stands, improve vegetation creating optimal grazing areas for wildlife, to prevent vegetation build-up that increased fire intensity resulting in complete loss of trees stand, and to improve nutrients in the soil thus encouraging new and thicker plant growth across grassland areas (Barrett 1981:1; Gruell 1983; Mason et al. 2012: 189). The Salish-Pend d’ Oreille Culture Committee and Elder Advisory Council Confederated Salish Kootenai Tribes (2005:30) state that tribes of western Montana often set fire to the low-lying valleys of this region in an effort to “create and maintain an environment that was both pleasant to live in and bountiful in its resources.” The production of finer more nutritious grass not only provided adequate food for horse, but it also attracted big game into these areas. American Indians also set fires for the purpose of communication across far distances and as a defense mechanism against enemies/warring groups (Krech III 1999:107; Mason 2012:189).

During a lecture given at the Native Plant Society meeting in 2015, Missoula County Conservation Lands Manager, Morgan Valliant discussed indigenous fire use on top of Mount Jumbo. Valliant stated that, historically, very few trees existed on Mount Jumbo because Native groups would set fire to the mountain top to prevent trees from growing and, thus, preventing the Blackfeet Indians from hiding among trees and attacking passing groups--which they were known
to do along the Hellgate Canyon in Missoula. Historical journals (e.g., Lewis and Clark) describe vast, pleasant, open prairies that--unknown to them--were the result of centuries of fire use among Indigenous groups (Salish-Pend d’Oreille Cultural Committee and Elder Cultural Advisory Council Confederated Salish Kootenai Tribes 2005:31).

Indigenous fire ecology practices decreased across western Montana as more Europeans moved into the region (Barrett 1977:67). The decrease use of fires across North America dramatically affected the ecosystem’s conditions (Cronon 1990; Mason et al. 2012:189). This was one of many decisions dictated by Europeans that reaped negative impacts on the ecology of not only the Missoula Valley, but throughout the American West. More recent research in areas of the Northern Rocky Mountain (NRM) region has begun to look into the natural and cultural history of fires regimes that were a part of the prehistoric landscape histories of this region.

Paleoecologists such as Cathy Whitlock and others, began to question if activities of anthropogenic burning in places like the West occurred at a level, and over time, created new vegetation types or have the impacts of climate change, soil change, and natural disturbances, over time, led to changes in plant communities (Whitlock and Knox 2002:196). Discerning this information requires knowledge of TEK as well as methods for separating impacts of human-set fires versus naturally-set fires caused by lighting. Whitlock and Knox (2002:196) used prehistoric pollen and plant microfossil records collected from lake sediments and wetlands, as well as plant remains preserved in packrat holes to create prehistoric vegetation conditions of areas in the Pacific Northwest. To assess fire regime data, dendrochronology records and lake-sediment data can also help to decipher when fires came through an area (Whitlock and Knox 2002). Whitlock’s research
represents a small fraction of the investigations being conducted on prehistoric fire regimes in the Pacific Northwest (also see Barrett 1981; Power et al. 2005; Baker 2002; Vale 2002).

Pollen and fire analysis provide a small fraction of land use and environmental history for the Missoula Valley; these studies paired with archaeological and ethnographic data help understand the timeline of this region. This valley began under glaciers, then under the great glacial lake, and eventually became the valley American Indians came to inhabit. Indigenous tribes of this region have lived here for so long that their stories of creation link them to the land itself. The Salish and Pend d’ Oreille state that “The Creator gave our people a rich land to care for and a varied and consequently stable supply of foods, medicines, and all materials necessary for a comfortable life” (Salish-Pend d’Oreille Cultural Committee 2010:20). American Indian beliefs about nature and the environment varied between tribes, but as a whole these beliefs can be distinguished from European attitudes by their tendency to endow nature with a spiritual dimension which lacks in European thought (White 1991:212).

**Prehistoric and Historic Trails in the Missoula Valley**

Western Montana held a network of prehistoric trails connecting the Missoula Valley with other valleys in the region (Griswold and Larom 1954; Flanagan 2001; also see Scott 2014) and served as travel corridors for millennia. These trails were accessible from the east through the Deerlodge Valley, from the west through the Cabinet Mountains, and from the south through the Bitterroot Valley. Created by early Nez Perce, Blackfeet, Kootenai, Salish, and Pend d’ Oreille tribes, these trail systems connected lands of the west to the desired hunting lands in the east.
(Salish-Pend d’Oreille Cultural Committee and Elders Advisory Council Confederate Salish and Kootenai Tribes 2005:49). One such path includes an old trail that followed the Clark Fork River from the Upper Deer Lodge Valley all the way west to the Columbia River; this trail was considered one of the major travel routes between the Plains and the Pacific Coast (Malouf 1982:1; Teit 1928:322). Mention of this trail can be read in journals written by Granville Stuart (1925), David Thompson (1808) and Lewis and Clark (1805).

The historic GLO maps of the Missoula Valley document several trails encountered during land surveys in the 1870s (see Figures 4.1, 4.5, 4.10, and 4.14). Four roads on the GLO maps labeled “U. S. Military Road,” “Road to Grass Valley,” “Road to Jocko Valley,” and “Road to Bitterroot Valley” were likely the paths of prehistoric trails that existed prior to the coming of Europeans into the area. It was not unusual for old trails to be widened and modified by Europeans for the use of wagons and motorized vehicles (Zedeño and Stoffle 2003:62). In the book Following Old Trails, author Arthur Stone (2004) observed that many old trails made by the region’s Indigenous people were often widened into roads. In reference to an ancient trail leading to present day Frenchtown, Stone states, “This road is one of the oldest trails in western Montana; it was a thoroughfare long before there was any Missoula” (Stone 2004:22).

Explorers such as Lewis and Clark documented the use of some of these trail systems while making their way through this region. When the Lewis and Clark expedition crossed over Gibbons Pass near the Big Hole Basin, they made their way into the Bitterroot Valley by following this existing trail (Stone 2004:61). The Salish-Pend d’Oreille Cultural Committee and Elder Cultural Advisory Confederated Salish Kootenai Tribe (2005:63) state that early explorers and Lewis and Clark’s expedition used the established Indigenous trails and passes. Lewis followed an old Indian
trail (the Cokahlarishkit Trail) that lead to the summit of what is now known as Lewis and Clark Pass; a trail the Salish and Flathead (Flanagan 2001), referred to as “Road to the Buffalo.” This trail, according to Stone (2004:97) served as a route to the annual hunting grounds into the plains of buffalo country. Flanagan (2001:27) describes this trail as a common route that led through the Hell Gate Canyon, on up along the Big Blackfoot and through the Continental Divide. Increased use of these trail systems by Europeans eventually led to a widened path to accommodate use by wagons and stagecoaches (Stone 2004:99). Indigenous groups had their own names for trails and important places where resources were acquired, such as food and plants. Few sources exist detailing Indigenous place names assigned by Indigenous groups of the valley, but efforts made by tribes such as the Salish-Kootenai, Pend d’Oreille, Blackfeet, and others, provide information about traditional place names.

**Indigenous Place Names**

A number of place names still known today in the Missoula Valley were given by Salish-Pend d’Oreille, tribes whose traditional homelands encompassed this valley. Table 2.1 lists some of these place names given to areas in the Missoula Valley as told by the Salish-Pend d’Oreille and Confederated Salish and Kootenai Tribes (2005). As a source of TEK, place names discussed in this chapter and throughout this thesis reflect historic and ecological conditions of the valley in addition to the traditional importance and meanings of specific areas in the Missoula Valley. A number of place names in the Missoula and Bitterroot Valley are discussed in the book, *The Salish People and the Lewis and Clark Expedition* (2005), where elders and tribal members of the Salish-Pend d’Oreille Culture Committee and Elders Cultural Advisory Council Confederate Salish Kootenai Tribes explain the importance and meaning of these place names and there relevance to
the cultural geography of their traditional homelands. Embedded in these place names are the stories and events that represent the importance of a place held by Indigenous groups. Table 3.1 lists some of the place names documented by the Salish-Pend d’ Oreille Cultural Committee and Elders Cultural Advisory Council Confederated Salish and Kootenai Tribes. These names, along with a more complete description of the stories behind these names, are described in the book mentioned above.

Table 3.1. Salish-Pend d’ Oreille and Confederated Salish-Kootenai place names.

<table>
<thead>
<tr>
<th>Native Name</th>
<th>Translation</th>
<th>English Name /Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snɫ̓pu̓’(p̓l̓m̓)</td>
<td>Place Where You Come Out to a Clear Area</td>
<td>The base of Evaro Hill.</td>
</tr>
<tr>
<td>Člmé</td>
<td>Tree Limb Cut Off</td>
<td>A Major camp in Grass Valley, in the area known as Council Grove, west of Missoula. This area was known to have an abundant source of Chokecherries. The area was also known by the Salish and Pend d’ Oreille as adequate grazing area for their horses in the winter.</td>
</tr>
<tr>
<td>Níʔay(ccstm)</td>
<td>Place of the Small Bull Trout</td>
<td>Missoula- specifically the confluence of Rattlesnake Creek (Smith 2010). This area was also an important Bitterroot collecting area.</td>
</tr>
<tr>
<td>Nʔayccstm</td>
<td>Place of the Large Bull Trout</td>
<td>In Bonner, MT at the confluence of the Blackfoot and Clark Fork River (Smith 2010)</td>
</tr>
<tr>
<td>Sloʔté</td>
<td>Two Valleys Coming Together to Make One Little Valley</td>
<td>Pattee Canyon, southeast side of Missoula and the trail that connects to Deer Creek to the confluence of the Clark’s Fork and Blackfoot rivers in Bonner.</td>
</tr>
<tr>
<td>Qalsá or Epł ītxʷeʔ</td>
<td>Wet Ground Where Camas is Plentiful and it has Camas</td>
<td>Camas digging grounds near Potomac, Montana along Union Creek and Camas Creek.</td>
</tr>
<tr>
<td>Tmsmlí</td>
<td>No Salmon</td>
<td>The area where Lolo Creek empties in the Bitterroot River.</td>
</tr>
<tr>
<td>Snt̓mčqey</td>
<td>Steam on a Ridge Top</td>
<td>The area near Lolo Hot Springs.</td>
</tr>
<tr>
<td>Symbol</td>
<td>English</td>
<td>Notes</td>
</tr>
<tr>
<td>--------</td>
<td>---------</td>
<td>-------</td>
</tr>
<tr>
<td>Nstetčexʷetkw</td>
<td>Water of the Red Osier Dogwood</td>
<td>The Bitterroot River where the Red Osier Dogwood was the predominate vegetation along the Bitterroot.</td>
</tr>
<tr>
<td>Čkʷlkʷlqéyn</td>
<td>Red-Topped Peaks</td>
<td>St. Mary’s Peak or the Bitterroot Range as a Whole.</td>
</tr>
<tr>
<td>Ncxʷotews</td>
<td>Something Growing by the Edge of the Water.</td>
<td>N/A</td>
</tr>
<tr>
<td>N̓m̓q̓wé</td>
<td>N/A</td>
<td>The Base of Mount Jumbo. Most of this area is buried under Interstate 90 and the Eastgate Shopping Center and was also a Bitterroot Collecting area.</td>
</tr>
<tr>
<td>Snɛlqeyiṅ</td>
<td>Place of School</td>
<td>The place that is now the location of the Missoula Fairgrounds.</td>
</tr>
<tr>
<td>Slnaycčstm</td>
<td>Rattlesnake Creek</td>
<td>Place to get small Bull Trout (Site report 24MO1623).</td>
</tr>
<tr>
<td>Čṛ˘ł˘us</td>
<td>Florence, Montana</td>
<td>NA</td>
</tr>
<tr>
<td>Naptnišá</td>
<td>Trail to the Nez Perce</td>
<td>The Lolo Trail</td>
</tr>
<tr>
<td>Sǫxǫxó</td>
<td>Many Trails</td>
<td>Skalkaho Pass and connecting trails leading to it from the Bitterroot Valley.</td>
</tr>
</tbody>
</table>
Other sources in archaeological reports and Indigenous histories mention the use of place names for areas in and around the Missoula Valley region. McLeod (1982) describes the historic Lolo Trail, located in the Bitterroot Valley, as being in existence since prehistoric times. Consisting of many trail segments, this trail connects trails from the Bitterroot Valley to trails in the Missoula Valley (see Figure 5.18). The Lolo Trail was used frequently by the Nez Perce (McLeod 1982:4), who referred to the trail as “k’uysey’ne’iskit,” meaning “bison hunt trail.” The Salish also made use of this trail, and according to the tribe, this trail led over the mountain from the west, up the Bitterroot Valley, and east into buffalo hunting grounds. Elders recall that from Lolo, this trail extends east, past Nez Perce lands, and all the way to the ocean (Salish Pend’Oreille Cultural Committee and Elders Cultural Advisory Council Confederated Salish and Kootenai Tribes).
The following table provides reference to other place names noted in text examined as a part of this thesis. Table 3.1 and Table 3.2 provide a list of Indigenous place names gathered from sources referencing the location and names of areas in Missoula Valley and some of the surrounding areas.

Table 3.2 Additional references to place names in the Missoula Valley and surrounding area.

<table>
<thead>
<tr>
<th>Native Name</th>
<th>Translation</th>
<th>Description</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lmisuletiku</td>
<td>Missoula Valley</td>
<td>This is the name given to the Missoula Valley by Flathead (Salish) Tribe</td>
<td>Koelbel (1972)</td>
</tr>
<tr>
<td>Nksuletiku</td>
<td>Missoula Valley</td>
<td>This is the name given to the Missoula Valley by Kalispel (Pend d’Oreille) Tribe.</td>
<td>Koelbel (1972)</td>
</tr>
<tr>
<td>Kehi-oo-le</td>
<td>Rattlesnake Creek</td>
<td>Supposed Salish word for Rattlesnake Creek. Named this by the Salish because during times of high water the creek sounded like the rattle of a rattlesnake.</td>
<td>(Rattlesnake Creek Watershed Group 2015).</td>
</tr>
<tr>
<td>Tum-sum-lech</td>
<td>Salmonless</td>
<td>Nez-Perce name for Lolo Creek.</td>
<td>McLeod (1982:4)</td>
</tr>
<tr>
<td>k’uysey’ne’iskit or Khusahna Iskit</td>
<td>Bison Hunt Trail</td>
<td>The Lolo Trail that came east over the Bitterroot Mountains at the Idaho Montana border and proceeded to buffalo hunting ground tin eastern Montana.</td>
<td>(Salish-Pend d’Oreille Cultural Committee and Elders Cultural Advisory Council Confederated Salish and Kootenai Tribes (2005:67). (McLeod 1982:4).</td>
</tr>
</tbody>
</table>
Place Names of European Origin

By the 19th century, Europeans began to assign new names to places they settled. Some Indigenous place names have persisted and others were slightly changed in pronunciation. The book *The Origin of Some Montana Place Names* by J. P. Rowe (n.d) provides descriptions of various places in Montana that were named mostly after Europeans who came to this area beginning in the 19th century. Table 3.3 contains names of places in and around the Missoula Valley.

Table 3.3 Missoula Valley Place names of European Origins.

<table>
<thead>
<tr>
<th>Place name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bonner</td>
<td>A town in Missoula County named after E.L. Bonner who was an early settler in Missoula and became the first president of the Missoula and Bitterroot Valley Railroad in 1888 and also owned land in Bonner. (Rowe, nd).</td>
</tr>
<tr>
<td>Grant Creek</td>
<td>A creek in Missoula Valley named after Captain Richard Grant who built a home in this area in the 19th century (Rowe, nd).</td>
</tr>
<tr>
<td>Grass Valley</td>
<td>Referenced on several maps but no explanation to the name; probably is in reference to the abundant growth of nutritious grass that grew in this area.</td>
</tr>
<tr>
<td>Hellgate</td>
<td>Once the name of the Missoula River (Known now as the Clark Fork River). Also the name of the canyon between Mt. Sentinel and Mt. Jumbo. Named by a French traders “port de l’enfer” meaning “gate of hell” (Koelbel 1972; Stone 2004; Rowe nd).</td>
</tr>
<tr>
<td>Mt. Jumbo</td>
<td>A mountain in Missoula, named for its resemblance to a huge elephant if it is viewed at a certain angle (Rowe nd).</td>
</tr>
<tr>
<td>Miller Creek</td>
<td>A creek in Missoula named after Ezra Miller who settled near the creek from 1866-1867 (Rowe nd).</td>
</tr>
<tr>
<td>Missoula</td>
<td>The name is said to be a Salish word meaning “the river of awe” Duncan MacDonald says it means “Sparkling Water” (Koelbel 1972; Rowe nd).</td>
</tr>
<tr>
<td>Missoula</td>
<td>Koelbel (1972:6) states that after David Thompson sketched the valley in 1812 from Mt. Jumbo, he named it, “Nemisoolatakoo” a name given to the valley by the Natives.</td>
</tr>
<tr>
<td>O’Keefe Creek</td>
<td>A creek in the Missoula Valley named after C.C. O’Keefe who settled this area in the mid-19th century. Missoulian1911;</td>
</tr>
</tbody>
</table>
Pattee Canyon  | A canyon in the Missoula Valley named after David Pattee who settled in the area in 1865 (Koebel 1972; Rowe nd).

Rattlesnake Creek | The story goes, sometime before 1853, a woodcutter was bitten by a rattle snake while gathering wood along the creek and died (Comer 2005; Poe 1992). Other versions say the name originated from the Salish word for Rattlesnake – “Heh-oo-lee-whi” (Wendel et al. 1983). In June 1935, The Missoulian states that Duncan McDonald said the name came from an Indian name; “Kehi-oo-lee” meaning rattlesnake (Missoulian 1935; Poe 1992).

Coriacan Defile | The trail running north up O’Keefe Canyon into the Jocko Valley. According to Stone (1923), this trail was well-established long before Europeans came into the region. This canyon was also known as - Koriaka’s Canyon, O’Keefe’s Canyon (Missoulian 1911; Stone 2004).

Flathead Trail | Upper Clark Fork River Basin Trail, also known to other explorers as the “the Salish Road to the Buffalo” (Griswold and Larom 1954:3).

Saleesh River | Name used by David Thompson for the Clark Fork River (McLeod 1982).

Soloas River | Name given to Lolo Creek by early trapper of the area (McLeod 1982:4).

Traveler’s Rest Creek | Name given to Lolo Creek by the Lewis and Clark expedition (McLeod 1982:4).

Lou-Lou Creek | 1840s and 1850s maps refer to Lolo Creek as Lou-Lou Creek or Lou-Lou Fork. The Lolo trail was also referred to as the Lou-Lou trail and by 1852 the name was shortened to Lolo (McLeod 1982:5).

Place names throughout the Missoula Valley served as a way of keeping the historical memory of important events that connected to the landscape. A number of historic sources give explanations for the names of places in and around the Missoula Valley; for example, Frank H. Woody (1896:95) states that the Bitterroot River and valley are named after the bitterroot plant, which grows abundantly throughout the valley. Woody also states that the eastern section of the Missoula Valley was known as “Hell’s Gate Rounde” by early Canadian trappers who came to the
Valley. The nearby river (today known as the Clark Fork River) was referred to as “Hell’s Gate River.” This area was known as Hell’s Gate because geographically this part of the valley and canyon was used by both Salish and Blackfeet Tribes who did not get along (Flanagan 2001: 25; Woody 1896:95).

The Blackfeet did not like the Salish going through their territory enroute to the plains to hunt buffalo and, therefore, used the canyon as a place to ambush the Salish (and in later years Europeans) as they passed through the treacherous canyon (Flanagan 2001:25). Woody (1896:95) states that to enter this canyon “it was almost certain death for an individual or even small parties to enter this pass, and it was called by the voyagers, in their language, Port d’ enfer, Gate of Hell or Hell’s Gate, and from which the river and subsequently a village took their names.” After the passing of the Lewis and Clark expedition, the Clark Fork was referred to as “Clark’s Fork” (Sanders 1913:28) and not to be confused with the Clark’s Fork of the Yellowstone River in eastern Montana. The stories mentioned above represent a small number of references made to meanings behind place names in the Missoula Valley. It is safe to assume that many original place names and the existence of prehistoric and historic trails once present for the Missoula Valley were lost over time, due to name replacement and/or because the information was simply never written down; such place names now are absent from the stories and memories of the people who knew them.

The Missoula Valley During European Exploration

Capitalistic agendas stand out when reading the notes and journals of the early explores of this region, where individuals such as Lewis and Clark (1804-1806), John Work (1831-32), Granville Stuart (1865), John Mullan (1853-54), and David Thompson (1809-1812) refer to and
make note of the wealth in resources. However, the most common misconception made by outsiders coming into this region was that these resources were limitless.

Northwest Montana was among one of the last places to be explored by Europeans during the early 19th century (McLeod and Melton 1986). In the 18th century, Fur Traders became the first Europeans to travel through western Montana, although it is unknown for sure considering most of these men did not keep written accounts of their experiences. Their purpose was to acquire beaver and other animal pelts to be sold to western Europe and China (Gosden 2004:85; White 1991:48). As Europeans moved westward across North America, they encountered cultural landscapes shaped by Indigenous people over thousands of years (Mason et al. 2012). In 1805-1806 Lewis and Clark led the infamous expedition exploring lands west of the Mississippi; their journey brought them through the Bitterroot and Missoula Valley (DeVoto 1953; Koelbel 1972; McLeod and Melton 1986:27; Salish-Pend’Oreille Cultural Committee and Elders Cultural Advisory Council Confederated Salish and Kootenai Tribes 2005:17; Woody1896: 89). On this journey both Lewis and Clark documented observations of the flora and fauna, soil and mineral potential, as well as lifestyles and patterns of the native inhabitants (McLeod and Melton 1986). In addition to searching for the Northwest Passage through the West, the Lewis and Clark Expedition was also instructed to document the land and natural resources along their journey. Lewis and Clark’s notes documented plants and animals observed in Montana during the early 19th century. In addition, several plants were collected in Montana and are housed in the Lewis and Clark Herbarium at the Academy of Natural Science in Philadelphia. Table 3.4 lists the plants collected by Lewis and Clark during their travels through western Montana. Information on flora and fauna observed along
the Bitterroot Valley, just south of the Missoula Valley, suggests that the environment was similar to that of today (Knight 1989:88).

Table 3.4 Plants collected in the Missoula and Bitterroot Valley in 1806 during the Lewis and Clark expedition.

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Date Collected</th>
<th>Place Collected</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Lewisia rediviva</em></td>
<td>Bitterroot</td>
<td>July 1806</td>
<td>Along Lolo Creek near Travelers Rest</td>
</tr>
<tr>
<td><em>Mimulus guttatus</em></td>
<td>Common Monkey Flower</td>
<td>July 1806</td>
<td>Blackfoot River</td>
</tr>
<tr>
<td><em>Orthocarpus tenuifolius</em></td>
<td>Thin-leaved owl clover</td>
<td>July 1806</td>
<td>Bitterroot Valley near Travelers Rest</td>
</tr>
<tr>
<td><em>Philadelphus lewisii</em></td>
<td>Lewis’s Mockorange: syringia</td>
<td>July 1806</td>
<td>Along Clark Fork River</td>
</tr>
<tr>
<td><em>Populus balsmifera ssp. Trichocarpa</em></td>
<td>Black Cottonwood</td>
<td>July 1806</td>
<td>Bitterroot River near Travelers Rest</td>
</tr>
<tr>
<td><em>Sedum stenopetalum</em></td>
<td>Yellow Stonecrop</td>
<td>July 1806</td>
<td>Near Travelers Rest</td>
</tr>
<tr>
<td><em>Zigadenus elegans</em></td>
<td>Mountain Death Camas</td>
<td>July 1806</td>
<td>Bitterroot Valley near Travelers Rest</td>
</tr>
</tbody>
</table>

In 1809-1812, explorer David Thompson made his way into the Missoula Valley. During this time he was working for the North West Company and in search of an ideal location to construct a trade fort (Koelbel 1972: 6). Within Thompson’s journals are details about various trail systems that transect the region and information about Indigenous economic relations, and traditional homelands (Tyrrell 1962). Journals kept by Thompson contribute to documenting conditions in the Missoula Valley and were seen as some of the earliest records on the Indigenous population of western Montana and of early landscape conditions (also see Boas and Teit 1928). Other Europeans began to make their way through and to the valley, eventually establishing the town of Hell Gate in 1862 approximately five miles west of current day Missoula (Koelbel 1972).
In the winter of 1853-54, Captain John Mullan was tasked with constructing a wagon and railroad route from Fort Benton along the Missouri River and west towards the waters of the Columbia River. His work brought him through the Missoula Valley several times and is described in books and journals written by Mullan in the mid-19th century. In 1865, Captain John Mullan published *Miners and Travelers’ Guide to Oregon, Washington, Idaho, Montana, Wyoming, and Colorado* to be used as a guide in navigating through areas of the West. Mullan’s guide makes several references to resources and conditions of the Missoula Valley. During one of his trips through the town of Hell Gate (referred to now as Missoula) Mullan writes:

road excellent; wood, water, and grass here; good place to rest animals for a day or two; blacksmith’s shop at Van Dorn’s, supplies of all kinds can be obtained, dry goods, groceries, beef, vegetable, and fresh animals if needed (Mullan 1865:14).

Mullan’s book includes information on mineral sources such as Cinnabar found along the Hellgate Canyon, as well as limestone and sandstone found throughout the Valley (Mullan 1865:29). Mullan records that spruce, hemlock and birch trees are present in and around the Missoula Valley. Mullan’s book also notes the town of Hell Gate Ronde as having around a dozen farms near two small creeks (Mullan is likely referring to Grant Creek and possibly a slough along the Hell Gate River -present day Clark Fork River). Information recorded by Mullan during his time in western Montana represents another primary source that is used to assess historical landscape conditions of the Missoula Valley.

A number of other adventurous individuals documented their experiences traveling through Montana during the early 19th and 20th centuries. The edited volume by Phillip Phillips, *Forty Years on the Frontier*, retells the experiences of Granville Stuart and his travels west during the
mid-19th century. During his time in Montana, Stuart observed life in the Deer Lodge Valley with his brother and told of their luck in finding gold. In 1865 Stuart published *Montana As It Is*, which provided general descriptions of land resource throughout the Montana territory. In December of 1865, Stuart drew a picture of the town of Missoula and the Mills (Figure 3.5); the picture also illustrates a few houses along the north side of the Clark Fork River. Stuart notes that at the time of this drawing, the settlement of Hell Gate (Missoula) had been established a year before (Phillips 1925), and although the picture is only a sketch, it details a few landscape features as well as the placement of a number of houses in the area.

Figure 3.5 *Missoula in 1865 Looking North*, drawn by Granville Stuart on December 25, 1865. Stuart was facing north on the south side of Clark Fork River. (Phillips 1925:163).
David Douglas, a 19th century botanist, traveled with John Work of the Hudson Bay Company during one of his expeditions into the northwest region of the U.S. During this trip (and many others he took throughout his life) Douglas kept copious notes documenting a large variety of plants he came across. Among his plants Douglas listed were *penstemon glandulosus*, also known as sticky-stem *penstemon, paeonia*, referred to as brown peony or native peony. Douglas also wrote that species of phlox were growing in small patches along Lewis and Clark’s River (Douglas 1923:164), known today as the Clark Fork River. Plant journals created by Douglas also detail the time of year in which certain plants and flowers grew, and went to seed, providing beneficial information to researchers interested in environmental conditions that can be determined by changes in plant communities.

In 1904, 1908, and 1909, Canadian ethnologist James Teit collected a vast amount of ethnographic information about Salishan language dialects and the general movement of the tribes in the interior of the Pacific Northwest (Boas and Teit 1927). In his published notes, *Coeur D’Alene, Flathead and Okanogan Indians*, Teit describes the Salish people who occupied the Missoula Valley over the past centuries and into the early 20th century. Teit’s published notes reveal that the territories of western Montana tribes fluctuated over time. He notes that the tribes utilized certain areas seasonally and that camas, bitterroot, and berries were important food sources for the Salish and Pend d’Oreille. During the early 19th century Teit collected a vast amount of information on Salishan tribes of the interior British Columbia, Washington, and Montana. Teit’s work with the Indigenous groups of western Montana provides information on territories associated with various Native groups and the distribution of Salishan dialects (Boas and Teit 1930) and is pertinent to understanding land use history of the Missoula Valley during this time period.
Information gleaned from historic documents as seen in this section provides fragmented references to Indigenous groups, plants, the landscape, and individuals present in the Missoula Valley during the mid-19th and early 20th centuries.

In 1855 the Hellgate Treaty was signed; this treaty established the Flathead Reservation and called for the Bitterroot Salish, Kootenai, and Pend d’Oreille tribes to reside in one area (see Koelbel 1972, Prucha 1994, and Stone 2004). For the American Indians of western Montana, this marked the beginning to an end of their traditional ways as mobile groups. This time period represents a transitional period for both settlers and American Indians and was inevitably the start of new land use agendas put into place by Europeans. Historic GLO records can be used as another line of evidence to understand both the physical and cultural landscape.

The General Land Office Surveys

Beginning in 1867 the GLO surveyed lands in Montana were overseen by the federal government (Habeck 1994; Shelly 2012:9; White 1926). The initial starting survey point for Montana was established in Willow Creek, an area south of Three Forks, Montana (Shelly 2012). Currently historic GLO notes for the state of Montana have been used to map pre-settlement landscape studies at the University of Montana Lubrecht Experimental Forest (White 1976) and to interpret forest succession in ponderosa pine and Douglas fir forest at the historic Fort Missoula Timber Reserve (Habeck 1994). In 2011, Rich looked at tree diameter, forest density and the forest shifts from ponderosa pine to an increased number of Douglas fir using GLO records. In 2012 Karen Shelly mapped six township sections in the Bitterroot Valley documenting the historic tree and vegetation data and comparing this data to current land cover data today (Shelly 2012:2).
The Missoula Valley was roughly split into five township sections by GLO surveyors during the late 19th century. For the scope of this thesis, four of the township sections were transcribed in an effort to help interpret historic landscape conditions of the project area. The GLO notes for the Missoula Valley offer a good description of the landscape and mention ownership of farms and fences that surveyors encountered along their survey lines.

In the summer of 1870, William H. Baker and Walter M. Johnson along with four other men surveyed four townships that made up the majority of the Missoula Valley (General Land Office Notes 1870). Documented in these notes are names of early farmers and the location of their fences in the area at this time. The notes also provide names and the paths of rivers and creeks, in the valley and notes the widths across. Surveyors also recorded soil rates and landscape features encountered during their surveys. For example, the description of McCauley’s Butte (located west of Fort Missoula) is described as ...“Rise 150 ft. Go down descend 150ft. enter upon a level prairie”... “Leand Level. Soil 1st rate. Pine and cottonwood timber on the banks of the Bitterroot River”. Per the instructions given to surveyors, landscape conditions were very descriptive, making it possible to reestablish certain characteristics of the historic landscape. Once completed, land surveys in the Missoula Valley were submitted to the federal government and eventually the sectioned lands would be sold to European settlers.

For the federal government, the General Land Office surveys served as a way facilitate the sale of public lands into private ownership. Other laws such as the Homestead Act, passed in 1862, granted 160 acres of public land to settlers and encouraged crop cultivation. The law required settlers to reside on and improved the land for five years giving them the option of purchasing the land after six months. Supporters of the Homestead Act had hoped this law would inspire a class of
small farmers whose own prosperity would support the economic development of the nation (White 1991:142-143), but the arid lands of the West would not support such goals. Aridity of the West caused settlers to rethink their methods of farming and agriculture.

For the settlers, lands of the West proved to be a year-round challenge. In turn the government continued to develop land policies in efforts to aid farmers (see White 1991), but in the end, only one-third of the settlers who filled lands claims through the Homestead Act were successful and obtained the title to their lands White (1991:147). The Homestead Act can be seen as one of many land policies that encouraged and supported the mass production of resources such as agriculture, timber, livestock, mining and the initial growth of towns across the West. To deal with the aridity of the lands, settlers constructed irrigation ditches; the federal government funded the construction of dams and canals to support farming and agriculture in this arid region.

Conclusion

Archaeologists (among others) play a critical role in interpreting past landscapes, ecosystems, and the impacts human populations have had on them (Crumley 1994; Lucas 2001; Rockman 2012:3). Carole Crumley states, “Historical Ecology traces the ongoing dialectical relations between human acts and acts of nature, made manifest in the landscape. Practices are maintained or modified, decisions are made and ideas are given shape, a landscape retains the physical evidence of these mental activities” (Crumley 1994).

In using the Missoula Valley as a case study to examine how processes of human adaptation and goals of production are carried out by different cultural groups plays an intricate role in understanding landscape changes that have taken place over time and the effects these process have
on a population and the land. Human-environmental relationships by both American Indians and Europeans each played their part in shaping North America and specifically for this thesis, the Missoula Valley. Over time, American Indians and Europeans developed their own adaptive strategies in correlation to their traditions, their beliefs, the landscape, and their experiences. For the American Indians, mobility and seasonal travel dictated food decisions as well as their economic and social behavior. Eager to exploit the “untouched” and “unused” resources of the West, European settlers did not understand the environmental balance and mutually beneficial relationships already existing in this region. Driven by capitalistic economies of the east, and the eager goal to expand, Europeans adversely began colonizing the West with little understanding of the nature of this region. Unable to seasonally travel for food and resources, the American Indians were encouraged to farm on their reservations. Denied their traditional economies, American Indians were forced to adapt to a new way of life, a reservation life. For the Europeans, adaptations to the arid lands of the West became their biggest challenge and would require new methods in dealing with unsuccessful farming and agriculture. Processes of adaptation and goals of resource production, first by the American Indians and later by the Europeans inevitably shape the region.
Chapter 4: Methods

Methods used for this project drew from a number of vegetation reconstruction projects across the United States (see literature review in Chapter 1). Information derived from GLO records are considered some of the most complete and systematic sources of data available to assess characteristics of historic landscapes (Shelly 2012:23). General Land Office Surveys facilitated the Homestead Act in 1853 and allowed Europeans to “map” new uses for lands in the West that were dedicated to agricultural production. These surveys documented lands ideal for farming, soil rates and the amount of timber for each township. A large part of work for this project was spent evaluating and transcribing four township sections in the Missoula Valley. In addition to transcription of historic journals, a number of other primary and secondary sources were incorporated into this project in an effort to develop a land use timeline for the Missoula Valley. Sources such as maps and Indigenous place names provided locational information of culturally significant places in and around the Missoula Valley. This chapter will discuss the methods required to complete this project.

GLO Surveys in the Missoula Valley

In 1870 deputy surveyors William H. Baker and Walter W. Johnson were in charge of laying out and surveying three and half township quadrants in the Missoula Valley totaling 67,266 acres (105 mi²) of the Missoula Valley (Figure 4.1). Procedures and techniques for conducting land surveys often changed or were amended as new methods developed to improve accuracy by surveyors (BLM 2014, Commissioner for the General Land Office 1919). Bourdo (1956:757) states that, “it can be assumed that a given survey conformed to the instructions in force at the time the survey was made, although special orders accompanied each contract.” Each township contains
approximately 23,040 acres measuring 6 miles on each side, and townships are identified by their location in reference to a base line and Principal Meridian (BLM 2014).

Figure 4.1 Overview of study area illustrating township and section lines in the Missoula Valley.

All four townships in the study area are aligned along the Bitterroot Guide Meridian, which runs north and south between the four townships. T14N R20W and T13N R20W lie to the west of the Bitterroot Guide Meridian, and T14N R19W and T13N R19W are to the east of the Bitterroot Guide Meridian. Each township is divided into 36 – one square-mile sections (640 acres) and numbered accordingly (BLM 2014, 2014 or 1973). The order in which sections lines were surveyed are sketched out in beginning pages of each township journal. Figure 4.2 shows the path of section lines surveyed in T13N R20W. For the Missoula Valley township sections, surveyors began their survey on the south end of the township between Section 35 and 36 (survey line is
marked 1), surveyed north, and established their corner for Sections 25, 26, 35, and 36. With the corner established, surveyors headed east between Sections 25 and 36 (survey line is marked 2) and so on until they reached the northwest corner between Section 5 and 6 for this particular township.

Figure 4.2 Index Diagram of survey lines established by GLO surveyors in the 1870s. (http://www.glorecords.blm.gov).

The unnumbered lines in Figure 3.2 represent mountainous portions of the township that were not surveyed because they were undesirable for settlement or farming and were, therefore, surveyed at a later time (Christy and Alverson 2011:96). For more detailed procedures in surveying methods used by workers see Shelly (2012:10) or White (1928).
Transcribing Historical Map Data Using ArcGIS

A total of 106 townships equaling 215 section lines were transcribed for the study area and have been mapped onto the ArcGIS program according to GLO reports. The majority of GLO information was accessed through the Bureau of Land Management (BLM) website [http://www.glorecords.blm.gov](http://www.glorecords.blm.gov), while other recorded data was acquired in microfiche film at the BLM Missoula office. The process of analyzing historical vegetation and cultural features for comparison was created by inserting historical GLO plat maps over modern images using the ArcGIS program, specifically ArcMap 10.1 (ESRI). Cultural features on the GLO maps are defined as features set into the landscape that are not natural such as roads, trails, houses, fences, and agricultural fields.

A number of other projects using GLO data to analyze historic vegetation have done so by creating geodatabases that code vegetation feature classes into an ArcGIS program (see Shelly 2012). Christy and Alverson (2011) entered vegetation and landscape feature data into an Access database, and units were outlined on mylar sheets that where then digitized to create a layer in ArcGIS. Although these methods tend to be reliable/accurate methods, they prove to be extremely time consuming and require superior working knowledge of ArcGIS. It should be mentioned that all data acquired from historical GLO journals and maps inevitably carry some degree of error in assumptions for assessing positions of historical vegetation and landscape features. Vegetation information for the interior of sections was not recorded by GLO workers during “original survey” contracts; only the vegetation and landscape features encountered on the section lines was documented. For both Christy and Alverson (2011) and Shelly (2012), the use of modern soil data was added as a layer in GIS to delineate vegetation boundaries encountered by surveyors.
Land cover analysis for the Missoula Valley used a less technological approach in mapping the historic data. Since I am in the process of learning how to create geodatabases in ArcGIS and do not have the background to create importable data from Access tables into ArcMap, this project used methods of rubbersheeting historic GLO maps over modern aerial images. The process of rubbersheeting is used to align features from one map to another; in this process the surface map is overlayed onto a modern image, and the imported map is positioned to fit desired points on underlying map/data sets (ESRI 2014). In order to align GLO maps onto modern aerial imagery, Public Land Survey System (PLSS) points and digitized township sections were downloaded into ArcGIS, providing points to position the corners of the GLO plat maps over their appropriate township section. PLSS points were initially created by GLO surveyors who recorded point data (in the non-digital form) in their field notes and plat maps; this data was used to determine limits of PLSS parcels for surveyors today (BLM 1973; White 1926).

Established township lines, section lines, land cover data, Geographic Coordinate Database (GCDB), and Public Land Survey Systems (PLSS) data was acquired from the Montana State Library’s Montana Spatial Data Infrastructure (MSDI) website http://geoinfo.msl.mt.gov/Home/msdi. Digital data pulled from GCDB is considered some of the most reliable PLSS data and its information is maintained by the Bureau of Land Management (BLM). Since historic GLO documents predate GIS technology, we know that coordinate information recorded in the GLO journals and maps comes with a degree of error and can be less accurate in comparison to data provided through the GCDB. Shelly (2012: 26) notes that for the Bitterroot Valley GLO study area, coordinate errors ranged from 0 to 135 feet. In order to estimate the range of error for the Missoula Valley townships, the northwest corner of section 22 and the
imported PLSS point for section 22 corner were measured on all maps. The range of error for each plate map is as follows:

- T13N R20W - 96 feet
- T13N R19W - 105 feet
- T14N R20W - 317 feet
- T14N R19W (southern boundary) - 63 feet

A larger degree of error for T14N R20W was noted in comparison to the other three maps for reasons unknown. As a process of situating plat maps over modern aerial images, three control points were selected on each township map. Control points were chosen for established corners within each township map. For this project no more than three control points were used when aligning GLO maps to modern aerial images, this was decided in order to prevent distortion of the historic GLO maps. Some sections of the township maps line up more accurately with PLSS points than other portions of the map. In an effort to line up corners to the PLSS points, the position of the GLO map was shifted and realigned to better fit the township provided by the GCDB, but this resulted in some points lining up with the map and others were off. Then when the other side was shifted, points on the other side of the map were thrown off. So each GLO map was positioned as close to the PLSS points as possible, but some corners remain a little off.

GLO records can offer extensive information on historical conditions of an area, but users should be aware, there are limitations to what these notes can provide. Data recorded during the GLO surveys was not consistent, and from 1804 to 1902, there were at least 20 versions of general instructions issued to surveyors (Galatowitsch 1990:190, White 1984). Galatowitsch (1990) explains that GLO records can contain inconsistent landscape descriptions; some surveyors
documented in great detail the soil, vegetation, landforms, and land use rating while other surveyors would just note the topography and general land use rating. Documentation did not always reflect pre-settlement conditions as some lands were surveyed after Europeans had settled in the area. In cases such as this, GLO descriptions included notes of features such as fences, railroads, houses, and roads. For the Missoula Valley, T13N R19W mentions of the newly established town of Hell Gate, roads, fences, and also notes the location of “Pattees” house.

Other notes of caution found among some GLO notes are the reported bias in the collection of vegetation information. In many cases the trees recorded were chosen because of their size, age, and species type, often corrupting quantitative tree data found within the notes, thus creating an underrepresented number of tree species (Galatowitsch 1990:186; Grimm 1984). Plant species and vegetation were sometimes misidentified or generalized by surveyors, such as the case in New Mexico by Gross (1973) where the description of “bunch grass” was used to describe tall-and mid-grass prairie species that encompassed several other species such as Andropogon spp (blues stream and beard grass varieties), Sorghastrum nutans (yellow indian grass) and panicum virgatum (Switch grass) (Gross 1973). The last limitation to be mindful of is the potential for fraudulent information being recorded by surveyors. Investigations into fraudulent records have concluded that most cases were found in journals for California and Colorado (Galatowitsch 1990:187). In any case, mis-recorded information can be hard to identify and are issues that readers and users of GLO notes should be aware of while consulting and interpreting the records.

Each township map for the Missoula Valley contains around 20 to 36 separate layers of feature data classes, depending on the vegetation and feature information noted by the GLO surveyors in each township. The projected coordinate systems for all layers added into ArcGIS
were set to \textit{NAD\_1983, UTM\_Zone\_11N} and \textit{Geographic Coordinate System = GCS\_North\_American\_1983} (Table 3.1).

Table 4.1 Feature classes entered into ArcGIS database to create point data.

<table>
<thead>
<tr>
<th>Missoula Valley Geodatabase</th>
</tr>
</thead>
<tbody>
<tr>
<td>World Imagery Map (the background modern image).</td>
</tr>
<tr>
<td>Montana State Map</td>
</tr>
</tbody>
</table>

Study area-
Cadastral Reference
- PLSS Points
- PLSS Second Division
- PLSS First Division
- PLSS Township

GLO Data (this information varies on each map depending on township)
- Plat Map Image – JPEG
- Level Prairie Line
- Open Pine Timber Line
- Open Pine and Fir
- Pine
- Cottonwood
- Willow
- Tamarack
- Alder
- Fir
- No Timber
- Cultural Features (roads, trails, fences)
- Saw Mill
- Wheat Field
- Agricultural Field
- House
- Cabin
- Ravines
- Pond
- Dry Creek Bed
- Slough
- Bitterroot River
- Clark Fork River (Hell Gate River)
- Grant Creek
Le Valle Creek
Sam Martin Creek
Two Creeks
O’Keefe Creek
Rattlesnake Creek

A hard copy of each township map was created before information was entered into ArcGIS in order to establish beneficial methods to relaying landscape information for each township. Each feature class was individually added into ArcGIS as it was encountered in the GLO notes. For example, journal entry on page 104 of the GLO written for T13N R20W notes at 40 chains,

Set ¼ sec. cor. a post from which:

- a willow 4 in. dia. bears N 30 W distance 22 lks.
- an alder 5 in. dia. bears S 40 E distance 12 lks.

Measurements noted in chains and links were converted into feet using the following formulas.

Converting chains to feet  \( \text{Feet} = \text{chains} \times 66.00 \)

Converting links to feet  \( \text{Feet} = \text{link} \times 0.66 \)

Using the converted measurements, it was then possible to measure the distance of trees (and other noted features and vegetation) from corner sections noted by the surveyors. In Figure 4.3, the location of the alder and willow are shown as they were laid out in ArcGIS program. (See Results chapter for entire township map).
Figure 4.3 Image showing the recorded location of two bearing trees (the orange dot represents the willow tree, the pink dot represents the alder tree). Image on the left shows the 1870 GLO map placed over modern aerial image, the map on the right show the location of the trees without the historic GLO map.

The 2013 Montana Land Cover classification was used to indicate differences between GLO and modern conditions. Modern Land Cover data is available through the Montana Natural Heritage Program (http://fieldguide.mt.gov/). During the 1870s, surveyors used a number of terms to describe land cover in the Missoula Valley. Cottonwood and pine trees were the two top recorded tree species mentioned by the surveyors. Mention of vegetation in GLO notes for the study area were described for section lines in one of five ways: scattering pine, scattering pine and cottonwood, no timber, level prairie, or open pine timber. In section lines that crossed rivers or creeks, surveyors often mentioned the type of trees that lined the banks of these water ways. For example, page 121 of the survey notes for T13N R20W, surveyors describe a section line as:

“Leand [Land] hilly, soil 1st and 2nd rate. Timber, pine and cottonwood on the banks of the Hell Gate River.”
From this information, it is possible to discern that pine and cottonwood were present at the intersection of the survey line and the Hell Gate River. The brief description also notes the hilly characteristic of this area and as well as the soil condition for the purpose of future agriculture use. Soil information provided by GLO surveys was not projected on ArcGIS maps for this project but would contribute another layer of information for analysis in the Missoula Valley. In addition to vegetation land cover mentioned above, GLO notes for the Missoula Valley area provided quantitative point data (tree type and diameter), but only for corner and quarter section corners and on few occasions along the section lines. A number of studies have used bearing tree data descriptions from GLO notes as a method for calculating tree density and vegetation structures (see Habeck 1994). Bourdo (1956) and Almendinger (1997) argue that in many cases, surveyors showed bias against choosing small and super large trees for bearing trees and certain species. Therefore, the use of bearing tree data is not the only source of evidence that should be used to determine overall vegetation composition (Bourdo 1956; Almendinger 1997; Shelly 2012:35). This project did not attempt to calculate tree densities using bearing tree data; the main focus was to map vegetation physically described by the GLO workers.

**Historical Journals and Photograph Sources**

One method of assessing the succession of vegetation over time is by comparing historic photographs with modern images taken from the same location. Several historic photos of the Missoula Valley exist in the University of Montana Mansfield Library collection. For this project five historic photos were chosen and duplicated as a way of looking at changes in vegetation in these sections of the Missoula Valley.
Photos used in the before and after comparison were taken between the late 19th and early 20th centuries and were chosen because of their overall representation to early views of the landscape and vegetation in the Missoula Valley during the early 19th century. Aside from GLO journals and historic photo comparisons, information acquired from historical journals and indigenous sources offered other primary sources. Found within the pages of early journals and are scattered references to descriptions of vegetation recorded by these individuals. Early travelers and settlers new to western Montana wrote down their recollections in journals. Some of these early observations were written prior to the introduction of livestock grazing and the establishment of farms in the Missoula Valley.

The journals of Meriwether Lewis and William Clark documented the famous exploratory expedition west from St. Louis Missouri, across the United States. Notes from Lewis and Clark’s journals include information of the men’s travels through the Missoula Valley in 1805 and 1806. In addition to their route taken through the Valley, the men made note of plants, animals, trails, and Native groups encountered along the way. British fur trader, John Work, was another individual who traveled through the Missoula Valley in 1831-1832 keeping a journal in the process. His entries describe the tribes he encountered, game that was hunted, weather conditions, and routes that were used in his journey up the Bitterroot, through the Missoula Valley, and on up to the Blackfoot River corridor. Work mentions that the grass along the Bitterroot and Clark Fork Rivers, and at Camas Plains near Potomac, provided excellent grass for their horses (Lewis and Phillips 2006: 90). In July 1826, Work set out on an expedition to trade in the valley of Clark’s Fork with the Flathead. Work was accompanied during this expedition by David Douglas a botanist who was interested in documenting and collecting seed along their route. Entries in the journal of David
Douglas in 1826 note the collection of *Pentstemon glandulosus* and *Ribes irriguum* and “many fine seeds” (Douglas 1914:65). Information from his notes provide minimal information specifically pertaining to Missoula Valley, but it does provide historical botanical information for the Pacific Northwest.

Known as an early pioneer and prospector in western Montana, Granville Stuart (1857-1919) was one of the first men to spread the word of gold to be had in the state (Stuart 1925:3). Stuart spent some time in Missoula and nearby Flint Creek area during the late 19th century and kept a journal of his time in the Valley. Information from journals such as Stuart’s provides a glimpse of Europeans’ frame of mind on views of the West and its landscape:

> the lovely valley of the “Hellgate”, which is about twenty-five miles long with an average breadth of about six miles. It is almost all good farm land with a good growth of bunch grass, and it is enough to make a man from the prairies of Iowa and Illinois cry to see the good pine timber that is going to waste here (Stuart 1865:4).

Another source of information comes from ethnographic work conducted in western Montana by ethnographer James Teit in the late 19th and early 20th centuries. During this time Teit was a devoted observer of Northwest Indians and spent much of his time documenting their language, culture, mythology, and art (Boas and Teit 1930). Sources written by J. H. Woody and Arthur Stone also provided information on population and historical references to trail systems in the Valley for this project because of their references to early life in the Missoula Valley.
Indigenous Sources (TEK)

Indigenous perspectives on the environment were compiled using sources from Confederate Salish and Kootenai Tribes, Blackfeet ethnobotany articles, and biographies (e.g. Emma Magee 1860-1954). These sources reflect a different view of production and adaptation practiced by the tribes of this region during the 19th and 20th centuries. Tribal sources also provide details about ancient trail systems that crossed the Missoula Valley, and about the use of highly sought after plant resources, as well as native place names of the study area. Many plants mentioned by explores and the native tribes are still found in the Missoula Valley today but the populations of those plants are in smaller quantities today. An ArcGIS map (Figure 5.18) shows bitterroot collecting areas described by indigenous groups in the Missoula Valley.

Archaeological Sites in the Missoula Valley

Information on archaeological sites in the Missoula Valley was collected and reviewed as a source of vegetation and land use records in the Valley. These reports and associated documents were acquired from the University of Montana’s Anthropological Curation Facility (UMACF) as well as from the State Historic Preservation Office (SHPO). A number of artifacts excavated in the Missoula Valley reside in the curation facility as well as site forms and reports detailing important information on time period and sometimes noting vegetation observed in site locations. To help illustrate the impacts European settlers had on the landscape of the Missoula Valley during the late 19th and 20th centuries, four tables in Chapter 4 were created for each township providing the number of recorded archaeological, and architectural sites, and when possible the time period of these sites are noted. As a part of this project, a sample of three site forms were examined in an effort to illustrate how vegetation descriptions documented in site reports can be used as in
correlation with historical landscape data (GLO records) and modern land cover data. In an effort to keep sites protected, the location of these sites are not mapped, but instead a table was created to provide the number of prehistoric and historic sites in the Missoula Valley.

Methods of Pollen Analysis

The use of pollen analysis at an archaeological site can provide a great deal of detail about past vegetation communities and their evolution into modern landscapes. Currently there are no archaeological sites in the Missoula Valley that incorporate pollen analysis as a part their research. In fact, only a small number of sites in Montana have incorporated the results of pollen and historic flora analysis to site reports (see reports for 24LC1325, 24BE1659, 24MO0048). However, studies in climate change research and fire ecology have conducted a number of charcoal analyses of lake sediments as a method of reconstructing long-term variation in history of fire occurrences. For example, Whitlock and Larsen (2001:20) explain that “pollen and charcoal data from the same cores are used to examine the linkages among climate, vegetation, fire, and sometimes anthropogenic activities of the past.” According to Brunelle et al. (2005), paleoecological studies in the Northern Rocky Mountains are mainly concentrated on middle to high-elevation sites where “environmental changes in the Holocene have been primarily driven by climate variation and secondarily by human impacts” (Power et al. 2005:420; see also Mehringer et al. 1977; Whitlock 1992; Reasoner and Huber 1999; Doerner and Carrara 2001; and Brunelle-Danes 2002). There is a lack of paleoecological research in lower elevation where influences of prehistoric and Euro-American population have contributed greatly to landscape changes (Power et al. 2005:420).

Pollen samples from the Fort Missoula Site (24MO00188) will contribute to environmental reconstructions based on pollen records in western Montana, and more importantly, will contribute
Mehringer et al. (1977) examined fossil pollen analysis collected from Lost Trail Bog area in the Bitterroot Mountains, and Mehringer et al. (1984) used pollen material from lake sediments in Sheep Mountain Bog near Missoula, Montana as a method of determining the season and time of ashfall from late-glacial eruptions of Glacier Peak in Washington. And although these sites are not associated specifically with archaeological sites, they provide a line of evidence in vegetation and climate data useful in assessing conditions of this region.

Methods of pollen and botanical analysis were used in this project to help understand changes in plant communities in the Missoula Valley. The objective of this testing was to determine whether pollen analysis from the Fort Missoula Historic Dump would show the rate of change from native vegetation (pre-European settlements) to the vegetation we see there now. In theory, the lower levels of Test Excavation Unit 4 at the Fort Missoula Historic Dump will show a higher concentration of pollen from native plants species in comparison to the upper sample, which theoretically will show a higher number of invasive species pollen. According to GLO records, the Fort Missoula Historic Site during the 1870s, existed in a section (township 13N 20W, Section 36, south east corner) described as having very little timber. The timber that did exist was noted as pine and cottonwood along the banks of the Bitterroot River. Previous work using GLO records (see Shelly 2012) have associated section corners noted as “no timber” to indicate these were likely glass land prairies. If this is the case, the Fort Missoula Historic Site would likely have been populated with assorted prairie bunch grasses such as Idaho Fescue, Rough Fescue, Prairie June grass, and others of the sort.
During archaeological excavation in August 2013 at the Fort Missoula Historic Dump site, three soil samples were collected from Excavation Unit 4, from the south wall. The Fort Missoula site is located on the north side of the Bitterroot River in Township 13N Range 20W Section 36. Historically this area was documented as being a dumping site for Fort Missoula military trash since its establishment in 1877. A 1x1 meter unit was excavated just over 60 cm deep and three soil samples were taken from the south wall. The excavation unit wall had three notable stratigraphic layers and it was decided to take a sample from each layer (see figure 4.4 and 4.5). Dry samples were extracted by scraping exposed layer of dirt from the wall. Once a fresh layer was exposed, a trowel was sanitized using bleach wipes and when dry, dirt was scooped into cloth soil sample bags. The samples were then placed in a black plastic tote and stored in a dry, temperature regulated area. Figure 4.4 and 4.5 are pictures taken of the south wall after the extraction of the samples.
Figure 4.4 Test Excavation Unit 4 at the Fort Missoula Historic Dump Site (24MO0188), photograph facing south. Three distinctive holes in the wall are shown indicating where soil samples were extracted. Photograph by the author.

Figure 4.5 Close-up view of the south wall of Test Excavation Unit 4 at the Fort Missoula Historic Dump Site (24MO0188). Photograph by the author.
Figure 4.6 A view of the Fort Missoula Historic Dump Site (24MO0188) facing south. Photograph shows the location of Test Excavation Unit 4 in correlation to the Bitterroot River as well as vegetation surrounding the site. The yellow arrow points to the center edge of the south wall and the white pipe of test well is located in the center of the excavation unit. Photograph by the author.
Fort Missoula Test Well

Through a partnership with Maury Valett and Marc Peipoch in the Division of Biological Sciences and the Institute on Ecosystems at the University of Montana, another research project was developed at Fort Missoula to record and assess how materials at the historic dump have influenced soil and water compositions in the area. In November 2013, three test wells were placed near the Bitterroot River on the Fort Missoula Historic Dump (24MO0188) to measure water levels of the Bitterroot River. Sadly, two of the wells were destroyed and pulled up by vandals, and
funding did not allow the two test wells to be reinstalled along the river. The test well placed in the center of Test Excavation Unit #4 was not destroyed and, therefore, well levels were tested (see Figure 4.6 and 4.8).

Figure 4.8 Fort Missoula field school 2014, Mary Bobbitt standing in the center of Test Excavation Unit 4 demonstrating the use of the well measuring device. Also in the photograph are field school students Thomas Livoti, and Micah Goodman.

Conclusion

This chapter has outlined methods used to interpret late 19th century landscape conditions in the Missoula Valley. The use of sources mentioned in this chapter have been brought together in
order to create comprehensive maps and documents illustrating the temporal and spatial changes that have taken place in the Missoula Valley. By comparing GLO survey records and information from TEK sources, different cultural land use agendas of Europeans and American Indians are evident. Other sources such as pollen analysis for the Fort Missoula Historic Dump (24MO0188) provide proxy environmental data about plant communities along the Bitterroot River during the late 19th and on up into the 20th century. The following chapter presents maps created in ArcGIS that reflect the spatial results of the research methods presented in this chapter.
Chapter 5: Results

This research provides a model for integrating multi-disciplinary lines of evidence using ArcGIS. Four historical vegetation maps in ArcGIS document ecological and cultural features according to surveyors’ observations in the 1870s. These records and maps are correlated with historical references, TEK, ecological data, pollen analysis, and archaeological site information to present systematic evidence illustrating early historical conditions of the Missoula Valley.

GLO Survey Information

GLO surveys for the Missoula Valley were conducted from 1870 to 1910 (Habeck 1994:69). Original surveys for T13N R20W were collected in July of 1870, T14N R20W was collected from September – October 1870, and T13N R19W was collected in August – September 1870. All three townships were surveyed by William H. Baker and Walter Johnson along with a small crew of axemen. Original surveys for T14N R19W were collected through a number of several surveys during 1884 and 1901, and were surveyed by Harry V. Wheeler and a small crew. Only original survey maps and journals were transcribed and mapped to document cultural and vegetation data for this thesis. A handful of later surveys and resurveys for the Missoula Valley can be found online (www.glorecords.blm.gov) and at the BLM Missoula Office.

Measurements of the landscape were taken by surveyors in chains and are converted in Table 5.1. These measurements can be found in the Commissioner of General Land Office (1919) report, and are also referenced in Galatowitsch (1990), and Shelly (2012).

Table 5.1 Unit Conversion Table
Once the survey notes for a township were completed, the surveyors included a general description section that accompanied the notes for each township (see Table 5.15 in Chapter 5). Plat maps were also created during or shortly after the survey. Plat maps, also known as survey plats, are the graphic drawings of a township boundary that contain the official acreage used in the landscape description (BLM 2014). These maps provide a glimpse of the historical landscape conditions preceding the mass migration of Euro-Americans into the region.

**Results for Township 13 North 20 West (Examination of Completed Township Maps)**

The following section provides a snapshot of each Township map and recorded features (e.g., fences, houses ravines, rivers, sloughs, ditches etc.) noted and drawn out by GLO surveyors. Four maps for each township are arranged by their respective sections; the first map shows the
GLO plat map as the visible top layer with noted GLO features (in the form of point data) highlighted from the 1870s. The second map shows GLO highlighted features over modern aerial imagery, without the GLO plat map. These two maps display all point data, (vegetation, cultural, and aquatic features) recorded on ArcGIS. The third map displays 2013 modern land cover data information provided by the Montana Natural Heritage Program (mslapps.mt.gov). The last map in each township section shows modern land cover data with the point data recorded from the GLO maps as a visible layer. Tables also accompany township maps detailing the number, diameter, and species of trees record, vegetation line descriptions, and the number and types of cultural and aquatic features noted in GLO notes.

A variety of vegetation descriptions were used by surveyors in describing section lines in the Missoula Valley, and it should be noted that terms were not strictly defined. Surveyors did not distinguish their references to timber densities; terms such as open, few, scattering, dense or heavily timbered were used to describe the number of trees observed on a section line. It is plausible to assume that few and scattering section lines contain less timber than those referred to as heavily or dense timbered areas, but to suggest the difference between the first three terms (open, few, and scattering) would be to assume timber densities implied by the surveyors. Other township section lines were noted as no timber, good grazing, or fine grazing. These section lines are likely areas of no timber, or with few trees, and possibly a sufficient amount of native grasses but to assume what the surveyors meant by their terms was not the goal of this thesis and with that in mind, section lines outlined on ArcGIS were named exactly the way surveyors noted them in the journals to avoid assuming vegetation types along section lines.
Township 13 North Range 20 West

Figure 5.1 GLO map of T13N R20W placed over modern aerial image with 1870s water, vegetation, and cultural features highlighted.
Figure 5.2 Modern aerial image of T13N R20W without the 1870s GLO map. Water, vegetation and cultural features highlighted.

Table 5.2 Bearing Tree data recorded by surveyors for T13N R20W.

<table>
<thead>
<tr>
<th>Tree Species</th>
<th>Other Common Names</th>
<th>Scientific Name</th>
<th>Number recorded</th>
<th>Quantity/Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cottonwood</td>
<td>Cottonwood</td>
<td><em>Populus trichocarpa</em></td>
<td>17</td>
<td>(1) 6 in diameter</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(1) 7 in diameter</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(3) 8 in diameter</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(1) 10 in diameter</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(3) 12 in diameter</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(1) 20 in diameter</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(3) 24 in diameter</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(3) 30 in diameter</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(1) 36 in diameter</td>
</tr>
</tbody>
</table>
The first township map examined as part of this project is T 13N R20W and is located on the southwest corner of the study area (see Figure 4.1 in Chapter 4). A total of forty-eight trees were recorded by surveyors in T13N R20W, the highest number being pine trees (see Table 5.2). Trees represented in Figure 5.1 and 5.2 were recorded in one of three places: along section lines, at section corners, or at quarter section corners. General observations made by surveyors also included descriptions of trees that lined the banks of the Hell Gate (Clark Fork) and Bitterroot Rivers, as well as sections along Grant Creek. Surveyors also made general references to tree species such as fir and pine, and, therefore, each table lists the possible species encountered during the survey. Historic photos of the Missoula Valley, such as Figure 5.20 and 5.26 (as well as GLO records) show a number of trees lined both the Bitterroot and Hell Gate (Clark Fork) Rivers. These
two major rivers support diverse communities of plants and animals as well as microbial organisms. Riparian rich in their nature, these rivers provided abundant resources for people for millennia and have played a key role in the development of the Missoula Valley. Around forty-four (44) township sections of T13N R20W were surveyed during the original 1870s survey, and about twenty-two (22) were left unsurveyed due to the ruggedness of the mountains in the western edge of the township.

Table 5.3 Section line descriptions of vegetation for T13N R20W.

<table>
<thead>
<tr>
<th>Line Description</th>
<th>Number of Section Lines</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Timber</td>
<td>27</td>
</tr>
<tr>
<td>Pine and Cottonwood Timber on the Bank of the Bitterroot</td>
<td>5</td>
</tr>
<tr>
<td>Pine and Cottonwood on the Hell Gate River</td>
<td>2</td>
</tr>
<tr>
<td>Scattering Pine and Cottonwood</td>
<td>3</td>
</tr>
<tr>
<td>Pine and Cottonwood</td>
<td>5</td>
</tr>
<tr>
<td>Level Prairie</td>
<td>3</td>
</tr>
<tr>
<td>Cottonwood Timber on the Banks of the Bitterroot</td>
<td>3</td>
</tr>
<tr>
<td>Scattering Pine</td>
<td>2</td>
</tr>
<tr>
<td>Open Pine Timber</td>
<td>2</td>
</tr>
<tr>
<td>Open Pine and Fir</td>
<td>1</td>
</tr>
<tr>
<td>Pine, Alder, along the banks of the Hell Gate</td>
<td>1</td>
</tr>
</tbody>
</table>

As shown in Table 5.3 and Figures 5.1 and 5.2, five (5) section lines were described as pine and cottonwood on the banks of the Bitterroot River, three (3) section lines described cottonwood timber on the banks of the Bitterroot River, twenty-seven (27) section lines were described as having no timber, two (2) section lines were described as pine and cottonwood on the banks of the Hell Gate River, three (3) section lines were described as scattering pine and cottonwood, five (5) section lines were described as pine and cottonwood, three (3) section lines mentioned areas of level prairie, two (2) section lines were described as scattering pine, one (2) section line was
described as open pine timber, and one (1) section line is described as having pine and alder along the banks of the Hell Gate River. The north line descriptions between sections 7 and 8 are described as both “open pine timber” and as “pine and cottonwood timber,” this is the only section line with overlapping in this township.

Paths of the Hell Gate and Bitterroot Rivers according to GLO maps appear to have shifted in some locations, and although these are hand drawn maps predating technologies of satellite imagery and GIS, they provide valuable land cover data for their time – they had to. The most notable change for the rivers in T13N R20W can be seen at the confluence of the Hell Gate River and Bitterroot Rivers in Sections 22, 23, 24, and 27. Modern aerial imagery shows an increased number of winding channels that make up the Hell Gate (Clark Fork) River today in comparison to the 1870s. It might be possible that surveyors just noted the main channels for the sake of time, but considering the detail of the rest of the township maps for Missoula Valley, it is likely that channels drawn by surveyors on the GLO provide a complete representation of the historic Hell Gate River.

Table 5.4 Cultural features noted by GLO surveyors for T13N R20W.

<table>
<thead>
<tr>
<th>Feature Descriptions</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trails</td>
<td>NA</td>
</tr>
<tr>
<td>Roads</td>
<td>3</td>
</tr>
<tr>
<td>House</td>
<td>1</td>
</tr>
<tr>
<td>Fences</td>
<td>15</td>
</tr>
</tbody>
</table>

**Modern Land Cover Date versus Historic Land Cover Data**

Modern land cover data was added as a layer to each Township map and used as a comparative source to historical vegetation and cultural features noted by GLO surveyors in the
1870s. Below, Figure 5.3 illustrates modern land cover provided by Montana Spatial Data Infrastructure (MSDI) for T13N R20W and was added to ArcGIS as a thematic layer to help illustrate differences between historic and modern vegetation.

Figure 5.3 Modern land cover map showing 2013 vegetation and land use data for T13N R20W.
Modern land cover maps provided by the Montana Natural Heritage website (http://geoinfo.msl.mt.gov/Home/msdi/land_use_land_cover) and the Montana Field Guide (www.fieldguide.mt.gov/displayES_LCLU.aspx) provide descriptive land cover classifications assigned to the Missoula Valley today and are used as a comparison to historic land cover information. Several modern land cover classifications for Missoula Valley exist, and although definitions of historic land cover did not exist within land cover classification, today certain methods in similar research (Shelly 2012) have paired historical vegetation descriptions with modern vegetation classes to serve as a way to create near equivalent land cover classifications—a method Shelly (2012) terms as “crosswalking.” Table 5.5 shows historical land cover descriptions.
recorded by surveyors in the 1870s and the likely 2013 land cover classification that these historical conditions most likely represented.

Table 5.5 GLO Land Cover Classifications Converted to Modern Land Cover Classes

<table>
<thead>
<tr>
<th>1870s GLO Section Line Descriptions</th>
<th>2013 Modern Land Cover Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level Prairie/ No Timber/ Good Grazing/ Fine Grazing.</td>
<td>Montane Grassland (L2)</td>
</tr>
<tr>
<td>Open Timber/ Scattering Timber/ Few Trees</td>
<td>Forest and Woodland System</td>
</tr>
<tr>
<td>Heavy Timber, Dense Timber.</td>
<td></td>
</tr>
<tr>
<td>Agricultural/ Field</td>
<td>Cultivated Crops</td>
</tr>
<tr>
<td>Bottom Lands/ Gravel Bar</td>
<td>Northern Rocky Mountain Lower Montane</td>
</tr>
<tr>
<td>Timber Along the Banks of River and Creeks</td>
<td>Riparian Woodland and Shrubland</td>
</tr>
<tr>
<td>Timber Burned</td>
<td>Recently Burned</td>
</tr>
<tr>
<td>Water</td>
<td>Open Water</td>
</tr>
</tbody>
</table>

|
Township 13 North Range 19 West

Figure 5.5 T13N R19W with 1870s GLO map as the top layer. Water, vegetation and cultural feature highlighted.
Figure 5.6 T13N R19W showing modern aerial image without 1870s GLO map. Water, vegetation, and cultural features highlighted.

Table 5.6 Bearing and line tree data recorded by surveyors for T13N R19W.

<table>
<thead>
<tr>
<th>Tree Species</th>
<th>Other Common Names</th>
<th>Scientific Name</th>
<th>Number recorded</th>
<th>Quantity/Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cottonwood</td>
<td>Cottonwood</td>
<td><em>Populus trichocarpa</em></td>
<td>6</td>
<td>(2) 8 in diameter</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(1) 20 in diameter</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(2) 24 in diameter</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(1) 30 in diameter</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(2) 24 in diameter</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(6) 30 in diameter</td>
</tr>
</tbody>
</table>
The second township examined for this project is T13N R19W and is located in the southeast corner of the study area (see Figure 4.1 in Chapter 4). As seen in Table 5.5, surveyors in T13N R19W recorded a total of sixteen (16) trees, the highest number being those of pine species. In addition to pine, surveyors recorded six (6) cottonwood (*Populus trichocarpa*) and a cluster of willows (*Salix*) located in the southeast corner of Section 18. So prevalent were these willows, that surveyors were forced to move the section line east 1 chain (66 feet) in order to proceed surveying north between section 17 and 18. The range of error is notable in some sections of this township, an example being the path of the Hell Gate (Clark Fork) River in Section 26 of this township. The GLO map places the river (when placed over modern images) up along the north slope of Mt. Sentinel, which is highly unlikely that the river ran this path in 1870. It would seem that surveyors made an error in drawing out the plat map for this area. Another possibility for the cause of this error might be in the rubbersheeting method used to align the GLO map with modern aerial image on ArcGIS (see Chapter 4: Methods); or it is possible that it is a mixture of both. That being said, other geographic features for the township do confirm the reliability of the surveyor’s accurateness in mapping. For example, two ravines recorded between Sections 3 and 4 are accurately mapped on ArcGIS using measurements provided by surveyors. Figure 5.7 shows the two ravines along the section lines without the GLO map as a top layer and line up nicely with the existing ravines today. This is just one of several examples.
Figure 5.7 Close up of two ravines mapped on ArcGIS and recorded by GLO Surveyors showing the accuracy of their mapping methods. The white lines at the center of the picture represent the location of ravines noted by GLO surveyors. The vertical light blue line is the section line splitting Section 3 and 4.

Due to the rugged steepness of Mt. Sentinel that lies on the southeast corner in T13N R19W, this section was not surveyed in the 1870s. Historic photographs positioned towards Mt. Sentinel exhibits conditions much like we see today (see Figure 3.3, 5.23, and 5.24), and surveyor notes between Section 23 and 24 refer to Mt. Sentinel as a “bald mountain”.

Table 5.7 Section line vegetation descriptions noted by GLO workers for T13N R19W.

<table>
<thead>
<tr>
<th>Line Description</th>
<th>Number of Section Lines</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Timber</td>
<td>47</td>
</tr>
<tr>
<td>Few Scattering Pines</td>
<td>2</td>
</tr>
<tr>
<td>Cottonwood and a Few Pine Along Bitterroot River</td>
<td>1</td>
</tr>
<tr>
<td>Pine and cottonwood on the banks of Rattlesnake Creek</td>
<td>2</td>
</tr>
<tr>
<td>Few Cottonwood on the Hell Gate River</td>
<td>2</td>
</tr>
<tr>
<td>Cottonwood, Alders, Birch and Willows above the Hell Gate River</td>
<td>1</td>
</tr>
<tr>
<td>Cottonwood and Pine along the Hell Gate</td>
<td>1</td>
</tr>
<tr>
<td>A Few Cottonwoods along Grant Creek</td>
<td>2</td>
</tr>
</tbody>
</table>
Cottonwood with a few Pine underbrush of Willows along the river bottoms. | 1  
---|---
Cottonwood, Pine, and Alder along Hell Gate | 1  
Cottonwood, Pine, and Birch along Rattlesnake Creek | 2  

The majority of trees noted for T13N R19W were noted along the banks of the Bitterroot and Hell Gate Rivers, and lining the banks of Rattlesnake, Sam Martin, and Grant Creeks. GLO survey notes describe the majority of this township as free of timber with the exception of two (2) section lines in the northeast corner, which are defined as *open pine timber*. Today, a good portion of urban Missoula lies within this township, including the downtown area, university campus, the lower Rattlesnake area, East Missoula, and numerous residential neighborhoods (see modern land cover image in Figure 5.6). By today’s land cover classification, historically, T13N R19W supported Montane Valley Grassland Systems. Areas such as Mt. Jumbo, Mt. Sentinel, and Water Works Hill still support these grassland systems. Although they now contain several invasive plant species that have established themselves, land management programs are working to eliminate these weeds in an effort to maintain grassland systems that have been here for centuries, if not longer (Valliant 2015; Valliant et al. 2014).

Stuart (1865) describes the Missoula Valley as:

the lovely valley of “Hellgate” which is about twenty-five miles long with an average breadth of about six miles. It is almost all good farming land with a good growth of bunch grass, and it is enough to make a man from the prairies of Iowa or Illinois cry to see good pine timber that is going to waste here (Phillips 1957:4).
Historic land cover records for the Missoula Valley have helped to answer questions relevant to current research dedicated to Missoula’s historic urban landscape. For example, in 2014 the Missoula Historic Underground Project (MHUP) examined GLO surveys in an effort to figure out if an area along Main Street was in or around a deep ravine or ditch. The 1870s GLO surveyors recorded numerous ravines during the process of their surveys and documented these in their journal and maps. However, the GLO records showed that no ravine was recorded in the area of MHUP’s interest. This helped MHUP determine that local lore about an “underground” created by filling in a ravine were merely rumors. Questions answered for MHUP represents just one example of how this research can work to answer question about the early landscape of the Missoula Valley.

In terms of historical research, sources in this thesis contributed to a more in depth understanding for the development/evolution of Missoula Valley’s urban ecosystems; issues related to water use, water rights and water histories; and the impacts of extractive industries in the region. Clearly, diversion of rivers and streams had negative impacts on ecological communities and natural resources that naturally supported urban and rural ecosystems.

Table 5.8 Cultural features noted by GLO surveyors for T13N R19W.

<table>
<thead>
<tr>
<th>Feature Descriptions</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trails</td>
<td>8</td>
</tr>
<tr>
<td>Roads</td>
<td>12</td>
</tr>
<tr>
<td>House</td>
<td>1</td>
</tr>
<tr>
<td>Fences</td>
<td>11</td>
</tr>
<tr>
<td>Buildings</td>
<td>12</td>
</tr>
</tbody>
</table>

Several cultural features were recorded in T13N R19W and are attributed to settlements of Europeans into the Missoula Valley. According to GLO journals, the house of David Pattee and his fences are located along Section 33 and 34. Pattee moved to the Missoula Valley in 1858 to farm
(Koelbel 1974:14). The 1870s census records shows that David Pattee was still farming in the Missoula Valley, and today the Canyon to the east of Pattee’s house is referred to as Pattee Canyon. The GLO map for this township also shows the early town of Missoula located between Sections 21 and 22, north of the Hell Gate (Clark Fork) River. Surveyors drew twelve (12) squares in two rows illustrating the location of the town, and although the names of these supposed building are not discussed, surveyors did note the location of Main Street, Wm. Stevens fence, and the U.S. Military Road. GLO journals also recorded four other fences owned by settlers of the valley that include C. P. Higgins, James Minesinger, Neil Coakly, Daniel Woodman, and an individual with the last name of Ingraham.

Several sources discussed in this thesis mention various trails that led through Missoula (Flanagan 2001; Malouf 1982; Patterson 1981; Stone 2004; and Stuart 1957; see also the journals of Lewis and Clark, David Thompson 1808-1812 and John Mullan 1865. Eight (8) trail sections were recorded by surveyors and support the location of prehistoric trails noted in a map by the Salish-Pend ‘Oreille Cultural Committee and Elder Cultural Advisory Council Confederated Salish Kootenai Tribes (2005:40). The segment of trail recorded between Section 13 and 24, as well as the U.S. Military Road to the east, are likely part of the famous “Salish Road to the Buffalo” trail. Another trail noted on the GLO map was recorded between Sections 28 and 33, and is likely associated with a known prehistoric trail that led east through Pattee Canyon and then north towards the Blackfoot river corridor (Salish-Pend d’Oreille Cultural Committee and Elder Cultural Advisory Council Confederated Salish Kootenai Tribes 2005:40). This trail and the trail referred to as “Old Trail to Walla Walla” and was used by Indigenous groups as alternative routes east and were taken when there was cause to avoid the dangers of the trail through the Hell Gate Canyon.
Within the northern portion of T13N R19W, GLO surveyors recorded a trail they referred to as “Old Trail to Walla Walla”, that led though the valley and over the north part of Mt. Jumbo.

Surveyors also recorded the U. S. Military road which runs east-west across this township. Before becoming a military road, this trail was used by early trappers of the area, and was referred to as the “Hellgate Road” and was no doubt part of an established prehistoric trail before, probably part of the “road to the Buffalo trail”. This road later became the Mullan Trail and after 1859 it was designated as the Military Road (Koelbel 1972). The roads on this township intersect and connect with other roads and trails throughout the valley, creating a myriad of travel routes, and representing a time when the prehistoric Indigenous trails of the Valley were exploited, widened, and modified by Europeans to support the movement of goods and people through this area.
Modern Land Cover Data for T13N R19W

Figure 5.8 T13N R19W showing 2013 Modern Land Cover data.
Figure 5.9 T13N R19W showing 2013 modern land cover data and recorded 1870s GLO point data on top of modern land cover.

Modern Land Cover data and aerial imagery for T13N R19W shows a landscape much different than the one surveyed in the 1870s. Section lines described in 1870 as “no timber” were presumably part of the abundant grass filled valleys described by early settlers of the area; these have been replaced with urban development, residential housing, railroads, and roads. This section of the Missoula Valley has undergone the most intense land cover transformation in comparison to the other three townships discussed in this thesis.
Township 14 North Range 19 West

Figure 5.10 Map showing T14N R19W with 1870s GLO map as the top layer. Water, vegetation, and cultural features highlighted.
The third township examined in this project is the southern portion of T14N R19W, located above T13N R19W in the northeast section of the study area (see Figure 4.1 in Chapter 4). This township encompasses most of the Rattlesnake Valley (also referred to as the Rattlesnake Drainage area, or the Lower Rattlesnake Creek area; see Rattlesnake Creek Water Shed Group 2015). The surveys and maps recorded for this township were completed in 1884, 14 years after the surveys for T13N R20W, T13N R19W, and T14N R20W were completed. The first white settler moved into
the Rattlesnake Creek area in 1858, and by 1890 a total of 12 individuals were occupying the area (Rattlesnake Creek Watershed Group 2015). Prior to the 1900s, the Rattlesnake area was primarily used as a source of water and timber for settlers in the Missoula Valley. Settlers soon realized the sufficient volumes of water provided by Rattlesnake Creek year round, and in 1860 this creek was diverted to power the Missoula Mills located on the north side of the Hell Gate (Clark Fork) River near the present day Higgins Street Bridge (Rattlesnake Creek Watershed Group 2015).

Trees in this township were recorded in greater number than the other three townships in this study area (see Table 5.9). In addition to the sixty-seven (67) pine trees recorded, surveyors also recorded seventeen (17) tamarack, and twenty (20) fir trees. The Rattlesnake drainage area is located at the southern tip of the Mission Mountain Range and contains some of the more rugged terrain found adjacent to the Missoula Valley. Elevation for this area ranges from 3,600 feet to around 8,620 feet at McLeod’s peak (McLeod 1982), which is just north of T14N R19W boundary. The environment of this township supports a very different community of vegetation due to the increased difference in elevation and the narrowness of the land in comparison to the rest of the Missoula Valley.

Table 5.9 Bearing and line tree data recorded by surveyors for T14N R19W.

<table>
<thead>
<tr>
<th>Tree Species</th>
<th>Other Common Names</th>
<th>Scientific Name</th>
<th>Number recorded</th>
<th>Quantity/Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pine</td>
<td>Ponderosa Pine, Lodgepole Pine, Western White Pine, Whitebark Pine</td>
<td><em>Pinus ponderosa, P. Contorta, ssp. Latifolia, P. monticola, P. albicaulis</em></td>
<td>67</td>
<td>(1) 6 in diameter (2) 8 in diameter (1) 9 in diameter (4) 10 in diameter (5) 12 in diameter (1) 13 in diameter (2) 14 in diameter (2) 15 in diameter (3) 16 in diameter (2) 18 in diameter</td>
</tr>
<tr>
<td>Line Description</td>
<td>Number of Section Lines</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------</td>
<td>-------------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Timber</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good Grazing/ Fine Grazing</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pine and Fir Timber (Heavily Timbered )</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pine Timber</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5.10 Section line vegetation descriptions noted by GLO workers for T14N R19W.
A total of forty-eight section lines were surveyed in T14N R19W and are represented in Table 5.10. Five (5) section lines are described as “no timber,” and seven (7) lines were recorded as “good grazing” or “fine grazing.” It is safe to assume that these three section lines supported prairie grasslands located in the southwest section of the township. Eight (8) section lines were recorded as “heavily timbered pine and fir,” three (3) were recorded as “pine timber,” two (2) lines were recoded as “scattering pine timber,” three (3) were recorded as “scattering pine and fir, three (3) were described as “scattering timber,” nine (9) recorded as “heavily timbered pine, fir, and tamarack, and one (1) line was recorded as both “no timber” and “few scattering pine.” A small portion the section line between 36 and 1 was recorded by surveyors as being burned, and is the only reference made of burned land in the Missoula Valley by surveyors. Surveyors also noted the location of one (1) agricultural field owned by John Rankin located between Section 21 and 28, west of Grant Creek. A sawmill, two houses, three fence lines, and around 200 acres of land are also recorded by GLO surveyors and are associated with Rankin (see Table 4.14 in this Chapter)

<table>
<thead>
<tr>
<th>Feature Descriptions</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trails</td>
<td>0</td>
</tr>
<tr>
<td>Roads</td>
<td>6</td>
</tr>
<tr>
<td>House/Cabin</td>
<td>7</td>
</tr>
<tr>
<td>Fences</td>
<td>4</td>
</tr>
<tr>
<td>Irrigation Ditch</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 5.11 Cultural features noted by GLO surveyors for T14N R19W.
Surveyors recorded a total of six (6) roads in T14N R19W (see table 5.11); two of the roads were recorded as “road from sawmill to Missoula” and the other as “wood road” (see figure 5.10). Two (2) irrigation ditches tap into Grant Creek, running north-south through Sections 21,28,29, and 32. According to GLO surveying notes, these are some of the first irrigation ditches dug in the Missoula Valley. Surveyor notes do not provide any information on the use or ownership of the ditches, but they were likely used by Rankin to irrigate his agricultural fields. In the northern portion of Section 36, surveyors note the location of Sebastian Effinger’s house and fence. General description for this township states that Effinger had 20 acres of land under cultivation. The GLO map shows an irrigation ditch that starts at a section of Rattlesnake Creek, and ends on the north side of a fence line. To the north of Effinger’s fence, on the west side of Rattlesnake Creek, is the home of William Losa. GLO notes do not document that Losa was doing any farming and the 1870s census records for Missoula record Losa as a “day laborer.”

**Modern Land Cover Data for T14N R19W**

Modern land cover data for T14N R19W is dominated by ponderosa pine woodland and savanna areas, dry-mesic montane woodland mixed conifer forest, and foothill and valley grasslands. As noted in Figure 5.12 and 5.13, a narrow strip of developed land lies along both sides of Rattlesnake Creek. Modern land cover along Grant Creek shows areas residential development, agricultural land use areas, as well as foothill and valley grasslands.
Figure 5.12 2013 Modern Land Cover Data for T14N R19W without GLO point data.
In comparison to historical land cover data, modern data in Figure 5.13 shows an increase in tree densities along section lines 19 and 18. GLO surveyors recorded these section lines as “no timber” areas; today these lines are defined in scattered section as developed, grasslands and mixed with sections of conifer-dominated forest and woodlands. In the location between section line 21 and 28, GLO surveys note this area as containing scattered timber. Modern images and land cover data show an increase in tree density and classify this area as conifer-dominated forest and woodlands. Other areas in this township show decreasing tree densities such as the section line between 33 and 34. GLO surveyors recorded this line as “heavily timbered pine and fir,” but in
comparison modern images and land cover data, this area is classified as montane grasslands, small section of deciduous shrubland, and some areas of conifer-dominated forest and woodland.

Township 14 North Range 20 West

Figure 5.14 T14N R20W with 1870s GLO map as the top layer. Water, vegetation, and cultural features highlighted.
The fourth township examined for this project lies at the northwestern portion of the study area within the Missoula Valley and is positioned directly above T13N R20W (see Figure 4.1 in Chapter 4 and 5.15). Historic GLO records indicate that the majority of this township was free of timber. Once the GLO plat map is removed exposing section line classifications, we can see that these section lines are still free of timber minus some ravines and the banks of Two Creeks and
O’Keefe Creek. The majority of bearing trees recorded in this township lie in the northeast corner and along the Bitterroot Guide Meridian.

A total of 18 trees were recorded in T14N R20W: sixteen (16) pine, one (1) cottonwood, and one (1) fir trees were recorded in this township.

Table 5.12 Bearing and line tree data recorded by surveyors for T14N R20W.

<table>
<thead>
<tr>
<th>Tree Species</th>
<th>Other Common Names</th>
<th>Scientific Name</th>
<th>Number recorded</th>
<th>Quantity/Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pine</td>
<td>Ponderosa Pine, Lodgepole Pine, Western White Pine, Whitebark Pine</td>
<td><em>Pinus ponderosa, P. Contorta, ssp. Latifolia, P. monticola, P. albicaulis</em></td>
<td>16</td>
<td>(1) 8 in diameter (2) 12 in diameter (3) 15 in diameter (1) 20 in diameter (2) 24 in diameter (6) 30 in diameter (1) 36 in diameter</td>
</tr>
<tr>
<td>Cottonwood</td>
<td>Cottonwood</td>
<td><em>Populus trichocarpa</em></td>
<td>1</td>
<td>(1) 10 in diameter</td>
</tr>
<tr>
<td>Fir</td>
<td>Douglas fir, Subalpine Fir, Grand Fir</td>
<td><em>Pseudotsuga menziesii, Abies lasiocarpa, A. grandis</em></td>
<td>1</td>
<td>(1) 24 in Diameter</td>
</tr>
</tbody>
</table>

Surveyors recorded vegetation for sixty-seven (67) section lines in T14N R20W shown in Table 5.12. The northwest corner of this township was not surveyed due to the rugged character of the mountains to the north. Fifty-six (56) section lines were described as “no timber,” two (2) section lines were recorded as “open pine timber,” one (1) section line was described as “pine and fir timber,” one (1) section line was described as “pine, fir, and tamarack,” one (1) line was described as “scattering pine,” one (1) line was described as “scattering pine and fir,” and three (3) section lines were described as “level prairie.” According to GLO records, surveyors did not mention any vegetation along the banks of O’Keefe and Two Creeks, which leads us to conclude
that these banks may not have held water year round. Modern aerial images show shrubs and some trees are supported today along sections of O’Keefe and Two Creeks.

Table 5.13 Section line vegetation descriptions noted by GLO workers for T14N R20W.

<table>
<thead>
<tr>
<th>Line Description</th>
<th>Number of Section Lines</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Timber</td>
<td>56</td>
</tr>
<tr>
<td>Pine and Fir Timber</td>
<td>1</td>
</tr>
<tr>
<td>Pine, Fir, and Tamarack</td>
<td>1</td>
</tr>
<tr>
<td>Open Pine Timber</td>
<td>2</td>
</tr>
<tr>
<td>Scattering Pine</td>
<td>1</td>
</tr>
<tr>
<td>Scattering Pine and Fir</td>
<td>1</td>
</tr>
<tr>
<td>Level Prairie</td>
<td>3</td>
</tr>
<tr>
<td>No Description</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 5.14 Cultural features noted by GLO surveyors for T14N R20W.

<table>
<thead>
<tr>
<th>Feature Descriptions</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trails</td>
<td>1</td>
</tr>
<tr>
<td>Roads</td>
<td>5</td>
</tr>
<tr>
<td>Fences</td>
<td>8</td>
</tr>
<tr>
<td>Fields</td>
<td>2</td>
</tr>
</tbody>
</table>

Cultural features recorded in this township and listed in Table 5.14 include one (1) trail that passes through Sections 7, 8, and 9 and is identified as being the “Trail to the Jocko.” Five (5) roads were mapped in this township (see Figures 5.14 and 5.15) and were identified as, “road Frenchtown to the Jocko Valley” and “Road- Missoula Mills to the Jocko Valley”; surveyors did not note the names of the other three roads. Cultural features for this township also recorded the location of eight (8) fences. Cornelius O’Keefe and two other individuals by the last name of Woodward and Colean are noted in the GLO records as having fences in this township. Two (2) recorded fields are illustrated in the southeast corner of Section 33 and fall within the boundary of
two fences. Surveyors do not indicate whether this intersect an agricultural field or an area of open grassland; it may have been in the process of becoming an agricultural field.

**Modern Land Cover Data for T14N R20W**

![Modern land cover data for T14N R20W.](image)

Figure 5.16 Modern land cover data for T14N R20W.
Modern land cover data in T14N R20W classifies the majority of this area as agricultural crop lands, grassland systems, areas of commercial development, roads, and railroads. The northwest portion of Sections 4, 5, 6, 8, 9, and 10 show an area of recently burned grassland and forest systems. To the east of this area, in Sections 1, 2 and 3, forest and grassland areas make up the vegetation communities of these sections. Surveyors in the 1870s did not record some of this area due to rugged terrain. The southeast corner of T14N R20W, in sections 33, 32, and 31, along Two Creeks, show several riparian areas and wet meadow areas intermixed with developed land use areas. On three section lines (30, 31, and 19), GLO surveyors record these areas as being “level
prairie.” Modern land cover data in the northern part of Section 19, shows this area is now classified under agricultural land use, railroad, and developed area. The prairie described in the northwest portion of Section 30 and 31 in the 1870s is now developed agricultural land with an irrigation canal and areas of residential development. Much of the area surrounding the historic “level prairie” lines are now used today for farming and agricultural purposes.

As described by GLO surveyors in the “general description,” much of this township does consists of rolling foothills, and portions are today still grass covered. The most notable change in modern land cover data versus historic GLO notes is the development of lower lying areas along the foothills, which have been developed for commercial industry purposes, residential development, and agricultural uses.

**General Descriptions for each Township**

As a part of their documenting duties, surveyors were required to write a general description in their journals following the completion of each township. Length and detail varied depending on the township and surveyor. In many cases, information recorded in the general descriptions discussed information absent from the field journals and maps. These summaries provide a variety of information on names and locations of European settlers into the area. Several names are recorded by surveyors indicating their place of settlement in the valley; these records help tell early history of the area. A census report was taken by Marshall Wheeler for the Missoula Valley in 1870 tallied a total of 2,554 Europeans inhabited the valley and of that count, 2,084 were men (Koelbel 1971:34).
Table 5.15 General Descriptions for each township in the Missoula Valley study area. These descriptions are found at the end of each township journal. Some words on the GLO documents are unknown and are indicated with a __ indicating an un-readable word, some words are highlighted meaning the word was hard to read but it could possibly be the word highlighted.

<table>
<thead>
<tr>
<th>Township</th>
<th>Surveyors</th>
<th>General Description/Land Summary</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>T13N R20W</td>
<td>Walter W. Johnson and William H. Baker</td>
<td>The quality of land in this township is above the common average. Although a considerable portion of the uplands is rolling yet there remains a large quantity of excellent farming land. In sections 26 and 27 the Hell Gate River empties into the Bitter Root forming by their junction a large and rapid stream. The banks of both these rivers are well timbered with pine and cottonwood and on the Bitter Root Range of Mountains at the foot of which the Bitter Root River runs, pine and fir timber is found in abundance. The town of Hell Gate situated in sec. 14 contains several houses and a store. It was formerly the county seat of Missoula Co. – Sept 17th</td>
<td>July 1870</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Two thirds if not more of the land in this township is arable and of 1st quality. There are many farms on the Bitter Root and Hell Gate rivers which unite near its center. There is fine pine timber on the opens of the mountains as well as scattered on the bottoms, and should be subdivided. April 26th</td>
<td>April 1870</td>
</tr>
<tr>
<td></td>
<td>Walter Johnson</td>
<td>The land over which this line passes is generally level and the soil is mostly 1st rate. There are many settlers on these lands and two __townships should be subdivided. The timber is confined to a belt of cottonwood, alders and pines which borders the Bitter Root and Hell Gate rivers that have their confluences about a mile west of the meridian.</td>
<td>July 1870</td>
</tr>
<tr>
<td>T13N R19W</td>
<td>Walter Johnson and William H. Baker</td>
<td>The quality of the land in this township is above the common average. The Southern and north western portions consist of rich bottom land well adapted to farming</td>
<td></td>
</tr>
</tbody>
</table>
The north eastern portion comprises rolling foot hills affording excellent feeding grounds for stock. Rattle snake creek is a beautiful stream of clean water is well adapted for mill seats. Missoula Mills situated in the center of the township is a flourishing town, is the county seat of Missoula County and is located on the right bank of the Hell Gate river which flows through the township from east to west.

<table>
<thead>
<tr>
<th>Township</th>
<th>Surveyor</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>T13N R19W</td>
<td>Walter Johnson and William H. Baker</td>
<td>The Land in the quarter part of this township is level and the soil is first and second rate. The town of Missoula Mills is situated near the center and has a population of about a hundred souls. There is a fine grist mill run by the water power aff--- by Rattle Snake creek. There is a saw mill on Grank Creek near the N. W. cor of this township and fine pine timber on the mountains on the north boundary the same. There are many fine farms on the Bitter Root River and on the Hell Gate. It should be subdivided. April 25th</td>
</tr>
<tr>
<td>T14N R20W</td>
<td>Walter Johnson and William H. Baker</td>
<td>Most of the land in this township consists of rolling foothills. There is a strip of land ----? (bending/boardering) on Two Creeks which is very rich and well adapted to farming purposes. Also in the vicinity of O’Keeffe Creek this is some very good farming land. The rolling hills are covered with a fine growth of grass making excellent feeding grounds for stock. The township is almost entirely free of timber except on the mountains which bound it on the north. These mountains from the source of the Jacko River, Grant Creek, and Two Creeks and are very rugged and precipitous in there character. The mouth of the Coriean Defile which forms a pass from the Hell Gate to the Jacko Valley lies in section 4 of this township</td>
</tr>
<tr>
<td>T14N R19W</td>
<td>Harry V. Wheeler</td>
<td>This township is of a fine mountainous</td>
</tr>
</tbody>
</table>

April 1870

September 1870

July/Aug 1884
character. Most of it is covered with pine, fir, and tamarack timber, in many places it is small and scrubby; nearly all of the good timber that was easy to access has been cut for settlers use and for ties and bridge timber for the Northern Pacific Railroad. There are narrow valleys of good tillable land along Rattle Snake and Grant creeks which are occupied by settlers. The S.W. portion of this township affords good grazing for stock, the northern and eastern portion are very rough and mountainous and entirely unsuitable for settlement.

Settlers and Improvements:
John Rankin the applicant has a sawmill on line between sec. 28 and 29, his other improvement consists of several houses in N.E. sec. 29 and a house in line between sec 21 and 28. He also has about 200 acres under cultivation lying in the S.W. ¼ sec. 21, N.W. ¼ sec. 28, N.E. ¼ sec. 29, S.E. ¼ sec. 20.
Higgins has several buildings and about 40 acres under cultivation in N.E. ¼ sec. 32.
Sebastian Effington has a house in the N.W. ¼ sec. 36 also about 20 acres under cultivation lying in N.W. ¼ sec. 36 and N.E. ¼ sec 35.
Wm. Losa has a cabin in S.E ¼ sec. 26
There are three cabins near the ¼ sec. corner between sec. 16 and 21.

Summary of Historic and Modern Land Cover Comparisons

Both T13N R19W and T14N R19W showed an increase in timber in some areas, and a decrease of timber along certain section lines. For T13N R19W, the north boundaries of Section 11 and 12 were recorded by 19th century surveyors as “few scattering timber.” Today these section lines show areas of no timber, scattering timber, and areas of heavier timber densities. The
northwest corner of Section 2 shows an increase in timber; this section line was originally described as “no timber,” but modern land cover images show an encroaching tree line to the north. GLO surveyors recorded the section line between Section 1 and 2 as containing “no timber,” but today this area is populated with an established forest, especially in the northern section of these two sections. Modern land cover data classifies the areas along section 1 and 2 as a conifer-dominated forest and woodland system with small areas of developed land and some sections of montane grasslands.

For T14N R19W, areas such as the north boundary of Section 20 and the west boundary of Section 34 show a decrease in timber densities. These lines were both recorded as “heavily timbered pine and fir,” in the late-19th century, but according to modern images, these areas contain large sections of no timber and are classified as montane grassland systems. On the north boundary of Section 28, the east half of the boundary was recorded by surveyors in the late-19 century as “scattering timber,” but today aerial images indicate that this section line passes through a thick patch of trees. There is also an increased number of trees present in the west boundary of Section 28; this area was originally recorded as “no timber,” but modern images show areas of encroaching timber. Areas along Grant Creek also support a good amount of timber not noted by the GLO records. The north and west boundary of this township (Section 19) shows an increase in timber; The GLO’s section line was originally recorded as “no timber,” but modern aerial images show areas of scattering and ticker timber for portions of this area.

Land cover for T14N R20W shows a decrease in timber along the west boundary of Section 4. This area was originally recorded as “scattering pine”; modern images show that this area is almost free of timber, and modern land cover data describes this area as recently burned. The west
boundary of Section 2 was originally recorded as “pine and fir timber”; but modern imagery shows a decrease in timber for this area and it is classified as montane grasslands. Modern aerial images show an increase in timber for the west boundary of Section 12. Surveyors originally recorded this line as “open pine timber,” but today a thick patch of timber consumes a large portion of this section line.

Variation differences in vegetation observed in T13N R20W were observed in the north boundary of Section 17. This line was previously recorded as “scattering pine” and today is mostly free of timber except along the Bitterroot River. A majority of the “no timber” lines have been transformed by urban development and also utilized by farming land use. Areas along the confluence of the Bitterroot and Clark Fork River continue to support grassland and riparian ecosystems. Surveyors did not record or mention any wetland areas along these section lines, but they did note wooded vegetation such as pine, cottonwood, fir, and alder trees in this area. These species are still supported here today.

Salish and Pend d’Oreille Place Names and Plant Collecting Sites

The Missoula Valley and the surrounding valleys (Bitterroot, Flathead, Potomac, and Jocko) harbored plentiful plant resources acquired seasonally by Salish, Pend d’Oreille and Kootenai tribes (and undoubtedly others over time as well). Several locations in the Missoula Valley were popular bitterroot collecting sites noted by the Salish-Pend d’Oreille Cultural Committee and Elders Advisory Council Confederated Salish and Kootenai Tribes (2005). These locations are mapped in Figure 5.18 of this chapter. Sources list the following locations in the Missoula Valley as being places where bitterroot were commonly collected and are as followed;
the area that is now the Missoula fairgrounds; the area that is now Shopko; the confluences of the
Rattlesnake and the Hell Gate (Clark Fork) River; along the base of Mt Jumbo; on the grounds of
the University of Montana campus; in north Missoula near the intersection of Hwy 90 and Hwy 93;
and south of town near Miller Creek along the south hills. Presence of bitterroot were also noted as
being abundant all along Reserve Street and in an area referred to as “the flats” somewhere near
Fort Missoula. Bitterroot locations for Reserve Street and the Flats are not documented on the
actual ArcGIS map due to their vague reference, but are noted as general areas where bitterroot
collecting occurred. Early Indigenous sources provide evidence of bitterroot prevalent on the valley
floor a century ago, but today bitterroot are found above the valley in the 21st century.

Another reference to bitterroot collecting was told in biography by Ida Patterson. During
the late 19th century, Patterson (1981), in the memoirs of Emma Magee, tell the story of when
Emma and her sister dug bitterroot during the springtime in a rocky area located behind their
outhouse. The interesting thing about Mrs. Emma Magee was that her father was James Madison
Minesinger, a resident of the Missoula Valley. According to GLO records for 1870, the fence of
James Minesinger was located in T13N R19W between Section lines 8 and 9. By using these two
sources it was possible to discern a probable location Emma Magee was referring to when she was
collecting bitterroot. Today, modern land cover information at the historic fence line of the
Minesinger property is classified as “commercial/ industrial human use” with a small section of
classified “grassland” to the southeast of the fence line (Montana Natural Heritage Website 2013).
This area was not surveyed as a part of this project, but future research by way of surveying and
perhaps pollen analysis could provide additional evidence of this area supporting a spread of
bitterroot in the late 19th century. Further research using other existing historical journals and
biographies of early residents in the Missoula Valley might also uncover stories such as the one above that would contribute to the placement of bitterroot collecting locations on the ArcGIS map.

Traditional Root Collecting and Trail Location in the Missoula Valley and Surrounding Area

Figure 5.18 Map shows prehistoric trails crossing through the Bitterroot and Missoula Valley, the Indigenous place names given to areas, and the locations of popular bitterroot and camas collecting areas.
As discussed in the literature review chapter and the historical background section, the use of indigenous references in understanding the historic conditions of the Missoula Valley has been an important part of this project. When examined alongside GLO records, TEK sources further reveal how land use agendas and landscapes changed during this time. Sources of TEK have led to identifying locations of historic and prehistoric root collecting areas, seen in Figure 5.18 and can be used in analyzing modern land cover. Information for this thesis provided by sources of TEK can be used to answer questions about whether or not these areas could (or do they still) support camas and bitterroot plants and if not, then why. Indigenous sources also provided several place names in areas of the Missoula, Potomac, and Bitterroot Valleys. The mention of historic trails that criss-crossed through sections of the Missoula Valley eventually became widened trails used by Europeans and led travelers to their desired destinations. These widened trails also supported supplies being brought into newly established towns. In addition to historical documents and information from Indigenous sources, this thesis turned to data collected from soil samples to help create a time line of vegetation changes occurring in the valley. The next section discusses the results of pollen analysis collected from an archaeological site in the Missoula Valley.

**Pollen Analysis Results:**

As a part of the summer 2013 archaeological excavations at the Fort Missoula Historic Dump (24MO0188) along the Bitterroot River, three soil samples were collected from Test Excavation Unit 4 (see Figure 4.4, 4.5, and 4.7). This site was recorded by Carling Malouf in 1982 and was noted by Malouf in 1944 while stationed at the Fort as a First Lieutenant (Malouf 1982). According to Malouf, the history of the site dates back to the establishment of the fort in 1877.
Soil samples collected from the excavation unit were submitted to PaleoResearch Institute to distinguish the types of plants present within each layer (see pages 89-94 for details on soil extraction). All information in this section has been extracted from the pollen analysis report completed by Linda Scott Cummings at PaleoResearch Institute.

It was hypothesized that soil samples from lower level samples (Strat II and/or Strat III) would have a higher number of native plants in comparison to non-native plants; the latter would be expected to dominate the upper layers (Strat I). Plants listed in Table 5.15 provide a list of recorded pollen identified from the samples. A total of 38 different pollen taxa were identified from soils samples submitted and represented seven (7) arboreal, seventeen (17) non-arboreal, eight (8) edible/economic, four (4) spores, one (1) algae, and three (3) classified as other. Pollen counts were acquired from all three layers and are presented graphically in Figure 5.20.

Table 5.16 Pollen types identified in soil samples from the Fort Missoula Historic Dump Site (24MO0188), Missoula Montana.

<table>
<thead>
<tr>
<th>Scientific Name (Arboreal Pollen)</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alnus</td>
<td>Alder</td>
</tr>
<tr>
<td>Pinaceae</td>
<td>Pine Family</td>
</tr>
<tr>
<td>Picea</td>
<td>Spruce</td>
</tr>
<tr>
<td>Pinus</td>
<td>Pine</td>
</tr>
<tr>
<td>Quercus</td>
<td>Oak</td>
</tr>
<tr>
<td>Salix</td>
<td>Willow</td>
</tr>
<tr>
<td>Scientific Name (Non-Arboreal Pollen)</td>
<td>Common Name</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>Amaranthaceae</td>
<td>Amaranth and Chenopodiaceae Family</td>
</tr>
<tr>
<td>Apiaceae</td>
<td>Umbel Family</td>
</tr>
<tr>
<td>Asteraceae:</td>
<td>Sunflower Family</td>
</tr>
<tr>
<td>Artemisia</td>
<td>Sagebrush</td>
</tr>
<tr>
<td>Cirsium</td>
<td>Thistle</td>
</tr>
<tr>
<td>Low-spine</td>
<td>Includes Ragweed, Cocksbeur, Sumpweed</td>
</tr>
<tr>
<td>High-spine</td>
<td>Includes Aster, Rabbitbrush, Snakeweed, Sunflower, etc.</td>
</tr>
<tr>
<td>Liguliflorae</td>
<td>Chicory tribe, includes chicory and dandelion</td>
</tr>
<tr>
<td>Brassicaceae</td>
<td>Mustard and Cabbage Family</td>
</tr>
<tr>
<td>Cyperaceae</td>
<td>Sedge Family</td>
</tr>
<tr>
<td>Erodium</td>
<td>Storkbill, Heron-bill, Filaree</td>
</tr>
<tr>
<td>Fabaceae:</td>
<td>Bean or Legume Family</td>
</tr>
<tr>
<td>Trifolium pretense-type</td>
<td>Red clover</td>
</tr>
<tr>
<td>Poaceae</td>
<td>Grass Family</td>
</tr>
<tr>
<td>Polygalaceae</td>
<td>Milkwort Family</td>
</tr>
<tr>
<td>Sarcobatus</td>
<td>Greasewood</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scientific Name (Edible/Economic)</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cerealia</td>
<td>Economic members of the Grass family that include <em>Triticum</em> (wheat), <em>Avena</em> (oat), <em>Hordeum vulgare</em> (barley), and <em>Secale cereale</em> (rye)</td>
</tr>
<tr>
<td>Organism/Category</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Fragaria</td>
<td>Strawberry</td>
</tr>
<tr>
<td>Nicotiana</td>
<td>Tobacco</td>
</tr>
<tr>
<td>Prunus-type</td>
<td>Cherry, Plum</td>
</tr>
<tr>
<td>Salvia</td>
<td>Sage</td>
</tr>
<tr>
<td>Zea mays</td>
<td>Maize, Corn</td>
</tr>
<tr>
<td>4CP transverse reticulate</td>
<td>Unidentified pollen with 4 colpi and 4 transverse pores, reticulate exine</td>
</tr>
<tr>
<td>Indeterminate</td>
<td>Too badly deteriorated to identify</td>
</tr>
<tr>
<td>Spores:</td>
<td><strong>Fern</strong></td>
</tr>
<tr>
<td>Monolete smooth</td>
<td><strong>Fern</strong></td>
</tr>
<tr>
<td>Selaginella densa</td>
<td>Little clubmoss</td>
</tr>
<tr>
<td>Trilete smooth</td>
<td><strong>Fern</strong></td>
</tr>
<tr>
<td>Trilete spiny</td>
<td><strong>Fern</strong></td>
</tr>
<tr>
<td>Algae:</td>
<td><strong>Spirogyra</strong></td>
</tr>
<tr>
<td>Spirogyra</td>
<td>Algal body representing a filamentous green algae common in freshwater habitats.</td>
</tr>
<tr>
<td>Other:</td>
<td><strong>Charred Asteraceae tissue fragment</strong></td>
</tr>
<tr>
<td>Charred Asteraceae tissue fragment</td>
<td>Charred tissue fragment from a member of the sunflower family.</td>
</tr>
<tr>
<td>Dendritic sheet element</td>
<td>Plant tissue from cereal glumes or one of a few native festucoid (cool season) grasses.</td>
</tr>
<tr>
<td>Microscopic Charcoal</td>
<td>Microscopic charcoal fragments.</td>
</tr>
</tbody>
</table>
Total pollen concentration for Stratum I was more than 27,000 pollen per cubic centimeter (cc) of sediment; Stratum II was around 31,000 pollen per cc of sediment; and pollen concentration for Stratum III totaled over 14,500 pollen per cc of sediment.

*Stratum I (10-15 cmbs)*

Stratum I represents the uppermost sample (#1), (see Figures 3.5 and 3.7 in Chapter 3). This sample yielded the largest variety of pollen. *Pinus* (Pine) remains dominant and is accompanied by small quantities of *Abies* (Fir) and *Picea* (Spruce) pollen, representing pine, fir, and spruce trees growing in the mountains. The small quantity of *Quercus* (Oak) pollen might reflect oaks growing in the mountains or closer to the fort. This is the only sample that yielded a small quantity of *Salix* (Willow) pollen, documenting growth of willows along Bitterroot River. Native vegetation is represented by an elevated Amaranthaceae pollen frequency, which likely represents burning bush, small quantities of *Artemisia* (Sagebrush), High-spine, Asteraceae (Sunflower Family), Cyperaceae (Sedge Family), and Poaceae (Grass Family). Pollen representing weedy plants includes Apiaceae (umbel family), Low-spine Asteraceae (Ragweed, Cocklebur, Marsh Elder, and Sumpweed), Liguliflorae (Chicory or Dandelion), Brassicaceae (Mustard or Cabbage Family), *Erodium* (Stockbill, Heron-bill, Filaree), Fabaceae (Bean or Legume family), *Trifolium pratense*-type (Red Clover), and Polygonaceae (Milkwort Family). Pollen that suggests discard into the dump are numerous and include Cerealia (Wheat, Oat, Barley or Rye), *Fragaria* (Strawberry), *Nicotiana* (Tobacco), *Prunus*-type (Cherry or Plum), *Salvia* (Sage), and *Zea mays* (Corn) representing cereals and or baked goods. This is the only evidence of tobacco recovered from this dump. It suggests use and discard of tobacco product. *Spirogyra*, algal spores were noted, documenting the presence of
moisture. Microscopic charcoal included a few pieces of burned sunflower stem. The total pollen concentration was more than 27,000 pollen per cc of sediment (Cummings 2015:7).

Stratum II (20-30 cmbs)

Samples for Stratum II were represented by quantities of Picea (Spruce), Pinus (Pine), and Quercus (Oak) pollen and are similar to those observed in sample 3. This level also contained small quantities of Alnus (Alder), and Abies (Fir) pollen represent local alder and possible windblown pollen from fir growing in the mountains. Local native vegetation is represented by Amaranthaceae, Artemisia (Sagebrush), High-spine Asteraceae (Rabbitbrush, Snakeweed, Aster, or Sunflower Family), Cyperaceae (Sedge Family), Poaceae (Grass Family), and Sarcobatus (Greasewood) pollen. Weedy plants are represented by Cirsium (Thistle), Liguliflorae (Chicory), Erodium (Storksbill, Heron-bill, Filaree) Fabaceae (Bean or Legume Family), Trifolium pratense-type (Red Clover), and Polygonaceae (Milkwort Family) pollen. This sample yielded a larger quantity of Cerealia (Wheat, Oat, Barley, Rye) pollen representing discard of cereals or perhaps baked goods. A small quantity of Zea mays (Corn) pollen also was observed. Once again, sheets of dendritic cells were observed indicating discard of glumes from cereals. Only a few spores representing clubmoss (Selaginella densa) and ferns (trilette smooth) were noted. Microscopic charcoal was less abundant relative to pollen in this sample. Total pollen concentration was nearly 31,000 pollen per cc of sediment (Cummings 2015:7).

Stratum III (54-59 cmbs)

The last level, Stratum III was dominated by pinus (Pine) pollen and represent pine trees that lie directly across (south) of the excavation unit. Mountains surrounding the Missoula Valley
support a large number of pines upon their peaks as well. Small quantities of *Picea* (Spruce) and *Quercus* (oak), which grow in the surrounding area, are also represented in the pollen record for this level. Local native vegetation identified in this stratum include, Amaranthaceae, *Artemisia* (Sagebrush), High-spine Asteraceae (Aster, Rabbitbrush, Snakeweed, and Sunflower), and Poaceae (Grass Family) pollen. Weedy plant pollen in Stratum III included Apiaceae (Umbel Family), Liguliflore (Chicory), Brassicaceae (Mustard and Cabbage Family), *Erodium* (Storkbill, Heron-bill, Filaree), Fabaceae (Bean and Legume Family), and *Trifolium* pretense-type (Red Clover) pollen. Concentrations of Cerealia pollen were abundant in this level and suggests that kitchen debris (baked goods and/or wheat flour) was discarded in this area. Small quantities of *Fragaria* (Strawberry) and *Zea mays* (Corn) pollen were also identified suggesting that strawberries and corn are probably associated with discarded kitchen debris. A small quantity of fern spores were observed in this stratum, indicating a shaded area supporting fern growth in a nearby area. Vegetation in the area directly south of the Fort Missoula Historic Dump, currently supports a few fern species. Sources of historic photos overlooking the Fort Missoula Area (see Figure 4.21 and 4.22) show the area south of the historic dump site as being similar to the conditions in vegetation that we see today. This sample also revealed a large quantity of burned charcoal with fragments of Asteraceae pollen representing plants in the sunflower family were burned. Historical notes and information from Missoula locals reveal that sections of the dump were often burned in an effort to reduce space taken up by discarded items in the dump (Malouf 1982). The pollen taxon of most interest in this sample may be described as tetracolporate (4CP on diagram) with an even reticulate surface. This particular pollen taxa remains unidentified, although due to the fact that this morphology is not typical of any plants known to be part of the native vegetation communities for this area, it is thought to represent a plant with economic importance that was brought into the site.
Total pollen concentration was more than 14,500 pollen per cubic centimeter (cc) of sediment (Cummings 2015:6).
Figure 5.19: Pollen Diagram for Missoula Historic Dump (24MO0188), Missoula, Montana.
Conclusions from the soil samples indicate a record of pollen taxa documenting conifer forests that supported pine, spruce, and fir in the adjacent mountains. Oak trees are found around the Fort property and are represented in the pollen taxa of these soil samples. Alder and willow are noted sporadically within the record. Today, a high concentration of willow (Salix) plants grow on the adjacent side of the Bitterroot River, south of the historic dump, as well as near the historic dump. Pollen analysis show plants growing in the immediate vicinity of the Fort include a member of the amaranth family, sagebrush, and various plants in the sunflower family, sedges, grasses, and occasionally greasewood.

Although some of these plants might have been weedy, pollen often interpreted to represent weedy vegetation included at least a member of the amaranth family, a member of the umbel or parsley family, ragweed, thistle, dandelion-type plants, a member of the mustard family, probably some of the sedges, filaree, legumes including clover, and knotweed. Cerealia pollen was common and abundant in these samples, indicating discard of cereals and probably baked goods. Corn was recovered in every sample, documenting use of corn at the site and its importance to the occupants. Pollen evidence for strawberries, tobacco, plums or a related fruit, and cooking sage were observed, particularly in the uppermost sample. The primary change in the pollen record comes between Strata I and II. Pollen analysis in these layers reveals evidence of a greater variety of food and economic plants or plant remains, as well as an increase in weedy vegetation at the Fort. The unidentified “Tetracolporate” pollen observed in the uppermost sample likely represents a plant food or medicine (Cummings 2015:8).
Test Well Measurements

Table 5.17 shows the recorded water level data for the Bitterroot River collected from a test well inserted into the center of Test Excavation Unit 4. As stated in Chapter 4, the site initially had three test wells, but due to vandalism two of them were pulled out of the ground. Test Well two remained, and so water table data was recorded. The following graph shows the ground water levels at the Fort Missoula Historic Dump Site (24MO0188) along the Bitterroot River starting in March 2014 and ending in April 2015.

Table 5.17 Measurements for test wells at the Fort Missoula Historic Dump Site (24MO0188)

![Recorded Measurements for Test Well at Fort Missoula](image-url)
Archaeological Sites in the Missoula Valley

Examinations of prehistoric and historic sites within the Missoula Valley are listed in Tables 5.18–5.21 and were examined as a source of land use history for the Missoula Valley. Included in a number of site reports are the descriptions of vegetation observed at the time the site was recorded. Archaeological sites, both historic and prehistoric, found throughout the Missoula Valley have been recorded since the 1950s. The Montana State Historic Preservation Office (SHPO) houses a database for all sites recorded in the state of Montana. Information was gathered from archaeological records housed in the University of Montana Anthropological Curation Facility (UMACF), as well as records acquired through the SHPO. These records provide number of prehistoric and historic sites documented within the Missoula Valley. Information from sites recorded throughout western Montana can be used for documenting and analyzing land use histories and human-environmental interactions of a region over time.

In addition to listed township sites in the Missoula Valley, the following section will also examine three archaeological site forms from sites recorded in the Missoula Valley. Information from these records offer comparative land use information about vegetation conditions within the study area, in what I refer to as the middle or the “in between” look at vegetation and landscape histories for the Missoula Valley. These records predate the 2013 modern land cover data but, do not extend as far back as GLO records or early pollen records; they serve as a 20th century bridge between GLO records and information from pollen records and vegetation recorded on archaeological site forms. This information can then be used to help create a timeline of vegetation and land use data for the Missoula Valley.
The following tables show a count of prehistoric and historic sites recorded for the Missoula Valley. Only site information for four townships that make up the study area are listed in the following tables.

Table 5.18 Archaeological Sites (Prehistoric and Historic) recorded in the Missoula Valley for T13N R19W.

<table>
<thead>
<tr>
<th>Prehistoric Sites in T13N R19W</th>
<th>Count</th>
<th>Time Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paleopoint Isolate</td>
<td>1</td>
<td>nd</td>
</tr>
<tr>
<td>Lithic Concentration</td>
<td>2</td>
<td>nd</td>
</tr>
<tr>
<td>Rock Cairn</td>
<td>1</td>
<td>Historic/Prehistoric</td>
</tr>
<tr>
<td>Mammal Fossil</td>
<td>1</td>
<td>Tertiary</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Historic Sites Types in T13N R19W</th>
<th>Count</th>
<th>Time Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Historic Military</td>
<td>4</td>
<td>1877-</td>
</tr>
<tr>
<td>Historic Irrigation System</td>
<td>21</td>
<td>1880, 1903, 1907</td>
</tr>
<tr>
<td>Historic Agriculture</td>
<td></td>
<td>1916, 1918-1921</td>
</tr>
<tr>
<td>Historic Vehicular/Foot Bridge</td>
<td>7</td>
<td>1900-1930</td>
</tr>
<tr>
<td>Historic Commercial Development</td>
<td>119</td>
<td>1915-1969</td>
</tr>
<tr>
<td>Historic Railroad, Stage Route, Travel</td>
<td>29</td>
<td>1888,1900-</td>
</tr>
<tr>
<td>Historic Railroad Building Structure</td>
<td>5</td>
<td>1888, 1909</td>
</tr>
<tr>
<td>Historic Mining</td>
<td>1</td>
<td>Historic Period</td>
</tr>
<tr>
<td>Historic Road/Trail</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Historic Homestead/Farmstead</td>
<td>4</td>
<td>1880-1956</td>
</tr>
<tr>
<td>Historic Site</td>
<td>26</td>
<td>Historic Period-</td>
</tr>
<tr>
<td>Historic Residence</td>
<td>288</td>
<td>1901, 1910, 1921</td>
</tr>
<tr>
<td>Historic District</td>
<td>22</td>
<td>1864-1955</td>
</tr>
</tbody>
</table>

Table 5.18 T13N R19W holds the largest number of recorded sites in the Missoula Valley. These site types include numerous historical homes, buildings, and historical districts.
Earliest historic sites in this township date from around 1855 and extend on up to the early 20th century.

Table 5.19 Archaeological Sites (Prehistoric and Historic) recorded in the Missoula Valley for T13N R20W.

<table>
<thead>
<tr>
<th>Prehistoric Site Types in T13N R20W</th>
<th>Count</th>
<th>Time Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lithic Concentration</td>
<td>3</td>
<td>nd- prehistoric</td>
</tr>
<tr>
<td>Mammal Fossil</td>
<td>1</td>
<td>Tertiary</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Historic Site Types in T13N R20W</th>
<th>Count</th>
<th>Time Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Historic Military Sites</td>
<td>8</td>
<td>1870-</td>
</tr>
<tr>
<td>Historic Homestead/Farmstead</td>
<td>5</td>
<td>1882-</td>
</tr>
<tr>
<td>Historic Railroad</td>
<td>8</td>
<td>1880</td>
</tr>
<tr>
<td>Historic Railroad Building</td>
<td>1</td>
<td>1910-1919</td>
</tr>
<tr>
<td>Historic Trash Dump</td>
<td>5</td>
<td>1878-</td>
</tr>
<tr>
<td>Historic Vehicular/Foot Bridge</td>
<td>1</td>
<td>NA</td>
</tr>
<tr>
<td>Historic School</td>
<td>1</td>
<td>1900-1909</td>
</tr>
<tr>
<td>Historical Commercial Development</td>
<td>2</td>
<td>1950-</td>
</tr>
<tr>
<td>Historic Structure</td>
<td>3</td>
<td>1940-1969</td>
</tr>
<tr>
<td>Historic Agriculture</td>
<td>1</td>
<td>1880-1889</td>
</tr>
<tr>
<td>Historic Residence</td>
<td>6</td>
<td>1890-</td>
</tr>
<tr>
<td>Other (Council Grove)</td>
<td>1</td>
<td>1855</td>
</tr>
<tr>
<td>Historic Irrigation System</td>
<td>21</td>
<td>1901-1959</td>
</tr>
</tbody>
</table>

Table 5.20 Archaeological Site (Prehistoric and Historic) recorded in the Missoula Valley for T14N R19W.

<table>
<thead>
<tr>
<th>Prehistoric Site Types in T14N R19W</th>
<th>Count</th>
<th>Time Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lithic Concentration (Rock Cairn)</td>
<td>2</td>
<td>Prehistoric Late Period</td>
</tr>
<tr>
<td>Historic Site Types in T14N R19W</td>
<td>Count</td>
<td>Time Range</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-------</td>
<td>------------</td>
</tr>
<tr>
<td>Historic Building</td>
<td>3</td>
<td>1898</td>
</tr>
<tr>
<td>Historic Trash Dump</td>
<td>2</td>
<td>1892</td>
</tr>
<tr>
<td>Historic Mining</td>
<td>3</td>
<td>Nd</td>
</tr>
<tr>
<td>Historic Vehicular/Foot Bridge</td>
<td>1</td>
<td>1888-</td>
</tr>
<tr>
<td>Historic Farmstead/Homestead</td>
<td>9</td>
<td>1895-1936</td>
</tr>
<tr>
<td>Historic School</td>
<td>1</td>
<td>1907</td>
</tr>
<tr>
<td>Historic Communication</td>
<td>2</td>
<td>1911-</td>
</tr>
<tr>
<td>Historic Energy Development</td>
<td></td>
<td>1950-1959</td>
</tr>
<tr>
<td>Historic Industrial Development (Pipeline)</td>
<td>8</td>
<td>1954-</td>
</tr>
<tr>
<td>Historic District (Upper Rattlesnake Homesteading District)</td>
<td>10</td>
<td>1882-</td>
</tr>
</tbody>
</table>

Table 5.21 Archaeological Sites (Prehistoric and Historic) recorded in the Missoula Valley for T14N R20W.

<table>
<thead>
<tr>
<th>Prehistoric Site Types in T14N R20W</th>
<th>Count</th>
<th>Time Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lithic Concentration (Rock Cairn)</td>
<td>2</td>
<td>Prehistoric /Late Prehistoric</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Historic Site Types in T14N R20W</th>
<th>Count</th>
<th>Time Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Historic Agriculture/Irrigation</td>
<td>5</td>
<td>1861-1959</td>
</tr>
<tr>
<td>Historic Railroad</td>
<td>24</td>
<td>1880-1889</td>
</tr>
<tr>
<td>Historic Railroad Bridge</td>
<td>2</td>
<td>1880-1889</td>
</tr>
<tr>
<td>Historic Residence</td>
<td>2</td>
<td>1872-</td>
</tr>
<tr>
<td>Historic Farmstead/Homestead</td>
<td>4</td>
<td>1862-</td>
</tr>
<tr>
<td>Historic Trash Dump</td>
<td>1</td>
<td>nd</td>
</tr>
<tr>
<td>Historic Energy Development</td>
<td>1</td>
<td>1950-1959</td>
</tr>
<tr>
<td>Historic Railroad, Stage Route, Travel</td>
<td>1</td>
<td>1903</td>
</tr>
<tr>
<td>Prehistoric/ Historic Site – Fur Trade</td>
<td>1</td>
<td>Nd</td>
</tr>
</tbody>
</table>
The recorded sites listed above provide information to urban, industrial development, and land use practices that took place Missoula Valley during the mid-19th century. The low number of recorded prehistoric sites in the Missoula Valley are undoubtedly due to European activities such as farming, logging, and industrial development that over time has destroyed (or covered up) many prehistoric sites. Site records for the Missoula Valley provide information on overall conditions of a site area as well as documentation of plants and animals. By piecing together information from archaeological site forms, this information contributes to the cultural and land use histories for the valley.

**Archaeological Sites Examined**

The first site form discussed is the historic homestead of Cornelius and David O’Keefe who were brothers and early settlers of the Missoula Valley. The O’Keefe homestead was built in the Missoula Valley in 1861. In 2005, an archaeological site form was completed the homestead and recorded as (24MO0948) and is located in Section 16 of T14N R20W. The GLO map and journals document the location of O’Keefe Creek, as well as the locations for two of O’Keefe’s fences. The section line for O’Keefe’s area was described as an area with no timber and 1st rate soil. In 2005 the remains of an outbuilding and a corral were recorded by the Confederate Salish and Kootenai Tribes Preservation Office, who noted the vegetation as being:

Dry land grasses including Bluebunch, Wheatgrass, and Rough Fescue with smaller segments of Idaho Fescue, Arrowleaf Balsam, Lupine, Columbia needle grass, Prairie Junegrass, and Sandberg Bluegrass. The small stream channel contains some limited riparian shrubs but the spring source appears to have been tapped for irrigation.
Conditions reported in 2005 on this site form seem to resemble land cover conditions similar in the 1870s recorded by GLO surveyors. Modern land cover data shows the O’Keefe homestead still supports areas of montane grasslands systems, but also now has several developed areas as well.

The second site form examined is for (24MO0489). This was historic mining site located in Section 35 of T14N R19W that likely dates to the late 19th to early 20th centuries. This site was recorded in 1988 by Dr. Tom Foor’s archaeological survey class at the University of Montana. The vegetation noted at the site documented “areas of short grass, Indian paintbrush” and surrounding vegetation listed ponderosa pine, lodgepole pine, short grasses, and wild strawberries. Modern land cover data for this area is classified as conifer-dominated forest and woodland systems. Future on the ground surveys could be conducted to examine the current conditions of this site and to see if vegetation in native plants such as Indian paint brush, wild strawberries, and “short grass” are still found in this area.

The third site form examined was the Grant Creek Rock Pile site (24MO1093), located in Section 5 of T13N R19W. This site was recorded in 1973 as a possibly prehistoric site near Grant Creek in the northern part of the Missoula Valley. Little detail on the vegetation was recorded for this site but it was noted that the site contained “bunch grasses,” and “various wild flowers.” The lack of detail recorded for vegetation, as seen in this site form, occurs often for archaeological sites recorded in the Missoula Valley, Montana, and no doubt for site forms across the United States. GLO records describe the Section line between 5 and 6 as. “land nearly level, soil 2nd rate,” and “a few cottonwoods on Grant Creek.” The Grant Creek Rock Pile Site is located near the historic trail/road that runs south to the Bitterroot Valley and north up the Grant Creek area. Matthews map (Figure 5.19) shows that historically, the trail along Grant
Creek was a known Indigenous trail and is labeled “Trail to Gather Bitterroot.” Modern land cover data classifies the majority of this area (between the historic road and the historic path of Grant Creek) as developed land with a small, sporadic sections of land classified as montane grasslands lying west of present, Grant Creek Road.

The three site forms examined in this section are used as an example to show the kind of information that can be pulled from archaeological site forms. These site forms provide useful information in assessing vegetation conditions observed during initial archaeological survey for each site. A thorough examination of all archeological site forms and accompanying reports for the Missoula Valley could be gather in the future and contribute vegetation data presented in this thesis. Future research might also include a resurvey of archaeological sites throughout Valley providing an update of site conditions and detailed vegetation observations that can be added to the existing site forms and contribute to long term data collection for the Missoula Valley.

It would also benefit site form records to include current pictures of sites such as the ones discussed in this section for future use in vegetation comparison. Landscape photographs have been used as a source of vegetation documentation by agencies such as the Forest Service, Bureau of Land Management, and Department of Agriculture. The following section takes a look at some historical photographs taken in the Missoula Valley during the late 19th century and early 20th century offering another source used in analyzing landscape.

**Historical Photograph Comparison**

Historic photos serve as excellent sources for analyzing landscape changes that have occurred over time. This section will discuss a handful of selected historical photos in taken
within the Missoula Valley, and although some of these photos are not dated, they still provide information on landscape conditions.

The first photograph in Figure 5.20 shows historic Fort Missoula in 1880 and the other (no date), is looking east across the Missoula Valley. From these two historic photographs, one can see an increase in houses and buildings spread out along the valley. The mountain in the background seems to be mostly free of timber for both historic images, and the current one of this view, but the hills to the left of the mountain (towards Pattee Canyon and the south end of Mt. Sentinel) seems to show more timber in comparison to the historic photos. The center left portion of these photos shows an area of land owned, today, by the University of Montana. At the bend in the Bitterroot River, on the right side is shows a plot of land that has remained undeveloped by Europeans since settlement of the Missoula Valley. Both modern and historical images show strikingly similar conditions in vegetation. Recent surveys of this area were conducted and an inventory of vegetation was taken not only to record vegetation found in this area, but to also discern the difference in vegetation communities in comparison to the landscape that lies north, right across the Bitterroot River from this area.
Figure 5.20 View of Fort Missoula in 1880 looking east towards Mt. Sentinel. The Bitterroot River flows on the right side of the picture and town of Missoula can be seen in the center of the photo. Photograph from (Koelbel 1971).

Figure 5.21 Image of Fort Missoula taken in 2015 from an almost identical location on top of McCully Butte. Photograph by Author.
Figure 5.22 Photograph of Mt. Sentinel circa 1905 with Main Hall in the bottom right corner. Photograph No. A.VI.a-2. Archives and Special Collections, Mansfield Library, The University of Montana, Missoula.

Figure 5.23 Similar image of Mt. Sentinel in 2015. Photograph by the Author.

Figure 5.22 shows an image of Mt. Sentinel circa 1905. Duplicating this photo today was difficult because of all the trees, vegetation, and buildings that are now part of this view in the
Valley. The comparison of the modern and historic photos shows an increase in vegetation around the top of Mt. Sentinel.

The next image (Figure 5.24) shows an 1891 bird’s-eye view map of the Missoula Valley detailing several buildings and homes along the Hell Gate (Clark Fork) River and Rattlesnake Creek. Although the bird’s-eye map is not an actual photograph, detailed and illustrated historical town maps were often created for towns in the early 19th century. The historic map shows a timberless valley just as one might picture from descriptions given by GLO records.

Figure 5.24 Bird’s-Eye view of the Missoula Valley looking southwest in 1891. Illustration courtesy of the Library of Congress Bird’s-Eye View Maps Collection.
Figure 5.25 was taken on top of Mt. Jumbo to resemble the 1891 Bird’s-eye view map. Notable differences between this photograph and the historic map show an increase in the number of homes and buildings throughout the valley. This photograph also shows a significant increase in the number of trees that now grow in the area.

The next group of photographs is taken looking east through the Hell Gate Canyon towards Bonner, Montana.
Figure 5.26 Hell Gate Canyon, looking east towards Bonner, photo date unknown. Photograph courtesy of Archives and Special Collections, Mansfield Library, The University of Montana, Missoula.

Figure 5.27 Photograph of Hell Gate Canyon in 2015 looking east towards Bonner. Photograph by the Author.
The modern photograph in Figure 5.27 shows an increase in the densities of trees on the mountain along the south side of the Clark Fork River (historically known as the Hell Gate River). The railroad in the historic photograph has been replaced with Highway 90, and the corner of Mt. Jumbo looks about the same, but maybe with a slight increase in shrubs and trees. The photographs discussed in this section provide evidence of historic landscape and vegetation conditions in the Missoula Valley ranging from 1880 to 1905. These images were then compared to modern photographs taken in 2015 and used as a source to document amounts of change that have occurred since the original historic photograph.

Conclusion

Examination of landscape changes occurring in the Missoula Valley during the 19th and 20th centuries offer a historical view into the human-environmental relationships that have shaped the Missoula Valley today. Often landcapes described in GLO records have inaccurately been referred to as “presettlement,” implying a landscape unoccupied by Europeans. Surveys of the Missoula Valley were conducted during the early stages of European settlement and contain information on its early European inhabitants. These early records have become useful resources for many researchers in numerous lines of work. For modern land surveyors, these transcribed records are used as foundational information for land ownership records and as a reference point for land survey lines. For ecologists and botanists, the GLO records offer data useful in assessing witness tree data, historical stand densities, fire histories, and plant species distribution. GLO records provide information on locations and width of streams, rivers and the vegetation found along side of the banks, information such as this can be used to assess and help to restore plant communities, species composition, and ecological processes (Portland State University 2015). These records have also proved useful to historians and archaeologists because they contain
information about human made features such as roads, fence lines (sometimes including names of the owner of the fence), agricultural fields, and towns. Surveyors also kept detailed notes that recorded distances and compass bearing data noting the location of buildings, and houses in reference to section line surveys and provide useful to researchers. It is true that these records are useful in historical land studies, but these records can also be used to interpret and document European land use agendas throughout the West. GLO survey records demonstrate how settlers used these surveys to map the landscape, catalogue resources for consumption, and reflect agendas of land use production for the West.

Using a number of historic and current sources, this chapter has presented records showing changes that have occurred throughout the Missoula Valley beginning in the late 19th century. A series of four maps were created to represent detailed data recorded by GLO surveyors in the 19th century and were compared to modern land cover data as a way to model and interpret vegetation changes and land use history of the area. Sources discussed as a part of this thesis also worked to create a time line of changes occurring within the four townships of this study area. Documents such as the 1870s GLO surveys, sources of TEK and historical journals, and historical photographs documented early conditions of the Missoula Valley and provided a starting point for the time period discussed in this thesis. Vegetation data from pollen analysis, archaeological site records, and written oral histories of popular Indigenous plant gathering grounds provided evidence about the vegetation and land use history for the valley. Sources of modern land cover data, pollen data, and current aerial images of the four townships were used as a method of comparing historical land data with current land conditions.
Chapter 6: Conclusion and Discussion

The purpose of this thesis is to provide an interdisciplinary history of the Missoula Valley that can be used to interpret landscape, land use, and environmental changes that took place during the 19th and 20th centuries and to address the following research question. How did European settlers impact the Missoula Valley’s natural and cultural resources, and can this information be extracted from the historical documents created by early explorers or the oral stories told by the region’s American Indians. To address these questions, I integrated multiple sources including historic GLO documents, historic photographs, Traditional Ecological Knowledge (TEK), digital land cover data using ArcGIS, and pollen data recovered during archaeological testing. I integrated this information by creating four interactive maps using ArcGIS. These maps were designed to present several sources of historical and modern landscape descriptions for four townships in the Missoula Valley. As stated in Chapter 3, each township map contains between 21-40 separate point class data files, depending on the township. These layers can be added or taken away from thematic layers of the map to help interpret land use and vegetation data over time, which allowed me to compare historic and modern land cover data.

I observed that several land cover classifications have completely changed due to human land use and development, which is no surprise due to the Missoula Valley’s increasing population, industrial, and agricultural expansion. This being said, information from these maps (see Chapter 4) documents how European processes of adaptation and land use production began to drastically change the Missoula Valley, especially as more settlers made their way into the region.
The Missoula Valley was home to people who lived by hunting and gathering for millennia, sustaining prairie and river resources including fish, bitterroot, big game, and other resources. Beginning in the mid-19th century land use practices started to shift in the valley, as Europeans settlers begin to move into this region. Europeans begin to aggressively consume and export natural resources of this valley by farming, ranching, mining, logging, and constructing irrigation ditches over a relatively short amount of time. Differences in land use practice between the Salish and Pend d’Oreille and Kootenai are seen through the sources discussed in this thesis and can be used to interpret drastic changes that occurred during this transitional period.

These recent transformations of the Missoula Valley reflected the changing agendas associated with American Indian and European uses of the environment. The maps generated here reflect these relatively sudden changes. Indigenous sources discussed in Chapters 3 and 5 enabled me to denote areas such as traditional root collecting ground and prehistoric trails illustrated on map5.18. This thesis research only compiled a few sources of TEK for this region to present on the map. Further research of place names and areas of cultural importance in the Missoula Valley (and throughout the region) would provide more content for the model presented here. Information detailing the use of plants and their location within the valley should be added to facilitate long-term ecological restoration plans for the area.

Each township map for the Missoula Valley study area showed varying degrees of change in vegetation communities in comparison to information shown on the map figure 5.18 and recorded by GLO surveyors. The most notable changes occurring in the Missoula Valley townships are the increase and decrease of tree densities in some areas (see Chapter 5), the conversion of prairie bunch grasses into agricultural fields and developed areas and road.
The results presented in Chapter 5 reflect the different ways landscape changes took place in correlation to different cultural views (i.e. American Indian and Europeans) of resource production. This work also reflects the adaptation behavior of both the American Indians and European populations of the West during the mid-19th and early 20th centuries. For American Indians, subsistence was based on traditional migration routes to acquire food and resources (see chapter 1 & 2) which can be seen as a sustainable, yet adaptive response to the production of limited resources readily available at certain times throughout the year. This was reflected in oral stories, and through the early landscape mapped out by the GLO surveyors, and via European documentary observations. For Europeans, subsistence was dictated by capitalist markets and an overwhelming push to colonize the western United States.

As a part of this project, pollen samples were analyzed from the Fort Missoula area, providing insight into food and economic plant remains being discarded as well as information about Native and non-Native plants. Information from these samples showed a primary change occurring in pollen extracted from Strata I and Strata II and an increase in non-native plant vegetation between the two samples. Dates for the soil samples and associated artifacts recovered from test excavations at Fort Missoula have not been confirmed, but future work on this is anticipated. Funds for this project only allowed samples from one area to be analyzed. Other archaeological pollen records exist in the Missoula Valley; therefore, future pollen data information collected for this valley would greatly benefit the work of both archaeologists and ecologists by creating a more complete timeline of changes in plant communities in the Valley over time. This information, as well and GLO records, TEK sources, and archaeological site data, could build a comprehensive ecological history, of the Missoula Valley.
Challenges encountered during this project included a lot of learning by trial and error. A big part of this project required the transcription of historical journals, which meant hand writing was difficult to read in some cases; deciphering surveying methods used to record township data was also a challenge and time consuming. The ArcGIS program required advanced techniques for displaying map data, and it became clear that other methods used in similar projects required a more working knowledge of ArcGIS than I had. The degree of error in GLO survey maps in correlation to modern point data inserted into ArcGIS also proved problematic. An example was discussed for T13N R19W, where the historical path of the Hellgate (Clark Fork) River was outlined over a portion of Mt. Sentinel (see Chapter 5). Degrees of error were also issues encountered by Shelly (2012) for the Bitterroot Valley in Montana and Christy and Alverson (2011) for the Willamette Valley, Oregon. Despite these challenges, the end product of this project has produced five maps that provide information on the historic land conditions of the Missoula Valley and that can contribute to future research in archaeological, ecological, historical, and palynological studies in the region.

To date, the only GLO work that has fully mapped townships in Montana was created by Karen Shelly for the Bitterroot Valley. My research presented here has only mapped Section lines in the Missoula Valley and lacks vegetation interpretation of township interiors found in parts of Shelly’s research. Other individuals such as Jim Haback have collected bearing tree data but have not fully mapped section lines. As stated in the literature review, many states have used historic GLO notes to produce complete historic vegetation maps. The state of Montana would benefit greatly from a completed historic GLO map, as this information would be beneficial to land managers, ecologists, archaeologists, historians, and anyone interested in the history of the
state. For example, the information presented in such spatial histories can be used to demonstrate the ecological subtle transformations taking place over the past few centuries.

Future research can explore a variety of historical ecological topics for water rights issues, water histories, and the impacts of agriculture and extractive industries on the region’s natural and cultural resources. Water diversion and agriculture throughout the Missoula Valley reflected European cultural agendas focused on the production and exploitation of natural resources and the land’s potential for agricultural production. GLO records and other sources used here have immense research potential to create sustainable land and water use planning for the future. We are therefore exploring funding options to move forward on this project by continuing to create maps like those presented here for remaining sections of the Missoula Valley and eventually the entire state. There is no doubt that this project would take years to complete, but the outcome would create a baseline of historical vegetation conditions for the region and this information could then be used for statewide land use research. Natural resource managers as well as members of the general public have expressed a great deal of interest in historical vegetation of the nation at the time of European settlements (Hickman and Christy 2011:7). This information would also benefit federal and state land management agencies and conservation organizations looking to preserve and restore native plant communities and to manage long term water issues in this region of the arid west.

Ultimately, this research intends to identify and analyze underlying causes to environmental issues involving long term complex human and ecological processes (Dincauze 2000:512; Fisher et al. 2009:2) in order to also contribute to the study in global change archaeology. As scientists continue to address growing issues of climate change fueled by the effects of human processes, many questions can be answered thorough archaeological research
dedicated to landscape histories, paleoenvironmental research, and analysis of land use production, adaptation, and human-environmental interactions that have played out over time. By developing smaller scale environmental and cultural timelines of places like the Missoula Valley, this will inevitably contribute to a more complete understanding of complex human processes and their effects on urban and rural ecosystems over time. Examining archaeological data in correlation to environmental change allows for an integrated approach to understanding the complexities of human impacts and responses to environmental conditions and of global change.
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