

SMALL DAMS AND HISTORIC PRESERVATION:
AN ASSESSMENT OF DAM INFRASTRUCTURE
AND CONTEMPORARY PRESERVATION
IN TEXAS

by

Stephen F. Austin, B.A.

A thesis submitted to the Graduate Council of
Texas State University in partial fulfillment
of the requirements for the degree of
Master of Arts
with a Major in History
December 2014

Committee Members:

Peter B. Dedek, Chair

Lynn Denton

Dan K. Utley

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DEDICATION

For my wife and family.

ACKNOWLEDGEMENTS

Thank you to Dr. Peter Dedek, Dr. Lynn Denton and Prof. Dan Utley for their guidance and support throughout this work. I am grateful to archivist Margret Vaverek, Dr. Jim Kimmel, Dr. Alan Skinner and the staff of various water management agencies which assisted in my research.

TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENTS	v
LIST OF FIGURES	vii
CHAPTER	
I. INTRODUCTION	1
II. HISTORIOGRAPHY	6
III. AN OVERVIEW OF TEXAS DAMS	26
IV. IMPERATIVES FOR PRESERVATION	41
V. TYPOLOGY	59
VI. CONCLUSION	98
BIBLIOGRAPHY	102

LIST OF FIGURES

Figure	Page
1. State of Texas Size Classification Criteria.....	38
2. TCEQ’s Hazard Ranking and Criterion.....	52
3. Blue Heron Dam, Wimberley, Texas.....	66
4. Old Stone Dam, Allen, Texas	69
5. Rio Vista Dam San Marcos, Texas	70
6. Purgatory Creek Dam, San Marcos, Texas	73
7. Zedler’s Mill Dam, Luling, Texas	82

CHAPTER I

INTRODUCTION

Inspiration for this thesis came from a small vernacular dam, built by my extended family and their neighbors in Wimberley, Texas in 1945. Issues surrounding maintenance of the dam sparked questions regarding the potential for historical significance and the status of contemporary preservation for Texas dams. As I began collecting data from various state agencies, watershed districts, and river authorities, it became clear that issues surrounding Texas' water and dam infrastructure raise more questions than answers. A combination of advanced age, drought, and a lack of funding for maintenance has created the potential for crisis. Many dams in Texas require repair or rehabilitation and are in danger of damage and failure should a major flood event occur.

Moreover, questions arose regarding the role of historic preservationists when dealing with the current issues around Texas dams. Research revealed that these problems crossed disciplines and were pertinent to cultural resource management (CRM) and conservation professionals. Hence, I began to view this thesis and its typology as a first attempt to address the complex set of issues surrounding the contemporary state of Texas' water infrastructure and how preservationists can interact and respond.

Once I grasped the breadth of this topic, I chose to narrow my focus and concentrate on ways historic preservation could address, prepare, and possibly defuse some issues surrounding dams in the state. I recognized historic preservation as a major crux which involves the aforementioned professions and could be used to explore ways in which these professions communicate and cooperate. The typology in Chapter Four is

intended to create a common document and language that could be used by professional in each field to communicate about Texas dams.

Once I decided upon a typology, I realized that large, medium, and small sized dams face different issues. The differences in size often coincide with different functions, histories, and levels of significance. After examining dams currently designated by the Texas Historical Commission, I chose to make small dams the subject of my thesis and typology. Small dams are viable historic resources, each with a distinct history and defined period of significance. Small dams are a unique group amongst all dam sizes in Texas and possess three characteristics which made them an ideal starting point for beginning the discussion around preservation, other cultural disciplines, and Texas dam infrastructure.

First, these structures have the potential to retain high levels of integrity as a result of their design. Small dams were not intended to mitigate or control major flooding. Many were intended to be overtopped and thus have withstood damage from natural elements. Second, and likewise, some small structures have been preserved by submersion due to the construction of a larger dam downstream. Small dams have the potential to be less impactful on local environments and pose minimal danger to public safety. Third, small dams have greater potential to be significant at the local level when compared to larger structures. It is my personal opinion that local histories are highly valuable as they are the details of larger historical patterns at the state and national levels. Resources with local significance provide the names, faces, and stories that put history into motion.

Historically, periods of prolonged drought have ended abruptly by major rains and flooding. If such an event were to occur, a number of small historic dams may be lost. Equally possible is the loss of small dams as a result of growth and rehabilitation of the state's water infrastructure. The threat of losing many of these resources motivated me to make small historic dams in Texas the primary subject of this thesis. With this work, I will promote these historic structures as viable resources that possess unique historical significance and make a case for the fragility of their current state.

Because Texas has such a large number of dams, it is reasonable to assume the majority of small dams do not meet standards sufficient for preservation. Such is true of many resources listed in the National Register of Historic Places. Still, I believe many historically significant small dams have yet to be identified. While Texas has recognized some of these resources with various designations, the majority of them have yet to be assessed and identified.

Through this process, I have gained a new perspective on the role dams play in modern society and a greater understanding of the adverse environmental impacts to ecosystems. Such information has helped to inform my ideas about the preservation of these structures and forced me to ask: What conditions would justify the possible environmental damage, rehabilitation costs, and potential hazard to people and property that may accompany the physical preservation of a dam? I arrived at the conclusion that preservation of small dams could be achieved through a uniformed assessment of state owned structures.

A state approved field guide would help to limit the quantity of dams preserved by standardizing the assessment process for preservation. Currently, a limited number of

Texas dams are already identified by the Texas Historical Commission and four structures are listed to the National Register of Historic Places. The author consulted the criteria of both organizations and created a typology based on the dam types already identified by the Texas Commission on Environmental Quality. The typology is designed to assist in the assessment of historic significance and integrity for dams across the state. A uniform tool would help to identify dams with historic value in conjunction with environmental, monetary, and public safety concerns. Additionally, it is my hope that identification of resources with the highest level of integrity will be identified, allowing for a reduction in the state's dam inventory, as non-viable dams would be identified in the process.

When research for this thesis began, Texas had yet to provide a legislative solution to the funding of water infrastructure projects. As of November 2013, the state passed Proposition 6, which established an official mechanism for funding water projects across the state for the next several decades.¹ This thesis identifies the need for reliable access to funding as a key component to improving and maintaining the health of Texas water infrastructure, including historic dams.

This thesis will advocate for small dams as non-traditional properties that deserve increased investigation and the attention of preservationists.² My key argument is that the

¹ Texas Secretary of State, "Election and Voter Information: Ballot Language for the November 5, 2013 Constitutional Amendment Election," accessed May 10, 2014.

<http://www.sos.state.tx.us/elections/voter/2013novballotlang.shtml>

² Andrew Kirk and Charles Palmer, "When Nature Becomes Culture: The National Register and Yosemite's Camp 4. A Case Study," *Western Historical Quarterly*, Vol. 37 No. 4, (2006), 421-444.; John H. Sprinkle, Jr. : "'Of Exceptional Importance': The Origins of the 'Fifty-Year Rule' in Historic Preservation." *The Public Historian*, Vol. 29, No. 2, (2007), 81-103. According to Kirk and Palmer, nomination of non-traditional sites is needed in order to propel historic preservation towards accurate representation of American history. By design, dams possess shelf lives of fifty years or more. The majority of America's dam infrastructure, including small dams, has either reached this threshold or will shortly. A reassessing of

application of a uniform assessment will help to identify unique and valuable resources and to protect currently endangered dams from being lost. Chapter two is a brief overview of dams and water infrastructure throughout Texas history. Chapter three consists of a short analysis of changes in the types of resources nominated to the National Register of Historic Places, followed by a recounting of issues currently threatening Texas dams. Chapter four offers a typology for small-sized dams found in Texas. It contains information and methods needed for the identification and assessment of these resources. Chapter five will includes of recommendations based on the information reviewed and produced in all previous chapters.

dam preservation must take place in order to effectively conserve and commemorate dams that inevitably are removed or lost to natural processes.

CHAPTER II

HISTORIOGRAPHY

From the beginning of recorded history, humanity has organized natural resources for the benefit of society and its survival. Whether in the origins of Mesopotamian agriculture or American fossil fuel extraction, mankind shapes vast systems of natural resources in an ongoing process that is marked by change over time and across space. As environmental scholar Donald Worster observes in “Nature and the Disorder of History,” events that shaped world history, human relationships, or nature itself all have one aspect in common: change.³ Dams are tools of change. They are the agents and the result of change in technological advancement and societal demand for resources. They allow humans to domesticate the most abundant and destructive element on Earth—water. President Hubert Hoover distilled the twentieth-century American ethos of human dominance over the natural world when he stated, “Every drop of water that runs to the sea without yielding its full commercial returns to the nation is an economic waste.”⁴ Other modern world leaders echoed similar sentiments, asserting that the natural world belongs solely to humankind. In recent years, many scholars and professionals have viewed humanity’s relationship to the natural world from different perspective. Environmentally-minded authors like Rachel Carson warned about the negative impacts of dams and drew attention to the observable and tangible effects dams have on regional and global ecosystems. Monetary, cultural, and environmental concerns were deemed equal to the benefits of manmade systems for controlling natural resources. National and

³ Donald Worster, “Nature and the Disorder of History,” *Environmental History Review*, Vol. 18, No.2, (1994), 1-15.

⁴ Steven Solomon, *Water: The Epic Struggle for Wealth, Power, and Civilization*, (New York: Harper, 2010), 322-367.

global trends are moving in the direction of removal and minimization of dam infrastructure; however, Texas has been slow to react. Adding further urgency, a combination of advanced age, structural degradation, quantity, oversight, and weather are reshaping the importance of dams in the state of Texas.

The historiographical framework of American dams begins prior to European settlement with the development of diminutive earthen dams built by indigenous peoples throughout the continental United States. The purpose of these structures was largely for the irrigation, fishing, or other subsistence needs. Similarly, early colonial American farmers built dams in the Eastern United States as a means to capture water for crop irrigation and to power manufacturing.⁵ While information regarding early industrial dam projects is important, it is the water infrastructure projects of the Western United States that ushered in the contemporary American and global image of large dams.

Massive water projects in the American West have been the topic of scholarly discussions since the 1930s. The intense focus on these types of dams is not surprising since credit is given to the western dam movement for inspiring the “Big Dam Era.”⁶ Predicated on “high modernism,” dams of the period were designed with little to no regard concerning the impact these structures could have on cultures and ecosystems. The environmental movement that emerged in the 1960s coincided with strong conservationist currents and became a force against ecological harm. Since the publication of Carson’s *Silent Spring*, the opinion among environmental historians has

⁵ Steven Solomon, *Water: The Epic Struggle for Wealth, Power, and Civilization*, (New York: Harper, 2010), 322-363.

⁶ U.S. Department of the Interior, Bureau of Reclamation, “The History of Large Federal Dams: Planning, Design, and Construction in the Era of Big Dams,” David P. Billington, Donald C. Jackson, Martin V. Melosi, Create Space Independent Publishing Platform, 2005.

been mostly negative toward large dam projects. Authors such as Terry S. Reynolds and environmental journalist Steven Solomon neglect to report on potential measures to mitigate negative effects while maintaining the ecological health of surrounding environments. The focus of many studies concerning western American dam projects is not one of redemption and restoration; rather, they serve as historical records of unfettered development and the absence of environmental foresight.

In his book *Building the Ultimate Dam: John S. Eastwood and The Control of Water in the West*, engineer and historian Donald C. Jackson focuses on the origins of a period between the 1930s and 1970s known as the Big Dam Era. Utilizing his background as a civil engineer, Jackson applied technical and scientific analysis to large western dam projects while developing the historical, social, and political narrative of their construction.⁷ Citing engineering journals such as the *Journal of Electricity, Power, and Gas* and historians such as Donald Worster, Jackson created a technical and historical review of the origins of western dams.⁸ Focusing on hydraulic engineer John S. Eastwood throughout the book, Jackson created the historical context and illustrate the corruption of Eastwood's humanitarian irrigation plans by powerful corporate interests.⁹ The emphasis of Jackson's book illustrated the tensions between dam designers, public interest, and private capital. Reynolds further dissected western hydroelectric dams and the innovations in technology which influenced design worldwide.¹⁰ Echoing the

⁷ Donald C Jackson, *Building the Ultimate Dam: John S. Eastwood and the Control of Water in the West*. (Lawrence: University of Kansas Press, 1995), ix-x.

⁸ Ibid., 1, 225.

⁹ Ibid., 1-12.

¹⁰ Terry S. Reynolds, "Technology in the American West: A Different Model," *The Journal of the Society for Industrial Archeology*, Vol. 22, No. 1, (1996), 5-10.

observations of Worster and Solomon, Reynolds declared the importance of western dams as crucial in establishing the origins of public water projects.

Michel Hiltzik's *Colossus: Hoover Dam and the Making of the American Century* provided a more comprehensive study of the effects of massive dam projects in the American West. Unlike Jackson, Hiltzik focused on less controversial aspects of western dams and provided a general historical narrative of the era. Citing Worster and Jackson, Hiltzik chose sources indicative of the balance he attempts to create between his critiques of environmental history and the realities of industrial progress. The majority of literature concerned with large western dams referenced the works of some of the earliest American historians and naturalists such as John Muir. *Colossus* extensively referenced Muir and John Wesley Powell, due to their positions of authority within their respective fields and their roles as outspoken critics of western dam infrastructure from the start.¹¹ Hiltzik's book lacks an assessment of how dams impact the surrounding environment and local culture. The scope of *Colossus* is focused on the process of constructing the Hoover Dam and not on the environmental effects of damming the Colorado River.

Jackson's and Hiltzik's exclusion of environmental issues can be explained by the subject focus and historical context of their work. However, most environmental historians focus heavily on the environmental impacts of large-sized dams. One of the first to draw public attention to the emerging environmental degradation caused by western dams was Rachel Carson's book, *Silent Spring*. The book is credited with influencing America's grassroots environmental movement while in its infancy. Environmental historians have cited Carson since her publication in 1962. Carson's work

¹¹ Michael Hiltzik, *Colossus: Hoover Dam and the Making of the American Century*. (New York, NY, Free Press, 2010), 470,474.

shed light on the creeping ecological disaster caused by previous generations who championed big dams for their economic and utilitarian prowess.¹² While historians such as Hiltzik chose the industrial and engineering history of western dams, Carson undoubtedly inspired a generation of historians to view the negative environmental impact of large dams as part of the structures narrative.

Donald Worster's *Rivers of Empire: Water, Aridity, and the Growth of the American West*, is a highly influential work within the field of environmental history. Similar to Jackson's analysis of the competing desires between private capital and public interest, Worster's work is highly critical of big dams and their impact on western American culture.¹³ According to him, the conventional mythos of western opportunity and development was constrained by corporate powers which controlled the water and electricity provided by large dams.¹⁴ Private influence and resource control resulted in exploitation of consumers and an entrenched social order.¹⁵ By illustrating environmental degradation and the disproportionate wealth accumulation by western elites, Worster argues that massive dams helped create environmental and cultural impacts that can still be felt to this day. *Rivers of Empire* is important to the narrative of all dams and is pertinent to the subject of small dams.

Political scientist Williams R. Lowry's 2003 book, *Dam Politics: Restoring America's Rivers*, echoes the message of *Rivers of Empire* but provides contemporary insight into the issues surrounding large western dams. His analysis of the state of

¹² Rachel Carson, *Silent Spring*. (Boston: Houghton Mifflin, 1962), 129-154.

¹³ Donald Worster, *Rivers of Empire: Water, Aridity, and the Growth of the American West*. (New York: Pantheon Books, 1985), 129-154.

¹⁴ Ibid., 217-256.

¹⁵ Ibid., 4.

America's water infrastructure is less condemning than Worster. *Dam Politics* examined the environmental and cultural impacts of large-sized dams in a decidedly more nuanced fashion than Worster and Carson. Lowry's book acts as a continuation of *Rivers of Empire* and *Silent Spring* by emphasizing the environmental damage caused by big dams and advocating for their restoration and redesign to foster ecological sustainability.¹⁶ John Warfield Simpson's 2005 book, *Dam! Water, Power, Politics, and Preservation in Hetch Hetchy and Yosemite National Park*, repeats much of the same argument made by Worster and Lowry. However, Simpson's emphasis on the damming of the Hetch Hetchy Valley near Yosemite National Park expands on the cultural and economic issues of large dam projects. Simpson's criticism of corporate controlled public utilities resonated with Worster's examination of western economic dominance by private entities through control of state-funded water infrastructure. The difference in Simpson's *Dam!*, is his assertion that western and native cultures suffered due to the environmental and economic effects caused by the damming and private control of the Hetch Hetchy Dam.¹⁷

Despite the negative ramifications of the western dam movement, preservationists and environmental professionals have adjusted their approaches in addressing large dams. Most literature on the topic lacks a balance of viewpoints but reflects a rise in professionals advocating mitigation of infrastructure necessities and environmental concerns. Large dams and western infrastructure are important to this thesis because they have influenced environmental and preservation movements throughout America. One

¹⁶ William R. Lowry, *Dam Politics: Restoring America's Rivers*. (Washington, D.C.: Georgetown University Press, 2003), 60-90.

¹⁷ John W. Simpson, *Dam!: Water, Power, Politics, and Preservation In Hetch Hetchy and Yosemite National Park*. (New York: Pantheon Books, 2005), 147-290.

concern within the field of preservation has been the challenges dam projects pose to cultural landscapes, local heritage, identity, and symbolism.

Illustrating the negative impacts of cultural disturbance, Barbara J. Cummings investigated the encroaching development into the Amazonian Basin in “Dam the Rivers; Damn the People: Hydroelectric Development and Resistance in Amazonian Brazil.”¹⁸ By documenting the effects of modernization on local peoples and their culture, Cummings clearly articulated remedies for what she portrays as attacks on social justice and cultural identity.¹⁹ Additionally, she explicated the hypocrisy in the environmental slogan “sustainable development.” The reality is that many developments called sustainable are actually corporately funded, extractive programs that are without social equality and justice available to affected peoples.²⁰ Spending the majority of her article documenting and explaining how dam projects adversely affect local communities and the environment, Cummings advocates for a conscious linking of environmental issues and human rights in order to unify their impacts.

Historian Daniel Klingensmith’s 2007 book, *One Valley and a Thousand: Dams, Nationalism, and Development*, expanded on Donald Jackson’s work with a deeper exploration into American perceptions of these structures after the Big Dam Era. Klingensmith demonstrated the negative impacts of big dams and their role in displacing millions of people and destroying river ecosystems.²¹ Adding to Donald Worster’s analysis of the role big dams play in creating environmental ruin and human suffering,

¹⁸ Barbara J. Cummings, *Dam the River; Damn the People: Hydroelectric Development and Resistance in Amazonian Brazil*. *Geo-Journal*, Vol. 35, No. 2, (1995), 151-160.

¹⁹ *Ibid.*, 153-159.

²⁰ *Ibid.*, 159.

²¹ Daniel Klingensmith, *One Valley and A Thousand: Dams, Nationalism, and Development*, (New Delhi: Oxford University Press, 2007), 1-41.

Klingensmith observed the importance of large dams to a nation's water infrastructure and its national identity as a symbol of modernization.²² He juxtaposed governmental desire for water utilities with the danger large dams pose to local cultures and environments. By applying his analysis to contemporary dam issues, it becomes clear that preservation and environmental concerns can be balanced with infrastructure requirements rather than the total removal of large dams.

Denis Cosgrove, Barbara Roscoe, and Simon Rycroft's, "Landscape and Identity at Ladybower Reservoir and Rutland Water," provided an example of the contemporary struggle between rural residents and two large-scale water projects. The authors illustrated the power of dams in affecting the cultural identities of residents by changing their cultural and physical landscapes. They depict local concerns regarding the balance of large water projects with impacts to the surrounding cultural landscape. Peakland residents lamented at the intrusion of the Ladybower Reservoir, holding it responsible for the "loss of local identity."²³ Similar to Lowry's insights, Cosgrove, Roscoe, and Rycroft recognized the necessity of large dams for water utilities and hydroelectric energy while demonstrating the strain dam projects put on the identity of local residents.²⁴ The visual impacts of the Ladybower Dam are indicative of negative effects caused by large dam construction.

Maria Kaika's "Dams as Symbols of Modernization," parallels the circumstances of Lowery and Cosgrove, Roscoe, and Rycroft. She described the social strife that arose

²² Daniel Klingensmith, *One Valley and A Thousand: Dams, Nationalism, and Development*, (New Delhi: Oxford University Press, 2007), 1-41.

²³ Ibid., 536.

²⁴ John W. Simpson, *Dam!: Water, Power, Politics, and Preservation In Hetch Hetchy and Yosemite National Park*, (New York: Pantheon Books, 2005), 345-348.

in the construction of Greece's Marathon Dam. Greek citizens were conflicted between the desire to modernize and to preserve their traditional cultural identity.²⁵ Like Ladybower Dam, the designers of Marathon Dam attempted to blend the project with existing structures already in its landscape. Lowery, Cosgrove, Roscoe, and Rycroft, and Kaika helped to demonstrate the growing trend among planners and designers to incorporate issues of cultural identity to mitigate the impacts of dams. Philip Van Huizen's article, "Building a Green Dam: Environmental Modernism and the Canadian-American Libby Dam," presented a positive example of blending environmental concerns with utilitarian necessities and economic growth.²⁶ Van Huizen investigated the Libby Dam on the Canadian-American Kootenay River Basin and offered recommendations to unify development and preservation efforts.

Van Huizen, Cosgrove, Roscoe, and Rycroft analyze similar issues in each of their respective topics. However, the Ladybower Dam was designed and constructed with preservation issues as a primary concern. The Libby Dam was built in the 1940s and modified several decades later to mitigate its detrimental effect on the surrounding environmental and cultural landscape. Van Huizen's article provides an example of a contemporary project that demonstrates the shift in how preservationists view dams.

Cultural historians, geographers, and social scientists of various disciplines have carried out analyses of dams and their effect on national identity and economic growth.²⁷

²⁵ Maria Kaika, "Dams as Symbols of Modernization: The Urbanization of Nature between Geographical Imagination and Materiality." *Annals of the Association of American Geographers*, Vol. 96, No.2 (2006), 276–301.

²⁶ Philip Van Huizen, "Building a Green Dam: Environmental Modernism and the Canadian-American Libby Dam," *Pacific Historical Review*, Vol. 79, No. 3, (2010), 418-453.

²⁷ Diane Barthel, "Historic Preservation: A Comparative Analysis," *Sociological Forum*, Vol. 4, No. 1, (1989), 87-105.; Philip Van Huizen, "Building a Green Dam: Environmental Modernism and the Canadian-

However, the majority of environmental historians are less concerned with questions of cultural significance and more concerned with the negative environmental effects of dams.²⁸ More than thirty years of literature on this topic have yielded persuasive evidence highlighting the harmful effects of dams.²⁹ However, ecologists and environmental historians are beginning to approach dam studies with more impartiality, recognizing that dams can have both negative and positive effects on local ecology.³⁰

In his article, “When Dams Weren’t Damned: The Public Power Crusade and Visions of the Good Life in the Pacific Northwest in the 1930s,” historian Wesley Arden Dick presented a comprehensive history of dams in the American Pacific Northwest. Dick provided insight into the events that led to the founding of the environmental grassroots movement. Citing Ernest Callenbach’s *Ecotopia* and Donald Worster’s *Rivers of Empire*, Dick built his case for the evolution of environmental activism and direct-action in the Pacific Northwest. Asserting that “dams kill rivers,” he explains the history of taming the rivers of the Northwest and local reactions to dam projects over time.³¹ Published in 1989, Dick’s piece provides a window into growing public concern over the ecological impacts of large dams.

Emphasizing the origins of western dam projects, Dick explains how the well-intentioned conservationism of the New Deal drove the construction of large dams. The

American Libby Dam,” *Pacific Historical Review*, Vol. 79, No. 3, (2010). ; Anthony Downs, “Up and Down with Ecology: The ‘Issue-Attention Cycle’,” *The Public Interest*, (1972), 38-50.

²⁸ Barbara J. Cummings, “Dam the River; Damn the People: Hydroelectric Development and Resistance in Amazonian Brazil,” *Geo-Journal*, Vol. 35, No. 2, (1995), 151-160.

²⁹ *Ibid.*, 418-453.

³⁰ *Ibid.*: Wesley Arden Dick, “When Dams Weren’t Damned: The Public Power Crusade and Visions of the Good Life in the Pacific Northwest in the 1930s,” *Environmental Review*, Vol. 13, No. 3, (1989), 113-153.; Daniel Klingensmith, *One Valley and A Thousand: Dams, Nationalism, and Development*. (New Delhi: Oxford University Press, 2007).

³¹ Wesley Arden Dick, “When Dams Weren’t Damned: The Public Power Crusade and Visions of the Good Life in the Pacific Northwest in the 1930s,” *Environmental Review*, Vol. 13, No. 3, (1989), 113-153.

prevailing thought of the 1930s promoted conservation of natural resources through manmade control. Initially, public and political reception was strong and full of praise for the “usher[ing] in of a new western movement...”³² Politicians and planners of the day sought to create an electrified utilitarian utopia in the West. Dick documents the entirety of western water history, beginning with the promotion of large dams by the Franklin Roosevelt administration through the environmental awakening of the American public.³³

Echoing Dick’s insight into the foundation of America’s environmental movement, D.T. Kuzmaik discusses the disposition of America environmentalism. Kuzmaik coupled the history of environmental movements in America with the analysis of the motivations which influenced American opinions of environmentalism.³⁴ He clarified the grassroots origins of American environmentalism by demonstrating the ebb and flow of public opinion and activism across the United States and its history.³⁵ Three major periods are identified for sustained environmental action: 1890-1920, 1933-1943, and 1960 to the present day. Kuzmaik attributes these events in public consciousness to “issue-attention cycle.”³⁶ Throughout American history, environmental movements have swelled with public and institutional support.

Kuzmaik’s analysis of grassroots American environmentalism is made tangible in B.D. Dhawan’s 1989 article, “Mounting Antagonism towards Big Dams.” Author and professor Dhawan discussed the drawbacks to large dam projects and the ambivalence of

³² Wesley Arden Dick, “When Dams Weren’t Damned: The Public Power Crusade and Visions of the Good Life in the Pacific Northwest in the 1930s,” *Environmental Review*, Vol. 13, No. 3, (1989), 125.

³³ Ibid., 113-153.

³⁴ D.T. Kuzmaik, “The American Environmental Movement,” *The Geographical Journal*, Vol. 157, No.3, (1996), 265-278.

³⁵ Ibid., 265-278.

³⁶ Anthony Downs, “Up and Down with Ecology – The ‘Issue-Attention Cycle’,” *The Public Interest*, (1972), 38-50.

the irrigation planners and engineers toward ecological and cultural concerns.³⁷ Basing the majority of his critiques on massive dam projects in India, he Dhawan illustrated the mounting pressure and vocal discontent for dam projects coming from ecologist, media outlets, and the public. Dhawan called into question the logic behind continued proliferation of dams, citing deforestation and soil degradation from rising salinity.³⁸ As stated before, Dhawan's article is indicative of criticism coming from many scholarly fields, including environmental historians. However, he closes his article by making recommendations for ecological and environmental inclusion into future dam design.

Maria Saleth's work, "Big Dams Controversy: Economics, Ecology, and Equity," argues that balance cannot be found between environmental concerns and large dams.³⁹ While the negative effects of large-sized structures are demonstrated in environmental literature, ecologists and environmental historians like Dhawan call for an ecologically friendly approach toward dam design. Saleth is a representative of traditional environmental conscience which finds Dhawan's call for a middle ground between economic benefits and ecological concerns infeasible.

Saleth's opinion reflects the primary attitude held by environmental historians for the past several decades. J. Bandyopadhyat, B. Mallik, M. Mandal, and S. Perveen's 2002 article, "Dams and Development: Report on a Policy Dialogue," takes a more balanced approach towards looking at dams. The authors provided close scrutiny to the process in

³⁷ B.D. Dhawan, "Mounting Antagonism towards Big Dams," *Economic and Political Weekly*, Vol. 24, No. 20, (1989), 1096-1099.

³⁸ Ibid., 1096.

³⁹ Maria R. Saleth, "Big Dams Controversy: Economics, Ecology, and Equity," *Review Economic and Political Weekly*, Vol. 27, No. 30, (1992), 1607-1609.

which dam projects have traditionally been developed.⁴⁰ They critique the exclusion of various stakeholder groups from the development and planning of dam projects. Using India as an example, they point out the traditional economic and infrastructure benefits of large water projects⁴¹ and contrast the promoted gains with the adverse effects of these projects.⁴²

Extensive recommendations for improvements to policy formation are presented in the conclusion of “Dams and Development.” Bandyopadhyay, Mallik, Mandal, and Perveen’s proposal reverberates with Letitia Obeng’s final recommendations in her article “Should Dams be Built? The Volta Lake Example.” Contrasting the beneficial aspects of dams, particularly in underdeveloped countries, with associated environmental degradation, Obeng organizes the standard grievances of many ecologists concerning dam projects.⁴³ Construction costs, environmental change, social disruption, and a limited lifespan of these structures left professionals feeling disenchanted towards dams. Though years apart in publication, Perveen and Obeng’s articles are representative of a movement towards observation of the negatives and a move to correct or mitigate ecological harm while balancing the positive benefits of dams.

Obeng’s investigation into The Tennessee Valley Authority’s (TVA) multipurpose reservoir system illustrates the benefits provided by the system. Obeng uses diverse examples to provide a balanced view of dam projects. The reservoir system is credited with controlling destructive seasonal flooding, preventing and controlling soil

⁴⁰ J. Bandyopadhyay, B. Mallik, M. Mandal, S. Perveen, “Dams and Development: Report on a Policy Dialogue,” *Economic and Political Weekly*, Vol. 37, No. 40, (2002), 4108-4112.

⁴¹ Ibid., 4108.

⁴² Ibid., 4108-4110.

⁴³ Letitia Obeng, “Should Dams Be Built? The Volta Lake Example,” *Ambio*, Vol. 6, No. 1, (1997), 46-50.

erosion, and providing hydroelectric power and a reliable water supply. she draws a distinction between large dams, such as Africa's Lake Volta project and the Hoover Dam, with the millions of small dams throughout the world. Obeng states that smaller dams provide greater water storage along with flood and erosion control on a small scale when compared to their larger counterparts.⁴⁴ Dams of diminutive size provide a great deal of positive benefits, including hydroelectric power and the enhancement of fisheries and waterways. The author raises the question: "Can dams be made environmentally safe?" Distinguishing between ecological change and adverse damage caused by dams, Obeng asserts that the question should not be, "Should we build dams?" But rather, "How can humans design dams to meet economic and utilitarian needs with environmental protection?"⁴⁵

Over the past fifty years, large dams have been identified as culprits in the destruction of ecosystems and cultures. There are specific sub-areas of study within the greater subject of dams. However, the lack of connection between the environmental and cultural studies will continue to hurt movements attempting to correct the negative effects of large dams. Currently, a call to unify both issues is underway as preservationists advocate that the natural environmental and human cultures are synonymous. As advocated by Cummings, Cosgrove, Roscoe, and Rycroft, professionals linked to environmentalism are beginning to connect these issues.

A brief investigation of the National Register of Historic Places (NRHP) reveals that dams are in a precarious place. While many states have several dams on the NRHP

⁴⁴ William R. Lowry, *Dam Politics: Restoring America's Rivers*, (Washington, D.C.: Georgetown University Press, 2003).

⁴⁵ Letitia Obeng, "Should Dams Be Built? The Volta Lake Example," *Ambio*, Vol. 6, No. 1, (1977), 46-50.

which possess strong ties to local economic and cultural history, unrecognized and unpreserved, the majority of those designated are large in size, leaving a host of smaller dams unidentified and assessed.

The disparity in preservation efforts can be blamed on the massive scale and overall technological achievements of large dams. Ignoring smaller structures undermines local culture and identity, and hinders the accuracy of the historical record. Small dams are more abundant than their large-sized counterparts and do not cause the same amount of ecological impacts. An investigation of preservation practices and NRHP literature helps clarify why professionals have overlooked small dams.

The passage of the Historic Preservation Act of 1966 codified American preservation and allowed for the professionalization of the preservation field. It tasked the Secretary of the Interior and the National Park Service with creating a framework for the federal organization of American preservation. The law established the NRHP as the primary preservation standard. Government publications like the “National Register Bulletin: How to Apply the National Register Criteria for Evaluation” are official documents designed to set guidelines and rules for the nomination process to the NRHP.⁴⁶ The assessment process is divided into four primary criteria, labeled A through D, as well as seven Criteria Considerations. While official register bulletins are created with public use in mind, greater understanding of the register can be found in texts like William J. Murtagh’s 2006 book, *Keeping Time: The History and Theory of Preservation in America*, which provides an introduction to American historic preservation and the

⁴⁶ U.S. Department of Interior, National Park Service. *National Register Bulletin: How to Apply the National Register Criteria for Evaluation*, Patrick W. Andrus, Rebecca H. Shrimpton, 2002.

tenets of the NRHP system. However, Murtagh fails to elaborate on the slow progress of American preservation efforts.

Sociologist Diane Barthel's 1989 article, "Historic Preservation: A Comparative Analysis," expands upon Murtagh's slim explanation of America's slow move toward historic preservation. Barthel contrasted American preservation with the older preservation practices of Great Britain. Highlighting the different social environments within each country, she presents a clearer picture as to why American preservation lagged behind Britain for close to a century.⁴⁷ While he neglects to comment on the contemporary differences between both country's interpretations and commitments to historic preservation, Andrew Kirk and Charles Palmer's 2006 article, "When Nature Becomes Culture: The National Register and Yosemite's Camp 4: A Case Study," criticized the stagnation in American preservation's scope of acceptable historic sites. Kirk and Palmer hint that the nomination of sites like Camp 4 in Yosemite National Park is an attempt to expand the parameters of what is considered historically significant in the U.S.

Camp 4 was nominated early in the twenty-first century and deemed significant for its connection to a group of rock climbers responsible for founding the Northface clothing brand.⁴⁸ The successful listing marked an easing in the rigid nature of the NRHP nomination guidelines. The main focus of "When Nature Becomes Culture" is a pronounced avocation for non-traditional sites.⁴⁹ The subject of the Kirk and Palmer

⁴⁷ Diane Barthel, "Historic Preservation: A Comparative Analysis," *Sociological Forum*, Vol. 4, No. 1, (1989), 87-89.

⁴⁸ Andrew Kirk and Charles Palmer, "When Nature Becomes Culture: The National Register and Yosemite's Camp 4. A Case Study," *Western Historical Quarterly*, Vol. 37 No. 4, (2006), 421-444.

⁴⁹ *Ibid.*, 421-444.

article is related to Paul Bentel's "Where Do We Draw the Land? Historic Preservation's Expanding Boundaries." Bentel promotes a serious reexamination of the boundaries of the National Register and values of American preservation.⁵⁰ His argument for a relaxation of NRHP standards coincided with Kirk and Palmer's support for the nomination of non-traditional sites, subjects, and structures. Each author represents an emerging consensus within American preservation that believes notions of aesthetic-based preservation are outdated and must be changed to accommodate America's growing cultural diversity.

Like Bentel, Kirk and Palmer support a new way to apply National Register standards to historic properties and structures. They advocate that the National Register be used as a vehicle for advocacy by including non-traditional and underrepresented histories.⁵¹ Elaborating on the sentiments of Kirk and Palmer is John H. Sprinkle who campaigned for a modification for National Register Criterion Consideration G.⁵² Sprinkle articulated that this criterion, known as the fifty-year rule, needs to be reevaluated in order to achieve a realistic representation of American history.

Comparable to the Kirk and Palmer call for a redefinition of significance, Sprinkle argued that changing or abolishing Criterion Consideration G would serve as evidence of the growing movement to modernize historic preservation from within. Rejection of non-traditional sites and the fifty-year rule are what Sprinkle refers to as relics of a bygone era. Perceptions of aesthetics and preservation etiquette have changed little since their creation by the National Park Service in 1935. Sprinkle asserts that the

⁵⁰ Paul Bentel, "Where Do We Draw the Land? Historic Preservation's Expanding Boundaries," *Future Anterior: Journal of Historic Preservation, History, Theory, and Criticism*, Vol.1, No. 2, (2004),43-44.

⁵¹ Ibid.

⁵² John H. Sprinkle Jr., "Of Exceptional Importance: The Origins of the 'Fifty-Year Rule' in Historic Preservation," *The Public Historian*, Vol. 29, No. 2, (2007), 81-103.

stagnation of American preservation has unintentionally created a system of rigid standards that serve to enforce nationalistic narratives of a non-factual version of U.S. history.

The NRHP traditionally has been viewed as a neutral party in the creation of historic narratives.⁵³ Still, literature presents a different picture. John Sprinkle's article explained the nature of the NRHP and its ability to sculpt historical narratives that they benefit the nation-state and stifle alternate histories.⁵⁴ Kirk and Palmer call for the blurring of lines within the NRHP's assessment and designation of properties and sites. All authors argue that historic preservation and the NRHP must be allowed to incorporate non-traditional sites and histories in order to create an accurate historical record.

Kirk and Palmer assert that opinions within preservation are shifting with respect to seeing nature and culture as synonymous. If applied to dams, the results would be a balance between the historical significance and negative environmental impacts of a structure. Dams listed in the National Register are overwhelmingly massive waterworks, which represent an antiquated national identity that celebrated modernization and progress over the natural environment or cultural lifeways. A new interpretation of the NRHP would result in diversity amongst the kinds of dams listed in the National Register. Increased variety in types and sizes recognized by preservationists will enhance

⁵³ Andrew Kirk and Charles Palmer, "When Nature Becomes Culture: The National Register and Yosemite's Camp 4. A Case Study," *Western Historical Quarterly*, Vol. 37 No. 4, (2006), 421-444.; U.S. Department of the Interior, National Park Service, U.S. Department of the Interior, National Park Service, *How to Complete the National Register Multiple Property Documentation Form*, Antoinette J. Lee and Linda F. McClelland, 1991.; U.S. Department of the Interior, National Park Service: *How to Evaluate and Nominate Designed Historic Landscapes*, J. Timothy Keller, ASLA, and Genevieve P. Keller Land and Community Associates, accessed February 2014.

⁵⁴ John H. Sprinkle Jr., "Of Exceptional Importance: The Origins of the 'Fifty-Year Rule' in Historic Preservation," *The Public Historian*, Vol. 29, No. 2, (2007), 81-103.

local and regional historical narratives. As issues of water conservation continue to grow in importance and severity, small historic dams could serve as an alternative to large dams for preservationists due to their minimal impact and possible benefits to local ecology and culture. Small dams could also aid in the promotion of local environmental heritage and help move the National Register discussion closer to recognition of the connection between nature and culture.

Changes in the types of sites and properties nominated would benefit small dams. As previously stated, the majority of dams listed in the National Register are large in scale and typically part of the western hydroelectric infrastructure. Nominating small dam types such as industrial-civic, earthen, or vernacular will be easier when recommendations by preservationists like Sprinkle are heeded. As ecological concerns move to the forefront of public discourse, it is logical to predict that large dams will continue to come under fire for their environmental and cultural impacts. While the backlash against large dam projects continues in various states throughout the U.S., it is important to create a framework regarding the removal or preservation of dams in the future.

CHAPTER III

AN OVERVIEW OF TEXAS DAMS

The state of Texas is no stranger to the positive and negative effects of dams. It has roughly 7,500 dams, more than any other state. Dams were a critical part of Texas industry, flood control, agriculture, and recreational life well before its establishment as a state in 1845. Given this past, one would assume that Texas would enthusiastically recognize the historic contributions of dams to the state's public water infrastructure and economic development. This does not seem to be the case. As of 2014, only four Texas dams were listed in the National Register of Historic Places (NRHP). Furthermore, only a small number of these structures have received some kind of preservation designation by the Texas Historical Commission

The reality of the state's emerging water crisis has begun to change the way lawmakers and state officials approach water policy. Current management and regulatory authorities were implemented in response to the devastating drought and subsequent flooding of the 1950s. Contemporary weather and climate conditions are similar to those that led to the founding of water conservation programs. If these trends continue unabated, they pose a threat to the integrity and health of historic small dams throughout the state.

Early Water Conservation to Texas Water Plan 2012

Water accessibility was an issue for Spanish missionaries and soldiers, who began arriving in the 17th century.⁵⁵ They employed minimal oversight and saw to the

⁵⁵ Texas Water Development Board, *Water for Texas 2012 State Water Plan – Introduction*, January 2012, 14.

construction of small dams and aqueducts.⁵⁶ It was not until the late-nineteenth century that modern methods of recordkeeping and regulation related to water access and control became common practice within Texas.⁵⁷ Growth of centralized authority and statewide water infrastructure has historically come in response to severe and sustained weather patterns.⁵⁸ Extreme drought and flooding of the early twentieth century resulted in a series of state governmental actions lasting from 1904 to 1925. During this time, the state saw the first public development of water resources, drainage districts, creation of conservation and reclamation districts (river authorities), and water control districts.⁵⁹ New agencies developed and organized irrigation, storage, flood mitigation, and water supply districts around the state. Additionally, the state created the Texas Board of Water Engineers (TBWE) in 1913. State leaders also created river authorities beginning in 1917, fresh water supply districts in 1919, and water control and improvement districts in 1925.

A predecessor to the Texas Commission on Environmental Quality (TCEQ), the TBWE was the primary early state authority concerning water development. In 1949, U.S. Sen. Lyndon B. Johnson requested help from the federal government in creating a statewide water program. In response, the U.S. Bureau of Reclamation issued the report “Water Supply and the Texas Economy: An Appraisal of the Texas Water Problem.” The report analyzed state water policy, recommended water supply planning, and endorsed the establishment of an official water plan and adjoining regulatory agencies.

⁵⁶ U.S. Department of the Interior, National Park Service, *Espada Aqueduct*, accessed October 2013. <http://www.nps.gov/nr/travel/tx/tx44.htm>.

⁵⁷ Texas Water Development Board, *Water for Texas 2012 State Water Plan – Introduction*, January 2012, 14.

⁵⁸ Ibid.

⁵⁹ Ibid., 15.

Formal Texas water policy began to take shape in 1956. Judging from the historical record, major policy change consistently followed significant drought and flooding in Texas. The seven years previous to 1956 were the driest in the state's recorded history, often known as the drought of record. The following year, immense rains bombarded the state causing every major river system to flood.⁶⁰ Contemporary Texas water planning is a direct result of the events of the drought of record and subsequent flooding. The 1957 Water Planning Act created the Texas Water Resource Planning Division as part of the Board of Water Engineers. The state tasked the group with assigning water resource planning to regions around the state. The goal was to help communities identify their water requirements and develop resources to meet those projections.

The first statewide water plan entitled, "A Plan for Meeting the 1980 Water Requirements of Texas," was published in 1961 at the request of Gov. Price Daniel. The report drew upon historical and contemporary data, and predicted reservoir and other infrastructure developments needed to sustain Texas water supplies until 1980.⁶¹ Six additional state water plans, created between 1968 and 2012, have informed and guided Texas water infrastructure and policy until the present day. Each report includes pertinent statistical projections such as population growth, rainfall, climate, financial costs, and

⁶⁰ Texas Water Development Board, *Water for Texas 2012 State Water Plan – Introduction*, January 2012, 17.

⁶¹ Ibid.

water supply requirements. Emphasis on resource conservation has steadily increased as a management strategy since publication of the 1984 State Water Plan.⁶²

Regional Water Planning

The advent of regional water planning began in 1996 as a result of a devastating ten-month drought that caused statewide crop failures and some municipalities to completely run out of water.⁶³ The following year, the Texas Legislature passed the general appropriation bill Senate Bill 1. Included were steps to improve the management and development of water resources across the state. In addition, the legislation created the contemporary regional water planning process by establishing a framework that began from the ground up. The process requires both local and regional stakeholders to develop a consensus-based regional water plan to address future supply requirements.⁶⁴ Each regional plan provides a basis for the development of a comprehensive state water plan every five years.⁶⁵

⁶² Texas Water Development Board, *Water for Texas 2012 State Water Plan – Introduction*, January 2012, 17. : The emphasis on conservation practices as a means of adding in the state’s water planning has steadily increased in scope beginning with the water plan of 1984.

⁶³ Ibid., 19.

⁶⁴ Texas Water Development Board, *Water for Texas 2012 State Water Plan – Introduction*, January 2012, 19. Currently, there are sixteen water planning regions created by the TWDB. Each region is required to complete ten tasks in conjunction with the creation of its water plan. They are as follows: Describe the regional water planning area, quantify current and projected population and water demands over a 50-year planning horizon, evaluate and quantify current water supplies, identify surpluses and needs, evaluate impacts of water management strategies on water quality, describe how the plan is consistent with long term protection of the state’s water, agricultural and natural resources, recommend regulatory, administrative, and legislative changes, describe how sponsors of water management strategies will finance projects, adopt the plan.

⁶⁵ Ibid.: “Regional water planning groups are required to have at least 11 interests represented, including the public, counties, municipalities, industries, agriculture, environment, small businesses, electric-generating utilities, river authorities, water districts, and water utilities. Planning groups must have at least one representative from each interest, and can designate representatives for other interests that are important to the planning area. Planning groups also have non-voting members from federal, state, and local agencies and have members that serve as liaisons with planning groups in adjacent areas.”

Federal and State Agencies

Oversight of water management and infrastructure falls to several state and federal agencies. Within each regional planning area, various state agencies provide consultation and technical support in the development of regional and statewide water plans. Federal agencies have had a hand in the development of Texas water policy for more than fifty years. As a result of the extreme flooding following the drought of record, federal agencies helped develop a series of flood control dams and reservoirs around the state. Similarly, federal monies have poured into Texas and have acted as the primary funds for much of the state's water development. The agencies include the Bureau of Reclamation, Army Corps of Engineers, and the Soil Conservation Service, now the National Resource Conservation Service (NRCS).

Contemporary water planning in Texas revolves around water classifications created by state law: surface, ground, drinking, and water quality.⁶⁶ Each designation is governed by its own set of rules that establish usage, amount, and purpose for use. The complex nature of Texas water law has its roots in the early state water policy of the 1800s. Spanish and English common law, combined with state and federal case law, have had a major hand in the development of Texas water law.

Currently, the state's response toward water planning and conservation has been slow and minimal in its scope. The publication of *Texas Water Plan 2012* stands as a poignant illustration of this fact. The report includes summaries of regional water districts, projections of population growth, current and future supply necessities, and

⁶⁶ Texas Water Development Board, *Water for Texas 2012 State Water Plan – Introduction*, January 2012, 25.

potential climate models. The document culminates with recommendations that outline methods and strategies to maintain the state's water supply until 2060. The *Texas Water Plan 2012* does not explicitly discuss small dams. However, policies recommended for the next several decades could damage a large majority of small historic dams in Texas.

As of 2012, Texas had 188 reservoirs capable of storing 1.5 acre-feet of water per capita.⁶⁷ While the numbers seem impressive, the facts paint a much more dismal picture. Population and regional growth have placed increasing demands on Texas' current dam and reservoir infrastructure. By comparison, the state had 179 major reservoirs that stored 2.5 acre-feet per resident as of 1980.⁶⁸ However, reservoir construction slowed significantly over the next two decades.⁶⁹ If current population trends continue, the state stands to have the lowest water storage numbers since the drought of record during the 1950s. This shortfall will make it difficult to meet the water demands of future populations whose growth is projected to cause a storage capacity to amount to only 1 acre-foot per citizen if changes are not made.⁷⁰ The obvious need to expand and improve Texas water infrastructure is imperative to the state's future.

In response to these possible realities, current planning has begun to shape the future of Texas' water infrastructure. Like each water plan before, the 2012 edition of the *Texas Water Plan* is based on data provided by regional water planning groups in order to gauge the future water requirements statewide. State agencies, universities, and various non-profit organizations are beginning to articulate the seriousness of water scarcity in

⁶⁷ Texas Water Development Board, *Water for Texas 2012 State Water Plan – Policy Recommendations*, January 2012, 237.

⁶⁸ Ibid.

⁶⁹ Ibid.

⁷⁰ Ibid.

the state's immediate and long-term future.⁷¹ The 2012 Texas Water Plan recommended several methods for preserving and increasing the state's water storage capacity over the next several decades.

The most costly recommendation came in 2011 as part of the state's Regional Water Plan. The document calls for the development of twenty-six new major reservoirs (5,000+ acre-feet), the majority of which would be located east of Interstate Highway 35.⁷² These new additions to the state water infrastructure are estimated to satisfy 16.7 percent of the state's total water demands until 2060.⁷³ Placement of the new reservoirs is a key concern regarding the feasibility of *Texas Water Plan 2012*. As required by the Texas Water Code, the legislature has slowly begun to designate possible new reservoir locations to meet the recommended goal of twenty-six new sites. In addition, federal action such as protection of ecologically sensitive areas has narrowed the viability of potential reservoir sites.⁷⁴ Looming water shortages have not yet translated into consistent action on the part of state and local officials; however, it is clear that water will be at the forefront of Texas political and environmental issues in the coming decades.

⁷¹ Terrence Henry, "How Climate Change Will Impact Texas," *State Impact Texas*, October 2013, accessed October 2013. <https://stateimpact.npr.org/texas/2013/01/08/how-climate-change-will-impact-texas/>.

⁷² Texas Water Development Board, *Water for Texas 2012 State Water Plan – Water Management Strategies*, January 2012. : see Figure 7.1. "Recommended New Major Reservoirs."; Texas Water Development Board, *Water for Texas 2012 State Water Plan – Water Management Strategies*, January 2012, 190.

⁷³ Texas Water Development Board, *Water for Texas 2012 State Water Plan – Policy Recommendation*, January 2012, 235.

⁷⁴ *Ibid.*, 238.: "the proposed Lake Fastrill, which was included in the 2007 State Water Plan as a recommended water management strategy to meet the future water supply needs of the City of Dallas, was effectively precluded from development by the U.S. Fish and Wildlife Service's designation of the Neches River National Wildlife Refuge on the basis of a 1-acre conservation easement."

The recommendation for new reservoirs highlights the reality of the state's crumbling dam infrastructure.⁷⁵ A 2008 study by the TCEQ found that out of 1,888 dams and reservoirs served, 245 were in what it termed "bad condition."⁷⁶ Approximately 2,000 dams were built through the 1950s and 60s in response to the flooding that followed the drought of record. These dams are primarily flood control and retention features. The designed functionality of a dam is roughly fifty years. Because a large number of dams were built after the drought of record, many have or will soon reach their design lifespans.⁷⁷ As population has grown around these once rural structures, many older dams pose a safety hazard to surrounding communities. Local and state agencies need to make decisions regarding the repair or removal of these dams if they hope to mitigate possible damage from a breach or collapse.

The 2012 water plan indicated that surface water will play a major role in the coming decades. The focus on major reservoirs and closer scrutiny of already existing

⁷⁵ Mose Buchele, "Why So Many Dams in Texas Are in Bad Condition," *State Impact Texas*, October 14, 2013. <http://stateimpact.npr.org/texas/2013/10/14/many-texas-dams-in-bad-condition/>; Mose Buchele, "How Hundreds of 'Significant Hazard' Dams Escape State Inspection in Texas," *State Impact Texas*, October 15, 2013. <http://stateimpact.npr.org/texas/2013/10/15/how-hundreds-of-significant-hazard-dams-escape-state-inspection/>.

⁷⁶ Texas State Senate Committee on Natural Resources, *The Senate Committee on Natural Resources Interim Report to the 81st Legislature: Dam Safety*, February 2009, 4, accessed December 2013. <http://www.senate.state.tx.us/75r/senate/commit/c580/c580.FINALDamReport80.pdf>. : "Approximately 85 percent of dams in Texas are over 25 years old, and 27 percent are over 50 years old. In many areas downstream of these dams, development has boomed. As development downstream of a dam increases, so does the hazard classification, requiring structural upgrades and increased maintenance costs."

⁷⁷ American Society of Civil Engineers, "Statement of the American Society of Civil Engineers to the Subcommittee of Homeland Security Committee on Appropriations U.S. House of Representatives on Appropriations for the Federal Emergency Management Agency for the Fiscal Year 2011," access October 2013. http://www.asce.org/uploadedFiles/Government_Relations/Testimony_and_Correspondence/DHS%20FY%202011%20statement.pdf; Wendee Holtcamp, "Texas' Thirst for Dam Bucks National Trend," *Pacific Standard Magazine*, August 04, 2011, accessed November 2013. <http://www.psmag.com/environment/texas-thirst-for-dams-bucks-national-trend-34541/>; Eva Hershaw, "Dams Are Coming Down But Not in Texas," *Reporting Texas*, December 9, 2011, accessed December 2013. <http://reportingtexas.com/dams-come-down-around-u-s-but-not-in-texas/>.

small dams will have negative effects on the preservation of small historic dams. In the event that Texas experiences a major flood event, a rush to build new water infrastructure could accelerate and exacerbate the removal of small dams without proper investigation into the resource. While Texas is slow to update its water infrastructure, many scientific and political indicators point to an eventual mobilization to address the issue.

Historic Preservation: Texas Dams

The legislature established the Texas State Historical Survey Committee, later known as the Texas Historical Commission (THC), in 1953.⁷⁸ Over the ensuing decades, the THC created several designations to document and protect historic resources. The Official Texas Historical Marker Program has become synonymous with Texas preservation. In 1962, the contemporary marker program began as a means of commemorating and identifying a diverse range of significant historic resources. The THC issues three types of markers—Historic Texas Cemetery (HTC), Recorded Texas Historic Landmark (RTHL), and subject—and it also provides oversight of the Texas Centennial markers from the 1930s.⁷⁹ The various types of markers provide dates, names, and basic information about the historical significance of locations or structures.⁸⁰

The category of State Archeological Landmark (SAL) is part of the Antiquities Code of Texas.⁸¹ By itself, the designation does not protect resources from alteration or

⁷⁸ Truett Latimer and Laurie E. Jasinski, "Texas Historical Commission," *Handbook of Texas Online*, accessed September 19, 2014. <http://www.tshaonline.org/handbook/online/articles/mdt17>.

⁷⁹ Texas Historical Commission, "Official Texas Historical Markers," accessed September 2014. <http://www.thc.state.tx.us/public/upload/forms/thc-historical-markers-factsheet.pdf>.

⁸⁰ Truett Latimer and Laurie E. Jasinski, "Texas Historical Commission," *Handbook of Texas Online*, accessed September 19, 2014. <http://www.tshaonline.org/handbook/online/articles/mdt17>.

⁸¹ Texas Historical Commission, *State Archeological Landmark Designation: A User's Guide*, June, 2011, accessed August 2014. <http://www.thc.state.tx.us/public/upload/archeology-state-landmark-designation.pdf>; Texas Historical Commission, "State Archeological Landmarks," June 26, 2013, accessed

destruction; however, it does require that any work that has the potential to impact a resource on public land as part of government subdivision or project utilizing public funds must be approved by the Texas Historical Commission before work may begin. Since the Antiquities Code of Texas took effect in 1969, thousands of resources located on public lands have been designated. The code requires that all state and local agencies comply by notifying THC of “ground-disturbing” activity on public land.⁸² The THC has designated some small dams under its Official Texas Historical Marker Program while the Antiquities Code has documented others. Dams currently designated by the State of Texas include: Saffold Dam, Seguin; Renfro Dam, Goldthwaite; Martindale Lumber Company: Dam B; Martindale, and the Mission San Francisco de la Espada Dam, Ditch and Aqueduct; San Antonio. Furthermore, river authorities and watershed districts are subject to compliance with the state’s Antiquities Code and must contact the THC regarding construction or disturbance of any kind.⁸³ These preservation guidelines have been in practice for many decades.

The preservation of structures with time-determinate lifespans is complex. Though a dam may be in excellent structural health or receive rehabilitation, possible future safety concerns must first be investigated. Presently, THC practices of documentation and marker designation are adequate as preservation tools given the finite nature of dams. Similarly, SALs maintain the option to address the potential safety needs of a structure while providing state protection. There are many more small dams with

September 2014. <http://www.thc.state.tx.us/preserve/projects-and-programs/state-antiquities-landmarks>.

⁸² Texas Historical Commission, “Antiquities Code of Texas,” June 3, 2013, accessed September 2014. <http://www.thc.state.tx.us/project-review/antiquities-code-texas>.

⁸³ Texas Historical Commission, “Antiquities Code of Texas,” June 3, 2013, accessed September 2014. <http://www.thc.state.tx.us/project-review/antiquities-code-texas>.

historical value that have yet to be identified or nominated to state or federal preservation programs.

With the passage of the National Historic Preservation Act of 1966, federal preservation programs were available to Texas. Currently, four Texas dams are listed in the NRHP. The Medina Dam at Mico is the fourth largest dam in the nation and is listed for its role in economic and design histories. Two of the four dams currently listed are small in size and excellent examples of historic structures; Seguin's Saffold Dam and the Old Stone Dam in Allen. Both possess high levels of historical significance, integrity, and safety.

Located on the Guadalupe River, the Saffold Dam is one of the four Texas dams listed in the National Register. The structure is a textbook example of an industrial-civic dam. Constructed in 1895 by Henry Torell, it is situated on a natural outcropping in the riverbed. Later, the addition of hydroelectric generators ran Torell's adjacent mill and provided power for the city of Seguin. In 1907, the dam conveyed to the city, which retains ownership today. The resource is identified as significant to historical patterns of engineering, industrial, and settlement histories.

The Old Stone Dam is also a prime example of an industrial-civic dam. Erected in 1874 by the Houston and Texas Central Railway Company, the dam and neighboring watering station provided water for railway cars. Later inundated as a result of a dam built in 1912, the Old Stone Dam later resurfaced following destruction of that later dam. The town of Allen now owns the resource and has successfully designated it a State Archeological Landmark.

The nominations of these two small dams recognize the structures for their historical contributions to industrial, agricultural, transportation, and other broad patterns of history. It is clear from the four dam nominations that small dams typically receive consideration under the NRHP's criterion A, as larger dams are usually linked to criterion C.⁸⁴ Developed to aid resource evaluation, the criteria also help identify "the range of resources and kinds of significance that will qualify properties for listing in the National Register."⁸⁵

Terminology

The following chapters consist of focused discussions regarding small dams. Thus, it is beneficial to clarify to the reader that the terminology and language used throughout this thesis allows for a uniform understanding of its content and stated objectives. The most important definition in this work is the term dam. The basic understanding of a dam is a type of structure that impounds a waterway or controls the flow and level of a body of water. The word dam, however, is often a general term for anything that retains water of any volume. In this thesis, the word dam refers to structures often located across creeks, streams, or bodies of water and with a minimal impound capacity of 500 acre-feet or more. Structures such as temporary gabions (retaining walls) and agricultural features like stock or earthen tanks are not defined as dams in this thesis. According to an article by Anne Chin, Laura R. Laurencio, and Adriana E. Martinez,

⁸⁴ U.S. Department of the Interior, National Park Service, *"How to Apply the National Register Criteria for Evaluation,"* National Register Bulletin, No. 15, 1997. Criterion A: "Those associated with events that have made a significant contribution to the broad patterns of our history." Criterion C: "That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction;"

⁸⁵ Ibid.

“The Hydrologic Importance of Small- and Medium-Sized Dams: Examples from Texas,” no standard dam size classifications exist. In Texas, official state standards determine dam size based on a combination of height and reservoir storage.⁸⁶ Currently, there are 87 dams classified as large, 1,945 dams classified as intermediate, and 5,120 dams classified as small. This thesis will adhere to size classification set forth by the State of Texas in multiple policy documents. Texas divides size into three categories: small, intermediate, and large. Small is defined as a dam under forty feet in height and less than one thousand acre-feet of reservoir capacity.⁸⁷ All of the dams in this typology adhere to this definition.⁸⁸

Size Classification Criteria Texas Administrative Code, Title 13, Section 299.11		
Category	Maximum Reservoir Storage Capacity ^a	Dam Height
Small	Less than 1,000 acre-feet	Less than 40 feet
Intermediate	Equal to or greater than 1,000 and less than 50,000 acre-feet	Equal to or greater than 40 feet and less than 100
Large	Equal to or greater than 50,000 acre-feet	Equal to or greater than 100 feet
^a One-acre foot of maximum water storage is the volume of water that would be required to cover one acre of land (43,560 square feet) to a depth of 1 foot. This is equal to 325,851 gallons.		

Figure 1. State of Texas Size Classification Criteria

⁸⁶ “Dams in Texas are classified in several ways, one of which is by size. The size classification of a dam is based on the dam's impoundment storage and height. Minimum size requirements for a dam to fall under TCEQ's authority are either (1) the dam height must be 25 feet or greater and the dam must have a maximum storage capacity of 15 acre-feet or greater; or (2) the dam height must be greater than six feet and the dam must have a maximum storage capacity of 50 acre-feet or greater.8 Dams that meet these minimum requirements are then grouped into three different categories. See Appendix C for the three size classifications of dams as noted in the TCEQ rules.” Texas State Senate Committee on Natural Resources, *The Senate Committee on Natural Resources Interim Report to the 81st Legislature: Dam Safety*, February 2009, 4.

<http://www.senate.state.tx.us/75r/senate/commit/c580/c580.FINALDamReport80.pdf>:

⁸⁷ Ibid.

⁸⁸ Ibid.

Types of Dams: Vernacular, Earthen, Industrial-Civic

The primary small dam types this typology will focus on are vernacular, earthen, and industrial-civic. It is important to define the differences between these kinds of small dams in order to distinguish and understand the qualities and character synonymous with each specific type.

Vernacular

Vernacular is defined as a structure that meets the size criterion of a small dam, built by a layperson or someone other than a professional engineer with a design that emphasizes functionality rather than style or craftsmanship. The materials are locally sourced or of immediate origin and typically show little evidence of shaping or additional refining. Rock, stone, and other rubble can be found along with low grade concrete or aggregate, wood, or rebar.

Earthen

Earthen or earth dams are the most numerous type of dams in Texas.⁸⁹ They are relatively inexpensive and easy to build in comparison with concrete or professional waterwork projects. Earthen dams are gravity structures often used for flood mitigation and water retention. Mainly constructed from dirt, they may utilize additional material such as rock and rubble as stabilizing fill materials. It should be noted that stock tanks or contour structures designed for water catchment or diversion structures may qualify as small earthen dams if they meet both the size and storage capacity criteria noted earlier.

⁸⁹ Texas Commission on Environmental Quality, Dam Safety Program, " *Unofficial: TCEQ's Dam Inventory*," Morgan Dean, October 2013.

Industrial-Civic

Industrial-civic dams are structures of various designs that are built using more complex designs and a higher caliber of materials than earthen or vernacular dams. They may include, but are not limited to, steel or metal interior support, concrete, cement, brick, and stone. They can be designed and constructed by both professional and unskilled labor. They are often owned by state or local governments, including municipalities.

Texas has three categories for potential hazard levels of dams: low, significant, and high. The classifications are designed to assess the structural health of a dam and the level of threat it may pose to the surrounding area.⁹⁰ The typology in this thesis will not address current systems of dam safety and classification used in the state of Texas. Its main objective is to create a framework for identifying dam types and assessing its significance and integrity. However, it is suggested that the “Hydraulic Adequacy Qualification,” established by the State of Texas should be consulted as an aid for preservationists when assessing a dam.⁹¹

⁹⁰ Texas State Senate Committee on Natural Resources, *The Senate Committee on Natural Resources Interim Report to the 81st Legislature: Dam Safety*, February 2009, 102.
<http://www.senate.state.tx.us/75r/senate/commit/c580/c580.FINALDamReport80.pdf>

⁹¹ Texas State Senate Committee on Natural Resources, *The Senate Committee on Natural Resources Interim Report to the 81st Legislature: Dam Safety*, February 2009, 102.
<http://www.senate.state.tx.us/75r/senate/commit/c580/c580.FINALDamReport80.pdf>

CHAPTER IV

IMPERATIVES FOR PRESERVATION

Historically, American preservation has been a tool to maintain traditional American standards of significance,⁹² although some present-day preservationists may classify such standards as culturally narrow and ethnocentric. The National Historic Preservation Act of 1966 was heavily influenced by its predecessor, the Historic Sites Act of 1935. As a result of this earlier legislation, much of the NRHP is rooted in aesthetic and cultural values of Anglo American society during the 1930s. “National Register Bulletin: Guidelines for Evaluating and Documenting Traditional Cultural Landscapes” details the traditional “Euro-American” prejudice of the National Register by exalting the objective or physical elements of a property above all else.⁹³ Historic preservationist John Sprinkle referred to this built-in ethnocentrism as a system that enforces nationalistic narratives and non-factual history.⁹⁴ Other preservationists have voiced concerns over the narrow nature of properties listed in the National Register and emphasized the need for a larger scope in the types of sites and resources considered for nomination to the register. It appears that contemporary American preservation has slowly begun to expand its scope beyond traditional understandings of NRHP guidelines. A growing consensus among professional preservationists has resulted in a greater awareness of multi-ethnic interpretations of cultural and historic resources. Native American religious or ceremonial sites and natural landscapes are examples of sites that

⁹² U.S. Department of the Interior, National Park Service, *Guidelines for Evaluating and Documenting Traditional Cultural Landscapes*, 1990.

⁹³ Ibid.

⁹⁴ John H. Sprinkle Jr., “Of Exceptional Importance: The Origins of the ‘Fifty-Year Rule’ in Historic Preservation,” *The Public Historian*, Vol. 29, No. 2, (2007), 81-103.

received different treatment under the traditional evaluation processes of the National Register.

Since the 1980s, preservationists have interpreted NRHP language to reflect broader American society and its history. As a result, there was an expansion of what kinds of history deemed representative of American culture. In addition, changes in social attitudes regarding race, culture, gender, and the environment helped to broaden the types of listed resources. The most notable effect of the change in interpretation and application of the NRHP may be the type of buildings chosen for preservation. This change is best demonstrated by the shift from glorification of high-style architecture in early American preservation to a more balanced focus that includes vernacular construction and design. Early homes and buildings listed in the NRHP were either designed or built by celebrated architects or were fine examples of specific architectural styles. Massive structures, like the Hoover Dam in Nevada, are comparable to the works of famous architects such as Frank Lloyd Wright and often considered the archetype of their style or kind. Simply put, many large dams currently listed in the National Register are celebrated for their “high-engineering” just as Wright’s buildings are regarded for “high-architecture.”⁹⁵ Often, structures such as bridges are nominated to the NRHP under criterion C for their contributions to the field of engineering.⁹⁶ Resources deemed significant for their

⁹⁵ “A building, such as a house, barn, church, hotel, or similar construction, is created principally to shelter any form of human activity. Building may also be used to refer to a historically and functionally related unit, such as a courthouse and a jail or a house and a barn. Examples: Houses; barns; stables; sheds; garages; courthouses; city halls; social halls; commercial buildings; libraries; factories; mills; train depots; stationary mobile homes; hotels; theaters; schools; stores; and churches.” U.S. Department of the Interior, National Park Service, *National Register Bulletin: Guidelines for Evaluating and Registering Archeological Properties*, Barbara Little, Erika Martin Seibert, Jan Townsend, John H. Sprinkle, Jr., John Knoerl, 2000. :

⁹⁶ Ibid. The bulletin titled “How To Apply The National Register Criteria for Evaluation” explains that criterion C is utilized by resources “That embody the distinctive characteristics of a type, period, or

architecture or engineering are often turning points in the history of that resource. The massive hydroelectric dams of the 1930s are deemed significant because they represent major progress and change in the history of dams.

Beginning in the late 1960s and early 1970s,” vernacular houses and buildings began to find acceptance in the NRHP as attitudes within American society and the historic disciplines began to exemplify a new understanding of diversity in cultural significance.⁹⁷ Vernacular construction personified the new social history as slave cabins, rural barns, and other buildings became the physical expression of various cultural histories. In addition, vernacular structures and homes often facilitated or had a direct link to the historic event for which the site was nominated. For this reason, vernacular houses are often nominated using Criterion A or C.⁹⁸

The same rationale can be applied to historically-significant small dams. Like vernacular and non-traditional houses, these structures are important to local and regional history. Some small dams can be significant to the economic, transportation, or industrial development of an area. Others are connected to larger patterns of history, such as recreation and infrastructure, at the state or national levels.⁹⁹

method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction.” Pp. 2.

⁹⁷ Bernard L. Herman, “The ‘New’ Architectural History,” *CRM*, Vol. 17, No.2, (1994): 6. “The most obvious analogy to the new architectural history is the new social history which arose in the 1960s and seized as its purpose writing ‘history from the bottom up’”

⁹⁸ U.S. Department of Interior, National Park Service. *National Register Bulletin: How to Apply the National Register Criteria for Evaluation*, Patrick W. Andrus, Rebecca H. Shrimpton, 2002.

⁹⁹ U.S. Department of the Interior, National Park Service, *National Register of Historic Places Register Form: Allen Water Station*, October 1990, accessed may 2014.

ftp://ftp.thc.state.tx.us/nr_program/Allen%20Water%20Station%20NR.pdf

A brief investigation of properties listed in the National Register between the late 1960s and the late 1990s shows that large or high-engineered dams make up the majority of dams listed to the NRHP by most states; Texas is no exception. Small vernacular and industrial-civic dams are a much smaller portion of the dams in the National Register's ranks nationwide. However, analyses of NRHP listings reveal an expansion in the types of resources nominated in the last decades of the twentieth century.

Currently, preservationists work to identify the intrinsic and cultural significance of resources in conjunction with the traditional emphasis on architecture and aesthetic features. However, it is clear from the disparity between the number of high-engineered and vernacular dams listed in the National Register that these resources have yet to experience a shift in perception like other historic resources have previously experienced. Based on the National Register, the aesthetic or technical merits of dams have been valued over historical significance. It is clear from reading samples of NRHP listings that there has been a noticeable change in the interpretation of historic homes and bridges over the past four or more decades.¹⁰⁰

It is logical to see vernacular, industrial-civic, and some earthen dams in the evolution of the National Register's methodology for assessment of significance. These structures could have an effect on the public perception of dams similar to that which vernacular houses had on the public understanding of what made a resource historically significant. Small dams have the potential to humanize resources that have traditionally been championed solely for their utilitarian contributions and engineering achievements. In Texas, contemporary preservation responsibilities are delegated to the Texas Historical

¹⁰⁰ Tiya Miles, *The House on Diamond Hill: A Cherokee Plantation Story*, (Chapel Hill: University of North Carolina Press, 2010).

Commission, often resulting in historical markers or designation as a State Archeological Landmark. However, a convergence of issues surrounding the state's water infrastructure threatens to damage many identified and unidentified historic dams.

Factors Effecting Dam Preservation

In Texas, dams follow the general rules of water infrastructure regarding the placement and design for a specific structural type. Location is chosen based on a site with the greatest strategic advantages to meet the desired function of the project.¹⁰¹ Large dams in the state are typically located near metropolitan areas or on major rivers and are used primarily for surface water retention. Small dams are mainly found in rural locations and serve a host of diverse functions.¹⁰² Dams embody the famous words of architect Louis Sullivan, "form follows function," in that the form of a dam follows its design function. However, the applicability of this phrase is different for dams than for buildings. What makes dams different is that the locations are also aspects of function. Whether for agriculture, storm water control, or recreation, the functions of small dams often dictate that they are found in rural or isolated areas, often on the periphery of urban centers.¹⁰³ In addition, small dams are not intended to serve large populations like structures of the Big Dam Era in the West.

¹⁰¹ S. Alan Skinner, "Archaeological Investigation at the Old Stone Dam: Allen, Texas," *Half Associates, Inc.*, City of Allen, Texas, (2002), 1-21. Examples of the connection between location and design purpose can be seen in both the Saffold Dam in Seguin, and the Allen Water Station. The location of each dam facilitates the design function of hydroelectric power in the case of the Saffold Dam. In addition, the purpose of the Allen Water Station required its construction near a contemporary railroad line.

¹⁰² U.S. Army Corps of Engineers, "Dams by Hazard Potential," *Crop Map: National Inventory of Dams*, accessed June 2014. http://geo.usace.army.mil/pgis/f?p=397:3:1691991705944::NO::P3_STATES:TX:

¹⁰³ Todd Staples, "Dams!" *Texas Department of Agriculture*, December 1, 2010, accessed May 2014. <http://texasagriculture.gov/NewsEvents/NewsEventsDetails/tabid/76/Article/1258/dams.aspx>.

The design purpose of small dams causes them to be located in areas where contact with the general public is infrequent. Additionally, the localized nature of their designed function often precludes them from general public sight or knowledge.¹⁰⁴ Their physical absence from sight and minimal impact to population centers has made small dams virtually invisible to most Americans. In Texas, these issues are compounded by the nature of land distribution and the history of federal and state involvement in water infrastructure. Out of nearly 7,500 dams in the state, sixty percent are located on private land.¹⁰⁵ The Texas Commission on Environmental Quality (TCEQ) is the primary state agency in charge of dam management and safety in the state. TCEQ is authorized to monitor the health of all dams, both public and private, in the state. However, as of 2008, the TCEQ inspected less than one thousand of the state owned dams in the last twenty years.¹⁰⁶ Moreover, a number of small private dams are exempt from oversight.¹⁰⁷ In recent years, TCEQ's regulatory power has been diminished as many dams located on private land became exempt from oversight.¹⁰⁸ Limited access to structures on private land impacts the accuracy of the TCEQ's dam inventory.

¹⁰⁴ Todd Staples, "Dams!" *Texas Department of Agriculture*, December 1, 2010, accessed May 2014. <http://texasagriculture.gov/NewsEvents/NewsEventsDetails/tabid/76/Article/1258/dams.aspx>.

¹⁰⁵ Gretchen Gavett, "Tailings Dams: Where Mining Waste is Stored Forever," *Frontline*, July 2012, accessed May 2014. <http://www.pbs.org/wgbh/pages/frontline/environment/alaska-gold/tailings-dams-where-mining-waste-is-stored-forever/>.

¹⁰⁶ Todd Staples, "Dams!" *Texas Department of Agriculture*, December 1, 2010, accessed May 2014. <http://texasagriculture.gov/NewsEvents/NewsEventsDetails/tabid/76/Article/1258/dams.aspx>; Veronica Castelo, "Owners Lose Lake after Dam Breaks," *Tim Warner Cable New*, January 2008, accessed May 2014. <http://austin.twcnews.com/content/news/208208/owners-lose-lake-after-dam-breaks/>.

¹⁰⁷ Texas Commission on Environmental Quality, *Guidelines for Developing Emergency Actions Plans for Dams in Texas*, GI-394, March 2012, 8, accessed December 2013. http://www.tceq.state.tx.us/assets/public/compliance/field_ops/damsafety/gi-394.pdf.

¹⁰⁸ Texas State Auditor's Office, *An Audit Report on the Dam Safety Program at the Commission on Environmental Quality*, SAO Report No. 08-032, May 2008, accessed January 2014. <http://www.sao.state.tx.us/reports/main/08-032.pdf>.

The reduction in regulatory action is only one of many issues threatening the health of Texas' small dams. Age, lack of funding, drought, population, and a historical precedence for flooding, all threaten the viability of a majority of Texas' water infrastructure. The following summary of contemporary issues affecting the sustainability, longevity, and integrity of small dams in Texas forms the background and context for the typology in Chapter Four.

Small dams are at a higher risk from these factors, as any combination of factors could breach or damage these structures. The possible loss of these resources warrants identification and review of all historic or aged small dams. It seems that resources with historic significance are in limited number around the state. Harm to these structures is probable if action to identify, document, and preserve them is not taken. The following is a recounting of contemporary issues concerning the health of small dams in Texas.

Threats to the Resources

Drought

State climatologist John-Nielsen Gammon stated that Texas is currently experiencing the worst drought since the 1950s.¹⁰⁹ Gammon estimates that current weather conditions could last until 2020.¹¹⁰ While rainfall has increased since 2013, more than seventy percent of Texas remained under drought conditions as of June 2014, with

¹⁰⁹ Forrest Wilder, "Q&A with State Climatologist John Nielsen-Gammon," *Texas Observer*, September 12, 2013, accessed May 2014. <http://www.texasobserver.org/qa-state-climatologist-john-nielsen-gammon>.

¹¹⁰ Matthew Tresaugue, "Texas Drought Could Rival State's Worst Dry Years," *Houston Chronicle*, February 5, 2013, accessed June 2014. <http://www.chron.com/news/article/Texas-drought-could-rival-state-s-worst-dry-years-4253137.php>; Lauren Morello, "Some Climatologist Worry That Texas' Mega-Drought Could Endure for Years," *New York Times*, October 3, 2011, accessed June 2014. <http://www.nytimes.com/cwire/2011/10/03/03climatewire-some-climatologists-worry-that-texas-mega-dro-4865.html>.

more than twenty-one percent of the state classified in extreme or exceptional conditions.¹¹¹ The combination of high summer heat and lack of rainfall has lowered surface water in reservoirs and rivers. It has also dramatically accelerated use of the state's groundwater supply.¹¹² Texas' total reservoir system water levels dropped to sixty-seven percent statewide as of June 2014,¹¹³ as a result, many large dams are showing the structural wear because of the drying of reservoir beds.¹¹⁴ Prolonged absence of rain and extreme heat reduces ground moisture; this causes contraction and shifting in the soil. The movement causes dams to crack, often beginning first at its concrete base.¹¹⁵

Relaxed regulation and continued exemption of dams from state inspection has increased structural degradation of small dams due to lack of rainfall. Current weather combined with reduced funding, advanced infrastructure age, structural degradation, and decreased oversight has the potential to develop into an emergency. Historically, severe drought in Texas abruptly ends with extreme flooding, and the drought of record ended with such an event in 1957 when torrential rains blanketed a majority of Texas.¹¹⁶ Legislation passed in response to the flooding of the fifties proved to be too late to prevent or mitigate potential flood damage. Given the similarities between the severity of

¹¹¹ U.S. Department of Agriculture, "U.S. Drought Monitor: Texas," *The United States Drought Monitor*, accessed July 2014. <http://droughtmonitor.unl.edu/Home/StateDroughtMonitor.aspx?TX>.

¹¹² Sandra Postel, "Drought Hastens Ground Water Depletion in Texas Panhandle," *National Geographic*, July 24, 2014, accessed July 2014. <http://newswatch.nationalgeographic.com/2014/07/24/drought-hastens-groundwater-depletion-in-the-texas-panhandle/>; National Public Radio, "Everything You Need to Know About Texas Drought," *State Impact Texas*, accessed October 2013. <http://stateimpact.npr.org/texas/tag/drought/>.

¹¹³ Texas Water Development Board, "Texas Reservoirs," *Water Data for Texas*, accessed June 2014. <http://www.waterdatafortexas.org/reservoirs/statewide>

¹¹⁴ Michael Marks, "If Rains Refill Reservoirs, Can Texas' Dams Hold Up?" *State Impact Texas*, November 26, 2013, accessed December 2013. <https://stateimpact.npr.org/texas/2013/11/26/if-rains-refill-reservoirs-can-texas-dams-hold-up/>.

¹¹⁵ Ibid.

¹¹⁶ Texas State Board of Water Engineers, "Texas Floods: April, May, June 1957," October 1957, access June 2014. http://www.twdb.state.tx.us/publications/reports/historic_groundwater_reports/doc/M278.pdf.

both the drought of record and current weather patterns, a rain event or succession of events has the potential to end drought conditions and stress aging dams beyond their capacities.

Specifically, throughout most of Texas, it is more important to understand the effects of drought on earthen dams which comprise ninety-seven percent of such features, according to the U.S. Army Corps of Engineers.¹¹⁷ Rains make cracks worse in both concrete and earthen dams by undermining the structural integrity.¹¹⁸ The head of the TCEQ's Dam Safety Division, Warren Samuelson, stated, "Rain causes two main issues for cracked dams: it increases the size of the cracks, and it increases the amount of water that the dam must hold back."¹¹⁹ Understood to have begun in October of 2010, Texas' current drought compares to the severity of the drought of record.¹²⁰ Four years of severe drought and more than 4,700 dams identified as fifty years and older by the Corps of Engineers puts the TCEQ's assessment of hazardous dams into perspective.¹²¹ It is questionable if such small dams could withstand a flood like that of the late 1950s.

¹¹⁷ U.S. Army Corps of Engineers, "Dams by Hazard Potential," *Crop Map: National Inventory of Dams*, accessed June 2014. http://geo.usace.army.mil/pgis/f?p=397:3:1691991705944::NO::P3_STATES:TX:

¹¹⁸ Julia Harte, "Texas Law Reducing Dam Inspection Sparks Criticism: Move Raises Concerns as Drought Threatens to Weaken Earthen Barriers," *Wall Street Journal*, July 9, 2014, under "U.S. News," accessed July 2014. <http://online.wsj.com/articles/texas-law-reducing-dam-inspections-sparks-criticism-1404949104>

¹¹⁹ Michael Marks, "If Rains Refill Reservoirs, Can Texas' Dams Hold Up?" *State Impact Texas*, November 26, 2013. Accessed December 2013. <https://stateimpact.npr.org/texas/2013/11/26/if-rains-refill-reservoirs-can-texas-dams-hold-up/>; Mose Buchele, "Aging Dams, Booming Growth And the Search For Solutions," *State Impact Texas*, October 17, 2013, accessed October 2013. <http://stateimpact.npr.org/texas/2013/10/17/aging-dams-booming-growth-and-the-search-for-solutions/>.

¹²⁰ National Public Radio, "Everything You Need to Know about Texas Drought," *State Impact Texas*, accessed October 2013. <http://stateimpact.npr.org/texas/tag/drought/>.

¹²¹ U.S. Army Corps of Engineers, "Dams by Hazard Potential," *Crop Map: National Inventory of Dams*, accessed June 2014. U.S. Army Corps of Engineers, "Dams by Hazard Potential," *Crop Map: National Inventory of Dams*, accessed June 2014. http://geo.usace.army.mil/pgis/f?p=397:3:1691991705944::NO::P3_STATES:TX:; Dam Safety Action, "Where Are High Hazard Potential Dams?" *Texas: Emergency Action Planning*, accessed April 2014.

Private Property and Safety

A major weather event that rivals that of 1957 may not come; however, it is likely that even more property damage could occur if it should. During the 1960s, Texas experienced the most recent dramatic increase in the number of dams constructed in the state. Since then, population centers have steadily encroached on the structures as people have settled near or downstream of dams. Because most Texas dams are small and located on private land, many citizens and residents are unaware of the threat they possess to downstream property. Still, some do not see a danger in being in the path of a dam, particularly given the low level of many Texas streams, lakes, and reservoirs in recent years.¹²²

It is unclear to what extent a major flood event would cause small dams to fail, but there is evidence of the damage a single breach can yield. Texas experienced one hundred and seventy dam failures over the past century.¹²³ In 2008, the Rhine Lake Dam located in Van Zandt County failed.¹²⁴ When last inspected in 1984, the dam garnered a

<http://www.damsafetyaction.org/TX/about-eaps/where.php>. A major factor in concern about dam safety and the need for EAPs is the age of many dams. The National Inventory of Dams information on Texas notes that 275 of the state's dams were built before 1900, and another 841 predate 1950, after which 1,069 were built in the 1950s. Another 2,755 were built during the 1960s, which was when many USDA conservation programs assisted in funding hundreds of dams. These NRCS project dams are under state regulation and are regularly inspected. Many dams become a greater hazard as they continue to age and deteriorate. While hundreds of them need to be rehabilitated, lack of funding prevents the work. Another problem that complicates rehabilitation efforts, along with EAP compliance, is that the ownership of some older dams is not known or uncertain.

¹²² Michael Marks, "If Rains Refill Reservoirs, Can Texas' Dams Hold Up?" *State Impact Texas*, November 26, 2013, accessed December 2013. <https://stateimpact.npr.org/texas/2013/11/26/if-rains-refill-reservoirs-can-texas-dams-hold-up/>.

¹²³ Julia Harte, "Texas Law Reducing Dam Inspection Sparks Criticism: Move Raises Concerns as Drought Threatens to Weaken Earthen Barriers," *Wall Street Journal*, July 9, 2014, under "U.S. News," accessed July 2014. <http://online.wsj.com/articles/texas-law-reducing-dam-inspections-sparks-criticism-1404949104>

¹²⁴ Veronica Castelo, "Owners Lose Lake after Dam Breaks," *Time Warner Cable New*, January 2008, accessed May 2014. <http://austin.twcnews.com/content/news/208208/owners-lose-lake-after-dam-breaks/>.

good rating by the TCEQ. The Rhine Lake Dam was classified as low-hazard because it did not pose a risk to life. Though no property was damaged or people hurt, the breach eliminated the area's primary recreation attraction. As a result, residents grew concerned about a drop in their property value due to the loss of the lake.¹²⁵

Currently, there is no mechanism to prevent development downstream from a dam.¹²⁶ This is most easily illustrated by the numerous additions of homes, neighborhoods, and other developments popping up in the outflow path of dams. Such growth has the potential to be a problem for all parties involved; roughly 7,300 dams are identified as hazardous to public safety and private property.¹²⁷ The rating levels established by the National Inventory of Dams (NID) increase with the amount of projected damage a dam failure could cause. The criteria are:

¹²⁵ Veronica Castelo, "Owners Lose Lake after Dam Breaks," *Time Warner Cable New*, January 2008, accessed May 2014. <http://austin.twcnews.com/content/news/208208/owners-lose-lake-after-dam-breaks/>.

¹²⁶ Mose Buchele, "Aging Dams, Booming Growth and the Search for Solutions," *State Impact Texas*, October 17, 2013, accessed October 2013. <http://stateimpact.npr.org/texas/2013/10/17/aging-dams-booming-growth-and-the-search-for-solutions/>.

¹²⁷ U.S. Army Corps of Engineers, "Dams by Hazard Potential," *Crop Map: National Inventory of Dams*, accessed June 2014. http://geo.usace.army.mil/pgis/f?p=397:3:1691991705944::NO::P3_STATES:TX:

Low-hazard:

(A) no loss of human life expected (no permanent habitable structures in the breach inundation area downstream of the dam); and
(B) minimal economic loss, located primarily in rural areas where failure may damage occasional farm buildings, limited agricultural improvements, and minor highways (classified by the Texas Department of Transportation as rural collector or rural local roads, including county roads and Farm-to-Market roads not used to provide service to schools).

Significant-hazard:

(A) loss of human life possible (one to six lives or one or two habitable structures in the breach inundation area downstream of the dam); or
(B) appreciable economic loss, located primarily in rural areas where failure may cause damage to isolated homes; damage to secondary highways (classified by the Texas Department of Transportation as rural major collector roads, including Farm-to-Market roads used to provide service to schools), damage to minor railroads; or interruption of service or use of public utilities, including the design purpose of the utility.

High Hazard

Loss of life expected (7 or more); economic loss excessive.

Figure 2. TCEQ's Hazard Ranking and Criterion

As with state dam totals, the total number of hazardous dams vary by agency and source data. However, variations between sources appears minimal as they all indicate that between eight hundred to one thousand Texas dams are likely to cause death and excessive property damage should they fail.¹²⁸ The Corps of Engineers' service, the National Inventory of Dams (NID), provides a publically accessible source with up-to-date accounting of Texas dam information. Analysis of the data shows that most dams are clustered around major population centers. With so many dams located near property and people, the large number of high-hazard dams makes sense. Still, it is difficult to understand why responsible parties, be they governments or private persons, allowed such an exorbitant number of dams near development to become structurally compromised.

¹²⁸ U.S. Army Corps of Engineers, "Dams by Hazard Potential," *Crop Map: National Inventory of Dams*, accessed June 2014.
http://geo.usace.army.mil/pgis/f?p=397:3:1691991705944::NO::P3_STATES:TX:

As dams around the country become obsolete, many states started removing these structures. The efforts have resulted in thousands of dam removal projects nationwide.¹²⁹ In comparison, Texas has removed thirty dams in its entire history.¹³⁰ The potential risks that a dam poses to property and public safety is a concern among all parties and individuals involved. Still, issues regarding Texas' aging dam infrastructure remain on the periphery of the state's legislative agenda.

Legislative Inaction

A prime cause of legislative inaction has been a relatively mute response from the general public on the issue. Many Texans are unaware of the severe condition of Texas' dam infrastructure, particularly the potential damage to property and loss of potential historic resources. States such as Washington have been compelled to remove dams due to the direct impacts on local wildlife. Texas is without "charismatic fish" like the migrating salmon in the Pacific Northwest.¹³¹ Although marine ecology and river biology are protected within Texas waterways, research does not suggest that wildlife or other environmental factors have been the impetus for the removal of dams in the state. As a consequence, removal of a local dam is often in reaction to being defunct, structurally unsound, or obsolete. The same reactionary safety policy has been observed in state and federal systems of governance, funding, and dam monitoring agencies mentioned in previous chapters. The prime culprit for the inaction of local and state regulatory agencies

¹²⁹ American Rivers, "Questions about Removing Dams," *American Rivers*, accessed May 2014. <http://www.americanrivers.org/initiatives/dams/faqs/>. Currently, *American Rivers* is aware of almost 1,150 dams that have been removed over the past 100 years in this country.

¹³⁰ Eva Hershaw, "Dams Are Coming Down, But Not in Texas," *Reporting Texas*, December 9, 2011, accessed June 2014. <http://reportingtexas.com/dams-come-down-around-u-s-but-not-in-texas/>.

¹³¹ *Ibid.*

is the limited availability of funds used for repair and maintenance of public and private small dams in Texas.

Ultimately, the financial and legal burden of a private dam is the owner's responsibility; however, historically, local, state, and in some cases, federal monies have been allocated to address failing private dams in Texas.¹³² Still, the Texas Legislature has recalled most of the expanded regulatory responsibility given to TCEQ's Dam Safety Division in 2008.¹³³ In addition, the report found that hundreds of dams had never been visited by state inspectors. The State Auditor's Office report gave goals and recommendations that the Dam Safety Program was to meet. According to Program Manager Warren Samuelson, a large portion of those requirements were completed as of 2013. A majority of Texas dams classified as high or significant hazard have been inspected and or documented.¹³⁴ Still, property owners' rights kept the TCEQ from inspecting a handful of dams in the state.

¹³² Kathy Wythe, "Providing Protection: Agencies Receive Funding to Repair, Upgrade Dams," *Texas Water Resource Institute*, Fall 2009, accessed February 2014. <http://twri.tamu.edu/publications/txh2o/fall-2009/providing-protection/>; Murphy Parks, "NRCS Accepting Application for Dam Rehab Funding," *Freese and Nichols*, July 21, 2014, accessed July 2014. <http://www.freese.com/resources/blog/nrcs-accepting-applications-dam-rehab-funding-0>. : "Due to the passage of time and difficulty in raising adequate funds locally, many sponsors approached the Texas Legislature with their concerns over amount of needed O&M and repairs. In recognition that these dams will continue to serve as a critical protection for our state's infrastructure, private property, and lives, the Legislature appropriated \$15 million dollars to the Texas State Soil and Water Conservation Board (TSSWCB) for grants to local SWCDs during the 2010-2011 biennium for O&M and structural repairs."

¹³³ Mose Buchele, "How Hundreds of 'Significant Hazard' Dams Escape State Inspection in Texas," *State Impact Texas*, October 15, 2013, accessed November 2013. <http://stateimpact.npr.org/texas/2013/10/15/how-hundreds-of-significant-hazard-dams-escape-state-inspection/>

¹³⁴ State Auditor's Office, "An Audit Report On: The Dam Safety Program at the Commission on Environmental Quality, Sao Report No. 08-032, May 2008, <http://www.sao.state.tx.us/reports/main/08-032.pdf>.

Funding

Government funding for maintenance of privately-owned dams has some historical precedence in Texas.¹³⁵ At present, funds are made available primarily through federal and local agencies. The National Resource Conservation Service (NRCS) offers several funding programs: the Structural Repair Grant and the Operations and Maintenance Grant this is not used again in this chapter, so not needed.¹³⁶ Federal legislation has provided additional funds for the repair of multiple dams often located across several states.¹³⁷ Examples would include the 2014 Farm Bill. Federal money is often provided by local and state sponsors such as soil and water conservation districts, river authorities, counties, cities, and Water Control and Improvement Districts (WCIDs).¹³⁸

Currently, a comprehensive funding system on a statewide scale is unavailable. Some Texas counties, such as Williamson, pay for their dam maintenance through local taxes; however, such a system is not common practice throughout the state.¹³⁹ Until such a system can be established, counties, municipalities, neighborhoods, or individual owners will continue to find difficulty securing funding for basic maintenance or repairs.

¹³⁵ Mose Buchele, "How Hundreds of 'Significant Hazard' Dams Escape State Inspection in Texas, *State Impact Texas*, May 28, 2013, accessed October 2013. <http://stateimpact.npr.org/texas/2013/10/15/how-hundreds-of-significant-hazard-dams-escape-state-inspection/>.

¹³⁶ Texas State Soil and Water Conservation Board, "*Flood Control Programs*," accessed November 2014. <http://www.tsswcb.texas.gov/en/floodcontrol>.

¹³⁷ U.S. Department of Agriculture, "*Recovery Act Funding Helps Dam Repairs in Collin County*," Randy Henry, accessed July 2014. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/tx/home/?cid=nrcs144p2_003006; U.S. Department of Agriculture, "2014 Rehabilitation Update," *Natural Resource Conservation Service*, accessed July 2014. <http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/wr/>.

¹³⁸ Texas State Soil and Water Conservation Board, "*Flood Control Programs*," accessed November 2014. <http://www.tsswcb.texas.gov/en/floodcontrol>.

¹³⁹ Mose Buchele, "Aging Dams, Booming Growth and the Search For Solutions," *State Impact Texas*, October 17, 2013, accessed October 2013. <http://stateimpact.npr.org/texas/2013/10/17/aging-dams-booming-growth-and-the-search-for-solutions/>.

Therefore, it will continue to be difficult to identify structures with historical integrity and significance.

Benefits of Addressing and Reforming Water Infrastructure

State regulators and citizens have raised concerns about the threats aging, small dams pose to people and property. While some funding and increased regulatory oversight has been granted by the legislature, it has not been adequate to address the size and scope of the issues threatening Texas dams.¹⁴⁰ Population statistics and climate projections indicate the state will be forced to address a multitude of troubled dams in response to a combination of age, drought, and flooding. The need may also come out of necessity to expand and update state surface water supplies and infrastructure. It is the recommendation within this thesis that Texas should be updating and expanding its water supply and infrastructure in order to prepare for projected future demand and potentially limited supply. However, preservationists should also study, identify, and take into account those historic dams that can be saved and preserved.

The benefits of increased state involvement would save the State of Texas money in both the short and long term. The Association of State Dam Safety Officials calculated that \$711 million dollars is required to repair all non-federal high-hazard dams in Texas. Most high-hazard dams in Texas are large in size and capacity. Still, medium and small

¹⁴⁰ "In 2003, the Association of State Dam Safety Officials estimated that it would cost more than \$711 million to rehabilitate the non-federally owned, high-hazard dams in Texas. However, federal and state funding available to dam owners to make repairs is limited. The National Dam Rehabilitation and Repair Act of 2007, passed by the U.S. House of Representatives in October 2007, would provide publicly-owned dams \$200 million nationally over five years to make repairs. However, should this bill become law, the funding that would be allocated to Texas falls far short of estimated costs to rehabilitate Texas dams." State Auditor's Office, *"An Audit Report On: The Dam Safety Program at the Commission on Environmental Quality, Sao Report No. 08-032, May 2008, <http://www.sao.state.tx.us/reports/main/08-032.pdf>.*

dams provide economic benefit to downstream properties across the state and also may have historical significance. It is unclear how costly the rehabilitation of small, less hazardous dams would be; although, the cumulative benefit of small dams appears to be substantial enough to justify state or local action.¹⁴¹ Preemptive action by Texas lawmakers will increase the likelihood that dams with the highest significance and integrity will be identified, assessed, and preserved. In addition, assessment of the state's small dam inventory could equally identify obsolete structures that could be removed as mitigation for the preservation of some small dams. Similarly, repair or rehabilitation of a historic dam would enhance public safety by strengthening such structures.¹⁴²

¹⁴¹ U.S. Department of Agriculture, "*Recovery Act Funding Helps Dam Repairs in Collin County*," Randy Henry, accessed July 2014. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/tx/home/?cid=nrcs144p2_002573; U.S. Department of Agriculture, "*Williamson County Gets Dam Repairs*," Randy Henry, accessed July 2014. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/tx/home/?cid=nrcs144p2_002579.

¹⁴² Texas Commission on Environmental Quality, *Dam Removal Guidelines*, GI-358, September 2006, accessed April 2014. http://www.tceq.texas.gov/publications/gi/gi-358.html/at_download/file.; Stanford University, "NPDP Database Access," *National Performance of Dams Program*, June 2014. <http://npdp.stanford.edu/node/83>.

CHAPTER V

TPOLOGY

As issues of water and infrastructure continue to grow in severity, all types of dams may eventually come under public scrutiny for their environmental impacts or threats to public safety. Texas governmental reports and documents clearly state the expanded role large reservoirs will have in the state's future water plan.¹⁴³ Equally clear is the consensus among state conservationist to remove as many dams as possible to protect and ensure ecological health.¹⁴⁴ Small dams typically are less crucial to state infrastructure and less costly to build or maintain than their larger counterparts. Should Texas ever choose to cull aging or unsafe dams from its inventory, small dams will be likely targets. New water infrastructure projects could require mitigation through removal of aging dams. Similarly, Texas may take steps to reduce the number of aging or damaged small structures out of safety concerns.

Currently, historically significant dams are not a top issue among the general public. Although voters recognize the need to revamp Texas' water policy and infrastructure, many may not fully grasp the ramifications that such a change may have

¹⁴³ "Reservoir construction has slowly declined since the 1980s. While fewer reservoirs are recommended now than in early state water plans, they still play an important role in meeting needs for water during a drought. The 2012 State Water Plan recommends 26 reservoirs that would provide 1.5 million acre-feet of water during a repeat of drought of record conditions in 2060. In the absence of these reservoirs, other water management strategies would simply not be enough to meet the needs of Texans during a severe drought." Texas Water Development Board, *Water for Texas 2012 State Water Plan – Policy Recommendations*, January 2012.

¹⁴⁴ Mary Van Zant, Watershed Coordinator, Meadows Center interview by Stephen Austin, San Marcos, Texas, March 11, 2014; Jim Kimmel, Professor, Department of Geography, Texas State University, interviewed by Stephen Austin, September 25, 2013; Dan Pryikyl, Lower Colorado River Authority, interviewed by Stephen Austin, March 9, 2014.

on historically significant dams.¹⁴⁵ Given the various factors at play in the future of Texas' water infrastructure, it is logical to assume that the preservation of dams will eventually become part of the discussion.¹⁴⁶ As is true with all types of resources represented in the National Register, the majority of dams will not be nominated or preserved. From its inception, the mission of the NRHP has been to identify resources that "possess exceptional values or qualities in illustrating or interpreting the heritage of the United States."¹⁴⁷ Thus, the goal of historic preservationists in Texas should be to aid and facilitate other professionals in the evaluation of small dams in order to save the best possible examples.

Typology

The following typology for the identification of types and assessment of integrity for small dams in the state of Texas is meant to address this need. The hope is this framework will aid in the identification and uniform assessment of such resources. This typology will provide an over of the kinds of small dams that can be found in the state and help preservationists identify the type, integrity, construction materials, and potential historic links to surrounding cultural landscapes.

This typology will be useful for cultural resource managers, preservationists, archeologists, and environmental professionals that frequently engage with historical

¹⁴⁵ "The voters of Texas subsequently approved a constitutional amendment authorizing TWDB to administer a \$200 million water development fund to help communities develop water supplies." Texas Water Development Board, *Texas Water Plan 2012*, January 2012.

¹⁴⁶ Eva Hershaw, "Dams are Coming Down, but Not in Texas," *Reporting Texas*, December 9, 2011, accessed December 2013 <http://reportingtexas.com/dams-come-down-around-u-s-but-not-in-texas/>.

¹⁴⁷ "To recognize the national significance of properties that possess exceptional values or qualities in illustrating or interpreting the heritage of the United States, the Secretary of the Interior designates some historic places as National Historic Landmarks." U.S. Department of The Interior, National Park Service, *"The National Register of Historic Places,"* accessed June 2014. <http://www.nps.gov/nr/publications/bulletins/pdfs/NRBroch.pdf>.

resources. It can be an aid to the general public as a basic tool to assess and identify small dams on private property. The purpose of creating a typology specific to Texas dams is to help preservation and conservation efforts to identify small dam types while quickly and uniformly assessing their historical integrity and potential for preservation. The large quantity of dams in the state makes Texas an appropriate place to develop a typology for an assessment of these structures.

This thesis does not attempt to serve as the official template for the assessment of all small dams in Texas; rather, the hope is that this typology can serve as a model for an official statewide field guide. Furthermore, it should be clear that the methodology for this framework is based on current National Register of Historic Places protocols for assessment and ascribes to the same definitions of the nomenclature used in the process. It is anticipated that this typology might serve as a supplement to the NRHP guidelines for assessment of historic resources.

Creating a framework for the assessment of small dams will aid in planning for the removal of hazardous dams. Creating a uniform system of assessment will help mitigate legal entanglements with local governments and private citizens by providing an official process that establishes uniform standards for all Texas dams. It will assist in assessments of dams in Texas and potentially expedite decisions to preserve or remove structures. Also, uniform assessment increases the likelihood that small dams with the highest level of integrity and significance will be preserved.

There is currently not a uniform style for the majority of small dams. No two are identical, even those with the same designed purpose. As previously noted, location is an aspect of a dam's design function. The location of a dam provides important clues as to

its intended function. Such information is useful in determining the types of resources preservationists may find on a specific cultural landscape.

The form of a small dam is often determined by its location. While function can dictate a dam's physical location, its form is determined by the features of the site. Two basic forms have become standard for almost all small dams: massive and structural.¹⁴⁸ Identifying the material makeup of a structure is important in confirming observations of the dam's form and function. The kinds of materials are often indicative of a certain type of dam; for example, earthen dams are always built with a soil composite, while vernacular structures can be a mix of masonry, concrete, or various local materials. Industrial-civic dams tend to be built from concrete and other professional-grade construction materials. Texas dams can be divided into two general categories based on their size and functions. A majority of large Texas dams are used for water impoundment, retention, and flood control.¹⁴⁹ Small dams can serve a multitude of functions such as agriculture, recreation, industry, and retention. The primary differences between small and large dams are size and the scope of their effect on broader society. Large dams tend to serve major populations, while the impacts of small structures tend to be focused on a local or community level.

This typology is organized into six sections: types (subtypes), function, form, materials, cultural landscape, and integrity assessment. Each division is designed to aid

¹⁴⁸ Donald C. Jackson, *Great American Bridges and Dams*, (Washington, D.C.: Preservation Press, (1988), 44-48: Massive: A structure that uses its sheer mass (bulk) of materials to resist hydrostatic water pressure. Structural: Utilizes the shape of its design to resist hydrostatic pressures and allows for a sustainable reduction in amount of materials used.

¹⁴⁹ Ibid.

the user in assessing a dam's individual characteristics in order to identify type and integrity. The following are the objectives for each section of the typology.

Types and Subtypes

An explanation of how to identify vernacular, earthen, and industrial-civic dams is provided. A brief history of each type will be provided along with listing of character defining features.¹⁵⁰ Following a discussion of all three types, a list of each design's subtypes are listed and identified by their character defining features.

Function

A discussion about the various functions of all dams will begin with a macro view of different kinds of dams. This section illustrates the importance of a dam's function in shaping its form and type.

Form

A brief history and scientific explanation is included in the explanation of each form. Understanding the form of a dam will help with identification and assessment of the structure's integrity.

Materials

Identification of materials used in a small dam's construction can yield much information about its type. A listing of the materials used in specific styles of dams is provided.

Cultural Landscape

A brief overview of the types of dams associated with a specific cultural landscape and methods for identifying dams in the field is provided.

Integrity Assessment

This will be an instructional guide for how to assess a structure's integrity through identification of the seven aspects of inquiry.

¹⁵⁰ U.S. Department of The Interior, National Park Service, *Guidelines for the Treatment of Cultural Landscapes: Defining Landscape Terminology*, accessed June 2014. <http://www.nps.gov/tps/standards/four-treatments/landscape-guidelines/terminology.htm>. The NRHP defines character defining features as "a prominent or distinctive aspect, quality, or characteristic of a cultural landscape that contributes significantly to its physical character. Land use patterns, vegetation, furnishings, decorative details and materials may be such features."

Types

The three categories of small dams are classified as vernacular, earthen, and industrial-civic. A visual inspection is the first step in discerning between the three types while identifying a dam's subtype is more nuanced. It is difficult to identify type and subtype using only one component of this typology due to the lack of uniformity in small dams. A great deal of variety exists within the confines of the three major types covered by this typology. The following section covers the three major types by identifying where they are found, by providing contextual histories, and by noting several character-defining features. A review of potential subtypes helps the user prepare for the subsequent sections by demonstrating the way each contributes to the grouping.

Vernacular dams

Identification – Vernacular:

For preservationists, the term vernacular refers to architecture concerned with the domestic and functional instead of monumental or decorative constructions. Such dams were often designed and constructed by unskilled builders to serve personal or community needs and functions. These structures are often located on rural land along creeks, streams, and drainages.¹⁵¹ Their physical composition varies, as vernacular dams utilized local materials for construction. They can also vary in size but tend to be below the forty-foot standard established by the State of Texas.¹⁵²

¹⁵¹ Texas Parks and Wildlife Department, *Texas River Guide*, accessed June 2014. http://www.tpwd.state.tx.us/publications/nonpwdpubs/water_issues/rivers/navigation/riddell/bridgesanddams.phtml. private dams are on small creeks and non-navigable waterways due to Texas law.

¹⁵² Texas State Auditor's Office, *An Audit Report On: The Dam Safety Program at the Commission on Environmental Quality*, SAO Report No. 08-032, Ch.2 pg.102, May 2008, <http://www.sao.state.tx.us/reports/main/08-032.pdf>.

Vernacular dams potentially possess a great amount of historic significance as a result of their construction by unskilled builders and their possible connections to local, and even broader, histories. The structures can be both privately or publicly owned but typically are found on private, non-navigable waterways. Few vernacular type dams are identified by the THC or included in NRHP listings for Texas. As stated in previous chapters, private ownership seems to be the primary factor behind the lack of preservation. However, financial incentives provided by the state may garner the support and involvement of private owners in preservation activities. The resources potentially possess significance under criteria A, C, and D. Vernacular dams are often associated with settlement, agricultural, or recreational histories. Likewise, they may have strong connections to various patterns of history and likely possess archeological artifacts. The design and materials are unique to each individual vernacular dam. In addition, they can be either completely manmade structures or incorporate natural features, such as outcroppings in the riverbed. Vernacular structures could easily meet criterion C, as they “represent a significant and distinguishable entity whose components may lack individual distinction.”¹⁵³

Examples:

The dam which inspired this thesis has no official name. Thus, for the purposes of clarity, it is referenced as the Blue Heron Dam on Cypress Creek in Wimberley. The structure was built in 1945 by the Weatherford, Cook, Bernon, Smith, and Dupree families, along with other stakeholding families on the immediate waterfront. The dam was constructed solely for recreational purposes. The community agreed the Blue Heron Dam would function as a private swimming

¹⁵³ U.S. Department of Interior, National Park Service. *National Register Bulletin: How to Apply the National Register Criteria for Evaluation*, Patrick W. Andrus, Rebecca H. Shrimpton, 2002.

area for the families involved in its creation. Various members of the families, all of whom were unskilled in engineering practices, built the structure using local materials, concrete, and several steel beams sunk into the riverbed for support. Blue Heron Dam is an example of a vernacular dam with high historical integrity and is representative of the strong connections to local histories such structures reflect.

Blue Heron Dam would be eligible under National Register criterion A because it is connected to broad patterns of history such as settlement, recreation, and post-World War II development. It would also be eligible under criterion C, as it represents a specific method of construction. More so, it is a distinguishable entity that embodies a distinctive type. In terms of integrity, the dam meets Criterion Consideration G, as it is roughly sixty-nine years old.

The integrity of the dam is high when assessed with the seven aspects of integrity outlined by the NRHP. Its location is original, as are its materials. The dam retains its original design and has not been altered in any way. The setting of the Blue Heron Dam has changed little since construction and has remained in its traditional recreational use for waterfront residential developments. Its workmanship is part of what makes it unique. It reveals a regional technology that can be observed in Central Texas dams of the same era.

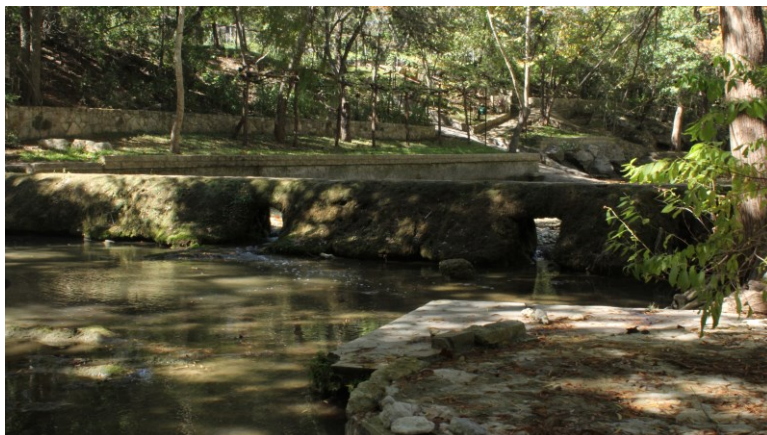


Figure 3. Blue Heron Dam, Wimberley, Texas

History - Vernacular:

Vernacular dams make up sixty percent of Texas dams located on private lands. This figure is not surprising considering that eighty-four percent of land in the state is privately owned.¹⁵⁴ Because of private landowner rights, some small dams have not been identified or investigated by state agencies. Thus, many remain undocumented and unprotected. The funds and manpower needed for the construction of a vernacular dam would have been minimal compared to industrial-civic dams and other massive or structural projects.

Character Defining Features – Vernacular:

Vernacular design values the domestic and functional over the monumental or monolithic. Such features are typically reflected in the minimal or unskilled appearance of vernacular dams. In addition, the structures are built using local materials. Both the design and material makeup are the most unique features of vernacular dams.

Industrial-Civic Dams

Identification – Industrial:

For this typology, industrial-civic dams are classified as structures used by industries, such as railways and mills. Also included are structures built or maintained by a government or sub-division of government. Industrial-civic dams are typically concrete, possibly designed or built by skilled or professional engineers. Such resources are often remnants of former production centers, such as a mill, which utilized the hydroelectric power or diverted water for industrial uses. Also, the dams may have once been privately

¹⁵⁴ General Land Office, "Texas: Farm and Ranch Lands Conservation Program," brochure, 2, accessed August 2014. http://www.glo.texas.gov/what-we-do/state-lands/_publications/FarmRanch-brochure.pdf.

owned but were sold or maintained by a government entity. Function is not an identifier in discerning type.

Examples:

Industrial-civic dams may be connected to the larger history of an area or region. Examples of these types of historical connections are present in several dams currently identified by the State of Texas. The Old Stone Dam in Allen, represents such a case. Built in 1874 for the Houston and Texas Central Railroad,¹⁵⁵ it impounded water on Cottonwood Creek for use in an adjoined watering station. The dam and the station are both significant to the transportation and economic histories of the area. Expansion of railways into Allen and Dallas would not have been possible without water impounded by the dam. Resources such as the Old Stone Dam in are minimal in number compared to the thousands of dams in the state. Though some resources, such as Old Stone Dam and Saffold Dam, have received some level of preservation, more historically significant small dams have yet to be identified by state or national preservation efforts.

The Old Stone Dam and its adjoined water station were found significant under criterion A for their connection to transportation and settlement histories.¹⁵⁶ The dam is more than one hundred years of age and meets the NRHP fifty year rule. The structure possesses good integrity, possibly because of its previous submersion by a large dam

¹⁵⁵ S. Alan Skinner, "Archaeological Investigation at the Old Stone Dam: Allen, Texas," *Half Associates, Inc.*, City of Allen, Texas, (2002), 1-9.; George C. Werner, "Houston Texas Railway Center," *Handbook of Texas Online*, modified March 12, 2014, accessed October 12, 2014. <http://www.tshaonline.org/handbook/online/articles/eqh09>.

¹⁵⁶ U.S. Department of the Interior, National Park Service, *National Register of Historic Places Register Form: Allen Water Station*, October 1990, accessed May 2014. ftp://ftp.thc.state.tx.us/nr_program/Allen%20Water%20Station%20NR.pdf.

downstream.¹⁵⁷ The location and design of the Old Stone Dam are original and have not been harmed or altered. The setting remains rural and has not changed since the resource's period of significance. The materials and workmanship remain original and intact. The large block stones of the dam, in conjunction with the structure's location, enhance a strong historical feeling.



Figure 4. Old Stone Dam, Allen, Texas

History - Industrial:

Industrial-civic dams in Texas are a scarce resource in the state. These structures were used in industrial production and small-scale hydroelectric production. They may also be used in irrigation, recreation, and flood mitigation. At present, several small, industrial mill dams exist in the state with little acknowledgement of their significance. Structures such as these hold historic value and deserve a closer investigation by preservationists.

¹⁵⁷ S. Alan Skinner, "Archaeological Investigation at the Old Stone Dam: Allen, Texas," Halff Associates, Inc., City of Allen, Texas, (2002), 1-9.

History - Civic:

These dams are often owned or purchased by local or state government bodies and could be designed by professional engineers or funded and maintained by a government entity due to their possible strategic location or function. Often, the management of industrial-civic dams falls to a local or state government in order to keep a strategic dam functioning.



Figure 5. Rio Vista Dam San Marcos, Texas

Character Defining Features- Industrial-Civic:

Some defining features of industrial-civic dams can be their materials, location, function, and overall quality of design and construction. Industrial-civic dams can serve industrial or public functions and are typically more durable when compared to earthen or vernacular structures. Reinforced concrete and other high-quality construction materials make up these structures. The resources are often owned by a government entity as they have historically, or more recently, performed vital tasks for the local community. A benefit of being government property may be regular maintenance of the structure over

time. For example, some municipalities such as San Marcos and Seguin have engaged in restorations efforts to repair small historic dams which are vital to local economy.

Earthen Dams

Identification – Earthen:

Earthen dams are the most massive of the small dams in this typology. They are also the most plentiful of all dam sizes in Texas. Currently, there are 6,986 earthen dams statewide, according to the Texas Commission on Environmental Quality. Earthen dams are water-retarding structures made from materials such as dirt, rock, timber, stone, etc. Because of the relatively cheap cost of materials and construction, earthen dams come in a variety of sizes. They can be small, intermediate, or large by State of Texas standards.¹⁵⁸ The structures have few functions in comparison with vernacular or industrial-civic dams. Earthen dams are often built for flood mitigation and water retention. Both functions are employed in agricultural irrigation and public water supply. However, the majority of earthen dams in Texas function in some type of water control or diversion. A majority of earthen dams in Texas are massive in nature and take the form of gravity operations. The structural form is chosen for earthen dams due to the effective use of extreme mass to repel water pressure.¹⁵⁹ For in-depth analysis of gravity dams, see the form section of this typology.

¹⁵⁸ Texas State Auditor's Office, *An Audit Report On: The Dam Safety Program at the Commission on Environmental Quality*, SAO Report No. 08-032, May 2008, 65-70.
<http://www.sao.state.tx.us/reports/main/08-032.pdf>.

¹⁵⁹ Donald C. Jackson, *Great American Bridges and Dams*, (Washington, D.C.: Preservation Press, 1988), 44-48.

Examples:

Though earthen structures are the most abundant dam type in Texas, many are larger than the size constraints of this typology. Earthen structures such as NRCS dams are often of medium size and can be found in rural areas. Similarly, private flood control structures have had settlements slowly encroach on their once-isolated location. The close proximity to people and property makes the condition of earthen structures increasingly important. Since a small earthen dam in the Central Texas area could not readily be identified as an example for the typology, the flood control dam located in the Purgatory Creek Natural Area in San Marcos is offered as an alternative example, although it is not of the proper age for historic preservation consideration. Despite its relatively young age, the dam provides an excellent example of the types of materials and functions common to earthen dams. Constructed in the 1980s, the dam has prevented two major flood events from impacting San Marcos. The structure is built from earthen materials such as soil, rock, and boulders, with a spillway constructed of reinforced concrete. Additionally, Purgatory Creek Dam represents the type of location that could house an earthen dam. Because flood control is a primary function of the structures, small earthen dams may be found on or near creeks, rivers, or flood plains. The Upper San Marcos Watershed District had the Purgatory Creek Dam built in response to flooding episodes along the Guadalupe River tributary in the 1970s.”¹⁶⁰

Earthen dams are typically of large or medium size because of their design, which uses their massive size to impound great volumes of water. For this reason, it is unlikely that a publicly-owned earthen structure will be small in size. It is possible that privately-owned earthen flood control dams may meet the criteria; however, access to such resources would require cooperation with the owners.

¹⁶⁰ Melissa Millecam, “44 Years after Deadly Disaster, Watershed Dams Guard City,” *San Marcos Daily Record*, May 05, 2014, accessed September 2014, <http://www.sanmarcosrecord.com/news/44-years-after-deadly-disaster-watershed-dams-guard-city>.

Purgatory Creek Dam would be eligible under criterion A of the National Register as it is significant within the larger regional history of San Marcos and the watershed area. It is not unique in its form as a large earthen dam, however, and therefore might not be considered eligible under criterion C. The location and design of the Purgatory Creek Dam are original and have not been changed or disturbed. The materials are original, and the workmanship is visible when compared to other control dams built by the Upper San Marcos Watershed. However, the dam does not generate a historic feeling because it dates to 1989 and does not meet the Criterion Consideration G.



Figure 6. Purgatory Creek Dam, San Marcos, Texas

History - Earthen:

A large portion of earthen dams in Texas were designed and funded by the federal government in the 1950s and 1960s in response to the drought of record.¹⁶¹ As stated

¹⁶¹ "For Texas as a whole, the drought began in 1950 and by the end of 1956, all but one of Texas' 254 counties were classified as disaster areas. Ironically, the drought ended in the spring of 1957 with massive rains that resulted in the flooding of every major river and tributary in the state. This drought represents the driest seven-year period in the state's recorded history and is still considered Texas' 'drought of record' upon which most water supply planning in the state is based." Texas Water Development Board, *Water for Texas 2012 State Water Plan – Introduction*, January 2013, 15-16.

earlier, the drought ended in 1957 with massive flooding.¹⁶² In response, the State of Texas passed a series of legislation throughout the late 1950s which helped establish 2,000 earthen dams, or flood-retarding structures, to aid the state in flood mitigation and retention of water. According to the Texas State Soil and Water Conservation Board, these dams existed “on private property, and were designed and constructed by the United States Department of Agriculture and the Natural Resources Conservation Service (NRCS).”¹⁶³ The dams were built under an agreement between property holders and the federal government. Landowners provided the property while the government designed and funded the projects with maintenance by local governments and partners. The NRCS stated that local partners were “required to obtain and enforce easements, conduct operation and maintenance (O&M) inspections, maintain the structures, and implement land treatment measures in the watershed.”¹⁶⁴ Given the nature of their function as flood control structures, these resources are often located in fields and pastures.¹⁶⁵ The caveat for the construction of these dams was that land owners or local partners, such as

¹⁶² The Texas State Water Plan 2012 provided a detailed account of the reason for the large USDA earthen dam projects: “The idea of a dedicated water planning agency came to fruition not long after the state experienced the worst drought in recorded history. For Texas as a whole, the drought began in 1950 and by the end of 1956, all but one of Texas’ 254 counties were classified as disaster areas.”

¹⁶³ Texas State Soil and Water Conservation Board, “Flood Control Programs,” accessed November 2014. <http://www.tsswcb.texas.gov/en/floodcontrol>.

¹⁶⁴ Ibid.: “Soil and water conservation districts (SWCD) are one of the local sponsors in all watershed projects and other local sponsors.”

¹⁶⁵ Texas State Soil and Water Conservation Board, “Flood Control Programs,” accessed November 2014. <http://www.tsswcb.texas.gov/en/floodcontrol>. The Texas State Soil and Water Conservation Board provides a brief history the nature of dams built on private lands using federal dollar in order to serve the public interest. The TSSWCB’s website states: “Nearly 2,000 floodwater retarding structures, or dams, have been built over the last 60 years within the State of Texas. The primary purpose of the structures is to protect lives and property by reducing the velocity of floodwaters, and thereby releasing flows at a safer rate. These are earthen dams that exist on private property, and were designed and constructed by the United States Department of Agriculture - Natural Resources Conservation Service (USDA-NRCS). They were built with the understanding that the private property owner would provide the land, the federal government would provide the technical design expertise and the funding to construct them, and then units of local government would be responsible for maintaining them into the future.”

counties, cities, and water control and improvement districts, assumed legal liability and monetary responsibility concerning maintenance. However, the reality of budgetary shortfalls in recent years has left these dams under-maintained. Some funding was allocated by the State of Texas in 2011; however, earthen dams remain an underfunded resource. Though 2,000 earthen dams can be attributed to the efforts of the NRCS and other watershed and soil districts throughout the state, more than 4,000 earthen dams can be attributed to private and state construction.

Character Defining Features - Earthen:

These structures are made of earthen materials, typically local soil, rocks, and stone, and possibly wooden and concrete features. The materials are constructed into a large water-retarding structure which utilizes the bulk of its size and materials to function. Originally, the Soil Conservation Service built earthen dams to slow storm water and prevent local soils from washing into waterways, but they also proved useful in the impoundment of water in lakes and reservoirs. Large earthen dams are typically used for retaining increased volumes of flood waters and releasing them in a controlled flow to mitigate potential damage.

Subtype

Vernacular, earthen, and industrial-civic dams are present in an array of forms and designs that help to create the dam's subtype. The primary types of small dams only require a few basic observable features to help identify them. A dam's sub-type is more descriptive and requires a closer look at the various components regardless of its major type. When writing about the subtype of a small dam, it is appropriate to address the dam by its full description of features.

For example:

Type:	Vernacular	Type:	Earthen
Subtype:	Stone/Concrete/Buttress	Subtype:	Earth/Gravity

The components that encompass a dam's subtype must first be identified. From there, a formula can be applied to help generate a basic signifier for a specific dam. The general features needed for subtype assessment are its form and materials. In this typology, form is understood as the engineered design utilized to obstruct water. Materials refer to the totality of the physical resources that make up the dam. For small dams in Texas, only a few combinations of form and material exist, but it is perceivable that a multitude of subtypes exist around the country.

Function

The function of a dam refers to its intended design purpose. To begin, the user must take note of the location of the dam, which can help reveal its designed function. The three types of dams reviewed in this typology can serve multiple functions, though individual structures often have a specific task. The following represent the primary purposes of vernacular dams.

Recreation

Some of the dams were built for the expressed purpose of recreation, often swimming or boating in the small lake they produced. For others, recreation is a byproduct of the dam's primary function. There is often no single telltale sign in the structural design that distinguishes recreational dams from any other vernacular function.

Agriculture

Irrigation is a common agricultural use for vernacular dams throughout the state. Whether for crops or livestock, vernacular dams serve to divert of water for agricultural purposes. Evidence of diversion or extraction systems are sometimes present if the dam was used for irrigation.

Flood mitigation

Small vernacular dams are typically not involved in flood mitigation in Texas as their size is not effective in deflecting floodwaters due to overtopping.¹⁶⁶ Diversion of storm water would be the most likely application for vernacular dams and flooding.¹⁶⁷ Some functions of industrial dams in Texas were for railroads, mills, and small-scale hydroelectric projects. Such dams may function as flood control structures that require governmental funding due to the important role they dam may play in protecting local property and lives. The most massive earthen dams are used to impound rivers for the creation of reservoirs and artificial lakes. Used for irrigation, municipal drinking water, and the prevention of property damage by mitigating the flow of floodwaters.¹⁶⁸ Industrial-civic and earthen dams can perform similar functions. The difference is in the amount of water small earthen dams are able to manage compared to their intermediate and large counterparts. In addition, small earthen structures tend to be located close to

¹⁶⁶ Donald C. Jackson, *Great American Bridges and Dams*, (Washington, D.C.: Preservation Press, 1988).

¹⁶⁷ Todd Staples, "Dams!" *Texas Department of Agriculture*, December 1, 2010, accessed May 2014. <http://texasagriculture.gov/NewsEvents/NewsEventsDetails/tabid/76/Article/1258/dams.aspx>; Mose Buchele, "Aging Dams, Booming Growth And the Search For Solutions," *State Impact Texas*, October 17, 2013, accessed October 2013. <http://stateimpact.npr.org/texas/2013/10/17/aging-dams-booming-growth-and-the-search-for-solutions/>.

¹⁶⁸ Texas State Soil and Water Conservation Board, "Flood Control Programs," accessed November 2014. <http://www.tsswcb.texas.gov/en/floodcontrol>.; See Canyon Lake Dam and Purgatory Creek Dam

populated areas. Some of these structures have been engulfed by the growth of nearby metropolitan areas while others function on the periphery of civilization, providing protection for property and water for local municipalities or agricultural work.

Form

According to Donald Jackson in his book *Great American Bridges and Dams*, the traditional form of dams can be divided into two separate spheres: massive or structural.¹⁶⁹ The dichotomy is rooted in the origins of dam construction and design. Massive dams are often simplistic in design and material and utilize the sheer bulk of their size to resist hydrostatic pressure. Commonly known as gravity dams, massive forms are constructed by a buildup of earth, rock, masonry, or concrete to achieve a mass that effectively resists the force of water.¹⁷⁰ The dam's stability is made possible by the force of gravity acting on it, hence the term gravity dam.¹⁷¹ For some, the term may be synonymous with the image of a large mound of dirt, and the connection is not without merit. Many small and earthen dams are gravity dams by form. Earthen dams can vary in size between massive, such as Canyon Dam near New Braunfels, and small private earth dams for irrigation or flood control. Many small dams tend to be gravity dams because of the lack of necessity for a highly engineered design of forty feet or less.

The second traditional form a dam may take is structural. This term applies to dam design that does not derive its strength from the massive amount of material as gravity dams do. Structural dams achieve their strength by relying on their design, which

¹⁶⁹ Donald C. Jackson, *Great American Bridges and Dams*, (Washington, D.C.: Preservation Press, 1988).

¹⁷⁰ Ibid.

¹⁷¹ Ibid.

distributes hydrostatic water throughout the structure. They require less material than massive dams and are cheaper to build.¹⁷² Arch dams and buttress dams are the two primary examples of structural design tradition.

Arch and Buttress

The subtypes of structural dams are the arch and buttress dams. Both styles have their strengths and weaknesses regarding their design and impoundment capacities. As the term implies, arch dams possess a gentle curve across their upstream face, which the arch design helps to transfer the hydrostatic pressure of the water toward canyon walls on either side of the dam.¹⁷³ At present, only one arch dam is listed on the TCEQ's inventory of dam types. This could be because of the design nature of arch dams, as they are best suited for narrow canyons with bedrock foundations. In addition, this subtype typically is applied to larger dams rather than those covered by this typology.

While arch dams are not a common style in Texas, the structural subtype known as buttress is widely used. Like arch dams, buttress dams require less material than gravity dams and achieve their structural strength through design. Buttress dams have a sloped upstream face which, like a gravity dam, involves both water pressure and the mass of the dam itself.¹⁷⁴ Buttress dams can be divided into two subtypes: flat-slab and multiple-arch, depending on the shape of the upstream face. Materials used are reduced

¹⁷² Donald C. Jackson, *Great American Bridges and Dams*, (Washington, D.C.: Preservation Press, 1988), 48.

¹⁷³ *Ibid.*, 48.

¹⁷⁴ *Ibid.*, 50.: "buttress dams usually have an upstream face that slopes into the reservoir. This means that the water in the reservoir exerts both a horizontal and a vertical load on the dam. As with a gravity design, the stability of the structure requires that the combined force of the water pressure and the weight of the dam proper pass through the center third of the base. But, because the vertical component of water pressure acts on the upstream face of the dam, not as much material is required to build a stable structure."

due to vertical buttresses spaced fifteen to seventy feet apart, thus transferring the load of the upstream face and concentrating it on the buttresses.¹⁷⁵ The form allows buttress dams to act like gravity dams but use the vertical element of water to attain stability.

Currently, there are thirty-three buttress dams and six buttress amalgamations within Texas. Specific information regarding the size of these structures is not available to the general public, due to security reasons. Still, despite their scarcity and applicability, it is beneficial to the user to have a minimal understanding of the various dam forms that exist or could potentially be found in Texas.

Vernacular

Vernacular dams in Texas do not adhere to one particular style. A few forms are indicative of small vernacular dams, but variation is common given the unskilled nature of vernacular design and construction. In this way, the form of vernacular dams is dictated by function and executed with readily available materials and minimal monetary investment.

Gravity and Timber Crib

The most common form employed by vernacular dams is a variation of massive or gravity structures. Many vernacular structures are gravity dams by design. They dams can be composed of many materials including earth, stone, and concrete. The timber crib is a dam of the massive design tradition, constructed of heavy logs or timbers and earth-rock aggregate. The dam resists hydrostatic pressure through a crib structure that is made of timbers bound together and filled with stone, rubble, etc. Timber crib dams are not a

¹⁷⁵ Donald C. Jackson, *Great American Bridges and Dams*, (Washington, D.C.: Preservation Press, 1988, 50.

common form of massive dam in Texas with only one listed in the TCEQ's inventory. In fact, the TCEQ's inventory of dams in Texas currently lists only one timber crib structure. Though they are not common, it is important to identify the basic form of a timber crib dam as more may exist throughout Texas but have not been recorded by TCEQ or other agencies.

Industrial-Civic

Industrial-civic dams are perhaps the most diverse in the types of form that are represented. It is logical to assume these dams are more varied in form due to their design than that of their vernacular counterparts. The range of forms employed in industrial-civic dams is unclear as a result of degradation, age, incomplete documentation, and limited information accessibility based on homeland security concerns.¹⁷⁶ However, evidence shows a few distinct and recurring forms taken by small industrial-civic dams statewide.

Gravity

Many civic and industrial small dams are gravity dams in form. Unlike earthen dams, industrial-civic dams tend to be made of reinforced concrete and other professional-grade construction materials. Such structures may be the predecessors of original timber or vernacular dams. Industrial-civic gravity dams tend to be larger than Texas vernacular dams, impounding more water and achieving heights closer to forty feet.

¹⁷⁶ Mose Buchele, "In Texas, Some Information about Dams is Off Limits," *Texas Tribune*, October 16, 2013, accessed May 2014. <http://www.texastribune.org/2013/10/16/in-texas-some-information-about-dams-is-off/>.

Buttress

Some industrial-civic dams possess a form derived from structural rather than massive designs. Currently, the TCEQ has identified thirty-three buttress dams under its jurisdiction. As explained earlier, the buttress design requires less material than gravity dams and attains its structural strength by reduces materials with vertical buttresses. The form can be found in several industrial mill dams around the state. It is unknown if buttress dams serve other functions than industrial-civic.



Figure 7. Zedler's Mill Dam, Luling, Texas

Earthen

Earthen dams are predominately massive and gravity structures. However, many large earthen dams in Texas are both gravity and multi-arched. This is a feature of large dams that require a concrete spillway or structural concrete work on a portion of the face. Dams with multiple forms tend to be larger than the dams reviewed in this typology. As stated previously, many earthen dams in Texas are used in flood mitigation and water retention. For these reasons, gravity structures are the most efficient design regarding the level of engineering required for construction. Gravity earthen dams are thus most

abundant type of dam in Texas because of the relative ease of their construction and low cost of materials.

Materials

Inspection of the physical materials that make up a small dam can yield a great amount of information about form, type, subtype, and integrity. Furthermore, materials can provide clues as to possible rehabilitation efforts, repairs, or additions that may have occurred in a dam's history. Vernacular dams can be comprised of a host of materials. Examining the materials of these structures can produce information about the quality of the dam's construction and the origins of its materials. Since vernacular dams are often built with local materials, it is important to investigate the immediate location for any that may be identifiable with those used in the dam's construction. If the dam is constructed from materials that are not from a site close to the dam, it is beneficial to check for any stone quarries, timber, or concrete facilities in close proximity that may account for the composition.

Small, industrial-civic dams tend to possess a higher caliber of engineering than vernacular dams. Because these dams are typically government-owned structures, the quality of their design and construction reflect a higher level of skill when compared to vernacular structures. They are also more cost efficient to construct and require less materials than gravity dams. The structural design of industrial-civic dams allows them to utilize forms such as the buttress or arch that are both strong and efficient. In addition, the quality of materials used in these resources surpasses vernacular and earthen dams, often employing large amounts of concrete, masonry, or reinforced concrete.

Dirt, rocks, stone, gravel, and even concrete are all types of materials that can be found in an earthen dam. The quality and quantity of any given material can provide the user with a glimpse into the potential cost and function of an earthen dam. The primary function of earthen dams is to divert or temporarily store floodwaters for various uses. According to TCEQ, there are 6,986 dams made solely from dirt currently located in Texas. Materials like rocks or concrete are utilized in filling the interiors of earthen dams in order to help reinforce the structures. Though these materials may not be visible, it is important to note that only a handful of earthen dams that possess additional materials can be found in the state.

Contemporary Viable Resource

Potential: Industrial-Civic and Vernacular Dams

Evidence suggests that Texas' earthen dams do not possess the highest historical integrity in comparison to other dam types. The enormous number of earthen structures in Texas is a primary reason for their diminished significance. Likewise, small earthen dams are often privately owned, which places them beyond the regulatory authority of the TCEQ and other government agencies. These factors have precluded many earthen dams from a connection to broader patterns of history, such as industrial or transportation.

For the purposes of practical historic preservation, it is recommended that regulatory agencies focus on industrial-civic and vernacular dams as potential historic resources. Preservation efforts would have a greater chance of success with a focus on small historic dams already owned by the state. This would avoid obstacles associated with private ownership. The design, function, proprietorship, and construction materials

of industrial-civic and some vernacular dams suggest that these types potentially possess higher levels of integrity and significance than earthen structures.

Cultural Landscapes

A review of historic landscapes currently in the National Register shows that dams rarely are incorporated in the nomination and listings of such properties. It is possible the underrepresentation of dams in landscape nominations is due to their often rural or visibly-diminished locations. It is equally possible that eligible cultural landscapes that hold a dam have yet to be identified. In either case, it is important to identify currently standing and or formerly existing structures to better understand the context of a cultural landscape. Dams play a significant role in creating human environments on the macro and micro level. In Texas, they are vital in supporting human settlement by protecting against flooding and providing water for basic needs. States, counties, communities, towns, cities, and entire regions of the continental United States are and have been made habitable because of dams. It is for these reasons that a template for identifying them on each type of cultural landscape is outlined by the NRHP.

To understand why dams would be important to the historical narrative of a landscape it is necessary to define the term cultural landscape in this context. This thesis adhere to the National Register's definition of as being "a geographic area (including both cultural and natural resources and the wildlife or domestic animals therein), associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values." From this basis, the NRHP recognizes four basic types of cultural landscapes: historic sites, historic designed landscapes, historic vernacular landscapes, and ethnographic landscapes. Each general category of cultural landscapes is defined by

the NRHP in the document “Guidelines for the Treatment of Cultural Landscapes” as follows:¹⁷⁷

Historic Site

A landscape significant for its association with a historic event, activity or person.

Examples: battlefields, presidential homes, and properties.

Historic Designed Landscapes

A landscape that was consciously designed or laid out by a landscape architect, master gardener, architect, engineer, or horticulturist according to design principles, or an amateur gardener working in a recognized style or tradition. The landscape may be associated with a significant person, trend, or event in landscape architecture; or illustrate an important development in the theory and practice of landscape architecture. Aesthetic values play a significant role in designed landscapes. Examples: parks, campuses, and estates.

Historic Vernacular Landscapes

A landscape that evolved through uses by the people whose activities or occupancy shaped it. Through social or cultural attitudes of an individual, a family, or a community, the landscape reflects the physical, biological, and cultural character of everyday lives. Function plays a significant role in vernacular landscapes. This can be a farm complex or a district of historic farmsteads along a river valley. Example: rural historic districts and agricultural landscapes.

¹⁷⁷ U.S. Department of Interior, National Park Service, *The Secretary of the Interior Standards for the Treatment of Historic Properties: Guidelines for the Treatment of Cultural Landscapes*, National Register Bulletin, accessed July 2014. <http://www.nps.gov/tps/standards/four-treatments/landscape-guidelines/index.htm>.

Ethnographic Landscapes

A landscape containing a variety of natural and cultural resources that associated people define as heritage resources, examples include: contemporary settlements, sacred religious sites, and massive geological structures. Small plant communities, animals, subsistence and ceremonial grounds are often components.

As historic resources, small dams in Texas potentially possess a great deal of cultural and historical significance as a result of their relationship with human habitation. In Texas, earthen, industrial-civic, and vernacular dams of historic age are connected to state water planning, infrastructure, flood prevention, agriculture, hydroelectric, transportation and other industrial histories.

Small dams can be linked to cultural landscapes based on the need of including such dams to modify natural features and resources for settlement or industry. Should a small dam be found in a cultural landscape, it will most likely have some, if not all, of its historical significance connected to the property. The three landscape categories of historic sites, historic designed landscapes, and historic vernacular landscapes have the highest potential of holding a dam. Ethnographic landscapes have the potential for small dams, but the chance of such a structures being located on any of the defined forms of ethnographic resources seems unlikely.

This portion of the typology will enumerates the kinds of small dams potentially found on each of the types of cultural landscapes. The following is to provide users with information to identify possible resources prior to an official field survey and to help

locate existing dams or ruins.¹⁷⁸ By determining the type of landscape under review, the user can more accurately predict the kind of small dams that may be present. Historic sites, designed landscapes, and vernacular landscapes encompass a range of assorted property types. The geographic variety in Texas makes predicting the types of dams that may be found on a given landscape difficult.

The advanced age of most dams in Texas gives validity to the notion some may have come and gone throughout the history of a landscape without leaving obvious evidence. Using contextual clues is the most accurate way to predict the current or former existence of a dam on a given cultural landscape. The first part of this section provides a list of criteria used to identify landscape characteristics needed for a dam. The criteria are intended to aid readers in establishing the presence of a dam on any cultural landscape with or without an observable structure. The second portion provides a brief description of the different kinds of historic sites, landscapes, and vernacular landscapes that could house a small dam. The kinds of dams are presented in chart format with the corresponding landscape types.

Indicators

Water on the Landscape

The user should identify if there is or ever has been a river, stream, creek, waterway, or water source present on the property. Look for evidence of storm-related runoff or flooding; the presence of water or floodplain conditions are important clues that

¹⁷⁸ "Ruins are defined by the National Register as buildings or structures that no longer possess original design or structural integrity." United State Department of the Interior, National Park Service, *National Register Bulletin: Guidelines for Evaluating and Registering Archeological Properties*, Barbara Little, Erika Martin Seibert, Jan Townsend, John H. Sprinkle Jr., and John Knoerl, National Register Bulletin, 2000.

may suggest a dam is nearby. Information about weather conditions and flood records are important in understanding the historic relationship between a landscape and water.

Structures, Buildings, and Infrastructure

Any type of manmade building, especially those near a waterway, may hold information regarding current or former water infrastructure within the landscape. Look for extant buildings, structures, or ruins. Footprints of structures and ruins may signal removal or washout, giving the user an indication of the probability of a dam's existence within the landscape. They can also yield a great deal of information regarding a dam's size, form, and function. Even though the structure itself may be gone, a structural footprint can help yield evidence as to what type of dam was located on the landscape. In addition, users should investigate any infrastructure that is present on the property in order to determine if it played a role in the distribution of water. Irrigation systems, either below or above ground, can provide clues about the need for water and its point of origin. In the absence of a physical structure, the following are methods designed to help users identify the probability of a dam being historically used on a property.

Environmental Footprint

As noted previously, the size classifications employed by this typology follow the guidelines established by the State of Texas. The height and impound capacity of a dam serve as primary criteria for determining a dam's size. If none of the previously discussed features can be found on a given cultural landscape, users should attempt to observe any physical or environmental footprint left by a dam. The most notable affected area will be where the impoundment and retention of water took place. Look to local vegetation and the embankments of waterways for signs of sustained water levels. A good indicator of

the former existence of a dam is root height of trees and vegetation. If a dam was once present, the root levels should be close to the height of the former surface of the. Similarly, water in the impounded zone normally has embankments that expand further onto dry land than waterways that have not been dammed. Both root height and embankment levels are subject to natural processes, though, which can alter their accuracy.

It is important for users to take into account that information in this section should be combined and supported by primary source research and field investigations of individual resources. Often, field surveys are designed to corroborate information gathered in the primary research of a landscape. Also, they are intended to yield information that may have been missed or to present evidence which was not found in a user's primary research. This section has identified three types of cultural landscapes that are the most advantageous towards possessing a small dam.

Designed Landscapes

Designed landscapes are resources such as parks, university campuses, businesses, estates, gardens, or other properties that have a planned landscape design. Observable evidence offers insight into the nature of designed landscapes and what type of dams may be present. Currently, there are six types of designed landscapes recognized by the NRHP, five of which belong to single, multiple property submissions.

According to the NRHP, designed landscapes are “consciously designed or laid out by a landscape architect, master gardener, architect, engineer, or horticulturist according to design principles, or by an amateur gardener working in a recognized style

or tradition...”¹⁷⁹ These guidelines and observations of currently designed landscapes to the National Register suggest that dams found on designed landscapes will be of skilled engineering and professional construction.

Industrial-civic dams are a logical type to associate with designed landscapes. Within designed landscapes, several types are more likely to have a dam than others; country clubs, planned communities, and bodies of water are a few examples of properties that could yield a dam.¹⁸⁰ However, each property may utilize any of the three primary dam types discussed in this typology. While vernacular and earthen dams seem less likely candidates to be found on a designed landscape, they are both a realistic possibilities given the multitude of properties under the umbrella of designed landscapes.

¹⁷⁹ U.S. Department of Interior, National Park Service, *Guidelines for the Treatment of Cultural Landscapes: Defining Landscape Terminology*, accessed July 2014. <http://www.nps.gov/tps/standards/four-treatments/landscape-guidelines/terminology.htm>. The NRHP defines designed landscapes as “a landscape that was consciously designed or laid out by a landscape architect, master gardener, architect, engineer, or horticulturist according to design principles, or an amateur gardener working in a recognized style or tradition. The landscape may be associated with a significant person, trend, or event in landscape architecture; or illustrate an important development in the theory and practice of landscape architecture. Aesthetic values play a significant role in designed landscapes.”

¹⁸⁰ “Small residential grounds, estate or plantation grounds (including a farm where the primary significance is as a landscape design and not as historic agriculture), arboreta, botanical, and display gardens, zoological gardens and parks, church yards and cemeteries, monuments and memorial grounds, plaza/square/green/mall or other public spaces, campus and institutional grounds, city planning or civic design subdivisions and planned communities/resorts, commercial and industrial grounds and parks, parks (local, State, and national) and camp grounds, battlefield parks and other commemorative parks, grounds designed or developed for outdoor recreation and/or sports activities such as country clubs, golf courses, tennis courts, bowling greens, bridle trails, stadiums, ball parks, and race tracks that are not part of a unit listed above, fair and exhibition grounds, parkways, drives, and trails, bodies of water and fountains (considered as an independent component and not as part of a larger design scheme)” U.S. Department of the Interior, National Park Service, *How To Evaluate and Nominate Designed Historic Landscapes*, J. Timothy Keller, ASLA, and Genevieve P. Keller Land and Community Associates Charlottesville, Virginia, National Register Bulletin, accessed July 2014. http://www.nps.gov/nr/publications/bulletins/nrb18/nrb18_3.htm.

Potential Types

Vernacular Landscapes

The National Register defines vernacular landscapes as places that evolved through use by human activities and reflect the social and cultural character of a given community, family, or an individual.¹⁸¹ The difference between a designed and vernacular landscape is usually an “arrangement of resources reflecting a significant land use, rather than a conscious design.”¹⁸² In this regard, identifying the criteria previously outlined will be more difficult due to the lack of uniformity or recognizable design. However, it is logical to assume vernacular property types have a role in dictating the form, function, and type of any small dam located on them.

An example would be a farm or ranch; as defined by the NRHP. Such properties would have noticeable signs of change due to the impacts of everyday human activities rather than intentional design and planning. When this definition is applied to the three small dam types discussed in this typology, vernacular and earthen dams seem the most likely candidates to be found on vernacular landscapes. Earthen and vernacular dams are both relatively cheap to construct and do not require a great amount of skill to build. Because of their use of local materials, these structures seem more attuned with the

¹⁸¹ U.S. Department of The Interior, National Park Service, *Guidelines for the Treatment of Cultural Landscapes: Defining Landscape Terminology*, accessed June 2014. <http://www.nps.gov/tps/standards/four-treatments/landscape-guidelines/terminology.htm>. In addition, to NRHP guidelines, the California Department of Transportation: “General Guidelines for Identifying and Evaluating Historic Landscapes” provides an in-depth listing of the types properties qualify as vernacular landscapes: Campsites, Ruins of buildings or structures, Small industrial sites, Food processing areas, Rock shelters, Road traces, Refuse sites, Small battlefields, Birthplaces, Treaty-signing locations Farms or ranches, Industrial areas, Factory complexes, Recreation sites, Battlefields, Rural communities, Transportation.

¹⁸² The California Department of Transportation: “General Guidelines for Identifying and Evaluating Historic Landscapes,” 10, accessed July 2014. <http://www.dot.ca.gov/ser/downloads/cultural/languide.pdf>.

NRHP's definition of the types of resources that would be indicative of a vernacular landscape. The low-tech and relatively inexpensive nature of small earthen and vernacular dams makes them versatile candidates that could be utilized in response to an immediate need or threat. The few properties types that do utilize dams, such as farms, ranches, industrial areas, and rural communities, typically do not require large, high-engineered, or industrial-civic dams. While it is possible that industrial-civic dams may be found in a vernacular landscape, it is more likely that properties categorized under the vernacular label with dams will have small earthen or vernacular dams.

Historic Sites

A historic site is classified as “a landscape significant for its association with a historic event, activity or person.” It can encompass both vernacular and designed landscapes. Thus, the types of small dams that may be found on a historic site follow the same guidelines as previously discussed. Historic sites can include battlefields, farms, and parks, as well as other types of landscapes. Each type must be identified as either designed or vernacular before a judgment can be made regarding the kinds of dams that potentially could exist on the site.

Information about the historic function of a landscape can produce clues or generate answers about the function and type of dam. The first part of this section outlined three criteria that are designed to aid users in the identification of properties with the potential for small dams and in their efforts to recognize the associated environmental and structural footprints. The second part of this section connects property types

Integrity

Seven Aspects of Integrity

In addition to evaluating the historical significance of a resource, the assessment of its existing integrity is required. The National Register defines integrity as the combination of a property's location, design, workmanship, materials, setting, feeling, and association. A resource is determined to have integrity based on the quality and level of preservation possessed by all seven aspects listed. After the user has sufficiently identified the type of historic dam under review, its integrity can then be assessed. With these seven aspects in mind, the user can evaluate the features discussed in this typology.

Location and setting are fairly straightforward and require little discussion in regard to appraising a dam's integrity. The NRHP defines location as "the place where the historic property was constructed or the place where the historic event took place."¹⁸³ To fulfill this part of the integrity assessment, users should refer to the information gathered about a dam's function. Using this information, they should be able to determine if the site chosen during the initial identification process is the actual historic location. Location and integrity have different ramifications for houses, bridges, and other structures than it does for dams. Such structures can typically be moved from their original sites while a dam cannot. However, the area surrounding a small dam can be subject to alteration, which damages the historical integrity of its setting. Assessing the integrity of a dam's setting should be aided by an analysis of its function. Setting, closely related to location, must also be examined. The National Register defines this aspect as

¹⁸³ U.S. Department of Interior, National Park Service. *National Register Bulletin: How to Apply the National Register Criteria for Evaluation*, Patrick W. Andrus, Rebecca H. Shrimpton, 2002.

“the physical environment of a historic property that illustrates the character of the place.”¹⁸⁴ Similar to steps taken to evaluate location, the user must make a judgment about the quality of the surrounding landscape.¹⁸⁵

The NRHP describes design as “the composition of elements that constitute the form, plan, space, structure, and style of a property.” In the evaluation of design, the user will find the function, form, type, sub-type, and material. The information gathered in these sections allows the user to assess the design of a small dam through an accumulation of the above mentioned elements of this typology.

Workmanship is classified as “the physical evidence of the crafts of a particular culture or people during any given period of history.” The function, form, and material sections of this typology will be the most helpful in the assessment of workmanship. The initial analysis of these three typographical aspects should yield evidence of workmanship, as each area is connected to the general assembly of this aspect of integrity.

The simplest aspect of integrity is assessment of materials. This is facilitated by this typology’s section on the material makeup of certain types of dams. The NRHP recognizes materials as “the physical elements combined in a particular pattern or configuration to form the aid during a period in the past.” Assessing a dam’s material integrity is different from recognizing the types of materials used in its construction. While identification is part of the process, the quality of the material composition of the

¹⁸⁴ U.S. Department of Interior, National Park Service. *National Register Bulletin: How to Apply the National Register Criteria for Evaluation*, Patrick W. Andrus, Rebecca H. Shrimpton, 2002.

¹⁸⁵ Ibid.

structure is the primary meaning of material integrity. A visual and onsite inspection of a resource's material integrity is satisfactory for the evaluation process.

Feeling is assessed based on the evocation of historic sense through the aesthetic of a property. Association is the link between a resource and the event or person for which it is significant. Assessment of these two aspects is aided through the convergence of each section of this typology. Both are based on personal observation in the case of feeling and historic research in order to assess association.¹⁸⁶

Public Safety

The challenges facing water infrastructure in Texas have the ability to make concerns about the preservation of dams an afterthought. For many lawmakers and citizens, safety is a higher priority. This order of anxieties is understandable, as questions about public safety should be primary when considering the preservation of small dams. If a structure is found to be a threat to public safety, no amount of historic value or integrity is sufficient reason to endanger life or property.

There is precedence for safety concerns trumping preservation practices. Often, the renovation of a historic building, bridge, or house is subject to local and state health and safety requirements¹⁸⁷ Modern fire suppression systems, removal of toxic materials such as asbestos, and upgrading stairways to meet contemporary safety code are standard

¹⁸⁶ U.S. Department of Interior, National Park Service. *National Register Bulletin: How to Apply the National Register Criteria for Evaluation*, Patrick W. Andrus, Rebecca H. Shrimpton, 2002: Feeling – “the quality that a historic property has in evoking the aesthetic or historic sense of a past period of time.” Association – “the direct link between a property and the event or person for which the property is significant.”

¹⁸⁷ U.S. Department of the Interior, The National Park Service, *The Secretary of the Interior's Standards for the Treatment of Historic Properties: with Guidelines for Preserving, Rehabilitating Restoring & Reconstructing Historic Buildings*. Kay D. Weeks and Anne E. Grimmer, National Register Bulletin, 1995, pg. 59, accessed December 2013. <http://www.nps.gov/tps/standards/four-treatments/treatment-guidelines.pdf>.

practices employed by preservationists and outlined by *The Secretary of the Interior's Standards for the Treatment of Historic Properties*.¹⁸⁸ However, it is possible that restoration or preservation efforts may improve the safety of small dams and increase their value to their immediate locations. The renovation of a damaged historic resource is normally preferable to complete removal, but the primary hindrance to such action is often the cost.

¹⁸⁸ U.S. Department of the Interior, The National Park Service, *The Secretary of the Interior's Standards for the Treatment of Historic Properties: with Guidelines for Preserving, Rehabilitating Restoring & Reconstructing Historic Buildings*, Kay D. Weeks and Anne E. Grimmer, National Register Bulletin, 1995, pg. 59, accessed December 2013. <http://www.nps.gov/tps/standards/four-treatments/treatment-guidelines.pdf>.

CHAPTER VI

CONCLUSION

Through the course of this work it has become clear that the preservation of historic dams represents a multifaceted and complex set of issues which involve the fields of historic preservation, cultural resource management, and conservation. Contemporary issues surrounding the future of Texas' water infrastructure are examples of the growing interconnection between these three professions.

Small dams were selected for this study due to their likely high level of historic significance and integrity. Also, they were chosen because of ongoing issues regarding the ecological impacts of dams. The environmental damage caused by small dams may be minimal; however, conservation-focused professionals still favor the removal of all unnecessary impediments to Texas waterways. Discussion about historic dams may be a vehicle for creating a comprehensive solution to addressing dams and the environment. It appears that the future of historic preservation must be addressed regarding the adverse impacts dams may have on ecosystems. Additionally, small dams present relatively low risks to public safety. This element would aid preservation efforts by removing impediments to the conservation and or designation of a resource. Lastly, small dams are most likely to be connected to history on a local level, but they might be significant at state and federal levels as well.

This thesis serves as a first attempt at addressing the larger topic of contemporary preservation of historic dams in Texas. Through this work, the emphasis has been on the need for direct attention to the many issues surrounding the preservation of Texas dams. Research has answered many pre-existing questions and raised a plethora of new ones.

For example, preserving structures with determinant utilitarian lifespans is a matter that has yet to be fully addressed, and dams are unlike other structures because they cannot be relocated as a form of mitigation. The majority of structures such as bridges, aircraft, and agricultural equipment have a given lifespan of functionality, but unlike dams, these structures can be moved when they have become obsolete.

Another issue to arise has been the concerns surrounding drought and context. Currently, Texas is experiencing one of the most severe droughts in its history. Surface water is in short supply in both reservoirs and state waterways. If weather patterns continue in this direction, many dams in Texas will be lacking a key component of their context—water. What would happen to dams if they permanently lost this context? Would this damage the integrity of the resources already designated by the state? The question appears to be unaddressed at the moment, but if major reservoir levels continue to drop, it may become a pertinent topic.

Additionally, how do preservationists treat a historic dam that has received modifications to retain functionality? Can such a situation be considered adaptive reuse? Does the resource lose its historical integrity? Is only half the structure historically significant? These are practical questions that need to be addressed if preservation of small dams is to take place. The research associated with this thesis has shown that the state's current situation is urgent. Although legislators passed a constitutional amendment to fund water infrastructure repairs and growth, questions of historic preservation and the failing health of state water infrastructure have yet to be discussed.

Investigation into official growth and climate projections suggests that questions regarding Texas dams will gain momentum as water use and conservation become

increasingly important. It is the responsibility of those involved in historic preservation and related fields to continue discussion on this topic. Possible next steps could entail the organization of common tools which serve professionals in related fields. The typology in this document is intended to be one such example. Ultimately, those involved in the disciplines of historic preservation, cultural resource management, and conservation must recognize that the future of cultural studies and professions will require some integration with one another.

Currently, Texas has extended preservation efforts to some dams, yet research suggests that more historically significant small dams remain to be assessed by preservationists. This issue is compounded by the contemporary threats to the state's dam infrastructure. Drought, age, and lack of funding for repairs and rehabilitation may have led to a potential disaster. Analysis of the historical record indicates that major flooding could be a catalyst for multiple dam failures in the future. Combined, these looming problems have the power to damage and destroy existing and unassessed resources.

A catastrophic flood event could harm historically significant dams in a manner similar to the vast cultural landscape alterations caused by major highway projects of the mid-twentieth century.¹⁸⁹ To avoid such an event, the key recommendation is that the State of Texas take preemptive action to evaluate the structural health of all dams under its regulation. In conjunction with this assessment, the historical significance and integrity of these resources can be determined. The typology provided in this work was designed with two objectives. The first is to aid in the quick and efficient assessment of

¹⁸⁹ Michael Cartzas, "Cross-Bronx: The Urban Expressway as Cultural Landscape." *Cultural Landscapes: Balancing Nature and Heritage in Preservation Practice*, ed. Richard W. Longstreth, (Minneapolis: University of Minnesota Press, 2008), 55-70.

the historical significance and integrity of all small dams in Texas while identifying the most exemplary resources for preservation. The second is to expedite any required historic or cultural assessment required by state or federal law. Such assessment would be beneficial should a dam be deemed a public safety hazard or structurally deficient. Through a field guide or uniformed assessment process, Texas preservationists will be equipped with basic information about small dam types and forms to help them in the identification and evaluation of these resources.

Small dams in Texas are an important resource that has the potential to possess a multitude of connections to many patterns of history. Industrial, agricultural, recreation, and engineering are but a few examples of the types of histories with which these structures are associated. Similarly, small dams may hold ties to local histories that are unique only to small those particular structures as determinants of economic growth and historic settlement of regions, communities, and towns. The preservation of small dams in Texas depends in large part on the accuracy of state and local historical records. Government officials should take immediate action to identify, assess, and preserve small dams of the highest integrity. If they do not, small dams in Texas are vulnerable to the destructive forces of nature, time, and neglect.

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