

**INVENTORY, ASSESSMENT AND PRELIMINARY
MANAGEMENT PLANNING FOR UTAH'S SOVEREIGN
LAND ALONG THE BEAR RIVER**



**Plan B Thesis Project
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**Utah State University
College of Natural Resources
Department of Environment and Society
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INVENTORY, ASSESSMENT, AND PRELIMINARY MANAGEMENT PLANNING FOR
UTAH'S SOVEREIGN LAND ALONG THE BEAR RIVER

by

Matthew S. Coombs

A master's project submitted in partial fulfillment
of the requirements for the degree

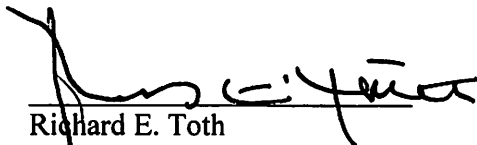
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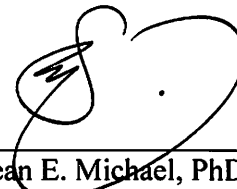
in

Bioregional Planning

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ABSTRACT

Inventory, Assessment and Preliminary Management Planning for
Utah's Sovereign Land along the Bear River

by

Matthew S. Coombs, Master of Science in Bioregional Planning

Utah State University, 2017

Major Professor: Richard E. Toth
Department: Environment and Society

The Utah Division of Forestry, Fire and State Lands (FFSL) is responsible for the management of state-owned sovereign land in Utah, which includes the bed and banks of the Bear River in Cache and Box Elder Counties. The purpose of this project is to provide relevant background information and data to support the future development of a comprehensive management plan for the Bear River.

This project develops a methodology and process to describe the Bear River Corridor, summarizes and integrates existing information regarding important biophysical and socio-cultural attributes of the river, delineates lands along the river into identified management classes, and recommends management goals and objectives to be carried forward into the future development of a comprehensive management plan.

While this project is not the most comprehensive or detailed report for any individual attribute of the Bear River, it is currently the most comprehensive resource addressing sovereign lands along the Bear River. Furthermore, it provides a methodology and process that is highly adaptable and can be replicated for use in other planning efforts for sovereign land resources or carried forward to be improved upon as new data and information is discovered or developed.

ACKNOWLEDGEMENTS

There are many people that have provided guidance and support for this project. First, I would like to thank my committee chair, Dick Toth, for his insight, mentorship, and encouragement for this project and throughout my graduate education. I would also like to thank my other committee members, Sean Michael and Nancy Mesner, for their time, patience, and feedback during the process of this project. Thank you for keeping me going.

I would like to thank staff from the Utah Division of Forestry, Fire, and State Lands for their support of this project, valuable feedback and recommendations throughout the process. In particular, Laura Ault and Blain Hamp have been very supportive. I would also like to thank the managers and resource specialists from several of the other intersecting agencies and organizations, including the Division of Wildlife Resources, U.S. Fish and Wildlife Service, Bear River Association of Governments, The Nature Conservancy, and many others who have developed an incredible amount of information through their work on the Bear River. I look forward to continuing these relationships.

Lastly, I would like to thank all of my colleagues, friends and family that have provided patience, support and encouragement along the way. Most importantly, I would like to thank my wife, Casey, and my daughter, Claire, for putting up with my long hours and moments of frustration. Without your support, this project would not have been possible. Thank you.

Matthew S. Coombs

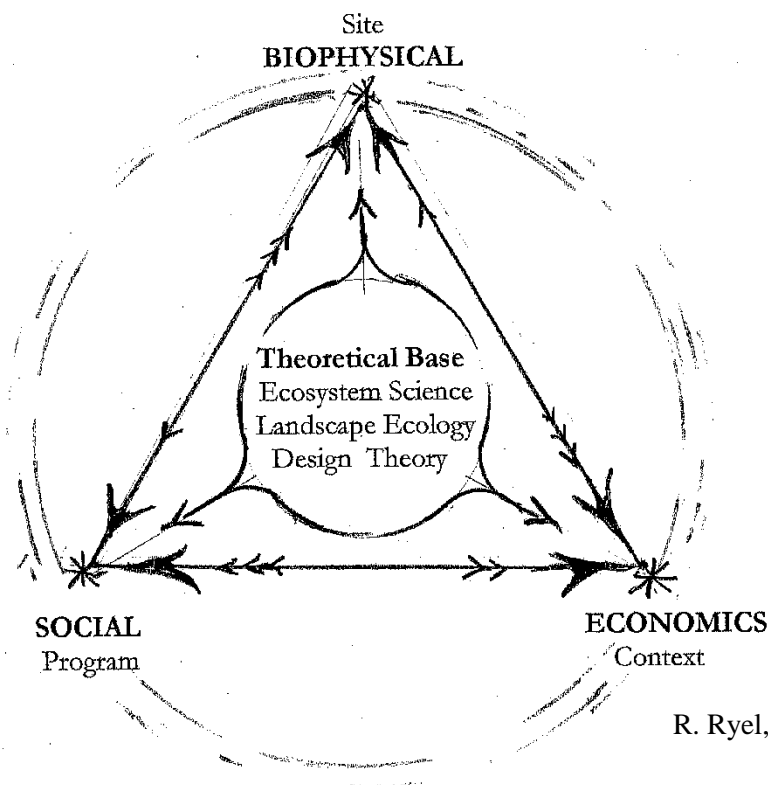
FOREWORD – “Bioregional Planning”

Charles H. W. Foster, a lecturer at Harvard University’s John F. Kennedy School of Government, attributes the term bioregional to Alan Van Newkirk, a Canadian Geographer, who first coined the term in 1973. The prefix bio relates to the life or living things and the term regional relates to some particular region or district on the surface of the earth. The primary emphasis is not just on a locality but a more inclusive characterization of a large area by geophysical and/or biological attributes. A less tedious definition offered by Foster in 1997 is simply that the term bioregional is that form of regionalism predicated upon the spatial arrangement assumed by living organisms and natural systems. This concept has been expanded upon by bioregional practitioners in recognizing that settlement and culture should be an integral part in the study of regions.¹ The fields of ecosystem science, landscape ecology and design theory form the theoretical base of those spatial arrangements. The title of the graduate degree program at Utah State University recognizes the more inclusive description by designating bioregional planning to include both the biophysical and the cultural attributes of a region.

Graduate education in bioregional planning recognizes the importance of how the biophysical attributes of a region influence the human dimensions of settlement and culture. In a reciprocal manner, settlement and culture are examined to assess their influence on the biophysical attributes of a region. This perspective provides a trans-disciplinary environment for the research and development of land use alternatives, their evaluation, policy, and implementation.

¹ Foster, Charles H.W., Autumn 1997, *Renewable Resources*, pp. 6-10

Richard E. Toth



R. Ryel, T. Sharik, & R. Toth
26 July 2011

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Figure 1: The Bear River in Cache Valley

Phase 1: Introduction

The introduction establishes the overall purpose and objectives, identifies and describes the selected study area, defines a methodology to guide the work moving forward, and provides background to establish a context for the project.

Purpose and Objectives

The Utah Division of Forestry, Fire and State Lands (FFSL) is responsible for managing sovereign lands in the State of Utah, which consist of the beds, banks or shorelines below the ordinary high water mark of any body of water that was navigable at the time of statehood. In Utah, state sovereign lands include the beds of Utah Lake, Great Salt Lake, Bear Lake (Utah's half), the Jordan River and portions of the Bear, Green and Colorado Rivers (Utah Administrative Code, §R652-70-100).

FFSL manages sovereign lands under comprehensive land management programs to ensure that navigation, fish and wildlife habitat, aquatic beauty, public recreation, and water quality are given due consideration and balanced against benefits derived from any proposed land use or activity (Utah Administrative Code, §R652-2-200). FFSL develops Comprehensive Management Plans (CMPs) for sovereign land resources to guide management decisions, develop and implement management goals and objectives, and facilitate permitting responsibilities. CMPs have been completed for Utah Lake (2009), Bear Lake (2009) and Great Salt Lake (2013), but have not yet been completed for the Bear, Jordan, Green or Colorado Rivers.

The purpose of this project is to provide relevant background information and data to be carried forward and provide a starting point for the development of a Bear River CMP. As determined in cooperation with both FFSL and the project committee, the primary objectives of this project are to:

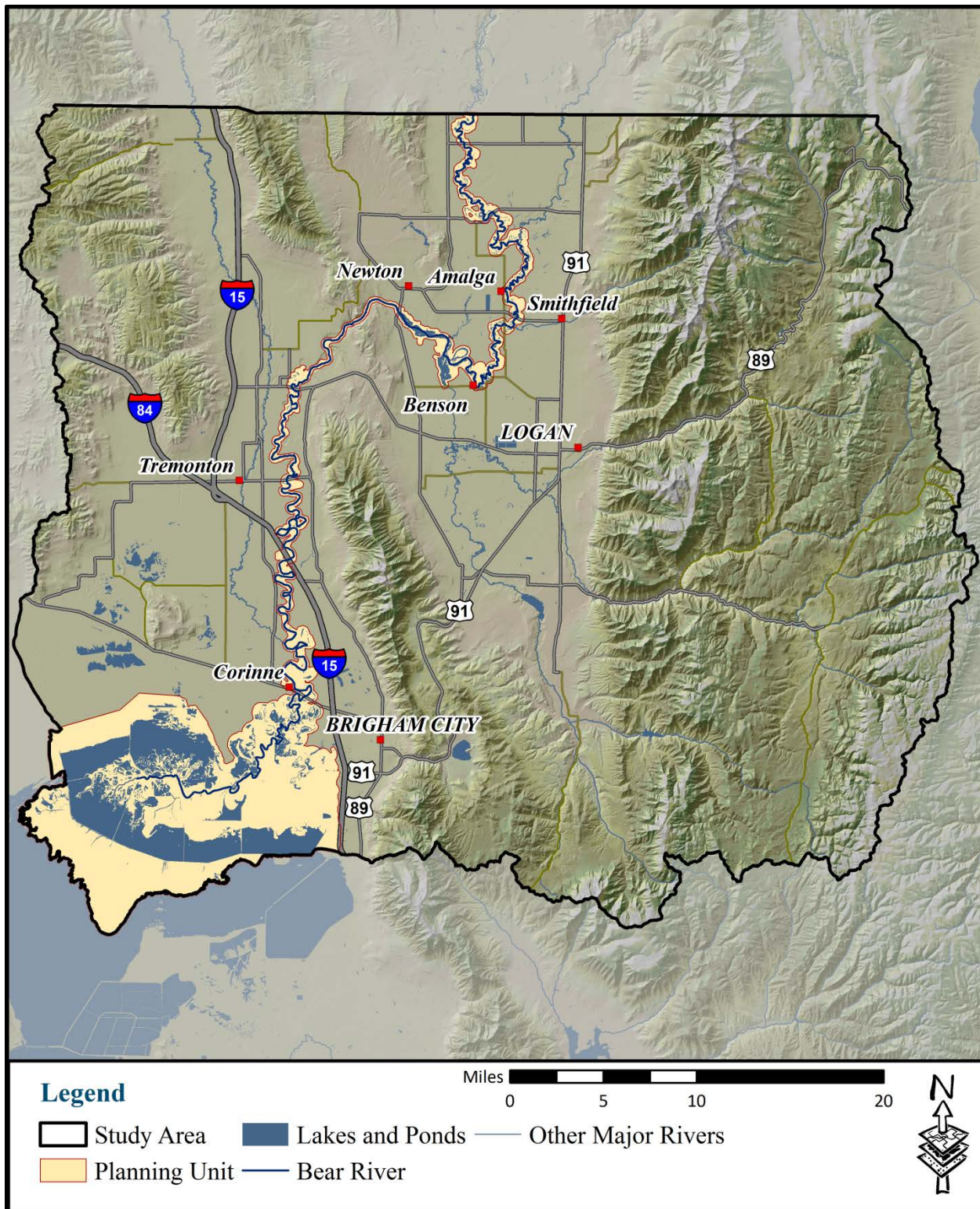
- Describe the Bear River Corridor and its surrounding landscape.
- Identify stakeholders, including agencies with management responsibilities for the Bear River.
- Explore and summarize relevant research and information for the Bear River CMP.
- Identify and map biophysical and socio-cultural attributes relevant to the Bear River.
- Provide a preliminary classification of lands along the Bear River into established sovereign land management classes.
- Make recommendations for relevant management goals and objectives.

Study Area

The study area for this project has two components: the larger study area for which data and information are gathered, and the planning unit, which represents the actual land area to be analyzed and classified according to established sovereign land management classes. The larger study area is derived from portions of three 8-digit hydrologic units within the State of Utah, and is intended to provide context for the river corridor and its relationship to the surrounding landscape. The planning unit is based upon a 500 foot buffer of the base, 100-year flood plain of the Bear River and is intended to represent the river corridor that directly influences the bed and banks of the river itself. The study area and planning area are shown in Map 1.

Ultimately, sovereign land classifications will be delineated for the main stem of the Bear River during the Comprehensive Management Planning process because that is the only area for which FFSL has management jurisdiction and authority. The larger study area selected for this project is intended to provide context for the river corridor as part of the larger landscape. Enlarging the planning unit to the base flood plain rather than limiting it to the main channel of the river is intended to capture features and attributes of lands adjacent to the river that largely determine the features and attributes of the river itself.

Map 1: Study Area and Planning Unit



Methodology

Addressing complex issues on a regional scale requires the identification or development of a suitable methodology to guide each phase of the overall project. The methodology employed for this project has been adapted from one first developed by Professor Richard Toth (Toth, 1974). Permutations of Professor Toth's methodology have been adapted and employed several times to meet the unique needs and opportunities of projects undertaken by the Bioregional Planning Studio at Utah State University (Toth et al., 2005, 2006, and 2010, among others). The methodology developed by Professor Toth and adapted throughout the years has been modified to incorporate the unique requirements and objectives of planning for management of Utah's sovereign lands.

A diagram of the resulting methodology is provided in Figure 2 and a description of each phase is included below. Upon first glance, it may appear to be a straightforward, linear process. However, different phases of work are quite fluid and often occur simultaneously. Multiple iterations of each phase or even multiple phases are sometimes necessary to incorporate information discovered or developed during subsequent phases or to adapt models to ensure more accurate or suitable outcomes. For example, while identifying critical habitat it may become necessary to revisit biological or cultural attributes of the region that were first addressed in the Regional Inventory. Additional information discovered or developed and added to the Regional Inventory may then be carried forward once again until a suitable outcome – acceptable to the researchers, stakeholders and client as providing a reasonably accurate depiction of the resources addressed based upon the best available data and information – is achieved.

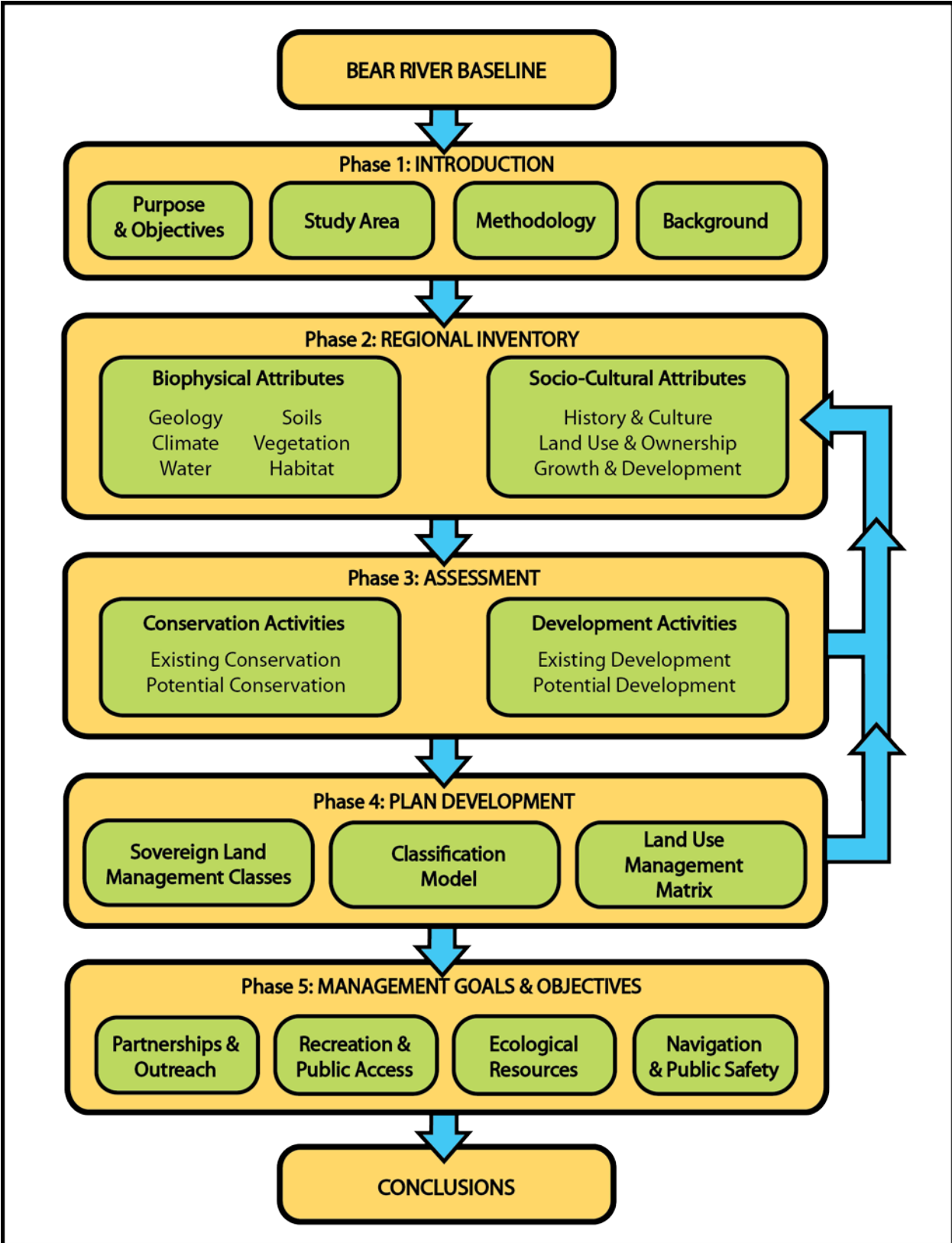


Figure 2: Methodology Diagram

Phase 1: Introduction

The primary objective of the Introduction phase is to develop an initial understanding of the project at hand for both the researcher and the audience. During this phase, the purpose and objectives of the project are established, an appropriate study area is identified, a suitable methodology is adopted or developed, and background information is gathered and presented to establish a context for the project at hand. In this case, background information will include a discussion of sovereign land ownership and public trust responsibilities, the identification of potential partners and stakeholders, and a brief overview of previous planning efforts and projects relevant to sovereign lands along the Bear River.

Phase 2: Regional Inventory

The Regional Inventory continues upon the preliminary review and inventory completed during the Introduction phase to identify and synthesize resources providing insight to the structural and functional aspects of the study area and resource. Existing geo-spatial data relevant to the project are also gathered during this phase. For this study, there are two primary categories of information identified: bio-physical attributes and socio-cultural attributes. While addressed separately for the purpose of inventory and analysis, relationships among attributes both within and across these two primary categories are essential to understanding the functions and processes within the landscape.

Phase 3: Assessment

During this phase of work, geo-spatial models representing specific attributes of the landscape are developed based on information gathered in Phase 1 and Phase 2. This phase of involves significant use of ArcGIS software to organize, create, and display the geo-spatial data.

For this project, individual attributes as well as composite models representing areas of existing and potential conservation, as well as existing and potential development, will be created from a series of sub-models and available datasets such as important wildlife habitat, local zoning designations, and others.

It is important to note the primary task during this phase is to identify areas where different land uses or resource protection activities *could* occur as opposed to making any sort of value judgment regarding where land uses or protection priorities *should* occur. Such decisions and value judgments will be reserved for later stages of the planning process and, in accordance with requirements of sovereign land management, involve more significant public and stakeholder participation (Utah Administrative Code, §R652-90-200).

Phase 4: Plan Development

During the Plan Development phase, conservation and development models developed during Phase 3 are used to classify lands along the Bear River Corridor into established sovereign lands management classifications. Models are synthesized to identify where individual or multiple uses may be expected to occur within the identified area. Careful consideration must be given to areas with multiple potential uses or areas where the demand for developed uses may be in conflict with the protection of important resources to determine if such land uses would be compatible or incompatible. It is expected that any proposal for future uses or activities within such areas of conflict will require site specific plans in accordance with existing FFSL policies and processes, but beyond the scope of this particular project.

Phase 5: Management Goals and Objectives

This phase of the work consists of developing potential management strategies for various aspects of sovereign lands along the Bear River, including the identification of relevant management goals and objectives based on the information gathered and developed through the course of the previous six phases. Examples may include potential projects to improve recreational access, work with Division of Wildlife Resources to obtain better data regarding sensitive species along the river, identify and remove navigational hazards, or otherwise enhance values FFSL is mandated to protect and manage in accordance with Public Trust Doctrine.

The goals and objectives presented in this study are intended to both provide guidance for FFSL based on the work that has been done as well as provide a starting point for the planning team during the formal CMP process. In general, management goals and objectives must be developed in coordination with stakeholders and the other agencies that also have management responsibilities along the river.

Background

The following sections present an overview of the Bear River Basin, a discussion of state ownership and management of sovereign lands in accordance with public trust responsibilities, the identification of relevant resource management agencies and other stakeholders, and a brief overview of previous planning studies and efforts related to the Bear River. More specific information regarding attributes of the study area will be presented as part of the Regional Inventory in Phase 2 of the project.

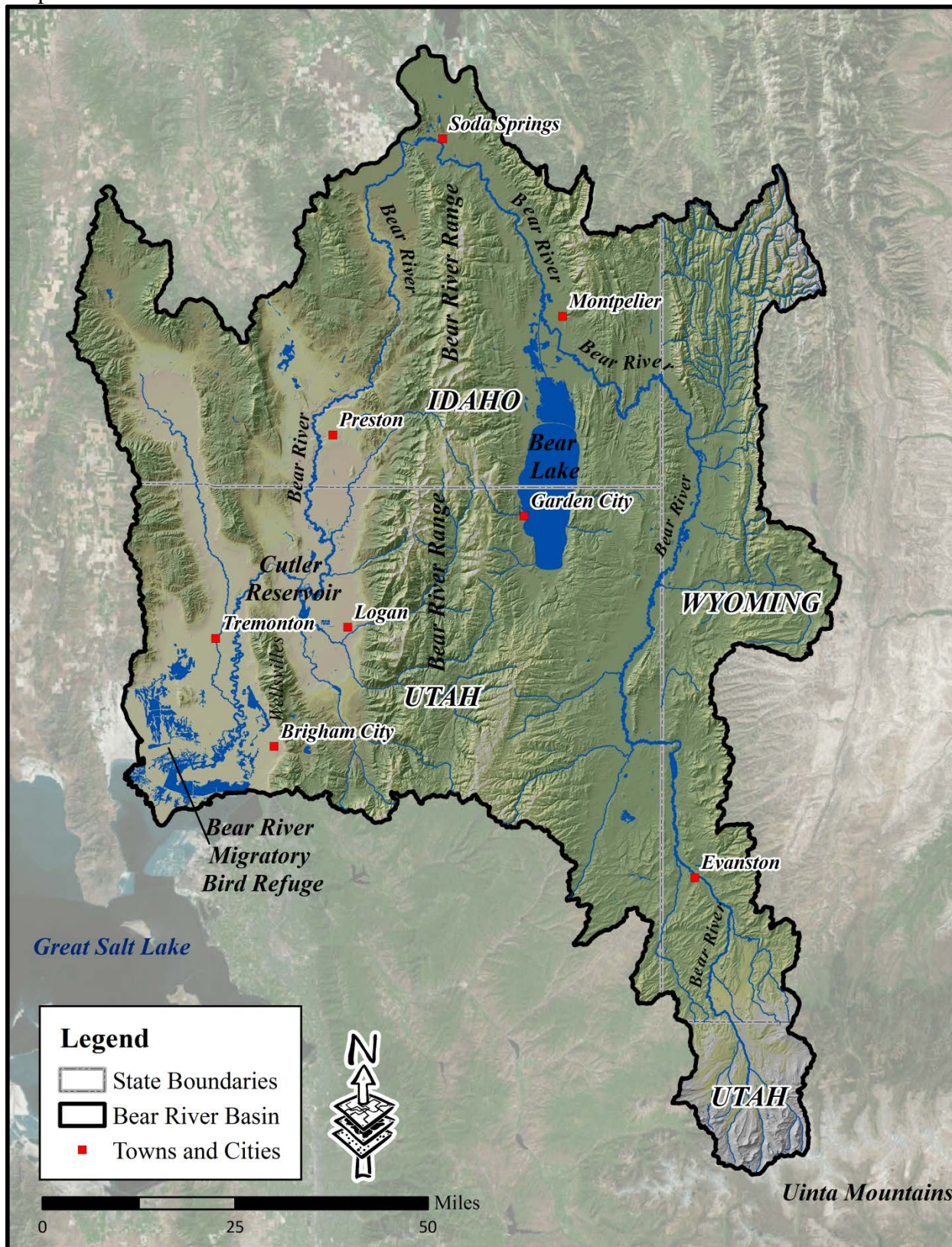
Overview of the Bear River Basin

The study area defined for this project, shown in Map 1, includes portions of three 8-digit hydrologic units that form part of the larger Bear River Basin, shown in Map 2. The Bear River Basin, in turn, lies in the northeastern portion of the Great Basin (Utah Board of Water Resources, 1992). The Bear River flows more than 500 miles from its headwaters in the Uintah Mountain Range, making a large U-turn from north to south around the northern end of the Bear River Range and eventually entering the Great Salt Lake just 80 miles from its source. It is the longest river in the western hemisphere that does not, ultimately, flow into an ocean (DWRe, 2000).

The Bear River is thought to have originally flowed northward through the Portneuf River Canyon into the Snake River Basin rather than making the turn south near Soda Springs into the Bonneville Basin and the identified study area for this project. Following the original course northward, waters of the Bear River would have ultimately flowed into the Pacific Ocean via the Snake and Columbia Rivers (Link, Kaufman, and Thackray, 1999).

Approximately 50,000 years ago volcanic eruptions associated with the wake of the Yellowstone Caldera created natural dams that diverted many stream drainages (Bouchard, Kaufman, Hochberg, and Quade, 1998). It is thought that the northward flow of the Bear River was blocked by a Quaternary basalt flow that now forms the northwestern rim of the Thatcher Basin, located in the southern end of the Gem Valley. This blockage redirected the Bear River southward into Lake Thatcher (Bouchard, et al., 1998) and established the Bear River's connection with the Bonneville Basin. As levels of both Lake Bonneville and Lake Thatcher rose, erosional processes incised the divide between the two and eventually cut through the Oneida Narrows northwest of Preston, Idaho (Bouchard, et al., 1998).

Map 2: The Bear River Basin



The connection between the Bear River and Lake Bonneville is estimated to have increased water flow into the Bonneville Basin by as much as 33% (Link, Kaufman, and Thackray, 1999). This addition of water, coupled with a period of cool and moist conditions, is generally thought to have been responsible for Lake Bonneville reaching its all-time high elevation of approximately 5,090 feet (Bouchard et al., 1998). This lake level was likely maintained less than 500 years (Oviatt and Miller, 1997) by small overflows across the Zenda Threshold (5,090 feet in elevation) and subsurface leakage through Red Rock Pass (Link et al., 1999).

Eventually, the natural dam at Red Rock Pass (Zenda Threshold) suffered a catastrophic failure (Gilbert, 1890; Malde, 1968; Jarrett and Malde, 1987; O'Connor, 1993). There are competing theories regarding the specific cause of this failure (Link et al., 1999; Godsey, Curry and Chan, 2005; and Janecke and Oaks, 2011) but the end result was that Lake Bonneville spilled northward into Marsh Valley through the Portneuf Gap and out onto the Snake River Plain. The massive flood that followed is considered the second largest flood known to occur in the world (Jarrett and Malde, 1987), and left geological evidence extending along the Snake River as far north as Lewiston, Idaho (O'Connor, 1993).

Following the flood, Lake Bonneville remained at the Provo Shoreline (the same elevation as the bedrock lip at Red Rock Pass) for about a thousand years until it began to rapidly recede approximately 13,000 years ago (Link et al., 1999). As the lake receded, the Bear River followed it southward through the Cache and Bear River Valleys to where it now flows into the Great Salt Lake near the Bear River Migratory Bird Refuge. Lakebed sediments deposited during the presence of Lake Bonneville and the invaluable water resources of the Bear River

carving its way down through them has created a rich environment supporting diverse plant communities and wildlife habitats as well as the foundation for human settlement in the region.

Sovereign Land Ownership and Public Trust Responsibilities

State sovereign lands, sometimes referred to as submerged lands or public trust lands, can be defined as lands underlying the ordinary high water mark of navigable bodies of water. Title to these lands is based in longstanding principles of the Public Trust Doctrine and, in the United States, was passed from the federal government to the state by virtue of the Equal Footing Doctrine (Slade et al., 1997). Utah's state sovereign lands include Utah Lake, Great Salt Lake, Bear Lake (Utah's half), the Jordan River, and portions of the Bear, Green and Colorado Rivers. These lands are held in trust and managed by FFSL for the benefit of the general public.

Public Trust Doctrine. Public Trust Doctrine provides that tidal and navigable freshwaters, the lands beneath them, and the living resources that inhabit them are subject to a special title (Slade, Kehoe, and Stahl, 1997). This title is held in trust by the state for the benefit of the general public and establishes the public's right to use and enjoy trust waters, lands, and resources for a wide variety of recognized public uses (Slade et al., 1997).

Origination of the Public Trust Doctrine dates back at least as far as sixth century Institutes and Digest of Justinian, which collectively formed Roman civil law (Slade et al., 1997). Under Roman law, the air, sea and running waters were held as a common resource for all citizens. All rivers and ports were public and the rights of fishing and navigation were shared by all citizens, and anyone was free to use the seashore to the highest tide as long as they did not interfere with use of the resource by others (FFSL, 2013).

The influence of Roman civil law was carried forward into English common law, under which the crown held title to lands underlying tidewaters. In contrast to Roman civil law, English common law only recognized a public right to waters and lands subject to the ebb and flow of the tide. It is important to note, however, that England has very few navigable waterways that are not influenced by the ebb and flow of the tide. Consequently, the terms “tidewaters” and “navigable waters” were essentially synonymous (Slade et al., 1997).

English common law became the law of the thirteen colonies and, subsequently, the foundation for the thirteen original states. Each of the thirteen original states, therefore, holds (and continues to hold) a public trust interest in all waterways and underlying lands subject to the ebb and flow of the tide. Furthermore, each was given the authority to define the boundaries of lands and waters held in the public trust (Slade et al., 1997).

Equal Footing Doctrine. Equal Footing Doctrine is a principle of constitutional law requiring that any state admitted to the Union after 1789 would be admitted as equal to the original thirteen colonies in terms of power, rights, and sovereignty.

In 1787, just prior to ratification of the U.S. Constitution, the Northwest Ordinance established guidelines for the Northwest Territory as well as the admission of new states. Specifically, it provided that any state joining the Union shall be admitted “on an equal footing with the original states” (Northwest Ordinance, 1787). As each of the 37 new states that followed the 13 original colonies were created, this provision was included as part of their enabling legislation and created a transfer of the title to public trust lands and waters from the federal government to the respective state at the time of statehood.

The United States originally adhered to English common law definitions of navigable waters, which only defined tidal waters (subject to ebb and flow) as part of the public trust.

However, the geography of the United States is very different from that of England. The United States contains a multitude of large, non-tidal rivers and lakes used for commercial navigation, fishing, and other uses. While these non-tidal rivers and lakes would not have been included as public trust resources under English common law, they would have been protected as under definitions provided in Roman civil law.

In response to several conflicts between commercial vessels operating on inland waterways, the United States Supreme court extended jurisdiction of federal district courts in 1845 to include non-tidal, navigable waterways. In the 1876 case, *Barney vs. Keokuk*, the Supreme Court held that “all waters are deemed navigable which are really so” (*Barney vs. Keokuk*, 1876) and that “there seems to be no sound reason for adhering to the old rule as to the proprietorship of the beds and shores of such waters” (*Barney vs Keokuk*, 1876). Further, the court held “[such lands and waters] properly belong to the States by their inherent sovereignty” (*Barney vs. Keokuk*, 1876). In the United States, therefore, public trust waters and underlying trust lands include both tidal waters as well as non-tidal, navigable waters.

Utah’s Sovereign Lands. As with all states admitted to the United States since Tennessee’s admission in 1796 (Justia, 2012), the Utah Enabling Act, enacted July 16, 1894, officially declared Utah “to be admitted to the Union on an equal footing with the original States” (Utah Enabling Act, 1894). Title to navigable public trust waters and lands in the state of Utah were, therefore, transferred from the federal government to state ownership at the time of statehood on January 4th, 1896.

Utah’s public trust lands are referred to as “sovereign lands” and defined as “those lands lying below the ordinary high water mark of navigable bodies of water at the date of statehood and owned by the state by virtue of its sovereignty” (Utah State Code §65a-1-1(4), 2017). These

lands include, but are not necessarily limited to the beds of Utah Lake, Great Salt Lake, Bear Lake (Utah's half) and portions of the Green, Colorado, and Bear Rivers (Utah Administrative Code, §R652-70-100).

Utah State Code §65A-1-2 and §65A-10-1 establish the Division of Forestry Fire and State Lands as the management authority for Utah's sovereign lands. Utah State Code §65A-2-1 states that the "Division [of Forestry, Fire and State Lands] shall administer lands under comprehensive land management programs using multiple-use, sustained yield principles" (Utah State Code, §65A-2-1). According to Utah Administrative Code §R652-2-200:

The state of Utah recognizes and declares that the beds of navigable waters within the state are owned by the state and are among the basic resources of the state, and that there exists, and has existed since statehood, a public trust over and upon the beds of these waters. It is also recognized that the public health, interest, safety, and welfare require that all uses on, beneath or above the beds of navigable lakes and streams of the state be regulated, so that the protection of navigation, fish and wildlife habitat, aquatic beauty, public recreation, and water quality will be given due consideration and balanced against the navigational or economic necessity or justification for, or benefit to be derived from, any proposed use." (Utah Administrative Code §R652-2-200)

The overarching management objectives of FFSL are to provide for reasonable and beneficial use of sovereign land while ensuring the long-term protection and conservation of sovereign land resources. There is no particular hierarchy of uses, but implementation of multiple-use framework and other legislative policies is subject to consistency with Public Trust

obligations and must avoid substantial impairment of Public Trust resources (Division of Forestry, Fire and State Lands [FFSL], 2013). Consequently, FFSL strives for an appropriate balance among compatible and competing uses for the lands under its jurisdiction.

Stakeholders, Roles and Responsibilities

FFSL is “the executive authority for the management of sovereign lands” in Utah, including sovereign lands along the Bear River (Utah State Code, §65A-1-4). However, several other resource agencies, organizations, and stakeholders play important role in the management of the Bear River and associated resources. These include federal, state, and local government agencies, non-profit organizations, private enterprise, and individual landowners. The Bear River Comprehensive Management Plan and associated planning process provide an opportunity for increased coordination and collaboration among state and federal agencies, local governments and other stakeholder groups.

Utah Division of Wildlife Resources (DWR). DWR is the wildlife authority for Utah and is responsible for protecting, propagating, managing, conserving, and distributing protected wildlife throughout the state of Utah (Utah State Code, §23-14-1). DWR manages both protected and non-protected wildlife species, regulates hunting and fishing, and manages a limited number of wildlife management areas and access points along the Bear River.

Utah Division of Water Resources (DWRe). DWRe and the Utah Water Resources Board are responsible for directing orderly and timely planning, conservation, development, protection, and preservation of Utah’s water resources. They conduct studies, investigations, and planning activities for water use. Recently, DWRe has been working with consultants to explore

options for developing water from the Bear River to support growth and development throughout northern Utah.

Utah Division of Water Rights (DWRi). DWRi regulates appropriation and distribution of water in the State of Utah, pursuant to Title 73 of the Utah State Code. The director of DWRi, who is also the State Engineer, approves the diversion and use of all water, regulates any alteration of natural streams, and also has authority to regulate dams and dikes to protect public safety.

Utah Water Quality Board. The Utah Water Quality Board guides development of water quality policy and regulations throughout the state of Utah. The Board consists of nine members, appointed by the governor with consent of the Utah Senate, intended to represent various interest groups of the water quality community. Membership includes representatives from the mineral, manufacturing, and agricultural industries, non-governmental organizations, a public health representative, local and special service districts, and state or local government (Utah State Code, §19-5-103). The Utah Division of Water Quality (DWQ) is the administrative arm of the board.

Utah Division of Water Quality (DWQ). DWQ is the administrative arm of the Utah Water Quality Board and is responsible for protecting public health and beneficial uses of water by maintaining and enhancing the chemical, physical, and biological integrity of Utah's surface and ground water resources. Their projects and activities include establishment of water quality standards, regulation of treatment facilities and wastewater discharges, and carrying out planning processes to control water pollution.

Utah State University (USU) Water Quality Extension. USU Water Quality Extension's mission "is to inform people of all ages about the link between their everyday activities and land

uses and the quality of our water. We strive to accomplish this by participating in water fairs, environmental competitions (e.g., Utah Envirothon and Science Olympiad), teacher trainings and workshops, volunteer monitoring (Utah Water Watch and other monitoring events) and general events for the public (e.g., Bear River Celebration and Free Fishing Day)” (Utah State University [USU] Water Quality Extension, 2017a).

Utah Geological Survey (UGS). UGS is a non-regulatory agency responsible for collecting, preserving, publishing, and distributing reliable information on geology, mineral resources, and geologic hazards relevant to the state of Utah. UGS is also responsible for assisting, advising, and cooperating with state and local agencies and educational institutions on all subjects related to geology.

U.S. Army Corps of Engineers (USACE). USACE jointly administers Section 404 of the Clean Water Act with the U.S. Environmental Protection Agency (EPA) and is responsible for regulating excavation and the placement of any fill material in water bodies throughout the country. USACE’s management responsibilities under the Clean Water Act are to protect the nation’s aquatic resources from unnecessary adverse impacts. This includes regulation and permitting of various activities, including the disturbance of wetlands.

U.S. Fish and Wildlife Services (USFWS). USFWS manages the Bear River Migratory Bird Refuge at the mouth of the Bear River west of Brigham City. The USFWS is responsible for the protection of migratory birds as well as threatened and endangered species (Gwynn, 2002). USFWS staff members from the Bear River Migratory Bird Refuge have been active participants in several planning studies and projects along the Bear River.

Natural Resource Conservation Service (NRCS). While NRCS doesn’t directly management lands along the Bear River, they play an important role in providing technical

assistance in conservation planning and land management practices for private landholders and agricultural operations. NRCS works in close partnership with farmers and ranchers, local and state governments, and other federal agencies to maintain healthy and productive working landscapes (Natural Resources Conservation Service [NRCS], 2013). Their programs include both technical and funding assistance to landowners interested in improving conservation practices on agricultural lands.

Cache and Box Elder Counties. The entirety of the study area lies within Cache and Box Elder Counties. While not responsible for directly managing land areas along the Bear River, counties do influence many areas through local policy-making and county-level zoning ordinances. These policies affect the distribution of land uses such as agriculture, commercial and residential activities as well as important guidelines for flood plains and other critical lands in terms of public health, safety and welfare. The counties and municipalities (below) are also important stakeholders in terms of water use. For example, the Cache County Water Master Plan identifies development of 60,000 acre-feet of water from the Bear River as a top priority for meeting future water needs in Cache County (Cache County, 2013).

Municipalities. Local municipalities within the study area also affect land uses through municipal zoning and code enforcement. Of thirty-three incorporated towns and cities within the identified study area, there are nine located directly adjacent to the Bear River. These include Cornish, Lewiston, Trenton, Amalga, Deweyville, Elwood, Honeyville, Bear River City, and Corinne. Municipal boundaries and generalized zoning classifications are included in the Regional Inventory.

PacifiCorp/Rocky Mountain Power. PacifiCorp operates four hydro-electric facilities along the Bear River, although only Cutler Dam is within the identified study area. They also

hold the exclusive right to divert water from the Bear River for storage in Bear Lake and operate the Lifton Pumping Station to move water from Bear Lake back into the Bear River to fulfill contracts with downstream water users during the irrigation season (Jibson, 1990).

In addition to operating the dams and pumping station, PacifiCorp owns approximately 1900 acres of property along the Bear River in Cache County. These lands are locally known as the “Bear River Bottoms” and were acquired by Utah Power and Light in 1981 as part of a settlement agreement with property owners whose lands were being flooded by high runoff (Bear River Land Conservancy, 2012). Many of these lands are managed to protect and enhance wildlife habitat as well as leased for grazing. PacifiCorp also provides recreational facilities to support canoeing, hunting, and bird-watching in areas around Cutler Reservoir and Marsh.

Water Conservancy Districts. The Bear River Water Conservancy District works to conserve and protect water rights and develop water for municipal, industrial and agricultural uses in Box Elder County. During the course of this study, residents of Cache County also voted to create the Cache Water District to carry out similar objectives in November of 2016. Previously, the role of water conservancy district had been taken on by Cache County.

Conservation Organizations. Several conservation-oriented organizations have shown a growing interest in lands and resources along the Bear River. Bear River Land Conservancy holds a conservation easement on approximately 500 acres of property (owned by PacifiCorp) in Cache Valley and is working to secure additional easements along the river. The Nature Conservancy (TNC) has identified the Bear River as a conservation priority and is actively engaged in their Conservation Action Plan process within the Bear River Watershed. TNC is also working to facilitate conservation easements throughout the area. Bridgerland Audubon Society has a long history with the Bear River Watershed, owns/manages parcels of land in

Cache Valley, and has identified areas around the Great Salt Lake, Amalga Barrens and Cutler Marsh as “Important Bird Areas” of global significance (National Audubon Society, 2013).

Private Property Owners. The vast majority of land adjacent to sovereign lands along the Bear River is privately owned and used for agricultural activities. While FFSL has management authority for the bed of the Bear River, these landowners control and manage the adjacent lands that have a significant bearing on most aspects of the river including water quality, vegetation, and wildlife habitat. Private landowners will, therefore, be an important partner and resource for FFSL both during the planning process as well as during implementation of future management activities along the Bear River.

Previous Studies, Planning Efforts, and Resources Relevant to the Bear River CMP

Although responsibility for planning and management of state sovereign lands along the Bear River lies with FFSL, other state agencies, public entities, and private stakeholders also have management responsibilities and significant interests in resources along the Bear River Corridor. The Bear River Comprehensive Management Plan and the associated planning process provide an opportunity for increased coordination and collaboration among state and federal agencies, local governments and other stakeholders.

The Bear River has received increased attention over the past several years as a critical resource for wildlife habitat as well as an important water resource to support future development. Population growth in Cache and Box Elder Counties has spurred a number of projects evaluating the impacts of changing land uses within the region. Consequently, there are a number of studies and reports that provide a significant body of information relevant to sovereign land management along the Bear River. Where applicable, this report takes advantage

of previous research projects and planning documents to provide context and background for this project. Many of the following references are also cited as key sources of more detailed information that has been synthesized as part of this project.

Lower Bear River and Tributaries TMDL Report (DWQ, 2002a). Both the Lower Bear River TMDL report that addresses the section of the Bear River from Cutler Dam to the Great Salt Lake and the Middle Bear River and Cutler Reservoir TMDL report (discussed below) that addresses the Bear River in Cache County, are critical sources of information regarding water quality in the Bear River.

The Lower Bear River Total Maximum Daily Load (TMDL) report is an U.S. Environmental Protection Agency (EPA) mandated report required to be completed for any water body listed as impaired from meeting designated beneficial uses. This report was developed utilizing information submitted by Ecosystems Research Institute through a locally administered contract with the Bear River Water Conservancy District. It provides an overview of the study area, identifies designated beneficial uses, pollutants of concern, and both point and non-point sources of pollution for the Bear River from Cutler Dam to the Great Salt Lake.

The recommended implementation strategy focused on reducing non-point source pollution to the river because point source pollution was initially determined to be a very small contributor to the impairment of the stream (DWQ, 2002a). However there have been several changes in the area, including the expansion of light industry and point sources of pollution as well as additional factors affecting non-point source pollution. An updated TMDL study for this section of river between Cutler Dam and the Great Salt Lake is currently under development to incorporate these issues.

Bear River Basin: Planning for the Future (Utah Division of Water Resources [DWRe], 2004). This document was prepared by DWRe as part the Utah State Water Plan series. It is intended to guide and direct water related planning and management in the Bear River Basin. The document identifies water use trends and, where possible, makes projections of water use. Additionally, it explores various means of meeting future water demands, and identifies important issues for making water-related decisions with in the Bear River Basin.

Box Elder County, Utah Resource Assessment (Natural Resources Conservation Service [NRCS], 2005). The Box Elder County Resource Assessment was completed through the cooperation of the Utah Association of Conservation Districts, the Utah Department of Agriculture and Food, and the NRCS to provide an assessment of important natural and social resources in Box Elder County, Utah. The assessment is primarily focused toward agricultural resources and issues. The intention of the report is to aid in resource planning, identify needs for conservation assistance, and outline specific resource concerns for the area.

Alternative Futures for the Bear River (Toth et al., 2005). The 2004 -2005 Bioregional Planning Studio at Utah State University completed the project entitled “Alternative Futures for the Bear River Watershed.” This project was oriented to addressing three central questions for residents in the entire watershed: 1) how can quality of life issues for the local population be represented or defended in the face of development; 2) How can we maintain clean air and water; and 3) can prime agricultural land and a rural lifestyle be maintained, including the preservation of open space and access to public lands as well as the benefits of a small community lifestyle for its residents? There was no single plan proposed in the study but rather a series of alternative future scenarios were identified and allocated across the region based upon expected 20-year growth predictions. To evaluate the alternative scenarios, a series of assessment models were

developed to analyze where each scenario may compromise quality of life concerns as well as those related to public health, safety, and welfare.

Cache Valley 2030: The Future Explored (Toth et al., 2006). Cache Valley 2030 looked specifically at Cache Valley to identify how projected future growth might affect the regional identity and ecological integrity of that area. This project produced a suite of alternative future scenarios based upon an expected 25-year growth prediction. Similar to the other bioregional planning projects employing the development of alternative futures, several assessment models were developed to analyze how and where each future scenario could impact public health, safety, and welfare as well as the overall quality of life within Cache Valley.

Bear River Watershed and its Role in Maintaining the Bear River Migratory Bird Refuge (Toth, Edwards, Perschon and White, 2010). The 2009-2010 Bioregional Planning Studio worked on a watershed-level project exploring growth and development within the Bear River Watershed and, specifically, potential impacts to the Bear River Migratory Bird Refuge. While the focus of this study was directed toward the refuge, it presents a thorough analysis of the Bear River Watershed as a whole including growth and development, agriculture, wildlife habitat, and public health, safety and welfare. The report provides an evaluation of alternative future scenarios that were developed and provides corresponding recommendations for implementing policies aimed at preserving critical resources within the region.

Middle Bear River and Cutler Reservoir TMDL Report (DWQ, 2010). This TMDL report was developed by DWQ in consultation with SWCA Environmental Consultants to meet requirements of the Clean Water Act in addressing water quality impairments for Cutler Reservoir and the Bear River in Cache Valley, Utah. Similar to the Lower Bear River TMDL described previously, this document provides an overview of the defined study area, identifies

designated beneficial uses, impaired uses, pollutants of concern, and sources of pollution contributing to the impairment of the Bear River and Cutler Reservoir. Phosphorous and dissolved oxygen were identified as the primary pollutants of concern. While the water quality of the Bear River is highly dependent on upstream sources of pollution and the water quality of the contributing tributaries, TMDL objectives and recommended management practices were identified to help manage the amount of phosphorous and dissolved oxygen entering the system and ultimately improve water quality.

Bear River Watershed Information System (Horsburgh, Mesner, Stevens, and Caplan, 2011). The Bear River Watershed Information System was developed in response to comments from citizens, educators, and resource managers who needed better access to information regarding the Bear River and surrounding watershed. It serves as a central location for data and information related to various watershed issues in the Bear River Basin and has been a valuable resource in the development of this project.

Cache County, Utah Resource Assessment (NRCS, 2011). The Cache County Resource Assessment was developed to provide guidance for resource management plans and to identify conservation assistance needs for natural and cultural resources in Cache County, Utah. Similar to the Box Elder County Resource Assessment described above, the report provides an overview and general observations of resources within the region and identifies resource priorities and concerns related to agricultural preservation, water resources, invasive weed species, and the condition of grazing lands.

Land Protection Plan: Bear River Watershed Conservation Area (U.S. Fish and Wildlife Service [USFWS], 2013). The U.S. Fish and Wildlife Service (USFWS) has been working on developing the “Bear River Watershed Conservation Area” and corresponding Land

Protection Plan. The document highlights resource values including agricultural lands, wildlife habitat, and water resources within the watershed and evaluates projected environmental and socio-economic impacts that may occur upon implementation of the conservation area and land protection plan.

The implementation of this plan would utilize voluntary conservation easements to protect wetlands, grasslands, and agricultural lands from being converted to other uses in order to preserve wildlife habitat in the watershed. Approval to move forward with the plan has been given by USFWS and project leaders are in the process of identifying priority areas and working with landowners to develop voluntary conservation easements that would be accepted into the program as donations from the respective landowners.

Envision Cache Valley (Envision Utah, 2009). Envision Cache Valley included an extensive public visioning process that began with the Cache Valley Regional Council – a group created by an agreement between Cache Valley jurisdictions and made up of elected officials from Franklin County, Idaho, and Cache County, Utah. A steering committee of local citizens with diverse backgrounds led the Envision Cache Valley effort. The Cache Valley Regional Council asked Envision Utah, a nonprofit organization that pioneered regional visioning, to facilitate Envision Cache Valley.

In a very general way, Envision Cache Valley summarizes how residents think Cache Valley should grow. The objective was to envision a place that preserves and enhances the quality of life that residents currently enjoy and that future generations will appreciate. Components favored by the public were used to create a vision statement, vision principles, and scenario maps. Although the level of true public involvement in this study has been criticized, it does represent one of the few broad visioning studies attempted in the area.

Conservation Action Plan for the Bear River (The Nature Conservancy, 2009).

Conservation Action Planning is a framework developed by TNC to identify and understand key species and ecological systems most in need of conservation, the factors that sustain or degrade them, and the necessary strategies to effectively protect them. The Conservation Action Planning process for the Bear River was initiated in 2009 and is intended to bring partners together to identify opportunities for collaboration in the effort to sustain important ecological systems in the Bear River Basin. The Bear River Conservation Action Plan is an ongoing effort to review progress made toward achieving conservation objectives and identify future plans and strategies.

Final Great Salt Lake Comprehensive Management Plan (FFSL, 2013). Utah

Department of Natural Resources and FFSL jointly sponsored development of the Great Salt Lake Comprehensive Management Plan in conjunction with SWCA Environmental Consultants. This management plan is included here for two reasons. First, it provides an example of Utah sovereign lands planning and includes a (legally vetted) summary of the role and authority of FFSL in managing state sovereign lands according to multiple use, sustained yield objectives in accordance with the Public Trust Doctrine. Additionally, the Bear River is the single largest source of water flowing into the Great Salt Lake and the interface between the two water bodies provides an expansive area of wetlands and mud flat habitats that represent one of the most critical areas for wildlife in the region. The importance of this area is well represented by the presence of the Bear River Migratory Bird Refuge.

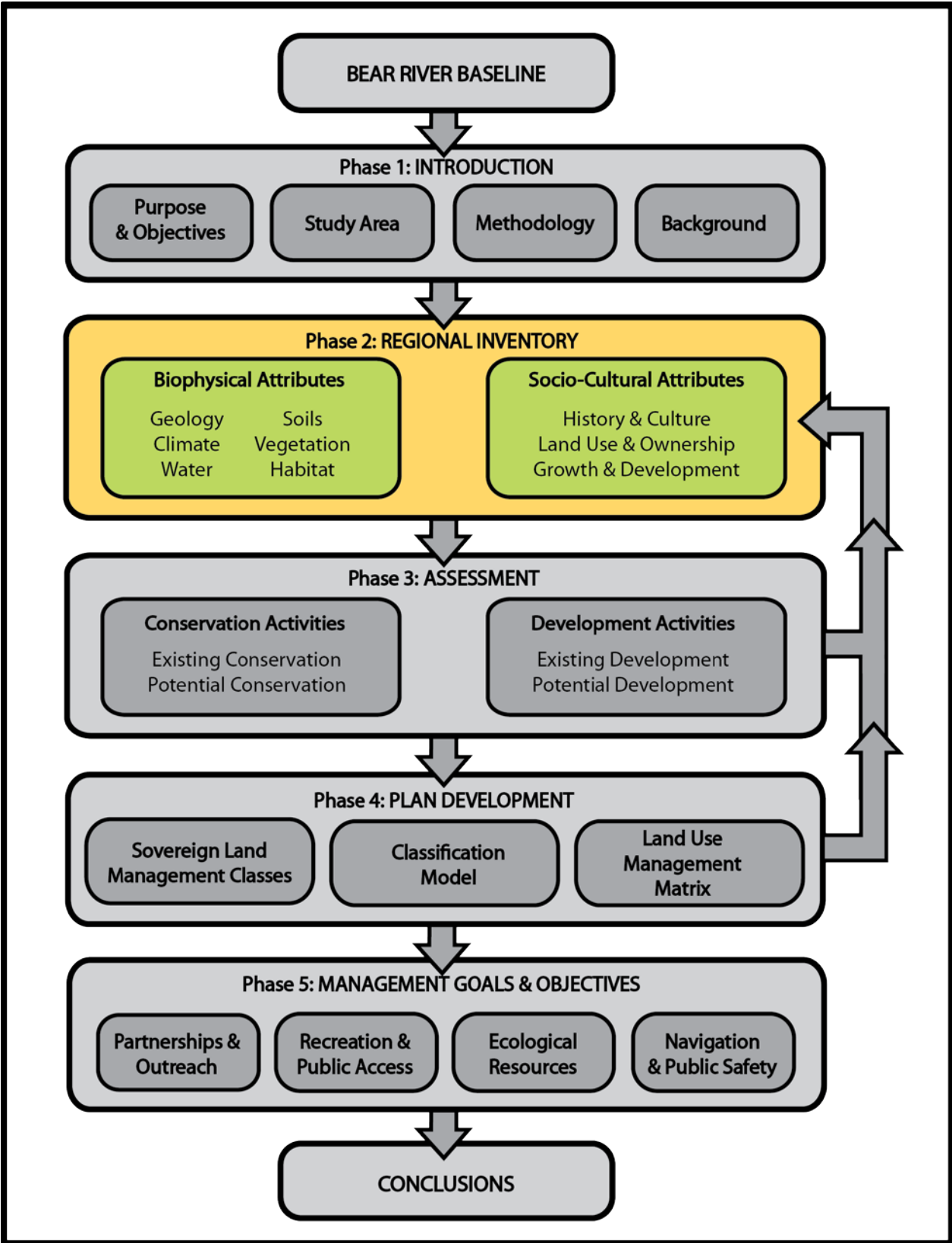


Figure 3: Regional inventory diagram

Phase 2: Regional Inventory

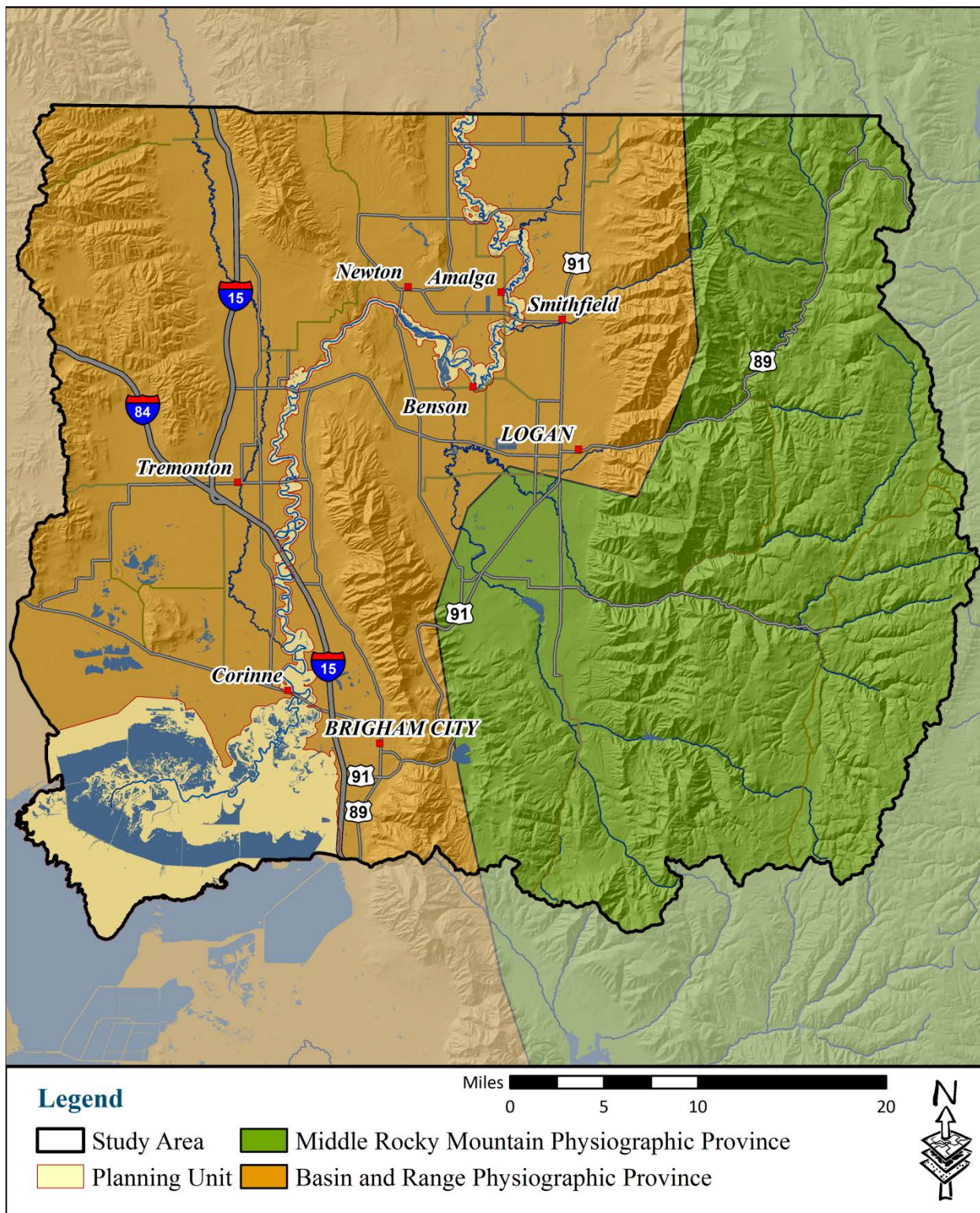
The objective of the Regional Inventory is to identify, evaluate, and synthesize resources to provide insight into structural and functional attributes of the study area and resource. For this study, the Regional Inventory includes two major sections: 1) biophysical attributes and 2) socio-cultural attributes. Biophysical attributes include geology, climate, water, soils, vegetation, and wildlife. Socio-cultural attributes will include history and culture. While these attributes are addressed separately for the purpose of this inventory, relationships among attributes within and across the biophysical and socio-cultural sections are essential to understanding the functions and processes within the landscape.

Biophysical Attributes

Geology

The study area contains portions of two physiographic provinces (see Map 3), defined by rock types, deformation, and erosional characteristics (Fenneman, 1931). The mountains in the east are part of the Middle Rocky Mountain Physiographic Province. The Basin and Range Physiographic Province, which contains most of the flat bottomed valleys and the flood plain of the Bear River, begins at the base of the Bear River Mountain Range and extends westward. The Wellsville and Clarkston Mountain Ranges break up the Basin and Range Province, dividing Cache Valley from the Bear River Valley. Landforms and terrain features within the watershed consist of gently sloping terraces, alluvial fans, and rolling uplands connecting to foothills and benches that provide a transition into the steep slopes of more mountainous terrain. For the purposes of this project, the area has been divided into three basic types of areas based primarily on elevation and topography: 1) mountains, 2) foothills, and 3) valley bottoms.

Map 3: Physiographic Provinces



Mountains. The Bear River Mountain Range runs north-south in the central part of the Bear River Basin and is characterized by Precambrian and Permian sedimentary and metamorphic geological formations. The Wellsville and Clarkston Mountains dividing Cache and Box Elder Counties have a similar geologic makeup (DWQ, 2010). Most valleys



Figure 4: Wellsville Mountains

within the mountain ranges have been incised by streams flowing downward from higher elevations to form V-shaped fluvial canyons. These streams typically have steep stream grades and surrounding slopes with bottoms consisting primarily of boulders and cobble (DWQ, 2010).



Figure 5: Foothills below the Bear River Range

Foothills. Foothills and benches provide a transition between steep, mountainous areas and the flat valley bottoms, and are generally made up of sedimentary deposits left over from Lake Bonneville. These deposits provide fertile agricultural soils, but also leave many areas susceptible to erosion.

Several alluvial deltas, formed by the interaction of rivers and streams with Lake Bonneville, have subsequently been carved out by streams to form alluvial canyons with relatively moderate stream grades and gravel bottoms that extend through the foothills and out onto the valley floors.

Valley Bottoms. The Cache and Bear River Valley bottoms are relatively flat, with undulating terrain at the edges, an occasional bluff, and the deep, meandering flood plains carved by rivers such as the Bear and Malad. Sediment carried downstream by the Bear River as it flowed into the receding Lake Bonneville created much of the rich farmland



Figure 6: Valley bottoms in Cache Valley

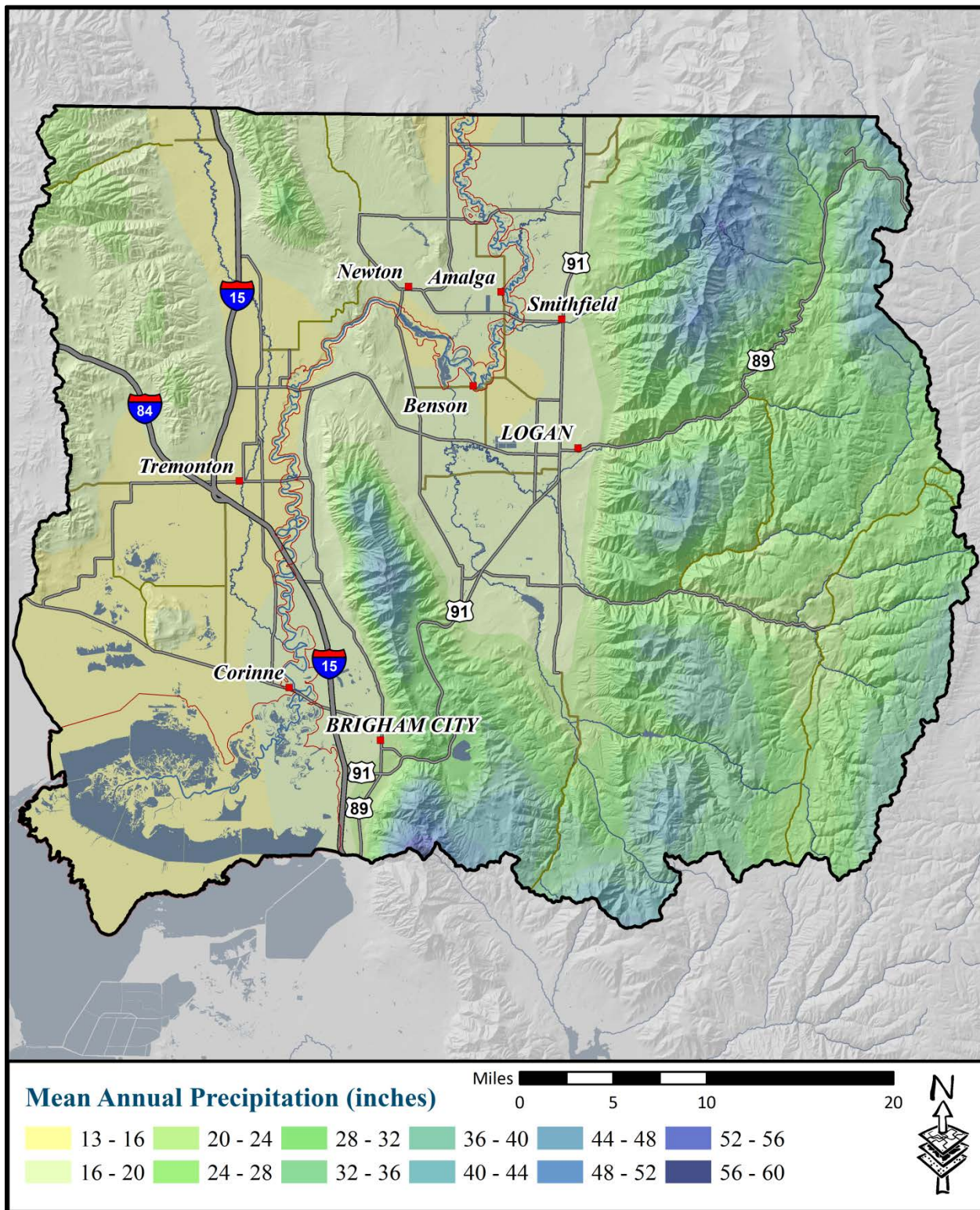
that exists in the Cache and Bear River Valleys. Bedrock and soils of the valley bottoms are composed of alluvial and lake deposits of varying thicknesses.

Climate

The diverse topology of the Bear River Basin creates a widely varying climate. Mountains and high elevation areas experience long, cold winters and relatively cool summers. Foothills are more temperate, and southeasterly aspects often contain microclimates that provide winter habitats and historically facilitated fruit production. Valley bottoms experience warm temperatures in summer, but generally have more extreme variances between high and low temperatures due to cold air from higher elevations being pushed down into lower lying areas.

As a general rule, precipitation is related to elevation. As air masses move upward into the upper atmosphere, they carry water vapor from evaporation and evapotranspiration (Brutsaert, 2005). At higher elevations, water vapor condenses and cools until the air reaches a certain temperature, water particles become too large, and precipitation falls from the atmosphere as rain, snow, or hail. Some areas of lower valleys receive as little as 13 inches of annual precipitation while high elevation mountainous areas receive 50 to 60 inches (see Map 4).

Map 4: Mean Annual Precipitation



Major storm systems impacting the region include frontal systems coming from the Pacific Northwest during the winter and spring as well as thunderstorms approaching from the south and southwest in late summer and early fall (DWRe, 2004). The majority of storm systems that bring significant precipitation approach from the west and mountain ranges cause significant rain shadow effects in some areas of the valleys. East facing slopes and significant portions of the valley bottoms are left relatively dry, while the west-facing slopes and adjacent areas of the valleys (such as those near Brigham City and Logan) receive significantly higher amounts of precipitation.

Water

A watershed, also referred to as a basin or drainage, is a hydrologic unit representing the area of land where all water running over the surface drains to a common water body such as a river, stream, wetland, lake, or ocean (U.S. Environmental Protection Agency [EPA], 2014).

Hydrology. The Bear River Basin (a relatively large watershed) drains an area of approximately 7500 square miles that includes portions of Utah, Wyoming, and Idaho (USFWS, 2013). It contains a complex system within which hydrologic processes, soil composition, land cover, and developed land uses play an important role in the quality and quantity of water delivered into the Bear River from the surrounding landscape. The Bear River is the largest river in the Bear River Basin and the largest source of water to the Great Salt Lake (FFSL, 2013).

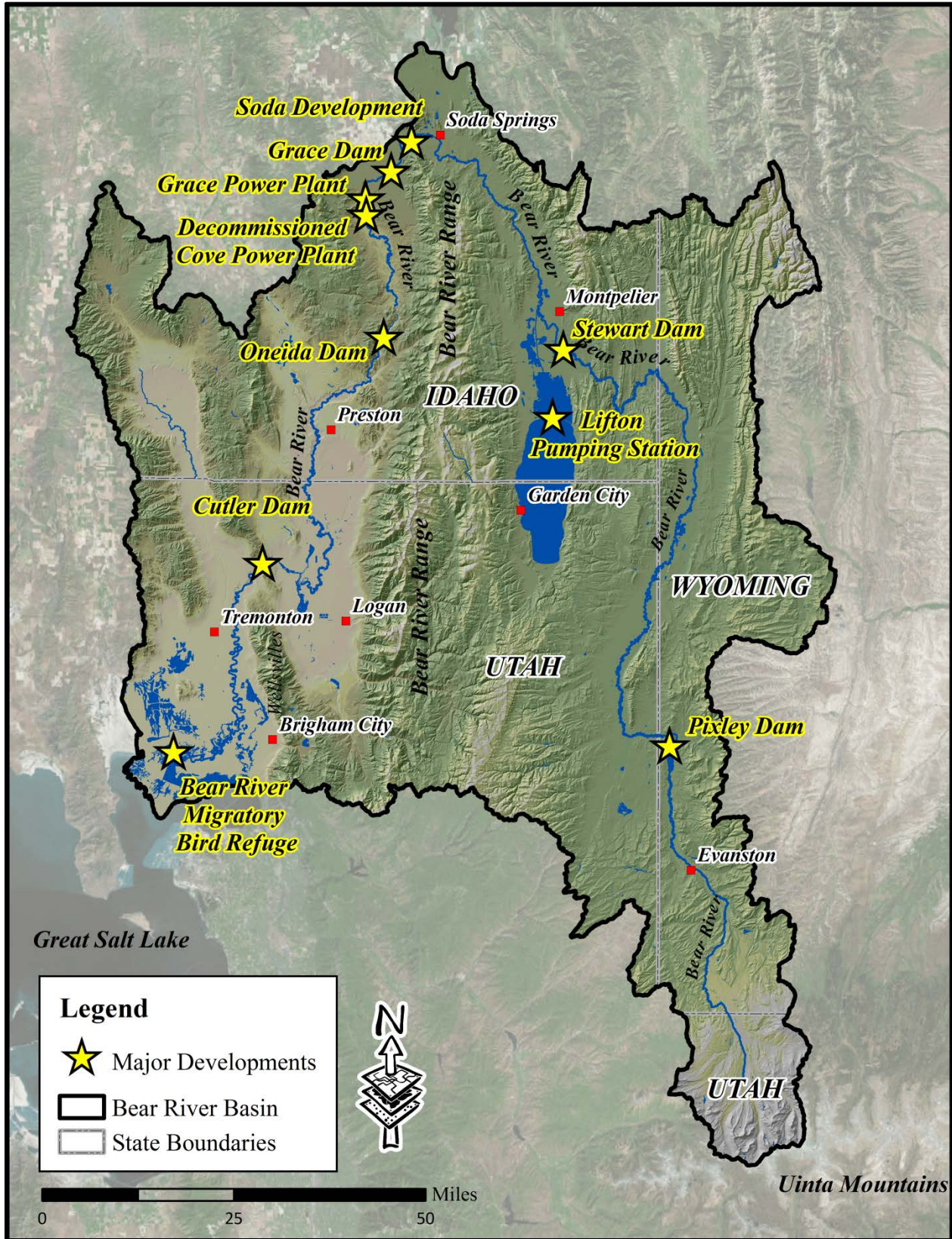
From its headwaters in the Uinta Mountains, at over 12,000 feet in elevation, to where it ultimately flows into the Bear River Bay of the Great Salt Lake, at less than 4500 feet in elevation, the Bear River travels a 500 mile course through three states and ends just 90 miles from its original source (FFSL, 2013). Along the way, the Bear River collects water from several major tributaries, including the Thomas Fork, Smith's Fork, Cub, Logan, Blacksmith

Fork, Little Bear, and Malad Rivers. Of these, all but the Thomas Fork and Smith's Fork flow into the Bear River within the identified study area.

The hydrology of the Bear River and its watershed has been significantly altered by human settlement and activities over the past century. As shown in Map 5, there are several hydroelectric plants and related facilities on the main stem of the Bear River, and over 450 irrigation companies own and operate water delivery systems within the larger watershed (DWQ, 2010). In 1911, a canal was constructed to connect the Bear River to Bear Lake, which had been hydrologically disconnected for approximately 11,000 years (Link et al., 1999). During periods of higher flow and low water demand (generally late October to June), water is diverted at Stewart Dam, flows through Mud Lake, and is stored in Bear Lake. During drier months, water is pumped from the north end of Bear Lake at Lifton Pumping Station, runs north through dingle marsh and the Bear Lake Outlet Canal, and is released back into the Bear River to provide water to downstream users (DWQ, 2010).

Between Bear Lake and Cache County, the Bear River makes its wide U-turn around the northern end of the Bear River Mountain Range and transitions from north-flowing to south-flowing near Soda Springs, Idaho. It is impounded in Alexander Reservoir and again at Grace. The river then flows southward through volcanic rock in Black Canyon and past the Grace Power Plant. Further south, the Bear River leaves Gem Valley near Thatcher, Idaho, and is once again impounded at Oneida Reservoir before finally entering Cache Valley via the Oneida Narrows northwest of Preston, Idaho.

Map 5: Major Developments on the Bear River



The Bear River enters Cache County and the state of Utah at the Utah-Idaho state line. A United States Geological Survey stream gauge located near the border shows the 30 year average annual flow volume from 1986 to 2015 was 773 cubic feet per second (PacifiCorp, 2014; Bear River Commission, 2016). In Cache Valley, the Bear River is

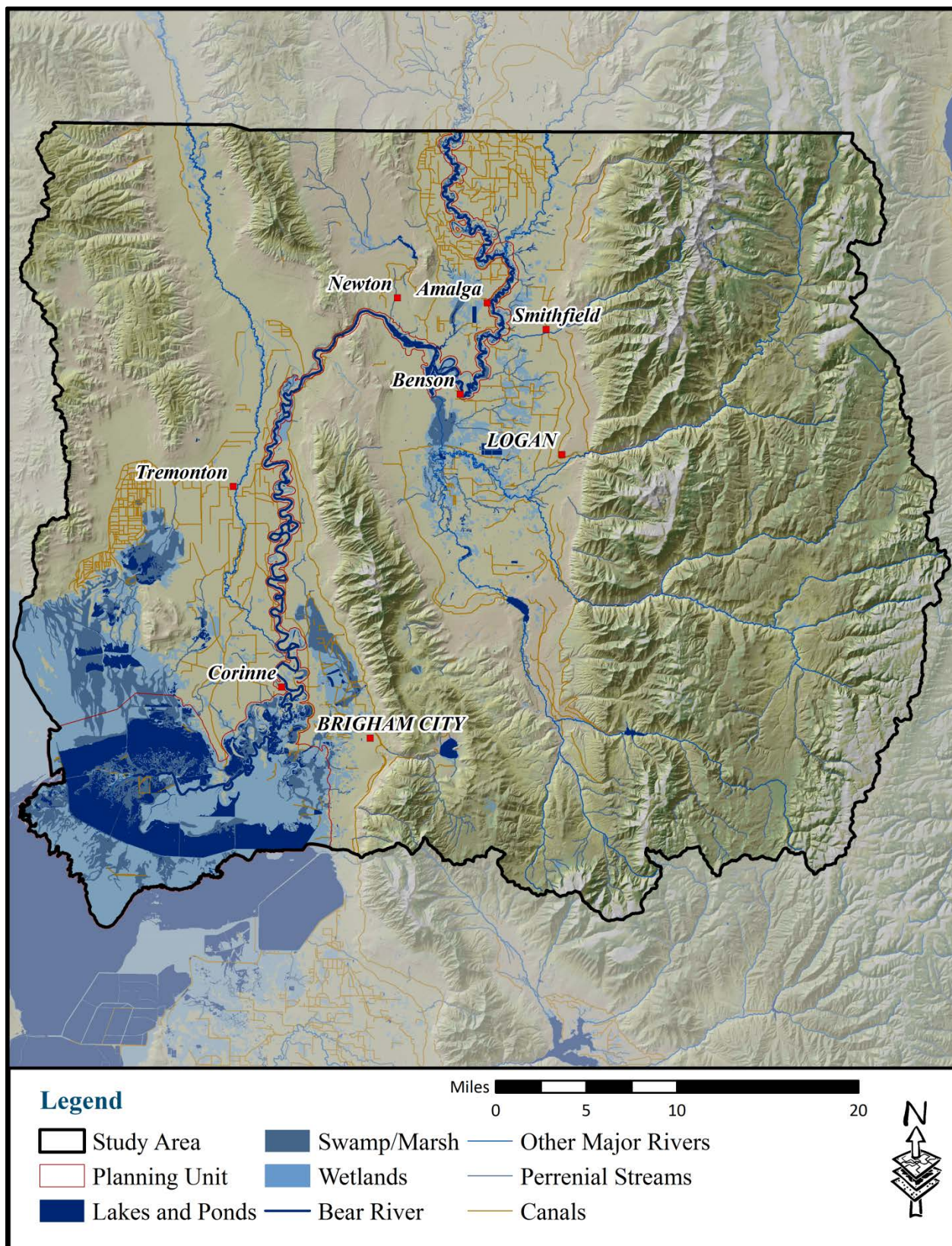


Figure 7: Bear River in northern Cache County

generally characterized by slow moving water and shallow gradients. Map 6 shows surface water within the study area. Meandering its way back and forth across the valley floor, the Bear River has carved a large, flat-bottomed flood plain flanked by steep walls. The flood plain contains a complex channel system with many oxbows, backwaters, eddies, and side channels.

Cutler Dam, located in Bear River Canyon near the Box Elder-Cache County line, impounds water from the Bear, Logan, Blacksmith Fork, and Little Bear Rivers along with several canals and sloughs. The dam was constructed in 1927 by Utah Power and Light to provide both agricultural water and power generation. However, as part of the 1980 amendments to the Bear River Compact (Jibson, 1990) water could not be released from Bear Lake solely for power generation. Consequently, electrical generation has become a secondary benefit that only occurs when natural flows are sufficient or water is being released into the river to fulfill irrigation contracts downstream.

Map 6: Surface Water and Canals in the Study Area



As part of PacifiCorp's Federal Energy Regulatory Commission (FERC) license, an operational elevation range of 4,406 to 4,407.5 feet has been established for Cutler Reservoir to support fish and wildlife populations (DWQ, 2010). With an average water level of 4,407 feet in elevation, reservoir volume is approximately 8,181 acre feet and spreads across nearly 10,000 acres of open water and emergent wetland areas in Cache County (DWQ, 2010). Cutler Reservoir's primary outlets include the West Side Canal and the Hammond Main Canal that distribute irrigation water to most of the Bear River Valley, and the lower Bear River that continues its course toward the Great Salt Lake.

Below Cutler Dam, the Bear River continues meandering through a complex channel system and flood plain similar to Cache Valley. One difference, however, is that summer flows in northern Box Elder County are often significantly lower due to impoundment and diversion of water at Cutler Dam. During the irrigation season, supplemental water previously stored in Bear Lake is often entirely diverted at Cutler Dam to serve longstanding contracts to supply 900 cubic feet per second (cfs) into the irrigation canals that feed agricultural lands in Box Elder County.

For several miles downstream of the dam, water often only enters the lower river in the form of seepage and agricultural return flows (DWQ, 2002). Water flows measured below Cutler Dam can sometimes be less than 40 cfs in the summer months (PacifiCorp, 2014), compared to relatively normal flows of 700 to 1000 cfs outside the irrigation season. The photographs in Figure 8 show a bridge directly below Cutler Dam. The photo on the left was taken in September of 2015 when a nearby stream gauge recorded an average daily flow of 42 cfs. The image on the right was taken in May of 2016 when the gauge recorded flows of 2200 cfs. On February 12-13, 2017, the same gauge recorded over 8500 cfs (Bear River Commission, 2017).



Figure 8: Comparison of water levels below Cutler Dam

The river slowly gathers water as it moves southward to the Great Salt Lake, but the entire water yield within the confines of the Lower Bear River Valley – including the inflow of the Malad River – adds less than 10 percent of the Bear River’s total flow (DWQ, 2002).

According to a gauge near Corinne, the 30 year average annual flow from 1986 to 2015 was 1280 cubic feet per second (PacifiCorp, 2014; Bear River Commission, 2016).

Water Quality. The Federal Water Pollution Control Act is federal legislation protecting surface waters such as lakes and rivers. Enacted in 1948, it was expanded and enhanced in 1972 and became known as the Clean Water Act (CWA). The primary purpose of the CWA is “to improve and protect water quality through restoration and maintenance of the physical, chemical, and biological integrity of the nation’s waterways” (DWQ, 2010). The CWA provides a mechanism to evaluate water bodies and establish beneficial uses and water quality criteria.

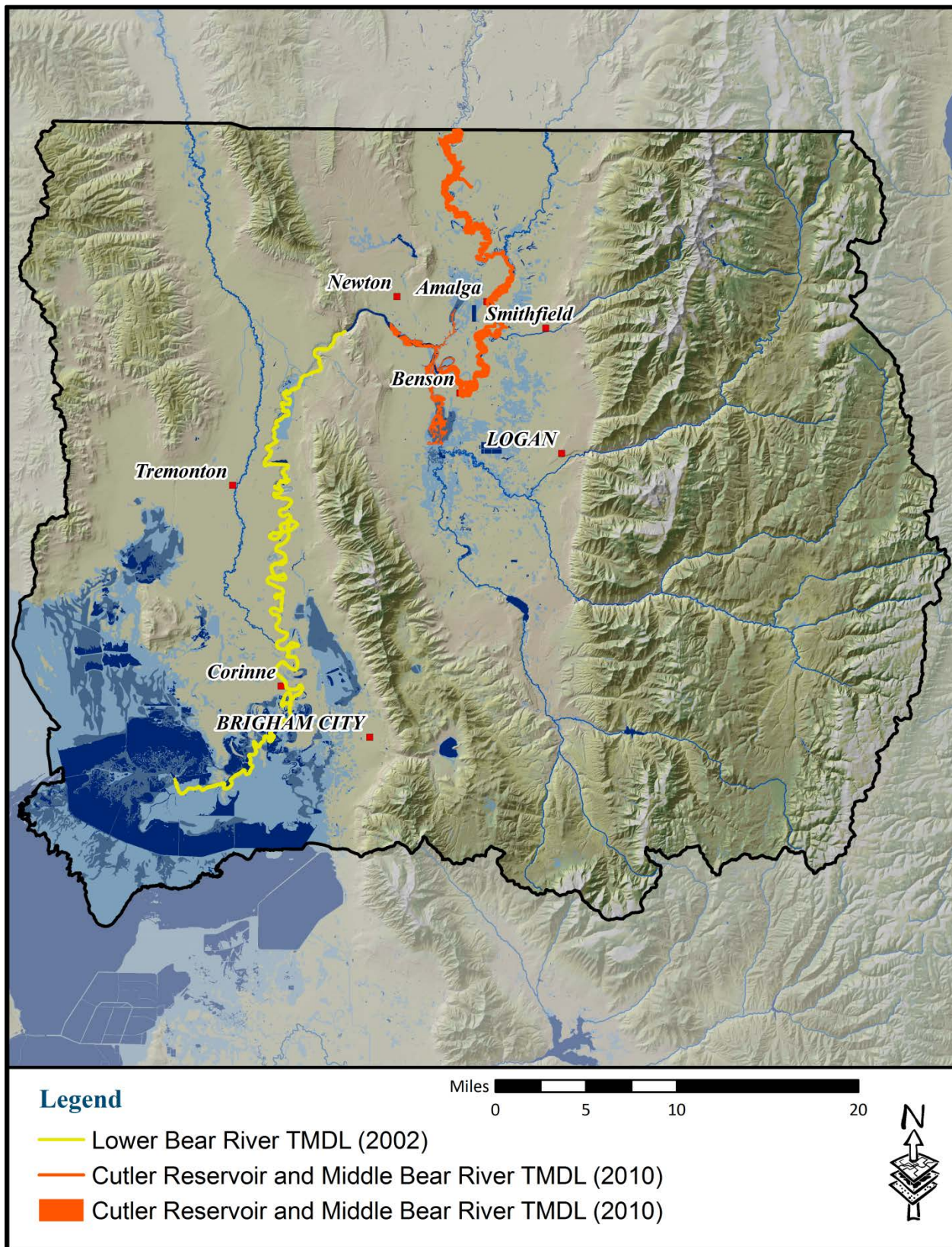
Section 303(d) of the CWA requires that states submit a list of impaired water bodies that fail to meet water quality standards to the U.S. Environmental Protection Agency (EPA) every two years. For each impaired water body, the CWA requires completion of a Total Maximum Daily Load (TMDL) report addressing each pollutant responsible for impairment. Following

identification of acceptable and actual pollutant loads, controls can be implemented to reduce daily loads until a water body is brought back into compliance with established water quality standards. As directed by Utah Code §19-5-104, Water Quality Act, the Utah Department of Environmental Quality (DEQ) is responsible for developing TMDL studies in Utah.

TMDL studies include an overview of the watershed, beneficial uses and associated water quality standards, and pollutants that impair the resource from supporting identified uses. Both point and nonpoint sources of pollution are identified. Point sources are single, identifiable sources such as factories or water treatment plants. Nonpoint sources are anything not meeting the definition of a point source. In other words, nonpoint source pollution comes from multiple diffuse sources such as agricultural return flows or urban runoff (Utah State University Water Quality Extension, 2017b). Following identification of pollutants and sources contributing to impairment of the water body, TMDLs identify maximum daily loads and propose controls and management practices to bring the water body back into compliance with established standards.

As noted in the “Previous studies” sub-section of the Introduction to this project, several TMDL studies have been completed for water bodies within the study area. The Cutler Reservoir and Middle Bear River TMDL study was completed in 2010 and is the most recent to address the area from the Utah-Idaho border to the Dam at Cutler Reservoir (see Map 7). The Lower Bear River and Tributaries TMDL was completed in 2002 and is the most recent study addressing the main stem of the Bear River from Cutler Dam to the Great Salt Lake. According to Mike Allred (personal communication, 2016), the Utah Division of Water Quality (DWQ) is currently working on an updated TMDL report for the lower Bear River.

Map 7: Areas addressed in 2002 and 2010 TMDL Reports



The middle and lower Bear River segments as well as Cutler Reservoir have the following four designated beneficial uses that establish water quality standards for the resource:

Secondary contact recreation (2B): Secondary contact recreation refers to activities such as boating and wading where full immersion does not occur. Waters with this designated beneficial use are required to maintain low bacteria counts to maintain healthy conditions for recreational users.

Warm water game fish (3B): Waters designated for warm water game fish and associated food chains are required to exhibit appropriate levels of dissolved oxygen, temperature, and pH levels as well as comply with other parameters for the support of warm water aquatic life.

Waterfowl, shorebirds and other water-oriented wildlife (3D): Waters with this designation are required to exhibit physical, chemical, and biological characteristics supportive of these wildlife and all levels of their associated food chain.

Agricultural water supply (4): Waters designated for use as agricultural water supply (including irrigation and livestock watering) are required to be suitable for the irrigation of crops or as water for livestock. They are also required to meet general surface water quality criteria for TDS (salinity) and various metals such as lead and cadmium.

The Cutler Dam and Middle Bear River TMDL Study (DWQ, 2010) and the Lower Bear River TMDL Study (DWQ, 2002) were used as the primary sources of water quality information for this report. As such, most of the following information was summarized directly from those reports with limited modifications.

Cutler Dam and Middle Bear River TMDL. Both Cutler Reservoir and the Middle Bear River experience low dissolved oxygen conditions that impair use as a warm water fishery, as well as algal growth that exceeds literature thresholds identified to support recreational uses (Raschke, 1994). The identified pollutants of concern for Cutler Reservoir were total phosphorus with associated low dissolved oxygen as a consequence of nutrient loading. Pollutants of concern for the Middle Bear River were total phosphorus and total suspended solids. Phosphorous was the primary focus of the TMDL analysis because “management of the system as phosphorous-limited reduces the threat of blue-green algae while also reducing the

concentration of total algae in the water column and thereby improving oxygen concentrations” (DWQ, 2010).

The majority of regulated point sources in the Cutler Reservoir watershed are accounted for in separate TMDLs for other water bodies in the area. The remaining regulated point sources that were directly addressed by the Cutler Dam and Middle Bear River TMDL include the Logan Regional Wastewater Treatment Plant, the Fisheries Experiment Station, and storm water from permitted municipal storm water systems. Nonpoint sources are grouped into four major land use types and sources: 1) agriculture, 2) forest, 3) urban/suburban (including storm water not included as part of a permitted municipal system), and 4) miscellaneous or natural sources. All of these sources contribute to the water quality impairment in the reservoir and were allocated a load in the TMDL.

Load allocations were broken into allocations for the southern portion of Cutler Reservoir, the northern portion of Cutler Reservoir, and the Middle Bear River. Separate allocations were determined for the winter season and normal allocations for remainder of the year. Winter and normal load allocations identified for the Southern reservoir require a 61% reduction of phosphorous for the summer season and a 46% reduction for the winter season. Allocations for the Northern Reservoir require a summer reduction of 59% and a winter reduction of 53%. For the Middle Bear River, identified load allocations require a 68% summer and 62% winter reduction of total phosphorous from non-point sources.

Because many sources of pollution originate along tributaries and other water bodies within the watershed that have separate TMDL studies, the attainment of water quality endpoints for Cutler Reservoir and the Middle Bear River depend on the attainment of TMDL allocations

identified in separate reports for the Little Bear River, Spring Creek,, Cub River, and Newton Creek.

Lower Bear River and Tributaries TMDL. The Lower Bear River and Tributaries TMDL addresses the main stem of the Bear River from Cutler Reservoir to the Bear River Bird Refuge. The designated beneficial uses of this section of the Bear River are the same as those listed for the Middle Bear River in the previous section. The main stem of the Lower Bear River was separated into two segments in the TMDL study: 1) From Cutler Dam to the confluence with the Malad River, and 2) from the Malad River confluence to the Bear River Migratory Bird Refuge and the Great Salt Lake. These river segments were both designated as not meeting water quality standards for the designated beneficial use of a warm water fishery. The primary pollutant of concern for both segments was total phosphorous. Although total suspended solids did not exceed state standards, it was also listed as a significant pollutant that may impair the use of the water as a fishery as well as for recreation. Bacterial contamination is an additional concern that may also present a health risk for recreational users, but the Bear River was not assessed for its designated beneficial use as a resource for secondary contact recreation.

The largest single source of total phosphorous into the Bear River below Cutler Dam is from upstream water sources that contribute an average of 700 kilograms of total phosphorous per day (DWQ, 2010). Animal waste from feeding operations is the second largest source, followed by stream bank erosion and irrigation return flows. Only five permitted point sources of pollution were identified at the time of the Lower Bear River and Tributaries TMDL Study. Of these, four were wastewater treatment facilities and one was an industrial source. Because nonpoint source loads represented the vast majority of the total sources of phosphorous, they

became the primary focus of implementation strategies proposed to bring the river back into compliance with the state-established water quality standards.

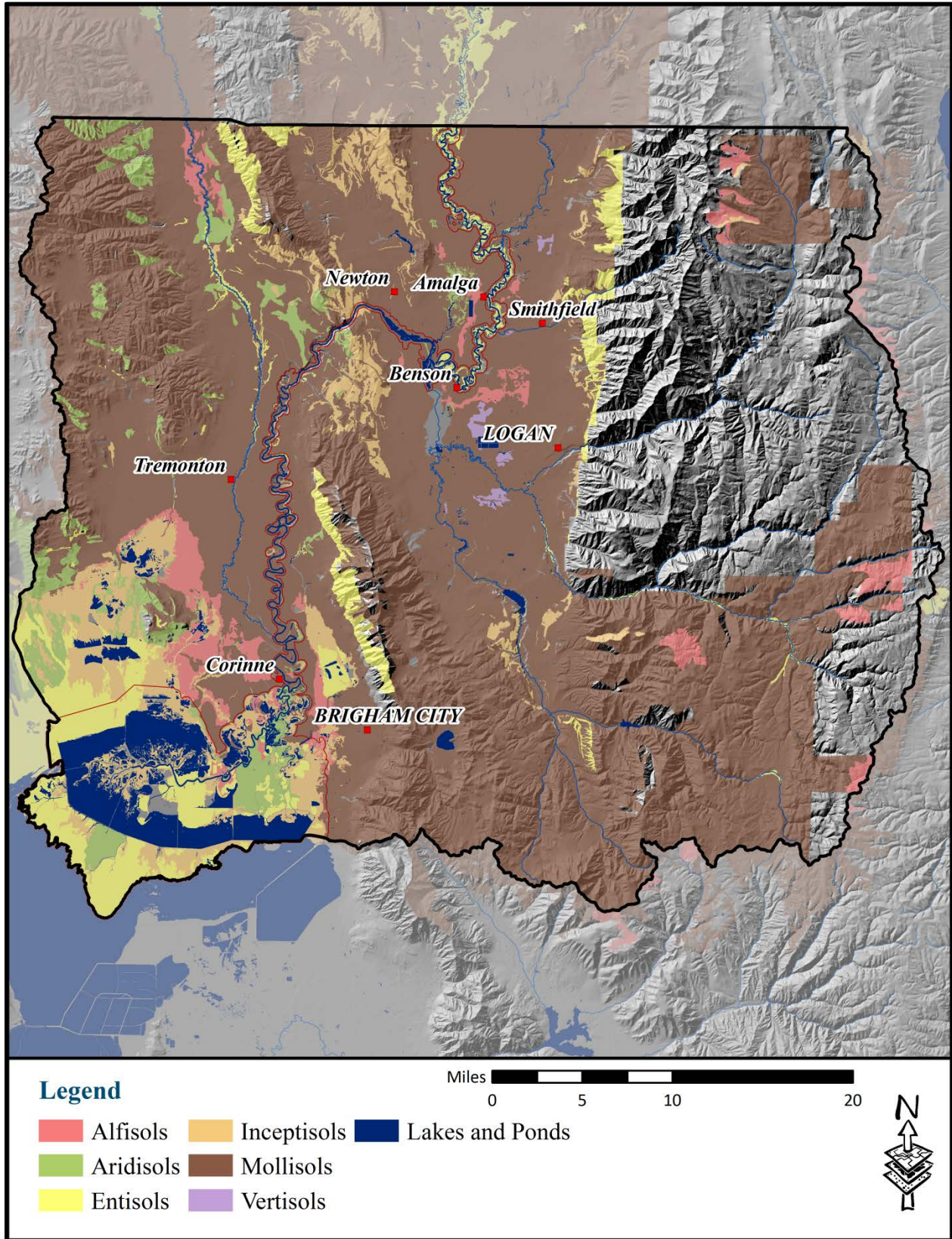
It is important to note that significant changes have occurred since the Lower Bear River and Tributaries TMDL was completed in 2002. New information has suggested that there are more extensive systems of agricultural field drainage tiles and associated inflows to the Bear River than were previously identified. Population growth and additional industrial activities within the area may also have increased the relative contribution of point sources of pollution.

Soils

Soils within the study area evolved as climate, topography, hydrology, and biological forces wore down and deposited parent materials from limestone, sandstone, quartzite, and dolomite (NRCS, 2011). Soils in the study area were strongly influenced by Lake Bonneville. Soils in the valley bottoms formed primarily from transported alluvial sediments that have been deposited by rivers and streams (Erickson and Mortensen, 1974). As Lake Bonneville receded, deposition of mixed materials formed terraces at the base of surrounding mountains. As a result, soils in valley bottoms tend to be fine textured and poorly drained, while foothills and terraces contain more coarse sediments and, in many cases, are moderately to excessively well drained (Erickson and Mortensen, 1974)

Soil data is incomplete for much of the high elevation mountain ranges, especially in the Bear River Range, but most areas are likely to consist of bedrock parent materials. Detailed soil data is available for most of the foothills and the valley bottoms. Soil orders, shown in Map 8, represent the most general level of classification in the USDA system of Soil Taxonomy and are defined by a single dominant characteristic such as prevalent vegetation, parent material, or climatic variables indicative of the processes under which they were formed (NRCS, 1999).

Map 8: Soil Orders within the Study Area



Soil orders for the study area, shown in Map 8, have been used here to provide a broad representation of the soils within the study area. Most soils within the flood plain of the Bear River are classified as Mollisols or Entisols. Aridisols become more prevalent as the River approaches the Bear River Migratory Bird Refuge and Great Salt Lake. Remaining soil orders include Inceptisols and Alfisols, but make up a significantly smaller portion of the study area.

Mollisols. Mollisols are generally associated with grassland ecosystems and make up the majority of soils within the Cache and Bear River Valleys. They are characterized by a thick, dark surface horizon that has resulted from the long-term addition of organic materials. Mollisols are very important and productive agricultural soils and are extensively used for this purpose throughout the region. They typically occur in areas above 4,400 feet in elevation that receive more than 12 inches of average annual precipitation (Boettinger, 2009).

Entisols. Entisols are more recently developed soils found in a wide diversity of areas in terms of both environmental settings and land uses. The central concept is that Entisol soils developed from unconsolidated parent material. All soils that do not fit into one of the other eleven soil orders are considered Entisols. Many of these soils are found in steep rocky areas, but those that occur in large river valleys can often be very fertile and capable of supporting significant cropland and habitat resources (Boettinger, 2009).

Aridisols. Aridisols are calcium carbonate containing soils found in arid regions. They are characterized by being dry most of the year with very limited leaching and contain at least some subsurface horizons in which clays, calcium carbonate, silica, salts, and/or gypsum have accumulated. Aridisols generally support drought-resistant vegetation such as sagebrush, saltbush and greasewood. Because of the dry climate in which they are found (generally less

than 12 inches of annual precipitation), they are not widely used for agriculture unless irrigation water is available (Boettinger, 2009).

Inceptisols. Inceptisols are also relatively young soils that exhibit minimal horizon development. They are more developed than entisols, but still lack features characteristic of the other soil orders. Inceptisols are widely distributed and occur across a range of ecological settings. They are often found on fairly steep slopes, young geomorphic surfaces, and on resistant parent materials. A sizable percentage of Inceptisols are found in mountainous areas and are used for forestry, recreation, and watershed (Boettinger, 2009).

Alfisols. Alfisols are moderately leached soils that have relatively high native fertility. These soils have mainly formed under forested vegetation conditions and have a subsurface horizon in which clays have accumulated. The combination of a generally favorable climate and high native fertility associated with Alfisols tends to represent productive soils for both agriculture and silviculture. However, soil horizons are strongly alkaline and vegetation within them generally consists of salt-tolerant grasses and shrubs in lower elevations and conifers at higher elevations (Boettinger, 2009).

Vegetation

Vegetative cover varies with climate, elevation, terrain, soils and both historic and current land uses. From subalpine plant communities at high elevations in the mountain ranges, to desert-shrub and mud flat communities in the lower elevations of the valley bottoms, the Bear River Basin encompasses many different vegetative zones (Ramsey and West, 2009). Along the main stem of the Bear River in Cache County, vegetation is dominated by agricultural crops and non-native rangelands but there are still some areas of natural and semi-natural vegetation.

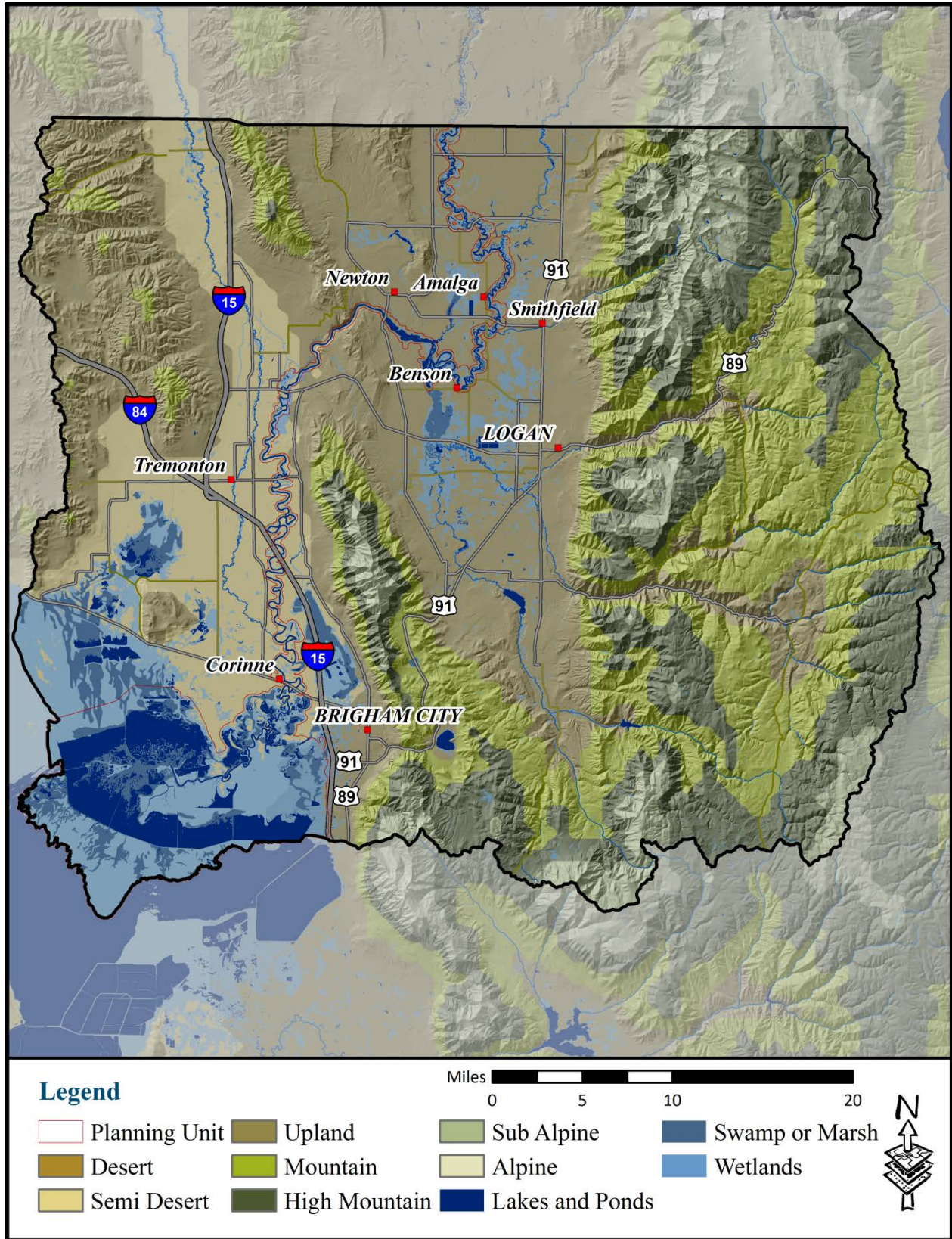
The use of ecoregions has become a widely used method of categorizing ecological variation across large landscapes. The two most common ecoregion delineations are the U.S. Forest Service Bailey Ecoregions and the Omernik Ecoregions used by the U.S. Environmental Protection Agency. However, “while ecoregions are applicable to regional and global representations, more local applications require a different approach in order to address ecoregional variances and understand differences between vegetation types” (Ramsey and West, 2009, p49). At the other end of the spectrum, GAP vegetation data (see Map 7) often provides a level of detail that becomes overwhelming when applied across large areas of the landscape. In Utah, major environmental determinants of vegetation include precipitation, temperature, and elevation. “Because of the great variation of elevation in Utah, the principle ecological distinction that has long been recognized is that of life zone” (Ramsey and West, 2009, p49). Since elevation, temperature, and precipitation can all be modeled spatially, Ramsey and West were able to spatially delineate vegetative life zones across the state of Utah.

The vegetative life zones identified in Rangeland Resources of Utah (Ramsey and West, 2009) will be used in this project to provide an overview of vegetation within the study area. Five of the seven vegetative life zones identified for Utah are present within the study area (see Map 9). These include subalpine, high mountain, mountain, upland, and semi-desert. One unfortunate shortcoming of the zonal approach is that some ecosystem types such as sand dunes, wet meadows, marshlands, and riparian areas do not easily fit into the structure (Ramsey and West, 2009). Since this report is primarily focused on lands along the Bear River, wetlands and marsh areas have been included on Map 9, and an additional section has been added to specifically address wetland and riparian vegetation along the Bear River riparian corridor. The more detailed GAP vegetation, land cover, and land use data is also presented in Map 10 and

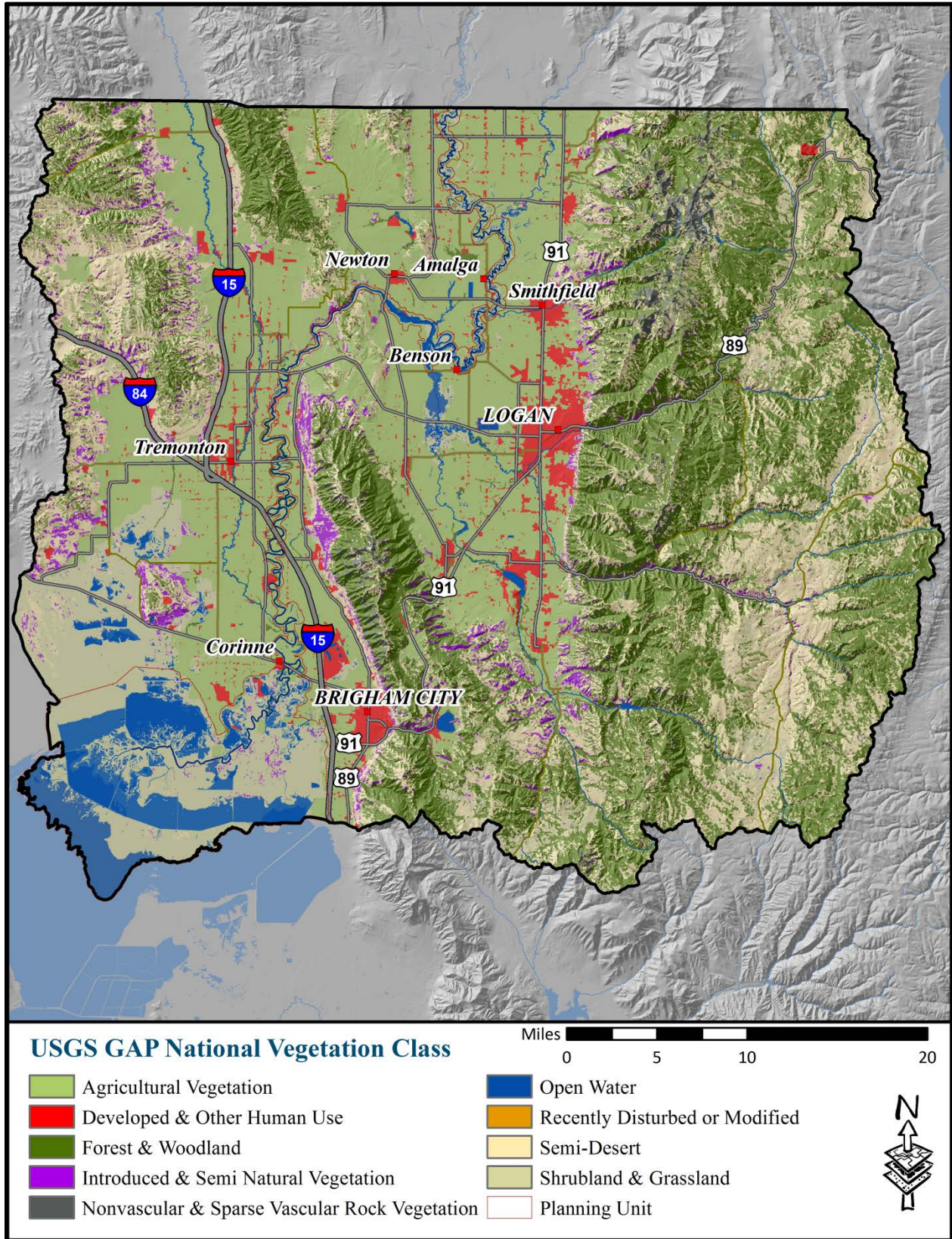
Map 11 to illustrate the pattern of vegetation in the landscape around the river as it flows from Cache Valley to the Great Salt Lake.

While vegetative life zones and the vegetative communities they contain are broken down primarily by elevation, many other factors also determine their occurrence. Transitions can be very subtle, with significant overlap and intermixing of plant communities based on differences in topology, soils, and the presence of micro-climates. Human impacts, such as grazing, agriculture, urbanization, and the introduction of invasive weed species, also play a significant role in the vegetative cover of the landscape and have altered or replaced natural vegetation, especially in lower lying portions of the study area.

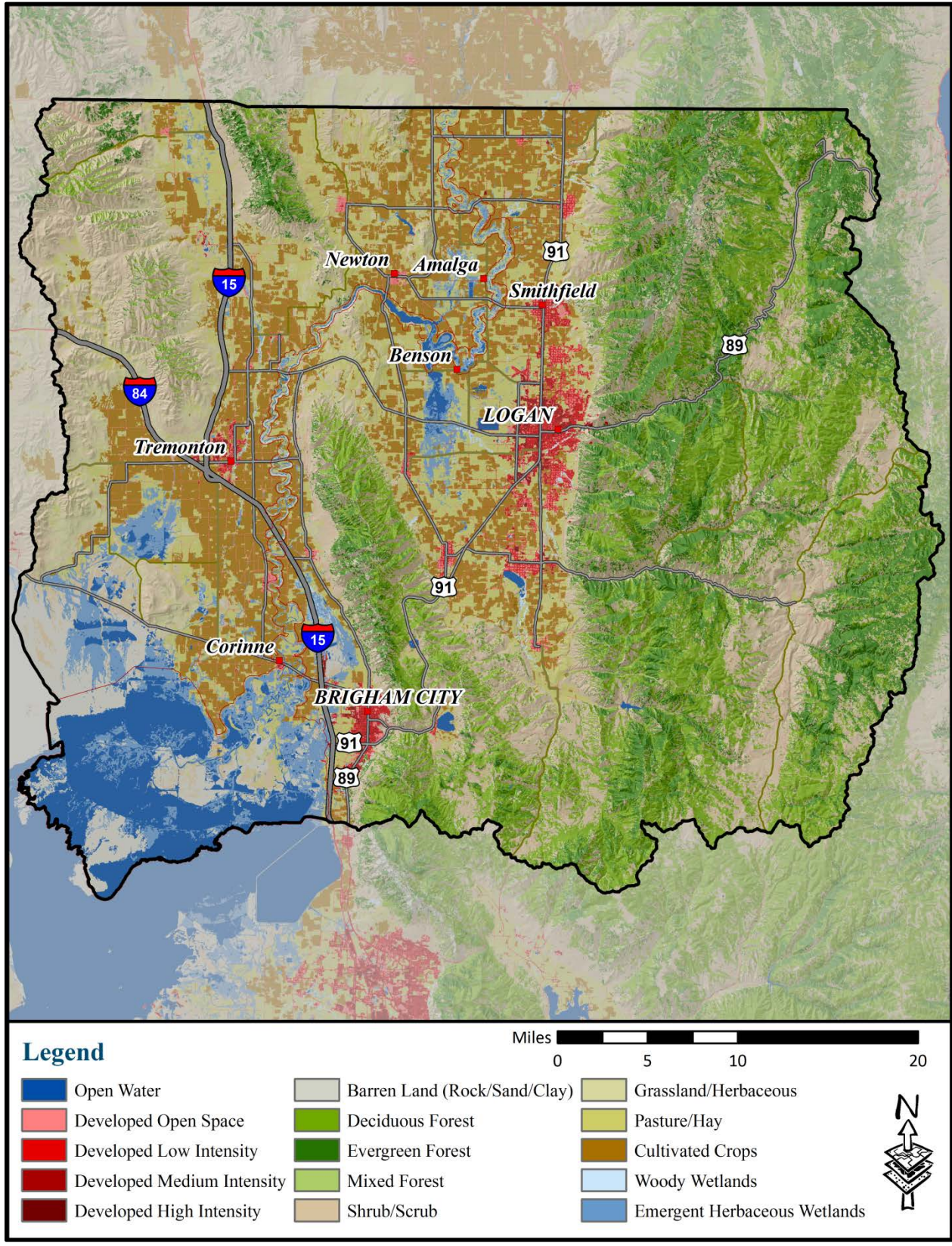
Map 9: Vegetative Life Zones



Map 10: GAP Analysis Program National Vegetation Classes



Map 11: National Land Cover Dataset



Noxious and invasive plant species are also increasingly present within the study area, especially where native vegetation has been disturbed by agriculture, grazing or other human impacts on the landscape. FFSL actively engages in the control of noxious and invasive species along the Bear River. Table 1 lists noxious and invasive species declared by the state of Utah, Cache County, and/or Box Elder County. Those species in bold are county priorities and/or known to exist along the Bear River Corridor.

Table 1

Noxious and Invasive Plant Species			
Common Name	Scientific Name	Class	List
Leafy spurge	Euphoria esula	A	Statewide
Oxeye daisy	Chrysanthemum leucanthemum	A	Statewide
Purple loosestrife	Lythrum salicaria	A	Statewide
Spotted knapweed	Centaurea maculosa	A	Statewide
Black henbane	Hysocamus niger	A	Statewide
Diffuse knapweed	Centaurea diffusa	A	Statewide
Perrenial Sorghum	Sorghum halepense	A	Statewide
Medusahead	Taeniatherum caput-medusae	A	Statewide
Squarrose knapweed	Centaurea squarrosa	A	Statewide
St. Johnswort	Hypericum perforatum	A	Statewide
Yellow starthistle	Centaurea solstitialis	A	Statewide
Yellow toadflax	Linaria vulgaris	A	Statewide
Russian knapweed	Centaurea repens	B	Statewide
Bermudagrass	Cynodon dactylon	B	Statewide
Broad-leaved peppergrass	Lepidium latifolium	B	Statewide
Dalmatian toadflax	Linaria dalmatica	B	Statewide
Dyers woad	Isatis tinctoria	B	Statewide
Hoary cress	Cardaria drabe	B	Statewide
Musk thistle	Carduus mutans	B	Statewide
Poison hemlock	Conium maculatum	B	Statewide
Scotch thistle	Onopordum acanthium	B	Statewide
Canada thistle	Cirsium arvense	C	Statewide
Houndstongue	Cynoglossum officinale	C	Statewide
Quackgrass	Agropyron repens	C	Statewide
Salt cedar	Tamarix spp.	C	Statewide
Field bindweed	Convolvulus arvensis	C	Statewide
Goatsrue	Galega officinalis	Local	Cache

Subalpine and High Elevation

Montane Zones. Subalpine and high mountain plant communities exist in the highest elevations of the watershed, generally above 7,500 feet in elevation. These communities represent the upper limit of the timber line and are characterized by short growing seasons and hardy plant species.



Figure 9: Subalpine zone in Bear River Range

Dominant land cover consists of intermixed areas of spruce-fir communities and bedrock scree in the highest elevation and areas of aspen, big sagebrush, and lodge-pole pine increasingly present in the lower elevations and areas of more favorable aspect within the zone (Ramsey and West, 2009).

Mid to Low Elevation Montane Zones. The montane zone generally occurs between 6,500 and 9,000 feet in elevation and makes up the majority of the area in the Bear River Range. The climate in these areas is generally cool and moist during winter and warm and dry in the



Figure 10: Mid-elevation montane zone

summer. Aspen and big sagebrush are increasingly dominant in this zone followed by oak brush, spruce-fir, and mixed conifer communities that slowly transition to big tooth maple, pinion-juniper and tall shrub communities that dominate the low elevation mountains and foothills. Common understory plants include bearberry, currant, snowberry,

serviceberry, mountain clover, mule's ear, mountain brome, and native grasses. The richness of vegetation in these areas supports a number of wildlife from large ungulates such as elk and mule deer to small ground-dwelling mammals (Ramsey and West, 2009).

Uplands. Upland zones generally occur from 5,000 to 8,000 feet in elevation and are predominantly characterized by foothills around mountainous areas, lower elevation mountains – such as those at the Western edge of the study area – bluffs or escarpments, and high elevation valleys. These upland areas represent a broad portion of the landscape, especially in Cache Valley, and have therefore been split into two sub-categories: Foothills and Valley Bottoms.

Foothills. The foothills subcategory of the upland zone represents higher elevation upland habitats that frequently occur around the perimeter of mountainous areas, in lower elevation mountains, and with bluffs and escarpments. Dominant plant species include mountain shrubs, maples, pinyon-juniper communities and sagebrush with intermixed



Figure 11: Foothills overlook Bear River Valley

grasses and forbs. These areas often have more moderate climates than lower elevations because cold air is pushed down across them and sinks into the lower valleys. This zone is also associated with significant rural and urban development due to moderate temperatures, undulating topography, and accessibility of water resources filtering down from higher elevations. Consequently many of these areas have been impacted or displaced by developed land uses.

Valley Bottoms. While south-eastern Box Elder County is associated with the semi-desert plant communities described in the next section, Cache Valley is somewhat different. It has a slightly higher elevation and relatively abundant water resources compared to the rest of the state due to higher precipitation, several significant rivers and streams draining the Bear River Range, and high groundwater tables throughout many areas of the valley bottom. According to historical records, explorers and early settlers found abundant grasslands with little sagebrush in Cache Valley. In 1972, Range Scientists A.C. Hull and Mary Kay Hull conducted a study in Cache Valley that identified 72 isolated areas that had escaped the heavy grazing experienced historically common throughout most of the watershed. The most dominant species identified was blue-bunch wheatgrass followed by other wheat grasses, basin wild rye, June grass, and various bluegrass species (Hull and Hull, 1972).

High water tables, abundant grasslands, and rich agricultural soils attracted settlers to the area and intensive grazing had a significant impact on the landscape. Grasslands quickly deteriorated and were replaced by sagebrush communities and cultivated farmland (Hull and Hull, 1972). The vast majority of valley bottom land in Cache and Box Elder Counties is still used for agriculture, including both cultivated cropland and grazing activities. Cultivated crops include small grains, alfalfa, corn (mostly for silage), and limited row crops. Rangelands used for grazing have usually been seeded with mixtures of intermediate and crested wheat grasses but are also intermixed with semi-natural vegetation including sagebrush, rabbit-brush, and forbs. The predominance of agricultural uses in these areas has left very little natural vegetation in place. Invasive species, such as cheat-grass and a number of noxious weeds are also present.

Semi-Desert Zone. The semi-desert vegetative life zone typically occurs from approximately 4,000 to 6,500 feet in elevation and is characterized by low levels of rainfall and relatively flat topography. Dominant vegetation includes sagebrush, desert shrub communities, and grasses. Various invasive species such as cheat-grass, Russian olive,



Figure 12: Semi-desert zone, Box Elder County

and tamarisk comprise a significant portion of vegetation in this zone. As with the upland zone, there are considerable differences between pre-settlement and existing vegetation, with agricultural and grazing lands making up a considerable portion of these areas. Residential development is also significant in some areas. Overall, the semi-desert zone probably has a much lower biodiversity of plant and animal species than would have occurred in pre-settlement vegetative communities (Ramsey and West, 2009).

Wetland and Riparian Zones. Riparian zones occur at all elevations throughout the watershed. Despite making up an extremely small portion of the land base, riparian areas generally have a much higher biodiversity than other areas of the landscape. In dry areas – Utah is the second driest state in the nation – these wetland and riparian areas have a heightened importance due to their scarcity. While riparian zones are important throughout the study area, this section specifically addresses the lowland riparian areas, generally occurring below 5,500 feet in elevation, that surround the Bear River and other rivers and streams flowing through the valley bottoms.

Along the Bear River. Lowland riparian areas in the West are typically narrow bands of trees and shrubs surrounded by upland vegetation (Knopf et al., 1988; Montgomery, 1996). Dominant woody species found in lowland riparian habitats in Cache and Box Elder County include cottonwood, hackberry, squaw-bush, box

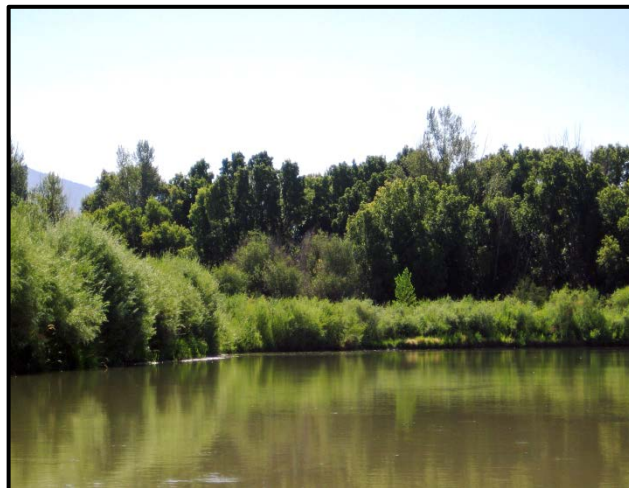


Figure 13: Riparian vegetation in Cache County

elder, red twig dogwood, and various willow species (DWR, 2005). Invasive species such as salt cedar (*Tamarix* sp.), Russian olive, purple loosestrife, Phragmites, and goatsrue are increasingly present in many areas (DWQ, 2010).

As the river has changed course over the years, previous channels and oxbows have been partially cut off or abandoned by the main river channel, creating significant wetland areas that are often still hydrologically connected to the river. The complex system that results may best be described as a riparian ecosystem incorporating wetlands, ponds, flowing water, and uplands

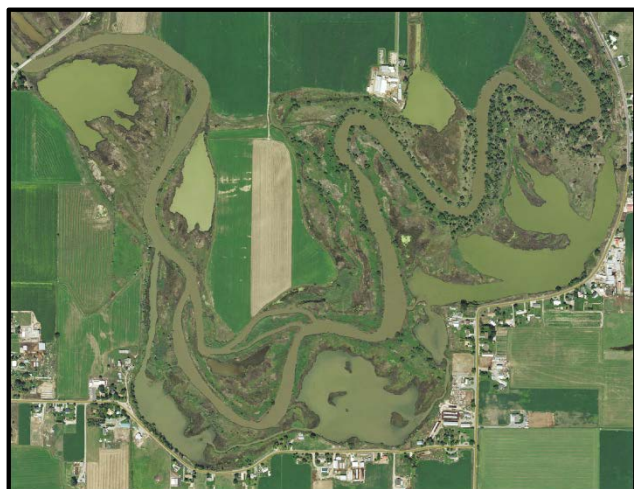


Figure 14: Bear River and wetlands at Benson

within the flood plain of a river (Hansen, 1991). Figure 14 shows aerial imagery of the Bear River and surrounding wetlands near Benson, Utah. Such riverine systems often support very diverse vegetative communities that represent important corridors for wildlife and cycle water, sediment, food, and nutrients (Emerson and Hooker, 2011).

Riparian areas are often associated with fertile soils, abundant water, and aesthetic values that put riverine ecosystems in competition with agriculture, grazing, and development. As land was developed, many sites near the river were cleared and leveled to support agricultural activities (Denton, 2007). Many wetlands along the river have been drained by extensive networks of ditches and drain tiles constructed to improve land for grazing and agriculture. Agricultural activities and livestock grazing can be compatible with riparian systems if maintenance of ecological function is included as a management objective and riparian systems are kept intact (Lucas et al., 2004). Many adverse impacts of grazing can be alleviated by manipulating timing, intensity, and duration of grazing (Clary and Webster, 1989; Elmore and Kauffman, 1994). However, agricultural lands are cultivated nearly to the River's edge in many areas, and eroded streambanks are very common in where concentrated grazing activities or animal feeding operations exist on adjacent lands.

The Bear River Land Conservancy conducted a plant survey for the Morton section of the Bear River Bottoms in Cache Valley (Bear River Land Conservancy, 2012). Results of their survey are provided in Table 2 as a representative sample of vegetation types that may be encountered in many sections of the river. Only those making up more than 0.1% of total land cover were included in the inventory. Plant species that are listed in bold are designated as noxious in the state of Utah or in other states as identified in the table. Other noxious and/or invasive species known to occur along the Bear River include purple loosestrife, goatsrue, poison hemlock, white-top, and medusa head rye.

Table 2

Plant Species identified at Morton Section of the Bear River Bottoms				
Common Name	Nativity	Plant Type	Notes	Coverage (%)
Reed canarygrass	Native	Graminoid		52.7
Russian olive	Introduced	Tree	Noxious in some states	10.1
Coyote willow	Native	Shrub		9.7
Hardstem bulrush	Native	Graminoid		6.5
Salt cedar / Tamarisk	Introduced	Tree	Noxious in Utah	3.9
Cheatgrass	Introduced	Graminoid	Invasive	2.6
Broadleaf cattail	Native	Forb/herb		1.7
Foxtail barley	Native	Graminoid		1.6
Black hawthorn	Native	Tree		1.0
Peach leaf willow	Native	Tree		0.7
Mixed grass species	Varies	Graminoid		0.5
Geyer willow	Native	Tree		0.3
Rough cocklebur	Native	Forb/herb		0.3
Canada thistle	Introduced	Forb/herb	Noxious in Utah	0.2
Common reed / Phragmites	Varies	Graminoid		0.2
Fuller's teasel	Introduced	Forb/herb	Noxious in some states	0.2
Narrow leaf cottonwood	Native	Tree		0.2
Quackgrass	Introduced	Graminoid	Noxious in Utah	0.2
Yellow rabbitbrush	Native	Shrub		0.2
American licorice	Native	Forb/herb	Invasive	0.1
Biennial wormwood	Introduced	Forb/herb	Invasive	0.1
Bull thistle	Introduced	Forb/herb	Noxious in some states	0.1
Common yarrow	Native	Forb/herb		0.1
Crack willow	Introduced	Tree		0.1
Curly cup gumweed	Native	Forb/herb		0.1
Inland saltgrass	Native	Graminoid		0.1
Fremont cottonwood	Native	Tree		0.1
Poison hemlock	Introduced	Forb/herb	Noxious in Utah	0.1
Povertyweed	Native	Forb/herb		0.1
Tall wheatgrass	Introduced	Graminoid		0.1
Western aster	Native	Forb/herb		0.1
Willow spp.	Varies	Tree		0.1
Houndstongue	Introduced	Forb/herb	Noxious in Utah	0.0
White bryony	Introduced	Forb/herb	Noxious in some states	0.0

Cutler Reservoir and Marsh. Surrounding Cutler Reservoir, lands owned by PacifiCorp are managed to protect wildlife habitat that supports a variety of waterfowl and other water-

dependent bird species (PacifiCorp, 2013). The wetland vegetation is a mixture of emergent marsh dominated by cattail and common reed (*Phragmites australis*). Freshwater wet meadows are dominated by hard stem bulrush and Baltic rush (Denton, 2007). Agriculture and grazing activities are allowed in some areas around the Reservoir as part of PacifiCorp's management plan, but vegetated buffer zones and bank stabilization projects have been established to protect habitat and water resources (PacifiCorp, 2013). Various types of vegetation, including intermediate wheatgrass and various shrub species, are used to provide both livestock forage and maintain vegetative cover on land areas surrounding the reservoir, and cultivated food plots have been incorporated to provide forage for various wildlife species (PacifiCorp, 2013).

Despite management efforts, invasive species comprise a significant portion of the vegetation surrounding Cutler Reservoir. Purple loosestrife and goatsrue are increasingly present as the river approaches Cutler Marsh and have begun to spread downstream into Box Elder County as well. Moreover, emergent marsh species such as reed canary grass, broadleaf cattail, and *Phragmites* (common reed) include both native and non-native phenotypes that become invasive and undesirable as they begin to develop into large monocultures. The threat posed by invasive species has been exacerbated by altered hydrological regimes (Glen and Nagler, 2005; Stromberg et al., 2007).

Bear River Delta and Bird Refuge. As the river nears the Bear River Migratory Bird Refuge, it enters the desert shrub vegetative zone. Many plant communities in this area exist on mudflats that fill with water during wet periods of the year and are left dry the rest of the time. Saline conditions require plants with a high salt tolerance such as greasewood, salt grass, and pickle weed. As native vegetation has been displaced or died out due to changes in water flows,

increasingly saline soils, and a lower water table, significant portions of this stretch have become dominated by the invasive species tamarisk (Olson et al., 2004).

There are significant wetlands located within the periphery of the desert shrub and mud flat communities that make up the Bear River Delta. Many historic wetlands that



Figure 15: Desert shrub near Great Salt Lake

would have likely been present along the floodplain pre-settlement have disappeared as upstream demands for water resources have increased. The U. S. Fish and Wildlife Service estimates that so much water was diverted from the Bear River that as much as 93% of the wetlands had been lost by the 1920s (USFWS, 2015).

The Bear River Migratory Bird Refuge was created by presidential proclamation in 1928, following concerns and advocacy efforts related to loss of marshes and dramatic bird die-offs from botulism, (USFWS, 2015) to provide habitat for waterfowl and migratory bird species and help mitigate the environmental impact of the shrinking Bear River delta (USFWS, 2013). The Fish and Wildlife Service manages approximately 41,000 acres of wetlands in addition to associated upland habitat areas that, together, comprise almost 80,000 total acres (USFWS, 2015). Wetlands in the refuge and nearby areas include deep-water submergent and emergent wetlands, shallow emergent wetlands, mud flats, and playas that support a variety aquatic, wetland, and riparian vegetation. As in Cutler Marsh, invasive species, including *Phragmites australis*, represent a significant threat to many of these systems.

Wildlife Habitat

At a regional scale, the geographic location of the Bear River Basin provides an important terrestrial link between the Greater Yellowstone Ecosystem in the Central Rocky Mountains, the Uintah Mountains in the Southern Rocky Mountains, and the Great Salt Lake Ecosystem in the Great Basin. The upper Bear River from the Uintah Mountains to Central Idaho is located along the path of the central flyway migratory corridor while the lower Bear River, through Cache Valley and Box Elder County, provides an important stopover for migrating birds in the Pacific flyway.

Topographical and climatic variation within the Bear River Watershed creates a wide range of habitat types for wildlife. High elevation mountain ranges are habitat for deer, elk and moose, along with a variety of upland birds and small mammals. Foothills and upland areas provide important winter range for large animals in addition to supporting a variety of their own avian and small mammal species. Wetlands and riparian areas are some of the richest habitat in the state yet make up a very small percentage of our land base. According to the Division of Wildlife Resources, lowland riparian areas make up less than 1% of the total land area in Utah (DWR, 2005).

The importance of the Bear River corridor as significant and critical wildlife habitat is evident through the various designations that have been assigned to areas along the river by both private and public entities. There are two national wildlife refuges and one waterfowl production area along the Bear River in Utah and Idaho. The Bear River corridor has been identified as a conservation focus area by The Nature Conservancy due to its importance for both human and wildlife communities. The Bear River Migratory Bird Refuge, Cutler Marsh and the Amalga Barrens have all been designated as Important Bird Areas of global significance by the Audubon

Society. In its 2005 Wildlife Action Plan (see Map 12), the Utah Division of Wildlife Resources identifies lowland riparian habitats as one of the most rare and threatened habitats in Utah (UDWR – 2005). The Western Governors’ Association critical habitat assessment tool rates the Bear River Corridor in the second highest category of critical

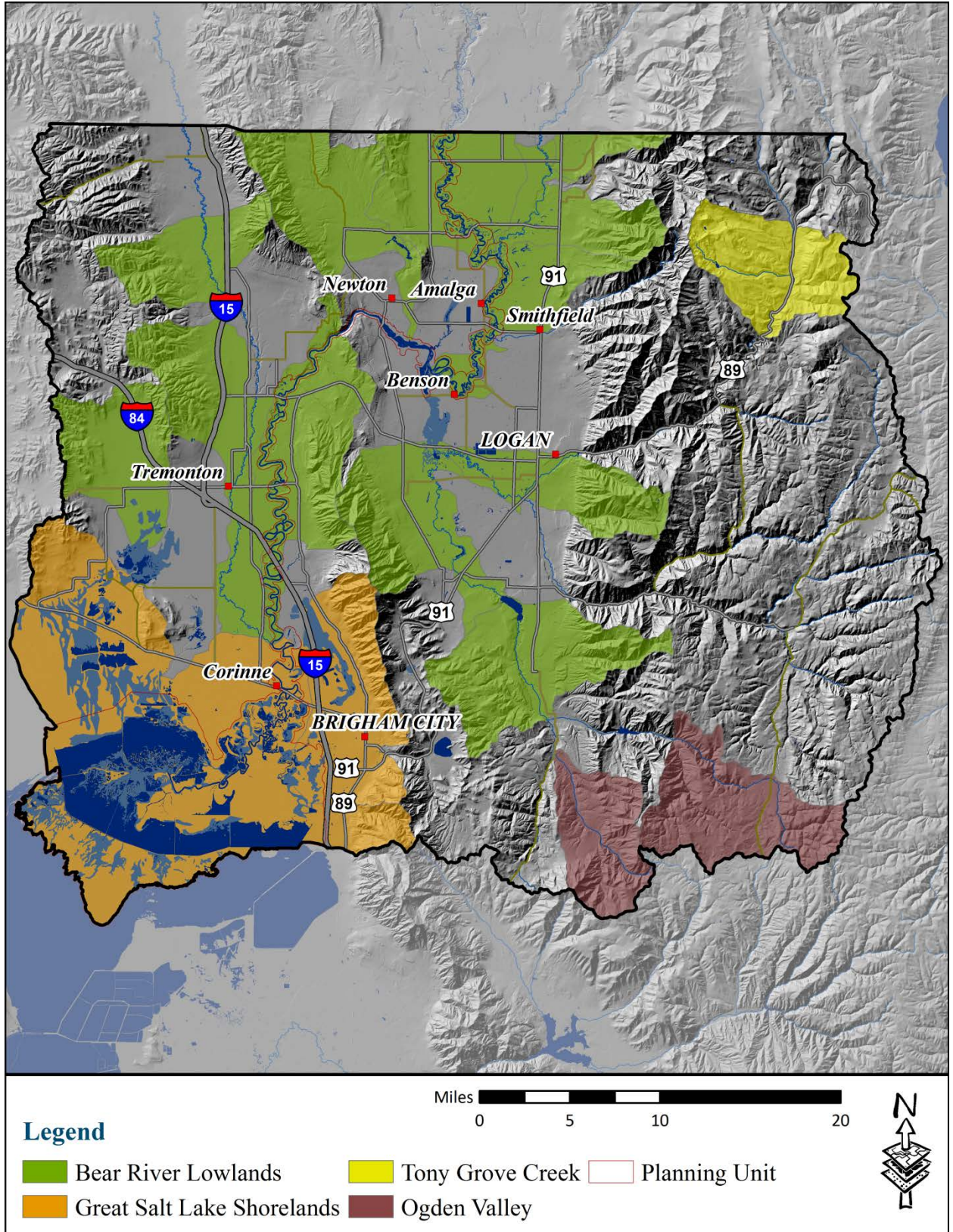


Figure 16: Pelicans over the Bear River

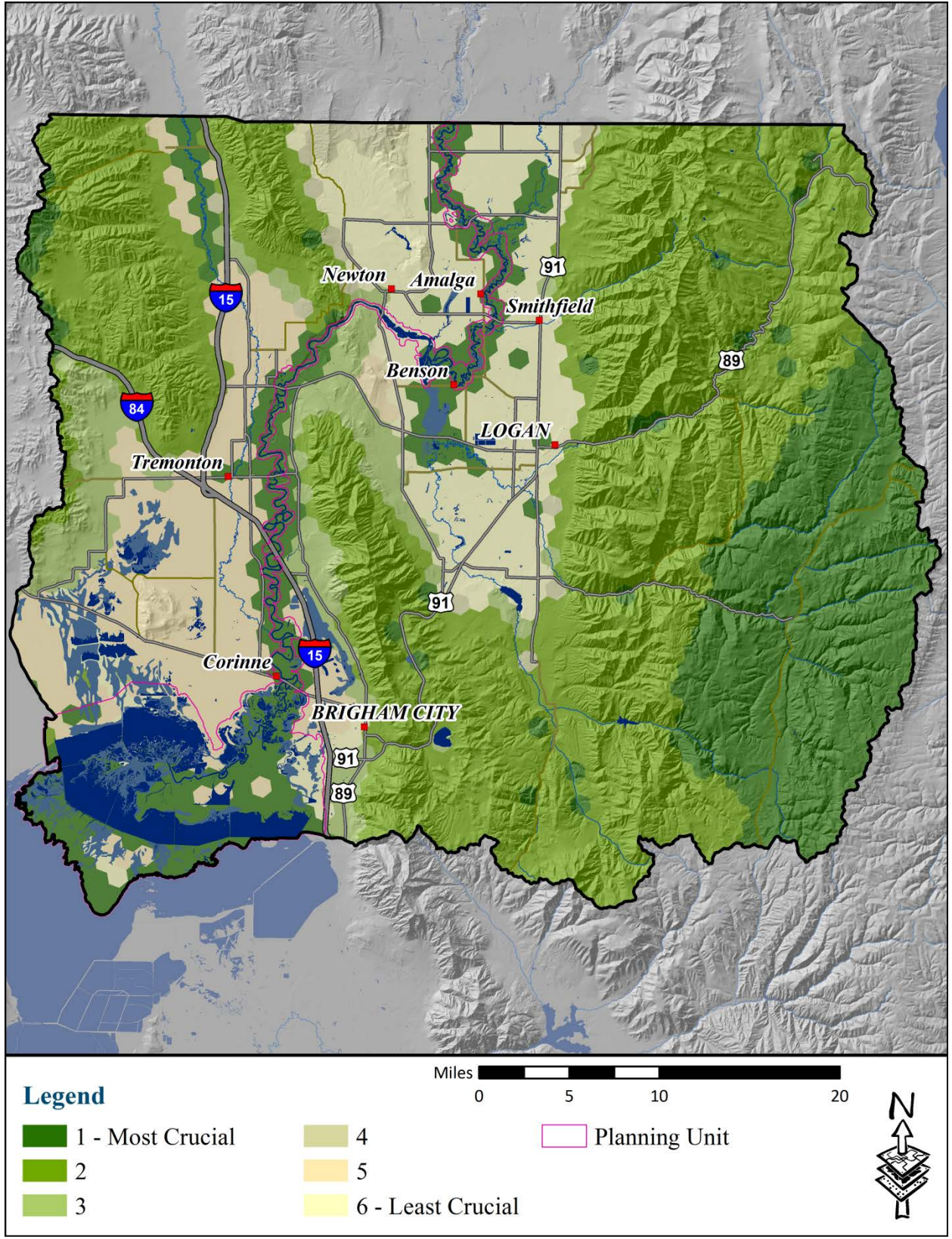
habitats in the Western United States (see Map 13). The Great Salt Lake, an ecosystem of global importance, receives the majority of its water from the Bear River (FFSL, 2013). Without this water, much of the shoreline habitat in the Great Salt Lake ecosystem could potentially be significantly altered if not lost.

While the habitat descriptions in this section have been separated into different categories, it is important to recognize that they are better represented as a mosaic of habitats within the larger landscape. The interaction among these habitats is at least as important as the attributes of each individual type. Furthermore, many species rely on multiple habitat types to support different life stages and activities. One example of such a species is the long-billed curlew, which requires upland habitats for nesting but also requires nearby wetland areas to provide forage (Saalfield et al., 2010).

Map 12: Utah Wildlife Action Plan Priority Habitats



Map 13: Western Governors Association Crucial Habitat Assessment Tool



Upland Habitats in the Valley Bottoms. Since the focus of this study is along the river corridor, this section specifically addresses upland habitat in the valley bottoms and the lowland riparian, wetland, and aquatic habitats along the Bear River. As explained in the vegetation section of this report, the valley bottoms in Cache and Box Elder County have been highly altered to support agricultural production and, to a more limited extent, residential development. Agricultural lands have displaced the vast majority of native vegetation and much of the associated habitat in these areas. However, agricultural lands themselves are used by a variety of different wildlife species and often provide an important source of forage. One example is provided by the ring-necked pheasant. While pheasants are an introduced species, they have become an important upland game bird in Utah and are almost always found in close proximity to irrigated farmland.

Bluffs overlooking the floodplain are largely devoid of trees due to clearing for agricultural uses. Where trees do remain along the river, they tend to be sparsely distributed with few shrub species in the understory. For wildlife, this makes connectivity among patches of vegetation a frequent problem. Such isolated patches present a significant amount of edge habitat, which is a benefit to some species but increases the rate of predation for others.

Wetland and Riparian Habitats. The Bear River supports significant and diverse wetland and riparian habitats. In this section, wetland and riparian habitats have been grouped into three primary categories: 1) oxbows and riverine wetlands and riparian habitats along the main stem of the Bear River, 2) wetlands and riparian habitats associated with Cutler Marsh and Reservoir, and 3) wetlands and riparian areas associated with the Bear River Delta and the Bear River Migratory Bird Refuge.

Along the Bear River. The Utah Division of Wildlife Resources identifies lowland riparian habitats as one of the most rare and threatened habitats in the State of Utah (DWR, 2005). The lowland riparian areas surrounding the Bear River play an important role in the lifecycle of various bird species. Many species use these areas as a stopover, breeding habitat, or as part of their winter range. It is a migration route for neo-tropical birds such as white-faced ibis, American avocet, snowy plover, and black-necked stilt – among dozens of others – that provides resting habitat and foraging areas (USFWS, 2013). Partners in flight reported the greatest songbird diversity in Utah at a banding station in the area (Denton, 2007). There are also abundant populations of predatory birds such as the great blue heron, osprey, and bald eagles.

The complexity of riverine ecosystems with their interwoven upland, wetland, and open water habitats create diverse communities with respect to both flora and fauna (USFWS, 2013). Linear features such as rivers, streams, and associated riparian areas that spread upward through a watershed provide a network of corridors that have become increasingly important as many of areas of the wider landscape have become fragmented by infrastructure and development.

There are many different types of wildlife that use these areas including reptiles and amphibians, small mammals such as beavers and foxes, and a wide variety of avian species. Larger species including mule deer are also known to inhabit the river bottoms and can frequently be observed feeding in nearby upland areas or agricultural fields.



Figure 17: Deer crossing below Cutler Dam

The Morton section of the Bear River Bottoms in Cache Valley represents one site that has been the subject of recent studies conducted by faculty and students at Utah State University. As part of the Bear River Land Conservancy's baseline study and management plan (BRLC, 2013), they included the following list of avian species. This information is presented in Table 3 to provide an example of the species that may be found in similar areas along the river.

Cutler Reservoir and Marsh. The wetlands in and around Cutler Reservoir are home to many species of reptiles, amphibians, and birds. Reptiles found in both uplands and wetlands of Cache Valley include the rubber boa and western yellow-bellied racer. Amphibians such as the boreal chorus frog and bullfrog commonly occur in wetlands at lower elevations in the valley.

Cutler Reservoir provides nesting and feeding habitat for a wide variety of bird species. A great blue heron rookery and an ibis rookery are located at the south end of the marsh. The heron rookery near Mendon Road was first documented in 1945. The ibis rookery on the east side of Cutler Reservoir was home to over 5% of the world's ibis population in 2006 (DWQ, 2010). Due to its use by the American white pelican, American avocets, black-necked stilts, and its status as a gathering site for wading birds such as the white-faced ibis, Cutler Reservoir was designated an Important Bird Area of global significance by the Utah Audubon Society in 2004 (Utah Audubon Society, 2013). PacifiCorp has designated the south end of the marsh, commonly known as the Wetlands Maze, for use by wildlife and has engaged in habitat improvement and recreation programs around Cutler Reservoir as part of their relicensing agreement for Cutler Dam (PacifiCorp, 2013).

Table 3

Avian Species identified at Morton Section of the Bear River Bottoms		
American avocet	Cedar waxwing	Ring-necked pheasant
American coot	Double-crested cormorant	Northern flicker
American crow	Downy woodpecker	Red-tailed hawk
American goldfinch	Eastern kingbird	Red-winged blackbird
American kestrel	Eurasian collared-dove	Sandhill crane
American robin	Eurasian starling	Savannah sparrow
American white pelican	Franklin's gull	Snowy egret
Barn swallow	Gadwall	Sora
Black-billed magpie	Great-horned owl	Song sparrow
Black-capped chickadee	Grasshopper sparrow	Spotted sandpiper
Black-crowned night heron	Great blue heron	Swainson's hawk
Belted kingfisher	Green-winged teal	Tree sparrow
Brown-headed cowbird	House sparrow	Violet-green swallow
Black-headed grosbeak	Killdeer	Western grebe
Bank swallow	Lazuli bunting	Western kingbird
Black-necked stilt	Long-billed curlew	Western meadowlark
Brewer's blackbird	Mallard	Western tanager
Broad-tailed hummingbird	Marsh wren	White-faced ibis
Bullock's oriole	Mourning dove	Willow flycatcher
Canada goose	Northern pintail	Willet
California gull	Northern shoveler	Wilson's phalarope
Common barn owl	Northern rough-winged swallow	Wilson's snipe
Cinnamon teal	Ring-billed gull	Yellow warbler
Clark's grebe	Redhead	Yellow-headed blackbird
Cliff swallow	Rough-legged hawk	Yellow-rumped warbler
Common raven	Rock dove	
Common yellowthroat	Rock pigeon	

Bear River Delta and Migratory Bird Refuge. Desert-shrub, mudflat and wetlands along the historic floodplain and delta of the lower Bear River create a mosaic of habitats that support a wide diversity of shorebirds such as American avocets, black-necked stilts, and sandpipers. The Bear River Migratory Bird Refuge hosts over 200 species of birds that use that area at different times of the year (USFWS, 1997). According to the Box Elder County Comprehensive Wetlands Management Plan, approximately 30% of the migratory waterfowl traveling along the Pacific

flyway use the Bear River Migratory Bird Refuge and surrounding area as a resting stop (SWCA Environmental Consultants, 1999). Table 4 lists the sixteen priority species identified by the Bear River Migratory Bird Refuge. Providing habitat for these species drives all management activities at the refuge, following the ecological principle than focused management actions on priority species also benefits most the of the bird species that use the refuge (Olson, Lindsay and Hirschboeck, 2004).

Table 4

Bear River Migratory Bird Refuge Priority Species			
Rank	Common Name	Scientific Name	Life Cycle Activity
1	American avocet	Recurvirostra americana	Breeding & Migration
2	Cinnamon teal	Anas cyanoptera	Breeding
3	Black-necked stilt	Himantopus mexicanus	Breeding
4	White-faced ibis	Plegadis chihi	Breeding
5	Shorebirds	Various species	Migration
6	Waterfowl	Various species	Migration
7	Tundra swan	Cygnus columbianus	Staging & Migration
8	Snowy plover	Charadrius alexandrinus	Breeding
9	Marbled godwit	Limosa fedoa	Staging/Migration
10	Long-billed curlew	Numenius americanus	Breeding
11	American white pelican	Pelecanus erythrorhynchos	Forage
12	Redhead	Aythya americana	Breeding
13	Wilson's phalarope	Phalaropus tricolor	Staging & Migration
14	Long-billed dowitcher	Limnodromus scolopaceus	Staging & Migration
15	Franklin's gull	Larus pipixcan	Breeding
16	Black tern	Chlidonias niger	Breeding & Migration

Aquatic Habitats. The Bear River and Cutler Reservoir are highly altered systems with few native fisheries remaining in most areas. Historic populations in the Bear River included Bonneville cutthroat trout and red side shiners, but these species are no longer found in the main stem of the River in Utah. Water quality is identified as the primary reason for the population shift in the fishery (DWQ, 2010). Changes in flow, sedimentation, and diversions associated with

historic agricultural activities are considered the most probable causes of the degradation in the fishery. These factors are exacerbated by the constant disturbance of bottom sediments by large populations of carp in both the river and reservoir.

Cutler Reservoir and Middle Bear River Fisheries. In 2005 and 2006, 14 species of game and non-game species were sampled in Cutler Reservoir and the Middle Bear River (Budy Dahl, and Thiede, 2006). The species found in Cutler Reservoir included largemouth bass, smallmouth bass, common carp, bluegill sunfish, green sunfish, brown trout, rainbow trout, Utah sucker, fathead minnow, channel catfish, walleye, suckers, black crappie, black bullheads, and fathead minnows (Budy et al., 2006). Overall, the abundance and diversity of fish species was found to be high throughout Cutler Reservoir, but carp still comprised almost 70% of the total fish biomass with walleye and catfish being the other dominant species.

Largemouth bass, walleye, channel catfish, black crappie, bluegill sunfish, green sunfish, fathead minnows, and carp have also been found in the Bear River just upstream of Cutler Reservoir, but lower quantities of fish and less species diversity existed further upstream near the Utah-Idaho border (Budy et al., 2006). Those that were captured near the border included largemouth and smallmouth bass, walleye, channel catfish, green sunfish, Utah sucker, fathead minnow, and carp (Budy et al., 2006).

Lower Bear River Fisheries. There is scarce information regarding fish species present below Cutler dam. A 1962-1965 fish survey identified twelve species of fish present. Walleye and largemouth bass were found directly below the dam with a transition downstream to channel catfish, common carp, and suckers (Bangerter, 1965). Surveys completed in 1990 as part of Cutler Dam's relicensing found nine species of fish. Fathead minnows made up 90% of the catch followed by carp (8%) and channel catfish (1%). In 1999, the USGS sampled species in

the Bear River near Corinne and found only five species, two of which were carp. Gizzard shad, which had not been noted in previous studies, made up 57% of the catch, followed by 40% carp, 1.5% channel catfish, and 1.5% walleye (Albano and Giddings, 2007). Thirty four species of benthic invertebrates were also collected by the USGS. However, 90% were Hydropsyches, Chironomids, or Naidides that serve as indicators of poor water quality (Albano and Giddings, 2007). Since the USGS only sampled lower reaches of the river, it seems possible that other fish species may be present further upstream, especially in the reach directly below Cutler Dam. According to Paul Thompson, an aquatic biologist with the Division of Wildlife Resources, fish surveys are planned is planning fish surveys along this section of the river within the next couple of years to determine the potential presence of bluehead suckers, which could potentially become listed as a threatened or endangered species in the future (personal communication, 2015).

Threatened, Endangered, or Sensitive Species. Table 5 provides a list of sensitive wildlife species that have historically been observed or are currently known to exist in Cache and/or Box Elder County. This list includes both federally listed “threatened,” “endangered” or “candidate” species as well as the State of Utah’s designated “conservation species” or “species of concern.” The only endangered species that has been known to occur along the river is the yellow-billed cuckoo. However, according to aquatic biologists from the Division of Wildlife Resources, the bluehead sucker may become a candidate for listing as an endangered species and was historically known to inhabit sections of the Bear River in Utah. They have recently been surveying sections of the river in to determine whether bluehead sucker may still be present in Cache Valley and/or the stretch of river directly below Cutler Dam.

Table 5

Threatened, Engangered, and Sensitive Species Listed for Cache and Box Elder Counties			
Common Name	Scientific Name	Status	County
American white pelican	<i>Pelecanus erythrorhynchos</i>	SPC	Both
Bald eagle	<i>Haliaeetus leucocephalus</i>	SPC	Both
Black swift	<i>Cypseloides niger</i>	SPC	Cache
Bluehead sucker	<i>Catostomus discobolus</i>	CS	Both
Bobolink	<i>Dolichonyx oryzivorus</i>	SPC	Both
Bonneville cutthroat trout	<i>Oncorhynchus clarkii</i> Utah	CS	Both
Brown (grizzly) bear	<i>Ursus arctos</i>	S-ESA	Cache
Burrowing owl	<i>Athene cunicularia</i>	SPC	Both
California floater	<i>Anondonta californensis</i>	SPC	Both
Canada lynx	<i>Lynx canadensis</i>	S-ESA	Cache
Deseret mountainsnell	<i>Oreohelix peripherica</i>	SPC	Both
Ferruginous hawk	<i>Buteo regalis</i>	SPC	Both
Fringed myotis	<i>Myotis thysanodes</i>	SPC	Cache
Grasshopper sparrow	<i>Ammodramus savannarum</i>	SPC	Both
Gray wolf	<i>Canis lupus</i>	S-ESA	Box Elder
Great plains toad	<i>Bufo cognatus</i>	SPC	Both
Greater sage grouse	<i>Centrocercus urophasianus</i>	S-ESA	Both
June sucker	<i>Chasmistes liorus</i>	S-ESA	Box Elder
Kit fox	<i>Vulpes macrotis</i>	SPC	Box Elder
Lahontan cutthroat trout	<i>Oncorhynchus clarkii hensawi</i>	S-ESA	Box Elder
Least chub	<i>Lotichthys phlegethontis</i>	S-ESA, CS	Box Elder
Lewis's woodpecker	<i>Melanerpes lewis</i>	SPC	Both
Long-billed curlew	<i>Numenius americanus</i>	SPC	Both
Lyrate mountainsnell	<i>Oreohelix haydeni</i>	SPC	Both
Mountain plover	<i>Charadrius montanus</i>	SPC	Box Elder
Northern goshawk	<i>Accipiter gentilis</i>	CS	Both
Northwest bonneville pyrg	<i>Pyrgulopsis variegata</i>	SPC	Box Elder
Preble's shrew	<i>Sorex preblei</i>	SPC	Box Elder
Pygmy rabbit	<i>Brachylagus idahoensis</i>	SPC	Both
Sharp tailed grouse	<i>Typpanuchus phasianellus</i>	SPC	Both
Short eared owl	<i>Asio flammeus</i>	SPC	Both
Three-toed woodpecker	<i>Picoides tridactylus</i>	SPC	Cache
Townsend's big-eared bat	<i>Corynorhinus townsendii</i>	SPC	Both
Utah physa	<i>Physella utahensis</i>	SPC	Box Elder
Western pearlshell	<i>Magaritifera falcata</i>	SPC	Box Elder
Western red bat	<i>Lasiurus blossevillii</i>	SPC	Cache
Western toad	<i>Bufo boreas</i>	SPC	Box Elder
Yellow-billed cuckoo	<i>Coccyzus americanus</i>	S-ESA	Both
Yellowstone cutthroat trout	<i>Oncorhynchus clarkii bouvieri</i>	SPC	Box Elder
Status Abbreviations			
S-ESA: Federally-listed or candidate species under the Endangered Species Act.			
SPC: Wildlife species of concern.			
CS: Species with special management under conservation agreement			

Socio-cultural Attributes

History and Culture.

Native American Inhabitants. Archaeological evidence suggests the earliest humans, Paleo-Indians, migrated into the region as the climate warmed following the last ice age approximately 12,000 years ago (Simms, 1990). These original inhabitants would have been largely nomadic hunters and gatherers drawn to the abundance of game species along shorelines, river deltas and riparian corridors. As climatic conditions continued to dry and warm, there was a gradual but definite shift in settlement patterns from approximately 8,000 years ago until approximately 2,500 years ago, during which time it is likely that semi-permanent occupation of villages began in the region (USFWS, 2012).

While evidence suggests the Bear River delta and shoreline of the Great Salt Lake had been occupied for several thousand years, the majority of documented sites are from about 1,500 years ago (Simms, 1990). It would have been around this time that Fremont people began to settle the Bear River drainage and establish more permanent settlements. Fremont subsistence would have likely included the cultivation of corn, beans, and squash in addition to hunting and gathering activities (USFWS, 2012). The Fremont inhabited the basin from the fourth to the fourteenth centuries, at which point the archaeological record largely disappears (USFWS, 2012). Whether the Fremont people were displaced or integrated into other groups, the Fremont culture was replaced by the Shoshone and Bannock tribes that were living in the area when the first Trappers arrived in the early 1800s (USFWS, 2012).

Trappers and Mountain Men. Exploration of the Western United States and much of Utah was promoted by the quest for furs, land, and a water passage through the Great Basin (Cline, 1963). Robert Stuart, a fur trapper, was the first documented European to enter the

region in 1812 (USFWS, 2012). Stuart was reportedly informed of the abundance of beaver in the area by a group of trappers from the American Fur Company who had entered the Bear River Basin via the Portneuf River in 1811 (Denton, 2007). During the 1820s and 1830s, several trapping parties including Peter Skene Ogden and the Hudson Bay Company, the Northwest Fur Company, the American Fur Company, and the Ashley-Henry Company were active along the Bear River (Denton, 2007). It was also during this period that Jim Bridger made his famous trip down the Bear River to the Great Salt Lake (Alter, 1947), but historical records seem to indicate he made the trip on horseback rather than in a bullboat (Crampton and Madsen, 1975).

Early trappers were organized around the rendezvous system, meeting periodically to deliver hides and resupply without travelling too far from the areas where they were trapping. The main rendezvous was in Cache Valley in 1826 and 1831 and at Bear Lake in 1827 and 1828 (Crampton and Madsen, 1975). While it was given various names in the early days of its exploration, the Bear River was named by French-Canadian Trapper Michael Bourdon for “the great number of these animals on its borders” (Box Elder County, 2014).

During this era, there is some record of navigational use of the Bear River with bull and buffalo hide canoes and other small watercraft used for checking traps (Crampton and Madsen, 1975; Wells, 1969; Hafen, 1965). In a statistical summary of a collection of accounts from 292 mountain men, Richard Fehrman found that the most frequently used modes of transportation were horses and mules, followed by canoes, bullboats, barges, and keelboats (Fehrman, 1972; Crampton and Madsen, 1975). During John C. Fremont’s second expedition from 1842 to 1843, a survey of the Bear River was done using a boat described as an India rubber boat, approximately 18 feet long, which carried five to six people and a considerable amount of equipment (Crampton and Madsen, 1975).

Early Settlement. By the mid-1840s, the fur trade had declined substantially and other uses including mining and grazing attracted settlers to the area. Deweyville was likely the first town established in the Bear River Valley (Box Elder County, 2014). Empey's Ferry was established near Deweyville in 1850 to facilitate travelers passing through the area on their way west to California or north to Oregon (Box Elder County, 2014; Crampton and Madsen, 1975; Denton, 2007). The Hampton's Ford Ferry was set up near Collinston in 1853 where Native Americans and trappers had often forded the river in a section of gravel bottom (Huchel, 1999). What is thought to be the first bridge across the Bear River was built at the site in 1859 and passersby were charged tolls for its use (Huchel, 1999). Hampton Ford became a stop for three different stage companies after the Hampton Ford Inn was built to accommodate passengers (Denton, 2007), and it is now included in the National Register of Historic Places.



Figure 18: Hampton Ford Inn and Bridge by William Henry Jackson (1872)

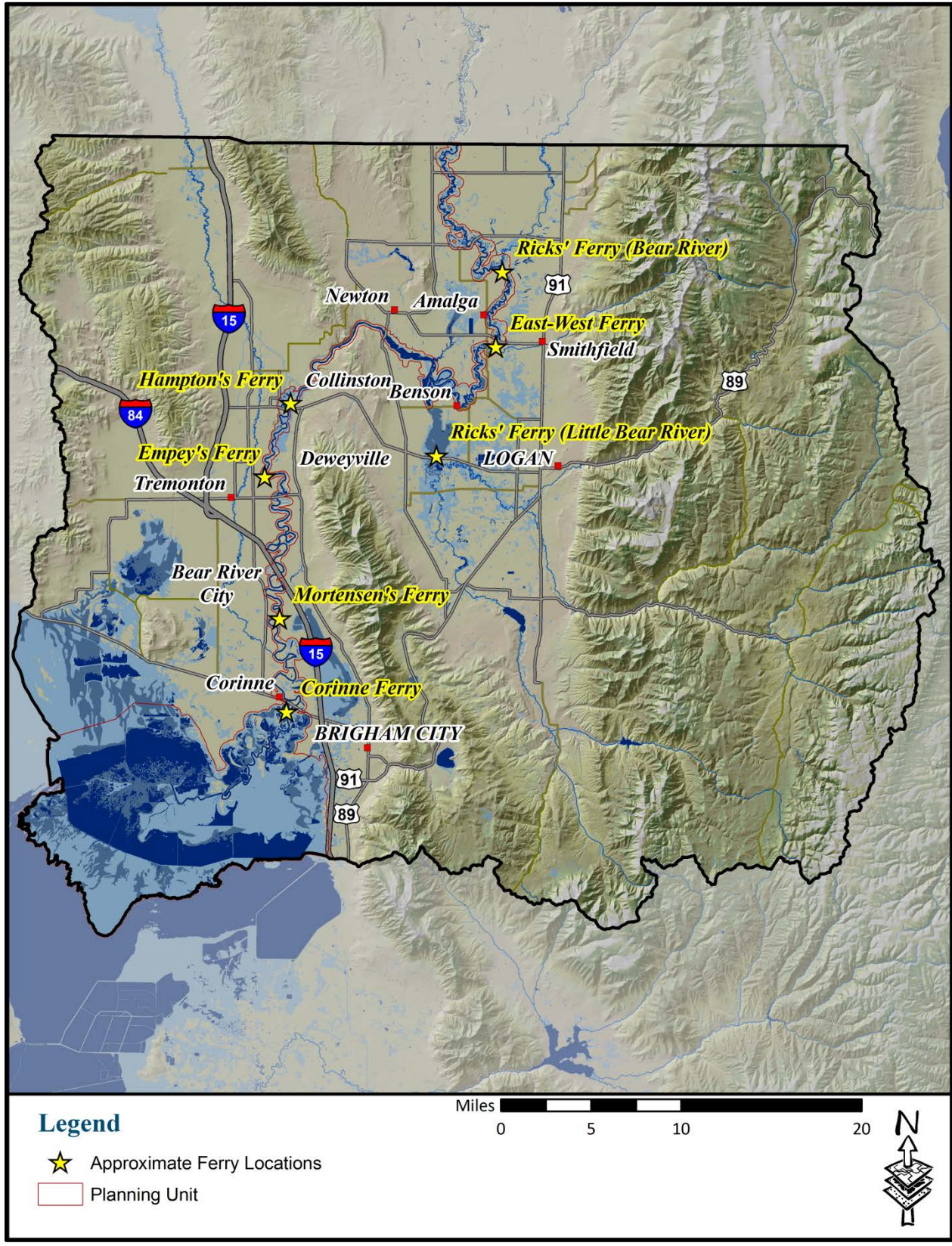
Other ferries operating along the river between 1850 and 1876 included Rick's Ferry and the East-West Ferry in Cache Valley, and Mortensen's Ferry and the Corinne Ferry in Box Elder County (Crampton and Madsen, 1975). Map shows approximate locations of ferries on the within the study area according to Crampton and Madsen (1975).



Figure 19: Work horses ferrying across Bear River. Photo courtesy of USU Digital Archives.

Mormon settlement in Cache Valley began in 1855 when a group drove a herd of cattle up from the Salt Lake Valley to take advantage of the abundant grasslands (Ricks, 1953). The first permanent settlement, Maughan's Fort, was established near Wellsville in 1856 with Providence, Mendon, Logan and Smithfield settled in 1859 (Denton, 2007). In 1867, a group from Wellsville (formerly Maughan's Fort) settled in the Bear River Valley near Portage, Utah and Plymouth was settled in 1869.

Map 14: Approximate Ferry Locations



The first commercial trip from the Great Salt Lake up the Bear River to Corinne was probably made by the *Kate Connor*, a ninety-ton schooner hauling building materials from the Black Rock Mills on the south end of the lake in 1869 (Crampton and Madsen, 1975). The *Kate Connor* also carried passengers between Lake Point and Corinne for \$5.00 round trip before later being refitted as a steamer to carry freight (Crampton and Madsen, 1975). The same year, the people of Corinne raised money to build a steamboat to transport both ores and passengers.

The City of Corinne was built in San Francisco and brought to Corinne by railroad. It was a 150 foot long triple decked ship propelled by a large paddle wheel. The ship was launched with 50 passengers aboard in June of 1871 (Crampton and Madsen, 1975). At the time, the Bear River at Corinne was 13 feet deep and 300 feet wide and was sailed three times a week until business declined just a few months later due to a lack of freight (Jameson, 1951; Crampton and Madsen, 1975). The City of Corinne was eventually renamed the *General Garfield* and stationed near Black Rock on the south end of the Great Salt Lake.

Other navigational references to the lower Bear River include a salt barge named the *Rosie Brown* that was used to haul salt from salt beds along the Bear River to Corinne, where it could be loaded on rail cars and the use of a motorized vessel capable of carrying 25 passengers that was used for pleasure cruises and hunting trips (Crampton and Madsen, 1975). Another boat operating on this lower section was the *LaVon*, which held up



Figure 20: The *General Garfield*.
Courtesy of Utah State Historical Society

to 25 passengers that travelled along the river for pleasure cruises and hunting trips (Crampton and Madsen, 1975).

In anticipation of the arriving railroad, Corinne was incorporated in 1870, shortly after the driving of the Golden Spike at Promontory in 1869. Strategically located where the railroad crossed the Bear River, business in Corinne flourished with ore coming south from Montana, and food and supplies produced in the surrounding valleys shipped back north. The Utah Northern Railroad opened a rail line between Brigham City and Logan in 1873 connecting Cache Valley to the Bear River and Salt Lake Valleys and providing new markets for agricultural products. Utah State University was established in Cache Valley in 1888 and remains a significant economic driver in the local economy today.

Water Development. Settlers were attracted to Box Elder County and the Bear River Valley for its fertile soils and the availability of water resources from the Bear River. John Wesley Powell and Grove Karl Gilbert recognized the importance of the Bear River to the development of the region in their 1878 report (Powell, 1879), which included a request for Congress to provide laws and regulations regarding water uses and priorities as part of the homestead laws (Jibson, 1990). In fact, one of the first stream-gauging stations in the United States was established near Collinston, Utah in 1889 (Jibson, 1990).

The Bear River Canal was first surveyed as early as 1868, but it wasn't until 1889 when the Bear Lake and River Water Works and Irrigation Company was



Figure 21: Diversion dam in Bear River Canyon, 1890s. Image courtesy of USU Digital Archives

incorporated and financed the project through the sale of bonds. The diversion dam in Bear River Canyon, where the river leaves Cache Valley, was built in the late 1889 (Jibson, 1990). Two canals coming from the diversion dam – the West Side Canal and the Hammond Main Canal – provided a substantial source of irrigation water to support agricultural development throughout the Bear River Valley (Jibson, 2000; Denton, 2007). Through a partnership with the Corinne Mill and Canal Stock Company, packaged deals including the sale of both land and water rights were advertised and sold in the Bear River Valley (Denton, 2007). Tremonton, Garland, and Fielding were all established between 1888 and 1892 with other towns and settlements established shortly thereafter (Box Elder County, 2014).

In 1912, the Utah-Idaho Sugar Company, which had been a significant driver of settlement in the area, and Utah Power and Light entered into a perpetual agreement. The Sugar Company conveyed all the property and infrastructure in the vicinity of the present Cutler Dam to Utah Power and Light in exchange for the delivery of a continuous water flow of 900 cubic feet per second between May 1 and October 31, and 150 cubic feet per second from November to April (Jibson, 1990). Utah Power and Light completed the Dingle Canal connecting the Bear River to Bear Lake in 1918 and continues to hold the only right to divert water from the Bear River into Bear Lake for storage (Jibson, 1990). The upstream storage of water in Bear Lake has allowed downstream users in Cache and Box Elder Counties to obtain a more reliable supply of irrigation water from the Bear River during the dry summer periods when flows would otherwise be very low and, potentially, insufficient to move water through the canals.

By 1920, 45,000 acres of mostly sugar beets and alfalfa were under cultivation with a canal capacity capable of irrigating another 55,000 acres (Hooton, 2000). The original diversion dam was replaced by the construction of Cutler Dam by Utah Power and Light in 1927 (Jibson,

1990). The West Side Canal and the Hammond Main Canal are still in use today, owned and operated by the Bear River Canal Company. Irrigation water from the Bear River has made Box Elder County one of the top agricultural areas in the State of Utah with more irrigated farmland than any other county in the state (Hooton, 2000).

The Bear River Compact.

Controversy regarding the right to use the Bear River water supply has extended well beyond the borders of Utah. The river both starts and ends in Utah, but it runs through Wyoming and Idaho as it makes its long winding course around the northern end of the Bear River Range. After several years of



Figure 22: Construction of Cutler Dam, 1925. Image courtesy of USU Digital Archives

conflict, Congress granted the states of Utah, Idaho and Wyoming the right to negotiate and enter into an interstate compact in 1946. The Bear River Compact was finally signed in 1958, following 12 years of extensive negotiations (Jibson, 1990).

Unfortunately, the 1958 Bear River Compact failed to address all of the problems regarding water allocation. Drought years continued to leave such low water flows in the Bear River that it became impossible to convey the water through the canal systems and Wyoming and Idaho became increasingly concerned about Utah's plans to develop their senior water rights (Jibson, 1990).

The Bear River Compact was amended in 1980 to address the many of the issues that arose following the original allocations that were established in 1958. Significant changes to the Compact included prohibiting water storage above Bear Lake when lake levels fall below 5,911

feet in elevation, eliminating a previous reserve of 120,000 acre feet to the Bear River Bird Refuge, and prioritizing irrigation over power generation (Jibson, 1990). The amendment also established specified quantities of water that could be developed by each of the three states. In the upper sections of the Bear River, above Bear Lake, Utah and Wyoming were each granted the right to store 35,000 acre-feet of water and Idaho was granted the right to store 4,500 acre-feet of water. In the sections below Bear Lake, Idaho was given the first right to develop 125,000 acre-feet, Utah the second right to develop 275,000 acre-feet, and a third right to develop an additional 150,000 acre-feet divided between Utah and Idaho (Jibson, 1990).

The Bear River Development Act. Water development studies and proposals for the Bear River date back as far as the initial settlement of the area in the late 1800s. Significant research was done by the U.S. Bureau of Reclamation in the mid-1960s and early 1970s, and the Utah Division of Water Resources conducted several studies on potential reservoir locations and storage options in Cache and Box Elder Counties during the 1970s and 1980s. In 1990, the Utah State Legislature requested a feasibility study for development of Bear River water and subsequently passed the Bear River Development Act in 1991. According to Utah State Code (§73-26-104):

The Division [of Water Resources] shall develop the surface waters of the Bear River and its tributaries through the planning and construction of reservoirs and associated facilities as authorized and funded by the Legislature; own and operate the facilities constructed; and market the developed waters. The Division is authorized to develop the Honeyville, Barrens, Hyrum Dam, and Avon reservoirs and associated works, including an interconnection from Honeyville Reservoir to Willard Reservoir, and shall proceed

with design work, environmental assessments, acquisition of land and rights-of-way, and construction subject to the appropriation of funds for those purposes by the Legislature.

(§73-26-104)

The 1991 Development Act provides for a diversion of 220,000 acre-feet of water, with 50,000 acre-feet allocated to the Jordan Valley Water Conservation District, 50,000 acre-feet allocated to the Weber Basin Water Conservancy District, 60,000 acre-feet allocated to the Bear River Water Conservancy District, and 60,000 acre-feet allocated to Cache County (DWRe, 2000). Cache County residents recently voted to form a water conservancy district in 2016 that is expected to represent their interests in future water development.

Several potential reservoir sites and storage options have been proposed over the years, including the expansion of existing reservoirs, the diversion of water into the Amalga Barrens, a dam on the main stem of the Bear River near Honeyville, a reservoir near Washakie, and even sites in White's Valley or Temple Fork Canyon. The Amalga Barrens and Honeyville sites have been very controversial and were effectively removed from consideration due to environmental and cultural concerns brought forward by local conservation groups, agricultural producers, and the Shoshone Tribe (DWRe, 2004). Other proposals to divert and store water both above (Cache County, 2013) and below Cutler Dam (DWRe, 2014) continue to be explored. Current plans for Bear River water development are discussed in the growth and development section later in this section of the report.

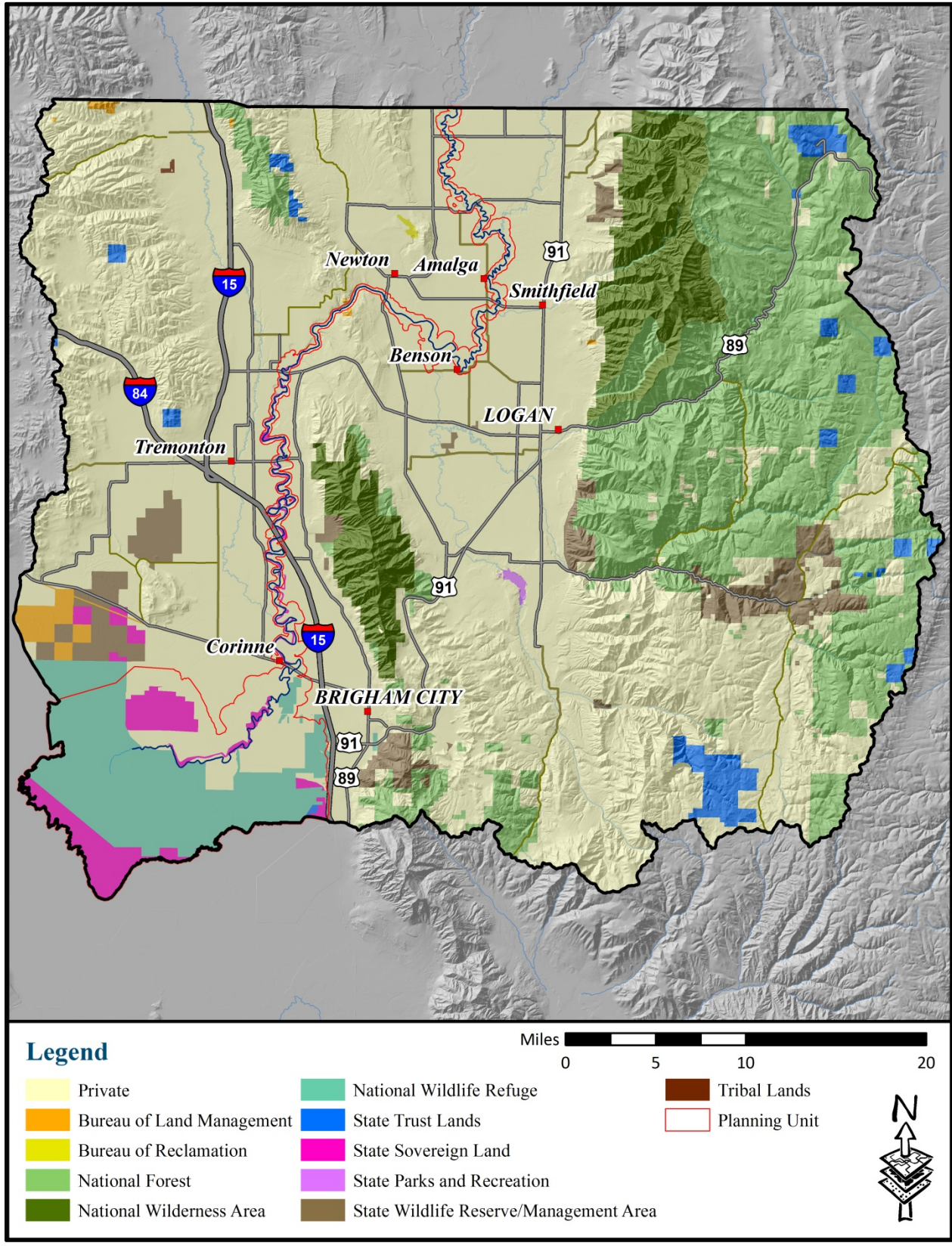
Land Use and Ownership

Agriculture remains a significant land use in the study area with 80 - 85% of the total land area (non-water or wetlands) utilized for agriculture and/or grazing (NRCS, 2005; NRCS,

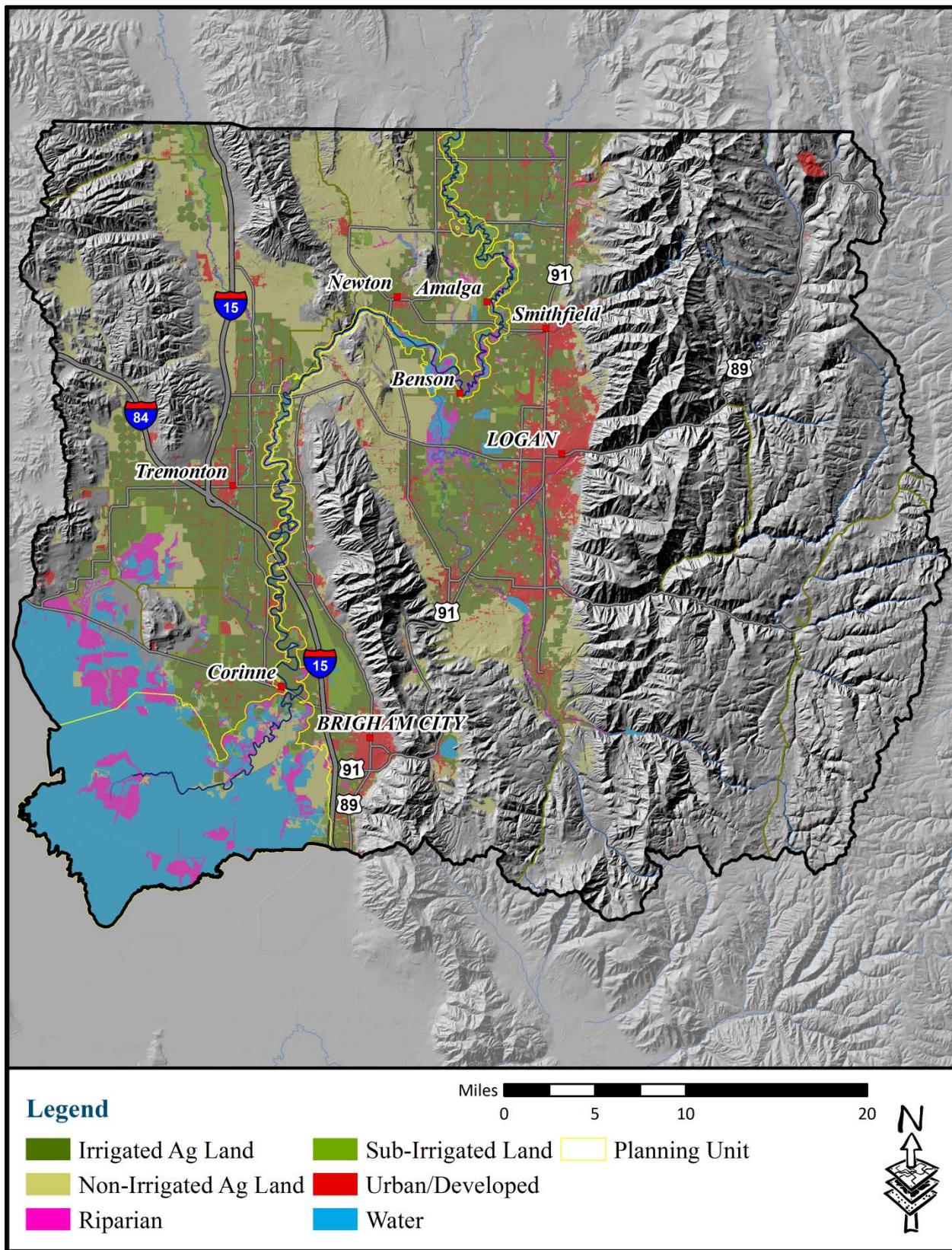
2011). Moreover, privately owned agricultural lands comprise the overwhelming majority of lands along the main stem of the Bear River as shown in (Map 15 and Map 16). However, the population has grown substantially in recent decades and urban and residential developments can be expected to become an increasingly significant portion of land use in the future. Cache County grew by 21,625 residents to a population of between 2000 and 2010 (Kem C. Gardner Policy Institute, 2017a) and is predicted to more than double in population between 2010 and 2050 (Utah Governor's Office of Management and Budget [GOMB], 2013). Box Elder County has grown somewhat slower, adding 7,230 residents between 2000 and 2010 (Kem C. Gardner Policy Institute, 2017b), but is still expected to increase its population by over 40 percent and add an additional 20,526 residents between 2010 and 2050 (GOMB, 2013).

The majority of publicly owned lands within the study area located in the mountainous areas of the Bear River Range and Wellsville Mountains and managed by the U.S. Forest Service. The U.S. Fish and Wildlife service manages a significant protected area at the Bear River Migratory Bird Refuge (approximately 78,000 acres) on the Bear River Delta where the Bear River enters the Bear River Bay of the Great Salt Lake. Smaller tracts of state-owned land include Wildlife Management Areas managed by the Division of Wildlife Resources and a small State Park near Hyrum Reservoir, but most of these are located outside the Bear River Corridor and planning unit. The state of Utah does own the beds of all navigable waters in the state, including the Great Salt Lake and the Bear River (Utah State Code, §65A-1-1(6)). However, recreation on the shoreline of the Great Salt Lake is very limited and the State's sovereign lands along the Bear River can be difficult to access in most areas due to surrounding private lands.

Map 15: Land Ownership



Map 16: Water Related Land Use

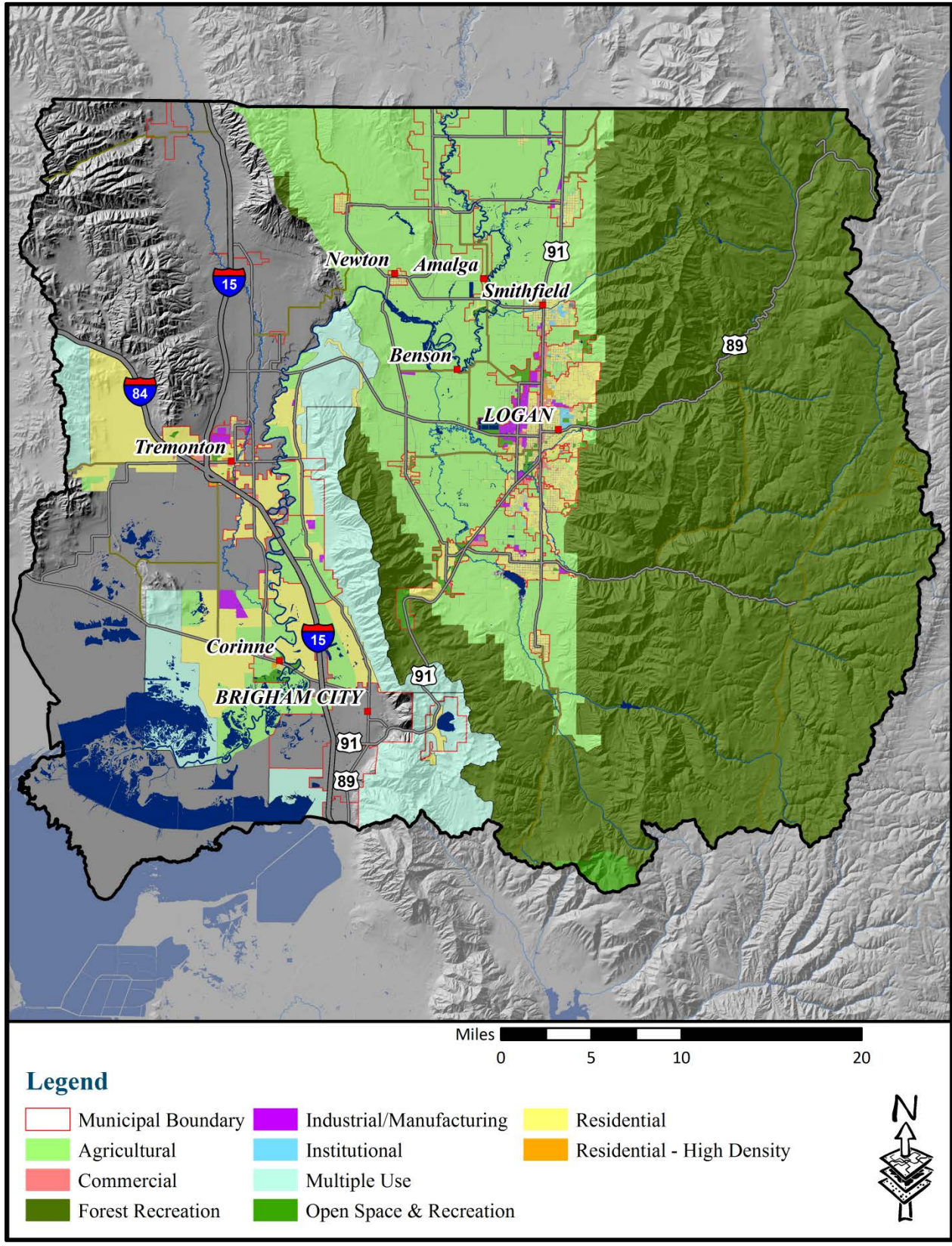


County and Municipal Zoning. Population growth and the associated urban, suburban, and exurban development in Cache County and the Bear River Valley are significant drivers for changing land uses. Where this development occurs is highly related to zoning ordinances enacted by Cache and Box Elder Counties as well as the municipalities within the area. Several areas have established zoning classifications directly adjacent to the river.

County and municipal level zoning for the study area was collected from a number of sources and integrated to create a zoning dataset shown in Map 17. County level zoning was available from the Cache and Box Elder County Planning and GIS offices. Most of the municipal zoning in Cache County was also made available by the Cache County GIS office, who has been working to compile zoning data into a county wide zoning map for all land areas. Zoning data in Box Elder County, however, only covers a portion of the land base because there are no zoning ordinances for many areas. With the exception of Brigham City, most of the municipal zoning in Box Elder County was obtained from each of the municipalities in the form of paper maps or PDF documents that were geo-referenced and digitized in ArcGIS.

While each municipality has several detailed zoning classifications that specify different types of residential development, concentration of commercial development, etc., the zoning presented shown in Map 17 has been generalized to include 9 broader classifications including: commercial, residential, manufacturing/industrial, agricultural, open space/recreation, forest recreation, multiple use (Box Elder County), and special zones such as Planned Use Development (PUD) and Development Zones (DZ in Corinne) that generally allow for higher density residential development.

Map 17: County and Municipal Zoning



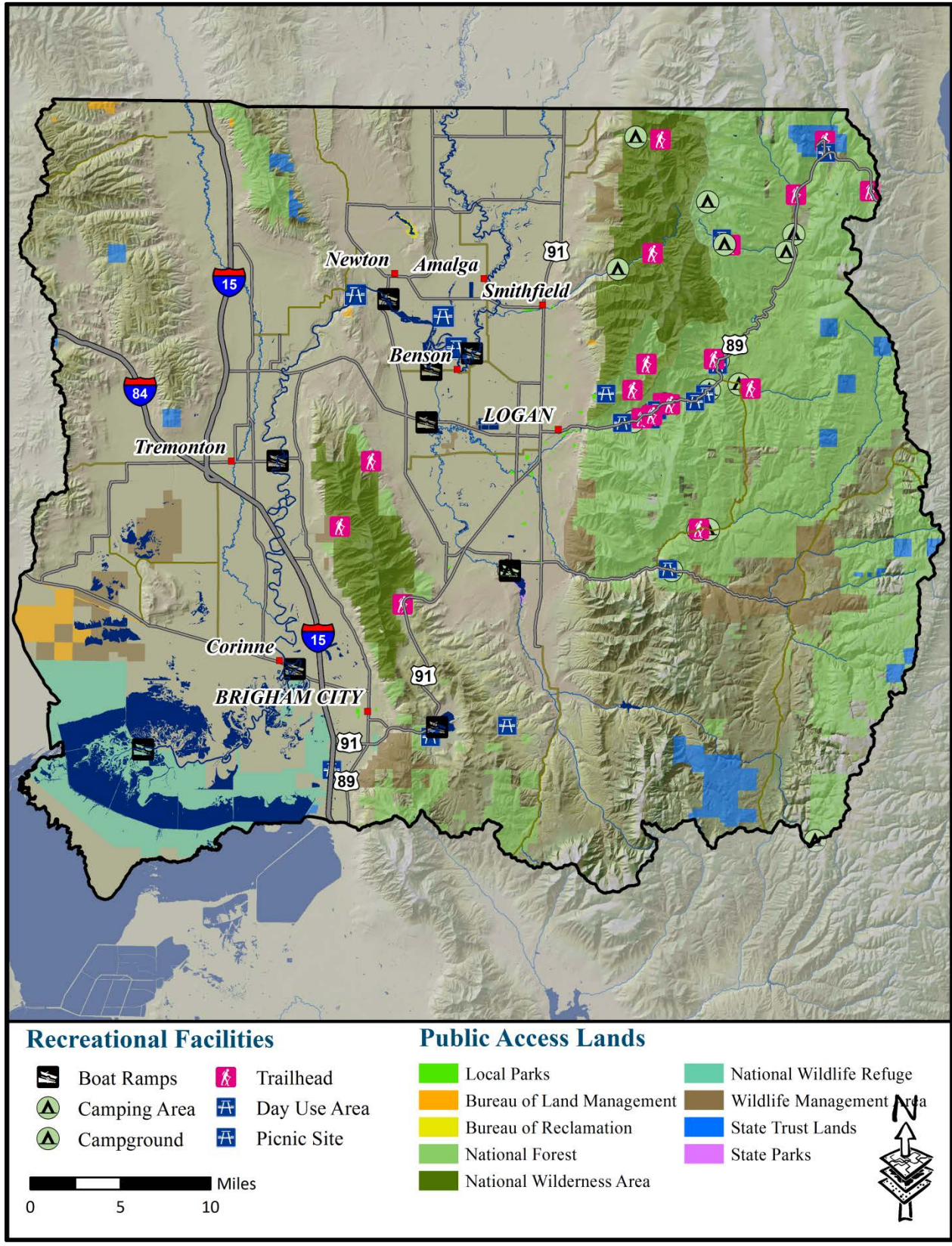
Current Recreational Uses and Facilities. Most outdoor recreation within the study area occurs on public lands in the canyons and mountainous areas managed by the U.S. Forest Service. Additional recreation opportunities are provided by reservoirs and limited public lands in the lower elevation valley bottoms. However, since the vast majority of land along the Bear River is privately owned, it is relatively difficult to access except by boat. Potential recreational opportunities along the river include fishing, hunting, bow fishing, wildlife viewing, boating, canoeing, and hiking. There are a handful of access points surrounding Cutler Reservoir that are managed by PacifiCorp and include boat launching facilities and picnic areas, and (PacifiCorp, 1995).



Figure 23: Paddlers on Bear River in Cache County

Sport fishing pressure on Cutler Reservoir is limited primarily to access and is classified as low to moderate with negligible boat angling. Primary sport fish targets appear to be channel catfish, black bullhead, and carp (Budy et al., 2007). A state catch and release record for channel catfish was recorded at Cutler Reservoir in April of 2013. Fishing for large channel catfish is also very popular on lower stretches of the Bear River from Corinne downriver into the Bear River Migratory Bird Refuge. According to Paul Thompson from the Division of Wildlife Resources (personal communication, 2016), people are known to fly into Utah from other areas of the country to fish for large Channel Catfish in the Bear River. The area directly below Cutler Dam is also becoming an increasingly popular for fishing, and several anglers can be found there on most summer evenings.

Map 18: Existing Recreational Opportunities



There has also been a growing interest in many areas of the country to fly-fish for warm-water species, including the common carp, which have become prevalent throughout the Lower Bear River. While doubtful that many anglers are currently targeting carp with a fly rod in the Bear River, it is an opportunity that may become more popular in the future. Bow-fishing for Carp has become popular in many areas of Cutler Reservoir. Both waterfowl and upland bird hunting are popular along the river and access points are often filled with vehicles and boat trailers during those seasons. Opportunities for trapping beaver and muskrat also exist along most sections of the river.

Perhaps the most significant recreational opportunity along the Bear River through Cache and Box Elder Counties is simply wildlife viewing. As discussed previously, there is a rich diversity of bird species that inhabit or use many different areas along the river. The Bridgerland Audubon Society and the Bear River Land Conservancy frequently host public outings to go out and see the many different species of migratory birds found in the area.

The most significant barrier to the recreational use of the Bear River is the difficulty for the public to gain access in most areas. The vast majority of land along the river corridor is privately owned (refer again to Map 15).

PacifiCorp allows public access to lands they own along the river, but their properties upriver from Cutler Reservoir can be difficult to access because they are often land-locked by surrounding private lands. There are no developed recreational or access facilities upriver of the Upper Bear Access Point in



Figure 24: Upper Bear Access near Benson

Benson, making the launch of canoes and kayaks fairly difficult and larger boats nearly impossible. In Box Elder County, there are three developed access points to the Bear River, but significant distances between these sites limit most paddlers to out and back routes rather than making downriver trips between access points. Providing additional and improved public access may be an important part of increasing public awareness regarding the value of the Bear River as a public resource.

Inventory of Structures and Devices along the Bear River. At the onset of this project, in 2013, I conducted an inventory with the help of FFSL seasonal staff to identify structures and devices along the Bear River that may require permits from FFSL. The inventory required approximately three weeks of field work in total. Inventory was conducted beginning from the Cub River Canal Company's diversion just north of the Utah-Idaho Border to Cutler Dam in August of 2013, and the section from Cutler Dam downstream to the large water diversion structure at the Bear River Migratory Bird Refuge was completed in November of 2013, taking advantage of higher flows and faster travel due to a scheduled drawdown of Cutler Reservoir.



Figure 25: Canoeing the Bear below Cutler in 2013

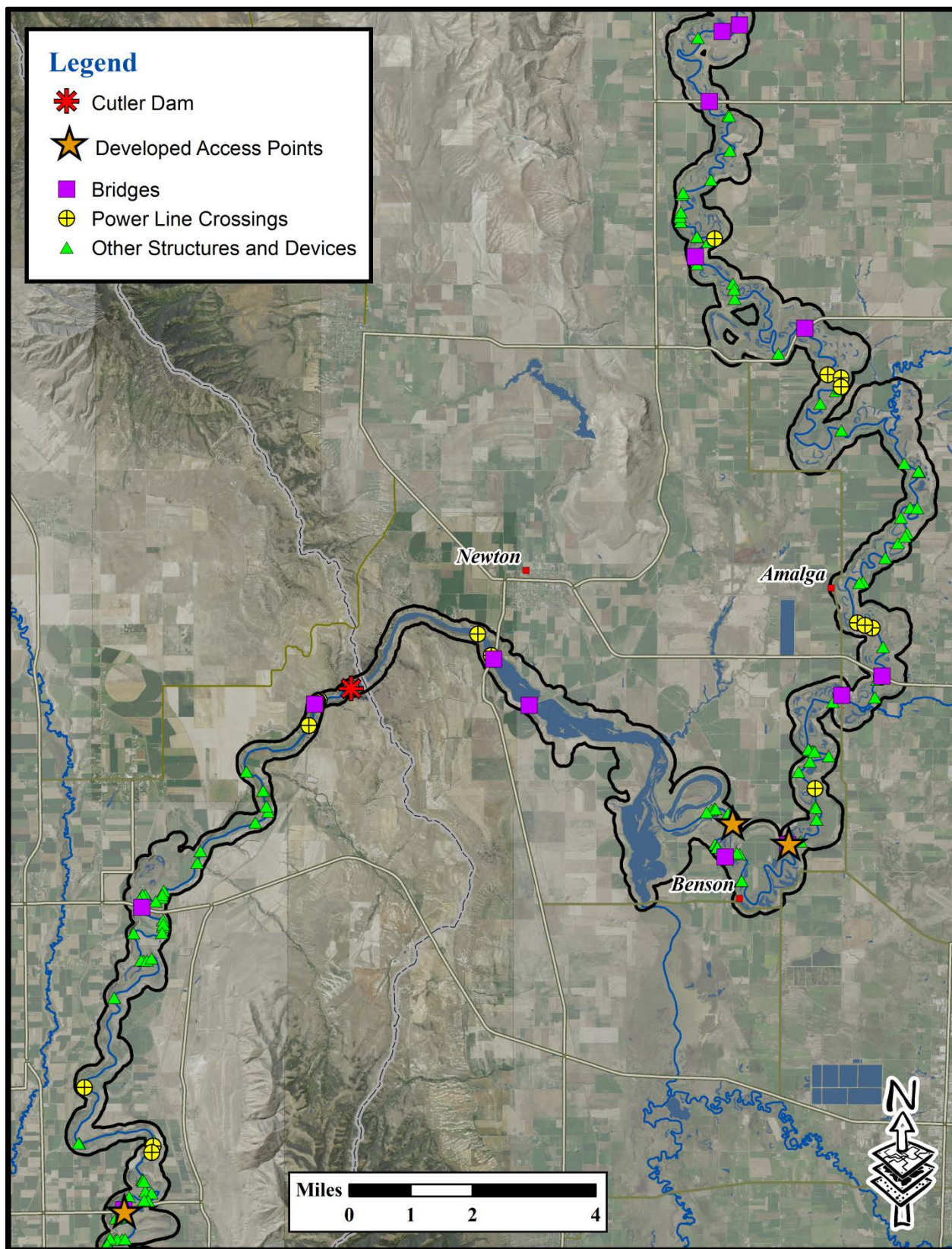
The inventory identified, photographed and provided GPS coordinates for over 330 different structures, devices, or other activities along the Bear River that would likely require permitting from FFSL. Table 6 provides a summarized list of the number and types of structures that were found along the river. Map 19 and Map 20 also show the locations of inventoried

features from the Utah-Idaho border downstream to Tremonton and from Tremonton downstream to the Bear River Migratory Bird Refuge. It is expected that several more structures and devices exist that were not captured in the inventory due to obscuring vegetation, the placement of utility lines underground, or other factors. While some structures have already been permitted by in the past, there are fewer than 20 active permits on the Bear River according to FFSL's records.

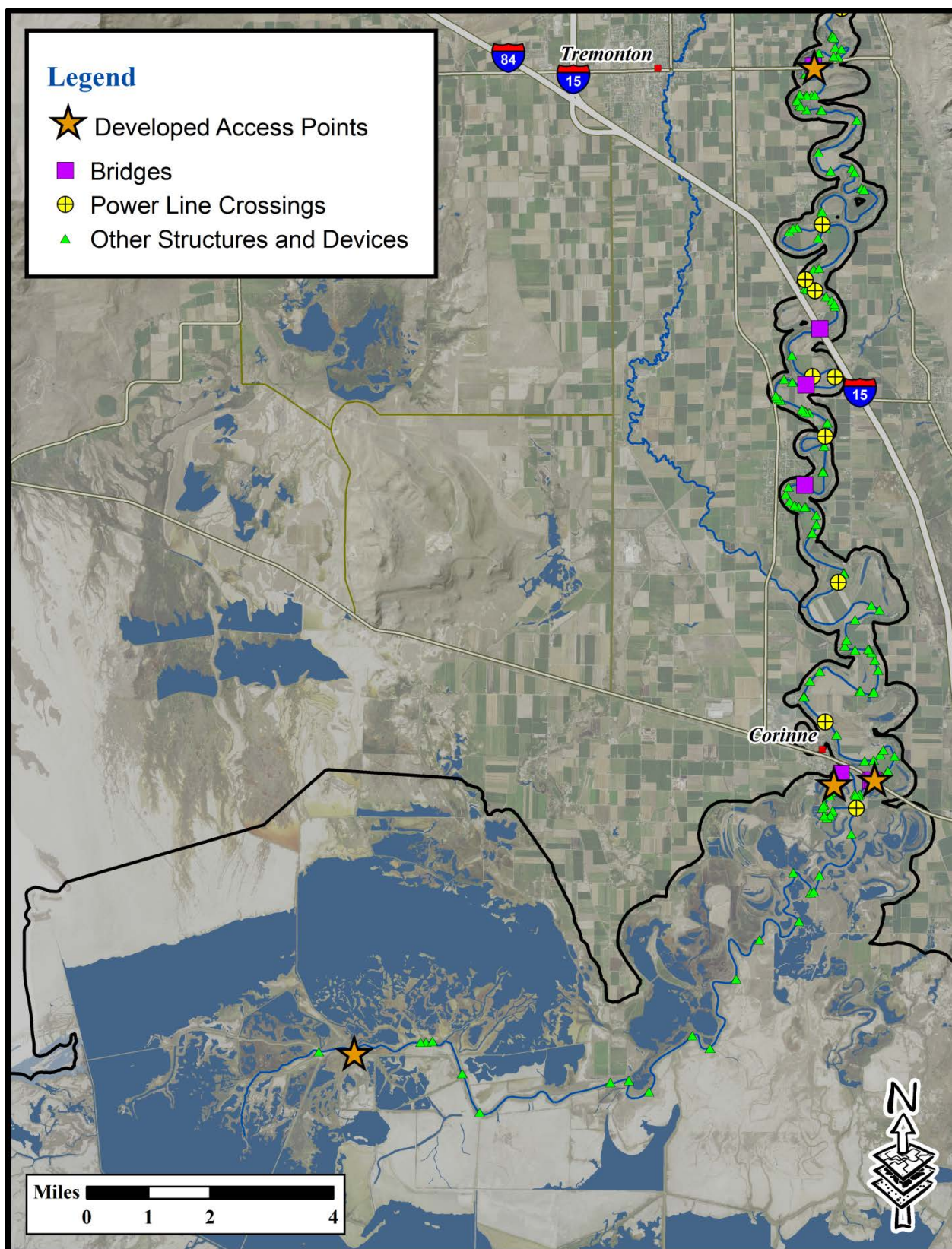
Table 6

Inventory of Structures and Devices	
Number	Structure or Device
94	Cases of significant dumping, including concrete, old cars, etc.
48	Agricultural pumps and related infrastructure
36	Power lines crossing the river
34	Pipes and field drain outlets
20	Bridges crossing the river
15	Ramps - mostly gravel, rock and concrete
14	Livestock watering facilities or fences coming into the river
13	Docks
6	Locations with abandoned bridge pilings or abutments
6	Developed public access points
1	Dam
44	Other miscellaneous structures
330	TOTAL

Map 19: Structure, Devices, and Activities in Northern Section



Map 20: Structures, Devices and Activities in Southern Section



Growth and Development

Population Growth. Recent trends in population growth within Cache and Box Elder Counties is expected to continue for the foreseeable future. Table 7 and Table 8 show population growth projections – broken down by municipality – for Cache and Box Elder Counties from the Utah Governor’s Office of Management and Budget (2013). As shown in the tables, most of the population growth is expected to occur within established municipalities, but growth in unincorporated areas of both counties is also significant.

Cache County is expected develop more rapidly than Box Elder County, with projected county-wide growth rates of 106% and 41%, respectively, between the 2010 census to the year 2050 (GOMB, 2013). However, the Box Elder County growth projections include the entire county, and most development is expected to occur within the eastern portion that is included in the study area. Much of the growth can likely be attributed to spill-over from the Wasatch Front. As areas along the rapidly growing Wasatch Front continue to build out, residents seeking more rural and semi-rural areas will likely look to build or buy homes further north. This is illustrated by higher population growth projections in the southern areas of both Cache and Box Elder Counties that have a higher potential to accommodate commuters traveling back and forth to the Wasatch Front.

During much of the last 20 years, counties with the highest rates of population growth were associated with the most rapid expansion of developed land and subsequent loss of farmlands (Jackson-Smith, Jensen, and Jennings, 2006). It is reasonably foreseeable that Cache and Box Elder County will experience similar changes in land use, and increased pressure for the development of land within the study area is likely to have a significant impact on agricultural lands that provide the majority of open space resources in the valley bottoms.

While agricultural areas are not natural areas, they do often provide benefits in terms of wildlife habitat (USFWS, 2013). Additionally, agricultural lands have played a critical role in the historic development of the area and have been identified among the most important factors in terms of cultural resources and regional identity (Toth et al., 2006; Guth, 2009; Envision Utah 2009).

Table 7

Population Projections for Cache County							
Location	2010	2020	2030	2040	2050	Growth 2010-50	% Growth 2010-50
Amalga	488	540	587	603	930	442	91%
Clarkston	666	696	841	983	1,162	496	75%
Cornish	288	332	362	384	465	177	61%
Hyde Park	3,833	4,930	6,214	7,552	7,673	3,840	100%
Hyrum	7,609	9,328	11,079	12,794	15,851	8,242	108%
Lewiston	1,766	1,777	2,186	2,555	3,487	1,721	97%
Logan	48,174	57,057	63,943	76,658	92,987	44,813	93%
Mendon	1,282	1,689	2,239	2,555	2,790	1,508	118%
Millville	1,829	2,196	2,593	2,951	3,834	2,005	110%
Newton	789	835	841	983	1,162	373	47%
Nibley	5,438	8,796	14,136	15,725	18,597	13,159	242%
North Logan	8,269	11,641	14,964	16,708	18,597	10,328	125%
Paradise	904	1,123	1,334	1,552	1,879	975	108%
Providence	7,075	9,050	11,770	13,759	16,273	9,198	130%
Richmond	2,470	2,785	3,026	3,342	4,184	1,714	69%
River Heights	1,734	2,088	2,152	2,258	2,557	823	47%
Smithfield	9,495	12,051	15,171	18,307	19,069	9,574	101%
Trenton	464	557	673	786	930	466	100%
Wellsville	3,432	4,160	5,036	5,831	7,098	3,666	107%
Other	6,651	7,597	8,991	10,274	12,941	6,290	95%
County Total	112,656	139,228	168,136	196,559	232,468	119,812	106%

Table 8

Population Projections for Box Elder County							
Location	2010	2020	2030	2040	2050	Growth 2010-50	% Growth 2010-50
Bear River City	853	871	951	971	1,058	205	24%
Brigham	17,899	19,100	21,397	22,970	25,028	7,129	40%
Corinne	685	764	892	1,035	1,058	373	54%
Deweyville	332	355	398	434	494	162	49%
Elwood	1,034	1,252	1,486	1,682	1,974	940	91%
Fielding	455	491	505	582	635	180	39%
Garland	2,400	2,783	3,066	3,452	3,525	1,125	47%
Honeyville	1,441	1,419	1,647	1,754	2,039	598	42%
Howell	245	273	297	324	353	108	44%
Mantua	687	709	773	841	987	300	44%
Perry	4,512	5,566	6,538	7,764	8,531	4,019	89%
Plymouth	414	478	553	635	561	147	35%
Portage	245	218	238	259	282	37	15%
Snowville	167	164	178	162	141	-26	-16%
Tremonton	7,647	8,731	9,510	10,353	11,985	4,338	57%
Willard	1,772	1,945	2,036	2,182	2,545	773	44%
Other	9,187	9,452	8,971	9,305	9,308	121	1%
County Total	49,975	54,571	59,437	64,704	70,501	20,526	41%

Additionally, the loss of farmland in upland areas suitable for residential development may create a demand to drain and cultivate more farmland along the river. This could lead to further fragmentation of important wildlife habitat as well as displacement of wetland areas that currently act as buffers and filters and benefit water quality within the ecosystem. Furthermore, the quantity of water in the Bear River, especially in Box Elder County, is highly dependent on return flows from agriculture (UDWQ, 2010). In addition to water quality and potential flooding associated with increases in non-permeable land cover, storm water and runoff in developed areas is generally a relatively closed system. The quantity of water returned into river system in the form of is generally higher in agricultural areas than areas developed for commercial or residential uses (Welsh, Enter-Wada, and Kettenring, 2013).

The Bear River flood plain is not the most suitable place to build due to risks associated with flooding, high water tables, unstable soils and liquefaction. Historically, very few residences or other permanent structures were built within the flood plain. As discussed previously, however, riparian areas often attract new residents due to their natural environment and aesthetic allure, and



Figure 26: New home built adjacent to the River in 2013

there may be significantly more development along the river as population growth continues and new residents move north from the Wasatch Front in search of more rural properties and lifestyles. The residential development and water-ski park next to Highway 30 near Collinston is one example of new development that may become more common along the river in coming decades.

Changes in land use along the river, whether from residential development or changing agricultural uses, have the potential to displace significant areas of critical wildlife habitat and have detrimental effects on water quality and quantity within the system. While not immediately apparent in many cases, subtle changes in land use along the river should be closely monitored to evaluate the potential impacts of further development in sensitive areas.

Future Water Development. Utah is one of the driest state in the nation and also one of the fastest growing. Population growth within the study area (described above), the larger Bear River Basin, and even areas outside the watershed along the Wasatch Front, is increasing the pressure to develop additional water resources. As mentioned earlier, the Bear River is

considered one of the few areas in the state with a significant amount of developable water (DWRe, 2000) that could be tapped to support additional residential, commercial, and industrial development beyond the current capacity of our existing water systems and storage reservoirs.

The Utah Division of Water Resources (DWRe) is currently exploring development of the 220,000 acre feet that the 1991 Bear River Development Act allocated to the Bear River Water Conservancy District (BRWCD), Jordan Valley Water Conservancy District (JRWCD), Weber Basin Water Conservancy District (WBWCD), and Cache County. The potential development of this water has generated significant concern from conservation organizations, other government agencies, and the public. Concern is not only for reduced flows in the Bear River but also for the Great Salt Lake, which is experiencing historic low water levels that pose an imminent threat to ecological resources as well as brine shrimp and mineral industries. Removing an additional 220,000 acre feet of water that may otherwise end up in the Great Salt Lake has been estimated to reduce lake levels by as much as four feet and may have significant long term impacts to wildlife as well as a billion dollar mineral industry (Bioeconomics, 2012).

The *Bear River Pipeline Concept Report* (Bowens, Collins and Associates and HDR Engineering [BCA and HDR], 2014) provides details regarding the research and planning efforts undertaken by DWRe. It includes evaluation of potential diversion sites, water storage facilities, and conveyance infrastructure that would supply each of the entities with the water allocated by the 1991 Development Act. Potential water diversions from the Bear River identified in this study are directly upstream of Cutler Reservoir, within Cutler Reservoir, below Cutler Dam near Collinston, and near the I-15 crossing of the Bear in Box Elder County (BCA and HDR, 2014). Potential water storage sites have been narrowed from approximately forty-five initial sites to seven that are currently under consideration. As shown in Map 21, sites currently considered as

potential reservoir sites include the Cub River west of Richmond, Temple Fork in Logan Canyon, above Cutler Reservoir near Newton, the Washakie area near Portage, White's Valley northwest of Tremonton, a dam directly on the Bear River near Fielding, and an area adjacent to Willard Bay. According to the Pipeline Concept Report, not all of the potential sites would need to be developed, but a combination of at least two or three would probably be necessary to ensure a reliable supply of 220,000 acre feet of water (BCA and HDR, 2014).

The Jordan River Water Conservancy District and Weber Basin Water Conservancy District have already obtained land for a water treatment facility to process their allocated water from the Bear River. Cache County, the only entity that wasn't a Water Conservancy District at the time, completed a water master plan in 2013 that identified developing their allocated 60,000 acre feet of water as a priority for meeting future water needs above Cutler Dam (Cache County, 2013) and maintaining their allocation of the water amidst the increasing pressure for development downstream to service the Wasatch Front. This notion was largely supported by local voters, who finally passed a proposition to form a water conservancy district in Cache County in November 2016 after the measure had failed two previous times in past years.

At one time, the Division of Water Resources estimated that water from the Bear River would need to be developed by 2015 (Utah Department of Natural Resources, 2017). More recent estimates, which lead to the Bear River Pipeline Concept Report, showed that the water would be needed by 2040. Following much criticism for underestimating the potential savings from water conservation efforts as an alternative to additional water development, as well as an audit requested by the Utah Legislature (State of Utah Legislative Auditor General, 2015), the Division of Water Resources announced that the project could actually be postponed even further into the future (Utah Department of Natural Resources, 2017).

Map 21: Potential Reservoir Sites



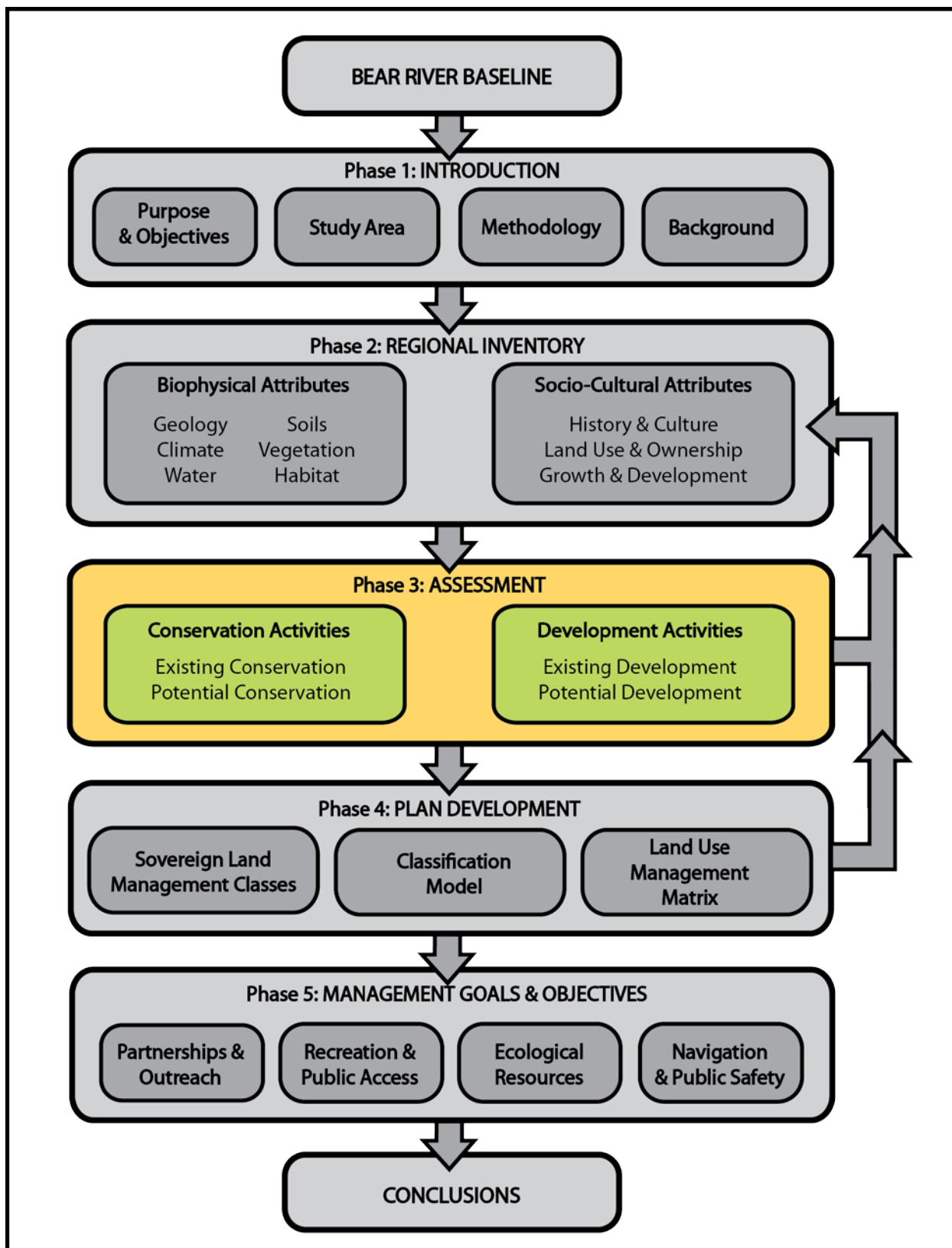


Figure 27: Assessment Diagram

Phase 3: Assessment

The primary objective of the Assessment is to use information gathered during the Regional Inventory to create spatial representations, or models, of resources relevant to the management of sovereign lands along the river. “A model is a rehearsal for reality, a way of making a trial that minimizes the penalties for error” (Judson, 1980, p 12). Models developed in this section include existing and potential areas of conservation, as well as existing and potential areas for resource development. Based on an objective of using commonly available data to facilitate replicability, the models presented in this section are fairly straightforward.

Relatively complex models and studies such as those employed by The Nature Conservancy, the U.S. Fish and Wildlife Service’s Land Protection Plan (2014), Division of Wildlife Resources Wildlife Action Plans (2005; 2015a), and others have already identified the river corridor as a critical area for conservation, which is a very important designation at the landscape level. However, most studies have generally focused only on conservation, and have not integrated existing or potential future development into the models. They have also not provided any prioritization of different areas within the river corridor.

The following section includes models for individual criteria as well as integrated conservation priorities and development opportunity models. Integrated conservation and development models will be carried forward into Phase 4 (Plan Development) and used to classify lands along the river into established sovereign land management classes.

Conservation Activities

This objective of this section is to identify areas that have already been established for conservation activities as well as potential areas for future resource conservation along the river.

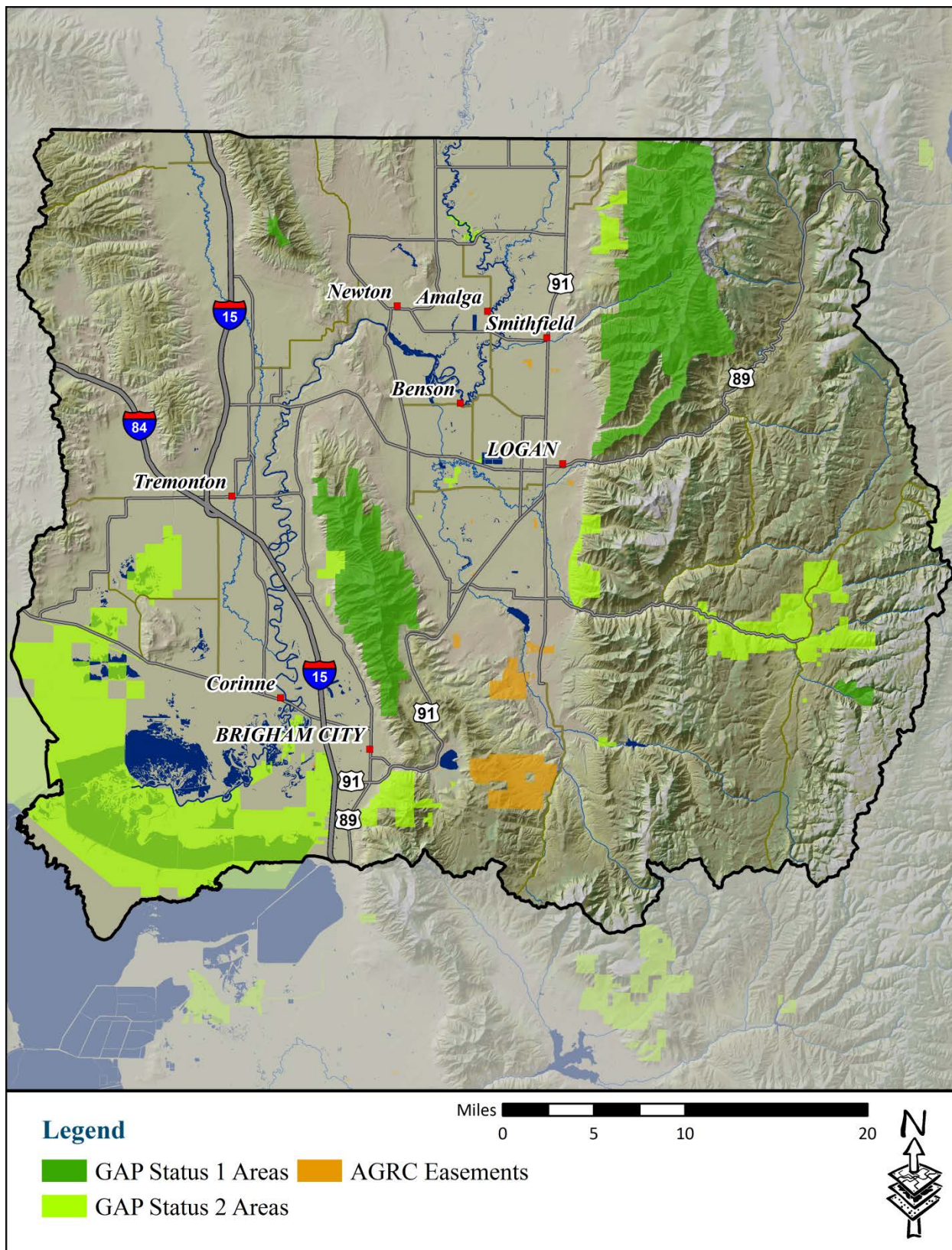
Existing Conservation

Protected Areas Database for the United States (PAD-US). The dataset used to identify existing conservation is the Protected Areas Database of the United States (PAD-US). PAD-US is a nationwide dataset maintained by the United States Geological Survey (USGS) National Gap Analysis Program (GAP) and includes thousands of parcels owned or managed by government agencies and conservation organizations throughout the United States (United States Geological Survey Gap Analysis Program [USGS GAP], 2016).

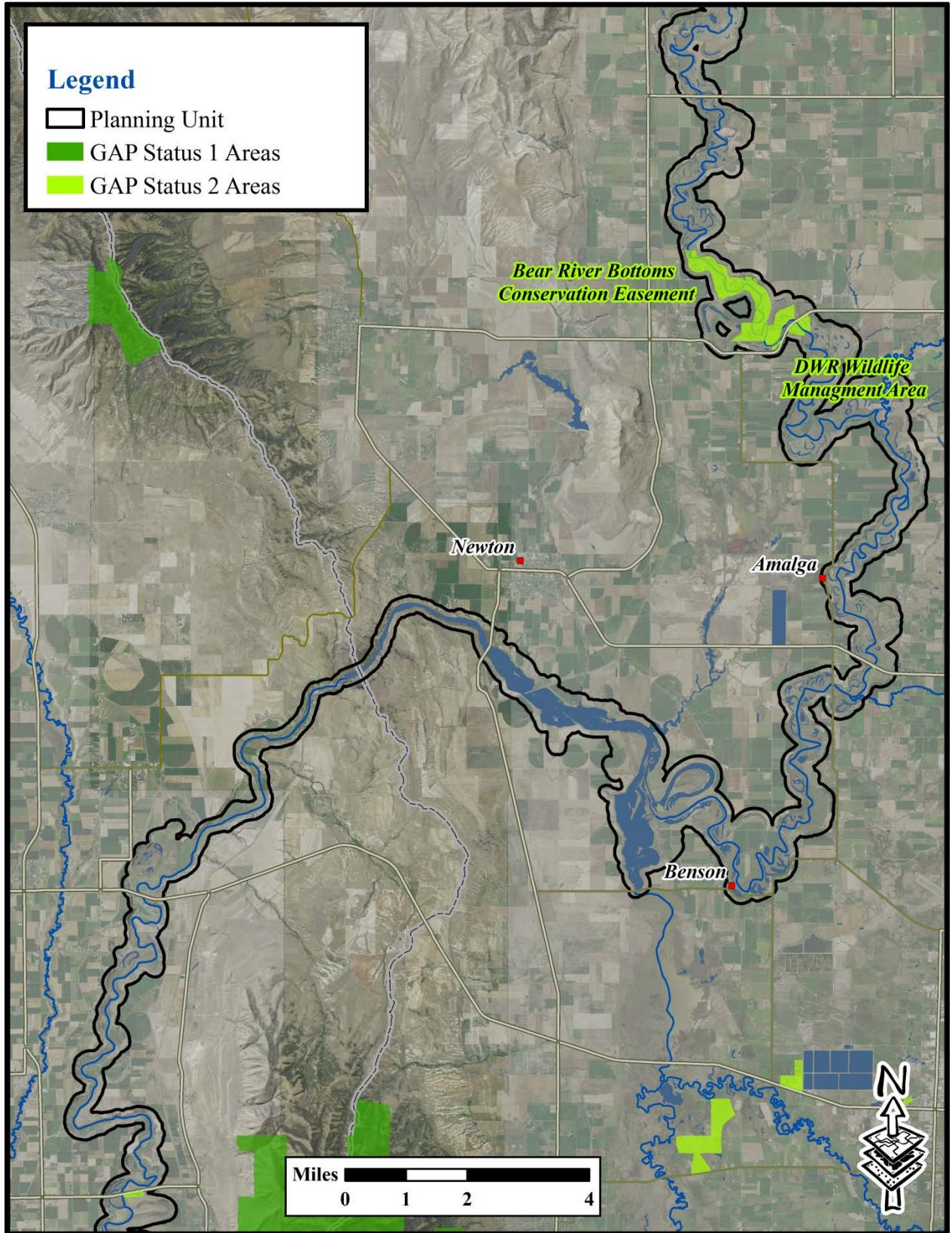
PAD-US data identifies four status classes based on level of protection or conservation management. Status 1 and 2 areas are generally regarded as having an adequate level of conservation management (USGS GAP, 2000) and include wilderness areas, wildlife refuges and management areas, and perpetual conservation easements. Status 3 areas are often owned or managed by a public agency but may allow resource extraction, off highway vehicle use, or other activities that could conflict with conservation values. Status 4 areas are also usually owned or managed by public agencies, but have no mandate for resource protection. Since this dataset is being used to identify existing conservation, only Status 1 and Status 2 areas will be included.

Three Status 1 and Status 2 areas exist along the Bear River. The Bear River Bottoms Conservation Easement property in Cache County is owned by PacifiCorp and managed by the Bear River Land Conservancy. The second is a Wildlife Management Area managed by Utah Division of Wildlife Resources, situated directly south of the Bear River Bottoms property where Highway 142 crosses the River in Cache County. Finally, the Bear River Migratory Bird Refuge is owned and managed by the U.S. Fish and Wildlife Service, and is a relatively large area where the River approaches the Great Salt Lake. Map shows protected areas in the study area, while Map 23 and Map 24 show a closer view of relevant areas within the planning unit.

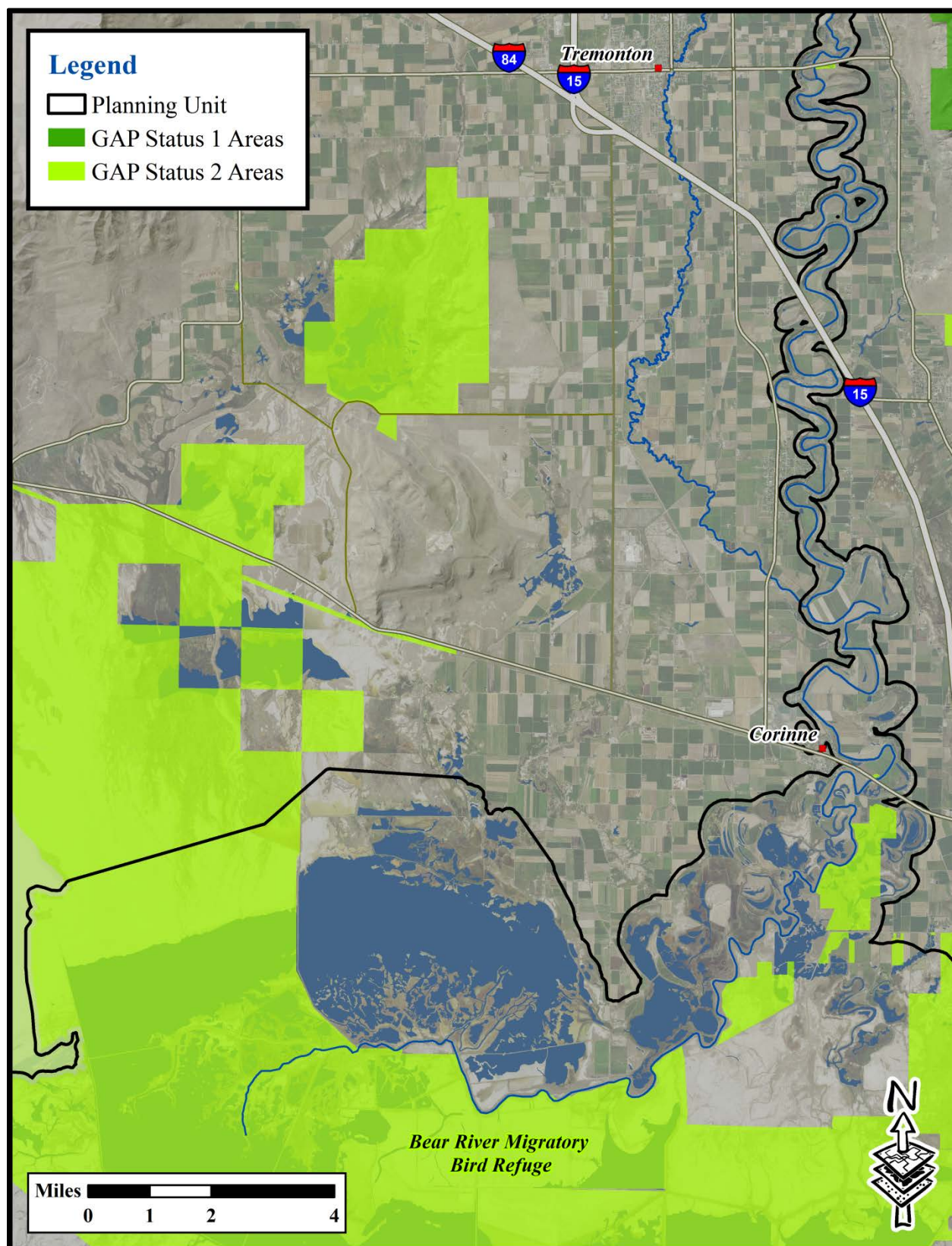
Map 22: Protected Areas in the Study Area



Map 23: Protected Areas in Northern Section



Map 24: Protected Areas in Southern Section

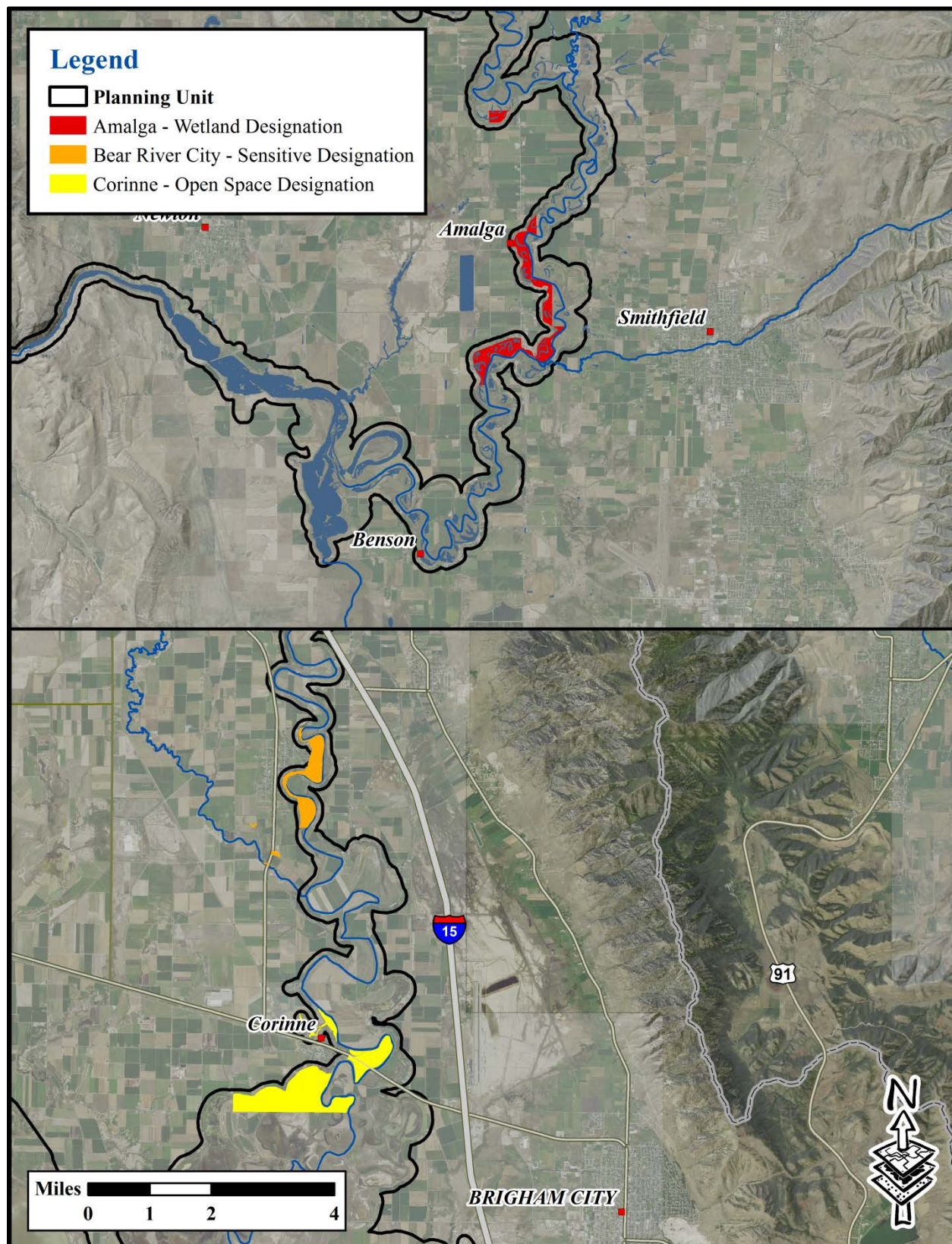


Potential Conservation

Local Zoning Designations. In addition to state and federal land management agencies, counties and local municipalities often create zoning designations due to the presence of sensitive resources or an established public benefit such as open space resources. Three areas along the river have been given local zoning designations that imply restrictions to development (see Map 25). The Town of Amalga has a designated “Wetland” zone adjacent to the river (red). Bear River City has established the area adjacent to the river as “sensitive” in their ordinances (orange). And, Corinne has designated a portion of land adjacent to the river as “Open Space” (yellow). While these designations may not be fully restricted from development or provide permanent protection, they are indications of sensitive or valuable areas at the community level and usually include some limitation to the amount and type of development occurring on those lands. Based on local designations, the three areas shown in Map 25 have been included in the model for potential conservation.

Important Wildlife Habitat. As discussed in the wildlife section of the Regional Inventory (Phase 2), the Bear River Corridor is well established as an important resource for various species of wildlife, and particularly avian species. This section presents a spatial model of important avian habitat along the river. While avian species are not the only type of wildlife that uses the river or adjacent land areas, they are arguably the most important within the context of the Bear River. Moreover, habitat supporting avian species is also likely to support a number of other wildlife species and avian species have often been proposed as indicators of ecosystem integrity (Croonquist and Brooks, 1991; Morrison, 1986; Sanders and Edge, 1998; Young et al., 2013). It is important to note that it is not necessarily a particular species that is of interest, but rather the type of habitat that it represents.

Map 25: Local Zoning Designations



A number of environmental organizations, resource agencies, and/or partnerships have already developed lists of priority avian species for conservation within the region. For a more detailed description of some of these organizations, prioritized species, and specific geographic areas they include, refer to the Intermountain West Joint Venture's Coordinated Implementation Plan for Bird Conservation in Utah (2005). The Utah Division of Wildlife Resources (DWR) has identified a number of sensitive species throughout the State of Utah that includes federally listed threatened and endangered species as well as state designated sensitive species (DWR, 2005; DWR, 2015a; DWR, 2015b; DWR, 2015c). The U.S. Fish and Wildlife Service has designated regional priorities within the Mountain Prairie Region as well as priority species for the Bear River Migratory Bird Refuge (USFWS, 2015; USFWS, 2016). The Nature Conservancy includes priority species in their Great Basin and Utah/Wyoming Rocky Mountain Ecoregional Assessments (IWJV, 2005). Finally, the Utah Working Group of Partners in Flight has identified 24 priority species in their Utah Avian Conservation Strategy (Partners in Flight, 2002).

These four lists of priority species have been used to select representative species for the identification of important habitat along the Bear River. In total, these lists include 114 different bird species considered as priorities within the region. If all 114 species were included, the vast majority of the study area and the entire river corridor would be identified as critical habitat. As identified in the Regional Inventory, it is already well established that the Bear River Corridor is important habitat for avian species (TNC, 2010; DWR, 2005; TNC, 2010, WGWC, 2013). While this is a valid and important observation, the objective of this study, and particularly this model, is to establish priority areas for conservation. Consequently, a series of criteria (questions) have been established to narrow the list of indicators for critical habitat.

Species distribution models developed by the USGS GAP Species Program, and available for thousands of species across the United States (USGS GAP, 2011), were used to identify habitat areas for the avian species under consideration. The following questions (criteria) were used to establish a subset of indicator species that represent habitat types operationally significant to the management of the Bear River. Appendix A provides a list of all species identified in the four priority lists and illustrates which species were maintained or eliminated from consideration based upon the following questions and criteria.

1. Is the species listed on more than one of the identified priority lists?
2. Is there identified habitat within the flood plain of the Bear River?
3. Is the species considered riparian, or do they have a specific relationship to the river?
4. Is habitat limited, moderate, or widespread within the area?
5. Do the remaining species share similar habitat types (i.e., is there redundancy)?

Ultimately, four bird species were selected as indicators for important habitat areas along the river. These four species include snowy plover (*Charadrius nivosus*), yellow-billed cuckoo (*Coccyzus americanus*), redhead (*Aythya americana*), and American avocet (*Recurvirostra americana*). Again, the particular species is not as important as the type of habitat it represents. Yellow-billed cuckoos use wooded habitat with dense cover and water nearby. Snowy plovers use more sparsely vegetated habitats such as sparsely vegetated beaches, levees, river bars, and edges of ponds. Redheads use seasonal ponds and wetlands deeper marshes, and river pools and bays. American avocets tend to use shallow freshwater and saltwater wetland areas and edges of water in relatively open areas.

Of the four identified species, yellow-billed cuckoo represents the most limited habitat type within the flood plain, mainly forested areas adjacent to or within is also federally listed as a threatened species with protection under the Endangered Species Act. Due to its scarcity, habitat for the yellow-billed cuckoo has been given a higher priority in the modeling. For the other three species, ArcGIS software and its raster calculator tool were used to identify areas providing habitat for at least two of the three species. The key concept is to identify areas containing multiple habitats where conservation activities may have the highest value. Figure 28 provides a conceptual diagram of how the model was put together and Map 26 and Map 27 show the resulting habitat areas in the planning unit.

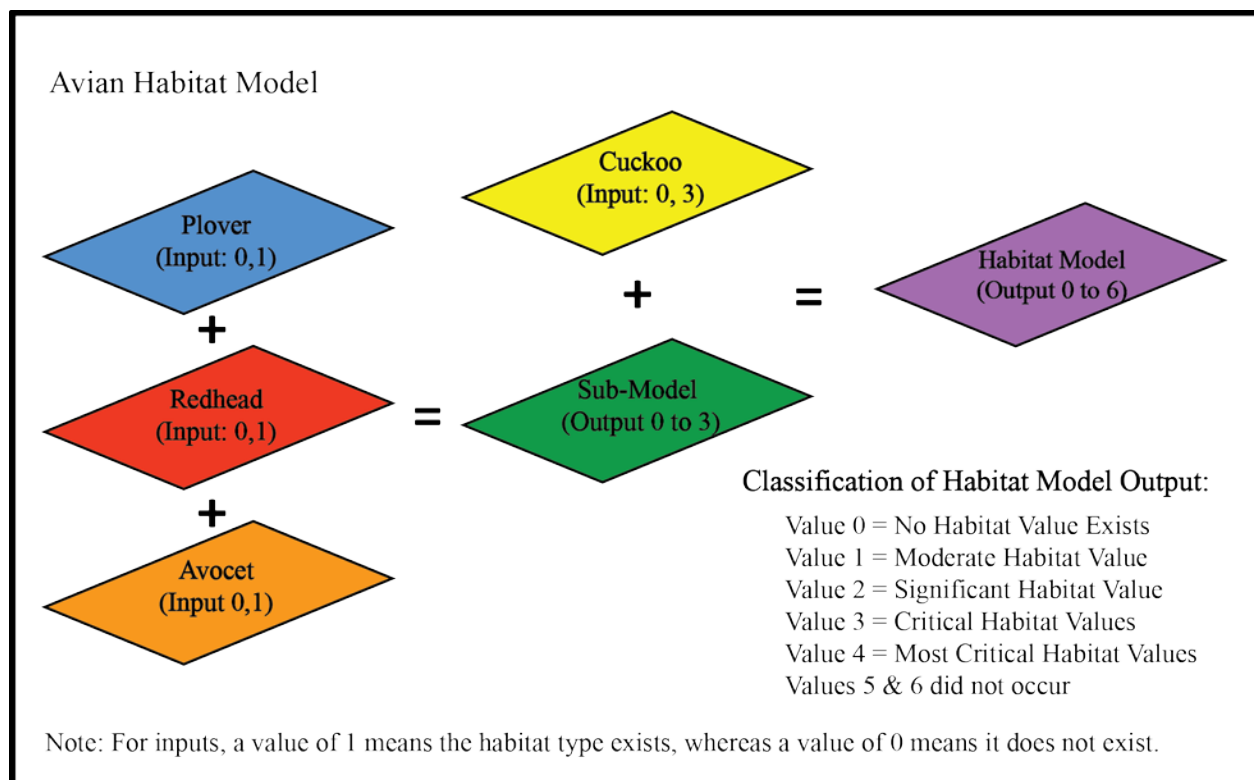
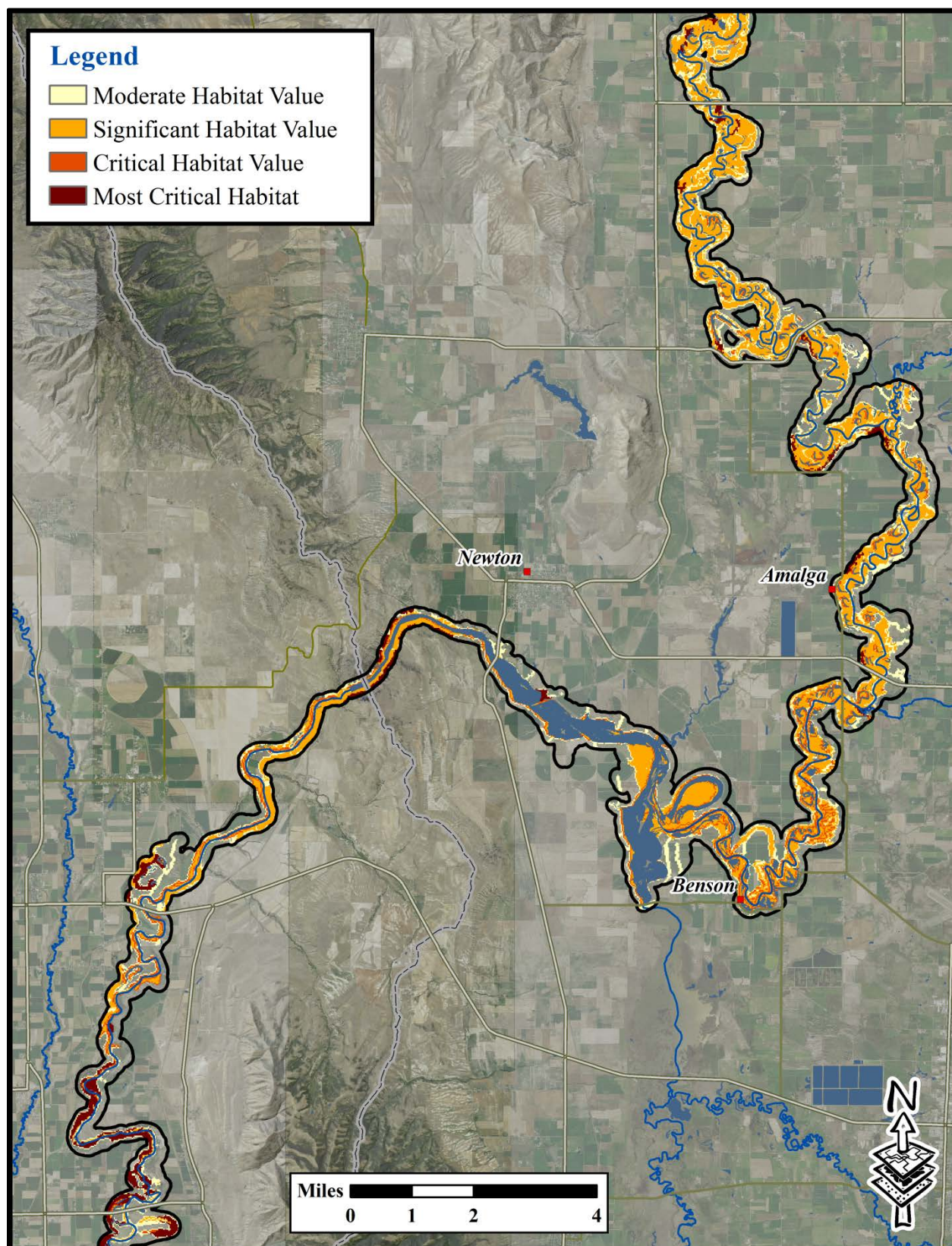
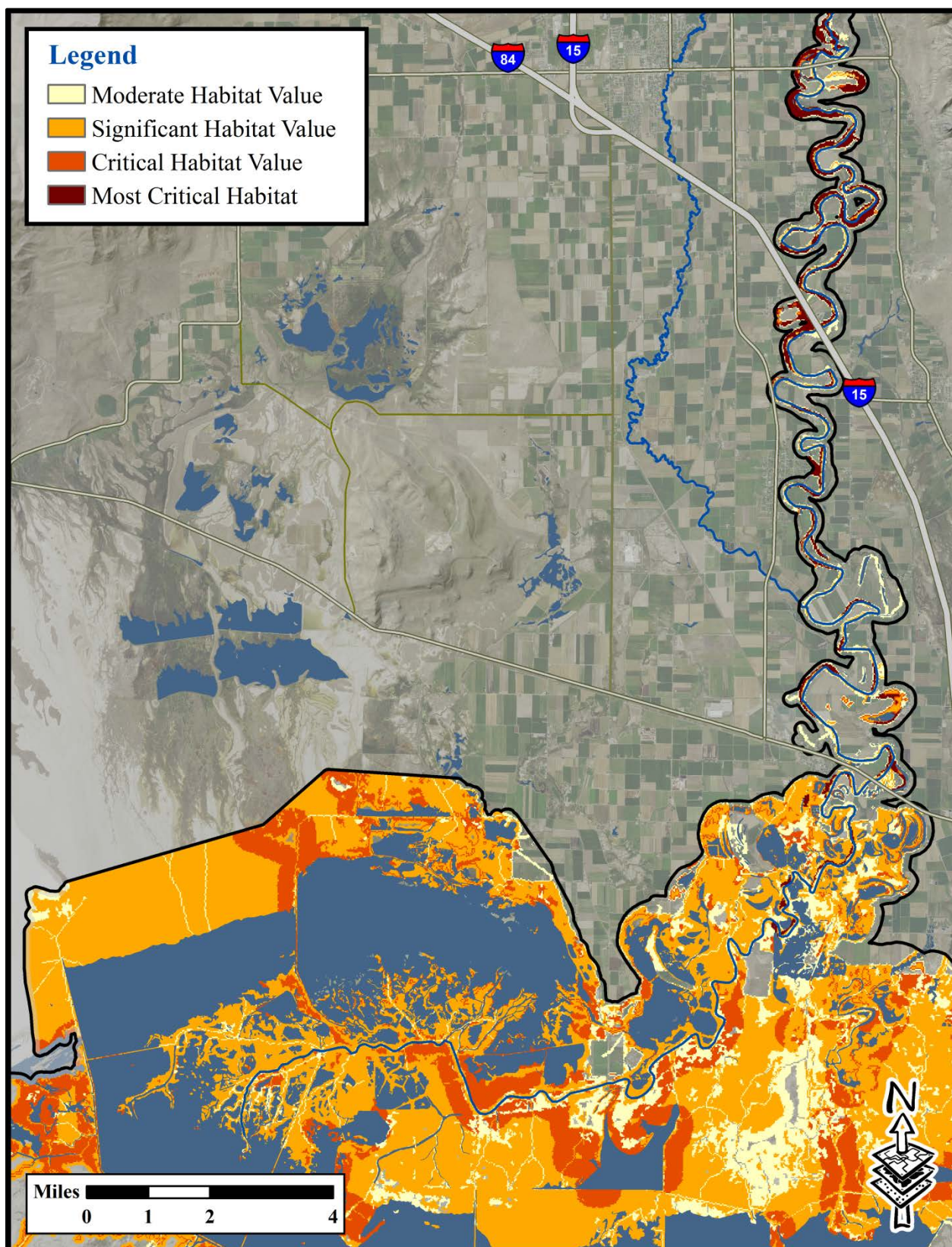


Figure 28: Avian Habitat Model Diagram

Map 26: Avian Habitat in Northern Section



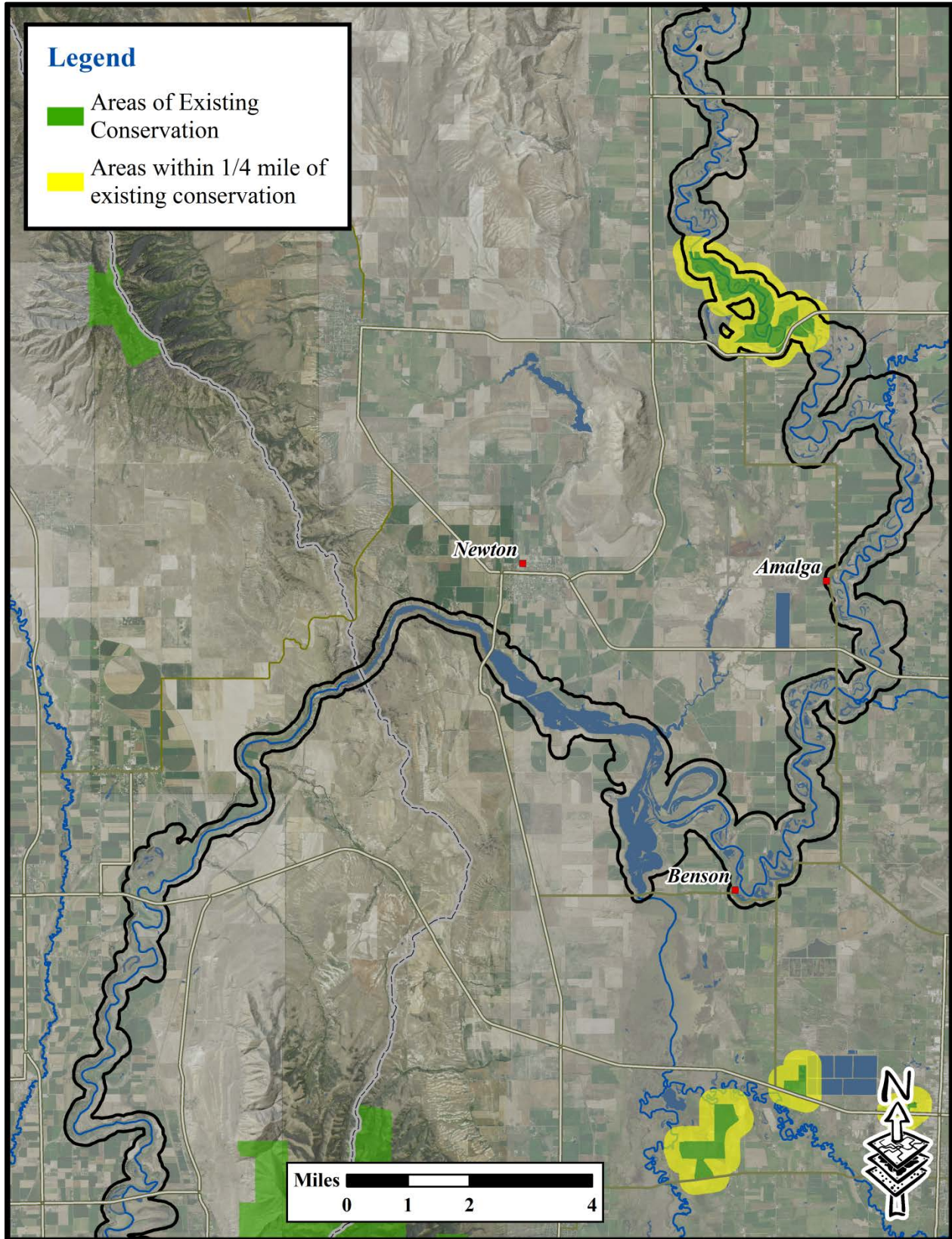
Map 27: Avian Habitat in Southern Section



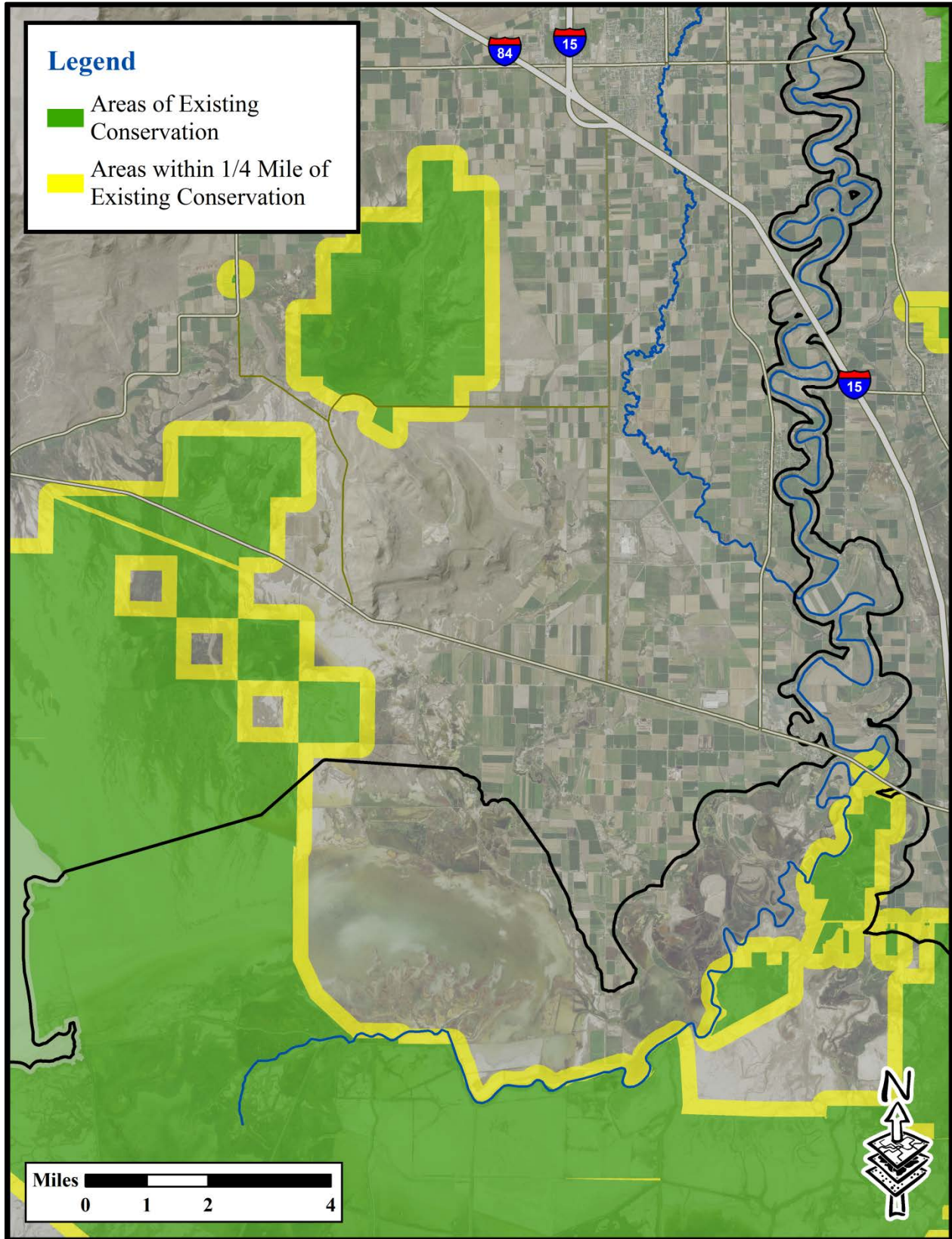
Areas Adjacent to Existing Conservation. An additional consideration for areas of potential conservation is proximity to areas of existing conservation. Enlarging or adding to areas of existing conservation may be more valuable than conserving individual, isolated areas. The key concept is that areas adjacent to or nearby lands that have already been preserved are likely to share some of the same conservation values and may help to reduce fragmentation and create additional connectivity of habitat in the landscape.

For example, expanding existing conservation areas near the Bear River Migratory Bird Refuge in the lower reaches of the Bear River by one quarter mile would pull three individual conservation areas together to create a more cohesive corridor nearly all the way from Corinne through the Refuge and into the Bear River Bay of the Great Salt Lake. Consequently, areas within one quarter mile of existing conservation areas that were presented in Map 23 and Map 24 are included as areas for potential resource conservation and identified in Map 28 and Map 29.

Map 28: Areas within 1/4 Mile of Existing Conservation in Northern Section



Map 29: Areas within 1/4 Mile of Existing Conservation in Southern Section



Composite Conservation Model

A composite conservation model was developed by combining the data from the models presented in all of the preceding maps in this section. It includes the following criteria: 1) areas of existing conservation, 2) locally zoned sensitive areas, 3) critical avian habitat (values 3 and 4 from the model), and 4) areas within one quarter mile of existing conservation. Figure 29 provides a diagram illustrating how the model was put together. Map 30 and Map 31 provide a spatial representation of the resulting model.

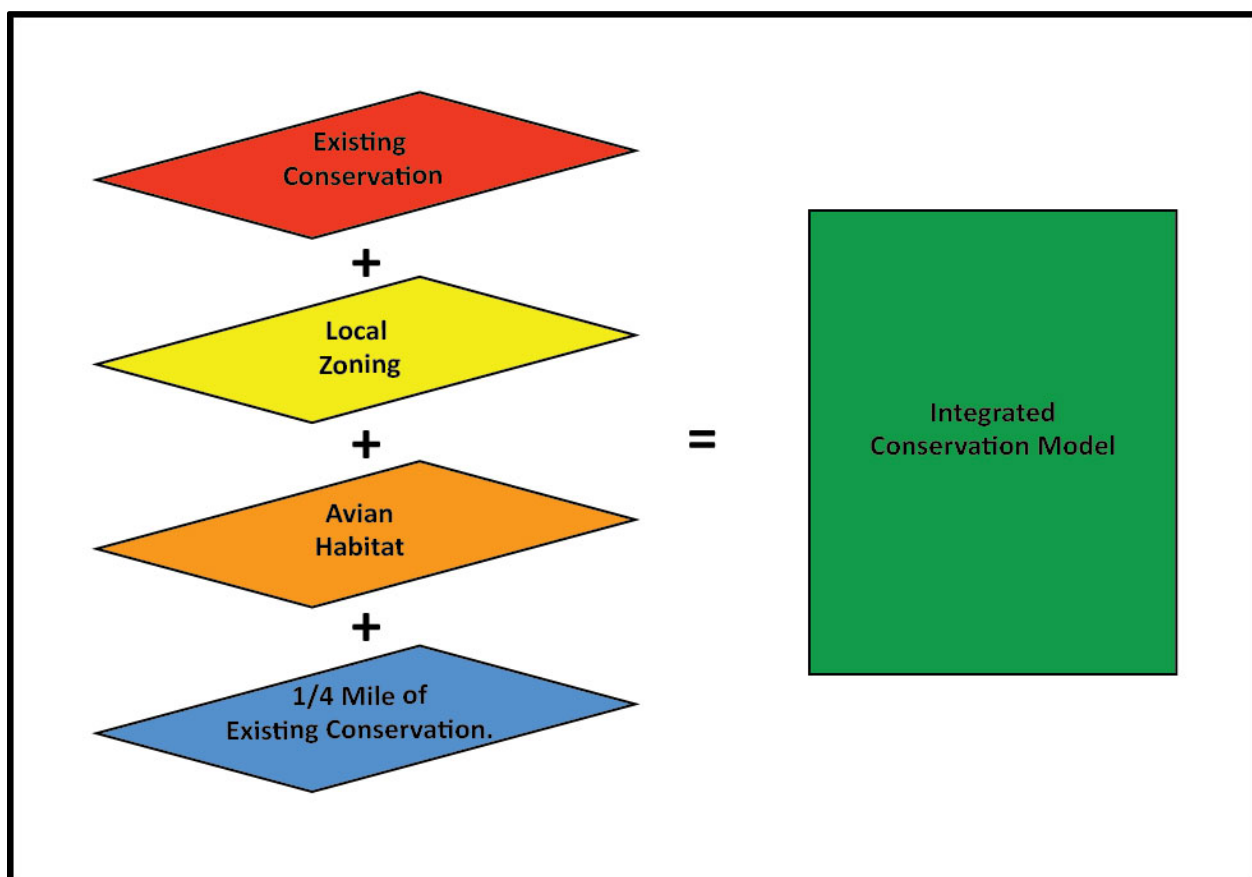
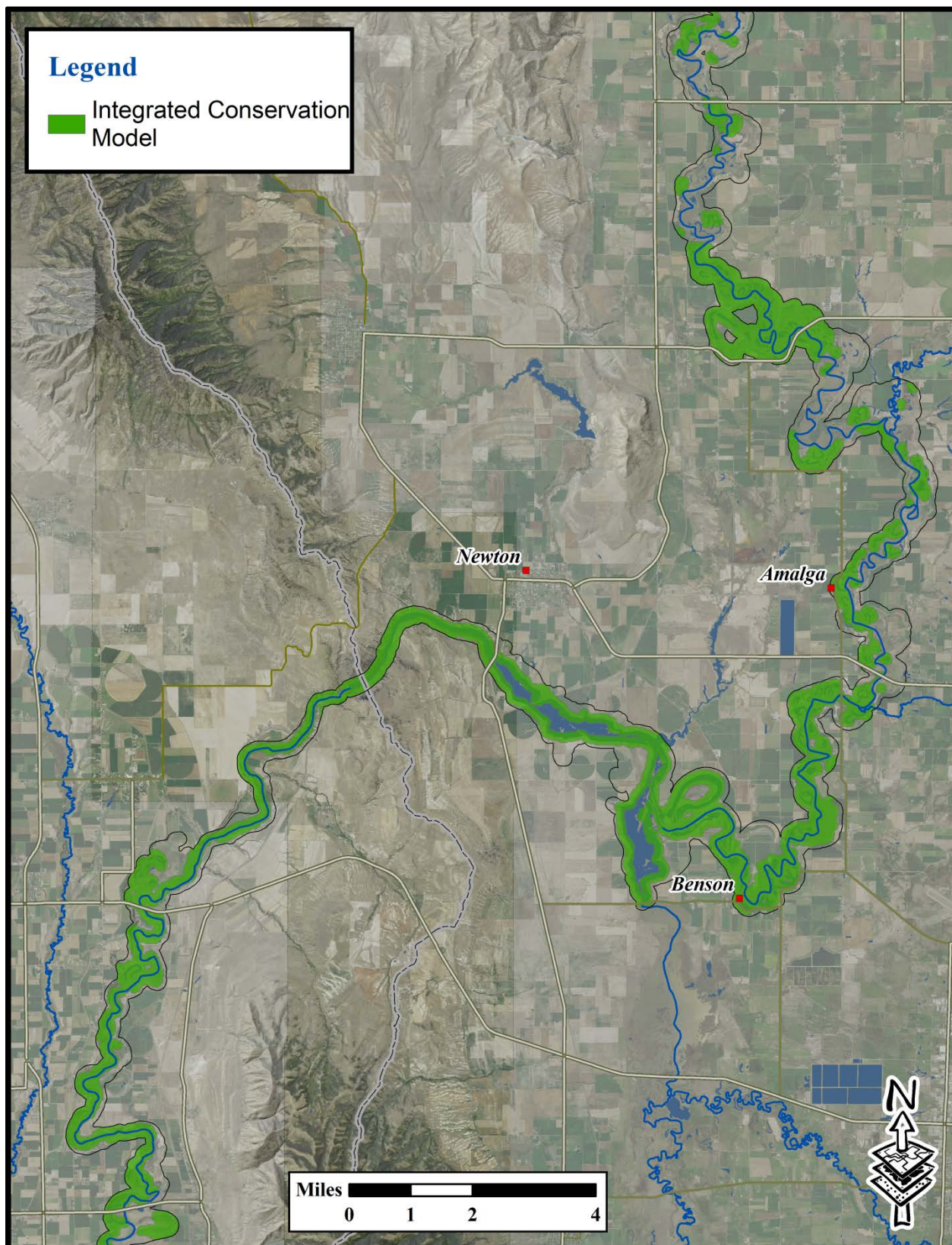
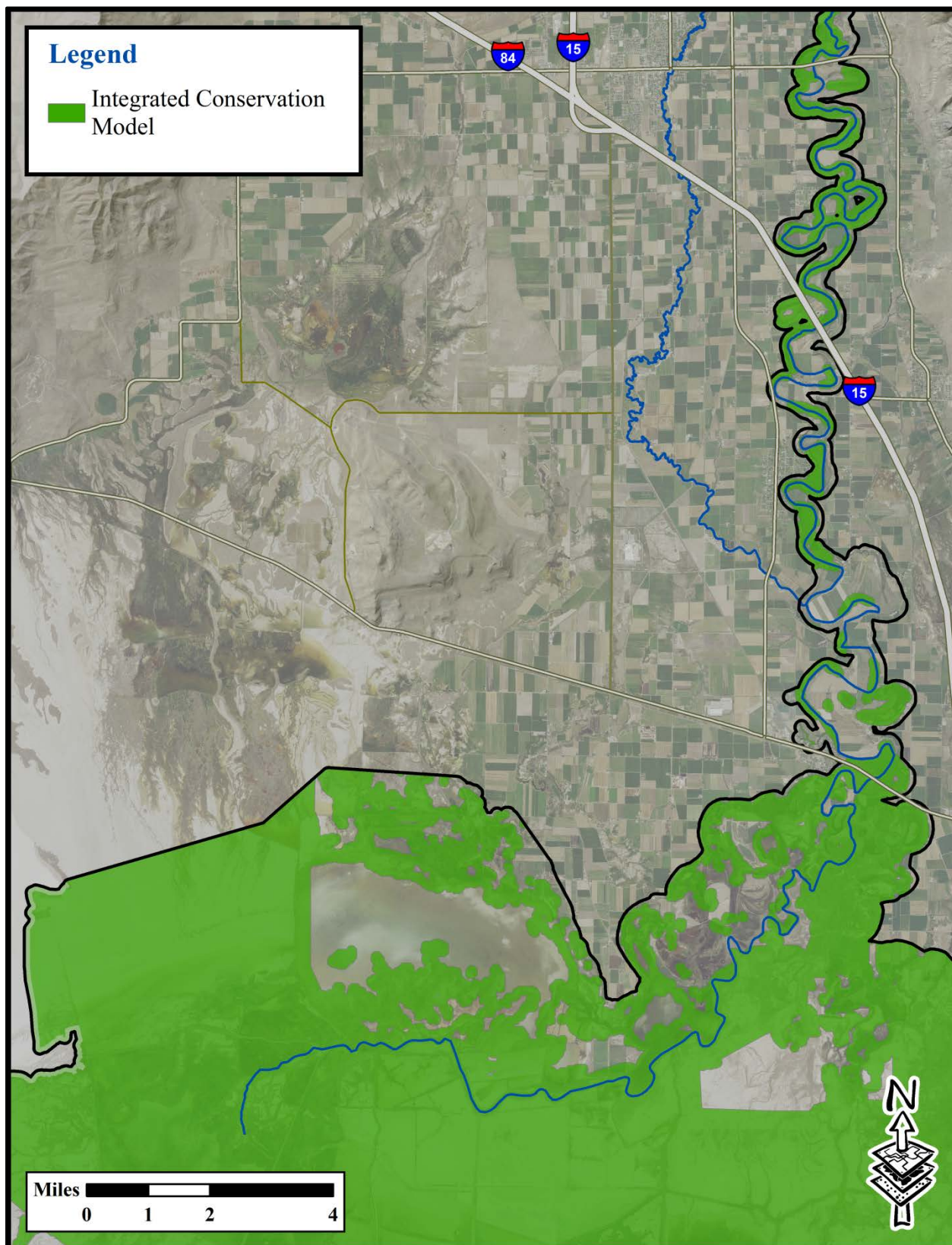


Figure 29: Diagram of Composite Conservation Model

Map 30: Integrated Conservation Model in Northern Section



Map 31: Integrated Conservation Model in Southern Section



Development Activities

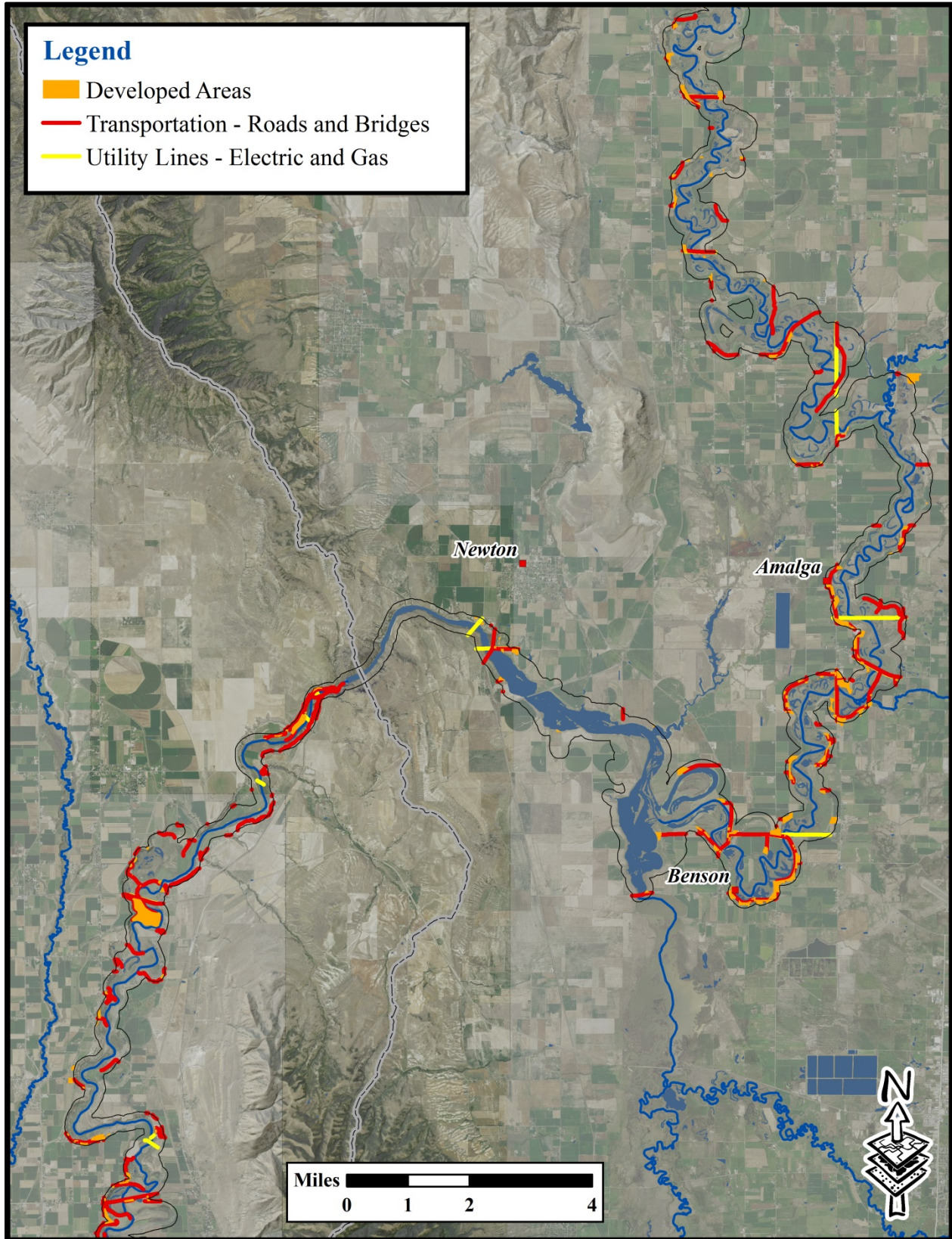
The majority of developed uses along the river are transportation infrastructure, utility lines, agricultural infrastructure, and recreational structures. The largest developed use along this segment of the Bear River is Cutler Reservoir, which has been in place since 1927. While the Division of Forestry, Fire and State Lands (FFSL) is the management authority for uses existing on, over, or under the riverbed, many structures and developed uses have never been officially permitted due to lack of a clear management plan and inadequate staffing and resources needed to implement the permitting process.

Existing Developed Uses

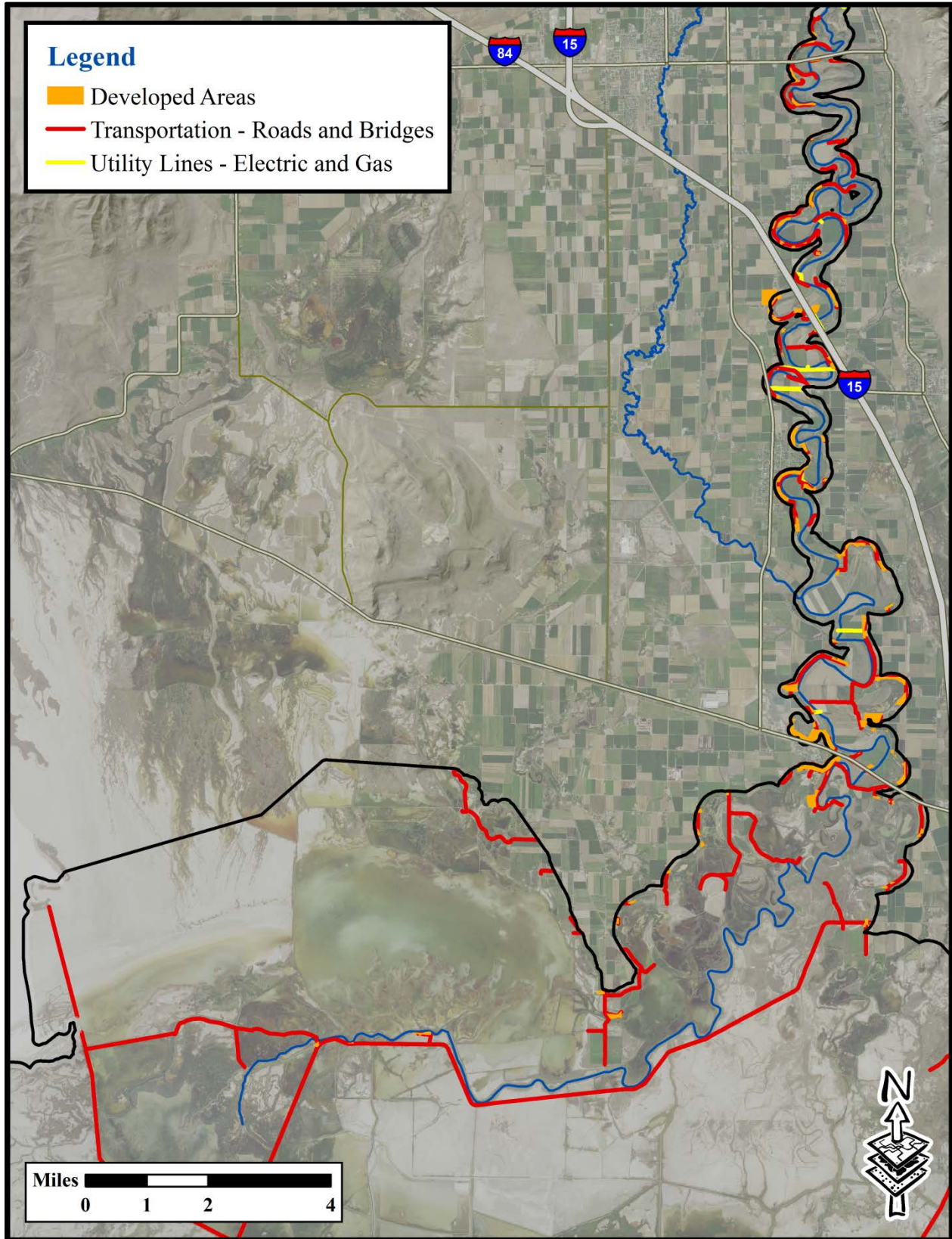
Two datasets evaluated to represent existing developed uses were from the USGS Gap Analysis Program (GAP) (2011b) and the National Land Cover Database (NLCD) (Homer et al., 2015). However, comparisons of the data with aerial imagery showed several developed areas that were not captured by the datasets. One explanation could be that areas were developed after GAP and NLCD data were created. However, it is likely the data are simply too coarse. Consequently, aerial imagery was used to identify developed areas such as residences, industrial plants, farmsteads and other infrastructure. Due to the labor intensive process of identifying these features and creating a dataset from the aerial imagery, this dataset and subsequent development models are limited to areas within the planning unit.

In addition to the dataset created for developed areas, several electrical transmission lines, highway bridges, and even a rail line cross the Bear River within the study area. To represent these features, a combination of data available from the Utah AGRC (roads and rail layers) was used in conjunction with aerial imagery and data gathered during the 2013 inventory that was conducted as part of this project. These features were also limited to the planning unit.

Map 32: Existing Developed Uses within the Northern Section of the Planning Unit



Map 33: Existing Developed Uses within the Southern Section of the Planning Unit



Potential Developed Uses

Residential and commercial developments exist in some areas of the planning unit but are not frequently found adjacent to the river. Although there are exceptions, such as the water ski park and new residences near Highway 30 in Box Elder County, people have historically avoided building in the flood plain. Developed areas are still considered in the potential development model because there is a higher likelihood of associated uses such as utility lines, irrigation pumps, and recreational structures where commercial or residential uses occur within or near the river corridor. It is also reasonable to assume that developed uses are most likely to occur along existing roads and/or nearby other existing infrastructure. Figure 30 provides a diagram and the criteria that were used to establish areas of potential development. Map 34 and Map 35 show the resulting model of areas for potential developed uses.

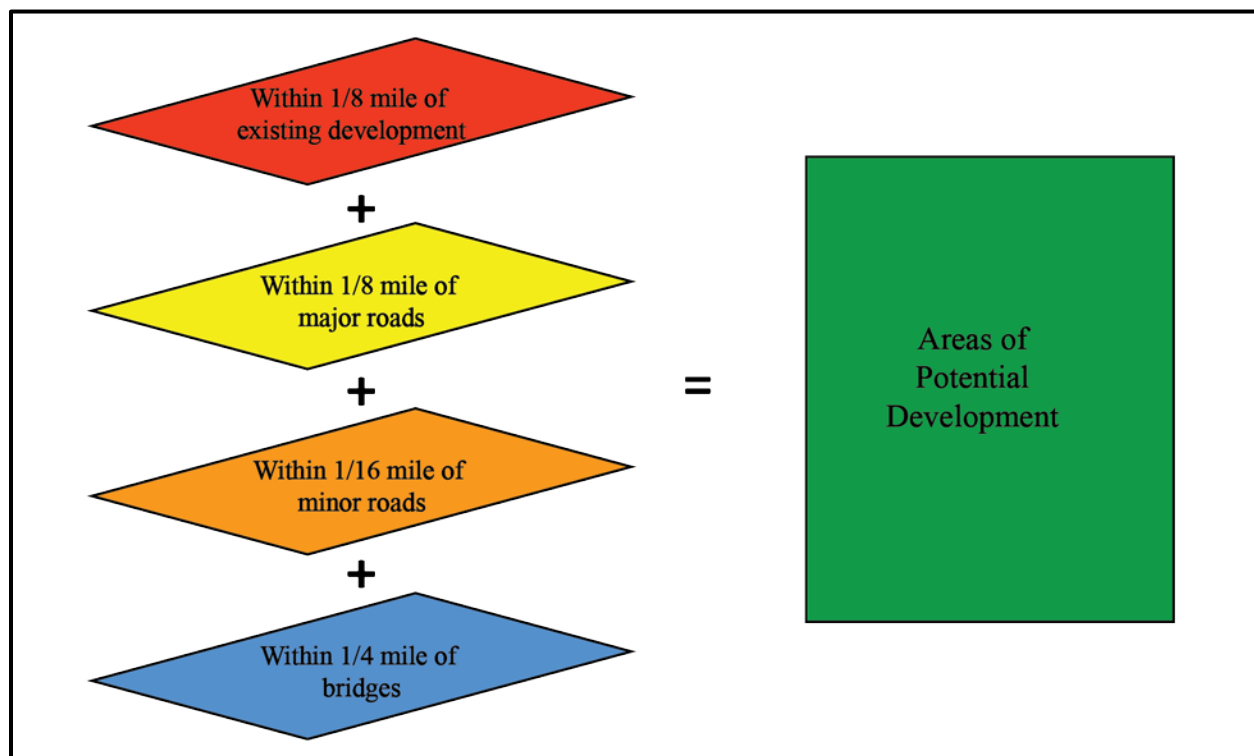
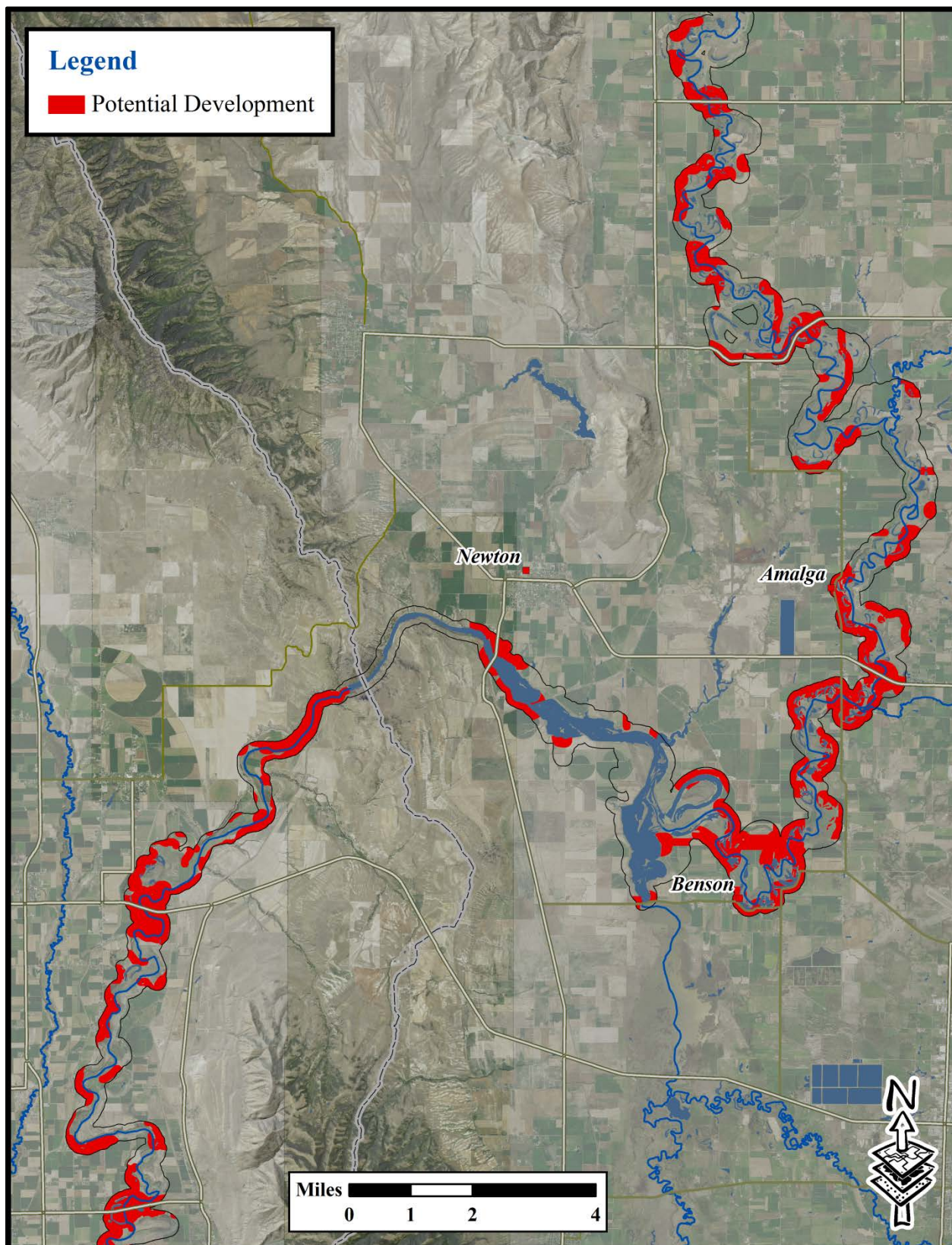
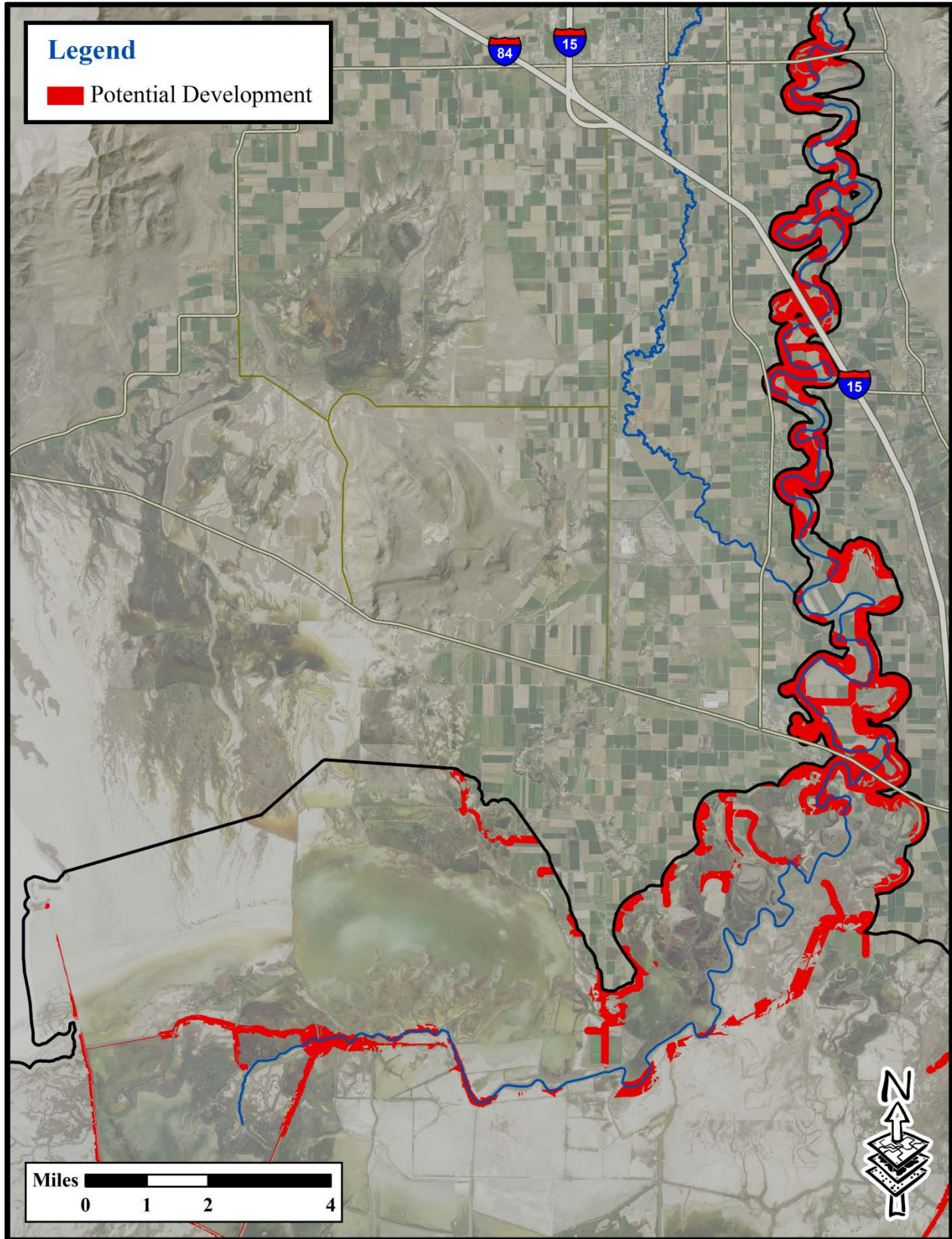


Figure 30: Diagram of Composite Development Model

Map 34: Potential Development in Northern Section



Map 35: Potential Development in Southern Section



Composite Development Model

In a similar fashion to the composite conservation model, the composite development model was created by combining the data representing existing and potential developed uses. In this case, it has not been mapped separately because it is essentially the same data presented in the model for potential developed uses. It is, however, necessary to combine all the data into a single dataset to carry it forward into the next phase of the project, Plan Development.

It is important to note that areas represent a very broad definition of development that could include uses such as utilities, pumps, and recreational infrastructure among many other types of uses. Furthermore, the areas presented in the development models are not necessarily areas that are recommended for development, but are simply areas where developed uses are foreseeable.

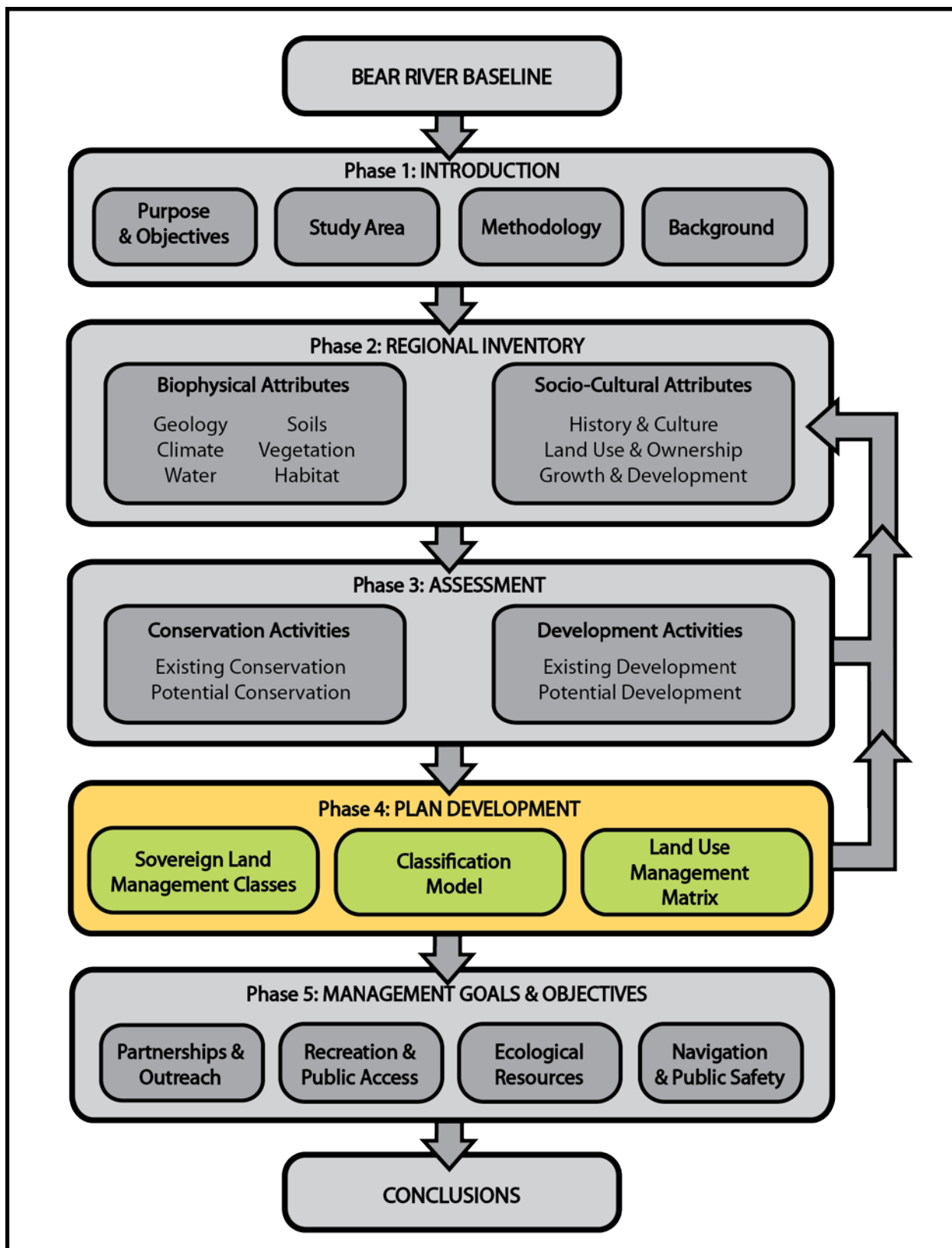


Figure 31: Plan Development Diagram

Phase 4: Plan Development

The primary objective of the Plan Development Phase is to employ models developed in the Assessment (Phase 3) to delineate management classifications for sovereign lands along the Bear River. Additionally, a number of commonly occurring land uses and activities observed along the river are included in a land use matrix that provides recommendations and guidance regarding which types of uses and activities may be considered allowable within each management classification.

Sovereign Land Management Classes

Table identifies six management classes provided in Utah Administrative Code (Section R652-70-200) for all sovereign lands in the State, along with a brief description and examples along the Bear River.

Table 9

Utah's Sovereign Land Management Classifications		
Class #	Management Objective	Description/Examples along Bear River
Class 1	Protect existing resource development uses.	Existing developed areas and structures, such as Cutler dam, highway bridges, developed recreational access points, etc.
Class 2	Protect potential resource development options.	Potential public access areas, areas adjacent to existing roads and utility corridors, and areas nearby residential or agricultural developments.
Class 3	Manage as open for consideration of any use.	Areas with few development opportunities and relatively low or unidentified conservation values. Not common along the Bear River.
Class 4	Further resource inventory and analysis needed.	Areas of potential conflict between development activities and conservation values, such as the Highway 102 crossing.
Class 5	Protect potential resource preservation options.	Areas of critical wildlife habitat, areas adjacent to existing conservation activities, or areas with local zoning such as the Corinne's Open Space Designation.
Class 6	Protect existing resource preservation uses.	Protected areas or areas where conservation activities are already taking place, such as the Bear River Migratory Bird Refuge and Bear River Bottoms Conservation Easement.

Classification Model

We already have models for existing development and existing conservation that were developed and presented during the Assessment in Phase 3. Existing uses generally take priority over potential future uses in sovereign lands management unless there is an extraordinary need that dictates otherwise. Consequently, the existing development and existing conservation models are carried forward here to provide the delineation of Class 1 and Class 6 areas.

In order to classify sovereign lands along the Bear River into the four remaining management classes in Table , an approach used previously in Uintah Basin, Revisited (Toth et al, 2013) and Alternative Future Growth Scenarios for Conserving Open Space along Utah's Wasatch Front (Toth et al, 2004) has been adapted and employed in this study of the Bear River. The primary advantage of this approach is that it is relatively simple, flexible, and easily replicated – either to use in other planning studies or to update as new information or better data is obtained, additional criteria for conservation or development are defined, or other improvements are made to the any of the conservation and development models presented in the Assessment.

The integrated conservation and development models presented in Phase 3 (Assessment) are used to identify: 1) areas for potential development, 2) areas for potential conservation, 3) areas open to consideration for any use, and 4) areas requiring further inventory or analysis. Areas where potential developed uses and activities may be foreseeable but significant conservation values have not been identified will be delineated as Class 2 areas for potential resource development. Areas where significant conservation values exist but the potential for developed uses and activities has not been identified will be delineated as Class 5 areas for potential resource conservation activities. Areas where neither significant conservation value nor

potential developed uses and activities are foreseeable are delineated as Class 3 areas that are open for consideration of any use. Finally, areas where both significant conservation values and the potential for developed uses and activities are foreseeable can be classified as Class 4 areas that need further resource inventory and analysis. In other words, the Class 4 areas are where it is possible, if not likely, that there will be conflict between developed uses and activities and conservation values. These areas will be particularly important for managers to evaluate further to determine appropriate uses and will likely require site-specific planning in order to determine the possibility and method for mitigating the impact of any proposed use on the sensitive resources present. Map 36 and Map 37 show the resulting spatial model.

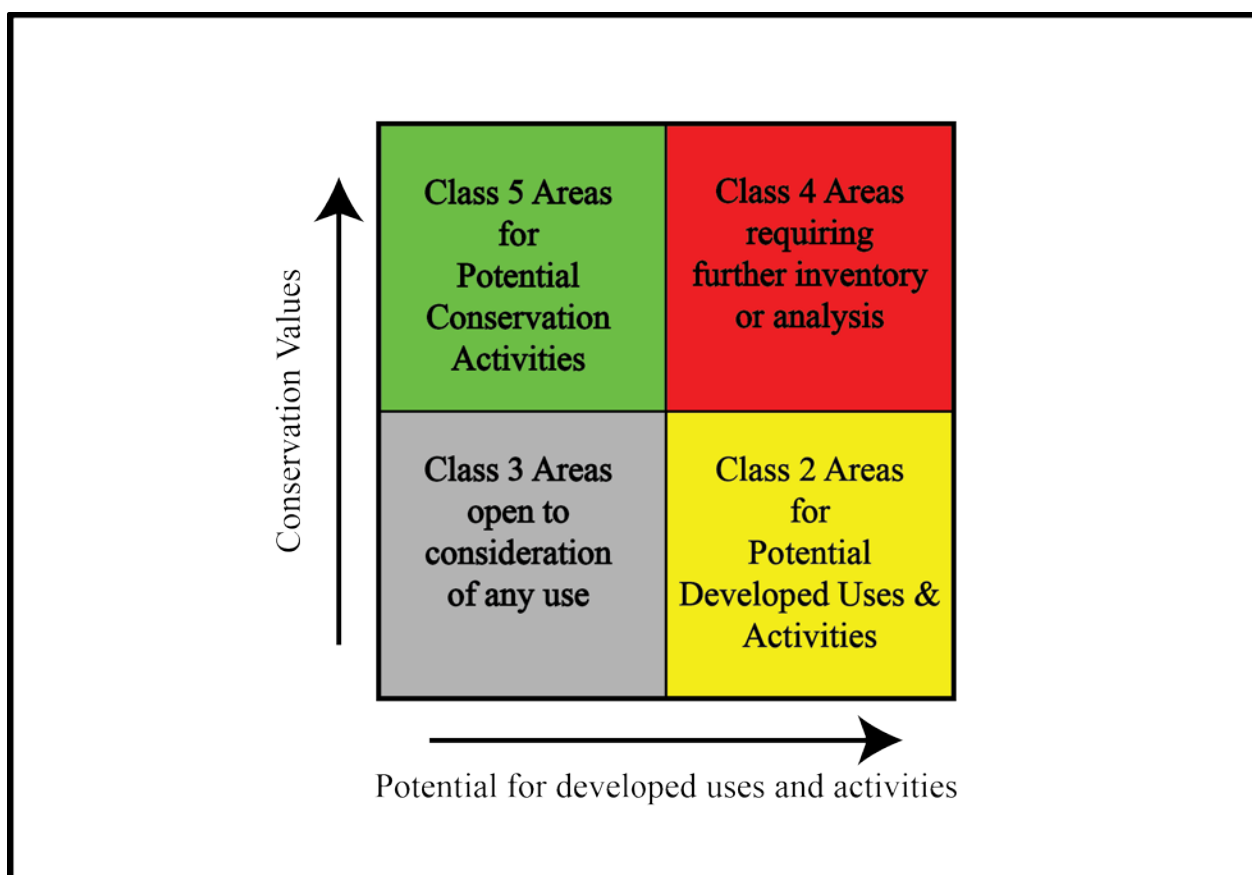
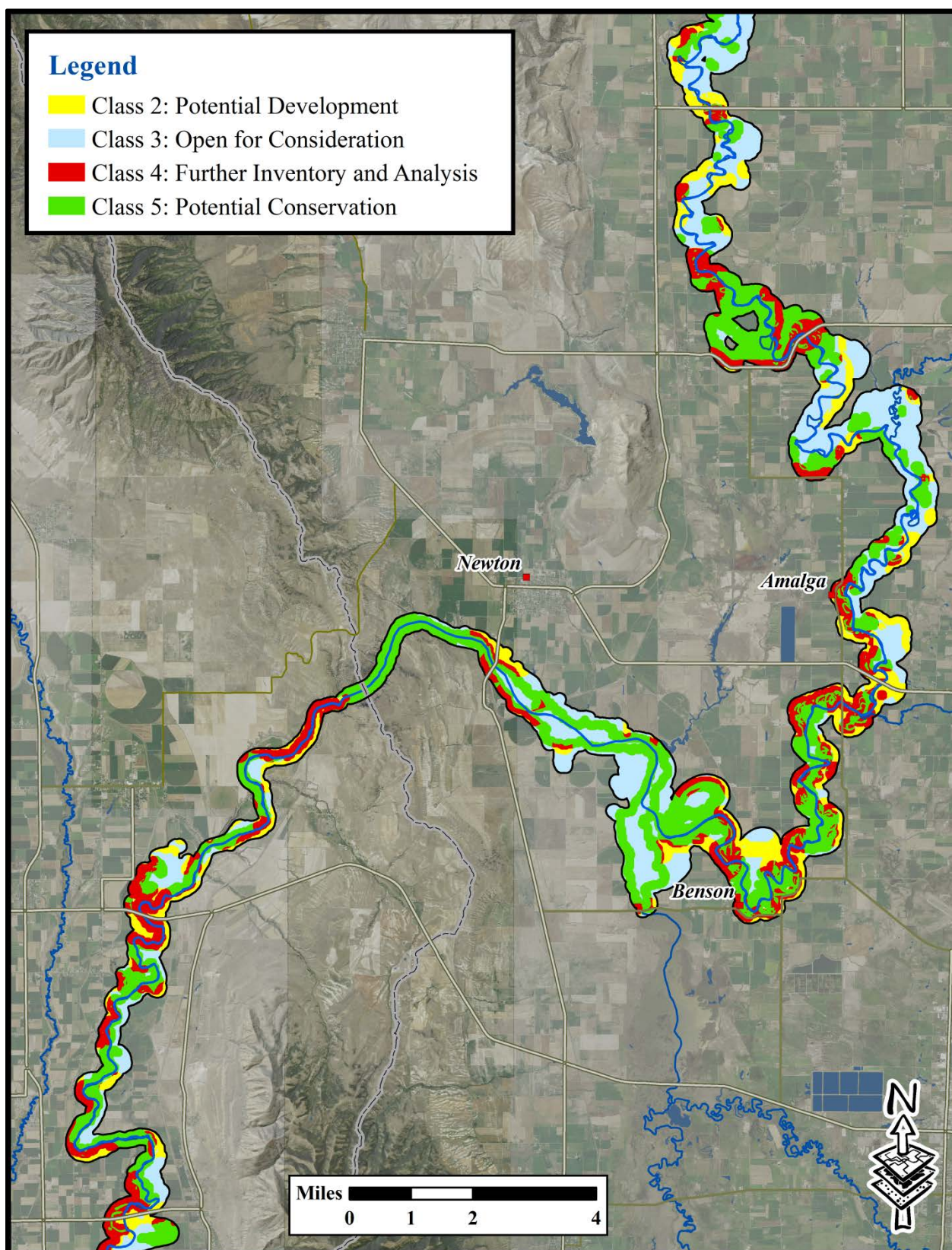
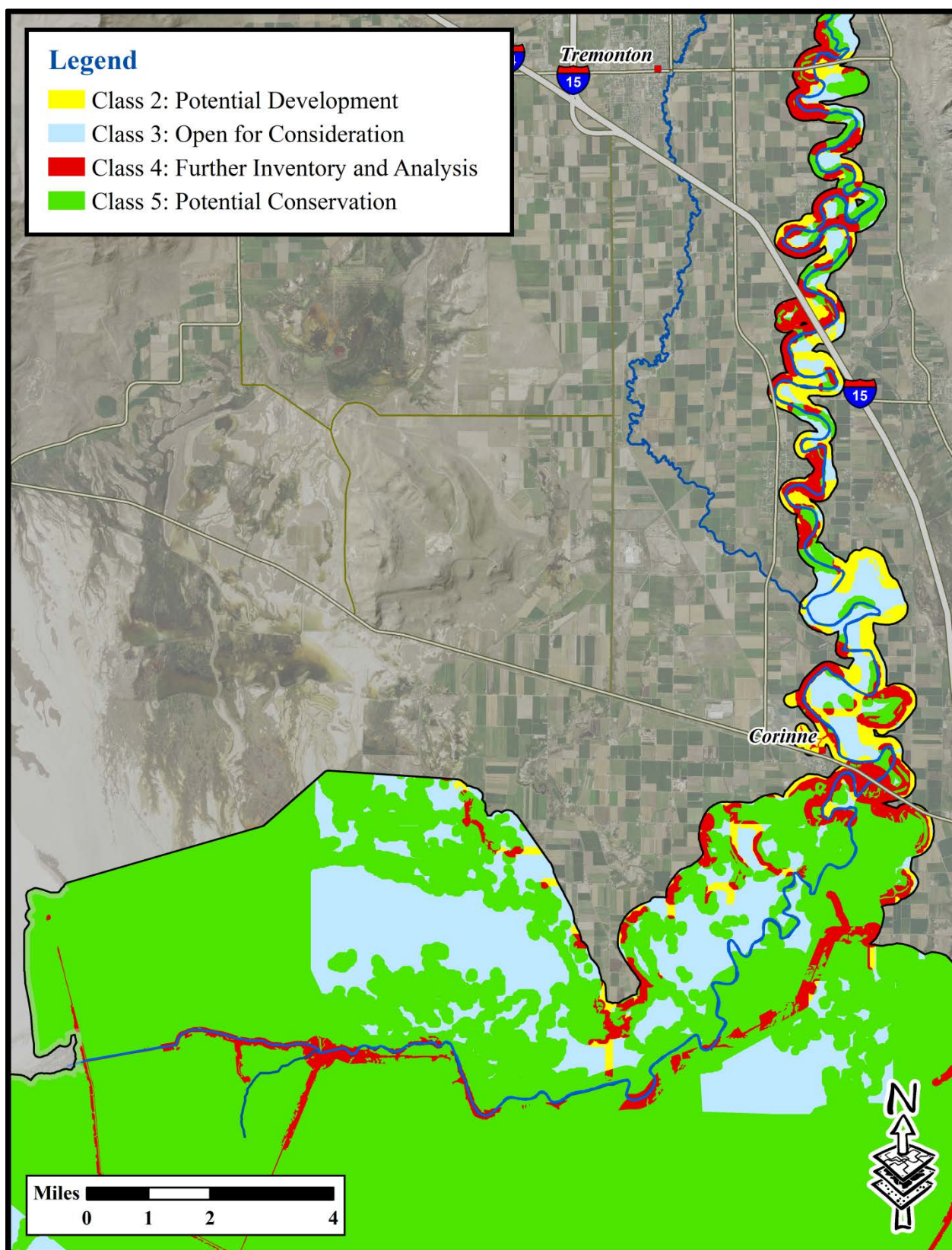


Figure 32: Conceptual Diagram of Classification Model

Map 36: Classification Model in Northern Section



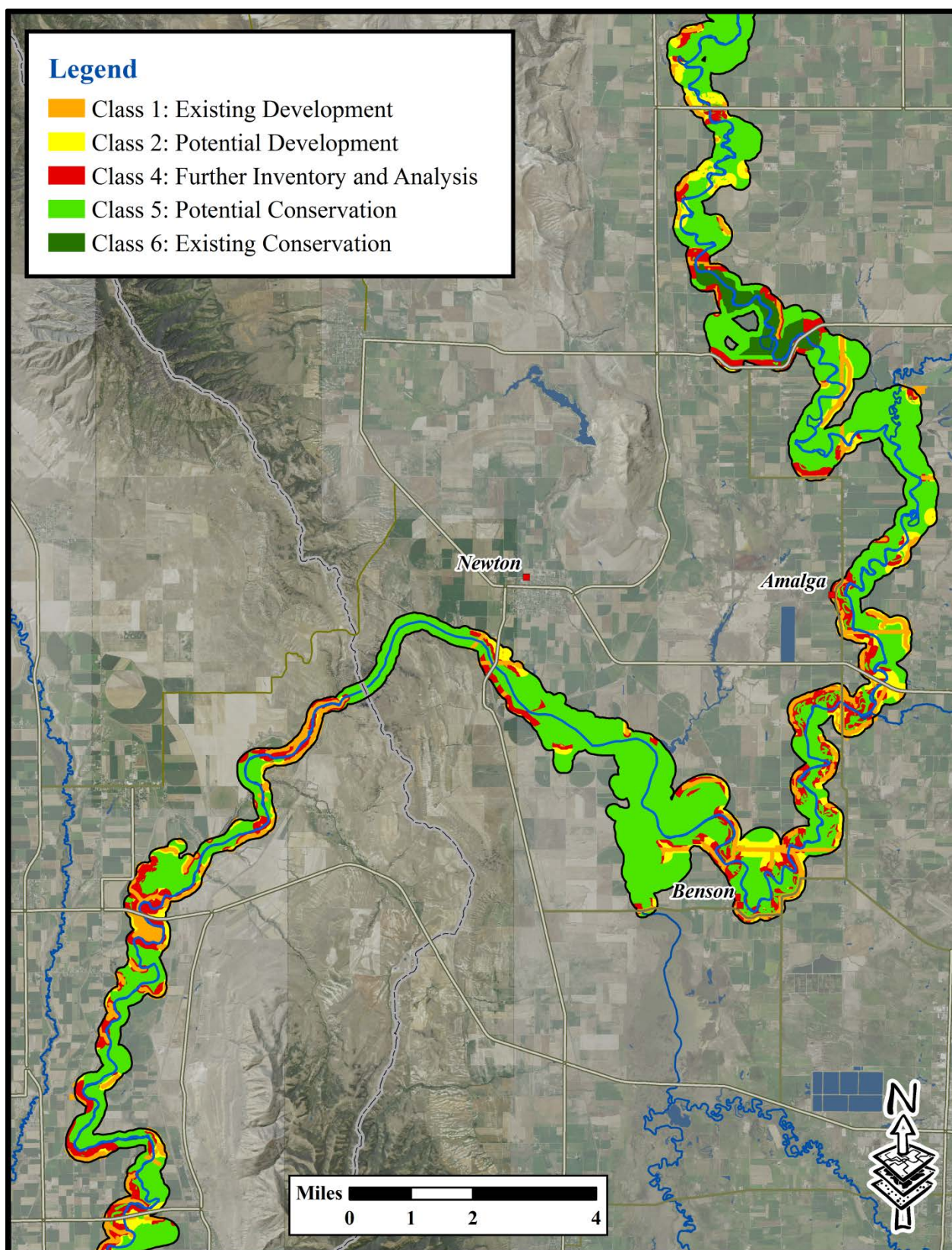
Map 37: Classification Model in Southern Section



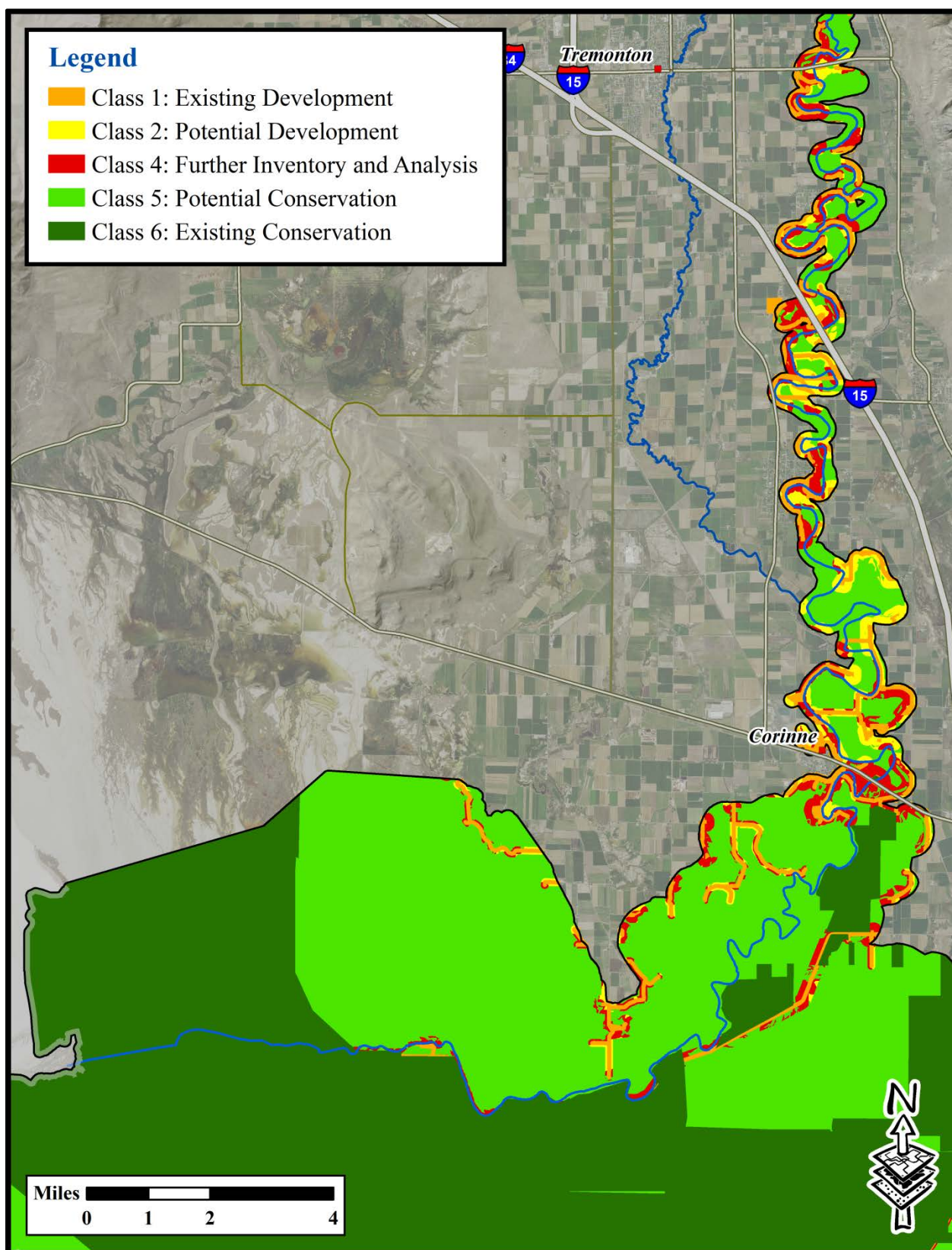
The classification model shown in Map 36 and Map 37 shows areas for potential development (Class 2), areas open to consideration of any use (Class 3), areas of potential conflict (Class 4), and areas of potential conservation (Class 5). However, as presented in the Assessment, the avian habitat model was intended to delineate the most critical areas of habitat along the river. The habitat model also included less critical, yet significant, areas of habitat that covered nearly the entire planning unit. It has also been well established that the entire river corridor is an important conservation area. Consequently, it is recommended that Class 3 areas shown in Map 36 and Map 37 be re-classified as Class 5 areas for potential conservation. This removes the classification of lands that were “open to any use.” Given the local and regional importance of the river corridor, this re-classification seems justified. Moreover, most uses can still be permitted within the Class 5 area on a case-by-case basis as long as they meet specified requirements and follow best management practices. The Class 5 designation will simply require that potential uses are more thoroughly evaluated than leaving these areas within the Class 3 designation.

The map and model presented in Map 36 and Map 37 is still useful to determine where potential conflict may exist within areas of existing uses and protections as well as which Class 5 areas may be most important in terms of conservation. Map 38 and Map 39 shows the final classifications with reclassification from Class 3 to Class 5 and also includes the Class 1 and Class 6 areas of existing development and existing conservation within the planning unit.

Map 38: Final Management Classification in Northern Section



Map 39: Final Management Classification in Southern Section



Land Use Management Matrix

Table 10, below, includes many of the common land uses and activities along the Bear River that require permitting by FFSL. Each use or activity is designated as allowed, potentially allowed, or not allowed within each of the six management classes. These, however, are simply recommendations based on the research and information gathered through the course of this study and the review of FFSL policies established in Comprehensive Management Plans for other sovereign land resources.

Table 10 is not intended to be an exhaustive list. Other uses and activities not included in the table should be considered and evaluated on case-by-case basis. It is also important to note that proposed land uses and activities could be allowed in any classification, including classes 5 and 6, if a sufficient need is established and appropriate conditions and guidelines are met to minimize or eliminate impacts to sensitive resources. If a use or activity is proposed in a classification area where it is listed as “potentially allowed” or “not allowed,” FFSL staff should follow the Division’s established process for site-specific plans and evaluation, which includes the notification of other resource management agencies, identified stakeholders, and adjacent landowners before any decision is made regarding the authorization of the proposed activity. It also recommended that any permanent uses of Class 4 areas also be evaluated on a case-by-case basis in accordance with site specific planning requirements and guidelines FFSL already has in place.

Table 10

Management Matrix: Acceptable Management Actions by Class						
Management Action	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6
Aboveground utility lines	P	P	N	N	N	N
Dredging	P	P	P	N	N	N
Bridges (vehicular)	A	P	P	P	P	N
Dams & water diversion structures	A	P	P	P	P	N
Hardened bank stabilization	A	A	P	P	P	P
Agricultural pumps	A	A	A	P	P	P
Boat ramps (permanent)	A	A	A	P	P	P
Bridges (pedestrian)	A	A	A	P	P	P
Outfall structures	A	A	A	P	P	P
Recreation structures (permanent)	A	A	A	P	P	P
Trash booms	A	A	A	P	P	P
Vegetation removal	A	A	A	P	P	P
Boat docks (seasonal)	A	A	A	A	P	P
Recreation structures (temporary)	A	A	A	A	P	P
Underground or buried utility lines	A	A	A	A	P	P
Aquatic habitat structures	A	A	A	A	A	A
Bio-engineered bank stabilization	A	A	A	A	A	A
Fisheries management activities	A	A	A	A	A	A
Herbicide treatments	A	A	A	A	A	A
Navigational hazard removal	A	A	A	A	A	A
Scientific research & equipment	A	A	A	A	A	A
Vegetation plantings & restoration	A	A	A	A	A	A
Wildlife habitat/nesting structures	A	A	A	A	A	A
Notes:						
A= Allowable						
P = Potentially allowable, subject to certain conditions and restrictions						
N = Not allowed except with certain conditions and a showing of extraordinary need						

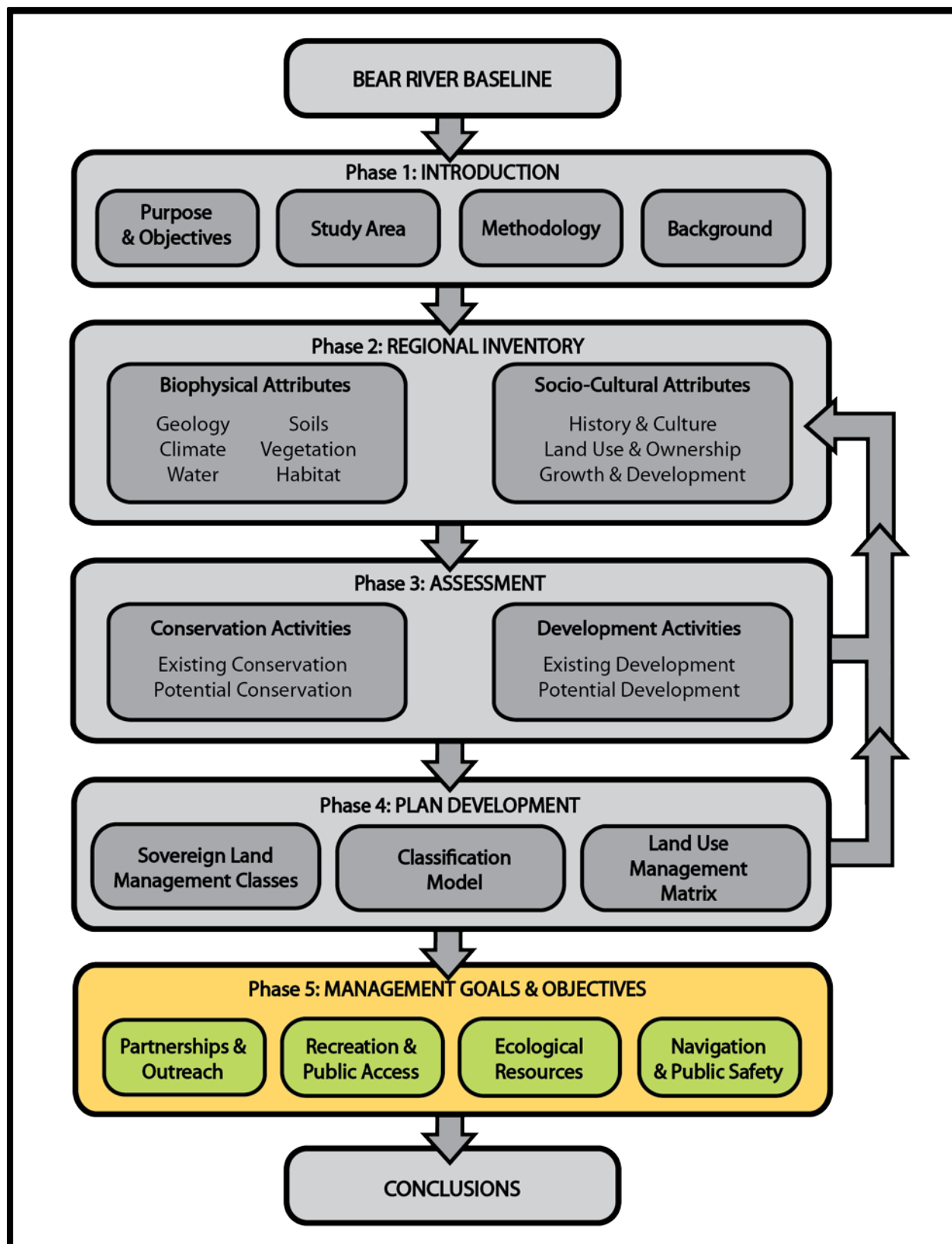


Figure 33: Management Goals and Objectives Diagram

Phase 5: Management Goals and Objectives

The objective of Phase 5 is to identify and develop relevant goals and objectives to provide guidance for FFSL's management activities and projects along the Bear River. Proposed objectives have been grouped into four categories: 1) partnerships and public outreach, 2) recreation and public access, 3) ecological resources, and 4) navigation and public safety. The goals and objectives presented are based on comprehensive management plans for other sovereign land resources and have also been discussed with FFSL staff and several partner agencies including the Natural Resources Conservation Service (NRCS), U.S. Fish and Wildlife Service (USFWS), Division of Wildlife Resources (DWR) and others.

Partnerships and Public Outreach

While FFSL has management authority for sovereign lands, its jurisdiction is limited to bed and banks of the main stem of the Bear River. The river is largely influenced by the condition of adjacent lands and the activities of other resource management agencies, stakeholder groups, and private landowners. Developing partnerships with other agencies, local governments, and stakeholder groups will be critical to the success of any management activity within the river corridor. Moreover, many potential partners, such as DWQ, NRCS, The Nature Conservancy (TNC), PacifiCorp, Utah State University (USU) Water Quality Extension and others have been working to improve conditions along the Bear River for decades. FFSL must work with these groups to identify the role it can play in the management of the river as an integrated system. Since the vast majority of lands adjacent to the river are privately owned, developing relationships and working with adjacent landowners will be particularly important for

FFSL to effectively manage sovereign lands, protect public trust values and implement projects along the Bear River.

Table 11

Goal 1: Develop partnerships with other management agencies, local governments and organizations.
Objective 1.1: Create a Bear River advisory group with representatives from key agencies, local governments, stakeholder groups, and adjacent landowners to identify issues and opportunities along the river and provide recommendations regarding management projects, planning activities, and other agency decisions.
Objective 1.2: Seek to participate in interagency meetings, advisory groups, and other efforts relevant to the Bear River, such as The Nature Conservancy's Conservation Action Plan, and USU's Spring Runoff Conference, and Water User's Conferences, to better understand and identify opportunities to collaborate in ongoing efforts along the Bear River.
Potential Partners: DWQ, USFWS, NRCS, TNC, USU Water Quality Extension, and many others.

Table 12

Goal 2: Provide outreach and education to increase awareness regarding sovereign lands and the Bear River.
Objective 2.1: Work with partners and stakeholders to develop and disseminate public information materials regarding sovereign lands management, recreational access and resources, environmental issues, and other topics relevant to the Bear River.
Objective 2.2: Work with partners to establish informational signage and educational materials to be posted at existing and future recreational areas and points of interest along the river.
Objective 2.3: Participate in local events, such as the Bear River Celebration, to increase awareness of Bear River sovereign lands, management objectives, and activities.
Potential Partners: USU Water Quality Extension, DWQ, DWR, The Nature Conservancy, PacifiCorp

Recreation and Public Access

Providing opportunities for public access, use and enjoyment of sovereign land resources is a central component of the Public Trust Doctrine and the overall management objectives of

FFSL. Currently, there are only 6 public access points along the Bear River and only 5 of them have facilities to launch a boat. Two of these, near Corinne, are less than 1.5 river miles apart while others are as much as 30 river miles apart. Moreover, the only developed access point in Cache Valley is near Amalga, leaving nearly 30 miles of river upstream to the Utah-Idaho border without any developed recreational access. It is possible to launch a canoe or kayak in some other areas that are used as informal access points, but parking is generally inadequate to non-existent, accessing the water can be difficult, and launching anything larger than a canoe is next to impossible. Improving recreational access to the Bear River for hunting, fishing, wildlife-watching, and boating may also increase awareness and help to engage stakeholder groups and the general public in the stewardship of the river and its many resources.

Table 13

Goal 3: Improve and expand public access to the Bear River.
Objective 3.1: Work with Division of Wildlife Resources, PacifiCorp, and U.S. Fish and Wildlife Service to maintain and enhance existing public access points on the Bear River.
Objective 3.2: Coordinate with partners to identify opportunities and establish priorities for creating additional access points along the Bear River.
Objective 3.3: FFSL should develop and use permitting requirements and best management practices to minimize impacts of existing and future developed recreational access points and structures on sensitive environmental resources.
Objective 3.4: Coordinate with partners and stakeholders to develop and integrated recreation master plan for the Bear River that addresses issues and concerns, identifies opportunities, and creates a more cohesive network of recreational access points with appropriate links to upland recreational areas and trails.
Potential Partners: DWR, USFWS, State Parks, Counties and Municipalities, PacifiCorp

Ecological Resources

Primary ecological resources of concern are wildlife habitat and water quality. As identified in the Regional Inventory, the Bear River corridor has been well established as a critical resource for many different species of wildlife. Lowland riparian habitats are very rare both in Utah and the Intermountain West. The Bear River has been designated by the state of Utah as an impaired water body in terms of water quality standards for meeting its designated beneficial use. High levels of sedimentation and dissolved oxygen as well as nutrient loading (total phosphorous) are a significant threat to the overall health of the resource and ecosystem. Poor water quality negatively impacts both developed uses as well as conservation efforts along the river and working with partners to improve water quality that impairs the river in terms of its ecological and recreational values should be a priority for FFSL. Management goals 4 and 5 include objectives to address wildlife habitat and water quality along the Bear River.

Table 14

Goal 4: Protect and enhance wildlife habitat along the Bear River
Objective 4.1: Cooperate with agencies and partners to identify, document, and maintain areas of important wildlife habitat along the river.
Objective 4.2: Coordinate with agencies, partners, and adjacent landowners to restore degraded riparian areas and re-establish connectivity between habitats along the river with an emphasis on creating vegetative buffers and riparian zones along agricultural lands.
Objective 4.3: Support the development of better data and information regarding the presence and distribution of sensitive wildlife species that utilize the Bear River and surrounding corridor.
Objective 4.4: Inventory, map, and treat noxious and invasive species such as Phragmites, goatsrue, purple loosestrife, Russian olive, and tamarisk that displace native vegetation and reduce habitat values.
Potential Partners: DWR, USFWS, The Nature Conservancy, Bridgerland Audubon, NRCS, Landowners

Table 15

Goal 5: Coordinate with management partners and landowners to protect and improve water quality
Objective 5.1: Encourage biological and, where appropriate, hardened stream bank restoration and stabilization efforts to reduce erosion and associated sedimentation.
Objective 5.2: Support activities to establish, maintain or restore degraded wetland and riparian vegetation buffers and infiltration zones on adjacent lands to reduce nutrient loading and sedimentation with an emphasis on adjacent cropland and animal feeding operations.
Objective 5.3: Encourage responsible management of grazing activities and implementation of best management practices such as off-stream watering, rotational grazing, and techniques to disperse rather than concentrate livestock in areas adjacent to the river.
Objective 5.4: Coordinate projects and permitting activities with DWQ to ensure that uses and activities along the river are in compliance with the Utah Water Quality Act and that management practices are implemented to mitigate or reduce impacts to water quality.
Potential Partners: DWQ, USU Water Quality Extension, NRCS, Conservation Districts, Landowners

Navigation and Public Safety

The 2013 inventory of structures and conditions along the river identified dozens of abandoned structures such as old bridge pilings, dumped vehicles, irrigation pumps, concrete, fence posts, and other obstacles that may pose a significant threat to the safety of people boating and canoeing on the river. Deteriorating or abandoned structures and materials within and along the river channel not only pose a risk to public safety, but also detract from the scenic quality and recreational experience of boaters on the Bear River. Especially following high water years, fallen trees and other natural debris can also become an obstacle to navigation. Maintaining navigability is a fundamental responsibility for sovereign lands management.

Table 16

Management Goal 6: Remove or mitigate navigational hazards and avoid the future placement of structures or materials that create navigational hazards along the river.
Objective 6.1: Identify, prioritize and seek funding to remove existing navigational hazards and, where appropriate, in-stream structures that inhibit the passage of watercraft.
Objective 6.2: Form partnerships with local governments or other entities capable of assisting in the removal of temporary or suddenly occurring navigational hazards such as fallen trees, woody debris, and collapsing stream banks.
Objective 6.3: Develop a schedule and protocol to provide regular monitoring to identify and make arrangements for removing navigational hazards along the river.
Objective 6.4: Ensure that the design and construction of new infrastructure and placement of structures or devices reduces the potential for creating navigational hazards.
Objective 6.5: Encourage the placement of electrical, water, gas and other utility lines underneath rather than over top of the river to preserve navigability as well as reduce impacts to wildlife and improve aesthetic values of the river corridor.
Objective 6.6: Coordinate with Division of State Parks and Recreation to establish appropriate rules and regulations for the safe operation of boats on the Bear River.
Potential Partners: State Parks, local governments, UDOT, adjacent landowners

Conclusion

Discussion

The purpose of this project was to provide relevant information and data to be carried forward and provide a starting point for the development of a Bear River Comprehensive Management Plan to be completed by the Division of Forestry, Fire and State Lands (FFSL).

Objectives of this project were to:

- Describe the Bear River Corridor and its surrounding landscape.
- Identify stakeholders, including agencies with management responsibilities for the Bear River.
- Explore and summarize relevant research and information for the Bear River CMP.
- Identify and map biophysical and socio-cultural attributes relevant to the Bear River.
- Provide a preliminary classification of lands along the Bear River into established sovereign land management classes.
- Make recommendations for relevant management goals and objectives.

To meet these objectives, a methodology and process was established based on a methodology used and taught by Professor Richard Toth, and adapted for use in many different projects undertaken by the Bioregional Planning Studio at Utah State University. Overall, this process worked well to meet the project objectives as well as to establish a methodology that can be employed to describe, assess, and plan for other sovereign land resources and, potentially, other river corridors with similar management requirements.

There are many different agencies, organizations, and stakeholders that have diverse interests in the Bear River ranging from environmental conservation to water development and agricultural uses. Finding common ground among these groups may be difficult at times, but

they do all share a common thread. They all rely on the river to provide something that benefits their lifestyle and interests. Consequently, the overall health and condition of the river as a system that supports the diverse interests of all these groups is, or at least should be, both a concern and a priority for all of them.

The overarching mandate and objective of sovereign land management in Utah is to provide for the reasonable and beneficial use of the resource while protecting public trust values and ensuring its long-term viability. On the spectrum of conservation and development, this mandate should put FFSL somewhere toward the middle of a diverse group of Bear River stakeholders and management agencies. This creates an opportunity for FFSL to work with entities from both ends of the spectrum to identify common interests, build collaborative projects, and develop solutions to address impacts that threaten viability of the resource. FFSL must recognize, however, that it is essentially the newcomer to management activities along the Bear River. Defining its role and developing strategies to support other stakeholders and interests while meeting its own objectives will be a critical component for the management of sovereign lands along the Bear River.

From the outset of the project, it became clear that an incredible amount of information exists regarding the Bear River. Much of this has been produced and is currently being expanded upon by resource management agencies, university programs, and other organizations with varying interests in the Bear River. The challenge was not finding *enough* information, but rather trying to find the right information, organizing, and summarizing it in a way that it becomes useful in establishing the context, important resources, and values associated with the river. The Regional Inventory of biophysical and socio-cultural attributes of the river may have been both too intensive and, at the same time, insufficient to fully develop an understanding of

the Bear River and surrounding landscape. However, the overall structure and process for gathering and presenting the information provides a useful framework for approaching similar projects in the future.

During the Assessment (Phase 3), the development of models to represent attributes of both conservation values and the potential for developed uses and activities is a process that can be iterated and re-iterated indefinitely as new or better information is discovered, obtained or developed. In fact, these models and the underlying data should be revisited frequently to achieve the best possible results over time. The concept of plotting the integrated development and integrated conservation models against each other to create the classification model and ultimately delineate the six sovereign land management classes seemed particularly well suited to that purpose and, hopefully, will be carried forward in future planning efforts.

The actual classification of land within the planning unit is not, nor was it intended to be, a final classification of sovereign lands along the Bear River. The final classification of sovereign land along the Bear River will require additional input from resource specialists, management agencies, and stakeholders to provide appropriate expertise and make management decisions based on the information presented. The classification of lands within the planning unit does, however, illustrate areas where conflict between conservation values and developed uses may be likely and, equally important, areas where conflict is less likely. This should provide a good starting point for the Bear River Comprehensive Management Plan and guide the discussion toward areas where further analysis, professional expertise, and/or more resources will be necessary to resolve issues.

Similarly, the land use management matrix presented in the Plan Development section and the Goals and objectives presented in the final section are intended to provide a starting point

for further discussion among members of the planning team and stakeholder groups. It is expected that they will be modified, refined, and adjusted accordingly. The over-arching concept behind the recommended management goals and objectives is that, as discussed previously, the development of partnerships and collaborative processes will be critical in order to implement management and objectives for sovereign lands along the Bear River.

Opportunities for Further Research

In addition to the expected continuation of this project to develop and implement a Bear River Comprehensive Management Plan, other opportunities for further research are nearly endless in this case. Select an attribute of the river, learn more about it, and communicate that information to others. Planning has no end point. There is, however, data and information that could be developed to significantly improve the results of the planning process.

While there is an incredible amount of information regarding the importance of the Bear River and its corridor, information to establish priorities within it is far less developed. In particular, the vegetation and land cover data that is currently available is very coarse, which makes accurate modelling of wildlife habitat and other vegetation-related features very difficult. Surveys to establish the presence and distribution of sensitive or indicator wildlife species would also be very useful in the establishment of conservation priorities.

While public access and recreation were discussed throughout the project, there is an opportunity to develop more specific guidance regarding recreational use of the river. Currently, recreational use seems relatively limited outside of hunting seasons and specific, planned events held by sponsoring agencies. This may be due to a lack of interest in the area, but could just as easily be due to a lack of awareness or, quite simply, a lack of sufficient access and infrastructure to support recreational activities. Regardless of the current demand, working to provide public

access to sovereign lands resources for the use and enjoyment of the general public is a fundamental component of sovereign land management and FFSL's obligations in accordance with the public trust. Following or concurrent with the development of the Bear River Comprehensive Management Plan, a more thorough evaluation of recreational opportunities and appropriate infrastructure to facilitate access is likely warranted.

An additional area of research that should be addressed is the establishment of best management practices for various uses along the river. While USU Water Quality Extension, DWQ, and NRCS have established recommendations and best management practices to improve water quality, best management practices to reduce the impact of developed uses and activities on other public trust values, such as navigation and aesthetic values.

Finally, a significant limitation of this study has been that it has not directly addressed the potential impacts of climate change. For example, it is expected that this region will experience less snowpack and more precipitation in the form of rainfall, which is likely to impact hydrological regimes and the demand for additional water storage within the Bear River Basin. Changes in temperature are also likely to impact vegetation communities and habitats along the river. The potential impact of climate change and how it may affect sovereign land resources, while outside the scope of this particular project, is a topic that should be addressed in the future.

Conclusions

The Bear River is an important resource for many different reasons. It has provided the water resources that formed the foundation of agriculture and settlement in Cache and Box Elder Counties and continues to support growth and development in the region today. It is a critical resource for wildlife habitat. It makes significant contributions to the identity and sense of place within the region. And, it has significant potential as a recreational resource for hunting, wildlife

viewing, boating, and canoeing. Balancing the varied interests of stakeholders in both the use and protection of the Bear River and its many resources will be a significant, long-term challenge that will require partnerships, collaboration, creativity, and persistence.

While this project isn't the most comprehensive or detailed report for any individual attribute of the Bear River, it is currently the most comprehensive resource addressing sovereign lands along the Bear River. It also represents the most comprehensive resource that has been developed for FFSL in preparation for a comprehensive management plan and has provided a solid foundation for moving forward into that process.

Additionally, this project has provided a process and methodology that can be replicated or adapted to evaluate and establish guidelines for the management of other sovereign land resources. Planning is, or at least should be, a dynamic process. Management plans, goals, and objectives should frequently be re-evaluated, adapted and updated to incorporate newly discovered or developed information. An advantage of the methodology used to delineate management classifications in this project is that it is relatively simple and highly adaptable. In this case, two basic models representing conservation values and the potential for developed uses were used to delineate four of the six management classes. Either of these models or any of the individual attributes that were used to create them could be altered or updated and, fairly easily, be employed by following the same process to achieve an alternative, and perhaps improved, outcome. In other words, it can and should be improved and built upon over time.

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