Alternative Futures for the Bear River Watershed

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Bioregional Planning Program
Department of Environment and Society
College of Natural Resources
Utah State University
May 2005
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Study Team left to right: Katie Hinman, Kevin Seegmiller, Kevin Kilpatrick, Jay Baker, Jessica Evans, and Clark Bryner
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INTRODUCTION

Utah State University is a land grant institution whose mission statement focuses on teaching, research, and service. The service component comprises a series of activities by which the University assists the public sector. This assistance is an outgrowth of the academic and research programs and, as such, parallels these two elements by applying the results of its research and academic activities. A primary purpose of the University’s outreach is to help various counties, towns, and public agencies in addressing major questions of future growth and development within the state and the region.

Over the past six years a number of faculty and graduate students were invited to examine future growth and development issues within the Bear River Watershed. Inquiries have been from both the public and private sector and have included the Bear River Resource Conservation and Development office, the Bear River Association of Governments, the Bear Lake Preservation Advisory Committee, Bear Lake Watch, Bear River Irrigators, the Bear River Watershed Council, the Cub River Technical Advisory Committee, U.S.F.S. Cache-Wasatch Forest, and PacifiCorp.

Since 1999, many of the future growth and development issues occurring within the watershed have been surfaced by way of public surveys, stakeholder meetings, and town meetings. The essential portion of this work can still be summarized from the first Bear River Watershed Futures Study initiated in September 2000.

Communities in the Bear River Watershed are currently experiencing various intensities of growth and development due to new residential, commercial, and agricultural development. This development occurs throughout many portions of the watershed and varies in its distribution and density of development. The residential development is expressed in both permanent housing and an equal amount of seasonal (summer and winter) residential construction. The commercial and service growth in the area is directed more toward the tourist/recreational growth of the region as opposed to support services for either the agricultural or full residential activities. In general, the development is distributed unevenly throughout the watershed from Evanston, Wyoming in the south to Montpelier and Garden City, in the east central valley sections around Bear Lake; Soda Springs in the north and much heavier concentrations occurring south of Grace, Idaho, continuing into Utah’s Cache Valley.

A number of the development issues within the Bear River Watershed were illuminated quite effectively in the 1999-2000 Cub River Futures Project. Three central questions seem to persist 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 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? To address these questions, it is important to define what form this new growth will take considering increasing demands on transportation systems, infrastructure (sewer, water, power, solid waste, emergency services) and general public health, welfare, and safety issues.

In 2000, the population of the entire watershed was approximately 170,000 people. The 2025 projected population for the watershed will grow to approximately 275,000 people. Approximately 80% of this growth will take place in Box Elder and Cache Counties. Franklin County will also feel a portion of this impact due to new transportation infrastructure currently being completed between Smithfield, Utah and Preston, Idaho. The objectives of the study which follows is not to deny the influx of new population but to analyze the landscape and quality of life issues so that the new population can be effectively, efficiently, and fairly distributed within the watershed. In addition, this study helps to define the critical lands of this region with respect to protecting the public health, welfare, and safety concerns for its residents.
There is no single plan proposed in the study which follows, but instead, a series of alternative futures have been identified and allocated across the region based upon the expected 20-year growth predictions. Several of these future alternatives are very aggressive in their consumption of the landscape which is due in part to current planning and zoning policies throughout the various counties. Most of these policies have a tendency to advance low density sprawl development throughout the region.

In order to evaluate which of the alternatives are more fit to the landscape, a series of assessment models are used in order to analyze how and where they may compromise quality of life concerns as well as those related to public health, welfare, and safety. It is sincerely hoped that this approach will assist decision makers with appropriate future visions and the trade-offs in management and policy may be required within the region over the next 20 years.

R. E. Toth
April 2005
INTRODUCTION

Overview

The Bear River Watershed (BRW) is located in north-eastern Utah, southeastern Idaho, and southwestern Wyoming. Over the three states the watershed encompasses an area of 7,500 square miles (4,800,000 acres). The Bear River’s headwaters begin at close to 13,000 feet in the High Uintas Wilderness Area of northeastern Utah. The course of the river follows a horseshoe pattern flowing north through Wyoming, Utah, and Idaho before bending south at Soda Springs. The river then meanders through the Gem and Cache Valleys before reaching its delta at the Great Salt Lake at an elevation of 4,211 feet.

The Bear River is:

- the largest tributary to the Great Salt Lake.
- 500 miles long; the longest river in the western hemisphere that does not empty into an ocean.
- from headwaters to mouth, a linear distance of approximately 90 miles apart.
- entirely enclosed by mountains with no external drainage outlets.

Geography

The Bear River Watershed enjoys an abundance of unique and spectacular scenery. The watershed is characterized by lush agricultural fields in the valleys surrounded by sharply rising mountain peaks. Bear Lake is the most distinguishable feature on the eastern side of the Bear River Mountains. The lake’s clear blue waters appear to be a Caribbean oasis that stands in sharp contrast to the expansive sage steppe rangelands surrounding it.

Some of the other scenic amenities of the watershed include:

- Wasatch-Cache and Caribou National Forests
- Logan Canyon Scenic Byway
- Hardware Ranch Elk Refuge
- Bear Lake National Wildlife Refuge
- Bear River Migratory Bird Refuge

Economy

The historical economy of the watershed has been primarily agrarian. The predominant land uses are currently farming, ranching, recreation, commercial, residential, industrial, logging, and mining.

At the heart of the watershed lies Utah State University in Logan, UT. The land grant university was established in 1888, and has served as a backbone for economic development, education, and culture throughout the region. In 2004 the university directly employed 2,622 people, and generated over $434 million in total revenues. USU is the primary economic generator in the watershed and its research and outreach missions have led to many companies relocating in the greater Cache Valley area. The Utah
State University Innovation Campus was given the 2004 Award for Excellence in Economic Development by the United States Department of Commerce as one of the best places in the nation for rural economic development.

Ownership

The ownership of land in Utah, Idaho and Wyoming is similar to other western states. Land ownership within the Bear River Watershed is not as disproportionately public as some areas of the west, but a significant portion of the watershed does remain under public management. The U.S. Forest Service is the largest public owner of land in the watershed, with the Wasatch-Cache and Caribou National Forests operating significant portions of the land in the Bear River Range of the Wasatch Mountains, Uinta Mountains as well as the Portneuf, Bannock, Malad and Preuss Ranges in Idaho. The Bureau of Land Management manages large tracts of land in the Wyoming and Eastern Bear River Valley portions of the watershed. The Bear River Migratory Bird Refuge and Bear Lake National Wild Refuge are operated by the U.S. Fish and Wildlife Service. Other significant non-private lands are those owned by the states of Utah, Idaho and Wyoming. Additionally, the National Park Service operates the Fossil Butte National Monument in western Wyoming.

Recreation

Outdoor recreation activities are defined by many residents as very important for their quality of life. With long, cold winters, and mountain snowfall averaging around 400 inches annually, ample opportunities abound for fantastic winter recreation. A significant portion of watershed residents participate in winter activities such as snowmobiling, downhill skiing, cross-country skiing and snowshoeing. The long days of summer are characterized by dry, pleas-
INTRODUCTION

antly warm days and cool nights. Opportunities for camping, hunting, fishing, OHV touring, hiking, biking, swimming, and rock climbing are found frequently in the many canyons and lakes of the watershed and are regularly enjoyed by residents during the spring, summer and fall months. The wide spectrum of proximal recreational opportunities continues to be a major reason that people enjoy living in the watershed.

Values

Residents of the watershed have historically enjoyed a rural lifestyle. As a result of the original pioneers’ settlement patterns, small distinct communities are scattered throughout the watershed. Within these communities there exists a friendly, almost familial social bond between neighbors and strangers alike. The citizens of the watershed enjoy the values that are associated with their rural lifestyle and would like to maintain these values in the midst of growth and urban influences.

Some of the main values identified by residents of the Bear River Watershed include:

- Landmarks (LDS Logan Temple, Old Main, Bear Lake, wetlands)
- Mountains
- Agricultural Land
- Small Town Atmosphere
- Scenic Views
- Open Spaces

Demographics

When looking at demographic patterns and populations, the Bear River Watershed could be considered a microcosm of the western United States. Scenic, formerly agricultural valleys that are close to urban

Figure 4 Population Projections Source: Utah Governor’s Office of Planning and Budget
areas or industries are experiencing rapid growth while traditional rural towns are experiencing a net loss of population and depressed economies. Cache Valley and the Brigham City area, specifically, have experienced rapid growth over the last two decades. Other areas, such as Caribou County, ID and Rich County, UT have actually decreased in population during the last 10 years. This dichotomy between the expanding and declining populations will also likely continue.

The Utah Governor’s Office of Planning and Budget and the U.S. Census Bureau predict that population in Cache County, UT (2005 population of ~100,000) could exceed 250,000 people by 2050. Similarly, the populations of Box Elder County, UT and Franklin County, ID are expected to double in the next 25–50 years. Most residents and planners in the area are likely unprepared for such rapid growth in such a short period of time.

In the face of a new century, the very characteristics and values that have made the area so attractive are in danger of disappearing. A number of acknowledged and emerging issues within the watershed threaten to alter the traditional values and characteristics. The issues listed below were identified in the study of the watershed and were key factors addressed in the report.

• Water Quality – with heavy agricultural and industrial impacts on the watershed, can healthy water quality be maintained or improved?
• Water Quantity – is there enough water to sustain an expected larger population?
• Quality of Life – can the watershed maintain a rural quality of life faced with increased growth pressure?
• Growth Management – what areas are most likely to grow, and how should growth happen?
• Agriculture – how can sustainable agricultural practices continue in a dynamic economy?
• Bear Lake – what are the effects of increased recreational and residential demands on this unique resource?
• Transportation – what options are available to best facilitate the expected increase in population?
• Air Quality – what are the effects of growth on the quality of air in formerly pristine narrow mountain valleys?
Methodology Flowchart

Pre-Analysis
♦ Field trips & over-flights
♦ Opinion paper
♦ Case studies
♦ Stakeholder meetings

Concept Evaluation
Stakeholder Meetings

Future Alternatives
♦ Destination Resorts
♦ Double Expected Population
♦ Growth Potential
♦ Light-Rail
♦ New City
♦ Plan Trend
♦ Regional Park System
♦ Small Town Growth

Data Inventory/Base Map Preparation

Full Scale Analysis
Research on Function & Structure of regional landscape
♦ Climate
♦ Culture & History
♦ Hydrology
♦ Soils & Geology
♦ Vegetation & Wildlife

Evaluation Criteria & Environmental Assessment Models

Figure 5  Methodology Flowchart
An outline of this methodology includes six basic phases. These phases should be viewed as a cycle of processes which promote feedback between each other (see Figure 5).

1) Pre-analysis
2) Data inventory/base map preparation
3) Full scale analysis
4) Evaluation criteria and environmental assessment models
5) Alternative Futures
6) Concept evaluation

The methodology used in this study was patterned after a land planning framework outlined by Toth (1974).

The various decisions made at the Pre-Analysis stage accomplished the following three objectives:

- set the context and scale of the study area
- determined which issues needed to be addressed in the analysis stage of the project
- identified which types of data were needed for future work

These objectives were accomplished by way of:

- reviewing past case studies
- meetings with stakeholders
- project opinion papers
- multiple over-flights and field trips of the study area

The Analysis phase included separating the study area into its parts in order to describe and understand its nature, proportion, function, and structure. The study team researched the major biophysical characteristics of the region along with those dealing with settlement and culture. As a result, several issues regarding "quality of life" were identified as being important to the study area.

Land-use and environmental assessment models were then created for the purpose of informing the decision making process. The following models established the evaluation criteria for alternative futures models.

- Critical Lands
- Ground Water
- Infrastructure
- Public Health, Welfare, and Safety
- Rural Quality of Life
- Surface Water
- Wetlands
- Wildlife

Based on the issues and objectives identified during the Pre-Analysis phase, several future growth scenarios were produced in order to assess their impacts within the watershed.

The final phase in this methodology addresses three important aspects to be considered in planning for the watershed:

1) New strategies and/or alternatives
2) New tools of implementation
3) New land use activities and evaluation models to be identified for future consideration

It should be noted that as various portions of the region are developed over time, new issues will surface. These issues may vary from biophysical concerns to those dealing with settlement and culture. The approach described here has the capacity to capture these issues over time for future analysis and resolution, either as part of this study, or as a separate alternative future analysis. Implementation strategies and mitigation measures may be developed to meet new and emerging issues across the study area.
A Pre-Analysis was conducted at the beginning stages of this project as an initial study of the Bear River Watershed. The research was carried out in order to learn about the watershed before the study team analyzed it for assessments and futures.

The components of the Pre-Analysis were:

- Project opinion papers: Subjective first impressions of the watershed and its issues
- Analysis of previous projects: In-depth critique of case-studies for similar projects, both old and recent
- A study of the area through site visits and overflights: Survey of the land and issues through observation and exploration
- Meetings with stakeholders: Issue analysis stemming from interviews with and presentations by key interest holders for the watershed
- Evaluation and activity research: Evaluation of important human activity assessment criteria
- A study of the area by research: Comprehensive survey of the land and its components

Together these factors enabled the study team to develop a strong understanding of the elements of the watershed, and a sense of how these elements work together to create the characteristics of the region.

Project Opinion Papers

As part of the pre-analysis, each contributor wrote a Project Opinion Paper based on the field surveys which were done around the watershed. The Project Opinion Papers helped to delineate various aspects of the watershed, such as topography, dam and reservoir locations, water quality (visual) at different points in the river, the economic state of towns in the watershed, vegetation and land uses observed when doing field surveys. Based on these aspects of the watershed, personal opinions were developed on what the issues in the watershed might be, where growth might occur, and what changes were happening that could affect the future of the watershed. These papers acted as a basic foundation for the project, providing a hands-on opportunity to observe these aspects and consider how future trends could affect the current state and needs of the watershed.

Case Studies

Following the Project Opinion Papers, the study team reviewed case studies in the field of bioregional planning. Several seminal and several more recent case studies were reviewed. Each case study had a unique approach to the question of planning on a bioregional scale and the challenges to be met. For example, the case study Early Warning System: The Santa Cruz Mountains Regional Pilot Study (Tito Patri et al. 1970) was intended as a tool for county planners in order that they could take landform hazards into account in their planning. The case study Biodiversity and Landscape Planning-Alternative Futures for the Region of Camp Pendleton, California (Carl Steinitz et al. 1996) looked at an area in coastal southern California that was experiencing growth, and took into consideration various aspects of the area which were worth conserving, or which would pose potential hazards if they were to be developed. The group conducting the Camp Pendleton study took these considerations and applied different future models to them, resulting in two versions of each future – one being a “build-out” (full proposed development) and the other with the conservation aspect or hazard taken into consideration, thus modifying the original “build-out”.

The case studies were used to give some direction to this project in terms of different possibilities for analyzing the Bear River Watershed.

Site Visits

In order to study the Bear River Watershed in its physical context, it is important to experience it first-hand through site visits. The team took three all-day
field trips through the watershed; two by car and several fly-overs in an airplane. The purpose of these trips was to gain a better understanding of the area and its issues from more than literature research. On the ground it was possible to get a feel for the size, pattern, and characteristics of the area, and observe issues such as water quality and rangeland health. From the air it was possible to see the landscape on a broader scale than on the ground, and more large-scale issues and patterns could be observed, like development encroaching on agricultural land. These initial perceptions of the watershed helped the study team shape the project by creating a “sense of place” for the region and for the people.

Stakeholder Meetings

Also as part of the Pre-Analysis, the study team met with key stakeholders from Pacificorp, Utah State University, US Forest Service, Bear River Resources Conservation District, and Bear River Association of Governments to get an idea of what they thought were important issues to focus on in the study. Their suggestions aided research and helped make the project applicable to the people that will be most affected by the future of the watershed.

Evaluation and Activity Papers

The analysis process began with defining the criteria for human activities. For example, to aid planning, it was necessary to know what environmental factors should be taken into consideration for industrial development, such as soil type and proximity to existing infrastructure. The characteristics deemed most important to evaluate were those relating to infrastructure, working landscapes, residential and commercial development, industry, and recreation. This information was used to guide the selection of criteria for the assessment and future models.

Gergel and Turner in the field of Landscape Ecology define landscapes as being “characterized by their structure (the spatial arrangement of landscape elements), their ecological function (how ecological processes operate within that structure), and the dynamics of change (disturbance and recovery).” In order to study a large-scale landscape such as the Bear River Watershed, it is important to examine the components of the watershed. For this part of the analysis, Function and Structure papers were written; a series of write-ups devoted to the science, ecology, and history of the region. They are intended to give an understanding of the watershed as a whole; what is there, how it functions, and what may impact it the most.

The information gathered for the Function and Structure papers was used as a backdrop to the issues surrounding the watershed throughout the rest of the project. The research was also used to determine what GIS data would be utilized to create future assessment models.

The environmental components that were considered most important to the watershed were:

- human impacts/history
- hydrology
- geology
- soil
- climate
- vegetation
- wildlife

The following section of this report is a summary of the research that was done in each of these areas. These components are included as a background for the study.
HISTORY

Prior to the white settlement of the Bear River Watershed in the 1840s, the region was inhabited by numerous tribes of Native Americans, mainly Shoshone. No permanent structures were left because they were nomadic. Additionally, as their culture was based on hunting small game and gathering fruits, roots and berries, they did not impact the land by use of agriculture. The main impact that the Native Americans left on the land were trails and routes through the valleys and across the mountains.

The first white men to travel and explore the BRW were most likely fur traders. By 1812, fur trappers such as John Jacob Astor were in the area in pursuit of valuable beaver pelts. From 1825 until 1831, many famous mountain man rendezvous were held either at Bear Lake or in Cache Valley near the Blacksmith Fork River. Many famous trappers and explorers were present at these events, including Jedediah Smith, Jim Bridger, William Sublette and John Weber. Due to their unabated procurement of beaver and other game, they had a very significant impact on the wildlife in the BRW. An area that had once been teeming with bison and beaver was nearly void of these species by 1837. Additionally, many famous explorers such as John Fremont, Benjamin Bonneville and Howard Stansbury came through on inventory and mapping assignments during the 1840s.
The first major human changes and impacts on the land were the result of the Mormon pioneers who immigrated to the area beginning in the late 1840s. The development of the Mormon Trail through the Evanston area led to an estimated 70,000 Mormon emigrants traveling through the south end of the BRW (Peterson, 1997). Due to the large number of people and their accompanying cattle and livestock, the vegetation in the Bear River valley and native game population adjacent to the Mormon and Oregon trails became noticeably depleted. The settlers also were pioneers in the creation of extensive canals and irrigation systems in which to farm. Both irrigated and dry farming were a primary land use. Up into the 1960s the sugar beet industry was a major player in the western part of the BRW (Peterson 1997).

The grazing of cattle and sheep was the earliest and one of the most predominant uses of land in the BRW, and in many areas in the eastern and southwestern portion of the BRW, it is still a primary land use (Parson 1996). The other major agricultural industry in the region is dairy farming, which has been an important economic industry and land use in all parts of the watershed since the 1870s. Another notable land use is mineral extraction (Peterson 1997).

The completion of the transcontinental railroad in 1869 marked an important event for the transportation and mobility of the people in the watershed. Now the most widely used method of transportation in the BRW is highways. The roadways are important to the people because of the connections they produce, both to land and its residents.

Some major industries that exist in the BRW are E.A. Miller and Sons, a meat packing plant in Hyrum (Peterson 1997), and Thiokol, a producer of solid propulsion motors, west of Brigham City.

Recreation is a prevalent land use in the BRW, the most popular destinations being Bear Lake, Logan Canyon, and the Uinta Mountains. Boating, fishing, hiking, skiing, birding, camping, rock climbing, swimming, backpacking, and snowmobiling are a few of the most popular activities. The area also provides many people with sites for vacation homes.

The majority of the population growth in the BRW is simply internal growth. Many people in the region stay in the region through adulthood. Influences that bring new people to the area are: Utah State University in Cache Valley, bringing faculty from all over the country and thousands of students each year, Thiokol outside of Brigham City, bringing a scientific community to the city, and the mountainous regions that attract recreationists. Another source of population grown is foreign immigration. According to the US Census Bureau, over 6% of Cache Valley residents are Hispanic.

The historical method of establishing towns in the BRW had a significant effect on the way it looks now. Historically, there were huge spaces of open land in between each settlement as the towns were set up with a community center, people living inside the town and the agricultural fields outside of the settlement. With this concept in mind, it is easy to see how towns began to annex land as they grew. The annexation and sprawl in many areas has led to indistinguishable city boundaries, especially in Cache Valley, as well as the loss of open space in the BRW (Jackson & Jackson 2003).

Around the Bear Lake area, development is sprawling outward from the lakeshore, up the sides of the
foothills. Most of the buildings are second homes and summer cabins. The building plots are big, and the space is being consumed quickly. Without careful planning, this pattern is expected to continue until the sprawl hits boundaries such as the National Forest to the west, and Laketown to the south. In Cache Valley, growth is happening outward and up the benches to the east throughout the valley and most likely will continue given current conditions. Growth in the far western part of the BRW is also following this pattern. Interstate 15 has always brought people to the area. The northern end of the valley, near Tremonton, would be a prime location to expect major growth with the coming of an already planned commuter rail to Brigham City.

The climate of the Bear River Watershed is a product of its latitude, elevation, topography, and location. According to the Köppen climate classification system, the watershed is made up of three predominant climate types: Mediterranean (Csa), Humid Continental, Mild Summer (Dfb), and Highland (Visher 1954).

The Mediterranean (Csa) Climate is found in the southwest corner of the watershed between the Great Salt Lake and the Wellsville Mountains. Mediterranean Climates are typically found along the west coasts of each of the continents. The presence of the Great Salt Lake has created a very small Csa type climate in the midst of a desert. The Csa climate type is characterized by a warm dry summer, a cool moist winter, and a lot of sunshine (Gabler et al. 1997). Precipitation averages 15-30 inches/year, with the majority (75%) of that falling during the winter months (Greer et al. 1981).

The Humid Continental, Mild Summer (Dfb) Climate covers the majority of the watershed’s lowlands and valleys. The Dfb climate type clearly experiences all four seasons (Gabler et al. 1997). Summers are mild; on occasion warm tropical air will invade from the south but rarely lasts more than a few days at a time. Winters are long, cold, and moderately severe. Arctic air invades periodically bringing frigid temperatures that last for weeks at a time. The Dfb climate type receives approximately the same amount of rainfall as the Csa climate type, but almost all of it comes as snow during the winter months (Roylance 1982).

The BRW is located in a very mountainous region. Mountains which are located within the Csa and Dfb climates often demonstrate characteristics of other climate types. Due to the effects that elevation, aspect, and orography have on climates, mountain zones are classified as Highland climates (Gabler et al. 1997). Highlands experience almost every cli-
of the valleys within the BRW is the inversion. An inversion occurs when cool air gets trapped near the earth’s surface because of overlaid warm air. Because the warm air is above and the cold air is below, the atmosphere is very stable and little circulation occurs. During temperature inversions air quality becomes a major health issue.

**GEOLOGY**

Geologically, the Bear River Watershed encompasses two provinces, the Basin and Range Province and the Middle Rocky Mountain Province. The Basin and Range province is characterized by numerous long, narrow mountain ranges caused by tilted fault blocks, alternating with basins partially filled with the gravel and sand that came from the mountains. The earth’s crust in this region is relatively thin because it is being pulled apart. As the crust is stretched it breaks in places from upwelling heat, forming faults (Morris & Stubben 1994). Shaping of the Middle Rocky Mountain province (MRMP) was also due to faulting. The many faults in MRMP are caused by shifting plate tectonics.

A common weather phenomenon that occurs in many
From faults and earthquakes to volcanoes and glaciers, the Bear River Watershed is geologically rich. Only 50,000 years ago the Bear River Watershed took on the boundaries it holds today (Link et al. 1999). Before this time the river flowed down to Soda Springs then westward through Portneuf Valley to Pocatello, Idaho, and then into the Snake River (Stokes et al. 1992). Lava flows and volcanic activity diverted the river southward to its. The new course of the Bear River led it to drain into the Great Basin, (see Figure 9) increasing inflow to Lake Bonneville by 30 to 40 percent (Stokes et al. 1992).

The increased inflow combined with maximum glacial conditions caused Lake Bonneville to reach its maximum level and to overflow its banks at Red Rock pass about 15,200 years ago (See Figure 9) (Link et al. 1999). The pass was weakened significantly before it gave way entirely 14,500 years ago. The lake dropped to the Provo level and remained there for approximately 1,000 to 2,000 years (Morgan 1992). While Lake Bonneville was at these two levels, wave action formed benches that are easily visible at the base of the Wasatch, Wellsville, and Bear River Mountains. Currently, near the outlets of streams and rivers, the soil is mostly unconsolidated sediment that formed deltas during the Bonneville and Provo lake levels. The valley’s floors that were covered by Lake Bonneville are composed of the fine sediments that settled to the bottom of the lake.

Evidence of glaciation in the Bear River Watershed is most prominent at its head waters in the Uinta Mountains. It is also found in the high areas of the Bear River Range. Glaciers found in Utah only covered valleys in the high mountain peaks.

The Wellsville, Malad, Bear River and Uinta mountain ranges are prominent features in the Bear River Watershed. All of these mountains were formed by faults; the Wasatch fault being the best known. It extends from about Malad City, ID to Fayette, Utah, a distance of about 240 miles (Eldridge 1996).

The movement on the fault is what produces the earthquakes that are commonly associated with faults. Many of the faults in the Bear River Watershed are still active. Earthquakes caused by active faults cause much damage to natural areas and built areas alike. Other hazards generated by earthquakes include soil liquefaction, flooding, slope failure, and surface fault rupture. Soil liquefaction occurs when loose, saturated sands or fine particle soil is shaken to the point that it acts like a liquid instead of solid ground (Cluff et al. 1974). Flood plains and lake shores tend to be at highest risk for soil liquefaction. Depending upon the magnitude of the earthquake many of the associated hazards can occur miles from the epicenter. A magnitude 7.5 earthquake in Brigham City, Utah could result in ground shaking, soil liquefaction, and slope failure within a 100 mile radius (Eldridge 1996).

Many of the faults in the Bear River Watershed were caused by the stretched crust in the Basin and Range province. But some of the faulting was also a result of the Yellowstone Hotspot. The hotspot is an area where concentrated heat within the earth is burning or pushing through the earth’s surface. As the North American plate moves southwestward the hotspot remains stationary leaving a U-shaped trail of volcanic activity.
SOILS

The soils of the Bear River Watershed are a product of climate, topography, time, and parent material. There are four predominant soil types found in the watershed: alfisols, mollisols, aridisols, and entisols.

Aridisols – The predominant soils of desert regions are aridisols. Aridisols develop in regions where precipitation is less than half of potential evaporation. Because the soil lacks water, only a thin lightly colored horizon develops. The horizon is often accompanied by a salt, calcium carbonate, or calcium sulfate deposit. Aridisols are very alkaline, but with irrigation can become profitable farmland. Without irrigation aridisol type soils are useful for limited grazing, wildlife habitat, and recreation. Aridisols are common in desert valleys and occur near the Great Salt Lake, the western portion of Cache Valley, and along the Utah/Wyoming border near Bear Lake (Gabler et al. 1997; Greer et al. 1981).

Entisols – Very young soils that lack horizons are known as entisols. Entisols can be found in many climatic regions, but usually occur in areas that experience constant erosion such as mountain slopes, alluvial floodplains, and some valley bottoms. Sometimes entisols will be found in very sandy regions where horizons are not easily developed, and on occasion are found in areas of intensive agriculture where the soil horizons have been depleted (Gabler et al. 1997; Greer et al. 1981).

Alfisols – A light colored surface and definite clayey subsoil characterize alfisols. The surface layer is generally very low in organic material and very thin. The subsurface is mostly made up of silicate clays (Gabler et al. 1997). This type of soil can be found in valley areas of Cache and Box Elder Counties. They also occur in some high mountain areas where the clay has moved from the surface to the subsurface. In this case there is a thin layer of dark, organic matter that covers the light-colored surface of the soil. Alfisols are highly alkaline due to the nature of their creation and are predominantly vegetated by salt-tolerant shrubs and grasses.

Mollisols – Thick, dark, fertile soils associated with grasslands are known as mollisols. The dark fertile surface comes from the abundant organic matter provided by the roots of grasses (Greer et al. 1981). Mollisols are characterized by having a soft to slightly hard granular structure (Gabler et al. 1997) which, accompanied by its fertile organic matter, makes these very good soils for agriculture. In the BRW mollisols occur in areas where annual precipitation is greater than 12 to 4 inches and at elevations greater than 4,500 feet. They occur mostly on mountains,
high plateaus, foothills, and the benches of historic Lake Bonneville (Greer et al. 1981). The soil ranges from being moderately alkaline at lower elevations to moderately acidic at higher elevations. Mollisol are susceptible to liquefaction if they become completely saturated.

**VEGETATION**

Pre-settlement vegetation in Cache Valley was described by explorers and early settlers as being “one of the most extensive and beautiful valleys of the Rocky Mountain Range...producing the most excellent grasses” (Ferris 1940). Abundant grass and little other vegetation in northeastern Utah and southeastern Idaho made the area ideal for grazing.

By 1888, less than 40 years after settlement, excessive grazing by livestock and migratory sheep ultimately caused the grass to decrease in abundance, and the sagebrush to increase. Most grassland areas were eventually plowed for dry or irrigated farming.

Understanding where vegetation occurs (the spatial structure and pattern) and its function within the landscape is critical in order to fully appreciate the landscape. According to Cronquist et al’s *Intermountain Flora* (1972), the entire study area can be divided into two regions, the Sagebrush zone and the Montane zone. However, for a more detailed description of the vegetation structure, the two main zones are subdivided into eight habitat types or ecoregions: Alpine/Sub-Alpine Zone, Wasatch Montane Zone, Semiarid Foothills, Foothill Scrublands and Low Mountains, Wet Valleys, Malad and Cache Valleys, High-Elevation Forests and Shrublands, and Sagebrush Steppe Valleys.

These ecoregions are influenced by various phenomena which include geology, physiography, vegetation, climate, soils, land use, wildlife, and hydrology. The following ecoregions are based on the Environmental Protection Agency Level IV Ecoregions (Omernik 1995).

**Alpine/Sub-Alpine Zone.** Low shrubs, mosses, cushion plants, sedges, wildflowers, alpine grasses, and willows are commonly found within the Alpine zone. Engelmann spruce, lodgepole pine, and sub-alpine fir with an understory of huckleberry and sedge are commonly found within the Sub-Alpine zone.

Primary landuses: Wildlife habitat, pastureland, logging, seasonal range, and recreation. Snow cover is a major source of summer water for lower, more arid ecoregions.

General location: Unita Mountains
Elevation: above 10,000’

**Wasatch Montane Zone.** Primary vegetation is aspen parkland with scattered Douglas fir and an under story of sagebrush, snowberry, elderberry, and mountain grasses.

Primary landuses: Logging, seasonal range, recreation, wildlife habitat, and water supply.

Grazing is more common to the east of the divide than to the west.

General location: Wasatch Range.
Elevation: 8,000’-10,000’
**Semiarid Foothills.** Mostly maple-oak scrub, gamble oak, juniper, pinyon, sagebrush, serviceberry, mountain mahogany, and associated grasses. Primary landuse: Wildlife habitat, livestock grazing, recreation, and water supply. General location: Benches of Wasatch Range. Elevation: 4,800’-8,000’.

**Wet Valleys:** Tufted hairgrass, sedges, Baltic rushes, cattails, alkali sacaton, saltgrass, bluegrass, basin wildrye, and sagebrush dominate these areas. Primary landuses: Irrigated hayland, pasture, rangeland, and wildlife habitat. General location: Montpelier south to Bear Lake; buffers Bear River until Bear Lake. Elevation: 6,000’-6,600’.

**Foothill Scrublands and Low Mountains.** Rocky mountain juniper, lodgepole pine, timber pine, aspen, and Douglas fir are found at higher elevations. Lower elevations are dominated by big sagebrush, rabbit brush, prickly pear, bluebunch wheatgrass, and Idaho fescue. Primary landuses: Livestock grazing and wildlife habitat. General location: Eastern side of study area. Elevation: 5,000’-9,100’


**Sagebrush Steppe Valleys.** Dominated by mountain big sagebrush, bluebunch wheatgrass, streambank wheatgrass, Idaho fescue, cheatgrass, bluegrass, and aspen. Primary landuse: Primarily livestock grazing, dryland wheat and barley farming, and irrigated alfalfa production. General location: North of Malad and Preston to Soda Springs. Elevation: 4,600’-6,500’
Wildlife

The Bear River Watershed provides unusually good habitat for a wide variety of fish and wildlife because of its large areas of forest, high mountain valleys, deep canyons, clear mountain streams, lakes, and wetlands (Wall et al. 1992). Many wildlife habitat areas in the watershed are considered to be of regional and continental importance for migrating waterfowl species and big game. Some of these exceptional areas are the Bear River Migratory Refuge, Bear Lake National Wildlife Refuge, and Hardware Ranch Elk Refuge. Wildlife plays an important economic, social, ecological, and aesthetic role in the study area.

Much of the wildlife information in this section comes from the 1992 Bear River Basin State Water Plan (Wall et al. 1992). It is useful to divide the watershed into four significant wildlife habitats in order to gain a basic understanding of the wildlife. Habitat is defined as the local environment of an organism from which it gains its resources (Marsh 1998). These areas include aquatic, wetland, riparian, and terrestrial habitats.

Aquatic Habitats

Cold-water fisheries, warm-water fisheries, and flat water fisheries are the three basic aquatic habitats within the study area. Each fishery includes certain unique attributes which provide food, cover, space, and other environmental factors for a particular species. Cold water fisheries support fish that prefer clear, cold waters, are not tolerant of extreme temperature changes, and cannot survive for long periods with temperatures above 68 degrees Fahrenheit (http://forestry.about.com/library/glossary). Cold water lakes and streams include Bear Lake, Blacksmith Fork, and Logan River. These habitats contain many game and non-game species of trout including Rainbow, Bonneville Cutthroat, Brook, Brown, and Mackinaw.

The areas considered as warm-water fisheries are areas where river quality has degraded to the point where it cannot support a cold-water fishery and where warm water species exist (Wall et al. 1992). Although it is difficult to identify where the Bear River changes from a cold-water fishery to a warm-water fishery, the approximate location begins in the north end of Cache County. Species found in these waters include channel catfish, black bullhead, largemouth bass, walleye, bluegill, perch, and occasional cold-water species.

The flat-water fisheries include warm and cold-water fisheries of numerous lakes and reservoirs in the watershed. Along with providing habitat for a number of amphibians and mollusks, these fisheries support species such as Bonneville whitefish, Bear Lake whitefish, Bonneville cisco, Bear lake cutthroat, Bear Lake sculpin, and Kokanee salmon, which spawn upstream of Porcupine Reservoir (Wall et al. 1992).

Wetland Habitats

Wetland habitats such as marshes, bogs, and swamps, support an incredible number of local and migratory species. The Bear River Migratory Bird Refuge, located in Box Elder County, UT includes 65,000
acres of prime wetland habitat. Of the 268 species of birds known to utilize the refuge, 68 are known to nest there, making this refuge one of the largest and most important bird refuges in the United States (Wall et al. 1992).

The Bear Lake National Wildlife Refuge, located at the north end of Bear Lake in Bear Lake County, Idaho is an 18,000-acre marsh that is home to over 165 species of birds, including sandhill cranes, bitterns, avocets, and white pelicans. Cutler Marsh, located in Cache County, and other wetlands throughout the watershed provide habitat for waterfowl, wading birds, shorebirds, pelican, herons, grebes, egrets, ibis, and sandhill cranes.

**Riparian Habitats**

Riparian habitats are the transition zones between aquatic and terrestrial systems. They are highly valued for wildlife habitat and are ideal areas for crop production, livestock grazing, fishing and recreational activities (CSREES). Common species living in these habitats include the Tiger salamander, garter snake, the Long-tail vole, Townsend’s big eared bat, chipmunk, mink, muskrat, weasel, beaver, red fox, American Kestrel, and osprey. Moose are also found in riparian areas throughout the watershed.

**Terrestrial Habitats**

Terrestrial habitats are home to a wide range of upland game, big game, and non-game species. These species include grouse, pheasants, ground squirrel, western rattlesnake, antelope, mule deer, elk, bald eagle, rabbit, badger, bobcat, black bear, cougar, coyote, red-tailed hawk, goshawk, sharp-skinned hawk, and wild turkey. The Utah Division of Wildlife Resources manages the Hardware Ranch Wildlife Management Area in Cache County. This management area provides 19,000 acres of winter-feeding to more than 400 elk whose winter ranges have been decreasing in size (Wall et al. 1992).

With the population in the study area projected to add approximately 95,000 people by the year 2025, it is becoming increasingly important to preserve wildlife habitat from the pressures of urban sprawl and development. Habitats are complex, interrelated systems, and once disturbed, are often difficult to rehabilitate (Rappaport and Whitford 1999). The leading threats to biodiversity are habitat loss, landscape fragmentation, and disruption of ecological processes. A collaborative effort by politicians, natural resource managers, land owners, and special interest groups to identify and preserve critical wildlife habitat areas and corridors will ensure a livable landscape in the future for the remarkable wildlife in the watershed.
HYDROLOGY

The main tributaries of the Bear River are (in Utah) the Logan River, Blacksmith Fork, Little Bear, the Cub River and the Malad River, which also flows through Idaho. In Idaho the main tributaries of the Bear River are Mink Creek, Soda Creek and the Malad River. The second largest tributary (the largest being the Logan River) is Smiths Fork in Wyoming.

Surface and Ground Water

Surface water is water which is exposed to the atmosphere – e.g. lakes and streams. In the Bear River Watershed surface water is the primary source of water for irrigation, as well as a source for culinary use and recreation. Although the rivers and lakes of the Bear River Watershed are considered to have plenty of water to support both current and projected populations in the watershed, the seasonal fluctuations present a constant need to maintain and develop ways to contain and distribute water so that it is available during dry periods.

Ground water is water which is not exposed to the atmosphere – it is located under ground and is generally accessed via wells. In the Bear River Watershed groundwater is a source of water for irrigation, culinary, industrial, domestic and stock uses. In Cache Valley alone, approximately 50% of residents’ drinking water comes from ground water via wells or springs (Kariya et al. 1994). The groundwater in Cache Valley is generally of a high quality: in 1999, 84% of Cache Valley groundwater was classified as class 1A (pristine) and 16% as class 2 (drinking water quality) (Lowe and Wallace 1999).

Water Sources

With an average annual precipitation of 22 inches, approximately 4 million acre-feet of water are produced in the Utah section of the Bear River Watershed (Utah Division of Water Resources 2004). However, only 40% of this water is actually accessible, as the rest is taken up for use by vegetation, and lost to the atmosphere by evaporation and evapotranspiration (Bear River Basin, 2004). This means that there are approximately 1,572,000 acre-feet of water that can potentially be available for other uses. The Bear River Watershed is considered to have a “plentiful water supply” and to be “one of the few areas in the state to have a significant amount of developable water” (Utah Division of Water Resources 2004).

The annual average precipitation of 22 inches is not dispersed evenly throughout the watershed. At the headwaters, in the Uinta Mountains, the average precipitation is 45-65 inches (much of this coming from snow), whereas in the Upper Bear River Valley the average precipitation is 10-15 inches. In fact, aside from its origins in the mountains, the Bear River generally flows through regions with between 10 and 20 inches of annual precipitation. The Bear River Range runs north-south through the center of the watershed and the average annual precipitation there ranges from 20-65 inches (Utah Division of Water Resources 2004). Based on the irregularity of precipitation, both seasonally and geographically, systems of retaining water are necessary for year-round distribution. For this purpose, reservoirs have been constructed at numerous points along the Bear River and its tributaries.
Hydrology

Water Quality

Since the passing of the Clean Water Act in 1972 the quality of water in the Bear River Watershed has improved. However, water quality is an ongoing issue with a continuous need for monitoring. The main water quality issues are the presence of nitrates and phosphates, fecal coliforms and sediment in the water. The groundwater in the watershed is generally good quality (Lowe & Wallace 1999; Utah Division of Water Resources 2004). The surface water in the watershed is of varying quality. Near the headwaters of the Bear River, in the Uinta Mountains, the water is of higher quality than other places in the watershed, mostly because there is less human activity near the water at that point in its course. Farther down the river there is more potential for impacts on water quality, such as runoff from feed lots, fertilizer, and other chemicals originating from agricultural practices, wastewater treatment systems, sediment, and natural substances found in soils which can potentially render water non-useable (Utah Division of Water Resources 2004).

Water Availability and Distribution

Currently there is not an overall shortage of water in the Bear River watershed. The problem is more about the seasonality of water. As the water supply wanes in the dry heat of the summer, there is a "shortage" of water. The intention at this time is to construct reservoirs to hold the water which would be distributed to Jordan Valley Water Conservancy District (50,000 acre-feet); Weber Basin Water Conservancy District (50,000 acre-feet), Bear River Water Conservancy District (60,000 acre-feet) and Cache County (60,000 acre-feet) (Utah Division of Water Resources 2004).

The water situation is more complex than simply considering the existing supply of water. How the landscape is treated now, as the population of the watershed continues to grow, can effectively maintain or decrease that supply of water. As the landscape is developed, the hydrologic regime is altered. Paving and building over permeable ground surfaces results in increased storm water run-off into surface water sources (e.g. streams, lakes, wetlands). Storm water run-off often contains the contaminants from roads, driveways, parking lots and lawns which are detrimental to the quality of surface water sources. The paving of permeable surfaces can also reduce the amount of water able to percolate down to the groundwater source and recharge the aquifer.

Thinking About the Future

There is no predicted cessation to the growth in the region. At this time, water is not considered to be a limiting factor in itself. Rather, it is the availability and distribution of water that is a concern. Building more reservoirs will help this problem for a while, but it is not a permanent solution. A somewhat more permanent, or at least longer lasting, solution is to consider the trends in water needs in the future and plan for growth appropriately.
MODELING PROCESS

FAULT LINES

FAULT BUFFERS

FLOODPLAINS

LANDSLIDE AREAS

STEEP SLOPES
The models were created by combining appropriate GIS data. The data layers were overlain and placed onto a base map that included the lakes, rivers, watershed boundary and digital elevation model. The combination of the layers formed the assessment models and alternative future models.

These pages illustrate this modeling process by showing how the Public Health, Welfare and Safety assessment model was created. The data layers used in this particular model are fault lines, fault buffers, floodplains, landslide areas and steep slopes.

Figure 11 Public Health, Welfare, and Safety Assessment Model
The following pages depict assessment models. These models are intended for use in evaluating the impacts of alternative futures. Each assessment model illustrates one or more attributes within the watershed, such as ground water recharge zones, wetlands, or public health, welfare and safety. The assessment attributes were selected after researching the historical, current and future issues and needs in the watershed. Discussions with stakeholders were also valuable in deciding what attributes to incorporate into assessment models. The photos at right represent some of the values we tried to preserve and hazards we are trying to avoid.

The GIS-based maps were developed to show locations of each attribute as well as levels of severity and/or importance. Levels of severity were determined by assessing the relative impact that growth could have on the features included in the model and the impact those features could have on growth.

For example, the wetlands assessment delineates and prioritizes wetlands within the watershed. By running alternative futures against this assessment, the acres of wetlands compromised can be calculated. From these calculations, evaluation of how much land in each priority level might be compromised. This can be used as a planning tool when determining where to develop and whether or not mitigation makes more sense than not developing at all.

Each future can be evaluated with one or more assessment models, resulting in a modified map that indicates areas are most suitable for development depending on the assessment model under investigation.

Each assessment model can be found in the back of this report on a transparency. These can be overlaid on the futures maps for the purpose of seeing how each assessment combines with each alternative future.

*Photo credits: Bald Eagle--Launi Evans; Others--Jay Baker*
Assessment Models:
SUMMARY - SURFACE WATER

In developing assessments for different futures for the Bear River Watershed, it is important to include the overall quality of surface water and health of riparian ecosystems. The water quality of the Bear River and its tributaries varies throughout the watershed. With the population of the watershed predicted to continue growing, especially in the Utah counties, it becomes increasingly important to look at taking preventative measures with regard to water quality when planning for growth.

The surface water assessment model is essentially an illustration of the current lakes, streams, reservoirs, and wetlands with a buffer around them to protect the quality of the particular water body. Reservoirs were included in order to incorporate human activity and man-made water bodies into the assessment. One hundred foot buffers were placed on either side of the larger-order streams in the watershed. The choice of 100 feet is somewhat arbitrary, as recommended buffer sizes range anywhere from 50 feet to 200 feet. 100 feet was chosen in this assessment because it is a middle ground and individual buffers will need to be determined on a case-by-case basis. The buffers are intended to act as no-growth and limited-use zones.

The purpose of the buffers is multifold, including but not limited to: preventing degradation of stream banks (or assisting in reconstruction of stream banks); maintaining and/or restoring riparian zones allowing them to fulfill their role in flood abatement, maintaining water quality, preserving wildlife habitat; maintaining an aesthetically pleasing landscape, and providing recreation areas for pastimes such as fishing. Providing a buffer would also hopefully diminish the direct depositing of inappropriate materials into streams.

Different buffer widths may be appropriate in different scenarios, and only larger-order streams and lakes have been included here, mainly because of data issues.

CRITERIA

- Bear River and major tributaries
- 100 foot buffer around Bear River and tributaries
- water bodies: lakes, reservoirs, streams, rivers, wetlands
- 100 foot buffer around lakes

ASSESSMENT BENEFITS

- Identifies areas adjacent to rivers and lakes in the Bear River Watershed which should be treated as no-growth and limited activity zones
- Promotes water quality and healthy streams
- Promotes functionality of riparian ecosystems
Surface Water ASSESSMENTS
SUMMARY - GROUND WATER

The groundwater assessment model is included to illustrate where the aquifer recharge areas in the Bear River Watershed are located. With a predicted population increase of about 100,000 people by 2025, water quality and availability (ground and surface water) will hopefully be an important consideration for planners. Running alternative future models against a groundwater assessment will be a good indicator of where development should occur to best keep aquifers from becoming contaminated.

Soil-type data was used to determine the aquifer recharge areas. The areas considered most important for maintaining water quality in aquifer recharge areas are those soils that are the most well-drained, as water will seep into the groundwater from the surface in these soils. In the assessment three levels of soil drainage are identified: excessively drained, somewhat excessively drained, and somewhat excessively drained plus well-drained. The three levels give an order of significance when considering land use for the region.

Based on the analysis of the GIS data that was collected, it appears that the most critical aquifer recharge areas to preserve are mainly at the base of the mountains, along benches created by Lake Bonneville. The valley bottoms have a layer of clay underneath the topsoil that offers the underlying aquifer some protection. In Cache Valley, development along these critical benches is increasing. Groundwater protection should be taken into account in the municipalities that are expanding onto the aquifer recharge areas.

CRITERIA

- Soil Type: levels of drainage/seepage
- Soil Type: highly permeable soils

ASSESSMENT BENEFITS

- Illustrates where the aquifer recharge areas are located within the watershed
- To consider groundwater quality when implementing land use
- To demonstrate that areas currently being developed along the Bonneville benches are valuable groundwater protection areas

Lake Bonneville Benches  Jessica Evans
Ground Water

ASSESSMENTS

DRAINAGE
- Excessively Drained
- Somewhat Excessively Drained
- Somewhat Excessively and Well Drained
- Town Boundaries
- Lakes
- Rivers

Miles

0 5 10 20 30

Utah
Idaho
Wyoming

Soda Springs
Montpelier
Sear Lake
Brigham City
Malad City
Logan
e

BRWR

Lakes

Rivers
SUMMARY - WETLANDS

Wetland areas are subject to strong legal protections and act as host to an abundance of biological diversity. Recreational uses for wetlands, such as birding, hunting, and fishing were important considerations when developing the wetlands assessments model. Conversely, due to safety risks associated with flooding and a high water table, wetlands provide poor sites for development. Therefore, this assessment model was created to identify all wetland areas and predict the impact alternative futures may have on them.

The data used to classify wetland areas were categorized based on water regime as follows:

1. Low preservation priority: Intermittently Exposed
2. Medium preservation priority: Temporarily Flooded, and Seasonally Flooded
3. High preservation priority: Semipermanently Flooded, Permanently Flooded, and Saturated

No wetland areas should have development promoted as a land use. However, if making a decision to protect wetlands with limited funds, those classified as high priority should be protected initially. Additionally, high impact uses are not recommended within at least a 100 foot buffer of all wetlands. Activities within this area should be evaluated on a case-by-case basis to determine the level of impact.

CRITERIA

• Currently designated wetland areas
• Major lakes and ponds

ASSESSMENT BENEFITS

• Determination of development impacts on current wetlands areas
• Identification of existing wetland areas for preservation
SUMMARY - WILDLIFE

The Wildlife assessment model was created to spatially illustrate and predict what wildlife habitats would be the critical or high priority areas for protection. For this model, elk was used as an umbrella species, meaning that because elk is a large ranging ungulate species, its selection as an umbrella species assumes that the protection of elk habitat and range will sufficiently encompass and protect the habitat of most other terrestrial species, including those threatened and endangered. Although this assumption can easily be critiqued, the protection of critical and high priority elk habitat offers a number of benefits and protections to other species.

Wetland habitats which, by nature, are very species-rich, were also included to provide some critical and high priority habitat for aquatic species.

In the assessment model, habitat shown is classified as either critical or high priority. Critical habitat areas are sensitive areas that are limited in scope and/or possess unique qualities. As such, the critical habitat areas displayed represent irreplaceable, critical locations for wildlife, excluding federally listed threatened and endangered species (USGS GAP 2004). High priority habitat is defined as intensive use areas that, due to relatively wide distribution do not constitute critical values but which are highly important to wildlife, excluding federally listed threatened and endangered species (USGS GAP 2004).

By incorporating the Wildlife assessment model with their conservation budget, planners and land managers should be able to adequately prioritize and protect critical or high priority elk habitat areas.

CRITERIA

• Vegetation
• Wetlands
• Elk habitat

ASSESSMENT BENEFITS

• Identification of areas that are critical or high priority to elk and wetland species
• Protects other species’ habitats
SUMMARY - HEALTH, WELFARE, AND SAFETY

The Public Health, Welfare and Safety assessment model was designed to spatially illustrate the hazardous areas in the Bear River Watershed. Areas that have a potential for:

- earthquakes
- flooding
- landslides
- damage caused by steep slopes

were all considered in this model. The identification of these areas should help decision makers create wise ordinances or zoning in order to minimize loss of life and property damage caused by natural disasters.

For the fault lines, only Quarternary faults that have been active in the last 10,000 years were considered. A 250 foot buffer was placed around these faults in order to simulate ordinances that are currently in place in Salt Lake County and many municipalities in Southern California.

The flood plains were estimated by using national soils data and selecting all of the soils that were frequently, occasionally or rarely submerged annually.

Similarly, landslide areas were selected from soils data. Areas with a slope steeper than 15 degrees and a moderate to high incidence or susceptibility to landslides were incorporated into this layer.

Slopes steeper than 15 degrees greatly increase the likelihood of property damage. Areas with steep slopes are identified so planners and decision makers will be better able to assess wise landuses in these areas.

Being able to identify and plan for areas with a high likelihood for natural disasters is invaluable for planners. Encouraging smart development or no development in these areas is strongly recommended.

CRITERIA

- Quarternary faults with activity in the last 10,000 years
- 250 foot buffer on Quarternary faults
- Floodplains: estimated by using soils data and selecting all soils that frequently, occasionally and rarely flooded
- Slopes steeper than 15 degrees
- Landslides: All areas with slopes steeper than 15 degrees that have moderate to high incidence of landslides or a moderate to high susceptibility for landslides

ASSESSMENT BENEFITS

- Location of planned projects in relation to potentially hazardous areas
- Identification of areas that could potentially cause damage to health or property
- Special zoning for areas to minimize the likelihood of injury or property loss from a natural disaster
- Probability and/or desirability of development based on proximity to hazardous areas

SUMMARY - HEALTH, WELFARE, AND SAFETY

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- landslides
- damage caused by steep slopes

were all considered in this model. The identification of these areas should help decision makers create wise ordinances or zoning in order to minimize loss of life and property damage caused by natural disasters.

For the fault lines, only Quarternary faults that have been active in the last 10,000 years were considered. A 250 foot buffer was placed around these faults in order to simulate ordinances that are currently in place in Salt Lake County and many municipalities in Southern California.

The flood plains were estimated by using national soils data and selecting all of the soils that were frequently, occasionally or rarely submerged annually.

Similarly, landslide areas were selected from soils data. Areas with a slope steeper than 15 degrees and a moderate to high incidence or susceptibility to landslides were incorporated into this layer.

Slopes steeper than 15 degrees greatly increase the likelihood of property damage. Areas with steep slopes are identified so planners and decision makers will be better able to assess wise landuses in these areas.

Being able to identify and plan for areas with a high likelihood for natural disasters is invaluable for planners. Encouraging smart development or no development in these areas is strongly recommended.

CRITERIA

- Quarternary faults with activity in the last 10,000 years
- 250 foot buffer on Quarternary faults
- Floodplains: estimated by using soils data and selecting all soils that frequently, occasionally and rarely flooded
- Slopes steeper than 15 degrees
- Landslides: All areas with slopes steeper than 15 degrees that have moderate to high incidence of landslides or a moderate to high susceptibility for landslides

ASSESSMENT BENEFITS

- Location of planned projects in relation to potentially hazardous areas
- Identification of areas that could potentially cause damage to health or property
- Special zoning for areas to minimize the likelihood of injury or property loss from a natural disaster
- Probability and/or desirability of development based on proximity to hazardous areas

SUMMARY - HEALTH, WELFARE, AND SAFETY

The Public Health, Welfare and Safety assessment model was designed to spatially illustrate the hazardous areas in the Bear River Watershed. Areas that have a potential for:

- earthquakes
- flooding
- landslides
- damage caused by steep slopes

were all considered in this model. The identification of these areas should help decision makers create wise ordinances or zoning in order to minimize loss of life and property damage caused by natural disasters.

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- Slopes steeper than 15 degrees
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Being able to identify and plan for areas with a high likelihood for natural disasters is invaluable for planners. Encouraging smart development or no development in these areas is strongly recommended.
SUMMARY - RURAL QUALITY OF LIFE

Based on the history and first hand research of the Bear River Watershed, the study team recognized that certain quality of life features were important to the residents of the area. Foremost among these qualities was an established rural quality of life; panoramic vistas defined by significant landmarks and the prevalence of small, distinct towns bounded by agricultural lands and mountains.

In order to visually represent these attributes, the study team first defined the existing urban areas and estimated a small growth buffer around each of them. These buffers were omitted from rural towns where growth potential is low. To keep the towns distinct, a ¼ mile no-growth buffer was included, adjacent to the growth buffer. The reason for this was to allow towns room to grow, while controlling sprawl and encouraging distinct, separate small towns. Reasonable elevations were determined which marked the upper growth limits in the valleys. These growth limits were determined to keep development from progressing further up the mountains, and thus preserving the mountain viewscape. The development moratoriums were set at five different elevations: Cache Valley 1500 m, Soda Springs 1800-1900 m, Bear Lake 1900 m, Evanston 2100 m, Malad/Brigham/Tremonton 1400 m.

Viewsheds were calculated along major roads within the watershed to preserve scenic vistas and some agricultural land as well as the overall feel of openness. The viewsheds made it possible to define which areas would be within viewing distance of culturally important landmarks, namely Bear Lake, Bear River Migratory Bird Refuge, Logan Temple, and Old Main Building on the Utah State University campus.

The combination of these factors resulted in the rural quality of life assessment model.

CRITERIA

- Municipal boundaries
- Growth rings around the municipal boundaries
- 1 mile no-growth ring around growth ring to separate the towns.
- Development moratorium at specified elevations
- Chosen landmarks to run viewshed calculations from
- Viewsheds from points on major roads within the watershed

All possible combinations of the criteria were evaluated and classified as high, medium, or low in the amount they contributed to the rural quality of the area. The combinations were classified as follows:

Low Priority: All areas that are currently towns; any combination of criteria that included the growth ring around towns

Medium Priority: Elevation ceiling; viewsheds from the landmarks; the combination of the two criteria above

High Priority: Viewsheds from major roads; no growth rings; any combination of criteria that includes one or both of the above criteria. Exceptions to this are those combinations already designated as low priority above.

ASSESSMENT BENEFITS

- Identifies views of agricultural land and other scenery from major roads
- Identifies areas that can view landmarks
- Promotes development in areas that do not go above the benches of the valleys, are closer to existing towns and urban areas, and are within sight of local landmarks
- Identifies areas in alternative futures that are within existing urban boundaries and expected growth rings
Rural Quality of Life

ASSESSMENTS
SUMMARY - INFRASTRUCTURE

When assembling the data for the infrastructure model, existing roads, railroads and municipalities with sewage systems were the primary focus. Other criteria that were considered, but not included, for the model were water lines, power lines, gas lines and telephone/cell phone serviceable areas. As it is, most of the afore-mentioned utilities’ infrastructure networks nearly parallel the major roads or railroad corridors. Even though many main distribution oil and gas pipelines go cross-country independent of a road within the watershed, these pipelines would probably not be a driving reason for development without the existence of a road or railroad.

As such, spatial representation of the existing roads, railroads and sewer service areas was determined to provide a good base model for the infrastructure in the Bear River Watershed. Road and railroad data was not difficult to find and compile. However, an approximation was required to spatially illustrate the sewer service areas. The first step in the approximation involved obtaining information that listed which municipalities in the watershed have sewage systems. The official boundaries for these municipalities were then selected and used to estimate the boundaries of the sewer service area.

Proximity to existing infrastructure will be the most valuable information that can be obtained by running a future model against this assessment model. A buffer or group of buffers set up different distances from the existing infrastructure will enable the user of the assessment model to determine the development probability given current conditions or expected conditions stated in the different future models. Growth pressure could easily be approximated using the infrastructure model in a similar way. By utilizing the different distances and proximity to existing infrastructure and towns, the user could also generate a cost estimate for providing infrastructure to new developments that are outliers to the existing towns and infrastructure.

CRITERIA

- Roads: Highways and other major Federal and State Roads
- Railroads
- Municipal boundaries of towns with sewer systems

ASSESSMENT BENEFITS

- Proximity to existing infrastructure
- Probability and/or desirability of development based on proximity to infrastructure
- Costs related to infrastructure development based on proximity to infrastructure
Infrastructure Assessment

ASSESSMENTS

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[Map showing infrastructure assessment areas, roads, and water bodies in Utah and Idaho]
SUMMARY - CRITICAL LANDS

The Bear River Watershed has many areas that can be considered critical lands. However, everyone has a different opinion of what critical lands are. The Critical Lands Assessment Models were designed with the intent of providing the user the ability to select which values he or she thinks are worthy of protection or preservation. Based on the assessment models listed earlier in the report, five qualities were developed to be incorporated into the Critical Lands Assessments. Public Health, Welfare, and Safety (PHWS) hazards, areas critical to water quality, wetland areas, wildlife habitat and areas crucial to rural quality or life were the five areas chosen for incorporation into the Critical Lands models.

CRITERIA

(read the abstracts for the specific models for a more detailed report of how the data was obtained):

• **Public Health, Welfare and Safety**: Merged fault buffers, floodplains and slopes steeper than 15 degrees and saved as a shapefile.

• **Wetlands**: Combined all wetland areas, removed the lakes and water bodies and saved as a shapefile.

• **Water Quality**: Merged river buffers, lake buffers, lakes, reservoirs and aquifer recharge areas and saved as a shapefile.

• **Wildlife**: Merged all critical wildlife areas, removed wetlands and saved as a shapefile.

• **Rural Quality**: Merged all values from the Rural Quality assessment that were medium or high, removed wetlands and lakes, and saved as a shapefile.

After individually merging and preparing the five topics listed above, each shapefile was assigned a unique field and value. The five shapefiles were then joined into one master file by process of union. Once the master file had been created, any combination of the five separate layers could be requested, and areas where the values overlap could be determined.

Herein lays the biggest strength of the Critical Lands assessment models. For example, if someone is only interested in wetlands and wildlife, the model can be run so that the output shows which areas have wetlands preservation value, wildlife preservation value and preservation value for both wetlands and wildlife. Therefore, if someone has limited funding and wants to preserve areas that are beneficial to both wildlife and wetlands, they will know which areas are higher priorities. Similarly, if you are interested in all five attributes, the future can spatially illustrate which areas have preservation value for all five layers, four layers, etc.
For the purposes of this study, three assessment models that cumulatively added on to each other were created.

Model 1: PHWS + Wetlands + Water Quality
Model 2: PHWS + Wetlands + Water Quality + Wildlife
Model 3: PHWS + Wetlands + Water Quality + Wildlife + Rural Quality

Following the formation of these three models, a new field that summed the total values of the input layers was created. The values in this new field were then able to illustrate which areas would be the best choices for preservation. The areas that had the most layers overlapping were designated as the highest priority, those with more than one but less than the maximum were designated moderate and those with one layer were designated lower priority.

Comparison of the three Critical Lands models shows how adding the wildlife layer to Model 1 increases the overall amount of critical lands and amount of higher priority lands. Similarly, it is easy to see the changes associated with the addition of the rural quality of life layer in Model 3. Critical Lands Model 2 was chosen to evaluate the future models because it entailed all major safety and environmental concerns and was the median of the three models that were made. Running Model 2 against the future models showed the impacts of the future on areas important to Public Health, Welfare and Safety, wetlands, water quality and wildlife.

Please note that these three models are by no means an exhaustion of the possibilities that can be done within this framework. Upwards of twenty different combinations of Critical Lands assessment models could be created from the layers listed above. The ability to choose and evaluate the impact of future plans on critical lands based on which attributes are most important to the organization or government entity should prove to be very useful to local planners and decision makers.
MODEL 1 = PHWS + WETLANDS + WATER QUALITY

MODEL 2 = MODEL 1 + WILDLIFE

MODEL 3 = MODEL 2 + RURAL QUALITY
ALTERNATIVE FUTURES

Overview

The purpose of the following Alternative Futures Models is to present different scenarios for the future use of the land within the Bear River Watershed. Each scenario represents different goals, emphases, and priorities. The goal in presenting different ideas is to represent the differing perspectives held by the stakeholders and other residents within the watershed. All of the models are composed of similar data that, if desired, could be used to create other potential futures. If a specific feature of any particular model is desirable, rather than the whole, it is possible to combine this element with elements of other future models. It is also possible to combine entire models to create a new model.

The following is a list of the future models created in this study.

- Growth Potential
- Plan Trend
- Double Expected Population
- Expanded Small Towns
- New Town
- Public Transit Oriented
- Regional Parks and Trail System
- Destination Resorts

With the future models developed the next step is to assess how they fit with the aspects identified as important to preserve within the watershed. Each future model can be compared to each assessment model to evaluate any possible conflicts in land use and preservation patterns. Some of the future models are composed of components taken from assessment models. As a result, it is unnecessary to run these futures against the assessments used to develop them. The assessments used by each future scenario will be discussed in more detail later in this chapter.

Each of the four main future models: New Town; Expanded Small Towns; Plan Trend; and Double Expected Population, was combined with the Critical Lands level 2 assessment model. Each of these futures was selected because of the land pressure these types of growth scenarios could put on the watershed. It was appropriate, therefore, to contrast each of these futures with an assessment that combined several attributes and would provide an idea of what kind of impact was possible with each of these futures, and compare differences between them.

Three of the futures are feature oriented, meaning they don’t account for the expected population growth within the watershed, but instead offer a feature that could be incorporated into any growth oriented alternative future. Therefore, it was not necessary to run these futures against the assessment models.

The Critical Lands level 2 assessment was chosen to combine with the futures because it included several important attributes in one assessment. Each of the attributes included in the Critical Lands level 2 assessment could have a significant effect on plans for growth in the watershed. Conversely, growth could significantly affect any of these attributes. The combination of each alternative future and this assessment provides a framework for discussion of possibilities and implications for different planning regimes.

Each future was combined with the assessment and the results define the amount of critical land which would be compromised if development occurred in the manner indicated by the future. It is important to keep in mind that although the assessment represents several attributes, these are not distinguished when combining the assessment with the futures. Thus, any detailed analysis of the future/assessment combination should break down the critical lands assessment into the individual attributes. This will allow in-depth interpretation – for example, looking at public health, welfare and safety separately from wetlands or ground water recharge areas, based on a given planning concern.

In the context of which was least likely to compromise lands considered to be critical, some futures fared better than others. At the end of the section for each future is a description of the results from running the future against the Critical Lands level 2 assessment.
Overview

Alternative Futures:

Growth Oriented Alternative Futures:

- Growth Potential
  - pg. 54

- Plan Trend
  - pg. 56

- Double Expected Population
  - pg. 60

Small Town Growth

- pg. 64

New Towns

- pg. 68

Feature Oriented Alternative Futures:

- Public Transit
  - pg. 72

- Regional Parks System
  - pg. 74

- Destination Resorts
  - pg. 76
The growth potential model was created to show all areas in the watershed that could potentially be developed under basic assumptions. The three main criteria that were removed from the model are federal lands, existing municipal areas, and areas selected in the Public Health, Welfare and Safety assessment model. The model removes all federal lands under the assumption that federal lands are not likely to be developed in the near future. As such, only private and state lands were considered. Similarly, areas that are currently developed were also selected and removed. Finally, all potentially hazardous areas selected in the Public Health, Welfare and Safety model (specifically, areas located in floodplains, on steep slopes, within 250 feet of fault lines or on water bodies) were filtered and removed from the model.

The acreage of the remaining areas was then calculated for each county in the Bear River Watershed. The available acreage was summed and tabulated on a spreadsheet (see Figure 12 below). Final calculations were then made to determine the potential number of people that the counties and watershed could hold based on different density rates (2.0, 4.1, or 6.8 people per acre). These density rates were based on the research of Glen Busch (2005). Busch estimated the number of people per acre of development in Cache County to be 4.1. He similarly estimated 6.8 people per acre for urban counties such as Salt Lake. Based on what he had done, an estimate of 2.0 people per acre for rural development more accurately reflects some of the rural counties in the Bear River Watershed.

The top row of the table shows the additional number of people that could potentially move to and reside in each county at the respective density rates. The bottom row shows the future potential county and watershed populations by adding the top row to the 2005 population. The 2005 population numbers were obtained from the Utah Governor’s Office of Planning and Budget. The figures in the table are not intended to be a prediction of future population growth, merely a basic, theoretical estimate of the potential for growth.

<table>
<thead>
<tr>
<th>County</th>
<th>Available Acres</th>
<th>4.1 people per acre</th>
<th>6.8 people per acre</th>
<th>2.0 people per acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Box Elder</td>
<td>70,488</td>
<td>289,001</td>
<td>479,318</td>
<td>140,976</td>
</tr>
<tr>
<td>Cache</td>
<td>310,646</td>
<td>1,273,649</td>
<td>2,112,393</td>
<td>621,292</td>
</tr>
<tr>
<td>Rich</td>
<td>318,620</td>
<td>1,306,342</td>
<td>2,166,616</td>
<td>637,240</td>
</tr>
<tr>
<td>Oneida</td>
<td>151,349</td>
<td>620,531</td>
<td>1,029,173</td>
<td>302,698</td>
</tr>
<tr>
<td>Caribou</td>
<td>136,948</td>
<td>561,487</td>
<td>931,246</td>
<td>273,896</td>
</tr>
<tr>
<td>Bear Lake</td>
<td>200,524</td>
<td>822,148</td>
<td>1,363,563</td>
<td>401,048</td>
</tr>
<tr>
<td>Franklin</td>
<td>234,168</td>
<td>960,089</td>
<td>1,592,342</td>
<td>468,336</td>
</tr>
<tr>
<td>Lincoln</td>
<td>128,480</td>
<td>526,768</td>
<td>873,664</td>
<td>256,960</td>
</tr>
<tr>
<td>Uinta</td>
<td>200,220</td>
<td>820,902</td>
<td>1,361,496</td>
<td>400,440</td>
</tr>
<tr>
<td>Summit</td>
<td>89,173</td>
<td>365,609</td>
<td>606,376</td>
<td>178,346</td>
</tr>
<tr>
<td>Bannock</td>
<td>45,983</td>
<td>188,530</td>
<td>312,684</td>
<td>91,966</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1,886,599</td>
<td>7,735,056</td>
<td>12,828,873</td>
<td>3,773,198</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>County</th>
<th>2005 Population</th>
<th>4.1 people per acre</th>
<th>6.8 people per acre</th>
<th>2.0 people per acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Box Elder</td>
<td>45,142</td>
<td>334,143</td>
<td>524,460</td>
<td>186,118</td>
</tr>
<tr>
<td>Cache</td>
<td>102,477</td>
<td>1,376,126</td>
<td>2,214,870</td>
<td>723,769</td>
</tr>
<tr>
<td>Rich</td>
<td>2,086</td>
<td>1,308,428</td>
<td>2,168,702</td>
<td>639,326</td>
</tr>
<tr>
<td>Oneida</td>
<td>4,132</td>
<td>624,663</td>
<td>1,033,305</td>
<td>306,830</td>
</tr>
<tr>
<td>Caribou</td>
<td>7,152</td>
<td>568,639</td>
<td>938,398</td>
<td>281,048</td>
</tr>
<tr>
<td>Bear Lake</td>
<td>6,306</td>
<td>828,454</td>
<td>1,369,869</td>
<td>407,354</td>
</tr>
<tr>
<td>Franklin</td>
<td>11,874</td>
<td>971,963</td>
<td>1,604,216</td>
<td>480,210</td>
</tr>
<tr>
<td>Lincoln</td>
<td>506</td>
<td>527,274</td>
<td>874,170</td>
<td>257,466</td>
</tr>
<tr>
<td>Uinta</td>
<td>11,507</td>
<td>832,409</td>
<td>1,373,003</td>
<td>411,947</td>
</tr>
<tr>
<td>Summit</td>
<td>100</td>
<td>365,709</td>
<td>606,476</td>
<td>178,446</td>
</tr>
<tr>
<td>Bannock</td>
<td>50</td>
<td>188,580</td>
<td>312,734</td>
<td>92,016</td>
</tr>
<tr>
<td>BRW</td>
<td>191,332</td>
<td>7,926,388</td>
<td>13,020,205</td>
<td>3,964,530</td>
</tr>
</tbody>
</table>

Figure 12 Potential Growth Table
SUMMARY - PLAN TREND

The Plan Trend future investigates where development pressure exists and would be feasible following current trends. This future is modeling continued growth in the Bear River Watershed in similar fashion to what is currently being experienced. With this future there would be an emphasis on suburban development and commuter-based infrastructure.

The areas focused on in the Plan Trend future are those within existing municipalities, adjacent to currently developed areas, in close proximity to roads and on a slope gradient of less than 15%. These criteria reflect the most cost-effective development strategies and are the basic conditions used in development over the last 15-20 years (Toth et al. 2002).

The only lands excluded from this scenario are public lands and those with a slope gradient greater than 25%. By not allowing growth on slopes steeper than 25%, the assumption is being made that developers will initially choose to build in the most cost-effective manner. Also implicit in this model is the presumption that the public lands will remain undisturbed by the effects of development pressure; however, this presumption does not adequately reflect the dynamic changes that occur in the agencies which oversee these lands.

Overall, this future attempts to present the Bear River Watershed as it most likely would look if development continued based on the status quo. The future illustrates the spatial range of development pressures on the watershed and it can be used as a basis for evaluation of proposed plans for the watershed, or as a basis of comparison for other alternative futures.

CRITERIA

- existing municipalities
- ~400 ft buffers around already developed areas*
- ~400 ft buffer around roads*
- slope gradient <=15%
- public lands (exclusion layer)
- slope gradient >=25% (exclusion layer)

* These buffer widths are based on previous reports for other regions (Toth et al., 2002).

WHAT IS BEING ILLUSTRATED

- A future where development continues to occur as it is currently
- Growth adjacent to or in close proximity to existing areas of development
- Suburban and commuter lifestyles consistent with status quo
- A dependence on fossil fuel based transportation systems
- The preservation of public lands in their current form
- Development in less steep, less risky and more economically viable areas
Plan Trend Future Combined with Critical Lands level 2 Assessment

In comparing the plan trend future to the critical lands assessment, there are a total of 1,794,084 acres (67% of total plan trend area) which could be developed without compromising critical lands.

For the rest of the land, a total of 17,636 acres (0.7%) of high priority critical lands would be compromised. Based on that low area, it might make sense that at a minimum these high priority lands are worth considering for conservation. The plan trend alternative future does not take into account public health, welfare and safety. However, these are considered by the critical lands assessment. It would be recommended to look what percent of critical lands compromised are part of the Public Health, Welfare, and Safety assessment criteria.

The table below outlines the areas of critical lands which could be compromised by the plan trend future. This table represents total acres compromised, and is not normalized by percent of land compromised. The total acreage covered varies by the category of development pressure. There is significantly more acreage contained in the Low Development Pressure category versus the High Development Pressure category.

<table>
<thead>
<tr>
<th>Development Pressure on Land</th>
<th>Priority Level of Critical Lands Level 2 Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>High</td>
<td>16,960</td>
</tr>
<tr>
<td>Medium</td>
<td>55,538</td>
</tr>
<tr>
<td>Low</td>
<td>604,311</td>
</tr>
</tbody>
</table>

Figure 13  Plan Trend Assessment Impacts. Note: the initial amounts of land in the low, medium, and high categories of the Critical Lands level 2 Assessment are not equal.
SUMMARY - DOUBLE EXPECTED POPULATION

As of 2005, 191,332 people are living in the Bear River Watershed. According to the Utah Governor’s Office of Planning and Budget, the watershed’s population is expected to increase by 95,000 people by the year 2025. Growth rates in selected areas of the Intermountain Region of the United States have often exceeded 10% annually during the last 30 years. As such, this projected 50% increase over 20 years may be an underestimate of what could actually happen.

Utah State University (USU) is the single largest employer in the watershed and the main engine of the local economy. Therefore, a plausible scenario would have augmented growth in the watershed tied to growth at USU. The basis for this model was an assumption that a larger focus on research would draw in approximately 50 new companies to the USU Research Park. Estimating a parcel size of 10 acres per company, an area 480 acres in size was plotted near the existing Research Park (in yellow on the map). The model also assumes that the projected 95,000 population increase would double, to 190,000. This is one example of many scenarios that could potentially bring a larger than expected amount of people to the area.

The county percentage of the BRW population growth was calculated using the 2005 population estimates. Cache, Box Elder, and Franklin Counties were forecast to be the primary recipients of the increased growth due to their close proximity to the expanded Research Park. The model was adjusted accordingly.

Current land-use densities were obtained from Glen Busch. His data showed that Cache County currently supports 4.1 people per developed acre (Busch 2005). Based on this rate, approximately 46,000 acres would be needed in order to accommodate 190,000 new people. The expected number of people and acres per county was calculated accordingly on the spreadsheet.

In order to spatially model the increased growth, the existing sewer areas were expanded by one mile. After calculating the expanded area, certain features were excluded from it: areas that are currently developed, floodplains, steep slopes, fault lines with 250 foot buffers, water bodies, and public lands. The acreage of the remaining areas was over 106,000 acres. This is enough land to support 2.2 times the expected 2025 population (627,000 total people).

As this area was larger than what was initially desired for the purposes of the model, a 0.5 mile expansion was subsequently calculated with the same areas excluded as the one mile expansion. This yielded approximately 56,000 acres, or enough area to support 1.5 times the expected 2025 population (421,000 total people).

As such, the exact area affected by doubling the expected population growth is not shown on this model. In order to illustrate the spatial impacts of double the expected 2025 population an area approximately 75% of the area of the 1 mile expanded area would be needed. Both the 1 mile and 0.5 mile expansions were included on the model to spatially demonstrate the effects of increased levels of growth on the Bear River Watershed if current development patterns and density are sustained.

WHAT IS BEING ILLUSTRATED

• Larger than expected population increase in the Bear River Watershed, due to the expansion of the Utah State University Research Park by 480 acres

• Areas in close proximity to the Research Park developing in a manner similar to present conditions

• Areas that would have a high likelihood of being developed in 20 years due to proximity to existing sewer infrastructure with larger than expected population growth, assuming a population density of 4.1 people/acre
Double Expected Population

The Double Expected Population future model was combined with the Critical Lands Model 2 assessment in order to determine how much critical land would be compromised if growth were to occur according to this future.

Looking at the Double Expected Population alternative future, there are a total of 26,374 acres of critical lands which would potentially be impacted by development if it occurred in the area specified by the expansion representing 2.2 times the expected 2025 population. Of this land, 25,331 acres of low priority critical lands, 940 acres of medium priority lands and 3 acres of high priority lands would be compromised by development in the watershed, according to the Double Expected Population future model.

This provides a quantitative measure for some of the reasonably foreseeable impacts growth like this could have. As the critical lands assessment encompasses a number of criteria, it is possible to break these down in order to understand which criteria present the most risk.

Even with this aggressive growth rate, a significant amount of available acreage would still remain eligible for development or preservation. However, it is important to note that other significant factors, such as water availability (which is limited) and the rural quality of life, which is a reason many people have for moving into the watershed, have not been accounted for in this future.

Figure 15 below outlines the critical lands which could be compromised by the Double Expected Population future.

<table>
<thead>
<tr>
<th>County</th>
<th>2005 Population</th>
<th>2025 Proj. Population</th>
<th>2050 Proj. Population</th>
<th>% of 2005 population</th>
<th>Acres w/1 mile expansion</th>
<th>Proj. Pop. w/1 mile expansion</th>
<th>Acres w/0.5 mile expansion</th>
<th>Proj. Pop. w/5 mile expansion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Box</td>
<td>45,142</td>
<td>68,038</td>
<td>97,789</td>
<td>23.59</td>
<td>25,644</td>
<td>150,282</td>
<td>12,132</td>
<td>94,883</td>
</tr>
<tr>
<td>Elder</td>
<td>102,477</td>
<td>165,626</td>
<td>266,711</td>
<td>53.56</td>
<td>44,294</td>
<td>284,082</td>
<td>26,444</td>
<td>210,897</td>
</tr>
<tr>
<td>Cache</td>
<td>2,086</td>
<td>2,574</td>
<td>2,809</td>
<td>1.09</td>
<td>3,155</td>
<td>15,022</td>
<td>1,567</td>
<td>8,511</td>
</tr>
<tr>
<td>Rich</td>
<td>4,132</td>
<td>4,958</td>
<td>5,496</td>
<td>2.16</td>
<td>4,671</td>
<td>23,283</td>
<td>2,416</td>
<td>14,038</td>
</tr>
<tr>
<td>Oneida</td>
<td>7,152</td>
<td>8,582</td>
<td>9,512</td>
<td>3.74</td>
<td>5,657</td>
<td>30,346</td>
<td>2,623</td>
<td>17,906</td>
</tr>
<tr>
<td>Caribou</td>
<td>6,306</td>
<td>7,567</td>
<td>8,387</td>
<td>3.30</td>
<td>8,453</td>
<td>40,963</td>
<td>3,465</td>
<td>20,513</td>
</tr>
<tr>
<td>Bear Lk.</td>
<td>11,874</td>
<td>17,811</td>
<td>23,748</td>
<td>6.21</td>
<td>5,792</td>
<td>35,621</td>
<td>2,524</td>
<td>22,222</td>
</tr>
<tr>
<td>Franklin</td>
<td>506</td>
<td>607</td>
<td>673</td>
<td>0.26</td>
<td>0</td>
<td>506</td>
<td>0</td>
<td>506</td>
</tr>
<tr>
<td>Lincoln</td>
<td>11,507</td>
<td>13,808</td>
<td>15,304</td>
<td>6.01</td>
<td>8,689</td>
<td>47,132</td>
<td>4,936</td>
<td>31,745</td>
</tr>
<tr>
<td>Uinta</td>
<td>100</td>
<td>120</td>
<td>133</td>
<td>0.05</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>Summit</td>
<td>50</td>
<td>60</td>
<td>67</td>
<td>0.03</td>
<td>0</td>
<td>50</td>
<td>0</td>
<td>50</td>
</tr>
<tr>
<td>Bannock</td>
<td>4,132</td>
<td>4,958</td>
<td>5,496</td>
<td>2.16</td>
<td>4,671</td>
<td>23,283</td>
<td>2,416</td>
<td>14,038</td>
</tr>
<tr>
<td>TOTAL</td>
<td>191,332</td>
<td>289,753</td>
<td>430,628</td>
<td>100.00</td>
<td>106,355</td>
<td>627,388</td>
<td>56,107</td>
<td>421,371</td>
</tr>
</tbody>
</table>

Figure 14 Population Projections

Double Expected Population Combined with Critical Lands level 2 Assessment

Acres of Critical Lands Potentially Compromised by Double Expected Population Growth

<table>
<thead>
<tr>
<th>Priority Level for Critical Lands Level 2 Model</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>25,331</td>
<td>940</td>
<td>3</td>
</tr>
</tbody>
</table>

Figure 15 Double Pop. Assessment Impact. Note: the initial amounts of land in the low, medium, and high categories of the Critical Lands level 2 Assessment are not equal.
SUMMARY - SMALL TOWN GROWTH

When the Mormons originally settled the watershed, the pattern of development was a series of small towns spread throughout the entire area. Each town was laid out along a grid system with houses collected around a town center. Lots were generally large by today’s standards, and consisted of not only a house, which was set at least 25 feet from the road, but also an orchard in front and gardens, livestock, and outbuildings in the back. Because of this, the towns were self-sufficient and spread miles from each other. The study team feels that this pattern of development is part of the culture and important to the people who live there, thus worth preserving.

In order to preserve this pattern, an alternative future was created in which all growth happens by simply expanding the medium-sized towns in the area, as opposed to all of the growth happening in the larger cities in the watershed or in new towns that currently don’t exist. Essentially, it is the opposite of the Big Towns alternative future.

CRITERIA

- *Population:* The towns chosen to be expanded were based on population in 2000; they must have between 1,000 and 15,000 residents. These towns would be more able to handle large growth, and are assumed to already be desirable to live in.

- *Sewage system:* The model’s expanded towns were partly chosen based on the fact that a sewage system currently exists. These towns could more feasibly hold more residents than the smaller towns that have no sewage in place.

- *Density:* Because expansion occurs with a variety of densities, the study team felt it necessary to give two different alternative density growths. The first is a density of 4.1 people per acre, which is the current average density of Cache County, and was used for one expansion model. The second scenario is based on a higher density of 5.1 people per acre.

- *Infrastructure:* The expanding towns must have a good road system, or at least be in close proximity to some major road or highway, for the same reason as the other criteria: that they will better be able to sustain high development.

- *Public safety:* Public health hazards were also taken into account by comparing the new town boundaries with floodplains, steep slopes, and landslide risk.

WHAT IS BEING PROMOTED

- A pattern of development where the growth happens in only the medium sized small towns in order to preserve the local culture of many small, distinct towns as opposed to only a few larger cities.

- The dispersal of population throughout the watershed, rather than the continued concentration around currently developed areas, such as Logan.

Grace, ID  

Clark Bryner
Expanding Small Towns Future Combined with Critical Lands level 2 Assessment

The expanding small towns future was combined with the Critical Lands level 2 assessment in order to determine how much critical land would be compromised if growth were to occur according to this future.

For this future, a total of 33,573 acres of land is being considered for growth potential. Of that land 20,700 acres (62%) could be developed without compromising land considered to be critical. Of the remaining land, expanding small towns at a high density would potentially compromise 4,228 (13%) acres of critical lands. Expanding small towns at a medium density could compromise 8,645 (26%) acres of critical lands.

With conservation of all critical lands, small towns could be expanded, according to this future, by 20,700 acres. As this future is looking at individual towns, it is important to recognize that critical lands may be more prevalent around some towns than others. Other factors which have not been considered in this assessment include water availability and existing infrastructure such as roads, which could affect the economic feasibility of expanding some towns versus others.

The chart below shows the critical land potentially compromised by expanding small towns.

### Acres of Critical Lands Potentially Compromised by Expanding Small Towns Based on Growth Density

<table>
<thead>
<tr>
<th>Growth Density</th>
<th>Priority of Critical Lands Level 2 Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>Medium</td>
<td>8210</td>
</tr>
<tr>
<td>High</td>
<td>3971</td>
</tr>
</tbody>
</table>

*Figure 16 Small Towns Assessment Impacts. Note: the initial amounts of land in the low, medium, and high categories of the Critical Lands level 2 Assessment are not equal.*
SUMMARY - NEW TOWNS

As discussed in the Double Expected Population alternative future, the population of the Bear River Watershed is projected to increase by 95,000 people by the year 2025. The study team thought it would be important to consider higher density residences throughout the watershed in order to preserve the cherished characteristics of the landscape. The New Towns alternative future estimated that an area of 8,000 square acres would accommodate a population of 50,000 people based on a 4.1 people per acre footprint, i.e., the additional land required for infrastructure, institutional, and commercial development. It should be noted that a new city of this size is not required in order to meet the goal of preserving landscape characteristics. Several smaller new cities around 20,000-30,000 people would also be ideal.

Although the idea of a new town is rather foreign to the study area, communities nationwide have experienced tremendous success with higher density neighborhoods. Kentlands in Maryland and Daybreak Community just outside of Salt Lake City, Utah are two examples.

“Residences, shops, services and employment areas are close together to preserve open space, encourage walking, reduce public costs, and provide sufficient scale to support local amenities, business, and public transportation. Close neighbors naturally develop social interactions, beautify their surroundings by adding landscaping and gardens, and watch over each other for collective security (http://www.kentlands.org/history.html).”

CRITERIA

- Access to transportation (highways, roads, railroads)
- Proximity to expected growth areas and existing infrastructure
- Access to recreation areas, i.e., public lands
- Aesthetics quality
- Public health, welfare, and safety, i.e., hazardous areas including floodplains, potential landslide areas, fault lines, slopes steeper than 15 degrees
- Cost of land acquisition

The study team identified five big town sites in the study area, three of which were then appraised based on the criteria.

<table>
<thead>
<tr>
<th>3&gt;2&gt;1</th>
<th>Plymouth</th>
<th>Weston</th>
<th>S.Cache</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access to transportation</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Proximity to expected growth areas</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Access to recreation</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Aesthetic quality</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Public Health, Welfare, &amp; Safety</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Cost of land acquisition</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
</tbody>
</table>

Figure 17  New Towns Rankings

Although each site resulted in an equal appraisal, Plymouth was chosen as first preference because of its close proximity to Interstate I-15.

WHAT IS BEING PROMOTED

- Provide the study area with compact, pedestrian-friendly neighborhoods and urban places
- Communities built and justified with a rhetoric of respect for the land
ALTERNATIVE FUTURES

New Towns

- Plymouth New Town
- Weston New Town
- South Cache New Town
- Highways
- Major Roads
- Railroads
- BLM
- Forest Service
- State Land
- Slopes > 15 degrees
- Faults
- Floodplains
- Potential Landslide Areas
- Sewer & Basic Infrastructure
- Lakes
- Rivers
New Towns Future Combined with Critical Lands level 2 Assessment

Each of the proposed towns from the New Towns alternative future was combined with the critical lands level 2 assessment to see how many acres of critical land might be compromised by growth according to the New Towns future.

Plymouth had a total of 7,880 acres (~99% of total land) developable without impacting critical land, and 20 acres of low priority critical lands potentially compromised.

Weston had a total of 7820 acres (92% of total land) developable without impacting critical land. The Weston big town plan potentially compromises 690 acres of low priority critical land and 3 acres of medium priority critical land.

The South Cache plan had the largest amount of critical lands potentially compromised. There were 2,650 acres of low priority critical lands, 170 acres of medium priority critical lands and 10 acres of high priority critical lands potentially compromised. This left 4,740 acres (63% of total land) developable without impacting critical land.

The table below outlines the critical lands acreage potentially compromised by new towns.

<table>
<thead>
<tr>
<th>New Towns</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plymouth</td>
<td>20</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Weston</td>
<td>690</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>South Cache</td>
<td>2650</td>
<td>170</td>
<td>10</td>
</tr>
</tbody>
</table>

Figure 18 New Towns Assessment Impacts. Note: the initial amounts of land in the low, medium, and high categories of the Critical Lands level 2 Assessment are not equal.
SUMMARY - PUBLIC TRANSIT

In developing a Public Transit based Alternative Future, a growing population is being envisioned which is more dispersed throughout the watershed, rather than clustered around already developed areas. A commuter rail provides fast service from towns in the watershed to hubs, (e.g. Logan, Preston, Brigham City, Evanston) and to cities outside the watershed such as Salt Lake City. With a light rail, smaller towns could be potential communities for people who work in the hubs. Without a light rail, it is unlikely that the towns in the north central or south east sections of the watershed will experience growth – economic or otherwise.

One of the features that the Public Transit future promotes is a rural quality of life. The countryside in much of the watershed is undeveloped and has a peaceful feel, dotted with farms and small towns. For people who want to move out of the metropolis of Salt Lake City, or those who want to remain in the watershed but do not want to be subjected to the inevitable urban encroachment, having the ability to live in a more rural part of the watershed could be appealing. With a commuter rail, the small towns up towards Grace and Swanlake could become small communities of 1000-3000 people*. A commuter rail would also increase to potential for recreation oriented developments.

The Public Transit future uses existing railroad infrastructure in the watershed. Existing railroad infrastructure is extended in two places in order to complete a watershed wide circuit. One of the two new sections is a 41.6 mile segment from Preston which connects to an existing rail line 7.8 miles SW of Soda Springs. The other section is a 40.11 mile segment from Evanston, WY to Sage, WY.

CRITERIA

• proximity to towns
• existing railroads
• slope <=8%
• low permeability soils (<=2 inches/hr)

WHAT IS BEING PROMOTED

• A future less dependent on individual fossil fuel oriented transportation
• Less crowding as a result of new roads being built to accommodate increase of people
• Option to experience rural quality of life in towns like Grace, while still being able to conveniently access the hubs where people work and shop
• Dispersal of new population throughout watershed rather than concentrated sprawl in currently developed areas
• Use of existing railroad infrastructure rather than building new highways

*This is an arbitrary number chosen by best professional judgement as a possible population range for an average small town.
SUMMARY - REGIONAL PARKS SYSTEM

There are two main purposes for constructing a model for a regional park and trail system. The first reason is to preserve some of the undeveloped, natural and/or scenic land within the watershed and to provide some connectivity between these areas. The second purpose is to preserve important habitat for wildlife. Other benefits of a regional park and trail system include promotion of a healthy lifestyle to those in the region by providing more outdoor recreation opportunities. This model also promotes a sense of connectivity between the communities by keeping some of the parks close to towns and connecting them with easily accessible trails. Also, by preserving these lands for parks, important areas that contribute to the rural feel of the region are preserved.

By combining the attributes of four assessment models, the parks identified are preserving quality agricultural land, scenic land, wetlands, aquifer recharge areas, and wildlife habitat. This allows the model to fulfill its aforementioned purposes. The routes for the trails were initially delineated by connecting most of the proposed parks. Then the routes for trails were chosen so as to cross the fewest number of major roads as possible. Some road crossings were necessary, however, these places could be taken advantage of by providing access sites to the trails in addition to those which are already provided by the parks. The final criterion for trail placement was to place them where the terrain of the area was the most gentle to allow use by people of all activity levels. A component not displayed in the model is an area flanking the trails that would remain free of urban development in order to preserve the feel of openness on the trail itself. Lastly, it is the intent of this model to maintain the proposed park areas in their current state with minimal improvements for public use in order to accomplish the model’s purpose of land preservation.

CRITERIA

- Combination of four assessments:
  - Wildlife
  - Rural Quality of Life
  - Wetlands
  - Combined Water Quality assessments

- Where three or more of the above assessments overlap this is designated as the best place for a park. If only two overlap the area is designated as ‘good’.

- Existing trails

WHAT IS BEING PROMOTED

- The use of public lands

- The extensive outdoor recreation opportunities available in the watershed

- An active, healthy lifestyle

- Easy access to trails for anyone in the watershed.

- Preservation of agricultural lands and other unde-
SUMMARY - DESTINATION RESORTS

The Bear River Watershed hosts an increasingly large human population that enjoys outdoor recreation. Many suitable sites exist within the watershed that could offer outstanding four-season recreation opportunities. For this future, the focus was on identifying potential sites for four season resorts that could accommodate the increasing demand for recreation amenities caused by the burgeoning human population.

Five potential resort sites were identified as being suitable and desirable for residents of the watershed and tourists. These five sites were selected based on the criteria listed below. All selected areas had the potential to host skiing activities, were located in scenic mountain areas, and were in close proximity to existing roads and municipalities. Along with skiing activities, the selected areas also had the potential to be desirable for other recreation activities, such as fishing, hiking, biking, snowmobiling and ATV riding.

After identifying the first five sites, the sites were then ranked based on realistic concerns. Preference was given to areas where ski lifts and operations already existed and to the areas that were closer in proximity to a sizable population. As such, the Beaver Mountain site was chosen as #1 because of its existing lifts, large parcels of private/non-federal land and connection by major plowed highway to Logan and Bear Lake. Powder Mountain was selected as #2 due to its existing lifts, resort facilities and availability of private land. Powder was ranked below Beaver because the development of Powder would require construction of new roads in order to quickly access the resort from the Bear River Watershed. The Uinta Mountains site was selected #3 because of its proximity to Evanston, WY and I-80, private land and the existence of an access road to the site. The Uinta Mountains site was less preferable because there are not currently any ski lifts or resorts in the area. Site #4 off of ID 36 was the fourth alternative proposed. The proposed resort recreation area for Site #4 is located entirely on public land, with the resort footprint on nearby private land near Sharon, ID. Site #4 was less preferable because it is located relatively far away from the more populated areas and does not have any existing ski infrastructure. Finally, Site #5 in Bloomington Canyon was ranked the least preferable because it would require the construction of a new access road and it would be located relatively far away from the more populated areas of the watershed. Similarly to Site #4, Site #5’s recreation area also would be located primarily on Forest Service land and would require Forest Service permits and approval before any development could take place. Site #4 and Site #5 would both require the main development footprint to be located away from the resort on nearby private land. The absence of a paved road was also a key factor in ranking Site #5 below the other sites.

All five sites potentially could be popular destination resorts. However, due to existing ski resort infrastructure, Beaver Mountain (Site #1) and Powder Mountain (Site #2) are the most likely locations for future resort development.

CRITERIA

• Land ownership - public or private for resort recreation area, private for resort community footprint area
• Ski area likelihood – slopes between 25-45 degrees, elevation greater than 7500 feet, and aspects between northwest and east (315-90 degrees)
• Existence of ski resort infrastructure
• Size of site area
• Proximity to major roads was primary, proximity to any existing roads was secondary
• Proximity to towns - higher preference was given to sites closer to larger towns

WHAT IS BEING PROMOTED

• Potential sites for four-season destination resort development
CONCLUSION

The Bear River Watershed is currently in a state of flux. The watershed is still primarily rural and most areas remain unaffected by encroaching development and a changing Western economy. However, in 2005, the watershed can no longer homogenously be described as a rural, agricultural region. Long-term residents of the watershed can easily draw attention to Cache Valley, Brigham City or Bear Lake as evidence of the change that is beginning to become incipient in the BRW. An increased number of residents (both immigrants and native), shifting economies and changes in land use have become increasingly prevalent over the last 30 years and all indicators hint that the pattern is likely to persist in the foreseeable future. Watershed areas such as Cache Valley, Brigham City and Bear Lake have already begun to discern the effects often associated with more urban problems. Issues such as water quantity, water quality, air quality, suburban sprawl and patterns of growth have all been apparent in Cache Valley and have come unexpectedly to many residents and officials. Concurrently, many areas in the northern and eastern sections of the Bear River Watershed have remained immune to growth and outside pressures, with some counties even having a net loss of people between 1990 and 2000. Woodruff, UT,
Grace, ID, and Malad, ID are perfect examples of the traditional agricultural lifestyle: distinct, compact towns surrounded by expansive working landscapes and sweeping vistas. These areas provide a link to the historical roots of the BRW and a sharp contrast to the landscapes and lifestyles in Cache Valley or Brigham City.

Due to the existence of copious amounts of private, developable acres, a large university, scenic vistas and proximity to a booming metropolitan area (Salt Lake City), the potential and expected growth for the region is large. The rapid growth is expected to be concentrated in the Cache Valley, Brigham City and Bear Lake areas of the watershed during the next twenty years. However, areas adjacent to these growing regions, and sites situated in close proximity to desirable, recreational resources (such as Bear Lake, southern Cache Valley, and the north slope of the Uinta Mountains), will also experience increasing development pressure and demands in the next two decades.
As such, an increased impetus should be directed towards proactive planning in conjunction with a long-term focus in local decisions. As most of the watershed is still in the infant stages of urbanization, now is the time to be proactive and define what the residents feel is in the best interest of the watershed in it’s inhabitants. Identifying and dealing with the crucial issues now will save time and money and it will be easier to implement plans proactively rather than retoactively.

The current decision makers and residents need to determine what values and attributes are considered essential to maintaining and enhancing the quality of life in the BRW. The issues and assessment models presented in this report provide some ideas, but should not be considered an exclusive, comprehensive list. Residents and elected officials undoubtedly have additional issues and concerns that should be incorporated into planning efforts. Following the identification stage, local leaders and decision makers also must follow through by implementing policies that reflect these values and address the issues.

The futures described in this study are by no means
CONCLUSION

comprehensive or a prescription for all of the issues that will be affecting the BRW in the near future. Many assumptions were made regarding data, trends and what was forecast to be in demand in the future. Furthermore, an infinite number of futures could have been considered based on different assumptions. Due to limited time, only a few were selected. The information provided is useful, but it remains the duty of the public officials and residents to prioritize and decide which aspects of the watershed they want to preserve for future generations.

The elected officials, planners and citizens of the region will be forced to make difficult decisions that will immediately affect the watershed in the near future. The appearance and future of the BRW will be very dependent upon and significantly reflect the actions that are undertaken in the next five years.

The ultimate goal of this report is to foster debates and discussions that will result in an educated, informed, publicly supported plan for the future of the region. Wise choices made today will result in a healthier environment, smarter development and a higher quality of life for residents of the Bear River Watershed.
REFERENCES


Division of Water Quality (1992). *Utah State Water Plan, Bear River Basin*. Salt Lake City, UT: Utah Department of Natural Resources.


REFERENCES


REFERENCES


REFERENCES


* Denotes citations of reviewed case studies.
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IMPLEMENTATION TOOLS BY AGENCY TYPE

Tools Available to the Public

We have presented a recommendation for land in the Wasatch Front planning region we think should be preserved as open space. Plans are great but without implementation, all the work is of little value. Here are two dozen tools that will help implement the plan. Not all are useful in any given situation but we hope they will include the particular tool needed for a particular site. The following list and description of tools was derived mainly from Mechanisms for Protecting Open Space in Utah (Lilieholm and Faulsold, 1999).

Implementation Tools available to Individuals, Governmental Agencies and Non-Governmental Agencies

Conservation Easements

A conservation easement (or conservation restriction) is a legal agreement between a landowner and a land trust or government agency that permanently limits uses of the land in order to protect its conservation values. It allows you to continue to own and use your land and to sell it or pass it on to heirs.

When you donate a conservation easement to a land trust, you give up some of the rights associated with the land. For example, you might give up the right to build additional structures, while retaining the right to grow crops. Future owners also will be bound by the easement’s terms. The land trust is responsible for making sure the easement’s terms are followed.

Conservation easements offer great flexibility. An easement on property containing rare wildlife habitat might prohibit any development, for example, while one on a farm might allow continued farming and the building of additional agricultural structures. An easement may apply to just a portion of the property, and need not require public access.

A landowner sometimes sells a conservation easement, but usually easements are donated. If the donation benefits the public by permanently protecting important conservation resources and meets other federal tax code requirements—it can qualify as a tax-deductible charitable donation. The amount of the donation is the difference between the land’s value with the easement and its value without the easement.

Placing an easement on your property may also result in property tax savings.

Perhaps most important, a conservation easement can be essential for passing land on to the next generation. By removing the land’s development potential, the easement lowers its market value, which in turn lowers estate tax. Whether the easement is donated during life or by will, it can make a critical difference in the heirs’ ability to keep the land intact (Land Trust Alliance, 2002). See the Utah State code for further details.

Purchase of Development Rights

PDR is a voluntary program, where a land trust (see OSU Extension Fact Sheet CDFS 1262-98, Land Trusts) or some other agency usually linked to local government, makes an offer to a landowner to buy the development rights on the parcel. The landowner is free to turn down the offer, or to try to negotiate a higher price. Once an agreement is made, a permanent deed restriction is placed on the property, which restricts the type of activities that may take place on the land in perpetuity. In this way, a legally binding guarantee is achieved to ensure that the parcel will remain agricultural, or as open (green) space forever. This is because the agency involved retires the development rights upon purchase. The deed restriction may also be referred to as a conservation easement, or, since most PDR programs are designed to preserve agricultural use, an agricultural conservation easement (The Ohio State University, 2002).
Right of First Refusal

A landowner may grant or sell a right of first refusal. The holder of such a right is given the opportunity to purchase the property when it becomes available. This right continues without time limit. When the property is offered for sale, the holder either buys or declines, at which point the property is placed on the open market. This is a common practice in many different arenas of business and the rules are well understood.

Fee Simple Acquisitions

While simply purchasing the land for conservation seems the simplest, it is not without problems. If the land is purchased by a government agency, it is removed from the tax rolls. The agency is also responsible for maintenance and management of the property. It is expensive in terms of money because the agency is purchasing all the rights to the land including those that are not in the public interest. The development rights to the land are still available and at some future time, the owner may decide to develop the land. However, for lands of high development potential and high conservation value, this may well be the best option.

Purchase Options

Somewhat similar to Right of First Refusal, this allows an interested agency to raise the money to purchase land that has become available. The option is usually for a set time, and if not exercised, the option may expire and the money spent on it is lost.

Bargain Sale

A bargain sale represents a compromise between outright donation and fee simple purchase. An agency or organization buys the land or perhaps just the development rights at less than “full market value” after negotiation with the landowner. The difference between full market value and the purchase price is a tax-deductible donation by the owner. Often the tax deduction results the same net financial gain to the seller as if they had sold the property at full market value and the buying organization gains the land for conservation purposes. As with all these tools, the advice of professionals is a wise investment.

Purchase and Sell-Back

After a government or conservation group purchases a property, it severs certain rights-of-development and then sells the land. This removes the development potential of the land and avoids the costs of land management.

Purchase and Lease-Back

Similar to purchase and sell-back, this option allows the owner to draw rent as income on the property. These methods are subject to many provisions of the tax code and the advice of professionals is strongly encouraged.

Tools Available only to Local Governments

Special Areas Preservation/Mitigation Programs

These are used in some states to identify important natural resource areas like watersheds. Mitigation measures are defined to ensure that land uses are compatible with the area’s ecological function. In Alberta Canada, local volunteer committees examine candidate crown lands for suitable sites to preserve. They help draft management plans including boundary options, management objectives and appropriate land uses for the Minister’s approval to ensure ecosystem protection (Alberta Special Places, 2002).

Sensitive Land Overlays

Overlay zoning implement specialized standards for unique areas. The purpose of these zoning regulations is the mitigation of natural hazards that may cause loss of life or property. Natural phenomena which could threaten new development include: flooding,
ground rupture, slope failure, rock fall, compaction/consolidation, liquefaction, ground water interception, earthquake damage, and fires. Natural phenomena which could be aggravated by new development include: ground water recharge problems, flooding, soil erosion, wildlife/fisheries habitat reduction, fires, losses of visual quality, and impediments to public access to public resources (Governor’s Office of Planning and Budget, 2002).

Exactions and Dedications

Local governments can require land dedications or assess impact fees for the purpose of land conservation. These requirements need to meet certain legal requirements such as proportionality and reasonableness. As you can imagine, these terms have been through the courts in some detail and the advice of legal professionals is highly desirable. See Exactions, Dedications And Impact Fees: Applicability Of Nollan-Dolan Rough Proportionality Requirements To Non-Possessory Exactions And Exactions Imposed By Legislative Enactment for a more complete discussion (Delaney, 2000).

Intergovernmental Agreements

Some states allow jurisdictions to join together to plan and protect open spaces. In Utah, cross-county planning is restricted to the activities of the state’s Association of Governments (Lilieholm and Fausold, 1999). Other states recognize that land use planning and open space preservation frequently cross local jurisdictional boundaries and require local government cooperation.

Cluster Zoning and Conservation Subdivisions

Cluster zoning sets a maximum per-acre density for dwellings but allows for closer spacing between homes to encourage open space in other parts of the development. This can reduce infrastructure and maintenance costs as well as increase the value of the homes because of their proximity to open space (Lilieholm and Fausold, 1999; Trust for Public Land, 1999).

Agriculture Land/Open Space Zoning

Open space zoning and exclusive agricultural zoning are two of the most promising method of preserving agricultural land. Open space zoning relies on the principal of cluster development, whereby new homes are clustered onto part of the development parcel. Clustering allows the remainder to be preserved as productive farmland or unbuilt open space. Since only the density and not the number of houses is changed, open space zoning can permanently protect a substantial portion of every development tract’s agricultural productivity without decreasing the development potential for both landowner and developer.

Exclusive agricultural zoning is less frequently used than nonexclusive zoning such as open space zoning, because it prohibits nonagricultural use of the land within the district. The main advantage is that it ensures there will be no conflict between residential and agricultural uses. However, the ordinances are more difficult to adopt because the farmland owners must forego (often reluctantly) the opportunity to sell their land to residential developers.

A more landowner friendly form of exclusive agricultural zoning is the voluntary creation of agricultural districts. The benefits that farmers obtain by voluntarily joining an agricultural district may include differential assessment, protection against nuisance ordinances, and limits on public investments for nonfarm improvements. Basic standards for reviewing district petitions should be outlined in the County Zoning Ordinance, if not at the state level. Like any zoning ordinance, however, its effectiveness can be undermined by a zoning authority’s lax supervision of rezoning and variance requests (Carver and Yahner, 1996).

The state of Utah has provisions for creating agricultural districts. See http://www.le.state.ut.us/~code/TITLE17/17_21.htm for details.
Impact Fees

Impact fees are gaining in popularity with local governments as a way to finance infrastructure without placing a large burden on existing taxpayers. The fees can be used for basic services such as water, roads, and sewers directly connected with a development or more non-connected projects such as fire stations, parks and other recreational facilities. The fees must meet several standards including reasonableness, fairness and appropriateness (Kolo and Dicker, 1993).

Agriculture Protection Areas

See the discussion for Agriculture Land/Open Space Zoning. The primary difference is that protection areas include protection for farmers from nuisance suits related to their farm activities by local residents. This is not an absolute protection and farmers still need to use Best Management Practices as well as good judgment in their farming operations.

Limited Development

Limited Development is usually associated with a conservation easement. The property owner works together with the holder of the easement to develop plans for the property that will allow limited use compatible with the purpose of the easement. This process has the potential for both income and tax benefits to the property owner (San Isabel Foundation, 2002; Brandywine Conservancy, 2002).

Land and Mitigation Banking

Land Banking is a way to comply with federal regulations requiring “no net loss” of wetlands or historical function lands. Developers or government agencies purchase land in advance of development projects, construct the necessary wetlands ecosystem and then use the land as an acre-for-acre exchange with properties that result in wetlands loss as they develop. The land banks should be in the same ecosystem as the property they are replacing. The process is subject to a wide range of federal regulations (NCSU Water Quality Group, 2002).

Transfer of Development Rights

Transfer of Development Rights uses market forces to help protect land. It is a process that requires significant expertise by the administering agency as well as education of developers and property owners. The process requires a governmental agency to identify land that they desire for conservation (the sending area) as well as land that can be developed to higher density (the receiving area) than would otherwise be allowed. Property owners in the sending area are given development rights that can be sold to developers for use in the receiving area. Boulder Colorado, Maryland, and New Jersey have working programs that have protected over 45,000 acres since 1980 (One Thousand Friends of Minnesota, 2001).

Urban Growth Boundaries

Urban growth boundaries establish a line around a city within which growth is permitted and outside of which development is prohibited or severely restricted. The reasoning behind the boundary is to control growth to reduce open space loss, suburbanization and escalating costs of infrastructure. The UGBs can be established by state legislatures as in Oregon, Tennessee and Washington or by local governments as in California (Staley and Milder, 1999; Ecotrust, 2002). Like any tool to control growth, the boundaries need to be revised from time to time as development occurs. UGBs can be implemented through zoning which is reversible or by conservation easements that are permanent.

Performance Zoning

Performance Zoning seeks to specify the intensity of use of land rather than the permitted uses of a parcel. The intent is to preserve the community vision of the area while allowing developers to be innovative in how the vision is carried out. The process is more flexible and more judgment
intensive on the part of the zoning administrators (Eastern Michigan University, 2002).

Preferential Tax Assessments

Preferential Tax assessments base tax levies on current use rather than “highest and best use”. This encourages land to stay in agriculture or open space rather than be developed to pay for the higher taxes. Iowa began such a program in 1955. As experience accumulated, they noticed that while farmers did receive the tax break, land conversion to development did not slow down. After some experimentation, a new process was developed. Land is placed in restrictive agreements where owners agree not to develop the land for ten years. Each year the land remains in the agreement, the time period is automatically extended another year. The result is that if a developer buys the land, they must hold it for ten years before developing it, a generally prohibitive arrangement. Under this program, farmland conversion has slowed substantially in Iowa (Edelman, 1998).

Building Moratorium

Building moratoriums are frequently used to allow planners to “catch up” with growth. Local governments generally impose the moratoriums when the current building permit process is inadequate to control development or when general plans for the area are being developed or revised. Unfortunately, moratoriums do nothing to prevent previously issued building permits or approved plans. Developers will frequently rush through a mass of projects if they get wind that a moratorium is planned. The Supreme Court (U.S. Supreme Court, 2001) recently ruled that moratoriums do not constitute a “taking” under the Constitution and are a legal and sometimes appropriate means of controlling growth. Utah limits moratoriums to six months, whereas other states have limits that vary.

Transfer Development Taxes/Conversion Taxes

This type of tax is focused on land conversion and development. Taxes are assessed and paid when open space land is developed. They are intended to discourage land conversion and can be used to pay for the increased municipal cost of development. They are not currently available in Utah (Lilieholm and Fausold, 1999).

IMPLEMENTATION TOOL BOX

The following text describes some of the better suited tools for Utah’s unique political climate in more detail, followed with a summary of other tools used throughout the country.

Conservation Easements

Description

A major reason for the conversion of working lands to non-agriculture uses is property and estate taxes. These inheritance taxes are bases on fair market value of the properties highest and best use, which can significantly increase the value of land based on its potential development. Heirs are often forced to split up the property to sell off some or all of the land just to pay taxes regardless of whether or not they intend on developing (American Farmland Trust, 2001).

One option to prevent a piece of property from being assessed at it highest and best use is a Conservation Easement. This type of easement allows for the separation of the development rights from a given piece of land, so that the remaining value of the land is the actual use of the land. These rights can be voluntarily sold or donated using a conservation easement, but the property remains in private ownership and the land can still be sold and leased. Often an easement can bring along significant tax benefits because the land is taxed on its actual use instead of highest and best use (Davis County Shorelands, 2001).

When to Use

Conservation easements are voluntary and under-
APPENDICES

APPENDIX A: Implementations

taken by the landowner when conservation of the land is desired for perpetuity. They are often used by ranching operations or farms that face some kind of developmental or sub-division pressure as well as by families who are concerned about passing the property to the next generation. It should be noted that a conservation easement does not necessarily remove all future development from the property. By working with a land trust it is possible to select a few home sites that can be built upon in the future.

Who to Contact

In Utah there are several trusts that can accept these easements. There are national land trusts like the Nature Conservancy or American Farmland Trusts, or local land trusts such as Utah Open Lands. The following websites offer more comprehensive descriptions of Conservation easements and the process through which they can be sold or donated.
- Land Trust Alliance http://www.lta.org
- The Trust For Public Land http://www.tpl.org
- Utah Open Lands http://www.utahopenlands.org

Purchase of Development Rights

Description

Purchase of Development Rights (PDR) is similar to Conservation Easements in that the rights to development are permanently separated from the land (American Farmland Trust, 1998). However, in this case the rights are purchased instead of donated. This method is incentive based in that landowners are compensated for the development right at the market value of potential development.

When to Use

This method is of use when the landowner wants to maintain current land uses, but cash is needed for the transaction instead of tax benefits. Securing funds for the purchase of the development rights can be difficult with this method, however. PDR most often occurs in areas of serious developmental pressure as well as significant conservation values.

Who to Contact

The following websites offer more comprehensive descriptions of the Purchase of Development Rights and the process through which they can occur please see the following websites.
- Land Trust Alliance http://www.lta.org
- The Trust For Public Land http://www.tpl.org
- Utah Open Lands http://www.utahopenlands.org

Transfer of Development Rights

Description

Transfer of development rights (TDR) is a method for land conservation that attempts to direct new growth from areas of environmental concern to areas of previous development. The development rights on the land with environmental concerns (sending area) are traded or sold for development rights within a city (receiving zone) (Lieholm and Fausold, 1999).

When to Use

A transfer situation occurs when a landowner within a designated sending zone wishes to develop the land finds a buyer willing to purchase the development rights from the sending zone which can then be applied to the receiving zone. Ideally the receiving zone is a prosperous urban location that would benefit with additional densities (Davis County Shorelands, 2001). City ordinance must be in place before TDR can occur.

Who to contact

Davis County’s Shoreland Master Plan contains sample ordinance that could be a starting point for a municipality interested in TDR.
- Davis County Shorelands Master Plan pg 25-28e
Agriculture Protection Areas

Description

As urban and residential development spreads from existing municipalities into the surrounding countryside, conflicts begin to arise between over the differing land uses. Farms produce noise, dust, smells, and pesticide over-sprays that become bothersome to nearby residence. Regardless of the fact that the residence was build near the farm, they often file complaints. If enough complaints are filed, the farm can be legally restrained from operating as usual.

Agriculture Protection Areas (APA) are implemented at the county level are designed to protect farmers rights to continue productive agricultural practices within a developing area. Enabled by the Utah Legislature in 1994, APA’s protect farm owners from unreasonable nuisance lawsuits, and prevent zoning changes within the APA unless the land owner allows the change. An APA also makes aware to potential nearby homebuyers that they are near a protected farm. Finally, farm owners in a protection area can remove their land from the agreement at any time for any reason (USDA, 1999).

When to Use

Agricultural Protection Areas are most useful in areas with large tracts of contiguous farmland, and areas that are currently zoned for agriculture. If excessive residential development exists in a given area, the county may not allow the initialization of the APA.

Who to Contact

For more information about agriculture protection areas, please refer to the following website.

- The American Farmland Trust http://www.farmland.org
- Western Rural Development Center http://extension.usu.edu/wrdc/

Agricultural Zoning

Description

Agricultural Zoning is used to protect farmland by prevent subdivisions of farms into unsustainably small units. Lot size limit is usually set at a minimum practical farming area (often 160 acres of greater). The Agriculture zone can restrict the number of dwellings on a farm or excluding non-farm development. These zones are intended to protect the viability of farmlands for the future, not as holding areas for future development (Davis County Masterplan, 2001). However, they are not permanent solutions, as zoning can be changed in a city or county plan.

When to Use

Cities and counties interested in protecting agricultural lands away from existing developments often use this tool. It is not well received near urban areas where land values have been inflated because of development potential.

Who to Contact

- Western Rural Development Center http://extension.usu.edu/wrdc/
- The American Farmland Trust http://www.farmland.org

Appendix

Cluster/ Conservation Development

Description

The following descriptions are based on the Conservation Development chapter from the Davis County Shorelands plan (2001). As its name implies, this type of zoning encourages development of dwellings away from critical environmental concerns. In comparison to normal zoning which results in houses on even sized lots over the entire parcel, cluster zoning allows for the same number of units, but groups them together. Essentially, the number of houses
that would have been built on a sensitive area are transferred to another area of the development. The remaining land can then be protected as open space using conservation techniques.

Cluster Zoning spreads the cost of open space over all the new developments instead of on the government. This method often increases the value of the new development because of its proximity to permanent open space. Cluster zoning also has the potential to reduce the costs of development because roads and sewers are not spread in a grid across the entire landscape.

When to Use

This strategy is useful when a particular piece of property has both developmental and conservation value such as a wetland or trail corridor. Both the city and the developer must be willing to work together to create a successful project. Since conservation development works on a parcel-by-parcel level the resulting open space will be localized. Large-scale open space protection requires a different strategy.

Who to Contact

- The American Farmland Trust http://www.farm-land.org
- Davis County Shorelands Master Plan Page 29 - 30

Fee Simple

This method involves the actual purchase of the desired land and all of the associated rights by a municipality or agency (Lilieholm and Fausold, 1999). This is one of the most expensive methods of land protection and it may be controversial in a state that has a high percentage of public land.

Deferential Assessment

Deferential assessment reassesses property taxes for farm or ranch lands based on its agricultural value rather than its full fair market value. Deferential assessment usually involves a contract period in which the land cannot be developed so that land speculation does not occur.

Urban Growth Boundaries

Essentially an urban growth boundary (UGB) is a line drawn around a city that marks the outer limit to which residential development will be allowed to expand. The UGB should be large enough to accommodate predicted population growth for the near future, but still provide public services efficiently.

Infill and Redevelopment

Infill is the process of developing all possible land inside a city before outward development is allowed. A positive infill strategy encourages higher density, which in turn keeps housing costs down. Redevelopment provides new affordable housing and the infrastructure necessary for higher densities. Palm Beach County, Florida formed a public-private partnership whose purpose was to reduce blight and provide affordable housing. The organization would acquire funds from various sources, buy land, and sell land to developers at reduced prices. Additional incentives are also offered to developers such as: zoning changes, low-interest loans, and the waiving of development fees.

Conclusions

Successful programs combine a variety of tools that incorporate both incentives and controls. On one hand they make farming more profitable by reducing taxes, and on the other, they prevent disruptive development in existing farmlands. There is not a one-size-fits-all solution to protection of farmlands, but there is usually a tool to apply to any given situation. Proper tools are only the first part of the solution. Critical to the implementation of any working land or open space plan is political will. These tools require support and enforcement from government officials in order to be of any value. A wonderful plan is inef-
effective if it sits on the shelf of the planner. Zoning is just as useless if variances are systematically granted to all who apply. Sticking to the goals of the open space or working land plan can be difficult when facing the opposition of a few individuals or businesses. It is important to remember that though there may be a few unhappy voices, the open space plan is for the benefit of the entire community. Survey results show overwhelming that the public wants the results of that these efforts create. Folding to the pressure will only result in more of the conditions we are trying to combat.

Multiple organizations throughout the country have been assisting local and county governments develop and effectively implement these tools. Below is a resource list of several Governmental and Non-Governmental Organizations that can assist with questions. Following the resources is a list of publication that describe in great detail the many benefits and drawbacks of the programs discussed above. There are also many tools not mentioned in our short summary that could also prove useful for working land protection. For images describing different types of cluster zoning see the Davis County Shorelands Comprehensive Land Use Master Plan (pp. 26, 30).
Threatened & Endangered Species

Utah — 44 listings

Animals — 22

**Status Listing**

- E Ambersnail, Kanab (Oxyloma haydeni kanabensis)
- E Chub, bonytail (Gila elegans)
- E Chub, humpback (Gila cypha)
- E Chub, Virgin River (Gila robusta seminuda)
- XN Condor, California [XN] (Gymnogyps californianus)
- E 1 Crane, whooping (except where XN) (Grus americana)
- XN Crane, whooping [XN] (Grus americana)
- T 2 Eagle, bald (lower 48 States) (Haliaeetus leucocephalus)
- E 3 Ferret, black-footed (except where XN) (Mustela nigripes)
- XN Ferret, black-footed [XN] (Mustela nigripes)
- E Flycatcher, southwestern willow (Empidonax trailii extimus)
- T 4 Lynx, Canada (lower 48 States) (Lynx canadensis)
- T Owl, Mexican spotted (Strix occidentalis lucida)
- E Pikeminnow, Colorado (except Salt and Verde R. drainages, AZ) (Ptychocheilus lucius)
- T Prairie dog, Utah (Cynomys parvidens)
- E Snail, Utah valvata (Valvata utahensis)
- E Sucker, June (Chasmistes irorus)
- E Sucker, razorback (Xyrauchen texanus)
- T (S/A) Tortoise, desert (outside/taken from Sonoran Desert) (Gopherus agassizii)
- T Tortoise, desert (U.S.A., except in Sonoran Desert) (Gopherus agassizii)
- T 5 Trout, Lahontan cutthroat (Oncorhynchus clarki henshawi)
- E Woundfin (except Gila R. drainage, AZ, NM) (Plagopterus argentissimus)

Plants — 22

**Status Listing**

- E Bear-poppy, dwarf (Arctomecon humilis)
- T Milkweed, Welsh’s (Asclepias welshii)
- T Milk-vetch, Deseret (Astragalus desereticus)
- T Milk-vetch, heliotrope (Astragalus montii)
- T Sedge, Navajo (Carex specuicola)
- T Cycladenia, Jones (Cycladenia humilis jonesii)
- T Daisy, Maguire (Erigeron maguirei)
- E Ridge-cress, Barneby (Lepidium barnebyanum)
- E Bladderpod, kodachrome (Lesquerella tumulosa)
- E Cactus, San Rafael (Pediocactus despainii)
- T Cactus, Siler pincushion (Pediocactus sileri)
- T Cactus, Winkler (Pediocactus winkleri)
- E Phacelia, clay (Phacelia argillacea)
- T 6 Primrose, Maguire (Primula maguirei)
- E Buttercup, autumn (Ranunculus acriformis aestivalis)
- T Reed-mustard, clay (Schoenocrambe argillacea)
- E Reed-mustard, Barneby (Schoenocrambe barnebyi)
- E Cress, toad-flax (Schoenocrambe suffrutescens)
- T Cactus, Unita Basin hookless (Sclerocactus glaucus)
- E Cactus, Wright fishhook (Sclerocactus wrightiae)
- T 7 Ladies’-tresses, Ute (Spiranthes diluvialis)
- T Townsendia, Last Chance (Townsendia aprica)

Counties found in:
1. Box Elder
2. Box Elder, Cache, Rich, Weber
3. Rich
5. Box Elder
6. Cache
7. Weber

Wyoming — 17 listings

Animals — 14

**Status Listing**

- T Bear, grizzly lower 48 States, except where listed as an experimental population (Ursus arctos)
- E Crane, whooping (except where XN) (Grus americana)
- XN Crane, whooping [XN] (Grus americana)
- E Dace, Kendall Warm Springs (Rhinichthys osculus thermalis)
Appendix B: Threatened & Endangered Species

T Eagle, bald (lower 48 States) (Haliaeetus leucocephalus)
E Ferret, black-footed (except where XN) (Mustela nigripes)
XN Ferret, black-footed [XN] (Mustela nigripes)
T Lynx, Canada (lower 48 States) (Lynx canadensis)
T Mouse, Preble’s meadow jumping (Zapus hudsonius preblei)
E Pikeminnow, Colorado (except Salt and Verde R. drainages, AZ) (Ptychocheilus lucius)
E Sucker, razorback (Xyrauchen texanus)
E Toad, Wyoming (Bufo hemiophrys baxteri)
E Wolf, gray (lower 48 States, except MN and where XN; Mexico) (Canis lupus)
XN Wolf, gray [XN] (Canis lupus)

T Snail, Bliss Rapids (Taylorconcha serpenticola)
E Snail, Snake River physa (Physa natricina)
E Snail, Utah valvata (Valvata utahensis)
E Springsnail, Bruneau Hot (Pyrgulopsis bruneauensis)
E Springsnail, Idaho (Fontelicella idahoensis)
T Squirrel, northern Idaho ground (Spermophilus bruneus bruneus)
T Steelhead (Snake R. Basin) (Oncorhynchus mykiss)
E Sturgeon, white U.S.A. (ID, MT), Canada (B.C.), (Kootenai R. system) (Acipenser transmontanus)
E Wolf, gray (lower 48 States, except MN and where XN; Mexico) (Canis lupus)
XN Wolf, gray [XN] (Canis lupus)

Plants — 3
Status Listing
T Butterfly plant, Colorado (Gaura neomexicana coloradensis)
E Penstemon, blowout (Penstemon haydenii)
T Ladies’-tresses, Ute (Spiranthes diluvialis)

Idaho — 24 listings

Animals — 21
Status Listing
T Bear, grizzly lower 48 States, except where listed as an experimental population (Ursus arctos)
E Caribou, woodland (ID, WA, B.C.) (Rangifer tarandus caribou)
E 1 Crane, whooping (except where XN) (Grus americana)
XN 2 Crane, whooping [XN] (Grus americana)
T 3 Eagle, bald (lower 48 States) (Haliaeetus leucocephalus)
E Limpet, Banbury Springs (Lanx sp.)
T 4 Lynx, Canada (lower 48 States) (Lynx canadensis)
T Salmon, chinook (spring/summer Snake R.) (Oncorhynchus tshawytscha)
T Salmon, chinook (fall Snake R.) (Oncorhynchus tshawytscha)
E Salmon, sockeye (Oncorhynchus nerka)

Counties found in:
1. Bear Lake
2. Caribou
3. Bear Lake, Caribou, Franklin
4. Bear Lake, Caribou
List of Communities at Risk for Wildfire in BRW

- Sage Jct, WY
- Evanston North, WY
- Cokeville, WY
- Fish Haven, ID
- St Charles, ID
- Paris, ID
- Ovid, ID
- Bloomington, ID
- Dingle, ID
- Montpelier, ID
- Bennington, ID
- Georgetown, ID
- Nounan, ID
- Geneva, ID
- Grace, ID
- Soda Springs, ID
- Conda, ID
- Bancroft, ID
- Lund, ID
- Mink Creek, ID
- Preston, ID
- Whitney, ID
- Franklin, ID
- Fairview, ID
- Weston, ID
- Dayton, ID
- Clifton, ID
- Banida, ID
- Malad, ID

- Brigham-Willard Bench, UT
- East Hyrum, UT
- Garden City/ Bridgerland, UT
- Garden City/Elk Hollow, UT
- Garden C/Little Switzerland, UT
- Garden City/Swan Creek, UT
- Garden City/ Sweetwater, UT
- Garden C/ Sweetwater Tlr., UT
- Hardware Ranch, UT
- Logan, UT
- Logan Canyon, UT

Mantua, UT
South Canyon, UT
South Canyon-Avon, UT
Stillwater, UT
Woodruff/Chournos, UT

Full List of Communities:
Federal Register List: August 21, 2001
http://frwebgate6.access.gpo.gov/cgi-bin/waisgate.cgi?WAISdocID=679697244600+26+0+0&WAISaction=retrieve

Full Communities list:
http://www.stateforesters.org/WUI_list.html
SAMPLE CASE STUDY

Case Study:
Dealing with Change in the
Connecticut River Valley: A Design Manual for
Conservation and Development

Jay Baker and Jessica Evans


Abstract: The Connecticut River Valley is a land that was first shaped by the physical forces of plate tectonics and glacial events, and then further shaped by human habitation. The Connecticut River shaped the lives of the people who have settled there. This is what makes the Valley a mosaic of urban areas, farmlands and scattered farmsteads, fields, forests and undulating hills. In the late 1940s the Valley became an area of extreme suburbanization. People living in cities moved there for the rural setting, and Interstate-91 was widened. These factors, among others, contributed to the decline of the Valley. Over 80,000 acres of the Valley’s agricultural land was developed between 1952 and 1972. Another contributor was the decline in the Connecticut River’s water quality. People have since worked to restore water quality and the region’s agricultural foundation. The efforts have helped in some ways but not when looking from the perspective of the landscape. The Valley is seeing residential sprawl, commercial strips, and an overall loss of open space. Many people believed that their current zoning and development by-laws would protect the landscape when in fact they were a prescription for unplanned growth and inappropriate development patterns. The purpose of this plan was to provide an alternative solution to the unplanned development. It also showed graphically the consequences of further development if no action were taken to preserve the landscape. The manual gives ideas of how to control future development by amending existing by-laws. The manual relies heavily on illustrations to contrast the two development scenarios which are conventional (using existing by-laws and zoning ordinances) and creative development (working to conserve the rural character of the area).

Background of Study
The Connecticut River Valley spans from the northern to the southern border of Massachusetts and includes nearly the entire western half of the state. The “Design Manual for Conservation and Development” chose eight sites within the Connecticut River Valley to illustrate creative land use strategies by showing alternative development situations. Two additional town sites were selected to show a more detailed approach to the problem. The manual also includes models of a number of by-laws that would help the towns implement the creative development approach.

Issues and Objectives
The overall problem in the Connecticut River Valley is rapid growth that is unplanned. While the growth has helped the Valley economically it has hurt the landscape. Open land converted to development nearly tripled over the period of 1951 to 1972. Housing prices have doubled and tripled. The increased population is surpassing the capacity of town services and schools. Traffic along the main corridor in the Valley increased ten times over five years. One of the bigger problems is that the rapid growth has been unplanned, resulting in random subdivisions built without considering how they relate to the landscape. The authors of the manual point out that the small towns have the most difficulty in dealing with the rapid change because they lack professional planning assistance and updated land-use techniques. One result of the rapid growth is the potential pollution of ground and surface water.

The main objective of the Manual was to “deliberately design new settings to suit [resident’s] new land uses.” To achieve this objective the authors se-
lected eight sites and sketched two-dimensional plans and three-dimensional perspectives to contrast the pre-existing landscape with two alternative development plans. Both plans depicted the same amount of development on the land but showed the difference between conventional development and creative development. The Manual also included more detailed plans for two towns in the Valley. The plans demonstrated approaches that the towns could implement to preserve a rural atmosphere while allowing for inevitable growth.

Project Staff
Authors of the “Design Manual for Conservation and Development” include Robert D. Yaro, Randall G. Arendt, Harry L. Dodson, Landscape Architect, and Elizabeth A. Brabec, Town Character Planner. All of the authors are part of the Center for Rural Massachusetts at the University of Massachusetts. The creation of the manual was supported by Thomas D. Dyer with the Department of Environmental Management (DEM). The DEM along with the Valley’s two regional planning commissions have been the major forces behind implementing the plans outlined in the manual. Other consultants were added to develop the town character planning and design portion of the manual. Another group developed the by-laws. The authors are also careful to note that it is only through the cooperation and support of valley residents, public officials, and business leaders, in conjunction with the aforementioned groups, that the plan can be successfully realized.

Key Terms
The following key terms were used within the context of the Design Manual.
Rural Landscape Planning: The guidelines outlined were a combination of regional planning and landscape architecture because they dealt directly with the countryside. The combination of regional planning and landscape architecture yielded a new field of study termed “Rural Landscape Planning.”
Creative Development: The plan presented was meant to show the results of down-sized lots and preserved open space and the advantages these offered to all parties. This idea in connection with the values deemed important by residents of each community constitutes the idea of Creative Development. The purpose of the “Design Manual for Conservation and Development” was not to develop a specific plan that would work for every community in the Valley but to give creative alternatives to conventional development and suggestions for how such a plan might be carried out in a community.

Methods
Small-scale projects were done on eight rural communities along the Connecticut River Valley. The sites were chosen to represent a variety of landscapes including riverfront, agriculture, alluvial plains, rolling hills, and tributary valleys. For each site two alternative scenarios were drawn up: a “conventional development” design and a “creative development” design. These projects were done to graphically illustrate the potential for urban development in a rural setting that does not take away the rural atmosphere and preserves the natural beauty and open space of the landscape.
Two town character plans are given in detail: one each for the towns of Hadley and Gill along the Connecticut River Valley. Creating the character plans involved three major steps: gathering historical data, evaluating present conditions, and working with municipal boards to come up with specific plans for the individual towns.
The final step in the design process was to make the report accessible to rural towns. The idea was that the manual would be a guide for small towns to utilize when coming up with a conservation and development plan of their own.

Data
The data compiled for the eight small projects was very limited, as the projects were general examples of the creative planning that could take place. The information used in the manual described the conditions of the areas as they were—minimal historical
data was used—and included landform, land use, land cover, utilities, and zoning. When developing the town character plans for Hadley and Gill, more extensive data was used. The researchers went in-depth on the historical and cultural background, learning about the towns as they were originally established and laid out, how they have grown, and with what kind of culture. They also scientifically researched the biophysical aspects of the towns. The areas were each divided into “areas of significant natural landscapes” that set importance on specific aspects to more effectively develop land use planning strategies. The last thing the researchers looked at when coming up with the character plans was the residents’ perspectives. Residents were asked questions about what they valued about the town and what they hoped to preserve. The opinions were incorporated when creating final plans.

The Plan
The eight small-scale plans for development were sketched. The idea behind the plans was to preserve the open agricultural space and natural beauty of the area while allowing urban development. Essentially, those plans consisted of smaller lots, laid closer together and set back in the trees where they would not be seen from the road. Fewer roadway entrances and shared community structures (such as docks) were a large part.

The major components of the plan that was developed for Hadley and Gill and can supposedly be applied to any small rural towns are by-laws and regulations. The big idea is a Use of Site Plan Review to allow the town the right to give permission on most building and renovating issues. The builders would have to comply with any by-laws applying to the situation. By-laws would be in place regarding how and where building can occur, and also take into account intracity regulations like lighting, parking, trees and signs to name a few.

Implementing the Plan
A three-strategy plan was developed for both Hadley and Gill: an administrative strategy, a land planning strategy, and a conservation of historical characteristics strategy.

Administrative Strategies: For Hadley, the planners recommend hiring a full-time planner in addition to the small planning board it now employs. The planner would have more specific responsibilities and could deal with long-range planning. The planners also feel Hadley should have a Site Plan Review Board to evaluate sites on an individual basis and perhaps distribute permits. The town of Gill does not have much funding, but it is recommended that they hire at least a part-time planner, preferably shared with other towns to get long-range perspectives.

Land Planning Strategies: To conserve agricultural open space, the planners feel that Hadley should enact some of the by-laws mentioned above to group homes together on smaller lots and keep the remaining land open to farmers with a deed restriction prohibiting development. In commercial districts, the planners recommend to Hadley to require many businesses to build with the least amount of floor space as possible. Also recommended is to revamp the zoning laws concerning strip malls and sections along routes 47 and 9.

For Gill, the planners suggest creating land use by-laws to preserve the open space. By-laws such as where and how much timber could be harvested would help Gill to manage the resource and also make sure the aesthetic value does not change drastically. New commercial zoning laws to establish business districts would be helpful when looking forward to future development.

Historical Preservation: To preserve historic areas, Hadley would benefit from a bylaw to have all renovations on existing buildings overseen. Because Gill has such a rich structural heritage, the planners suggest taking an inventory of what is there, and bring it recognition so it can be preserved.
SAMPLE PROJECT OPINION PAPER

BEAR RIVER WATERSHED
PROJECT OPINION

Kevin Kilpatrick

The Bear River Watershed (BRW) is a large study area that consists of many diverse ecosystems and human settlements. The characteristics and defining traits of the BRW vary drastically from the headwaters in the High Uinta Mountains to the delta at the Bear River Migratory Bird Refuge adjacent to the Great Salt Lake. Any future scenarios that deal with the BRW must take into account an assortment of present and future biophysical and socio-economic issues. Before any meaningful analysis can be done on the BRW, one first must be familiar with the varying areas encompassed within the BRW, the current land uses of the area and the existing and future issues that will be the basis for the study.

A. DEFINITION AND STATUS OF THE AREA

I. DISTRICTS
A. Headwaters
B. Eastern Bear River Valley (EBRV)
C. Bear Lake Basin
D. Northern Bear River Valley (NBRV)
E. Cache Valley
F. Western Bear River Valley
G. Mountains

II. NODES
A. Bear Lake
B. Logan, UT
C. Preston, ID
D. Soda Springs, ID
E. Montpelier, ID
F. Garden City, UT
G. Evanston, WY
H. Brigham City, UT
I. Tremonton, UT

III. MAJOR PATHS
A. Bear River
B. Interstate 15
C. Interstate 80
D. Interstate 84
E. US 89
F. US 91
G. US 30
H. UT 165
I. UT 39
J. UT 16/WY 89
K. UT 30
L. UT/WY 150
M. ID 34
N. ID 36

IV. LANDMARKS
A. Wasatch Mountains
B. Bear Lake
C. Logan Temple
D. Big Bend of the Bear River
E. Wellsville Mountains
F. Uinta Mountains
G. Monsanto Plant in Soda Springs
H. Bear River Migratory Bird Refuge
I. Bear Lake National Wildlife Refuge

B. CURRENT LAND USES
Within the Headwaters district, the majority of current land use activities are controlled by the U.S. Forest Service, which operates the Wasatch-Cache National Forest. In the forest, land use activities are primarily recreational. These activities include camping, skiing, fishing, hunting, snowmobiling, OHVs, backpacking and rock climbing. Timber sales and grazing of sheep and cattle are the only industrial uses permitted in the forest. Outside of the forest boundary, the remainder of the Headwaters district is primarily used for ranching or agriculture. Recently, there has been an increase in development on the private property near the forest boundary. Numerous new cabins and second homes have been built near the edge of the forest and the winter gate on Mirror Lake Highway. Due to the districts high recreational appeal and close proximity to major urban areas, the
development pressure on the private land will most likely remain at a high level. The water quality and quantity in the Headwaters district appears to be very clear and abundant, as there are no dams on the Bear River until you are north of Evanston. However, overgrazing or poor grazing techniques around the river corridor could negatively affect the water quality of the district.

The major land uses in the East Bear River Valley (EBRV) are ranching, agriculture, urban industrial and residential use. For the majority of the EBRV, ranching and dry agriculture are the primary uses of the land. Small towns such as Woodruff, Randolph and Cokeville are interspersed with large sweeping, arid ranchlands. However, the Bear River corridor on the north side of Evanston is noticeably different. Evanston has a population of approximately 11,500 and exacts considerable human industrial and development impacts on the watershed (http://www.evanstonwy.org/economic_dev/default.asp?id=99). Consequently, human caused sprawl and pollution are noticeable near Evanston. Following the Bear River downstream north of Evanston, there are lots of new housing subdivisions and mixed industries (metal works, auto repairs, lumber yards, natural gas wells) that are scattered among the residential and agricultural properties. The water quality that is found immediately after this area appears to be of significantly less quality than the quality found upstream of Evanston. Viewed from above, all of the old river oxbows are very visible. When observing all of the development that has taken place very close to the river around Evanston, it does not appear that the town has taken into account that the channel and direction of the river can change drastically over a short period of time due to natural meanderings or flooding.

The traditional use of the low lying plains surrounding Bear Lake has been and continues to be agriculture in the locations that are not under high development pressure. Agriculture currently is still the primary land use found in the Bear Lake Basin. The Bear Lake National Wildlife Refuge near Dingle is another large use of land around the lake’s north and northeastern shores. However, along the west and south shores, new cabin and housing developments and their accompanying roads can be seen climbing increasingly further up the mountains. Most of this development has occurred within the last 5-10 years and does not appear to be following any master plan. Along with the rampant development on the west and south shores of the lake, the receding water level of Bear Lake is another matter of concern. Bear Lake is currently 30% of capacity and its shoreline has receded significantly in the past five years. In some flatter areas, the shore of the lake is 300 yards out from its location when the lake is full. The continued loss of water in the lake could have a substantial affect on tourism, boating, housing prices, development and the ecosystem of Bear Lake and its surrounding wetlands.

Agriculture and ranching continue to be the predominant land uses in the North Bear River Valley (NBRV). The towns of Montpelier, Soda Springs, Georgetown and Grace are separated by stretches of rolling farmland and have small, compact urban and residential areas. Soda Springs has a large industrial presence and dependence in the Monsanto Phosphorous plant located north of town. Housing developments south of Soda Springs have also begun to creep into the wildland areas located near the Caribou National Forest. However, the development pressure in the NBRV is probably not as high as the Bear Lake Basin or the Cache Valley districts.

The land uses in Cache Valley range from agricultural fields and dairy farms to urban and suburban use. Over the last two or three decades, Cache Valley has gone from being a predominantly rural agricultural area to a region increasingly becoming more industrial, commercial and urban. The population of the valley has now surpassed 100,000 and many areas that were formerly farms or ranchland have now been converted into subdivisions or commercial zones. Many small towns surrounding Logan that used to be separated by large swaths of open space are now connected to Logan through a matrix of housing and
of poor land use is the wasteful use of water in urban areas. In a watershed where the quantity of available water is a prominent issue, the wasteful use of water on many residential, municipal and commercial properties is a practice ill-suited for the region.

Conversely, there are also currently many positive uses of the land within the BRW that should be continued. Most of the lands administered by the U.S. Forest Service and BLM are still beautiful relatively undisturbed areas with lots of open space. The Headwaters and Mountain districts contain many pristine fisheries and untainted ecosystems that are well suited for wildlife habitat and recreational opportunities. The large primarily unbroken spine of the Wasatch Mountains provides an excellent wildlife habitat as well as easily accessible recreational opportunities for residents of the local communities. Additionally, dry farming and ranching in many areas of the EBRV, NBRV and WBRV is a wise use of an arid landscape that preserves wildlife corridors and open space. The NBRV and most of the EBRV are good examples of wise land use, as the towns are small and centered in one area with ample amounts of farm and rangelands present in between the urban areas. Finally, most of the uses of wet farming in many areas of the NBRV, Cache Valley and WBRV can be considered a beneficial use of the land and water, as the land is preserved as open space and the water is used to produce a tangible economic benefit to the communities.

C. ISSUES AND IMPRESSIONS OF THE BRW

Overall, the three major issues that face the BRW are the use and distribution of water, water quality, and development. Ingrained in each of these three issues are a plethora of smaller issues that can have major affects on both the biophysical and cultural aspects of the BRW.

In dealing with the water distribution and water use for the BRW, a good plan must take into account not only the human demand for water within the watershed, but also the pressure from neighboring urban
areas such as Salt Lake County who also want to get access to water from the Bear River. Any additional withdrawals from the river will also impact the natural ecosystems and species that inhabit them. The Bear River flows through three different states, has its largest lake straddling two states, has numerous dams on it and its tributaries and goes through multiple county and local jurisdictions. As such, the water rights and usage become a significant issue with a lot of stakeholders.

The quality of the water in the BRW affects every person and every species in the watershed. A severe decrease in the water quality could be disastrous not only for the fish, wildlife and plants that depend on the water, but also for the farmers, ranchers and residents of the communities who depend on the water for their irrigation and culinary needs. Therefore, it will be important to address land use habits such as industry and overgrazing that degrade the quality of the water.

The role of development in the BRW will have a large impact on the water distribution and water quality issues. If development continues to go unplanned and unbridled by any restrictions, there will be an increased demand for the water and less supply downstream for all other parties who depend on the water. Additionally, increased development ruins many wildlife corridors and can negatively affect the runoff and saturation of groundwater that finds its way into the rivers, reservoirs and lakes of the BRW. Inherent within the larger issue of development are all of the wildlife and habitat removal issues associated with the wildland urban interface. Public access to rivers, lakes, mountains and national forests also becomes an issue with increased development along the shorelines and edges of these natural resources. High development pressure and demand are currently issues in Cache Valley, Bear Lake Basin, Evanston and near the Uinta Mountains.

The opportunities that are available on the BRW are numerous and substantial. With a good plan, the community can preserve critical wildlife and fishery areas and provide a fundamental water plan that takes into account the sustainable amount of water needed for both humans and the natural environment. Critical open space habitat can also be preserved with smart planning. Careful placement and evaluation of future roads and housing developments can greatly reduce the future sprawl and congestion that is associated with unplanned development.

Limitations to the planning on the BRW almost all hinge on the amount of water available for use. If the watershed area continues to experience drought conditions, the issues of water pollution and new developments will be moot and everyone will have to consider alternatives to make do with what water is left. Other limitations to agriculture and ranching are the amount of arable land available, as most is either currently being used, is controlled by public agencies or is in danger of being unusable due to drought conditions. Similarly, the amount of land that is available and attractive for development could also be a limitation sometime in the future. As much of the land that is desirable to developers is owned by the state or federal governments, the availability of prime real estate could also be a limiting factor. The availability of water for sewage and wells will also be a major limitation on the number and location of future developments, both inside the watershed and outside it. A final, but very important limiting factor will be the influence of local politicians, regional political attitudes and the economies of the local communities. If the small farmers and ranchers are being pushed off or being forced to sell off their property and water rights to developers or to cities on the Wasatch Front, the attitudes of the politicians making the decisions could change and affect the outcome of the proposed plans.

My overall impression of the BRW is of a vast mainly agricultural region that is starting to feel the strain of human impacts in select areas. The BRW is a unique area that is highly dependent on having its ecosystem and resources in a harmonious balance. Making the right decisions now and in the future will insure that the region will maintain the beauty, natural resources and opportunities that it still possesses today.
APPENDICES

Appendix F: GIS Data Notes

COORDINATE METADATA FOR GIS MAPS

Coordinate system: Universal Transverse Mercator
UTM zone 12

Transverse Mercator projection parameters:

Scale factor at central meridian: 0.999600
Longitude of central meridian: -111.000000
Latitude of central meridian: 0.000000
False easting: 500000.000000
False northing: 0.000000

Planar coordinates are encoded using coordinate pair.
Abcissae (x-coordinates) are specified to nearest 0.000512.
Ordinates (y-coordinates) are specified to the nearest 0.000512.

Planar coordinates are specified in meters.

Ellipsoid: Geodetic Reference System 80.
Semi-major axis of ellipsoid is 6378137.000000.
Flattening of ellipsoid is 1/298.257222.

For questions about GIS maps or metadata, contact:

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