TECHNICAL MEMORANDUM

SUBJECT: **Green River Basin Plan II**
Future Recreation and Environmental Water Use Projections

DATE: **October 2009**

PREPARED BY: **ERO Resources Corporation & WWC Engineering**

Introduction

This memorandum presents an evaluation of future demand for recreational and environmental water uses in the Green River Basin for the period of 2005 through 2055.

Most water-based recreation activities do not directly result in the consumptive use of water, with the exception of irrigation for parks, golf courses, and other landscapes. As described in the *Recreation Water Uses Technical Memo*, little quantitative data is available on recreation use in the Basin. Therefore, the projections in this memo are generally descriptive in nature, taking into account a combination of anticipated recreational use trends and population projections.

Environmental water uses include the water needed to support fish and other water-dependent plant and animal species, and the associated water-dependent ecosystem functions. Environmental water uses are primarily non-consumptive, with many of the benefits to the environment accruing from the natural flow in streams and rivers, as well as in-situ environmental uses occurring coincident and coterminous with the storage, distribution, and use of water for other purposes, including recreation.

Future Recreational Water Requirements

A Background and Approach

Information on existing water-based or water-dependent recreational uses in the Green River Basin were developed based on existing documents and interviews with individuals familiar with recreational activities in the region. This information is described in detail in the *Recreational Water Use Technical Memo*. Anticipated trends and projections on future recreational use and demand were developed using data and information published by the State of Wyoming and State of Colorado Statewide Comprehensive Outdoor Recreation Plans, and national-level trend data published by the Outdoor Industry Association.

B Current Recreation Activity

Current water-based or water-dependent recreation activities in the Green River Basin are described in detail in the *Recreation Water Use Technical Memo*. In general, water-based

recreational uses in the Green River Basin include fishing, boating, skiing, and waterfowl hunting. Some of these activities, such as boating and fishing, are clearly water based, while others such as hunting depend on water to support waterfowl habitat. Streams and lakes also provide an indirect amenity that enhances the recreation experience for activities like camping, hiking, and other recreation facilities located near open water. Although golf and recreational activity in parks are not water-dependent recreation activities, a reliable supply of water is needed for irrigation and maintenance.

Considering the dispersed nature of outdoor recreation activities, there is little quantitative data available on the number of recreation users. However, available state-wide data provides an indication on recreation activity. The Wyoming Business Council tracks recreation and tourism trends throughout the state using visitor surveys. Based on the most recent surveys (2008), 11 of the 15 top outdoor recreation activities in Wyoming are either water-based (boating, fishing, skiing) or water-related (hunting, camping, bird watching) (SMRI 2008). The top ten water-based or water-dependent activities, in order, are:

- Wildlife watching
- Camping
- Bird watching
- Fishing
- River-rafting
- Snow skiing/snowboarding
- Boating
- Canoeing or kayaking
- Hunting
- Snowmobiling

C Anticipated Recreation Trends

In general, population increases in Wyoming, in neighboring states, and nationally are anticipated to result in a greater demand for all types of recreation, although the popularity of particular types of recreation will change over time. National recreation trends are tracked by the Outdoor Industry Association. Their recent findings of changes in participation in the top ten water-based or water-related recreation activities are detailed in Table 1 (OIA 2009).

Table 1 - Participation in Water-Related Recreation Activities, 2007-2008

Activity	Change in Participation 2007-2008
Wildlife watching	5.0%
Camping	
Recreational Vehicle	2.2%
Other (within ¼ mile of vehicle)	7.4%
Bird watching	5.4%
Fishing	
Fly fishing	3.2%
Traditional fishing	- 8.0%
River rafting	7.2%
Skiing	
Alpine/downhill	- 0.2%
Snowboarding	4.6%
Cross-country	9.0%
Boating	n/a
Canoeing	1.4%
Kayaking	6.9%
Hunting	
Shotgun/waterfowl	2.2%
Snowmobiling	- 3.1%

At a national level, general participation in water-related recreational activities is steadily increasing, with the exception of traditional fishing, alpine skiing, and snowmobiling. While no similar data is available for Wyoming or the Green River Basin, it is reasonable to assume that the national declines in those activities would be less apparent in the region due to their overall popularity in Wyoming and in the Basin. If that assumption is correct, one can further assume that all of the top ten water-related recreational activities in the Green River Basin will continue to increase in participation in the foreseeable future.

The aging of the baby boomer generation in coming years is also anticipated to increase the demand for recreation. Baby boomer recreationists will generally have more leisure time, a comparably high disposable income, and a greater concern for health and fitness. While many plan to remain active and pursue recreation activities such as hiking, wildlife viewing, skiing, and bicycling, some recreation planners foresee potential shifts in recreational use patterns. For example, recreation that is less physically demanding may increase along with recreation activities that provide higher levels of comfort (CSP 2008). In addition to an increasing retirement-age population, current demographic trends indicate Wyoming's recreation providers will have to address the needs of a more obese population and youth that are digitally engaged (SPCR 2009).

As noted in the State of Wyoming's 2009 Statewide Comprehensive Outdoor Recreation Plan (SCORP), participation in all types of outdoor recreation has grown dramatically in recent decades. Statewide surveys conducted as part of the SCORP indicates increasing

public support for expanded water-based recreation opportunities, as well as non-structured recreation activities (SPCR 2009).

Recent planning documents by the BLM and WGFD (BLM 2008, WGFD 2007) have predicted an overall increase in recreation demand in the Green River Basin, as well as the following trends:

- The demand for fishing, floating, camping, off–highway vehicle (OHV) use, and new technology-based recreation is expected to increase
- Visitation throughout the planning area will continue to increase as resource availability and conditions allow
- As the population of neighboring states and the local area continues to grow, the desire for less crowded or more remote recreation opportunities will continue to bring more people to the public lands in Wyoming
- Access for hunting and fishing on private lands will continue to be more restrictive, resulting in heavier use and more crowding at public access sites

D Recreation Demand Projections

The *Population Projections Technical Memo* provides detailed information on likely population growth trends in the Green River Basin. Those findings are summarized in Table 2~~Table 2~~:

Table 2 - Summary of Population Projections in the Green River Basin

	2010	2015	2020	2035	2055
Low Growth Scenario					
Population	61,762	62,727	63,077	64,052	66,465
Moderate Growth Scenario					
Population	67,078	70,552	74,314	87,280	104,226
High Growth Scenario					
Population	67,078	70,552	84,314	117,280	134,225
Retirement-age Population					
Percent population above age 55 – Moderate Scenario	21.8% (2005)	31.9%	n/a	42.4%	54.2%

The population and demographic projections summarized in Table 2~~Table 2~~ underscore that, even under the low growth scenario, the population of the Green River Basin is anticipated to grow by about 7.6 percent over the next 45 years. During that same time period, Green River Basin populations under the moderate scenario are expected to expand by about 55 percent. Maximum projected growth predicts a 100.1 percent increase. The proportion of retirement age persons (above the age of 55) are expected to substantially increase in the next 45 years, from about 22 percent of the population in 2005 to over 50 percent of the population in 2055 (under the moderate scenario).

It is difficult to speculate on how population projections will influence recreation demand for the following reasons:

1. There is not always a clear, direct correlation between population and recreational use.
2. Much of the recreational demand in the Green River Basin is from other parts of Wyoming and from nearby states.
3. Recreational uses change based on economic conditions and the availability of time and money for recreation.
4. Specific recreational activities fall in and out of favor and popularity over time.

However, it is reasonable to assume that overall recreational demand trends will generally track with population trends, resulting in growth rates of about 1 to 2 percent annually (for the low-to-high growth scenarios). The average annual growth rates for low, moderate, and high population projections are .17, 1.01, and 1.67 percent, respectively. Table 3 shows projected recreational activity days based upon these population projection scenarios and the number of recreational activity days surveyed in the 2000 *Future Recreational and Environmental Water Requirements Memo*.

Table 3 - Projected Water-based Recreational Activity Days 2000-2055

Activity	2000 Activity Days	Low Growth	Moderate Growth	High Growth
Stillwater Fishing	485,000	521,860	751,750	974,850
Stream Fishing	300,000	322,800	465,000	603,000
Waterfowl Hunting	10,600	11,406	16,430	21,306

Based on the findings and assumptions about recreational trends and population/ demographics described above, the following recreation demand trends are anticipated:

- Overall visitation and recreational use in the Green River Basin will continue to grow and expand
- Rates of growth will vary based on population trends in Wyoming and in nearby states, but will range between about 1 and 3 percent annually
- Participation in passive water-based recreation activities, including wildlife viewing and bird watching will continue to expand and will become increasingly popular among aging populations
- Demand for fly fishing and float fishing in the Basin will continue to grow, while boating and fishing access will be more competitive
- Participation in hunting activities will remain steady, while hunting access will become more limited
- Most recreational water uses continue to be non-consumptive, with the exception of alpine skiing (snowmaking) and golf. Although golf is a recreational consumer of water, the water consumed is included in municipal water use projections because golf courses are supplied by municipal systems. Likewise snowmaking takes place at

only one ski area near Pinedale and the amount of water consumed at that operation is small. No new water-consuming downhill ski areas are anticipated in the Green River Basin over the planning horizon. Thus, for planning purposes, consumptive water use for the recreational sector is non-consumptive and anticipated to remain so for the planning period.

Implications for recreation water demands in the Green River Basin include:

- Water demands (e.g., lake levels, river flows) to support all water-based recreation will increase
- Demand for river access for fishing and boating will increase
- Demand for sufficient river flows to support recreational fishing and boating will increase
- Any new water development projects will face increasing scrutiny from recreationists and recreation interests and depending on the nature of the project, could provide new or reduced recreational opportunities
- Any new water projects should consider mitigation measures to accommodate recreational uses, including:
    - Improved boating and fishing access
    - Minimum stream flow or lake level commitments to protect fishing and boating opportunities
    - Measures to protect water-based wildlife habitat
    - Wildlife viewing and interpretive opportunities

Future Environmental Water Requirements

A Background and Approach

Information on current environmental water needs was summarized from the *Environmental Water Uses Tech Memo* for the Green River Basin. Anticipated future environmental water needs are based on assumptions about changes in values and priorities related to water-based recreation and environmental resources, and potential conflicts between those priorities and future water needs for agriculture, municipal, industrial and other uses.

1. Current Environmental Water Needs

Environmental water uses are primarily non-consumptive, with many of the benefits to the environment accruing from the natural flow in streams and rivers, as well as in-situ environmental uses occurring coincident and coterminous with the storage, distribution, and use of water for other purposes. Environmental water uses and needs associated with streams, reservoirs, wetlands, riparian habitat, federally listed threatened or endangered plant and wildlife species, state species of concern, and other water-dependent wildlife species are briefly described below.

Instream Flow – The Wyoming Instream Flow Law allows for the maintenance of streamflows to be considered a beneficial use, and allows for unappropriated water to be

appropriated to maintain or improve fisheries. Several streams in the Green River Basin have instream flow water rights issued by the Wyoming State Engineer's Office. In addition, there are bypass requirements below several reservoirs in the Green River Basin. Most Wyoming Game and Fish Department identified stream segments are stream segments habituated by the Colorado River Cutthroat Trout, a sensitive species. The WGFD is also evaluating appropriate instream flows for other reaches. It is likely that instream flow designations will continue to expand in the future as the WGFD identifies areas for protection. All of the instream flow water rights are subject to more senior water rights, but they are senior to new water right applications. Between 2001 and 2005, the number of instream flow sections in the Green River Basin increased from 33 to 35, and this increasing trend is expected to continue over the planning horizon.

Reservoir Minimum Pools – Five reservoirs in the basin, Big Sandy, Boulder, Flaming Gorge, Fontenelle, and High Savery, have minimum pool sizes for fish and wildlife purposes. The WGFD also has identified recommended water surface area for lakes and reservoirs larger than 100 acres that are desirable for supporting game fish populations. Recommended minimum acres of surface area for these reservoirs are not permitted minimum storage rights and are not enforceable. No change in the minimum reservoir pool for these reservoirs is anticipated in the future although given the current federal regulatory environment and the desires of the public to maintain and enhance recreational fisheries in the Basin, it is likely that any additional storage developed in the future will have a portion of its storage devoted to fish and wildlife purposes.

Reservoir Bypasses -- Another environmental water use is the provision of minimum reservoir pools for fish and wildlife purposes. Only four reservoirs have flow bypasses required by permit. These are Fontenelle Reservoir (50 cfs at the City of Green River), Meeks Cabin Reservoir (10 cfs), Stateline Reservoir (7 cfs), and High Savery Reservoir (10 cfs). The development of additional reservoir storage in the future would likely bring about requests by the WGFD and others for such minimum flow bypass requirements.

Wetland and Riparian Habitat – Wetland and riparian areas are important habitat types that depend on surface and ground water. The Upper Green River Basin hosts the most continuous system of riverine wetlands that support the highest production of ducks per unit area in Wyoming (SCORP, 2009). Wetlands provide significant nesting and breeding habitat for bird populations, microbes, plants, reptiles, amphibians, and some mammals. Riparian areas provide an important source of forage, cover, and habitat diversity in arid environments for a variety of wildlife species. Based on existing vegetation mapping, the Green River Basin supports about 383,000 acres of wetlands and about 758,007 acres of riparian habitat. Many of the wetland and riparian areas in the Green River Basin are created and sustained by irrigation, namely flood irrigation practices. The need for water to support this habitat will continue in the future and is subject to competing water uses. There are several wetland and riparian habitat mitigation or construction projects planned in the Green River Basin over the planning horizon, detailed in the next section.

Federally Listed Species – Of the 20 federally listed plant and animal species (under the Endangered Species Act) in the Green River Basin, six are potentially dependent on water

sources. Those include five fish species (bonytail, Colorado pikeminnow, humpback chub, Kendall Warm Springs dace, and razorback sucker) and one plant species (Ute ladies'-tresses orchid). Future changes in Green River flows or water quality in Wyoming have the potential to impact downstream habitat for the endangered fish species, and may also affect listed plant species.

State Listed Species – The State of Wyoming has identified 32 wildlife species of concern that depend on water, shores, riparian areas, and wetlands and 32 plant species of concern that are dependent on wetland habitat. These species also rely on a continued future supply of water to support habitat requirements.

Water-Dependent Wildlife Species – Most common wildlife species depend on wetland and riparian habitat for some or all of their life cycle needs, while many others are exclusively dependent on water-supported habitats. Typical water-dependent species include American beaver, common snapping turtle, moose, muskrat, water shrew, water vole, western painted turtle, western spiny softshell turtle, mallard duck, white-winged scoter, willet, willow flycatcher, Wilson's phalarope, wood duck, and the yellow-headed blackbird. These species rely on the wetland, riparian, and aquatic habitat and future dependable water sources are needed to meet their habitat requirements.

2. Future Environmental Demands

B The availability of water for environmental water uses in the Green River Basin is an important component for supporting aquatic, wetland, and riparian habitats and the abundance of fish, waterfowl, and wildlife that rely on these habitats for cover, forage, and reproduction. Future environmental water demands in the Green River Basin can be anticipated by looking at current values and trends, plans for future environmental projects, and areas that are identified for environmental protection. However, any future projections are somewhat speculative, since environmental water uses will vary based on climate conditions, federal and state species listing status, changes to state and federal laws, and changes in community values and water uses. Most environmental water uses continue to be non-consumptive, with the exception of evaporation from environmental construction such as riparian area improvements, increased diversion and consumption at Seedskadee National Wildlife Refuge, developments in the Little Snake River, and increased enrollment in federal assistance programs such as the Conservation Reserve Program (CRP), the Wetlands Reserve Program (WRP), and the Wildlife Habitat Incentive Program (WHIP).

There are five identified major watersheds called "Waterfowl Management Areas" in the Green River Basin as identified by the Wyoming Statewide Comprehensive Outdoor Recreation Plan (SPCR, 2009). This document outlines problems, suggested solutions, and possible future environmental construction projects and actions. These proposed areas of possible wetland protection and improvement help to parameterize the possible future amount of environmental water consumption.

Upper Green River Basin Waterfowl Management Area

The problem identified in this area is the fact that the majority of the floodplain wetland and riparian areas are on private land, and thus risk development. An example of this is the recent natural gas drilling and consequent demand for housing and development around Pinedale. Proposed strategies to mitigate this wetland loss include development of wetland improvement projects on state and federal land to offset the losses on private land, continue to enforce environmental regulations, and to consider acquiring the most valuable wetland tracts for protection. The nineties saw numerous wetland improvement projects in this area, including the 28-acre wetland development on Soda Lake in 1988, Civilian Conservation Corps (CCC) Ponds improvement project ongoing throughout the nineties, and the Ordway wetland project was completed in 1994. Identified areas for future improvement include Indian Creek Pond, 67 Reservoir, and Fontenelle Creek.

Lower Green River Basin Waterfowl Management Area

This area is characterized by large construction projects that have greatly impacted wetlands such as the Farson-Eden irrigation project, and projects with great potential for large-scale improvement and growth, such as Seedskadee National Wildlife Refuge. Future consumption of Seedskadee National Wildlife Refuge was estimated in the 2000 Green River Basin Plan. The Refuge is permitted to divert a maximum 28,000 acre-feet per year; as estimated in the first Green River Basin Plan, low growth would see no increase in diversions at Seedskadee; moderate growth would see an additional 14,000 acre-feet per year diversion, consumed at a 50 percent consumption rate; the high growth scenario would see the full 28,000 acre-feet per year diversion, also calculated at a 50 percent consumption rate. These possible increases in diversion and consumption could substantially increase the amount of water used in the environmental sector.

Another area of possible diversions includes the Farson-Eden area. As a result of the Colorado River Salinity Control Program, farming practices have moved from flood irrigation to center-piviot systems in this area. Although 21 acres of new wetlands have been created to mitigate this loss of wetland habitat, several more are required to balance the losses and likely will continue to be constructed. Sites to be considered for future environmental protection in this area include the Grandy property. Bob McMurray property, and potholes at Prospect and Gold Creeks.

Hams Fork/Blacks Fork Waterfowl Management Area

This area is characterized by water quality issues stemming from overgrazing as well as developments threatening wetland areas. Protection of wetlands through enforcement of existing laws and regulations, mitigation for wetland losses, easements for protection and enhancement of wetlands as well as cooperation with the US Forest Service and Bureau of Land Management to improve grazing practices and water quality are all goals in this area to improve environmental water conditions. Possible future wetland protection or enhancement sites in this area include Hickey Mountain stock pond, Henry's Fork, Albert Creek, Lower Hams Fork wetland, Austin Reservoir, and the Viva Naughton Reservoir property.

Little Snake River Waterfowl Management Area

The Little Snake River Basin is an area where numerous water management and water mitigation projects have been recently completed, are ongoing, or are planned for the near future. The recent completion of High Savery Dam in 2003 inundated approximately 482 acres, including 53 acres of riparian habitat and 8 acres of wetlands. These losses are being mitigated by project sponsors at a 4:1 ratio for wetland habitat and 3:1 for riparian habitat using methods such as spreader dikes to create wetlands and these efforts are ongoing. In addition to the High Savery Reservoir wetland mitigation, two projects on Muddy Creek, the George Dew Dike and the Mexican Flats wetland project, have been successfully completed between 2000 and 2005, increasing environmental water use in this area. A possible problem in this waterfowl management area includes the present and future increase in demand for domestic and agricultural water, which may take water away from wetland areas; however, effective water planning is a good way to control the effects of future demand. Opportunities for wetland improvement include continued mitigation of High Savery Dam project wetland losses and the possibility of good quality mining and energy wastewater to be spread upon the land surface, creating new wetlands.

Great Divide Basin Waterfowl Management Area

The Great Divide Basin is an arid, closed basin with no documented wetland losses. Improvements in grazing practices, wetland improvements in the 1,500 acre of the Chain Lakes Wildlife Habitat Management Area (WHMA), and created wetlands or reclaimed lands with suitable quality excess industrial water from mining operations are all possible imparters of future environmental demand. The BLM Rawlins District is also planning improvements to wetlands with projects such as planting shoreline vegetation, livestock enclosures, dike repairs, pothole blasting, and well water retention.

The above possible improvements and changes to waterfowl management areas all have the potential to effect the amount of water used in the environmental sector. As society continues to be increasingly environmentally conscious and environmental regulations more stringent, the amount of wetland and riparian creation and improvement are expected to increase, although it is difficult to quantify for several reasons. In addition to the reasons listed at the beginning of this section, it is quite ambiguous whether or not environmental consumption is substantially impacted by human activity. Most environmental wetland enhancement and protection projects are simply mitigation for destroyed wetlands seeking a balance between wetlands destroyed and created; thus there is no net gain or loss of wetland habitat across most of the Green River Basin. Arguably, the only human induced environmental consumption of water is the creation and subsequent evaporation of water from reservoirs; wetlands existed and “consumed” water before human activity began creating and destroying them.

It is also important to put the scale of environmental water consumption in the framework of overall water consumption. In the 2000 Green River Basin Plan, environmental water consumption, the lowest consumer, was 2000 acre-feet per year. Agriculture, the highest consumer, depleted approximately 401,000 acre-feet per year (normal hydrologic conditions assumed). Environmental water consumption is .5 percent of what agriculture consumes and

the uncertainties associated with estimating and projecting environmental water use is just a drop in the bucket in terms of basinwide water consumption. Thus the above identified opportunities for future environmental water consumption should be considered with the small scale of environmental consumption and the minimal influence of humans in mind.

Potential areas of conflict between environmental uses and new water projects or water diversions could include the following:

- Changes in the availability of water to support fish and aquatic habitat
- New federal listings, rulings, or designations under the Endangered Species Act that require certain amounts of water to sustain habitat
- Streamflow reductions resulting in increased water temperatures and other conditions that adversely affect the aquatic environment
- Physical impacts to the existence, function, or connectivity of wetland and riparian habitats
- Indirect impacts to wetland and riparian habitats due to lower streamflows or changes in the timing of water supplies

Environmental water use demands may be driven in part by recreation demands. Increased participation in water-based recreation activities (fishing and boating) and water-related activities (such as wildlife viewing and hunting) are likely to precipitate a greater interest and concern about environmental water needs and the impacts of water projects, diversions, and competing water uses on fisheries, stream flows, and other environmental values.

Based on the current environmental uses, potential areas of conflict, and overall trends, some of the following can be anticipated regarding future environmental water demands:

- Instream flow and minimum pool designations will persist, and may expand over time in response to protection of resources, changing uses, and public priorities
- The demand for sufficient water supplies to support wildlife habitat will continue and increase
- Any new water projects will face increasing scrutiny and demands to protect water-dependent values, particularly fisheries and wildlife habitat
- Periods of prolonged drought will exacerbate conflicts over environmental uses and priorities

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