

TECHNICAL MEMORANDUM

SUBJECT: **Green River Basin Plan**
 Basin Water Use Profile-Environmental

DATE: June 2009

PREPARED BY: ERO Resources Corporation

Introduction

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. This assessment describes 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.

Approach

The objective of this assessment is to identify environmental water needs and locations where water requirements to support environmental needs have been quantified, and to identify other important plant and wildlife species and associated habitats that are dependent on water or the habitat that water availability creates. Environmental water needs in terms of minimum flows and reservoir pools were quantified when information was available. The consumptive use of environmental water needs is related primarily to evaporation from streams, ponds, and reservoirs, as well as transpiration by wetland and riparian plants and; therefore, it is not readily quantified. Direct consumption of water by wildlife also results in a consumptive environmental water use, but the amount is minimal relative to overall water uses in the Green River Basin.

Information for this assessment was obtained from state and federal land management agencies, existing documentation, and other sources. Public agency data sources include the Wyoming Game and Fish Department (WGFD), the U.S. Geological Survey (USGS), and the U.S. Fish and Wildlife Service (Service). The WGFD and Wyoming State Engineer's Office (WSEO) provided information on permitted instream flow water rights and recommendations for other maintenance flows or reservoir pools. Wetland mapping was taken from the Service National Wetland Inventory (NWI) mapping. Riparian mapping and information for irrigated lands was obtained from the Wyoming Gap Analysis (WGA). Information for threatened, endangered, candidate, and state-sensitive species was provided by the Service from the five primary counties in the Green River Basin in Wyoming—Carbon, Lincoln, Sublette, Sweetwater, and Uinta—while state-sensitive information was gathered from the Wyoming Natural Diversity Database (WNDD).

Instream Flow and Reservoir Minimum Pools

A. Instream Flow Water Rights and Estimated Stream Maintenance Flows for Fish

The Instream Flow Law, passed in 1986 by the Wyoming Legislature, allows for the maintenance of streamflows to be considered a beneficial use (WSEO 2008). Designation of instream flow water rights are regulated under Wyoming Statutes, Article 10-Instream Flows, 41-3-1001, et seq. Under these statutes, “unappropriated water flowing in any stream or drainage in Wyoming may be appropriated for instream flows to maintain or improve existing fisheries and declared a beneficial use of water by the Wyoming State Engineer’s Office, if such use does not impair or diminish the rights to any other appropriator” (WYO STAT. ANN. § 41-3-1001). Only the WGFD, through the State Game and Fish Commission, can apply for an instream flow permit. The WGFD completes biological studies to determine what instream flows are necessary to support and maintain the form, function, and ecological processes of a river. After the WGFD identifies stream segments where instream flow protection is needed to maintain the fishery, the Wyoming Water Development Commission (WWDC) assesses the feasibility of the application. The feasibility study includes a determination of water necessary to maintain or improve existing fisheries and the availability of unappropriated water. The WSEO then holds a public hearing prior to making the decision regarding the amount of instream flow (WSEO 2008). Based on this information and public input, the WSEO then issues a decision on the application. The WWDC holds the water right for all instream flow permits.

Several rivers and streams in the Green River Basin have had instream flow water rights issued by the WSEO and several are in the process of being studied by the WGFD to determine appropriate flows. For most permitted streams and rivers, the WGFD has determined that a seasonal range of values rather than a constant flow is required to sustain a healthy environment for fish and other wildlife. Table 1 contains a list of permitted instream flow water rights in the Green River Basin and the monthly flow values.

Three reservoirs in the Green River Basin have minimum flow bypasses included in their reservoir permits: Fontenelle (50 cfs at the Town of Green River), Meeks Cabin (10 cfs), and Stateline (7 cfs).

The WGFD has also estimated stream maintenance flows for several other streams in the Green River Basin that do not have instream flow rights (States West 2001; WGFD 2008a). These values, as shown in Table 2, are preliminary estimates of the flows necessary to support game fish populations in the late season during low flow months. A WGFD application for an instream flow permit for these or other drainages in the Green River Basin could occur in the future upon further study and in accordance with the instream flow permitting process previously described. There is no enforcement or legal water rights associated with WGFD stream maintenance values.

Table 1 - Permitted Instream Flow Water Rights in the Green River Basin

Water Name	Tributary To	WSEO Permit No.	Priority Date	Instream Flow Water Rights (cfs)											
				Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Big Sandstone Creek	Little Savery Creek	60IF	6/27/96	3.40	2.80	2.30	2.10	2.30	2.40	3.50	3.5/22	22.00	3.50	3.20	2.30
Big Sandstone Creek, North Fork	Little Savery Creek	59IF	6/27/96	1.00	0.80	0.60	0.50	0.70	0.60	1.30	1.6/19	19.00	1.70	1.70	1.70
Cottonwood Creek, North	Cottonwood Creek	73IF	7/12/89	8.00	8.00	8.00	8.00	8.00	8.00	16.00	16/35	35.00	25.00	25.00	8.80
Cottonwood Creek, South	Cottonwood Creek	74IF	6/27/89	17.00	11.54	11.54	11.54	11.54	11.54	17.00	17.00	17.00	17.00	17.00	17.00
Currant Creek	Green River	42IF	6/8/00	1.20	1.20	1.20	1.20	1.20	1.20	1.2/11	11.00	11.00	3.50	3.50	3.50
Deadman Creek	Little Snake River	51IF	6/21/91	0.90	0.90	0.90	0.90	0.90	0.90	2.00	2.00	2.00	2.00	2.00	2.00
Deep Creek	Little Savery Creek	57IF	12/19/95	0.50	0.50	0.50	0.50	0.50	0.50	0.50	4.60	4.60	0.50	0.50	0.50
Dirtyman Fork	Little Snake River	55IF	12/19/95	0.50	0.50	0.40	0.40	0.40	0.40	0.50	1.40	1.40	0.50	0.50	0.50
Douglas Creek	Big Sandstone Creek	56IF	12/19/95	0.30	0.30	0.30	0.30	0.30	0.30	0.30	3.60	3.60	0.50	0.50	0.40
Fish Creek	Green River	30IF	3/11/91	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6/10	10.00	10.00	10.00	10.00
Gilbert Creek	Cottonwood Creek	37IF	12/6/99	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30
Granite Gulch/Green Timber Creek	Little Snake River	49IF	6/21/91	0.75	0.75	0.75	0.75	0.75	0.75	1.00	1.00	1.00	1.00	1.00	1.00
Green River (above Daniel)	Colorado River	6IF	—	101.0 0	101.0 0	101.0 0	101.0 0	101.0 0	101.0 0	101.00	101.00	101.0 0	350.0 0	350.0 0	314.0 0
Harrison Creek	Little Snake River	50IF	6/21/91	0.61	0.61	0.61	0.61	0.61	0.61	1.00	1.00	1.00	1.00	1.00	1.00
LaBarge Creek Section 1	Green River	29IF	12/17/90	17.00	17.00	17.00	17.00	17.00	17.00	25.00	25.00	25.00	25.00	25.00	25.00
Little Gilbert Creek	Gilbert Creek	38IF	12/6/99	0.20	0.20	0.20	0.20	0.20	0.20	0.20	3.50	3.50	0.20	0.20	0.20
Little Snake River, West Fork, and North Fork	Little Snake River	44IF	6/21/91	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
Little Snake River, North Fork	Little Snake River	46IF	6/21/91	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Little Snake River, Roaring Fork	Little Snake River	54IF	6/27/96	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.6/4.4	4.40	1.60	1.60	1.60

Water Name	Tributary To	WSEO Permit No.	Priority Date	Instream Flow Water Rights (cfs)											
				Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Mill Creek	Big Sandstone Creek	58IF	6/27/96	1.20	1.00	0.80	0.70	0.90	0.80	1.70	1.70	6.80	1.70	1.20	0.80
New Fork (East Fork to Pine Creek)	Green River	71IF	1/21/05	95.00	95.00	95.00	95.00	95.00	95.00	95.00	95.00	95.00	135.00	135.00	135.00
Pine Creek	New Fork	34IF	6/4/02	0.00	32.00	20.00	20.00	20.00	20.00	26.00	0.00	40.00	40.00	0.00	0.00
Piney Creek, Middle Fork	Green River	36IF	3/11/91	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	15.00	15.00	15.00
Piney Creek, North	Green River	35IF	3/11/91	25.00	25.00	25.00	25.00	20.00	18.00	20.00	25/35	35.00	40.00	40.00	40.00
Piney Creek, South	Green River	28IF	3/11/91	9.00	9.00	9.00	9.00	9.00	9.00	15.00	15.00	15.00	15.00	15.00	15.00
Rabbit Creek	Little Snake River	45IF	6/21/91	0.70	0.70	0.70	0.70	0.70	0.70	1.50	1.50	1.50	1.50	1.50	1.50
Red Creek	Little Snake River	40IF	12/6/99	0.70	0.70	0.70	0.70	0.70	0.70	0.7/4.8	4.80	4.80	0.90	0.90	0.90
Rose Creek	Little Snake River	48IF	6/21/91	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Sage Creek	Little Snake River	39IF	12/6/99	1.10	1.10	1.10	1.10	1.10	1.10	3.90	3.90	3.90	1.10	1.10	1.10
Solomon Creek	Little Snake River	47IF	6/21/91	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ted Creek	Little Snake River	52IF	6/21/91	0.20	0.20	0.20	0.20	0.20	0.20	1.00	1.00	1.00	0.60	0.60	0.60
Third Creek	Little Snake River	53IF	6/21/91	0.35	0.35	0.35	0.35	0.35	0.35	1.00	1.00	1.00	1.00	1.00	1.00
Trout Creek	Green River	41IF	12/6/99	1.50	1.50	1.50	1.50	1.50	1.50	1.5/13	13.00	13.00	2.70	2.70	2.70

Source: WSEO 2008, WGFD 2008a.

Table 2 - Estimated Instream Maintenance Flows to Support Aquatic Life for Streams in the Green River Basin

Water Name	Tributary To	Estimated Maintenance Flow (cfs)
Big Sandy River	Big Sandy River	29
Boulder Creek	New Fork River	64
Boulder Creek Section 2	New Fork River	40
Clear Creek	Green River	15
Cottonwood Creek	Green River	33
Devils Hole Creek	Hams Fork River	10
Duck Creek	New Fork River	10
East Fork River Section 1	New Fork River	33
Elbow Creek	Pine Creek	10
Faler Creek	Green River	20
Fall Creek	Pole Creek	13
Fall Creek	Pole Creek	10
Fish Creek	East Fork River	15
Fontenelle Creek	Green River	23
Fontenelle Creek, North Fork	Fontenelle Creek	17
Green River (above Lakes)	Colorado River	30
Green River (below New Fork)	Colorado River	551
Hams Fork (above Kemmerer City Res.)	Black Fork River	30
Henrys Fork River	Green River	14
Horse Creek	Green River	30
Horse Creek, North	Horse Creek	32
Horse Creek, South	Horse Creek	15
Lake Creek	Willow Creek	10
Little Snake River	Yampa River	167
New Fork River (below East Fork)	Green River	234
New Fork River (on Forest)	Green River	17
Pole Creek Section 1	New Fork River	36
Pole Creek Section 2	New Fork River	15
Prairie Creek	Green River	45
Silver Creek	East Fork River	14
Slide Creek	Clear Creek	10
Titcomb Creek	Fremont Creek	20
Twin Creek, Big	Green River	10

Source: States West 2001; WGFD 2008a.

B. Reservoir Minimum Pools

Certain reservoirs in the Green River Basin have water storage permitted for environmental and recreational uses. Environmental uses include water storage for fish and wildlife. Reservoirs that have recreational purposes also provide water for environmental resources, wildlife, and plants. Reservoirs with fish and wildlife uses or pool sizes listed in the reservoir permit include:

- Big Sandy
- Boulder (1,621 acre-feet)
- Fontenelle
- High Savery (4,955 acre-feet; 580 minimum surface acres as permitted)

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 (States West 2001; WGFD 2008a) (Table 3). Recommended minimum acres of surface area for these reservoirs are not permitted minimum storage rights and are not enforceable. The water levels in these reservoirs are subject to seasonal operational fluctuations consistent with the purposes for which they were constructed, which typically includes storage and releases for agricultural, industrial, or municipal uses rather than explicitly for environmental purposes.

Table 3 - Recommended Reservoir Minimum Water Surface Area for Maintenance of Aquatic Life

Reservoir Name	Tributary To	Total acres	Min. acres
Flaming Gorge Reservoir	Green River	42,020	34,600
Fontenelle Reservoir	Green River	8,819	5,940
Fremont Lake	Pine Creek	4,996	4,996
Big Sandy Reservoir	Big Sandy River	2,748	1,450
Boulder Lake	Boulder Creek	1,843	1,400
Willow Lake	Willow Creek (Lake Creek)	1,805	1,600
Viva Naughton Reservoir	Hams Fork River	1,458	1,375
Eden Valley Reservoir	Sandy Creek, Big and Little	1,361	1,361
Halfmoon Lake	Pole Creek	921	921
New Fork Lake, Lower	New Fork River	837	700
Burnt Lake	Fall Creek	815	815
Meeks Cabin Reservoir	Blacks Fork River	488	137
Green River Lake, Lower	Green River	453	453
New Fork Lake, Upper	New Fork River	400	370
"67" Reservoir	Piney Creek, North	323	150
Soda Lake	Fremont Lake Area	313	313
Fayette Lake	Pole Creek	288	288
Soda Lake	Boulder Area	261	261
Middle Fork Lake	Boulder Creek, Middle Fork	257	257
Halls Lake	Halls Creek	206	206
Silver Lake	Silver Creek	171	171
North Fork Lake	Boulder Creek, North Fork	163	163
Cock Lake, Upper	Pole Creek	162	162
Junction Lake	Boulder Creek, Middle Fork	160	160
Rollins Reservoir	Blacks Fork River	160	60
Seneca Lake	Fremont Creek	159	159
Green River Lake, Upper	Green River	155	155
Kemmerer City Reservoir	Hams Fork River	150	130
Jim Bridger Pond	Three Mile Marsh	148	148
Piney Lake, Middle	Piney Creek, Middle	142	120
Victor Lake	Boulder Creek, North Fork	139	139
Raid Lake	Boulder Creek, South Fork	131	131
Divide Lake	Divide Creek	130	120
Long Lake	Fremont Creek	126	126
Island Lake	Fremont Creek	118	118
Meadow Lake	Meadow Creek	115	115
Bear Lake	Clear Creek	107	107
Titcomb Lake #5	Titcomb Creek	107	107
Titcomb Lake #4	Titcomb Creek	106	106
Sequa Lake	Fall Creek, Little	106	106

Reservoir Name	Tributary To	Total acres	Min. acres
Wall Lake	Pole Creek	105	105
Horseshoe Lake	Fall Creek	100	100
Junction Lake	Pole Creek	100	100

Source: States West 2001; WGFD 2008a.

B. Evaporation

Evaporation is an indirect consumptive water use from reservoirs that support environmental water needs. Most reservoirs support a variety of uses and evaporation use is typically charged to the primary purpose of the reservoir, which is generally for uses other than environmental needs.

Wetlands

Wetlands are transitional areas between terrestrial and aquatic systems that are inundated by surface or ground water with sufficient frequency to support wetland vegetation and undrained hydric soil (Service 2008a). Wetland environments provide significant nesting and breeding habitat for bird populations, microbes, plants, reptiles, amphibians, and some mammals. In addition, wetlands provide benefits such as natural water quality improvement, flood storage, shoreline erosion protection, recreation, and educational purposes (EPA 2008).

For this assessment, wetland mapping was obtained from the NWI (Service 2008a). The Service produces information on the characteristics, extent, and status of U.S. wetlands and deepwater habitats. The Service's wetland maps are produced from high altitude imagery, collateral data sources, and field work. NWI mapping represents reconnaissance-level information on the location, type, and size of wetland habitats. The Service uses the Cowardin classification of wetland system, subsystem, class, and subclass (Cowardin et. al. 1979) to map wetlands by wetland type and function in their environment.

The NWI mapped three major classes of wetlands in the Green River Basin: freshwater emergent, freshwater forested/scrub-shrub, and open water habitats defined as freshwater pond, riverine, and lake. Characteristics for these wetland classes are described below.

- **Freshwater Emergent Wetlands** - Freshwater emergent wetlands are the most dominant wetland class in the Green River Basin. Emergent wetlands are usually dominated by grasses, rushes, sedges, forbs, and other rooted herbaceous plant species (USGS 2008). Emergent wetlands include marshes, meadows, fens, prairie potholes, and sloughs. Emergent wetlands are typically found along shallow and flat drainages in the Green River Basin, along slow-moving water, in standing water, and near irrigated croplands.
- **Freshwater Forested/Shrub-Scrub** - Forested and scrub-shrub wetlands are combined in this assessment and include wetlands dominated by woody vegetation. These wetlands may have broad-leaved deciduous trees or shrubs, or needle-leaved evergreen species (USGS 2008). In the Green River Basin, these wetlands occur along rivers and streams in higher elevations, shaded drainages, and in areas with steep slopes.

- **Freshwater Pond** - Freshwater pond wetlands can include open water and emergent wetland vegetation (USGS 2008). In the Green River Basin, these wetlands occur in shallow and flat drainages, near emergent wetlands, along slow-moving streams, and around lakes.
- **Riverine** - Riverine wetlands include sparsely vegetated and nonvegetated channels and streambeds. Streambeds can be lined with bedrock, rubble, cobble-gravel, sand, mud, and organic soils (USGS 2008). These wetlands are typically found along fast-moving smaller streams and rivers in the Green River Basin. Riverine wetlands may be vegetated with emergent, woody, or submergent vegetation.
- **Lake** - Lakes include areas in the Green River Basin such as deep lakes and reservoirs. Lakes includes areas with little emergent wetland vegetation and aquatic ecosystems.

A. Wetland Areas

The Green River Basin supports about 383,000 acres of wetlands based on NWI mapping (Figure 1). No NWI digital wetland mapping is available in the northern portion of the Green River Basin in the Bridger National Forest; therefore, estimates of total wetland acreage are understated. Most wetland areas are found adjacent to streams, rivers, lakes, and ponds in the Green River Basin. The Green River and major tributaries such as New Fork River, Big Sandy River, Hams Fork River, Prairie Creek, Piney Creek, Cottonwood Creek, and Horse Creek support freshwater emergent, forested/shrub-scrub, and riverine wetland classes.

The Seedskadee National Wildlife Refuge (Refuge), which consists of 26,400 acres along 36 miles of the Green River, provides important wetland and riparian habitat. The Refuge was created as environmental mitigation in 1965 following construction of the Flaming Gorge and Fontenelle reservoirs by the Bureau of Reclamation (Reclamation). The Refuge provides riparian, wetland, riverine, and upland habitats supporting migrating songbirds, bald eagles, several hawk species, moose, and mule deer (Service 2009). Wetlands are managed to provide habitat for birds such as trumpeter swans, ruddy ducks, white-faced ibis, redheads, cinnamon teal, pied-billed grebes, sora rails, and marsh wrens. Diversions from the Green River and contributions from the Big Sandy River at its mouth contribute the water to support 335 acres of wetland habitat and 1,394 acres of riverine habitat on the Refuge (States West 2001). In a 1962 contract between the State of Wyoming and Reclamation, the Refuge has first priority of 5,000 acre-feet of reservoir water, along with 115 cfs of direct flow rights. The Refuge uses pre-1965 irrigation works to distribute water for wetland development and maintenance. Between the reservoir and direct flow water rights, the contract further specifies diversion allocations of 6,000 acre-feet per year for irrigation, plus 22,000 acre-feet per year for “pondage,” resulting in a total allotment of up to 28,000 acre-feet per year. The Green River, which flows through the Refuge also provides average flows of 850 to 1,500 cfs from August to April (for the 1980 to 2007 period of record) with average flows in May to July ranging from 2,100 to 3,700 cfs as measured below Fontenelle Reservoir (USGS 2009).

Vegetation mapping indicates that about 452,000 acres of irrigated croplands are present in the Green River Basin and are comprised of row crops, alfalfa fields, irrigated native meadows, and orchards (WGA 2008). Comparison of the NWI wetland mapping with WGA vegetation mapping indicates that NWI wetlands include about 177,000 acres of irrigated land in the wetland mapping acreages. These areas likely include irrigated meadows that support wetland vegetation or other mesic grass and forb species on seasonally wet soils.

Riparian Areas

For purposes of this assessment, riparian areas are defined as areas occurring along the banks of rivers and streams and are generally characterized by a prevalence of hydrophytic vegetation, but may not meet other criteria for wetlands. WGA riparian mapping provides an indication of the amount of riparian habitat in the Green River Basin (Figure 2). The WGA was initiated in 1991 with the Biological Resource Division of the USGS and state, federal, and private natural resources groups in Wyoming (WGA 2008). WGA mapping describes land cover types, land management and stewardship status at a scale of 1:100,000. WGA separates riparian areas into forest-, grass-, and shrub-dominated riparian areas. Riparian vegetation in the Green River Basin totals about 758,007 acres. There is some overlap between areas mapped as wetlands by the NWI and riparian by WGA.

Riparian areas are of great importance on the local and regional landscape scales because they provide an important source of forage and cover and habitat diversity in arid environments for a variety of species. Riparian cover types that occur in small linear areas are likely be underrepresented in land cover data (WGA 2008). Dominant riparian species in the Green River Basin include cottonwood (*Populus* spp.), willow (*Salix* spp.), tamarisk (*Tamarisk chinensis*), spruce (*Picea* spp.), subalpine fir (*Abies lasiocarpa*), and maple (*Acer* spp.) (Dorn 2001). Greasewood (*Sarcobatus* spp.) is also common in flat areas around the margins of playas and in dry stream beds in the Green River Basin (WGA 2008).

WGA land use cover and vegetation mapping, which encompasses the entire Green River Basin, was used to provide an indication of the total area where water-dependent plant communities, irrigated agriculture, and open water is present. As indicated in Table 4, about 1.5 million acres in the Green River Basin rely on natural and irrigated sources of water, as well as natural and manmade impoundments.

Table 4 - Land Use Cover and Vegetation Types Dependent on Water in the Green River Basin

Land Cover Type	acres
Forest-dominated riparian	58,256
Grass-dominated riparian	200
Irrigated crops	452,018
Open water	61,164
Shrub-dominated riparian	699,551
Unvegetated playa	15,536
Wetlands (from WGA mapping)	236,108
TOTAL	1,522,833

Source: WGA 2008.

Threatened and Endangered Species

A. Federally Listed Species

Twenty plant and animal species are listed as threatened or endangered in the State of Wyoming (Service 2008b). Of the 20 species, six threatened and endangered species are potentially dependent on water sources in the Green River Basin. The six listed species potentially occur in Carbon, Lincoln, Sublette, Sweetwater, and Uinta counties (Service 2008b) (Table 5). Water-dependent threatened and endangered species are defined as species that spend more than one-half of their lives in water, shores, wetlands, or riparian areas. Of the listed threatened and endangered species, only two water-dependent threatened and endangered species—Kendall Warm Springs dace and Ute ladies'-tresses orchid—are known to occur in Wyoming. The Kendall Warm Springs dace is found in Sublette County in the Kendall Warm Springs. The Ute ladies'-tresses orchid is found in southwestern Wyoming along the base of the Rocky Mountains in wet meadows and wetlands. Four endangered fish species are located downstream of Flaming Gorge Reservoir as described below.

Table 5 - Federally Listed Threatened and Endangered Species Dependent on Water, Wetlands, and Riparian Areas in Carbon, Lincoln, Sublette, Sweetwater, and Uinta Counties

Common Name	Species Name	Status	Found	General Habitat
Bonytail	<i>Gila elegans</i>	E	Not known to occur in Wyoming*	Fast flowing waters
Colorado pikeminnow	<i>Ptychocheilus lucius</i>	E	Not known to occur in Wyoming*	Swift flowing muddy rivers with quiet, warm backwaters
Humpback chub	<i>Gila cypha</i>	E	Not known to occur in Wyoming*	Deep, fast moving, turbid waters
Kendall Warm Springs dace	<i>Rhinichthys osculus thermalis</i>	E	Sublette County in the Kendall Warm Springs	85°F spring water in Bridger-Teton National Park in Wyoming
Razorback sucker	<i>Xyrauchen texanus</i>	E	Not known to occur in Wyoming*	Deep, clear to turbid waters of large rivers
Ute ladies'-tresses orchid	<i>Spiranthes diluvialis</i>	T	Rocky Mountains in southwestern Wyoming	Riparian edges, gravel bars, old oxbows, high-flow channels, and moist to wet meadows along perennial streams

*Water depletions and effects to water quality in the Green River systems may affect the species and/or its designated critical habitat in downstream locations.

E – endangered.

T – threatened.

Source: Service 2008b.

There is no designated critical habitat for threatened or endangered species in Wyoming (Service 2008b). However, critical habitat for Colorado pikeminnow, razorback sucker,

bonytail, and humpback chub has been designated at downstream locations outside of Wyoming in the Yampa River from Craig, Colorado to the Green River, the White River from Rio Blanco Dam to the Green River, and the Green River from Dinosaur National Monument to Lake Powell (Service 2008b). Changes in Green River flows or water quality in Wyoming have the potential to impact downstream habitat for these endangered fish species. The Upper Colorado River Endangered Fish Recovery Program (UCREFRP) involves federal, state, and private organizations and agencies in Wyoming, Colorado, and Utah. Its objective is to recover endangered bonytail, Colorado pikeminnow, humpback chub, and razorback sucker, while providing for future water development for human use (UCREFRP 2008). The WSEO has participated in the UCREFRP since 1984. The UCREFRP provides Endangered Species Act compliance, which allows Wyoming to develop its water resources. This program is directed at the upper Colorado River Basin and includes the following rivers: Colorado, Gunnison, Dolores, White, Yampa, Little Snake, Green, Duchesne, Price, and San Rafael. Goals of the UCREFRP include:

- Acquiring and protecting adequate streamflows to re-create more natural flow patterns
- Improving the river habitat by modifying dikes, protecting habitat, and implementing river improvement projects
- Conducting research
- Managing nonnative fish populations
- Stocking endangered fish

B. State Listed Species

A number of animal species listed by the WNDD as species of concern in the State of Wyoming depend on water, shores, riparian areas, and wetlands for more than one-half of their lives. Water-dependent sensitive animal species that occur or potentially occur in Carbon, Lincoln, Sublette, Sweetwater, and Uinta counties are listed in Table 6.

Table 6 - Water-dependent Animals Listed as Species of Concern in Carbon, Lincoln, Sublette, Sweetwater, and Uinta Counties

Common Name	Species Name	Heritage Rank		General Habitat
Birds				
American bittern	<i>Botaurus lentiginosus</i>	G4	S3B	Tall, dense, emergent wetland vegetation
American white pelican	<i>Pelecanus erythrorhynchos</i>	G3	S1B	Open nonvegetated islands near lakes
Bald eagle	<i>Haliaeetus leucocephalus</i>	G4	S3B/S5N	Forested habitat near lakes
Black tern (breeding colonies)	<i>Chlidonias niger</i>	G4	S1	Dense stands of emergent wetland vegetation
Black-billed cuckoo	<i>Coccyzus erythrophthalmus</i>	G5	S2	Cottonwood riparian areas
Caspian tern	<i>Sterna caspia</i>	G5	S1	Inland lakes, rivers, marshes
Clark's grebe	<i>Aechmophorus clarkii</i>	G5	S1B	Tall emergent wetland vegetation near large lakes
Common loon	<i>Gavia immer</i>	G5	S1B/S2N	Shallow water with emergent vegetation near small lakes

Common Name	Species Name	Heritage Rank		General Habitat
Forster's tern	<i>Sterna forsteri</i>	G5	S1	Marshes and aquatic areas
Harlequin duck	<i>Histrionicus histrionicus</i>	G4	S1B	Dense streamside shrubs
Long-billed curlew	<i>Numenius americanus</i>	G5	S3B	Moist meadows usually near water
Snowy plover	<i>Charadrius alexandrinus</i>	G4	SA	Cottonwood riparian areas
Trumpeter swan	<i>Cygnus buccinator</i>	G4	S2	Shallow marshes, ponds, lakes, river oxbows
White-faced ibis	<i>Plegadis chihi</i>	G5	S1B	Marshes, wet meadows, lakes, irrigated meadows
Yellow-billed cuckoo	<i>Coccyzus americanus</i>	G5	S1	Riparian obligate species
Amphibians				
Boreal western toad	<i>Bufo boreas boreas</i>	G4	T1/S1	Beaver ponds, reservoirs, streams, marshes, wet meadows
Northern leopard frog	<i>Rana pipiens</i>	G5	S3	Wetlands, ponds, streams, marshes, wet meadows
Columbia spotted frog	<i>Rana luteiventris</i>	G4	S3	Subalpine forests near water
Wood frog	<i>Rana sylvatica</i>	G5	S1	Beaver ponds, slow moving streams, small lakes, wetlands
Mammals				
Preble's meadow jumping mouse	<i>Zapus hudsonius preblei</i>	G5	T2/S1	Riparian areas with tall cottonwood stands and dense underbrush
Fisher	<i>Martes pennanti</i>	G5	S1	Forests and cottonwood-riparian areas
River otter	<i>Lontra canadensis</i>	G5	S3	Permanent rivers, aquatic, riparian areas
Fish				
Leatherside chub	<i>Gila copei</i>	G3G4	S1	Deep pools in medium-sized streams
Roundtail chub	<i>Gila robusta</i>	G3	S3	Green and Little Snake rivers, small streams and lakes
Hornyhead chub	<i>Nocomis biguttatus</i>	G5	S1	Medium-sized to large clear, gravel-bottomed streams
Kendall Warm Springs dace	<i>Rhinichthys osculus thermalis</i>	G5	T1/S1	Warm spring tributary to the Green River
Bluehead sucker	<i>Catostomus discobolus</i>	G4	S3	Streams with strong currents, muddy streams
Flannelmouth sucker	<i>Castostomus latipinnis</i>	G3G4	S3	Large rivers, smaller streams, lakes in Green and Little Snake river drainages
Yellowstone cutthroat trout	<i>Oncorhynchus clarki bouvieri</i>	G4	S2	Lakes, large rivers, small tributary streams
Fine-spotted Snake River cutthroat trout	<i>Oncorhynchus clarki spp. 2</i>	G4	T1Q/S1	Lakes, reservoirs, large rivers
Colorado River cutthroat trout	<i>Oncorhynchus clarki pleuriticus</i>	G4	T2/S1	Green River, Black's Fork and Little Snake River enclaves

Common Name	Species Name	Heritage Rank		General Habitat
Bonneville cutthroat trout	<i>Oncorhynchus clarki utah</i>	G4	T2/S1	Gravel-bottomed creeks, small rivers, lakes
<p>G = Global rank assigned by NatureServe: range-wide probability of extinction for a species. T = Trinomial rank: refers to the range-wide probability of extinction for a subspecies or variety. S = State rank assigned by WNDD biologists: probability of extinction from Wyoming. These letters are each followed by a numeric 1–5 score: 1 = Critically imperiled because of extreme rarity (often <5 extant occurrences) or because some factor makes it highly vulnerable to extinction. 2 = Imperiled because of rarity (often 6–20 extant occurrences) or because of factors making it vulnerable to extinction. 3 = Rare or local throughout its range or found locally in a restricted range (often 21–100 known occurrences). 4 = Apparently secure, although it may be quite rare in parts of its range, especially at the periphery. 5 = Demonstrably secure, although it may be rare in parts of its range, especially at the periphery. Some taxa receive nonnumeric scores, indicating special situations: A = Accidental or vagrant: taxon appears irregularly and infrequently. X = Believed to be extinct. Some taxa may also receive rank modifiers, indicating other special situations: B = Breeding rank: indicates the status of a migratory species during the breeding season; applied only to animals. N = Nonbreeding rank: indicates the status of a migratory species during the nonbreeding season; applied only to animals. Q = Questions exist regarding the taxonomic validity of a species, subspecies, or variety. Source: WGFD 2008b; WNND 2008.</p>				

The Colorado River cutthroat trout is of particular concern because it is the only native trout present in the Green River and Little Snake River drainages. The Colorado River cutthroat trout prefers cold, clear water in relatively steep drainages with a rock bottom (NatureServe 2009). Maintaining pure populations is challenging because of hybridization with rainbow trout and other cutthroat trout, and competition with nonnative brook trout. Habitat loss, fragmentation, and degradation are also concerns. The WGFD comprehensive management and enhancement plan for the Colorado River cutthroat trout was developed to protect this species and prevent listing as an endangered species (WGFD 1987). On June 13, 2007, the Service determined that listing the Colorado River cutthroat trout as threatened or endangered under the Endangered Species Act was not warranted. The WGFD has been actively working to restore habitat for the species in the LaBarge Creek drainage and in the headwaters of the Little Snake River on the west slope of the Sierra Madres (WGFD 2009a, 2009b). In addition, High Savery Reservoir is managed by the WGFD as a Colorado cutthroat trout brood stock for use in stocking all cutthroat restoration waters in the Little Snake River watershed, as well as an opportunity to fish for the native cutthroat trout (WGFD 2008c). The WGFD and WWDC also are working together to promote suitable habitat conditions for a recreation sport fishery in the tailwater of Savery Creek immediately downstream of the reservoir.

The WNDD lists 460 plant species of concern in the State of Wyoming. Of those sensitive plants listed, 32 species are listed as facultative wetland or obligate wetland (USDA, NRCS 2008) and potentially occur in Carbon, Lincoln, Sublette, Sweetwater, and Uinta counties (Table 7). Facultative wetland species are plants that typically occur in wetlands (estimated probability 67% to 99%), but occasionally are found in non-wetlands (USDA, NRCS 2008). Obligate wetland plants almost always occur (estimated probability 99%) in wetlands. These

wetland plant species are dependent on the various water sources in the Green River Basin that contribute to providing suitable habitat.

Table 7 - Facultative and Obligate Wetland Plants Listed as Species of Concern in Carbon, Lincoln, Sublette, Sweetwater, and Uinta Counties

Species Name	Common Name	Wetland Indicator Status (Region 9 or National)	Heritage Rank	
<i>Antennaria arcuata</i>	Box pussytoes	FACW	G2	S2
<i>Astragalus leptaleus</i>	Park milkvetch	OBL	G4	SH
<i>Astragalus paysonii</i>	Payson's milkvetch	FACW	G3	S2
<i>Carex diandra</i>	Lesser panicled sedge	OBL	G5	S1S2
<i>Carex limosa</i>	Mud sedge	OBL	G5	S2
<i>Carex livida</i>	Livid sedge	OBL	G5	S2
<i>Carex microglochin</i>	Fewseeded bog sedge	FACW+	G5	S2
<i>Downingia laeta</i>	Great Basin calicoflower	OBL	G5	S1
<i>Eriophorum scheuchzeri</i>	White cottongrass	OBL	G5	S2
<i>Juncus filiformis</i>	Thread rush	FACW+	G5	S2
<i>Juncus vaseyi</i>	Vasey's rush	FACW	G5	S1
<i>Ligusticum tenuifolium</i>	Idaho licorice-root	FACW	G5	S1?
<i>Lipocarpa drummondii</i>	Drummond's halfchaff sedge	FACW	G4G5	S1
<i>Lomatogonium rotatum</i>	Marsh felwort	OBL	G5	S2
<i>Muhlenbergia glomerata</i>	Spiked muhly	FACW+	G5	S2
<i>Najas guadalupensis</i>	Southern waternymph	OBL	G5	S1
<i>Phippisia algida</i>	Icegrass	OBL	G5	S1
<i>Porterella carnosula</i>	Fleshy porterella	OBL	G4	S1
<i>Potamogeton amplifolius</i>	Largeleaf pondweed	OBL	G5	S1
<i>Potamogeton friesii</i>	Fries' pondweed	OBL	G4	S1
<i>Potamogeton illinoensis</i>	Illinois pondweed	OBL	G5	S1
<i>Potamogeton nodosus</i>	Longleaf pondweed	OBL	G5	S1
<i>Potamogeton robbinsii</i>	Robbins' pondweed	OBL	G5	S1
<i>Potamogeton strictifolius</i>	Narrowleaf pondweed	OBL	G5	S1?
<i>Primula egaliksensis</i>	Greenland primrose	FACW	G4	S1
<i>Psilocarphus brevissimus</i>	Short woollyheads	FACW+	G4	S2
<i>Ranunculus flabellaris</i>	Yellow water buttercup	OBL	G5	SH
<i>Salix candida</i>	Sageleaf willow	OBL	G5	S2
<i>Selaginella selaginoides</i>	Club spikemoss	FACW+	G5	S1
<i>Sparganium natans</i>	Small bur-reed	OBL	G5	S2
<i>Trichophorum pumilum</i>	Rolland's bulrush	FACW	G3Q	S1
<i>Utricularia minor</i>	Lesser bladderwort	OBL	G5	S2

G = Global rank assigned by NatureServe: range-wide probability of extinction for a species.

S = State rank assigned by WNDD biologists: probability of extinction from Wyoming.

These letters are each followed by a numeric 1–5 score:

1 = Critically imperiled because of extreme rarity (often <5 extant occurrences) or because some factor makes it highly vulnerable to extinction.

2 = Imperiled because of rarity (often 6–20 extant occurrences) or because of factors making it vulnerable to extinction.

3 = Rare or local throughout its range or found locally in a restricted range (often 21–100 known occurrences).

4 = Apparently secure, although it may be quite rare in parts of its range, especially at the periphery.

5 = Demonstrably secure, although it may be rare in parts of its range, especially at the periphery.

Some taxa receive nonnumeric scores, indicating special situations:

H = Known only from historical records (typically pre-1970; varies by taxon).

Some taxa may also receive rank modifiers, indicating other special situations:

Q = Questions exist regarding the taxonomic validity of a species, subspecies, or variety.
 ? = Questions exist regarding the assigned numeric score.
 Wetland indicator status (Region 9 or National).
 OBL = Obligate Wetland - Occurs almost always (estimated probability 99%) under natural conditions in wetlands.
 FACW = Facultative Wetland - Usually occurs in wetlands (estimated probability 67%–99%), but occasionally found in nonwetlands.
 A positive (+) or negative (-) sign is used with the Facultative Indicator categories to more specifically define the regional frequency of occurrence in wetlands. The positive sign indicates a frequency toward the higher end of the category (more frequently found in wetlands), and a negative sign indicates a frequency toward the lower end of the category (less frequently found in wetlands).
 Source: WNND 2008.

Water-Dependent Wildlife Species and Wildlife Consumption

Animals such as the 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 are just a few of the water-dependent species in the Green River Basin. Habitat for wildlife species in the Green River Basin is an important component of water needs and includes areas such as open water, riparian, shores, and wetlands. Wetland and riparian mapping for the Green River Basin (Figure 1 and Figure 2) provides an indication of the land cover and vegetation types that support aquatic and water-dependent wildlife habitat. Riparian areas, open water, playa, and wetlands provide important habitat that supports water-dependent wildlife species. In addition, irrigated agricultural lands, streams, and reservoirs provide habitat for wildlife. A total of about 1.5 million acres of land in the Green River Basin rely on water from streams, reservoirs, and irrigation to support a variety of environmental water needs (Table 4).

Direct consumption of water by wildlife represents an additional environmental water use in the Green River Basin. The largest water users include elk, mule deer, antelope, and other big game species, although consumptive water use also occurs for smaller mammals, birds, and other species. Quantifying consumptive water use is challenging because of the uncertainties about wildlife population and specific animal water needs. Previous investigations (States West 2001) have estimated direct wildlife water consumption in the Green River Basin is likely around 400 acre-feet per year. In relation to other water uses in the Green River Basin, direct wildlife consumption is a minor, but important component of overall water use.

Benefits of Environmental Water Uses

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. Environmental water supplies are also critical to the support of popular recreation activities such as fishing, hunting, and wildlife viewing that depend on suitable habitat for fish and wildlife populations. These outdoor recreational pursuits provide an important economic contribution to the Green River Basin. In addition, the overall health of

the environment and the ecological integrity of the Green River Basin is linked to sufficient water resources to maintain ecological functions.

Competition with Other Uses

Environmental water uses in the Green River Basin can conflict with other water uses because of the competition for limited water supplies. In general, these impacts usually stem from competing uses for surface water supplies (rivers, streams, and lakes). Stream diversions and the use of surface water supplies for agricultural, industrial, or municipal uses affect the quality and availability of water to support fish and the aquatic life ecosystem. Reductions in streamflow can affect the quality of water by increasing temperatures and concentrations of constituents deleterious to aquatic life. Lower streamflows also can impact the composition and distribution of wetland and riparian habitats that is critical to amphibians, birds, waterfowl, and mammals in an arid environment. Likewise, substantial reductions or fluctuations in surface water levels on reservoirs can impact the amount and quality of water to support fish and angling.

Government Policies Affecting Environmental Water Use

Much of the current environmental water use in the Green River Basin is incidental to other water uses or nonregulated sources of water available to support fish, wildlife, and the associated vegetation communities and aquatic habitat. Available streamflow to support fish and wildlife are dependent on existing water rights, diversions, and in some locations, minimum instream flow water rights. It is likely that in the future, more applications for instream flow rights will be requested to protect important river reaches. Environmental water use of reservoirs is generally secondary to other primary water storage rights and this is expected to remain the same in the future. Water-dependent threatened and endangered species are protected under the Endangered Species Act; therefore, changes in operation of current water resource facilities or future developments would be subject to review. Wetlands are currently protected under the Clean Water Act and any activities that require the dredging or filling of wetlands are subject to permitting and mitigation requirements. However, activities that change the hydrology of an area without requiring dredging or filling, are not subject to review under the Clean Water Act and could impact wetlands or riparian habitat. Any new developments with federal involvement would require environmental review under the National Environmental Policy Act to determine potential effects to environmental resources including those of water-dependent plants and animals.

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Figure 1. Greater Green River Basin National Wetland Inventory Mapping

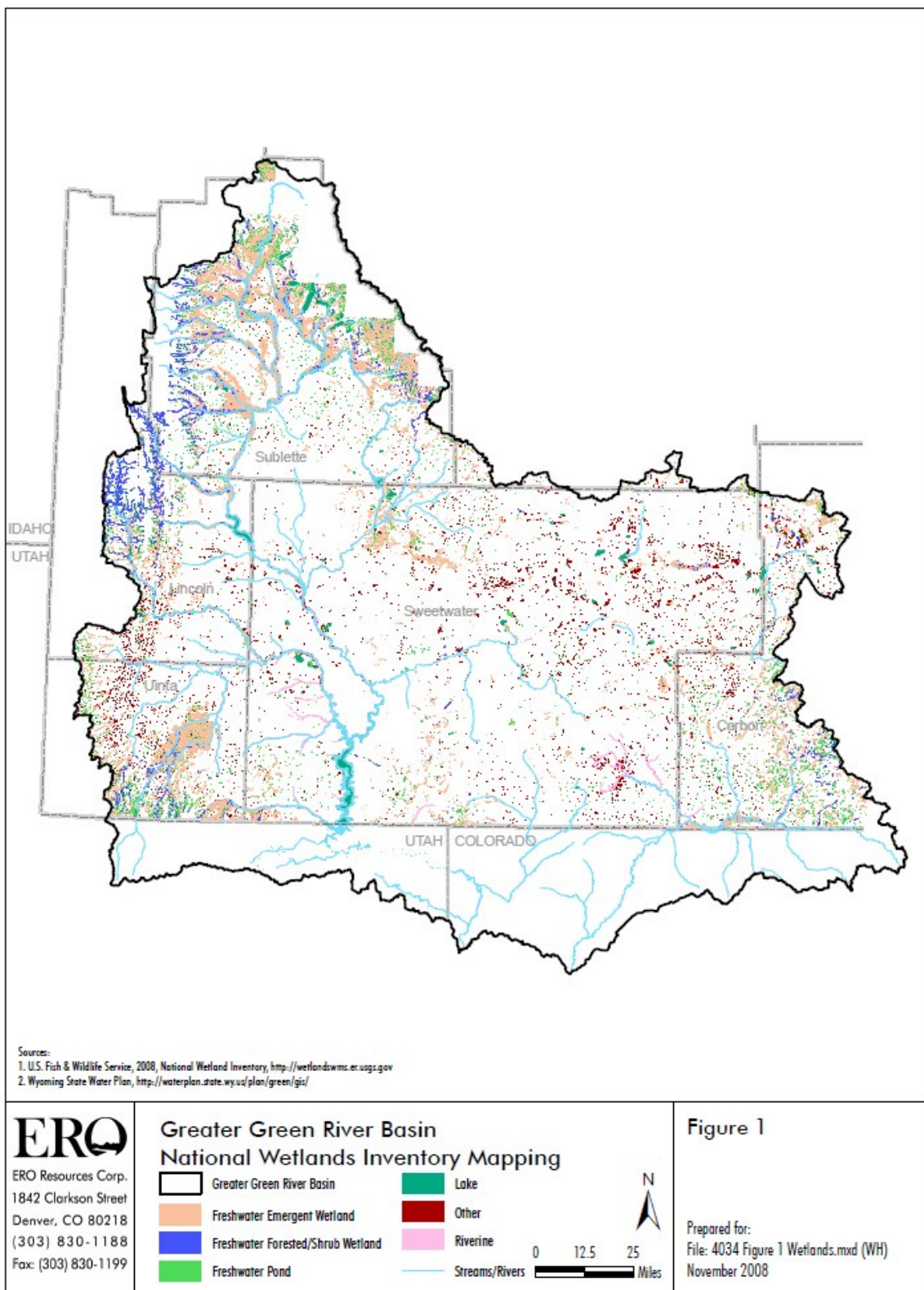


Figure 2. Greater Green River Basin Riparian Areas

