

BRUSH CREEK WATERSHED MANAGEMENT PLAN



Town of Eagle

April 18, 2011

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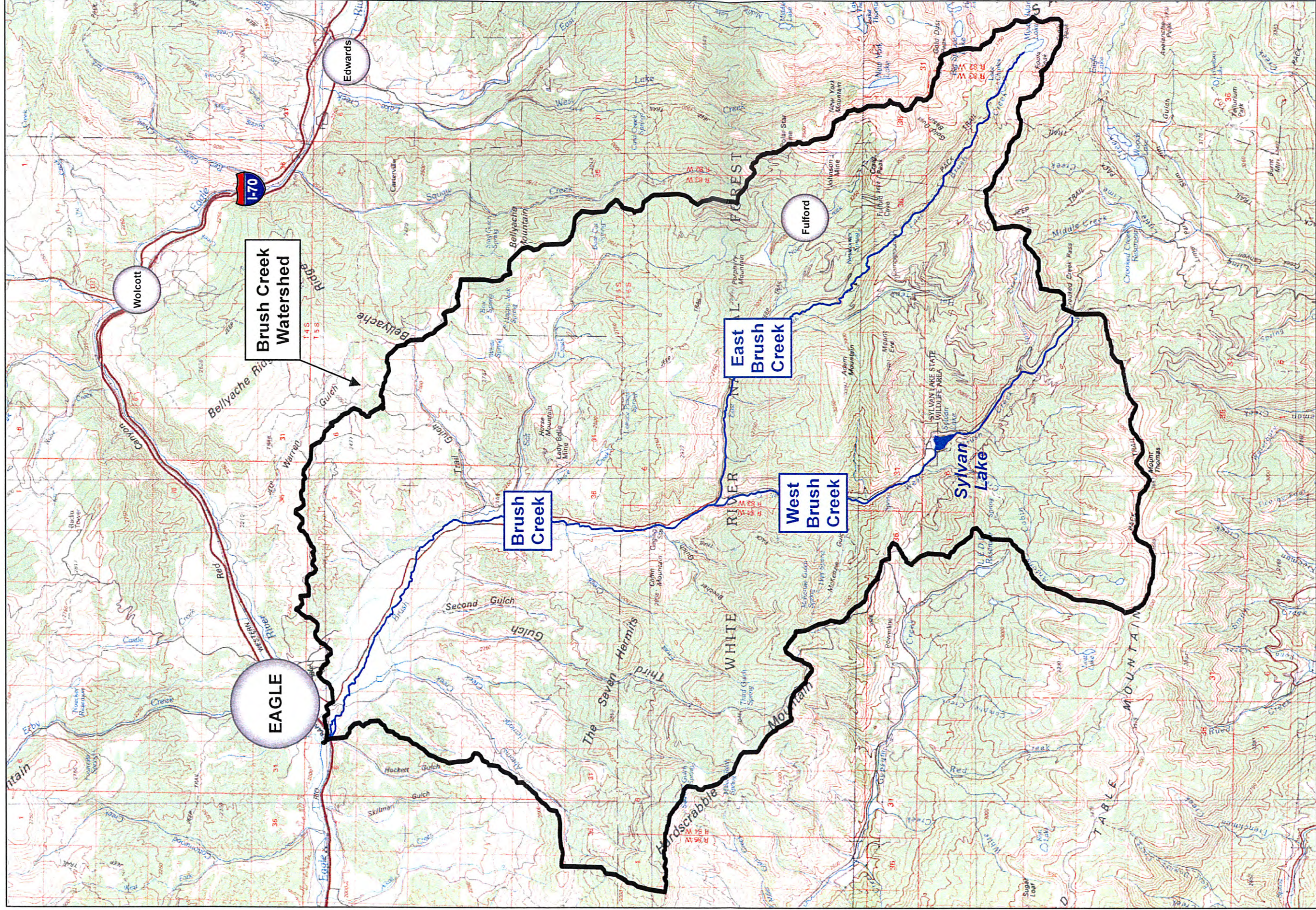
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1.0 INTRODUCTION

The Town of Eagle is situated in the lower Brush Creek watershed near its confluence with the Eagle River. The watershed gives rise to Brush Creek, a high quality mountain stream that provides essential municipal, domestic and agricultural water supplies to area residents. The 145 square mile basin ranges in elevation of from 13,360 feet in its headwaters region to 6,520 feet near the Town. The watershed is ecologically diverse and supports a variety of indigenous plant and wildlife species. This diversity creates an attractive residential setting and provides Town residents with recreational opportunities including; fishing, hiking, biking and hunting. In 1999, in recognition of this important asset, the Town of Eagle initiated development of a watershed management plan for the Brush Creek watershed for the purpose of protecting the basin's water quality and quantity. The Brush Creek watershed and its relationship to the Town of Eagle is shown on the Vicinity Map in **Figure 1**.

In the initial management plan for the Brush Creek watershed, the Town developed a set of strategies to conserve water, reduce stream diversions and protect the Brush Creek riparian corridor. This initial plan, however, was never finalized and remained in draft format for several years. In 2006, as part of efforts to revise the Town of Eagle's Community Plan, the Town reinitiated its interests in establishing a Brush Creek Management Plan. The Community Plan is a public process that addresses important issues and makes decisions regarding growth, transportation and the protection of natural resources surrounding the Town. The public process included the completion of surveys, participation in public meetings, coordination with Eagle County and appurtenant planning documents. The effort culminated in a document entitled *2010 Eagle Area Community Plan*. This document reflects the local residents' vision of the Town and surrounding area including the Brush Creek watershed. With respect to natural resources, the plan makes clear the citizen's goals to maintain Brush Creek's distinctive environmental diversity and aquatic environment. In response to this directive, the Town reinitiated efforts to complete its Brush Creek Watershed Management Plan.

The Brush Creek Watershed Management Plan is organized into 6 sections. This introductory section is followed by Sections 2.0 and 3.0, which provide a brief summary of the Brush Creek watershed and existing influences on the basin's water resources. Section 4.0 then describes the Town's goals, objectives and management direction for the Brush Creek watershed, while Section 5 outlines the specific policies and management strategies designed to meet these goals. The management plan concludes with Section 6.0, which highlights the Town's continued commitment to protecting and maintaining the Brush Creek watershed.



Source: USGS 100k Maps

Figure 1
Vicinity Map of Brush Creek Watershed
Brush Creek Watershed Management Plan

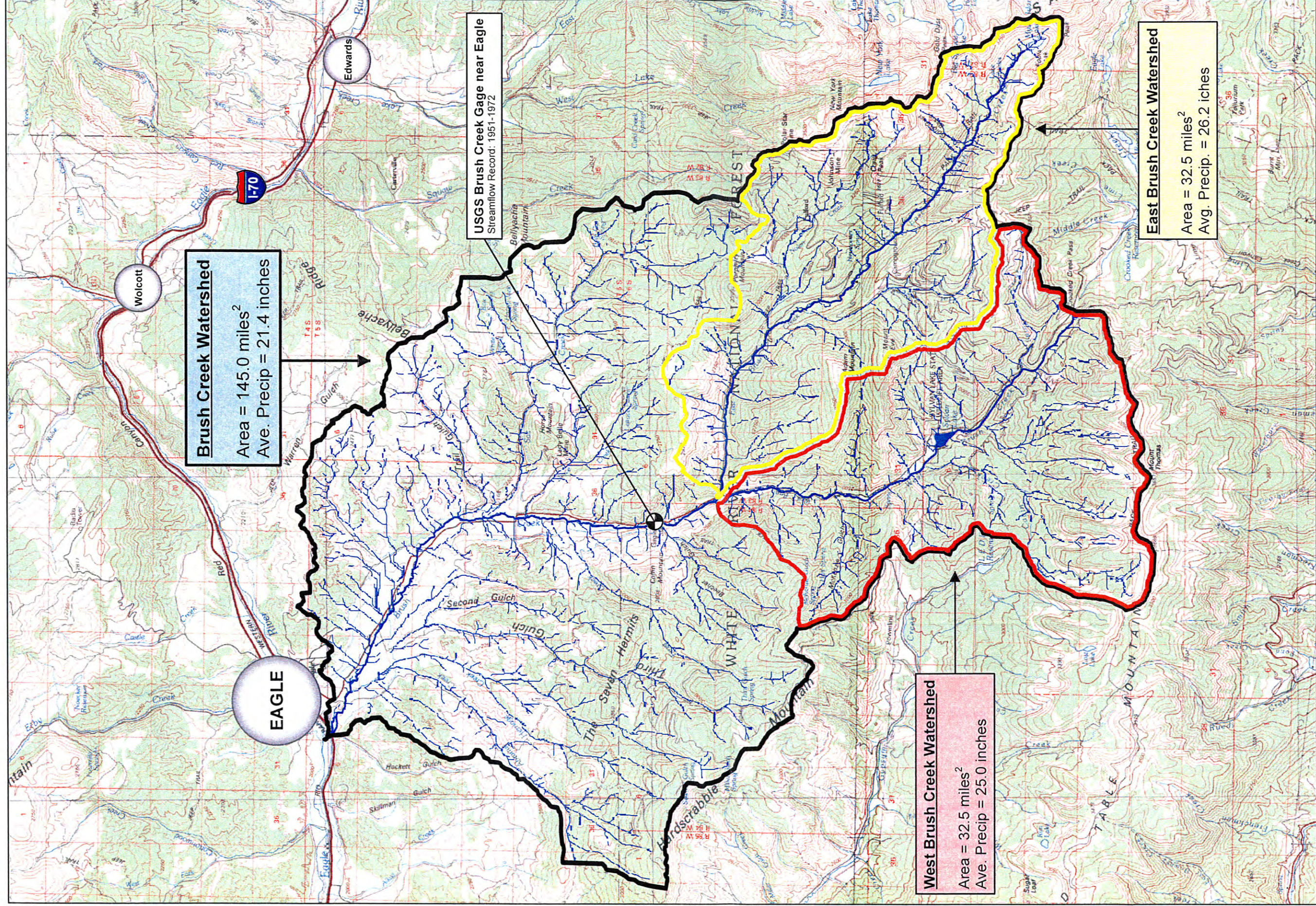


2.0 BRUSH CREEK WATERSHED

Annual precipitation across the Brush Creek watershed varies from over 30 inches in the headwaters region to less than 15 inches near the Town of Eagle. Overall, the watershed has an average annual precipitation of approximately 21.4 inches. The stream network that collects this water supply through the East Brush Creek watershed, the West Brush Creek watershed, and the encompassing Brush Creek watershed is shown on the Hydrology Map in **Figure 2**. The higher elevation, wetter regions of East and West Brush Creek consist of spruce-fir forest intermixed with stands of aspen, while the lower elevation regions generally consist of sagebrush and oak communities with areas of irrigated agriculture land. Land ownership in the higher elevation region consists mainly of National Forest lands combined with a small mix of private and State lands. In the lower elevation region, land ownership is dominated by Bureau of Land Management (BLM) and private lands. Basin wide, federal/state property comprises 82.8% of the watershed. This ownership distribution is shown on the Land Use Map in **Figure 3**.

Brush Creek is underlain with a diverse variety of geologic formations that influence overall surface and ground water quality. The geology varies from relatively resistant sandstones in the basin's headwaters to softer sediments and gypsum formations near the Town of Eagle. Specifically, the higher elevation regions are dominated by interblended sandstones, siltstones and conglomerates of the Maroon, State Bridge and Chinle formations. In lower elevation regions, the basin is underlain by the Eagle Valley Evaporite formation and gravel deposits from historic Brush Creek streamflows. The Eagle Valley Evaporite formation is highly erodible and contains soluble gypsum (CaSO_4) and halite (NaCl), commonly referred to as rock salt. Streams passing through evaporites exhibit higher levels of total dissolved solids (TDS). Moreover, the water diverted for agricultural purposes infiltrates through porous terrace gravels and comes in contact with the underlying evaporates, which significantly increases the salinity of the irrigation return flows that accrue to Brush Creek.

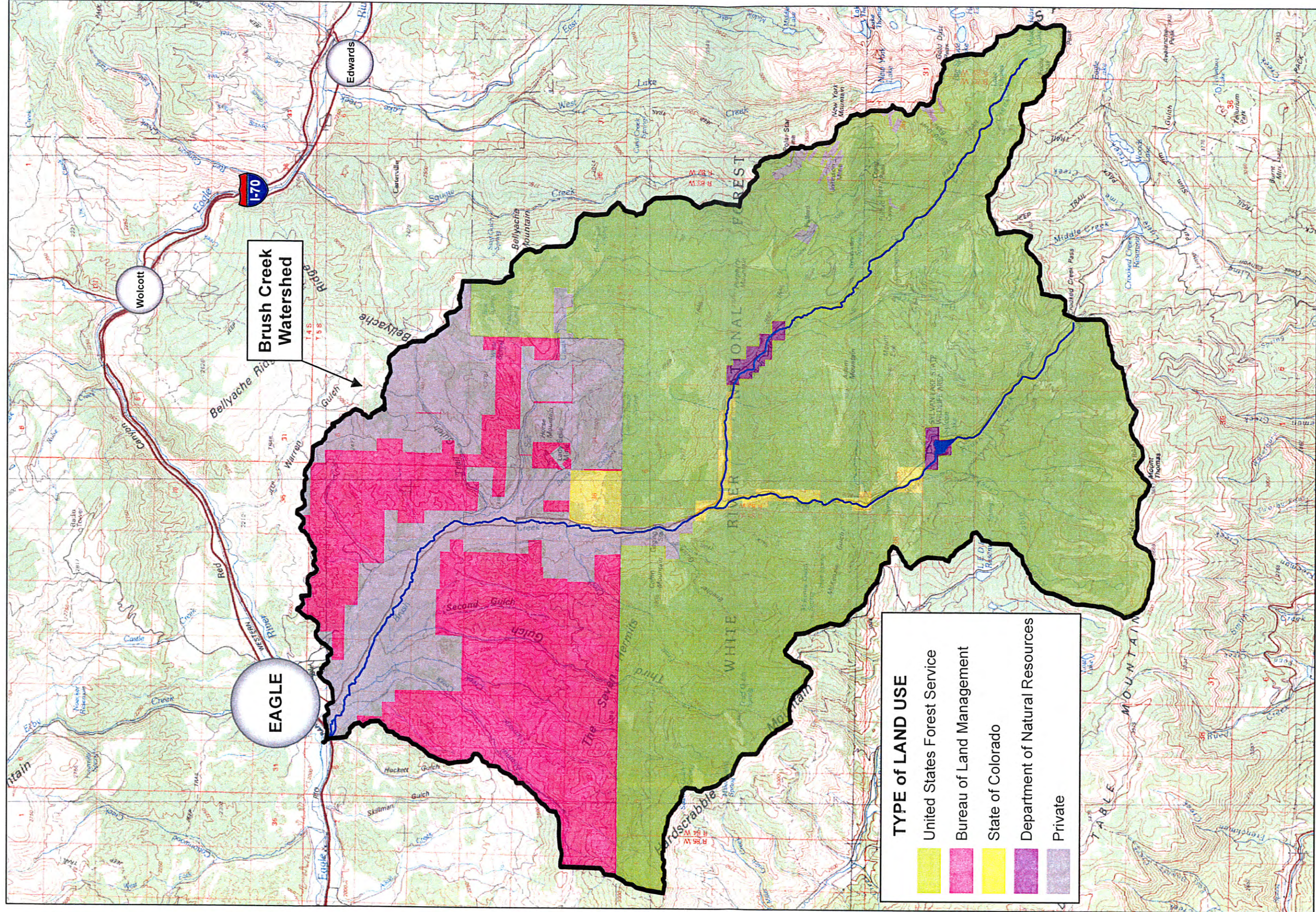
The diminishment of Brush Creek water quality was first documented in a 1975 study completed for the Colorado Department of Health by Mark Wuerthale. Wuerthale concluded that the water quality of Brush Creek generally decreased in the lower reaches. The study indicated that stream parameters such as, hardness, sulfates, conductivity and TDS increased approximately two fold from upstream to downstream positions.



Source: USGS 100k Map

Figure 2
Hydrology Map of Brush Creek Watershed
Brush Creek Watershed Management Plan





TYPE of LAND USE

 United States Forest Service
 Bureau of Land Management
 State of Colorado
 Department of Natural Resources
 Private

Source: USGS 100k Maps

Figure 3
Land Use Map within the Brush Creek Watershed
 Brush Creek Watershed Management Plan

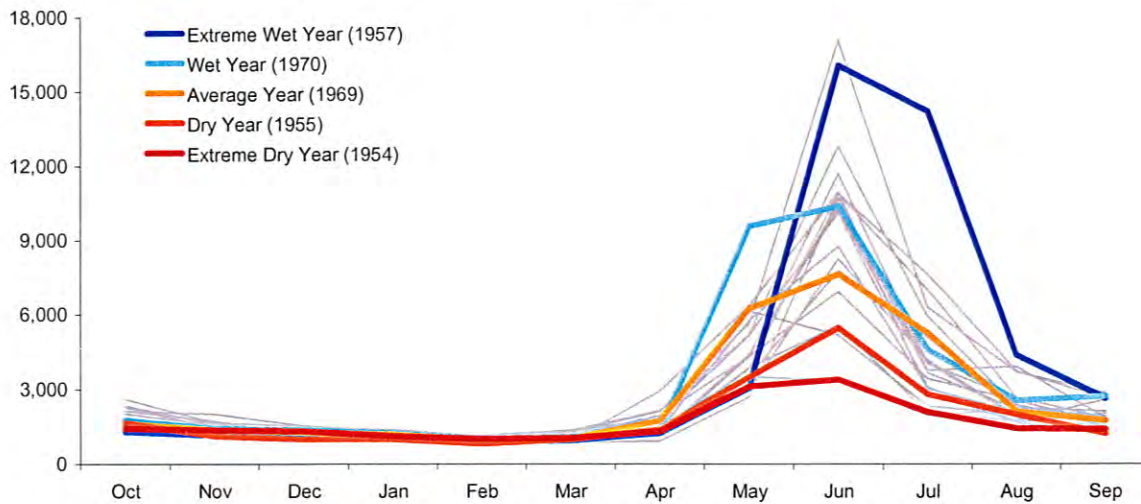


Despite these differing geologic types and associated influences, the overall water quality of Brush Creek is relatively high. The Colorado Department of Public Health and Environment (CDPHE) has classified Brush Creek as Aquatic Life Cold 1, Recreation 2, Water Supply and Agriculture. Generally, the State considers these waters capable of sustaining a wide variety of cold water biota and suitable for potable water supplies after receiving standard treatment methods.

Brush Creek streamflows exhibit run-off patterns typical of high elevation mountain watersheds. The streamflows are highest during the spring and early summer in response to melting snowpack followed by lower flows over the late summer and fall seasons. Streamflows reach minimum levels during the winter when most of the water is derived from ground water sources. The volume and distribution of typical streamflow patterns on Brush Creek can be illustrated through the review of historic gage records. The U.S. Geological Survey (USGS) maintained continuous streamflow records on Brush Creek at a location approximately 1.2 miles downstream from the confluence of East Brush Creek and West Brush Creek. The records begin in 1951 and continue for a period of 22 years, ending in 1972. This 22 year period of record contains a variety of water years (dry, average, and wet), and therefore, adequately represents the annual volume and seasonal distribution that is typical seen in Brush Creek. At the mid-valley location of the gage site, the Brush Creek watershed annually produces an average volume of 31,960 acre feet (AF). Seasonally, streamflows vary from an average of 156 cubic feet per second (cfs) in June to an average of 18 cfs during the winter. Peak daily flows during the spring runoff can exceed 450 cfs.

As mentioned above, the 22 year period of record on Brush Creek contains annual water yield totals representative of wet, average, dry and critically dry years. Throughout Colorado, the mid-1950s are commonly considered an extremely dry period, comparable to the recent drought of the early 2000s. The statewide drought sequence of the 1950s ended with a record setting wet year in 1957. Both of these events are seen in the Brush Creek record. The 1957 water yield of 48,120 AF is the wettest on record and is 51% greater than the average over the 22 year study period. Conversely, the driest years on record totaled 20,070 AF in 1954 and 27,950 AF in 1955. These streamflow volumes represent 63% and 72% respectively of the 22 year streamflow average. Generally, a dry year is defined as one that would occur on average, one year in 20. A critically dry year is defined as one that would occur on average, one year in 50. Understanding the streamflow and aquatic conditions associated with dry and critically dry years is a key component for watershed management planning. The annual hydrographs and monthly streamflow data over the 22 year record is summarized in **Figure 4**.

Figure 4
Annual Hydrographs and Streamflow Summary of Brush Creek
USGS Brush Creek Gage: 1951-1972
(acre-feet)



Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Percent	
													Total	Avg
1951	1,787	1,430	1,317	1,152	918	990	1,309	3,546	7,781	5,074	2,382	1,676	29,364	92%
1952	1,509	1,458	1,345	1,301	1,073	1,275	2,130	5,665	17,056	6,298	3,707	2,846	45,664	143%
1953	2,027	1,581	1,371	1,234	1,045	1,148	1,232	4,344	10,439	4,050	2,606	1,396	32,474	102%
1954	1,444	1,365	1,319	1,129	1,000	1,045	1,319	3,126	3,400	2,095	1,434	1,394	20,089	63%
1955	1,654	1,131	990	998	811	992	1,386	3,501	5,486	2,809	1,982	1,210	22,949	72%
1956	1,222	1,244	1,262	1,222	873	1,025	1,466	5,792	8,761	3,021	2,077	1,232	29,195	91%
1957	1,299	1,162	1,154	1,055	895	958	1,258	3,074	16,035	14,208	4,395	2,626	48,120	151%
1958	2,128	2,015	1,533	1,295	1,087	1,109	1,226	6,351	10,951	2,864	1,644	1,275	33,479	105%
1959	1,256	1,214	1,208	1,158	988	1,083	1,254	4,429	10,241	3,675	2,198	1,561	30,264	95%
1960	2,152	1,720	1,095	1,083	1,075	1,178	1,952	4,372	11,697	4,070	1,859	1,488	33,739	106%
1961	1,656	1,450	1,269	1,224	1,083	1,059	1,111	3,852	5,590	2,017	1,738	2,590	24,639	77%
1962	2,279	1,452	1,077	1,077	908	944	2,942	6,379	10,897	7,004	2,672	1,843	39,474	123%
1963	1,763	1,575	1,285	1,242	982	1,178	1,361	3,517	3,356	1,960	2,190	1,922	22,330	70%
1964	1,291	1,148	1,010	928	899	946	1,137	4,346	6,936	3,439	2,551	1,640	26,271	82%
1965	1,406	1,216	1,150	1,119	899	986	1,281	3,886	10,893	7,625	3,747	2,622	36,830	115%
1966	2,600	1,668	1,523	1,309	1,063	1,246	1,783	6,169	5,191	2,321	1,999	1,313	28,186	88%
1967	1,414	1,244	1,129	928	853	1,025	1,351	2,969	8,257	4,173	1,926	1,849	27,118	85%
1968	1,450	1,123	1,035	922	793	883	924	2,719	10,689	3,771	3,931	1,843	30,084	94%
1969	1,628	1,363	1,260	1,196	962	1,020	1,753	6,252	7,638	5,274	2,108	1,749	32,204	101%
1970	1,779	1,426	1,353	1,236	976	1,081	1,386	9,574	10,370	4,604	2,551	2,731	39,067	122%
1971	2,327	1,595	1,230	1,144	1,170	1,357	2,150	5,221	12,794	5,945	2,273	2,126	39,331	123%
1972	1,755	1,414	1,480	1,375	1,123	1,365	1,795	5,189	10,120	3,084	1,676	2,031	32,406	101%
Avg	1,720	1,409	1,245	1,151	976	1,086	1,523	4,740	9,299	4,517	2,438	1,862	31,966	100%

Notes:

The highlighted years were chosen to represent each "year-types" of a five level classification developed by RESOURCE and based on a distribution of the percent annual average values.

Year Type	Distribution		
Extreme Dry	<=	65%	
Dry	btw	66%	85%
Average	btw	86%	114%
Wet	btw	115%	134%
Extreme Wet	=>	135%	

3.0 WATERSHED INFLUENCES

Throughout the history of the Brush Creek Valley, various activities have adversely impacted the watershed basin and associated stream systems. These activities include; agricultural diversions, municipal diversions and the development of roads and urban environments. Both agricultural and municipal diversions are depletive to the stream system, and the runoff from agricultural irrigation diminishes the water quality. The development of roads and urban areas also has potential to diminish the water quality. The following subsections describe these effects in more detail.

3.1 Agricultural Diversions

Historically, Brush Creek streamflows have been significantly reduced due to surface water diversions through agricultural headgate structures located throughout the Brush Creek valley. Numerous irrigation operations divert large volumes of water to serve hundreds of acres of hay and pasture lands. The diversions are of such magnitude that during dry year conditions, Brush Creek has been completely dewatered within certain reaches below the headgate of major diversion structures. Irrigation return flow and tributary inflow help to restore a portion of the streamflows downstream; however, these flows are subject to diversion and are often relied upon by downstream diverters.

Some of the major agricultural diversions that have influenced Brush Creek include: the Upper Frost Ditch, the Frost Ditch, the McKenzie Ditch, the Hollingsworth-Potter Ditch, the Love and White Ditch, the Wilkinson Ditch, the Mathews Ditch, the Hernage Ditch, the Squire and Hammond Ditch and the CKP Ditch. The location of these agricultural diversions is shown on the Water Rights Map in **Figure 5**.

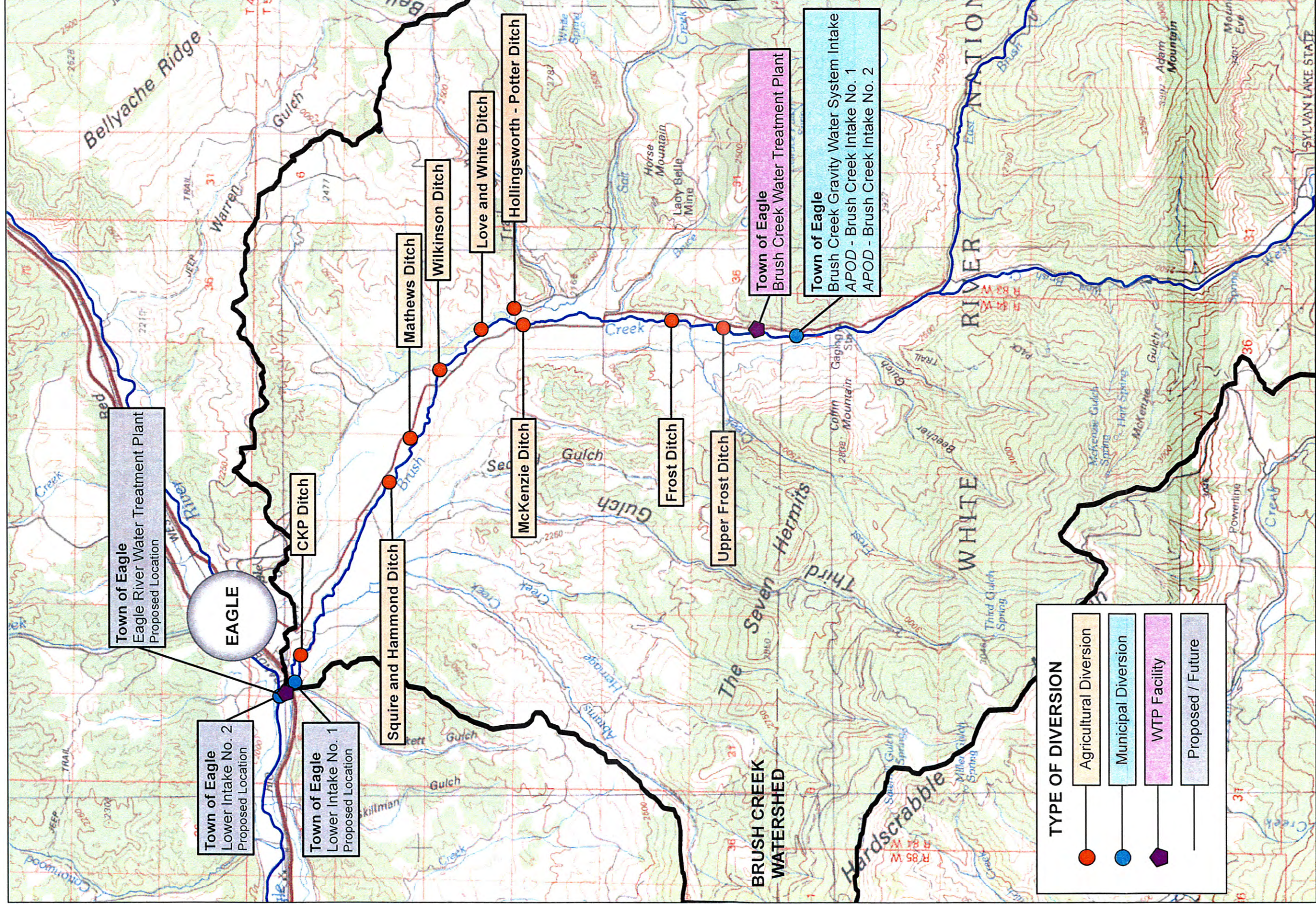
In addition to influencing the quantity of water in Brush Creek, these agricultural diversions potentially degrade the quality of the streamflows. As shown on the Water Rights Map in **Figure 5**, many of the major ditch headgate structures are located in the mid to upper portion of Brush Creek. As mentioned above, the streamflow in this upper region is derived from areas underlain by the resistant sediment formation and is therefore of higher quality. Diverting this higher quality water at upstream locations reduces the amount available to mix with and dilute the poorer quality downstream water derived from the soft Eagle Valley Evaporite formation.

3.2 Municipal Diversions

In the early 1970's the Town of Eagle constructed a municipal diversion structure and water treatment plant on Brush Creek located below the Matthew's Ditch headgate. Then in the early 1980's the water treatment capacity was increased and the plant was moved upstream to a location approximately 7.2 miles south of Town. Most recently, in the early 2000's a pretreatment system was added to meet stringent water quality standards. The Brush Creek diversion structure and associated water treatment plant are critically important features to the Town's municipal water supply system. The Brush Creek diversion structure is currently the Town's only potable source of municipal water supply. Water is diverted from Brush Creek and conveyed to the Town's water plant and treated through a series of mixed media filters. The treated water is then conveyed down valley to the Town residents via pipeline. Once the water has been used by Town residents for in-house uses, the water is routed to the Town's wastewater treatment plant located on the Eagle River just downstream of its confluence with Brush Creek. The treated effluent is discharged directly to the Eagle River and thus, the Town's municipal water diversions for in-house uses are essentially 100% depletive to Brush Creek, in the reach between the diversion facility and the confluence of Brush Creek and the Eagle River.

Currently, the Town's diversion and distribution system provides water to approximately 6,000 town residents and approximately 1,000 extra-territorial users. The water production records maintained by the Town between 2006 and 2010 indicate that approximately 1,500 to 1,600 AF of water is annually diverted from Brush Creek. During this period of record, diversions averaged approximately 3.80 cfs in the summer season with peak day demands topping 5.0 cfs. In the winter season, the daily diversion rate dropped to an average of approximately 1.15 cfs with peak day demands dropping below 3.0 cfs. The average daily diversion rate and peak day municipal water demand from 2002 through 2010 is summarized in **Figure 6**.

Similar to the agricultural diversions, these municipal diversions potentially degrade the quality of the streamflows in Brush Creek. As shown on the Water Rights Map in **Figure 5**, the Town's municipal diversion structure is located in the upper portion of the Brush Creek basin. Again, diversions from this region remove the higher quality water derived from areas underlain by the resistant sedimentary formations. If this higher quality water were left in Brush Creek, it would mix with and dilute the poorer quality water derived from the more soluble Eagle Valley Evaporite formation.



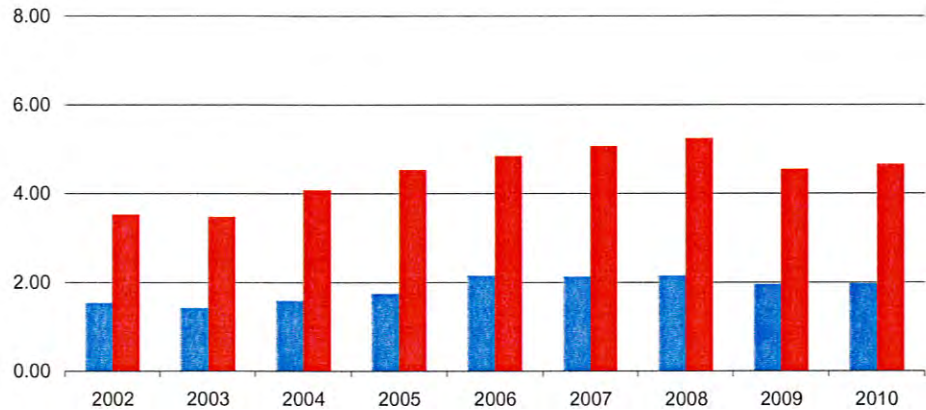
Source: USGS 100k Map

Figure 5
Water Rights Map of Major Agricultural and Municipal Diversions
Brush Creek Watershed Management Plan

Figure 6
Town of Eagle Municipal Water Use

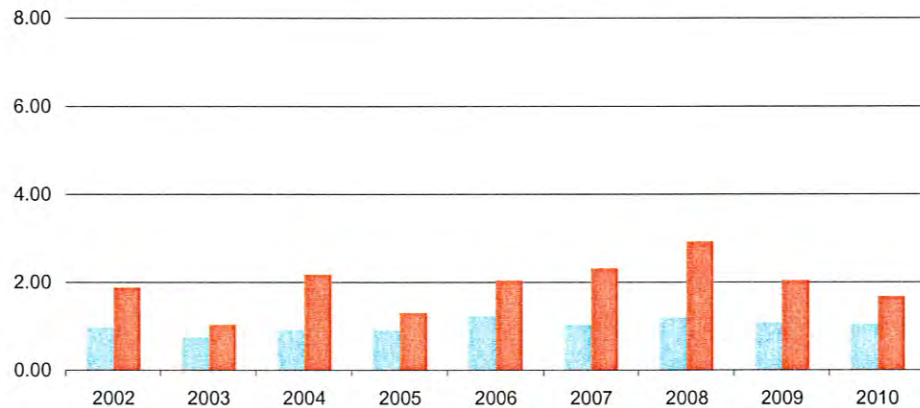
Average Daily Demand vs. Peak Day Municipal Water Demand

Year	Avg (cfs)	Peak (cfs)
2002	1.54	3.53
2003	1.43	3.48
2004	1.59	4.08
2005	1.75	4.53
2006	2.15	4.85
2007	2.13	5.07
2008	2.15	5.24
2009	1.96	4.55
2010	1.97	4.66
Avg	1.79	4.24



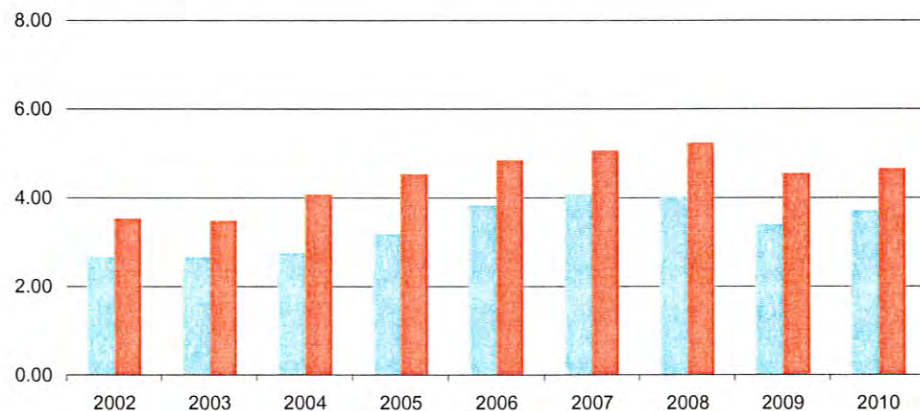
Average Daily Demand vs. Peak Day Demand - WINTER (Nov-Mar)

Year	Avg (cfs)	Peak (cfs)
2002	0.97	1.88
2003	0.75	1.02
2004	0.91	2.17
2005	0.91	1.30
2006	1.24	2.04
2007	1.03	2.32
2008	1.19	2.92
2009	1.08	2.04
2010	1.05	1.66
Avg	1.00	1.84



Average Daily Demand vs. Peak Day Demand - SUMMER (Jun, Jul, Aug)

Year	Avg (cfs)	Peak (cfs)
2002	2.66	3.53
2003	2.66	3.48
2004	2.75	4.08
2005	3.18	4.53
2006	3.83	4.85
2007	4.08	5.07
2008	4.01	5.24
2009	3.40	4.55
2010	3.70	4.66
Avg	3.22	4.21



3.3 Urban Land and Road Development

Water quality in the lower Brush Creek basin is also potentially impacted due to urban development within the Town. Brush Creek bisects the Town and is located in proximity to roads, residential homes and light commercial development. These developments produce urban runoff and if not properly managed and controlled can adversely affect stream water quality. Urban influences on Brush Creek are expected to increase as the Town of Eagle continues to grow within areas close to lower Brush Creek.

3.4 Future Town Growth

The Town of Eagle has exhibited strong and continuing growth patterns over the last 100 years. Over this last century, the Town's population has increased from approximately 185 residents to today's estimated population of 7,000 residents.¹ The average annual growth rates over this period have varied from 3% to over 6%, with the most recent growth projection established at 3.4%.² A summary of the Town's historic growth pattern over the last century and its projected future population based on a 3.4% growth rate is shown in **Figure 7**.

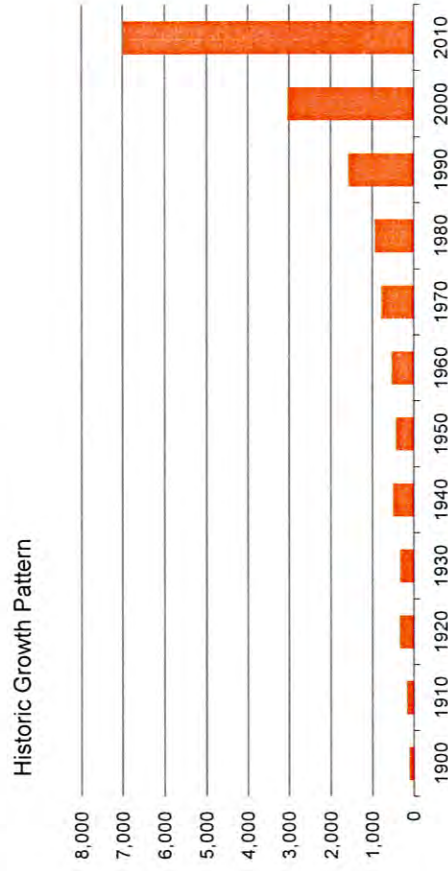
At an annual growth rate of 3.4%, the Town of Eagle could expect a population increase of 170% over the next 30 years, which equates to approximately 19,000 residents. Assuming that the future population will have similar water demands and similar water use patterns to existing residents, the Town's annual municipal diversions could approach 4,100 AF. The average and peak day diversions associate with this growth could approach 5.6 cfs and 13.2 cfs respectively.

¹ Venturoni Surveys & Research, Inc., 2007 Town of Eagle Community Survey and Town of Eagle Data

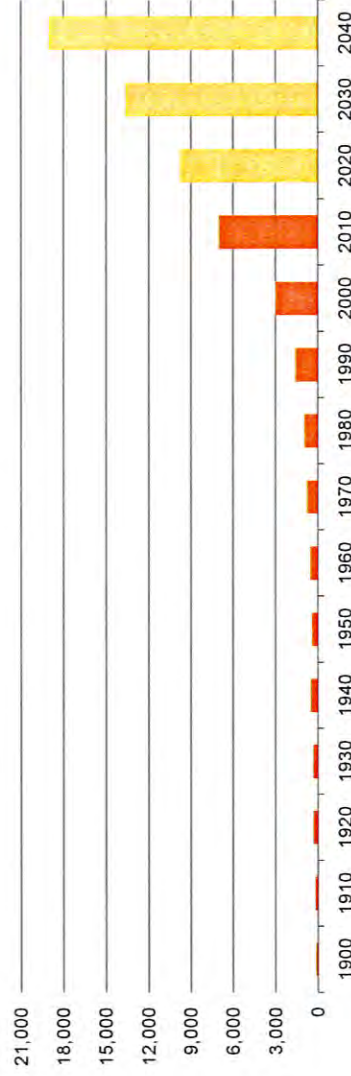
² Town of Eagle Community Plan, 2010.

Figure 7

	(1)	(2)	(3)	(4)
Year	Population	10-Year Percent Growth	Yearly Population Increase	Average Annual Growth
1900	124			
1910	186	50%	6	4.1%
1920	358	92%	17	6.8%
1930	341	-5%	-2	-0.5%
1940	518	52%	18	4.3%
1950	445	-14%	-7	-1.5%
1960	546	23%	10	2.1%
1970	790	45%	24	3.8%
1980	950	20%	16	1.9%
1990	1,580	66%	63	5.2%
2000	3,032	92%	145	6.7%
2010	7,000	131%	397	8.7%



Year	Population	10-Year Percent Growth	Yearly Population Increase	Average Annual Growth
2010	7,000			
2020	9,779	40%	278	3.4%
2030	13,662	40%	388	3.4%
2040	19,086	40%	542	3.4%



Notes:

NOTES:
(1) Population data from 2007 Community Survey by Venturoni Survey & Research, Inc.

(2) 10-Year Percent Growth was calculated based on the population data in Column 1.

(3) Yearly Population Increase equals the annual number of people add/subtracted from the population if the 10-Year growth was equally distributed over the 10 years.

(4) Average Annual Growth equals the 10 year average of the annual growth rate if the 10-Year growth was equally distributed over the 10 years.

4.0 MANAGEMENT PLAN – MISSION STATEMENT AND GOALS

The overall mission of the Brush Creek Management Plan is to provide guidance for the implementation of actions that will protect and enhance the water resource values associated with the Brush Creek watershed. To achieve this mission, three goals have been developed. Attainment of these goals will help protect and sustain the economic and ecological resources provided by the Brush Creek watershed. The Town's watershed goals are as follows.

- Goal No. 1:** Maintain sufficient streamflow in Brush Creek to support and protect the Stream's aquatic environment.
- Goal No. 2:** Protect and improve the quality of Brush Creek and its tributaries.
- Goal No. 3:** Establish and promote land and water management practices that conserve and protect the natural resources of the watershed.

5.0 WATERSHED POLICIES AND MANAGEMENT STRATEGIES

In order to successfully accomplish the goals set forth in the previous section, specific Town policies and management strategies have been developed. This section describes in some detail how these policies and management strategies address the Town's goals for the protection of the Brush Creek watershed.

GOAL NO. 1: MAINTAIN SUFFICIENT STREAMFLOW IN BRUSH CREEK TO SUPPORT AND PROTECT THE STREAM'S AQUATIC ENVIRONMENT

Policy No. 1: Decisions that affect the quantity of water in Brush Creek will include collaboration with relevant public and private entities, as well as relevant planning documents adopted by the Town (2010 Community Plan).

Strategies:

1. Work with the Bureau of Land Management (BLM), United States Forest Service (USFS), State Land Board and Eagle County to amend the resource management and forest plans applicable to the Eagle Area to reflect the tools and implementing actions

set forth in the Eagle County Comprehensive Plan, Eagle River Watershed Plan, the Town's Open Lands Conservation Plan, the Eagle Area Community Plan and this watershed management plan.

2. Implement the relevant policies and action items from the Eagle River Watershed Plan.
3. Work with the USGS to monitor water quantity and water quality by utilizing the Eagle River Watershed Retrospective Assessment Program.

Policy No. 2: Improve irrigation efficiencies, reduce the amount of water historically diverted by large agricultural ditches, and implement water conservation practices within the Town.

Strategies:

1. Work with basin diverters to implement water conservation measures and reduce diversions through improved irrigation efficiencies such as converting flood irrigation to sprinkler irrigation.
2. Implement the Kummer Development Corporation Irrigation Plan.

In 2002, the Town and Kummer Development Corporation (KDC) entered into an irrigation agreement, which governs the amount of allowable diversions through various headgate structures in Brush Creek. KDC owned a significant portion of the large agriculture diversion structures and associated water rights in the upper and mid Brush Creek regions, and was seeking various developments in and around the Town. The Irrigation Plan was part of a larger Settlement Agreement that was entered into to resolve issues related to the development proposals. The Irrigation Plan was designed to sustain and/or enhance Brush Creek streamflows during dry year periods. Portions of the KDC properties have been sold; however, the commitment to implement the Irrigation Plan has been assigned to the successors in interest to the KDC properties. Subsequent references to KDC in this document also include KDC's successors in interest.

In general, the Irrigation Plan seeks to maintain minimum streamflows in Brush Creek equivalent to the Colorado Water Conservation Board's (CWCB) instreamflow right of 12.0 cfs. This instream water right is the amount of water that the Colorado Division of

Wildlife and the CWCB have determined adequate to protect the natural environment of Brush Creek to a reasonable degree. To maintain this streamflow, the Irrigation Plan places limits on the amount of water that can be diverted from Brush Creek under senior KDC water rights. Portions of the Irrigation Plan have been completed in recent years, while other segments have yet to be implemented. Overall, the key components of the Irrigation Plan are shown in **Figure 8** and include:

- a. KDC has agreed to move its points of diversion for the Staton and Cissna Ditch and the Matheny and Tabor Ditch water rights to a location downstream of the Town's municipal intake on Brush Creek. This downstream transfer will help maintain streamflow levels at critical locations in Brush Creek immediately below the Town's point of diversion.
- b. KDC has funded the installation and operation of a streamflow gaging station on Brush Creek downstream of the Love and White Ditch headgate. This gaging station will be one of three monitoring sites on Brush Creek to help implement the Stream Management Plan. Eagle Ranch has constructed a gaging station near Ouzel Lane for the purpose of monitoring stream flow in the middle section of Brush Creek and to implement conservation measures of the Eagle Ranch Golf Course Irrigation Plan. A future gaging station will also be installed below the Town's intake.
- c. KDC agreed to place certain limits on the amount of water it diverts from its various Brush Creek diversion structures. These limits are less than historic diversions and are made possible by increased irrigation efficiencies associated with the Frost Creek golf course and residential development and reduced flood irrigation on agricultural tracts in the Haymeadow and KDC Lower Ranch properties. As described above, the diversion limits were part of various settlement and water service agreements between the Town and KDC and are binding on KDC's successors in interest to the Brush Creek properties and water rights.

Three scenarios have been developed to determine the diversion limit placed on each diversion structure; one for average and wet year conditions, a second for dry year conditions, and a third for "critical" dry year conditions. The amount of water allowed for diversion was calculated based upon crop needs, irrigation efficiencies

and reduced ditch conveyance losses. The allowed maximum diversion limits for each scenario are summarized in **Tables 1, 2 and 3.**³

The definition of average/wet conditions, dry year conditions and critically dry year conditions will be based upon the Brush Creek streamflows. During dry and critically dry years, KDC will reduce its diversion amounts to help maintain Brush Creek streamflows. The streamflow gaging station installed on Brush Creek below the headgate of the Love and White Ditch is used to help define the type of water year (average, wet, dry and critically dry) and corresponding diversion limits.

Average/Wet Year

During average and wet years when streamflows below the Love and White Ditch remain well above the CWCB's 12.0 cfs minimum, KDC can divert at rates up to the amounts shown in **Table 1** for each diversion structure.

Dry Year

As streamflows recede and approach the CWCB's minimum streamflow of 12.0 cfs, KDC will begin to cut back its diversion to amounts no greater than those shown in **Table 2**. For the purposes of this agreement, the trigger point by which diversions will be reduced to values in **Table 2** will occur when the streamflow at the gaging station located below the Love and White Ditch is at or below 16 cfs. During these dry conditions KDC will use the Brush Creek diversions only as necessary to meet irrigation demand and not for flow through water features.

When streamflows beneath the Love and White Ditch are at or drop below 16 cfs and KDC has had to curtail diversions to meet the limitations in **Table 2**, the Town of Eagle and other participants in the Brush Creek Watershed Management Plan would also begin to implement water conservation components as identified in later Sections of this Brush Creek Management Plan. The intent of this Irrigation Plan is that during dry year conditions, all participating entities in the Management Plan, including KDC, would begin to implement water conservation measures at approximately the same time.

³ The identified diversion amounts outlined in Tables 1 through 3 are not guaranteed and may not be fully available in certain months of dry years. Like all Colorado water rights, the Kummer Development Corporation rights must be in priority and have sufficient physical water supplies available at the respective points of diversion on Brush Creek. Similarly, the identified restrictions can only apply to those water rights owned or controlled by the Kummer Development Corporation.

Critical Dry Year

If streamflows continue to recede and drop below the CWCB minimum of 12.0 cfs, KDC will further curtail its diversions to amounts shown in **Table 3**. Furthermore, KDC will curtail its irrigation on 50% of the golf course rough associated with the Frost Creek development. This provision will result in an irrigation reduction of at least 50 acres. The extent of golf course irrigation and associated curtailment will be based on a golf course as-built survey submitted to the Town.

Under all three operating scenarios KDC agrees not to place a call on Brush Creek from any of its water rights if such a call would cause any of the Town of Eagle's municipal water rights in Brush Creek to go out of priority.

Irrigation Table Modifications

The allowable diversion amounts shown in **Tables 1, 2, and 3** assume that the agricultural fields associated with KDC's properties will continue to be flood irrigated. If in the future these areas are converted to sprinkler irrigation, the allowable diversion rates will be reduced to reflect the improved irrigation efficiencies.

In addition, the Town and KDC may from time to time review the effectiveness of the diversion limitations outlined in **Tables 1, 2, and 3** and make adjustments if necessary. Any adjustments, however, will be made only to benefit Brush Creek and/or to protect senior water rights and the adjustments must be mutually agreed to by both parties.

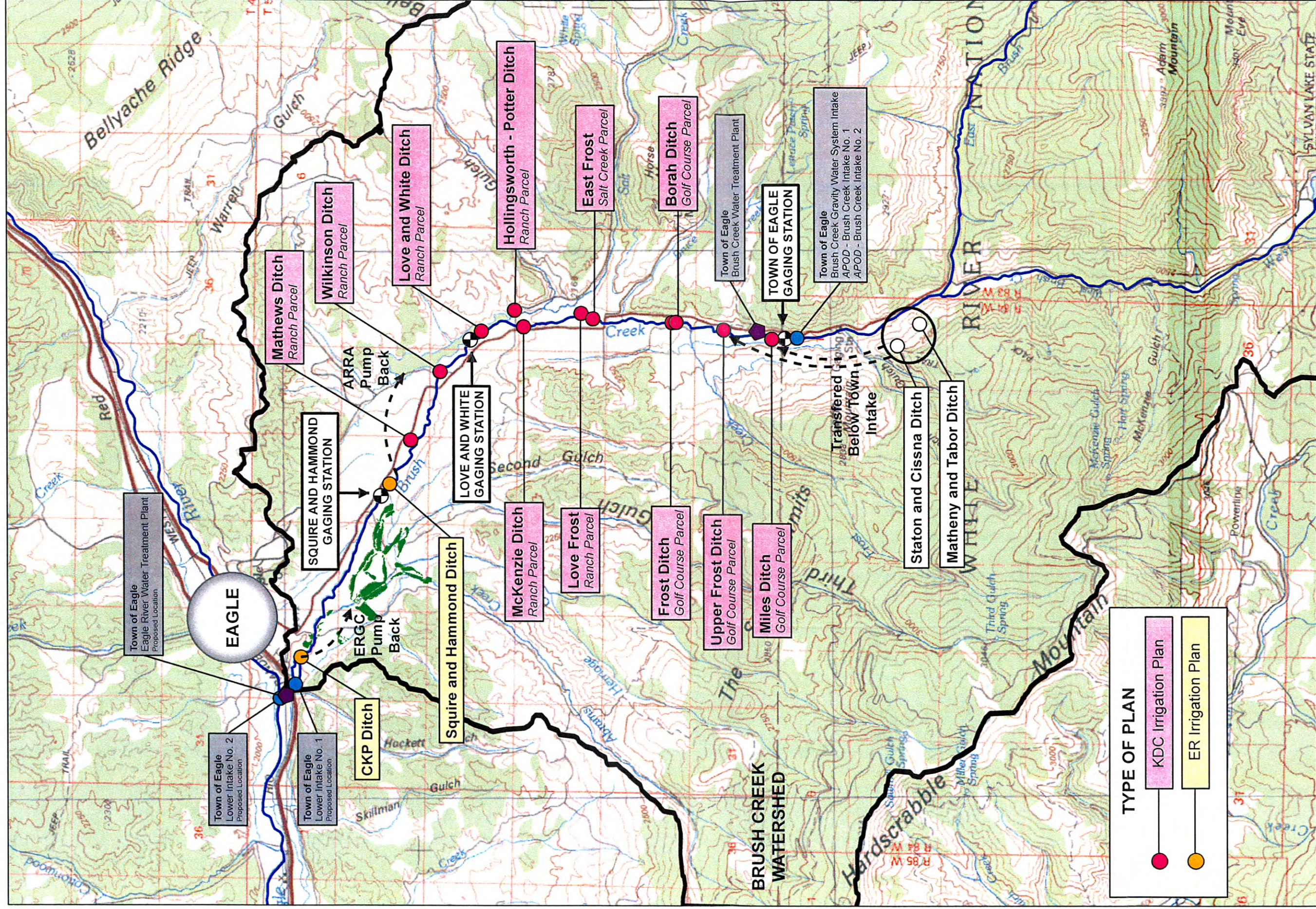
The allowable diversion limits outlined in **Tables 1, 2, and 3** for the proposed Frost Creek Golf Course and residential development were based upon the calculated maximum day irrigation demands, which include up to 108 acres of golf course irrigation and up to 265 acres of residential/open space landscape irrigation. To the extent that actual irrigated acreage is less than that anticipated above, the allowable diversion rates expressed in **Tables 1, 2, and 3** will be adjusted downward accordingly.

Increased Streamflow Trigger Point

KDC acknowledges that the Town, as part of this Brush Creek Watershed Management Plan, is studying the possibility of constructing a new water treatment

plant located downstream near the confluence of Brush Creek and the Eagle River. When constructed, the downstream treatment plant could reduce the Town's municipal water diversions from upper Brush Creek thereby helping maintain critical streamflows. Should the Town construct and operate a new downstream treatment plant, it would require that the amount of water saved and bypassed at its upper diversion site remain in Brush Creek past KDC diversions. As a result, KDC agrees to initiate its streamflow curtailment as outlined in **Tables 1, 2, and 3** at higher streamflow amounts equal to the volume of water being diverted at the new downstream treatment plant. By way of example, if the new downstream treatment plant was diverting 1 cfs of water during the summer period, KDC would increase its streamflow mitigation trigger point from 16 cfs to 17 cfs in dry years and from 12.0 cfs to 13.0 cfs in critically dry years (**Table 3**). Similarly, if the Town was diverting 1.5 cfs of water at the new downstream treatment plant, KDC would increase its trigger point in a critical dry year to 13.5 cfs. This trigger point increase would only be required if the Town transfers existing upper basin water rights down to the new treatment plant and demonstrates an actual reduction in upper basin diversions.

- d. Historically, many of the agricultural ditches to be curtailed under this Irrigation Plan diverted water to irrigate KDC's "Haymeadow" property located southeast of Town. These ditches include the Hollingsworth-Potter Ditch, the Love and White Ditch, the Wilkinson Ditch and the Mathews Ditch. The location of these historic ditch headgates are depicted on the Irrigation Plan Map in **Figure 8**. To the extent that Brush Creek streamflows within the reach located between the Love and White Ditch and the Squire and Hammond Ditch headgate drop below 12.0 cfs, KDC will divert up to 4.0 cfs of the allowable diversions identified in **Tables 1, 2, and 3** through a pump back system. The pump back system will originate from a location immediately above the Squire and Hammond Ditch and serve the Haymeadow property. By foregoing diversions at the upper ditch headgate sites, KDC will be able to irrigate a portion of the Haymeadow property while helping to maintain Brush Creek streamflows through a 2.3 mile stream reach extending from the Love and White Ditch headgate down to the Squire and Hammond Ditch headgate.



Source: USGS 100k Map

Figure 8
Map of Kummer Development Corporation and Eagle Ranch Irrigation Plans
 Brush Creek Watershed Management Plan

Table 1
Kummer Development Corporation Creek Developments
Allowed Diversion Limits

Average and Wet Years

GOLF COURSE PARCEL <i>Diversion Structure</i>	May (cfs)	Jun (cfs)	Jul (cfs)	Aug (cfs)	Sep (cfs)	Oct (cfs)
Upper Frost System ⁽¹⁾	8.57	8.57	8.57	7.49	6.49	5.49
Borah Ditch ⁽²⁾	0.50	0.50	0.50	0.50	0.50	0.50
Frost Ditch ⁽²⁾	1.70	1.70	1.70	1.70	1.50	1.50
Total Allowed Diversions	10.77	10.77	10.77	9.69	8.49	7.49
SALT CREEK PARCEL <i>Diversion Structure</i>	May (cfs)	Jun (cfs)	Jul (cfs)	Aug (cfs)	Sep (cfs)	Oct (cfs)
East Frost Ditch ⁽²⁾	1.00	1.00	1.00	1.00	1.00	1.00
Total Allowed Diversions	1.00	1.00	1.00	1.00	1.00	1.00
RANCH PARCEL <i>Diversion Structure</i>	May (cfs)	Jun (cfs)	Jul (cfs)	Aug (cfs)	Sep (cfs)	Oct (cfs)
Love Frost Ditch ⁽²⁾	1.50	1.50	1.50	1.50	1.00	1.00
McKenzie Ditch ⁽²⁾	3.50	3.50	3.50	2.50	2.50	2.50
Hollingsworth/Potter Ditch ⁽²⁾	2.00	2.00	2.00	2.00	1.00	1.00
Love & White Ditch ⁽³⁾	5.00	5.00	5.00	5.00	5.00	5.00
Wilkinson Ditch ⁽³⁾	5.80	5.80	5.80	5.80	5.80	5.80
Mathews ⁽³⁾	5.00	5.00	5.00	5.00	5.00	5.00
Total Allowed Diversions	22.80	22.80	22.80	21.80	20.30	20.30
TOTAL ALLOWED DIVERSIONS	34.57	34.57	34.57	32.49	29.79	28.79

Notes:

- (1) Upper Frost System includes diversions under the Schlutter, the Staton and Cissna, and the Matheny and Tabor water rights. Diversion values have been reduced by 0.93 cfs from those in the 1999 KDC Irrigation Plan. This amount represents diversions by others in the ditch system. Therefore, the net amount allotted to KDC remains unchanged from the 1999 Agreement.
- (2) Diversion values unchanged from KDC Irrigation Plan 1999 Agreement.
- (3) Diversion up to decreed amount.

Table 2
Kummer Development Corporation Creek Developments
Allowed Diversion Limits

Dry Year

Streamflow below Love & White Ditch are less than 16.0 cfs and greater than 12.0 cfs

GOLF COURSE PARCEL Diversion Structure	May (cfs)	Jun (cfs)	Jul (cfs)	Aug (cfs)	Sep (cfs)	Oct (cfs)
Upper Frost System ⁽¹⁾	5.85	6.18	6.50	5.39	4.23	4.23
Borah Ditch ⁽²⁾	0.50	0.50	0.50	0.50	0.50	0.50
Frost Ditch ⁽²⁾	1.45	1.45	1.45	1.45	1.45	1.45
Total Allowed Diversions	7.80	8.13	8.45	7.34	6.18	6.18

SALT CREEK PARCEL Diversion Structure	May (cfs)	Jun (cfs)	Jul (cfs)	Aug (cfs)	Sep (cfs)	Oct (cfs)
East Frost Ditch ⁽²⁾	0.46	0.46	0.46	0.46	0.46	0.46
Total Allowed Diversions	0.46	0.46	0.46	0.46	0.46	0.46

RANCH PARCEL Diversion Structure	May (cfs)	Jun (cfs)	Jul (cfs)	Aug (cfs)	Sep (cfs)	Oct (cfs)
Love Frost Ditch ⁽²⁾	0.50	0.50	0.50	0.25	0.50	0.50
McKenzie Ditch ⁽²⁾	2.42	2.48	2.54	2.03	2.23	1.98
Hollingsworth/Potter Ditch ⁽²⁾	2.00	2.00	2.00	1.70	1.30	1.30
Love & White Ditch ⁽³⁾	5.00	5.00	5.00	4.25	3.25	3.25
Wilkinson Ditch ⁽³⁾	5.80	5.80	5.80	4.93	3.77	3.77
Mathews ⁽³⁾	5.00	5.00	5.00	4.25	3.25	3.25
Total Allowed Diversions	20.72	20.78	20.84	17.41	14.30	14.05

TOTAL ALLOWED DIVERSIONS	28.98	29.37	29.75	25.21	20.94	20.69
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Notes:

- (1) Upper Frost System includes diversions under the Schlutter, the Staton and Cissna, and the Matheny and Tabor water rights. Diversion values have been reduced by 0.93 cfs from those in the 1999 KDC Irrigation Plan. This amount represents diversions by others in the ditch system. Therefore, the net amount allotted to KDC remains unchanged from the 1999 Agreement.
- (2) Diversion values unchanged from KDC Irrigation Plan 1999 Agreement.
- (3) May through July diversions are based on the lesser of: 1.) an irrigation duty of 1 cfs per 35 acres irrigated or 2.) the sum of all senior water rights in the ditch. Senior water right is defined as any water right decreed prior to the 1907 basin adjudication. August diversions were calculated as 85% of July diversions. September and October diversions were calculated as 65% of July diversions (same as the KDC Irrigation Plan 1999 Agreement).

Table 3
Kummer Development Corporation Creek Developments
Allowed Diversion Limits

Critical Dry Year

Streamflow below Love & White Ditch are less than 12.0 cfs and Golf Course rough irrigation is reduced 50%

GOLF COURSE PARCEL Diversion Structure	May (cfs)	Jun (cfs)	Jul (cfs)	Aug (cfs)	Sep (cfs)	Oct (cfs)
Upper Frost System ⁽¹⁾	4.39	4.64	4.20	3.49	2.63	2.63
Borah Ditch ⁽²⁾	0.50	0.50	0.50	0.50	0.50	0.50
Frost Ditch ⁽²⁾	1.45	1.45	1.45	1.45	1.45	1.45
Total Allowed Diversions	6.34	6.59	6.15	5.44	4.58	4.58

SALT CREEK PARCEL Diversion Structure	May (cfs)	Jun (cfs)	Jul (cfs)	Aug (cfs)	Sep (cfs)	Oct (cfs)
East Frost Ditch ⁽²⁾	0.46	0.46	0.46	0.46	0.46	0.46
Total Allowed Diversions	0.46	0.46	0.46	0.46	0.46	0.46

RANCH PARCEL Diversion Structure	May (cfs)	Jun (cfs)	Jul (cfs)	Aug (cfs)	Sep (cfs)	Oct (cfs)
Love Frost Ditch ⁽²⁾	0.38	0.38	0.50	0.25	0.50	0.50
McKenzie Ditch ⁽²⁾	1.82	1.86	2.54	2.03	2.23	1.98
Hollingsworth/Potter Ditch ⁽²⁾	1.50	1.50	1.40	1.00	1.30	1.30
Love & White Ditch ⁽³⁾	3.75	3.75	3.75	3.19	2.44	2.44
Wilkinson Ditch ⁽³⁾	4.35	4.35	4.35	3.70	2.83	2.83
Mathews ⁽³⁾	3.75	3.75	3.75	3.19	2.44	2.44
Total Allowed Diversions	15.55	15.59	16.29	13.36	11.74	11.49

TOTAL ALLOWED DIVERSIONS	22.35	22.64	22.90	19.26	16.78	16.53
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Notes:

- (1) Upper Frost System includes diversions under the Schlutter, the Staton and Cissna, and the Matheny and Tabor water rights. Diversion values have been reduced by 0.93 cfs from those in the 1999 KDC Irrigation Plan. This amount represents diversions by others in the ditch system. Therefore, the net amount allotted to KDC remains unchanged from the 1999 Agreement.
- (2) Diversion values unchanged from KDC Irrigation Plan 1999 Agreement.
- (3) Critical dry year diversions were calculated as 75% of the dry year diversions.

3. Implement the Eagle Ranch Golf Course Irrigation Plan.

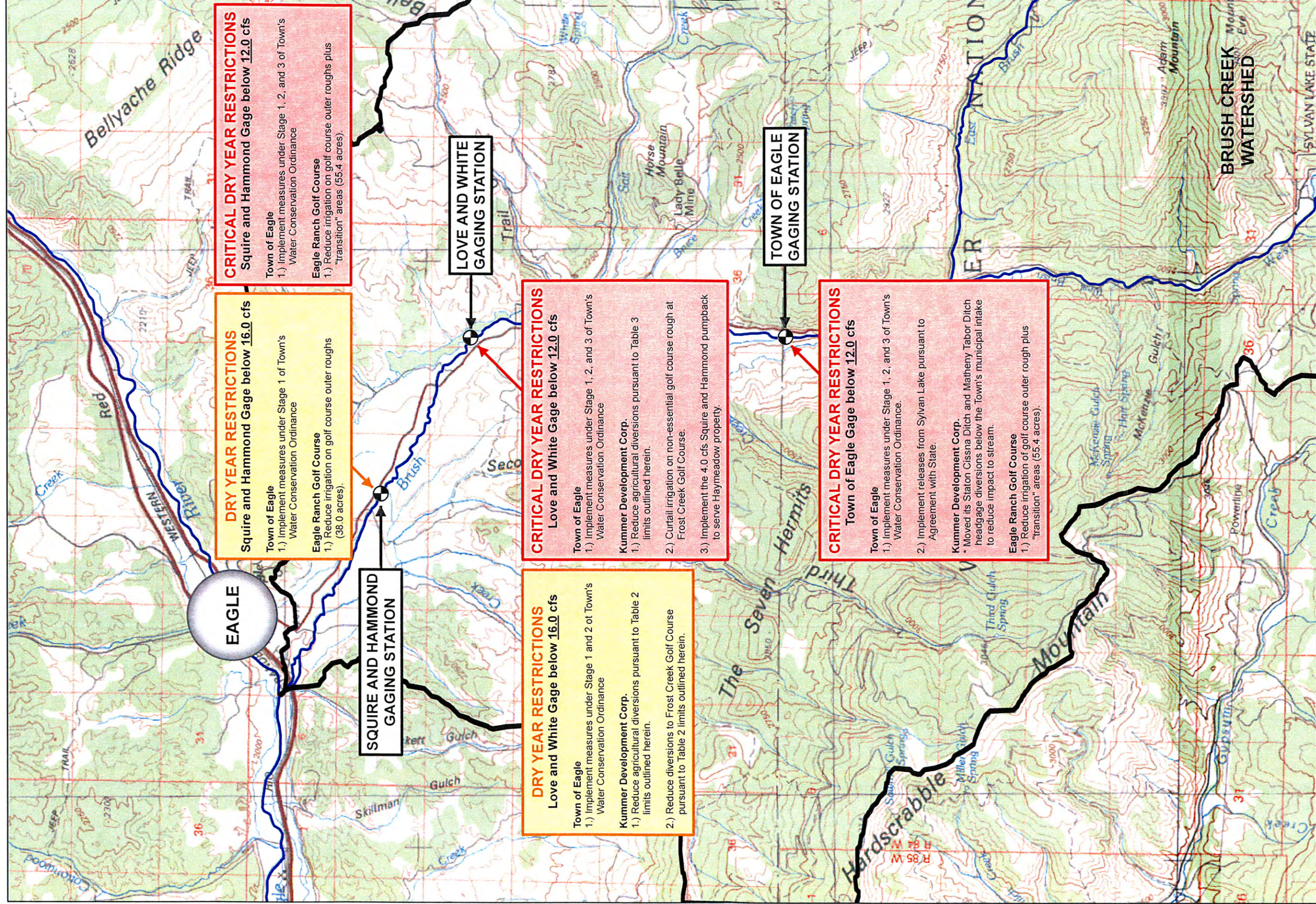
The Town of Eagle leases a certain amount of its water rights to the Eagle Ranch Metropolitan District (Lessee) for the irrigation of the Eagle Ranch Golf Course. Under the Terms of the water right lease agreement and upon terms contained in an earlier Annexation Agreement involving the subject property, the golf course is under obligation to curtail irrigation diversions during low flow conditions. The golf course irrigation diversions generally occur through the headgate of the Squire and Hammond Ditch. Under the Eagle Ranch Golf Course Irrigation Plan, when the streamflows in Brush Creek, as measured below the headgate of the Squire and Hammond Ditch, drop below 12 cfs, the Lessee shall bypass its irrigation water as necessary to maintain 12.0 cfs below the headgate. Alternate irrigation supply will be obtained through a pump back system originating at the downstream CKP Ditch headgate. This pump back system, which is shown in **Figure 8**, helps preserve the minimum flows within a reach of Brush Creek extending from the Squire and Hammond Ditch down to the CKP Ditch.

Under this Irrigation Plan, the Lessee shall at no time place a call on the water rights of the Town. Furthermore, the Lessee shall also be required to curtail irrigation of all or a portion of the golf course roughs (approximately 38.0 acres) during dry conditions when and if the flows in Brush Creek drop below 16 cfs. The extent and location of these outer roughs have been identified in the Lease Agreement. The effect of this curtailment will be to reduce irrigation from approximately 133.4 acres down to approximately 95.4 acres. During critical dry year conditions when streamflows drop below 12 cfs as defined in the Town's Water Conservation Plan adopted as Section 12.07 of the Eagle Municipal Code (discussed in Goal No. 3) the Lessee shall also curtail the irrigation of "transition areas". The extent and location of these "transition areas" have been identified in the Lease Agreement. The effect of this additional curtailment is to remove an additional 55.4 acres of irrigated land during the critical drought period. During "emergency restrictions" as defined in the municipal code, the Lessee must limit golf course irrigation to tees and greens (7.6 acres).

4. Conserve water for the protection of the Town's municipal water supply system and Brush Creek

Develop and implement a water conservation ordinance. In 2009, the Town amended its municipal code to include a water conservation plan. Section 12.07 of the Town's Water Conservation Plan establishes comprehensive guidelines for lawn and open space irrigation and other water use activities within the Town. The goal of the water conservation plan is to reduce both peak day water demands and overall water use by Town residents. This action helps prolong the life of the Town's current water treatment system, and it protects the health, quality and quantity of the streamflow in Brush Creek.

The water conservation plan provides four tiers of water use restrictions dependent upon the type of year: average, dry, critically dry and emergency situations. As conditions in the Brush Creek basin become dryer, the water use restrictions increase. Stage 1 conservation measures are required each year. This stage prohibits the waste of water within the Town, places limits on the time of day and season when irrigation water can be used, and establishes Even/Odd irrigation schedules. Stage 2, Stage 3, and Stage 4 are implemented during dry, critically dry, and water emergency years respectively. Each stage requires an additional set of water conservation measures. The dry year and critically dry year triggers are based, in part, upon the same minimum streamflow amounts identified in the KDC and Eagle Ranch Irrigation Plans. These water use restrictions help to provide basin wide water conservation by all parties during periods when the streamflow is low. **Figure 9** provides a summary of the various water conservation efforts designed to protect and maintain Brush Creek streamflows as identified in Goal No. 1.



Source: USGS 100k Map

Figure 9
Map of Dry Year and Critical Dry Year Restrictions
Brush Creek Watershed Management Plan



5. When conservation efforts are not enough to protect the Town's municipal water supply system and Brush Creek, mitigate with available upstream water sources.

Initiate streamflow mitigation in accordance with the Sylvan Lake Agreement. In October 1994, the Town entered into a contractual agreement with the State of Colorado by and through the Department of Natural Resources for 125 AF/yr of reservoir space in Sylvan Lake. In exchange, the Town transferred its interest in the Confluence Reservoir storage right (360 AF/yr), the historic consumptive use credits associated with its interest in the Love and White Ditch 2nd Enlargement water right (94 AF/yr), and a portion of the historic consumptive use credits associated with its interest in the Upper Frost Ditch 1st Enlargement water right (25.9 AF/yr) to Sylvan Lake. These transferred water rights provide both an augmentation supply to replace evaporation and seepage losses from Sylvan Lake and a "last-in-line" water supply for the Town.

The mitigation action plan would server as a backstop to the Town's water conservation efforts. At such times when the Town is following the strategies outlined in the Water Conservation Plan and the streamflow in Brush Creek below the Town's municipal gravity diversion structure drops below minimum standards, the Town can request that the Division of Parks and Outdoor Recreation release water from Sylvan Lake. This available upstream water supply allows the Town, as a last resort, to continue diverting from Brush Creek in an amount of 125 AF/yr without further impacting the streamflow conditions below the Town's municipal gravity system.

GOAL NO. 2: PROTECT AND IMPROVE THE QUALITY OF BRUSH CREEK AND ITS TRIBUTARIES

Policy No. 3: Maintain Brush Creek streamflow standards and use classification as designated by the Colorado Department of Public Health and Environment.

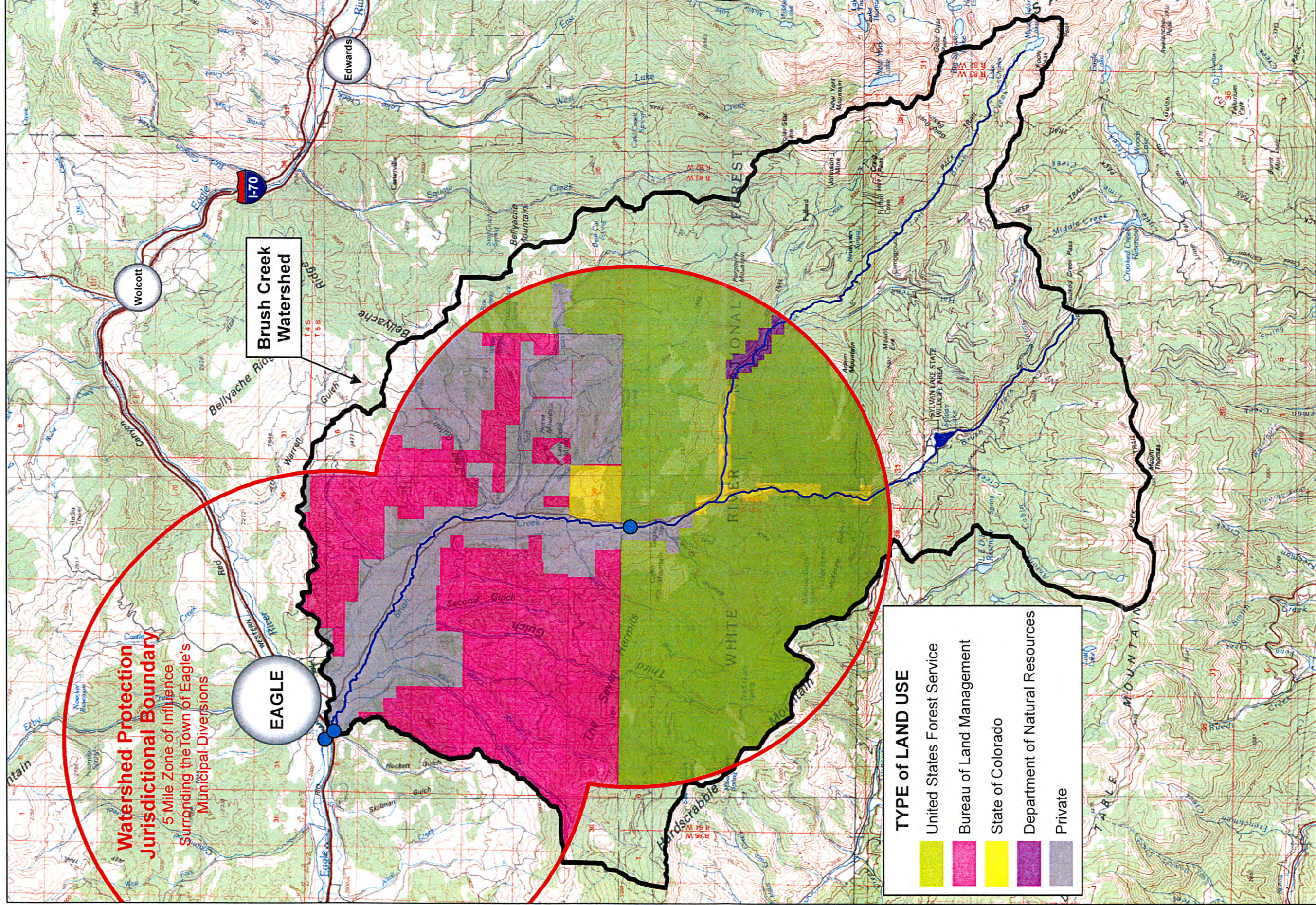
Strategies:

1. Control and/or minimize the input of sediment, stormwater runoff, nutrients and other pollutants to Brush Creek through implementation of the Town's Municipal Watershed Protection Ordinance. Section 12.24 of the Eagle Municipal Code.

Under Town Municipal Code 12.24.030, the Town is directed to exercise regulatory and supervisory jurisdiction over all streams and sources contributing to municipal water supplies for a distance of five (5) miles above the points from which municipal supplies are diverted. The authority to implement this regulation arises from State Statute 31-15-707(b) and is commonly referred to as the "municipal watershed protection ordinance". The purpose of the Statute is to provide local municipal governments with a procedure to protect their domestic water supply. The ordinance is not intended to be a tool to regulate land use activities; such activities will continue to be regulated by the County, federal government, or other entity with jurisdiction over land use activities within the 5 mile zone of influence. The Town, however, can enforce water quality regulations or activities that create a foreseeable risk of injury to the Town's water supply intake. Such regulations might include; implementation of site specific Best Management Practices (BMP's), grading plans, revegetation requirements and limits on herbicides or other potentially hazardous materials.

The Town will take the following actions.

- a. Update the Town's jurisdictional map (5 mile radius) and maintain such map on file in the Town Clerk's office. The jurisdictional area is shown in **Figure 10**.
- b. Distribute a copy of the Town's jurisdictional map to Eagle County, the Bureau of Land Management and the U.S. Forest Service with an alert that the Town will require review of any proposed activities that fall within the 5 mile jurisdictional zone.
- c. Under the municipal watershed protection ordinance, develop a list of prohibited activities and activities that the Town will require notice and permitting.
- d. Develop a permit application form and fee. The application forms should outline the specific information needed from the Applicant to facilitate evaluation by the Town.



Source: USGS 100k Maps

Figure 10
Watershed Protection Jurisdictional Boundary
Brush Creek Watershed Management Plan

Policy No. 4: Impacts from development will be mitigated so that environmentally sensitive areas are protected and stream health can be maintained.

Strategies:

1. Utilize the Analysis Mapping in the Eagle Area Community Plan to identify which critical lands to conserve and address impacts through the development review process.
2. Continue to restrict new development in floodplains and riparian areas with a 75' minimum setback. Require site-specific studies to ensure full protection of water quality, wildlife habitat and visual/aesthetic qualities.
3. Explore development incentives to encourage and assist landowners in the protection of river/stream corridors and wetlands. These incentives might include flexibility in site development and TDR programs.
4. Implement vegetation and tree protection standards which require developers to document the extent and type of vegetative cover on a site, and preserve (a specified percentage) of such cover. Require appropriate revegetation as a result of grading and excavating.
5. Restrict development on steep slopes, areas with geologic hazards, wildlife habitat areas, and areas with erosive soils and/or mud flows.
6. Implement educational programs about wildlife habitat.

GOAL NO. 3: PROMOTE WATER MANAGEMENT PRACTICES THAT CONSERVE AND PROTECT THE NATURAL RESOURCES OF THE WATERSHED

Policy No. 5: Protect and improve the stream health of Brush Creek.

Strategies:

1. Promote the protection of stream banks and vegetation within the Brush Creek "water influence zone" through education and cooperation with local land owners. The "water influence zone" is the area 100 feet to either side of the ordinary high water line.

2. Work cooperatively with other governmental entities to promote land use activities that minimize adverse impacts to the Brush Creek watershed.

In 1999, the consortium of Colorado State Parks, Eagle County, and the Town of Eagle provided funding to purchase from the Kummer Development Corporation all private lands in the East and West Brush Creek valley floors. The purchase ended several decades of proposed land use scenarios ranging from a large ski area with attendant base area development to dividing the acreage into 35 acre parcels for small residential development. The result of the land purchase was to expand the Sylvan Lake State Park from a small reservoir site to a more significant state park. The Colorado Division of Parks has planned and implemented a lower impact park that results in dramatically less watershed impact than the formerly proposed land uses.

3. Utilize funds from the Eagle Ranch property transfer tax and associated Eagle Ranch Wildlife Mitigation fund to help restore and improve the health and aquatic resources of Brush Creek.

Recently, the Town of Eagle in cooperation with the Eagle Ranch Association, Colorado Division of Wildlife and local property owners used available funds from the Eagle Ranch property transfer tax and the wildlife mitigation fund to improve the health of Brush Creek along 3.5 miles of stream through the Town. The project helped create gravel bars, pools, and riffles to help improve the fishery resources. The project also helped to stabilize eroding stream banks. An example of the types of improvements made through this project are shown in the before and after photographs in **Figure 11**.

Figure 11
Eagle Ranch Wildlife Mitigation Fund
Improvements on Brush Creek

Before Project: Bank Erosion



After Improvement Work: Bank Stabilized with Willows and Rock



Town of Eagle Photographs

6.0 CONCLUSION

The Brush Creek Management Plan is the culmination of two decades of efforts: the evaluation of Brush Creek hydrology, acquiring significant water rights within the basin, negotiation and establishment of agreements with major land owners and state agencies, and establishment of ordinances and policies – all with the objective to maintain and improve the health of the Brush Creek Watershed.

The plan summarizes various agreements, ordinances, and policies of the Town of Eagle. The document is designed to meet the needs of educating the public of the Town's efforts, provide a useful guide to policy makers of the Town, and serve as a guide for future land use decisions.

The plan will need to be updated from time to time, as further changes to the nature of the valley occur.