2002 ROARING FORK WATERSHED MANAGEMENT PLAN

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1.0 WATERSHED OVERVIEW

1.1 Geography and Hydrology

The Roaring Fork watershed is located in Pitkin, Eagle, Garfield, and a small portion of Gunnison Counties, in west-central Colorado, comprising an area of high glaciated mountainous terrain and deep intervening valleys. Altitudes in the watershed range from 14,265 feet along the continental divide and within the Maroon Bells/Snowmass Wilderness, to 5,800 feet at Glenwood Springs. The drainage area for the entire watershed (to Glenwood Springs) is approximately 929,000 acres (1,451 square miles, US Geological Survey [USGS] Water Resources Data, 1993). A map of the watershed is provided in Figure 9.

The Roaring Fork, with headwaters in the Independence Pass area, drains most of Pitkin County, flowing northwest to its confluence with the Colorado River at Glenwood Springs. Principal tributaries to the Roaring Fork include Castle and Conundrum Creeks, flowing north to Aspen; Brush Creek, flowing east through the Snowmass Ski areas to its confluence with the Roaring Fork River at the Town of Woody Creek; the Fryingpan River, flowing westward to Basalt; and the Crystal River, flowing north to Carbondale. The Roaring Fork River contributes more water to the Colorado River than any other stream in Colorado except for the Gunnison, yielding an average of almost 1,000,000 acre-feet per year.

Major tributaries to the Crystal River are Avalanche, Coal, and Thompson Creeks.

The three major rivers in the watershed, the Roaring Fork, the Crystal, and the Fryingpan, contribute approximately 54%, 32%, and 14% of the flow in the watershed, respectively (Bureau of Reclamation, Ruedi Reservoir, Colorado Round II Water Marketing Program Addendum to the Draft Environmental Statement, 1988). Average annual water yield from the Roaring Fork watershed is 857,000 acre-feet (Bureau of Reclamation, Ruedi Reservoir Colorado Round II Water Marketing Program, Final Supplement to the Environmental Statement, 1989).

Annual precipitation in Eagle County is 14.1 inches; Garfield County, 18.6; and Pitkin County 24.5 inches (Fryingpan-Arkansas Project, Colorado, Final Environmental Statement, Bureau of Reclamation, 1975). The primary source for streamflow in the Roaring Fork is the spring melting of the accumulated winter snowpack. The annual hydrograph (stream discharge over time) shows the highest stream flows occurring during the late spring and early summer (over 50% of the stream flow in May, June and July, Bureau of Reclamation, 1975). Stream flows are at their lowest August-October and March-April (Bureau of Reclamation, 1988).

Figure 8. Roaring Fork Watershed Map.

Stream flows in the Roaring Fork watershed are affected by diversions which transport water out of the basin to the Arkansas River via the Fryingpan-Arkansas Project (approximately 157,000 acre-feet in 1993 and 97,743 acre-feet in 2000, State Engineer's Office). The Ruedi Dam and Reservoir is the only major water storage facility in the Roaring Fork watershed with an active conservation capacity of 102,369 acre-feet and a surface area of 997 acres. Ruedi Reservoir was built in 1968 and is operated by the Bureau of Reclamation to mitigate the effects of the Fryingpan-Arkansas project (Bureau of Reclamation, 1989).

1.2 Land Uses and Population Characteristics

The Roaring Fork watershed includes a portion of Gunnison County (the headwaters of the Crystal River), all of Pitkin County, a portion of Eagle County, and a portion of Garfield County. Based on very rough approximations, the Roaring Fork watershed is 929,000 acres in size (1,451 square miles). Approximately 70% of the land in the Roaring Fork watershed is managed by the US Forest Service, 5% is managed by the Bureau of Land Management, and 25% is privately owned. Most of the private land occurs along the valley floor, and most of the BLM land is located in the lower portion of the watershed.

Most of the population and the principal economic activities are centered around Aspen and Glenwood Springs. Tourism in the form of recreation and skiing is the predominant economic activity. Ski areas in the Roaring Fork valley include: Aspen Mountain, Aspen Highlands, Buttermilk/Tiehack, Snowmass, and Sunlight.

The lower Roaring Fork valley north and west of Aspen, has historically been used for ranching, but development has increased because of recreation demands further up the valley.

Mining activities are a third important part of the economy, with coal (Coal Creek and North Thompson Creek drainages) and iron-ore mining providing the greatest resources. However, mining activity is declining and the large coal mines in the Coal Creek and North Thompson Creek drainages have closed. Gravel mining continues to be an important industry in the watershed.

The 2000 population centers in the Roaring Fork basin include Aspen (5,914), Snowmass Village (1,822), Basalt (2,681), El Jebel, Carbondale (5,196), and Glenwood Springs (7,736). (US Census, as reported by the Denver Post March 20, 2001).

In Pitkin and Eagle Counties in the Roaring Fork watershed there are 31 community drinking water systems, 12 non-community transient systems (such as restaurants and campgrounds), and four non-community non-transient water systems (such a schools). Eight drinking water systems are reliant upon surface water sources (serving a population of 34,957 and 39 drinking water systems are reliant upon groundwater (serving a total population of 10,123). This does not include any systems (including private wells) serving less than 25 persons.

1.3 Watershed Water Quality Management

Because of the complexity of the different jurisdictions within the Roaring Fork watershed, watershed management is difficult. For example, the Northwest Colorado Council of Government's (NWCCOG's) planning region and authority for 208 planning includes Eagle and Pitkin counties, but does not include Garfield and Gunnison counties.

NWCCOG has informally approached Garfield County, Carbondale and Glenwood Springs concerning incorporation of their issues into this watershed plan, and has met with favorable response.

A number of public meetings were held in the Roaring Fork basin during development of the watershed's water quality management plan, sponsored by the Ruedi Water and Power Authority. Participants included local officials, the Colorado River Water Conservation District, sanitation district representatives, the Division of Wildlife, and interested members of the community.

2.0 WATERSHED WATER QUALITY ASSESSMENT

Generally speaking, water quality in the Roaring Fork watershed is excellent. The Roaring Fork and its tributaries have excellent fisheries, with several segments designated as "Gold Medal" by the Division of Wildlife. The overall concern in the watershed is the protection of the existing water quality in a rapidly urbanizing environment.

In 1999, the Roaring Fork Conservancy initiated a watershed water quality monitoring program, modeled after the Colorado Division of Wildlife's River Watch program. The program uses existing River Watch efforts and oversees/ coordinates numerous "stream teams". Between twenty-three and twenty-five stations in the watershed are monitored on a regular basis.

In 2001, the Roaring Fork Conservancy issued the "Roaring Fork Watershed State of the River Report (November 25, 2001). The report states that the major issues regarding water quality are wastewater treatment discharges, stormwater runoff and erosion and sediment loading. Additional water resource related concerns include filling of the floodplain and channel, degradation and removal of natural vegetation, and increased recreational use. Specific pollutants of concern include sediment, nutrients (nitrogen and phosphorus), bacteria, dissolved metals and salts.

2.1 Upper Roaring Fork Watershed (Stream Segments 1, 2, & 3)

Water quality data collected by Aspen Middle School through the Division of Wildlife River Watch program on the Roaring Fork at Herron Bridge Park in Aspen. Data collected in 1991 and 1992 indicates metal concentrations (cadmium, copper, iron, manganese, lead and zinc) are well below water quality standards, but that dissolved oxygen concentrations in June and July 1992 were below 6.0 mg/L, the water quality standard for a coldwater fishery. Additional sampling should be done to confirm if dissolved oxygen is a concern at this location.

The Water Quality Control Division maintained a monitoring station on the Roaring Fork

below Aspen until 1992. Water quality data collected between 1988 and 1992 at this station showed good water quality, with no exceedance of standards for metals. Total phosphorus concentrations at this station were high (a mean value of 0.089 mg/L for 49 samples), and un-ionized ammonia exceeding the standard of 0.02 mg/L (maximum value of 0.108 mg/L). The minimum dissolved oxygen concentration measured at this station between 1988 and 1992 was 7.6 mg/L.

The 1988 208 Plan stated that dissolved-solids concentrations on the Roaring Fork River have been related to geologic formations in the area. Dissolved-solids concentrations on the Roaring Fork River increase from a mean of 36 mg/L upstream from Aspen to a mean of 408 mg/L at Glenwood Springs. Conundrum Creek had a specific conductance of 850 umho/cm as a result of thermal-spring discharges. Castle Creek, upstream from Conundrum Creek, had a maximum dissolved-solids concentration of 344 mg/L and a specific conductance of 404 umho/cm for the same sampling period.

According to the USGS [USGS, Reconnaissance Evaluation of Surface-Water Quality in Eagle, Grand, Jackson, Pitkin, Routt, and Summit Counties, Colorado, Open File Report 79-420, 1979] the Upper Roaring Fork River above Aspen has water suitable for all uses, with an average dissolved solids concentration of approximately 50 mg/L.

The USGS [USGS, 1979] found that downstream from Aspen, the dissolved-solids, bacteria, hardness, and sulfate concentrations increase, as compared to upstream, with as much as a 500 percent increase in dissolved solids concentration. Chemical concentrations probably increased because of mineralized thermal springs on Conundrum Creek, which joins the Roaring Fork River at Aspen, urban and rural activities, and a greater contribution from ground water. The average concentration of dissolved solids of Conundrum Hot Springs is 2,200 mg/L.

The USGS report [USGS, 1979] stated that it is difficult to separate the effects of urban activities from natural effects on water quality. Bacterial and nutrient increases downstream from Aspen indicate a contribution from urban activities. The increased turbidity and suspended sediment concentration may be partly a result of urban runoff, but a part probably is contributed by erosion of outcrops of sandstone, siltstone and shale, which tend to be more easily weathered than the areas upstream.

According to the USGS [USGS, 1979], downstream from the Aspen sewage treatment plant discharge, sulfate, calcium, nutrient, and dissolved solids concentrations increase as compared to upstream. Turbidity and suspended sediment concentrations are also greater than upstream, probably as a result of erosion from outcrops of Mancos Shale and Maroon Formation, which are easily weathered, fine-grained sandstone and siltstone. Slight increases in nutrient concentrations, probably contributed from discharge of the sewage-treatment plant have been observed downstream of Aspen.

The 1988 208 Plan reviewed Colorado Water Quality Control Division water quality monitoring data from 1979 through 1987 at the Roaring Fork station below Aspen, and found that the average total phosphorus concentration was above the EPA recommended criteria established to minimize downstream eutrophication and prevent interference with coagulation in water treatment plants. Dissolved solids and turbidity were also reported to be at concentrations higher than EPA recommended criteria for domestic water supplies. Occasional exceedances of aquatic life standards for copper, lead, zinc, and cadmium were reported. Information on silver indicated very high

concentrations but was extracted from a limited data base (1979-1983, nine samples with a mean value of 5.7 ug/L total recoverable silver). When compared to average concentrations for the period 1984-1987 all elevated concentrations had improved and there were no standard exceedances for cadmium; silver was not monitored. Phosphorus and dissolved solids are still reported in high concentrations based on data collected by the Division between 1988 and 1992. Metals data collected by the Division during this period indicated water quality exceeding standards set for the protection of aquatic life.

Water quality modeling performed on the Roaring Fork below Aspen by the Colorado Department of Public Health and Environment's Water Quality Control Division has indicated that water quality standards violations associated with municipal wastewater treatment discharges would occur without the provision of advanced wastewater treatment. Wasteload allocations for ammonia have been established and advanced treatment has been provided to further reduce ammonia consistent with the stream standards.

The USGS report [USGS, 1979] stated that, with the exception of nutrients, the concentrations of minerals and suspended sediments increase on the Roaring Fork River downstream from its confluence with Brush Creek near Snowmass. Irrigation returns and erosion from irrigated cropland along Woody Creek, East Sopris Creek, Capital Creek, Red Canyon Creek and the Crystal River may contribute to the salinity in the Roaring Fork. Upstream from the confluence with Brush Creek, the stream and its tributaries drain outcrops of the Mancos Shale, Maroon Formation, and State Bridge Formation, all yielding calcium bicarbonate type water. The Mancos Shale is partly carbonaceous, which may account increasing concentrations of total organic carbon.

The USGS report [USGS, 1979] found that in general, trace element concentrations on the Roaring Fork River were low, although total cadmium and lead exceeded aquatic life standards during high flows in May of 1976. Lead concentrations have been documented in the 1989 Colorado Nonpoint Assessment Report [Colorado Water Quality Control Division, 1989] to exceed aquatic-life standards from Aspen to Snowmass. As previously noted, recent water quality data collected by the Water Quality Control Division (WQCD) below Aspen between 1988 and 1992, and the Division of Wildlife's River Watch Program shows metals to be meeting all water quality standards.

The 1988 208 Plan stated that from Snowmass to the Crystal River concentrations of copper, cadmium and iron are in exceedance of aquatic life standards. The 1989 Colorado Nonpoint Assessment Report also states that the Roaring Fork, from Snowmass to the Crystal River confluence, exceeds aquatic life standards for copper and cadmium. Inactive mining in the Aspen and Snowmass areas are considered possible sources of this problem. Water quality data has been collected at the Woody Creek Bridge on the Roaring Fork by the Aspen Community School as part of the Division of Wildlife's River Watch Program. Data has also been collected by Aspen Middle School at the Highway 82 Bridge below Snowmass Creek, and by Basalt High School at the 7-11 Bridge. Data collected between 1991 and 1993 did not show any exceedances of water quality standards for metals.

The Roaring Fork Conservancy's water quality monitoring program found dissolved oxygen values at the Ranch at Roaring Fork station to be excellent year- round. Of 11

observations at the site the minimum dissolved oxygen level was 8.2, and the mean value was 9.6 [Roaring Fork Watershed 2000 Report]. One observed data point of 2.5 mg/L dissolved oxygen is not included due to the potential anomaly of the observation.

The 1988 208 Plan stated that the Roaring Fork from its confluence with the Crystal River to its mouth contained cadmium concentrations in excess of the aquatic life criteria but that despite the problems, the lower Roaring Fork River provides a good aquatic habitat and supports a good fishery.

The Roaring Fork Conservancy's monitoring program in 2000 did not identify cadmium concentrations in exceedance of State water quality standards in the lower Roaring Fork River, but did observe total iron concentrations greater than 1,000 ug/L in April 2000. This is likely due to ground water return flows with high iron concentrations during periods of low in-stream flows.

In 2001 Pitkin County contributed $20,000 to a study to determine if growth and development in the upper valley may be polluting the local watershed. The study is being conducted by Ken Kolm, Colorado School of Mines, Argon National Laboratories, and the EPA.

2.2 Brush Creek (Stream Segment 4)

Past water quality studies have documented that natural and urban storm runoff are sources of pollution affecting the water quality of Brush Creek at Snowmass [referenced by USGS, 1979]. The greatest documented nonpoint source problem was suspended sediment concentrations as a result of runoff from parking lots and recreational development. The West Fork of Brush Creek is noted as an erosion area by the Soil Conservation District.

The Brush Creek drainage downstream from the Snowmass Ski Resort was assessed for possible water quality effects from recreational and urban activities [USGS, 1979]. At a site upstream from the ski area, water quality seemed to be adversely affected only during spring runoff. A relatively high level of sediment and nutrient probably are due to the natural runoff from the erosive Mancos Shale, mudflow deposits, and unconsolidated rock debris upstream. Downstream from the Snowmass ski area and sewage treatment plant, nearly all chemical concentrations increase as compared to upstream. The larger sediment and nutrient concentrations at this site are from natural runoff and runoff from ski area facilities.

The 1988 208 Plan stated that nutrient concentrations downstream of the Snowmass Sanitation District discharge were elevated as compared to upstream values. Wasteload allocations for ammonia, chlorine and BOD have been established and advanced treatment has been provided to reduce ammonia, BOD and discharges to the maximum feasible level.

The Snowmass Ski Area Final Environmental Impact Statement (USFS, Aspen Ranger District, 1994) states "This stream [Mainstem Brush Creek] has been highly affected by human use on both National Forest Service Land and private lands, resulting in considerable habitat and water quality degradation. In many areas, riparian vegetation has been eradicated or significantly altered."

The macroinvertebrate community in Brush Creek differs from those in other streams within the assessment area, indicating poor water quality and the abundance of fine particulate organic material in the channel (USFS, 1994). Surveys conducted by the Colorado Division of Wildlife and Forest Service confirm that brook trout inhabit Brush Creek in sufficient numbers to warrant the consideration of habitat improvement. The Water Quality Control Commission has classified Brush Creek as "Aquatic Life Class 2" and "Use Protected" (not subject to antidegradation review) because of habitat limitations.

Finally, the USFS 1994 FEIS states "On National Forest Service Land, there has been a 22% reduction of riparian habitats since pre-development, while on private land the reduction is significantly higher at 66%. Most notable is the elimination of riparian floodplain areas."

In 1995 the Town of Snowmass Village applied for a nonpoint source grant from the EPA. In their application they stated that in 1993, a below average runoff year, as much as 40 tons of sediment and bedload per day was measured during peak stream runoff. Sources of suspended sediment included: construction sites (9,000 mg/L); unpaved ditches (6,900 mg/L); unpaved parking lots (6,300 mg/L); and paved sanded parking lots (800 mg/L). Natural runoff was measured at 12 mg/L.

In 1999 the Water Quality Control Commission upgraded the Classification of Brush Creek from Aquatic Life Class 2 to Aquatic Life Class 1 based on biological data that supported the change.

A draft Watershed Management Plan for Brush Creek in and near the Town of Snowmass Village was presented to the Town by Wright Water Engineers in August 2000. Generally, the report characterizes the soil characteristics for areas directly tributary to Brush Creek as moderate to severe for hazard of water erosion. Control of TSS and sediment are the highest priority issues identified in the watershed plan.

A macroinvertebrate and trout population evaluation was prepared for The Town of Snowmass Village by William Walsh in May of 2001. The best brook trout population in Brush Creek was found in the lower Golf Course section of the Creek. Both wild and hatchery trout were found in Brush Creek. It was reported that suspended sediment in Brush Creek range from 0 to 668 mg/l, and that both the trout population and macroinvertebrates could be impacted to some degree by this level of sediment.

The Roaring Fork Conservancy's site on Brush Creek has observed pH values exceeding the State standard (9.0) on a few occasions. The maximum value of 11 observations was a pH of 9.04, with two other readings to 9.02 [Roaring Fork Watershed 2000 Report].

2.3 Woody Creek (part of Stream Segment 3)

The USGS [USGS, 1979] evaluated the Woody Creek drainage for water quality conditions prior to the proposed construction of a lead and zinc mine near the town of Lenado (the mine is no longer under consideration). Water samples were collected from the stream upstream and downstream from the proposed mine site. Except for total

cadmium concentrations which exceeded aquatic life standards at both sites and total lead concentrations which exceeded standards, all trace element concentrations were low, with zinc concentrations at detection limits. The dissolved solids concentrations also were low, with a maximum observed value of 111 mg/L. In 1987 State standards for cadmium and lead were changed from total to dissolved concentrations for these (and most other) metals.

2.4 Snowmass Creek (part of Stream Segment 3)

Water quality data for Snowmass Creek does not exist, however macroinvertebrate collections indicate excellent water quality (USFS, 1994). Fisheries data collected above the Snowmass Water and Sanitation District diversion indicate a reproducing, self-sustaining population of brook trout, and possibly brown trout and sculpin population (USFS, 1994).

Water quality data has been collected on the Roaring Fork at the 7-11 Bridge by Basalt High School as part of the Division of Wildlife's River Watch Program in 1992 and 1993. The data indicates good water quality with respect to pH, dissolved oxygen, and metals.

2.5 Fryingpan River (Stream Segments 5, 6, &7)

Past studies, including the Fryingpan-Arkasas Project Final Environmental Impact Statement (1974), USGS [USGS, 1979], and Ruedi Reservoir Round II Water Marketing Program Final Supplement to the Environmental Statement [Bureau of Reclamation, 1989], have documented that the Fryingpan River has water quality suitable for all uses.

The Fryingpan River in the upper reaches at Norrie has water suitable for all uses with very low chemical concentrations [USGS, 1979]. Chemical concentrations increase downstream, especially sulfate, calcium, and dissolved solids. The lower reaches drain the Maroon Formation and various siltstone and sandstone layers, which yield calcium sulfate water. Also, there is an increased amount of flow from ground water stored in alluvial deposits in the lower reaches of the Fryingpan River. Because of this, there is a greater mineral content discharged to the stream, as compared to upstream. The dissolved-solids concentration averages about 200 mg/L, and is thus similar to the downstream reaches of the Roaring Fork River USGS, 1979]. Suspended solids average less than 10 mg/L [Bureau of Reclamation, 1989].

The Colorado River Water Conservation District and cities of Aurora and Colorado Springs are studying the possibility of pumping 20,000 acre-feet of Ruedi water across the Continental Divide each winter, the cheapest of several possible alternatives (the others being in the Eagle River watershed) that would bring water needed for growth to the two cities. Two studies, one on the economic impacts of changes in stream flow and reservoir levels and the other on aquatic life impacts, are being conducted by the Roaring Fork Conservancy, and should be completed by the middle of 2002.

2.6 Crystal River and Tributaries (Stream Segments 8, 9, and 10)

The Crystal River upstream from Redstone to Marble contains concentrations of

cadmium, zinc, lead, copper and mercury that exceed values for aquatic life, according to the 1989 Colorado Nonpoint Source Assessment Report [WQCD, 1989]. Possible sources of these metals are the Avalanche mining district in Pitkin County, the Crystal River area in Gunnison County, or the Crested Butte coal mining district. The Water Quality Control Division has indicated that claims of cadmium exceedances were based on inaccurate or misleading data.

According to the 1989 Nonpoint Source Assessment Report [WQCD, 1989] the upper portion of the Crystal River above Redstone is a poor fishery, possibly due to metals pollution or habitat problems. Water quality sampling by the WQCD at Redstone between 1988 and 1992, however, did not detect cadmium, chromium, copper, lead, or zinc in any of 20 samples (mercury was not sampled).

Calcium and sulfate concentrations are slightly increased in the upper reach of the Crystal River [USGS, 1979]. These concentrations are due to natural sources as the stream drains the Maroon Formation overlying some areas of Eagle Valley Evaporite. The influence of Eagle Valley Evaporite is even more noticeable downstream from Redstone as the sulfate concentration increased. The effect of the Redstone Sanitation Plant discharge to the Crystal River is minimal as there appeared to be no significant increases in nutrient or bacteria concentrations.

The State's 1998 303(d) list includes Coal Creek and the Crystal River below Coal Creek as a segment for monitoring and evaluation to determine if there is use impairment. In spite of this, the 1989 Nonpoint Source Assessment Report [WQCD, 1989] states that the lower Crystal River and the Roaring Fork below the Crystal River provide very good aquatic habitat and support good fisheries.

The 1988 208 Plan reviewed WQCD water quality monitoring data from 1979 through 1987 at the Crystal River station located at Redstone and found that eight year average concentrations of silver, nickel, cadmium, lead and copper exceeded aquatic life standards. Conclusions regarding nickel and silver were tenuous as there is a very limited database for these two metals. Levels of total phosphorus, dissolved solids and turbidity are also high. Comparing eight-year average concentrations with those from the most recent three year period (1984 -1987) it appeared the water quality improved for all parameters listed above. Three year average lead concentrations still exceed the aquatic life standards. Nickel and silver were not monitored in this period. Total phosphorus and dissolved solids are also reduced.

More recent WQCD water quality data at the Redstone station (1988-1992) showed high total suspended solids (average of 65 mg/L, 23 samples), did not include sampling for silver and nickel, did not detect cadmium, chromium, copper, lead, or zinc in any of 20 sampling events. Samples for un-ionized ammonia, manganese and iron never exceeded stream standards. Fecal coliform bacteria exceeded stream standards once in 22 samples (220 MPN /100 ml), while the standard is 200).

The Roaring Fork Conservancy's water quality monitoring station at Redstone could be considered the one lone metals "hotspot" in the watershed (with the exception of total iron from Coal Creek and North Thompson Creek). Exceedances of the selenium water quality standards were observed in June, August, September, and December. Exceedances of the cadmium standard was observed in June and August, and lead exceeded the water quality standard in June of 2000 [Roaring Fork Conservancy

Riverwatch monitoring data].

Water quality data collected in 1975 on Coal Creek (Roaring Fork Segment 9) by the Water Quality Control Division, showed increases in specific conductance and concentrations of turbidity, suspended solids, and dissolved solids downstream from the Mid-Continent Coal Mine, compared to upstream from the mine. Previous studies documented that the dissolved and suspended sediment concentrations downstream from the mine exceeded water supply and recommended aquatic-life standards.

Studies conducted by the USGS in 1979 [USGS, 1979] assessed water quality both upstream and downstream from the Mid-Continent mine in Coal Basin. A high concentration of suspended sediment was attributed to natural runoff from the alluvium and outcrops of Mancos Shale and Mesa Verde Formation, which are fairly easily weathered, fine grained sandstones. The suspended sediment concentration decreased downstream on Coal Creek probably as a result of a decrease in stream gradient. The maximum total iron concentration of iron from wells in the Coal Creek basin that exceed water-supply standards. The total organic-carbon concentration of 24 mg/L may be due to groundwater contribution during low flow from areas of the Mesa Verde Formation containing carbonaceous shales.

The USGS monitors a site on the Crystal River between the Town of Redstone and Avalanche Creek. Data collected between 1998 and 2001 showed occasional values of total recoverable iron above 500 ug/L and three values of greater than 2,000 ug/L (May 12 and June 2, 1998, August 22, 2000). The State chronic standard for total recoverable iron for protection of aquatic life is 1,000 ug/L. All other parameters at this site meet State water quality standards.

The Division of Minerals and Geology (DMG) has reclamation responsibility for the Mid-Continent mine, which filed for bankruptcy in 1992. The DMG has been actively overseeing reclamation of the site, and is expecting completion of reclamation activities by 1998. More information on the reclamation is given in Section 4.1 - Existing Watershed Improvement Projects.

Previous studies on North Thompson Creek (Segment 10) [Colorado Department of Health and Colorado Division of Wildlife, 1977] showed increases in chemical concentrations downstream from the Anshutz Coal Mine. Studies of mine discharges, revealed a 1,000 percent increase in specific conductance and concentrations of dissolved solids, and as much as a 5,000 percent increase in suspended sediment concentrations, compared to samples collected upstream from the mine. Calcium and sulfate concentrations also increased on North Thompson Creek, downstream from the Anshutz Coal Mine. The dissolved and suspended sediment concentrations downstream from the mine exceeded drinking water and aquatic life standards in previous studies. Note that this data is extremely outdated.

North Thompson Creek was also evaluated by the USGS in 1979 [USGS, 1979] to determine possible water quality effects from the operation of the Anshutz coal mine in the drainage basin. Upstream from the mine, a total iron concentration of 3,400 ug/L, was attributed to natural runoff. On North Thompson Creek downstream from the Anshutz coal mine, dissolved solids, calcium, sodium, magnesium, and sulfate concentrations markedly increased from upstream. Dewatering of the mines or ground-water contribution may have provided greater concentrations of these constituents from

outcrops of Eagle Valley Evaporite and the Maroon Formation. A high suspended sediment concentration indicates the erosive potential of soils upstream. There also may be a large suspended sediment load downstream as a result of discharges from the Anshutz coal mine. Please note that this data is extremely dated. The mine has been closed to MLRB standards (1987) so resultant improvements in water quality may be expected. The Division of Minerals and Geology has found that suspended sediments from the site are currently (1996) at background levels. The Anshutz mine is responsible for a 17% increase in salinity to North Thompson Creek, however the conductivity of the discharge has been decreasing over the last seven years. The other remaining outstanding issue is the relatively high concentration of iron discharged from two portals. The mine, however, consistently discharges water which is better that what its discharge permit requires.

The Division of Wildlife's River Watch Program has a number of stations on the Crystal River. Carbondale Middle School monitors a station at the Division of Wildlife's hatchery. Roaring Fork High School monitors at Gray Ranch, and Marble Charter School monitors at the Genter Mine Bridge. The Gray Ranch site appears to have low dissolved oxygen concentrations during low flow conditions, which approach the standard set for the protection of coldwater fish (the standard is 6.0 mg/L). The hatchery site also appears to have low dissolved oxygen concentrations during low flow conditions. Sweet Hill Bridge appears to have the worst problem of any of the River Watch sites in the Crystal River, with respect to dissolved oxygen concentrations. Twelve of thirty samples collected between 1992 and 1993 fell below the standard set to protect aquatic life (less than 6 mg/L). If this data is accurate, it would indicate the need to do additional work to identify what is causing the dissolved oxygen problem at this site.

The Roaring Fork Conservancy's Water Quality monitoring program includes three sites on the Crystal River and one on Coal Creek, replacing the sites discussed in the preceding paragraph. These sites are: Crystal River Genter Mine bridge; Crystal River Redstone; Coal Creek at Coal Creek reclamation; and Crystal River at Coryell Ranch. High total iron values were observed in April 2000. Values for total iron exceeding the State standard of 1,000 ug/L (total recoverable) ranged from 3,545 ug/L at Coal Creek Reclamation site, to 1,441 ug/L at Park East, in April of 2000 [Roaring Fork Watershed: 2000 Report]. Additionally, high values for cadmium, lead and selenium were observed at the Redstone site. Total iron concentrations at other times of the year in 2000 met the water quality standard of 1,000 ug/L total recoverable iron.

Dissolved oxygen on the Crystal River and downstream sites of the Roaring Fork Conservancy's Water Quality monitoring program in 2000 exhibited no dissolved oxygen concerns. The minimum dissolved oxygen value recorded was 6.6 mg/L at the Coal Creek site and the mean value of 11 samples was 8.8 mg/L. All other sites below the Coal Creek site (including the mainstem Roaring Fork sites below the confluence) had mean values above 9.0 mg/L dissolved oxygen.

2.7 Lower Roaring Fork (Crystal River Confluence to the Confluence with the Colorado River, Stream Segment 3)

One Water Quality Control Division monitoring station exists on the Roaring Fork - just above the confluence with the Colorado River. Water quality data from this station

indicates that water quality is good at this site, with no water quality standards being exceeded. Phosphorus levels between 1988 and 1992 were well below the regional average, at 0.054 mg/L. Metals were all at low concentrations and the fecal coliform standard was only exceeded once.

The USGS maintains a station on the Roaring Fork at Glenwood Springs approximately 1/2 mile above the confluence. This station was sampled in 1994 by the USGS on four occasions for metals, dissolved oxygen, pH, and bacteria. All parameters met water quality standards.

Glenwood High School collects water quality samples on the Roaring Fork at the 7th Avenue Bridge as part of the Division of Wildlife's River Watch Program. Again, water samples collected at this station showed the Roaring Fork meeting water quality standards for the parameters analyzed. This continues to be the case as reported in the Roaring Fork Conservancy's Roaring Fork Watershed: 2000 State of the River Report.

2.8 Watershed Instream Flows

Appendix 14 lists the Colorado Water Conservation Board's (CWCB) instream flow filings in the Roaring Fork River watershed. Colorado statute (CRS 37-92-102(3) recognizes that preserving the natural environment to a reasonable degree, through the protection of instream flows and maintenance of natural lake levels in natural lakes, is a beneficial use of water. Under the same statute, the Colorado Water Conservation Board is declared the exclusive agent authorized to appropriate water rights for the purpose of preserving the natural environment. It is also stated that the acquisition of the water rights to protect instream flows has to be made within the context of existing water rights appropriation regulations. Instream flows are therefore subject to appropriation dates, and the CWCB can only call out water rights junior to their own for maintenance of those flows. Most of the appropriation dates in the Roaring Fork watershed are between 1973 and 1985.

The CWCB appropriation flows, determined in consultation with the Division of Wildlife and the Division of Parks and Outdoor Recreation, are the flows necessary "to preserve the natural environment to a reasonable degree" (CRS 37-92-102(3)). The fact that the CWCB has filings for these instream flows does not ensure that stream flows will always exceed the minimum necessary to protect the natural environment, as the water rights associated with these flows have relatively junior appropriation dates. Exercise of water rights that are senior in date to the CWCB instream flow appropriation dates can result in stream flows lower than the CWCB appropriation amount.

The National Conservation Fund has donated senior water rights to the Colorado Water Conservation Board to insure protection of natural stream flows in Snowmass Creek.

The City of Aspen has entered into an agreement with the CWCB for maintenance of in-stream flows in Castle Creek (set at 12 cfs by the CWCB) through a systematic program of stream monitoring and administration of the City's water rights.

It should be noted that the Roaring Fork River from the confluence with the Crystal River to the confluence with the Colorado River, and Four Mile Creek which flows into the Roaring Fork above Glenwood Springs, have no CWCB instream flow appropriation.

The Division of Wildlife has indicated that they will be examining these streams for appropriate instream flow appropriations in 1996 or at the latest 1997 [Jay Skinner, DOW, personal communication, 1996].

A Colorado Water Conservation Board instream flow appropriation on Snowmass Creek (12 cfs year round) has received important attention. In 1991, the CWCB initiated a review of its Snowmass Creek instream flow water right to verify that the Board's rights conformed to today's scientific standards. Based on those standards, the Board determined that the 17 mile Snowmass Creek right should be segmented into three shorter reaches and that flow amounts should be split into summer and winter flows. As a result of this review, Snowmass Creek Instream flow need determinations both increased and decreased, depending on the segment and time of year. The Aspen Wilderness Workshop sought an Administrative Process Act (APA) review of the CWCB's decision to reduce its Snowmass Creek instream flow water right. The Denver District Court upheld the CWCB's actions, and the decision was appealed. The Colorado Supreme Court reversed the District Court's decision, holding that the CWCB did not have the authority to reduce an appropriation and that it must implement the terms of the original decree until that decree is modified by the water court. A significant statement was made by the Supreme Court in its decision, declaring that the CWCB has a unique statutory fiduciary duty to appropriate the minimum stream flows necessary to preserve the natural environment to a reasonable degree. *Application for Water Rights to Hines Highlands Ltd. Partnership* 929 P.2d 718 (Colo.1996).

3.0 WATER QUALITY ISSUES

3.1 Point Source Issues

Point source problems were extensively evaluated by the Colorado Department of Health in 1974 as part of the Roaring Fork River Basin 303(e) Plan. Point source treatment needs, consolidation of wastewater treatment facilities, waste load allocations, treatment alternatives and other related matters were addressed in the basin plan. The principal problems addressed included the need for advanced wastewater capability at domestic facilities to protect Roaring Fork River and Brush Creek from toxicity due to discharges of ammonia, chlorine and BOD. The plan also addressed the need for future consolidation of facilities in the El Jebel area as result of anticipated growth in the area. Since the adoption of the basin plan in 1974 and development of the 208 plan (which incorporated its recommendations), the development of wastewater treatment facilities has generally proceeded in accordance with the 303(e) Plan recommendations except for the mid-valley area consolidation opportunity. Facility plans under Section 201 of the Clean Water Act have defined the precise treatment mechanisms and locations for wastewater treatment and have implemented the recommendations of both the 208 and basin plans.

3.1.1 Municipal Discharges

Table 15 lists the municipal and domestic wastewater treatment plants with average discharges of more than 10,000 gallons per day in the Roaring Fork watershed along

with their Colorado Discharge Permit System number and their hydraulic capacity.

Table 15. Roaring Fork Municipal and Domestic Wastewater Treatment Plants

CDPS Number	Facility Name	Responsible party	Hydraulic capacity, MGD
CO-00263873	Aspen WWTF	Aspen Consol SD	3.0 (4.5 anticipated)
CO-0023086	Snowmass WWTF	Snowmass W&SD	3.2
CO-0022721	Aspen Village WWTF	Aspen Village HOA.	0.051
	Woody Creek WWTF	Woody Ck MHP	0.032
CO-0020303	Lazy Glen WWTF	Lazy Glen HOA	0.045
CO-0031810	Sopris Village	Sopris Village HOA	0.05
COG-584051	Ranch at Roaring Fork WWTF	Ranch at Roaring Fork HOA	0.10
CO-0021491	Basalt WWTF	Basalt SD	0.8
CO-00584007	Mid-Valley WWTF	Mid-Valley Metro Dist.	0.5
CO-0043184	El Jebel WWTF	??	0.14
CO-0023922	Redstone WWTF	Redstone W&SD	0.05
COG-584050	Carbondale WWTF	Town of Carbondale	0.995
CO-0044750	Aspen Glen WWTF	Roaring Fork W&SD	0.107
	Mountain Meadows WWTF	Mtn Meadows HOA	0.010
CO-0045331	Spring Valley WWTF	Spring Valley SD	0.052
COG-584035	H Lazy F WWTF	H Lazy F Mobile Home Park	0.040
COG-584029	El Rocko WWTF	El Rocko MHP	0.010
CO-0038598	Ski Sunlight WTF	Ski Sunlight, Inc.	0.03
CO-0020516	Glenwood Springs	City of Glenwood Spr.	2.3

A more detailed list of the permitted wastewater treatment plants in Region XII is included in Appendix 3. This appendix includes information on the regions' wastewater treatment plants' capacities, average and peak flows, treatment type, biosolids processing and disposal practices, permit expiration dates, discharge locations, condition and expansion plans. A brief description of municipal and domestic wastewater treatment facilities in the watershed follows.

Aspen Consolidated Wastewater Treatment Plant

The Aspen Consolidated wastewater treatment facility is a tertiary treatment plant with 3.0 MGD capacity that discharges to Segment 3 of the Roaring Fork. There is an anticipation that the capacity of the plant will need to be expanded to 4.5 MGD. Permitted Biological Oxygen Demand (BOD) capacity is 9,100 pounds per day. The treatment facility consists of pretreatment works (bar screen, comminuters, and grit chambers), aeration basins, secondary clarifiers, nitrification filters, final filters (rapid sand filters), and disinfection. The facility has an aerobic digestor and two centrifuges for biosolids treatment. Aspen Consolidated Sanitation District has an ongoing Capital Improvement Plan to address long-term capacity and treatment needs. The plant has an excellent history of operation and compliance with its permit. The district currently disposes of its biosolids at the county landfill, which is investigating the feasibility of use of the material for local landscaping. The plant's current discharge permit expires January 31, 2006.

Snowmass Village Wastewater Treatment Plant

The Snowmass Village wastewater treatment facility is a 3.2 MGD activated sludge plant with Rotating Biological Contactor (RBC) for effluent polishing which discharges to irrigation ponds and also directly to Brush Creek, Segment 4 of the Roaring Fork River. The plant was at 80% of capacity in March 1990. An aggressive infiltration and inflow program was initiated in the late 1980's and the district performs annual TV surveillance, cleaning and repair. Ammonia monitoring in Brush Creek was a condition of the previous permit, and at the next permit renewal (June 30, 1996), the permit may be changed to reflect new limits for total ammonia. The new draft permit includes chronic total ammonia discharge limits ranging from 1.2 to 3.9 mg/L. Biosolids disposal is accomplished by thickening and aerobic digestion, followed by disposal at a dedicated disposal site that accepts only sewage sludge from the Snowmass wastewater treatment works. An expansion has been completed for an enlarged treatment works with an average daily flow capacity of 3.2 MGD. The treatment process is conventional activated sludge, fixed media nitrification (two rotating biological contactor basins), flow equalization pond and/or effluent filtration, and UV disinfection. The renewal permit for this facility was issued September 6, 1996 and expired October 31, 2001. This discharge permit is currently under an administrative extension of the existing permit (with a 1.8 MGD hydraulic capacity and 6,000 pounds BOD). A draft renewal permit was issued in March 2002. The renewal permit recognizes a hydraulic capacity of 3.2 MGD and an organic capacity of 6,000 pounds of BOD_5 per day.

Aspen Village Wastewater Treatment Plant

The Aspen Village wastewater treatment facility is a 0.051 MGD aerated lagoon system which discharges to Segment 3 of the Roaring Fork River and is operated by Aspen Village, Inc. Organic capacity is permitted at 120 pounds of BOD per day. The facility consists of one lift station, two aerated lagoons with surface aeration, a polishing pond, and chlorination. Since the facility is a lagoon, sludge removal is infrequent. The plant has had problems with algal growth in the polishing pond, as it has residence time of 16 days (the recommended residence time is three to five days). No infiltration or inflow problems have been documented in the service area. The permit for this facility expires July 31, 2005. A compliance schedule was established for implementing a groundwater monitoring program. The District is conducting monthly groundwater monitoring.

Woody Creek Wastewater Treatment Facility

The Woody Creek Mobile Home Park is served by this facility, which has a design flow of 0.032 MGD. This facility has previously not been permitted. A permit is currently being developed by the Water Quality Control Division in 2002. The facility is a mechanical plant which was designed to discharge to groundwater. Preliminary effluent limits of groundwater discharge were issued in May of 2000 and surface water preliminary effluent limits were issued in January 2001.

Rivers Bend Apartments

This sequencing batch reactor, recirculating sand filter facility of 3,040 gallons per day facility was recommended for site approval with conditions by the NWCCOG in February 2001. The site application requested an organic loading of 7.34 pounds BOD per day.

The facility serves 19 units or approximately 38 people.

Lazy Glen Wastewater Treatment Plant

The Lazy Glen wastewater treatment facility is a 0.045 MGD aerated lagoon with an organic capacity of 58 pounds of BOD per day that uses an aerated lagoon, rock filter, polishing pond and chlorination disinfection treatment process. Discharge is to the Segment 3 of the Roaring Fork. The facility serves approximately 290 people. The Lazy Glen Mobile Home Park was included in the service area of the Basalt Sanitation District in July 1999. The Basalt Sanitation District is the water quality management agency for the service area. The Lazy Glen Mobile Home Park operates the wastewater treatment plant and is the discharge permit holder. The Lazy Glen area has been incorporated into the Basalt Sanitation District's service area. The Lazy Glen wastewater treatment facility should be managed and operated by the Basalt Sanitation District.

Past problems have included inadequate chlorination, possible lagoon leakage and flooding. The lagoon is not lined and will be required to meet new Water Quality Control regulations concerning discharge to groundwater. No ammonia limits are needed due to the high calculated total ammonia effluent limits, based on stream flows and hydraulic loading. Since the facility is a lagoon, sludge removal is infrequent. Infiltration and inflow (approximately 10,000 gallons per day during the spring) do occur. A TV survey of the collection system will be done to identify problems. The discharge permit for this facility expires December 31, 2004.

Basalt Wastewater Treatment Plant

The Basalt Wastewater Treatment facility is a 0.8 MGD plant with a headworks, oxidation ditch, secondary clarifiers, UV disinfection, and a polishing pond. The plant discharges to Segment 3 of the Roaring Fork River. The organic loading capacity of the pant is rated at 1,600 pounds of BOD per day. The facility is operated by the Basalt Sanitation District and serves the Town of Basalt and surrounding area. The discharge permit does not include limits for ammonia or ammonia monitoring as calculated limits were much greater than expected effluent concentrations. Sludge from the facility is aerobically digested and de-watered with a centrifuge prior to ultimate disposal at the Pitkin County landfill which has a sludge composting program. The discharge permit for the facility is currently on an administrative extension. A new discharge permit application was submitted in February 2001. A site application was approved by the Division in August 1999 for the 0.8 MGD hydraulic capacity.

NWCCOG and its member jurisdictions have identified that Lazy Glen, Holland Hills and Wingo Junction can and should be included within the Basalt Sanitation District's service area subject to the terms and conditions of the District's rules, regulations and agreements. These communities, located along Highway 82 less than two miles up-valley of the Town of Basalt, were identified by the Basalt Sanitation District in their 1974 201 facility plan as areas appropriate for service by the District.

The Ranch at the Roaring Fork

The wastewater treatment facility for the Ranch at the Roaring Fork is a 0.10 MGD package plant using an extended aeration activated sludge process, installed in 1973 which discharges to Sopris Creek, Segment 3 of the Roaring Fork River. It is permitted

at 150 pounds of BOD per day. The homeowners association is responsible for the operation and maintenance of the facility. The facility consists of 2 gravity grit channels, 2 lift stations, 2 aeration tanks, a clarifier, chlorinator, and polishing pond. Sludge is treated in an aerobic digestor, after which it is applied to four drying beds. Dried sludge is held on site until it is transported to the Pitkin County landfill. Site application for expansion of the facility from 0.05 to 0.1 MGD was approved in 1999. The design review was completed in March 2000 that showed that the facility could meet the approved flow and loading. The facility serves the Ranch at Roaring Fork, Preshana Farms, and Saint Finbar developments. The permit for this facility expires December 31, 2004.

The Town of Marble has been platted as 1/20 acre lots on septic systems with 2,000 lots platted inside the town boundary and 1,500 outside of the town limits. The town is on central water, which is supplied by shallow wells, possibly under the influence of surface water, and possibly in the same aquifer as the septic systems. Currently there not enough taps to justify any type of community system.

Sopris Village Homeowners Association Wastewater Treatment Plant

The Sopris Village homeowners association wastewater treatment facility is a 0.052 MGD Can-Tex package treatment plant which discharges to groundwater via ex-filtration ponds. The organic capacity of the facility is rated at 91 pounds of BOD per day. The plant can be operated in a contact stabilization or conventional mode, followed by effluent chlorination, and two ex-filtration ponds Overflow from the ponds and groundwater is to segment 3 of the Roaring Fork River. The package plant consists of a bar screen, activated sludge aeration and re-aeration basins, a clarifier and an aerobic sludge digestion tank. Biosolids are trucked to the South Canyon sanitary landfill. Ammonia limitations and monitoring are not required due to the expected effluent concentrations and instream flows. The discharge permit for this facility expired November 30, 1994, but has been had been administratively extended.

Redstone Wastewater Treatment Plant

The Town of Redstone's wastewater treatment facility is a 0.05 MGD extended aeration, activated sludge plant built in 1974 which discharges to the Crystal River, Segment 8 of the Roaring Fork River. The permitted organic capacity of the facility is 85 pounds BOD per day. The facility serves a permanent population of about 170 - 200 people. The facility consists of a bar screen, aerated chamber, grit channel, and a wet well with two lift pumps followed by a package plant with a subsurface aeration basin, a center feed clarifier, gas chlorination, and infiltration/polishing pond and discharge to the groundwater and the Crystal River. Due to the large dilution factor (greater than 400:1) of the Crystal River compared to the hydraulic capacity of the plant, limits for ammonia and other mass balance parameters is not necessary. Infiltration and inflow has been documented to be about 10,000 gallons per day during wet times - especially during the spring runoff. Repairs are made as resources allow. Waste sludge is aerobically digested and land applied. In 1997 the wastewater facility was at 80% capacity. The permit for this facility expires September 30, 2002.

Mid-Valley Metro District Wastewater Treatment Plant

The Mid-Valley Metro District wastewater treatment facility is a 0.325 MGD lagoon

system built in 1984, which discharges to Segment 3 of the Roaring Fork. The facility serves the El Jebel area on the northeast side of the Roaring Fork and operates under a general discharge permit for chronic low flows: design flows of greater than 100:1. The facility consists of two aerated lagoons, a settling ponds, and chlorine contact tank, prior to discharge to the Roaring Fork River. The facility has a 30 mg/L total ammonia discharge limit. No infiltration/inflow problems have been documented in the service area. There is one lift station within the service area. In 1998 Mid-Valley Metro District is examining expanding their district boundaries to include additional development in the Mid-Valley area. NWCCOG is encouraging Mid-Valley to provide leadership in developing a coordinated approach to wastewater treatment in the mid-valley area. The Division renewed this permit on December 15, 1999, with an expiration date of December 31, 2004. The hydraulic capacity remains at 0.325 MGD and the organic capacity at 545 pounds of BOD per day. In this permit renewal the monitoring requirement for ammonia was discontinued.

On January 2, 2002, the Water Quality Control Division approved a site application from the Mid Valley Metropolitan District for a facility expansion to an average daily flow capacity of 0.499 MDG, and an organic loading capacity of 957.6 pounds of BOD per day. The approved facility is an extended aeration, secondary clarification with nitrification/de-nitrification system, and is expected to be under construction in the summer of 2002.

El Jebel Mobile Home Park Wastewater Treatment Plant

The El Jebel Mobile Home Park wastewater treatment facility is a 0.136 MGD aerated lagoon that discharges to groundwater via an exfiltration/storage pond and irrigation of hay fields adjacent to Blue Creek. The organic capacity of the facility is rated at 272 pounds of BOD per day. The facility was last upgraded in 1993 and consists of a preaeration basin (also used for grit removal and screening), two aerated lagoons, a chlorine contact chamber, and an exfiltration and storage pond. Since this is a lagoon system, sludge removal is infrequent. The discharge permit for this facility expired in April, 1999, and is under an administrative extension.

Carbondale Wastewater Treatment Plant

The Town of Carbondale wastewater treatment plant is a 0.995 MGD aerated basin facility expanded in 1976, which discharges to Segment 3 of the Roaring Fork River. The treatment works consist of a bar screen, aerated grit chamber, two subsurface aerated basins, two clarifiers, gas chlorination, and two polishing ponds. Historical infiltration and inflow problems appear to have been corrected. No ammonia limits are needed, based on mass balance calculations for the existing 0.5 MGD facility. Waste activated sludge is aerobically digested and applied to several land application sites around Carbondale using a liquid sludge truck equipped with a soil injection system. The permit for this facility expires December 31, 2004. The town submitted a Site Application to the WQCD in 1995 for an expansion to 0.995 MGD, through the addition of additional blower and digestor capacity, which is expected to meet the needs of the community through 2010. The site application was approved in 1996 for a hydraulic capacity of 0.995 MGD and an organic load capacity of 2,248 pounds of BOD per day. The design review was completed in April 1998 showing that this flow and loading could be met.

Aspen Glen Wastewater Treatment Plant

The Aspen Glen wastewater treatment facility is a 0.107 MGD facility operated by the Roaring Fork Water and Sanitation District, which is an extended aeration facility with primary and secondary clarifiers, biosolids aerobic digestor, tertiary filtration and chlorine disinfection. The permitted organic loading is 225 pounds of BOD per day. The district boundary begins just below the confluence of the Crystal and Roaring Fork Rivers and extends down both sides of the Roaring Fork River to the City of Glenwood Springs. Discharge is to wetlands tributary to Segment 3 of the Roaring Fork River. Aspen Glen Water and Sanitation District also serves Coryell Ranch, Colorado Mountain College turnoff area ("midway area") and Unical. Rose Ranch is also in the service district and will be served. Biosolids disposal is through aerobic digestion and a commercial disposal company that hauls the material to the sanitary landfill at South Canyon. The discharge permit for this facility expired December 31, 2001 and is under an administrative extension.

H Lazy F Mobile Home Park Treatment Plant

H Lazy F Mobile Home Park wastewater treatment plant is a 0.04 MGD mechanical extended aeration facility that discharges to Segment 3 of the Roaring Fork River, approximately six miles south of Glenwood Springs. The organic capacity of this facility is rated at 83 pounds to BOD per day. No infiltration/inflow problems have been documented. Sludge is hauled, as needed, to the South Canyon Landfill. Total Residual Chlorine and BOD violations were found during a State monitoring inspection in 1992. The discharge permit expires December 31, 2004.

Spring Valley Sanitation District Wastewater Treatment Facility

The Spring Valley Sanitation District (SVSD) completed a 0.499 MGD activated sludge plant in December 2001. The Discharge Permit for new facility was issued effective January 1, 2002. The new facility is expected to be on line sometime during the calendar year 2002. The facility currently in use is a 3-cell aerated lagoon system with a rated capacity of 52,000 gpd. The facility discharges to groundwater, which is thought to be tributary to the Cattle Creek drainage. A draft permit for this facility was issued in April 2002.

The new facility is based on the "Aero-Mod" technology for activated sludge (extended aeration with secondary clarification and nitrification/de-nitrification system). The facility consists of a headworks facility with bar screen and flow measurement, activated sludge treatment, chlorination and de-chlorination, aerobic digestion and sludge-handling facilities consisting of a filter press. Sludge from the facility will be hauled off site for disposal. Discharge from the new facility will be by pump station into the Landis Creek Basin (commonly known as Spring Valley), a tributary to Segment 3 of the Roaring Fork River. Ammonia limits have been calculated for the facility using the Colorado ammonia model and vary by month. De-chlorination is required because of strict residual chlorine limitations in the effluent. The organic capacity is expected to be permitted for 999 pounds of BOD. The system includes two lift stations with capacities of 300,000 and 28,000 gallons per day. The permit for this facility is expected to be issued in early 2002.

Mountain Meadows Wastewater Treatment Plant

This facility serves the Mountain Meadows Mobile Home Park. The facility, which currently operates without a discharge permit, is designed to treat approximately 10,000 gallons per day and discharge to groundwater. The leach field for this facility has failed and the facility is discharging to a ditch. The facility is currently under an enforcement order issued in 2001 by the Water Quality Control Division.

El Rocko Mobile Home Park Wastewater Treatment Plant

The El Rocko wastewater treatment facility is a 0.01 MGD extended aeration package plant built in the early 1970's which discharges to Segment 3 of the Roaring Fork River approximately three miles south of Glenwood Springs. The organic capacity of the facility has been rated at 20 pounds of BOD per day. The facility serves a house, 23 mobile homes, seven RV spaces and a laundry (approximately 75 people). The facility consists of an extended aeration package plant with a comminutor and bar screen at the inlet to the aeration basin, subsurface aeration, a double hopper bottom clarifier, tablet chlorination, a chlorine contact chamber, tablet dechlorination, and discharge either to a leach field or to the Roaring Fork River. The facility has experienced numerous problems with the leach field over the years. This facility has experienced poor operations and maintenance. Hydraulic capacity is also an issue, as flows have exceeded the hydraulic capacity of the plant. No expansion of the facility has been planned for the next five years. Sludge is disposed of by pumping and hauling to the Garfield County landfill. The discharge permit for this facility expires December 31, 2004.

Ski Sunlight Wastewater Treatment Plant

The Ski Sunlight wastewater treatment facility is a 0.03 MGD lagoon system expanded in 1990 which discharges to Fourmile Creek, tributary to Segment 3 of the Roaring Fork River. The organic capacity of the facility is rated at 60 pounds of BOD per day. The facility consists of a headworks with a bar screen followed by two subsurface aerated ponds and backup surface aerators, a polishing pond, gas chlorination, a chlorine contact chamber, and a storage pond with a direct discharge to Fourmile Creek, or effluent can be pumped to the snow making/irrigation equipment. The facility has not had a direct discharge to Fourmile Creek in several years. It is possible that the final storage pond could be discharging to groundwater through seepage. The Colorado Department of Public Health and Environment required an ex-filtration study as part of it permit renewal. Ammonia limits have been calculated for the facility using the Colorado Ammonia Model (1.1 - 8.1 mg/L total ammonia as N). Ammonia monitoring will also be required as part of permit compliance. Since the facility consists of aerated lagoons, sludge removal will probably occur infrequently. The discharge permit for this facility expired September 30, 1998, and is under an administrative extension. Ski Sunlight has submitted a site application for a 0.05 MGD extended aeration, secondary clarification with nitrification/de-nitrification facility to the Water Quality Control Division in January 2002. The requested BOD load is 84 pounds.

City of Glenwood Springs Wastewater Treatment

The City of Glenwood Springs' wastewater treatment plant is a 2.3 MGD Rotating Biological Contactor (RBC) facility that discharges to Segment 3 of the Roaring Fork

River approximately 750 feet above the confluence with the Colorado River. The organic capacity of the facility is rated at 4,320 pounds of BOD per day. The facility consists of: coarse and fine bar screens; a primary clarifier; two RBC basins with four air driven shafts each; two secondary clarifiers; gas chlorination. Average flows between 1988 and 1990 were approximately 0.8 MGD (maximum of 0.9 MGD). In the December 2001 permit renewal total ammonia effluent limits of 27-29 mg/L were imposed on the facility for the months of May, August, September, and October. Anaerobic sludge digestion occurs in both primary and secondary digestors followed by sludge holding. The facility was build in the early 1970's. Digested sludge is currently being hauled by a contract hauler and applied for beneficial use. The discharge permit for this facility expires December 31, 2006. Glenwood Springs' 201 Planning area extends to Carbondale, but the Aspen Glen Sanitation District's formation has precluded serving this extended area.

3.1.2 Population Statistics and Projections

Population projections for the counties and the municipalities in the Roaring Fork watershed are listed in Table 16. Various areas within the Roaring Fork watershed have significantly different rates of growth. Pitkin County between 1980 and 1990 experienced an increase in permanent population of 22.5%, and between 1990 and 2000 an increase of 17.5%. Peak population projections are extremely important with respect to water quality planning, as wastewater treatment plant capacity needs to be able to meet peak demand. More information needs to be developed with respect to projected peak populations for some areas in the Roaring Fork watershed.

Table 16. Roaring Fork Watershed Population Statistics and Projections

Roaring Fork Watershed Permanent Population[1]

ENTITY	1980	1990	2000	2000 projected[2]	2010	2020
Pitkin Co	10,338	12,661	14,872	17,011	18,149[3]	21,725[3]
Aspen	3,678	5,049	5,914	6,430		
Snowmass Village	999	1,449	1,822	1,725		
Basalt	529	1,210	2,681	1,699		
El Jebel[4]			4,488			
Marble		64				
Redstone						
Carbondale[5]	2,084	3,004	5,196			
Glenwood Springs	4,637	6,561	7,736			
Garfield Census trct 9518.01&02			11,114			
Garfield Co	22,514	29,974	43,791	37,521	56,822[3]	72,301[3]

[1]: US Census data, from Denver Post, Census 2000 special report, March 20, 2001.
[2]: NWCCOG 1996 208 Plan, based on projections from the State Demographer's Office, Department of Local Affairs, Dec. 1994.
[3]: Population projection, State Department of Local Affairs, State Demographer's Office,

October 2000 projections.
[4]: Census tract information for the remainder of Eagle County in the Roaring Fork watershed
[5]: Does not include Redstone, which is included in Pitkin County data.
NOTE: Permanent population projections are not available for Towns

3.1.3 Industrial Discharges

Currently there are a number of active gravel mining operations including Mountain Mobile, Mid-Valley, just inside the Garfield County line, and Mobile Premix.

Inactive mines in the area include: North Thompson Creek Mines, which is currently under reclamation by Minrec, Inc., and was shown to have significant water quality impacts to North Thompson Creek, Anshutz Coal Mine; Coal Basin, which is currently under reclamation by the Colorado Division of Minerals and Geology, and the Smuggler Mine near Aspen (no surface or ground water quality concerns have been associated with this mine).

Other industry and point sources in the Roaring Fork watershed include the Division of Wildlife Fish hatchery on Crystal River, Filoha Meadows, a health spa which discharges a design flow of 0.11 MGD - discharge from therapy pools and radiant heating unit to the Crystal River, construction dewatering, and water treatment plant backwash discharges. These discharges are all controlled by permits issued through the Water Quality Control Division.

3.1.4 Point Source Issue Summary

In summary, the point source water quality problems of streams and lakes in the Roaring Fork River basin are:

High dissolved solids, and potentially high iron concentrations in North Thompson Creek as a result of natural runoff and because of drainage from the Anshutz Coal Mine;

Excessive metal and suspended sediment concentrations in Coal Basin as a result of the Mid-Continent Resources Coal Mine;

Point source discharges to Brush Creek are impacted by seasonal low stream flows and contribute to observed water quality problems.

Anecdotal evidence suggests that nutrient concentrations (from both point and nonpoint sources) in the Roaring Fork watershed are increasing and could cause aquatic ecological changes. An increase over time in periphyton, or algae attached to the river substrate, has been noted by long- time fishermen and guides.

3.2 Point Source Recommendations

A number of consolidations of IGSs or some other method of reduction in number of small failing domestic facilities have been recommended. These include:

The Woody Creek Wastewater treatment facility permit should go through the State site application process, including antidegradation review. This facility should be operated by a management agency.

The Lazy Glen area has been incorporated into the Basalt Sanitation District's service area. The Lazy Glen wastewater treatment facility should be managed and operated by the Basalt Sanitation District.

Redstone is meeting its discharge permit but needs to be upgraded and expanded. [A site application for expansion of this facility is expected in 2002.]

Colorado Rocky Mountain School's lagoon should be abandoned and the school should be connected to Carbondale's wastewater treatment facility.

A Consolidated Sanitation Management District in the mid-valley area should be established in the future. The sanitation districts which could be managed by a single management organization include: El Jebel, Basalt, Sopris Village, the Ranch at Roaring Fork, Mid-Valley, Carbondale, and Roaring Fork Water and Sanitation District.

H Lazy F**,** Mountain Meadows, El Rocko, and other ISDS systems which lie between Glenwood Springs and the H Lazy F should be connected to the Glenwood Springs wastewater treatment facility or other management agency, such as Roaring Fork Water and Sanitation District.

Spring Ridge, a 180 unit development on Fourmile Creek - has been permitted by Garfield County such that septic systems are acceptable until 75 units are built, and then will have to go on central sewer. Glenwood Springs is the appropriate sanitation district to provide wastewater treatment management for the development at that time.

Spring Ridge and Zilm/Sunlight should be connected to Glenwood Springs wastewater treatment facility.

3.3 Nonpoint Source Issues

The major nonpoint source water quality issues in streams and lakes in the Roaring Fork watershed include: the effects of both existing and inactive mining activities; urban and construction activities (including septic systems); agricultural activities (specifically silvicultural, or logging) and hydrologic modifications.

3.3.1 Urban and Construction Activities

Relatively high (compared with background) nutrient and sediment loads are found downstream of urbanized areas. Water quality monitoring in Vail and Summit County has documented elevated levels of nutrients, sediment, and heavy metals in stormwater runoff and downstream of urbanized areas.

Inconsistent enforcement of erosion control regulations continues to be an issue related to urban and construction activities.

Brush Creek has been impacted by the development of Snowmass Ski Resort in the mid-1960s. In 1994, a below average runoff year, as much as 40 tons of sediment and bedload per day was measured during the peak runoff [Snowmass Village, Brush Creek 319 proposal, 1995]. Although Brush Creek has been identified as an erosional area by the Natural Resource Conservation Service, this serves to indicate the potential impacts to water quality from sediment in urbanized areas.

The expanded use of septic systems can increase nutrient loading. Documented water quality problems from septic systems include high levels of bacteria in private and public water supplies and elevated levels of nutrients [Septic Tank System Effects on Ground Water Quality, Canter and Knox, 1985; SWQC An Evaluation of Methods to Control Phosphorus Contributions to Lake Dillon From Onsite Sewage Disposal Systems, 1988]. In Summit County, the Dillon Reservoir Clean Lakes Study and subsequent special studies have documented the contribution of nutrients from areas served by septic systems. At present it is not clear if the elevated nutrient levels in Blue River watersheds, which have a relatively high number of septic systems, are due to a few failing systems or the general performance of septic systems. After a thorough review of existing literature it was determined that the most cost effective approach to controlling phosphorus from septic systems is by targeting systems which perform poorly and correcting those systems, rather than requiring more sophisticated designs on new systems being installed.

Eagle, Garfield, and Pitkin Counties utilizing state and local criteria perform regulation of septic systems.

Another issue concerning septic systems is that as more and more lots are developed the development of lots that were previously considered "unbuildable" are being developed. In some case these lots were considered "unbuildable" due to septic system constraints. Thus, septic systems are being developed in unsuitable locations, and the engineering of these systems is increasingly complex and the efficiency and longevity of these systems is unknown.

The loss of riparian habitat and native vegetation in urbanized areas can impact water quality. As lawns are established that encroach into the natural riparian areas, increases in nutrient and other pollutant loads occurs. Lawns are also responsible for increased water consumption.

Increased in-basin water diversions for future urban development and snowmaking will have an impact on instream water quality.

Water conservation efforts should be diligently pursued.

3.3.2 Hydrologic Modifications

Water diversions are reducing instream flows. Trans-basin diversions, which often occur high in the watershed, reduce dilution flows further down the basin. Both trans-basin, and in-basin diversions impact water quality in those segments in which the water is lacking. However, trans-basin diversions are 100% consumptive in the basin of origin, whereas in-basin diversions are generally on the order of 10 - 50% consumptive. In

other words, trans-basin diversions do not return water to the stream of origin, while for in-basin diversions, the majority of the wastewater is returned to the stream at some point downstream.

In the Roaring Fork watershed there are three trans-basin diversions, which have a ten-year average diversion of 106,391acre-feet per year [State Engineers Office, Division of Water Resources, Division V records, for water year 2000]. In 2000 the total diverted trans-basin volume was 97,743 acre-feet (Table 17). The names of the diversion structures are: the Boustead Tunnel (Fryingpan River diversion); the Twin Lakes Tunnel (Roaring Fork River diversion); and the Busk-Ivanhoe Tunnel (Fryingpan River diversion). In 2000, the annual total runoff for the Roaring Fork River calculated at the USGS Glenwood Springs gauge was 708,600 acre-feet. Thus the trans-basin diversions were approximately fifteen percent of the Roaring Fork River's flow.

Table 17. Roaring Fork Watershed Trans-basin Diversions – 2000

Name	Stream (location)	Annual Flow (acre-feet)	Receiving stream
Boustead Tunnel	Fryingpan River	50,061	Lake Fork Creek
Twin Lakes Tunnel	Roaring Fork River	41,854	Lake Fork Creek
Busk-Ivanhoe Tunnel	Fryingpan River	5,208	Lake Fork Creek

Existing water development projects have had an effect on the water quality and on Colorado River salinity. Diversion of snow melt high in the basins with very low salinity results in less dilution of downstream salinity inputs.

Existing wastewater treatment levels have been based on meeting water quality standards under existing hydrologic conditions. Changes in the operations of the reservoirs to increase system yields, including reduction in residence times have the potential to modify the future treatment requirements to maintain the same level of water quality. The concern is that discharge permit limits can be made more stringent to meet instream water quality standards, when actual discharge quantities have not changed.

Existing treatment levels are determined, in part, by the one day in three year low flow event (1E3, used for establishing acute level discharge limits) and 30 day in three year low flow events (30E3, for establishing chronic level discharge limits). With consistently lower stream flows, average concentrations of pollutants will increase and the flow available for dilution will also decrease. Because ambient conditions are considered in effluent permit discharge limitations, more stringent permit limits could result from increased average concentrations of pollutants even though flow levels are not below the permit's low flow criteria.

There is also the requirement to comply with the state's antidegradation policy. The antidegradation policy for streams which are not "Use Protected" is that waters will be maintained at their existing quality unless lowering water quality is necessary to accommodate important economic or social development in the area. This would mean that plant discharge concentrations would have to decrease if stream flows decreased, in order to maintain the existing water quality.

As previously stated (section 2.5), studies are being currently conducted to examine the potential to divert an additional 20,000 acre-feet to the Arkansas River basin from the Frying Pan River. Potential impacts from trans-basin diversions, as stated in this

section, should be thoroughly evaluated.

3.3.3 Mining

Coal mining in the Crystal River drainage has had an impact on water quality for a significant amount of time. A Crystal River Drainage Study (completed between August 1978 - May 1979 by the Division of Wildlife) stated "Coal Creek, Bear Creek, and Dutch Creek exhibited very poor water quality with high solids, sulfate and heavy metals concentrations due to the Mid-Continent Resources Coal Mines". The same report states, "[t]here exists a sufficient difference in sulfate and solids concentrations below the North Thompson Creek Mines as compared to above the mines. A healthy trout population existed in North Thompson Creek above the mines, while only stock fish were recovered below the mines."

A 1990 White River National Forest Service report "Coal Basin: Crystal River Non-point Source Sediment Report" by Linda Ulmer stated "[t]his data suggests that mining operations are contributing substantially to increased sediment within Coal Basin." A 1991 USFS Report by Tony Svatos and Linda Ulmer entitled "Coal Basin Report" further documented existing problems and provided recommendations for "resolving issues relating to associated mining activities and related facilities" because "roads and abandoned coal spoils continue to degrade water quality in the watershed's tributary streams and the Crystal River near Redstone, Colorado." As previously stated, the Division of Minerals and Geology is continuing to reclaim the Coal Basin area. In 2002 the Division of Minerals and Geology is submitting a 319 proposal for slope remediation at a cost of approximately $80,000.

3.3.4 Recreational Activities

Numerous recreational activities can impact water quality. These include golf courses; snow making for skiing; and activities associated with water features such as fishing, rafting, etc.

Development of new homes and associated infrastructure which are secondary impacts from recreational development are an important impact on water quality, as many areas which were previously undisturbed are becoming developed or urbanized.

Some of the activities associated with skiing which impact water quality include: snowmaking (reduced stream flows at low flow times), large scale soil disturbance activities during construction of ski runs, runoff from denuded slopes that aren't well vegetated, increased urbanization, and habitat loss (wetland and riparian areas). There are currently (January 1996) 4,235 acres of lift served skiable terrain in Pitkin County (Aspen Ski Corp).

Golf courses impact water quality through fertilizer and pesticide runoff, large scale soil disturbance during construction, increased runoff, and watering practices.

Activities associated with water features can impact the riparian and aquatic community as well as water quality. Erosion from foot and vehicle traffic; increased stream bottom disturbance, inadequate toilet facilities; and littering can all lead to water quality impacts.

3.3.5 Agricultural Activities

Timbering activities which disturb large areas of land can produce a significant water quality impact. A study funded by the Summit Water Quality Committee examined three types of forest management practices in Summit County: control (no action); over-story removal (partial removal of timber); and clear cut (complete removal of timber). Eight sites were studied over a two year period. The combined data show beyond reasonable doubt (better than 90% confidence that increased phosphorus loads may result from areas subject to over-story removal and that clear cutting can increase the phosphorus load by as much as 30 times higher than background phosphorus yields.

Agricultural activities in the Roaring Fork River watershed (including cattle grazing, hay production, and logging) are contributing phosphorus and nitrogen, to the aquatic environment, although the significance of this contribution is unknown. It is likely that these impacts are insignificant with respect to other sources of nutrients and sediment already described. Reduction of agricultural impacts in the riparian and wetland areas through the voluntary implementation of best management practices could potentially improve water quality.

3.3.6 Nonpoint Issues - Summary

The existing major nonpoint source water quality problems of streams and lakes in the Roaring Fork watershed include:

Excessive suspended sediment concentrations in specific areas of watershed, including the Brush and Coal Creeks, as a result of natural runoff and human land use practices;

Increases in nutrient and dissolved solids concentrations in the Roaring Fork River downstream from Aspen and other urban areas as a result of urban runoff.

Increases in direct urban stormwater runoff as well as pollutants associated with the stormwater flows.

3.4 Nonpoint Source Recommendations

Policy 1 - Water Quality; Policy 2 - Water Use and Development; Policy 3 - Land Use and Development; Policy 4 - Domestic, Municipal, and Industrial Wastes; and Policy 5 - Chemical Management; in Volume I should be implemented by the appropriate management agencies in the Roaring Fork watershed to address nonpoint source issues discussed in Section 3.3. Other recommendations include:

Municipal and county nonpoint source water quality improvement projects should continue to be supported by local, state and federal funding.

Collaborative efforts such as the Colorado River Headwaters Forum should continue as a means to integrate water quality and water quantity planning and include consideration of negative water quality impacts of trans-basin diversions, so that constructive

arrangements with respect to such things as the operation of Ruedi Reservoir and related issues can be forged.

Projects designed to augment or improve instream flows in the headwater of the Roaring Fork River should be pursued.

A county inspection and maintenance program for ISDSs should be considered.

Water conservation practices, including in-home, landscaping, and wastewater reuse need to be vigorously pursued.

Projects designed to stabilize stream banks and protect the aquatic resource.

4.0 WATERSHED IMPROVEMENT PROJECTS

4.1 Existing Watershed Improvement Projects

A number of watershed water quality improvement projects are occurring in the Roaring Fork basin. A number of the larger efforts are documented below. In addition, a number of wetland creation/improvement projects and aquatic habitat improvement projects are active in the watershed.

4.1.1 Snowmass Village Sediment Control Efforts in Brush Creek

The Town of Snowmass Village applied for an EPA Nonpoint Source Grant in 1995 to address some of the issues associated with high sediment loads in Brush Creek. The town has identified several areas within their jurisdiction which would be suitable for water quality improvement demonstration projects. $150,000 of EPA funding was requested for a total project cost of $831,300. The proposed projects include: bank stabilization; channel reconstruction; road-side wall to prevent road sanding materials from directly entering the creek, and public education.

4.1.2 Snowmass Creek Projects

Two projects in the Snowmass Creek drainage have occurred recently, both privately funded. The first was a wetland enhancement and bank stabilization project, which consisted of enhancement of a 1/4 acre of wetlands and bank stabilization on two meander lengths of Snowmass Creek about midway to the confluence with the Roaring Fork. The other project took place on 15,000 acre Wildcat Ranch (Wildcat Creek is a tributary to Snowmass Creek) and consisted of gully stabilization with drop structures and sedimentation ponds.

4.1.3 Fryingpan River Projects

Aquatic habitat work was completed on a 1/4 mile length of the Fryingpan River in the vicinity of the Norrie colony, which was sponsored by the homeowners association. A series of vortex weirs and deflectors were constructed to increase stream velocities, and

some pool areas were established. These improvements were done to offset reduced stream flows as a result of the Fryingpan-Arkansas Project. In the Basalt area a 1/4 acre wetland was created.

A “Ruedi Futures” study is being done by the Roaring Fork Conservancy which includes a user survey of Ruedi Reservoir visitors, including an estimate of total visitor use in the lower Frying Pan River, economic modeling, a fishery study, and instream flow modeling. This work is expected to run through 2002. The work is being done to evaluate potential changes in operations of Ruedi Reservoir.

4.1.4 Roaring Fork Stream Bank Stabilization near Carbondale

A stream restoration plan has been developed for a three-mile section of the Roaring Fork from the Catherine Store Bridge to the Carbondale Bridge. This plan is a result of the resolution of a major violation of Section 404 of the Clean Water Act. The actual stream restoration and bank stabilization will begin in 1996. Continuation of the project will occur as private funds become available.

4.1.5 Mid-Continent Resource Coal Mine Reclamation

The Colorado Division of Minerals and Geology (DMG) is responsible for reclamation of the Mid-Continent Resources Coal Mine site, which was declared bankrupt effective July of 1994. Approximately 200 acres of land were disturbed by coal mining activities in Coal Basin. In 1995, contractors under the direction of DMG re-vegetated two waste rock piles (pile of rejected materials from the wash plant) and two mine sites on the property. In 1996 it is anticipated that the two last un-reclaimed mine sites will be re-vegetated, that the Rock Tunnel entry will be reclaimed, and that approximately one-third to one-half of the 14 miles of roads on the property will be re-vegetated. The work on is project is being funded by sales of the property and services provided by Mid-Continent (including structural demolition). In 2002 the DMG is proposing an $80,000 319 project for slope remediation in Coal Basin.

4.1.6 Anshutz Coal Mine And Mill Reclamation

The Anshutz Coal Mine area in North Thompson Creek has been reclaimed, and suspended sediment concentrations have been reduced to background levels. Dissolved solids concentrations from the draining portals are decreasing.

4.1.7 Basalt Stormwater Evaluation and Recommendation Report

The Town of Basalt and the Roaring Fork Conservancy obtained an EPA 319 grant for the development of a Watershed Improvement and Education Project in 1999. The project had two main components, evaluation of non-point source pollutants and developing recommendations for Best Management Practices for the Town, and expansion of educational activities including water quality monitoring programs and public outreach focused on preventative strategies to minimize soil erosion and stormwater runoff.

4.1.8 Glenwood Stormwater Evaluation and Public Education

The City of Glenwood Springs and the Roaring Fork Conservancy obtained an EPA 319 grant in 2002 for the development of a project similar to the successful Basalt stormwater evaluation and public education project described above.

4.2 Future Project Needs

4.2.1 Public Education Programs

There is a need for public education programs that further the public's knowledge concerning nonpoint source water quality impacts and methods for minimizing those impacts through Best Management Practices. This includes issues regarding septic systems, household hazardous waste disposal, erosion control**,** and urban stormwater runoff.

4.2.2 Coal Basin projects

There is a need for additional reclamation work in the Coal Basin to address sediment and iron issues from activities associated with the Mid-Continent Mine.

4.2.3 Basalt Stormwater Detention Ponds

A number of detention pond projects (6) have been identified by the Basalt Stormwater 319 project, ranging in cost from $15,000 to $136,000 [Matrix Design Group September 30, 2001 Statement of Probable Cost]. These ponds are designed to improve the quality of urban stormwater runoff and reduce the velocity of the runoff to historical levels, in order to reduce the erosive nature of stormwater flows in the Basalt area.

5.0 LAND USE REGULATIONS APPLICABLE TO WATER QUALITY PROTECTION AND IMPROVEMENT

A number of land use regulations currently exist in the Roaring Fork basin which assist in minimizing water quality impacts from various land uses. Aspen/Pitkin County has "Environmentally Sensitive Lands" regulations (Division 5, Section 7-501. These regulations establish a 100 foot development setback from the Roaring Fork River and its tributary streams, and allow no development within 100 year floodplains. Stormwater runoff is required to maintain the off site historical rate of runoff for the 100 year flood.

Stormwater permits are required by the state for construction activities which disturb greater than five acres of land. The permits require erosion controls and spill protection plans. In July of 2002, stormwater discharge permits will be required for construction activities disturbing more than one acre of land. The permits are issued by the Colorado Department of Public Health and Environment’s Water Quality Control Division.

The Town of Snowmass Village requires erosion controls on construction sites.

Regulation of septic systems is performed by Eagle, Garfield, and Pitkin Counties utilizing state and local criteria.

Policies 1- 6 and the implementation recommendations found in these policies are all appropriate for implementation in the Roaring Fork watershed.

6.0 WASTELOAD ALLOCATIONS

Wasteload allocations have been established for point source discharges in the upper Roaring Fork watershed. Total maximum loads for all sources have been determined by the Water Quality Control Division. A summary of these loads is presented below:

Roaring Fork Discharger:	Aspen Consolidated	Period
Ammonia	8.6-28 mg/L	October - April
Brush Creek: Discharger:	Snowmass San	Period
Ammonia	1.2 – 3.9 mg/L	Monthly
Roaring Fork Discharger:	Mid-Valley W&SD	Period
Ammonia	30 mg/L	Annual
Roaring Fork Discharger:	Glenwood Springs	Period
Ammonia	27 – 29 mg/L	May, Aug.-Oct.
Four Mile Creek Discharger:	Ski Sunlight	Period
Ammonia	1.1 – 8.1 mg/L	Monthly

As previously stated, increases in nutrient concentrations are a concern in the Roaring Fork watershed. Sources are both point and non-point in origin.

7.0 WATER QUALITY MONITORING

7.1 Current Water Quality Monitoring

The Colorado Water Quality Control Division (WQCD) currently has one active water quality monitoring station in the Roaring Fork watershed - located just above the confluence with the Colorado River. Prior to 1992, the WQCD had four stations in the Roaring Fork watershed. The WQCD plans to do "in-depth" sampling on a five year basis in each of the major basins in the state. The Roaring Fork is included in the lower Colorado River basin, and is scheduled for monitoring in 1996.

The Division of Wildlife's River Watch Program has approximately 23 on-going monitoring stations in the Roaring Fork watershed. The water quality data collected at this sites is somewhat limited, but the monitoring efforts are extremely valuable in

augmenting other data sources.

The Roaring Fork Conservancy has taken on the task of coordinating and reporting on the River Watch program in the Roaring Fork watershed. This Water Quality Monitoring Program has produced the Roaring Fork Watershed: 2000 State of the River Report.

The USGS had one water quality monitoring station in the Roaring Fork, which has been monitored regularly (the Roaring Fork at Glenwood Springs). Additional USGS water quality monitoring sites have been established intermittently.

A study of the impacts of use of magnesium chloride as a road de-icing compound has been initiated by the Colorado Association of Ski Towns, Colorado Department of Transportation, and the USGS. The study, to assess the possible water quality and human health impacts of the use magnesium chloride and determine whether better alternatives may exist, should be completed in the spring of 2002.

The USGS was contracted by Pitkin County, the Colorado River Water Conservation District, and others in 2001 to develop a water quality database and retrospective analysis. This work is expected to be on-going for several years.

The Water Quality Control Division has monitored 7-8 sites in the Roaring Fork watershed on a frequency of 8-12 times per year in 2000 and 2001.

7.2 Water Quality Monitoring Needs

Locating sources of and monitoring concentrations of suspended sediment in Brush and Coal Creeks and nutrient and bacteria concentrations in Brush Creek would aid in evaluating effects on water quality from natural and urban runoff. This work is currently being done through efforts by the Town of Snowmass Village. Section 4.1.1 discusses the Town's current projects.

A water quality data collection program maintained on a monthly basis at sites on the Roaring Fork River, especially downstream from Aspen, would determine possible spatial or temporal changes in water quality and aid in maintaining the river as a fisheries resource. Monthly sampling of nutrients and supplemental sampling of benthic invertebrates or periphyton could be used as indicators of water quality changes.

Determination of stream flows for the purpose to insuring CWCB instream flow appropriation protection. The Division of Wildlife will be examining instream flow needs in the lower Roaring Fork watershed in 1996, and concerns in the upper watershed would be appropriately addressed at this time.

The determination of long term-water needs to meet future growth in the basin would be very useful. It is possible that the Colorado River Water Conservancy District could assist the local entities in the watershed in this effort.

Monitoring is needed to determine the quality and quantity of groundwater in the watershed and what kind of interactions exist between the ground water and surface water.

Monitoring is needed to determine the cumulative impact of ISDSs on ground and surface water quality. A groundwater sensitivity analysis could also be extremely useful in determining locations where heightened management of septic systems is warranted.

8.0 WATER QUALITY STANDARDS AND RECOMMENDATIONS

8.1 Existing Classifications and Standards

Streams in the Roaring Fork watershed are classified for protection of cold water aquatic life (Class I), primary contact recreation, water supply and agricultural uses. One tributary wetland to which the Aspen Glen facility discharges was classified as Recreation class 2. Red Canyon, except for Landis Creek from its source to the Hopkins ditch diversion upstream of the Spring Valley wastewater facility, was classified as Aquatic Life Class 2.

Brush Creek previously received a temporary modification for ammonia under the water quality standards but current treatment levels are in accordance with the defined ammonia limitations.

The watershed has one segment that is under temporary modifications to the numeric standards: the mainstem and tributaries of Coal Creek, due to mining activities. The temporary standard for iron on Coal Creek was removed in the 1999 Upper Colorado River Basin Standards hearing. The current standard for iron for this segment is 300 ug/l dissolved and 1,000 ug/L total recoverable. At the July 2000 Water Quality Control Commission Basic Standards hearing, the Commission decided that “[f]or segments with a Water Supply Classification that do not have an actual water supply use, no numerical standards for sulfate, iron and manganese will be established unless determined to be necessary and appropriate in accordance with section 31.7 as the result of a future site-specific rulemaking. For segments with a water supply classification that have an actual water supply use (as opposed to a potential use), the Commission is adopting numerical standards based on the less restrictive of (a) existing quality as of January 1, 2000, or (b) the water supply table value criteria for iron, manganese, and sulfate” [Statement of Basis, Specific Statutory Authority and Purpose, July 2000 Rule Making Hearing, CCR 1002-31.37].

Waters within the Maroon Bells/Snowmass Wilderness area and in the Hunter Fryingpan Wilderness are designated "Outstanding Waters".

Waterbodies designated "Outstanding Waters" "shall be maintained and protected at their existing quality" (5 C.R.R. 1002-8, 3.1.8.1.a). These waters are considered to be of the highest quality, and are afforded the most protection.

Regulated activities taking place in reviewable waters are subject to antidegradation review. Antidegradation review requires that regulated activities (discharges to those waters) be reviewed to: determine if the activity will result in significant degradation of that water; and if so, if "the degradation is necessary to accommodate important economic or social development is the area in which the waters are located." (5 CRR 1002-8, 3.1.8.3.d.). All waters in the Roaring Fork River except the "Outstanding Waters" and the mainstem of Brush Creek (Segment 4) are reviewable waters.

Use Protected" designation indicates that those waters so designated do not require the special protection of antidegradation review (generally speaking, waters not meeting several water quality criteria or standards, or subject to significant point source discharges), but no activity can result in the exceedance of water quality standards. Brush Creek**,** and Red Canyon, as previously described, are the only "Use Protected" segments in the watershed.

8.1.1 Designated Use Impairment Stream Segments

The state has designated one stream segment in the Roaring Fork watershed as "Use Impaired" (Roaring Fork and Crystal River).

The segment listed, Coal Creek – from the source to the Crystal River – is listed for iron, the source of which is identified as the Mid-Continent Mine.

8.1.2 303(d) List

The Clean Water Act requires the state to list those stream segments or waterbodies which require Total Maximum Daily Load (TMDL) allocations in order for the segment to attain or maintain water quality standards. The State's 2000 305(b) report lists the current 303(d) list (Table 29). In the Roaring Fork watershed, one stream segment is identified - Coal Creek (iron). This list represents stream segments that receive pollutant loads in excess of the stream's capacity to cleanse itself. Coal Creek is listed as low priority.

A TMDL is the estimated assimilative capacity of a waterbody which estimates how much of a pollutant may enter a water body without affecting its designated uses. The TMDL represents the sum of the point sources, the nonpoint sources, and a margin of safety (which can include anticipated future pollutant loading).

The State's 1998 303(d) list has an appendix for monitoring and evaluation for 303(d) list status. Coal Creek and the Crystal River below Coal Creek are listed in the Appendix for monitoring and evaluation for impairment by sediment.

Additionally, NWCCOG recommends the addition of Four Mile Creek (Segment 3 of the Roaring Fork River) for monitoring and evaluation for impacts to the aquatic life class 1 designation. Four Mile Creek is likely impaired due to low stream flows, point and significant nonpoint source inputs of nutrients, and nonpoint source sediment loading.

8.2 Recommendations on Standards

Existing water quality standards (including use designations and criteria) for the Roaring Fork River watershed are adequate to protect the existing uses under current conditions.

NWCCOG is supportive of the State's antidegradation provision and protection of high quality waters. NWCCOG is concerned, however that currently classified Recreation

Class 2 waters will be reclassified as Recreation Class 1a unless a Use Attainability Analysis (UAA) is completed. It is likely that Recreation Class 2 is the appropriate classification for some of these segments. It is unlikely that UAAs will be completed for all these segments, due to financial and time constraints. In the Roaring Fork River watershed these waters are:

Segment 4 – Brush Creek
Segment 10 – Mainstem of Thompson Creek to the confluence with the Crystal River

There is a permitted discharge to Segment 4 (Snowmass Water and Sanitation District).

8.3 Outstanding Waters Designations

The Northwest Colorado Council of Governments does not currently recommend any additional waterbodies to the list of "Outstanding Waters" designation. If new wilderness areas within the watershed are approved by Congress, NWCCOG recommends investigations of waterbodies within those areas for appropriate ness of "outstanding waters" designation.

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