

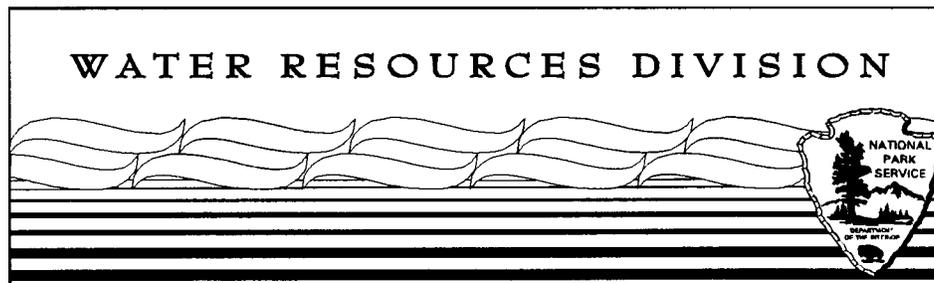
CURECANTT NATIONAL RECREATION AREA
WATER RESOURCE SLOPING REPORT

Curecanti National Recreation Area

and

Water Resources Division

Technical Report NPSINRWRS/NRTR-95/54



National Park Service - Department of the Interior
Fort Collins - Denver - Washington

The National Park Service Water Resources Division is responsible for providing water resources management policy and guidelines, planning, technical assistance, training, and operational support to units of the National Park System. Program areas include water rights, water resources planning, regulatory guidance and review, hydrology, water quality, watershed management, watershed studies, and aquatic ecology.

Technical Reports

The National Park Service disseminates the results of biological, physical, and social research through the Natural Resources Technical Report Series. Natural resources inventories and monitoring activities, scientific literature reviews, bibliographies, and proceedings of technical workshops and conferences are also disseminated through this series.

Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the National Park Service.

Copies of this report are available from the following:

National Park Service
Water Resources Division
1201 Oak Ridge Drive, Suite 250 Fort
Collins, CO 80525

National Park Service
Technical Information Center Denver
Service Center
P.O. Box 25287
Denver, CO 80225-0287

(970) 225-3500

**CURECANTI NATIONAL RECREATION AREA
WATER RESOURCE SCOPING REPORT**

Curecanti National Recreation Area

and

Water Resources Division

Technical Report NPSINRWRSINRTR-95154

July 1995



United States Department of the Interior • National Park Service

CONTENTS

EXECUTIVE SUMMARY / ix

1. INTRODUCTION / 1
 - 1.1 Reservoir Levels / 1
 - 1.2 Upstream Impacts / 4
 - 1.3 Impacts within Curecanti NRA / 4
 - 1.4 Floodplain Management / 6
 - 1.5 Participation in Basin Water Resource Issue and Resolution / 6
 - 1.6 Summary / 7
2. DESCRIPTION OF WATER AND RELATED RESOURCES / 7
3. OBJECTIVES OF CURECANTI NRA'S WATER RESOURCES MANAGEMENT PLAN / 11
4. WATER RESOURCES MANAGEMENT PLAN / 12
5. WATER RESOURCES ISSUES AT CURECANTI NRA: INFORMATION NEEDS AND IMPACTS / 13
6. WATER QUALITY / 13
 - 6.1 Summary of Water Quality Studies / 13
 - 6.2 The Present Monitoring Program / 16
 - 6.2.1 Water Quality / 16
 - 6.2.2 Limnological Studies / 18
 - 6.2.3 Biomonitoring / 18
 - 6.2.4 Coordination with Other Agencies / 20
 - 6.3 Outstanding Waters Designation / 20
7. FISHERY AND RECREATION ISSUES / 22
 - 7.1 The Reservoirs / 22
 - 7.2 The Rivers and Streams / 23
 - 7.2.1 The Gunnison River / 23
 - 7.2.2 Tributaries to the Reservoirs / 24
 - 7.3 Contaminants in Fish / 24
 - 7.4 Fisheries Management Plan / 24
8. INVENTORY OF WATER RESOURCES / 25

CONTENTS (cont.)

9. FLOODPLAIN, WETLANDS AND WATERSHED MANAGEMENT /	
25 9.1 The Gunnison River Alluvial Floodplain / 25	
9.2 Floodplain Assessment / 27	
9.3 Wetlands and Riparian Dynamics and Protection / 27	
9.4 Watershed Management / 29	
10 WATER RIGHTS / 29	
10.1 Well Permits / 29	
10.2 East Elk Creek / 30	
10.3 Blue Mesa Reservoir / 31	
11. UPSTREAM IMPACTS / 31	
11.1 Impacts to Curecanti NRA from Upstream Infrastructure /	
31 11.2 Grazing / 32	
11.3 Logging / 34	
11.4 Mining / 34	
11.5 Oil and Gas / 35	
11.6 Roads / 36	
12. CURECANTI NRA'S IMPACTS ON WATER RESOURCES /	
37 12.1 Drinking Water / 37	
12.2 Waste Water Treatment / 39	
12.3 Fuel Storage / 40	
12.4 Hazardous Materials / 40	
12.5 Parking Lot Runoff / 41	
12.6 Ramp Expansion / 41	
12.7 Boater Use and Visitor Use of Reservoir Shoreline /	
41 12.7.1 Boater and Camping / 41	
12.7.2 Visitor Shoreline Use / 42	
13. CONCESSIONAIRE'S IMPACTS ON WATER RESOURCES /	
43 13.1 Operations / 43	
13.2 Fuel Storage / 43	
13.3 Water Supply and Waste Water Treatment / 44	
14. BUREAU OF RECLAMATION'S IMPACTS ON WATER RESOURCES /	
44 14.1 Reservoir Levels / 44	
14.2 Storage of Fuel / 46	
14.3 Septic Systems / 46	
RECOMMENDATIONS / 46	

CONTENTS (cont.)

LITERATURE CITED / 49

PREPARERS / 57

ACKNOWLEDGEMENTS / 57

FIGURES

Figure 1. Map of Curecanti NRA, Gunnison, Colorado / 9 Figure 2.

Map of Upper Gunnison Basin / 10 Figure 3. Water Quality Sampling Sites, 1987-1994 / 17

TABLES

Table 1. Aspinall Unit Storage Allocations / 7

Table 2. Water Quality Monitoring Sites and Associated Threats, 1987-1992 / 19

Table 3. Water Quality Monitoring Sites and Associated Threats, 1993-Present / 21

Table 4. Well Locations and Permit Numbers / 30

Table 5. Drinking Water Well Location and PWSID # / 38

EXECUTIVE SUMMARY

Curecanti National Recreation Area (Curecanti NRA), located near Gunnison, Colorado encompasses Blue Mesa, Morrow Point and Crystal reservoirs of the Colorado River Storage Project (CRSP). As Curecanti NRA's most important natural resource, water covers some 25% of the total park unit area. Therefore, ensuring and maintaining appropriate reservoir levels and naturally high water quality while protecting water-related and water-dependent resources are the key objectives in Curecanti NRA's overall natural resources management scheme. The reservoirs were formed by damming the Gunnison River at three sites. Blue Mesa Dam was completed in 1965, with the Morrow Point and Crystal dams following in the 1970s. Blue Mesa and Morrow Point reservoirs serve as power producing systems, and Crystal Reservoir serves as a re-regulation system.

Several large tributaries flow into the reservoir system, including Lake Fork of the Gunnison River, Cebolla Creek, Soap Creek, and West Elk Creek. Other tributaries contribute minor or ephemeral flows to the reservoirs, but provide excellent aquatic and riparian habitat for the wildlife and aquatic organisms in the area.

The Gunnison River upstream of the reservoirs, meanders through a wet meadow and provides unique river fishing opportunities. The reservoirs, on the other hand, provide an excellent flat water fishing experience.

The purposes of the Curecanti NRA Water Resources Scoping Report are: 1) to identify Curecanti NRA water resources objectives; 2) to identify and discuss water resources-related issues and management concerns; 3) to provide a summary of existing hydrologic information pertaining to these issues; and 4) to provide park management with a recommendation regarding the need for development of a Water Resources Management Plan (WRMP).

Curecanti NRA water resources objectives identified in the scoping process include:

- 1) Maintenance or restoration of natural high quality water in reservoirs and tributaries in order to support park purposes including fish and wildlife habitat, recreation, and scientific study.
- 2) Recognition and anticipation of the significance of potential reservoir level changes resulting from flows for endangered fish species, flows for the Black Canyon of the Gunnison National Monument, and for hydropower production.
- 3) Participation in, initiation, and instigation of basin discussions and projects which affect Curecanti NRA water quality and quantity.

- 4) Promotion, creation, restoration, and maintenance of habitat for native fisheries in and outside park boundaries.
- 5) Insurance that park development and operations do not adversely affect park water resources and water-dependent environments.
- 6) Recognition of the significance of natural aquatic and riparian resources, identify and preserve wetlands, and manage them in a manner that will preserve their natural functions and integrity.
- 7) Acquisition of appropriate information to understand and manage water-related resources.
- 8) Recognition of water issues related to public health and safety including flood hazards, palatability of fish, and general water quality.
- 9) Insurance that Curecanti NRA maintains its water rights. Water related

issues identified within this report include:

- review of the reservoirs' and tributaries' water quality
 - assessment of upstream impacts to Curecanti NRA's water resources
- discussion of introduction of native cutthroat trout
- maintenance of fishery health
- development of appropriate floodplain, wetland, and watershed management strategies
- integration of water resources information for the Gunnison Basin
- presentation of an overview of water resources-related aspects of park development and operational activities
- evaluation of park water rights
- evaluation of operation of Aspinall Unit in light of recreational activities at Curecanti NRA

Curecanti NRA has no enabling legislation and operates under a Memorandum of Agreement between the National Park Service (NPS) and Bureau of Reclamation (BoR) (1965). The agreement notes that NPS is responsible for construction, maintenance, and administration of recreational facilities and related activities. To that end, Curecanti NRA must acknowledge several issues which impact its ability to abide by its recreational mandate, and to manage its natural resources including water resources. Developed in the following text are discussions of present and potential issues and impacts to Curecanti NRA's water resources. Briefly, 1) reservoir operation changes may alter the overall levels of the three reservoirs resulting in potential changes in the type of recreational experience at Curecanti; 2) increasing development upstream of Curecanti NRA may impact water quality and

quantity as they enter the park on its eastern boundary; 3) impacts are occurring to water resources resulting from Curecanti NRA's own operations as well as the BoR, and the concessionaire; and 4) recognition of watershed values and functions, and floodplain management is critical to Curecanti NRA's water resources and its interaction with surrounding land agencies and private property owners. Because of the complexity of issues and impacts which face Curecanti NRA in management of its water resources, this scoping report recommends the development of a WRMP.

1. INTRODUCTION

This scoping report for a Water Resources Management Plan (WRMP) was undertaken to provide analysis of the water resource issues facing Curecanti National Recreation Area (Curecanti NRA). Insuring and maintaining appropriate reservoir levels and naturally high water quality, while protecting water-related and water-dependent resources are the key objectives in Curecanti NRA's overall natural resources management scheme.

Curecanti NRA encompasses the Aspinall Unit of the Colorado River Storage Project (CRSP). Under the authority of Section 8 of the Colorado River Storage Project Act of April 11, 1956, the Secretary of the Interior was directed to "investigate, plan, construct, operate, and maintain, public recreation facilities." The purpose of Curecanti NRA is derived from this legislation and is stated as follows: "To conserve the scenery, the natural, historic, and archeological objects and the wildlife, and to provide for public use and enjoyment of lands withdrawn or acquired and water areas created by the projects by such means as are consistent with their purpose" (70 Stat. 105).

No enabling legislation has been passed for Curecanti NRA, and thus Curecanti NRA operates under a 1965 Memorandum of Agreement between the National Park Service (NPS) and the Bureau of Reclamation (BoR) stating that the service is responsible for administration of lands and waters in the Aspinall Unit area for purposes of providing recreation. The BoR has complete authority over the operation and maintenance of the three reservoirs, Blue Mesa, Morrow Point, and Crystal, including releases made to fulfill project purposes of hydropower, irrigation, and flood control. In light of this Memorandum of Agreement, Curecanti NRA recognizes its need to focus on providing recreational opportunities while insuring preservation of its water and natural resources.

This introductory statement presents a general overview of issues and impacts associated with water resources at Curecanti NRA which served as the impetus for beginning the water resources scoping process. The topics are divided into appropriate sections including: 1) reservoir levels, 2) upstream impacts, 3) impacts within Curecanti NRA, 4) floodplain management, and 5) participation in basin water resource issue identification and resolution. Following the introduction is a section characterizing the park's water resources; a section which includes the parks objectives; a section discussing water resource management plans, several sections discussing specific water resource issues at Curecanti NRA; and finally, recommendations regarding a Water Resources Management Plan (WRMP).

L1 Reservoir Levels

Curecanti NRA encompasses the Aspinall Unit of the CRSP. The Gunnison River, which was dammed beginning in 1965 to create the Aspinall Unit, is tributary to the Colorado River. Crystal, Morrow Point, and Blue Mesa dams are operated in close

association with six other large dams by the BoR as part of the Colorado River reservoir system. The Secretary of the Interior, in consultation with the Colorado River Basin states and the general public, is required to develop an annual operating plan (AOP) for the allocation of water among the eight major storage reservoirs on the Colorado River system.

The AOP is developed in accordance with Section 602 of the Colorado River Basin Project Act and the Operating Criteria developed by the Secretary pursuant to that Act. The plan, which is strongly linked to annual hydrologic forecasts and projections of upper and lower basin consumption, also considers flood risk, surplus water deliveries to the lower basin, management of water supply shortages, and instream environmental interests. The plan determines monthly deliveries of water between reservoir units, and monthly changes in reservoir storage. While the AOP does not deal with daily operations (e.g., for hydro-power), it does need to factor in hydrologic allocations to accommodate special instream flow needs such as periods of low or high flows.

As part of previous NPS participation in the AOP process, Curecanti NRA identified several issues directly related to reservoir operations (NPS 1992). AOP issues at Curecanti NRA include minimum reservoir levels, annual reservoir level fluctuations, and the timing of reservoir level increases and decreases. Reservoir levels below 7,460 feet render two of the park's five boat launch ramps unusable. Lake levels below 7,440 render the remaining boat launch ramps unusable (NPS 1994). Concerns also extend to the quality of the fishery experience provided the public, and management of the fishery itself. The NPS endorses the proposed "target level" management plan of the BoR, with gradual filling through spring and early summer to a level at, or near full pool in July, and gradual lowering, thereafter. The preferred operation is to reach maximum reservoir levels in June and maintain them as high and as stable as possible through Labor Day.

Curecanti NRA hosts over a million visitors each year. In a 1991 Decision, District Water Court Judge Robert Brown determined that the CRSP of 1968 expressly makes recreation, fish, and wildlife the primary purposes of the CRSP, such that "the United States could place a refill call for Blue Mesa for the sole purpose of recreation."

Extreme changes in reservoir levels in any single year (especially during the boating season) cause problems and additional expense for the NPS and concession facilities. Each two to three feet of lake level change requires moving floating docks, breakwaters, and concession marina facilities. Extreme annual fluctuations are also believed to intensify problems of wave erosion on shoreline archeological resources in the registered national archeological district.

Additionally, the U.S. Department of Energy (DOE), Western Area Power Administration (WAPA) is presently discussing the replacement power process as a result of re-operation of several reservoirs on the Colorado River. This re-operation will deal with daily peaking power operations and is distinct from the AOP which deals with monthly and annual water allocations. Replacement power from other reservoirs may include providing power from the Aspinall Unit. Reservoir levels at Curecanti NRA based on year-round high fluctuating flow ,and seasonally adjusted fluctuating flows, have been outlined in the Salt Lake City Area Integrated Projects Electric Power Marketing Draft Environmental Impact Statement (EIS) (1994). Impacts to the reservoir system as a result of re-operations are discussed in the draft EIS, but lack depth with regards to impacts on Crystal Reservoir where elevational changes on a daily basis could exceed eight feet. The re-operation for replacement power, for endangered fish species, and for the Black Canyon NM flows may affect the reservoir levels at Curecanti NRA, thus impacting recreational activities, the fishery, and aquatic and riparian habitat along the reservoir corridor and tributaries.

Most resource management issues at Curecanti NRA related to Colorado River operations can not be solved in isolation from interests of other NPS units including Black Canyon of the Gunnison NM, other resource interests such as native fishes, and other primary purposes of the CRSP which include water allocation and hydropower. It is critical that Curecanti NRA, along with the seven other NPS units associated with major Colorado River dams, coordinate issues, needs, and concerns related to the AOP process, and effectively represent those interests, as an agency, to the BoR. NPS needs related to the AOP process include: 1) additional research into relationships between resource conditions and dam operations; 2) a formal mechanism (model) to permit an analysis of resource benefits and tradeoffs (systemwide) associated with alternative river operations; 3) improved representation of collective NPS interests (and river/reservoir interests, in general) in the AOP process; and 4) development of a tool to assess Aspinall Unit operations based on proposed flow requirements for native fishes, the Black Canyon of the Gunnison NM, the other primary purposes of the unit, and various means of accommodating the needs.

With regards to re-operation of the Aspinall Unit several research projects are already under way. They include: 1) a study designed to determine the effects of reservoir water-level fluctuations on fisheries resources (Johnson; Hebein), 2) a study to determine the impacts of varied hydropower operations on the entrainment of fish through the turbines at the Blue Mesa Dam (Mueller; Hiebert), 3) excavation of a sauropod found at an elevation impacted by reservoir drawdown, and 4) an archeological study of site near the edge of Blue Mesa Reservoir. Lastly, Curecanti NRA has made available a tool to assess Aspinall Unit operations (Clark III 1994) which provides monthly releases for various needs and resulting reservoir elevations.

1.2 Upstream Impacts

Upstream from Curecanti NRA, the Upper Gunnison Basin which includes the towns of Mt. Crested Butte, Crested Butte, Almont, Sargents, White Pine, and Gunnison, is impacted by development as the economy expands. With this increased development comes increased pressure for more available drinking water, water for snow-making, and increased capacity or new waste-water treatment facilities. Given this, the seasonal tourist industry, and the increase in population in the upper end of the valley, water resources tend to be viewed with great concern by local governmental agencies (e.g., Gunnison City Manager comments at Curecanti NRA water resources scoping meeting).

Another impact to Curecanti NRA takes the form of grazing on surrounding Bureau of Land Management land (BLM). One allotment, Iola-Powderhorn, located to the south of Blue Mesa Reservoir on Cebolla Creek, exhibits heavy to severe grazing in an area called the Kezar Basin Pasture (BLM 1989). BLM grazing allotments encompass drainages upstream of Curecanti NRA; utilization and supervision surveys again document the severe to heavy use in these areas (BLM 1989). Curecanti NRA has observed runoff of sediments from these areas and from the Cimarron River drainage, but has not initiated cooperative programs to alleviate sediment inputs to its reservoirs.

Curecanti NRA also continues to note changes of land ownership on its boundaries. In one case, a 126-site recreational vehicle camping area is being proposed on the southern shore of Blue Mesa Reservoir. Road construction for this project and others like it present the potential of increased sediment inputs to tributaries and to the reservoirs. Logging, as well as mining, continues to occur in the watershed.

One of the objectives of the NPS is to maintain and enhance water quality at Curecanti NRA. For the past 13 years, Curecanti NRA has implemented a water quality monitoring program which, in the past seven years, has addressed potential threats to the park. The proposed WRMP would insure that Curecanti NRA will address the problems mentioned previously, plan for continuation of a cyclical monitoring program evaluating impacts of outside land use activities, implement ways to alleviate some of the recognized sediment inputs especially on the Cimarron River, and conduct watershed and wetland inventories.

1.3 Impacts within Curecanti NRA

No park unit is without its and the concessionaire's impacts to water resources. Curecanti NRA acknowledges: 1) the apparent inadequacies of Curecanti NRA's drinking water system and sewage treatment systems, and its lack of knowledge regarding stormwater runoff; 2) the existence of a sand and gravel mining operation within its boundaries; and 3) the existence of grazing activities within its

boundaries. Curecanti NRA also notes the potential introduction of hydrocarbon products to the water as a result of boating and marina operations.

Development/Study Proposal Form 10-238 (1992) identifies the inadequate capacity of the drinking-water treatment facility at Elk Creek. The study proposal notes that the existing building lacks space and that the treatment facility also would not be able to meet future drinking water quality standards. The storage reservoir, built in 1967, experiences ice formation during winter. The proposal presents a design for the new treatment and reservoir system and costs associated with the project. The sewage lagoons near Elk Creek are unsightly; have experienced problems with liners in the past; and are located at the head of a drainage to Blue Mesa Reservoir. The leach field at the Lake Fork Campground lacks the capacity to treat the fish-cleaning station wastes and other wastes. Immediate corrections were made to the system in the summer of 1994, and completion of the corrections will occur prior to June, 1995 (Riley, pers. corn. 1994).

More important are potential problems with the septic systems at Cimarron Campground and East Portal Ranger Station. The Cimarron Campground system could reach its capacity, because sewage from the Morrow Point Dam facilities is transferred to the Cimarron Campground septic system. The East Portal system was built prior to many state regulations and is now incompatible with those regulations. Lastly, stormwater runoff from the maintenance parking lot area runs downhill and infiltrates through the ground. Little potential exists for this runoff to reach Blue Mesa Reservoir; however, Curecanti NRA does not know the extent of the runoff from precipitation events and park operations, nor do they know the impacts to ground water (Riley, pers. corn. 1994).

At the eastern boundary of Curecanti NRA, special use permit RMR-CURE-6000-0003 grants access and approval of a sand and gravel mining operation on 9.9 acres of NPS land. The mine is located north of the Gunnison River, and north of Highway 50. No stipulations in the permit require construction of retention ponds or other sediment trapping structures; however the permittee, Gunnison Gravel, is required to construct haul roads in a manner which minimizes erosion.

Curecanti NRA controls and supervises grazing activities in consultation with the BLM (NPS and BLM 1989); however, until recently, Curecanti NRA has not taken an active role in managing the fifteen allotments (both BLM and US Forest Service) which straddle NPS and the other federal land agency property. Curecanti NRA has fenced off from cattle a portion of the Cooper Ranch area south of the Gunnison River. This effort attempts to reduce streambank degradation and to allow for narrowleaf cottonwood regeneration in this unique riparian area.

These issues and associated problems imply that Curecanti NRA rectify the water-related resource problem or monitor them to determine the extent of the problem.

Again, the proposed WRMP would insure the park plans for continuation of a cyclical monitoring program evaluating impacts from Curecanti NRA, the BoR, and the concessionaire. The plan will include an engineer's review of stormwater and park operations runoff from the maintenance parking area and provide designs to manage this runoff.

1.4 Floodplain Management

An unique part of Curecanti NRA incorporates the eastern portion of the park. Here the Gunnison River is a free-flowing stream bordered by a healthy riparian community and an outlying wet meadow community sub-irrigated by surrounding private property. In the Upper Gunnison Basin, there are few stretches of the Gunnison River accessible to the public. The two primary access points of any length are the Van Tuyl property, recently purchased by the city of Gunnison to serve as a recharge area to ground water, and the Gunnison River near the Neversink and Cooper Ranch picnic areas. The Cooper Ranch area, not including the picnic grounds, is managed by Curecanti NRA as a natural zone. Curecanti NRA conducts long-term monitoring in this area on the vegetation and birds. There are few areas along the Gunnison, or other stream systems, which support the expanse of wet meadow as this area does. In that the area encompasses an alluvial floodplain, the landscape is very dynamic and experiences channel avulsions with the most recent one occurring in 1993, a high-flow year. Curecanti NRA is interested in allowing natural ecological functions to occur on this stretch of the river. Upstream to a large degree, the Gunnison is constrained naturally by canyon walls or by human activities such as haying and grazing operations or housing developments.

Curecanti NRA recognizes this floodplain as unique and wishes to continue managing it for its natural characteristics. Continued monitoring of the Cooper Ranch area and inventories of springs and wetlands at other sites in Curecanti NRA insures that the park understands and acknowledges all its water resources and complies with the Clean Water Act, Executive Order 11990 and NPS guidelines. Additionally, the park needs to conduct floodplain assessments in developed zones to comply with the NPS Floodplain Management Guideline (1993).

1.5 Participation in Basin Water Resource Issue Identification and Resolution

Curecanti NRA is lodged between up-valley uses of water and the downstream requirements of irrigation, hydropower production, and flow delivery for Black Canyon of the Gunnison NM and endangered fish species. However, as its name implies, Curecanti NRA is a recreation area striving to provide its visitors with a recreational experience of exceptional quality. In order to be proactive in the basin regarding water issues, Curecanti NRA's presence is required at the AOP meetings

which define the operation of the Aspinall Unit on a monthly basis, water conservation district meetings, and other water-related events. In addition, Curecanti NRA has the opportunity to compile water resource information, disseminate information, and facilitate meetings concerning water resources. A position dedicated to these activities and the overall management of water resources at Curecanti NRA would allow for the park's participation in basin issues and in its own operations.

1.6 Summary

As its name implies, Curecanti NRA is a recreation area striving to provide its visitors with a recreational experience of exceptional quality. Coupled with that intent, Curecanti NRA, as with all other park units, must preserve its resources (NPS Organic Act, 16 U.S.C., Sec. 1 *et. seq.*) The conditions described above, as well as the park's dual purposes, suggest that a WRMP is not only appropriate, but necessary, to adequately protect water quality and quantity, and water-related resources within Curecanti NRA.

2. DESCRIPTION OF WATER AND RELATED RESOURCES

Curecanti NRA encompasses the Aspinall Unit of the CRSP. The Gunnison River, which was dammed beginning in 1965 to create the Aspinall Unit, is tributary to the Colorado River. The reservoirs, comprised of Blue Mesa, Morrow Point, and Crystal, store approximately 1,084,146 acre-feet. Blue Mesa is the largest reservoir with some 941,000 acre-feet of water and a surface acreage of approximately

Table 1. Aspinall Unit storage allocations.

	Blue Mesa	Morrow Point	Crystal
Total capacity (ac-ft)	940,700	117,165	25,273
Active capacity (ac-ft)	748,430	42,090	12,928
Inactive capacity (ac-ft)	81,070	74,910	4,645
Dead Storage (ac-ft)	111,232	165	7,700
Surcharge (ac-ft)	0	4,130	5,490
Maximum Elevation (ft)	7519.40	7,160	6755.00
Maximum Depth (ft)	342	400	≈100.0
Surface Acreage (ac)	9000	800	300

Source: Bureau of Reclamation, AOP notes, April 21, 1994 and NPS, General Management Plan, Curecanti NRA, 1980

9,000 acres; Morrow Point surface acreage totals approximately 800, and Crystal Reservoir, 300 acres (NPS 1980). Table 1 provides information on individual reservoir surface acreage and storage capabilities.

Curecanti NRA is located 16 miles west of the town of Gunnison and extends some 50 miles to the west (Figure 1). A short segment of the Gunnison River lies within park boundaries to the east of Blue Mesa Reservoir. This area supports wet meadows, originally hayed and grazed circa 1880s, until August 1989. Also, an extensive riparian area extends along the Gunnison River supporting various willow species and narrowleaf cottonwood (*Populus angustifolia*). Blue Mesa Reservoir's shoreline perimeter is 98 miles long and is bordered by an extensive sagebrush-steppe plant community. Several drainages flow from the south and north into Blue Mesa (Figure 2). With the exception of Cebolla Creek, Lake Fork of the Gunnison River, and possibly Soap Creek, these drainages contain small creeks with either low perennial flows or ephemeral flows. The two lower reservoirs, Morrow Point and Crystal, are surrounded by steep cliffs covered only intermittently by mixed conifer, and deciduous tree and shrub communities. The tributaries reaching these reservoirs tend to have much steeper gradients. The Cimarron River, tributary to Crystal Reservoir, however, is gently sloped and carries a tremendous amount of sediment (turbidity ranging from 13 to 300 NTU) particularly during spring runoff (Curecanti NRA, unpublished data). The lower two reservoirs reside in areas cutting through Precambrian granite and metamorphic units, in contrast to the Mesozoic sedimentary materials which rise above Blue Mesa Reservoir; Cenozoic volcanics overlie these Mesozoic sedimentary rocks. Evidence of Precambrian metamorphics also exist at the most eastern end of Blue Mesa Reservoir (Westwater Associates 1991).

Generally, the Gunnison River, providing over 50% of the inflow to Blue Mesa, is of good quality and classified by the Colorado Water Quality Control Commission as Aquatic Life Cold 1, Recreation 1, Water Supply and Agriculture, and designated a High Quality 2 water. The Aquatic Life Cold Class 1 classification denotes waters which support a wide variety of cold water biota. Recreation 1 waters have a fecal coliform count of 200 colony forming units per 100 milliliters (based on a geometric mean of representative stream samples); these waters are suitable for primary contact including such activities as swimming, kayaking, rafting, and water-skiing. The Water Supply and Agriculture classifications denote that the waters are suitable for such purposes. The High Quality 2 designation recognizes waters which are not outstanding state or national resources, but exhibit high quality. This latter designation and waters classified as Aquatic Cold 1, and Recreation 1 yield to the antidegradation review process, a process which allows degradation of water quality if economic or social development benefits override the benefit existing water quality. These classifications and designations make derogation of the water quality as a result of development difficult, but possible in an effusive economic climate.

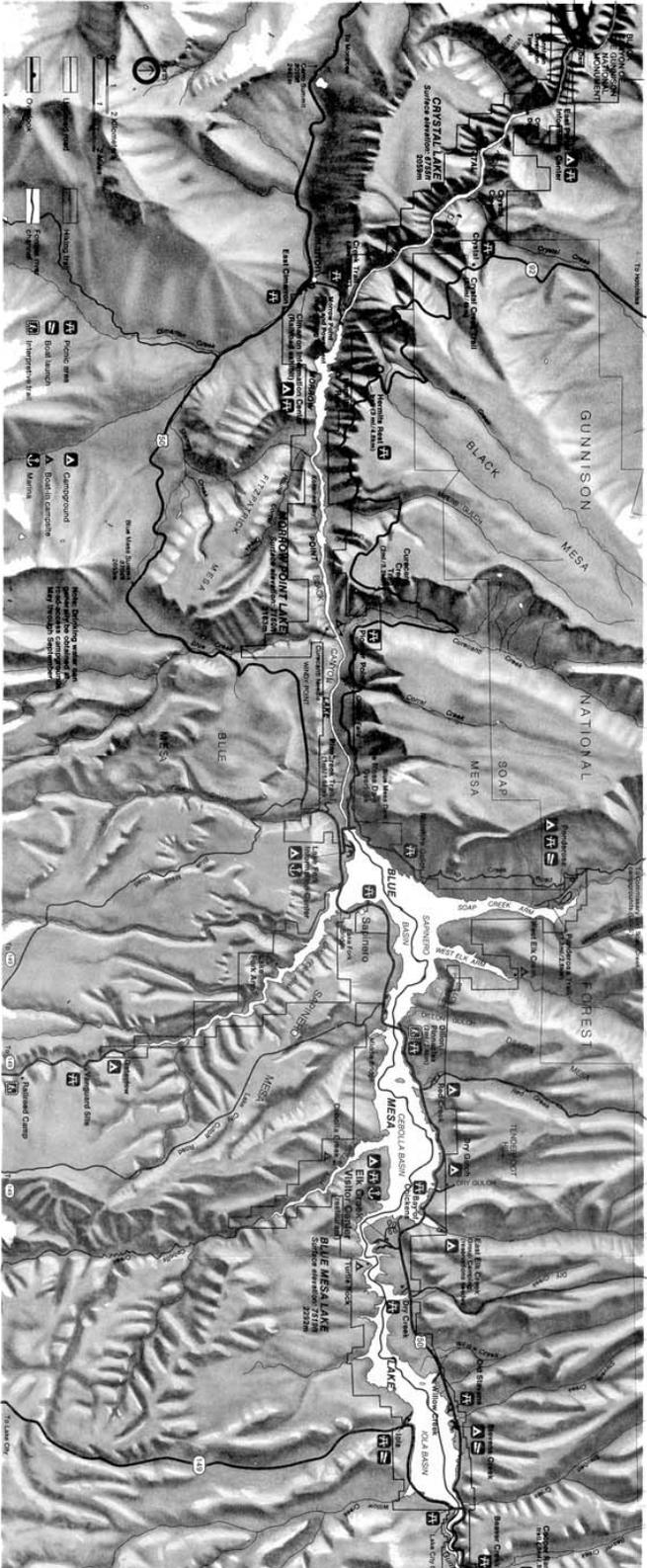
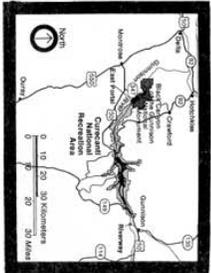


FIGURE 1



PARK MAP
 CURECANTI
 NATIONAL RECREATION AREA
 6/16/2009/DSC/JAN 95

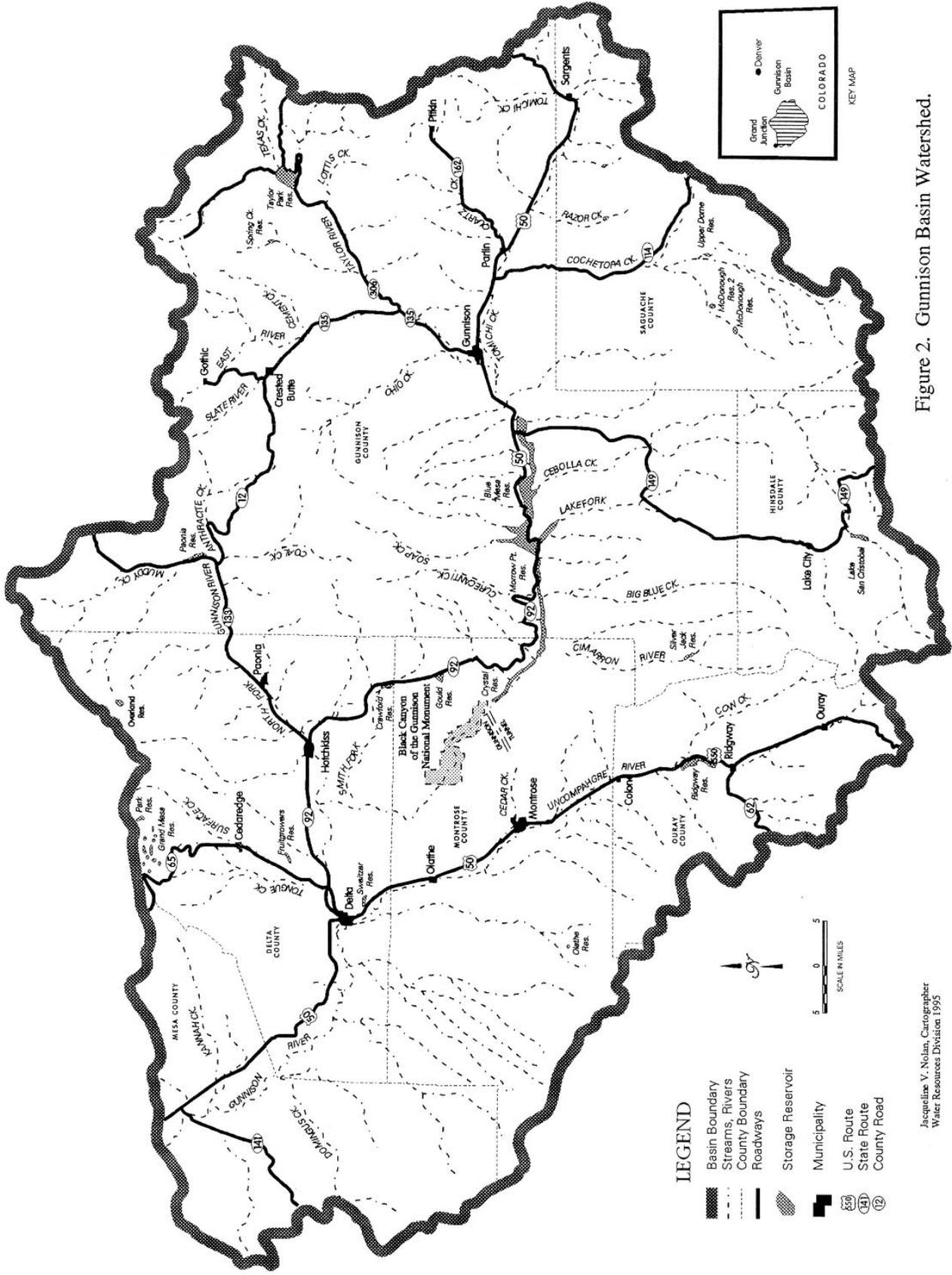


Figure 2. Gunnison Basin Watershed.

Josephine V. Nolan, Cartographer
Water Resources Division 1995

The three reservoirs are classified as Aquatic Life Cold 1, Recreation 1, Water Supply and Agriculture, with a High Quality 2 designation. The following creeks flowing into the three reservoirs are classified as Aquatic Life Cold 1, Recreation 2, Water Supply and Agriculture: N. Beaver Creek, S. Willow Creek, Steuben Creek, East Elk Creek, Cebolla Creek, Red Creek, Pine Creek, Blue Creek, Stumpy Creek, Cimarron Creek, Crystal Creek, and Corral Gulch. All other tributaries to the reservoirs are classified as Aquatic Life Cold 2, Recreation 2, and Agriculture (state of Colorado 1993).

3. OBJECTIVES OF CURECANTI NRA'S WATER RESOURCES MANAGEMENT PLAN

The following objectives were developed in the April 12 and 13, 1994 water resources scoping meeting designed to identify water resource issues at Curecanti NRA. Sound management of Curecanti NRA's water resources require that the NPS:

- 1) Maintain or restore the natural high quality water in reservoirs and tributaries in order to support park purposes including fish and wildlife habitat, recreation and scientific study.
- 2) Recognize and anticipate the significance of potential reservoir level changes resulting from flows for endangered fish species, flows for the Black Canyon of the Gunnison NM, and for hydropower production.
- 3) Initiate, participate in, and instigate basin discussions and projects which may affect Curecanti NRA's water quality and quantity.
- 4) Promote, create, restore, and maintain habitat for native fisheries, in and outside park boundaries.
- 5) Insure that park development and operations do not adversely affect park water resources and water dependent environments.
- 6) Recognize the significance of natural aquatic and riparian resources, identify and preserve wetlands, and manage them in a manner which will preserve their natural functions and integrity.
- 7) Acquire appropriate information to understand and manage water-related resources.
- 8) Address water issues related to public health and safety including flood hazards, palatability of fish, and general water quality.

9) Insure that Curecanti NRA maintains its water rights.

4. WATER RESOURCES MANAGEMENT PLAN

Whether in support of natural systems or providing for visitor use, water is often a significant resource in units of the National Park System. Consistent with its fundamental purpose, the NPS seeks to perpetuate surface and ground waters as integral components of park aquatic and terrestrial ecosystems, by carefully managing the consumptive use of water and striving to maintain the high quality of surface and ground waters in accordance with all applicable federal, state, and local laws and regulations. In addition, the NPS assures compliance with all floodplain management and wetland protection requirements, and obtains and uses water for the preservation, management, development, and use of the National Park System in accordance with legal authority and with due consideration of the needs of other water users.

Planning is an essential step in addressing a park's water resources issues, and a WRMP is often prepared in parks where water resources are sufficiently important, complex, or controversial. Completion of a Water Resources Scoping Report is the first step in assessing the need for a WRMP. The WRMP structures and uses information about the park's hydrologic resources to assist management in evaluating the range of alternatives concerning water resource issues.

There are three major sections in a WRMP. First, the plan provides the necessary background with respect to the park and water resource issues, concerns, and needs which have led to the preparation of a WRMP. In particular, this section provides information on laws, regulations, and policies applicable to the park, and land status and uses adjacent to the park. This section also sets forth the objectives concerning use and management of water in the park, and lists the specific water resources issues which have been identified for evaluation in the plan. The second section of the plan provides sufficient information to characterize the hydrologic setting of the park and to describe the current condition and status of park water resources. Depending upon the hydrologic resources of the park and the water resource issues to be addressed, the description of the hydrologic environment section should summarize published information, and perform, where necessary, an analysis of available unpublished data, including information relating to the physiography, climate geology, surface water resources, ground water resources, aquatic and riparian resources and habitats, water uses within the park, and water rights. The final section of the plan presents the action program of the planning effort. This section includes specific project statements which describe operational activities and special projects necessary to address the water resource concerns and issues facing the park. These activities and projects may consist of management, monitoring, interpretation, law enforcement specifically directed toward water resources protection, program administration, research, management studies, and

mitigation/treatment action. Guidance for development of a WRMP may be found in *Draft. Instructions for the preparation of water resources management plans* (NPS 1991).

5. WATER RESOURCES ISSUES AT CURECANTI NRA: INFORMATION NEEDS AND IMPACTS

Water Resources Division (WRD), representatives from the regional staff, Curecanti NRA personnel, and local agency and groups held an initial scoping session to identify water resources issues and concerns of the park management on April 12 and 13, 1994. Subsequent discussions have been held with additional NPS personnel, state officials, and water resource professionals to further define issues and concerns. Specific water resources issues identified for consideration in a proposed WRMP were manifold. The following summary of those issues proceeds from a discussion of the information that Curecanti NRA has and what gaps are apparent (Sections 6-10), to what impacts are occurring or could potentially occur to the water resources of Curecanti NRA (Sections 11-14).

6. WATER QUALITY

One of the primary management concerns for Curecanti NRA is maintenance and/or restoration of the naturally high quality water in reservoirs and tributaries in order to support fish and wildlife habitat, recreation, and scientific study. This section identifies sources of water quality data, areas where important information is lacking, and identifies ongoing studies related to water quality.

6.1. Summary of Water Quality Studies

A relatively large amount of water quality data is available for the Upper Gunnison Basin including Curecanti NRA. The following discussion documents these studies; some are park-based and others were initiated by other agencies or academic institutions. Tributaries to Blue Mesa received early scrutiny prior to and just after impoundment (Wiltzius 1965, 1966, 1967, 1971, 1974, 1976). These studies focused on fisheries and water quality measurements including temperature, pH, conductivity, dissolved oxygen, alkalinity, hardness, turbidity, and various ions. Reed (1968) anticipated certain limnological developments in light of reservoir completion on the Gunnison River. He suggested that nutrient leaching and an availability of major ions after impoundment would create a productive reservoir. The study notes that blue-green algal blooms had been encountered in the reservoir soon after river inundation.

Boettcher (1971) evaluated water quality and supply at six planned or existing recreation sites at Curecanti NRA. The Colorado Department of Health (1975) discussed baseline water quality and potential problem sites within the upper

Gunnison River drainage. In the Gunnison River, dissolved solids were low, specific conductance ranged from 167 to 257 $\mu\text{mhos/cm}$, and hardness as CaCO_3 averaged 140 mg/L. Ammonia was detectable, and phosphorus levels were high after return flows of irrigation water in 1975. The largest increases in fecal coliform counts occurred in the river approximately two miles north of Gunnison. The lowest benthic fauna diversity was encountered in channelized sections of the river.

Colburn (1981) studied levels of trace elements in aquatic insects in Gunnison area tributaries including the East River, Slate River, Oh-Be-Joyful Creek, Coal Creek, and the Gunnison River. Aquatic insects concentrated cadmium at two to four orders of magnitude; like cadmium, manganese in the insects may reflect cumulative effects of past water quality. Richards and Ferchau (1978) and Apley (1981) focused on studies of surface and ground water in the Powderhorn area south of Curecanti NRA. Chemical, physical, and biological data were summarized for Cebolla Creek, a main tributary to Blue Mesa Reservoir. Rumberg et al. (1978) noted that waters in the upper Gunnison Basin including tributaries to Curecanti NRA were generally of high quality. Only fecal coliform, some metals, and ammonia levels exceeded standards at some sites. Effects of the Aspinall Unit impoundments on the physico-chemistry and biology of the downstream environment were discussed by Stanford and Ward (1983). Total dissolved solids and the organic carbon pool increased downstream. Winter water temperatures below the impoundments were elevated, and summer water temperatures were depressed below the last outlet. In addition, Stanford and Ward (1989), Hauer et al. (1989), and Ward and Stanford (1990, 1991) noted faunal discontinuities resulting from damming upper and middle reaches of the Gunnison River.

Metals, inorganics, organic hydrocarbons, and radionuclide data were reported in a documents by Aaronson (1982a, 1982b). Only manganese exceeded US Environmental Protection Agency (EPA) criteria (1976) in Cimarron Creek. Fish tissue analyses (Kunkle et al. 1983; US Fish and Wildlife 1987) for metals were completed in 1983 and 1987. In both studies, metals were not found at levels harmful to humans. The former study suggests follow-up studies which sample the game fish every five years to establish a baseline, and to interpret changes over time.

A summary of fisheries and benthic studies in the Gunnison River were presented by Nehring and Anderson (1983). Excluding yearly creel surveys and salmonid stocking records, little research until 1993 has been conducted on population structure and dynamics of the fishery at Curecanti NRA. Wiltzius (1971, 1974) focused on post-impoundment investigations of fish populations after initial stocking. Middleton's (1969) research entailed studies on catostomid fishes in Blue Mesa Reservoir and associated tributaries. Wiltzius (1976) prepared a report on the historical influences of irrigation diversions and reservoirs on temperature and fish distribution in the Gunnison River. Wiltzius and Smith (1976) chronicled harvest

trends and migration of salmonids in the Aspinall Unit. Weiler (1985) conducted a trend analysis on rainbow trout and kokanee salmon versus catch per angler. McAda and Kaeding (1990) describe the effects of dam construction on the fishery of the Gunnison River as it relates to endangered fish species. Johnson (1994) outlines in a annual project report a study that elucidates impacts to the productivity of plankton and the quality of the fishery in Blue Mesa Reservoir from reservoir re-operations.

A preliminary report on Blue Mesa Reservoir noted the waters were mesotrophic, and that they ranked sixth in overall trophic quality for Colorado's lakes and reservoirs (EPA 1976a). Blue Mesa Reservoir's water quality was surveyed as part of a selected lakes and reservoir study; Sapinero Basin was sampled and determined to be oligotrophic (Britton and Wentz 1980). Blackwell and Boland (1979) included Landsat imagery and principal components technique to determine trophic status of Blue Mesa Reservoir. Additional multispectral scanner information was obtained in 1983 (Verdin 1984), and correlated to actual water samples. Lack of good relationships between surface and image data sets were attributed to a 24-hour delay between image acquisition and data collection. Water variability patterns were recognized and reported.

Summaries of biological, chemical, and physical data on Blue Mesa Reservoirs and tributaries to Curecanti NRA are presented by Bio-Environs (1985), NPS (1986), Hickman (1987), and Cudlip et al. (1987). The NPS (1986) study gathered baseline information on benthic fauna at four stream sites: Gunnison River, Cebolla Creek, Lake Fork of the Gunnison River, and Soap Creek, and on the phytoplankton in Blue Mesa Reservoir. At each of the stream sites, benthic organisms associated with high to medium quality water were found. In 1983, low numbers of phytoplankton and few species were found in Blue Mesa Reservoir. The report noted that there appeared to be no problem with algal blooms particularly, *Aphanizomenon floc-aquae*; however, 1983 was an anomalous year such that influx of water to the system was extremely high. Chlorophyll and phytoplankton data gathered in 1984 are also presented in the report. Bio-Environs (1985) noted that the three basins in Blue Mesa Reservoir differed in their trophic status: Sapinero was considered oligotrophic, Iola—mesotrophic, and Cebolla—intermediate between the other two. Hickman (1987) presented a trend analysis of water quality data from 1982-1985. He demonstrated that no gross pollution or variation from water quality state standards or EPA criteria have occurred in Blue Mesa Reservoir. Cudlip et al. (1987) stated that chlorophyll data for Blue Mesa Reservoir do not corroborate reservoir-aging theory that productivity decreases after an initial "boom cycle". The report summarizes biological, physical, and chemical data collected on Blue Mesa Reservoir, and notes further research ideas.

At least four major park-based efforts (including the present program) at monitoring the water resources at Curecanti NRA have occurred. The first included an early

period of sampling pre- and post-impoundment (Wiltzius 1965, 1966). In these studies, sites in the Gunnison River prior to impoundment, by the dam post-impoundment, and some tributaries were monitored for basic parameters, alkalinity, some ions, and some metals. In 1982, Roger Andrascik, Resource Management Specialist, and Don Hickman, Park Ranger, initiated a water quality monitoring program in Blue Mesa Reservoir and its tributaries, primarily to document baseline conditions and assess potential threats to water quality. During the 1982-1985 sampling period, data were collected from 48 Blue Mesa Reservoir (BML1-BML48) sites, four Crystal Reservoir sites (CL1-CL4), and six sites on Morrow Point Reservoir (MPL1-MPL6). Twenty-one tributaries were sampled. The following parameters were measured at least once at the above sites:

air temperature, water temperature, discharge on streams, depth and elevation for reservoir sites, specific conductance, pH, dissolved oxygen, secchi depth in reservoirs, total dissolved solids, total suspended solids, fecal coliform, fecal streptococcus, total acidity, total alkalinity, calcium, chloride, magnesium, organic nitrogen, total Kjeldahl nitrogen, ammonium, nitrate, sodium, sulfate, potassium, ortho-phosphate, total phosphorus, and hardness (Curecanti NRA, unpublished data).

In 1987, Wayne Valentine, Resource Management Specialist, reactivated the water quality monitoring program in Blue Mesa Reservoir. The 1987 program was designed to monitor potential threats to water quality in shoreline embayments from tributary inflows and adjacent land use. Table 2 notes the sites sampled and the potential threats at those sites (Figure 3).

These sites were monitored for air temperature, water temperature, specific conductance, pH, dissolved oxygen, secchi depth at reservoir sites, total dissolved solids, total Kjeldahl nitrogen, total phosphorus, ortho-phosphate, fecal coliform, and chlorophyll a at reservoir sites. The chlorophyll sample was collected in a 5m x 0.025m PVC pipe. Ammonium and nitrates were measured at the three Cimarron and Squaw creek sites. Four beach areas (sites 14-17) were monitored for fecal coliform bacteria only (Curecanti NRA, unpublished data).

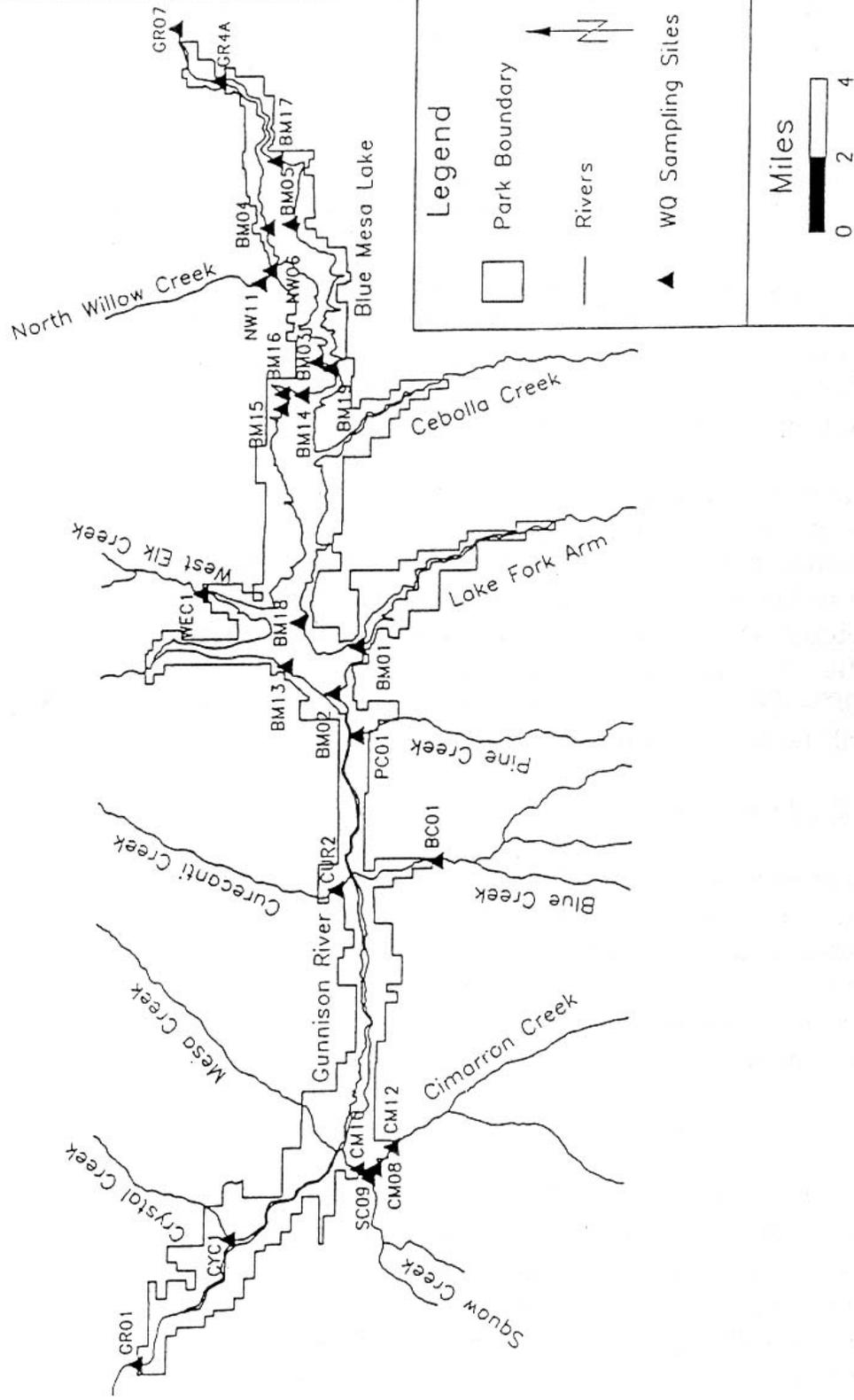
6.2 The Present Monitoring Program

6.2.1 Water Quality

In 1992, Curecanti NRA requested technical assistance to review its water quality monitoring program. Related to this request, other program needs were identified and included: 1) relocating current monitoring sites to address changing resource demands and uses, 2) formalizing the threats-based program by developing a

CURECANTI NATIONAL RECREATION AREA

Water Quality Sampling Sites



monitoring plan, 3) correlating past data with recent data, 4) providing input for the General Management Plan (GMP), 5) developing a WRMP for the park (Long 1993).

Discussions led by Barry Long (WRD) and Tim Graham (Curecanti NRA) revealed: 1) that no sites on Morrow Point or Crystal Reservoirs were being monitored; 2) that recent increased urbanization in Crested Butte and Gunnison may cause impacts to water resources; 3) that land-use activities such as mining, logging, and grazing *in* the watershed surrounding Curecanti NRA had not been assessed; 4) that impacts from new and existing roads presented potential threats; 5) that marinas in Blue Mesa Reservoir, and to a lesser extent in the two lower reservoirs, posed hazards for introduction of oils, fuels and organic solvents from boats; and 6) uranium mill tailings near the Gunnison River upstream of Curecanti NRA presented a potential threat to Curecanti NRA water resources. Presently, contractors for the DOE are removing the tailings from the site, with work planned for completion in 1996. The DOE has established groundwater monitoring programs for the removal site and the new disposal site (1994b, 1994c).

In light of the identification of these potential threats to Curecanti NRA water resources, the park revised the list of monitoring sites. Presently, Curecanti NRA continues with their threats-based water quality monitoring effort for six sites on Blue Mesa Reservoir, and nine stream sites flowing into all three reservoirs (Figure 4). Curecanti NRA measures basic parameters, nutrients, and chlorophyll a. The sites are noted in Table 3. The WRD continues to analyze and interpret the 1987—1993 water quality data. Pending the results of the analysis, Curecanti NRA will revise its monitoring program.

6.2.2 Limnological Studies

A present study will define the trophic dynamics of Blue Mesa Reservoir. Research carried out by Colorado State University (CSU) and US Fish and Wildlife Service investigators will define the relationship between fish, their food source, and reservoir operations (Johnson 1994; NBS 1994). Additionally, research on entrainment of fish through the dam will provide seminal information on effects of release regimes on a stocked fishery (Jennings, pers. corn. 1994).

6.2.3 Biomonitoring

In 1992, Curecanti NRA began a biomonitoring program on all the stream sites of the established water quality monitoring program. The need for a program was identified from a 1992 highway spill in which gallons of fertilizer entered Blue Creek (tributary to Morrow Point Reservoir) from a drainage *on* Highway 50. This, and an incident at Capitol Reef National Park, point to the need for parks to monitor the biological component of aquatic systems in addition to monitoring the chemical and

Table 2. Water quality monitoring sites and associated threats, 1987-1992.

Site	Site Name	Septic	Mining	Oil/Gas	Road	Recreation	Issues					Development
							Marinas	Grazing	Upstream	Logging	UST	
BM01	Lake Fork Arm		x		x	x		x				
BMO2	Lake Fork Marina	x					x					
BM03	Haystack Gulch	x										
BM04	Sunnyside	x										
BM05	Iola	x				x		x				
NW06	Lower N Willow	x				x						
GR07	Gunnison River								x			
CM08	Cimarron a. Squaw	x									x	
SC09	Squaw a. Cimarron	x						x				
CM10	Cimarron b. Squaw	x						x				
NWII	Upper N Willow						x	x				
CM12	Cimarron Benny's	x						x				
BM13	McIntyre Gulch	x			x							x
BM18	Blue Mesa High	x				x						x
14	Old Hwy 50					x						
15	Bay of Chicks E					x						
16	Bay of Chicks W					x						
17	Iola Beach					x						

physical aspects. At Capitol Reef NP the chemical and physical monitoring program did not capture the severity of a rotenone spill (Cudlip et al. 1994). Over 300 fish and thousands of macroinvertebrates were killed as a result of the spill (NPS 1991). Curecanti NRA's efforts using the Rapid Bioassessment Technique (EPA 1989) attempt to inventory the stream and to compare those sites over time, and compare impacted sites such as the Cimarron River to more pristine sites in terms of the macroinvertebrates. Since 1994, six sites have been monitored on a yearly basis. Relative numbers of genera at stream sites ranged from 10 to 23 in 1994 (Cudlip et al. 1994). Further analysis of data awaits more years of sampling.

6.2.4 Coordination with Other Agencies

The US Geological Survey (USGS) through their National Water Quality Assessment program (NAWQA) will monitor water quality and quantity at sites above and below Curecanti NRA. Under a Memorandum of Understanding between the NPS and the USGS, two sites on the Gunnison River will be sampled as basic fixed sites for fiscal year 1995. Samples will be taken on a monthly basis with two additional extreme flow samples. Bed sediment and tissue samples will also be taken at these sites. Curecanti NRA will assist in sampling at the Riverway site and will have access to the data generated from the study.

Curecanti NRA anticipates participation in the Colorado Division of Wildlife River Watch Network. This program involves middle and high schools, colleges, and other entities in monitoring the waters of Colorado. In 1996, Curecanti NRA expects to incorporate sites on the Lake Fork of the Gunnison River, and Cebolla Creek in its monitoring program. Curecanti NRA would collect the samples, and Gunnison High School and the Colorado Division of Wildlife would analyze the samples for pH, dissolved oxygen, alkalinity, hardness, and metals.

6.3 Outstanding Waters Designation

Every three years, the Colorado Department of Health's Water Quality Control Commission holds a review of stream standards and classifications. The next review has been postponed indefinitely until funds are made available to the staff for their monitoring program. Curecanti NRA anticipates that the Colorado Water Quality Control Division (CWQCD), which serves as staff to the commission, will recommend an Outstanding Waters Designation for the three reservoirs (Anderson, CWQCD, pers. corn. 1994). The designation would help maintain the excellent water quality which currently exists at Curecanti NRA. However, such a designation prompts the antidegradation review for all projects which involve discharges to these waters. Such a designation would carry with it impacts to park management. If Curecanti NRA needed to construct a sewage system requiring discharge to these waters, the antidegradation review would require performance of

Table 3. Water quality monitoring sites and associated threats, 1993 to present.

Site	Site Name	Septic	Mining	Oil/ Gas	Road	Recreation	Issues					
							Marinas	Grazing	Upstream	Logging	UST	Development
BM01	Lake Fork Arm		x		x	x		x				
BM03	Haystack Gulch	x										
BM04	Sunnyside	x										
BM05	Iola	x				x		x				
BM18	BM Highlands	x				x						x
BM19	Elk Cr. Marina					x	x					
GR07	Gunnison River								x			
GR4A	Cooper Ranch										x	
GR01	Gunnison River	x				x						
WEC1	West Elk Creek	x										x
PCOI	Pine Creek	x				x		x			x	
BC01	Blue Creek				x							
CUR2	Curecanti Creek			x				x				
CM10	Cimarron Creek	x			x	x		x			x	x
CYC1	Crystal Creek			x		x		x				
14	Old Hwy 50				x							
15	Bay of Chicks E					x						
16	Bay of Chicks W					x						
17	Iola Beach					x						

an alternatives analysis, or altogether prohibit construction. In addition, adjacent and upstream landowners could be impacted by such a designation.

As the Curecanti NRA desires to maintain and even improve water quality, the proposed WRMP should include:

- ◆ Providing a plan for cyclical monitoring of potential threats to Curecanti NRA water resources, and a reassessment of the parameters which should be measured.
- ◆ Developing a monitoring design on Crystal and Morrow Point reservoirs and on stream sites including Cimarron and Squaw creeks which produce and contribute some of the worst water quality to the park.
- ◆ Completing data analysis for the most recent water quality data by the WRD (in progress).
- ◆ Reviewing the appropriateness of an Outstanding National Waters designation for the Aspinall Unit.
- ◆ Implementing a protocol and techniques for water resources data management.

7. FISHERY AND RECREATION ISSUES

7.1 The Reservoirs

One of Curecanti NRA's prime recreational opportunities is fishing. The Colorado Division of Wildlife is responsible for managing the fishery and Curecanti NRA manages the recreational opportunities. To insure that recreationists enjoy fishing here, developed areas devoted to reservoir access have been constructed; these include ramps, marinas, and fish cleaning stations. The reservoirs receive the greatest amount of angling use, to the extent that poor catch years cause the angling public to question the management of the reservoir. For example in 1988, a dry year, angling was poor in Blue Mesa Reservoir. At two meetings in 1988, the public and representatives from the Colorado Division of Wildlife, BLM, and BoR discussed the poor fishery and the direction the Division of Wildlife would take regarding release and stocking of kokanee and rainbow trout. Of interest was a statement from the Division of Wildlife noting that the reservoir was 23 years-old and that nutrients were leached out, thus the decline in the fishery (Langlois 1988).

Newly impounded reservoirs typically pass through an initial period of high productivity followed by severe decline, and finally a period of stasis in which productivity levels remain the same over many years (Baxter 1977; Lindstrom 1973;

Goldman and Kimmel 1978). Cudlip et al. (1987) noted that this reservoir-aging theory may not apply to Blue Mesa in that levels of chlorophyll a are similar in 1975 and 1983-1985. Little data are available prior to 1975, and therefore, Curecanti NRA lacks information about potential initial trophic upsurges, and a following trophic depression. However, in that chlorophyll a levels have remained the same from 1975 even to 1994, suggests that the reservoir exists in some type of trophic equilibrium. That the fishery is poor in some years may indicate that over the years too many fish have been stocked, i.e., the reservoir's zooplankton and phytoplankton cannot support the number of stocked fish. Still others note that poor fishing corresponds with low reservoir levels.

Several of these issues are now being addressed by Colorado State University as outlined in section 6.2.2. The study, conducted by Brett Johnson, will provide in depth information regarding Blue Mesa Reservoir, but will not provide any information regarding Morrow Point and Crystal reservoirs. These two reservoirs provide a primitive fishing experience and do produce large fish. Because the requirements for endangered species below the Aspinall Unit may affect Blue Mesa Reservoir, so too may the lower reservoirs be affected. In addition to studies on Blue Mesa, background information is needed on Morrow and Crystal reservoirs' chemistry and biology.

Compounding the complexity of the affects of reservoir trophic dynamics and general operations on the sport fishery is the appearance of whirling disease in the kokanee and rainbow fishery in all three reservoirs. Creel survey information gathered in 1993 revealed that the first year age-class of kokanee was missing or had declined (Hebein, pers.comm. 1993). Continuation of the creel survey will elucidate to what extent the whirling disease will affect the Aspinall Unit's fishery.

7.2 The Rivers and Streams

7.2.1 The Gunnison River

Another aspect of the sport fishery at Curecanti NRA are the opportunities afforded by the rivers and streams. Curecanti NRA is pressed with the question of what types of instream flows are required for recreational purposes on the Gunnison River above and below the reservoir system in light of upstream uses and operation of the Aspinall Unit. Instream flow methodologies have been used to define flow requirements for recreation whether it be fishing or rafting in the Dolores River (Vandas et al. 1990) and the Gunnison Gorge (Elliot et al. in press). Selecting the most suitable methodology for this area will assist us in addressing what flows best accommodate the fishery and the white-water boating experience, and will also guide the park when trying to anticipate upstream use and reservoir operation changes.

7.2.2 Tributaries to the Reservoirs

Some of the more unexplored fishing opportunities at Curecanti NRA occur on the tributaries. Several tributaries to Blue Mesa including Soap Creek, West Elk Creek, and North Beaver Creek, Lake Fork of the Gunnison River, and Cebolla Creek support naturally reproducing sport fish. In addition, Curecanti Creek and Blue Creek, tributaries to Morrow Point Reservoir, and Crystal Creek, tributary to Crystal Reservoir, support naturally reproducing trout populations. Crystal Creek is diverted to the extent that later in the year it runs dry. However, some trout remain in the upper stretches of Crystal Creek.

Through inter-agency cooperation, the US Forest Service, the BLM, the Colorado Division of Wildlife, and the NPS, native cutthroat trout have been introduced to North Beaver Creek on Forest Service land. It is Curecanti NRA's desire to continue with re-introduction of this species in East Elk Creek, West Elk Creek, and perhaps Soap Creek. In order to introduce the cutthroat, the streams must be treated to rid them of all resident trout, and a barrier must be placed downstream to prohibit upstream migration of non-native trout or cutthroat hybrids. Introducing the native cutthroat to Curecanti NRA's water would provide yet one more angling opportunity for the sport angler. However, obstacles to the effort include public's potential dislike of treatment. A WRMP would offer a plan for re-introduction of native cutthroat species.

7.3 Contaminants in Fish

Metals in fish were found at levels not harmful to humans (Kunkle et al. 1983). Again in 1987, the same results were found (US Fish and Wildlife Service 1987). Since a large amount of the fish that are caught from the reservoirs are consumed, we should continue with monitoring to insure that fish are safe for human consumption. Although industrial inputs of contaminants are almost non-existent, the park may experience inputs of metals from areas like Lake City and Crested Butte, areas of high background mineral content and past mining activity, respectively. Inputs of pesticides or herbicides from agricultural entities may be minimal, because most agricultural operations consist of hay crops. Above Curecanti NRA, ranchers fertilize some pastures, but, on a regular basis they do not apply pesticides and herbicides (Cudlip, pers. observ. 1994).

7.4 Fisheries Management Plan

Because the park has diverse opportunities for fishing and the chance to develop greater opportunities such as the native cutthroat, Curecanti NRA feels a fisheries management plan may enable the park to pursue and enhance programs. Additionally, findings from the present fisheries study may allow the park, under

the direction of the Colorado Division of Wildlife, to manage the fishery in a better manner.

The proposed WRMP would:

- ◆ Address means of examining the biology, chemistry and physical nature of the two lower reservoirs in light of changes in upstream use and re-operation of the Aspinall Unit.
- ◆ Provide a plan for re-introduction of native cutthroat trout in tributaries to the reservoirs.
- ◆ Address the appropriateness of, and provide a schedule for examining levels of metals, pesticides, and herbicides in fish found in the reservoirs.
- ◆ Address the need for a fisheries management plan.

8. INVENTORY OF WATER RESOURCES

Curecanti NRA currently has: 1) a hydrography layer in our geographic information system, 2) location of wells and information concerning these wells including all pertinent and updated permits, and 3) information from the BoR concerning the characteristics and operations of the reservoirs.

The park lacks historical and current flow data on all tributaries to the reservoirs. Curecanti NRA also has no information on spring location or flow within the park boundaries. Although few springs exist within park boundaries, these are very important to wildlife in the area. With regards to water resources inventory a WRMP could include:

- ◆ The assessment of the park's status in meeting level I, inventory and monitoring requirements as provided in NPS-77.

9. FLOODPLAIN, WETLANDS AND WATERSHED MANAGEMENT

9.1 The Gunnison River Alluvial Floodplain

As stated in the introduction, Curecanti NRA encompasses an extensive riparian and wetland site in the eastern portion of the park upstream of Blue Mesa Reservoir. Here, the Gunnison River is a free-flowing stream bordered by a healthy riparian community and an outlying wet meadow community sub-irrigated by surrounding private property. Two developed areas, Neversink and Cooper Ranch picnic areas, border the Gunnison River on the north side. The general area is

referred to as Cooper Ranch. This area, not including the picnic grounds, is managed by Curecanti NRA as a natural zone. Curecanti NRA conducts long-term monitoring in this area on the vegetation and birds. There are few areas along that Gunnison, or other large stream systems in the vicinity, which support functioning wet meadow and narrowleaf cottonwood habitats. The area encompasses an alluvial floodplain, therefore, the landscape is very dynamic and experiences channel avulsions, with the most recent one occurring in 1993, a high-flow year. Curecanti NRA is interested in allowing natural ecological functions to occur on this stretch of the river; upstream to a large degree, the Gunnison River is constrained naturally by canyon walls, or by human activities such as haying and grazing operations or housing developments.

Three studies address the dynamics of the Gunnison River avulsion. Smillie and Long (1993) investigated the Gunnison River channel avulsion and noted that rivers in alluvial floodplains such as the Gunnison River change course and are naturally dynamic. The request for their technical assistance from the WRD to the park arose from community pressure to move the river back to the north channel after the avulsion occurred. Subsequently, Martin (1993) collected survey data to assess the stability of the new channel, and develop information relevant to returning flow to the north channel. Results showed that the south (new) channel is 0.5 meters lower in elevation than the north channel, indicating that the Gunnison River at the avulsion site is more stable than prior to the channel change in 1993. Lastly, Wohl and Hammack (1995) addressed the following questions: 1) What is the historic frequency of channel avulsions on the Gunnison River in the vicinity of Curecanti NRA?, and 2) What do present channel characteristics indicate in terms of channel stability over the next 50 years? They determined that the Gunnison River exhibits characteristics resembling braided and meandering channels. It is predicted that the Gunnison River will move laterally in the study area over time intervals of years to decades. The point of these studies was directed towards understanding how the Gunnison River functions at that stretch, and how difficult it is to control such a stretch over the long term.

Another concern in the Cooper Ranch area includes a portion of the new south channel which may eventually cut through private property as it meanders back to the north channel. The private property owner is aware of the situation and not adverse to the river moving onto his property. The park continues to monitor the movement of the channel from a fixed photo-point, and a permanent point near the private property owner's corner.

One area of concern at Cooper Ranch includes increased use of the island south of the north channel. This area harbors abundant wildlife including nesting geese. With increased use of the area, Curecanti NRA wishes to insure that the wildlife and habitat are not disturbed. The proposed WRMP would:

- ◆ Discuss alternatives for addressing floodplain dynamics and protection issues on the Gunnison River above Blue Mesa Reservoir.

9.2 Floodplain Assessments

Curecanti NRA conducted an internal floodplain assessment in 1976 in the Neversink and Cooper Ranch picnic areas. A report (Engineering Consultants 1976) details the floodplain assessment conducted on the Gunnison River and Tomichi Creek, in the vicinity of Gunnison. This assessment includes the Riverway Picnic Area located at the most eastern end of Curecanti NRA. For any proposed developments, Curecanti NRA will refer to the new NPS Floodplain Guidelines (NPS 1993a).

The Gunnison River upstream of Curecanti NRA had experienced ice jams resulting from the construction of Blue Mesa Reservoir (Morrison-Knudsen Engineers, Inc. 1985). These ice jams tended to inundate property upstream of Curecanti NRA. Two efforts resulted in amelioration of impacts to upstream landowners. The first effort included purchase of land by the BoR for administration by Curecanti NRA (BoR 1976). The second effort involves lowering of Blue Mesa Reservoir to 7,490 feet by December 31 of every year. This critical elevation was developed through two studies (Burghi 1979; Morrison-Knudsen Engineers, Inc. 1985) on the ice jamming and flooding problems on the Gunnison River.

The proposed WRMP would:

- ◆ With the assistance of WRD, find and review the floodplain assessments conducted for Neversink and Cooper Ranch picnic areas, and other sites. The WRD will conduct other floodplain assessments as needed in existing developed sites in floodplains, and as directed by the GMP process.

9.3 Wetlands and Riparian Dynamics and Protection

Currently, the wetlands within the park boundaries have not been mapped by park personnel. Mapping by the National Wetland Inventory has occurred in this area, but the data have not been digitized (Elliot, pers. corn. 1993). Curecanti NRA needs to recognize and delineate the park's wetland areas, and establish a research and protection emphasis for identified wetlands. Because the park's wetland resources are scarce and are linear in nature (the majority is found along stream courses), the scale of the National Wetland Inventory would be unsuitable for interpreting and managing this resource.

The park recognizes that the Cooper Ranch area currently supports a wet meadow system; the naturally high water-table in this area is augmented by sub-irrigation from nearby pastures. This area was hayed, irrigated, and grazed until 1989, after

which the permit was revoked for not completing improvements requested by Curecanti NRA and the BLM. Now this area serves as wildlife habitat and a place for scientific research. The area is unique to Curecanti NRA, and contributes to the overall role that other wetlands and riparian areas have within Curecanti NRA boundaries.

In addition to delineation of wetlands, Curecanti NRA needs to conduct more research to answer questions about cottonwood regeneration in abandoned river channels. The park's riverine vegetation consists primarily of narrowleaf cottonwood (*Populus angustifolia*). Curecanti NRA knows little about this tree, the age-classes that are present in the park, and how the park insures maintenance of this habitat, particularly in light of its use by great blue herons to the east of Curecanti NRA.

In 1994, personnel from the NBS visited the park to discuss research possibilities regarding narrowleaf cottonwood regeneration at the Gunnison River avulsion site. Scott et al. (in press) notes how various fluvial processes temporally and spatially regulate the development of cottonwood stands across the landscape. As of yet, they have not been able to study avulsion sites. Although water continues to flow through the north channel, the low-flow conditions and stagnant ponds developing late in the season, provide opportunities for Curecanti NRA to witness recruitment of herbaceous plants and development of wetlands. On a micro-scale, the area is extremely dynamic—with aggradation and degradation of bar material, scouring by ice jams and peak flows, and encroachment of willows and herbaceous plants occurring within a year's time. On a macro-scale, the park will witness the evolution of various patterns of cottonwood regeneration. The park might ask simply where and how many cottonwoods will be recruited to this area over the long term? Some answers rest with other galleries located across the way on the alluvial floodplain. To date, Curecanti NRA has established a small monitoring program regarding cottonwood establishment, and another study to address impacts to cottonwood regeneration from ice jams on the Gunnison River. Currently, Curecanti NRA and the NBS are coordinating a potential study of cottonwood regeneration at the avulsion site.

Also, the park recognizes that riparian areas course along most of the tributaries which feed into the reservoir system. These areas, and the wetlands they harbor, need to be delineated. In 1994, the Nature Conservancy, in concert with the BLM, classified riparian areas in the western region of Colorado. Some of their work has been conducted at Curecanti NRA. The resulting report will be available to the park in 1995. The proposed WRMP would:

- ◆ Include the delineation of wetlands within Curecanti NRA at a scale that meets the park's interpretation and management needs.

- ◆ In coordination with research efforts by the NBS, outline the study of cottonwood regeneration at the Gunnison River avulsion site.

9.4 Watershed Management

Curecanti NRA cannot manage its natural resources in a vacuum. Because the park has a small land base, yet serves as the receptacle for water draining a 2,000 square mile watershed, it must acknowledge that activities occurring on surrounding private property and other agency lands will have impacts on the parks terrestrial and water resources.

Watershed management can best be addressed in concert with the US Forest Service and BLM efforts to identify watersheds, denote land use activities, and characterize the watersheds which include Curecanti NRA. The park identified the need to: 1) conduct a condition survey, 2) utilize other agencies' methodologies, 3) work across boundaries, 4) involve themselves with the non-point pollution program, and 5) develop mechanisms to identify high erosional sites and identify fixable problem sites. The proposed WRMP would:

- ◆ Implement a watershed program which links directly to the programs undertaken by the US Forest Service and the BLM. This action would serve as the basis for a GIS interpretation of land use activities' impacts on park water resources.
- ◆ Direct the park in identifying all springs, and provide the park with recommendations for obtaining flow data.

10. WATER RIGHTS

10.1 Well Permits

Table 4 identifies wells, their permit numbers, dates of priority, and quantity. None have been adjudicated.

The Neversink, Beaver Creek, Cooper Ranch, East Cimarron, and Riverway are now inactive; the hand-pumps pulled, and the wells plugged.

Table 4. Well locations and permit numbers.

Well Name	Permit #	Date of Priority	Quantity of Water*
Elk Cr Well #1	33692-F	01/11/90	5.5gpm:24ac-ft per yr
Elk Cr Well #2	32263-F	12/15/89	15gpm:40ac-ft per yr
Stevens Cr Well	119675	10/07/80	15gpm:1.6ac-ft per yr
Cimarron Town Well	119613	09/29/80	11gpm:6.5ac-ft per yr
East Elk Cr Well	119671	10/30/80	5gpm:0.8ac-ft per yr
Lake Fork	31666-F	05/20/89	30gpm:10ac-ft per yr
Gateview	139681	05/23/85	1pgm:0.3ac-ft per yr
Ponderosa	28618-F	06/21/85	25gpm:10ac-ft per yr

* Values listed are actual maximum pumping rates (in gallons per minute - gpm), and average annual amount of ground water to be appropriated (in acre-feet).

10.2 East Elk Creek

Curecanti NRA has at least one known water right on East Elk Creek. The Gunnison County water files note that a 1.85 cubic feet per second (cfs) right on East Elk Creek was deeded to the BoR prior to the construction of Blue Mesa Dam. The two ditches developed to carry this water are the Henry F. Ditch and the Elk Creek Ditch. Fed by these two ditches, the irrigation system at the present day Elk Creek Visitors Center and Campground was believed to have been constructed in the latter part of the nineteenth century. Prior to the BoR's acquisition of the water right, the Colorado Division of Wildlife maintained the canals leading down from East Elk Creek to the present day Elk Creek Visitors Center and Campground. The BoR's water right became a NPS water right when Curecanti NRA was organized to administer recreational activities at the Aspinall Unit.

In 1969, the NPS completed an upgrade to its irrigation system. This consisted of a concrete diversion dam, excavation of approximately 22,005 feet of earth-lined ditch, four long-span pipe structures, lateral turnout boxes, concrete siphon boxes, and metal pipe sections. This contract totalled \$82,279.38 and was performed by the Strahan Construction Company of Riverdale, Michigan. The project required a full-time irrigator position during the spring, and for several hours almost daily through the summer, to insure proper operation. By 1978, the necessary man-hour commitment to tend the system had been discontinued. Water flowed freely through and over the irrigation ditch system, and as a result, the Elk Creek

Campground experienced serious flooding with motor homes stuck up to their axles in mud or water.

Since 1993, the irrigation system has been successfully used to control the prairie dog population and to revegetate the denuded area around the visitors center and the campground. Curecanti NRA wishes to continue to develop and use the water right for irrigation purposes.

10.3 Blue Mesa Reservoir

Curecanti NRA believed that a contract between the BoR and the NPS existed and authorized Curecanti NRA to use 500 acre-feet of water out of Blue Mesa Reservoir. After discussions, with the BoR (McCall, pers. corn. 1994), it was discovered that no such contract exists.

Curecanti NRA desires to pursue acquisition of this 500 acre-feet water use for culinary purposes. The appropriate manner to pursue this use is through the current contract negotiations taking place between the BoR, the Black Canyon of the Gunnison NM, and Curecanti NRA for water releases through the Black Canyon of the Gunnison NM.

The proposed WEMIP needs to address several water rights-related issues. These include:

- ◆ Status of the East Elk Creek water right.
- ◆ Inclusion of the 500 acre-feet water use from Blue Mesa Reservoir in the contract negotiations between the NPS and the BoR.
- ◆ Steps necessary to adjudicate existing well permits.
- ◆ Pursuance of water rights for springs and reservoir tributaries besides East Elk Creek.

11. UPSTREAM IMPACTS

11.1 Impacts to Curecanti NRA from Upstream Infrastructure

Development upstream of Curecanti NRA has, and will dramatically increase; which may impact the quality of water reaching Blue Mesa Reservoir. The state of Colorado has required that the ski-based towns of Crested Butte and Mt. Crested Butte, which are located in the Slate and East river drainages (tributaries to the Gunnison River), conduct a Clean Water Act Section 201 study regarding waste-

water treatment facilities. The result of the study, as well as increasing population trends in the East and Slate river drainages may indirectly affect the water resources of Curecanti NRA.

Additionally, as the city of Gunnison becomes more of a service community for the up-valley towns, the impacts associated with the city move closer to the park's boundary. In fact, Riverway, a Curecanti NRA picnic area located on the Gunnison River, is immediately below the city of Gunnison's sewage treatment facility. Many use this picnic area as a take out for kayaks and rafts. This stretch of the river is classified as Recreation I which requires a fecal coliform water quality standard of less than 200 colony forming units (CFU) per 100 ml of water. The plant's total capacity is 4.2 million gallons per day (mgd). Presently, during the summer as a result of infiltration, the facility treats approximately 3 mgd; however, during the winter the amount drops to 0.5 to 0.7 mgd. Although the facility during the summer reaches a little more than half of its capacity, increased population in Gunnison could utilize the remaining capacity. The facility, completed in 1987, is state of the art; it uses UV disinfection instead of chlorine, and has been designed to carry heavier loads than now utilized. Fecal coliform monitoring at Riverway reveals levels less than 200 CFU (Curecanti NRA, unpublished data). However, there exists a potential problem from this waste-water facility including increased nutrient loading, turbidity, and biological oxygen demand.

11.2 Grazing

Notably, another impact to Curecanti NRA takes the form of grazing on surrounding BLM land. One allotment, Iola-Powderhorn, located to the south of Blue Mesa Reservoir on Cebolla Creek, exhibits heavy to severe grazing in an area called the Kezar Basin Pasture. Although cattle migrate to the edge of Blue Mesa Reservoir, they normally remain around springs and small tributaries on BLM land which drains to the reservoir. Utilization and supervision surveys (BLM 1989) relate the extent of grazing and note that gullying occurs in many areas, but is especially severe in the northern drainages, particularly in an unnamed drainage in Sec. 4, T.48N., R.2W. The area surrounding this drainage is seeded with crested wheatgrass, severely grazed, and exhibits no interspace plant growth. During rain events, the potential for this area to contribute tremendous amounts of sediments to Blue Mesa Reservoir is high (Cudlip, pers. obser. 1993).

Certain rain events have triggered high sediment loads to the Gunnison River. These include mud/debris flows from Dry Gulch, and Six Mile Gulch, approximately 13 and 12 miles west of Curecanti NRA, respectively. Although these areas do not abut the recreation area, sediment in the Gunnison River is visible at the park's boundary during severe rain events (Cudlip, pers. obser. 1993). BLM grazing allotments encompass these drainages; utilization and supervision surveys document the severe-to heavy-use in these areas (BLM 1989). Curecanti

NRA has identified sediments from these areas and from the Cimarron River, but has not initiated cooperative programs to alleviate sediment inputs to its reservoirs.

Cimarron Creek reveals high turbidity levels during spring runoff. Total dissolved solids are also high ranging from 100 to 700 mg/L (Curecanti NRA, unpublished data). This creek drains land which is timbered, grazed, hayed, and irrigated. These cumulative impacts, concomitant with the nature of the surrounding soils, can contribute to high sediment loads. Squaw Creek, tributary to Cimarron Creek, also contributes high levels of sediments, total dissolved solids, and nutrients. Recent monitoring reveals high fecal counts approaching the state standard of 2,000 CFU/100ml (Curecanti NRA, unpublished data).

The BLM's Gunnison Resource Area Proposed Resource Management Plan and Final EIS (BLM 1992) describe all management unit plans for this particular BLM area. Review of the draft and final documents provide an excellent description of the area and detailed prescriptions for each unit. Grazing, its impacts, and its mitigation are provided. By instituting its management plan, the BLM can mitigate impacts to Curecanti NRA water resources.

The BLM proposed management plan for the Gunnison Basin Resource area (BLM 1992) notes that:

- 1) Vegetation would generally be managed to achieve at least a late seral ecological status.
- 2) Soil and water resources would be monitored to define problem areas. Measures would be taken to reduce erosion and increase plant basal cover. Best management practices, and other measures designed to reduce soil erosion and water quality deterioration would be required in all plans involving surface disturbance.
- 3) Riparian areas would be inventoried and prioritized where necessary to determine site-specific management strategies.
- 4) Reduction in deer and elk herds in an area north of Tomichi Creek and west of the city of Gunnison, the Cebolla Creek drainage, and south of Morrow Point Reservoir would be recommended and implemented in order to increase plant vigor, and to reduce resource conflicts.
- 5) Fishery streams and associated riparian areas would be managed to improve overall condition. Measures designed to prevent fishery stream or riparian zone deterioration would be required in all plans for surface disturbing activities.
- 6) For those areas without grazing plans, the maximum level of use in upland areas would be forty to sixty percent of the current year's production by weight on key species. For most riparian areas, forage utilization levels would not exceed forty to sixty percent of key herbaceous forage species, with a 2¹/₂-inch minimum stubble height required throughout the grazing period.

11.3 Logging

The Final Supplemental EIS for the Grand Mesa, Uncompaghre and Gunnison national forests (GMUG) (US Forest Service 1991) identifies areas for suitable timber production. Several of the areas are located in drainages near the reservoirs or the Gunnison River. Actual wood production and aspen management units include areas around Soap Creek, N. Willow Creek, Stevens Creek, N. Beaver Creek, W. Antelope Creek, Blue Creek, and Pine Creek drainages.

In discussions with the local state forester (Ayers, pers. *corn.* 1994), recent timber cuts have occurred on private property on the north and south sides of Morrow Reservoir. Also, from 1990 to 1993, timber cuts occurred on the Ute Mountain Ute property located on the south side of Blue Mesa Reservoir west of Sapinero. In 1990, aspen cutting occurred in the East Elk Creek drainage. Impacts of the cuts were addressed in individual management plans using best management practices (Ayers, pers. *corn.* 1994).

Several years ago timber cuts in the Soap Creek area (35 acres) and the Blue Mesa Summit area (80 acres) occurred. Impacts from these cuts are unknown, but were viewed to be small (Ayers, pers. com. 1994).

Effects of logging again may realize themselves in the form of sediment production (MacDonald 1991). Although, it is unknown whether existing cuts contribute to heavy sediment loads, these and future timber cuts must be monitored for best management practices.

11.4 Mining

Although mining in the area has ceased to a large extent, abandoned mines or abandoned mining activity may cause extensive problems such as acid mine drainage, subsidence, and fires. On the Slate River located in Crested Butte, several abandoned mine addits have released dissolved metals to Peanut Lake. The drainage waters contain high concentrations of Mn, Cu, Cd, and Zn. For example, the Peanut Mine drainage, located west of Wildbird Estates, revealed a zinc level of 2,456 µg/L collected in July 1992. Breach of the beaver structure which serves to dam Peanut Lake could result in entrainment into the Slate River water column of accumulated sediments and associated metals (Cooper 1993). Other abandoned mines exist in the Lake City area, and Oh-Be-Joyful Creek, tributary to Slate River (McArdle, pers. *corn.*). Wentz (1974) and Moran and Wentz (1974) document that significant amounts of acidity and metals are added to surface waters by drainage from mines and associated tailings. Specifically, Coal Creek and Oh-Be-Joyful Creek near Crested Butte, and tributaries to Lake Fork of the Gunnison River, revealed levels of metals such as zinc, which exceeded state standards during their studies.

Two active projects may also affect Blue Mesa Reservoir water quality. These include a proposed titanium operation on Cebolla Creek, upstream of park boundaries, and a gold-leaching operation near Vulcan, upstream of S. Willow Creek, an ephemeral stream. The titanium project operated by a Canadian firm, Teck Corporation, has a water quality and quantity monitoring program already instituted. The gold-leaching project has hired a consultant firm to deal with the environmental aspects of the project.

As mentioned in the water quality section, the uranium mill tailings site near the Gunnison River above Blue Mesa Reservoir, has been undergoing remediation since 1993. The tailings are being removed to a site south of Gunnison. The project will terminate in 1996. Although the present removal of the tailings material may elevate the levels of uranium in the ground water near the Gunnison River, complete removal of tailings will diminish the plume of uranium once detected downstream of the area.

The Gunnison Resource Area Management Plan and Final EIS (BLM 1992) discusses plans for saleable and locatable minerals which may impact Curecanti NRA water resources.

At the eastern boundary of Curecanti NRA, special-use permit RMR-CURE-6000-0003 for Gunnison Gravel grants access and approval of a sand- and gravel-mining operation on 9.9 acres of NPS land. The mine is located north of the Gunnison River, and north of Highway 50. No stipulations in the permit require construction of retention ponds or other sediment trapping structures; however the permittee is required construct haul roads in a manner which minimizes erosion.

11.5 Oil and Gas

The Oil and Gas Leasing Draft EIS for the Grand Mesa, Uncompaghre and Gunnison national forests (US Forest Service 1992) identified only a small portion of the forest as having any potential for leasing. However, NPS comments on the document noted that the area near Cimarron Point (north side of Crystal Reservoir) should be classified as having no potential (NPS 1992). The classification was requested, because Crystal Creek, tributary to Crystal Reservoir, flows directly through the area. Surface flow in the area would drain into Crystal Reservoir and could impact aquatic and riparian resources of the drainages and the reservoir. Geological assessment of this area by the Chief, NPS Mining and Minerals Branch, found little potential for hydrocarbon production.

The Gunnison Resource Area Management Plan and Final EIS (BLM 1992) recognized that the possibility of oil and gas development in this area is almost non-existent due to geologic evidence and previous exploration (see page P-80).

11.6 Roads

Highway 50 parallels Blue Mesa Reservoir for most of its length, and Highway 92 parallels Morrow Reservoir. Impacts to these water resources reside with highway snow removal processes and maintenance. In particular, one stretch of Highway 50 constantly shifts as a result of the base geology. Maintenance of this area requires periodic movement of materials and dumping of up to 4,000 cubic feet of material onto the side, and perhaps into Blue Mesa Reservoir.

Additionally, the Gunnison County Transportation Plan (1994) notes that widening of Highway 50, although potentially desirable, is unlikely in the twenty year focus of the plan. Improvement to the road would potentially cause impacts to Blue Mesa and the tributaries in the form of sediment and hydrocarbon inputs.

Presently, wintertime maintenance of the highways consists of plowing and sanding. The sand mixture used by Curecanti NRA on its roads contains approximately 5% salt, which ultimately finds its way into the reservoir.

While a spill contingency plan is outside the scope of this document, Curecanti NRA needs to acknowledge that hazardous materials do travel the roads through Curecanti NRA. In 1992, a truck carrying liquid fertilizer spilled its shipment on a curve of Highway 50. The area drains into Blue Creek, a tributary to Blue Mesa Reservoir. Presently, the park monitors Blue Creek to establish background water quality levels. Curecanti NRA intends to work with other agencies in the event that spills occur; this coordination is outlined in the draft Oil Hazardous Spill Plan (NPS 1992).

Most drainages have roads bordering the immediate creek or stream. As a result, sediment-loading to the stream systems may occur. A monitoring program which incorporates the most significant impact areas could be instituted. Where soils are highly erosive and where the road immediately borders the stream, the park could monitor water quality, especially during precipitation events. Presently, Curecanti NRA has not identified any severe problems associated with this combination of factors.

Being aware of potential upstream impacts to Curecanti NRA's water resources requires the participation of Curecanti NRA in basin discussions and projects. The proposed WEMP should address:

- ◆ Developing partnerships to coordinate information exchange and execute solutions to various problems.
- ◆ Discussing the impacts of mining, logging, grazing, and oil and gas development on Curecanti NRA's water resources. By using GIS, a model

may detail land-use activities and water quality and quantity to identify potential and existing problem areas.

- ◆ Utilizing Colorado's burgeoning non-point source program to focus on the Cimarron Creek drainage.
- ◆ Documenting changes in land ownership around Curecanti NRA which may impact water resources.

12. CURECANTI NRA'S IMPACTS ON WATER RESOURCES

12.1 Drinking water

Curecanti NRA has eleven water systems of which the Elk Creek system serves the greatest number of visitors and staff, and is operated throughout the year. These systems include those served by the wells listed in Table 4, as well as the East Portal and Iola systems, and the Gateview, Dry Gulch, and Red Creek systems. Table 5 identifies each well, notes the Colorado State Health Department's drinking water permit number, and actual pumping rates. East Elk Creek, Dry Gulch, Red Creek, and Gateview campgrounds are served by solar pumps.

The primary source of culinary water for the Elk Creek area comes from two groundwater wells located in the Elk Creek Campground. These wells are approximately 400 feet deep. Westwater Associates (1991) discussed location of new wells for drinking water including exploration of Haystack Gulch, Dry Creek area, and East Elk Creek, north of Highway 50. A recommendation was made to proceed with a test well at the East Elk Creek site, though this option was not taken and wells were revitalized at the Elk Creek campgrounds.

As a back-up to the existing system, Curecanti NRA can pump water from Blue Mesa Reservoir through a 2.5-inch diameter, 340-foot long pipe. This water is treated by two pressure-rapid sand filters, bag filters, and is chlorinated. A 200,000-gallon reservoir stores water for the approximate maximum demand of 70-80,000 gpd. A 550-foot deep well drilled in 1973, now abandoned due to geologic activity that sheared the casing, is used for injection of the backwash from the lake water filtration plant under an EPA permit (File # CO5000-03914). Another EPA permit (CO-0034657) for surface discharge of this backwash is maintained, but not used due to the inability of the effluent to meet the current standards without

Table 5. Drinking water well location, PWSID #, and pumping rates.

Well Location	Pumping Rate (gpm)	PWSID #
Iola	11.5	32601
Stevens Creek	15	326002
Elk Creek	20.5	326003
East Elk Creek	1	326004
Dry Gulch	1	326005
Red Creek	1	326006
Gateview	1	326007
Lake Fork	30	326007
Ponderosa	25	326009
Cimarron	5.5	326010
East Portal	11.5	32011

treatment. The Elk Creek water supply needs to be upgraded. A Development/ Study Proposal (10-238) to replace the water treatment plant and reservoir was submitted in August, 1992 (Riley, pers. corn.).

Private septic systems exist upstream of the Iola Picnic Area, and the park is concerned that this may affect water supply at the park's well. The park needs to document such an effect, if it is a problem. Lastly, the Lake Fork well is very close to the highway, and impacts from potential spills on the highway may be potentially realized in this thinking-water system.

All water supply systems at Curecanti NRA with the exception of the Elk Creek wells are shallow wells located near streambeds or reservoirs. All wells have been tested for surface water influence, and at this time show no evidence of such influence. All wells have state permits. Water at the Cimarron Visitors Center is potable, but is of poor quality due to the existing treatment. Presently, there are no plans to improve this drinking-water source. In the fall of 1994, the park capped and removed the pumping equipment from four unused wells. These wells, Neversink, Beaver Creek, Cooper Ranch, and East Cimarron, are now inactive.

To meet Federal Safe Drinking Water Act (40 CFR § 141-144) requirements, and NPS-83 (NPS 1993b), Curecanti NRA samples for total coliform bacteria at each of the operational wells on a bimonthly basis. The park, however, is required by the state to sample only on a quarterly basis at the handpump sites. Samples are

analyzed at the city of Gunnison Water Laboratory using the most probable number (MPN) methodology. Only the Elk Creek system remains functioning during the winter; the other well systems operate from approximately May through September. Beginning in 1993, Curecanti NRA was required to sample for radionuclides and inorganics in 1994, and organics in 1995. This sequence will begin again in 1996. However, through the Chaffey Amendment, Curecanti NRA was able to waive the organic testing requirement (Walker, pers. corn. 1994). Also, Curecanti NRA is required to test for nitrates on a quarterly basis at each of the operating wells. Nitrite testing was waived as a result of using chlorine as a disinfection technique (Walker, NRA, pers. corn. 1994).

12.2 Waste Water Treatment

Waste water at Elk Creek is treated in an open-air lagoon system consisting of two primary and two secondary lagoons. No aeration is provided. However, funding has been requested to install the necessary equipment to handle the high biological oxygen demand caused by the fish-cleaning station (Riley, pers. corn. 1992). The lagoons were originally lined with bentonite clay, but loss of sealing led to lining them with polyethylene in 1989. Low flush toilets were installed in 1990 when it became apparent that total lagoon capacity was insufficient to handle existing flows. Staff gauges, installed as part of the lining contract, have caused leaks in the toe of the lagoons, allowing effluent to reach organic matter under the liners. The resulting bubbles of trapped gases further diminished lagoon capacity. One primary lagoon was removed from service in 1994 to install perforated pipe and gravel under the liner to vent gases. The parks needs to assess the potential for future growth in the area in order to determine the relative increases in loading to the lagoon system. Depending upon the assessment, the park may expand the existing facilities or change to different waste-water treatment facility.

The Lake Fork waste-water system consists of a series of septic tanks and a gravity-fed leach field. In 1994, the leach field was nonfunctional due to sedimentation in the feed and leach lines from the septic tank. A temporary line was placed in the existing field. The fish-cleaning station was closed through the end of the summer. Regional maintenance, and US Public Health Service staff have visited the site to assist in properly sizing and engineering a system to handle future waste-water loading at Lake Fork.

At the Iola Picnic Area, a septic tank and a leach field, which serve a fish-cleaning station and a flush toilet comfort station, appear to function properly.

Curecanti NRA has identified a need for a fish-cleaning station at the Stevens Creek Campground. Park maintenance staff is reviewing the feasibility and capacity of a composting fish-cleaning station, with the potential of using them at Steven's Creek, and to replace existing ones on Elk Creek, Iola, and Lake Fork.

At Cimarron, the park has a septic system which receives a heavy inflow, and presents a potential problem. One of the park's water quality monitoring sites, located on Cimarron Creek, is below the septic system. From Curecanti NRA's 1988-1992 water quality monitoring program, the park has data which documents fecal coliform counts of nearly the same level or variability above and below the leach field. Most likely the inflows from Squaw Creek, a polluted water source, outweigh the effects of potential problems associated with the leach field.

At East Portal, the park has a septic system which was placed into service in 1971, prior to state regulations regarding individual sewage disposal systems (Riley, pers. corn. 1992). Replacement would not be possible at the existing location. Very low loading occurs at this facility now. The park has a water quality monitoring site on the Gunnison River, located immediately downstream of the septic system, and in 1993, completed special monitoring on the river above and below estimated inputs from the septic system. At that time, no problem was identified.

Curecanti NRA has vault toilets located at 25 sites which are associated with either campgrounds or picnic areas. In most cases, these vault toilets are located near streambeds. Several times a year, these toilets are pumped, and the waste is taken to the lagoon system at Elk Creek. One of the park's water quality monitoring sites is located downstream of the Pine Creek vault toilet. To date, the fecal coliform counts at this site have been low (maximum = 29 CFU/100m1).

12.3 Fuel Storage

Curecanti NRA has fuel storage facilities at Elk Creek, Morrow Point Darn and East Portal. The fuel storage tanks at Elk Creek are above-ground double-walled tanks located on a bluff in the maintenance area. These systems include a 2,000-gallon gasoline tank, and a 550-gal gasoline diesel tank. Curecanti NRA has addressed new regulations regarding storage of fuels at Elk Creek by reconstructing this storage facility in 1992. At Morrow and East Portal, the park has single-walled above-ground tanks with secondary containment, each totalling 500 gallons.

12.4 Hazardous Materials

Liquid flammables, consisting of hydrocarbon-based products used for motor vehicles, are stored at the maintenance office building at Elk Creek. These materials are stored in a signed room. Pesticides and herbicides used for dusting prairie dog burrows for fleas and for killing exotic plants, respectively, are stored in the law enforcement/resource management building at Elk Creek. These materials are located in an off-the-ground, locked cabinet.

12.5 Parking Lot Runoff

At both of the major marinas and Iola boat ramp, parking lot runoff goes directly into the water. We have not documented the characteristics, amount, or quality of the runoff. Since both marinas receive substantial use during the summer, we need to document the quality and quantity of runoff, and how it may affect water quality at the marinas. One other boat ramp which may contribute to runoff is the Steven's Creek boat ramp. At this site, no drains were directly constructed to flow into the reservoir, however, runoff is very likely. We can also document water quality at this site as well, but our efforts would be best placed at the marinas and at Iola.

The park has also identified that runoff occurs from the maintenance parking lot located on a bluff above the road to Elk Creek Marina. This does not reach Blue Mesa Reservoir, but instead flows down the hillside filtering into the soil. Most of the maintenance vehicles are stored at this parking lot. Vehicles, including the pumper truck and garbage truck are also washed at this site. Curecanti NRA wishes to characterize the runoff from the parking lot. If the park determines that the runoff contains organic and inorganic compounds which could be toxic to vegetation and wildlife, and could potentially create ground water problems, Curecanti NRA would design and construct some type of containment or treatment apparatus for the problem.

12.6 Ramp Expansion

Curecanti NRA is widening and lengthening a ramp at Steven's Creek. This will allow boater access at lower reservoir levels. Other expansion's include Ponderosa ramp in 1995, and Iola in 1996. A Section 404 permit from the US Army Corps of Engineers exists for the Old Steven's Creek ramp expansion.

12.7 Boater Use and Visitor Use of Reservoir Shoreline

12.7.1 Boater Use and Camping

As a recreational facility, Curecanti NRA must be concerned with the number of boaters, their experience here, their ability to catch fish as it relates to reservoir level, and their effects on the reservoirs. On a nationwide basis, park units will be required to charge launching fees for using ramps. Curecanti NRA will begin the collection in 1996. Curecanti NRA is undergoing a General Resources Management planning process to address the needs of the boater and other visitors. In doing so, much of the information from a Water Resources Scoping Report and Management Plan can be utilized in support of a General Management Plan.

The park needs to determine whether dumping from boats occurs, and if it does occur; to what extent? Additionally, the park needs to document hydrocarbon levels at the marinas, as well as at open water sites in order to develop background conditions. Curecanti NRA is nationally known for its archeological resources, to the extent that the park is recognized as having the Curecanti Archeological District on the National Register of Historic Places. Interestingly, archaeologists, in dating the materials found below high water level, need hydrocarbon water quality data so that they can validate their chronometric dating techniques and results (Jones, pers. corn. 1994).

On each reservoir, several improved campsites exist. The number of visits to these sites and undesignated sites is unknown. However, Curecanti NRA, since 1987, has conducted a boat-in campsite assessment in an effort to assess use and to make recommendations for stabilizing, improving, or rehabilitating sites. Four established sites exist on Blue Mesa Reservoir, one on Crystal Reservoir, and two on Morrow Point Reservoir. Each of these campsites have toilets, picnic tables, garbage cans, and tent pads. The toilets consist of outhouse structures with buckets. The Visitor Protection Division is responsible for removal of wastes. The buckets are sealed, removed from the outhouses, and the contents taken to sewage lagoon ponds near Elk Creek. Currently, the campsites are used frequently; however, rapid increase of use is not anticipated.

12.7.2 Visitor Shoreline Use

Visitors are allowed to drive vehicles in areas below the high-water line around Blue Mesa Reservoir (Curecanti NRA, Superintendent's Compendium). Environmental damage, as a result of vehicle operation below the high-water line, is estimated to be minimal. However, hydrocarbon inputs to water, archeological site damage, and disturbance of shorebird nests is possible. Vehicular-use below the high-water line is greatest at a site called the Iola Beach, which is located on the east shore of Blue Mesa Reservoir, south of the Lake City Bridge (Hwy 149), and at the Bay of Chickens, west of the Elk Creek area. The former site harbors archeological sites above the high-water mark. The latter area is outside of the Curecanti Archeological District.

The proposed WRMP would address the most significant impacts that operation of the park unit has on the water resources. In order of priority these include:

- ◆ Monitoring the effects of parking lot runoff from the maintenance lot at Elk Creek.
- ◆ Developing background levels of hydrocarbons in the reservoirs, and monitoring the effects of hydrocarbons on the water quality at the developed marinas, and at the most used boat ramps.

- ◆ Monitoring the effects of the Cimarron and East Portal septic systems on the Cimarron and Gunnison rivers, respectively.
- ◆ Monitoring the extent of dumping of sewage from boats directly into the water, and the effects and efficacy of pumping sewage into the floating collectors at Elk Creek Marina and Lake Fork Marina.
- ◆ Replacement of the Elk Creek water treatment plant and reservoir. This project is addressed in a Development/Study Proposal (10-238) submitted by Curecanti NRA on August 13, 1992.
- ◆ Assessment of the Elk Creek sewage treatment system's future capacity needs; location of a future site; and the need for primary treatment and groundwater injection.
- ◆ Redesign and construction of the septic tank and leach field at the Lake Fork Campground.

The first item can be addressed through an environmental assessment and design of containment. The next two items can be addressed through the development of a cyclical monitoring program. The fourth item will be addressed by the Visitor Protection Division, and the latter three items will be addressed by the Maintenance Division. In particular, the redesign and construction of the septic tank and leach field at the Lake Fork Campground is currently under way.

13. CONCESSIONAIRES IMPACTS ON WATER RESOURCES

13.1 Operations

The concessionaire, Jim Loken, operates two marinas on Blue Mesa Reservoir: Elk Creek and Lake Fork. They also run a tour boat business on Morrow Point Reservoir (suspended for the season of 1994). The concessionaire also operates a restaurant at the Elk Creek facility.

Gasoline and oil products may leak from boats at these sites, but documentation is lacking. The park has one water quality monitoring site located at Elk Creek Marina. However, Curecanti NRA does not monitor for hydrocarbons at this, or any other site.

13.2 Fuel storage

The concessionaire, Jim Loken, has fuel storage tanks at Elk Creek and Lake Fork marinas including: 1) two 6,000-gallon, double-walled above-ground storage (AST)

2 tanks at Elk Creek Marina, 2) a 1,000-gallon, double-walled floating tank at Lake Fork Marina. This latter tank will be replaced with a floating double-walled tank before the start of the 1995 summer season. At Morrow Point Dam, the concessionaire has a 2,000-gallon tank which is a single-walled AST with containment.

13.3 Water Supply and Waste Water Treatment

The concessionaire, Jim Loken, is supplied with water from developed Curecanti NRA sources. They also use the Curecanti NRA infrastructure for waste-water treatment. Additionally, boaters utilize concession and park operated pump-out facilities at the two marinas to dispose of sewage. The sewage is transferred by the park to the Elk Creek lagoons.

Curecanti NRA does not anticipate that the proposed WRMP will need state items of actions relating to concessionaire activities other than including monitoring of water quality at marina sites.

14. BUREAU OF RECLAMATION'S IMPACTS ON WATER RESOURCES

14.1 Reservoir levels

The overall operation of the reservoirs is changing; the Endangered Species Act has driven a recovery program for endangered fish species to a reservoir operation based on maintaining habitat for the bonytail chub (*Gila elegans*), razorback sucker (*Xyrauchen texanus*), Colorado squawfish (*Ptychocheilus lucius*), and humpback chub (*Gila cypha*). Additionally, the Black Canyon of the Gunnison NM, downstream of the lowest reservoir, Crystal, is quantifying its water rights for flows in the Gunnison River. These changes will affect storage in the units, though to what degree is unknown. DOE (1994a) suggests in their Electric Power Marketing DEIS, that all needs, including hydropower production, can be met except in the shadow of a series of drought years.

Upstream water rights owners on the Gunnison River have reconfirmed their interest in an 60,000 acre-feet subordination in Blue Mesa Reservoir (BoR 1994). The BoR had agreed that not less than 60,000 acre-feet could be depleted upstream of Crystal Reservoir, and could potentially be used by upstream water rights owners who were junior to the BoR's 1957 right in the Aspinnall Unit (BoR 1964). This, however, does not protect upstream water rights owners from calls made by downstream senior water rights owners, the Black Canyon of the Gunnison NM federal reserve right (not yet quantified), and flows (also not quantified) required for the four endangered fish species in the Gunnison and Colorado Rivers. In light of

this, staff of the Colorado Water Conservation Board have provided several potential means of off-setting administrative water rights calls to upstream water users. One plan includes formulation of a mitigation pool in Blue Mesa Reservoir (BoR 1994). Another view notes that in the design of the Aspinall Unit, depletion by upstream water rights owners was considered (BoR 1964). In light of this, the Colorado Water Conservation Board offers that the unit could be operated simply on criteria which respect historic agricultural activities (Randy Seaholm, staff, Colorado Conservation Board, Memorandum, September 13, 1994). One effect may result in the overall lowering of reservoir levels. As a recreation unit, the effects of overall lowering may be realized as a decrease in aesthetic values, and a less productive fishery (Johnson 1994). Another possibility may be realized by levels in the reservoir that the park has historically experienced. In either case, Curecanti NRA has at its disposal, information and a tool to assess Aspinall Unit operations (Clark 1994).

Curecanti NRA needs to understand how the operation of the reservoir system could change, and how changes may affect their management of water resources. For example, Curecanti NRA hosts over a million visitors each year. On a monthly basis, summer visitor-use decreased by the thousands from 1987 to 1988, a year in which total drawdown leveled off at an elevation of 7,432 feet. Public hearings were held in the wake of the complaints received about the poor visitor and fishing experience. If Curecanti NRA's requests to achieve full pool by summer fail, and if the operation of Blue Mesa were to change to the extent that the quality of the visitor's experience declined, Curecanti NRA must have some plan on how to deal with visitor complaints. In addition, the overall drop may lead to changes in the functioning of riparian habitats along the Gunnison River above Blue Mesa, and in the tributaries. The trophic dynamics of the fishery may also be impacted. Finally, paleontological and archeological resources are impacted by the rise and lowering of the reservoir. In anticipation of re-operation, several studies were begun and they can answer some of the questions. These projects include: 1) two studies designed to determine the effects of reservoir water-level fluctuations on fisheries resources (Johnson; Hebein 1993), 2) a study to determine the impacts of varied hydropower operations on the entrainment of fish through the turbines at the Blue Mesa Dam (Mueller; Hiebert n.d.), 3) excavation of a sauropod found at an elevation impacted by reservoir drawdown, and 4) an archeological study of a site near the edge of Blue Mesa Reservoir.

To address the questions raised about relationships between visitor use and reservoir level, a section of the update of Curecanti NRA's GMP will test visitors' perception of various reservoir levels. The present studies, and those dictated by the GMP process, will serve as the basis for requesting certain levels in the reservoir at the AOP meetings which define how the Aspinall Unit is operated throughout the year. The proposed WRMP will note this ongoing research and provide a review of the work to date.

14.2 Storage of Fuel

The BoR has small diesel tanks at Morrow Point and Crystal Dams for emergency power generation. At Morrow Point, they now have a single-walled 450-gallon tank on a trailer. This will be replaced in the very near future with 450-gallon double-walled tank. At Crystal Dam, they have a 55-gallon drum on the deck; this will be replaced with a 450-gallon single-walled tank to be housed inside the facility. No diesel is currently being stored at Blue Mesa Dam, but a 450-gallon single-walled tank will be obtained and housed in the dam facility.

14.3 Septic Systems

The BoR has small package waste-water treatment plants at all three dams. The Morrow Point plant has not been in operation for at least five years. Sewage is pumped from the 4,000-gallon tanks at Blue Mesa and Crystal dams by Curecanti NRA, as required. The proposed WRMP would:

- ◆ Discuss accomplishments of research on impacts to reservoir levels from re-operation of the Aspinall Unit.
- ◆ Provide a questionnaire designed to address visitors' perception of changes in reservoir levels.
- ◆ Formalize the desired reservoir levels at Curecanti NRA.
- ◆ Discuss the impacts of reservoir re-operation on archeological resources at Blue Mesa Reservoir.

RECOMMENDATIONS

This Water Resources Scoping Report recommends that a WRMP be developed in order to address some of the complex issues facing the park unit. Although the waters in the reservoirs are of high quality, upstream land-use activities may ultimately impact this condition. Coupled with activities on surrounding lands, the re-operation of the Aspinall Unit may influence the fishery and overall trophic dynamics of this reservoir system. Curecanti NRA feels that the development of a WRMP would provide the park with a blueprint to address important water issues over the next 5-10 years, and be integral to the development of a comprehensive water resources management program for the park.

The water resource scoping discussions at Curecanti NRA and the development of this document have lead to a list of actions at the end of each section which could be addressed in a WRMP. Following, is a compilation of these actions. The order in which the actions are listed is directed by the order of objectives stated in

Section 3 of this document. In some cases, several actions are required to meet one of the original objectives identified at the scoping meeting.

The proposed WRMP would focus on:

- ◆ The development of a cyclical water quality monitoring program for potential threats to reservoirs and tributaries from grazing, mining, logging, and development. The program would also include assessment of impacts from Curecanti NRA's, the concessionaire's, and the BoR's operations. The program would be based on the analysis of water quality being currently completed by the WRD. The program will also develop an appropriate means of monitoring the two lower reservoirs, Morrow Point and Crystal, for chemical as well as biological features. The program would include measurement of biological, chemical, and physical parameters, and be based on the base funding available for the program presently in existence.
- ◆ The review of the appropriateness of an Outstanding National Resource Waters designation for the three reservoirs.
- ◆ A discussion of the ongoing studies related to the re-operation of the Aspinall Unit. This discussion will include establishment of the historical reservoir elevations typically related to recreational use on the reservoirs.
- ◆ The development of a questionnaire which seeks to assess the visitors' perception of reservoir levels.
- ◆ The development of a problem statement to outline the impact of reservoir level changes on the archeological resources at Curecanti NRA.
- ◆ A plan for coordinating information exchange and for executing solutions to various problems would be developed. The park participates in discussions concerning the operation of the Aspinall Unit, serves on the liaison committee of the Upper Colorado NAWQA, and has organized a water quality forum for the basin. A hydrologist position at Curecanti NRA would enable the park to continue its participation in the above capacity, and to implement and analyze the data from the water quality monitoring program at Curecanti NRA.
- ◆ A plan to insure a healthy and palatable fishery, and to promote the introduction of native cutthroat to the area's tributaries.
- ◆ An engineering assessment of stormwater and park operation's runoff from the maintenance parking lot.

- ◆ Alternatives for managing the Gunnison River floodplain above Blue Mesa Reservoir. In addition, the proposed WRMP would discuss coordinated efforts between the NPS and the NBS to conduct research regarding cottonwood establishment at this site.
- ◆ A wetland delineation for Curecanti NRA at a scale adequate for interpretation and management needs. Springs would also be identified.
- ◆ The development of a GIS product that defines landownership and activities, soil erosivity, and geology, in an effort to pinpoint significant problem areas.
- ◆ The implementation of a watershed inventory with the methodologies used by the BLM and US Forest Service on contiguous lands.
- ◆ The assessment of the park's status in meeting level I, inventory and monitoring requirements (NPS-77).
- ◆ The review of floodplain assessments conducted for developed sites at Curecanti NRA; and with the assistance of the WRD, conduct additional floodplain assessments as directed by the outcome of the upcoming GMP.
- ◆ The drinking-water treatment system noting the types of treatment system for individual wells and the Elk Creek source.
- ◆ An assessment of Curecanti NRA water rights including a 500 acre-feet use of water from Blue Mesa Reservoir.

Because of staff constraints both within the park and the WRD, it is recommended that the WRMP be developed under cooperative agreements, with the assistance of the WRD, and in-house, utilizing a GS-401-7 position for 14 months, over a two-year period. Including time, travel, printing expenses and cooperative agreements, the estimated cost of the project is \$45,000.

It is further recommended that this Water Resources Scoping Report be utilized, as an interim guidance document for water resources-related issues until the completion of a WRMP. Components of the scoping report may be used in the development of management strategies and project statements relating to water resources issues requiring immediate management attention. The long-term development of a WRMP, however, provides the advantage of allowing park management to address water resources-related issues programmatically, rather than on a project-by-project basis.

LITERATURE CITED

- Aaronson, M.J. 1982a. *Testing of water quality for inorganics and heavy metals for the National Park Service*. Fort Collins: Institute of Environmental Health, Colorado Epidemiological Pesticide Studies Center, Colorado State University.
- Aaronson, M.J. 1982b. *Testing of water quality for total dissolved solids, radiation, and chlorinated hydrocarbon pesticides for the National Park Service*. Fort Collins: Institute of Environmental Health, Colorado Epidemiological Pesticide Studies Center, Colorado State University.
- Anderson, Dennis. Colorado Water Quality Control Division, pers. corn. 1994.
- Apley, M. 1981. *Buttes gas and oil surface water quality study 1979-1980*. Western State College, Gunnison.
- Aquatic Environmental Services. 1983. *Phytoplankton of Blue Mesa Reservoir*. Unpublished report.
- Aquatic Environmental Services. 1984. *Data from Blue Mesa Reservoir survey, Gunnison, CO*. Unpublished report.
- Baxter, R.M. 1977. Environmental effects of dams and impoundments. *Ann. Rev. Ecol. Syst.* 8:255-283.
- Bio-Environs. 1985. *Limnological survey of Blue Mesa Reservoir*. Prepared for the Bureau of Reclamation, Denver, CO. Unpublished report.
- Blackwell, R.J., and D.H. Wentz. 1979. *Trophic classification of selected lakes*. Jet Propulsion Laboratory, California Institute of Technology. EPA-600/4-79-005.
- Boettcher, A.J. 1971. *Evaluation of the water supply at six sites in the Curecanti Recreation Area, Southwestern Colorado*. Denver: US Geological Survey Open File Report 71005. Denver, CO.
- Britton, L.J., and D.A. Wentz. 1980. *Characteristics of selected lakes and reservoirs in Colorado*. Denver: US Geological Survey Open File Report 80-436.
- Bureau of Land Management. 1989. *Utilization report and use supervision report*. Gunnison: Gunnison Resource Management Area.
- Bureau of Land Management. 1992. *Gunnison resource area proposed resource management plan and final environmental impact statement*. Gunnison, CO.

- Bureau of Reclamation. 1964. Upper Gunnison Project, Colorado. Region 4. Salt Lake City.
- Bureau of Reclamation. 1976. Memorandum 460 715, dated March 10, 1976.
- Bureau of Reclamation. 1994. Gunnison River activities, meeting notes July 12, 1994.
- Burghi, P. 1979. *Winter ice jams on the Gunnison River*. Bureau of Reclamation REC-ERC-79-4.
- Clark, Ralph, III. 1994. Gunnison POWER. Memorandum dated June 6, 1994.
- Colburn, T. 1981. Thesis on aquatic insects as measures of trace element presence: Cd and Mo. M.A. thesis, Western State College, Gunnison.
- Cooper, D.J. 1993. *Wetlands of the Crested Butte region: mapping, functional evaluation, hydrologic regime*. Town of Crested Butte.
- Cudlip, L.S. pers. observ. 1994.
- Cudlip, L.S., M. Malick, and S. Borthwick. 1994. Biomonitoring stream sites: key to addressing biodiversity at Curecanti National Recreation Area? Presentation given to American Water Resources Association Meeting. Unpublished.
- Cudlip, L.S., R.D. French, and D. Hickman. 1987. *Blue Mesa Reservoir, Colorado: a historical review of its limnology, 1965-1985*. Bureau of Reclamation REC-ERC-87-3.
- Elliot, Chuck. US Fish and Wildlife Service. pers. corn. 1993.
- Elliot, J.G., D.M. Murphy, and K.S. Tucker. In press. *Resource management considerations in a changing physical environment: the Gunnison Gorge, Colorado*.
- Engineering Consultants, Inc. 1976. *Floodplain information report Gunnison River/Tomichi Creek, Gunnison, Colorado*. Prepared for the city of Gunnison, Gunnison County and the Colorado Water Conservation Board.
- Goldman, C.R., and B.L. Kimmel. 1978. Biological processes associated with suspended sediment and detritus in lakes and reservoirs. In *Current perspectives on river-ecosystems*, eds. J. Cairns, Jr., E.F. Benfield, and J.R. Webster. Blacksburg: North American Benthological Society.
- Gunnison County. 1994. Gunnison County Transportation Plan. Gunnison, CO.

- Hauer, F.R., J.A. Stanford, and J.V. Ward. 1989. Serial discontinuities in a Rocky Mountain River. II. Distribution and abundance of Tricoptera. *Regulated Rivers: Research and Management* 3:169-175.
- Hebein, Sherman. Colorado Division of Wildlife. pers. coin. 1993.
- Heibert, Steve. Bureau of Reclamation. Unpublished report.
- Hickman, D. 1987. *Water quality trends at Blue Mesa Reservoir, Gunnison, Colorado: a baseline water quality survey conducted by the National Park Service, 1982-1985*. M.A. thesis, Western State College, Gunnison.
- Jennings, Daryl. National Park Service. pers. corn. 1994.
- Johnson, B. 1994. *Ecological effects of reservoir operations on Blue Mesa Reservoir. Annual Progress Report, June 1, 1993—May 31, 1994*. Fort Collins: Department of Fishery and Wildlife Biology. Colorado State University.
- Johnson, B., and Sherman Hebein. Colorado Division of Wildlife. pers. corn. 1993.
- Jones, Bruce. National Park Service, Midwest Archeological Center. pers. coin. 1994.
- Kunkle, S., R. Nickerson, G.M. Smillie, and R. Andrascik. 1983. *Metal concentrations in fish at Curecanti National Recreation Area, Gunnison, Colorado*. National Park Service WRFSL Project Report No. 83-3-P.
- Lindstrom, T. 1973. Life in a lake reservoir: fewer options, decreased production. *Ambio* 2(5):145-153.
- Long, Barry. 1993. *Trip report for travel to Curecanti NRA, March 8-10, 1993*. Fort Collins: National Park Service.
- MacDonald, L. 1991. *Monitoring guidelines to evaluate effects of forestry activities on streams in the Pacific Northwest and Alaska*. US Environmental Protection Agency EPA/910/9-91-001.
- McAda, C.W., and L.R. Kaeding. 1990. *Physical changes in the Gunnison and Colorado rivers resulting from construction of the Aspinall Unit and related projects, with possible effects on the endangered fishes*. Grand Junction: Colorado River Fishery Project. US Fish and Wildlife Service.
- McArdle, Jim. Colorado Division of Minerals and Geology. pers. corn. 1994.
- McCall, Steve. Bureau of Reclamation. pers. corn. 1994.

- Martin, M. 1994. Trip report for travel to Curecanti NRA, November 1-3, 1994. Fort Collins: National Park Service.
- Middleton, W.H. 1969. Hybridization and distribution of catostomid fishes in Blue Mesa Reservoir and the upper Gunnison River drainage. M.A. thesis, Western State College, Gunnison.
- Moran, R.E., and D.A. Wentz. 1974. *Effects of metal-mine drainage on water quality in selected areas of Colorado, 1972-1973*. Denver: Colorado Water Conservation Board Colorado Water Resources Circular No. 25.
- Morrison-Knudsen Engineers, Inc. 1985. *Gunnison River icing study: summary report*. Gunnison: Upper River Water Conservancy District.
- Mueller, Gordon, and Steve Hiebert. Unpublished report.
- National Biological Survey. 1994. Study Plan, Blue Mesa Reservoir, Fish Entrainment Study. Denver.
- National Park Service. Curecanti National Recreation Area. Superintendent's Compendium.
- National Park Service. Curecanti National Recreation Area. Unpublished data.
- National Park Service. 1980. Curecanti National Recreation Area General Management Plan. Gunnison.
- National Park Service. 1991. Case Incident Report #910130. Capitol Reef National Park.
- National Park Service. 1986. *Curecanti National Recreation Area water quality report, 1983-1984*. Fort Collins.
- National Park Service, and Bureau of Recreation. 1989. Memorandum of Agreement (2/11/65). In Interagency agreement between National Park Service and Bureau of Land Management.
- National Park Service. 1991. Final draft. Revised instructions for the preparation of water resources management plans. Fort Collins: Water Resources Division.
- National Park Service. 1992. Draft Memorandum L3023(661) dated September 14, 1992.

- National Park Service. 1992. Draft oil hazardous spill plan. Curecanti National Recreation Area.
- National Park Service. 1992. Water Resources Division correspondence dated July 14, 1992.
- National Park Service. 1993a. *Floodplain Management Guidelines*. The Department of Interior Special Directive 93-1, July 1, 1993.
- National Park Service. 1993b. NPS-83. *Public Health Management Guidelines*. Release No. 2.
- National Park Service. 1994. Meeting notes—contract negotiations with Bureau of Reclamation, February 2, 28, 1994.
- National Park Service. 1994. Water resources scoping notes, Curecanti National Recreation Area, Gunnison.
- Nehring, R.B., and R. Anderson. 1983. *Stream fisheries investigations*. Fort Collins: Fish Research Station, Colorado Division of Wildlife.
- Reed, E.B. 1968. *Limnological aspects of the Curecanti Unit*. Fort Collins: Dept. of Zoology, Colorado State University. Report to the National Park Service.
- Richards, R., and H.A. Ferchau. 1978. Buttes gas and oil Iron Hill-Powderhorn study 1977. Vol. 2. Gunnison: Western State College.
- Riley, Steve. Curecanti National Recreation Area Facilities Manager. pers. com. 1994.
- Rumberg, C.B., B.H. Gery, and K. Butcher. 1978. *Gunnison County stream water quality study*. US Environmental Protection Agency EPA-908/3-78-001.
- Scott, M., J.M. Friedman, and G.T. Auble. In press. Fluvial process and the establishment of bottomland trees. *Geomorphology*.
- Seaholm, Randy. 1994. Staff, Colorado Conservation Board, memorandum dated September 13, 1994.
- Smillie, Gary, and Barry Long. 1993. Trip report for travel to Curecanti National Recreation Area on September 30—October 1, 1993. Fort Collins: National Park Service.

- Stanford, J.A., and J.V. Ward. 1983. The effects of mainstream dams on physiochemistry of the Gunnison River, Colorado. In *Aquatic resources management of the Colorado river Ecosystem*. Eds. V.D. Adams, and V.A. Lamarra. Ann Arbor: Ann Arbor Science Publishers.
- Stanford, J.A., and J.V. Ward. 1989. Serial discontinuities in a Rocky Mountain River. I. distribution and abundance of Plecoptera. *Regulated Rivers: Research and Management* 3:169-175.
- State of Colorado. 1975. *The upper Gunnison River drainage*. Denver: Colorado Department of Health.
- State of Colorado. 1993. *Classification and numeric standards for Gunnison and lower Dolores River basins*. Denver: Water Quality Control Commission, Colorado Department of Health.
- Vandas, S., D. Whitaker, D. Murphy, D. Pritchard, L. MacDonnell, B. Shelby, D. Muller, J. Fogg, and B. Van Havern. 1990. *Dolores River instream flow assessment: project report*. Denver: Bureau of Land Management.
- Verdin, J.P. 1984. *Enhancement of airborne scanner imagery of Blue Mesa Reservoir to reveal surface water quality patterns*. Applied Sciences Referral Memorandum No. AP-84-4-8.
- US Department of Energy. 1994a. *Salt Lake City area integrated projects electric power marketing draft environmental impact statement*. Salt Lake City: Western Area Power Authority.
- US Department of Energy. 1994b. *Work plan for ground water elevation data recorder/monitor well installation at Gunnison, Colorado*. DOE/AL/62350-139, REV. 2.
- US Department of Energy. 1994c. *UMTRA project water sampling and analysis plan, Gunnison, Colorado*. DOE/AL/62350-139, REV. 1.
- US Environmental Protection Agency. 1976. *Quality criteria for water*. Washington.
- U.S. Environmental Protection Agency. 1976. *Preliminary report on Blue Mesa Reservoir, Gunnison, County, Colorado National Eutrophication Survey*. Corvallis: CERL, and Las Vegas: EMSL.
- US Environmental Protection Agency. 1989. *Rapid bioassessment protocols for use in streams and rivers; benthic and macroinvertebrates and fish*. EPA/440/4-89/001.

- US Fish and Wildlife Service. 1987. Results of metals concentrations in fish from Curecanti National Recreation Area, Gunnison, Colorado. Unpublished data.
- US Forest Service. 1991. *Final supplemental EIS for the Grand Mesa, Uncompaghre, and Gunnison national forests*. Gunnison.
- US Forest Service. 1992. *Oil and Gas leasing DEIS for the Grand Mesa, Uncompaghre and Gunnison national forests*. Gunnison.
- Walker, Greg. Curecanti National Recreation Area Maintenance Division. pers. coin. 1994.
- Ward, J.V., and J.A. Stanford. 1990. Ephemeroptera of the Gunnison River, Colorado, USA. In *Mayflies and stoneflies: life histories and biology*. Ed. I. Campbell. Dordrecht: Kluwer Academic Publishers.
- Ward, J.V., and J.A. Stanford. 1991. Benthic faunal patterns along the longitudinal gradient of a Rocky Mountain river system. *Verh. Internat. Verein. Limnol.* 24:3087-3094.
- Wentz, D.E. 1974. *Effect of mine drainage on the quality of streams in Colorado, 1971-1972*. Denver: Colorado Water Conservation Board, Colorado Water Resources Circular No. 21.
- Westwater Associates. 1991. *Alternative water supply well location, Elk Creek facilities, Curecanti National Recreation Area*. Montrose.
- Weiler, W. 1985. *Blue Mesa Reservoir historic data review related to rainbow and kokanee fishery 1971-1984*. Report to Colorado Division of Wildlife.
- Wiltzius, W. 1965. *Pre-impoundment investigations of Curecanti Unit, Upper Colorado River Storage Project. Determination of chemical and physical characteristics of the Upper Gunnison drainage*. Montrose: Colorado Division of Wildlife. Southwest District. Job Completion Report.
- Wiltzius, W. 1966. *Pre-impoundment investigations of Curecanti Unit, Upper Colorado River Storage Project. Determination of chemical and physical characteristics of the Upper Gunnison drainage*. Montrose: Colorado Division of Wildlife. Southwest District, Montrose. Job Completion Report.
- Wiltzius, W. 1967. *Pre-impoundment investigations of Curecanti Unit, Upper Colorado River Storage Project. Determination of chemical and physical characteristics of the Upper Gunnison drainage*. Montrose: Colorado Division of Wildlife. Southwest District. Job Completion Report

- Wiltzius, W. 1971. *Post-impoundment investigations of Curecanti Unit, Upper Colorado River Storage Project. Determination of chemical and physical characteristics of the Upper Gunnison drainage.* Montrose: Colorado Division of Wildlife. Southwest District. Job Completion Report.
- Wiltzius, W. 1974. *Post-impoundment investigations of Curecanti Unit, Upper Colorado River Storage Project. Determination of chemical and physical characteristics of the Upper Gunnison drainage.* Montrose: Colorado Division of Wildlife. Southwest District. Job Completion Report.
- Wiltzius, W. 1976. *Some historic influences of reservoir and irrigation on flows, temperatures, and fish distribution in the Gunnison River.* Final report to US Bureau of Reclamation. Fort Collins: Colorado Division of Wildlife.
- Wiltzius, W.J. and N.F. Smith. 1976. *Curecanti Unit, lower Gunnison River fishery investigation, Colorado fisheries review, 1972-1975.* Colorado Division of Wildlife.
- Wohl, E. and L. Hammack. 1995. *Recent channel change along the Gunnison River at Curecanti National Recreation Area.* Fort Collins: Dept. of Earth Resources, Colorado State University.

PREPARERS

Curecanti National Recreation Area

Lynn Cudlip - Biological Science Technician

Water Resources Division

William Jackson - Water Operations Branch

Mark Wondzell - Water Rights Branch

ACKNOWLEDGEMENTS

The authors wish to acknowledge the Superintendent, and Chief of Resources Management, Curecanti NRA, for their support and comments on this scoping report. Also, much of Curecanti NRA's operations could not have been described without the assistance of Steve Riley, Facilities Manager, and Greg Walker, Utility Systems Operator. The authors would like also to thank Mark Flora, Janet Wise, Barry Long, Dave Sharrow, and Gary Smillie for their excellent help in identifying issues; careful review of the manuscript; and their willingness to provide suggestions and assistance whenever requested. Lastly, the authors wish to acknowledge the editorial assistance provided by Jacquie Nolan (WRD) and production assistance provided by the Branch of Micrographics (Denver Service Center) whose efforts made the publication and distribution of this report possible.



As the nation's principal conservation agency, the Department of the Interior has the responsibility for most of our nationally owned public lands and natural and cultural resources. This includes fostering wise use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people. The Department also promotes the goals of the Take Pride in America campaign by encouraging stewardship and citizen responsibility for the public lands and promoting citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.