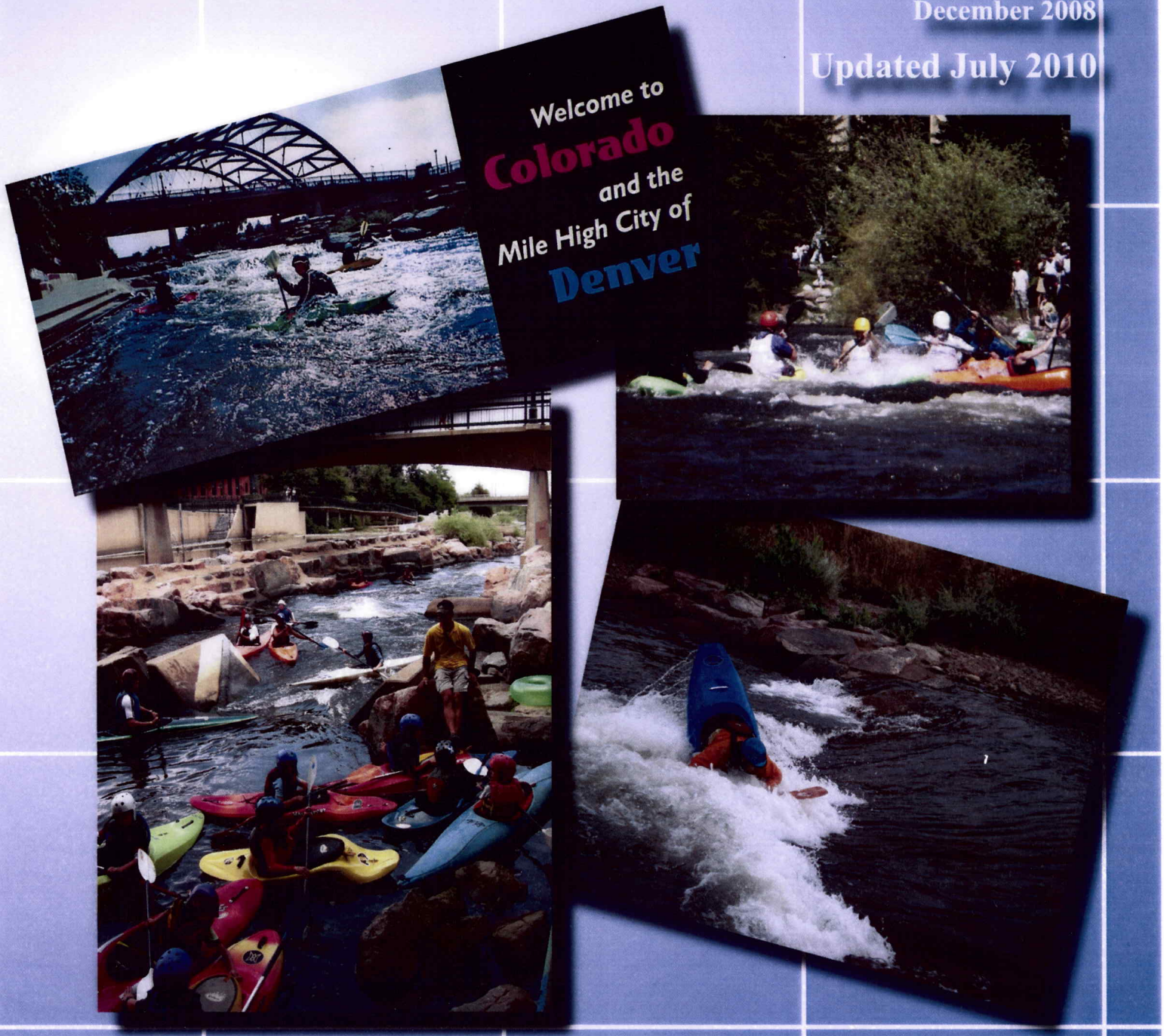
December 2008

Updated July 2010



Whitewater Course Evaluation Selected Venues in the State of Colorado

Prepared for the
State of Colorado
Department of Natural Resources
Water Conservation Board

McLaughlin Whitewater design group

ACKNOWLEDGEMENTS

This report is the summary document for work efforts on the identification and collection of various documents and parameters of 14 whitewater courses constructed in the State of Colorado.

The work was performed under the direction of Ted Kowalski, Program Manager in the Water Supply Protection Section of the Colorado Water Conservation Board (CWCB). His active participation throughout the project was greatly appreciated. In addition, the following CWCB staff members provided direction and support in this assessment and in the supporting sections included within.

Tom Browning, P.E., CFM, Section Chief
Kevin Houck, P.E., CFM, Senior Engineer
Joe Busto, Water Resource Specialist

Others who provided expertise and assistance include:

US Army Corps of Engineers
Kara Hellige, Sondra C. Sperr – Sacramento District
Willa Prato – Albuquerque District
Linda F. Burke – Omaha District

Greg Barrie, Town of Vail, Colorado
David Cosgrove, Lyons Parks and Recreation
Bill Coughlin, Western Streamworks
Kent Ford, Owner, Performance Video
Kyle McCutcheon, Co-Author, *Whitewater of the Southern Rockies*
Alan Moores, Gunnison County Public Works
Bo Shelby, Ph.D
Doug Whittaker, PhD

McLaughlin Whitewater Design Group members who contributed to complete this effort were:

Risa Shimoda, Recreation/Conservation Specialist, USA Freestyle Kayaking Chair, USA World Championships Freestyle Kayaking Team Member
Richard McLaughlin, P.E., Vice President, Recreational Kayaker
Derk Slottow, Technical Assistant, Expert Kayaker
Jimmy Blakeney, Former Professional Freestyle Kayaker
Nick Turner, EIT, Expert Kayaker
John Anderson, Architect, Former US Canoe and Kayaking Team Member
Diana Ramser, Editor and Graphics

In Memory of Derk Slottow
After completion of the field investigation of this project, Mr. Derk Slottow, died in a kayaking accident. He was paddling on the Big South Fork of the Cache La Poudre River just west of Fort Collins on July 18, 2009. Derk completed many of the site visits and collected much of the information provided in this report. Derk was a very positive and energetic person. Derk will be missed by the members of this team and all who knew him.

TABLE OF CONTENTS

I. SUMMARY OF PROCESS AND FINDINGS

This report outlines an initial assessment of selected whitewater parks and courses that have been designed and installed in rivers across the State of Colorado. This effort has been undertaken to provide a convenient, useful description of the location, ownership, design, intended use and success to date for examples of this genre of public works which have become institutionalized recreation amenities and economic development catalysts for river communities. As outlined below, information regarding these courses was usually not readily available and forthcoming. Updates to this report may be undertaken from time to time based upon input from readers or subsequent updating efforts.

Whitewater courses in Colorado represent roughly 50% of those built in the United States today and they collectively serve as a bellwether for design, cost, and demand for water appropriation and sustainability for destination-oriented whitewater park recreational facilities.

Information for this report has been obtained through several means:

- Primary research of hard copy and online files, including files made available by CWCB;
- Freedom of Information Act request responses from the US Army Corps of Engineers District Offices in Albuquerque, Omaha and Sacramento;
- News Articles;
- Interviews of persons using or responsible for the venue development and care; and
- Site visits by McLaughlin Whitewater Design Group staff.

Gathering data requires significant time and it was realized that Cases included are those as those which are likely to be of greatest interest. Case research was completed in two phases:

Phase I	Avon, Golden, and Gunnison
Phase II	Breckenridge, Buena Vista, Denver/Confluence Park, Durango, Lyons, Pagosa Springs, Pueblo, Ridgway, Salida, Steamboat Springs and Vail.

A Phase III was also identified in the event further research is requested and funding made available. They include Glenwood Springs, Frisco, Fort Collins, and Union Chutes – Englewood.

Whitewater courses or “whitewater parks” (terms used interchangeably) are initiated when citizens or municipal leaders identify opportunities to enhance the recreational value of a local river. Occasionally, this is accomplished in conjunction with providing a diversion, or enhancing flood protection, public safety, and riparian habitat. The first in-river whitewater courses in the US were constructed along Colorado’s Front Range in the 1970’s and 1980’s. The design of most of these early projects – including Confluence Park in Denver - included a number of multiple objectives. During the 1990’s a number of whitewater parks were built to specifically enhance the recreational value of communities’ rivers. Colorado is one of the few states that statutorily recognizes "recreational in-channel diversion" (RICD) water rights. To help insure sufficient flow, a number of communities have secured RICD water rights. Prior to 2001, six communities obtained decrees for water rights including: Fort Collins, Littleton, Golden, Breckenridge, Vail, and Aspen. Since then, many more courses have been constructed

throughout the State and a number have obtained, or are in the process of obtaining, decrees for water rights.

The success of Colorado's whitewater courses has varied wildly. Vail's initial venue did not become a regional paddling destination as anticipated, yet hosted one of the town's most successful internationally-attended events. Golden has grown a year-round following, hosts popular regional events and is an integral component to the city's parks and recreation portfolio. Breckenridge is viewed as a disappointment, having been designed for flows that are rarely achieved.

A significant number of these whitewater courses have experienced structural failures including movement of boulders, failure of grouting, undercutting, and collapse. Some of these failures have changed the hydraulic formation of the features and resulted in undesirable performance. Other failures have resulted in hazardous conditions. Summaries included within this report document some of these failures and should prove beneficial to those considering future projects or more detailed or comprehensive evaluation efforts.

II. RELATED STUDIES CONDUCTED FOR THE CWCB

Throughout this evaluation effort, the McLaughlin Whitewater Design Group participated in several other studies for the CWCB related to man-made whitewater courses. This includes development of design criteria and gathering safety data.

1. DEVELOPMENT OF DESIGN CRITERIA

The CWCB has developed a Colorado Floodplain and Stormwater Criteria Manual (Statewide Manual). The Statewide Manual contains engineering and management guidelines to help local agencies to establish standards in dealing with the drainage issues and problems. Many communities within the State of Colorado currently do not have adequate drainage manuals that address the floodplain and stormwater issues. Establishment and enforcement of drainage criteria are important for these communities to reduce future flood damages to public and private properties and promote public safety and general welfare of their communities. The CWCB recommends for these communities to adopt and implement the stormwater management and engineering criteria outlined in this Statewide Manual.

The CWCB has updated the Statewide Manual to include a section on the planning and design of Recreational Structures. This is the most comprehensive attempt at formulating guidance for the design of these types of in-river recreational facilities. The reader may refer to the most recent update of the adopted Statewide Manual as obtained from the CWCB website http://cwcb.state.co.us/WatershedProtectionFloodMitigation/RelatedInformation/ToolsResources/CriteriaManual/

The Recreational Structures Section of the Statewide Manual is based upon criteria outlined in the Drainage Criteria Manual (rev 2008) by the Urban Drainage and Flood Control District (UDFCD). Related excerpts of this manual are included in Section IV - APPENDIX: DESIGN CRITERIA FROM UDFCD. The Statewide Manual is also based on other technical design references, design experience of the authors, and a decision produced by the Colorado State Board of Licensure for Architects, Professional Engineers and Professional Land Surveyors as outlined below.

Subject: Report of Investigation; Board Action:

The Board reviewed the Report of Investigation submitted by the Office of Investigations regarding an inquiry into a possible license law violation. …. The Board's position that although in-channel improvement is a developing field; the basic theories and principles of engineering apply. Therefore, projects … should involve the considerations listed below.

The plans, specifications, and calculations should contain the following:

- **Existing or proposed topography.**
- **Exact dimensions and proposed elevations/distances for any of the improvements.**
- **Methods of water control and erosion control during construction or any type of construction phasing.**
- **The plan view for improvements should have dimensions for any improvements, and horizontal control, ties to any landmarks, property lines, or to something.**
- **Calculations should contain the following:**
- **Structure calculations.**
- **Stability analysis.**
- **Seepage analysis.**
- **Backwater calculations.**
- **Analysis of sequent depths and hydraulic jump movement tendencies for smaller or larger flows.**
- **Calculations for smaller or larger flows other than the design flow.**

The technical specifications should include the following:

- **Stability analysis.**
- **Backfill.**
- **Water control.**
- **Erosion control.**
- **Un-grouted rock/riprap or landscaping (even though the construction of the project requires all of these).**

Some of the above should be required for the development of contract documents for projects. Material specifications for the earthwork should be provided and provisions made for quality control (testing). The basis for filing for a water right of, for example, 1800-cfs, should not be arbitrary. Computations should be done to justify this number.

Decision related to the design of whitewater courses produced by the Colorado State Board of Licensure for Architects, Professional Engineers and Professional Land Surveyors.

2. SAFETY DATA RELATED TO MAN-MADE WHITEWATER COURSES

Data and reporting of serious accidents occurring on man-made whitewater courses is not readily available. In addition, we are not aware of any comprehensive study of serious accidents or fatalities related to man-made whitewater facilities. Researching fatalities and drownings that have occurred on courses has proven somewhat easier as these are usually reported in the news media. The course in Pueblo was the only course evaluated as part of this effort that has experienced a fatality. The Englewood/Union Avenue Chutes, identified for a future phase, has experienced the highest number of known fatalities on a man-made whitewater course (as indicated in the table below).

As part of an independent effort for the CWCB, data was collected on fatalities that have occurred on man-made whitewater courses in the U.S. In this limited effort, we briefly searched the internet, contacted five fire departments that responded to accidents at various whitewater courses, and contacted several parks departments. The following table summarizes the only fatalities about which we are aware that have occurred on man-made courses. Dates were obtained from newspaper articles.

City	***River***	***Number of Drownings***	***Year***
Pueblo, CO	Arkansas River	1	2005
Green River, WY	Green River	1	2007
Englewood, CO	South Platte River	3	2005, 2006, 2007
Farmington, NM	San Juan River	1	2006

There are many whitewater courses in this state and in this country and there may be other courses that have experienced such accidents. It is noted that all the drownings in Colorado involved recreational users who were not wearing Personal Floatation Devices (PFDs) and were improperly equipped. Based upon various interviews, it is our understanding that Tort law does not differentiate between liability assigned on completely natural versus modified rivers, since there are many reasons for and interpretation of the effect of modifications on the specific incidents.

3. WHITEWATER BASICS

A. ABILITY TO ATTRACT PEOPLE

The quality of recreational experience is a product of the quality and quantity of the whitewater features. A high quality course creates opportunity to draw a larger audience of users and spectators. Courses can be ranked in accordance with their ability to draw users from long distances and previous authors have proposed the following classifications:

Local Merit. A whitewater park of local merit would be used by local residents, providing convenient boating, but not of a caliber to routinely draw recreational boaters from great distances.

Regional Merit. A whitewater park of regional significance would attract recreational users from nearby states. It could also host national-level events if aggressively promoted and sponsored, without world-class hydraulic features.

Whitewater Feature in Vail Colorado

National or International Merit. A nationally significant whitewater park would provide a high level whitewater course consisting of recreational and competitive features that would routinely draw users from across the nation and abroad. It would be known nationally for reliably providing a high quality experience and would easily attract organizational capable and interested in hosting national competitions. Note that national and international whitewater events are awarded by sports governing bodies to the most deserving whitewater sites after review of several competing proposals. An example of this type of course is in the Ocoee River near Chattanooga, Tennessee, which was used for the 1996 Olympics and national freestyle competitions.

B. COURSE AND PARK USERS

Users of whitewater parks include canoeists, kayakers, rafters, and spectators. Some successful parks have been noted to draw more spectators than actual in-river users.

There are a number of different types of whitewater enthusiasts and activities:

River Running: Boaters paddle a river stretch for several miles and navigate through rapids in route, stopping to surf and perform other moves as afforded by the river.

Freestyle Kayaking: Usually involves traveling to a specific river feature to practice various maneuvers or "tricks" at a hole or wave feature. Typically a freestyle feature will have high quality waves or holes followed by pools of calm water for queuing and recovery. This is also known as "park and play" boating and is the dominant use of whitewater parks in Colorado and the US. Freestyle is contested at the international and international level and is lobbying for inclusion in the Summer Olympic Games.

Slalom Canoe/Kayak: An Olympic sport and involves navigation of kayaks and canoes through a series of gates which are suspended over a whitewater river. The current minimum course length is 250 meters of continuous rapids. A drop-pool course designed for freestyle kayaking could potentially host slalom, provided that it has adequate length and sufficient current velocities through the pools.

If a local sponsor proceeds with development of a venue, stakeholder input helps the designers provide features that best suit the intended user groups. However, the site and reach of river needs to support the intended users and design. A whitewater park site can be identified and evaluated based upon existing site characteristics. Some of the more important characteristics or

"site factors" are listed below. In addition to these site characteristics, construction, programs, and marketing efforts can be critical to the success of whitewater parks.

C. WHITEWATER FUNDAMENTALS

The quality and costs of man-made whitewater parks and features can vary substantially. Three "site factors" that impact the quality of specific whitewater features and costs are:

- Flow Hydrology
- Hydraulic Drop
- Access

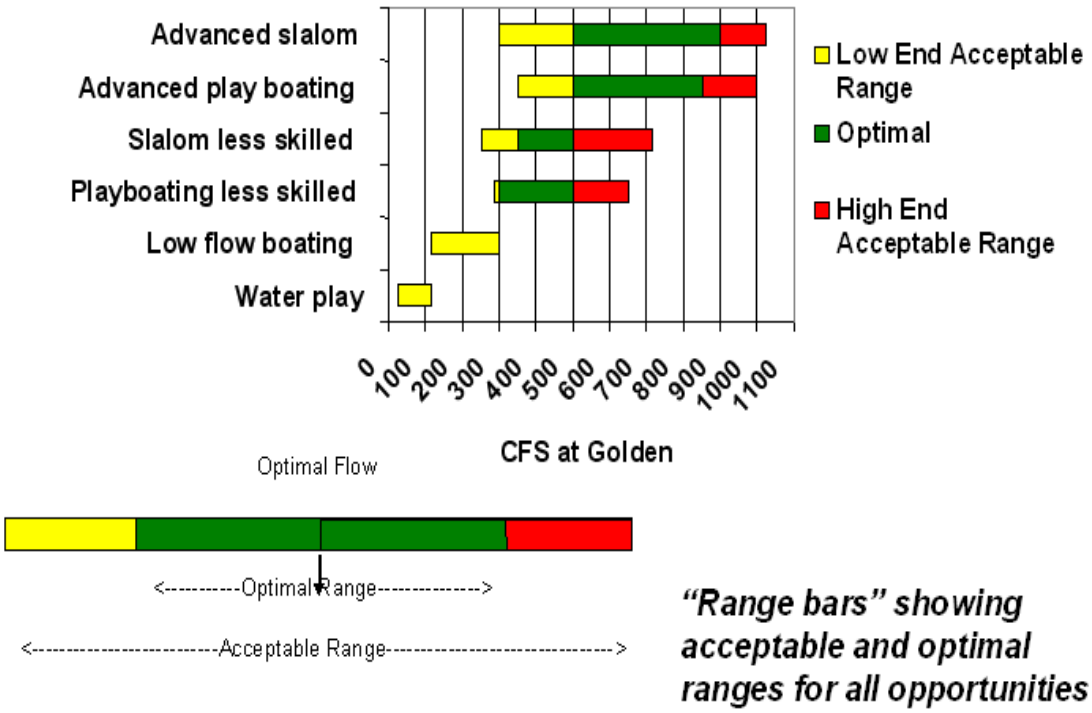
The combination of these factors determines the overall potential of the site and its potential to make a positive contribution to the surrounding community. The performance of the whitewater course is affected by the available flow and hydraulic drop. Access is a measure of the ability of its audience to use it and of the convenience of the surrounding environs to course users. It should be remembered however, that good potential by itself does not guarantee success--thoughtful design and adequate funding is required in order for a site to realize its full value to a community.

D. Flow Hydrology

The value of a whitewater course relies upon the river's hydrologic conditions including the: rate of flow; frequency of suitable flows; reliability or predictability of the flow - especially in summer months; and water quality.

Rate of Flow: The range of flow rates can be gathered from 30 years of precedent of constructing whitewater courses in Europe and the US. Generally these courses have limited flow, so their designs and user expectations revolves around what has been built before. Where reliable and frequent flow rates occur, these courses typically operate in the range of 200 to 1000 cfs. The low end of this range is the flow required to induce people to pay fees for participation (a common practice in Europe, where natural whitewater rivers are limited) The mid range of this flow has been used on man- made courses for four of the last five Olympic Canoe/kayak venues. The higher flow rates can be found at artificial courses with limited amount of hydraulic drop (see below) and at courses in natural rivers.

- <200 cfs tubing and wading, beginning whitewater boating, but generally limited experience.
- 200 to 500 cfs: Typical range for recirculating and other whitewater courses worldwide and the range at which people are willing to pay for the experience.
- 1000cfs: High end of artificial whitewater courses on the European model of man –made canals
- >1000 cfs: High quality whitewater experience but generally limited to natural rivers where higher flow rates are available and needed to compensate for larger river cross-sections.



"Range bars" showing acceptable and optimal ranges for all opportunities

Flow needs for the whitewater park in Golden, Colorado. (Shelby)

Frequency of Flow: The frequency at which suitable flows occur in a whitewater course is of obvious importance. The period when more frequent flows occur in courses is also important. Value is higher during periods or seasons when natural rapids and drops in natural rivers and rapids do not have sufficient flow.

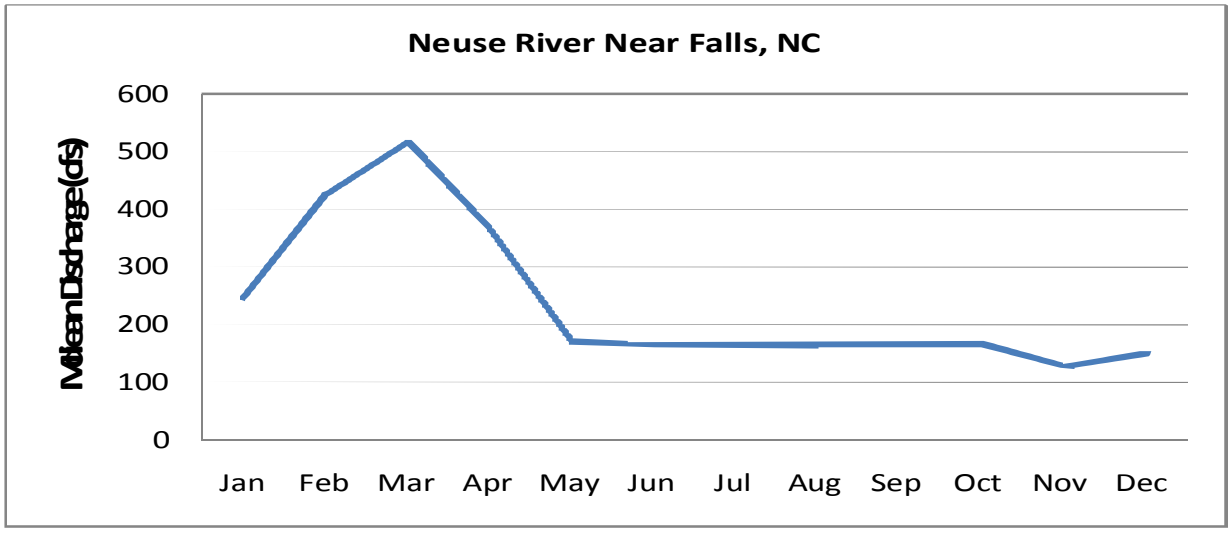
Reliability/Predictability of Flow: The highest value water is in the warmer months at a rate sufficient to provide the desired experience. Reliable water from snow-melt (known in advance from snow pack) and scheduled water releases from dams have the highest value to the commercial rafting industry because it is possible to sell reservations around known dates. Relative value water is as follows:

Seasonal Value of Water

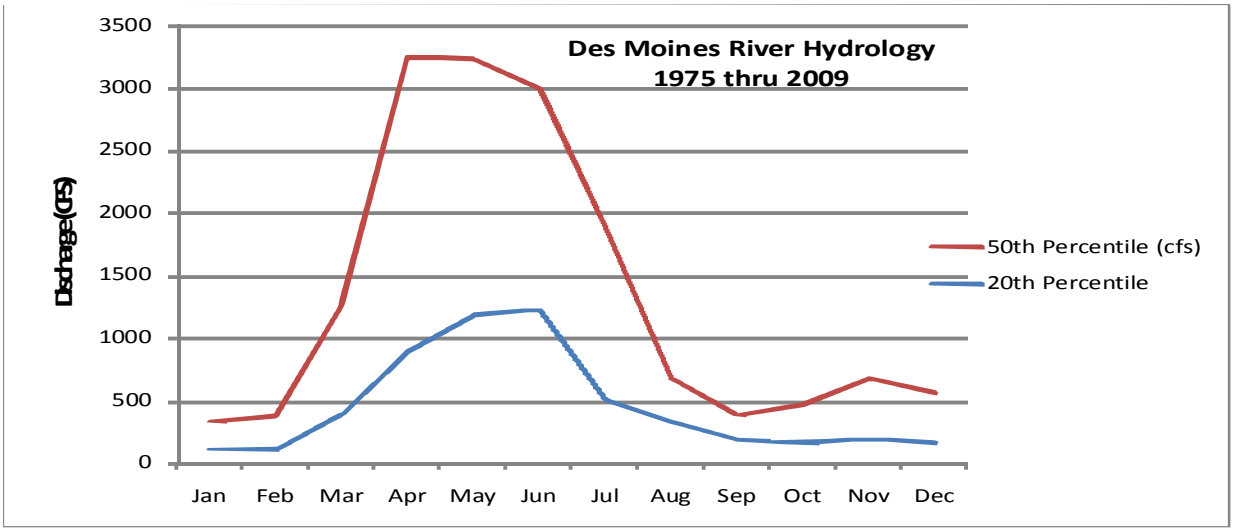
Winter ----------	Lowest value
Early spring, late fall----------	Medium value
Late spring to early fall and summer	Highest value

Reliability Value of Water

Unpredictable intermittent flow-	Lowest value
Seasonal flow----------	Low to moderate value depending on time of year
Reliable flow year round --------	High value
Dam releases - appropriate periods	Highest value



Hydrograph of a seasonal eastern river with boatable flows only in the winter and early spring.

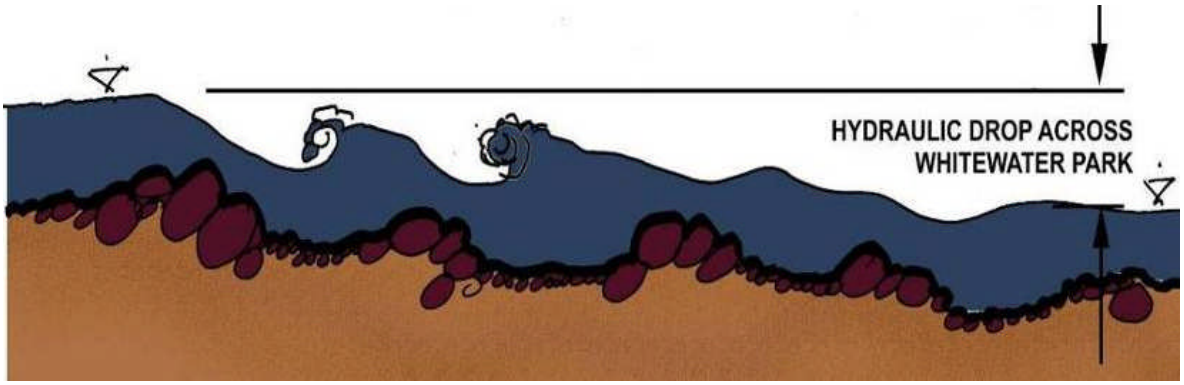


Hydrograph of a mid-western river with boatable flows most of the year with lower flows occurring only during the winter.

Water Quality: Water quality affects the quality of the experience and public health. Water quality at the whitewater park examples which follow ranges from cool water trout habitat to degraded urban rivers. State regulations govern water quality of rivers according to use, and the higher the quality the more enjoyable the experience. Most courses in Colorado are on rivers with generally good water quality. Others such as Confluence Park in central Denver, experience degraded water quality from urbanized runoff and point discharges. However, even this reach of the South Platte is classified by the State for recreational use as: *Classification (a) Recreation (i) Class E - Existing Primary Contact Use. These surface waters are used for primary contact recreation or have been used for such activities since November 28, 1975. The primary health-related measure relative to meeting this standard is the E.coli level, which is 126 cfu / 100 ml.*

E. Hydraulic Drop

Hydraulic drop refers to the difference in the elevation of the water surface downstream of a particular site subtracted from the elevation of the water surface at the upstream end, measured in feet. Whitewater courses and individual features within the course require hydraulic drop to create the energy needed to create the various hydraulic formations such as waves and holes (hydraulic jumps). The hydraulic drop multiplied by the flow rate correlates to the power and the quality of the boater's experience.

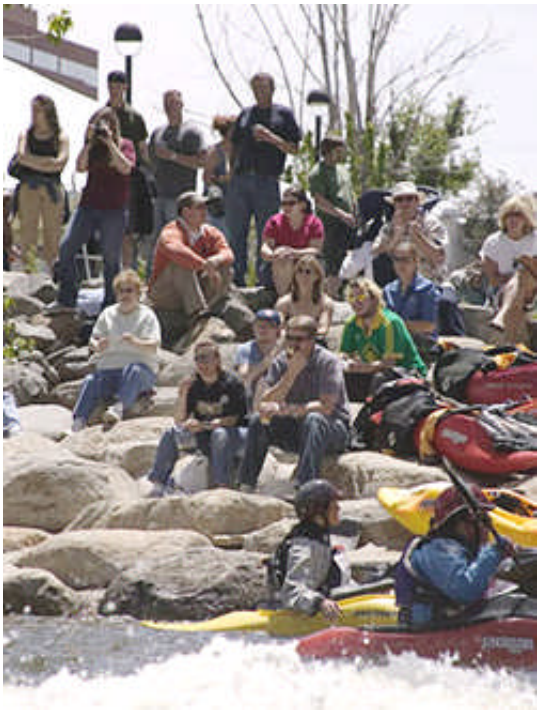


The drop throughout an entire course can range from 2 feet (or less) for one or two whitewater features to 30 feet for a slalom course. A nationally recognized slalom course typically requires at least 10 feet of hydraulic drop. Individual drops, waves, and holes for freestyle have been designed using 6-inches to 4 feet of hydraulic drop.

F. Access

The third site factor that is considered in the evaluation of whitewater courses is access. There are several components to providing access, including:

- Parking for boaters and spectators
- "Put in" and "take out" locations that accommodate groups of paddlers
- A portage route for users to carry around the course or return upstream
- Emergency entrance or exit access along one or both of the banks adjacent to the whitewater course
- Spaces for spectator viewing
- Construction access and staging
- Street visibility



Good visibility “at street level” is the single most important factor in the return on a community’s investment in a whitewater park. A site in a convenient, in-town location which is both attractive and easily accessible will draw the non-boating public to watch. (Kayakers are just the entertainment for the real audience—non boaters.) It is generally considered that most visitors of whitewater parks are viewing or land-based users. Access to the “waters edge” is also valuable to park users as well as in-river users.

G. GLOSSARY OF TERMS

The following glossary is reprinted from a draft design criteria is repeated below for the convenience of the reader. While the exact definitions of all terms are not universally recognized within this specialize industry, these are provided in an effort to improve consistency and accuracy in communications.

Term or Abbreviation	**Meaning**
Aggradation	Raising of river bottom by deposition of sediments
Bed load	Coarse sediment transported along the bottom of the river by sliding, hopping, etc.
CFS	Cubic Feet per Second--measure of discharge or flow
Construction Documents	Plans and specifications that are sealed by a Professional Engineer that is registered in the State of Colorado. These documents and supporting efforts and documents meet the requirements as outlined by the by the Colorado State Board of Licensure for Architects, Professional Engineers and Professional Land Surveyors.
Degradation	Lowering of river bottom by net removal of sediments
Drop Structure	A constructed feature or structure in a Channel that creates a downward step in the water surface and a resulting hydraulic jump downstream of the structure. It can typically have a hydraulic drop of one-half to eight feet. Drop structures can be used for a number of purposes including diversions, recreation, and river stability. They can be called control structures, diversions, grade control structures, low-head dams, weirs, or just drops. They have been constructed of boulders, concrete, steel, wood, and plastic.
Eddies	Eddies are usually formed immediately downstream from an obstruction or curvature in a river or channel. Eddies swirl on the horizontal surface of the water. Typically, they are areas where the downward movement of water is partially or fully arrested and currents flow in an upstream direction - a nice place to rest or to make one's way upstream.
Flood Recurrence	The statistical probability of a particular flood level occurring within a specified time period, e.g. one year, five year, 100 year.
Freestyle	Competitive event where boaters perform named maneuvers at a wave or hole.
Gradient	The ratio of vertical drop to horizontal run, expressed in terms of percentage slope.
Hole(s)	A “hole” is formed when water pours over a submerged structure causing the surface water to flow back upstream toward the object. In hydraulic design terms, it is a particular formation of a hydraulic jump. (See below) In the design of man-made whitewater or other structures within a river or waterway, it is usually created by a drop structure which creates a significant constriction in the channel. Holes in recreational structures are designed for entertainment and skill-building, places where paddlers use the features to perform various moves. Poorly designed holes can be dangerous. They can dramatically aerate the water, possibly to the point where they lose the capacity to carry watercraft. In overly retentive holes or “keepers” (see below) a boater may become stuck in the recirculating water. Some of the most dangerous types of holes are formed by low-head dams (weirs), underwater ledges, and similar types of obstruction. Low-head dams form a perfectly uniform hydraulic with no irregular or weak point. When the sides of the hydraulic are blocked by man-made walls it is impossible to

	slip off the side of the hydraulic on the laminar flow. Low-head dams are insidiously dangerous because their danger cannot be easily recognized by people who have not studied whitewater.
Hydraulic	A hydraulic can refer to a hole or wave – see below. The technical term is a hydraulic jump, although it could also be used to describe a hydraulic formation known as a supercritical shock wave.
Hydraulic Drop	Sometimes referred to as just "drop". The vertical distance between the upstream and downstream water surface elevation. This can be applied to a single feature or to multiple features within a river reach or whitewater course.
Hydraulic Jump	A hydraulic transitional formation that occurs between supercritical and subcritical flow. This occurs downstream of a Drop Structure when the fast flow collides with the slower moving flow in a downstream pool. It is the commonly referred to by river recreationalists as a "hole," "wave," or "hydraulic."
Invert	The bottom of the river channel.
Keeper or Overly Retentive Hydraulic	A hydraulic condition –technically a specific form or a hydraulic jump – that can occur below a natural or man-made feature (such as a low-head dam) that tends to trap boaters, swimmers, or other floating objects for an extended length of time. Can also be called a roller, reverse roller, or hole.
Maintenance	Includes effort and costs for long term: clean up after storms, normal maintenance related to parks, revegetation after large storms, and replacement of loose rock if: 1.) the movement does not involve whitewater performance/safety and 2.) the efforts are previously outlined in an *Operations and Maintenance Plan & Budget*. Also see *Structural Failure* and *Tuning/Adjustments*.
Play boating	Recreational boating primarily for surfing and performing named maneuvers on waves or in holes
Pillows	Pillows are formed when a large flow of water runs into a large obstruction, causing water to "pile up" or "boil" against the face of the obstruction. Pillows are also known as Pressure Waves
Sediment	Mineral particles of varying sizes transported by a river
Slalom	Competitive event where boaters negotiate gates suspended over the river for the fastest time
Structural Failure	Movement of rock, or structures that: 1) is unanticipated or 2) results in a condition that negatively impacts safety. Correction of structural failures usually occurs after the initial construction. Also see *Maintenance* and *Tuning*.
Suspended Bed Load	Fine sediment suspended in moving water.
Thalweg	Deepest portion of the invert in a Channel.
Tuning or Adjustments	Due to the complex nature of hydraulics and the use of irregular boulders, adjustments to rock or structure are usually required after the initial construction and the river is observed to flow through the features. This is usually conducted at the direction of the designer shortly after the initial construction or after the first year or two of operations. Also see *Maintenance* and *Structural Failure*.
Wave(s)	Waves are formed in a manner similar to holes and are sometimes considered "hydraulics" as well. In hydraulic design terms, it is a formation of a hydraulic jump which is created downstream of a supercritical reach of flow. In the design of man-made whitewater or other structures within a river or waterway, it is usually created by a drop structure or a structure which creates a significant constriction in the channel. Waves are noted by the large smooth sloping face on the water "green water" at the upstream portion of the formation followed by a crest and downward sloping face. A wave can contain at its peak a significant amount of white water and appear similar to a hole. These are called breaking

waves. Sometimes a particularly large wave will also be followed by a "wave train," a long series of waves or “haystacks.”

III. CASE SUMMARIES

Information for case studies was secured from employees in their respective city or town, community stakeholders, consultants and course users. At least one member of the McLaughlin Whitewater Design Team visited each course at least once in the preparation of this report.

In many cases municipal managers, parks and recreation and public works staff were extremely approachable and willing to spend time discussing their experience and providing helpful references: those in Golden, Gunnison, Lyons, and Ridgway were particularly helpful.

In a few locations it was very difficult or not possible to ascertain pertinent course information from the city or those identified as being able to provide the requested information. Notable among these are Breckenridge, Buena Vista, Durango, Salida, Pagosa Springs, Pueblo, Steamboat Springs, and Vail. In spite of this encumbrance we are fortunate to have secured a great deal of the information of interest from the US Army Corps of Engineers in response to Freedom of Information Act requests to the Albuquerque, Omaha and Sacramento Districts.

The following provides an overview of the information provided for each case, as it was made available. Data labeled 'not available' or 'not found' indicates 1) the material was requested and our team was not able to reach the pertinent staff member (i.e. calls were not returned after repeated attempts); 2) availability was refused, or 3) the information does not exist (e.g., hydraulic calculations may not have conducted).

1. BACKGROUND *INFORMATION*

- Location – Geographical and contextual location, as information is available in permits, RICD decrees, guide books and websites.
- Owner – Municipalities and non-municipal groups responsible for course oversight, maintenance and stewardship.
- Cost for construction and to obtain an RICD water right – This information in many cases is incomplete and difficult to compare, as "costs" cited are in some cases those reported in the media.
- Completion – Many recreational courses have been constructed in phases; have been repaired or expanded; and have been informally or frequently modified by hand or with construction equipment. In addition, in-kind services are referenced inconsistently. Given the limited scope of this effort, costs cited are assembled to the best ability of the reporting staff.

2. SAFETY ISSUES AND ACCIDENT REPORTS

Information on safety-related incidents was not shared by cities in which incidents have occurred. A cursory web search was conducted and information provided was obtained through online newspaper articles.

3. DESIGN AND CONSTRUCTION DOCUMENTS AND DRAWINGS

- Preliminary Design – In most cases the clients did not differentiate between preliminary and final designs and the accompanying 'design' documents include one set of drawings.
- Construction Documents – See Glossary

- Construction Methods – In most cases the construction methods include the use of grouted boulders. Deviations are noted.
- Floodplain and hydraulic evaluations, hydraulic drop, and design calculations are listed as available.
- Course length and construction width reflect survey measurements and in a few cases, actual measurements at the downstream end of the invert under discussion.
- Photographs are included of key locations. Additional photographs are included in cases' digital reference files.

4. WATER AND STREAMBED REQUIREMENTS AND PERFORMANCE

- Permits – This information varies somewhat by case but most often includes the permit application and accompanying drawings.
- RICD Information – This includes the decreed water level, frequency, and primary constraints or exceptions with detail regarding terms of the decree, as appropriate.
- Flows, Records and Gages – These data include historical flow and links to gauges.
- Water Management Impacts – This documents expert opinion that accompanied the RICD or permit applications (or both) and post-construction articles written on this topic relative to the specific course.
- Modification, Failures and Repairs – These are documented as information is available. Repairs that have been conducted under a general permit and for which discretionary funds have been used are not well-documented.
- Sedimentation Issues – These have not been well documented for the reasons cited immediately above.

5. ECONOMIC DEVELOPMENT INTENTION AND PERFORMANCE

- Intended use is mentioned in addition to that cited in the 'Background' section as appropriate or available.
- Economic development and usage studies have been conducted for a few courses. For others, reports of new or increased river activity such as events related to the course are reported, sourced from research and from having participated as members of the outdoor adventure sports community.

6. OTHER

This section includes other information such as the notes from some of the site visits, web articles, etc.

7. REFERENCES & ENCLOSED DVD

References from some of the sources are included in this section. Additional information and some of the referenced documents of the report are included in the enclosed DVD in the attached Section V – Appendix. An index of this information is also included in the Section V – Appendix.

8. Attachments

Attachments labeled A, B, and (if included) C and D follow each Case Summary. These include some of the references, and permitting information included in the various sections of each Case Summary.

AVON WHITEWATER PARK ON THE EAGLE RIVER

1. BACKGROUND INFORMATION

Recreational enhancements on the Eagle River in Avon were built in a section that has been mildly popular for rafting during a 2–6 week period each year. The site incorporated a commercial takeout that had been lost to development and for which the town of Avon secured permanent access easements. The Town of Avon also enhanced the whitewater at the site, created access points and enhanced the ability of passive users to access the river. The project beautified the rip-rap bank into attractive spectator seating.

Bob Jr. in Avon at Low Water

A. LOCATION

Eagle River, Avon, Colorado near the intersection of Avon Road and Hurd Lane where Avon Road crosses the river at the bridge named "Bob."

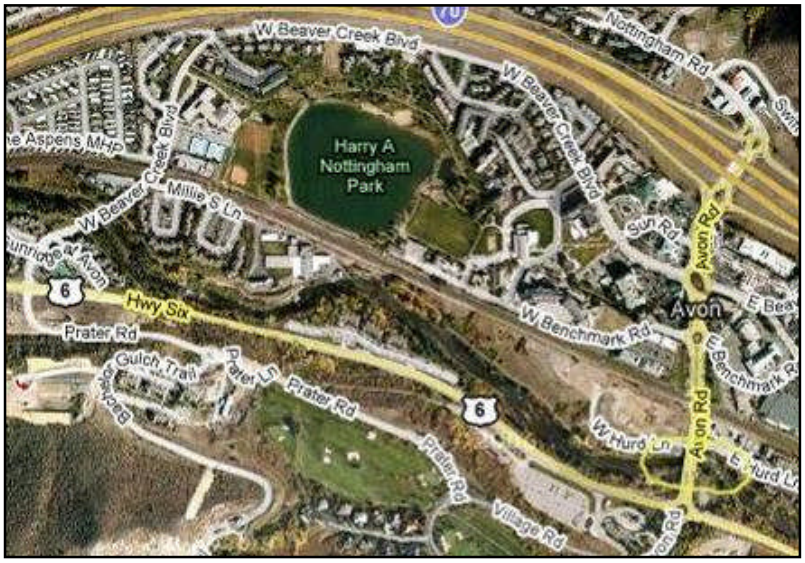
SE ¼ of the NW ¼ Section 12, Township 5S, R82W, 6th PM[1]

Bob Sr. - 550 feet east of west section line and 2,300 feet south of north section line (1656708 N, 2711985 E SCP Central Zone).
Bob Jr. - 2,600 feet east of west section line and 2,350 feet south of north section line (1656680 N, 2712151 E SCP Central Zone).
Baby Bob - 2,400 feet east of west section line and 2,400 feet south of north section line (1656598 N, 2712305 E SCP Central Zone).

B. OWNER/OVERSIGHT

Owner: Town of Avon
PO Box 975
Avon, CO 81620
Ph: (970) 748-4000
Fax: (970) 949-9139

Steward: Town of Avon
Parks & Facilities Maintenance
500 Swift Gulch Road
P.O. Box 975
Avon, CO 81620
Phone: (970) 748-4100
Fax: (970) 748-1958



Avon Recreation Enhancements Site Map.

Maintenance Responsibility: Town of Avon
Parks & Facilities Maintenance
500 Swift Gulch Road
P.O. Box 975
Avon, CO 81620
Phone: (970) 748-4100
Fax: (970) 748-1958

C. COST

Approximately:		
Construction – year 1:	**$**	**530,000**
Construction - year 2:	**$**	**170,000**
RICD water right:	**$**	**390,000**
Total	**$**	**1,090,000**

Source: Nick Turner
This project was funded by the Town of Avon.

HTTP://WWW.VAILDAILY.COM/APPS/PBCS.DLL/ARTICLE?AID=/20060904/EDITS/109040061&SEARCHID=73311337676232&TEMPLATE=PRINTART

D. COMPLETION DATE

June 6, 2007

2. SAFETY ISSUES/ACCIDENT REPORTS

No known to date (6/30/08)

3. DESIGN/CONSTRUCTION DOCUMENTS & DRAWINGS

A. PRELIMINARY DESIGN

Designers - Nick Turner, Jason Carey, River Restoration, Inc., Glenwood Springs. CO

B. CONSTRUCTION DOCUMENTS

i. Engineer of Record – Jason Carey, P.E. River Restoration[2]

ii. The course is in the channel of the Eagle River and starts upstream of the bridge crossing of Avon Road. The three control structures are designed to divert, capture, control and concentrate the flow of water in the course between specific points to utilize minimum stream flows for three distinct recreation experiences and different skill levels. Baby Bob is a pour over hole. Bob, Jr. is the middle structure in the course constructed as a wave hole 75 feet upstream of the upstream face of the Bob Bridge. Bob Senior is twenty feet downstream of the bridge. See Attachment A: *Avon Recreation Enhancements*[3]

C. CONSTRUCTION METHODS

i. Contractor-Ted Siepel Construction[4]

ii. Pre-Cast Concrete Structures with Stacked Boulders. No grout between boulders.

D. FLOODPLAIN AND HYDRAULIC EVALUATIONS

Floodplain Management Permit # 2006-002[5, 6]
See Attached B: Floodplain Documents

Cartwheeling in Baby Bob

E. HYDRAULIC DROP

5.5 ft.

F. DESIGN CALCULATIONS

Letter from Jason Carey, P.E., River Restoration Engineer to Gary Greer[7]
See Attached C: Design Calculations

G. COURSE LENGTH

The course measures 348 feet.

H. CONSTRICTION WIDTHS

As shown on drawings: 35-65 feet
Measured Widths:

Feature above Baby Bob	77’
Baby Bob	60’
Bob Junior	60’
Bob Senior	77’

See Attachment A: Avon Recreation Enhancement’*s*

I. PHOTOGRAPHS

See the accompanying folder entitled **Avon Site Photos**.

4. WATER AND STREAMBED REQUIREMENTS AND PERFORMANCE

A. PERMITS

ACOE 404 Permit # 200675059 [8]

B. RICD INFORMATION

CWCB Case # 05CW258

Structure	Period	Amount
Baby Bob	April 20-August 7	200 cfs
Bob Junior	May 1-July 20	360 cfs
Bob Senior	May 25-July 7	1400 cfs

Flows are decreed for the timeframe of 8:00am - 8:00pm. [9]

C. FLOW RECORDS, GAUGES

USGS Station #09067020
http://waterdata.usgs.gov/usa/nwis/uv?site_no=09067020

D. WATER MANAGEMENT IMPACTS

There could be water management issues with exchanges through this reach of the Eagle River in the future; however, because the final decree included certain terms and conditions, significant water management issues may be avoided.

E. MODIFICATIONS, FAILURES AND REPAIRS

Year two modifications were planned from the beginning to "tune" the structures and were completed Fall 2007. No other Modifications, Failures or Repairs have been reported.

F. SEDIMENTATION ISSUES

None observed or reported.

5. ECONOMIC DEVELOPMENT INTENTION AND PERFORMANCE

A. INTENDED USES

Included but not limited to boat passage, kayaking; and rafting[10].

B. ECONOMIC AND USAGE STUDIES

None conducted.

C. EVENTS

Avon Town Rodeo – ATR, Teva Mountain Games (qualifying site).

D. RECENT DEVELOPMENT IN VICINITY

Located in highly developed area (retail, multiple-unit dwellings).

6. OTHER

A. SITE VISIT SUMMARY

Date: 11:00 am – 1:00 pm July 13, 2007
Flow: Approximately 400cfs.
By: Derk Slottow

The recommended parking is in the Beaver Creek Day Use Lot (Skier's Elk Lot) approximately 100 yards downstream of the whitewater park. Finding the park from here is not intuitive. I parked in the Burger King parking lot directly across from the "Kayak Loading Zone" sign (not recommended). Strangely, there is no pullout or shoulder at the "Kayak Loading Zone," which is immediately after a stoplight, making this a very poor place to load kayaks. It is reported that there is additional parking upstream on river-left near the launch ramp above Baby Bob, but I was not able to find either the ramp or the parking.

Instead, I launched from the terraced river access on river-right. There is a feature above Baby Bob that you can access from the launch eddy. This provided the best surfing for spinning and cartwheeling. Baby Bob was good for front-surfing. Bob Junior was good for surfing, side-surfing, and cartwheeling but was very flushy with a small foam pile and was difficult to stay in for more than one move. The surfer's right shoulder of the feature may be good for blunts, especially with more water. Bob Senior was not "in." The structure that forms the feature was above water but I was able to cartwheel in the pour-over off the corner of the structure. There was a small log wedged into the river-bottom and sticking out of the water to the right of Bob Senior. I removed the log at the end of the site visit.

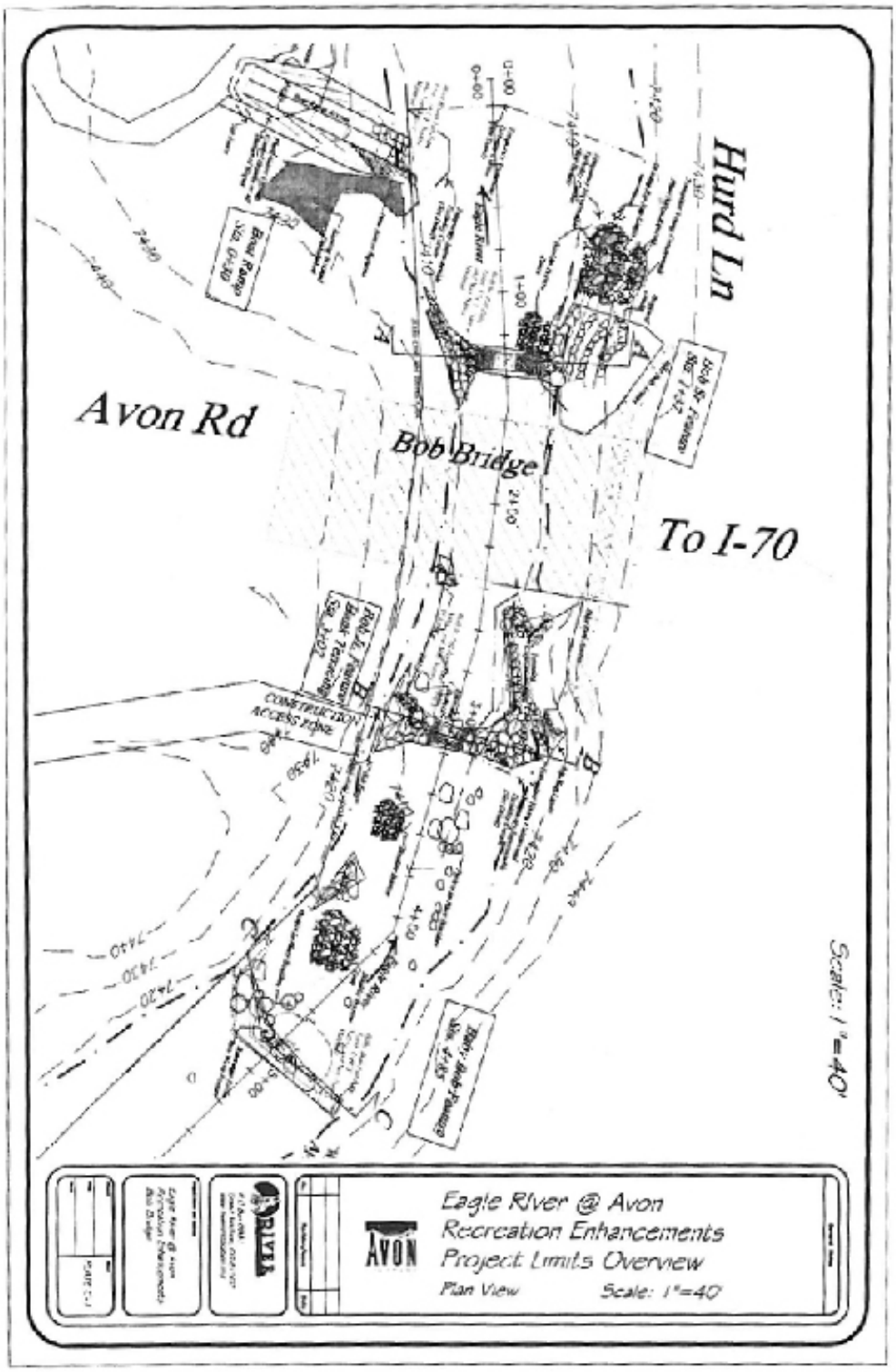
All eddies were good for squirts and eddy-line cartwheels. The river was sufficiently deep to roll and cartwheel in and around all features. All structures appeared to be permanent and there was no evidence of changes in the structures or riverbed resulting from peak flows. Measured pool depths and constriction widths are close.

Additional documents available include responses from three user interviews,[11] a river improvements easements agreement, [12] and a link to an online promotional video.[13]

7. REFERENCES

1. *Application for Surface Water Rights for Recreational In-Channel Uses*, December 27, 2005, 2.
2. *Ibid*., 1- 2.
3. *Eagle River @Avon Recreation Enhancements*: nine (9) drawings
4. *Avon Project Manual*, Section 1.20.
5. *Engineering Report Case No. 05-05CW258 Town of Avon's Recreational In-Channel Diversion Water Right in the Eagle River,* Sections II, III, Leonard Rice Engineering, Inc. June, 2006.
6. (Unknown title): "Section Floodplain Compliance and One Dimensional Hydraulic Parameters for Control Sections and Hydraulic Jumps", January 23, 2006, River Restoration, 5 and 8.
7. Avon Volumetric Calculations.
8. *ACOE File # 200675059*, Floodplain Management Permit # 2006-002, River Access Plan Report
9. Tables (2) : *Number of Days with Anticipated Calls – Historic and Modele*d.; Graphs (3): Modeled *Volume and 12 Hr. Request Volume* April 20-August 7, *Anticipated Days of RICD*; *Call, April 20-August 7 Baby Bob; May 25-July 7 Bob, Senior; Gage and Requested Flow Water Year 2002*, Eagle River below WWTP at Avon.
10. *Application for Surface Water Rights for Recreational In-Channel Uses,* December 27, 2005, 3.
11. User interviews (3)
12. *River Improvements Easements Agreement* (Tract Zero). August 14, 2006.
13. *Promotional Video – 2007, http://vail.plumtv.com/videos/avon_whitewater_park*

Attachment A


Hurd Ln
Avon Rd
Bob Bridge
To I-70
CONSTRUCTION ACCESS ZONE
Scale: 1"=40'
Eagle River @ Avon
Recreation Enhancements
Project Limits Overview
Plan View
Scale: 1"=40

Attachment B

RIVER RESTORATION.ORG
PO Box 0981 Grand Junction Colorado 81502 (970) 389-5987

published in a Floodplain Information Report, August 22, 2003, prepared by Matrix Design Group for Eagle County and the Colorado Water Conservation Board. A Corps of Engineers 404 Individual Permit is being applied for and notice will be given to the Colorado Department of Public Health and Environment for 401 Water Quality review. Furthermore, an Eagle County Floodplain Development Permit is being applied for.

VII. Floodplain Compliance

A Floodplain Information Report (FIR), prepared by Matrix Design Group for Eagle County and the Colorado Water Conservation Board, is the most current floodway information available for the Eagle River (2003). The FIR presents Base Flood Elevations (BFE) through the project site based on use of the HEC-RAS floodway model developed by the U.S. Army Corps of Engineers (USACE, 1997).

As applied to the Eagle River, the HEC-RAS model used in the 2003 FIR represents six channel cross-sections over the project reach to describe channel geometry. To evaluate potential effects of the Avon RICD structures on flood profiles for the Eagle River, three additional control cross-sections were added to the existing HEC-RAS model based on field surveys conducted in 2005 and the proposed RICD design. These additional cross-sections represent the physical changes to the channel geometry that will result from construction of the RICD structures. The HEC-RAS model was then run with the additional cross-sections ("Eagle_River Bob Design") and results were compared to the original model results ("Eagle_River"). The HEC-RAS model results (Table 2) indicate water surface elevations (WSEL) will remain at or below established BFE following construction of the RICD.

Table 2

Station	Description	BFE [1] (ft)	WSEL [2] (ft)
337[3]	220 feet upstream of project area	7424.84	7424.49
336.506[4]	Cross-Section at Baby Bob	7423.02	7422.88
336.107[4]	Cross-Section at Bob Junior	7421.54	7421.49
336[3]	Upstream of Bob Bridge	7421.14	7421.14
335.5[3]	Bob Bridge	N/A	N/A
335.2[3]	Downstream of Bob Bridge	7417.44	7417.44
335.117[4]	Cross-Section at Bob Senior	7417.36	7417.10
335[3]	17 feet downstream of Bob Senior	7417.25	7417.25
334[3]	416 feet downstream of project area	7412.87	7412.87

Notes: 1. Base Flood Elevation established in 2003 FIR
2. Water Surface Elevations with Avon RICD
3. Cross-section from existing HEC-RAS Model
4. Cross-section added to evaluate Avon RICD

Attachment C

Yield (AF)		0.1	0.25		0.75	0.9
Day	MeanQ	10th%	25th%	MedianQ	75th%	90%
TotalAF/Year	257436	136570	171702	231192	314353	408073

Impact of 1400 cfs

Percentage of Annual Yield

1400	cfs	MeanQ	10th%	25th%	MedianQ	75th%	90%
115.7	= AF/hour	0.04%	0.08%	0.07%	0.05%	0.04%	0.03%
2776.9	= AF/Day	1.08%	2.03%	1.62%	1.20%	0.88%	0.68%

Impact of 350 cfs

Percentage of Annual Yield

350	cfs	MeanQ	10th%	25th%	MedianQ	75th%	90%
28.9	= AF/hour	0.01%	0.02%	0.02%	0.01%	0.01%	0.01%
694.2	= AF/Day	0.27%	0.51%	0.40%	0.30%	0.22%	0.17%

Impact of 200 cfs

Percentage of Annual Yield

200	cfs	MeanQ	10th%	25th%	MedianQ	75th%	90%
16.5	= AF/hour	0.01%	0.01%	0.01%	0.01%	0.01%	0.00%
396.7	= AF/Day	0.15%	0.29%	0.23%	0.17%	0.13%	0.10%

January 23, 2006

RIVER RESTORATION.ORG
PO Box 0981 Grand Junction, Colorado 81502 (970) 389-5987

Table 3. One-Dimensional Hydraulic Parameters for Control Sections and Hydraulic Jumps

FLOW cfs	Baby Fr# - U/S	Baby Fr# - Str.	Baby FR# - D/S	Baby Velocity*	Baby Depth**	Junior Fr# - U/S	Junior Fr# - Str.	Junior FR# - D/S	Junior Velocity*	Junior Depth**	Senior Fr# - U/S	Senior Fr# - Str.	Senior Fr#-D/S	Senior Velocity*	Senior Depth**
200						0.3	1.0	2.2	10.9	2.3	0.2	0.5	0.3	2.3	5.0
350	0.3	1.0	2.6	14.3	3.6						0.2	0.6	0.4	3.2	5.5
500	0.4	1.0	2.3	14.3	4.0	0.4	1.0	1.9	12.3	3.6	0.3	0.8	0.4	3.9	5.9
750	0.4	1.0	2.0	14.2	4.6	0.4	1.0	1.9	13.0	4.3	0.3	0.8	0.5	5.1	6.4
1300	0.5	1.0	1.9	14.3	5.5	0.5	1.0	1.6	14.0	5.7	0.4	1.0	0.7	7.0	7.2
1400	0.5	1.0	1.9	14.4	5.7	0.5	1.0	1.6	14.1	6.0					
2500	0.6	1.0	1.8	15.1	7.1	0.6	0.8	0.6	7.3	8.2	0.4	1.0	1.6	16.6	6.3
5430	0.7	0.9	0.6	8.0	10.2	0.5	0.6	0.5	8.0	12.1	0.5	1.0	1.5	19.0	8.9

Note: Froude #s are average for 1 dimensional flow, upstream (U/S), at (Str.), and downstream (D/S) of the control section.

*Average velocity at super critical section.

**Depth of pool downstream of hydraulic jump

BRECKENRIDGE WHITEWATER PARK ON THE BLUE RIVER

1. BACKGROUND INFORMATION

A. LOCATION

The Breckenridge Kayak Park is located on the Blue River behind the Recreation Center, on the east side of Kingdom Park, between the Blue River pathway and Highway 9. Phase I: Each of the structures that comprise Phase I are located in the NW1/4 SW1/4 and SW1/4SW1/4 of Section 30, T.6S., R.77W., the 6th P.M.

B. OWNER/OVERSIGHT

Owner: Town of Breckenridge
PO Box 168
Breckenridge, CO 80424
(970) 453-2251

Steward: Town of Breckenridge
websiteadmin@townofbreckenridge.com
970-453-3166

Maintenance Responsibility: Town of Breckenridge
websitepw@townofbreckenridge.com
970-453-3170

Breckenridge Park Below Pedestrian Bridge

C. COST

Construction Phase I:	**$ 160,000**
Phase II Construction:	**$ 200,000**
RICD Water Right (est.)	**$ 100,000**
Total:	$ 460,000

Does not include reconstruction costs as reported in 2004, and it does not include the costs to obtain the RICD water right.

D. COMPLETION DATE

2002

2. SAFETY ISSUES AND ACCIDENT REPORTS

None reported

3. DESIGN AND CONSTRUCTION DOCUMENTS/DRAWINGS

A. PRELIMINARY DESIGN

Recreation Engineering and Planning-Gary Lacy

B. CONSTRUCTION DOCUMENTS

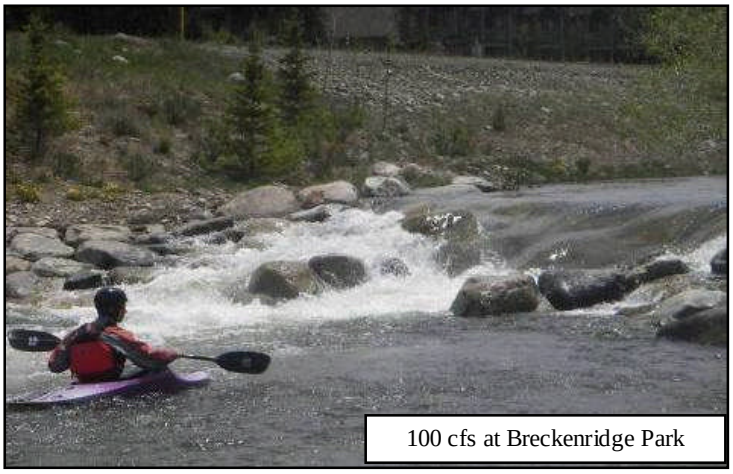
No sealed drawings or design drawings meeting the description outlined by the Colorado State Board of Licensure for Professional Engineers were found.

Recreation Engineering and Planning-Gary Lacy

The capacity of the course is 500 cfs. The structures create waves and jets of water, self-scouring pools, hydraulic holes, large changes in current direction, and other whitewater features that are used by kayakers and other boaters for recreational purposes. Usage is possible at low flow due to the concentration of flow through a constructed low flow channel. According to the application, dam structures and flow deflectors will also establish fish habitat.[1]

The structures concentrate and control the Blue River for boating purposed. Phase I: Each of the eight (8) dam structures and water deflector structures that comprise Phase I are located in the NW1/4 SW1/4 and SW1/4SW1/4 of Section 30, T.6S., R.77W., the 6th P.M.

Phase II: Seven (7) dam structure and water deflector structures are located in the SW1/4SW1/4 of Section 30, T.6S. R.77W. the 6th P.M.[2]



100 cfs at Breckenridge Park

C. CONSTRUCTION METHODS

1,400 cubic yards of rock and 80 cubic yard of cement grout were used for Phase I construction. 1,200 cubic yards of rock and 80 cubic yards of grout were used to build the Phase II structures.[3]

D. FLOODPLAIN AND HYDRAULIC EVALUATIONS

See Attachment A for FEMA map.

E. HYDRAULIC DROP

Information not found.

F. DESIGN CALCULATIONS

None found.

G. COURSE LENGTH

1800 feet within the existing channel of the Blue River in the Town of Breckenridge.[4]

H. CONSTRICTION WIDTHS

Not determined

I. PHOTOGRAPHS

See Breckenridge Site Photos for additional images.

4. WATER AND STREAMBED REQUIREMENTS AND PERFORMANCE

A. PERMITS

No permit information was released from the US Army Corps of Engineers after the submission of a Freedom of Information Act request. The project work may have been designed and constructed under a Nationwide Permit.

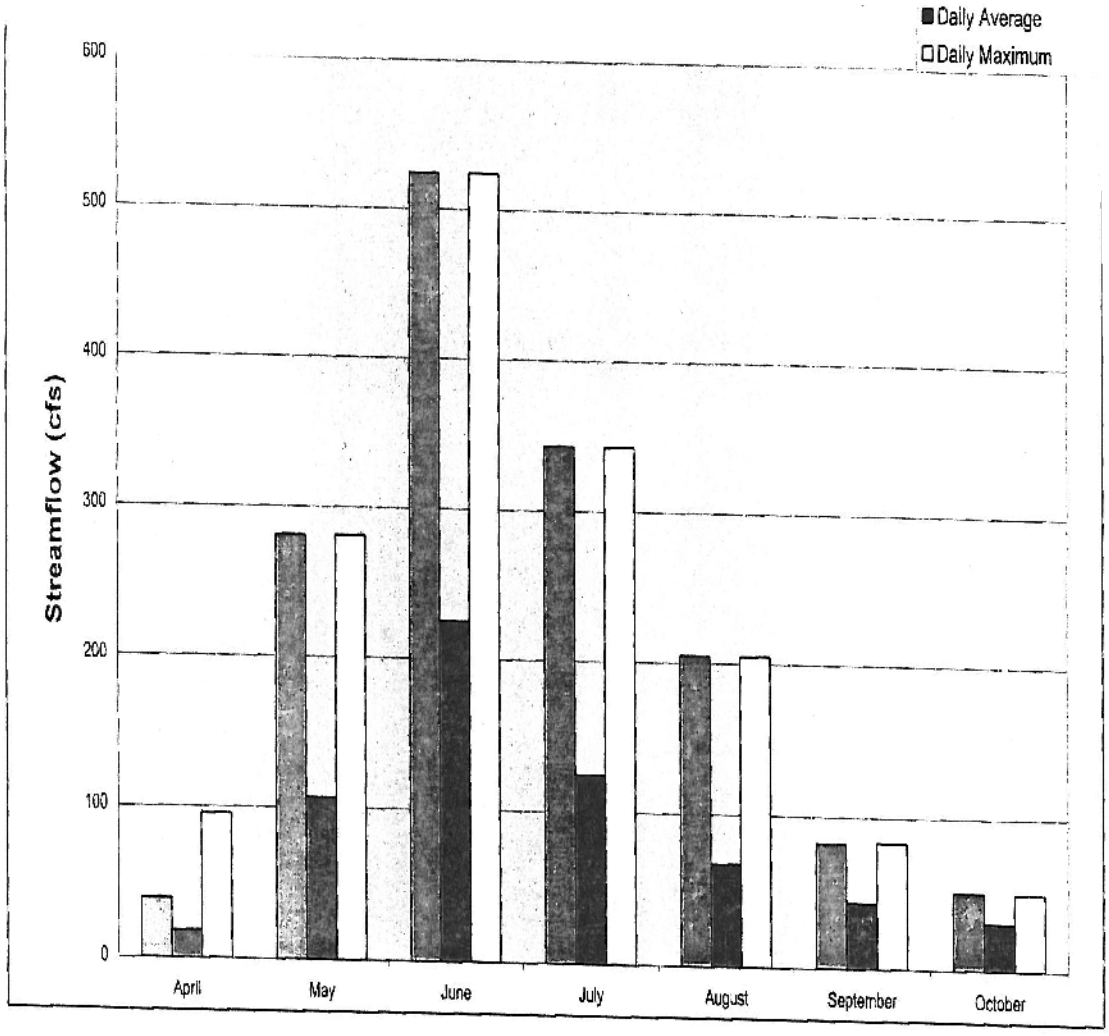
B. RICD INFORMATION

The Court found "that the 15 Park structures are capable of efficiently diverting and controlling the water flows to the extent the flows exceed 100 cfs, without waste for the claimed conditional amount as identified in the monthly chart Please recreate table without April, September or October (below): [5]

May	June	July	August
281 cfs	500 cfs	343 cfs	205 cfs

C. FLOW RECORDS GAUGE

Current and historical flows can be found at USGS Blue River at Blue River 09046490. *http://waterdata.usgs.gov/co/nwis/uv/?site_no=09046490&PARAmeter_cd=00065,00060*
Real time water level/depth is located at Digital Indigo Technologies' *http://river-depth.com/graphs/09046490*. See Attachment B for more detailed historical flow information.



Based on data provided by Applicant (Table 1, Engineering Report)

D. WATER MANAGEMENT IMPACTS

Articles have been written around the impact of low water availability for the town and, as a related matter, the whitewater park.[6]

E. MODIFICATIONS, FAILURES AND REPAIRS

Reported in 2004:
"That work will include rebuilding 80 percent of a structure in the first phase and modifying the faces of three other structures to provide a better whitewater experience".[10]

F. SEDIMENTATION ISSUES

None reported.

5. ECONOMIC DEVELOPMENT INTENTION AND PERFORMANCE

A. INTENDED USES

The structures concentrate and control the Blue River for boating purposes.

The town of Breckenridge has and will continue to derive substantial economic benefits from the recreational use of the park, particularly during the spring and early summer months when there are higher flows in the park. These higher flows attract the greatest number of users, spectators and competitive events. These users and spectators spend many thousands of dollars in Breckenridge, especially when competitive events are held.

Therefore, the evidence was uncontested that the economic value to the town of Breckenridge will continue to increase as the park attracts increasing numbers of boater and spectators from the region and out of state.[7]

B. ECONOMIC AND USAGE STUDIES

None have been produced. The Town of Breckenridge Director of Leisure Services estimates usage is five people daily between 1 and 6 pm.

C. EVENTS

Events have been planned and cancelled due to insufficient water levels.[8]

D. RECENT DEVELOPMENT IN VICINITY

None related to the whitewater park.

6. OTHER

This was a beautiful idea that failed horribly, and a valuable lesson was learned. Don't build whitewater parks at an elevation that is too high to collect enough water to ever run. The result is more beneficial as pretty streamside landscaping than for the freestyle features. But, supposedly, if there is 50 cfs (rare) then you can sit in an eddy, and at 100 cfs (super rare) you might be able to throw an end. The park was built for a minimum of 200 cfs but the Court decreed that it only creates whitewater when the flows exceed 100 cfs, …[9]

7. REFERENCES

1. *Summary of Findings of Fact, Conclusions of Law and Decree of the Water Court Case No. 00CW281, June 5, 2002,* 4.
2. *Ibid,* 2.
3. *Ibid*.
4. *Ibid*.
5. *Findings of Fact, Conclusions of Law and Decree of the Water Court- Case No. 00CW281,* June 2, 2002, 5,6.
6. *Water embroglio affects Breckenridge and beyond, Randy Wyrick Vail Daily (no date), "Dillon Reservoir Water for Breck?" Summit Daily News,* October 3, 2004.
7. *Summary of Findings of Fact, Conclusions of Law and Decree of the Water Court Case No. 00CW281, June 5, 2002*, 5.
8. *Kayak Events Cancelled,* Associated Press.
9. *Whitewater of the Southern Rockies,* Evan Stafford and Kyle McCutcheon,340.
10. Summit Daily News, April 13, 2004.

Additional References included in Breckenridge_References

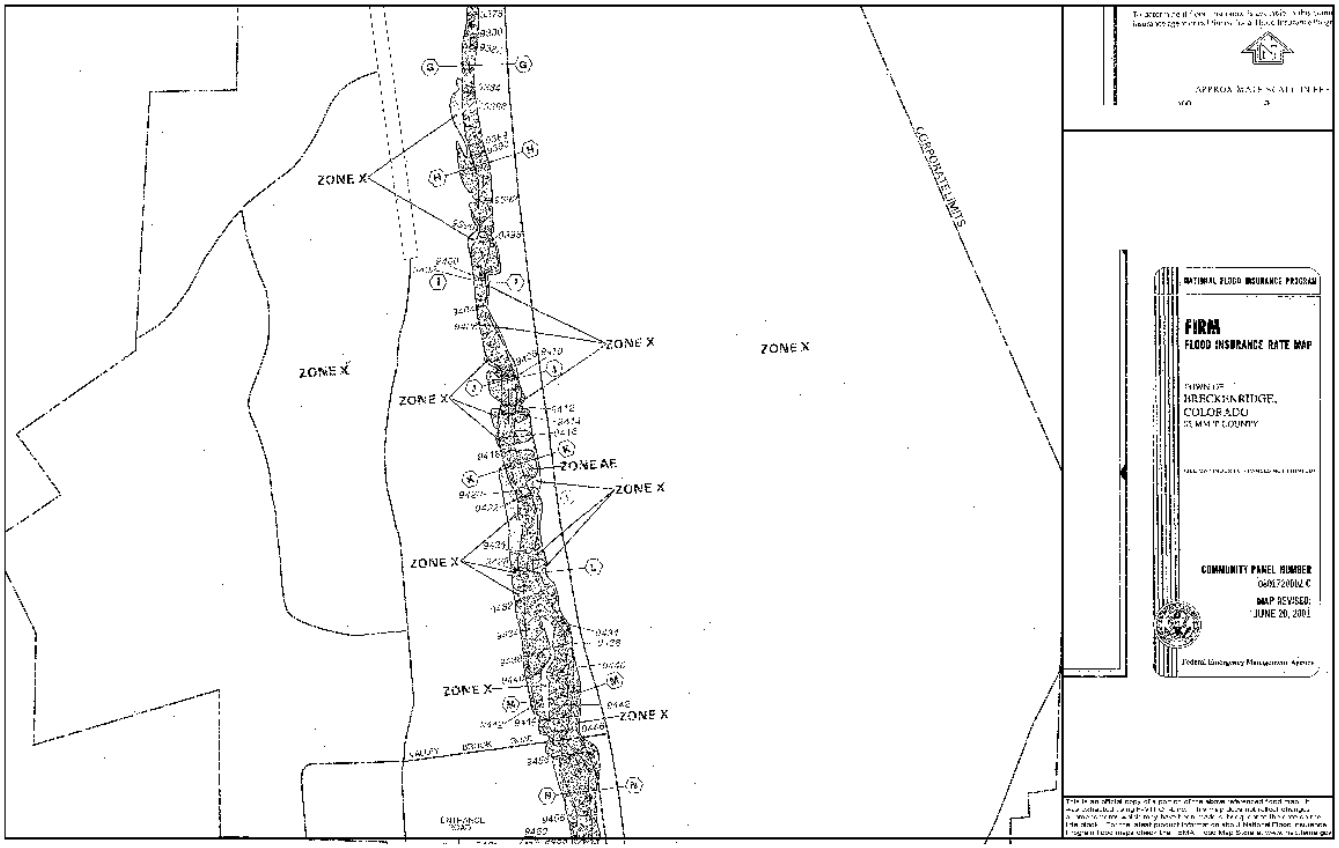
- Stipulation and Agreement – Case No. 00CW281 (draft)
- *Motion for Clarifying Language in Decree – Case No. 00CW281*, 17 June, 2002
- *Decree for Case No.97CW283 , February 13, 2001*
- *Proceeding: Motions for Determination of Questions of Law*, Presiding Judge Thomas W. Ossola,

February 13, 2002.

- Memo from Ted Kowalski to CWCB Board Members *Re: Ruling regarding the Breckenridge and Eagle Water and Sanitation District Applications for Recreation In-Channel Diversion (RICDs),* June 10, 2002

Attachment A

FEMA Map for Breckenridge



Attachment B

BLUE RIVER BASIN
09046530 FRENCH GULCH AT BRECKENRIDGE, CO

LOCATION.--Lat. 39°29'35", long. 106°02'39", in SE14SW14, sec.30, T.6 S, R.77 W, Summit County, Hydrologic Unit 14010002, on left bank, 300 ft south of Summit Co. Rd. 450, 200 ft upstream from the bridge on Hwy. 9, in Breckenridge.

DRAINAGE AREA.--10.9 mi2.

PERIOD OF RECORD.--October 1995 to current year. Daily water temperature record available, October 1996 to September 1998. For a complete listing of historical data available for this site, see http://waterdata.usgs.gov/co/nwis/inventory/?site_no=09046530

GAGE.--Water-stage recorder with satellite telemetry. Elevation of gage is 9,510 ft above NGVD of 1929, from topographic map.

REMARKS.--Records good except for estimated daily discharges, which are fair. No diversion or regulation upstream from gage. Several measurements of specific conductance and water temperature were obtained and are published in the "Supplemental Water-Quality Data For Gaging Stations" section of this report.

09046530 FRENCH GULCH AT BRECKENRIDGE, CO

SUMMARY STATISTICS FOR 2002 CALENDAR YEAR
FOR 2003 WATER YEAR
WATER YEARS
1996 - 2003

ANNUAL TOTAL	1,309.3 3,386.9
ANNUAL MEAN	3.59 9.28 9.35
HIGHEST ANNUAL MEAN	13.0 1997
LOWEST ANNUAL MEAN	3.67 2002
HIGHEST DAILY MEAN	16 Jun 1 106 Jun 1 115 Jun 5, 1997
LOWEST DAILY MEAN	1.2 Feb 23 1.3 Jan 6 1.2 Feb 23, 2002
ANNUAL SEVEN-DAY MINIMUM	1.3 Feb 20 1.4 Jan 1 1.3 Feb 20, 2002
MAXIMUM PEAK FLOW	115 May 31 124 Jun 5, 1997
MAXIMUM PEAK STAGE	6.99 May 31 7.09 Jun 5, 1997
ANNUAL RUNOFF (AC-FT)	2,600 6,720 6,770

10 PERCENT EXCEEDS 7.3 26 24
50 PERCENT EXCEEDS 3.0 3.2 3.7
90 PERCENT EXCEEDS 1.5 1.5 1.7

U.S. Department of the Interior, U.S. Geological Survey, Water Resources of Colorado
Last Modified: April 29, 2004

See enclosed *09046530 French Gulch at Breckenridge, Colorado* for a table showing 2002-2003 daily mean flows.

BUENA VISTA WHITEWATER PARK
ON THE ARKANSAS RIVER

1. BACKGROUND INFORMATION

A. 2010 UPDATES

The information below is based upon the initial 2008 investigation. The 2010 update established that two additional features were constructed by the Spring, 2010. These are downstream from the four features in place and complete the master planned whitewater park expansion.

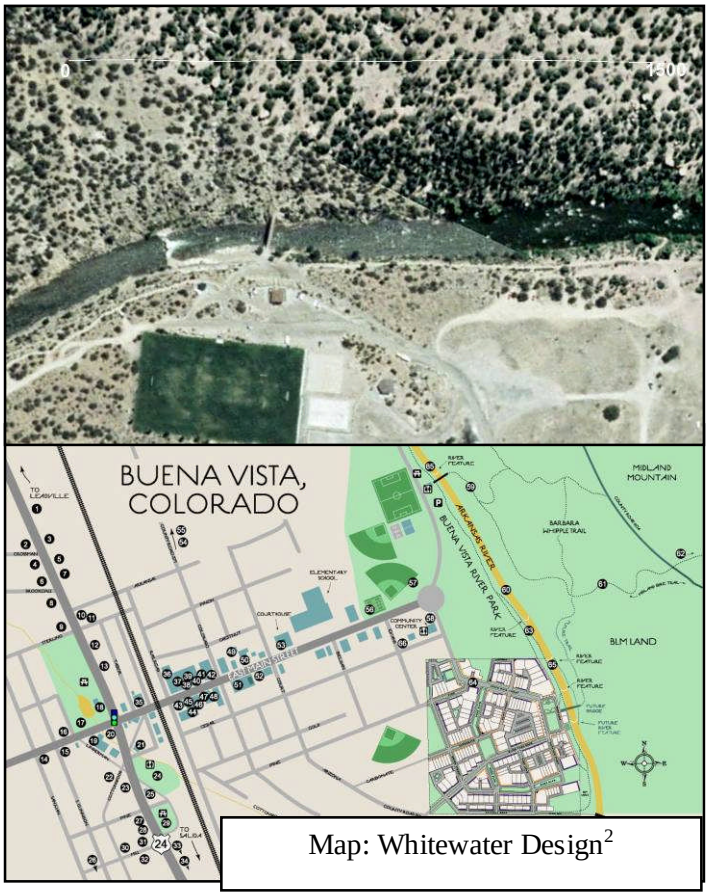
The Town has copies of drawings sealed by the Engineer.

B. LOCATION

The Buena Vista Whitewater Park is located in the channel of the Arkansas River, east of Buena Vista, Colorado.

Structure No. 1 is located in the SW quarter of Section 9, T14S, R 78 W of the 6th PM, Chaffee County, Colorado. Structures No. 2-4 are located as follows relative to Structure No. 1:

Structure No. 2 is approximately 2,000 feet downstream;
Structure No. 3 approximately 2,150 feet downstream; and
Structure No. 4 approximately 2,300 feet downstream.[1]



Map: Whitewater Design[2]

C. OWNER/OVERSIGHT

Owner: Town of Buena Vista
210 East Main
Buena Vista, Colorado 81211

The Town Company, LLC
c/o Katy and Jed W. Selby
P.O. Box 4259
Buena Vista, Colorado 81211

Steward: Town of Buena Vista
The Town Company

Maintenance Responsibility: Town of Buena Vista

D. COST

Design, Engineering, Construction estimated for initial construction (Source date 2005) by funding source:

Funding Source	
Great Outdoors Colorado	**$187,000**
Town of Buena Vista	**30,000**
Total	**$217,000**[3]

The cost to secure the RICD was not made available. Costs for subsequent re-construction/adjustments not made available.

E. COMPLETION DATE

This is a project that has been installed one drop at time. The first was completed Fall, 2004. As of 2008, four have been installed. It is not clear whether or not one or two additional features are confirmed.

2. SAFETY ISSUES AND ACCIDENT REPORTS

While the second feature as originally installed performed well within the normal flow range, it was viewed to be hazardous for users with only intermediate skills at levels above 2000 cfs. Modifications were made in the fall of 2006. Additional modifications were made in 2007.

http://nt1.adventuresports.com/canoe/whitewatercoursesandparks/2007presentations/WCP2007_Paddler-Driven_Whitewater%20Parlks_Mike_Harvey.pdf. The image on page 3 shows the Lower Drop at ~1000 cfs

Uptown Hole 2200 cfs 6/06

3. DESIGN AND CONSTRUCTION DOCUMENTS/DRAWINGS

A. PRELIMINARY DESIGN

Recreational Engineering and Planning, Mike Harvey
This course has been built one feature at a time, the first in 2004. As of 2008, four of possibly features are installed.

B. CONSTRUCTION DOCUMENTS

The Town's Engineering Department had sealed drawings in its possession in 2010.

Designer: Gary Lacy, P.E.
See Attachment A for drawings included in 404 Permit Application.[4]

C. CONSTRUCTION METHODS

The constriction involves grouted sloping boulder drops. Initial construction followed by subsequent adjustments in following years.

D. FLOODPLAIN AND HYDRAULIC EVALUATIONS

None found. See Attachment B for FEMA Map.

E. HYDRAULIC DROP

Not included in drawings.

F. DESIGN CALCULATIONS

None found.

G. COURSE LENGTH

The four current drops create a park that measures nearly 6,500 feet.

"A new expansion to the South Main River Park will make it the longest whitewater park of its kind in the country." *www.colorado.com,* 3-5-08.

H. CONSTRICTION WIDTHS

Estimated to be 50-60 feet (design drawings are not drawn to scale).

I. PHOTOGRAPHS

See Buena Vista Site Photos.

Downtown Hole 2200 cfs prior to modification, 6/06

4. WATER AND STREAMBED REQUIREMENTS AND PERFORMANCE

A. PERMITS

A 404 Permit application was submitted to open ACOE File No. 200400658 and subsequently withdrawn in the face of a need for the Bureau of Land Management Environmental Assessment. A second permit application was submitted upon completion of the EA and Permit 200500536 was awarded October 24, 2005. Two years later to the day a three year extension was authorized to extend the project period from December 31, 2007 to December 31, 2010.[5]

B. RICD INFORMATION

Time Period	March 15-Thursday before the Last Monday in May	Friday before the Last Monday in May – June 30	July 1 – August 15	August 16 – November 15
Flow (cfs)	250	700-1800 adjustable	700	250

The adjustable rate for the "High Flow Period" (Friday before the Last Monday in May through the end of June) is determined the by Applicant at its sole discretion, in consultation with the City of Salida and the Town of Buena Vista.

On or before April 1each year, the County shall notify in writing the Division Engineer, and any party that has requested such notice, of

1) *Event Days - 8 days in June during the High Flow Period when the water rights for the RICD shall be 1,800 cfs*
2) *30-Day Period - up to 30 consecutive days within the High Flow Period during which RICD rights shall be limited to 1,400 cfs, except for the 8 Event Days which shall fall within that 30-Day Period.*

Event Days to not need to be consecutive, but most occur on days when boating events are scheduled for one or both Boating Parks and /or on any day preceding such events, and must occur in the month of June. During the remainder of the High Flow Period that is not part of the 30-Day Period, the RICD water rights shall be limited to 700 cfs.

Once the Event Days and the 30-Day Period are designated for a given year, they are not subject to change regardless of available flows. If written notice is not provided to the Division Engineer by the dates provided above, the Division Engineer is not required to honor a call placed by the County for the 30-Day Period and the Event Days for that year. The above water rights are absolute for both structures at the Salida Park and Structure No. 1 at the B.V. Park, and are conditional for Structure Nos. 2-4 at the B.V. Park.

The County has committed to implement Reduced RICD Calls to facilitate Recovery Year Exchanges and Limited Future Exchanges.

Limited Future Exchanges - the Reduced RICD Call shall not be required to drop below 1200 cfs during the 30-Day Period that is not one of the 8 Event Days (whose flow remains at 1800 cfs). Recovery Year Exchanges - the Reduced RICD Call shall not be required to drop below 1500 cfs during the 8 Event Days and 1,000 cfs during the remainder of the 30-Day Period, except for Saturday and Sundays during the 30-Day Period that are not Event Days, during which the Reduced RICD Call for Recovery Year Exchanges shall not be required to drop below 1100 cfs.[7]

See Attachment C for further an expanded discussion about Reduced RICD Calls.

C. FLOW RECORDS, GAUGES

Water flow is monitored at USGS Station # 07091200, Arkansas River Near Nathrop,

Colorado: http://waterdata.usgs.gov/usa/nwis/uv?site_no=07091200. The RICD water right is administered at the Colorado Department of Water Resources (DWR) gage near Wellsville (ARKWELCO), www.dwr.state.co.us/SurfaceWater/data/detail_graph.aspx?ID=ARKWELCO.

D. WATER MANAGEMENT IMPACTS

Concern was expressed around the potential negative impact dewatering of the river during construction and about the use of grout.[7] There has been no documented negative result of the park construction. There could be water management issues with exchanges through this reach of the Arkansas River in the future; however, because the final decree included certain terms and conditions, significant water management issues may be avoided.

E. MODIFICATION, FAILURES AND REPAIRS

The second feature as originally installed created an overly retentive hydraulic and modification was necessary. Modifications were made in the fall of 2006 and additional modifications have been implemented since. The latest notice regarding modifications – March, 2008:
http://coloradokayak.blogspot.com/2008_03_01_archive.html
Two additional features are planned for construction by spring, 2010. These are downstream from the four features in place and complete the master planned whitewater park expansion.

F. SEDIMENTATION ISSUES

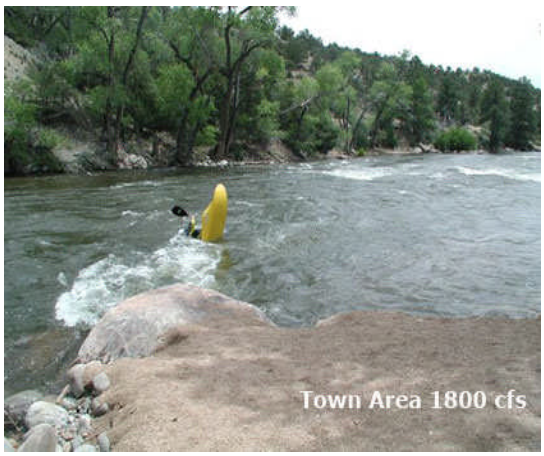
None publicly recorded.

5. ECONOMIC DEVELOPMENT INTENTION AND PERFORMANCE

A. INTENDED USES

The decreed beneficial uses for the RICDs at each structure in the Park(s) are boating, kayaking, tubing, rafting, floating, and canoeing. The following excerpts are from the website of a kayaking retailer in Buena Vista, Colorado Kayak Supply:

Uptown Wave
Optimal Flows: 500-2000 cfs
This is the original wave/hole that was constructed in 2002. It is located just upstream of the Whipple or Midland Trail Bridge at the end of E. Main St. The boat ramp provides easy access to large eddies and is a popular rafting put in and take out. The feature is dynamic and has some power to it. It looks bigger than its bite and always will wash you out and has a large recovery area for rolling



Midtown Wave

Optimal Flow 300-1000 cfs

This friendly surfer is located 1/4 mile downstream of the Uptown Hole and… is a river wide feature that is great for beginner and intermediate play boaters. There is a great viewing area and is the starting point of the new river trail that leads down from the Midtown Wave.

Town Area

Optimal flow: 200 cfs and greater

Below Midtown you will find some incredible new large and pocket eddies…a great training area for attaining, eddy drills, rolling practice, ferrying, etc. A few hundred yards down … two river wings that jet into the current from both river bank help accelerate the water to the center of the river, where a large island of rock is located creating a fun foam pile for surfing, spinning and cart wheeling.

Downtown Hole

Optimal flows 200-900 cfs

This hole is located at the South Main Town Square and is accessible by boat from the Uptown or Midtown features, by foot on the river trail, or by car if you drive into the South Main Neighborhood off of E Main St. The Downtown Hole is the most obvious and powerful hole in the Buena Vista River Park. It is river wide and is retentive at all levels. As the water rises above 1000 cfs the hole gets stickier (very retentive) so beware.[8]

B. ECONOMIC USAGE STUDIES

None found.

C. EVENTS

Freestyle event will be last of a week long series of paddling-oriented events in late May (2008 – Year I) to kick off the annual high water season (June)

D. RECENT DEVELOPMENT IN VICINITY

South Main River Park is a forty-one acre green, walkable residential development set beside the river, owned by professional kayaking siblings Jed and Katie Selby.
http://www.southmainco.com/river-park.asp

6. OTHER

Found at the end of Main Street, the whitewater park, which will serve as the future centerpiece to the South Main Project, is excellently designed by the Selby's and company … CKS employees sneak it in on their lunch break and an occasional night session creates a constant flow of paddlers playing the features that run all summer long.[9]

7. REFERENCES

1. *Chaffee Finding of Fact, Conclusion of Law and Decree*, 3.
2. Drawing, South Main River Park, Buena Vista, Colorado, Credit: Whitewater Design, March 19, 2004.
3. "Adventure by Design," *Outside Magazine*, August, 2005.
4. *200500536 Public Notice with Design Sketches.*
5. ACOE Documents: *200400658 Permit Withdrawal Approval, 404 Permit Application, ACOE Permit 200500536, 200500536 Yr Permit Extension.*
6. Chaffee_*Finding of Fact, Conclusion of Law and Decree of the Water Court*, October 20, 2006, 4-6.
7. *Comments CDNRDOW*
8. http://www.coloradokayak.com/Buena_Vista_Playpark.html
9. *Whitewater of the Southern Rockies,* Kyle McCutcheon and Evan Stafford, "BV Park and Beginner" Section, np.

Attachment A

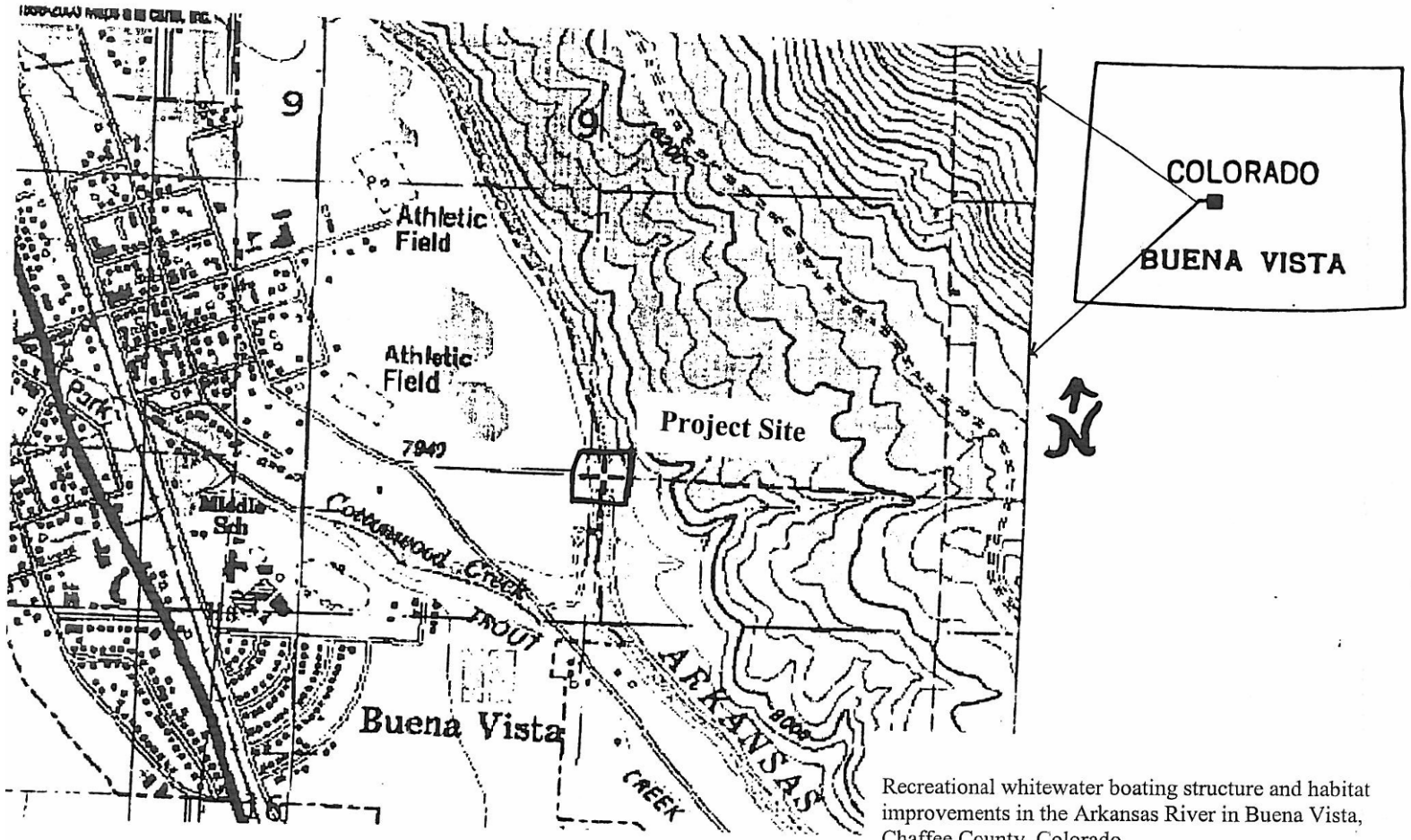
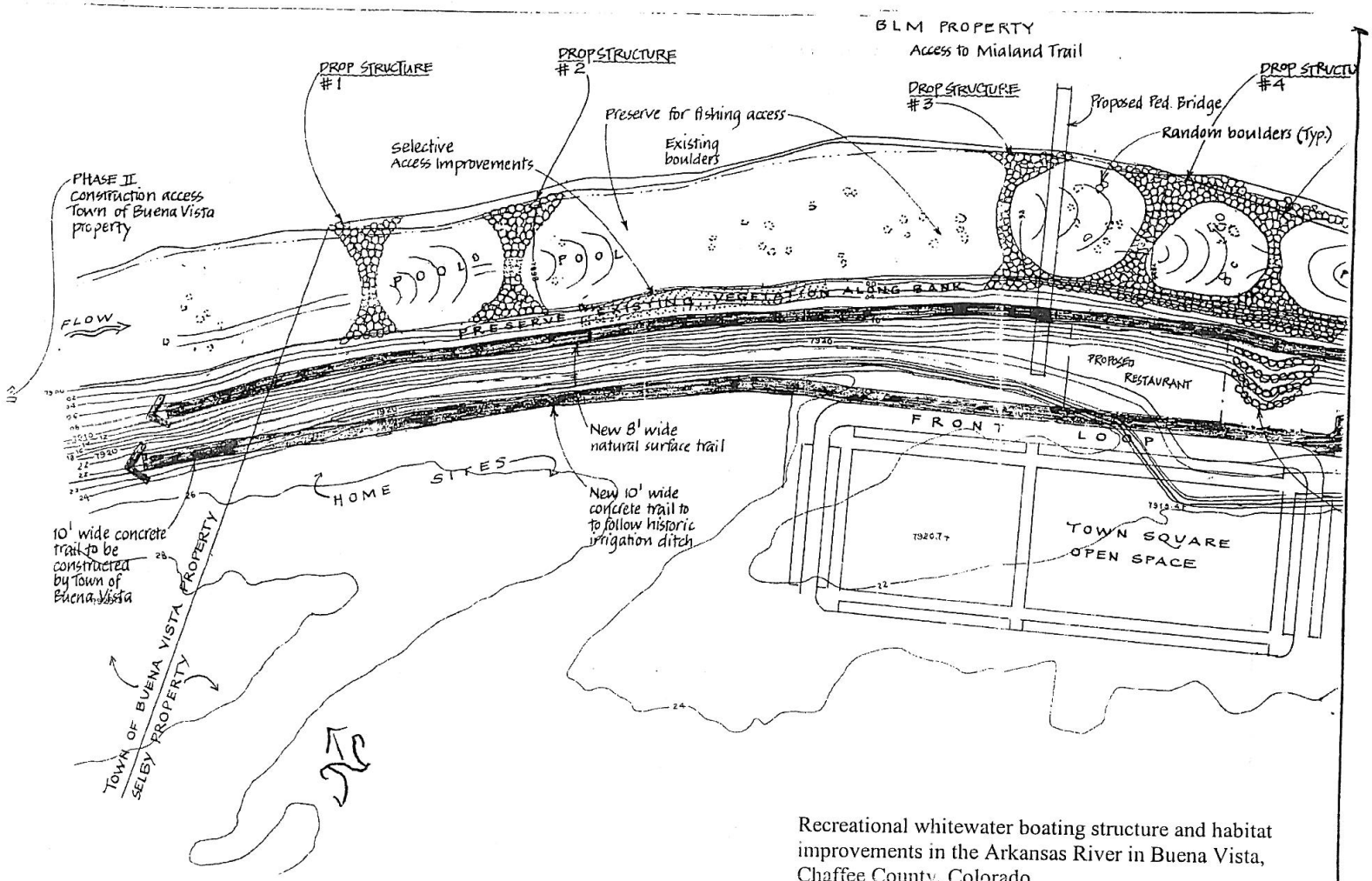


Figure 1 **Vicinity**

Recreational whitewater boating structure and habitat improvements in the Arkansas River in Buena Vista, Chaffee County, Colorado

Application by: Town of Buena Vista
Application No. 200500546

Sheet 1 of 7 Sept 2, 2005



Overview A

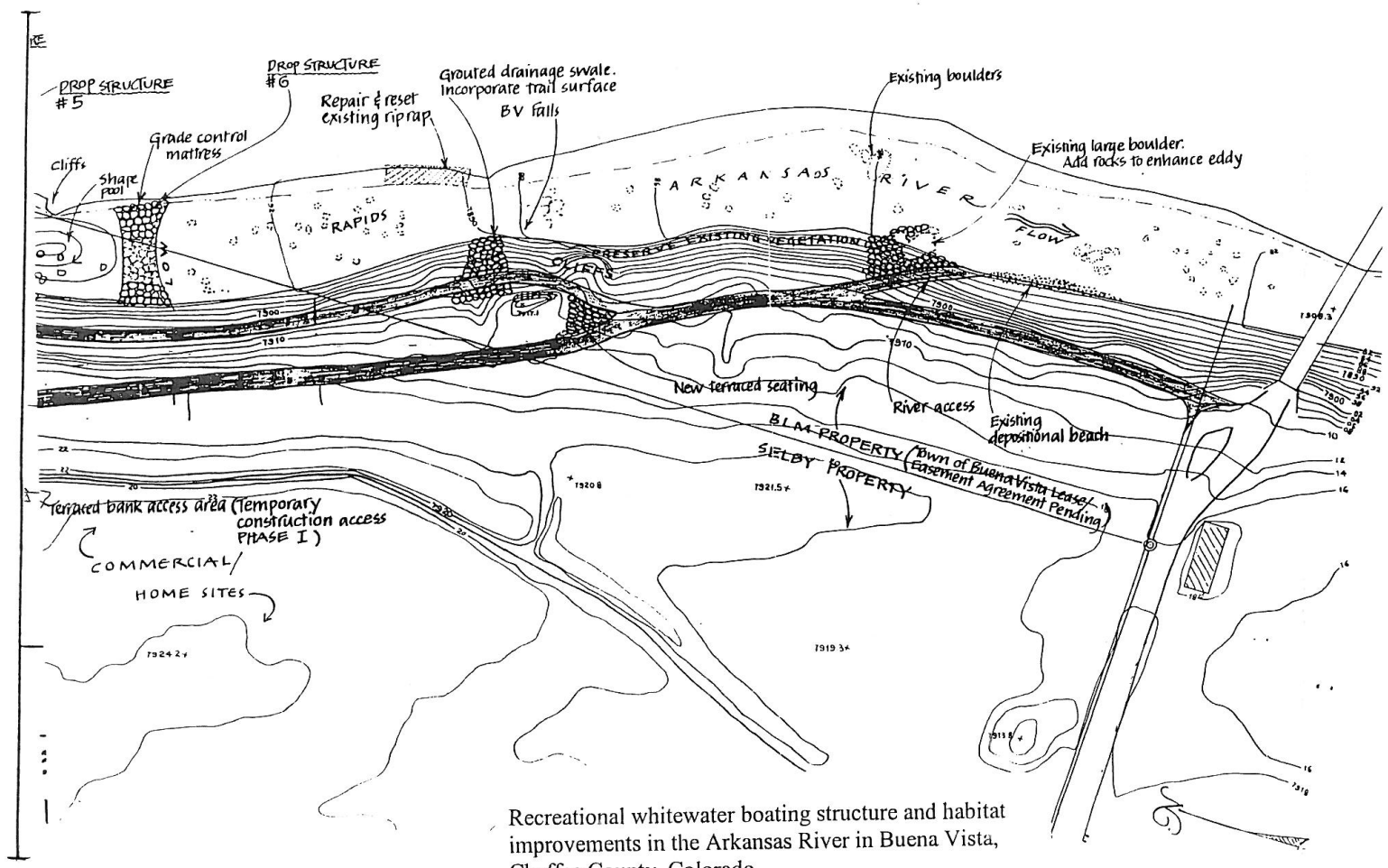
NTS

Recreational whitewater boating structure and habitat improvements in the Arkansas River in Buena Vista, Chaffee County, Colorado

Application by: Town of Buena Vista
Application No. 200500546

Sheet 2 of 7

Sept 2, 2005



Overview B

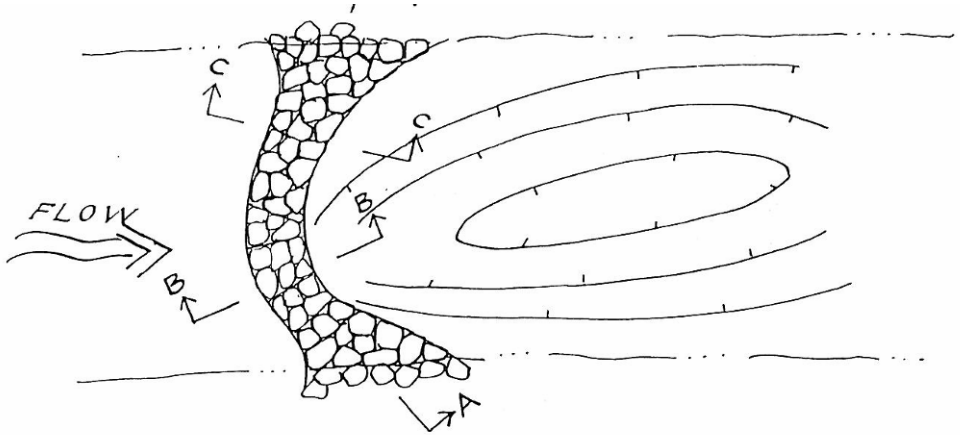
NTS

Recreational whitewater boating structure and habitat improvements in the Arkansas River in Buena Vista, Chaffee County, Colorado

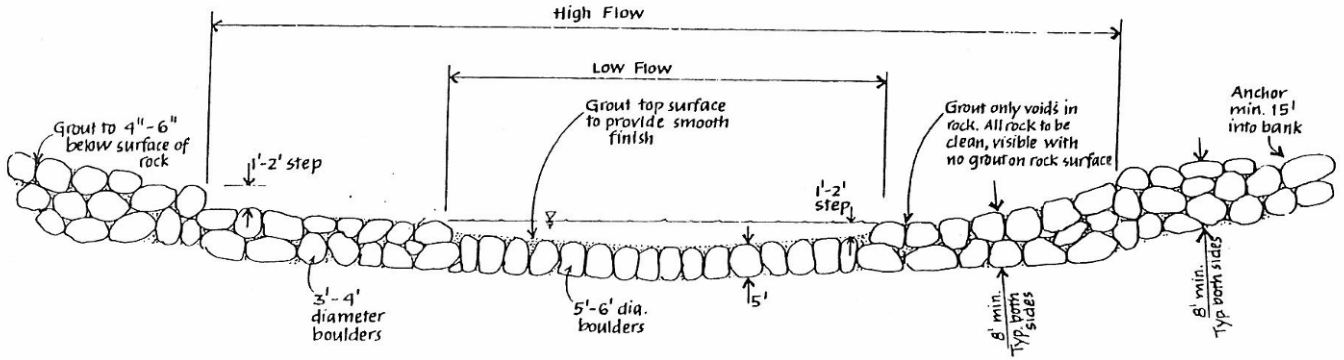
Application by: Town of Buena Vista
Application No. 200500546

Sheet 3 of 7

Sept 2, 2005



TYPICAL DROP STRUCTURE
NO SCALE



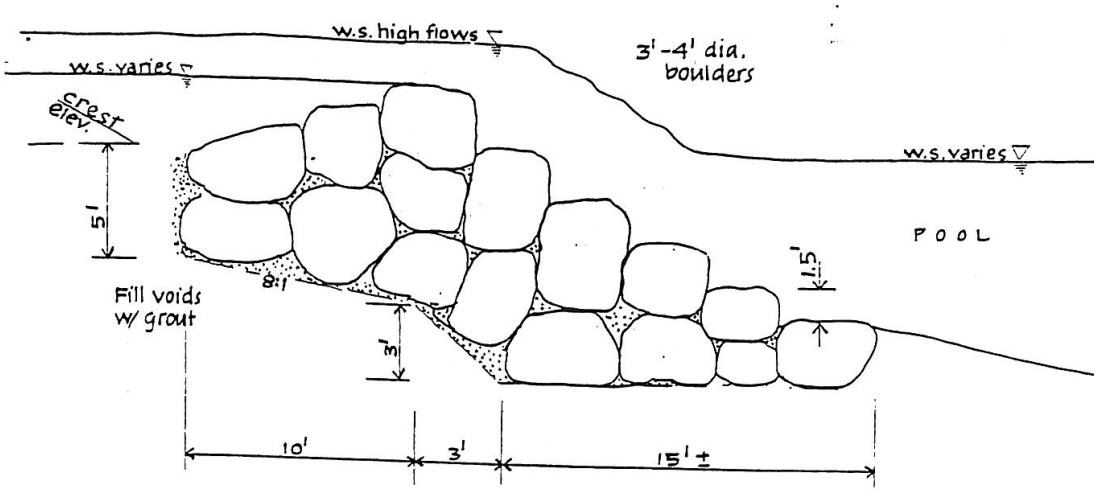
TYPICAL CROSS SECTION DROP STRUCTURE BANK TO BANK
Looking downstream. No scale A-A

Typical Drop Structure

Recreational whitewater boating structure and habitat improvements in the Arkansas River in Buena Vista, Chaffee County, Colorado

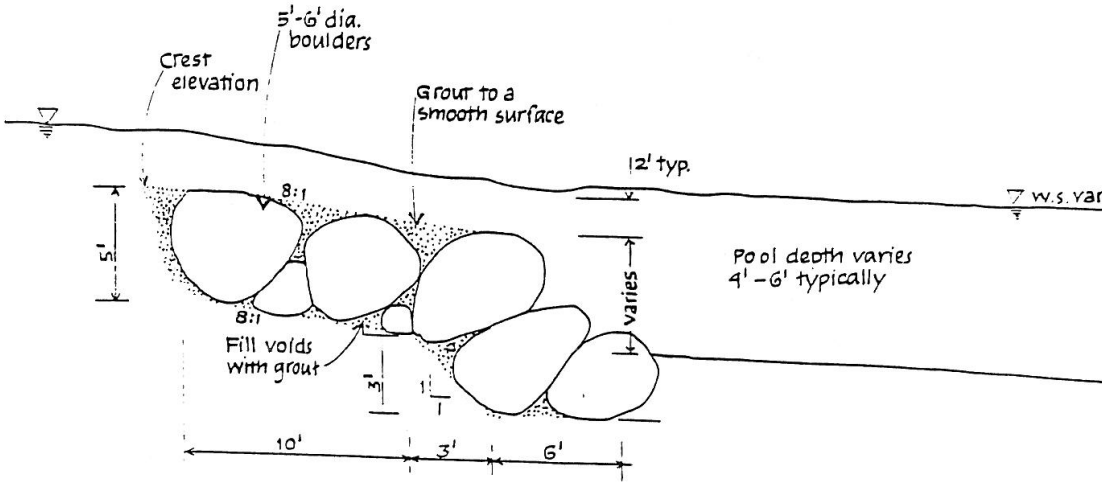
Application by: Town of Buena Vista
Application No. 200500546

Sheet 4 of 7 Sept 2, 2005



TYPICAL SECTION OF ROCK BEYOND DROP STRUCTURE OPENING, C-C

NO SCALE



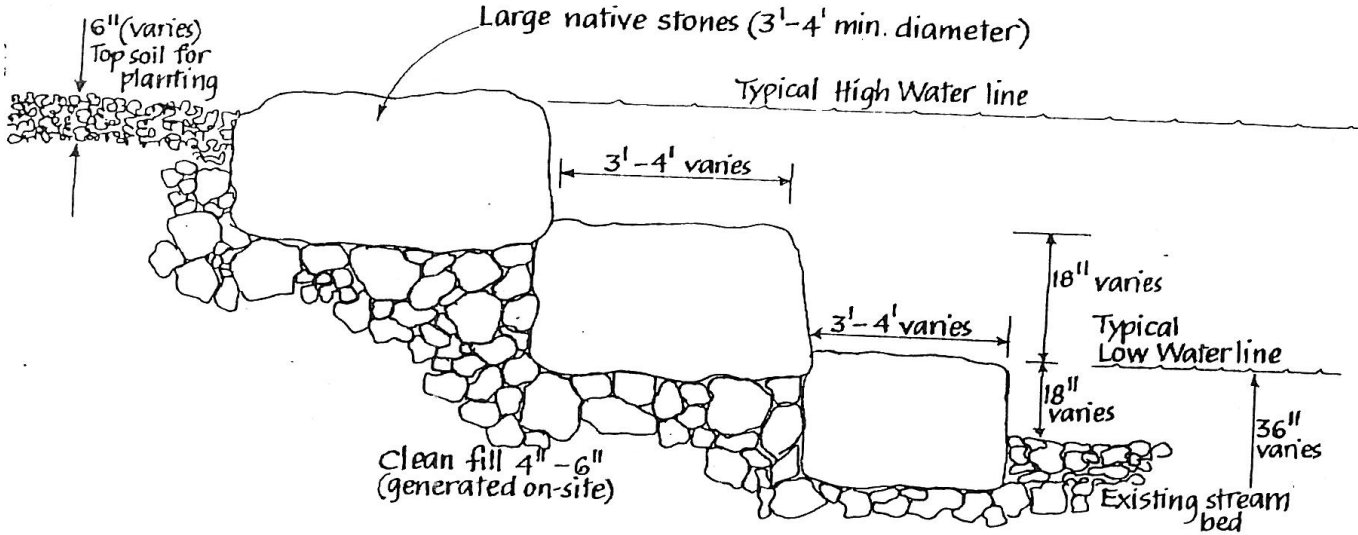
TYPICAL ℄ PROFILE VIEW OF DROP STRUCTURE, B-B AT OPENING

NO SCALE

Cross Section Views

Recreational whitewater boating stru
improvements in the Arkansas River
Chaffee County, Colorado

Application by: Town of Buena Vist
Application No. 200500546



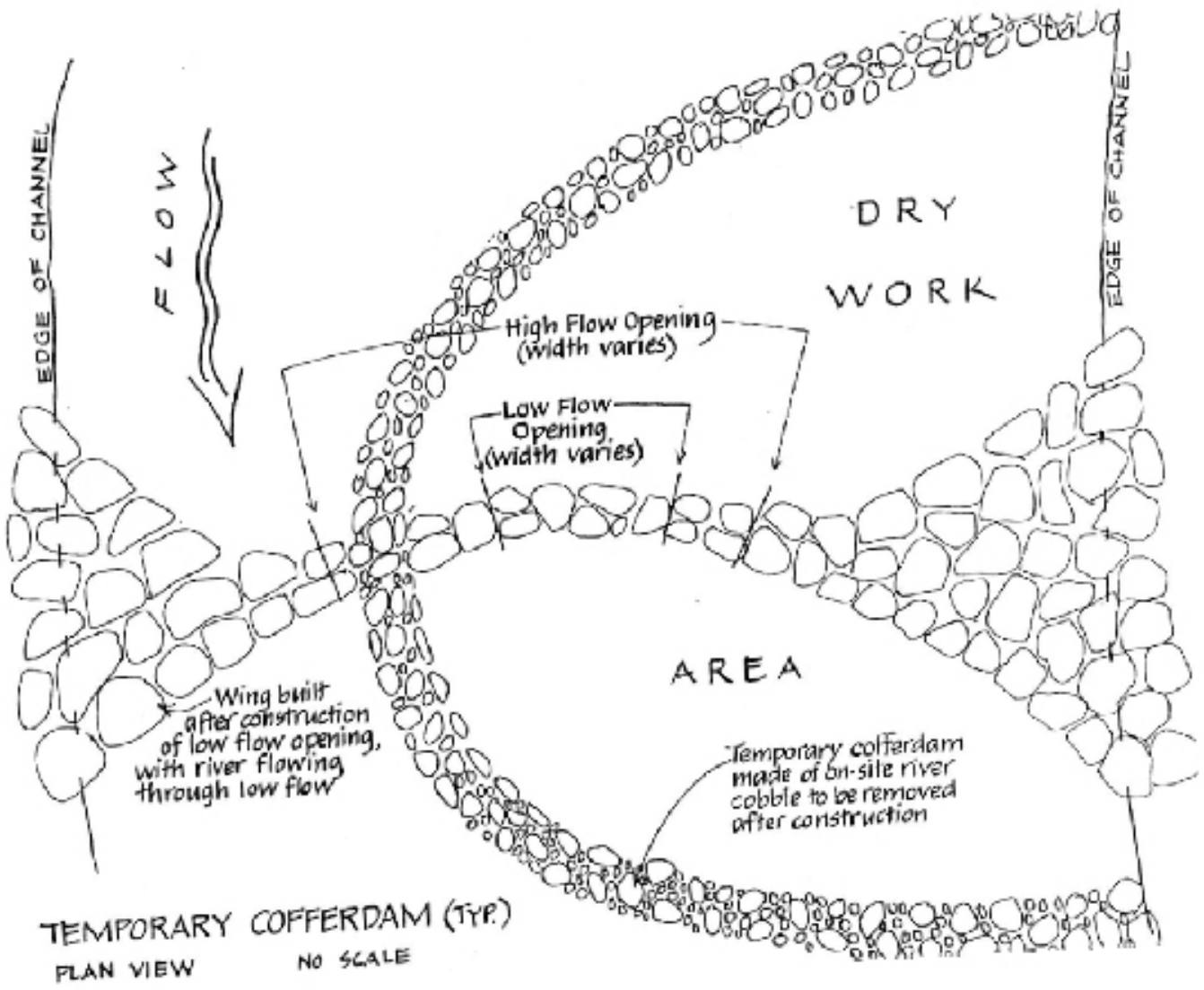
TYPICAL CROSS SECTION BANK TERRACING no scale

Bank Terracing

Recreational whitewater boating structure and habitat improvements in the Arkansas River in Buena Vista, Chaffee County, Colorado

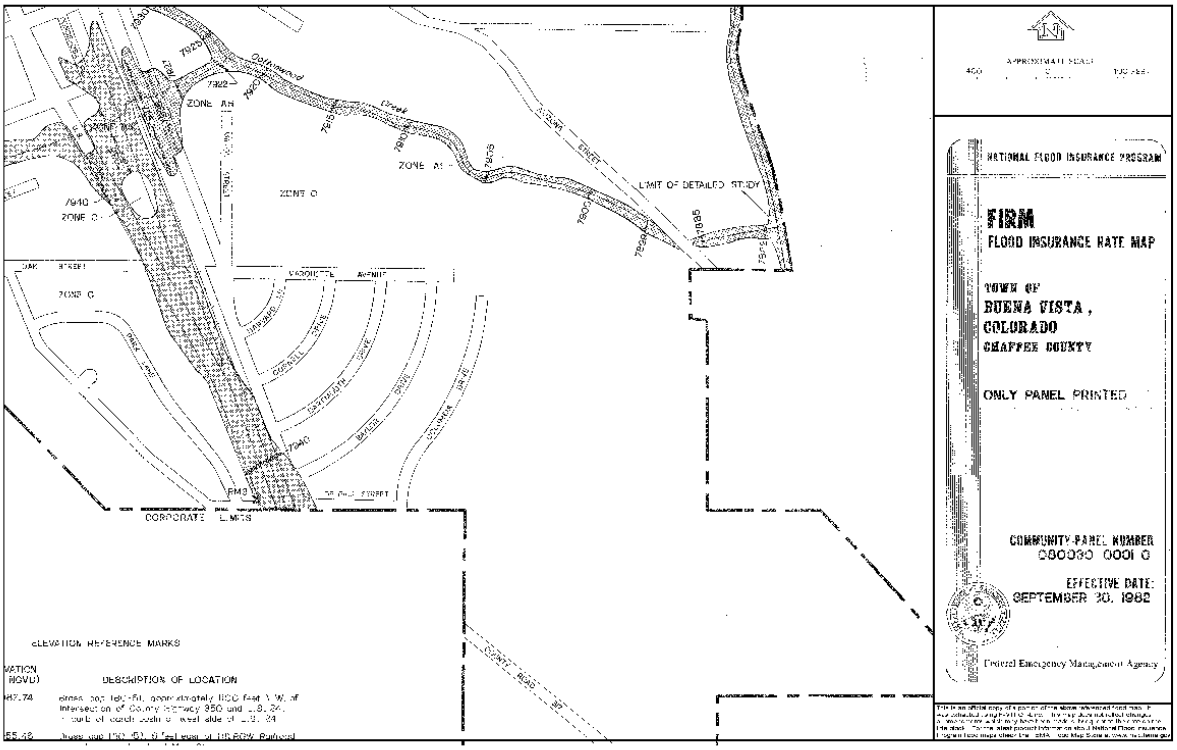
Application by: Town of Buena Vista
Application No. 200400546

Sheet 6 of 7 Sept 2, 2005


EDGE OF CHANNEL
FLOW
DRY
WORK
AREA
EDGE OF CHANNEL
High Flow Opening
(width varies)
Low Flow
Opening
(width varies)
Wing built
after construction
of low flow opening,
with river flowing
through low flow
Temporary cofferdam
made of on-site river
cobble to be removed
after construction
TEMPORARY COFFERDAM (TYP.)
PLAN VIEW
NO SCALE

Attachment B

Buena Vista FEMA Map



Attachment C

Chaffee County RICD Decreed "Reduced RICD Calls" – Detail

10. Reduced RICD Calls. By settlement agreement, the County has agreed that under certain defined circumstances, it shall reduce its call under the RICD water rights decreed herein in order to facilitate certain future exchanges by some of the Objectors ("Reduced RICD Calls"), as further described below. Circumstances requiring Reduced RICD Calls are (a) certain water shortfall conditions requiring exchanges in addition to existing senior rights in order to refill depleted reservoirs ("Recovery Year Exchanges"); and (b) certain limited exchanges currently anticipated to be necessary to allow for future water supply needs upstream and downstream of the Boating Parks (referred to herein as "Limited Future Exchanges"). The specific circumstances in which the County has agreed to implement Reduced RICD Calls to facilitate Recovery Year Exchanges and Limited Future Exchanges, as well as the conditions and limitations placed upon such exchanges and reduced calls, are more specifically set forth in the Memorandum of Understanding between many of the parties hereto, dated July 24, 2006 ("MOU"), a copy of which is attached to this Decree as Exhibit C, and in separate stipulations between Applicant and certain Objectors.

The Court hereby incorporates herein paragraphs 2 - 5 of the MOU and the aforementioned separate stipulations, so that under the defined circumstances set forth therein, and subject to the conditions and limitations contained therein, the County shall be required to implement Reduced RICD Calls to the extent necessary in order to help facilitate the Recovery Year Exchanges and Limited Future Exchanges. For Limited Future Exchanges, the Reduced RICD Call shall not be required to drop below 1200 cfs during the 30-Day Period that is not one of the 8 Event Days (Events Days remain at 1800 cfs). For Recovery Year Exchanges, the Reduced RICD Call shall not be required to drop below 1500 cfs during the 8 Event Days and 1000 cfs during the remainder of the 30-Day Period, except for Saturdays and Sundays during the 30-Day Period that are not Event Days, during which the Reduced RICD Call for Recovery Year Exchanges shall not be required to drop below 1100 cfs.

The Reduced RICD Call for Limited Future Exchanges and Recovery Year Exchanges is not cumulative, so that even if Limited Future Exchanges and Recovery Year Exchanges are both being operated at the same time by multiple entities, the County shall never be required to call for less than 1500 cfs for Event Days or less than 1100 cfs on weekend days during the 30-Day Period that are not Event Days, or less than 1000 cfs for the remainder of the 30-Day Period that is not an Event Day or weekend day. Exchange capacity made available by the Reduced RICD Call shall be available to any water user in priority.

The Court finds the above compromise both reasonable and practicable in addressing the concerns of water supply providers while reasonably protecting the recreational use and values sought to be protected by the RICDs. The Court recognizes that the State and Division Engineer are not a party to the MOU or to the separate Stipulations and those documents are only incorporated herein with respect to operation of the Reduced RICD Call for Limited Future Exchanges and Recovery Year Exchanges. In order for the Division Engineer to administer the Reduced RICD Call, the Applicant shall provide written notice to the Division Engineer of the Reduced RICD Calls and any changes to the Reduced RICD Call that may occur during the 30-Day Period in a timely fashion.

CONFLUENCE PARK ON THE SOUTH PLATTE RIVER

1. BACKGROUND INFORMATION

The whitewater course at Confluence Park near Downtown Denver is a multi-use structure with the primary purpose of providing cooling water for a downstream power plant.

Originally constructed in 1975, this was the first whitewater recreational facility designed in an active river in the United States. Despite its initial success as a multiple use diversion and whitewater recreation amenity, urban encroachment continued to reduce the capacity of the river channel. While other sections of the river could weather a 19,400 cfs 100 year flood event, this reach began to overflow at events slightly greater than the 10 year flood level.[1]

In 1995 the facility was reconstructed to lower the upstream floodplain to allow development in this area immediately west of Denver. The whitewater course, dam, and intake were all entirely redesigned and replaced. The new dam includes a low-hazard step design – one of the first in the country, and the whitewater course includes a series of relatively small drops and tightly spaced eddies which form a bypass around the dam. The venue forms the hub of the Riverfront Park and recreational trails in the Denver Metropolitan area.

Unless otherwise noted, the information contained below was authored by Rick McLaughlin, P.E., design engineer for the current whitewater course (1995).

A. LOCATION

South Platte River, Denver, CO Section 33, T36, R68w. the approximate latitude is N39 degrees, 45 minutes, 16 seconds and the approximate longitude is W105 degrees, 0 minutes, 30 seconds.

B. OWNER/OVERSIGHT

Owner: Ownership of the various project elements is not entirely clear. The City of Denver Parks Department, the Denver Water Department, the Greenway Foundation, and the Urban Drainage and Flood Control District (UDFCD) are all involved in this facility.

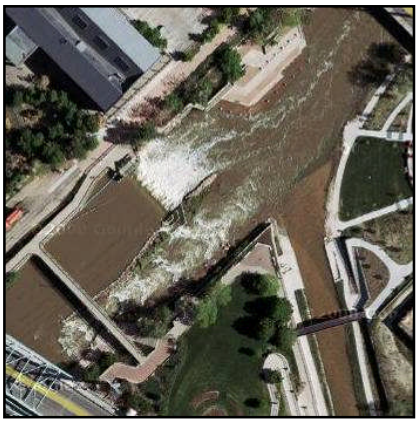
Steward: All those entities listed above. The Greenway Foundation actively promotes this and the entire South Platte River corridor.

Maintenance Responsibility: All those entities listed above. The role of the Urban Drainage and Flood Control District (UDFCD) includes primarily in-river maintenance duties.

City of Denver maintains the land-based aspects of the park related maintenance, UDFCD takes care of in-river maintenance, and Denver Water Department manages diversion-related aspects.

C. COST

Construction of whitewater course was completed as part of a larger project and it's cost was not separately tracked. However, its construction cost was estimated at the time (based upon bid unit costs) to be approximately $1,200,000 (1995 dollars)



D. COMPLETION DATE

The initial configuration was completed in the mid-1970's.
The present configuration was completed spring, 1996.

2. SAFETY ISSUES/ACCIDENT REPORTS

No fatalities or serious accidents known by author or project stewards.

3. DESIGN/CONSTRUCTION DOCUMENTS & DRAWINGS

A. PRELIMINARY DESIGN

Wright McLaughlin Engineers completed original, sealed design in the mid 1970s. A preliminary evaluation was completed by McLaughlin Water Engineers in 1989.

B. CONSTRUCTION DOCUMENTS

For the existing course:
Engineer of Record – Richard McLaughlin
McLaughlin Water Engineers completed the design on the entire current facility in the early 1990s. Partial plans are included in Attachment A. See accompanying final plans in Confluence Park References: *Confluence Park 1995 Plans.*

C. CONSTRUCTION METHODS

Large grouted boulders, sheet pile cut-offs, formed concrete inverts.

Confluence Park prior to the Initial Park Project

D. FLOODPLAIN AND HYDRAULIC EVALUATIONS

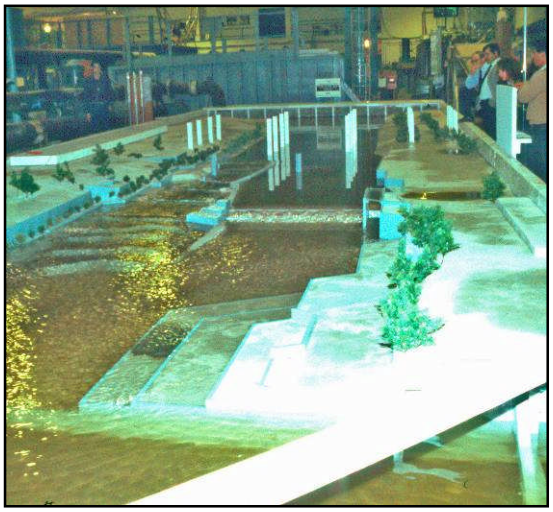
Detailed HEC –II model included in reach is available from UDFCD.
Extensive physical modeling was conducted at Colorado State University; computer hydraulic modeling: HEC-II models, and momentum models were included.

E. HYDRAULIC DROP

The course drops eight feet during lower flows. While this decreases at flood flows, the course remains active throughout the 100-year event.

F. DESIGN CALCULATIONS

See Section 3d.



Physical Model conducted at Colorado State University

G. COURSE LENGTH

The bypass extends 400 feet through upper section adjacent to dam.

The entire permitted project extended between mile 319.7 (15th Street Bridge) and mile 321.5 (8th Avenue Bridge). The work actually occurred between the 15th Street Bridge and the I-25 Bridge, reducing the reach by about 50%.[2]

H. CONSTRICTION WIDTHS

The constriction width varies, but typically measures 15 feet.

I. PHOTOGRAPHS

Included in Confluence Park Site Photos

4. WATER AND STREAMBED REQUIREMENTS AND PERFORMANCE

A. PERMITS

Permit 199175982 was allowed to expire, despite a request for a one year extension requested May 22, 1996, and subsequent minor improvements were covered by Nationwide Permit 199680634.[3]

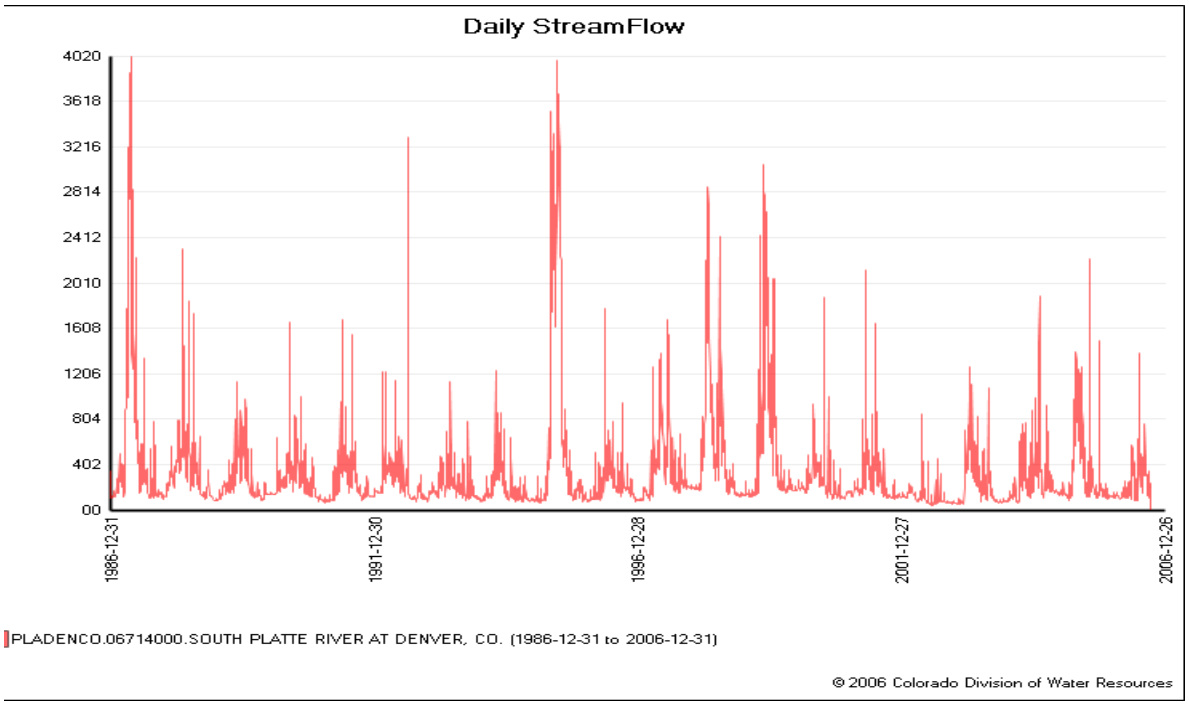
Amendment 1 - The original 404 permit expired November 30, 1994. A one year extension was approved to allow for a delay in the move of Elitch's Park, which opened in spring, 1995.
Amendment 2 authorized the construction of an access road necessary for construction.
Amendment 3 authorized the creation of a temporary instream settling pond along the left bank of the South Platte River upstream of the 15th Street Bridge.
Amendment 4 extended the permit expiration to May 31, 1996, a revision to the project location description, and the related impact on the projected wetlands impacts.

ACOE concurred with the Urban Drainage and Flood Control District that an additional permit would not be required to remove "accumulated sediment in the boat chutes at the confluence."[4]

B. RICD INFORMATION

No application was submitted.

FLOW RECORDS, GAUGES



20 Years of Record, note that this gage includes flows from Cherry Creek.

Note: Only a fraction of the flow in the Platte River is diverted through the whitewater course. The remainder flows over the dam, through a gate, or into the diversion.

SOUTH PLATTE RIVER AT DENVER (PLADENCO)
Data Source: Corps of Engineers (Station cooperator)
Division: 1 ; Water District: 8 ; Denver, CO

Location - Lat. 39°45'35", Long. 105°00'10", in NW¼SE¼ sec. 28, T.3 S., R.68 W., Denver County,

Hydrologic Unit 10190003, on right bank 90 ft Upstream from Nineteenth Street Bridge in Denver and 0.4 mi downstream from Cherry Creek. Drainage Area and Period of Record - 3,861 mi². May 1889 to Oct. 1890 sporadic record. July 1895 to current year continuous. Monthly data only for some periods.

This gage includes flows from Cherry Creek, so accurate flow estimates should subtract this .

C. WATER MANAGEMENT IMPACTS

The facility is designed to operate with minimal existing low flows. These are typically in the range of 50 to 150 cfs. The primary objective of the course is to divert water to the gravity diversion.

Portions of river flow are routed through a sluice gate and to the diversion. At river flows above approximately 200 cfs, flow is routed over the adjacent stepped dam.

D. MODIFICATIONS, FAILURES AND REPAIRS

Analysis of data gathered from three years of monitoring and conducting annual compliance inspections on this project showed that the Lower South Platte Improvement project had improved the riparian environment around the dredged, re-channelized and stabilized confluence of Cherry Creek and the South Platte River. Based on the progressively improved condition of the wetland shrub beds, willow staking, riparian tree and shrub re-planting and grass seeding the Corps of Engineers saw no need to continue the annual monitoring.[5]

No failures or feature movements have been reported. Adjustment/modifications included one-time modification of three boulders. No in-river maintenance other than sediment removal in three pools in 2007.

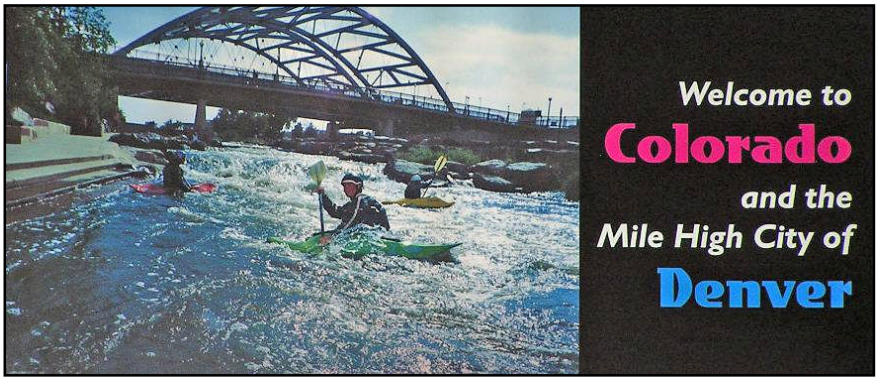
E. SEDIMENTATION ISSUES

Some sediment accumulates in the lower pools; however the pools generally flush and self-scour after reaching equilibrium. Removal of sediment in several drops was conducted once in the past twelve years.

5. ECONOMIC DEVELOPMENT INTENTION AND PERFORMANCE

A. INTENDED USES

Uses include continuous boating of the reach and destination-oriented kayaking, and tubing. Most users of the facilities are spectators. During the summer months the course is used mostly by swimmers and tubers.



B. ECONOMIC AND USAGE STUDIES

No formal economic studies have been completed. However, the Greenway Foundation estimates that over four billion dollars of economic development has occurred in the reach since the redevelopment of Confluence Park in 1995. While this extensive redevelopment is due to a number of factors, this whitewater park probably represents the greatest example of impact on adjacent economic redevelopment in the nation.

C. EVENTS

Regional freestyle and minor slalom events have been conducted.

D. RECENT DEVELOPMENT IN VICINITY

Over four billon dollars have returned to the vicinity of Confluence Park: [6]

Private Investment

Coors Field	$ 220 m
Pepsi Center	175 m
Invesco Field	350 m
R.E.I.	35 m
Six Flags Elitch's Gardens	110 m
Aquarium, Children's Museum	120 m
Residential Development	3 billion
Investment to Date	$ 4 billion

6. OTHER

This is an entry in the whitewater river guidebook for kayakers and canoeists, regarding Confluence Park:

Confluence WWP is located in the heart of Downtown Denver, at the focal point of a landscape architect's dream of grassy fields, perfectly placed rocks, and sculpted concrete walkways. A place where kids, young lovers, and white collar workers can escape the high rise world that surrounds them, and spend a few moments eating lunch while basking in the warm spring sun. Beautiful…kind of.

The nicknames hint at the underlying problem to this fairy tale locale – Cons wage, Confluenza, Consludge. The features were originally named Hepatitis A through D and it's been even known as kayaking's cheap hooker, partially due to stolen wallets. Although the judgments are a bit harsh, I have narrowly avoided stepping on a syringe while barefoot, and an immediate shower to flush the eyes, avoid the skin rash and disinfect the body will be necessary. By the same token, the uncomfortably warm waters of Confluence have offered a much needed freestyle session between college classes, to the dismay of my classmates as I returned to class with smelly, wet hair.[7]

7. REFERENCES

1. *404 Permit Application, South Platte River Improvements, 8th Avenue to Cherry Creek, City and County of Denver,* October 2, 1990, 6.
2. *ACOE Permit Extension*, 6.
3. Ibid., 4-25.
4. *UDFCD Permit Not Required,* November, 2006.
5. *Post Construction Inspection,* ACOE Letter to City of Denver, November 23, 2000.
6. *South Platte River Greenway Central Platte Valley Investment Summary,* The Greenway Foundation, October, 2006.
7. *Whitewater of the Southern Rockies,* Evan Stafford and Kyle McCutcheon, 322.

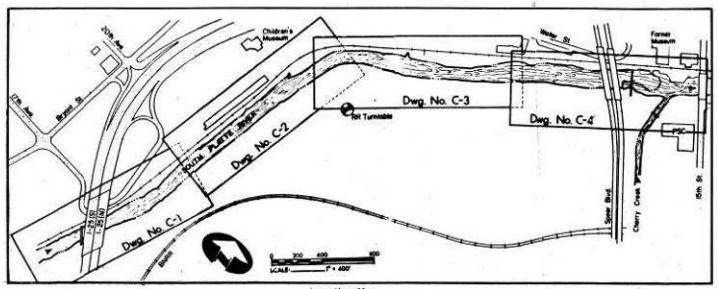
Attachment A

CENTRAL PLATTE VALLEY
SOUTH PLATTE RIVER IMPROVEMENTS
CHERRY CREEK TO I-25

LIST OF DRAWINGS

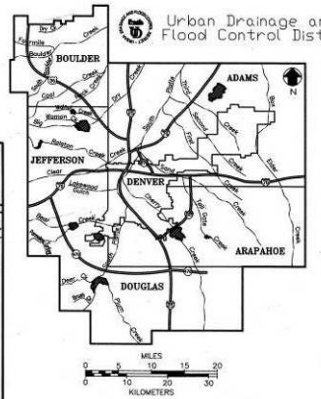
	DRAWING NUMBER	DESCRIPTION
1	A-1	TITLE SHEET
2	A-2	LEGEND, TYP. SECTION & LAYOUT DATA FOR CHANNEL
3	C-1	PLAN AND PROFILE STA. 1302+00 TO STA. 1294+40
4	C-2	PLAN AND PROFILE STA. 1294+40 TO STA. 1280+00
5	C-3	PLAN AND PROFILE STA. 1280+00 TO STA. 1265+00
6	C-4	PLAN AND PROFILE SAT. 1265+00 TO STA. 1251+00
7	C-5	CONFLUENCE PLAN
* 7A	C-5A	CONFLUENCE PLAN – AS RECORDED
8	C-6	CONFLUENCE CROSS SECTIONS
9	C-7	CONFLUENCE DEMOLITION PLAN
10	C-8	WEST BANK PLAN/SECTIONS
**10A	C-8A	WEST BANK PLAN – AS RECORDED
**10B	C-9	STORM SEWER PLAN AND PROFILE
11	G-1	FARMERS AND GARDENERS CONDUIT PLAN AND PROFILE
12	G-2	FARMERS AND GARDENERS CONDUIT DETAILS
13	B-1	BOAT CHUTE PLAN AND PROFILE STA. 0+00 TO STA. 2+00
*13A	B-1A	BOAT CHUTE PLAN AND PROFILE STA. 0+00 TO STA. 2+00 – AS RECORDED
14	B-2	BOAT CHUTE PLAN AND PROFILE STA. 2+00 TO STA. 4+00
*14A	B-2A	BOAT CHUTE PLAN AND PROFILE STA. 2+00 TO STA. 4+00 – AS RECORDED
15	B-3	BOAT CHUTE DETAILS
16	B-4	BOAT CHUTE AND MISCELLANEOUS DETAILS
17	B-5	VAULTS AND MISCELLANEOUS DETAILS
18	B-6	FABRIDAM BASE DETAILS
18A	B-7	VAULT ELECTRICAL PLAN
19	F-1	FABRIDAM PLAN AND DEVELOPED BOLTING
20	F-2	FABRIDAM DETAILS
21	F-3	FABRIDAM CONTROLS
22	F-4	FABRIDAM ELECTRICAL SCHEMATIC
23	P-1	EAST BANK PLAZA PLAN
*23A	P-1A	EAST BANK PLAZA – AS RECORDED
24	P-2	EAST BANK PLAZA DETAILS
25	H-1	HANDRAIL DETAILS
26	H-2	HANDRAIL LAYOUT
27	M-1	MISCELLANEOUS DETAILS
28	M-2	MISCELLANEOUS DETAILS
29	M-3	MISCELLANEOUS DETAILS
30	M-4	MISCELLANEOUS DETAILS
31	W-1	7th ST. WATERLINE–PLAN AND PROFILE
32	W-2	7th ST. WATERLINE DETAILS
33	W-3	7th ST. WATERLINE DETAILS
34	D-1	DAM AND DIVIDER WALL SECTION/DETAILS
35	D-2	EAST DAM ABUTMENT
36	I-1	FARMERS AND GARDENERS INTAKE–PLAN AND SECTIONS
37	I-2	RADIAL GATE
38	I-3	SECTION AND DETAILS
39	S-1	WEST BANK WALLS STRUCTURAL PLAN AND ELEVATION
40	S-2	TYPICAL RETAINING WALL AND WEST BANK WALL SECTIONS
41	S-3	WEST BANK MISCELLANEOUS DETAILS
42	S-4	INTAKE STRUCTURE PLAN
43	S-5	INTAKE STRUCTURE SECTIONS
44	S-6	INTAKE STRUCTURE SECTIONS
45	S-7	INTAKE STRUCTURE WALL SECTIONS AN STOP LOG DETAILS
46	S-8	PARTIAL PLAZA STRUCTURAL PLAN–UPSTREAM
47	S-9	PARTIAL PLAZA STRUCTURAL PLAN–DOWNSTREAM
48	S-10	PLAZA AND MISCELLANEOUS SECTIONS AND DETAILS
49	S-11	PEDESTRIAN BRIDGE PIER SECTIONS AND DETAILS
**49A	S-12	PEDESTRIAN RAMPS
**49B	S-13	PEDESTRIAN RAMP SECTIONS
**49C	S-14	PEDESTRIAN BRIDGE AND RAMP REVISIONS

* DRAWING HAS BEEN REPLACED BY THE FOLLOWING CONSECUTIVE DRAWING AS INDICATED.
** NEW DRAWING ADDED DURING CONSTRUCTION.



Location Map

50	L-1	LANDSCAPE PLAN
51	L-2	LANDSCAPE PLAN
52	L-3	LANDSCAPE PLAN
53	L-4	LANDSCAPE DETAILS
54	L-5	IRRIGATION PLAN
55	L-6	IRRIGATION PLAN
56	L-7	IRRIGATION PLAN
57	L-8	IRRIGATION DETAILS
58	L-9	IRRIGATION DETAILS
59	E-1	STORMWATER MANAGEMENT PLAN
60	E-2	STORMWATER MANAGEMENT PLAN
61	E-3	STORMWATER MANAGEMENT PLAN AND DETAILS



VICINITY MAP

THESE "AS RECORDED" DRAWINGS ARE IN LIEU OF "AS BUILT" DRAWINGS. THE INFORMATION SHOWN IS BASED UPON SOME DATA PROVIDED BY OTHERS.

McLAUGHLIN WATER ENGINEERS, Ltd.
2420 ALCOTT ST. ——— DENVER, CO 80211

CTL/THOMPSON,INC.
EDAW,INC.
N.M. IMBERTSON AND ASSOCIATES, INC.
JORGENSON, HENDRICKSON, CLOSE AND SCHAFER INC.
TAGGART ENGINEERING ASSOCIATES, INC.
THE RMH GROUP, INC.

"AS RECORDED"

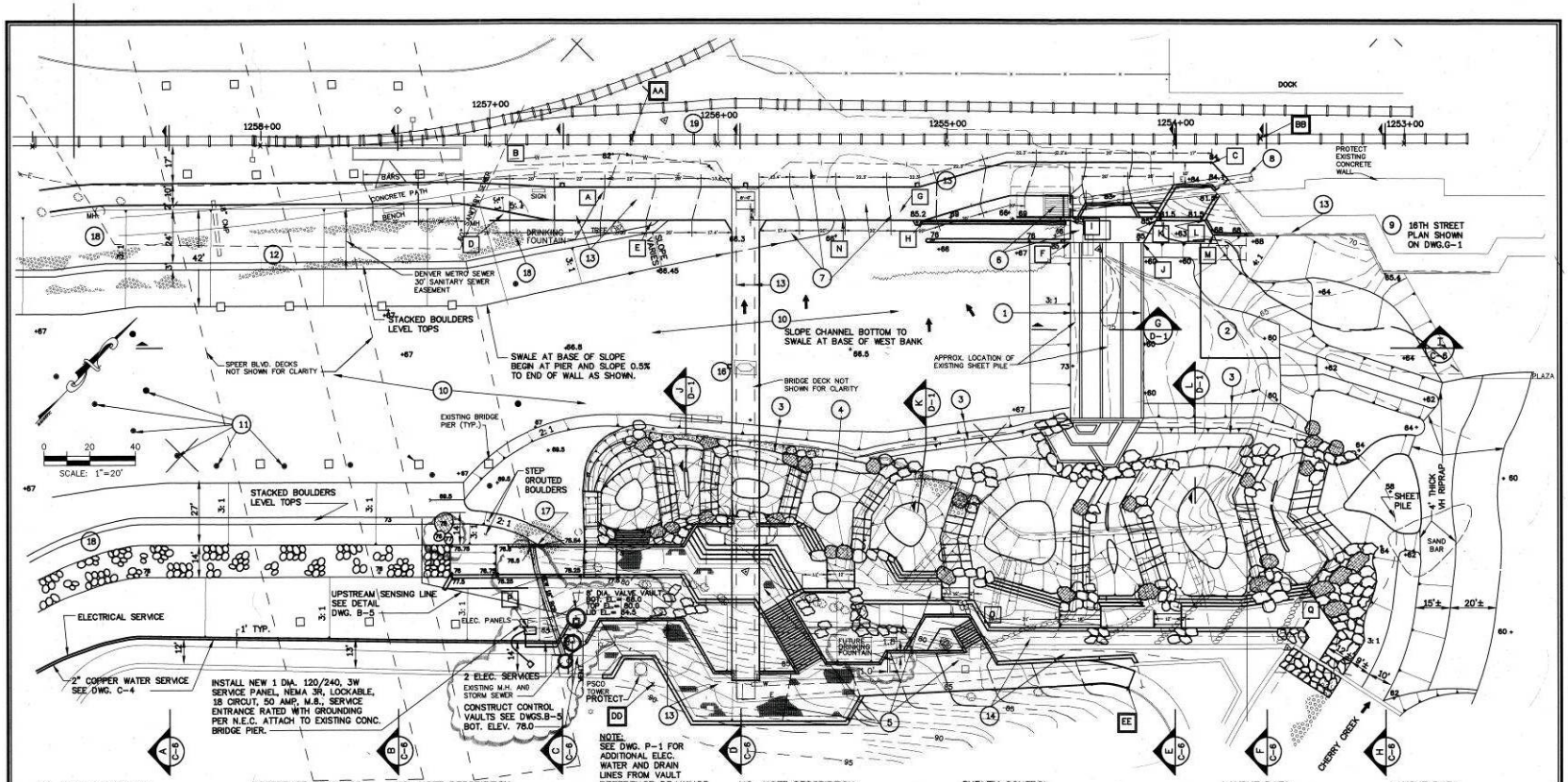
DRAWING NO. A-1

CENTRAL PLATTE VALLEY / CENTRAL PLATTE RIVER IMPROVEMENTS 88-009.01C

CITY AND COUNTY OF DENVER
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

INDEX.DWG

1



NO.	NOTE DESCRIPTION	REFERENCE DRAWINGS
1	CONSTRUCT DAM	D-1, D-2,
2	CONSTRUCT STILLING BASIN AND RELATED CHANNEL WORK	C-6
3	CONSTRUCT UPPER AND LOWER DIVIDER WALLS	C-6, D-1
4	CONSTRUCT BOAT CHUTE	B-1, B-2, B-3, B-4, B-6, P-1, S-11, F-1, F-2, F-3, F-4
5	CONSTRUCT EAST BANK PLAZA	P-1, P-2, S-8, S-9 S-9, S-10
6	CONSTRUCT FARMERS AND GARDENERS INTAKE STRUCTURE	I-1, I-2, I-3, S-1, S-4, S-5, S-6, S-7
7	CONSTRUCT WEST BANK WALLS, TRAIL AND PEDESTRIAN BRIDGE RAMPS	C-8, S-1, S-2, S-3
8	CONSTRUCT FARMERS AND GARDENERS CONDUIT	G-1, G-2
9	CONSTRUCT CONTROL SILL AT 16TH. STREET	G-1, M-3
10	CONSTRUCT GROUTED ROCK, AND GROUTED RUBBLE CHANNEL	C-6, M-3, M-4
11	CONSTRUCT BUOYS	M-2
12	CONSTRUCT SANITARY SEWER ROCK PROTECTION	C-6, M-3, M-4
13	CONSTRUCT HANDRAIL	H-1, C-8 & P-1
14	CONSTRUCT LANDSCAPING WORKS	L-3, L-4
15	CONSTRUCT IRRIGATION WORKS	I-3, I-4
16	CONSTRUCT PEDESTRIAN PIER PROTECTION	S-11
17	CONSTRUCT 24" OUTLET THROUGH WALL	S-3
18	CONSTRUCT RIPRAP WITH PLANTINGS	M-3, M-4

NO.	NOTE DESCRIPTION
19	BASELINE FOR PROJECT IS THE INSIDE OF EASTERLY RAIL OF MAIN RAILROAD LINE.
	18" GROUTED RUBBLE AND ROCK VH RIPRAP
	24" GROUTED STACKED ROCK (LIKE STEPS)
	PLANTED H RIPRAP
	24" GROUTED ROCK (NOT SMOOTH HOLD GROUT DOWN)
	DAM GROUTED ROCK/BOULDERS/(1.5'-5.0')
	LANDSCAPE AREAS
	18" GROUTED ROCK
	M RIPRAP (SOME WITH PLANTING)

ROCK, 10' DIA. OR LARGER

SURVEY CONTROL

BENCH MARK AND HORIZONTAL CONTROL FOR THE CONFLUENCE PARK WORK ARE SHOWN AS ☐ ON THE DRAWING AND ARE AS FOLLOWS:

POINT	ELEVATION	NORTH	EAST
AA	5181.99	153,736.00	2,138,046.54
BB	5182.29	153,927.48	2,138,243.96
CC	5186.23	153,139.50	2,138,446.99
DD	5189.45	153,571.15	2,138,218.19
EE	5181.19	153,713.88	2,138,369.03
FF	5179.13	153,840.21	2,138,504.84

SEE DRAWING NO. C-4 FOR LOCATION OF CC & FF

LAYOUT DATA

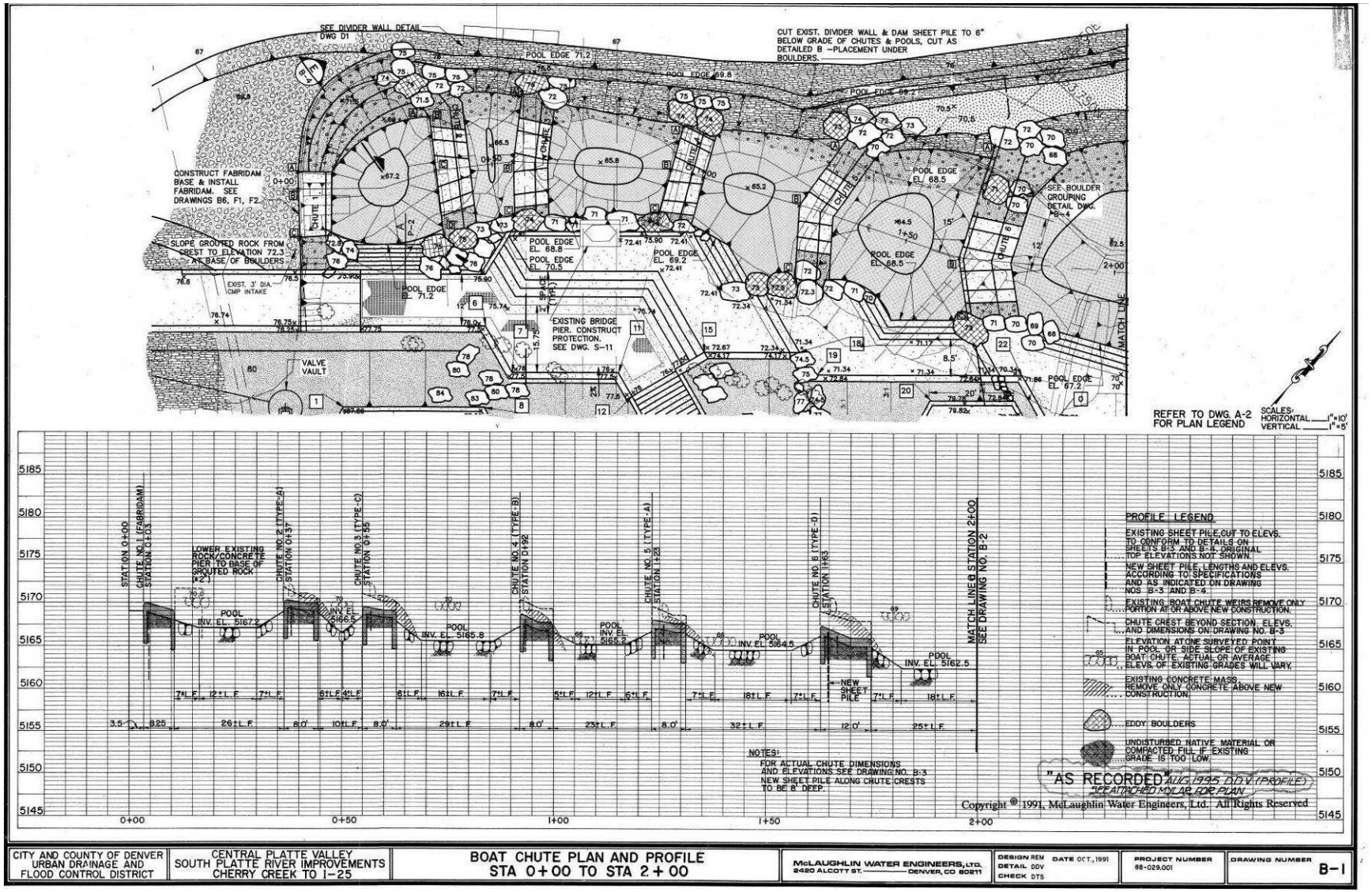
POINT	NORTH	EAST
A	153,899.21	2,138,060.91
B	153,702.03	2,138,025.60
C	153,905.22	2,138,236.01
D	153,672.55	2,138,029.13
E	153,715.26	2,138,076.13
F	153,836.35	2,138,216.13
G	153,793.52	2,138,153.76
H	153,798.73	2,138,163.49
I	153,843.19	2,138,209.53

LAYOUT DATA

POINT	NORTH	EAST
J	153,858.58	2,138,239.15
K	153,869.23	2,138,236.49
L	153,884.15	2,138,251.95
M	153,882.23	2,138,258.67
N	153,773.53	2,138,137.83
O	153,691.54	2,138,306.65
P	153,551.11	2,138,161.35
Q	153,787.29	2,138,405.92

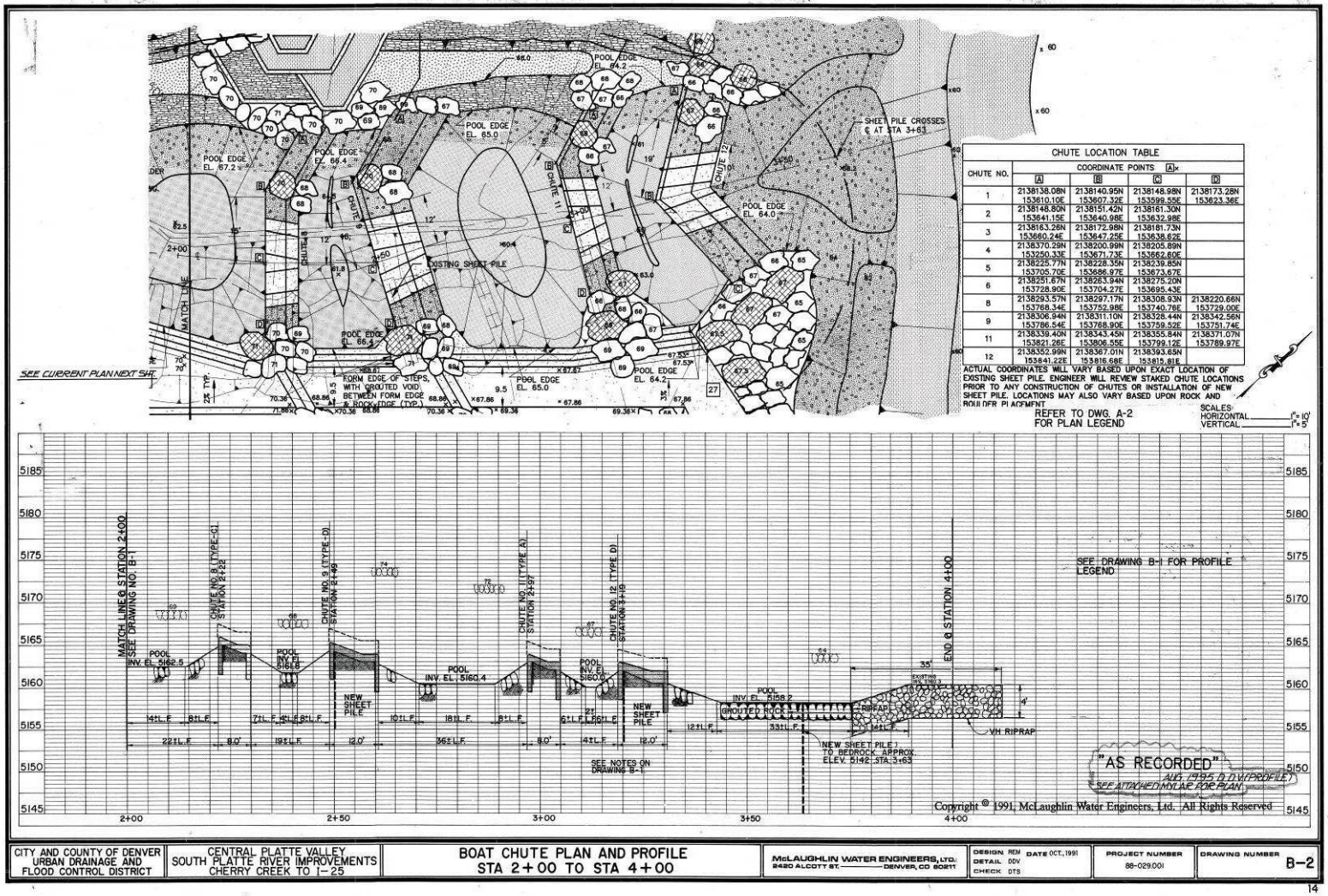
AS RECORDED MAR. 8, 1996 DDV

CITY AND COUNTY OF DENVER FLOOD CONTROL DISTRICT	CENTRAL PLATTE VALLEY PLATTE RIVER IMPROVEMENTS	PEDESTRIAN RAMPS	McLaughlin Water Engineers, Ltd. 2420 Alcott Street Denver Co. 80211	DESIGN: B.S.K. DETAIL: D.D.V. CHECK:	PROJECT NUMBER 88-029.001C DATE: SEPT., 1994	DRAWING NUMBER C-5A



Copyright © 1991, McLaughlin Water Engineers, Ltd. All Rights Reserved

CITY AND COUNTY OF DENVER URBAN DRAINAGE AND FLOOD CONTROL DISTRICT	CENTRAL PLATTE VALLEY SOUTH PLATTE RIVER IMPROVEMENTS CHERRY CREEK TO I-25	BOAT CHUTE PLAN AND PROFILE STA 0+00 TO STA 2+00	McLAUGHLIN WATER ENGINEERS, LTD. 2420 ALCOTT ST. — DENVER, CO 80211	DESIGN REM DETAIL DDV CHECK DTS DATE OCT., 1991	PROJECT NUMBER 88-029.001	DRAWING NUMBER B-1



CHUTE LOCATION TABLE				
CHUTE NO.	COORDINATE POINTS [A]×			
	[A]	[B]	[C]	[D]
1	2138138.08N 153810.10E	2138140.95N 153607.32E	2138148.98N 153599.55E	2138173.28N 153623.36E
2	2138148.80N 153641.15E	2138151.42N 153640.98E	2138161.30N 153632.98E	
3	2138163.26N 153660.24E	2138172.98N 153647.25E	2138181.73N 153638.82E	
4	2138370.29N 153250.33E	2138200.99N 153671.73E	2138205.89N 153662.80E	
5	2138225.77N 153705.70E	2138228.35N 153686.97E	2138239.85N 153673.67E	
6	2138251.67N 153728.90E	2138263.94N 153704.27E	2138275.20N 153695.43E	
8	2138293.57N 153768.34E	2138297.17N 153752.98E	2138308.93N 153740.78E	2138220.66N 153729.00E
9	2138306.94N 153786.54E	2138311.10N 153768.90E	2138328.44N 153759.52E	2138342.56N 153751.74E
11	2138339.40N 153821.26E	2138343.45N 153806.55E	2138355.84N 153799.12E	2138371.07N 153789.97E
12	2138352.99N 153841.22E	2138367.01N 153816.68E	2138393.65N 153815.81E	

ACTUAL COORDINATES WILL VARY BASED UPON EXACT LOCATION OF EXISTING SHEET PILE. ENGINEER WILL REVIEW STAKED CHUTE LOCATIONS PRIOR TO ANY CONSTRUCTION OF CHUTES OR INSTALLATION OF NEW SHEET PILE. LOCATIONS MAY ALSO VARY BASED UPON ROCK AND ROUGHER PLACEMENT

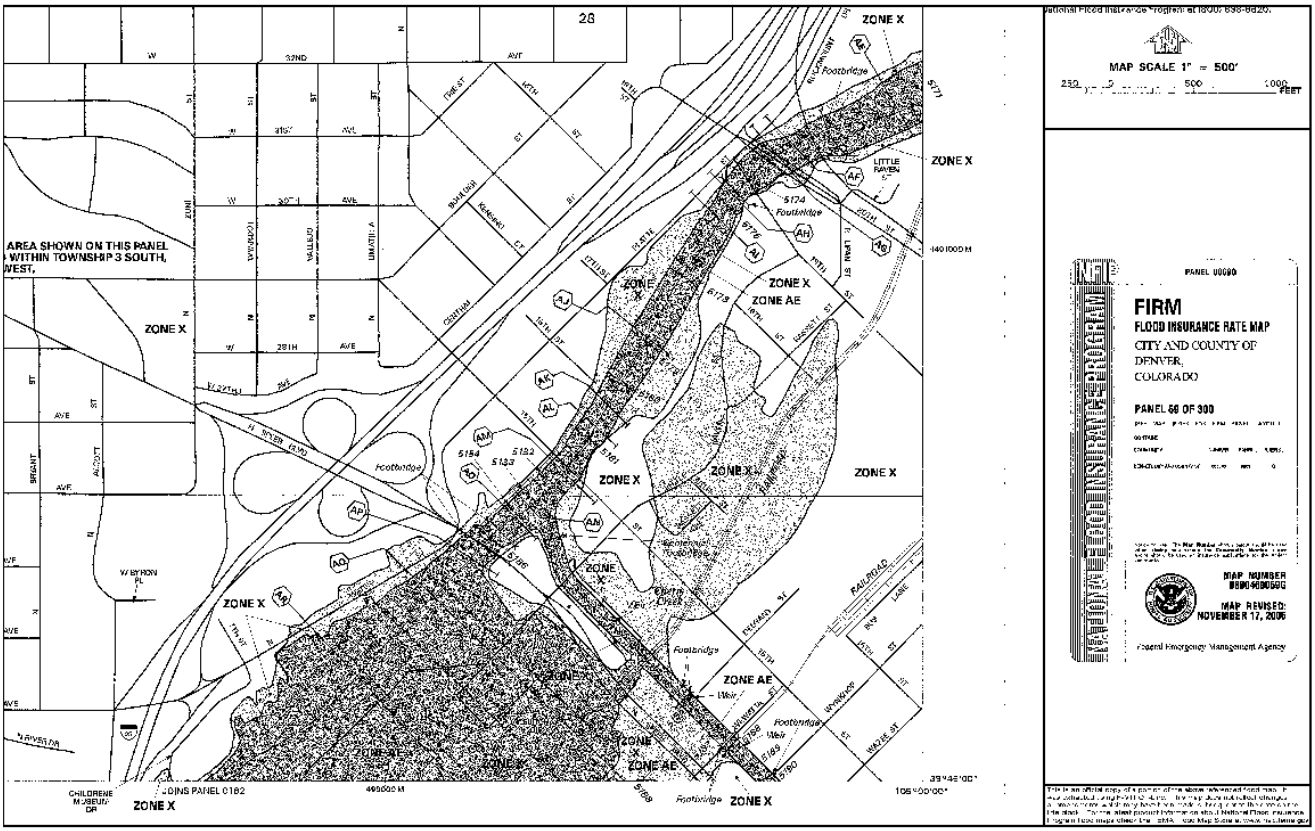
Copyright © 1991, McLaughlin Water Engineers, Ltd. All Rights Reserved

CITY AND COUNTY OF DENVER URBAN DRAINAGE AND FLOOD CONTROL DISTRICT	CENTRAL PLATTE VALLEY SOUTH PLATTE RIVER IMPROVEMENTS CHERRY CREEK TO I-25	BOAT CHUTE PLAN AND PROFILE STA 2+00 TO STA 4+00	McLAUGHLIN WATER ENGINEERS, LTD. 2420 ALCOTT ST. — DENVER, CO 80211	DESIGN REM DATE OCT., 1991 DETAIL DDV CHECK DTS	PROJECT NUMBER 88-029.001	DRAWING NUMBER B-2

14

Attachment B

Confluence Park Area FEMA Map

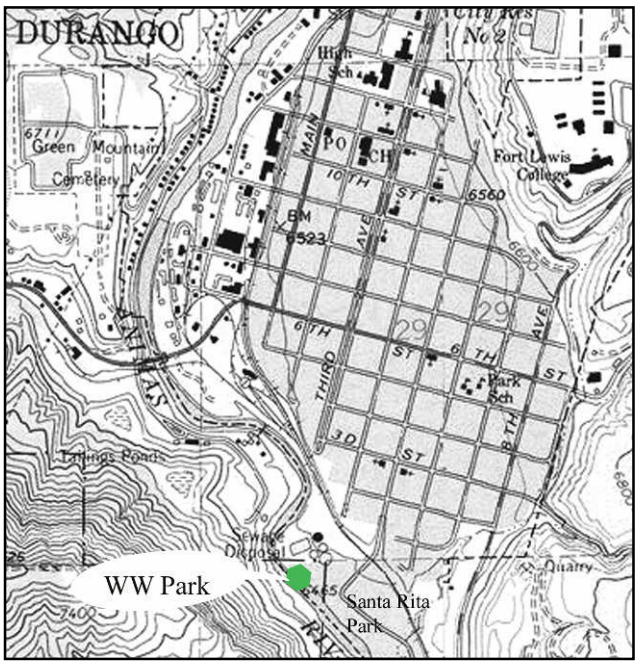


DURANGO WHITEWATER PARK
ON THE ANIMAS RIVER

1. BACKGROUND INFORMATION

The City of Durango constructed the Smelter Rapid Boating Park in Whitewater Park in the late 1980's. The park was the first US river reach of its size and scale to be modified to host national and international competition, setting Durango apart as a whitewater destination.

In 2003, the Animas River Task Force was formed to explore improvement of the in-stream whitewater features. In 2005, the City of Durango contracted with Recreation Engineering and Planning to evaluate potential sites for an improved Durango Boating Park. After considerable public input, Smelter Boating Park was chosen as the best alternative for a destination park and play facility while preserving and enhancing the existing slalom facility.[1]



A. 2010 UPDATES

The information below is based upon the initial 2008 investigation. The 2010 update effort established that construction of the proposed whitewater park improvements are projected to occur in 2012. The delays are due to an extended permitting period and indecision as to the preferred park location. The $550,000 cost will be paid for by a .25 cent sales tax approved in 2005.

B. LOCATION

The location of the exiting whitewater park and planned improvements (As of 2008) are near the intersection of South Camino del Rio and Santa Rita Drive. (As of 2010 the Town is considering an alternate site.) The existing site is located near the waste water treatment plant downstream of the confluence with Lightner Creek and upstream of the Animas-La Plata Project pumping station. It is located approximately 21 river miles upstream of the Colorado-New

Mexico State line, downstream of the confluence of the Animas and Florida rivers.

Key elements of Durango Boating Park are four Control Structures for which recreational in-channel diversion water rights are claimed, located in the SW ¼ of the SW ¼, Section 29, Township 35 North, Range 9 West, N.M.P.M. More specifically, they are described as follow relative to this section:

Structure 5 is 700 feet east of the west section line and 360 feet north of the south section.
Structure 9 is 650 feet east of the west section line and 80 feet north of the south section.
Structure 11 is 950 feet east of the west section line, 250 feet north of the south section.
Structure 12 is 1180 feet east of the west section line, 460 feet north of the south section.[2]

On July 24, 2008 an alternative location was presented by the designer for public comment.[3] Unless otherwise noted, this case report will address the design and location for which the RICD was decreed.

C. OWNER/OVERSIGHT

Owner: City of Durango
Steward: City of Durango
Community Recreation Center
2700 Main Avenue
Mailing address: 949 E 2nd Avenue
Durango, CO 81301-5109
970-375-7300 phone
970-375-7337 fax
Cathy Metz, Director

Maintenance Responsibility: City of Durango
Public Works Director
City of Durango
949 East Second Avenue
Durango, CO 81301-5109
970-375-5000 phone
970-375-5098 fax

D. COST

Construction and related project costs are not available for the numerous construction efforts completed since the 1980s. The cost associated with obtaining the RICD water right decree was not available. The proposed construction for the 2008 design was earlier estimated at $500,000 [4] As of 2010, the estimated cost is $2,000,000 [20].

E. COMPLETION DATE

The original Smelter Rapid Boating Park was completed in the late 1980's.[5] As of July, 2008, the boating park renovation remained in the planning and design stages. As of March 2010, the construction date is estimated in 2012.[20]

2. SAFETY ISSUES AND ACCIDENT REPORTS

No fatalities or serious accidents were found or reported.

3. DESIGN AND CONSTRUCTION DOCUMENTS/DRAWINGS

A. PRELIMINARY DESIGN

For earlier construction & design efforts a number of local residents have been involved but there was no records found of any professional designs or engineering

For the proposed improvements:

Designer: Recreation Engineering and Planning- Scott Shipley, P.E.
Structures 1, 2, 3, and 4 are rough approximations of existing features already in the river. These are shown to illustrate the character of the river upstream of the Smelter Drop. Enhancements to reinforce these structures are recommended but not required, in the initial phase. Structure 5 is an existing drop structure nicknamed 'Smelter' that will be redesigned, reshaped and reinforced in order to permanently capture, control and divert the Animas River.

"U" structures 10, 11, and 12 are envisioned as wider, more distributed structures than those planned at Smelter and at the Corner Pocket (second drop). These structures and the increased width they create
provide for:

i. increased variety as well as providing options for multiple boaters
ii. novice/intermediate boating, instruction at lower flows
iii. access for boaters intimidated by Smelter and Corner Pocket

Riparian restoration will repair degraded corridors by planting vegetation, preserving endangered and native vegetative populations and removing non-native species such as tamaris and (illegible).[6]

B. CONSTRUCTION DOCUMENTS

For earlier construction & design efforts a number of local residents have been involved but there was no records found of any professional designs or engineering. No sealed drawings or design drawings meeting the description outlined by the Colorado State Board of Licensure for Professional Engineers were found.

For the proposed improvements:

Engineer of Record: Recreation Engineering and Planning- Scott Shipley, P.E.
The design has not been finalized as of August, 2008. See Attachment A for the plan included in the Final Decree.

C. CONSTRUCTION METHODS

Past river modifications have been executed without the use of grout or formal engineering - primary reasons for the high number of reconstruction efforts.

A system that utilizes grout is planned, despite concern that has been expressed over its use. The design firm, Recreation Engineering and Planning commits to a responsible use of grout that allows it to remain hidden, allow for interstitial spaces for macro-invertebrates, allow for fish migration, upstream and downstream, and provide for the overall stability of the structure, thereby virtually eliminating regular instream maintenance requirements. The construction methods use of this grout represent current best practice standards in a dry environment such that no toxins are release to the stream flow and there is not effect on the habitat outside of the park. Short tem effects in the selected reach are limited to construction impacts. [7]

D. FLOODPLAIN AND HYDRAULIC EVALUATONS

An engineering analysis concluded that the proposed Durango RICD will satisfy the hydrologic and water rights criteria considered by the CWCB and the Water Court.

E. WATER MANAGEMENT

The fact that the RICD is located on the Animas River mainstem near the state line could have water management impacts. Since the RICD is located just upstream of the diversion for the Animas La Plata Project, Colorado could divert the water for consumptive beneficial use after it passes through the whitewater park. However, there will be times when the RICD water right could have the effect of delivering water downstream out of Colorado without putting the water to consumptive beneficial use.

F. HYDRAULIC DROP

The slope of the proposed boating park is greater than .5% and its length is longer than 1,000 feet. It has demonstrated that it has the necessary physical characteristics to host an international level competition.[10] See Attachment B for FEMA Map. HEC-RAS Modeling is enclosed.

G. DESIGN CALCULATIONS

None found. A description of the features and general design modeling equations are included in the *Report on the Design, Functionality, and Physical Characteristics of the Durango Boating Park as it Relates to the RICD Application*, 27-40.[11]

H. COURSE LENGTH

(July, 2007) Measured in the field to be 1,086 ft., stated in the RICD to be 1,183 ft.

I. CONSTRICTION WIDTH (JULY, 2007)

1st Feature (Smelter) : 154”
2nd Feature (Corner Pocket): 308”
3rd Feature: 385”

J. PHOTOGRAPHS

Top Left: Smelter / First Feature
Bottom Left: Third Feature in foreground, second feature to the upper right
Right: Second Feature

A sewage treatment intake is located above the first feature, Smelter. The outflow is downstream of the third and final feature.

Additional photographs are included in supplemental digital file entitled Durango Site Photos.

4. WATER AND STREAMBED REQUIREMENTS AND PERFORMANCE

A. PERMITS

Nationwide general permit number 3 was approved for minor maintenance at the Smelter Whitewater Park site in September, 2003. An NWP27 was issued April, 002 for a plan that was rejected by the community. There have been no permits issued since the maintenance authorization September 17, 2003 per the receipt of all ACOE permitting documents related to this whitewater park.[12]

B. RICD INFORMATION

(Per the Durango RICD Final Decree)
The following table defines the flows decreed for each of the Control Structures.

	Values in cfs		
Time Period	Structures 5, 9	Structures 10, 11	Structure 12
1/1-3/14	185	185	185
3/15-3/31	250	250	250
4/1-4/14	400	400	400
4/15-4/30	850	850	850
5/1-5/14	1200	900	900
5/15-5/31	1250	900	900
6/1-6/14	1400	1250	900
6/15-6/30	1200	900	900
7/1-7/14	900	600	600
7/15-7/31	600	600	400
8/1-8/14	400	400	400
8/15-9/30	300	300	300
10/1-12/31	185	185	185

From April 16-Septembe 29 the hours of operation are 8:00 a.m. – 8:00 p.m.
From September 30 – April 15 the hours of operation are 10:00 a.m. – 6 p.m.

During competitive events the operation can be extended to 6 a.m. – midnight for up to four days, up to 8 times per year. Events must provide 30 days notice, and a call may be placed outside of the stated hours to insure water is in the course during those hours. Each flow rate is a minimum instream flow for a particular recreational experience or set of recreational experiences. Thus, each flow rate also includes the right to call for any other lower flow rate specified above, even if the lower flow rate is specified for a different time period.[13]

A comprehensive file of the following is available at
http://cwcb.state.co.us/WaterSupply/RICDDecApps.htm

- *Application of the City of Durango, Case No. 7-06CW9*
- *Pre-Hearing Statements*
- *Staff's Proposed Findings & Recommendations*
- *Final Findings & Recommendations of the CWCB*[14]

C. FLOW RECORDS AND GAUGES

Animas River at Durango" gauge:
www.crh.noaa.gov/ahps2/hydrograph.php?wfo=gjt&gage=drgc2

D. WATER MANAGEMENT IMPACTS

See Section 3d.

E. MODIFICATIONS, FAILURES OR REPAIRS

This park has been modified at least six times since original construction in the late 1980's.

F. SEDIMENTATION ISSUES

There has been some concern that tailings from an old smelter may remain as a toxic contaminant in downstream sediment, and that instream modifications in this Gold Medal Water Fishing reach may stir these sediments and negatively impact the habitat.[15]

5. ECONOMIC DEVELOPMENT INTENTION AND PERFORMANCE

A. INTENDED USES

All recreational uses in and on the Animas River in connection with the Durango Boating Park include kayaking, tubing, rafting, canoeing, and other general recreational uses.

Improvements will provide a destination park and play facility while preserving and enhancing the existing slalom facility by

- increasing variety as well as providing options for multiple boaters
- offering used by instructional, recreational, and developing boaters at lower flows
- creating variety and a significant challenge to slalom boaters
- leveraging existing facilities including parking, trails, and access[16]

B. ECONOMIC AND USAGE STUDIES

The current economic impact of whitewater recreation on the Lower Animas River has been reported to underscore the importance of maintaining and improving the facility. Total impacted has been estimated to be over $19 million annually (2005), employing 375 part time staff.

In order to grow as a destination in the face of aggressive growth of whitewater park installation the following is projected if the Lower Animas Whitewater Park sees significant improvements and assured flows. Water diversion and whitewater park improvements would dramatically increase the existing boating season to 365 days, with the following as projected impacts in the year 2015:

- Commercial boating skills classes and equipment rentals could yield between $19.7 and $21.1 million annually.
- Non-commercial boating could yield between $2.5 and $3.6 million annually in positive economic benefits.
- Events could yield between $707, 678 and $3.2 million annually in positive economic benefits to the region

The total 2015 low/high range of economic benefits of whitewater recreation are as follows:

	2015 Estimate	
Category of Impact	Low	High
Commercially Guided Rafting	$ 18,935,603	$ 20,222,489
Commercial Equipment Rentals & Classes	847,970	905,599
Non Commercial Boating	2,553,114	3,647,750
Event Use $ Training Camps	707,676	3,206,630
Total Economic Impacts of Whitewater Recreation	$ 23,044,363	$ 27,982,288
Total Employment Associated with Whitewater Recreation (PTE)	591	717 [17]

EVENTS

1983-2006 Animas River Days
1989 Regional Team Trials Qualifier
1989 International Wildwater Races
1990-1996 Champion International Series
1990-2006 Numerous Training Camps
1992 Regional Olympic Qualifier
1993 Open Canoe National Championships
1995 US Rodeo Team Selections
2001-2003 National Race Team Selections
2001-2003 Junior Race Team Selections
2002 Masters National Championships
2004 Senior National Team Trials
2005 U.S. Team Trials
Eddie Bauer Kayaking Championships

C. RECENT DEVELOPMENT IN VICINITY

The Animas-La Plata project description is located at http://www.usbr.gov/uc/progact/animas/
Tourism continues as the primary economic driver for Durango and La Plata County.
www.creativelinks.com/business/tourismtrend.htm

D. OTHER

- Designated Gold Medal Fishery by Colorado Wildlife Commission
  http://wildlife.state.co.us/Fishing/WhereToGo/HotSpots/SouthwesternHotSpots.htm
- Former Superfund Site
  http://www.usbr.gov/newsroom/presskit/factsheet/factsheetdetail.cfm?recordid=5000
- *Executive Summary Commercial Use in Colorado*, Greiner, 6-9.[18]
- *Parks Master Plan*, Durango, CO (2001)[19]

6. OTHER

A. USER INTERVIEWS

n/a

B. SITE VISIT SUMMARY

Date: 12:00p.m. 20 July 2007
Flow: 576cfs
By: Derk Slottow

The Durango Whitewater Park is located at Smelter Rapid, adjacent to the sewage treatment plant. There is lots of parking at the park at the bottom of the whitewater course. You can smell the treatment plant several miles upstream and downstream of the park but it is particularly intense at the top of the whitewater course. There is a large grate at river level at the top of the rapid that is an inlet to the treatment plant. There is an outlet (you can see and hear the water coming out) covered by boulders at the bottom of the rapid. There is a path down to river level to launch above the course but after this point highly eroded banks make leaving the river difficult. At the launch, the river is very wide and shallow. It is channelized by a large pile of boulders at the top of the rapid, extending down to the first drop. At these low flows, a small, surfable wave formed in this constriction. The feature below this was good for surfing, spinning and cartwheels but was not very retentive. The bottom feature (Corner Pocket) was okay for advanced surfing, spinning, and blunts. The boulder garden and eddy lines below this provided a good set of features to paddle around and practice technique.

7. REFERENCES

1. *Final Decree*, December 3, 2007, 3.
2. *City of Durango RICD Presentation to the Water Conservation Board*, 1.
3. "Two Options Proposed," *Durango-Telegraph*, July 24, 2008
4. *City of Durango RICD Presentation to the Water Conservation Board*, 2.
5. *Ibid*,1.
6. *Report on the Design, Functionality, and Physical Characteristics of the Durango Boating Park as it Relates to the RICD Application*, 20, 21.
7. *Report on the Design, Functionality, and Physical Characteristics of the Durango Boating Park as it Relates to the RICD Application*, 22.
8. *City of Durango Boating Park Hydrology Study*, WW Wheeler and Associates, February, 2006, 20, 21.
9. *Supplement to City of Durango Boating Park Hydrology Study*, WW Wheeler and Associates, June, 2006, 3.
10. Report on the Design, Functionality, and Physical Characteristics of the Durango Boating Park as it Relates to the RICD Application, 42.
11. *Report on the Design, Functionality, and Physical Characteristics of the Durango Boating Park as it Relates to the RICD Application*, 27-40.
12. ACOE Durango-Durango (2003), 1, 3.
13. *Final Decree*, December 3, 2007, 3.
14. *Final Findings & Recommendations of the CWCB*, July 27, 2006.
15. *Report on the Design, Functionality, and Physical Characteristics of the Durango Boating Park as it Relates to the RICD Application*, 4.
16. *Ibid*., 21.
17. *Economic Impacts of Whitewater Recreation, City of Durango, Colorado*, 16, 21, 22.
18. *Executive Summary Commercial Use in Colorado*, Greiner, 6-9.
19. *Parks Master Plan*, Durango, CO (2001), np.
20. The Durango Telegram, Volume 9, No. 11, March 18, 2010

Attachment A

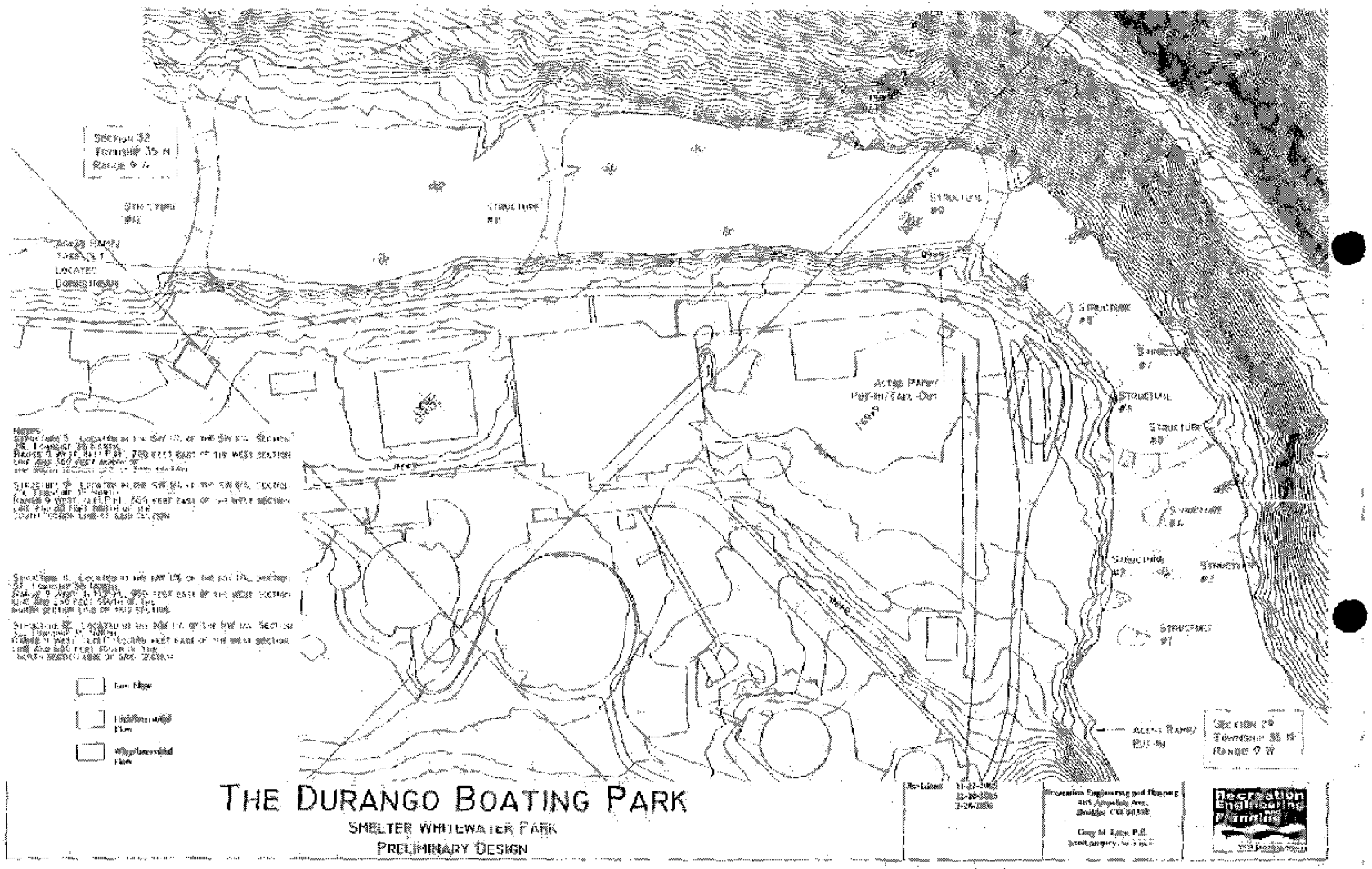
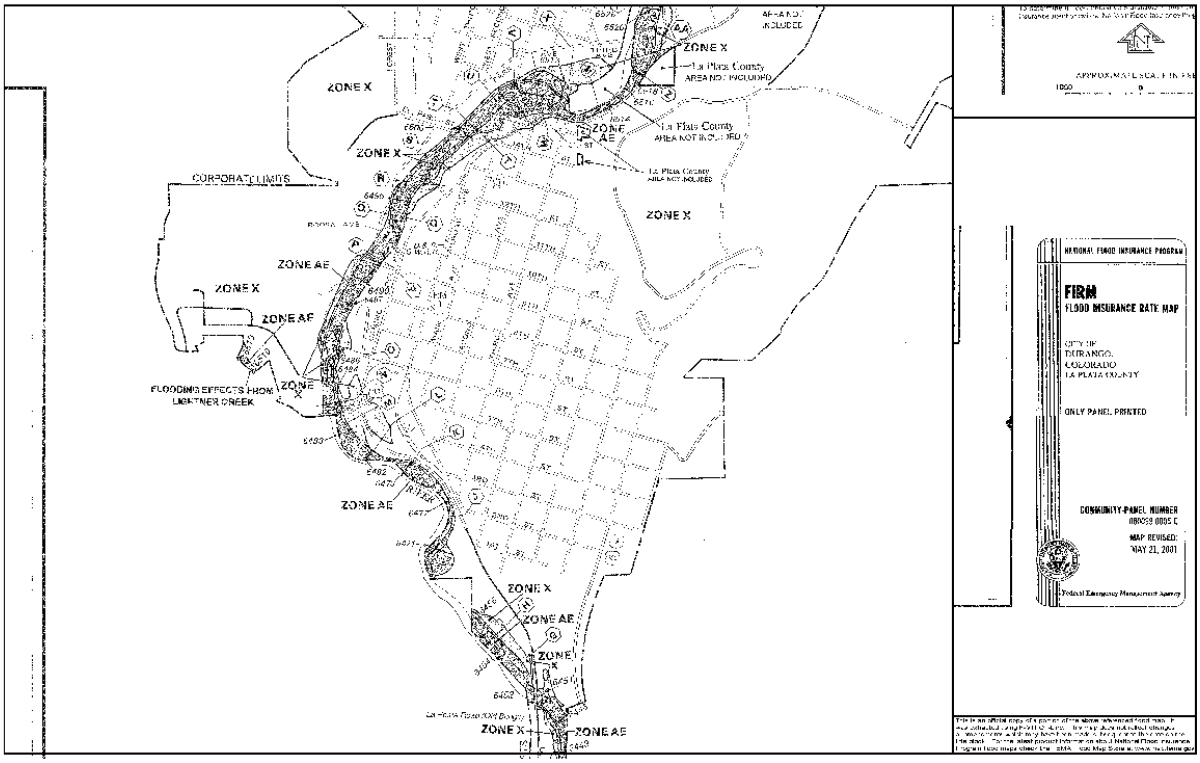

Section 32
Township 35 N
Range 9 W
Structure #10
Structure #11
Structure #9
Structure #8
Structure #7
Structure #6
Structure #5
Structure #4
Structure #3
Structure #2
Structure #1
Access Ramp/ Put-In/Take-Out
Access Ramp/ Put-In
Section 29
Township 36 N
Range 9 W
Low Flow
THE DURANGO BOATING PARK
SMELTER WHITEWATER PARK
PRELIMINARY DESIGN

EXHIBIT A

Attachment B

Durango FEMA Map



GOLDEN WHITEWATER PARK ON CLEAR CREEK

1. BACKGROUND INFORMATION

The Clear Creek Whitewater Park consists of a series of instream channel modifications that create features suitable for a variety of activities: slalom racing, freestyle, and general kayaking skill development as well as canoeing, river boarding and tubing. An original set of seven structures comprise the first installation, completed in 1998. A second phase consisting of six additional structures was completed in 2002.

The course spans approximately seven city blocks. Parking near the central section of the course is available at Lions Park, the City ball fields and adjacent areas, and Vancouver Park provides parking and user access at the takeout.[1]

A. LOCATION

The Clear Creek Whitewater Park is located at 1201 10th Street adjacent to Lions Park in downtown Golden. Coordinates are within Sections 27, 28 and 33 of Township 3 South, Range 70 West of the 6th P.M., Jefferson County, Colorado.

B. 2010 UPDATES

The 2010 update effort established that several improvements were initiated in 2009 and completed March, 2010. These are included and described throughout this section. This updated information was provided by *Rod Turullo, City of Golden,on March 22, 2010*

C. OWNER/OVERSIGHT

Owner: City of Golden
Department of Parks and Recreation
1470 Tenth Street
Golden, CO 80401
303-384-8120

Steward: City of Golden
Department of Parks and Recreation
Parks and Recreation Advisory Board
1470 Tenth Street
Golden, CO 80401
303-384-8120

Maintenance Responsibility: City of Golden Department of Public Works
1445 10th St. / Shops at 1300 Catamount Dr.
Golden, CO 80401
303-384-8161

D. COST

The project was initially completed and dedicated in spring, 1998.

Construction Costs [6]	
Initial Park Construction (approx)	$165,000.
1999 Bleachers Hole Maintenance	$8,472
2002 Course Expansion	$21,888
2003 Course Expansion	$119,332
2003 Maintenance	$275
2004 Course Expansion	$27,685
2004 Maintenance	$186
2005 Maintenance	$999
2006 Maintenance	$22,825
2009/2010 Improvements	76,000

2010 Update:

Total Expansion Costs 1998-2010	$244,905
Total Maintenance Costs 1998-2010	$32,759
Total Costs 1998-2010	$442,662

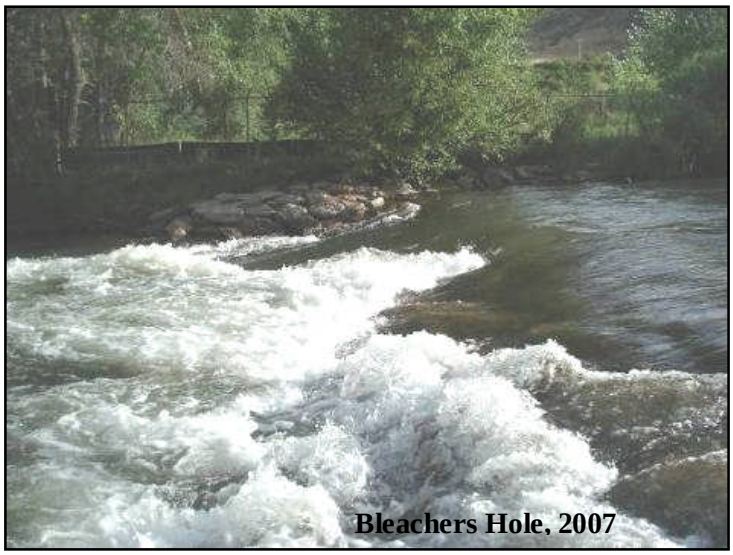
The costs associated with obtaining the RICD water right were not available. Conservation Trust Fund (lottery) funds were used to develop this site.[2]

E. COMPLETION DATE

June 7, 1998 (Initial Phase)
Expansions 2002, 2003, 2004,2009/2010

2. SAFETY ISSUES AND ACCIDENT REPORTS

"The course designer noted that safety is a high priority, and that the course is designed to minimize the risk of accidents through the range of flows. The Golden Hole (later renamed "Bleachers Hole") structure was modified after the first year to address safety concerns and improve whitewater play opportunities (the original ledge was apparently too steep, the hole too "retentive" at higher flows)."[3]



Bleachers Hole, 2007

3. DESIGN and CONSTRUCTION DOCUMENTS/DRAWINGS

A. PRELIMINARY DESIGN

Designer: Gary Lacy, Recreation Engineering and Planning
See Attachment A, the *Habitat Restoration Plan View*

B. CONSTRUCTION DOCUMENTS

Designer: Recreational Engineering and Planning, Gary Lacy, P.E.

No sealed drawings or design drawings meeting the description outlined by the Colorado State Board of Licensure for Professional Engineers were found (as of 2008).

Structure and feature description:
"Numerous natural stone drops and excavated pools…These will be in varying curvilinear shapes similar to drops that naturally appear in this type of stream. Stone terraces will be constructed along a portion of the north bank to create a riparian vegetation zone and protect the bank from further erosion."[4]
Three double current deflectors and four "V" Dams Seven dam structures were located within the channel of Clear Creek between these two locations:

- The NW corner of Section 33, T.3S. R. 70 W. bears north. 82E56'9"W, a distance of approximately 2,790 ft.
- The NW corner of Section 33, T.3S. R. 70 W. bears north. 88E25'32"W, a distance of approximately 3,546 ft.[5]

C. CONSTRUCTION METHODS

Contractor: Aquatic & Wetland Construction[6]
The course was constructed using the Grouted Sloping Boulder Drops method. Boulders were grouted together at their base.

Double Current Deflectors are constructed by placing two angled current deflectors directly opposite one another. Boulders are stabilized with concrete grout. Up to 45 cubic yards of boulders and grout material are required.

Boulder V-Dams used 21-36 three foot diameter boulders at each location, spanning the entire channel anchored at each stream bank and stabilized with concrete grout. Boulders' top surfaces match flush to the existing channel invert.

Self-maintaining pools will be excavated below each structure to provide fish habitat and will scour annually during high flow periods. The drop associated with each V-Dam will dissipate stream energy and aerate the water.

Four to six foot diameter riffle roughness boulders will be placed at six locations below thalweg and plunge pools to enhance the quality of the riffle. They will increase channel roughness and improve macro invertebrate aquatic habitat.[7]

D. FLOODPLAIN AND HYDRAULIC EVALUATIONS

None have been found. See Attachment B, the FEMA Flood Insurance Rate Map for Golden.

E. HYDRAULIC DROP

The hydraulic drop from the start pool above first drop (est. elevation 5,682 ft) to the pool below the final drop (est. elevation 5,668 ft.) is fourteen feet.

F. DESIGN CALCULATIONS

None were located.

G. COURSE LENGTH

The course length as of 2007 was 800 ft (2007).

H. CONSTRICTION WIDTHS

Measurements were taken on July 25, 20007, 6:00p.m.-8:00p.m. 7-25-07. The water flow at that time was 242 cfs**.**

Measurements below are expressed in inches as measured during Site Visit.
Note that these are approximate measurements of the width of the lowest invert of each structure. Other measurements included elsewhere in this document relate to the top width of the constriction and not the width of the lowest invert.

Structure 1	78
Structure 2	79
Structure 3	116
Structure 4 (Rodeo Hole)	77
Structure 5	River-wide
Structure 6 (Bleachers Hole)	48
Structure 7(Curveball)	50
Structure 8 (Library Hole)	>154
Structure 9	154
Structure 10 (Bingo Hole)	River-wide

I. PHOTOGRAPHS

The following photographs were taken July 25, 2007, 6:00p.m.-8:00p.m. Flow: 242 cfs

First Drop (left)

Second Drop (right)

Third Drop (left)

Rodeo Hole (right)

Terracing at Bleachers (left)

Ends at Library Hole (right)

Ballfields Bingo Hole

Additional photos are included in the file Golden Site Photos.

4. WATER AND STREAMBED REQUIREMENTS AND PERFORMANCE

A. PERMITS

1996 - Original Permit 016900, Army Corps of Engineers File 20028095, DA Nationwide Permit Number 13, File 199681163

1997 - Regional Permit GP7907 for bank stabilization was issued.[8]

1999 - Maintenance was authorized under Permit 1996681163 to reset existing large boulders within the channel and reconstruction of the right wing drop Structure 7 (rock and grout).[9]

2001 - Maintenance was authorized under Permit 199681163 to In Stream Habitat Structures 1, 5, 6, and 7 to repair failures due to "problems associated with ice and high flow deposition."[10]

2004 - Repairs were performed under Permit 200280295 prior to its expiration August, 2004.[11]

2006 - Repairs were authorized by the Nationwide Permit No. 3, found in the Federal Register, Issuance of Nationwide Permits; Notice (67 FR 2077). The Corps File Number for this activity is 200680135.[12]

B. RICD INFORMATION

RICD No. 98CW48 Decreed the following:

Table 1

6 a.m.-6 p.m.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Claimed cfs	70	70	70	255	1000	1000	1000	559	51	143	103	70
Absolute cfs	43	42	45	166	325	840	562	157	129	85	62	49
Conditional cfs	27	28	25	89	675	160	438	402	122	58	41	21

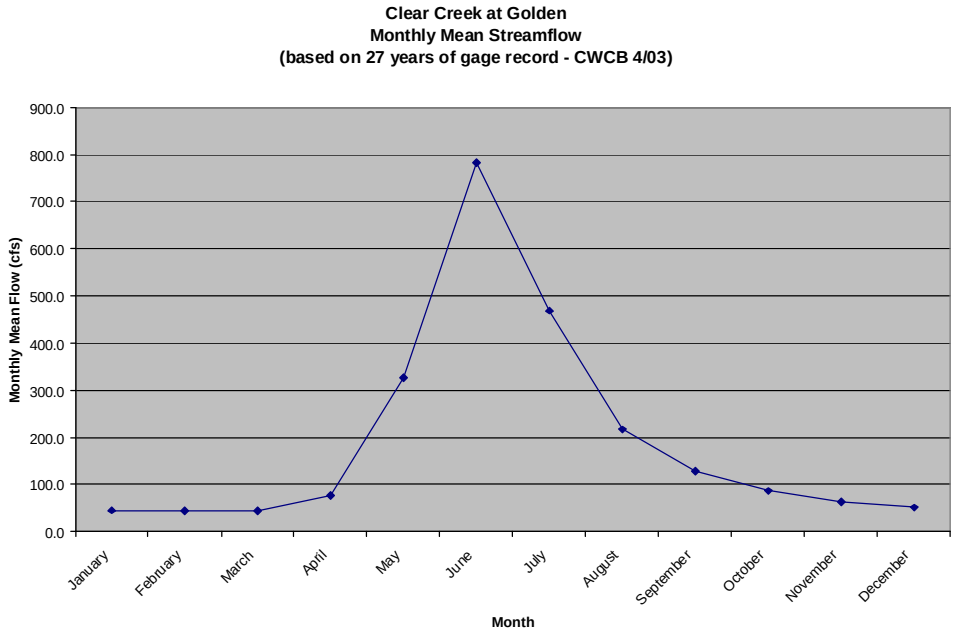
Table 2

6 p.m.-6 a.m.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Claimed cfs	70	70	70	255	1000	1000	1000	559	251	143	103	70
Absolute cfs	0	0	0	0	0	0	0	0	0	0	0	0
Conditional cfs	70	70	70	255	1000	1000	1000	559	251	143	103	70

Diversion and Control: The design capacity of the Course is 1,000 cfs and the Course was constructed to that design capacity based on the directions from the Golden City Council. The 1,000 cfs flow rate was used by the Course designer weir formulas and other calculations for the structures in the Course. At that flow rate, diversion structures 2-7 do not overtop. All of the structures function at the optimal level to concentrate and control the flow of water, to create waves and jets of water, self-scouring pools, hydraulic holes, large changes in current direction, and other white-water features that are used by kayakers and other boaters for recreational purposes. In addition, while over-topping directly affects the above features and begins to camouflage them, initially it does not destroy the features. The flow rate, above which the Course's structures are inundated to the point that they no longer create detectable white-water features, has not been established; hence, the 1000 cfs sought by Golden is reasonable in light of its intended use.

The Course structures can divert and control water at the claimed monthly flows that are less than 1000 cfs. Minimum control occurs at 20 cfs. Whitewater features begin to develop at 200 cfs. http://www.courts.state.co.us/supct/watercourts/wat-div1/ordergolden.htm

C. FLOW RECORDS, GAUGES



http://waterdata.usgs.gov/co/nwis/uv/?site_no=06719505&PARAmeter_cd=00065,00060

This data was obtained from USGS Gauge 06719505.[13]

D. WATER MANAGEMENT IMPACTS

There were concerns that this RICD water right could have water management impacts because it could prevent exchanges of water through this segment of Clear Creek. During the first six years after the decree was entered , no significant water management impacts were reported.

The U.S. Fish and Wildlife Service determined that this project would not jeopardize the continued existence of an endangered species, the Preble's meadow jumping mouse or destroy or adversely modify its habitat.[14]

Initial concern by the Colorado State Division of Wildlife was addressed and the attending fisheries biologist believed "this project should have benefits to the fishery and instream environment in general."[15]

E. MODIFICATIONS, FAILURES AND REPAIRS

The park was completed June, 1998.

1999 - Bank stabilization was performed.[16]

Maintenance/Reconstruction was authorized under Permit #1996681163 to reset existing large boulders within the channel and reconstruction of the right wing drop #7 (rock and grout).[17]

2002 - Addition of 6 new drop structures[25]

2004 – Maintenance/Reconstruction was performed to repair Structures II 5 and II 6 for what the Army Corps of Engineers viewed to be "improper placement of grout on top of, and not as the foundation for, the boulders."[18]

2006 – Maintenance/Reconstruction was performed to repair Structure II 5, the "V" Dam at City Hall, also known as Structure II 6; the "U" Dam at Parfet Park, Structure II 7 and a section of the northern bank where a grouted boulder had given way.[19]

2009/2010 – The following improvements were initiated in 2009 and completed March, 2010 [25]:

1) Bank retention and stabilization of the put-in area.
2) Bolstering of the river left wing (that was previously built up by hand placed rocks) on the third drop which will increase the dynamic power of that drop at lower flows.
3) Rehabilitation of the bleacher hole including changes in geometry, pool configuration, and orientation.
4) Replacing random boulders to optimize slalom opportunities in the pool below the bleacher hole.
5) Creation of a meandering pilot channel, replacement of low deflectors, and placement of random boulders in the "beginner" area between the pedestrian bridge and the Library Hole. The work included additional terracing just upstream of the pedestrian bridge to increase access and decrease erosion, plus minor improvements just upstream of the Library Hole to facilitate access

Information from City Records[6]

1999 Bleachers Hole Maintenance
2002 Course Expansion
2003 Course Expansion
2003 Maintenance
2004 Course Expansion
2004 Maintenance
2005 Maintenance
2006 Maintenance
2009/2010 Course Expansion[25]

F. SEDIMENTATION ISSUES

No records were found, though locals say annual city maintenance occurs, particularly after high runoff years.

Measurements were taken on July 25, 20007, 6:00p.m.-8:00p.m. 7-25-07. The water flow at that time was 242 cfs**.**

Measured Pool Depths:

Above Structure 1	18"
Below Structure 1	57"
Below Structure 2	47"
Below Structure 3	38"
Below Structure 4 (Rodeo Hole)	65"
Below Structure 5	35"

Below Structure 6 (Bleachers Hole)	79”
Below Structure 7 (Curveball)	69”
Below Structure 8 (Library Hole)	>116”
Below Structure 9	31”
Below Structure 10 (Bingo Hole)	30”

5. ECONOMIC DEVELOPMENT INTENTION AND PERFORMANCE

A. INTENDED USES

There appear to be six basic types of boating opportunities in the Clear Creek Whitewater Park:

- *Slalom racing/training for highly skilled boaters*
- *Playboating for highly skilled boaters*
- *Slalom racing/training for less skilled boaters*
- *Playboating for less skilled boaters*
- *“Low flow boating” (general boating on moving water but without high quality play or slalom features)*
- *“Water play” (beginner boating, tubing, swimming, or other water-based activities that don’t depend on power in whitewater features).*[20]

The overall project objective is to improve aquatic and riparian habitat conditions by: 1) the creation of self-scouring pools between riffle areas, 2) stabilizing and eroded streambank, and 3) planting riparian vegetation to enhance overhead cover and shading.

Specifically, improvements requiring fill include:
- Stabilization of eroded and rip-rapped streambank through terracing and revegetation. Although this activity requires some cut and fill excavation as well as boulder stabilization, under no circumstances was materials place as fill in jurisdictional wetland.
- Construction of double current deflectors is intended to create a scour pool, dissipate stream energy and provide aeration.
- Construction of boulder V-Dams create self-scouring plunge pools and dissipate stream energy. Plunge pools excavated below each V-Dam will improve the pool to riffle ratio of the reach, provide high quality fish habitat and be scoured of sediment during high flows;
- Addition of large riffle boulders below and within pools will improve macro invertebrate habitat.[21]

B. ECONOMIC AND USAGE STUDIES

The course is estimated to represent between $1.4 and 2 million per year.[22]

The peak season is from early May to late July. Formal usage includes up to ten events (slalom and freestyle) each year, along with training sessions and boat demonstrations. Warm summer evenings regularly see 200 boaters during a three hour period. These include professionals arriving after work or college students from the Colorado School of Mines.

The Park draws from Golden itself and from the surrounding Denver/Boulder area.

Golden WWP is the focal point of the greater Denver kayaking scene. This is where feeble beginners take their first strokes and swims, intermediates attain their first squirt or vertical end, and stories resonate in the parking lot about the pals of the Colorado kayaking world. It's a place where seasoned freestyle pro's, former Olympic slalom racers, shirtless inner tubers, and nervous beginners share eddies and laugh together. Along the walkway, dogs run wild, joggers weave around the scattered boats and a youth-girls softball game fills the night air as the sun drops behind the towering hills that Para gliders launch from.[23]

C. EVENTS

Golden Community Rodeo – Annual four-week series
CSM Kayak Club Spring Icebreaker - Annual
2007 Junior Olympics
2005-2006 First Descents Paddle-a-Thon
Eddie Bauer Kayaking Championships
Clear Creek Whitewater Festival
1999 Open Canoe Championships

D. RECENT DEVELOPMENT IN VICINITY

Beginning just upstream of the course on river-right there is a large building under construction. On river-right near the Rodeo Hole, dirt moving work has partially collapsed the chain link fence that runs the length of the original course and supports the slalom gates.

6. OTHER

User interviews (25 Clear Creek boaters filled out a complete survey) provided input for the user study conducted for RICD case input. These were conducted January-February, 2001.[25]

The Clear Creek Whitewater Park was the winner of the 1998 Starburst Award for Outstanding Use of Lottery Funds[25]

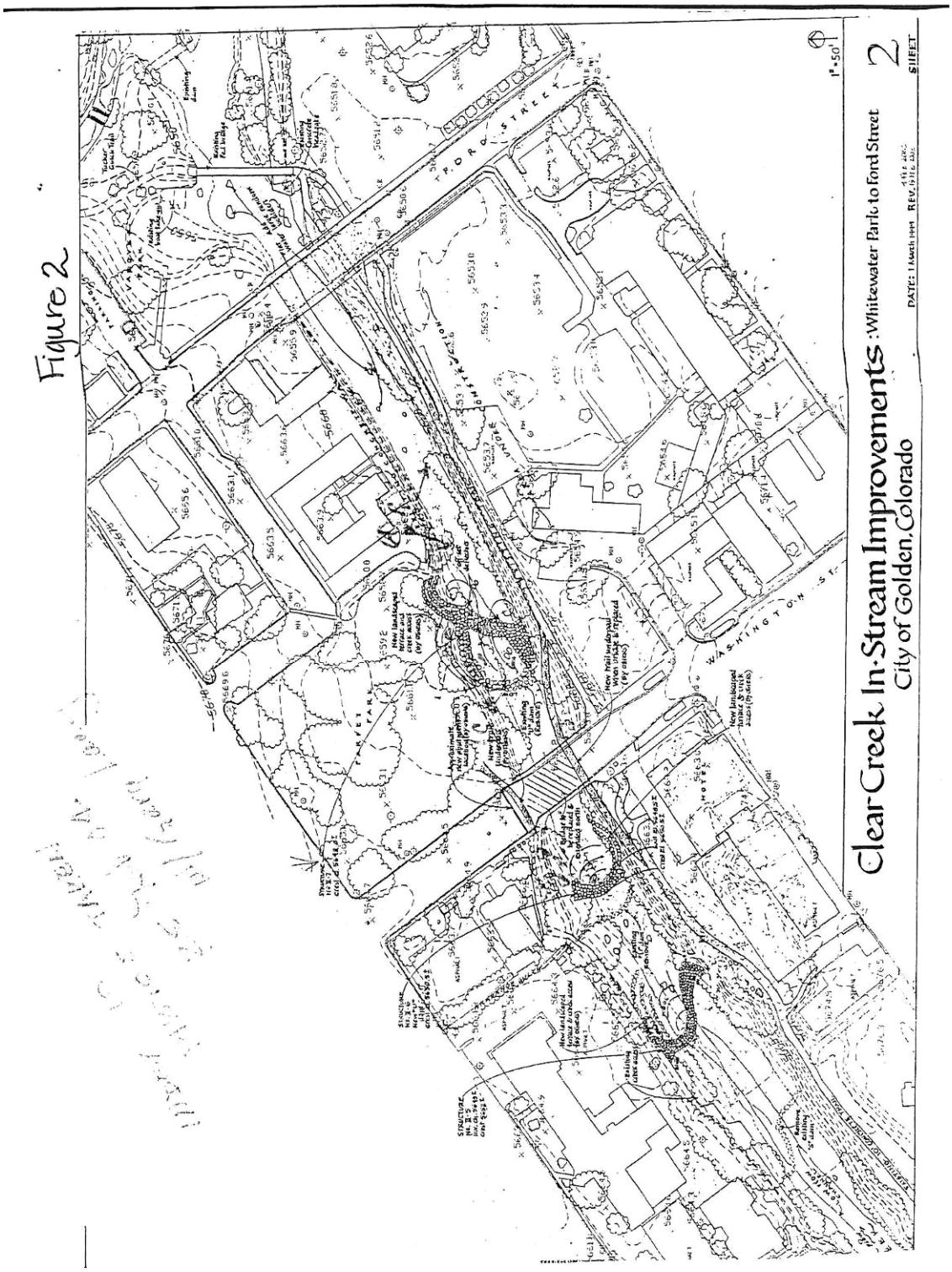
7. REFERENCES

1. *RFDMS Notebook 2007*, page 5.
2. *Ibid*, page 1.
3. *Clear Creek Whitewater Park, Golden, Colorado Flow Assessment for Recreation, Supplemental Expert Witness Report*, Revised March 12, 2001, Shelby and Whittaker, page 6.
4. Application for 404 Permit, December 9, 1996, *ACOE- Lakewood-Golden*, page 19.
5. *Ibid*, pages 25, 26.
6. *RFDMS Notebook 2007*, page 5.
7. Application for 404 Permit, December 9, 1996, *ACOE- Lakewood-Golden*, pages 25, 26.
8. ACOE Lakewood – Golden, page 9, Letter from ACOE to City of Golden, January 9, 1997.
9 ACOE Lakewood – Golden, p.6, Letter from Gary Lacy to Terry McKee, ACOE, January 5, 1999.
10 ACOE Lakewood – Golden, p.2, *Re: Maintenance of In-Stream Habitat Structures on Clear Creek, File #199681163*, October 8, 2001, Gary Lacey.
11. *ACOE Permit 20028029*, ACOE, February 25, 2004.
12. *ACOE Permit 200680135*, March 15, 2006.
13. USGS Flows 1974-2007 *Clear Creek, Golden 27 year Monthly Mean Streamflow*
14. ACOE Lakewood – Golden, p. 5, *Re: Clear Creek Whitewater Park, Nationwide Permit 03, Corps File No. 199681163*, January 12, 1999.
15. ACOE Lakewood – Golden, p.11, *Re: General Permit CO-OYT-0169A-Recration Engineering and Planning – Clear Creek Project*, December 31, 1996.
16. ACOE Lakewood – Golden, p. 5, *Re: Clear Creek Whitewater Park, Nationwide Permit 03, Corps File No. 199681163*, January 12, 1999.
17. *Maintenance of Instream Habitat Structures on Clear Creek, File 199681163*, October 8, 2001 and response from Army Corps of Engineers October, 12, 2001.
18. *ACOE Permit 20028029*, February 25, 2004.
19. *ACOE Permit 200680135*, March 15, 2006.
20. *Shelby and Whittaker*, page 10.
21. *A 404 Regional Permit Application for Clear Creek*, Recreation Engineering & Planning, 18 November, 1996.
22. *Preliminary Evaluation of the Beneficial Value of Waters Diverted in the Clear Creek Whitewater Park in the City of Golden*, Stratus Consulting, Inc., page 14.
23. *Whitewater of the Southern Rockies*, Evan Stafford and Kyle McCutcheon, page 322.
24. *Clear Creek Whitewater Park*, Golden Guide 06, March 31, 2006
25. Phone conversation with Rod Turullo, City of Golden, March 22, 2010

Attachment A

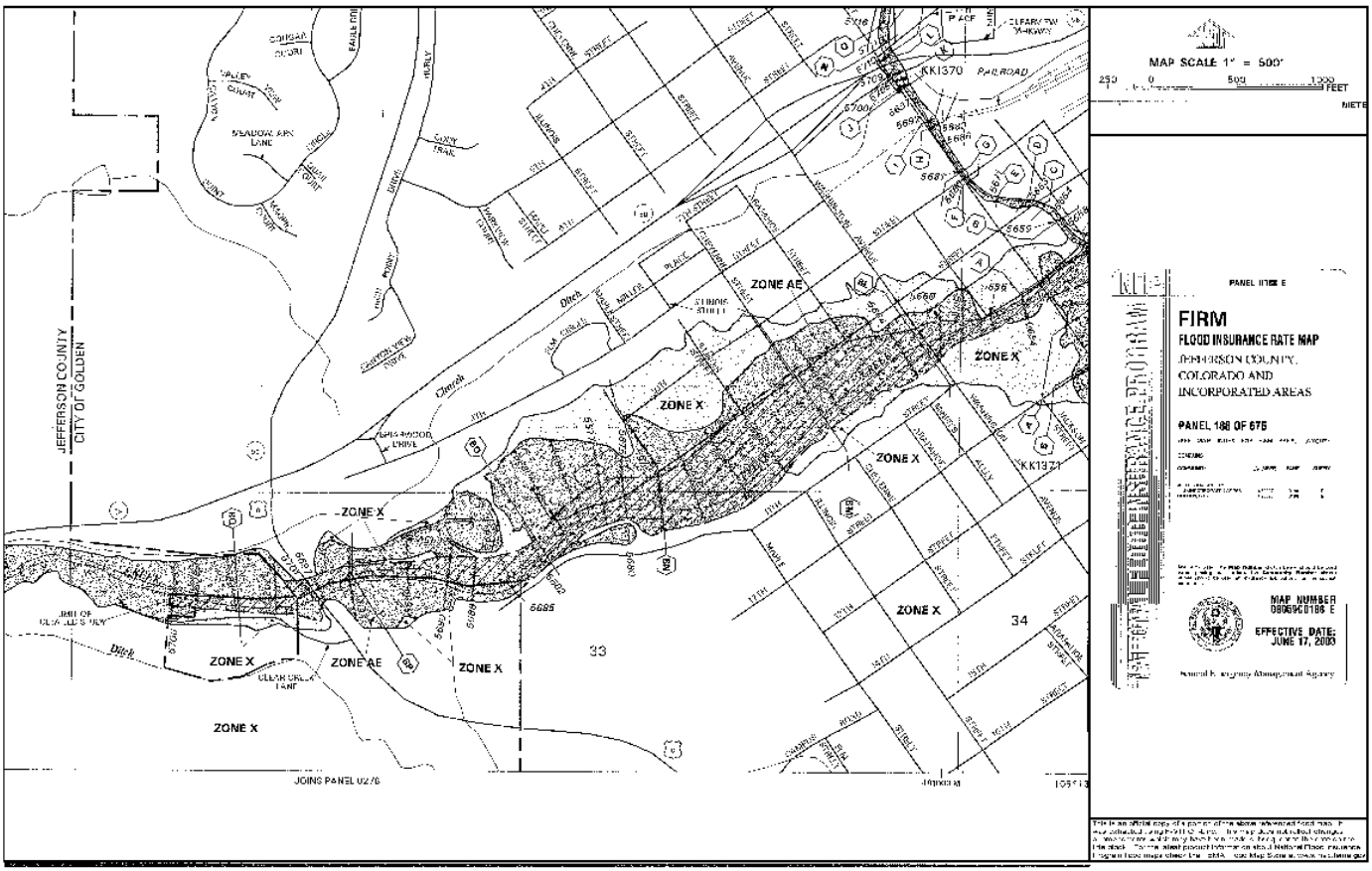
FIGURE 2: Plan view of habitat restoration improvements (sheet 1).

From Initial 404 Permit Application



From 2004 - 404 Permit Application

Attachment B


MAP SCALE 1" = 500'
FIRM
FLOOD INSURANCE RATE MAP
JEFFERSON COUNTY, COLORADO AND INCORPORATED AREAS
PANEL 188 OF 675
MAP NUMBER
EFFECTIVE DATE:
JUNE 17, 2008
ZONE X
ZONE AE
JEFFERSON COUNTY
CITY OF GOLDEN
JOINS PANEL 0276
33
34

GUNNISON WHITEWATER PARK ON THE GUNNISON RIVER

1. BACKGROUND INFORMATION

A. LOCATION

The Gunnison Whitewater Park is located in Gunnison, Colorado on the Gunnison River.

Section 3, Township 49 North Range 1 West, Gunnison County, Colorado.
http://www.gunnison-co.com/images/regimap1.gif

B. 2010 UPDATES

The information in the remainder of this report is based upon the initial 2008 investigation. The 2010 update effort 1) established that in June, 2009 the designer returned (gratis) to improve the second drop prior to the Gunnison River Festival freestyle event in response to criticism and complaints; and 2) noted participation in a new national event series,

Cost: the City does not have a reserve budgeted for whitewater park maintenance. Public Works paid for an excavator at $160/hr. for a day and a half or more, roughly $2,000. They were very happy with the performance.

Source: Alan Moores, City of Pueblo, 22 March, 2010

C. OWNER/OVERSIGHT

Owner: City of Gunnison, jointly with Gunnison County
P.O. Box 239
201 W. Virginia Avenue
Gunnison, CO 81230
970-641-8080

Steward: Upper Gunnison River Water Conservancy District - UGRWCD
P.O. Box 1330
234 North Main Street, Suite 3C
Gunnison, CO 81230
970-641-6065
970-641-1162
ugrwcd@ugrwcd.org

D. MAINTENANCE RESPONSIBILITY:

Maintenance Responsibility: Gunnison County Public Works
Alan Moores - County Planning, Bridge and Road Department
970 - 641-0044
P.O. Box 239 1100 W. Virginia Ave.
Gunnison, CO 81230

"The management and maintenance of the Gunnison Whitewater Park will be overseen by the Todd Crane Center for Outdoor Leadership and the Recreation Department at Western State College." http://www.gunnisoncrestedbutte.com/page.php?pname=areatour/gunnison/whitewater
Western State stepped back from its management role due to personnel changes.

E. COST

Construction Costs	$200,000
RICD Water Rights – Legal etc (estimated)	$475,000
TOTAL Documented	**$675,000**[1]

Does not include costs from subsequent reconstruction and maintenance efforts.

F. COMPLETION DATE

The initial project was completed in 2002. It has been repaired several times during the 2005-07 period and seems to suit users well as of the 2008 season.

2. SAFETY ISSUES AND ACCIDENT REPORTS

There is a drop (not part of this whitewater park) a quarter of a mile downstream of the course that some consider a hazard.

No reports of fatalities or serious accidents were found.

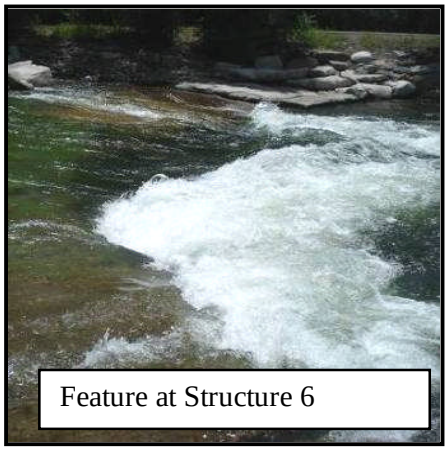
3. DESIGN and CONSTRUCTION DOCUMENTS/DRAWINGS

A. PRELIMINARY DESIGN

Designer: Recreational Engineering and Planning, Gary Lacy, P.E.
"It is my opinion is that the whitewater park will function best at high flow rates…will turn the Whitewater Park into a facility capable of holding whitewater events, and will result in the highest amount of use by the general public. Speaking as the designer of this course, if is my opinion that water flows of 250 cfs represent a minimum navigable flow. Higher flow rates of between 1,600 and 2,000 cubic feet per second ("cfs") are what draw the most boaters


Kiddie Pool at Structure 5

from the most areas. The boating experience and the operation of the Whitewater Park are best at these higher flow rates. The flows of up to 1,600 cfs are controlled at the U-structures and flows up to 2,000 cfs are controlled at the offset deflectors. These water flows of up to 2,000 cfs are put to beneficial use and there will be no waste. The Whitewater Park will be used by many boaters at 250 cfs and above. However, the quality of the Whitewater Park will be enhanced as flows increase. Higher flows make the Whitewater Park the attraction it was meant to be."[3]



Feature at Structure 6

B. CONSTRUCTION DOCUMENTS

Designer: Recreational Engineering and Planning, Gary Lacy, P.E.

No sealed drawings or design drawings meeting the description outlined by the Colorado State Board of Licensure for Professional Engineers were found. Structure and feature description:[4] This park features six drops. The first, fifth and six are river-wide 'U" structures created from grouted rock. The second, third and fourth features are created by "Offset Double Deflectors" used to constrict and direct the flow.

"The Whitewater Park design incorporates a variety of diversion and control structures to create whitewater features that are conducive to whitewater paddling….Structures included in the Whitewater Park include off-set deflectors and "U" drops. Each of these is followed by a self-scouring pool. These structures are designed to divert and control the flow at specific points to create surf waves, rodeo holes, standing waves, eddies, and jets of water for squirt boating."[5,6]

C. CONSTRUCTION METHODS

Grouted boulders were used to construct the features. Alan Moores indicated he wishes they hadn't used this method because it is difficult to repair. Instead, he wishes they had built a diversion so that they could make repairs in a de-watered channel.

Mr. Moores believes that lining the river bottom with larger boulders would have prevented the extreme scouring and that engineering design (retaining walls, etc.) could have eliminated some of their repair issues, to keep the river from constantly changing. He wishes they had thought more 'long term' regarding the design of the course. (Phone conversation with Alan Moores, 10 July, 2007)

Construction of the course employed arched-shaped structural features and base rock for strength and reinforcement.[7]

D. FLOODPLAIN AND HYDRAULIC EVALUATIONS

None were found

E. HYDRAULIC DROP

Through Course (downstream of Diversion drop) = approximately 5 feet.[8]

Surveyed Water Surface Elevations:

7642.6 upstream of diversion
7640.2 downstream of diversion
7635.1 downstream of last structure

F. DESIGN CALCULATIONS

None were found.

G. COURSE LENGTH

Measured to be approximately 1,073 ft. from put-in area to the take-out (July 14, 2007 site visit).

H. CONSTRICTION WIDTHS

See Figure in Attachments.

Structure 1	not constructed (existing diversion)
Structures 2-4 (Deflectors)	
Structure 5	28 feet
Structure 6	38 feet

Measurements below are expressed in inches as measured during a Site Visit. They are approximate measurements of the width of the lowest invert of each structure. Measurements included elsewhere in this document relate to the top width of the constriction.

Structures 2-4 (Deflectors)	19 feet
Structure 5	19 feet
Structure 6	19 feet

I. PHOTOGRAPHS

See file "Gunnison Site Photos" taken 14 July, 2007 when the river level was 763 cfs.

Feature 1

Feature 5

Feature 6

4. WATER AND STREAMBED REQUIREMENTS AND PERFORMANCE

A. PERMITS

Permit 19997550 for aquatic habitat restoration/ whitewater boating improvement project." Regional general permit Number 12 (CO-OYT-0169C) authorized a limited amount of dredge and material discharge.[9]

Nationwide Permit Number 3 authorized maintenance to improve undercutting at two structures 30 November, 2005. In this authorization Permit 200575676 is referenced with a handwritten '75 Ditch' noted. A copy of the 2005 permit was not included in the FOIA response.[10]

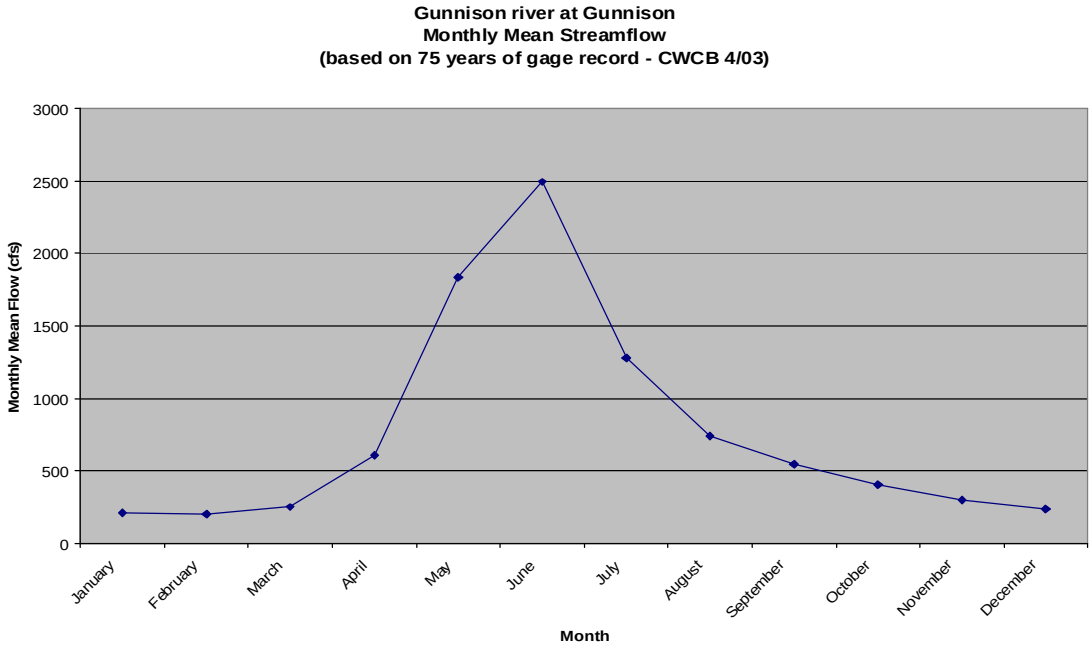
B. RICD INFORMATION

The following flows are decreed according to CWCB case number 02CW38:

Period	**Flows (cfs)**
May 1-15	570
May 16-31	1190
June 1-15	1460
June 16-30	1500
July 1-15	1100
July 16-31	530
August 1-15	460
August 16-31	390
September 1-15	300
September 16-30	270

The Upper Gunnison applied for an RICD water right shortly after the passage of Senate Bill 01-216 in 2001, which authorized certain local governmental entities to obtain one in a river channel for the "minimum stream flow in order to offer a "reasonable recreational experience."[11]

C. FLOWS, RECORDS AND GAGES



Gage for Gunnison River near Gunnison:
http://waterdata.usgs.gov/usa/nwis/uv?site_no=09114500

D. WATER MANAGEMENT IMPACTS'

Results of engineering analysis indicated the park will not affect other uses, and that "77% of the time flow is within design parameters" during usage period (May-Sept). [12]

The CWCB was concerned that this RICD water right could have significant water management impacts. Within several years after the decree for the RICD was entered, the Upper Gunnison River Water Conservancy District recognized that the RICD water rights was having water management impacts, and the District filed a water right application that resulted in a decree amending the RICD decree so the amounts originally decreed were reduced by 2% to allow upstream exchanges could occur without injury to the RICD decree. The Colorado Water Conservation Board determined that exercising the decreed water right will not "cause material injury to any CWCB instream water rights." [13]

E. MODIFICATIONS, FAILURES AND REPAIRS

2005 - REP returned to repair drop that had been scoured out. The initial fix was "okay," according to Alan Moores (July, 2007).

2006 - REP returned to repair the course again as the wave had lost its retentiveness.

2007 - REP returned to help with repairs to Structures 5 and 6 on July 10th. Features were forming only high levels at which there was no eddy access (Alan Moores, 3/25/08).

Engineer and hydrologist Jeff Crane re-built parts of the upstream end of the park, and "fine tuned" other features,. This included "improving the diversion structure for the 75 Ditch, located at the upstream end of the whitewater park…to divert a full decree of water into the ditch, and also create a little water feature at the top end."[2]

In June, 2009 the designer returned (gratis) to improve the second drop prior to the Gunnison River Festival freestyle event in response to criticism and complaints. Cost: the City does not have a reserve budgeted for whitewater park maintenance. Public Works paid for an excavator at $160/hr. for a day and a half or more, roughly $2,000. They were very happy with the performance.[17]

NPR produced a story about Gunnison WW park problems and repairs:
http://www.npr.org/templates/story/story.php?storyId=5670357

F. SEDIMENTATION ISSUES

A site visit was conducted 1:00-3:00 p.m., July 14, 2007. The river level was 703cfs. The river bottom was silty/muddy throughout the park and it appeared that a large amount of debris had washed in at the put-in area. Users report that the bottom feature has been filled in with silt from 2007 high water events, decreasing the drop and rendering the feature unusable.

Measured Pool Depths:	
Below Launch Area	18"
Below First Structure	50"
All Deflector Structures	60"

Below Structure 5 (First playable feature, called "Kiddiepool")	99"
Below Structure 6 (Second playable feature, called "G-Spot")	>116"
Below Structure forming final pool	18"

5. ECONOMIC DEVELOPMENT INTENTION AND PERFORMANCE

A. INTENDED USES

"At lowest flows, the park will mainly be used for beginners and novices to practice their skills on moving water. At higher flows, it will be capable of being used for slalom events, play boating, cartwheeling, Whitewater rodeos, etc."[14]

B. ECONOMIC AND USAGE STUDIES

None found.

C. EVENTS

This course will host one of five events that comprise the 2010 USA Freestyle Kayaking Point Series. www.usfreestylekayak.com/ptseries.html

An annual Gunnison River Festival has been established during the late summer (e.g., August 14-18, 2008) that includes a 'Build Your Own Boat Hooligans Race," float trips, and an Artists' Reception. www.gunnisonriverfestival.com

August 15th through the 17th is the date for this year's Gunnison River Festival! Boaters are already raving about the new improvements made to the local white water park on the Gunnison! With the improvements, boatercross and Down River Race on the Taylor this year's festival is the one you shouldn't miss.

Not all the fun will be at the river's edge. Downtown Gunnison will be the place to bring with the whole family with a climbing wall and tons of fun games and activities. Even Fido has a chance to participate!! Come to closing ceremonies at Timbers Sport Bar for live music, drinks, a white trash costume contest and a good time! This festival is also the same time as River Awareness Week. Take hikes, a float trip or go bird watching around the beautiful Gunnison Valley to see for yourself the importance of our river systems.

Check out the festival at www.gunnisonriverfestival.com for a complete line-up of events. *http://www.boatertalk.com/event/events.php#1025*

D. RECENT DEVELOPMENT IN VICINITY

No evidence or reported recent development in vicinity, and there was no planned upstream development at the time of RICD application. [15]

6. OTHER

Mountain Buzz; Mike Harvey; 04-16-08
Quote:
Originally Posted by sandoz
Once again they allegedly fix our park! Are they gonna come do a tune up like they did in Buena Vista? IT is not even remotely funny how bad the park has gotten. I thought Lacy and Harvey came in last fall? Once again we have a nice joke for everyone to laugh at as they drive by on their way to go someplace ELSE! Doesn't recourse exist anymore?

we did some improvements this fall. they were the types of improvements that could be done with no water control and no grout (i.e. cheap) if things are not working right now at 700cfs I would like to know what it looks like. Could someone post pictures?

I know some are frustrated with the quality of our park. This can be changed. If an RICD Water Right is denied, we can say good-by to fixing what we have.

The truth about the Gunnison Whitewater Park is that it isn't maintained properly so it doesn't get much use by paddlers. If the park was good it would be obvious to everyone that there is an economic benefit from it. I regularly drive to Buena Vista or Salida from Crested Butte to paddle the play parks there because the Gunny park is not worth going to in the condition that it has been in the last few years.
http://www.mountainbuzz.com/forums/f11/save-the-gunny-park-14436.html

Authored by: Admin on Thursday, May 17 2007 @ 03:02 PM MDT

I don't hate to say it, cause I am sure it is true. Our park is so bad it has actually made the kayaking around here worse. It isn't friendly for beginners, because it's hard to surf. Its no good for intermediates, because once you have learned to surf it, you have mostly maxed out its potential. Any advanced paddler who does pull something off might also tell you it took a lot of finesse to land it. The only reason I like the park is because in a squirtboat, it gives up great mystery moves at the right levels, it also has a big water feel and a tough eddy fence which is great for preparing yourself for harder water.

I think what is really bad about the park is that the idea of it raises expectations and the reality of it crushes them. What is sad about the water situation in the park is that if it isn't being enjoyed, it isn't putting the water to good use. The county would probably like to cut their losses on the whole proposition. It will be increasingly difficult to improve the park as more and more failed attempts are made.
http://paddle.gunnison.com/article.php?story=20070509080748196

The Gunnison River starting at the Gunnison Whitewater Park starting at the Gunnison Whitewater Park is the most commonly paddled section of the water near town. The park itself has been in constant state of change to natural high water events and reconstruction since its development in 2001 but there are two main play features with more potentially on the way. The upper one, Kiddiepool, has been a favorite for those working on their front surf and spins. The lower hole, G-Spot, is more popular for more advanced aerials and combos. The character of these features varies greatly with water levels.[16]

7. REFERENCES

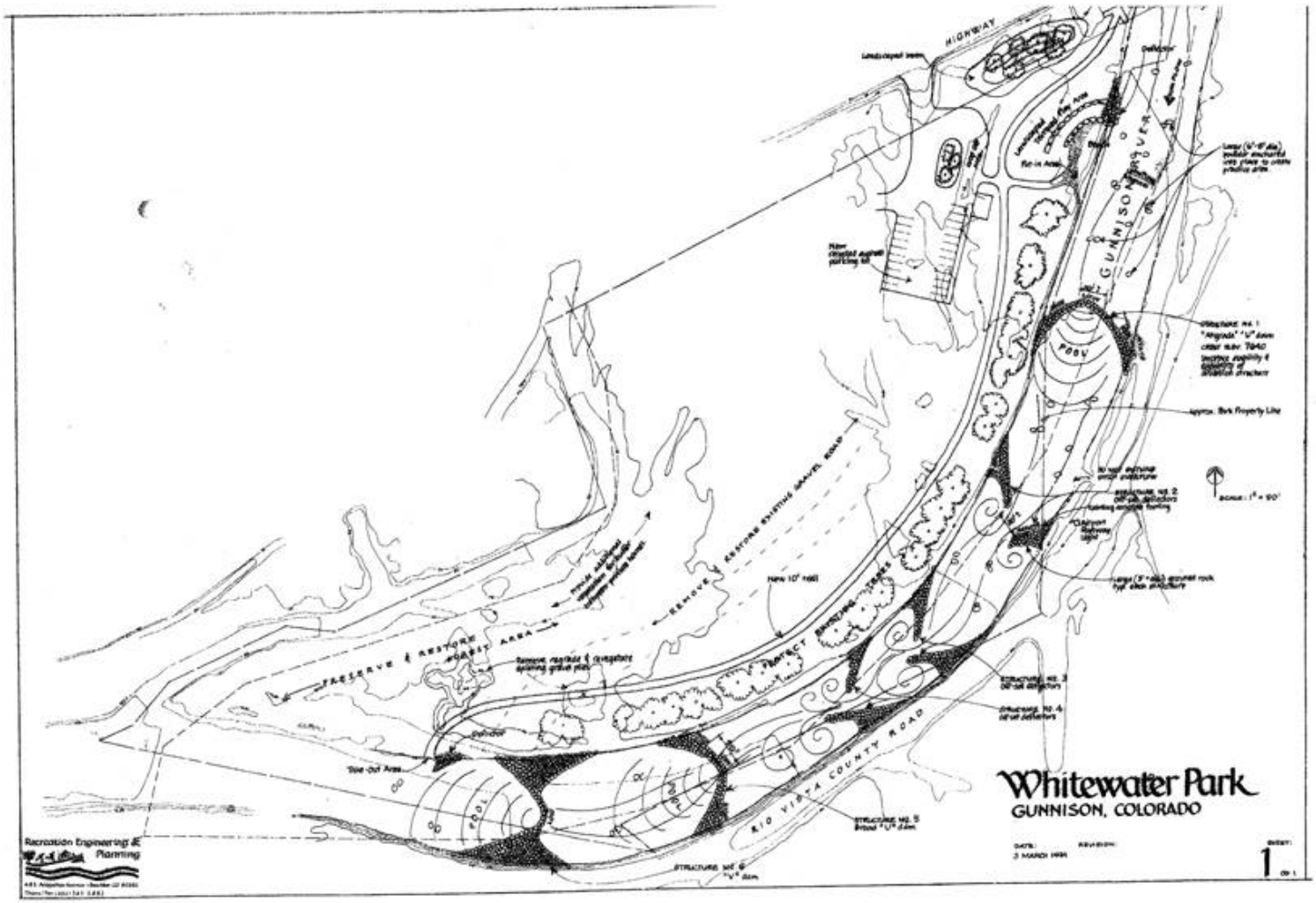
1. Headwaters, Spring, 2006, page 9, 10 & Phone Interview with Alan Moores 8/07
2. Headwaters, Spring, 2006, page 7.
3. Report for the Gunnison River Whitewater Park, Recreation Engineering and Planning, May 17, 2003 pp. 3,4.
4. Upper Gunnison Application for Water Right, page 2.
5. Report for the Gunnison River Whitewater Park, Recreation Engineering and Planning, May 17, 2003, p.10-13.
6. Ibid, pp. 26, 29-31.
7. Ibid, p.10-13.
8. Site survey elevations, R.E. McLaughlin and R. J. McLaughlin, June 19, 2003.
9. USACOE Permit 19997550 for aquatic habitat restoration/ whitewater boating improvement project." Regional general permit Number 12 (CO-OYT-0169C) authorized a limited amount of dredge and material discharge.
10. USACOE Nationwide Permit Number 3 authorized maintenance to improve undercutting at two structures 30 November, 2005. Permit 200575676 is referenced in this authorization.[9]
11. Press release (unknown author) dated December 22, 2005.
12. Letter from Helton & Williamsen, P.C., to Alperstein & Covell, P.C. Subject: Gunnison River Whitewater Course – Case No. 02CW38, July 17, 2002
13. Findings and Recommendations for the Colorado Water Conservation Board to the Water Court Case No. 02CW38, page 2.
14. Report for the Gunnison River Whitewater Park, Recreation Engineering and Planning, May 17, 2003, page.8.
15. Helton & Williamsen, P.C.
16. Whitewater of the Southern Rockies, Evan Stafford and Kyle McCutcheon, page 140.
17. Phone conversation with Alan Moores, City of Pueblo, and 22 March, 2010

User interview notes are included in Gunnison Resources file.

A. Additional Contacts

Gunnison Chamber of Commerce 970-641-1501
Cary Denison, Colorado Land & Water Specialist 970-249-6027 Paddle.Gunnison.com
Frank Kugel - Upper Gunnison River Water Conservation District
Greg Osgood - Gunnison Valley Paddle Club gosgood@gmail.com
Todd Crane - Center for Outdoor Leadership
Terri Stinson, 970.943.2010, tstinson@western.edu
Dr. Kathleen Kinkema - Outdoor Leadership & Resort Management Program, Gym 209, Western State College, Gunnison, CO 81231 970-943-7133, kkinkema@western.edu
Dan Impetro - Parks and Recreation Department, 970-641-8060
Kara Hellige and Cathy Dadey USACE Region (Durango)
Jeff Crane - Consultant, Paonia, CO (interviewed in NPR story)

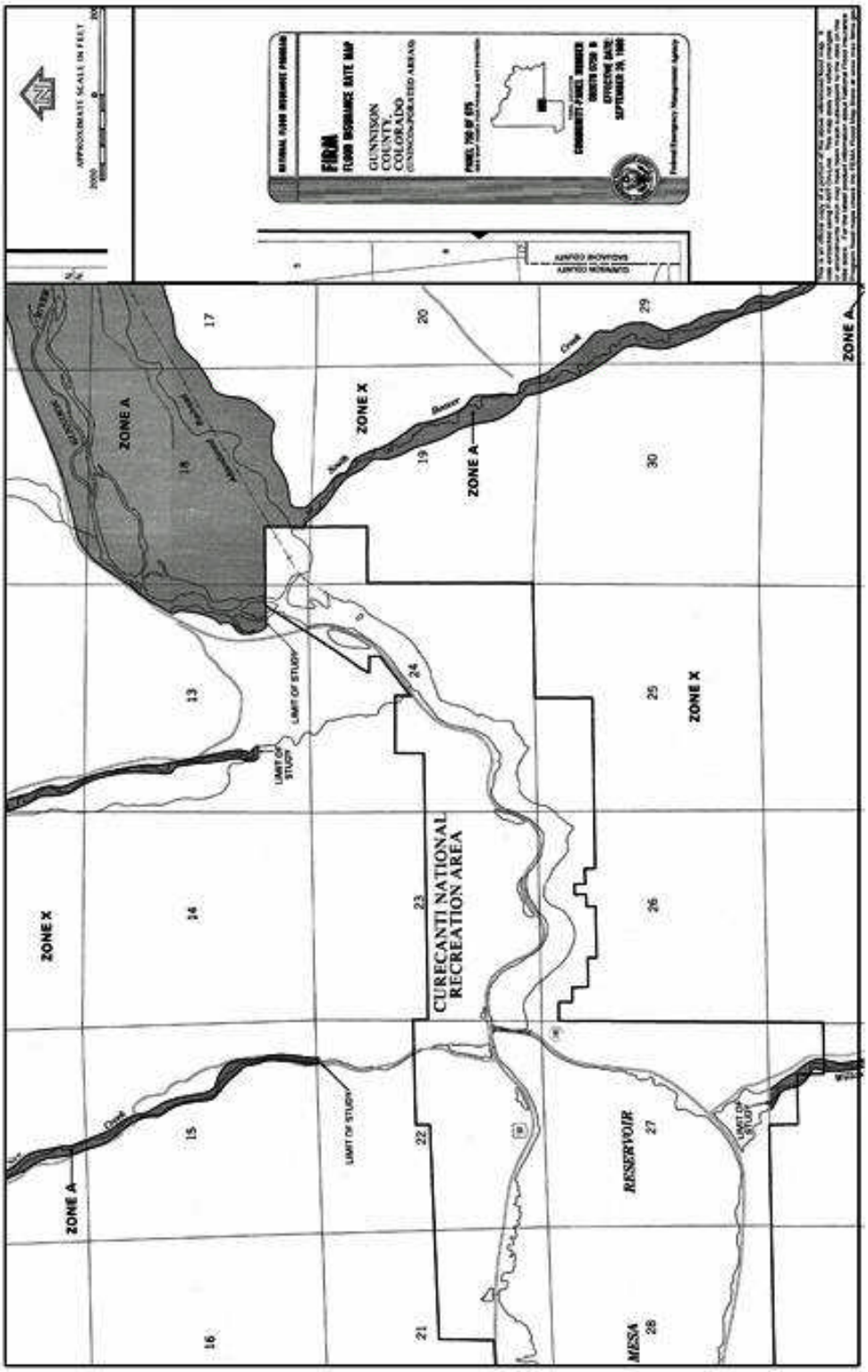
Attachment A


HIGHWAY
GUNNISON RIVER
RIO VISTA COUNTY ROAD
POOL
PRESERVE & RESTORE HABITAT AREA
REMOVE & RESTORE EXISTING GRAVEL ROAD
Whitewater Park
GUNNISON, COLORADO
Recreation Engineering & Planning

Attachment B


1000
0
©2007 Google™

Attachment C

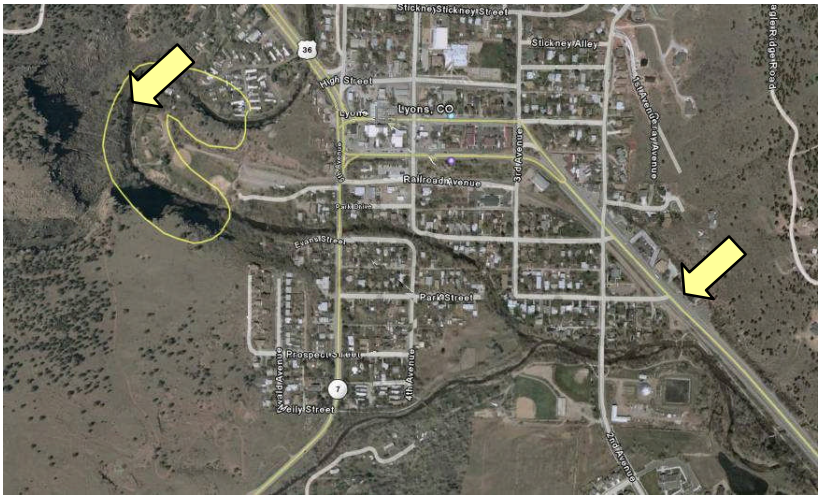

FIRM
FLOOD INSURANCE RATE MAP
GUNNISON COUNTY, COLORADO
ZONE A
ZONE X
CURECANTI NATIONAL RECREATION AREA
RESERVOIR
MESA
LIMIT OF STUDY

LYONS WHITEWATER COURSE INFORMATION

1. BACKGROUND INFORMATION

A. LOCATION

The first recreational feature (circa 1989) is located at Bohn Park, located off of 2nd Ave. just south of Park Street, Lyons, Colorado: Section 18, Township 3 north, Range 70 West, Boulder County, Colorado.[1]



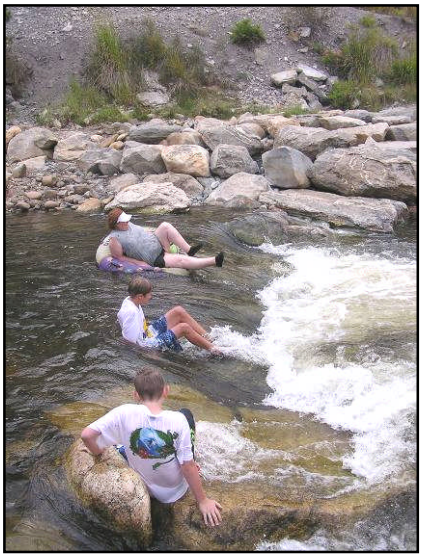
Bohn Park is just south of the confluence of the North and South St. Vrain Rivers

In 2003 work continued at Meadow Park, located just west of the intersection of Highway 7 (5th Ave.) and Railroad Ave. Location is Section 20, Township 3 north, Range 7O West, 4078 Ute, Road, Lyons.[2]

The eight structures that comprise the Lyons Whitewater Park include popular Black Bear Hole. This was installed in 1989, and rebuilt in 2003 after its failure.

B. 2010 UPDATES

The information below is based upon the initial 2008 investigation. No further improvements were identified during the 2010 update.



C. OWNER/OVERSIGHT

Owner: Town of Lyons Recreation Department
Town of Lyons
P.O. Box 49
Lyons, Colorado 80540
Phone: 303-823-6622
Fax: 303-823-8257

Contact: David Cosgrove
Parks and Recreation Director
303-823-8250
davec@townoflyons.com

Steward: Town of Lyons Recreation Department.

Maintenance Responsibility: Lyons Recreation Department (part of Public Works)

The Town of Lyons maintains all park sites, which include Meadow Park (primary course), Black Bear (where festival takes place) and October hole (downstream).

D. COST

Funding sources estimated in an interview with David Cosgrove, Town Manager 8/07.

Construction & Design Costs:	
(2002-03 Meadow Park modifications)	
Cash and in-kind contributions:	$ 130,029
(Cash $103, 258, in-kind $26,772)	
Grants, matches, donations:	
GOCO %72,250, Town $30,700,	
John Elway $1,000 match	$ ~120,000
Total:	$ 250,029

Subsequent to the 2003 improvements Black Bear hole $14K additional was raised to improve Black Bear, and October Hole was improved in 2006 with Town maintenance funds.

In 2007 a line item established for river maintenance: It cost $4,000 first year and is now estimated to total $8,000 annually.

E. COMPLETION DATE

The initial instream modifications were completed in 1989 and the second set of modifications were completed in 2003. Subsequent enhancements mentioned in Section 1c above were completed in 2006.

2. SAFETY ISSUES AND ACCIDENT REPORTS

None were found. Each year the City conducts a review and assessment with kayakers and tubers.

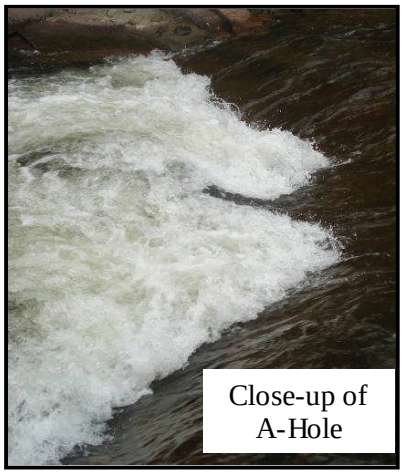
3. DESIGN and CONSTRUCTION DOCUMENTS/DRAWINGS

A. PRELIMINARY DESIGN

Designer: Recreational Engineering and Planning, Gary Lacy
"The 1989 park was designed and permitted to increase instream pool/cover areas for trout."[3] Engineering drawings were not included with the application

B. CONSTRUCTION DOCUMENTS

Designer: Recreation Engineering and Planning - Gary Lacy, P.E.



Close-up of A-Hole

No sealed drawings or design drawings meeting the description outlined by the Colorado State Board of Licensure for Professional Engineers were found.

As described by designer:
V-Dams extend across the entire channel, anchored to the streambanks.[4] Attachments A and B illustrate the 2003 and 2005 improvements, respectively.

C. CONSTRUCTION METHODS

Contractor: Left Hand Excavation Company (Doug Lile)
Grouted Sloping Boulder Drop Construction - Constructed of boulders and grout.
Boulders were placed such that the surfaces match flush to the existing channel invert. A four foot deep pool will be excavated below the structure, with pool depth gradually decreasing in the downstream direction to form the pool tail-out. The resulting pool will provide plunge pool habitat and will be scoured of sediment during high flows. The V-Dam drop will dissipate energy and aerate the water.[5]

D. FLOODPLAIN AND HYDRAULIC EVALUATIONS

Documentation regarding the 1989 construction was not available. In 2003, there was no real opposition to course construction. Few environmentalists were opposed to modifying river because of the pre-existing instream modifications. See Attachment C for FEMA Map.

E. HYDRAULIC DROP

The course gradient is 45 feet per mile.

F. DESIGN CALCULATIONS

None were found.

G. COURSE LENGTH

The course length is approximately one half mile.

H. CONSTRICTION WIDTHS

Documentation was not found.

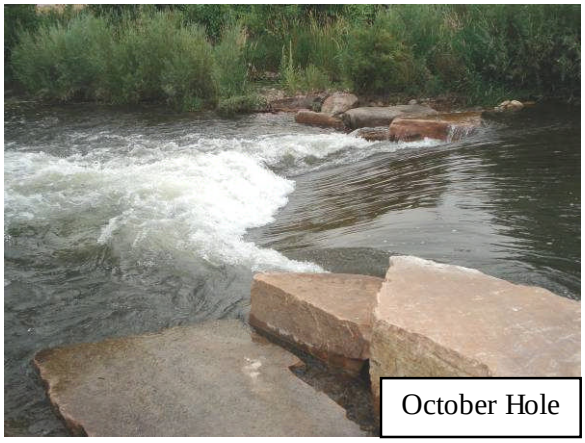
I. PHOTOGRAPHS

See Lyons Site Photos for additional images of this course.

4. WATER AND STREAMBED REQUIREMENTS AND PERFORMANCE

A. PERMITS

The first permits issued were for a "Fishing is Fun" grant program that funded modifications around Bohn Park constructed 1989-1993.


October Hole

GP 79-07 Application 00055 was approved August 29, 1989 to improve fish habitat under the general permit established for Phase II and Phase III. Waterways Within the State of Colorado July 20, 1979.[6]

Permit 199280661 (not included in FOIA response) authorized instream modification at Structure #2.

Permit 200180319 was issued September 21, 2001 to improve recreation, bank stabilization, and fish habitat per an August 30, 2001 amendment that included the use of grout to improve structure stability (this does not make sense but is so documented.)[7]

Authorization for structure maintenance was provided by General Permit No. 79-07 (CO-OYT-0169) Application Number 00055. March 18, 2002 to:
Structure 1 – Stabilize base of concrete sewer line encasement, pool excavation, and raise the downstream invert, downstream of existing sewer line crossing.
Structure 2 - Raise both wings and re-grout, upstream of pedestrian bridge.[8]

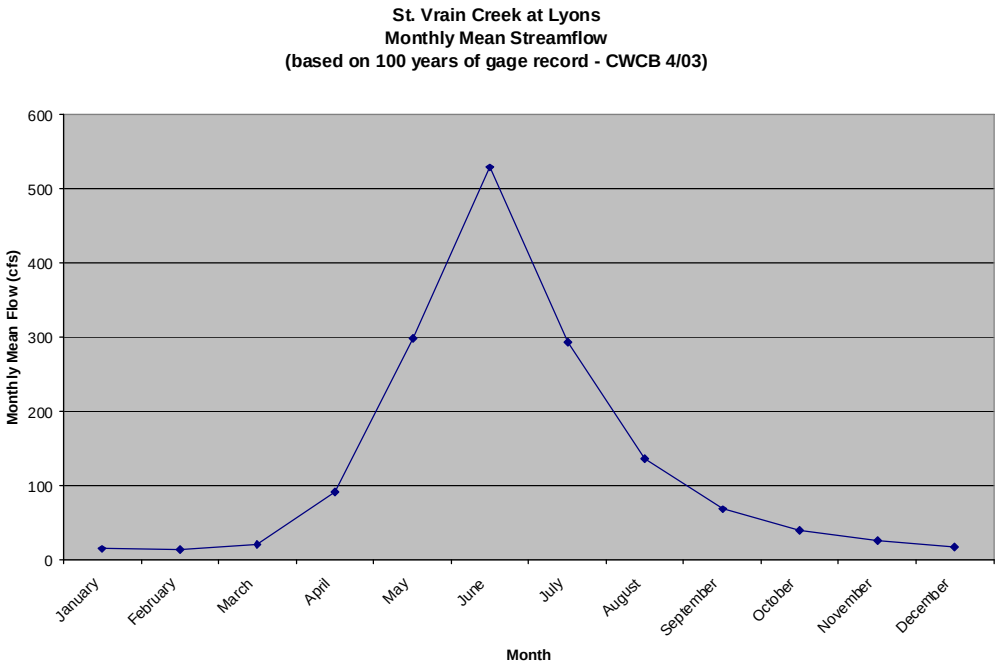
Approval for maintenance under Nationwide Permit No. 3 File No. 200580753 (old ACOE File No. 200180139 – GP 79-07), Meadow Park #3 Structure and Nationwide Permit No. 3, File No. 20050754 (old ACOE File No. 199280661 – GP 79-07), Black Bear #2 Structure.[9]

Permit 200580694 was authorized March 22, 2006 to improve whitewater boating.
Construction of a boulder V-Dam intended to create a self-scouring plunge pool and to dissipate stream energy. The plunge pool excavated below the V-Dam will improve the pool to riffle ration, provide winter holding water, and be scoured of sediment during high flow; Addition of large riffle boulders below and within the pool. [10]

B. RICD INFORMATION

There has been no application for an RICD.

C. FLOW RECORDS GAUGES



The Colorado Division of Water Resources monitors the flow for this park at the Town of Lyons Diversion Station:
www.dwr.state.co.us/SurfaceWater/data/detail_graph.aspx??MTYPE=DISCHRG&ID=LYODIVCO

D. WATER MANAGEMENT IMPACTS

None were found.

E. MODIFICATIONS, FAILURES AND REPAIRS

The flood in 1994 inundated and destroyed what had been built in 1989. Maintenance funds were used to "tweak" the course for safety improvements after the initial adjustments for safety improvements and to remove debris. In 2005, the October Hole was created downstream from the Carter Canal inlet which allows that feature to run to the end of September. Annual maintenance budget has increased from $2,000 to $8,000 / year for instream maintenance and improvements. (David Cosgrove, March 26, 2008).

F. SEDIMENTATION ISSUES

None were mentioned during interviews, nor documented in researched materials.

5. ECONOMIC DEVELOPMENT INTENTION AND PERFORMANCE

A. INTENDED USES

*The whitewater park in Lyons is new as of 2003…The drop structures are spread out more than other local playparks leaving nice big pools and eddies. This playpark is easier than Boulder Creek and the Golden Playpark making it a better choice for the novice boater. The drops are at different angles/slopes lending to a variety of water features and waves. Currently there are not any gates set up. With all the trees around this course, temporary gates will not be a problem. The best rodeo hole is 1/2 mile below the actual playpark. It is just downstream of a foot bridge....*http://boc123.com/Kayak/PlayparkLyons.cfm

Bohn Park has lighted ball fields, a playground, fishing ponds, a shelter house and restrooms, picnic area and a fishing ramp for the handicapped. Meadow Park features playgrounds, picnic sites, a horseshoe pitching area, and camping. The Meadow Park Shelter House has been declared a historic sight.

B. ECONOMIC AND USAGE STUDIES

None have been conducted.

C. EVENTS

The Lyons Outdoor Games (formerly Lyons Whitewater Festival) takes place each summer along the river at Black Bear Hole. The freestyle component participates in the USAFK Point Series www.usafreestylekayak.com

Created 6-years ago [2002], *the Lyons Whitewater Festival, an excuse for paddling buddies from around the country to come together for a day of play in the famed Lyons Whitewater park, the Lyons Outdoor Games has grown into a world class celebration of mountain sports featuring kayaking, mountain biking and even dog events. In addition to competitions for all skill levels the Games will offer numerous clinics and exhibitions put on by some of the world's most elite professional athletes. With such a myriad of activities the 2008 Lyons Outdoor Games promises to offer something for every outdoor enthusiast.* http://www.lyonsoutdoorgames.com/

D. RECENT DEVELOPMENT IN VICINITY

None were reported. The City plans to construct additional drops in Bohn Park.

6. OTHER

The following is a portion of the review of the Lyons Whitewater Park in the most current guidebook for paddling in the southern Rockies:

Although some of the design work came earlier for this in-town stretch, the park has really only developed a personality recently. In 2003 the Black Bear was given a face lift, and was good enough that high water paddlers could throw huge, nearly effortless air loops. In 2005 more changes came, with the immediately downstream construction of the A-Hole – a sweet pocket for hole moves that can be a better feature. Watch for the slightly ugly river left shore line. It isn't

bad for paddling through, but can get exciting if suddenly floating upside-down forwards the rock after a botched freestyle maneuver.

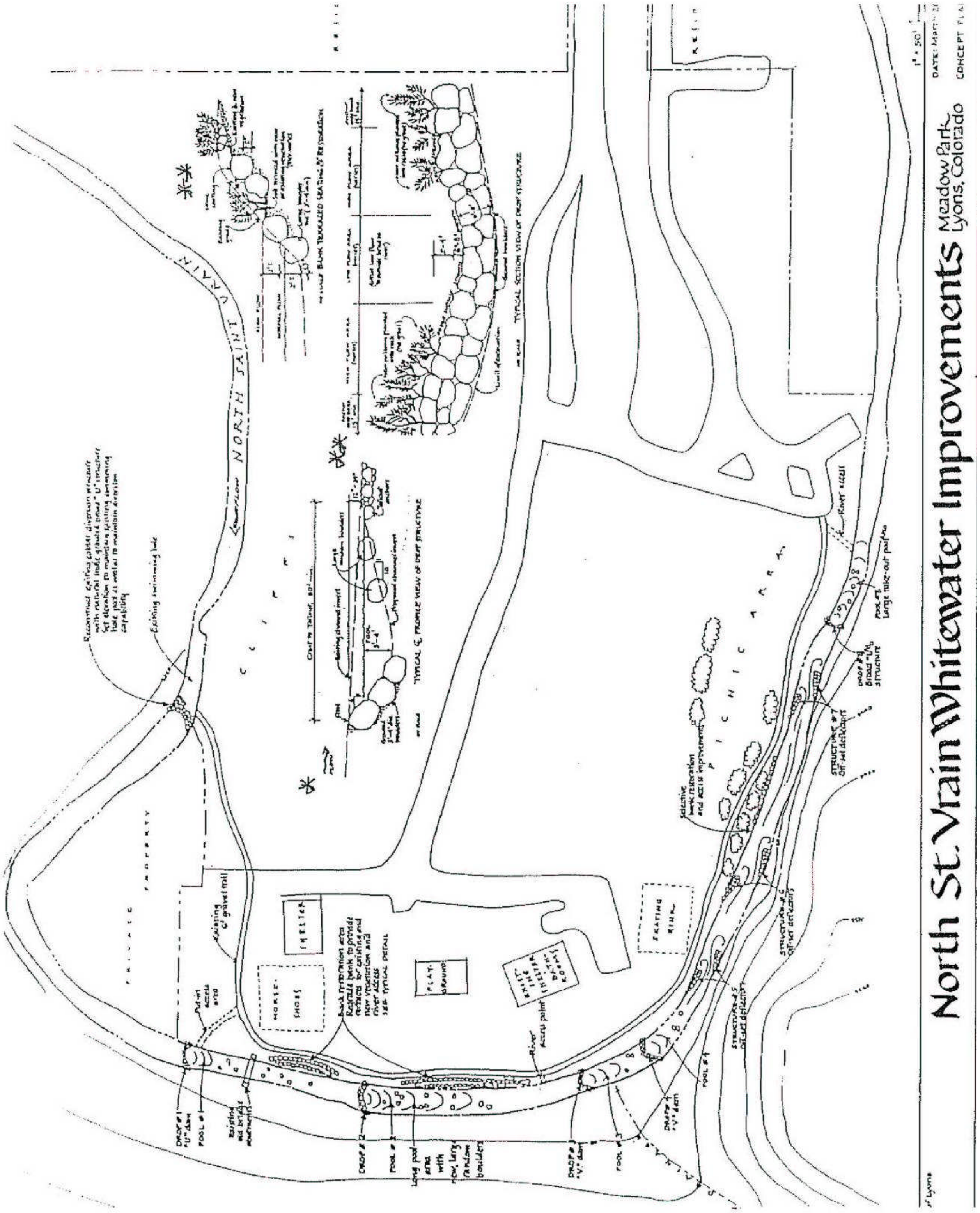
The newest addition to the freestyle options is October Hole, designed to ideally run through October. Although it appears to be a little shy of being good for that long, it is the best of the features at low water. Loops are good as low as 300 cfs, and at lower flow it is still okay for low angle moves and blasts. The feature is a ½ mile downstream of the other two, where the river splits briefly. The left channel is a fun boof over a dam at certain levels, but the higher or lower flows create a bigger hole or shallow landing, making the right channel the better option.

The original whitewater park and the best proving grounds for stark beginners, is located ½ mile upstream of the park and the play features. This is a good thing, since it allows beginners to get a longer run, despite having fewer drops than the other area parks.[11]

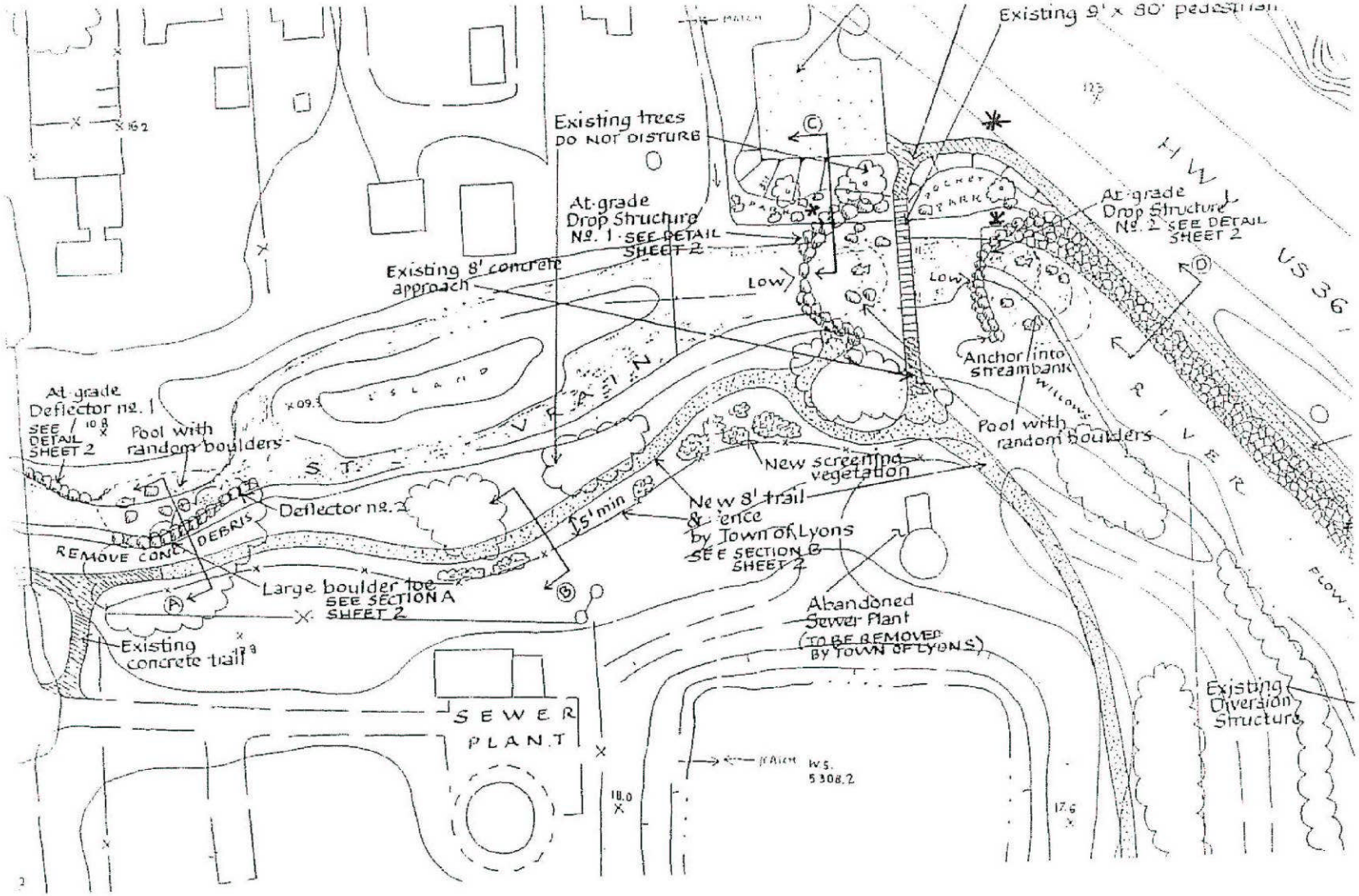
7. REFERENCES

1. *Work Under 1989 General Permit* 79-07 0055, August 22, 1989
2. ACOE Permit 200180319, *ACOE-Lakewood-Lyons,* pages 4-22.
3. *2002 Request for Maintenance Approval*, Lyons_*2002 Maintenance Approval,* March 18, 2002
4. *ACOE Permit 200580694*
5. *Ibid.*
6. *Work Under 1989 General Permit* 79-07 0055
7. ACOE Permit 200180319, *ACOE-Lakewood-Lyons,* pages 4-22.
8. *2002 Request for Maintenance Approval,* March 18, 2002
9. *ACOE Permits 200580753 and 200580754*
10. ACOE Permit 200580694
11. *Whitewater of the Southern Rockies*, Evan Stafford and Kyle McCutcheon, page 292.

Attachment A

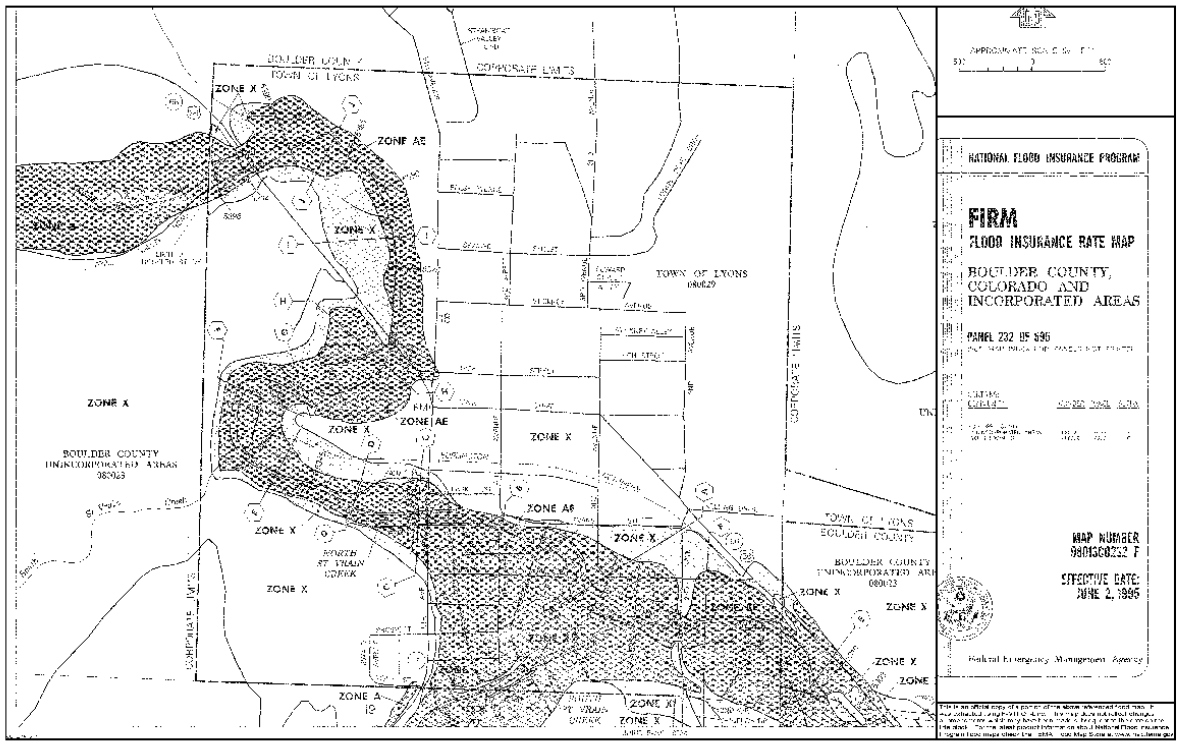

North St. Vrain Whitewater Improvements
Meadow Park
Lyons, Colorado
NORTH SAINT VRAIN
TYPICAL SECTION VIEW OF DROP STRUCTURE
TYPICAL & PROFILE VIEW OF DROP STRUCTURE
SHELTER
PLAY-GROUND
HORSE-SHOES
SKATING RINK
PRIVATE PROPERTY

Attachment B


Existing 9' x 80' pedestrian
Existing trees
DO NOT DISTURB
At-grade
Drop Structure
No. 1 SEE DETAIL
SHEET 2
Existing 8' concrete
approach
At-grade
Drop Structure
No. 2 SEE DETAIL
SHEET 2
Low
Low
Anchor into
streambank
At-grade
Deflector no. 1
SEE DETAIL
SHEET 2
Pool with
random boulders
Pool with
random boulders
New screening
vegetation
New 8' trail
& fence
by Town of Lyons
SEE SECTION G
SHEET 2
15' min
Deflector no. 2
DEBRIS
REMOVE CONC.
Large boulder toe
SEE SECTION A
SHEET 2
Existing
concrete trail
Abandoned
Sewer Plant
(TO BE REMOVED
BY TOWN OF LYONS)
Existing
Diversion
Structure
SEWER
PLANT
W.S.
5308.2
US 36
FLOW
* BLACK BEAR HOLE

Attachment C

Lyons FEMA Map



PAGOSA SPRINGS WHITEWATER PARK
ON THE SAN JUAN RIVER

1. BACKGROUND INFORMATION

A. LOCATION

The Pagosa Springs Whitewater Park is located on the San Juan River, at Hot Springs Boulevard: Section 18, Township 35 North, Range 1 West and Section 13, Township 35 North, Range 2 West, Archuleta County, Colorado.

B. 2010 UPDATES

Except for several 2010 updates, the information in the remainder of this report is based upon the initial 2008 investigation. The 2010 update effort established that in 2009, Davey Wave was removed and a new "replacement" feature (designed by the original engineer) was added. However these improvements are not performing as desired by the Town and a fourth attempt will be made in the future. The future improvements are being designed by another engineering firm.

Source: Pagosa Springs Daily News, February 9, 2010

C. OWNER/OVERSIGHT

Owner: Town of Pagosa Springs
Mark Garcia
Town Manager
PO Box 1859
Pagosa Springs
CO. 81147
(970) 264-4151 ext 236
mgarcia@pagosasprings.co.gov

Tamra Allen
Town Planner
(970) 264-4151 ext 235
tallen@pagosasprings.co.gov

Steward: Town of Pagosa Springs
Same contacts as above.

Maintenance Responsibility: Town of Pagosa Springs
Same contacts as above.

D. COST

Initial structures were constructed in 1993. A portion (removed during later construction in 2005) of that construction cost was reported at $200,000. (The Durango Herald, October 23, 2005, included in Attachments) Construction costs for the 1993 or 2005 construction were not available.

Engineering fees of the 2005 effort by REP was reported at $100,000. Engineering and Management of the future improvements is expected to cost $41,000.

E. COMPLETION DATE

Early river restoration work was completed in 1993. River restoration that included recreational enhancement was conducted in 2005.

2. SAFETY ISSUES AND ACCIDENT REPORTS

None found or reported.

3. DESIGN and CONSTRUCTION DOCUMENTS/DRAWINGS

A. PRELIMINARY DESIGN

Initial Project/Designer (1993-1994): David L. Rosgen, Hydrologist.

Second Project, 2005
Designer: Gary Lacy, P.E.

B. CONSTRUCTION DOCUMENTS

Initial Project
Designer: David L. Rosgen, Hydrologist

This improvement involves 1.5 miles of stream habitat improvement structures, a fish hatchery, and recreational trails within the City of Pagosa Springs.

No sealed drawings or design drawings meeting the description outlined by the Colorado State Board of Licensure for Professional Engineers were found.

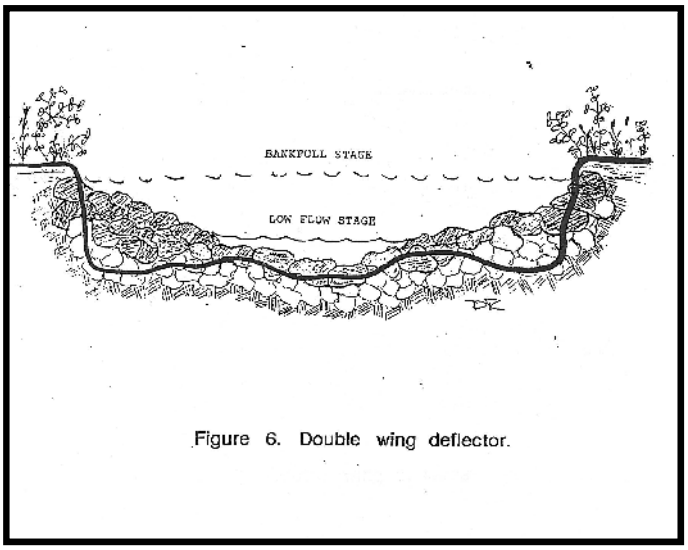


Figure 6. Double wing deflector.

Sketch of W-shape Weir (Rosgen)

Second Project, 2005
Engineer: Gary Lacy, P.E.

Revision Designer: Recreation Engineering and Planning, Gary Lacy
No sealed drawings or design drawings meeting the description outlined by the Colorado State Board of Licensure for Professional Engineers were found.

A general plan was prepared (See Attachment A). REP believed the pre-existing W-Weir and reflectors "provide good habitat for aquatic life but to do not provide good features for kayakers at normal flows."[2]

No sealed drawings or design drawings meeting the description outlined by the Colorado State Board of Licensure for Professional Engineers were found.

Feature from Upstream

Close-up of Feature

The Town of Pagosa Springs placed a number of habitat improvement structures throughout the reach of the San Juan River in 1994. Through public process and feedback from the recreational paddlers in Pagosa Springs the Town was made aware of the need for modification to several of the "W" weirs including the structure that was removed as a result of the recent project. The "W" weir was perceived, at best, to have little to no recreational value for the boating community and, at worst, was a hazard to downstream navigation by all types of watercraft and users. Through a Request for Proposal (RFP) issued by the Town and a subsequent evaluation process Recreation, Engineering and Planning was hired to replace the "W" weir with a "U" drop structure.

The "U" Drop was designed and built with many functions in mind including, safety, navigability, pedestrian access, bank stability sediment transport, whitewater performance and aquatic habitat.[3]

C. CONSTRUCTION METHODS

Initial construction by Wildland Hydrology for habitat structures utilized ungrouted boulders. "Vegetative transplants were planted along the river banks throughout the project reach. A stream bar at the northernmost inside bend was cut and filled to re-contour the main channel in this area. A river center (or fish hatchery) was constructed at the north end of the project that included the excavation of two ponds and a spawning channel. Excavation at the hatchery will total 16,000 cy and 15,200 cy of this material was distributed inland to create an 8-foot high terrace. Excess excavated material was hauled off-site."[4]

2005 construction utilized heavily grouted boulders.

D. FLOODPLAIN AND HYDRAULIC EVALUATIONS

Proper floodplain calculations and evaluations were not originally performed in 2005, and the ACOE viewed the structures and the floodplain were illegally placed and raised, respectively.[5] See Attachment B for FEMA map.

E. HYDRAULIC DROP

This information is not included in design plans.

F. DESIGN CALCULATIONS

Records design calculations were not found. Illustrations such as the one below exemplify design substantiation, from the designer's permit application[6]:

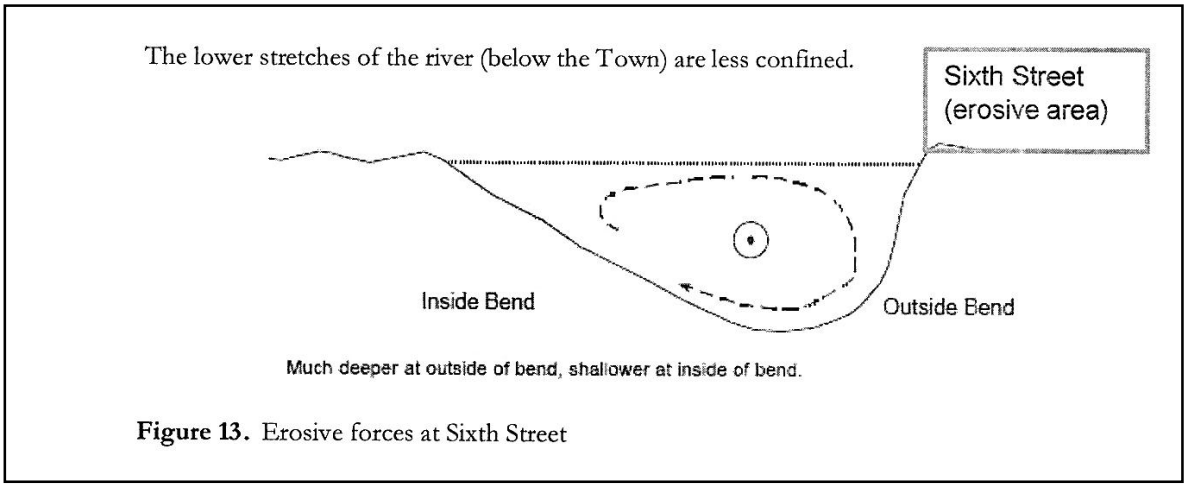


Figure 13. Erosive forces at Sixth Street

G. COURSE LENGTH

The course measures 4,000 feet.

H. CONSTRICTION WIDTHS

The constriction width measure approximately 30-40 feet.

I. PHOTOGRAPHS

See Pagosa Springs Site Photos for additional images.

4. WATER AND STREAMBED REQUIREMENTS AND PERFORMANCE

A. PERMITS

Permit #199375014 was issued to construct 25 single deflectors, 5 double-wing deflectors, 12 vortex rock weirs, 4 W-shaped weirs, and 65 individual rock retards in 1.5 miles of the San Juan River.[7]

Permit #200575106 - The permit was signed March 12, 2007. [8]

B. RICD INFORMATION

An application has not been submitted.

C. FLOW RECORDS GAUGES

http://www.waterdata.usgs.gov San Juan River at Pagosa Springs Station Number 09342500

D. WATER MANAGEMENT IMPACTS

March, 2005 instream work removed a USGS gauging station (09342500) that had been in place since 1910 providing real-time stage and streamflow data to federal, state and local governments as well as recreational water users. It was anticipated that the replacement gauge, located 200 ft. upstream, would alter stream flow once the new construction took place. There was no post-construction documentation found regarding this concern.

The U-Structure installed below the Hot Springs Boulevard Bridge increased the level of the San Juan River floodplain. ACOE expressed concerns about a lack of data and documentation concerning the purpose of the installed structures.[9]

E. MODIFICATIONS, FAILURES AND REPAIRS

The Town was ordered to cease activity by the ACOE on March 15 on the 2005 project. A request to shore up damaged due to the halted work was requested by the City April 20, 2005, and Permit 200575106 was approved March 12, 2007.

2010 Update: The work was completed in 2009: however, the performance of the improvements did not meet recreational needs. Further engineering and management fees have been authorized for further work in 2011.[10]

F. SEDIMENTATION ISSUES

Concern about the sedimentation impacts were expressed by the ACOE. No post-construction evaluation was found online or received in materials procured through a FOIA request.

5. ECONOMIC DEVELOPMENT INTENTION AND PERFORMANCE

A. INTENDED USES

The original objectives for the project were to

- *Establish self-sustaining fish populations*
- *Improve conditions for recreational fishing*
- *Provide a self-guided Nature Center for education*
- *Provide a handicap fishing and trail opportunity*
- *Improve the visual values of the river*
- *Provide year-round recreation*[11]

The revision in 2005 intended to improve recreational and functional habitat characteristics.

B. ECONOMIC AND USAGE STUDIES

No economic impact studies have been fielded.

C. EVENTS

None related to the completion of this project.

D. RECENT DEVELOPMENT IN VICINITY

Not documented relative to the completion of this project.

6. OTHER

Site Visit Summary: Rosgen's structures did not provide good features for freestyle kayaking. The U structures provide opportunities for cartwheels, flat spins, blunts and loops.

A year ago, in March 2009, men and machines waded into the downtown stretch of the San Juan River to fix some problems that similar men and machines had created here in March 2005. In the process of that repair, they created a new, artificial "white water wave" feature directly in front of the Chamber of Commerce Visitor Center — a feature that was enjoyed by hundreds of swimmers, kayakers, and inner tube riders throughout the summer months[10].

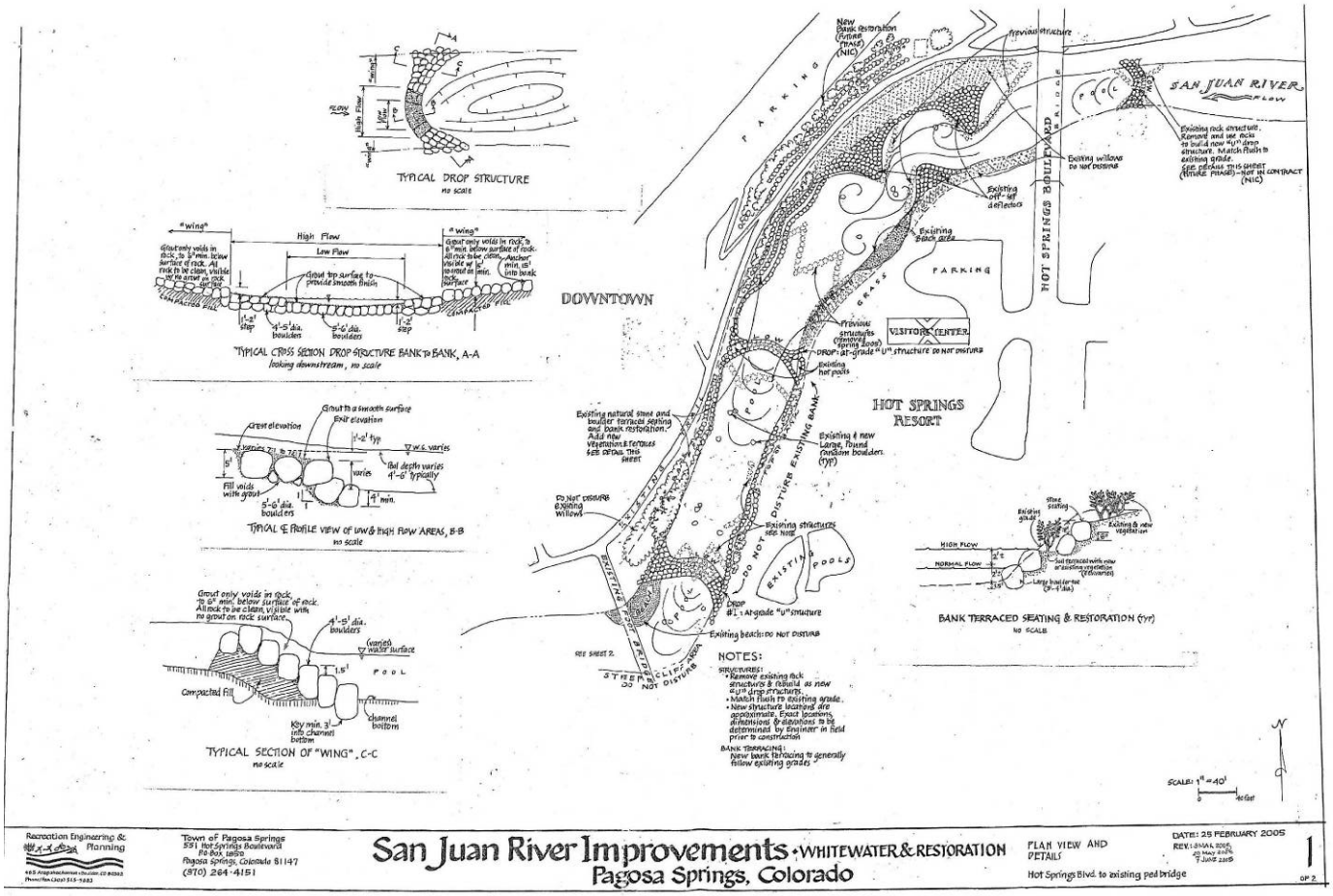
This Article reported on the instream work in 2005 both clarified public sentiment for the improvements and the nature of the violations.

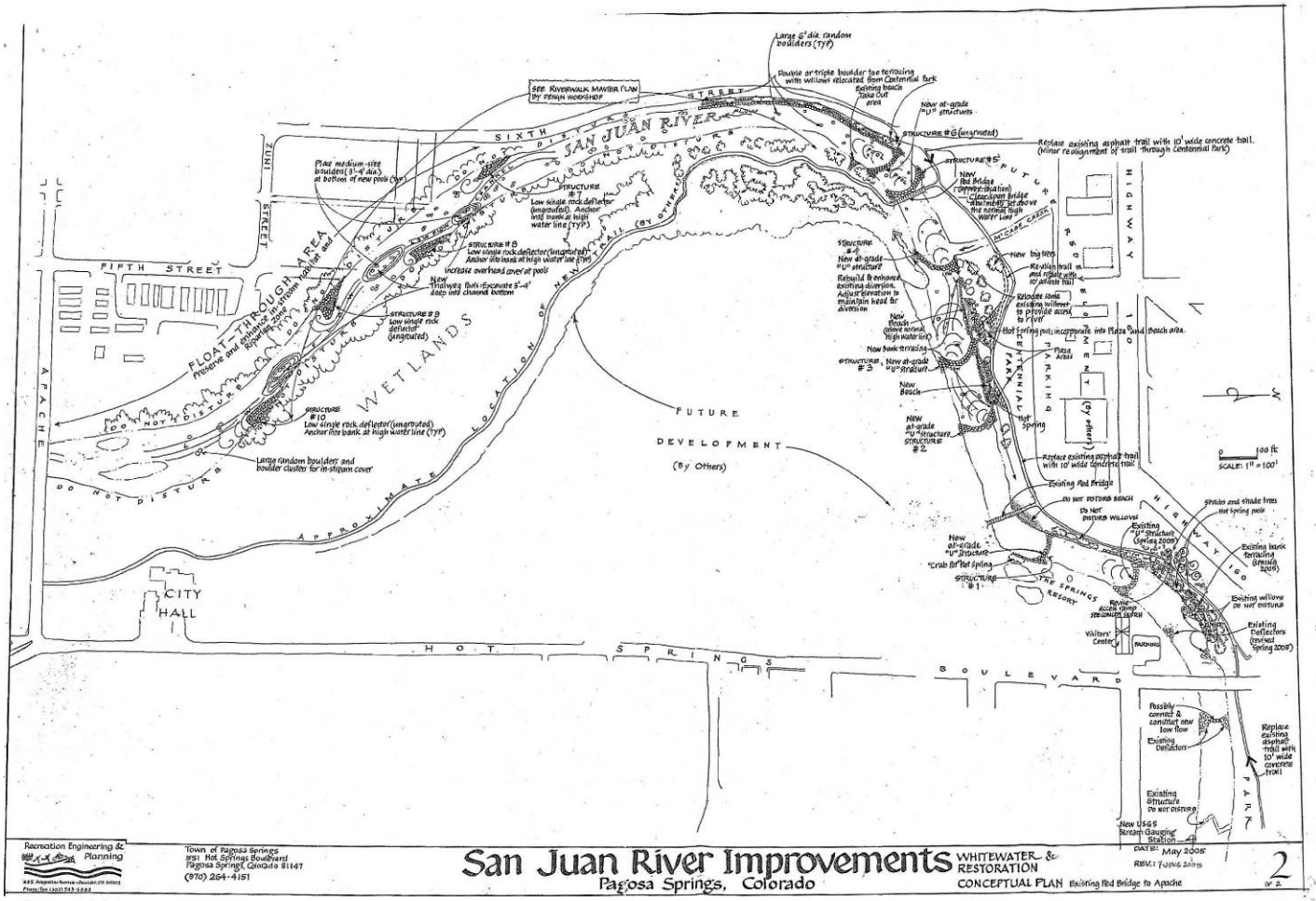
7. REFERENCES

1. Durango ACOE *Durango Herald*, October 23, 2005, pp 12-16
2. ACOE Permit 1993.
2. *The Cross-Vane, W-Weir and J-Hook Vane Structures…Their Description, Design and Application for Stream Stabilization and River Restoration*, Recreational Engineering and Planning (not dated).
3. 200575106 Submission of Additional Information, *Design Analysis for the Pagosa Whitewater Park and Fish Habitat Improvement*, Recreational Engineering and Planning, December 15, 2005.
4. ACOE Permit 199375104.
5. *200575106 Request for Additional Information*, Letter from Kara Hellige to Mark Garcia, August 26, 2005.
6. *200575106 Submission of Additional Information*, page 27.
7. *199375014 Request for Additional Information*, Letters from Colorado Water Division 7, CDWR and ACOE Permit 200575106.
8. *ACOE Permit 200575106*.
9. *200575106 Request for Additional Information*, Letter from Kara Hellige to Mark Garcia, August 26, 2005.
10. *199375014 Additional Information Request*, page 7.
11. Delay in White Water Project May Be a Good Thing?; *Pagosa Springs Daily News*,B. Hudson ; 2/9/10

Attachment A

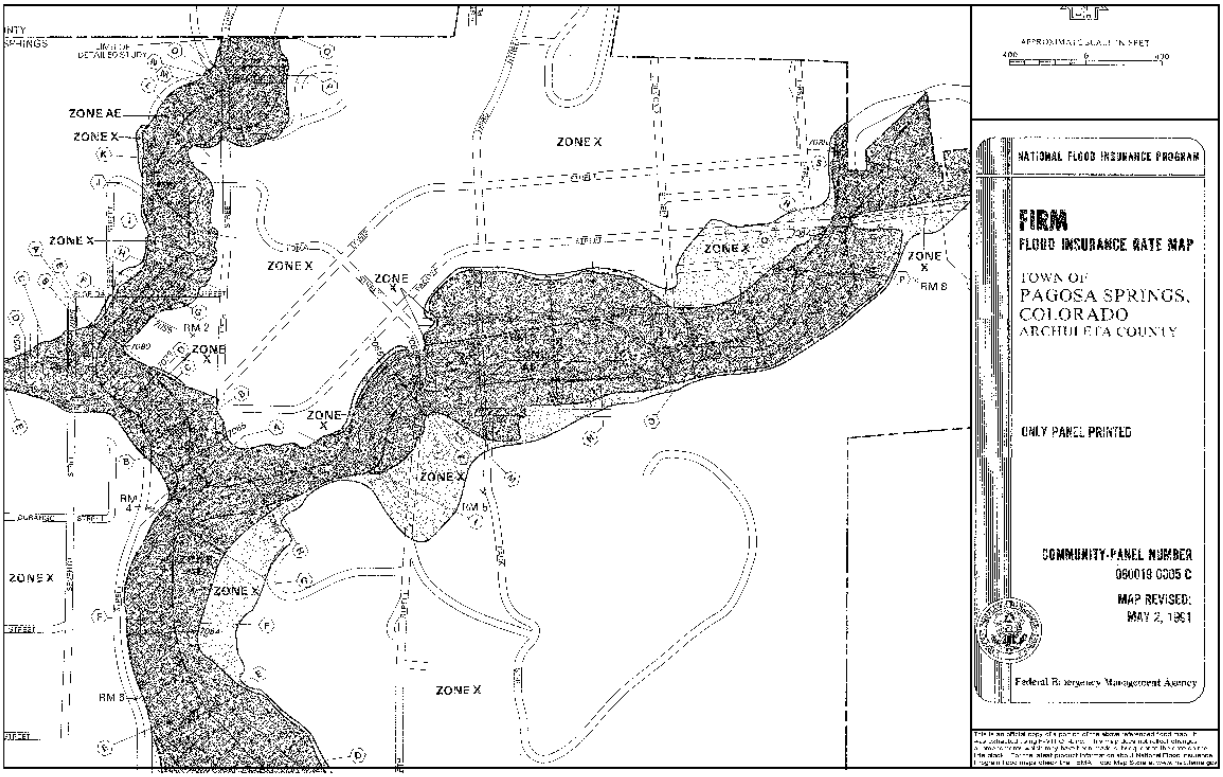
Pagosa Springs Restoration and Recreation Improvement Plan - 2005


TYPICAL DROP STRUCTURE
no scale
"wing"
High Flow
Low Flow
"wing"
Grout only voids in rock, to 6" min. below surface of rock. All rock to be clean, visible with no grout on rock surface
Grout top surface to provide smooth finish
Anchor min. 18" into bank
Compacted Fill
4'-5' dia. boulders
5'-6' dia. boulders
1'-2' step
TYPICAL CROSS SECTION DROP STRUCTURE BANK to BANK, A-A
looking downstream, no scale
Grout to a smooth surface
Crest elevation
Exit elevation
1'-0' typ
w.s. varies
5'
varies
Bed depth varies 4'-0' typically
Fill voids with grout
5'-6' dia. boulders
4' min.
TYPICAL E PROFILE VIEW OF LOW & HIGH FLOW AREAS, B-B
no scale
Grout only voids in rock, to 6" min. below surface of rock. All rock to be clean, visible with no grout on rock surface
4'-5' dia. boulders
Varied w.s. surface
1.5'
POOL
Compacted Fill
Key min. 3' into channel bottom
Channel bottom
TYPICAL SECTION OF "WING", C-C
no scale
New Bank Restoration (Future Phase) (NIC)
Previous structure
SAN JUAN RIVER
FLOW
POOL
Existing rock structure. Remove and use rocks to build new 4'0" drop structure. Match flush to existing grade. See details this sheet (FUTURE PHASE) - NOT IN CONTRACT (NIC)
Existing willows do not disturb
Existing off-set deflectors
HOT SPRINGS BOULEVARD
PARKING
Existing beach area
PARKING
DOWNTOWN
GRASS
Previous structures (Remove & dispose of upon completion)
VISITORS CENTER
DROP-at-grade "U" structure DO NOT DISTURB
Existing hot pools
HOT SPRINGS RESORT
Existing natural stone and boulder terrace seating and bank restoration. Add new vegetation & terraces SEE DETAIL THIS SHEET
Existing & new Large, found Custom boulders. (typ)
DO NOT DISTURB EXISTING BANK
DO NOT DISTURB Existing Willows
Existing structures see note
EXISTING POOLS
Drop #1 - At-grade "U" structure
Existing beach: DO NOT DISTURB
see sheet 2.
OTHER AREAS DO NOT DISTURB
NOTES:
STRUCTURES:
• Remove existing rock structure & rebuild as new 4'0" drop structure.
• Match flush to existing grade.
• New structure locations are approximate. Exact locations, dimensions & elevations to be determined by Engineer in field prior to construction
BANK TERRACING:
New bank terracing to generally follow existing grades
Stone seating
Existing grade
Existing & new vegetation
HIGH FLOW
NORMAL FLOW
Soil terraced with new or existing vegetation (3 locations)
Large boulder for seat (3'-5' dia.)
BANK TERRACED SEATING & RESTORATION (typ)
no SCALE
SCALE: 1" = 40'
Recreation Engineering & Planning
Town of Pagosa Springs
551 Hot Springs Boulevard
PO Box 1859
Pagosa Springs, Colorado 81147
(970) 264-4151
San Juan River Improvements - WHITEWATER & RESTORATION
Pagosa Springs, Colorado
PLAN VIEW AND DETAILS
Hot Springs Blvd. to existing ped bridge
DATE: 25 FEBRUARY 2005
REVISIONS: 20 MAY 2005, 7 JUNE 2005
1
SP 2.


SEE RIVERWALK MASTER PLAN BY DENVER WORKSHOP
SIXTH STREET
SAN JUAN RIVER
FIFTH STREET
APACHE
CITY HALL
FLOAT-THROUGH AREA
WETLANDS
FUTURE DEVELOPMENT (By Others)
APPROXIMATE LOCATION OF NEW TRAIL (By Others)
HOT SPRINGS BOULEVARD
HIGHWAY 160
PARKING
Large 6' dia. random boulders (TYP.)
Bouvie ar-triple boulder toe terracing with willows relocated from Centennial Park
Existing Beach Take Out area
New at-grade "U" structures
STRUCTURE #6 (ungrouted)
STRUCTURE #5
Replace existing asphalt trail with 10' wide concrete trail. (Minor realignment of trail through Centennial Park)
Place medium-size boulders (3'-4' dia.) at bottom of new pools (TYP.)
STRUCTURE #7 Low single rock deflector (ungrouted). Anchor into bank at high water line (TYP.)
STRUCTURE #8 Low single rock deflector (ungrouted). Anchor into bank at high water line (TYP.)
Increase overhead cover at pools
New Trailway flow - Excavate 3'-4' deep into channel bottom
STRUCTURE #9 Low single rock deflector (ungrouted)
STRUCTURE #10 Low single rock deflector (ungrouted). Anchor into bank at high water line (TYP.)
Large random boulders and boulder cluster for in-stream cover
DO NOT DISTURB
New Fishing Pool
New Bridge (approximate location) Clear span bridge abutments set above the normal high water line
New big trees
Re-align trail as noted with 10' wide trail
New at-grade "U" structure
Rebuild & enhance existing diversion. Adjust elevation to maintain head for diversion
Relocate bank, existing willows to provide access to river
New Beach (above normal high water line)
New bank terracing
STRUCTURE #3 New at-grade "U" structure
Plaza Areas
New Beach
Hot spring pool incorporate into Plaza and beach area.
New at-grade "U" structure STRUCTURE #2
Hot Spring
Replace existing asphalt trail with 10' wide concrete trail
Existing Rod Bridge
DO NOT DISTURB BEACH
DO NOT DISTURB WILLOWS
Shade and shade trees not spring pole
New at-grade "U" structure
"Crab for Hot Spring
STRUCTURE #1
HOT SPRINGS RESORT
Existing "U" Structure (Spring 2009)
Existing bank terracing (Spring 2009)
Existing willows DO NOT DISTURB
Existing Deflectors (Revised Spring 2009)
Revise access ramp per CDOT/CDPHE
Visitors' Center
PARKING
Possibly connect & construct new low flow
Existing Deflectors
Existing Structure DO NOT DISTURB
Replace existing asphalt trail with 10' wide concrete trail
New USGS Stream Gauging Station
0 100 ft
SCALE: 1" = 100'
Recreation Engineering & Planning
Town of Pagosa Springs
1551 Hot Springs Boulevard
Pagosa Springs, Colorado 81147
(970) 264-4151
San Juan River Improvements
Pagosa Springs, Colorado
WHITEWATER & RESTORATION
CONCEPTUAL PLAN Existing Rod Bridge to Apache
DATE: May 2005
REV.: June 2005
2 of 2

Attachment B

Pagosa Springs FEMA Map



PUEBLO WHITEWATER PARK ON THE ARKANSAS RIVER

1. BACKGROUND INFORMATION

A. LOCATION

The Pueblo Whitewater Park is located upstream of 500S Union Street in the Arkansas River, Pueblo, Colorado. It runs between Power Plant Diversion Structure 1 and the Union Street Bridge, and includes the Moffat Street Chute (Structure 9).

SW ¼ of NW ¼, Section 36, T. 20 S., R. 65 W., of the 6th P.M. at a point approximately 2,326 ft. South of the North Section line and 810 ft. East of the West Section line of Section 36.[1]

B. 2010 UPDATES

The information in the remainder of this report is based upon the initial 2008 investigation. The 2010 update effort established that levy seepage between and downstream of Drops 3 and 4 has occurred due to the higher water level below Drop 1. The levy is cracked and the Pueblo Flood Control District is working with the USACE to determine a corrective plan.

Separately, access improvements are planned for implementation after the completion of a bridge replacement at the site.

Scott Hobson, City of Pueblo, March 24, 2010

C. OWNER/OVERSIGHT

Owner: City of Pueblo
c/o Mr. Lee R. Evett
City Manager
One City Hall Place
Pueblo, CO 81003
719-584-0800

Steward: City of Pueblo with help of Pueblo Paddlers
http://www.pueblopaddlers.com/

Maintenance Responsibility: City of Pueblo Public Works
Dan Centa
211 East D Street · Pueblo, CO 81003
719-553-2295
http://pueblo.us/cgi-bin/gt/tpl_page.html,template=1&content=57&nav1=1&

D. COST

Design and Engineering $1,500,000[2]
The cost to secure the RICD was not available**.**
The cost for repair, reconstruction and erosion control after initial installation is not available.

E. COMPLETION DATE

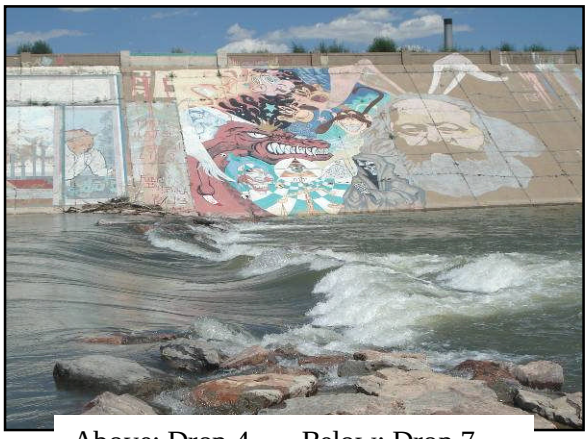
The course was originally completed May, 2005[3] Corrective construction continues on an on-going basis.

2. SAFETY ISSUES AND ACCIDENT REPORTS

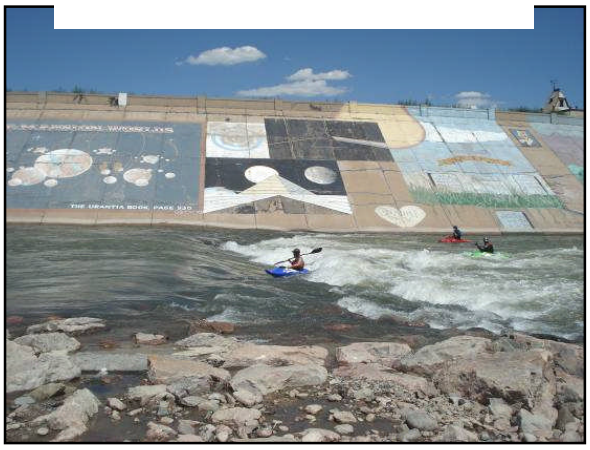
There were safety concerns regarding the bottom two features after a high water drowning occurred shortly after the opening of the park in May, 2005. These have reportedly been altered to improve safety.

Around midnight on July 17 2008, a man fell into the whitewater park and drowned.

During a site visit 8-08-08 signs are in place warning paddlers about dams (one mile) downstream.



Above: Drop 4 Below: Drop 7



3. DESIGN AND CONSTRUCTION DOCUMENTS/DRAWINGS

A. PRELIMINARY DESIGN

Designer: Recreation Engineering and Planning-Gary Lacy, P.E.

B. CONSTRUCTION DOCUMENTS

US Army Corp of Engineers

Gary Lacy, P.E. participated in design.

Construction Documents provided in Attachments.

The Arkansas River Legacy Whitewater Park will include a boat chute/fish ladders to allow kayaks, boat sand other recreational water craft, as well as native and sport fish to pass over an existing 13-foot high diversion structure, the Southern Colorado Power Plant/West Plains Energy diversion dam.

A series of seven smaller, permanent control structures will then be constructed between the Power Plant diversion and the Union Street Bridge to create self-scouring pools and to divert and control the flow of the river at specific points to create various wave forms desirable for whitewater kayaking and recreational boating.

The Whitewater Park includes a boat chute downstream at the existing St. Charles Mesa Water District diversion downstream of the Santa Fe bridge. Near Moffat Street built in the 1980's, it is known as the Moffat Street Chute (inconsistently included and referenced as the ninth drop).

Access to the Whitewater Park is available at points along the paved public trail, down to a take out point above the Union Street Bridge.[4]

C. CONSTRUCTION METHODS

Contractor – not available
Contracting Agency: ACOE
The grouted boulder construction method was used to construct this course.

D. FLOODPLAIN AND HYDRAULIC EVALUATIONS

Not available

E. HYDRAULIC DROP

The drop appears to be 16 feet, based on data points found on ACOE drawings, Attachment A: This is the difference between the Structure 1 crest invert 4,661 feet and Structure 8 excavation target of 4,645 feet.

F. DESIGN CALCULATIONS

Not available

G. COURSE LENGTH

Measured to be 2,420 ft. (8-08-07)

H. CONSTRICTION WIDTHS

Generally 40 ft.

I. PHOTOGRAPHS

For additional photos see Pueblo Site Photos taken during site visit 8-08-07, 3-5 pm, 1440 cfs in Attachments.

4. WATER AND STREAMBED REQUIREMENTS AND PERFORMANCE

A. PERMITS

This work was completed under the Nationwide Permit No. 27, File No. 199900441[5]

B. RICD INFORMATION

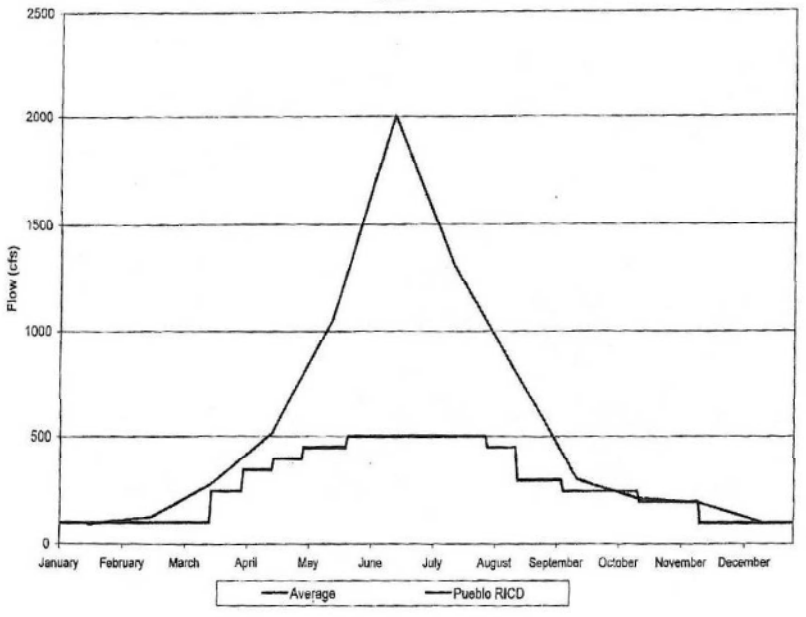
	Conditional Water Right	
	Average Year	Drier Year
October 1- October 15	250	150
October 16- November 14	200	150
November 15- March 15	100	100
March 16- March 31	250	200
April 1- April 15	350	250
April 16- April 30	400	300
May 1- May 22	450	350
May 23- July 31	500	500
August 1- August 15	450	350
August 16- September 7	300	300
September 8- September 30	250	150

RICD Water Right is reduced to 100cfs any time the water supply forecast predicts less than 70% of "normal flows."[6]

C. FLOW RECORDS GAUGES

Arkansas River at Moffat St Tunnel at Pueblo, Colorado-USGS 07099970 *http://waterdata.usgs.gov/usa/nwis/uv?site_no=07099970*

Figure 3
Average Year RICD
Arkansas River Average Monthly Flow at the Moffat St. Gage
1989-2004



D. WATER MANAGEMENT IMPACTS

The RICD water right could have water management impacts because it could limit exchanges through this reach of the Arkansas River. However, terms

and conditions of the RICD include provisions to avoid limiting exchange potential, such as a dry year provision limiting the effect of the recreational water right during dry years.

Surface flows of the Arkansas River in Colorado are greatly over appropriated, and decreed surface rights suffer frequent shortages. In fact, the river was fully appropriated before the turn of the (20th) century, and in most years there is not enough water to provide a full irrigation season supply for any priority dates after 1880.[7]

A drainage pipe for storm water lies exposed along the shore of the Arkansas River in the Pueblo whitewater park Friday. Recent high flows through the park have caused some damage to the river in the area.

Pueblo Chieftain, July 17, 2006
CHIEFTAIN
PHOTOS/BRYAN KELSEN

E. MODIFICATIONS, FAILURES AND REPAIRS

In July 2006 flooding, there was a breach causing flow around the first drop. Backfill in feature 5 washed out. Several portions of the footpath on river-right washed out. Several trees on the bank were lost. Repairs to this, along with changes to drops 7 and 8 (for safety reasons), were planned and reportedly completed late 2006/early 2007.[8]

Modifications related to negative impacts on an adjacent diversion were also reported to be necessary. (Phone conversation with COE personnel)Flows Damage Kayak Course" Pueblo Chieftain, 15 July 2006

Posted on: Saturday, 15 July 2006, 09:00 CDT

Flows Damage Kayak Course

By Chris Woodka, The Pueblo Chieftain, Colo.

Jul. 15--While portions of the Downtown kayak course were damaged by high releases of water from Pueblo Dam recently, the major structures in the course appear to have held, city officials say.

Kayakers, however, are concerned about the high flows that washed away parts of a footpath next to the Arkansas River, took out some trees, left logs lying in the course and created a sinkhole.

"We've got a creek running around the side of Hole No. 1. We've probably lost a dozen trees and we've lost 8-10 feet of sho reline in some places," said Bob Walker, president of Pueblo Paddlers. "I've been disappointed in the quality of work they're payi ng for."

Pueblo still has not accepted the work done on the kayak course and fish ladder below Pueblo Dam from the U.S. Army Corps o f Engineers, which supervised the project.

Some temporary work was done on the kayak course this spring, but there is still $800,000 left in a $4 million budget to fi nish the work from the dam through the kayak course, said Scott Hobson, senior land use planner.

The kayak course itself cost $1.5 million and includes eight holes created by grouted rock wings jutting into the river fro m both sides of the river.

While the damage to the kayak course, which endured peak flows of up to 5,500 cubic feet per second and sustained flows abo ve 4,000 cfs for about a day earlier this week, looks bad in places, it's mostly cosmetic, Hobson said.

F. SEDIMENTATION ISSUES

There are some sedimentation and scour issues, especially at high/flood water levels.

5. ECONOMIC DEVELOPMENT INTENTION AND PERFORMANCE

A. INTENDED USES

These structures will be designed to control, concentrate, and direct the flow of the Arkansas River for use by kayaks, canoes, rafts, and other types of recreational water crafts, and to establish and maintain fish habitat for piscatorial and other purposes. The structures will be of the type and nature described in the letter report dated December 24, 2001 by Gary M. Lacy, submitted as Pueblo's Exhibit D in the hearing before the CWCB on July 22-23, 2002, and will be constructed generally in conformity therewith.[9]

B. ECONOMIC AND USAGE STUDIES

None were conducted.

C. EVENTS

Local Events
Local events like the Chile and Frijole Festival have been organized. The Town is beginning to institutionalize the park and the local paddling club has fielded paddling-oriented events and fundraisers.

http://www.paddlepueblo.blogspot.com/

In 2008 a transplanted paddling family saw their twelve year old daughter qualify to represent the United States in the Junior Women's Class at the Whitewater Freestyle World Cup. The family moved from the Southeast to Pueblo so their daughter could have easy access to training water.[10]

D. RECENT DEVELOPMENT IN VICINITY

Not applicable.

6. OTHER

A. USER INTERVIEWS

3:00 P.M.-5:00 P.M. 8-8-07, 1440cfs (relative to attached photos)

B. SITE VISIT

3:00 P.M.-5:00 P.M. 8-8-07
1440cfs (relative to attached photos)

Site Visit Summary: Park on the side of the residential street adjacent to the whitewater park. Walk down the steps to the river and to the put-in. All structures are river-wide U-dams. The first feature is fast dynamic wave-hole excellent for aerial maneuvers like blunts and flat spins. It is also a good feature for cartwheeling. The second feature is a river-wide hole good for side-surfing, spinning, and cartwheeling. The third feature is a standing wave excellent for dynamic surfing, spins and blunts. The fourth feature is a variable drop with a small pocket forming a standing wave that is okay for spins and blunts but difficult to stay on. The fifth feature has a wave in the center good for surfing, spins, cartwheels and small blunts and aerials. However, there is not good eddy access to the feature. The sixth feature has a pair of waves that are difficult (but possible) to get to from the eddy and are challenging to stay on. They are good for spins and cartwheels. The seventh feature has a pair of good waves for surfing and possibly cartwheels and small aerials. This feature probably gets better with more water. The eighth feature resembles a low head dam with a tongue on river-left. There is no surfable hole or wave. This structure is in place to create the pool for the seventh feature. Despite signs warning of dangerous dams downstream of the take-out, there are no dams within a mile of the take-out.

The Town of Pueblo did it right. They took the concrete canal that contains the Arkansas River dictating the river's course through downtown and transformed this manmade ditch into a better manmade river, or ditch. Large murals run the length of at the park on the 58' high wall, continuing on for about two miles, with a short section overshadowing the park with dragons, random spirals, and a weird angel thing that according to some "has a nice set of tits." It's an art show direct from the polluted eddy.

Eight features total [excludes feature below bridge] with an optimal flow of about 700 cfs create a worthwhile play in the form of easy surf waves, some shallow holes for cartwheeling, and a weird pocket directly behind t#5 that allows for air loops, but nothing else. Playable eddy lines and pools are found about as low as you want to catch it, but most locals won't bother until it hits about 450 cfs. It's not as good as the upstream neighbors, but it will give the South Platte parks a run for their money.

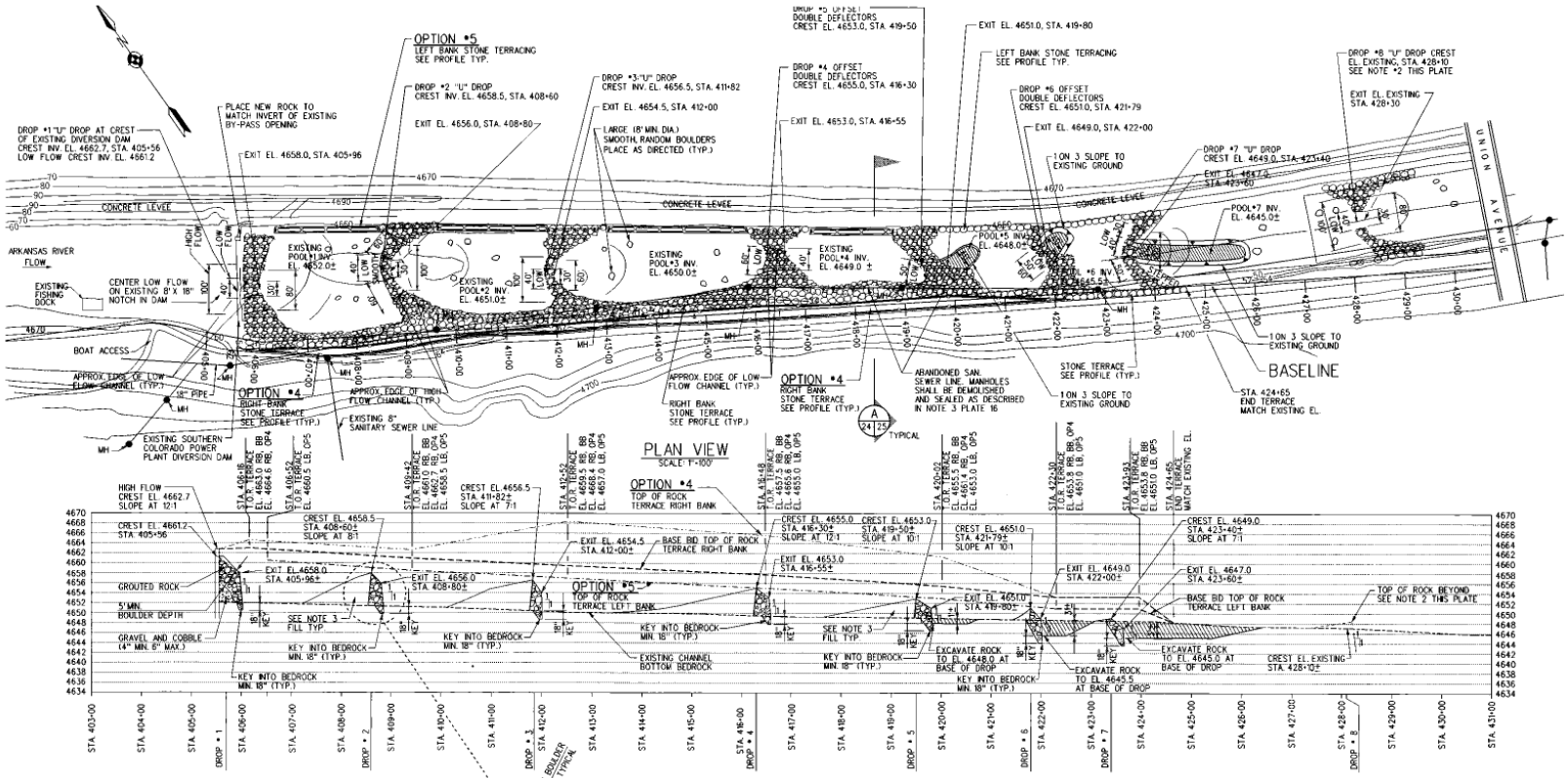
The fourth and seventh features are the most popular, since they are typically the biggest wave and hole, respectively. I prefer #6 for the most variety for spins and surfs, since #4 can be a flushy front surfer at in-between levels. The more water the better here, and changes are likely to occur as the park further develops into its own center of the Pueblo kayaking world.

This is also the closest kayaking to Colorado Springs, and there is a lot of good single-track mountain biking in the nearby foothills, an option for a multi-sport day.[11]

7. REFERENCES

1. Pueblo RICD Decree – pages 3, 4.
2. "Flows Damage Kayak Course," Pueblo Chieftain, 15 July, 2006
3. "Pueblo Whitewater Park Opens," Pueblo Chieftain, May 7, 2005.
4. Pueblo_Finding of Fact, Conclusion of Law and Decree, Case No. 01CW160, CWCB, April 5, 2006, page 3.
5. ACOE Permit 199900441
6. Pueblo_Finding of Fact, Conclusion of Law and Decree, Case No. 01CW160, CWCB, April 5, 2006, page 3.
7. Engineering Report and Documentation for the Application for Water Rights, Case No. 01CW160 (Division 2), Appendix B, TZA Water Engineers, Inc., October, 2005. http://paddlepueblo.blogspot.com/2007/03/improvements-in-park-continue.html
8. "Flows Damage Kayak Course," Pueblo Chieftain, 15 July 2006, "Improvements to the Park Continue," Pueblo Paddlers Boating Beta March 7, 2007
9. Pueblo_RICD Case No. 01CW160, Findings of Fact, Conclusion of Law and Decree, April 5, 2006, page 3.
10. "Young kayaker a whitewater wonder," Pueblo Chieftain, July 26, 2008.
11. Whitewater of the Southern Rockies, Evan Stafford and Kyle McCutcheon, page 86.

Attachment A



DROP STRUCTURE DATA

DROP	CREST INVERT ELEVATION	CREST INVERT STATION	CREST INVERT BASELINE OFFSET	EXIT INVERT ELEVATION	EXIT INVERT STATION	EXIT INVERT BASELINE OFFSET
*1	4661.2	405+56	90' L	4658.0	405+96	95' L
*2	4658.5	408+60	130' L	4656.0	408+80	130' L
*3	4656.5	411+82	95' L	4654.5	412+00	95' L
*4	4655.0	416+30	34' L	4653.0	416+55	100' L
*5	4653.0	419+50	34' L	4651.0	419+80	39' L
*6	4651.0	421+79	48' L	4649.0	422+00	65' L
*7	4649.0	423+40	55' L	4647.0	423+60	47' L
*8	EXISTING	428+10	63' L	EXISTING		

LEGEND

- NEW BOULDER CONSTRUCTION FOR BASE BID
- NEW BOULDER CONSTRUCTION FOR OPTIONS
- EXCAVATION
- GRAVEL FILL AND COBBLE
- RB RIGHT BANK
- LB LEFT BANK
- OP4 OPTION *4
- OP5 OPTION *5
- TOP OF ROCK TERRACE FOR BASE BID
- TOP OF ROCK TERRACE FOR OPTION *4
- TOP OF ROCK TERRACE FOR OPTION *5
- T.O.R. TOP OF ROCK
- EXISTING SANITARY SEWER

NOTES:
1. ALL GEOMETRY (INCLUDING PLACEMENT AND ORIENTATION OF ROCK, AND EXCAVATION OF EXISTING GROUND AND VEGETATION) MAY BE ALTERED IN THE FIELD AS DIRECTED BY THE CONTRACTING OFFICER.
2. DROP *8: CROSS SECTION TO HAVE SIMILAR GEOMETRY AS TYPICAL DROP STRUCTURES. LOW FLOW AREA TO REMAIN AS EXISTING GROUND. HIGH FLOW AND OUTSIDE PORTIONS OF WEIR STEP UP 18" AND TO BE KEYED 18" DEEP.
3. IF AVAILABLE, EXCESS SOIL (FROM PROJECT EXCAVATION ACTIVITIES) MAY BE PLACED UPSTREAM OF DROPS *2 TO DROPS *6 AS DIRECTED BY CONTRACTING OFFICER.
4. DROP STRUCTURES SHOWN ON THE PLAN AND PROFILE MAY NOT BE DRAWN TO SCALE. IF DISCREPANCIES ARISE, INFORMATION IN THE DROP STRUCTURE DATA TABLE SHALL GOVERN.
5. SEE PLATE 25 FOR DETAILS.

BID ITEMS

BASE BID FOR FISH PASSAGE SHALL CONSIST OF ALL DATA SHOWN ON THIS PLATE EXCEPT AS NOTED FOR LEFT AND RIGHT BANK STONE TERRACING

BASE BID:
RIGHT BANK STONE TERRACING FROM DROP *1 TO DROP *7 AS INDICATED IN PROFILE. LEFT BANK STONE TERRACING FROM DROP *5 TO DROP *7 AS INDICATED ON PROFILE

OPTION *4:
RAISE RIGHT BANK STONE TERRACING FROM DROP *1 TO DROP *6 AS INDICATED IN PROFILE.

OPTION *5:
ADD LEFT BANK STONE TERRACING FROM DROP *1 TO DROP *5 AS INDICATED IN THE PROFILE.

GRAPHIC SCALE

US Army Corps of Engineers
ALBUQUERQUE DISTRICT
Albuquerque, New Mexico

REVISIONS
No. | Date | Description

DESIGNED, REVIEWED AND PRESENTED BY ALBUQUERQUE DISTRICT STAFF
SEE COMPLETE LIST ON COVER

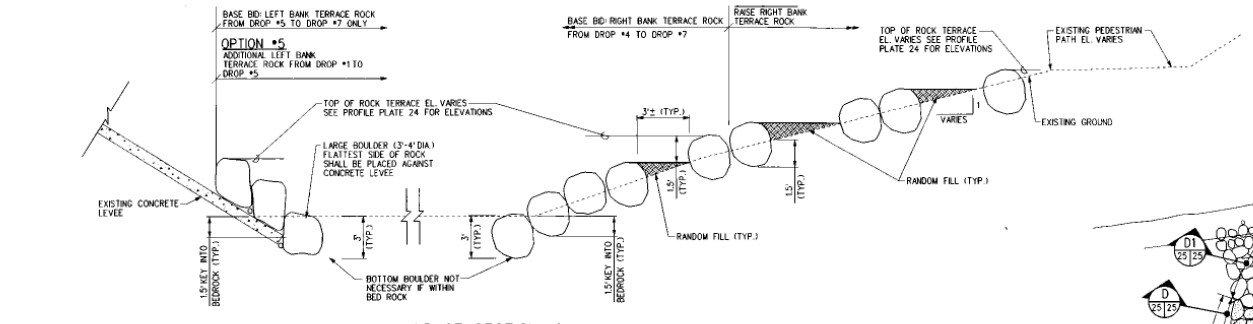
U.S. ARMY ENGINEER DISTRICT ALBUQUERQUE, NEW MEXICO
DRAFT: NOVEMBER 2003
DATE:

PUEBLO, COLORADO
ARKANSAS RIVER FISHERIES HABITAT RESTORATION
FISH PASSAGE
PLAN AND PROFILE

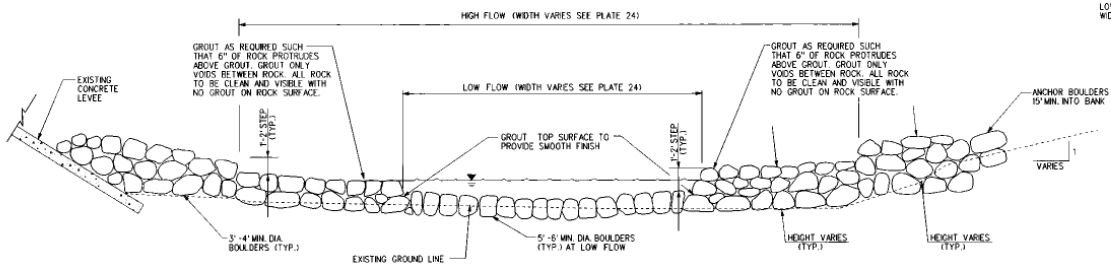
ARKANSAS RIVER

FILE NUMBER: AR-FH-A-24

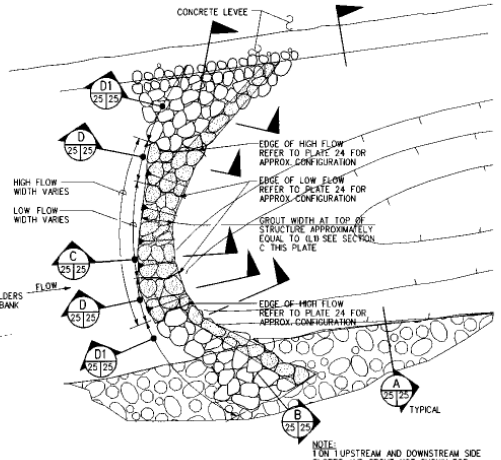
PLATE



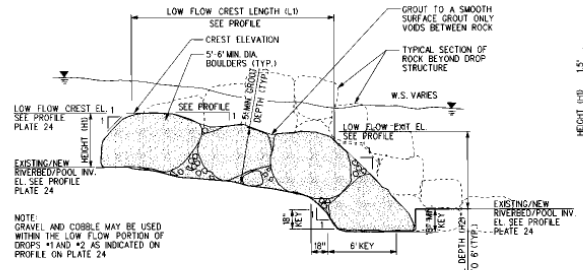
TYPICAL STONE TERRACE SECTION (A 24|25)
N.T.S.



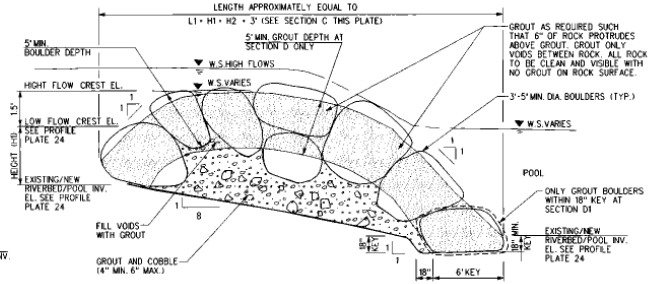
TYPICAL CROSS SECTION DROP STRUCTURE BANK TO BANK (B 25|25)
N.T.S.



TYPICAL DROP STRUCTURE
N.T.S.



TYPICAL VIEW SECTION OF LOW FLOW PORTION OF DROP STRUCTURE (C 25|25)



TYPICAL SECTION VIEW OF ROCK BEYOND LOW FLOW PORTION DROP STRUCTURE OPENING (D 25|25 D1 25|25)

NOTES:

1. THE CONTRACTOR SHALL SUBMIT THE SOURCE OF ROCK TO BE IMPORTED FOR APPROVAL BY THE CONTRACTING OFFICER BEFORE START OF CONSTRUCTION. FLAT FACED BOULDERS SHALL BE USED ON THE DOWNSTREAM FACE OF FISH PASSAGE. ROUNDER BOULDERS SHALL BE USED ON THE UPSTREAM FACE OF DROP STRUCTURES, AND ANGULAR ROCK SHALL BE USED TO BUILD UP THE STRUCTURES FOR FINAL FINISHING ROCK PLACEMENT. SMALLER ROCKS MAY BE PLACED IN VOIDS TO MINIMIZE GROUT.
2. DROP #8 CROSS SECTION TO HAVE SIMILAR GEOMETRY AS TYPICAL DROP STRUCTURES. LOW FLOW AREA TO REMAIN AS EXISTING GROUND. HIGH FLOW AND OUTSIDE PORTIONS OF WEIR TO STEP UP 18" AND BE KEYED 18" DEEP.
3. ALL GEOMETRY (INCLUDING PLACEMENT AND ORIENTATION OF ROCK), MAY BE ALTERED IN THE FIELD BY CONTRACTING OFFICER.

US Army Corps of Engineers
ALBUQUERQUE DISTRICT

REVISIONS

DESIGNED, REVIEWED AND PRESENTED BY ALBUQUERQUE DISTRICT DESIGN TEAM
SEE COMPLETE LIST ON COVER

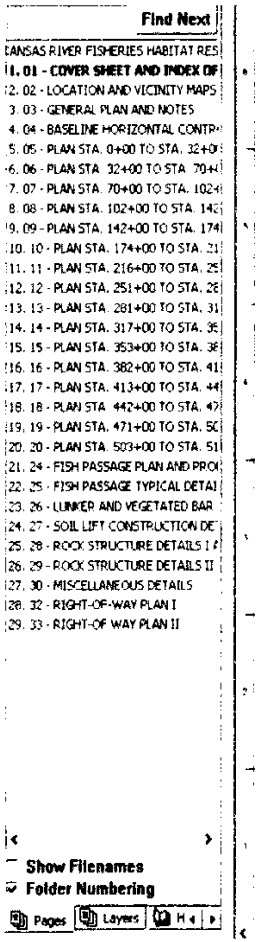
U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS ALBUQUERQUE, NEW MEXICO

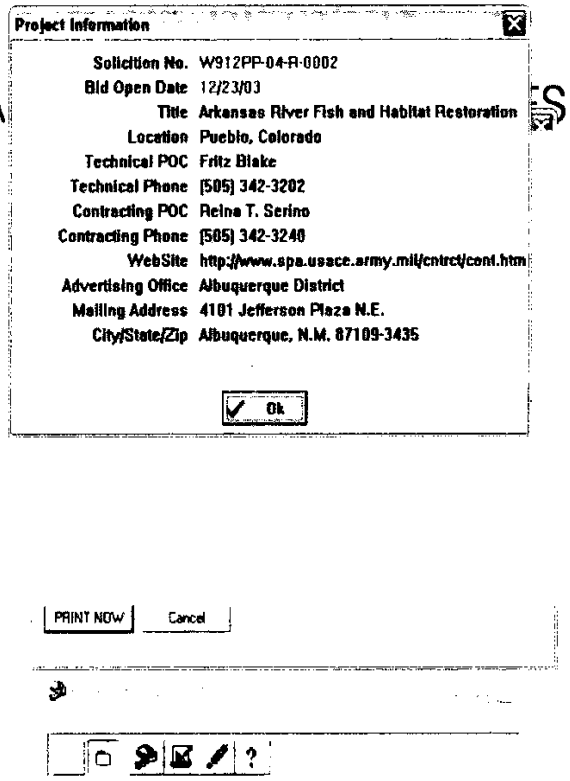
DWG. DATE: NOVEMBER 2003

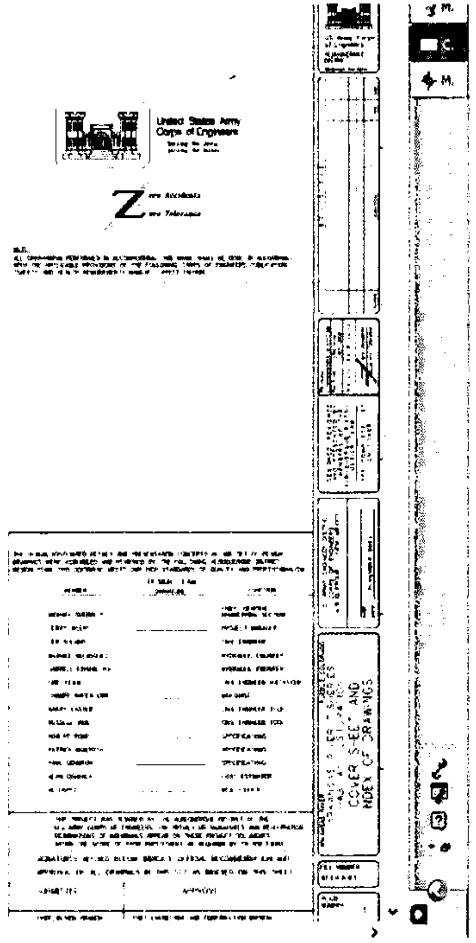
PUEBLO, COLORADO
ARKANSAS RIVER
ARKANSAS RIVER FISHERIES HABITAT RESTORATION
FISH PASSAGE
TYPICAL DETAILS

FILE NUMBER: AR-FH-A-25

PLATE

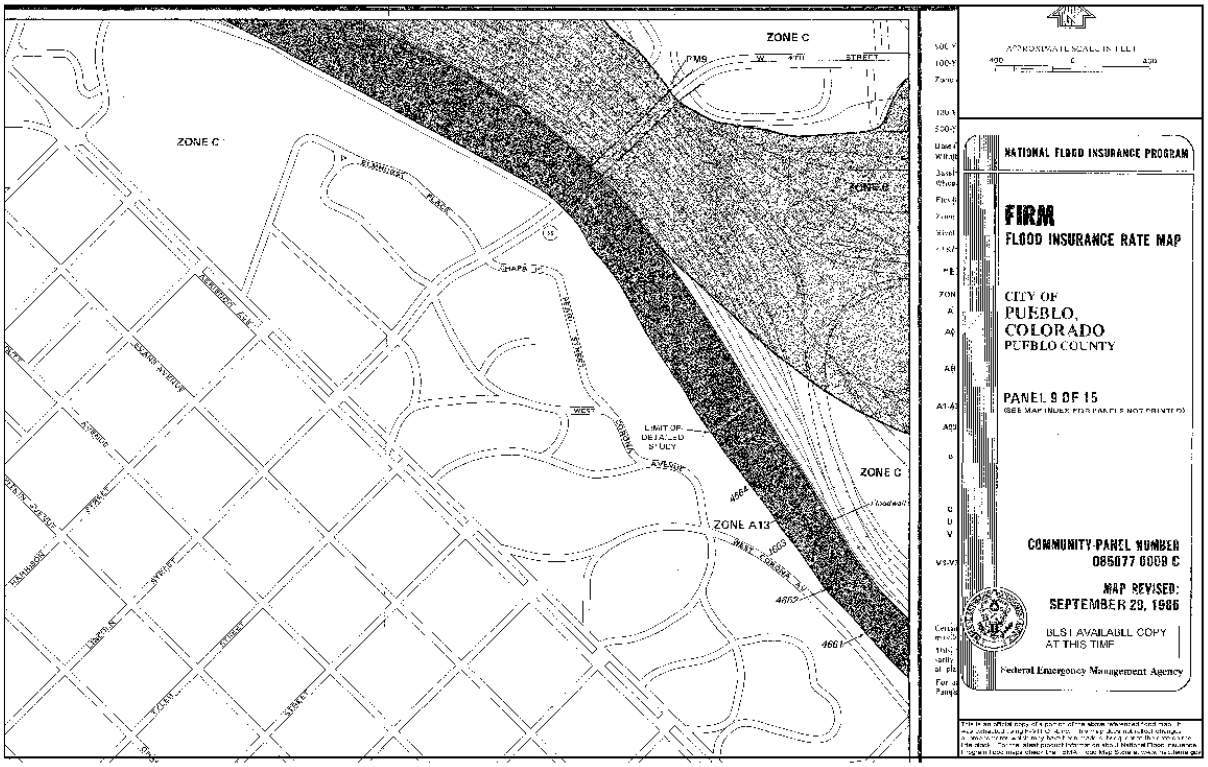

Find Next
CANSAS RIVER FISHERIES HABITAT RES
1. 01 - COVER SHEET AND INDEX OF
2. 02 - LOCATION AND VICINITY MAPS
3. 03 - GENERAL PLAN AND NOTES
4. 04 - BASELINE HORIZONTAL CONTR
5. 05 - PLAN STA. 0+00 TO STA. 32+0
6. 06 - PLAN STA. 32+00 TO STA. 70+
7. 07 - PLAN STA. 70+00 TO STA. 102+
8. 08 - PLAN STA. 102+00 TO STA. 14
9. 09 - PLAN STA. 142+00 TO STA. 17
10. 10 - PLAN STA. 174+00 TO STA. 21
11. 11 - PLAN STA. 216+00 TO STA. 25
12. 12 - PLAN STA. 251+00 TO STA. 28
13. 13 - PLAN STA. 281+00 TO STA. 31
14. 14 - PLAN STA. 317+00 TO STA. 35
15. 15 - PLAN STA. 353+00 TO STA. 38
16. 16 - PLAN STA. 382+00 TO STA. 41
17. 17 - PLAN STA. 413+00 TO STA. 44
18. 18 - PLAN STA. 442+00 TO STA. 47
19. 19 - PLAN STA. 471+00 TO STA. 5
20. 20 - PLAN STA. 503+00 TO STA. 51
21. 24 - FISH PASSAGE PLAN AND PRO
22. 25 - FISH PASSAGE TYPICAL DETAI
23. 26 - LUNKER AND VEGETATED BAR
24. 27 - SOIL LIFT CONSTRUCTION DE
25. 28 - ROCK STRUCTURE DETAILS I
26. 29 - ROCK STRUCTURE DETAILS II
27. 30 - MISCELLANEOUS DETAILS
28. 32 - RIGHT-OF-WAY PLAN I
29. 33 - RIGHT-OF WAY PLAN II
Show Filenames
Folder Numbering
Pages
Layers


Project Information
Solicition No. W912PP-04-R-0002
Bid Open Date 12/23/03
Title Arkansas River Fish and Habitat Restoration
Location Pueblo, Colorado
Technical POC Fritz Blake
Technical Phone (505) 342-3202
Contracting POC Reina T. Serino
Contracting Phone (505) 342-3240
WebSite http://www.spa.usace.army.mil/cntrct/cont.htm
Advertising Office Albuquerque District
Mailing Address 4101 Jefferson Plaza N.E.
City/State/Zip Albuquerque, N.M. 87109-3435
Ok
PRINT NOW
Cancel


United States Army
Corps of Engineers
COVER SHEET AND INDEX OF DRAWINGS

Attachment B

Pueblo FEMA Map



RIDGWAY WHITEWATER PARK
ON THE UNCOMPAHGRE RIVER

1. BACKGROUND INFORMATION

A. LOCATION

The course is in the channel of the Uncompahgre River near Main Street in the Town of Ridgway, Colorado. To get to the park from Town, drive east on the Hwy 62 bridge and turn right into a parking lot.

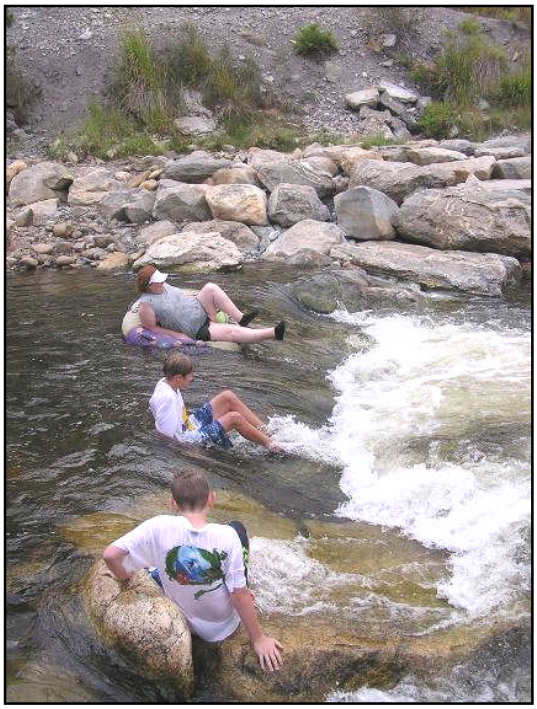
B. 2010 UPDATES

The information below is based upon the initial 2008 investigation. No further improvements were identified during the 2010 update.

C. OWNER/OVERSIGHT

Owner: Town of Ridgway
Post Office Box 10
Ridgway, Colorado 81432
Phone: 970-626-5308
Fax: 970-626-3962

The administrative offices and Council Chambers are located at 201 North Railroad Street
Contact: Town Clerk
970-626-5308 ext. 10



Steward: Town of Ridgway
Contact: Pam Craft, Town Clerk and Treasurer
970-626-5308 ext. 11

Maintenance Responsibility: Town of Ridgway
Contact: Joanne Fagan, Public Works Director/Engineer
970-626-5227

D. COST

This project's cost exceeded $2,000,000. It was funded through a variety of sources:

Grants	$1,010,000
Town funds	260,000
In-kind contributions	550,000
Land donated (value)	560,000
	$2,380,000[1]

E. COMPLETION DATE

Initial Construction: 2005
Revision/Corrections: 2006

2. SAFETY ISSUES AND ACCIDENT REPORTS

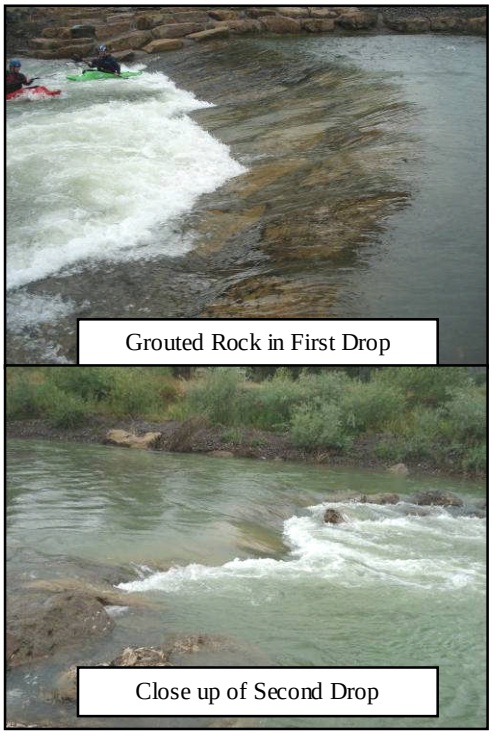
None have been reported.

3. DESIGN and CONSTRUCTION DOCUMENTS/DRAWINGS

A. PRELIMINARY DESIGN

Designer: Rivers Trails, Conservation Assistance Program 2002-03 staff member Gary Weiner was assisted by David Rosgen on this initial project.

The 2002 design included three in-stream structures intended to create diverse aquatic habitat structures, an aesthetic feature and the integration of open water surface wetland in the adjoining east floodplain area of the river. Whitewater boating enhancement was deemed a secondary benefit.[2]



Grouted Rock in First Drop

Close up of Second Drop

B. CONSTRUCTION DOCUMENTS

Engineer of Record: Riverbend Engineering - Chris Phillips, P.E.
P.O. Box 2979
102 Third Street
Pagosa Springs, CO 81147
970-264-1195
cphilips@frontier.net

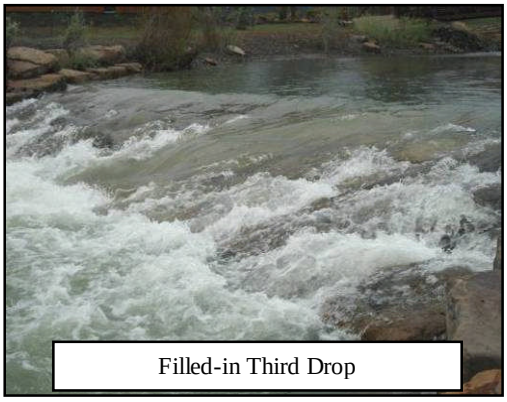
Plans are included in the Attachments.

The 2006 modification to maintain and stabilize existing features consolidated the drop structures below the pedestrian bridge; stabilized Whitewater Drop #2 to stabilize it and improve it's whitewater quality; rebuilt two rock and log clusters; and removed gravel deposits at two locations.[3]

The second drop is downstream of the bridge. It was designed and built, then redesigned when the Town felt it looked too 'engineered' by Chris Phillips. The third drop is a low weir that has filled in and is modestly functional. See Attachment A for drawings submitted in 2006.

C. CONSTRUCTION METHODS

The original construction used no grout. Improvements in 2005-06 used grouted boulders.



Filled-in Third Drop

D. FLOODPLAIN EVALUTION

See Attachment B, FEMA Flood Insurance Rate Map.

E. HYDRAULIC DROP

The park is located in the 'upper reach' of the project and drops six feet. The total drop for the restored area is about 8 feet.

F. DESIGN CALCULATIONS

See Attachment A.

G. COURSE LENGTH

The 'upper reach' of the project extends 300 feet. The entire restoration measures over one mile.[4]

H. CONSTRICTION WIDTHS

The constriction at Structures 1 and 2 is 50 feet, and measures 40 feet at Structure 3.[5]

I. PHOTOGRAPHS

Additional photos are included in Ridgway Site Photos.

4. WATER AND STREAMBED REQUIREMENTS AND PERFORMANCE

A. PERMITS

Work completed prior to April, 2005 was conducted under the authority of Nationwide Permit No. 27, Stream and Wetland Activities Action No. 200275036.[6]

Permit No.200575719 was issued to address modifications of structures installed during Phase I. This permit was awarded October 13, 2006 and the work was completed in 2006.[7]

B. RICD Information

There is no RICD for this project.

C. FLOW RECORDS/GAGES

Narrative here
http://waterdata.usgs.gov/co/nwis/current/?type=flow&group_key=huc_cd
USGS #09146200 (above reservoir)
USGS #09147025 (below reservoir)

D. WATER MANAGEMENT IMPACTS

The Colorado Department of Transportation ("CDOT") expressed some concern about possible impacts to the highway bridge from the restoration project. The Town undertook a bridge scour study and engineering analysis of the impacts to the bridge from the Project. This study concluded that the bridge would not be adversely impacted by the Project, provided that a stable grade was maintained in the river bed immediately downstream of the highway bridge. CDOT concurred with this finding, and the project was constructed in conformance with this criteria.[8]

E. MODIFICATION, FAILURES, AND REPAIRS

2003 - Spring runoff damaged the rock structures and a redesign was constructed in the fall. Three 'Cross Vane & J-Hook" type structures of the original design were changed to "Low Weir" type of structures to spread the water's energy over a wider are of the river bed.

2004 - Three rock weirs were damaged in the spring runoff, though less severely. The Town was authorized to make repairs, but additional reinforcement was requested in light of the building of a pedestrian bridge north of the Highway 62 Bridge and between the first two drop structures.

The repairs included a rock reinforcement of the bed and banks of the river, raised river bank height to withstand a 100-year flood and rebuilding of the three structures to tie them more securely to the armored banks. During this year, boaters expressed interest in incorporating high boating quality.

2005 - Structure No. 1 was rebuilt with grouted boulders such that it would withstand a 100-year flood. It withstood the ice flow and 10-year flood runoff levels, though the structures downstream sustained damage. Structure No. 2 was modified and constructed such that grout was evident during periods of low flow. ACOE viewed the construction as non-compliant with the terms of the existing permit. [9]

Structure 1 was observed to have seepage damage on the river-left side during according to the City Manager.

F. SEDIMENTATION ISSUES

This river is in a glacial valley and regularly carries up to a six-inch bedload – no bedrock. The Town therefore views regular maintenance as a necessity.

5. ECONOMIC DEVELOPMENT INTENTION AND PERFORMANCE

A. INTENDED USES

River and habitat restoration began with river re-channelization and included construction of off-channel wetlands, and the placement of over 1,500 indigenous trees and native shrubs. Recreation enhancements encourage hiking, biking, picnicking and boating:

- Mile-long natural trail
- Parking lot, solar-powered restroom, picnic areas, and outdoor classroom
- 106-foot pedestrian bridge with connecting sidewalk
- Instream recreation features[10]

B. ECONOMIC AND USAGE STUDY

No economic studies have been conducted.

C. EVENTS

In June, 2008 the Town held its first Ridgway River Festival.

D. RECENT DEVELOPMENTS IN VICINITY

In October, 2005 the Town honored a local land donor by dedicating a large section of the river corridor as Rollans Park.

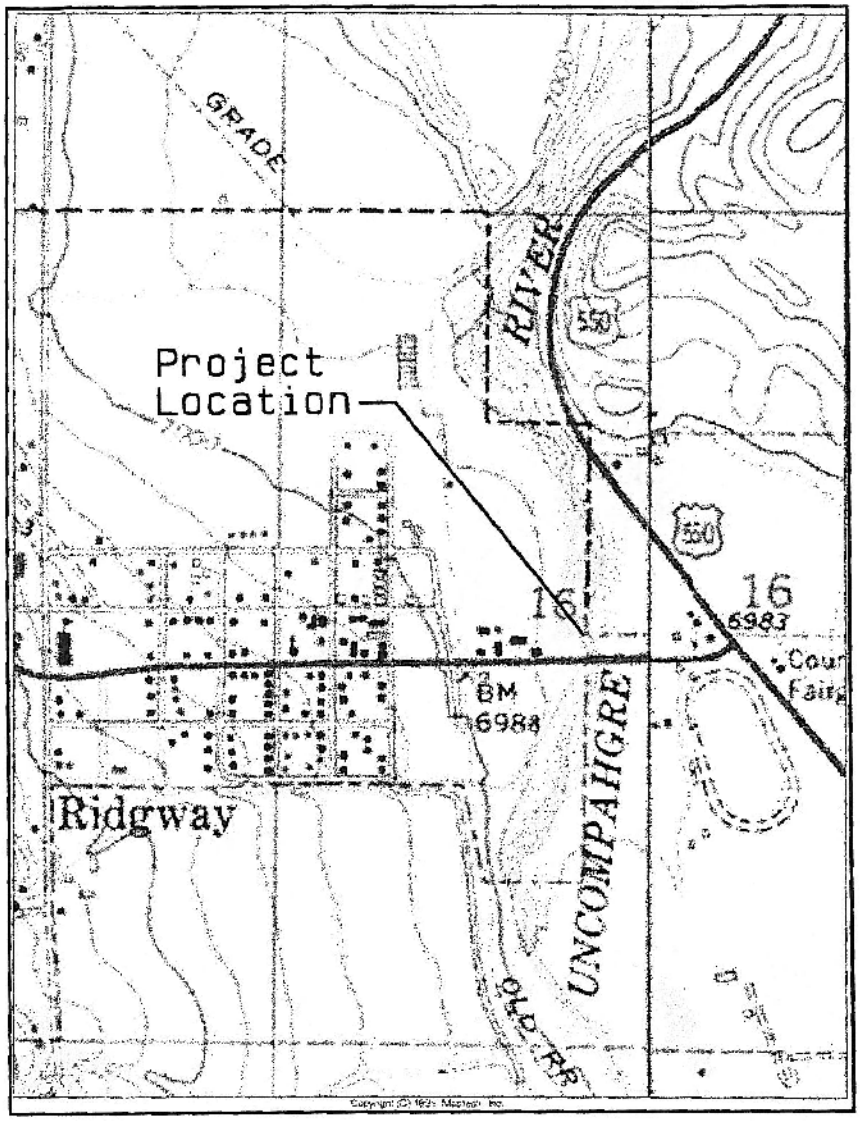
6. OTHER

It does exist. And, it is actually a pretty good double set of holes, formed from the cold waters of the Uncompahgre River flowing north to their inevitable union with the Gunnison. – after helping to irrigate the Olathe Sweet corn fields. Access is excellent, and the features allow for standard hole moves at good flow, ideally over 600 for things to get cranking. Best of all, the good eddies will likely be vacant of other paddlers, and the locals will stare in wonder as they watch you desperately try to make it upstream without success. Round out a day with the other Uncompahgre sections, the Ouray Hot Springs, or drive to another kayaking destination.[11]

7. REFERENCES

1. ACOE ApplicationNo2_2005, page 2.
2. Ibid., page 5.
3. ACOE Approval of Structural Redesign 2005, page 1.
4. RTCA Phase II Drawing
5. ACOE Permit 200575719, page 17.
6. ACOE Permit 200275036, Phase I and Phase II.
7. ACOE Permit 200575719
8. Ibid., page 5.
9. Ibid., pages 3-8.
10. Ibid., page 3.
11. Whitewater of the Southern Rockies, Evan Stafford and Kyle McCutcheon, page 543.

Attachment A

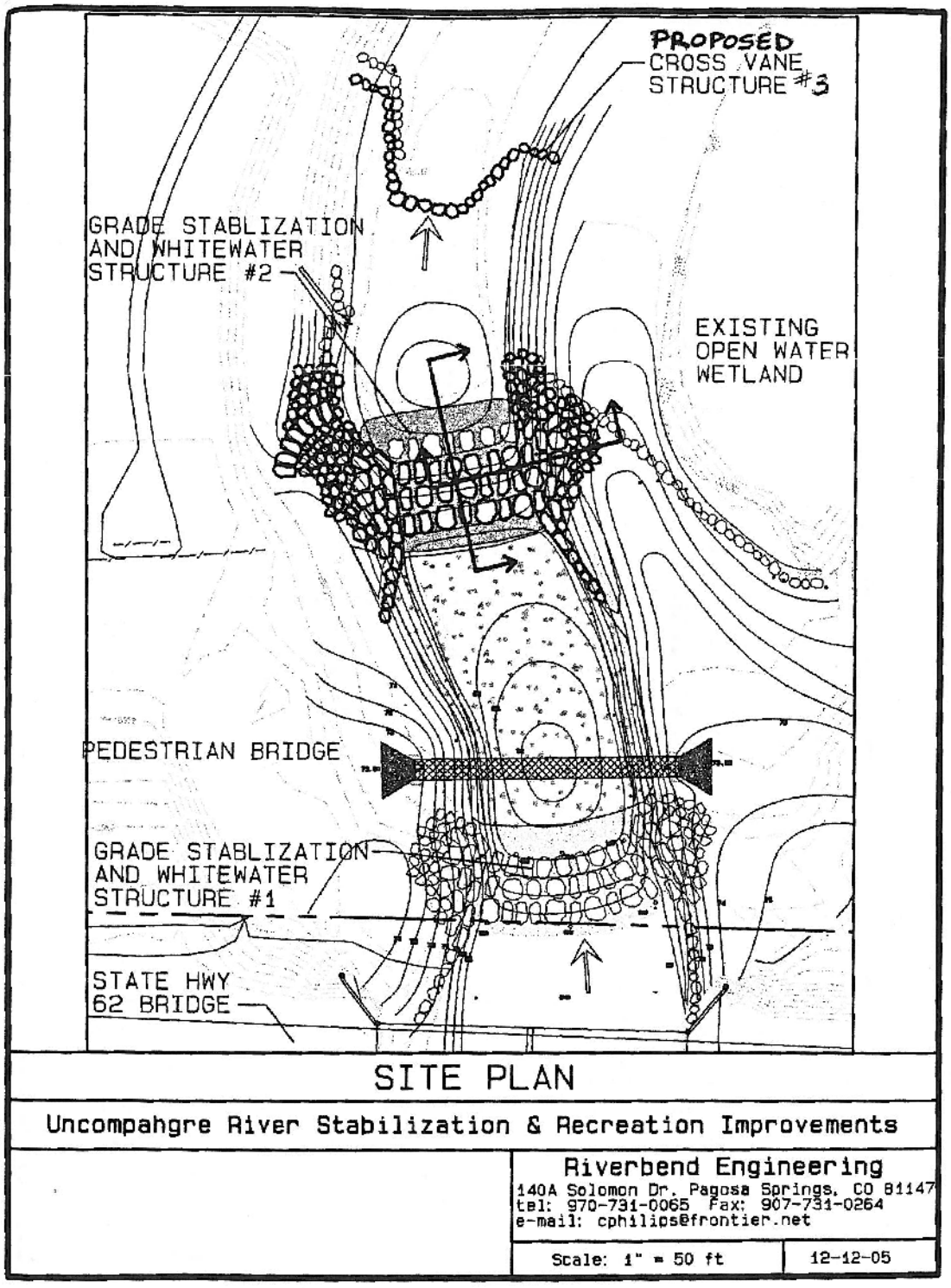


Vicinity Map

Uncompahgre River Stabilization & Recreation Improvements

Riverbend Engineering
140A Solomon Dr. Pagosa Springs, CO 81147
tel: 970-731-0065 Fax: 907-731-0264
e-mail: cphilips@frontier.net

Scale: 1" = 2000 ft | 12-12-05

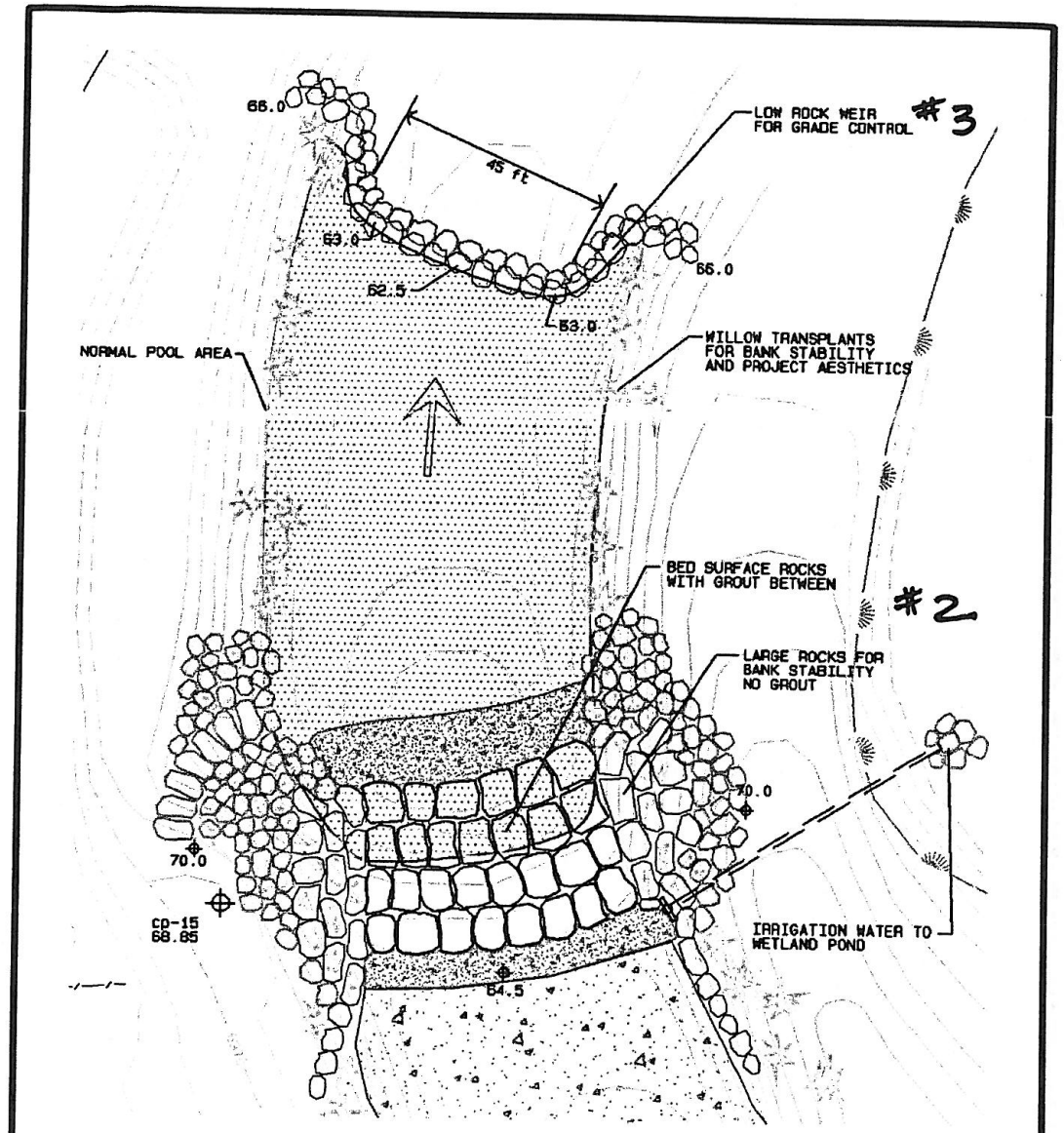


SITE PLAN

Uncompahgre River Stabilization & Recreation Improvements

Riverbend Engineering
140A Solomon Dr. Pagosa Springs, CO 81147
tel: 970-731-0065 Fax: 907-731-0264
e-mail: cphilips@frontier.net

Scale: 1" = 50 ft | 12-12-05



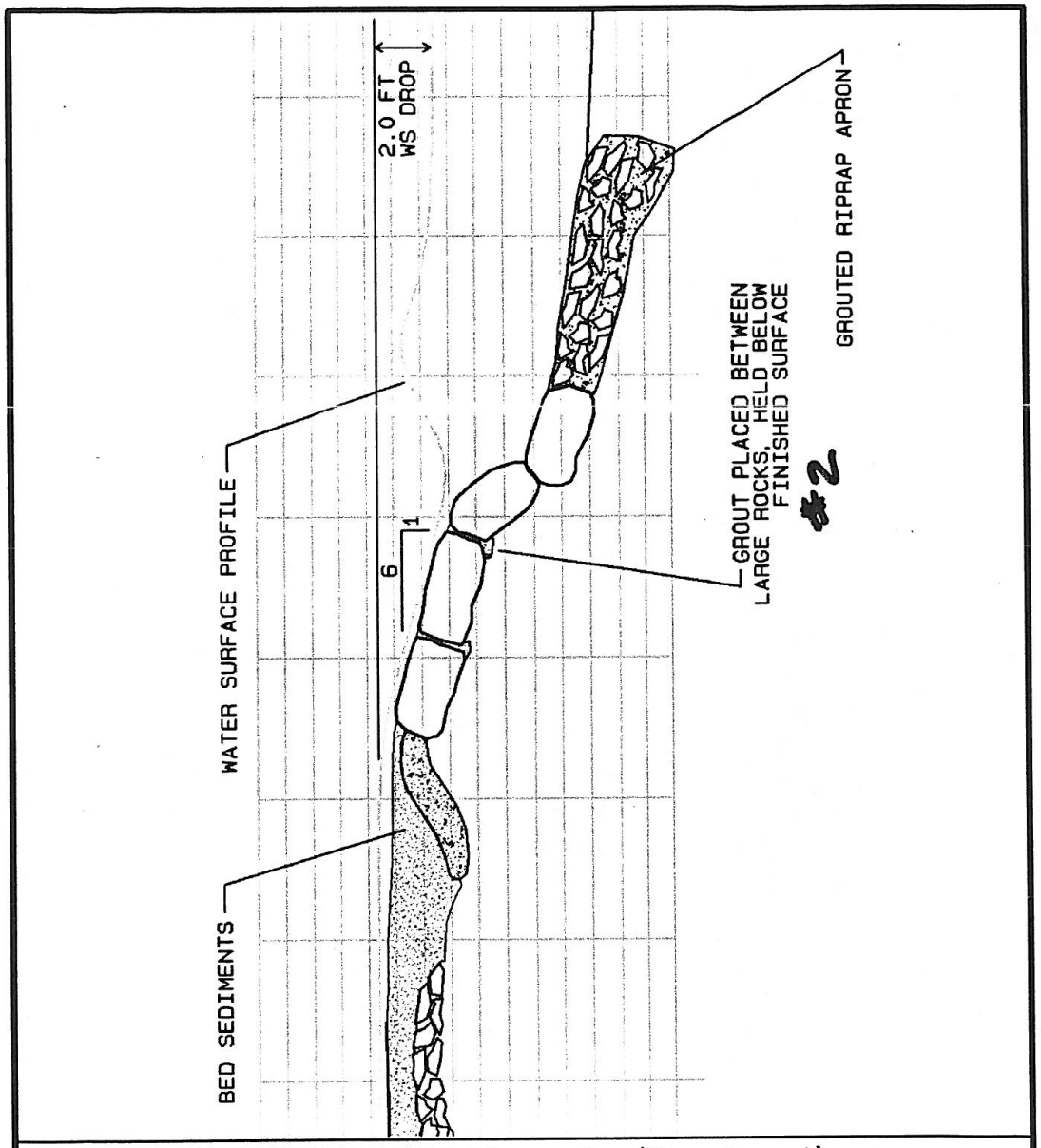
ALTERNATIVE No. 4 (Revised)

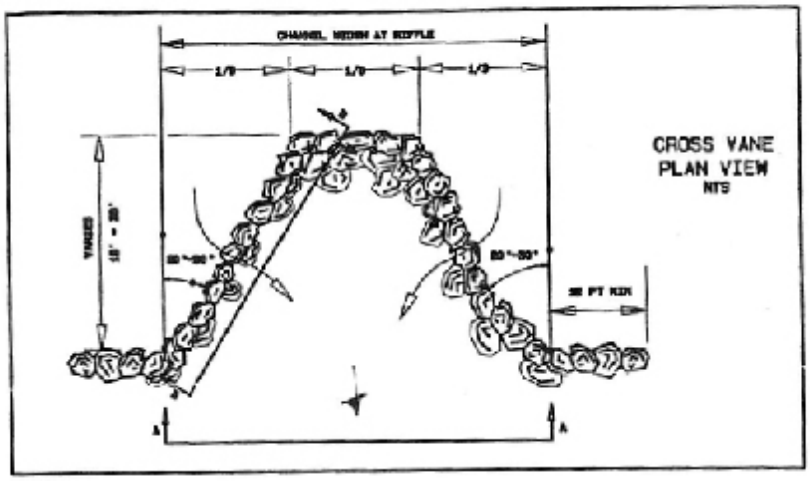
Uncompahgre River Stabilization & Recreation Improvements

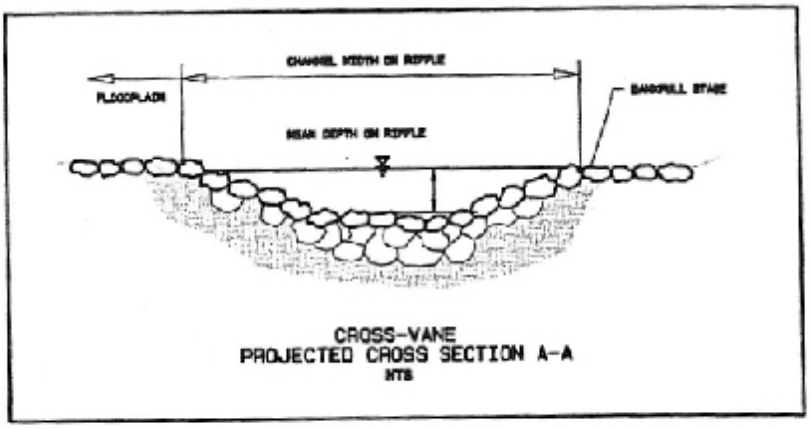
PLAN VIEW

Riverbend Engineering
P.O. Box 2979, Pagosa Springs, CO 81147
tel: 970-264-1195 Fax: 907-264-1196
e-mail: cphilips@frontier.net

Scale: 1" = 30 ft | 8-31-2006


2.0 FT
WS DROP
6
1
WATER SURFACE PROFILE
BED SEDIMENTS
GROUTED RIPRAP APRON
GROUT PLACED BETWEEN
LARGE ROCKS, HELD BELOW
FINISHED SURFACE
#2
ALTERNATIVE No. 4 (Revised)
Uncompahgre River Stabilization & Recreation Improvements
PROFILE VIEW
Riverbend Engineering
P.O. Box 2979 Pagosa Springs, CO 81147
tel: 970-264-1195 Fax: 907-264-1196
e-mail: cphilips@frontier.net
Scale: 1" = 10 ft
8-31-06





PROPOSED CROSS VANE DETAILS. Structure #3

Uncompahgre River Stabilization & Recreation Improvements

Riverbend Engineering
140A Solomon Dr. Pagosa Springs, CO 81147
tel: 970-731-0065 Fax: 907-731-0264
e-mail: cphilips@frontier.net

Scale: 1" = 20 ft | 1-18-06

Design Calculations

Uncompahgre River Improvements - 2006

CSP : 1/17/06

Scour Assessment of the Uncompahgre River @ Ridgway

Per the Veronese Eqn, (USBR, 1984)

Depth of Scour, $d_s = K H_T^{.225} q^{.54} - d_m$

where d_s = depth of scour, ft.

K = constant = 1.32

H_T = Total drop in head, ft.

q = unit discharge over structure, cfs/ft.

d_m = tail water depth

Structure is nominally 50 ft. wide
At bankfull discharge, $q = 650/50 = 13$ cfs/ft.
At 100-yr discharge, $q = 2700/50 = 54$ cfs/ft.

For Grade Stabilization & whitewater Structure #2:

$d_s = (1.32)(2.4)^{.225}(13)^{.54} -$

$= 6.4$ ft $- d_m$ $\quad d_m \approx 2.5$ ft

$= 6.4 - 2.5 = 3.9$ ft.

∴ 4 ft potential scour depth @ bankfull discharge

For Cross Vane immediately downstream:

$d_s = (1.32)(1.0)^{.225}(13)^{.54} - 2.5$

$d_s = 2.7$ ft.

For Structure #2 @ 100-yr flow:

$d_s = 1.32(2.4)^{.225}(54)^{.54} - 6.5$

$d_s = 7.4$ ft.

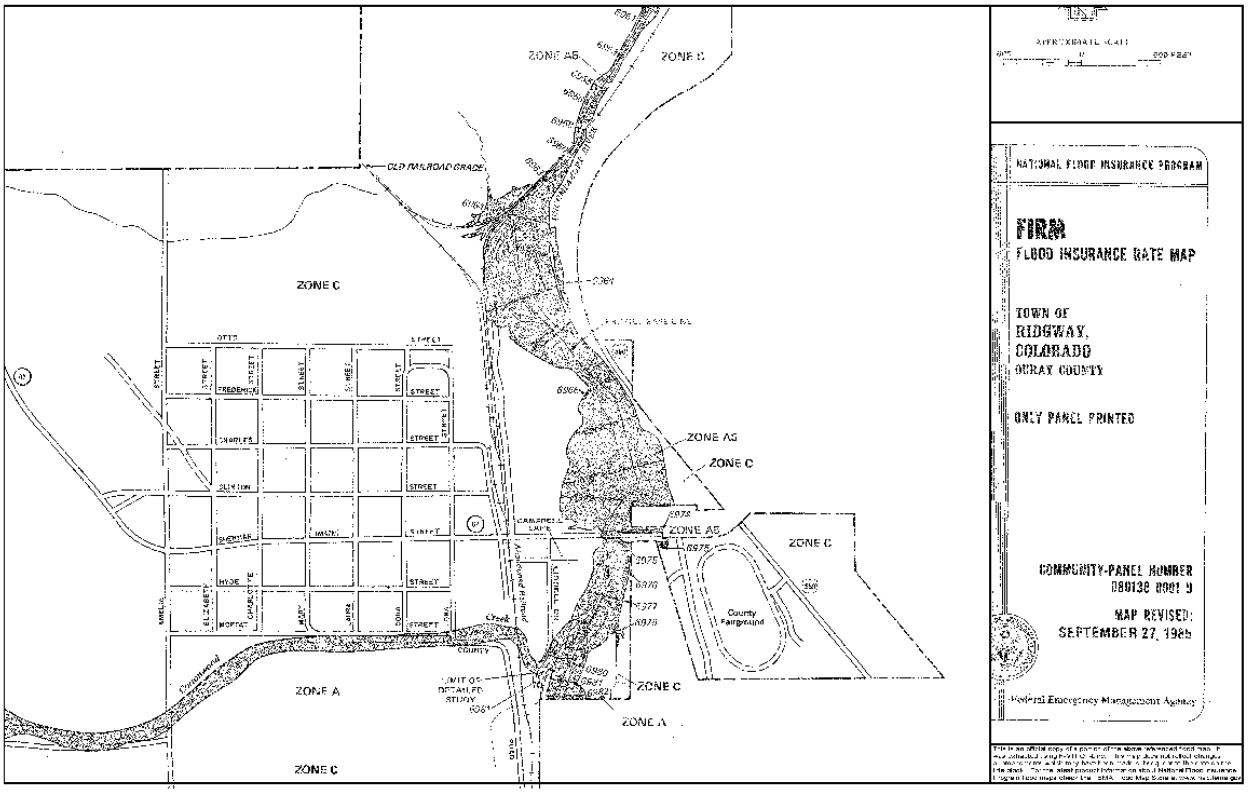
For Cross Vane @ 100-yr flow:

$d_s = 1.32(1.0)^{.225}(54)^{.54} - 6.5$

$d_s = 4.9$ ft.

Attachment B

Ridgway FEMA Map



SALIDA WHITEWATER PARK ON THE ARKANSAS RIVER

1. BACKGROUND INFORMATION

A. LOCATION

The Salida Whitewater Park is located upstream of the F Street Boat Ramp to Riverside Park, East Sackett Street, Salida, Colorado.

The Salida Park is located within the channel of the Arkansas River. A reach measuring approximately 1,000 feet includes three deflectors that create eddies and beginner training opportunities above two ledges. These latter recreational in-channel diversion structures are located in the Southeast quarter of Section 32, T. 50N., R 9 E of the New Mexico Principal Meridian, Chaffee County, Colorado. The project extends from 950 feet upstream of F Street bridge to 250 feet downstream of the bridge adjacent to downtown Salida.[1]

B. 2010 UPDATES

The information below is primarily based upon the initial 2008 investigation with minor 2010 updates noted. The 2010 update effort established that two additional features were added in the spring of 2010. These are located upstream from the primary drop.

Coyote Gulch, March 10, 2010

C. OWNER/OVERSIGHT

Owner: City of Salida
City Planner
124 E. Street
Salida, CO 81201
719-539-4555

Union Pacific Railroad
Real Estate Department
1400 Douglas Street
Omaha, Nebraska 68179-1690

Steward: Arkansas River Trust, founded in 1999 to fund the whitewater park
332 1/2 W Sackett
Salida, CO 81201
719-539-0700 ; info@arkrivertrust.org

Maintenance Responsibility:
City of Salida Public Works
Robert Vance, Director of Public Works
340 W. Highway 291; Salida, CO 81201
719-539-6257; rvance@cityofsalida.com

D. COST

Design, Engineering and Construction - based on funding sources.

Pocket Park – 1986-87	Private contributions and Coors Co. grant (cost unknown)
Phase I and earlier	In-kind
Phase II	$ 80,000
Phase III (Shoreline work included)	158,000[2]
TOTAL Phase I-III	$238,000+

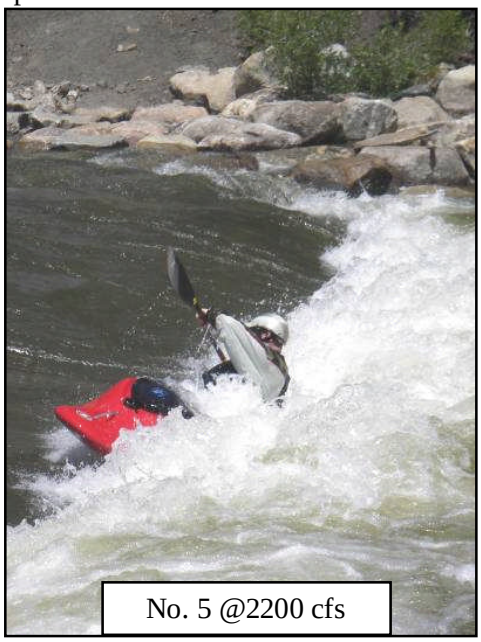
The costs to secure the RICD and design/build costs of the 2010 additions were not available**.**

A. COMPLETION DATE

The City's Boat Landing and Pocket Park was built in 1986-87

Built under the auspices of the Arkansas River Trust Riverpark:

Phase I	spring, 2000
Phase II	October, 2001
Phase III	May, 2003
Additions	March, 2010


No. 5 @2200 cfs

2. SAFETY ISSUES AND ACCIDENT REPORTS

None reported.

3. DESIGN and CONSTRUCTION DOCUMENTS/DRAWINGS

A. PRELIMINARY DESIGN

Designer: Recreational Engineering and Planning, Gary Lacy, Mike Harvey

B. CONSTRUCTION DOCUMENTS

Engineer of Record- Gary Lacy, P.E.

No sealed drawings or design drawings meeting the description outlined by the Colorado State Board of Licensure for Professional Engineers were found.

C. CONSTRUCTION METHODS

The proposed construction used *…large boulder on a 1,200-linear-foot reach of river. One V-dam will be constructed and an existing V-dam will be repaired using 3- to 5-foot-diameter boulders. The riverbed below each dam will be excavated to create 4-foot-deep plunge pools. Large 4- to 6-foot diameter boulders will be placed below and within the plunge pools to create riffles. Four sets of boulder double-current deflectors will be built to the banks to create our pools. Portions of both banks would be protected with riparian terraces by placing boulders along the water's edge and high on the bank. On the north bank, this will involve cleaning and removing existing dumped concrete and regrading the bank.*[4]

The contractor was Lowry Contracting, 625 Illinois Ave., Salida, CO 81201, 719-539-6676.

D. FLOODPLAIN AND HYDRAULIC EVALUATION

None found.

E. HYDRAULIC DROP

Not found.

F. DESIGN CALCULATIONS

Not found.

G. COURSE LENGTH

The entire reach is 1,200 feet. The distance between the two feature drop structures is 400 feet.

H. CONSTRICTION WIDTHS

Estimates based on the 2001 project design drawing (not drawn to scale) are 60-70 feet and 50-60 feet respectively for Structures No. 5 and 9, respectively.

I. PHOTOGRAPHS

See additional site photos in the attachments.

4. WATER AND STREAMBED REQUIREMENTS AND PERFORMANCE

A. PERMITS

Pemit # 200100045 authorized work to improve whitewater boating features and create riparian terraces.[5]

Permit #200500047 was issued to stabilize Structure No. 9 with grout.[6]

B. RICD INFORMATION

The flows decreed in the RICD reference measurements at the Wellsville gage located downstream from the City of Salida.

Time Period	March 15-Thursday before the Last Monday in May	Friday before the Last Monday in May – June 30	July 1 – August 15	August 16 – November 15
Flow (cfs)	250	700-1800 adjustable	700	250

The adjustable rate for the "High Flow Period" (Friday before the Last Monday in May through the end of June) is determined the by Applicant at its sole discretion, in consultation with the City of Salida and the Town of Buena Vista.

On or before April 1each year, the County shall notify in writing the Division Engineer, and any party that has requested such notice, of

1) Event Days - 8 days in June during the High Flow Period when the water rights for the RICD shall be 1,800 cfs

2) 30-Day Period - up to 30 consecutive days within the High Flow Period during which RICD rights shall be limited to 1,400 cfs, except for the 8 Event Days which shall fall within that 30-Day Period.

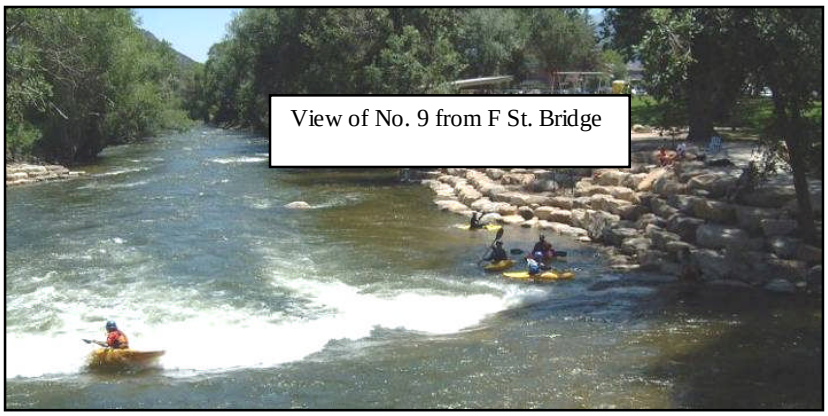
Event Days to not need to be consecutive, but most occur on days when boating events are scheduled for one or both Boating Parks and /or on any day preceding such events, and must occur in the month of June. During the remainder of the High Flow Period that is not part of the 30-Day Period, the RICD water rights shall be limited to 700 cfs.

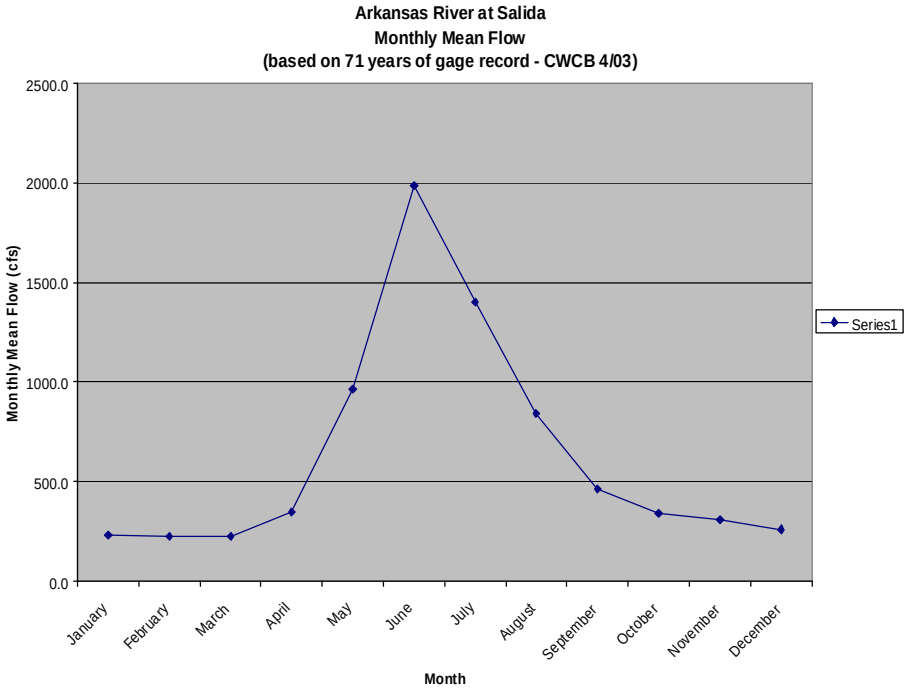
Once the Event Days and the 30-Day Period are designated for a given year, they are not subject to change regardless of available flows. If written notice is not provided to the Division Engineer by the dates provided above, the Division Engineer is not required to honor a call placed by the County for the 30-Day Period and the Event Days for that year. The above water rights are absolute for both structures at the Salida Park and Structure No. 1 at the B.V. Park, and are conditional for Structure Nos. 2-4 at the B.V. Park.

The County has committed to implement Reduced RICD Calls to facilitate Recovery Year Exchanges and Limited Future Exchanges.

Limited Future Exchanges - the Reduced RICD Call shall not be required to drop below 1200 cfs during the 30-Day Period that is not one of the 8 Event Days (whose flow remains at 1800 cfs).

Recovery Year Exchanges - the Reduced RICD Call shall not be required to drop below 1500 cfs during the 8 Event Days and 1,000 cfs during the remainder of the 30-Day Period, except for Saturday and Sundays during the 30-Day Period that are not Event Days, during which the Reduced RICD Call for Recovery Year Exchanges shall not be required to drop below 1100 cfs.[7]





See Attachment D for further an expanded discussion about Reduced RICD Calls.

C. FLOW, RECORDS, GAGES

Flow information is available through several online resources:
National Weather Service: Arkansas River 2NW Wellsville
http://www.crh.noaa.gov/ahps2/hydrograph.php?wfo=pub&gage=wsvc2&view=1,1,1,1,1,1,1,0
Colorado Division of Water Resources: Arkansas River at Salida (ARKSALCO)
http://www.dwr.state.co.us/SurfaceWater/data/detail_graph.aspx?ID=ARKSALCO&MTYPE=DISCHRG&points=0&disp=2&period=WY&zoom=no
US Geological Survey: Arkansas River Near Nathrop, Colorado
http://waterdata.usgs.gov/co/nwis/uv/?site_no=07091200

D. WATER MANAGEMENT IMPACTS

There has been no documented negative result of the park construction. There could be water management issues with exchanges through this reach of the Arkansas River in the future; however, because the final decree included certain terms and conditions, significant water management issues may be avoided.

E. MODIFICATIONS, FAILURES AND REPAIRS

Original pocket park 1986-87: repair status undetermined.

***Boat Landing and Pocket Park**, Salida, CO 1986-1987. Design engineer and project manager for an in-town river boat landing and mini whitewater park on the Arkansas River. The project was built with a grant from the Coors Company.* http://www.wwparks.com/projects.html

In 2003, grout was added to the first ledge under the 200100045 permit to stabilize the structure.[9]

In 2005, maintenance was approved to repair Structure # 5 above the F Street Bridge. This maintenance introduced the use of grout to both improve the structural stability and improve the hydraulic performance. This was recommended by the designer:

(2005) Since the construction of the structure during the spring of 2000, it has required maintenance in three of the last four years. Frequent maintenance and the resulting impact is not desirable over the long term.[9]

2010 Update: Two additional drops were added to the course in March, 2010.

F. SEDIMENTATION ISSUES

None found.

5. ECONOMIC DEVELOPMENT INTENTION AND PERFORMANCE

A. INTENDED USES

The decreed beneficial uses for the RICDs at each structure in the Park(s) are boating, kayaking, tubing, rafting, floating, and canoeing.

The 30-Day Period allows the County to attract elite boaters during traditional runoff season during which paddlers travel from around the world to visit Colorado's rivers, notably competitors who value the park's high quality whitewater. For the July 1-August 15 period and the days within the High Flow period outside of the 30-Day Period the County seeks to attract beginner and intermediate skill-level paddlers.

The remainder of the time period during which an RICD is established encourages sustainable traffic and traditionally expected flows for local and regional residents, regardless of their skills.[10]

B. ECONOMIC AND USAGE STUDIES

None have been conducted.

C. EVENTS

Whitewater Festival is a huge celebration of all things river that draws crowds in excess of 25,000 people. 2008 will the 60th FiBArk, which stands for "First in Boating the Arkansas River." The festival's roots lie in a bet between two boaters who, nearly 60 years ago, laid down a competition to settle who could paddle the 56 miles from Salida to Cañon City the fastest. A 26-mile race from Salida to Cotopaxi, pays homage to the founders. Other competitions include freestyle kayaking, boatercross (Class V on Pine Creek reach, upstream), a raft rodeo and slalom races. http://www.insideoutsidemag.com/issues/columns/CornerTown/SALIDA,_COLORADO/

D. RECENT DEVELOPMENTS IN THE VICINITY

2008 - The streamside building complex adjacent to and immediately upstream of the boating ramp and primary surf feature (Structure No. 5) has completed its renovation from a former life as the Town's steam plant. The "Steam Plant" now houses a theater and conference center overlooking the whitewater park. In addition, a co-founder of the Arkansas River Trust and long time proprietor of an outdoor specialty shop and rafting company has opened a restaurant at the F Street Bridge, overlooking the river between the two primary surf features.

6. OTHER

The park is considered by many to be one of the best in the state, due to the main feature having a long season, being exceptionally friendly for freestyle beginners, and still offering up big aerials for experts. More than a few Salida paddlers refuse to paddle at BV more than a few times a year, and the territoriality between paddling towns has led to a friendly rivalry among local paddlers. A nearby streetlight allows for night paddling, and the only serious hazard is the bridge abutment just downstream of the boat ramp. A few other features exist here, and the park seems to host annual off-season construction, partially in response to the high water that occasionally blows out a feature. Fortunately, locals like Mike Harvey keep things in excellent working order, making Salida a worthy quick session, or a great place to spend a weekend.[11]

See Attachments for a short narrative of the Salida Whitewater Park, found at the Arkansas River Trust website.

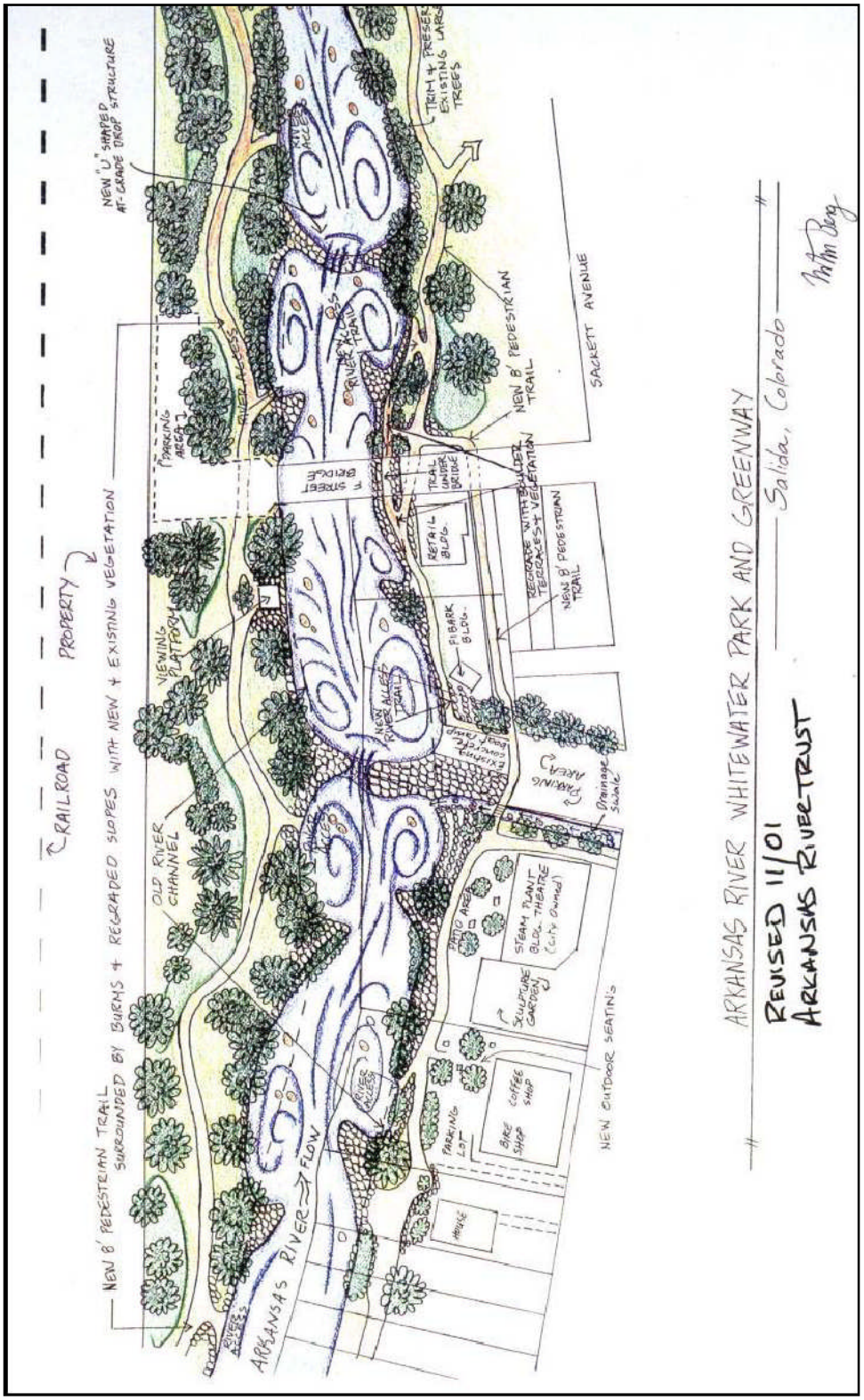
7. REFERENCES

1. Chaffee_*Finding of Fact, Conclusion of Law and Decree of the Water Court,* October 20, 2006, pages 2,3 and *ACOE Permit 200100045*, page 27.
2. *Mountain Mail*, April 3, 2003. www.arkrivertrust.org/mtnmail_030403.htm\
3. *ACOE Permit No. 200100045*, pages 8-14.
4. *Ibid*., page 27.
5. *Ibid*.
6. *ACOE Permit No. 200500047*.
7. Chaffee_*Finding of Fact, Conclusion of Law and Decree of the Water Court,* October 20, 2006, pages 4-6.
8. *ACOE Permit 200100045*, page 8.
9. *ACOE Permit No. 200500047 Repairs*, page 6.
10. Chaffee_*Finding of Fact, Conclusion of Law and Decree of the Water Court,* October 20, 2006, page 6,7.
11. *Whitewater of the Southern Rockies,* Evan Stafford and Kyle McCutcheon, page 80.

Attachment A

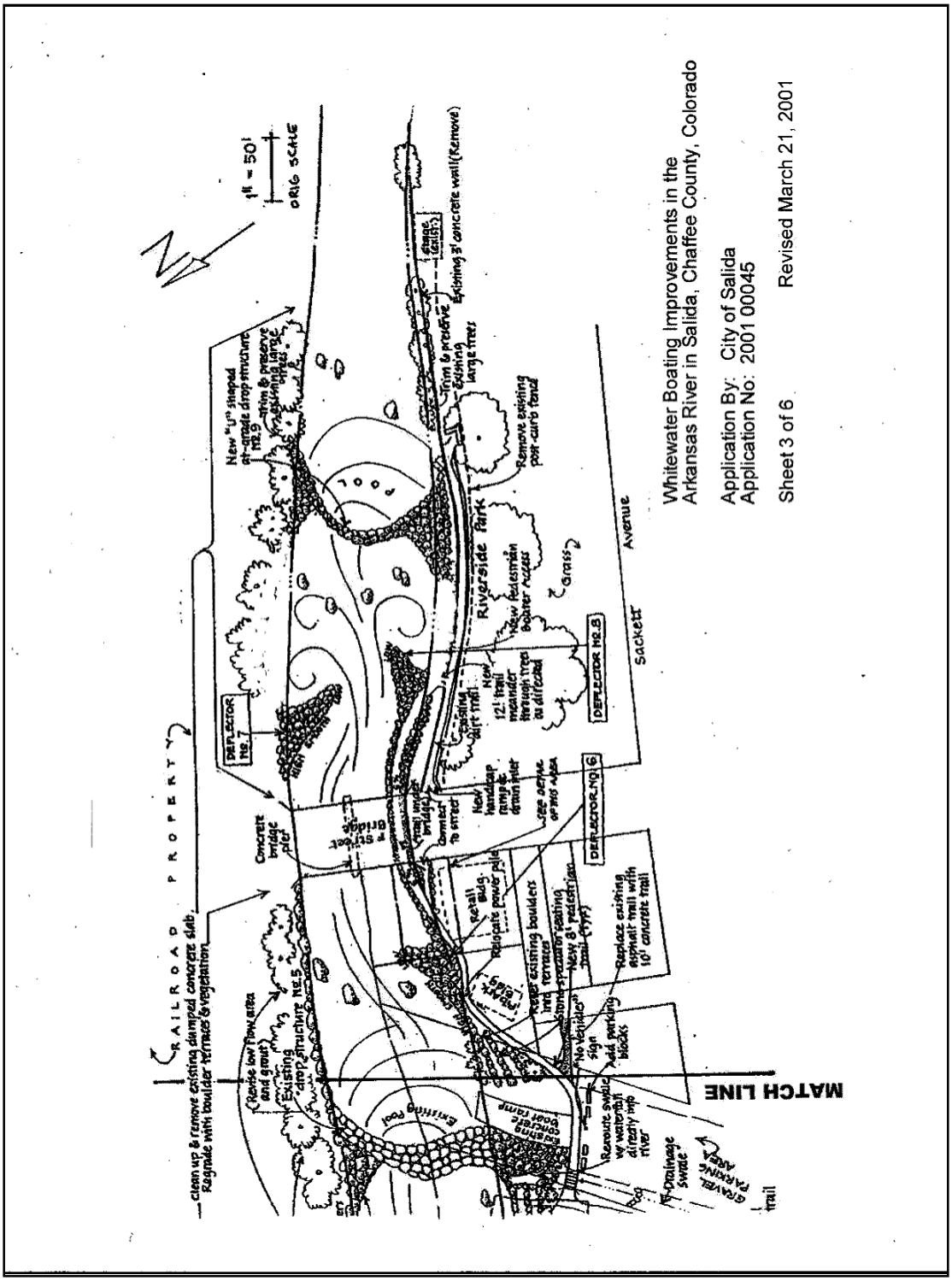
Arkansas River Trust Greenway

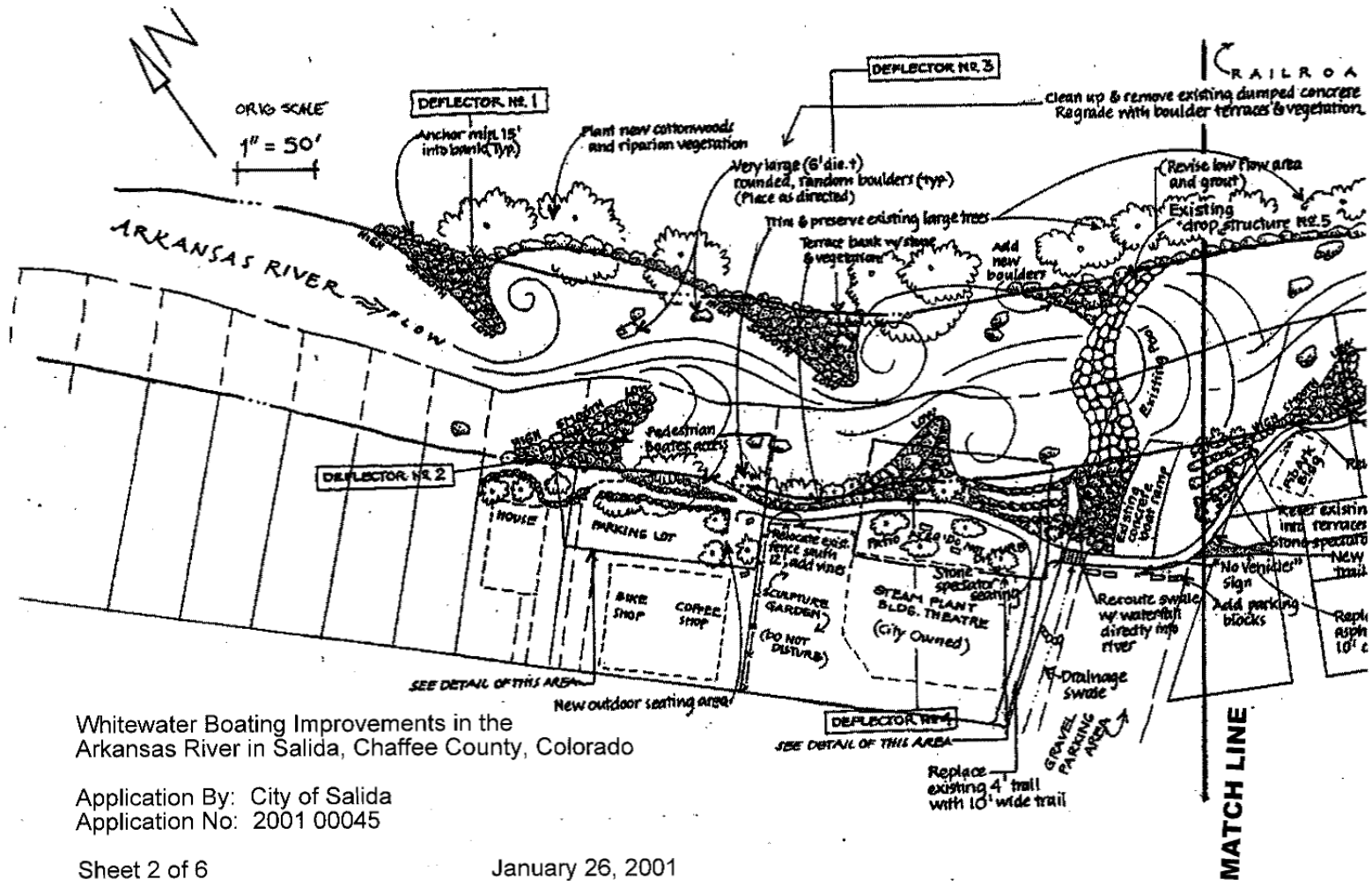
Project Rendering 11/01



Salida Whitewater Park

2001 Design Drawings



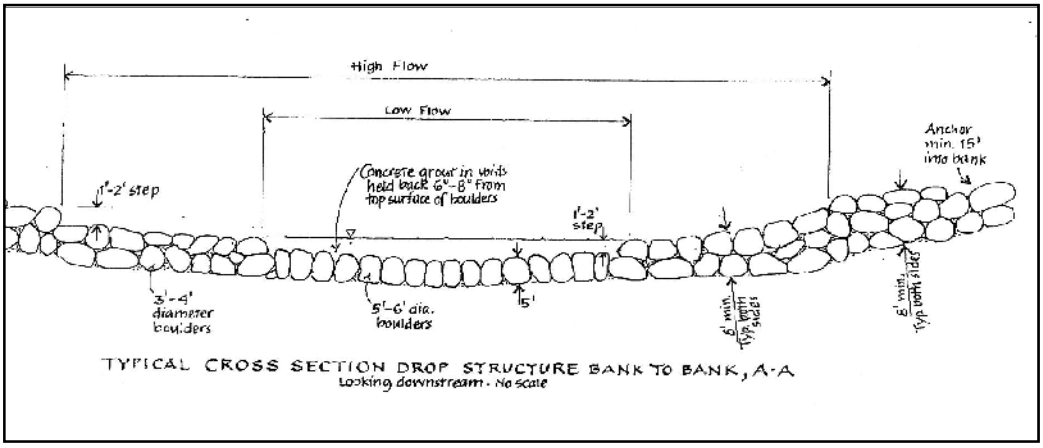


Whitewater Boating Improvements in the
Arkansas River in Salida, Chaffee County, Colorado

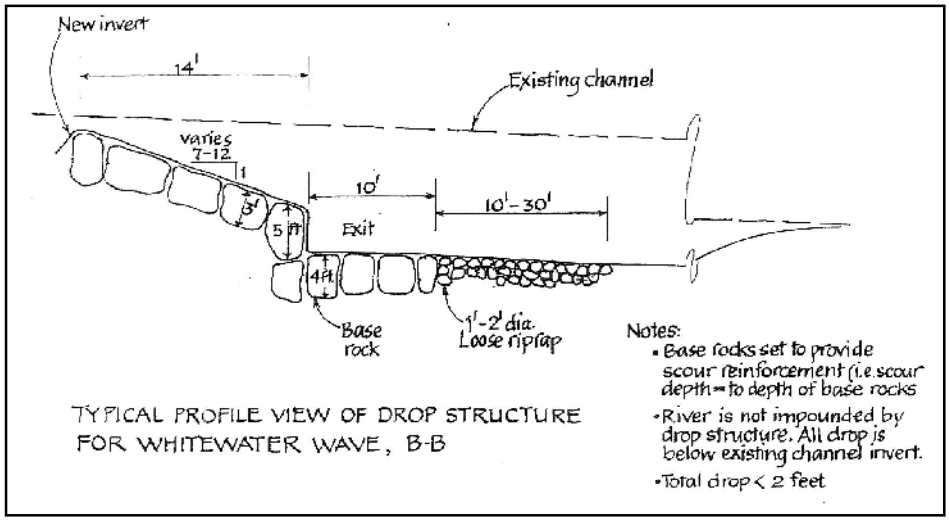
Application By: City of Salida
Application No: 2001 00045

Sheet 2 of 6

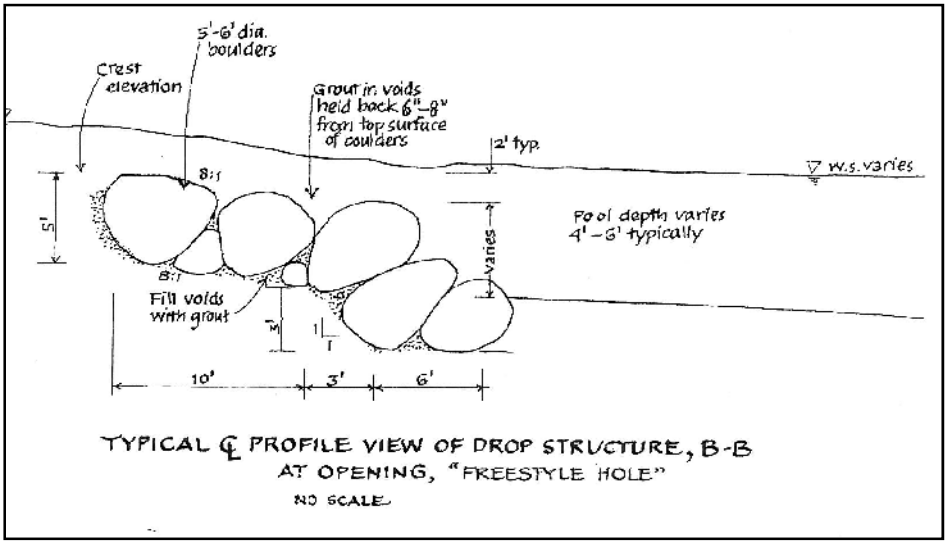
January 26, 2001



TYPICAL CROSS SECTION DROP STRUCTURE BANK TO BANK, A-A
Looking downstream - No scale



TYPICAL PROFILE VIEW OF DROP STRUCTURE FOR WHITEWATER WAVE, B-B



TYPICAL ℄ PROFILE VIEW OF DROP STRUCTURE, B-B
AT OPENING, "FREESTYLE HOLE"
NO SCALE

Attachment B

2003 Post-Construction Inspection Images

21 March 2003 #11 2001 00045
Salida whitewater boating improvements in Arkansas River
in Salida, Chaffee County, Colorado

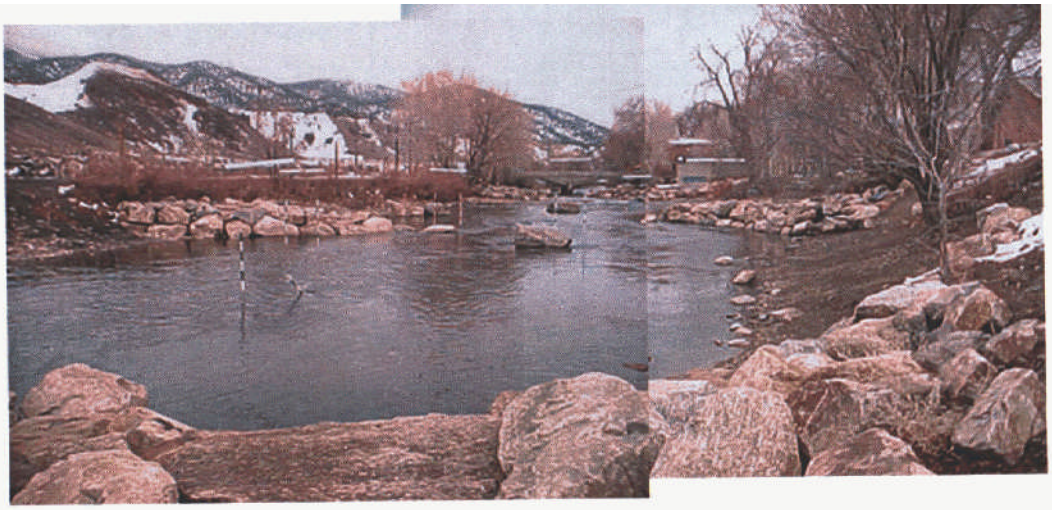
Looking upstream at Deflector No. 1 on north bank and several randum boulders.

So Colo Reg Ofc photo by Anita Culp

21 March 2003 #12-13 2001 00045
Salida whitewater boating improvements in the Arkansas River in Salida, Chaffee County, Colorado

Looking downstream (easterly) at Deflector No. 2 (south bank) and Deflector No. 3 (north bank) and several random boulders.

So Colo Reg Ofc photo by Anita Culp



21 March 2003 #14-15 2001 00045
Salida whitewater boating improvements in the Arkansas River in Salida, Chaffee County, Colorado

From Deflector No. 2, looking downstream (easterly) at Deflector No. 3 on north bank and Deflector No. 4 on south bank.

So Colo Reg Ofc photo by Anita Culp

21 March 2003 #16 2001 00045
Salida whitewater boating improvements in the Arkansas River in Salida, Chaffee County, Colorado

Looking downstream at drop structure located above F Street bridge.

So Colo Reg Ofc photo by Anita Culp

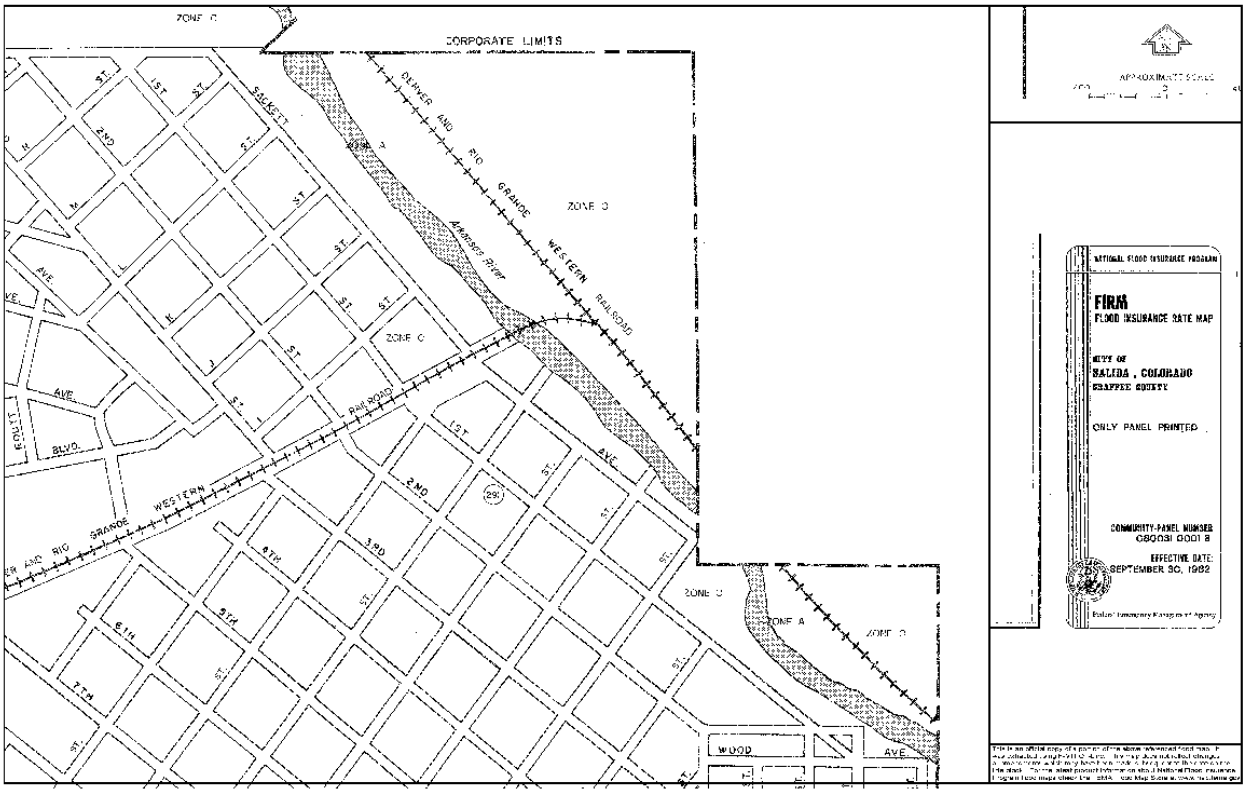
21 March 2003 #17 2001 00045
Salida whitewater boating improvements in the Arkansas River in Salida, Chaffee County, Colorado

From F Street bridge, looking upstream at Deflector No. 6 (fisherman) and upper project site.

So Colo Reg Ofc photo by Anita Culp

Attachment C

Salida FEMA Map



Attachment D

Chaffee County RICD Decreed "Reduced RICD Calls" – Detail

10. Reduced RICD Calls. By settlement agreement, the County has agreed that under certain defined circumstances, it shall reduce its call under the RICD water rights decreed herein in order to facilitate certain future exchanges by some of the Objectors ("Reduced RICD Calls"), as further described below. Circumstances requiring Reduced RICD Calls are (a) certain water shortfall conditions requiring exchanges in addition to existing senior rights in order to refill depleted reservoirs ("Recovery Year Exchanges"); and (b) certain limited exchanges currently anticipated to be necessary to allow for future water supply needs upstream and downstream of the Boating Parks (referred to herein as "Limited Future Exchanges"). The specific circumstances in which the County has agreed to implement Reduced RICD Calls to facilitate Recovery Year Exchanges and Limited Future Exchanges, as well as the conditions and limitations placed upon such exchanges and reduced calls, are more specifically set forth in the Memorandum of Understanding between many of the parties hereto, dated July 24, 2006 ("MOU"), a copy of which is attached to this Decree as Exhibit C, and in separate stipulations between Applicant and certain Objectors.

The Court hereby incorporates herein paragraphs 2 - 5 of the MOU and the aforementioned separate stipulations, so that under the defined circumstances set forth therein, and subject to the conditions and limitations contained therein, the County shall be required to implement Reduced RICD Calls to the extent necessary in order to help facilitate the Recovery Year Exchanges and Limited Future Exchanges. For Limited Future Exchanges, the Reduced RICD Call shall not be required to drop below 1200 cfs during the 30-Day Period that is not one of the 8 Event Days (Events Days remain at 1800 cfs). For Recovery Year Exchanges, the Reduced RICD Call shall not be required to drop below 1500 cfs during the 8 Event Days and 1000 cfs during the remainder of the 30-Day Period, except for Saturdays and Sundays during the 30-Day Period that are not Event Days, during which the Reduced RICD Call for Recovery Year Exchanges shall not be required to drop below 1100 cfs.

The Reduced RICD Call for Limited Future Exchanges and Recovery Year Exchanges is not cumulative, so that even if Limited Future Exchanges and Recovery Year Exchanges are both being operated at the same time by multiple entities, the County shall never be required to call for less than 1500 cfs for Event Days or less than 1100 cfs on weekend days during the 30-Day Period that are not Event Days, or less than 1000 cfs for the remainder of the 30-Day Period that is not an Event Day or weekend day. Exchange capacity made available by the Reduced RICD Call shall be available to any water user in priority.

The Court finds the above compromise both reasonable and practicable in addressing the concerns of water supply providers while reasonably protecting the recreational use and values sought to be protected by the RICDs. The Court recognizes that the State and Division Engineer are not a party to the MOU or to the separate Stipulations and those documents are only incorporated herein with respect to operation of the Reduced RICD Call for Limited Future Exchanges and Recovery Year Exchanges. In order for the Division Engineer to administer the Reduced RICD Call, the Applicant shall provide written notice to the Division Engineer of the Reduced RICD Calls and any changes to the Reduced RICD Call that may occur during the 30-Day Period in a timely fashion.

Attachment E

The Arkansas River Trust Story

In the spring of 2000 the Arkansas River Trust undertook a small river improvement project on the Arkansas in Salida. Thanks to the generous donation of materials and labor from of a local contractor, The Arkansas River Trust oversaw in-stream and bank improvements. This first project created a more appealing and accessible site for both spectators and whitewater paddlers alike.

This improvement gave the community an exciting glimpse of the future. The Arkansas River corridor in downtown Salida has historically been one of the least attractive and least accessible sections of the Arkansas. Pinched between, a now abandoned, switching yard and rail road depot on one side and homes on the other; the banks of the Arkansas have been used as a dumping ground for concrete, building materials and all manner of trash and debris. The Arkansas River Whitewater Park and Greenway project represented an opportunity to take this neglected corridor and re-integrate the river into downtown Salida and into the collective heart of our community.

Building off the momentum of this early project, the Arkansas River Trust got underway on Phase II of the Whitewater Park Project in the early spring of 2001 and cut the ribbon on Phase II in October of 2001.

The second phase of the Whitewater Park and Greenway project represented a partnership between the Arkansas River Trust and the City of Salida. The City Council budgeted $50,000 and the Arkansas River Trust raised nearly $30,000 from private sources. Again Lowry Contracting generously donated time and materials and today the River Corridor is more accessible and attractive then it has ever been in downtown Salida.

The first section of Riverwalk was built allowing people to make their way from F St. along the river to upstream businesses. In addition, two access points were built and incorporated into instream current deflectors, allowing safe access to the river for fishermen, boaters, or anyone wishing to enjoy the waters of the Arkansas. Hundreds of tons of concrete were removed off the banks and native vegetation is being planted in its place.

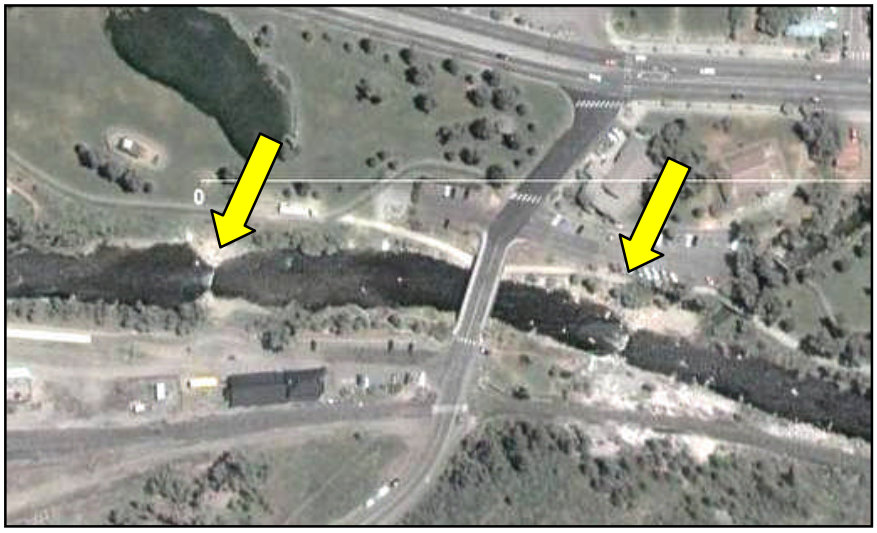
http://www.arkrivertrust.org/proj_arkwwpark.htm

STEAMBOAT SPRINGS BOATING PARK ON THE YAMPA RIVER

1. BACKGROUND INFORMATION

A. LOCATION

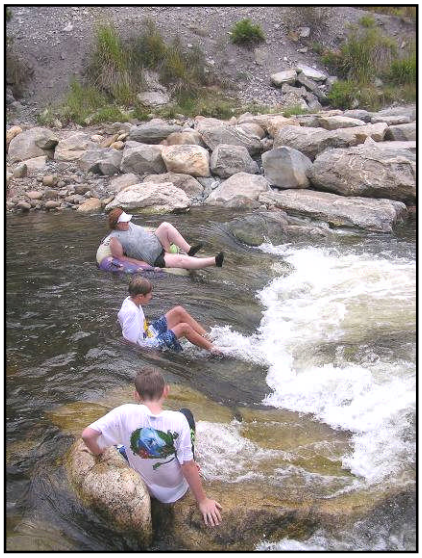
The 2001 permit was issued for work conducted instream within 2,300 feet of the Yampa River from the 13th Street bridge downstream to the Stock bridge. Within the E 1/2of Section 7 and the SW1/4 of Section 8, Township 6 North, Range 84 West, Routt County, Colorado.



The Boating Park is located within the channel of the Yampa River adjacent to the library and immediately upstream of the 13th Street Bridge. There are two RICD structures located at SW ¼ SW ¼ of Section 8. Township 6N., R84 W., 6th P.M.

Structure I (aka Charlie's Hole) – The northeast end point is 649.5 feet from the south line and 669.4 feet from the west line of the SW ¼ of Section 8; and the southwest end point is 594.8 feet from the south line and 571.3 feet from the west line of the SW ¼ of Section 8.

Structure II (aka D-Hole) – The northeast end point is 1066.2 feet from the south line and 217.7 feet from the west line of the SW ¼ of Section 8; and the southwest end point is 974.6 feet from the south line, 135.2 feet from the west line of the SW1/4 of Section 8.[1]



Tubers on C Hole

B. 2010 UPDATES

The information below is based upon the initial 2008 investigation. No further improvements were identified during the 2010 update.

C. OWNER/OVERSIGHT

Owner: Town of Steamboat Springs
Open Space Supervisor
245 Howeleen Parkway

PO Box 775088
Steamboat Springs, CO 80477-5088
970-879-4300 phone
970-870-0173 fax
www.ci.steamboat.co.us

Steward:	Town of Steamboat Springs
Maintenance Responsibility:	Town of Steamboat Springs Parks and Recreation Director 137 10th Street, Steamboat Springs CO 80477

D. COST

2001 Initial Work	$9,178.23 + Unknown by Designworks of Salt Lake City
2003 Repair and Enhancement	$22,111.61
2004 Bank Stabilization-	$1,950.00
2005 Repair and Enhancement	$4,169.65

Repair Receipts Document compiled by numbers provided by and available from the City of Steamboat Springs. These costs do not include the costs of obtaining the RICD water right, which may be in the hundreds of thousands of dollars.

COMPLETION DATE
November 12, 2001
April 16, 2003
November 2004
April 14, 2005

2. SAFETY ISSUES AND ACCIDENT REPORTS

No known fatalities or serious accidents have occurred at the site.

3. DESIGN and CONSTRUCTION DOCUMENTS/DRAWINGS

A. PRELIMINARY DESIGN

Preliminary Design: Instream modifications have been made in this reach of the Yampa River since the mid-1970 with Gary Lacy's assistance, according to local boaters and retailers.[2]

Recreation Engineering and Planning- Gary Lacy, P.E.

B. CONSTRUCTION DOCUMENTS

Final Design for instream work 2001-2005: Recreation Engineering and Planning- Gary Lacy, P.E.

No sealed drawings or design drawings meeting the description outlined by the Colorado State Board of Licensure for Professional Engineers were found

See Attachments A and B (Engineering Designworks, Inc. and Recreation Engineering and Planning.

C. CONSTRUCTION METHODS

The current phase of instream modifications was originally constructed November, 2001. The course consists of 2 Grouted Sloping Boulder Drops approximately 500 ft apart. The upper hole or "C Hole" also has pedestrian viewing and seating areas. See Attachment A.

D. FLOODPLAIN EVALUATION

HEC-RAS Modeling available from the City.
FEMA Flood Insurance Map is included as Attachment C.

E. HYDRAULIC DROP

C-Hole Hydraulic Drop varies from 0.95'-1.42' depending on flow
D-Hole Hydraulic Drop varies from 0.3'-1.45' depending on flow

2005 DATA

Date	Upstream WSE	Flow	Depth	Downstream WSE	Hydraulic Drop
8/9/2005	84.10	100	1.1		
5/3/2005	86.04	709	3.035	84.8	1.24
4/19/2005	86.42	789	3.42	85.08	1.34
5/17/2005	87.50	1422	4.495	85.87	1.63
5/23/2005	89.40	3276	6.395	87.62	1.77

See rating curves for C-Hole and D-Hole in Steamboat References

F. DESIGN CALCULATIONS

None were found.

G. COURSE LENGTH

The boating extends approximately 630 feet (.12 mile) within the channel of the Yampa River between Charlie's Hole and D-Hole.

H. CONSTRICTION WIDTHS

The length appears to be 40-75 feet, based on the Design Drawings. See Attachment A.

I. PHOTOGRAPHS

See additional photos in Steamboat Site Photos

4. WATER AND STREAMBED REQUIREMENTS AND PERFORMANCE

A. PERMITS

Permit 200175121 was awarded August 10, 2001.

Permit amendment request submitted October 2, 2002 was approves for work completed in 2003 additional request drawings submitted December 27, 2002.[3]
Permit 200475103 was awarded March 24, 2004 (application date: March 17, 2004) for work completed in 2005. [4]

B. RICD INFORMATION[5]

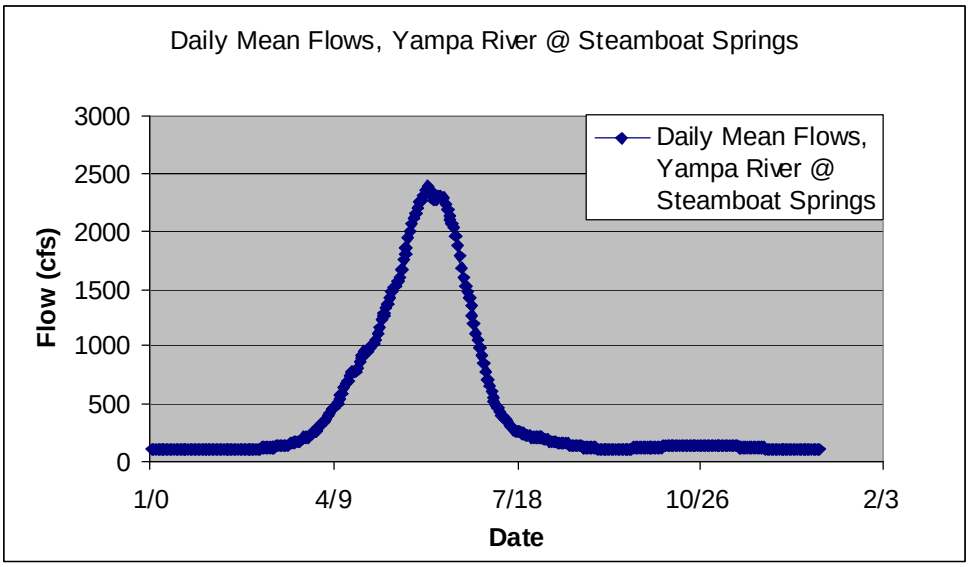
The following flows were decreed for Case No. O3CW86:

Time	April	May	May	June	June	July	July	August
Period	15-30	1-15	16-31	1-15	16-30	1-15	16-31	1-15
Flows	400	650	1000	1400	650	250	100	95

A comprehensive file of the following is available at
http://cwcb.state.co.us/WaterSupply/RICDDecApps.htm

C. FLOW RECORDS/GAUGES

Current and historical flow records are available on the USGS web site for the gauge "Yampa River at Steamboat Springs. The gauge is located just upstream from the course and there is a tributary, Fish Creek, between the gauge and course. Fish Creek adds approximately 8-15% more flow to the river. The following graph represents 90 years of record (1884-2003) for the Yampa River at Steamboat.



D. WATER MANAGEMENT IMPACTS

There may be water management impacts that result from the decree of this RICD water right; however, there have been no significant water management impacts to dates since the decree has been entered.

E. MODIFICATIONS, FAILURES AND REPAIRS

Modifications have been made multiple times since construction of the current phase for instream modification in late 2001. The course was modified in December 2002. One structure failed in spring, 2003 and rebuilt in October 2003. Bank stabilization was conducted in November, 2004. C and D Holes were rebuilt April, 2005.

F. SEDIMENTATION ISSUES

A May, 2007 site study (Section 4) indicated that there has been some sedimentation, but it does not seem to affect the structures performance.

The D-Hole was built in October 2001 where the Yampa River passes by the Depot Art Center just below the 13th Street Bridge. Kayakers never got a chance to see it in full effect in the summer of 2002 because maximum stream flows were less than 500 cubic feet per second. Last year, the kayak hole washed out before the river peaked.

…What happens if the D-Hole washes out again? Neumann said one possibility is grouting the boulders in place with cement. That would require a lengthy process to amend the city's permit from the Army Corps of Engineers, and there are no plans to follow that course. Lacy said he would add to his base of knowledge from the experience with the D-Hole.

"Every project is a learning experience for everyone," Lacy said. "This is a community that pulls together. If there's an issue, the approach is to be constructive and solution oriented. That's the way I am on all my projects."

Steamboat Pilot&Today, October 17, 2003

5. ECONOMIC DEVELOPMENT INTENTION AND PERFORMANCE

A. INTENDED USES

Uses include, boating, kayaking, tubing, rafting, floating, canoeing, and similar general recreational uses.

B. ECONOMIC AND USAGE STUDIES

Stratus Consulting estimated the following in a report prepared for Porzak, Browning, Bushong:

Our results demonstrate that waters diverted in the Steamboat Springs boating park can generate considerable economic benefit. We estimate that future annual monetary benefits potentially derived from the boating park are greater than $7.2 million. When capitalized over 20 years at 7%, the present value of benefits are greater than $81.4 million. This estimate will be refined when actual boater visitation data are collected for 2005.[6]

C. EVENTS

An invitational pro rodeo has been held the first week in June since 2005-6.

RECENT DEVELOPMENT IN VICINITY
n/a

6. OTHER

A. USER INTERVIEWS

April 1st 2005 through July 6th 2005. Variety of flows all over 600 cfs.
Many of the kayakers interviewed were seen freestyle kayaking repeatedly at the C-Hole and D-Hole at lower flows. On average, kayakers had a "good" kayaking experience at the C Hole and D Hole at flow levels of 500cfs and above.

Site Visit
Date: 5-11-07, 6:00 p.m.
Flow: 1400cfs
By: Derk Slottow

Site Visit Summary: Parking available immediately adjacent to C Hole. River was flowing approximately 1,400 cfs on the Yampa River at Steamboat Gauge at time of 1 site visit. C Hole was the only feature working and was working well. 6-8 kayakers were using the C Hole, no kayakers were using the D Hole or any other feature. Passive users were using the terraced rocks leading down to the river.

Steamboat's Yampa River is a mellow stretch of whitewater that cruises just a few blocks to the east of the main drag… A handful of manmade obstructions have increased the entertainment value of this river substantially, but low flow now attracts a string of inner tubes – the byproduct of multiple tube-rental companies nearby.

As the water increase…the level transforms the manmade obstacles into well-defined eddies and eddy lines, and the Yampa River Park slalom course is the relaxed training ground of the run, found roadside to Lincoln Ave. immediately south of the downtown business district.

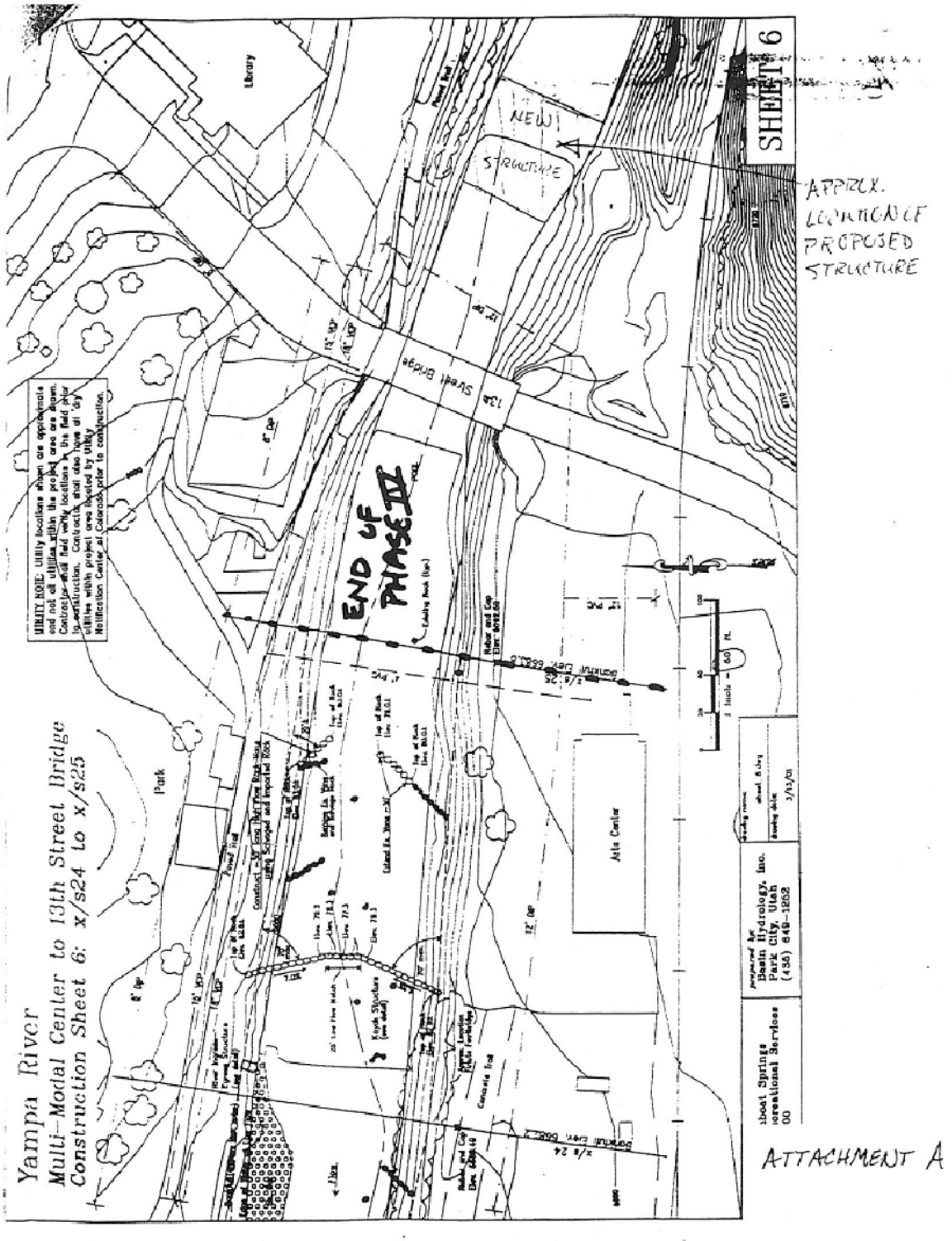
Charlie's Hole, or C-Hole (just upstream of the 20 Mile Road bridge, next to the Library) is more well-formed than A, B, and D nearby…The C-Hole goes off with blunts on the corners, helixes and more when a wave at higher flows and big loops interlaced with cartwheel-to-splitwheel combinations at hole-like levels.[7]

7. REFERENCES

1. ACOE Permit 200475103, pages 1, 11.
2. Whitewater Courses and Parks 2005 Conference, Glenwood Springs, October, 2005 www.whitewatercoursesandparks.com.
3. ACOE Permit 200475121
4. ACOE Permit 200475475
5. Steamboat RICD Decree No. 03CW86, page 4.
6. Supplemental Economic Study #10, Potential Beneficial Value of Waters Diverted in the Yampa River for Steamboat Springs Boating Park prepared for Porzak, Browning, Bushong, Raucher, Whitcomb, Henderson and Rice, April 19, 2005, page 4.
7. Whitewater of the Southern Rockies Whitewater of the Southern Rockies, Evan Stafford and Kyle McCutcheon, page 589.

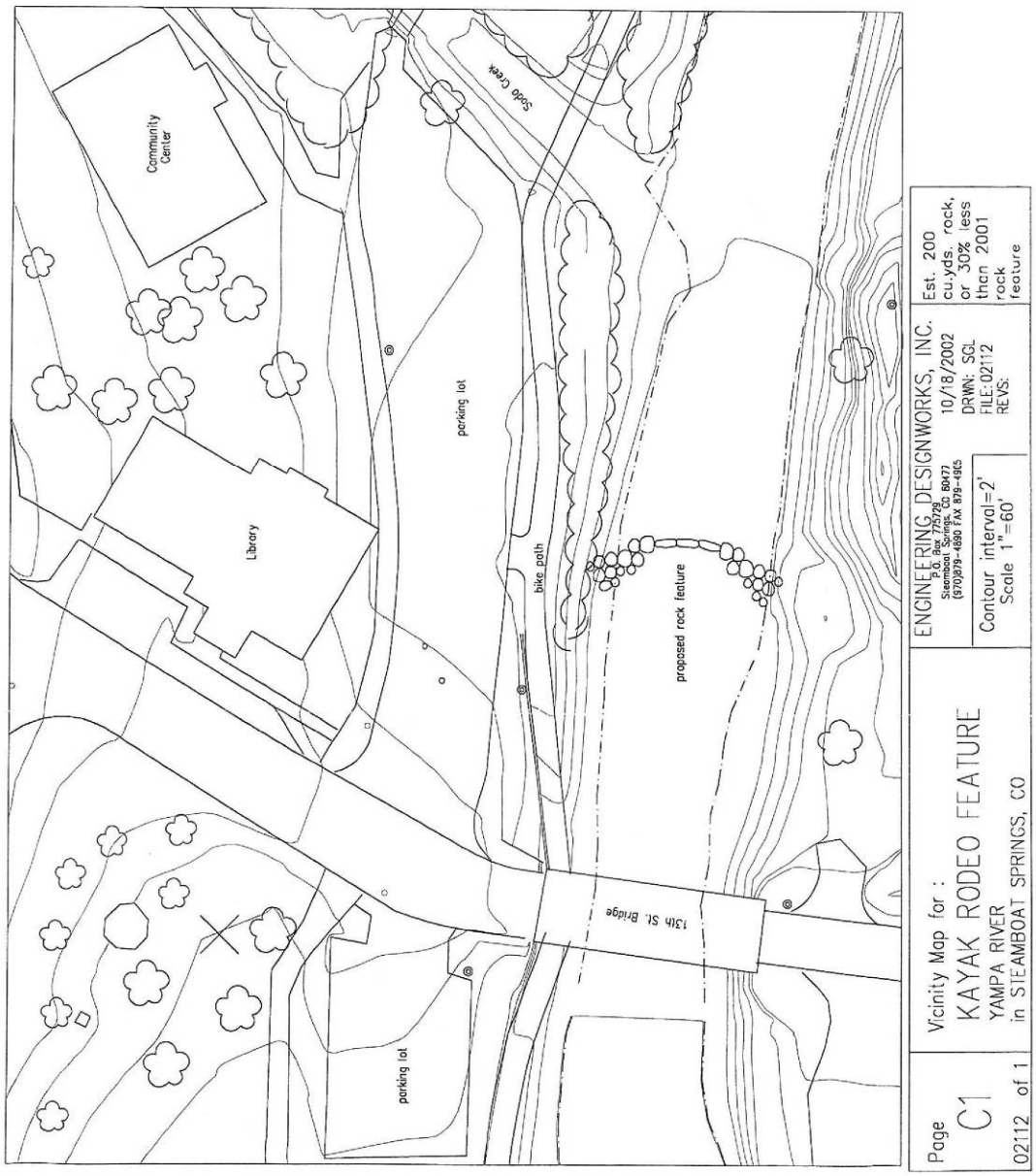
Attachment A

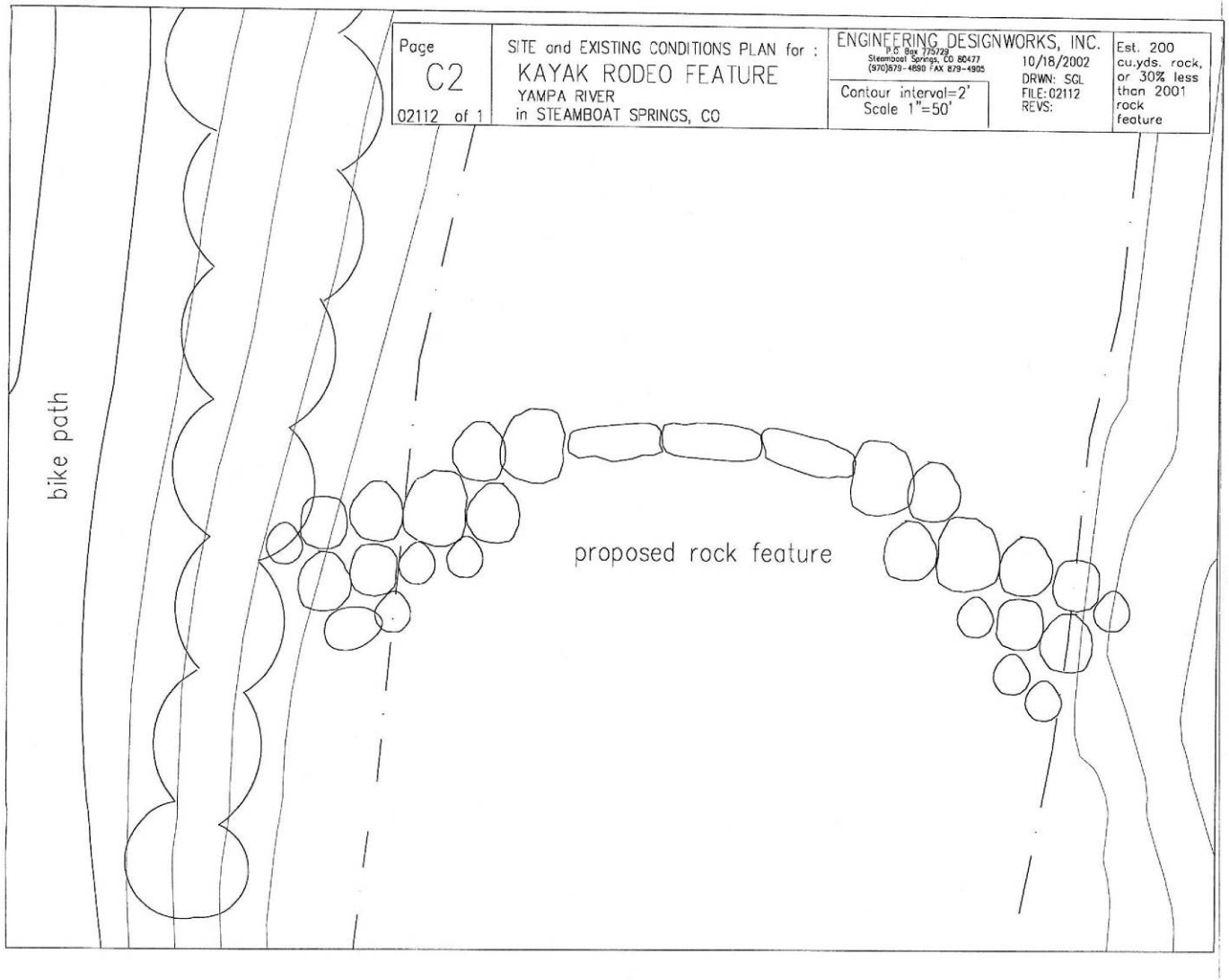
Drawing from ACOE Permit 200175121



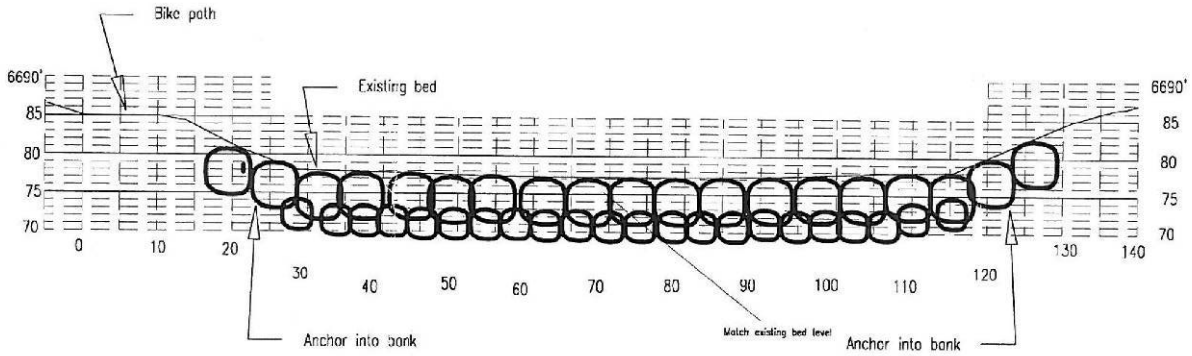
Attachment B

Drawings from Permit 200475103



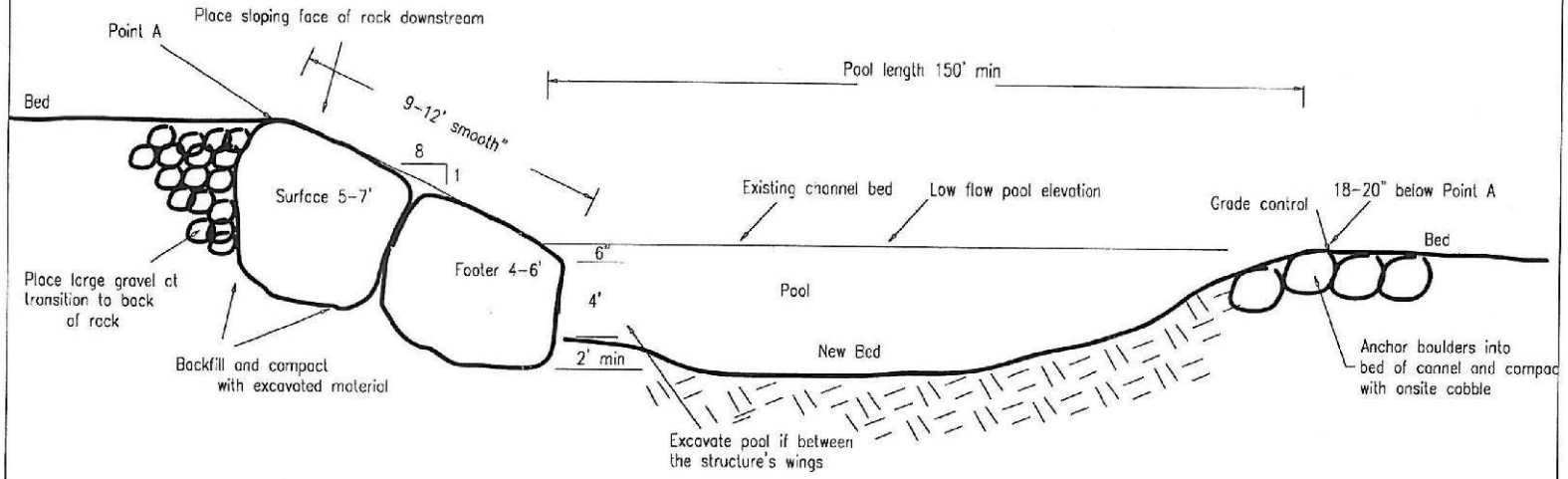

Page
C2
02112 of 1
SITE and EXISTING CONDITIONS PLAN for :
KAYAK RODEO FEATURE
YAMPA RIVER
in STEAMBOAT SPRINGS, CO
ENGINEERING DESIGNWORKS, INC.
P.O. Box 775729
Steamboat Springs, CO 80477
(970)879-4890 FAX 879-4905
10/18/2002
DRWN: SGL
FILE:02112
REVS:
Contour interval=2'
Scale 1"=50'
Est. 200 cu.yds. rock, or 30% less than 2001 rock feature
bike path
proposed rock feature

Page	Section looking up/downstream for :	ENGINEERING DESIGNWORKS, INC.	
C3 02112 of 1	KAYAK RODEO FEATURE YAMPA RIVER in STEAMBOAT SPRINGS, CO	P.O. Box 775728 Steamboat Springs, CO 80477 (970)879-4890 FAX 879-4905 12/18/2002 DRWN: SGL FILE: 02112 REVS:	Est. 200 cu.yds. rock, or 30% less than 2001 rock feature



PROFILE FROM UPSTREAM

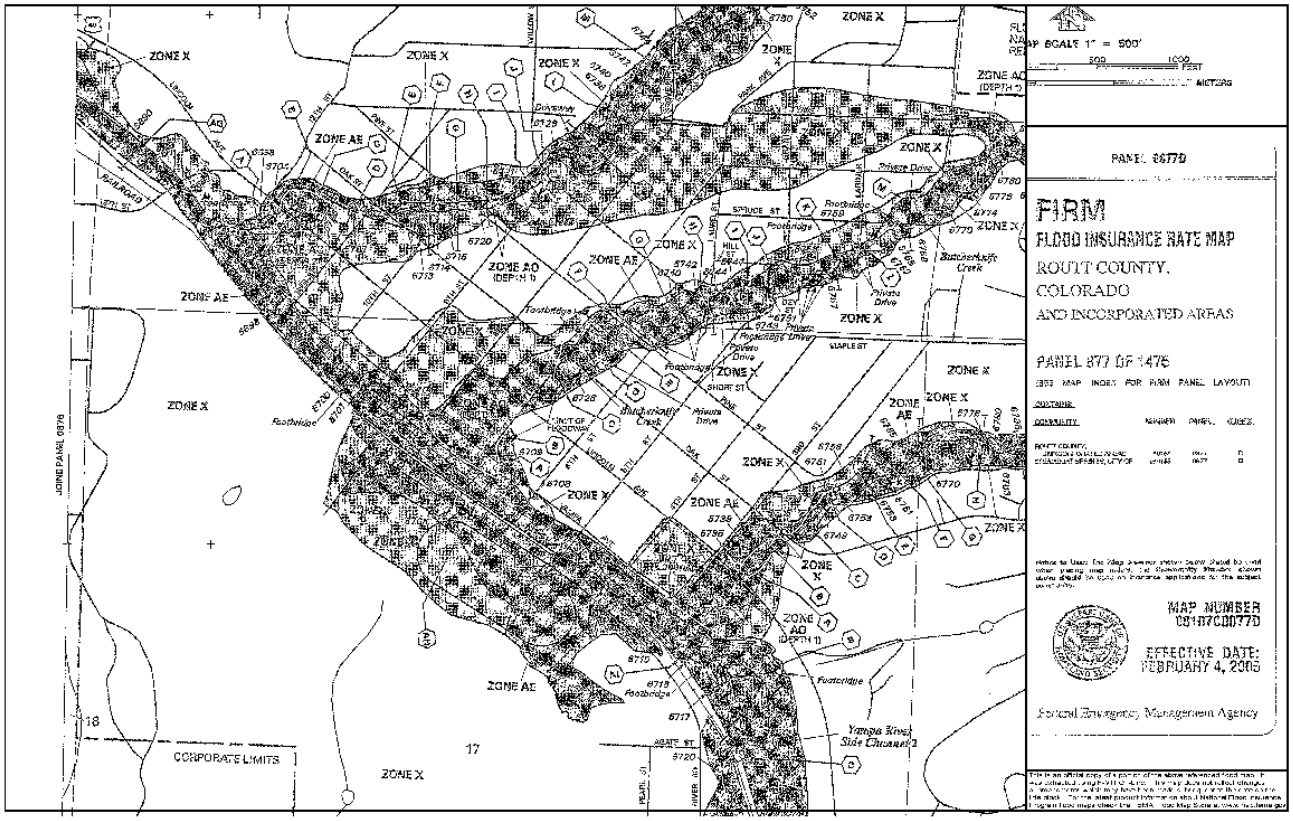
Page	Longitudinal Section for:	ENGINEERING DESIGNWORKS, INC.	
C4 02112 of 1	KAYAK RODEO FEATURE YAMPA RIVER in STEAMBOAT SPRINGS, CO	P.O. Box 775728 Steamboat Springs, CO 80477 (970)879-4890 FAX 879-4905 10/18/2002 DRWN: SGL FILE: 02112 REVS:	Est. 200 cu.yds. rock; or 30% less than 2001 rock feature



LOW FLOW AREA

Attachment C

Steamboat Springs FEMA Map



VAIL WHITEWATER PARK ON GORE CREEK

1. BACKGROUND INFORMATION

A. LOCATION

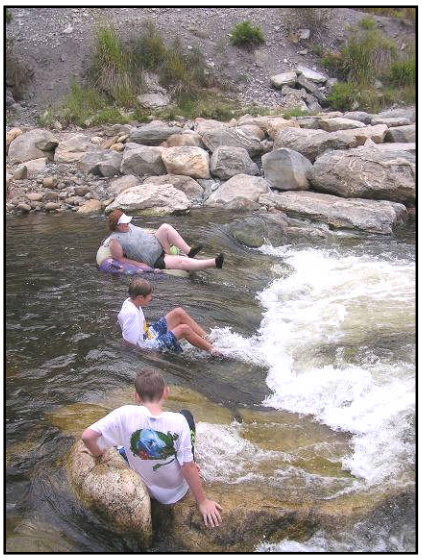
Downtown Vail, Colorado on Gore Creek just upstream of Willow Bridge Road.

The structures are located in a 300 ft. segment of Gore Creek in the NW ¼ NW ¼ of sec. 8, T. 4S., R. 80 W. of the 6th P.M. below the confluence with Mill Creek and above Willow Bridge Road (aka "International Bridge").[1]

Gore Creek is a small tributary of the Eagle River and is typically used for paddling in the summer months - usually from June to July. The park was built in 2001 and the site hosts one of the largest freestyle kayaking events in the country. The flows are relatively low and the site tries to maintain a world-class whitewater feature with minimum flow.

B. 2010 UPDATES

The information below is based upon the initial 2008 investigation. No further improvements were identified during the 2010 update.



C. OWNER/OVERSIGHT

Owner: Eagle River Water and Sanitation District
846 Forest Road
Vail, CO 81657

Steward: Town of Vail
Stan Zemler, Town Manager
75 S. Frontage Road, Vail, CO 81657

Gregg Barrie, Landscape Architect gbarrie@vailgov.com

Maintenance Responsibility:
Town of Vail
Department of Public Works
970-479-2158

D. COST

2007 Reconstruction	
Design and Engineering Phase I	$ 130,000
Adjustable bladder modifications	376,000
Total	$ 506,000

The cost to secure the RICD is not available**.**
Construction costs for the 2000 construction and design were not found.

E. COMPLETION DATE

Original - 2000, revision - 2007

2. SAFETY ISSUES AND ACCIDENT REPORTS

None reported.

3. DESIGN and CONSTRUCTION DOCUMENTS/DRAWINGS

A. PRELIMINARY DESIGN

Same as presented below in Construction Documents

Designer: Recreation Engineering and Planning-Gary Lacy, P.E.
The Preliminary and Final Designs were based on drawings included in Attachment B.

B. CONSTRUCTION DOCUMENTS

Original – Constructed in 2000
Engineer of Record: Recreation Engineering and Planning-Gary Lacy, P.E.

No sealed drawings or design drawings meeting the description outlined by the Colorado State Board of Licensure for Professional Engineers were found.

Three features, a natural amphitheater and wading pools were included.
(www.whitewatercoursesandparks2005.com, "Lessons Learned," Ian Anderson.

Structure and feature description:
I designed the Course to work the best at 400 cfs. This flow rate was based upon… the physical parameters of the stream channel, my working knowledge of Gore Creek, hydraulic formulas, the purpose to be served by the Course, and the available flows. Basic hydraulic formulas were used

to determine the necessary design parameters of the structures to ensure complete control of the stream flow at 400 cfs and higher, and to provide flow passage.

Structures included in the Whitewater Course include "U" drops and "V" drops followed by self-scouring pools. These structures are designed to divert and control the flow at specific points to create surf waves, rodeo holes, standing waves, eddies, and jets of water for squirt boating, and slalom racing. The structures work in tandem to create the desired features. These features provide a better boating experience and therefore draw more boaters at higher rates.

The Course also works to allow passage at low flows. The structures and their elevation/configuration were designed to provide depth for boating during very low flows, even when the whitewater wave features are not present.[3]

See Attachments A and B for the Vail Whitewater Park Construction and Staging Plan and course design drawings, respectively.

Reconstruction 2007

The design and engineering for the 2007 revision was completed by Riverrestoration.org – Nick Turner, Jason Carey, P.E.

The design includes adjustable bladders to confine flow and included only the main drop immediately upstream of International Bridge.

C. CONSTRUCTION METHODS

The original 2001 construction was stacked boulder construction: no grout was used. In 2007 construction consisted of the addition of adjustable bladders on the existing concrete slab.

D. FLOODPLAIN AND HYDRAULIC EVALUATIONS

A letter from J.F. Sato and Associates indicates that the proposed design to "…remove existing channel material and replace it with large boulders that will provide a more conducive environment for kayakers…If the project is constructed as proposed, with an equal balance of removal and replacement, BFEs (Base Flood Elevations) should not change significantly."[4]

See Attachment C for FEMA Map of Vail. HEC-RAS Modeling and AutoCAD drawings of this course are available from McLaughlin Whitewater Design Group, Denver, Colorado.

E. HYDRAULIC DROP

Elevations are not found on design drawings. Average gradient for Gore Creek is 60 ft per mile.[5]

F. DESIGN CALCULATIONS

Not available.

G. COURSE LENGTH

The original course length is 300 ft. within the channel of Gore Creek, below the confluence with Mill Creek and above the Willow Bridge Road.

H. CONSTRICTION WIDTHS

Measurements below are approximate and expressed in feet as measured during the Site Visit. Note that these are approximate measurements of the width of the lowest invert of each structure. Other measurements included elsewhere in this document relate to the top width of the constriction and not the width of the lowest invert.

Feature 1: 12.8 feet
Feature 2: 25.7 feet
Feature 3: 32.1 feet.

I. PHOTOGRAPHS

See Vail Site Photos for additional images.

4. WATER AND STREAMBED REQUIREMENTS AND PERFORMANCE

A. PERMITS

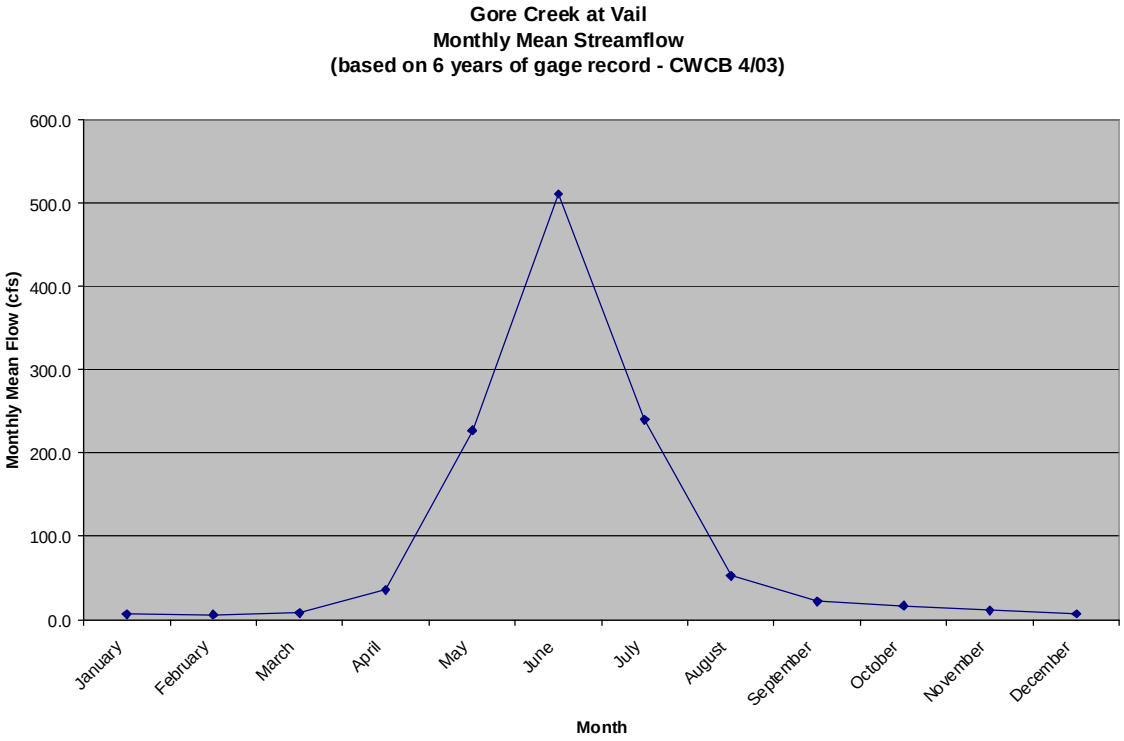
"The U.S. Army Corps of Engineers granted the Town a permit for the project."[6]
The ACOE did not provide permit information in response to a Freedom of Information Act request related to this project.

B. RICD INFORMATION

The following summarizes the water claimed (cfs) for this project: [7]

March	April	May	June	July	Aug	September	Oct
54	227	400	400	400	218	617	48

C. FLOW, RECORDS, GAUGES



Source: Daily Stream flow Statistics for Colorado, USGS 09066325 Gore Creek ABV Red Sandstone Creek at Vail, CO http://waterdata.usgs.gov/usa/nwis/uv?site_no=09066325

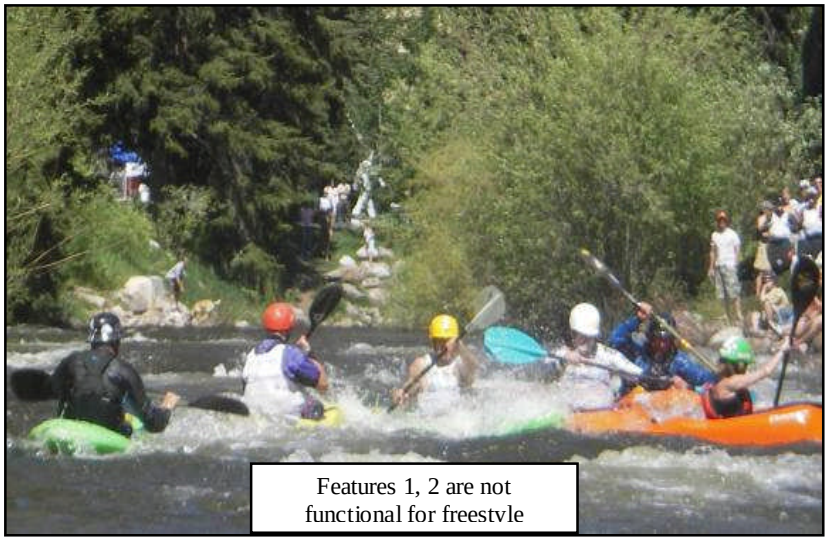
D. WATER MANAGEMENT IMPACTS

The RICD has not had any significant water management impacts to date.[9]

5. MODIFICATIONS, FAILURES AND REPAIRS

Three features were originally installed. The first two filled in with sediment during 2001.

In the summer of 2007, the Town funded improvements which attempt to maximize the performance of the available river flow at the site. Inflatable bladder structures were chosen and installed to increase adjustability, due to pre-existing tight floodplain mapping at the site.[10]



Features 1, 2 are not functional for freestyle

http://ci.vail.co.us/release.asp?r_id=3532

A. SEDIMENTATION ISSUES

Since features #1 and #2 have filled in they are no longer used for on-water practice or competition. The course is rarely used by boaters outside of competitive events.

6. ECONOMIC DEVELOPMENT INTENTION AND PERFORMANCE

A. INTENDED USES

Recreational in connection with the Vail Whitewater Park include boating, kayaking, tubing, rafting, floating, canoeing, and other general recreational uses.

It has not created a kayaking destination or restored energy and vitality to the Village core, as expected (www.whitewatercoursesandparks2005, Anderson). However, the event conducted each June has exceeded expectations and continues to be one of the most successful outdoor-sports competitions in the world.

Photo: Toni Axelrod, TMG

B. ECONOMIC AND USAGE STUDIES

In 2002, Stratus Consulting was hired by Porzak, Browning, Bushong to project the economic impact of this course on the Town. The study projected the course's impact to be $1.8 m annually.

C. EVENTS

2001-2008 Teva Mountain Games: Freestyle and Boatercross events are held annually in early June. Event organizers estimated 2008 attendance to exceed 2,000 athletes and 35,000 attendees. 2007 results indicated the event created incremental revenue totaling $4.6m for the Vail community www.outdoorindustry.org/media.outdoor.php?news_id=3051

D. RECENT DEVELOPMENT IN VICINITY

Vail Village initiated a renovation that is scheduled to be completed in 2008.

7. OTHER

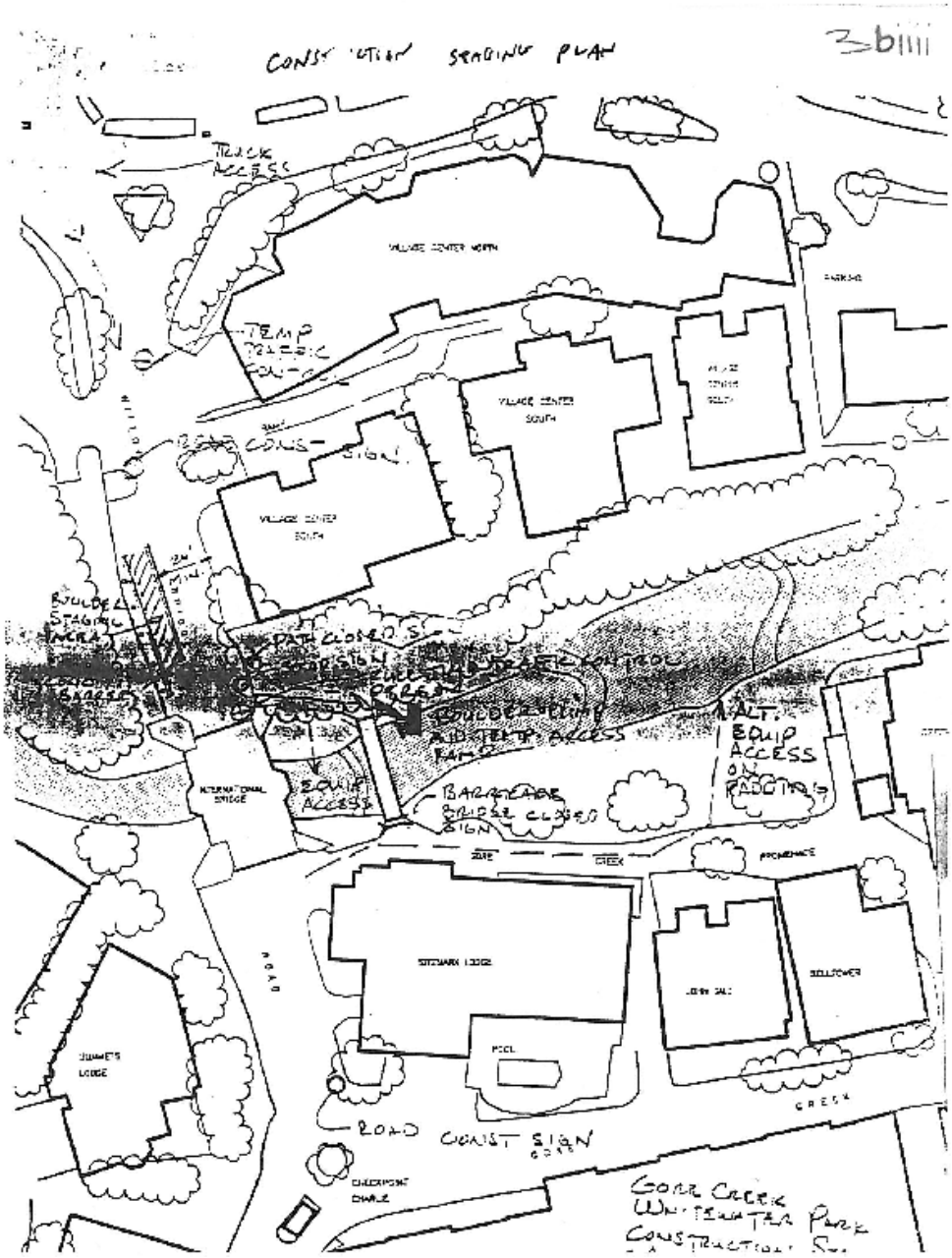
User interviews: none

8. REFERENCES

1. Vail Findings of Fact, Conclusions of Law and Decree of the Water Court, June 5, 2002, page 3.
2. Gore Creek Whitewater Park/Gore Creek Promenade/Vail Village, Circulation and Access Plan Narrative, Recreation Engineering and Planning, April 19, 2000.
3. Summary Testimony Provided by Gary Lacy, December 29, 2001 by Gary Lacy for the Eagle River Water and Sanitation District, page 2.
4. Flood Plain Analysis of Gore Creek Whitewater Park, Vail, Colorado, letter from J.F. Sato and Associates, Consulting Engineers, April 17, 2000.
5. Floodplain Profile and Plan, FEMA
6. Memorandum from Vail Community Development Department to Planning and Environmental Commission, Subject: "Final PEC review of proposed modifications to the Gore Creek Flood Plain, located at the Gore Creek Whitewater Park, Gore Creek Promenade/Tracts I & A, Block 5B, Vail Village 1st Filing." Applicant: Town of Vail and the Vail Valley Chamber and Tourism Bureau. Planner: Brent Wilson, May 8, 2000.
7. Vail_Findings of Fact, Conclusions of Law and Decree of the Water Court, June 5, 2002, page 4.
8. Letter from Aquatic and Wetland Company re: Planning and Environmental Commission (PEC) consideration of the combined in-stream habitat improvements and kayak course on Gore Creek, March 29, 2000.
9. Letter from Helton & Williamsen, P.C., Subject: Vail Whitewater Park – Case No. 900CW259, January 3, 2002.
10. "Improvements to Vail's Whitewater Park," Vail Information, August 31, 2007.

Attachment A

Vail Whitewater Park
Construction and Staging Plan



(2000)

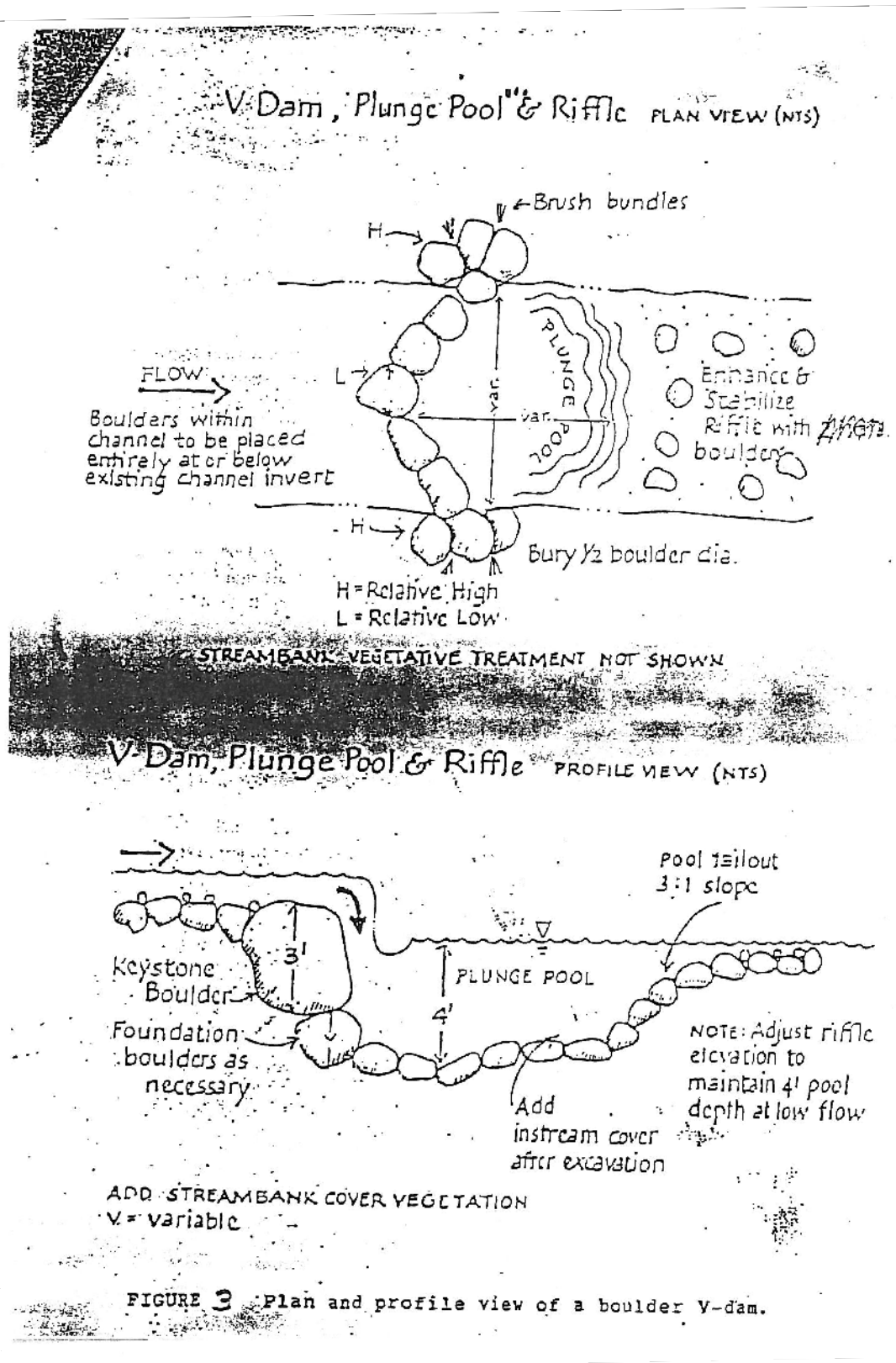


FIGURE 3 Plan and profile view of a boulder V-dam.

Attachment B

Vail Whitewater Park

Original Design Drawings - (2000)

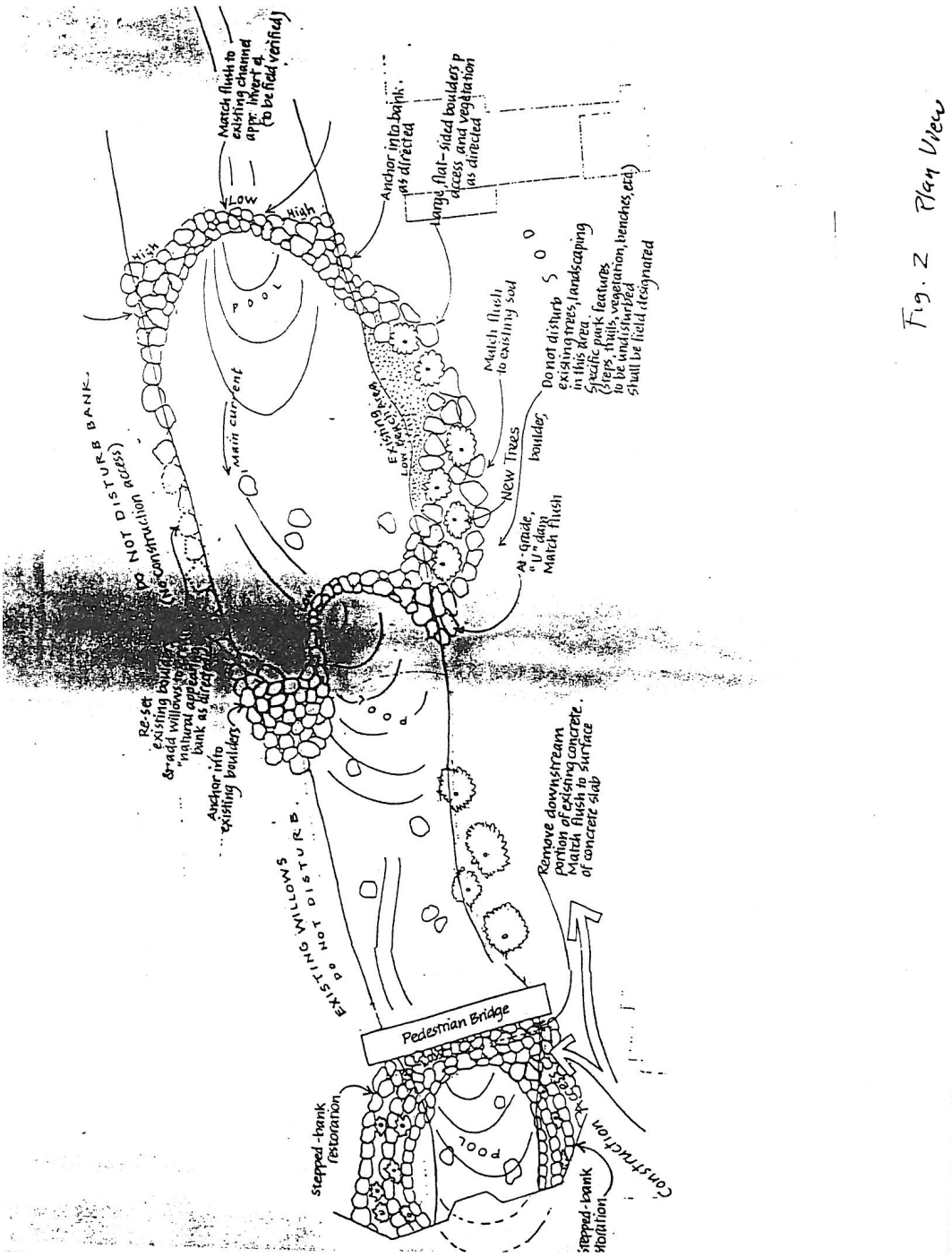


Fig. 2 Plan View

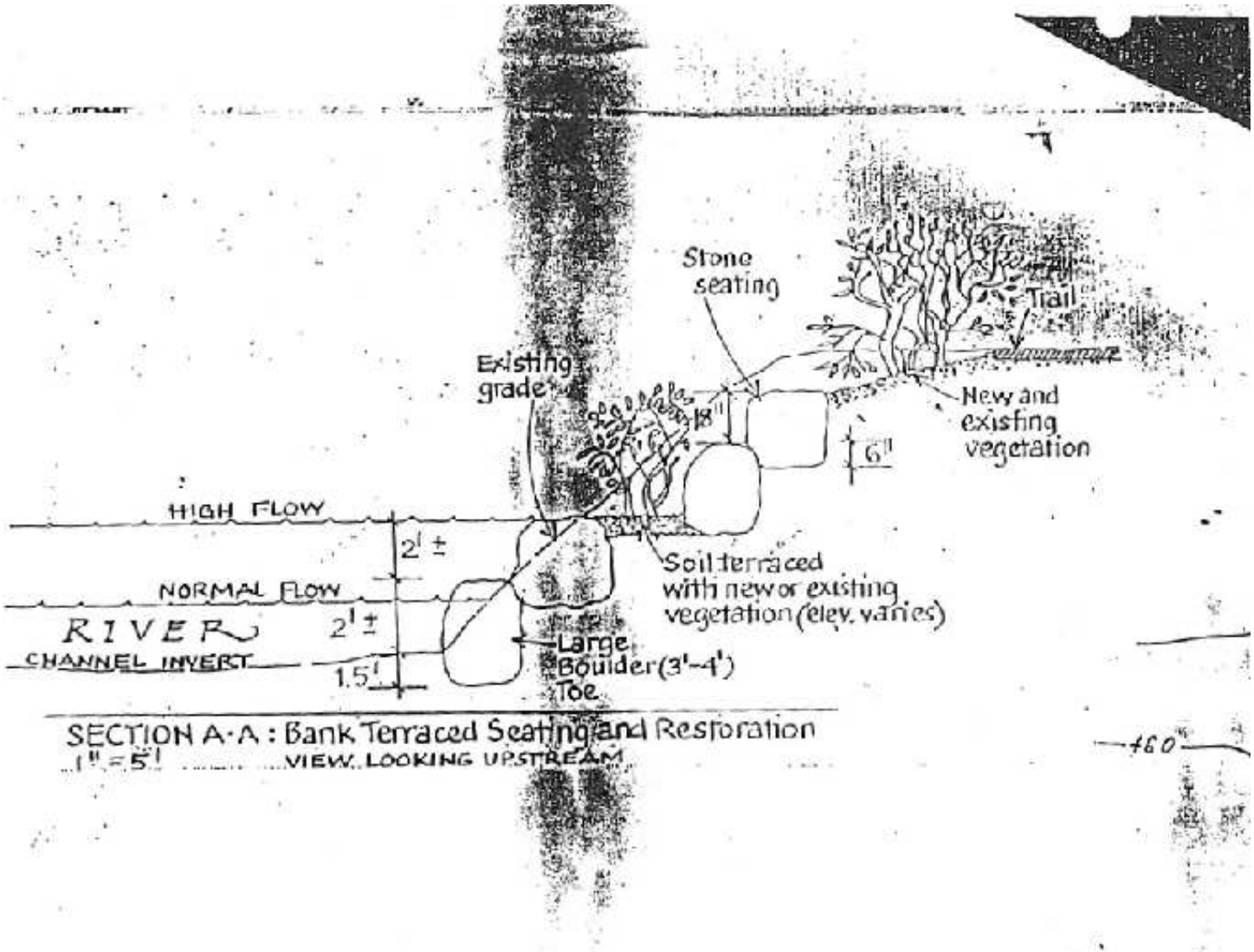


Fig 4 Boulder Edge

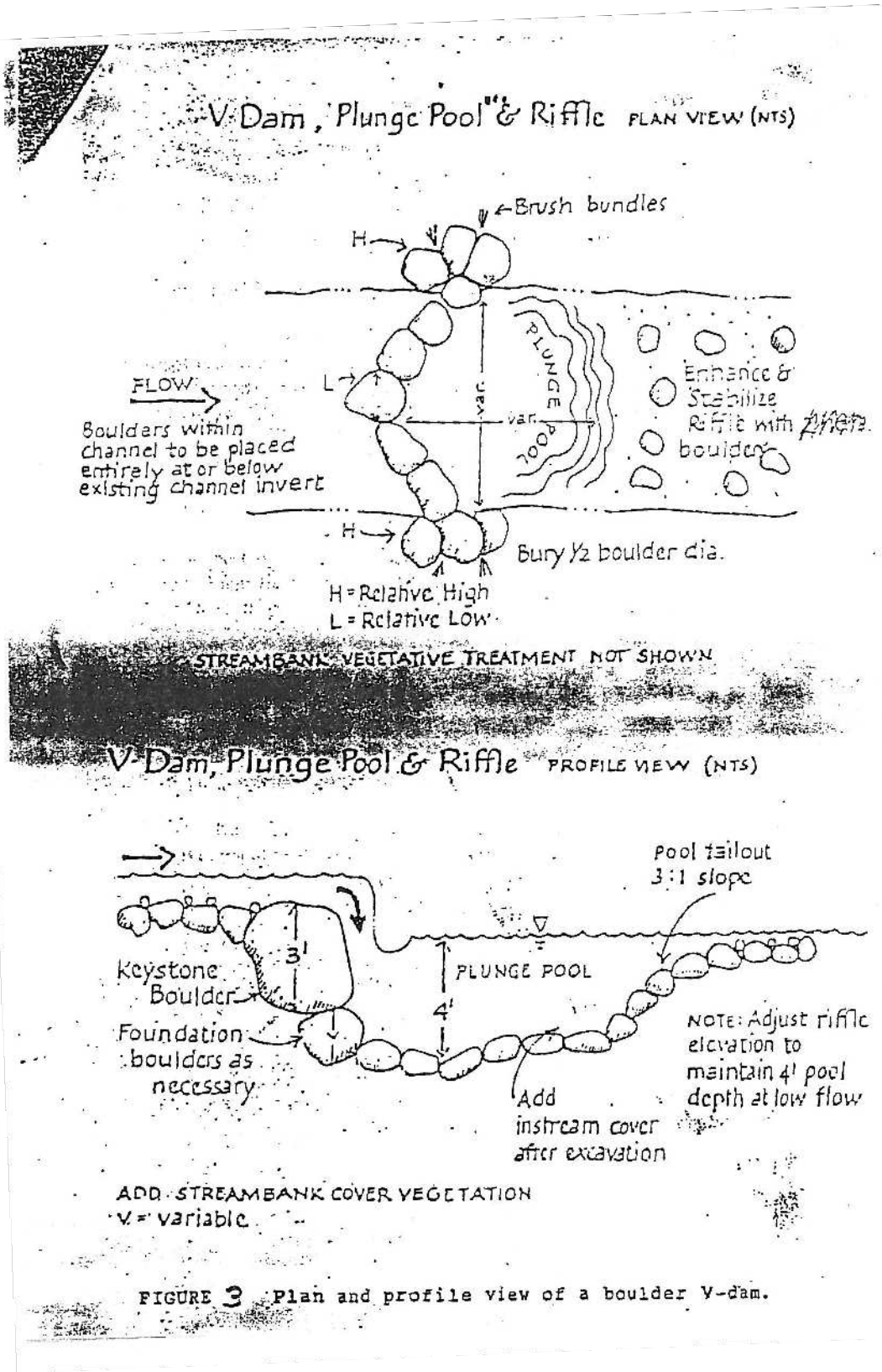
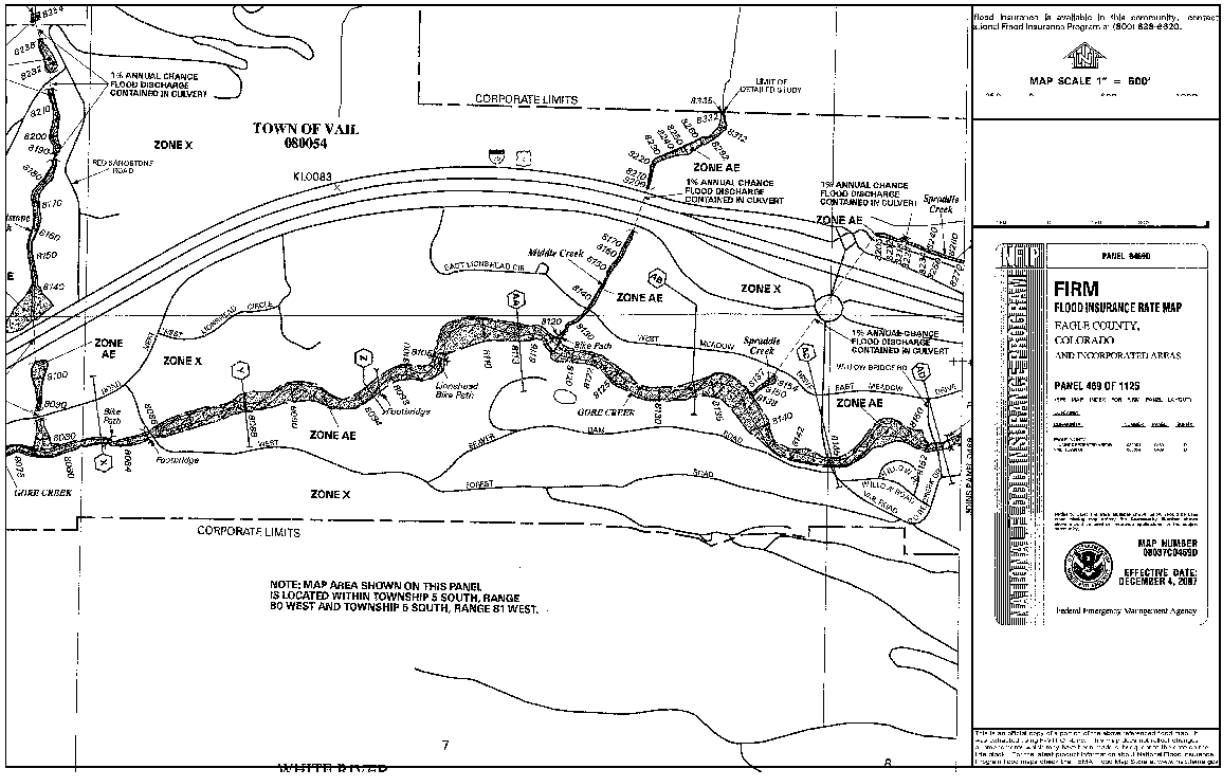


FIGURE 3 Plan and profile view of a boulder V-dam.

Attachment C

Vail FEMA Map



2010 Updates

A brief effort to update this report was conducted in the spring of 2010. A summary of the findings are included in the Background sections of this report and are included below.

1. AVON

No further improvements have been implemented.

Danita Chirichillo, City of Avon, March 24, 2010.

2. BRECKENRIDGE

No further improvements have been implemented.

3. BUENA VISTA

Two additional features were constructed by the spring, 2010. These are downstream from the four features in place and complete the master planned whitewater park expansion.

www.southmainco.com.

The Town has copies of drawings sealed by the Engineer.

4. CONFLUENCE PARK

No further improvements have been implemented.

5. DURANGO

Construction of the whitewater park is projected to be 2012. The delays are due to an extended permitting period and indecision in Town as to the preferred park location. The $550,000 cost will be paid for by a .25 cent sales tax approved in 2005.

The Durango Telegraph, March 25, 2010.

6. GOLDEN

Several improvements were initiated in 2009 and completed March, 2010:

- Bank retention and stabilization of the put-in area.
- Bolstering of the river left wing (that was previously built up by hand placed rocks) on the third drop which will increase the dynamic power of that drop at lower flows.
- Rehabilitation of the bleacher hole including changes in geometry, pool configuration, and orientation.
- Replacing random boulders to optimize slalom opportunities in the pool below the bleacher hole.
- Creation of a meandering pilot channel, replacement of low deflectors, and placement of random boulders in the "beginner" area between the pedestrian bridge and the Library Hole. The work included additional terracing just upstream of the pedestrian bridge to increase access and decrease erosion, plus minor improvements just upstream of the Library Hole to facilitate access.

These improvements cost $76,000 and were paid for by a Jefferson County grant and its match from the City. Design work for a moveable structure has been performed, whose plans await funding.

Rod Turullo, City of Golden, March 22, 2010

7. GUNNISON

In June, 2009 the designer returned (gratis) to improve the second drop prior to the Gunnison River Festival freestyle event in response to criticism and complaints. Cost: the City does not have a reserve budgeted for whitewater park maintenance. Public Works paid for an excavator at $160/hr. for a day and a half or more, roughly $2,000. They were very happy with the performance.

Alan Moores, City of Pueblo, 22 March, 2010

8. LYONS

No further improvements have been implemented.

9. PAGOSA SPRINGS

Two enhancements are planned to respond to the City's having removed two publicly funded features and installed an unauthorized feature in 2005 cost $100,000. This was removed in 2009, and the new features are projected to cost the Town about $41,000 in engineering and management fees.

Pagosa Springs Daily News, February 9, 2010

10. PUEBLO

Levy seepage between and downstream of Drops 3 and 4 has occurred due to the higher water level below Drop 1. The levy is cracked and the Pueblo Flood Control District is working with the USACE to determine a corrective plan.

Separately, access improvements are planned for implementation after the completion of a bridge replacement at the site.

Scott Hobson, City of Pueblo, March 24, 2010

11. RIDGWAY

No further improvements have been implemented.

12. SALIDA

Two additional features were constructed spring, 2010. These are located upstream from the primary drop.

Coyote Gulch, March 10, 2010.
Site Visit by Staff.

13. STEAMBOAT SPRINGS

No further improvements have been implemented.

14. VAIL

No further improvements have been implemented.

IV. APPENDIX: DESIGN CRITERIA FROM UDFCD

Excerpts Related to the Planning and Design of Boatable Drops From the UDFCD Drainage Criteria Manual

June 2001

Revised April 2008

MAJOR DRAINAGE

3.3.1 Types of Channels for Major Drainageways

Boatable Channels—Larger, natural, perennial waterways such as the South Platte River, Clear Creek, and Boulder Creek in the Denver metropolitan area are regularly used for boating and, because of their size and capacity, are subject to more **comprehensive hydraulic analyses and considerations**. Unless there is evidence of erosion, suitable natural armoring of the channel should not be disturbed; however, boater-friendly drop structures and diversion structures are often necessary. Refer to the discussion on boatable channels in the HYDRAULIC STRUCTURES chapter of this Manual.

HYDRAULIC STRUCTURES

1.2 Channels Used for Boating

There are streams in the District in which rafting, canoeing, kayaking, and other water-based recreational activities occur. Design and construction of hydraulic structures in these waterways require a standard of care consistent with common sense safety concerns for the public that uses them. The ultimate responsibility for individual safety still resides with the boating public and their prudent use of urban waterways.

It is reasonable to retain a whitewater boating specialist to assist in the design criteria for a hydraulic structure on a boatable stream. In particular, reverse rollers are to be avoided (USACE 1985).

1.12 Structure Safety and Aesthetics

The design of structures must consider safety of flood control workers and the general public, especially when multiple uses are intended. Regulations and interpretations vary from community to community and may change with time. There are some inherent safety risks in any waterway that have to be recognized by the public, designers, and government officials. General suggestions are given in regard to safety; however, the designer must use a reasonable standard of care for the particular structure being designed or retrofitted that includes evaluation of present or likely future public access and uses such as recreation. The designer should give special consideration to structures located in waterways where boating is likely to occur. These structures need to be designed to avoid known hazards, such as reverse rollers (Leutheusser and Birk 1991), often referred to by some as “keepers.”

2.1.2 Boatable Channels

Channels that are known to be boatable, either now or that will be in the future, and those others that are classified by the Colorado Water Quality Control Commission for Class 1 or 2 Recreation, but are not presently judged to be boatable, should have hydraulic structures designed with public safety as a special consideration. The designer should not set the stage for hazardous hydraulics that would trap a boater, such as at a drop structure having a reverse roller that may develop as the hydraulic jump becomes submerged.

Designs for boatable channels, grade control structures, and low-head dams have to prevent the development of submerged hydraulic jumps, have a gently sloped or stepped downstream face, and not have a deep stilling basin that would encourage the creation of a submerged hydraulic jump. One design approach is to direct the hydraulic momentum at the bottom of the drop at a

relatively flat angle to help prevent a reverse roller. A downstream face on a drop having large grouted boulders and high roughness that is sloped at 10(H) to 1(V) has been used successfully on several projects along the South Platte River and on Clear Creek, permitting safe passage of boaters as the move over them.

Drop structures or low-head dams in boatable channels should incorporate a boat chute designed in accordance with carefully planned components that are consistent with recreational requirements for boater safety. Often, physical model studies are used to verify the efficacy of the proposed design.

Hydraulic structures on boatable channels should not create obstructions that would pin a canoe, raft or kayak, and sharp edges should be avoided.

2.1.3 Grass and Wetland Bottom Channels

Based on experience, the sloped drop has been found to be more desirable than the vertical wall drop with a hardened energy dissipation basin. Vertical drops can create a reverse roller and backflow eddies that have been know to trap boaters. Because of boater and public safety concerns, vertical drops are less desirable than sloping drops in urban areas. Other disadvantages of a vertical drop include the turbulence and erosive effect of the falling water on the drop structure, necessitating high maintenance.

It is desirable to limit the height of most drops to 3 to 5 feet to avoid excessive kinetic energy and to avoid the appearance of a massive structure, keeping in mind that the velocity of falling water increases geometrically with the vertical fall distance. If vertical drops are use, it is best to limit their height to 3 feet.

2.3.7.2 Hydraulic Analysis.

After review of the crest and upstream hydraulics, the analysis proceeds to the supercritical flow and the hydraulic jump downstream. It is here that the designer should give special consideration to the potential of reverse rollers and avoid them in boatable channels and, where practicable, in grass-lined channels.

2.7 Simplified Minimum Design Approach for Boatable Channels

Due to the fact that a special standard of care for the design of drops and low-head dams on boatable channels is required, the following design approach for boatable channels is limited to suggestions for the experienced hydraulic structure designer once the channel has been determined to be a boatable one.

1. Contact reliable whitewater boating experts to discuss general design objectives and boater safety concerns.
2. Select maximum height of individual drops—generally 4 feet. If they are more than 4 feet, a physical hydraulic model may be necessary.
3. Determine basic drop characteristics to be compatible with public safety and recreational boating. Suggestions are as follows:
    - Use a Froude number, Fr, less than 1.5 at the toe of the drop.
    - Avoid reverse rollers under all conditions of flow.
    - Assess stability of the structure taking into account expected downstream channel degradation.
    - Consider the slope of the downstream face of a sloping drop; 10(H) to 1(V) is common.

- Provide boat chute with pilot rocks for routine boat passage of drop.
- Do not use an energy dissipating basin; instead, continue the sloping surface at least 5 feet below the downstream thalweg of the stream.
- Provide adequate warning signs and portage area.
- Use grouted sloping boulder or appropriately sized large ungraded sloping boulder structure.
- Consider vertical cutoff walls at the upstream end for seepage control.

4. Obtain peer review on the preliminary design
5. Allow for follow-up rock adjustment after completion, especially for boat chutes.

9.0 BOATABLE DROPS

9.1 Introduction

Low-head dams or drop structures on a stream that includes boating should not present undue hydraulic hazards to boaters, maintenance workers or to the public. This is why some low-head dams and drop structures are retrofitted. This section outlines the approach for use in improving recreational boater safety.

9.2 Retrofitting Existing Structures

Retrofitting low-head dams and drop structures generally includes installing a stepped or sloped downstream structure face and suitable boat chute with upstream pilot rocks; eliminating sharp edges; and providing appropriate barriers, signing and accessible portages with take-out and put-in landings. A structure that is too high for the site may be replaced with two or more structures to reduce the drop at a single location.

Retrofitting boatable low-head dams or drop structures requires specific care to insure that the retrofit meets the objective of enhancing public safety. Hydraulic model tests are common for retrofitting of low-head dams and drop structures.

9.2.1 Downstream Face

A vertical or steep downstream face of a structure to be retrofitted may be corrected with a rock face having a slope of 10(H) to 1(V). Large rock or derrick stone is often used. The engineer may select a stepped face of either concrete or stone.

9.2.2 Boat Chute

Installing a boat chute to provide passage around or over the low-head dam or drop is desirable for boatable streams, even where the total drop may be only 3 feet or less. The boat chute may be combined with a relatively flat, sloping downstream face in many instances. Pilot rocks planted upstream of the boat chute signal the entrance to the boat chute.

9.2.3 Sharp Edges

Exposed sheet piling edges, sharp concrete edges, sharp rock protuberances, and angle-iron ends should be avoided in boatable stream structures.

9.2.4 Barriers and Signing

A range of barriers may be considered for use at structures to help keep watercraft from crests, intakes, and areas of highly turbulent flow. Barriers often include buoy lines. Warning signs should be placed upstream of structures at easily visible locations.

9.2.5 Portages

At many hydraulic structures, portages are provided to permit beginning boaters to bypass a boat chute or to avoid a more challenging hydraulic structure. Portages have take-outs and put-ins at appropriate locations combined with suitable signing.

9.3 Safety

Retrofitting hydraulic structures on boatable streams should be undertaken with an adequate standard of care related to public safety for boating. A retrofit often includes installation of anchor points and suitable access for use by rescue personnel (Wright, et al. 1995).

10.3 Safety

Design and construction of urban drainage facilities must account for potential public safety hazards. When planning and providing for recreation within public parks and open space, safety must always be considered, and safety for the public and maintenance workers should be incorporated. The design engineer must consider the variations in hydraulic jumps as they relate to the tailwater elevation as illustrated in Figure HS-28. Some hydraulic structures and drainage features offer an invitation to play; therefore, what is constructed should be made safe and attractive. While safety, to a reasonable extent, becomes the responsibility of the user, appropriate warning signage must be used. In some instances, fencing and emergency access and egress should be provided.

Photograph HS-18—Warning signs can be used to help achieve public boating safety, but signs cannot in themselves serve as a substitute for an appropriate standard of care in the design of a reasonable grade control structures on a boatable waterway.

Safety requirements are usually defined by local government agencies. However, case-made law may define the responsibilities of involved parties. Risk and liability are important with respect to including signs, handrails, or barriers at steep slopes or vertical drop-offs as well as other safety related features. Signage should be provided at locations where public use is intended near hydraulic structures and where hazards are not obvious to the average person. For boatable waterways the standard of care should include avoidance of hazardous hydraulics such as reverse rollers and reverse flow eddies associated with hydraulic structures. When bicycle paths are incorporated with the construction of structures, there should be adequate directional and warning signs, sight distance, and avoidance of unannounced sharp turns and dropoffs.

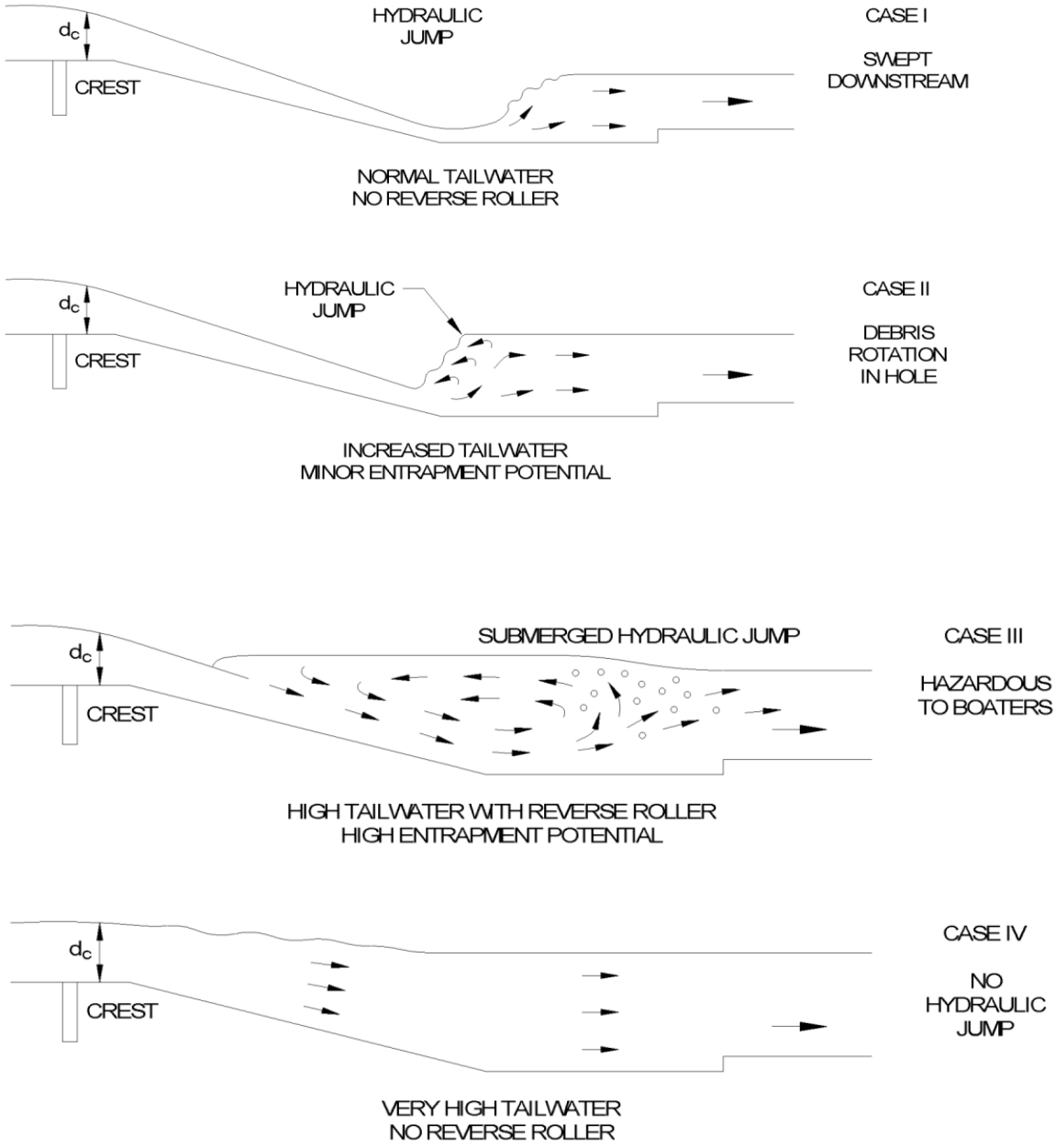


Figure HS-28—Hydraulic Jump Tailwater Stages as Related to Boating Hazards

11.0 CHECKLIST Criterion/Requirement (Note: Before work begins in a floodplain, obtain a floodplain development permit form local jurisdiction)	
Drop Structures (All Types)	
Simplified design or detailed hydraulic analysis	
Soils and seepage analysis	
Environmental permits	
High public usage or low public usage	
Likely downstream degradation or no likely downstream degradation	
Critical depth at crest	
Transition head loss	
Hydraulic roughness	
Hydraulic jump length and location	
Basin length	
Seepage control (need detailed analysis or provisions for drops taller than 5 feet)	
Individual force analysis	
Trickle and low-flow zone provisions	
Sloping Drop Height > 6 feet, Use Special Design	
Sloping Drop Height ≤ 6 feet, Used Simplified Design	
Vertical Drop	
Rock sizing	
Boatable channel, or not	
Froude number at toe	
Reverse roller evaluation	
Portages and warning signs, with peer review	
Boatable Channel Drops	
Maximum drop height of 4 feet	
Froude number at toe < 1.5	
Reverse rollers avoided	
Downstream face slope 10:1	
Pilot rocks and signing	
Suitable portage facilities	
Peer review	
Criterion/Requirement	
Boatable Drop Structures	
Downstream face at reasonable slope (e.g., 10H to 1V)	
Stepped face, or derrick stone	
Boat chute	
No sharp protrusions	
Pilot rocks	
Barriers if desirable	
Signing, informational and warning	
Portage with adequate signing	
Anchor points suitable for emergency rescue	

Peer review by whitewater expert
General Items for Hydraulic Structures
Visual quality
Forms and lines
Colors
Vegetation
Accessibility for maintenance; long-term maintenance assured
Safety
Public access
Maintenance workers
Hydraulic jump analysis with various tailwater elevations
Signage
Absence of reverse rollers and minimal reverse eddies
Peer review
Permitting

V. APPENDIX: DVD AND INDEX OF COLLECTED INFORMATION

LISTING OF FILES ON ATTACHED DVD

==========

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Articles on Drowning

==========

0 news 2007 - Man drowns in Sou... 322 KB 1/19/2008 06:47:24 PM
chutes drowning 2 8 06.pdf 2657 KB 8/28/2006 08:43:02 AM
Chutes drowning 8 06.pdf 250 KB 8/28/2006 08:44:04 AM
Copy of Union drowning.pdf 148 KB 7/22/2005 08:17:10 AM
Copy of union drowning2.pdf 126 KB 7/22/2005 08:17:56 AM
Farmington Daily News 2-2.jpg 236 KB 3/13/2008 12:18:08 PM
Farmington Whitewater Park.doc 27 KB 3/13/2008 12:18:08 PM
Thumbs.db 13 KB 12/1/2009 09:54:36 AM hs
Union Ave Dam Boating Modificat... 10642 KB 2/14/2008 05:18:42 PM
union deaths.pdf 1118 KB 9/19/2007 08:22:26 AM

Total 10 file(s); Size: 15916044 Byte(s)

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Avon_Maps, Refences and Photos

==========

Total 0 file(s); Size: 0 Byte(s)

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Avon_Maps, Refences and Photos\1 Avon_Maps, Aerials, FEMA

==========
==========

Avon Site Map.tif 1292 KB 4/7/2008 05:16:16 PM
Avon_FEMA.pdf 366 KB 4/7/2008 02:51:56 PM
Thumbs.db 15 KB 12/10/2008 04:47:42 PM hs
townofavonapp.pdf 185 KB 4/7/2008 12:54:54 AM

Total 4 file(s); Size: 1904199 Byte(s)

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Avon_Maps, Refences and Photos\2 Avon_References

==========
==========

ACOE Permit # 200675059.pdf 3266 KB 6/16/2008 10:32:20 AM
Appendix 3iii_Before and After.jpg 168 KB 4/9/2008 09:54:32 AM
Application for Surface Water R... 1412 KB 6/16/2008 10:24:28 AM
Armbruster Engineering Report.pdf 1506 KB 8/6/2007 02:37:28 PM
Army Corps Permit.pdf 408 KB 8/6/2007 02:45:28 PM
Avn Project Manual Sect. 1.20.pdf 2232 KB 6/16/2008 10:27:08 AM
Avon Cost_Vail Daily Sept 4, 20... 10 KB 4/7/2008 12:54:54 AM

Avon Recreation Enhancements.pdf 3811 KB 4/9/2008 08:59:54 AM
AvonfinalRICDfindingsrecommenda... 34 KB 4/7/2008 12:54:54 AM
Design Calculations.pdf 59 KB 8/6/2007 02:56:54 PM
Eagle River at Avon Rec Enhance... 3149 KB 6/16/2008 10:25:16 AM
Easement Agreement and Design D... 961 KB 8/6/2007 02:36:14 PM
Engineering Report Case No. 05-... 11968 KB 6/16/2008 10:28:08 AM
Excerpts from Letter from LRE t... 2083 KB 6/16/2008 10:34:54 AM
FINALFINALAVONFINDINGSANDRECOMM... 37 KB 4/7/2008 12:54:54 AM
Floodplain Compliance.pdf 752 KB 6/16/2008 10:31:14 AM
Floodplain Documents.pdf 148 KB 8/6/2007 02:50:26 PM
Flow Information.pdf 192 KB 8/6/2007 02:57:26 PM
Gage and Requested Flow, Water ... 205 KB 6/16/2008 10:34:12 AM
Graphs - Anticipated Calls.pdf 919 KB 6/16/2008 10:33:44 AM
Project Specifications.pdf 271 KB 8/6/2007 02:44:54 PM
RICD Application.pdf 177 KB 8/6/2007 02:56:36 PM
River Improvement Easement Agre... 7579 KB 6/16/2008 10:37:20 AM
Tables (2) Number of Days with ... 295 KB 6/16/2008 10:32:54 AM
Thumbs.db 5 KB 12/10/2008 04:47:42 PM hs
Unlabeled Photos.pdf 2297 KB 6/16/2008 10:39:36 AM
User Interviews.pdf 969 KB 6/16/2008 10:35:32 AM
Water Management Information.pdf 457 KB 8/6/2007 03:13:06 PM
Total 28 file(s); Size: 46471565 Byte(s)

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Avon_Maps, Refences and Photos\3 Avon_Site Photos
==========
Above Baby Bob.jpg 2918 KB 7/16/2007 08:28:14 AM
Avon Marker.jpg 2494 KB 7/16/2007 08:28:48 AM
Avon Whitewater Park.jpg 2834 KB 7/16/2007 08:28:28 AM
Avon WWP.jpg 2936 KB 7/16/2007 08:28:30 AM
Avon.jpg 2826 KB 7/16/2007 08:55:08 AM
Babty Bob Feature.jpg 2278 KB 7/16/2007 08:55:08 AM
Baby Bob and Bob Junior.jpg 2620 KB 7/16/2007 08:28:40 AM
Baby Bob.jpg 2680 KB 7/16/2007 08:28:20 AM
Behind Baby Bob.jpg 2819 KB 7/16/2007 08:28:26 AM
Bob Junior Sideview.jpg 2615 KB 7/16/2007 08:55:08 AM
Bob Junior.jpg 2575 KB 7/16/2007 08:28:32 AM
Bob Senior Feature from Above.jpg 2862 KB 7/16/2007 08:28:36 AM
Bob Senior from Above.jpg 2886 KB 7/16/2007 08:28:42 AM
Bob Senior.jpg 2684 KB 7/16/2007 08:28:44 AM
Close-Up of Baby Bob.jpg 2422 KB 7/16/2007 08:55:08 AM
Close-Up of Bob Junior.jpg 2539 KB 7/16/2007 08:55:10 AM
Close-Up of Bob Senior Feature.jpg 2285 KB 7/16/2007 08:28:44 AM
Hole Above Baby Bob.jpg 2892 KB 7/16/2007 08:28:16 AM
Terracing.jpg 2771 KB 7/16/2007 08:28:38 AM
Thumbs.db 195 KB 12/10/2008 04:47:42 PM hs
Walkway.jpg 2642 KB 7/16/2007 08:28:46 AM
Total 21 file(s); Size: 55074348 Byte(s)

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Breckenridge_Maps, References and Photos

==========

Total 0 file(s); Size: 0 Byte(s)

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Breckenridge_Maps, References and Photos\1 Breckenridge_Maps, aerials, FEMA

==========

Breckenridge north.jpg	832 KB	10/29/2007 11:26:46 AM	
Breckenridge south.jpg	602 KB	10/29/2007 11:26:56 AM	
Breckenridge Vicinity.jpg	428 KB	10/29/2007 11:27:00 AM	
Breckridge_FEMA.pdf	257 KB	8/6/2008 03:59:48 PM	
Thumbs.db	22 KB	8/6/2008 03:56:50 PM	hs

Total 5 file(s); Size: 2194710 Byte(s)

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Breckenridge_Maps, References and Photos\2 Breckenridge_References

==========

APressEventsCancelledLowWater.pdf	295 KB	6/16/2008 01:21:58 PM	
BlueRiveratBreckStreamflow97-20...	250 KB	6/16/2008 01:20:50 PM	
Breck course.pdf	134 KB	5/4/2004 10:27:48 AM	
Breck_Decree00CW281.pdf	4098 KB	6/16/2008 01:18:38 PM	
Breck_FindingsofFactConclofLawa...	4077 KB	6/16/2008 01:16:20 PM	
Breck_Motion for Law Clarifying...	762 KB	6/16/2008 01:20:10 PM	
Breck_OrderCase97CW283.pdf	3214 KB	6/16/2008 01:19:36 PM	
Breck_Stipulation and Agreement...	996 KB	6/16/2008 01:17:20 PM	
Breck_Summit Daily Legal Fees S...	659 KB	6/16/2008 01:15:46 PM	
ReRulingBreckandERWSDApplforRIC...	1020 KB	6/16/2008 01:20:34 PM	
SummitDNDillonResrvforBreck.pdf	992 KB	6/16/2008 01:21:26 PM	
VailDailyWaterRightsChallengeNo...	574 KB	6/16/2008 01:21:04 PM	
WW Southern Rockies Guidebk Bre...	4098 KB	4/10/2008 12:52:02 PM	

Total 13 file(s); Size: 21685720 Byte(s)

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Breckenridge_Maps, References and Photos\3 Beckenridge_ Site Photos

==========

Below Culvert, Lower Restoratio...	1285 KB	3/7/2008 02:02:30 PM	
Culvert, Lower Restoration.JPG	1230 KB	3/7/2008 02:02:32 PM	
Kayak Park Below Pedestrian Bri...	31 KB	4/8/2008 05:29:10 PM	
Restoration Below Kayak Park at...	1209 KB	3/7/2008 02:02:26 PM	
Thumbs.db	50 KB	4/9/2008 10:30:38 AM	hs

Total 5 file(s); Size: 3899373 Byte(s)

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Buena Vista_Maps, References and Photos

==========

Total 0 file(s); Size: 0 Byte(s)

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Buena Vista_Maps, References and Photos\1 BV_Maps, Aerials, FEMA

==========

Appendix 1a Arkansas at Salida.jpg	1449 KB	4/7/2008 01:59:26 AM	
Appendix 3aiii_BV river_park_1.pdf	1260 KB	3/5/2008 05:24:46 PM	
Appendix S 1ai_ salida co.jpg	1449 KB	4/7/2008 01:59:26 AM	
Buena Vista CO Vicinity.jpg	393 KB	10/29/2007 11:27:04 AM	
Buena Vista CO.jpg	690 KB	10/29/2007 11:27:18 AM	
Buena Vista FEMA.pdf	305 KB	4/7/2008 12:59:56 PM	
Buena Vista Map_1.jpg	578 KB	1/9/2008 02:58:42 PM	
Buena Vista Map_2.jpg	634 KB	1/9/2008 02:58:42 PM	
Thumbs.db	40 KB	3/19/2010 10:20:00 AM	hs

Total 9 file(s); Size: 6964677 Byte(s)

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Buena Vista_Maps, References and Photos\2 BV_References

==========

200500546 3 yrExtension.pdf	373 KB	7/7/2008 01:26:58 PM	
200500546 Extension Request.pdf	511 KB	7/7/2008 01:25:50 PM	
200500546 PublicNotice withDesi...	4091 KB	7/7/2008 01:11:18 PM	
ACOE Permit 200500546.pdf	1856 KB	7/7/2008 01:13:12 PM	
ACOE Permit Appoval Notificatio...	6547 KB	7/7/2008 01:26:48 PM	
ACOECovertoComments.pdf	380 KB	7/7/2008 01:12:52 PM	
Appendix 4biiiSalida and BV RIC...	54 KB	4/7/2008 01:54:46 AM	
BV Permit Application.pdf	1300 KB	7/7/2008 01:08:50 PM	
Chaffee_ ProposeFindingsandReco...	64 KB	4/13/2008 09:47:38 PM	
Chaffee_Application for Surface...	296 KB	4/13/2008 09:47:38 PM	
Chaffee_FindingofFactandReco.pdf	54 KB	4/13/2008 09:47:38 PM	
Chaffee_FindingofFactConclusion...	15437 KB	6/16/2008 11:37:34 AM	
Chaffee_ReApplicationLetters.pdf	1265 KB	7/7/2008 01:04:16 PM	
Comments CDNRDoW.pdf	968 KB	7/7/2008 01:12:36 PM	
Comments CoParks.pdf	934 KB	7/7/2008 01:11:42 PM	
Comments DWR.pdf	675 KB	7/7/2008 01:12:06 PM	
Environmental Assessment.pdf	14454 KB	7/7/2008 01:10:22 PM	
p2-3 Harvey to ACOE Addtnl Info.pdf	863 KB	7/7/2008 01:09:14 PM	
The Colorado Kayak Chronicle Ma...	2122 KB	12/4/2008 07:48:54 PM	
WCP2007_Paddler-Driven_Whitewat...	8082 KB	3/25/2010 05:32:30 PM	
WW Southern Rockies Guidebk BV.pdf	4898 KB	4/10/2008 12:54:06 PM	

Total 21 file(s); Size: 66800347 Byte(s)

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Buena Vista_Maps, References and Photos\2 BV_References\USAWE PERMIT #200400658

```
==========================================================================
2004 Permit Withdrawal.pdf          1022 KB     7/8/2008 09:37:16 AM
200400658 ACOE Request for Addi...   862 KB     7/7/2008 12:59:36 PM
200400658 Application Form.pdf      1364 KB     7/7/2008 01:00:44 PM
200400658 CDOW Comments.pdf          964 KB     7/7/2008 01:02:14 PM
200400658 CoStateParks Comments.pdf  350 KB     7/7/2008 01:02:34 PM
200400658 DPHE Comments.pdf          594 KB     7/7/2008 01:03:26 PM
200400658 Permit Appl Withdrawa...   413 KB     7/7/2008 01:02:52 PM
200400658 Raft Ind Comments.pdf      916 KB     7/7/2008 01:01:52 PM
200400658 Request for Public Co...  3971 KB     7/7/2008 01:01:18 PM
200400658 Response to Request f...  1386 KB     7/7/2008 01:00:20 PM
404 Permit Application.pdf          4636 KB     7/7/2008 12:58:46 PM

Total 11 file(s);  Size: 16878804 Byte(s)
```

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Buena Vista_Maps, References and Photos\3 BV_Site Photos

```
==================================================
Downtown Hole Before Repair, 22...  1292 KB  3/16/2008 09:08:06 PM
Thumbs.db                             68 KB  4/9/2008 11:53:52 AM     hs
Uptown Hole, 2200 cfs 6-06.JPG      1353 KB  3/16/2008 09:08:06 PM
Total 3 file(s);  Size: 2779179 Byte(s)
```

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Confluence Park_Maps, References and Photos

```
==========================================================================
Total 0 file(s);  Size: 0 Byte(s)
```

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Confluence Park_Maps, References and Photos\1 Confluence Park_Maps, aerials, FEMA

```
==========================================================================
Confluence Park FEMA Map.pdf         954 KB     4/2/2008 10:14:54 AM
Confluence Park Vicinity.jpg         418 KB     4/7/2008 05:43:24 PM
Confluence Park.jpg                  374 KB     4/7/2008 05:41:56 PM
Confluence Park.psd                 1496 KB     4/7/2008 05:43:10 PM
Thumbs.db                             29 KB  8/30/2008 09:07:18 AM     hs

Total 5 file(s);  Size: 3351026 Byte(s)
```

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Confluence Park_Maps, References and Photos\2 Confluence Park_References

```
==========================================================
Chart_90.jpg                        35 KB     4/9/2008 01:34:10 PM
confluence economic.jpg             107 KB    4/8/2008 05:51:02 PM
Confluence Park_404 Application.pdf  10897 KB  8/25/2008 09:25:10 AM
Confluence Park_Extension Denie...   1724 KB   8/25/2008 09:29:44 AM
Confluence Park_Permit Extensio...   7778 KB   8/25/2008 09:27:18 AM
Confluence Park_Permit wRevisio...   9363 KB   8/25/2008 09:31:32 AM
Confluence Park_Post Constructi...   6874 KB   8/25/2008 09:29:08 AM
Confluence Park_UDFCD Permit No...   816 KB    8/25/2008 09:30:36 AM
Thumbs.db                           16 KB     8/25/2008 09:34:42 AM     hs
WW Southern Rockies Guidebk Con...   4073 KB   4/10/2008 12:52:32 PM
Total 10 file(s);  Size: 42688666 Byte(s)
```

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Confluence Park_Maps, References and Photos\3 Confluence Park_ Siite photos

```
=====================================================================
Confluence Park 1970s.tif           625 KB    3/8/2001 10:40:58 AM
Front Range Paddling School Cla...  886 KB    6/21/2006 02:15:02 PM
Long Lookng Upstream to Boat Ch...  1391 KB    3/8/2008 11:20:48 AM
Rafting Through Chute.jpg           1412 KB   3/8/2008 11:17:56 AM
Sign at Denver Airport.jpg          557 KB    3/12/2008 01:53:56 PM
South Platte.jpg                    133 KB    3/16/2005 12:36:06 PM
Thumbs.db                           56 KB     8/30/2008 09:11:44 AM     hs
Winter Boating.JPG                  642 KB    1/1/2002 01:00:00 AM
Total 8 file(s);  Size: 5842158 Byte(s)
```

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Durango_Maps, References and Photos

```
================================================================
Total 0 file(s);  Size: 0 Byte(s)
```

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Durango_Maps, References and Photos\1 Durango_Maps, Aerials, FEMA

```
============================================================
Durango CO Vicinity.jpg             242 KB   10/29/2007 11:27:32 AM
Durango CO.jpg                      558 KB   10/29/2007 11:27:40 AM
Durango FEMA Map.pdf                370 KB    7/28/2008 03:03:06 PM
Durango Site Map.tif                2776 KB   4/8/2008 10:52:14 AM
DURANGO!map.TIF                     3213 KB   4/7/2008 03:13:16 PM
Thumbs.db                           48 KB     12/2/2008 03:58:50 PM     hs
Total 6 file(s);  Size: 7382632 Byte(s)
```

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Durango_Maps, References and Photos\2 Durango_References

```
=====================================================
ACOE Maintenance Authoraization...  979 KB    6/16/2008 01:42:42 PM
ACOE-Durango-Durango.pdf            508 KB    4/7/2008 01:13:32 AM
City of Durango Boating Park Hy...  2539 KB   7/28/2008 10:01:34 PM
City of Durango RICD Presentati...  345 KB    4/7/2008 01:13:32 AM
```

Durango Final Decree.pdf 403 KB 4/7/2008 01:13:32 AM
Durango Maintenance Request 200... 504 KB 6/16/2008 01:43:04 PM
Durango Master Plan - 2001.pdf 19177 KB 7/28/2008 03:27:28 PM
Durangofinalfindingsandrecommen... 64 KB 4/7/2008 01:13:32 AM
EconomicImpactsofWhitewaterRecr... 1272 KB 4/7/2008 01:18:22 AM
ExecSumCommercialRiverUseinCO20... 1162 KB 4/7/2008 01:19:38 AM
Report on the Design, Functiona... 2373 KB 7/28/2008 09:57:50 PM
Supplement to City of Durango B... 599 KB 4/7/2008 01:16:44 AM
The Durango Telegraph - The...pdf 140 KB 3/19/2010 02:20:36 PM
The Durango Telegraph 2 Options... 222 KB 7/28/2008 09:57:50 PM
Total 14 file(s); Size: 31022033 Byte(s)

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Durango_Maps, References and Photos\2 Durango_References\HEC-RAS Modeling

==========

ricd.f01 1 KB 8/7/2008 07:24:34 AM
ricd.g03 15 KB 8/7/2008 07:24:34 AM
ricd.g04 17 KB 8/7/2008 07:24:34 AM
ricd.g05 14 KB 8/7/2008 07:24:34 AM
ricd.O02 482 KB 8/7/2008 07:24:34 AM
ricd.O03 439 KB 8/7/2008 07:24:34 AM
ricd.O04 147 KB 8/7/2008 07:24:36 AM
ricd.p02 1 KB 8/7/2008 07:24:36 AM
ricd.p03 1 KB 8/7/2008 07:24:36 AM
ricd.p04 1 KB 8/7/2008 07:24:36 AM
ricd.prj 1 KB 8/7/2008 07:24:34 AM
Total 11 file(s); Size: 1149705 Byte(s)

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Durango_Maps, References and Photos\3 Durango_Site Photos

==========

Beginning of Artificial Constri... 2883 KB 3/6/2008 03:55:18 PM
dsc_7934_thumb.jpg 10 KB 6/17/2008 08:24:56 AM
Feature Below Smelter.jpg 2734 KB 3/6/2008 03:55:18 PM
Rock Garden and Slalom Gates Be... 2639 KB 2/3/2008 01:46:52 PM
Second Feature Below Smelter.jpg 2791 KB 2/3/2008 01:46:52 PM
Smelter.jpg 2613 KB 2/3/2008 01:46:58 PM
Thumbs.db 105 KB 11/23/2009 04:31:48 PM hs
Total 7 file(s); Size: 14109146 Byte(s)

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Golden_Maps, References and Photos

==========

Total 0 file(s); Size: 0 Byte(s)

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Golden_Maps, References and Photos\1 Golden_Maps, Aerials, FEMA

```
==========================================================
Golden CO Clear Creek.jpg          4695 KB   10/13/2007 10:16:42 AM
Golden CO Vicinity.jpg             327 KB    10/29/2007 11:28:54 AM
Golden_FEMA Map.pdf                630 KB    10/25/2007 03:12:32 PM
Thumbs.db                          15 KB     8/4/2008 03:04:42 PM     hs
Total 4 file(s);  Size: 5805761 Byte(s)
```

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Golden_Maps, References and Photos\2 Golden_References

```
==================================================
ACOE-Lakewood-Golden.pdf           4252 KB     4/7/2008 01:29:12 AM
Clear Creek WWPark.pdf             12834 KB    3/4/2004 02:37:00 PM
Denver Post Article 8-96.pdf       2077 KB     6/16/2008 01:12:12 PM
Golden 404 Permit Application 1...  2383 KB    6/16/2008 01:08:20 PM
Golden ACOE Permit 1996.pdf        559 KB      6/16/2008 01:11:26 PM
Golden Historical Society 1996.pdf  309 KB     6/16/2008 01:11:42 PM
Golden Maintenance Authorizatio...  2149 KB    6/16/2008 01:10:56 PM
Golden Maintenance Request 10-0...  518 KB     6/16/2008 01:09:34 PM
Golden REP Response to Question...  603 KB     6/16/2008 01:08:48 PM
Golden_ACOE Permit 200280295.pdf   12380 KB    8/25/2008 08:56:48 AM
Golden_ACOE Permit 200680135.pdf    3652 KB    8/25/2008 08:57:28 AM
Golden_economic_study.pdf          5880 KB     8/5/2004 04:59:16 PM
Pages from Golden_ACOE Permit 2...  693 KB     12/10/2008 11:44:50 AM
RFDMS 2007 Facilities Sections ...  1722 KB    6/16/2008 01:05:32 PM
Supplemental Report Revised, Sh...  150 KB     4/7/2008 01:20:10 AM
USGS 6719505 Flows from 1974-20...  590 KB     8/6/2007 02:16:34 PM
Welcome to Great 8 Newspapers.pdf   314 KB     3/19/2010 02:50:22 PM
WW Southern Rockies Guidebk Gol...  4073 KB    4/10/2008 12:52:50 PM
Total 18 file(s);  Size: 56469294 Byte(s)
```

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Golden_Maps, References and Photos\3 Golden_Site Photos

```
==================================================
Bank Erosion Upstream of Rodeo ...  2683 KB     2/3/2008 01:50:12 PM
Bleachers Hole.jpg                 2778 KB     2/3/2008 01:50:18 PM
Close-Up of Bingo Hole.jpg         2735 KB     2/3/2008 01:50:34 PM
Close-Up of Library Hole.jpg       2817 KB     2/3/2008 01:50:42 PM
Close-Up of Rodeo Hole.jpg         2844 KB     2/3/2008 01:50:48 PM
Drop at Ballfields.jpg             2938 KB     2/3/2008 01:50:48 PM
Ends in Library Hole.jpg           2878 KB     2/3/2008 01:50:54 PM
Second Drop.jpg                    2706 KB     7/30/2008 02:56:16 PM
Terraced Bank Between Rodeo Hol...  2419 KB    7/30/2008 02:51:44 PM
Third Drop from Below.jpg          2625 KB     7/30/2008 03:03:36 PM
Third Drop from Upstream.jpg       2932 KB     7/30/2008 03:07:48 PM
Thumbs.db                          329 KB    11/23/2009 04:31:50 PM     hs

Total 12 file(s);  Size: 31427918 Byte(s)
```

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Gunnison_Maps, References and Photos

```
==========================================================================
Total 0 file(s);  Size: 0 Byte(s)
```

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Gunnison_Maps, References and Photos\1 Gunnison_Maps, Aerials, FEMA

```
==========================================================================
Guinnison, CO.jpg                1555 KB   10/13/2007 10:16:42 AM
Gunnison Drawings.jpg             201 KB    3/19/2010 05:06:00 PM
Gunnison Drawings.pdf             142 KB    7/12/2007 02:32:52 PM
Gunnison Drawings.tif            1922 KB    3/19/2010 04:58:02 PM
Gunnison Surveying.pdf             64 KB    7/12/2007 02:33:12 PM
Gunnison, CO Vicinity.jpg         314 KB   10/29/2007 11:29:46 AM
Gunnison_FEMA.jpg                 140 KB    3/19/2010 05:04:10 PM
Gunnison_FEMA.pdf                 652 KB   10/25/2007 04:30:04 PM
Total 8 file(s);  Size: 5112289 Byte(s)
```

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Gunnison_Maps, References and Photos\2 Gunnison_References

```
==========================================================================
Gunnison whitewater park fi...pdf      352 KB    3/19/2010 03:25:08 PM
Gunnison_ACOE Permit 199975500 ...    4600 KB    8/25/2008 08:50:04 AM
Gunnison_AOCE Permit 199975500.pdf    1347 KB    8/25/2008 08:48:16 AM
Gunnison_Application for Water ...    1358 KB     4/7/2008 01:45:18 AM
Gunnison_Finalfindingsandrecomm...      88 KB     4/7/2008 01:45:18 AM
Gunnison_Permit Mod for Repairs...    3453 KB    8/25/2008 08:50:50 AM
Gunnison_RICD Settlement Press ...      58 KB     8/7/2008 07:28:44 PM
Gunnison_User Survey Forms.pdf         450 KB    6/16/2008 09:25:12 AM
Gunnison_WW Southern Rockies Gu...    4253 KB    4/10/2008 01:40:28 PM
Gunnison's Developing Relations...    5925 KB    4/19/2006 10:19:42 AM
Headwaters April 2006.pdf             2196 KB   12/10/2008 01:08:06 PM
Letter from Helton&Williamson.pdf     2102 KB    6/16/2008 09:32:10 AM
Report for the Gunnison River W...    9820 KB    6/16/2008 09:27:22 AM
USGS 9114500 Historical Streamf...    1128 KB    6/16/2008 09:29:30 AM
Total 14 file(s);  Size: 38028500 Byte(s)
```

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Gunnison_Maps, References and Photos\3 Gunnision Site Photos

```
==========================================================================
Feature at Structure 6.jpg            2806 KB    7/16/2007 08:29:36 AM
Gunnison_Scans of Word Doc Site...   11760 KB    6/16/2008 09:31:02 AM
Gunnison_Unlabeled Photos.pdf        11760 KB     8/5/2008 06:12:48 PM
gunny_wave_003_thumb.jpg                10 KB    6/17/2008 09:43:10 AM
Structure 1 from Put-in Area.jpg      2842 KB    7/16/2007 08:29:06 AM
Structure 1.jpg                       2941 KB    7/16/2007 08:29:08 AM
Structure 2.jpg                       2926 KB    7/16/2007 08:29:12 AM
Take-Out Area.jpg                     2912 KB    7/16/2007 08:29:44 AM
Thumbs.db                              148 KB   11/23/2009 04:31:48 PM     hs
Wave at Structure 5.jpg               2671 KB    7/16/2007 08:29:28 AM
Total 10 file(s);  Size: 41759331 Byte(s)
```

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Lyons_Maps, References and Photos

```
============================================================
Total 0 file(s);  Size: 0 Byte(s)
```

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Lyons_Maps, References and Photos\1 Lyons_Maps, Aerials, FEMA

```
============================================================
BlackBearHoleMap.pdf              61 KB     4/7/2008 01:51:24 AM
Lyons CO Vicinity.jpg            705 KB     4/7/2008 05:30:32 PM
Lyons CO Vicinity1.jpg           254 KB   10/29/2007 11:30:16 AM
Lyons CO.jpg                     466 KB   10/29/2007 11:30:20 AM
Lyons_FEMA.pdf                   831 KB     4/7/2008 01:37:14 PM
LyonsWWP(close-up1).pdf           44 KB     4/7/2008 01:51:24 AM
LyonsWWP(close-up2).pdf           64 KB     4/7/2008 01:51:24 AM
LyonsWWPMap.pdf                   41 KB     4/7/2008 01:51:24 AM
Thumbs.db                         18 KB   12/10/2008 04:48:04 PM     hs
Total 9 file(s);  Size: 2547231 Byte(s)
```

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Lyons_Maps, References and Photos\2 Lyons_References

```
============================================================
Appendix 4cii_RICD monthly flow...      57 KB    4/27/2008 03:06:18 PM
Lyons ACOE Permit 200580694.pdf        719 KB    8/29/2008 04:40:42 PM
Lyons_1989 Work Under General P...    1232 KB    8/29/2008 04:44:28 PM
Lyons_200180319 Additional Info.pdf   1047 KB    8/29/2008 04:40:08 PM
Lyons_200180319 Public Comments.pdf    847 KB    8/29/2008 04:38:02 PM
Lyons_2002 MaintApproval.pdf           990 KB    8/25/2008 09:05:52 AM
Lyons_2002 ReqforMaintAporoval.pdf     362 KB    8/25/2008 09:06:08 AM
Lyons_200580694 Application.pdf       1294 KB    8/29/2008 04:39:08 PM
Lyons_200580694 Comments.pdf          1213 KB    8/29/2008 04:45:28 PM
Lyons_401 Cert 3-06.pdf                747 KB    8/29/2008 04:37:14 PM
Lyons_80319 Public Comments.pdf       6531 KB    8/25/2008 09:09:10 AM
Lyons_ACOE 200180319 Addtional ...    8116 KB    8/25/2008 09:10:46 AM
Lyons_ACOE 200580694.pdf              5737 KB    8/25/2008 09:01:40 AM
Lyons_ACOE 200580753and20058075...    5243 KB    8/25/2008 09:00:14 AM
Lyons_ACOE Permit 200180319 Eva...    1781 KB    8/29/2008 04:43:28 PM
Lyons_ACOE Permit 200180319.pdf        743 KB    8/29/2008 04:42:02 PM
Lyons_ACOE Permit 200180319wCov...   14413 KB    8/25/2008 09:08:18 AM
Lyons_ACOE Permits 200580753 an...     716 KB    8/29/2008 04:41:26 PM
Lyons_General PermitIncomplete.pdf    9801 KB    8/25/2008 09:12:40 AM
Lyons_Public Comments Q106.pdf        9452 KB    8/25/2008 09:04:46 AM
WW Southern Rockies Guidebk Lyo...    4432 KB    4/10/2008 01:39:58 PM
Total 21 file(s);  Size: 77294824 Byte(s)
```

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Lyons_Maps, References and Photos\3 Lyons_Site Photos

```
============================================================
Close-Up of Baffles.jpg              2457 KB     2/3/2008 01:48:22 PM
Close-Up of Blackbear Hole.jpg       2418 KB     2/3/2008 01:48:22 PM
Close-Up of Fourth Drop.jpg          2756 KB     2/3/2008 01:48:30 PM
Close-Up of Second Drop.jpg          2393 KB     2/3/2008 01:48:32 PM
Close-Up of Third Drop.jpg           2658 KB     2/3/2008 01:48:32 PM
Diversion Dam Between A-Hole an...   2540 KB     2/3/2008 01:48:38 PM
Fifth Drop.jpg                       2728 KB     2/3/2008 01:48:38 PM
First Drop-From Bridge.jpg           2616 KB     2/3/2008 01:48:44 PM
Put-In on South Saint Vrain.jpg      2741 KB     2/3/2008 01:48:54 PM
Sideview of Third Drop.jpg           2368 KB     2/3/2008 01:49:32 PM
Thumbs.db                             154 KB   12/10/2008 04:47:56 PM     hs
Total 11 file(s);  Size: 26453679 Byte(s)
```

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Pagosa Springs_Maps, References and Photos

```
==========================================================
Total 0 file(s);  Size: 0 Byte(s)
```

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Pagosa Springs_Maps, References and Photos\1 Pagosa Springs_Maps, Aerials, FEMA

```
=========================================================================
Copy of Pagosa Springs CO vicin...    248 KB   10/29/2007 11:30:34 AM
Course Design.pdf                    1668 KB     7/7/2008 01:47:56 PM
Course Design_1.jpg                  1280 KB    12/8/2008 04:00:28 PM
Course Design_2.jpg                  1250 KB    12/8/2008 03:57:54 PM
Pagosa Springs CO vicinity.jpg        248 KB   10/29/2007 11:30:34 AM
Pagosa Springs CO.jpg                 309 KB   10/29/2007 11:30:36 AM
Pueblo_FEMA.pdf                      1388 KB     4/7/2008 01:08:52 PM
Thumbs.db                              31 KB    12/8/2008 04:00:38 PM     hs
Total 8 file(s);  Size: 6578215 Byte(s)
```

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Pagosa Springs_Maps, References and Photos\2 Pagosa Springs_References

```
============================================================
199775104ACOE Notee.pdf              18132 KB     7/7/2008 01:39:48 PM
199775104Addiitonal Info Reques...   16823 KB     7/7/2008 01:37:08 PM
199775104Request to Rosgen for ...    5765 KB     7/7/2008 01:40:26 PM
200575106 Submission of Additio...   10699 KB     6/16/2008 11:12:06 AM
200576106AcknofApplication.pdf        2305 KB     7/7/2008 01:57:16 PM
200576106ACOERemoveorRevisePlan.pdf   2333 KB     7/7/2008 01:57:50 PM
ACOE Permit 199775014.pdf            14661 KB     7/7/2008 01:33:36 PM
ACOE Permit 200575106.pdf             4422 KB     7/7/2008 02:02:38 PM
ACOE Permit Application 2005.pdf      4512 KB     7/7/2008 01:47:14 PM
ACOE2ndReqforAddtlInfo.pdf            4491 KB     7/7/2008 01:58:36 PM
Appendix 1c_ACOE-Durango-Pagosa...   11653 KB     8/17/2008 09:02:56 PM
ComparativeStudyofWWeirandUDrop.pdf  25407 KB     6/16/2008 11:08:46 AM
Delay in White Water Project.pdf       299 KB     3/19/2010 10:10:26 AM
DivWaterResourcestoACOEp1.pdf          363 KB     6/16/2008 11:10:02 AM
```

DivWaterResourcestoACOEp2.pdf 84 KB 6/16/2008 11:10:12 AM
WW Southern Rockies Guidebk Pag... 3587 KB 4/10/2008 12:49:42 PM
Total 16 file(s); Size: 128559803 Byte(s)

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Pagosa Springs_Maps, References and Photos\3 Pagosa Springs_Site Photos
==========
Close-Up of Feature from Above.jpg 1912 KB 9/6/2007 03:14:02 PM
Close-Up of Feature from Above.tif 34823 KB 4/9/2008 02:04:10 PM
Looking Up at W-Weirs.jpg 2039 KB 9/6/2007 03:13:36 PM
Looking Up at W-Weirs.tif 33938 KB 4/9/2008 02:04:46 PM
Sideview Close-Up of Feature.jpg 2011 KB 9/6/2007 03:13:58 PM
Sideview Close-Up of Feature.tif 34855 KB 4/9/2008 02:05:20 PM
Thumbs.db 46 KB 5/20/2008 01:53:28 PM hs
W-Weir Above Feature.jpg 1812 KB 9/6/2007 03:14:00 PM
W-Weir Above Feature.tif 34552 KB 4/9/2008 02:05:52 PM
Total 9 file(s); Size: 149496498 Byte(s)

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Pueblo_Maps,References and Photos
==========
Total 0 file(s); Size: 0 Byte(s)

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Pueblo_Maps,References and Photos\1 Pueblo_Maps, Aerials, FEMA
==========
COE drawings.pdf 319 KB 10/15/2004 09:02:02 AM
Fish Passage Plan and Profile.pdf 354 KB 1/7/2004 11:58:00 AM
Fish Passage Typical Details.pdf 231 KB 1/7/2004 11:58:22 AM
FM0850770010C.pdf 3640 KB 10/24/2007 03:01:34 PM
Pueblo CO Vicinity.jpg 425 KB 10/29/2007 11:30:44 AM
Pueblo CO.jpg 2060 KB 10/13/2007 10:11:58 AM
Pueblo_FEMA.pdf 1053 KB 10/23/2007 02:59:04 PM
Total 7 file(s); Size: 8279784 Byte(s)

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Pueblo_Maps,References and Photos\2 Pueblo_References
==========
ACOE drawings.pdf 319 KB 4/7/2008 01:52:38 AM
Boy presumed drowned at Pue...pdf 312 KB 7/6/2010 06:09:50 PM a
CWCBStafRecommendationstoBoard.pdf 2216 KB 6/16/2008 01:53:34 PM
Drowning .pdf 198 KB 7/6/2010 05:58:52 PM a
EngineeringReportandDocumentati... 10256 KB 6/16/2008 01:54:58 PM
FindingofFactConclusionofLawand... 3656 KB 6/16/2008 01:52:58 PM
Flows Damage Kayak Course - Sci... 81 KB 4/7/2008 01:52:38 AM
Near Drowning at Pueblo Pla...pdf 243 KB 7/6/2010 06:23:26 PM a
Pueblo Boating Beta_ IMPROVEMEN... 118 KB 4/7/2008 01:52:38 AM
pueblo damage 06.pdf 98 KB 7/19/2006 01:40:16 PM
Pueblo update2.doc 24 KB 5/12/2010 06:52:52 PM
Pueblo Whitewater Park Opens_Ma... 29 KB 4/7/2008 01:52:38 AM
Pueblo_ACOE 199900441 NWP 10-29... 677 KB 8/25/2008 08:25:56 AM

Pueblo_ACOE 199900441 NWP27 03-... 501 KB 8/25/2008 08:25:32 AM
Pueblo_ACOE 199900441 RecordofD... 833 KB 8/25/2008 08:26:50 AM
PuebloChieftainFlowsDamageKayak... 683 KB 6/16/2008 01:52:14 PM
QUESTIONS IN DROWNING – TEE...pdf 33 KB 7/6/2010 06:15:24 PM a
WW Southern Rockies Guidebk Pue... 4245 KB 4/10/2008 01:40:56 PM
Total 18 file(s); Size: 25122314 Byte(s)

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Pueblo_Maps,References and Photos\3 Pueblo_Site Photos
==========
Bob Marley.jpg 2648 KB 2/3/2008 01:53:00 PM
Close-Up of Drop 1.jpg 2822 KB 2/3/2008 01:53:02 PM
Close-Up of Drop 3.jpg 2653 KB 2/3/2008 01:53:08 PM
Close-Up of Drop 4.jpg 2486 KB 2/3/2008 01:53:08 PM
Close-Up of Drop 5.jpg 2883 KB 2/3/2008 01:53:08 PM
Close-Up of Drop 8.jpg 2752 KB 2/3/2008 01:53:14 PM
Downstream Put-in.JPG 1309 KB 6/17/2006 11:17:00 PM
Drop 2.jpg 2452 KB 2/3/2008 01:53:26 PM
Drop 6.jpg 2901 KB 2/3/2008 01:53:32 PM
Drop 7.jpg 2848 KB 2/3/2008 01:53:32 PM
First Drop.JPG 1279 KB 6/17/2006 11:21:00 PM
Rapids Rebuilt Fall 2005 Center.JPG 1318 KB 6/17/2006 11:27:00 PM
Rvr Rt Bank at Final Rapid.JPG 1217 KB 6/17/2006 11:32:00 PM
Thumbs.db 66 KB 5/20/2008 01:54:18 PM hs
Total 14 file(s); Size: 30353937 Byte(s)

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Ridgway_Maps, References and Photos
==========
Total 0 file(s); Size: 0 Byte(s)

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Ridgway_Maps, References and Photos\1 Ridgway Maps, Aerials, FEMA
==========
NRTC Phase II Drawing.pdf 1829 KB 7/7/2008 04:53:44 PM
PedBridgeBoatingRampDrawings200... 1056 KB 7/7/2008 02:33:54 PM
Ridgway_FEMA.pdf 508 KB 4/7/2008 03:18:52 PM
Ridgway_Uncompahgre@Main St.jpg 46 KB 3/12/2008 08:11:50 PM
Thumbs.db 8 KB 7/30/2008 03:48:06 PM hs
TypicalSectionDrawing2004.pdf 744 KB 7/8/2008 08:58:50 AM

Total 6 file(s); Size: 4295386 Byte(s)

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Ridgway_Maps, References and Photos\2 Ridgway_References

```
==========================================================================
ACOE ApprovalforMaintandStructR...    2851 KB     7/7/2008 04:37:50 PM
ACOE Permit 200275036 Phase I.pdf     7403 KB     7/8/2008 08:31:40 AM
ACOE Permit 200275036 Phase II.pdf    1004 KB     7/8/2008 08:45:50 AM
ACOE Permit 200575719.pdf             6443 KB     7/7/2008 02:21:46 PM
ACOE_AdditionalInfoRequest 3-06.pdf   7739 KB     7/7/2008 02:20:18 PM
PermitApplicationNo2_2005.pdf         14301 KB    7/7/2008 02:19:00 PM
Ridgway_Public Notice Comments.pdf    982 KB      8/7/2008 07:52:52 AM
RTCAHandwrittenCovertoPlan2001.pdf    470 KB      7/7/2008 04:36:34 PM
SupplementalEngInfotoACOE_1-06.pdf    3109 KB     7/7/2008 02:22:26 PM
Thumbs.db                             9 KB    7/30/2008 03:48:32 PM     hs
WW Southern Rockies Guidebk Rid...    3838 KB     4/27/2008 04:21:34 PM

Total 11 file(s);  Size: 49311461 Byte(s)
```

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Ridgway_Maps, References and Photos\3 Ridgway_Site Photos

```
==========================================================================
Close-Up of First Drop.jpg            2755 KB     2/3/2008 01:49:46 PM
Close-Up of Second Drop.jpg           2789 KB     2/3/2008 01:49:52 PM
Filled in Third Drop.jpg              2557 KB     2/3/2008 01:49:52 PM
Grouted Rocks in First Drop.jpg       2687 KB     2/3/2008 01:49:54 PM
Put-In Eddy.jpg                       2771 KB     8/17/2008 06:47:36 PM
Thumbs.db                             47 KB     3/18/2010 04:23:02 PM     hs

Total 6 file(s);  Size: 13935733 Byte(s)
```

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Salida_Maps, References and Photos

```
==========================================================================

Total 0 file(s);  Size: 0 Byte(s)
```

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Salida_Maps, References and Photos\1Salida_ Maps, Aerials, FEMA

```
==========================================================================
Arkansas at Salida.jpg                1449 KB     4/13/2008 09:42:50 PM
Salida CO Vicinity.jpg                 411 KB    10/29/2007 11:31:12 AM
salida co.jpg                         1449 KB    10/13/2007 10:11:58 AM
Salida_DrawingofMapandGreenway.pdf     305 KB     6/16/2008 11:38:40 AM
Salida_FEMA.pdf                        286 KB     4/7/2008 01:02:50 PM
Salida-Aerial.pdf                      244 KB     6/16/2008 11:38:50 AM
SalidaWhitewaterPark_Map2001.pdf       191 KB     4/13/2008 09:47:38 PM
Thumbs.db                              7 KB     8/7/2008 12:24:38 PM     hs

Total 8 file(s);  Size: 4449291 Byte(s)
```

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Salida_Maps, References and Photos\2 Salida_References

```
 ACOE Permit 200100045.pdf          121019 KB    8/15/2008 09:39:56 AM
 Appendix 4biiChaffeeStaffRecomm...     64 KB    8/17/2008 08:10:22 PM
 ArkatSalidaHydrograph Projectio...     63 KB    4/13/2008 09:47:38 PM
 Chaffee_ ProposeFindingsandReco...     64 KB    4/13/2008 09:47:38 PM
 Chaffee_Application for Surface...    296 KB    4/13/2008 09:47:38 PM
 Chaffee_FindingofFactandReco.pdf       54 KB    4/13/2008 09:47:38 PM
 Chaffee_FindingofFactConclusion...  15437 KB    6/16/2008 11:37:34 AM
 Chaffee_ReApplicationLetters.pdf     1265 KB     7/7/2008 01:04:16 PM
 Salida_ACOE 200500047 Repairs.pdf    3110 KB     7/7/2010 10:45:18 AM      a
 Salida_RICD Monthly Flow Charts...     57 KB    4/27/2008 03:23:46 PM
 Thumbs.db                               6 KB    4/27/2008 03:23:04 PM     hs
 WCP2007_Paddler-Driven_Whitewat...   8082 KB    3/25/2010 05:32:14 PM
 WW Southern Rockies Guidebk Sal...   4411 KB    4/10/2008 12:53:40 PM

 Total 13 file(s);  Size: 157629459 Byte(s)
```

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Salida_Maps, References and Photos\3 Salida_Siite Photos

```
 Salida - Pedestr and Retail Acc...   1262 KB    3/16/2008 09:22:04 PM
 Salida 2200 from RRt Eddy.JPG        1256 KB    3/16/2008 09:22:04 PM
 Salida Ledge 2200 cfs.JPG            1182 KB    3/16/2008 09:22:04 PM
 Salida Ledge Low-Med Flow.jpg         651 KB     8/6/2004 08:43:06 AM
 Salida_Upstream of Ledge Lookin...    663 KB     8/6/2004 08:42:38 AM
 Thumbs.db                             243 KB    8/15/2008 10:43:06 AM     hs

 Total 6 file(s);  Size: 5386804 Byte(s)
```

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Steamboat Springs_Maps, References and Photos

```
 Total 0 file(s);  Size: 0 Byte(s)
```

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Steamboat Springs_Maps, References and Photos\1 Steamboat_Maps, Aerials & FEMA

```
 steamboat Co.jpg                    1101 KB   10/13/2007 10:11:58 AM
 Steamboat_FEMA.pdf                  1221 KB   10/25/2007 04:56:40 PM
 Thumbs.db                             17 KB    12/8/2008 04:05:20 PM     hs

 Total 3 file(s);  Size: 2396251 Byte(s)
```

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Steamboat Springs_Maps, References and Photos\2 Steamboat References

```
==========================================================================
2003 economic summary.xls              29 KB    4/27/2004 12:31:54 PM
C Hole Drop Update 10 03.pdf           13 KB    10/3/2005 04:00:50 PM
Design Drawings by Lacy.pdf           336 KB    10/2/2005 07:24:56 PM
RICD monthly flow charts 4-03.xls      57 KB    4/27/2008 03:18:26 PM
steamboat course reconstruction.pdf    74 KB    5/4/2004 10:29:30 AM
Steamboat_200175121 Comments Ot...   1105 KB    8/22/2008 01:49:00 PM
Steamboat_200175121CommentsCDPH...   1917 KB    8/22/2008 03:26:20 PM
Steamboat_ACOE 200175121 Amendm...   3867 KB    12/8/2008 04:15:26 PM
Steamboat_ACOE 200475103 NWP3 C...   7954 KB    12/8/2008 04:14:06 PM
Steamboat_Plan Drawing.pdf           6275 KB    8/22/2008 01:48:14 PM
submittal to COE.pdf                  163 KB    9/25/2005 03:11:48 PM
Supplemental EconomicStudy(#10).pdf   829 KB    5/17/2005 04:40:46 PM
Thumbs.db                              79 KB    12/8/2008 04:16:00 PM     hs
User Interviews - Yampa River F...     91 KB    4/8/2008 03:57:20 PM
WW Southern Rockies Guidebk Ste...   4784 KB    4/10/2008 12:48:08 PM
Yampa-Daily.xls                      6886 KB    4/8/2008 11:05:08 AM

Total 16 file(s);  Size: 35293563 Byte(s)
```

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Steamboat Springs_Maps, References and Photos\2 Steamboat_References\ACOE permit

```
==========================================================================
Steamboat_ACOE 200175121 Amendm...    157 KB    12/8/2008 04:15:38 PM
Steamboat_ACOE 200175121 Amendm...    206 KB    12/8/2008 04:15:36 PM
Steamboat_ACOE 200175121 Amendm...    369 KB    12/8/2008 04:15:38 PM
Steamboat_ACOE 200175121 Amendm...    371 KB    12/8/2008 04:15:40 PM
Steamboat_ACOE 200175121 Amendm...    385 KB    12/8/2008 04:15:38 PM
Steamboat_ACOE 200175121 Amendm...    461 KB    12/8/2008 04:15:40 PM
Steamboat_ACOE 200175121 Amendm...    545 KB    12/8/2008 04:15:38 PM
Steamboat_ACOE 200175121 Amendm...    570 KB    12/8/2008 04:15:40 PM
Steamboat_ACOE 200175121 Amendm...    627 KB    12/8/2008 04:15:36 PM
Steamboat_ACOE 200175121 Amendm...    634 KB    12/8/2008 04:15:36 PM
Steamboat_ACOE 200175121 Amendm...    638 KB    12/8/2008 04:15:38 PM
Steamboat_ACOE 200175121 Amendm...    645 KB    12/8/2008 04:15:36 PM
Steamboat_ACOE 200175121 Amendm...   1022 KB    12/8/2008 04:15:40 PM
Thumbs.db                             36 KB    12/8/2008 04:19:14 PM     hs

Total 14 file(s);  Size: 6832461 Byte(s)
```

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Steamboat Springs_Maps, References and Photos\2 Steamboat_References\HEC Models

EYAMPA.f01	9 KB	11/6/2001 02:40:20 PM
EYAMPA.f04	14 KB	11/6/2001 02:49:30 PM
EYAMPA.g01	856 KB	11/7/2001 11:42:02 AM
EYAMPA.g02	396 KB	11/7/2001 11:43:54 AM
EYAMPA.g03	97 KB	11/2/2001 11:28:38 AM
EYAMPA.g04	199 KB	11/2/2001 11:31:00 AM
EYAMPA.g05	165 KB	11/2/2001 11:31:36 AM
EYAMPA.O01	1059 KB	11/9/2001 02:49:04 PM
EYAMPA.O02	514 KB	11/7/2001 03:18:20 PM
EYAMPA.O03	117 KB	11/9/2001 12:37:02 PM
EYAMPA.O04	2072 KB	11/7/2001 03:08:18 PM
EYAMPA.O05	110 KB	11/9/2001 12:46:00 PM
EYAMPA.O06	345 KB	11/9/2001 12:55:52 PM
EYAMPA.O07	1024 KB	4/22/2004 11:25:30 AM
EYAMPA.O08	221 KB	11/12/2001 02:48:56 PM
EYAMPA.O09	208 KB	11/12/2001 02:50:24 PM
EYAMPA.O10	670 KB	11/12/2001 02:53:40 PM
EYAMPA.p01	37 KB	11/9/2001 02:49:24 PM
EYAMPA.p02	37 KB	11/6/2001 02:40:28 PM
EYAMPA.p03	37 KB	11/2/2001 01:22:32 PM
EYAMPA.p04	1 KB	11/2/2001 01:22:32 PM
EYAMPA.p05	37 KB	11/2/2001 01:22:34 PM
EYAMPA.p06	37 KB	11/2/2001 01:22:34 PM
EYAMPA.p07	1 KB	11/2/2001 01:22:34 PM
EYAMPA.p08	1 KB	11/2/2001 01:22:34 PM
EYAMPA.p09	1 KB	11/2/2001 01:22:34 PM
EYAMPA.p10	1 KB	11/2/2001 01:22:34 PM
EYAMPA.prj	1 KB	11/15/2001 11:24:10 AM
EYAMPA.r01	497 KB	11/9/2001 02:48:44 PM
EYAMPA.r02	262 KB	11/7/2001 03:18:08 PM
EYAMPA.r03	59 KB	11/9/2001 12:36:58 PM
EYAMPA.r04	460 KB	11/7/2001 03:07:34 PM
EYAMPA.r05	50 KB	11/9/2001 12:45:58 PM
EYAMPA.r06	126 KB	11/9/2001 12:55:48 PM
EYAMPA.r07	250 KB	4/22/2004 11:25:02 AM
EYAMPA.r08	54 KB	11/12/2001 02:48:50 PM
EYAMPA.r09	47 KB	11/12/2001 02:50:22 PM
EYAMPA.r10	115 KB	11/12/2001 02:53:32 PM
mrupdated.f02	5 KB	5/5/2004 02:53:14 PM
mrupdated.f03	5 KB	5/5/2004 02:52:36 PM
mrupdated.g06	404 KB	4/22/2004 12:02:18 PM
mrupdated.g07	396 KB	5/5/2004 03:09:48 PM
mrupdated.g08	396 KB	4/26/2004 11:10:22 AM
mrupdated.O01	1059 KB	11/9/2001 02:49:04 PM
mrupdated.O02	294 KB	5/5/2004 03:10:02 PM
mrupdated.O03	117 KB	11/9/2001 12:37:02 PM
mrupdated.O04	2072 KB	11/7/2001 03:08:18 PM

mrupdated.O05	110 KB	11/9/2001 12:46:00 PM
mrupdated.O06	345 KB	11/9/2001 12:55:52 PM
mrupdated.O07	294 KB	5/5/2004 02:55:52 PM
mrupdated.O08	221 KB	11/12/2001 02:48:56 PM
mrupdated.O09	208 KB	11/12/2001 02:50:24 PM
mrupdated.O10	1561 KB	4/27/2004 10:04:08 AM
mrupdated.O11	305 KB	5/5/2004 03:15:56 PM
mrupdated.O12	14701 KB	5/4/2004 11:18:58 AM
mrupdated.O13	14701 KB	5/4/2004 11:28:26 AM
mrupdated.p02	1 KB	4/22/2004 06:40:10 PM
mrupdated.p07	1 KB	4/26/2004 11:10:22 AM
mrupdated.p11	1 KB	4/22/2004 12:02:56 PM
mrupdated.prj	1 KB	5/5/2004 03:20:30 PM
mrupdated.r02	248 KB	5/5/2004 03:09:56 PM
mrupdated.r07	248 KB	5/5/2004 02:55:46 PM
mrupdated.r10	258 KB	4/27/2004 10:03:32 AM
mrupdated.r11	255 KB	5/5/2004 03:15:50 PM
mrupdated.r12	2646 KB	5/4/2004 11:17:30 AM
mrupdated.r13	2646 KB	5/4/2004 11:27:06 AM

Total 66 file(s); Size: 55000424 Byte(s)

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Steamboat Springs_Maps, References and Photos\2 Steamboat_References\HEC Models\Models same from lap top

EYAMPA.f01	9 KB	11/6/2001 02:40:20 PM
EYAMPA.f04	14 KB	11/6/2001 02:49:30 PM
EYAMPA.g01	856 KB	11/7/2001 11:42:02 AM
EYAMPA.g02	396 KB	11/7/2001 11:43:54 AM
EYAMPA.g03	97 KB	11/2/2001 11:28:38 AM
EYAMPA.g04	199 KB	11/2/2001 11:31:00 AM
EYAMPA.g05	165 KB	11/2/2001 11:31:36 AM
EYAMPA.O01	1059 KB	11/9/2001 02:49:04 PM
EYAMPA.O02	514 KB	11/7/2001 03:18:20 PM
EYAMPA.O03	117 KB	11/9/2001 12:37:02 PM
EYAMPA.O04	2072 KB	11/7/2001 03:08:18 PM
EYAMPA.O05	110 KB	11/9/2001 12:46:00 PM
EYAMPA.O06	345 KB	11/9/2001 12:55:52 PM
EYAMPA.O07	1024 KB	4/22/2004 11:25:30 AM
EYAMPA.O08	221 KB	11/12/2001 02:48:56 PM
EYAMPA.O09	208 KB	11/12/2001 02:50:24 PM
EYAMPA.O10	670 KB	11/12/2001 02:53:40 PM
EYAMPA.p01	37 KB	11/9/2001 02:49:24 PM
EYAMPA.p02	37 KB	11/6/2001 02:40:28 PM
EYAMPA.p03	37 KB	11/2/2001 01:22:32 PM
EYAMPA.p04	1 KB	11/2/2001 01:22:32 PM
EYAMPA.p05	37 KB	11/2/2001 01:22:34 PM
EYAMPA.p06	37 KB	11/2/2001 01:22:34 PM
EYAMPA.p07	1 KB	11/2/2001 01:22:34 PM
EYAMPA.p08	1 KB	11/2/2001 01:22:34 PM
EYAMPA.p09	1 KB	11/2/2001 01:22:34 PM
EYAMPA.p10	1 KB	11/2/2001 01:22:34 PM
EYAMPA.prj	1 KB	11/15/2001 11:24:10 AM
EYAMPA.r01	497 KB	11/9/2001 02:48:44 PM
EYAMPA.r02	262 KB	11/7/2001 03:18:08 PM
EYAMPA.r03	59 KB	11/9/2001 12:36:58 PM
EYAMPA.r04	460 KB	11/7/2001 03:07:34 PM
EYAMPA.r05	50 KB	11/9/2001 12:45:58 PM
EYAMPA.r06	126 KB	11/9/2001 12:55:48 PM
EYAMPA.r07	250 KB	4/22/2004 11:25:02 AM
EYAMPA.r08	54 KB	11/12/2001 02:48:50 PM
EYAMPA.r09	47 KB	11/12/2001 02:50:22 PM
EYAMPA.r10	115 KB	11/12/2001 02:53:32 PM
mrupdated.f02	5 KB	5/5/2004 02:53:14 PM
mrupdated.f03	5 KB	5/5/2004 02:52:36 PM
mrupdated.g06	404 KB	4/22/2004 12:02:18 PM
mrupdated.g07	396 KB	5/5/2004 03:09:48 PM
mrupdated.g08	396 KB	4/26/2004 11:10:22 AM
mrupdated.O01	1059 KB	11/9/2001 02:49:04 PM
mrupdated.O02	294 KB	5/5/2004 03:10:02 PM
mrupdated.O03	117 KB	11/9/2001 12:37:02 PM
mrupdated.O04	2072 KB	11/7/2001 03:08:18 PM
mrupdated.O05	110 KB	11/9/2001 12:46:00 PM

mrupdated.O06	345 KB	11/9/2001 12:55:52 PM
mrupdated.O07	294 KB	5/5/2004 02:55:52 PM
mrupdated.O08	221 KB	11/12/2001 02:48:56 PM
mrupdated.O09	208 KB	11/12/2001 02:50:24 PM
mrupdated.O10	1561 KB	4/27/2004 10:04:08 AM
mrupdated.O11	305 KB	5/5/2004 03:15:56 PM
mrupdated.O12	14701 KB	5/4/2004 11:18:58 AM
mrupdated.O13	14701 KB	5/4/2004 11:28:26 AM
mrupdated.p02	1 KB	4/22/2004 06:40:10 PM
mrupdated.p07	1 KB	4/26/2004 11:10:22 AM
mrupdated.p11	1 KB	4/22/2004 12:02:56 PM
mrupdated.prj	1 KB	5/5/2004 03:20:30 PM
mrupdated.r02	248 KB	5/5/2004 03:09:56 PM
mrupdated.r07	248 KB	5/5/2004 02:55:46 PM
mrupdated.r10	258 KB	4/27/2004 10:03:32 AM
mrupdated.r11	255 KB	5/5/2004 03:15:50 PM
mrupdated.r12	2646 KB	5/4/2004 11:17:30 AM
mrupdated.r13	2646 KB	5/4/2004 11:27:06 AM

Total 66 file(s); Size: 55000424 Byte(s)

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Steamboat Springs_Maps, References and Photos\2 Steamboat_References\REP UPDATED HEC-RAS

```
 Directory of I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Steamboat Springs_Maps, References and Photos\2 Steamboat_References\REP UPDATED HEC-RAS

==========================================================================
997023..dxf                 21 KB     9/1/2005 01:30:44 PM
997023.dxf                  25 KB     9/1/2005 01:28:46 PM
C_CREST.dwg                 44 KB     9/2/2005 09:01:36 AM
CREST6941.dwg               45 KB     9/1/2005 04:22:00 PM
FEMA6598.dwg                44 KB     9/1/2005 04:06:56 PM
FEMA6598.dxf                26 KB     9/1/2005 04:06:08 PM
fema7023.dwg                44 KB     9/1/2005 01:39:18 PM
fema7023.dxf                26 KB     9/1/2005 01:38:28 PM
FEMA7360.dwg                43 KB     9/2/2005 09:02:18 AM
FEMA7360.dxf                23 KB     9/2/2005 08:58:30 AM
FEMA7833.dwg                44 KB     9/2/2005 09:02:54 AM
FEMA7833.dxf                23 KB     9/2/2005 08:58:58 AM
final.f01                    9 KB     8/19/2005 09:32:32 AM
final.f04                    9 KB     9/6/2005 12:57:24 PM
final.g01                  328 KB     9/6/2005 04:08:38 PM
final.O01                 1045 KB     8/19/2005 09:32:32 AM
final.O02                 1045 KB     8/19/2005 09:32:32 AM
final.O03                 1024 KB     8/19/2005 09:32:32 AM
final.O04                 1383 KB     9/6/2005 04:04:30 PM
final.p02                    1 KB     8/19/2005 09:32:32 AM
final.p04                    1 KB     9/6/2005 04:08:38 PM
final.prj                    1 KB     9/6/2005 04:08:38 PM
final.r04                  223 KB     9/6/2005 04:03:58 PM
JJ7134.dwg                  54 KB     9/2/2005 09:45:22 AM
JJ7134.dxf                  68 KB     9/2/2005 09:43:00 AM
JJREP7134.dwg               61 KB     9/2/2005 09:45:52 AM
JJREP7134.dxf               96 KB     9/2/2005 09:44:20 AM
PFPlot.dxf                 102 KB     8/29/2005 04:10:26 PM
plot.log                     1 KB     9/2/2005 10:20:30 AM
REP6954.dwg                 43 KB     9/1/2005 03:09:06 PM
REP6954.dxf                 23 KB     9/1/2005 03:05:54 PM
REP7023.dwg                 44 KB     9/1/2005 02:10:58 PM
REP7023.dxf                 26 KB     9/1/2005 02:09:44 PM
REPUPDATE_C_CREST.dxf       25 KB     9/2/2005 09:00:36 AM
REPUPDATE6941.dxf           28 KB     9/1/2005 04:21:16 PM
REPUPDATE6954.dwg           44 KB     9/1/2005 04:19:10 PM
REPUPDATE6954.dxf           25 KB     9/1/2005 04:18:34 PM
repupdate7023.dwg           44 KB     9/1/2005 01:33:02 PM
REPUPDATE7134.dwg           43 KB     9/1/2005 03:08:08 PM
REPUPDATE7134.dxf           24 KB     9/1/2005 03:16:24 PM
X_SECTION_COMP.dwg         200 KB     9/2/2005 10:18:50 AM

Total 41 file(s);  Size: 6602026 Byte(s)
```

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Steamboat Springs_Maps, References and Photos\2 Steamboat_References\REP UPDATED HEC-RAS\JJ TEMP

```
==========================================================================
FEMA_100.dwg                  52 KB     9/2/2005 09:59:26 AM
FEMA_100.dxf                  60 KB     9/2/2005 09:58:14 AM
plot.log                       1 KB     9/6/2005 05:45:50 PM
PROFILE.dwg                 1207 KB     9/6/2005 05:42:50 PM
REP_100.dwg                   53 KB     9/2/2005 11:59:04 AM
REP_100.dxf                   66 KB     9/2/2005 11:58:12 AM
REP-Untouched.dxf            121 KB     9/6/2005 01:31:12 PM
REPUPDATE.dwg                 64 KB     9/2/2005 04:56:38 PM
REPUPDATE.dxf                 98 KB     9/2/2005 04:50:14 PM
REPUPDATE1.dxf                98 KB     9/2/2005 04:55:52 PM

Total 10 file(s);  Size: 1869423 Byte(s)
```

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Steamboat Springs_Maps, References and Photos\3 Steamboat_Site Photos

```
==========================================================
C1.jpg                        793 KB    10/3/2005 12:49:20 PM
C4.jpg                        835 KB    10/4/2005 09:33:50 AM
C5.jpg                        821 KB    10/4/2005 09:34:16 AM
C-Hole 1.jpg                  669 KB     8/6/2004 08:41:12 AM
C-Hole 6.jpg                  915 KB    3/17/2005 11:07:10 AM
C-Hole 7.jpg                  751 KB    3/17/2005 11:07:18 AM
Immed Uptream of C-Hole 1.jpg         726 KB    3/17/2005 11:32:52 AM
Thumbs.db                     228 KB    12/2/2008 04:01:34 PM     hs
Upstream of C-Hole1.jpg             695 KB     8/6/2004 08:41:08 AM

Total 9 file(s);  Size: 6593686 Byte(s)
```

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Vail_Maps, References and Photos

```
====================
Total 0 file(s);  Size: 0 Byte(s)
```

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Vail_Maps, References and Photos\1 Vail_Maps, Aerials, FEMA

```
=========================================
Thumbs.db                     25 KB    12/2/2008 04:01:20 PM     hs
Vail CO Creek.jpg            679 KB   10/29/2007 11:31:58 AM
Vail CO Vincinity.jpg        421 KB   10/29/2007 11:32:02 AM
Vail_FEMA.pdf                293 KB     4/7/2008 11:58:38 AM

Total 4 file(s);  Size: 1453074 Byte(s)
```

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Vail_Maps, References and Photos\2 Vail_References

==========

ApplicationforPECApproval.pdf	607 KB	6/16/2008 09:52:08 AM	
ConstructionStagingPlan.pdf	567 KB	6/16/2008 09:50:50 AM	
FinalPECReviewofProposedModific...	2041 KB	6/16/2008 09:52:34 AM	
FloodplainAnalysis.pdf	1027 KB	6/16/2008 09:51:14 AM	
GoreCreekAvg10YrFlow.pdf	340 KB	6/16/2008 10:02:58 AM	
GoreCreekWParkCirculationandAcc...	3382 KB	6/16/2008 09:49:46 AM	
Helton&WilliamsonVailWPark.pdf	1069 KB	6/16/2008 10:03:16 AM	
PECConsideratioConditionsofInst...	910 KB	6/16/2008 09:51:48 AM	
RICD monthly flow charts 4-03.xls	57 KB	4/27/2008 03:09:02 PM	
SummaryTestimonyGLacy.pdf	1556 KB	6/16/2008 09:50:32 AM	
Town of Vail _ News Release...pdf	71 KB	7/7/2010 01:38:46 PM	a
Vail_ApplicationforSurfaceWater...	3175 KB	6/16/2008 09:53:34 AM	
Vail_Decree.pdf	3040 KB	6/16/2008 09:56:04 AM	
Vail_ExpertWitnessDisclosures.pdf	2505 KB	6/16/2008 09:54:38 AM	
Vail_FindingofFactConclusionsof...	3817 KB	6/16/2008 09:55:20 AM	
Vail_Respondant'sAnswerBrief.pdf	7934 KB	6/16/2008 10:04:38 AM	
Vail_RulingReBreckandERWSDRICD.pdf	1036 KB	6/16/2008 09:59:00 AM	
VailVillageMasterPlanExerpts.pdf	2538 KB	6/16/2008 10:03:46 AM	

Total 18 file(s); Size: 36538501 Byte(s)

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Vail_Maps, References and Photos\3 Vail_Site Photos

==========

Thumbs.db	149 KB	11/23/2009 04:31:38 PM	hs
TMG BX Men.JPG	1081 KB	8/17/2008 11:58:04 PM	
TMG Eric Jackson.JPG	1329 KB	3/16/2008 09:25:16 PM	
TMG Fly Casting 1.JPG	1355 KB	8/17/2008 11:58:04 PM	
TMG Jay 5.JPG	1249 KB	3/16/2008 09:25:16 PM	

Total 5 file(s); Size: 5288162 Byte(s)

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Web Sites

==========

1.mht	187 KB	6/26/2007 10:40:24 AM
American Whitewater - Protect R...	119 KB	6/26/2007 11:34:50 AM
Cedar Valley Paddle Sports Recr...	211 KB	6/25/2007 01:25:08 PM
Cergy.htm	13 KB	7/3/2007 10:25:04 AM
City Of Binghamton.mht	116 KB	6/25/2007 01:41:40 PM
Clay Hole at Cedar Falls, IA.mht	178 KB	6/22/2007 01:38:38 PM
Compagnie Nationale du Rhône.mht	108 KB	7/3/2007 11:32:40 AM
Confederação Brasileira de Cano...	519 KB	6/25/2007 02:27:16 PM
Durango Herald Online.mht	298 KB	6/26/2007 10:32:24 AM
fall2005.pdf	747 KB	6/20/2007 10:57:30 AM
Harvie Passage Calgary Bow Riv...	165 KB	6/25/2007 02:36:44 PM
Holland & Hart LLP.mht	67 KB	6/26/2007 10:51:22 AM
Holtwood Dam - Wikipedia, the f...	318 KB	6/25/2007 01:52:40 PM
Hydrostadium, créateur en eau v...	293 KB	7/3/2007 10:15:40 AM

Hydrostadium, créateur en eau v...	339 KB	7/3/2007 10:19:12 AM
Hydrostadium, white water desig...	138 KB	7/3/2007 10:26:18 AM
Kansas Whitewater.mht	294 KB	6/20/2007 01:35:18 PM
Kayak Yukon News - Rock the Riv...	16 KB	6/28/2007 03:55:10 PM
KnoxNews Columnists.mht	183 KB	6/22/2007 01:51:46 PM
List of Completed Projects.mht	91 KB	6/25/2007 09:43:00 AM
London 2012.mht	84 KB	7/3/2007 01:21:46 PM
Mad Whitewater Parks.mht	7 KB	6/22/2007 04:12:10 PM
Nene Whitewater Centre - Northa...	505 KB	6/22/2007 04:06:04 PM
Ocoee Whitewater Center.mht	121 KB	6/25/2007 01:57:48 PM
Olympian champions water park p...	214 KB	6/25/2007 01:59:52 PM
P E N R I T H W H I T E W A T E...	158 KB	6/25/2007 02:17:48 PM
Paddler Magazine Online The Wa...	220 KB	6/28/2007 03:32:26 PM
Platte River Parkway - Casper W...	146 KB	7/24/2007 02:25:02 PM
Please let me know if I'm missi...	990 KB	6/20/2007 09:24:16 AM
Prague, Troja, River Moldau, Tr...	488 KB	6/25/2007 03:36:38 PM
Public Participation Plan Updat...	92 KB	6/25/2007 02:08:00 PM
RAFTCENTRUM.mht	112 KB	6/25/2007 03:40:38 PM
Sacandaga River Whitewater Raft...	198 KB	6/22/2007 03:13:10 PM
save the gunny park!!!! - Mount...	622 KB	6/25/2007 11:26:20 AM
Stonycreek Whitewater Park.mht	23 KB	6/22/2007 03:31:34 PM
Surfline Forums - Waveyard To B...	246 KB	6/25/2007 09:20:02 AM
Team Dirt Clod Forums View top...	88 KB	6/22/2007 03:00:16 PM
Team Dirt Clod Forums View top...	148 KB	6/22/2007 02:59:52 PM
Team Dirt Clod Forums View top...	151 KB	6/22/2007 03:00:36 PM
Tees Canoe Course.mht	233 KB	6/25/2007 03:46:28 PM
Unsponsored_co_uk - National Wa...	120 KB	7/3/2007 01:30:16 PM
Welcome to Whitewater Warehouse...	739 KB	6/22/2007 01:39:50 PM
Whitewater Ontario.mht	154 KB	6/25/2007 02:38:50 PM

Total 43 file(s); Size: 10526609 Byte(s)

I:\1 MWDG Active Jobs\CWCB - Course Evaluation\final report\Enclosed DVD\Web Sites\Cergy_files
==============================

cergy.jpg	35 KB	7/3/2007 10:08:38 AM
cergy1.jpg	21 KB	7/3/2007 10:16:54 AM
cergy2.jpg	9 KB	7/3/2007 10:16:54 AM
cergy3.jpg	11 KB	7/3/2007 10:23:44 AM
cergy4.jpg	23 KB	7/3/2007 10:23:44 AM
logo.gif	3 KB	7/3/2007 10:23:16 AM
mission.jpg	21 KB	7/3/2007 10:08:38 AM
obstaclesmob.jpg	10 KB	7/3/2007 10:23:16 AM
phpmyvisites.js	2 KB	7/3/2007 10:08:38 AM
pratiquantraft.jpg	18 KB	7/3/2007 10:23:16 AM
style.css	1 KB	7/3/2007 10:25:04 AM

Total 11 file(s); Size: 162853 Byte(s)

^^

Total 66 folder(s); 728 file(s)

Total files size: 1404 MB; 1404441 KB; 1438147098 Bytes