Cañon City River Improvement Master Plan

Cañon City, Colorado

October 10, 2016

Authorized by:

Eastern Fremont County Trails, Open Space and River Corridor Master Plan

Prepared for:

Whitewater Kayak & Recreation Park Committee
Cañon City, Colorado 81212

Prepared by:

Nathan Werner, P.E., CFM
S2o Design and Engineering
318 McConnell Drive
Lyons, CO, 80540

Introduction:

There is interest in Cañon City, Colorado, to expand on the existing river park that will function as a community riverside park and that will beautify the river corridor, stabilize the streambanks, and enhance the venue for rafting, whitewater kayaking (slalom and freestyle), tubing and other healthy, active, outdoor recreational activities. River sports are some of the fastest growing sports in America and there is a growing trend among many towns and cities to create these parks in their own backyards. River parks, often surrounded by trails and recreational areas, not only achieve their original goal of attracting paddle sports enthusiasts, but often exceed these expectations by becoming focal points of their communities and destinations for outdoor recreation-based tourism from throughout the region. These parks often play host to major events centered on slalom or freestyle competitions or to community celebrations such as the Royal Gorge Whitewater Festival. In addition, river parks can have a significant economic impact on the local community as visitors spend money at local restaurants, hotels, and retail establishments. Some cities, like Golden, Colorado and Reno, Nevada, have reported impacts on the local economy from tourism generated by the park on the order of millions of dollars per year.

The Whitewater Kayak and Recreation Park Committee have commissioned a study to develop a river corridor master plan for the reach of the Arkansas River from Pink House to 9th Street in Cañon City, Colorado. This detailed master plan was proposed in the Eastern Fremont County Trails, Open Space and River Corridor Master Plan as the next design step. The studied reach was previously agreed to be whitewater focused with Colorado Parks and Wildlife during the development of the existing whitewater features near Centennial Park. This study will begin the process of conceptualizing possible design solutions that meet project objectives to enhance whitewater recreation, fish habitat and stream beautification. This report summarizes the findings of that study.

Project Objectives

Project goals and objectives of this feasibility study are defined as follows:

1. **Recreation Enhancement –** Recreational improvements will enhance the river experience for both city visitors and members of the local community. Instream enhancements will provide for a safe and enjoyable river experience for rafters, kayakers and tubers; creating a valuable city attraction. While river bank enhancements such as a connected trail system and open plan areas provide a relaxing out of water river experience
2. **Beautification of the River Corridor –** Following earlier construction work, large quantities of concrete rubble and debris are present throughout the proposed project area. Debris removal and restoring the area's ecosystem will aid in creating a thriving natural river and visually appealing parkland for all public users.
3. **Habitat Restoration –** As part of the proposed project work, instream developments will provide valuable habitat for fisheries. Boulders tactfully installed as velocity barriers will aid in creation of fish habitat and holding areas, while riffles and pools along current seams provide ample habitat opportunities for fish stock. By creating a multistage channel with stepped banks, riparian vegetation can be restored, providing critical habitat for macro-invertebrates, further enhancing fish ecological benefits and angling opportunities through Cañon City.

Section 1: Site Information

This study is focused on the reach of the Arkansas River through Cañon City from Pink House Recreation Area to 9th Street. Pink House is an Arkansas River Headwaters Recreations Area (AHRA) managed river access that functions as a takeout for the Royal Gorge or a put-in for the town run. The downstream boundary of the study is the 9th Street Bridge as a result of a previous agreement with Colorado Parks and Wildlife to keep river recreation improvements upstream of 9th Street.

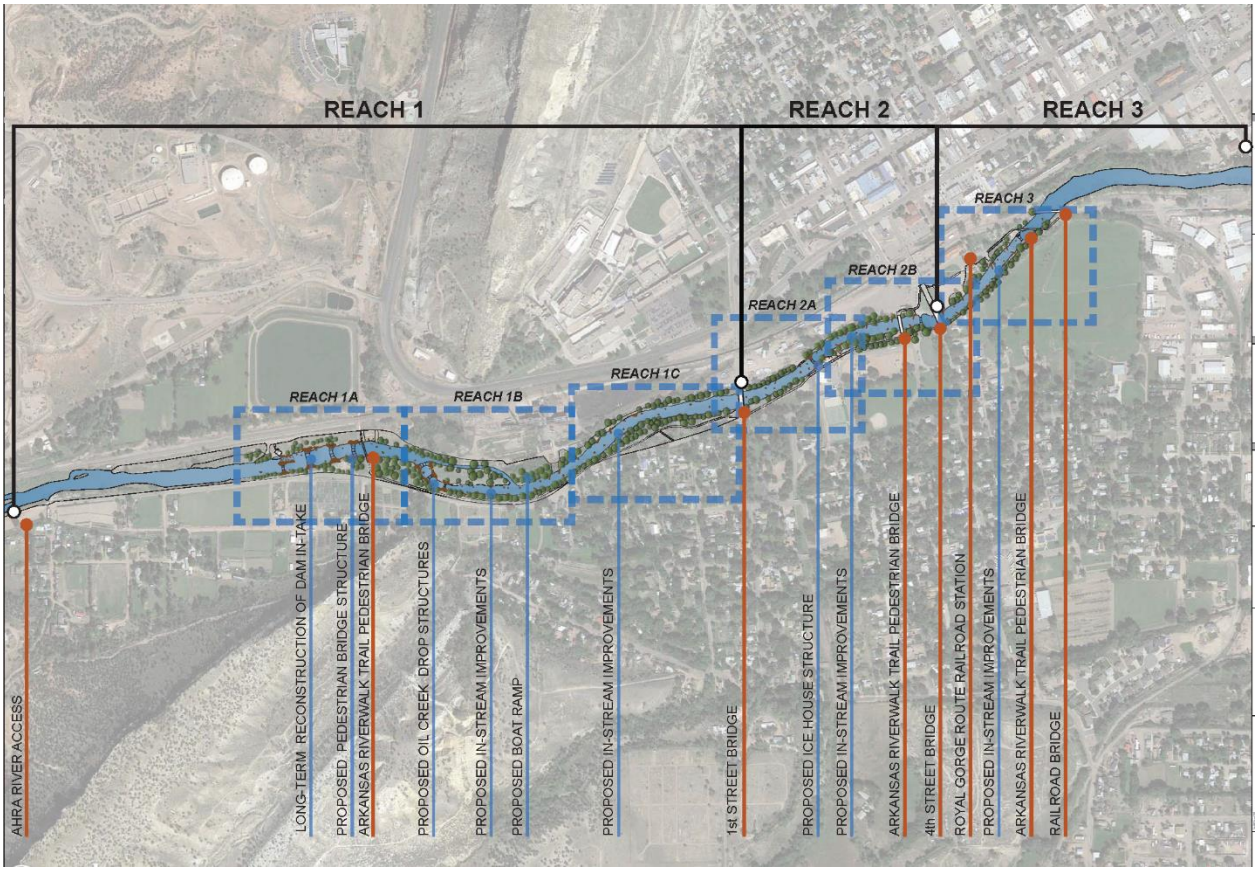

Figure 1: An overview of the proposed project area

As shown in Figure 1, the project area has been broken into three reaches. Reach 1 is from Pink House to 1st Street, Reach 2 is from 1st Street to 4th Street, and Reach 3 is from 4th Street to 9th Street.

Areas within each reach will be planned for and prioritized through this study. Reach 2 was identified as the highest priority with the goal of establishing a competition slalom course while also providing additional benefits for the ecology and visual appeal of the river corridor. Reach 1 was identified as the next priority, with long term planning for additional whitewater structures to be installed from the existing Cañon City Water Intake Facility to downstream of the Oil Creek Ditch Diversion. Reach 3 was identified as the lowest priority, with only minor instream improvements proposed to provide character to the river, velocity barriers and streambank stabilization. These priorities are relative and general in assignment. If a project in Reach 3 is feasible to be implemented prior to a higher priority project, as determined by this study, it should not be delayed based on the assigned priority.

Cañon City

Cañon City is located in southern Colorado along the Arkansas River. It is the county seat of Fremont Count and has a population of 16,337 people in 2014 (US Census Bureau, Canon City, Colorado, 2016). Cañon City originated during the Pike's Peak Gold Rush and was intended as a commercial center for mining.

Currently the largest employer in Cañon City is the Colorado Department of Corrections. There are several prisons in Cañon City and the surrounding area. Additionally, tourism related to the Royal Gorge is a principal economic driver for the City.

Figure 2 illustrates the location of the Cañon City within the State of Colorado.

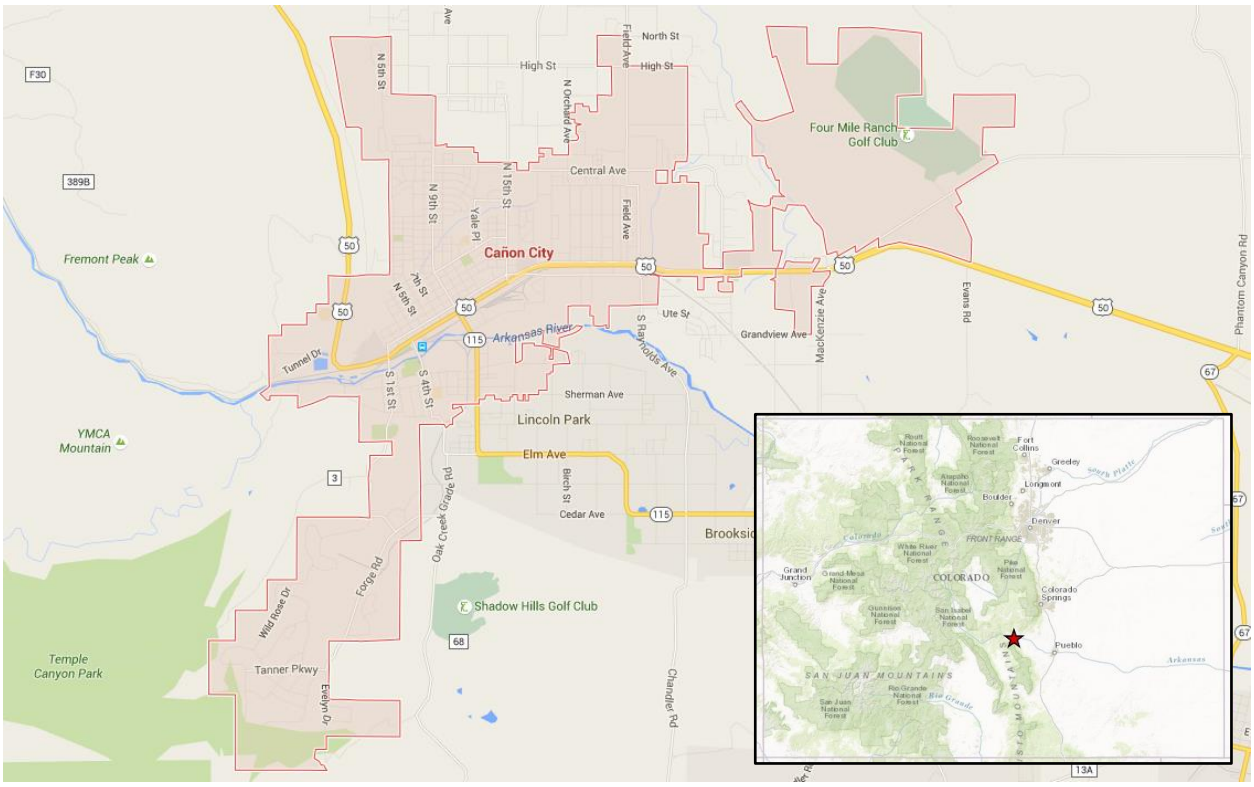

Figure 2: Location Map for Cañon City, CO

Hydrology

The Arkansas River flows through Cañon City and has a predictable flow rate year round. The flow is dominated by a snowmelt spring runoff, but also has significant influence from water storage and augmentation. Since the timing and magnitude of available flows are key factors in the overall potential of a river park, the hydrology of the project sites has been analyzed to identify target flow rates for each site that balance both the magnitude and duration of the recreational experiences sought.

The United States Geological Survey (USGS) operates a stream gage that collects flow data every fifteen minutes in Cañon City. The stream gage has records for stream flow starting in 1888. This is a substantial period of gage data that is well representative of flow characteristics of the Arkansas River in Cañon City. Over that period of time the human influence has altered the flow regime through the construction of large reservoirs and trans-basin diversion systems. This human influence has attenuated high flows

through the routing of water through reservoirs, as well as artificially increased flows during historic periods of low flow. The average monthly flow for this reach is shown in Figure 3.

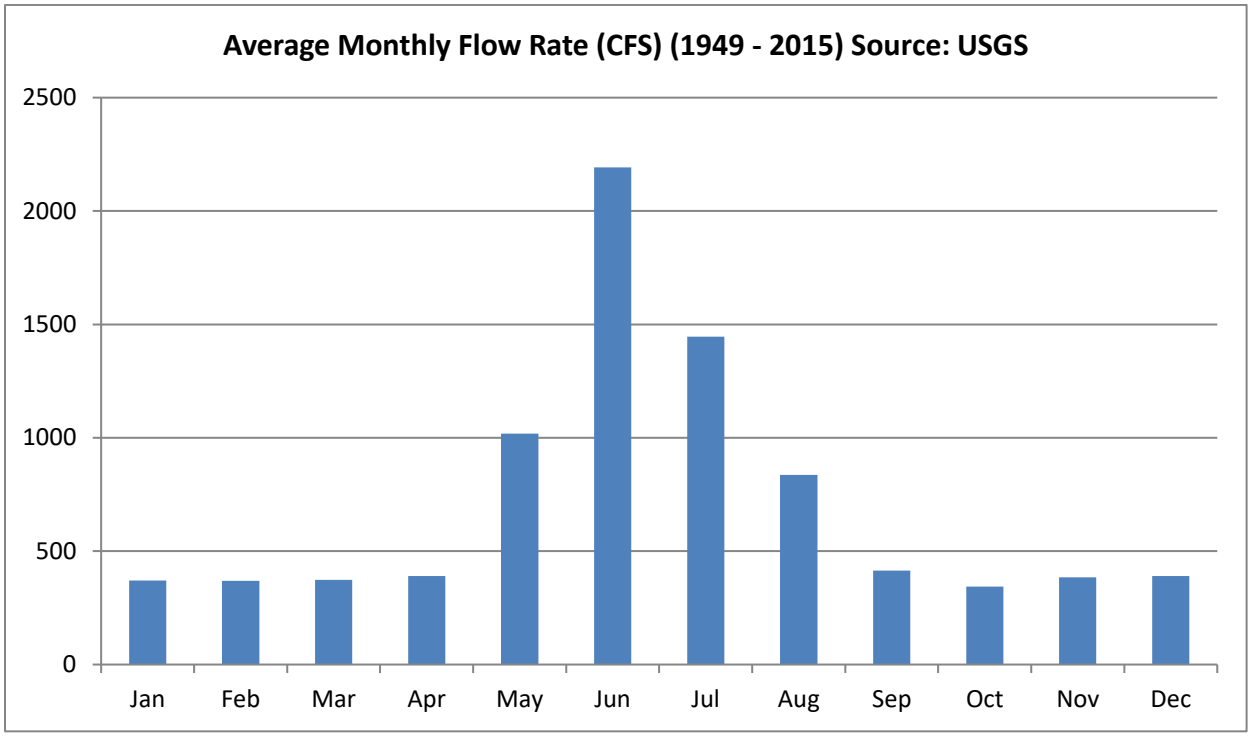

Figure 3: Average monthly flow rate for the Arkansas River through Cañon City (United States Geological Survey, 2016)

To characterize stream gaging data the mean daily flows was selected. Mean daily flows are used to describe the central tendency of the hydrology of a potential site. An analysis of the hydrograph at the site reveals average low flows of roughly 350-400 cfs, spring and fall flows of 800 to 1400 cfs, and average high flows of more than 2,000 cfs.

In snowmelt dominated streams in Colorado it is typical for flow rates to ramp up to a peak flow then decrease all within a matter of weeks. The peak flow rate in Cañon City is typically between 2,500 and 5,000 cfs as shown in Figure 4.

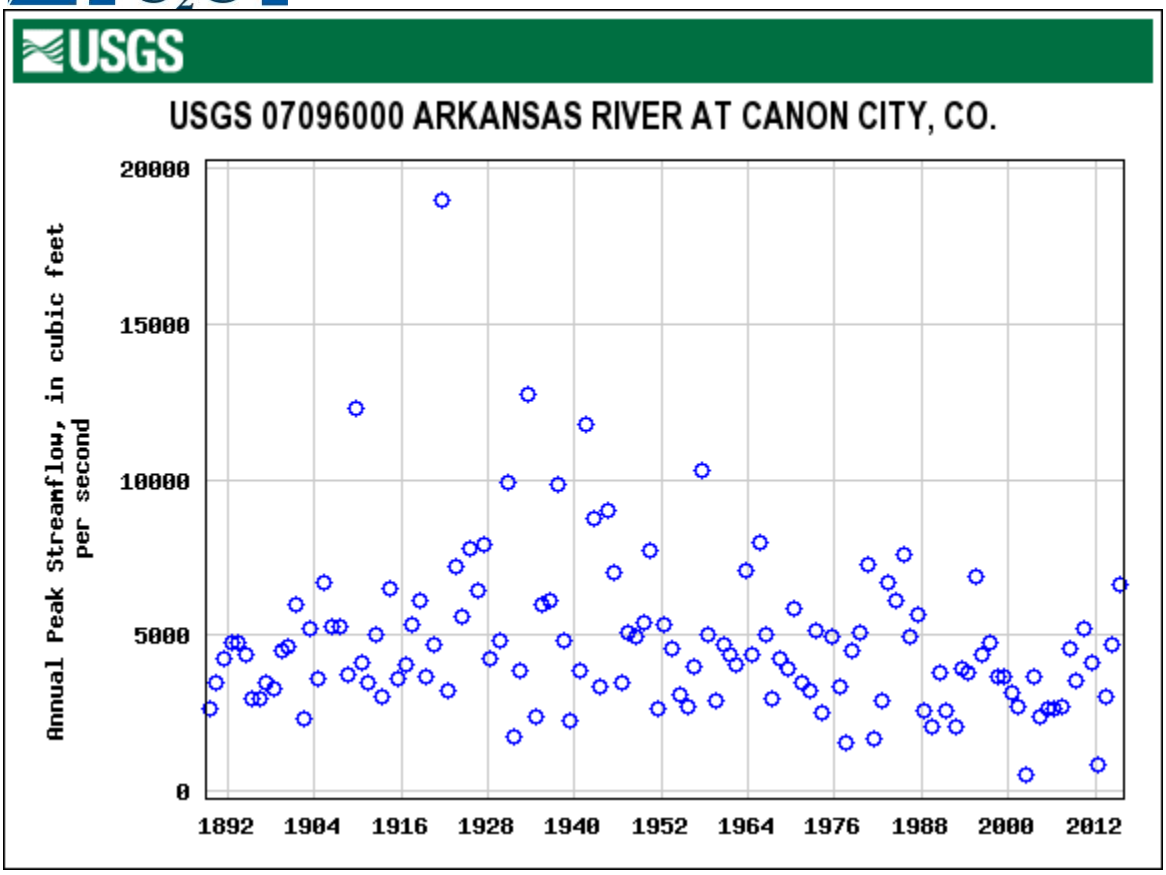

Figure 4 Peak Flows for the Arkansas River through Cañon City (United States Geological Survey, 2016)

In comparison to the majority of recreational river improvements in existence today, the typical flow rates of this site are at the higher end of the spectrum. In general, river improvements typically provide a competition-level whitewater experience, in a comparable river channel, at flows approaching 1,000 cfs or greater. This places the proposed river improvements in an excellent position to provide high level whitewater opportunities for a range of experience, catering from beginners to high level competitive athletes. The statistical analysis above is intended to describe anticipated typical conditions; however, it does not explicitly describe annual or even seasonal peak flows at the project site. These more fleeting high flows can be expected less often during more extreme rainfall events. During these periods the recreational experiences of the river parks will increase substantially, offering high level competition whitewater for the duration of the runoff event. Though expert level whitewater may only be available for three to four months each year, recreational opportunities including surfing, spinning, rec paddling, tubing, slalom, skills training, as well as paddle-through recreation will still be available throughout the year to varying degrees at the project site.

Flooding

The Fremont County Flood Insurance Study (FIS) was reissued on July 3, 2012 to reflect revised and updated Flood Insurance Rate Maps (FIRM) for Fremont County, Colorado: including the independent City of Cañon City (Federal Emergency Management Agency, 2012). Flooding within the City of Cañon City is principally based around the Arkansas River floodplain. There is a substantial amount of infrastructure

present in the 100 year floodplain, with several parcels owned by the City of Cañon City as well as numerous residential parcels. The extent of inundation is shown in Figure 5.

Figure 5: 100 Year flood extent of inundation through Cañon City (Fremont County, 2016)

According to the FIS the 1% annual chance floods (100 year flood) for the project site location is 20,500cfs in the Arkansas River in Cañon City. Proposed changes to the existing channel geometries will require coordination with FEMA to either demonstrate no-rise to the effective Base Flood Elevations (BFE) or to revise FIRMs to reflect changes in 100 year flooding before and following construction activities. A table of regulatory flow rates is shown in Table 1.

Table 1: Regulatory flood rates for the Arkansas River in Cañon City (Federal Emergency Management Agency, 2012)

REGULATORY FLOOD RATES FOR THE ARKANSAS RIVER AT CANON CITY	
ARI	FLOW RATE (CFS)
10 Year	8850
50 Year	16500
100 Year	20500
500 Year	32200

Flood Impacts

All Whitewater Parks are constructed to meet all Federal, State, and Local flood codes and are designed using flood modeling software approved by the US Army Corps of Engineers. These river parks can typically be designed to a “no-rise” condition, which ensures no impact during the 1% chance annual flood (100 year flood) to neighboring properties or changes to existing flood hazard zoning and associated flood insurance requirements. This condition requires that proposed changes within 100 year floodplain create no net increase in modeled water surface elevations during the 100 year base flood. Base Flood Elevations (BFE) are used to define effective water surface elevations at sites where detailed flood studies have been performed.

A requirement of the National Flood Insurance Program is that a proposed project can create no-net-negative-impact to insurable structures. This requirement is particularly robust in the regulatory floodway.

The configuration of this site substantiates the need for a project designed to meet a no-rise requirement. A challenge in design of recreational river enchantments is to find a design that focuses flows and energy at lower flows (by consolidating drop at average flows) but that does not cause a rise at higher flows.

Figure 6 shows the regulatory floodway, 100 and 500 year floodplain, calculated BFEs, and associated flood hazard zoning in Reach 2. The yellow hatched area represents the floodway, the darker blue shaded area labeled zone AE represents the 100 year floodplain and the light blue shaded area is the 500 year floodplain.

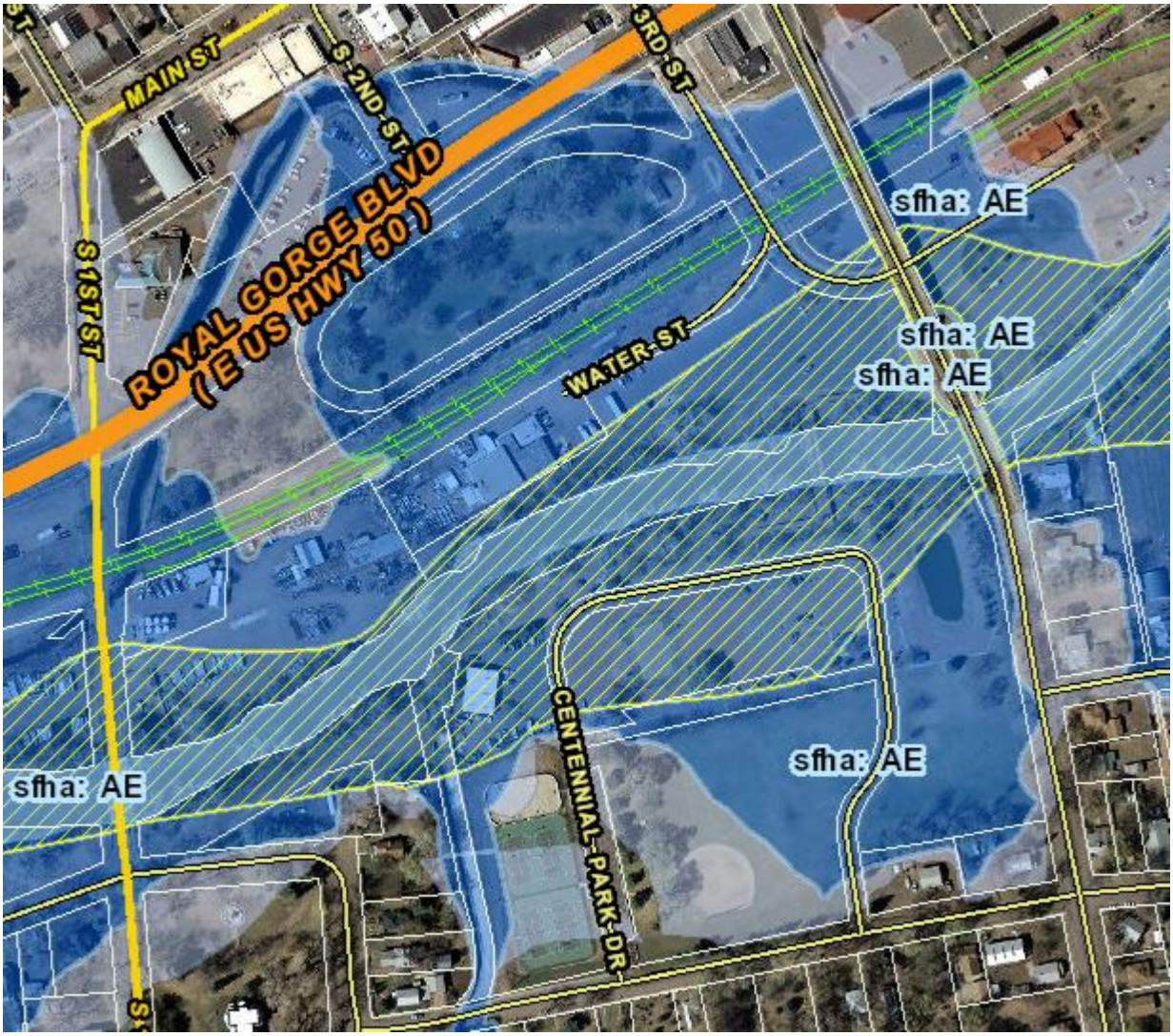

Figure 6: FEMA Flood Hazard Mapping for the Reach 2 project site (Fremont County, 2016)

The floodplain at this site is extensive with an active floodway mapped that is well outside the typical riverbed and crosses US Highway 50. There are numerous residential and commercial structures that are

currently found within the 100 year floodplain. Improvements at this site are limited to those improvements that can be implemented with no net negative impact to the 100 year floodplain.

Historic Structures in Cañon City

Cañon City was established in 1860 as a supply center for the nearby mining camps located further in the mountains. Cañon City's important role in the mining development of Colorado was further enhanced when linked to the Denver and Rio Grande Railroads. Resulting from this, there are numerous historic sites in the Cañon City Downtown Historic District which, along with the famous suspension bridge across the Royal Gorge, attract substantial tourist numbers to Cañon City every year.

A preliminary review of the areas surrounding the proposed project site, for historic properties listed on the National Register of Historic Places, was conducted using the National Park Services geospatial dataset (National Park Service , 2015). A map describing the location of the project site relative to the two properties list on the National Historic Register is provided in Figure 7.

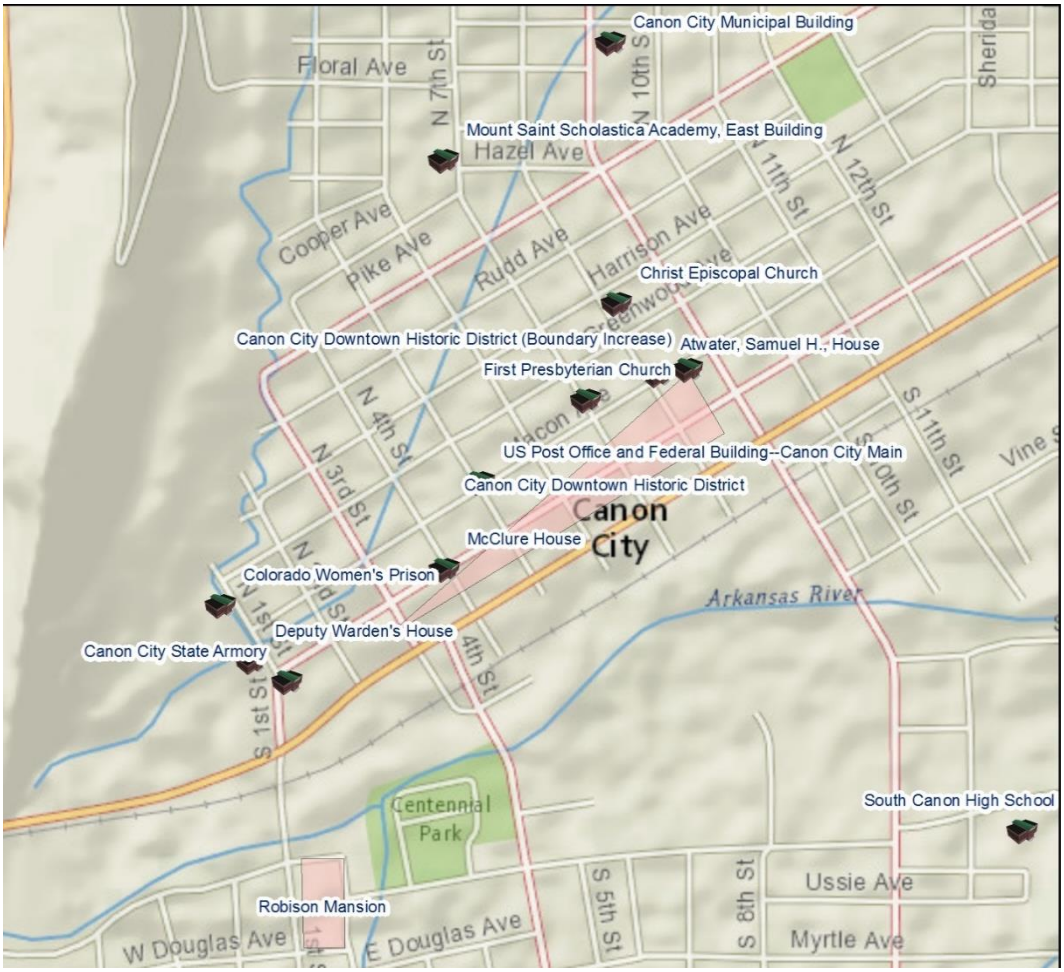

Figure 7: Map showing approximate location of historic structures and areas

A complete archeological assessment of all of the proposed project sites, to determine impacts to listed and eligible sites on the National Register of Historic Places, may be required prior to receiving 404 authorization to build the river enhancements. Though this assessment typically has little impact on in-

channel river parks, the project owner should be aware of this requirement as it could result in significant delays and/or costs to a potential project if impacts to historical or culturally significant resources are identified.

Protected Species

Within the project reach there are three species listed on the threatened and endangered species list. There are also several list migratory birds. All federally listed species identified within the immediate project areas, as described by the U.S. Fish and Wildlife Service, are shown in Table 2.

Table 2: Listed species within the project areas of Cañon City.

Group	Common Name	Scientific Name	Status
Birds	Mexican Spotted Owl	Strix occidentalis lucida	Threatened
Fishes	Arkansas Darter	Etheostoma cragini	Candidate
Mammals	Canada Lynx	Lynx canadensis	Threatened
Migratory Birds	American Bittern	Botaurus lentiginosus	Bird of conservation concern
Migratory Birds	Bald Eagle	Haliaeetus leucocephalus	Bird of conservation concern
Migratory Birds	Black Rosy-finch	Leucosticte atrata	Bird of conservation concern
Migratory Birds	Brewer's Sparrow	Spizella breweri	Bird of conservation concern
Migratory Birds	Brown-capped Rosy-finch	Leucosticte australis	Bird of conservation concern
Migratory Birds	Burrowing Owl	Athene cunicularia	Bird of conservation concern
Migratory Birds	Cassin's Finch	Carpodacus cassinii	Bird of conservation concern
Migratory Birds	Ferruginous Hawk	Buteo regalis	Bird of conservation concern
Migratory Birds	Flammulated Owl	Otus flammeolus	Bird of conservation concern
Migratory Birds	Golden Eagle	Aquila chrysaetos	Bird of conservation concern
Migratory Birds	Juniper Titmouse	Baeolophus ridgwayi	Bird of conservation concern
Migratory Birds	Lewis's Woodpecker	Melanerpes lewis	Bird of conservation concern
Migratory Birds	Loggerhead Shrike	Lanius ludovicianus	Bird of conservation concern
Migratory Birds	Long-billed Curlew	Numenius americanus	Bird of conservation concern
Migratory Birds	Mountain Plover	Charadrius montanus	Bird of conservation concern
Migratory Birds	Olive-sided Flycatcher	Contopus cooperi	Bird of conservation concern
Migratory Birds	Peregrine Falcon	Falco peregrinus	Bird of conservation concern
Migratory Birds	Pinyon Jay	Gymnorhinus cyanocephalus	Bird of conservation concern
Migratory Birds	Prairie Falcon	Falco mexicanus	Bird of conservation concern
Migratory Birds	Sage Thrasher	Oreoscoptes montanus	Bird of conservation concern
Migratory Birds	Short-eared Owl	Asio flammeus	Bird of conservation concern
Migratory Birds	Snowy Plover	Charadrius alexandrinus	Bird of conservation concern
Migratory Birds	Swainson's Hawk	Buteo swainsoni	Bird of conservation concern
Migratory Birds	Veery	Catharus fuscescens	Bird of conservation concern
Migratory Birds	Virginia's Warbler	Vermivora virginiae	Bird of conservation concern
Migratory Birds	Western Grebe	aechmophorus occidentalis	Bird of conservation concern
Migratory Birds	Williamson's Sapsucker	Sphyrapicus thyroideus	Bird of conservation concern
Migratory Birds	Willow Flycatcher	Empidonax traillii	Bird of conservation concern

Additional assessments of the sites and impacts to these species may need to be conducted during the preliminary design/permitting stages of the project. Additional consultation with the U.S. Fish and Wildlife

Service is anticipated once the final project sites are selected to ensure that they do not include known populations or critical habitat for federally listed species and/or additional species of concern within the project areas. If critical habitats are identified, the project will need to work with Fish and Wildlife to determine if the project, in design or implementation, can minimize impacts in an acceptable manner.

Typical Economic Impacts of River Parks

The economic impacts of the proposed parks could have a significant impact on decision maker's choice in funding a particular park. Many river parks, built in similar towns and settings throughout the United States, have become significant tourist attractions. These parks bring enthusiasts and spectators alike to their respective communities, and create measurable economic impacts through increased property values, direct spending at the site, and tourism dollars spent at local restaurants, hotels, and businesses. The area can attract tourists and generate total economic impacts on the order of hundreds of thousands of dollars per year. Instream river parks located in Colorado have had impacts as high as $7-9 million dollars per year. Table 3 illustrates some typical economic impacts of these parks:

Table 3. Economic Impacts of River Parks (per year in US Dollars) (Multiple sources)

Economic Impacts of River Parks

River	Location	User Days	Additional Spending	Total Impacts (Millions)
Clear Creek	Golden, CO	13,000-14,000	$910,000-$1.1 Million	$1.3-2.2 Million
Blue River	Breckenridge, CO	1,200-2,300	$220,000-$460,000	$0.4-$1.1 Million
Gore Creek	Vail, CO	1000-2,300	$3.5 Million	$3.5-$4 Million
Sacandaga River	Saratoga/Warren County, NY	17,600-25,400	$1.8-$2.8 Million	$2.3-$3.7 Million
Cuyahoga River	Kent, OH	10,000-40,000	$200,000-$800,000	$0.5-$1.7 Million
Yampa River	Steamboat Springs, CO	75,700	$4.9 Million	$7.2 Million

The impacts of these parks are diverse and are based on regular usage of the River Park, as well as instructional programs, competitions, festivals, and other recreational events. Freestyle events like those that occur weekly in Colorado during spring runoff, can bring millions of dollars into the local economy on a single weekend alone. For example, the GoPro games in Vail, CO reported an economic impact of $4.7 million dollars in 2013 (Wong, 2014). In addition to creating economic impacts, these events also help to market a particular community as an outdoor town and whitewater destination.

Project Site Locations

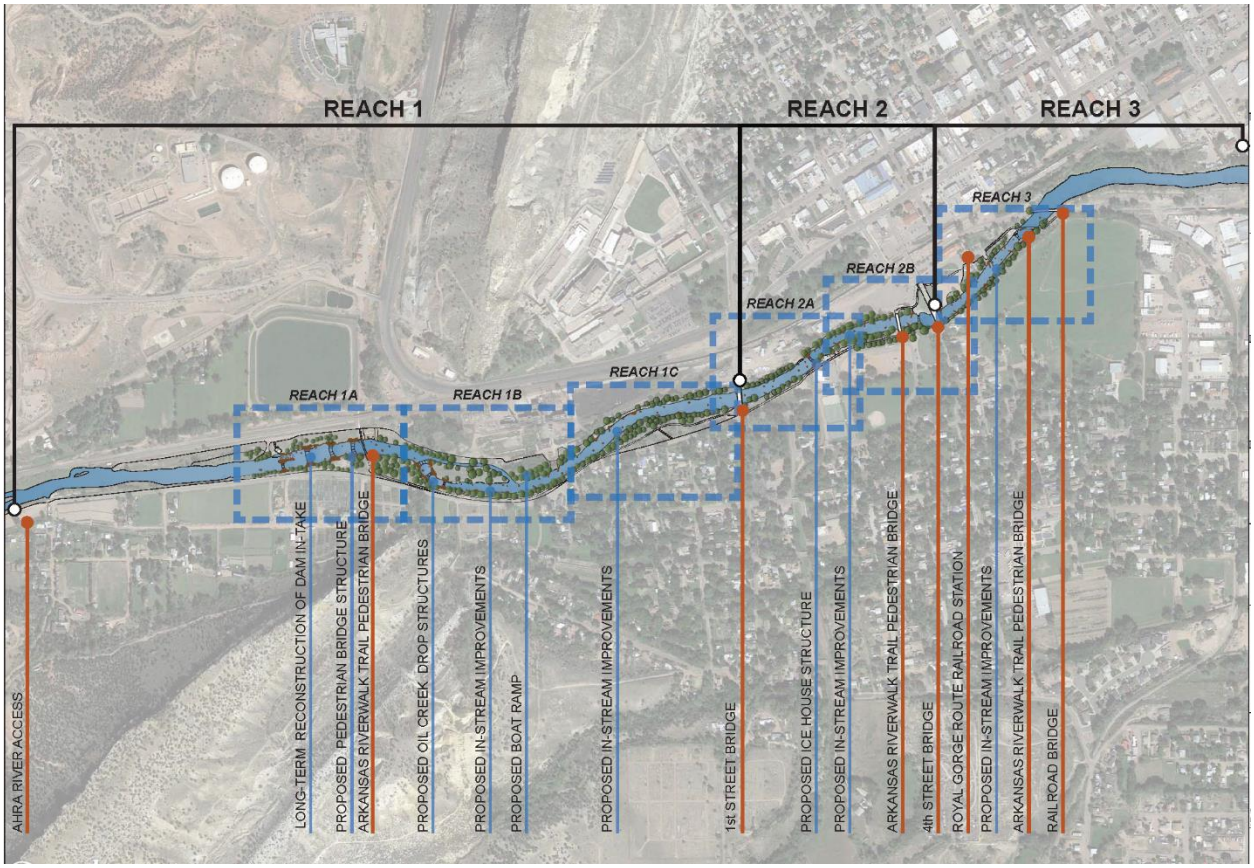

Figure 8: Proposed project locations in Cañon City, Colorado

The project location extends from the Pink House river access at the upstream boundary and 9th Street as the downstream boundary. The project has been split into three reaches, then within each of the three reaches opportunities have been identified and prioritized. Reach 1 extends from Pink House to 1st Street, Reach 2 extends from 1st Street to 4th Street, and Reach 3 extends from 4th Street to 9th Street. A prior agreement with Colorado Parks and Wildlife determined this reach to be highlighted for instream river recreation, while the downstream reach has been highlighted for fish habitat improvements. While the project reach is being highlighted for instream recreation, the improvements will also be targeting multipurpose goals including fish habitat and streambank stabilization.

The reaches within the project area have been analyzed to prioritize the improvements proposed. These prioritizations have been determined based on location, ease of implementation, cost of implementation, need of improvements and stream characteristics. While this study focused on the reaches defined above, recreational enhancements should also be considered for river projects in the region that do not fall within these reaches. Reconstruction of diversion structures should be considerate of downstream recreational passage, in particular, the reconstruction of the Hydraulic Ditch Diversion upstream of Reach 1 is in a reach that experiences high usage by instream users. This usage includes commercial rafting trips through the Royal Gorge that have a significant economic impact to the region.

Figure 9: Reach 1 of the project site

Existing Conditions

Reach 1 is located between the existing river access point used by the Arkansas Headwaters Recreation Area (AHRA) at Pink House and the 1st Street Bridge. Within Reach 1 there are two diversion dams, one being the Cañon City municipal water intake and the other being the Oil Creek Ditch Diversion. The reach is characterized by a uniform channel that has little to no instream diversity. There are no boulders within the reach to provide velocity barriers and complexity to the reach and the streambanks are generally steep with little vegetation. This section has many areas that would benefit from bank improvements for aesthetics and safety. The old Black Hills Plant water intake and the metal skirting on the north bank are unsightly and dangerous. There are also numerous areas of dumped concrete on both banks.

The Cañon City municipal water intake is a concrete low head dam approximately six feet tall. There has been a boat chute installed on the north, river left side of the structure for recreational passage. There is signage directing floaters into the boat chutes in the reach upstream of the intake structure.

In the reach in between the Cañon City municipal water intake and the Oil Creek Diversion Dam there is a pedestrian bridge that crosses the river and several volunteer trails along the river banks. The pedestrian bridge is a part of the Arkansas Riverwalk Trail that extends downstream from this bridge through the entire project area on the south river bank.

At the Oil Creek Ditch Diversion there is a rock and gravel pushup dam that needs annual maintenance to ensure the ditch company can divert water out of the north side of the river. This pushup dam has been a concern locally for instream recreation and has been considered through the Eastern Fremont County Trails, Open Space and River Corridor Master Plan for replacement with permanent structures to reduce potential hazards. This diversion dam is a high priority site within Reach 1, as identified in the Eastern Fremont County Trails, Open Space and River Corridor Master Plan.

Downstream of the Oil Creek Diversion the river makes a hard turn and flows adjacent to Riverside Avenue and the Arkansas Riverwalk Trail. In this area down to the 1st Street Bridge there has been rock armoring installed along the south bank for protection. There are several areas within this armoring where the rocks have settled and in one area near the upstream extent of the armoring the rock protection has failed. The north bank through this reach has several areas of concrete waste dumped along the banks for streambank stabilization.

Land Ownership

Land ownership along Reach 1 varies between public and private ownership. In Reach 1A, the northern bank is owned by the City of Cañon City at the Cañon City Municipal Water Intake, whereas the south bank is privately owned by Edwin Carmelo. This property layout indicates any construction access will have to be based from the northern bank, and will require written consent from the property owner or acquisition of property should any river improvements be performed on this section of river

In Reach 1B, the City of Cañon City owns the southern bank, whereas the Black Hills Corporation owns the northern bank and the island formed by the Oil Creek Ditch and the Arkansas River. As the proposed conceptual design involves the reconfiguration of the Oil Creek Ditch diversion structure, a partnership with all land owners will be necessary to implement any improvements. Figure 10 shows the regions of land owned by the City of Cañon City on Reach 1. At the time of this study, the City has a motivated interest in acquiring the Black Hills Corporation property.

Figure 10: Blue shading indicates the properties owned by the City of Cañon City.

Reach 1 Conceptual Design

Within Reach 1 there are three project areas of differing priority. Reach 1A; stretching from Pink House to the Arkansas Riverwalk Trail Pedestrian Bridge, Reach 1B; from the Oil Creek Diversion ditch to downstream of the proposed boat ramp, and Reach 1C; from the proposed boat ramp to the 1st Street Bridge.

Reach 1A

Reach 1A contains three structures that are currently part of a long term planning concept which could be considered by the city when the existing water intake structure reaches the end of its design life. On the more immediate term, a drop structure upstream of the pedestrian bridge can be considered a higher priority as it does not require the replacement of the water intake structure. Its location just upstream of the pedestrian bridge is an ideal location for spectating and the stream characteristics of this reach could potentially provide ample recreational opportunities.

Any improvement conducted in this reach would incorporate habitat enhancement boulders, bank stabilization structures and removal of existing rubble and debris from the river.

The proposed improvements for Reach 1A are shown in Figure 11.

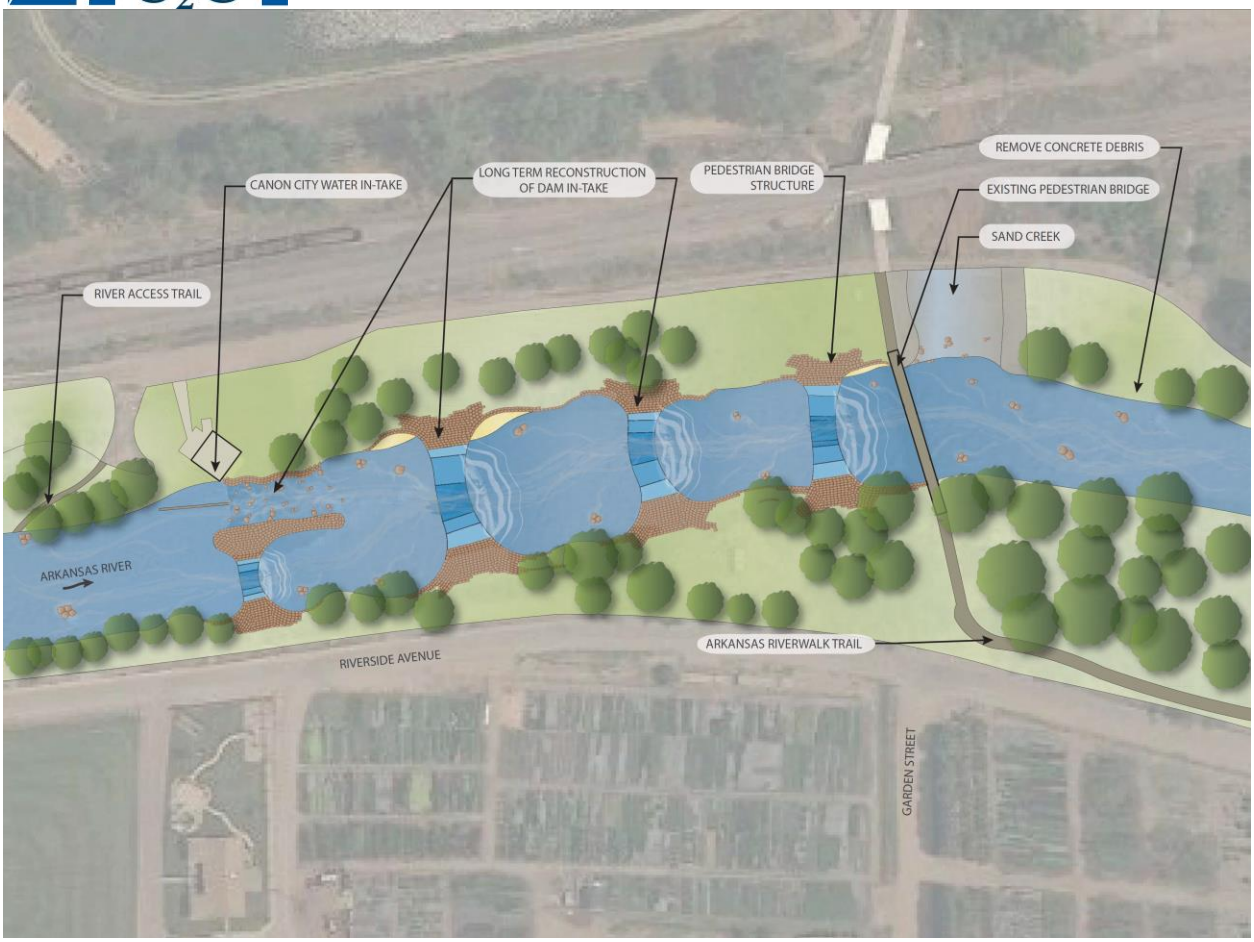

Figure 11: The conceptual design for the Reach 1A

Table 4: Opinion of Probable Cost of Reach 1A

Project: Canon City River Improvement Master Plan
Issue Date: 10/10/2016
Developed By: NW, JR

Reach 1A: Estimated Construction Costs

Description	Quantity	Unit	Unit Cost	Item Total Cost
Site Setup				
Traffic Control	1.0	LS	$ 5,000.00	$ 5,000.00
Install & Maintain Best Management Practices	1.0	LS	$ 5,000.00	$ 5,000.00
Opperate & Maintain Water Control	1.0	LS	$ 30,000.00	$ 30,000.00
Debris Removal and Disposal	1.0	LS	$ 25,000.00	$ 25,000.00
Demoliton of Existing Diversion Dam	1.0	LS	$ 75,000.00	$ 75,000.00
Water Intake Structure 1				
Install Equipment Access Ramps & Roads	2.0	EA	$ 1,500.00	$ 3,000.00
Reclaim Equipment Access Ramps, Roads, & Staging Areas	2.0	EA	$ 2,500.00	$ 5,000.00
Furnish & Install Boulder (Avg 36" B Axis)	933	Tons	$ 50.00	$ 46,650.00
Furnish & Install Riprap Armoring (Type VH)	70	CY	$ 50.00	$ 3,500.00
Furnish & Install Riprap Armoring (Type H)	87	CY	$ 50.00	$ 4,350.00
Excavate & Grade Native Alluvium	1250	CY	$ 20.00	$ 25,000.00
Furnish & Install Bedding Material	200	CY	$ 35.00	$ 7,000.00
Furnish & Install Mirafi 180n Filter Fabric	700	SY	$ 4.00	$ 2,800.00
Furnish & Install Concrete Grout	35	CY	$ 650.00	$ 22,750.00
Unclassified Hauloff	1050	CY	$ 20.00	$ 21,000.00
Water Intake Structure 2				
Install Equipment Access Ramps & Roads	2.0	EA	$ 1,500.00	$ 3,000.00
Reclaim Equipment Access Ramps, Roads, & Staging Areas	2.0	EA	$ 2,500.00	$ 5,000.00
Furnish & Install Boulder (Avg 36" B Axis)	1700	Tons	$ 50.00	$ 85,000.00
Furnish & Install Riprap Armoring (Type VH)	70	CY	$ 50.00	$ 3,500.00
Furnish & Install Riprap Armoring (Type H)	87	CY	$ 50.00	$ 4,350.00
Excavate & Grade Native Alluvium	1250	CY	$ 20.00	$ 25,000.00
Furnish & Install Bedding Material	200	CY	$ 35.00	$ 7,000.00
Furnish & Install Mirafi 180n Filter Fabric	700	SY	$ 4.00	$ 2,800.00
Furnish & Install Concrete Grout	35	CY	$ 650.00	$ 22,750.00
Unclassified Hauloff	1050	CY	$ 20.00	$ 21,000.00
Water Intake Structure 3				
Install Equipment Access Ramps & Roads	2.0	EA	$ 1,500.00	$ 3,000.00
Reclaim Equipment Access Ramps, Roads, & Staging Areas	2.0	EA	$ 2,500.00	$ 5,000.00
Furnish & Install Boulder (Avg 36" B Axis)	1650	Tons	$ 50.00	$ 82,500.00
Furnish & Install Riprap Armoring (Type VH)	70	CY	$ 50.00	$ 3,500.00
Furnish & Install Riprap Armoring (Type H)	87	CY	$ 50.00	$ 4,350.00
Excavate & Grade Native Alluvium	1250	CY	$ 20.00	$ 25,000.00
Furnish & Install Bedding Material	200	CY	$ 35.00	$ 7,000.00
Furnish & Install Mirafi 180n Filter Fabric	700	SY	$ 4.00	$ 2,800.00
Furnish & Install Concrete Grout	35	CY	$ 650.00	$ 22,750.00
Unclassified Hauloff	1050	CY	$ 20.00	$ 21,000.00
Pedestrian Bridge Structure				
Install Equipment Access Ramps & Roads	2.0	EA	$ 1,500.00	$ 3,000.00
Reclaim Equipment Access Ramps, Roads, & Staging Areas	2.0	EA	$ 2,500.00	$ 5,000.00
Furnish & Install Boulder (Avg 36" B Axis)	1600	Tons	$ 50.00	$ 80,000.00
Furnish & Install Riprap Armoring (Type VH)	70	CY	$ 50.00	$ 3,500.00
Furnish & Install Riprap Armoring (Type H)	87	CY	$ 50.00	$ 4,350.00
Excavate & Grade Native Alluvium	1250	CY	$ 20.00	$ 25,000.00
Furnish & Install Bedding Material	200	CY	$ 35.00	$ 7,000.00
Furnish & Install Mirafi 180n Filter Fabric	700	SY	$ 4.00	$ 2,800.00
Furnish & Install Concrete Grout	35	CY	$ 650.00	$ 22,750.00
Unclassified Hauloff	1050	CY	$ 20.00	$ 21,000.00
Habitat Boulders				
Furnish and Install Boulder (Avg 60" B Axis)	200.0	Ton	$ 60.00	$ 12,000.00
Additional Included Items				
Additional Excavator Time as directed by S2o	40	HR	$ 250.00	$ 10,000.00
PROJECT SUBTOTAL				$ 833,750.00
Contingency (15%)				$ 125,062.50
CONSTRUCTION SUBTOTAL				$ 958,812.50
Design/Permitting				$ 119,851.56
Construction Bonding/Ins				$ 28,764.38
Mob and Demob				$ 47,940.63
Construction Stakeout				$ 9,588.13
Construction Monitoring				$ 76,705.00
TOTAL PROJECT COST OPINION				**$ 1,241,662.2**

The focal point of Reach 1B is the Oil Creek Ditch Diversion. The diversion structure has been identified as a hazardous structure in the river for instream users. Tubers are the users who are most risk from this structure as they have the least amount of knowledge of hazardous features in rivers. The proposed conceptual design for Reach 1B is shown in Figure 12.

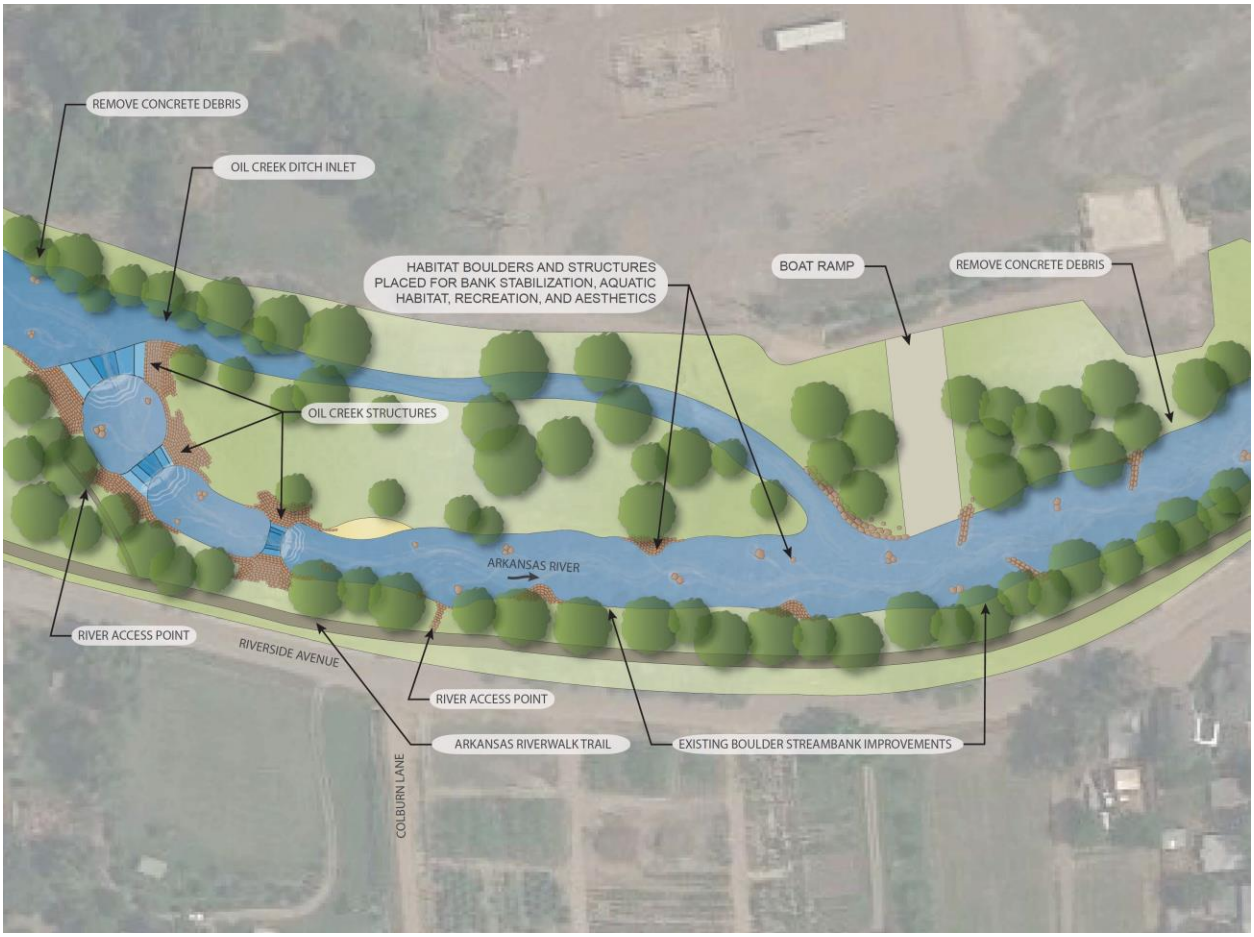

Figure 12: Conceptual Design of Reach 1B

The replacement of the Oil Creek Diversion is the highest priority in Reach 1. These improvements would be beneficial to the ditch company by providing a permanent structure that would need maintenance on a reduced interval, as well as significant reductions to the hazards currently created by the structure. Potential collaboration with the Oil Creek Ditch Company could be leveraged to enhance the ditch companies intake structure and ditch. These enhancements could include redesigning the intake structure with a screen that would protect against debris or fish from entering the ditch and would be designed with appropriate approach velocities to protect against hazards to potential instream users. Other potential enhancements could include piping the ditch through the power plant property to prevent any opportunity for people to accidentally fall into the ditch. The ditch could be day lighted downstream of the access improvements.

The upstream-most of the proposed structures on Reach 1B is shown in Figure 12 as a fixed grouted boulder structure typical to whitewater parks of this stream type, but there is interest in examining its

potential as an adjustable pneumatic structure. While this results in an increased cost (detailed in Table 6), it provides additional versatility to the overall design, both in improving recreational function of the structure and in improving the overall hydraulic behavior leading into the Oil Creek Ditch.

Downstream of the Oil Creek Diversion on the north side of the river at the location of the former power plant there is potential for river access. From discussions with WKRP, there is potential that AHRA will not continue the lease with Pink House for use as the river access point for trips finishing the Royal Gorge, or for floaters who want to float the town sections. If this lease is not continued the City of Cañon City will need to identify a new river access point that would be appropriate for commercial rafting use, as well as, private users. The power plant property is large enough that this could be an adequate alternative to the Pink House river access site. Of particular interest to the Whitewater Kayak and Recreation Park Committee is the potential for a boat ramp, shown in Figure 12, to be installed on the northern bank of the Arkansas River. The scale of a new river access point on this location has a lot of uncertainty and could range from a simple gravel parking lot to a highly developed access point. It would be anticipated that AHRA would have substantial input and guidance in the development of a river access point that would likely include improvements including a boat ramp, parking lot, restroom facilities and potentially picnic tables. In our experience, similar projects can range from several hundred thousand dollars to over one million dollars to construct.

As with Reach 1A, any improvement conducted in this reach would incorporate habitat enhancement boulders, bank stabilization structures and removal of existing rubble and debris from the river.

Opinion of Probable Cost of Reach 1B

The opinion of probable cost of Reach 1B was calculated for the design showed in Figure 12 and the alternate design with Oil Creek Diversion Structure 1 with a pneumatic head gate. These cost estimates are shown in Table 5 and Table 6.

Table 5: Opinion of Probable Cost of Reach 1B

Project: Canon City River Improvement Master Plan
Issue Date: 10/10/2016
Developed By: NW, JR

Reach 1B: Estimated Construction Costs

Description	Quantity	Unit	Unit Cost	Item Total Cost
Site Setup				
Traffic Control	1.0	LS	$ 5,000.00	$ 5,000.00
Install & Maintain Best Management Practices	1.0	LS	$ 5,000.00	$ 5,000.00
Opperate & Maintain Water Control	1.0	LS	$ 30,000.00	$ 30,000.00
Demolition	1.0	LS	$ 15,000.00	$ 15,000.00
Oil Creek Diversion Structure 1				
Install Equipment Access Ramps & Roads	2.0	EA	$ 1,500.00	$ 3,000.00
Reclaim Equipment Access Ramps, Roads, & Staging Areas	2.0	EA	$ 2,500.00	$ 5,000.00
Furnish & Install Boulder (Avg 36" B Axis)	1053	Tons	$ 50.00	$ 52,650.00
Furnish & Install Riprap Armoring (Type VH)	68	CY	$ 50.00	$ 3,400.00
Furnish & Install Riprap Armoring (Type H)	67	CY	$ 50.00	$ 3,350.00
Excavate & Grade Native Alluvium	1000	CY	$ 20.00	$ 20,000.00
Furnish & Install Bedding Material	220	CY	$ 35.00	$ 7,700.00
Furnish & Install Mirafi 180n Filter Fabric	760	SY	$ 4.00	$ 3,040.00
Furnish & Install Concrete Grout	40	CY	$ 650.00	$ 26,000.00
Unclassified Hauloff	600	CY	$ 20.00	$ 12,000.00
Oil Creek Diversion Structure 2				
Install Equipment Access Ramps & Roads	2.0	EA	$ 1,500.00	$ 3,000.00
Reclaim Equipment Access Ramps, Roads, & Staging Areas	2.0	EA	$ 2,500.00	$ 5,000.00
Furnish & Install Boulder (Avg 36" B Axis)	835	Tons	$ 50.00	$ 41,750.00
Furnish & Install Riprap Armoring (Type VH)	55	CY	$ 50.00	$ 2,750.00
Furnish & Install Riprap Armoring (Type H)	47	CY	$ 50.00	$ 2,350.00
Excavate & Grade Native Alluvium	800	CY	$ 20.00	$ 16,000.00
Furnish & Install Bedding Material	175	CY	$ 35.00	$ 6,125.00
Furnish & Install Mirafi 180n Filter Fabric	590	SY	$ 4.00	$ 2,360.00
Furnish & Install Concrete Grout	34	CY	$ 650.00	$ 22,100.00
Unclassified Hauloff	625	CY	$ 20.00	$ 12,500.00
Oil Creek Diversion Structure 3				
Install Equipment Access Ramps & Roads	2.0	EA	$ 1,500.00	$ 3,000.00
Reclaim Equipment Access Ramps, Roads, & Staging Areas	2.0	EA	$ 2,500.00	$ 5,000.00
Furnish & Install Boulder (Avg 36" B Axis)	695	Tons	$ 50.00	$ 34,750.00
Furnish & Install Riprap Armoring (Type VH)	40	CY	$ 50.00	$ 2,000.00
Furnish & Install Riprap Armoring (Type H)	32	CY	$ 50.00	$ 1,600.00
Excavate & Grade Native Alluvium	650	CY	$ 20.00	$ 13,000.00
Furnish & Install Bedding Material	147	CY	$ 35.00	$ 5,145.00
Furnish & Install Mirafi 180n Filter Fabric	500	SY	$ 4.00	$ 2,000.00
Furnish & Install Concrete Grout	34	CY	$ 650.00	$ 22,100.00
Unclassified Hauloff	503	CY	$ 20.00	$ 10,060.00
Bank Directive Structures				
Furnish & Install Boulder (Avg 36" B Axis)	600	Tons	$ 50.00	$ 30,000.00
Excavate & Grade Native Alluvium	75	CY	$ 20.00	$ 1,500.00
Furnish & Install Mirafi 180n Filter Fabric	415	SY	$ 4.00	$ 1,660.00
Unclassified Hauloff	75	CY	$ 20.00	$ 1,500.00
Additional Included Items				
Ditch Intake Reconstruction	1	LS	$ 100,000.00	$ 100,000.00
Additional Excavator Time as directed by S2o	40	HR	$ 250.00	$ 10,000.00
PROJECT SUBTOTAL				$ 548,390.00
Contingency (15%)				$ 82,258.50
CONSTRUCTION SUBTOTAL				$ 630,648.50
Design/Permitting				$ 78,831.06
Construction Bonding/Ins				$ 18,919.46
Mob and Demob				$ 31,532.43
Construction Stakeout				$ 6,306.49
Construction Monitoring				$ 50,451.88
TOTAL PROJECT COST OPINION				**$ 816,689.8**

Table 6: Opinion of Probable Cost of Reach 1B with Pneumatic Gate Alternate Design

Project: Canon City River Improvement Master Plan
Issue Date: 10/10/2016
Developed By: NW, JR

Reach 1B: Estimated Construction Costs (Pneumatic Alternative)

Description	Quantity	Unit	Unit Cost	Item Total Cost
Site Setup				
Traffic Control	1.0	LS	$ 5,000.00	$ 5,000.00
Install & Maintain Best Management Practices	1.0	LS	$ 5,000.00	$ 5,000.00
Opperate & Maintain Water Control	1.0	LS	$ 30,000.00	$ 30,000.00
Demolition	1.0	LS	$ 15,000.00	$ 15,000.00
Oil Creek Diversion Structure 1 (Pneumatic Alternative)				
Install Equipment Access Ramps & Roads	2.0	EA	$ 1,500.00	$ 3,000.00
Reclaim Equipment Access Ramps, Roads, & Staging Areas	2.0	EA	$ 2,500.00	$ 5,000.00
Furnish & Install Boulder (Avg 36" B Axis)	700	Tons	$ 85.00	$ 59,500.00
Furnish & Install Riprap Armoring (Type VH)	68	CY	$ 50.00	$ 3,400.00
Furnish & Install Riprap Armoring (Type H)	67	CY	$ 50.00	$ 3,350.00
Excavate & Grade Native Alluvium	1000	CY	$ 20.00	$ 20,000.00
Furnish & Install Bedding Material	220	CY	$ 35.00	$ 7,700.00
Furnish & Install Mirafi 180n Filter Fabric	760	SY	$ 4.00	$ 3,040.00
Furnish & Install Pneumatic Gates	80	LF	$ 4,000.00	$ 320,000.00
Furnish, Install, & Finish Concrete Ramp (CDOT Class D)	100	CY	$ 300.00	$ 30,000.00
Furnish & Install #5 Rebar	5700	LF	$ 2.00	$ 11,400.00
Unclassified Hauloff	600	CY	$ 20.00	$ 12,000.00
Oil Creek Diversion Structure 2				
Install Equipment Access Ramps & Roads	2.0	EA	$ 1,500.00	$ 3,000.00
Reclaim Equipment Access Ramps, Roads, & Staging Areas	2.0	EA	$ 2,500.00	$ 5,000.00
Furnish & Install Boulder (Avg 36" B Axis)	835	Tons	$ 85.00	$ 70,975.00
Furnish & Install Riprap Armoring (Type VH)	55	CY	$ 50.00	$ 2,750.00
Furnish & Install Riprap Armoring (Type H)	47	CY	$ 50.00	$ 2,350.00
Excavate & Grade Native Alluvium	800	CY	$ 20.00	$ 16,000.00
Furnish & Install Bedding Material	175	CY	$ 35.00	$ 6,125.00
Furnish & Install Mirafi 180n Filter Fabric	590	SY	$ 4.00	$ 2,360.00
Furnish & Install Concrete Grout	34	CY	$ 650.00	$ 22,100.00
Unclassified Hauloff	625	CY	$ 20.00	$ 12,500.00
Oil Creek Diversion Structure 3				
Install Equipment Access Ramps & Roads	2.0	EA	$ 1,500.00	$ 3,000.00
Reclaim Equipment Access Ramps, Roads, & Staging Areas	2.0	EA	$ 2,500.00	$ 5,000.00
Furnish & Install Boulder (Avg 36" B Axis)	695	Tons	$ 50.00	$ 34,750.00
Furnish & Install Riprap Armoring (Type VH)	40	CY	$ 50.00	$ 2,000.00
Furnish & Install Riprap Armoring (Type H)	32	CY	$ 50.00	$ 1,600.00
Excavate & Grade Native Alluvium	650	CY	$ 20.00	$ 13,000.00
Furnish & Install Bedding Material	147	CY	$ 35.00	$ 5,145.00
Furnish & Install Mirafi 180n Filter Fabric	500	SY	$ 4.00	$ 2,000.00
Furnish & Install Concrete Grout	34	CY	$ 650.00	$ 22,100.00
Unclassified Hauloff	503	CY	$ 20.00	$ 10,060.00
Bank Directive Structures				
Furnish & Install Boulder (Avg 36" B Axis)	600	Tons	$ 50.00	$ 30,000.00
Excavate & Grade Native Alluvium	75	CY	$ 20.00	$ 1,500.00
Furnish & Install Mirafi 180n Filter Fabric	415	SY	$ 4.00	$ 1,660.00
Unclassified Hauloff	75	CY	$ 20.00	$ 1,500.00
Additional Included Items				
Ditch Intake Reconstruction	1	LS	$ 100,000.00	$ 100,000.00
Additional Excavator Time as directed by S2o	40	HR	$ 250.00	$ 10,000.00
PROJECT SUBTOTAL				$ 919,865.00
Contingency (15%)				$ 137,979.75
CONSTRUCTION SUBTOTAL				$ 1,057,844.75
Design/Permitting				$ 132,230.59
Construction Bonding/Ins				$ 31,735.34
Mob and Demob				$ 52,892.24
Construction Stakeout				$ 10,578.45
Construction Monitoring				$ 84,627.58
TOTAL PROJECT COST OPINION				**$ 1,369,909.0**

Reach 1C

Reach 1C is the downstream-most section of Reach 1. Currently, Reach 1C is lacking character in the river, with minimal velocity barriers, scour pools or similar variation in the channel. While there is limited opportunity in this stretch for enhanced recreation, there is substantial room for improvement from a river restoration perspective. Proposed instream work is to add habitat boulders and bank armoring structures such as J-hooks to improve habitat opportunities, beautify the river, improve bank stabilization and remove existing construction debris from the stream corridor. The south bank through Reach 1C currently has toe boulder stabilization constructed throughout the reach. There are several locations where these toe boulders are failing and need maintenance. A small river access is proposed just upstream of the 1st Street Bridge to provide access to the instream improvements in Reach 2. This access ramp has been included in the cost estimate and proposed plan for Reach 2. A rendering of the proposed instream work in Reach 1C is shown in Figure 13.

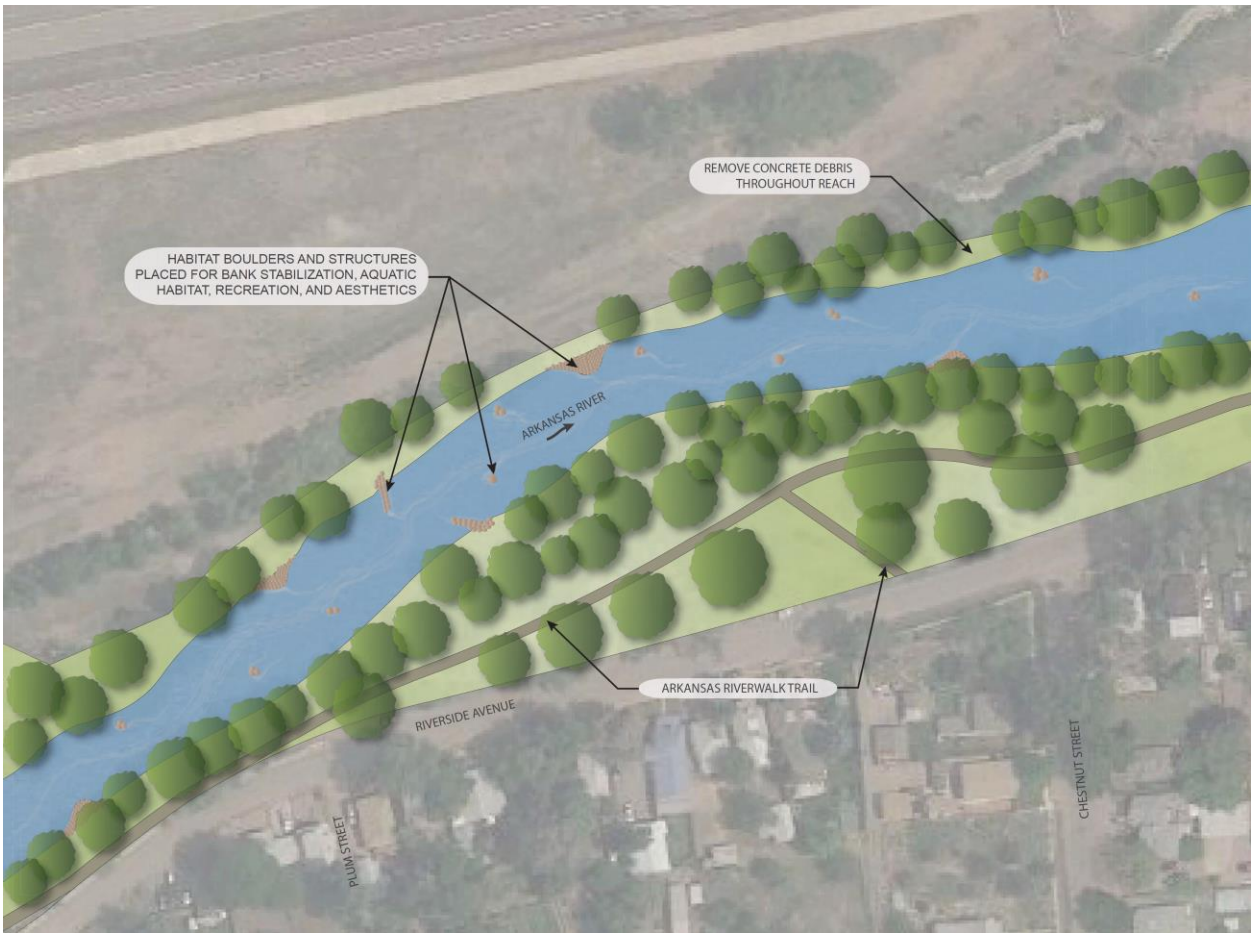

Figure 13: Proposed instream improvements for Reach 1C.

Table 7: Opinion of Probable Cost of Reach 1C

Project: Canon City River Improvement Master Plan
Issue Date: 10/10/2016
Developed By: NW, JR

Reach 1C: Estimated Construction Costs

Description	Quantity	Unit	Unit Cost	Item Total Cost
Site Setup				
Traffic Control	1.0	LS	$ 3,000.00	$ 3,000.00
Install & Maintain Best Management Practices	1.0	LS	$ 1,500.00	$ 1,500.00
Opperate & Maintain Water Control	1.0	LS	$ 4,000.00	$ 4,000.00
Debris Removal and Disposal	1.0	LS	$ 10,000.00	$ 10,000.00
Bank Directive Structures				
Furnish & Install Boulder (Avg 36" B Axis)	780	Tons	$ 50.00	$ 39,000.00
Excavate & Grade Native Alluvium	75	CY	$ 20.00	$ 1,500.00
Furnish & Install Mirafi 180n Filter Fabric	415	SY	$ 4.00	$ 1,660.00
Unclassified Hauloff	75	CY	$ 20.00	$ 1,500.00
Habitat Boulders				
Furnish and Install Boulder (Avg 60" B Axis)	250	Ton	$ 60.00	$ 15,000.00
PROJECT SUBTOTAL				$ 77,160.00
Contingency (15%)				$ 11,574.00
CONSTRUCTION SUBTOTAL				$ 88,734.00
Design/Permitting				$ 11,091.75
Construction Bonding/Ins				$ 2,662.02
Mob and Demob				$ 4,436.70
Construction Stakeout				$ 887.34
Construction Monitoring				$ 7,098.72
TOTAL PROJECT COST OPINION				**$ 114,910.5**

Figure 14: Reach 2 – Looking Upstream from Pedestrian Bridge

Existing Conditions

Reach 2 is the recreational highlight of the Arkansas River in Cañon City. Multiple existing access points, Centennial Park, the Arkansas River Trail, and an existing whitewater feature provide an ideal base for the design of an enhanced river corridor. The hydraulic characteristics of this reach provide ample opportunities for the development of high quality whitewater features, while the predominantly publically owned land on the riverbanks provide straightforward logistics for construction staging purposes.

Reach 2 is located between 1st Street and 4th Street. Most of Reach 2 is adjacent to Centennial Park on the south side. The Arkansas Riverwalk Trail follows along the streambank on the south side from 1st Street to the pedestrian bridge, where it crosses to the north side of the river for the rest of the reach. Along the Arkansas Riverwalk Trail in Centennial Park there are four hardened river access points with steps made of buff sandstone. There are also granite toe boulders along the south bank of the reach for bank stabilization.

In the downstream end of Reach 2 between the pedestrian bridge and the 4th Street Bridge is a whitewater feature that was constructed in 2010. The whitewater feature is constructed with concrete chute blocks in the middle of the river with boulder wings and sandstone terracing. The feature provides good eddy service to the wave that performs best at flows over 1500 cfs. An aerial image of Reach 2 is shown in Figure 15.

Figure 15: Aerial Imagery of Reach 2

Land Ownership

Reach 2 has additional benefits compared to reaches 1 and 3 in that the majority of the land adjacent to the proposed project site is owned by the City of Cañon City. This opens up more opportunities than the other reaches as no land acquisition will be required and construction can stage from both banks of the river. There is a parcel of private property in the upstream end of the reach on the northern bank. This property could be investigated for acquisition by the City, agreement from the landowner to implement improvements, or improvements could be limited to the south half of the river and bank. The relatively uncomplicated property ownership contributes to Reach 2 being the most feasible location for river improvements on the Arkansas River in Cañon City. A map of land ownership is shown in Figure 16

Figure 16: Aerial imagery of Reach 2 on the Arkansas, with blue shaded regions representing land owned by the City of Cañon City.

Reach 2 Conceptual Design

Reach 2 has been divided into two sub-reaches; Reach 2A spanning from 1st Street Bridge to Centennial Park, and Reach 2B spanning from Centennial Park to 4th Street Bridge. The proposed improvements to Reach 2A are shown in Figure 17.

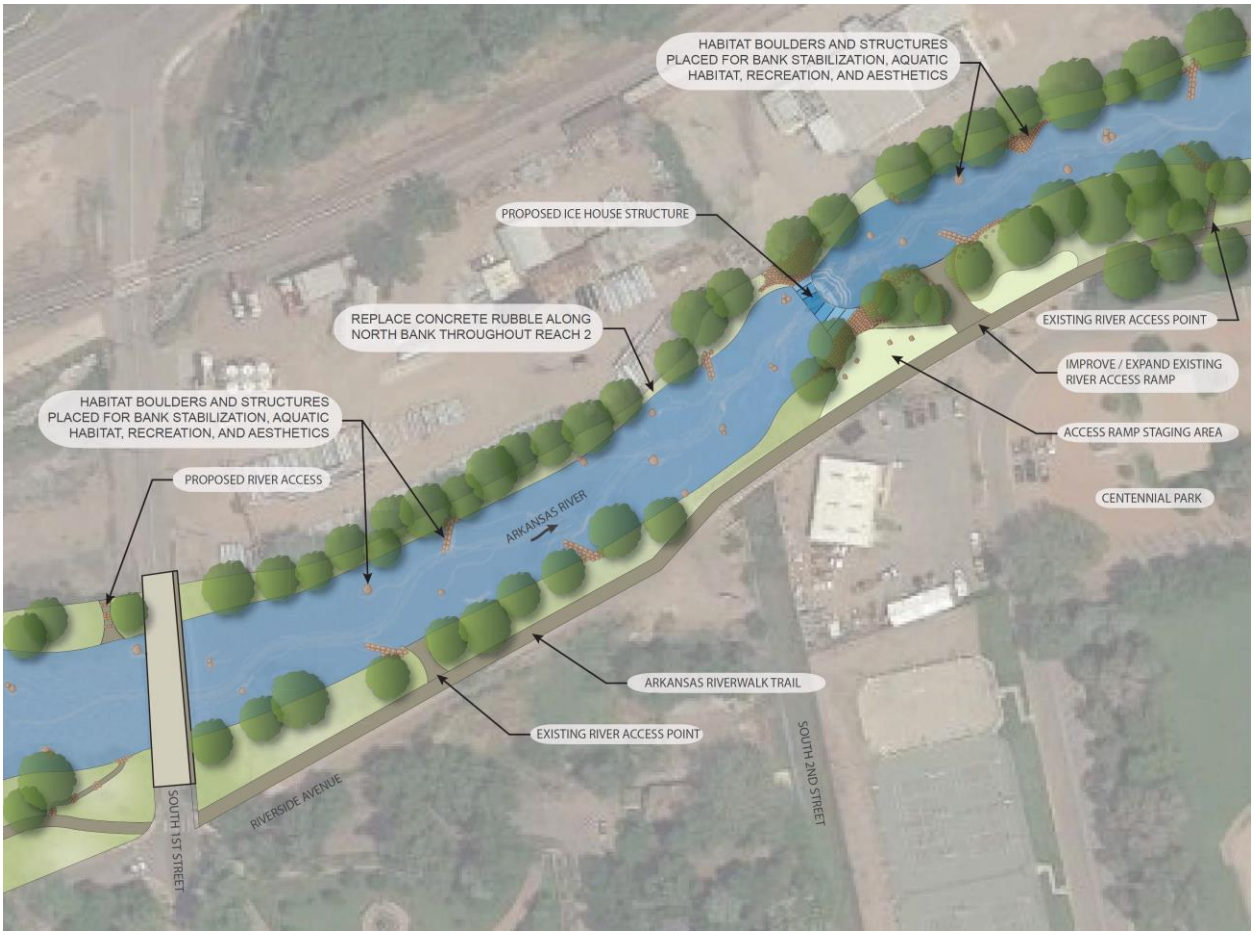

Figure 17: Proposed instream improvements in Reach 2A

There are multiple improvements detailed in Figure 17. A channel spanning whitewater structure is proposed by the Ice House and the public works building. The design shown is that of a standard grouted rock structure, but there is interest in investigating the feature as a pneumatically adjustable structure. This would come at an additional cost, shown in Table 9, but would provide a highly functional and adjustable feature to provide enhanced recreation at a variety of flow rates.

Further incorporated into Reach 2A is an array of strategically placed habitat boulders and stream stabilization structures which will perform multiple purposes of providing velocity barriers and scour pools to improve fish habitat, reducing the risk of erosion along the banks of the river, and creating a high quality slalom course.

The additional complexity given to the stream characteristics of the river will provide great recreational opportunities, improve the ecological health of the reach and create an aesthetically pleasing greenway to give residents and visitors a scenic river experience. As with Reach 1, all instream improvements will be performed along with the removal of existing concrete rubble and debris from the river.

The south bank throughout Reach 2 has toe boulders installed. These toe boulders provide bank protection and allows for low impact river access through the reach. The north bank in Reach 2 would also benefit from installation of toe boulders. The toe boulders were investigated and a cost estimate was established based on a cost per linear foot. This approach would allow toe boulders to be installed as desired or as project scope and budgets become available. Toe boulders are a great alternative for the existing dumped concrete debris as it provides great stabilization, as well as, increase the aesthetic value of the river corridor. Figure 18 shows what toe boulders along the Skyline Steel Company's property would conceptually look like.

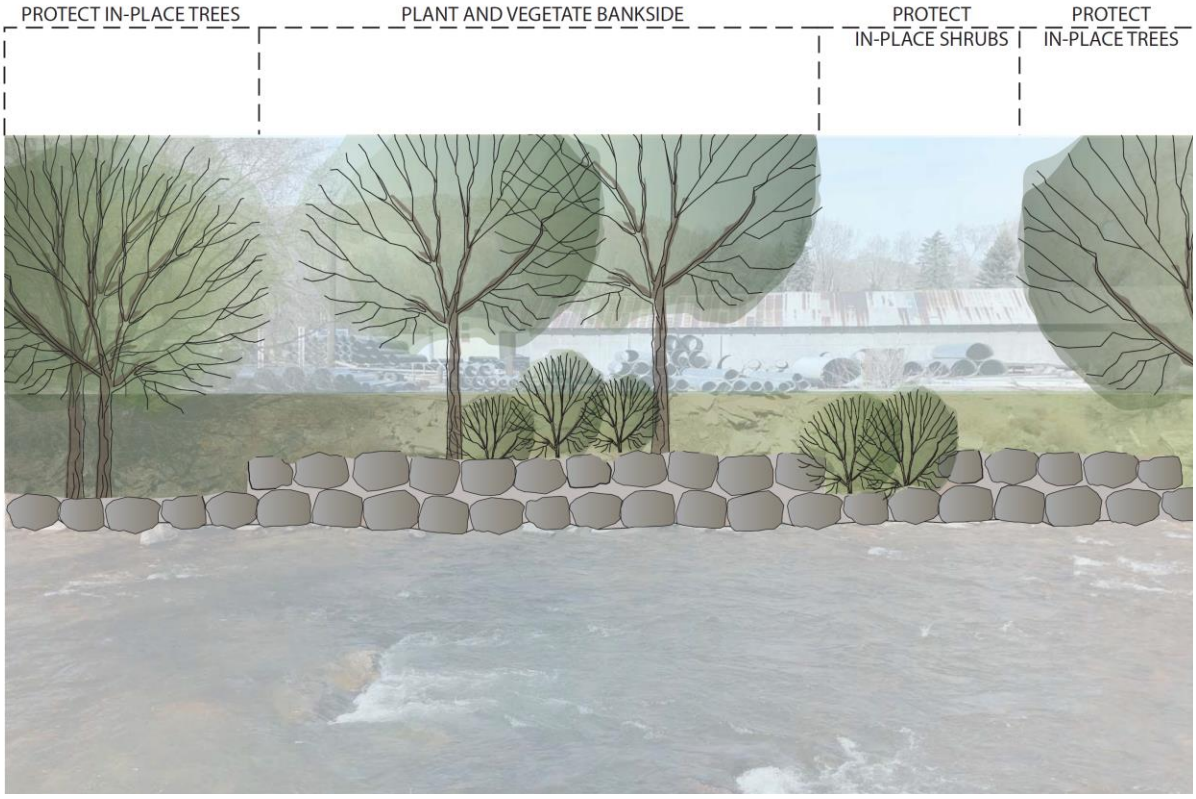

Figure 18 Bank Profile Improvements with Toe Boulders and Vegetation

There are several existing river access points in Reach 2 for people to access the river and existing instream features. The proposed improvements will increase the recreational use of the entire reach so additional access has been proposed just upstream of the 1st Street Bridge. This is proposed to be a similar access point to the many other sandstone access points along the Arkansas Riverwalk Trail. Also, with the increased usage improvements and enhancements are proposed to the existing river access point downstream of the proposed Ice House Structure.

Reach 2B features the similar habitat boulders and stabilization structures to promote a healthy river corridor with a focus on a high level slalom course. Cañon City has adequate flow nearly year round to become a destination for slalom training in Colorado. Currently there are several groups, including Team Colorado Whitewater Racing and the Dawson Kayak Club, that travel to train slalom throughout the year. The stream improvement in Reach 2B, combined with a gate system would provide an excellent training ground for competitive slalom paddlers and beginner/intermediate recreational paddlers alike year round.

Improvements on the existing whitewater feature to tune it to provide recreational uses at a wider array of flow rates than it currently operates is also an opportunity. The scope of work required to tune the existing feature contains significant uncertainty. Tuning could be done in intermediate stages by creating a concrete pad upstream of the existing structure that would have embedded Unistrut rails. This pad would use RapidBlocs adjustable obstacle to reconfigure the flow entering the existing structure. RapidBlocs are easily reconfigurable so multiple orientations can be used to tune the structure to a desirable whitewater feature. The cost estimate for the RapidBlocs includes 20 RapidBlocs 4 HalfBlocs, 15 Round Lids, 6 Wedges and all necessary mounting anchors and fitting. A graphic of the proposed Reach 2B improvements is shown in Figure 19.

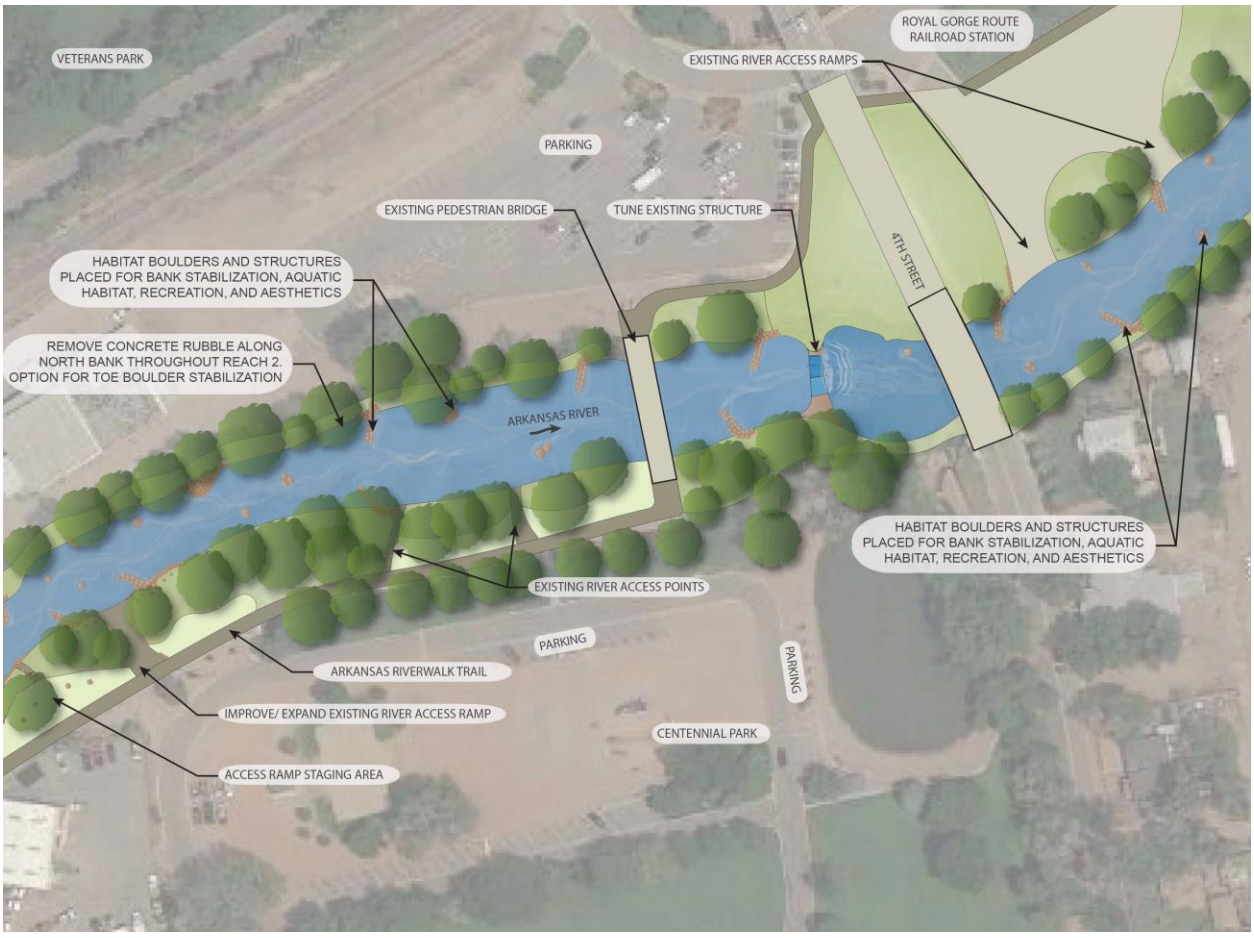

Figure 19: Proposed instream improvements in Reach 2B.

Opinion of Probable Costs for Reach 2

An opinion of probable cost was developed for the anticipated design of Reach 2, with the Ice House Structure constructed from grouted boulders, as well as the alternative design with the Ice House Structure constructed with a pneumatic head gate. These estimates are shown in Table 8 and Table 9. The cost estimates include a cost estimate for a 6" galvanized steel mast to hang the slalom gates from. An option to look at a lighted gate mast was also investigated and would cost an estimated $1,250 more per mast.

Table 8: Conceptual level cost estimates for the Reach 2 Site

Project: Canon City River Improvement Master Plan
Issue Date: 10/10/2016
Developed By: NW, JR

Reach 2: Estimated Construction Costs

Description	Quantity	Unit	Unit Cost	Item Total Cost
Site Setup				
Traffic Control	1.0	LS	$ 3,000.00	$ 3,000.00
Install & Maintain Best Management Practices	1.0	LS	$ 5,000.00	$ 5,000.00
Opperate & Maintain Water Control	1.0	LS	$ 30,000.00	$ 30,000.00
Debris Removal and Disposal	1.0	LS	$ 15,000.00	$ 15,000.00
Ice House Structure				
Install Equipment Access Ramps & Roads	2.0	EA	$ 1,500.00	$ 3,000.00
Reclaim Equipment Access Ramps, Roads, & Staging Areas	2.0	EA	$ 2,500.00	$ 5,000.00
Furnish & Install Boulder (Avg 36" B Axis)	889	Tons	$ 50.00	$ 44,444.44
Furnish & Install Riprap Armoring (Type VH)	70	CY	$ 50.00	$ 3,500.00
Furnish & Install Riprap Armoring (Type H)	87	CY	$ 50.00	$ 4,350.00
Excavate & Grade Native Alluvium	1250	CY	$ 20.00	$ 25,000.00
Furnish & Install Bedding Material	200	CY	$ 35.00	$ 7,000.00
Furnish & Install Mirafi 180n Filter Fabric	700	SY	$ 4.00	$ 2,800.00
Furnish & Install Concrete Grout	35	CY	$ 650.00	$ 22,750.00
Unclassified Hauloff	600	CY	$ 20.00	$ 12,000.00
1st Street River Access				
Sandstone Access Stairs	1	EA	$ 3,000.00	$ 3,000.00
North Bank Toe Boulders				
Furnish & Install Boulder (Avg 36" B Axis)	780	LF	$ 100.00	$ 78,000.00
Bank Directive Structures				
Furnish & Install Boulder (Avg 36" B Axis)	1425	Tons	$ 50.00	$ 71,250.00
Excavate & Grade Native Alluvium	220	CY	$ 20.00	$ 4,400.00
Furnish & Install Mirafi 180n Filter Fabric	415	SY	$ 4.00	$ 1,660.00
Unclassified Hauloff	220	CY	$ 20.00	$ 4,400.00
Habitat Boulders				
Furnish and Install Boulder (Avg 60" B Axis)	200.0	Ton	$ 60.00	$ 12,000.00
Slalom Course				
Slalom Gates	25.0	EA	$ 500.00	$ 12,500.00
Slalom Gate Installation	1.0	LS	$ 3,600.00	$ 3,600.00
Non-lighted Gate Masts	50.0	EA	$ 750.00	$ 37,500.00
Tune Exisitng Structure				
Concrete Pad	15.0	CY	$ 650.00	$ 9,750.00
RapidBlocs	1.0	LS	$ 15,000.00	$ 15,000.00
Additional Included Items				
Additional Excavator Time as directed by S2o	20	HR	$ 250.00	$ 5,000.00
PROJECT SUBTOTAL				$ 440,904.44
Contingency (15%)				$ 66,135.67
CONSTRUCTION SUBTOTAL				$ 507,040.11
Design/Permitting				$ 63,380.01
Construction Bonding/Ins				$ 15,211.20
Mob and Demob				$ 25,352.01
Construction Stakeout				$ 5,070.40
Construction Monitoring				$ 40,563.21
TOTAL PROJECT COST OPINION				**$ 656,616.9**

Table 9: Cost Estimate of the Alternative Design of Reach 2

Project: Canon City River Improvement Master Plan
Issue Date: 10/10/2016
Developed By: NW, JR

Reach 2: Estimated Construction Costs (With Alternative Ice House structure)

Description	Quantity	Unit	Unit Cost	Item Total Cost
Site Setup				
Traffic Control	1.0	LS	$ 3,000.00	$ 3,000.00
Install & Maintain Best Management Practices	1.0	LS	$ 5,000.00	$ 5,000.00
Opperate & Maintain Water Control	1.0	LS	$ 30,000.00	$ 30,000.00
Debris Removal and Disposal	1.0	LS	$ 15,000.00	$ 15,000.00
Ice House Structure (Pneumatic Alternative)				
Install Equipment Access Ramps & Roads	2.0	EA	$ 1,500.00	$ 3,000.00
Reclaim Equipment Access Ramps, Roads, & Staging Areas	2.0	EA	$ 2,500.00	$ 5,000.00
Furnish & Install Boulder (Avg 36" B Axis)	450	Tons	$ 50.00	$ 22,500.00
Furnish & Install Riprap Armoring (Type VH)	70	CY	$ 50.00	$ 3,500.00
Furnish & Install Riprap Armoring (Type H)	87	CY	$ 50.00	$ 4,350.00
Excavate & Grade Native Alluvium	1250	CY	$ 20.00	$ 25,000.00
Furnish & Install Bedding Material	200	CY	$ 35.00	$ 7,000.00
Furnish & Install Mirafi 180n Filter Fabric	700	SY	$ 4.00	$ 2,800.00
Furnish & Install Pneumatic Gates	60	LF	$ 4,000.00	$ 240,000.00
Furnish, Install, & Finish Concrete Ramp (CDOT Class D)	80	CY	$ 300.00	$ 24,000.00
Furnish & Install #5 Rebar	2950	LF	$ 2.00	$ 5,900.00
Unclassified Hauloff	600	CY	$ 20.00	$ 12,000.00
1st Street River Access				
Sandstone Access Stairs	1	EA	$ 3,000.00	$ 3,000.00
North Bank Toe Boulders				
Furnish & Install Boulder (Avg 36" B Axis)	780	LF	$ 100.00	$ 78,000.00
Bank Directive Structures				
Furnish & Install Boulder (Avg 36" B Axis)	1425	Tons	$ 50.00	$ 71,250.00
Excavate & Grade Native Alluvium	220	CY	$ 20.00	$ 4,400.00
Furnish & Install Mirafi 180n Filter Fabric	415	SY	$ 4.00	$ 1,660.00
Unclassified Hauloff	220	CY	$ 20.00	$ 4,400.00
Habitat Boulders				
Furnish and Install Boulder (Avg 60" B Axis)	200.0	Ton	$ 60.00	$ 12,000.00
Slalom Course				
Slalom Gates	25.0	EA	$ 500.00	$ 12,500.00
Slalom Gate Installation	1.0	LS	$ 3,600.00	$ 3,600.00
Traditional Gate Masts	50.0	EA	$ 750.00	$ 37,500.00
Tune Exisitng Structure				
Concrete Pad	15.0	CY	$ 650.00	$ 9,750.00
RapidBlocs	1.0	LS	$ 15,000.00	$ 15,000.00
Additional Included Items				
Additional Excavator Time as directed by S2o	20	HR	$ 250.00	$ 5,000.00
PROJECT SUBTOTAL				$ 666,110.00
Contingency (15%)				$ 99,916.50
CONSTRUCTION SUBTOTAL				$ 766,026.50
Design/Permitting				$ 95,753.31
Construction Bonding/Ins				$ 22,980.80
Mob and Demob				$ 38,301.33
Construction Stakeout				$ 7,660.27
Construction Monitoring				$ 61,282.12
TOTAL PROJECT COST OPINION				**$ 992,004.3**

Reach 3 – 4th Street to 9th Street

Figure 20: Reach 3

Existing Conditions

Reach 3 is located between South 4th Street Bridge and the railway bridge before the meander bend to the east. Within Reach 3 there is a reasonably established riparian zone on both the north and south banks of the river, an American Disability Act fishing access point constructed by Colorado Parks and Wildlife in conjunction with an array of fish habitat boulders just upstream.

There are multiple access points, including a boat ramp downstream of 4th Street Bridge and the Arkansas Riverwalk Trail extending along the banks for the duration of the reach. There is a second pre-existing whitewater feature upstream of the Arkansas Riverwalk Trail Bridge that includes access and seating areas next to the river. Downstream of the whitewater feature on the south bank is an ADA fishing access path constructed of boulders and concrete.

Land Ownership

The northern bank along the reach is owned by the City of Cañon City, as is a parcel on the southern bank at the abutment of the Arkansas Riverwalk Trail Bridge. The southern bank in the upstream section of the reach is comprised of two private lots. A graphic of the land ownership of Cañon City along Reach 3 is shown in Figure 21. Proposed improvements on private property would require land acquisition or landowner agreements/easement to implement.

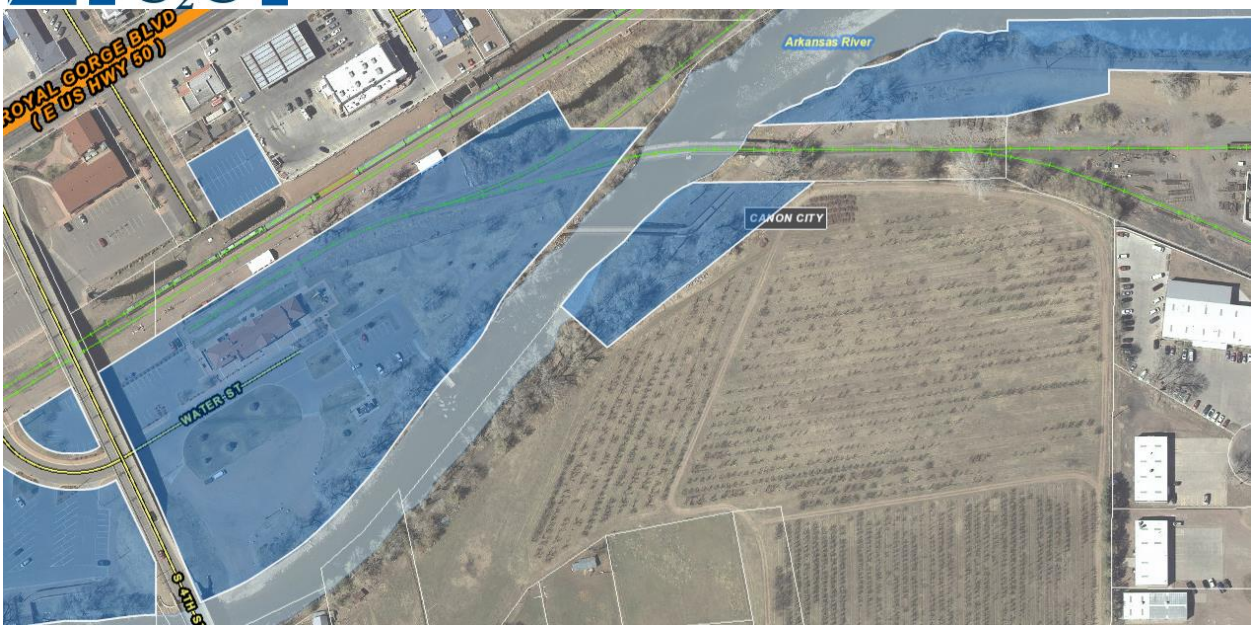

Figure 21: Reach 3 of the project area, blue shaded area representing property of the City of Cañon City.

Reach 3 Conceptual Design

The conceptual design of reach three involves enhancing the existing habitat boulders installed by CPW to reduce possible hazards to instream users. Several redirected structures will be implemented to provide additional streambank stabilization and habitat creation throughout the reach. The addition of these features will add velocity barriers to promote fish habitat, as well as creating a more natural meander of the thalweg at low flow, providing pools, sand bars and benches to allow local wildlife and vegetation to thrive. The conceptual design of Reach 3 is shown in Figure 22.

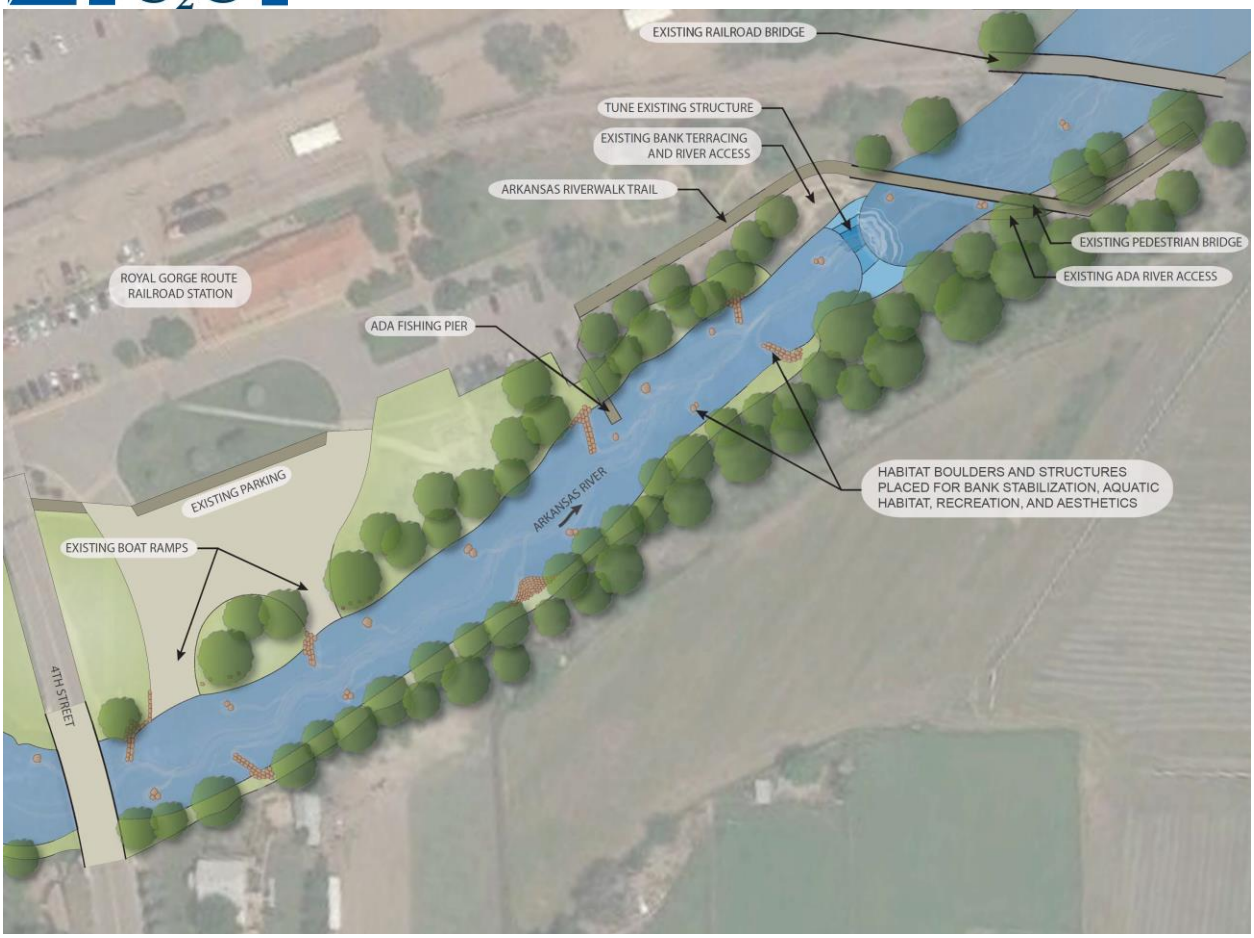

Figure 22: Reach 3 Conceptual Design

Similar to Reach 2, the existing whitewater feature could be tuned to provide greater recreational use at a wider range of flow rates, but there is significant uncertainty of the level of effort required to achieve this. A greater resiliency will be achieved, assessing the feature for strength and integrity for higher flow events, to ensure it does not wash out in flood events contributing to maintenance costs. Access points will be enhanced for both anglers and floaters, as well as beautification of the river corridor to improve the aesthetics of the river corridor to add to the experience of the scenic Arkansas River Trail.

The downstream portion of Reach 3 is from the Railroad Bridge to 9th Street. This reach of the river could benefit from some habitat structure and bank stabilizing structures, however, the priority and benefit of implanting improvements in this reach are low. There are some quality point bars in the reach that provide for habitat in the existing condition.

Opinion of Probably Costs for Reach 3

The conceptual level cost estimates for Reach 3 are shown in Table 10:

Table 10: Opinion of Probable Cost of Reach 3

Project: Canon City River Improvement Master Plan
Issue Date: 10/10/2016
Developed By: NW, JR

Reach 3: Estimated Construction Costs

Description	Quantity	Unit	Unit Cost	Item Total Cost
Site Setup				
Traffic Control	1.0	LS	$ 1,500.00	$ 1,500.00
Install & Maintain Best Management Practices	1.0	LS	$ 2,000.00	$ 2,000.00
Opperate & Maintain Water Control	1.0	LS	$ 3,000.00	$ 3,000.00
Debris Removal and Disposal	1.0	LS	$ 5,000.00	$ 5,000.00
Bank Directive Structures				
Furnish & Install Boulder (Avg 36" B Axis)	780	Tons	$ 50.00	$ 39,000.00
Install Boulder on Site (Avg 36" B Axis)	106	Tons	$ 30.00	$ 3,180.00
Excavate & Grade Native Alluvium	75	CY	$ 20.00	$ 1,500.00
Furnish & Install Mirafi 180n Filter Fabric	415	SY	$ 4.00	$ 1,660.00
Unclassified Hauloff	75	CY	$ 20.00	$ 1,500.00
Habitat Boulders				
Furnish and Install Boulder (Avg 60" B Axis)	100.0	Ton	$ 60.00	$ 6,000.00
PROJECT SUBTOTAL				$ 64,340.00
Contingency (15%)				$ 9,651.00
CONSTRUCTION SUBTOTAL				$ 73,991.00
Design/Permitting				$ 9,248.88
Construction Bonding/Ins				$ 2,219.73
Mob and Demob				$ 3,699.55
Construction Stakeout				$ 739.91
Construction Monitoring				$ 5,919.28
TOTAL PROJECT COST OPINION				**$ 95,818.3**

Permitting

River parks, typically require Federal, State, and Local permits prior to the initiation of construction activities. Obtaining these approvals may require a number of tasks, including but not limited to:

- Detailed site survey;
- Wetland delineations;
- Historic structures and/or culturally significant resources surveys;
- Threatened and endangered species surveys;
- Establishment of a Proposed Conditions flood model; and
- Issuance of design drawings stamped by a licensed professional engineer.

Federal and State Permitting

Whitewater Parks within the United States require, at minimum, a 404/401 permit. This joint permit application involves a thorough review process, which includes an assessment of all impacts of the proposed park to the environment including an alternatives analysis demonstrating that the selected project is the least environmentally damaging and most practicable alternative. During this review, coordination with both Colorado Parks and Wildlife and the US Fish and Wildlife Service (USFWS) may be required. The following federal and state permits are anticipated for this project:

- U.S. Army Corps of Engineers (USACE) –Section 404 Individual Permit; and
- Colorado Department of Public Health and Environment (CDPHE) - Section 401 Water Quality Permit.

Depending on the phasing and approach to the implementation of project elements there may be an opportunity to construct some of the improvements with a nationwide or regional general permit from the Army Corps of Engineers. If the enhancements are focused on streambank stabilization and habitat creation these permits may be allowable. Channel spanning whitewater park structures will likely not be viable for a permit under a nationwide or regional general permit and will require an individual permit. The differences in these permits has implications of schedule timelines. Nationwide or region general permits generally can be approved within one to two months. An individual permit requires a lengthy public comment period and commonly take 6 to 9 months. Occasionally an individual permit can be obtained in as little as three months, but that is atypical.

Permitting can have a significant impact on timelines to construct a project. 404 permits are typically applied for with a preliminary design that includes enough detail to show the amount of impacts a project will have. Under the jurisdiction of the 404 permit any material that is placed or removed from waters of the United States, which are defined as the area within the ordinary high water line, must be permitted.

Fremont County

The proposed improvements are all located within the city limits of Cañon City, therefore, it is expected that no county permits would be required. During the detailed design of the project reaches communication should be initiated with the County to ensure no additional permitting will be required.

City of Cañon City

For all project sites located within the municipal boundaries of City of Cañon City, a local floodplain development permit should be anticipated. Obtaining approvals to construct within either the effective floodway typically require, at minimum, a no-rise certification, stamped by a licensed professional engineer within the State, demonstrating that the proposed improvements will not increase the regulatory Base Flood Elevation (BFE) or alter the delineated flood hazard areas. A specific floodplain development permit should be anticipated for all phases of implementation of the projects identified in the plan. Each individual phase of the work may potentially be permitted as a whole or as parts as applicable.

In the case that a project does not demonstrate no increase to the regulatory Base Flood Elevation (BFE) a Conditional Letter of Map Revision (CLOMR) will be required through the Federal Emergency

Management Agency (FEMA). Upon completion of the project the as-built survey will be required to make the CLORM an official Letter of Map Revision (LOMR). This process includes a lengthy public comment period as a rise in base flood elevation implies potential damage to adjacent habitable structures, which could have impacts on flood insurance rates.

Process

This study has evaluated the sites and suggested possible design solutions that satisfy specific project site constraints and requirements and that would provide for a river based recreational attraction. This is not, however, a completed design that is ready to be constructed. Additional project phases including preliminary design, detailed design and final construction documentation are necessary before construction at the preferred alternative project sites can begin.

Design

Figure 23: River Parks are designed for many differing kinds of users.

River parks typically require several stages of design. The following outlines S2o's typical process from design through construction:

a) **Feasibility/Conceptual Design**—this is the first must-do part of a project. This phase is tasked with determining whether a particular project is possible and, if so, how it could look and function and what the approximate costs of the project would be. If done right this part of the project is very powerful as it provides the client with the materials necessary to pursue funding and grants and documentation useful for preliminary public process and stakeholder coordination. Deliverables include a feasibility report outlining project site opportunities and constraints, tasks for completion, and permit requirements along with conceptual design drawings and budgetary cost estimates. This plan is this feasibility/conceptual design step.

b) **Preliminary Design**—this phase gets to the heart of the design elements of the project. If the Feasibility phase is about identifying what needs to be done to complete a project, Preliminary Design is about doing them. It is a phase tasked with completing the necessary actions required to finalize the design functionality and layout and to gather and process the data necessary to

undertake detailed design. Preliminary Design often includes all of the tasks related to preparing for permitting, surveying, creating baseline models, meeting with stakeholders and agencies to define constraints and objectives, and completing design documents to the permitting level.

c) **Permitting**—permitting is a process that permeates most of the design phases. It is typical to work with regulatory authorities during the preliminary design phase to establish criteria and priorities for the project. Permit applications are typically submitted following the completion of Preliminary Design. Some permits, as outlined above, have lengthy review times for specialty projects such as river parks.

d) **Detailed Design**—the detailed design is about getting to the nuts-and-bolts of the project. Now that the project has been defined and adapted to the constraints and objectives laid out in Preliminary design the project is ready for detailed calculations and modeling. Often the level of computations and modeling is defined by the nature of the project. In some cases, such as the Holme-Pierrepont River Park, the project can be accomplished with 1-dimensional modeling. In other cases, such as the Calgary River Park, detailed physical models were undertaken.

e) **Construction Documentation**—this is the "after-design" phase. Documents are created that help define the project for the contractor including all sections, details, specifications and bid items. Often the River park designer will work with the client or the community to step through these processes.

f) **Project Bidding and Construction**—the project is put to bid by the project owner and a contractor is selected and contracted.

g) **Construction Oversight and Inspection**—in this phase the contractor and the design team work together to build the project to our exacting specifications. Often we have representatives in the field virtually full-time to ensure an accurate build that is aesthetically beautifully and highly functional.

h) **Course Commissioning**—the final phase and the one where we finally get to get wet! Paddling experts get in the water and test the project, often tuning wave characteristics and project features until the project is fully functional and meets design objectives.

The process of design is informed by the input from the project owner, local stakeholders, and regulatory agencies and is typically based on a standard of care that is evolving for this new industry.

Construction

Once detailed construction drawings, specifications, and bid information have been developed and the permits have been obtained, construction of the project may begin. The anticipated construction timeline for each of the concept plans described above ranges from three to six months, depending on the number and size of the drop structures proposed, along with the overall complexity of the total project area improvements. In-channel construction activities typically occur when the flows are at seasonal lows and when there is the least impact to aquatic species. Further analysis and coordination with the Colorado Fish and Wildlife and/or the USFWS will be needed to identify preferred construction windows for the project sites.

Conclusion

The Whitewater Kayak and Recreation Park Committee commissioned a feasibility study on the installation of river improvements on the Arkansas River in Cañon City, Fremont County. The proposed project has a multi-faceted list of objectives; with the goals of the project to provide a high quality whitewater course, improve bank stabilization, provide ecological benefits including fish habitat, as well as to beautify the river corridor through the removal of debris and the establishment of aesthetically pleasing river features.

A stretch of river was examined from Pink House to the 9th Street Bridge. This stretch of river was subdivided into three separate reaches with different priorities and proposed improvements. Reach 2 was identified as the highest priority with the goal of establishing a competition slalom course, providing additional benefits for the ecology and visual appeal of the river corridor. Reach 1 was identified as the next priority, with long term planning for additional whitewater park structures to be installed from the existing instream Cañon City Municipal Water Intake Facility to downstream of the Oil Creek Ditch Diversion. Reach 3 was identified as the lowest priority, with only minor instream improvements proposed to provide character to the river, velocity barriers and streambank stabilization.

Reach 1 – Reach 1 begins at Pink House and stretches to the 1st Avenue Bridge. There are multiple proposed improvements in this reach. The upstream section of the reach has many areas that would benefit from bank improvements for aesthetics and safety. The old Black Hills Plant water intake and the metal skirting on the north bank are unsightly and dangerous, and there are numerous areas of dumped concrete on both banks. As part of a long term planning project, when the Cañon City Municipal Water Intake Facility reaches the end of its design life, three whitewater structures could be installed to replace the 6 foot high dam and boat chute, and a whitewater structure could be installed upstream of the existing pedestrian bridge. The pedestrian bridge structure can be independent of the structures at the water intake. The development of the river adjacent to the Oil Creek Diversion Ditch was identified as the highest priority on the reach. There have been concerns regarding the safety of the structure as the existing structure is a gravel push up type dam with random angular rocks with no clear path for floaters and potential entrapment areas. It has been proposed to work with the Oil Creek Ditch Company to create a series of whitewater drop structures to replace the diversion dam in a way that will provide a recreational benefit, clear downstream floating direction, and will guarantee the ditch company will receive their decreed water right to their intake structure. Additionally, an updated intake structure could be designed with head gates that don't allow fish or debris to flow into the ditch. The updated intake could be installed to add to the ditch's functionality while also promoting safety. An additional alternate design for the first whitewater structure was developed as an adjustable pneumatic head gate. This would add an additional level of confidence to the ditch company to ensure they receive their water, and will provide adjustability to the whitewater structure. Downstream of the Oil Creek Ditch, a boat ramp is proposed for improved river access, along with a series of bank stabilization structures, boulder gardens for fish habitat creation and the removal of all existing debris and rubble from the river to enhance the natural beauty of the area surrounding the scenic Arkansas River Trail.

Reach 2 – Reach 2 stretches from 1st Street Bridge to 4th Street Bridge. Within Reach 2 are several existing river access points and an existing whitewater structure. Reach 2 has been identified as the highest priority for enhancements to the river corridor in Cañon City. This design includes the tuning of the existing

whitewater structure such that it provides greater recreational opportunities at different water levels, the addition of a second whitewater feature at the Ice House as either a grouted boulder structure or pneumatic gate, and the development of a high quality slalom course in between the Ice House and the 4th Street Bridge. The slalom course would be of great benefit to the overall health of the Arkansas River, as the qualities of a superior slalom course requires the same features of a healthy river corridor; velocity barriers created by habitat boulders which will aid fish passage, and eddy currents along the river bank created by stream stabilization structures that will reduce erosion and promote riparian growth. As with Reach 1, any river improvements would include the removal of existing debris and concrete rubble.

Reach 3 – Reach 3 stretches from the 4th Street Bridge to 9th Street. This reach has an ADA fishing pier installed by Colorado Parks and Wildlife, some habitat boulders upstream of the pier, as well as an existing whitewater structure located by the two bridges at the bottom of the reach. The proposed improvements in this stretch of river are relatively minimal, and consist primarily of the enhancement of the habitat boulders and the addition of several bank stabilization structures. The re-tuning of the whitewater structure is also an element that could be investigated in this reach, but involves significant uncertainty.

Cost estimates of the various options were performed, and are summarized in Table 11.

Table 11: Summary of Cost Estimates of the Cañon City Whitewater Park

Summary of Cost Estimates		
River Section	**Opinion of Probable Cost**	
Reach 1A	$	1,241,662.19
Reach 1B	$	816,689.81
Reach 1C	$	114,910.53
Reach 2	$	656,616.94
Reach 3	$	95,818.35

The study found that instream improvements to enhance the recreational experience, fish habitat, bank stabilization, and beatification would be a feasible addition to the Arkansas River in Cañon City. This study recommends that priority be placed on Reach 2 of the proposed project area, as it has the greatest opportunity for overall benefit to river recreation; as well as stream function, improved ecological opportunities and beautification of the river corridor. This reach is adjacent to predominantly public land, providing for straightforward construction access as well as river and greenway access points when the features are installed.

It is likely that the proposed project will be of great benefit to the residents of Cañon City, and will provide a regional attraction to entice others to visit Cañon City.

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