Aquatic Assessment
&
Habitat Enhancement Plan
Fountain Creek - Soda Springs Park
City of Manitou Springs
El Paso County - Colorado

Prepared by

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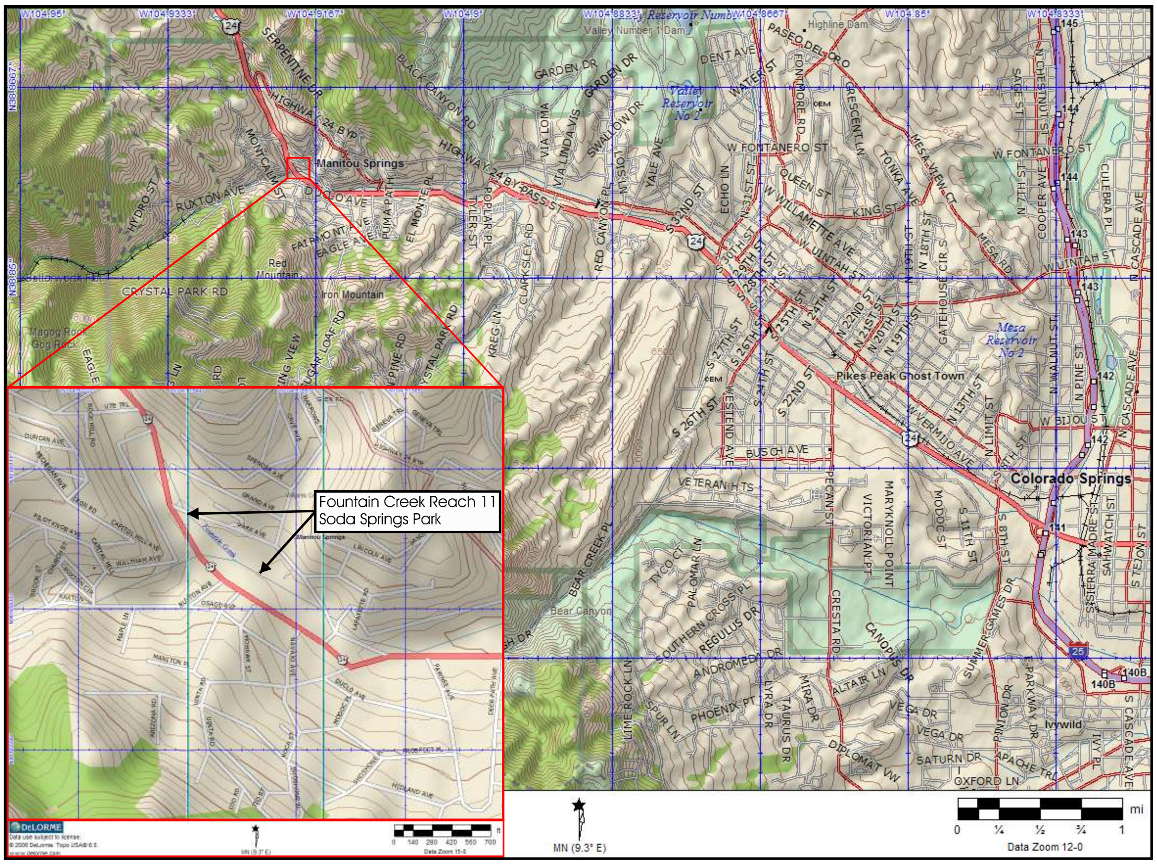
In February 2007, FIN-UP Habitat Consultants, Inc. was contracted by the City of Manitou Springs to conduct an aquatic habitat analysis and habitat enhancement strategy for a segment of Fountain Creek within Soda Springs Park, immediately west of the downtown business district. The stream within the park is approximately 700 feet in length, and is mostly confined by concrete retaining walls and a moderately entrenched natural channel throughout its length. An aquatic assessment was conducted within the project area during the 2nd week of March, 2007, and the results of this work are summarized in this document.



Map 1: Location of project reach on Fountain Creek - Soda Springs Park, Manitou Springs, CO.

Watershed and Hydrology

The headwaters of Fountain Creek consist of several perennial streams with headwaters in the city of Woodland Park and along the north slope of Pikes Peak. The watershed extends downstream to the confluence with Monument Creek near downtown Colorado Springs. The aspect of the watershed is mostly southeasterly. The headwaters of Fountain Creek watershed have a contributing drainage area of approximately 119 square miles at its confluence with Fountain Creek and Monument Creek near downtown Colorado Springs.

Most of the headwaters are part of the Pike National Forest and are dominated by pine and fir forest on very steep slopes consisting of decomposing Pikes Peak granite. Urban development is present in the headwaters, and is likely influencing the watershed. Urban areas include a portion of Woodland Park, and the communities of Crystola, Green Mountain Falls and Cascade. In the middle portion of the watershed, the Pike National Forest continues with pine and fir forest. The stream emerges from a steep canyon immediately upstream of the city of Manitou Springs, where the surrounding geology changes from decomposing granites to the tilted sedimentary layers of the Dakota Hogback. The lower portion of the headwater Fountain Creek watershed contains the city of Manitou Springs and has been developed with interspersed commercial, industrial, and residential areas.

The upstream portion of the creek is a mountain stream with boulders, cobbles, and gravel in a narrow valley. Through the city of Woodland Park, the creek transitions to a wide sand-bed channel. Downstream of the city of Woodland Park, the channel becomes a mountain stream with boulders and natural drops and pools along U.S. Highway 24. The main channel throughout much of this segment has been dramatically altered by the construction of US Highway 24, and exhibits a step-pool morphology characteristic of a stream flowing through a narrow and confined valley/canyon. Downstream of the canyon and through the city of Manitou Springs, the stream has been channelized in several segments, and is diverted underground in many places. Downstream of the city of Manitou Springs, the channel continues to be somewhat entrenched, with occasional meanders down to the confluence with Monument Creek.

Six major tributary streams contribute to Fountain Creek between its headwaters and the project area in Soda Springs Park within the Town of Manitou Springs. These streams include Catamount Creek, Crystal Creek, Severy Creek, French Creek, and Ruxton Creek. Five of these major headwater tributaries have significant reservoirs or other water diversion structures, affecting the natural hydrology of the basin.

The US Geological Service (USGS) Hydrologic Unit of the watershed is 1102000301. The nearest automated stream gauge to the project area is located behind the Safeway west of 31st St in Colorado Springs, and is maintained by the USGS and Colorado Springs Utilities (CSU). The location of this gauge is at Latitude 38°51'17"", Longitude 104°52'39", in the SE¼SW¼ of Section 3, Township14 S., Range 67 W., on left bank 200 ft upstream from the water diversion for Colorado Springs Utilities, and approximately 1.0 mi downstream from Sutherland Creek. The watershed area upstream of this gauge is approximately 103 square miles. A 48 year record of flow data is available at this site. For the period of record, peak yearly flows have ranged from a minimum of 43cubic feet per second (cfs) to 2630cfs. The median peak flow during the period of record was 340 cfs.

Extensive hydrologic modeling has been conducted in the watershed using the HEC-HMS model developed by the US Army Corps of Engineers (*Fountain Creek Watershed Preliminary Hydrology Report, URS, 2005*). The model was run at several locations along Fountain Creek upstream of the gauge, applying a 24-hour storm event with 2, 5, 10, 25, 50, and 100-year recurrence intervals. The HEC-HMS models of current conditions in the watershed indicate that the bank full stage discharge at the USGS gauge is approximately 330 cfs. Upstream of the gauge, within the Soda Springs Park project area, bank full stage discharge is estimated to be 52 cfs upstream of the confluence of Ruxton Creek, and 64 cfs downstream of the confluence. A table of the HEC-HMS predictions for above bank-full stage recurrence intervals is shown in the Table 1. Based on the HEC-HMS modeling and cross sectional channel data collected during this assessment, it is estimated that the stream will exceed the carrying capacity of the existing channel in the park at approximately 2,275 cfs, or somewhat less than a twenty-five year flood event. At this flow, average velocities in the channel may be expected to reach 15 feet per second, exerting in excess of 4 lbs/ft^2 of sheer stress within the channel and adjacent stream banks.

		Estimated Peak Discharge (cfs)					
Location	Area (Mi^2)	2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
At 31st St (USGS near Colorado Springs Gauge)	103	330	690	2000	5300	8800	13000
At the Manitou Springs Arcade	87.5	64	490	1500	4100	7000	10000
Immediately Upstream of Ruxton Creek	~70	52	410	1200	3400	5300	8000

Table 1: Storm Event Return Interval Estimates Using HEC-HMS models

Existing Fish Populations

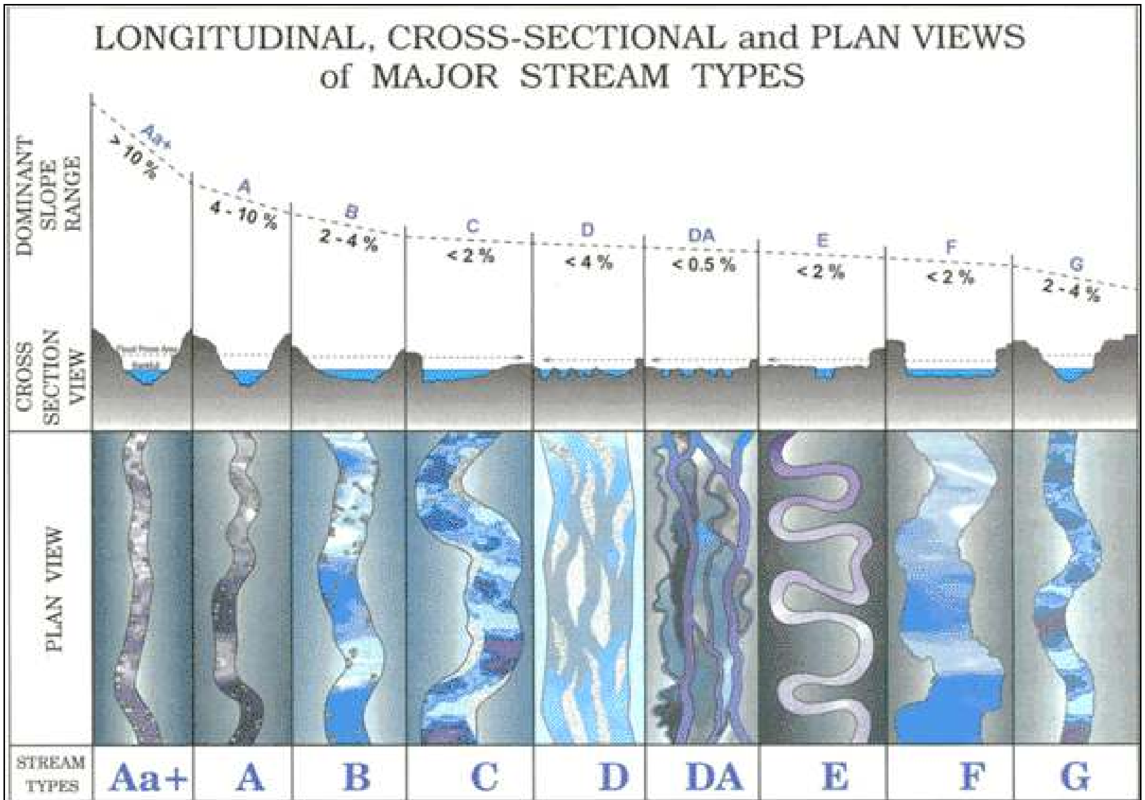
Fountain Creek contains resident populations of both native and non-native fishes. Three important native species are present in the watershed, including the greenback cutthroat trout (*Oncorhynchus clarki stomias* - federal and state threatened), the Arkansas darter (*Etheostoma cragini*- state threatened) and the flathead chub (*Platygobio gracilis* - a state species of special concern), however none of these species are present in the project reach. Brown trout (*Salmo Trutta*) and brook trout (*Salvelinus fontinalis*) are the most common non-native salmonids in Fountain Creek, and have been observed in the project reach. Additionally, rainbow trout (*Oncorhynchus mykiss*) are occasionally stocked by private individuals, and may or may not remain resident in the watershed. An electro-fishing monitoring site has been established several hundred feet downstream of the project area and is routinely monitored by the Colorado Division of Wildlife and the USGS. During the most recent sampling in 2005, 42 adult brown trout were captured within the station.

Stream Channel and Habitat Assessment Methods

For the purposes of this assessment, Fountain Creek through Manitou Springs was delineated into distinct reaches, or segments, based on valley type, channel morphology, perennial vs. intermittent flows, and administrative or physical boundaries. Reaches were numbered consecutively, beginning at the furthermost downstream ranch boundary, and continuing upstream to the headwaters. A total of 13 reaches were identified within the city limits.

Rosgen Stream Classification System

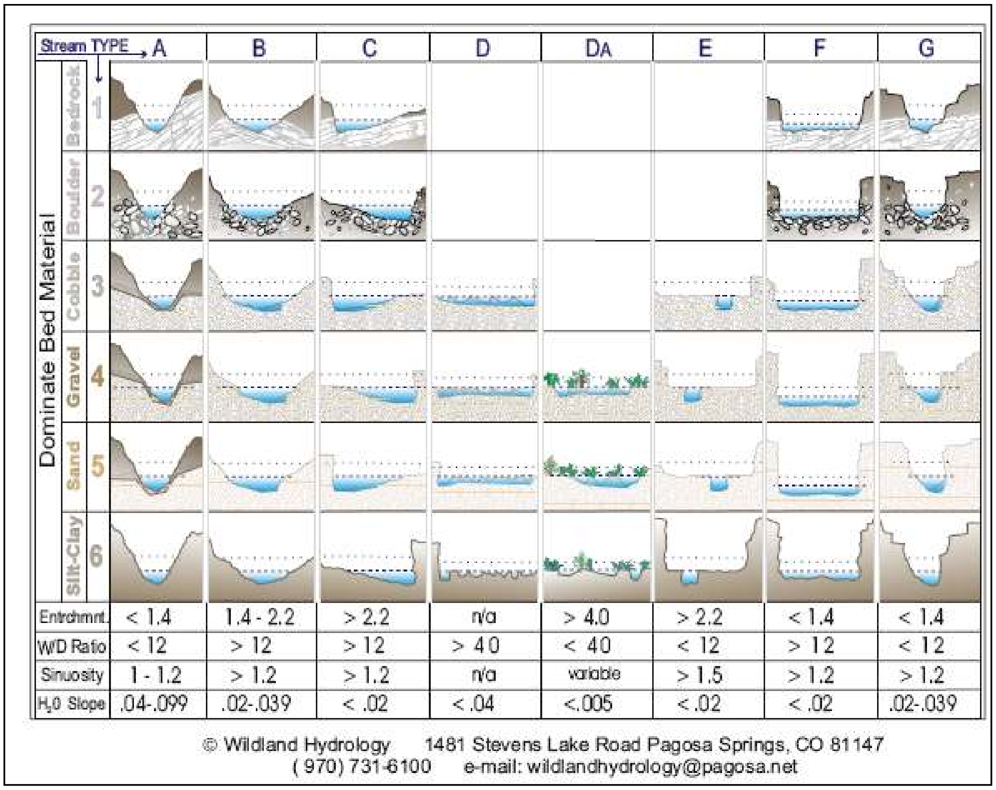
Stream reaches are classified using the Rosgen Stream Classification System (D.L. Rosgen, CATENA, 1994). The Rosgen classification system groups streams by similar channel geomorphology, gradient, sinuosity and function. The classification system is stratified into three progressive levels, based on channel form, dominant substrate, and gradient. A graphic depiction of the Level 1 classification is shown in the diagram below.



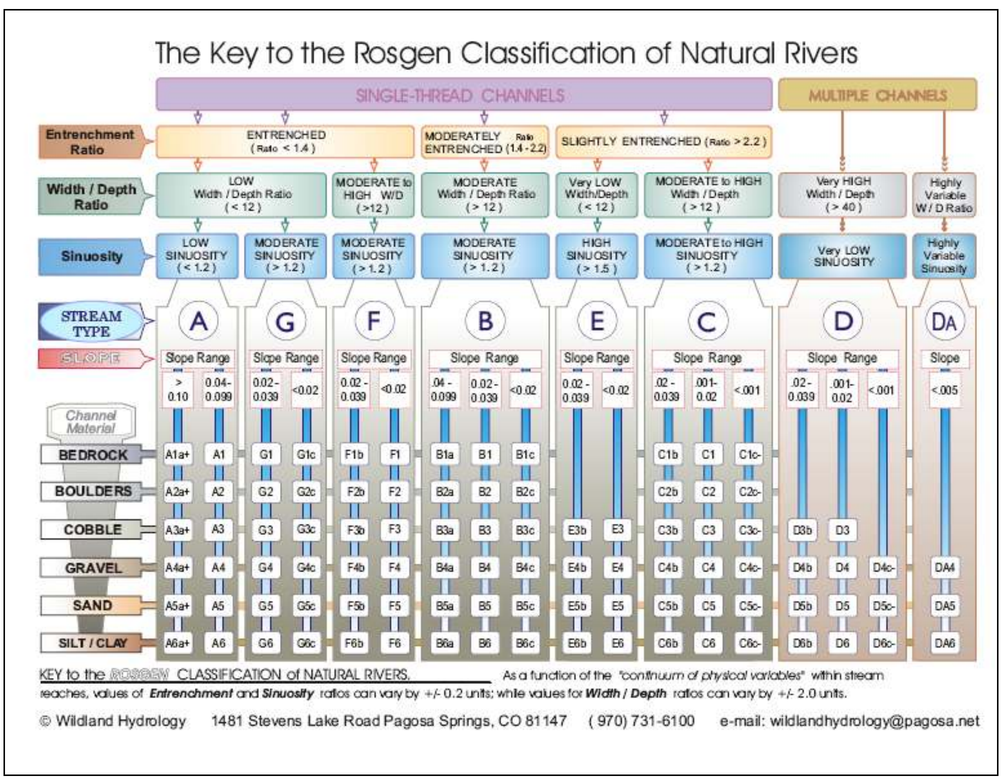
Rosgen, David L. "A classification of natural rivers." Catena 22 (1994): 179. www.wildlandhydrology.com

Generally, A type channels are typically found near the headwaters of mountain streams. Lower gradient B channels are characteristic of streams flowing though alluvial plains and broad mountain valleys below the headwaters. C and E channels tend to be found in lower elevation reaches with broad floodplains and low gradients. Each of these channel type supports different assemblages of aquatic habitats, and each can be important in providing habitat complexity for trout. F and G channels are typically found in areas that have been subjected to some disturbance, such as a flood or significant down-cutting of the stream channel. Frequently, in recovering F type channels, a new C channel will begin to form in the flat bottom of the F channel, establishing a new floodplain at a lower elevation.

The Level 2 classification stratifies dominant substrate composition, and ranges from 1, bedrock or native bed material, to 6, which represents fine particles of less than 1/4" diameter. A diagram of the Level 2 classification is shown on the following page. Level 3 of the Rosgen system includes more detailed gradient and sinuosity values. For example, a Rosgen A3a channel would be a steep (<10%), deeply entrenched, and confined channel that exhibits low width/depth ratios and low sinuosity. Channel materials are typically unconsolidated, non-cohesive materials, dominated by cobbles, but also containing some boulders, gravel and sand. The A3a type is generally found in



landforms associated with slump/earth-flow and debris torrent erosional processes, and would likely exhibit fluvial entrainments, mass wasting of steep adjacent slopes and debris scour. A detailed diagram of the Level 3 Rosgen classification system is shown below. The Rosgen classification system has been widely adopted by water professionals throughout the west, and is a useful tool for evaluation and comparative analysis of similar stream channels and habitat conditions.



Aquatic and Riparian Habitat Assessment Protocols:
Each reach may be assessed separately, in order to characterize existing habitat conditions and evaluate current management and restoration potential. Stream reaches are analyzed using a basin-wide stream habitat survey protocol developed by the US Forest Service and Colorado Division of Wildlife for smaller streams in the Rocky Mountain Region (Winters and Gallagher, 1997). This protocol is a modified basin-scale aquatic habitat inventory based on the Hankin & Reeves survey method. All meso-habitat types within a delineated reach are measured for multiple attributes, including physical dimension, morphic form, bank condition and composition, substrate class, and cover for salmonids. The advantage of the Winters protocol is that it is a repeatable method, and therefore can be used to quantify changes in habitat resulting from management, habitat enhancement, or natural events. A copy of the Winters Protocol is provided as a separate document under this contract.

Aquatic Habitat Survey Results:
The project reach for this study is located in downtown Manitou Springs and is delineated as Reach 11(Map 1). Reach 11 on Fountain Creek encompasses all of Soda Springs Park, beginning at the confluence with Williams Canyon Creek, immediately west of the Spa Building on the eastern boundary of Soda Springs Park. The reach continues upstream 765 feet to the bridge where Park Avenue crosses the creek, at the western boundary of the city park. A rapid assessment of channel morphology and aquatic habitat was undertaken within the reach, and a detailed stream habitat inventory was conducted in March, 2007 on Fountain Creek within the project area. Discharge was measured during the survey at a point approximately in the middle of the project area using a Marsh-McBirney Flow-Mate 2000 flow meter, and was calculated to be 9.73 cubic feet per second, which is within the estimated base flow range for the stream.

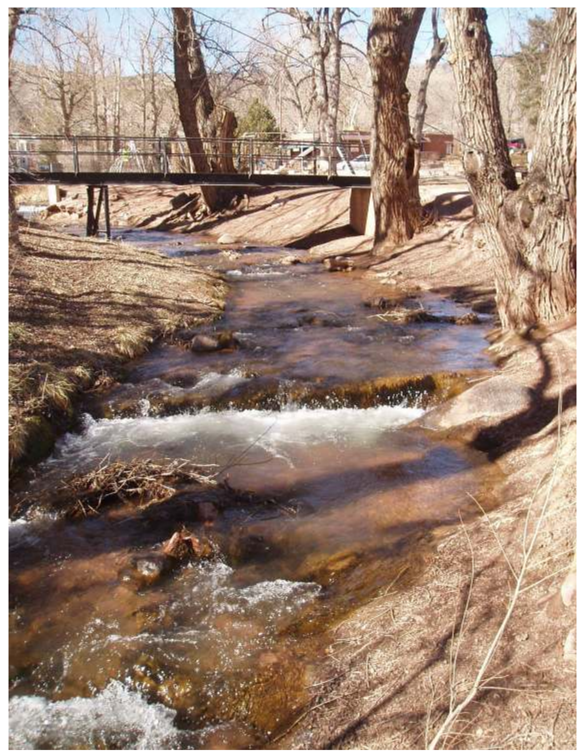


Photo 1: Fountain Creek at Soda Springs Park, Manitou Springs, CO

Reach11:
Reach 11 has been dramatically altered throughout much of its length through channelization and construction of concrete retaining walls on either bank. The middle portion of the reach is characterized by a deeply incised channel through relatively unstable depositional material composed mostly of smaller gravel. The stream exhibits a very narrow valley bottom with minimal riparian green-line, low sinuosity and moderate (2%) gradient, and is classified as a Rosgen G4c. G4 channels tend to be very unstable due to the very high sediment supply available from both upslope and channel derived sources. Several log drop structures are providing a degree of vertical channel stability in the reach (Photo #1).

Initial reconnaissance indicates that Reach 11 exhibits generally poor quality aquatic habitat. Sedimentation from local erosion sources, as well as from sources upstream, are negatively impacting aquatic habitat within the reach.

There were 27 individual meso-habitats measured in the reach (10 pools, 12 riffles and 5 glides), along a length of 765 feet of stream, and comprising a total wetted area of 8,980ft^2. The total area of the reach consisted of 63% riffles and 17% glides, with the remaining 20% consisting of pool habitat (Chart 1). The average wetted width of the stream was 11.2 feet throughout the reach. Due to the presence of the concrete retaining walls, approximately 80% of the stream banks were found to be stable. Stream bank stability outside of the segments confined by retaining walls was exceptionally poor, consisting mostly of bare slopes comprised of sand and gravel sized fragments. There were 225 feet of actively eroding stream banks contributing sediment directly into the stream. This accounted for slightly more than 15% of the total length of banks in the study reach.

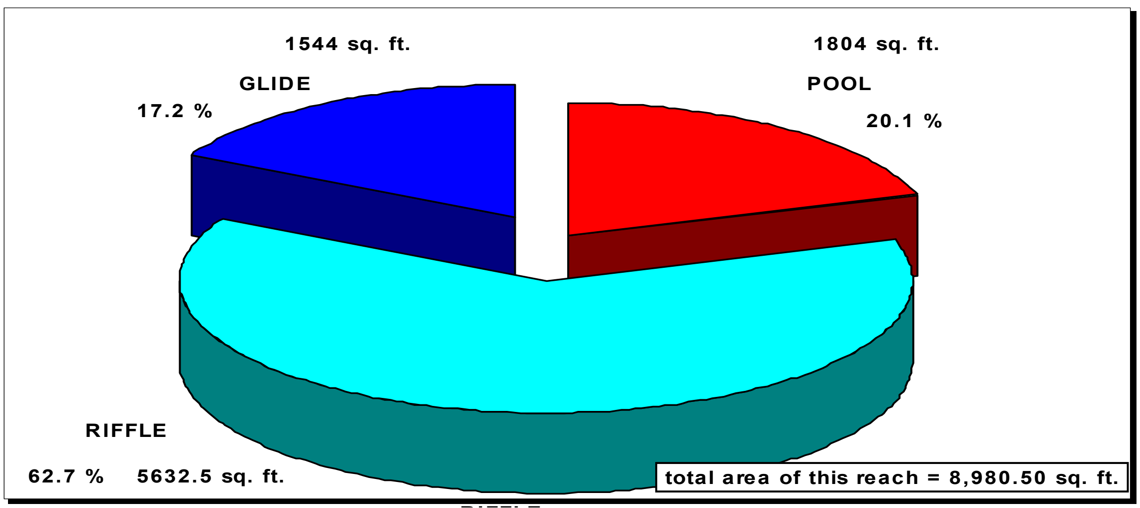


Chart 1 - Distribution of Pool, Riffle and Glide habitats in Reach 11 of Fountain Creek.

Low gradient cobble riffles were the most common habitat type in terms of numbers and area, accounting for 46% of the total reach area (Chart 2). Low gradient riffles can provide good spawning habitat, but are somewhat limited in terms of cover from high flows and predators. Two higher gradient, pocket water dominated riffle types were observed in the reach. Overall, very little cover for trout was observed in the riffles, amounting to less than 0.6% (20 ft^2) of the total wetted area of these habitat types. The average width of all the riffles observed in the reach was 11.5 feet.

Pool habitat is very limited in the reach, with plunge pools being the most abundant (Chart 2). The plunge pools in the reach are principally associated with log-drop structures and boulder, and comprised 13% of the total wetted area of the reach. One lateral scour pool and two trench pools were observed, but these habitats accounted for less than 6% of the total reach. All of the pools exhibited some degree of in-filling of sediment, mostly consisting of smaller particles of decomposed granite. Due to this in-filling of fines, the average pool depth in Reach 11 was barely more than 1/2 foot. Residual pool depth (RPD) in Reach 11 was found to range from 0.5 to 1.6 feet, with an average of 1.0 foot throughout the reach. RPD in the reach is relatively poor, and may limit adequate over-wintering habitat for salmonids and other native species in this reach. Cover for trout accounted for 8% of the total wetted area of the pools, which is quite poor for a stream of this size. The average wetted width of all pool types found within the reach was 11.2 feet.

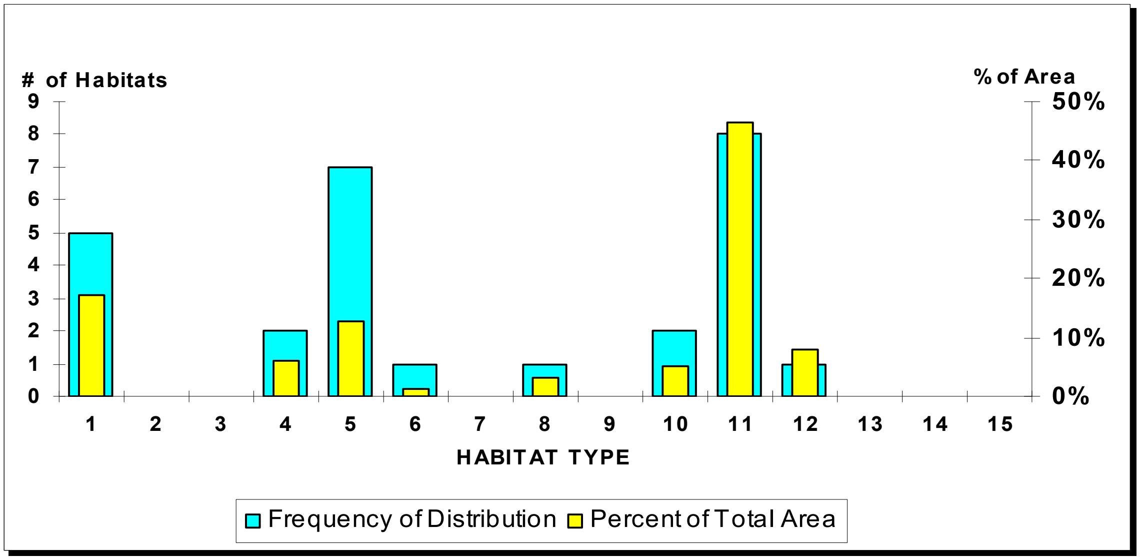


Chart 2 - Distribution of Meso-Habitat Types as a percentage of # of habitats and as a percentage of wetted perimeter of Reach 11 on Fountain Creek.

Glide habitat is present throughout the reach, comprising 20% of the reach. Glide habitat is unusual for this channel type, and is most likely the result of excessive sediment inputs upstream. Most of the glide habitats observed appeared to be former pools that had been completely in-filled with gravel and smaller diameter materials. Cover for trout was extremely limited in these habitats, which are characterized by laminar flow profiles and tend to provide little velocity shelter or protection from predators. The average width of these glide habitats was 11.1 feet.

Cover for adult trout accounted for fewer than 2% of the reach (Chart 3). Available cover appears to be a severely limiting factor to the health of the fishery, and will be addressed in the Habitat Enhancement Plan. Instream object cover (Cover Type 2 - >1' deep) was the dominant type observed in the reach, and was typically associated with the pool habitats. Pool cover (Cover Type 5 - >1.5'deep) was very limited in the reach, and comprised only 2% of the wetted area of the pools and 0.4% of the total reach area. Pool cover is an important indicator for determining the available over-wintering capacity of the stream reach, and appeared to be severely limited in this reach. Combination and overhead cover were the least abundant cover types, due to the lack of streamside vegetation and poor stability of the stream banks. Instream cover could be enhanced in the riffle habitats by adding structure and velocity shelters along the stream banks with strategically placed boulders and large wood. Pool cover may be increased by improving scour in existing pools as well as creating new pool habitats. Overhead and combination cover may be improved throughout the reach through stabilizing and revegetating the eroding stream banks.

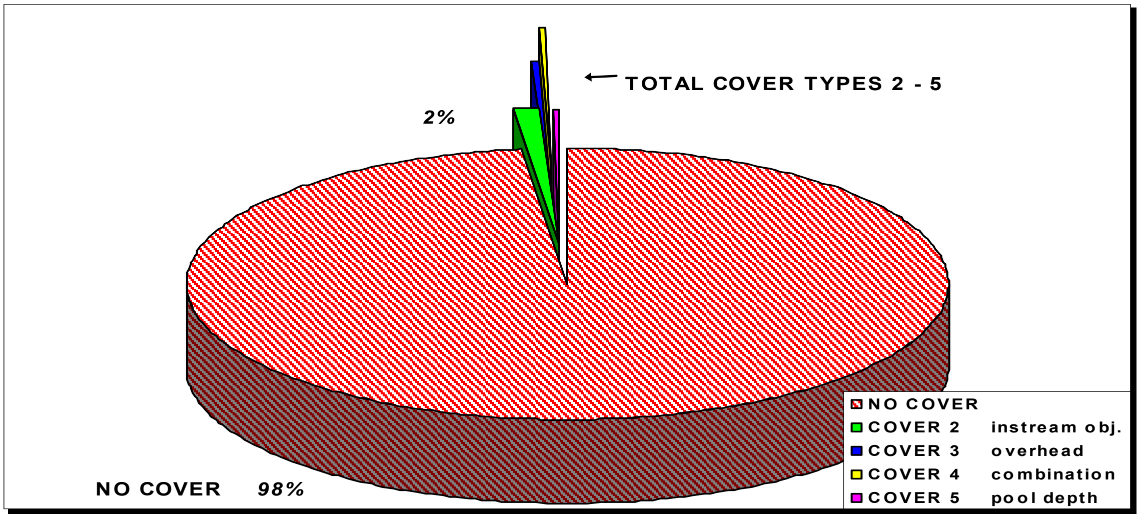


Chart 3 - Percentage of cover for trout to the total wetted perimeter Reach 11 on Fountain Creek.

In the segments not confined by concrete retaining walls, stream bank stability was generally poor, primarily due to lack of vegetation on the steep banks resulting from heavy recreational use. In segments of the reach where access is more difficult, such as the left bank at the steel foot bridge, the stream banks were generally in good condition. Deeply rooted, streamside riparian vegetation is a critical component in maintaining the integrity of stream banks during runoff and other high flow events. Fifty-two percent of the left bank and 11% of the right bank were found to be vegetated and stable. 41% of the left bank and 52% of the right banks were confined by concrete retaining walls. The remaining 7% of the left bank and 37% of the right bank were found to be unstable. (Chart 4). Bank rock content consisted either of concrete (Type 2) or mostly of sand and smaller fragments (Type 7), with small accretions of larger material and rip-rap (Chart 5).

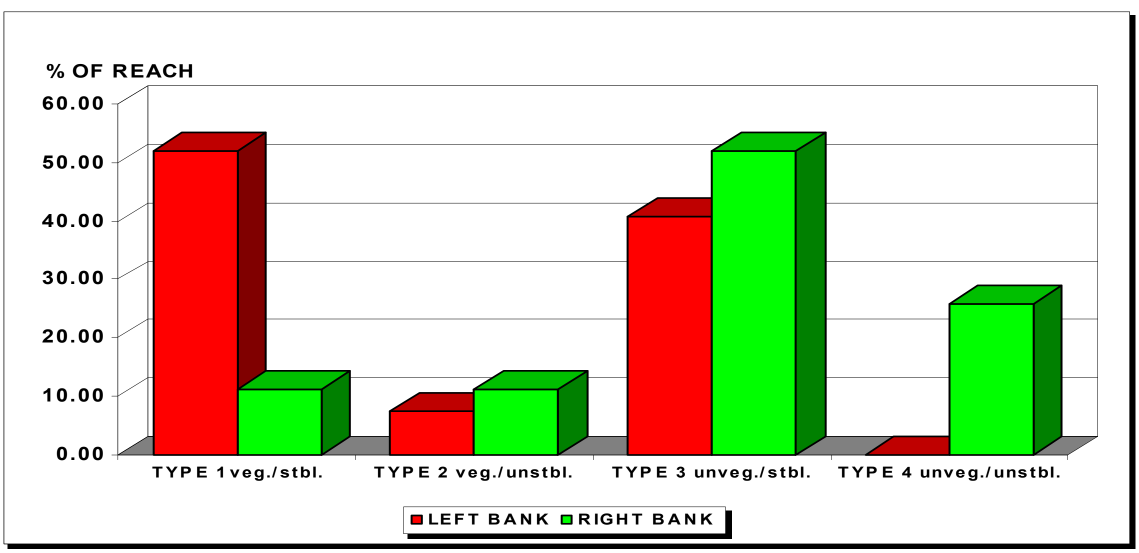


Chart 4 - Percentage of stable banks to unstable banks in Reach 11 on Fountain Creek.

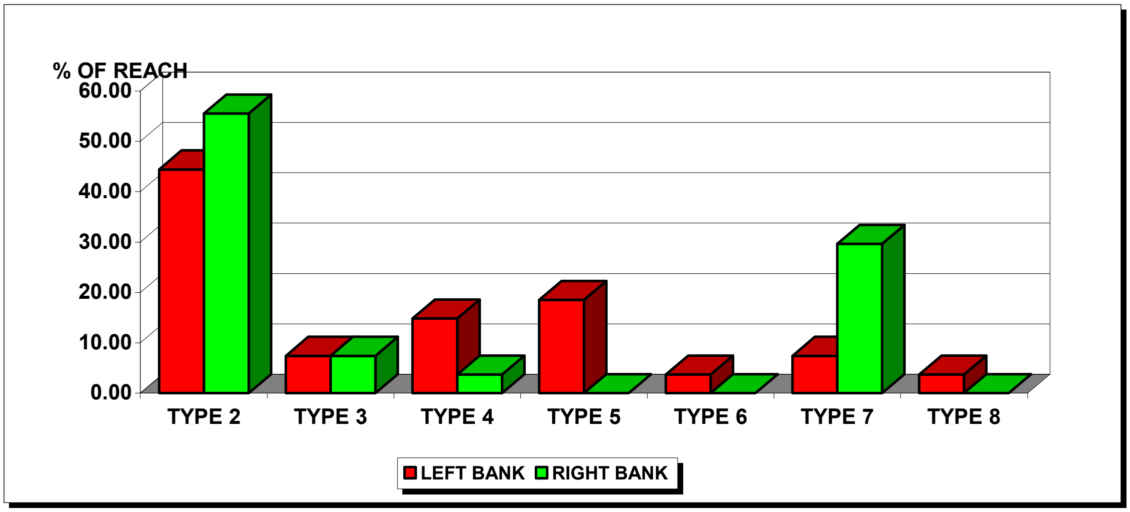


Chart 5 - Percentage of bank rock content sizes in Reach 11 on Fountain Creek.

The general reach substrate was calculated using a Wolman pebble Count (Bevenger, 1997) and the results are shown in Table 2. A tri-modal distribution of smaller particles (fines) small gravel, and larger boulder is apparent in the pebble count data (Chart 6), and suggests that sediment inputs to the stream may exceed the capacity of the stream to move the material. Large wood (>4" diameter and > 3' long) is somewhat scarce in the reach, with only six pieces being observed. All of these pieces were associated with log-drop structures. Large wood is an important habitat forming component for rivers in the Rocky Mountains, and provides cover and complexity to the aquatic ecosystem, but may not be desirable for use in an urban environment such as Reach 11.

Wolman Pebble Count		Class	Dot & Dash Count	Total	% of	Cumulative
Metric - mm	Inches	Name	: . = 3, : : = 9	Number	Total	%
.125-.25		Fine			0.0%	0.0%
.25-.50		Medium		27	25.5%	25.5%
.50-1.0		Coarse		6	31.1%	31.1%
1.0-2.0		Very Coarse		6	6	36.8%
2.0-4.0		Very Fine		2	38.7%	38.7%
4.0-8.0		Fine		10	48.1%	48.1%
8.0-16	.08-.6	Medium		21	67.9%	67.9%
16-32	.6-1.3	Coarse		4	71.7%	71.7%
32-64	1.3-2.5	Very Coarse		8	2	73.6%
64-128	2.5-5.0	Small		12	84.9%	84.9%
128-256	5-10	Large		3	87.7%	87.7%
256-512	10-20	Small		2	89.6%	89.6%
512-1024	20-40	Medium		7	96.2%	96.2%
1024-2048	40-80	Large		4	100.0%	100.0%
2048-4096	80-160	Very Large			0.0%	100.0%

Table 2 - Results of the Wolman Pebble Count, showing distributions of substrate size classes in Reach 11 on Fountain Creek.

Aquatic habitat conditions throughout Reach 11 were generally very poor. Limiting factors to the fishery appear to be excessive sedimentation due bank erosion and sediment from upstream areas, poor quality pool habitat, and limited in-channel object cover in the low gradient riffles. Several problem areas were identified during the course of the inventory that should be addressed in order to alleviate potential worsening problems and loss of habitat, as well as to help the river achieve its full potential as a cold water fishery.

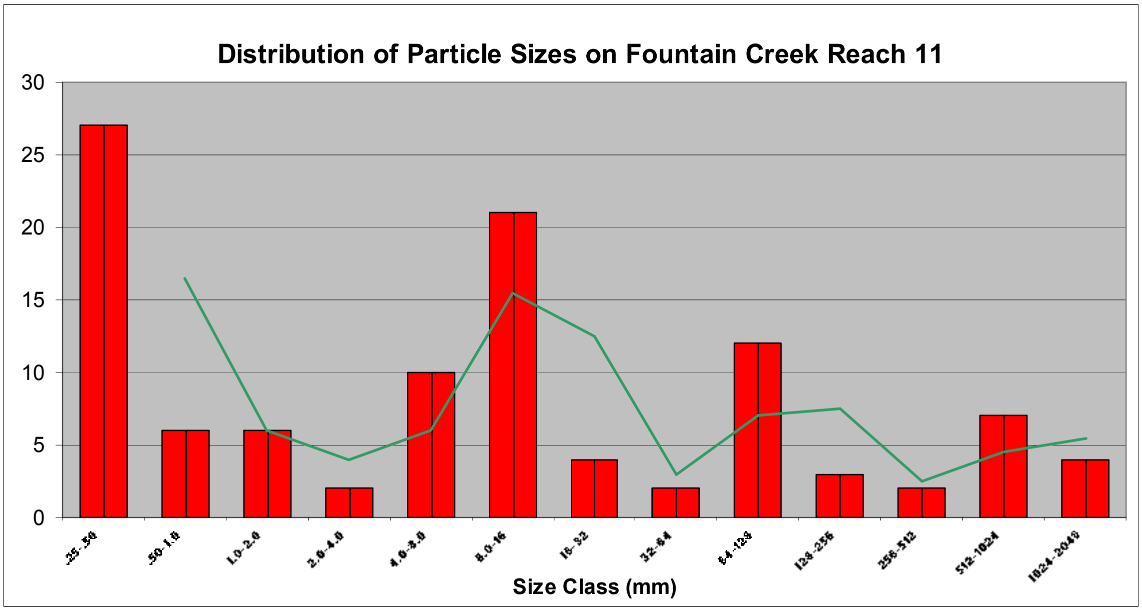


Chart 6 - Distribution of particle size classes distribution of sand and larger cobbles and boulder in Reach 11 on Fountain Creek.

Photo 2: Plunge Pools #3 and 4. near the Confluence with Ruxton Creek.

Aquatic Habitat Enhancement Plan for Fountain Creek - Reach 11.
The reach of Fountain Creek flowing through Soda Springs Park in Manitou Springs presents a real challenge for restoration of the channel, stream banks, and associated aquatic and riparian habitats. Several factors will constrain any effort to return the stream to its natural hydrologic function. These include the inability to significantly change the dimension, pattern or profile of the channel through the reach, due to urban development along the stream banks, and the existence of utilities running under the stream in several areas. There are, however, some improvements that may enhance the stream corridor, both in terms of hydrologic and habitat function, as well as the esthetic values of the reach.

The enhancement plan has been divided into four priorities, based on immediate restoration needs, visual/esthetic enhancement, maximization of in-channel habitat improvement, and feasibility/difficulty of implementation. Dividing the project into four distinct segments allows for project implementation based on available funding and public support. If adequate funding for the entire project cannot be secured, the City may have the option of implementing stream improvements on a priority basis.

The four priority restoration efforts include stream bank stabilization and re-vegetation, in-channel stream habitat enhancement, relocation of the playground and removal of the concrete retaining wall from the upstream segment of the reach, and in-channel structural enhancements in the concrete confined channel below the stone bridge. The following section will address these priorities, and give specific recommendations and treatments to enhance aquatic habitat conditions throughout the reach. A site plan showing the locations of the proposed enhancements can be found in the Appendix.

Priority 1: Stabilization of Eroding Stream Banks in Reach 11.
The aquatic assessment indicates that stream bank erosion within Soda Springs Park is a significant contributing factor for sedimentation of pool habitats in the reach. Heavy recreational pressure continues to further erode these banks. Visually and esthetically, the bare gravel stream banks are detrimental to the overall park values, and may constitute a safety hazard, due to the unstable nature of the decomposing granitic material comprising these steep sided slopes.

The assessment identifies 217 feet of unvegetated, actively eroding stream bank on the right (north) side of the stream between Pool #5 and Glide #3 that may be stabilized and revegetated using a combination of techniques (Photo 3). First, the toe-slope along this segment of the reach will need to be stabilized through the anchoring of large diameter wood (10"-16"DBH) and boulder (1/2 - 2/3cy) at the base of the stream bank (see design drawings #5 & #10 - Appendix). This method of toe-slope stabilization will create a small bank-full bench on which riparian plants such as willow and sedge may be planted, further armoring the base of the stream bank. Due to the entrenched nature of the G channel, care must be taken in the installation of these toe slope structures so as not to further constrict the cross-sectional area of the stream channel throughout this segment.

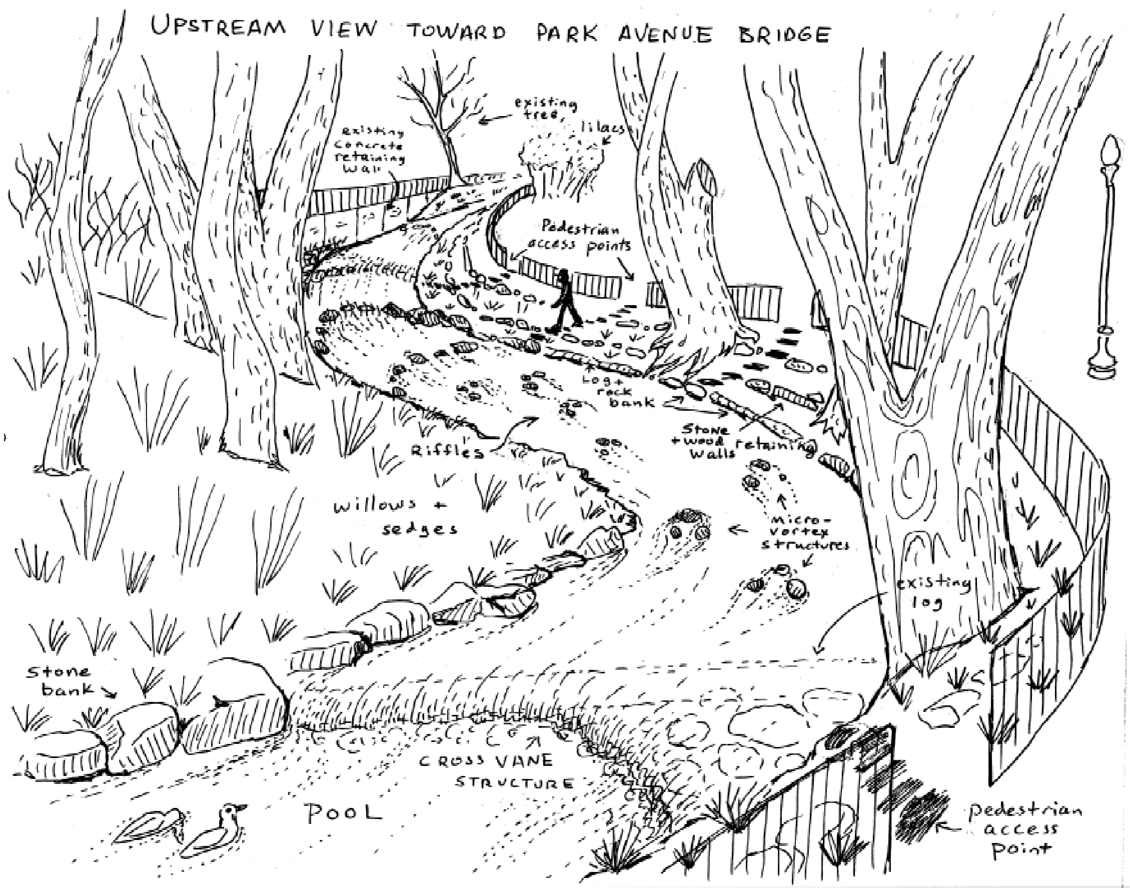
In addition to toe-slope stabilization, the upper portion of the right stream bank between Pool #5 and Glide #3 may be revegetated by constructing one or two terraces using existing stone walls and landscape timbers. These terraces will reduce the velocity of storm water entering the creek from the park, and will allow for stabilization with upland woody vegetation such as mountain mahogany, native grasses and sedge. These areas will require additional top soil and erosion control fabric in order to allow the newly planted vegetation to become established.

Photo 3: Actively Eroding Stream Banks in the Middle of Reach 11 - Fountain Creek.

Access to Fountain Creek has been identified as an important public concern (Thomas & Thomas, 2006). Unfortunately, uncontrolled recreational access to the creek is the principal contributor to poor stream bank condition and aquatic/riparian habitat function in Soda Springs Park. We recognize that streamside access is an important component of the visitor experience in Soda Springs Park, and it is not the objective of this plan to eliminate access to the stream. There will be a need however, at least in the short term, to protect the restored stream banks until adequate vegetation has become established. Ideally, seven access routes have been identified, that will allow park visitors access to the stream. These paths may be constructed using stone and/or landscape timbers, providing a hardened access route to specific segments of the stream enhanced in Priority 2 below. Larger, woody plants and shrubs may be planted along the edges of these paths, to further encourage users to stay on the trail. Once at the stream, park visitors may move upstream and down without restriction (Artist Drawing #1).

In order to direct park visitors to the stream access paths and further protect the restored stream banks, it is recommended that the existing wrought iron fence near the stone bridge be extended along the top of the stream bank to the west end of the park.

Openings can be created where the stream access trails intersect the fence-line, allowing visitor access to the stream.



Drawing #1: Artist's Rendering of Bank Stabilization and Channel Habitat Improvements
Steven J. Wood - Public Art Associates, 2007

In addition to the stream bank restoration on the right side of the channel, a small segment of the left bank between Pool #6 and Pool #7 will require similar toe-slope stabilization and bank revegetation. This segment of the bank is currently layered with large slabs of concrete rip-rap. It is recommended that this concrete be removed from the bank, or broken into smaller pieces that can be embedded into the bank and planted over with native vegetation. Additionally, a small portion of the old stone retaining wall on the right bank immediately upstream of the stone bridge (Pool #4) has collapsed, and will need to be repaired.

Priority 2: Channel Habitat Enhancements throughout the upstream 2/3rds of the Project Reach.

The assessment has identified excess sedimentation and lack of cover as severely limiting the available habitat for trout in Reach 11. Boulder associated plunge pools in the vicinity of the stone bridge have become filled with sediment. Several log drop structures upstream are currently providing limited pool habitat in the reach, but due to

Drawing #2: Bank Stabilization and Channel Habitat Improvements Upstream of the Stone Bridge - **Steven J. Wood - Public Art Associates, 2007**

the inherent tendency of this structure type to over-widen the stream channel, these habitats occupy only a very small length along the stream channel. Additionally, one of these log drop structures currently protects a partially exposed utility pipe crossing the stream channel. The log drop structure immediately downstream of this structure has failed, causing the channel to head-cut back to this log drop structure. At present, the log drop is undercut approximately one foot, and is at risk of failure.

Several of the log-drop plunge pools and most of the glide habitats may benefit from conversion to or installation of cross-vanes and minor excavation of some of the stored sediments. Cross vanes reduce sheer stress along the stream banks by focusing the energy into the center of the channel. Cross vanes will help to further stabilize the vertical profile of the channel in the reach, and enhance scour in the pools to maintain adequate depth along a greater length of the stream channel. The log drop structure at the utility crossing at Pool #9 may be stabilized by reinforcing the structure through construction of a boulder cross vane immediately downstream of the log. Additionally, the failed drop log structure at Glide #3 will need to be reconstructed, as well as possibly another cross vane in Riffle #9, in order to create a stable, pocket water associated cascade between Riffle #10 and Glide #3. This work will not only protect the utility crossing, but will convert Glide #3 to pool habitat, and eliminate a potential migration barrier at the Pool #9 log-drop structure.

The boulder associated plunge pools in the vicinity of the stone bridge and the confluence of Ruxton Creek may be further improved by adjusting the existing boulders to improve scour. Minor dredging of deposited sediments may be required in Pool #3 and Pool #4, and may be accomplished at the same time as the adjustment of the boulders. Any sediment excavated from the channel will need to be completely removed from the site and stored in a location consistent with federal and state regulations. Enhancement of Pool #3 and Pool #4 will provide excellent fishing viewing opportunities for park visitors entering the park along the stone bridge, and an interpretive sign describing the stream ecosystem and enhancement project should be considered here (Artists Drawing #2).

In-channel object and overhead cover in the low gradient riffle habitats may be enhanced through the selective placement of bank-side boulders and the large wood toe-slope stabilization efforts described in Priority #1. Small boulder micro-vortex structures should be installed along Riffle #8, both upstream and downstream of the steel footbridge. These structures will not only provide additional pocket water, cover and velocity shelter for resident salmonids, but also additional viewing opportunities for park visitors.

Conceptual drawings and photos of actual cross-vanes and micro-vortex structures may be found in the Appendix. Each enhancement is listed in order of progression from the downstream boundary of the reach, not necessarily in order of priority. The following habitat and channel stability enhancements are recommended, but are not as critical a priority as the work described in Priority #1.

1. Adjust existing boulders to form a cross vane underneath the stone bridge at Pool #3. Excavate accumulated sediment from the pool and remove from the site.
2. Adjust existing boulders to form a cross vane immediately upstream of the confluence with Ruxton Creek at Pool #4. Excavate accumulated sediment from the pool and remove from the site.
3. Install interpretive signage at the stone bridge.
4. Adjust existing boulders to improve scour and protect eroding stream banks at Pool #5.
5. Use existing boulders to redefine riffle crest at log-drop Pool #7. Construct a rock vane on the right bank, and tie this structure into the existing log to create a cross vane.
6. Install six to eight micro-vortex structures in Riffle #8 upstream and downstream of the steel bridge.

7. Use existing boulders to re-define the riffle crest at the upstream boundary of Riffle #8. This work will further enhance the new pool constructed at Glide #3.
8. Reconstruct the failed log drop structure at Glide #3 through installation of a boulder cross vane. Excavate accumulated sediment from the pool and remove from the site.
9. Reinforce existing log-drop structure protecting utility crossing at Pool #9 through construction of boulder cross vanes to create a continuous pocket water cascade between Pool #9 and Glide #3.
10. Construct a boulder cross vane at the upstream boundary of Pool #10, further enhancing scour in this meso-habitat and converting Glide #4 to pool habitat.
11. Install a boulder cross vane at Glide #5, to further augment pool habitat in the reach. Integrate the structure with the existing boulder embedded in the historic stone wall on the right bank.
12. Adjust existing boulders in Riffle #12 to provide velocity shelter and pocket water habitat.

Priority 3: Removal of the Playground Concrete Retaining Wall and Reconstruction of Natural Stream Bank.

The Fountain Creek Restoration Committee has proposed that the playground on the west end of Soda Springs Park be relocated, allowing the concrete retaining wall to be removed along this segment of the creek. Removal of the concrete wall will allow us to reconstruct a more natural stream bank along this segment, increasing the length of stream available to the public, increasing bank side overhead cover and velocity shelter for fish, and increasing channel cross section area to reduce sheer stress and stream

Photo 4: Playground Retaining Wall and Utility Crossing at Log Drop Pool 9

Photo 5: Historic Stone Wall and Interface with Concrete Retaining Wall at Glide 5

power during flood events. We propose to remove approximately 150' of the concrete wall, from Glide #3 upstream to Glide #4. Care will need to be taken in demolition of the concrete wall, to protect the historic wall immediately upstream and the utility crossing at Pool #9 At the utility crossing, it may be best to cut the wall at the bank-full elevation, and leave the segment anchoring the log and pipe in place (Photo 4). We recommend that the wall be cut at a downward angle where it ties to the existing stone wall to provide stability for this structure (Photo 5). The right stream bank will need to be sloped back to a similar angle as the downstream restored stream bank in Priority #1, and stabilized using the same toe-slope and revegetation techniques described above. The willow covered island upstream of Pool #9 can be removed, and the vegetation will be transplanted along the newly constructed stream bank. Two additional stream access paths have been identified to be installed in this segment to provide for visitor access to the stream.

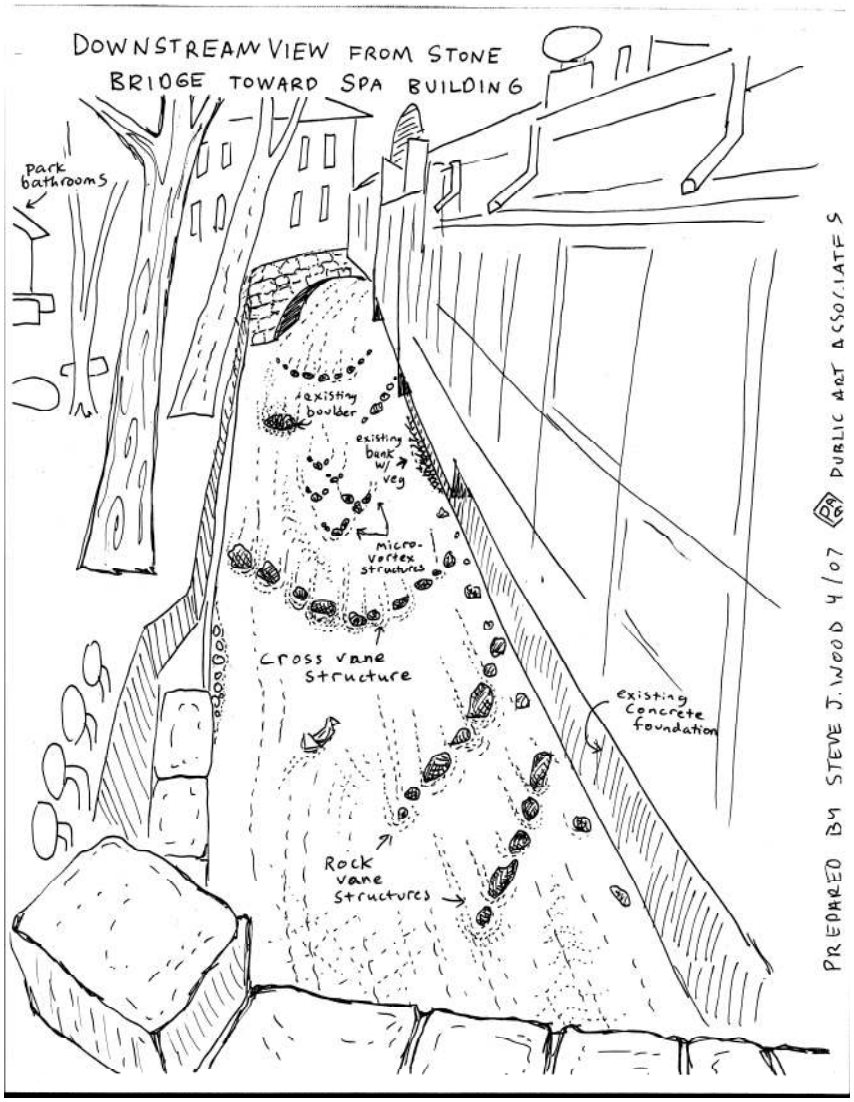
Priority 4: Installation of Habitat Features and Flow Deflectors in the Concrete Retaining Wall Confined Channel Downstream of the Stone Bridge.
Improvements in this segment of the reach represent the greatest challenge for aquatic enhancement in Soda Springs Park. The stream has been straightened and channelized by concrete retaining walls on either side of the channel (Photo 6). Useable aquatic habitat is extremely limited in this segment, and the foundations of several of the buildings overhanging the channel on the left bank appear to be threatened by high flow sheer stress. Enhancing the stream through this segment may help reduce some of the foundation erosion risk along the left bank, and provide a unique fish-viewing experience for customers of businesses such as Kinfolks, the Ancient Mariner, and Mate Factor, where the windows in the back of these establishments look directly down on the stream. While there is somewhat greater risk in working in this segment, the potential benefits may warrant consideration in implementing this portion of the enhancement project.

Photo 6: Concrete Retaining Wall Channel Downstream of the Stone Bridge - XS#1.

We propose to enhance the natural habitat features already present in this segment through strategic placement of small cross vanes, J-hook vanes and micro-vortex structures. Full channel cross vanes will provide vertical stability in the channel, helping to prevent undercutting of the building foundations. The smaller J-hook vanes will be installed along left bank to direct the thalweg away from and reduce sheer stress along the foundation walls, and to protect a utility crossing immediately upstream of Pool #2. Micro-vortex rock clusters may be installed within the riffle meso-habitats to provide critical velocity shelter and holding areas for trout along this severely confined segment (Artists Drawing #3).

Because the channel is confined by concrete retaining walls on both sides, tying structures to the bank will be problematic, because these structures cannot be anchored deep into the bank. In addition to making certain that these structures are not constructed higher in the channel than the bank-full stage, it is recommended that triple footers be used, particularly where the structure meets the concrete retaining wall. This technique is similar to efforts successfully employed to protect a dinosaur trackway in Picketwire Canyon within the Comanche National Grassland in southeastern Colorado (see Appendix photos).

Work in this segment will require a very small piece of equipment and an experienced operator to perform the work without damaging the buildings overhanging the stream channel on the left side of the stream. Equipment will need to be walked into the site from upstream, passing underneath the stone bridge. This will limit us to no larger than an 8,000lb excavator. It will be critical to gain the support of the businesses along Manitou Avenue adjacent to this segment before the work can be implemented.



Drawing #3: Channel Habitat Improvements and Foundation Protection Downstream of the Stone Bridge
Steven J. Wood - Public Art Associates, 2007

Conceptual drawings and photos of the structure types recommended for this segment may be found in the Appendix. Each enhancement is listed in order of progression from the downstream boundary of the segment, not necessarily in order of priority.

1. Install a full channel cross vane at Glide #1, integrating the structure into the existing large boulder in the stream channel. Perform minor excavation of accumulated sediment downstream of the structure and remove from the site. This structure will provide important vertical profile stability in the channel, protecting the utility crossing upstream at Pool #1, and the foundation on the left bank, as well as providing fish viewing opportunities from Kinfolks.

2. Install rock vane along the left bank of Pool #1 to further protect foundation wall and utility crossing.
3. Install several micro-vortex boulder clusters along Riffle #3
4. Install a full channel cross vane near the upstream boundary of Riffle #3. This structure will provide additional vertical profile stability in the channel, as well as increasing overall pool habitat in the reach. This structure should be visible from dining tables along the windows in the back of the Ancient Mariner.
5. Install two J-hook rock vanes along Riffle #4 to protect foundation on the left side of the stream from direct pressure from thalweg as it emerges from the pool under the stone bridge.

Photo 7: Example of a Boulder Cross Vane Structure - Fountain Creek at 21st Street.

Project Implementation Schedule:
Preliminary estimates are that this work would take approximately two to three weeks to complete, and would require the use of a 20-35K lb excavator with a hydraulic thumb, a smaller 8K lb excavator with a hydraulic thumb, and a front end loader. Approximately 225 yd^3 of large rock will likely need to be imported into the site in order to complete the work. Additionally, approximately 10 - 15 cottonwood or other trees, averaging 10"-16" DBH, will need to be secured to complete the toe-slope stabilization work. A preliminary budget estimate for completing all four priority segments is included in the appendix. This estimate should not be construed as a fixed cost proposal to complete the project by FIN-UP Habitat Consultants, Inc., and is provided solely for planning and fund-raising purposes for the City and the Fountain Creek Restoration Committee (FCRC).

Goals and Objectives of Habitat Restoration in Reach 11

- Stabilize and re-vegetate 347 feet of actively eroding stream bank. Create nine access paths to the stream to focus recreation use along the stream channel. Re-plant approximately 4,740 ft^2 of denuded stream banks within the reach.

- Create 150ft of new riparian bank-full bench and adjacent floodplain by removing the playground retaining wall in the upstream segment of the reach.

- Increase pool habitat by 75% in the reach by converting sediment filled glide habitats back to self scouring pool habitat through the use of cross vanes and other structure.

- Increase average pool depth by 50%. Increase residual pool depth by 25%. Increase deep water pool cover in the pool meso habitats by 100% (37 square feet) by excavating fines from existing pools and conversion of glides back to pools.

- Increase riffle pocket water cover by 100% through installation of 6 micro-vortex structures in the higher gradient riffle habitats and increased depths along the perimeter of the pool habitats.

- Protect approximately three hundred feet of foundation walls along the stream channel downstream of the stone bridge. Protect two utility crossings within the reach.

- Create multiple fish viewing areas within the park. Install interpretive sign describing aquatic/riparian ecosystems and the enhancement efforts near the stone bridge.

- **Glossary of Terms:**

Benthic Zone - The benthic zone is the lowest level of a body of water. It is inhabited mostly by organisms that tolerate cool temperatures and low oxygen levels, called benthos or benthic organisms.

Cascade - A meso-habitat type. Cascades are the steepest riffle habitat types, in terms of gradient, in streams. These riffles consist of alternating small waterfalls and shallow pools. These habitats may appear to have the characteristics of a Step-pool system. Cascades are characterized by swift current flows and often have exposed rocks and boulders above the water surface, which creates considerable turbulence and surface agitation. The substrate normally found in cascades is bedrock or accumulations of boulders.

Cover - Locations where fish prefer to rest, hide and feed are called cover. Cover serves to visually isolate fish, which increases the number of territories in the same space. Additionally, cover can create areas of reduced velocities providing critical resting and feeding stations for fish. The amount of cover available in a stream can influence the production of a number of fish and invertebrate species.

Cross-Vane - A structure spanning the entire width of the channel, constructed of large boulders and/or large wood, that provides vertical stability, increased scour, increased stage upstream, and reduced stream power. This structure type is commonly used as a diversion structure for irrigation ditches, as well as for treating active down cutting and head cuts in the stream channel.

Embeddedness - The degree to which the interstitial spaces between larger substrate particles are filled with finer sediments. Embeddedness tends to armor the substrate, thus limiting available habitat for benthic dwelling macroinvertebrates and spawning habitat for salmonids.

Glide - A meso-habitat type. Glides are those portions of streams which have relatively wide uniform bottoms, low to moderate velocity flows, lack pronounced turbulence, and have substrates usually consisting of either cobble, gravel or sand. Glides are usually described as stream habitat with characteristics intermediate between those of pools and riffles. These habitats are commonly found in the transition between a pool and the head of a riffle, however they are occasionally found in low gradient stream reaches with stable banks and no major flow obstructions.

Green Line - A narrow band of riparian plant species immediately adjacent to the stream bank in deeply entrenched streams. These are typically streams that have no identifiable flood plains.

Head-Cut - An area of active down-cutting in the channel where a river or stream is eroding down to a new, lower flood plain.

Intermittent - An intermittent stream is one that only flows for part of the year.

Lotic - Of, relating to, or living in moving water such as streams and rivers.

Meso-Habitat - A channel scale habitat form. Typically a pool, riffle, rapid, cascade or glide habitat. A meso-habitat occupies the entire width of the stream channel, and with few exceptions (most notably plunge pools in high gradient step-pool systems) is at least as long as the channel is wide.

Micro-Habitat - Micro habitats are small, site specific habitats within a meso-habitat form, and may include spawning redds, in-stream or overhead cover, and velocity shelters.

Micro-Vortex - A small rock cluster structure that replicates pocket water habitat in riffles, rapids and cascades.

Over-Wintering Habitat - Areas of a stream or water body exhibiting depths that may sustain a population through the winter months.

Perennial - A perennial stream is one that flows year round.

Pocket Water - A micro-habitat type. Pocket water habitats are typically found in higher gradient riffles, rapids, and cascades with large cobble, boulder, and large woody debris. These pocket water habitats provide small areas for velocity shelter and cover within these fast-water habitat forms.

Pool - A meso-habitat type. Pools are channel segments exhibiting areas of scour and deposition where the water is deeper and slower moving.

Primary Producers - Primary producers are those organisms in an ecosystem that produce biomass from inorganic compounds. In almost all cases these are photosynthetically active organisms.

Rapid - A meso-habitat type. Rapids are riffles associated with high gradients (greater than 4%) with swiftly flowing (greater than 1.5 ft/sec), moderately deep, and highly turbulent waters. These riffles are generally associated with boulder substrates, which protrude through the surface of the water.

Residual Pool Depth (RPD) - Residual pool depth is estimated as the depth of water which would be retained in a pool under highly reduced flows or the stoppage of flows in the stream. This area of pools would be utilized by fish in low flow conditions. Residual pools would also provide habitat for overwintering of fish when ice buildup restricts movement in riffles or glides between pools. Residual pool depth is calculated by locating and measuring the greatest depth of the pool at the riffle crest (deepest point of the downstream boundary cross-section of the pool), and subtracting this value from the greatest measured depth of the pool habitat. The difference in these measurements is described as the RPD. RPD may be difficult to determine in some habitats, particularly dam pools with woody debris structural associations. In many of these habitat units, the RPD may actually be a very low value or zero due to water flowing through these debris dams.

Riffle - A meso-habitat type. Riffles are those areas of the stream in which turbulence in the water column is the major identifying characteristic, as a result of relatively high gradients. These units contain moderately deep to shallow, swift flowing water, and are characterized by boulder or cobble substrates. Riffles are very important for macroinvertebrate production, due to the availability of light and oxygen, and the corresponding vegetative growth on the bottom substrate. The quality of riffles, including low sediment deposition and resulting embeddedness can have a direct impact on fish populations. The cleaner and healthier the vegetative growth and benthic macroinvertebrate community, the more food there is for the fish population.

Salmonids - Salmonidae is a family of ray-finned fish, the only family of order Salmoniformes. It includes the well-known salmons and trouts; the Atlantic salmons and trouts of genus Salmo give the family and order their names.

Subfamily - Salmoninae
- Brachymystax - lenoks
- Oncorhynchus - Pacific salmon and trout
- Salmo - Atlantic salmon and trout
- Salvelinus - Char and trout (Brook trout, Lake trout)

Substrate - Stream substrate (sediment) is the material that rests at the bottom of a stream.

Thermal Refugia - Micro habitats found in streams and lakes that provide thermal protection for cold water species such as trout. These may include shaded areas, cool water springs, and deep water habitats.

Toe-Slope - The foot, or bottom, of the sloping bank of a stream. This is the area of the highest sheer stress and erosion potential on a stream bank, and is typically the point of failure leading to mass wasting and collapse.

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APPENDIX

Project Area Map - Including locations of proposed treatments

Longitudinal Profiles of Reach 3

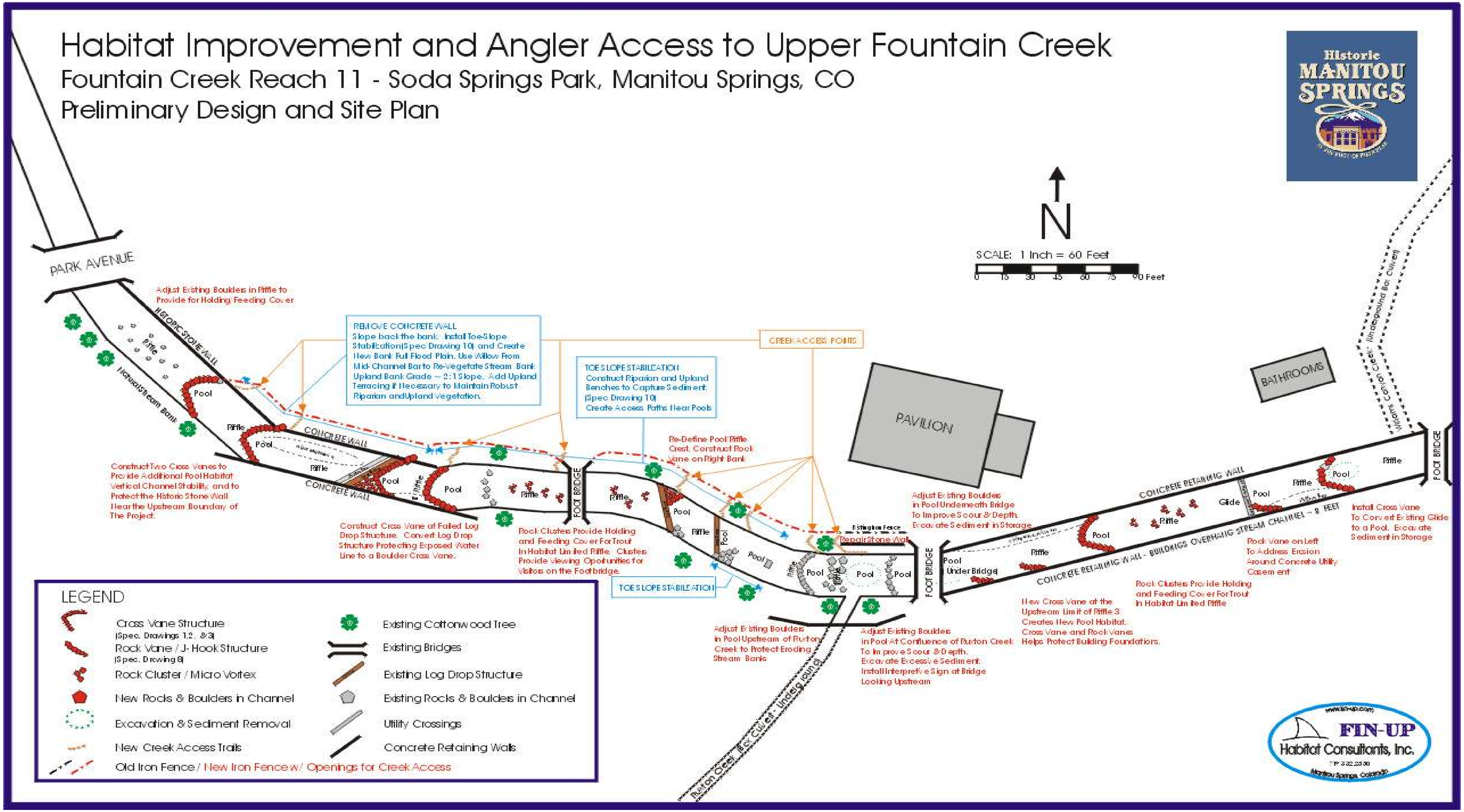
Cross - Sections

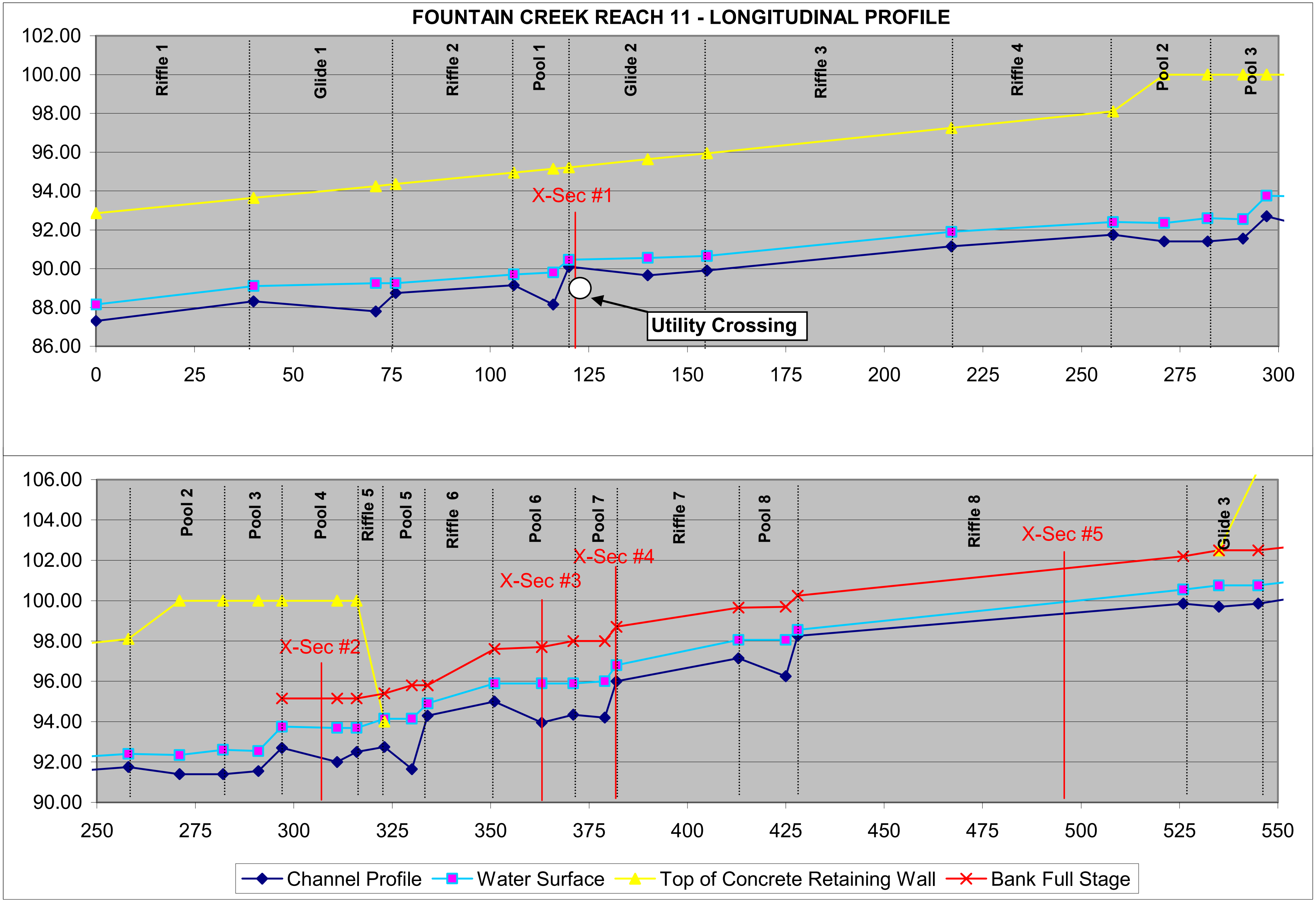
Proposed Treatments Designs and Conceptual Drawings

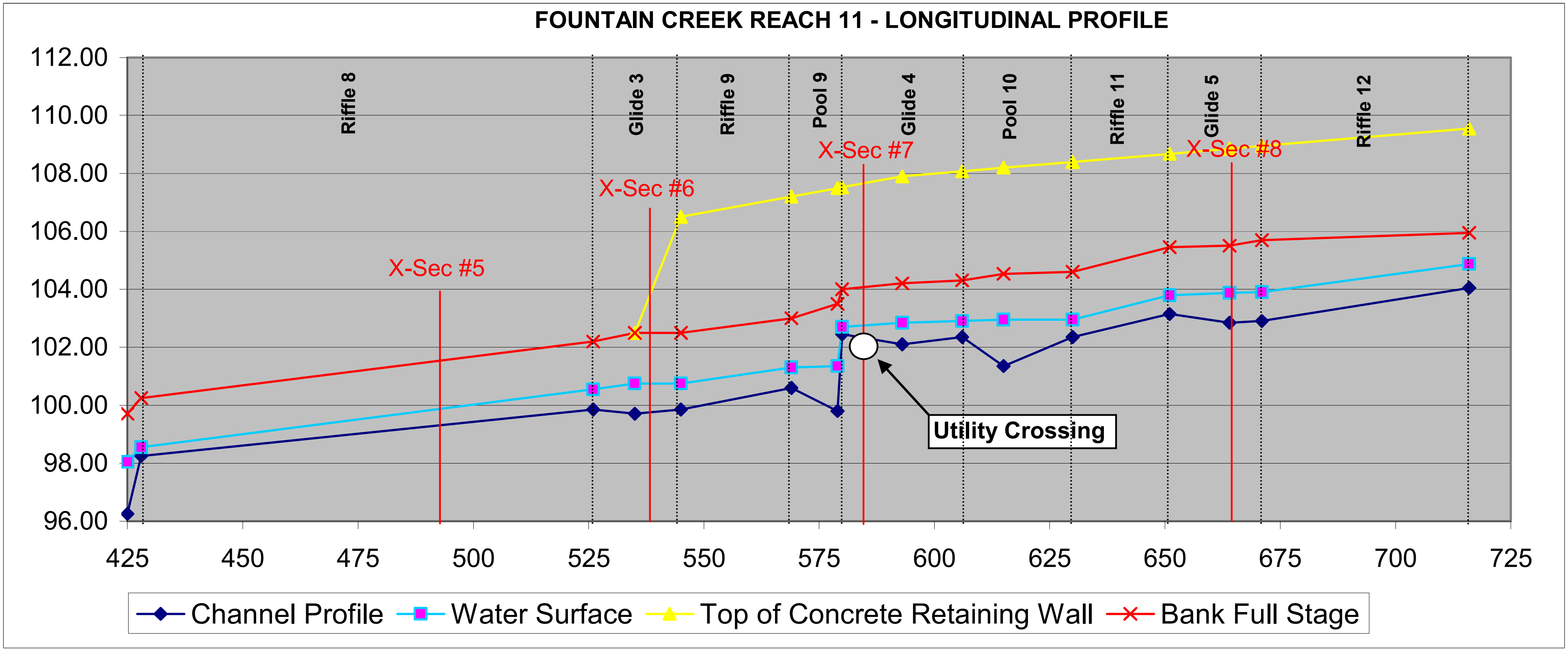
Photographs of Proposed Treatment Types

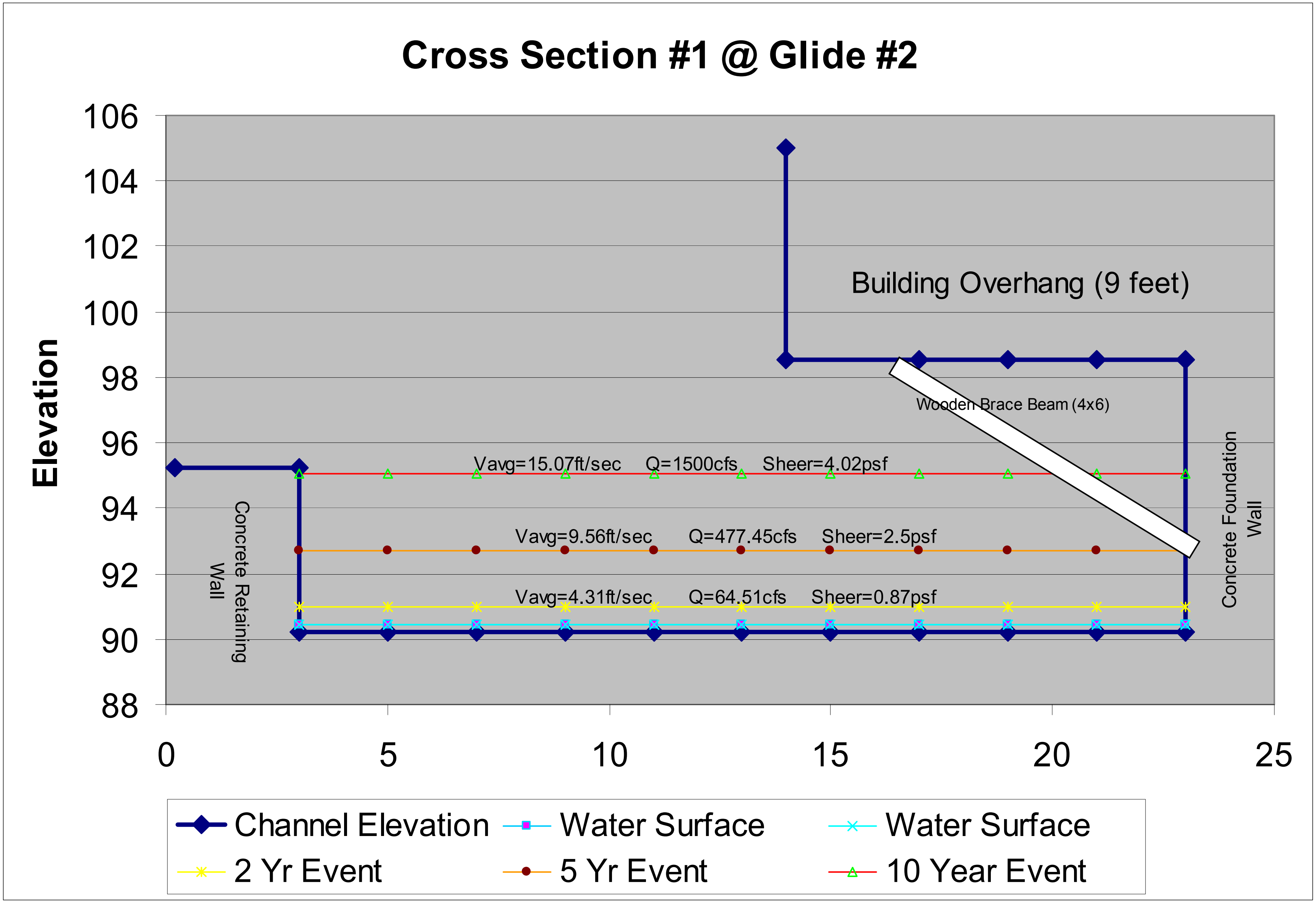
Stream Inventory BWSHI Data Sheets and Summaries

Winters / Gallagher Basinwide Stream Habitat Survey Protocol Documentation

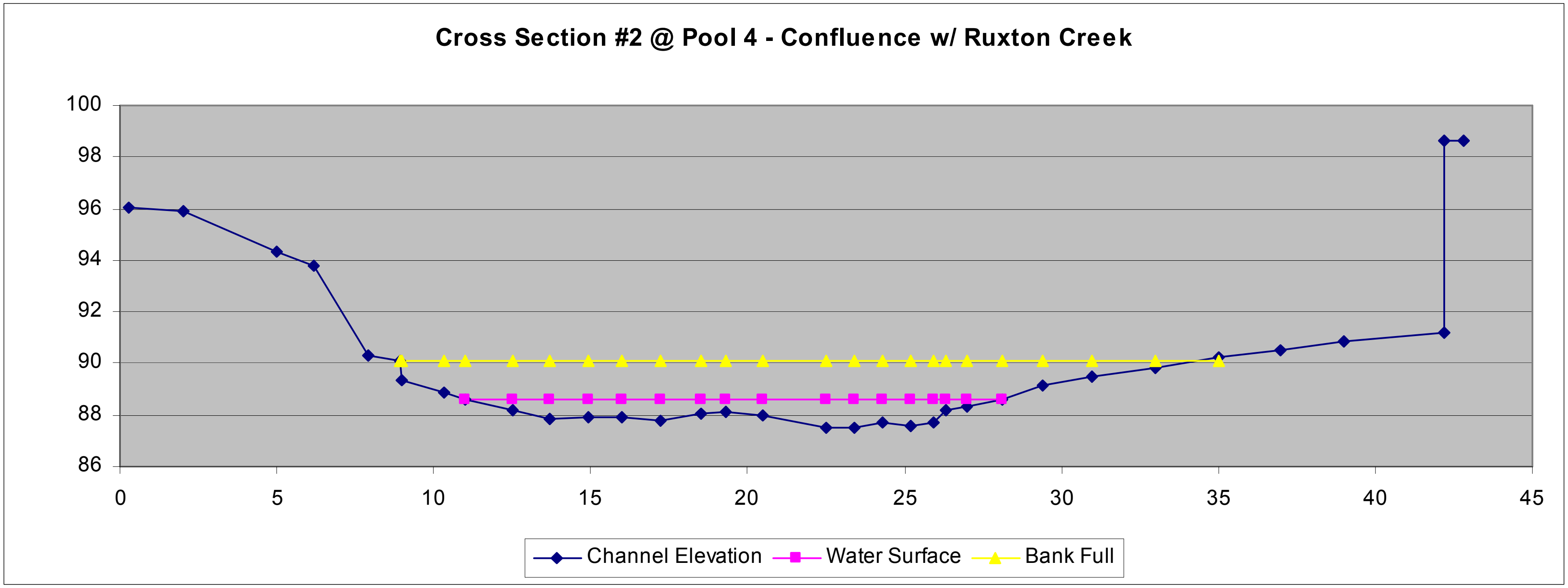

Habitat Improvement and Angler Access to Upper Fountain Creek
Fountain Creek Reach 11 - Soda Springs Park, Manitou Springs, CO
Preliminary Design and Site Plan
Historic MANITOU SPRINGS
N
SCALE: 1 Inch = 60 Feet
0 15 30 45 60 75 90 Feet
PARK AVENUE
HISTORIC STONE WALL
Natural Stream Bank
Adjust Existing Boulders in Riffle to Provide for Holding/ Feeding Cover
REMOVE CONCRETE WALL
Slope back the bank. Install Toe-Slope Stabilization(Spec Drawing 10) and Create New Bank Full Flood Plain. Use Willow From Mid-Channel Bar to Re-Vegetate Stream Bank. Upland Bank Grade ~ 2:1 Slope. Add Upland Terracing if Necessary to Maintain Robust Riparian and Upland Vegetation.
CREEK ACCESS POINTS
TOE SLOPE STABILIZATION
Construct Riparian and Upland Benches to Capture Sediment. (Spec Drawing 10)
Create Access Paths Near Pools
Re-Define Pool/Riffle Crest. Construct Rock Vane on Right Bank
PAVILION
BATHROOMS
Williams Canyon Creek: Underground Box Culvert
CONCRETE WALL
Construct Two Cross Vanes to Provide Additional Pool Habitat Vertical Channel Stability, and to Protect the Historic Stone Wall Near the Upstream Boundary of The Project.
Construct Cross Vane at Failed Log Drop Structure. Convert Log Drop Structure Protecting Exposed Water Line to a Boulder Cross Vane.
Rock Clusters Provide Holding and Feeding Cover For Trout In Habitat Limited Riffle. Clusters Provide Viewing Opportunities for Visitors on the Footbridge.
FOOT BRIDGE
TOE SLOPE STABILIZATION
Existing Iron Fence
Repair Stone Wall
Pool
Riffle
Glide
Pool Under Bridge
Adjust Existing Boulders in Pool Underneath Bridge To Improve Scour & Depth. Excavate Sediment in Storage
CONCRETE RETAINING WALL
CONCRETE RETAINING WALL - BUILDINGS OVERHANG STREAM CHANNEL ~ 8 FEET
Install Cross Vane To Convert Existing Glide to a Pool. Excavate Sediment in Storage
Rock Vane on Left To Address Erosion Around Concrete Utility Casement
Rock Clusters Provide Holding and Feeding Cover For Trout In Habitat Limited Riffle
New Cross Vane at the Upstream Limit of Riffle 3 Creates New Pool Habitat. Cross Vane and Rock Vanes Helps Protect Building Foundations.
Adjust Existing Boulders in Pool Upstream of Ruxton Creek to Protect Eroding Stream Banks
Adjust Existing Boulders in Pool At Confluence of Ruxton Creek To Improve Scour & Depth. Excavate Excessive Sediment. Install Interpretive Sign at Bridge Looking Upstream
Ruxton Creek Box Culvert: Underground
LEGEND
Cross Vane Structure (Spec. Drawings 1,2, & 3)
Rock Vane / J-Hook Structure (Spec. Drawing 8)
Rock Cluster / Micro Vortex
New Rocks & Boulders in Channel
Excavation & Sediment Removal
New Creek Access Trails
Old Iron Fence / New Iron Fence w/ Openings for Creek Access
Existing Cottonwood Tree
Existing Bridges
Existing Log Drop Structure
Existing Rocks & Boulders in Channel
Utility Crossings
Concrete Retaining Walls
www.fin-up.com
FIN-UP Habitat Consultants, Inc.
Manitou Springs, Colorado

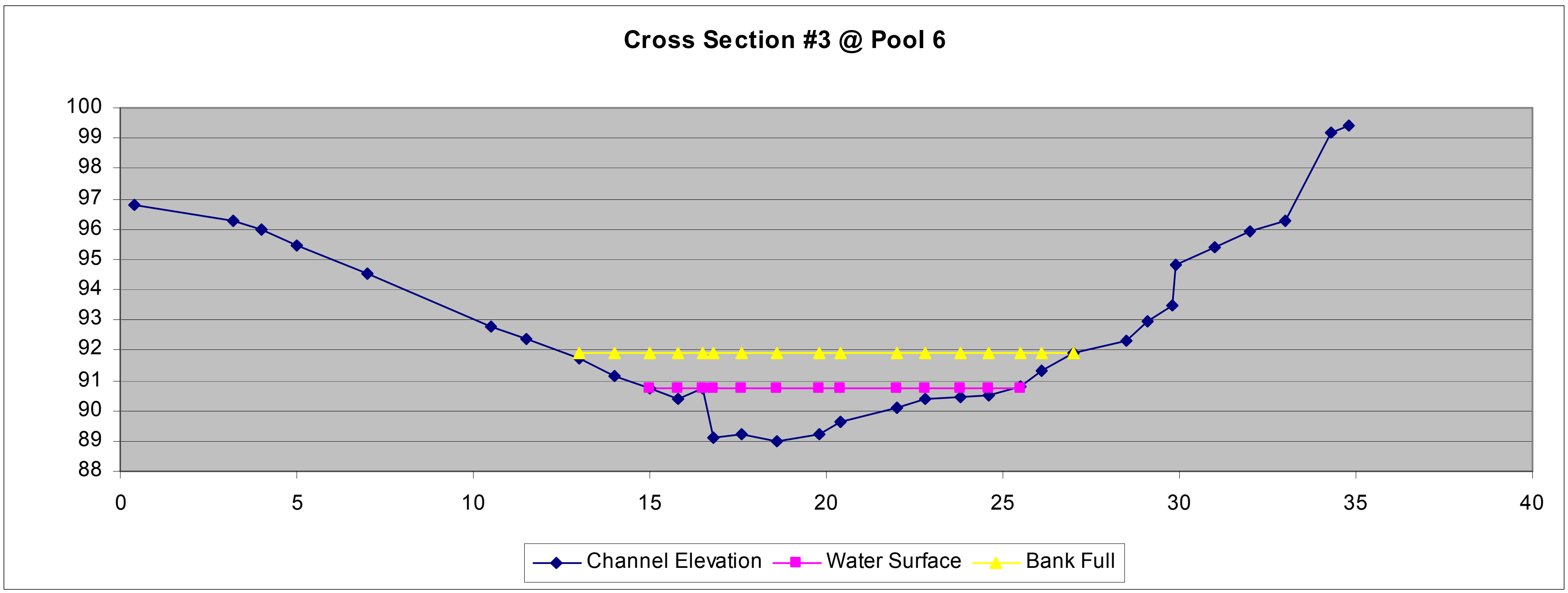

FOUNTAIN CREEK REACH 11 - LONGITUDINAL PROFILE
Riffle 1
Glide 1
Riffle 2
Pool 1
Glide 2
Riffle 3
Riffle 4
Pool 2
Pool 3
X-Sec #1
Utility Crossing
Pool 4
Riffle 5
Pool 5
Riffle 6
Pool 6
Pool 7
Riffle 7
Pool 8
Riffle 8
Glide 3
X-Sec #2
X-Sec #3
X-Sec #4
X-Sec #5
Channel Profile
Water Surface
Top of Concrete Retaining Wall
Bank Full Stage

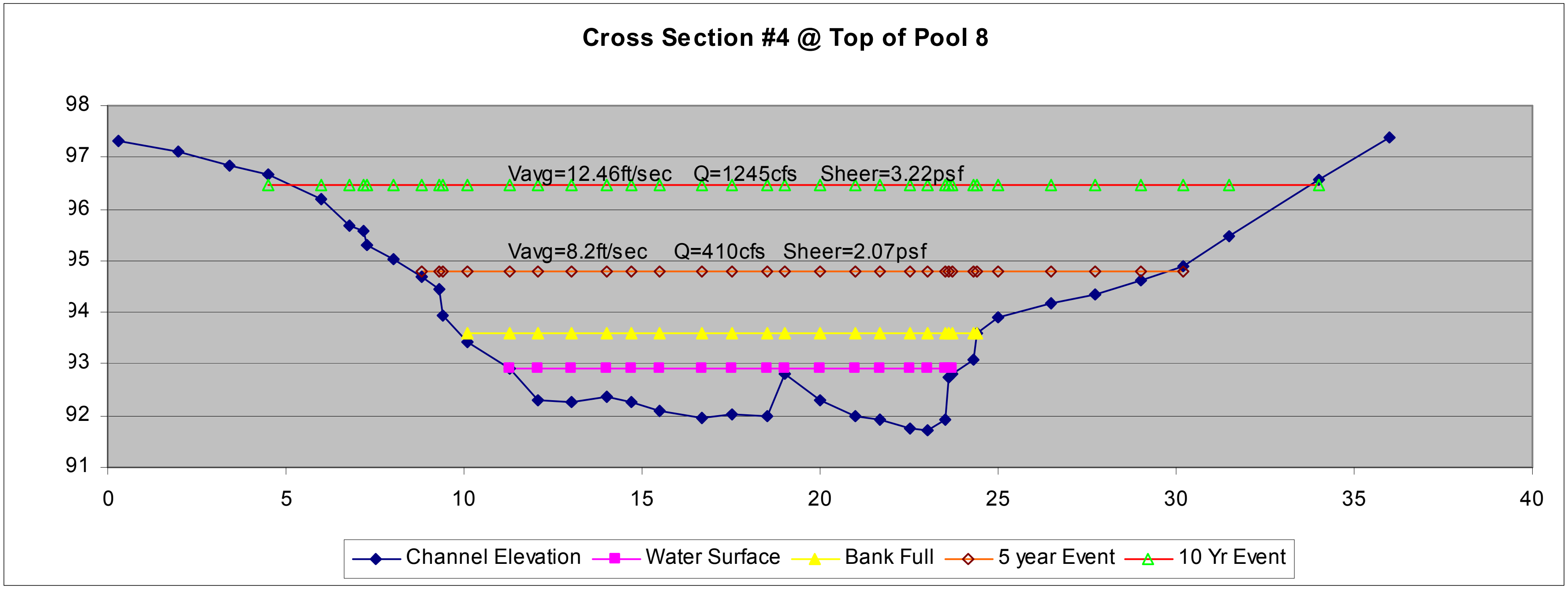

FOUNTAIN CREEK REACH 11 - LONGITUDINAL PROFILE
112.00
110.00
108.00
106.00
104.00
102.00
100.00
98.00
96.00
425
450
475
500
525
550
575
600
625
650
675
700
725
Riffle 8
Glide 3
Riffle 9
Pool 9
Glide 4
Pool 10
Riffle 11
Glide 5
Riffle 12
X-Sec #5
X-Sec #6
X-Sec #7
X-Sec #8
Utility Crossing
Channel Profile
Water Surface
Top of Concrete Retaining Wall
Bank Full Stage

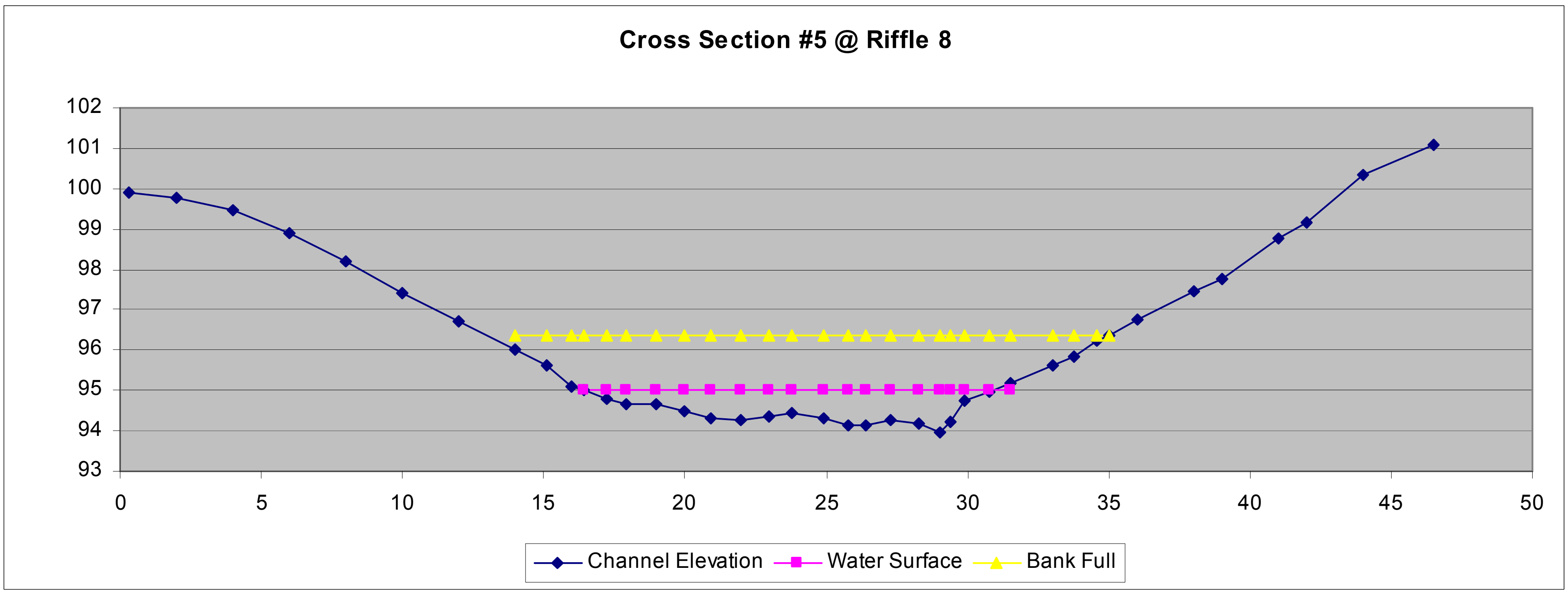


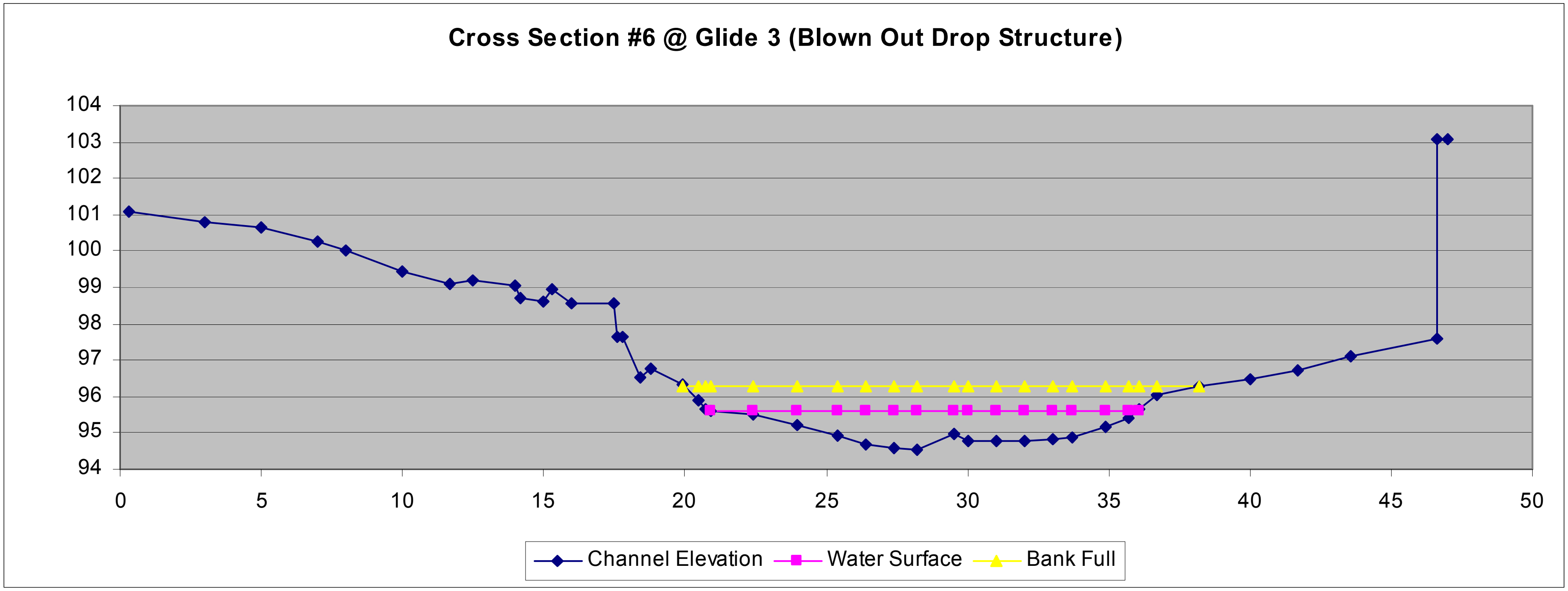
Cross Section #1 @ Glide #2
Elevation
106
104
102
100
98
96
94
92
90
88
0
5
10
15
20
25
Building Overhang (9 feet)
Wooden Brace Beam (4x6)
Vavg=15.07ft/sec Q=1500cfs Sheer=4.02psf
Vavg=9.56ft/sec Q=477.45cfs Sheer=2.5psf
Vavg=4.31ft/sec Q=64.51cfs Sheer=0.87psf
Concrete Retaining Wall
Concrete Foundation Wall
Channel Elevation
Water Surface 2 Yr Event
Water Surface 5 Yr Event
Water Surface 10 Year Event

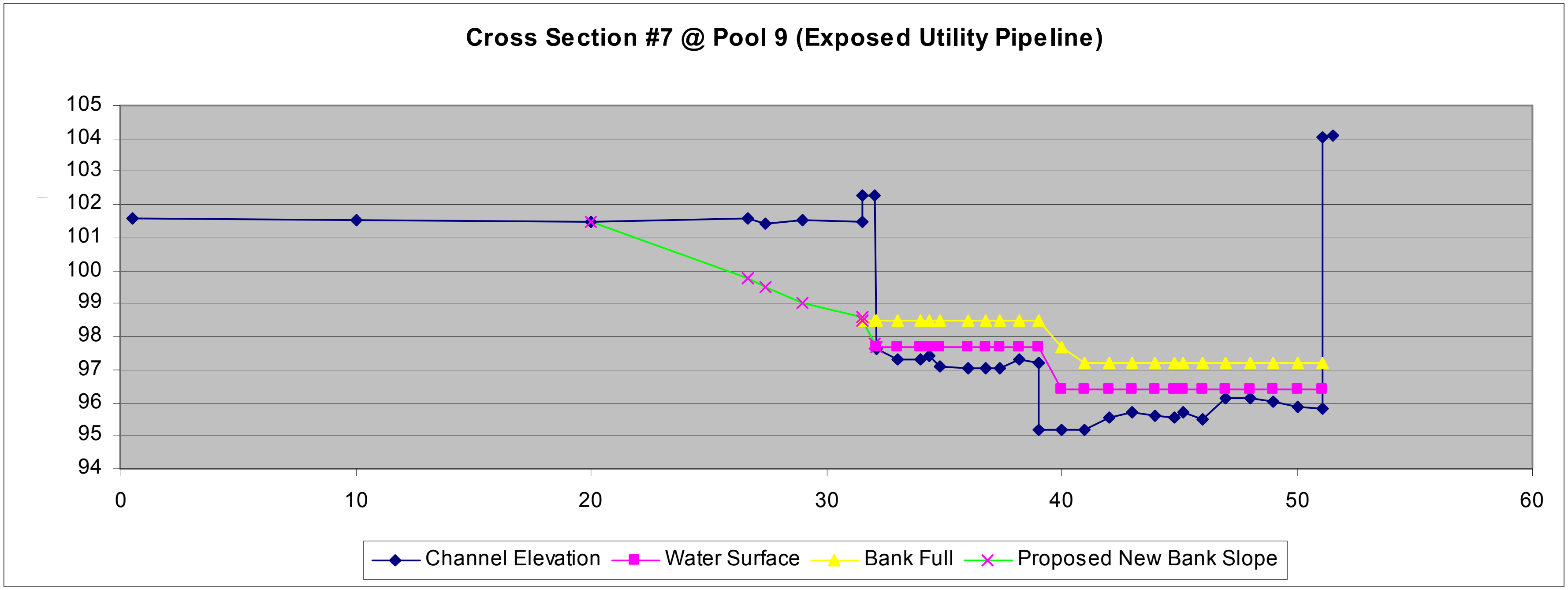

Cross Section #2 @ Pool 4 - Confluence w/ Ruxton Creek
100
98
96
94
92
90
88
86
0
5
10
15
20
25
30
35
40
45
Channel Elevation
Water Surface
Bank Full

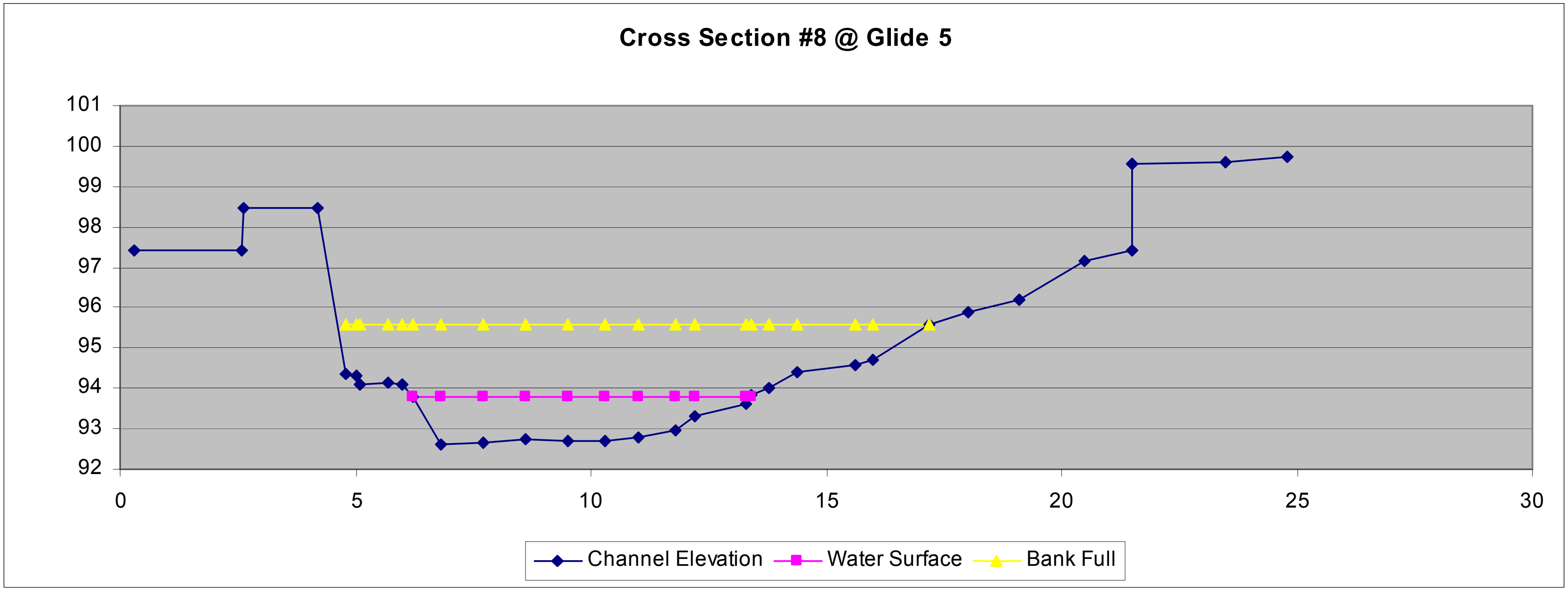

Cross Section #3 @ Pool 6
100
99
98
97
96
95
94
93
92
91
90
89
88
0
5
10
15
20
25
30
35
40
Channel Elevation
Water Surface
Bank Full


Cross Section #4 @ Top of Pool 8
Vavg=12.46ft/sec Q=1245cfs Sheer=3.22psf
Vavg=8.2ft/sec Q=410cfs Sheer=2.07psf
98
97
96
95
94
93
92
91
0
5
10
15
20
25
30
35
40
Channel Elevation
Water Surface
Bank Full
5 year Event
10 Yr Event

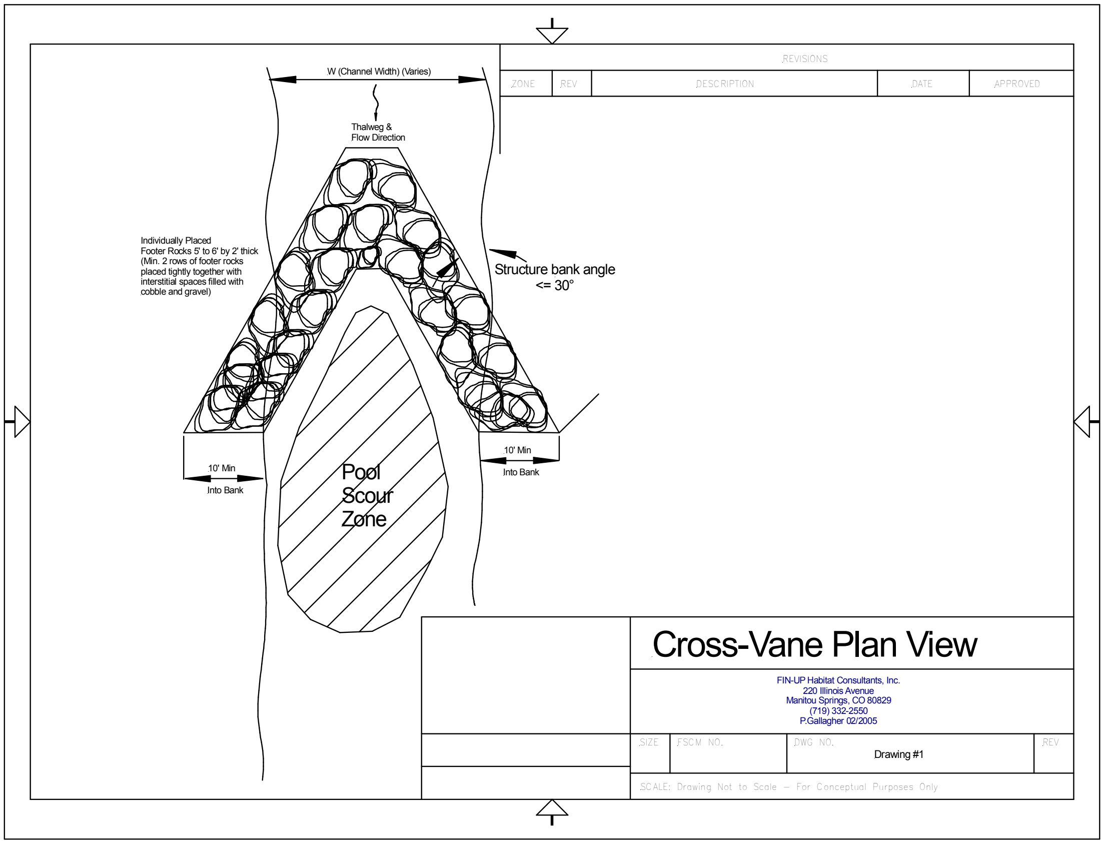

Cross Section #5 @ Riffle 8
102
101
100
99
98
97
96
95
94
93
0
5
10
15
20
25
30
35
40
45
50
Channel Elevation
Water Surface
Bank Full

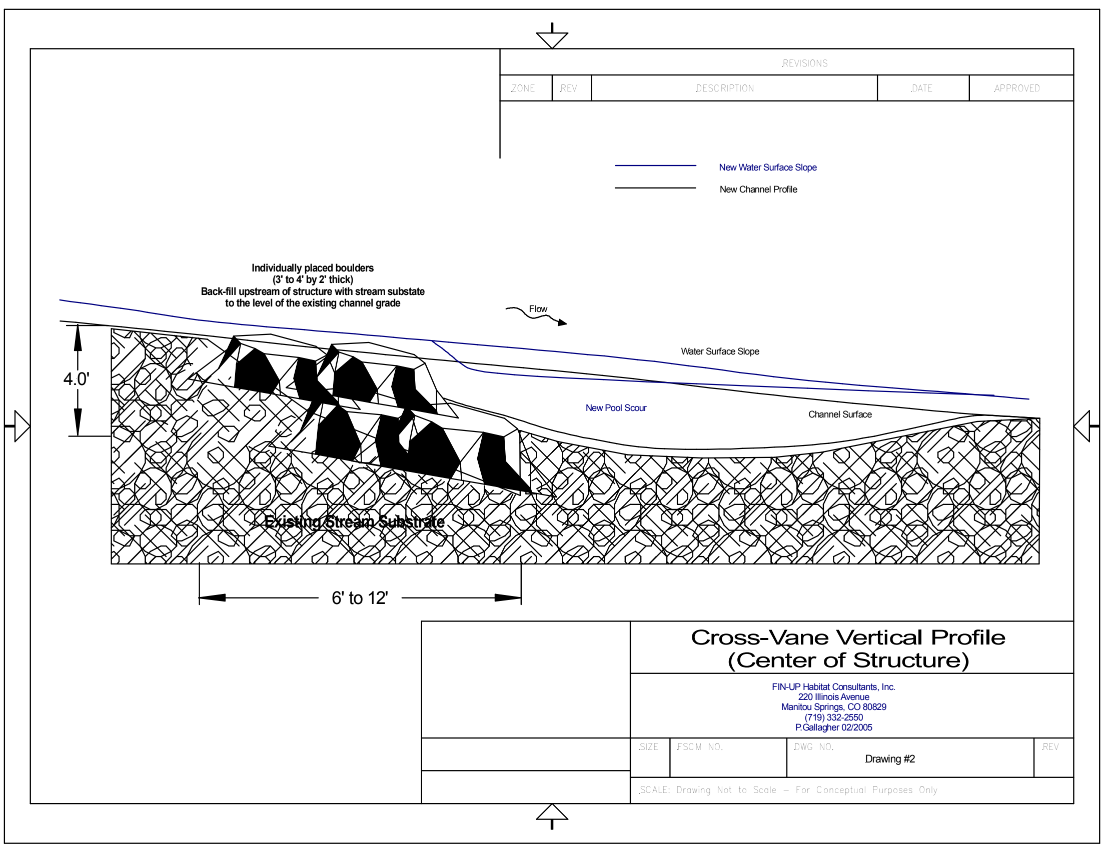

Cross Section #6 @ Glide 3 (Blown Out Drop Structure)
Channel Elevation
Water Surface
Bank Full

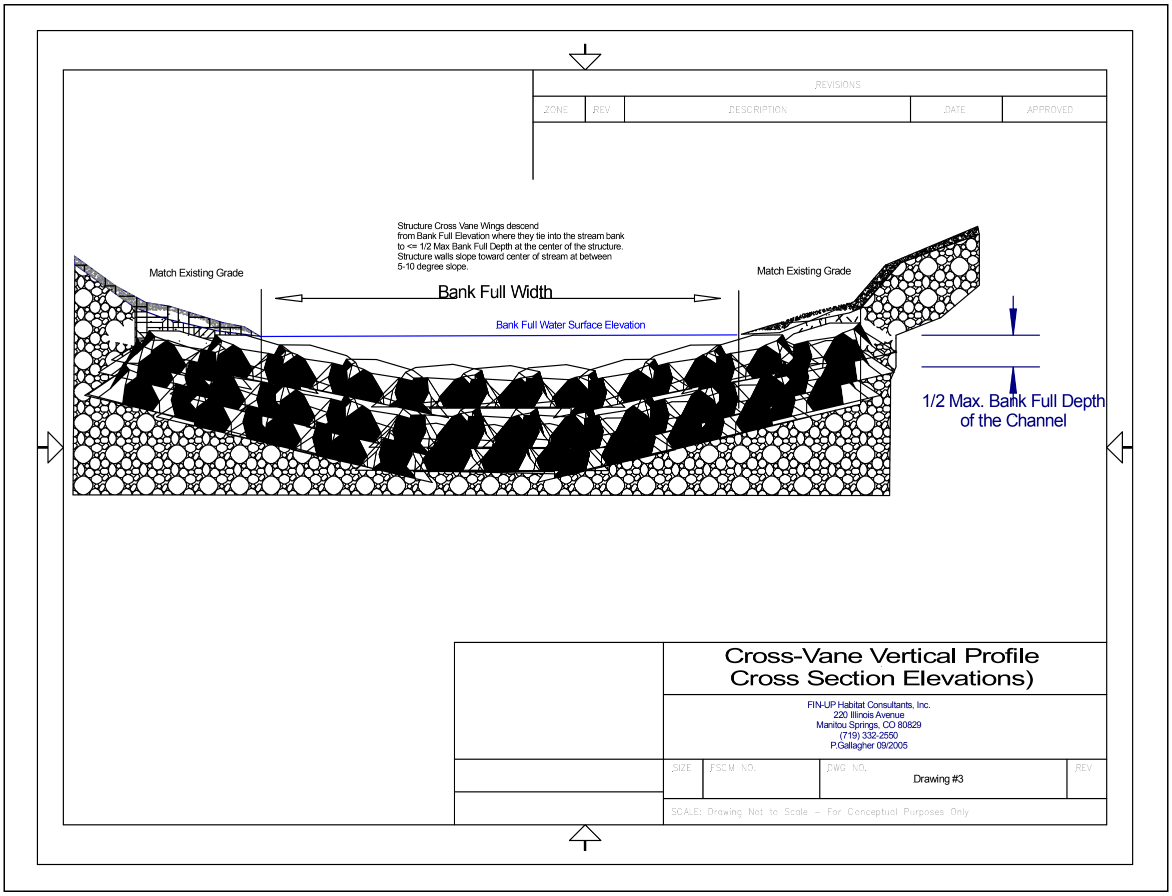

Cross Section #7 @ Pool 9 (Exposed Utility Pipeline)
Channel Elevation
Water Surface
Bank Full
Proposed New Bank Slope

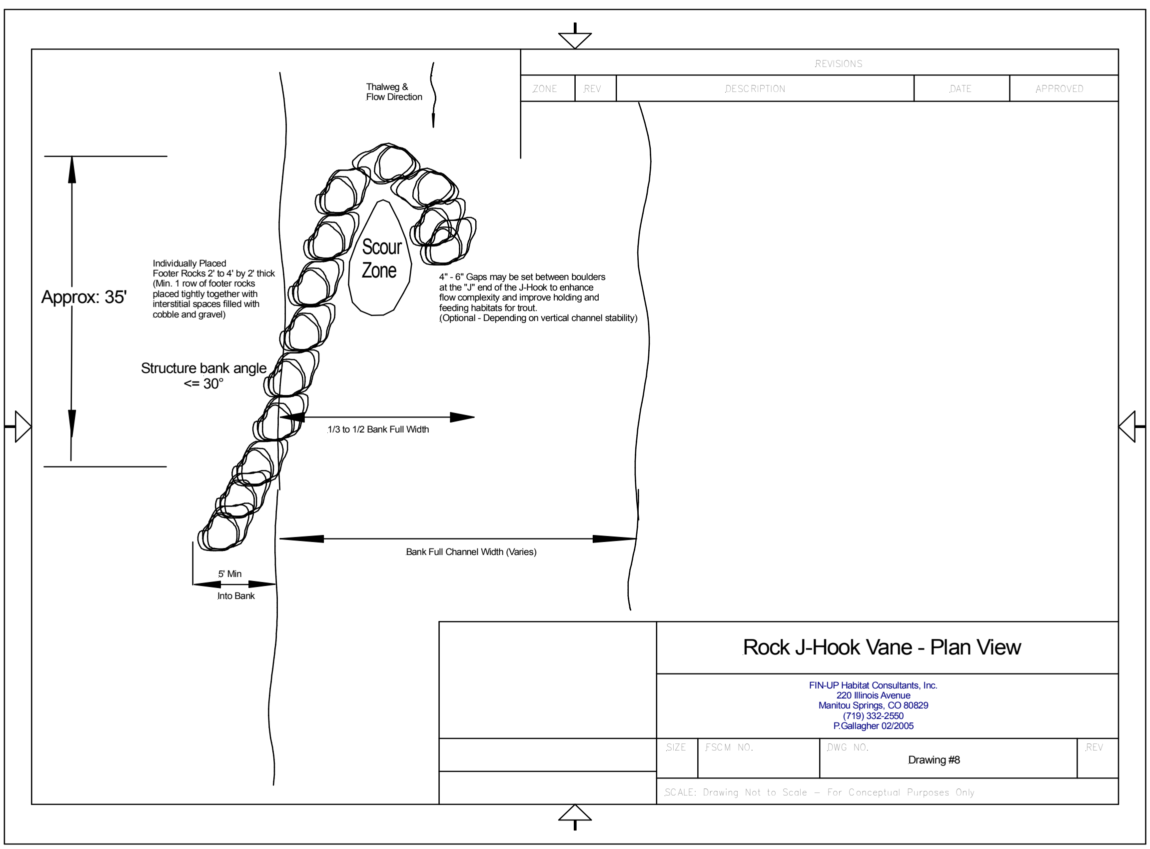

Cross Section #8 @ Glide 5
101
100
99
98
97
96
95
94
93
92
0
5
10
15
20
25
30
Channel Elevation
Water Surface
Bank Full

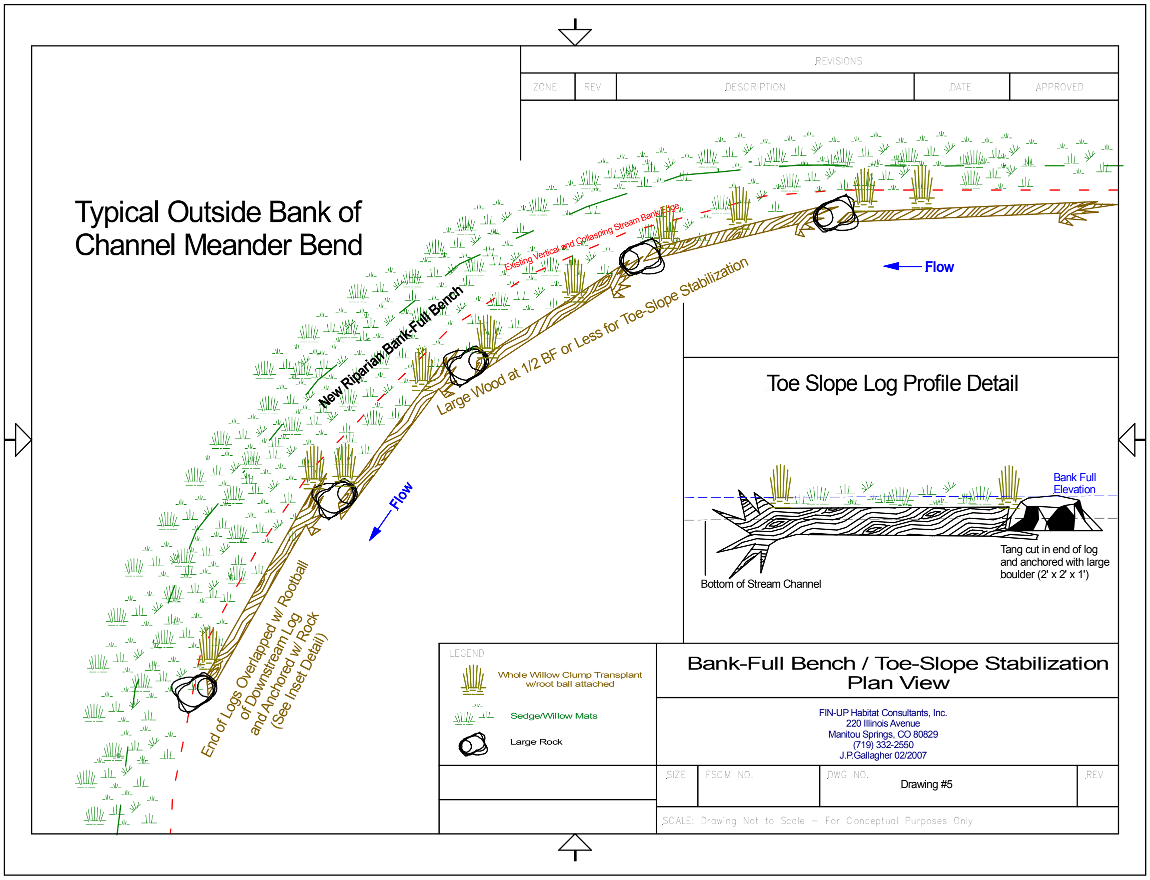
STREAM CHANNEL STRUCTURE DRAWINGS

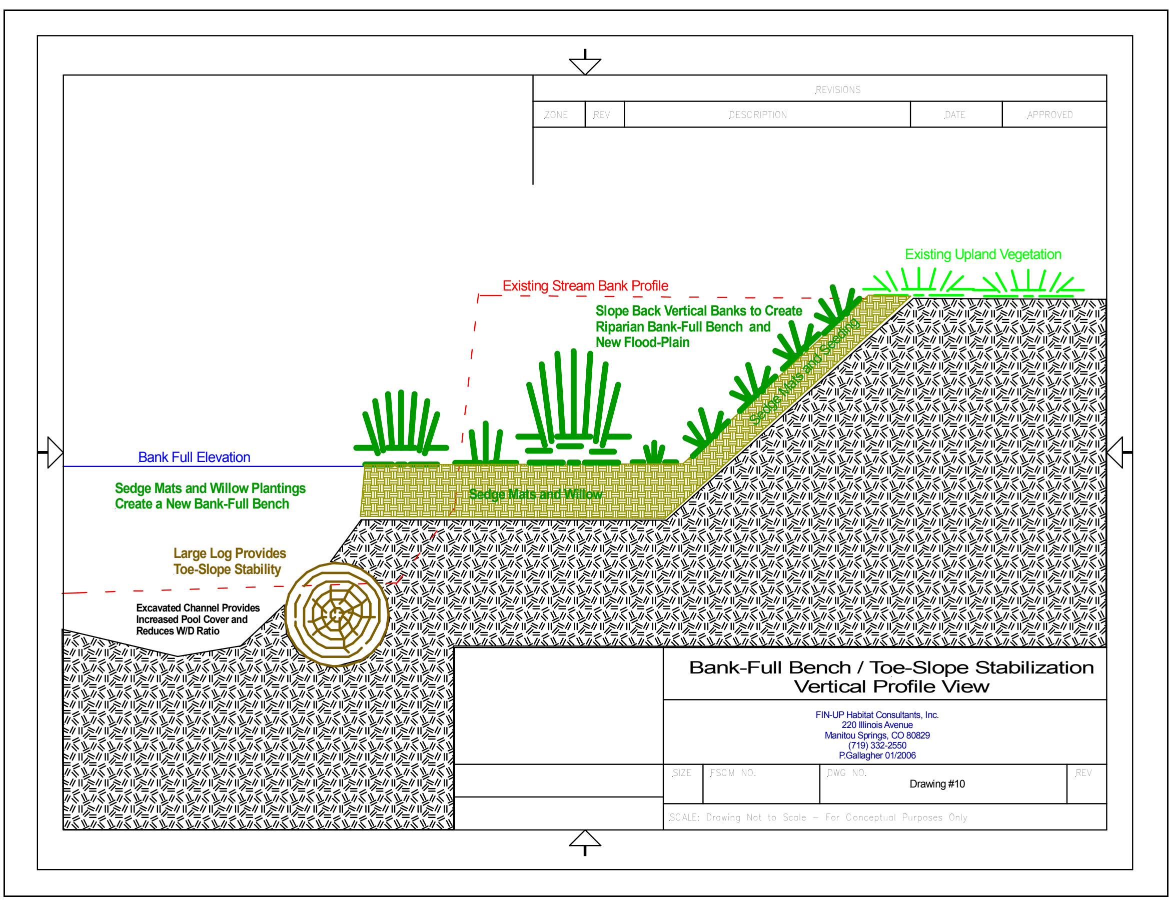





REVISIONS
ZONE
REV
DESCRIPTION
DATE
APPROVED
Structure Cross Vane Wings descend from Bank Full Elevation where they tie into the stream bank to <= 1/2 Max Bank Full Depth at the center of the structure. Structure walls slope toward center of stream at between 5-10 degree slope.
Match Existing Grade
Bank Full Width
Match Existing Grade
Bank Full Water Surface Elevation
1/2 Max. Bank Full Depth of the Channel
Cross-Vane Vertical Profile
Cross Section Elevations)
FIN-UP Habitat Consultants, Inc.
220 Illinois Avenue
Manitou Springs, CO 80829
(719) 332-2550
P.Gallagher 09/2005
SIZE
FSCM NO.
DWG NO.
Drawing #3
REV
SCALE: Drawing Not to Scale - For Conceptual Purposes Only

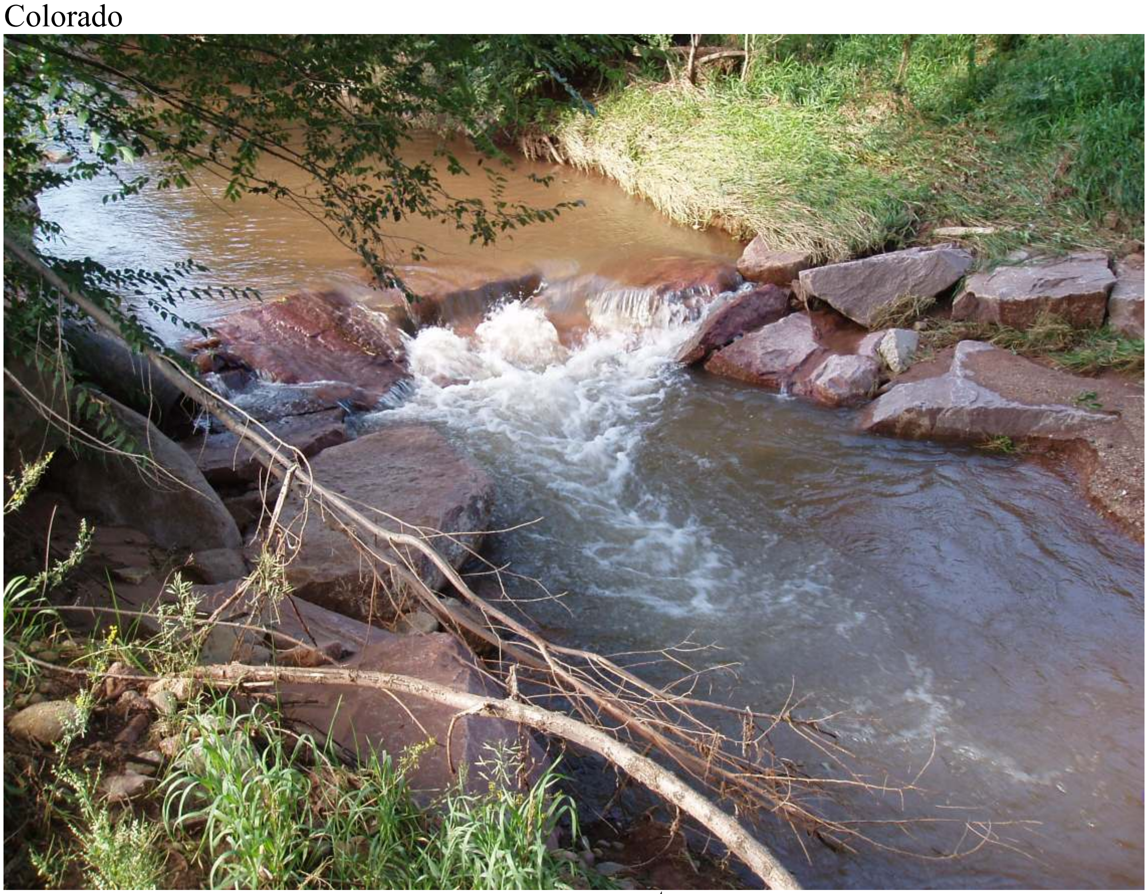

REVISIONS
ZONE
REV
DESCRIPTION
DATE
APPROVED
Thalweg & Flow Direction
Scour Zone
Approx: 35'
Individually Placed Footer Rocks 2' to 4' by 2' thick (Min. 1 row of footer rocks placed tightly together with interstitial spaces filled with cobble and gravel)
4" - 6" Gaps may be set between boulders at the "J" end of the J-Hook to enhance flow complexity and improve holding and feeding habitats for trout. (Optional - Depending on vertical channel stability)
Structure bank angle <= 30°
1/3 to 1/2 Bank Full Width
Bank Full Channel Width (Varies)
5' Min
Into Bank
Rock J-Hook Vane - Plan View
FIN-UP Habitat Consultants, Inc.
220 Illinois Avenue
Manitou Springs, CO 80829
(719) 332-2550
P.Gallagher 02/2005
SIZE
FSCM NO.
DWG NO.
Drawing #8
REV
SCALE: Drawing Not to Scale - For Conceptual Purposes Only


REVISIONS
ZONE
REV
DESCRIPTION
DATE
APPROVED
Typical Outside Bank of Channel Meander Bend
Existing Vertical and Collapsing Stream Bank Edge
New Riparian Bank-Full Bench
Large Wood at 1/2 BF or Less for Toe-Slope Stabilization
Flow
Flow
End of Logs Overlapped w/ Rootball of Downstream Log and Anchored w/ Rock (See Inset Detail)
Toe Slope Log Profile Detail
Bank Full Elevation
Tang cut in end of log and anchored with large boulder (2' x 2' x 1')
Bottom of Stream Channel
LEGEND
Whole Willow Clump Transplant w/root ball attached
Sedge/Willow Mats
Large Rock
Bank-Full Bench / Toe-Slope Stabilization Plan View
FIN-UP Habitat Consultants, Inc.
220 Illinois Avenue
Manitou Springs, CO 80829
(719) 332-2550
J.P.Gallagher 02/2007
SIZE
FSCM NO.
DWG NO.
Drawing #5
REV
SCALE: Drawing Not to Scale - For Conceptual Purposes Only


REVISIONS
ZONE
REV
DESCRIPTION
DATE
APPROVED
Existing Upland Vegetation
Existing Stream Bank Profile
Slope Back Vertical Banks to Create Riparian Bank-Full Bench and New Flood-Plain
Sedge Mats and Seeding
Bank Full Elevation
Sedge Mats and Willow Plantings Create a New Bank-Full Bench
Sedge Mats and Willow
Large Log Provides Toe-Slope Stability
Excavated Channel Provides Increased Pool Cover and Reduces W/D Ratio
Bank-Full Bench / Toe-Slope Stabilization Vertical Profile View
FIN-UP Habitat Consultants, Inc.
220 Illinois Avenue
Manitou Springs, CO 80829
(719) 332-2550
P.Gallagher 01/2006
SIZE
FSCM NO.
DWG NO.
Drawing #10
REV
SCALE: Drawing Not to Scale - For Conceptual Purposes Only

PHOTOGRAPHS OF TREATMENT TYPES

Cross Vane Structure on Cheyenne Creek below I-25 Overpass. Colorado Springs, El Paso County, Colorado

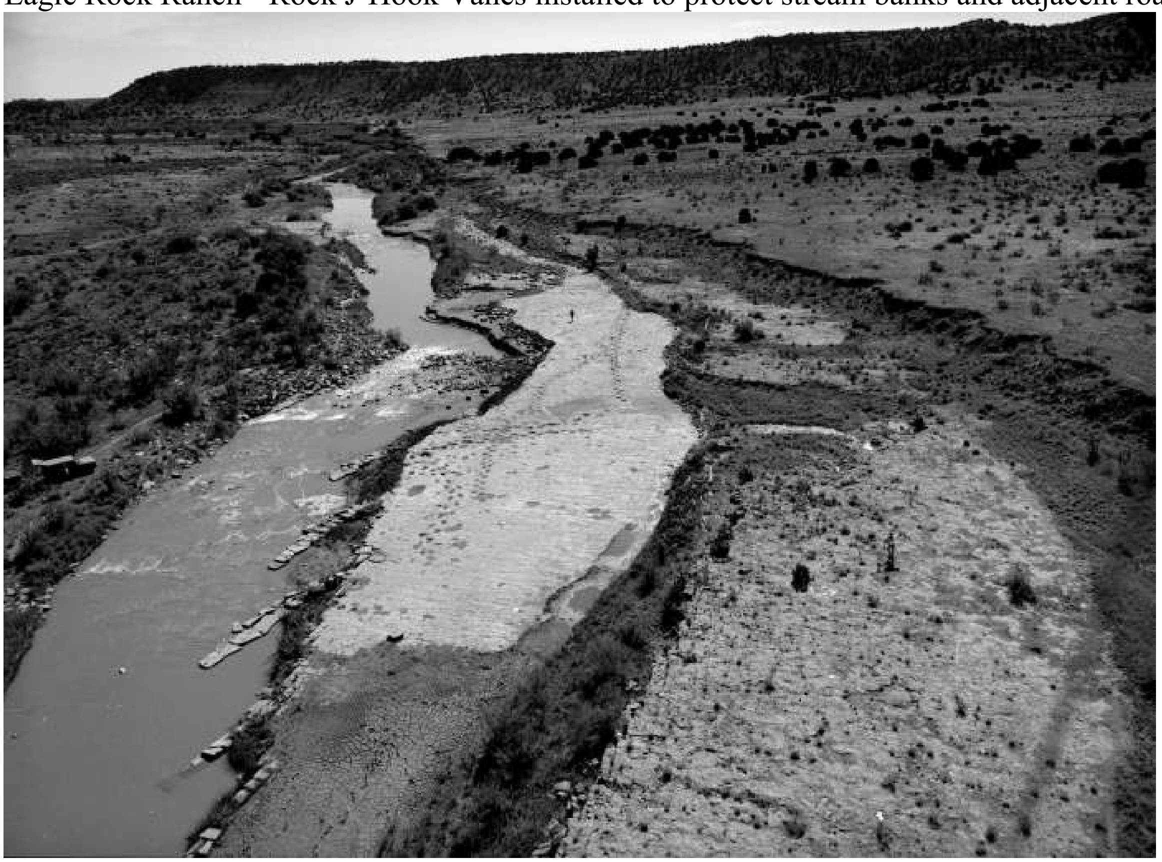


Cross Vane Structure on Fountain Creek below 21st Street Bridge, El Paso County, CO.


Cottonwood trees used as toe-slope stabilization with riparian benches. Cucharas Creek, Huerfano County, Colorado.

Boulders placed in clusters to create pocket water micro vortex habitats. South Platte River, Park County, CO.

Eagle Rock Ranch - Rock J-Hook Vanes installed to protect stream banks and adjacent road,, 2003.



Picketwire Canyonlands, SE Colorado - Rock vanes used to protect dinosaur trackway. These structures were installed in 1998, and survived a 100 year event the following spring. Note the deposition and new willow vegetation taking hold in between the structures.

Stream inventory BWSHI data sheets and summaries

Preliminary Project Budget Estimate

Prepared for the Fountain Creek Restoration Committee
For the
2007 Fishing is Fun Grant Application

BUDGET						
Item Description	QTY	UOM	UNIT COST	TOTAL COST	LOCAL SHARE	FEDERAL SHARE
Demolition & Grading	1	ls	$3,200.00	$3,200.00		$3,200.00
Boulders (224)	1	ls	$7,840.00	$7,840.00	$4,540.00	$3,300.00
Geotextile fabric (roll)	16	ea	$75.00	$1,200.00		$1,200.00
Trees/Logs (30 ft each)	12	ea	$150.00	$1,800.00		$1,800.00
Shrubs (1 gal)	80	ea	$10.00	$800.00		$800.00
Native Seed Mix	40	lb	$8.00	$320.00		$320.00
Gravel	2	cy	$75.00	$150.00	$150.00	
Landscape timbers	98	ea	$20.00	$1,960.00	$1,960.00	
Equipment	1	ls	$20,080.00	$20,080.00		$20,080.00
Labor	1	ls	$17,600.00	$17,600.00		$17,600.00
Assessment, Design, Permitting & Approvals	1	ls	$3,000.00	$3,000.00	$3,000.00	
Engineering	1	ls	$5,000.00	$5,000.00	$5,000.00	
Interpretive Signage	2	ea	$250.00	$500.00	$500.00	
Etiquette Signage	2	ea	$25.00	$50.00	$50.00	
Project Management	1	ea	$2,400.00	$2,400.00	$2,400.00	
TOTALS				$65,900.00	$17,600.00	$48,300.00
BREAKDOWN OF LOCAL SHARE						
Item Description				IN-KIND	CASH	DONOR
Boulders (130 @ $35)				$4,540.00		City
Gravel				$150.00		City
Laandscape timbers					$1,960.00	City
Assessment, Design, Permitting & Approvals					$3,000.00	City
Engineering					$5,000.00	City
Interpretive Signage (18"x 24**")**					$500.00	City
Etiquette Signage (steel)					$50.00	City
Project Management (City Staff 80 hrs @ $30/hr)					$2,400.00	City
TOTALS				$4,690.00	$12,910.00	
GRAND TOTAL LOCAL SHARE						$17,600.00