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

Prepared by

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Table of Contents

Introduction:
- Watershed and Hydrology p. 1
- Existing Fish Populations p. 3

Assessment Methods and Protocols p. 3

Aquatic Assessment Results p. 6

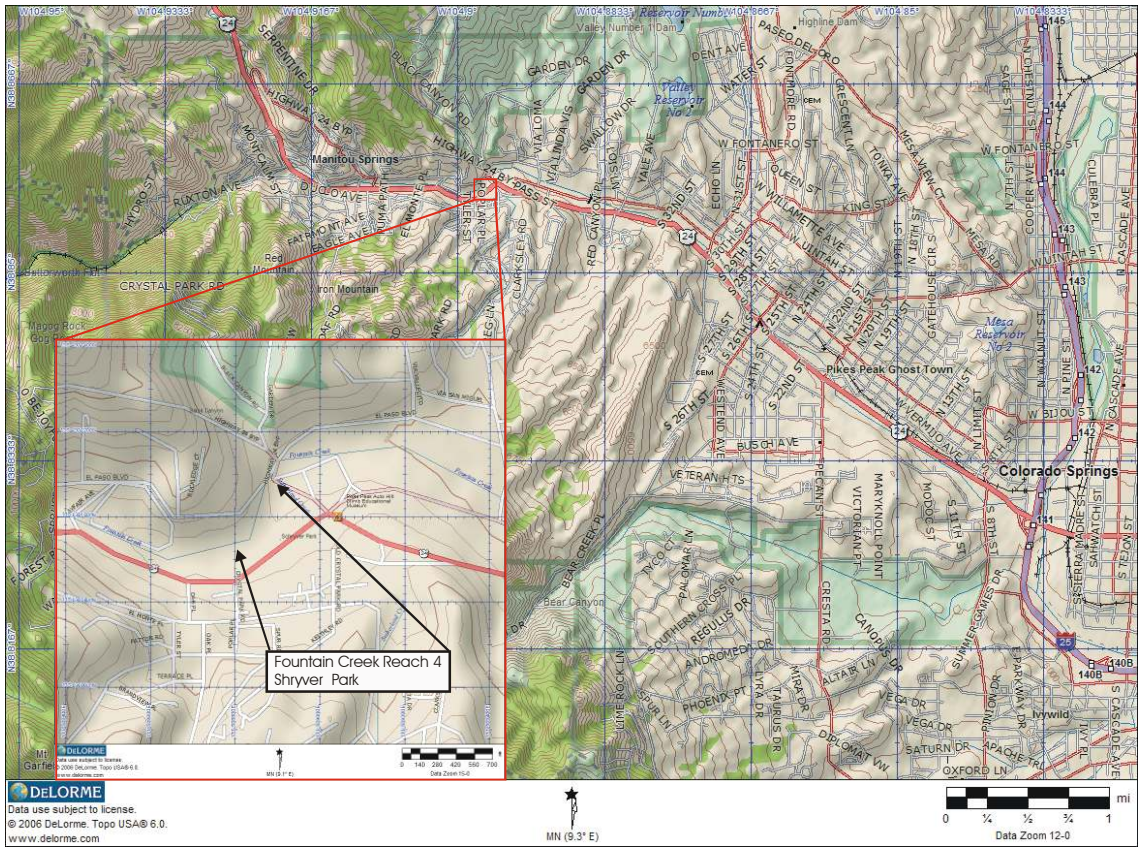
Aquatic Habitat Enhancement Plan p.17
- Goals and Objectives of Plan p.23

Glossary of Terms p. 24

References p.27

Appendix p.29
- Project Area Site Plan
  Including proposed treatment areas and type p.31
- Longitudinal Profile of the Project Area p.37
- Cross-section analysis p.41
- Proposed treatment design drawings p.57
- Photographs of treatment types p.57
- Stream inventory BWSHI data sheets and summaries p.61
- Project Budget Estimate & Materials Suppliers p.69

In December 2007, FIN-UP Habitat Consultants, Inc. was contracted by the City of Manitou Springs to design a new inlet structure on Fountain Creek to feed the small pond in Shryver Park. Incidental to this work for the city, FIN-UP, Inc. entered into an informal agreement with the Fountain Creek Restoration Committee to conduct an aquatic habitat analysis and habitat enhancement strategy for the segment of Fountain Creek within Shryver Park, immediately west of the downtown business district on a pro-bono basis, to be included with the Section 404 permit application for the stream work done in conjunction with the new inlet structure. The stream within the park is



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

approximately 700 feet in length, exhibiting a moderately entrenched natural channel in the upstream half of the reach. Detailed channel morphology data was collected for the new diversion structure in December 2007, and an aquatic assessment was conducted within the entire project area during the 2nd week of May, 2008. The results of this work are summarized in this document.

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.

Six major tributary streams contribute to Fountain Creek between its headwaters and the project area in Shryver 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. 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.

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 2,630 cfs. 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 Shryver Park Reach is immediately upstream of the confluence with Sutherland Creek, a major headwater tributary to Fountain Creek A table of the HEC-HMS predictions for above bank-full stage recurrence intervals is shown in the Table 1. The Shryver Park project reach bank full stage discharge is estimated to be approximately 75 cfs. 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 and

flow into the pond in the park at approximately 1,000 cfs, or somewhat less than a ten year flood event. At this flow, average velocities in the channel may be expected to reach 17 feet per second, exerting in excess of 8 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 Old Man Trail	91.1	69	530	1600	4500	7600	11000
At US 24 near Manitou Bypass	97	350	630	1800	4900	8200	12000

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

Existing Fish Populations

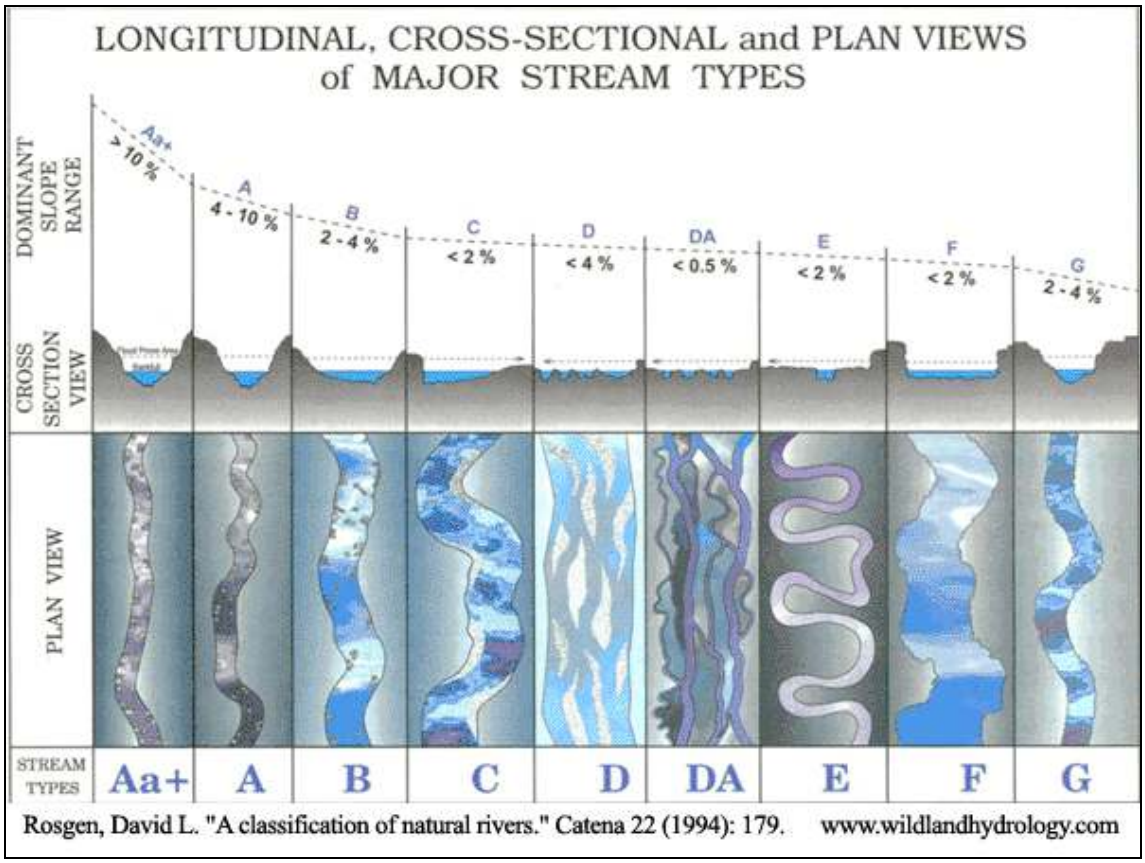
Fountain Creek contains resident populations of both native and non-native fishes. Three important native species are present in the watershed, including the greenback cutthroat trout (*Oncorhynchus clarki stomias* - federal and state threatened), the Arkansas darter (*Etheostoma cragini*- state threatened) 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 upstream 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.

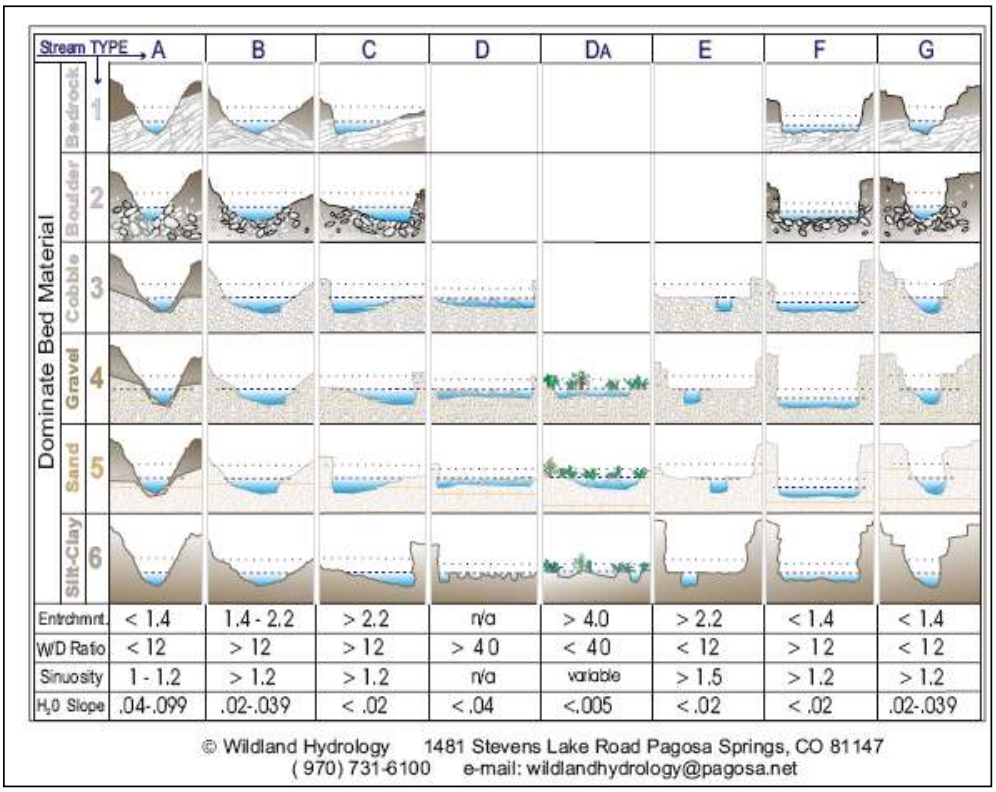
Rosgen Stream Classification System

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.

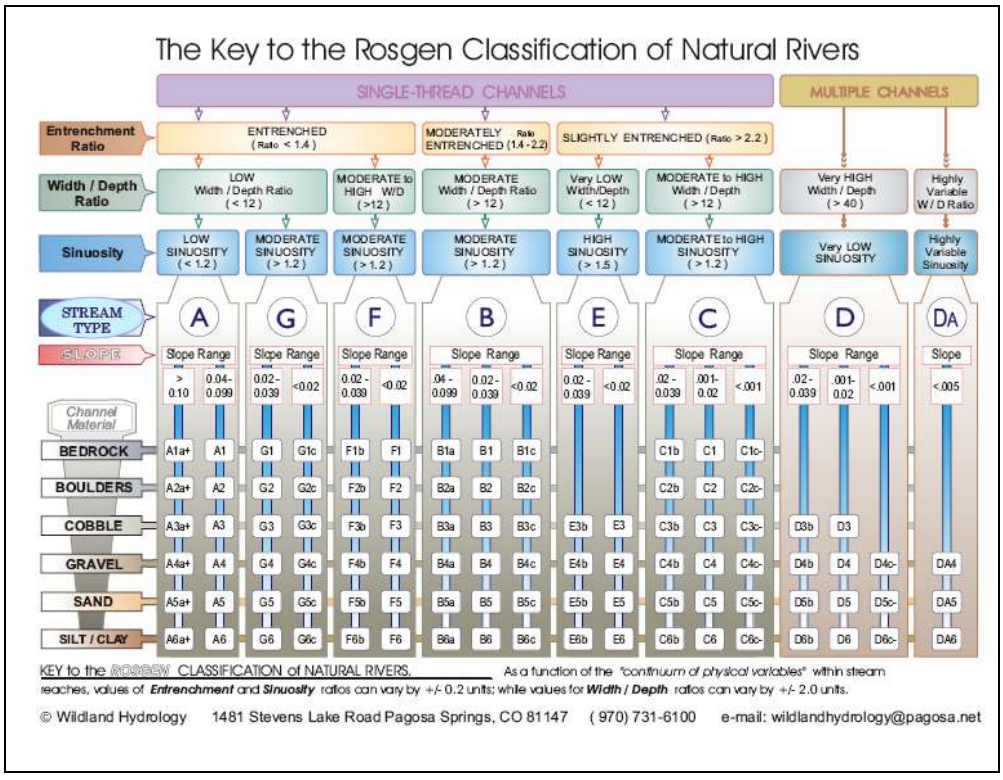


Generally, A type channels are typically found near the headwaters of mountain streams. Lower gradient B channels are characteristic of streams flowing though alluvial plains and broad mountain valleys below the headwaters. C and E channels tend to be found in lower elevation reaches with broad floodplains 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.



Stream Channel Morphology:
For the purposes of the stream channel morphology study, eight cross-sections were established and numbered consecutively beginning at the downstream boundary of the reach and continuing upstream. All directional references to stream banks and cross-sectional head pins are for the channel geometry study are from a hydrologist's perspective, with left and right banks determined looking downstream along the channel.

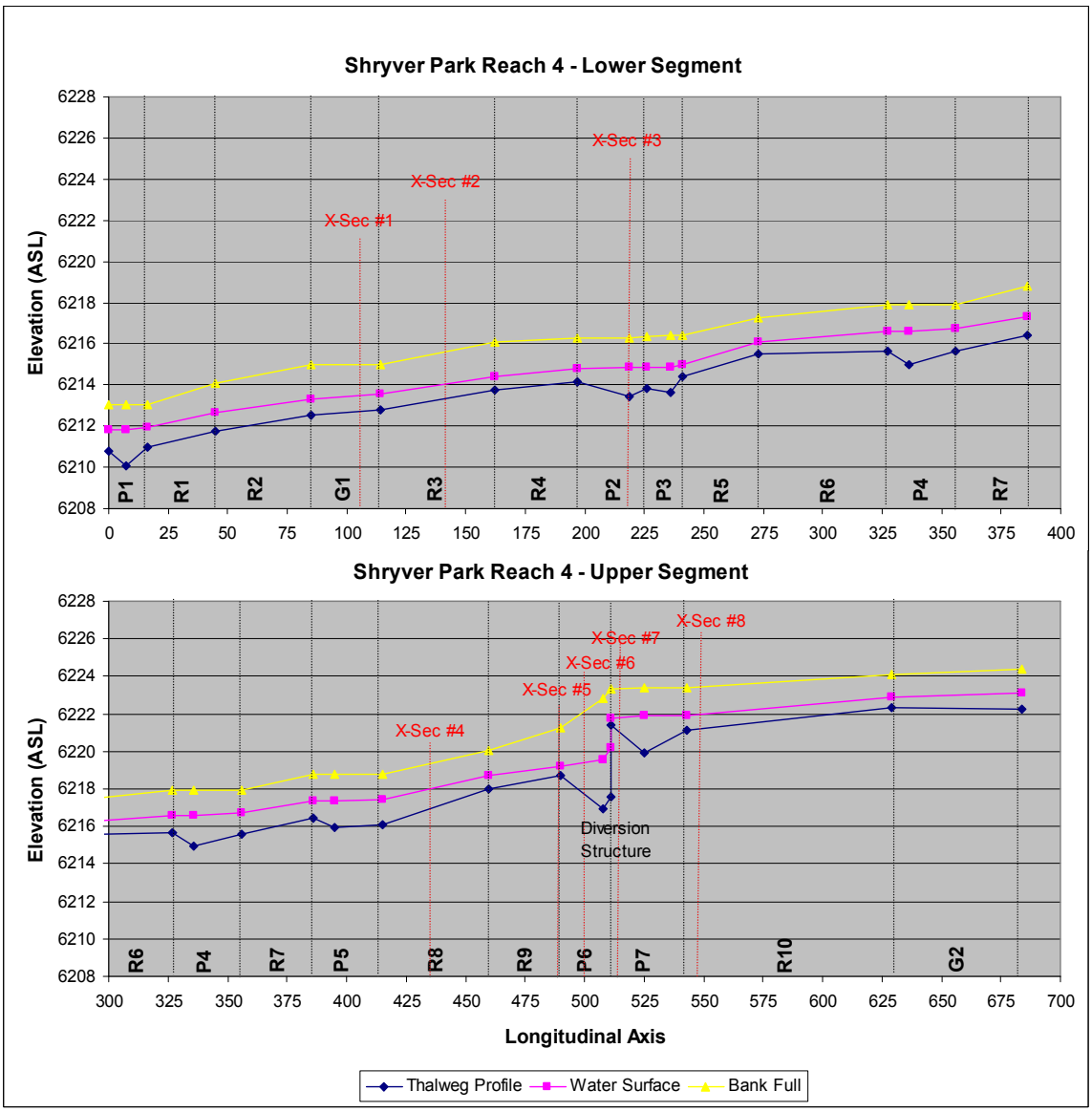


Chart 1: Longitudinal Profile of Reach 4 on Fountain Creek.

A longitudinal profile (Chart 1) of the stream channel and the two cross-sections were established in May 2008. Stream flow was measured at cross-section #2, using a Marsh-McBirney FlowMate 2000 flow meter, and was calculated to be 8.5 cfs. The longitudinal profile is typical of Fountain Creek through the City of Manitou Springs, characterized by relatively low gradient, a moderate to high degrees of entrenchment, and infrequent pool habitat. The average slope of the channel, water surface and bank full elevation

throughout the profile was 2%. Riffle slopes ranged from 2% to 5%. Stream channel sinuosity was low (<1.5) in the reach, as would be expected for a B type channel.

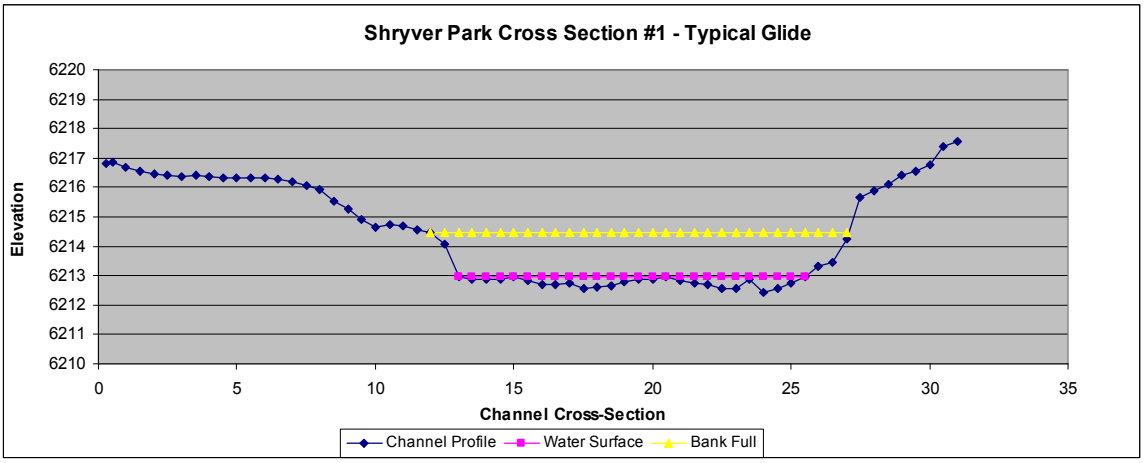


Chart 2: Cross Section #1 on Fountain Creek - Typical Glide Habitat.

Cross-sections #1 through #3 show representative profiles of a typical glide, riffle and pool habitat within the reach. The glide cross-section exhibits the typical uniform channel elevation and laminar flow characteristics typical of this meso-habitat form. The riffle cross-section is dominated by larger substrate particle sizes, resulting in greater velocity complexity and surface turbulence. The pool cross-section was surveyed in a trench pool, which was the most typical form observed in the reach, and exhibits a maximum bank-full depth of just under 3 feet. Each of the cross-sections exhibits the moderate to high entrenchment characteristics of the stream channel within the reach. Entrenchment ratios of 1.9 to 2.8 were observed at the cross-sections. Width/depth ratios were calculated to be approximately 7.5. W/D ratios were less than would be expected to occur in a B channel, and may indicate that the channel has down-cut and begun to exhibit more of a G characteristic. The reach upstream of the diversion structure for the inlet to Shryver Pond is somewhat more entrenched, and exhibits characteristics more closely related to a true G type channel (see cross-section data in the appendices).

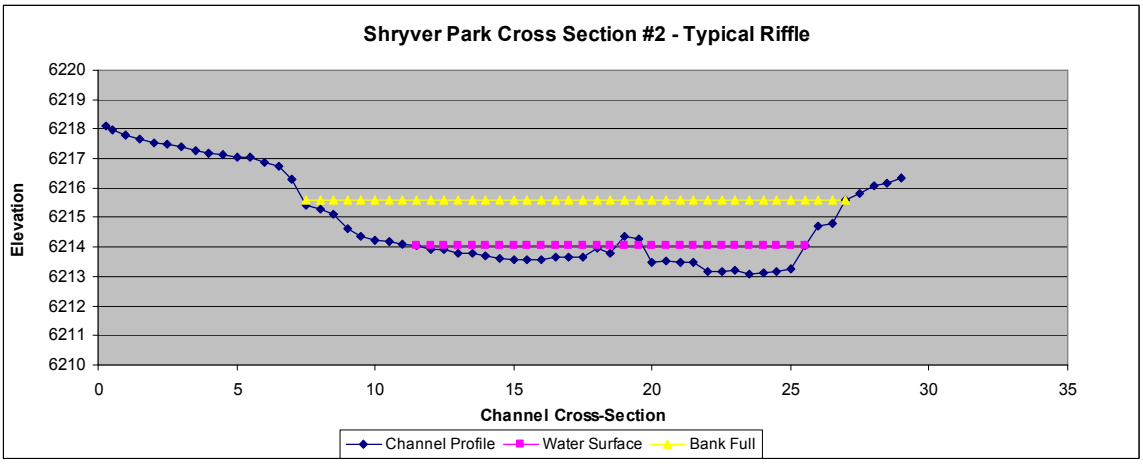


Chart 3: Cross-Section #2 on Fountain Creek - Typical Riffle Habitat.

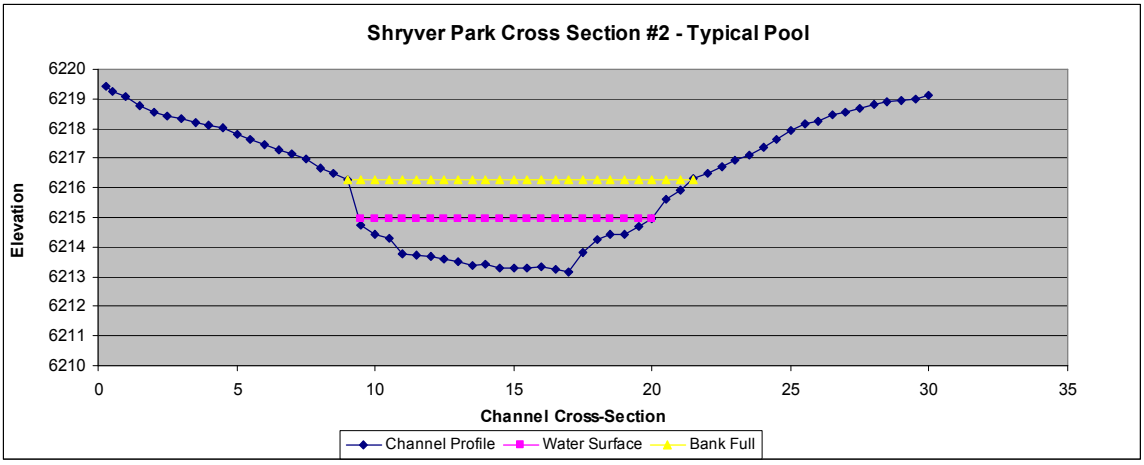


Chart 4: Cross-Section #3 on Fountain Creek - Typical Pool Habitat.

The general reach substrate was calculated using a Wolman pebble Count (Bevenger, 1997) and the results are shown in Table 1. A bi-modal distribution of smaller particles (fines), and large gravel/small cobble is apparent in the pebble count data (Chart 5), 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 extremely scarce in the reach, with the only pieces observed being part of the diversion structure. 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 4.

Wolman Pebble Count	Class		Total	% of	Cumulative
Metric - mm	Inches	Name	Number	Total	%
<.066		Silt	1	0.33%	0.33%
.066 -.125		Very Fine	4	1.32%	1.64%
.125-.25		Fine	8	2.63%	4.28%
.25-.50		Medium	24	7.89%	12.17%
.50-1.0		Coarse	13	4.28%	16.45%
1.0-2.0		Very Coarse	8	2.63%	19.08%
2.0-4.0		Very Fine	9	2.96%	22.04%
4.0-8.0		Fine	22	7.24%	29.28%
8.0-16	.08-.6	Medium	30	9.87%	39.14%
16-32	.6-1.3	Coarse	36	11.84%	50.99%
32-64	1.3-2.5	Very Coarse	41	13.49%	64.47%
64-128	2.5-5.0	Small	37	12.17%	76.64%
128-256	10-May	Large	34	11.18%	87.83%
256-512	20-Oct	Small	16	5.26%	93.09%
512-1024	20-40	Medium	13	4.28%	97.37%
1024-2048	40-80	Large	4	1.32%	98.68%
2048-4096	80-160	Very Large	4	1.32%	100.00%

Table 1 - Results of the Wolman Pebble Count, showing distributions of substrate size classes in Reach 4 on Fountain Creek.

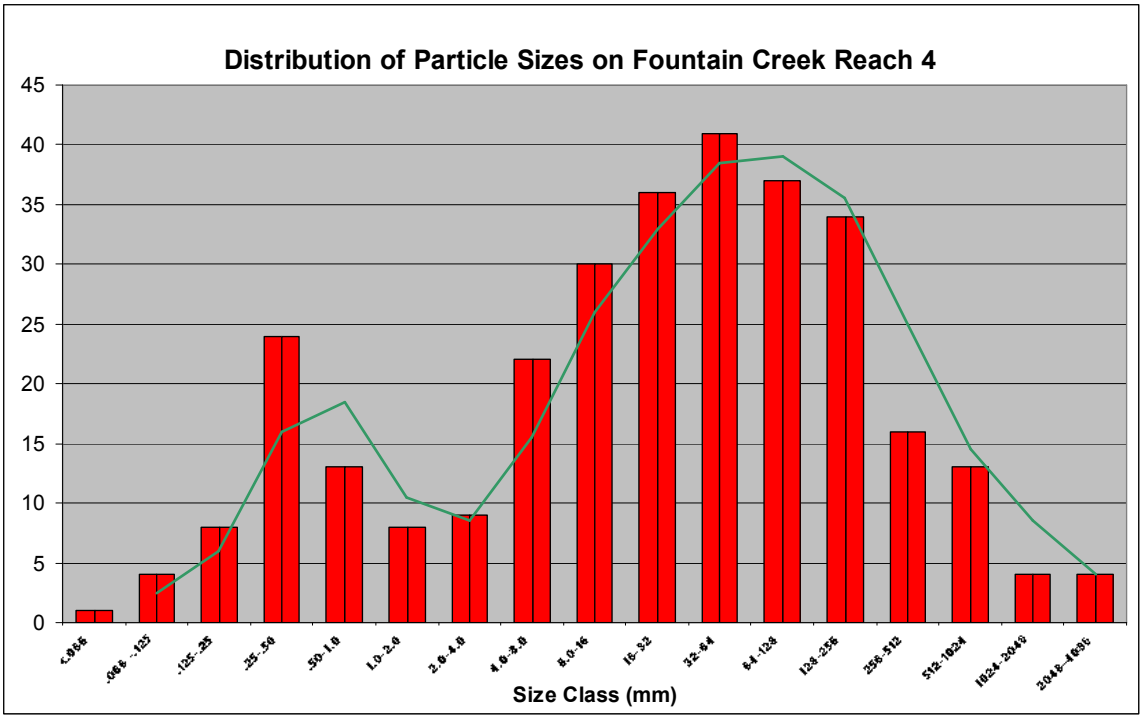


Chart 5 - Distribution of particle size classes distribution of sand and larger cobbles and boulder in Reach 4 on Fountain Creek.

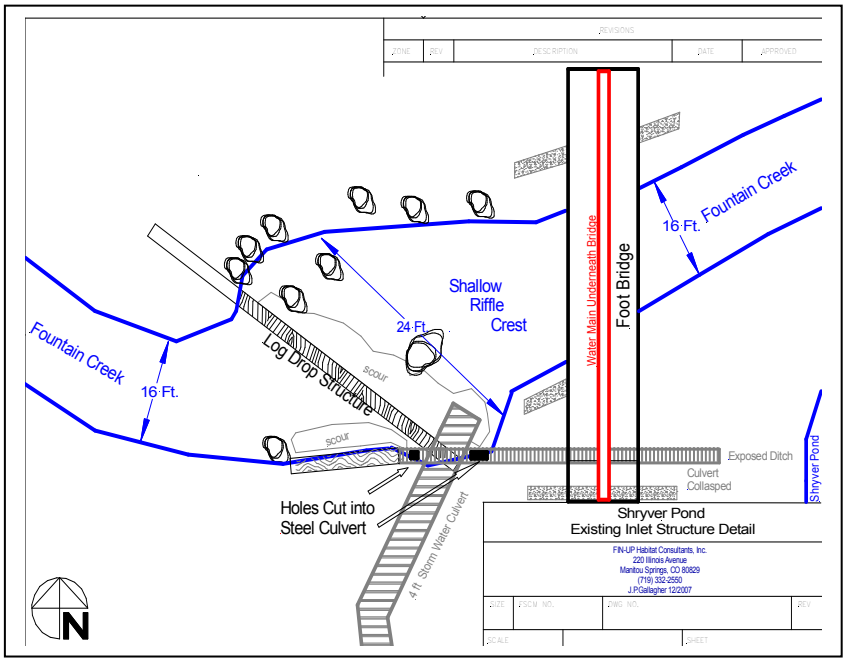
Based on the reach longitudinal profile survey, the channel cross-section analysis, and the stream substrate data, the channel was determined to be a G3c in the upper segment of the reach (upstream of the diversion point), and a B3c type downstream of the diversion point to the downstream boundary of the reach at the Garden of the Gods Place bridge. The channel appears to be relatively stable at this time, but is affected by high flow shear forces eroding unstable and unvegetated stream banks in the upper portion of the reach. Sediment from these eroding banks, and from sources upstream of the reach appear to be accumulating in the pools and smaller velocity shelters in the channel and are likely having a negative effect on the quantity and quality of useable habitat for resident trout.

Photo 1: Fountain Creek near bank-full stage (75cfs) in the Project Reach.

Shryver Pond Diversion Existing Condition:
Shryver Pond is a unique urban fishing resource located on the south side of Fountain Creek in Shryver Park. Shryver pond offers easily accessible fishing and recreation opportunities to residents of Manitou Springs and surrounding communities in El Paso County. Unfortunately, Shryver Pond currently suffers from severe water quality problems, including low dissolved oxygen levels and elevated temperatures due to a poorly designed inlet structure feeding the pond from nearby Fountain Creek and accumulated organic debris from the mature cottonwood trees surrounding the pond.

The diversion structure that feeds the pond is located on Fountain Creek immediately upstream and west of the pond. The intake culvert lacks a controlling head-gate, and is in significant disrepair. The downstream end of this culvert is approximately 0.4 ft higher than the upstream, intake end at the stream, causing frequent plugging of the pipe due to excessive sediment build up at the diversion point. This results in significantly reduced and sometimes completely restricted flows into the pond. Additionally, the log-drop structure at the intake represents a significant barrier to migration of resident brown and rainbow trout in Fountain Creek. A four foot diameter storm drain culvert has been installed directly over the pond inlet pipe, and is suspended approximately four feet over the stream channel, creating additional erosion problems along the bed of the channel downstream of the diversion point. A 12" water main is suspended underneath the foot bridge immediately below the project site. This high pressure water main crosses over the existing Shryver Pond inlet pipe underneath the south foundation of the bridge.

Shryver Pond is the only lentic habitat within the city limits, but in the current condition can not support a viable trout fishery. A complete redesign and reconstruction of the inlet structure is necessary to improve D.O. and temperature, particularly during the summer months, and restore the health of the pond. As part of reconstruction of the inlet structure, the drop structure barrier should be eliminated from Fountain Creek, and replaced by a series of boulder cross-vane structures, allowing for upstream migration and creating additional velocity shelter and cover for resident trout in the stream



Aquatic and Riparian Habitat Assessment Protocols:
For the purposes of the stream and riparian habitat study, all directional references are from a fisheries biologist's perspective, with left and right banks determined looking upstream along the channel. Assessments 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 on the eastern part of Manitou Springs and is delineated as Reach 4 (Map 1). Reach 4 on Fountain Creek encompasses all of Shryver Park, beginning at the bridge where Garden of the Gods Terrace crosses Fountain Creek. The reach continues upstream 684 feet to a chain link fence on the right side of the creek that delineates the private property boundary on the west side of Shryver Park. A rapid assessment of aquatic habitat was undertaken within the reach, and a detailed stream habitat inventory was conducted in May, 2008 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 9.4 cubic feet per second, which is within the estimated base flow range for the stream.


Photo 2: Diversion structure and potential fish barrier on Reach 4 - Shryver Park.

Reach 4:
Reach 4 has not been dramatically altered through channelization and encroachment of urban development. The reach is characterized by a moderately incised channel through relatively stable depositional material composed mostly of larger gravel and small cobble. The stream exhibits a very narrow valley bottom with minimal riparian green-line, low sinuosity and moderate (2%) gradient. Habitat for trout appears to be somewhat limited due to the very high sediment supply available from both upslope and channel derived sources. A significant large log drop structure exists in the reach that functions as a diversion point for the inlet to Shryver Pond (Photo #2). This structure appears to be a significant barrier to fish passage through the reach. Initial reconnaissance indicates that Reach 4 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 19 individual meso-habitats measured in the reach (7 pools, 10 riffles and 2 glides), along a length of 684 feet of stream, and comprising a total wetted area of 9,155ft^2. The total area of the reach consisted of 61% riffles and 13% glides, with the remaining 26% consisting of pool habitat (Chart 6). The average wetted width of the stream was 13.5 feet throughout the reach. Greater than 50% of the stream banks were found to be stable, partly due to the presence of concrete bank toe structures along portions of the reach. Stream bank stability in the upstream half of the reach was relatively poor, consisting mostly of bare slopes comprised of sand and gravel sized fragments. There were 512 feet of actively eroding stream banks contributing sediment directly into the stream. This accounted for slightly more than 37% of the total length of banks in the study reach.

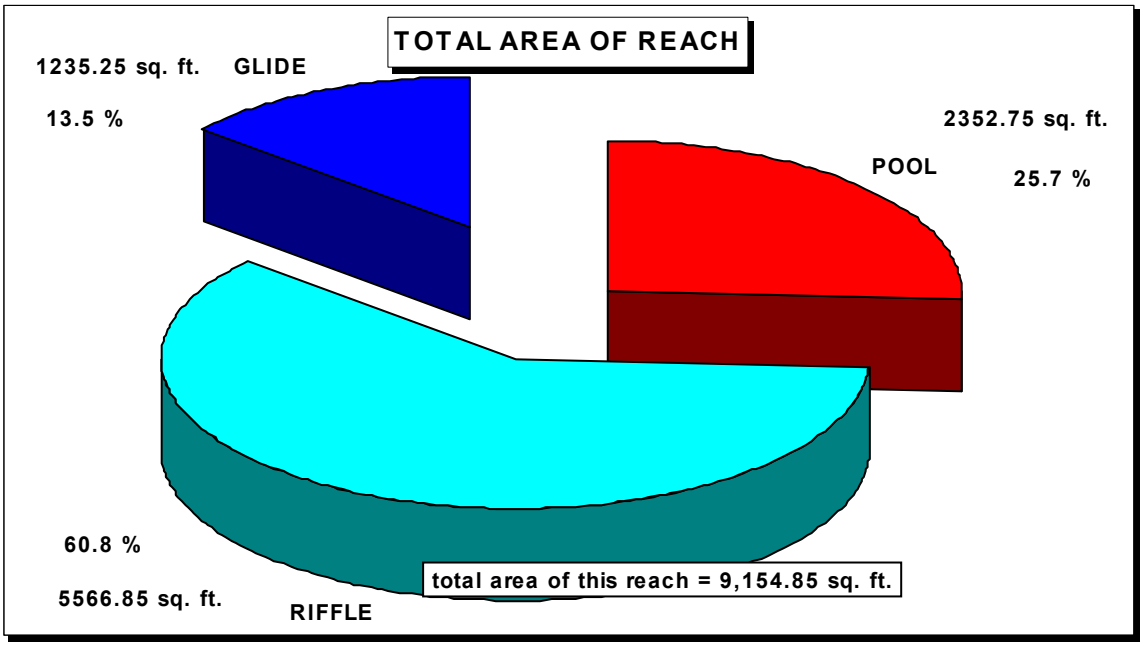


Chart 6 - Distribution of Pool, Riffle and Glide habitats in Reach 4 of Fountain Creek.

Low gradient gravel dominated riffles were the most common habitat type in terms wetted area, accounting for 26% of the total reach area (Chart 7). Cobble dominated riffles were the next most common habitat, occurring with greater frequency, but accounting for slightly less area than gravel riffles. Low gradient riffles can provide good spawning habitat, but are somewhat limited in terms of cover from high flows and predators. Two of the cobble riffles exhibited slightly higher gradient, with pocket water cover observed in each habitat unit. Two boulder riffle habitats were observed in the reach, exhibiting pocket water associated with higher gradient riffle form. Overall, very little cover for trout was observed in the riffles, amounting to less than 0.5% (24 ft^2) of the total wetted area of these habitat types. The average width of all the riffles observed in the reach was 12.9 feet.

Photo 3: Lower half of the Shryver Park project reach, looking upstream.

Pool habitat is somewhat limited in the reach, with trench pools being the most abundant (Chart 2). The trench pools were mostly associated with constrictions in the stream channel created by boulder and concrete toe structures along the stream bank. Dam pools and plunge pools were also observed in the reach, accounting for slightly less wetted area than the trench pools. One of the plunge pools is principally associated with log-drop structure forming the diversion point for Shryver Pond. This plunge pool consists of a 3 ft drop that may be a barrier to migration of trout through the reach. Dam pools and plunge pools comprised 16% of the total wetted area of the reach. All of the pools exhibited some degree of in-filling of sediment, mostly consisting of smaller particles of decomposed granite. The average pool depth in Reach 4 was one foot. Residual pool depth (RPD) in Reach 4 was found to range from 0.8 to 2.2 feet, with an average of 1.1 foot throughout the reach. RPD was found to be relatively poor, and may limit adequate over-wintering habitat for salmonids and other native species in this reach. Cover for trout accounted for less than 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 14.1 feet.

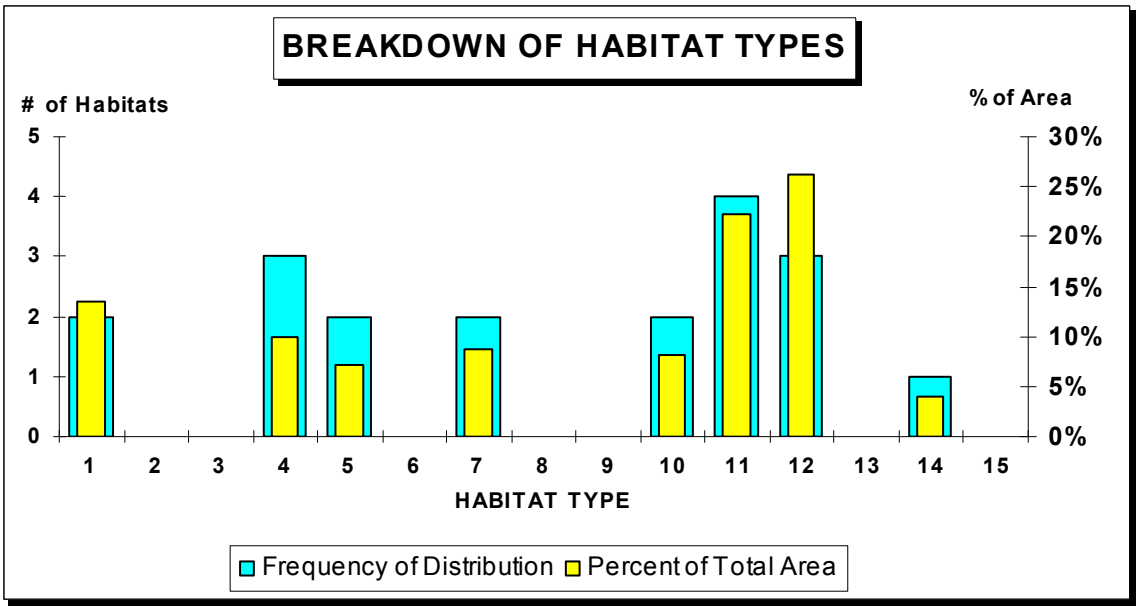


Chart 7 - Distribution of Meso-Habitat Types as a percentage of # of habitats and as a percentage of wetted perimeter of Reach 4 on Fountain Creek.

Glide habitat is present, comprising slightly more than 10% of the reach. Glide habitat 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 12.9 feet.

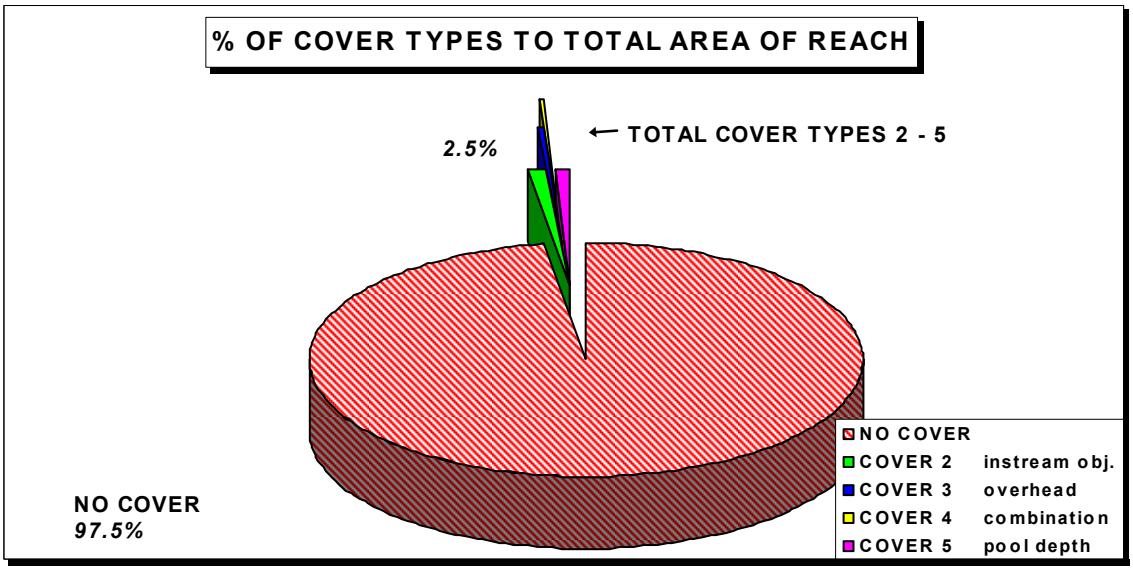


Chart 8 - Percentage of cover for trout to the total wetted perimeter Reach 4 on Fountain Creek.

Cover for adult trout accounted for 2.5% of the reach (Chart 8). Available cover appears to be a 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 somewhat limited in the reach, and comprised only 3.4% of the wetted area of the pools and 0.9% 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.

Photo 3: Middle of the Shryver Park project reach and Shryver Pond.

Stream bank stability was generally poor in the reach, primarily due to lack of vegetation on the steep collapsing stream banks. Several areas of actively eroding stream banks were observed, particularly in the upstream half of the reach. Deeply rooted, streamside riparian vegetation is a critical component in maintaining the integrity of stream banks during runoff and other high flow events, and was generally lacking in this reach. Fifty-three percent of the left bank and 42% of the right bank were found to be vegetated and stable. 5% of the left bank and 11% of the right banks were observed to be stable due to concrete toe walls that have been installed along the stream bank. The remaining 42% of the left bank and 47% of the right bank were found to be unstable. (Chart 9). Bank rock content in the reach is shown in Chart 10, and consisted either of concrete (Type 2), large boulder (Type 3) or gravel and smaller fragments (Type 6 and 8). Smaller fragments were the most dominant type, indicating that the stream banks are susceptible to erosion due to sheer forces occurring during high flows.

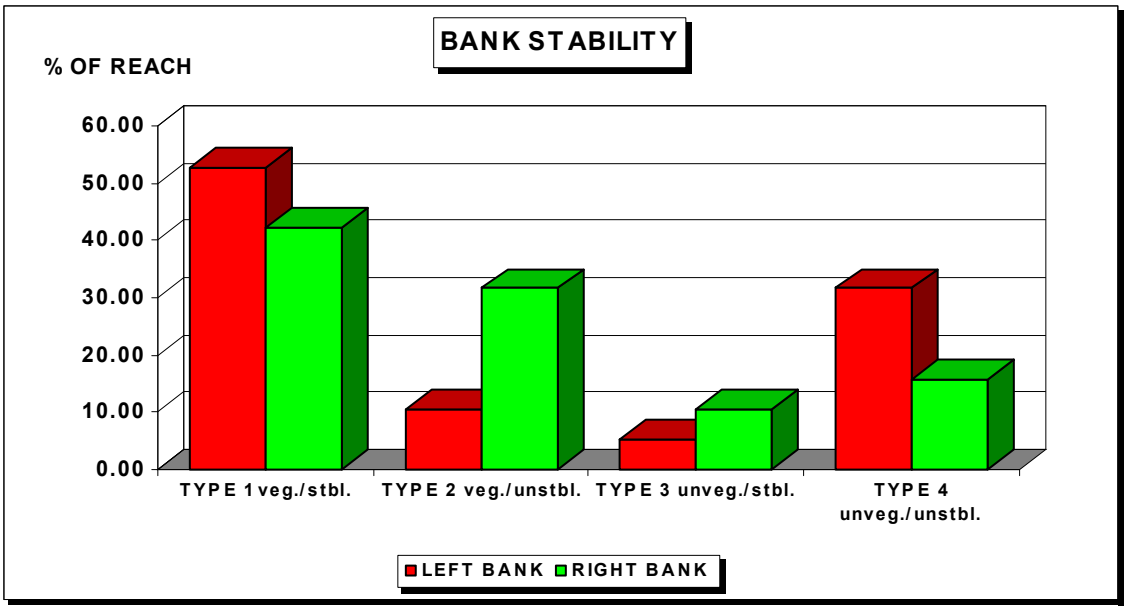


Chart 9 - Percentage of stable banks to unstable banks in Reach 4 on Fountain Creek.

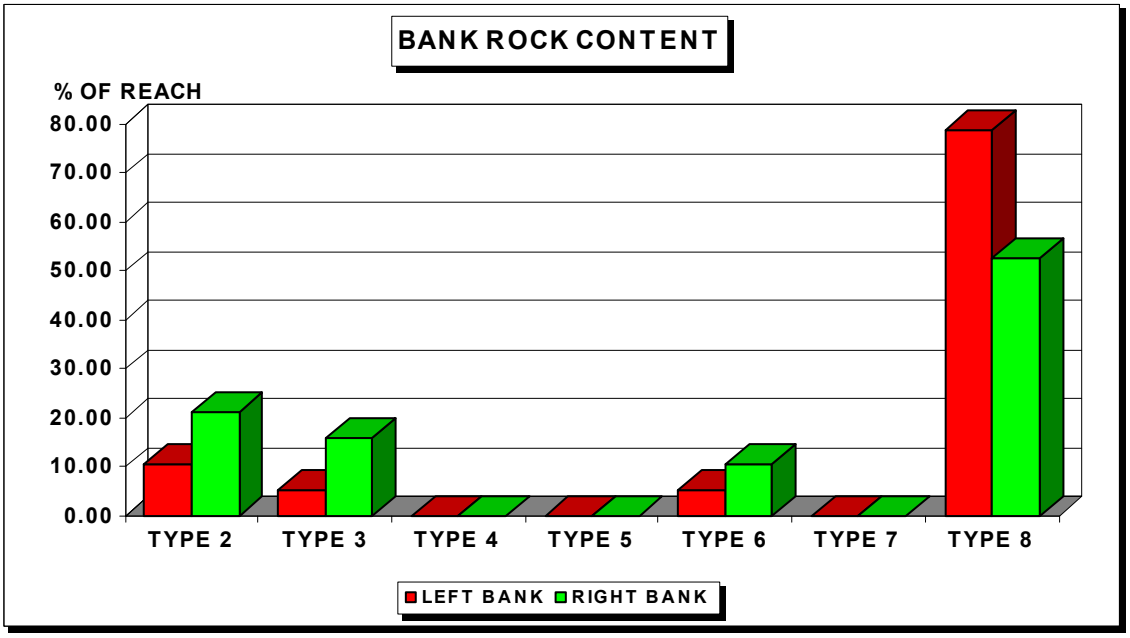


Chart 10 - Percentage of bank rock content sizes in Reach 4 on Fountain Creek.

Aquatic habitat conditions throughout Reach 4 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.

Aquatic Habitat Enhancement Plan for Fountain Creek - Reach 4.
The reach of Fountain Creek flowing through Shryver Park in Manitou Springs may benefit from efforts to restore of the channel, stream banks, and associated aquatic and riparian habitats. Several factors, however, may 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 two priorities, based on immediate restoration needs, visual/esthetic enhancement, maximization of in-channel habitat improvement, and feasibility of implementation. Dividing the project into two 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.

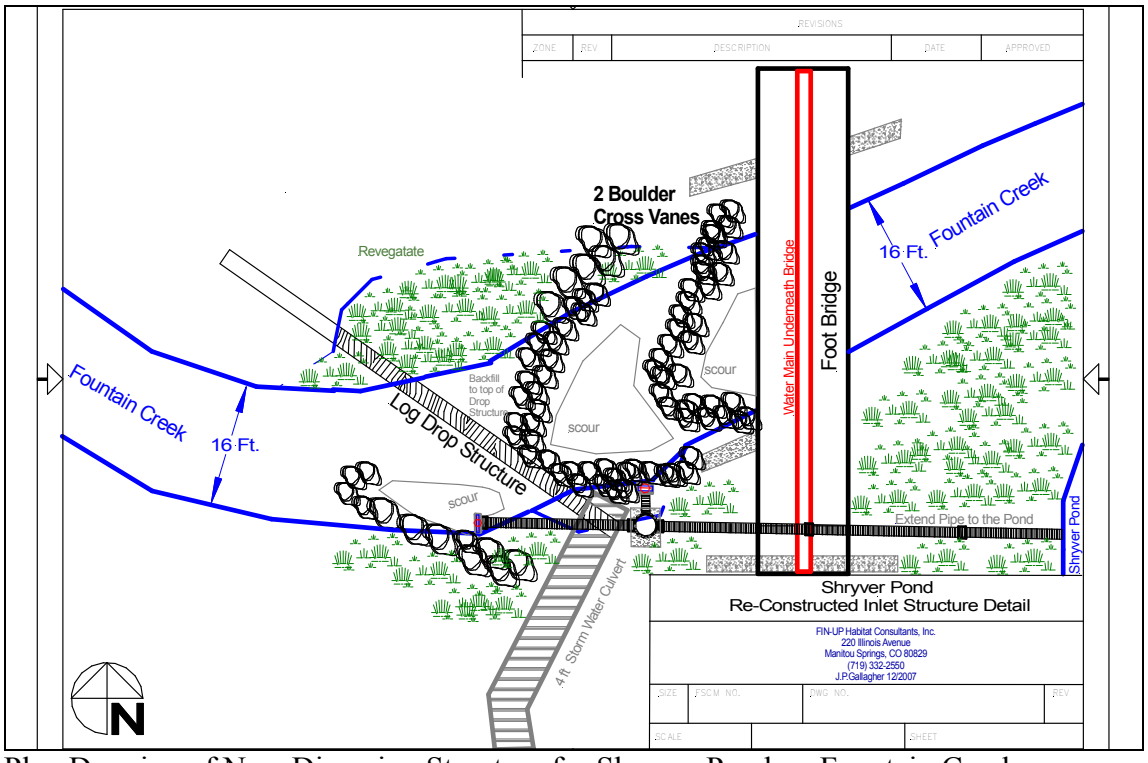
The first priority restoration effort includes reconstruction of the Shryver Pond Inlet works, including the elimination of the barrier to fish migration at the diversion point along Fountain Creek. The second priority will include bank stabilization and re-vegetation, as well as in-channel stream habitat enhancement within the remaining segments of Reach 4 in Shryver Park. The following section will address these priorities, and give specific recommendations and treatments to improve aquatic and riparian habitat conditions throughout the reach. A site plans showing the locations of the proposed enhancements can be found in the Appendix.

Priority 1: Reconstruction of the Shryver Pond Inlet Structure.
The Shryver Pond inlet reconstruction will accomplish the restoration of year round flows to the pond, but will present some difficult challenges to complete. Access to the creek for heavy equipment is limited to a single entry point immediately upstream of the diversion and the working "swing radius" for heavy equipment is severely limited at the site. Due to these considerations, specialized equipment and an experienced equipment contractor will be required for the work. A 15 metric ton "zero-tail" excavator (Komatsu PC78 or equivalent), with a hydraulic thumb, will be necessary to complete the rough site preparation work, and to install the full channel boulder cross-vanes and J-hook vane for the project. If the project can be completed concurrently with the 2008 Soda Springs fisheries project, some savings in equipment mobilization costs may be achieved by using the same contractor for both projects. Much of the site preparation work will need to be done by hand labor. This hand labor can consist of hired laborers or TU / FCRC Volunteers.

Due to the high sediment loads in Fountain Creek, and the difficulty the City of Manitou Springs has experienced in keeping the existing structure clear of sediment and debris, a low maintenance dual head-gate design will be used to allow for continuous scouring of sediment from the inlet head gate structure. The new inlet works will consist of 73 feet

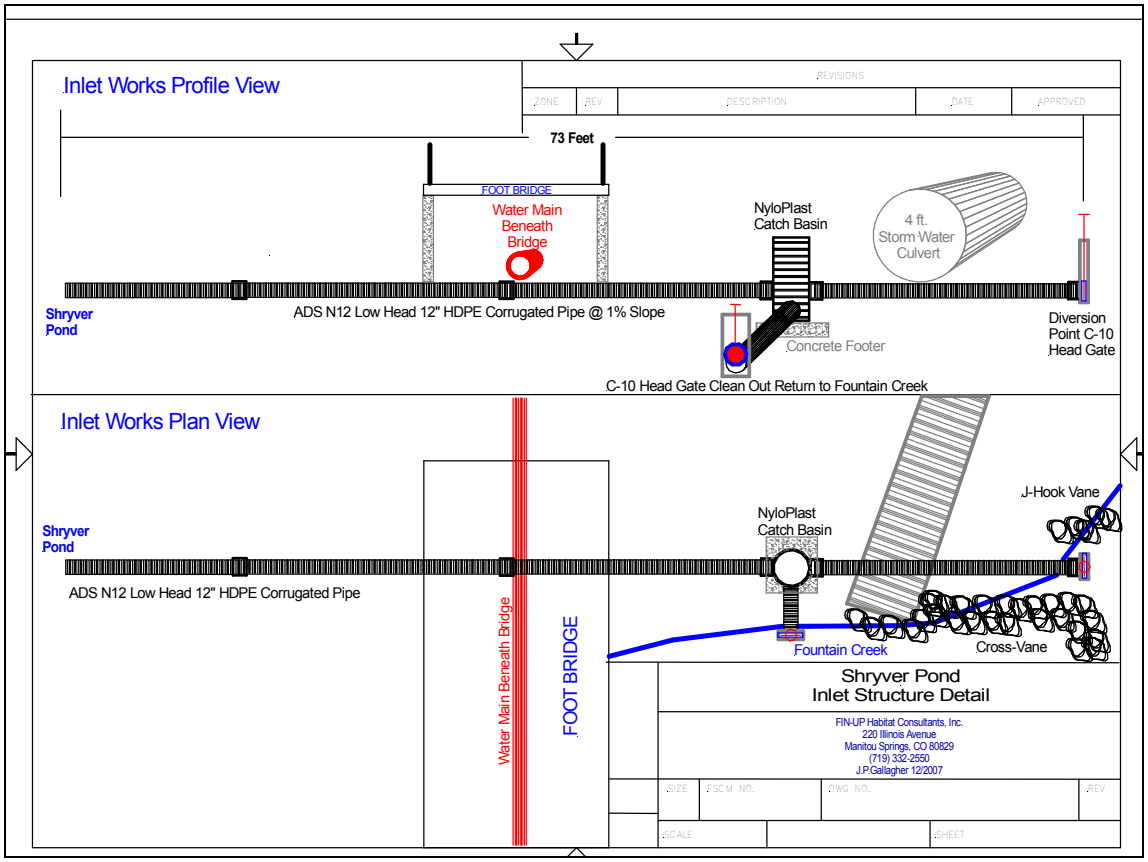
of 12" corrugated HDPE plastic pipe, with a Waterman C-10 12" head-gate installed at the diversion point at the stream. A 24" NyloPlast catch basin with one inlet and two outlet stubs will be installed 20 feet downstream of the diversion point. Details on the materials specifications and suppliers are included in the appendix. The inlet and pond outlet stubs on the catch basin will be 1 foot above the bottom of the basin. A second outlet stub will be installed flush with the bottom of the catch basin and directed back into the stream channel. This outlet stub will also be capped by a Waterman C-10 head-gate. When water is not being moved into the pond, this bypass head gate will be opened, allowing for water to continually flush through the diversion point head-gate, preventing deposition of sediment at the gate. During flood flows, both head-gates may be closed in order to reduce suspended sediments and turbidity in Shryver Pond.

The first phase of the project will consist of removal of the existing inlet pipe, and preparation of the site to install the new inlet works. The excavator will be used to remove soil from around the existing 4 foot storm water culvert, and from either side of the bridge. The last 24 foot section of the storm water culvert will be disconnected and temporarily removed from the site. Four feet of this culvert will be cut off so that the culvert no is longer suspended over the creek when re-installed at the end of the project. Hand laborers will complete the excavation of the existing inlet pipe from under the bridge and water main, and prepare the trench for the new replacement pipe. A small concrete footer / foundation will be formed and poured for the catch basin bypass assembly. Excavation / removal of the existing inlet works and preparation of the site for the new inlet works is expected to take one day.



Plan Drawing of New Diversion Structure for Shryver Pond on Fountain Creek

The second phase of the project will consist of conversion of the existing wooden drop-structure that is creating a barrier in the channel to a series of full channel boulder cross-vanes. These cross-vanes will be constructed in a manner to mimic a pocket water associated cascading step-pool series in the stream channel, allowing for velocity shelter and cover for trout migrating upstream through the reach. The channel and water surface elevation at the diversion point will be maintained at the existing level by tying the cross-vanes into the existing log drop structure. The cross-vanes will be constructed to reduce the bank-full width of the channel from 24' to a width of 16', matching the undisturbed stream channel upstream and downstream of the site. A small boulder J-Hook vane will be installed on the south bank of the stream immediately upstream of the diversion point, in order to eliminate sediment deposition in the stream channel at the head-gate, as well as providing additional cover and velocity shelter for resident trout. Installation of the cross-vanes and J-Hook vane are expected to take one day.



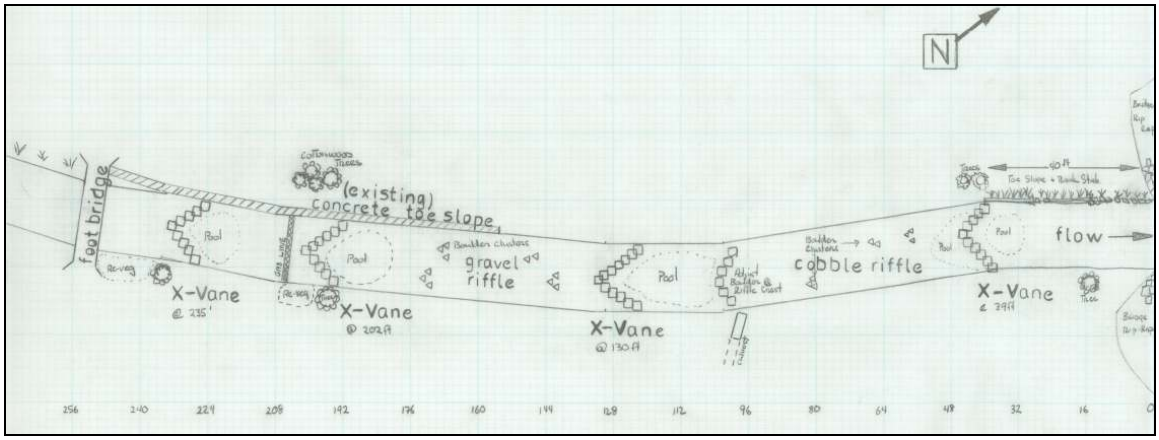
Profile and Plan View of New Inlet Works for Shryver Pond on Fountain Creek.

The third phase of the project will include installing the new head-gate, HDPE inlet pipe, and catch basin bypass assembly. The bottom of the new head-gate should be set at an elevation of 6,224.45ft (ASL) along the left bank of Pool 7, immediately downstream of the J-hook vane described in the paragraph above. This work will be mostly done by hand crews, assuring that a minimum 1% slope is attained along the inlet pipe works. Once the new inlet works has been installed, the trench will be backfilled using the excavator, and the shortened 4 foot storm water culvert will be reinstalled. This structure

will be back-filled to the existing pre-project grade, and energy dissipating boulders will be placed in the creek channel immediately below the culvert outlet to reduce down-cutting and erosion in the channel. TU / FCRC volunteers will complete project site rehabilitation and revegetation immediately following completion of the project.

The final phase of the pond restoration effort will consist of minor excavation of Shryver Pond to remove the accumulated organic debris, restoring some of the deeper water pelagic habitat that has been lost over time. This excavation will be done in a non-jurisdictional manner, immediately removing dredged spoils from the site using an excavator and haul trucks. Approximately 200 feet of eroding and unstable pond shoreline will be treated along the eastern and southern side of the pond, providing hardened areas that can sustain recreational fishing use. I also recommend considering the removal of the large 4 foot diameter culvert and fill from the west side of the pond, replacing this structure with a small wooden foot bridge to allow visitors to access the island in the middle of the impoundment and construction of a handicapped fishing area along the northeastern shoreline. These enhancements are mostly esthetic in value, but could be implemented depending on fund raising success for the other phases of the project.

Priority 2: Aquatic Habitat Enhancements and Stream Bank Stabilization.
Natural river restoration techniques will be utilized to enhance and restore 684 feet of Fountain Creek, creating new holding areas and cover for trout within the project reach. Pool scour will be enhanced by adjusting boulders to optimize the river's capacity to move sediment. Enhancing pool scour should increase average pool depth and residual pool depth in the channel, providing additional cover and over-wintering capacity for trout, and are expected to be self-maintaining. Pool habitat will be increased by constructing boulder cross vanes to scour existing glide/run features in the channel.

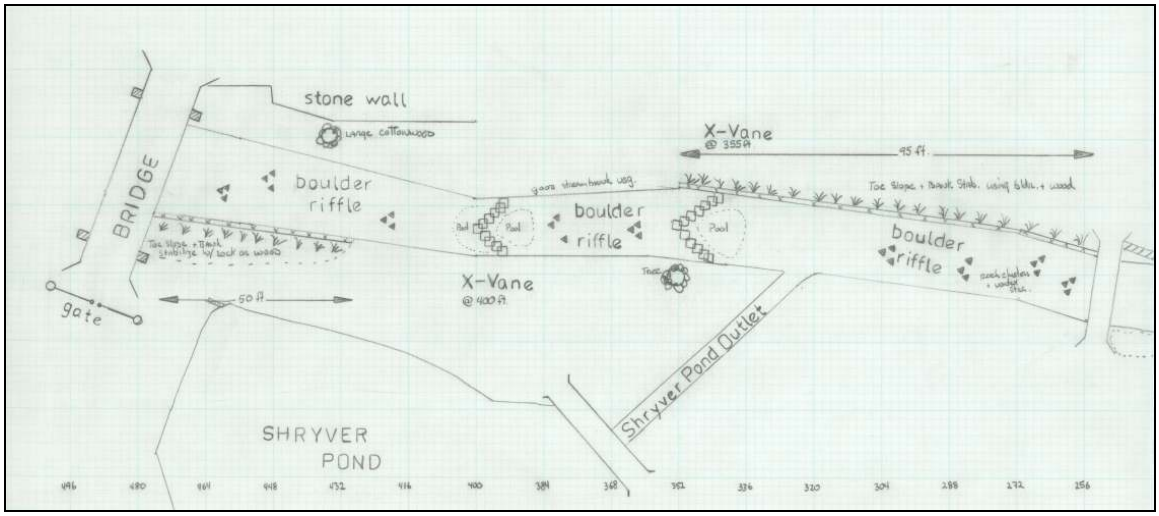


Plan view of Habitat enhancements and bank stabilization in the downstream 1/3 segment of Reach 4 of Fountain Creek within Shryver Park.

These cross vanes will also provide enhanced vertical stability in the stream channel. Pocket water cover will be increased within several of the riffles using small rock cluster vortex structures. 390 feet of stream bank will be stabilized using large wood and/or boulders embedded in the toe of the bank slope to create riparian benches at the bank-full

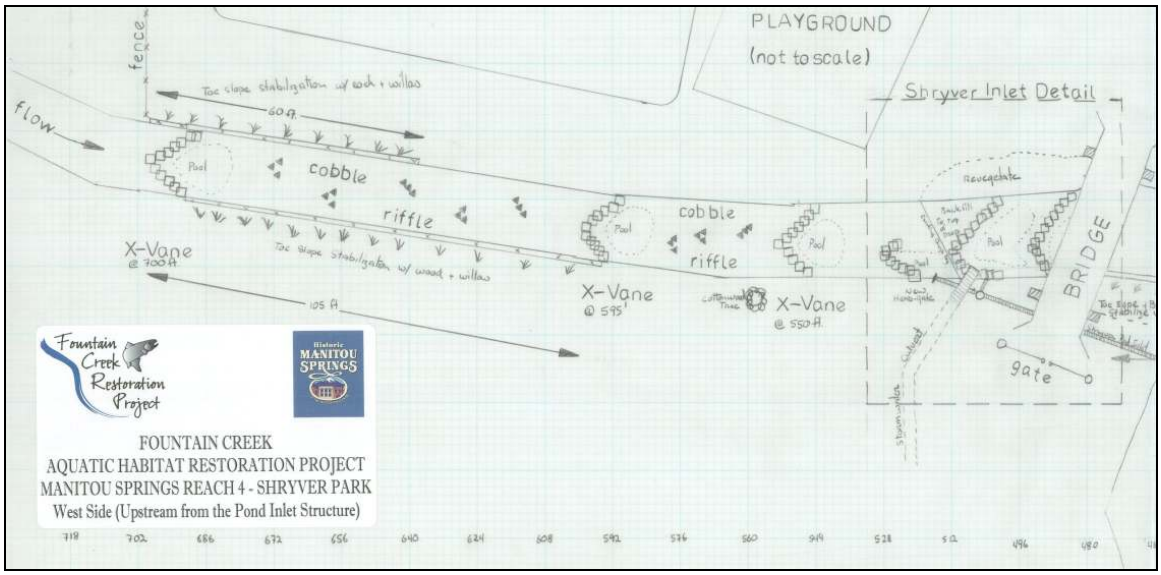
elevation of the stream channel. Willows and sedge mats will be planted along these benches, creating a small riparian floodplain. Additional slope stabilization and re-vegetation will take place above the toe-slope structures, using landscaping timbers and other features to create benches that will capture sediment and run-off from the adjacent park areas. Stabilized slopes will be covered with biodegradable geo-textile fabric, and planted with native willow, sedge and upland grasses. Site specific details of each enhancement are provided below.

Beginning at the downstream boundary of the reach, a boulder cross-vane will be installed at the transition from Pool 1 to Riffle 1 to enhance scour through the habitat. Additionally, 40 feet of actively eroding stream bank will be treated using log toe-slope and riparian bench techniques on the right stream bank. Another cross-vane will be installed at the interface of Glide 1 and Riffle 4, to convert this habitat form to a pool, and the riffle crest between Glide 1 and Riffle 3 will be modified to increase residual pool depth. Two more cross-vanes will be installed at the top of Pool 2 and Pool 3 to further enhance the scour of sediment in these habitats, and to protect the utility crossing immediately upstream of Pool 2. Pocket water cover will be increased in Riffles 1, 2, 3 and 4 using strategically placed small boulders and by adjusting existing boulders to create small scour pockets and micro-vortices.



Plan view of habitat enhancements and bank stabilization in the central 1/3 segment of Reach 4.

Between the footbridge leading to the pool house and the larger bridge immediately upstream of Shryver Pond, two more cross-vanes will be installed to improve depth, complexity and scour in Pools 4 and 5. Ninety-five feet of the right stream bank immediately upstream of the lower footbridge will be stabilized with log toe-slope structures and a riparian bank full bench. Additionally, 50 feet of left stream bank immediately below the upstream bridge will be treated in a similar manor. The three riffles between the two bridges will be enhanced for pocket water using the techniques described above. Approximately 9 pocket water micro vortices are estimated to be used in this segment



Plan view of habitat enhancements and bank stabilization in the upstream 1/3 segment of Reach 4, including the new Shryver Pond Inlet Works.

The treatments in the area around the diversion/Shryver Pond inlet structure have already been described in the previous section. Upstream of the diversion structure, three more cross-vanes will be installed to create new pool habitat, as well as enhance existing features in the stream. Stream banks are in exceptionally poor condition in this segment, requiring 165 feet of stream bank toe-slope and bank full benching treatments be installed to stabilize these features. Pocket water habitat is very limited in the riffles within this segment, and will be greatly improved by the installation of at least 8 boulder associated micro-vortices. Detailed drawings of the habitat structures to be used in this project may be found in the Appendix. Bank-full and center structure elevations of the cross-vanes, bank full elevation of the stream bank benches, and 1/2 bank full elevations of the micro-vortex structures will be determined on an individual basis, using the longitudinal profile data collected in the pre-project assessment.

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 and a front end loader. The head-gates, pipe, and other inlet works materials will need to be ordered at least 6 weeks prior to the construction start date, in order to assure timely delivery of the materials. We estimate that 330 - 350 boulders (225 $yd^{3)}$ will likely need to be imported into the site in order to complete the work. Additionally, approximately 12 - 14 cottonwood or other trees, averaging 10"-16" DBH, will need to be secured to complete the toe-slope stabilization and riparian benching work. There is no available willow on site, so a source of willow needs to be determined for the project. 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 4

- Greater sediment transport efficiency, as measured by increased maximum pool depth, residual pool depth and total volume within newly constructed pools within the reach.

- 390 feet of eroding stream banks stabilized and revegetated (28% of the total stream banks in the reach).

- 1/3 Acre of improved in-stream and stream bank riparian habitat along 700 feet of Fountain Creek, including 11 Cross-Vanes to create or enhance 14 pool habitats, 1 J-Hook Rock Vane to provide additional pool habitat and to project the pond inlet structure, and 24 rock clusters to provide pocket water holding and feeding areas and velocity shelter within the riffle habitats of the reach.

- 1/4 Acre pond enhanced.

- Improved educational and recreational opportunities within the park, leading to the designation of Shryver Pond as the only "Kids Fishing Pond" in El Paso County.

- 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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Ariel Photography used with permission: Data from Google Earth and USGS/Microsoft TerraServer. Topographical maps created using USGS and Delorme TOPO 6.0

APPENDIX

Project Area & Reach 4 Restoration Treatment Maps

Longitudinal Profiles of Reach 4

Cross - Sections

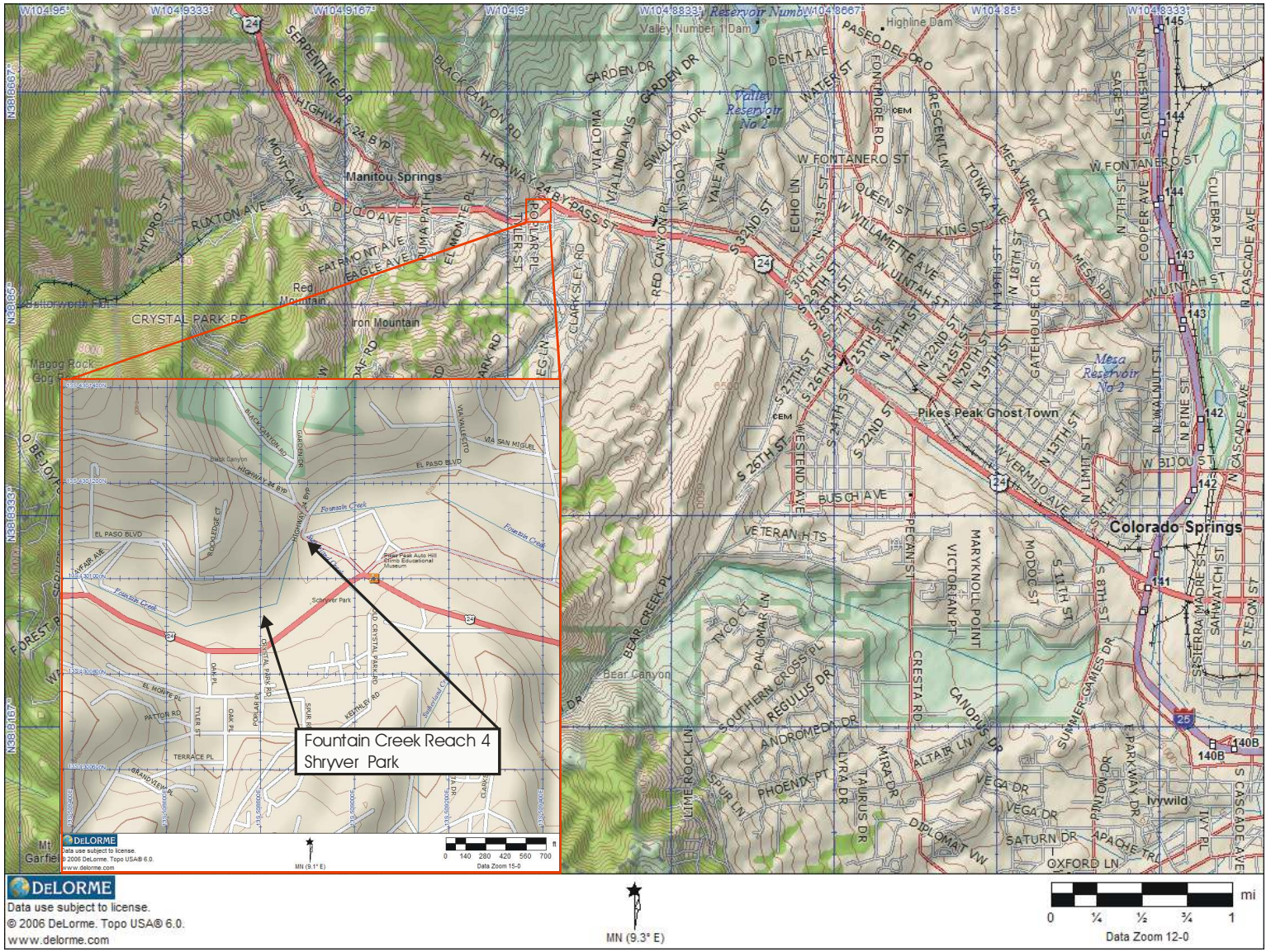
Proposed Treatments Designs and Conceptual Drawings

Photographs of Proposed Treatment Types

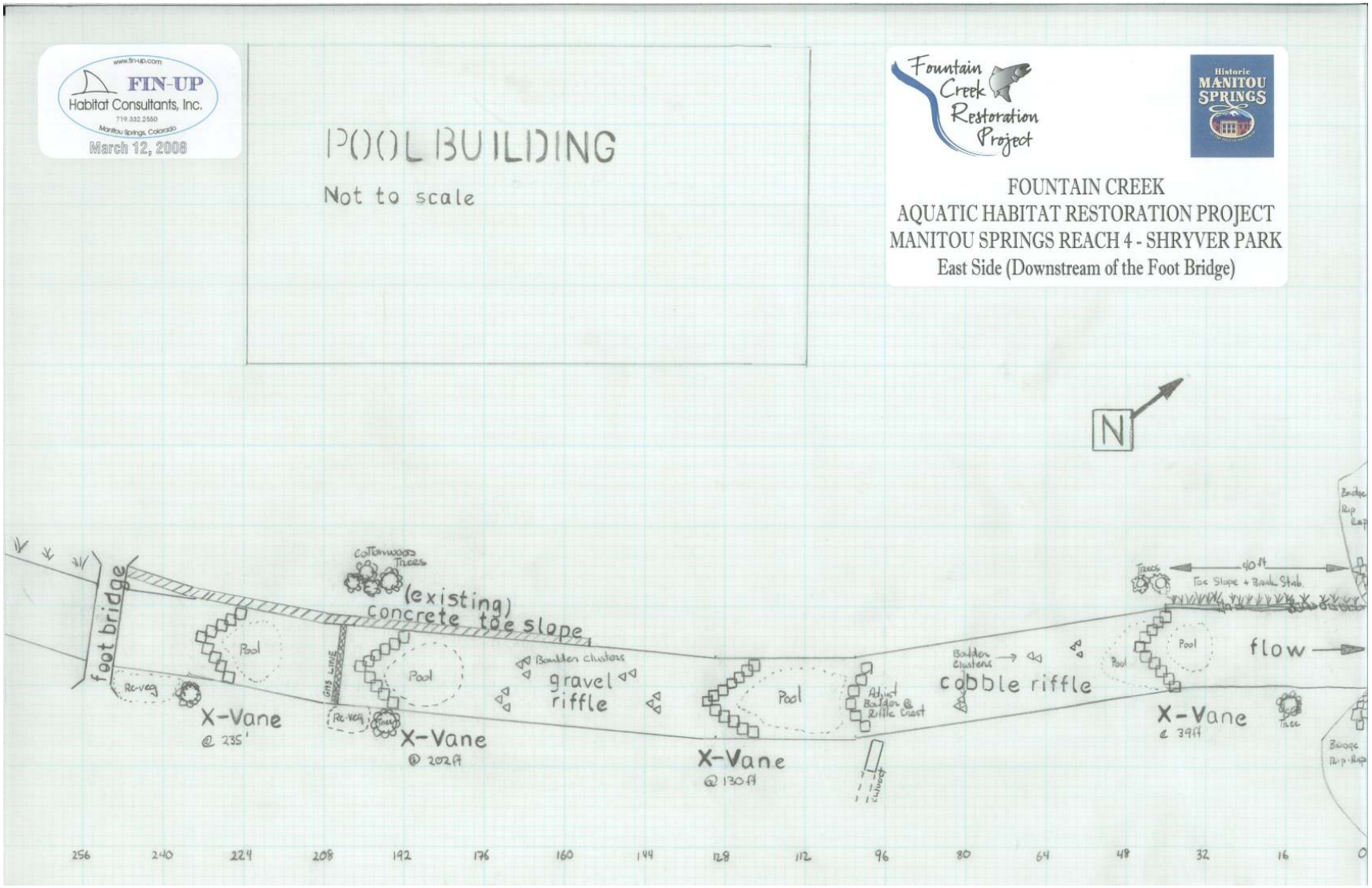
Stream Inventory BWSHI Data Sheets and Summaries

Budget and Implementation Estimate

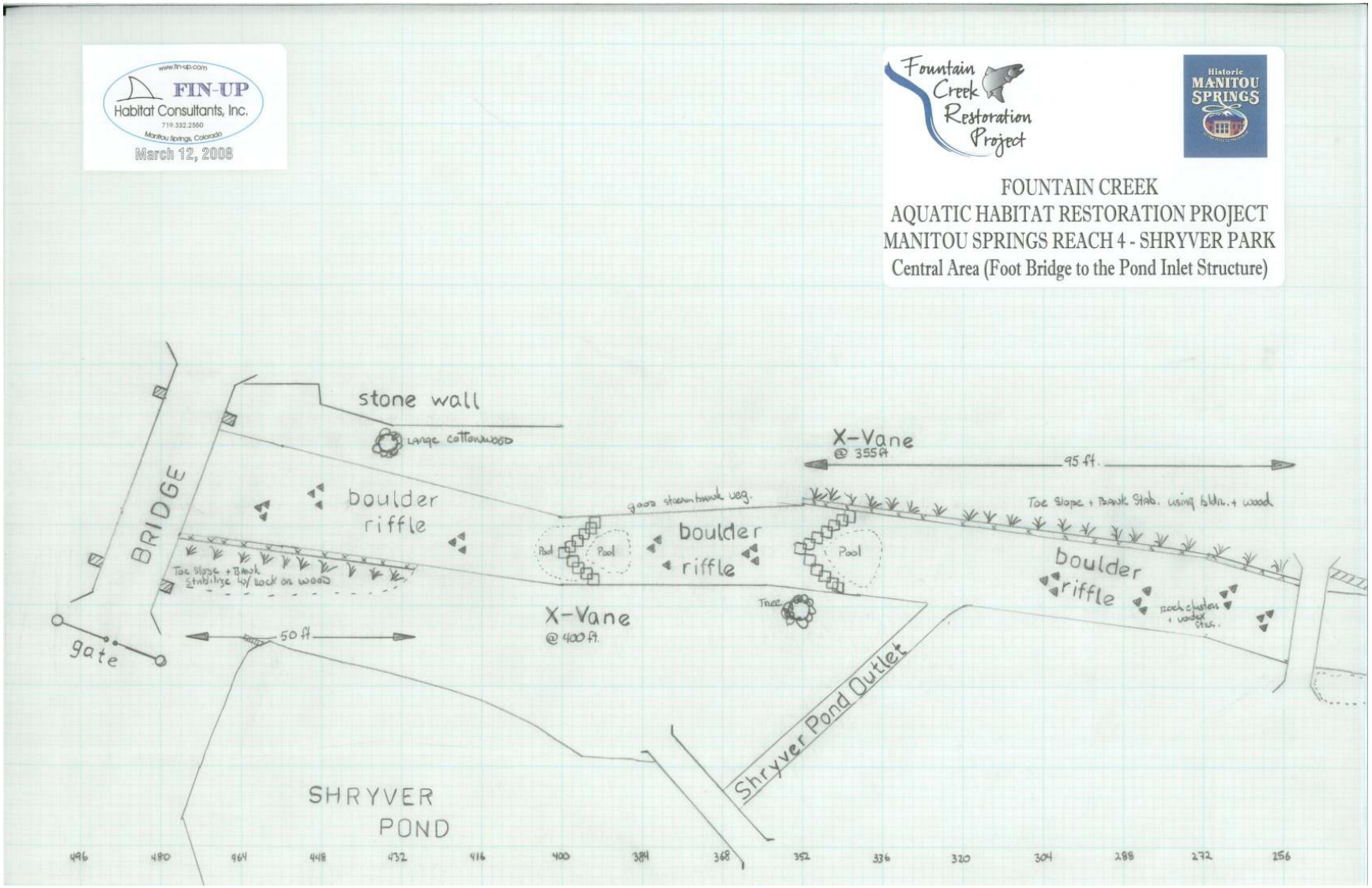
Project Area & Reach 4 Restoration Treatment Maps



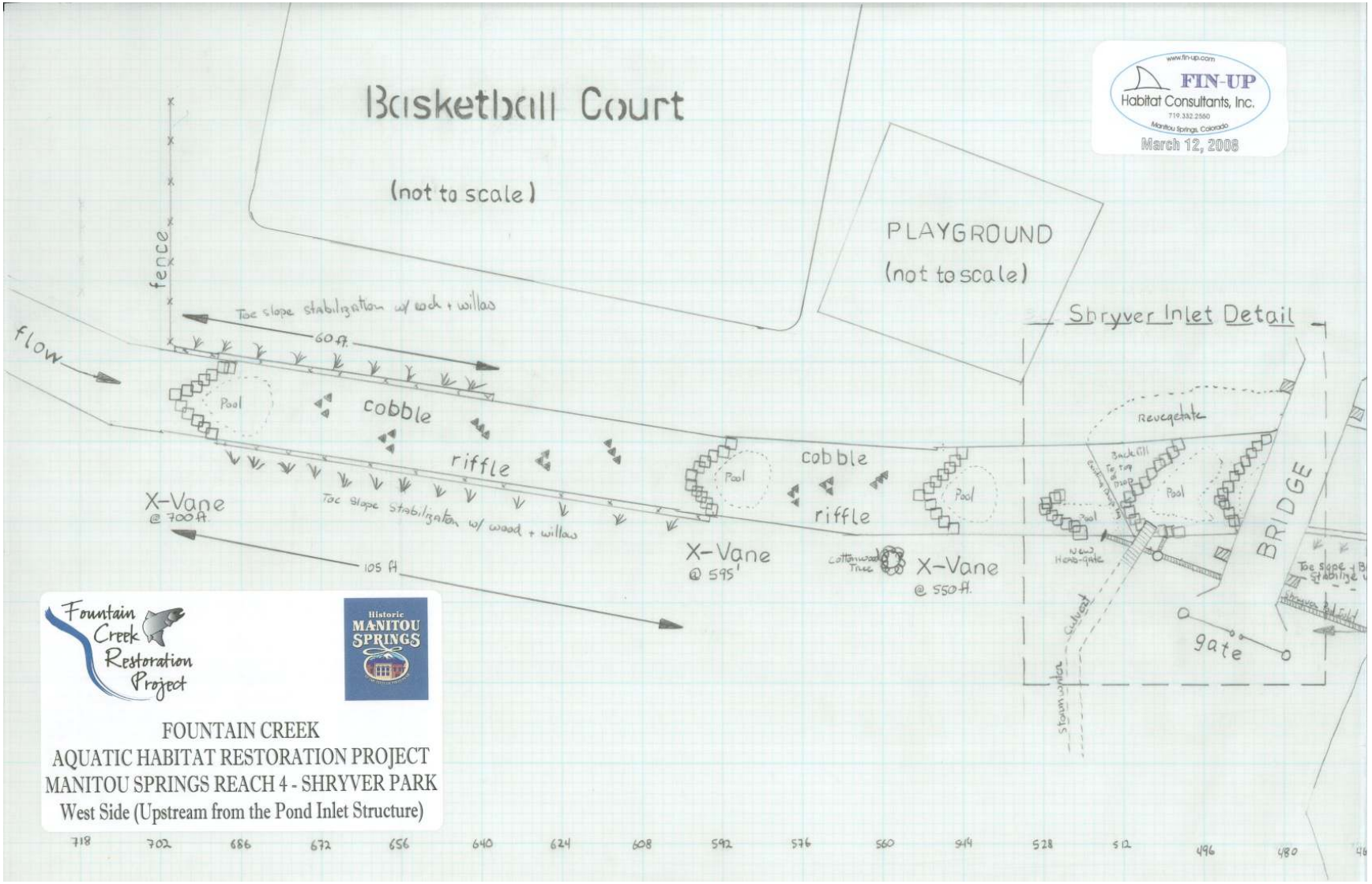
Project Vicinity and Location Map.



Fountain Creek - Shryver Park Reach 4 Downstream Segment - Proposed Stream Restoration Treatments.

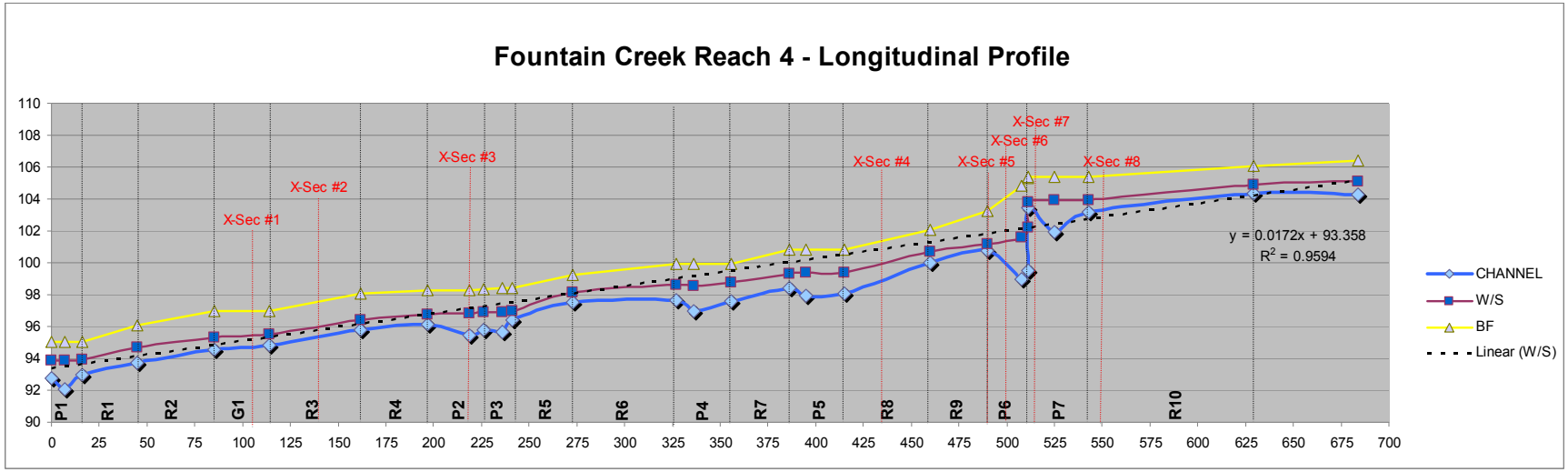


Fountain Creek - Shryver Park Reach 4 Middle Segment - Proposed Stream Restoration Treatments.



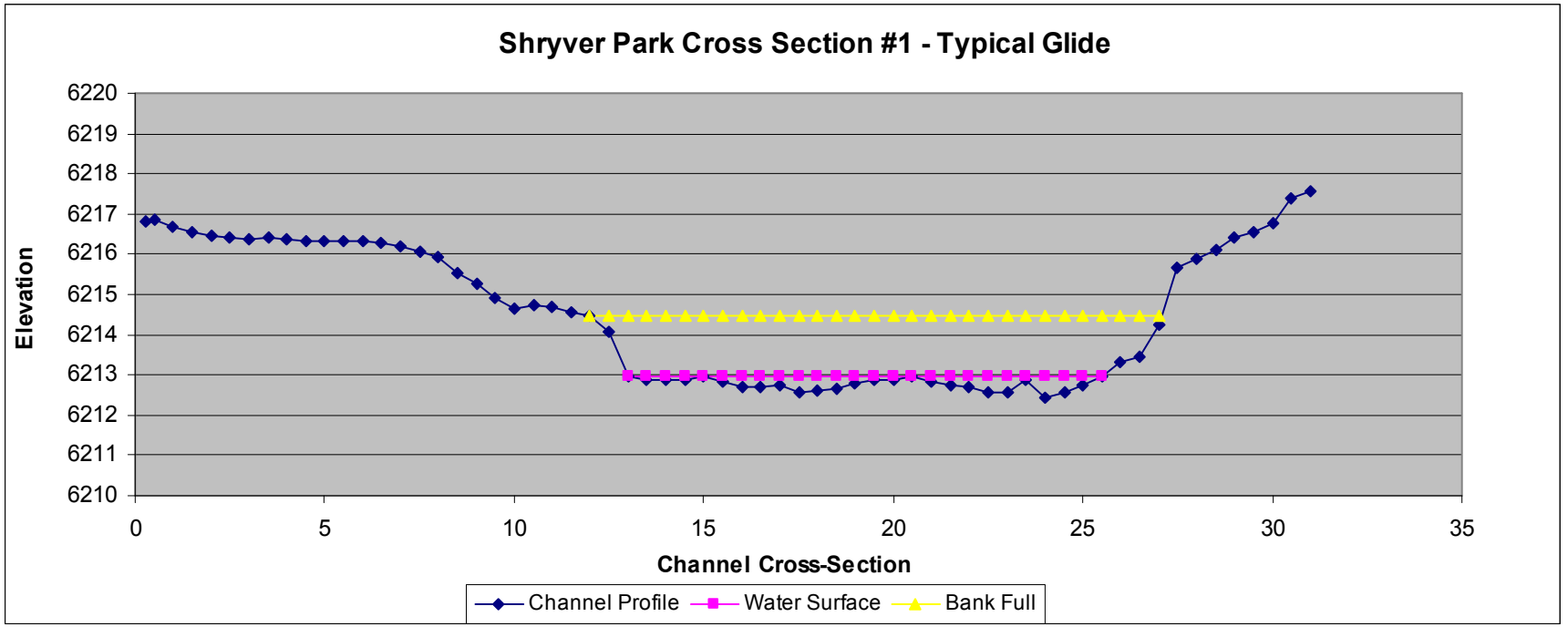
Fountain Creek - Shryver Park Reach 4 Downstream Segment - Proposed Stream Restoration Treatments.

Longitudinal Profiles of Reach 4



Longitudinal Profile of Fountain Creek Reach 4 - Shryver Park in Manitou Springs, CO.

Shryver Park Reach 4 Cross - Sections


Shryver Park Cross Section #1 - Typical Glide
Elevation
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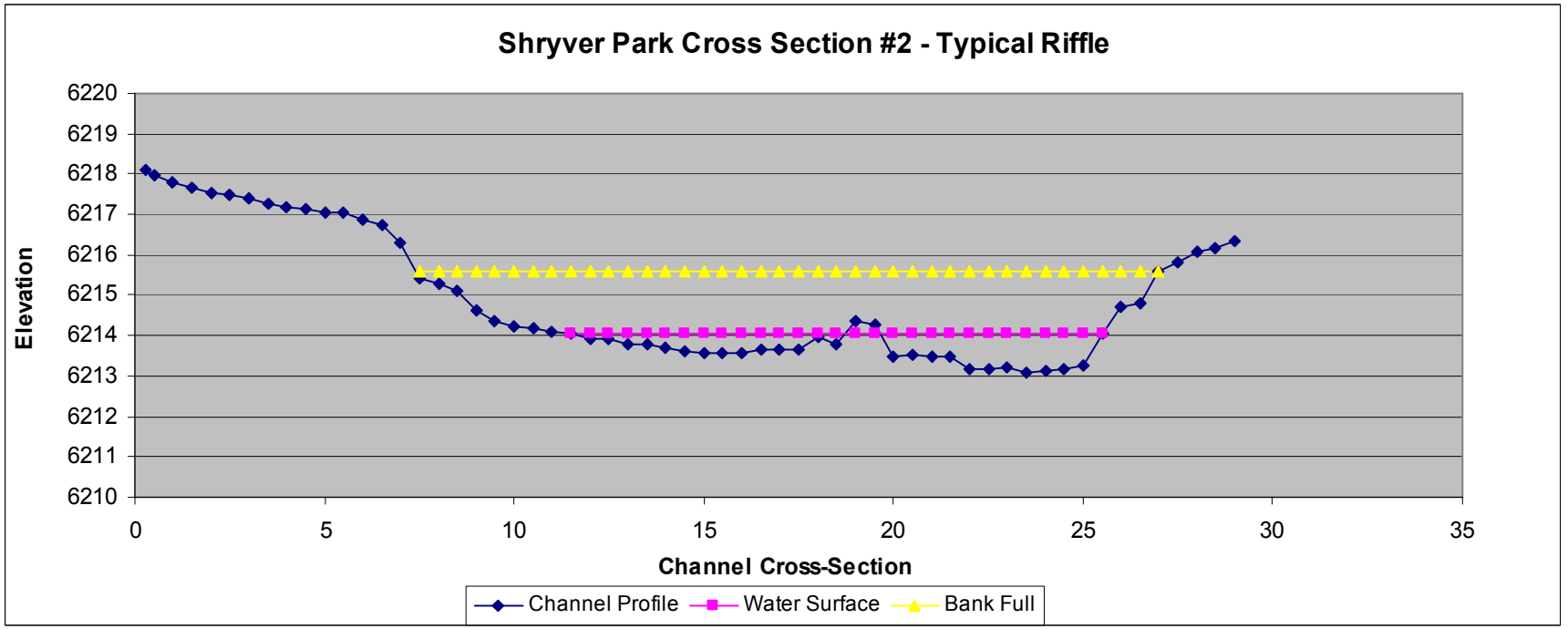
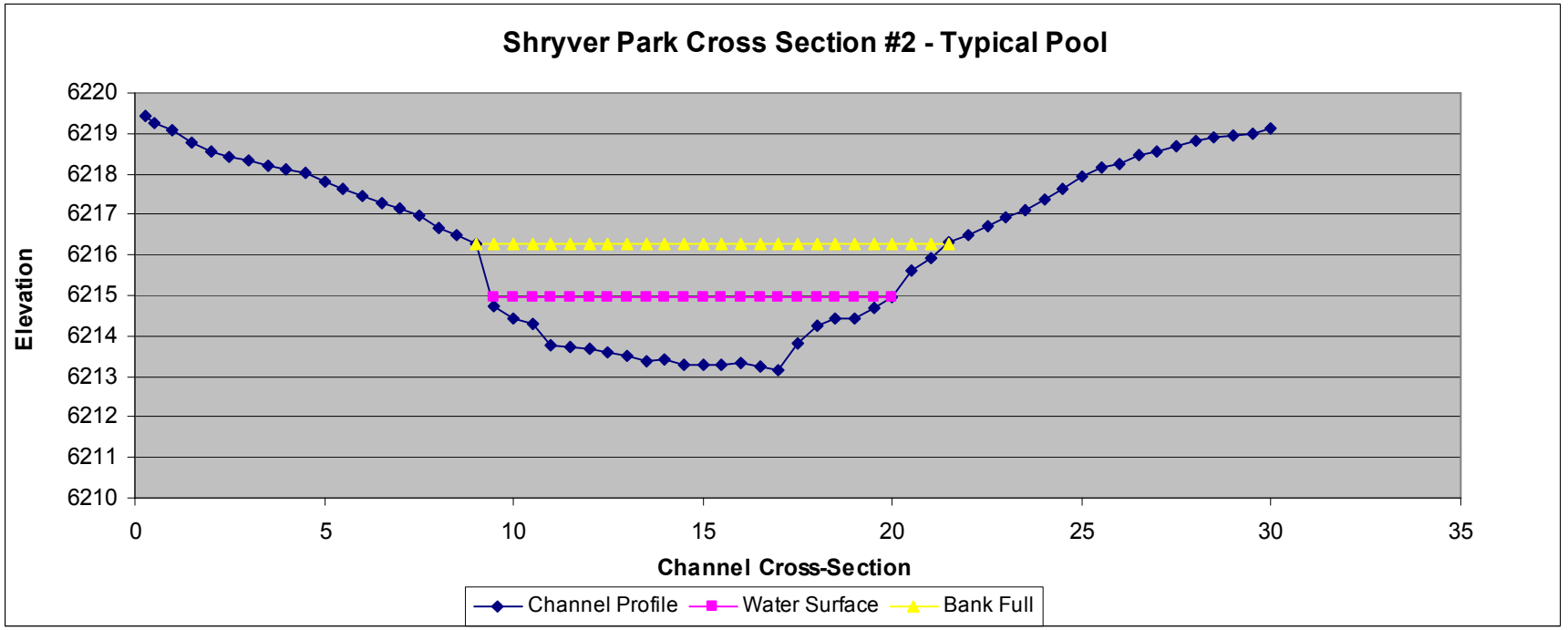
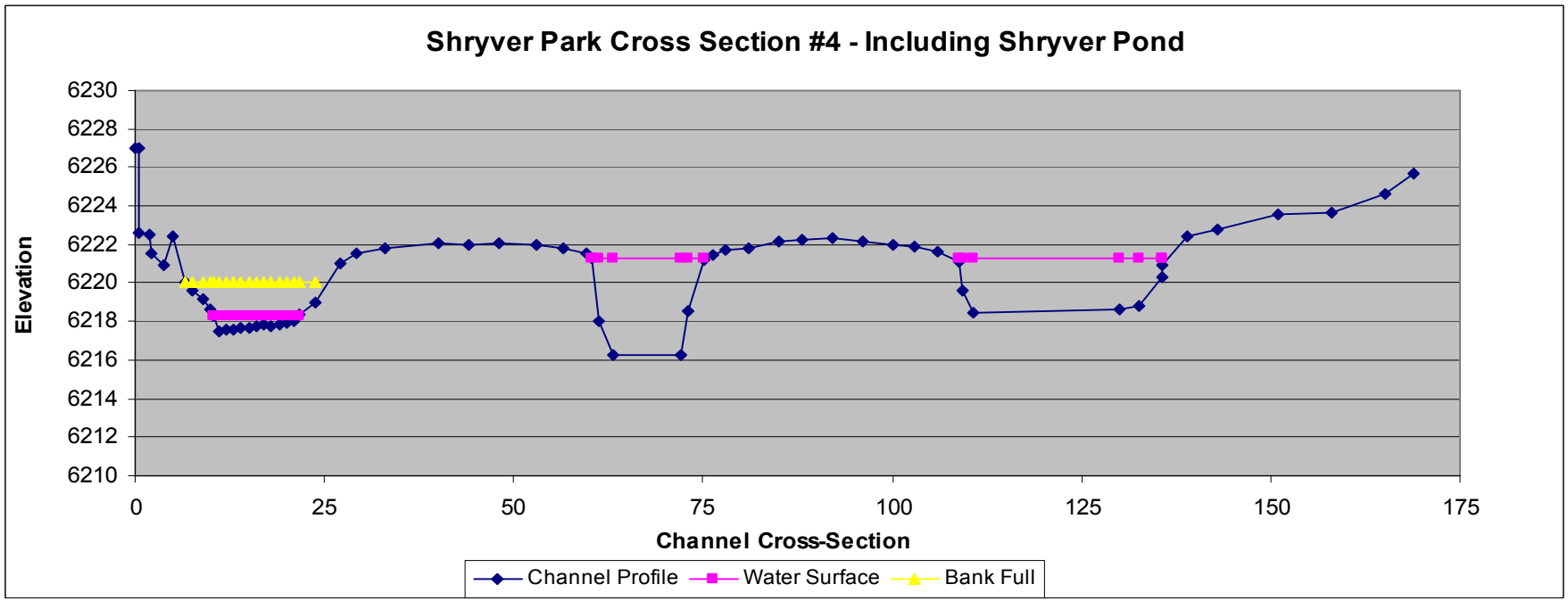
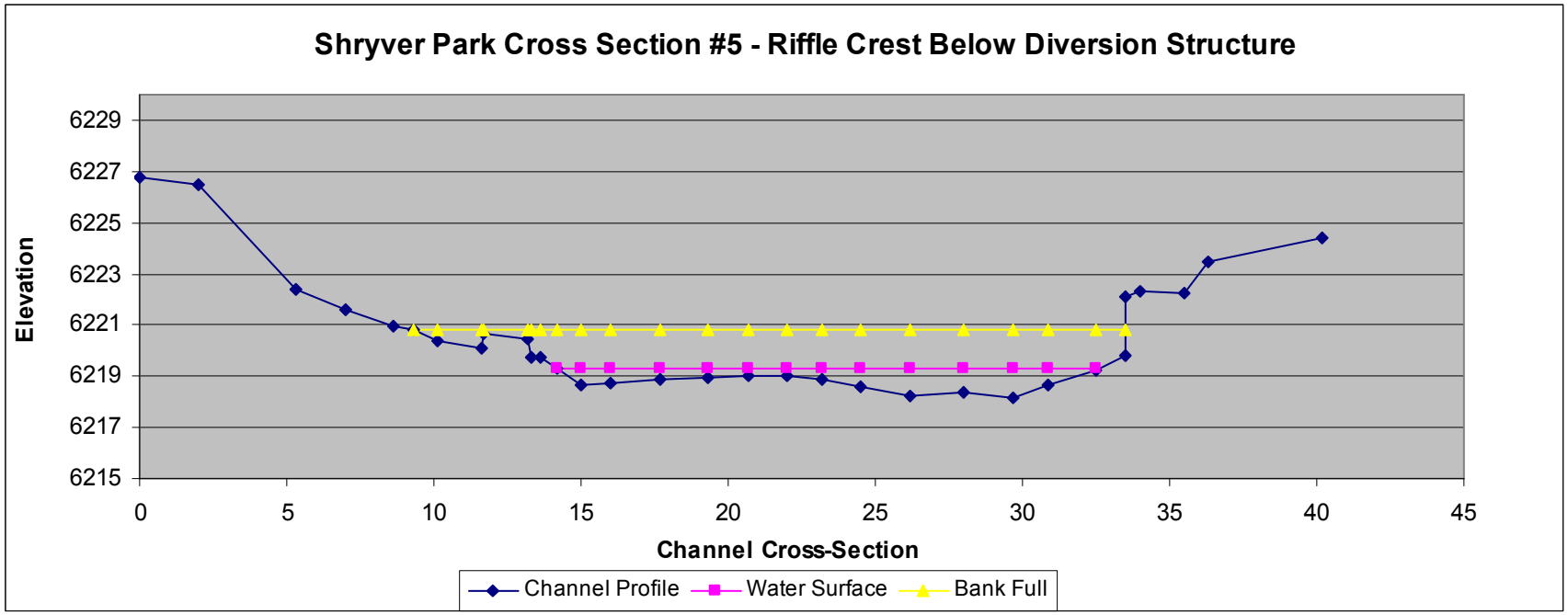
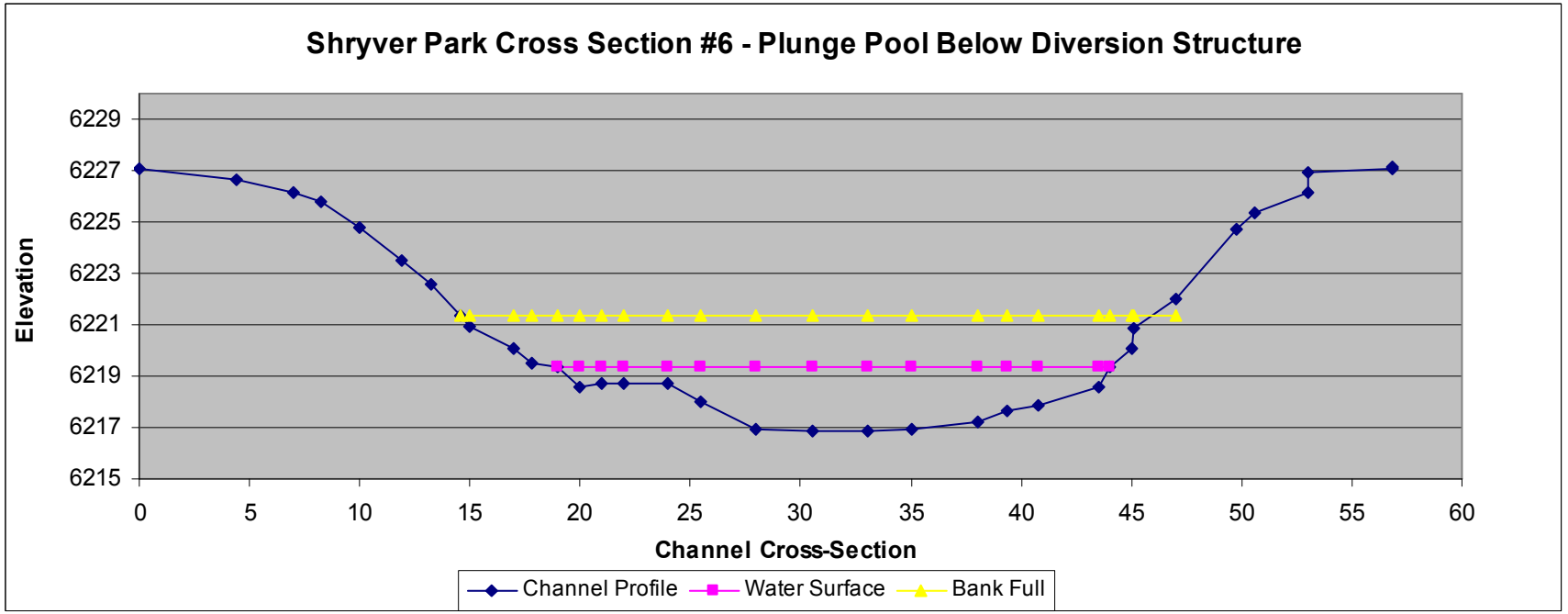
6211
6210
0
5
10
15
20
25
30
35
Channel Cross-Section
Channel Profile
Water Surface
Bank Full

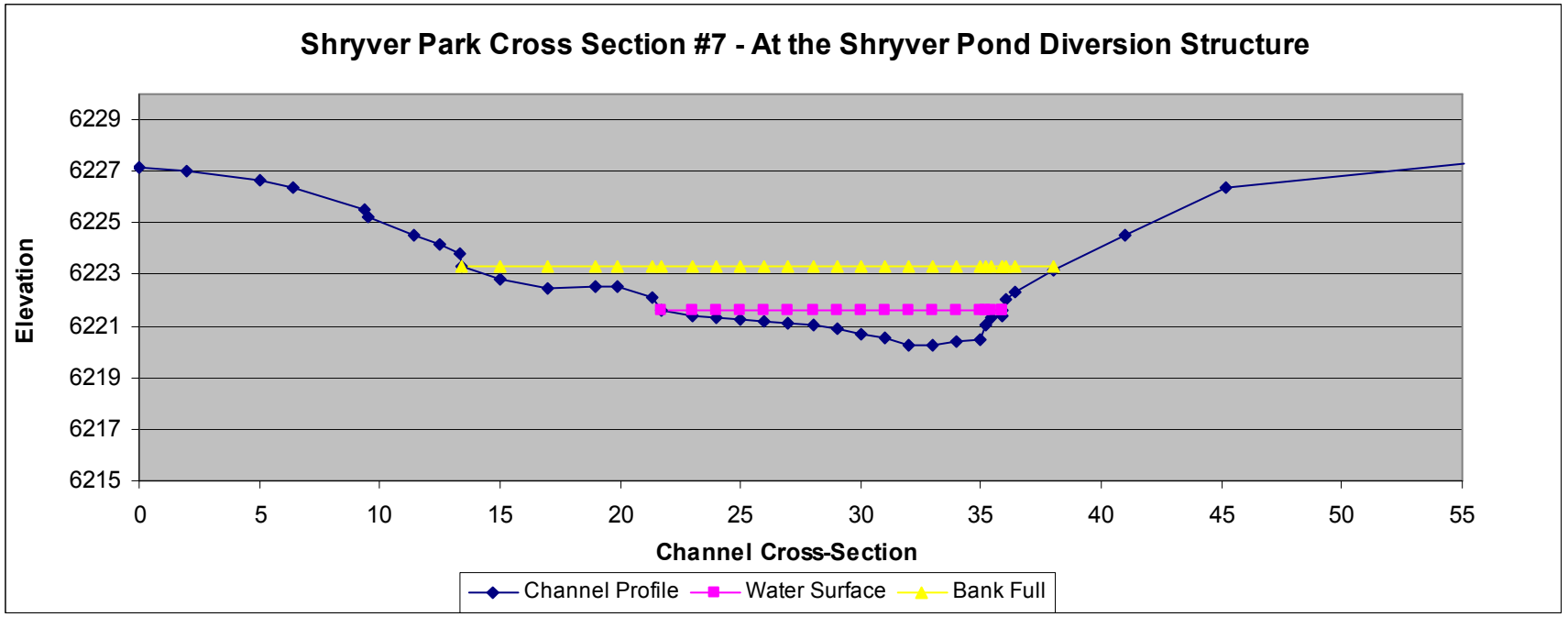

Shryver Park Cross Section #2 - Typical Riffle
Elevation
6220
6219
6218
6217
6216
6215
6214
6213
6212
6211
6210
0
5
10
15
20
25
30
35
Channel Cross-Section
Channel Profile
Water Surface
Bank Full

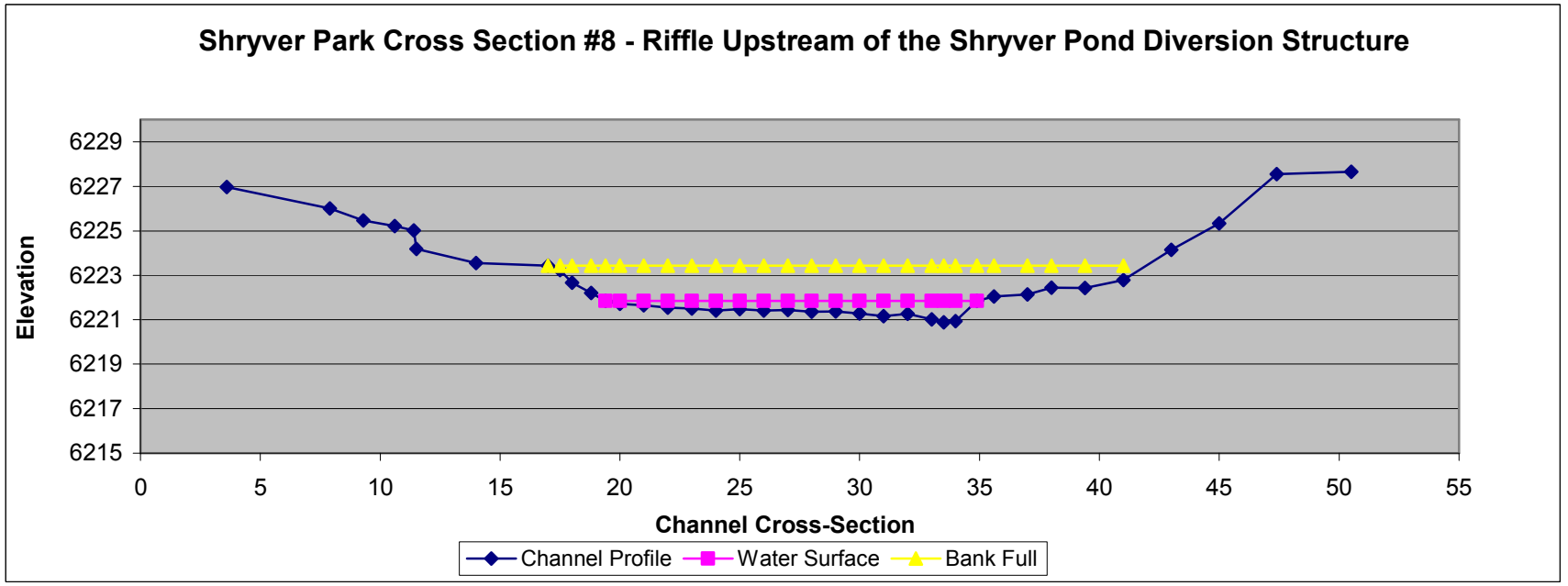

Shryver Park Cross Section #2 - Typical Pool
Elevation
6220
6219
6218
6217
6216
6215
6214
6213
6212
6211
6210
0
5
10
15
20
25
30
35
Channel Cross-Section
Channel Profile
Water Surface
Bank Full


Shryver Park Cross Section #4 - Including Shryver Pond
Elevation
6230
6228
6226
6224
6222
6220
6218
6216
6214
6212
6210
0
25
50
75
100
125
150
175
Channel Cross-Section
Channel Profile
Water Surface
Bank Full

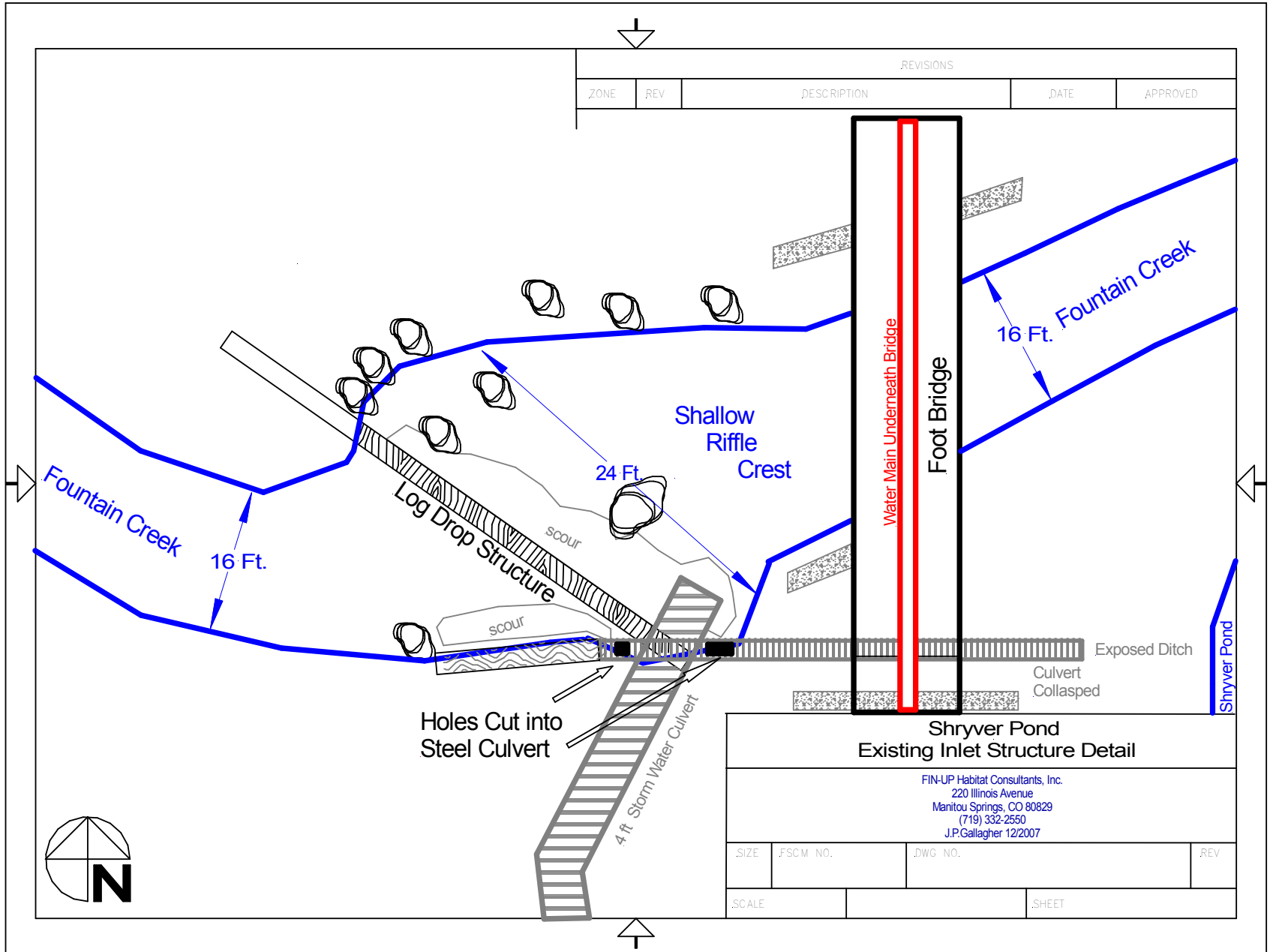

Shryver Park Cross Section #5 - Riffle Crest Below Diversion Structure
Elevation
6229
6227
6225
6223
6221
6219
6217
6215
0
5
10
15
20
25
30
35
40
45
Channel Cross-Section
Channel Profile
Water Surface
Bank Full

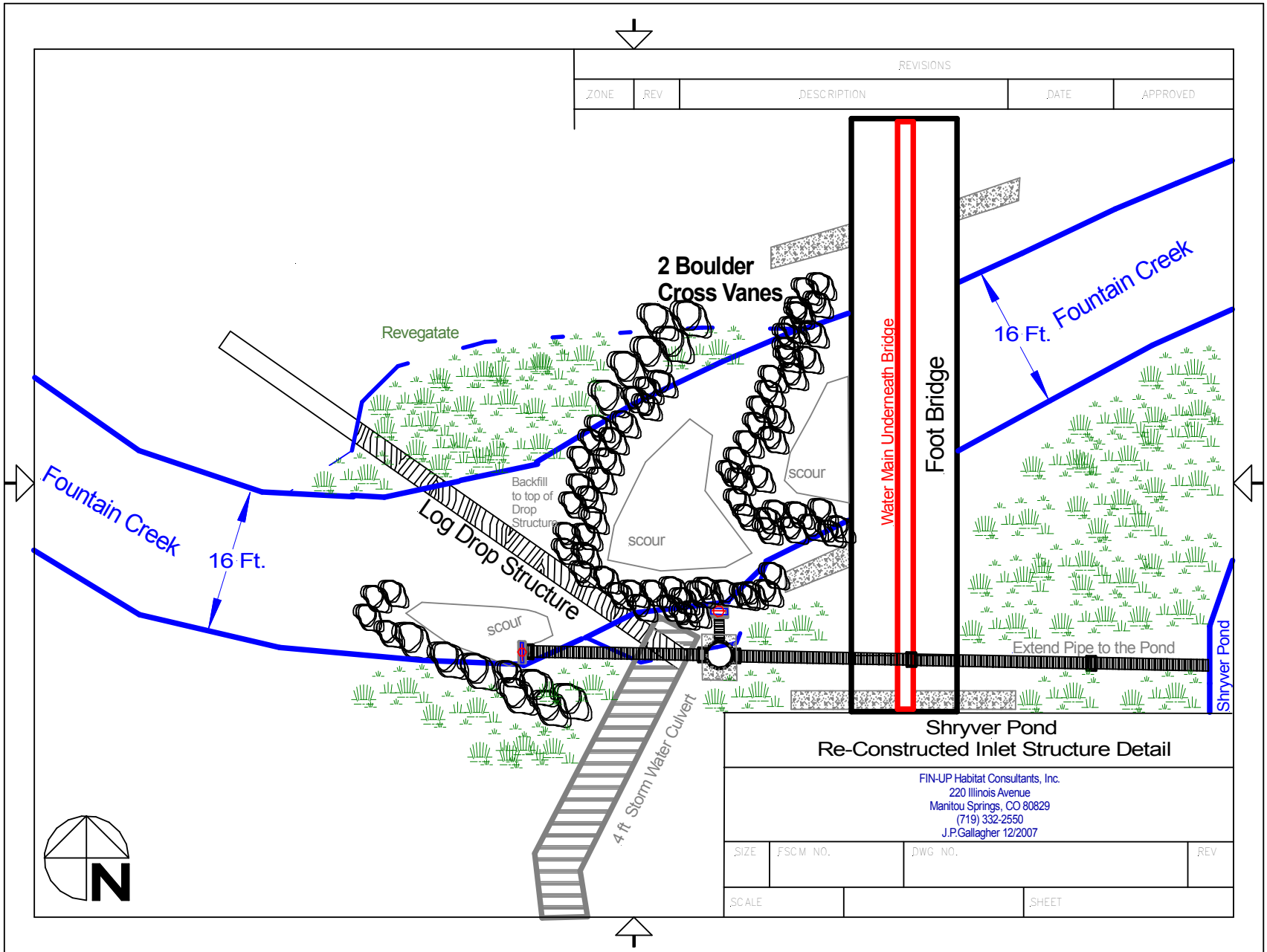

Shryver Park Cross Section #6 - Plunge Pool Below Diversion Structure
Elevation
6229
6227
6225
6223
6221
6219
6217
6215
0
5
10
15
20
25
30
35
40
45
50
55
60
Channel Cross-Section
Channel Profile
Water Surface
Bank Full

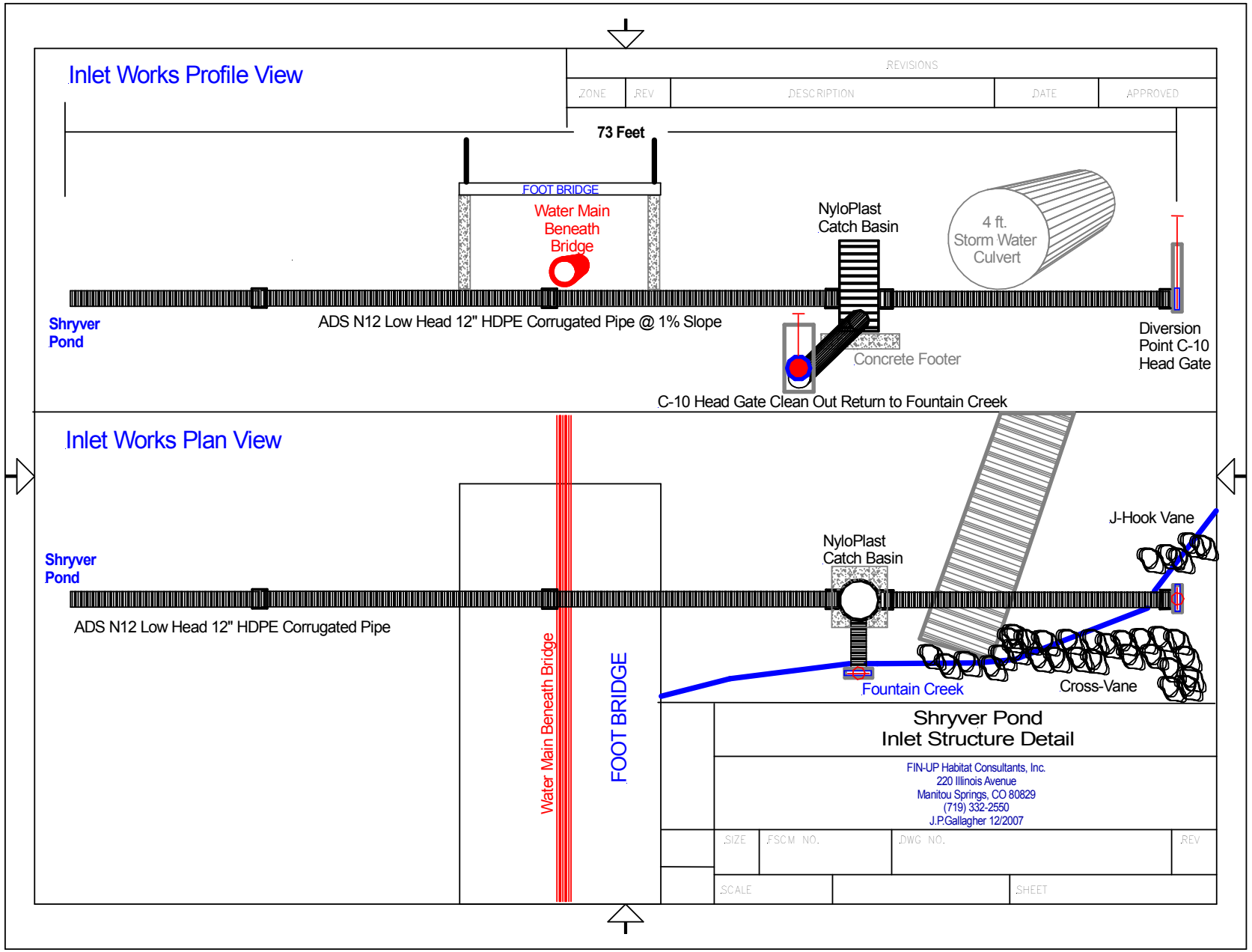

Shryver Park Cross Section #7 - At the Shryver Pond Diversion Structure
Elevation
6229
6227
6225
6223
6221
6219
6217
6215
0
5
10
15
20
25
30
35
40
45
50
55
Channel Cross-Section
Channel Profile
Water Surface
Bank Full


Shryver Park Cross Section #8 - Riffle Upstream of the Shryver Pond Diversion Structure
Elevation
6229
6227
6225
6223
6221
6219
6217
6215
0
5
10
15
20
25
30
35
40
45
50
55
Channel Cross-Section
Channel Profile
Water Surface
Bank Full

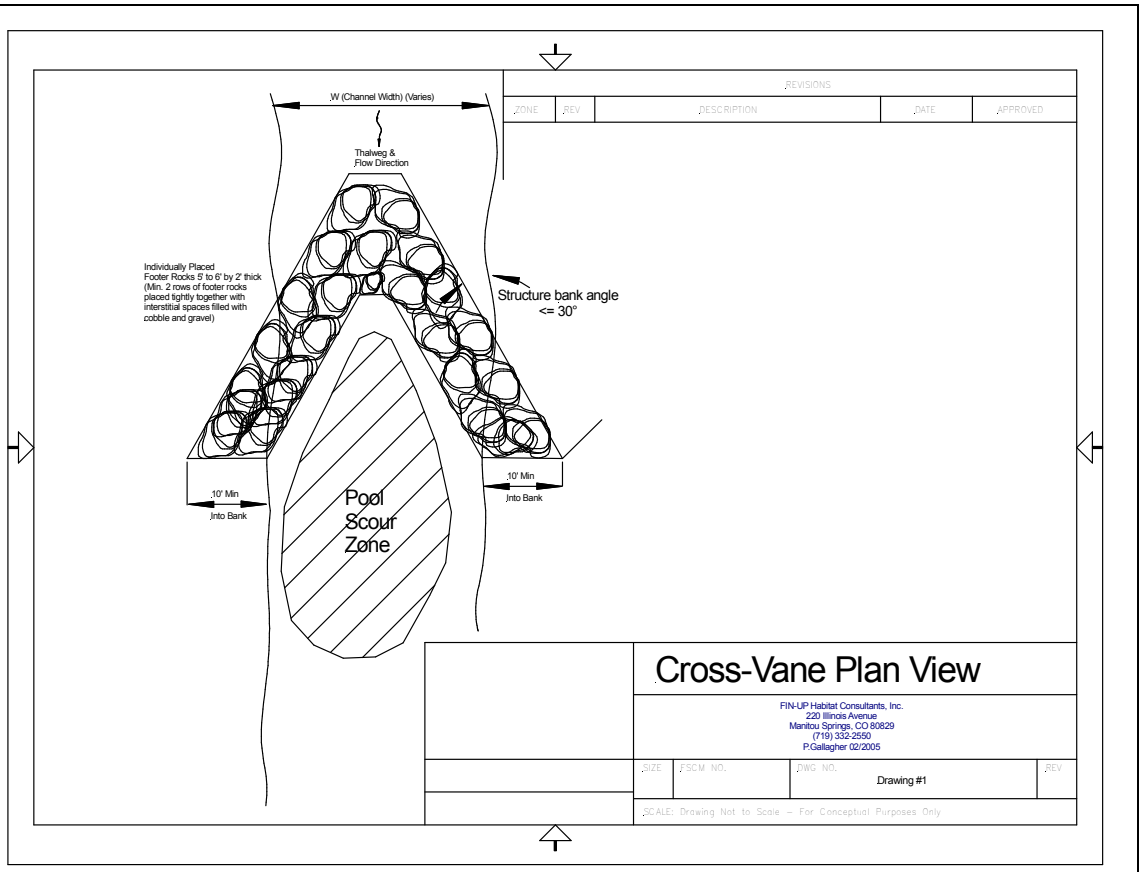
Proposed Treatments Designs and Conceptual Drawings

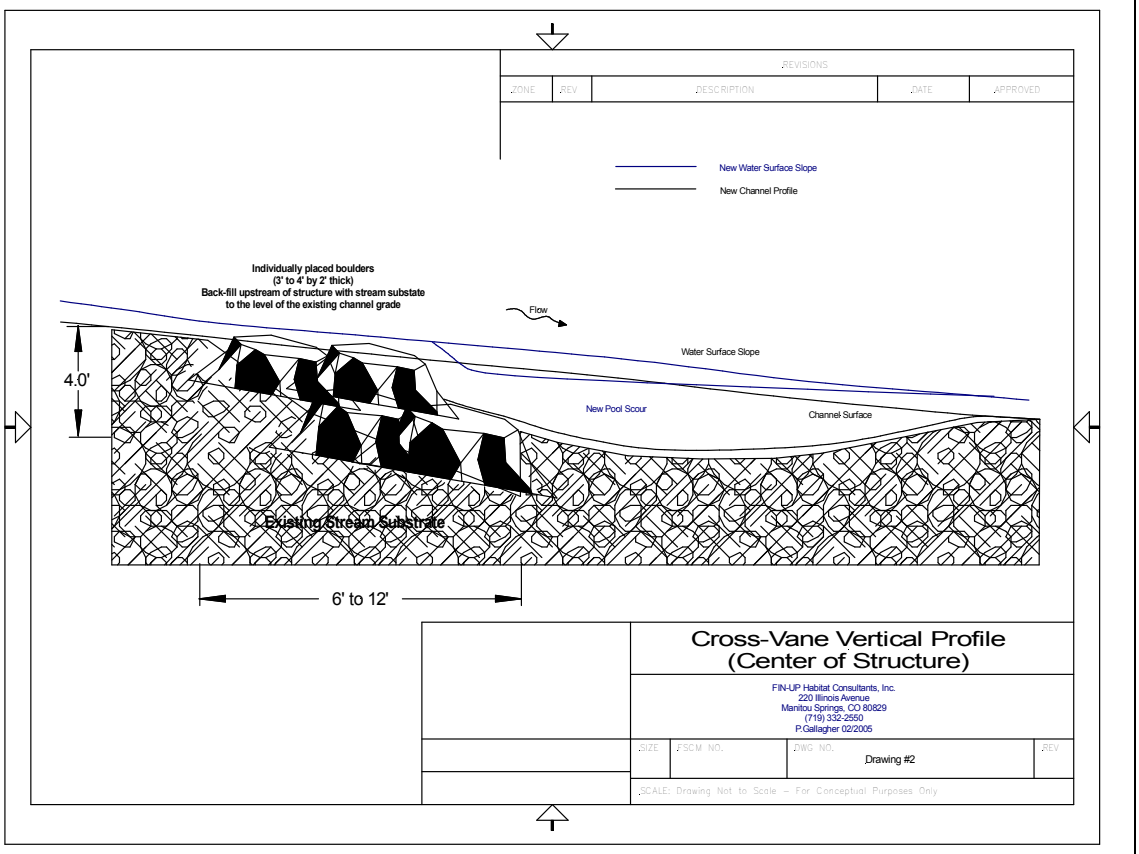

REVISIONS
ZONE
REV
DESCRIPTION
DATE
APPROVED
Fountain Creek
16 Ft.
Log Drop Structure
scour
scour
24 Ft
Shallow
Riffle
Crest
Water Main Underneath Bridge
Foot Bridge
16 Ft.
Fountain Creek
Exposed Ditch
Culvert
Collasped
Shryver Pond
Holes Cut into
Steel Culvert
4 ft Storm Water Culvert
N
Shryver Pond
Existing Inlet Structure Detail
FIN-UP Habitat Consultants, Inc.
220 Illinois Avenue
Manitou Springs, CO 80829
(719) 332-2550
J.P.Gallagher 12/2007
SIZE
FSCM NO.
DWG NO.
REV
SCALE
SHEET

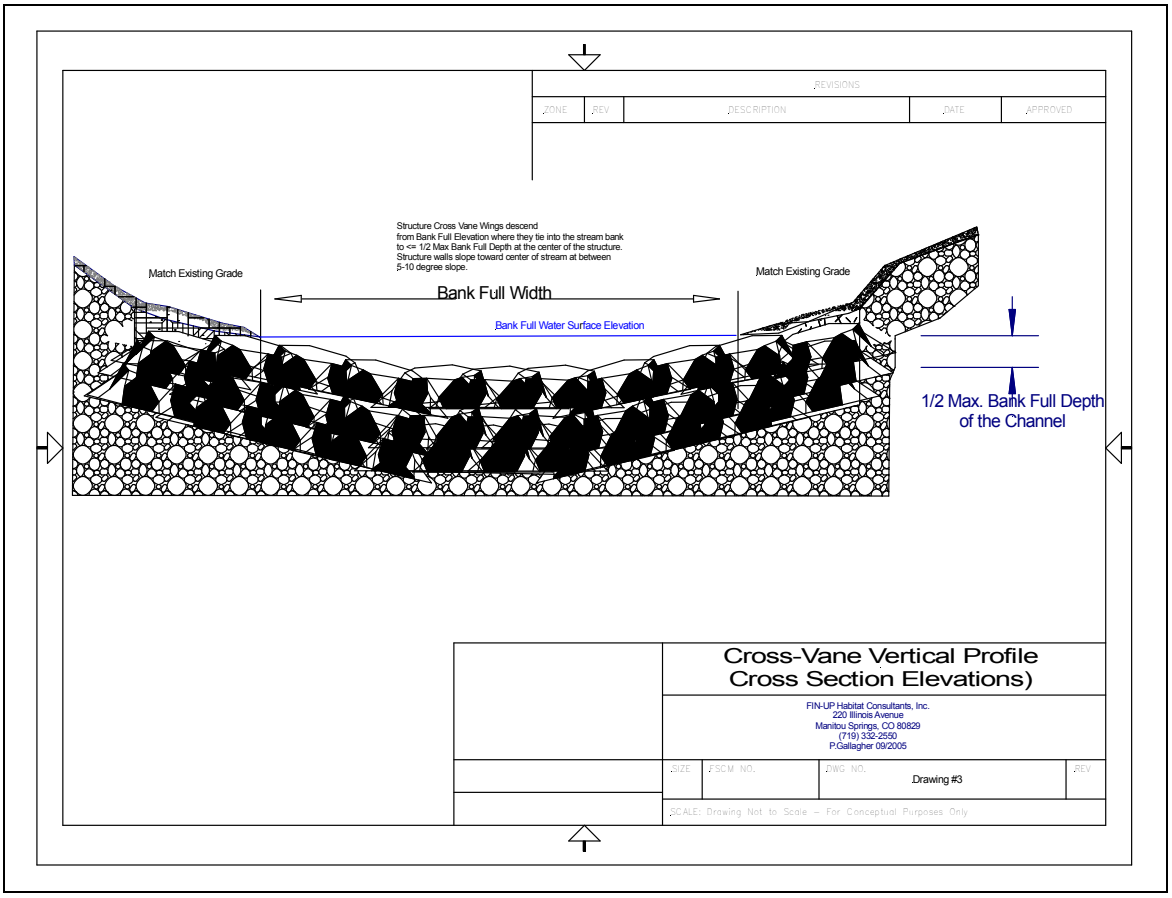

REVISIONS
ZONE
REV
DESCRIPTION
DATE
APPROVED
2 Boulder
Cross Vanes
Revegatate
Fountain Creek
16 Ft.
Log Drop Structure
Backfill
to top of
Drop
Structure
scour
scour
scour
Water Main Underneath Bridge
Foot Bridge
16 Ft. Fountain Creek
Extend Pipe to the Pond
Shryver Pond
4 ft Storm Water Culvert
N
Shryver Pond
Re-Constructed Inlet Structure Detail
FIN-UP Habitat Consultants, Inc.
220 Illinois Avenue
Manitou Springs, CO 80829
(719) 332-2550
J.P.Gallagher 12/2007
SIZE
FSCM NO.
DWG NO.
REV
SCALE
SHEET

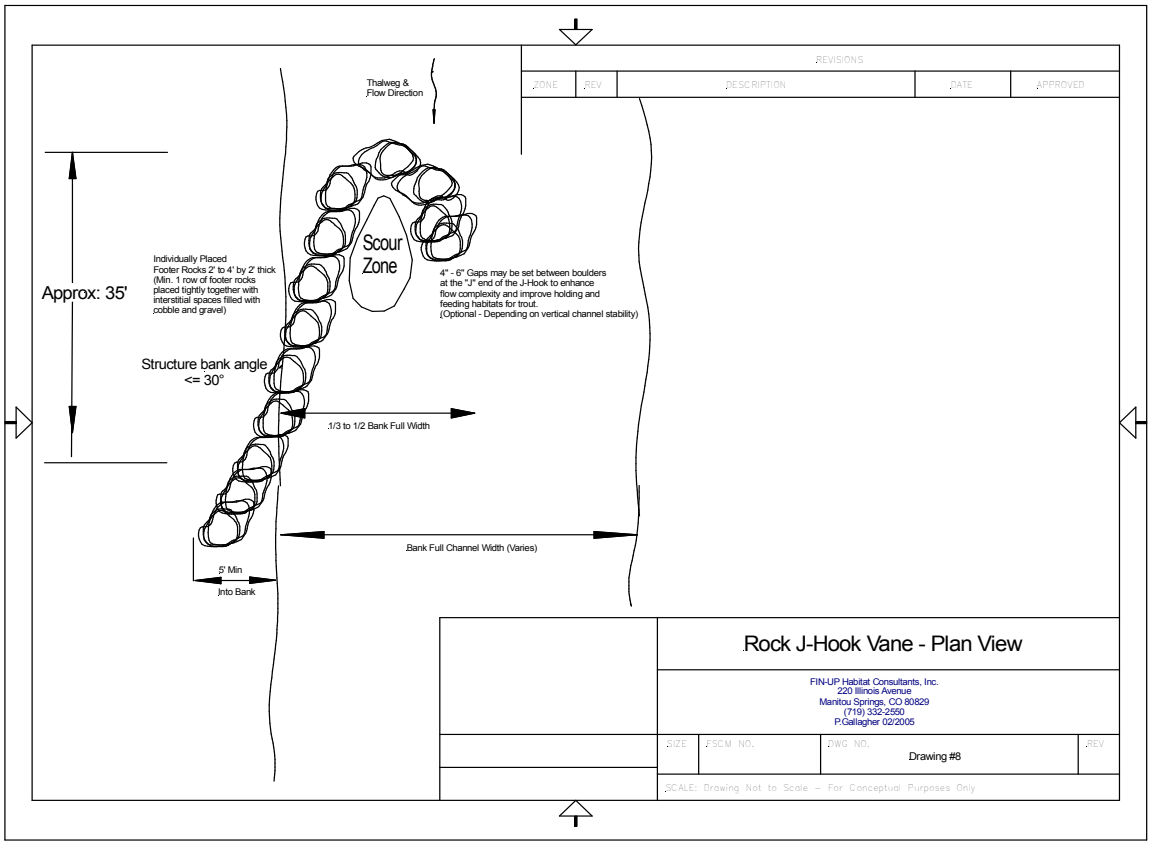

Inlet Works Profile View
REVISIONS
ZONE
REV
DESCRIPTION
DATE
APPROVED
73 Feet
FOOT BRIDGE
Water Main Beneath Bridge
NyloPlast Catch Basin
4 ft. Storm Water Culvert
Shryver Pond
ADS N12 Low Head 12" HDPE Corrugated Pipe @ 1% Slope
Concrete Footer
Diversion Point C-10 Head Gate
C-10 Head Gate Clean Out Return to Fountain Creek
Inlet Works Plan View
Shryver Pond
ADS N12 Low Head 12" HDPE Corrugated Pipe
NyloPlast Catch Basin
J-Hook Vane
Water Main Beneath Bridge
FOOT BRIDGE
Fountain Creek
Cross-Vane
Shryver Pond
Inlet Structure Detail
FIN-UP Habitat Consultants, Inc.
220 Illinois Avenue
Manitou Springs, CO 80829
(719) 332-2550
J.P.Gallagher 12/2007
SIZE
FSCM NO.
DWG NO.
REV
SCALE
SHEET

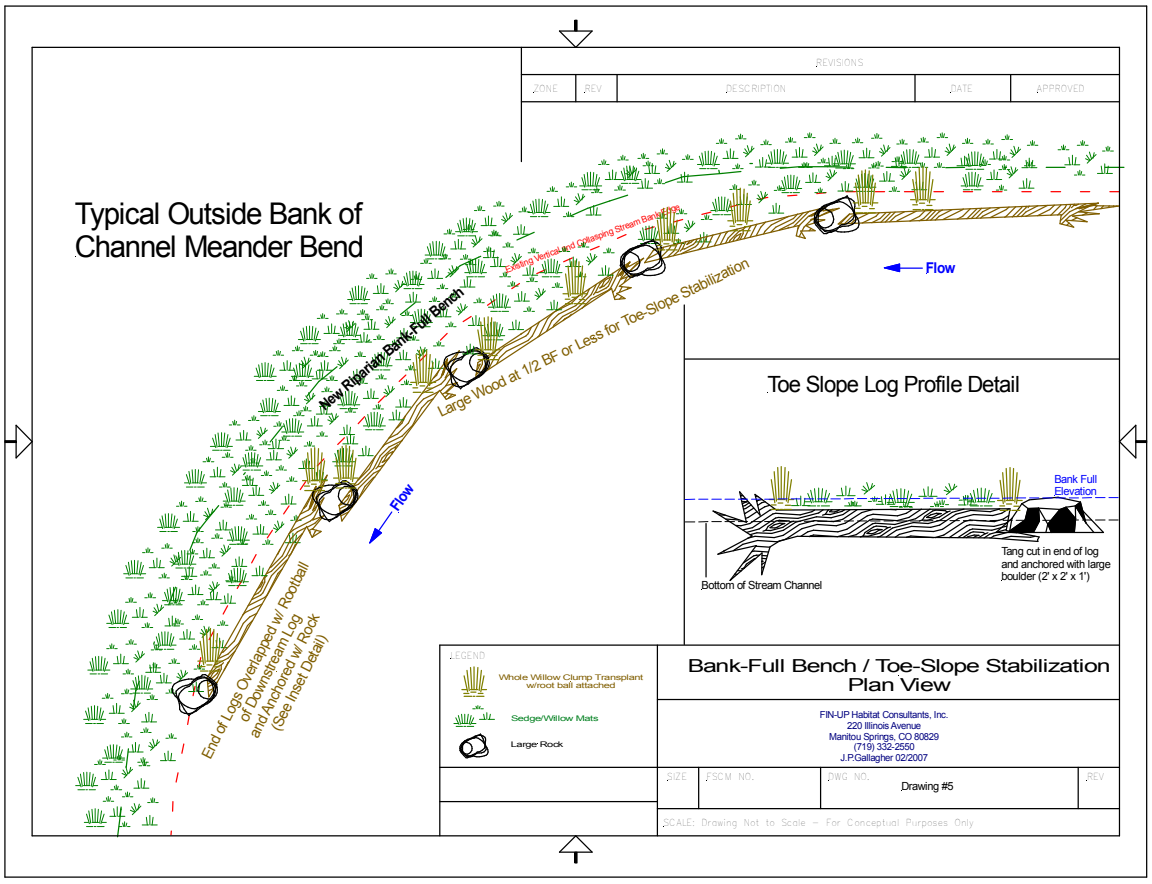
STREAM CHANNEL STRUCTURE DRAWINGS

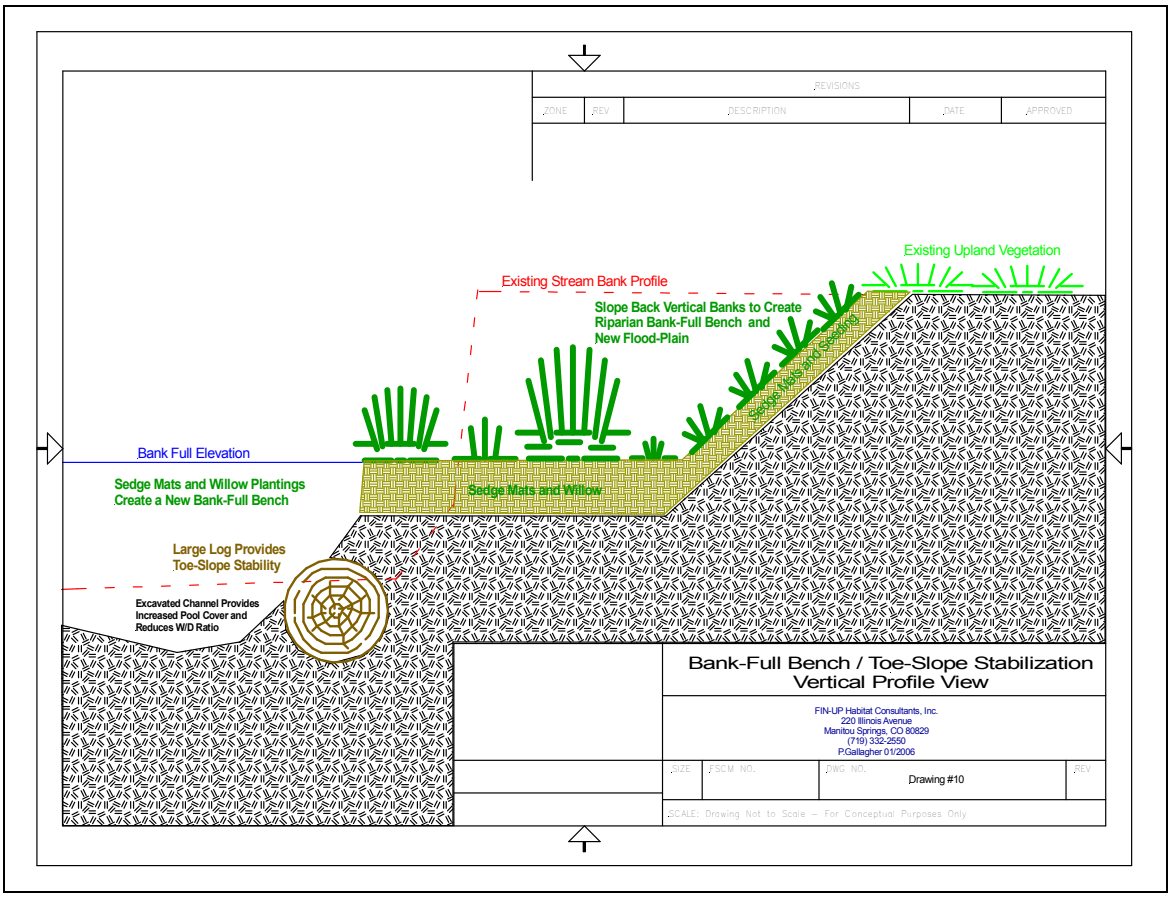





REVISIONS
ZONE
REV
DESCRIPTION
DATE
APPROVED
Structure Cross Vane Wings descend from Bank Full Elevation where they tie into the stream bank to <= 1/2 Max Bank Full Depth at the center of the structure. Structure walls slope toward center of stream at between 5-10 degree slope.
Match Existing Grade
Bank Full Width
Bank Full Water Surface Elevation
Match Existing Grade
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 Profile
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
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

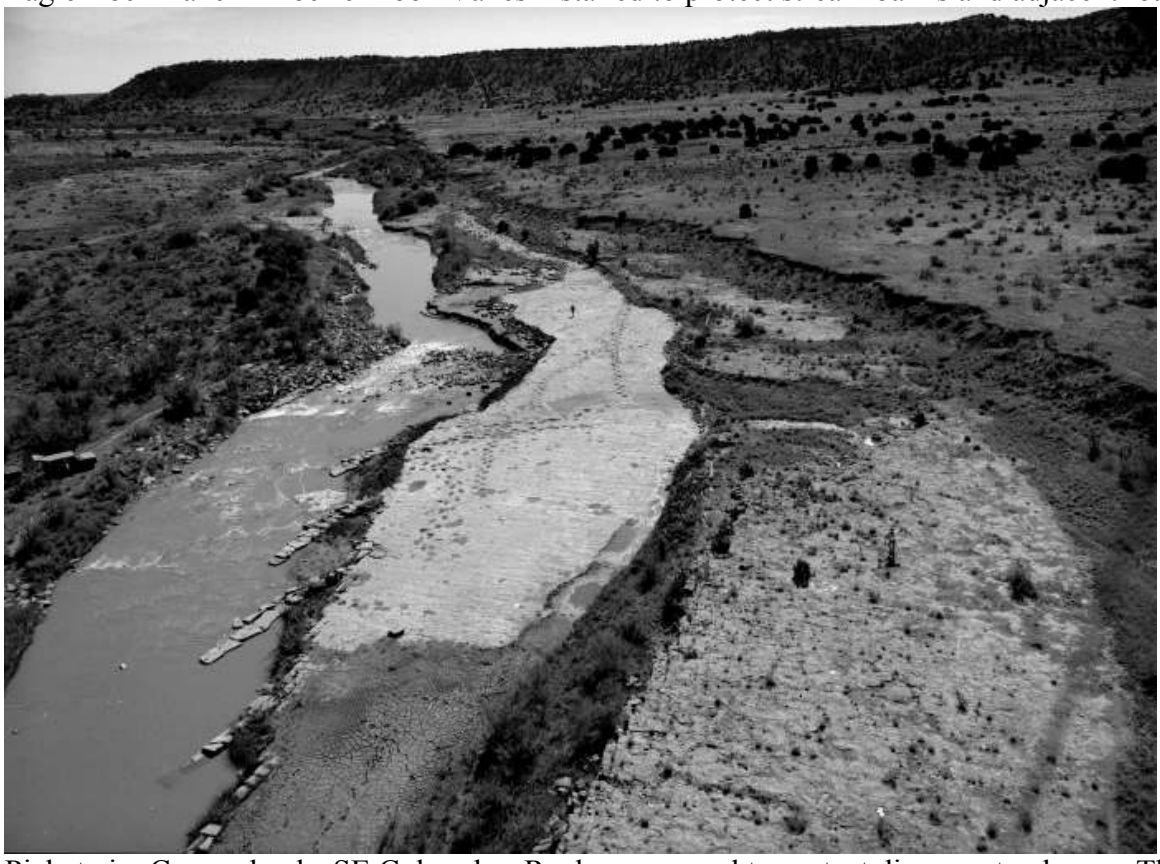
Cross Vane Structure on Cheyenne Creek below I-25 Overpass. Colorado Springs, El Paso County, Colorado

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.

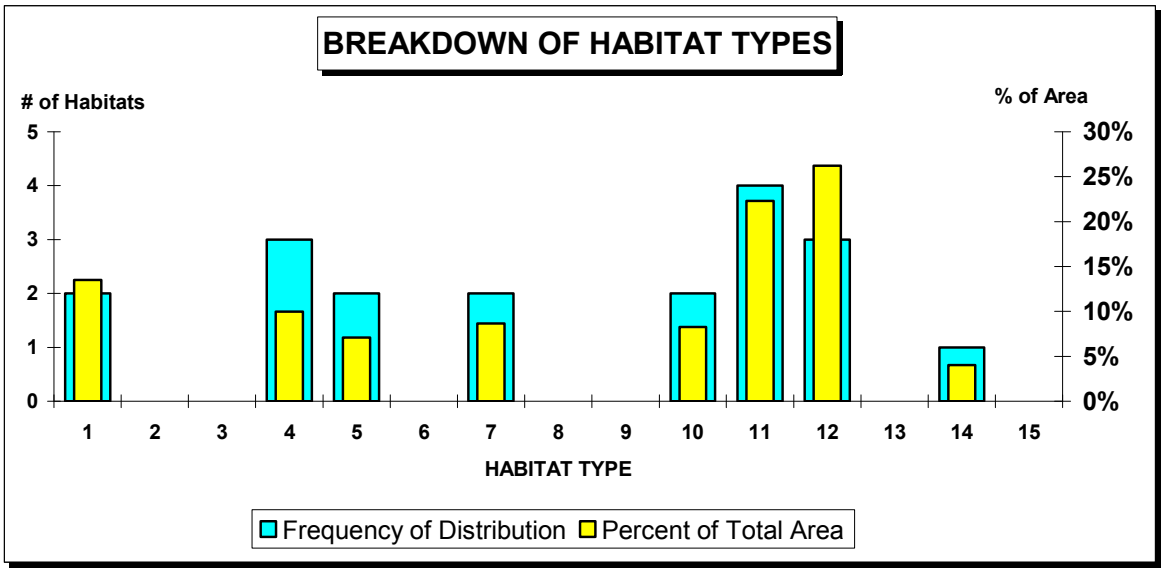
Stream inventory BWSHI data sheets and summaries

FOUNTAIN CREEK - REACH 4

MAY 6, 2008

	POOL	RIFFLE	GLIDE	REACH TOTAL		POOL	RIFFLE	GLIDE	REACH TOTAL
TOTAL LENGTH OF HABITAT (	171.00	429.00	84.00	684.00	TOTAL AREA OF HABITAT (sq	2352.75	5566.85	1235.25	9154.85
AVERAGE WIDTH OF HABITAT	13.75	12.87	14.13	13.58	% OF TOTAL NUM. OF HABIT/	36.84	52.63	10.53	100.00
AVERAGE RESIDUAL DEPTH (	1.14	0.00	0.00	1.14	HABITAT TYPE	25.70	60.81	13.49	100.00
					AS A % OF TOTAL AREA				
AVERAGE DEPTH (ft.)	1.02	0.00	0.00	1.02					
					% OF TOTAL COVERS 2 - 5	7.91	0.52	0.81	2.46
TOTAL COVER TYPE 2 (sq. ft.)	92.00	14.00	3.00	109.00	TO TOTAL HABITAT				
AVE. TYPE 2 COVER PER UNI	13.14	1.40	1.50	1.19					
					% OF CVR 2 TO TOTAL AREA	3.91	0.25	0.24	1.19
TOTAL COVER TYPE 3 (sq. ft.)	1.00	10.00	4.00	15.00	% OF CVR 3 TO TOTAL AREA	0.04	0.18	0.32	0.16
AVE. TYPE 3 COVER PER UNI	0.14	1.00	2.00	0.16					
TOTAL COVER TYPE 4 (sq. ft.)	13.00	5.00	3.00	21.00	% OF CVR 4 TO TOTAL AREA	0.55	0.09	0.24	0.23
AVE. TYPE 4 COVER PER UNI	1.86	0.50	1.50	0.23					
TOTAL COVER TYPE 5 (sq. ft.	80.00	0.00	0.00	80.00	% OF CVR 5 TO TOTAL AREA	3.40	0.00	0.00	0.87
AVE. TYPE 5 COVER PER UNI	11.43	0.00	0.00	0.87					
					% BANK ROCK CONTENT				
% BANK STABILITY TYPE 1					TYPE 2				
LEFT BANK	57.14	50.00	50.00	52.63	LEFT BANK	14.29	10.00	0.00	10.53
RIGHT BANK	28.57	50.00	50.00	42.11	RIGHT BANK	28.57	20.00	0.00	21.05
% BANK STABILITY TYPE 2					TYPE 3				
LEFT BANK	28.57	0.00	0.00	10.53	LEFT BANK	0.00	0.00	50.00	5.26
RIGHT BANK	28.57	40.00	0.00	31.58	RIGHT BANK	14.29	20.00	0.00	15.79
% BANK STABILITY TYPE 3					TYPE 4				
LEFT BANK	0.00	10.00	0.00	5.26	LEFT BANK	0.00	0.00	0.00	0.00
RIGHT BANK	28.57	0.00	0.00	10.53	RIGHT BANK	0.00	0.00	0.00	0.00
% BANK STABILITY TYPE 4					TYPE 5				
LEFT BANK	14.29	40.00	50.00	31.58	LEFT BANK	0.00	0.00	0.00	0.00
RIGHT BANK	14.29	10.00	50.00	15.79	RIGHT BANK	0.00	0.00	0.00	0.00
					TYPE 6				
					LEFT BANK	14.29	0.00	0.00	5.26
					RIGHT BANK	0.00	20.00	0.00	10.53
TOTAL OF ERODING BANKS (	109.00	327.00	76.00	512.00					
					TYPE 7				
					LEFT BANK	0.00	0.00	0.00	0.00
					RIGHT BANK	0.00	0.00	0.00	0.00
TOTAL LRG. ORGANIC DEBRIS	3.00	0.00	0.00	3	TYPE 8				
					LEFT BANK	71.43	90.00	50.00	78.95
					RIGHT BANK	57.14	40.00	100.00	52.63
AVERAGE OF SUBSTRATA TYPE FOR HABITAT ON THIS REACH									
PLANT DEBRIS	0.00	0.00	0.00	0.00	SAND\SILT	0.00	0.00	0.00	0.00
GRAVEL	0.00	0.00	0.00	0.00	RUBBLE	0.00	0.00	0.00	0.00
BOULDER	0.00	0.00	0.00	0.00	BEDROCK	0.00	0.00	0.00	0.00

HABITAT TYPE ANALYSIS									
				TOTAL					TOTAL
NUMBER OF TYPE 2 HABITAT	0.00	0.00	0.00	0.00	NUMBER OF TYPE 9 HABITAT	0.00	0.00	0	0.00
% OF HABITAT	0.00	0.00	0.00	0.00	% OF HABITAT	0.00	0.00	0	0.00
NUMBER OF TYPE 3 HABITAT	0.00	0.00	0.00	0.00	NUMBER OF TYPE 10 HABITAT	0.00	2.00	0	2.00
% OF HABITAT	0.00	0.00	0.00	0.00	% OF HABITAT	0.00	13.55	0	10.53
NUMBER OF TYPE 4 HABITAT	3.00	0.00	0.00	3.00	NUMBER OF TYPE 11 HABITAT	0.00	4.00	0	4.00
% OF HABITAT	38.83	0.00	0.00	15.79	% OF HABITAT	0.00	36.69	0	21.05
NUMBER OF TYPE 5 HABITAT	2.00	0.00	0.00	2.00	NUMBER OF TYPE 12 HABITAT	0.00	3.00	0	3.00
% OF HABITAT	27.51	0.00	0.00	10.53	% OF HABITAT	0.00	43.13	0	15.79
NUMBER OF TYPE 6 HABITAT	0.00	0.00	0.00	0.00	NUMBER OF TYPE 13 HABITAT	0.00	0.00	0	0.00
% OF HABITAT	0.00	0.00	0.00	0.00	% OF HABITAT	0.00	0.00	0	0.00
NUMBER OF TYPE 7 HABITAT	2.00	0.00	0.00	2.00	NUMBER OF TYPE 14 HABITAT	0.00	1.00	0	1.00
% OF HABITAT	33.66	0.00	0.00	10.53	% OF HABITAT	0.00	6.63	0	5.26
NUMBER OF TYPE 8 HABITAT	0.00	0.00	0.00	0.00	NUMBER OF TYPE 15 HABITAT	0.00	0.00	0	0.00
% OF HABITAT	0.00	0.00	0.00	0.00	% OF HABITAT	0.00	0.00	0	0.00
TOTAL NUMBER OF HABITAT	7.00	10.00	2.00	19.00	NUMBER OF GLIDES	0.00	0.00	2	2.00
TOTAL % OF HABITAT	100.00	100.00	100.00	100.00		0.00	0.00	100.00	10.53



FOUNTAIN CREEK REACH 4 page 1	POOLS						RIFFLES								GLIDES
	TYPE 2	TYPE 3	TYPE4	TYPE5	TYPE 6	TYPE 7	TYPE 8	TYPE 9	TYPE 10	TYPE 11	TYPE 12	TYPE 13	TYPE 14	TYPE 15	TYPE 1
TOTAL LENGTH OF HABITAT TYPES	0.00	0.00	87.00	36.00	0.00	48.00	0.00	0.00	61.00	148.00	175.00	0.00	45.00	0.00	84.00
AVERAGE WIDTH OF HABITAT (ft.)	0.00	0.00	10.50	16.88	0.00	15.50	0.00	0.00	12.35	13.70	13.65	0.00	8.20	0.00	14.13
AVERAGE DEPTH (ft.)	0.00	0.00	1.05	1.01	0.00	0.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RESIDUAL DEPTH (ft.)	0.00	0.00	0.80	1.60	0.00	1.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL AREA OF HABITAT (sq. ft.)	0.00	0.00	913.50	647.25	0.00	792.00	0.00	0.00	754.40	2042.40	2401.05	0.00	369.00	0.00	1235.25
% OF TTL # OF HABITATS	0.00	0.00	0.16	0.11	0.00	0.11	0.00	0.00	0.11	0.21	0.16	0.00	0.05	0.00	0.11
HAB. TYPE AS A PERCENTAGE OF TOTAL AREA OF REACH	0.00	0.00	0.10	0.07	0.00	0.09	0.00	0.00	0.08	0.22	0.26	0.00	0.04	0.00	0.13
COVER															
TOTAL COVER TYPE 2 (sq.ft.)	0.00	0.00	40.00	27.00	0.00	25.00	0.00	0.00	4.00	5.00	2.00	0.00	3.00	0.00	3.00
AVE. COVER 2 per UNIT	0.00	0.00	13.33	13.50	0.00	12.50	0.00	0.00	2.00	2.50	2.00	0.00	3.00	0.00	3.00
% OF COVER 2 TO TTL AREA	0.00	0.00	4.38	4.17	0.00	3.16	0.00	0.00	0.53	0.24	0.08	0.00	0.81	0.00	0.24
TOTAL COVER TYPE 3 (sq.ft.)	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	2.00	0.00	0.00	0.00	4.00
AVE. COVER 3 per UNIT	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	2.00	0.00	0.00	0.00	4.00
% OF COVER 3 TO TTL AREA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL COVER TYPE 4 (sq.ft.)	0.00	0.00	3.00	10.00	0.00	0.00	0.00	0.00	1.00	3.00	1.00	0.00	0.00	0.00	3.00
AVE. COVER 4 per UNIT	0.00	0.00	3.00	10.00	0.00	0.00	0.00	0.00	1.00	3.00	1.00	0.00	0.00	0.00	3.00
% OF COVER 4 TO TTL AREA	0.00	0.00	0.33	1.54	0.00	0.00	0.00	0.00	0.13	0.15	0.04	0.00	0.00	0.00	0.24
TOTAL COVER TYPE 5 (sq.ft.)	0.00	0.00	13.00	50.00	0.00	17.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVE. COVER 5 per UNIT	0.00	0.00	6.50	25.00	0.00	8.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% OF COVER 5 TO TTL AREA	0.00	0.00	1.42	7.72	0.00	2.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SUBSTRATA															
PLANT DEBRIS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SAND \ SILT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GRAVEL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RUBBLE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BOULDERS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BEDROCK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

FOUNTAIN CREEK REACH 4 page 2	POOLS						RIFFLES								GLIDES
	TYPE 2	TYPE 3	TYPE4	TYPE5	TYPE 6	TYPE 7	TYPE 8	TYPE 9	TYPE 10	TYPE 11	TYPE 12	TYPE 13	TYPE 14	TYPE 15	TYPE 1
BANK STABILITY															
% OF BANK STABILITY TYPE 1															
LEFT BANK	0.00	0.00	100.00	50.00	0.00	0.00	0.00	0.00	50.00	50.00	66.67	0.00	0.00	0.00	50.00
RIGHT BANK	0.00	0.00	33.33	0.00	0.00	50.00	0.00	0.00	0.00	75.00	33.33	0.00	100.00	0.00	50.00
% OF BANK STABILITY TYPE 2															
LEFT BANK	0.00	0.00	0.00	50.00	0.00	50.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIGHT BANK	0.00	0.00	0.00	50.00	0.00	50.00	0.00	0.00	50.00	25.00	66.67	0.00	0.00	0.00	0.00
% OF BANK STABILITY TYPE 3															
LEFT BANK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.00	0.00	0.00	0.00	0.00	0.00
RIGHT BANK	0.00	0.00	33.33	50.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% OF BANK STABILITY TYPE 4															
LEFT BANK	0.00	0.00	0.00	0.00	0.00	50.00	0.00	0.00	50.00	25.00	33.33	0.00	100.00	0.00	50.00
RIGHT BANK	0.00	0.00	33.33	0.00	0.00	0.00	0.00	0.00	50.00	0.00	0.00	0.00	0.00	0.00	50.00
BANK ROCK CONTENT															
TYPE 2															
LEFT BANK	0.00	0.00	0.00	50.00	0.00	0.00	0.00	0.00	0.00	25.00	0.00	0.00	0.00	0.00	0.00
RIGHT BANK	0.00	0.00	33.33	50.00	0.00	0.00	0.00	0.00	0.00	25.00	33.33	0.00	0.00	0.00	0.00
TYPE 3															
LEFT BANK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.00
RIGHT BANK	0.00	0.00	33.33	0.00	0.00	0.00	0.00	0.00	50.00	0.00	0.00	0.00	100.00	0.00	0.00
TYPE 4															
LEFT BANK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIGHT BANK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TYPE5															
LEFT BANK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIGHT BANK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TYPE 6															
LEFT BANK	0.00	0.00	0.00	50.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIGHT BANK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.00	33.33	0.00	0.00	0.00	0.00
TYPE7															
LEFT BANK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIGHT BANK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TYPE 8															
RIGHT BANK	0.00	0.00	100.00	0.00	0.00	100.00	0.00	0.00	100.00	75.00	100.00	0.00	100.00	0.00	50.00
LEFT BANK	0.00	0.00	33.33	50.00	0.00	100.00	0.00	0.00	50.00	50.00	33.33	0.00	0.00	0.00	100.00
OTHER															
TOTAL OF ERODING BANKS (ft.)	0.00	0.00	27.00	34.00	0.00	48.00	0.00	0.00	75.00	59.00	164.00	0.00	29.00	0.00	76.00
TOTAL LRG. ORG. DEBRIS	0.00	0.00	0.00	2.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

STREAMNAME	FOUNTAIN CREEK										CHANNEL TYPE	B3 / G3							
REACH NO.	4										MIN. TEMP.								
DATE	MAY 6, 2008										MAX. TEMP								
PERSONNEL	P.GALLAGHER, H.DROSSMAN, S.ROBERTS										DISTRICT	MANITOU SPRINGS							
DESCRIPTION	SHYRVER PARK REACH 4 - BEGIN AT GARDEN OF THE GODS PLACE BRIDGE																		
	END AT THE CHAIN LINK FENCE AT THE UPSTREAM PARK BOUNDARY																		
	HABITAT UNIT TYPE		LENGTH	WIDTH	RESIDUAL DEPTH	AVE. DEPTH	MAX. DEPTH	COVER TYPES				BANK STABILITY		BANK ROCK CONTENT		ERODING BANKS			
NO.	TYPE	SA	(FT.)	(FT.)	(FT.)	(FT.)	(FT.)	2	3	4	5	LEFT	RIGHT	LEFT	RIGHT	(FT.)	LOD		COMMENTS
P1	7	B	16.00	12.50	0.80	1.12	1.80	10			11	2	2	8	8	16.00			ERODING BANK ON RIGHT SIDE
R1	10	P	29.00	12.00				2		1		1	4	8	3	29.00			ERODING BANK ON RIGHT SIDE
R2	11	O	40.00	15.00								1	1	2	6				12" CULVERT ON LEFT AT TOP OF HABITAT UNIT
G1	1		29.00	12.25				3				1	1	3	8	6.00			CROSS SECTION #1 LOCATED IN THIS HUBITAT UNIT
R3	11	P	48.00	13.80				1	8	3		3	1	8	8	13.00			CROSS SECTION #2
R4	12	O	35.00	12.75				2				1	1	8	2				BEGINNING OF RIGHT BANK CONCRETE TOE SLOPE BARRIER
P2	4	R/S	29.00	10.00	1.00	1.09	1.60	15			7	1	3	8	2				CROSS-SECTION #3
P3	5	B	15.00	10.25	1.00	0.91	1.70	6			2	1	3	2	2	3.00			STEP POOL BELOW FOOTBRIDGE
R5	10	P	32.00	12.70				2				4	2	8	8	46.00			ERODING UNDERNEATH FOOTBRIDGE
R6	12	O	54.00	14.70					2	1		1	2	8	6	54.00			SHRYVER POND OUTLET CONFLUENCE @ 40FT ON LEFT BANK
P4	4	B	29.00	12.00	0.70	0.96	1.70	17	1	3	6	1	4	8	8	27.00			
R7	11	P	30.00	11.30				4				1	1	8	2	10.00			
P5	4	B	29.00	9.50	0.70	1.10	1.50	8				1	1	8	3				INFILLED WITH SEDIMENT
R8	14	B	45.00	8.20				3				4	1	8	3	29.00			RAPID LEADING TO THE 2ND BRIDGE - CROSS-SECTION 4
R9	11	O	30.00	14.70								4	2	8	8	36.00			UNDER BRIDGE - RIGHT SIDE CONCRETE - CROSS SECTION 5
P6	5	S	21.00	23.50	2.20	1.12	2.90	21		10	48	2	2	6	8	31.00	2		LOG DROP STRUCTURE - BARRIER - CROSS SECTION 6
P7	7	S	32.00	18.50	1.60	0.82	2.00	15			6	4	1	8	8	32.00	1		POND DIVERSION ON LEFT - CROSS SECTION 7
R10	12	O	86.00	13.50								4	2	8	8	110.00			GOOD GRAVEL SPAWNING AREAS - CROSS SECTION 8 & 9
G2	1		55.00	16.00					4	3		4	4	8	8	70.00			END OF REACH 4 AT STEEL FENCE

Budget and Implementation Estimate

	FOUNTAIN CREEK [MANITOU SPRINGS] REACH 4 - SHRYVER PARK REACH							
	BUDGET							
Work Item	Item Description	QTY	UOM	UNIT COST	TOTAL COST	CWCB GRANT	LOCAL SHARE	In-Kind Donation
Project Management, Contacting & Labor								
1	**Assessment, Design Data Collection & Project Layout / Oversight**	1	ls	$80.00/hour	$15,660.00	$11,920.00	$3,000.00	$740.00
2	**Equipment Contract (Stream Work and Lake Dredging)**	1	ls	$28,080.00	$28,080.00	$28,080.00		
3	**Diversion Excavation Labor - 2 Laborers x $40.00/hr x 20 hrs**	1	ls	$1,600.00	$1,600.00		$1,600.00	
4	**Stream Bank, Lake Shoreline and Project Revegetation Rocky Mountain Field Institute**	1	ls	$10,000.00	$10,000.00	$10,000.00		
5	**TU Volunteer Labor $18.77/hr^. x 6 hrs.**	10	ls		$1,126.20			$1,126.20
Project Materials								
6	**Boulders** (332 boulders - 225 yd^3)	225	yd^3	$45.00/ton	$10,125.00			$10,125.00
7	**Trees/Logs** (30 ft each)	12	ea	$150.00	$1,800.00			$1,800.00
8	**Manta Ray Deadman Anchors**	12	ea	$65.00	$780.00			$780.00
	ADS, Inc. Hilliard, OH							
9	**80 ft HDPE Corrugated Pipe 12"**	1	ls	$580.00	$580.00		$580.00	
10	**24" NyloPlast Catch Basin**	1	ea	$860.00	$860.00		$860.00	
	Waterman Industries, Exeter, CA							
11	**C-10 Head Gate (2 x $600.00 each)**	2	ea	$600.00	$1,200.00		$1,200.00	
12	**Shipping Costs**	1	ls	$300.00	$300.00		$300.00	
	Local Suppliers, CO							
13	**Geotextile fabric** (roll)	8	ea	$100.00	$800.00		$800.00	
14	**Shrubs** (1 gal)	80	ea	$10.00	$800.00		$800.00	
15	**Native Seed Mix**	40	lb	$8.00	$320.00		$320.00	
16	**Concrete**	4	bags	$25.00	$100.00		$100.00	
Rental Equipment/Other Costs								
17	**Concrete Mixer ($72.85/day x 1 day)**	1	ls	$72.85	$72.85			$72.85
18	**Acetylene Cutting Torch w/Operator ($37.50/hr x 2 hours)**	1	ls	$75.00	$75.00			$75.00
19	**Compressor & Jackhammer**	1	ea	$135.00/day	$135.00			$135.00
20	**City Planning & Engineering**	1	ls	$5,000.00	$5,000.00			$5,000.00
21	**Interpretive Signage**	2	ea	$250.00	$500.00		$500.00	
22	**Etiquette Signage**	2	ea	$25.00	$50.00		$50.00	
23	**New wooden footbridge for the lake**	1	ls	$7,500.00	$7,500.00		$7,500.00	
24	**Post Project Workday Lunches and Refreshments CMCTU Chuck Wagon**	1	ls	$125.00	$125.00			$125.00
	TOTALS				$87,589.05	$50,000.00	$17,610.00	$19,979.05
				Share of Project Costs	100%	57%	20%	23%
	Notes:							
1	**Project Mgmt is based on 18 days (project layout, implemtation, and revegation work) @ $80.00/hour - In Kind services for TU workday following project**							
2	**Equipment costs reflect 10 days of use, include all mobilization charges, excavation of the pond, and pond shoreline stabilization**							
4	**Revegatation labor is an estimate, pending formal review of plan by the Rocky Mountian Field Institute**							
8/19	**Manta Ray MR1 Anchors will be used to anchor trees for toe-slope stabilization. Anchors will be driven using a jack hammer and drive steel**							
16	**Concrete footing for NyloPlast Catch-basin**							
20	**Administative costs for project planning absorbed by the City of Manitou Springs (Dan Folkes time, etc.)**							
23	**This would entail removing the 48 inch black culvert and fill, and replacing with a bridge to the island in the middle of the lake**							
24	**In-Kind donation of lunch and refreshments for the TU workday following the project**							