

# Whitewater Features Cost - Whitewater Damage Assessment - PW35

Attachments:      Verification of costs from recent local bids  
 Post Flood Field Survey of Structures

Document Description/Notes
<p>Prior to the flood Lyons had 3 whitewater parks with a series of drop structures in each. Additionally there were various structures located throughout the Town's land over sewer crossings and in some cases as fish passage structures. This document takes into account conversations with FEMA to ensure what is included is accurate to the current care and codes of standards.</p>
<p>Whitewater parks are structures that span the entire river from one bank to the other. They are created from large boulders grouted together (in most cases) and create waves and eddies to play, surf, and kayak in. In many cases the structures are bordered by areas of terracing to prevent bank erosion and provide seating as well as ingress and egress locations on either side of the structure. Pools are excavated below the structures to enhance the characteristics of the wave. These pools are then armored in order to prevent further erosion and scour under the structure itself which could cause the structure to fail.</p>
<p>This document is broken out by site locations of whitewater features. Within each site the features are broken out by structure and further by components to each structure (such as rock, grout, terracing, etc.) . Reuse of rock that is preexisting or leftover from structures has been taken into account in this document. The notes section further clarifies this and can be found on page 4 of the cost breakdown document.</p>
<p>The construction of these structures in an active waterway in the United States is typically required, by permit, to be in the low flow season when there is least effect due to sedimentation and least impact to native fish species. In Colorado the window for construction is typically from roughly mid-october to mid-march and is timed specifically with historical flows in mind. This will mean that the work required for restoration of the scale of project defined by the lost structures in Lyons would typically require a general contractor to complete in one year. Alternately, it would require multiple years and multiple differing mobilizations/demobilizations. I believe that the preferred alternative will be to build the features together in a single year. There are added cost factors for the General Contractor.</p>
<p>The Structures that we have been able to get in and inspect closely have cracked cracks and piping issues. We have assumed that every structure will need to be removed and replaced. The reasons include (1) Unknown piping and cracking issues that might be a life safety issue, (2) construction methods for the previous park that do not meet current standards of care for design, stability, and fish passage, (3) It is nonsensical to repair structures that do not provide for connectivity of habitat at the same time that we are spending money to create drop structures that do provide for a connected habitat.</p>

Attachments Include:	
Number of Pages	Document Name and Page Numbers
1-3	Whitewater Features Cost Breakdown by Site
	2 Meadow Park
	2 North ST Vrain Structures
	2 Bohn Park Fishing Structures
	2 Black Bear Hole
	2 October Hole
	2 Total Cost
	3 Unit Cost Breakdown and Notes
0.0-4.0	Whitewater Features Drawings by Site
	0.0 Map Overview
	1.0 Meadow Park
	2.0 North Stem and Bohn Park
	3.0 Black Bear Hole
	4.0 October Hole
1-8	Backup Documentation from Recent Bids in Lyons and Durango for Material Costs
	1-2 Durango Bids
	3-4 Emergency Channel (Lyons)
	5-8 NRCS (Lyons)

Additional Notes:
<p>The drop structures will be created with the minimum amount of grout required to be stable. This will include grouting of interstitial spaces of natural rock with a holdback that varies from 6" to 16" and creates roughened fish passage routes up the structures through these interstitial voids and through the accompanying boundary layer (a buffer layer of slower moving water that allows fish to migrate upstream). This approach mimics the natural morphology for drop structures while providing a product that is stable and that does not require ongoing regular maintenance. this approach is also consistent with our discussion with Colorado's parks and wildlife and is consistent with the research and results they have been receiving. We have also committed to working with parks and wildlife to further augment the design in a way that provides for the required stream connectivity.</p>

**WHITEWATER FEATURES QUANTITIES - WHITEWATER DAMAGE ASSESSMENT - PW 35**

Site	Feature Name	PT #	latitude	longitude	Feature (see note 2)		Terracing			Excavated Pool		Feature Rocks		Pool Armoring	Grout	Heavy Equipment Time (see note 3)	Furnish and Install Water Control Diversions	
					Area (ft)	Volume (cy)	Area(ft)	Volume (cy)	LF (ft)	Area (ft)	Volume (cy)	Quantity	Volume (cy)	Volume (cy)	Volume(cy)	Hours	LS	
Meadow Park	Diversion Ditch		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Price for region below	1	
	P-1	2	N 40.224964	W 105.274686	2043.6	605.5	678.6	75.4	49.1	2709.7	602.2	3.0	29.8	2709.7	121.1	Price for region below	1	
	M-1	3	N 40.224958	W 105.276592	902.1	267.3	1049.2	116.6	60.1	1306.8	290.4	2.0	19.9	1306.8	53.5	Price for region below	1	
	M-2	4	N 40.2244	W 105.276669	811.8	240.5	440.5	48.9	34.2	1160.1	257.8	1.0	9.9	1160.1	48.1	Price for region below	1	
	M-3	5	N 40.223906	W 105.276572	1160.2	343.8	458.9	51.0	39.9	1070.1	237.8	1.0	9.9	1070.1	68.8	Price for region below	1	
	M-4	6	N 40.223694	W 105.276397	927.1	274.7	2164.2	240.5	142.5	1262.1	280.5	1.0	9.9	1262.1	54.9	Price for region below	1	
	M-5	7	N 40.223442	W 105.276006	1117.5	331.1	NA	NA	NA	1104.9	245.5	NA	0.0	1104.9	66.2	Price for region below	1	
	M-6	8	N 40.22335	W 105.275736	1715.8	508.4	736.4	81.8	87.9	1558.1	346.2	1.0	9.9	1558.1	101.7	Price for region below	1	
	M-7	9	N 40.223133	W 105.274978	1456.3	431.5	NA	NA	NA	1726.5	383.7	11.0	109.2	1726.5	86.3	Price for region below	1	
	M-8	10	N 40.223017	W 105.274361	1146.6	339.7	749.5	83.3	71.9	1726.5	383.7	NA	0.0	1726.5	67.9	Price for region below	1	
	Unit Subtotal						3342.5			485.6		3027.7	20.0	198.6	13624.8	668.5	60.0	10.0
Unit Cost (see Pg 3 for further details)						\$196.66			\$65.55		\$22.61		\$570.00	\$57.61	\$271.71	\$220.00	\$7,789.00	
Component Subtotal (\$)						\$657,328.55		\$31,832.16		\$68,441.91		\$11,400.00		\$784,970.14	\$181,639.14	\$13,200.00	\$77,890.00	
Construction Total (pre-flood cond)																		<b>\$1,826,701.91</b>
North St. Vrain Structures	5th Ave Bridge Structure	11	N 40.2227	W 105.271767	927	274.7	NA	NA	NA	767	170.4	NA	NA	767	54.9	Price for region below	1	
	Sewer Line Structure (Park St.)	12	N 40.222083	W 105.268453	664	196.7	NA	NA	NA	621	138.0	NA	NA	621	39.3	Price for region below	1	
	Unit Subtotal						471.4		0.0		308.4		0.0	1388.0	94.3	15.0	2.0	
	Unit Cost (see Pg 3 for further details)						\$196.66		\$65.55		\$22.61		\$570.00	\$57.61	\$271.71	\$220.00	\$7,789.00	
	Component Subtotal (\$)						\$92,705		\$0		\$6,972.39		\$0.00		\$79,967.31	\$25,617.22	\$3,300.00	\$15,578
Construction Total (pre-flood cond)																		<b>\$224,140.32</b>
Bohn Fishing Structures	Structure 1	13	N 40.219614	W 105.269589	357	105.8	NA	NA	NA	274	50.7	3.0	29.8	274	NA	Price for region below	1	
	Structure 2	14	N 40.219947	W 105.268497	270	80.0	379	42	39	274	50.7	NA	0.0	274	NA	Price for region below	1	
	Structure 3	15	N 40.220003	W 105.268186	312	92.4	NA	NA	NA	274	50.7	NA	0.0	274	NA	Price for region below	1	
	Structure 4	16	N 40.220158	W 105.267725	357	105.8	NA	NA	NA	990	103.8	1.0	9.9	990	NA	Price for region below	1	
	Structure 5	17	N 40.220344	W 105.267361	228	67.6	NA	NA	NA	274	50.7	NA	0.0	274	NA	Price for region below	1	
	Unit Subtotal						451.6		39.0		306.7	4.0	39.7	2086.0	0.0	40.0	5.0	
Unit Cost (see Pg 3 for further details)						\$196.66		\$65.55		\$22.61		\$570.00	\$57.61	\$271.71	\$220.00	\$7,789.00		
Component Subtotal (\$)						\$88,801.41		\$2,556.54		\$6,933.87		\$2,280.00		\$120,181.41	\$0.00	\$8,800.00	\$38,945.00	
Construction Total (pre-flood cond)																		<b>\$268,498</b>
Black Bear Hole	Black Bear	18	N 40.220633	W 105.263675	751	222.5	NA	NA	NA	1105	245.6	NA	0.0	1105	44.5	Price for region below	1	
	A-Hole	19	N 40.220622	W 105.263269	850.4	252.0	505.4	56.2	52.5	1104.9	245.5	NA	0.0	1104.9	50.4	Price for region below	1	
	Unit Subtotal						474.5		56.2	52.5	491.1	0.0	0.0	2209.9	94.9	20.0	2.0	
	Unit Cost (see Pg 3 for further details)						\$196.66		\$65.55		\$22.61		\$570.00	\$57.61	\$271.71	\$220.00	\$7,789.00	
Component Subtotal (\$)						\$93,311.40		\$3,441.49		\$11,101.06		\$0.00		\$127,319.71	\$25,784.68	\$4,400.00	\$15,578.00	
Construction Total (pre-flood cond)																		<b>\$280,936.34</b>
October Hole	October Hole	20	N 40.216633	W 105.259592	1618.1	479.4	NA	NA	NA	1104.9	245.5	NA	0.0	1104.9	95.9	Price for region below	1	
	November Hole	21	N 40.216361	W 105.259653	1161.7	344.2	NA	NA	NA	1104.9	245.5	NA	0.0	1104.9	68.8	Price for region below	1	
	Unit Subtotal						823.6		0.0	0.0	491.1	0.0	0.0	2209.8	164.7	20.0	2.0	
	Unit Cost (see Pg 3 for further details)						\$196.66		\$65.55		\$22.61		\$570.00	\$57.61	\$271.71	\$220.00	\$7,789.00	
Component Subtotal (\$)						\$161,975.17		\$0.00		\$11,100.56		\$0.00		\$127,313.94	\$44,758.49	\$4,400.00	\$15,578.00	
Construction Total (pre-flood cond)																		<b>\$365,126.16</b>

All Sites	
Total	\$2,985,761.05

Overall Quantities											
Feature rock (cy)				Terracing (LF)		Excavation (cy)	Feature Rocks (qty)	Pool Armoring (cy)	Grout (cy)	Heavy Equipment Time (hrs)	Water Control Diversions (qty)
5563.6				577.1		4625.1	24.0	21518.5	1022.4	155.0	21.0


Depth Key:	(ft)	Comments
Feature	8	
Terracing	3	
Pool	6	
Armoring	1	
Pool - fishing	5	
Volume Key	(cy)	
Feature Rock	268	
Grout	0.2	0.2*rock Volume
Price Key	\$	Units
Feature	196.66	\$/cy
Terracing	65.55	\$/ft
Pool	22.61	\$/cy
Feature Rock	570	\$/8' dia rock

Notes:
1: Feature Rock Credit: A 5% credit was removed from the overall cost of each feature rock due to re-use of large feature rocks remaining in stream.
2: Demo Costs: No demolition costs were included in construction of the river features themselves as the cost of demolition would be made up in the re-use of some rocks contained within the feature.
3: Heavy Equipment Time: The heavy equipment time is an additional service used in construction of all whitewater features. This includes the additional excavation and shaping of the pool and river feature as well as cosmetic alterations of the feature and terracing. This cost is always used in whitewater feature construction.

Itemized costs	\$	Units	Comments
Rock costs per cubic yard, acquisition and placement	\$196.66	cy	
Terracing costs per linear foot	\$65.55	ft	
Excavation	\$22.61	cy	
Grout costs per cubic yard	\$271.71	cy	Interstitial grout, trowelled smooth
Heavy equipment cost/hour	\$220.00	hr	
8' diameter boulders, acquisition and placement	\$570.00	ea	See Note 1
8" d50, acquisition and placement	\$57.61	cy	
Furnish and Install Water Control Diversions	\$7,789.00	ls	

**Cost Comparison Based on Similar projects in the past 8 month period**

Durango - Bid	Durango - Internal Estimates	E1 (Defalco)	E2 (Premier)	E3 (ECI)	NRCS (1)	NRCS (2)	Average
		\$145.19	\$160.00	\$284.78			\$196.66
		\$48.40	\$53.33	\$94.93			\$65.55
\$16.00		\$11.18	\$14.50	\$16.55	\$27.40	\$50.00	\$22.61
\$271.71							\$271.71
\$220.00							\$220.00
\$600.00							\$600.00
		\$75.16	\$41.40	\$56.28			\$57.61
\$13,578.00	\$2,000.00						\$7,789.00

 Red text denotes Lyons post flood actual bid pricing on similar projects