

Strawberry Run Stream Restoration – Large Wood Alternative Concept Design

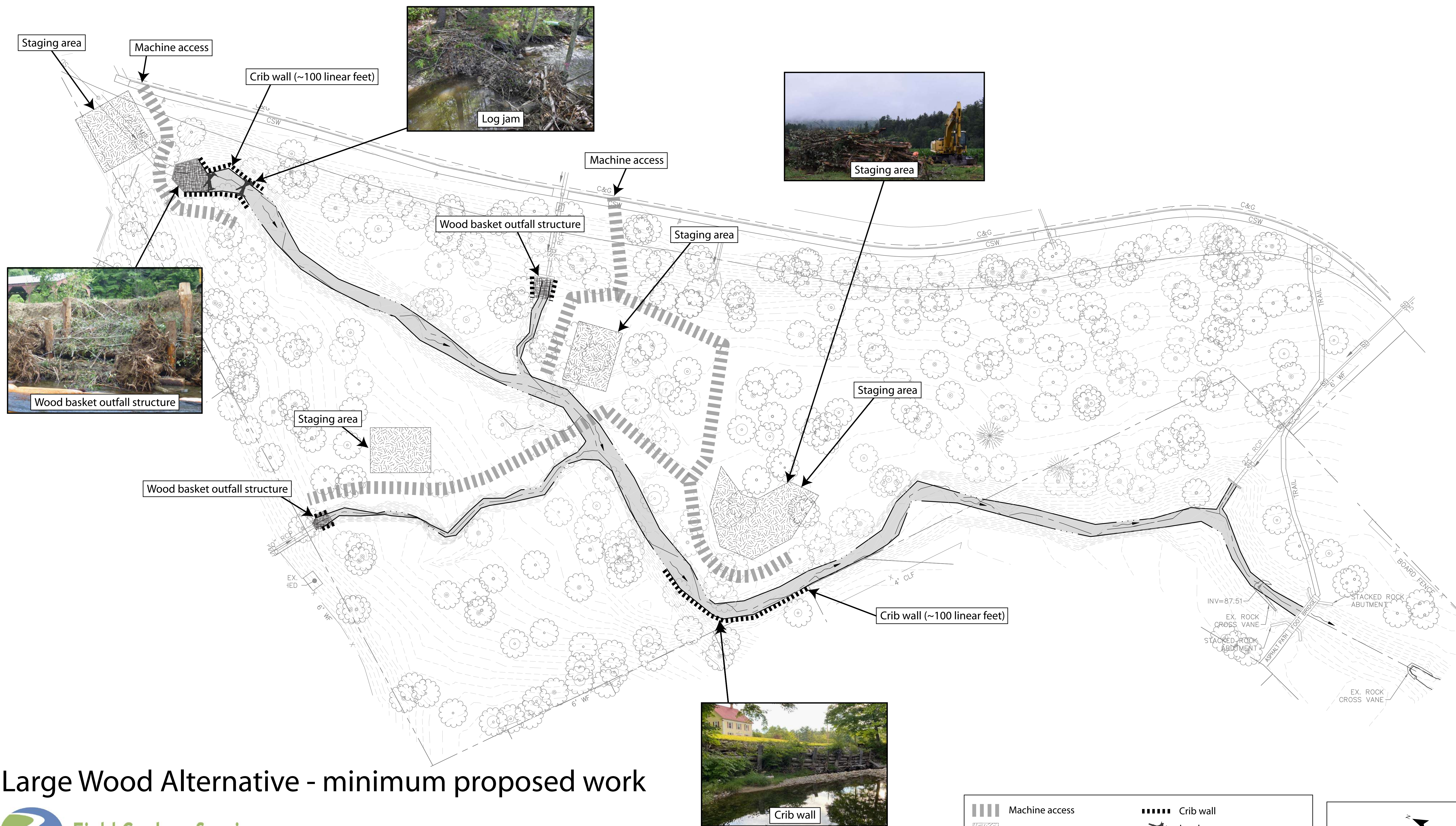
Prepared for
City of Alexandria (Virginia)



Strawberry Run tributary outfall in Alexandria, VA






Prepared by
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Field Geology Services
Portland, ME

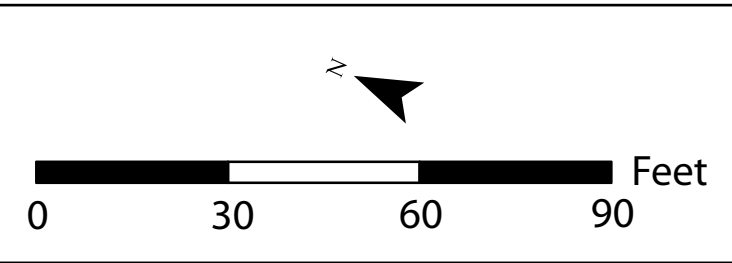
January 2023

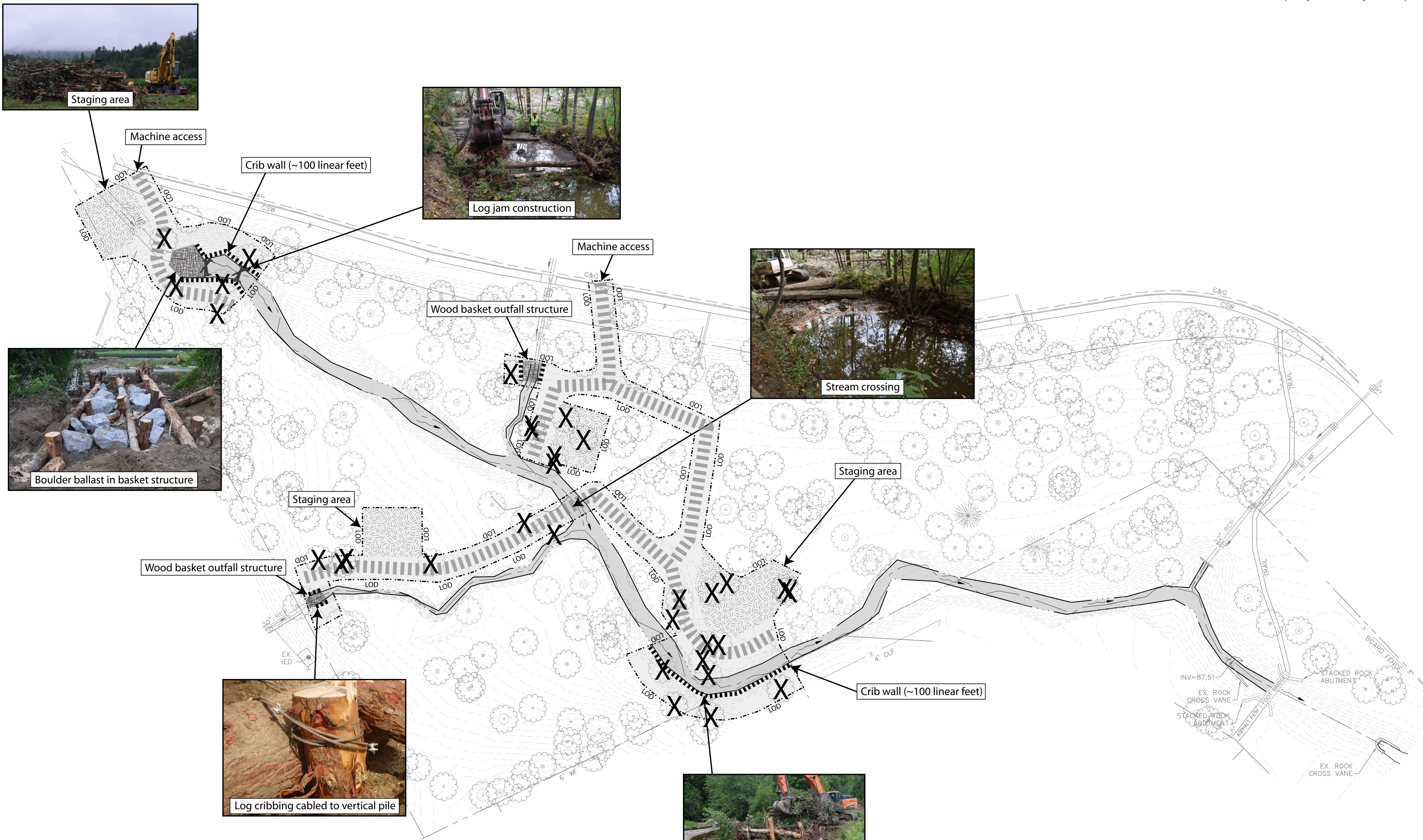


Large Wood Alternative - minimum proposed work

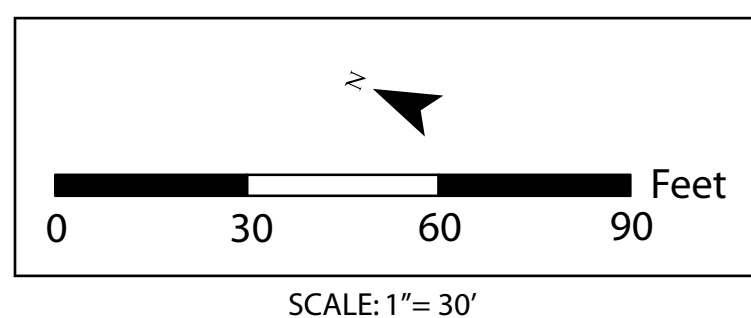
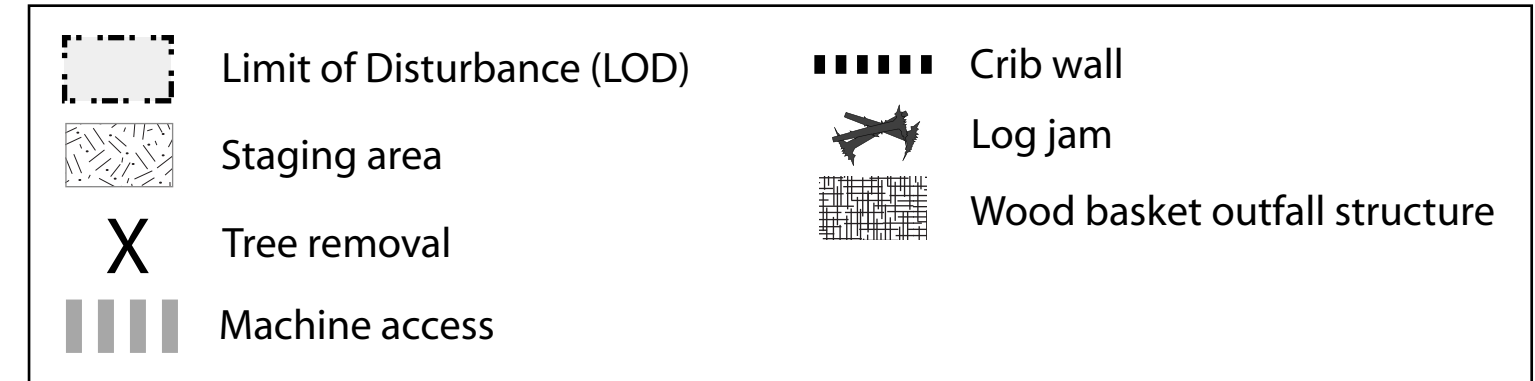


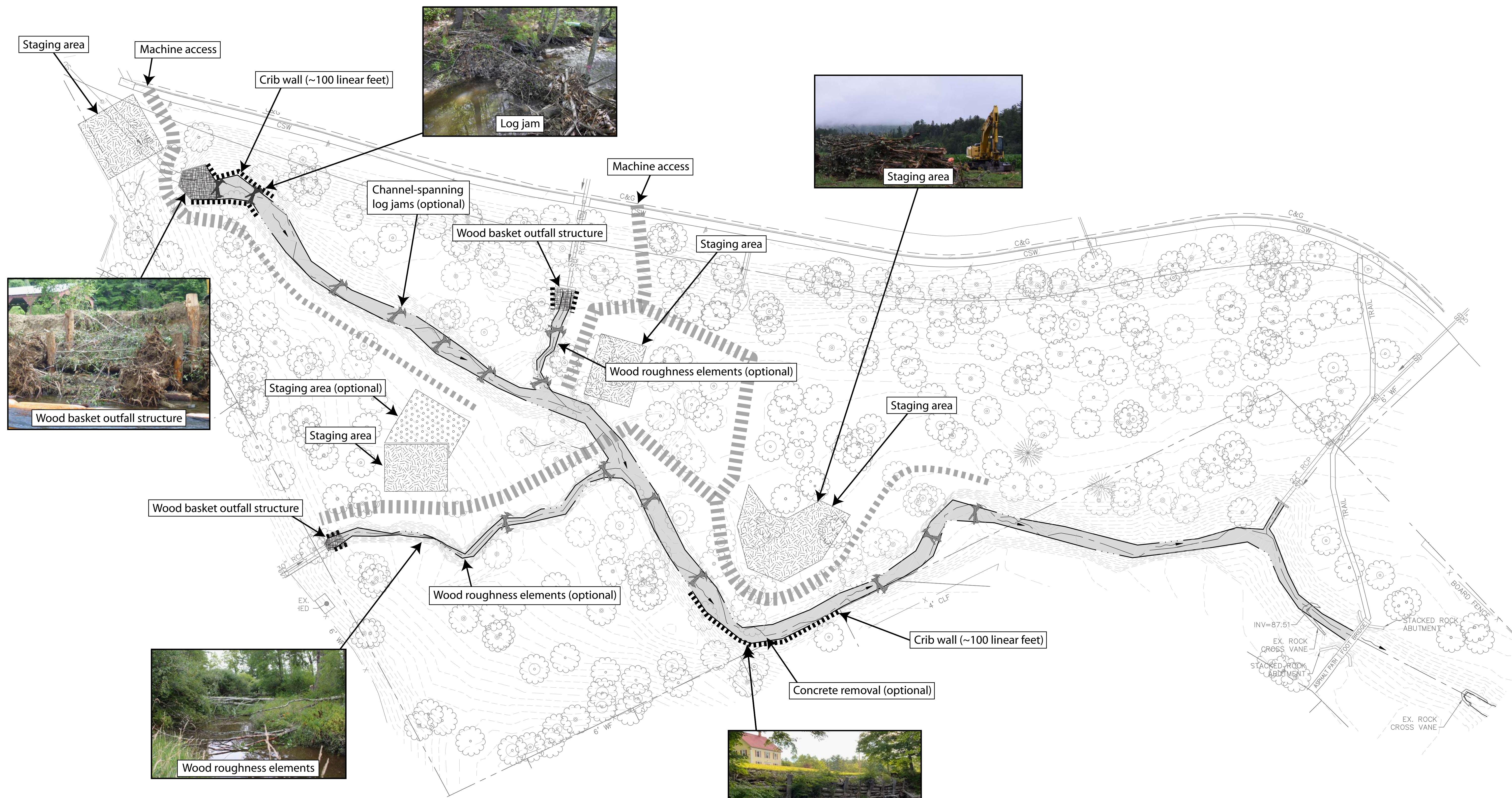
	Machine access		Crib wall
	Staging area		Log jam
			Wood basket outfall structure





Large Wood Alternative - impacts of minimum work

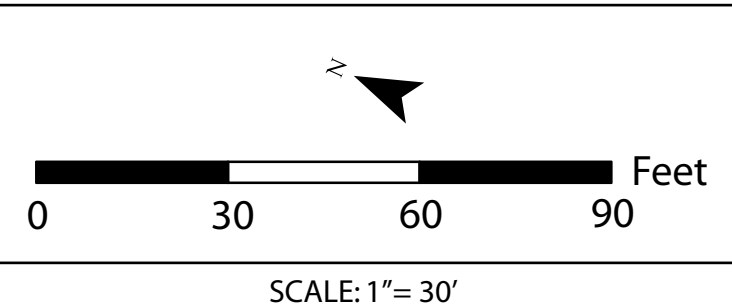




Large Wood Alternative - with optional proposed work



	Machine access		Crib wall
	Machine access (optional)		Log jam
	Staging area		Log jam (optional)
	Staging area (optional)		Wood basket outfall structure





Staging area



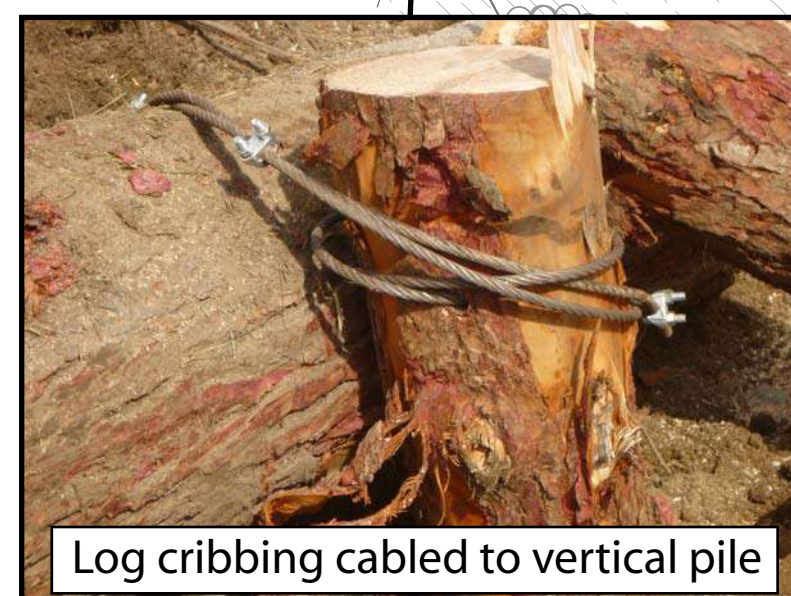
Log jam construction



Stream crossing



Boulder ballast in basket structure



Log cribbing cabled to vertical pile



Crib wall installation

Large Wood Alternative - impacts with optional work

Machine access

Crib wall (~100 linear feet)

Channel-spanning
log jams (optional)

Wood basket outfall structure

Machine access

Staging area (optional)

Staging area



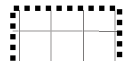









Wood basket outfall structure

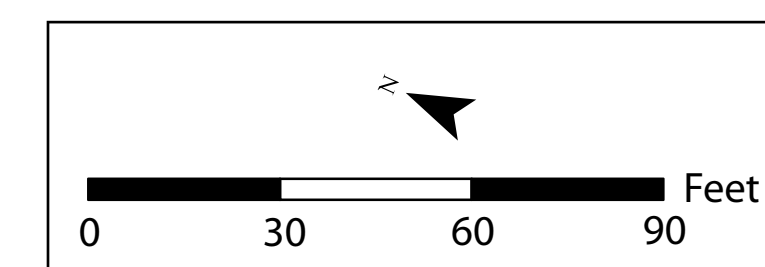
Wood roughness elements (optional)

Staging area

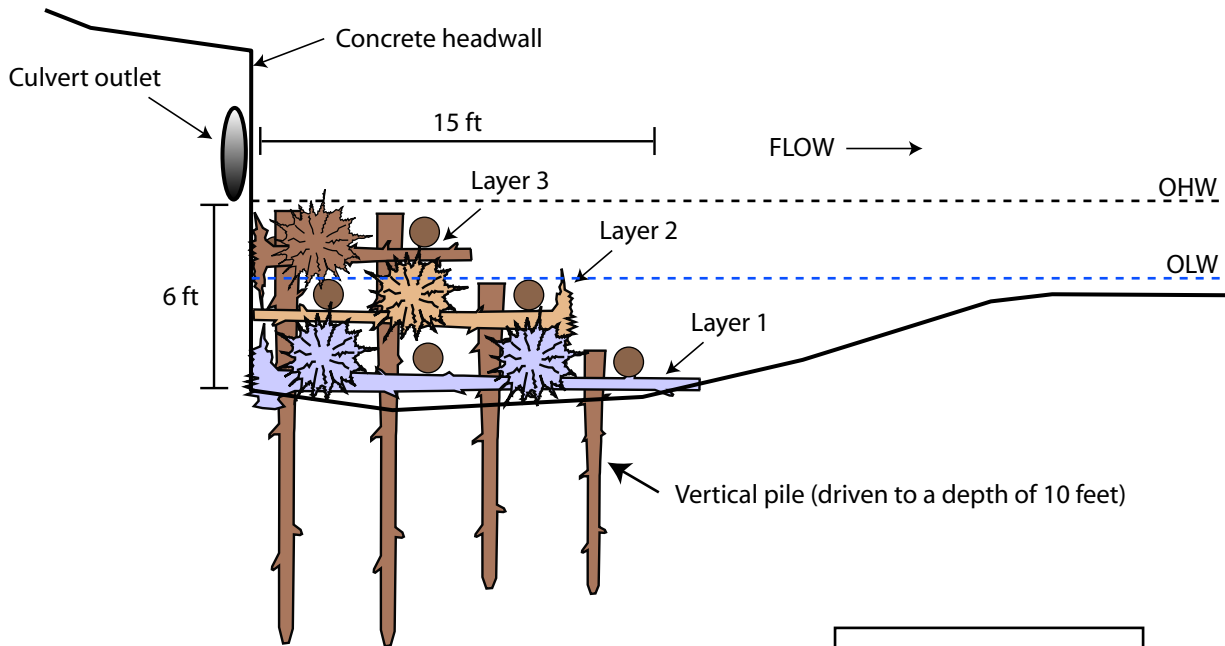
Crib wall (~100 linear feet)

Concrete removal (optional)

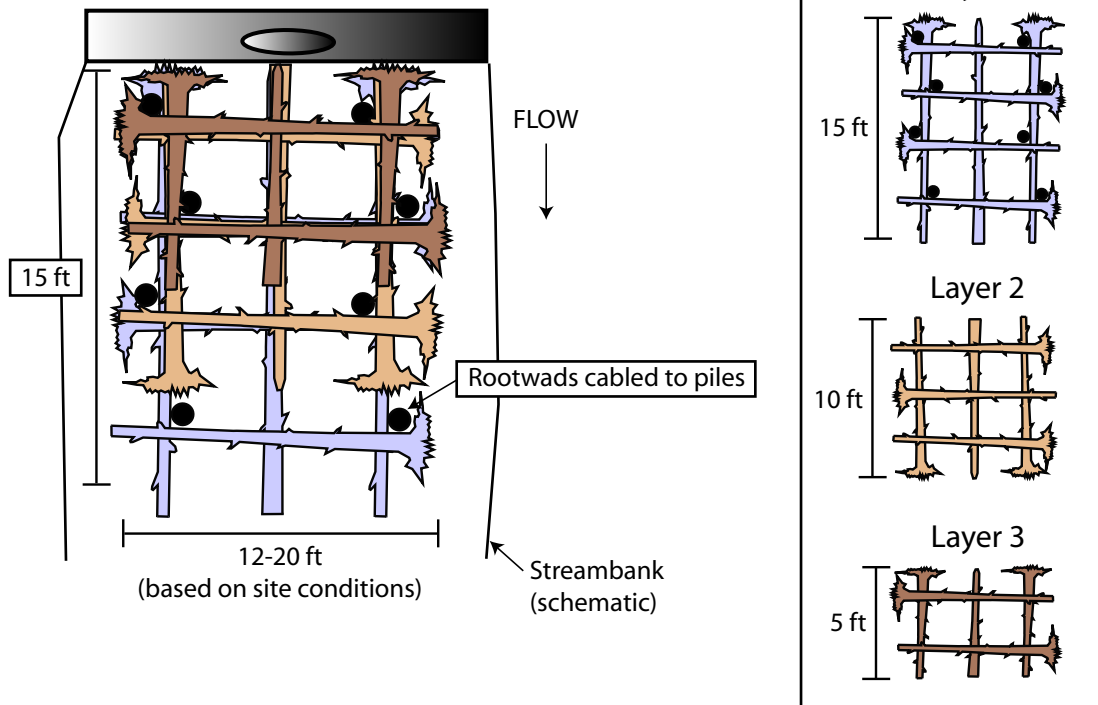
	Limit of Disturbance (LOD)		Staging area
	Limit of Disturbance (optional)		Staging area (optional)
	Tree removal		Crib wall
	Tree removal (optional)		Log jam
	Machine access		Log jam (optional)
	Machine access (optional)		Wood basket outfall structure



LONGITUDINAL VIEW



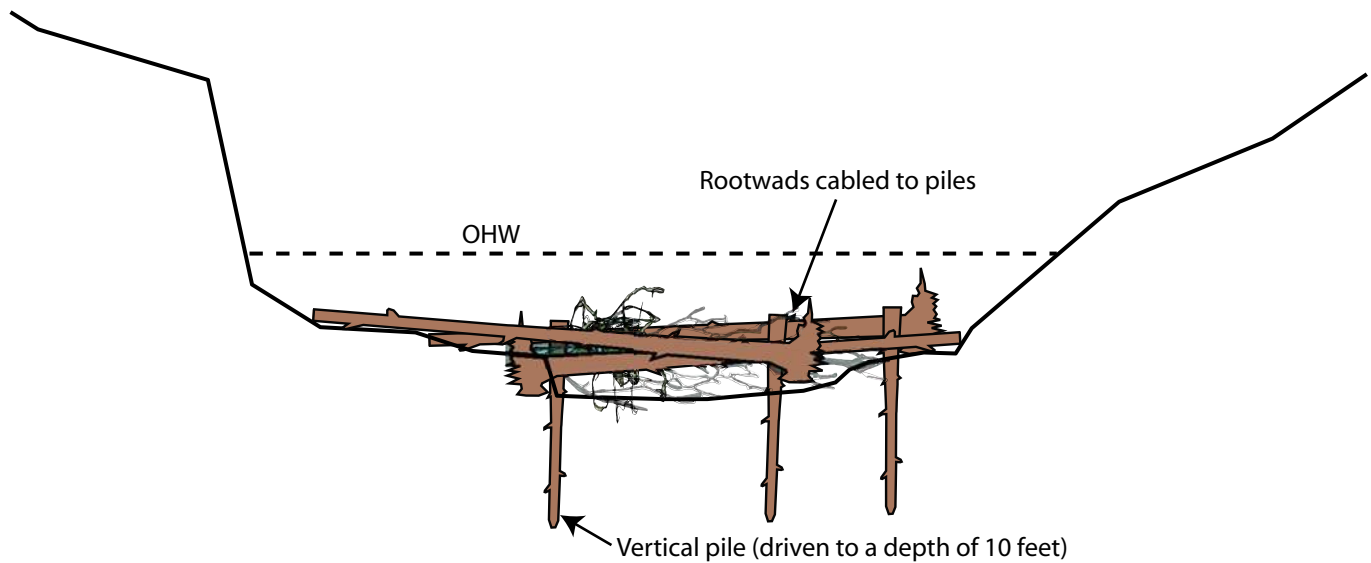
PLAN VIEW



Note: Structural members only shown for clarity. Basket structure filled with alternating layers of brush/slash and boulders/cobbles for ballast.

Wood basket outfall structure design typical.

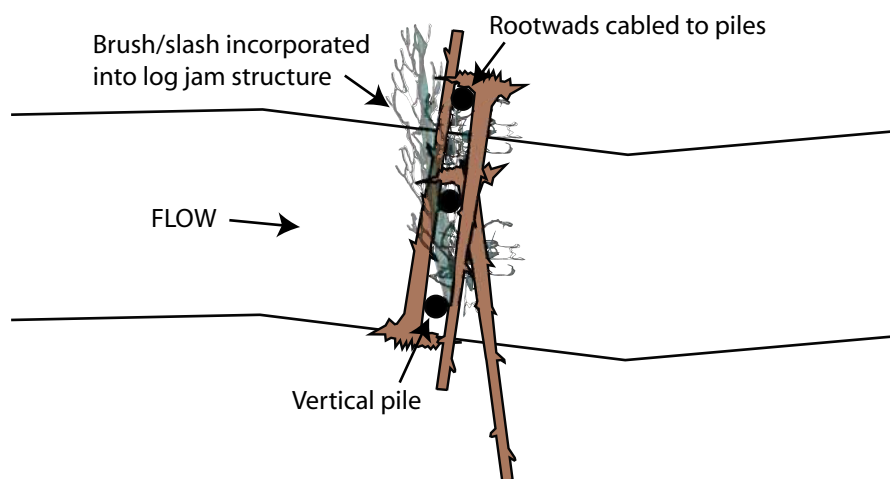
CROSS SECTION VIEW



Note: Schematic - Not to scale

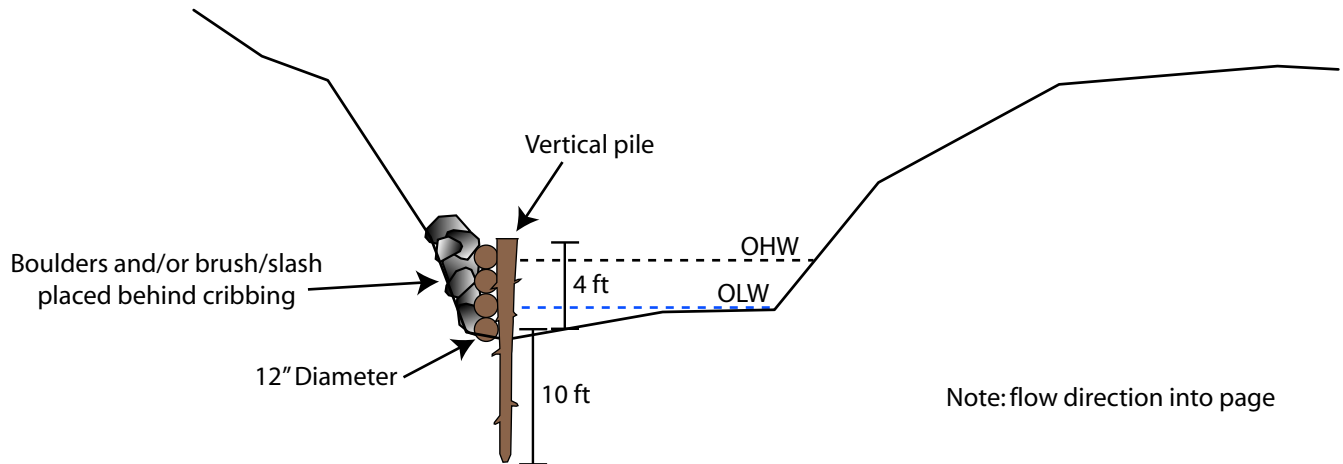
Note: flow direction into page

PLAN VIEW

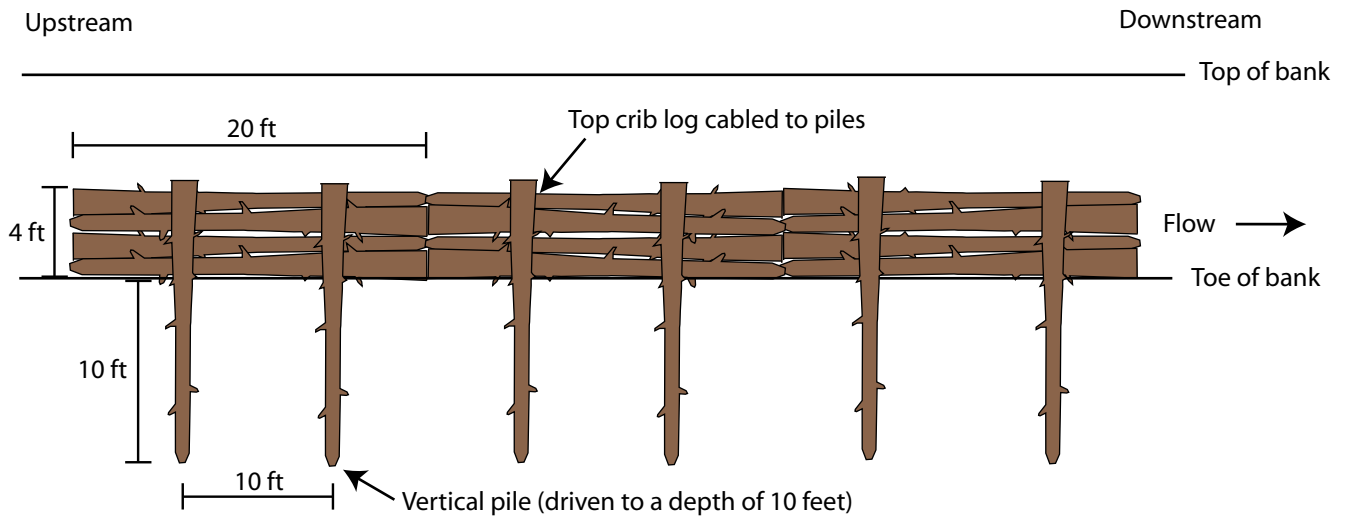


Channel-spanning log jam design typical.

Cross section view

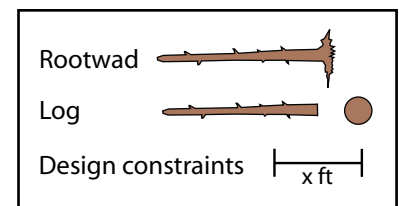


Longitudinal view



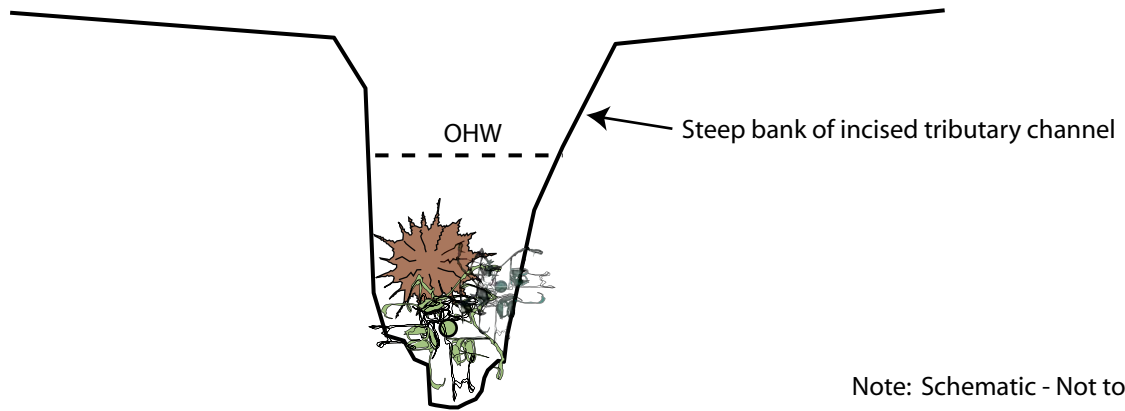
Note: Schematic - Not to scale

*Only a portion of treatment area displayed to show detail



Log crib wall design typical.

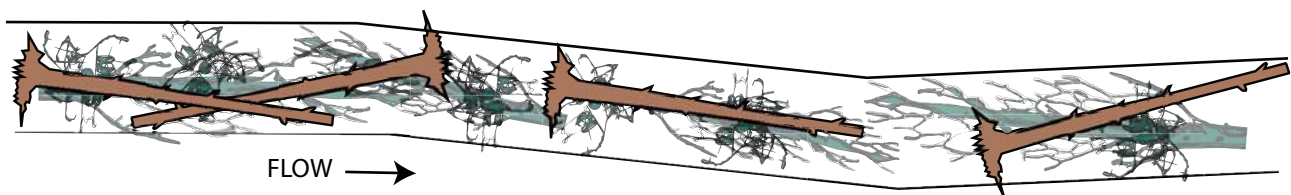
CROSS SECTION VIEW



Note: Schematic - Not to scale

Note: flow direction into page

PLAN VIEW



Wood roughness elements design typical.

Strawberry Run - Alexandria, VA

Estimated Materials List: Large Wood Alternative - Minimum Proposed Work

Structure Type	Number of structures	Quantity per structure	Material (description)	Diameter (dimensions)	Length (feet)	Total Count
Log jam	2	3	Rootwads	12+	20	6
		3	Logs (vertical piles)	12+	15	6
		4 cu.yd.	Brush / slash / tops			8
		4 cu.yd.	Boulders (Type II riprap)			8
Wood basket outfall	3	15	Rootwads	12+	20	45
		8	Logs (vertical piles)	12+	15	24
		9	Logs (horizontal)	12+	20	27
		16 cu.yd.	Brush / slash / tops			48
		20 cu.yd.	Boulders	1.5 to 2.0 ft	1.5 to 2.0 ft	60
Crib wall	15	5	Logs (cribbing)	12+	20	75
260 linear feet		2	Logs (vertical piles)	12+	15	30
		4 cu.yd.	Brush / slash / tops			60
		8 cu.yd.	Boulders (Type II riprap)			120

Material	Subtotal	add 10%	Total with contingency	Unit cost	Unit	Material cost
Rootwads (20 ft long)	51	5	56	\$ 600.00	rootwad	\$ 33,600.00
Crib/horizontal logs (20 ft long)	102	10	112	\$ 300.00	log	\$ 33,600.00
Pile logs (15 ft long)	60	6	66	\$ 250.00	log	\$ 16,500.00
Brush / slash / tops	116	12	128	\$ 50.00	cu.yd.	\$ 6,400.00
Boulders (Type II riprap)	188	18	206	\$ 150.00	cu.yd.	\$ 30,900.00
						\$ 121,000.00

Strawberry Run - Alexandria, VA

Estimated Materials List: Large Wood Alternative - With Optional Proposed Work

Structure Type	Number of structures	Quantity per structure	Material (description)	Diameter (dimensions)	Length (feet)	Total Count
Log jam	2	3	Rootwads	12+	20	6
		3	Logs (vertical piles)	12+	15	6
		4 cu.yd.	Brush / slash / tops			8
		4 cu.yd.	Boulders (Type II riprap)			8
Log jam (optional)	13	3	Rootwads	12+	20	39
		3	Logs (vertical piles)	12+	15	39
		4 cu.yd.	Brush / slash / tops			52
		4 cu.yd.	Boulders (Type II riprap)			52
Wood basket outfall	3	15	Rootwads	12+	20	45
		8	Logs (vertical piles)	12+	15	24
		9	Logs (horizontal)	12+	20	27
		16 cu.yd.	Brush / slash / tops			48
		20 cu.yd.	Boulders	1.5 to 2.0 ft	1.5 to 2.0 ft	60
Crib wall 260 linear feet	15	5	Logs (cribbing)	12+	20	75
		2	Logs (vertical piles)	12+	15	30
		4 cu.yd.	Brush / slash / tops			60
		8 cu.yd.	Boulders (Type II riprap)			120
Crib wall (optional) 340 linear feet	24	5	Logs (cribbing)	12+	20	120
		2	Logs (vertical piles)	12+	15	48
		4 cu.yd.	Brush / slash / tops			96
		8 cu.yd.	Boulders (Type II riprap)			192
Wood roughness elements (optional) 250 linear feet	2	12	Rootwads	12+	20	24
		8 cu.yd.	Brush / slash / tops			16

Material	Subtotal	add 10%	Total with contingency	Unit cost	Unit	Material cost
Rootwads (20 ft long)	114	11	125	\$ 600.00	rootwad	\$ 75,000.00
Crib/horizontal logs (20 ft long)	222	22	244	\$ 300.00	log	\$ 73,200.00
Pile logs (15 ft long)	147	15	162	\$ 250.00	log	\$ 40,500.00
Brush / slash / tops	280	28	308	\$ 50.00	cu.yd.	\$ 15,400.00
Boulders (Type II riprap)	432	43	475	\$ 150.00	cu.yd.	\$ 71,250.00

\$ 275,350.00

Construction Cost Estimate - Strawberry Run Large Wood Alternative (Minimum Proposed Work)

January 2023

ITEM #	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL	NOTES
1.0	Construction Surveying					
1.1	Construction Stakeout	2	Day	\$2,100.00	\$4,200.00	Rate from AECOM's Minimal Intervention cost
1.2	As-Built	205	LF	\$12.00	\$2,460.00	Rate from AECOM's Minimal Intervention cost estimate
2.0	Access Roads					
2.1	Deck Mats (Access, Staging, and Stream Crossing)	1245	LF	\$35.00	\$43,575.00	Rate from AECOM's Minimal Intervention cost estimate
2.2	Filter Fabric (placed beneath Deck Mats)	3060	SY	\$5.00	\$15,300.00	Rate from AECOM's Minimal Intervention cost estimate
3.0	Clearing and Demolition					
3.1	Light Clearing & Grubbing	0.63	AC	\$12,000.00	\$7,560.00	Rate from AECOM's Minimal Intervention cost estimate
4.0	Infrastructure Stabilization/Structure Construction					
4.1	Furnish 15-20' Logs, Roots, Boulders, & Slash (tops)	1	LS	\$121,000.00	\$121,000.00	See materials list for explanation and per item cost
4.2	0.5" Galvanized Steel Cable, Clamps, & Accessories	1	LS	\$7,500.00	\$7,500.00	Based on previous projects/To anchor logs to piles
4.3	Installation of Structures (includes mobilization)	1	LS	\$145,200.00	\$145,200.00	20% increase on materials cost (based on similar projects)
4.4	Rental of Drill Attachment to Excavator	1	Week	\$5,000.00	\$5,000.00	Added cost if augering pile holes does not work
5.0	Vegetation					
5.1	Planting and Invasive Control	3060	SY	\$15.00	\$45,900.00	Rate from AECOM's Minimal Intervention cost estimate
6.0	Erosion and Sediment Control					
6.1	Erosion Control	1	LS	\$50,000.00	\$50,000.00	From AECOM's Minimal Intervention cost estimate
7.0	Maintenance of Traffic					
7.1	Temporary Traffic Control Signs	2	EA	\$481.00	\$962.00	From AECOM's Minimal Intervention cost estimate

Subtotal \$448,657.00

FY22 Escalation Factor Amount \$53,838.84 Increase of 12% as determined by AECOM

Construction Contingency \$251,247.92 50% of subtotal and escalation as per AECOM's estimate

Total \$753,743.76**Anticipated 10-Year Maintenance Cost** \$305,192.16 See accompanying spreadsheet

10-Year Maintenance Cost Estimate - Strawberry Run Large Wood Alternative (Minimum Proposed Work)

January 2023

ITEM #	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL	NOTES
1.0	Access Roads					
1.1	Deck Mats (Access, Staging, and Stream Crossing)	1245	LF	\$35.00	\$43,575.00	Rate from AECOM's Minimal Intervention cost estimate
1.2	Filter Fabric (placed beneath Deck Mats)	3060	SY	\$5.00	\$15,300.00	Rate from AECOM's Minimal Intervention cost estimate
2.0	Clearing and Demolition					
2.1	Light Clearing & Grubbing	0.32	AC	\$12,000.00	\$3,840.00	Rate from AECOM's Minimal Intervention cost estimate
2.2	Clearing & Reuse of Accumulated In-Stream Debris	1	LS	\$5,000.00	\$5,000.00	From AECOM/To prevent flow impoundments
3.0	Infrastructure Stabilization/Structure Construction					
3.1	Furnish 15-20' Logs, Roots, Boulders, & Slash (tops)	1	LS	\$36,300.00	\$36,300.00	Based on need to replace 30% of logs in 10-yr period
3.2	Installation of Structures (includes mobilization)	1	LS	\$43,560.00	\$43,560.00	Based on need to rebuild 30% of structures every 10 yrs
4.0	Vegetation					
4.1	Turfgrass Establishment (Road and staging areas)	2625	SY	\$3.00	\$7,875.00	From AECOM's Minimal Intervention maintenance cost
4.2	Invasive Species Control	2625	SY	\$2.00	\$5,250.00	From AECOM's Minimal Intervention maintenance cost
5.0	Erosion and Sediment Control					
5.1	Erosion Control	1	LS	\$20,000.00	\$20,000.00	From AECOM's Minimal Intervention maintenance cost
6.0	Maintenance of Traffic					
6.1	Temporary Traffic Control Signs	2	EA	\$481.00	\$962.00	From AECOM's Minimal Intervention maintenance cost
Subtotal					\$181,662.00	

FY22 Escalation Factor Amount \$21,799.44 Increase of 12% as used in AECOM's estimate

Construction Contingency \$101,730.72 50% of subtotal and escalation as per AECOM's estimate

Anticipated 10-Year Maintenance Cost \$305,192.16 See accompanying spreadsheet

Construction Cost Estimate - Strawberry Run Large Wood Alternative (Including Optional Work)

January 2023

ITEM #	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL	NOTES
1.0	Construction Surveying					
1.1	Construction Stakeout	2	Day	\$2,100.00	\$4,200.00	Rate from AECOM's Minimal Intervention cost
1.2	As-Built	725	LF	\$12.00	\$8,700.00	Rate from AECOM's Minimal Intervention cost
2.0	Access Roads					
2.1	Deck Mats (Access, Staging, and Stream Crossing)	2125	LF	\$35.00	\$74,375.00	From AECOM's Minimal Intervention cost estimate
2.2	Filter Fabric (placed beneath Deck Mats)	5560	SY	\$5.00	\$27,800.00	From AECOM's Minimal Intervention cost estimate
3.0	Clearing and Demolition					
3.1	Light Clearing & Grubbing	1.1	AC	\$12,000.00	\$13,200.00	Rate from AECOM's Minimal Intervention cost estimate
4.0	Infrastructure Stabilization/Structure Construction					
4.1	Furnish 15-20' Logs, Roots, Boulders, & Slash (tops)	1	LS	\$275,350.00	\$275,350.00	See materials list for explanation and per item cost
4.2	0.5" Galvanized Steel Cable, Clamps, & Accessories	1	LS	\$10,000.00	\$10,000.00	Based on previous projects
4.3	Installation of Structures (includes mobilization)	1	LS	\$330,420.00	\$330,420.00	20% increase on materials cost (based on similar projects)
4.4	Rental of drill attachment to excavator	2	Week	\$5,000.00	\$10,000.00	Added cost if augering pile holes does not work
5.0	Vegetation					
5.1	Planting and Invasive Control	5560	SY	\$15.00	\$83,400.00	Rate from AECOM's Minimal Intervention cost estimate
6.0	Erosion and Sediment Control					
6.1	Erosion Control	1	LS	\$75,000.00	\$75,000.00	Increased by 50% from AECOM for increased disturbance
7.0	Maintenance of Traffic					
7.1	Temporary Traffic Control Signs	2	EA	\$481.00	\$962.00	From AECOM's Minimal Intervention cost estimate

Subtotal \$913,407.00

FY22 Escalation Factor Amount \$109,608.84 Increase of 12% as determined by AECOM

Construction Contingency \$511,507.92 50% of subtotal and escalation as per AECOM's estimate

Total \$1,534,523.76**Anticipated 10-Year Maintenance Cost** \$578,496.24 See accompanying spreadsheet

10-Year Maintenance Cost Estimate - Strawberry Run Large Wood Alternative (Including Optional Work)

January 2023

ITEM #	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL	NOTES
1.0	Access Roads					
1.1	Deck Mats (Access, Staging, and Stream Crossing)	2125	LF	\$35.00	\$74,375.00	Rate from AECOM's Minimal Intervention cost
1.2	Filter Fabric (placed beneath Deck Mats)	5560	SY	\$5.00	\$27,800.00	Rate from AECOM's Minimal Intervention cost
2.0	Clearing and Demolition					
2.1	Light Clearing & Grubbing	0.6	AC	\$12,000.00	\$7,200.00	Rate from AECOM's Minimal Intervention cost estimate
2.2	Clearing & Reuse of Accumulated In-Stream Debris	1	LS	\$5,000.00	\$5,000.00	From AECOM/To prevent flow impoundments
3.0	Infrastructure Stabilization/Structure Construction					
3.1	Furnish 15-20' Logs, Roots, Boulders, & Slash (tops)	1	LS	\$82,605.00	\$82,605.00	Based on need to replace 30% of logs in 10-yr period
3.2	Installation of Structures (includes mobilization)	1	LS	\$99,126.00	\$99,126.00	Based on need to rebuild 30% of structures every 10 yrs
4.0	Vegetation					
4.1	Turfgrass Establishment (Road and staging areas)	3455	SY	\$3.00	\$10,365.00	Rate from AECOM's Minimal Intervention cost
4.2	Invasive Species Control	3455	SY	\$2.00	\$6,910.00	Rate from AECOM's Minimal Intervention cost
5.0	Erosion and Sediment Control					
5.1	Erosion Control	1	LS	\$30,000.00	\$30,000.00	Increased by 50% from AECOM for increased disturbance
6.0	Maintenance of Traffic					
6.1	Temporary Traffic Control Signs	2	EA	\$481.00	\$962.00	From AECOM's Minimal Intervention maintenance cost
Subtotal					\$344,343.00	

FY22 Escalation Factor Amount \$41,321.16 Increase of 12% as used in AECOM's estimate

Construction Contingency \$192,832.08 50% of subtotal and escalation as per AECOM's estimate

Anticipated 10-Year Maintenance Cost \$578,496.24 See accompanying spreadsheet

Estimated impacts

Strawberry Run			
	Length (linear feet)	Area (sq.ft.)	Area (acres)
Travel	860	13,760	0.316
Additional travel (optional)	320	5,120	0.118
Staging areas	180	6,400	0.147
Additional staging areas (optional)	40	1,080	0.025
LOD*	205	7,380	0.169
Additional LOD (optional)	520	16,300	0.374
Total	1,245	27,540	0.632
Total (includes optional)	2,125	50,040	1.149

*LOD = Limit of Disturbance or stream length of proposed treatments

Tree Impacts	Hard Armoring	Bioengineering	Minimal Intervention	Large Wood	Large Wood (+ options)
Limit of Disturbance (in acres)	1.72	1.72	0.68	0.63	1.1
Number of Trees To Be Cleared	52	46	36	32*	47*
Total Trees to Be Planted**	906	882	320	276	366
Net Trees Gained	854	836	284	244	319

*Based on City direction to assume work occurs from top of bank but can be reduced to 20 (or 28 w/ options) if Contractor agrees to do construction from one side of the stream and is willing to work under or prune tree canopy

** Disturbed areas will be replanted at 600 stems/acre

Cost Estimate	Hard Armoring	Bioengineering	Minimal Intervention	Large Wood	Large Wood (+ options)
Construction	\$1.5 million	\$1.8 million	\$604,750	\$753,740	\$1.5 million
Mitigation*	\$853,600 (970 LF)	\$640,200 (970 LF)	\$372,000 (465 LF)	\$180,400 (205 LF)	\$638,000 (725 LF)
Maintenance**	\$74,000	\$26,000	\$228,250	\$305,200	\$578,500
Grand Total	\$2.4 million	\$2.5 million	\$1.2 million	\$1.2 million	\$2.7 million

*Mitigation estimated from the USACE USM Compensation Calculation based on linear feet (LF) of disturbance and a credit purchase rate of \$800/credit

** Maintenance based on expected work and materials during 10-yr storm or over a 10-yr period